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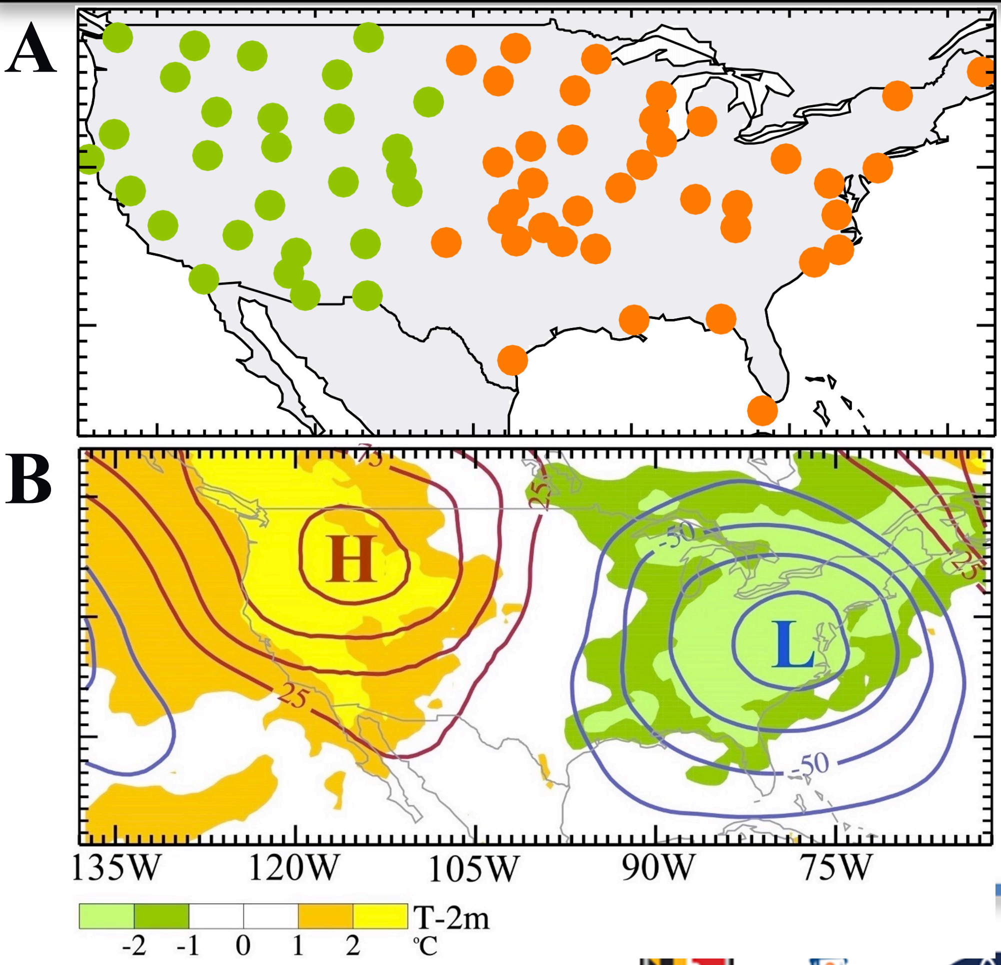
# Continental patterns of bird migration linked to climate variability




Using radar-based observations, a new spatial concept is introduced for bird migration patterns across the contiguous U.S. This framework objectively divides the U.S into two regions (Fig. A), each reflecting a specific year-to-year variability of bird migration arrival date in Spring. This approach, which is intrinsically different from the “flyway concept”, allowed us to find the large-scale climatic drivers of bird migration including Rossby waves (Fig. B).

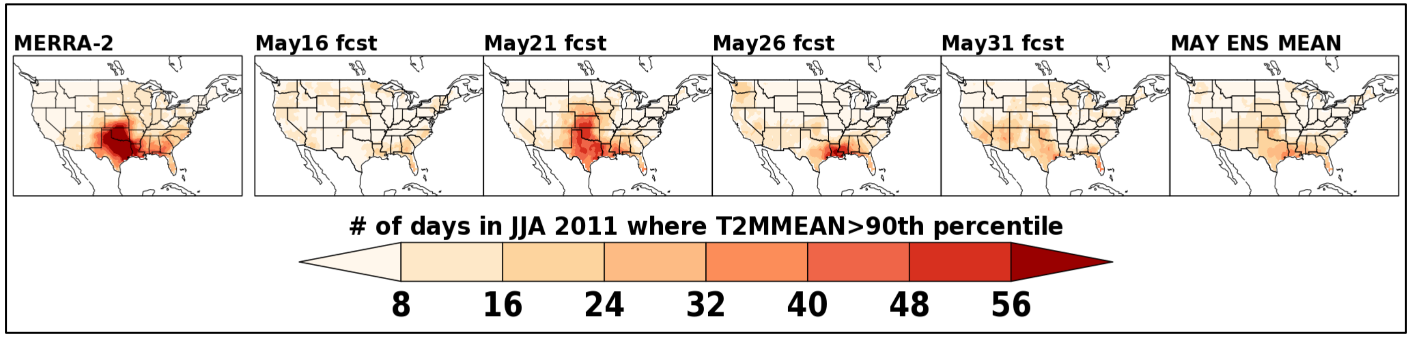
**A**: Two regions identified based on interannual variability of peak bird migration date in spring. Circles show the location of NEXRAD stations.

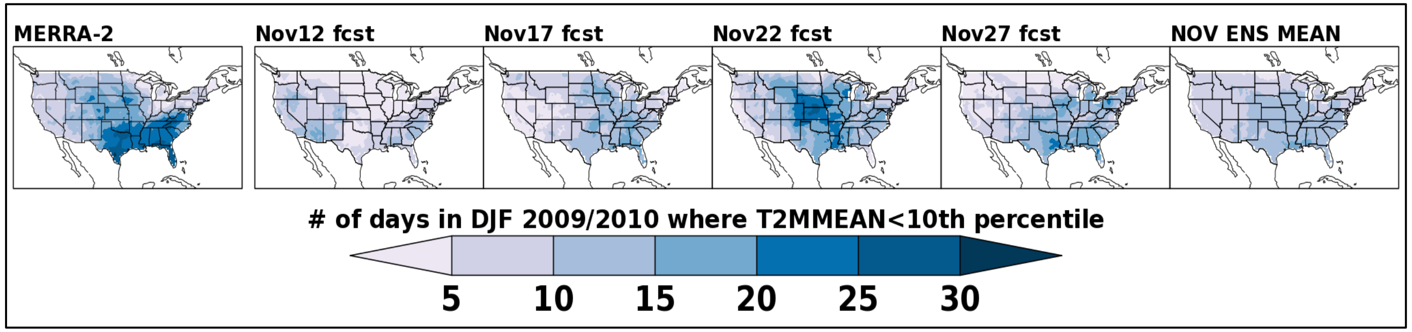
**B:** T-2m (shading) and 300-hPa geopotential heights during April/May (contours) for 2005 minus 2010, years with notably east-west contrast in arrival dates of migratory birds.

Dezfuli, A., Horton, K.G., Zuckerberg, B., Schubert, S.D. and Bosilovich, M.G., 2021. Continental patterns of bird migration linked to climate variability. *Bulletin of the American Meteorological Society*.

Amin Dezfuli (UMBC)

# Seasonal Prediction of Extreme Temperature Indices




- Extreme temperature indices represent the number of days per season where the daily mean temperature is above or below a percentile threshold
- This study examines the ability of the GEOS-S2S-2 seasonal hindcasts to predict patterns of extreme cold and warm indices over the United States; the figures to the right show examines for given years

Natalie Thomas (UMBC)

Poster #50 - Seasonal Prediction of Extreme Temperature Indices over the United States, Monday at 3pm, Hall E

# The Madden-Julian Oscillation (MJO) in NASA's subseasonal to seasonal (S2S) forecast system

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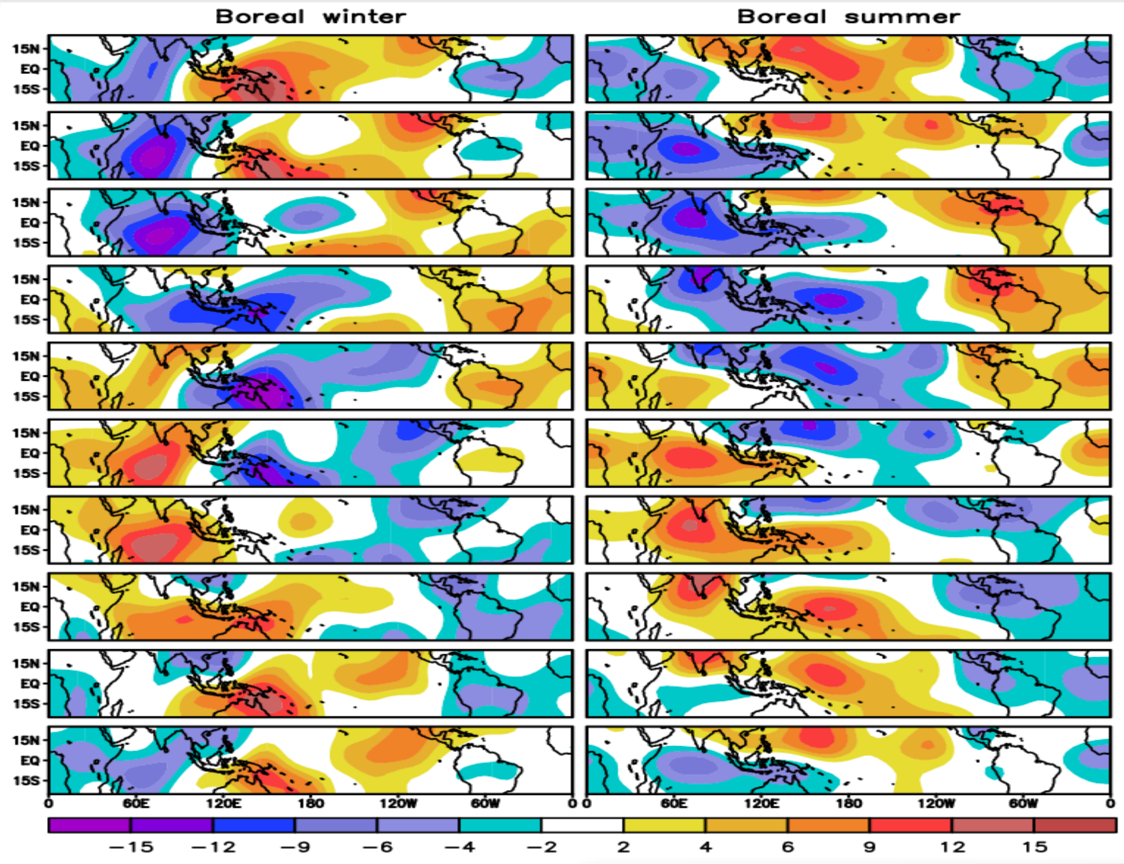



Day 1-5
Day 6-10
Day 11-15
Day 16-20
Day 21-25
Day 26-30
Day 31-35
Day 36-40
Day 41-45
Day 46-50

The eastward MJO propagation represented by OLR in NASA's GEOS-S2S Version 3 (GEOS-S2S-V3) for the boreal winter (left) and summer (right). Each panel from the top to the lowest panel displays 5-day averaged MJO from Day1-5 through Day 46-50.

The forecast system clearly represents the eastward propagation of the MJO convection along the equatorial region for both seasons.

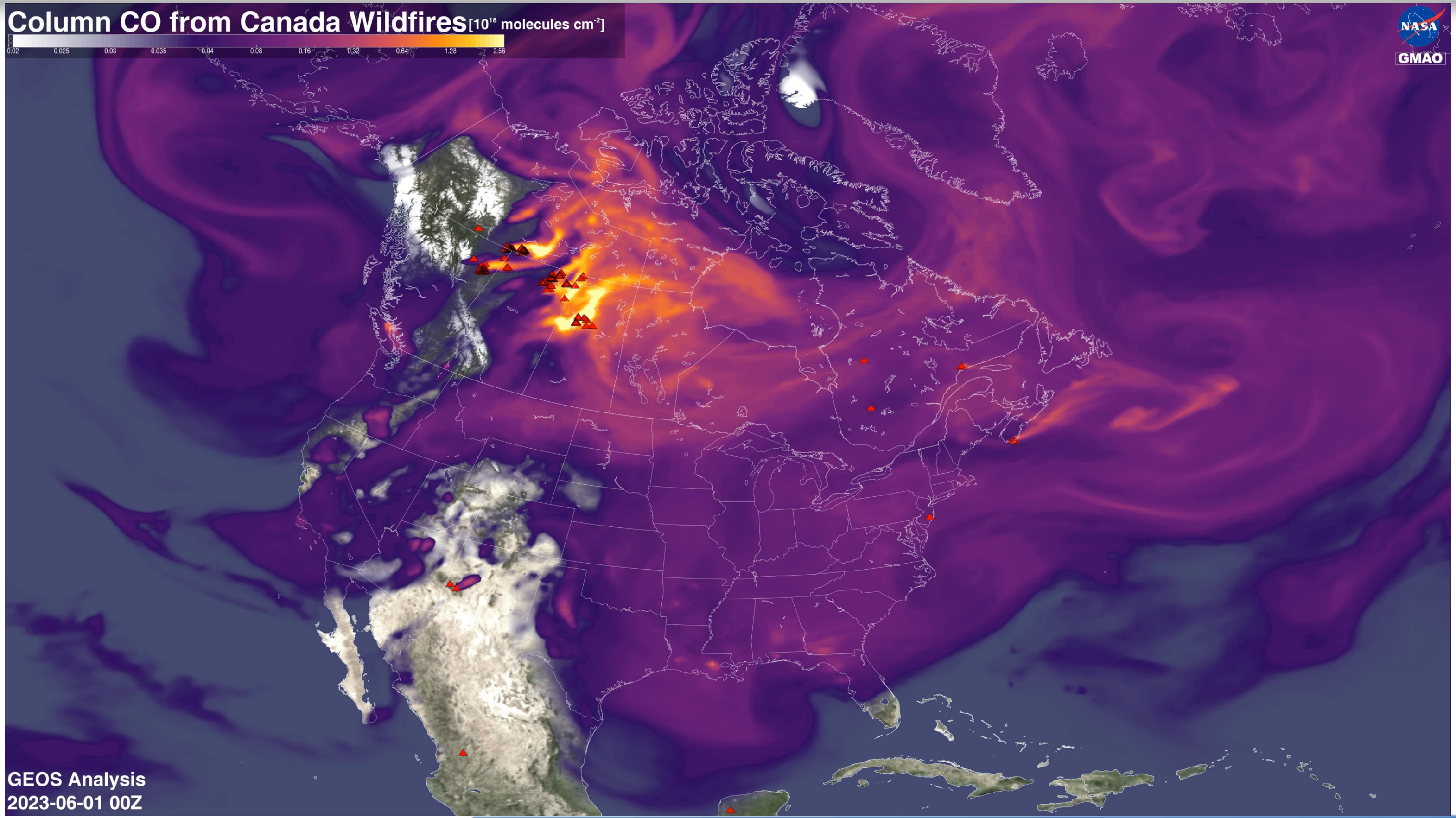
It takes about ~45 days for the propagating MJO to complete one round along the equator. 45 days corresponds to 5m/sec, which is widely accepted as the average speed of MJO from observations.

