

NASA BDEC Annual Team Meeting  
May 8<sup>th</sup>, 2024

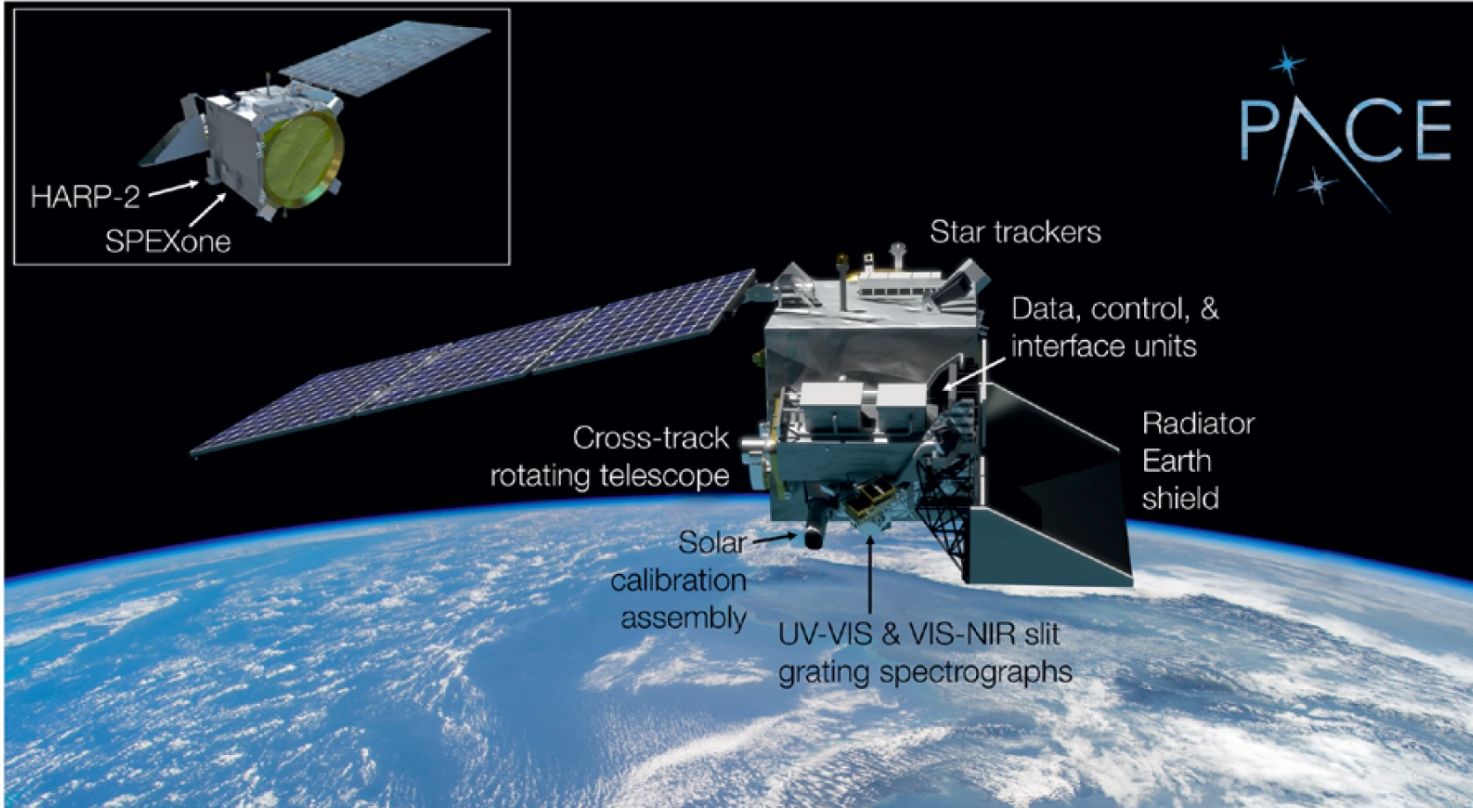
# PACE Mission Overview & Updates

Morgaine McKibben, PhD  
PACE Mission Applications Lead

*Thank you to Erin Urquhart & Skye Caplan  
for contributed slides!*

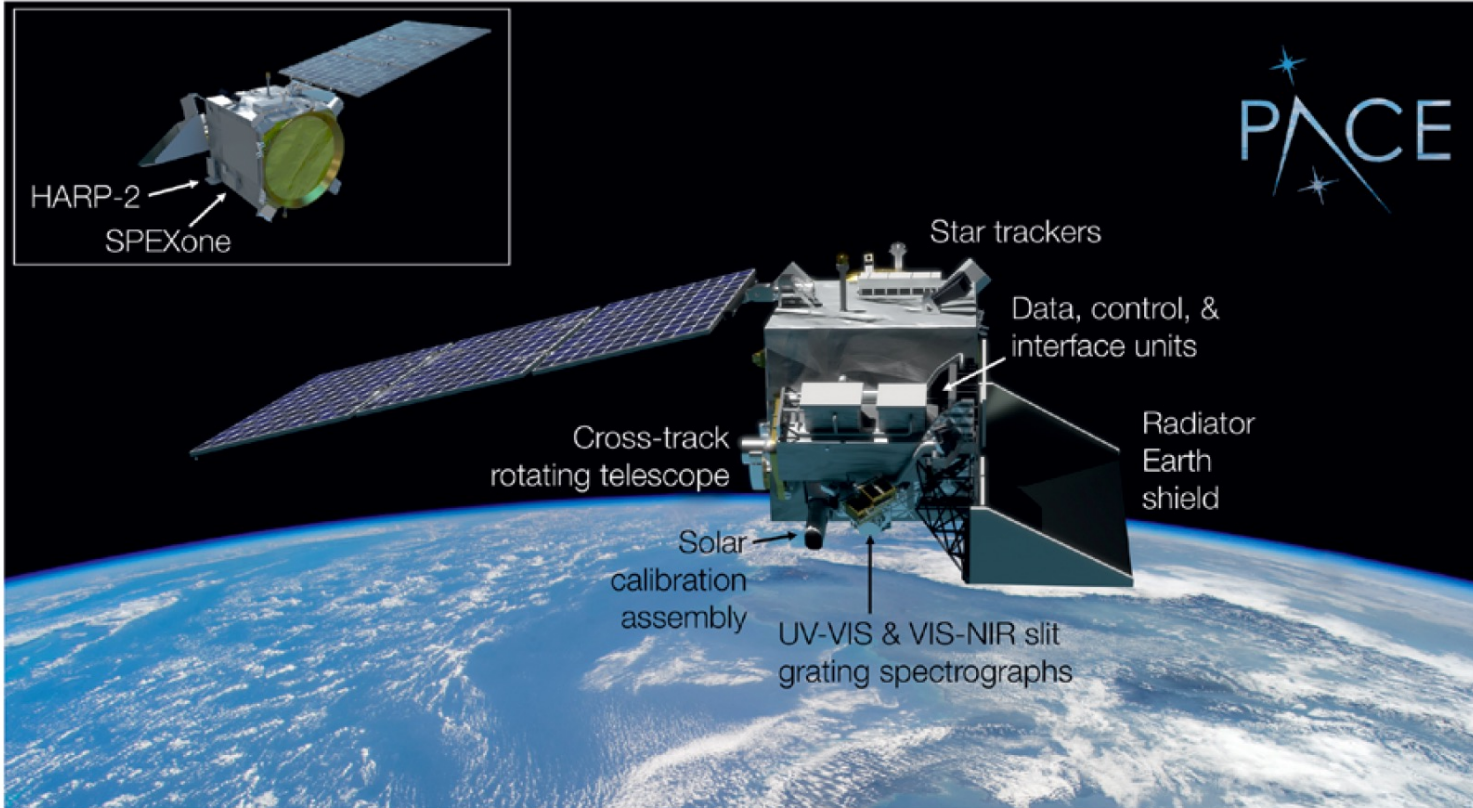
Image: PACE Chlorophyll a product, Maine & East  
Coast, April 26, 2024 Credit: Joseph Knuble





PACE is NASA's next great investment to extend ocean biological, ecological, and biogeochemical data records, as well as cloud, aerosol and terrestrial data records. PACE is the most advanced global ocean color & aerosol mission to date.

- **Global**, 13:00 local equatorial crossing
- **3yr mission** (at least 10yrs of propellant)
- **Instruments:**
  - Hyperspectral imager: **Ocean Color Instrument (OCI)**,
    - 340-890 nm 5nm bandwidth, 2.5nm steps
    - 2-day global coverage
    - 1 km<sup>2</sup> at nadir
  - Two multi-angle polarimeters:
    - **HARP-2** (wide-swath, hyper-angular, 4 bands; 3km<sup>2</sup> nadir)
    - **SPEXone** (Narrow swath, 5 viewing angles, hyperspectral (UV-NIR), 2.5km<sup>2</sup> nadir)
- **Data products are free & open to all**



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## Science Goals

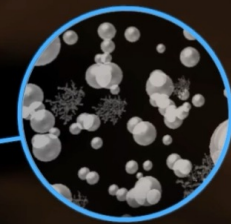
- (1) **Continue NASA's multi-decade, global record** of satellite ocean color, clouds and atmospheric aerosol particles observations from SeaWiFS, MODIS, MISR, and VIIRS; and
- (2) **Provide new measurements** of aerosols, clouds, aquatic biology, ecology, and biogeochemistry through the spectral resolution of the Ocean Color Instrument (OCI) and multi-angle polarimetry.



# PACE DATA PRODUCTS

## ATMOSPHERIC

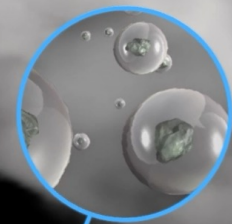
Aerosol absorption  
Aerosol size distributions  
Concentrations of brown/black carbon



