Keeping PACE

Introduction to the Plankton, Aerosol, Cloud,
ocean Ecosystem mission, its products, and discovering data
at OB.DAAC

March 27, 2024

Alicia Scott, Deputy Manager at OB.DAAC

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2. Data Products
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Mission Introduction

An overview of the PACE mission and it’s data archive center.

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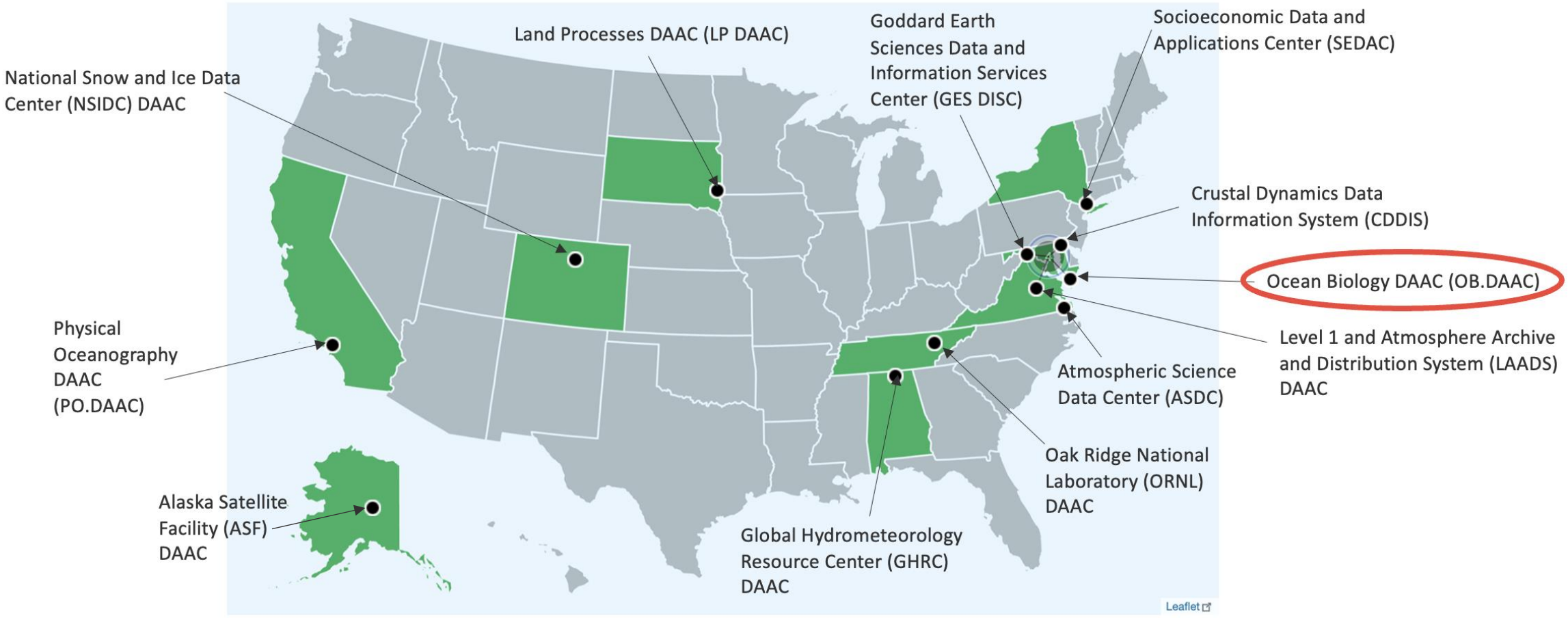
NASA DAACs



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Who is OB.DAAC

The Ocean Biology Distributed Active Archive Center (OB.DAAC) joined the NASA DAACs in 2013. It is located at NASAs Goddard Space Flight Center in Greenbelt, MD and is co-located with its data provider, the Ocean Biology Processing Group (OBPG).

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Mission Overview

The Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission will extend the high-quality ocean ecological, ocean biogeochemical, cloud, and aerosol particle data records begun by NASA from heritage missions such as SeaWiFS, MODIS, MISR, and VIIRS.

Mission Overview

Key characteristics:

- Launched on February 8, 2024 on a Falcon 9 from Kennedy Space Center in Florida.
- 676.5 km Altitude
- Polar, Ascending, Sun-Synchronous Orbit; 98-degree inclination
- 13:00 UTC Local Equatorial Crossing
- 3-yr design life; 10-yr propellant
- 9-12 hrs latency (on average; full range ~3-24 hrs)

Mission Management:

NASA Goddard Space Flight Center, UMBC Earth and Space Institute, and SRON/Airbus (Netherlands)

Data Summary:

- Expected Data Delivery: April 2024
- L0-L3 Science Data*
- Data Volume: 1.5PB (over mission lifetime based on current heritage products)

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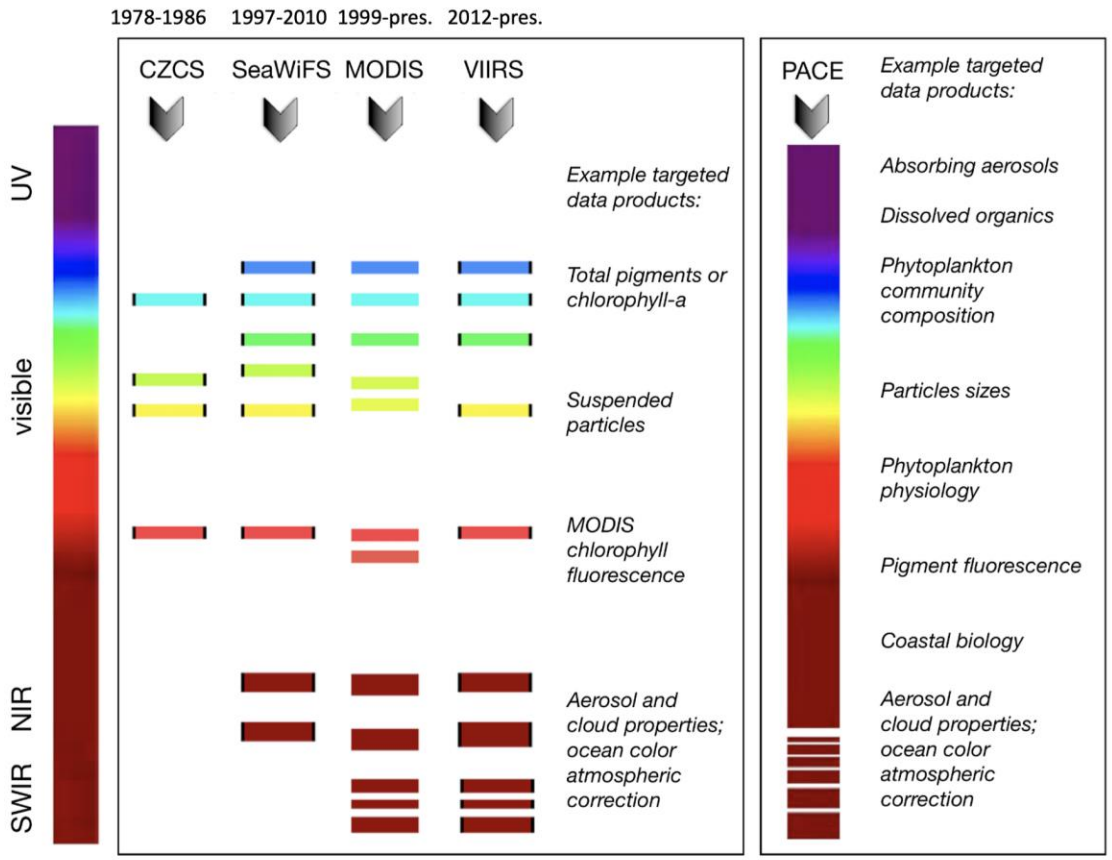
Instruments