12th Symposium on the MJO and Sub-Seasonal Monsoon Variability.

Propagation of the MJO and associated moist dynamics, and advantages of enhanced resolution in NASA's GEOS-S2S forecast system
Monday at 5:15pm, Room 342

Young-Kwon Lim (UMBC)

# Transport of CO from North American Biomass Burning in June 2023




- Smoke emitted from Canadian wildfires in Alberta and Quebec was transported into the United States in early June and resulted in hazardous air quality
- A quasi-stationary low-pressure system funneled the smoke into the metropolitan corridor of the northeast US
- This animation, produced using GEOS FP, demonstrates the transport from the perspective of carbon monoxide (CO)

Allison Collow (UMBC),
Animation by Joe Ardizonne

9A.2 - Challenges in Observing, Modeling, and Forecasting the June 2023 Smoke Event over the Northeast US
Wednesday at 8:45am, Room 310

# EVALUATING AEROSOLS IN THE NASA CHEMISTRY CLIMATE MODEL (GEOS-CCM)

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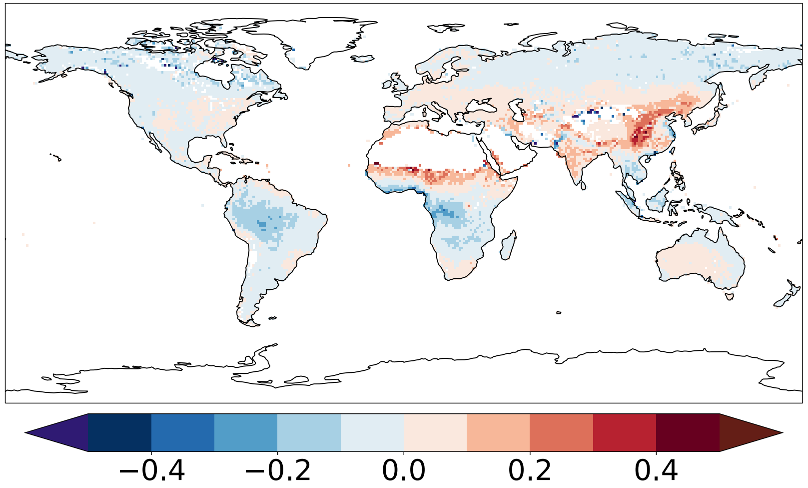
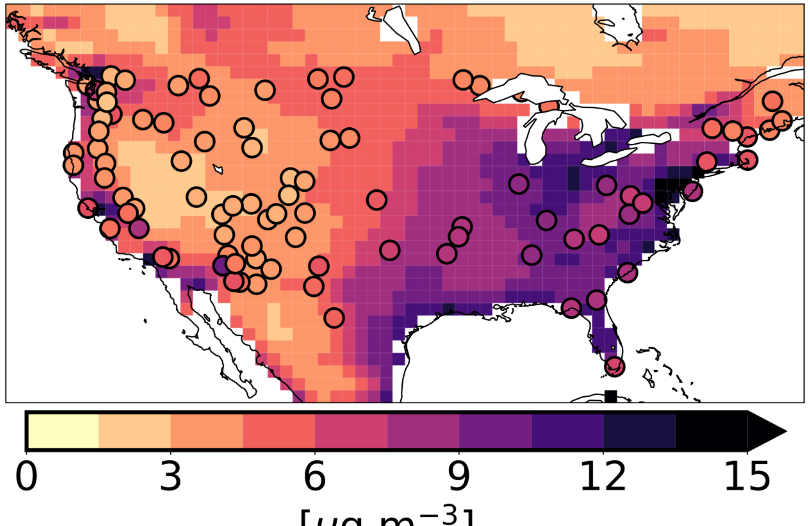
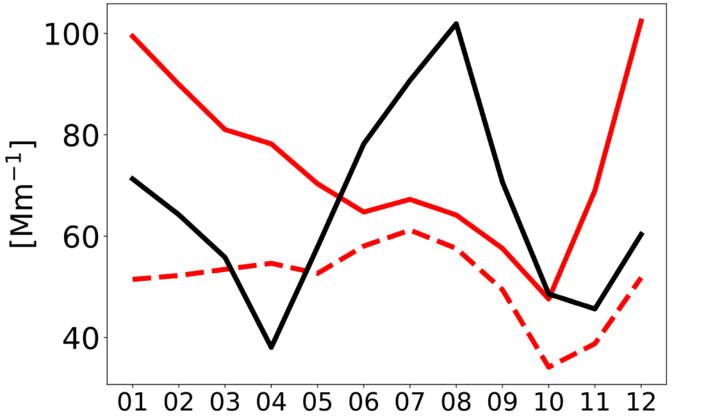
AOD : GEOS-CCM - MODIS 2001-2018




$PM_{2.5}$ : GEOS-CCM vs IMPROVE OBS (Circles) 2001-2018




SCATTERING COEFFICIENT
Great Smoky Mountain Site annual 2001-2018





**Caterina Mogno (UMBC)**,
Pete Colarco, Allison Collow (UMBC) ,
Sarah A Strode (MSU), Vanessa Valenti,
Qing Liang, Luke Oman, and
K. Emma Knowland (MSU)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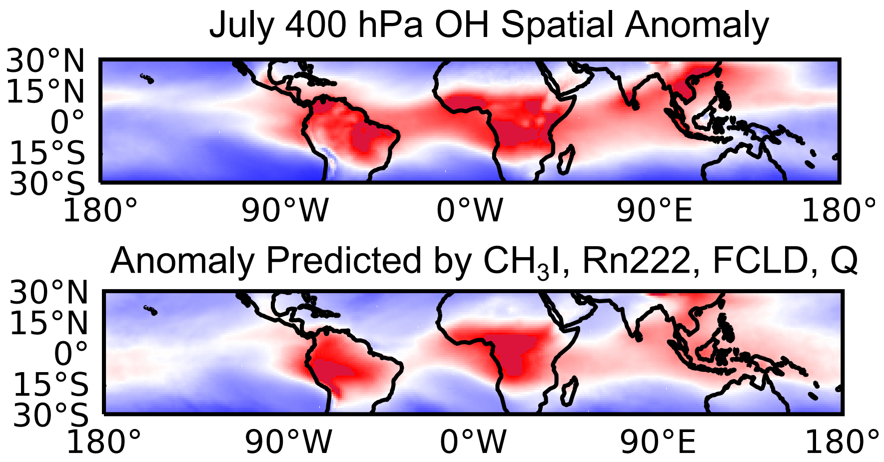
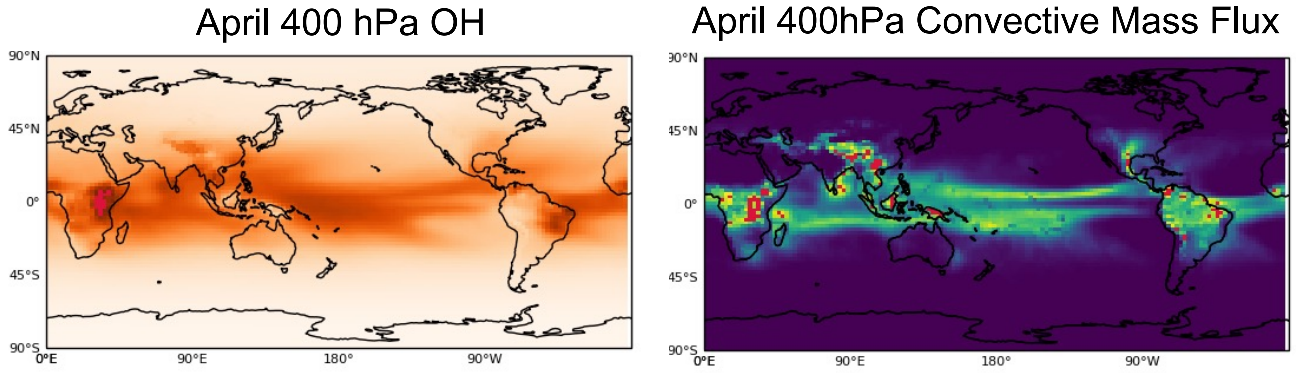
# Linking Interannual and Inter-Model Variability in OH to Meteorology

- The distribution of OH simulated by GEOSCCM at 400hPa shows co-location with convection.
- While OH has a short lifetime, it is chemically coupled to other species that can undergo transport.
- We investigate how inter-model and interannual variability in meteorology and transport affect simulated OH



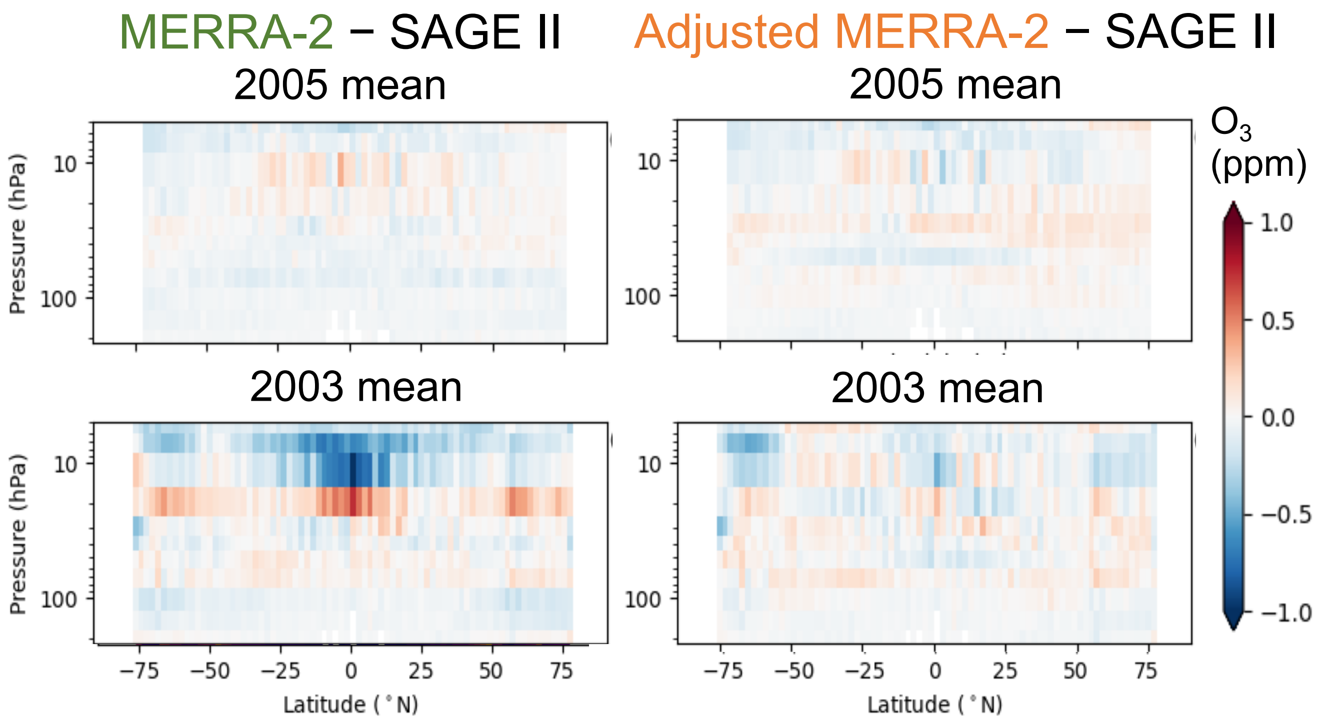




- Linear regression on 4 tracer and meteorological variables can predict spatial anomalies in simulated July 400hPa OH ($r^2$=0.64)
- We aim to develop observation-based diagnostics for model OH differences


Sarah Strode(MSU)
Bryan Duncan (NASA)
Daniel Anderson (UMBC)
Luke Oman (NASA)
Clara Orbe (NASA)


For more information, see poster 865 "Linking Interannual and Inter-Model Variability in OH to Meteorological Variability" Thurs. Feb 1, 3pm in the ACMAP poster session

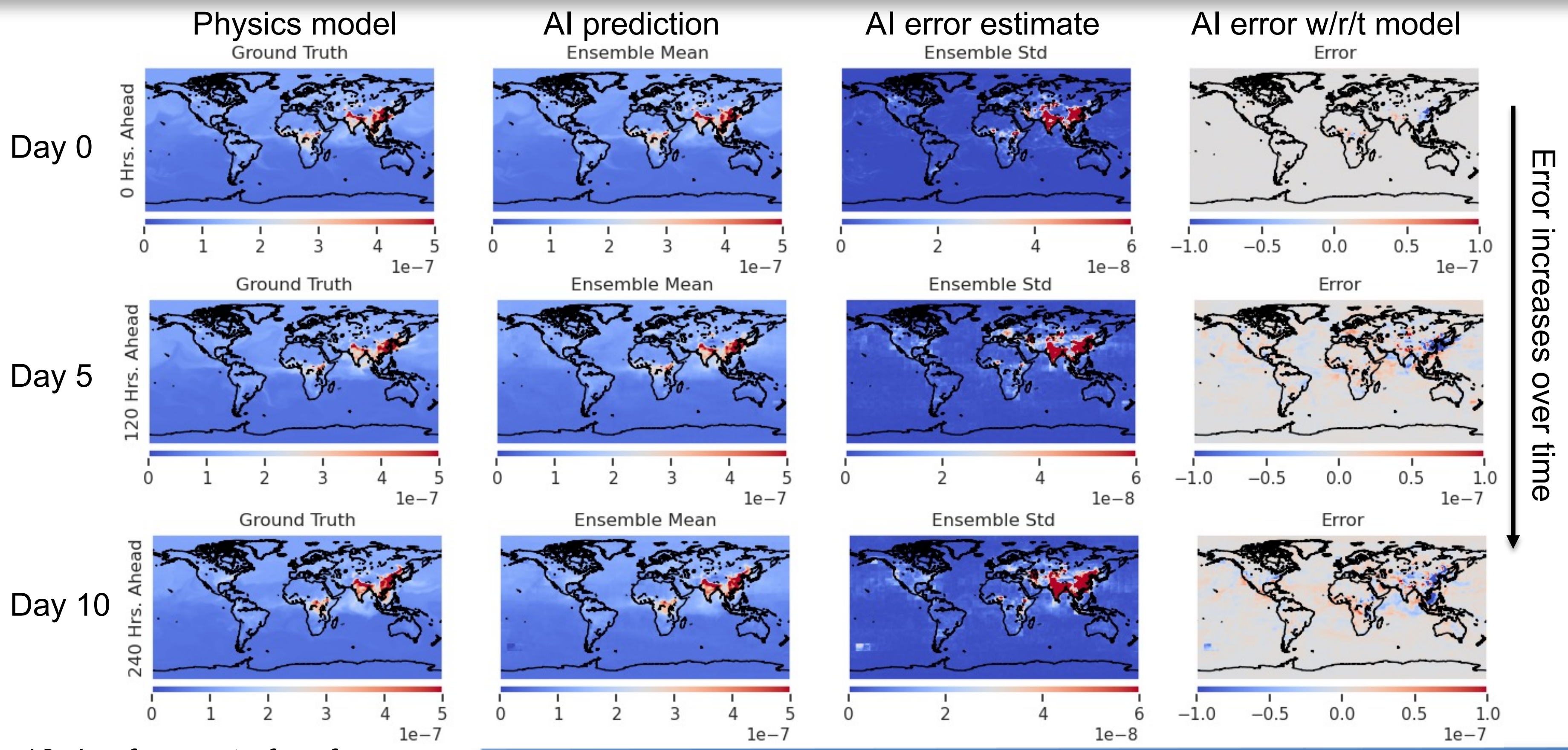
# A Continuous Ozone Record through SAGE and Aura Satellite Missions with MERRA-2




