GESTAR II THIRD ANNUAL REPORT

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NASA Cooperative Agreement Goddard Earth Sciences Technology and Research II (GESTAR II)

UMBC · Morgan State University · Colorado State University · Penn State · Arizona State University · SURA Southeastern Universities Research Association · ERT · Northrop Grumman

OUR RESEARCHERS

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MESSAGE FROM THE **DIRECTOR**

It gives me great joy to present the third annual report of the NASA Goddard Earth Sciences Technology and Research II (GESTAR II) cooperative agreement. This report provides a summary of the research activities and related accomplishments by GESTAR II scientists during the 2023-2024 reporting period from October 1, 2023, to September 30, 2024. This is my second year as Director of GESTAR II, and I continue to be amazed at the exceptional standards set and followed by both the NASA Goddard Earth Sciences Division (ESD) leadership and the consortium partnership in the implementation of this important cooperative agreement. The competency, problem-solving skills, efficiency, dedication, and teamwork of the GESTAR II administrative personnel continue to be outstanding. The GESTAR II researchers themselves, in partnership with their respective NASA sponsors, are undoubtedly world class, both in their cutting-edge scientific research endeavors and in their consistent demonstration of leadership through various synergistic activities locally, nationally, and globally.

There are currently about 150 GESTAR II research personnel distributed practically across all research laboratories of the ESD (*i.e.*, Codes 610.1, 612, 613, 614, 615, 616, 617, 618, 61A) and one branch (*i.e.*, Code 555) of the Instrument Systems & Technology Division. These scientists are involved in a wide spectrum of scientific research activities that support NASA's strategic goals and Earth Science Mission objectives. Indeed, GESTAR II scientists actively participate (some with leadership roles) in the implementation of various existing and upcoming space missions (*e.g.*, TERRA, AQUA, AURA, CALIPSO, GPM, JPSS, SMAP, DSCOVR, TEMPO, PACE, AOS, TSIS-2, GLIMR, GeoXO), including those on the International Space Station (ISS) and those with international partnerships, as well as major field campaigns (*e.g.*, EXPORTS, IMPACTS, AEROMMA, PACE-PAX, Asia-AQ). GESTAR II scientists also play crucial roles in the development and operations of major Earth-system models or data systems (*e.g.*, GEOS, JEDI, EIS) and ground-based networks (*e.g.*, AERONET, MPLNET, PANDONIA).

One of the most recent mission accomplishments that GESTAR II is very proud of is the successful launch of NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission on February 8, 2024. A significant number of GESTAR II scientists were intimately involved in its development and now in its operational activities. Specifically, one of the three PACE instruments, HARP2, contributed by UMBC is almost completely operated by GESTAR II researchers. PACE is now generating a variety of unprecedented data products that will lead to new discoveries and insights into various

atmospheric, oceanic, and even terrestrial phenomena. To support PACE validation and related scientific investigations, the PACE-PAX field campaign, involving a research vessel, two aircraft, and multiple scientific instruments, is going on in California even as I write this message in September 2024. GESTAR II researchers constitute a good number of the 100+ member PACE-PAX team, with one serving as a deputy mission scientist.

In addition to their roles in these and other major spaceborne and airborne missions, ground-based networks, Earth-system models, and related programs, GESTAR II scientists are also engaged in multiple other cutting-edge research activities and have been remarkably productive, publishing in high-ranking refereed journals, giving invited and contributed presentations at a wide variety of international conferences, workshops, and seminars, and leading and participating in science team meetings and working groups. During the current reporting period, many of our scientists won competitive proposals and served on proposal review panels for NASA and other funding agencies. Some GESTAR II scientists taught full courses, served as guest lecturers, and/or mentored students at UMBC and/or Morgan State University. Our scientists also engaged in student and peer mentoring and training programs, media communication, and other public outreach activities. A significant number of GESTAR II scientists received NASA individual and group achievement awards, attesting to their remarkable dedication to NASA's missions and their outstanding performance. This 2024 summer, GESTAR sponsored three visiting graduate fellows who conducted research at Goddard under the mentorship of our scientists and NASA scientists. The fellows came from our three non-local partner institutions: Arizona State University, Colorado State University, and Pennsylvania State University.

It is pertinent to mention that GESTAR II was initially awarded for three years, which would have been ending this November 2024. However, during this reporting period, the GESTAR II institutional consortium leadership and the ESD leadership agreed that it would be beneficial for NASA and the partnership to extend GESTAR II to a standard five-year performance period, which is typical for such large cooperative agreements. A proposal submitted by our leadership team to formalize that extension was approved by NASA in July 2024, extending GESTAR II's performance period to November 2026. This extension not only reflects the goodwill of the ESD and the consortium leadership to see GESTAR II continue on its successful trajectory but is also a reflection of the outstanding performance of both the GESTAR II scientific and administrative personnel.

I applaud the wonderful efforts and accomplishments of all GESTAR II scientists and research associates, the leadership and administrative personnel at all GESTAR II member institutions and organizations, the NASA civil service sponsors of the GESTAR II faculty, and the leadership and management of the cooperative agreement at NASA Goddard ESD. This is a tremendous team. I consider myself highly privileged to work with this A-Team to fulfill our common purpose of advancing NASA's Earth Science strategic goals and priorities. I look forward to our continued success and accomplishments as a team in the coming months and years.

CHARLES ICHOKU, DIRECTOR

SCIENTIFIC TASKS

CODE 555: MICROWAVE INSTRUMENTS AND TECHNOLOGY BRANCH

PRISCILLA MOHAMMED-TANO

Sponsor Jeffrey Piepmeier / Code 555 / Task 020

NASA's Soil Moisture Active and Passive (SMAP) Mission is the first of a series of Earth Science Decadal Survey missions and launched January 31, 2015. The mission is providing global measurements of soil moisture and freeze/thaw state using L-band radiometry. As part of the continued mission work, Mohammed was responsible for monitoring SMAP radiometer data by processing and observing instrument data from the L1A and L1B_TB products. Automated reports were generated to ensure normal instrument performance. Radio frequency interference (RFI) monitoring tools were run weekly to monitor RFI and algorithm performance.

Although SMAP operates within the protected Earth Exploration Satellite Service passive frequency allocation of 1400-1427 MHz, unauthorized in-band transmitters and out of band emissions have been causing interference to the SMAP microwave data. To reduce the impact, sources are identified and reported to the appropriate administrations for enforcement of shutting down the sources. Reports were created for a different country each month and submitted to NASA which were then submitted to the relevant authorities. Follow up responses were also provided to the spectrum office relating to any feedback received from administrations. Mohammed also worked closely with OfCom from the United Kingdom providing weekly data updates to aid identification of interference sources.

Mohammed serves as the point of contact and is the expert for RFI related activities for the SMAP mission. Over the past year, activities included liaising with the SMOS team for coordination of reporting activities by both missions, providing updated SMAP data to the spectrum office to be presented at various meetings such as the International Space Radio Monitoring Meeting.

Mohammed is also part of a team for the IIP project “Hyperspectral Microwave Photonic Instrument (HyMPI)” to become the first in-space demonstration of an integrated microwave photonic system for future microwave radiometers. Mohammed is tasked to develop and write the calibration and radio frequency and interference detection algorithms. During this reporting period, Mohammed worked on system modeling as well as data analysis of the ASIC to be used in the digital back end of the instrument. Mohammed has completed system modeling of all the subsystems including the Radio Frequency (RF) front end, the optical link, and the ASIC digital back end. The model was used to optimize the RF front end, to reduce calibration error via various trade studies of the optical link, and to predict uncertainty. A measurement procedure was developed and end to end measurements were analyzed.

Spectrum studies took place in support of the Hyperspectral Microwave Sensor (HyMS) and preliminary data analysis was done for the Conical Scanning Millimeter-wave Imaging Radiometer - Hyperspectral (CoSMIR-H).

Upcoming plans for Mohammed include continuing to monitor the SMAP radiometer and provide monthly radio frequency interference reports for SMAP. She will also continue work with system modeling of HyMPI to include the digital back end and system non-idealities. Detailed data analysis of recent flight data from CoSMIR-H will also be completed.

J I N Z H E N G P E N G
Sponsor Jeffrey Piepmeier / Code 555 / Task 020

SMAP (Soil Moisture Active/Passive) level 1B correction algorithm and radiometer calibration
Although the SMAP mission has successfully operated in space over the past 9 years, it has encountered several anomalies (e.g. SAR failure, memory corruption, non-rotating antenna/ambient temperature cool down, miniature inertial measurement unit swap, etc.). All of these have a potential impact to the radiometer's performance including calibration drift and geolocation (or antenna pointing) accuracy. In the past year, its overall performance of calibration drift and geolocation (or antenna pointing) accuracy has been re-evaluated. The results have been presented in the SMAP Engineering Review meeting 2024 and IGARSS 2024. Dr. Peng also supports the operation of the SMAP mission by monitoring/reporting of the SMAP radiometer status and the L1B_TB data quality weekly, and he also works together with Science Data System (SDS) and the operation team to solve problems, especially during SMAP radiometer's L1B_TB data transition from local data processing to cloud processing in the past year.

PolSIR (Polarized Submillimeter Ice-cloud Radiometer) calibration error budget
PolSIR is a new NASA satellite mission to better understand the influence of ice clouds on the Earth's climate by studying ice clouds that form at high altitudes throughout tropical and sub-tropical regions. Two identical CubeSats with radiometers (325 and 680 GHz frequency bands) onboard will provide crucial information about how ice clouds act in Earth's climate system. Launch of the two CubeSats is currently anticipated for 2027.

PolSIR is currently in the phase of preliminary design at the system and subsystem levels to assure that the proposed design and associated implementation approach will satisfy the system and subsystem functional requirements. Dr. Peng is working on the radiometer's calibration error budget. He has been comprehensively analyzing the radiometric performance of current/preliminary radiometer system design together with the unwanted impact from the environment (Sun, Galaxy, sources in the antenna's sidelobe, etc). The analysis results of the radiometer calibration error budget are used to demonstrate the performance of the preliminary radiometer design against the requirements, and they will be used as the guidance for the improvement of the subsystems design, pre-launch calibration activities and science algorithm.

GLOWS (Global L-Band Active/Passive Observatory for Water Cycle Studies) calibration error budget
L-band global observations from space missions (NASA's Aquarius and SMAP, ESA's SMOS) have proven useful to estimate land soil moisture and sea surface salinity. GLOWS provides a new low-cost instrument concept to continue L-band time series observations with the same

resolution and accuracy of other missions. The key innovation of GLOWS is the flat and symmetrically rotating lens antenna with a compact feed. The overall performance of the GLOWS radiometer measurement needs to be studied as well.

The radiometric performance of GLOWS lens antenna (membrane with transmitting array) has not been previously studied. Dr. Peng has analyzed the antenna patterns of the antenna assembly at varied frequencies and rotation angles. His analysis shows that 1) current design of the antenna assembly causes a dominant error in the radiometer measurements due to low main-beam efficiency and large sidelobe; 2) the actual spatial resolution on the Earth's surface is about 2 times larger than expected. Furthermore, Dr. Peng provided the requirement on the main-beam efficiency of the antenna assembly to meet the science requirement on the radiometer measurement accuracy.

Dr. Peng will continue working on the SMAP radiometer project by supporting operation and SDS activities and submitting a manuscript for journal publication. Dr. Peng will also continue working on the PolSIR radiometer project by updating the calibration error budget for CDR and provide support for the system design and calibration activities.

CODE 587: SOFTWARE ENGINEERING DIVISION

FRED HUEMMRICH

Sponsors: James Mackinon; David Harding / Codes 587&618 / Task 158

The Concurrent Artificially intelligent Spectrometry and Adaptive Lidar System (CASALS) project is combining lidar descriptions of topography and vegetation structure with visible to shortwave-infrared spectral imaging of foliar biochemistry to improve descriptions of forest function, productivity, and stress responses. Machine learning (ML) approaches are being applied to merge these diverse data types and evaluate the significance of different inputs. For the development of datasets for training and testing the ML approaches, Dr. Huemmrich has worked with eddy covariance flux tower observations, advised on the use of spectral vegetation indices, and helped in choosing the array of input variables. He has also aided in the interpretation of the modeling results.

Dr. Huemmrich has also examined diurnal change in spectral vegetation indices, canopy light environment, and productivity for corn and soybean crops at different times in the growing season.

In the coming months, Dr. Huemmrich will work with the National Ecological Observatory Network (NEON) flux tower data from multiple sites to examine diurnal change across different vegetation types.

JOHN BLAKE CLARK

Sponsor Stephanie Schollaert Uz / Code 610 / Task 076

Dr. Clark made significant progress towards the implementation of a geostatistical modeling component for inclusion into the DEEP-VIEW machine learning prediction system for coastal water quality in the Chesapeake Bay (PI: Schollaert-Uz). The methodology allows for independent estimates of water clarity (diffuse attenuation and Secchi depth) to be fused into the satellite-imagery-based deep learning model for gap filling, validation, and uncertainty estimation. He published the work as part of the conference proceedings of the International Geoscience and Remote Sensing Symposium 2024.

In the coming months, Dr. Clark and the AIST21 DEEP-VIEW team will begin transitioning DEEP-VIEW to be utilized with the Virginia Institute of Marine Science Chesapeake Bay Environmental Forecast System (CBEFS) in an assimilative manner. The time- and spatially-consistent products from DEEP-VIEW, such as the diffuse attenuation coefficient, will be assimilated with CBEFS to provide a better model forecast assessment initially and secondarily better model initialization of the light field within the Chesapeake Bay. Model simulation runs with and without assimilation will be compared to assess model skill improvements, and the technology package will be transitioned to stakeholders as the technology progresses.

AMITA MEHTA

Sponsor Stephanie Schollaert Uz / Code 610 / Task 096

Dr. Amita Mehta is a Science Team Member of NASA's Western Waters Applications Office (WWAO). Mehta joined WWAO in August 2023. She was a reviewer of several proposals submitted in response to Rio Grande Request for Information (RFI) (September 2023). Mehta attended the WWAO Team Meeting at JPL (12-13 October 2023) and gave a presentation on "Applied Remote Sensing Training and Research Highlights." She also attended the WWAO annual meeting virtually from 29 April - 2 May 2024. Dr. Mehta participated in WWAO Arkansas-White-Red River Basin Needs Assessment Workshop and co-led a group of stakeholders on issues concerning watershed management in the basin (11-13 June 2024). She is currently reviewing the workshop report. Dr. Mehta facilitated a joint Applied Remote Sensing Training (ARSET)-WWAO training on 1 August 2024 focusing on the Drought Severity Evaluation Tool (DSET) developed by WWAO for the Navajo Nation.

In the coming months, Dr. Mehta will be a reviewer for WWAO Missouri River Basin RFI. She plans to disseminate information about water quality data from PACE, sub-seasonal to seasonal predictions data and climate change projections data from earth system models to WWAO stakeholder communities.

JESSICA SUTTON

Sponsor Dalia Kirschbaum / Code 610 / Task 160

Dr. Sutton has been working on several projects over the past year. She published her previous work in the Journal of Hydrometeorology. She is currently working on four projects. One of her projects is using multi-band IR to estimate precipitation in mountainous regions. Another is analyzing precipitation before, during, and after landslide events to estimate return periods of the event. The third is comparing precipitation from GPM IMERG V06 to V07 for landslide hazard assessment. The last is analyzing precipitation in Ghana using GPM IMERG.

Over the upcoming year, Dr. Sutton plans to 1) publish her current research, 2) present current research at the Precipitation Measurement Missions Science Team Meeting (September 2024) and the AGU Fall Meeting (December 2024), 3) submit a project proposal to SERVIR focused on developing a precipitation atlas for West Africa, and 4) submit a project proposal to NSF focused on identifying virga precipitation events.

CODE 610.1: GLOBAL MODELING AND ASSIMILATION OFFICE

BRYAN KARPOWICZ

Sponsor Steven Pawson / Code 610.1 / Task 006

Dr. Karpowicz, along with Dr. Erica McGrath-Spangler and Dr. Nikki Privé, have developed a series of Orbit Scenario Observing System Simulation Experiments (OSSEs) highlighting the importance of polar orbiting satellites in combination with future Geostationary satellites in support of the Joint Polar Satellite System (JPSS) program office. Two journal articles are in various stages of development describing the work. The first, which has been submitted to Tellus A: Dynamic Meteorology, highlights the impacts of an additional Microwave and Infrared instrument (ATMS/CrIS) at a 0530 LTAN Low Earth Orbit. This demonstrates the importance of an additional 0530 LTAN Microwave and Infrared observation platform (ATMS/CrIS) in the context of future scenarios of global observation systems with and without a ring of Geostationary (GEO) Infrared hyperspectral sounders. The second paper under development investigates the synergy between future GEO and LEO platforms.

In addition to OSSE work, Dr. Karpowicz has led or contributed to several Observation System Experiments (OSE). First, he led an effort to prepare for the use of future hyperspectral sounders in the GEOS-ADAS. Given the high data volume of future GEO hyperspectral sounders, future missions will only transmit Principal Component Scores (PCS), a form of lossy compression. The resulting radiance observation after reconstruction from PCS differs primarily by dropping noise from the observations. In doing so, the resulting channel variance decreases while increasing the inter-channel correlation between the observation and estimate from the data assimilation system. Initial experiments with the GEOS-ADAS using an available IASI PCS product, without modification to quality control measures, have shown a neutral impact apart from a strong degradation in water vapor at 850 hPa. It is believed this is caused by feedback between the bias correction and a cloud detection, which is too strict for surface channels. This degradation is unique to the GEOS-ADAS as similar experiments conducted by ECMWF have shown neutral impact. Experiments with a modified quality control are underway to determine if this degradation can be mitigated. Similar experiments using a different instrument CrIS and its PCS product are under development. It is believed that there will be fewer differences using

the CrIS product as the instrument is already very low noise whereas IASI has a relatively high instrument noise.

As part of a visiting scientist stay at the European Center for Medium-range Weather Forecasting (ECMWF), Dr. Karpowicz, along with Ms. Erin Jones of (CISESS/UMD/NOAA) and Dr. Chris Burrows of ECMWF, investigated the possibility of using the CrIS instrument without a longwave temperature sounding band, instead of relying upon the midwave and shortwave bands. Currently, one of the CrIS instruments aboard SNPP does not have a functioning longwave band and has been dropped from the observing system in all weather prediction centers as the longwave band has always been used in conjunction with the midwave band both for assimilation and cloud detection. The shortwave band has challenges associated with solar contributions and has been overlooked in the past. While ECMWF has used recent improvements in their fast radiative transfer model, and error inflation to assimilate shortwave channels, they have still relied upon the longwave band for cloud detection. An optimized configuration of the ECMWF cloud detection scheme was developed and used in an experiment using only the midwave and shortwave bands on CrIS. The experiment showed an improved fit to other observations relative to an experiment without CrIS observations, along with some small, but statistically significant improvement to forecast skill. This work may allow weather prediction centers to use CrIS NPP data without a longwave band, along with the use of future low-cost instruments without a longwave infrared band. There is ongoing work at NOAA EMC to include the ECMWF cloud detection package into components of the data assimilation system shared with NASA; thus, this work could benefit NASA GMAO soon both in terms of near real time forecasting and reanalysis.

The Joint Center for Satellite Data Assimilation (JCSDA) is an organization created by NOAA, NASA, the US Navy, and US Air Force to advance the state of satellite data assimilation. Dr. Karpowicz has been involved in several aspects of this effort including contributions to the Community Radiative Transfer Model (CRTM), and the next-generation data assimilation system known as the Joint Effort in Data Integration (JEDI). Dr. Karpowicz has contributed pyCRTM to the JCSDA, a Python package that he developed to serve as a wrapper to CRTM. The package allows for quick and easy simulation of various satellite instruments. The package is widely used in the community, including by researchers at NASA, NOAA, and the US Naval Research Laboratory. Dr Karpowicz has updated pyCRTM such that it may work with the latest CRTM 3.1, along with previous versions. Additionally, a new wrapper has been developed for the active sensor model which has been added to CRTM 3.1. This allows the simulation of active RADAR instruments in addition to passive radiometers.

In November 2024 Dr. Karpowicz was named Co-I on the NASA Polarized Submillimeter Ice-cloud Radiometer (PolSIR) mission. In addition to sensing ice clouds, PolSIR will have 325 GHz channels which provide information on a key variable in numerical weather prediction – water vapor. His role will focus on adding PolSIR to the suite of instruments available in the GEOS-ADAS model and conducting observation system experiments to highlight the impact of PolSIR. Initial work prior to launch has included the discussion of radiative transfer model requirements, along with the discussion of test data sets.

Dr. Karpowicz will work with Dr. Erica McGrath-Spangler and Dr. Nikki Privé on finishing a paper on the synergy between Geostationary and Low Earth Orbiting hyperspectral infrared sounders in numerical weather prediction. He will also work with Ms. Erin Jones, and Dr. Chris Burrows on

a manuscript describing the modified cloud detection configuration, and an associated experiment. A talk is planned for the next ITSC meeting in 2025.

He also will continue work on observing system experiments using reconstructed hyperspectral radiances that will continue to be refined. A manuscript describing reconstructed radiance experiments is under development, and a talk is planned for the upcoming ITSC meeting in 2025. Finally, Dr. Karpowicz will provide input to the PolSIR team regarding fast radiative transfer, and test data sets prior to launch in 2027.

NIKKI PRIVÉ
Sponsor Ron Gelaro / Code 610.1 / Task 007

Dr. Privé completed a set of polar Orbit Scenario Observing System Simulation Experiments (OSSEs) for the Microwave Barometric Radar and Sounder (MBARS) project. She wrote a manuscript on the polar orbit results and submitted this to Earth and Space Sciences. At the request of the instrument team, she ran a set of inclined orbit constellation cases to compare the polar and inclined orbit performance. Dr. Privé also contributed to a report for the Earth Sciences Technology Office describing the results of the OSSE experiments.

Dr. Privé performed OSSEs for the Joint Polar Satellite Program investigating the impacts of an orbit platform with 0530 local time of ascending node in a future global observing network scenario. She generated the simulated observations for an ATMS-like microwave instrument and a CrIS-FSR type hyperspectral infrared instrument. She also ran two of the four OSSE experiments and submitted a publication on the results to Tellus-A.

Dr. Privé ran an analysis of correlations between forecast and analysis error fields using output from the baseline OSSE. She also worked with a GESTAR II Graduate Fellow to investigate the use of machine learning techniques in future OSSE development with very high-resolution Nature Runs.

In the coming months, Dr. Privé expects to complete the correlation analyses and prepare a manuscript with the results. Starting in October, Dr. Privé will begin work on OSSE development for high resolution Nature Runs and the transition to Joint Effort for Data assimilation Integration (JEDI) as part of an Advanced Information Systems Technology project.

ERICA MCGRATH-SPANGLER
Sponsor Ron Gelaro / Code 610.1 / Task 008

Dr. McGrath-Spangler uses the Global Modeling and Assimilation Office (GMAO) Observing System Simulation Experiment (OSSE) framework to evaluate the impact of hyperspectral infrared (IR) sounders from geosynchronous Earth orbit (GEO) in preparation for the planned NOAA/NASA Geostationary eXtended Observations (GeoXO) satellite mission, to be launched in the 2030s. Her research has focused on the GeoXO Sounder (GXS), proposed to be the first IR sounder in GEO for the United States. Studies performed include evaluations of the impact of GXS within an internationally coordinated global ring of GEO sounders and comparisons of the differing foci and impact of GEO sounders to those existing in a low-Earth orbit (LEO). Two

manuscripts, one as lead author, have been published that examine the impact of GXS. Their manuscripts are also in preparation.

Additionally, Dr. McGrath-Spangler has modified the Goddard Earth Observing System (GEOS) Data Assimilation System (DAS) to assimilate adaptively thinned IR radiances from LEO satellite missions with a goal of optimizing data densities around tropical cyclones for their proper representation in analyses and forecasts.

Upcoming plans include attending and presenting at the 2024 EUMETSAT conference in Würzburg, Germany in October 2024 and finalizing preparations of a manuscript to be submitted to the peer-reviewed literature. Additional plans include organizing a GXS subgroup meeting related to proxy, nowcasting, and retrievals. New research will be started on the impact of eliminating GXS from the US satellite program, and the impact of assimilating IR radiances at a higher density in the proximity of tropical cyclones. A new project that will fall under this task involves the generation of a new, higher resolution nature run and an associated OSSE framework that includes GEO sounder observations.

PAMELA WALES
Sponsor Lesley Ott / Code 610.1 / Task 022

Dr. Wales contributes to the validation and development of the GEOS Composition Forecast (GEOS-CF) model and is a member of the GEOS atmospheric composition reanalysis team. Using remotely sensed observations, she has evaluated stratospheric constituents within GEOS-CF and is preparing metrics to assess changes in performance between the current system and the upcoming update. Dr. Wales developed and implemented tagged nitrogen oxide tracers in the near-real time GEOS-CF system to support the Asia-AQ aircraft campaign that took place in Spring 2024. These air quality tracers were tagged based on their source region and were included in forecasts that were used in flight planning during the campaign. Dr. Wales also has provided an analysis of satellite-based retrievals of carbon monoxide over Canada in support of a manuscript evaluating the intensity of the 2023 Canadian wildfire season.

Dr. Wales will continue to validate the updated GEOS-CF system and will contribute to the publication of a technical document describing changes in the system. She will contribute as co-author to publications related to the Earth Information System (EIS) Fire project.

LIONEL ARTEAGA
Sponsor Lesley Ott / Code 610.1 / Task 023

Dr. Arteaga has been working on the validation of the NASA Ocean Biogeochemical Model data against available profiling float data from BGC-Argo floats. Specifically, he focused on assessing the model skill in simulating vertical profiles of phytoplankton chlorophyll biomass and compared model output against float-based observations in the Southern Ocean from the Southern Ocean Climate and Carbon Observations and Modeling (SOCCOM) project, as well as in situ data from station ALOHA near Hawaii. These results were recently published in the journal *Earth and Space Science*. Dr. Arteaga also submitted two research proposals as PI to both the Modeling, Analysis, and Prediction (MAP) and Ocean Biology and Biogeochemistry (OBB)

ROSES calls in July 2024. He also has been monitoring the progress of the spin-up run for the newly coupled GEOS-NOBM configuration.

Dr. Arteaga is currently working on estimating the impact of the El Niño 2016 heatwave on biological export production in the equatorial Pacific using NOBM output and 3D-mapped products of ocean particle backscattering and dissolved oxygen based on machine-learning algorithms. He expects to submit a manuscript on this research for publication in late 2024/early 2025. As the biogeochemical variables in the spin-up GEOS-NOBM run approach equilibrium, Dr. Arteaga will dedicate a considerable amount of time in 2025 analyzing the model output for air-sea CO_2 fluxes against several observational products. In parallel, he is also collaborating with external researchers in studies evaluating future projections of CMIP models on the evolution and seasonality of Southern Ocean planktonic ecosystems, and characterizing the ability of CMIP models to reproduce the contemporary seasonality in pCO_2 and air-sea CO_2 flux in the Southern Ocean.

KATHERINE EMMA KNOWLAND
Sponsor Lesley Ott / Code 610.1 / Task 024

Dr. Knowland is working in collaboration with Dr. Christoph Keller and other members of the GMAO to validate and further develop the GEOS Composition Forecast system (GEOS CF). This year the focus was on producing a version 2 of the GEOS-CF system for public release, which includes bringing together many advances since the version 1 system was rolled out in 2019, such as multi-constituent data assimilation, updated GEOS model, updated GEOS-Chem chemistry module, and updated anthropogenic emissions. Dr. Knowland continues to lead the transition of GEOS-CF model development to the GMAO production team, especially addressing any needs from the TEMPO retrieval team regarding the TEMPO-specific GEOS-CF files, forecasting test runs prior to launch and the start of support following the April 2023 launch with first light in summer 2023 and the start of retrievals. Dr. Knowland is the point-of-contact for the TEMPO retrieval team, who use GEOS-CF as the model prior for the trace gas retrievals, and several other stakeholders. Dr. Knowland met with TEMPO retrieval team members in Boston at the Smithsonian Astrophysics Observatory in June 2024 following the NASA HAQAST meeting to discuss testing requirements with the updated GEOS-CF prior to officially releasing the new version.

Drs. Knowland and Keller jointly led the GEOS-CF system team, which involved several individual and sub-group meetings. They met weekly with Dr. Viral Shah (SSAI/GMAO), who is tasked with monitoring the GEOS-CF near-real time system and current events. Drs. Knowland and Keller met twice monthly with the GMAO FLUID (Framework for Live User-Invoked Data) visualization website developers (Mr. Callum Wayman (SSAI/GMAO) and Mr. Joe Ardizzone (SSAI/GMAO) to discuss visualization capabilities and model download on FLUID for the GEOS-CF and the NASA-Google Partnership project to ingest GEOS-CF into the Google Earth Engine (GEE) platform and to explore downscaling techniques using GEE tools, on which Mr. Wayman is tasked half time (https://gmao.gsfc.nasa.gov/research/science_snapshots/2023/new-generation-gmao-apps.php).

Dr. Keller left Morgan State University and GMAO in May 2024 and Dr. Knowland became the lead of Dr. Keller's task work, with shared responsibility leading the GEOS-CF monitoring and

development activities now with Dr. Viral Shah (SSAI/GMAO). Dr. Knowland now leads the effort to support the NASA Satellite Needs Working Group which will provide biased-corrected forecasts at Pandora instrument locations for stakeholders including the US Department of State. Dr. Knowland meets weekly with software developers (Navteca) and a postdoc Dr. Noussair Lazrak (NYU) to discuss the bias-correction algorithm development and API development. Dr. Knowland and Dr. Shah are working with the Joint Center for Satellite Data Assimilation (JCSDA) Joint Effort for Data assimilation Integration (JEDI) constituent data assimilation developers on the transition from the legacy GSI data assimilation system used in GEOS to the JEDI framework for use in GEOS-CF.

Dr. Knowland leads a group of GMAO and Code 614 scientists on transport evaluation specific diagnostics which can be used during the testing of the GEOS Earth System model and how changes in model physics may impact the transport and chemistry in GEOS chemistry simulations. This work has expanded into a separate group of GMAO and GEOS-Chem model developers meeting every 4 to 8 weeks, led by Dr. Knowland, to prepare model experiments for an intercomparison study specific for GEOS transport evaluation and the impacts on GEOS-Chem chemistry in the three different flavors of model setup. For the two months leading up to the 11th International GEOS-Chem (IGC11) meeting in June 2024, this group met weekly. Dr. Knowland and Dr. Todd Mooring (Harvard) reported on the group's activities to the GEOS-Chem Transport working group at IGC11.

Dr. Knowland is a member of the GEOS Chemistry-Climate Model (CCM) leadership committee. This committee meets monthly and with the CCM developers bimonthly. As part of the CCM leadership committee, Dr. Knowland is supporting the development of visualization tools and platforms specific for the analysis of the long-term chemistry model output, meeting twice monthly with the "Eviz" development team led by Dr. Carlos Cruz (Code 606). She is also the Computational PI for the CCM group and is in charge of managing the group's super-computing users, High-End Computing Program requests, and Data Management Plans.

Dr. Knowland is a World Meteorological Organization (WMO) Global Air Quality Forecasting and Information System (GAFIS) Steering Committee member since 2020. Dr. Knowland attended the annual committee meeting online in September 2023, and attended the regular online meetings throughout the year.

Dr. Knowland participates in two NASA HAQAST Tiger Teams: "Mitigating Uncertainties in Lateral Boundary Conditions used for Regional Air Quality Assessment Modeling" led by Brad Pierce (U. Wisconsin-Madison) and "Analysis to Support Air Quality and Health TEMPO Applications for Surface Ozone" led by Arlene Fiore (MIT). Dr. Knowland is a named Partner on the Lateral Boundary Condition Tiger Team. The GEOS-CF version 1 output includes files appropriate for this use and is developing new files for LBC use for version 2 based on the feedback from other modeling partners from this Tiger Team during the monthly online meetings and electronic communication. Since GEOS-CF is used as the *a priori* for TEMPO trace gas retrievals, Dr. Knowland gave a GEOS-CF overview presentation during one of the monthly online meetings, and regularly attends meetings to provide insight on the model.

Dr. Knowland is an Atmospheric Processes And their Role in Climate (APARC) Reanalysis Intercomparison Project (A-RIP) Steering Committee member as a representative from the

GAFIS Steering Committee. She virtually attended the 2024 A-RIP Planning Workshop, held in Boulder, Colorado, July 22-24, 2024.

Dr. Knowland is the Air Quality Forecast lead for the NASA-Rio Partnership since 2023. As part of the partnership, two NASA GSFC partnership team members traveled to Rio de Janeiro, Brazil to attend their city government's workshop on current activities and initiatives. Dr. Knowland provided an overview of the air quality forecast system being developed with support from ROSES grant funding. The workshop which was held live and translated into Portuguese. The team members had additional meetings at the city's control center to discuss how the forecasts could be incorporated into the city's communication infrastructure. Dr. Knowland conducted three social media interviews discussing the NASA-Rio partnership agreement and the ROSES project, with the US Consulate in Rio, the Instituto Pereira Passos, and with the Rio Operational Center.

Dr. Knowland will continue to lead the transition of GEOS-CF updates to the production system and to prepare the TEMPO retrieval team for this update. This activity aligns with the GMAO's Composition Reanalysis development efforts which will use a similar model framework to GEOS-CF v2 but with additional stratospheric and carbon constituent assimilation; Dr. Knowland is a Composition Reanalysis group member, and the group expects that at least a sweeper version for the composition reanalysis may start in Fall 2024 and the group will validate and monitor the sweeper and the development of this system.

BRAD WEIR
Sponsor Lesley Ott / Code 610.1 / Task 025

Dr. Brad Weir has continued the development of constituent assimilation and greenhouse gas monitoring in GEOS. This includes modernization of a legacy biospheric model, the Carnegie-Ames-Stanford Approach (CASA), which is widely used throughout the greenhouse gas community. The modernized product, Más informada CASA (MiCASA), is a considerable upgrade in resolution from a monthly, 0.5 degrees to daily, 0.1 degrees. This dataset has been released to the public through the NCCS DataPortal and the interagency United States Greenhouse Gas Center (GHGC). MiCASA is a cornerstone, founding product of the GHGC which plans to serve as a main access point of information and data about greenhouse gasses across the US government including agencies like NASA, NOAA, and EPA. Dr. Weir has also continued the development and support of constituent assimilation in GEOS through the Constituent Data Assimilation System (CoDAS). This work supports the long-term effort to produce a next-generation constituent reanalysis.

In the upcoming months (September 1, 2024 – November 30, 2024), Dr. Weir plans to continue development of constituent assimilation products. This includes releasing an upcoming 0.1 degree global forward analysis of the two main anthropogenic greenhouse gasses (CO_2 and CH_4). This product will also support the GHGC.

CHRISTOPH KELLER
Sponsor Steven Pawson / Code 610.1 / Task 045

Dr. Keller led the upgrade of the GEOS composition forecast system GEOS-CF from GEOS-CF v1 to GEOS-CF v2. The new version includes important scientific improvements, incorporates better information on air pollution sources, and makes better use of satellite observations through direct assimilation of ozone, nitrogen dioxide, and sulfur dioxide. Dr. Keller led the design of the overall GEOS-CF v2 system, set up the run experiments, and oversaw the model spinup and validation process.

Dr. Keller also worked with the Joint Center for Satellite Data Assimilation (JCSDA) on the adoption of the Joint Effort for Data Assimilation (JEDI) framework for trace gas simulations. These efforts include the development of the near real-time use of TEMPO observations for efficient model validation and improvement, and the development of a demonstration application on the use of generative artificial intelligence for improved data assimilation of atmospheric composition.

NIAMA BOUKACHABA

Sponsor Yanqiu Zhu / Code 610.1 / Task 046

Dr. Boukachaba is working on enhancing the use of the hyperspectral infrared sounders, such as the infrared Atmospheric Sounding Interferometer (IASI) and the Cross Track Infrared Sounder (CrIS), radiances over land in the NASA Goddard Earth Observing System (GEOS) data assimilation system through enhanced data selection techniques, error modeling, and data sampling. Dr. Boukachaba, along with Dr. Yanqiu Zhu, modified and corrected the code to retrieve Land Surface Temperature (LST) from selected IASI and CrIS surface-sensitive channels. Dr. Boukachaba then used these retrieved LST in the assimilation of other IASI and CrIS surface-sensitive channels. She also ran several stand-alone experiments by taking one GEOS forward processing (FP) experiment as a reference (CTRL experiment). She looked at the quality control for LST retrieval, the bias correction, and tuned the existing cloud-detection algorithm over land and ocean. Dr. Boukachaba ran several data assimilation (DA) experiments to test the code and re-adjust it, if needed. Some experiments included the following: 1) LST retrieval code, and the bias correction changes, to study the impact of IASI over land and LST retrievals compared to the control experiment; 2) tuning the cloud detection to study the impact of IASI land and ocean data along with cloud detection changes; and 3) tuning the Ts for CrIS only, for which the goal was to study the impact of CrIS land data and LST retrieval compared with the first experiment as well as the control one.

The results of using the LST retrieved from selected IASI and CrIS surface-sensitive channels over land in the radiance assimilation in the GEOS are encouraging. A paper summarizing this effort was submitted to JTECH in July 2024.

The next step of this work is to investigate the impact of using different land surface emissivity, such as the Combined ASTER and MODIS Emissivity database over Land (CAMEL) (Borbas et al. 2018; Feltz et al. 2018; Loveless et al. 2021), on improving the previous results.

VIRGINIE BUCHARD

Sponsor Arlindo da Silva / Code 610.1 / Task 050

Dr. Buchard has been actively working on the aerosol data assimilation (DA) system development in GEOS. Currently, the aerosol observing system is being expanded to include observations of Aerosol Optical Depth (AOD) from VIIRS, which necessitates thorough testing before integration into GMAO's operational systems. This work is ongoing. In addition, efforts are being made to transition the current aerosol data assimilation system to a JCSDA/JEDI based system; she is enhancing the multi-wavelength AOD observation operator, a capability she previously developed in JEDI - Unified Forward Operator (UFO). These improvements aim to provide more flexibility and functionalities in the process, such as the ability to select observations at specific wavelengths to assimilate rather than using all available observations. She has also introduced the option to use the natural logarithm of AOD as the observable quantity in the assimilation process, by developing its tangent-linear and adjoint models in UFO. Moreover, this new DA system involves working on the development of essential codes, including for the Interface for JEDI - Observation Data Access (IODA), which is a component for observation formatting and processing. Over the past year, Dr. Buchard has also contributed to two proposals as a Principal Investigator and Co-Investigator and has co-authored several papers.

Dr. Buchard plans to continue her work on aerosol data assimilation (DA) within GEOS. This includes the ongoing testing of integrating VIIRS data into the current DA system and developing key components for the future DA system based on the JCSDA/JEDI framework. Additionally, she intends to participate in a proposal submission for the ROSES call related to the TEMPO science team.

ALLISON COLLOW
Sponsor Arlindo da Silva / Code 610.1 / Task 051

Dr. Collow has been working to evaluate aerosols in GEOS, particularly with respect to the science updates and code refactoring that were included in GOCART-2G. Dr. Collow completed an evaluation of GOCART-2G using a 4-year benchmark simulation that was compared to the previous version of GOCART as well as observations of aerosol optical depth, surface particulate matter, and aerosol backscatter. A manuscript documenting this evaluation has been published in Atmospheric Chemistry and Physics (ACP). Additional evaluations of GOCART-2G have been in the context of the configuration of GEOS used for numerical weather prediction. Dr. Collow assisted the monitoring team by evaluating the representation of aerosols in the "x runs" that incorporate GOCART-2G.

Dr. Collow has been involved in the reanalysis activities with the GMAO. In addition to attending weekly meetings to offer guidance pertaining to aerosols, Dr. Collow evaluated the representation of aerosols in GEOS-IT and revised the aerosol output collections to make the data more intuitive for users in preparation for GMAO's next reanalysis, MERRA-21C.

Dr. Collow spent a small fraction of her time contributing to the National Climate Assessment group within the GMAO. As part of that effort, she produced a new style of seasonal cycle time series plots from MERRA-2 that soon will be added to the FLUID website.
Looking ahead, Dr. Collow expects to lead the evaluation effort for aerosols in MERRA-21C. Also, Dr. Collow anticipates contributing towards the incorporation of updated versions of QFED

biomass burning aerosol emissions and CEDS anthropogenic aerosol emissions in future versions of GEOS.

MANISHA GANESHAN
Sponsor Rolf Reichle / Code 610.1 / Task 052

The research performed under this grant involves investigating the impact of assimilating SMAP soil moisture observations on the prediction of landfalling Tropical Cyclones (TCs). Dr. Ganeshan's contribution included running Observing System Experiments (OSEs) using a weakly coupled version of the GEOS ADAS and LDAS systems, to explore the sensitivity of TCs and TC-related precipitation to soil moisture. Dr. Ganeshan further helped develop diagnostic metrics to quantify the land influence on TC structure and intensity by conducting back trajectory analyses and helping to isolate the land areas that influence the TC. A manuscript describing this research has been revised and re-submitted to the journal *Monthly Weather Review*. A new ROSES 2023 proposal to continue this work has been recently funded.

Dr. Ganeshan will continue working on this project and will contribute to any revisions requested by reviewers for the first paper. She will contribute to a second follow-up paper to *Monthly Weather Review*, describing the impact of assimilating SMAP observations on the forecasts of TC Idai. She will contribute to research under the newly funded ROSES grant, including running experiments using the coupled GEOS ADAS and LDAS systems to investigate new TCs. She will contribute as co-author to a presentation titled "Assimilation of soil moisture observations over land improves analysis and prediction of Tropical Cyclone Idai" to be presented at the fall AGU 2024 meeting.

ERICA MCGRATH-SPANGLER
Sponsor Rolf Reichle / Code 610.1 / Task 052

Dr. McGrath-Spangler's work on this task is focused on evaluating the impact of NASA's Soil Moisture Active Passive (SMAP) soil moisture information on numerical weather prediction. As part of this project, SMAP data are assimilated into the coupled land-atmosphere Global Earth Observing System (GEOS) Data Assimilation System (DAS) and compared to a control simulation in a set of Observing System Experiments (OSEs) to calculate the beneficial impact to Tropical Cyclones (TCs) that are proximate to land. Recent efforts have focused on Cyclone Idai (2019) that affected the population on the southeastern part of the African continent and Madagascar. Dr. McGrath-Spangler has led the evaluation of the TC impact in both analyses and forecasts and a manuscript focused on the analysis improvements of Idai was submitted for peer-reviewed publication in May 2024 with Dr. McGrath-Spangler as a co-author.

In the following months, it is expected that Dr. McGrath-Spangler will work with co-authors in responding to reviews on the submitted manuscript and that efforts will be made to write and submit a new manuscript detailing the improvements to the forecast of Cyclone Idai.

YEHUI CHANG
Sponsor Randal Koster / Code 610.1 / Task 058

Dr. Chang has been working on the productions of NASA/GMAO GEOS-IT Ocean data assimilation from 1998-2024. The systems assimilate all available sea level and in situ temperature and salinity observations, Aquarius, SMAP, SMOS, and other satellite data sets combined. The assimilated ocean stats have been used to initiate the GEOS-S2S forecast system. The simulated data has been used in research works and presented at conferences and published in journals. The long productions of assimilated atmosphere/ocean data will be released to the public. Dr. Chang has been working on the testing and implementation of NASA/GMAO ocean data assimilation productions in near real-time for use in the S2S predictions.

Dr. Chang has been generating the large-number ensemble NASA/GMAO/GEOS-AGCM regional relay runs for many different replay regions. The large numbers of simulations have been used in many climate extreme studies and results have been submitted and accepted to multiple publications. Dr. Chang has been working on the development, testing, and implementation of the new ocean replay capability in the NASA/GMAO GEOS coupled GCM in simulation and ocean data assimilation. He also develops, tests, and implements the tendency bias correction techniques in the NASA/GMAO GEOS coupled GCM to improve its subseasonal-to-seasonal prediction skills.

The spring and summer of 1993 were marked by a number of apparently disparate climate extremes. Dr. Chang is conducting research to develop a dynamical framework that links these extremes and provides insights into the uniqueness of the US Midwest flooding event. This research is ongoing.

EUNJEE LEE
Sponsor Randal Koster / Code 610.1 / Task 059

Dr. Lee worked on investigation of subseasonal forecast skill of streamflow for the Mekong River and two rivers in Myanmar and the contributing mechanisms to the hydrological forecast skill. She submitted a manuscript that demonstrates improved forecast skill of the region's river water availability and highlights the important contribution of land initialization to the Hydrology and Earth System Sciences. While the manuscript was entering into a review process, the research team realized that the forecast skill can be improved to a higher level and decided to do a quick revision and resubmission. In addition, Dr. Lee participated as a co-author in preparing a manuscript that explores seasonal forecasts of methane, which is led by Colin Quinn (UMD / NASA GSFC). During the current performance period, Dr. Lee made two research visits (Oct-Dec 2023 and July 2024) to the EcoHydrology group in the Department of Civil and Environmental Engineering at Yonsei University in Korea, supported by a visiting scientist fellowship of the National Research Foundation of Korea. Collaborating with Prof. Yeonjoo Kim and a graduate student (Hocheol Seo), she conducted collaborative research that explored the relationship between soil moisture and carbon flux from a land surface model and participated in the manuscript preparation led by the student. She also worked with another graduate student (Hyunyoung Oh) and developed a plan to investigate the performance of wildfire simulation in the Community Land Model (which has the same wildfire scheme as in GMAO's Catchment-CN model) to explore the seasonal forecast skill of wildfire.

Upcoming Plans for Dr. Lee include conducting revised analysis of the hydrological forecast skill and re-submission of the manuscript to a peer-reviewed journal. The co-authored paper led by C. Quinn is expected to be submitted in September. She will continue to supervise the investigation of the performance evaluation of wildfire simulation.

YOUNG-KWON LIM
Sponsor Adrea Molod / Code 610.1 / Task 061

Dr. Lim has been involved in several projects, including: 1) enhancing and assessing NASA's GEOS subseasonal to seasonal (S2S) forecast model, 2) examining the effects of surface salinity assimilation on Madden-Julian Oscillation (MJO) simulations, 3) investigating how non-hydrostatic higher-resolution models improve MJO simulations, 4) studying climate variability and the dynamical causes of extreme weather, particularly focusing on large-scale atmospheric wave propagation, 5) evaluating the GEOS S2S system's accuracy in representing and predicting tropical cyclones, and 6) depicting major low-frequency climate modes in observations and the NASA GEOS model system for visualization on NASA GMAO's Framework for Live User-Invoked Data (FLUID) website.

For project #1, Dr. Lim has worked with the S2S team to develop Version 3 of the GEOS S2S forecast system (GEOS-S2S-3). He also evaluated this new model and in particular, its depiction of the MJO and key climate modes, including processes like premoistening before MJO convection and heat-driven tropical circulation responses. He explored how sea surface salinity assimilation (project #2) and higher spatial resolution (project #3) enhance MJO simulations. His findings were presented at AGU and AMS meetings, with a paper being prepared for JGR-Ocean. In project #4, Dr. Lim investigated the dynamic causes behind the 2023 California floods, the 2023 Texas heatwaves, and the 1993 historic flood in the U.S. Collaborating with his team, he produced three papers as a co-author either published in the Journal of Climate or currently under review, along with several presentations at AGU and AMS conferences. For project #5, he assessed the GEOS S2S system's capability to replicate the observed characteristics of tropical cyclones, such as their spatial structure, occurrence frequency, and intensity. This work led to two published papers in Weather and Forecasting and another paper is in progress. In project #6, Dr. Lim created an automated system to calculate and visualize major climate modes, which will be displayed on the FLUID website.

Dr. Lim will continue to work on validating the newest version of the GEOS S2S forecast system, which is set to replace the current system soon. This task includes evaluating its ability to predict the Madden-Julian Oscillation (MJO), monsoons, ENSO, major climate modes, the Quasi-Biennial Oscillation (QBO), and tropical cyclones. Using the GEOS model/asssimilation system, Dr. Lim will also continue investigating the dynamic causes of the 2023 Texas heatwaves, one of the most intense in the region in several decades. Papers on tropical cyclone prediction and the impact of surface salinity assimilation on MJO simulations are underway and are expected to be submitted in the coming months.

PETER NORRIS
Sponsor / William Putnam / Code 610.1 / Task 080

Dr. Norris has continued his role as Radiative Transfer lead in the Global Modelling and Assimilation Office (GMAO) Modeling Group. In general, this involves RRTMGP (Rapid Radiative Transfer Model for GCM applications – Parallel version) integration and testing, general radiation code maintenance, adding diagnostics, and user / Modeling Team / Office assistance.

Specific areas of work performed include the following. Dr. Norris participated in the RRTMGP vs. RRTMG (the operational non-parallel version) comparison studies, including analysis of the differences using a variety of cloud physical and optical property diagnostics. Also included was testing various RRTMGP tuning knobs and presenting the findings to the GMAO Modeling Team. In the process of these comparison studies, several RRTMGP implementation bugs were identified and fixed, including an accidental omission of delta-scaling in the RRTMGP implementation. Also, an RRTMG-like forward scattering fraction was included for an apples-to-apples RRTMGP vs. RRTMGP delta-scaling comparison. The main conclusion thus far is that ice clouds change the most in RRTMGP, being significantly more optically thick than in RRTMG. The outstanding question becomes whether we can tune for this by reducing ice water path or increasing ice crystal effective radius in GEOS-5.

He was involved in the coding of various improved or additional cloud fraction and cloud property diagnostics (optical depth, including several in-cloud options and phase-specific forms, and higher order properties such as single-scattering albedo and asymmetry parameter). These diagnostics were provided for both RRTMG and RRTMGP to assist in analysis of the radiative difference between these codes. As always, these code fixes and additions were incorporated into the GitHub repository for the working development version of GEOS-5 with much help from Dr. Matt Thompson. Significant parties were also updated by email, Teams discussion, or Modeling Team presentations. Additionally, Dr. Norris coded or helped to code the changes for the newly released RRTMGP v1.7 and v1.8 to keep our version of RRTMGP up to date with the work of the RRTMGP creators.

Dr. Norris added a full suite of solar and infrared top-of-atmosphere individual-band diagnostics for both RRTMG and RRTMGP for use by Dr. Bill Putman in GOES satellite comparisons. This required adding band-specific surface temperature Jacobians into RRTMGP (not provided out-of-the-box), and interactions with RRTMGP co-creator Dr. Rob Pincus on this matter. In addition, Dr. Norris did extensive outreach both within and external to GMAO to answer various questions about how radiation transfer works in GEOS-5 and to explain the various diagnostics that the codes produce. Numerous users were aided in various contexts (Drs. Mike Long, Huisheng Bian, Mike Bosilovich, Michael Mehari, Florian Deconinck, Matt Thompson, Scott Rabenhorst, etc.)

NOTE: Dr. Norris retired from UMBC effective June 30, 2024.

DHRUVA KATHURIA
Sponsor Alexey Shiklomanov / Code 610.1 / Task 093

Dr. Kathuria has been working on developing novel Bayesian statistical algorithms for predicting plant functional traits (such as chlorophyll, nitrogen, etc.) from hyperspectral data at leaf and canopy scales. He has successfully developed a statistical algorithm which is (a) interpretable and (b) computationally efficient, (c) accounts for uncertainties in input reflectance, and (d)

provides parameter and prediction uncertainties. The proposed algorithm is an improvement over commonly used algorithms such as Partial Least Squares Regression. The algorithm is relevant to developing trait retrieval algorithms for upcoming hyperspectral satellite missions such as Surface Biology and Geology (SBG). Dr. Kathuria has finished a manuscript on this work which will be submitted to an Ecology journal in Fall 2024.

Dr. Kathuria is also working on improving the land surface temperature (LST) product of The Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) reanalysis product produced by NASA's Global Modeling and Assimilation Office (GMAO) at approximately 50 km spatial resolution by characterizing its spatio-temporal variability using 2 km hourly LST data Geostationary Operational Environmental Satellites (GOES)-R satellites. This analysis will help us better understand how much information we lose when we go from 2 km GOES resolution to 50 km Merra resolution and how this information loss varies between land use/land cover types. Dr. Kathuria has finished most of the analysis for this work and is currently writing a manuscript.

Additionally, Dr. Kathuria is working on developing novel unmixing algorithms to generate flowering maps using airborne and satellite hyperspectral data. A manuscript is under review based on this work which successfully maps yellow flowering areas using airborne data collected as part of the SBG High-Frequency Time Series (SHIFT) campaign in Santa Barbara, California. A NASA ROSES proposal was accepted to extend this work to other study sites. Dr. Kathuria is a co-investigator in that proposal.

Dr. Kathuria is also a core member of the NASA SBG vegetation group and the 2024-2025 ISRO-NASA AVIRIS campaign. In these roles, Dr. Kathuria is developing vegetation trait algorithms for the future SBG mission and helping to organize field campaigns in India as part of the vegetation cal/val activities.

Between September 1, 2024 to November 30, 2024, Dr. Kathuria will submit two manuscripts based on the Bayesian trait estimation algorithm and LST work. Dr. Kathuria will also present his Bayesian trait estimation work at a conference in The Netherlands in November 2024.

ANDREW FOX
Sponsor Rolf Reichle / Code 610.1 / Task 094

Over the past year, much of Dr. Fox's work has been focused on the development of new features in the NASA GMAO Goddard Earth Observing System modeling system. Specifically, he has added capabilities to jointly assimilate ASCAT soil moisture and SMAP brightness temperature observations simultaneously into the GEOS Catchment land surface model. Through a series of multi-year experiments, the impact of this new capability has been thoroughly tested, with validation performed against in-situ measurements and alternative satellite observations of soil moisture, and careful examination of data assimilation diagnostics. The code he developed forms a key component of updates captured in the public release of GEOS Land Data Assimilation System (LDAS) v18.0.0 (https://github.com/GEOS-ESM/GEOSldas/releases/tag/v18.0.0).

Regarding future plans, Dr. Fox has begun drafting a manuscript describing the new multi-sensor DA capabilities in GEOS LDAS; this will be completed and submitted during Fall 2024. The anticipated start date for a new CYGNSS Science Team funded proposal is also occurring during this period, so work will begin on adding the capabilities of assimilating the CYGNSS soil moisture product in GEOS LDAS.

YUJIN ZENG
Sponsor Randal Koster / Code 610.1 / Task 124

Dr. Zeng has introduced a global runoff routing model founded on hydraulic geometry principles and hydrologic catchments, specifically designed for integration with ESMs. To simulate river dynamics, the model capitalizes on: (1) the river network topology defined by the Pfafstetter coding system, (2) hydraulic geometry principles that connect river discharge to flow velocity, and (3) calibration using more than 2.7 million field measurements of flow velocity in the contiguous US (CONUS). The model is shown to produce reasonably accurate natural daily river discharge over CONUS except within some arid regions and the region adjacent to the Great Lakes, where streamflow is strongly impacted by reservoir management and by the natural buffering behavior of the large lakes themselves. The average correlation coefficient is 0.81 for tested major rivers over CONUS except the arid regions and the Great Lakes. A unique feature of the model is its ability to simulate flow velocity and water storage with realistic magnitudes, standing it in good stead for tracer tracking and water management applications.

Upcoming Plans for Dr. Zeng include further implementation of reservoir and lake modules to the runoff routing model.

WILLIAM OLSON
Sponsor Michael Bosilovich / Code 610.1 / Task 125

The overarching goal of this task is to produce a budget-consistent description of the Earth's water and energy cycles. That is, for any region of the globe over a given time period, the amount of water or energy being horizontally transported into (out of) a region either leads to increases (decreases) of water/energy storage in that region or vertical fluxes of water/energy out of (into) the region. For example, water vapor carried by the atmosphere into a region must lead to an increase of total water vapor storage in the atmosphere of that region or increased precipitation or decreased evaporation at the surface in that region. In the current project, the globe has been divided into 25 continental/ocean basin regions and monthly water and energy flux/storage data have been collected for each region, but due to errors in those data, the budgets of water and energy data are not balanced.

The balancing method, previously developed, for calculating budget-consistent water and energy fluxes/storages closest to the collected (and unbalanced) monthly, regional observations is an application of constrained optimization, which (a) assumes that the collected observations are unbiased and Gaussian-distributed, and (b) requires estimates of the uncertainties of those observations. During the reporting period, the assumption of unbiased, Gaussian-distributed errors in the observations was challenged by Dr. Olson, since mean imbalances of the water and energy fluxes/storages were shown to have an annual cycle that dominated the yearly imbalance cycle. This suggests that the observational errors that contribute to the yearly

imbalances are also cyclical and systematic. Dr. Olson proposed a simple two-parameter model for the systematic error of each water and energy budget component, as well as an optimization method for estimating the two parameters using the full time series of water and energy data that is available. The method was implemented, and systematic errors were shown to contribute about 80% to the total imbalance of the observed water and energy budget components. The remaining 20% of the imbalance was mostly due to random error fluctuations of those observed components.

However, the optimization of the systematic error parameters requires specification of "bounds" on those parameters to prevent unrealistic solutions, similar to what is required for the bounding of random errors. Dr. Olson demonstrated that since the systematic error model is linear in the two controlling parameters, setting maximum error bounds at both the maximum and minimum values of the observed water/energy components leads to a simple bounding of the two parameters. This bounding was shown to be fairly representative in relation to Monte Carlo-generated distributions of synthetic errors based on the same assumed errors at the minimum and maximum observed values. Dr. Olson also created software for estimating the error bounds using multiple sources of observations for any particular water and energy budget component.

In the upcoming months, bounds for each water and energy budget component will be evaluated, using the multiple-source method together with input from the scientists who contributed the observations. Then, a full balancing of the water and energy cycle, accounting for both systematic and random errors, will be performed.

CARL MALINGS
Sponsor Patricia Castellanos / Code 610.1 / Task 129

Dr. Malings is working on a ROSES-funded project in Earth Science Applications: Health and Air Quality to combine model, satellite, and in-situ monitor data to improve air quality forecasting. Since September 2023, he has worked to develop, test, and refine data fusion algorithms. He has attended numerous project team meetings and meetings with end-users and stakeholders to discuss developments in the project as well as future needs. He has submitted a publication related to this work (currently under review) and has submitted a ROSES proposal to pursue a follow-on project.

Also, Dr. Malings is working on a ROSES-funded project supporting the Asia-AQ field campaign (Jan-Feb 2024) by providing high spatial and temporal resolution air quality forecasts. Since September 2023, he has gathered necessary surface, model, and satellite datasets to support forecasting, and has tested the basic forecasting methodology for a case study covering Seoul, Korea using data from the GEMS instrument alongside other information sources.

Dr. Malings is a trainer in the NASA Applied Remote Sensing Training (ARSET) capacity-building program in the Health and Air Quality topic. He has contributed to two trainings: "Satellite Data for Air Quality Environmental Justice and Equity Applications" (Aug-Sep 2023) and "NASA Atmospheric Composition Ground Networks Supporting Air Quality and Climate Applications" (Aug 2024). Additionally, he has supported the development of an online self-paced training in Developing Sustainable Earth Science Applications.

Dr. Malings continues to engage in various activities aimed at promoting the use of NASA resources in air quality applications and building user capacity. This includes serving as a guest lecturer in an introductory course on air quality at UMBC (Apr 2024), mentoring a GESTAR II Fellow in developing applications of NASA satellite and model data to air quality assessments in Phoenix, AZ (Jun-Oct 2024), organizing a workshop in air quality applications of satellite data in the Americas as part of the AmeriGEO Week meeting (Aug 2024), and organizing sessions at the MAC-MAQ (Sep 2023) and ASIC (May 2024) conferences. He also continues to serve as a lead of the GSFC Air Quality and Health working group (since 2021), a lead of the GEO Health Community of Practice Air Quality working group (since 2023), and an organizer of the GMAO Machine Learning and AI Journal Club (since May 2024).

Looking ahead, Dr. Malings will continue to support all of the projects and activities outlined above. He will prepare presentations on these projects for the AGU Fall Meeting (Dec 2024). Dr. Malings will begin to draft a paper describing the current and planned future applications of the GMAO GEOS-CF system. To support the ARSET program, Dr. Malings will help to deliver a revised version of the Fundamentals of Remote Sensing course as an online self-paced program in September 2024. He will also begin to develop a future online self-paced course in the Fundamentals of Remote Sensing for Air Quality Applications, as well as an in-person training on the TEMPO mission and a virtual training on applications of satellite data to study and forecast climate-sensitive infectious diseases. Additionally, he will serve as an organizer of the GMAO Seminar Series, beginning September 2024.

KATHERINE BREEN
Sponsor Donifan Barahona / Code 610.1 / Task 140

Dr. Breen has been working to develop AI/ML-based enhancements to new and existing numerical parameterizations for cloud and aerosol microphysics. Her work has focused on developing physically constrained parameterizations for vertical wind velocity, the aerosol size distribution, and cloud droplet number concentration – all critical parameters in the sub-grid simulation of cloud formation – which have been published in peer-reviewed journals (Artificial Intelligence for Earth Systems, Nature Communications, etc.) within the past year. Additionally, Dr. Breen has provided ML expertise to a variety of projects, including the AOS mission (development of a satellite-simulation emulator) and ML-enhancement of various atmospheric chemistry modules. Recently, she has begun working with the GSFC AI Center of Excellence to benchmark foundation models for downstream tasks related to GMAO mission objectives.

Dr. Breen has given numerous scientific presentations, both internally and externally to NASA during the past year. Dr. Breen presented both posters and professional talks at workshops, conferences, seminars, and outreach opportunities. She submitted one proposal as a Principal Investigator to the ROSES F7 solicitation and was a co-Investigator on two more ROSES MAP proposals.

Dr. Breen is currently working on a proposal for a workshop at IPAM on the topic of ML in weather and climate modeling. The proposal will be submitted in September. From October 30-November 1, 2024, Dr. Breen will attend the 6th Annual WCRP International Conference on Reanalysis for an oral presentation in Tokyo, Japan.

MANISHA GANESHAN
Sponsor Yanqiu Zhu / Code 610.1 / Task 152

Under this task, Dr. Ganeshan contributes to research of optimal utilization of satellite hyperspectral infrared radiances by allowing their assimilation in areas affected by clouds with a goal of improving Tropical Cyclone representation and related processes in the GEOS. Dr. Ganeshan has completed running the Northern Hemisphere control experiment for 2020, using the GEOSadas-5.29.4-p3 version, which involves running the ensemble 4D variational (4DEnVar) hybrid data assimilation system and daily 10-day forecasts for a 3.5 month long experiment covering the Atlantic Hurricane season of 2020. Further, Dr. Ganeshan has submitted a proposal to a NASA ROSES 2023 solicitation (Advanced Information Systems Technology) to use Artificial Intelligence (AI) for efficient sub-sampling of satellite radiances to improve Tropical Cyclone (TC) prediction in global models. As part of this task, Dr. Ganeshan also contributes to exploring strategies for assimilating PBL height observations in the GEOS, specifically GNSS RO derived PBL height. Dr. Ganeshan prepared a poster presentation detailing the strategies for PBLH assimilation in the GEOS for the fall 2023 AGU meeting. Dr. Ganeshan also contributed to a paper titled "Utilizing PBL Height Data from Multiple Observing Systems in the GEOS System (I): Assimilation Framework" submitted to *Monthly Weather Review*.

Dr. Ganeshan will verify the performance of the 2020 GEOS control experiment using anomaly correlation and other forecast statistics, as well as evaluate the representation of TCsand Polar Lows (PLs) in the control experiment. She will perform frequency analysis using the 2D Hilbert Huang Transform (HHT) for studying tropical waves, and she will prepare a manuscript detailing the results to be submitted to a suitable peer-reviewed journal. Dr. Ganeshan will contribute to several AGU presentations as co-author, including one presentation on the impact of assimilating all-sky hyperspectral infrared radiances on the simulation and forecast of Hurricane Sally, and two presentations related to the use of Machine Learning for improving TC detection and TC prediction in a global modeling and data assimilation framework. Dr. Ganeshan will contribute as co-author to a presentation titled "Surface-based PBL height retrievals from a collocated ceilometer, lidar, and radar wind profiler in contextof a global PBL observing system" to be presented at the AMS 2025 meeting, as well as co-author of a presentation titled "Improving Boundary Layer Data Assimilation using observation data from multiple observing systems in the NASA GEOS System" to be presented at the 2024 AGU Fall meeting.

SEUNGHEE LEE
Sponsor Patricia Castellanos / Code 610.1 / Task 157

Dr. Lee has been working on the Airborne and Satellite Investigation of Asian Air Quality (ASIA-AQ) project, focusing on the evaluation of aerosol data assimilation and forecast performance within the GEOS-Forward Processing (FP) system, specifically for $PM_{2.5}$ prediction in South Korea. During the campaign, she provided real-time $PM_{2.5}$ composition forecasts using the GEOS-FP system for South Korea from mid-February to mid-March 2024, delivering these forecasts daily along the flight tracks. Through the intensive observations of this campaign, she analyzed the characteristics of long-range transport and local events of $PM_{2.5}$ in South Korea, as

well as the forecast performance of the GEOS-FP model. Furthermore, she is validating the vertical distribution of $PM_{2.5}$ in the GEOS-FP model using airborne observations.

Dr. Lee has been involved in the development of a system for assimilating aerosol optical depth (AOD) from the TROPOMI satellite. She has contributed to creating preprocessing codes for the assimilation of TROPOMI AOD, building on the existing MODIS AOD assimilation system. The assimilation of TROPOMI AOD is a foundational step towards the future assimilation of aerosol layer height retrievals from TROPOMI. By assimilating aerosol layer height, the vertical profile simulations of aerosols can be significantly improved, providing substantial potential for further research into the impact of aerosol vertical distribution.

In the coming months, Dr. Lee will continue to evaluate the GEOS-FP model using ASIA-AQ observation and plans to submit a paper titled "Evaluation of Aerosol Data Assimilation and Forecasts in the NASA GEOS Model during the ASIA-AQ Campaign" to a peer-reviewed journal.

AMIN DEZFULI
Sponsor Michael Bosilovich / Code 610.1 / Task 162

Dr. Dezfuli has been contributing to the Framework for Live User-Invoked Data (FLUID), which is an online platform for climate/weather visualization developed at GMAO. In this task, he writes and runs computer programs that produce NetCDF files for MERRA-2-based climate statistics, which are then plotted in FLUID. The files are also transferred to GES-DISC to be made available to the broader community.

He is a team member of the GMAO National Climate Assessment (NCA) enabling tools group funded by NASA, working on various climate applications using NASA products.

Using various NASA products, Dr. Dezfuli has analyzed the climatic drivers of biomass burning in Africa and their impacts on other regions. He is the lead author on a related paper currently in its second revision at GRL.

Dr. Dezfuli has recently submitted an opinion piece as the lead author on transboundary waters. The manuscript is currently under review.

Dr. Dezfuli has also served as a co-author on a paper recently submitted to Journal of Hydrometeorology by colleagues at UCLA. The paper is entitled "Evaluation of Seasonal Precipitation Forecasts in the Tigris-Euphrates Basin."

Dr. Dezfuli has recently joined Goddard Applied Science at 0.1 FTE to coordinate an interagency health-related collaboration between NASA and CDC. The project will continue through June 2027.

He has submitted two abstracts as lead author to be presented in Fall 2024. The first one titled, “Role of Large-Scale Climate Features in Fire Emissions and Transport in Africa”, will be presented at the AGU Annual Meeting. The second one titled, “Applications of MERRA-2 data for avian migration, biomass burning, and dusty atmospheric rivers” is submitted to the Sixth WCRP International Conference on Reanalysis to be held in Tokyo, Japan.

Dr. Dezfuli has obtained several certificates required for Human Research/Institutional Review Board (IRB) approval, provided by the Collaborative Institutional Training Initiative (CITI) Program, under requirement set by UMBC. These certificates were required for collaborative research that he is leading with Pediatrix Inc. aiming to study the impacts of climate and air quality extreme events on morbidities in infants admitted to the neonatal intensive care unit across the United States.

In July 2024 Dr. Dezfuli received the health data from Pediatrix Inc. and is planning to perform the analysis in the next 1-2 years.

He will also examine the impacts of weather extremes on migraine headaches in the United States. He has already initiated this effort and formed a team including neurologists from the Johns Hopkins University School of Medicine and Medical University of South Carolina. The medical team has recently incorporated data collection into an existing mobile application. By the end of 2024, the team expects to have several months' worth of data, which Dr. Dezfuli will start analyzing in close communications with the medical members of the team.