- PACE's primary sensor, the Ocean Color Instrument (OCI), is an advanced global, hyperspectral imaging radiometer with a continuous spectral range from the ultraviolet to near-infrared, plus 7 shortwave infrared bands.
- The Spectro-Polarimeter for Planetary Exploration (SPEXone) is a narrow swath, ultraviolet to near-infrared hyperspectral, multi-angle polarimeter built by a consortium in the Netherlands (SRON, Airbus DS Netherlands).
- The Hyper Angular Rainbow Polarimeter (HARP2) is a wide swath, visible to near-infrared multispectral, hyperangular polarimeter built and contributed by the University of Maryland Baltimore County.

Societal Benefit

- PACE will extend **key systematic ocean color, aerosol, cloud & land climate data records**.
- PACE will reveal the **diversity of organisms fueling marine food webs** & how ecosystems respond to change.
- **Looking at the ocean, clouds, land & aerosols together** will improve knowledge of the roles each plays in our planet.

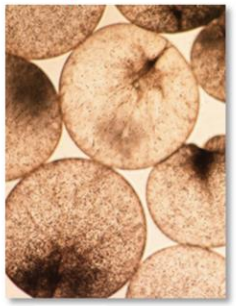
Science Capabilities – OCI



Example diatom

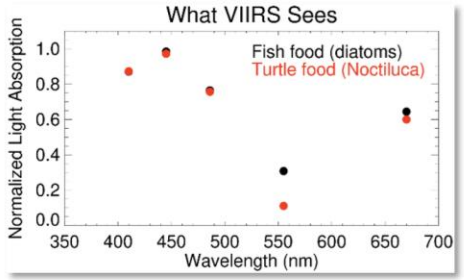
Linda Armbrecht, abc.com.au

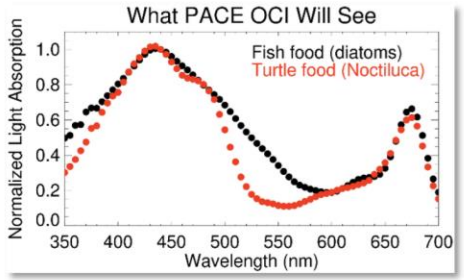
Example Noctiluca



Joaquim Goes, LDEO

signals from the ocean are small & differentiating between constituents requires additional information relative to what we have today





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Science Capabilities – HARP2

HARP Cubesat RGB imagery, West Africa with Saharan dust, glint, clouds 2020 / 06 / 13

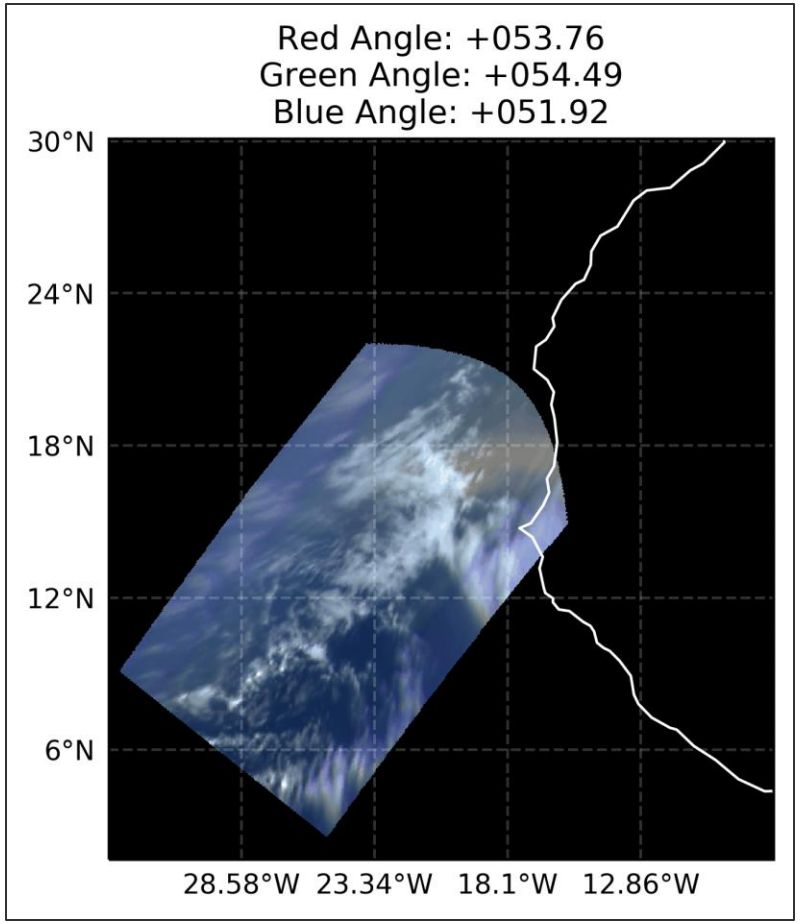

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Image Credit: UMBC, from: https://esi.umbc.edu/hyper-angular-rainbow-polarimeter/