- Stable, long-term records are necessary to monitor the recovery of the ozone ($O_3$) layer
  - Data assimilation products, such as MERRA-2, can provide high resolution, long-term records
- MERRA-2 assimilates $O_3$ observations from SBUV (1980 – 2004) and Aura (2004 – present) satellite instruments
  - Switching to Aura in 2004 introduces a discontinuity in the MERRA-2 record, as seen with respect to SAGE II measurements
- Adjusting MERRA-2 using a chemical model stabilizes $O_3$ with respect to the SAGE II record (1984 – 2005)


Pamela Wales (MSU)
K. Emma Knowland (MSU)
Kris Wargan (SSAI)
Brad Weir (MSU)
Steven Pawson (NASA GSFC)

# Improve atmospheric composition forecasts using generative AI

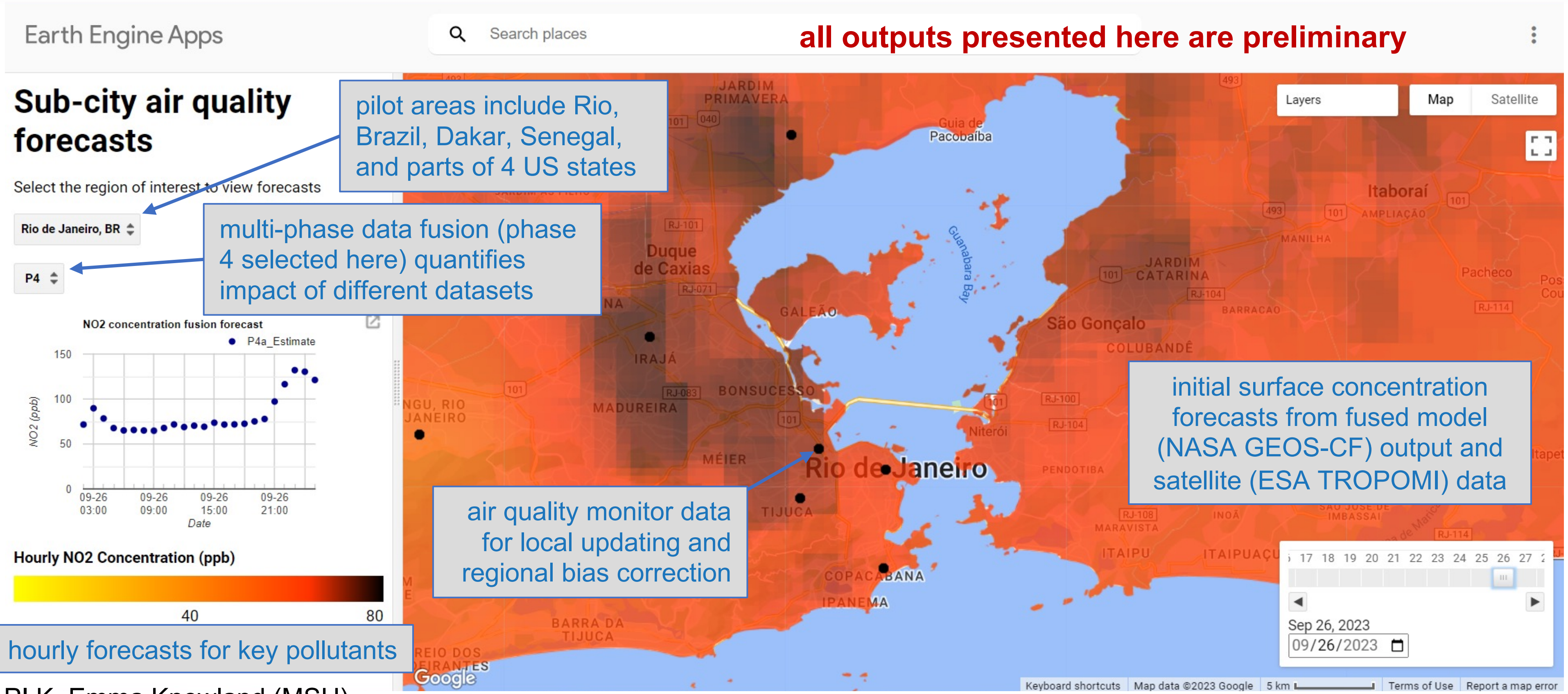



- Forecasting atmospheric composition - including air quality - is computationally very demanding
- We explore the potential of AI models to accelerate and improve composition forecasts
- Initial results indicate that generative AI models can produce accurate short-term forecasts at a fraction of the cost

10-day forecast of surface carbon monoxide (CO), in v/v

Christoph Keller (MSU)

# Air Quality Data Fusion to Support Local Forecasting and Management




The NASA Health and Air Quality Applied Sciences Program funds GESTAR II scientists working with Sonoma Technology Inc. and others to implement an air quality data fusion tool in Google Earth Engine. This tool combines global information (NASA GMAO GEOS-CF atmospheric composition forecasts, NASA VIIRS and ESA TROPOMI satellite products) with locally collected air quality data. The tool will produce hourly estimates and forecasts up to several days in advance of key air quality parameters ($PM_{2.5}$, $NO_2$, $O_3$) relevant at sub-city (1-5 km) scales, supporting comprehensive local assessment and management.

PI K. Emma Knowland (MSU)
Co-I Carl Malings (MSU)
Co-I Christoph Keller (MSU)

Implementation for Google Earth Engine by Nathan Pavlovic & Justin Coughlin (Sonoma Technology Inc.)

23rd Joint Conference on the Applications of Air Pollution Meteorology with the A&WMA
Air Quality Forecasting I
Monday at 1:45 PM, Room 316

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# Stratospheric composition near-real time and forecasting capability with NASA GEOS Composition Forecast System, GEOS-CF

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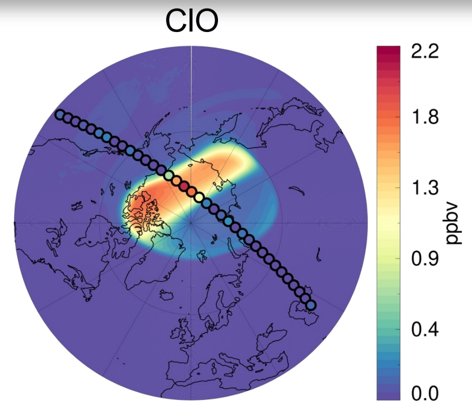
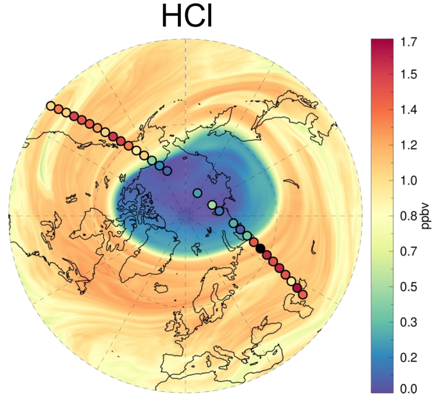
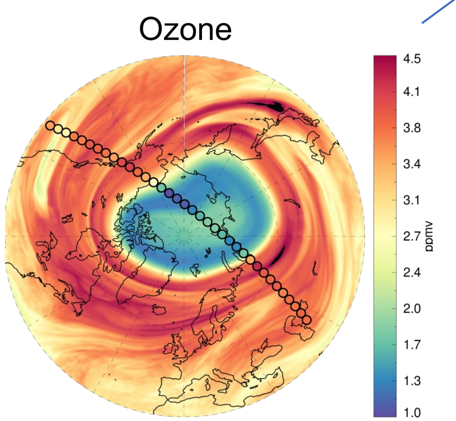
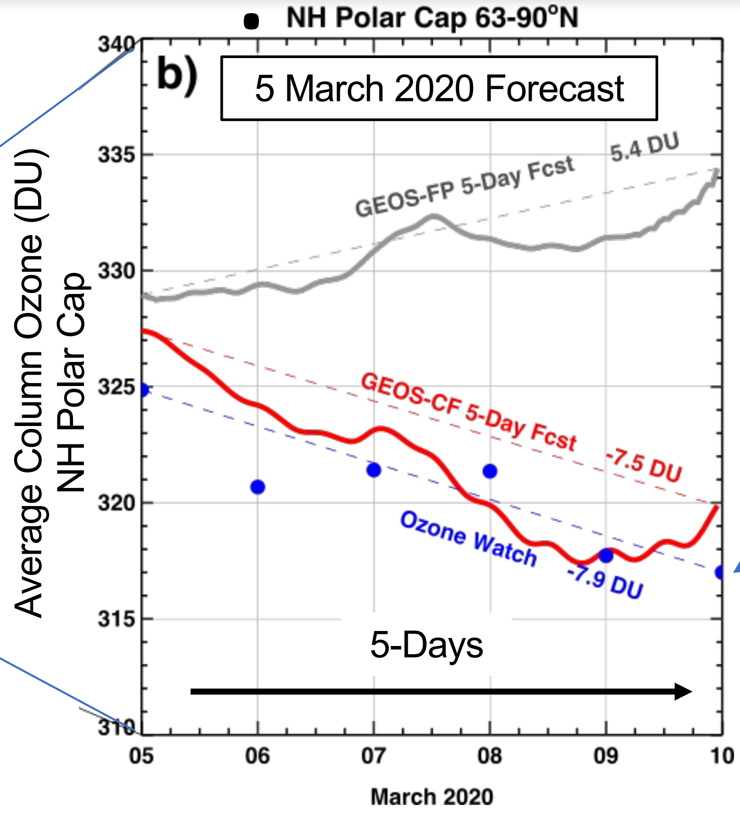


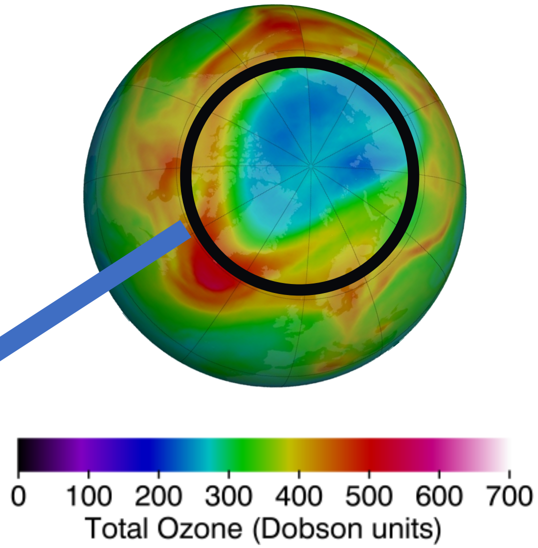




March 5, 2020
GEOS-CF
(45 hPa)




March 10, 2020
Ozonewatch




Ozonewatch.gsfc.nasa.gov

Knowland et al. 2022 (10.1029/2021ms002852)

The GEOS-CF with stratospheric chemistry is responsible for the improved ozone forecasts

This adds realistic near-real-time stratospheric ozone forecasting capability to the NASA GMAO during anomalous dynamic and chemical situations such as the Northern Hemisphere polar vortex of 2020.

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MSU: K. Emma Knowland, Christoph Keller, Pamela Wales

# Understanding trends in the tropospheric hydroxyl radical

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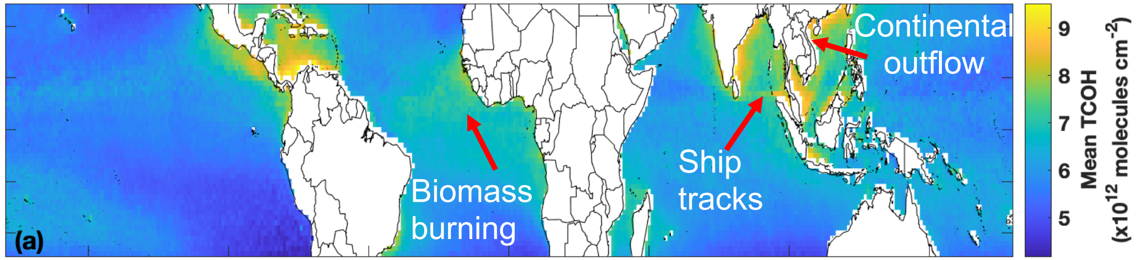
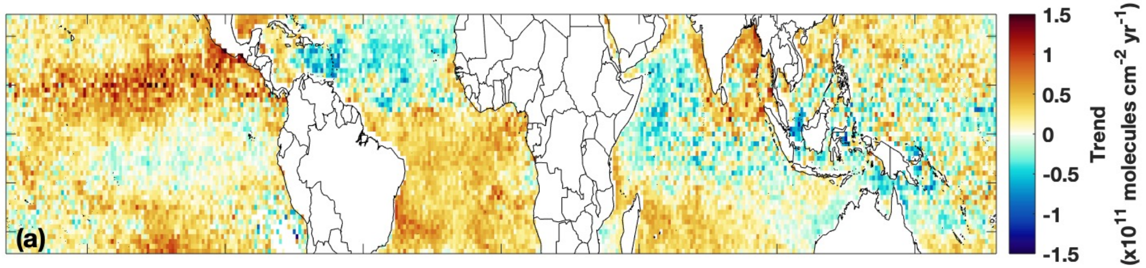
**Tropical OH in SON averaged over 2005 - 2019**

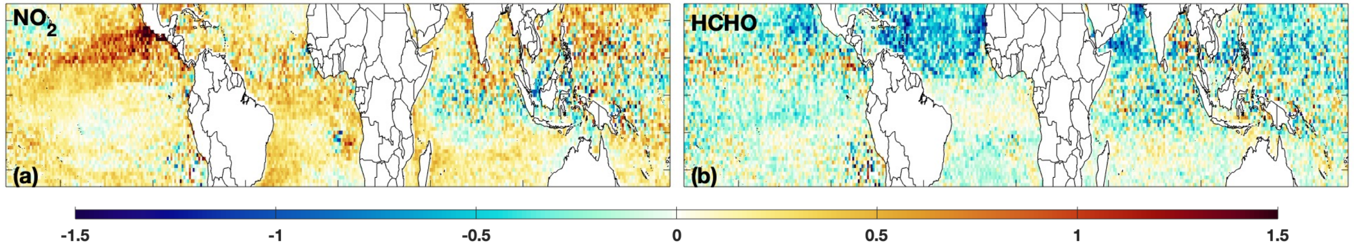



**OH trend in SON over 2005 - 2019**




- Increases in $NO_2$ are leading to increases in OH while changes in formaldehyde, a proxy for many OH sinks, are leading to decreases over the Atlantic (right).