Following up on a recent interdisciplinary project that he led, Dr. Dezfuli is planning to further explore the continental patterns of bird migration in North America and their large-scale climatic drivers. He is also actively looking for external funding for this analysis.

If the proposal he submitted as PI gets selected, in the next four years he will lead a study on dusty atmospheric rivers.

EUN-GYEONG YANG
Sponsor Yanqiu Zhu / Code 610.1 / Task 163

Dr. Yang contributes to the development and evaluation of Planetary Boundary Layer (PBL) data assimilation (DA) capability in the Goddard Earth Observing System (GEOS) model of the Global Modeling and Assimilation Office (GMAO) to provide a global PBL height (PBLH) analysis and monitoring capability. She continued developing the infrastructure to ingest PBLH data derived from the radar wind profiler into the GEOS model and implemented corresponding quality control (QC) procedures, in addition to other PBLH data (e.g., radiosonde, Global Navigation Satellite System (GNSS)-Radio Occultation (RO), space- and ground-based lidars), and continued refining DA infrastructure including thinning and QC procedures for all PBLH data from multiple observing systems.

In addition, Dr. Yang, along with sponsor Dr. Yanqiu Zhu, implemented methods to better capture capping inversions which benefit other observations near inversions by improving background error covariances through inflation of ensemble spread and adjustment of vertical localization length scale. Dr. Yang is a contributing author on a paper on these results led by Dr. Yanqiu Zhu, which has been submitted. Dr. Yang is currently working on conducting and evaluating the experiments to see the impact of assimilating PBLH for a one-month period. Furthermore, she evaluated PBL structure from the prototype-MERRA-21C PBLH using PBLH data derived from radiosonde and two different Spire-RO data for a one-month period and she presented this work at the AMS Annual Meeting 2024.

In the coming months, Dr. Yang will submit a first-author manuscript to a peer-reviewed journal, describing the evaluation of PBLH data and results of assimilation experiments. She will work on developing a method to assimilate GNSS-RO refractivity gradient in the lower troposphere. She will also present the results of assimilation experiments for PBLH data and new DA capability for lower troposphere at the AGU Fall Meeting in December 2024.

MICHAEL MURPHY
Sponsor Steven Pawson / Code 610.1 / Task 168

Dr. Murphy has been working on the use of Global Navigation Satellite System (GNSS) Radio Occultation (RO) observations in the Goddard Earth Observing System (GEOS) numerical weather prediction (NWP) modeling and data assimilation systems. His focus has been on assessing 1) the impact of assimilating large datasets of commercial RO and 2) the impact of different observation uncertainty models and quality checks for RO observations on NWP forecasts. The assimilation work has primarily used the massive dataset of commercial RO from Spire in NASA's Commercial Smallsat Data Acquisition (CSDA) archive but has also included a broader range of commercial RO from various commercial providers as part of his participation in the RO Modeling Experiment (ROMEX) in collaboration with numerous operational NWP centers. A large part of the assimilation work compares the quality of the Spire RO dataset in the CSDA archive to the much smaller real-time Spire RO dataset acquired by NOAA and the state-of-the-science COSMIC-2 RO mission. The observation uncertainty and quality check work were motivated by the desire to use more of the RO observations in the GEOS NWP system, particularly for commercial RO which is currently not used below approximately 3 km in altitude, as well as using a framework that is more consistent across latitudes and RO missions. This work includes careful review of current procedures and the implementation of the ECMWF method of specifying observation uncertainties and quality control checks and initial assessment of its impact on the NWP forecasts. Finally, Dr. Murphy has been working with RO colleagues at NASA JPL on ways to use the emerging technique of polarimetric RO in NWP models, including a recently submitted NASA ROSES proposal.

Dr. Murphy will continue work on assimilation of commercial RO through ROMEX, including assessment of the results and comparison with other operational NWP centers. The impact of using the ECMWF observation uncertainty and quality checking method on GEOS forecasts will be further assessed. Collaborative work with JPL on polarimetric RO will continue and if Spire commercial polarimetric RO observations become available through NASA's CSDA archive during this time frame, initial assessment of these observations will be undertaken.

RETHA MATTHEE MECIKALSKI
Sponsor Steven Pawson / Code 610.1 / Task 169

Dr. Mecikalski has been working on comparing lightning observations from (1) the Geostationary Operational Environmental Satellites (GOES) Geostationary Lightning Mapper (GLM) and (2) the Lightning Imaging Sensor (LIS) on the International Space Station (ISS) to the lightning produced by the GMAO GEOS-5 model. Further, the impact of the different cloud microphysics schemes on the various lightning parameterization schemes in the GEOS-5 model

are being compared to the observations to verify the accuracy of the location of the lightning as well as the flash rates/counts from the model output.

Dr. Mecikalski is also comparing brightness temperatures from the GOES Advanced Baseline Imager (ABI) that were associated with GOES GLM observations to obtain statistical relationships between cloud top brightness temperature fields and lightning initiation location to use in developing updated lightning parameterization schemes in the GEOS-5 model. Additionally, she submitted a proposal as Principal Investigator to NASA ROSES to update the current lightning parameterization schemes in the GEOS-5 model, as well as to develop a new data-driven (machine learning) lightning parameterization scheme that will form part of the GEOS-5 model lightning parameterization schemes.

In the coming months, Dr. Mecikalski will present her results from the statistical relationships between cloud top brightness temperature fields and lightning initiation location, as well as their comparison to the current lightning output from the GEOS-model, at the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) satellite conference in late September 2024. She will also be developing two papers for submission to journals. The first paper will focus on the results from the GOES ABI and GLM comparison to the model output, and the second paper will focus on the results of the ISS LIS comparison to the model output.

AMITA MEHTA
Sponsor Nathan Arnold / Code 610.1 / Task 171

This task started in October 2023 to focus on developing statistical desegregation methodology for precipitation to use in a land surface model. Amita Mehta, assisted by a UMBC graduate student Nimit Tolia from Data Science, is working on the desegregation of IMERG (Integrated Multi-satellitE Retrievals for GPM --Global Precipitation Measurement) precipitation datasets. Mehta, helped by Tolia, has used 20 years of half hourly IMERG data at 0.1x0.1 degree spatial resolution to compute desegregation coefficients. These coefficients will be used to downscale precipitation data from a global atmospheric model with 1x1 degree resolution to 0.1x0.1 degree resolution. The downscaled precipitation data will be used in a land surface model to obtain land-atmosphere fluxes with improved accuracy.

Mehta will complete this analysis by September 2024 and subsequently will help the task sponsor with model output analysis.

JANAK JOSHI
Sponsor Arlindo da Silva / Code 610.1 / Task 176

Dr. Joshi's work focused on implementing, enhancing, testing, and evaluating various dust emission schemes within the second generation of GOCART (GOCART-2G, hereafter G2G) aerosol module of the GEOS model. With his work, the number of working dust emission schemes in G2G has been increased from two (G2G-default and K14) to five (G2G-simplified, DEAD (Dust Entrainment and Deposition)), and FENGSHA (windblown dust in Mandarin), along with the existing G2G-default and K14). The DEAD and G2G-simplified schemes are new

implementations to G2G. Except K14, he has modified the other four schemes to enhance physical representation, technical implementation, and code configurability.

Dr. Joshi has developed a new dust source map using high-resolution topography and land use data, which will enable dust emission from high latitude sources. Furthermore, he introduced a vegetation mask to scale the emissions and a suppressant function to eliminate the emissions from snow-covered and frozen soil. He modified the G2G-default, G2G-simplified, and DEAD schemes to incorporate these features and set a threshold velocity for the G2G-simplified scheme. For the DEAD scheme, he implemented dust source function, size distribution, and model-predicted air density (as opposed to a fixed constant) and modified soil-wetness and drag correction factors. For the FENGSHA scheme, he implemented data, removed double scaling for distribution, recomputed distribution, corrected some variable references, and updated parameters.

He carried out GEOS model simulations with these various emission schemes and presented them at GMAO aerosol group meetings. To present results from these and additional experiments, he (as a lead author) has submitted abstracts to the upcoming AGU Fall and AMS Annual Meetings. Besides his dust-specific work, (in consultation with other experts, particularly Dr. da Silva and Dr. Colarco), Dr. Joshi is also involved in reviewing and testing aerosol model development activities for the G2G system.

Over the past year, he presented two lead-author abstracts on dust modeling at the AGU Fall Meeting 2023 and published one single-author research paper. This paper utilized a dust model he had previously improved and has significance for improving dust modeling and interpreting model intercomparisons.

In the upcoming months, he will continue to evaluate and compare the multiple dust emission schemes, implement necessary changes, and investigate reasons for discrepancies.

MENG ZHOU
Sponsor Arlindo da Silva / Code 610.1 / Task 185

Dr. Zhou's research primarily focuses on estimating modified combustion efficiency (MCE) and their modulation of Emission Factors (EF) and data driven estimates of plume height and thermodynamically consistent vertical mass distribution functions. Dr. Zhou has developed a multi-channel biphasic extension of Dozier's algorithm for wildfire characterization, leveraging data from the Fire Light Detection Algorithm version 2 (FILDA-2). The FILDA-2 product, innovated by Dr. Zhou, is NASA's new nighttime fire MCE product. His research on biphasic fire parameters offers crucial insights into qualifying MCE and EF and provides essential data for modeling plume rise and the vertical distribution of fire emissions for NASA’s Quick Fire Emission Dataset (QFED) and GEOS modeling system. Dr. Zhou is currently preparing a manuscript on multi-channel biphasic wildfire characterization for submission to the journal Remote Sensing of Environment.

Upcoming plans of Dr. Zhou for September 1, 2024 to November 30, 2024 include: 1) Extending the detection capability of FILDA-2 to daytime; 2) Conducting long-term evaluation of the biphasic wildfire characterization algorithms.

FEI LIU
Sponsor Arlindo da Silva / Code 610.1 / Task 186

Dr. Liu has been working to develop a framework for tracking and analyzing individual aerosol plumes in different types of datasets, such as model simulations and geostationary satellite retrievals. Her work will focus on GOES observations and the future AOS mission. The developed framework will provide a flexible new way to understand the evolution of the characteristics of individual aerosol plumes in model intercomparison studies or model assessment based on observational data. She has developed a machine learning model designed to detect pyrocumulonimbus (pyroCb) events during nighttime using IR channels from the Advanced Baseline Imager (ABI) aboard GOES-16. Furthermore, she has employed an established cloud-tracking tool known as Tracking and Object-Based Analysis of Clouds (TOBAC) to analyze the evolution of the clouds' plumes and infer their lifetimes. She has demonstrated the framework using a pyroCb firestorm event known as the Pacific Northwest Event (PNE), on August 12, 2017, as the case study. The cloud tracking project is ongoing, aiming to enhance our understanding of pyroCb dynamics.

Dr. Liu's upcoming plans include applying the pyroCb-detecting method developed under the same task to more events. She aims to extend this case study on a global scale, with the objective of creating a comprehensive database for the lifetimes of pyroCb events. Such a database will enhance our understanding of pyroCb dynamics, which is helpful for investigating the radiative implications and the potential impact on stratospheric chemistry. Dr. Liu plans to present her findings on pyroCb tracking at the upcoming AGU Meeting.

STEVEN FLETCHER
Sponsor Ricardo Todling / Code 610.1 / Task 190

Dr. Fletcher has been working on developing a non-Gaussian version of the NASA data Assimilation system to allow for a better prediction of moisture-based variables. He has focused on creating a control Gaussian-based Data Assimilation through the Joint Center for Satellite Data Assimilation (JCSDA) FV3-JEDI data Assimilation system. He has also been working to identify which parts of the JEDI software to alter to create a non-Gaussian-based system.
Dr. Fletcher's upcoming plans include completing the creation of the control version of the JEDI system as soon as possible and the creation of the non-Gaussian version at the same time. Finally, there are plans to conduct testing with a basic configuration of the two systems before the end of the task period.

ANDREW SCHUH, SCOTT DENNING, AND CHRISTOPHER O'DELL (TEAM CSU)
Sponsor Lesley Ott / Code 610.1 / Task 196

This task supports Drs. Andrew Schuh, Scott Denning, and Christopher O'Dell (all CSU). Dr. Schuh led the Summer School for Inverse Modeling of Greenhouse Gases (SSIM-GHG) in Fort Collins, CO, June 11-21, 2024 (https://www.cira.colostate.edu/conferences/rmtgw/). This work involved

meetings and work efforts spread across at least 6 months in advance of summer school. In particular, Dr. Schuh was involved in organizing meetings across a group of about a dozen instructors, creating an hour-by-hour summer school agenda, and implementing logistics including acceptance, travel, lodging, plus building course materials for one full day of the school. Drs. Denning and O'Dell assisted Dr. Schuh and others by teaching 3-4 hours on one of the summer school days and participating in the first 1-1.5 weeks of the summer school. Dr. O'Dell helped lead one of the group hikes as well.

While this task provides funding for two graduate students, the funding arrived too late to identify a student for the 2024-2025 academic year; however, they have identified a student, Jessie Lyons, who has been accepted for the program starting Jan 1, 2025. Any funding left for Dr. Schuh after the portions are used for SSIM-GHG summer school will be applied to support mentoring of Ms. Lyons. In lieu of hiring a graduate student for the 2024-2025 academic year, Dr. O'Dell hired a data scientist, Nicholas Kedzuf, with support from this task to generate a long-term GOSAT XCO2 data record (2009-2024) using the latest Atmospheric Carbon Observations from Space (ACOS) algorithm version 11 product from JPL. GOSAT is a Japanese greenhouse gas-measuring satellite that has been in operation since 2009. The ACOS algorithm, largely developed by Dr. O'Dell, has been shown to be the most accurate retrieval algorithm for deriving column-mean carbon dioxide concentration (XCO2) from hyperspectral, near-infrared observations of reflected sunlight from satellites. The ACOS algorithm, which is now on version 11, was recently used to process all available data from the two Orbiting Carbon Observatory (OCO-2, OCO-3) satellites. The carbon cycle community in general, and NASA GMAO in particular, is in strong need of the GOSAT data processed through the latest ACOS algorithm for their greenhouse gas predictions as it relates to the work they do as part of the new Greenhouse Gas Center. Over the next 3-6 months, using their expertise at CSU, this team will create and validate the ACOS/GOSAT version 11 XCO2 product, and deliver it to the NASA GSFC DAAC for use by GMAO and other partners.

In the coming months, Dr. Schuh will prepare a presentation on the successful SSMI-GHG summer school and begin planning for a future summer school, in collaboration with Dr. Sourish Basu from UMD/NASA GMAO. Dr. O'Dell will work with Mr. Kedzuf to create the new ACOS/GOSAT carbon dioxide product and will coordinate with the GMAO so they can use this product in their modeling activities. Dr. O'Dell and Mr. Kedzuf will present their plans at the annual OCO 2/3 Science Team Meeting, Pasadena, CA, September 10-13, 2024.

CODE 612: MESOSCALE ATMOSPHERIC PROCESSES LABORATORY

JACKSON TAN

Sponsor George Huffman / Code 612 / Task 018

Dr. Tan has been working on the IMERG satellite precipitation algorithm. He is involved with refining the code and implementing research ideas, with the goal of improving IMERG products. An accomplishment during this period is the identification of bad data in the newly released V07A of the product, for which Dr. Tan developed an automated detection scheme that facilitated the process. Since then, a V07B update has been released, not only for the research-oriented Final Run but also for the near-real-time Late and Early Runs. Dr. Tan has presented his

work at the AGU Fall Meeting, the AMS Annual Meeting, GEWEX Open Science Conference, the International Precipitation Working Group Workshop, and the NASA PMM Science Team Meeting; and he is a co-author on a paper published in the Journal of Hydrometeorology. Dr. Tan is currently involved in an ongoing effort to extend the V07B record back in time from 2000 to 1998.

Dr. Tan anticipates the completion of the extension of the IMERG V07B record back to 1998.In addition, he will continue development of the IMERG algorithm towards V08. At the same time, the automated error detection scheme—now implemented operationally—will be refined and published in a relevant journal. He will also attend and present at the NASA PMM Science Team Meeting.

LIANG LIAO
Sponsor George Huffman / Code 612 / Task 053

Dr. Liao's work on this task is two-fold. First, he works on the "Application of NASA Multi-Frequency Airborne Doppler Radar for Estimates of Hydrometeor Microphysical Properties." NASA Goddard Space Flight Center has developed multi-frequency radar systems that have been deployed to many NASA-sponsored field campaigns, such as the Investigation of Microphysics and Precipitation for Atlantic Coast – Threatening Snowstorms (IMPACTS) that provided observations critical to understanding the mechanisms of snowband formation, organization, and evolution. The combination of these three radars installed on the NASA ER-2 high-altitude aircraft provides four-frequency reflectivity and Doppler measurements from rain and snow during IMPACTS in 2020, 2022 and 2023.

To explore the full capability of NASA multi-frequency radar systems, a comprehensive study involving theoretical simulations was carried out using the measured rain-drop/snow-particle size distribution (DSD/PSD) data, acquired from a variety of storm systems during the NASA field campaigns. Measurements from NASA ER-2 (X, Ku, Ka and W bands) radar systems during IMPACTS are being used to test and validate the multi-frequency techniques for the estimates of snow and rain parameters.

Second, he works on the "Utilization of multi-frequency airborne Doppler radar for hydrometeor phase identification." This study investigates the feasibility of using dual-/multi-frequency Doppler radar to classify hydrometeor phase states and to develop a phase identification algorithm for the NASA multi-frequency radar. Theoretical model simulations indicate clear distinction of the Doppler velocities (V) and differential Doppler velocities (DDV) at two radar frequencies between snow and rain hydrometeors, which is useful for the identification of hydrometeor phases. To develop the algorithm, Doppler measurements from the NASA multi-frequency (X-, Ku-, Ka- and W-band) airborne radar during the NASA-sponsored IMPACTS field campaign are employed in a statistical analysis of V and DDV. The results show that snow can be clearly separated from rain and mixed-phase (melting snow) by using either V or DDV. Conversely, rain and mixed-phase hydrometeors cannot be distinguished from the Doppler data. To differentiate rain and mixed-phase, LDR data are needed. It is also found that differences of V between snow and rain/mixed-phase are larger than those from DDV. Unlike the Doppler velocity alone, DDV is independent of air motion. To take advantage of both V and DDV for phase classification, a technique has been developed to use both V and DDV. With the

use of V and DDV, along with LDR, hydrometeor phases can be identified from the NASA airborne radar dataset.

In the coming months, Dr. Liao will continue working on and completing his current studies. He will explore new fields that can improve and enhance the space/air-borne radar algorithms for the detection and estimation of precipitation microphysical properties.

HYOKYUNG KIM
Sponsor George Huffman / Code 612 / Task 054

Dr. Kim has been working as a member of the science team developing algorithms for estimating global precipitation using Dual frequency Precipitation Radar (DPR) onboard the GPM satellite. The main objectives of her task are as follows: 1) contributing to more accurate precipitation estimation by enhancing and improving Level 2 algorithms that estimate the radar surface return signals attenuated by precipitation, and 2) developing, improving, and providing operational support for Level 2 and Level 3 algorithms.

Over the past year, Dr. Kim worked on improving the attenuation correction algorithm by the precipitation over snow-covered land using the new version of AutoSnow for GPM radars. This year her research focuses on improving and evaluating the attenuation correction algorithm over the ocean using wind speed information. She established σ^0(no-rain) vs wind speed (WS) relationships for each incidence angle for the Ku-band and Ka-band frequencies using σ^0 data from the Dual-frequency Precipitation Radar (DPR) on board the GPM satellite along with wind speed information either from the GANAL dataset or the GMI windspeed retrievals. These σ^0(no-rain) vs WS relationships are then assembled into look-up tables so that for a given radar frequency (Ku- or Ka-band) and incidence angle (0^0 to 18^0, in steps of 0.75^0), the GANAL or GMI-derived wind speed is converted into σ^0(no-rain) so that the inferred path attenuation is obtained by subtracting the measured or apparent value of σ^0 in rain from the wind speed-derived reference estimate, σ^0(no-rain). The associated error variance is taken to be the error variance in estimating σ^0(no-rain) from wind speed.

In the coming months, Dr. Kim will continue to refine this attenuation correction algorithm using ocean wind speed data. She will implement the algorithm into Version 8 GPM radar algorithm, which is scheduled for release in 2025. Additionally, Dr. Kim will continue to develop and provide the operational support for the GPM radar Level 3 algorithms.

MIRCEA GRECU
Sponsor George Huffman / Code 612 / Task 055

Dr. Grecu developed a machine-learning based methodology to mitigate the effects of ground clutter on precipitation estimates from the Global Precipitation Mission Combined Radar-Radiometer Algorithm (CORRA). Ground clutter can corrupt and obscure precipitation echo in radar observations, leading to inaccuracies in precipitation estimates. To improve upon previous work, Dr. Grecu introduced a general Machine Learning (ML) approach that enabled a systematic investigation and a better understanding of uncertainties in clutter mitigation. Several ML-based estimation methods were investigated, and a Neural Network Model (NN)

was ultimately identified as the best candidate. The NN provides unbiased estimates; however, it does not significantly outperform a simple bias correction approach in reducing random errors in the estimates.

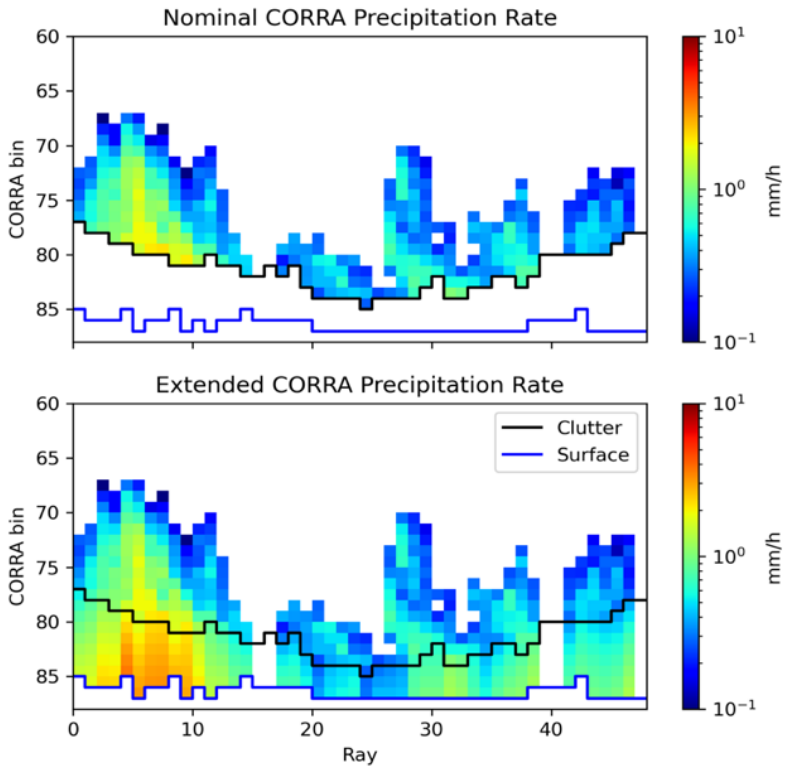


Figure left: Example of extension of CORRA precipitation estimates into the clutter zone for orbit 50632 over Continental US on 26 January 2023.

In the coming months, Dr. Grecu will work on extending the clutter correction methodology to a two-dimensional formulation able to account for wind-shear effects.

JAINN JONG SHI
Sponsor Scott Braun / Code 612 / Task 067

NASA's Atmosphere Observing System (AOS) mission goal is to optimize how we examine links among tiny particles known as "aerosols," clouds, atmospheric convection, and precipitation. AOS will deliver key data for improving forecasts of weather, air quality and climate. AOS will provide unmatched insight into the vertical structure of our atmosphere with observations from space. During the past 12 months, Dr. Shi has been using the Goddard Cloud Ensemble (GCE) Model to produce idealized convective cloud simulations with high temporal (2 minutes) and horizontal (200 meters) resolutions. The simulated convective cloud data were used to derive Ku-band radar reflectivities and brightness temperatures of microwave radiometers using the Goddard Satellite Data Simulator Unit (G-SDSU). This was done to evaluate what the scientific benefits the potential AOS spaceborne instruments could bring. The vertical motion and vertically integrated ice water path inside the simulated cloud were also calculated to understand/estimate how fast convective clouds are developing, moving downstream, and decaying.

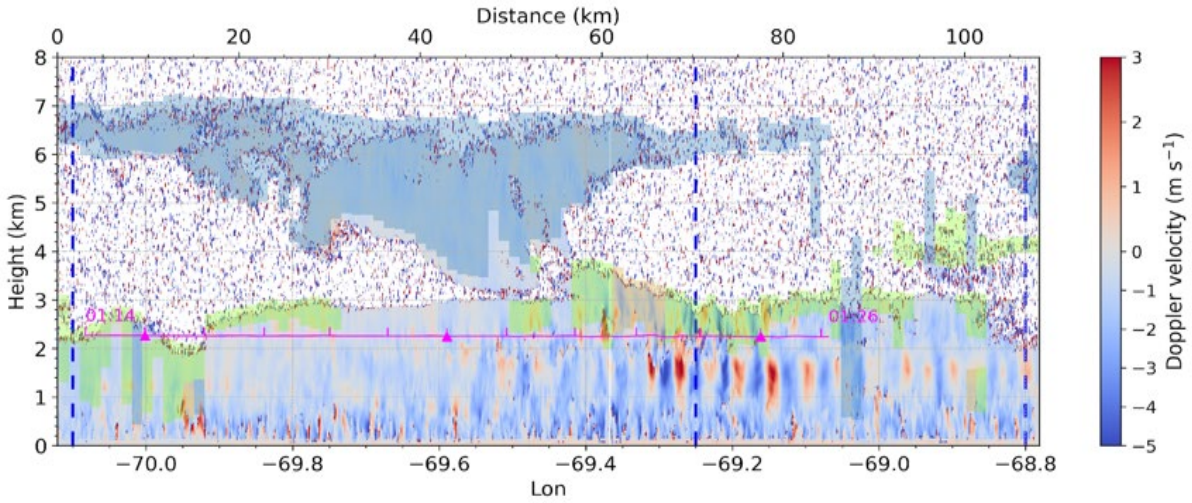
In addition, Dr. Shi has also been working with scientists at the Woods Hole Oceanographic Institution (WHOI) to couple their ocean model with the NASA-Unified Weather Research and Forecasting (NU-WRF) model. The atmospheric planetary boundary layer over the ocean, also

called the Marine Atmospheric Boundary Layer (MABL), interacts thermodynamically and mechanically with the ocean surface. An ocean model is a crucial component to improve weather forecasts due to its ability to improve the representation of the interaction between the ocean surface and the turbulent processes in the MABL. The coupling has been completed and is currently under further evaluations.

Dr. Shi will continue his collaboration with WHOI scientists to further the ocean model coupling with the NASA-Unified Weather Research and Forecasting (NU-WRF) model, and to conduct scientific research using the coupled models. As a core member of the NU-WRF team, he will continue to improve the aerosol-cloud-radiation coupling inside the NU-WRF.

MEI HAN
Sponsor Scott Braun / Code: 612 / Task 068

Dr. Han has been working on the projects of Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Storms (IMPACTS) field campaign and the Global Precipitation Measurement (GPM) mission. Her current research has focused on understanding supercooled liquid water in mixed phase clouds that produce snow, using measurements from multiple airborne remote-sensing (radar and lidar) and in-situ instruments and simulations from high-resolution models. She has conducted retrieval and intercomparison of turbulence from airborne cloud radar and in-situ wind probes. Dr. Han submitted a first author manuscript to the *Journal of Geophysical Research-Atmospheres*. The research findings are applicable for improving our understanding of cloud and precipitation processes, aviation hazards, and uncertainties in climate projections. Dr. Han also conducts research for the land surface emissivity retrieval with GPM microwave imager and dual-frequency precipitation radar. This research is ongoing.



Radar Doppler velocity (blue and red) by NASA GSFC Cloud Radar System (CRS, 94-GHz) overlaid with cloud phase (transparently shaded: green is liquid, blue is ice) by Cloud Physics Lidar (CPL) onboard ER-2 research aircraft for a snowing cloud. Magenta line shows the P-3 aircraft penetrating the cloud.

Dr. Han will continue working on the land surface emissivity retrieval. She will prepare presentations for the annual AGU meeting in Washington DC in December 2024. Dr. Han will work on the revision of the manuscript for publication.

JASPER LEWIS
Sponsor Judd Welton / Code 612 / Task 101

Dr. Lewis has continued efforts to evaluate aerosol and cloud observations from the CALIPSO satellite based on level 3 MPLNET products using multiple years of collocated satellite-surface measurements from several diverse sites within the lidar network. Additionally, he has examined the spatiotemporal variations in aerosols using CALIPSO, MPLNET and AERONET observations. These results have been used as a basis for validating the joint European Space Agency – Japanese Aerospace Exploration Agency EarthCARE mission, which launched on May 28, 2024. Furthermore, Dr. Lewis has collaborated in a study intended to develop PBL data assimilation capabilities in the NASA Global Earth Observing System, focusing on planetary boundary layer height retrievals from multiple observing systems.

Dr. Lewis will participate in the EarthCARE Validation Workshop in November 2024. He will also conduct an intercomparison of planetary boundary layer height retrievals from a collocated lidar, radar wind profiler, and ceilometer. These surface-based retrievals will be used to contextualize satellite-based and model results.

WILLIAM OLSON
Sponsor Scott Braun / Code 612 / Task 108

This task has two focus areas. The first focus area is the development and testing of software for operational estimation of precipitation rates based on a combination of spaceborne radar and passive microwave observations from the Tropical Rainfall Measuring Mission (TRMM) and Global Precipitation Measuring (GPM) mission core satellites. During the reporting period, studies of the impact of the GPM satellite boost on combined radar-radiometer (CORRA) estimates of precipitation were conducted. The boost put the GPM core instruments in an orbit roughly 35 km higher than the original orbit. The expected impact was a loss of detection of very light precipitation because of the weaker, received backscatter signal at the higher altitude, and possibly a more general underestimation of heavier precipitation due to the larger sensor footprints at that altitude. Surface gauge-calibrated radar (MRMS), matched with radar-radiometer estimates from CORRA, were used to develop statistics for pre- and post-boost periods. As expected, precipitation detection was reduced, but this had limited impact on estimated mean precipitation rates, because only the lightest precipitation events were lost. Some slight change of the higher precipitation rates might also have occurred due to the boost, but the current sample of data is too small to draw conclusions.

The second focus of this task is the continued development of CORRA which would lead to improvements of the V08 version, due in January 2026. In collaboration with Dr. Craig Pelissier, Dr. Robert Schrom, Dr. Adrian Loftus, Dr. Kwo-Sen Kuo, and Dr. Ines Fenni, a computational model for melting snow particles (SnowMeLT) was developed (in previous reporting periods), and the single-scattering properties of a few smaller snow particles were computed. However, SnowMeLT was computationally too slow to melt larger snowflakes. Dr. Pelissier has recently developed a Graphics Processing Unit (GPU) version of SnowMeLT which will greatly increase its processing speed. Dr. Olson selected a set of snowflakes from a database developed by Dr. Kuo,

and Dr. Schrom melted the smaller of these flakes. The group is now looking at the single-scattering properties of these particles derived from both the discrete dipole approximation (ADDA) and a new method called the Characteristic Basis Function Method (CBFM) developed by Dr. Fenni.

During the post-reporting period (Sep. 1 – Nov. 30), for the first focus, a larger set of post-boost, collocated CORRA and MRMS data will be analyzed to infer the impact of the boost on higher precipitation estimates. For the second focus, Dr. Olson will help oversee the melting of the full selected set of snow particles using the GPU version of SnowMeLT and calculate the bulk (size-distribution integrated) scattering properties of those melting particles. These properties will be tested against radar-radiometer and *in situ* airborne observations of melting snowflakes derived from the IMPACTS field campaign.

ALI TOKAY
Sponsor David Wolff / Code 612 / Task 123

Dr. Tokay is a member of NASA's Global Precipitation Measurement (GPM) mission ground validation program. The vast majority of the activities are related to the three-winter long field study in Storrs, Connecticut. The field study included in-situ and remote sensing precipitation measurement instruments and Dr. Tokay was responsible for the near real time data analysis and reporting any issues on data quality. It should be noted that this activity differs from the working status of an instrument. The instrument technicians report the working status but the data quality needs to be assessed in near real time. The field campaign was nearly six months long starting in December 2023.

Dr. Tokay continued analyzing the GPM field study database from the first two winters prior to the third year field campaign. The research topic was the evaluation of radar snowfall estimate, which was initiated by a 2023 summer intern. A key conclusion of this study was to define three separate radar snowfall relationships based on synoptic settings in New England. The national weather service and NASA's GPM program currently use a single radar snowfall relationship, which is inadequate for different synoptic systems.

Winter Precipitation Measurements Field Campaign in Southern New England (2022-23). Photo courtesy Dr. Diego Cerrai of the University of Connecticut.

Dr. Tokay was the mentor for a Ph.D. candidate at the Federal University of Rio Grande de North in Brazil. This is a two-month long GPM capstone project. The mentee examined NASA's multi-satellite precipitation product, IMERG, over a river basin in Northeast Brazil. The region has

sparsely located rain gauges and a gauge-based precipitation product. Through a comparative study, it was found that IMERG V07 performed significantly better than V06 in that region.

Dr. Tokay was the mentor for three NASA interns during the Summer of 2024. This is a ten-week program and the projects included evaluation of precipitation phase algorithms, evaluations of precipitation products, and performance of Precipitation Imaging Package (PIP) in rain. It seems that wet-bulb temperature based probabilistic IMERG algorithms perform well if in-situ environmental observations are used. However, this is not feasible globally and the model output parameters suffer from coarse spatial and temporal scales. A good agreement between the PIP bulk density, Doppler velocity and PARSIVEL fall velocity-based phase algorithms provided a solid base as a reference. The deterministic MRMS algorithm, on the other hand, did not perform well during rain-to-snow transitions.

In the coming months, Dr. Tokay will continue working on three summer intern research projects. Specific attention will be given to the evaluation of NASA's GMAO and IMERG final precipitation products. The PIP reprocessing has been continuing and more events are coming available for analysis. The clear improvement of the reprocessed PIP database has a potential to replace the standard processing. The findings of these studies will be presented during the 2025 American Meteorological Society annual meeting. In addition, the fourth year field study in Connecticut will start in December 2024.

YULI LIU
Sponsor Ian Stuart Adams / Code 612 / Task 149

Dr. Liu has been working on two projects. The first project focuses on developing tomographic retrieval algorithms to reconstruct 2D cloud structures using along-track scanning (sub)millimeter-wave radiometer observations. Two tomographic cloud reconstruction algorithms grounded in Bayes' theorem have been developed. These algorithms have demonstrated the superiority of multi-view observations in constraining ice water content profiles compared to single-angle observations. The second project involves assisting in the development of a radiative transfer model to build a comprehensive retrieval database for PoLSIR and developing a retrieval algorithm based on physical modeling. This retrieval database is constructed using a full year of CloudSat orbit data and covers a wide geographic region to include a comprehensive range of different cloud situations. The developed physical retrieval algorithm will be used in conjunction with a parallel machine learning algorithm to provide retrieval results of Ice Water Path (IWP) and particle size for PoLSIR .

Dr. Liu has completed a draft of a manuscript as the first author on the tomographic cloud reconstruction algorithm, with plans to submit it in October. Following the submission, the tomographic algorithm will be applied to actual observations from the IMPACTS campaign to further evaluate the capabilities of the multiview methodology. Additionally, Dr. Liu is a co-author on a paper introducing the retrieval database and algorithm development for PoLSIR, which is also expected to be submitted during this period.

SEAN FOLEY
Sponsor Scott Braun / Code 612 / Task 181

Sean has a first-author publication to Atmospheric Measurement Techniques in review, discussing the application of convolutional neural networks to vertical cloud profile estimation in POLDER-3 data. He was involved in an Internal Research and Development (IRAD) proposal at Goddard about the usage of foundation models for a similar vertical cloud profiling task. Sean has also developed publicly available tutorials on the usage of multi-angle data and the implementation of machine learning techniques on satellite data.

At AGU 2023, Sean presented some preliminary work on multi-view stereo which serves as a motivation and point of comparison for the work. Sean later presented this poster at the center-wide poster fair. He submitted a notice of intent to the ROSES A.28 “Remote Sensing Theory” call as a primary investigator.

Over the next year, Sean's first focus will be finishing his proposal to the ROSES A.28 “Remote Sensing Theory” call. Sean will discuss this work at AGU in December of 2024, and will also submit a paper on this work to at least one computer vision conference over the coming year. If one of the three proposals Sean is involved with receives funding, his activities will be impacted. If the IRAD proposal is selected, Sean will spend the requisite amount of time adapting an existing foundation model to multi-angle data by developing a downstream model with similar ideas to his AMT paper. If the AIST proposal is selected, his work on neural rendering will be adapted to wildfire and/or volcanic plumes.

SERGEY KORKIN
Sponsor Scott Braun / Code 612 / Task 182

Dr. Korkin has been supporting activities relevant to the Atmospheric Observing System (AOS mission) as a local GSFC expert in numerical simulation of solar light multiple scattering and absorption in Earth’s atmosphere, commonly referred to as radiative transfer (RT) modeling. He participated in bi-weekly meetings of the AOS Aerosol Working Group (AWG) led by Dr. Reed Espinosa (613). As a lead author, Dr. Korkin submitted a full-length peer-reviewed paper and presented a poster at two meetings. Details of these activities are provided in the supplemental information. Dr. Korkin plans to revise the paper according to the reviewers’ comments and resubmit it in late September.

As NASA is currently revising the AOS mission, the role of GSFC and relevant FTEs are therefore uncertain. **Currently, this task has expired.**

COLTEN PETERSON
Sponsor Scott Braun / Code 612 / Task 182

Dr. Peterson has recently started working on further developing and evaluating a cloud retrieval algorithm called IROE, which was created by a former member of Dr. Peterson’s group at GSFC. IROE is an optimal estimation-based retrieval of ice cloud properties using the infrared channels of the VIIRS and MODIS instruments. This is relevant to the AOS mission because AOS involves infrared-microwave ice cloud retrieval synergy algorithms and could also utilize an optimal

estimation framework. Dr. Peterson has also become more familiar with AOS-related algorithms and is participating in AOS-related meetings.

CODE 613 CLIMATE AND RADIATION LABORATORY

SERGEY KORKIN

Sponsor Alexei Lyapustin / Code 613 / Task 001

As an expert in numerical simulation of multiple scattering and absorption of sunlight in Earth's environment (commonly called Radiative Transfer - RT), Dr. Korkin collaborates with colleagues from GSFC Codes 612 (joint ROSES proposal on laser remote sensing of land from orbit), 613 (support of A. Lyapustin's algorithm MAIAC, which is Dr. Korkin's primary task), 614 (a new open source code for light scattering by spheroids), and 616 (a joint paper about line-by-line atmospheric absorption spectroscopy and a relevant new open-source code).

As a result of these efforts, during the past year Dr. Korkin has: a) given 4 seminars; b) created and uploaded online 2 new publicly available codes; c) presented 2 talks at the AGU-2023 Fall meeting; d) published one paper as a co-author; e) submitted 1 proposal as PI, participated in 4 proposals as Co-I, and in 1 as a Collaborator (3 proposals are pending, including the one led by Dr. Korkin as PI; others have been declined); and, f) received 1 individual and 1 group Award from NASA GSFC. As a reviewer, Dr. Korkin has commented on 3 full-length papers. Details for these activities are provided in the appendices.

Upcoming plans depend on the outcome of the submitted proposals (expected in mid-2025). If selected, Dr. Korkin will focus on (a) the development and implementation of ML/AI techniques in Radiative Transfer (RT) and (b) laser remote sensing of polarized land reflection from space. Otherwise, Dr. Korkin is planning to refactor, document and publish as open source an existing RT code for multiple scattering of Sunlight in a spherical-shell atmosphere. The old RT code has been used at GSFC for decades mostly as a "black box" due to lack of support. Given that the geostationary fleet is increasing, the need for spherical-shell RT at the zeniths close to the horizon has become pressing (e.g., at the polar regions and for local morning/evening hours). Dr. Korkin also plans to submit one ROSES HPOSS (High Priority Open-Source Software) and one UMBC IRAD proposal (PI in both) and participate in both the AGU-2024 Fall Meeting in December and the Aeronet Science Exchange in September. He will be providing continuous support with RT numerical simulation to the aforementioned groups.

MANISHA GANESHAN

Sponsor Yuekui Yang / Code 613 / Task 012

Dr. Ganeshan's research involves studying the changing behavior of the polar atmosphere, particularly the Planetary Boundary Layer (PBL) and clouds that are crucial for correctly predicting the surface radiation budget and climate. She uses satellite and in-situ measurements to study the Arctic and Antarctic atmospheres, cloud properties, and PBL behavior, and for comparing their representation in model and reanalysis data. Dr. Ganeshan is preparing a new manuscript titled "Cloud properties over Dome C, Antarctica, using CALIPSO and in-situ measurements." Dr. Ganeshan is also involved in exploring the use of GNSS RO satellite

observations for PBL studies, over polar and midlatitude land regions. She is currently revising a manuscript titled "Exploring commercial GNSS RO products for Planetary Boundary Layer studies in the Arctic Region" for submission to the OPAC-IROWG 2022 Special Issue in *Atmospheric Measurement Techniques (AMT)*, which discusses the lower atmospheric sounding capability of GNSS RO over the Arctic Ocean from new commercial products. Dr. Ganeshan has recently been awarded a ROSES 2023 research grant by NASA to continue her work of evaluating GNSS RO commercial products. Dr. Ganeshan is also part of NASA HQ's Satellite Needs Working Group to help assess the GNSS RO satellite needs of federal agencies such as NOAA, USGS, and DOE, and to provide solutions for the same.

In the coming months, Dr. Ganeshan will re-submit her revised manuscript to *Atmospheric Measurement Techniques (AMT)*, and present her work describing Dome C cloud properties using in-situ and CALIPSO measurements at the AGU fall meeting. Dr. Ganeshan will collaborate with scientists from the Institute of Atmospheric Sciences and Climate (Italy) for complementing her Dome C analysis with ground-based sodar and lidar observations and will submit a fresh manuscript describing the results to a suitable AGU journal. Dr. Ganeshan is co-author on an AGU presentation titled "Properties of Antarctic Boundary Layer Thermodynamic Structure from Long-Term Radiosonde Observations," which will be presented at AGU by Dr. Yuekui Yang. Dr. Ganeshan plans to hire and mentor a graduate student to work on her ROSES 2023 grant to evaluate the potential of PlanetiQ measurements for PBL science.

CORNELIUS CSAR JUDE H. SALINAS

Sponsor Dong Wu / Code 613 / Task 035

Dr. Salinas has been principally working on analyzing and modeling ionospheric E-region electron density variations observed by Global Navigation Satellite System Radio Occultation (GNSS RO) measurements. Dr. Salinas has developed the first empirical E-region electron density model that accounts for monthly-mean variabilities due to photoionization, solar cycle, and non-photoionization forcing (e.g. auroral precipitation). The model, called E-region Prompt Radio Occultation Based Electron Density (E-PROBED), has been validated through comparisons with ionosonde and radar observations as well as simulations from other empirical and Physics-based models. The model development manuscript has been submitted to the AGU journal Space Weather; the first round of reviews did not have any major objections to the model's architecture. Dr. Salinas expects publication soon along with the release of the model's first version via github.

The development of E-PROBED helped Dr. Salinas in winning a NASA ROSES grant as PI under the NASA Living With A Star Program. The grant is titled "Investigation of Global Ionospheric Conductivity Variabilities driven by E-region electron density." E-PROBED will be a major tool that will be used for the project.

Dr. Salinas also has been studying day-to-day variabilities of ionospheric E-region electron density. He first started looking at the impacts of geomagnetic storms and solar flares on ionospheric E-region electron density. To date, his analysis has revealed substantial enhancements and depletion due to energetic particles from storms and/or solar flares in the ionospheric E-region, depending on latitude and local-time. He most recently found that

another dominant day-to-day variability in the ionospheric E-region electron density is driven by the ~30-day solar rotation.

Through the preliminary results of his analysis, Dr. Salinas won a 1-year grant under UMBC's Strategic Awards for Research Transitions (START) program. The proposal was titled "Space Weather Effects on Ionospheric E-region Electron Density as observed by Global Navigation Satellite System Radio Occultation Missions." He also used his preliminary results to write another NASA ROSES grant.

A side project that Dr. Salinas completed was on the quasi-2-day wave in the mesosphere. In this work, he reports that the summer mesosphere easterly jet significantly drives the phase-speed of a decaying quasi-2-day wave to a point that even interannual variabilities in the jet are partially reflected into the interannual variabilities of the wave's phase-speed. These research results were published in Nature Scientific Reports.

In addition to his own projects, Dr. Salinas has been assisting with other projects under his NASA sponsor, Dr. Dong Wu, NASA colleague Dr. Nimalan Swarnalingam, and Air Force Institute of Technology colleague Major Dan Emmons. He has co-authored manuscripts with each of them that are currently in review. He also assisted with a project by Norwegian colleagues that centered on the impacts of energetic electrons on mesospheric ozone; these results were published in Nature Communications Earth and Environment.

In the upcoming months, Dr. Salinas aims to have the manuscript detailing the development and validation of his E-PROBED model published as well as the first version of the model released. He also aims to publish additional manuscripts centered on the solar rotation signatures in E-region electron density as well as on geomagnetic storm and/or solar flare-related variabilities of E-region electron density. These manuscripts shall help prepare Dr. Salinas for his presentations at the 2024 American Geophysical Union Fall Meeting.

Dr. Salinas will be presenting the first version of E-PROBED at the GNSS RO workshop to be held in September in Boulder, Colorado. He will also meet with the other grant winners of NASA ROSES' Living With A Star Program this November at UC Berkeley. This meeting is being held in accordance with the requirement of the grant that all winning teams need to develop research plans to perform together.

YOUNG-KWON LIM
Sponsor Dong Wu / Code 613 / Task 036

The primary objective of this project is to enhance our understanding of the dynamic mechanisms driving sea ice variation and change in polar regions. During the 2023-2024 project period, Dr. Lim has focused on Antarctic sea ice variation and recent ice loss, particularly in the Ross/Amundsen/Bellingshausen Sea (RAB) region, using NASA's observational and reanalysis products as well as modeling systems. He concentrated on the impact of remote tropical climate factors on sea ice variation over decadal timescales. His research revealed that Antarctic sea ice variation is strongly influenced by decadal changes in the Antarctic Dipole (AD) and the Pacific South American (PSA) pattern over the past forty years, with these decadal changes linked to changes in ENSO over the same period. His findings indicate that stronger, more Eastern Pacific

ENSOs during the late 20th century (1980-1999) and weaker, more central Pacific ENSOs in the early 21st century are associated with changes in the AD pattern and sea ice variation. The study also proposed detailed dynamic mechanisms. A paper detailing these findings was submitted as a lead author to the journal *Atmosphere* and was published in November 2023. Additionally, Dr. Lim has been investigating how sea ice variation is affected by the Pacific Decadal Oscillation (PDO) and the strengthening of the Amundsen Sea Low, which are key to explaining sea ice changes and temperature variations in the RAB region.
Dr. Lim continues to focus on investigating Antarctic sea ice variation. Over the coming months, he will concentrate on understanding the causes and generation mechanisms of the Amundsen Sea Low system.

LIPI MUKHERJEE
Sponsor Dong Wu / Code 613 / Task 037

Dr. Mukherjee has set up the Pandora spectrometer instrument on the rooftop of Building 33 at NASA GSFC in Greenbelt, MD, and has compared the data with Aeronet's data. She also has been working with the twilight Photometer and collected data during summer 2024. The aim of this endeavor is to obtain the aerosol's AOD and layer height information. Dr. Mukherjee has alsoperformed the calibration of the Pandora spectrometer and the twilight Photometer using GSFC's Grande and GLAMR facilities. She has been working on a validation technique for stratospheric aerosols' height information using spectrometer data. She has compared this data with Aeronet's AOD data and has found promising results. Dr. Mukherjee is working on a manuscript where she will report her findings.

Dr. Mukherjee plans to finish writing her paper on the Twilight Study, which will incorporate theory as well as data to support the work; this will include the aerosol study of layer height and AOD. Her plans also include studying Ozone. First, she will study the Pandora spectral data from Lauder, NZ; second, she will use the libRadtran model to retrieve Ozone concentration.

DONGMIN LEE
Sponsor Lazaros Oreopoulos / Code 613 / Task 038

Dr. Lee has been actively engaged in evaluating cloud and radiation interactions within the GEOS model using both passive and active cloud measurements. The research focused on utilizing MODIS for passive observations and CloudSat/CALIPSO for active measurements, enhancing the understanding of cloud and radiation effects. This work was presented at the CloudSat/CALIPSO Science Team Meeting held in October 2023 in Washington, DC, and titled "Viewing Cloud Radiative Effect through Active Cloud Regimes." Additionally, Dr. Lee conducted a thorough evaluation of model subgrid radiation fluxes with the CERES FBCT dataset, providing insights into the accuracy and reliability of current climate models. A significant component of this work involved calculating CO2 forcing using satellite datasets, which has contributed to refining climate feedback. Dr. Lee also published a peer-reviewed paper titled "ENSO Disrupts Boreal Winter CRE Feedback," further contributing to the scientific community's understanding of climate feedback mechanisms.

Dr. Lee will focus on advancing research efforts by developing a new proposal for submission to NASA ROSES. This proposal will leverage the CloudSat and CALIPSO datasets alongside machine learning techniques to enhance the representation of clouds in radiation processes. In addition to the proposal development, Dr. Lee is revising a paper titled "Regimes of Cloud Vertical Structure from Active Observations." This paper aims to provide new insights into clouds' vertical distribution and radiative effects, contributing to the broader understanding of atmospheric processes. These activities align with NASA's strategic objectives to improve climate models and enhance the understanding of clouds and their impact on Earth's radiation budget.

NAYEONG CHO
Sponsor Lazaros Oreopoulos / Code 613 / Task 039

Nayeong Cho has been working to create and analyze a new type of cloud classification called Regimes of Regimes (ROR), which is a temporally higher-order (monthly) classification based on a mixture of daily cloud regimes (CR) as the distribution of cloud fraction within distinct combinations of cloud top pressure and cloud optical thickness from satellite observations using a 20-year dataset (https://doi.org/10.5281/zenodo.11099765). This ROR classification is meaningful and useful for gaining insight into cloud-related climate studies, such as trends and feedback of the cloud radiative effect. The RORs can be a good application to capture the change of weather states driven by the major seasonal progression of the monsoon or El Niño (and La Niña). This work has been submitted to *Journal of Climate* under the title “Describing Seasonal Mixtures of Cloud Regimes via ‘Regimes of Regimes’.” and is currently under revision. She has presented the results at several conferences and meetings.

Regarding the CloudSat/CALIPSO task, the team introduced a new type of cloud class, which is called “Active Cloud Regime” (ACR), owing to its provenance from active (lidar and cloud radar) spaceborne cloud observations. The ACR flavor of this work describes prevalent monthly mixtures at ~400 km scales of previously introduced cloud vertical structures (CVS) inferred from instantaneous ~2 km observations. Nayeong Cho produced CVS dataset (https://doi.org/10.5281/zenodo.12574972) for this work from the 2B-CLDCLASS-LIDAR CloudSat fusing CALIPSO (lidar) and CloudSat (cloud radar) cloud detections. Using NASA’s GEOS model, the team also demonstrate that it is possible to apply the ACR concept to Earth System Models that have the capability to produce subgrid cloudiness obeying pre-specified vertical overlap rules, providing thus another means to assess the realism of simulated clouds. The team submitted a paper based on the results, titled “Regimes of cloud vertical structure from active observations” to the *Journal of Geophysical Research: Atmospheres*, that I participated in as co-author.

Dr. Cho will continue her climate study with Regimes of Regimes (RORs), such as the relationship between cloudiness and the well-known near-symmetry in reflected shortwave radiation (RSW) between the Earth’s Northern and Southern hemispheres. She will explore radiative flux anomalies observed over the last two decades by CERES, focusing on changes in particular cloud types (RORs). Another potential work is to figure out cloud radiative effect changes by different cloud types, including the decomposition of non-cloud masking effects and isolate cloud feedback components.

DAEHO JIN
Sponsor Lazaros Oreopoulos / Code 613 / Task 040

Dr. Jin examined the change in clouds and associated radiation properties in relation to global mean surface temperature, which is known as cloud radiative effect (CRE) feedback. Based on a seasonal comparison of MODIS cloud regimes and reanalysis data, Dr. Jin showed that strong ENSO activities disrupt the boreal winter CRE feedback pattern. This result was published as "ENSO disrupts boreal winter CRE feedback" in the *Journal of Climate* (https://doi.org/10.1175/JCLI-D-23-0282.1).

In addition, Dr. Jin investigated the relationship between observed low clouds and atmospheric stability indices (also known as low cloud amount indices [LCAIs]). Dr. Jin demonstrated that this relationship contains large uncertainties, particularly at smaller spatio-temporal resolutions. Dr. Jin also examined the relationship between cloud and radiation and found a possibility to predict cloud types from observed radiation using machine learning methods. Based on this finding, Dr. Jin submitted a proposal to ROSES2024, in the section of "Modeling, Analysis, and Prediction."

In the coming months, Dr. Jin will organize the results regarding the relationships between low clouds and LCAIs and write and submit a journal paper. Dr. Jin will also continue to develop machine learning methods to effectively predict cloud types from radiation data, aiming to make these predictions comparable to satellite-observed clouds.

GUOYONG WEN
Sponsor Alexander Marshak / Code 613 / Task 043

Dr. Wen has been working on studying aerosol in cloudy atmospheric conditions using MODIS and CALIPSO observations. Retrieval of aerosol properties near clouds from passive remote sensing is challenging. Sunlight scattered by clouds into nearby clear regions can effectively enhance the clear area reflectance. These cloud 3D radiative effects may lead to large biases in aerosol retrievals if uncorrected, risking an incorrect interpretation of satellite observations for aerosol-cloud interaction in cloudy atmosphere. He and his colleagues applied an existing simple two-layer model (2LM) to estimate the cloud-induced clear-sky radiance enhancements in cloud fields for MODIS aerosol retrievals. From two-year's worth of co-located data in Amazon region, they found that: 1) MODIS and CALIPSO aerosol optical depth (AOD) retrievals agree very well in completely clear atmospheric conditions; 2) there is an increase in average AOD from clear to cloudy conditions for both MODIS and CALIPSO. However, the increase is much larger for the operational MODIS-retrieved AOD compared to CALIPSO-retrieved AOD. After the correction for 3D radiative effects, the MODIS AOD in cloudy conditions is much closer to CALIPSO observations. They also examined the impact of 3D correction on aerosol Angstrom exponent (AE) and fine mode fraction (FMF). The results were published in a peer-reviewed journal and presented in an AMS meeting and the International Radiation Symposium (IRS). They are planning to implement the 2LM in the MODIS operational retrieval algorithm.

Dr. Wen plans to collaborate with the aerosol retrieval team at NASA/GSFC to incorporate the 2LM into the operational retrieval algorithm.

ALFONSO DELGADO BONAL
Sponsor Alexander Marshak / Code 613 / Task 044

Dr. Delgado-Bonal has continued his work on analyzing the diurnal evolution of cloud properties using the EPIC instrument onboard the DSCOVR mission. His analysis of cloud optical thickness provides the first comprehensive study of diurnal cloud depth variability for the whole globe. Combining almost a decade of observation, the statistical methods that had been derived to obtain cloud properties such as cloud fraction and height, were expanded to optical thickness. Furthermore, Dr. Delgado Bonal's research shows that clouds of different thicknesses behave in different ways throughout the day, which is ultimately related to the amount of water the clouds can hold. Dr. Delgado Bonal published a research article summarizing the new findings and explaining how to use these datasets as a benchmark for General Circulation Models to test their outputs.

After finalizing his research on cloud properties, Dr. Delgado Bonal is expanding his methodology to analyze other products from the DSCOVR/EPIC mission, such as ozone or aerosols. He has submitted proposals to study the diurnal changes in ozone, and the implications that it may have for health and climate modeling.

SURENDRA BHATTA
Sponsor Yuekui Yang / Code 613 / Task 098

Dr. Bhatta has been working on Blowing Snow (BLSN) diagnosis, height, and optical depth within the MERRA2 grid from 1980 to the present. For this purpose, he has used a Machine Learning (ML) model to produce these data, which were inaccessible in MERRA2. Having these datasets within MERRA2 helps to understand the contribution of BLSN in Surface Mass Balance in Antarctica. He submitted the ML algorithm development paper in Artificial Intelligence for the *Earth Systems* journal (under review).

Upcoming Plans include producing the official BLSN data through NASA's Goddard Earth Sciences Data and Information Services Center (GES DISC).

TAMÁS VÁRNAI
Sponsor Alexander Marshak / Code 613 / Task 102

Dr. Várnai and his colleagues continued examining sun glints from ice clouds, which are caused by the intense, focused reflection of sunlight by ice crystals that maintain a steady horizontal orientation. As first author, Dr. Várnai completed the publication of a manuscript about the impact of sun glints on cloud properties provided in the operational cloud product of the Earth Polychromatic Camera (EPIC) onboard the Deep Space Climate Observatory (DSCOVR) spacecraft. Dr. Várnai also contributed to developing and publishing a novel visualization technique highlighting longer-term changes and semi-permanent features such as the ever-present ocean glitter, while suppressing geographic "noise" in EPIC datasets. Dr. Várnai was also first author and co-author of two papers (one still in review) that explore statistical relationships

between spectral or spatial variations in satellite-observed radiances and cloud properties, with the goal of improving our ability to characterize the observed clouds. Finally, Dr. Várnai continued expanding the user community of the first publicly available online simulator of atmospheric three-dimensional radiative processes, which the team developed earlier; this year the user community expanded by more than 450 people so that it now includes people from 82 countries.

Dr. Várnai plans to expand the analysis of spaceborne sun glint observations by considering data from additional satellite instruments such as MODIS. He also plans to make improvements to the EPIC operational sun glint product.

ZHIBO ZHANG
Sponsor Lazaros Oreopoulos / Code 613 / Task 103

The Earth's radiation budget is greatly influenced by clouds. Hence, a better understanding of cloud properties will provide a clearer insight into the role of clouds in the Earth's climate. Among others, cloud optical thickness (COT) and cloud droplet effective radius (CER) are two important cloud properties that determine how clouds interact with radiation. COT and CER are retrieved globally from satellite observations (e.g., MODIS instrument) which utilize the radiance observations at specific wavelengths, but these retrievals are sometimes biased due to 3D radiative transfer effects. Deep learning approaches have emerged to address this bias, and continued efforts towards developing machine learning models are being explored to provide better retrievals of COT and CER from 3D radiance. The main objective of this project is to utilize deep learning to provide better retrieval of cloud properties compared to those obtained from existing state-of-the-art physics-based methods.

During the period of 8/30/23 – 8/30/24, Dr. Zhang's research team worked with Dr. Jianwu Wang and Dr. Sanjay Purushotham's team in UMBC's information Systems department to solve the 3D inversion problem via machine learning and obtain cloud properties from 3D radiance observations. The team achieved this by providing the deep learning team with ground truth data (COT and CER) from Large-eddy Simulations (LES) cloud fields as well as corresponding simulated 3D RT radiance fields (at wavelengths of 0.66 and 2.13 μm). To this effect, the team first simulated radiance output at a single geometry (with configuration SZA 60°, VZA 0°, RAA 0°); firstly, 102 LES cloud fields profiles with a constant CER of 12 μm across the domain as well as simulated 3D radiance fields and bi-spectral retrieved cloud properties were provided to the deep learning team. Afterwards, 800 profiles of more realistic LES cloud fields from LASSO (where the COT and CER vary across the domain), and their corresponding simulated 3D radiance fields were provided. The team then simulated additional datasets consisting of more SZA's (4°,20°,40°,60°) and off nadir VZA's (15°,30°) on each side of the principal plane ([VAA 0°, VAA 180°] and SAA 0°), which the team also provided to train the model from a multi angle perspective. The results from this study showed that the developed deep learning model provides better retrieval of cloud properties compared to those obtained from existing traditional and physics-based methods.

Another major achievement of this project is a novel study investigating the Influence of cloud retrieval errors due to 3D radiative effects on calculations of broadband shortwave cloud radiative effect (CRE). We utilized the retrieved COT and CER from LES cloud fields at different

solar geometries (a high and low Sun position) to reconstruct cloud fields, then used a RT solver to compute the radiative flux and calculated the CRE. These computed CRE's from the retrieved cloud properties are then compared with those computed from the ground truth LES cloud fields using 1D RT and those computed using the ground truth LES cloud fields but 3D RT (called the "true flux"). Under high sun (SZA 5°), the domain-averaged flux values computed from the retrieved cloud fields are in excellent agreement with the true flux, all within 7 % relative CRE bias. When the sun is oblique (SZA 60°), the CRE differences between calculations from the retrieved cloud field and the true flux are determined by how the cloud side-brightening and darkening effects offset each other in the radiance, retrieval, and broadband fluxes. This study suggests that although the cloud property retrievals based on the 1D RT theory may be biased due to the 3D radiative effects, they still provide CRE estimates that are comparable to or better than CREs calculated from the true cloud properties using 1D RT. Results from the second achievement of this project is published in a paper Ademakinwa A. S. et. Al. (2024) in the *ACP* journal.

In the coming year, the team plans to go beyond the LES by increasing the realism of their dataset by constructing their ground truth cloud fields from satellite observations and deliver these cloud properties and corresponding radiance simulations to the deep learning team for use in their model development.

YAPING ZHOU
Sponsor Hongbin Yu / Code 613 / Task 106

Dr. Zhou is working on two main projects under Task 106, both related to remote sensing of clouds and aerosols. A third project is a science-driven investigation of the interactions of cloud-radiation-convection aggregation-precipitation in the tropics.

As a Co-I of the MEaSURES project titled "Developing a Comprehensive and Augmented Multi-decadal Remote-sensing Observations of Dust (CAMRO-Dust) Data Record for Earth Science Research and Applications," Dr. Zhou is responsible for developing a standalone level-2 dust AOD from MODIS and VIIRS data using the algorithms she developed in prior years for the Dark Target aerosol retrieval algorithm over ocean. Dr. Zhou has transferred her codes for dust detection and retrieval algorithms with non-spherical dust models to the team, trained a postdoc – Dr. Jianyu Zheng – to run her algorithms, and is further assisting him in developing a joint Vis/NIR and thermal IR dust algorithm. She also participates in the team's effort to develop machine-learning based dust detection algorithms.

This year Dr. Zhou has reduced her active research with the DSCOVR EPIC cloud product science team because of a funding shift. However, she is still involved with research using the EPIC cloud products and is assisting the EPIC cloud team with algorithm related questions. This has resulted in her participation as a coauthor on a paper led by Dr. Tamas Varnai.
As a Co-I of a TASNPP project, titled "*Investigating the Relationships of Cloud and Radiative Properties and Extreme Precipitation with Convective Clustering in the Tropics with Observations,*" Dr. Zhou was responsible for producing and analyzing extreme precipitation events in the tropics, as well as generating dynamic and thermodynamic convective aggregation indices from MERRA-2 products and assisting the PI with the analysis of cloud and radiation properties according to the convective aggregation indices. From this project, one journal article

has been published, one is under revision and another in preparation. Several talks were presented at AGU, AMS, and other international conferences.

Dr. Zhou will continue to work closely with the MEaSURES project science team members. The main planned work is to advance the joint Vis/NIR and thermal IR retrieval algorithm for dust and finalize the ML algorithm for dust detection. For the TASNPP project, Dr. Zhou will aim to publish a paper that documents the characteristics of extreme precipitation events in the tropics and their association with the environments and convective aggregation.

ANIN PUTHUKKUDY
Sponsor Reed Espinosa / Code 613 / Task 110

The retrieval-simulation setup for the CAMP2Ex observations has been meticulously developed for the multi-angular polarimeter (MAP), specifically utilizing a polarimeter from the HARP family of MAPs. This task required a detailed examination of the impact of various assumptions on the measured versus modeled size distribution of aerosols, as well as the effects of simplified modeling approximations on aerosol and surface properties, which significantly influence the retrieved products from MAP. The framework established through this research is highly adaptable and can be seamlessly integrated into future MAP instruments. The findings were showcased by Dr. Puthukkudy at the CAMP2EX 2024 science meeting in Pasadena, CA, and a draft manuscript of the study has been prepared and reviewed by supervisor Reed Espinosa. The project will be wrapped up with the submission of the manuscript for publication and the release of the code and data used in this study to the public domain.

TIANLE YUAN
Sponsor Lazaros Oreopoulos / Code 613 / Task 112

Dr. Yuan has been working on deriving surface PM2.5 concentrations from satellite-based remote sensing data on this task. He works on using NASA GEOS model simulated data as synthetic data and machine learning tools to retrieve surface PM2.5. Dr. Yuan has presented his research at major conferences such as the AGU fall meeting and international conferences such as AEROCOM 2023 in the state of Washington.
Upcoming Plans include the collection of all the materials and publishing the research results as a paper in the coming months.

JAE N. LEE
Sponsor Dong Wu / Code 613 / Task 114

Dr. Lee's major task involves providing theoretical and physical scientific expertise for the Total and Spectral solar Irradiance Sensor-1 (TSIS-1) mission operation and upcoming TSIS-2 mission development. The TSIS-2 mission, which will be flown in 2025 on a free flyer as a follow-on to TSIS-1, will continue to measure solar irradiance toward a continuous climate data record as indicated in the 2017 decadal survey for earth science and applications from space (ESAS) under the program of record (POR, Table A.1). Throughout mission activities, Dr. Lee is managing science data quality and engaging in validations and calibration status so that the mission can

fulfill all levels of requirements and science objectives. During 2023-2024, Dr. Lee supported the completion of the Instrument Pre-Ship Review (I-PSR) and Mission Operations Review (MOR) for TSIS-2. In addition to the solar irradiance, Dr. Lee's broader research interests encompass the Sun-climate connection, exploring the complex interplay between solar variations and Earth's atmosphere, and producing many science publications. In 2024, Dr. Lee was recognized with a Scientific Leadership Award by NASA "for outstanding leadership in Sun-Climate research."

For more than 45 years, NASA has been measuring how much solar irradiance is arriving on top of Earth's atmosphere. In December 2017, NASA launched the TSIS-1 with two instruments to the International Space Station to continue monitoring the Sun's energy input to Earth, as a follow-on to the SORCE mission. The Total Irradiance Monitor (TIM) is taking measurements of the total amount of radiant energy emitted from the Sun coming to the Earth; this is known as total solar irradiance. The Spectral Irradiance Monitor (SIM) is measuring solar spectrum and spectral solar irradiance.

Despite extensive research on the Sun-Earth relationship, the precise mechanisms underlying the solar forcing of climate change remain elusive. Accurate and consistent solar irradiance measurements are crucial for establishing Earth's energy balance and attributing climate change to various natural forcing factors. Dr. Lee's research aims to unravel the complexities of the Sun-climate connection by exploring a wide range of atmospheric and solar phenomena. This includes exploring processes throughout the whole atmosphere from the planetary boundary layer to the heliosphere. A comprehensive understanding of the models for both the Earth system and solar irradiance is essential for uncovering the Sun's role in shaping our planet's climate.

While continuing her science research on solar irradiance, middle atmosphere dynamics, teleconnections in the Arctic and Antarctic changes, and the Sun-Climate Connection, Dr. Lee plans to continue to support TSIS-1 and TSIS-2 missions. In particular, the upcoming year is critical for the TSIS-2 mission, as shipment of the instruments and system integration must be completed in preparation for its successful launch in 2025.

YUJIE WANG
Sponsor Alexei Lyapustin / Code 613 / Task 118

Dr. Wang has been continuously working on the improvement and extension of the Multi-Angle Implementation of Atmospheric Correction (MAIAC) algorithm. First, Dr. Wang finished the MAIAC VIIRS operational code and delivered it to MODAPS. The science test of the code has been completed, and the code will start production in October 2024; Second, Dr. Wang further extended his calibration work to cross-calibrate Aqua MODIS, SNPP VIIRS, JPSS 1 VIIRS and JPSS 2 sensors using Aqua MODIS as benchmark. This work makes the joint retrieval of VIIRS surface reflectance, AOD and other MAIAC products possible and guarantees the data continuity between MODIS and VIIRS products; Third, Dr. Wang finished the calibration analysis of MODIS collection 6.1 L1B data and re-developed calibration coefficients as part of the C6.1 calibration change introduced in 2023. He also finished MODIS C7 L1B calibration analysis to support the on-going MODIS C7 process; The code had been delivered to MODAPS for production. Fourth, Dr. Wang worked on a new version of the EPIC MAIAC algorithm and finished a whole mission re-processed MAIAC process of EPIC data. The data has been provided to the community for

further research. Lastly, Dr. Wang worked on the MAIAC OCI algorithm and independently developed the OCI gridding algorithm, which is an important pre-process step for MAIAC OCI processing. The code has been tested and delivered to the PACE OCI team for operational production.