Science Capabilities – SPEXone

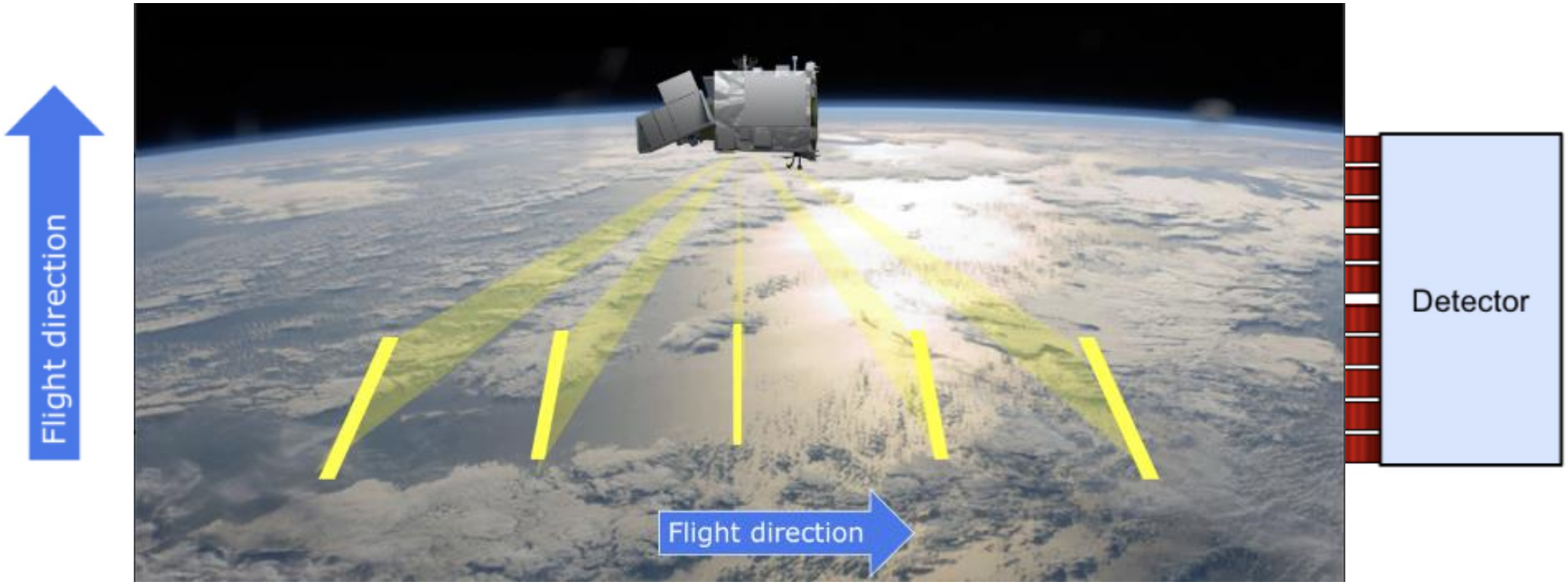

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Image Credit: SRON, the Netherlands Institute for Space Research.

PACE Data Products

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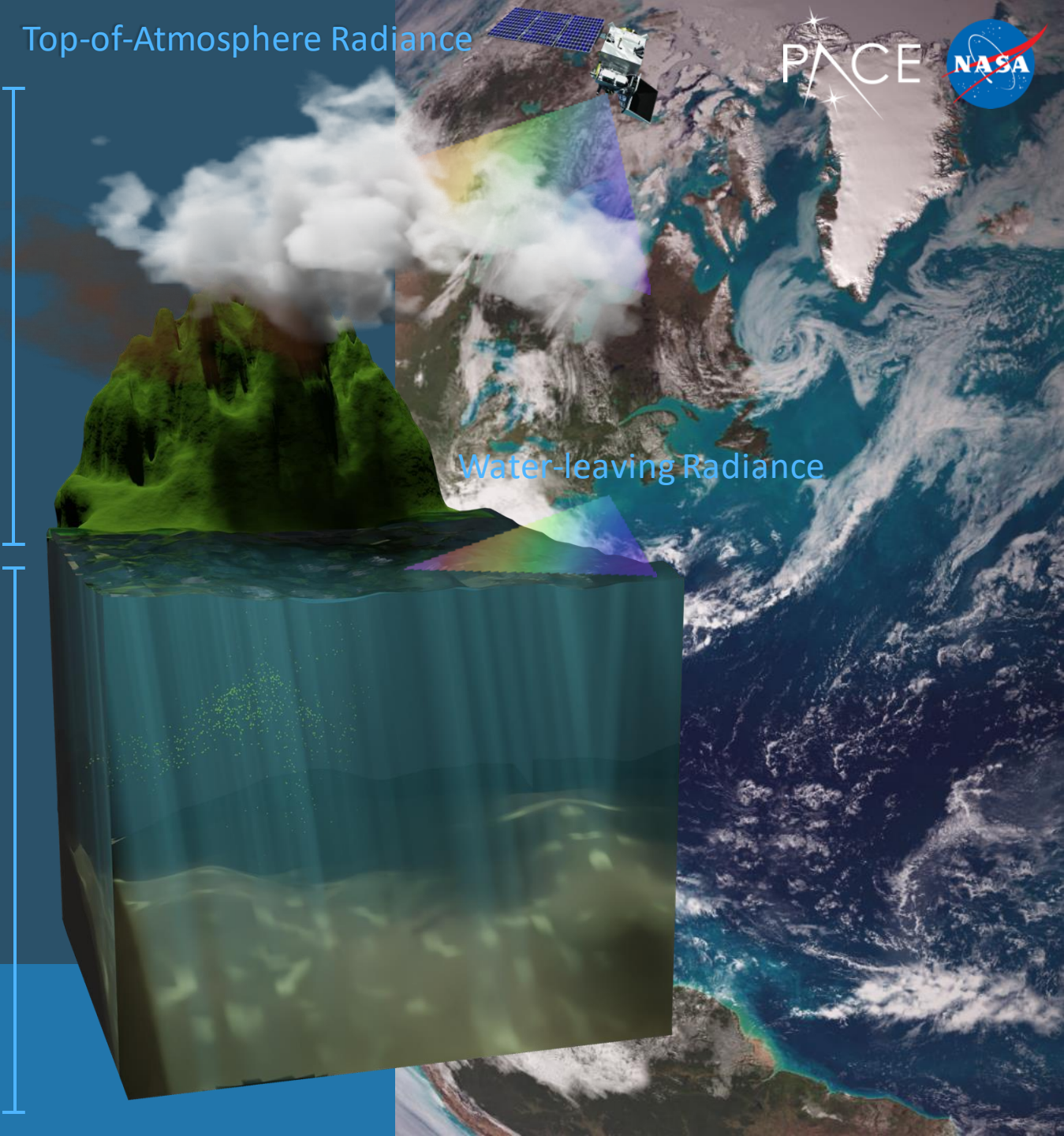
PACE DATA PRODUCTS

ATMOSPHERIC
OCEAN COLOR



Water-leaving Radiance comprises 5-15% of the total Top-of-Atmosphere Radiance signal …

Coupling the communities is essential!