Aerosol optical depth  
Aerosol heights and layers

Cloud optical depth  
Cloud height  
Cloud thickness

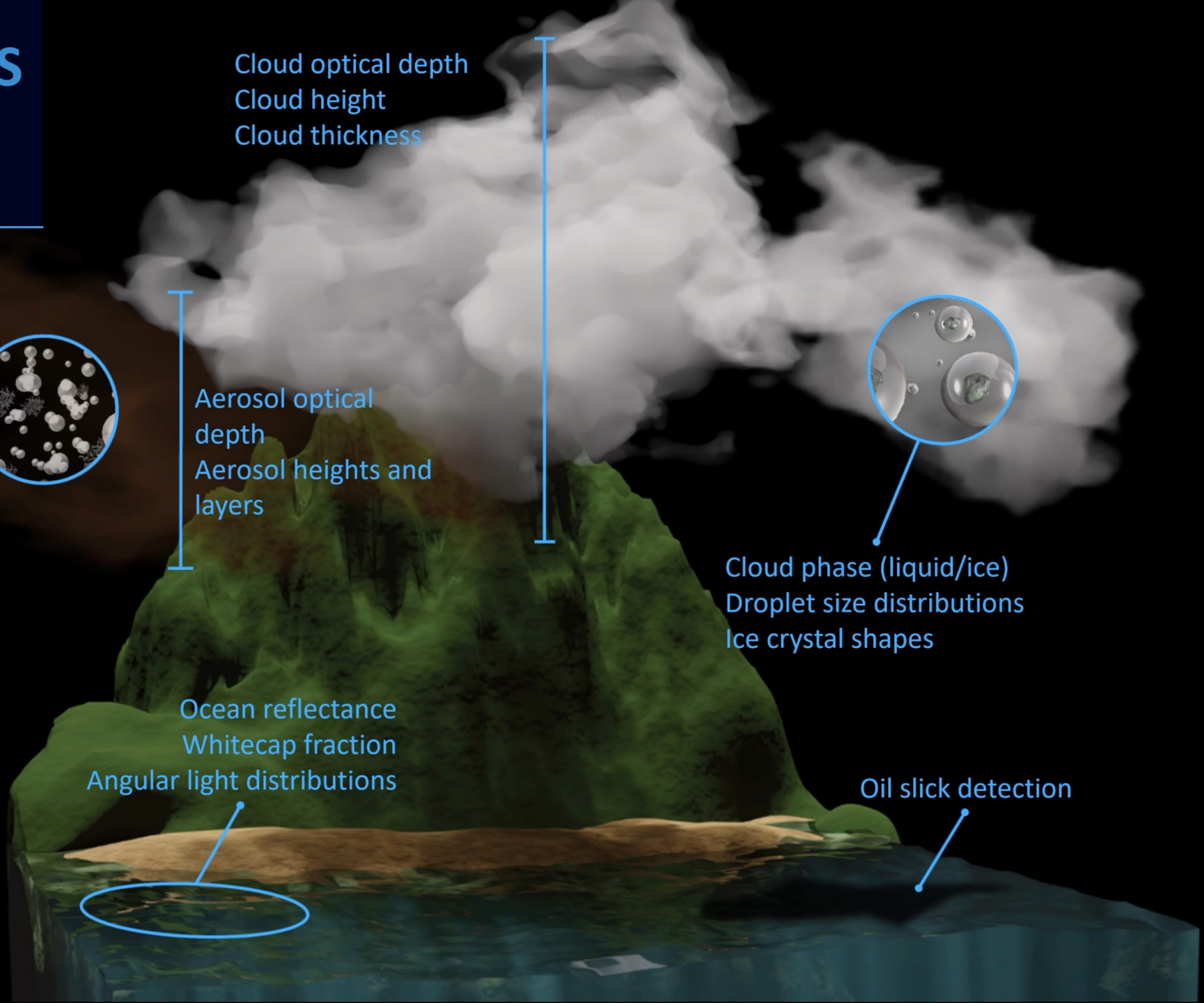
Cloud phase (liquid/ice)  
Droplet size distributions  
Ice crystal shapes



Ocean reflectance  
Whitecap fraction  
Angular light distributions

Oil slick detection

Observations span the ocean, atmosphere, cloud, and terrestrial domains



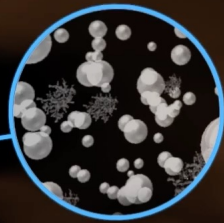


# PACE DATA PRODUCTS

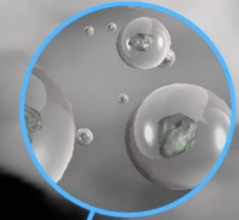
## ATMOSPHERIC

Cloud optical depth  
Cloud height  
Cloud thickness

Aerosol absorption  
Aerosol size distributions  
Concentrations of brown/black carbon