In the coming months, Dr. Wang will continue MAIAC VIIRS code development/maintenance, develop MAIAC VIIRS CMG code, develop MODIS C7 MAIAC code and finish PACE OCI MAIAC code. In addition, Dr. Wang will work on the NASA Earth surface Mineral dust source InvesTigation (EMIT) project, develop a new atmospheric correction algorithm for EMIT and support the EMIT dust Direct Radiative Effects (DRE) analysis.

SUJUNG GO
Sponsor Alexei Lyapustin / Code 613 / Task 119

Dr. Go has been working on generating climatological data for dust iron-oxide species (e.g., hematite and goethite) using the MAIAC EPIC version3 algorithm. This work particularly focuses on the aerosol layer height retrieval updates, which utilize EPIC's UV and Oxygen-A, -B bands. Her analysis includes the monthly and seasonal climatology of mineral dust iron-oxide species, as well as the vertical distribution of hematite and goethite over major dust source regions globally. Additionally, the study monitors long-range dust transport over the Atlantic Ocean, with a focus on the Godzilla dust event in June 2020, using MAIAC EPIC level 2 products. Dr. Go is preparing to submit two first-author manuscripts: one to the *Journal of Geophysical Research* (JGR) and the other to *Geophysical Research Letters* (GRL). The co-author review is currently underway.

Dr. Go will submit these two manuscripts to JGR and GRL. Additionally, she will submit a renewal proposal for a grant from the Naval Research Laboratory (NRL) titled "Advancing Aerosol Retrieval with MAIAC EPIC v3: Enhancements of size distribution for NAAPS and Integration with PACE OCI for High-Resolution Global Analysis" for FY25-FY27. She will also participate in a TEMPO proposal submission. After that, Dr. Go plans to improve the algorithm development for MAIAC TROPOMI, which retrieves hyperspectral surface reflectance from UV (340nm) to NIR (760nm).

MYUNGJE CHOI
Sponsor Alexei Lyapustin / Code 613 / Task 120

Dr. Choi developed a retrieval algorithm to estimate two key absorbing components in smoke, black carbon (BC) and brown carbon (BrC), using DSCOVR EPIC measurements combined with the MAIAC processing algorithm. The analysis highlighted distinct smoke properties, including spectral absorption, aerosol layer height, and BC and BrC concentrations, over regions of North America and Central Africa. These retrieved smoke properties provide valuable observational data that can help improve radiative forcing models and support health-related studies. The findings were submitted as a journal article to *Atmospheric Chemistry and Physics* and accepted on July 24, 2024.

Dr. Choi conducted and analyzed a calibration of the Maxar constellation over the Libya-4 site using the MAIAC technique. The research characterized long-term calibration trends and cross-calibration coefficients for four Maxar satellites (GeoEye-1, QuickBird-2, WorldView-2, and WorldView-3) through the MAIAC processing method. The results were published in the *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* on February 19, 2024.

Dr. Choi gave two presentations in September and October 2024: "Validation and uncertainty estimation for MAIAC EPIC smoke AOD and spectral SSA using AERONET" at the AERONET Science and Application Exchange 2024 on 17-19 September 2024, and "Global smoke characterization using MAIAC from DSCOVR EPIC measurement record" at the DSCOVR EPIC and NISTAR STM on 16-18 October 2024.

Upcoming plans include a presentation titled "Climatology of MAIAC EPIC smoke properties including BC and BrC light-absorbing components (2015-2023)" at the AGU Fall meeting on 9 December 2024. In addition, Dr. Choi initiated the evaluation of radiometric calibration for Satellogic satellites under the Commercial Satellite Data Acquisition (CSDA) Program. His primary efforts focus on analyzing absolute radiometric calibration, assessing temporal stability, and evaluating signal-to-noise ratios, culminating in the preparation of a detailed evaluation report. Dr. Choi is also working to refine the MAIAC EPIC smoke and dust retrieval algorithms and plans to extend the methodology to incorporate PACE OCI measurements.

LORRAINE REMER
Sponsor Robert Levy / Code 613 / Task 131

The highlights of this past year (Sept 2023 to April 2024) are the publication of three papers. For the first two papers, Dr. Remer's role was to be involved in discussions, writing, editing and answering reviewer comments during the review process.

Shi et al. (2024) uses data from airborne images collected over active fires during the FIRE-AQ field experiment. Historically, Dark Target aerosol retrievals applied to moderate resolution sensors such as MODIS and VIIRS have had difficulty characterizing smoke plumes near fire sources. With the recent addition of Advanced Baseline Imagers (ABI) on the Geostationary Environmental Satellite (GOES) series, there is now the opportunity to watch these smoke plumes evolve over a day, but only if the plumes can be resolved by the satellite's spatial resolution and not discarded by the algorithm's masking routines. The relatively fine resolution offered by airborne imagers that were flown back and forth over smoke plumes for hours, gave the researchers the opportunity to explore both temporal and spatial resolution effects on characterizing the plumes. The study concluded that the satellite sensors themselves are capable of characterizing smoke plumes near fire sources, but that the protective masks of the global algorithm prevent these plumes from retrieval in the global product. Specialized modifications to the global algorithm can be devised to characterize the evolving smoke plumes that are at least 5 km wide. Dr. Remer was a co-author on the paper (led by Yingxi Shi) titled "Investigating the spatial and temporal limitations for remote sensing of wildfire smoke using satellite and airborne imagers during FIREX_AQ," published in *JGR-Atmospheres*.

Kim et al. (2024) explores the spectral surface reflectance ratios necessary for the Dark Target overland algorithm, specifically as applied to geostationary sensors. The important finding of the paper is noting that geostationary sensors produce geometries never seen in the 20 years of MODIS observations and the surface reflectance parameterizations applied to MODIS and VIIRS were inadequate in these new geometries. The new geometries introduced a bias in the diurnal signature of aerosol optical depth. A varying bias with diurnal hour negates any information the researchers would obtain on true diurnal patterns in aerosol loading using the geostationary sensors. Therefore, the paper works to create a new parameterization that flattens the diurnal bias. Dr. Remer was a co-author of the paper (led by Mijin Kim) titled "Parameterizing spectral surface reflectance relationships for the Dark Target aerosol algorithm applied to a geostationary imager," published in *Atmos. Meas. Tech*.

For the third paper published during this period, Dr. Remer was asked to contribute to the 20th anniversary of the introduction of the new Copernicus journal *Atmospheric Chemistry and Physics*. She was asked to write something speculative and provocative about the future of aerosol remote sensing. With her co-authors, they speculated about a future in which multi-sensor retrievals and assimilation systems were prevalent, where space filled with satellites of all sizes, traditional space agencies like NASA and ESA switched their focus from launching missions to providing validation and calibration infrastructure, and where the commercial sector grew to accommodate a wide variety of needs. The result was indeed provocative; reviewers sent long lists of statements that needed greater support, and subsequently, these comments improved the final result. Dr. Remer was lead author of the paper titled "Opinion: Aerosol remote sensing over the next 20 years," published in *Atmos. Chem. Phys*.

Dr. Remer also devoted time to general discussion with other Dark Target group members, and especially with consulting with Dark Target lead and Sponsor Robert Levy, who sometimes conferred with Dr. Remer on special topics.

NOTE: THIS TASK ENDED IN APRIL 2024.

YINGXI SHI
Sponsor Robert Levy / Code 613 / Task 132

Dr. Shi executed a thorough and careful validation work on all final Dark Target (DT) aerosol products that are created under MEaSUREs projects, including DT on MODIS Aqua and Terra, VIIRS, NOAA20, ABI-16, ABI-17, and AHI. The data are validated against AERONET and MAN separately for over land and ocean data. All level2 products were validated against ground-based measurements as well as inter compared with DT on MODIS Aqua to determine the similarity/differences between the products. The large impact of sampling differences among all sensors are also demonstrated. Dr. Shi delivered a new version of ATBD regarding the DT package algorithm, which is what is used to generate all the products under the MEaSUREs project. Dr. Shi prepared the delivery of MODIS C7 algorithm change, including analyzing its potential improvement over the coastal aerosol algorithm and evaluating the heavy smog scheme that retrieves intense pollution over East China during winter seasons. Evaluation and tests were performed to ensure the improvement is efficient and robust. Dr. Shi is developing the aerosol absorption algorithm using critical reflectance methods and high-temporal resolution geostationary data. The smoke single scattering albedo over North America is

retrieved and evaluated against AERONET. The sensitivity study of potential assumed smoke size distribution and other uncertainty sources impacts are evaluated and modeled. Multiple case studies have shown that our SSA product can capture the temporal evolution of SSA with high accuracy when compared against ground truth. Dr. Shi is developing a Machine Learning algorithm to identify atmospheric components, including clouds and aerosols using spectrum, spatial, and temporal information. The machine learning model is trained using collocated active and passive sensors to utilize the lidar's high sensitivity in identifying dust. Careful evaluation is performed to adjust the targeting values of dust to match the dust detectability of passive sensors. Various models are trained to accommodate different sensors' unique measurements. Dr. Shi also provides datasets for NASA MUREP PBI/HBCU Data Science Equity, Access and Priority for Research and Education (DEAP) project to guide Morgan State University students to learn how to use ML techniques.

In the coming months, Dr. Shi will continue to analyze algorithm results to ensure the success of the MODIS Dark Target C7 product release. Dr. Shi will evaluate the VIIRS products between two algorithm teams: DeepBlue and DarkTarget to provide guidance in future product merging processes. Dr. Shi will continue to optimize and improve the ML models to identify sub-aerosol types along with identification of clouds and aerosols.

PENGWANG ZHAI
Sponsor Yuekui Yang / Code 613 / Task 135

Dr. Zhai, who develops radiative transfer (RT) simulations for the PACE mission, further refined the improved pseudo spherical shell (IPSS) approximation for simulating the polarized radiance field in the Earth system. Particularly the sensor location was assumed at the surface of the Earth in the IPSS approximation. Now it is made flexible to be at the Top of the Atmosphere. Furthermore, Dr. Zhai has refined the surface reflection model to include snow surface, and the generalized Ross-Li BRDF model.

Upcoming Plans include working with the project sponsor to improve cloud data products based on the RT simulations.

SEOYOUNG LEE
Sponsor Christina Hsu; Si-Chee Tsay / Code 613 / Task 156

Dr. Lee has been working on evaluating and improving the Deep Blue (DB) aerosol retrieval algorithm. Her work has primarily involved applying the DB algorithm to AVIRIS-NG data for the 2024 NASA ARCSIX field campaign, as well as assessing the MODIS Collection 7 (C7) data. Most of her efforts have been focused on implementing the DB algorithm on MODIS C7 data, including the task of cloud masking to ensure the accuracy of aerosol retrievals.

In addition to working with the MODIS data, Dr. Lee has been working on the calibration of NOAA-21 data, which became available in March 2023. This calibration work is aimed at enabling the accurate retrieval of aerosol data, contributing to the overall goal of generating long-term aerosol data records using both MODIS and VIIRS datasets.

In the coming months, Dr. Lee will focus on validating the MODIS C7 DB aerosol products. This validation analysis will include a comprehensive comparison with other satellite datasets. She has also submitted an abstract about this study to the upcoming 2024 AGU meeting.

MIJIN KIM
Sponsor Robert Levy / Code 613 / Task 165

Dr. Kim has been working to evaluate and improve the Dark Target (DT) aerosol retrieval algorithms. The DT algorithm is being ported to VIIRS and other GEO sensors, including ABI and AHI, which will relay the 25-year legacy of the DT aerosol dataset. In her pursuit of continuing the high performance of DT aerosol retrievals, she is working on enhancing the surface reflectance assumption on the DT algorithm. Dr. Kim published a first author paper in *Atmospheric Measurement Techniques* titled 'Parameterizing spectral surface reflectance relationships for the Dark Target aerosol algorithm applied to a geostationary imager.' Through a modification of surface reflectance parameterization, notable improvements have been achieved in the aerosol optical depth retrieval, particularly in capturing diurnal variations.

In the coming months, Dr. Kim will continue working on improving the DT algorithm for urban areas for MODIS and VIIRS. On this topic, she will attend the AERONET Science and Application Exchange on Sep 17-19, 2024, in College Park, MD. Additionally, she is interested in the synergy of GEO and LEO observations and has submitted proposals focused on enhancing this synergy for atmospheric components.

COLTEN PETERSON
Sponsor Kerry Meyer / Code 613 / Task 170

Dr. Peterson has been developing and evaluating new pixel-level radiative flux datasets to be included in the upcoming releases of Aqua and Terra Collection 7 MODIS Standard Products and the MODIS-VIIRS Continuity Cloud Products Version 2. Numerous code changes were implemented into the radiative transfer model used to produce the flux datasets, including a more realistic spectral ocean albedo, improving the cloud optical property models, and adding a cloud-base parameterization. The downwelling surface flux datasets have been evaluated globally against the Baseline Surface Radiative Network, and the top-of-atmosphere fluxes have been evaluated against the CERES single satellite footprint and cloud radiative swath products. In addition to developing and evaluating the flux datasets, Dr. Peterson has been involved in the NASA ARCSIX campaign in Greenland, which took place over 8 weeks during the summer of 2024. During the campaign, Dr. Peterson was a main flight planner, which involved developing flight plans for coordinated flights between three separate aircraft to collect remote sensing and in-situ measurements of Arctic clouds and measuring cloud radiative effects and sea ice albedo in different sea ice conditions. Additionally, Dr. Peterson and his group at NASA GSFC are responsible for producing cloud retrieval products for the AVIRIS instrument, which flew aboard the NASA G3 during ARCSIX. This involved data processing and retrieval code modifications while in the field.

Moving forward, Dr. Peterson will be finishing the evaluations of the MODIS/VIIRS flux datasets using surface and satellite radiation measurements. This work will then be published in at least

two journal articles. The flux datasets should become publicly available in 2025, as a part of the aforementioned MODIS/VIIRS cloud product releases. Dr. Peterson will continue to be heavily involved in ARCSIX activities, and this includes further developments of the AVIRIS cloud retrieval code. Numerous collaborations have been established between Dr. Peterson's group at GSFC and other groups involved in ARCSIX. A major focus of this effort is to evaluate the AVIRIS cloud retrievals and derived surface radiative fluxes against collocated observations made by the other aircraft, which should improve remote sensing of Arctic clouds, especially over sea ice.

YAPING ZHOU
Sponsor Antonia Gambacorta / Code 613 / Task 191

Under Task 191, Dr. Zhou is responsible for leading the development of physical retrieval of hyperspectral microwave instruments. Microwave sensors have been used widely in weather and climate applications due to their ability to measure atmospheric temperature and water vapor profiles and hydrometeors in all-weather conditions. Past space microwave instruments only used a limited number of channels (~20 channels) because of limitations in instrument size, weight and power consumption, and cost (SWaP-C).

Hyperspectral Microwave (HMW) sensors are crucial for future PBL sounding architecture. Goddard has been developing the Hyperspectral Microwave Photonic Instrument (HyMPI) with hundreds to thousands of spectral channels using integrated photonic circuits. Dr. Zhou has adapted NOAA's operational microwave retrieval system (MiRS) to enable the retrieval of HyMPI and similar instruments with hundreds and thousands of channels. During the process, she has built up additional modules, fixed bugs in the operational MiRS's code and tested various retrieval configurations and optimizations for the new simulated instrument.
During the next year, Dr. Zhou plans to develop the MiRS code to retrieve measurements from the West-coast & Heartland Hyperspectral Microwave Sensor Intensive Experiment (WH^2yMSIE) and demonstrate the advanced capability of new hyperspectral sensors in resolving PBL thermodynamic structure.

JIANYU ZHENG
Sponsor Hongbin Yu / Code: 613 / Task 193

Dr. Zheng has been working on developing the retrieval algorithms of dust aerosol in both mid-visible and thermal infrared (TIR) wavelengths for MODIS observation. First, the recently developed TIR retrieval relies on the CALIOP observations of dust vertical distributions along the orbit track. Dr. Zheng has extended it to the off-CALIOP-track MODIS pixels by using the derived CALIOP 10-year climatological dust vertical distributions with relatively low uncertainty. Second, Dr. Zheng has explored the extension of the TIR retrieval from over oceans to over lands with improved representations of atmospheric profiles and surface characteristics. The new TIR retrieval is planned to have a synergistic retrieval with the Dark Target (DT) and Deep Blue (DB) algorithms over oceans and lands for dust aerosols. He began his work in January 2024, and the framework of both algorithms is built. The validation of the algorithms through comparison with AERONET and the multi-year data processing is ongoing.

Looking ahead, Dr. Zheng will perform the TIR retrieval over land and ocean on-CALIOP-track and 1) extend the retrieval to off-CALIOP-track MODIS pixels for one-year data, and 2) compare the retrieval results with the in-situ measured dust particle size distribution. He also will validate the one-year retrieval data through comparisons with AERONET and independent retrieval products from other satellites (e.g., IASI).

ALEXANDER MATUS
Sponsor Lazaros Oreopoulos / Code 613 / Task 195

Dr. Matus is working on a MEASURES-funded project using NASA satellite data to construct a climate data record of observed radiative forcing and feedback responses. Since joining the Climate and Radiation Lab in November 2023, he has worked to develop, test, and refine kernel-based methods used to estimate radiative responses due to individual changes in temperature, water vapor, clouds, and surface albedo. His analysis applies observation-based radiative kernels to measurements from CERES, AIRS, CrIS, and VIIRS spaceborne instruments to produce spatially-resolved time-series of broadband and spectrally-resolved radiative forcing and feedback. Dr. Matus is developing data products to assess shortwave and longwave radiation budgets on global scales, allowing for the investigation of both climate and hydrological sensitivity. He has attended numerous project team meetings with end-users and stakeholders to discuss developments in the project and future needs.

Dr. Matus also is leading air quality research focused on enhancing model estimates of surface fine particulate matter ($PM_{2.5}$) concentrations from the GEOS-5 model using vertically-resolved NASA CATS spaceborne lidar data. Through these efforts, Dr. Matus has begun to design, develop, and deliver global estimates of surface $PM_{2.5}$ concentrations enhanced by vertical observations from spaceborne lidar. He has collaborated on this project in support of the NASA Model, In situ, and Remote sensing of Aerosols (MIRA) working group, and he presented research findings at the 2023 NASA Health and Air Quality Applied Sciences Team (HAQAST) meeting in Salt Lake City, Utah. He also assisted the airborne lidar instrument team in Code 612 with deployment, maintenance, and data analysis of atmospheric profile observations in the IMPACTS field campaign to study snowfall formation with results presented at the IMPACTS STM in July 2024.

Going forward, Dr. Matus will continue to lead efforts on the MEASURES project to investigate observed radiative forcing and feedback, focusing on refining estimates and uncertainty quantification of cloud radiative forcing. Special attention will be given to evaluating the spectral variability in radiative responses as well as their implications on our understanding of radiative changes due to greenhouse gasses. He will integrate new multi-sensor observational datasets and present results of these efforts at the AGU Annual Meeting in December 2024. He will continue to refine satellite retrievals of fine particulate matter in support of improving air quality initiatives in the United States. Furthermore, he will collaborate with international research partners on focused studies of air quality conditions in India. In the coming months, a manuscript currently in preparation is expected to be submitted to a peer-reviewed journal.

HIREN JETHVA
Sponsor Robert Levy / Code 613 / Task 198

Porting of above-cloud aerosol algorithm to Dark Target-VIIRS Package:
Dr. Jethva, with the help of Vinay Kayetha (SSAI), worked on the original Dark Targe-VIIRS code, for implementing subroutines and look-up tables of aerosols above clouds. It required generation of additional LUT suitable for the VIIRS wavelengths. The code was tested on many granules of VIIRS over the southeastern Atlantic Ocean. A preliminary validation of the retrieved above-cloud aerosol optical depth against ORACLES airborne measurements from HSRL-2 lidar and 4STAR sun photometer showed promising results.

Dr. Jethva will work towards delivering the first version of the global above-cloud aerosol product, ported to DT-VIIRS aerosol algorithm package. This task involves testing and analysis of the retrievals over different regions and validation of the product using ORACLES airborne measurements over the southeastern Atlantic Ocean.

CODE 614: ATMOSPHERIC CHEMISTRY AND DYNAMICS LABORATORY

DANIEL ANDERSON

Sponsor Bryan Duncan / Code 614 / Task 013

Using a satellite-constrained hydroxyl radical (OH) product that he developed, Dr. Anderson explored the trends and spatial variability of OH over the remote tropics, demonstrating the role of various chemicals in driving that variability. This is the first observationally-constrained study of its type, representing a significant advance over previous studies which could only constrain OH on global or hemispheric scales. He also used results from this effort to help write an opinion piece making recommendations for improvements to the global orbital and sub-orbital observation strategy necessary to constrain OH with the ultimate goal of informing the next decadal survey. In addition, he is developing a methodology to constrain CO_2 emissions from global power plants using emission ratios derived from in situ observations and NO_X emissions determined from TROPOMI.

Dr. Anderson will continue his work to constrain global CO_2 emissions from power plants, with the goal of creating an emissions inventory and determining what additional information is needed to constrain CO_2 in regions where his methodology fails. He will also develop a validation strategy using emissions derived from OCO3 observations.

JUNHUA LIU

Sponsor Bryan Duncan / Code 614 / Task 014

Dr. Liu has been analyzing trends in tropospheric OH, evaluating the accuracy of model output using satellite and in situ observations. Her work contributes to Dr. Daniel Anderson's (614/UMBC) ACCDAM project, which focuses on developing a machine learning algorithm to infer tropospheric column OH (TCOH). Dr. Liu also has been working with Dr. Sarah Strode (614/UMBC) on the developments of the Quick-Chem Ozone module, running and evaluating the Quick-Chem ozone sensitivity simulations. She also evaluates the free-running and replay

Computationally Efficient CH4-CO-OH (ECCOH) simulations with satellite and in-situ measurements.

Dr. Liu has been carrying out sensitivity simulations using the 2-D F0AM box model constrained by aircraft measurements from the Long Island Sound Tropospheric Ozone Study (LISTOS) and the Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) campaigns to examine spatiotemporal variations in O_3 production efficiency and photochemical regime shifts between NOx-limited and VOC-limited scenarios. The results from this work support Dr. Lok Lamsal's (614/UMBC) ACCDAM project on examining the O_3-NOx-VOCs Sensitivity using high-resolution observations.

Dr. Liu also provides model chemistry evaluations of new simulations performed by the NASA GEOS-CCM group including the RefD2 simulation and several new benchmark runs. Additionally, she is involved in the development of NASA's eViz (Easy Visualization) applications for Earth System Models. She also participates in transport evaluation activities for global atmospheric models in collaboration with colleagues from GMAO.

Dr. Liu will continue working with Dr. Daniel Anderson to produce a tropospheric column OH (TCOH) product over an extratropical region using machine learning algorithms; she will continue working with Dr. Sarah Strode on the developments of the Quick-Chem Ozone module; and she will continue working with Dr. Lok Lamsal on his ACCDAM project on analyzing the O3-NOx-VOCs sensitivity using a box model and aircraft campaign measurements. Dr. Liu will continue her work on the model evaluations of new simulations carried out by the GEOS-CCM group, and she will continue to support the development of eViz applications of Earth System Models and GMAO model transport evaluation activities.

SARAH STRODE
Sponsor Bryan Duncan / Code 614 / Task 015

Dr. Strode is contributing to the development of a quick chemistry capability for the GEOS chemistry climate model (GEOSCCM). She is working on implementing a machine learning parameterization of tropospheric ozone and adjusting the implementation to better reproduce the results of a "full chemistry" simulation that explicitly accounts for numerous chemical reactions involved in ozone chemistry. She is also a co-author on two papers that used the quick chemistry simulation of OH in the GEOSCCM.

Dr. Strode contributed to the development and presentation of an online training on remote sensing for environmental justice applications through the NASA ARSET program. The title of this training was "Satellite Data for Air Quality Environmental Justice and Equity Applications."

Dr. Strode is participating in the Intelligent Long Endurance Observing System (ILEOS) project. She provides subject matter expertise on use cases for ILEOS. She has submitted an abstract on the ILEOS work to the upcoming American Geophysical Union (AGU) meeting.

Dr. Strode plans to continue developing and testing the Quick Chemistry machine learning ozone capability. She also plans to help with the testing of ILEOS and present ILEOS work at the fall AGU meeting.

F E I L I U
Sponsor Joanna Joiner / Code 614 / Task 019

Dr. Liu has been working to estimate anthropogenic emissions of air pollutants and greenhouse gasses based on both satellite and model data. Her research has primarily used observations from Aura OMI, Sentinel 5p TROPOMI, and TEMPO. She has developed a comprehensive NO_x emissions database for major US cities based on TROPOMI NO_2 data, which will help to improve the performances of air quality models. Dr. Liu's work has led to a publication in *Atmospheric Chemistry and Physics*. The development of a NO_x emission database for cities with hourly emissions using geostationary satellite TEMPO observations is ongoing. Currently, she is actively engaged in extending this database to incorporate hourly observations from geostationary TEMPO, aiming to provide even more detailed insights into urban air quality dynamics.

In the coming months, Dr. Liu is going to enhance CTM-Independent SATellite-derived Emission estimation Algorithm for Mixed-sources (MISATEAM) developed under the same task. This refinement will extend the applicability of MISATEAM to data from the geostationary satellite TEMPO. The anticipated results from the TEMPO-based analysis are expected to provide crucial insights into the diurnal variations of urban NO_x emissions and their lifetimes. In addition, Dr. Liu plans to present her findings on satellite-derived urban NO_x emissions at the upcoming TEMPO/GEMS Joint Science Team Meeting and at the AMS Annual Meeting.

L O K N . L A M S A L
Sponsor Nickolay Krotkov / Code 614 / Task 021

Dr. Lamsal leads the development, improvement, and maintenance of the Ozone Monitoring Instrument (OMI) operational nitrogen dioxide (NO_2) Standard Product (OMNO2) algorithms and products. As PI of Making Earth System Data Records for Use in Research Environments (MEaSUREs) NO_2 project entitled 'Multi-Decadal Nitrogen Dioxide and Derived Products from Satellites (MINDS)' and Co-I of the MEaSUREs continuation project led by Dr Krotkov, Dr. Lamsal is responsible for satellite NO_2 product development projects. The goal of the projects is to develop consistent long-term (1995-present) global trend-quality data records of tropospheric NO_2 columns and value-added surface NO_2 concentrations and NO_x emissions. He and his team are currently working on a new version – Collection 4 and Version 5, of the OMNO2 product as well as a new version of the TROPOMI NO_2 product. Several algorithm updates made for these two instruments in the past several months enhances the quality of the product in a significant way. Dr. Lamsal has also contributed to another MEaSUREs project, Fluxnet Satellite GPP (FluxSat) GPP (Gross Primary Production), led by Dr. Joanna Joiner.

Dr. Lamsal has been leading the development of trace-gas products from airborne sensors. Two major projects include the NASA ACCDAM-21 (Atmospheric Composition Campaign Data Analysis and Modeling, 2021) project led by Dr. Lamsal, and the NASA Instrument Incubator Program (IIP) project led by Dr. William Swartz. His ACCDAM-21 project focuses on the retrieval and analysis of the data from airborne sensor during the LISTOS (Long Island Sound Tropospheric Ozone Study) and FIREX-AQ (Fire Influence on Regional to Global Environments and Air Quality) field campaigns. For FIREX-AQ, a new sensor was developed - CHAPS-D

(Compact Hyperspectral Air Pollution Sensor-Demonstrator) and will be deployed on aircraft in September 2024.

Upcoming plans include release of the V5 OMNO2 product and V2 TROPOMI NO2. He will be involved in two proposals as Co-I that will be submitted to the NASA TEMPO Science Team call.

STEPHEN STEENROD
Sponsor Luke Oman / Code 614 / Task 041

Mr. Steenrod made many important improvements to the GMI chemistry package in the GEOS Chemistry Climate Model (GEOSCCM). A major improvement was the addition to the GEOSCCM model to possess the ability to have many different mechanisms in place and allow the user to choose with a compile option. A few new mechanisms are in development, including one that focuses on stratospheric ozone chemistry. Mr. Steenrod also formulated another new mechanism that includes very short-lived chlorine chemistry. He also updated the kinetics generating software (KMG) to fully support the GEOSCCM model structure and fixed a very long-standing bug that only affected mechanisms with multiples of 150 reactions. Additionally, he added new capabilities to the GEOSCCM, such as coupling the aerosols directly from GOCART2G and CARMA into the GMI kinetic and photolytic chemistry. This facilitates several types of studies, including the Hunga Tonga-Hunga Ha'apai volcanic eruption or forest fire injections of gases, to understand their effect on atmospheric chemistry. Mr. Steenrod ran several simulations that were used in AGU and AMS presentations by the principal investigators for those projects.

Mr. Steenrod will continue to develop changes needed to update the GMI reactions to Evaluation Number 19 of the "Chemical Kinetics and Photochemical Data for Use in Atmospheric Studies." He will test and document the changes to the GMI mechanisms. He also will continue work on the chemical effects of the Australian forest fires (Das-PI).

HIRENKUMAR T. JETHVA
Sponsor Omar Torres / Code 614 / Task 047

Near-UV Aerosol Task:
Dr. Jethva worked on several aspects of the assigned tasks under the Near-UV (NUV) Aerosol algorithm and products. 1) He helped in finalizing the Collection 4 of the OMAERUV aerosol product by analyzing its consistency, accuracy, and delivery of the code to the processing system. 2) He further refined, tested, and analyzed the improved algorithm for the retrieval of aerosol layer height using O2-B band observations from DSCOVR-EPIC and S5p-TROPOMI. This task required testing different configurations of radiative transfer simulations (or look-up table) and experimenting with the actual retrieval algorithm developed for EPIC and TROPOMI. A final set of RT configurations has been derived and is now being tested with observations from both sensors on a global scale.

PACE-OCI Aerosol Task:
Dr. Jethva was an integral part of the Unified Aerosol Algorithm developed for its application to the Ocean Color Instrument (OCI) sensor, now on board the PACE spacecraft. Under this project,

Dr. Jethva took an active participation in all group meetings, delivered his expertise and knowledge in improving the initial version of the NUV retrievals.

UV-VIS Multifilter Shadowband Radiometer for OCI aerosol absorption retrievals:
This task is funded by the PACE Validation Team for collecting the ground-based, remote sensing data from the UV-VIS MFRSR sensor operated at Izaña Observatory between 2019-2023 and currently in operation at the Santa Cruz station in Tenerife Island. Dr. Jethva took the charge of modifying the original inversion code by introducing the new capability of simulating the randomly oriented spheroidal dust particles. He also tested and ran the inversion package to produce the MFRSR+AERONET combined inversion product using observations from both the Izaña and Santa Cruz locations.

Remaining Activities related to the 2019 Aura Science Team Project:
Dr. Jethva re-calculated the aerosol-cloud joint look-up table with improved input configurations for selected regions. The new set of LUTs were used for the final processing of the CALIOP-OMI-MODIS collocated dataset for the period 2006-2022. The derived product is now being evaluated against ORACLES airborne and in situ measurements. Once the accuracy and integrity of the results are confirmed, he expects to release the product to the community this fall.

Task # 047: PACE-OCI Validation Activities:
Dr. Jethva will continue working on processing, analyzing, and delivering the UV-VIS shadow band radiometer data collected at the Santa Cruz site in Tenerife Island. This task also includes publishing a paper describing the inversion procedure, retrieval examples, and multiyear spectral aerosol absorption record collected at the Izaña Observatory site.

Near-UV Aerosol Activities:
He will work towards the delivery of the next operational versions of the DSCOVR-EPIC and S5p-TROPOMI Near-UV aerosol products with added capability of O2-B band aerosol layer height retrievals.

F E N G L I
Sponsor Luke Oman / Code 614 / Task 064

Dr. Li has assessed two common model biases in the Southern Hemisphere (SH) large-scale circulation: the position of the SH tropospheric midlatitude jet and the timing of the Antarctic stratospheric polar vortex breakdown. He investigated the connection of these two biases and found that they are closely related as they both reflect model deficiencies in representing the SH winter-to-summer circulation transition.

Dr. Li has investigated the response of the Southern Ocean sea surface temperature (SST) and Antarctic sea ice to stratospheric ozone recovery, focusing on the timescale and seasonality of the response. The SST response has large seasonal variations. Ozone recovery causes subpolar Southern Ocean SST warming in summer and cooling in other seasons. The Antarctic sea ice extent increases in spring, fall, and winter, consistent with the surface cooling response in these seasons. However, ozone recovery does not affect the summer sea ice extent, because the summer SST warming response occurs on the equatorward side of the sea ice edge.

Upcoming plans include a first-author paper by Dr. Li entitled “Transient and Seasonal Response of Southern Ocean Sea Surface Temperature and Antarctic Sea Ice to Stratospheric Ozone Recovery” and is expected to be accepted and published by the *Journal of Climate*.

JIN LIAO

Sponsor Thomas Hanisco / Code 614 / Task 070

Dr. Liao has continued her work on the project comparing satellite HCHO retrievals with integrated HCHO columns from ATom airborne observations. She presented a talk titled “Comparison of satellite formaldehyde retrievals (OMI SAO, OMPS-NPP SAO, and OMI BIRA-IASB) in the remote ocean atmosphere with NASA ATom aircraft observations in four seasons” at the AGU meeting in San Francisco, CA in December 2023. In April 2024, Dr. Liao submitted a first-author manuscript on this study to *Atmospheric Measurement Techniques*. The manuscript is currently under review and is available online: https://amt.copernicus.org/preprints/amt-2024-72/.

Dr. Liao participated in the ALEGROS (Associating Local Emissions of Gases with Regional Observations from Satellites) and the SARP-East (Student Airborne Research Program-East site) airborne field campaigns in June 2024.

Dr. Liao has begun analyzing data from the Asia-AQ field campaign, conducted from February to March 2024 to measure air pollutants over the Philippines, South Korea, and Thailand, and to help validate GEMS satellite products. She wrote code to generate level-3 GEMS HCHO and NO_2 data and to calculate the GEMS HCHO and NO_2 averages corresponding to each aircraft profile. Dr. Liao explored the agreement between GEMS retrievals and integrated columns derived from in situ measurements across various countries and concentration levels. She also examined the diurnal variation of HCHO, NO_2, and the HCHO/NO_2 ratio using both satellite retrievals and in situ measurements. Additionally, she plans to assess the ozone sensitivity/regimes for urban and suburban regions in these countries, along with their diurnal variation, using satellite HCHO/NO_2, in situ measurements, and 0-D box modeling. She has submitted a related abstract for the 2024 AGU fall meeting.

In the coming months, Dr. Liao will revise the manuscript submitted to *Atmospheric Measurement Techniques* once the reviews are received. She will also continue to analyze the Asia-AQ data and may assist with a TEMPO proposal.

JERRY ZIEMKE

Sponsor Richard McPeters / Code 614 / Task 074

Dr. Ziemke has been responsible for developing tropospheric ozone data products from NASA-involved satellite measurements. Earth Probe Imaging Camera (EPIC), Ozone Monitoring Instrument (OMI), and Ozone Mapping and Profiler Suite (OMPS) satellite instruments are all operational at the current time. Dr. Ziemke has included these measurements together with coincident MLS profile ozone and MERRA2 (profile ozone and meteorological fields) for deriving both short- and long-record tropospheric ozone data products. All satellite tropospheric ozone products are available from either the NASA AVDC (https://avdc.gsfc.nasa.gov/) or NASA

Goddard tropospheric ozone website (https://acdext.gsfc.nasa.gov/Data_services/cloud_slice/). The EPIC tropospheric ozone product provides maps of tropospheric ozone every 1-2 hours and is available from the NASA Langley ASDC via NASA Goddard NCCS.

In the coming months, Dr. Ziemke plans to continue the development of tropospheric ozone products with new added improvements including boundary-layer, clouds, and aerosol adjustments. He will continue to attend and contribute to all of the Code 614 regular meetings on the development of SBUV, OMI, OMPS, EPIC, TOMS, Ozone, etc. products. Also, Dr. Ziemke will continue to attend upcoming large-attendance meetings (in person or virtual) for DSCOVR, AGU, AMS, EGU, the Quadrennial Ozone Symposium and other meetings deemed relevant. He will continue to contribute to the writing and analyses for journal papers and reports, including the current international Tropospheric Ozone Assessment Report-II (TOARII).

GHASSAN TAHA
Sponsor Glen Jaross / Code 614 / Task 084

Dr. Taha continues to lead the development of the SNPP OMPS LP aerosol algorithm, focusing on enhancing aerosol retrieval during large volcanic eruptions and improving the cloud detection algorithm. The newly developed aerosol products show strong agreement with SAGE III/ISS data and are set for release in the coming months. Additionally, he headed the development of OMPS LP near-real-time aerosol retrievals using neural networks, with these data products now being released through NASA's LANCE system. He is also working on improving aerosol retrieval for the recently launched N21 OMPS LP instrument.

In the coming months, Dr. Taha plans to release a new version (v2.5) of the OMPS-NPP LP L2 and L3 aerosol products. He is preparing to release the first version of the OMPS-N1 L2 aerosol products once processing is complete. Dr. Taha is also leading the effort to develop and release the OMPS-N1 near-real-time data products. Additionally, he is planning to develop the aerosol retrieval algorithm for the new ARGOS instrument, which is scheduled for launch aboard the STRIVE mission.

ZHINING TAO
Sponsor Mian Chin / Code 614 / Task 087

Dr. Tao continues to work on multiple projects of which he serves as PI or co-I. Specifically, he led the effort to investigate the long-term effects of wildfire on regional hydrology. Under his oversight, a two-moment microphysics scheme has been integrated into NU-WRF and coupled with the newly updated GOCART aerosol module. The development of burnt LULC, based on satellite observations to better understand the impact of wildfires, is close to completion. He used observations and modeling to examine the impact of urbanization on the onset and intensity of local to regional precipitation. Dr. Tao conducted a NU-WRF modeling study of the impact of anthropogenic aerosols on regional air quality and meteorology over North American and Asia. In addition, Dr. Tao led and contributed to the development and submission of several research proposals to NASA.

During the next three months, Dr. Tao will focus on designing and carrying out NU-WRF simulations related to wildfires and air pollution tied to two funded projects. He will also start to analyze the finished simulations to prepare for writing a related manuscript.

DONGCHUL KIM

Sponsor Mian Chin / Code 614 / Task 088

Dr. Kim's research is on aerosol modeling using GEOS/GOCART and NU-WRF. His main focus is to improve understanding of the global and regional dust processes and distribution. He has been contributing to a NASA/MAP project (PI: M. Chin) focused on NU-WRF model development. Dr. Kim has conducted a long-term GEOS dust simulation with multiple tagged sources for the GAC project which aims to improve the estimate of lidar ratio for CALIOP (PI: Schuster).

Dr. Kim will continue working on the current tasks including AEROCOM dust optical depth in thermal infrared wavelength intercomparison experiment, dust mineralogy study, the Alaskan dust, and dust settling velocity study. An abstract of the preliminary result of the Alaskan dust has been submitted to the AGU Fall meeting (Dec. 9-13, 2024) in Washington, DC.

AMIR H. SOURI

Sponsor Bryan Duncan / Code 614 / Task 111

Dr. Souri has implemented an effective algorithm called OI-SAT-GMI, which is available to the public, that can adjust several vital variables used in the parameterization of tropospheric OH (TOH) based on satellite retrievals. The algorithm follows a Bayesian data fusion, taking into account the satellite errors and the a priori profile used in the retrievals to ensure that only radiance information is used in the analysis. Dr. Souri also conducted multiple atmospheric modeling experiments using GEOS equipped with machine-learning-based OH parametrization (called ECCOH) to provide one of the most recent (2005-2019) TOH trends globally at 1x1 degrees. Various satellite observations constrain the long-term trends. This was an essential achievement because most former studies only provided a global average trend that was not informative enough to understand their resulting effect on various compounds evolving at different spatial scales. He showed that HCHO (a proxy for VOC-oxidation in remote regions), NO2 (a proxy for reactive nitrogen), tropospheric and stratospheric ozone, and water vapor explain up to 65% of the variance in the TOH trend, all of which are observable by satellites. Dr. Souri's work was published in *Atmospheric Chemistry and Physics*.

In the coming months, Dr. Souri will continue to use his expertise in remote sensing and optimization to improve the representation of OH and ozone in the GEOS-QuickChem model.

HUISHENG BIAN

Sponsor Mian Chin / Code 614 / Task 127

Dr. Bian has been researching atmospheric aerosols and their impact on air quality and climate. She has supported the ASIA-AQ field campaign and post-analysis to study atmospheric pollution

in Asia. She led a study using NASA ATom measurements and AeroCom model simulations to study sulfur cycling in the marine atmosphere.

Dr. Bian also conducted a series of GEOS experiments to support studies on the impact of changes in shipping emissions from 1950 to present as well as the dramatic drop of more than 80% in international shipping emissions in 2020 (IMO2020) on direct and indirect aerosol radiation, and interpolating aircraft ACCLIP measurements to understand the impact of the Asian monsoon on UTLS species originating from pollution and biomass burning in Asia. Other work she has been involved in includes the application of ORACLES aircraft measurements to study biomass burning aerosols in the source and outflow regions of fires in southern Africa. During the coming months, Dr. Bian will continue to support ASIA-AQ post-analysis and conduct surface air quality studies using satellite AOD data. She will present an experiment protocol at the upcoming AeroCom/AeroSat meeting to initiate the AeroCom phase-4 general multi-model aerosol experiment.

LARRABEE STROW

Sponsor James Gleason / Code 614 / Task 136

Dr. Strow's team supported the calibration of three CrIS sounding instruments now operating in orbit: SNPP, NOAA-20 (JPSS-1), and NOAA-21 (JPSS-2). The CrIS sounder on NOAA-21 (JPSS-2) was commissioned this year. In particular, the team continued spectral calibration of all of these sensors with a special emphasis on NOAA-21 which was discovered to have a very clear 14-day oscillation in the spectral calibration. However, the oscillation only has a magnitude of 0.5 ppm peak-to-peak, which is small enough to ignore (this translates to ~0.1K on the sides of sharp spectral lines).

Dr. Strow's team has provided support to NASA for the development of the GSX high-spectral resolution infrared sounding sensor for a geosynchronous orbit.

Production of the climate-quality radiance product (the Climate Hyperspectral Infrared Radiance Product) continues at GES-DIS and is migrated operationally to AWS Cloud storage in the form of netcdf granules. This product converts both AIRS and CrIS radiances to a common spectral response and radiometric calibration. However, this form of the Level 1B (L1b) radiance data is unsuited for time-series studies of the earth's outgoing infrared radiation for climate applications. Much of this year was devoted to generating a version of CHIRP organized into individual time-series for each cell in a 3x5 latitude/longitude grid, chunked by 16-days' worth of L1b/c data (which is the orbit repeat cycle). An award from the NASA ADVANCE program of 100 TB of storage on the Amazon AWS Open Registry enabled the team to store the data in Zarr format, which permits very high speed I/O directly from AWS S3 buckets, unlike netcdf. In addition, the AWS Open Registry does not require hourly authentication, which greatly hinders serious analysis in the cloud of large geophysical time series. The transfer of the CHIRP time series in Zarr format for AIRS, SNPP, and JPSS-1 CHIRP was completed in late June 2024. The Zarr time-series for each of these instruments can be found at s3://nasa-chirp-tiling/ on AWS. Validation of these datasets and the development of Open-Source software showing how to use these data have begun, mostly using the Julia language.

Thermal vacuum ground testing of the last CrIS sensor (for launch on JPSS-4) took place in November and December 2023. Dr. Strow's team successfully performed the spectral calibration of this sensor, again using the gas cell test procedures they designed almost 20-years ago. This calibration determined the Neon calibration lamp absolute frequency and the positions of all nine detectors for three different focal planes (bands) relative to the interferometer axis. These parameters are used to create L1b radiances that are all referenced to an effective on-axis interferometer to an accuracy of ~1 ppm, correcting the raw data by up to a factor of 500x larger. Documentation for all five CrIS sensors will be gathered and homogenized in the next year.

Several changes and upgrades were made to the CrIS/CHIRP Radiative Transfer Algorithms (RTAs) that Dr. Strow's team maintains under this Task. These include improvements to the shortwave non-LTE (non-Local Thermodynamic Equilibrium) parameterization, which is important for sounding in the shortwave channels during the day. The CHIRP RTA has been updated to the same spectroscopy as the CrIS RTA used by CLIMCAPS. Although the RTAs have been under configuration control (GITHUB repos) Dr. Strow's team is now working to package the software used to produce the RTA parameterizations so that others can more easily change the basic spectroscopy in the future. These RTAs (based on the AIRS SARTA) were originally required to only use 30 Mbytes of memory! This requirement **severely** impacted the complexity of the RTA code. The team plans on removing this software requirement that will (a) allow for far simplified RTA code development (in different languages, for example) and more importantly will simplify the development of better/faster parameterization techniques. They have experimented a little with very simple 2-layer feed-forward Neural Net parameterizations and found that these can work well if extremely careful attention is paid to the training data set. More sophisticated approaches using deep learning may be studied since the upcoming GSX sensor will likely need a far faster RTA for many applications. The team does not think that generative AI is particularly relevant here since they can produce very accurate and complete training data for deep learning.

ANNE THOMPSON
Sponsor Ryan Stauffer / Code 614 / Task 138

For the project, "Ozone trends and data analysis using ozonesonde and other ground-based ozone datasets," Dr. Thompson worked with SHADOZ PI Dr. Stauffer on quality-assurance aspects of ozonesonde measurements and with ozone-measuring partners globally in the TOAR II HEGIFTOM (Harmonization and Evaluation of Ground-based Instruments of Free Tropospheric Ozone Measurements) project. Dr. Thompson is the co-lead author of a paper in progress on HEGIFTOM free tropospheric (FT) ozone trends from 2000 to 2022. She presented HEGIFTOM results at the 2023 AGU Meeting in San Francisco (Dec 2023), the AMS Meeting in Baltimore (Jan 2024), and at the Global Monitoring Annual Conference (GMAC) in Boulder (May 2024). The major finding of the HEGIFTOM trends is that throughout the globe, pole-to-pole and east-to-west, FT ozone changes are relatively small (0-2%/decade) and negative in many cases. There are exceptions in boundary-layer trends at selected regions, most notably SE Asia. However, studies claiming that growing emissions are controlling ozone trends throughout the tropics are oversimplified. This was clearly demonstrated in the Stauffer, Thompson et al., ACP paper, 2024.

In addition, Dr. Thompson co-authored satellite validation studies by Orfanoz-Cheuquelaf et al. (2024); Keppens et al. (2024); Satheesan et al. (in review, 2024); Zou et al. (in review, 2024). Dr. Thompson also participated in "Satellite & Field work related to NO2 and greenhouse gas emissions (CO2, methane) from oil and natural gas (ONG) activity." She worked with PI Dr. Stauffer and NPP Post-doc Dr. Niko Fedkin on two Interagency Agreement projects on emissions from ONG in the Gulf of Mexico. She helped prepare bimonthly reports to the BOEM Agency. Satellite NO2 measurements are from OMI, TROPOMI and the 2023-launched TEMPO. In Fedkin et al. (ESS, 2024) major ONG platform emitters, "hot spots" were highlighted at NASA Goddard (see figure below).

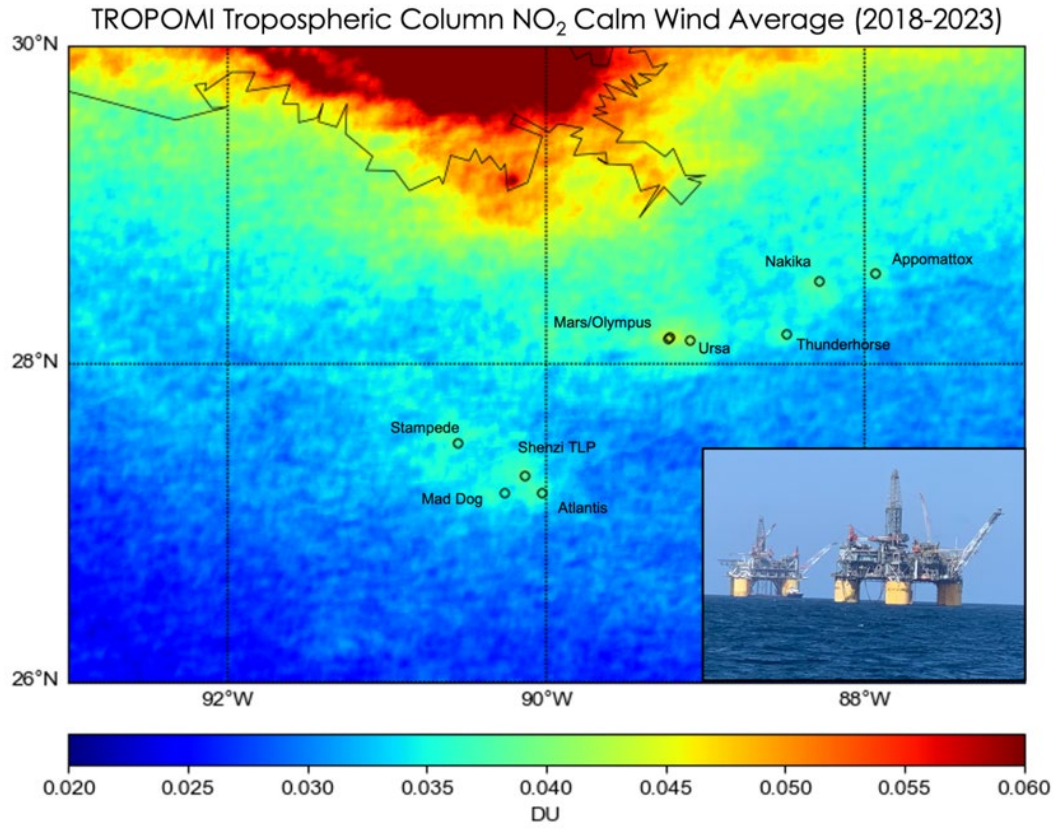


Figure from Fedkin, et al., "Nitrogen Dioxide Emitting Oil Platforms in Gulf of Mexico," provided by A. Thompson.

The "hot spots" guided the design and operation of an oceanographic cruise in June 2024. Designated "SCOAPE II" after Dr. Thompson's 2019 SCOAPE cruise (Thompson et al., ESS, 2023), she worked with a GSFC-based complement of 7 scientists on the Research Vessel Point Sur based out of LUMCON (Cocodrie, LA) for 13 days. SCOAPE II results were submitted for the 2024 AGU Meeting and the 2025 AMS Meeting as presentations. Note that publications from SCOAPE (Balashov et al., JGR, Sept. 2023) and from the 2023 SARP NO2 and ozone measurements collected by Thompson, Stauffer and Fedkin (Huang et al., submitted, 2024) have examined pollution patterns in coastal regions.

Photo left: Dr. Thompson, NASA NPP post-doc Niko Fedkin, and UMBC Physics graduate student Joshua Richards, launching an ozonesonde on the Research Vessel Point Sur, June 2024.

In the coming months, two manuscripts will be submitted to the *Atmospheric Chemistry and Physics TOAR II* special issue, and analyses of NO2 SCOAPE II data will be presented at the AGU Meeting in Washington, DC. An invited paper on a SHADOZ overview will also be given.

NIGEL RICHARDS
Sponsor Natalya Kramarova / Code 614 / Task 143

Dr. Richards has been working on the validation of SNPP OMPS LP ozone profile measurements processed with the new NASA GSFC version 2.6 retrieval algorithm. The first OMPS Limb Profiler (OMPS LP) satellite instrument, launched in October 2011, performs limb measurements of scattered solar radiation in the ultraviolet and visible wavelengths, which allow for the retrieval of ozone profiles from the top of clouds up to 57.5km. Previous versions of OMPS LP retrievals were evaluated using MLS observations, but with MLS due to be decommissioned in the near future, other sources of observations are needed for the validation of future stratospheric ozone profile retrievals. Therefore, in this work, Dr. Richards utilized ozone profile retrievals from two solar occultation satellite instruments, SAGE III/ISS and ACE-FTS, together with ozonesonde and lidar data, to validate OMPS LP profile measurements. OMPS LP started operational observations in April 2012, whereas ACE-FTS observations started in February 2004. Therefore, there are currently 12 years of data overlap to exploit for validation. SAGE III/ISS observations started in June 2017, which provides 7 years of data overlap with OMPS LP. These overlaps allow us to determine if there are any long-term drifts or seasonal biases between OMPS LP and ACE-FTS/SAGE III. Dr. Richards also used MLS data to investigate if the limited spatial sampling of both ACE-FTS and SAGE III/ISS contributes to any observed seasonal biases. This is achieved by first comparing MLS to OMPS LP at all OMPS/MLS coincident observation locations and then sub-sampling MLS to ACE-FTS and SAGE III/ISS observation locations and

comparing these to OMPS, any changes in the observed seasonal biases will be due to the sampling. A paper presenting the results of this work is currently in preparation.

Dr. Richards has also recently started work on validation of ozone profile retrievals from the new OMPS LP instrument on the NOAA-21 satellite, again using data from ACE-FTS, SAGE III/ISS and ozonesondes.

Dr. Richards plans to submit a paper on the OMPS LP validation work in the September/October time frame.

NADER ABUHASSAN
Sponsor Thomas Hanisco / Code 614 / Task 146

The primary objectives of NASA's Pandora Project include satellite validation and verification, advancing Earth System Sciences, and ensuring long-term monitoring of air quality and atmospheric composition using the nationally and globally deployed Pandora Spectrometer systems. Pandora Spectrometer Systems (Pandoras) are compact, ground-based, passive

hyperspectral remote sensing instruments designed to detect trace gases and aerosols. The systems primarily measure the total column concentrations of O3 (ozone), NO2 (nitrogen dioxide), SO2 (sulfur dioxide), HCHO (formaldehyde), and BrO (bromine monoxide). Dr. Abuhassan's role within the Pandora Project focuses on several key areas: providing laboratory and field support as well as offering expert consultation. Dr. Abuhassan has contributed critical laboratory and field support for the development, maintenance, refurbishment, and deployment of the Pandora spectrometer systems. His work ensures that the instruments remain reliable and effective across various environmental conditions. Additionally, he provided specialized consultations on the operation, calibration, and data processing of the Pandora spectrometers to ensure accurate data analysis. Dr. Abuhassan will continue to play an essential role in advancing the capabilities and applications of the Pandora Project, contributing to the goals of enhancing satellite validation, improving atmospheric science research, and supporting environmental monitoring initiatives.

JASON ST. CLAIR
Sponsor Thomas Hanisco / Code 614 / Task 147

Dr. St. Clair supported the NASA ASIA-AQ field campaign, leading the instrument integration of GSFC instruments on the NASA DC-8 aircraft and supporting the instruments for the Philippines and Thailand portions of the deployment. He was instrument PI for the CANOE NO_2 and ROZE O_3 instruments and co-I for the ISAF formaldehyde instrument. Dr. St. Clair supported the NASA Student Airborne Research Program (SARP) project through involvement with the Dynamic Aviation B200 aircraft platform, which was outfitted with NASA GSFC instrumentation. He was instrument PI for the CANOE NO_2 and CAFE formaldehyde instruments, and he served as mission scientist for the B200 platform during SARP East. The data from SARP East flights will be valuable for validation of Pandora network data products.

Photo above: Jason St. Clair during air quality and greenhouse gas monitoring flights over the mid-Atlantic region with the NASA Student Airborne Research Program (SARP) on the B200 aircraft. Dr. St. Clair served as the flight mission scientist for the B200 aircraft.

In 2024, Dr. St. Clair started leading the GSFC effort to set up a ground-based remote sensing network for CO_2 and CH_4, which will include deployment of 10 EM27/SUN instruments to minority-serving institutions, in addition to 8 other EM27/SUNs and a high-resolution IFS 125HR (TCCON instrument) that will also be part of the network. The considerable logistical and engineering tasks have just begun.

Dr. St. Clair will continue to participate in the science team of recent NASA field campaigns, including ASIA-AQ and DCOTSS. Pandora network validation work will continue as a collaboration with the GSFC Pandora team, making use of recent Pandora overflights. He will be involved in writing proposals to multiple EVS-4 projects with the teams' GSFC NO_2, O_3, and HCHO instruments well-positioned to be selected as part of the aircraft payload. The bulk of his time will be spent getting the EM27 network started and the TCCON instrument installed and functional.

KEITH EVANS
Sponsor Nickolay Krotkov / Code 614 / Task 159

In order to advance understating of natural and anthropogenic sources of trace gases and their impacts on Earth's climate, air quality and environment, Mr. Evan's effort involves research on volcanic and anthropogenic gaseous emissions, primarily but not limited to sulfur dioxide (SO_2) and nitrogen dioxide (NO_2), in support of NASA's legacy and ongoing atmospheric composition

missions, such as TOMS, OMI, OMPS, and ESA/Copernicus S5P/TROPOMI. He maintains and further develops the NASA/Goddard Sulfur Dioxide Monitoring Web Site (http://so2.gsfc.nasa.gov), archiving OMPS, OMI and TOMS SO_2 data in NASA required formats, and participates in NASA's ESDSWG. Mr. Evans created, developed and maintained the NASA/Goddard Nitrogen Dioxide Home Page (http://so2.gsfc.nasa.gov/no2/no2_index.html) using OMI, OMPS and TROPOMI data.

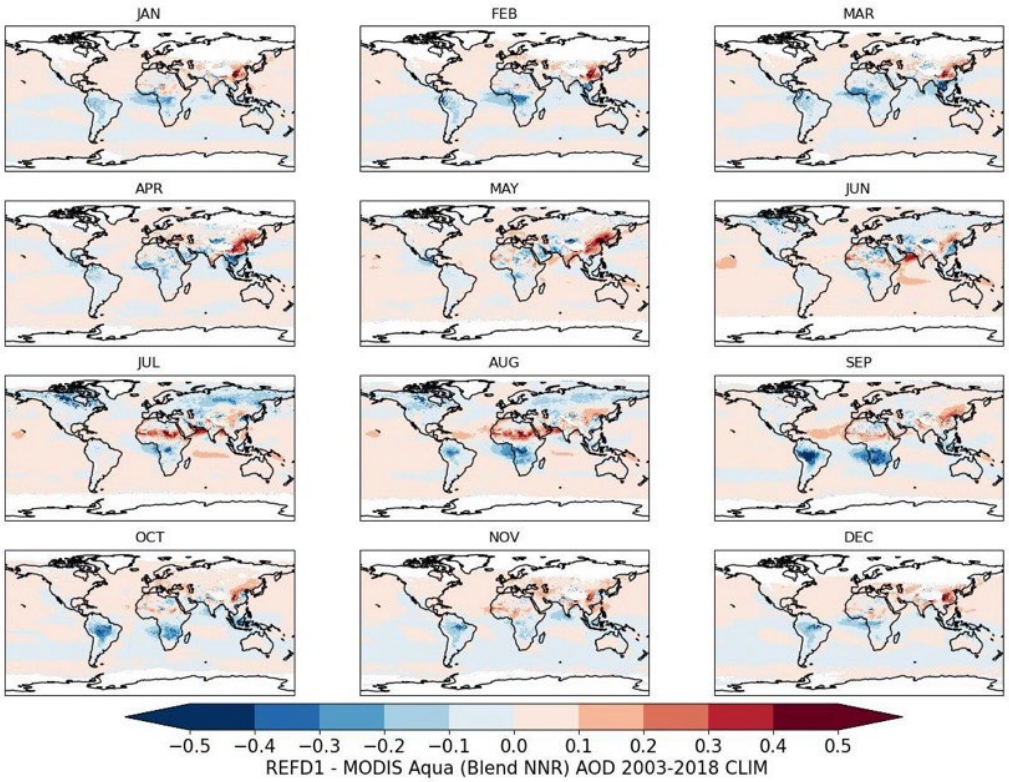
Mr. Evans created maps of (mostly) volcanic SO_2 outgassing for 37 regions around the world using OMI, OMPS and TROPOMI data as needed and created weekly reports of worldwide volcanic SO2 outgassing from OMI, OMPS and TROPOMI data for comparisons and for validation. He added NOAA's JPSS1-OMPS data to the SO2 website showing daily and weekly images of SO2. Additionally, Mr. Evans created the NO_2 web site showing NO_2 with time series plots and daily movies in 317 cities around the world. He must upload images daily due to the 2-factor security currently in place.

In the coming months, Mr. Evans will study the sources of trace gases (SO_2 and NO_2) to answer the question of how natural and anthropogenic sources impact the local people and their environment. He will maintain the functionality and add enhancements to the SO_2 and the NO_2 websites as needed. This extends long-term monitoring of sulfur dioxide and nitrogen dioxide with new satellite instruments as they become available. He will add AIRS SO_2 maps when possible.

CATERINA MOGNO
Sponsor Peter Colarco / Code 614 / Task 172

Dr. Mogno has been working to evaluate the aerosols component of the GEOS Chemistry Climate Model (GEOS-CCM), which is a configuration of the NASA GEOS model suitable for climate studies. This work was conducted as part of the NASA Modeling, Analysis, and Prediction (MAP) Program.

Dr. Mogno compared a decadal hindcast simulation of GEOS-CCM (REF-D1 experiment) with multiple in-situ and satellite long-term observations of optical properties of aerosols, as well as of surface particulate matter concentrations ($PM_{2.5}$). The work conducted by Dr. Mogno serves as a benchmark for future GEOS-CCM model developments in the aerosol module for climate studies. This evaluation work is completed, and a publication (article for peer-reviewed journal) is in preparation. In addition, during the past year, Dr. Mogno presented this work at four national and international conferences.



Climatological monthly average difference in total aerosol optical depth (AOD) between GEOS-CCM and satellite observations from MODIS Aqua (average 2003-2018). In the comparison, we exclude areas where MODIS has no observations in the monthly means (white areas). Figure credit: C. Mogno.

The aforementioned GEOS-CCM aerosols evaluation revealed deficiencies in the model representation of the nitrate aerosol component. Dr. Mogno will be focusing on improving the nitrate component in the aerosol module of the GEOS-CCM. She also will be presenting ongoing results at the Annual AeroCom meeting (October 2024, Lille FR).

APOORVA PANDEY
Sponsor Thomas Hanisco / Code 614 / Task 177

Dr. Pandey has been supporting operational efforts at the NASA Goddard Pandora laboratory by performing lab calibrations and instrument performance analysis for Pandora instruments. She has also been involved in field calibration and dataset preparation for currently deployed instruments. She participated in the CINDI-3 in Cabauw, Netherlands, which is a systematic intercomparison of ground-based remote sensors (including the Pandora instruments). In June and July 2024, she provided flight and ground measurement support for the ALEGROS and SARP field campaigns to enable validation of Pandora data products against in-situ instruments.

Dr. Pandey will continue to work on operational calibration and data analysis tasks. She will conduct experiments for identifying sources of optical noise in the Pandora spectrometers, as well as evaluations for improved instrument design. She will further her analysis of formaldehyde retrievals from Pandora Multi-Axis Differential Optical Absorption Spectroscopy measurements and utilize her findings for validating TEMPO formaldehyde columns.

MICHAEL D. HIMES

Sponsor Natalya A. Kramarova & Avi Mandell / Codes 614, 693 / Task 205

Since joining GESTAR II on June 26, 2024, Dr. Himes has been working on machine learning (ML) applications to limb-scattered radiance measurements from the Ozone Mapping and Profiler Suite Limb Profiler (OMPS LP). They have submitted a paper to *Atmospheric Measurement Techniques* on their ML-based near-real-time aerosol retrieval algorithm, and they have made updates so that the algorithm can be applied to NOAA-21 data. They are finalizing work on a novel ML-based NO_2 retrieval algorithm for OMPS LP, which is not possible via non-ML approaches; results show good agreement with instruments designed to measure NO_2, such as the Optical Spectrograph and Infra-Red Imaging System (OSIRIS) and the Ozone Monitoring Instrument (OMI). They also are exploring a novel ML-based approach to retrieving H_2O from OMPS LP measurements; preliminary results show excellent agreement with the state-of-the-art retrievals from the Aura Microwave Limb Sounder.

Between September 1, 2024, to November 30, 2024, Dr. Himes expects to submit proposals to the NASA ROSES Remote Sensing Theory for Earth Science program and the Earth Science Division Strategic Science call for proposals, submit a paper on the aforementioned NO_2 retrieval algorithm, and continue development on their aerosol, NO_2, and H_2O retrieval algorithms.

CODE 615: CRYOSPHERIC SCIENCES LABORATORY

PAOLO DE MATTHAEIS

Sponsor David Le Vine / Code 615 / Task 016

Dr. Paolo de Matthaeis' work falls in the framework of estimating sea surface salinity from space, for study of large-scale ocean processes and climate change, using measurements from the Soil Moisture Active Passive (SMAP) radiometer and the Aquarius instruments. Activities focus on minimizing the various errors in the brightness temperature measurements acquired over the ocean to perform a reliable retrieval of sea surface salinity. In particular, during the period from 1 September 2023 to 31 August 2024, Dr. de Matthaeis has contributed to investigations on the geolocation of SMAP data and the measurement of the dielectric constant of sea water; research published in journal articles listed below. He is also part of the RFI (Radio Frequency Interference) SMAP team, and regularly presents his work in its bi-weekly online meetings. Among the aspects that he has been focusing on is the analysis and reporting of observed interference to the competent authorities so the sources can be identified and removed. Results of his work are included in two conference papers (AMS 2024 and IGARSS 2024) and a journal article for the *IEEE Transactions on Geoscience and Remote Sensing*, also listed below. He is also analyzing data acquired by the airborne Scanning L-Band Active Passive (SLAP) radiometer over Utah in October 2023. Finally, Dr. de Matthaeis is Chair of the IEEE GRSS Frequency Allocations in Remote Sensing Technical Committee and has contributed to presentations on the protection of remote sensing instruments for Earth Observation from RFI and related regulatory issues.

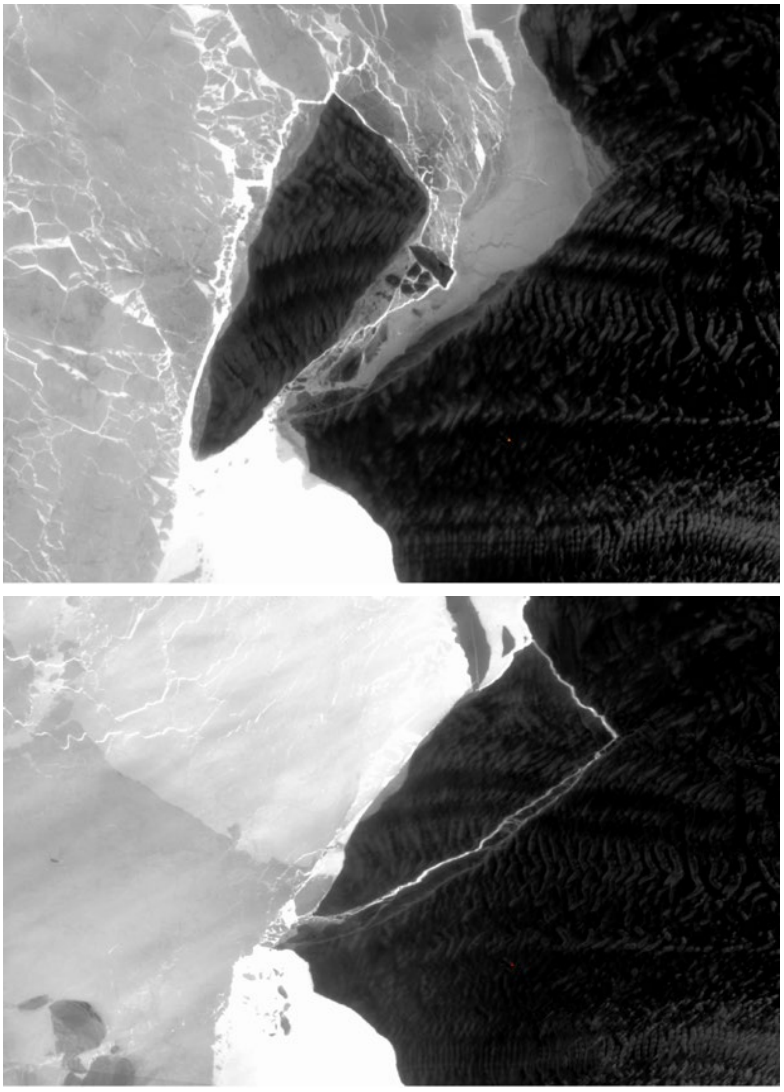
Dr. Paolo de Matthaeis will continue his work on errors affecting the estimation of sea surface salinity from space, in particular RFI, and the analysis of the SLAP measurements. He will be

attending the RFI 2024 Workshop in October, where he is also part of the Scientific Organizing Committee, and give two oral presentations there.

