

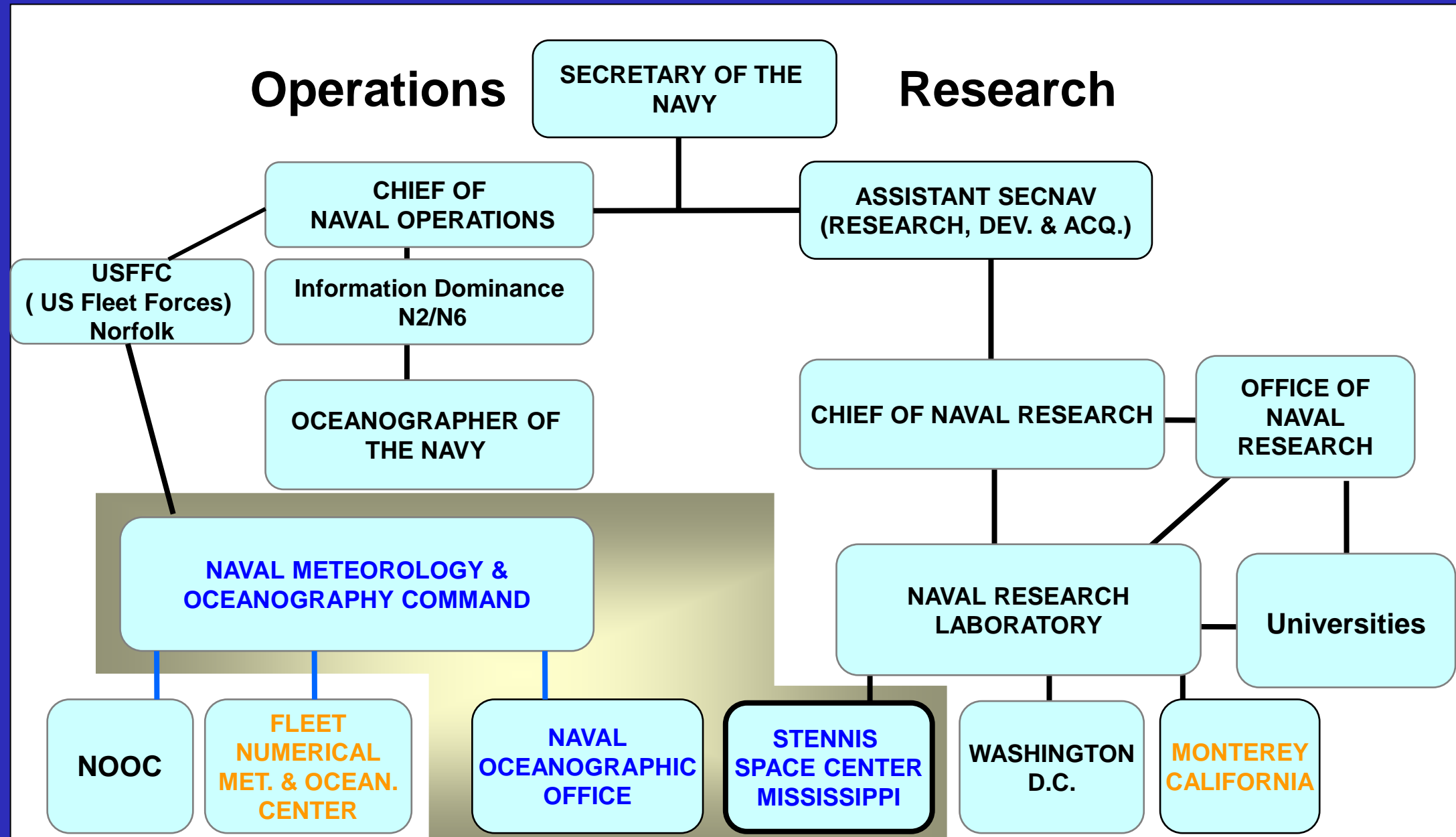


Naval Research Laboratory Ocean Sciences Division 2022

Richard Crout, PhD
Ocean Sensing and Processes Branch
Naval Research Laboratory - South
8 March 2022