Aerosol optical depth  
Aerosol heights and layers

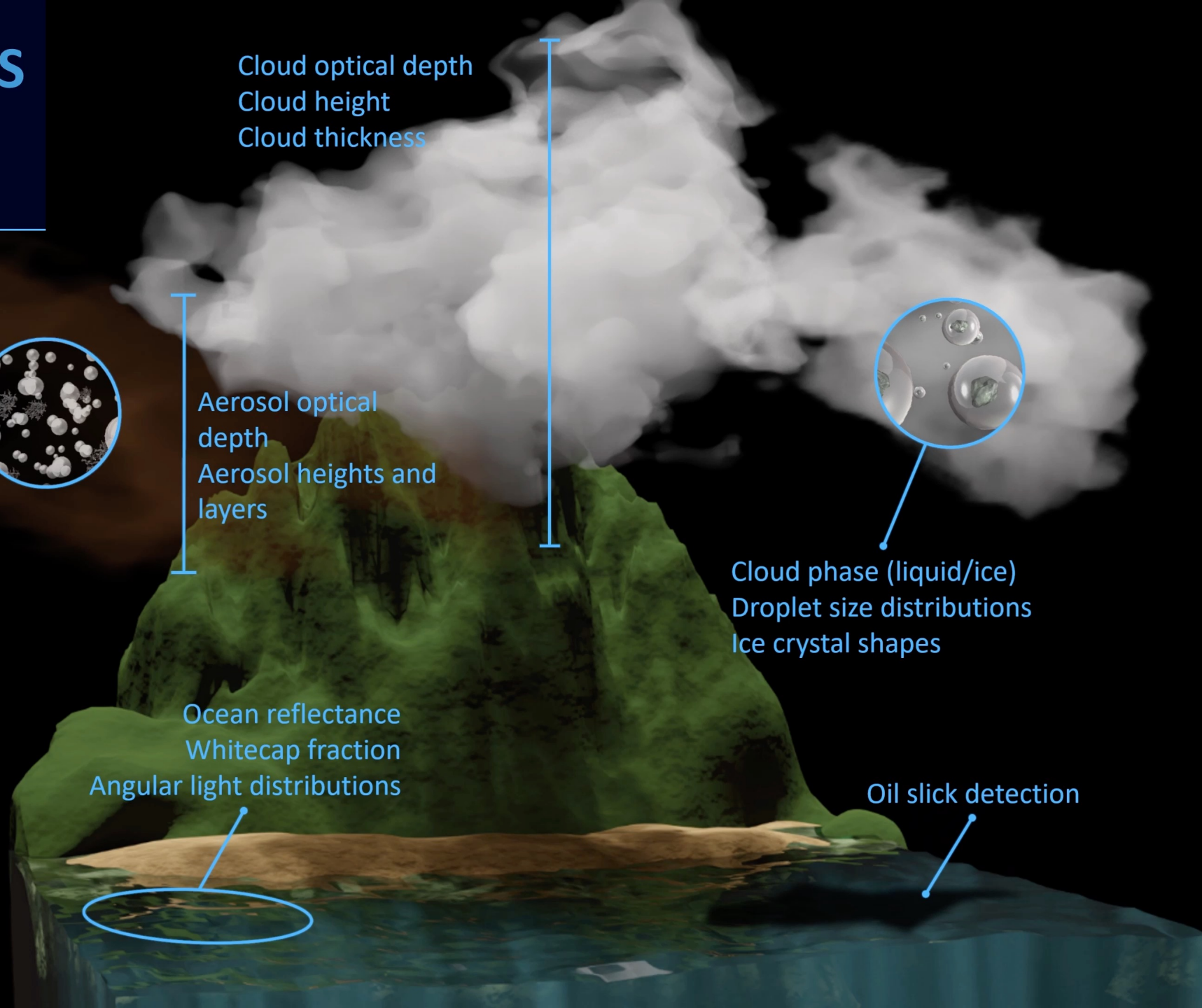


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Droplet size distributions  
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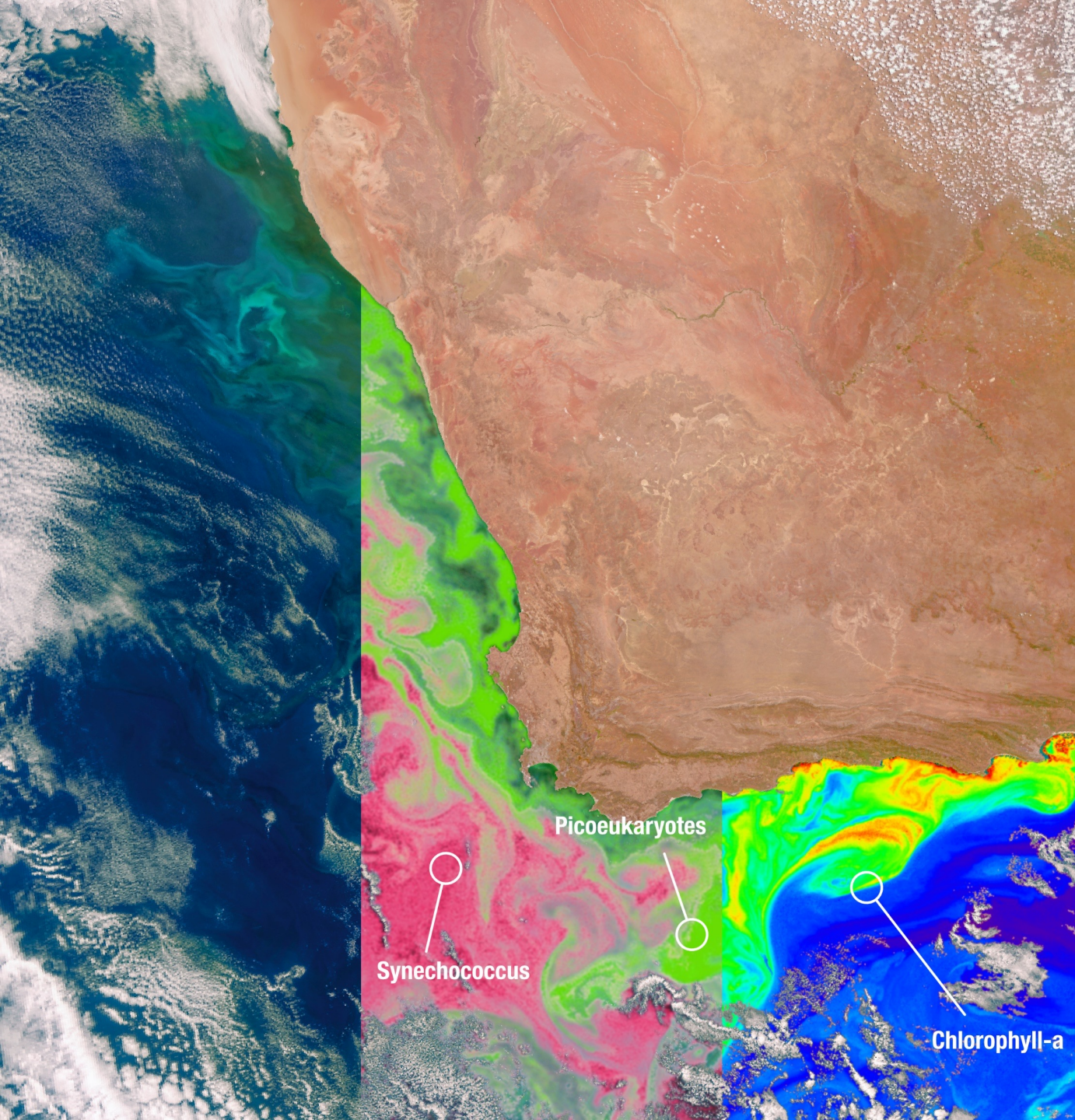


February 8<sup>th</sup> 2024





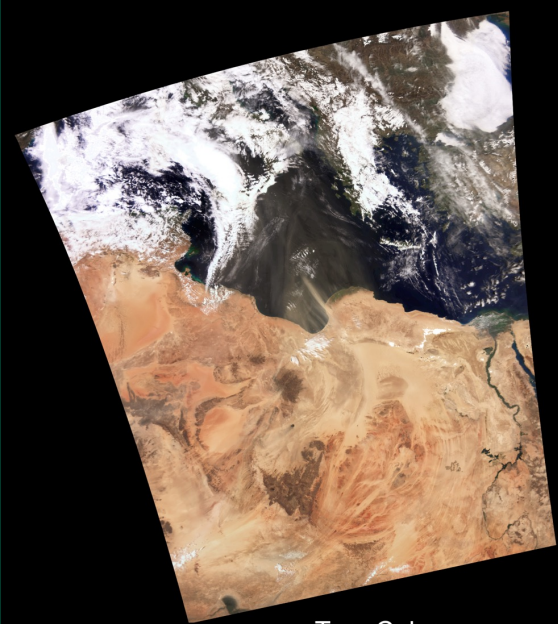
63 days later...