- Hydroxyl (OH) controls atmospheric methane removal, but we are currently unable to directly observe OH from space.
- We combined machine learning and satellite observations of chemical and dynamical drivers of OH to calculate tropical OH.
- The satellite-constrained product shows the effects of anthropogenic emissions on OH (top left).
- This product resolves OH trends at much higher resolutions than previous methodologies (bottom left).




**Inferred contribution of $NO_2$ and HCHO to OH trend**

For more information, see talk at Wed. Jan. 31 at 11:30 in room 310.

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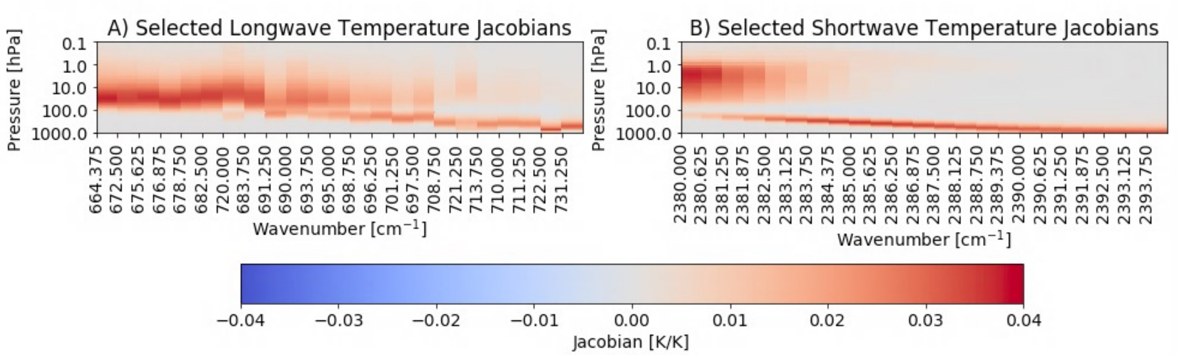
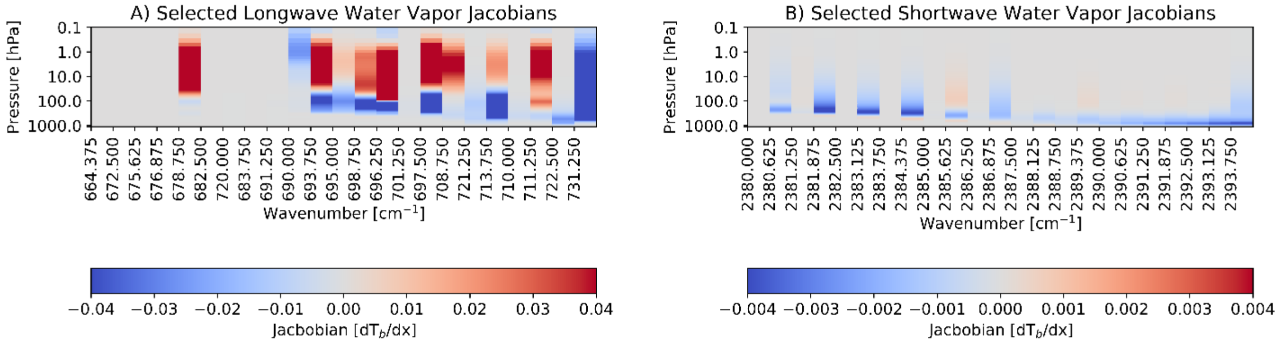
Dan Anderson (UMBC), Junhua Liu (MSU), Sarah Strode (MSU), Amir Souri (MSU), Julie Nicely (UMD), Bryan Duncan (GSFC), Melanie Follette-Cook (GSFC)

# Radiance Assimilation Utilizing New/Underutilized Spectral Regions




**Study Exploring the use of CrIS Shortwave Infrared Region**

- **Top two panels show temperature sensitivity of commonly used longwave channels (left) and shortwave channels (right)**
- **Shortwave channels exhibit sensitivity with sharper peak sensitivity vs. longwave channels**
- **Bottom two panels show water vapor sensitivity for the same longwave channels (left) and equivalent shortwave channels (right)**
- **Shortwave channels (right) have the benefit of having less water vapor sensitivity than longwave channels (left) reducing aliasing of temperature and water vapor signals in data assimilation**
- **Jacobians (sensitivity) easily plotted directly in python using pyCRTM (https://github.com/JCSDA/pycrtm)**


Bryan M. Karpowicz (UMBC)
Erin E. Jones (UMD/NOAA)
Kevin Garrett (NOAA)
Kayo Ide (UMD)
Yingtao Ma (UMD/NOAA)
Chris Barnett (SGT)
Sid Boukabara (NASA HQ)

# Evaluation of Planetary Boundary Layer Structure from NASA GMAO's Next Reanalysis

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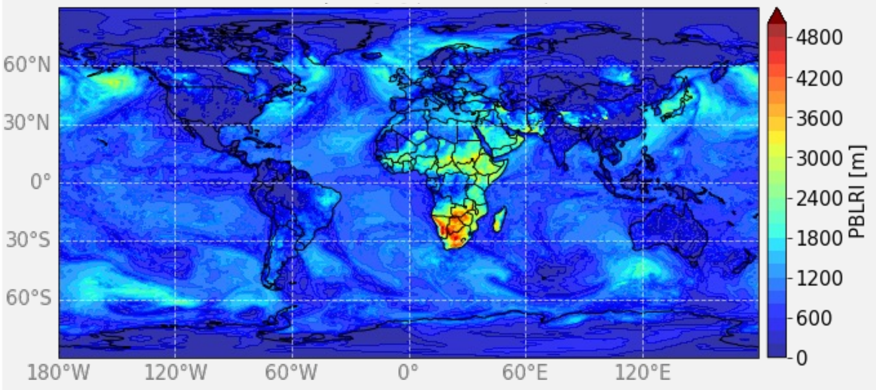
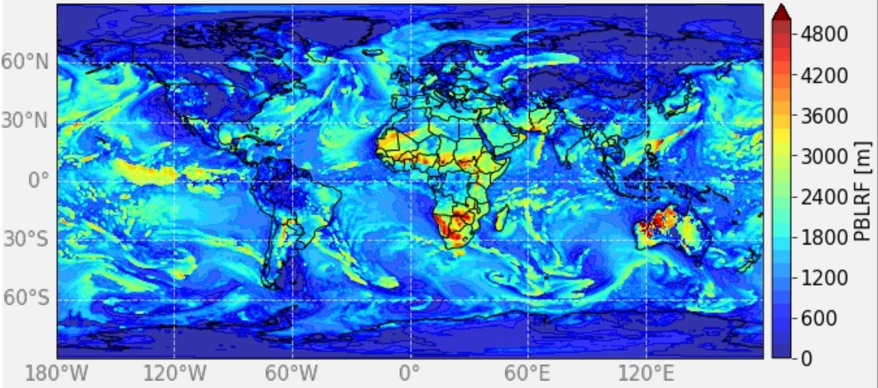
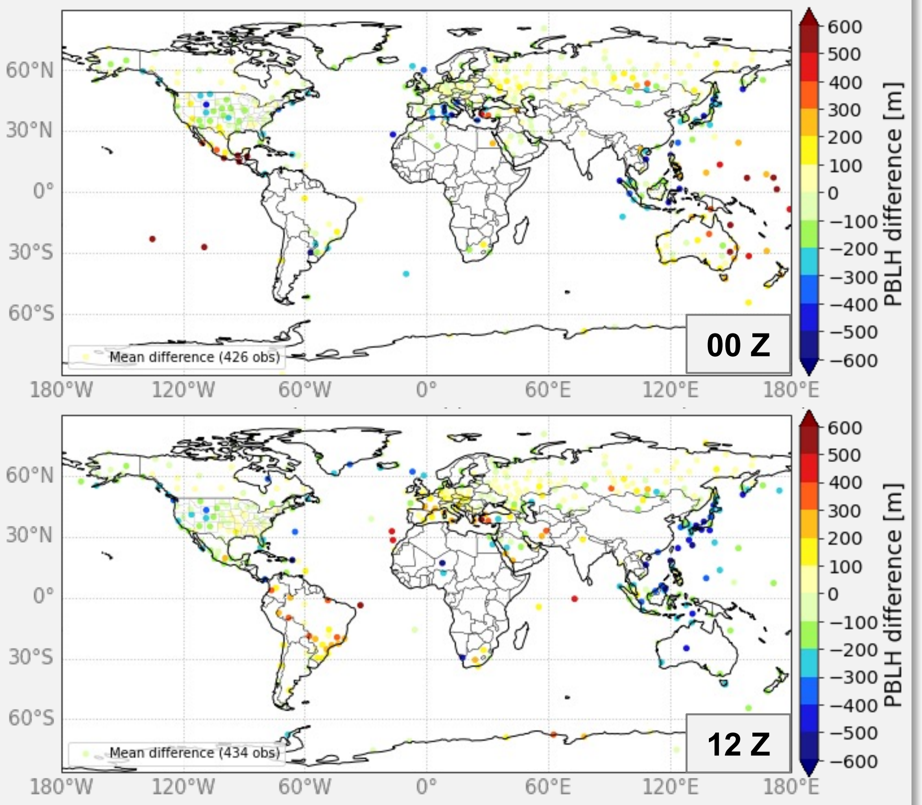
**RiB-based PBLH (2021/Dec/01 12 Z)**




**Refractivity gradient-based PBLH (2021/Dec/01 12 Z)**




**Mean of RiB PBLH Difference (Raob minus R21C) (2021Dec)**




- In this study, we evaluate PBL structures as well as PBL height from NASA Global Modeling and Assimilation Office (GMAO)'s next retrospective analysis product: the Goddard Earth Observing System Retrospective Analysis of the early 21st Century (GEOS-R21C) using radiosonde and GNSS RO observations.
- A clear diurnal variation is observed in Bulk Richardson number (RIB)-based and refractivity gradient-based PBL height from preliminary GEOS-R21C (Left) and in the mean of RiB-based PBL height difference between radiosonde and GEOS-R21C (Right).


**Eun-Gyeong Yang (UMBC)**
Yanqiu Zhu (NASA GSFC)
Amal El Akkraoui (NASA GSFC)
Nathan Arnold (NASA GSFC)
Manisha Ganeshan (MSU)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- Poster # 646 – Evaluation of Planetary Boundary Layer Structure from NASA Global Modeling and Assimilation Office's Next Retrospective Analysis Product GEOS-R21C
- Wednesday at 3pm, Hall E

# Soil Moisture & Brightness Temperature Assimilation for GEOS Reanalysis

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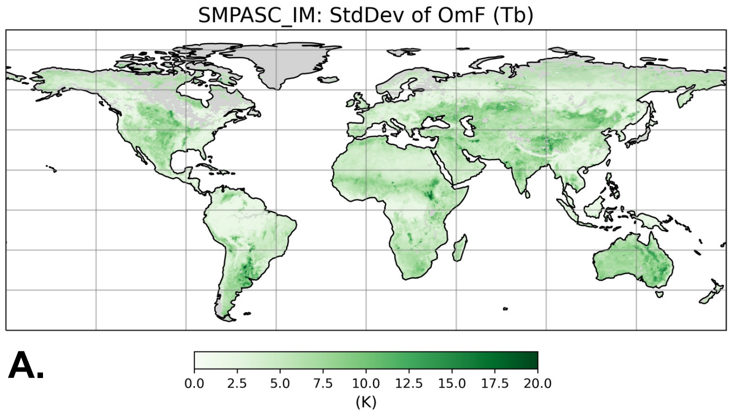
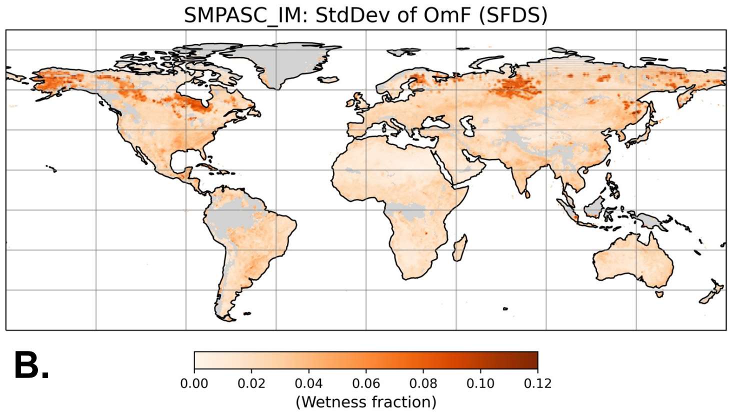
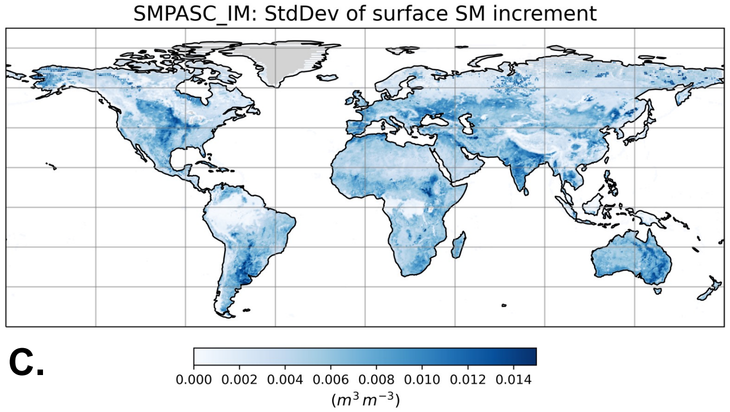


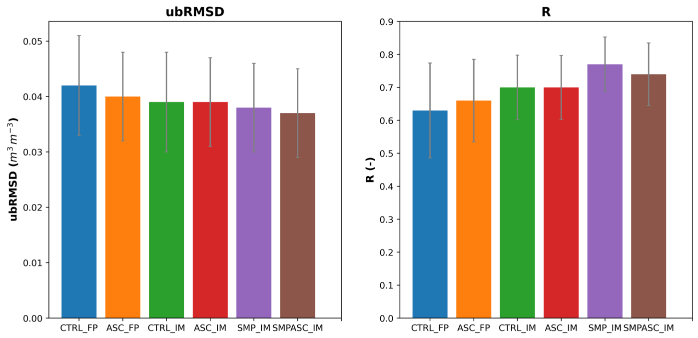

A.