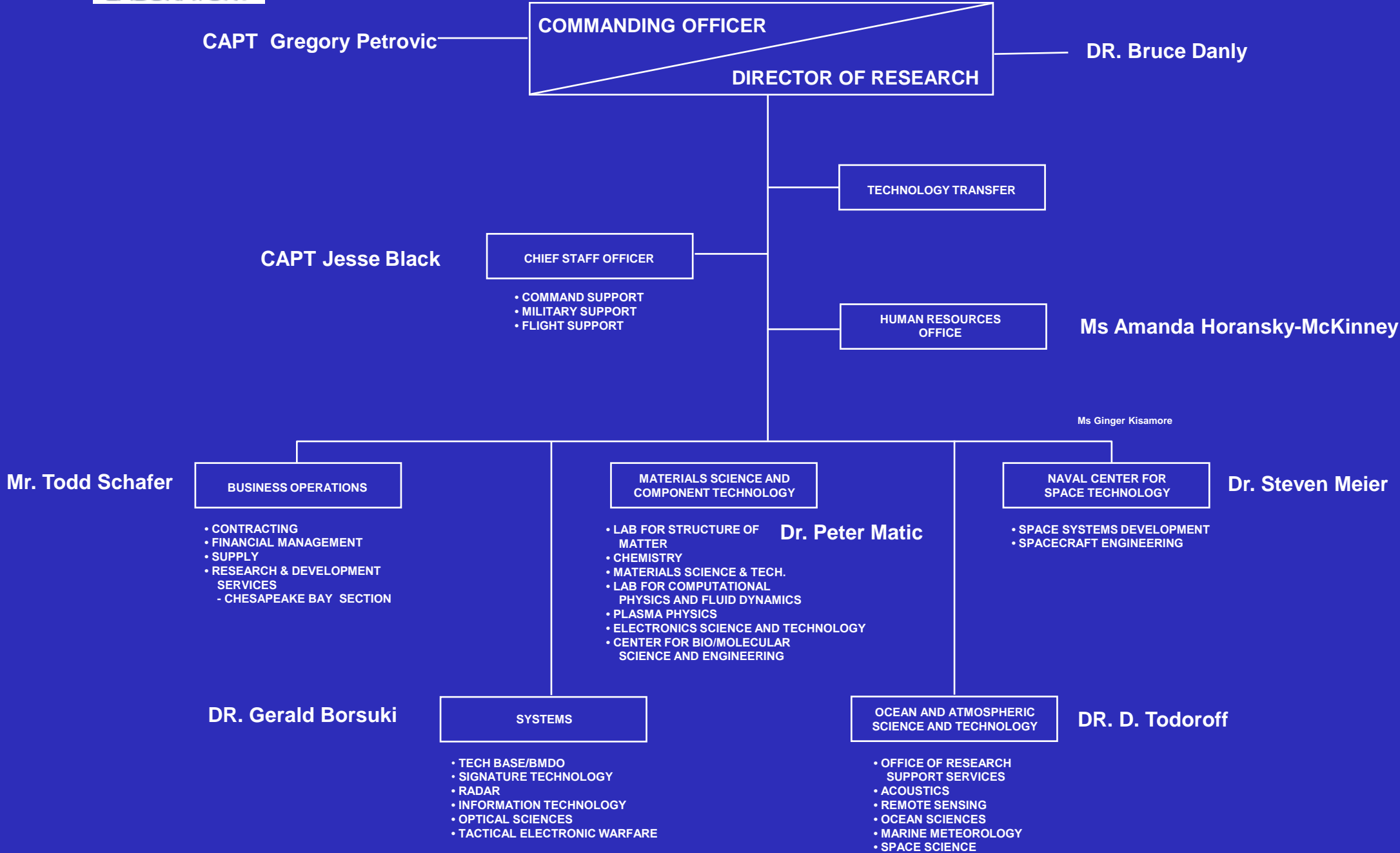
Organization

Collocated Research & Operational Centers



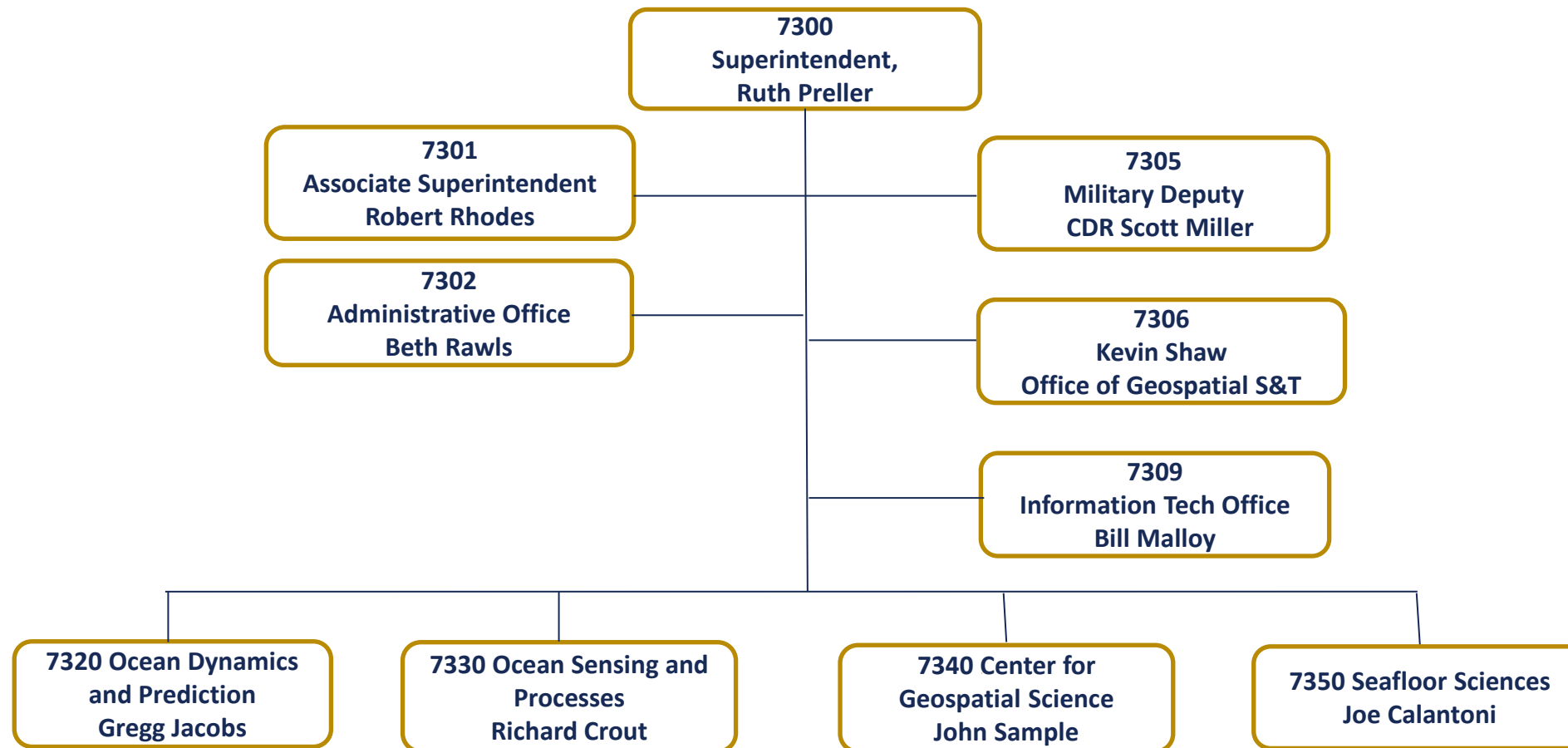


NRL FUNCTIONAL ORGANIZATION



Ocean Sciences Division

Code 7300



Ocean Sciences Division Code 7300

Established 7 July 2019 from the
Oceanography and Marine Geoscience
Divisions

- 175 FTE Government Employees
- 19 Students
- 2 Military
- ~57 contractors (13 Post-Docs)



Acoustic Simulation, Measurements and Tactics Branch Code 7180

- 7 Government Employees

Support Services Code 7030, Legal, Security and Contracts

- 18 Government Employees

How is NRL different from other Navy and Federal entities?