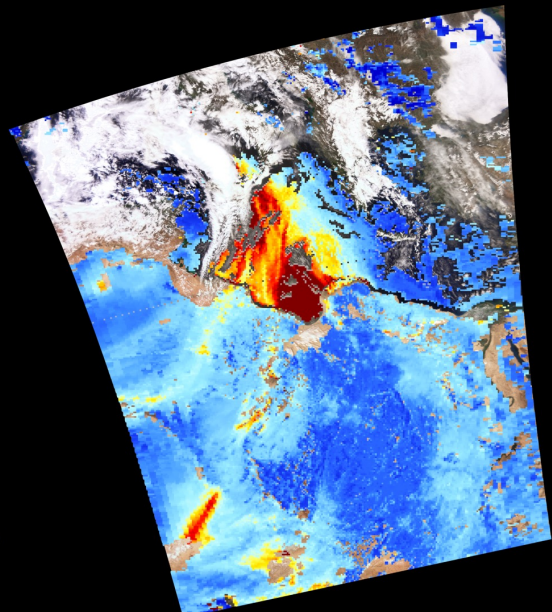
## First Light

Initial data products  
released  
April 11<sup>th</sup> 2024

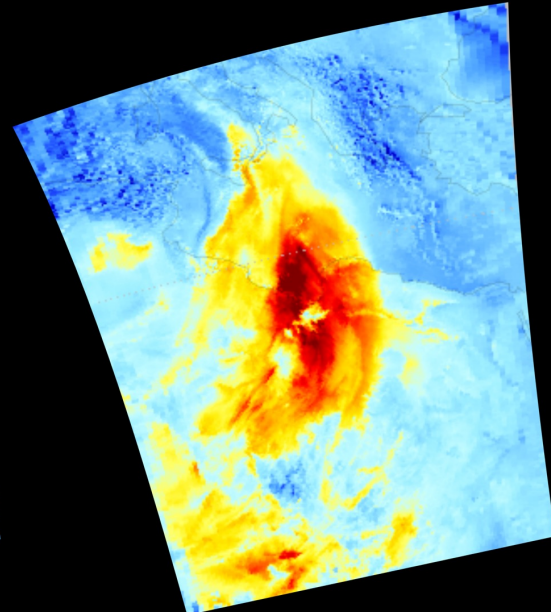




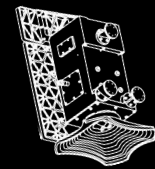
True Color



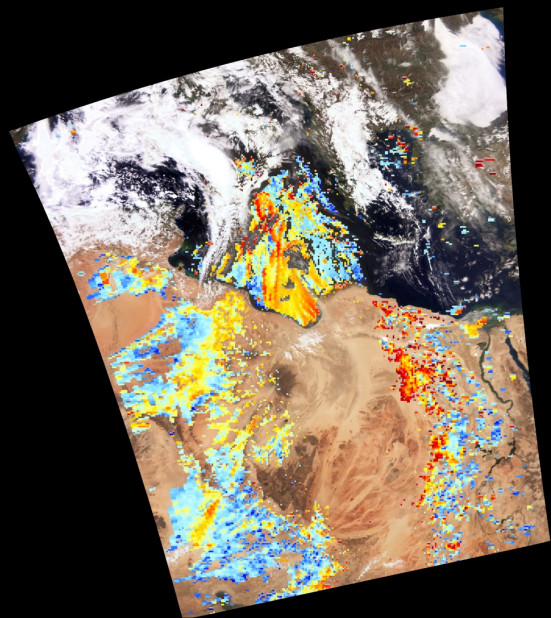
Aerosol Optical Depth 0.55  $\mu\text{m}$   
0.00 0.25 0.50 0.75 1.00



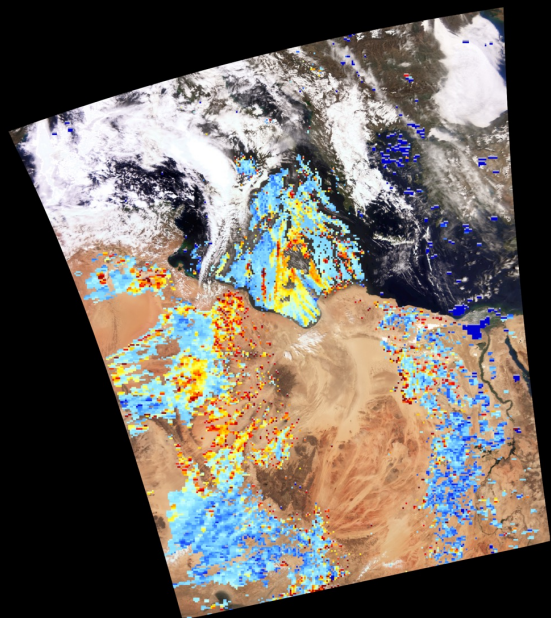
NUV Aerosol Index (UVAI)  
-1.0 0.2 1.4 2.6 3.8 5.0