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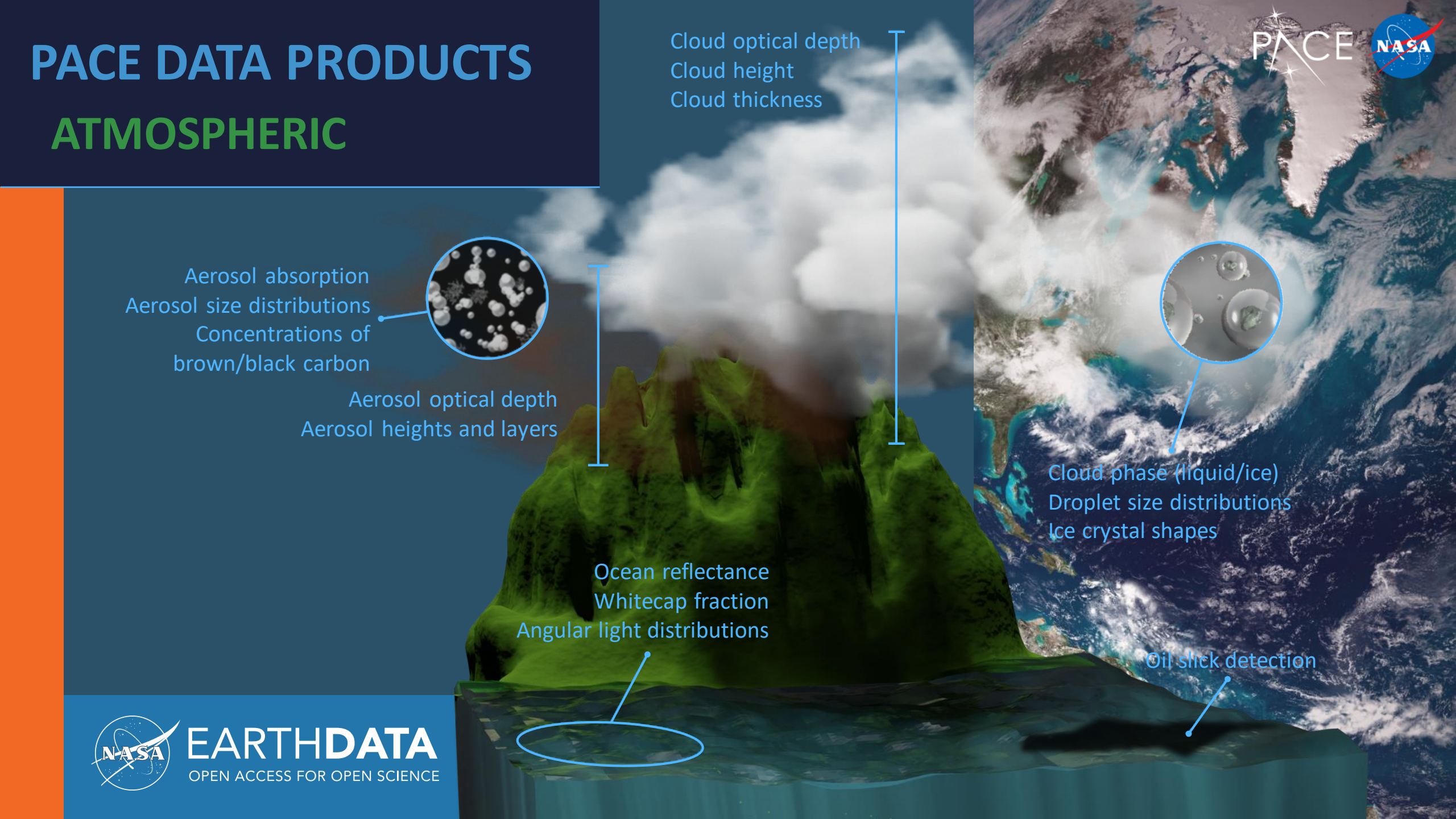
PACE DATA PRODUCTS

ATMOSPHERIC



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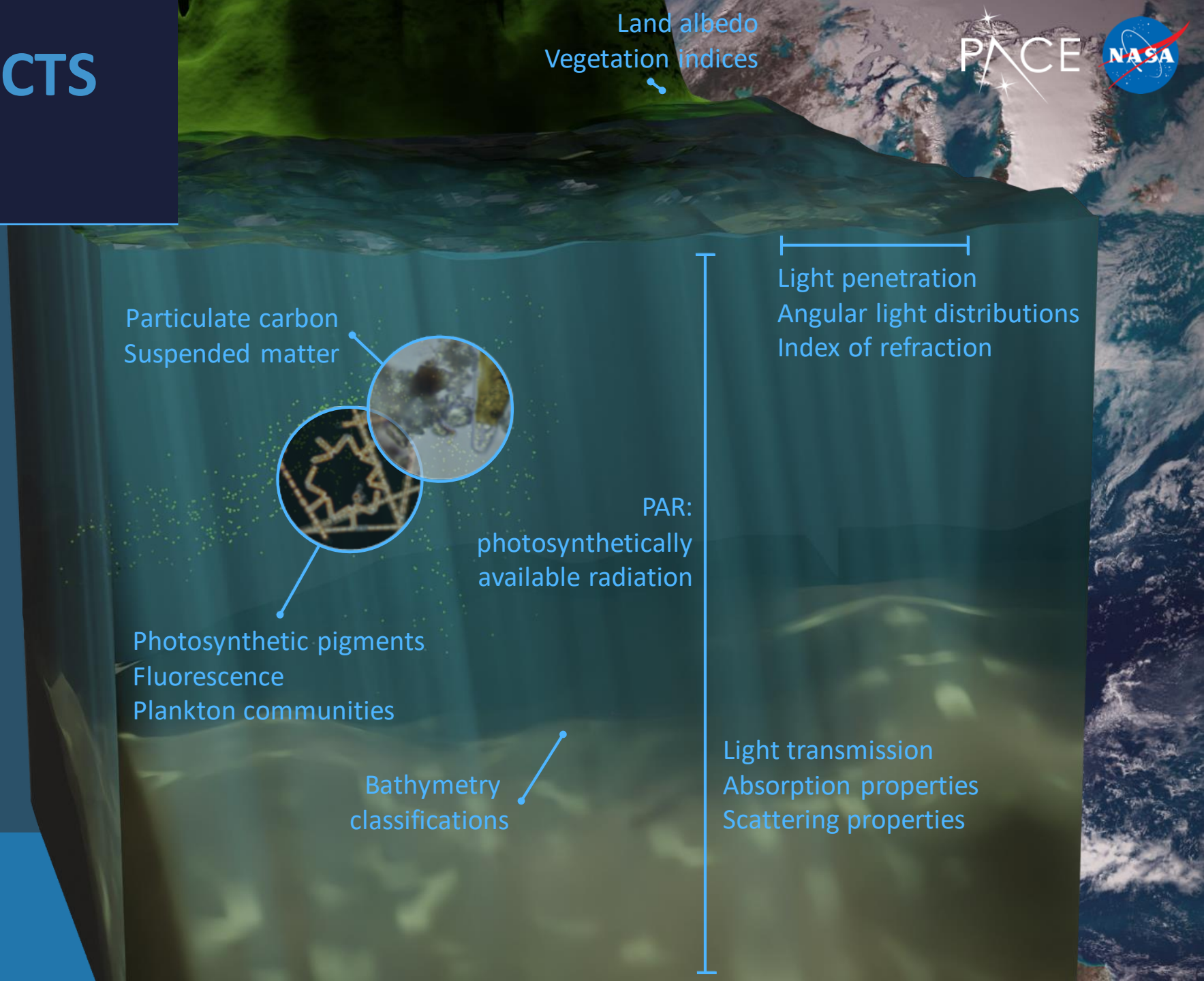
PACE DATA PRODUCTS

