PACE Data: Applications, Access, and Resources

Morgaine McKibben, PhD
PACE Mission Applications Lead
NASA Goddard Space Flight Center / SSAI

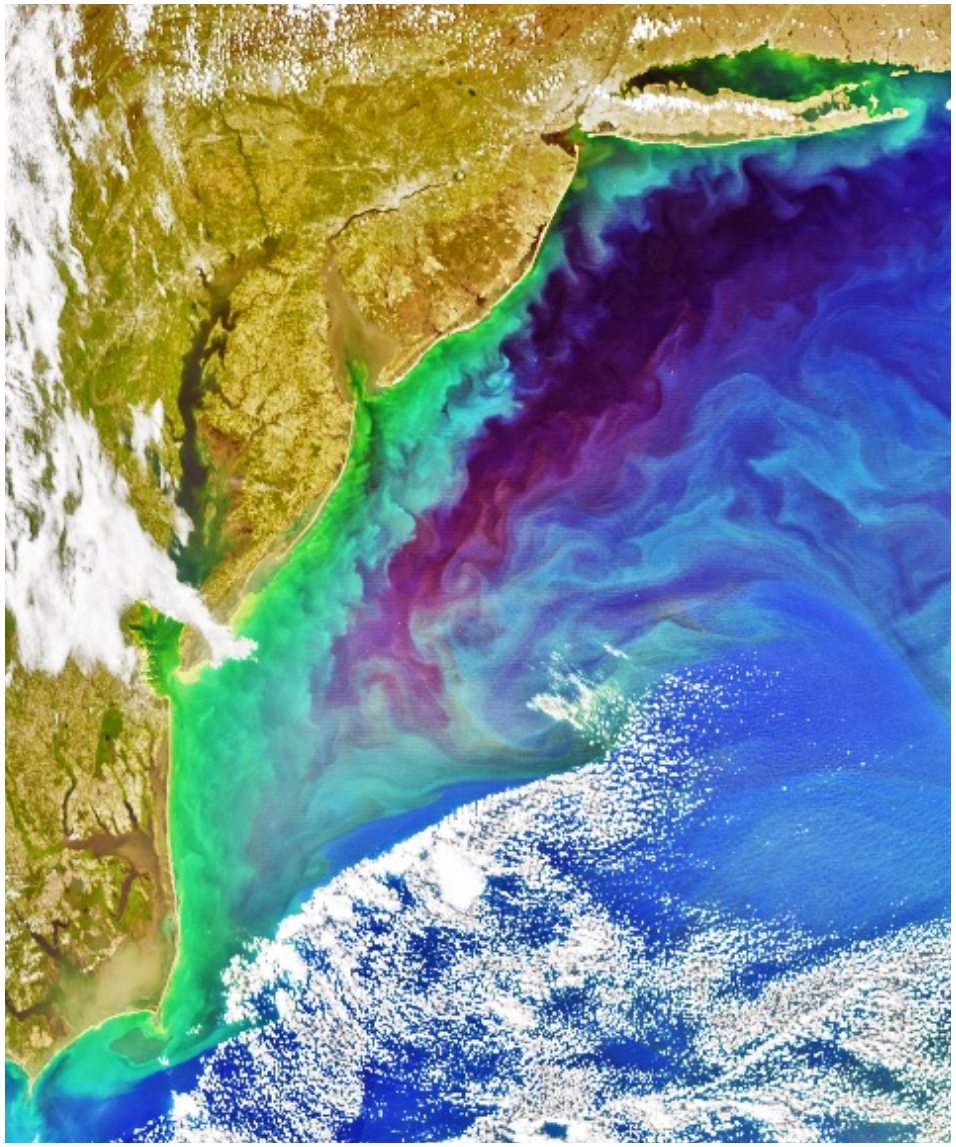
July 29th, 2024
NOAA Satellite Symposium: Water

Special thanks to contributors: Erin Urquhart, Antonio Mannino, Jeremy Werdell, Skye Caplan

Overview

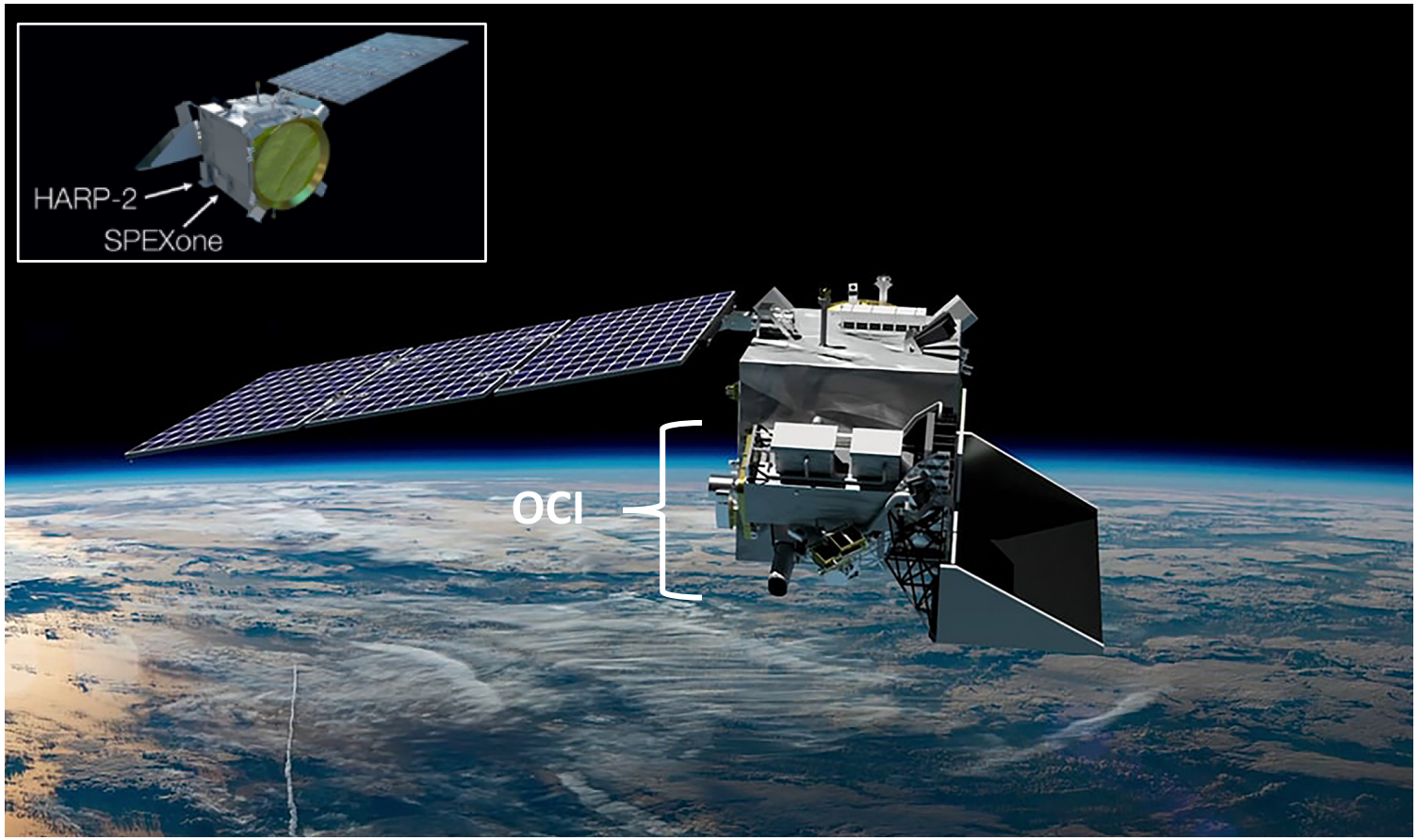
Today we'll explore…

- PACE Applications Program & use case examples
- Where to access PACE ocean color data products available now
- Resources & support available to work with PACE data



PACE enhanced RGB, US East Coast, April 26, 2024. Credit: Joseph Knuble

PACE Observatory: Leading a new era of global imaging spectroscopy



- Global, 13:00 local equatorial crossing
- 3yr mission (at least 10yrs of propellant)
- **Data products are free & open to all**

Ocean Color Instrument (OCI)

- Hyperspectral 340-890nm (UV-NIR) 5nm bandwidth, 2.5nm steps; 7 SWIR bands
- 1-2 day global; 1.2 km^2 at nadir

Two multi-angle polarimeters:

- **HARP-2:** wide-swath, hyper-angular, 4 bands; 2 day global; 3 km^2 nadir
- **SPEXone:** narrow-swath, hyperspectral from UV-NIR, 5 viewing angles, >30 day global, 2.5 km^2 nadir

Science Goals: PACE is NASA's next great investment to advance and 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 mission to date.**

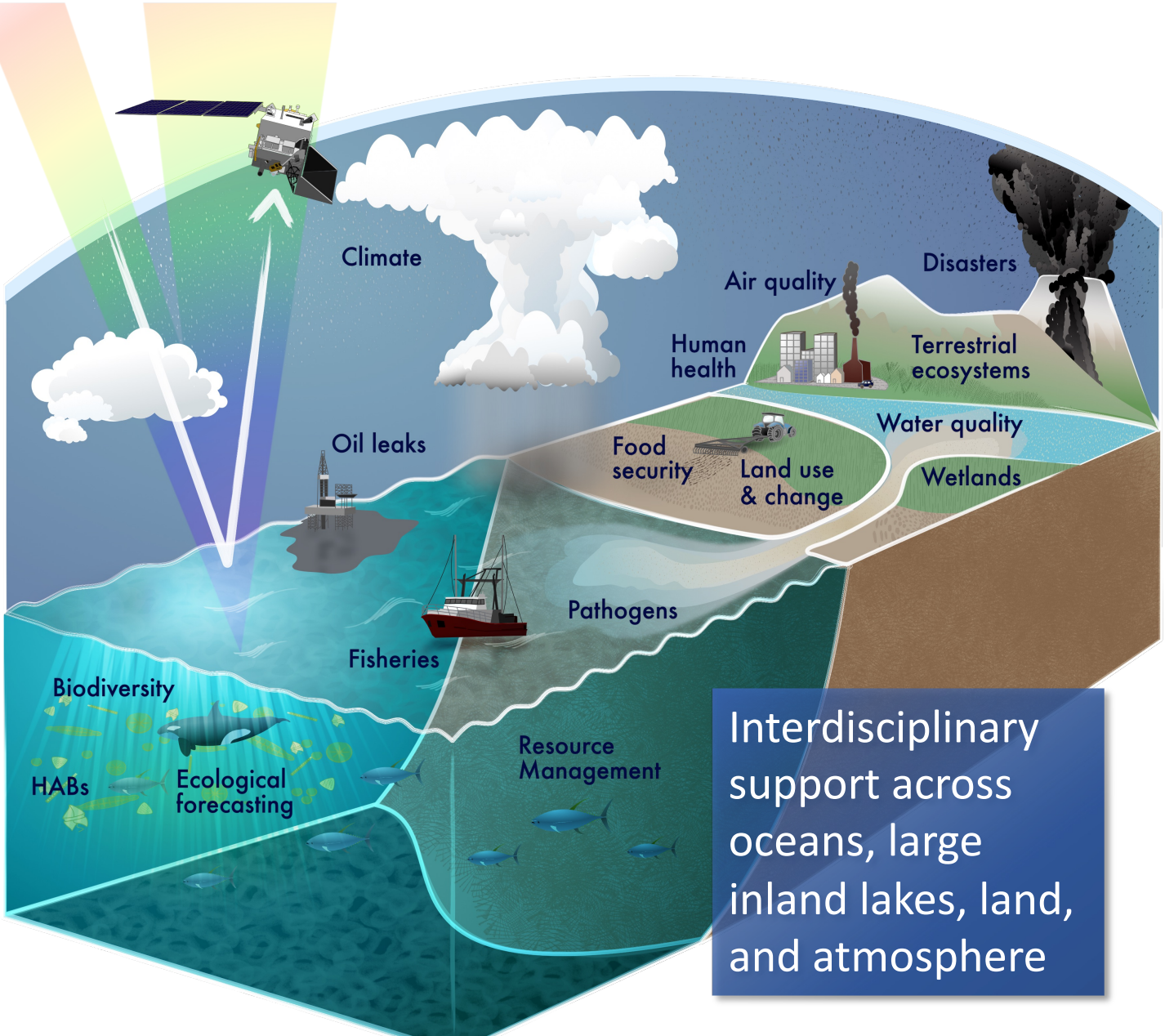
PACE Applications & Use Cases

PACE Applications: Putting PACE data to work across the Earth System

- **Applications** are innovative uses of NASA PACE data products to improve *decision-making activities & help provide practical solutions to meet societal needs.*

- **Applied Research** bridges PACE data & applications. Provides fundamental knowledge of how to *scale* & *integrate* PACE data products into *users'* policy, business & management activities.