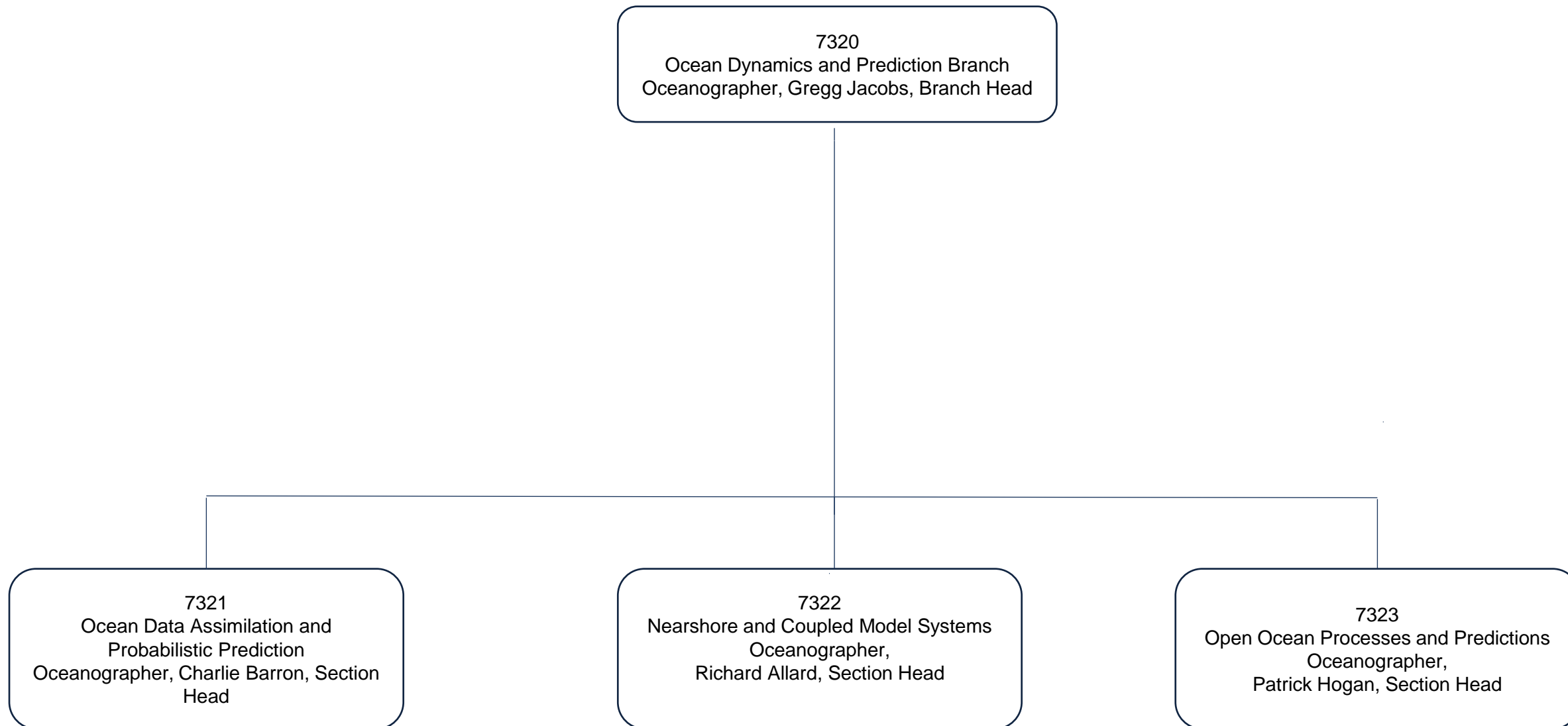
NRL is a Working Capital Fund Organization.

NRL is NOT block funded like NAVO, or NASA, or NOAA.

Some ONR funding set aside to fund specific 6.1 and 6.2 focus areas (ex. Battlespace Env, USW)

Individual Principal Investigators (PIs) compete for these and outside funds (other Navy, NOAA, NASA, DARPA, SERDP, BOEM, etc.)