OCEAN COLOR

Mission is actively engaging the terrestrial science community (best effort basis)



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Data Products

Land

- Surface Reflectance
- Enhanced Vegetation Index
- Photochemical Reflective Index
- Aerosol optical depth in the near infrared
- BRDF/albedo and model parameters

Atmospheric

- Spectral aerosol optical depth
- Aerosol size distribution
- Aerosol complex refractive index
- Aerosol layer height
- Cloud Mask
- Optical thickness of liquid and ice clouds

Ocean

- Spectral remote sensing reflectances
- Spectral particlulate matter absorption coefficients
- Phytoplankton community composition
- Spectral phytoplankton absorption coefficients
- Net Primary Production
- Apparent visible wavelength

Data Products - Availability

Available at launch	1-3 months post-launch	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 TBD; daily	Standard product	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 TBD; daily	Standard product	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 TBD; daily	Standard product	Level-1C draft data format and examples

Ocean Properties to be Produced by OCI

Bio-optical and biogeochemical properties of seawater constituents in the sunlit upper ocean.

Product	Description and Use	Units	Availability	Status	Additional Info
Spectral remote sensing reflectances	Spectral color of the ocean in the ultraviolet-to-near infrared spectral range. Used as input into algorithms to retrieve information about colored dissolved organic matter, phytoplankton, non-algal particles, and other aquatic constituents. Provided in continuous 2.5-nm steps from 350 to 717.5-nm with a resolution (bandwidth) of 5-nm.	sr^{-1}	Level-2 1-km at nadir; daily - Level-3 4-km; daily, 8-day, monthly, annual	Standard product	ATBD SAT members: Boss, Zhai, Krotkov, Chowdhary, Stamnes, Zhang In situ measurement protocols

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https://pace.oceansciences.org/data_table.htm

Finding PACE Data

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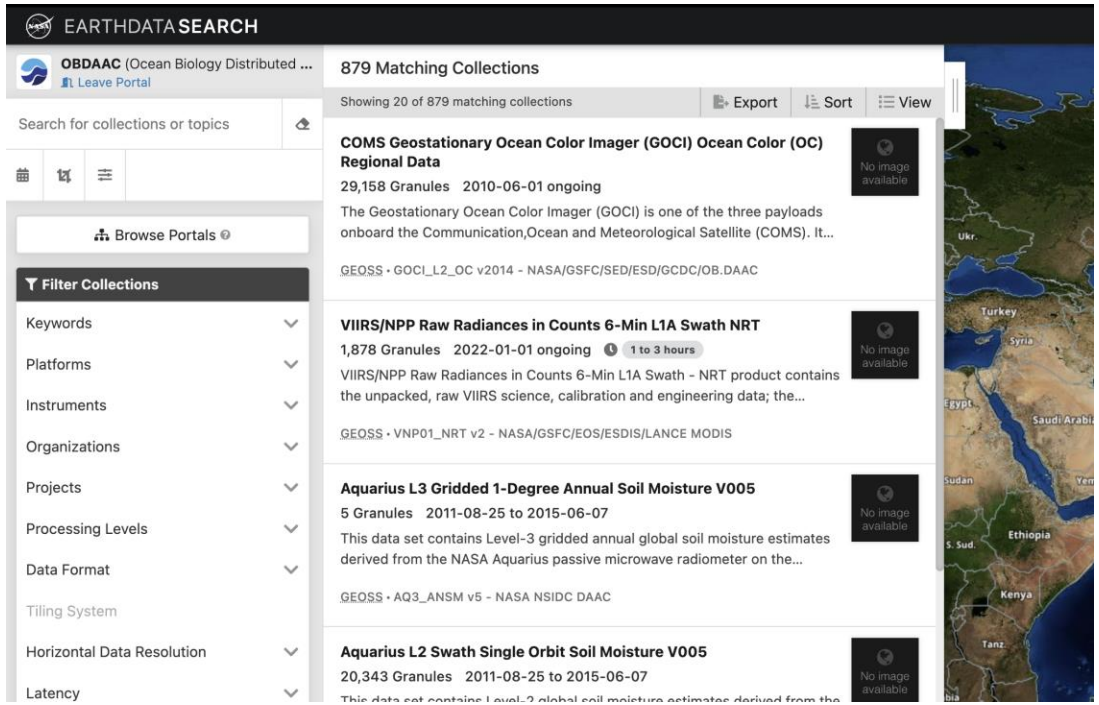
Data Access

Earthdata Search Client

- Find data from any NASA DAAC and filter by various search parameters
- OB.DAAC Portal