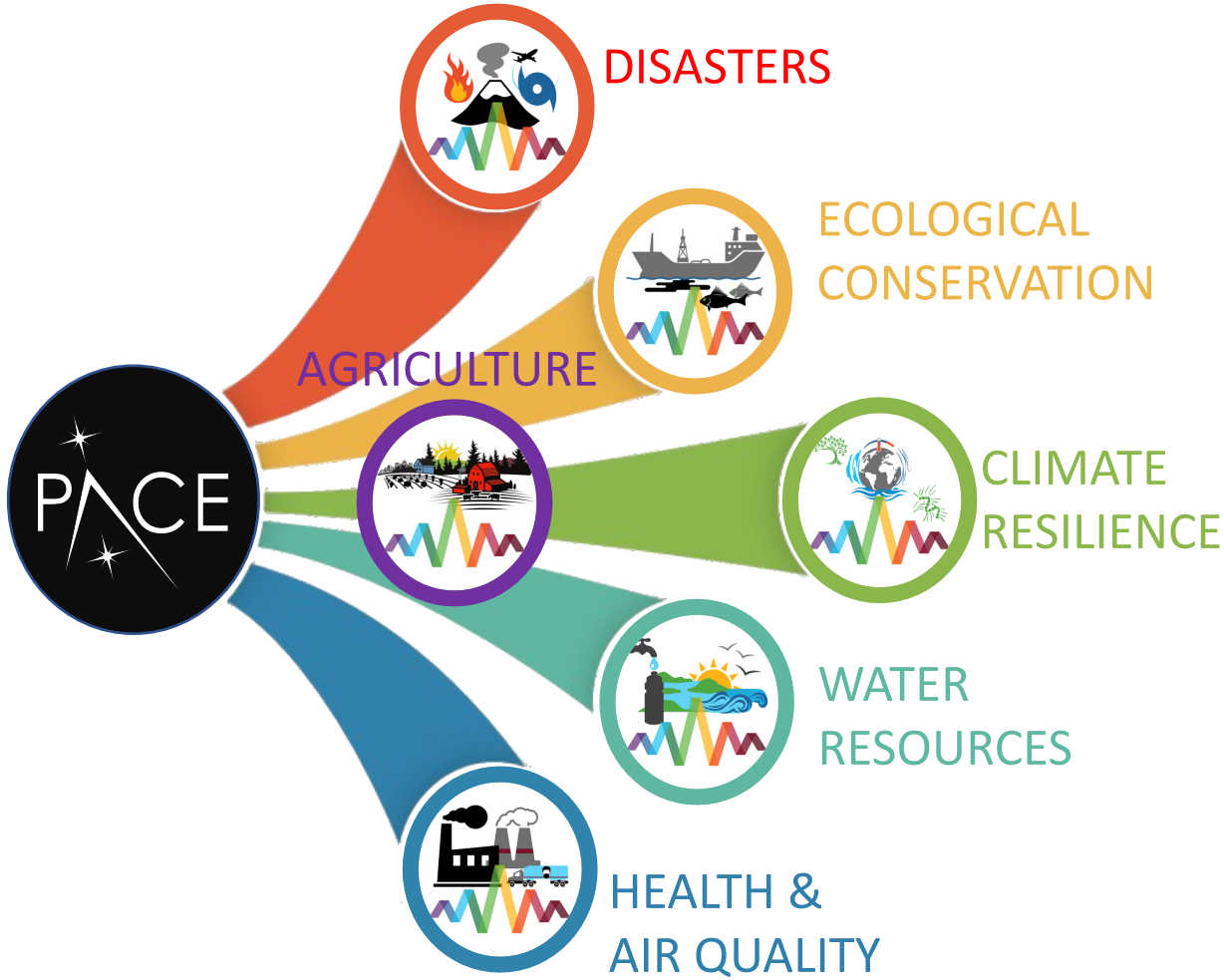
- **End-user communities** include
  - Individuals & groups
  - Public, private, academic sectors
  - National & international orgs
  - Local & global scales



PACE Applications Program

Goal: accelerate & support translation of PACE's advanced data into societal *action*

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



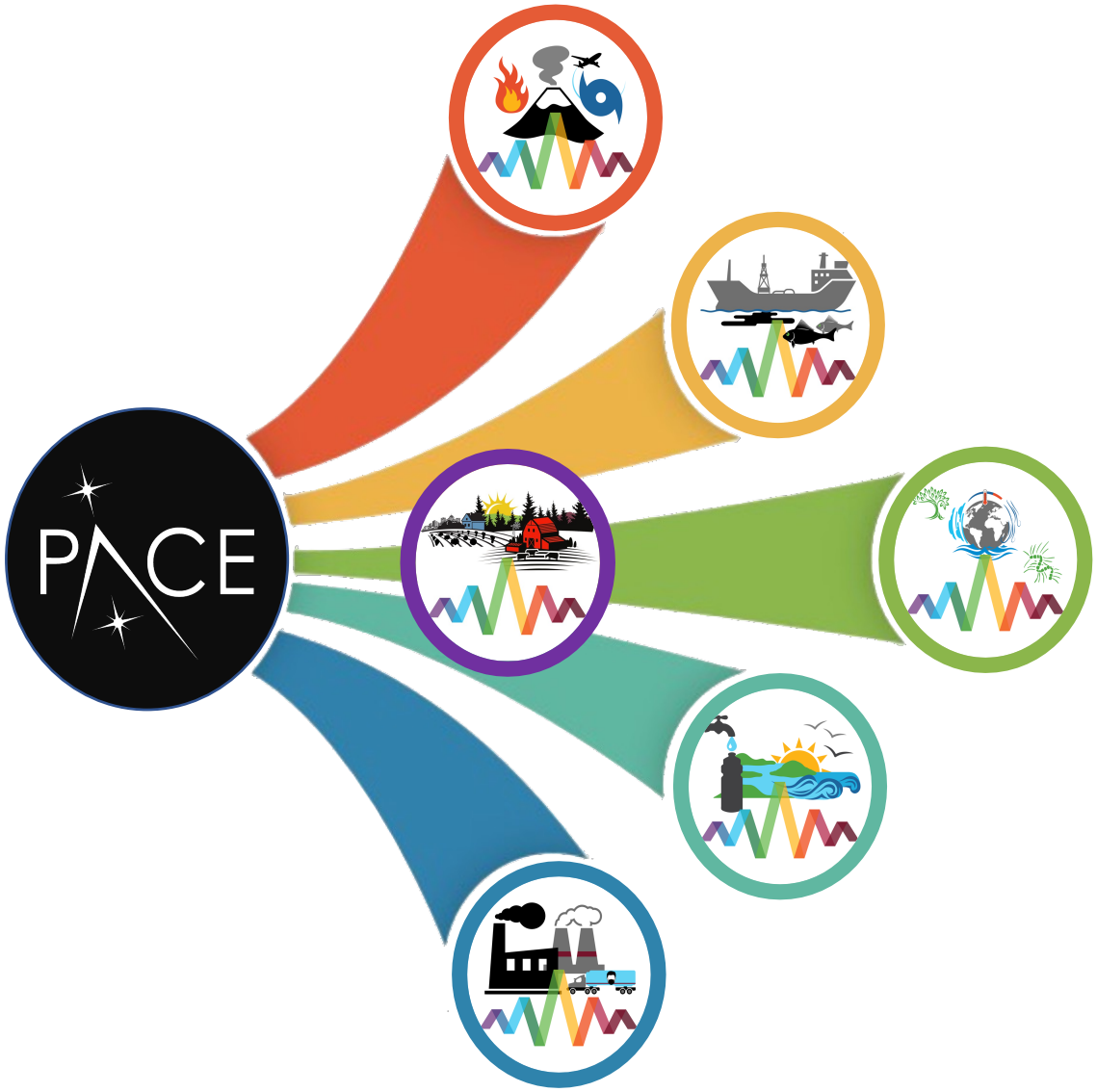
PACE Applications: Community Engagement

Community of Practice: Anyone interested in staying up-to-date on the PACE mission, data, and applications. ***Join us!!***

1. *Send an email to ***with 'join' in the subject line*** to pace-community-join@lists.nasa.gov*
2. *Look for confirmation email → confirm!*

Science & Applications Team: NASA-funded scientists working on algorithm development, applications, validation, etc.

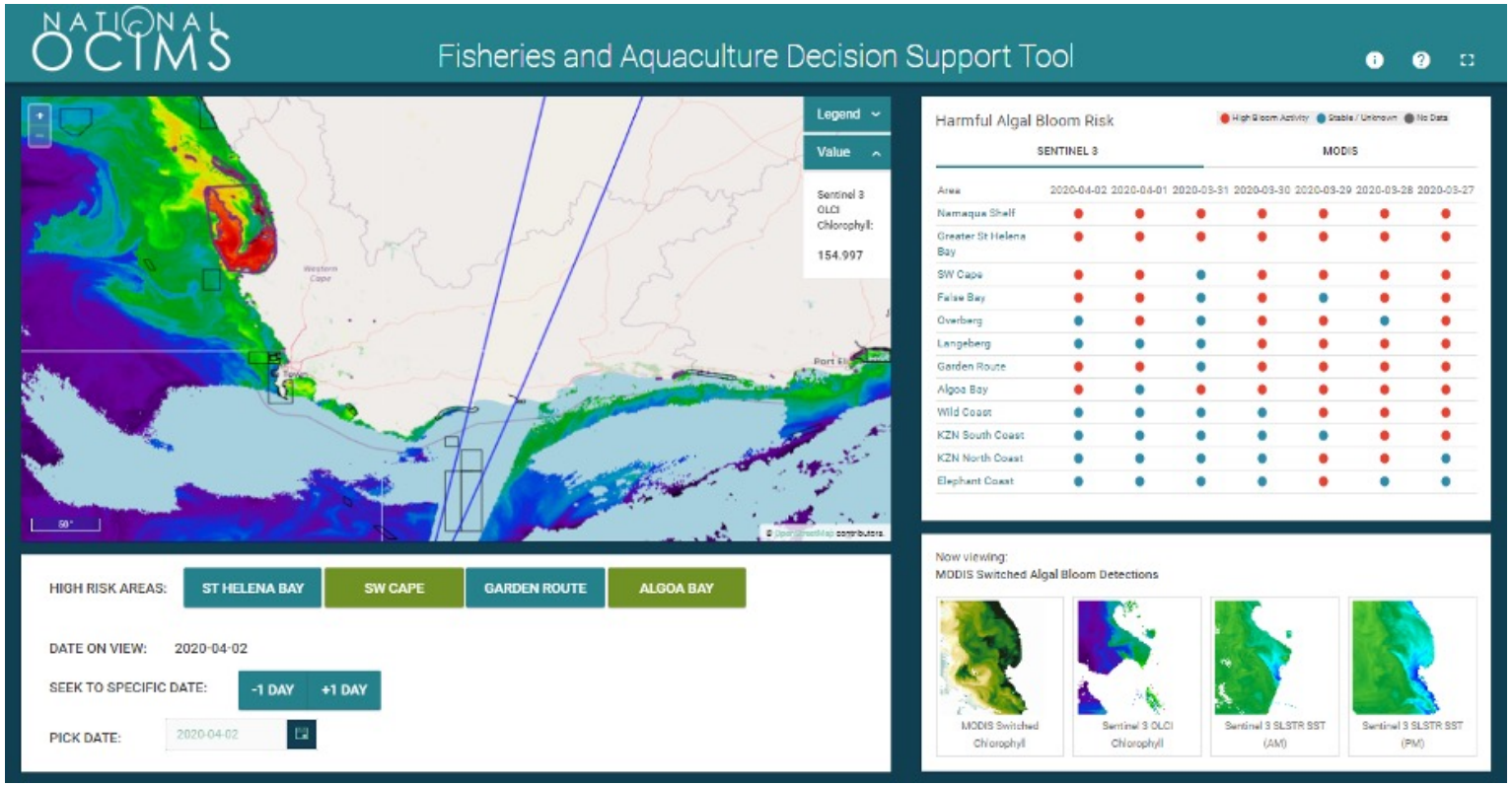
Early Adopters: Researchers and others with applied projects/needs teamed with stakeholders to develop and apply advanced PACE applications



PACE Applications - Water Resources & Water Quality Examples

New, hyperspectral-based PACE data products & advanced versions of legacy ocean color products will advance water quality management & understanding of aquatic ecosystems by improving:

- Identification & tracking of harmful algal blooms (HABs)
- Assessment of fisheries & aquaculture health
- Evaluating & maintaining ecosystem health
- Identification of oil spills
- Post-disaster water quality impacts (e.g., floods, fires, hurricanes): particularly regarding suspended solids, HABs, and fish kills/hypoxia



Top: The National Oceans and Coastal Information Management System (OCIMS) Fisheries and Aquaculture Decision Support Tool will incorporate phytoplankton community composition from PACE.