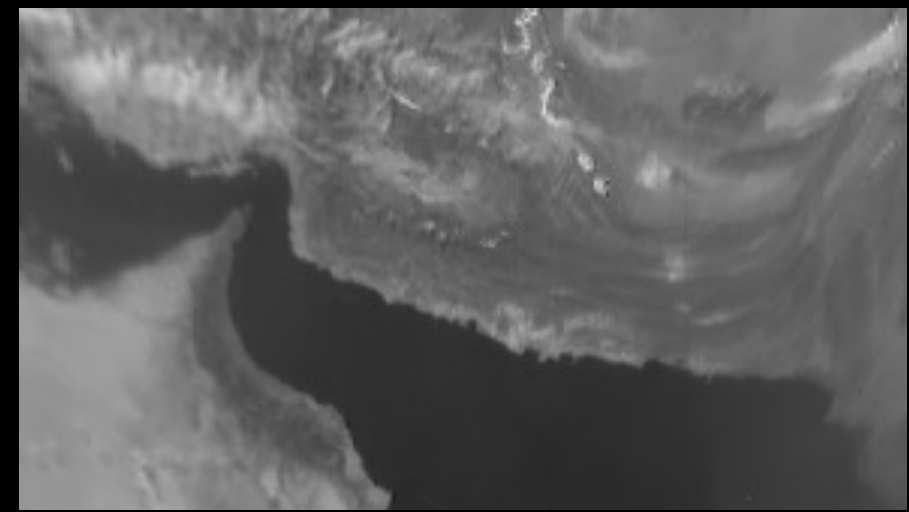
**HARP2**  
wide swath polarimeter, 3 km  
440, 550, 670, 870 nm  
10-60 viewing angles



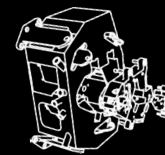
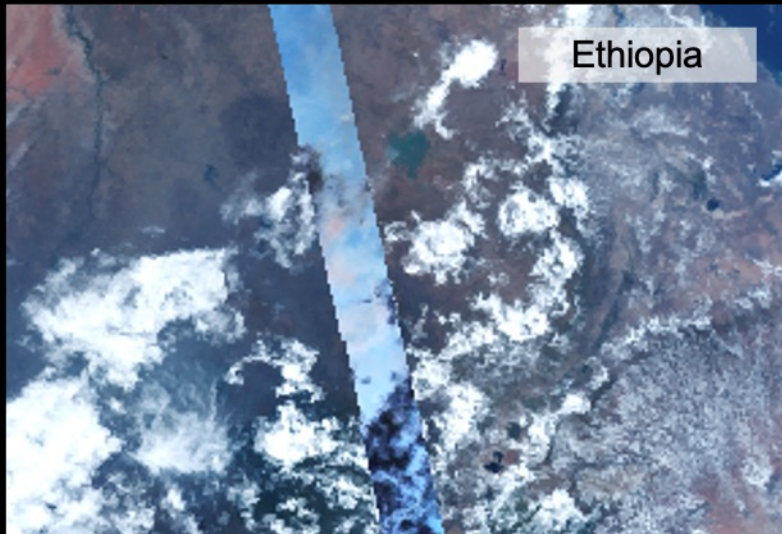
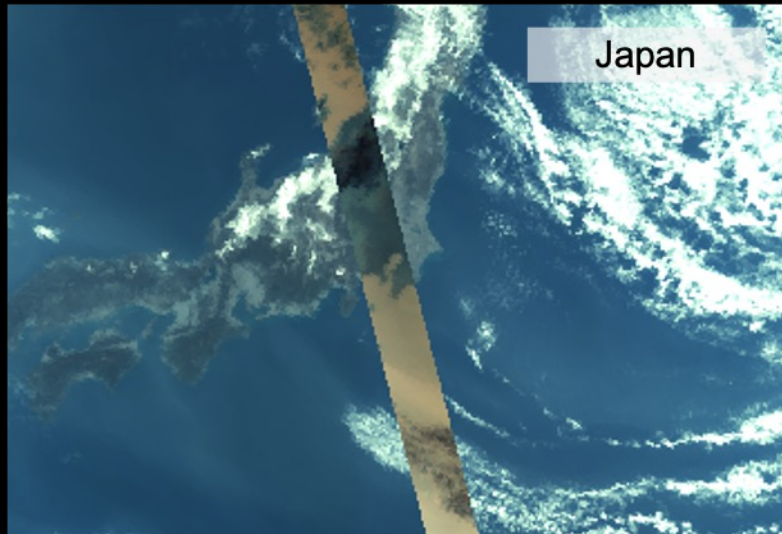
Single Scattering Albedo (SSA) 0.55  $\mu\text{m}$   
0.80 0.84 0.88 0.92 0.96 1.00