Ocean Dynamics and Prediction Branch 7320



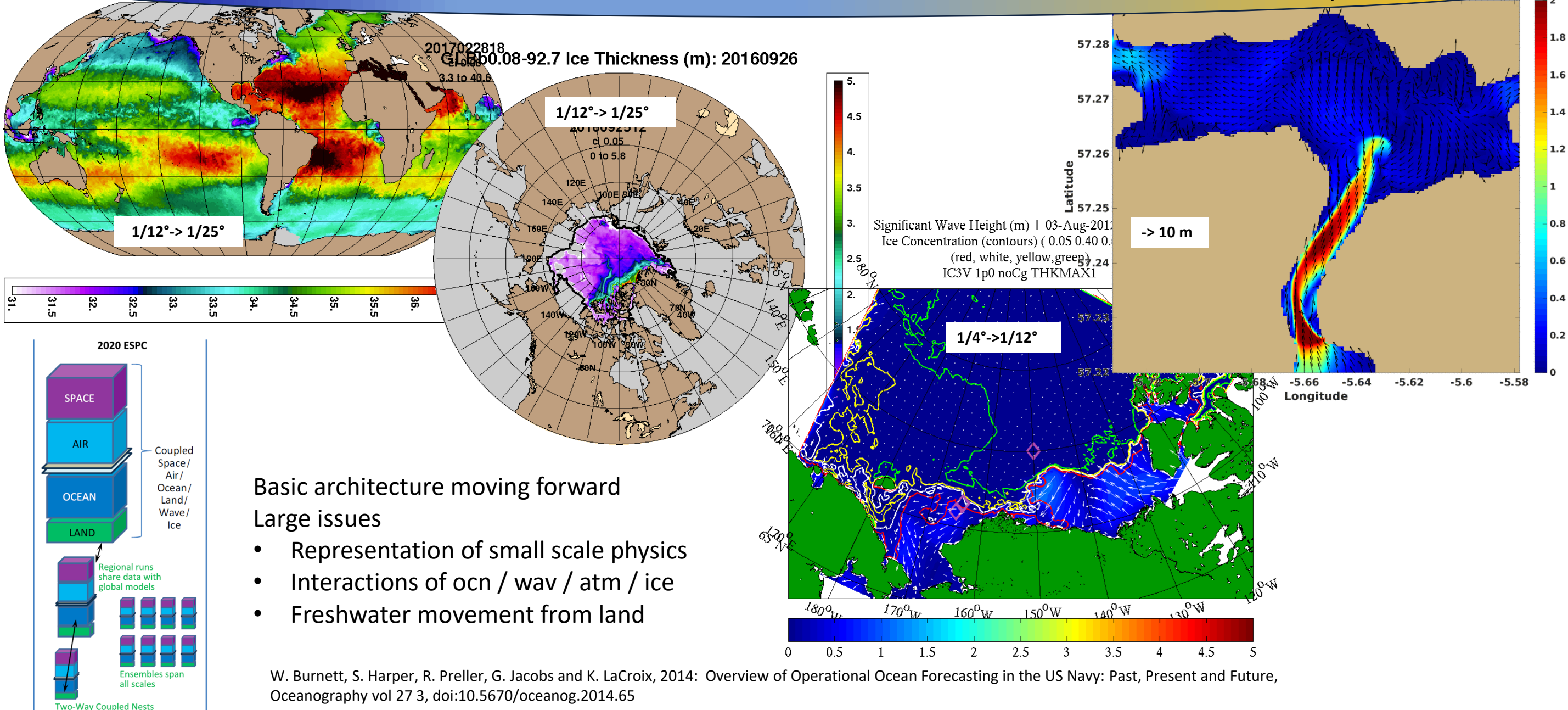
Scope of ocean forecasting

Circulation

Ice

Waves

Bays



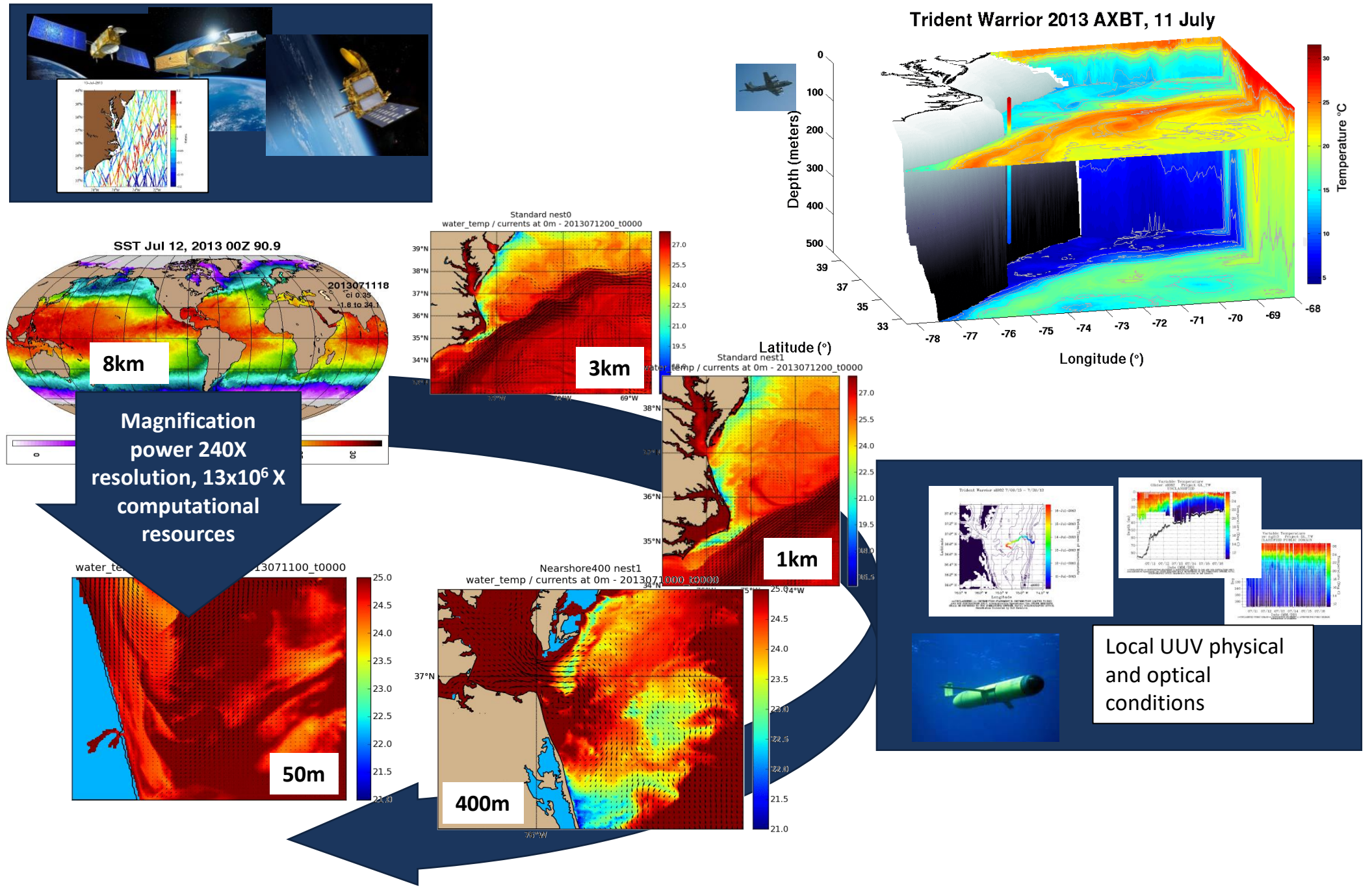
Ocean forecasting encompasses models, observations, and assimilation