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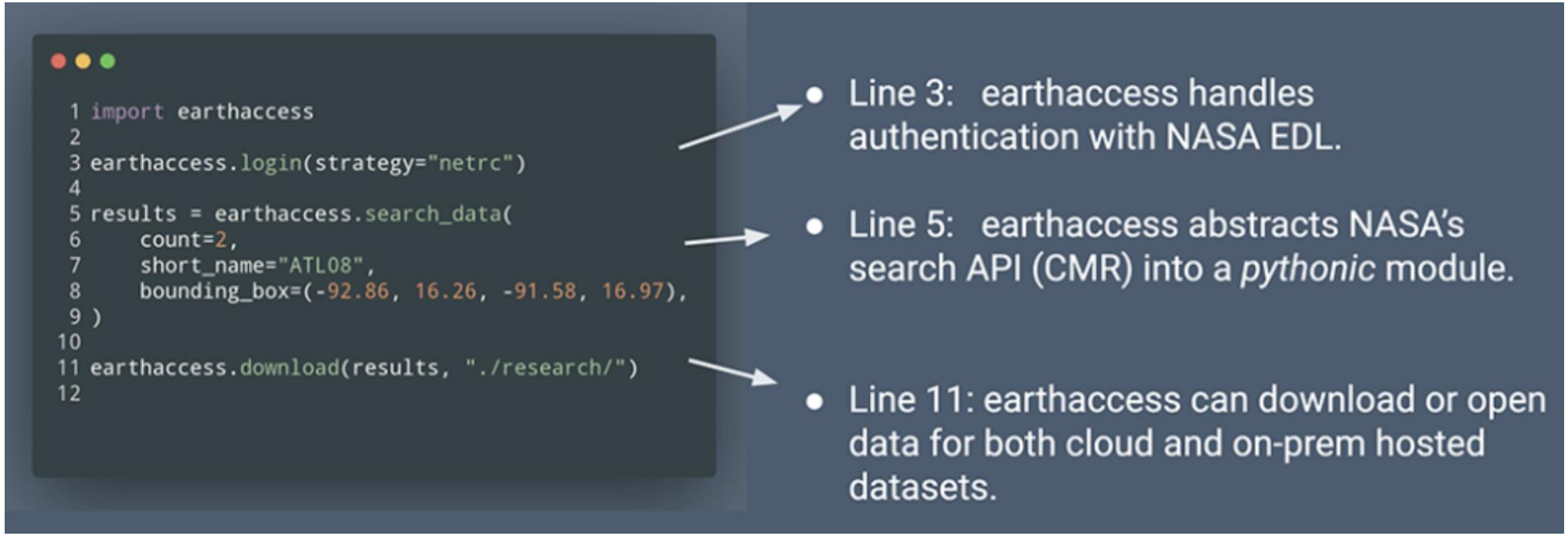
https://search.earthdata.nasa.gov/

Data Access

Python API Library: earthaccess



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https://www.earthdata.nasa.gov/learn/blog/earthaccess

Data Access

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https://oceancolor.gsfc.nasa.gov/

How to Prepare

Accessing PACE data in the cloud

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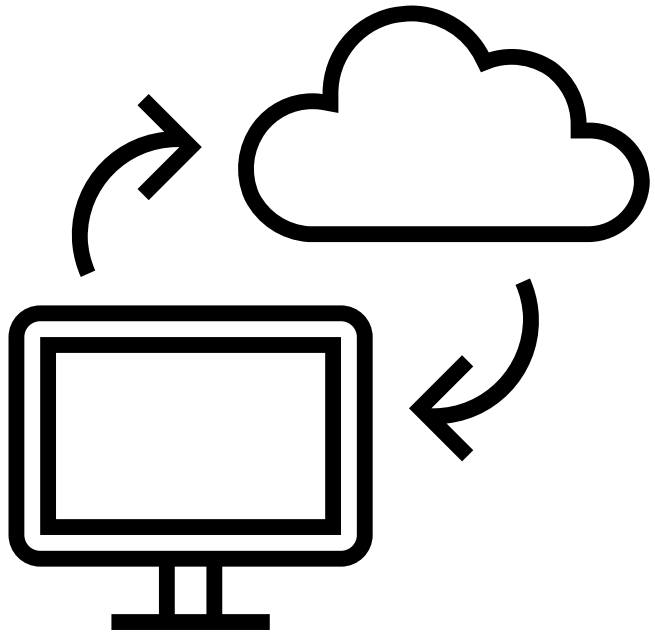
Data Access: PACE in the Cloud

NASA has decided to use **Amazon Web Services** as our cloud provider. All public NASA science data will be available in **us-west-2** region.



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https://www.earthdata.nasa.gov/eosdis/cloud-evolution

Data Access: PACE in the Cloud

- Create Earthdata Login account: https://urs.earthdata.nasa.gov/
- Create an AWS account in **us-west-2** region
- Community Developed Resources:
- NASA Openscapes Earthdata Cloud Cookbook: https://www.youtube.com/watch?v=FcATnW5KJJo

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PACE in the Cloud: Benefits

- Improved performance
- Multiple data access methods
- Multidisciplinary data access
- Analysis next to data
- Expanded services

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Trainings and Tutorials

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Cloud Resources

- Earthdata Cloud Primer: https://www.earthdata.nasa.gov/learn/webinars-and-tutorials/cloud-primer-amazon-web-services

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Ocean Color Resources

Jupyter Notebooks:

- Read and plot level-2 chlorophyll map

- Download and visualize level-2 products

- Read and plot level-3 files

More to come!

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https://oceancolor.gsfc.nasa.gov/resources/docs/tutorials/