CHRISTOPHER SHUMAN
Sponsor Compton Tucker / Code 610 / Task 089

Dr. Shuman contributed to the success of the documentary *Canary* (https://www.canarythemovie.com/about-the-film) in late 2023, which included attending a screening at the National Academy of Science in Washington DC. *Canary* is a documentary that focuses on climate change through the lens of renowned climate scientist and mountaineer, Dr. Lonnie Thompson. Known for his groundbreaking research on glaciers, Thompson's work has uncovered crucial evidence of the Earth's warming temperatures over time. The documentary weaves together his personal journey and professional achievements, exploring his deep connection with the natural world and his determination to raise awareness about the dire consequences of climate change.

In the coming months, Dr. Shuman will continue to promote LEAP (Landsat Extended Acquisitions of the Poles) images prior to the upcoming AGU meeting in Washington DC. He will also continue to support media interest in the cryosphere.



Photos Left: Two LEAP thermal views of Iceberg A-83 that calved from the Brunt Ice Shelf. Landsat 9's TIRS-2 captured the release of the berg during the austral winter as well as its later motion past the MacDonald Ice Rumples, a small ice rise. Thicker sea ice is indicated by darker greys in the later image. Rifts show brighter tones of warmer ocean water relative to the cold, dark shelf ice. Movement of the iceberg is obvious over the ~three month time span but so is the advance of the remaining Brunt Ice Shelf that supports the British research station Halley which has been moved multiple times.

SUSANNE CRAIG

Sponsor Bryan Franz / Code 616 / Task 004

Dr. Craig is the science lead for PACE (Plankton, Aerosol, Cloud, and ocean Ecosystem) system vicarious calibration (SVC) activities. With the successful launch of PACE this year on February 8, 2024, SVC activities have ramped up to near operational status. During this year, an early career scientist was assigned to help in this substantial task, and Dr. Craig has been responsible for supervising him and directing his activities. SVC involves comparing high quality, radiometric in situ data to that measured by the satellite sensor. This is achieved through a close collaboration with two SVC instrument teams who deploy their sensors in various regions of the global ocean. Dr. Craig has worked closely with these two teams to develop near-real time data staging and ingestion into the Ocean Ecology Laboratory's (OEL) ODPS (Ocean Data Processing System). This has also involved close collaboration with the ODPS teamto develop new pipelines to ingest the SVC data and match it temporally and spatially to the measurements made by PACE's Ocean Color Instrument (OCI). One of the SVC teams has a very novel approach to data collection and deploys profiling, Lagrangian floats in oceanographic retentive features (e.g., mesoscale eddies). This required that the ODPS pipeline be developed from scratch to account for the dynamic positioning of the floats and Dr. Craig worked closely with various members of the ODPS team to achieve this. Staging, ingestion, and processing of SVC data is now operational and actively under way.

Now that the mechanics of SVC data collection and ingestion have been achieved, Dr. Craig is now working on generating the first set of PACE mission calibration gain factors. These are the first set of hyperspectral gain factors to be calculated, and she has generated 3 sets of gains – one from each of the SVC platforms from mission start to present, and another from implementation of an ocean reflectance model, run to check for systematic instrumental biases and environmental effects. This has involved collaborating closely with several members of the ODPS team to learn how to implement these processes – previously only performed for multispectral sensors – for hyperspectral datasets. The PACE project plans to apply these gain factors in the next mission reprocessing that is anticipated to take place in the next month or so.

Last year, Dr. Craig reported that she had applied for GSFC support for her two instrument concepts via the Strategic Science Task Group programs. The two instrument platforms are RoboHyPO (Robotic Hyperspectral Polarimeter for the Ocean), which measures the polarization state of the ocean and overlying atmosphere, and AUTOCRACY (Aerial Autonomous Ocean Color and Atmospheric Chemistry System), an UAV that simultaneously measures ocean color and atmospheric chemistry. She was successful in both applications and received 0.3 FTE for both projects. Through some task swapping in the OEL's budget, she was able to transform these FTEs into procurement dollars. This facilitated a very fruitful collaboration with the technology company, SciGlob, headed by UMBC GESTAR scientist, Dr. Nader Abuhassan and RoboHypo's inventor, Dr. Deric Gray of NRL. RoboHypo has now been completely rebuilt and is currently being tested on the roof of GFSC Building 34. The instrument will be deployed for field testing in the next 1-2 months at Horn Point Laboratory (University of Maryland Center for Environmental Science). The AUTOCRACY system is also being integrated and engineered by SciGlob, and the Science Task Group funds have allowed procurement of a cutting edge, miniaturized Scanning

Electrical Mobility Sizer (Brechtel mSEMS). The combination of an ocean color sensor, the mSEMS, and thermal desorption sampling of volatile organic compounds (VOCs) will allow Dr. Craig to investigate the role of VOCs associated with phytoplankton communities in the formation of secondary organic aerosols (SOAs).

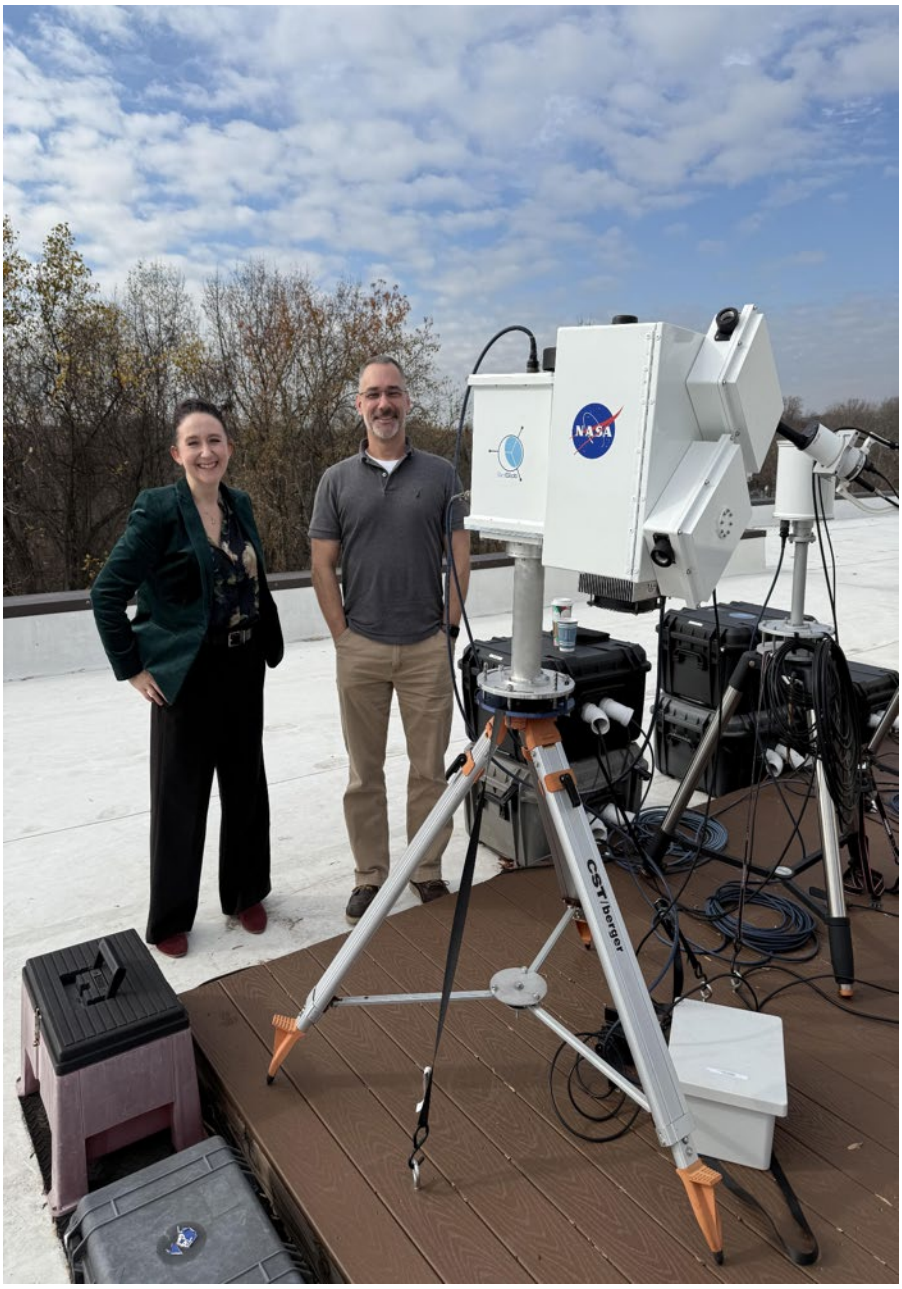


Photo left: Susanne Craig and NRL colleague, Dr. Deric Gray, alongside the RoboHypo (robotic hyperspectral polarimeter for the ocean) in a test deployment on the roof of technology partner, SciGlob. Photo courtesy of Dr. Bob Swap, NASA GSFC.

In response to the 2024 call for GSFC Strategic Science concepts, Dr. Craig submitted a proposal entitled, “The Role of Oceans in the Earth System: Preparing the Oceans Community for the 2027 Decadal Survey.” In this proposal, she proposed to formulate a series of activities to coordinate the ocean research community and ensure readiness to respond to the anticipated requests from the 2027 Decadal Survey committees for white papers and committee member nominations. This was written in collaboration with Earth system modeler, Dr. Cecile Rousseaux, planetary boundary layer scientist, Dr. Joseph Santanello, and GMAO modeler and SOLAS scientist, Dr. Santiago Gassó. Results will be announced within the coming weeks.

Dr. Craig is currently preparing a proposal for submission to the 2024 GSFC Science Task Group. This will involve requesting funds for the development of a benchmark dataset for the development of machine learning, hyperspectral ocean color algorithms to predict phytoplankton community composition. In recent years, new technologies have allowed the acquisition of high-fidelity metrics of phytoplankton community composition (i.e., what groups of phytoplankton are present in the bulk assemblage). It has long been an ambition of the ocean color community to use these new datatypes to develop cutting edge algorithms. However, there are currently no standardized repositories that allow for hyperspectral ocean color data to be spatiotemporally matched with these complex datasets that can be composed of esoteric taxonomic information and/or omic assays. Dr. Craig and GESTAR II data scientist, Dr. Ian Carroll will collaborate with harmful algal bloom specialist, Dr. Clarissa Anderson (Scripps Institution of Oceanography) to develop a standardized framework to develop a benchmark dataset of hyperspectral ocean color and bleeding edge taxonomic training data. This would be the first of its kind and would accelerate the full exploitation of hyperspectral ocean color and these new taxonomic datasets.

It is anticipated that the RoboHyPO instrument will be ready for field deployment in October. Dr. Craig will work with SciGlob and NRL partners to achieve this. Additionally, through a collaboration established with GSFC's Dr. Thomas Hanisco, Dr. Craig will prepare an SBIR Phase III proposal to allow further development of the RoboHyPO instrument through fabrication of several version 2.0 units. These will address a pressing need in the community for well characterized, affordable, hyperspectral polarimeters and will be invaluable to the ongoing PACE validation effort. Dr. Craig has already approached partners in NOAA and Scripps Institution of Oceanography who are eager to deploy them on their observation platforms.

Dr. Craig will be continuing her work on her ROSES funded machine learning algorithms for predicting phytoplankton community composition from ocean color. Collaborator, Dr. Erdem Karaköylü, has recently developed a new approach using boosted trees (XGBoost), which is being tested on a synthetic dataset ocean color dataset generated by the NASA Ocean Biogeochemical Model (NOBM) coupled with an Ocean-Atmosphere Spectral Irradiance Model (OASIM). Dr. Ian Carroll is part of this research team, and he has developed an alternative approach in the form of a Convolutional Neural Network (CNN). These results will form the basis of at least two publications that will be prepared over the coming months.

As a recognized national and international expert on remote sensing, phytoplankton ecology, and harmful algal blooms, Dr. Craig has been invited to speak at two upcoming events: 1) the National Harmful Algal Bloom Network (NHABON) webinar series, 18th September 2024, https://ioosassociation.org/nhabon/, and 2) The Ocean Biodiversity TechSurge, 1-2 October 2024, Baltimore, MD, https://oceanenterprise.com/oceanbiodiversitytechsurge/.

VIOLETA SANJUAN CALZADO
Sponsor Bryan Franz / Code 616 / Task 005

NOMAD database
Dr Sanjuan Calzado continues to gather data for the NOMAD database. After technical specifications have been set, the database is incorporating data streams from different

products. Currently, the AOP data stream is fully operational and soon will incorporate more products as they get delivered.

Validation
During this year, most efforts have been dedicated to PACE post-launch validation activities. The PACE Validation Science Team will be taking measurements during 2024 and 2025 as part of the post launch activities helping with the generation of PACE data products. Dr Sanjuan Calzado leads the AOP in-water product. As part of her activities, data submission protocols and data formatting and specifications have been reviewed with all PVST scientists to guarantee data submission and processing within 60 days of acquisition. New software has been generated to process AOP acquisitions from AOP in-water buoys and data streams from profiling radiometers that are operationally processed with Visual SeaBASS.

Visual SeaBASS
Visual SeaBASS is an AOP processing software for in situ radiometry to generate water leaving radiances for validation activities of ocean color missions, including PACE. Dr. Sanjuan Calzado leads its development and implementation. Software is currently undergoing the New Technology Report (NTR) invention public software release process. During this year, new functionalities have been added to provide support for PACE validation activities. Visual SeaBASS has a new module included for data processing on the HyperNAV system vicarious calibration platform. HyperNAV is one of the two system vicarious calibration platforms available for PACE together with the MOBY optical buoy. Due to technical problems with MOBY, HyperNAV is currently the only system in operation. Visual SeaBASS is processing HyperNAV data and calculating gains to calibrate PACE.

Ocean Optics XXVI conference
Ocean Optics is the main professional conference dedicated to marine optics. Dr. Sanjuan Calzado led a proposal (selected) to host the conference in Las Palmas de Gran Canaria, Spain, from 6th-11th October 2024. This edition will have an important local participation with the School of Oceanography from the University of Las Palmas de Gran Canaria and PLOCAN, the oceanographic platform from the Canary Islands, participating and supporting this event. Additionally, some Spanish government institutions will be cosponsoring this event. Dr. Sanjuan Calzado has obtained support from local organizations and funding for the conference and coordinating the conference organization locally.

Dr. Sanjuan Calzado will be working during the next couple of months on the organization of the Ocean Optics XXVI conference and providing support to the PACE Validation Science Team and analyzing and processing AOP data collected by the team during the PACE-PAX validation campaign.

D I R K A . A U R I N
Sponsor Antonio Mannino / Code 616 / Task 009

In the run-up to and following the successful launch of the PACE mission, Dr. Aurin has continued to support the NASA Ocean Ecology Laboratory (OEL) and the PACE mission with his expertise in field radiometry and in situ optical measurements used for satellite validation and the development of algorithms to remotely retrieve biogeochemical properties from the surface

ocean. As the lead NASA scientist for the open-source field radiometry community processor, HyperCP, Dr. Aurin has assembled and collaborated with an international team of experts from US and European space agencies, academia, and the private sector. Under his management, the HyperCP team has introduced a major upgrade to the community processor that applies groundbreaking new metrology incorporating end-to-end uncertainty budgets, improving accuracy and precision of the resultant ocean color data products. HyperCP has been adopted by numerous domestic and international laboratories over the past year including principal investigators on the PACE Validation Science Team (PVST). As the numbers of community contributors and end users have grown, so has the need to train new scientists and technicians, and Dr. Aurin, together with members of the HyperCP team, has conducted multiple training courses and workshops for HyperCP this year. He has continued to provide his expertise to OEL and the SeaWiFS Bio-optical Archive and Storage System (SeaBASS) team as a subject matter expert (SME) for above-water radiometry (AWR). This included updating guidelines for community submissions of AWR to SeaBASS and developing a set of tools to review and quality control submissions. This work closely dovetails his advisory role within PVST on matters related to AWR data collection, instrumentation, processing, and data submission, including coordination of instrument calibration and characterization at the Tartu Observatory in Estonia for PVST PIs. As the designated SME, he regularly reviews SeaBASS submissions of AWR from the community and provides NASA with quality-controlled data together with reports to advise those tasked with satellite mission validation and the assembly of a revised NASA bio-Optical Marine Algorithm Dataset (NOMAD). Dr. Aurin also supports the Field Support Group (FSG) of OEL with the management, processing, and submission of on-water and above-water radiometric measurements collected during frequent oceanographic cruises. Since September 2023, this has included the Atlantic Meridional Transect (AMT-30) from the Falkland Islands to the UK, the EKAMSAT ASTRAL_2024 cruise in the Bay of Bengal in May 2024, and the VIIRS validation cruise around Florida in May 2024. With the new updates available in HyperCP providing higher precision and accuracy, he has also been reprocessing data from numerous past cruises for resubmission to SeaBASS.

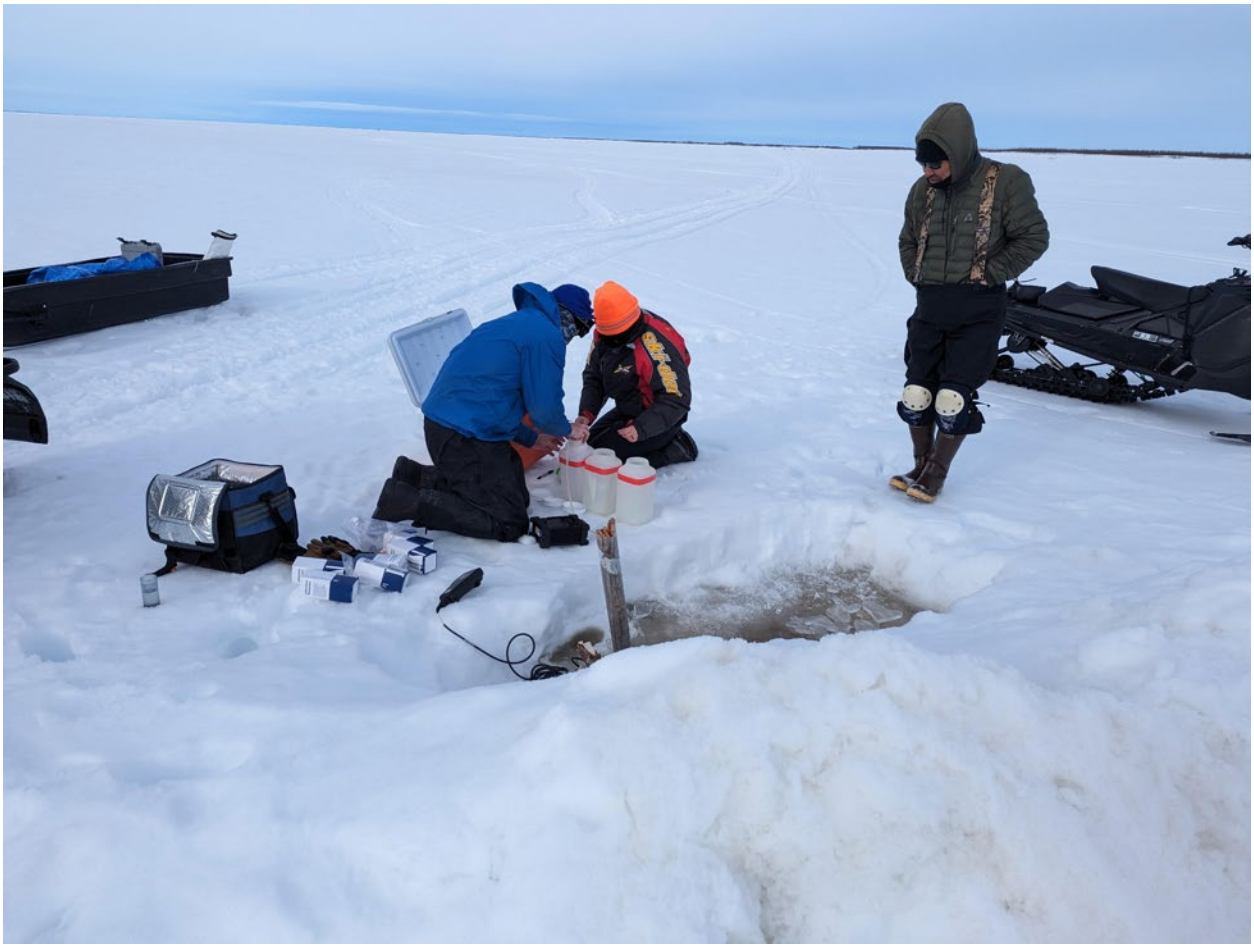
Dr. Aurin's support of the deputy chief scientist for the GLIMR mission science team has increased significantly over the past year. He has been responsible for building tools to model the anticipated radiometric performance of the HyperSpectral Imager (HSI) based on vendor design specification changes to instrument optics and electronics as they emerge to ensure data quality on orbit will meet program level requirements. He has regularly reported his findings to the science team and the NASA Earth System Science Pathfinder Program Office.

As the principal investigator for the Chesapeake Bay node of the AERONET-OC network, Dr. Aurin monitors the in situ AWR telemetered from the instrumentation located atop a 30 meter tower in the Bay. He led a team visit to the tower in October 2023 in coordination with NOAA, Maryland Department of the Environment, the US Coast Guard, and colleagues at NASA to maintain and service the observatory.

In the coming months, Dr. Aurin will lead another team out to the AERONET-OC tower on the Chesapeake to perform annual maintenance to the observatory. He will also be working with PVST investigators involved in the PACE-PAX experiment off the coast of California in September in the context of collection and processing of AWR for PACE validation. Later in the fall he will travel to the Ocean Optics conference in Spain to teach a workshop for HyperCP and present updates to the community processor. He will continue to reprocess AWR from FSG in HyperCP

and resubmit the data to SeaBASS, while also training others within FSG to carry on that work. As new data from vendors regarding the specifications of the GLIMR HSI instrument are made available over the winter, he will update the projections for radiometric performance to ensure it is continuing to meet program requirements.

JOHN BLAKE CLARK
Sponsor Antonio Mannino / Code 616 / Task 010



Dr. Clark collecting water samples in April 2024 with local partners from the village of Alakanuk for carbon analysis in the Yukon River. Also pictured, Dr. Robert Spencer and FSU PhD Student Alexis Slents. Photo credit: Blake Clark.

Dr. J. Blake Clark has been working on projects related to aquatic carbon cycling and biogeochemistry in multiple regions, spanning the coastal Alaskan Arctic and Chesapeake Bay. His work in North Slope Alaska and the Yukon River has focused on setting up and running model simulations of high-resolution unstructured grid hydrodynamic-carbon cycle models, now running for 5-10 model years continuously. These model systems (Coastal Beaufort Sea – FVCOM and Yukon – FVCOM) include dynamic sea ice and landfast ice which is a critical development to accurately represent the nearshore environment.

Dr. Clark is also a Deputy PI on a new project “Arctic Coastlines: Frontlines of Rapidly Transforming Ecosystems (FORTE)” that began in May 2024 and is funded by NASA EVS-4. Since May, Dr. Clark and team have written documents in preparation for the science team solicitation (inclusion plan, white paper) and assembled the core project management team. In August 2024, the PI group (Dr. Clark, Dr. Antonio Mannino (616) and Dr. Maria Tzortziou (CCNY/CUNY))

visited the North Slope of Alaska and held outreach meetings with the Native Village of Nuiqsut Tribal Council and the North Slope Borough Government. They also visited Fairbanks to meet with the ABoVE mission flight crew and to participate in a science flight on the NASA AFC C-20A over Alaska.

In the coming months, two drafted publications (currently with co-authors) will be submitted that detail the ocean physical environment and analyze interannual sea ice and landfast dynamics in the coastal Beaufort Sea at very fine (50 m – 2.5 km) resolution. These will come as Dr. Clark nears the completion of the current project work on the North Slope of Alaska and Yukon River physics/sea ice/ and carbon cycle modeling components. Cross system (Yukon River and North Slope of Alaska) comparisons of interannual carbon cycle dynamics will be conducted with comprehensive carbon budgets including aquatic-atmosphere net CO_2 exchange. The main research question that will be addressed is how the combined variability of sea ice and river flow determine the seasonal net carbon flux from the aquatic environment to the atmosphere in these rapidly changing ecosystems.

IVONA CETINIĆ
Sponsor Jeremy Werdell / Code 616 / Task 017

This last year has been marked with the highly successful PACE launch. As part of her role as PACE Science lead for Ocean Biogeochemistry, Dr. Cetinić has been overseeing the implementation of the new PACE targeted algorithms pre- and post-launch, as well as testing their current and historical product implementation using PACE data. She is still working on implementing several new algorithms. Part of that work is associated with the validation of the named products, so she continued working closely with the SeaBASS team on producing validation files (for PACE and other instruments). This is tightly coupled with her position as a liaison with the PACE Validation Science Team (PVST), and as a PACE-PAX Deputy Mission Scientist. For the former, Dr. Cetinić is organizing meetings and overseeing communication across the team, confirming that both the needs of the 24 teams within PVST and the needs of the mission are satisfied. PACE-PAX, happening in September 2024, has taken increasingly more time in her day-to day work, as she is facilitating the ocean component in this targeted field campaign that will collect PACE validation data.

Dr. Cetinić has participated in national and international meetings and performed much outreach and media promotion for the PACE mission. Her science production was mostly focused on publications in the field of biogeochemical remote sensing and the role of phytoplankton in the global carbon cycle. (She co-authored 7 peer-reviewed publications and one chapter of the State of the Climate). Highlighted publications this year are the shared first-author review paper on tools to monitor phytoplankton from space, and one that she co-authored with the team from Code 616 on the impact of the Hunga-Tonga volcanic eruption to ocean color products. She has submitted three proposals (one as a collaborator, two as a co-PI), and one was selected for funding.

In the next three months, Dr. Cetinić will participate in a PACE-PAX experiment that will occur in September 2024 in California. During that time, in addition to coordinating the ocean component, she will continue supporting the needs of science and validation of PACE ocean products. She also will continue to coordinate the PVST. She is a collaborator on another

proposal to support the Ocean Optics class that she has been teaching for over a decade. In her free time, she is hoping to start further exploring PACE data.

BRIDGET SEEGERS
Sponsor Jeremy Werdell / Code 616 / Task 029

Dr. Seegers has been working to expand the impact of NASA's inland water and coastal satellite products. She has continued work with the Cyanobacteria Assessment Network (CyAN) project and interagency collaborators at the US EPA, NOAA, USGS, and US Army Corps of Engineers. The team continues to assess and deliver high-quality data for monitoring harmful algal blooms. Recent efforts have focused on developing products that use the higher spatial resolution Multi-Spectral Instrument (MSI) on the Sentinel-2 satellites. Dr. Seegers had a proposal selected that provided funding for a post-doc to join the Ocean Ecology Lab. She has mentored a diversity of students with backgrounds from data scientists to documentary film makers. Dr. Seegers has supported NASA communications by participating in interviews, events, and outreach.

Looking ahead, Dr. Seegers will continue work with CyAN. Additionally, Dr. Seegers will be supporting the PACE-PAX field campaign by sailing and sampling the ocean from September 5-20, 2024. She will attend and present at the Ocean Optics Conference from October 6-11, 2024, and will attend and present at the US Harmful Algal Bloom Symposium from October 27 - November 1, 2024. Dr. Seegers will be supporting NASA's Satellite Needs Working Group, focusing on water quality requests throughout the fall of 2024.

ANDREW SAYER
Sponsor Jeremy Werdell / Code 616 / Task 048

Dr. Sayer supports NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission as its Project Science Lead for Atmospheres (i.e., the aerosol and cloud component of the mission). This year was particularly busy and exciting as the PACE satellite launched on February 8, 2024, and is now in routine operations. Prior to launch, he developed and oversaw the evaluation of algorithms to retrieve aerosol and cloud properties from the primary sensor on the satellite. Post-launch, he has verified processing with real PACE observations, being intimately involved with data analysis and identification/fixing of bugs. He also has been developing validation pipelines for the data. A major scientific highlight this year has been the public release of PACE cloud data products that he and others developed – this speed (within 4-5 months of satellite launch) speaks to the effort put in by all over the past years. Non-scientific highlights include extensive media activities in the lead up to and after the PACE launch, including multiple TV appearances, as well as NASA social media and US public radio.

Over the coming months, Dr. Sayer plans to continue PACE atmosphere development/evaluation activities. Goals are a reprocessing of the aforementioned cloud data products with some fixes and updates, plus a public release of PACE aerosol products. This will complete the suite of atmospheric data products formally required by NASA HQ. He also plans to attend the AeroCom/AeroSat workshop in Lille, France, in October (he is a vice-chair of the AeroSat organization). These meetings are a regular forum for aerosol climate modelers and remote sensing specialists to share updates and make progress on challenges in aerosol science.

INIA M. SOTO RAMOS
Sponsor Jeremy Werdell / Code 616 / Task 049

Since the summer of 2023, Dr. Soto Ramos' main objective has been co-leading the PACE validation efforts, alongside her data manager tasks as part of the SeaBASS Team and EXPORTS field Mission. As part of the validation lead role, Dr. Soto Ramos is responsible for overseeing the validation data flow, which includes direct collaboration and communication with the teams collecting validation data and making sure data is collected following vetted protocols; tracking data collection and submission in compliance with SeaBASS data requirements and NASA data submission latency policies; assisting with the data submission process and making sure data undergoes quality control and quality assurance (QA/QC); working alongside the SeaBASS subject matter experts and individual data products validations leads to make sure good data is used for validation; and finally running the satellite validation match-ups and making sure validation results are publicly available. Alongside Dr. Cetinić, Dr. Soto Ramos has been training, communicating and collaborating with the 24 PACE Validation Science Teams (PVST). Dr. Soto Ramos has participated in all the PVST meetings and training; and her primary task is to make sure teams adhere to the data submission protocols and deadlines. Dr. Soto Ramos is responsible for determining any roadblocks or gaps that could affect the validation data flow and lead the stand-up meetings with all subject matter experts and validation leads. In addition to PACE, Dr. Soto Ramos assists with the validation process for all the other ocean color missions and continues to help with data management for SeaBASS and EXPORTS.

PACE validation will continue to be Dr. Soto Ramos' priority including making sure the process has no gaps and that it is operational. In addition to that, Dr. Soto Ramos plans to expand the validation system to newer satellite products such as phytoplankton community composition and others.

VANDERLEI MARTINS, XIAOGUANG XU, ANIN PUTHUKKUDY
Sponsor Bryan Franz / Code 616 / Task 115

Dr. Richard Xu has been working with Dr. Vanderlei Martins to develop a validated, robust, and computationally efficient Level-1 processing system for UMBC's Hyper-Angular Rainbow Polarimeter 2 (HARP2) onboard the NASA's PACE satellite. The PACE mission satellite, launched in Feburary 2024, are designed to make extended observation records for ocean color, aerosols, and clouds. Dr. Xu has delivered several versions of HARP2 Level 1 processing software to the NASA PACE Science Data Segment, which are being used to generate operational PACE HARP2 L1A, L1B, and L1C products. The software has been used to promptly process HARP2 measurements during various pre-launch (i.e., calibration and thermal-vacuum activities), and post-launch tests during commissioning. He and the HARP2 team have made efforts to substantially improve the geo-registration and radiometric/polarimetric performance of the instrument, providing science-level of L1 products for the PACE community.

Dr. Puthukkudy has been overseeing the quality of HARP data by comparing it with other instruments on the NASA PACE platform. This involved comparing HARP2's radiometric data with that from the OCI and SPEXOne instruments. The initial findings from lab calibration were documented, highlighting the adjustments made to the calibration and radiometric coefficients

of HARP2. Additionally, the polarimetric performance was tested and confirmed through SPEXOne observations. Dr. Puthukkudy identified and corrected discrepancies in the blue band of HARP2 to align its performance with SPEXOne, leading to the creation of version 2.1 of the HARP2 L1B and L1C data sets. Furthermore, a new aerosol retrieval algorithm compatible with HARP2 was developed and tested at the ESI HPC facility.

Dr. Xu will continue support the maintenance of the HARP2 Level-1 data processing system and provide further implementations of a variety of calibration and geo-registration improvements. He will assist to evaluate HARP2 data products and support the Level-2 science products from HARP2 observations. Dr. Puthukkudy plans to submit this new retrieval algorithm, developed in collaboration with GRASP EARTH, for near real-time processing of aerosol data from HARP2. He will continue to monitor both the radiometric and polarimetric performance of HARP2 in conjunction with OCI and SPEXOne and plans to evaluate the radiometric performance over time using PICS. The anticipated Level 2 aerosol products will be hosted on NASA's OBDAAC, and Dr. Puthukkudy will ensure that the necessary software and technical support are provided to the PACE SDS team for implementing the algorithm in their operational environment.

IAN CARROLL
Sponsor Amir Ibrahim / Code 616 / Task 161

Dr. Carroll's work within the Ocean Ecology Laboratory (OEL) fulfilled key computations and algorithms for the performance of atmospheric correction (AC) and cloud masking (CM) for the Ocean Color Instrument (OCI) on board the recently launched PACE satellite. Working with UMBC colleague Dr. Pengwang Zhai - author of a novel radiative transfer numerical model, Dr. Carroll completed the production of look-up tables for AC that are now used in production for OCI. Together with GESTAR-II colleague Dr. Andrew Sayer, he also completed development of a neural network (NN) model that is now providing the operational CM for OCI. Dr. Sayer and Dr. Carroll also jointly mentored a GESTAR-II undergraduate fellow, who successfully applied to an REU program in Translational AI after presenting her project on dust aerosol estimation from space-borne thermal radiometry at the annual AMS meeting. With the launch of PACE, Dr. Carroll has become involved in several outreach activities including the NASA Openscapes Mentors program and the PACE Hackweek.

A report on the PACE Hackweek, a collaboration and training meeting of 41 PACE data users organized by Dr. Anna Windle (SSAI) with Dr. Carroll's support, will be developed from participant feedback and demographic data for presentation at the annual AGU meeting. Dr. Carroll is also contributing to the development of a ROSES proposal led by Dr. Sayer.

JAMES ALLEN
Sponsor Amir Ibrahim / Code 616 / Task 174

Dr. Allen has focused on integrating atmospheric and oceanic retrievals from multiple sensors on the Terra satellite to improve information content and characterize uncertainties across all levels of algorithm retrievals. He developed software to download, geolocate, and process Terra-MISR Level 1B Ellipsoid data in the OEL Level 1B format for more accessible algorithm development. He has also created a Bayesian Inference algorithm to retrieve ocean color and

atmospheric aerosol products, along with their uncertainties, which are currently being validated against AERONET-OC field data.

Dr. Allen also conducted the first validation exercise for PACE OCI Remote Sensing Reflectance using data collected from the AERONET-OC program. His analysis identified an error in the forward processing of field radiometric data used in prior validation exercises. Although the error itself has been corrected, discussions with collaborators across agencies are underway to update best practices for radiometric field validation. A static webpage showcasing these initial PACE validation results will soon be available to the PACE community, with further updates planned as more data becomes available from the PACE Validation Science Team.

Through November 2024, Dr. Allen will extend his Bayesian Inference algorithm to incorporate polarization information and test retrievals from PACE instruments (OCI, SPEXone, and HARP2). He is preparing a manuscript on the Terra algorithm, which will continue to be developed. Dr. Allen will present his work at the Ocean Optics Conference in Gran Canaria, Spain, in early October 2024, and the APOLO polarization conference in Kyoto, Japan, in November.

SEAN FOLEY
Sponsor Kirk Knobelspiesse / Code 616 / Task 175

Sean Foley has focused his scientific contributions in two different areas, both involving the application of machine learning to multi-angle satellite imagery. The first area is the application of neural networks to the estimation of vertical cloud profiles from multi-angle data. The second area is his ongoing adaptation of neural rendering algorithms to multi-angle data from HARP2, AirHARP, and HARP CubeSat, with the goal of developing a 3D cloud reconstruction data product.

Sean has also developed publicly available tutorials on the usage of multi-angle data and the implementation of machine learning techniques on satellite data that were provided as part of the course material for the PACE Hack Week.

Neural rendering is an extremely new area of research that is still quite understudied for atmospheric remote sensing. Sean has adapted neural rendering algorithms to HARP2, AirHARP, and HARP CubeSat, and his framework allows for easy extension to new sensors. This work allows for the fully unsupervised 3D reconstruction of clouds from multi-angle data over a wide swath. Sean has presented this work at various stages of its development. He gave a talk on his first approaches at the Early Career Science Fair at Goddard in September of 2023. He was invited to UMBC to discuss his work with the HARP2 PI and other team members: Vanderlei Martins, Xiaoguang (Richard) Xu, Zhibo Zhang, and their collaborators. He also gave a talk at the AI showcase. This aspect of Sean's work has been included in an AIST proposal involving the use of new observing systems for quick response to extreme events like wildfires and volcanic eruptions.

Sean was involved in the PACE Hack Week as a planner and mentor. He attended and contributed to planning meetings leading up to the event. He developed two interactive code notebooks: one on the use of multi-angle data from HARP2, and one on the use of machine learning for satellite data. These notebooks are hosted online. Sean gave a lecture on the use of machine learning for satellite data during the event, and assisted participants in the Hack Week

with their coding projects. Sean continues to serve as a resource for information on machine learning within and outside the Ocean Ecology Lab.

Over the next year, Sean plans to further develop his work on neural rendering, enabling its eventual operational usage for both PACE and other upcoming missions, as well as convincing more of the atmospheric science community of its utility. He plans to make improvements to his current neural rendering algorithm by achieving a speed-up in runtime. Validation of the results of his algorithm will continue, and better validation efforts will allow further improvements to the algorithm. Sean's ultimate goal is to enable the operational usage of neural rendering, and he will begin working with members of the PACE team to apply it operationally to HARP2. Finally, Sean plans to continue aiding others in his lab to understand and implement machine learning algorithms, as well as for future events like the PACE Hack Week.

VANDERLEI MARTINS
Sponsor Jeremy Wardell / Code 616 / Task 178

Over the past year, Dr. McBride supported the pre-launch preparation, launch, and post-launch mission and instrument support for the Hyper-Angular Rainbow Polarimeter (HARP2) instrument on the NASA PACE climate mission. This work includes pre-launch calibration activities, observatory-level simulations, commissioning, data processing, and on-orbit performance studies. Dr. McBride is preparing two publications on HARP2 data – one on cloud microphysical retrievals, and the other on on-orbit activities (solar and lunar calibration) and vicarious trends from Earth view sites. In parallel, Dr. McBride has supported the development and pre-flight calibration of the AirHARP2 suite – a copy of HARP2 designed for integration on the NASA ER-2 research aircraft. Dr. McBride led the AirHARP2 calibration activities in June – July 2024 at NASA GSFC Radiometric Calibration Facility and GLAMR labs. Dr. McBride published work to Atmospheric Measurement Techniques on the calibration of the AirHARP instrument, and recently submitted another paper to AMT that expands on that framework with HARP2 instrument data (citations below).

Dr. Puthukkudy has used HARP CubeSat data as a proxy for HARP2. The HARP CubeSat data has been thoroughly analyzed to determine the feasibility of aerosol retrievals, focusing on the radiometric and polarimetric accuracy of the data. Initial comparisons of the radiometric data with established sensors like MODIS and VIIRS have been documented in a manuscript that is currently under review by co-authors. Additionally, the accuracy of radiometric measurements was evaluated using a forward model on selected ocean captures at various viewing angles. Efforts have also been made to simulate observations for the upcoming HARP2 mission using the GRASP algorithm, and a digital twin setup for the MAP instrument was implemented to understand its limitations. Dr. Puthukkudy has developed a high-performance computing (HPC) setup to handle the computationally intensive data analysis for MAP observations, aiming to achieve near real-time data processing while considering cost-efficiency, all in preparation for HARP2 analysis.

Dr. Martins will continue to lead the effort on the operation and analysis of HAPR2 on orbit. Dr. McBride will evaluate HARP2 calibration and will lead the AirHARP2 deployment during the NASA PACE Post-launch Airborne eXperiment (PACE-PAX) from August 18 – October 5. The ER-2 will underfly PACE in over 8 6-hour flights for the purpose of validating radiance/polarization

measurement and science products. Dr. McBride and Dr. Martins will attend a SPIE Sensors and Imaging conference in Edinburgh, UK from Sept 15-19 2024, and present two works - one with a focus on small satellite pre-launch calibration, and the other on the first 6 months of HARP2 data. Dr. McBride also applied to affiliate with the UMBC Physics Department, which includes proposals for new special topics classes and stronger collaboration between ESI and Physics. He will discuss his plans to the Physics faculty on 1 November 2024. From September to November, the focus will shift to finalizing the project, which includes writing a paper on aerosol retrieval using the HARP2 data and the GRASP algorithm.

VANDERLEI MARTINS
Sponsor Jeremy Wardell / Code 616 / Task 183

This task will support the collection of airborne science measurements for the post-launch calibration and validation of retrievals from the PACE observatory, namely HARP2 and SPEXone. It includes preparation of aircraft instrument(s) - including airHARP - and their pre- and post-campaign calibration(s), deployment, and data processing, as well as science analysis of the measurements. This task will support participation in the PACE-PAX aircraft field campaign (https://pace.oceansciences.org/campaigns.htm) to be conducted in September 2024, where the airHARP instrument is to be deployed.

Dr. J. Vanderlei Martins leads a team to pursue innovative science associated with the HARP2 multi-angle polarimeter delivered to NASA for the PACE mission. The overarching accomplishment since the establishment of this Task in February 2023 has been to develop the hardware and software necessary to prove the calibration of this unique instrument, to implement this infrastructure and to apply it during the environmental testing of the PACE observatory with HARP2 fully integrated. The point is that HARP2's wide FOV optics presents a scientific challenge for characterization, and while there was a successful initial calibration campaign at Goddard in the Fall, that calibration was not done under space-relevant conditions. Transferring the laboratory calibration to space conditions for this type of instrument has never been done and is the focus of the research under this Task. Success in this work will provide Earth science with high quality multi-angle polarimetric data from HARP2 and for generations of Earth science missions in the future.

Specific accomplishments to date include Completed AirHARP2 aircraft payload for integration in the ER2 aircraft and participation in the PACE PAX campaign; Completed extensive calibration exercises for AirHARP2; Completed air worthiness review and integrated AirHARP2 to the ER2 aircraft. In the coming months, we expect to accomplish these tasks: Participation in the PACE PAX aircraft campaign and successfully collected ER2 data for 1 month in support of the PACE mission; Processing of the preliminary data for PACE PAX/AirHARP2 and preparing it for archival.

JOHN BLAKE CLARK
Sponsor Cecile Rousseaux / Code 616 / Task 192

As part of the Carbon Monitoring System 2022 project "Integrating Lateral Carb on Fluxes into CMS Ocean Carbon Estimates" (PI: Rousseaux), Dr. Clark made several additions to his previously published carbon cycle model ICM-DOM-PD. This was done in conjunction with his

projects focused on coastal carbon cycling in the Arctic Ocean. These additions include: sea ice and landfast ice biogeochemistry and bio-optics; dissolved inorganic carbon chemistry, alkalinity, and pH; and operation in spherical (rather than cartesian) coordinates for polar regions and potentially at global scales.

Dr. Clark and team will hold an in-person all-day science and applications team meeting for the CMS project in September 2024 to chart out the technical advancements under this task necessary over the next 18 months. He will begin incrementally implementing the new river-estuary carbon cycle model on a regional-to-global scale for all major and most minor rivers. In conjunction with a new GESTAR II research scientist (Dr. Tesfa Meshasha), Dr. Clark will assemble a database of global river carbon-related properties and couple the model and land-use land-change model with CMS project team members from the University of Maryland and the NASA Ocean Biogeochemical Model (NOBM). In addition, Dr. Clark is leading the writing of a Perspectives paper for the Carbon Monitoring System Wet Carbon Working Group that will be submitted by late December 2024.

CODE 617: HYDROLOGICAL SCIENCES LABORATORY

ROBERT EMBERSON

Sponsor Dalia Kirschbaum / Code 617 / Task 030

Dr. Emberson continues to engage in a wide range of different activities, both research and programmatic, which each contribute 50% of his funded FTE for the task he is on. For research, he continues to lead two projects as PI. The first, a NASA New Investigator Program project assessing soil erosion using satellite data, is providing highly novel research findings to analyze where and when agricultural soil is degrading around the world. He has brought on a UMBC student, Pranali Talla, as a student assistant to the project, and this has been extremely successful and allowed for the first time a global model of soil erosion impacts on hydrological systems to be developed. Both Dr. Emberson and Ms. Talla will attend the AGU Fall meeting later this year to present their findings. This has allowed for mentoring of Ms. Talla and Dr. Emberson has provided reference letters and support to her to help apply for future opportunities.

The second research project Dr. Emberson leads uses NASA's GEOS Seasonal to Subseasonal forecast data to assess potential for extreme rainfall months in advance and the potential connections to hydrological hazards. The S2S data used has been updated to the newest variation (version 3) and the project team is the first to test whether this brand-new data source can provide useful forecasts of extreme rainfall for hazard assessment. The Co-I team at the University of Wisconsin is already testing highly novel methods for this data to be used. Although computational challenges and slow processing of the initial grant delayed the start date of this award, significant progress has been made this year and 2-3 research papers are expected to come out of it in the next 12 months.

For the other 50% of his time, Dr. Emberson serves as the Associate Program Manager for NASA's Earth Action Disasters program. This is a multi-faceted role that involves financial and project tracking of funded projects, and presentations and communication on behalf of the

program. Paramount this year, were development and management efforts on the ROSES solicitation process to help determine the next set of completed projects the program will fund. Dr. Emberson also prepared briefings for US Congressional committees, the White House Subcommittee on Disaster Reduction, the National Space Council, and led briefings for the National Science Foundation. Dr. Emberson helped lead a workshop on AI for Disaster Risk Management at UMBC earlier this year on behalf of the program. A large part of this role has also included leading and coordinating NASA scientists to provide disaster response-relevant data to emergency responders as part of the Disaster Response Coordination System (DRCS). The formal launch in June 2024 of the DRCS, which includes a dedicated office of 5 full time staff to conduct this role, means Dr. Emberson will be less involved in the next 12 months in this activity, but it is notable that Dr. Emberson and his other Associate program manager counterpart at MSFC have been carrying out the roles of 5 people while only being covered for 50% of their time as program officers.

Looking ahead, Dr. Emberson expects to submit PI proposals to a NASA ROSES solicitation for SERVIR and PACE opportunities before the end of the year. Dr. Emberson will also help guide the NASA ROSES panel for the A.42 Disasters solicitation in the period between now and Nov 2024. Further details are competition sensitive. He will continue to conduct research on both funded research projects and intends to submit 2 papers before the end of November.

ELIJAH ORLAND

Sponsor Dalia Kirschbaum / Code 617 / Task 031

Elijah Orland has been continuing his research on linking satellite observations of active fire properties to field validated measures of burn severity. This work is part of NASA's Earth Information System (EIS) program, where he leads the program focused on post-fire research. His work as a first author is currently in review with *Fire Ecology*. He furthermore has served as a representative of NASA's EIS program in multiple meetings and at conferences and served as a town hall panelist for the program in December 2023 at the AGU Fall Meeting. Additionally, he was awarded $80,000 to undertake new work in collaboration with USGS and USFS to examine the trajectory of post fire recovery in the 2022 Hermit's Peak/Calf Canyon burn scar in New Mexico. This included a field visit where he assisted with data collection documenting vegetation recovery in the burned area. This work is ongoing. Lastly, he continues to contribute as a scientific advisor and developer for the Fire Events Data Suite (FEDS) algorithm he and others use for their research. This codebase is in production, generating new information in near real-time, and used in numerous studies, including frequent features in NASA Earth Observatory articles. He worked with the NASA Disaster program to send FEDS data directly to program stakeholders such as World Central Kitchen, and the Chilean government. His achievements this year and in the past have culminated in significant recognition, including an award for Scientific Achievement in Fall 2023, a promotion from Research Associate I to Research Associate II, and being asked to be an invited speaker for AGU 2024. In the next year, he plans to continue his newly funded work in New Mexico, to continue to advise his colleagues on post-fire research and prepare for future work related to tracking wildfire residence time using VIIRS data.

THOMAS STANLEY

Sponsor Dalia Kirschbaum / Code 617 / Task 032

Mr. Stanley assessed the impact of new algorithms for satellite-based precipitation estimation, specifically on the Landslide Hazard Assessment for Situational Awareness (LHASA) system. In addition, he assessed the performance of a prototype landslide forecasting system for western Nepal over the 2023 monsoon. He also advised a NASA DEVELOP team on landslide susceptibility mapping in Coronado National Memorial.

Mr. Stanley will continue developing the prototype landslide forecasting system for Nepal. The next phase of work will tackle the Gandaki River Basin (Central Nepal).

NISHAN KUMAR BISWAS
Sponsor Sujay Kumar / Code 617 / Task 033

Dr. Nishan Kumar Biswas has been working on the monitoring and quantification of dams and reservoir storage using satellite remote sensing and global modeling efforts. His effort served a better understanding of how the reservoirs in the international river basins are being operated. This information democratizes the dissemination of reservoir operations among the riparian countries. He has also served as a Land Information System (LIS) team member of the NASA Integrated Digital Earth Analysis System (IDEAS), an Earth System Digital Twin Architecture funded by the Advanced Information Systems Technology program of NASA's Earth Science Technology Office. This work has been initiated to build a scalable framework for flood and inundation modeling based on the NASA-developed Land Surface Modelling Framework.

Dr. Nishan Kumar Biswas envisions working on climate change impact quantification on the global scale using the Climate Adaptation Science Investigation (CASI) model simulation and visualization. He will also work on submitting proposals to NASA ROSES funding opportunities.

GOUTAM KONAPALA
Sponsor Sujay Kumar / Code 617 / Task 056

Dr. Konapala worked on snow retrievals based on AMSR2 and AMSRE. Dr. Konapala has been working to evaluate snow retrieval algorithms for AMSR2, particularly with respect to the algorithm upgrades, machine learning and code refactoring to be included in the recently funded Measures proposal. His analysis has focused on the CONUS region as well as on a 20-year global retrieval. A publication detailing this work has been submitted to *JGR Machine learning*.

For his work on EIS Freshwater, Dr. Konapala contributed to the global land surface model runs for evaluating the propagation of droughts from the meteorological to the hydrologic phase. This is a global analysis based on the years 2000 - 2022. A publication related to this work has been submitted to *One Earth*.

Note: Dr. Konapala resigned from GESTAR II on May 27, 2024, to pursue other career opportunities.

FADJI ZAOUNA MAINA
Sponsor Sujay Kumar / Code 617 / Task 057

Dr. Maina has been working on the development of a fine-scale North American precipitation analysis and surface meteorology dataset for retrospective and operational applications by leveraging high-quality gauge, satellite, and model datasets through advanced data assimilation methods. Dr. Maina is also leading the integration of the hydrologic model ParFlow into the NASA Land Information System (LIS) to better improve the representation of groundwater flow in NASA LIS and therefore better interpret NASA's GRACE and GRACE FO satellite data.

In addition, Dr. Maina has worked on understanding projections of future hydrologic changes in response to global warming. Specifically, Dr. Maina led a study that investigates potential future changes in rain-on-snow and their impacts on the runoff as well as the future responses of groundwater storage to the changes in precipitation and temperature.

Over the past year, Dr. Maina has led the publication (first author) of three peer-reviewed papers, and one that is currently under review. She has also contributed to two other peer-reviewed papers.

Dr. Maina will continue working on the projects mentioned above. She plans to submit two papers on future hydrologic changes in the upcoming months. She also will address any comments on the paper that is currently under review. Additionally, she will be working on upcoming invited presentations at the Conference of the Parties (COP16) of the United Nations Convention to Combat Desertification (UNCCD) that will take place in Riyadh, Saudi Arabia, and seminars at the King Abdullah University of Science and Technology in Saudi Arabia and Khalifa University in the United Arab Emirates.

PUKAR AMATYA
Sponsor Dalia Kirschbaum / Code 617 / Task 063

Dr. Amatya was a PI on the "Commercial SmallSat Data Acquisition New Vendor Onramp Evaluation (CNVOE)" program, evaluating synthetic aperture radar (SAR) data from ICEYE for its use in NASA's Earth Science Research. He led the project in evaluating the usefulness of ICEYE data for supporting disaster response with a particular focus on landslides. The evaluation included every aspect from data acquisition, download, delivery speed, quality and accuracy. A final report summarizing all findings and suggestions was submitted to the program in May 2024.

Dr. Amatya was involved in the closeout of the High Mountain Asia (HMA) grant and a 1-year augmentation grant looking at developing a landslide mapping and forecasting system for the Karnali Basin in Nepal. A related paper titled "Multitemporal landslide inventory and susceptibility map for the Arun River Basin" was published in the *Geoscience data journal*. He also generated rainfall-induced landslide inventory covering the 2023 monsoon season for the Karnali basin; this inventory was used to validate the forecasting system.

Additionally, Dr. Amatya was involved in the closeout of the Rapid Response and Novel Research in Earth Science project, examining the 2023 Türkiye earthquake and post-earthquake cascading hazards. He tested the applicability of the Semi-Automatic landslide Detection (SALaD) system for mapping landslides and flood damage.

This past year, Dr. Amatya actively participated in 4 proposals submitted to NASA ROSES Citizen Science, Disasters and ESI calls.

Dr. Amatya is a Co-I on the third iteration of an HMA grant where the goal is to scale landslide mapping and the forecasting system for all of Nepal. He will be leading an effort that aims to develop a deep-learning-based landslide mapping system capable of mapping landslides at the national scale.

ARMAGHAN ABEDELMDOUST
Sponsor Sujay Kumar / Code 617 / Task 072

Dr. Abedelmdoust was responsible for the development of modeling and uncertainty estimation capabilities within the Land Information System (LIS). She contributed to this area of research by exploring the optimal use of terrestrial remote sensing data with land surface models and advanced ensemble/uncertainty estimation algorithms.

Over six months (Sept 2023 - Feb 2024), Dr. Abedelmdoust devised a probabilistic machine learning technique known as LSTM-MDN (Long Short-Term Memory Mixture Density Network). She also delivered a code package that can successfully forecast LIS uncertainty estimates for hydrologic variables, including soil moisture, snow depth, and snow water equivalent, at various spatiotemporal resolutions. Her efforts resulted in multiple conference presentations and several scientific articles are in preparation.

Note: Dr. Abedelmdoust accepted another position at the end of Feb 2024.

CHENG-HSUAN LYU
Sponsor Edward Kim / Code 617 / Task 073

Throughout the past year, Dr. Lyu completed revising the J2 post-launch report specifically on J2-ATMS-6105 Active Geolocation Verification PLT. In November Dr. Lyu supported JPSS-3 ATMS SN305 Regression TVAC tests from Nov. 1 to Nov. 30, 2023. In this TVAC, Dr. Lyu helped to investigate the differences between Compensator Motor on and off cases and presented all of his analysis results to the NASA ATMS science team.

Dr. Lyu reviewed and/or approved the following documents: JPSS J3/J4 ATMS On-orbit User Manual RE-21479 Rev.D and 472-00377 ATMS Performance Requirement Documents (PRD); RE-22019 Rev.B, J3 Trend Analysis Report; J3 Regression System Cal Report, RE-22993, and Thermal cycling and thermal balance report, RE-22996; RE-22380 J3 ATMS SN305 Calibration Data Book; and RE-21895 J3 ATMS SN305 Sensor Performance Math Model.

Dr. Lyu attended the MicroRad 2024 Conference in Alexandria, VA and presented "Joint Polar Satellite System (JPSS) Advanced Technology Microwave Sounder (ATMS) Status Update." He also supported SMBA, a next-gen microwave sounder: NOAA's sounder for microwave-based applications (SMBA) tasks.

Dr. Lyu worked with ATMS science team members, NASA colleagues, MIT-LL, NOAA, and UMD, putting together a government version of the J2 Calibration Data Book (J2 GCDB), w.r.t. NG's Calibration Data Book, RE-21657. This J2 GCDB will be created for an ATMS public-released document. Dr. Lyu's own assignment was to present to the general science users the results of J2 ATMS radiometric dynamic range, and its short-term gain stability.

Dr. Lyu was in charge of the NEON QuickSounder TVAC calibration from May 29 to June 11, 2024. This included creating preparation notes for the TVAC activities, arranging POC (Point of Contact) for all the calibration daily support, coordinating the meetings to discuss TVAC results and issues, and compiling the QS final report. He also supported J3 Satellite level TVAC Calibration testing for the month of August, which included data analysis, sharing results with the team, and producing the J3 science report.

Looking forward, Dr. Lyu will continue supporting S-NPP, JPSS-1, and JPSS-2 on-orbit data analysis and he will continue monitoring the sensor performance from NEON QuickSounder, JPSS-3 & JPSS-4 Satellite level Thermal Vacuum (TVAC) tests & in collaboration with MIT-LL, NOAA, NG and UMD teams for the reviews and the planning of future QuickSounder and JPSS-3 ATMS SN306 pre-launch and post-launch calibration and validation activities. Dr. Lyu will continue working with ATMS science team members, NASA colleagues, MIT-LL, NOAA, and UMD, putting together a government version of J2 Calibration Data Book (J2 GCDB), w.r.t. NG's Calibration Data Book, RE-21657. Finally, Dr. Lyu will continue to work on J3 Sat TVAC test report.

CODE 618: BIOSPHERIC SCIENCES LABORATORY

CELIO RESENDE DE SOUSA

Sponsor Lola Fatoyinbo / Code 618 / Task 060

Dr. De Sousa has been assisting with the development of pathways for blue carbon projects in West Africa to access blue carbon finance and promote regional cooperation for climate change mitigation and adaptation through the restoration, conservation and sustainable use of mangroves at the local, national and regional scales. He is doing so by developing a mapping and monitoring approach using remote sensing to evaluate the potential to put together Blue Carbon projects on the marine protected areas in West Africa (from Senegal to Gabon). Activities developed in this period include (but are not limited to): downloading and processing Earth Observation data; land cover mapping of 275 marine protected areas; extent change analysis and reporting; and, defining target products with end users (World Bank, International Union for Conservation of Nature (IUCN), Africa Nature Investors, Blue Seeds), defining management scenarios with them and developing training modules.

From September 2024 to November 2024, Dr. De Sousa will be working on co-creating and co-leading a training workshop in Liberia and Senegal for 30 people from November 4-8th. The goal

is to convene all project partners together, 1) to learn more about the monitoring objectives and the Earth observation goals of each organization, 2) to share relevant global, regional and local EO data products and analytical techniques that may address some current monitoring needs, and 3) to jointly develop a plan to improve, customize, and deploy EO applications to help each partner organization achieve their protected area monitoring and management goals.

MINJEONG JO
Sponsor Batuhan Osmanoglu / Code 618 / Task 082

Dr. MinJeong Jo has been working on evaluating commercial small-satellite data on NASA's Commercial Smallsat Data Acquisition program (CSDA). The CSDA program was established by NASA's Earth Science Division (ESD) to identify, evaluate, and acquire commercial small-satellite data. Her analysis has focused on 1) feasibility of measuring surface displacements for volcanic unrest and eruptions using ICEYE imagery based on the synthetic aperture radar interferometry (InSAR) technique and 2) quality assessment of commercial SAR data, particularly focusing on ICEYE and Capella.

Dr. Jo led a research project and assessed the InSAR capability of ICEYE data for observing volcanic activity, focusing on the feasibility of measuring three-dimensional (3D) displacements, decorrelation analysis, and InSAR measurement accuracy. The project team examined ICEYE datasets from the Kilauea volcano during the September-October 2023 summit eruption and from the volcanic eruption over the Reykjanes Peninsula in Iceland from October to December 2023. For Kilauea, the project team evaluated the coherence of ICEYE interferograms and compared them with those from other X-band SAR sensors, such as COSMO-SkyMed (CSK) and TerraSAR-X/TanDEM-X (TSX/TDX). Furthermore, the team assessed the feasibility of estimating 3D deformation measurements from ICEYE data, focusing on the Iceland Ground Track Repeat (GTR) collection. The key findings regarding image quality and potential for observing volcanic activity with the ICEYE constellation will be discussed at the 2024 AGU Fall conference and published in a peer-reviewed journal article.

Dr. Jo will continue working on the CSDA project to evaluate Umbra SAR data, focusing on the capability of the InSAR method, quality assessment, and geolocation accuracy. She is also involved in a research project entitled 'Tracking Sea Level Rise in American Samoa with Ultra-High-Resolution SAR Imagery: An Umbra Feasibility Study' as a Co-Investigator.

THOMAS ECK
Sponsor Pawan Gupta / Code 618 / Task 085

Mr. Eck performed sun channel calibrations utilized for the measurement of aerosol optical depth (AOD) for the NASA/GSFC portion of the AERONET global network. Additionally, he participated in the analysis of various techniques for the calibration of sky radiance measurements, including the empirical vicarious technique for estimating solid view angle, sky radiance transfer technique, and laboratory integrating sphere measurements. He also assisted in the analysis of AERONET AOD data made from direct measurements of the Moon. Mr. Eck continued conducting research into airborne mineral particulate optical properties from multi-

year AERONET monitoring at many globally distributed dust sites. Spectral absorption properties, size distributions and spectral AOD are being analyzed.

In the coming months, Mr. Eck will be attending the AERONET Workshop in College Park, MD from Sep. 17-19, 2024, and presenting a talk on this dust aerosol research. He also will attend the AGU Annual Meeting in Washington, DC from Dec 09-13, 2024, and make a presentation on his research on dust optical/physical properties. Additionally, he will begin writing a journal paper on his dust properties research. Mr. Eck will continue assisting in the analysis of Lunar AOD measurements from AERONET and in assessing sky scan retrievals that include the additional wavelengths of 340, 380 and 1640 nm.

ANTHONY CAMPBELL
Sponsors Temilola Fatoyinbo; Benjamin Poulter / Code 618 / Task 109

Dr. Campbell has been working on understanding coastal ecosystem change and how this impacts resilience, carbon, and biodiversity. This work is part of two grant projects and partnership work between NASA and Conservation International. Dr. Campbell successfully planned and led fieldwork in South Africa as part of the BioSCape field campaign. The team

Fieldwork in Langebaan Lagoon, South Africa, as part of the NASA BioSCape field campaign. Photo credit: Jeremy Shelton.

measured sixty-four wetland vegetation plots, collected species distribution, and *in situ* imaging spectroscopy data. This work included nine researchers, from students to professors.

As part of a coastal resilience grant, Dr. Campbell has mentored two students and helped create nearshore bathymetric maps in Belize, Puerto Rico, Cuba, and Fiji to improve our ability to model storm surge and wave propagation from storm events. As part of the NASA-Conservation

International partnership, he has mapped blue carbon ecosystems in the Riau Islands, Indonesia, to support the newly created Bintan Marine Protected Area.

Dr. Campbell's upcoming Plans include participation in the International Blue Carbon Scientific Working Group in Cape Town, South Africa 9/2-9/5/2024, and the Surface Topography and Vegetation Community Meeting, October 28-29, 2024.

PETYA CAMPBELL
Sponsor Christopher Neigh / Code 618 / Task 122

Photo left shows Petya Campbell installing a MoniPAM instrument in the USDA cornfield around the corner from Goddard. The instrument measures leaf level photosynthesis using fluorescence, in the background is Maggie Wooten (SSAI).

Task 122 includes the following activities / projects:

Project / Title	Identifier	Time (%)	Civil Servant	NASA

South Central and Eastern European Regional Information Network (USA Coordinator)	SCERIN	10%	Garik Gutman	HQ
Raising Stella (Science and Outreach, 0-10%)	STELLA	10%	Chris Neigh	GSFC
Satellite Needs Working Group (Subject Expert, LCLUC)	SNWG	10%	Frederick Policelli, Thomas Holmes	GSFC
Surface Biology and Geology (GSFC SBG team, collection of automated time series, SBG algorithms group)	SBG	30%	Benjamin Poulter	GSFC
PACE Reflectance Evaluation (PI Fred Huemmrich, 10-20%)	PACE	10%	Fred Huemmrich	GSFC

Photo left shows Petya Campbell installing a FLoX (Fluorescence Box) at the USDA cornfield down the road from Goddard, which measures canopy reflectance and solar induced fluorescence. She is working with Maggie Wooten (SSAI) and Will Wagner (SSAI).

Photo above shows Petya Campbell describing the FLoX system to Julia Marrs and David Allen of NIST in the USDA cornfield near Goddard.

SCERIN: During the past decade Dr. Campbell has been coordinating the work of the "GOFC-GOLD, South Central and Eastern European Regional Information Network (SCERIN)" as the USA Coordinator, working closely with the SCERIN Coordinators in the EU. In 2024 she co-organized and co-led the Joint SCERIN and MedRIN Workshop, which took place July 26-29, 2024. SCERIN-10 was held in Chania, Crete, Greece and was attended by 65+ members from 15+ countries. The next SCERIN workshop will be would be held jointly with MedRIN in Burgas, Bulgaria during the second half of June 2025, in coordination with a Trans-Atlantic training (TAT) for students and young professionals.

During the timeframe of September 1, 2024 - November 30, 2024, Dr. Campbell will meet with the Bulgarian hosts and the GOFC-GOLD, MedRIN and TAT leads and coordinators to discuss preparations required in 2024-2025 for the next joint SCERIN and MedRIN Workshop.

STELLA: In 2024, Dr. Campbell contributed to the scientific and outreach use of the STELLA instruments and data. She also advised in the development of the instrument and data processing tools. She participated in field measurement efforts using STELLA during the winter, spring and summer months in Maryland and Kansas, USA. She introduced STELLA to the SCERIN network members during the SCERIN and MedRIN Workshop.During the timeframe of September 1, 2024 - November 30, 2024, Dr. Campbell will meet with the STELLA team to discuss 'field protocols' for data collection and processing and to plan the efforts and developments for 2024-2025.

NASA/SNWG: Dr. Campbell participated in the Satellite Needs Working Group (SNWG) 2024 assessment as a subject matter expert (SME) in the Land Cover/Land Use team, conducting interviews and assessments for seven SNWG tasks. Further, she will participate in the evaluation of the needs and the discussions planned by NASA/HQ to discuss new solutions and what went well and what should be changed in preparation for the 2026 assessment. She will also contribute to the lessons learned survey to help identify common issues.

NASA/SBG: Dr. Campbell has continuously contributed to the advancement of hyperspectral remote sensing at GSFC and world-wide. At GSFC, she is contributing scientific support for the advancement of the NASA Surface Biology and Geology (SBG) mission study as a member of the GSFC Team and Algorithm WG Member.

During the past several years, Dr. Campbell has installed automated field spectrometers at multiple flux sites (e.g., agricultural, forested and grassland ecosystems) to measure reflectance and solar induced fluorescence and observe the changes in the spectral responses with vegetation function. During 2023-2024, she participated in the collection of field measurements and seasonal spectral time series at Konza, KS, USA and worked together with Dr. Huemmrich and a summer student intern, Sara McKnight, to analyze collected time series data.
She will conduct analysis using collections from 2024 for the deciduous forest at SERC, MD, OPE3 cornfield in Greenbelt, MD and tall grassland prairie at Konza, KS. Currently, Dr. Campbell is preparing two research letters, summarizing the results from the analysis of the time series for tundra and boreal forest, which will be published in 2025. She is using the timeseries to develop prototype products for the forthcoming ESA/FLEX and NASA/SBG satellite missions and will present the findings at AGU2024.

NASA/PACE Reflectance Evaluation: Dr. Campbell has extensive experience working with imaging spectrometer data, including aircraft, satellite and ISS images. She has completed the processing and analysis of the PACE imagery and FloX time series collected during the spring and summer over the tallgrass prairie in Konza, KS. She will enrich the collection to augment the PACE and FLoX collections with additional data from the summer and fall, and with corresponding flux observations.