PACE Early Adopter: Brady Aquaculture site prospecting

Damian Brady

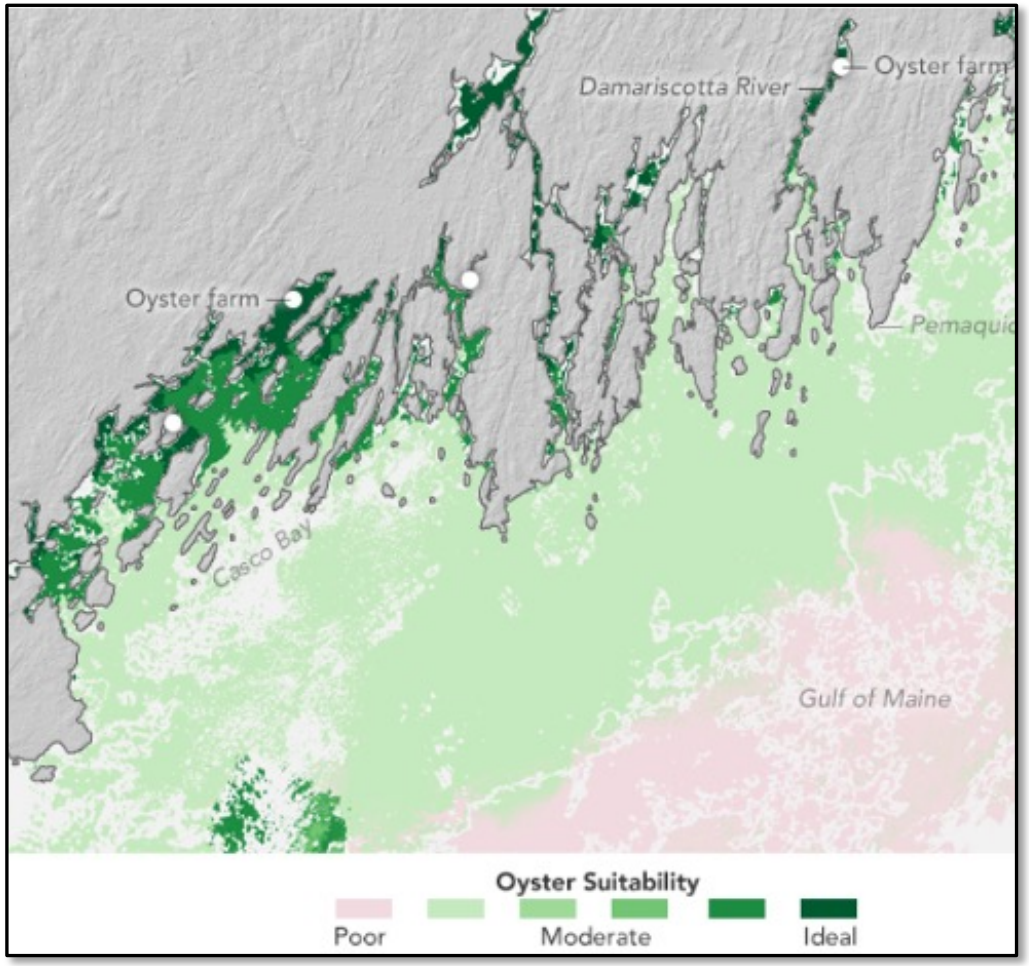
Aquaculture site prospecting: Applying PACE products to sustainable aquaculture site selection »

Application Aquaculture Site Prospecting: Applying PACE products to sustainable aquaculture site selection

Significance: Choosing optimal aquaculture sites with the best available information could save prospective oyster, mussel, and scallop growers money and time.

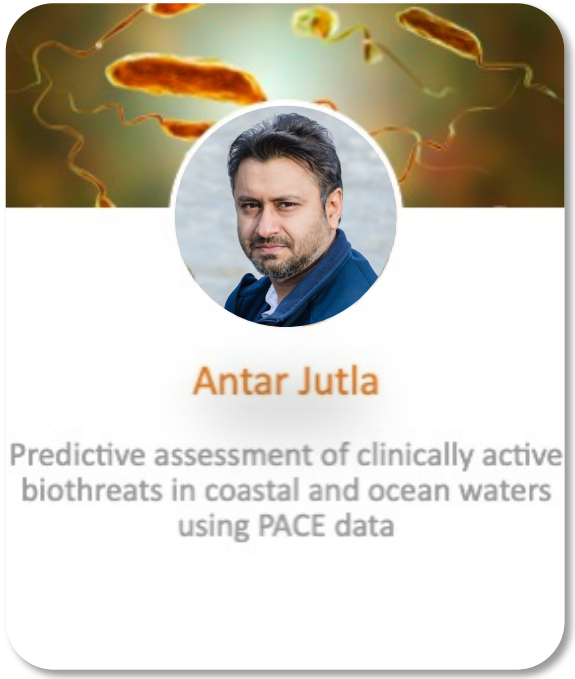
How PACE can help: PACE's spectral resolution could help optimize site selection tools by relating phytoplankton size to oyster feeding rates.

Stakeholders: End-users change each year with over 600 Limited Purpose Aquaculture License holders in the state of Maine.



Example map from oyster farm site selection tool
https://pace.oceansciences.org/people_ea.htm?id=52

PACE Early Adopter: Enhanced cholera risk models



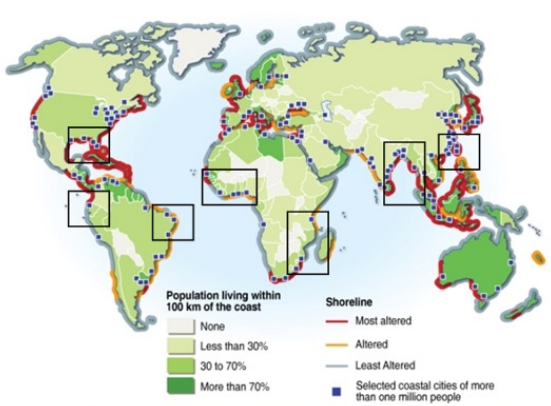


Figure 1: Population distribution and water-borne disease outbreak. Rectangles represent regions with reported disease epidemics.

Application: Enhanced cholera risk models through integration of hyperspectral remotely sensed plankton & plankton health data into algorithms for Florida & the Chesapeake Bay.

Significance: Water-borne pathogens pose a significant threat to human and environmental health. Better understanding of the relationship between plankton and *Vibrio cholerae* will improve risk assessment and improve human health advisories. This work can be used to make real-time decisions of when and where to initiate cholera relief and mitigation activities, as well as, for decision-making for safe water and sanitation.

How PACE can help: The hyperspectral capabilities of PACE OCI will enhance existing prediction models (for Vibrio cholera) by integrating phytoplankton type and phytoplankton health metrics into algorithms. It is anticipated that PACE will enhance such activities to support public health, policy analysis, and decision-making.

Stakeholders: United Nations Office for Coordinator of Humanitarian Affairs (UNOCHA); World Health Organization (WHO); UNCEF

https://pace.oceansciences.org/people_ea.htm?id=68

PACE Early Adopter: Northern Gulf of Mexico Water Quality

Bingqing Liu

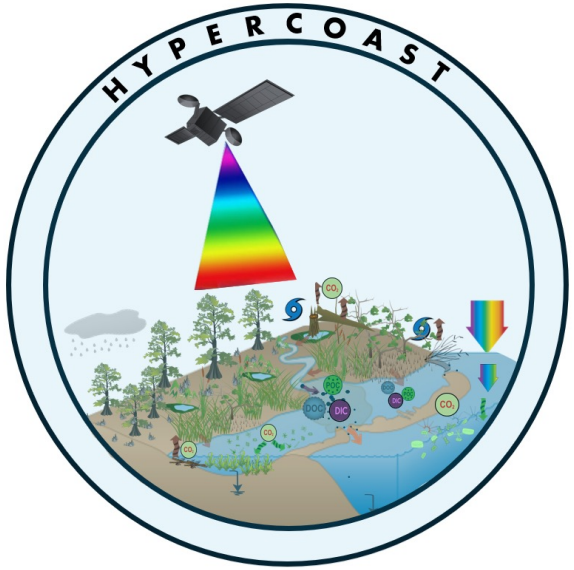
Assessing the potential impact of a changing climate on the water quality of northern Gulf of Mexico »

Application: Assessing the potential impact of a changing climate on the water quality of northern Gulf of Mexico, including advancing harmful algal bloom identification & forecasting for oyster farms in the Gulf region

Recently released the HyperCoast Data Visualization Tool:
https://hypercoast.org/

PACE Notebook:
https://hypercoast.org/examples/pace_oci_l2/

Next step: using these PACE spectra and in situ data in machine learning for characterization of water and phytoplankton types

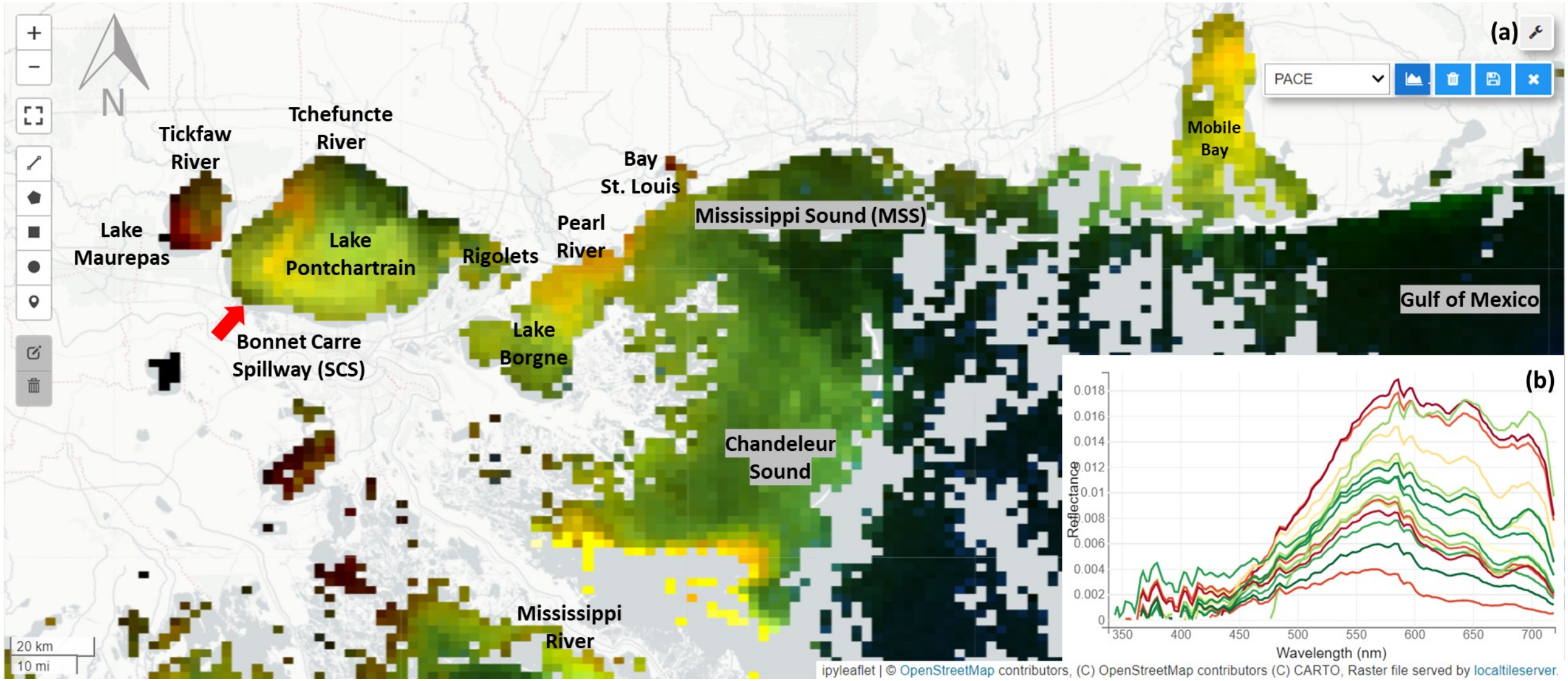


Stakeholders:

- Barataria-Terrebonne National Estuary Program (BTNEP)
- Oyster Program Manager at Louisiana Department of Wildlife and Fisheries (LDWF)
- Louisiana Department of Environmental Quality (LDEQ)
- Pontchartrain Conservancy