B.




C.




D.

- We are working towards including soil moisture data assimilation in upcoming GEOS reanalysis efforts, and have recently tested the impacts of jointly assimilating both SMAP brightness temperatures and ASCAT soil wetness retrievals in GEOS LDAS.
- Preliminary results from a 6 year long experiment suggest that observations-minus-forecasts (OmF) are larger for both observation types when assimilated jointly versus separately (**A** and **B**)
- The resultant update increments in soil moisture (SM) are also correspondingly larger than in the existing system that assimilated SMAP observations alone (**C**)
- However, validation against in-situ SM observations suggests limited improvements in skill when ASCAT observations are assimilated, or even degradation in correlations with observed SM (**D**)
- Improvements are still required in how the ASCAT assimilation treats desert and peatland regions


**Andrew Fox (MSU)**
**Qing Liu (SSAI)**
**Rolf Reichle (NASA GMAO)**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15C.3 - Soil Moisture and Brightness Temperature Assimilation for GEOS Reanalysis

Thursday, February 1, 2024

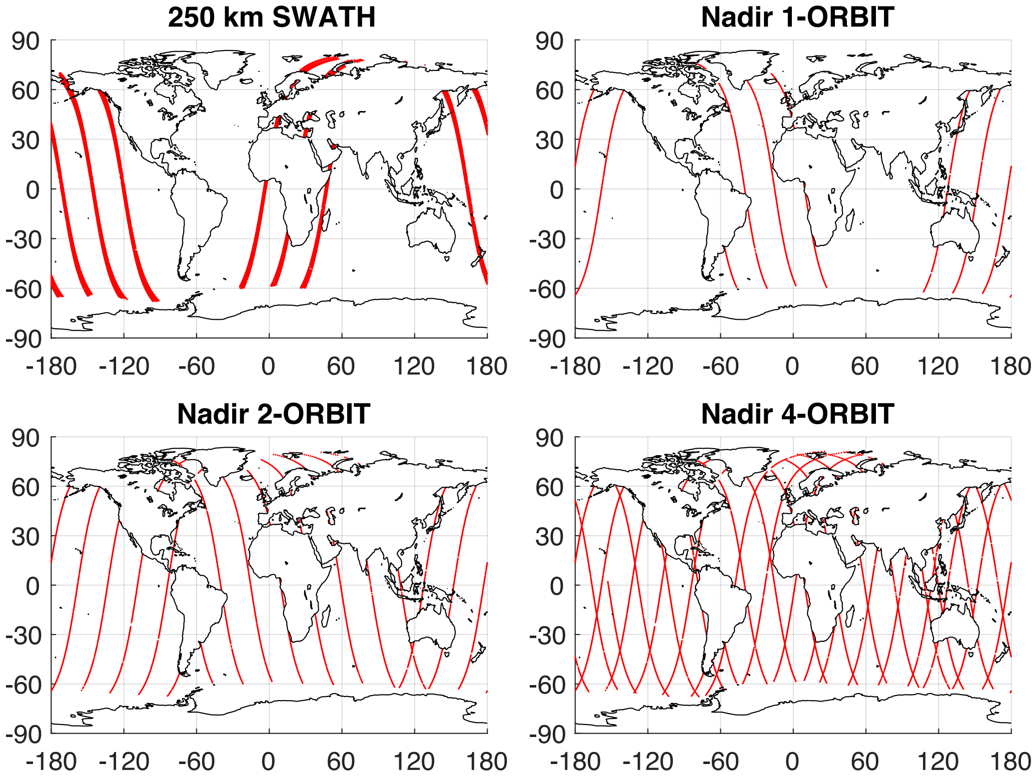
2:15 PM - 2:30 PM

*339 (The Baltimore Convention Center)*

# NWP OSSEs for Spaceborne DAR

Evaluating spaceborne differential absorption radar for marine surface pressure observations with an OSSE

- Instrument requirements
- NWP impacts
- Observation error effects

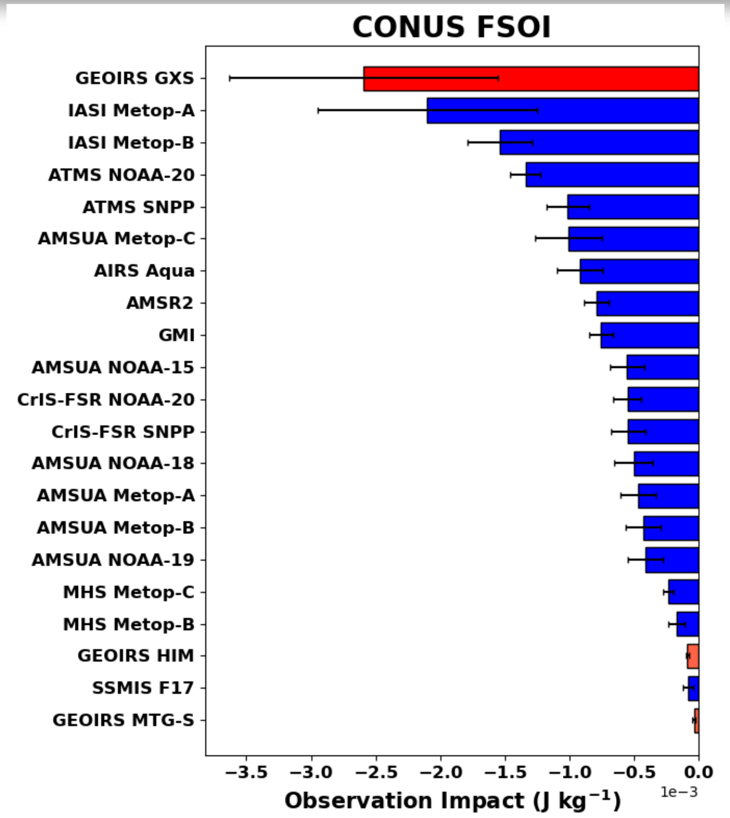




Nikki Privé (MSU)
Matt McLinden
Bing Lin
Gerry Heymsfield

Steve Harrah
Lihua Li
Xia Cai

# Evaluating GXS Impact in the Context of International Coordination




Experiments performed using the global GMAO OSSE framework to estimate the impact of the proposed GeoXO Sounder (GXS) relative to a global ring of geostationary sounders

Regional FSOI shows how each satellite instrument reduces the 24 h forecast error.

Over CONUS, the proposed GeoXO Sounder (GXS) has the largest beneficial impact

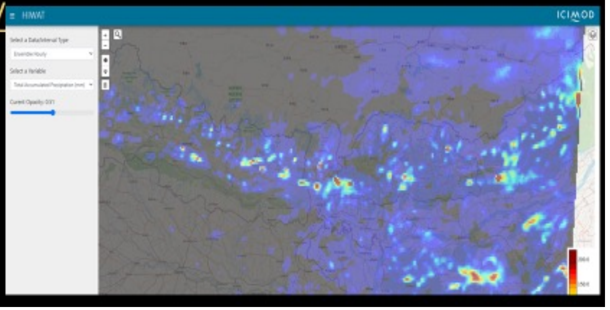
Erica McGrath-Spangler (MSU)
Nikki Privé (MSU)
Bryan Karpowicz (UMBC)
Isaac Moradi (UMD)
Andy Heidinger (NOAA)

13.4 Overview and Applications of the Next Generation GEO Satellite Series Thursday 9:15am, Rm 309

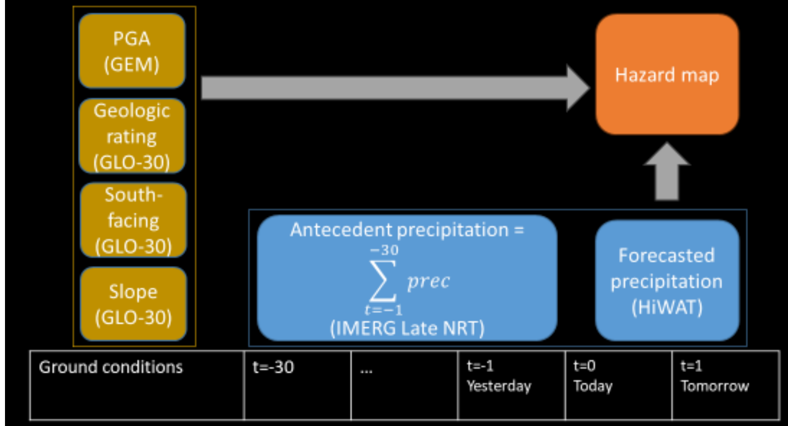
# Landslide forecasting in Nepal's Karnali Basin

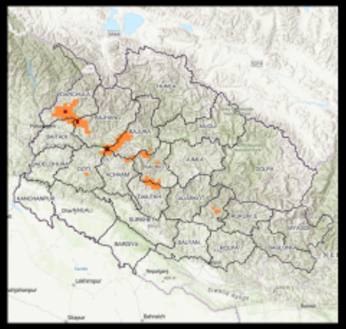
## High-Impact Weather Assessment Toolkit ( HIWAT)

- Provides rainfall, lightning probability, hail probability, temperature, wind
- 54 hrs. lead time & 4 km resolution
- We access the ensemble total precipitation variable to get a daily precipitation.
- http://tethys.icimod.org/apps/hiwat/




## Landslide Hazard Awareness System for Karnali basin (LHASKarnali)



http://nepal.spatialapps.net/LHASKarnali

Thomas Stanley (UMBC)

# River flow and dissolved organic carbon export has likely increased in the Arctic

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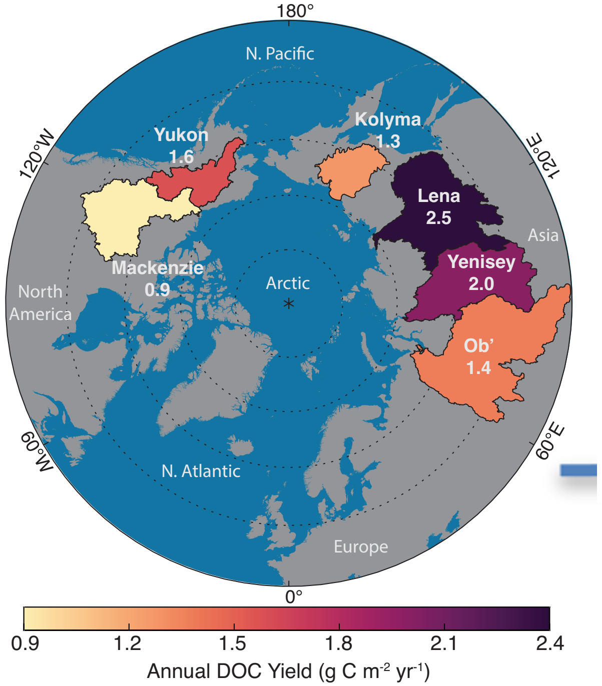
## The Arctic is warming at 4x faster than the rest of the word. The time for action is now.

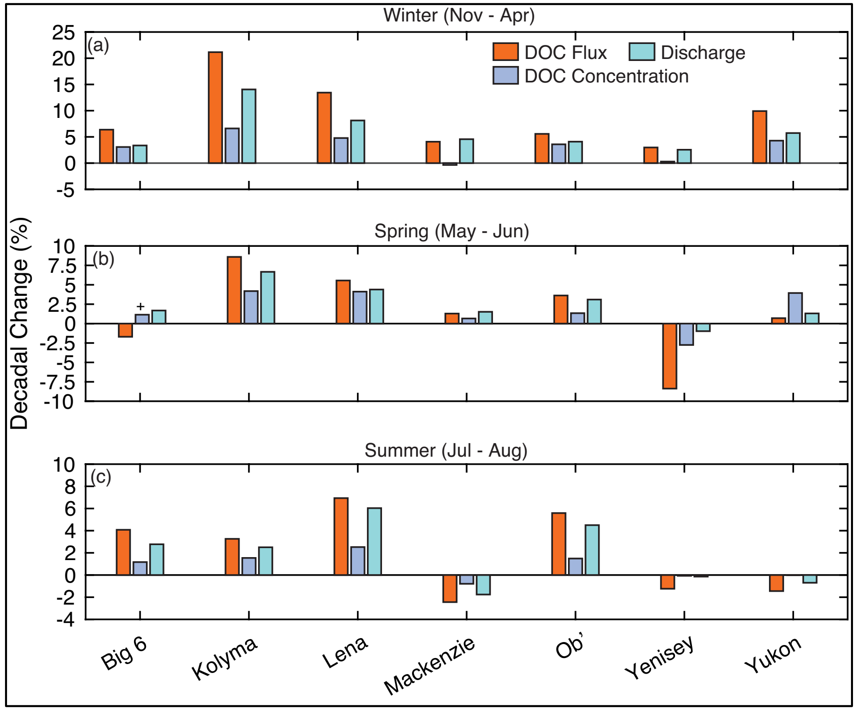
- The Arctic Great Rivers Observatory (ArcticGRO) allowed for this analysis by having such a robust and complete 20+ years (and ongoing) time series. https://arcticgreatrivers.org/
- **The greatest changes in flow and export are happening in the coldest locations (i.e., Kolyma River) and the winter and shoulder months.** The strong historical link of high discharge with concentration indicates this may persist and increase into the future
- **Understanding Arctic terrestrial-hydrologic-marine carbon cycling is key for climate carbon feedbacks – not just for the Arctic but the entire world.**




| | Kolyma | Lena | Mackenzie | Ob' | Yenisey | Yukon | Big 6 |
|---|---|---|---|---|---|---|---|
| Jan | 10.64 | 9.468 | 4.438 | | | 5.524 | 3.828 |
| Feb | 13.43 | 7.86 | | | | 4.692 | 2.756 |
| Mar | | 6.247 | 3.609 | 4.901 | | 3.697 | |
| Apr | 13.08 | 7.041 | 3.9 | 6.104 | | 3.398 | 4.151 |
| May | | 37.9 | 7.895 | 11.45 | | 13.71 | 16.46 |
| Jun | | | | | -4.257 | | -3.059 |
| Jul | | | | | -5.897 | | |
| Aug | | | | | | | |
| Sep | | 14.34 | | 7.192 | | | 4.711 |
| Oct | 10.04 | 12.97 | | | 4.615 | | 6.264 |
| Nov | 19.24 | 8.969 | | | | | 5 |
| Dec | | 7.516 | | | 3.982 | 9.925 | 5.055 |