Lectures

OCB's PACE Mission Training Lectures

https://www.youtube.com/playlist?list=PL2JK_uZ15iZBq7XGAvQIo3NkwVVBMKZZO

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User Engagement

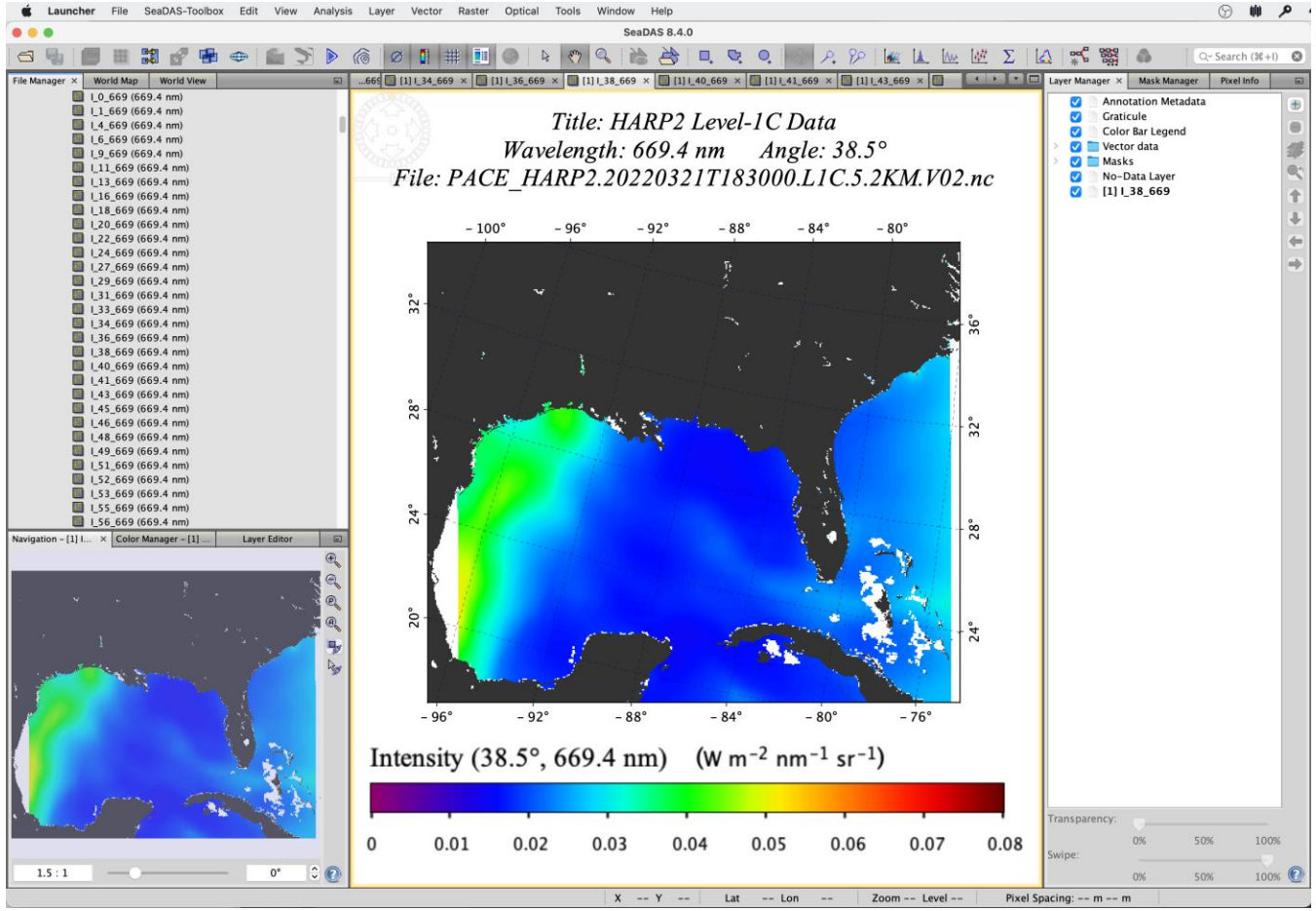
- Pace Hackweek: Aug 4-8
    - Presentations and code will be made publicly available once session is completed.
- Join Ocean Color mailing list

Analysis & Visualization Support

SeaDAS release: April 2024

- support for multi-angle polarimetry data

- data animation feature



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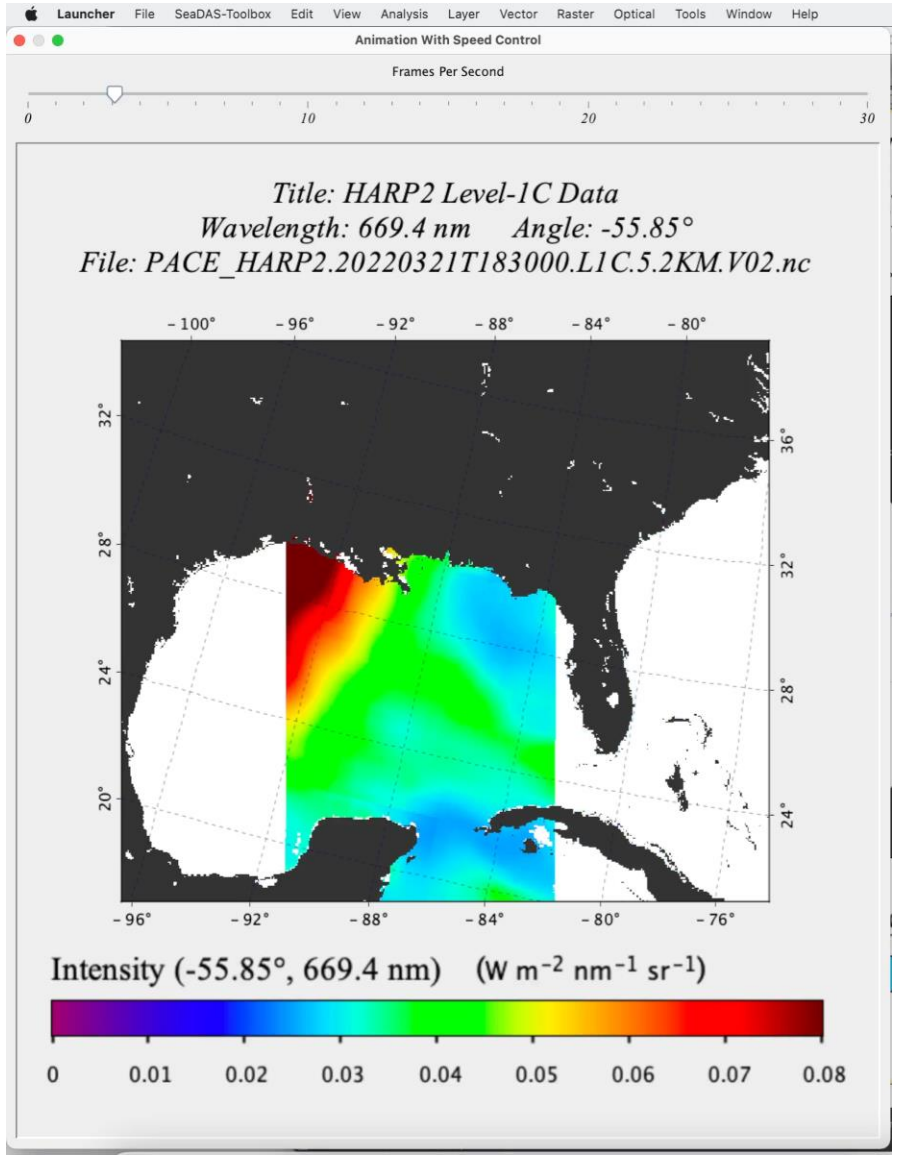
PACE Support in SeaDAS