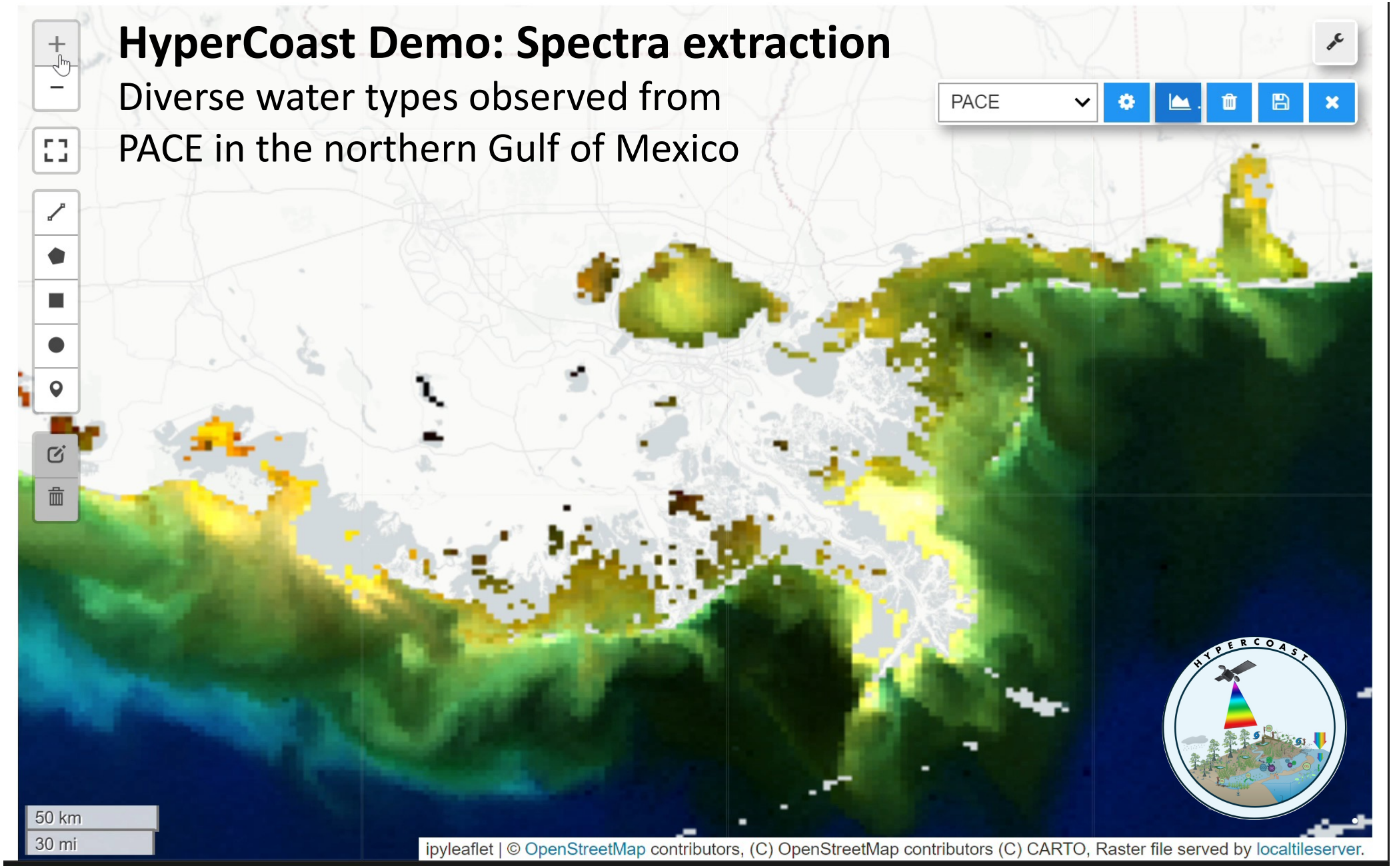
https://pace.oceansciences.org/people_ea.htm?id=68

HyperCoast: PACE's Application in Lakes and Estuaries



Diverse water types observed from PACE in the northern Gulf of Mexico

Slide contributed by Bingquing Liu



Learn more: September 5th, 1-2pm (ET) during our PACE Community of Practice Quarterly Meeting

Slide contributed by Bingquing Liu

PACE Data Access:
Roadmap for getting started

Accessing PACE Ocean Color Products

Knowledge & experience level of this presentation:

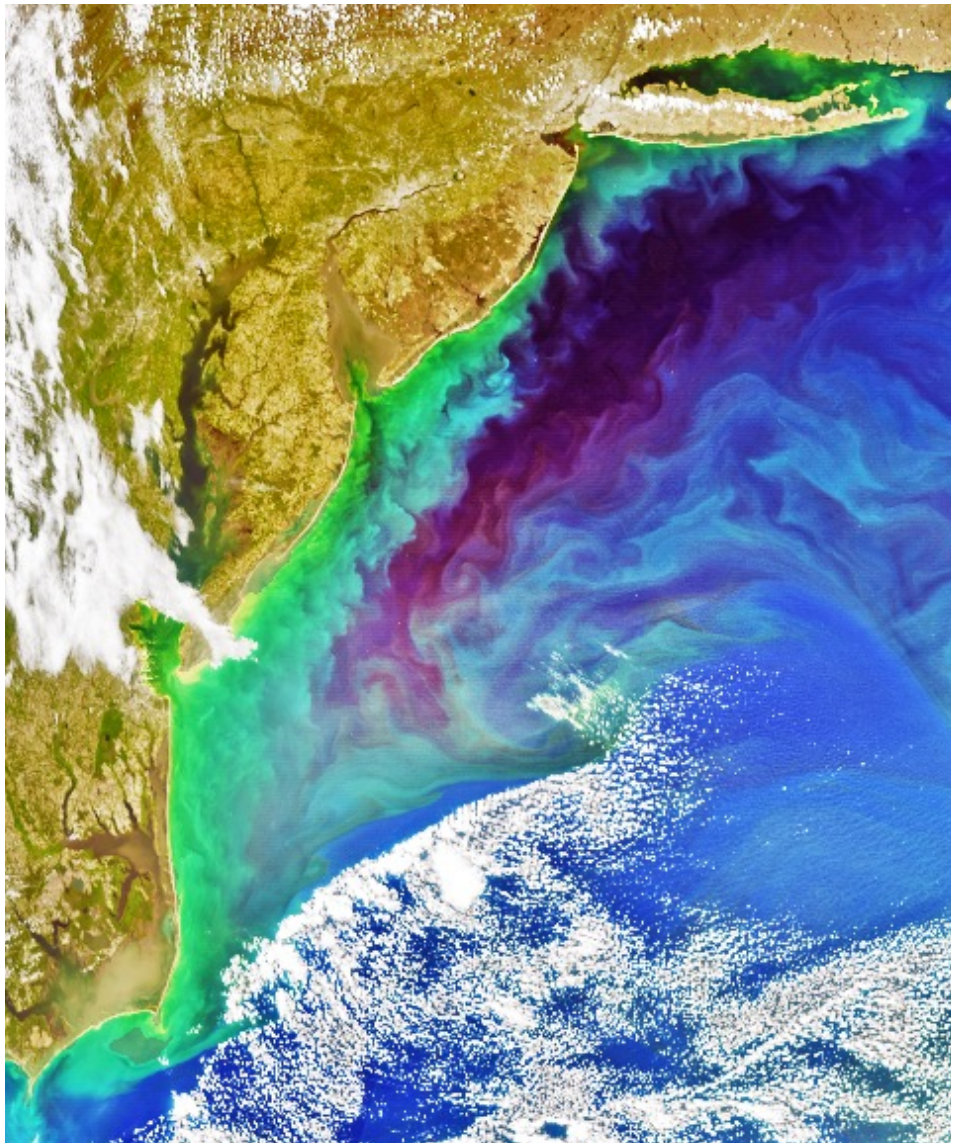
Familiar with downloading, visualizing, and interpreting ocean color satellite data products

Information is current as of July 2024

Data versions, access points, resources will evolve!

By the end of this section you will

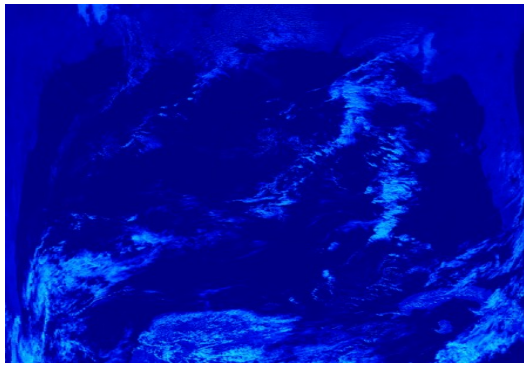
- Know which NASA tools provide access to PACE data
- Know where to find resources available to utilize PACE data (software, Python notebooks, tutorials)



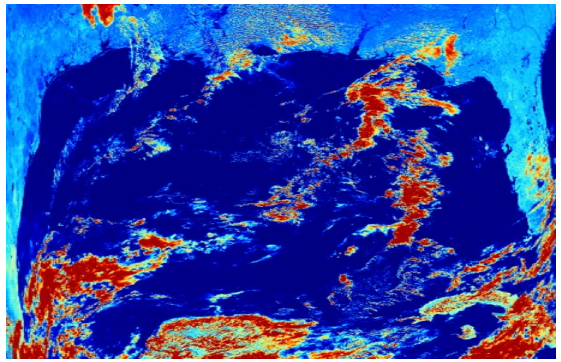
PACE enhanced RGB, US East Coast, April 26, 2024. Credit: Joseph Knuble

Definition of terms: Data Levels

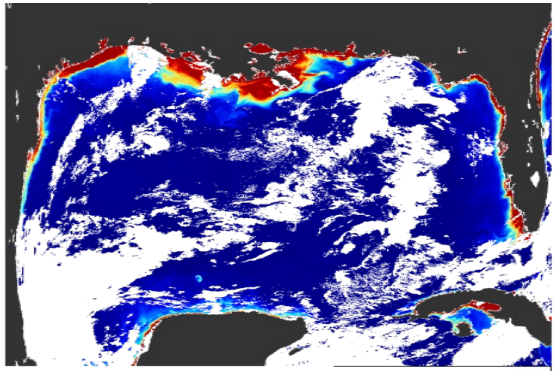
Data Level	Description	Format
Level 1A	Raw instrument data and spacecraft telemetry, reformatted to netCDF4	netCDF4
Level 1B	Calibrated & geolocated instrument data	netCDF4
Level 1C	Calibrated, geolocated, and co-registered to a common grid	netCDF4
Level 2	Derived geophysical science data products	netCDF4
Level 3	Temporally and spatially composited (binned and mapped) products	netCDF4
Level 4	Geophysical products derived from combined Level-3 inputs and/or models	netCDF4



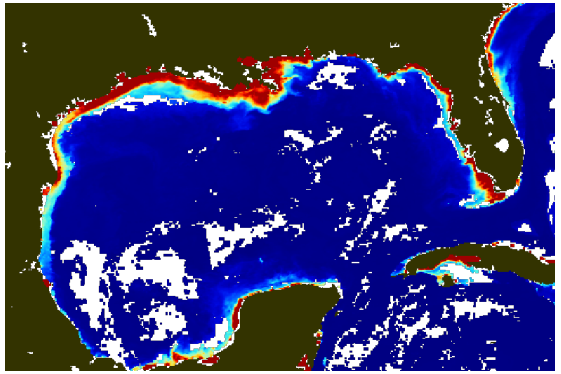
Level 1A – uncalibrated
859 nm band



Level 1B – calibrated
top-of-atmosphere radiance at 859 nm



Level 2- Remote Sensing
Reflectance at 645 nm



Level 3
mapped 4km 8-day Chlorophyll-*a*

https://www.earthdata.nasa.gov/engage/open-data-services-and-software/data-information-policy/data-levels

Definition of terms: Data Status

Data Status: Descriptor of data maturity. Diagnostic is the least & Standard is the most mature.

Data Status	Description	Maturity
Diagnostic	Products that support analysis of algorithm behavior, but are not intended for science	Least Mature
Test	Have not yet been reviewed by algorithm developers an/or may have known errors under investigation	
Provisional	Results have been reviewed and are within expectations, but have not yet been validated and may still contain significant errors	
Standard (Science Quality)	Products produced by an algorithm that has community consensus and have been validated	Most Mature

All currently available PACE data products are Diagnostic, Test, or Provisional status

Definition of Terms: Level 2 Ocean Data Product Suites

Data Product Suites: Related data products that are packaged together in one file

OC_AOP

Apparent Optical Properties

- Remote Sensing Reflectance
- Rrs uncertainty
- AOT
- Angstrom
- ~~Incident Photosynthesis Available Radiation~~
- ~~Normalized Fluorescence Line Height~~
- Apparent Visible Wavelength

OC_IOP

Inherent Optical Properties

- Spectral phytoplankton absorption coefficients
- Spectral non-algal particle plus dissolved organic matter absorption coefficients
- Spectral chromophoric dissolved organic matter absorption coefficients
- Spectral non-algal particle matter absorption
- Spectral particulate matter absorption coefficients
- Spectral slope coefficients of chromophoric dissolved organic matter absorption
- Spectral particle backscattering coefficients
- Total spectral backscattering coefficients
- Total absorption coefficients
- Backscattering Slope
- Non-algal particle matter absorption Slope
- Uncertainties (for some listed above)
- Diffuse attenuation coefficient (Kd_Lee)
- Kd_Lee uncertanties

OC_BGC

BioGeoChemistry

- Concentration Of Chlorophyll-a
- Concentration Of Particulate Organic Carbon
- ~~Concentration Of Particulate Inorganic Carbon~~
- Concentration Of Phytoplankton Carbon

OC_PAR

Photosynthetically Available Radiation

- Daily PAR scalar 0-
- Daily PAR planar 0+
- Daily PAR planar 0-
- Instantaneous PAR planar 0+
- Instantaneous PAR planar 0-

More to come:

Phytoplankton Community Composition Suite

Net Primary Production Suite

And more…

Adapted from slide by Ivona Cetinic (EGU 2024). Data products that are crossed out are planned for the data suite but not yet available.