Models represent the physics and are required for predictions into the future

Observations provide information to correct feature positions in models

Assimilation is the process of correcting the models

All these must coordinate across scales from global to nearshore



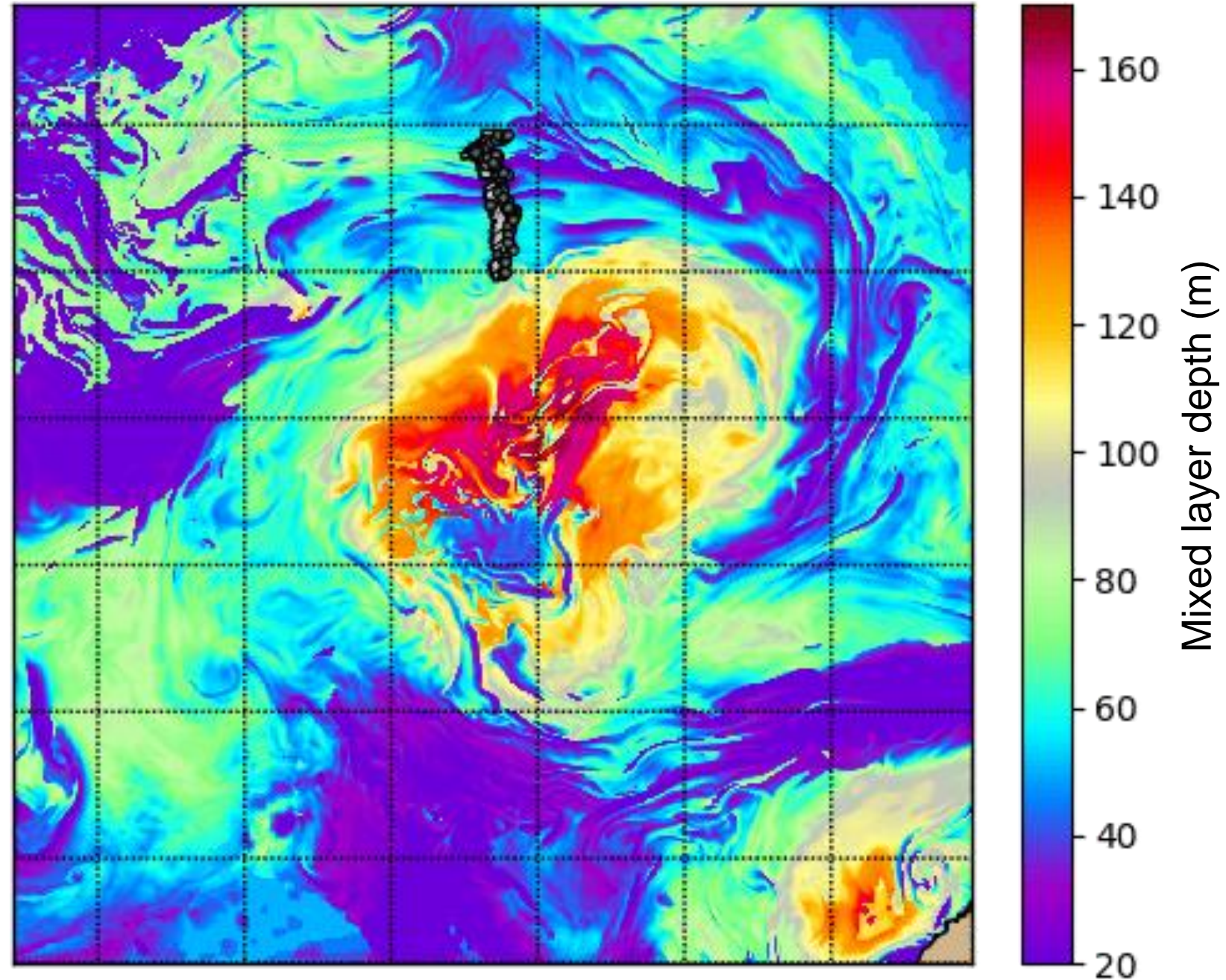
Forecasting our local waters

Drifters - 2020012400

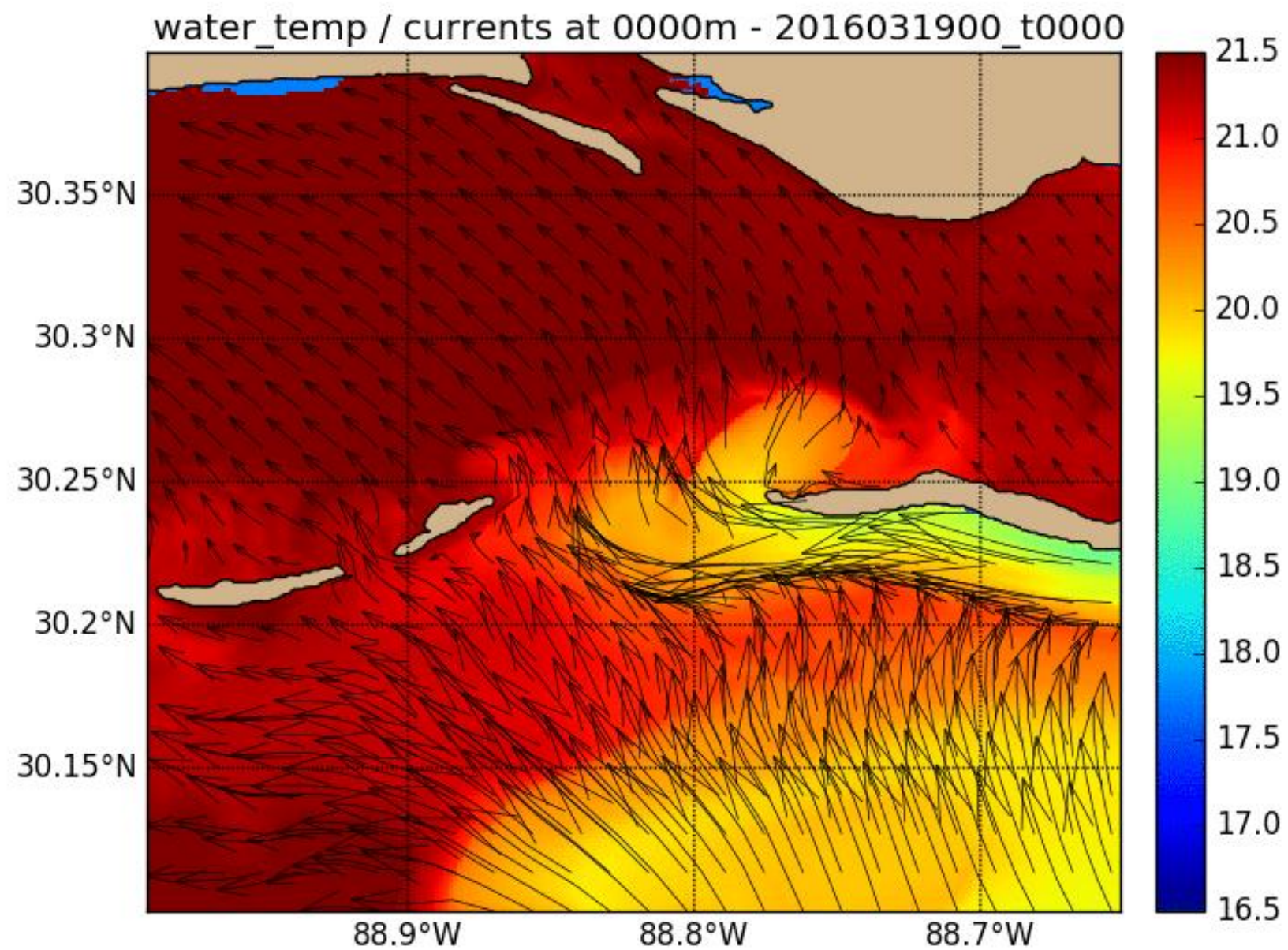
Ocean of Things
deployment

January 24, 2020

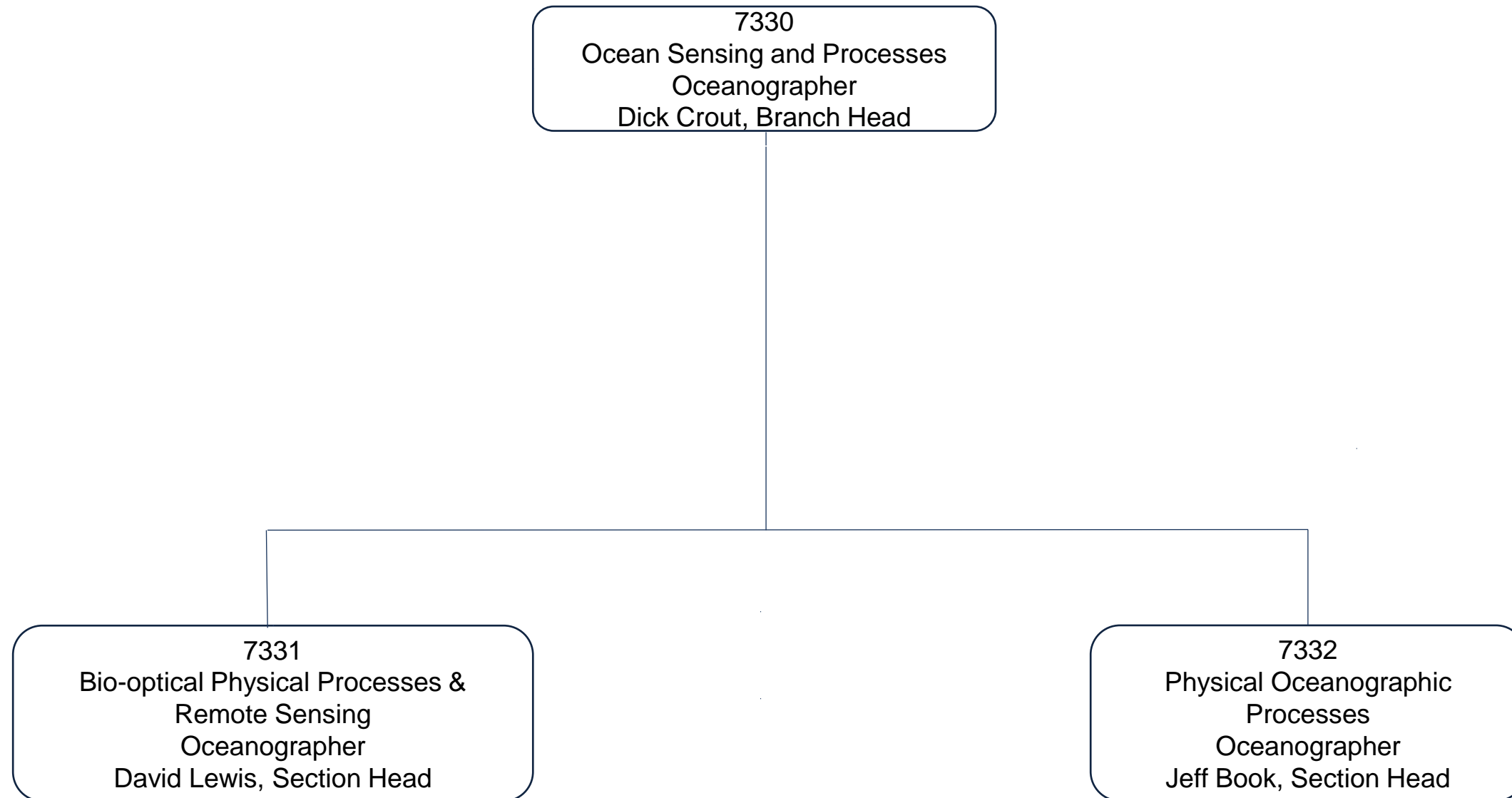
Color – Mixed Layer Depth



Forecasting our local waters



Ocean Sensing and Processes Branch 7330