Decadal Change (%): 35, 30, 25, 20, 15, 10, 5, 0, -5; NS

Δ River Flow since 1982

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Clark, J. B., Mannino, A., Spencer, R. G. M., Tank, S. E., & McClelland, J. W. (2023). Quantification of discharge-specific effects on dissolved organic matter export from major Arctic rivers from 1982 through 2019. *Global Biogeochemical Cycles*. https://doi.org/10.1029/2023gb007854

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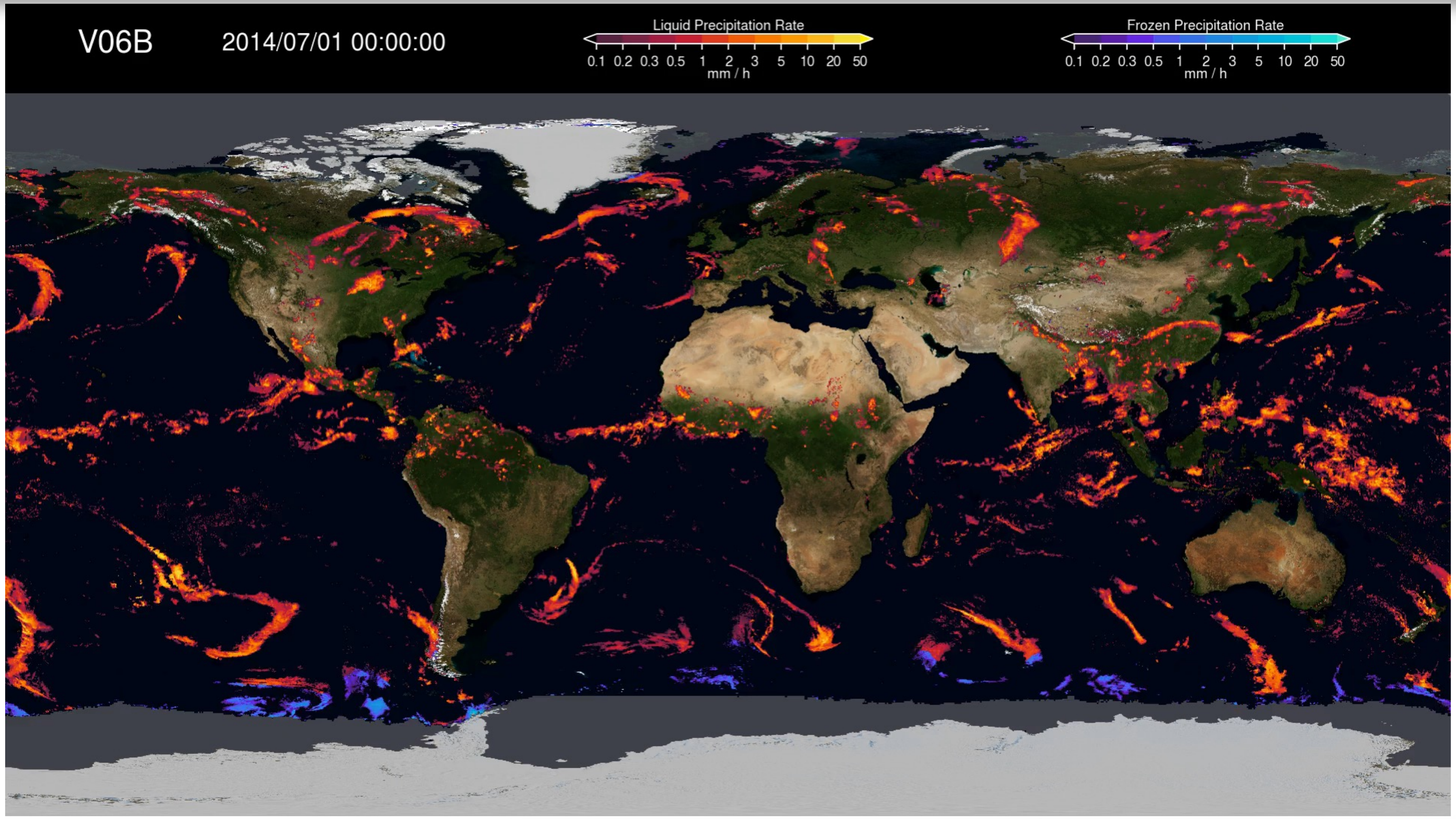
Goddard Earth Sciences Technology and Research II

# Global Precipitation from IMERG V07

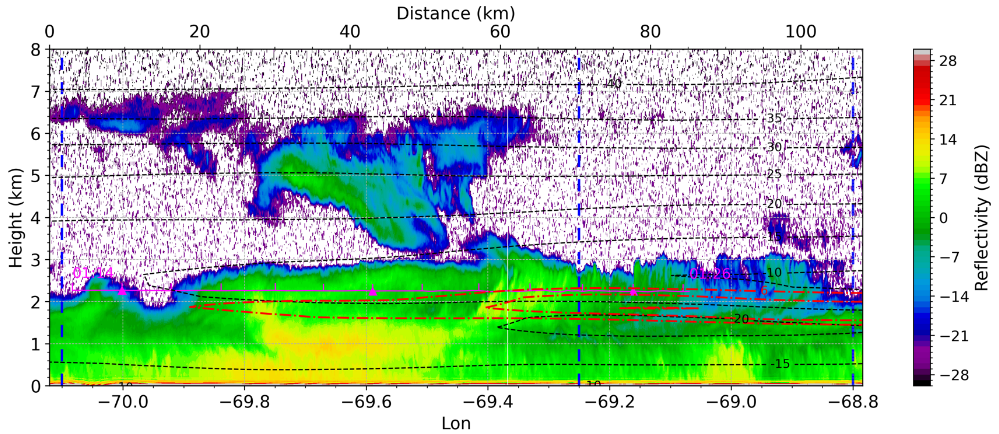


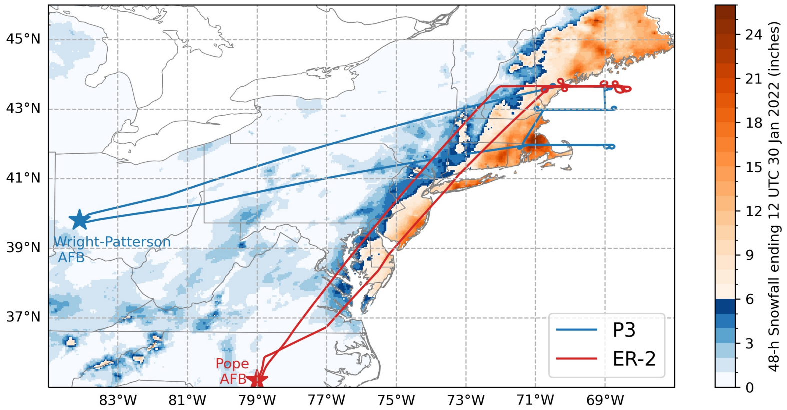

- NASA's Integrated Multi-satellite Retrievals for GPM (IMERG) combines precipitation estimates from the GPM Constellation to provide **surface precipitation rates** at **0.1° every half-hour globally** from **June 2000 onwards**.
- IMERG **V07** incorporates a wide range of changes, with collective impacts that provide:
  - **Complete global coverage** except for a few grid boxes at the poles.
  - Appreciable **improvement in skill**.
  - **More consistent behavior** between the TRMM era (2000–2014) and the GPM era (2014–present).
- See https://gpm.nasa.gov/ for more information.
- With the latest advances in the algorithm, IMERG V07 represents a **unique opportunity to study global snowfall**. See presentation below.

9C.4
Global Snowfall as Revealed by IMERG V07
Wed 31 Jan 2024, 9:15am
Room 339

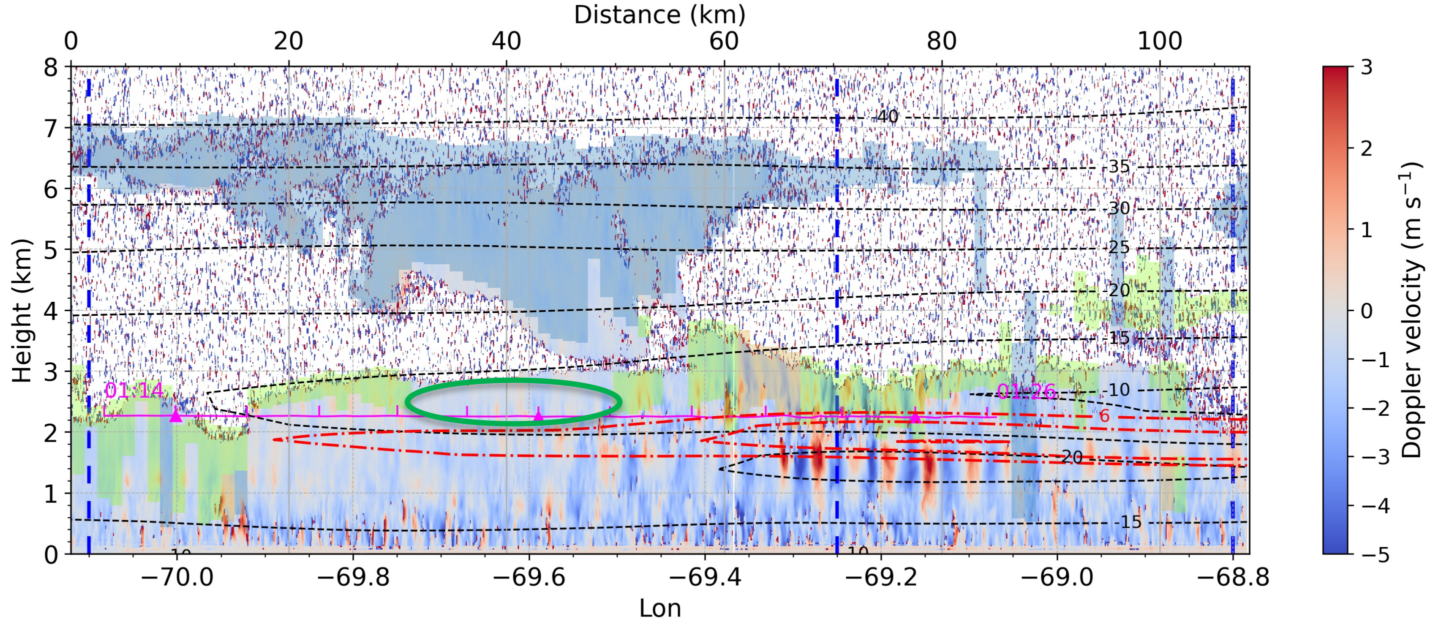
Jackson Tan (UMBC)

# Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) field campaign




**IMPACTS field campaign radar, lidar, and in-situ observations show a supercooled-cloud-liquid-water top of a snow-producing nimbostratus cloud**



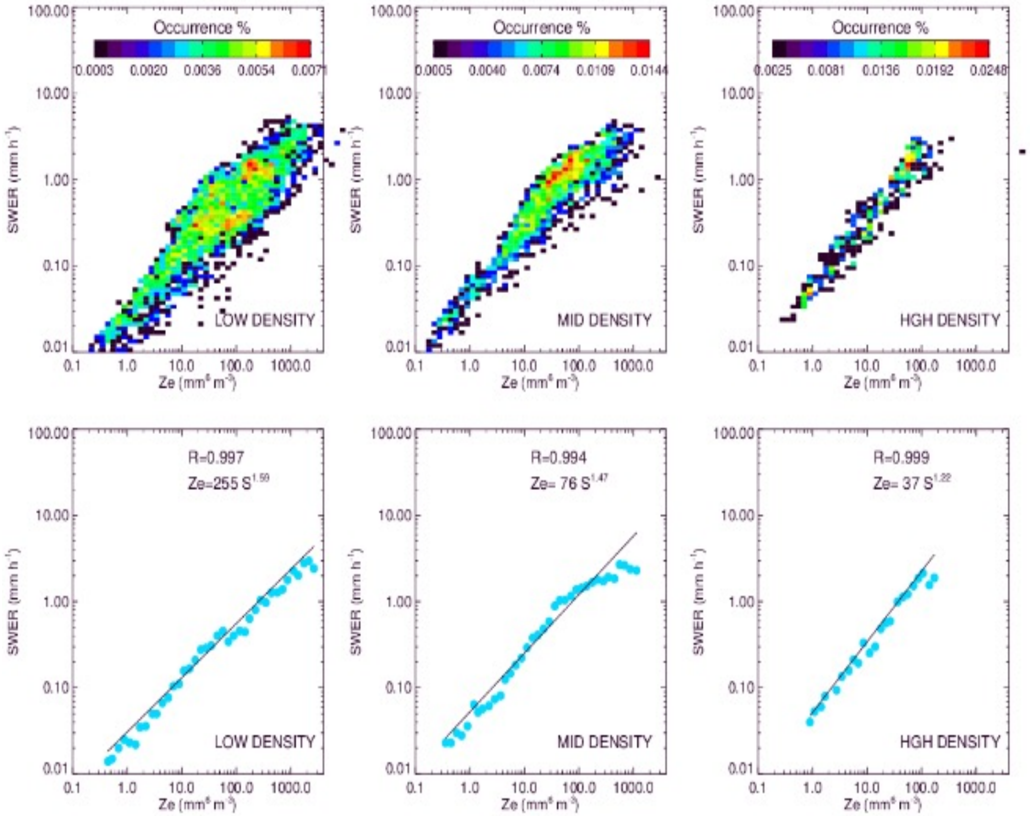


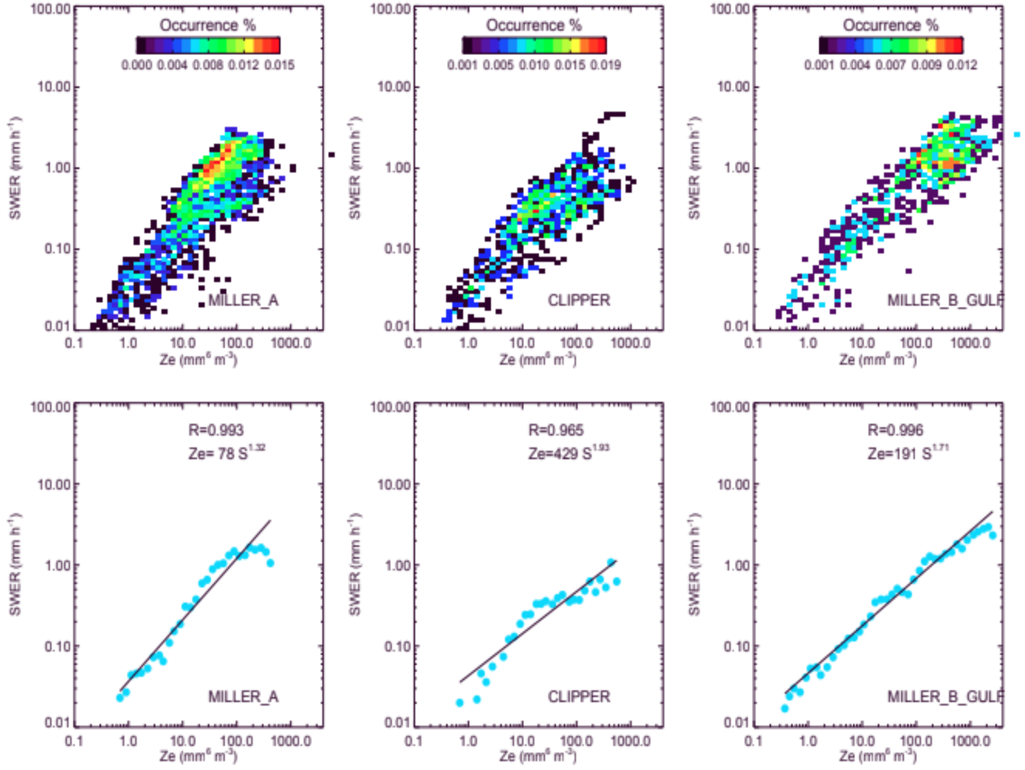
Mei Han (MSU)
Scott Braun (NASA GSFC)
Timothy Lang (NASA MSFC)