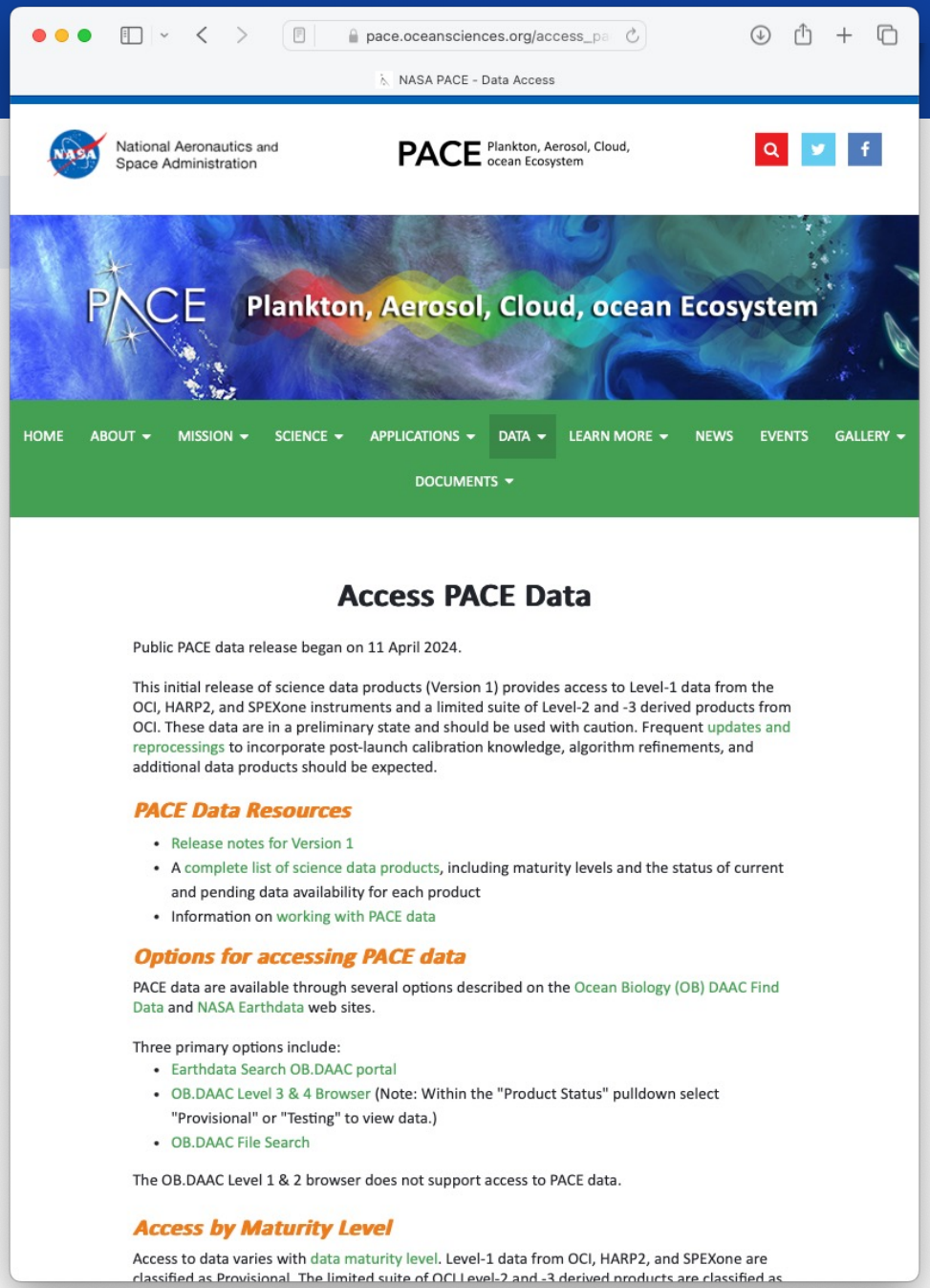
Access PACE Data: Getting Started

PACE Data Access Landing Page

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

→ *Go-to-source for current information*

→ *Bookmark this page!*



What data products are currently available?

Data Products Table Webpage: current & future data products, availability, and status.
https://pace.oceansciences.org/data_table.htm Always up-to-date → ***Bookmark this page!*** ←

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

Access PACE Data: Getting started

I am accustomed to getting ocean color data from OB.DAAC (Ocean Biology Distributed Active Archive Center) via the Level 1,2 and Level 3,4 browsers on the Ocean Color Website.
Is accessing PACE data different?

Yes!

- Access varies with data level & data status (data maturity).
  For example:
  - Provisional Level-1 &2 data available through Earthdata Search
  - Provisional, Test, and Diagnostic data available from the OB.DAAC File Search and the OB.DAAC Level 3 & 4 Browser

Data Status	Maturity
Diagnostic	Least Mature
Test	
Provisional	
Standard (Science Quality)	Most Mature

What is available today?

- **Level 1 Provisional** data from **OCI, HARP2**, and **SPEXone**
- Limited suite of **OCI Level 2 & Level 3** derived products
- ***Version 2 release*****.** Preliminary data, use with caution.
  Frequent updates & reprocessing should be expected.

Access PACE Data: Where to find data products

NASA Worldview

Visualization. Quickly outputs images & videos.

Currently OCI Level 2, Chl-a & True Color

https://worldview.nasa.gov

NASA Earthdata

*Comprehensive: data from *all* NASA Distributed Active Archive Centers (DAACs). Cloud-based.*

Level 1 & 2, Provisional: OCI, SPEXone, HARP2 data

https://earthdata.nasa.gov

NASA OB.DAAC (Ocean Biology DAAC) Website

"File Search" & "Level 3 & 4 Browser" Search Tools

- Provisional, Test, and Diagnostic data
- Level/maturity available varies by instrument/product

https://oceancolor.gsfc.nasa.gov

Access PACE Data

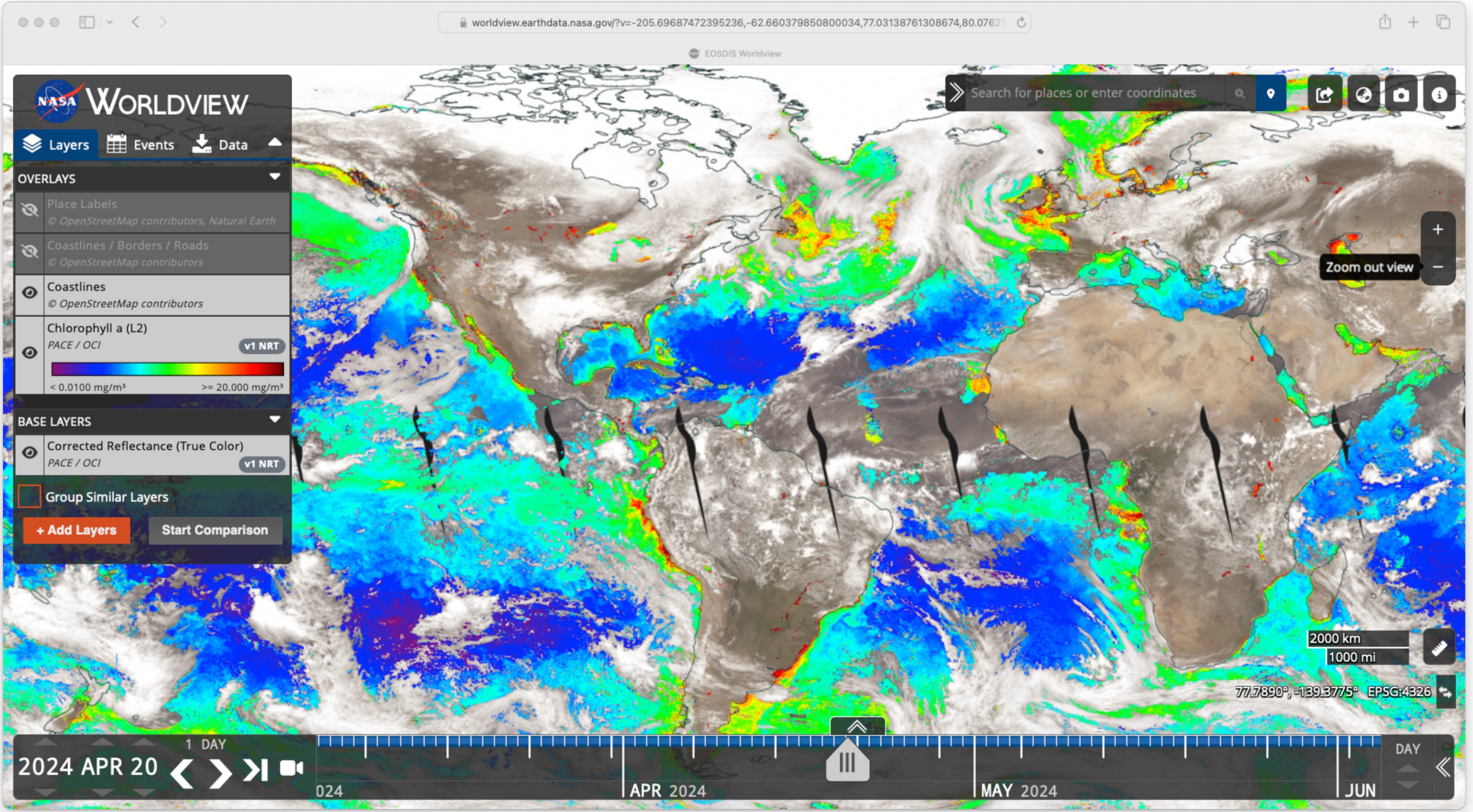
1.

NASA Worldview

Visualization. Quickly outputs images & videos.

Currently OCI Level 2, Chl-a & True Color

https://worldview.nasa.gov


worldview.earthdata.nasa.gov/?v=-205.69687472395236,-62.660379850800034,77.03138761308674,80.07621
EOSDIS Worldview
NASA WORLDVIEW
Layers
Events
Data
OVERLAYS
Place Labels
© OpenStreetMap contributors, Natural Earth
Coastlines / Borders / Roads
© OpenStreetMap contributors
Coastlines
© OpenStreetMap contributors
Chlorophyll a (L2)
PACE / OCI
v1 NRT
< 0.0100 mg/m³
>= 20.000 mg/m³
BASE LAYERS
Corrected Reflectance (True Color)
PACE / OCI
v1 NRT
Group Similar Layers
+ Add Layers
Start Comparison
Search for places or enter coordinates
Zoom out view
2000 km
1000 mi
77.7890°, -139.3775° EPSG:4326
1 DAY
2024 APR 20
024
APR 2024
MAY 2024
JUN
DAY

Access PACE Data

NASA Worldview

Visualization. Quickly outputs images & videos.