Ocean Sensing and Processes Branch (7330) Organization

Bio-optics and Physical Processes and Remote Sensing Section (7331)

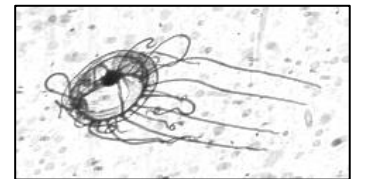
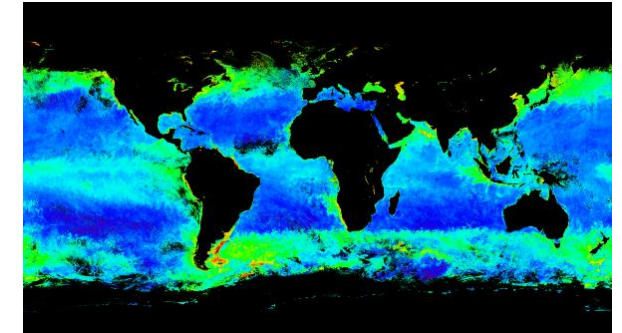
Calibration/validation of satellite ocean color imagery

Automated Processing System for satellite imagery

Bioluminescence Potential

Bio-Optical-Physical Modeling

Turbulence Ocean, Shipboard Profiling, and Airborne LIDAR



Physical Oceanography Processes Section (7332)

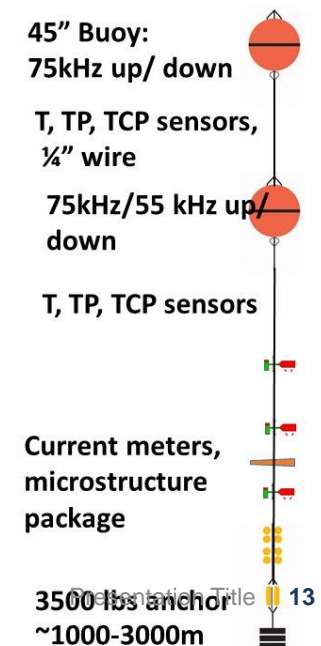
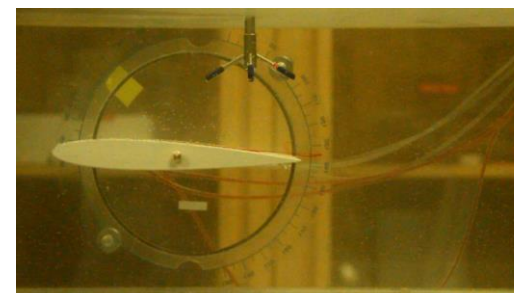
Surface waves, internal waves, turbulence, mixing,
currents, air-sea interaction, etc.