ARIF RUSTEM ALBAYRAK

Sponsor Batuhan Osmanoglu / Code 618 / Task 133

Dr. Albayrak, as a member of the Disaster Group (HQ), has been instrumental in advancing the use of machine learning and remote sensing for disaster management, notably as one of the lead organizers for the NASA/UMBC/ITU focus group meeting in March 2024, bringing together over 250 participants from around the world to meet at UMBC.

As Co-I, Mr. Albayrak continues leading ML/AI-related efforts in flood and landslide hazard assessment through the project "Combining SAR Remote Sensing and Machine Learning to Advance Flood Monitoring in the HKH" project. He also works with the US Census Bureau and NASA/UMBC on the "Cascading Effects of Weather-Related Disasters on New Business Formation."

As PI, Mr. Albayrak also completed the NASA FireSAFE proposal activities on fire event situation awareness (2022 to the end of 2023). As a follow-up, he collaborated with Alaska State on a proposal (pending) to continue this work. Internationally, as Data/AI/ML Co-Chair for the ITU focus group on "AI for Natural Disaster Management," he successfully co-edited a technical report, marking the completion of a multi-year effort (2021-2024).

Upcoming activities include representing the NASA HQ Disaster group at the AMERIGEO meeting (August, Quito), where he will lead a panel on digital technologies (1 hour), 6 participants, and give a 50-minute ML/AI class. (Expected participation over 400). He will also continue the following activities: SERVIR proposal as the Co-I, SAR-related activities including data fusion problems and theory, the Census project with Emin Dinlersoz (Principal Economist at the U.S. Census Bureau's Center for Economic Studies) on "Measuring the Effects of Weather Events and Climate Change on Entrepreneurship and Business Formation," and participate in the ITU/UN group as Co-chair to the data group on the newly established AI/ML data standards for Natural Hazards initiative.

In the coming month, Mr. Albayrak plans to complete the following documents: "Tech4DRR" Contribution to the UNDRR report. This is under implementation, "Committee on Earth Observation Satellites (CEOS) ML/DL/AI White Paper," and a CEOS.WGISS Issue 0.3 including but not limited to machine learning operational workflow capabilities.

FRED HUEMMRICH

Sponsor Jon Kenneth Ranson / Code 618 / Task 134

This task supports work on remote sensing of the Structure and Function of Ecosystems (SAFE) from Commercial Data Sources. Dr. Huemmrich leads an effort funded by the NASA Commercial Smallsat program to combine commercial spectral imaging from the DLR Earth Sensing Imaging Spectrometer (DESIS) on the International Space Station (ISS) to inform the retrievals and interpretation of photosynthetic and photoprotective leaf pigment contents that describe plant productivity and stress responses. He has examined a number of approaches to relate spectral reflectance with gross primary productivity across different sites and through the seasons. Approaches included spectral vegetation indices (SVI), spectral derivatives, spectral feature analysis (SFA) which uses continuum removal techniques to quantify the characteristics of absorption features in the spectrum, and partial least squares regression (PLSR).

Dr. Huemmrich was a member of the Science and Applications Team (SAT) for NASA's PACE mission. Although the primary objectives for PACE are directed toward the study of atmospheric and oceanic processes, by providing frequent global moderate-resolution hyperspectral observations, PACE has the potential to produce a new generation of remotely sensed products addressing key science questions on terrestrial ecosystem productivity, function, and biodiversity. He represented the remote sensing land community in the SAT and is working to define potential terrestrial products from PACE. A key challenge for the development of PACE terrestrial products was that there were little existing data that have important PACE OCI qualities of hyperspectral global observations with nearly daily temporal repeat. This, therefore, required the development of datasets using available existing data that have aspects of the PACE data to examine the function and performance of potential product algorithm approaches. Dr. Huemmrich worked with available satellite (DESIS), aircraft (Airborne Visible/Infrared

Imaging Spectrometer (AVIRIS)), and ground (Fluorescence Box (FLoX) and ASD spectrometers) measurements. He has examined seasonal patterns of foliar pigments based on SVI and related them to ecosystem productivity and stress responses for crops and forests. Following the launch of PACE in February, Dr. Huemmrich has been working with the PACE data to examine global and seasonal patterns of foliar pigment indices, now available for the first time.

Upcoming plans include a paper in prepartion describing the use of DESIS spectral reflectance to describe GPP of forested sites. In addition,Dr. Huemmrich will be co-author of a letter aimed to *Remote Sensing Letters* describing the PACE terrestrial products. In addition, Dr. Huemmrich will teach Special topics in Geography: Arctic Geography, GES302, UMBC, Fall 2024.

GIUSEPPE ZIBORDI
Sponsor Pawan Gupta / Code 618 / Task 151

Dr. Zibordi worked on the application of multispectral remote sensing reflectance R_{RS} data from the Ocean Color component of the Aerosol Robotic Network (AERONET-OC) for the validation of hyperspectral R_{RS} from the Ocean Color Instrument (OCI) onboard the PACE satellite. The implemented method reconstructs hyperspectral R_{RS} from multispectral AERONET-OC ones using theoretical reference R_{RS} spectra representative of a large variety of water types. The method showed the potential to reconstruct hyperspectral R_{RS} data with an uncertainty generally within 2% at spectral bands of major importance for ocean color applications in the blue and green spectral regions. Dr. Zibordi also contributed to the implementation of a provisional Version-4 of the AERONET-OC database benefitting from extensive quality control of real-time data to best support the creation of near real-time high-quality matchups for the validation of satellite ocean color data products. Finally, Dr. Zibordi contributed to the setup and assessment of an absolute radiometric calibration facility for marine optical instruments at the Ocean Ecology Laboratory. Inter-comparison results from calibrations of the same instrument performed at different laboratories showed differences typically within 2%.

During the coming months, Dr. Zibordi will contribute to the validation of OCI data.

FRED HUEMMRICH
Sponsor Benjamin Poulter / Code 618 / Task 154

Dr. Huemmrich has been working to develop and evaluate algorithms using spectral reflectance to describe terrestrial vegetation physiological condition, productivity, and biodiversity in support of the NASA SBG (Surface Biology and Geology) mission. He used a variety of available existing data types that provide continuous high spectral resolution reflectances including: DLR Earth Sensing Imaging Spectrometer (DESIS) on the International Space Station (ISS), Airborne Visible/Infrared Imaging Spectrometer Next Generation (AVIRIS-NG) imagery from aircraft, and ground measuring Fluorescence Box (FLoX) and ASD spectrometers. In addition, he worked with data from existing networks of eddy covariance flux towers to describe spatial and temporal patterns of ecosystem productivity. He also measured leaf-level spectral reflectance and transmittance using an integrating sphere and FluoWat leaf clip. He has analyzed data collected as part of the Surface Biology and Geology High-Frequency Time Series campaign (SHIFT) field study.

He evaluated data collected from a new sensor, the NoX (for NearIR Box), which provides frequent (approximately every 3 minutes) measurements of reflectance for visible through shortwave infrared wavelengths.

Dr. Huemmrich is an active member of the SBG Algorithms Working Group and the SBG Visible-Shortwave Infrared Terrestrial Vegetation team.

Note, this task ended March 28, 2024.

AMENI MKAOUAR

Sponsor Christopher Neigh / Code 618 / Task 166

Dr. Mkaouar has been working on the integration of light detection and ranging (LiDAR) data and stereo imaging to estimate surface models over vegetation, as part of the NASA Surface Topography and Vegetation (STV) target observable. Since achieving this directly with actual data is challenging, she has created simulations of both very high-resolution stereo images and LiDAR data (full waveform and photon counting). These simulations are based on a 3D realistic scene reconstructed from small footprint, discrete, and dense airborne LiDAR data using the discrete anisotropic radiative transfer (DART) model.

Dr. Mkaouar participated in the AGU 2023 conference, where she presented her research on laser altimetry geolocation evaluation and enhancement using radiative transfer modeling and full waveform matching. Additionally, she has submitted a manuscript on this topic to the *Remote Sensing of Environment* journal.

Looking ahead, Dr. Mkaouar plans to integrate the simulated data to refine surface models and publish her findings in a scientific journal. She will also be participating in AGU 2024, where she aims to share further advancements and insights from her ongoing research.

SEOHUI PARK

Sponsor Pawan Gupta / Code 618 / Task 173

Dr. Park has been working to develop and analyze ground-level PM2.5 concentrations using TEMPO, GOES-R, and HRRR products through the machine learning and deep learning approaches. She adopted several approaches (e.g., random forest (RF), light gradient boosting machine (LGBM), deep neural network (DNN), TabNet) to investigate the best accuracy model for ground-level PM2.5 monitoring. The output of this study can monitor ground-level PM2.5 concentrations with high accuracy. Specifically, the model can estimate PM2.5 concentrations at high concentration situations such as during Canadian wildfire events. In addition, she found that TEMPO L1b radiance data can contribute to improvement in estimating ground-level PM2.5 concentrations in short-term periods (e.g., 10 days). The estimated PM2.5 concentration was evaluated with ground-based observations (i.e, AirNow PM2.5) using 10-fold cross validation (CV). The three sampling methods were used for 10-fold CV (i.e., random CV (RDCV), spatial CV (SPCV), and temporal CV (TPCV)). The spatial and temporal analyses were also conducted to

evaluate the model in spatial and temporal aspects. The evaluation using 10-fold CV and the impact of TEMPO L1b radiance data for long-term periods is ongoing. Upcoming Plans for Dr. Park include submission of a manuscript in September as first author manuscript.

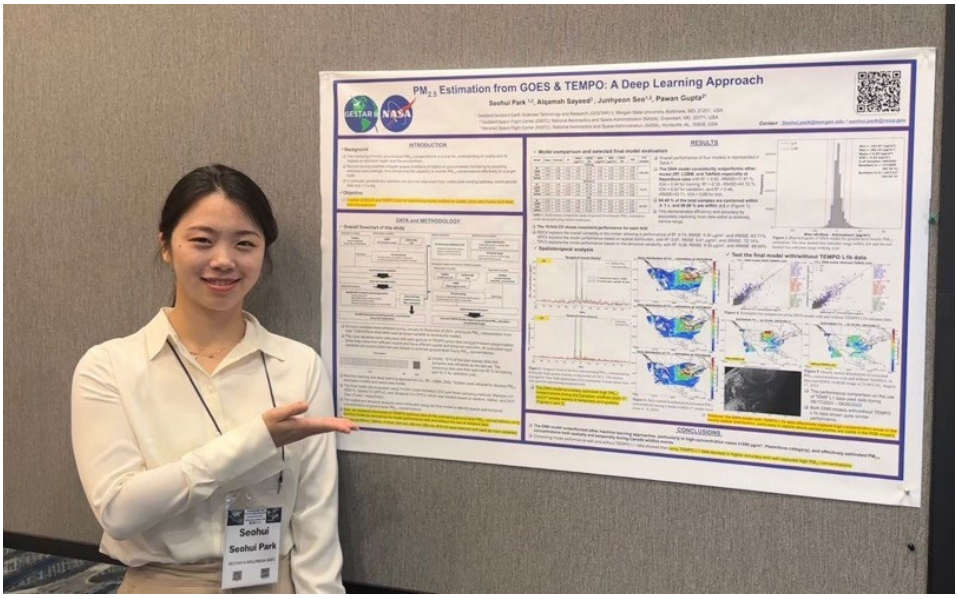
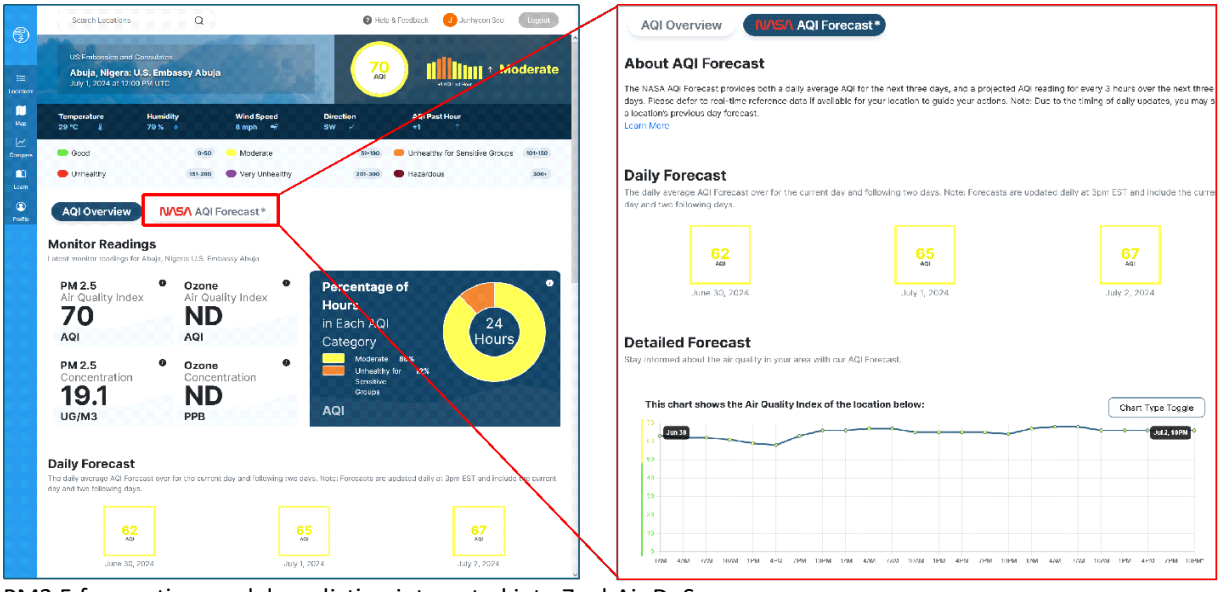


Photo left: Seohui Park presenting poster in the GEMS/TEMPO workshop held August 26-30, 2024.

JUNHYEON SEO
Sponsor Pawan Gupta / Code 618 / Task 173

Dr. Seo has been working on developing machine-learning-based PM2.5 forecasting models using GEOS-FP (Forward Processing) data. His work was presented at the annual HAQAST 2024 public meeting in Cambridge, Massachusetts. In collaboration with the Department of State's Greening Diplomacy Initiative team, his model provides three-day air quality forecasts for 269 U.S. embassy sites, contributing to public health efforts. These forecasts are embedded within the Department of State's application, ZephAir as shown in Figure 1. This work has received recognition on the Department of State's website and through several LinkedIn posts. Dr. Seo will present these research achievements at AGU 2024.



PM2.5 forecasting model prediction integrated into ZephAir DoS.

Under the guidance of Dr. Gupta, Dr. Seo has led the effort to install low-cost air quality monitoring instruments at various AERONET sites. Collaborating with AERONET colleagues and Clarity, a supplier of low-cost monitoring instruments, he has expanded global air quality monitoring capabilities using these affordable solutions. The team has successfully installed 12 nodes, with 8 more planned, and is working with Clarity to develop a machine-learning-based calibration method to improve measurement accuracy.

Upcoming Plans for Dr. Seo include focusing on completing the documentation for the ZephAir and HAQAST projects, which he plans to submit to a peer-reviewed journal. He will also initiate the development of a machine-learning-based calibration model as part of his collaboration with Clarity. Additionally, he will work on creating a machine-learning-based interpolation and extrapolation model aimed at filling in missing data for AERONET for various levels of datasets.

KEVIN TURPIE
Sponsor Eric C. Brown de Colstoun / Code 618 / Task 187

During December 2023 and January 2024, Dr. Kevin Turpie supported Phase A efforts for the Surface Biology Geology (SBG) mission development. During this time SBG passed its System Requirements Review and Mission Design Review, which used scientific expertise provided by Dr. Turpie regarding aquatic remote sensing.

Dr. Turpie continued his on-going organization and moderation of the Aquatic Cross-Mission Exchange (ACME). The ACME provides a forum to discuss synergistic science, applications, and resource sharing across NASA's passive remote sensing aquatic missions, including Plankton, Aerosol, Cloud, ocean Ecosystem (PACE), Geosynchronous Littoral Imaging and Monitoring Radiometer (GLIMR), and SBG (Landsat and Landsat Next were added in June of 2024). During this time, the Surface Water and Ocean Topography (SWOT) team was engaged regarding their land/water mask data product for use across the aquatic missions. This initiated an interest in participation of the Landsat and Landsat Next program in the ACME, which was later encouraged by NASA HQ.

Dr. Turpie continued to contribute expertise in the development of a study to consider the aquatic scientific impact of a trade between SBG instrument tilt and the equatorial crossing time. He also had structured discussions with the VSWIR spectrometer instrument team regarding remote sensing needs of the aquatic community, especially regarding calibration accuracy targets, methods of calibration and characterization, and in-flight monitoring of calibration stability. Dr. Turpie wrote a recommendation regarding the need for polarization response characterization, providing published reports on methods and the topic for aquatic remote sensing.

Dr. Turpie contributed to discussions regarding planning aquatic data products and science for the SBG mission. Much of this exchange helped to establish the science topics for discussion at a science community Technical Information-exchange Meeting planned for later in the year. However, it mainly provided input to the project regarding the key aquatic science-related issues for SBG, especially regarding calibration accuracy, glint mitigation, and radiometric stability, sensitivity and signal-to-noise ratio (SNR).

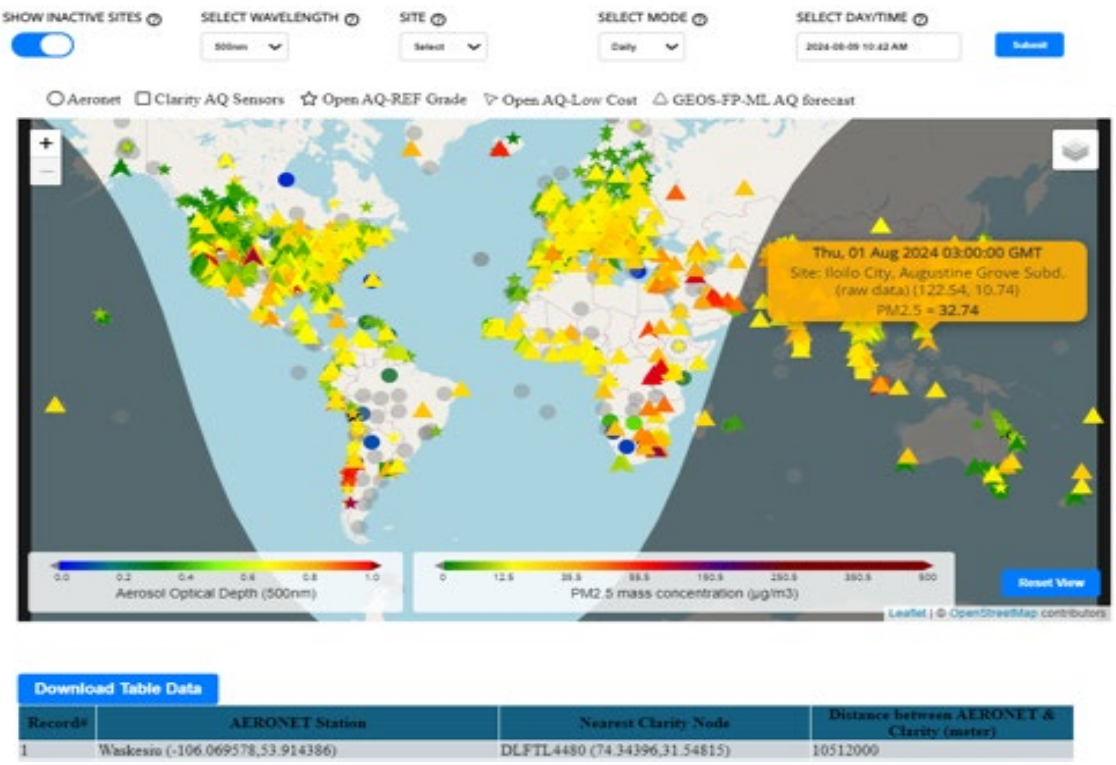
Dr. Turpie wrote a request to the SBG project regarding the future of the Calibration and Validation (Cal/Val) Working Group, which he co-chaired since its inception. This followed the publication of the peer-reviewed Cal/Val concept for SBG and similar missions.

Dr. Turpie continues to support the WATERHYPERNET instrument station development as part of SBG and PACE validation infrastructure.

RITIKA PRASAI

Sponsor Pawan Gupta / Code 618 / Task 201

Ms. Prasai works on the project, "Development of a Web-Based Application for Air Quality Data Visualization and Machine Learning Techniques for Missing Data Imputation in AERONET Observations." This project focuses on two key aspects: developing a web-based application for air quality data visualization and exploration and employing machine learning to address missing data issues in Aerosol Optical Depth (AOD) observations from the AERONET network. For her work on web application development, Ms. Prasai has designed and implemented a web application that facilitates the visualization and download of air quality data from various sources, including AERONET, Clarity-AQ Sensors, OpenAQ, and GOES-FP-ML-AQ forecasts. This user-friendly platform provides researchers with access to the following: 1) Real-time and historical data: Users can access and download hourly and daily updates of AOD and PM2.5 data from diverse sources; 2) Data visualization and exploration: The application offers interactive features for visualizing time-series trends, enabling researchers to identify patterns and relationships within the data; 3) Data download: Users can conveniently download the data of their interest in CSV format for further analysis and integration into their research projects; and 4) Data source differentiation: The application employs color coding to clearly differentiate data points based on their source, enhancing data clarity and facilitating source-specific analysis. Ms. Prasai's web application, the AERONET-Clarity Data Explorer (available at AERONET-Clarity Data Explorer (nasa.gov), is a valuable open-source resource designed to empower researchers across the globe in their pursuit of air quality research.



Web application User Interface (image provided by R. Prasai).

Ms. Prasai also works on Machine Learning for Missing Data Imputation, in addition to the web application development. She is actively engaged in research aimed at addressing the challenge of missing AOD values in the AERONET dataset. Her research project is titled: "Leveraging Machine Learning for Imputation of Missing AERONET AOD550 Time Series Using MERRA-2 Reanalysis Data." This approach utilizes machine learning algorithms to impute missing AOD values, enhancing the completeness and usability of the AERONET data archive. Ms. Prasai will be presenting her research findings at the upcoming American Geophysical Union (AGU) Fall Meeting in December 2024 in Washington, DC.

In the coming months, Ms. Prasai aims to complete the web application with additional functionalities (target date: November 2024). She also anticipates the finalization of the machine learning model for AOD550 time series imputation using MERRA-2 data. Ms. Prasai also will be developing a research paper for submission to a peer-reviewed scientific journal and conference proceedings.

CODE 61A: GEODESY AND GEOPHYSICS LABORATORY

MAGDA KUZMICZ-CIESLAK & KEITH EVANS

Sponsor Stephen Merkowitz / Code 61A / Task 128

Following Dr. Pavlis's retirement, Dr. Magda Kuzmicz-Cieslak along with Mr. Keith Evans have taken the lead in conducting comprehensive daily and weekly analyses of sea-level rise (SLR) data and the combination of products from the International Laser Ranging Service (ILRS) network. Throughout the reporting period, they ensured the timely delivery of these analyses

and combination products to the ILRS archives at CDDIS and EDC. In addition to these tasks, the team provided critical support to the ILRS Central Bureau operations and the ILRS network of stations. This support included performing necessary validation and qualification tests for systems in quarantine or for newly installed systems. The team also actively participated in the ILRS Central Bureau (CB) and Quality Control Board (QCB) teleconferences, which were held monthly and bimonthly, respectively.

Dr. Kuzmicz-Cieslak and Mr. Evans have successfully completed the products for the new v80, v180, and v280 series, consistently submitting these versions since their introduction. These new series fully replaced the old series (v70, v170, and v230) by the end of 2023. As of January 2024, support for the v70, v170, and v230 series was discontinued, with only the new versions (v80, v180, and v280) being submitted going forward.

The v85 series, involving a comprehensive re-computation of the entire weekly SINEXs from 1993 to the present, has been established, and production is underway. This series, which covers the period from the start of 1993 to the end of 2023, was processed in December 2023 and January 2024 and has already been submitted to the EDC.

Lastly, they have initiated the production of a new (test) series, version v320, which includes data from five satellites: LAGEOS, LAGEOS2, ETALON1, ETALON2, and LARES-2. This series represents a modification of the earlier v80 version. The near-term plans for their SLR work include providing an ILRSB solution for the v280 and v320 series.

Furthermore, over the past year, on behalf of the ILRS Central Bureau and the ILRS Analysis Standing Committee (ASC), the team has evaluated several ILRS stations, including Tsukuba (TKBL, 7306), Yebes (7217), and Mt. Stromlo (7825). These stations have either been newly commissioned or undergone major repairs or renovations of the ranging system.

Looking ahead, Dr. Kuzmicz-Cieslak and Mr. Evans have plans for SLR work, which include developing an ILRSB solution for the v280 and v320 series by combining input from different Analysis Centers (ACs) and utilizing Variance Component Estimation (VCE) to ensure the highest quality of results. Furthermore, they will commence research on the correlation between geodetic satellite passes and the sigma of the ITRF2020 station position residuals. This project aims to enhance their analysis to determine the minimum number of observations needed for each geodetic satellite to maintain ITRF accuracy, focusing on data from 2017 to 2021. The goal is to establish guidelines for ILRS stations that will allow them to manage the increasing number of satellites while adhering to the strict accuracy and stability standards of the ITRF. Lastly, they will continue providing regular updates on their webpage to ensure that users have access to the latest analyses and products in support of the broader objectives of the ILRS network as well as scientific exploration advancements.

ERRICOS PAVLIS
Sponsor Stephen Merkowitz / Code 61A / Task 128

During this partial performance period (due to Dr. Pavlis's retirement on Nov. 1, 2023), the tasks that cover the development of the operational ILRS products were continued uninterrupted and

the products were deposited at the ILRS Data Centers, CDDIS and EDC. Additionally, Dr. Pavlis and his team completed the products for the new (under test) series v80, v180, and v280, catching up to the current date and continuing regularly since then with these parallel submissions until the old series (v70, v170 and v230) are replaced by these new series, sometime before the end of 2023.

Furthermore, the series v85, a re-computation of the entire Weekly SINEXs from 1993 to present, were established and production was initiated. Finally, a new (test) series that includes the data from LARES-2 was also established and production was initiated. With the re-analysis of the LARES-2 data, a new test of the Lense-Thirring frame dragging effect was performed along the lines of the originally proposed experiment (back in the early 1980s), using only the data from LAGEOS and LARES-2 (in place of the originally proposed LAGEOS-3 that was never launched). The results of this experiment were published in a recent article (Ciufolini et al., 2023).

Note: Dr. Pavlis retired from UMBC on Nov 29, 2023.

STACEY HUANG
Sponsor Jeanne Sauber-Rosenberg / Code 61A / Task 188

Dr. Huang has been working to develop novel processing and observation methods using interferometric synthetic aperture radar (InSAR) data to constrain spatiotemporal trends of subsidence in densely vegetated island terrain to better understand their contributions to sea level rise. In particular, she has been leveraging the European Space Agency's public Sentinel-1 dataset to study the Samoan Islands, where subsidence has become a significant contributor to sea level rise since the 2009 Samoa-Tonga earthquake. Dr. Huang's research products have been incorporated into the American Samoa Sea Level Rise Viewer developed by the University of Hawaii at Manoa, and she presented the most up-to-date findings to local stakeholders in American Samoa at a virtual talk in October 2023. Dr. Huang also presented updated research findings to a broad scientific audience at the AGU Fall Meeting 2023. In January, she published a paper describing details of the new InSAR processing methods that she developed for imaging American Samoa. She has also submitted a first author manuscript for review at *Journal of Geophysical Research: Solid Earth* on the results of subsidence estimation over the islands of Upolu (Samoa) and Tutuila (American Samoa).

Dr. Huang has also worked on evaluating novel observation concepts for InSAR that are of interest to future missions, in particular the Surface Deformation and Change (SDC) mission study that was recommended by the 2017 Decadal Survey and is now conducted between the Jet Propulsion Laboratory (JPL) and the European Space Agency (ESA). Specifically, as part of the SDC mission study, in addition to her role as a funded Co-I on a NASA ROSES proposal through the Commercial Smallsat Data Acquisition (CSDA) program at NASA, Dr. Huang has worked on analyzing the data quality and scientific potential of commercial smallsat data providers of SAR and InSAR data. Smallsat constellations offer spurious but targeted high-resolution imagery with local coverage, in contrast to flagship missions, which offer consistent global coverage at moderate resolution. Dr. Huang recently submitted a first-author manuscript for review at *Earth and Space Science* covering the work of the SDC Commercial SAR sub team and is currently

working on another first author manuscript covering her work as Co-I evaluating ICEYE data for applications to volcanic studies.

Dr. Huang will be on parental leave until the middle of October 2024. Upon her return, she will begin to work on a newly funded NASA ROSES Earth Surface and Interior proposal, on which she is Co-I, to study deformation trends over time on Kodiak Island in Alaska. In tandem with geodesy experts on the team using GPS and gravimetric data, Dr. Huang will leverage her extensive experience developing InSAR processing methods for difficult terrain to shed new insights on geohazards and geodynamics of the Kodiak Island and Katmai segments of the Alaska-Aleutian subduction zone. She will also work on incorporating peer-review feedback for the manuscripts she has submitted for peer review regarding her work in the Samoan Islands and evaluating commercial SAR data in order to complete the publication process for both manuscripts.

KYLE GWIRTZ

Sponsor Weijia Kuang / Code 61A / Task 204

Dr. Gwirtz joined GESTAR II on June 15, 2024. He has been and will continue conducting research concerning the estimation of the dynamics of the Earth's deep interior from geomagnetic observations. Specifically, he works with Dr. Weijia Kuang of NASA GSFC on geomagnetic data assimilation (GDA) with numerical dynamos.

In the coming months, his research will focus on optimally characterizing the error of the geomagnetic observations used in GDA. The expectation is that this will lead to improved core state estimates as well as improved decadal forecasting of geomagnetic field variations.

CODE 672 HELIOSPHERIC PHYSICS LABORATORY

JAY HERMAN

Sponsor Adam Szabo / Code 672 / Task 155

Dr. Herman serves as the Instrument Scientist for the Earth Polychromatic Imaging Camera (EPIC) onboard the Deep Space Climate Observatory (DSCOVR). As part of this task, Dr. Herman attends the bi-weekly meetings that oversee the health and operations of the EPIC instrument and manages the special operations, such as the periodic lunar calibrations needed for accurate Earth observations. In addition to this work, Dr. Herman performs research using data from EPIC and other Earth-observing instruments, such as the Ozone Mapping and Profiler Suite (OMPS) and Ozone Monitoring Instrument (OMI) as well as the network of ground-based spectrometer instruments Pandora. The combination of instruments is used for validation of EPIC data products and other atmospheric research.

Dr. Herman published two papers this year, one as lead author in *Atmos. Meas. Tech.* and another as a co-author in *Geosci. Model Dev*. He also has two other papers currently under review.

Looking ahead, Dr. Herman will be participating in a cross-satellite validation project that combines the data from EPIC with data from the recently launched US geostationary satellite TEMPO. He also will be completing the review process for two of his journal articles.

YINGXI SHI

Sponsor / Braun Scott / Code 612 / Task 182

Dr. Shi has recently started working on this task. She attends bi-weekly and weekly AOS Aerosol Algorithm Working Group Meetings and provides suggestions on the aerosol algorithm designs and synergy between multi-sensors. In the coming months, Dr. Shi will continue attending the AOS Aerosol Algorithm Working Group Meeting and working with the group to design the aerosol algorithm focusing on the synergy between multi-sensors.

STUDENT PROGRAMS

GESTAR II MSU UNDERGRADUATE FELLOWSHIP

This year, selected undergraduate fellows from Morgan State University worked with research scientists on the following projects:

Name/Major	GESTAR II Researcher/Code	Title of Project
Ajan Coleman	Dhruva Kathuria/61	Surface Biology and Geology (SBG) mission related research
Ashley Curry/Architecture and Environmental Design	Erica McGrath Spangler/610.1 Nikki Prive/610.1	Connecting Observation Impact Studies with the Real World
Teqwon Norman/Computer Science	Yaping Zhou/612	Extreme Precipitation and Analysis

Olamilekan Sulaiman/Computer Science	Thomas Stanley/617	Landslide Research
Micah Wallace/Computer Science	Ian Carroll/616 Andrew Sayer/616	Can neural networks learn to see airborne dust and sand in thermal satellite imagery?

- Olamilekan Sulamain concluded work with Thomas Stanley in December 2023. He was offered a position with the National Security Administration which was contingent upon his graduation from his undergraduate program.
- Micah Wallace successfully completed a one year fellowship with GESTAR II in May 2024. She highlighted her research in a poster session of AMS with the guidance of Ian Carroll and Andrew Sayer. She was selected for a summer researcher experience at the Translation AI Center at Iowa State University. She learned about this program through GESTAR II. Dr(s). Carroll and Sayer supported her application for this program by providing her with career guidance. Subsequently, Micah attributes her participation in the program to GESTAR II and remained in touch throughout her 8-week experience in Iowa.
- Teqwon Norman was mentored by Yaping Zhou for summer 2024 as a recent graduate. He presented in the centerwide virtual student presentations in August. He recently relocated to Texas as an incoming software engineer at Google.
- Ajan Coleman will continue with GESTAR II through December 2024 under the guidance of Dr. Dhruva Kathuria.

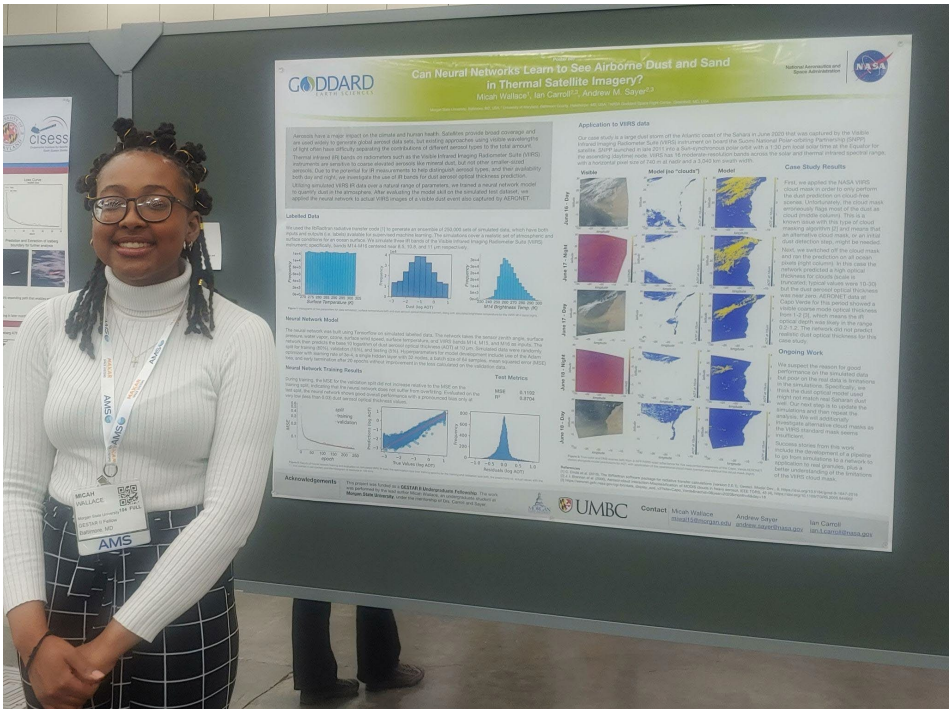


Photo left: Micah Wallace presenting her poster at the AMS meeting.

GESTAR II Graduate Fellowship

Name/Major	GESTAR II Researcher/Code	Title of Project
Yu-An Chen	Stephen Guimond	"Hurricane Dynamics and Predictability: Coupling boundary-layer to cloud observations in a Nonlinear Data Assimilation Framework"
Chhaya Kalkurni	Nikki Prive/610.1	"Estimating Radiance Observation Uncertainties from Spatial Footprints"
Madison Shogrin	Lok Lamsal/614	"Exploring satellite nitrogen dioxide and formaldehyde observations to diagnose ozone formation sensitivity."
Alexis Cole	Manisha Ganeshan/613	"Exploring the relationship between GNSS RO penetration and lower tropospheric moisture in the Arctic using multi-observational datasets"
Praveenaa Kulandhaivel	Carl Mailings/610.1	"A Comprehensive Approach for Hyperlocal Air Quality Determination in Phoenix, Arizona Utilizing Multimodal Data and Deep Learning"

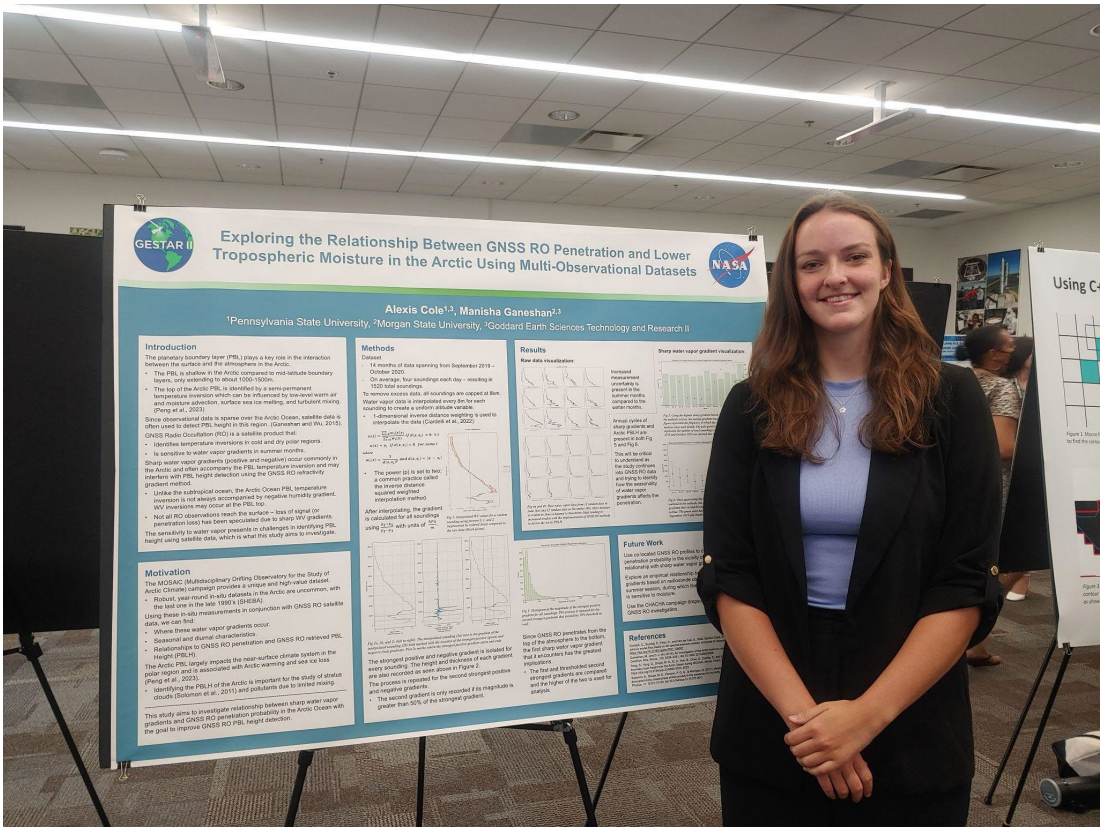
GRADUATE SHORT-TERM TRAVEL

GESTAR II recently developed a new 6 week short term visit that allowed students from Arizona State University, Colorado State University, and Pennsylvania State University to participate in research on-site at Goddard Space Flight Center. A graduate student was selected by the GESTAR II Associate Director and paired with a GESTAR II host to conduct research based on the student's proposal.

The three visiting fellows: Madison Shogrin, Praveena Kulandhaivel, and Alexis Cole joined their

mentors this summer and participated in a number of activities. They also met with Dr. Kristen Whitney (617) to learn about her individual research experience and the NGAPs group at Goddard. Madison Shogrin participated in the Earth 610 Townhall highlighting her research in June. Alexis Cole participated in the on-site centerwide poster presentations in August. Dr. Ganeshan has requested Alexis continue to provide support to her research in Fall 2024 extending Alexis' participation with GESTAR II.

CSU student Madison Shogrin, a summer 2024 GESTAR II visiting scholar at NASA GSFC.



Alexis Cole presenting poster at NASA Goddard, August 2024.

NASA HEADQUARTERS VISIT

Trena Ferrell invited students from Morgan and UMBC to visit NASA Headquarters for the Earth Day event on April 19, 2024. GESTAR II researchers Inia Soto Ramos (616) and Caterina Mogno (614), provided event support leading a tour group and presenting research at activity tables.

Photo Left: Morgan State and UMBC students at NASA Headquarters, April 2024

Photo Left: GESTAR II Faculty Inia Soto Ramos leading hands-on activities at NASA Headquarters for Earth Day, April 2024

EARTH DAY SYMPOSIUM ORGANIZED BY GESTAR II GRADUATE STUDENTS

On Monday, April 29, 2024, graduate students supported by GESTAR II, Kamal Aryal, Maurice Roots, Tony La Luna, Adeleke Ademakinwa, Roshan Mishra, along with GES students, Rhonda Plofkin and Erin Hamner, organized a highly successful Earth Day Symposium with the theme "Monitoring Planetary Health" (https://eds.umbc.edu/).

They invited several scientists and researchers from NASA, EPA, the Naval Research Lab and UMD to give presentations and panel discussions. They also organized fun activities such as "Earth Hour Nature Hike" and student poster competition/award. UMBC president, Dr. Valerie Sheares Ashby attended the event and gave a closing remark.

Photos: GESTAR II Students at the Earth Day Symposium at UMBC, April 2024

GESTAR-2 GRADUATE STUDENT COLLOQUIUM: INTRODUCTION TO THE PACE MISSION

In Spring 2024, GESTAR II graduate students, in collaboration with Prof. Zhibo Zhang, launched a Student Colloquium Series focused on NASA's latest mission—Plankton, Aerosol, Cloud, ocean Ecosystem (PACE)—which was successfully launched on February 8, 2024. Over the course of the semester, eleven distinguished scientists from GESTAR II, NASA, and the Netherlands Institute for Space Research were invited to deliver weekly presentations, offering graduate students an in-depth look at various aspects of the PACE mission. Topics ranged from the scientific foundations and mission design to operational algorithms and early mission results.

Above: Flier from Student Colloquium Series on the PACE Mission

AWARDS

Global Modeling and Assimilation Office
CODE 610.1

Task 059 / Eunjee Lee
On December 7, 2023, Dr. Lee received the NASA Goddard Space Flight Center (GSFC) GMAO Peer Award for Scientific Achievement with the citation by GMAO's Chief, Dr. Steven Pawson: "The GMAO is proud to recognize your science achievements over the past year forwarding the GMAO's treatment of the land component of the global carbon cycle. Your studies utilizing the developing models are critical for guiding their continued development by illustrating their scientific value--and, importantly, their scientific limitations. You continue to serve as the scientific point person in the GMAO for land carbon science."

Task 124 / Yujin Zeng
Yujin Zeng was recognized with an award for Outstanding Technical Contribution by a New GMAO Member, NASA GSFC, in December 2023.

Task 129 / Carl Malings
Carl Malings received a Peer Distinguished Contribution Group Award, GSFC Earth Sciences Division Atmospheres Peer Awards 2023, Greenbelt, MD, on December 6, 2023.

Task 185 / Meng Zhou
In May 2024, Meng Zhou received the Academic & Scholarly Achievement Award, University of Iowa.

Task 196 / Scott Denning, Christopher O'Dell, and Andrew Schuh (Team CSU)
The Colorado State University Cooperative Institute for Research in the Atmosphere (CIRA) Research Initiative Award for 2024 was presented to Andrew Schuh for activities highlighted by the 2024 SSIM-GHG Summer School.

Mesoscale Atmospheric Processes Laboratory
CODE 612

Task 068 / Mei Han
2023 Presidential Rank Group Achievement Award was presented to the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) Science Team.

Task 123 / Ali Tokay
Dr. Tokay received an outstanding service award from the AMS radar meteorology committee during the 104th AMS annual meeting on January 24, 2024, in Baltimore, MD.

Task 001 / Sergey Korkin

On February 2, 2024, Sergey Korkin and team received the NASA Goddard Space Flight Center (GSFC) Climate and Radiation Laboratory – MAIAC Group Award: "For a true team effort that culminated in the v3 MAIAC EPIC algorithm and the re-processing of EPIC data." (M. Choi, S. Go, S. Korkin, and Y. Wang).

On December 6, 2023, Sergey Korkin received the NASA GSFC Earth Sciences Division: Atmospheres – Best Senior Author Publication Award: "For an elegant and rigorous exposition in the paper *"Radiative interaction of atmosphere and surface: write-up with elements of code"* that showed how the matrix-operator method can simulate polarized atmosphere-surface radiative interactions."

Task 040 / Daeho Jin

On December 6, 2023, the Best Earth Science Research Results Portal (ESRRP) Entry Award by Earth Sciences Division – Atmosphere (610AT) was presented to Daeho Jin.

On February 2, 2024, the Best First-Authored Paper by Climate and Radiation Laboratory (Code 613), was presented to Daeho Jin at NASA GSFC.

Task 043 / Guoyong Wen

Best First-Authored Paper was presented for "*Biases of passive aerosol property retrievals amidst clouds are thoroughly assessed and corrected.*"

Task 102 / Tamás Várnai

Tamás Várnai received the annual "Scientific Leadership Award" of the NASA GSFC Climate and Radiation Laboratory, with the citation: "For breakthroughs in our understanding of terrestrial glint signals from deep space." NASA GSFC, February 2, 2024.

Task 114 / Jae N. Lee

On January 30, 2024, Jae Lee received a Scientific Leadership Award from the NASA Climate and Radiation Lab. "For outstanding leadership in Sun-Climate research."

Task 119 / Sujung Go

In February 2024, Sujung Go received a "Group Award" from the Climate and Radiation Laboratory (613).

Task 120 / Myungje Choi

On February 2, 2024, Myungje Choi received a MAIAC Group Award from NASA GSFC Climate and Radiation Laboratory - "For a true team effort that culminated in the v3 MAIAC EPIC algorithm and the re-processing of EPIC data."

Task 170 / Colten Peterson

In July 2024, Colten Peterson received the Robert H. Goddard Award for Science.
This was awarded to all members of the MODIS/VIIRS Cloud Products Science Team.

Atmospheric Chemistry and Dynamics Laboratory CODE 614

Task 013 / Daniel Anderson
On December 6, 2023, Daniel Anderson received the 610AT Peer Award: Outstanding Performance in Science.

Task 015 / Sarah Strode
Sarah Strode received a Goddard Earth Sciences Division 2023 Peer Awards Distinguished Contribution Group Award to the ARSET team, on Dec. 6, 2023.

Task 138 / Anne Thompson
Anne Thompson was elected Honorary Member of the American Meteorological Society.

Ocean Ecology Laboratory- CODE 616

Task 010 / John Blake Clark
Blake Clark received an HBG Peer Award for Scientific Achievement, 2024.

Task 017 / Ivona Cetinić
Ivona Cetinić received a NASA GSFC 2023 Hydrosphere, Biosphere and Geophysics (HBG) award, at NASA GSFC on October 16, 2023.

Hydrological Sciences Laboratory- CODE 617

Task 030 / Robert Emberson
2023: NASA Agency Honor Award - Early Career Achievement Medal.

Task 031 / Elijah Orland
Scientific Achievement – NASA GSFC HBG Peer Awards.

Task 076 / John Blake Clark
J. Blake Clark received an HBG Peer Award for Scientific Achievement, 2024.

Biospheric Sciences Laboratory - CODE 618

Task 173 / Seohui Park
In November 2023, Seohui Park received an outstanding Paper Citation Award at Korean Journal of Remote Sensing.

OUTREACH

GESTAR faculty members have been actively involved in outreach throughout the year, including volunteering at public events, student mentoring, and speaking at local schools.

Photo right: Bridget Seegers and Andy Sayer leading a pre-launch trivia game for friends and family at the PACE Mission in Cocoa Beach, Florida.

Microwave Instruments and Technology Branch CODE 555

Task 020 / Priscilla Mohammed-Tano
Priscilla Mohammed-Tano Virtually presented to the Robotics Club at Syosset High School as part of their mentoring program. Mohammed Spoke to students about her background in graduate school and some of the research that she conducts at NASA.

Science Data Processing Branch - CODE 587

Task 158 / Fred Huemmrich
Dr. Fred Huemmrich is mentoring two PhD students from Virginia Tech.

Earth Sciences Division - CODE 610

Task 160 / Jessica Sutton
Mentor for 2024 GPM Mentorship Program

Global Modeling and Assimilation Office CODE 610.1

Task 007 / Nikki Privé
Dr. Privé was a GESTAR II Undergraduate Fellowship co-host with Erica Mc-Grath Spangler for the project: “Connecting Observation Impact Studies with the Real World,” with Morgan State University student Ashley Curry for the Fall 2023-Spring 2024 semesters.

Dr. Privé was the 2023-2024 GESTAR II Graduate Fellowship host for the project: “Estimating Radiance Observation Uncertainties from Spatial Footprints.” The hosted UMBC graduate student, Chhaya Kulkarni, from the University of Maryland, Baltimore County, worked on this project using machine learning techniques to determine the representativeness error of radiances simulated with a high resolution Nature Run.

Task 024 / Katherine Emma Knowland
Mentor in 610 mentoring circles (2021- present), role included leading and organizing meeting schedule, in 2023-2024 (co-lead with Stephen Merkowitz and Matt Pearce), in 2022-2023 (co-leads with Jim Irons and Matt Pearce) and in 2021-2022 (co-lead Matt Pearce).

Task 045 / Christoph Keller
Supervising three grad students/postdocs: Obin Sturm (University of Southern California), Noussair Lazrak (New York University), Uzzal Kumar (University of Minnesota); Supervision of one intern: Eliot Kim (Code 614).

Task 046 / Niama Boukachaba
Niama Boukachaba (610.1/MSU) volunteered at the Earth Day event hosted by NASA HQ on Apr 19th, 2024. She was assigned to three students from the PGCPS Online Campus, leading them through the student activity rotation.

Niama also served as a judge at the 43rd Annual Mathematics-Science-Engineering Fair, in Baltimore MD, March 16th, 2024. This event which hosted the work of local middle and high school students was organized by MSU Center for Excellence in Mathematics and Science Education (CEMSE).

Photo left: Niama Boukachaba at NASA Earth Day event, April 18-19, 2024, Washington DC.
Photo Right: Niama Boukachaba at the Science Fair, March 16, 2024.

Task 051 / Allison Collow
Allison Collow chaired the committee to organize a booth for GESTAR II at the AMS Annual Meeting in January 2024.

Allison Collow presented to the pre-K classes at the Goddard Child Development Center at NASA GSFC on being a meteorologist.

Task 052 / Erica McGrath-Spangler
Dr. McGrath-Spangler was a co-advisor (with Nikki Privé, Morgan State) to two separate GESTAR II undergraduate fellows from Morgan State University.

Dr. Mcgrath-Spangler was also a middle school science fair judge at the St. John the Baptist Catholic School in Silver Spring, MD (March 12, 2024).

Task 059 / Eunjee Lee
During her visits to Korea, Dr. Lee participated in three outreach events at which she explained the basic science about climate change to the general public. The events were “What a wonderful world” (December 2023), “Now’s the time” and “A night at the museum” (July 2024). The outreach events were performed in Korean.

Task 061 / Young-Kwon Lim
Dr. Lim has been a dissertation committee member, providing guidance to a PhD student from the University of Colorado. The dissertation, titled “Examination of the Impact of Ocean Subsurface Data Assimilation on MJO Propagation Across the Maritime Continent in ECMWF Subseasonal Forecasts,” was successfully defended by the student in June 2024. Additionally, in 2023, he mentored a post-doctoral researcher from Oak Ridge National Laboratory, advising on their study of global variability modes and their effects on climate in high mountain Asia.

Task 093 / Dhruva Kathuria
Dr. Kathuria is mentoring an undergraduate student from Morgan State University as part of the GESTAR II undergraduate fellowship program. The student - Ajan Coleman - is working on retrieving and compiling leaf hyperspectral reflectance data along with the associated in situ measurements of multiple plant functional traits associated with chemical, physiological and structural properties of leaves from publicly available data repositories. Ajan will continue working with Dr. Kathuria at least until December 2024.

Dr. Kathuria served as a volunteer judge for three high school research projects for the 2024 GLOBE International Virtual Science Symposium (IVSS).

Task 129 / Carl Malings
Carl Malings served as a Research Mentor for a GESTAR II Visiting Fellow’s project, “A Comprehensive Approach for Hyperlocal Air Quality Determination in Phoenix, Arizona Utilizing Multimodal Data and Deep Learning,” from June through October 2024.

Task 140 / Katherine Breen
Katherine Breen participated as an outreach speaker at the HB Woodlawn Middle School Science Fair, Arlington, VA (Spring 2024).

Katherine Breen has served as the industry sponsor/mentor for an elite team of students selected for the Research in Industrial Projects (RIPS) program in collaboration with the Institute for Pure and Applied Mathematics (IPAM) at the University of California Los Angeles (June 2024 – present).

Task 162 / Amin Dezfuli
Dr. Dezfuli has written a children's book on environmental protection titled, "Save the Earth Seven Days a Week." The book will be available on Amazon in September 2024.

Task 176 / Janak Joshi
Dr. Joshi mentored one final-year undergraduate science student from George Mason University during the 2024 spring semester.

Task 196 / Scott Denning, Christopher O'Dell, and Andrew Schuh (Team CSU)
Andrew Schuh led the Summer School for Inverse Modeling of Greenhouse Gases (SSMI-GHG) at CSU in June 2024. https://www.cira.colostate.edu/conferences/rmtgw/

Mesoscale Atmospheric Processes Laboratory CODE 612

Task 055 / Mircea Grecu
Dr. Grecu participated in the 2024 GPM Mentorship program (https://www.watersheds.online/gpm-mentorship-2024), during which he delivered two lectures and mentored five students.

Task 068 / Mei Han
Dr. Han mentored a graduate student in the GPM mentorship program in 2023.

Task 101 / Jasper Lewis
Dr. Lewis helped to organize and host the AeroCenter-CPC Annual Update, which took place at the NASA Goddard Visitor Center on May 22, 2024. Nearly 100 researchers from NASA GSFC, GISS, and local universities attended this event in-person and virtually.

Dr. Lewis has begun mentoring two UMBC physics students (one graduate and one undergraduate) and training them to calibrate and maintain the Micro Pulse lidar on campus. These mentoring opportunities will continue into the next reporting period.

Task 123 / Ali Tokay
Dr. Tokay mentored several undergraduate and graduate students: Amalie Rebstock (undergraduate, UMBC, Summer 2024 intern), Connor Mahone (undergraduate, UMBC, Summer 2024 intern), Sloane Poppei (graduate, University of Michigan, Summer 2024 intern), and Flavia Batista (Federal University of Rio Grande North, Brazil, GPM capstone mentee, April-May 2024).

Dr. Tokay participated in the NASA Earth Day symposium, and presented at the 2024 AMS student conference, Engineering Science session.

Climate and Radiation Laboratory: CODE 613

Task 012 / Manisha Ganeshan
Dr. Ganeshan helped mentor a NASA 2024 summer intern undergraduate student, contributing to his project which focused on evaluating long-term Antarctic climate records from radiosonde measurements. Dr. Ganeshan also mentored a 2024 GESTAR II summer graduate student intern from Penn State University (PSU), and is guiding her master's thesis project that explores the relationship between GNSS RO penetration and lower tropospheric moisture in the Arctic using multi-observational datasets. Dr. Ganeshan also mentored a graduate student from UMBC in the summer and fall of 2023, guiding him in his PhD research topic. His work with Dr. Ganeshan focused on evaluating the potential of GeoOptics GNSS RO data for Arctic and midlatitude land PBL studies. He was funded using Dr. Ganeshan's 2022 ROSES grant.

Task 018 / Jackson Tan
Mentored Faith Hunja and Bridget Okudinia under the GPM Mentorship Program on the project "Investigating the Precipitation Climatology over Lake Victoria," 19 Apr 2024 – 05 Jun 2024.

Task 037 / Lipi Mukherjee
During the Summer of 2024, Lipi Mukherjee mentored NASA OSTEM (Office of STEM Engagement) intern, Corie Bryant. The project was to set up independently running weatherproof solar photometers. The motivation was to obtain AOD and aerosol height information.

Task 040 / Daeho Jin
Dr. Jin presented "Introduction of NASA GSFC and the life of a NASA earth scientist" at the Visitor Center to 1) Jeonbuk Science Highschool in S. Korea on 10/03/2023, 2) Hansung Science Highschool in S. Korea on 10/10/2023, 3) Sejong Science Highschool in S. Korea on 10/24/2023, and 4) Jinsan Science Highschool in S. Korea on 05/16/2024.

Task 043 / Guoyong Wen
Provided NASA solar eclipse glasses to Climate Science Division of Morgan State University students to watch the solar eclipse of April 8, 2024.

Task 106 / Yaping Zhou
Dr. Zhou served as a GESTAR II Undergraduate Fellowship mentor, during the Summer of 2024.

Task 114 / Jae N. Lee
Jae Lee hosted and mentored a summer student intern, Dylan Hubert (American University, Computer Science Dept.) for Summer 2023 semester; based on his work, his talk entitled "A Machine Learning Approach to Connecting TSI and HMI Observations" was presented at the Sun-Climate Symposium 2023, October 20, 2023.

Jae Lee hosted a TSIS-2 (Total and Spectral Solar Irradiance Sensor-2) booth, handed out new mission information, and promoted the NASA Sun-Climate Symposium 2025, at UMBC's Earth Day event on May 10, 2024.

Task 132 / Yingxi Shi

Dr. Shi mentored two PhD students from UMBC and Towson University on their dissertation research. Dr. Shi also took part in a large outreach event hosting students visiting GSFC.

Task 193 / Jianyu Zheng
Jianyu Zheng was invited to give a lecture on remote sensing of aerosols to undergraduate and graduate students at the University of Puerto Rico on April 22, 2024.

Jianyu Zheng was accepted as a participant of the American Meteorological Society (AMD) Early Career Leadership Academy in 2024.

Task 195 / Alexander Matus
Alexander Matus was a guest lecturer for a course entitled "Climate Change and Health: Research and Policy" at Emory University, Georgia on Feb. 1, 2024. He gave a 45-minute seminar on the IMPACTS field campaign and NASA aircraft measurement capabilities for studying winter snowstorms.

Atmospheric Chemistry and Dynamics Laboratory CODE 614

Task 019 / Fei Liu
Dr. Liu has served as a committee member for the dissertation of a PhD student at the University of Houston.

Task 138 / Anne Thompson
Dr. Thompson presented at the Earth & Atmospheric Sciences Department Colloquium, at Georgia Tech, Atlanta, 14 Sept 2023: "Satellite and Ship-based Views of Gulf of Mexico Pollution: The SCOAPE Project."

On February 14, 2024, Dr. Thompson gave a presentation to UMBC atmospheric physics graduate students entitled "Satellite and Ship-based Views of Gulf of Mexico Air Pollution: The SCOAPE Project" (with D. Kollonige, R. Stauffer)

Dr. Thompson was a mentor to PhD student Joshua Richards (B. Demoz, Academic Advisor)

Task 147 / Jason St. Clair
Dr. St. Clair mentored UMD graduate student Abby Sebol during the NASA ASIA-AQ field campaign. The NASA SARP student program also provided an opportunity for mentorship of students, with about 25 students getting an opportunity to fly with GSFC instruments on research flights; when not flying, they had the chance to talk with scientists about data and science careers.

UMD Graduate Student, Abby Sebol working on the NASA DC-8 during the NASA Asia-AQ Mission.

Jason St. Clair visited a local high school in Angela City, the Philippines in January. He did some citizen science with them and talked to them about what it is like to be a scientist.

Left: Daisy Gonzalez (NASA Ames Earth Science Project Office). Right: Jason St. Clair at outreach event in Angeles City, Philippines, January 2024.

Angeles City High School students with Jason St. Clair.

Task 172 / Caterina Mogno
On April 19, 2024, Caterina Mogno served as one group lead for NASA Earth Day activities at NASA HQ, Washington, DC.

Task 177 / Apoorva Pandey
Dr. Pandey participated in the NASA Student Airborne Research Program as flight scientist for student flights.

Cryospheric Sciences Laboratory: CODE 615

Task 089 / Christopher Shuman
Dr. Shuman contributed to summer student outreach activities through a Digital Storytelling activity led by UMBC's Dr. Karen Chen as part of the iHARP grant to UMBC. iHARP is the NSF HDR Institute for Harnessing Data and Model Revolution in the Polar Regions.

Ocean Ecology Laboratory: CODE 616

Task 004 / Susanne Craig
Dr. Craig gave a talk at the PACE Friends and Family Day held at GSFC on October 28, 2023.

During the Ocean Sciences Meeting in New Orleans, LA, February 5-10, 2024, Dr. Craig gave a NASA Hyperwall talk on the recently launched PACE mission. Ocean Sciences is a large, international meeting with more than 6,000 attendees.

Task 005 / Violeta Sanjuan Calzado
Dr Sanjuan Calzado is an alumna of the University of Las Palmas de Gran Canaria, where she studied Oceanography and she is the sponsoring liaison with the University.

Task 017 / Ivona Cetinić
In 2024, Ivona Cetinić joined the PhD committee of Lou Andres, PhD committee, *Sorbonne Universite, France.*

Task 029 / Bridget Seegers
Bridget Seegers participated in an informal outreach event at Lucha Cantina in Rockford, IL on June 11, 2024. The event included hands-on science and a fun lecture about ocean color remote sensing, adventures as a scientist, the Cyanobacteria Assessment Network, and the PACE satellite.

Bridget Seegers served as a science advisor to an American University student earning a graduate degree in Environment Filmmaking, who developed a documentary focused on PACE and harmful algal blooms called “An Ocean in Bloom” (January 2023 -May 2024).

Bridget Seegers advised a group of Harvard University graduate students on their data science project from July 2023 until May 2024. The project used satellite remote sensing and water quality data to provide tools and satellite products useful for water quality monitoring. The project was very successful. The students were selected for Harvard’s Outstanding Capstone Award and were given a speaking slot at a United Nations conference focused on AI for Good.

Bridget Seegers led an outreach event with Tech Trek, a group of young girls in grades 8 to 11 interested and inspired by STEM in Poway, CA on April 14, 2024. The presentation covered Dr. Seegers’ journey that led to her current position in NASA’s Ocean Ecology Lab. She shared stories from high school, college, graduate school and jobs and experiences along the way. The event included a local and live plankton sample that the attendees explored under a microscope.

Bridget Seegers led a PACE launch outreach event combining fun informal lectures with trivia at the Tiny Turtle restaurant in Cocoa Beach, FL on February 4, 2024.

Bridget Seegers co-led with Kelly Luis (JPL) an Introduction to Ocean Color and SeaDAS software workshop at the Pacific GIS and Remote Sensing Conference at the University of the South Pacific in Suva, Fiji, December 1, 2024. The trip included a visit to the US Embassy to hear their thoughts and ideas about agency engagement in the Pacific region.
Bridget Seegers with Blake Schaeffer (USEPA) on September 19, 2024 led an Association of State Drinking Water Administrators (ASDWA) webinar titled *CyAN Potential Satellite Monitoring of Drinking Water Sources* focusing on the Cyanobacteria Assessment Network (CyAN). The training included interviews with colleagues from NOAA and two from the Oregon Department of Environmental Quality highlighting successful uses of the CyAN data for water quality monitoring. The webinar recording is available on the ASDWA website at https://www.asdwa.org/past-events-webinar-recordings/.

Task 048 / Andrew Sayer
Andrew Sayer mentored a GESTAR II Undergraduate Fellow (Micah Wallace of Morgan State University), jointly with Ian Carroll. The project was highly successful, both scientifically and as a growth experience for all involved and is forming the seed of a funding proposal to NASA.

Task 049 / Inia M. Soto Ramos
On April 18-19, 2024, Dr. Ramos assisted at the PACE Booth at the NASA Earth Day event at Headquarters in Washington, DC. She assisted both days in the morning.

On October 28, 2023, Dr. Ramos gave a talk during the PACE Family Day at Goddard Visitor Center.

On March 15, 2024, Dr. Ramos was a speaker during the professional day at Whitehall Elementary in Bowie. Her talk, “What's an oceanographer?” was given to 3 different classes.

Photo left: Inia Soto Ramos showing students PACE activities at NASA’s Earth Day, April 18-19, 2024, Washington DC.

Task 161 / Ian Carroll
Ian Carroll was co-organizer for the PACE Hackweek held at UMBC from Aug 4-8, 2024.
Ian Carroll was guest speaker on using PACE data products in the cloud at the OB.DAAC User Working Group (UWG) meeting. Finally, Ian Carroll was guest speaker on NASA Openscapes activities at NOAA Enterprise Data Management Workshop and at NASA CDDIS UWG meeting.

Task 174 / James Allen
Dr. Allen participated in a series of PACE science outreach events at the NASA GSFC Visitors center including PACE Family Day on October 28, 2023 and Goddard Visitor Center Experiment Day on November 19, 2023.

Task 175 / Sean Foley
Sean Foley served as a mentor at the PACE Hack Week, where he contributed tutorials, a lecture, and coding assistance to participants.

Task 183 / Vanderlei Martins
The Task involves mentoring and experiential learning of graduate students: Noah Sienkiewiscz and Rachel Smith, both Ph.D. students in Atmospheric Physics at UMBC. These students are placed in professional environments and function as peers with established instrument scientists stationed at UMBC and at Goddard, picking up knowledge, skills and experience along the way. The students are responsible for data collection, development of software infrastructure, analysis and interpreting results. These students also provided leadership for UMBC's Earth Day symposium, while Dr. Martins and other professionals working on the Task participated in Earth Day with tours, demonstrations and sitting on the panel discussion. They are both participating actively in the PACE-PAX aircraft campaign and will help to coordinate the flight and instrument activities, as well as data processing and analysis.

HYDROLOGICAL SCIENCES LABORATORY- CODE 617

Task 030 / Robert Emberson
Dr. Emberson mentored UMBC student, Pranali Talla, as part of a NASA New Investigator Program Student internship.

In April 2024, Dr. Emberson gave a presentation to the Institute of Civil Engineers (UK) Student group on landslides. In June 2024, Dr. Emberson gave a NASA GPM Outreach Seminar.

Task 031 / Elijah Orland
Dr. Orland was group mentor to four summer interns, and primary advisor to two of them.

Task 057 / Fadji Zaouna Maina

Dr. Maina was Jury Member of the UNESCO-Al Fozan Prize for the Promotion of Young Scientists in STEM, appointed by the UNESCO Director-General, 2022-present.

Biospheric Sciences Laboratory- CODE 618

Task 060 / Celio Resende de Sousa
Celio De Sousa presented at the Dia do Engenheiro Florestal: Historias de Sucesso [English: Forest Engineer's Day: Success Stories] held at the Universidade Federal de Lavras [English: Federal University of Lavras], Lavras, Minas Gerais, Brazil, July 14-16, 2024.

Task 122 / Petya Campbell
Dr. Campbell mentored one NASA/GSFC Summer Student Intern in 2023 Sara McNight (UNL, Lincoln, NE, USA).

Geodesy and Geophysics Laboratory- CODE 61A

Task 188 / Stacey Huang
Stacey Huang mentored a master's student in Electrical Engineering at Stanford University and met with the student monthly.