Currently OCI Level 2, Chl-a & True Color

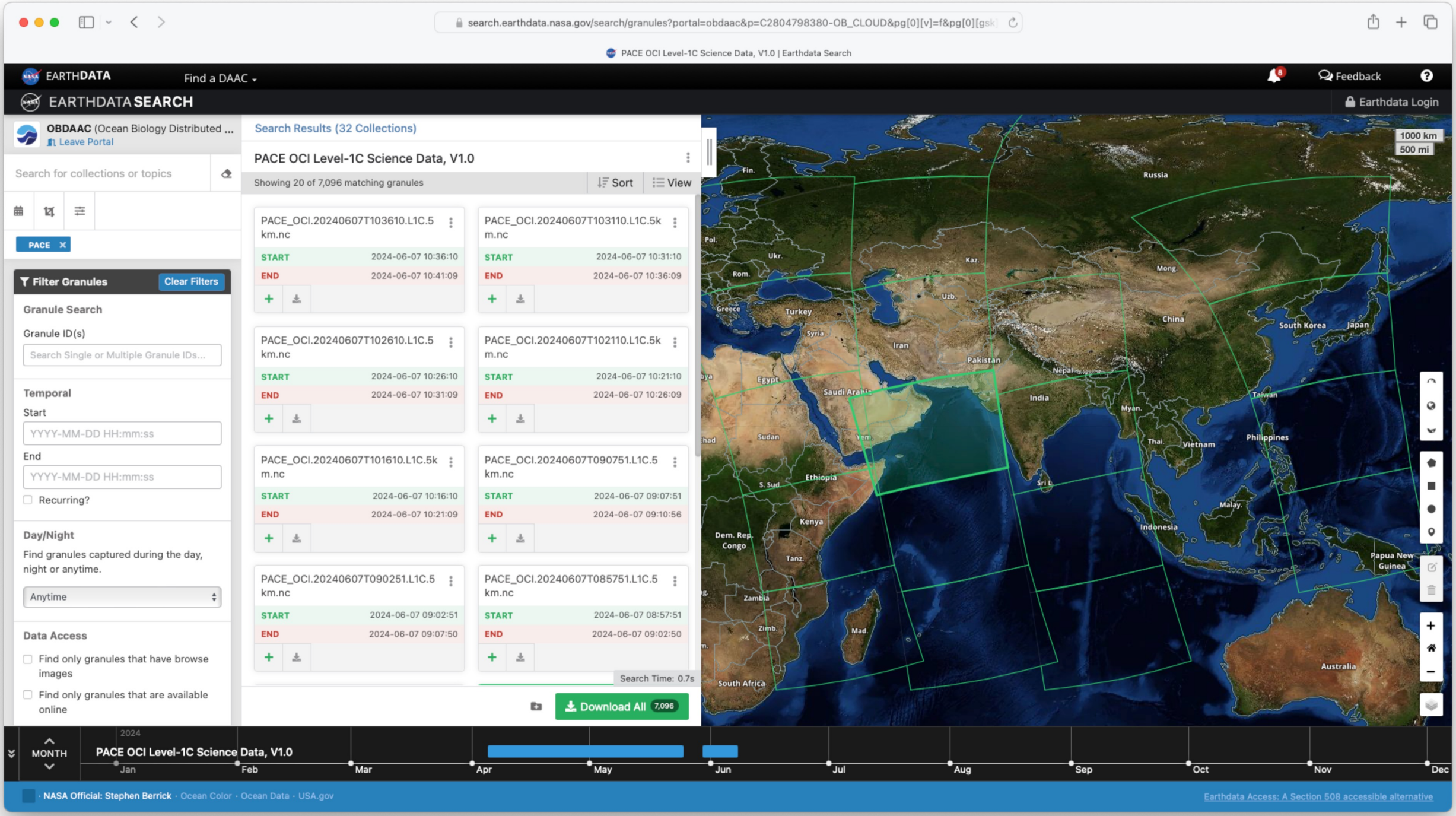
https://worldview.nasa.gov

NASA Earthdata

*Comprehensive: data from *all* NASA Distributed Active Archive Centers (DAACs). Cloud-based.*

Level 1 & 2, Provisional: OCI, SPEXone, HARP2 data

https://earthdata.nasa.gov


search.earthdata.nasa.gov/search/granules?portal=obdaac&p=C2804798380-OB_CLOUD&pg[0][v]=f&pg[0][gsk
PACE OCI Level-1C Science Data, V1.0 | Earthdata Search
EARTHDATA
Find a DAAC
Feedback
EARTHDATA SEARCH
Earthdata Login
OBDAAC (Ocean Biology Distributed ...
Leave Portal
Search for collections or topics
PACE
Filter Granules
Clear Filters
Granule Search
Granule ID(s)
Search Single or Multiple Granule IDs...
Temporal
Start
YYYY-MM-DD HH:mm:ss
End
YYYY-MM-DD HH:mm:ss
Recurring?
Day/Night
Find granules captured during the day, night or anytime.
Anytime
Data Access
Find only granules that have browse images
Find only granules that are available online
Search Results (32 Collections)
PACE OCI Level-1C Science Data, V1.0
Showing 20 of 7,096 matching granules
Sort
View
PACE_OCI.20240607T103610.L1C.5km.nc
START 2024-06-07 10:36:10
END 2024-06-07 10:41:09
PACE_OCI.20240607T103110.L1C.5km.nc
START 2024-06-07 10:31:10
END 2024-06-07 10:36:09
PACE_OCI.20240607T102610.L1C.5km.nc
START 2024-06-07 10:26:10
END 2024-06-07 10:31:09
PACE_OCI.20240607T102110.L1C.5km.nc
START 2024-06-07 10:21:10
END 2024-06-07 10:26:09
PACE_OCI.20240607T101610.L1C.5km.nc
START 2024-06-07 10:16:10
END 2024-06-07 10:21:09
PACE_OCI.20240607T090751.L1C.5km.nc
START 2024-06-07 09:07:51
END 2024-06-07 09:10:56
PACE_OCI.20240607T090251.L1C.5km.nc
START 2024-06-07 09:02:51
END 2024-06-07 09:07:50
PACE_OCI.20240607T085751.L1C.5km.nc
START 2024-06-07 08:57:51
END 2024-06-07 09:02:50
Search Time: 0.7s
Download All 7,096
1000 km
500 mi
Russia
China
India
Japan
South Korea
Taiwan
Philippines
Indonesia
Australia
Papua New Guinea
Kazakhstan
Mongolia
Pakistan
Iran
Saudi Arabia
Egypt
Sudan
Ethiopia
Kenya
Dem. Rep. Congo
Tanzania
Zambia
Zimbabwe
Madagascar
South Africa
Turkey
Greece
Ukraine
Poland
Finland
Uzbekistan
Syria
Nepal
Myanmar
Thailand
Vietnam
Malaysia
Sri Lanka
MONTH
2024
PACE OCI Level-1C Science Data, V1.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
NASA Official: Stephen Berrick · Ocean Color · Ocean Data · USA.gov
Earthdata Access: A Section 508 accessible alternative

Access PACE Data: NASA Earthdata

ALL downloads require an Earthdata account

Register:

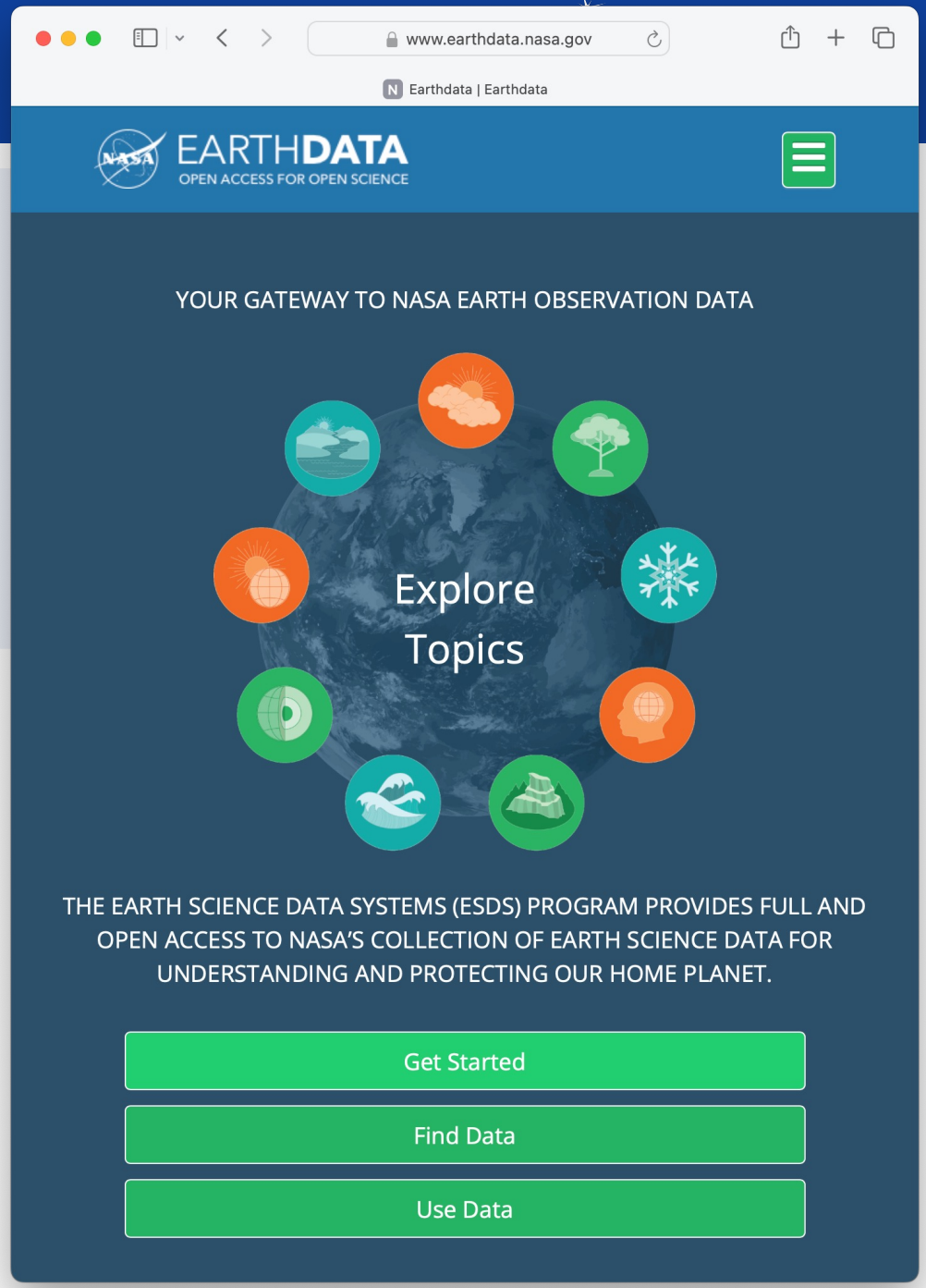
https://www.earthdata.nasa.gov/eosdis/science-system-description/eosdis-components/earthdata-login

Getting started with Earthdata:

https://www.earthdata.nasa.gov/learn/get-started

Recent PACE OB.DAAC Tutorial, includes Earthdata (& OB.DAAC) data search details:

https://www.earthdata.nasa.gov/learn/webinars-and-tutorials/pace-mission-products-data-discovery-webinar



Access PACE Data

NASA Worldview

Visualization. Quickly outputs images & videos.

Currently OCI Level 2, Chl-a & True Color

https://worldview.nasa.gov

NASA Earthdata

*Comprehensive: data from *all* NASA Distributed Active Archive Centers (DAACs). Cloud-based.*

Level 1 & 2, Provisional: OCI, SPEXone, HARP2 data

https://earthdata.nasa.gov

NASA OB.DAAC (Ocean Biology DAAC) Website

"File Search" & "Level 3 & 4 Browser" Search Tools

- Provisional, Test, and Diagnostic data
- Level/maturity available varies by instrument/product