UXV RDT&E

Field Programs – Oceanographic equipment

East Sea (2022), Barents Sea (2023)

Experiments - Turbulence and Flow Tanks



Basic and Applied Research Projects

Buoyancy Plume Modulation of Coastal Air-Sea Exchange Processes

Intermediate Trophic Levels: Interconnections with Fronts, Eddies and Primary Production

Decrease of Boundary Layer Turbulent Flow Inspired by Nature

Integrated Radiometric Indices of Surface Ocean Features

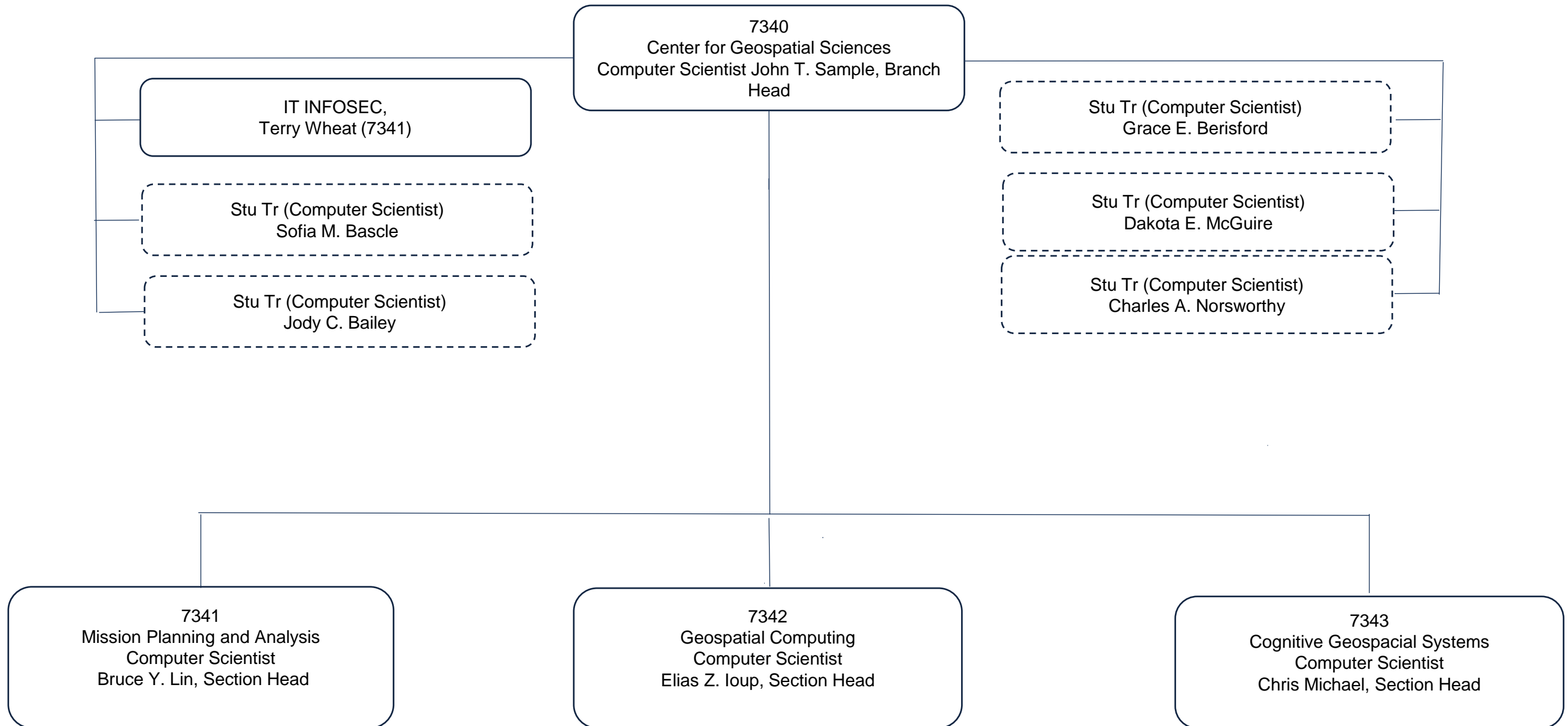
Active Reduction of Bioluminescence in the Ocean with Light

Mechanisms and Consequences of Accumulated Corrosion Products

Air-sea fluxes across waves and impact on upper ocean mixing

Smart Glider Teams

Center for Geospatial Sciences 7340



Mission Planning and Analysis Section

Next generation mission planning systems

Advanced environmental assessment and analysis tools

Specialty areas are aeronautical and mine warfare mission planning.

Geospatial Computing Section

Next generation aeronautical and navigation charting systems

Data dissemination systems

Mapping, imagery and METOC data

Advanced compression techniques

Cognitive Geospatial Systems Section

Machine Learning and Artificial Intelligence systems to assist Navy users.

Improved user interfaces and training methods.

Section includes team of cognitive/engineering psychologists conducting active human subject studies.