Animation of PACE simulated HARP2 Level-1C data: angular view



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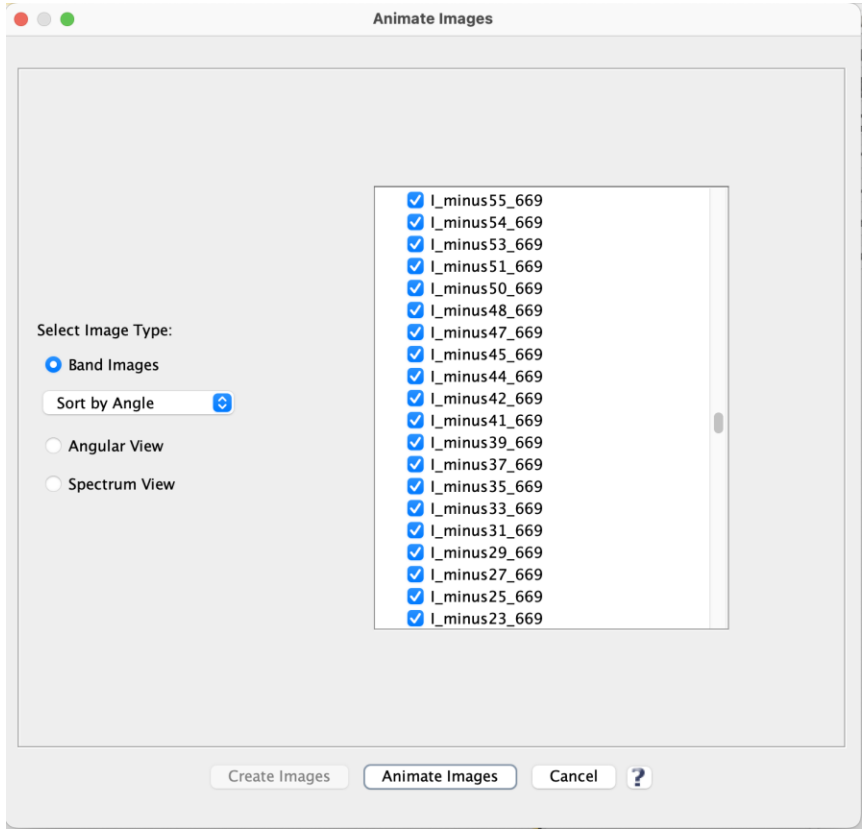
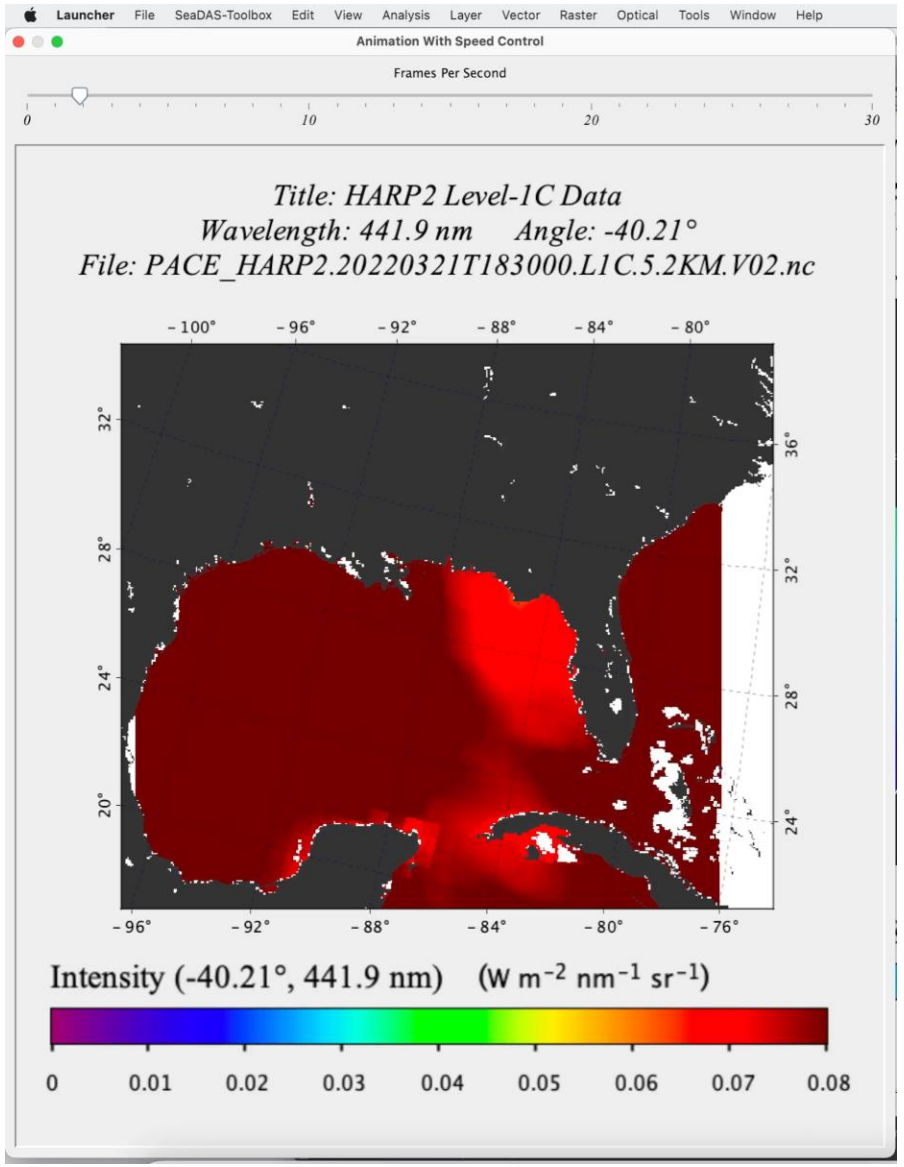
PACE Support in SeaDAS





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SeaDAS Resources

Find SeaDAS course material, software feature tutorials and case studies!

https://seadas.gsfc.nasa.gov/tutorials/

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User Resources

PACE data will be available in the cloud at OB.DAAC starting in April 2024! Stay connected for announcements, updates and learning opportunities.

Ocean Color Mailing List: Subscribe

Learning: Earthdata Cloud Primer

User Support: Earthdata Forum

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Learn more about PACE and it’s data products

https://pace.gsfc.nasa.gov
https://pace.oceansciences.org/data.htm

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