https://oceancolor.gsfc.nasa.gov

Access PACE Data: NASA OB.DAAC Tools

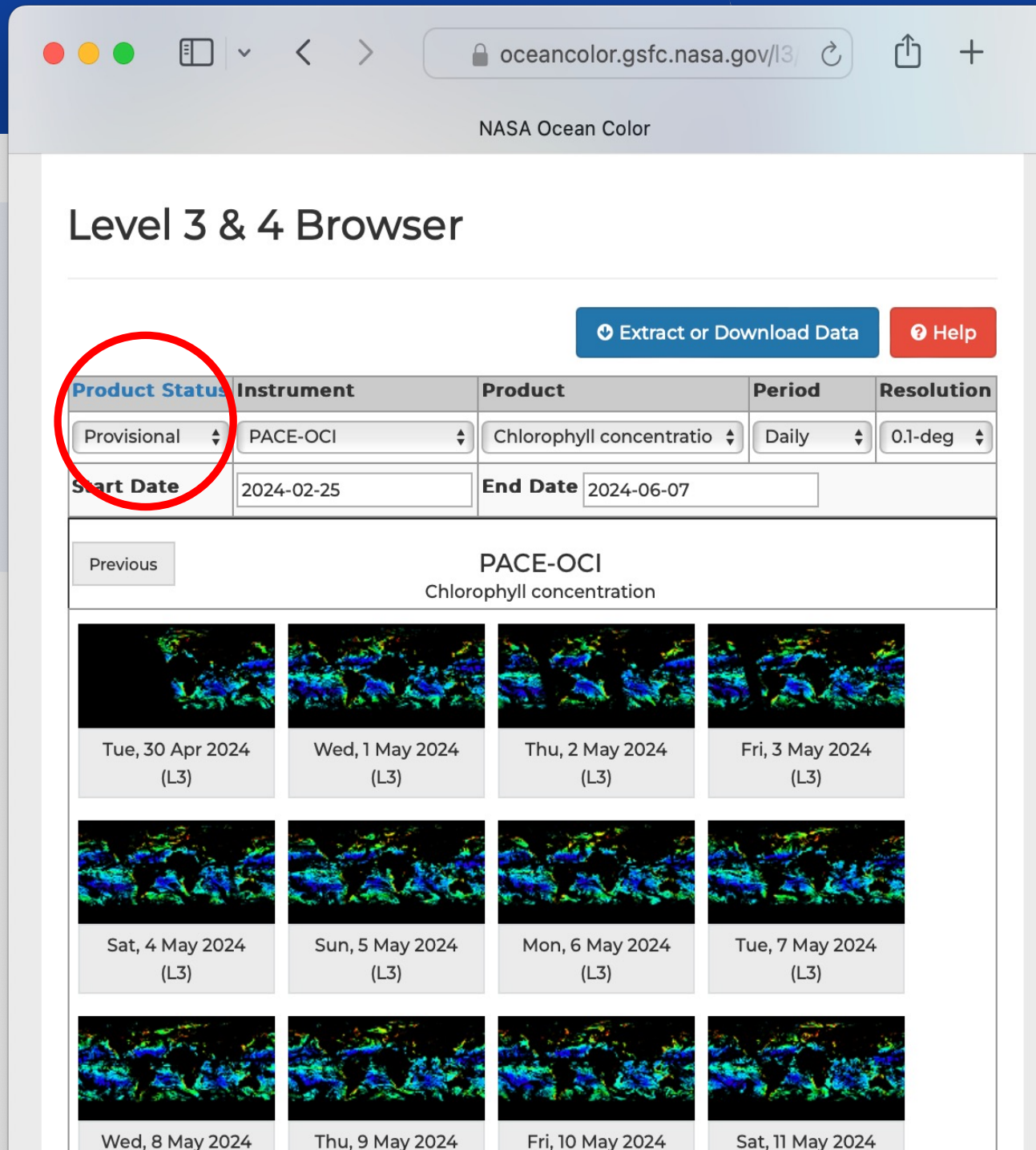
Level 3 & 4 Browser

https://oceancolor.gsfc.nasa.gov/l3/

Visualize, extract, and download select Level 3 PACE data products

User Note:

- (1) First, in the “Product Status” menu, select “Provisional” or ”Test”; (2) *then* select PACE instrument options in the ”Instrument” menu; and (3) select your product, period & resolution
- Includes useful help feature (red button to right)
- *Downloads require NASA Earthdata account https://urs.earthdata.nasa.gov*



Access PACE Data: NASA OB.DAAC Tools

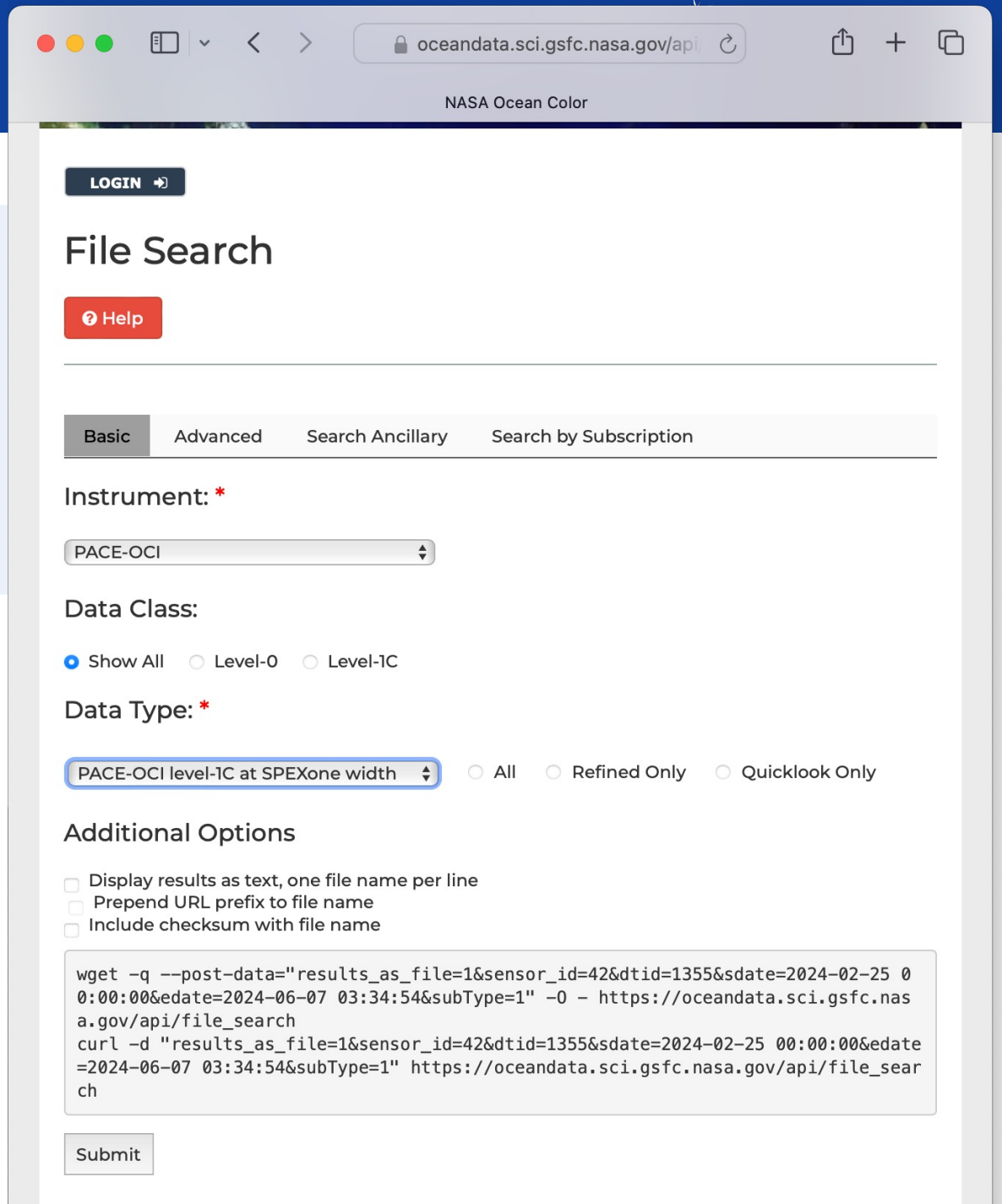
File Search

https://oceandata.sci.gsfc.nasa.gov/api/file_search

Search currently available Provisional, Diagnostic, and Test data

User Notes:

- Has a useful help feature (red button on left) that details useful search features, e.g. wget & curl text generation for data of interest, advanced search, etc.
- *Downloads require NASA Earthdata account https://urs.earthdata.nasa.gov*



Resources to work with PACE Data: Python

PACE Jupyter Notebook Tutorials

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

Learn with OCI Tutorial Notebooks

- Data Access
- File Structure at Three Processing Levels
- OCSSW: Installing & Running Command-line Tools
- OCSSW: Processing with Command-line Tools
- (also Learn with HARP2: Data Visualization)
- More to come…

Resources to work with PACE Data: Cloud, Github

NASA Cloud Support

earthaccess, a Python API to search for and download or stream data from the Earthdata cloud.

- **Information:** https://earthaccess.readthedocs.io/en/latest/
- **Download:** https://github.com/nsidc/earthaccess

NASA Openscapes Earthdata Cloud Cookbook

- **Vital resource to understanding Earthdata & the Cloud**

  https://nasa-openscapes.github.io/earthdata-cloud-cookbook/

Github

nasa-pace

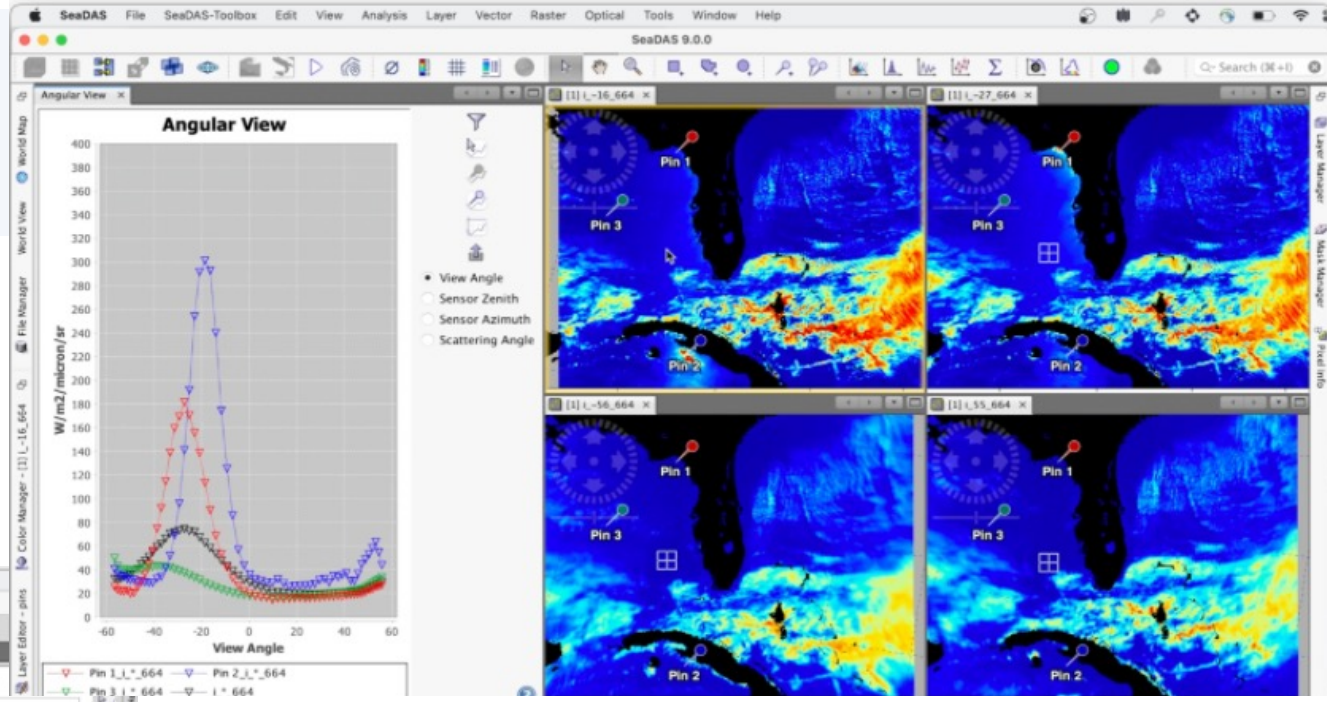
Want to share your PACE-relevant code on Github repository with the Community? Tag it with "nasa-pace"

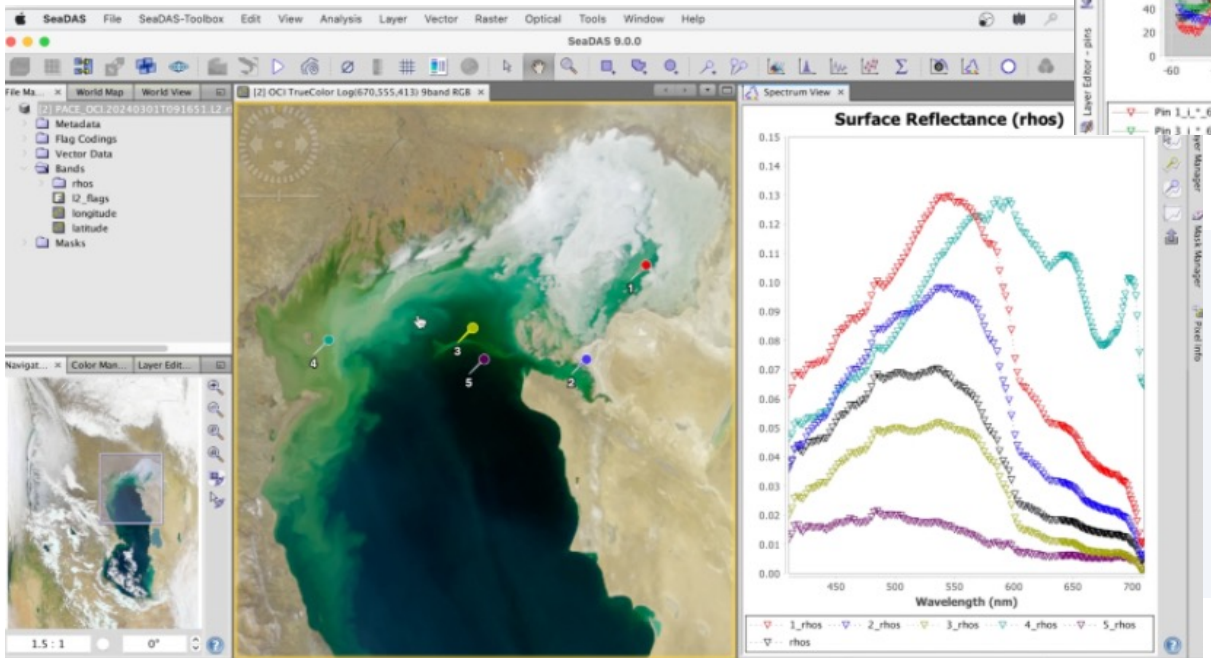
Resources to work with PACE Data: SeaDAS