GESTAR II SEMINAR SERIES

The GESTAR II Seminar Series presentations are held virtually on Tuesdays or Thursdays on a monthly basis. Carol Kuehn (SURA) organizes and facilitates the presentations. Speakers come from universities, research facilities, within GESTAR II, etc. Since this series began, speakers have included the following:

Speaker Name	Title of Seminar Talk	Affiliation	Date of Talk
Dr. Xianglei Huang	"Including two missing longwave physics into the earth system model"	University of Michigan	June 8, 2023
Dr. Xubin Zeng	"Clouds, precipitation, and organized convection: from land surface effect to a new satellite wind mission concept"	University of Arizona	June 27, 2023
Dr. Anne Thompson	The SHADOZ Tropical Network at 25 years: Tropical Ozone Variability and Trends	GESTAR II	August 29, 2023
Dr. Susan van den Heever	Observing Convective Storms in the Tropics through the Lens of the NASA INCUS Mission	CSU	September 14, 2023
Dr. William Blackwell	New Frontiers in Atmospheric Sensing from Small Satellites: TROPICS and CREWSR	MIT	September 26, 2023
Dr. Mark Gibson	Source apportionment of Canadian wildfire smoke PM2.5	Environmental Compliance & Remediation	October 24, 2023
Dr. Meredith Hastings	Fingerprinting Reactive Nitrogen Sources and Oxidation Chemistry	Brown University	November 9th 2023
Dr. Paquita Zuidema	"Smoke-cloud-land-meteorology couplings over the south Atlantic"	University of Miami	January 23, 2024
Dr. Greg McFarquhar	"Use of Airborne Cloud Measurements and Model Simulations to Inform About Ice Multiplication"	University of Oklahoma	February 8, 2024
Dr. Karin Ardon-Dryer	"Dust in the air, a bigger problem than we think!"	Texas Tech University	February 27, 2024
Dr. Berry Wen	"Creating synergy between satellite and radar precipitation measurements aided by symbolic deep learning"	University of Florida	March 14, 2024
Dr. Paquita Zuidema	"Smoke-cloud-land-meteorology couplings over the south Atlantic"	University of Miami	January 23, 2024
Dr. Rong Fu	"Understanding drought, heatwaves and fire weather from weather to climate scales"	University of California, Los Angeles	April 30, 2024

Dr. Mimi Hughes	"Too much and too little water: using hydrometeorological modeling to characterize and understand water extremes"	NOAA	May 21, 2024
Dr. Meredith Hastings	"Empowering scientists to transform workplace climate through the ADVANCEGeo community-based intervention program"	Brown University	June 13, 2024
Dr. Bayes Ahmed	"Leveraging Geospatial Technologies for Disaster Risk Reduction in Bangladesh"	University College London	June 20, 2024
Dr. Daniel Tong	"Climate Change, Dust Storms, and Social Vulnerabilities in the United States"	George Mason University	July 11, 2024
Dr. Silvia Newell	"Nitrogren as a Driver of Cyanobacterial Harmful Algal Blooms"	Michigan Sea Grant	August 8, 2024
Dr. Yackar Mauzole	"Synergy of Satellite Observations and Ocean Dynamics in the Bay of Bengal"	University of California San Diego	August 27, 2024
Dr. Jessica Scheick	"Transforming ICESat-21 Research through Collaboration and Learning"	University of New Hampshire	September 12, 2024

COMMUNICATIONS/MEDIA

Global Modeling and Assimilation Office
CODE 610.1

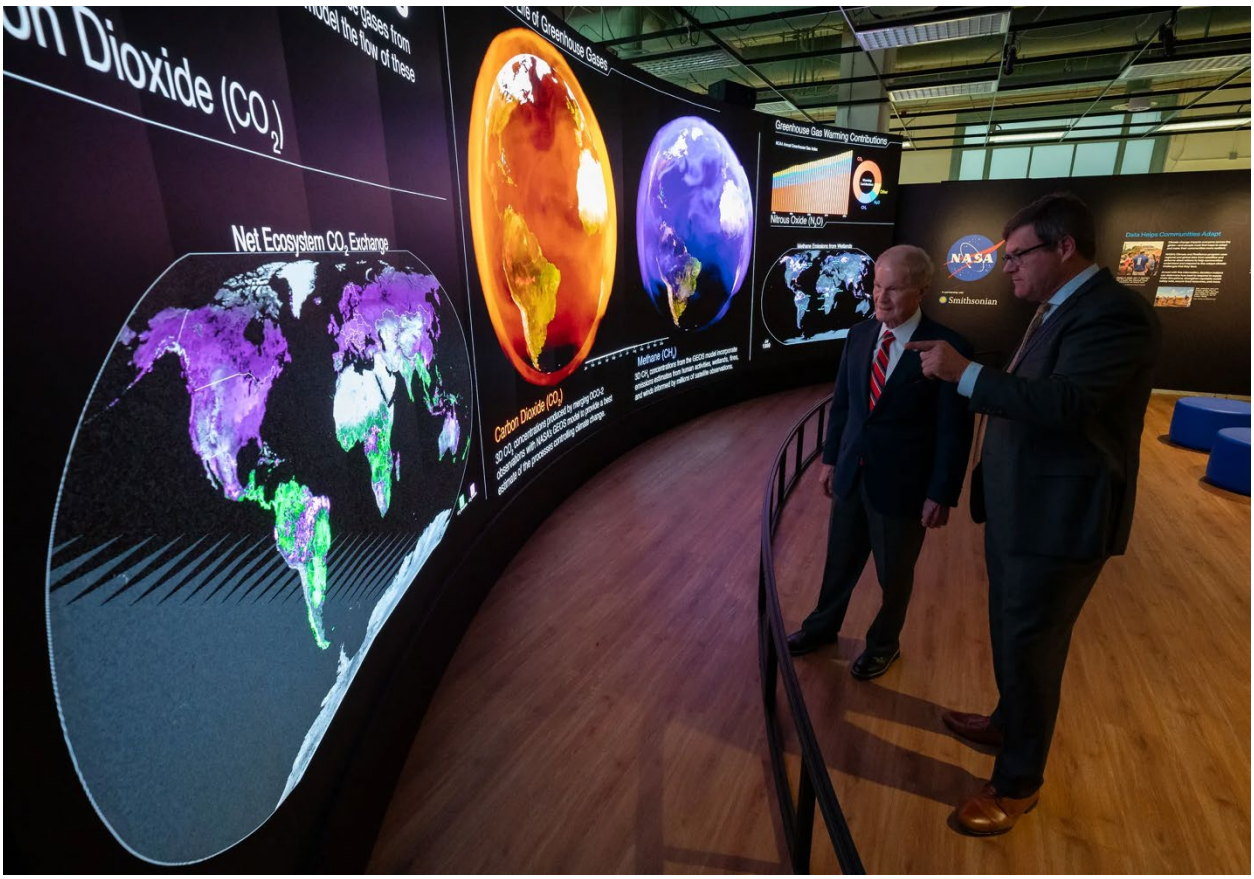
Task 007 / Nikki Privé
Dr. Privé was the subject of a NASA Center for Climate Simulation (NCCS) User Spotlight in June 2024, https://www.nccs.nasa.gov/news-events/nccs-highlights/Nikki-Prive.

Task 023 / Lionel Arteaga
A recent paper from Lionel Arteaga on the impact of heatwaves on phytoplankton community composition was highlighted as a story map on the PACE website: https://pace.oceansciences.org/storymaps.htm?id=2198.

Task 024 / Katherine Emma Knowland
Dr. Knowland contributed to the GMAO Science Snapshot for the GMAO webpage, "Google Earth Engine Data Fusion Tool to support Air Quality Managers," published in November 2023 in both English and Portuguese, and led by Carl Malings (MSU) with co-authors: K. Emma Knowland, Nathan Pavlovic, Justin Coughlin, Alan Chan, Felipe Mandarino, Christoph Keller, Callum Wayman, and Stephen Cohn.
https://gmao.gsfc.nasa.gov/research/science_snapshots/2023/air_quality_data_fusion.php

Task 025 / Brad Weir
Dr. Weir contributed to an article in the Washington Post (February 1, 2024): https://www.washingtonpost.com/climate-environment/interactive/2024/carbon-dioxide-emissions-source-earth/ and a NASA press release (July 23, 2024): https://science.nasa.gov/earth/watch-carbon-dioxide-move-through-earths-atmosphere/.

Dr. Weir was featured in a NASA News piece on the opening of the Earth Information Center at the Smithsonian. https://www.nccs.nasa.gov/news-events/nccs-news/GMAO-Featured-in-New-NASA-EIC-Exhibit-at-Smithsonian-Museum



NASA Administrator Bill Nelson, left, and Kirk Johnson, Sant director, the Smithsonian's National Museum of Natural History, observe the new EIC exhibit at the Museum of Natural History. The images being displayed on the exhibit monitors are GMAO products showcasing CO2 and CH4. Photo Credit: NASA/Bill Ingalls.

Task 045 / Christoph Keller

Christoph Keller contributed to a GMAO Science Snapshot about the development of a Google Earth Engine tool to support air quality managers, November 2023: https://gmao.gsfc.nasa.gov/research/science_snapshots/2023/air_quality_data_fusion.php.

Christoph Keller contributed to the article "Filling an Air Pollution Data Gap," published on Earth Observatory on November 30th, 2023: https://earthobservatory.nasa.gov/images/152131/filling-an-air-pollution-data-gap

Task 051 / Allison Collow

Allison Collow contributed to "NASA Data Shows July 22 Was Earth's Hottest Day on Record" for NASA.gov (July 29, 2024): https://www.nasa.gov/earth/nasa-data-shows-july-22-was-earths-hottest-day-on-record/.

Task 061 / Young-Kwon Lim
Dr. Lim worked with scientists and visualization specialists to produce a video depicting the transition from La Niña to El Niño. The video animated the changes in ocean and atmospheric spatial structures during this transition, incorporating narration. The project leader, Dr. Atousa Sabari (code 606.4), presented the video at an international conference. Dr. Lim computed and supplied the atmospheric data required for the video.

Additionally, Dr. Lim was interviewed by a weather reporter from Korean Broadcasting System (KBS) in South Korea. The discussion addressed various climate topics, including global warming, extreme weather events, marine heatwaves, and the impacts of ENSO and extra-tropical climate modes on global climate. The interview aired on KBS news on May 20.

Task 162 / Amin Dezfuli
Dr. Dezfuli was interviewed by BBC News (in Persian) on recent heat waves in Iran: causes, energy implications, adaptation and mitigation policies. August 2024.
https://www.youtube.com/live/38JlBOrpS3M

Dr. Dezfuli was featured in a Forbes article, titled "Floods In Rural Iran Cause $40 Million In Damages, Raise Long-Term Health Concerns." March 2024.
https://www.forbes.com/sites/sanammahoozi/2024/03/21/devastating-floods-in-irans-sistan-and-baluchistan-raise-concerns-over-long-term-consequences/?sh=5579309d4fd7

Dr. Dezfuli was interviewed by BBC News (in Persian) on global warming and the record heat in 2023. January 2024.

Dr. Dezfuli was interviewed by BBC News (in Persian) on the outcomes of COP28 in UAE. December 2023. https://www.youtube.com/watch?v=-KzLh6DGjXs

Dr. Dezfuli was featured in a Forbes article discussing climate change impacts on the Middle East ahead of COP28 in UAE. November 2023.
https://www.forbes.com/sites/sanammahoozi/2023/11/28/iran-fails-to-fight-climate-change-as-cop28-takes-place-next-door/?sh=781be6335118

Task 185 / Meng Zhou
Meng Zhou was interviewed by International Programs of the University of Iowa for his Academic & Scholarly Achievement Award.
https://international.uiowa.edu/news/2024/05/pioneering-wildfire-monitoring-nasa-iowa-informatics-alumnus-meng-zhou-shares-his

Atmospheric Chemistry and Dynamics Laboratory CODE 614

Task 047 / Hirenkumar T. Jethva
Hiren Jethva contributed to an article about "**Smoke and Fire in British Columbia"** in the NASA Earth Observatory Image of the Day (IOTD) article (May 14, 2024):
https://earthobservatory.nasa.gov/images/152806/smoke-and-fire-in-british-columbia

Task 064 / Feng Li
Dr. Li's paper about the impact of stratospheric ozone recovery on Southern Ocean heat uptake was featured by Nature Research Highlight "The ozone layer's comeback brings a chill to Antarctica's ocean" (https://www.nature.com/articles/d41586-023-03008-3).

Ghassan Taha / Task 084
Ghassan Taha contributed to the Earth Observatory Item of the Day (IOTD), "A Blanket of Ash from Ruang" (April 12, 2024), https://earthobservatory.nasa.gov/images/152716/a-blanket-of-ash-from-ruang

Caterina Mogno / Task 172
Caterina Mogno was featured in the NASA GSFC Early Career Scientist Spotlights (March 12, 2024): https://science.gsfc.nasa.gov/600/ECSS/Caterina-Mogno.html

Cryospheric Sciences Laboratory- CODE 615

Task 089 / Christopher Shuman
Internet article: Ice Sheets Today (published by NSIDC), (August 14, 2024),
'No medal for Greenland melt in 2024'
https://nsidc.org/ice-sheets-today/analyses/no-medal-greenland-melt-2024

Internet article: The Washington Post (August 13, 2024),
'A frigid vortex is slowing the iceberg's journey north to warmer waters, where most icebergs in the region eventually drift before disintegrating.'
https://www.washingtonpost.com/climate-environment/2024/08/12/largest-iceberg-spinning-antarctica/ (paywall)

Internet article: The New York Times, (August 7, 2024),
'After Breaking Free, World's Largest Iceberg Is Stuck Spinning in Circles'
https://www.nytimes.com/2024/08/07/science/a23a-iceberg-antarctica-spinning.html?unlocked_article_code=1.BE4.s2Uq.8CDOBdZ45Vso&smid=nytcore-ios-share&referringSource=articleShare&sgrp=c-cb

Internet article, NASA Earth Observatory, (June 7, 2024), 'Humboldt Glacier's Demise'
https://earthobservatory.nasa.gov/images/152893/humboldt-glaciers-demise

Internet article, NASAEarthdata on Facebook, (June 7, 2024), 'NASA Worldview Image of the Week: Icebergs A-74, A-81, and A-83 in the Weddell Sea, Antarctica.' (post is too detailed to summarize).

Internet post, NASAEarthData on X (Twitter), (June 3, 2024).
'A fine day across Antarctica's Weddell Sea shows icebergs A-74, A-81, and A-83 that calved from the Brunt Ice Shelf in February 2021, January 2023, and May 2024, respectively.'
https://x.com/NASAEarthData/status/1797612294328942754

Radio, BBC World Service 'The Inquiry,' (May 30, 2024).
BBC World Service 'The Inquiry' (4th person interviewed)

‘What can the world’s biggest iceberg tell us?’ https://www.bbc.co.uk/programmes/w3ct5xh8

Internet article, NASA Earth Observatory, (May 24, 2024),
‘Antarctic Ice Shelf Spawns Iceberg A-83’
https://earthobservatory.nasa.gov/images/152848/antarctic-ice-shelf-spawns-iceberg-a-83

Internet article, NASA Earth Observatory, (April 6, 2024),
https://earthobservatory.nasa.gov/images/152653/is-the-wilkins-ice-shelf-weakening

Internet article, NASA Earth Observatory, (April 2, 2024),
https://earthobservatory.nasa.gov/images/152623/scenes-from-the-polar-night

Internet article, Earth Resources Observation and Science Center (EROS), (February 21, 2024),
https://www.sciencebase.gov/catalog/item/65ca8963d34ef4b119cb3343

Internet article, EOS (AGU), (February 20, 2024), ‘Monitoring Polar Ice Change in the Twilight Zone Landsat’s new extended data collection program is mapping Arctic and Antarctic regions year-round, even in polar twilight,’
https://eos.org/science-updates/monitoring-polar-ice-change-in-the-twilight-zone

Internet article, NASA Earth Observatory, (January 5, 2024),
‘Sea Ice Blues off the Antarctic Peninsula,’
https://earthobservatory.nasa.gov/images/152280/sea-ice-blues-off-the-antarctic-peninsula

Internet article, Ice Sheets Today (published by NSIDC), (December 21, 2023),
‘Antarctic melt season off to fast start; Greenland 2023 melt season review,’
https://nsidc.org/ice-sheets-today/analyses/antarctic-melt-season-fast-start-greenland-2023-melt-season-review

Other: CBC National News, (December 14, 2023).
Shuman was interviewed while at AGU by Carly Thomas via Zoom regarding Iceberg A-23A but they elected to shorten the segment and didn't use any of his recorded content.

Internet article, NASA Earth Observatory, (December 1, 2023), ‘Antarctic Iceberg Sails Away,’
https://earthobservatory.nasa.gov/images/152142/antarctic-iceberg-sails-away
Note, Shuman acted more as a technical reviewer than for any image interpretation.

Internet article, LiveScience, (November 28, 2023), ‘World's biggest iceberg 3 times the size of New York City is finally escaping Antarctica after being trapped for almost 40 years,’
https://www.livescience.com/planet-earth/antarctica/worlds-biggest-iceberg-3-times-the-size-of-new-york-city-is-finally-escaping-antarctica-after-being-trapped-for-almost-40-years

Internet article, NASA Earth Observatory, (November 27, 2023), ‘Quelccaya Ice Cap Then and Now,’ https://earthobservatory.nasa.gov/images/152124/quelccaya-ice-cap-then-and-now

Internet article, GESTAR II Web Site, (November 27, 2023), ‘Shuman contributes to EO IOTD about Quelccaya Ice Cap,’ https://gestar2.umbc.edu/post/137306/

Internet article, NASA Earth Observatory, (September 30, 2023),
'A Brief Iceberg–Island Encounter,'
https://earthobservatory.nasa.gov/images/151891/a-brief-iceberg-island-encounter

Internet, CANARY Documentary, (September 20, 2023), 'Lonnie Thompson (and family): A Portrait of Perseverance,' https://www.canarythemovie.com/about-the-film

Internet article, NASA Earth Observatory, (September 18, 2023), 'Melting on Humboldt Glacier,' https://earthobservatory.nasa.gov/images/151840/melting-on-humboldt-glacier

Internet article, Greenland Ice Sheet Today (published by NSIDC), (September 5, 2023). 'Late-season melt spike,' https://nsidc.org/greenland-today/2023/09/late-season-melt-spike/

Ocean Ecology Laboratory- CODE 616

Task 004 / Susanne Craig
During the PACE Launch week in February 2024, BBC Radio and BBC World Service contacted Dr. Craig to give interviews on the PACE mission on their flagship science shows, 'Science in Action' and 'Inside Science' respectively. These programs have audiences of millions across the world. The interviews may be found at the following links:

- BBC World Service, Science in Action: https://www.bbc.co.uk/sounds/play/w3ct4sdm, interview starts ~16:55 mins
- BBC Radio 4, Inside Science: https://www.bbc.co.uk/sounds/play/m001w12r, interview starts at 11:50 mins

Task 005 / Violeta Sanjuan Calzado
During 2023 and 2024, Dr Sanjuan Calzado has participated in numerous outreach activities related to PACE launch, including:

- PACE interview for Telemundo news. September 2023. Short documentary about PACE mission, including PACE construction, scientific data and products.
- PACE live shots for PACE launch: February 2024.Short interviews for Spanish speaking news agencies presenting the mission and PACE scientific capabilities.
- PACE first light and earth day interviews: April 2024. Presenting PACE first scientific data release and PACE mission as part of the earth observing system from NASA.
- Earth Information Center documentary: July 2024. Dr Sanjuan Calzado is the face of PACE mission on the upcoming documentary on EIC.

Task 017 / Ivona Cetinić
Ivona Cetinić participated in the following communications activities:

- Featured on a radio show "Science Friday" about the PACE mission, 03/22/2024, https://www.sciencefriday.com/segments/nasa-pace-plankton-satellite/
- Participated in the PACE launch broadcast (https://www.youtube.com/live/dFKJbzTRvZE) , @NASASocial event (https://www.youtube.com/live/8-Yh3Dwl00M) , and gave several TV interviews during that time (week of 02/08/2024)
- Chat with Alex Holden about PACE (https://www.youtube.com/watch?v=gKY7H7b2zYA), 01/30/2024

- Chat with Anthony Mackie about how NASA is monitoring oceans (Anthony Mackie Asks NASA About Ocean Science), 01/30/2024
- Assisted with science consulting on 50 Years of Harmful Algal Blooms (2024)
- Highlighted in People of PACE blog (2024)
- TV interviews as part of the Global temperature release and NASA Earth Day (January and April, 2024)
- Worked on PACE promo video, lead scientist: The Insanely Important World of Phytoplankton (2023), and PhyTon Phrightday: PACE and ICESat-2 Mess with Mesodinium (2023)

Task 029 / Bridget Seegers
Bridget Seegers joined NASA's chief scientist Kate Calvin as she explored the PACE mission in depth with fellow oceanographer Dr. Ivona Cetinić in a NASA video called "Keeping PACE with the Oceans." https://www.youtube.com/watch?v=OpxQZjEWC14

Bridget Seegers participated in the NASA Earth Day live shots communication campaign and gave remote interviews in a number of cities including Chicago, IL and Orlando, FL.

Bridget Seegers participated in a NASA Headquarters social event on X Spaces to communicate NASA climate science with the public on April 18, 2024. She talked about studying ocean color and water quality from space and highlighted the exciting data from the PACE satellite. She joined a group of NASA experts, which included Parag Vaze, Gavin Schmidt, Meg Everett, and William Stefanov, in answering live questions with Jenny Turner as the fantastic moderator. The full event is here: https://twitter.com/NASA/status/1781034388731408737

Task 048 / Andrew Sayer
In January and February 2024, Andrew Sayer participated in several media events related to the PACE satellite launch. This resulted in eight television interviews, NASA's PACE pre-launch science briefing on NASA TV and YouTube https://www.youtube.com/watch?v=8v0QwgWPqPU, contributions to multiple written articles, and an appearance on the NPR/WFME "Are We There Yet?" science podcast https://www.npr.org/podcasts/470937634/are-we-there-yet

Task 049 / Inia M. Soto Ramos
- Dr. Soto Ramos was a panelist for the NASA Engage PACE panel discussion on January 25, 2024. https://www.youtube.com/watch?v=i4f99ffck_A
- Dr. Soto Ramos was interviewed by Vanessa Hauc for Telemundo on September 23, 2023.
- Dr. Soto Ramos was featured in the PACE Blog: https://blogs.nasa.gov/pace/2024/03/12/people-of-pace-inia-soto-ramos-studies-data-from-the-sea-and-space/?linkId=409959989
- PACE Live shots for NASA in Español on February 5, 2024:
    - https://teleonce.com/noticias/tecnologia/nasa-lanzara-satelite-para-la-investigacion-de-los-aires-y-oceanos/
    - https://www.telemundosanantonio.com/noticias/local/nasa-el-satelite-pace-tomara-fotos-del-oceano-con-mas-de-250-colores/2326516/
    - https://www.youtube.com/watch?v=sfmj9WlgExQ
    - https://youtu.be/VV7XBuJ3Kmw?si=8lyqAK5wGVGbxxHY
    - https://www.telemundochicago.com/noticias/ciencia/nueva-mision-de-nasa-lanzar-el-satelite-pace-para-estudiar-el-oceano-y-su-relacion-con-la-atmosfera/2429186/

- Earth Day Live shots for NASA in Español on April 22, 2024:
    - Freelance @hectorroldantv
    - Telemundo
    - Metro PR (https://www.youtube.com/watch?v=bPiRrJARFns)
    - NTN24 Colombia
    - Telemundo Los Angeles

Task 174 / James Allen
Dr. James Allen was featured in an Earthdata User Profile showcasing his work as part of GESTAR. (Nov 23, 2023) https://www.earthdata.nasa.gov/learn/data-user-profiles/user-profile-james-allen.

Task 175 / Sean Foley
- Sean contributed to two tutorials for the PACE Hack Week (Satellite Data Visualization and Machine Learning with Satellite Data): https://pacehackweek.github.io/pace-2024/presentations/tutorials.html
- A more in-depth version of the multi-angle tutorial can be found here: https://oceancolor.gsfc.nasa.gov/resources/docs/tutorials/notebooks/harp2-basic-visualizations/

Task 181 / Sean Foley
- Sean contributed to two tutorials which, although developed for the PACE Hack Week, are generally useful for multi-angle satellite data processing (Satellite Data Visualization and Machine Learning with Satellite Data): https://pacehackweek.github.io/pace-2024/presentations/tutorials.html
- A more in-depth version of the multi-angle tutorial can be found here: https://oceancolor.gsfc.nasa.gov/resources/docs/tutorials/notebooks/harp2-basic-visualizations/

Hydrological Sciences Laboratory- CODE 617

Task 030 / Robert Emberson
- Early Career highlight: https://science.gsfc.nasa.gov/600/ECSS/Robert-Emberson.html
- NASA Earth Observatory Image of the Day (Landslides in Canada): https://earthobservatory.nasa.gov/images/153158/landslide-dams-the-chilcotin-river
- Washington Post – part of GSFC / NASA Team developing and publishing landslide maps used here: https://www.washingtonpost.com/world/interactive/2024/visualizing-scale-floods-that-left-south-brazil-submerged/

Task 031 / Elijah Orland
Three features on NASA Earth Observatory: California Park Fire; 2023 Canadian Fire Season; Wildfires in Chile.

Task 032 / Thomas Stanley
The LHASA development team was highlighted by an article on the GSFC website (Sep 26, 2023): https://www.nasa.gov/centers-and-facilities/goddard/goddard-team-wins-nasa-2023-software-of-the-year-award/

Thomas Stanley was interviewed by the Weather Channel on the topic of the Landslide Reporter website (February 15, 2024).

Task 057 / Fadji Zaouna Maina
April 12th, 2024 Dr. Maina's research on High Mountain Asia was featured in Nature behind the paper blog post. The link: Irrigation reduces the streamflow in the Bay of Bengal

Task 072 / Armaghan Abedelmdoust
Armaghan Abedelmdoust was highlighted in NASA's Early Career Scientist Spotlight: https://science.gsfc.nasa.gov/600/ECSS/Armaghan-Abed-Elmdoust.html

Biospheric Sciences Laboratory - CODE 618

Task 109 / J. Blake Clark
Contributed to "The slow recovery of millennial-old salt marshes in Spain," EREB Journal, Author: María Elorza Saralegui. https://ereb.eu/story/the-slow-recovery-of-millennial-old-salt-marshes-in-spain/, October 19, 2023.

Task 122 / Petya Campbell
Dr. Campbell contributed to the articles about the ABoVE project *Clarifying linkages between canopy SIF and physiological function for high latitude vegetation*. Sponsor: NASA/ROSES Terrestrial Ecology, Co-Investigator (PI. F. Huemmrich, 2019-2024). The articles were written by Dr. K. F. Huemmrich, and appeared in the Earth Observatory's Notes from the Field, at the links below:

- https://earthobservatory.nasa.gov/blogs/fromthefield/2024/05/06/springtime-in-the-deciduous-forest/
- https://earthobservatory.nasa.gov/blogs/fromthefield/2023/05/18/illuminating-a-boreal-forests-spring-wake-up/

Task 133 / Arif Rustem Albayrak
UMBC internet article 'UMBC and GESTAR II host UN-ITU Focus Group's annual workshop,' Dr. Albayrak co-organized the workshop on March 13, 2024: 'FG-AI4NDM workshop on Resilience to Natural Hazards through AI Solutions,' https://gestar2.umbc.edu/post/140581/

Task 134 / Fred Huemmrich
Dr. Huemmrich was interviewed as a member of the PACE SAT: https://blogs.nasa.gov/pace/2024/01/30/people-of-pace-fred-huemmrich-plants-the-seeds-of-inspiration/.

Task 154 / Fred Huemmrich
Contributed to articles in NASA Earth Observatory describing fieldwork:
https://earthobservatory.nasa.gov/blogs/fromthefield/2024/05/06/springtime-in-the-deciduous-forest/
https://earthobservatory.nasa.gov/blogs/fromthefield/2023/09/12/boreal-summer/

Task 173 / Junhyeon Seo

Junhyeon Seo contributed to articles about an air quality forecasting model development on LinkedIn and DoS announcement (May 10, 2024):
https://www.linkedin.com/feed/update/urn:li:activity:7195864434114785280/.
https://www.linkedin.com/posts/carolinedangelo_new-air-quality-dashboard-uses-ai-to-forecast-activity-7199091585148403712-BohU?utm_source=share&utm_medium=member_desktop
https://www.state.gov/announcing-the-release-of-forecasting-functionality-for-the-department-of-states-air-quality-app-zephair/

REVIEWER ACTIVITIES

Microwave Instruments and Technology Branch
CODE 555

Jinzheng Peng / Task 020
Reviewer for MicroRad 2024. Reviewed 6 abstracts.

Reviewer for IGARSS 2024 conference. Reviewed 6 abstracts.

Priscilla Mohammed-Tano / Task 020
Reviewed 5 papers for the International Geoscience and Remote Sensing Symposium (IGARSS) 2024.

Reviewed 2 journal articles for the IEEE Geoscience and Remote Sensing Society Section.

Reviewed 4 proposals for the NASA Instrument Incubator Program 2023 and served on the in-person panel.

Global Modeling and Assimilation Office
CODE 610.1

Bryan Karpowicz / Task 006
Bryan Karpowicz reviewed a journal article for Bulletin of the American Meteorological Society, August 2023 – December 2023.

Nikki Privé / Task 007
Dr. Privé was a journal reviewer for Frontiers in Marine Science and the Journal of Atmospheric and Oceanic Technology.

Pamela Wales / Task 022
Pamela Wales served as a reviewer on a NASA ROSES panel.

Lionel Arteaga / Task 023
Lionel Arteaga served as reviewer for an NSF grant. He also served as a reviewer in the 2024 NASA FINESST panel, and for the NOAA Ocean Alkalinity Program.

Lionel Arteaga served as reviewer for four scientific manuscripts for the journals Geophysical Research Letters, Journal of Geophysical Research, Nature Communications, and Journal of Marine Systems.

Katherine Emma Knowland / Task 024
Dr. Knowland served as a reviewer on one NASA ROSES review panel. Dr. Knowland served as a reviewer for Nature and for Journal of Geophysical Research (JGR).

Brad Weir / Task 025
Dr. Weir served as an editor of Frontiers in Remote Sensing and a science adviser for AGU's *Eos* magazine. He reviewed papers in several journals including *Nonlinear Process in Geophysics*.

Christoph Keller / Task 045
Christoph Keller reviewed a total of 2 papers (Atmospheric Environment, Journal of Geophysical Research) and 1 NSF proposal. He also provided a promotion evaluation letter for University of Maryland.

Virginie Buchard / Task 050
Reviewer for Journal of Advances in Modeling Earth Systems, Atmospheric Chemistry and Physics, and Journal of Climate

Allison Collow / Task 051
Allison Collow served as a reviewer for the journals Nature Communications, Journal of Geophysical Research, Atmospheric Environment. She also reviewed proposals for NASA ROSES FireSense.

Erica McGrath-Spangler / Task 052
In July 2024, Dr. McGrath-Spangler agreed to be an associate editor for the American Meteorological Society's Journal of Atmospheric and Oceanic Technology peer-reviewed journal.

Young-Kwon Lim / Task 061
Dr. Lim served as a reviewer for Journal of Climate, Journal of Geophysical Research – Atmospheres, and NPJ Climate and Atmospheric Science. He also has been serving as an executive editorial coordinator for Asian-Pacific Journal of Atmospheric Sciences (impact factor: 2.3)

Dhruva Kathuria / Task 093
(1) Journals: Served as a reviewer for Journal of Hydrology, and Geophysical Research Letter
(2) Proposal Review panel: Served as a review panelist for NASA Future Investigators in NASA Earth and Space Science and Technology (FINESST) proposal 2024.

Andrew Fox / Task 094
Andrew Fox served as a reviewer for AGU Journal of Advances in Modeling Earth Systems and EGU journals. He served as panel reviewer for a Department of Energy Office of Science Biological and Environmental Research Earth System Model Development and Analysis call.

Yujin Zeng / Task 124
Yujin Zeng served as a reviewer for the Journal of Applied Meteorology and Climatology.

Carl Malings / Task 129
Carl Malings reviewed manuscripts for the following: GeoHealth (AGU), Atmospheric Measurement Techniques, Atmospheric Pollution Research, ES&T Air (ACS), Environmental Pollution, Journal of Aerosol Science, Remote Sensing Applications: Society and Environment. He also reviewed a book proposal for Elsevier.

Carl Malings served as a NASA ROSES Proposal Review panelist twice.

Katherine Breen / Task 140
Dr. Breen served as a reviewer for the NASA FINESST program.

Amin Dezfuli / Task 162
Dr. Dezfuli served on the Weather and Atmospheric Dynamics FINESST panel, reviewing eight proposals.

Dr. Dezfuli has reviewed a proposal submitted to NSF's Physical and Dynamic Meteorology (PDM) program.

Michael Murphy / Task 168
Member of review panel for proposals to NASA Commercial Smallsat Data Acquisition New Vendor Onramp Evaluation during late April/early May 2024.

Reviewer for journal article in "Journal of Atmospheric and Oceanic Technology," May 2024.

Retha Matthee Mecikalski / Task 169
Retha Mecikalski served as a reviewer for the GESTAR II fellowship proposals.

Janak Joshi / Task 176
Dr. Joshi served as a reviewer for the International Journal of Environmental Research from Springer.

Meng Zhou / Task 185
Fire – MDPI: 1

Remote sensing – MDPI: 1

Remote sensing of environment – Elsevier: 2

Atmospheric Environment – Elsevier: 1

Journal of climate – AMS: 1

Journal Geophysical Research – AGU: 1

Mesoscale Atmospheric Processes Laboratory CODE 612

Liang Liao / Task 053
Liang Liao served as a reviewer for two articles submitted to Journal of Geophysical Research.

Mircea Grecu / Task 055
He also served as a reviewer for the American Meteorological Society's (AMS) *Artificial Intelligence for the Earth Systems*, and the MDPI Remote Sensing journals. In addition, he was a member of the 2023 NASA Advanced Information Systems Technology (AIST) review panel.

Mei Han / Task 068
Dr. Han served as a reviewer for the Atmospheric Measurement Techniques (AMT) journal in EGUsphere.

Dr. Han served as a reviewer for the GESTAR II Graduate Fellowship program 2024.

Jasper Lewis / Task 101
Dr. Lewis served as a peer reviewer for multiple journal articles, including *Atmospheric Research*, *Atmosphere*, and *Remote Sensing of the Environment*.

Ali Tokay / Task 123
Dr. Tokay reviewed five (5) different Journal of Hydrometeorology articles.

Dr. Tokay reviewed two (2) different Journal of Atmospheric and Oceanic Technology articles.

Yuli Liu / Task 149
Remote Sensing of Environment (one paper, two rounds), Journal of Applied Meteorology and Climatology (one paper, one round), Journal of Quantitative Spectroscopy and Radiative Transfer (one paper, one round), AGU Earth and Space Science (one paper, two rounds)

Climate and Radiation Laboratory - CODE 613

Sergey Korkin / Task 001
Dr. Korkin has commented on 3 full-length papers, submitted for possible publication to: MDPI Remote Sensing (1) and Elsevier's Journal of Quantitative Spectroscopy and Radiative Transfer (1) and Computer Physics Communications (1).

Manisha Ganeshan / Task 012
Dr. Ganeshan served as a Reviewer for Geophysical Research Letters, Journal of Hydrometeorology, and Remote Sensing journals.

Jackson Tan / Task 018
Reviewed manuscripts for the Journal of Hydrometeorology, Journal of Geophysical Research Atmosphere, and the Journal of Oceanic and Atmospheric Technology.

Panel reviewer for seven NASA FINESST proposals in May 2024.

Cornelius Csar Jude H. Salinas / Task 035
Cornelius Salinas served as a reviewer for the Journal of Geophysical Research: Space Physics and the Atmospheric Chemistry and Physics journal.

Young-Kwon Lim / Task 036
Dr. Lim served as a reviewer for Journal of Climate, Journal of Geophysical Research – Atmospheres, and NPJ Climate and Atmospheric Science. He also has been serving as an executive editorial coordinator for Asian-Pacific Journal of Atmospheric Sciences (impact factor: 2.3).

Lipi Mukherjee / Task 037
Lipi Mukherjee served as a reviewer for Applied Optics (2) and Optics Express (1).

Daeho Jin / Task 040
10 papers in total were reviewed:
- 6 papers for Atmosphere
- 1 paper for International Journal of Climatology
- 1 paper for EGU – Sphere
- 1 paper for Journal of Geophysical Research – Atmosphere
- 1 paper for Nature Climate and Atmospheric Science

Guoyong Wen / Task 043
Served as a reviewer for Journal of Geophysical Research-Atmospheres

Surendra Bhatta / Task 098
Atmospheric Measurement Techniques

Applied Optics

IEEE Transactions on Geoscience and Remote Sensing

Tamás Várnai / Task 102
As a member of the editorial board of Remote Sensing, Tamás Várnai made editorial decisions for 18 manuscripts submitted to the journal. He also reviewed 4 manuscripts for Remote Sensing, and one each for Atmospheric Environment, Atmospheric Research, Journal of Geophysical Research, and the Journal of Quantitative Spectroscopy and Radiative Transfer. Additionally, he also reviewed two proposals submitted to the National Science Foundation.

Yaping Zhou / Task 106
Served as review panel on NASA AIST program, April 2024.

Reviewed articles for Journal of Geophysical Research – Atmosphere, IEEE Transactions on Geoscience and Remote Sensing, and Remote Sensing of Environment.

Anin Puthukkudy / Task 110
Reviewed multiple articles in Remote Sensing of Environment, Remote Sensing, Atmospheric Environment, Frontiers in Remote Sensing, Optics express.

Yujie Wang / Task 118
Dr. Wang served as reviewer for following journals: Frontiers in Earth Science, Remote Sensing, Atmospheric Research, Atmospheric Environment, Environmental Pollution, and The Science of The Total Environment

Sujung Go / Task 119
Sujung Go served as a reviewer for journals Atmospheric Measurement Techniques, Frontiers, Atmosphere, Atmospheric Environment.

Myungje Choi / Task 120
Myungje Choi reviewed six papers for three journals: IEEE Transactions on Geoscience and Remote Sensing, Atmospheric Environment, and ACS ES&T Air.

Yingxi Shi / Task 132
Served as reviewer for 15 papers in the following journals (Atmospheric Environment, Atmospheric Measurement Techniques, Geophysical Research Letters, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Advances in Atmospheric Sciences, Journal of Geophysical Research, Remote Sensing of Environment).

Colten Peterson / Task 170
Dr. Peterson has reviewed two journal articles (now published) during the period of this report, one for Environmental Research Letters, and one for EGUsphere.

Jianyu Zheng / Task 193
Jianyu Zheng served as a reviewer for Journal of Geophysical Research - Atmosphere, Journal of Quantitative Spectroscopy and Radiative Transfer, Remote Sensing of Environment, Atmospheric Environment, Scientific Reports.

Alexander Matus / Task 195
Alexander Matus served as a reviewer for Geophysical Research Letters (GRL) and Atmospheric Chemistry and Physics (ACP).

Atmospheric Chemistry and Dynamics Laboratory CODE 614

Task 013 / Daniel Anderson
Reviewed 8 papers for Atmospheric Chemistry and Physics, Journal of Geophysical Research Atmospheres, Geoscientific Model Development, and Environmental Research Letters. Served on a review panel for a ROSES call.

Junhua Liu / Task 014
Junhua Liu served as a reviewer for J Geophysical Res: Atmospheres.

Task 015 / Sarah Strode
Sarah Strode served on a NASA proposal review panel. She also reviewed journal articles for Atmospheric Environment, Environmental Research Letters, and Nature Communications.

Fei Liu / Task 019
Dr. Liu reviewed two publications for ACP, two for JGR, and two for Remote Sensing of Environment.

Lok N. Lamsal / Task 021
Advisor: Dr. Lamsal has been advising GESTAR II Visiting Fellows Madison Shogrin (a PhD student from Colorado State University) and Janhavi Singh (a PhD student from Banaras Hindu University). He is also an advisor to a UMBC graduate student Sujan Neupane.

Associate Editor: Dr. Lamsal serves as an Associate Editor for Atmospheric Measurement Technique journal.

Reviewer Activities: Dr. Lamsal has reviewed several articles from multiple journals.

- Atmospheric Chemistry and Physics
- Atmospheric Measurement Technique
- Atmospheric Environment
- Geophysical Research Letters

Feng Li / Task 064
Dr. Li reviewed 1 manuscript for Science Advances, 1 manuscript for Journal of Geophysical Research, 1 manuscript for Theoretical and Applied Climatology, and 1 proposal for the National Science Foundation.

Jin Liao / Task 070
Jin Liao served as a reviewer for Journal Earth and Space Science and PNAS.

Ghassan Taha / Task 084
Ghassan Taha reviewed three manuscripts: two for Geophysical Research Letters and one for Atmospheric Measurements Techniques Journal.

Amir H. Souri / Task 111
Amir Souri reviewed articles for ACP, JGR, and GRL, and he served as a reviewer on two NASA grant panels.

Huisheng Bian / Task 127
Huisheng Bian reviewed one article for JGR and one for ACP.

Larrabee Strow / Task 136
Reviewer for Earth and Space Science.

Task 138 / Anne Thompson
Anne Thompson served as a reviewer for articles in Atmospheric Chemistry and Physics, Earth and Space Science, and Atmospheric Measurement Technology.

Anne Thompson as Editor was appointed to the Board of Reviewing Editors of the PNAS [Proceedings of the Natl Academy of Sciences]-NEXUS journal, July 2024-June 2027.

Jason St. Clair / Task 147
Jason St. Clair reviewed an article for Atmospheric Measurement Techniques.

Caterina Mogno / Task 172
Caterina Mogno served as a reviewer for the journal Environmental Research Letters (ERL).

Caterina Mogno served as Executive Secretary in the review Panel for NASA - Research Opportunities in Space and Earth Science (ROSES) call. (November 2023).

Apoorva Pandey / Task 177
Served as a reviewer for Aerosol Science and Technology (2), Environmental Science and Technology (1), Journal of Climate (1).

Michael D. Himes / Task 205
Michael Himes served on a review panel for the NASA ROSES Exoplanet Research Program in July 2024.

Cryospheric Sciences Laboratory- CODE 615

Paolo de Matthaeis / Task 016
Dr. de Matthaeis served as a reviewer for IEEE Transactions on Geoscience and Remote Sensing (2 papers), IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (1 paper) and MDPI Remote Sensing (1 paper)

Christopher Shuman / Task 089
Dr. Shuman reviewed a Geophysical Research Letters paper on the Hektoria Glaciers response to long-term climate change. The re-review has begun.

Ocean Ecology Laboratory- CODE 616

Susanne Craig / Task 004
Dr. Craig served as a reviewer for the 2023-2024 GESTAR II Graduate Fellowship Proposal Review Committee.

Dr. Craig served as a reviewer and Editor for Frontiers in Remote Sensing.

Dirk A. Aurin / Task 009
Reviewer for Remote Sensing of Environment.

John Blake Clark / Task 010
Blake Clark was a peer reviewer for various AGU journals, Nature Geosciences, and Nature Communications. He also served on review panels for NASA ROSES and Delaware Sea Grant.

Ivona Cetinić / Task 017

Ivona Cetinić served as a reviewer for NSF (write in review) and for NASA proposals.

Bridget Seegers / Task 029
Bridget Seegers was a reviewer for a manuscript submitted to the Journal of Great Lakes Research.

Bridget Seegers served on a NASA proposal review panel in Spring 2024.

Inia M. Soto Ramos / Task 049
Manuscript reviews for:

- Remote Sensing Applications: Society and Environment
- Journal of Atmospheric and Oceanic Technology
- Frontiers in Marine Science
- Remote Sensing of Environment
- F1000Research

External Reviewer for ROSES23 F.8 Supplement for Open Source Science solicitation.

23-2024 academic year Tenure Review for Associate Professor of Biology in the Division of Natural Sciences at New College of Florida.

Vanderlei Martins, Xiaoguang Xu, Anin Puthukkudy / Task 115
Reviewed multiple articles in *Remote Sensing of Environment, Remote Sensing, Atmospheric Environment, Frontiers in Remote Sensing, Optics express, Remote Sensing of Environment, and Atmospheric Measurement Techniques;* Associate editor of *Frontiers in Remote Sensing.*

Ian Carroll / Task 161
Review for *Atmospheric Measurement Techniques* and *Ecology Letters*.

James Allen / Task 174
Dr. Allen served as a reviewer for several papers in Optics Express, Nature Communications Earth & Environment, Scientific Data, and Progress in Oceanography.

Sean Foley / Tasks 175 & 181
Sean served as a reviewer for Atmospheric Measurement Techniques.

Hydrological Sciences Laboratory- CODE 617

Robert Emberson / Task 030
Reviewer for 2x NASA ROSES panels:

- Reviewer for 3x NASA SMDSS proposals

- Reviewer for journals *JGR, Earth Surface, Landslides*

Elijah Orland / Task 031
Journal peer reviewer for *Fire Ecology*, mail in reviewer for NOAA, and panel review for NASA.

Thomas Stanley / Task 032
Mr. Thomas Stanley served as a reviewer for: Geoscience Frontiers, Transactions in GIS, and Land.

Nishan Kumar Biswas / Task 033
Journal reviewer for: AGU Water Resources Research, AGU Earth's Future, Remote Sensing of Environment, MDPI Remote Sensing, AGU Geo Health, and NASA ROSES Proposal (RIA 2023).

Goutam Konapala / Task 056
Journal reviewer: Water resources research, Nature communications, Nature water, Journal of hydrology.

Review Panel: NASA Early Career panel in January 2024.

NSF Hydrology sciences review in Dec 2023.

Fadji Zaouna Maina / Task 057
Editor for HESS, 2023 – present.

NSF Career panelist for grant reviews, 2023.

User Working Group Member of NSIDC, 2021 – present.

Member of AMS hydrology committee, 2021 – present.

Associate Editor for Scientific Report, 2023 - present.

Reviewer for Nature Sustainability, Earth's Future, Communication Earth and Environment, and Journal of Hydrometeorology.

Pukar Amatya / Task 063
Pukar Amatya reviewed articles for Engineering Geology and for Natural Hazards.

Biospheric Sciences Laboratory - CODE 618

Thomas Eck / Task 085
Thomas Eck reviewed publications in the following scientific journals: Atmospheric Chemistry and Physics, Journal of Geophysical Research, Atmospheric Environment, Atmospheric Measurement Techniques, Geophysical Research Letters, and Journal of Hazardous Materials.

Thomas Eck also continued to serve as an Associate Editor for the journal Atmospheric Measurement Techniques.

Anthony Campbell / Task 109
Associate Editor - All Earth

Associate Editor for Special Issue – Journal of Applied Remote Sensing

Nature Communications

Nature

Remote Sensing of the Environment

Served on a Mississippi-Alabama Sea Grant Consortium Panel for the "Emerging Techniques in Monitoring and Research" Call.

Petya Campbell / Task 122
Dr. Campbell contributed as a reviewer for peer reviewed publications in the AGU JGR Biogeosciences, Canadian Journal of Remote Sensing, Ecological Applications, Journal of Applied Meteorology and Climatology, and Remote Sensing of Environment.

She served in 2023 and 2024 as a reviewer on NASA's FINNEST and LCLUC proposal review panels.

Arif Rustem Albayrak / Task 133
Currently reviewing a NATO document on data/AI/ML & data fusion. Document originated from Virginia Norfolk.

Fred Huemmrich / Task 134
Dr. Huemmrich served as a reviewer for a paper from Science of Remote Sensing

Giuseppe Zibordi / Task 151
Giuseppe Zibordi served as a reviewer for Applied Optics, Optics Express, IEEE Transactions on Geoscience and Remote Sensing, Journal of Oceanic and Atmospheric Technology, and Frontiers in Remote Sensing.

Junhyeon Seo / Task 173
Served as a reviewer for journals, "Engineering Optimization", "Scientific Reports", and "Structural Multidisciplinary Optimization."

Seohui Park / Task 173
Served as a reviewer for journals (GIScience & remote sensing, Journal of Geophysical Research - Machine Learning and Computation).

Kevin Turpie / Task 187
Papers Reviewed:

- Correction of ocean surface sunglint reflections in AVIRIS images, Mingxiu, Wang; Lifeng, Wang; Jiao, Junnan; Song, Qingjun; Ma, Chaofei; Ju, Weimin$_1$; Lu, Yingcheng, Submitted to *Geoscience and Remote Sensing Letters* 04-Jan-2024.

Proposal Review Panels:

- NASA Space Technology Graduate Research Opportunities 2024 (NSTGRO24).
- Phytoplankton, Aerosol, Cloud, and ocean Ecology (PACE) Science and Applications Team 3.

Geodesy and Geophysics Laboratory - CODE 61A

Stacey Huang / Task 188
Stacey Huang served as a reviewer for a NASA ROSES proposal review panel and a peer reviewer for Geophysical Review Letters (3 papers) and Journal of Geodesy (1 paper).

Heliospheric Physics Laboratory - CODE 672

Jay Herman / Task 155
Jay Herman served as a reviewer for two journal articles.

MISCELLANEOUS

Microwave Instruments and Technology Branch CODE 555

Task 020 / Priscilla Mohammed-Tano
Member of the IEEE P4006 Working Group providing support for documents related to radio frequency interference Earth Sciences Division - CODE 610.1

Global Modeling and Assimilation Office CODE 610.1

Task 007 / Nikki Privé
Dr. Privé was the Chief organizer, 12th Workshop in Meteorological Sensitivity Analysis and Data Assimilation, Lake George, NY, May 19-24 2024.

Task 022 / Pamela Wales
Dr. Wales was a co-organizer for the GMAO Seminar Series on Earth system science for the Fall 2023 season.

Task 024 / Katherine Emma Knowland
Dr. Knowland was a co-Lead Chair of the Technical Program Committee organizing this year's Meteorology and Climate – Modeling Air Quality Conference that was held in Davis, CA September 13-15, 2023. https://macmaq.aqrc.ucdavis.edu/technical-program-committee

Dr. Knowland was a Session Chair, "Advances in the Integrated Global Observing System for Air Quality: Science and Societal Benefit" Session, AGU Fall Meeting 2023

Task 025 / Brad Weir
Dr. Brad Weir served as secretary for AGU's *Nonlinear Geophysics* section and was a member of the program committee for AGU's 2024 annual meeting.

Task 051 / Allison Collow
Allison Collow participated in the Code 600 Goal Team on recruitment, the Code 600 Values and Goals Retreat in May 2024, and the Code 600 initiative on orientation, training, and mentoring. She also attended monthly meetings of Code 610's Early-Mid Career Council and led their shadowing effort.

Task 093 / Dhruva Kathuria
Dr. Kathuria was one of the co-organizers of the NASA 2024 SBG Science & Applications Technical Interchange meeting held at NASA HQ in Washington DC, from May 29 – 31, 2024.

Task 094 / Andrew Fox
Andrew Fox served as Steering Committee member for AIMES Land Data Assimilation Working Group (https://aimesproject.org/ldawg/) and organizer for 4th annual Land Data Assimilation (DA) Community

Virtual Workshop on “Developments in Land Data Assimilation” 24-25 June, 2023 (https://aimesproject.org/land_da_workshop_2024/)

Andrew Fox was also organizer and Co-chair of "Land Data Assimilation for Improved Model Output" session at AMS Annual meeting, 1 Feb, 2024 (https://ams.confex.com/ams/104ANNUAL/meetingapp.cgi/ Session/67012)

Task 129 / Carl Malings

- Co-lead, NASA Goddard Space Flight Center Health and Air Quality Working Group (since 2021).
- Co-lead, GEO Health Community of Practice Air Quality Working Group (since January 2023).
- Organizer, GMAO Machine Learning and AI Journal Club (since May 2024).
- Member, GMAO Seminar Planning Committee (since August 2024).
- Program Committee Member, Meteorology and Climate Modeling for Air Quality Conference (2023), Jan-Sep 2023. Conference website: https://macmaq.aqrc.ucdavis.edu/
- Volunteer judge for the Meteorology and Climate Modeling for Air Quality Conference early-career poster awards, September 2023.
- Conference Planning Committee Member, Air Sensors International Conference (2024), Apr 2023-May 2024. Conference website: https://asic.aqrc.ucdavis.edu/
- Served as the coordinating lead author for World Meteorological Organization Global Atmospheric Watch Report 293 on “Integrating Low-cost Sensor Systems and Networks to Enhance Air Quality Applications”, published in June 2024. Available online at: https://library.wmo.int/idurl/4/68924.
- Volunteer Judge for the 2023 NASA Future Engineers Techrise Student Challenge, November 2023.
- Volunteer Judge for the 2024 NASA Future Engineers Power to Explore Student Challenge, February 2024.
- Volunteer Judge for the 2024 NASA Future Engineers Future Creatures Student Challenge, April 2024.

Task 140 / Katherine Breen

Katherine Breen was a member of the Global Modelling and Assimilation Office (GMAO) Seminar Series organizing committee. She proposed and hosted many speakers who were all well-received by the GMAO.

Katherine Breen has served as the organizer of the GMAO ML Group since Spring 2024.

Katherine Breen participated as a member of the Goddard Earth Innovation Hub Tiger Team to develop a detailed plan to enhance the mission-data-modeling lifecycle at Goddard (Nov 2023 – Mar 2024). The recommendations proposed by the Tiger Team were well-received by both GSFC leadership and NASA HQ and have led to further intensive development by downstream teams.

Climate and Radiation Laboratory - CODE 613

Task 001 / Sergey Korkin

Dr. Korkin has created two new open-source codes for (a) light scattering by spheroids (presented at the seminar titled “Partial refactoring of a widely used code for light scattering by spheroids” – see below) and (b) for line-by-line absorption spectroscopy in a gas cell and in the atmosphere (a first-authored paper describing the package was compiled within Task 182 and reported therein). Links to the codes: (a) https://github.com/korkins/spheroids (b) https://github.com/korkins/aspect_gcell

Task 012 / Manisha Ganeshan

Dr. Ganeshan is seminar coordinator for her lab (Code 613) at Goddard.

Task 018 / Jackson Tan
Editor, Journal of Hydrometeorology, 01 Feb 2024 – present.
Associate Editor, Journal of Hydrometeorology, 05 Oct 2022 – 31 Jan 2024.
Member of the AGU Precipitation Technical Committee.
Chair of the AGU Precipitation Technical Committee Awards Subcommittee, Dec 2023 – present.

Task 114 / Jae N. Lee
Jae Lee is serving as an organizing committee member of the Sun-Climate Symposium 2025, which will be held in Fairbanks, Alaska from March 31 – April 4, 2025.

Task 132 / Yingxi Shi
Convenor of the clouds and aerosols session in the 9th COAA International Conference on Atmosphere, Ocean, and Climate Change, Singapore, July 2023

Task 170 / Colten Peterson
Dr. Peterson was a main flight planner for the NASA ARCSIX campaign, which was performed in addition to his funded scientific/algorithm role in the campaign.

Task 195 / Alexander Matus
Alexander Matus served as an active member of the GEWEX early career researcher working group.

Atmospheric Chemistry and Dynamics Laboratory CODE 614

Task 013 / Daniel Anderson
Served as co-lead of the GSFC Health and Air Quality Applied Sciences Group.

Task 015 / Sarah Strode
Sarah Strode helped present an ARSET training on “Satellite Data for Air Quality Environmental Justice and Equity Applications”.

Task 019 / Fei Liu
Dr. Liu contributed to the chapter about the use of NASA satellite data for estimating the impact of COVID lockdowns on emissions of CO2 and NO2 for the CGMS-51 Working Group II report that NASA ESD submits every year.

Task 021 / Lok N. Lamsal
Dr. Lamsal joined as a new member of the GES-DISC User Working Group for two years.

Task 084 / Ghassan Taha
Ghassan Taha was co-author on a paper that was one of the most downloaded during its first 12 months of publication in JRL, “Analysis and Impact of the Hunga Tonga-Hunga Ha'apai Stratospheric Water Vapor Plume.”

Task 087 / Zhining Tao
Zhining Tao volunteered at the event “Taste of Asia and the Pacific Islands (TAPI)” during the Asian American and Pacific Islander Heritage Month, NASA GSFC, 2024.

Task 127 / Huisheng Bian
Huisheng Bian served as a member of the AeroCom Steering Committee.

Task 136 / Larrabee Strow
Dr. Strow continued serving on the NASA Sounder Science Leadership Team, including extensive follow-up involving the TERRA/AQUA/AURA Continuity Workshop that took place in May 2023

Task 172 / Caterina Mogno
Caterina Mogno volunteered as student presentation judge at the 26th Conference on Atmospheric Chemistry, American Meteorological Society Annual Meeting (AMS24), Baltimore, MD, Jan 2024
Caterina Mogno volunteered as booth personnel at the GESTAR II booth at 26th Conference on Atmospheric Chemistry, American Meteorological Society Annual Meeting (AMS24), Baltimore, MD, Jan 2024.

Ocean Ecology Laboratory- CODE 616

Task 004 / Susanne Craig
GESTAR II Service:

- Dr. Craig has served as the Chair on a GESTAR II Promotions Committee. August-November 2023.
- Dr. Craig is serving on a GESTAR II Promotions Committee, August 2024-
- Dr. Craig is a GESTAR II Team Lead for the 616 group.

Professional Service:

- Dr. Craig is a PhD Committee member for UMBC PhD candidate, Kamal Aryal
- Dr. Craig is the external examiner for PhD candidate, Nikolaos Papagiannopoulos at the King Abdullah University of Science and Technology, Saudi Arabia.
- Dr. Craig is participating in the Goddard 2040 Initiatives and is a member of 2 working groups, 1) SED Workforce Initiative Team 2, 'Strategic Imperative 2: Revamp Cooperative Agreement and Contract agreements to eliminate barriers and build a more unified and integrated SED workforce'; and 2) "SED Workforce Initiative 5, Vector 3/Strong Foundations".
- Dr. Craig has formed a DEIA committee in the Ocean Ecology Laboratory, July 2024-
- Dr. Craig is a member of the Scientific Steering Committee for Ocean Carbon and Biogeochemistry (OCB, https://www.us-ocb.org/), a NASA and NSF funded scientific organization. This role includes organizing the annual summer workshop (~200 participants), reviewing requests for various funding opportunities, interacting with other national/international research organizations, and participating in monthly meetings.
  DEIA is high on OCB's list of priorities. Each year, we strive to improve equity and access in our field by ensuring funding requests are only met if satisfactory and demonstrable DEIA plans are in place. A strict code of conduct is enforced at all OCB workshops and related activities. April 2022-present.
- Dr. Craig is the Chairperson for The Oceanography Society's (TOS) Justice, Equity, Diversity, and Inclusivity (JEDI) Committee (https://tos.org/diversity). Her role includes guiding and facilitating committee activities, attending TOS Executive and JEDI committee meetings, and authoring JEDI content in society's bi-monthly publication. The JEDI committee strives to dismantle barriers to participation in the ocean sciences and related disciplines through challenging and updating our parent organization's codes of conduct, bylaws, and practices. Achievements to date include organizing a DEIA Town Hall Meetings at the 2022 and 2024 Ocean Sciences Meetings, establishing a regular DEIA column in Oceanography Magazine, and fundamentally re-writing the eligibility criteria for TOS Awards and Honors. The re-thinking of how Awards and Honors are given is something that many professional societies are now recognizing as a systemic barrier to the inclusivity in our disciplines. The TOS JEDI committee hopes to set an example by dismantling long-standing, biased, and privilege-based award eligibility criteria. June 1, 2020 - December 31, 2026.

- Dr. Craig was a co-chair for the OCB 2024 Summer Workshop plenary session on, 'Fast processes in the surface ocean and the power of geostationary satellites to resolve them'. Along with her co-chairs, she recruited subject matter experts to deliver presentations, organized the scheduling, and facilitated a panel discussion during the session. She is now leading the effort to organize a special issue in Oceanography magazine (peer reviewed) and collate the presentations into a collection of peer reviewed articles.
- Dr. Craig was the Primary Chair for the Ocean Sciences Meeting 2024 on 'Phytoplankton Ecology at Large Scales'. This role included reviewing session poster and oral submissions and overall organization of >100 submissions. **This session accounted for more than 40% of all submissions to the meeting (>6,000 attendees) and was given 4 oral sessions and 2 poster sessions.**
- Dr. Craig is the Primary Chair for a session at the 2024 Fall AGU Meeting entitled, "GC148-I. The Earth through the PACE Lens: Atmospheres, Oceans, Land, and Lakes - The multidisciplinary science of the PACE mission". This session will have one oral and one poster session and will present results of PACE's first year of Earth observations.

Task 010 / John Blake Clark

Blake Clark was a member of the Arctic-COLORs Science Definition Team from August 2023-August 2024 as a co-author of the Science Implementation Plan. He served as the Modeling Activities section working group lead. Dr. Clark also began work as a co-author for the 3rd Decadal Carbon Cycle Science Plan as part of the U.S. Carbon Cycle Science Program in August 2024.

Task 017 / Ivona Cetinić

- NASA Hyperwall presentations at EGU in Vienna (2024).
- Lead editor and co-author for PACE Tech memorandum series (2 volumes published during this period).
- Took part in the NOAA workshop (remotely) - International Workshop to advance ocean carbon and acidification data management and interoperability (May 2024).
- Organized PVST and co-organized PACE-PAX all hands meeting at NASA Ames (2024).

Hydrological Sciences Laboratory- CODE 617

Task 032 / Thomas Stanley

Session Chair, 6th World Landslide Forum, Florence, Pro Bono. (November 16, 2023),

SESSION 2.8 EARTH OBSERVATION DATA FOR LANDSLIDE PREDICTION AND RISK ASSESSMENT.

Session Chair, 6th World Landslide Forum, Florence, Pro Bono. (November 15, 2023), SESSION 2.10 SOIL MOISTURE AND RAINFALL MEASURED THROUGH REMOTE SENSING FOR MONITORING AND PREDICTING LANDSLIDES.

Session Chair, 6th World Landslide Forum, Florence, Pro Bono. (November 15, 2023), Session 2.1: CASE STUDIES AND STATE OF THE ART ON LANDSLIDE MONITORING.

Task 033 / Nishan Kumar Biswas

Nishan Kumar Biswas (UMBC) attended as a subject matter expert in an invited workshop on Agricultural Water Productivity Assessment in Coastal Bangladesh organized by the Radcliffe Institute of Harvard University. This workshop is focused on the application of satellite remote sensing data to gather weather information to assess irrigation water requirements which will be essential to support solutions to reduce agriculture productivity gaps and to build resilience for the food-water nexus across the country.

Nishan Kumar Biswas (UMBC) led a workshop entitled “Supporting Water Management and flood modeling through the use of satellite remote sensing for Bangladesh Water Development Board” from August 20-25, 2023, Dhaka, Bangladesh and supported by the University of Washington, funded by Ivanhoe Foundation.

Task 057 / Fadji Zaouna Maina

Maina, F.Z., Panelist at the high-level ministerial event “Elevating the Climate-Land-Nature-Drought-Nexus, from Climate COP28 to Land COP16” organized by UNCCD IDRA (International Drought Resilience Alliance) at the COP28, December 9th 2023, Dubai, United Arab Emirates (Invited).

Maina, F. Z., Panelist at UNESCO’s conference, Euro-Africa Water Days, October 9th 2023, Montpellier, France (Invited).

Biospheric Sciences Laboratory - CODE 618

Task 173 / Seohui Park

Served as guest editor in special issue of Remote sensing- Satellite Remote Sensing of Atmospheric Aerosols for Air Quality Applications (Second Edition).

Task 187 / Kevin Turpie

PhD Student Committee of Nicole Trenholm, UMCES.

Meetings:

- Optica Congress: Hyperspectral Imaging and Sounding of the Environment (HISE), program committee and discussion moderator. Munich, Germany. 31 July – 4 Aug 2023
- *Global Assessment of Limnological, Estuarine and Neritic Ecosystems (GALENE) mission proposal group workshop. International Space Science Institute ISSI. Berne, Switzerland. 9 – 12 July 2023*
- Global Space-based Inter-Calibration System (GSICS) Annual Meeting EUMETSAT, Darmstadt, Germany. 12 – 16 March 2024.

Geodesy and Geophysics Laboratory – Code 61A

Task 188 / Stacey Huang

Stacey Huang completed the NASA Transform to Open Science training.

COURSES TAUGHT

Global Modeling and Assimilation Office
CODE 610.1

Task 023 / Lionel Arteaga
Lionel Arteaga served as a remote instructor in the CLIVAR-FIO Summer School on "Biogeochemical Processes in Earth System Models" in July 2024.

Task 129 / Carl Malings
Carl Malings was a Guest Lecturer in an Air Quality course at UMBC, Baltimore, MD, April 11-16, 2024.

Task 162 / Amin Dezfuli
In the Fall of 2023, Dr. Dezfuli gave a guest lecture on the "Role of large-scale climate dynamics: from atmospheric rivers to bird migration" in Professor Ichoku's class - Atmospheric Science, at UMBC.

Mesoscale Atmospheric Processes Laboratory
CODE 612

Task 123 / Ali Tokay
In the Fall of 2023, Dr. Tokay taught Geography and Environmental Systems (GES) 311- Weather and Climate. This is a required upper-level undergraduate course that had 42 students on the roster.

Cryospheric Sciences Laboratory
CODE 615

Task 089 / Christopher Shuman
Dr. Shuman presented Earth's Ice: Changing Now, 52+ Years Of Landsat for UMD Geography 172, July 23, 2024. A secondary part of the presentation included recent LEAP acquisitions from Thwaites Glacier.

Task 009 / Dirk A. Aurin

Developed and taught *Hyperspectral In situ Support for PACE (HyperInSPACE) Community Processor (HyperCP); Training Session 6*. International Ocean Colour Science Meeting 2023, St. Petersburg, FL. November 13 (half-day workshop).

Developed and taught *Reference Measurements for Satellite Ocean Colour (FRM4SOC-2) InterComparison Experiment (FICE 2024) training event*, National Research Council, Venice, Italy, May 5 – 17, 2024 (two-week training course). The course will be repeated at FICE 2025 in Venice in July 2025 in conjunction with a radiometry Field InterComparison Experiment similar to FICE 2018 and FICE 2022.

Photo of instructors and students at the Copernicus FICE 2024 course in Venice, Italy, May 6-17, 2024. Dr. Aurin represented NASA/GESTAR-II/MSU as a lead instructor (second from left, first row, wearing the PACE shirt).

Task 017 / Ivona Cetinić
Guest lecturer at Oceanography class - virtual, Wake Forest University (2023)
Guest lecturer, PACE graduate lecture series, University of Maryland, Baltimore County (2024)
Guest lecturer at PACE Hackathon, University of Maryland, Baltimore County (2024)

Task 174 / James Allen
Dr. Allen ran a tutorial session for the PACE Hackweek (https://my3.my.umbc.edu/groups/gestar2/posts/143167) (https://pacehackweek.github.io/pace-2024/) introducing scientists to toolkits designed to download, collocate, and validate field and satellite observations.

Biospheric Sciences Laboratory
CODE 618

Task 122 / Petya Campbell
In the Spring of 2024, Dr. Campbell taught the undergraduate/graduate class GEOG481/GEOG681, Remote Sensing for Environmental Applications. She was the Course Instructor at GES, UMBC.

A P P E N D I C E S

Publications

Presentations

Proposals Awarded

Proposals Pending

Proposals Not Funded

PUBLICATIONS

Microwave Instruments and Technology Branch CODE 555

Task 020

D. M. Le Vine, Emmanuel P. Dinnat, Paolo de Matthaeis, **Jinzheng Peng**. (2024). "Look Angle Correction for SMAP L-Band Radiometer Using Geolocation Measurements," *IEEE Trans. Geosci. Remote Sens*, vol.62, pp.1-11, doi: 10.1109/TGRS.2024.3405811.

Earth Sciences Division - CODE 610.1

Task 160

Sutton, J. R. P., D. Kirschbaum, T. Stanley, and E. Orland (2024). Evaluating Precipitation Events Using GPM IMERG 30-Minute Near-Real-Time Precipitation Estimates. J. Hydrometeor., 25, 991–1006, https://doi.org/10.1175/JHM-D-23-0141.1.

Global Modeling and Assimilation Office CODE 610.1

Task 006

Karpowicz, B.M. and Privé, N.C. (2024). Using the GEOS 5 Nature Run to Simulate 2053 nm Coherent Doppler Wind Lidar Observations. Journal of Atmospheric and Oceanic Technology, http://dx.doi.org/10.1175/jtech-d-23-0117.1.

McGrath-Spanger, E.L., Privé, N.C., **Karpowicz, B.M.**, Moradi, and I., Heidinger, A.K. (2024). Using OSSEs to Evaluate GXS Impact in the Context of International Coordination. Journal of Atmospheric and Oceanic Technology, http://dx.doi.org/10.1175/jtech-d-23-0141.1.

Privé, N.C., McGrath-Spanger, E.L., Carvalho, D., **Karpowicz, B.M.**, and Moradi, I. (2023). Robustness of Observation System Simulation Experiments. Tellus A: Dynamic Meteorology and Oceanography, http://dx.doi.org/10.16993/tellusa.3254.

Kelp, M.M., Keller, C.A., Wargan, K., **Karpowicz, B.M.,** and Jacob, D.J. (2023). Tropospheric ozone data assimilation in the NASA GEOS composition forecast modeling system (GEOS-CF v2.0) using satellite data for ozone vertical profiles (MLS), total ozone columns (OMI), and thermal infrared radiances (AIRS, IASI). Environmental Research Letters, http://dx.doi.org/10.1088/1748-9326/acf0b7.