Aerosol Layer Height  
0.0 2.0 4.0 6.0 8.0

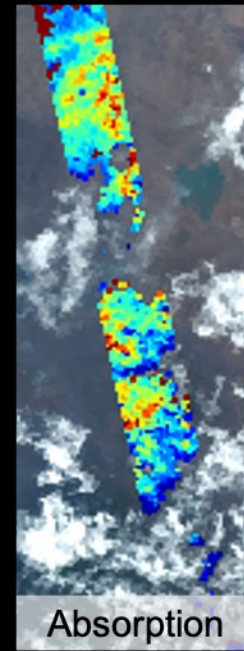
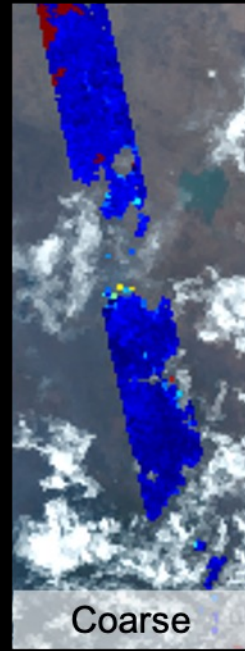
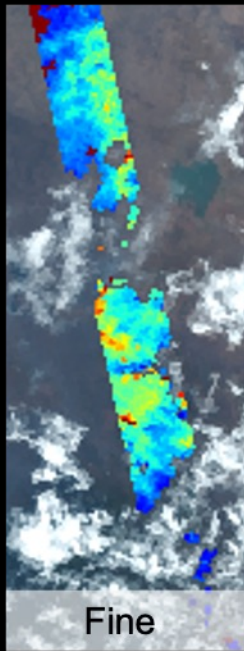
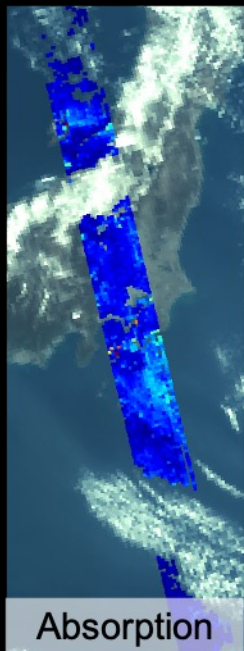
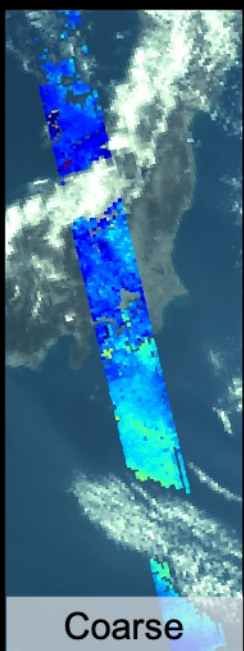
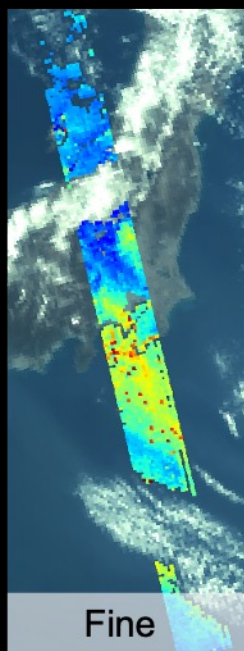






### SPEXone

narrow swath polarimeter; 2.5 km  
380-770 nm in 2-4 nm  
5 viewing angles





# Getting PACE Data: What is available today?



**Bookmark now: [PACE Data Products Table](https://pace.oceansciences.org/data_table.htm)**

[https://pace.oceansciences.org/data\\_table.htm](https://pace.oceansciences.org/data_table.htm)

Detailed list of current and future data products, availability, and status.

## Data Products Table

[Calibrated Radiometry and Polarimetry](#) | 
 [Ocean Properties to be Produced by OCI](#) | 
 [Atmospheric Properties to be Produced by OCI](#) | 
 [Land Data Products to be Produced by OCI](#) | 
 [Aerosol and Ocean Properties from HARP2](#) | 
 [Aerosol and Land Surface Properties from HARP2](#) | 
 [Cloud Properties from HARP2](#) | 
 [Ocean Surface Properties from HARP2](#) | 
 [Aerosol and Ocean Properties from SPEXone](#) | 
 [Aerosol and Land Surface Properties from SPEXone](#) | 
 [Aerosol and Ocean Properties from OCI + HARP2 + SPEXone](#)

Access to data varies with its status (data maturity level). Provisional data are available through [Earthdata Search](#), the [OB.DAAC File Search](#) and [Level 3 & 4 Browser](#). Test and Diagnostic data are available through the [OB.DAAC File Search](#) and [Level 3 & 4 Browser](#). See also "[Access PACE Data](#)".

### What do colors in the "Availability" column mean?

Available

Coming soon!

Currently implementing and evaluating

No approach currently identified

### Calibrated Radiometry and Polarimetry

Calibrated and geolocated radiometry and polarimetry as observed at sensor.

Product	Description and Use	Units	Availability	Status	Additional Info
Spectral top-of-atmosphere radiances from OCI	Spectral radiance observed at the top of the atmosphere.	$W m^{-2} um^{-1} sr^{-1}$	Level-1B 1-km at nadir; daily - Level-1C; daily	Provisional	Level-1C draft data format and examples
Spectral top-of-atmosphere radiances and polarimetry from SPEXone	Spectral radiance and polarimetry observed at the top of the atmosphere, for all sensor viewing angles.	Various	Level-1B TBD; daily - Level-1C; daily	Provisional	Level-1C draft data format and examples
Spectral top-of-atmosphere radiances and polarimetry from HARP2	Spectral radiance and polarimetry observed at the top of the atmosphere, for all sensor viewing angles.	Various	Level-1B TBD; daily - Level-1C; daily	Provisional	Level-1C draft data format and examples



# PACE Applications Program



*Get involved:* Join the  
Community of Practice or  
become an Early Adopter

- *Build partnerships* between PACE data producers & users
- *Increase accessibility & actionability* of PACE data
- *Demonstrate the societal value* & utility of PACE

PACE provides the world's first and only daily hyperspectral coverage of land, a platform for advancing metrics of surface vegetation and crop health.

Synergy between PACE and terrestrial monitoring platforms, such as Landsat, will provide actionable information at a holistic, local-to-ecosystem scale