NASA/OB.DAAC Data Analysis and Visualization Software

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

- Newest version: 9.0.1, May 2024
- Version 9.x supports PACE data
- Operating Systems: Mac, Linux, Windows
- *Exports to formats including **GeoTIFF** (readable by GIS), **KML** (readable by Google Earth) **& others***





Tutorial Video on SeaDAS 9.0

includes OCI hyperspectral (left) and polarimeter (above) data examples

https://www.youtube.com/watch?v=GZG2saE9ecc

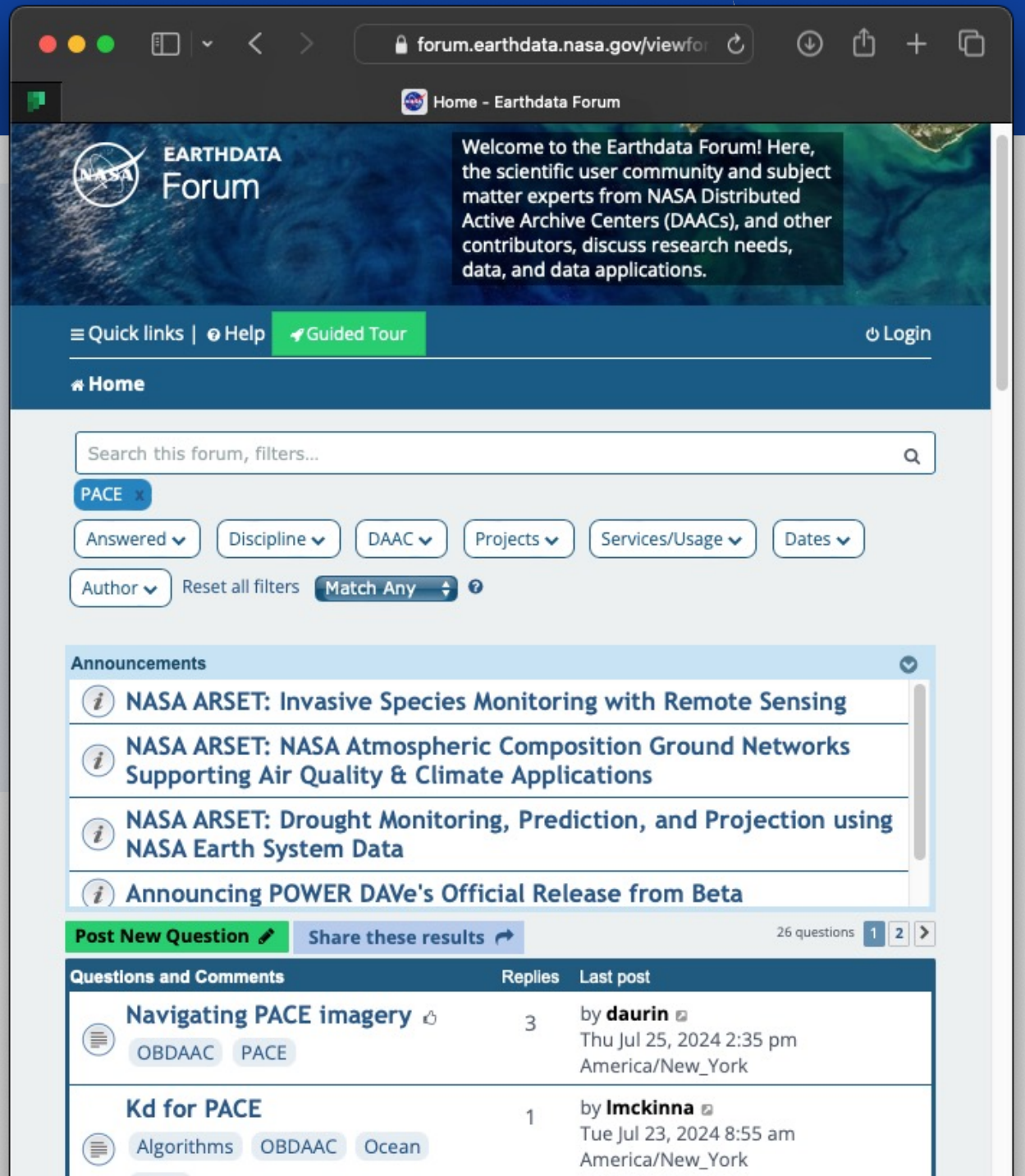
Resources: Questions

Data Questions:

Earthdata Forum

https://forum.earthdata.nasa.gov
(all EO missions)

https://forum.earthdata.nasa.gov/viewforum.php?f=7&&Projects=102
(links to PACE-tagged questions)



Resources: NASA Applied Remote Sensing Training (ARSET)

https://appliedsciences.nasa.gov/arset

Cost-free training on the use of Earth Observations for decision making

- Our trainings are:
  - Online and in-person
  - Live and instructor-led, or self-guided
  - Provided at no cost, with materials and recordings available from our website
  - Often **multi-lingual**
  - Range in level from **introductory** to **advanced**

PACE-Relevant Trainings

- Water quality (WQ) monitoring
- How to use SeaDAS software for WQ
- Remote sensing of coastal ecosystem
- Using hyperspectral data
- Air quality monitoring and modeling

Online Resource Guide listing all ARSET trainings

Coming Late 2024 – "Introduction to Hyperspectral (PACE) Data for Water Quality Monitoring"

Disasters | Agriculture | Land | Water Resources | Climate | Health & Air Quality

PACE Data Resources: Summary of links from Webinar

- *How do I prepare to work w/PACE data?* https://pace.oceansciences.org/work_with_pace_data.htm
- *Release notes for version 2?* *Version 2, Release notes:* https://oceancolor.gsfc.nasa.gov/data/reprocessing/v1/pace/
- *Which data products are available?* https://pace.oceansciences.org/data_table.htm
- *How do I access PACE Data?* https://pace.oceansciences.org/access_pace_data.htm
- *Where to register an Earthdata account?* To download data, register at https://urs.earthdata.nasa.gov
- *Where do I ask PACE questions?* https://forum.earthdata.nasa.gov/viewforum.php?f=7&&Projects=102 *(links to PACE-tagged questions)*

Which NASA tools provide access to PACE data?

- Earthdata portal (this link is only PACE instruments) https://search.earthdata.nasa.gov/search?portal=obdaac&fps0=PACE ***(links only to PACE data)***
- OB.DAAC Search https://oceandata.sci.gsfc.nasa.gov/api/file_search/
- OB.DAAC Level 3 & 4 Browser https://oceancolor.gsfc.nasa.gov/l3/
- Worldview Click here for PACE in Worldview (***only OCI Chlorophyll-a & True Color products at this time***)

What software and Python resources are available for using PACE data?

- Jupyter Notebook Tutorials https://oceancolor.gsfc.nasa.gov/resources/docs/tutorials/
- SeaDAS 9.0.1, NASA-developed software https://seadas.gsfc.nasa.gov
  - SeaDAS 9 Tutorial Video https://www.youtube.com/watch?v=GZG2saE9ecc

Stay updated!! Join the PACE Community of Practice https://forms.gle/cAe4cSLGt3GhmmPc6

Wrap Up: Upcoming PACE Events

***Updates for below via PACE-community email list, PACE website**

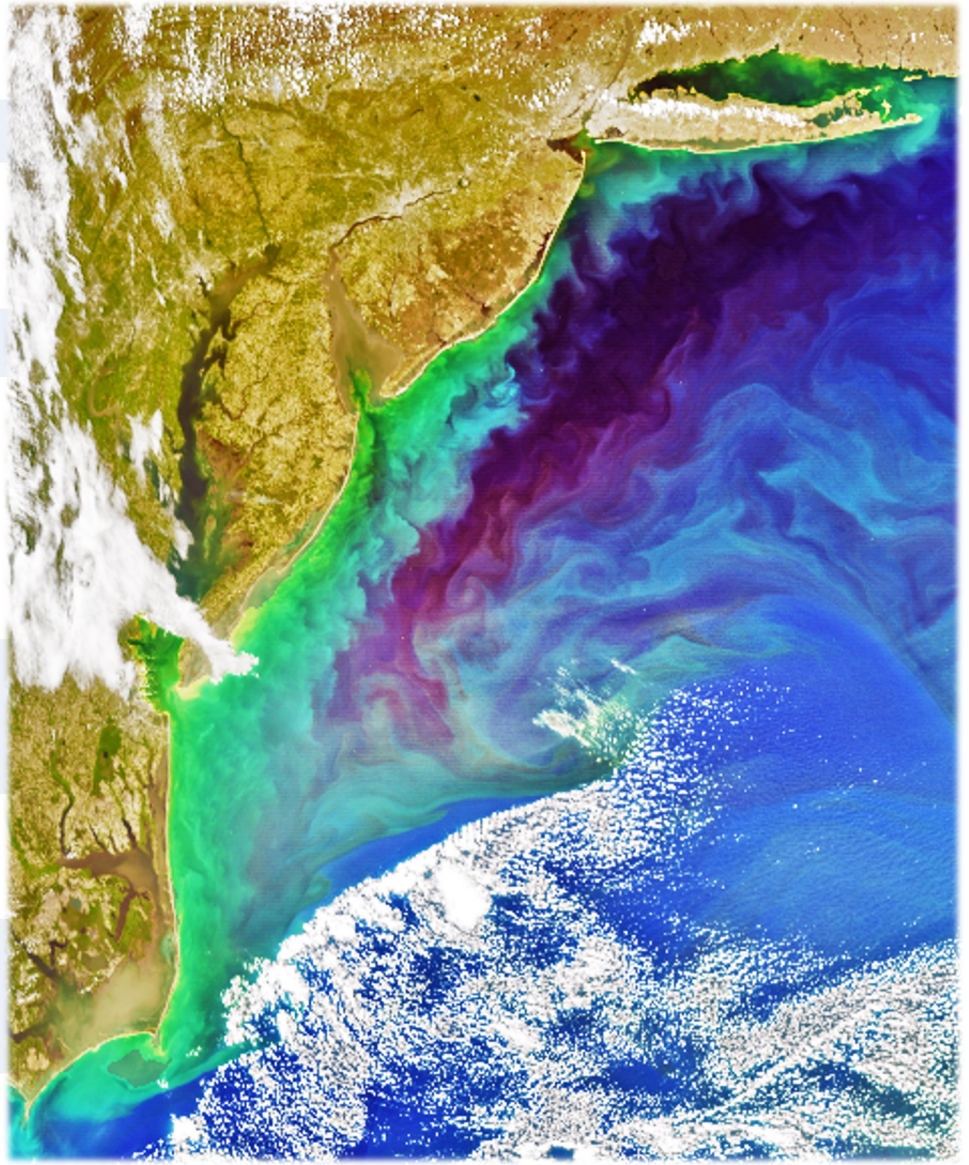
- **August 4-8th: Hackweek: a social coding event**
  - *Recordings and coding material posted online afterward*

- **Sept. 5, 1-2pm ET: PACE Comm. of Practice Quarterly Meeting**
  - *Bingqing Liu, Asst. Professor, U of Louisiana*
  - *Topic: Hypercoast, open source PACE data visualization tool & advancing HAB monitoring for oyster farms in LA Gulf region*

- **October 2024** (Date TBD soon): **ARSET Introduction to (PACE) Hyperspectral Observations for Water Quality Monitoring**
  - Online course from NASA ARSET, registration opens in coming weeks.

- **December 8th 2024: 4th Annual PACE Applications Workshop Washington DC, 9am-5pm, free, in person**
  - *Cross-disciplinary. Sunday before the AGU Fall Meeting.*

******Going to AGU? In the area? JOIN US!!!***



PACE Enhanced RGB, US East Coast, April 26, 2024 Credit: Joseph Knuble

- Next generation of ocean color science and applications is here with PACE
- On ramp to future hyperspectral missions, e.g. NOAA GeoXO, NASA GLIMR & SBG

https://pace.gsfc.nasa.gov

Follow us: @NASAOcean

Speaker email:
morgaine.mckibben@nasa.gov

Stay up-to-date with all things PACE:

- PACE-community email list
- PACE Website https://pace.gsfc.nasa.gov
  - Data Access & Data Product Table webpages
  - News & Events Sections

Image Description: PACE OCI true color image of the South African Coast, March 9, 2024