Task 007

Lin B., M. W. Mclinden, X. Cai, G.M. Heymsfield, **N. Privé**, S. Harrah, and L. Li. (2024). Sea surface barometry with an O2 differential absorption radar: retrieval algorithm development and simulation. Frontiers in Remote Sensing, 5. https://doi.org/10.3389/frsen.2024.1399839.

Karpowicz B. M. and **N. C. Privé.** (2024). Using the GEOS 5 Nature Run to Simulate 2053 nm Coherent Doppler Wind Lidar Observations. Journal of Atmospheric and Oceanic Technology https://doi.org/10.1175/jtech-d-23-0117.1.

McGrath-Spangler E. L., **N. C. Privé,** B. M. Karpowicz, et al. (2024). Using OSSEs to Evaluate GXS Impact in the Context of International Coordination. Journal of Atmospheric and Oceanic Technology 41 (3): 261-278. https://doi.org/10.1175/jtech-d-23-0141.1.

Privé N. C., E. L. McGrath-Spangler, D. Carvalho, et al. (2023). Robustness of Observing System Simulation Experiments. Tellus A: Dynamic Meteorology and Oceanography 75 (1): 309-333. https://doi.org/10.16993/tellusa.3254.

Task 008

Privé, N. C., **McGrath-Spangler, E. L.**, Carvalho, D., Karpowicz, B. M., and Moradi, I. (2023). Robustness of observing system simulation experiments. Tellus A, 75(1), 309-333, doi: 10.16993/tellusa.3254 Published: 13 October 2023.

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Task 023

Arteaga, L. A., and Rousseaux, C. S. (2024). Evaluation of vertical patterns in chlorophyll-a derived from a data assimilating model of satellite-based ocean color. *Earth and Space Science*, 11, e2023EA003378. https://doi.org/10.1029/2023EA003378.

Task 024

Malings C., **K. E. Knowland**, C. Keller, S. E. Cohn, B. N. Duncan and N. Pavlovic. 2024. "Forecasting with the GEOS-CF System and Other NASA Resources to Support Air Quality Management." Advances in Air Quality Research in Africa. ICAQ-Africa 2022. Advances in Science, Technology & Innovation. [10.1007/978-3-031-53525-3_13] [Article in Book].

Liu F., S. Beirle, J. Joiner, S. Choi, Z. Tao, **K. E. Knowland**, S. J. Smith, D. Q. Tong, S. Ma, Z. T. Fasnacht and T. Wagner. 2024. "High-resolution mapping of nitrogen oxide emissions in large US cities from TROPOMI retrievals of tropospheric nitrogen dioxide columns." Atmospheric Chemistry and Physics 24 (6): 3717-3728 [10.5194/acp-24-3717-2024] [Journal Article/Letter].

Shah V., Keller, C. A., **Knowland, K. E.,** Christiansen, A., Hu, L., Wang, H., Lu, X., Alexander B. and Jacob. D. J. (2024). Particulate Nitrate Photolysis as a Possible Driver of Rising Tropospheric Ozone. Geophysical Research Letters 51 (5): https://doi.org/10.1029/2023gl107980.

Task 025

Pandey S., Miller, J. B., Basu, S., Liu, J., **Weir, B.**, et al. (2024). "Toward Low-Latency Estimation of Atmospheric CO_2 Growth Rates Using Satellite Observations: Evaluating Sampling Errors of Satellite and In Situ Observing Approaches." *AGU Advances,* **5 (4)**: https://doi.org/10.1029/2023av001145.

Souri, A. H., Duncan, B. N., Strode, S. A., Anderson, D. C., Manyin, M. E., Liu, J., Oman, L. D., Zhang, Z., and Weir, B. (2024). "Enhancing long-term trend simulation of the global tropospheric hydroxyl (TOH) and its drivers from 2005 to 2019: a synergistic integration of model simulations and satellite observations." Atmospheric Chemistry and Physics, 24 (15): 8677–8701, https://doi.org/10.5194/acp-24-8677-2024.

Task 045

Shah V., **C. A. Keller**, K. E. Knowland, et al. 2024. "Particulate Nitrate Photolysis as a Possible Driver of Rising Tropospheric Ozone." Geophysical Research Letters 51 (5): [10.1029/2023gl107980]..

Silva S. J. and **C. A. Keller**. 2024. "Limitations of XAI methods for process-level understanding in the atmospheric sciences." Artificial Intelligence for the Earth Systems [10.1175/aies-d-23-0045.1].

Amos H. M., N. K. Skaff, S. Schollaert Uz, **C. A. Keller**, et al. 2023. "Public Health Data Applications Using the CDC Tracking Network: Augmenting Environmental Hazard Information With Lower-Latency NASA Data." GeoHealth 7 (12): [10.1029/2023gh000971].

Task 050

Collow A. B., P. R. Colarco, A. M. da Silva, **Buchard V.**, et al. 2024. "Benchmarking GOCART-2G in the Goddard Earth Observing System (GEOS)." Geoscientific Model Development 17 (3): 1443-1468 [10.5194/gmd-17-1443-2024].

Shang, X., Lipponen, A., Filioglou, M., Sundström, A.-M., Parrington, M., **Buchard, V.**, et al., Mielonen, T. (2024). Monitoring biomass burning aerosol transport using CALIOP observations and reanalysis models: a Canadian wildfire event in 2019. Atmospheric Chemistry and Physics, 24(2). https://acp.copernicus.org/articles/24/1329/2024/.

Bresciani, A., Herdies, D., Figuerora, S., **Buchard, V.**, da Silva, A., Jones, C., Carvalho, L. (2024). The South American Tropopause Aerosol Layer (SATAL). Bulletin of the American Meteorological Society, 105(1), E176–E192. https://doi.org/10.1175/BAMS-D-23-0074.1.

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Collow, A., **Buchard, V.**, Chin, M., Colarco, P., Darmenov, A., da Silva, A. (2023). Supplemental Documentation for GEOS Aerosol Products. NASA GMAO. https://gmao.gsfc.nasa.gov/pubs/docs/Collow1463.pdf.

Task 051

Thomas, N. P., **Marquardt Collow, A. B.**, Bosilovich, M. G., & Dezfuli, A. (2023). Effect of baseline period on quantification of climate extremes over the United States. Geophysical Research Letters, 50, e2023GL105204. https://doi.org/10.1029/2023GL105204.

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Task 058

Insights into the Causes and Predictability of the 2022/23 California Flooding Siegfried Schubert; **Yehui Chang**; Anthony M. DeAngelis; Young-Kwon Lim; Natalie P. Thomas; Randal D. Koster; Michael G. Bosilovich; Andrea M. Molod; Allison Collow; Amin Dezfuli. Journal of Climate, https://doi.org/10.1175/JCLI-D-23-0696.1.

Dynamical Drivers of the Exceptional Warmth over Siberia during the Spring of 2020 Anthony M. DeAngelis, Siegfried D. Schubert, **Yehui Chang**, Young-Kwon Lim, Randal D. Koster, Hailan Wang, and Allison B. Marquardt Collow. Journal of Climate, https://doi.org/10.1175/JCLI-D-22-0387.1.

Task 061

Garcia-Franco, J. L., Lee, C., Camargo, S., Tippett, M., Emlaw, N., Kim, D., **Lim, Y.-K.**, and Molod, A. M. (2024). Tropical cyclones in the GEOS-S2S-2 subseasonal forecasts. Wea. Forecasting, https://doi.org/10.1175/WAF-D-23-0208.1.

Schubert, S. D., Chang, Y., DeAngelis, A. M., **Lim, Y.-K.**, Thomas, N. P., Koster, R. D., Bosilovich, M. G., Molod, A. M., Collow, A., and Dezfuli, A. (2024). Insights into the causes and predictability of the 2022/23 California flooding. J. Climate, 37(13), 3613-3629, https://doi.org/10.1175/JCLI-D-23-0696.1.

Massoud, E. C., **Lim, Y.-K.**, Andrews, L. C., and Girotto, M. (2024). Connecting global modes of variability to climate in high mountain Asia. Atmosphere, 15(2), 142, https://doi.org/10.3390/atmos15020142.

Garcia-Franco, J. L., Lee, C., Camargo, S., Tippett, M., Kim, D., Molod, A. M., and **Lim, Y.-K.** (2023). Climatology of tropical cyclone precipitation in the S2S models. Wea. Forecasting, 38(9), 1759-1776, https://doi.org/10.1175/WAF-D-23-0029.1.

Task 094

Yin, J., Zhan X., Barlage, M., Kumar, S., **Fox, A. M.**, Albergel, C., Hain, C. R., Ferraro, R. R. and Liu, J. (2023) Assimilation of Blended Satellite Soil Moisture Data Products to Further Improve Noah-MP Model skills. Journal of Hydrology, https://doi.org/10.1016/j.jhydrol.2023.129596.

Task 140

Barahona, D., **Breen, K. H.**, Kalesse-Los, H., & Röttenbacher, J. (2024). Deep Learning Parameterization of Vertical Wind Velocity Variability via Constrained Adversarial Training. Artificial Intelligence for the Earth Systems, 3(1), e230025.

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Task 162

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Task 168

Turk, F. J., E. Cardellach, M. de la Torre-Juárez, R. Padullés, K. N. Wang, C. O. Ao, T. Kubar, **M.J. Murphy**, J. D. Neelin, T. Emmenegger, D. Wu, V. Nguyen, E. R. Kursinki, D. Masters, P. Kirstetter, L. Cucurull, K. Lonitz (2024). Advances in the Use of Global Navigation Satellite System Polarimetric Radio Occultation Measurements for NWP and Weather Applications. Bulletin of the American Meteorological Society, 105(6), E905-E914. doi: 10.1175/BAMS-D-24-0050.1.

Task 176

Joshi, J.R. (2024). Dust model sensitivity to dust source mask, sandblasting efficiency, air density, and land use: Implications for model improvement. Atmos. Pollut. Res., https://doi.org/10.1016/j.apr.2024.102230.

Task 185

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Mesoscale Atmospheric Processes Laboratory CODE 612

Task 096

Zhneng, G., S. S. Uz, P. St-Laurent, M. AM. Friedrichs, **A. Mehta**, P. M. DiGiacomo, 2024: Hypoxia Forecasting for Chesapeake Bay Using Artificial Intelligence, Artificial Intelligence for the Earth Systems. https://doi.org/10.1175/AIES-D-23-0054.1.

Task 101

Gil-Diaz, C., Sicard, M., Comerón, A., Fortunato dos Santos Oliveira, D. C., Muñoz-Porcar, C., Rodríguez-Gómez, A., **Lewis, J. R**., Welton, E. J., Lolli, S. (2024). Geometrical and optical properties of cirrus clouds in Barcelona, Spain: analysis with the two-way transmittance method of 4 years of lidar measurements. Atmos. Measure. Tech., 17, https://doi.org/10.5194/amt-17-1197-2024.

Task 123

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Climate and Radiation Laboratory - CODE 613

Task 001

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Task 012

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Task 018

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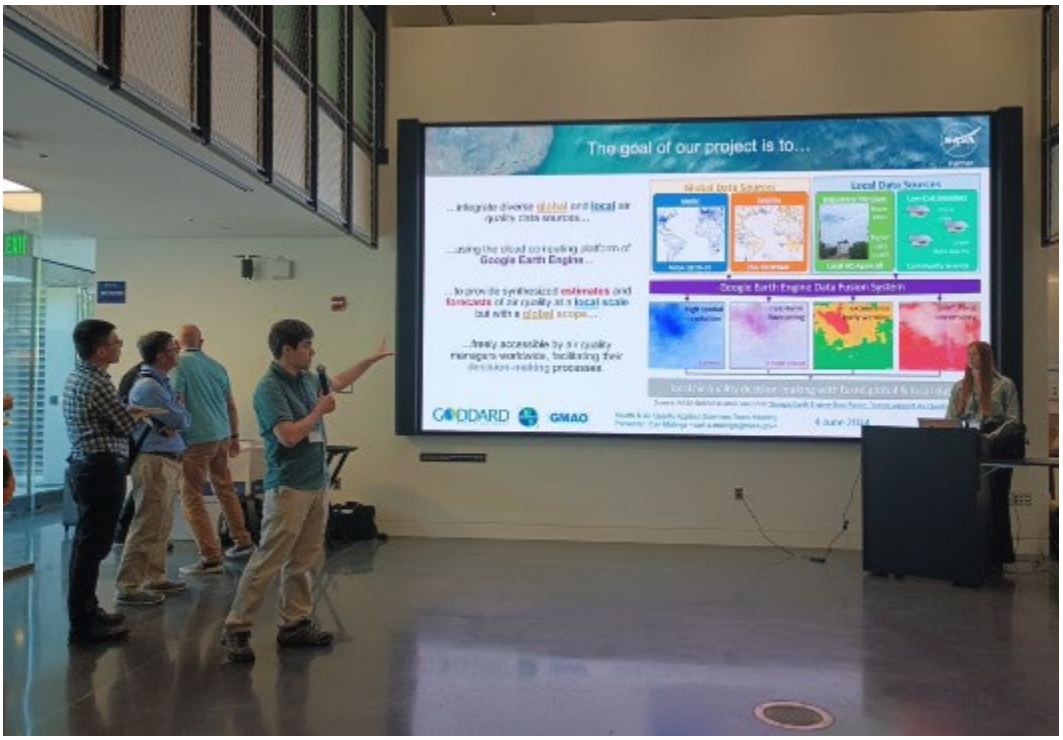

Carl Malings presenting poster at the 2024 HAQAST annual meeting in Boston, MA, June 4, 2024. Photo Credit: K. Emma Knowland.

Microwave Instruments and Technology Branch CODE 555

Jinzheng Peng / Task 020
J. Peng (Co-lead), 'Radiometer Status, Performance and EM Assessment,' SMAP Engineering Review 2024 by SMAP mission Project, NASA JPL, Feb 21-22, 2024.
J.Peng (lead), 'Soil Moisture Active/Passive (SMAP) L-band Microwave Radiometer Performance Evaluation from 2015 to 2024,' IGARSS 2024, Athens, Greece, Jul 7-12, 2024.

Priscilla Mohammed-Tano / Task 020
Mohammed, P. (lead), 'SMAP Radiometer RFI Operations and Reporting,' AMS 2024, Baltimore, MD, January 30, 2024.
Mohammed, P. (lead), 'Improving the L-band Environment Using SMAP Data,' MicroRad 2024, Alexandria, VA, April 10, 2024.

Earth Sciences Division - CODE 610

Jessica Sutton / Task 160

Sutton, J. (lead) NOAA/WMO RA IV Workshop: An Interactive Analysis of Tropical Storm Philippe, virtual, Caribbean Institute for Meteorology and Hydrology, 'Landslide Hazard Assessment,' June 2024 (invited).
Sutton, J. R. P.(lead), D. Kirschbaum, T. Stanley, and E. Orland, 2024 American Meteorology Society, Baltimore, MD, Oral Presentation, 'Evaluating Precipitation Events Using GPM IMERG 30-Minute Near-Real-Time Precipitation Estimates,' January 2024.
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Global Modeling and Assimilation Office- CODE 610.1

Bryan Karpowicz / Task 006
Karpowicz, B.M. (lead), 'Using the GEOS 5 Nature Run to Simulate 2053 nm Coherent Doppler Wind Lidar Observations,' AGU Fall Meeting, San Francisco, CA, Dec 11-15, 2023.
Karpowicz, B.M. (lead), 'The GEOS-ADAS' Preparedness for GeoXO, GeoXO DA Subgroup Meeting,' College Park, MD, June 17, 2024.
Karpowicz, B.M. (lead), 'Infrared Cloud Detection Without a Long-wave Band?,' Advanced Sounder Working Group, ITSC Interim meeting (virtual), June 27, 2024.

Nikki Privé / Task 007
Privé, N.C., 'OSSE Trivia,' Poster presentation, 12th Workshop in Meteorological Sensitivity Analysis and Data Assimilation, Lake George, NY, May 21, 2024.
Privé, N., 'Arctic OSSEs and Beyond,' Virtual seminar for the Institute for Harnessing Data and Model Revolution in the Polar Regions, University of Maryland, Baltimore County, February 13, 2024.
Privé, N.C., M. Walker McLinden, B. Lin, G. Heymsfield, S. Harrah, L. Li, and X. Cai. 'Observing System Simulation Experiments to Determine the Impact of Spaceborne Differential Absorption Radar Measurements of Marine Surface Pressure on Numerical Weather Prediction,' speaker, 104th American Meteorological Society Annual Meeting, Baltimore, MD, January 29-February 1, 2024.

Erica McGrath-Spangler- Task 008
'Assessment of Future Geostationary Hyperspectral Infrared Sounders from the Perspective of Global NWP,' EUMETSAT 2023, Malmo, Sweden, September 13, 2023, 'Evaluating the Impact of Geostationary Sounders in the Context of International Coordination,' AIRS/Sounder Science Team meeting, Hyattsville, MD, October 5, 2023.
'Evaluating GXS Impact in the Context of International Coordination,' AMS Annual Meeting 2024, Baltimore, MD, February 1, 2024.
'BLUF (bottom line up front) slide of recent results,' GeoXO Sounder Kickoff Meeting, College Park, MD, February 2, 2024.
'Estimates of Future Numerical Weather Prediction Impacts from Hyperspectral Sounders', 12th Workshop on Meteorological Sensitivity Analysis and Data Assimilation, Lake George, NY, May 24, 2024.
'Numerical Weather Prediction Impact of GEO and LEO IR Sounders in an OSSE Framework', 8th WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction and Earth System Prediction, Norrköping, Sweden (attended virtually), May 29, 2024.
'GMAO's OSSE preparations for GXS', invited, GeoXO Sounder (GXS) data assimilation subgroup workshop, NOAA College Park, June 17, 2024.

Lionel Arteaga / Task 023

Arteaga L. (lead), 'Advancing satellite-constrained modeled air-sea CO2 fluxes with a focus on the strength of the Southern Ocean Carbon Sink,' Annual NASA Carbon Monitoring System (CMS) meeting, Pasadena CA, Sep 26-28, 2023.
Arteaga L. (lead), 'Impact of Pacific Ocean heatwaves on Phytoplankton Community Composition,' Ocean Sciences Meeting, New Orleans, Feb 18-23, 2024.
Arteaga L. (lead), 'Impact of Pacific Ocean heatwaves on Phytoplankton Community Composition,' Advances in Marine Ecosystem Modeling Research, Plymouth UK (virtual), July 7-12, 2024.

Katherine Emma Knowland / Task 024
Knowland, K. Emma (lead), 'NASA GEOS Composition Forecast System, GEOS-CF: TEMPO Support,' HAQAST Massachusetts Meeting, Cambridge, MA, 6/2024 (poster).
Knowland, K. Emma (lead), 'NASA GEOS Composition Forecast System, GEOS-CF: TEMPO Support,' GeoXO ACX Science Team Meeting, NOAA, College Park, MD, 5/2024 (poster).
Knowland, K. Emma (lead), 'Global-to-Local Air Quality Forecasts using the NASA GEOS Composition Forecasting System,' American Meteorological Society (AMS) 104th Annual Meeting, Baltimore, MD, 1/2024.
Knowland, K. Emma (lead), 'Data Fusion for Urban Air Quality and Health Assessment & Forecasting for the city of Rio de Janeiro,' III Seminar SIURB held at the Museu do Amanha in Rio de Janeiro, Brazil, 11/2023.
Knowland, K. Emma (lead), 'NASA GEOS Composition Forecast System,' GEOS-CF: Overview, Applications, and Future Directions, HAQAST TEMPO Tiger Team monthly meeting, 5/2024 (virtual).
Knowland, K. Emma (lead), 'NASA GEOS Composition Forecast System,' GEOS-CF: Overview, Applications, and Future Directions, Committee on Earth Observation Satellites (CEOS) Atmospheric Composition Virtual Constellation AC-VC Meeting, Brussels, Belgium, 10/2023.
Knowland, K. Emma (lead), 'NASA GEOS Composition Forecast System, GEOS-CF: Overview, Applications, and Future Directions,' MAC-MAQ Conference, Davis, CA, 9/2023, (poster).

Christoph Keller / Task 045
Christoph Keller, 'Overview of the NASA GEOS Composition Forecast Modeling System GEOS-CF, CanAiry Learn: Air Quality Community of Practice,' Clean Air Fund & World Resources Institute, virtual, November 22, 2023 (invited).

Niama Boukachaba / Task 046
Boukachaba, N., Zhu, Y., and Pawson, S., 2024, 'Impact of Assimilating Surface Sensitive IASI and CrIS Radiance Observations Over Land in the NASA GEOS,' 8th WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction and Earth System Prediction, May 27-30, 2024, Sweden (virtual).

Allison Collow / Task 051
Collow, A. (lead), 'Challenges in Observing, Modeling, and Forecasting the June 2023 Smoke Event over the Northeast United States,' AMS Annual Meeting, Baltimore, MD, January 2024.
Collow, A. (lead), 'Aerosol Configurations and Preliminary Evaluations for GMAO's Newest Reanalyses,' AeroCenter Annual Update, Greenbelt, MD, May 2024.

Eunjee Lee / Task 059
Lee. E. (lead), 'Predictability of land carbon and hydrology at the subseasonal-to-seasonal (S2S) scale,' Lab seminar at the School of Earth and Environmental Sciences, Seoul National University, Seoul, Korea, July 5, 2024 (invited).
Lee. E. (lead), 'Contributions of Land Initialization and Subseasonal Rainfall Forecasts to River Water Availability Forecasts in Southeast Asia,' oral presentation, Asia Oceania Geosciences Society (AOGS) meeting, PyeongChang, Korea, June 27, 2024.

Lee. E. (lead), 'Subseasonal River Water Availability Forecasts for Southeast Asia,' The 2nd NASA SERVIR Technical Meeting and Stakeholder Engagement workshop, Bangkok, Thailand, June 12, 2024
Lee. E. (lead), 'Improved sub-seasonal river water availability forecasts for southeast Asia,' poster presentation, AMS 2024 meeting, Baltimore, MD, February 1, 2024.
Lee. E. (lead), 'Seasonal forecasts of carbon and water on land, Department seminar series at the department of Earth and Environmental Sciences,' Jeonbuk National University, Jeonju, Korea, November 1, 2023 (invited).
Lee. E. (lead), 'Improved sub-seasonal river water availability forecasts for southeast Asia,' Seminar Series on Water Resources at the Department of Civil and Environmental Engineering, Yonsei University, Seoul, Korea, October 18, 2023.

Young-Kwon Lim- Task 061
Lim, Y.-K. (lead), 'Propagation of the MJO and associated moist dynamics, and the advantages of enhanced resolution in NASA's GEOS-S2S forecast system,' The 104th AMS meeting, Baltimore, MD, Jan 28–Feb 1, 2024.

Peter Norris / Task 080
Periodic updates at GMAO Modeling Group meetings and comments at the weekly GMAO Monitoring Meeting on radiative transfer issues, as necessary.

Dhruva Kathuria / Task 093
Kathuria, D. (lead), 'Fast and interpretable Bayesian algorithm for predicting plant functional traits,' EARSeL Workshop on Imaging Spectroscopy, Valencia, Spain, Apr 16-18, 2024.

Kathuria, D. (lead), 'A Fast and Interpretable Bayesian algorithm for predicting plant functional traits across scales,' Valencia, Spain, May 29-31, 2024.
Kathuria, D. (lead), 'A Bayesian approach with enhanced interpretability and uncertainty propagation for plant trait estimation using imaging spectroscopy,' IEEE International Geoscience and Remote Sensing Symposium, Athens, Greece, Jul 7-12, 2024.

Andrew Fox / Task 094
Fox, A., 'Soil Moisture & Brightness Temperature Assimilation for GEOS Reanalysis
AM Fox,' Q Liu, R Reichle - 104th American Meteorological Society (AMS) Annual Meeting, Baltimore, 2024.

Yujin Zeng / Task 124
Zeng, Y (lead), 'A Global River Routing Model based on Hydraulic Geometry and Hydrologic Catchments for Earth System Models,' AMS 2024 Annual Meeting, Baltimore, MD, February 1, 2024.

Carl Malings / Task 129
Malings, C. (lead), 'Data fusion with uncertainty quantification for sub-city-scale air quality assessment and forecasting,' Meteorology and Climate Modeling for Air Quality Conference 2023, Davis, CA, Sep 13, 2023.
Malings, C. (lead), 'Air Quality Analysis with Sensors, Satellites, and Models,' University of Arkansas Little Rock Donaghey College of Science, Technology, Engineering, and Mathematics Colloquium Series, virtual, Oct 13, 2023 (invited).
Malings, C. (lead), 'Satellites and Low-Cost Sensors: Advantages, Limitations, and Opportunities for Integration,' Seminar on Air Quality and IoT-based Air Sensors, virtual, Nov 8, 2023 (invited).
Malings, C. (lead), 'Air Quality Data Fusion with Sensors, Satellites, and Models, Google Sustainability Air Quality Journal Club,' virtual, Nov 15, 2023 (invited).
Malings, C. (lead), 'Satellite Data for Air Quality,' University of Ghana & Columbia University Air Quality Certificate Program for West Africa, virtual, Jan 18, 2024. (invited).

Malings, C. (lead), 'Supporting Global Air Quality Management Needs with a Flexible Data Fusion Tool for Estimation and Forecasting in Google Earth Engine,' American Meteorological Society 2024 Annual Meeting, Baltimore, MD, Jan 29, 2024.
Malings, C. (lead), 'Air Quality Data Fusion with Sensors, Satellites, and Models,' Seminar for Dr. Daniel Tong's research group at George Mason University, Fairfax, VA, Mar 5, 2024 (invited).
Malings, C., & Mehta, A. (GESTAR II UMBC) (co-leads), 'Applied Remote Sensing Training (ARSET): Building Capacity in Using NASA Earth Observations for Societal Benefit, 'NASA Space Apps Collective Genius Summit, virtual, Mar 8, 2024 (invited).
Malings, C. (lead), 'Air Quality at NASA: Models, Satellites, and Data Integration,' University of Miami Seminar, virtual, Apr 5, 2024 (invited).
Malings, C. (lead), 'Introduction to Satellite Remote Sensing with applications for air quality and low-cost sensors,' Air Sensors International Conference pre-conference training session, Davis, CA, Apr 30, 2024.
Malings, C. (lead), 'Air Quality Forecasting with Uncertainty Quantification by Fusing model, satellite, and in-situ data,' Presentation to South Coast Air Quality Management District, virtual, May 10, 2024 (invited).
Malings, C. (lead), 'Air Quality Forecasting with Uncertainty Quantification by Fusing model, satellite, and in-situ data,' NASA Health and Air Quality Applied Sciences Team Public Meeting, Boston, MA, Jun 4, 2024.
Malings, C. (lead), 'Integrating Low-Cost Sensor Systems and Networks to Enhance Air Quality Applications, Clean Air Monitoring and Solutions Network and India Clean Air Summit,' virtual, Aug 28, 2024 (invited).
Malings, C. (lead), AmeriGEO Workshop on Satellite-Derived Air Quality Information for the Americas, AmeriGEO Week 2024, virtual, Aug 29, 2024.

Katherine Breen / Task 140
Breen, K. H. (lead), 'AI/ML enhancement for GEOS Products,' Goddard AI Center of Excellence (GSFC ML Showcase), NASA GSFC, July 23, 2024 (invited).
Breen, K. H. (lead), 'AI enhancement for GEOS Products, 'GMAO Science Theme Meeting, NASA GSFC, April 11, 2024 (invited).
Breen, K. H. (lead), 'Deep learning enhancement for GEOS AGCM parameterizations,' GSFC 614 Lab Lunch Seminar, NASA GSFC, March 14, 2024 (invited).
Breen, K. H. (lead), 'Deep learning enhancement for Earth system models,' Institute for Pure and Applied Mathematics Workshop Reunion, UCLA Lake Arrowhead Conference Center, Lake Arrowhead, CA, December 11-15, 2023 (invited).

Manisha Ganeshan / Task 152
Ganeshan, M., Zhu, Y., Yang, E. G., Arnold, N., Palm, S. P., Santanello, J. A., ... & Wu, D. L. (2023, December), 'Utilizing Multi-Source PBL Height Observations in the NASA GEOS System: Assessing the Potential for Improved PBL Representation,' in AGU Fall Meeting Abstracts (Vol. 2023, No. 257, pp. A31M-257).

Amin Dezfuli / Task 162
Dr. Dezfuli was an invited scholar to Symposium on the State of the Environment in Iran. Oklahoma State University, April 2024.
Dr. Dezfuli gave a virtual invited talk titled, 'Climate change and extreme events in the Middle East: mechanisms and impacts,' United Nations University Institute for Water, Environment and Health (UNU-INWEH), November 2023.
Dr. Dezfuli gave a virtual invited talk titled, 'Climate change and extreme events in the Middle East: mechanisms and impacts,' University of Arizona, Department of Hydrology and Atmospheric Sciences, November 2023.
He served as Co-chair of a session entitled 'Development of Indices for Applied Climatology Research in Large Datasets,' AMS Annual Meeting, Baltimore, MD, January 2024.

Eun-Gyeong Yang / Task 163

Yang, E.-G. (lead), 'Global Planetary Boundary Layer Height Analysis and Monitoring for Multiple Observing Systems in the GEOS,' NASA Decadal Survey Planetary Boundary Layer Incubation Community Meeting, Pasadena, CA, Apr 23-24, 2024.

Yang, E.-G. (lead), 'Evaluation of Planetary Boundary Layer Structure from NASA Global Modeling and Assimilation Office's Next Retrospective Analysis Product GEOS-R21C,' 104th AMS Annual Meeting. Baltimore, MD, Jan 28-Feb 1, 2024.

Yang, E.-G. (lead), 'Global Planetary Boundary Layer Height Analysis and Monitoring for Multiple Observing Systems in the GEOS,' the Annual SED Poster Party, NASA Goddard Space Flight Center, MD, Jan 23, 2024.

Yang, E.-G. (lead), 'Assimilation of PBL Height Data from Multiple Observing Systems in the GEOS System for Global PBL Height Analysis and Monitoring System,' NASA Decadal Survey Planetary Boundary Layer Incubation Community Meeting, Oct 2-3, 2023.

Michael Murphy / Task 168

Murphy, M.J., Chattopadhyay, M., El Akkraoui, A., Damon, M. (2024) 'The Impact of Assimilating Large Volumes of GNSS Radio Occultation Observations from Spire's Commercial Constellation into NASA's GEOS.' Lecture presented at the IROWG ROMEX Workshop, EUMETSAT, Darmstadt, Germany, 17-19 April 2024.

Murphy, M.J., Chattopadhyay, M., El Akkraoui, A., Damon, M. (2024) 'The Impact of Assimilating Large Volumes of GNSS Radio Occultation Observations from Spire's Commercial Constellation into NASA's GEOS.' Lecture presented at the 104th American Meteorological Society Annual Meeting, Baltimore MD, USA, 28 Jan – 01 Feb 2024.

Murphy, M.J. (2023) 'Potential use of Polarimetric RO in Numerical Weather Prediction at GMAO.' Lecture presented at the 2nd PAZ-Polarimetric Radio Occultations User Workshop, Caltech, Pasadena, CA, USA, 28-29 November 2023 (invited).

Murphy, M.J. (2023) 'Atmospheric Rivers in the Multi-center Exercise for PAZ.' Lecture presented at the 2nd PAZ-Polarimetric Radio Occultations User Workshop, Caltech, Pasadena, CA, USA, 28-29 November 2023 (invited).

Janak Joshi / Task 176

Joshi, J. R. (lead), 'Dust Model Sensitivity to Dust Source Mask, Sandblasting Efficiency, Air Density, and Land Use: Implications for Model Improvement,' AGU Fall Meeting, San Francisco, CA, Virtual, December 13, 2023.

Joshi, J. R. (lead), 'Butterfly Effect' for dust storms, AGU Fall Meeting, San Francisco, CA, Virtual, December 13, 2023.

Meng Zhou / Task 185

Zhou, M., Wang, J., Chen, X., Gomes, J., Levy, R. C., & Miller, S. D. (2023, December). 'Link Day and Night: A Deep Learning Framework to Retrieve Global Nighttime Aerosol Optical Depth from VIIRS DNB,' AGU Fall Meeting 2023. AMS.

Zhou, M., Wang, J., Chen, X., Gomes, J., Levy, R. C., & Miller, S. D. (2024, January). 'Link Day and Night: A Deep Learning Framework to Retrieve Global Nighttime Aerosol Optical Depth from VIIRS DNB,' In 104th AMS Annual Meeting. AMS.

Fei Liu / Task 186

Liu, F. (lead), 'Detecting diurnal cycle and lifetime of pyrocumulonimbus using GOES-16 infrared data with a machine learning model,' EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024.

Liang Liao / Task 053
Liao, L. (lead), 'Study on microphysical properties of hydrometeors from space/airborne radar,' NASA PMM Science Meeting, Minneapolis, MN, 18-22 September 2023.
Liao, L. (lead), 'Hydrometeor phase identification from multi-frequency Doppler radar,' NASA IMPACTS Science Meeting, Annapolis, MD, 24-25 October 2023.
Liao, L. (lead), 'DPR Path Attenuation Estimates,' NASA ISFM panel meeting, Greenbelt, MD, 28 February 2024.
Liao, L. (lead), 'Application of NASA multi-frequency airborne Doppler radar for identification of hydrometeor phases,' International Precipitation Working Group, Tokyo, Japan, 15-18 July 2024.
Liao, L. (lead), 'Implementation of snow retrieval algorithm to the ER-2 multi-frequency radar', NASA IMPACTS Science Meeting, Boston, MA, 30-31 July 2024.

Hyokyung Kim / Task 054
Kim, H. (lead), 'Effects of AutoSNOW changes on Path Integrated Attenuation Estimates for GPM-DPR,' NASA Precipitation Measurement Mission (PMM) Science Team Meeting, Minneapolis, MN, September 17-22, 2023.
Kim, H., 'Implementation of Snow Retrieval Algorithm to the ER-2 Multi-Frequency Radar,' IMPACTS 2024 Science Team Meeting, Boston, MA, July 30-31, 2024
Kim, H., 'Application of NASA Multi-Frequency Airborne Doppler Radar for Identification of Hydrometeor Phases, 11th Workshop of International Precipitation Working Group (IPWG-11),' Tokyo, Japan, July 15-18, 2024.

Mircea Grecu / Task 055
Grecu, M. (2023). 'Updates in the GPM CORRA algorithm,' 2023 NASA PMM Science Team Meeting, September 18–22, 2023.
Olson, W.S., Grecu, M., Pettersen, C., Richter, J., Tokay, A., Pippitt, J.L., Wolff, D.B. and Stough, S.M., (2023). 'Validation of Ice-Phase Precipitation Estimates Derived from GPM Satellite Combined Radar-Radiometer Observations,' AGU23, 13 December 2023, San-Francisco, CA.
Grecu, M, G Heymsfield, SD Nicholls (2024). 'A NASA IMPACTS-based investigation of uncertainties in the GPM combined algorithm estimates of winter precipitation,' 104th AMS Annual Meeting, 28 January - 1 February, 2024, Baltimore, MD.
Grecu, M., PI (2024) 'New Multi-layered Graph Approaches for the Prediction of Extreme Events Driving Compound Coastal Flooding,' Proposal submitted to the NSF Collaborative Research CAIG Program, declined.

Mei Han / Task 068
Han, M. (lead), 'Supercooled Liquid Water at the Top of a Snow-Producing Nimbostratus Cloud and Its Association with Gravity-Wave Breaking and Turbulence During IMPACTS,' NASA IMPACTS Science Team Meeting, Boston, MA, July 30 – 31, 2024.
Han, M. (lead), 'Observations of Supercooled Liquid Water Layers at the top of Snow-Producing Nimbostratus Clouds During the IMPACTS Campaign,' AMS 104th Annual Meeting, First Symposium on Cloud Physics, Baltimore, MD, January 28 – February 1, 2024.
Han, M. (lead), 'Planning of Airborne Under Flights for GPM Overpasses and Comparing GPM Observations to Airborne Remote Sensing and In-situ Data During IMPACTS Campaign,' NASA Precipitation Measurement Missions Science Team Meeting, Minneapolis, MN, September 18-22, 2023.
Han, M. (lead), 'Understanding Supercooled Liquid Water Near the Top of Cold Clouds During the IMPACTS Campaign,' AMS 40th Conference on Radar Meteorology, Minneapolis, MN, August 27 – September 1, 2023.

Jasper Lewis / Task 101
Lewis, J. (lead), 'EarthCARE Cal/Val Using the NASA Micro Pulse Lidar Network (MPLNET),' ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop, Frascati, Italy, Nov 13 – 17, 2023.
Lewis, J. (lead), 'Evaluating uncertainties in PBL height retrievals from space-based lidars compared to MPLNET,' AGU Fall Meeting, San Francisco, CA, Dec 11 – 15, 2023.
Lewis, J. (lead), 'Utilizing surface-based observations from the Micro Pulse Lidar Network (MPLNET) for validation of space-based satellite missions,' EGU General Assembly, Vienna, Apr 14 – 19, 2024.

William Olson / Task 108
Olson, W. S., Grecu, M., Pelissier, C., Schrom, R., Kuo, K.-S., Fenni, I., Loftus, A., Adams, I., Johnson, B., Pettersen, C., Richter, J., Tokay, A., Kirstetter, P., Wang, J., Wolff, D., Pippitt, J., Stough, S., Liao, L., Meneghini, R., Huffman, G., 'Integration and Testing of Ice and Mixed-Phase Particle Models for Combined Radar-Radiometer (CORRA) Estimation of Precipitation,' Precipitation Measurement Missions 2023 Science Team Meeting, Minneapolis, MN, September 18-22, 2023 (invited).
Olson, W. S., Grecu, M., Ringerud, S., Kwiatkowski, J., 'PMM Combined Radar-Radiometer Algorithm (CORRA),' Precipitation Measurement Missions 2023 Science Team Meeting Minneapolis, MN, September 18-22, 2023, (invited).
Olson, W. S., Grecu, M., Pettersen, C., Richter, J., Tokay, A., Pippitt, J., Wolff, D., and Stough, S., 'Validation of Ice-Phase Precipitation Estimates Derived from GPM Satellite Radar-Radiometer Observations,' American Geophysical Union 2023 Fall Meeting, San Francisco, CA, December 11-15, 2023.

Ali Tokay / Task 123
Tokay, A., Helms, C. N., Wolff, D. B., Cerrai, D., and Spaulding, A., (2023), 'Radar snowfall relationships during IMPACTS,' 40th AMS Radar Meteorology Conference, poster presentation, Minneapolis, Minnesota.
Tokay, A., Wolff, D. B., Helms, C. N., Cerrai, D., Filipiak, B., and Inglis, B., (2024), 'Can we measure falling snow?' Engineering and Weather, invited talk, AMS student conference, Baltimore, Maryland
Inglis, B., Tokay, A., and Helms, C. N., (2024) 'Radar snowfall estimate in Southern New England,' First Cloud Physics Symposium, 2024 AMS Annual Meeting, poster presentation, Baltimore, Maryland

Yuli Liu / Task 149
Liu, Y. (lead), 'Tomographic retrieval algorithm for reconstructing 2D ice cloud sturcture using along-track scanning (sub)millimeter-wave radiometer, 'ARTS Workshop, Sweden, Jun 4-7, 2024.

Sergey Korkin / Task 182
Korkin, S., Sayer, A.M., Ibrahim, A., and Lyapustin, A., 'The Paper-and-Code Bundle Concept in Atmospheric Radiation Science,' 104th American Meteorological Society Annual Meeting (Kuo-Nan Liou Symposium), Baltimore MD, USA, January 28 - February 1, 2024 (poster).
Korkin, S., Sayer, A.M., Ibrahim, A., and Lyapustin, A., 'The Paper-and-Code Bundle Concept in Atmospheric Radiation Science,' NASA GSFC Annual Sciences and Exploration Directorate New Year's Poster Party, Greenbelt, MD, January 23, 2024 (poster).

Photo Left: Sergey Korkin presenting poster at AMS in Baltimore, January 2024. Photo courtesy Dr. Amir Ibrahim (GSFC Code 616).

Sergey Korkin / Task 001

Korkin S., Sayer A.M, and Ibrahim A., 'Transfer of Knowledge and Experience Using a Paper-and-Code Bundle Paradigm: An Atmospheric Radiation Showcase,' American Geophysical Union Fall Meeting, San-Francisco CA, USA, December 11-15, 2023 (poster).

Korkin S., and Lyapustin A., 'Addressing the Need for Azimuthally Dependent Diffuse Transmittance in Polarized Atmospheric Correction: Radiative Transfer Approach,' American Geophysical Union Fall Meeting, San-Francisco CA, USA, December 11-15, 2023 (talk).

Korkin S., 'A Personal Journey in Radiative Transfer Codes Development,' Leidos Innovations Center (host: Dr. M. J. Egan,) - July 23, 2024 (invited).

Korkin S., 'Decision trees and random forests: basic concepts explained via code snippets,' 610AT Machine Learning Applications Seminar Series, NASA Goddard Space Flight Center, Greenbelt, MD (hosts: Drs. M. Himes & Z. Fasnacht, Code 614) - April 3, 2024.

Korkin S., 'Radiative Transfer Approach to Atmospheric Correction: Azimuthal Dependence of Diffuse Transmittance, Polarization, and a Review of a Recent Paper with Snippets of Code,' Ocean Ecology Laboratory Seminar, NASA Goddard Space Flight Center, Greenbelt, MD (host: Dr. E. Sirk, Code 616) - November 2, 2023 (invited).

Korkin S., 'Partial refactoring of a widely used code for light scattering by spheroids,' Atmospheric Chemistry and Dynamics Laboratory (informal), NASA Goddard Space Flight Center, Greenbelt, MD (host: Dr. N. Krotkov, Code 614) - October 24, 2023 (invited).

Sergey Korkin presenting at the 2023 AGU Annual Fall Meeting, San Francisco, CA.

Jackson Tan / Task 018
Tan, J., Major, 'Changes and Early Results from IMERG V07,' NASA PMM Science Team Meeting, Minneapolis, MN, Sep 18-22, 2023.
Tan, J., 'Overview of IMERG, NASA SPoRT GPM Application Stakeholder Summit,' virtual, Oct 11, 2023.
Tan, J., IMERG V07: 'Impact of Major Changes,' AGU Fall Meeting, San Francisco, CA, Dec 11-15,2023.
Tan, J., 'Global Snowfall as Revealed by IMERG V07,' AMS Annual Meeting 38th Conference on Hydrology, Baltimore, MD, an 28 – Feb 1, 2024.
Tan, J., 'GPM Mission Overview and IMERG V07,' GPM Mentorship Program, virtual, Mar 13, 2024.
Tan, J., 'Monitoring Clouds and Precipitation from Space,' City College of New York Department of Earth and Atmospheric Sciences, New York, NY, Apr 9, 2024 (invited).
Tan, J., 'Global Snowfall as Revealed by Satellite Precipitation Products,' GEWEX Open Science Conference, Sapporo, Japan, Jul 7-12, 2024.
Tan, J., 'Understanding Global Cloudiness through Regimes of Regimes,' GEWEX Open Science Conference, Sapporo, Japan, Jul 7-12, 2024
Tan, J., 'An Automated Quality Control Scheme for GPM Satellite Precipitation Products,' 11th Workshop of the International Precipitation Working Group, Tokyo, Japan, Jul 15-18, 2024.

Cornelius Csar Jude H. Salinas / Task 035
Salinas, C.C.J. (lead) and Wu, D.L., 'Dynamics revealed from the High Correlation between the Mesospheric Summer Westward Jet and the Phase Speed of a Decaying Quasi-2-day Wave,' AMS 2024, Baltimore, Maryland, Jan 28 – Feb 1, 2024.

Young-Kwon Lim / Task 036
Lim, Y.-K. (lead), 'Decadal changes in the Antarctic sea ice response to the changing ENSO in the last four decades,' The 104th AMS meeting, Baltimore, MD, Jan 28 – Feb 1, 2024.

Lipi Mukherjee / Task 037
Mukherjee, L. (lead), 'Detection of Aerosol Layer Height and Optical Depth By Twilight VIS/NIR Radiometry,' AGU Fall Meeting, San Francisco, CA, Dec 11-15, 2023.

Dongmin Lee / Task 038
Lee, D, 'Regimes of Cloud Vertical Structure from Active Observations,' CloudSat/CALIPSO Science Team Meeting, Washington D.C., Oct 10-12, 2023.

Nayeong Cho / Task 039
Cho, N. (lead), 'Active views of passive cloud 'regimes of regimes',' AGU 2023 Annual Meeting, Poster, San Francisco, CA 11-15 December, 2023.
Cho, N.(lead), 'Active views of passive cloud 'regimes of regimes',' CloudSat/CALIPSO Annual Science Program Review, Oral Presentation, Washington D.C, 10-12 October, 2023.

Daeho Jin / Task 040
Jin, D. (lead), 'ENSO disrupts boreal winter CRE feedback,' AGU Fall Meeting, San Francisco, CA, Dec 11-15, 2023 (virtual, A12-07).
Jin, D. (lead), 'ENSO disrupts boreal winter CRE feedback,' 30th ECS Symposium on 01.23.2024, virtual. (https://www.youtube.com/watch?v=bW8qrI89yQc).
Jin, D. (lead), 'MODIS-based evaluation of low cloud amount indices: 'Do the spatiotemporal scales matter?' 2C.1 in 37th Conference on Climate Variability and Change, 104th AMS Annual Meeting, Baltimore, MD, Jan 29-Feb 1.

Guoyong Wen / Task 043
Wen, G. (lead), 'The Behaviour of DSCOVR/EPIC Reflectance near Perfect Backscattering Angles,' AGU Fall Meeting Annual Meeting, San Francisco, CA, December 11-15, 2023.
Wen, G. (lead), 'Aerosol properties near clouds from MODIS and CALIPSO,' AMS Annual Meeting, Baltimore, MD January 28 to February 1, 2024.

Alfonso Delgado Bonal / Task 044
Delgado Bonal, A. (Author), Marshak, A., Yang, Y., Oreopoulos, L., AGU 2023 Fall Meeting, Poster, 'Diurnal variability of Cloud Optical Thickness derived from DSCOVR/EPIC observations,' NASA Goddard Space Flight Center, Peer Reviewed? No, Published in Proceedings? No. (December 12, 2023).
Delgado Bonal, A. (Author), Marshak, A., Yang, Y., Oreopoulos, L., DSCOVR 9th STM, Poster, 'Cloud Optical Thickness variability from DSCOVR/EPIC observations,' NASA Goddard Space Flight Center, (October 9, 2023).

Surendra Bhatta / Task 098
Dr. Bhatta presented two of his research in AGU2023, one as lead author and the other as co-author.
S Bhatta, Y Yang, 'Machine Learning Model for Operational MERRA2 BLSN Data Product Over Antarctica.'

Tamás Várnai / Task 102
Várnai, T., A. Marshak, A. Kostinski, Y. Yang, and Y. Zhou, 'Cloud composition from the analysis of sun glints off horizontally oriented ice crystals,' 104th Annual Meeting of the American Meteorological Society, Baltimore, MD, February 1, 2024 (meeting dates: Jan. 28-Feb. 1).
Várnai, T., A. Marshak, A. Kostinski, Y. Yang, Y. Zhou 'EPIC observations of sun glint off ice clouds,' San Francisco, CA, December 11, 2023 (meeting dates: Dec. 11-15).

Yaping Zhou / Task 106
Zhou, Y., Y. Yang, P.-W. Zhai, 'Evaluation of the stability and calibration of EPIC oxygen bands with observations and radiative transfer model simulations over South Pole,' DSCOVR STM Meeting, Oct 16-17, 2023.
Zhou Y.P., K.-M. Xu, 'Characteristics of event-based extreme precipitation in the tropics and its large-scale environment,' AGU, San Francisco, Dec 11-15, 2023
Yaping Zhou, and K. M. Xu (oral), 'Characteristics of event-based extreme precipitation in the tropics and mid-latitude land regions,' AMS, Baltimore, Jan 28-Feb 1, 2024.

Tamas Varnai, Alexander Marshak, Alexander B Kostinski, Yuekui Yang, Yaping Zhou, EPIC observations of sun glint off ice clouds, AGU, San Francisco, Dec11-15, 2023 Tamas Varnai, and A. Marshak, A. Kostinski, Y. Yang, and Y. Zhou, 'Cloud Composition from the Analysis of Sun Glints Off Horizontally Oriented Ice Crystals,' AMS, Baltimore, Jan 28-Feb 1, 2024.
Yingxi Rona Shi, and R. C. Levy, L. Remer, S. Mattoo, P. Gupta, V. R. Sawyer, and Y. Zhou, 'Working Towards Dark Target Aerosol Product Synergy Among Geo and Leo Sensors,' AMS, Baltimore, Jan 28-Feb 1, 2024.
Hongbin Yu, NASA Goddard Space Flight Center, Greenbelt, MD; and Z. Zhang, J. Zheng, Q. Tan, Y. R. Shi, Y. Zhou, and M. Chin, 'Developing a Comprehensive and Augmented Multi-decadal Remote-sensing Observations of Dust (CAMRO-Dust) Data Record for Earth Science Research and Applications,' AMS, Baltimore, Jan 28-Feb 1, 2024.

Anin Puthukkudy / Task 110
McBride, B., Sienkiewicz, N. C., Xu, X., Puthukkudy, A., Smith, R., Remer, L. A., Martins, J. V. (2023), 'HARP2 Pre-Launch Instrument Performance Testing and Results.' AGU23. Current Status is Published.
Martins, J. V., Puthukkudy, A., Xu, X., Smith, R., Sienkiewicz, N. C., Borda, R. A. F., McBride, B., Remer, L. A. (2023), 'The capabilities of the HARP2 instrument to retrieve aerosol, cloud, and surface properties from the PACE observatory,' AGU23. Current Status is Published.
Invited talk at NASA GSFC on 'Preliminary aerosol retrievals from HARP2,' NASA GSFC, May, 2024.
Talk at the CAMP2Ex science team meeting 2024, 'Assessment of Aerosol Retrieval Accuracy with Multi-Angle Polarimeters Using Synthetic Data and Particle Size Distribution from the CAMP2Ex Field Campaign,'
https://espo.nasa.gov/sites/default/files/pages/CAMP2ExSTM_Agenda_Semifinal3_20240221.pdf (https://docs.google.com/presentation/d/1mHznba5tpuqEmnWA-NaCknaxo-gVib2x/edit#slide=id.p1), February 28, 2024, Pasadena, CA.
Jayasinghe, N., Espinosa, R., Puthukkudy, A. and Martins, J.V., 2024, January, 'Aerosol Retrievals using GRASP from HARP CubeSat Data in Near Cloud Regions: the Impact of Different Cloud Masking Techniques.' In the 104th AMS Annual Meeting. AMS.
Regmi, G., Espinosa, R., Martins, J.V., Puthukkudy, A., Saito, M., Dubovik, O. and Kemppinen, O., 2024, January, 'A Comparative Study of Combined Lidar-Polarimeter Aerosol Retrievals using Spheroidal and Hexahedral Particle Shape Models with Data from the ORACLES Field Campaigns,' 104th AMS Annual Meeting.
Martins, J.V., Puthukkudy, A., Xu, X., Smith, R., Sienkiewicz, N.C., Fernandez Borda, R.A., McBride, B. and Remer, L., 2023, December, 'The capabilities of the HARP2 instrument to retrieve aerosol, cloud, and surface properties from the PACE observatory,' In AGU Fall Meeting Abstracts (Vol. 2023, No. 923, pp. GC11H-0923).
McBride, B., Sienkiewicz, N.C., Xu, X., Puthukkudy, A., Smith, R., Remer, L. and Martins, J.V., 2023, December, 'HARP2 Pre-Launch Instrument Performance Testing and Results,' In AGU Fall Meeting Abstracts (Vol. 2023, No. 922, pp. GC11H-0922).
Puthukkudy, A., Martins, J.V., et al., 'Validating aerosol products from the HARP family of polarimeters using AERONET data,' In AERONET Science and Application Exchange September 17-19, 2024.

Sujung Go / Task 119
Go, S., Lyapustin A, Wang Y, Korkin S, Choi M., 'Developing a hyperspectral atmospheric correction for TROPOMI data over land using MAIAC algorithm: preliminary results and inter-comparison,' AGU23, December 14, 2023.

Myungje Choi / Task 120
Choi, M. (lead), 'MAIAC v3 Algorithm for synergistic aerosol characterization including AOD, spectral absorption and height,' DSCOVR EPIC and NISTAR STM, NASA GSFC, in person, Oct 16-17, 2023.
Choi, M. (lead), 'MAIAC smoke aerosols from EPIC measurements including BC and BrC light-absorbing components,' AGU Fall Meeting, San Francisco, CA, in person, Dec 11-15, 2023.
Choi, M. (lead), 'Light-absorbing BC and BrC components of biomass burning smoke aerosol from DSCOVR EPIC measurements,' AeroCenter CPC Update, NASA GSFC, in person, May 22, 2024.

Choi, M. (lead), 'Validation and uncertainty estimation for MAIAC EPIC smoke AOD and spectral SSA using AERONET' at the AERONET Science and Application Exchange 2024 on 17-19 September 2024.
Choi, M. (lead), 'Global smoke characterization using MAIAC from DSCOVR EPIC measurement record' at the DSCOVR EPIC and NISTAR STM on 16-18 October 2024.

Yingxi Shi / Task 132

Shi, Y., R. Mishra, Z. Zhang, R. C. Levy, L. A. Remer, and J. V. Martins, 'Retrieving Aerosol Absorption in Dynamic Smoke Plumes using Geostationary Observations,' The international Radiation Symposium 2024, Hangzhou, China, June 2024.
Shi, Y., R. C. Levy, L. A. Remer, S. Mattoo, P. Gupta, Y. Zhou, V. Sawyer, and Q. Tang, 'Working Towards Dark Target Aerosol Product Synergy Among Geo and Leo Sensors – An Uncertainty and Validation Study,' SIAM Uncertainty Quantification 2024, Trieste, Italy, February 2024.
Shi, Y., R. C. Levy, L. A. Remer, S. Mattoo, P. Gupta, Y. Zhou, and V. Sawyer, 'Working Towards Dark Target Aerosol Product Synergy Among Geostationary Orbit (GEO) and Low Earth Orbit (LEO) Sensors,' AMS Annual Meeting, 26th Conference on Satellite Meteorology, Oceanography, and Climatology, Baltimore, MD, January 2024.
Shi, Y., Remer, L. A., PACE science meeting 2023 Poster, 'Extrapolating Visible AOD to Ultra-Violet spectrum using Machine Learning,' (February 28, 2023).

Jae N. Lee / Task 114

Lee, J. N. (lead), 'Quasi-quadrennial Oscillations of the Polar Mesospheric Clouds,' Dec. 12-16, 2023, AGU Fall meeting, San Francisco, CA.
Lee, J. N. (lead), 'Non-Gaussian Features of the TOA SW Flux from MISR and CERES,' Dec. 20-21, 2023, MISR science team meeting, Pasadena, CA.
Lee, J. N. (lead), 'The Absent Solar Cycle Response of the Polar Mesospheric Clouds,' Oct. 18-21, 2023, Sun Climate Symposium 2023, Flagstaff, AZ.

Mijin Kim / Task 165

Kim, M. (lead), 'Toward GEO and LEO Synergy in Dark Target Aerosol Products: Improving Surface Reflectance Parameterization,' AGU Fall Meeting, San Francisco, CA, 11-15 Dec 2023 (Vol. 2023, No. 2619, pp. A23R-2619).

Colten Peterson / Task 170

Peterson, C., Meyer, K., Platnick, S., Wind, G., Amarasinghe, N. 'Evaluation of the MODIS/VIIRS Cloud Team's Pixel-Level Cloudy-Sky Radiative Flux Datasets using Ground- and Space-based Radiation Measurements,' Third Workshop of the International Cloud Working Group (Darmstadt, Germany), February 27, 2024 (oral).
Peterson, C., Meyer, K., Platnick, S., Wind, G., Amarasinghe, N. 'Evaluation of the NASA MODIS-VIIRS Continuity Cloud Product's Pixel-level Radiative Flux Datasets,' American Meteorological Society Meeting (Baltimore, MD), January 30, 2024 (poster).
Peterson, C., Meyer, K., Platnick, S., Wind, G., Amarasinghe, N. 'The MODIS/VIIRS Cloud Team's Pixel-Level Cloudy-Sky Radiative Flux Datasets,' American Geophysical Union Fall Meeting. (San Francisco, CA), December 15, 2023 (oral).

Yaping Zhou / Task 191

Antonia Gambacorta, Rachael Kroodsma, Alexander Kotsakis, James P Mackinnon, Joseph A Santanello Jr, John M Blaisdell, Robert I Rosenberg, Yaping Zhou, Narges Shahroudi, Isaac Moradi, Edward P Nowottnick, Meloe S Kacenelenbogen, Kenneth Edward Christia, Jie Gong, Fabrizio Gambini, Mark Stephen, Jeffrey R Piepmeier and Robert Swap, 'A Combined Passive-Active, Multi-Sensor Approach to Earth's Planetary Boundary Layer (PBL) Sounding,' AGU, San Francisco, Dec 11-15, 2023.

Yaping Zhou, Antonia Gambacorta, John Blaisdell, Robert Rosenberg, Narges Shahroudi, Christopher Grassotti, Yong-Keun Lee, Alexander Kotsakis, Isaac Moradi, 'Developing Physical Retrievals for Hyperspectral Microwave Sensors,' IRS2024, June 17-21, 2024 Hangzhou, China.

Yaping Zhou, Antonia Gambacorta, John Blaisdell, Robert Rosenberg, Narges Shahroudi, Christopher Grassotti, Yong-Keun Lee, Alexander Kotsakis, Isaac Moradi, Christopher Kung, 'Adapting Microwave Retrieval System (MiRS) for Hyperspectral Microwave Sensors,' NASA Decadal Survey Planetary Boundary Incubation Community Meeting, Pasadena, CA, April 23-24, 2024.

Alexander Matus / Task 195
Matus, A. (lead), 'Enhancing PM2.5 air quality retrievals using CATS lidar and GEOS-5 model data,' NASA Health and Air Quality Applied Science Team (HAQAST) Meeting, Salt Lake City, Utah, October 20, 2023.
Matus, A. (lead), 'Disrupting Equilibrium: A Climate Data Record of Radiative Forcing and Feedbacks,' Global Energy and Water Exchanges (GEWEX) Open Science Conference, Sapporo, Japan, July 10, 2024.

Atmospheric Chemistry and Dynamics Laboratory CODE 614

Daniel Anderson / Task 013
Anderson, D., (lead), 'Constraining tropical OH trends and variability with machine learning and satellite observations of its drivers,' CCMI Annual Meeting, Toulouse, France, Oct. 4, 2023.
Anderson, D., (lead), 'Trends and variability of the tropical hydroxyl radical constrained with satellite proxy data,' AMS Annual Meeting, Baltimore, MD, Jan. 30, 2024.
Anderson, D., (lead), 'Towards constraints on the tropospheric oxidizing capacity: the role of models, machine learning and satellite observations,' UMD College Park Atmospheric and Oceanic Sciences Departmental Seminar, College Park, MD, Mar 3, 2024. Invited.

Junhua Liu / Task 014
Liu, J. (lead), 'Interannual variability and trend analysis of atmospheric formaldehyde in boreal autumn over recent decades,' AMS, Baltimore, MD, Jan. 2024.

Sarah Strode / Task 015
Strode, S (lead), 'Theory and Analysis Working Group,' NDACC Steering Committee meeting, Murnau, Germany (attended virtually), Sept. 12, 2023.
Strode, S (lead), 'Linking Interannual and Inter-Model Variability in OH to Meteorological Variability,' poster presented at the AMS Annual Meeting, Baltimore, MD, Feb. 1, 2024.

Fei Liu / Task 019
Liu, F. (lead), 'High-resolution mapping of nitrogen oxide emissions from TROPOMI retrievals of tropospheric nitrogen dioxide columns,' AMS Annual Meeting, Baltimore, MD, January 28 to February 1, 2024.
Liu, F. (lead), 'High-resolution mapping of nitrogen oxide emissions in large US cities from satellite retrievals of tropospheric nitrogen dioxide columns,' 2nd Annual Air Quality Research and Development Consortium (AIRDC), George Mason University Fairfax campus, June 17, 2024.
Liu, F. (lead), 'High-resolution mapping of nitrogen oxide emissions in large US cities from TROPOMI retrievals of tropospheric nitrogen dioxide columns,' AQRD Expert Seminar, virtual, Mar 28, 2024 (invited).

Lok N. Lamsal / Task 021
Lamsal, L. (lead), 'Towards a long-term global NO2 data record: applying a consistent retrieval algorithm to OMI and TROPOMI,' AGU Fall Meeting, San Francisco, December 16, 2023 (poster).

Lamsal, L. (lead), 'Rapid Satellite Nitrogen Dioxide Processing Using Machine Learning,' AMS, Baltimore, January 30, 2024.
Lamsal, L. (lead), 'OMI Collection 4, Version 5 Nitrogen Dioxide Standard Product: Algorithm Updates and Assessment,' OMI-TROPOMI Workshop/Science Team Meeting, Colorado, June 3, 2024 (oral)

Hirenkumar T. Jethva / Task 047
Jethva, H. (lead), 'One-and-half Decade Long Global Retrieval Dataset of UV-VIS Spectral Optical Depth and Single-scattering Albedo of Absorbing Aerosols above Clouds from A-train Synergy,' AGU Fall Meeting, San Francisco, eLightening presentation, 11-15 December 2023.
Jethva, H. (lead), 'One-and-half Decade Long Global Retrieval Dataset of UV-VIS Spectral Optical Depth and Single-scattering Albedo of Absorbing Aerosols above Clouds from A-train Synergy,' 104th AMS Annual Meeting, Kuo-Nan Liou Symposium, Poster presentation, 28 Jan – 1 Feb, 2024.

Feng Li / Task 064
Li, F. (lead), 'Transient and Seasonal Response of Southern Ocean Sea Surface Temperature and Antarctic Sea Ice to Stratospheric Ozone Recovery,' 22nd AMS Conference on Middle Atmosphere, Burlington, VT, June 24-27, 2024.

Jin Liao / Task 070
Liao, J. (lead) et al., 'Comparison of satellite formaldehyde retrievals (OMI SAO, OMPS-NPP SAO, and OMI BIRA-IASB) in the remote ocean atmosphere with NASA ATom aircraft observations in four seasons,' AGU Fall Meeting, San Francisco, CA, in person, Dec 11-15, 2023.

Ghassan Taha / Task 084
Taha, G. (lead), 'The Ozone Mapping and Profiler Suite (OMPS) Limb Profiler (LP) Aerosol Retrieval: Global 3-D View of the Stratospheric Aerosol, summer school on volcanic effects on atmosphere and climate,' University of Greifswald, Germany, September 4-8, 2023 (invited).
Taha, G. (lead), 'Aerosol retrieval from the Ozone Mapping and Profiler Suite (OMPS) Limb Profiler (LP),' Perspectives on Stratospheric Aerosol Observations meeting at the International Space Science Institute (ISSI), Bern, Switzerland, October 10-12, 2023 (invited).
Taha, G. (lead), T'racing the Trail of the 2022 Hunga Tonga-Hunga Ha'apai Aerosol Plume: Two Years On,' 104th AMS Annual Meeting, Baltimore, Maryland, January 28 to February 1, 2024.

Zhining Tao / Task 087
Tao, Z. (lead), 'Emissions characterization and smoke transport of a prescribed fire,' 104th AMS Annual Meeting, Baltimore, MD, 28 January - 1 February 2024.
Tao, Z. (lead), 'The role of anthropogenic aerosols on radiation, PBL processes, and air quality – A case study over the contiguous United States,' International Radiation Symposium, Hangzhou, China, 17-21 June 2024.
Tao, Z. (lead), 'Urban effect on air pollution and precipitation,' 21st AOGS Annual Meeting, Pyeongchang, South Korea, 23-28 June 2024.

Dongchul Kim / Task 088
Kim, D., et al., 'Dust source attribution to the global land and ocean regions,' Dec. 16, 2023, AGU Fall Meeting, San Francisco, CA.

Kim, D., et al., 'Dust source attribution to the global land and ocean regions,' Oct. 16, 2023, AEROCOM Workshop, Richland, WA.

Jerry Ziemke / Task 102
Ziemke, J. R. (lead), 'Current status of EPIC tropospheric ozone and anomalously low NH amounts in 2020-2022,' DSCOVR EPIC/NISTAR meeting. NASA GSFC, MD, in person talk,16-18 October 2023.

Ziemke, J. R. (lead), 'NASA tropospheric ozone from EPIC, OMI, and OMPS satellite measurements: Current status and science results,' CEOS AC-VC meeting, Brussels, Belgium, virtual talk, 24-27 October 2023.
Ziemke, J. R. (lead), 'Evidence of anomalously low free-tropospheric ozone in the NH from satellite measurements starting 2020 during the Covid pandemic and still continuing,' AGU Fall Meeting, San Francisco, CA. virtual talk, 25 January 2024.
Ziemke J. R. (lead), 'Evaluation of TEMPO total ozone measurements,' TEMPO Validation Kickoff meeting, virtual talk, 7 February 2024.
Ziemke J. R. (lead), 'Anomalously low free-tropospheric ozone in the NH starting 2020 during the Covid pandemic and continuing: Impact on trends,' OMI-TROPOMI meeting, Boulder, CO, virtual talk, 3-6 June 2024.
Ziemke J. R. (lead), 'Anomalously low free-tropospheric ozone in the NH starting 2020 during the Covid pandemic and continuing: Impact on trends,' Quadrennial Ozone Symposium, Boulder, CO, virtual talk, 15-19 July 2024.

Amir H. Souri / Task 111
Souri, A. H. (lead), 'Exploring Biases and Long-term Trends in Tropospheric OH: A Synergistic Approach with Model Simulations, Interpretable Machine Learning, and Satellite Observations,' EGU General Assembly 2024, Vienna, Austria, in person. Apr 14–19, 2024.
Souri, A. H. (lead), 'Enhancing Long-Term Trend Simulation of OH Through the Synergy of Model Simulations and Aura Ozone Monitoring Instrument (OMI) NO2 and HCHO Retrievals,' AGU Fall Meeting, San Francisco, CA, in person, Dec 11-15, 2023

Huisheng Bian / Task 127
Bian, H., (lead), 'Improved Simulation of Biomass Burning Aerosol Lifetimes and Optical Properties in the NASA GEOS Earth System Model During the NASA ORACLES Field Campaign,' AeroSat Workshop Oct. 19, 2023 (invited).
Bian, H., (lead), 'Observationally constrained analysis of sulfur species in the marine atmosphere – Integrating NASA ATom measurements and AeroCom model simulations,' AeroCom Workshop, Oct. 16, 2023.
Bian, H., (lead), 'Recent decadal trend of the Pacific westerly jet in response to anthropogenic aerosol emissions,' AeroCenter annual meeting, May 22, 2024.

Anne Thompson / Task 138
SAGE Science Team Meeting (12 Sept 2023), Atlanta: 'Updates on Tropical SHADOZ Sonde Data Quality Assurance & Trends.'
AGU Talk, December 12, 2023: 'Homogenized Ground-based and Profile Ozone Datasets from TOAR-II/HEGIFTOM: Methods and Station Trends.'
AMS Talk Jan 29, 2024): 'Trends in Free Tropospheric Ozone from Homogenized Ground-based and Profile Datasets (1995-2020): The TOAR II/HEGIFTOM Project.'
GMAC Talk (May 22, 2024): 'Global Ground-based Tropospheric Ozone Measurements: Reference Trends (2000-2022) from the TOAR II/ HEGIFTOM Project.'
Quadrennial Ozone Symposium (Talk, July 16, 2024): 'Tropical Tropospheric Ozone Trends (1990 to 2022): A Re-evaluation Based on SHADOZ & IAGOS Profiles & TOMS/OMI Columns.'

Nigel Richards / Task 143
Richards, N. A. D. (lead), 'Comparisons of Ozone Profile Retrievals From the OMPS Limb Profiler and ACE-FTS,' SCISAT 20th Anniversary Meeting, Canadian Space Agency, Montreal, Canada, Oct 16-18, 2023.
Richards, N. A. D. (lead), 'Validation of OMPS LP Ozone Profile Retrievals Using Solar Occultation Satellite Measurements,' AGU Fall Meeting, San Francisco, CA, Dec 11-15 Dec, 2023.
Richards, N. A. D. (lead), 'Validation of OMPS LP Ozone Profile Retrievals in the Post-MLS Era, Quadrennial Ozone Symposium,' Boulder, CO, Jul 15-19, 2024.