Poster 959 - Observations of Supercooled Liquid Water Layers at the top of Snow-Producing Nimbostratus Clouds During the IMPACTS Campaign
Thursday 3-4:30 pm, Hall E

# Radar Snowfall Estimation in Southern New England

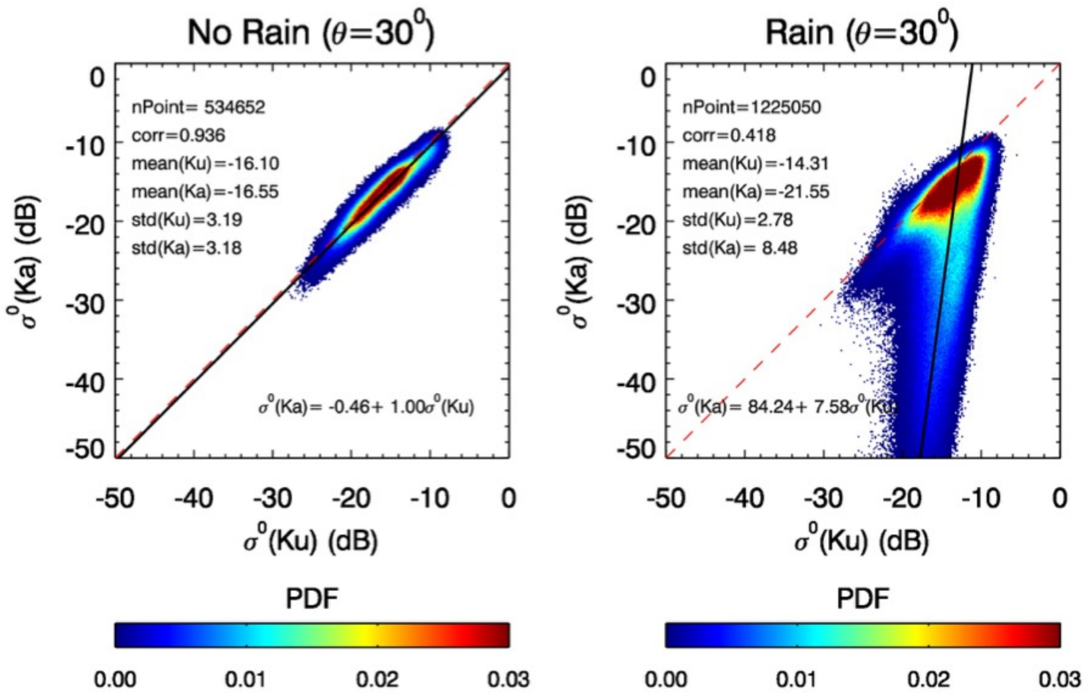
Brian Inglis[1] (bringlis@udel.edu), Ali Tokay[2, 3], Charles N. Helms[3,4]
[1]University of Delaware, [2]University of Maryland Baltimore County, Baltimore, MD;
[3]NASA Goddard Space Flight Center, Greenbelt, MD; [4]University of Maryland, College Park, MD



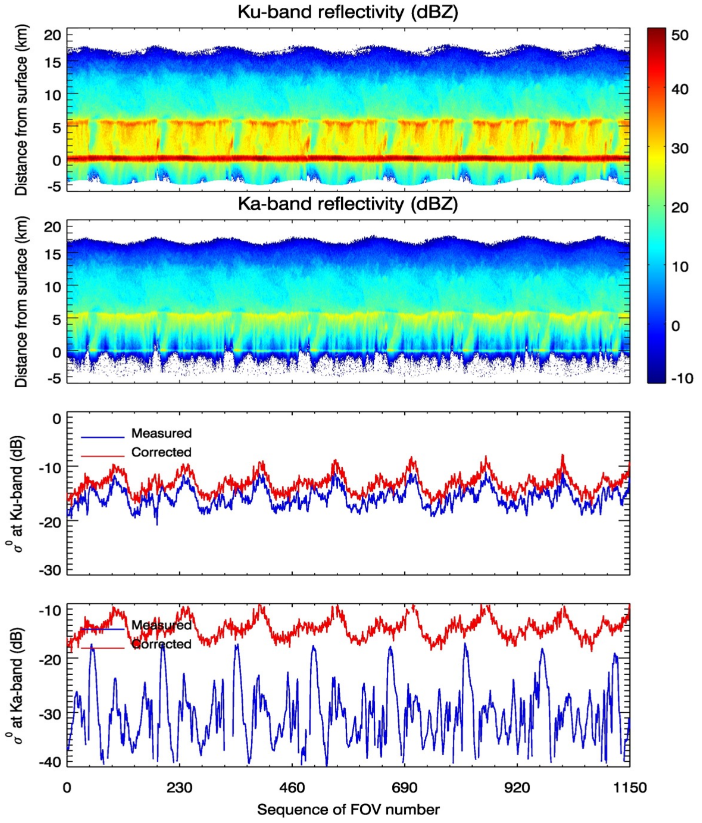




A single SWER(Ze) relationship that is currently used by the NWS results in anomalously high water content for low and mid density cases and for all storm tracks except Clipper. Triple bulk density and storm track SWER(Ze) relationships are recommended for research and operational radar snowfall estimate, respectively.

# Correction and Evaluation of Rain Effects on Ocean Wind Vector Estimates from Dual-Frequency Radar



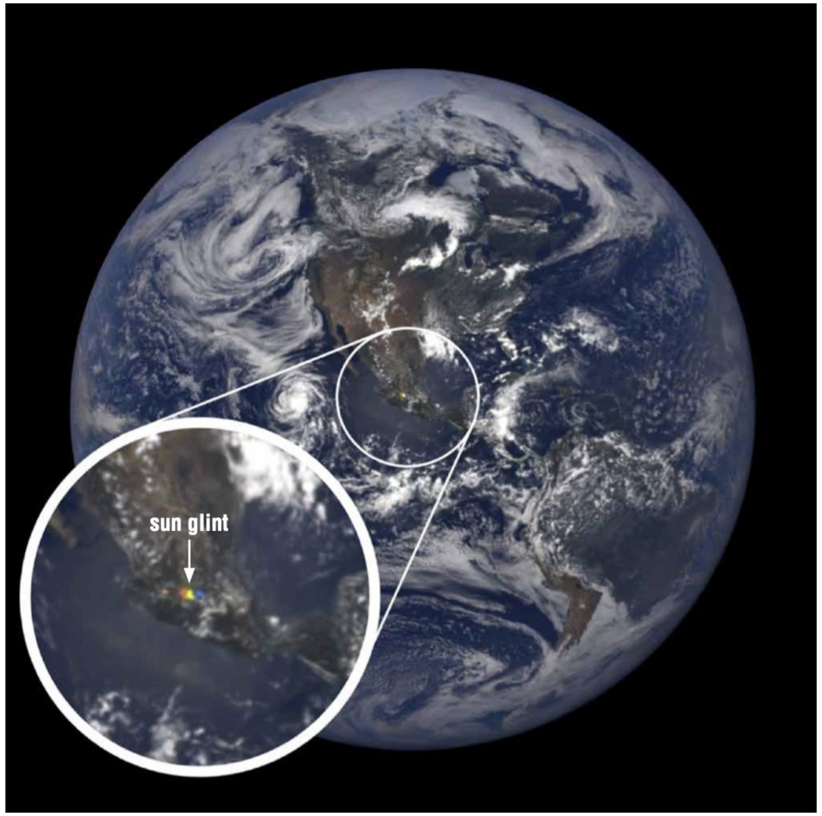

The normalized radar cross section (NRCS) of the ocean surface is closely related to the near-surface wind speed and direction. However, the measurement is affected by path attenuation introduced by precipitation. The objective of this research is to correct for this effect so that the wind vector can be retrieved under both rain and rain-free conditions.




L. Liao (GESTAR II/MSU)
R. Meneghini(NASA GSFC)
G. Heymsfield (NASA GSFC)

R. Meneghini, L. Liao and G. M. Heymsfield, 2019: Attenuation Correction over Ocean for the HIWRAP Dual-Frequency Airborne Scatterometer. *J. Atmos. Oceanic Technol.*, **36**, 2015-2030.

# Horizontally oriented ice crystals in clouds observed from deep space




From a position four times farther than the Moon, the DSCOVR spacecraft observes the sunlit side of Earth at 1-2-hour intervals.

The images provided by DSCOVR often feature sun glint from tropical ice clouds (see image at left, observed on July 4, 2018, at 16:39 UTC).

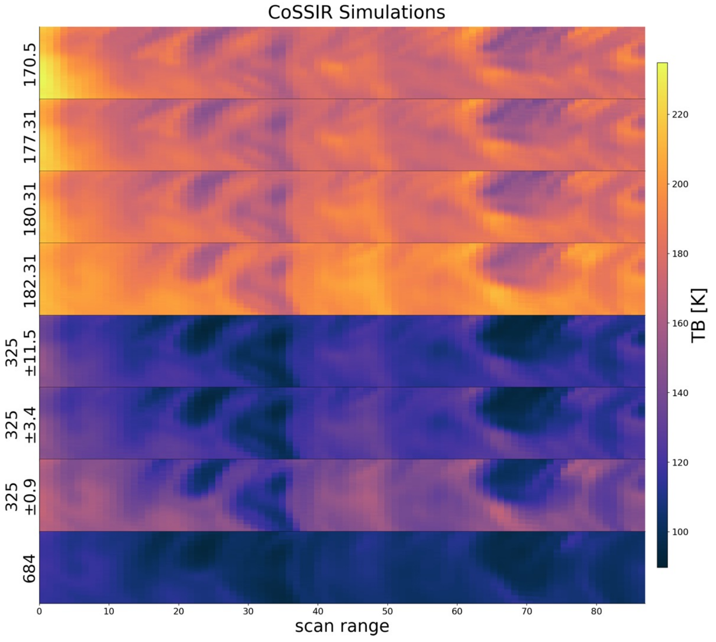
Such glints affect cloud property retrievals but can also yield information on the horizontally oriented ice crystals that cause the glints.

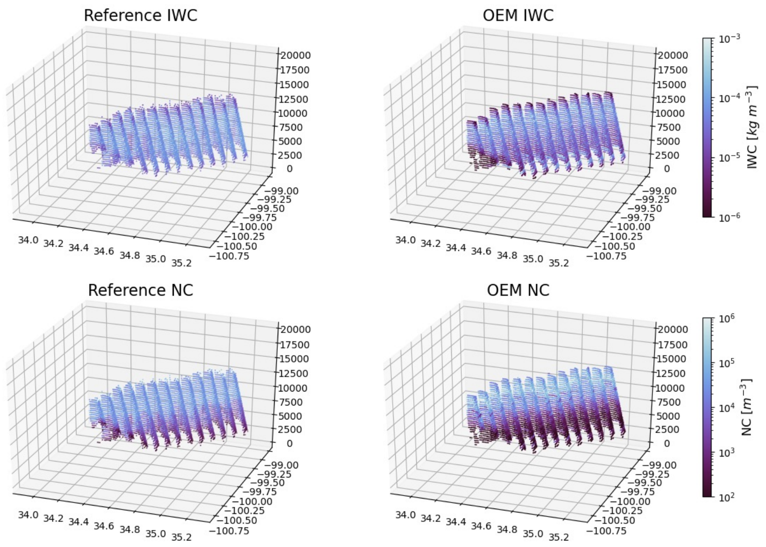
Presentation 15A.5
Thursday, 2:45 PM, Room 310
Cloud composition from the analysis of sun glints off horizontally oriented ice crystals

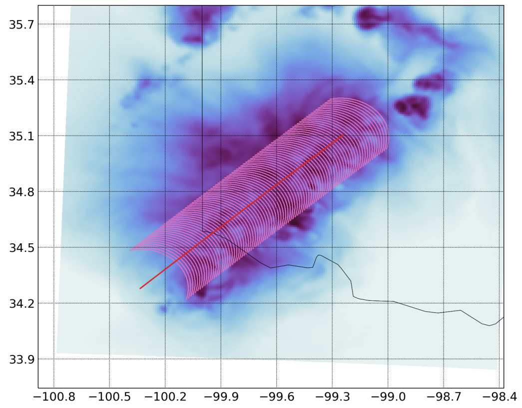
Tamás Várnai (UMBC)

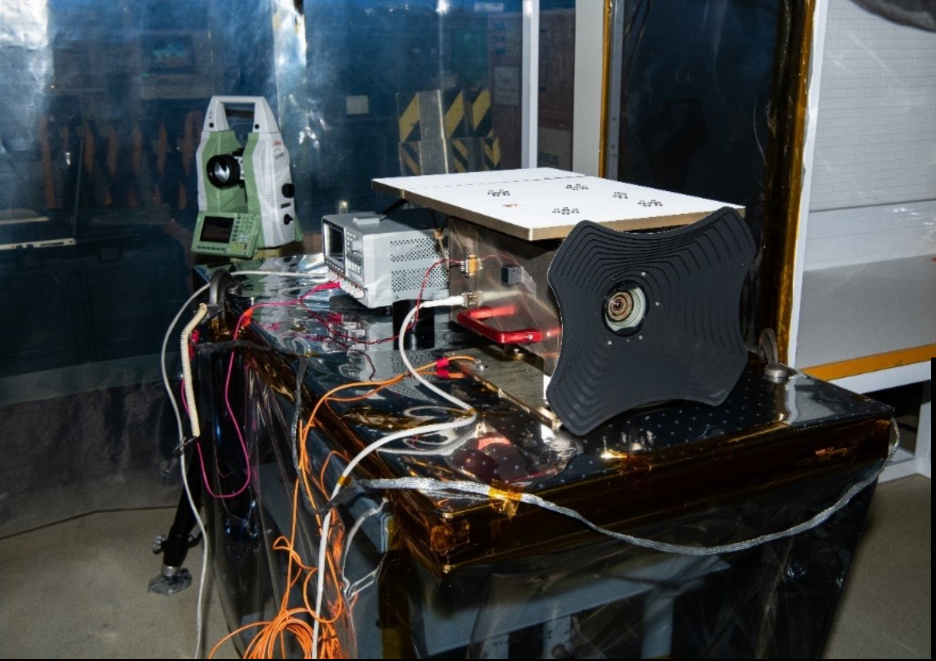
# Three-dimensional Tomography algorithm
# (Yuli Liu, GESTAR II)