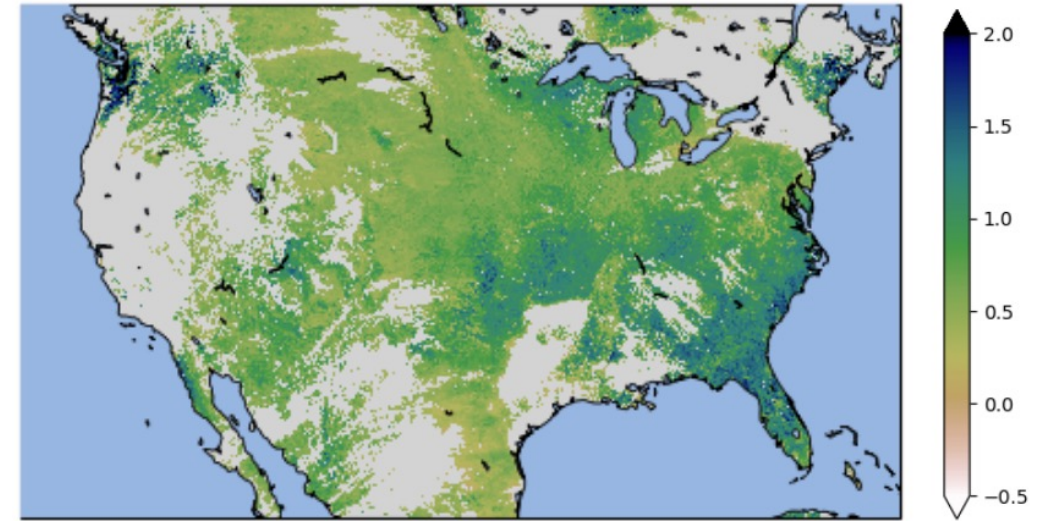
## Key PACE land data products for applications are anticipated to include:

- Surface reflectance
- Legacy NDVI, EVI, NDWI metrics (vegetation health)
- Land cover
- New indices related to foliar pigment content and plant function (e.g. mARI, Car)

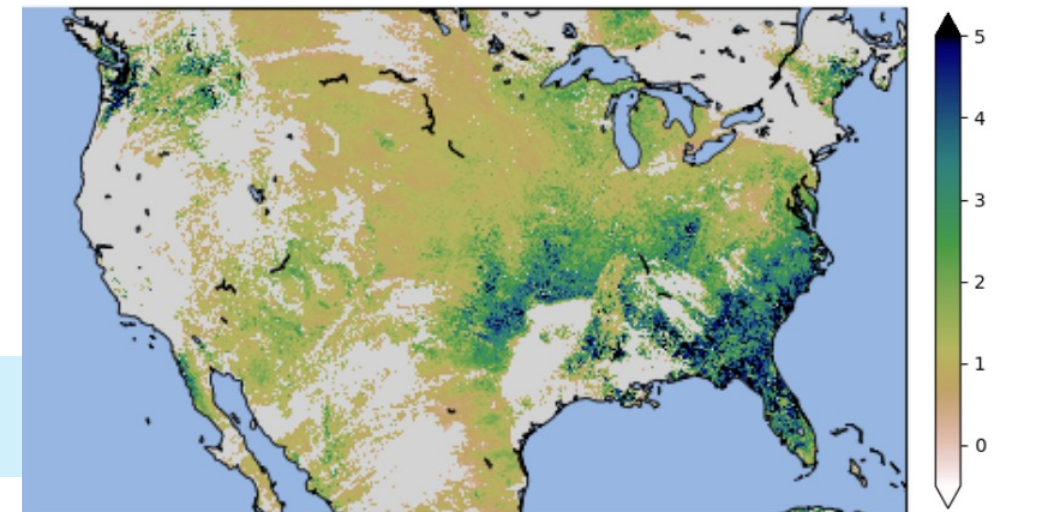


*Figures: New vegetation status metrics based on pigment content using PACE-OCI's hyperspectral information*

### Modified Anthocyanin Index (mARI)



### Carotenoid Content Index (Car)





# PACE Community of Practice (CoP) Data Access Webinar coming soon! Join CoP list to get PACE updates!



Learn more about the  
PACE mission  
<https://pace.gsfc.nasa.gov>



Join the PACE CoP and/or  
Early Adopter Program

@NASAOcean



## Data Resources: Summary of Links

- How do I prepare to work w/PACE data? [https://pace.oceansciences.org/work\\_with\\_pace\\_data.htm](https://pace.oceansciences.org/work_with_pace_data.htm)
- Which data products are available? [https://pace.oceansciences.org/data\\_table.htm](https://pace.oceansciences.org/data_table.htm)
- How do I access PACE Data? [https://pace.oceansciences.org/access\\_pace\\_data.htm](https://pace.oceansciences.org/access_pace_data.htm)
- Release notes: what version are the data? <https://oceancolor.gsfc.nasa.gov/data/reprocessing/v1/pace/>
- Where do I ask questions? Earthdata Forum <https://forum.earthdata.nasa.gov>
  
- Get data via Earthdata portal <https://search.earthdata.nasa.gov/search?portal=obdaac>
- Get data via OB.DAAC Search [https://oceandata.sci.gsfc.nasa.gov/api/file\\_search/](https://oceandata.sci.gsfc.nasa.gov/api/file_search/)
- Get data via OB.DAAC Level 3 & 4 Browser <https://oceancolor.gsfc.nasa.gov/l3/>
  
- SeaDAS 9.0.0, support PACE data <https://seadas.gsfc.nasa.gov>
- SeaDAS 9.0.0 Tutorial Video <https://www.youtube.com/watch?v=GZG2saE9ecc>
- Other SeaDAS Tutorials [https://www.youtube.com/playlist?list=PLf60TttfDm32jMmIXuFQKiJnhU-g\\_LE0j](https://www.youtube.com/playlist?list=PLf60TttfDm32jMmIXuFQKiJnhU-g_LE0j)
  
- *Join the PACE Community of Practice (CoP) to stay up to date via the CoP mailing list and routine webinars  
Fill out the form to join at this link.*



## Links: First Light, PACE Mission Info & Status

- PACE Website  
<https://pace.gsfc.nasa.gov>
- **Eye candy! First Light Story Map with 36 stunningly gorgeous images:**  
<https://pace.oceansciences.org/storymaps.htm?gallery=FL&id=3>
- Press Releases  
NASA: <https://www.nasa.gov/earth/nasas-pace-data-on-ocean-atmosphere-climate-now-available/>  
UMBC: <https://umbc.edu/stories/first-light-from-harp2-on-pace/>  
SRON: <https://www.sron.nl/news/eerste-beelden-klimaatsatelliet-pace-vrijgegeven/> (in Dutch and English)