Keith Evans / Task 159
Evans, K. (lead), 'Has NO2 in Metropolitan Areas Returned to Pre-COVID-19 Levels as Measured by OMI Satellite Data?' 2023 Fall Meeting, AGU, San Francisco, CA, 11-15 Dec 2023.

Caterina Mogno / Task 172
Mogno, C. (Author & Presenter), Colarco, P. (Author), Poster Presentation, 'Assessing GEOS-CCM aerosol optical properties using in-situ observations over the CONUS region,'
Poster presentation, AeroCenter Annual Meeting 2024, NASA GSFC, May 22, 2024.
Mogno, C. (Author & Presenter), Colarco, P. (Author), Collow, A. (Author), Strode, S. A. (Author), Valenti,V. (Author), Liang, Q. (Author), Oman, L. (Author), Knowland, K. E. (Author),
Evaluation of NASA GEOSCCM Simulated Trends in Global Surface PM and Aerosol Optical Properties using Ground-Based and Satellite Observations,' e-Poster Presentation, 26th Conference on Atmospheric Chemistry, American Meteorological Society Annual Meeting (AMS24), Baltimore, MD, January 2024.
Mogno, C. (Author & Presenter), Colarco, P. (Author), Collow, A. (Author), Strode, S. A. (Author), Valenti, V. (Author), Liang, Q. (Author), Oman, L. (Author), Knowland, K. E. (Author) 'Analysis of Simulated and Observed Trends in Global Surface PM2.5 and Aerosol Optical Properties from 1958 to 2018 Using the NASA GEOSCCM,' oral Presentation Geophysical Union Annual Meeting 2023 (AGU23), San Francisco, CA December 2023.
Mogno, C. (Author & Presenter), Colarco, P. (Author), Poster Presentation, 'Investigating the relationship between modeled PM2.5 concentrations and surface aerosol optical properties in the NASA GEOSCCM,' poster presentation, AeroCom/AeroSAT Annual Meeting 2023, Pasco, WA October 2023.

Apoorva Pandey / Task 177
Pandey, A. et al., 'Pandora lab calibration and clearance overview,' Pandora Asia Network meeting, NIER Korea, November 2023, virtual. (invited).
Pandey, A., 'Pandora lab calibration and clearance overview,' Pandonia Global Network user group meeting, NASA, October 2023.
Pandey A. et al., 'Using Pandora direct sun and MAX-DOAS formaldehyde columns for evaluating satellite retrievals,' EGU meeting, Vienna, Austria, April 2024
Pandey A. et al., 'Evaluating Pandora NO2 and HCHO columns and near-surface concentrations as inputs for studying tropospheric ozone production,' Quadrennial Ozone Symposium, Boulder CO, Jul 2024.

Cryospheric Sciences Laboratory: CODE 615

Paolo de Matthaeis / Task 016
Priscilla Mohammed (presenter), David Le Vine, Paolo de Matthaeis, James Higgins and Jeff Piepmeier, 'SMAP Radiometer RFI Operations and Reporting,' 104th American Meteorological Society Annual Meeting, Baltimore, Maryland, January 28 – February 1, 2024.
Beau Backus (presenter), Paolo de Matthaeis, Roger Oliva Balague, Raul Díez Garcia , Ryo Natsuaki, Priscilla Mohammed and Siri Jodha Khalsa, 'Standard for Remote Sensing Frequency Band Radio Frequency Interference (RFI) Impact Assessment,' 104th American Meteorological Society Annual Meeting, Baltimore, Maryland, January 28 – February 1, 2024.
Paolo de Matthaeis (presenter) and Beau Backus, 'Agenda Items of the World Radiocommunication Conference 2027 Potentially Impacting Remote Sensing Radio Spectrum Users,' 4th URSI Atlantic Radio Science Conference (URSI AT-RASC), Gran Canaria, May 19-24, 2024.
Paolo de Matthaeis (presenter), Priscilla Mohammed, David Le Vine, Alexandra Bringer and James Higgins, 'Radio Frequency Interference (RFI) at L-Band: Update on the SMAP RFI Team Efforts to Reduce Its Global Impact,' International Geoscience and Remote Sensing Symposium (IGARSS) 2024, Athens, Greece, July 7-12, 2024.

Raul Díez Garcia (presenter), Roger Oliva Balague, Priscilla Mohammed, Ryo Natsuaki, Beau Backus, Mingliang Tao, Paolo de Matthaeis, 'Leveraging the IEEE Standardization Process to Promote Innovation in Remote Sensing,' International Geoscience and Remote Sensing Symposium (IGARSS) 2024, Athens, Greece, July 7-12, 2024.

Christopher Shuman / Task 089
Shuman, C. A. and Mark A. Fahnestock, Poster, 'Last of the Big Thwaites Bergs – Iceberg B22A Modulates Fast Ice and Ice Front Stability, as it Departs the Amundsen Sea Embayment (2017-2023),' iHARP Annual Meeting, attended virtually, Fairbanks, AK, June 20-21, 2024.

Ocean Ecology Laboratory: CODE 616

Susanne Craig / Task 004
Invited Plenary Speaker: Craig, S.E., 'The NASA PACE Mission: A Hyperspectral View of the Ocean,' 3rd National Workshop on Marine eDNA, Applied Physics Laboratory, Johns Hopkins University, June 3-52024.

Craig, S.E., Karaköylü, E., Carroll, I.T., Rousseaux, C.S., Werdell, P.J., 'Deriving metrics of phytoplankton biomass from hyperspectral top of atmosphere reflectance using a Bayesian machine learning approach,' Oral Presentation, Ocean Sciences Meeting, New Orleans, LA, USA, February 5-10, 2024.

Panelist, National Harmful Algal Bloom Network (NHABON) Town Hall, Ocean Sciences Meeting, New Orleans, LA, USA, February 5-10, 2024.

Violeta Sanjuan Calzado / Task 005
Presentation of NOMAD database at the International Ocean color Science Meeting, St Petersburg, Florida, November 14-17, 2023.
Invited talk 'Visual Seabass 3, a radiometric data processing software,' 8th Sentinel 3 Validation Team meeting Eumetsat in Darmstadt, December 5-7, 2023. (remote attendance).
Invited talk 'Ocean color remote sensing at NASA'. School of Oceanography. University of Las Palmas de Gran Canaria,' June 3, 2024, Las Palmas de Gran Canaria, Spain.
Invited talk 'PACE mission,' International Symposium of Marine Sciences, July 18, 2024, Valencia, Spain (remote attendance).
NASA NTR invention for 'Visual Seabass Apparent Optics Properties Evaluation Software,' Christopher Proctor, Violeta Sanjuan Calzado, Noah Vegh-Gaynor. Submitted and accepted 2022.

Dirk A. Aurin / Task 009
Aurin, D., 'HyperCP standardizes in situ above water radiometry processing including end-to-end uncertainties in compliance with protocols and Fiducial Reference Measurement standards,' Ocean Sciences Meeting 2024, New Orleans, Feb 18-23. Oral presentation.

John Blake Clark- Task 010
Clark, J.B., Moses, W., Koestner, D., Turner, K., Tzortziou, M., El-Habashi, A., Ackleson, S., 'Interannual Landfast Ice and Sea Ice Dynamics on the North Slope of the Alaskan Arctic Using a new Hydrodynamic Model,' 2024 Ocean Sciences Meeting, February 2024.
Clark, J. B., Schollaert Uz, S., Ames, T., 'Increasing the Spatial Coverage of Labeled Data for Satellite Image Based – Machine Learning Derived – Estimates of Water Quality,' American Geophysical
Union Annual Meeting, San Francisco, CA, December 2023.

Ivona Cetinić / Task 017

Cetinić, I., & Werdell, J. 'Keeping the PACE with the NASA Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission,' In 2024 European Geosciences meeting, EGU. (2024, April) - INVITED

Cetinić, I., Knobelspiesse, K., Cairns, K., & Piñol Solé, M., 'PACE-PAX validation campaign; validating PACE and supporting Earthcare,' In 2024 European Geosciences meeting, EGU, (2024, April).

Bridget Seegers / Task 029

Seegers, B., PACE, 'A Sea of Data,' Jet Propulsion Laboratory Interagency Coastal Resilience Working Group meeting on June 10, 2024, virtual.

Seegers, B., 'The Cyanobacteria Assessment Network's successful delivery of a remote sensing monitoring tool for cyanobacteria blooms,' Association for the Sciences of Limnology and Oceanography (ASLO) 2024 conference, Madison, Wisconsin, June 3-7, 2024.

Seegers, B., 'Successful Water Quality Monitoring with Satellite Remote Sensing, 'Department of Marine Sciences at the University of Georgia Skidaway Institute of Oceanography seminar, Savannah, GA, April 1, 2024 (invited).

Seegers, B. (lead), 'A Sea of Data,' Scripps Institution of Oceanography in San Diego at the Sea Meets the Stars event, San Diego, CA March 26, 2024 (invited).

Seegers, B. (lead), 'NASA Earth Observations to Investigate Our (Water) World and A Sea of Data with PACE,' two talks at the Pacific GIS and Remote Sensing Conference, University of the South Pacific, Suva, Fiji, November 27 – December 1, 2023 (invited).

Andrew Sayer / Task 048

Sayer, A. M. (lead), 'On scales of variation in aerosol optical depth fields,' AeroCom/AeroSat 2023 workshop, Richland, WA, virtual, Oct 16-20, 2023.

Sayer, A. M. (lead), 'Cloud masking without thermal infrared bands: a neural network approach based on MODIS,' AMS Annual Meeting, Baltimore, MD, Jan 28-Feb 1 2024.

Sayer, A. M. (lead), 'Cloud products from the new NASA PACE mission,' International Cloud Working Group third workshop, Darmstadt, Germany, virtual, Feb 26-28 2024, invited.

Sayer, A. M. (lead), 'Some things we want to do with the PACE Ocean Colo(u)r Instrument that aren't focused on the ocean,' UMBC Graduate Seminar Series, Baltimore, MD, Apr 25 2024, invited.

Sayer, A. M. (lead), 'PACE and multi-mission synergies,' SBG Technical Interchange Meeting, Washington, DC, 29-31 May, invited, panelist.

Sayer, A. M. (lead), 'An introduction to NASA's PACE mission, focusing on atmospheric composition,' OMI/TROPOMI Science Team Meeting, Boulder, CO, virtual, Jun 3-6 2024, invited.

John Blake Clark / Task 076

Clark, J. B. (Author & Presenter), Schollaert Uz, S. (Author), Ames, T. (Author). International Geoscience and Remote Sensing Symposium 2024. Poster. 'Non-Euclidian Water-Distance Based Interpolation for Increased Mapping of Coastal Water Clarity,' (July 2024).

Vanderlei Martins, Xiaoguang (Richard) Xu, Anin Puthukkudy / Task 115

McBride, B., Sienkiewicz, N. C., Xu, X., Puthukkudy, A., Smith, R., Remer, L. A., Martins, J. V. (2023). *HARP2 Pre-Launch Instrument Performance Testing and Results*. AGU23. Current Status is Published.

Martins, J. V., Puthukkudy, A., Xu, X., Smith, R., Sienkiewicz, N. C., Borda, R. A. F., McBride, B., Remer, L. A. (2023). *The capabilities of the HARP2 instrument to retrieve aerosol, cloud, and surface properties from the PACE observatory*. AGU23. Current Status is Published.

Invited talk at NASA GSFC on "*Preliminary aerosol retrievals from HARP2*", NASA GSFC, May, 2024.

Talk at the CAMP2Ex science team meeting 2024, "*Assessment of Aerosol Retrieval Accuracy with Multi-Angle Polarimeters Using Synthetic Data and Particle Size Distribution from the CAMP2Ex Field Campaign.*"

James Allen / Task 174

Allen, J. (lead), Ibrahim, Amir, Sean Bailey, Bryan A Franz, Gerhard Meister, Christopher W. Proctor, Minwei Zhang, and Jeremy Werdell, 'PACE Remote sensing reflectance (Rrs) validation from the Ocean Color Instrument,' Ocean Sciences Meeting, New Orleans, LA, Feb 18-23, 2024 (poster).
Allen, J. (lead), 'PACE Synergies: The PACE MAPP Algorithm,' OEL-GISS Modeling Collaboration Workshop, NASA GSFC, May 20-21, 2024.

Sean Foley / Task 175
Foley, S. (lead), Knobelspiesse, K., Sayer, A., Rajapakshe, C., 'A Prototype Multi-view Stereo Method for Determining Cloud Structure with Multi-angle Imagery,' AGU Fall Meeting, San Francisco, CA, Dec 11-15, 2023 (invited).

Vanderlei Martins, Brent McBride, Anin Puthukkudy / Task 178
Invited talk at NASA GSFC on "*Preliminary aerosol retrievals from HARP2*", NASA GSFC, May, 2024
Talk at the CAMP2Ex science team meeting 2024, "*Assessment of Aerosol Retrieval Accuracy with Multi-Angle Polarimeters Using Synthetic Data and Particle Size Distribution from the CAMP2Ex Field Campaign*",https://espo.nasa.gov/sites/default/files/pages/CAMP2ExSTM_Agenda_Semifinal3_20240221.pdf (https://docs.google.com/presentation/d/1mHznba5tpuqEmnWA-NaCknaxo-gVib2x/edit#slide=id.p1), February 28, 2024, Pasadena, CA.

Sean Foley / Task 181
Foley, S. (lead), Knobelspiesse, K., Sayer, A., Rajapakshe, C., 'A Prototype Multi-view Stereo Method for Determining Cloud Structure with Multi-angle Imagery,' AGU Fall Meeting, San Francisco, CA, Dec 11-15, 2023 (invited).

HYDROLOGICAL SCIENCES LABORATORY CODE 617

Robert Emberson / Task 030
Emberson. R., 'Risk and Response: NASA data for Landslides,' World Meteorological Org Webinar, August 2024.
Emberson, R. McClain, S, Schultz, S., 'NASA Disasters Program,' Hyperwall presentation, IGARSS 2024, Athens Greece July 2024.
Emberson, R., 'Studying Modern Geohazards from Orbit,' International Ocean Drilling Program meeting, April 4, 2024.
Emberson, R. Panelist on 2x panels at Understanding Risk conference, Himeji, Japan, July 2024.
Emberson, R. 'Dynamically modelling soil erosion globally using satellite data and linking model outputs with impacts to water quality,' AGU 2023, San Francisco, CA Dec 2023.
Emberson, R, McClain, S., 'NASA Landslides research,' Interagency Coordinating Committee on Landslide Hazards, Feb 2024.

Elijah Orland / Task 031
Orland, E. (lead), 'Linking Active Fire Properties to Post-Fire Impacts on Vegetation and Hydrology,' Establishing Directions in Postfire Debris Flow Science Conference, May 2024.
Orland, E. (lead), 'Linking Active Fire Properties to Post Fire Impacts on Vegetation, Streamflow, and Mass Wasting Hazards,' NASA AEOIP Workship, April 2024.
Orland, E. (lead), 'Linking Active Fire Properties to Post Fire Impacts on Vegetation, Streamflow, and Mass Wasting Hazards,' AGU Fall Meeting, December 2023.

Thomas Stanley / Task 032
Thomas Stanley, 'Projections of landslide hazard across High Mountain Asia,' 6th World Landslide Forum, Florence, Italy, November 15, 2023.

Nishan Kumar Biswas / Task 033

Schmitt, R., Biswas, N.K. (2024), 'Using Ocean Salinity and Machine Learning for Improved Seasonal and Sub-Seasonal Forecasts of Soil Moisture and Streamflow,' WaterSciCon24 by AGU and CUAHSI, St. Paul, Minn., June 24-27, 2024.

Biswas, N.K., Getirana, A., Sakib, N., Kumar, S.V., Nie, W., Rahman, K.S., Biswas, R.K. (2023), 'Satellite remote sensing observation based groundwater monitoring over Bangladesh,' AGU Fall Meeting, San Francisco, CA, December 11-15, 2023.

Biswas, N.K., Laverde, M., Stanley, T., Amatya, P.M., Kirschbaum, D. (2023), 'Dynamic landslide hazard forecasting over the Lower Mekong Region using global forecasting precipitation products,' AGU Fall Meeting, San Francisco, CA, December 11-15, 2023.

Biswas, N.K., Laverde, M., Stanley, T.A., Kirschbaum, D.B., Amatya, P.M., Meechaiya, C. (2023), 'A near-real-time and dynamic landslide hazard forecasting framework for the Lower Mekong Region,' 6th World Landslide Forum, Florence, Italy, November 2023.

Fadji Zaouna Maina / Task 057

Maina, F.Z. 'Deciphering the impacts of climate-human interactions on hydrology through satellite observations,' June 20th 2024, JMSC, Strasbourg, France. (Invited)

Maina, F.Z. 'Creating a water atlas: a scientist's odyssey across borders and disciplines,' June 18, 2024, ENGEES, Strasbourg, France. (Invited)

Maina, F.Z. 'The impacts of climate change and human management on the hydrology of High Mountain Asia,' March 13, 2024, George Mason University, Fairfax, Virginia, USA. (Invited)

Maina, F.Z. 'Providing transboundary solutions through innovative products overcoming the challenges of data sharing,' August 20, 2023, World Water Week, online & Stockholm, Sweden. (Invited)

Maina, F.Z., Kumar S.V., Mocko D., Kemp E., Collins C., Beck J., 'NLDAS-3, a fine scale surface meteorology dataset for North and Central America,' June 25, 2024, AGU Water Science Conference, Saint Paul, Minnesota, USA.

Maina, F.Z., Kumar S.V., Mocko D., Kemp E., Collins C., Beck J., 'Development of a fine-scale North American precipitation analysis for retrospective and operational applications,' January 30, 2024, AMS Annual Meeting, Baltimore, Maryland, USA.

Maina, F.Z., Getirana A., Kumar S.V., Saharia M., Kumar B. N., McLarty S., Appana R., 'A multivariate data assimilation to estimate the impacts of groundwater depletion in the Ganges-Brahmaputra on the Bay of Benghal's streamflow,' December 12, 2023, AGU Fall Meeting, San Francisco, California, USA.

Maina, F.Z., Kumar S.V., Mocko D., Kemp E., Collins C., Beck J., 'Development of a fine-scale North American precipitation analysis for retrospective and operational applications,' July 29, 2024, NLDAS-3 stakeholders workshop, virtual.

Pukar Amatya / Task 063

Amatya, P., 'Landslide mapping and forecasting system for the Karnali River Basin, Nepal,' AGU, virtual, December 12, 2023.

Amatya, P., USGS Geologic Hazard Science Seminar, Oral Presentation, 'Rapid response landslide map generation using open-source tools and its validation,' USGS, virtual, October 24, 2023.

Amatya, P., USGS Landslide Hazards Seminar, Oral Presentation, 'Accuracy assessment of rapid response landslide maps generated using open-source tools during the August 2021 Haiti earthquake,' USGS, virtual, April 10, 2024.

Armaghan Abedelmdoust / Task 072

Abed-Elmdoust, A., Y. Kwon, M. Navari, D. M. Mocko, J. W. Wegiel, S. V. Kumar, 'Advances in Operational Near Real-Time SMAP Soil Moisture Retrieval,' 38th Conference on Hydrology at the 104th Annual Meeting of the American Meteorological Society, January 28 – February 1, 2024, Baltimore, MD.

Abed-Elmdoust, A., D. M. Mocko, R. Bindlisha, P.-W. Liua, J. W. Wegiel, S. V. Kumar, 'Snow uncertainty quantification using probabilistic machine learning,' American Geophysical Union (AGU) Fall Meeting 2023.

Mocko, D. M., J. W. Wegiel, S. V. Kumar, E. M. Kemp, Y. Yoon, M. Navari, Y. K. Lim, A. Abed-Elmdoust, A. Getirana, J. V. Geiger, and S. Wang, 'Evaluation and intercomparison of the effects of snow and soil moisture data assimilation in three LSMs from the Air Force's operational Global Hydro-Intelligence System,' 38th Conference on Hydrology at the 104th Annual Meeting of the American Meteorological Society, January 28 – February 1, 2024, Baltimore, MD.

Cheng-Hsuan Lyu / Task 073

Presentations at IEEE MicroRad 2024, Alexandria, VA, April 8-11, 2024:
Cheng-Hsuan Lyu, et. al., 'Joint Polar Satellite System (JPSS) Advanced Technology Microwave Sounder (ATMS) Status Update,' April 8-11, 2024.
Hu Yang, XingMing Liang, Edward Kim, Matthew Sammons, Cheng-Hsuan Lyu, James Fuentes, et al., 'On Developing an Advanced Calibration Algorithm for Quicksounder ATMS Striping Noise Mitigation,' IGARSS 2024 Session: TH2.R4: Microwave and Infrared Sounders, LEO/GEO/other, July 7-12, 2024.
Hu Yang, Xingming Liang, Flavio Sanchez, Ninghai Sun, Siena Iacovazzi, Edward Kim, Matthew Sammons, Cheng-Hsuan Lyu, Alexandra Bringer, James Fuentes, James Kam, 'Validation of the Calibrated Microwave Lunar Radiative Treansfer Model (CMLRTM) with the NOAA-21 ATMS Two-Dimension Moon Observations,' IGARSS 2024 Session: WE4.R4: Advances in Microwave Radiometer Calibration, July 17, 2024.

Biospheric Sciences Laboratory- CODE 618

Celio Resende de Sousa / Task 060

De Sousa, C. (lead), 'Earth Observation-based Mapping of Protected areas of West Africa: A Gateway to Blue Carbon Projects,' 11th Regional Coastal and Marine Forum (PRCM), Bissau, Guinea-Bissau, in person, April 22-26, 2024 (invited).

MinJeong Jo / Task 082

Jo, M., Osmanoglu, B., Meyer F.J., Schultz L. A., Kennedy, JH., Smale J., Macorps E., and Albayrak A. (2023), 'HAND-based Flood Estimtion for Bangladesh Floodplains using Multi-temporal L- and C-band Synthetic Aperture Radar,' AGU 2023.
Huang, S., Osmanoglu, B., Jo, M., and Scheuchl, B. (2024) 'Commercial Synthetic Aperture Radar Data for Surface Deformation and Change,' IEEE IGARSS 2024.

Thomas Eck / Task 085

Eck, T. (lead), 'Desert Dust Optical Properties from AERONET Observations: Spectral AOD, Size Distributions,' Spectral Absorption and Seasonal Dynamics, 2023 AGU Annual Meeting, San Francisco, CA, Dec 11-15, 2023.

Anthony Campbell / Task 109

Campbell, A. et al., 'Remote sensing monitoring of salt marsh ecosystems with very high-resolution imagery and in situ elevation data,' AGU2023 December 13, 2023, Invited.
Campbell, A., 'Monitoring and mapping salt marshes change and carbon emissions with earth observation,' International Blue Carbon Scientific Working Group, October 5, 2023, Invited.
Campbell, A., 'Remote sensing for Estuarine and Coastal Research: Biodiversity, Resilience, and Carbon monitoring,' South African Environmental Observation Network Graduate Student Network, Indibano, October 23, 2023, Invited.
Campbell, A. et al., 'Engaging stakeholders in Biodiversity-Remote sensing for Estuarine and Coastal Habitat research,' BioSCapes Application Workshop, South Africa, May 23, 2023, Invited.
Campbell, A. et al., 'BioREaCH: Biodiversity-Remote sensing for Estuarine and Coastal Habitat research,' NASA Joint Science Workshop, College Park MD, May 11, 2023, Invited.

Fred Huemmrich / Task 134
Huemmrich, K.F. (lead), P. Campbell, 'Observing 20 Years of Tundra Change,' UMBC GES GSTAR-II Seminar, Baltimore, MD, virtual, Nov. 29, 2023.
Huemmrich, K.F. (lead), P. Campbell, J. Joiner, Y. Yoshida, S. Caplan, 'Terrestrial Ecology Products from PACE,' AGU Fall Meeting, San Francisco, CA, Dec. 11-15, 2023.
Huemmrich, K.F. (lead), 'Monitoring Terrestrial Vegetation Chlorophyll Content and Productivity from PACE,' Kennedy Space Center Visitor Center, Feb. 3, 2024.
Huemmrich, K.F. (lead), S.A. Vargas Z., C. Tweedie, P.P.K. Campbell, E.M. Middleton, 'Examining Tundra Greening from Ground-based to Satellite Observations,' SED Poster Party, Greenbelt, MD, Jan. 23, 2024.

Ameni Mkaouar / Task 166
A. Mkaouar, T Yin, DE Shean, CSR Neigh, et.al. (2023), 'Evaluating and Improving the Geolocation Accuracy of GEDI Spaceborne LiDAR Products using 3D Radiative Transfer Modeling and Full-Waveform Matching,' AGU Fall Meeting Abstracts 2023.

Junhyeon Seo / Task 173
Seo, J. (lead), 'PM2.5 3-day Forecasting at U.S. Embassy Locations using Machine Learning,' HAQAST Annual Meeting, June 3-5, 2024, Boston, MA.

Geodesy and Geophysics Laboratory- CODE 61A

Stacey Huang / Task 188
Huang, S (lead), 'Rising Waters, Sinking Land: Using remote sensing to identify patterns of subsidence in American Samoa,' as part of the Let's Talk About the American Samoa Sea Level Rise Viewer event at American Samoa Community College, virtual, October 5, 2023 (invited).
Huang, S. (lead) and Biondi, E. 'Multidepth optimization based on time-domain backprojection (TDBP) for InSAR time series,' AGU Fall Meeting, San Francisco, CA, Dec 11-15, 2023.
Huang, S. (lead), Sauber, J., Fielding, E., Ray, R., and Han, S.-C., 'Tracking Coastal Changes in the Samoan Islands since the 2009 Samoa-Tonga Earthquake using Multi-Sensor Satellite Geodesy,' AGU Fall Meeting, San Francisco, CA, Dec 11-15, 2023.
Huang, S. (lead), 'Sinking Lands and Rising Seas: Tracking Coastal Subsidence in the Samoan Islands since the 2009 Samoa-Tonga Earthquake using Multi-Sensor Satellite Geodesy,' Stanford University Department of Geophysics Weekly Seminar, February 13, 2024 (invited).

PROPOSALS AWARDED

Proposal Title	Funding Agency	PI (GESTAR II)	CO-I(s) GESTAR II)	Period of Performance
Passive Radiometer Interference Management for Earth-Observing Systems (N-Prime) A Study to Examine Approaches and Methodologies for the Detection, Characterizing and Mitigation of Passive Sensor Data Corrupting Emissions (DMiPS)	NOAA	Priscilla Mohammed-Tano (MSU)		Awarded
Direct Assimilation of PolSIR radiances in GEOS	NASA		Bryan Karpowicz (UMBC)	11/27/2023 – 03/31/2030
12th Workshop in Meteorological Sensitivity Analysis and Data Assimilation	NASA	Nikki Privé (MSU)	Erica McGrath-Spangler (MSU)	10/10/2023 – 10/03/2024
Exploring Diurnal Characteristics of O3 and NO2 using the SAGE III/ISS Instrument and GEOS Earth System Model	NASA		Emma Knowland (MSU)	Awarded
A systematic investigation of the potential of SMAP soil moisture assimilation for improving the simulation and prediction of tropical cyclones	NASA		Manisha Ganeshan (MSU)	10/1/2024 – 09/30/2027
Climate-induced Hazards Impacting Pastures and People (CHIPP): Mapping the spectral colors of blooming deserts with EMIT (23-EMIT23-0039)	NASA		Dhruva Kathuria (MSU)	Awarded
Enhancing Coupled Land-Atmosphere Reanalysis Through the Assimilation of CYGNSS Soil Moisture Retrievals	NASA	Andrew Fox (MSU)		08/01/2024 – 07/31/2027
Sustainment and enhancement for an open-source Python-Fortran binding to integrate machine learning tools within NASA weather and climate models	NASA	Katherine Breen (MSU)		Awarded
Improve the quantification of aerosol indirect forcing during the EOS era with a hybrid model-observation approach	NASA	Tianle Yuan (UMBC)	Katherine Breen (MSU)	Awarded

A statistical cloud condensation scheme driven by deep learning	NASA		Katherine Breen (MSU)	Awarded
Cooperation and AgReements enhancing Global interOperability for Aerosol, Cloud and Trace gas research infrastructures (CARGO-ACT)	European Commission		Jasper Lewis (UMBC)	Awarded
ISFM work package for GPM ground validation research and analysis	NASA		Ali Tokay (UMBC)	Awarded
Evaluating the use of PlanetiQ GNSS RO measurements for Planetary Boundary studies.	NASA	Manisha Ganeshan (MSU)		09/01/2024 – 08/31/2025
Towards an Integrated Data Record for Antarctic Climate Studies	NASA		Manisha Ganeshan (MSU)	09/01/2023 – 10/01/2024
Investigation of Global Ionospheric Conductivity Variabilities driven by E-region electron density	NASA	Cornelius Csar Jude H. Salinas (UMBC)		06/07/2024 – 06/06/2028
Space Weather Effects on Ionospheric E-region Electron Density as observed by Global Navigation Satellite System Radio Occultation Missions	NASA	Cornelius Csar Jude H. Salinas (UMBC)		07/01/2024 – 06/30/2025
Retrieval of spectrally-resolved dust aerosol direct radiative effect from EMIT hyperspectral observations	NASA	Zhibo Zhang (UMBC)	Yujie Wang (UMBC)	01/01/2024 – 12/31/2026
MAIAC Aerosol Retrieval and Atmospheric Correction for PACE OCI	NASA		Sujung Go (UMBC)	08/01/2024 – 04/30/2025
Using Multi-Spectral, Multi-Overpass Passive Satellite Imagery to Characterize and Investigate the Radiative Properties of Snow and Sea Ice in the Arctic	NASA		Colten Peterson (UMBC)	11/15/2024 – 11/14/2027
Ultraviolet Aerosol Index (UVAI) and 380 nm Aerosol Absorption Optical Depth: Validation Plan	NASA		Hirenkumar Jethva (MSU)	01/01/2024 – 12/31/2027
Stratosphere Troposphere Response using Infrared Vertically-resolved light Explorer (STRIVE)	NASA		Ghassan Taha (MSU)	08/01/2024 – 07/31/2025
Resolving recent ozone trends with sampling-bias-corrected multi-satellite dataset (GOZCARDS), models and sonde observations	NASA		Anne Thompson (UMBC)	06/01/2024 – 05/31/2027
First Supplement to Collaborative Research: Greater New York (NY) Oxidant, Trace gas, Halogen, and Aerosol Airborne Mission (GOTHAAM)	NSF	Jason St. Clair (UMBC)		09/01/2024 – 03/03/2025

Supplemental analysis funding from the NASA DCOTSS EVS: UT/LS enhancements of reactive trace gases by convection: transport and photochemistry insights from DCOTSS and ACCLIP,	NASA	Jason St. Clair (UMBC)		10/01/2023 – 09/30/2024
Leveraging GISS and GEOSCCM strengths for building predictability of atmospheric composition	NASA		Caterina Mogno (UMBC)	10/01/2023 – 09/30/2024
Improving, Miniaturizing, and Refining RoboHypo, a robotic hyperspectral polarimeter for the ocean	NASA		Susanne Craig (UMBC)	Awarded
Investigating the relationship between ocean biology and the production of biogenic aerosols: Developing capabilities for a Goddard EVS and future collaboration with the Naval Research Laboratory	NASA		Susanne Craig (UMBC)	Awarded
FORTE: Arctic Coastlines –Frontlines Of Rapidly Transforming Ecosystems	NASA		J. Blake Clark (UMBC)	05/01/2024 – 04/30/2030
Precipitation extremes and land-sea biogeochemical connections in the California Current System	NASA		Ivona Cetinić (MSU)	09/01/2024 – 08/31/2025
PACE Hackweek: A social coding event that keeps PACE with NASA's next great Earth science mission	US Ocean Carbon & Biogeochemistry Program	Ian Carroll (UMBC)		Awarded
Leveraging the Hawaii Ocean Time-series program for validation of the PACE Mission in oligotrophic waters	NASA		James Allen (MSU)	06/01/2024 – 05/31/2026
Near Real-Time Fire Behavior and Progression to Predict Hydrologic Burn Severity and Post Fire Recovery	USGS		Elijah Orland (UMBC)	Awarded
Characterizing extreme storms to better inform hydrometeorological hazard assessment	NASA		Elijah Orland (UMBC)	09/01/2022 – 08/31/2025
Landslide mapping and forecasting in Nepal	NASA	Thomas Stanley (UMBC)	Pukar Amatya (UMBC)	10/01/2024 – 09/31/2026
SWOT contribution to the understanding of global terrestrial water storage and fluxes through a multi-satellite data assimilation framework	NASA		Nishan Kumar Biswas (UMBC)	07/01/2024 – 06/31/2025
Development of a multidecadal land reanalysis over South America"	NASA	Fadji Zaouna Maina (UMBC)		07/01/2024 – 06/30/2026
Earth Observation-based restoration and monitoring in Coastal and	NASA		Celio Resende de	09/01/2023 – 08/31/2026

Forested Protected Areas of West Africa			Sousa (UMBC)	
Tracking Sea Level Rise in American Samoa with Ultra-High-Resolution SAR Imagery: An Umbra Feasibility Study	NASA		Minjeong Jo (UMBC)	09/01/2024 – 08/31/2025
BlueFlux-2: Multi-scale measurements of blue carbon ecosystems to support climate mitigation and adaptation in Southern Florida	NASA		Anthony Campbell (UMBC)	10/01/2024 – 09/30/2027
Spectrometer measurements and retrievals from Chesapeake Bay tower in support of PACE-OCI validation	Maryland Department of Environment	Kevin Turpie (UMBC)		03/14/2024 – 03/13/2027
Measurements and retrievals from ground-based network spectrometers in support of PACE-OCI validation	NASA		Kevin Turpie (UMBC)	03/14/2024 – 03/13/2027
Ocean Color Cal/Val Support of the PACE Mission through Multi-institutional Synergy	NASA		Kevin Turpie (UMBC)	03/14/2024 – 03/13/2027
UMBC Support of Surface Biology and Geology	NASA	Kevin Turpie (UMBC)		10/1/2023 – 09/30/2024
Airborne Lunar Spectral Irradiance (air-LUSI) Mission - Operational Campaign 02	NASA	Kevin Turpie (UMBC)		03/24/2018 – 09/30/2024
A New Geohazards Perspective of the Kodiak Segment of the Eastern Aleutians from Innovative Processing of Remote Sensing Data	NASA		Stacey Huang (UMBC)	07/01/2024 – 12/31/2026

PROPOSALS PENDING

Proposal Title	Funding Agency	PI (GESTAR II)	CO-I(s) GESTAR II)
Improving SMAP Radio Frequency Interference Detection and Geolocation and Consolidating SMAP Calibration	NASA		Jinzheng Pen (MSU) & Priscilla Mohammed-Tano (MSU)
A New Observing Strategy to Link Field, Canopy and Spaceborne Earth Observations for Detection of Vegetation Stress and Productivity	NASA		Fred Huemmrich
Assimilation of PACE hyperspectral data into the NASA Ocean Biogeochemical Model	NASA	Lionel Arteaga (UMBC)	
Retrospective analysis and forecasting of the impact of marine heatwaves on oceanic export production	NASA	Lionel Arteaga (UMBC)	Ivona Cetinic (MSU)
Tracking stratospheric intrusions through NASA's high-resolution reanalyses: a novel recipe for characterizing climate-related variability in stratosphere-troposphere exchange and links to air quality over North America	NASA	Emma Knowland (MSU)	
Supporting local air quality managers with actionable model diagnostics for exceptional events and mitigation strategies	NASA	Emma Knowland (MSU)	
Improving public health in Latin America by integrating advanced air pollution forecasting and risk communication tools into local operations	NASA		Emma Knowland (MSU) & Ana Prados (UMBC)
DSCOVR and TEMPO characterization of Ozone diurnal cycles and comparison with atmospheric reanalyses	NASA	Alfonso Delgado-Bonal (UMBC)	Emma Knowland (MSU)
Modeling the Aerosol Lifecycle Across Scales in the Goddard Earth Observing System	NASA	Allison Collow (UMBC)	Emma Knowland (MSU)
Scaling Data Fusion Tools to Support Local Air Quality Managers in Latin America	NASA	Carl Malings (MSU)	Emma Knowland (MSU)
Transport and wet scavenging of aerosols in the NASA GEOS model as constrained by radionuclide tracers and aircraft observations: characterization, representation, uncertainties, and trends	NASA		Emma Knowland (MSU) & Huisheng Bian (UMBC)
Integrating GEOS-CF, NU-WRF, TEMPO, and HAMAQ via Deep Learning for Superior Atmospheric Composition Data and Forecasting	NASA		Emma Knowland (MSU) & Zhining Tao (MSU)

Developing New and Enhancing Existing Lightning Parameterization Schemes in the GMAO GEOS-5 GCM Through Use of Observational Lightning Datasets	NASA	Retha Mecikalski (MSU)	Emma Knowland (MSU)
Towards Assimilation of Aerosol Optical Centroid Height in the Goddard Earth Observing System (GEOS) Model	NASA		Virginie Buchard (UMBC)
Probabilistic Air Quality Forecasts for Decision Making Ahead of Prescribed Burns in Coastal Environments	NASA	Allie Collow (UMBC)	Natalie Thomas (UMBC)
Dusty Atmospheric Rivers: Processes, Impacts, and Predictions in GEOS Model	NASA	Amin Dezfuli (UMBC)	Allie Collow (UMBC)
AI-Driven Subsampling Techniques: Optimizing Thinning Strategies in Numerical Weather Prediction Models	NASA	Manisha Ganeshan (MSU)	Erica McGrath-Spangler (MSU) & Niama Boukachaba (MSU)
Harnessing the Power of Quantum Machine Learning for Tropical Cyclone Segmentation and Forecasting	NASA		Erica McGrath-Spangler (MSU)
Investigation of the Amazon Forest's responses to climate change	NASA		Eunjee Lee (UMBC)
Investigation of tropical cyclogenesis in NASA GEOS-S2S system and near-real-time TC forecast products	NASA		Young-Kwon Lim (UMBC)
Earth system pathways to extreme events in observations and GEOS sub-seasonal and seasonal forecasts: A multi-scale machine learning approach	NASA		Young-Kwon Lim (UMBC)
QBO modulation of the MJO in the next generation of GEOS earth system models	NASA		Young-Kwon Lim (UMBC)
Quantifying hyperlocal variations in traffic-related pollution: A citizen science approach from New York to Nairobi	NASA		Carl Malings (MSU)
Using satellite remote sensing data and atmospheric composition models to assess and enhance the utility of low-cost air quality sensors to national, state, local, and tribal air quality managers	NASA	Carl Malings (MSU)	Andrew Sayer (UMBC) & Caterina Mogno (UMBC)
Great frigatebirds as a novel inclusion to planetary boundary layer assimilation efforts	NASA	Eun-Gyeong Yang (UMBC)	
Advancing the use of Polarimetric Radio Occultation in NASA's GEOS Model	NASA	Michael Murphy (UMBC)	
High Spatial and Temporal Resolution Biomass Burning Emission Estimates: Integrating LEO and GEO Observations into QFED	NASA	Meng Zhou (UMBC)	
Enrich air quality and public health management in wildfires: air quality forecast by integrating advanced satellite data and machine learning technique	NASA		Meng Zhou (UMBC)
GPM Algorithm Work Package Report: DPR Path-Attenuation Estimates	NASA	Liang Liao (MSU)	Hyokyung Kim (MSU)
Photonic Atmospheric Radar (PAR)	NASA		Liang Liao (MSU)
Unlocking New Potential of NASA's Spaceborne Polarized Lidar Data for Earth System Studies	NASA	Sergey Korkin (UMBC)	

Looking Beyond Lookup Tables: An Open-source Deep Learning Framework for Fast, Multidimensional, Hyperspectral Radiative Transfer Modeling	NASA	Michael Himes (MSU)	Sergey Korkin (UMBC)
Virtual EOS Observatory for Advanced Aerosol Characterization	NASA		Sergey Korkin (UMBC) & Yuije Wang (UMBC)
Investigation of Diurnal-to-Interannual Variations of PBL Height from Long-Term Multi-Constellation GNSS-RO	NASA		Manisha Ganeshan (MSU)
Antarctic Snowfall and Diamond Dust in MERRA-2: Enhancement with Machine Learning Models	NASA		Manisha Ganeshan (MSU)
Investigation of Global Ionospheric E-region Electron Density Variabilities driven by Geomagnetic Activity	NASA	Cornelius Csar Jude H. Salinas (UMBC)	
Machine Learning-Ready Global F-Region Electron Density From GNSS-POD Limb Sounding	NASA		Cornelius Csar Jude H. Salinas (UMBC)
“Cloud Simulator” vs. “Cloud Translator” for MODIS-Compatible Cloud Representation	NASA	Daeho Jin (UMBC)	Dongmin Lee (MSU)
Antarctic Snowfall and Diamond Dust in MERRA-2: Enhancement with Machine Learning Models	NASA	Surendra Bhatta (MSU)	Manisha Ganeshan (MSU)
Detection of marine debris using hyperangular polarimetry	NASA		Anin Puthukkudy (UMBC)
Steering improvements in aerosol retrieval assumptions with suborbital datasets in preparation for the next generation of space-based multiangle polarimeters and lidars	NASA		Anin Puthukkudy (UMBC)
Enhanced Parallax Correction in Multi-Angle Polarimeter Retrievals: Addressing Horizontal Inhomogeneity in Clouds and Aerosols	NASA	Anin Puthukkudy (UMBC)	
Integrating Lidar and GEO Retrievals for Enhanced Aerosol Characterization”	NASA		Anin Puthukkudy (UMBC)
Using Earth Observations to Enhance Modeling and Decision-Making of Health-Related Hazards in Africa	NASA	Yujie Wang (UMBC)	
Using Earth Observations and Machine Learning to Enhance the Wildfire Smoke Decision Framework	NASA	Yujie Wang (UMBC)	
Enhancing the modeling capability of fire absorbing aerosols in the GEOS system for assessing brown carbon radiative forcing	NASA		Myungje Choi (UMBC) & Huisheng Bian (UMBC)
CAIG: Towards 3-D Structure of Wildfire Smoke Plumes: Integrating Physics-Informed Machine Learning with Multi-Sensor Data	NSF		Yingxi Shi (UMBC) & Jianwu Wang (UMBC)
Towards 3-D structure of Wildfire Smoke Plumes: Integrating Physics-Informed Machine Learning with High Spatial, Temporal, and Spectral Observations	NASA	Yingxi Shi (UMBC)	

Refinement of the Unified Algorithm for aerosol retrieval from PACE OCI measurements	NASA	Lorraine Remer (UMBC)	Yingxi Shi (UMBC) & Hiren Jethva (MSU)
Three-dimensional analysis of Ozone and aerosol change	NASA	Mijin Kim (MSU)	
Cloud Credits Supplement to Enable Open Sciences for MEASURES and EMIT projects	NASA	Jianyu Zheng (UMBC)	Zhibo Zhang (UMBC) & Jianwu Wang (UMBC)
Towards an integrated observing system of the hydroxyl radical: Assessing the feasibility of constraining spatiotemporally-resolved abundance, trends, and variability of OH with satellite proxy data	NASA	Daniel Anderson (UMBC)	Junhua Liu (MSU)
Determining near real time surface ozone concentrations from TEMPO and machine learning: a feasibility study	NASA	Daniel Anderson (UMBC)	
Leveraging the power of high-resolution satellite data and a machine learning parameterization to represent non-linear ozone chemistry in chemistry-climate model simulations	NASA	Sarah Strode (MSU)	Daniel Anderson (UMBC), Junhua Liu (MSU), Lok Lamsal (UMBC) & Amir Souri (MSU)
Investigating the Impacts of Tropospheric ozone Precursor and Ozone Depleting Substance Emissions on Ocean Heat Uptake in the Past and Future	NASA	Feng Li (UMBC)	Junhua Liu (MSU) & Huisheng Bian (UMBC)
Improving Climate Projections and Subseasonal-to-Seasonal Predictions in GEOS by Understanding the Biases of Southern Hemisphere Large-Scale Circulation	NASA	Feng Li (UMBC)	
STARS: Stratospheric Trace gas and Aerosol Remote Sensor	NASA		Taha Ghassan (MSU)
Connecting a Broad Community to Earth System Digital Twin Technologies at the Interface of Atmospheric Composition with the Earth System	NASA		Zhining Tao (MSU)
Quantifying Methane Sources by Developing an Inverse Capability of NU-WRF to Embrace Growing Satellite Observations	NASA	Zhining Tao (MSU)	Huisheng Bian (UMBC)
Integrating NASA Data and Model Capabilities to Enhance Agriculture Decision Support	NASA		Zhining Tao (MSU)
Building AI-Powered NU-WRF for Compound Extreme Events: Linking Together Winter Precipitation, Spring Flash Droughts, Summer Heatwaves, and Fall Wildfires at the Wildland-Urban Interface	NASA		Zhining Tao (MSU)
Enabling observation driven hourly smoke emission, plume injection height parameterization, and strong dust simulation for NU-WRF aerosol capability over North America	NASA	Dongchul Kim (UMBC)	Zhining Tao (MSU)

Assessment of the emission, distribution, and spatiotemporal variation of the Alaskan dust, a major high latitude dust source	NASA	Dongchul Kim (UMBC)	
Characterizing the Variability of Dust Mineralogy, Dust-borne Nutrients and Direct Radiative Effect Over the Last Two Decades	NASA		Dongchul Kim (UMBC)
Closure studies of biomass burning aerosol optical properties from aircraft to improve NASA GOCART-2G optical property estimates	NASA		Dongchul Kim (UMBC)
Investigation of the Amazon Forest's responses to climate change	NASA	Huisheng Bian (UMBC)	
Improve the quantification of aerosol indirect forcing during the EOS era with a hybrid model-observation approach	NASA		Huisheng Bian (UMBC)
Improving fire aerosol simulations in the GEOS modeling system: Global assessment of brown carbon radiative forcing	NASA		Huisheng Bian (UMBC)
Second Supplement to Collaborative Research: Greater New York (NY) Oxidant, Trace gas, Halogen, and Aerosol Airborne Mission (GOTHAAM)	NASA	Jason St. Clair (UMBC)	
The Role of Oceans in the Earth System: Preparing the Oceans Community for the 2027 Decadal Survey	NASA	Susanne Craig (UMBC)	
Erosion of Coastal Arctic Permafrost and its Impact on Offshore Conditions	Office of Naval Research		J. Blake Clark (UMBC)
REU Site: EXPeriments in Earth and Atmospheric Science: Learning Opportunities and Research Experience (EXPLORE	NSF		Ivona Cetinic (MSU)
Cyanobacteria Assessment Network: Inclusion of Sentinel-2 derived chlorophyll-a	NASA		Bridget Seegers (MSU)
Dust remote sensing in the thermal infrared: a missed opportunity	NASA		Ian Carroll (UMBC)
3D Cloud Reconstruction in Multi-Angle Polarimetry with a Foundation Model	NASA	Sean Foley (MSU)	
A New Observing Strategy for Extreme Air Pollution	NASA		Sean Foley (MSU)
Atmospheric Neural Radiance Fields	NASA		Sean Foley (MSU)
3D Cloud Reconstruction in Multi-Angle Polarimetry with a Foundation Model	NASA		Sean Foley (MSU)
A New Observing Strategy for Extreme Air Pollution	NASA		Sean Foley (MSU)
Atmospheric Neural Radiance Fields	NASA		Sean Foley (MSU)
Enhancing global landslide research with citizen science	NASA	Thomas Stanley (UMBC)	Pukar Amatya (UMBC) & Robert Emberson (UMBC)

Tracking freshwater availability and its changes in the lakes and reservoirs of West Tennessee	NASA	Nishan Biswas (UMBC)	Thomas Stanley (UMBC)
Landslide impacts on lifelines to Cali, Colombia	NASA	Thomas Stanley (UMBC)	Pukar Amatya (UMBC)
Earth Surface Model Investigation of Cascading Earthquake Hazards augmented by field and remote sensing observations	NASA		Pukar Amatya (UMBC) & Thomas Stanley (UMBC)
Conflict and Catastrophe: Navigating Landslide and Flash Flood Risks in Cox's Bazar, Bangladesh	NASA		Nishan Biswas (UMBC)
Earth Observations, Machine Learning, and Smartphone-based Dissemination for Nationwide High-Resolution Cholera Surveillance and Forecasting in Bangladesh	NASA		Nishan Biswas (UMBC)
The WAVE: Water AVailability reanalysis and scenario Exploration to map natural and anthropogenic impacts on future global freshwater cycle	The Wave Future	Fadji Zaouna Maina (UMBC)	
TRaining AI for a Disaster ResIlENT Caribbean (TRIDENT)	NASA	Pukar Amatya (UMBC)	Jackson Tan (UMBC)
Coastal wetland Biodiversity across Scales: A global synthesis of the spatial, temporal, and spectral relationships between field, airborne, and spaceborne data	NASA	Anthony Campbell (UMBC)	
TRaining AI for a Disaster ResiliENT Caribbean (TRIDENT)	NASA	Arif Rustem Albayrak (UMBC)	
Quantum Phase Unwrapping	NASA		Arif Rustem Albayrak (UMBC)
AK FirE-SAFE: Alaska Fire Event Situational Awareness From Earth Observations	NASA		Arif Rustem Albayrak (UMBC)
Terrestrial Photosynthesis from PACE	NASA	Fred Huemmrich (UMBC)	
Collaborative Research: Sustaining the ITEX-AON to advance understanding of recognized and emerging changes in Arctic tundra ecosystems	NASA		Fred Huemmrich (UMBC)
Integrating satellite and field data to characterize biodiversity changes across forest biomes	NASA		Fred Huemmrich (UMBC)
Integrating NASA satellite data, model outputs and research into U.S. State Department’s Environmental Diplomacy Efforts in Africa	NASA		Junhyeon Seo (MSU)
Tracking Sea Level Rise in American Samoa with Ultra-High-Resolution SAR Imagery: An Umbra Feasibility Study	NASA	Stacey Huang (UMBC)	
Retrieving up-to-date DEM and monitoring surface deformation for volcanic unrest and eruptions using Umbra imagery	NASA	MinJeong Jo (UMBC)	Stacey Huang (UMBC)

A New Geohazards Perspective of the Kodiak Segment of the Eastern Aleutians from Innovative Processing of Remote Sensing Data	NASA	Stacey Huang (UMBC)	MinJeong Jo (UMBC)
Geomagnetic data assimilation with Kalman smoothing: fitting core dynamics to geomagnetic secular variation".	NASA	Kyle Gwirtz (UMBC)	
Detection of marine debris using hyperangular polarimetry	NASA	Vanderlei Martins (UMBC)	
Steering improvements in aerosol retrieval assumptions with suborbital datasets in preparation for the next generation of space-based multiangle polarimeters and lidars	NASA	Vanderlei Martins (UMBC)	
Enhanced Parallax Correction in Multi-Angle Polarimeter Retrievals: Addressing Horizontal Inhomogeneity in Clouds and Aerosols	NASA	Vanderlei Martins (UMBC)	

PROPOSALS NOT AWARDED

Proposal Title	Funding Agency	PI (GESTAR II)	CO-I(s) GESTAR II)
WindMapper: Breakthrough Wind Observations Revealing the Mechanisms Driving Atmospheric Rivers and Monsoon Disturbances	NASA		Nikki Privé (MSU)
Assimilation of PACE hyperspectral data to infer phytoplankton community composition and related biogeochemical fluxes	NASA	Lionel Arteaga (UMBC)	
Assimilating PACE/OCI multi-wavelength Aerosol Optical Depth from UV to visible in GEOS system, with the aim of future integration in the MERRA-3 reanalysis.	NASA	Virginie Buchard (UMBC)	
Climate-induced Hazards Impacting Pastures and People (CHIPP): Transdisciplinary NASA product applications in a Northern Mongolian participatory environmental justice study	NASA		Dhruva Kathuria (MSU)
OSCARS: Open Science Capacity-building for Applied Remote Sensing	NASA	Carl Mailings (MSU)	
Building Machine Learning-based Cloud Retrieval Algorithm and Radiance Observation Operator in the GEOS and GEOS OSSE	NASA	Kathleen Breen (MSU)	Nikki Privé (MSU) & Min-Jeong Kim (MSU)
Towards 3-D structure of Wildfire Smoke Plumes: Integrating Physics-Informed Machine Learning with High Spatial, Temporal, and Spectral Observations	NASA		Meng Zhou (UMBC)
NuRTM: NASA Unified Machine Learning-Based Physics-Informed Radiative Transfer Model	NASA		Sergey Korkin (UMBC)
Multi-satellite Advanced Smoke Aerosol Characterization and Fire Tracking System	NASA		Sergey Korkin (UMBC)
MAIAC Aerosol Retrieval and Atmospheric Correction for PACE OCI	NASA		Sergey Korkin (UMBC)
E-region Prompt Radio Occultation Based Electron Density Model"	NASA	Cornelius Csar Jude H. Salinas (UMBC)	
Improving understanding of aerosol-cloud interactions using shortwave spectrometer data from ARM's EPCAPE Campaign	NASA		Guoyong Wen (MSU)
Improving understanding of aerosol-cloud interactions using shortwave spectrometer data from ARM's EPCAPE Campaign	NASA		Surenda Bhatta (MSU)
An improved treatment of parallax in PACE polarimeter retrievals: accounting for horizontal inhomogeneity in clouds and aerosols	NASA		Anin Puthukkudy (UMBC)
Accelerating HARP2 Aerosol and Surface Property Retrieval with Machine Learning-Driven Radiative Transfer	NASA	Anin Puthukkudy (UMBC)	
Addressing Parallax Challenges in Aerosol Retrieval from Multi-Angle Polarimeter Observations: Cloud Screening and Horizontal Inhomogeneity	NASA	Anin Puthukkudy (UMBC)	
Use of the Enhanced AirHARP-2 suite for airborne validation of the PACE algorithms for aerosol, cloud, and surface properties	NASA		Anin Puthukkudy (UMBC)
Marine stratocumulus clouds: a new polarized interband calibration target for upcoming multi-angle polarimeter missions	NASA		Anin Puthukkudy (UMBC)

Disentangling the surface optical properties and chemical composition from the suspended dust signal by combining in situ and laboratory measurements	NASA		Anin Puthukkudy (UMBC)
Multi-satellite Advanced Smoke Aerosol Characterization and Fire Tracking System	NASA		Myungje Choi (UMBC), Sujung Go (UMBC), Sergey Korkin (UMBC) & Yujie Wang (UMBC)
Technical and Science Analysis of EMIT Data	NASA		Myungje Choi (UMBC), Sujung Go (UMBC), Sergey Korkin (UMBC) & Yujie Wang (UMBC)
Enhanced retrievals of smoke aerosols from combined ABI and EPIC measurements	NASA	Myungje Choi (UMBC)	Zhibo Zhang (UMBC), Sujung Go (UMBC), Sergey Korkin (UMBC) & Yujie Wang (UMBC)
MAIAC Aerosol Retrieval and Atmospheric Correction for PACE OCI	NASA		Myungje Choi (UMBC), Sujung Go (UMBC), Sergey Korkin (UMBC) & Yujie Wang (UMBC)
Constraining the response of the hydroxyl radical to changes in its drivers with machine learning and satellite proxy data	NASA	Daniel Anderson (UMBC)	
Investigating urban anthropogenic CO2 and NOx emissions from the C40 Cities using the synergy of the OCO-2/3 and NO2-observing missions	NASA		Fei Liu (MSU)
Augmenting 610 Capacity in Satellite GHG Observations: Advanced Techniques for Retrieval Improvement and Emission Quantification	NASA		Fei Liu (MSU)
TEMPO Observations for Diurnal O3-NOx-VOCs Sensitivity Diagnosis: An Assessment of O3 Response in Texas	Texas Air Quality Research Program	Lok Lamsal (UMBC)	
Enhancing the Data Quality and Science Value of OCO-2/-3 SIF and XCO2 Products Using Innovative Machine Learning Techniques	NASA		Lok Lamsal (UMBC)
Carbon Flux Orbiting Explorer (CarbonFOX)	NASA		Lok Lamsal (UMBC)
Connecting UV-VIS-NIR Spectral Absorption of Dust with Surface Mineralogy from Synergy of EMIT-AERONET-TROPOMI	NASA	Hirenkumar T. Jethva (MSU)	
Atmospheric retrievals from SAGE III limb scatter measurements: Phase 3	NASA		Ghassan Taha (MSU)
Using SAGE III/ISS Observations and a Global Chemistry-Climate Model to Constrain the Impact of Volcanic Injections on the Bulk and Microphysical Properties of the Stratospheric Aerosol Layer	NASA		Ghassan Taha (MSU)

Analysis of SAGE III/ISS Aerosol Measurements	NASA		Ghassan Taha (MSU)
Stratospheric Hunga Tonga volcanic impacts: SAGE III observations and modeling	NASA		Ghassan Taha (MSU)
Eyes on ecosystem demography and post-disturbance forest recovery using OCO (XCO2, SIF) with support from ISS sensors	NASA		Zhining Tao (MSU)
Quantifying Discharge in Ice-dominated Arctic Deltas Using SWOT	NASA		J. Blake Clark (UMBC)
Enhancing soil erosion risk assessments with SMAP soil moisture	NASA	Robert Emberson (UMBC)	
Earth Observation for Coastal Wetland Resilience and Carbon Monitoring: Algorithm development and Uncertainty analysis with Satellite Imaging Spectrometers and Very High-Resolution imagery	NASA	Anthony Campbell (UMBC)	
Tropospheric and Ionospheric Removal with Radio Occultation Networks (TIRRON): A New Method for Sensitive InSAR Deformation Analysis over Tropical Pacific Islands Using Dense Commercial Constellations	NASA	Stacey Huang (UMBC)	
Ionospheric disturbance associated with geohazards and its potential use for geohazard monitoring and warning from nanosatellite constellation	NASA	Shin-Chan Han (UMBC)	Stacey Huang (UMBC)
An improved treatment of parallax in PACE polarimeter retrievals: accounting for horizontal inhomogeneity in clouds and aerosols	NASA	Vanderlei Martins (UMBC)	
Accelerating HARP2 Aerosol and Surface Property Retrieval with Machine Learning-Driven Radiative Transfer	NASA	Vanderlei Martins (UMBC)	
Addressing Parallax Challenges in Aerosol Retrieval from Multi-Angle Polarimeter Observations: Cloud Screening and Horizontal Inhomogeneity	NASA	Vanderlei Martins (UMBC)	
Use of the Enhanced AirHARP-2 suite for airborne validation of the PACE algorithms for aerosol, cloud, and surface properties	NASA	Vanderlei Martins (UMBC)	
Marine stratocumulus clouds: a new polarized interband calibration target for upcoming multi-angle polarimeter missions	NASA	Vanderlei Martins (UMBC)	
Disentangling the surface optical properties and chemical composition from the suspended dust signal by combining in situ and laboratory measurements	NASA	Vanderlei Martins (UMBC)	

ACRONYMS

ACCDAM	Atmospheric Composition Campaign Data Analysis and Modeling
ACCLIP	Asian Summer Monsoon Chemical & CLimate Impact Project
AEROMMA	Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas
AERONET	Aerosol Robotic Network
AI	Artificial Intelligence
AIRS	Atmospheric Infrared Sounder
AOD	Aerosol Optical Depth
AOS	Atmospheric Observing System
APARC	Atmospheric Processes And their Role in Climate
ARCSIX	Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment
Arctic COLORs	Arctic-COastal Land Ocean interaction
ASIA-AQ	Asian Air Quality
ASIC	Application Specific Integrated Circuit
A-RIP	Reanalysis Intercomparison Project
ATBD	Algorithm Theoretical Basis Document
AVDC	Aura Validation Data Center
AVIRIS	Airborne Visible/Infrared Imaging Spectrometer
AVIRIS-NG	Airborne Visible/Infrared Imaging Spectrometer Next Generation
BioSCape	Biodiversity Survey of the Cape
BLUEFLUX	Blue Carbon Prototype Products for Mangrove Methane and Carbon Dioxide Fluxes
BOEM	Bureau of Ocean Energy Management
CAMEL	Combined ASTER and MODIS Emissivity database over Land
CAMP2Ex	Cloud, Aerosol and Monsoon Processes Philippines Experiment
CASA / MiCASA	Carnegie-Ames-Stanford Approach (CASA) / Más informada CASA (MiCASA)
CASALS	Concurrent Artificially-intelligent Spectrometry and Adaptive Lidar System
CBS-FVCOM	Coastal Beaufort Sea Finite Volume Community Ocean Model
CCM	Chemistry-Climate Model
CCS	Carbon Cycle Science project
CESAS	Committee on Earth Science and Applications from Space
CHIRP	Climate Hyperspectral Infrared Radiance Product
CMIS	Compact Midwave Imaging System
CoDAS	Constituent Data Assimilation
COSMIC-2 RO	Constellation Observing System for Meteorology Ionosphere and Climate-2 Radio Occultation
COWVR	Compact Ocean Wind Vector Radiometer
CrIS	Cross Track Infrared Sounder
CRTM	Community Radiative Transfer Model
CSDA	Commercial Smallsat Data Acquisition
CSS-DESIS	Commercial Small Sat DESIS evalutation
CyAN	Cyanobacteria Assessment Network
DA	Data Assimilation

DCOTSS	Dynamics and Chemistry of the Summer Stratosphere
DEEP-VIEW	Deep learning for Environmental and Ecological Prediction-eValuation and Insight with Ensembles of Water quality
DESIS	DLR Earth Sensing Imaging Spectrometer
DRCS	Disaster Response Coordination System
DSCOVR	Deep Space Climate Observatory
DT	Dark Target
DUSA	Dust Source Attribution
EarthCARE	Earth Cloud Aerosol and Radiation Explorer satellite mission
ECCOH	Efficient CH4-CO-OH chemistry module
ECS	Equilibrium Climate Sensitivity
EIS	Earth Information System
EMIT	NASA Earth surface Mineral dust source InvesTigation
EPE	Extreme Precipitation Events
EPIC	Earth Polychromatic Imaging Camera
E-PROBED	E-region Prompt Radio Occulation Based Electron Density model
ESTO	Earth Science and Technology Office
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EXRAD	ER-2 X-band Doppler Radar
FG-AI4NDIM	Focus Group on AI for Natural Disaster Management
FILDA	Fire Light Detection Algorithm
FLUID	Framework for Live User-Invoked Data
G7 FSOI	G7 Future of the Seas and Oceans Initiative
GAFIS	Global Air Quality Forecasting and Information System
GEE	Google Earth Engine
GEOBON	Group on Earth Observation Biodiversity Observation Networks
GEOS	Goddard Earth Observing System
GEOS-ADAS	Global Earth Observing System-Atmospheric Data Assimilation System
GEOS-LDAS	Global Earth Observing System-Land Modeling and Data Assimilation System
GEOS-CF	GEOS Composition Forecast system
GEOS-FP	GEOS Forward Processing system
Geo-XO	Geostationary Extended Observations Program
GES DISC	Goddard Earth Science Data and Information Services Center
GFDL SPEAR	Geophysical Fluid Dynamics Laboratory's Seamless system for Prediction and EArth system Research
GHGC	Greenhouse Gas Center
GHRC	Global Hydrometeorology Resource Center
GIS	Geographic Information Systems
GLIMR	Geosynchronous Littoral Imaging and Monitoring Radiometer
GLOWS	Global L-Band Active/Passive Observatory for Water Cycle Studies
GNSS-RO	Global Navigation Satellite System Radio Occultation
GOCART	Goddard Chemistry Aerosol Radiation and Transport
GOCART-2G	Goddard Chemistry Aerosol Radiation and Transport 2nd generation
GOTHAAM	Greater New York Oxidant Trace gas Halogen and Aerosol Airborne Mission
GPM	Global Precipitation Measuring
HARP2	Hyper-Angular Rainbow Polarimeter-2
HIPP	Hyper-angle Image Processing Pipeline
HMA	High Mountain Asia

HyMPI	Hyperspectral Microwave Instrument
HyperCP	HyperInSPACE community processor
IAGOS	In-service Aircraft for a Global Observing System
IASI	Infrared Atmospheric Sounding Interferometer
ICESat-2	Ice, Cloud, and land Elevation Satellite 2
ICIMOD	International Centre for Integrated Mountain Development (Nepal)
IGC	International GEOS-Chem
ILEOS	Intelligent Long Endurance Observing System
ILRS	International Laser Ranging Service
IMERG	Integrated Multi-SatellitE Retrievals for GPM
IMPACTS	Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms
ISCCP	International Satellite Cloud Climatology Project
ISS	International Space Station
ITRF	International Terrestrial Reference Frame
JCSDA	Joint Center for Satellite Data Assimilation
JEDI	Joint Effort in Data Integration
KMG	Kinetics Generating Software
LADAS	Land-Atmosphere Data Assimilation System
LARES-2	Laser Relativity Satellite 2
LHASA	Landslide Hazard Assessment for Situational Awareness
LIS	Lightning Imaging Sensor
LST	Land Surface Temperature
MAIAC	Multi-Angle Implementation of Atmospheric Correction
MAP	Modeling, Analysis, and Prediction
MAP	Multi-Angular polarimeter
MBARS	Microwave Barometric Radar and Sounder instrument
MC	Mid-latitude Cyclones
MCSSA	Monte Carlo code for Spherical Shell Atmosphere
MJO	Madden-Julian Oscillation (MJO) simulations
MISATEAM	CTM-Independent SATellite-derived Emission estimation Algorithm for Mixed-sources
MLS	Microwave Limb Sounder
MOBY	Marine Optical Buoy
MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Marine Protected Areas
NCCS	NASA Center for Climate Simulation
NDACC	Network for the Detection of Atmospheric Composition Change
NEON	National Ecological Observatory Network
NSF LSAMP	NSF Louis Stokes Alliances for Minority Participation program
NSIDC	National Snow and Ice Data Center
NOMAD	NASA bio-Optical Marine Algorithm Dataset
OBB	Ocean Biology and Biogeochemistry
OCI	Ocean Color Instrument
OCO-2	Orbiting Carbon Observatory 2
OMI	Ozone Monitoring Instrument
OMPS-NM	Ozone Mapping Profiler Suite – Nadir Mapper
OSE	Observing System Experiments

OSSEs	Observation System Simulation Experiments
PACE	Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission
PACE-PAX	Plankton, Aerosol, Cloud, ocean Ecosystem Post-launch Airborne eXperiment
PARSIVEL	Particle Size Velocity
PBLH	Planetary Boundary Layer Height
PCC	Phytoplankton Community Composition
PIP	Particle Imaging Package
PL	Polar Lows
PMCs	Polar Mesospheric Clouds
PyTOAST	Python Top of Atmosphere Simulation Tool
QBO	Quasi-Biennial Oscillation
RoboHypo	Robotic Hyperspectral Polarimeter for the Ocean
ROZE	Rapid OZone Experiment
RRTMG	Rapid Radiative Transfer Model Global
SAFE	Structure and Function of Ecosystems
SALaD	Semi-automated Landslide Detection (SALaD) system
SARP-East	Student Airborne Research Program-East
SATAL	South American Tropopause Aerosol Layer
SCERIN	South Central and Eastern European Regional Information Network
SDC	Surface Deformation and Change mission
SeaBASS	SeaWiFS Bio-optical Archive and Storage System
SeaPRISM	Sea Photometer Revision for Incident Surface Measurements,
SLR	Sea-Level Rise
SMAP	Soil Moisture Active and Passive Mission
SMOS	Soil Moisture and Ocean Salinity
SNPP	Suomi National Polar-orbiting Partnership
SNWG	Satellite Needs Working Group
SSS	Sea Surface Salinity
SSEM PP	Station Systematic Error Model Pilot Project
S2S	Subseasonal to Seasonal (S2S) forecast model
SVC	System Vicarious Calibration
TC	Tropical Cyclones
TEMPO	Tropospheric Emissions: Monitoring of Pollution spectrometer
TIM	Total Irradiance Monitor
TOAR	Tropospheric Ozone Assessment Report
TOBAC	Tracking and Object-Based Analysis of Clouds
TRMM	Tropical Rainfall Measuring Mission
TROPICS	Time-Resolved Observation of Precipitation structure and storm Intensity with a Constellation of Smallsats mission
TROPOMI	TROPOspheric Monitoring Instrument (TROPOMI)
TSIS-1	Total and Spectral solar Irradiance Sensor
TTE	Tundra-Taiga Ecotone
UFO	Unified Forward Operator
WMO	World Meteorological Organization
WSF-M	Weather Satellite Follow-on-Microwave