## Three-dimensional Ice Cloud Tomography Algorithm for the (Sub)millimeter-wave Radiometer



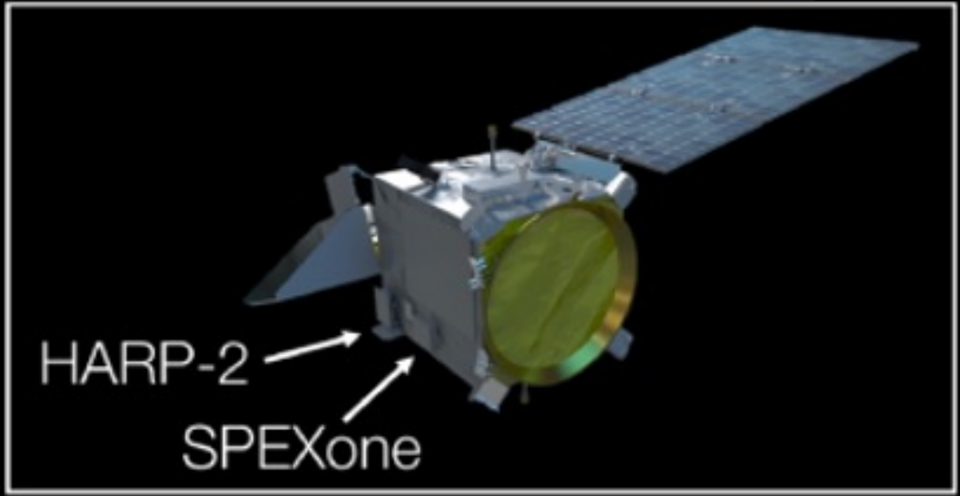





UMBC HARP2

PACE




HARP2, built at UMBC, is on NASA's PACE observatory

Ready for launch on Feb. 6th!

# Andrew Sayer: supporting NASA's PACE mission

GESTAR II

NASA Partner

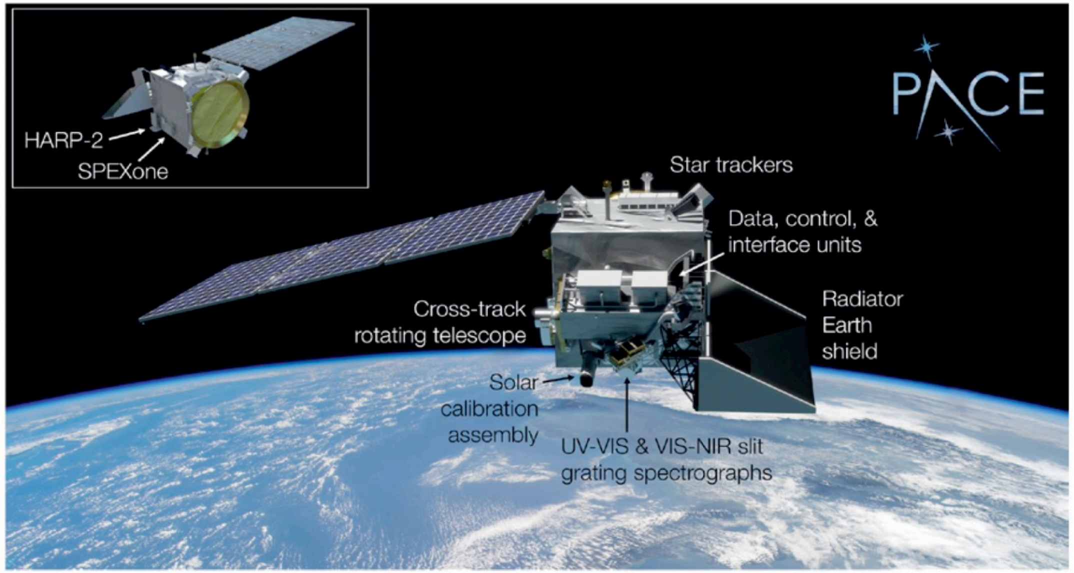
**NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission launches in Feb 2024!**

PACE represents NASA's next big investment in its eponymous science domains.

Dr. Andrew Sayer is Project Science Lead for the atmospheric (aerosol and cloud) products from the main instrument, OCI.

Many other GESTAR II members further support this mission.

https://pace.gsfc.nasa.gov/

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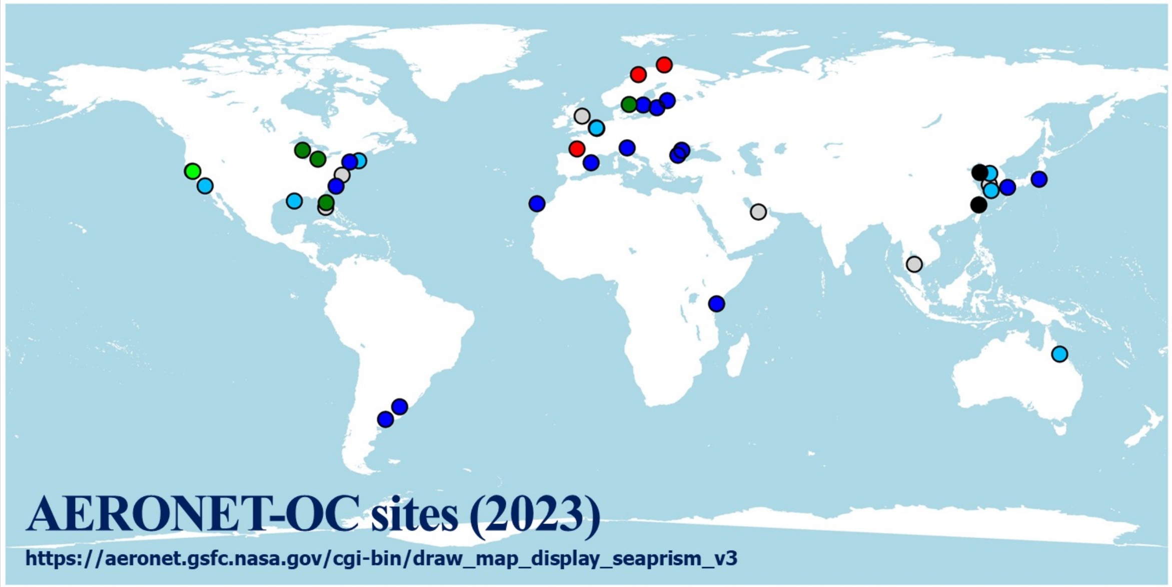
# On the use of AERONET-OC data to assess PACE hyperspectral

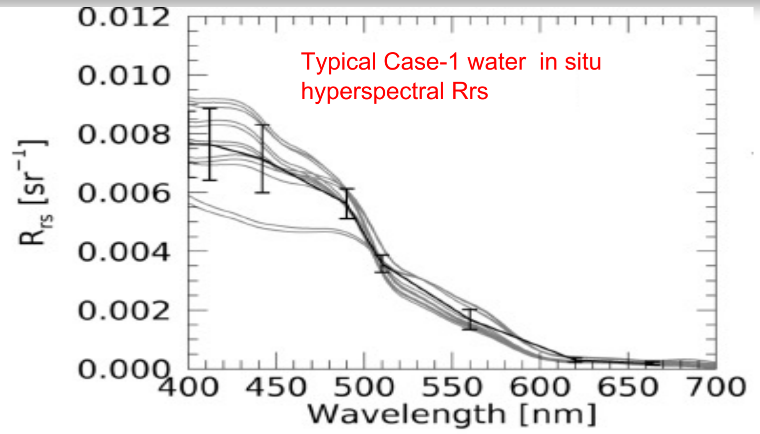
GESTAR II

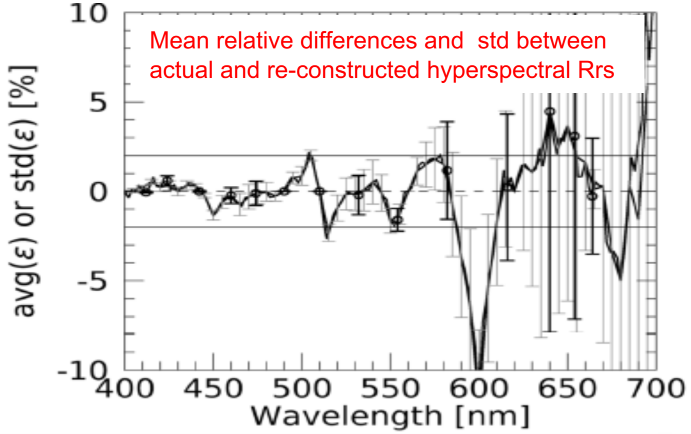
NASA Partner




Active marine  Active inland  Potential  Dismissed

*The Ocean Color component of the Aerosol Robotic Network (AERONET-OC), relying on automated multi-spectral radiometers operated at offshore structures, generates globally distributed time-series of standardized Rrs measurements targeting the validation of satellite ocean color data products*




A scheme to re-construct hyperspectral remote sensing reflectance (Rrs) data from multispectral ones has been implemented to support PACE validation activities. Benefiting of a comprehensive data set of simulated spectra, the performance of the reconstruction scheme has been verified for PACE-OCI hyperspectral data in the 400-700 nm interval using Rrs at the AERONET-OC visible center wavelengths.

By exploiting in situ hyperspectral Rrs representative of diverse water types, results obtained at PACE-OCI center-wavelengths of major interest for ocean color applications, have shown mean relative differences within +/-2% between re-constructed and in situ hyperspectral values across large portions of the visible spectrum.

More details in: M. Talone, G. Zibordi & J. Pitarch, 2023. On the application of AERONET-OC multispectral data to assess satellite derived hyperspectral Rrs. Geoscience and Remote Sensing Letters, in press.

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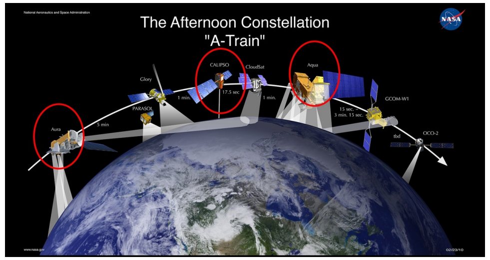
# Global Dataset of Above-cloud Aerosol Absorption from A-train Synergy

GESTAR II

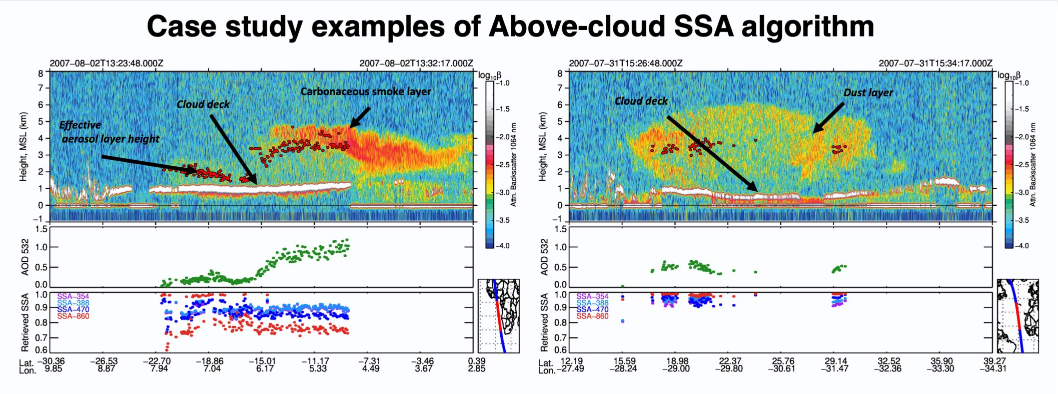
NASA Partner

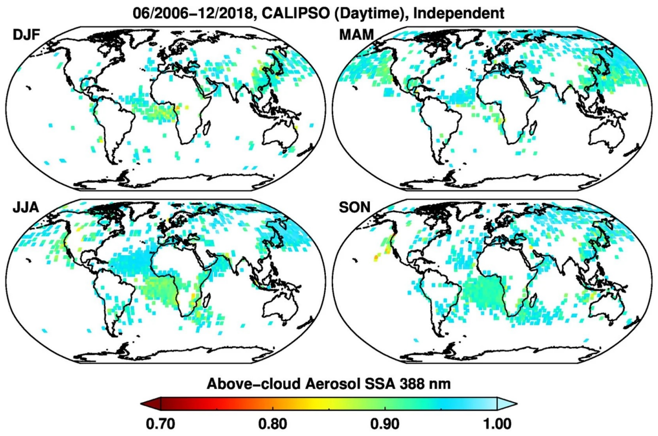
We introduce a one-and-half decade long global retrieval dataset of UV-VIS spectral optical depth and single-scattering albedo of absorbing aerosols above clouds from A-train Synergy.

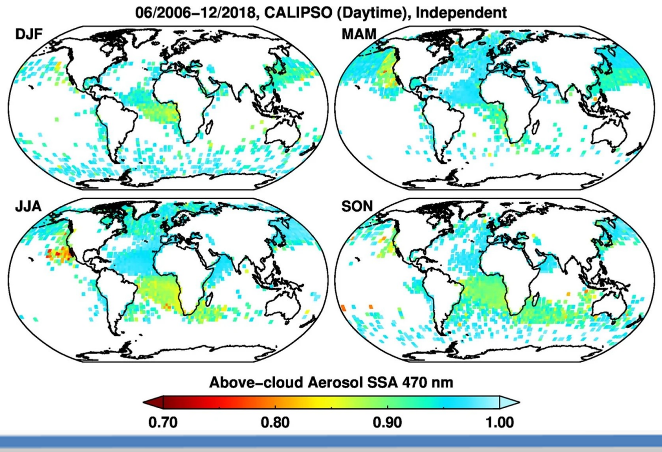



*A novel synergy algorithm combines NASA's A-train sensors CALIOP, OMI, MODIS measurements.*


**Hiren Jethva (MSU)**


The availability of the global aerosol-cloud joint product will reenergize the community by offering

1) an improved representation of aerosol extinction and absorption properties over clouds
2) much-needed observational estimates of the radiative effects of aerosols in cloudy regions for constraining the climate models.

280 - 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

Tuesday, January 30, 2024

3:00 PM - 4:30 PM

Hall E (100 Level, The Baltimore Convention Center)

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