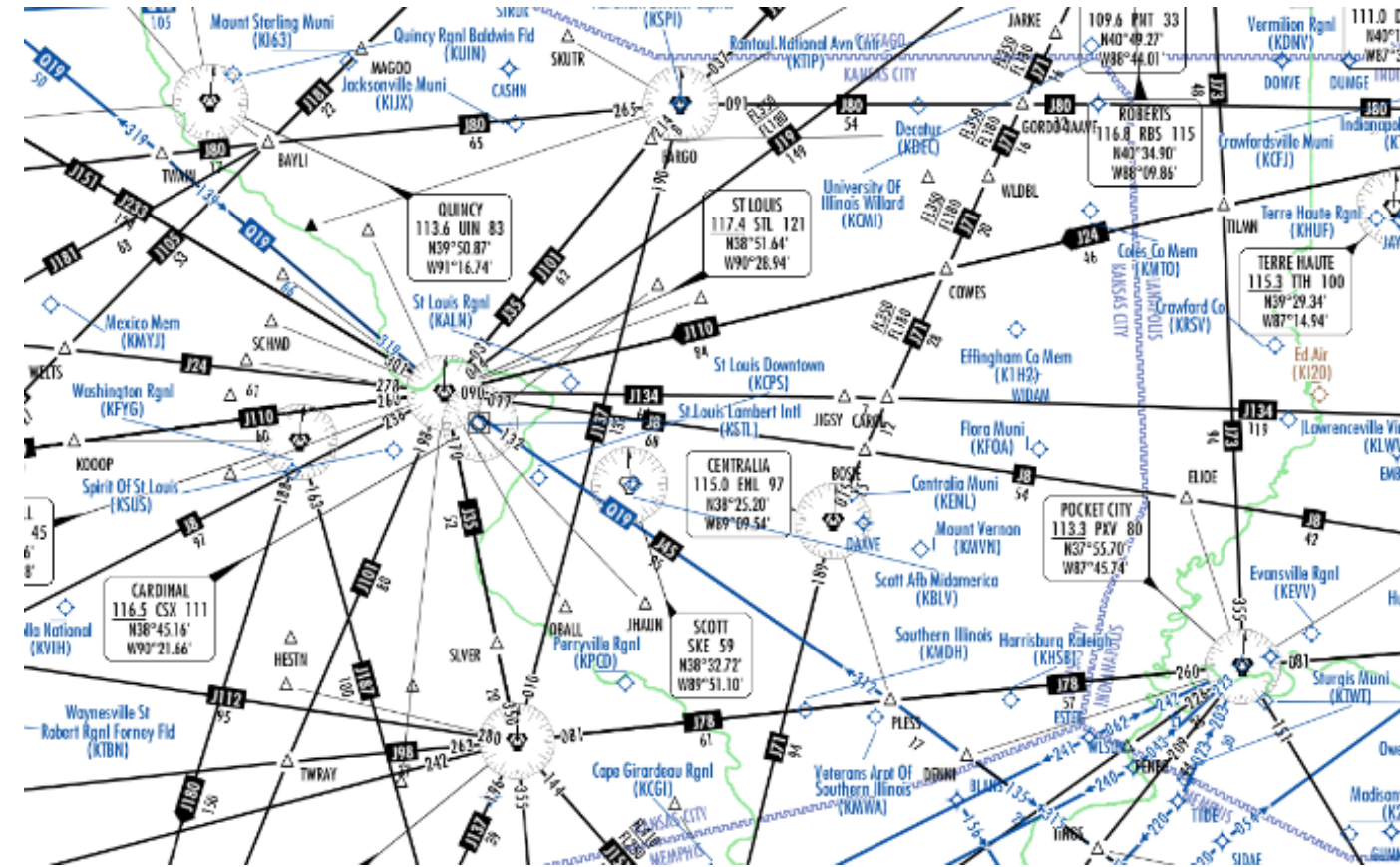
Automation of Chart Creation

Aeronautical and nautical charts require 100's of hours of analyst time to design and place features.

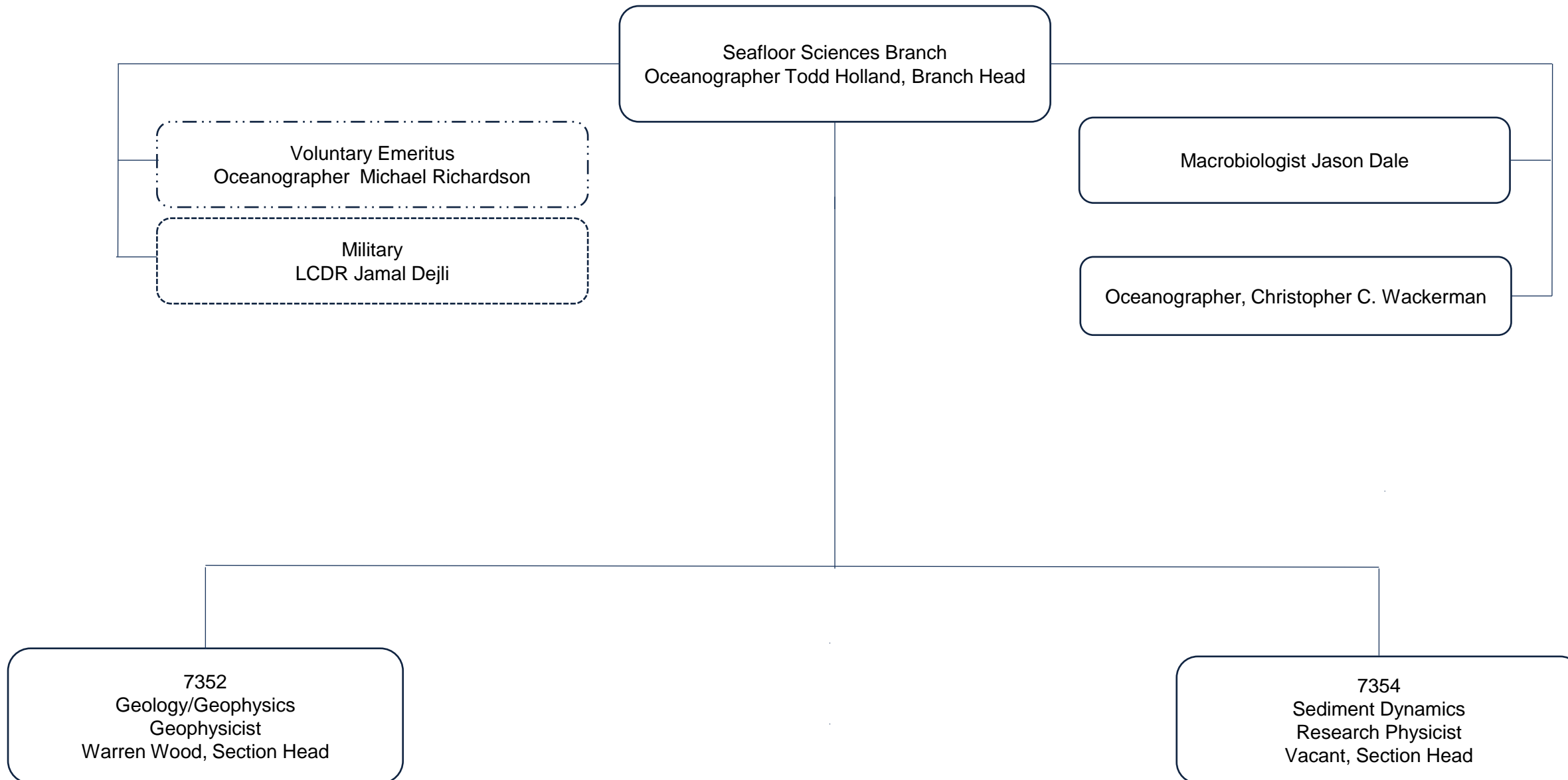
Dense, legally required information.

Frequently changes.

Many charts are legally required to be updated monthly.



Seafloor Sciences Branch 7350



- Interdisciplinary team
 - 22 civilians, 10 postdocs, 3 contractors, 8 students, 1 inter. faculty
- Strong external collaborations
- Balanced portfolio of basic and applied research, up to demonstration and validation (6.1 - 6.4)
- Simulation and experiments (field and lab)

Broad S&T Objectives

- Probabilistic operational forecasting with data assimilation
(through machine learning)
- Transfer high fidelity laboratory sensors to the field
(both commercial and custom)
- Validate and fuse remote sensing with in situ observations
(focused on unmanned platforms)

FY21 Portfolio Summary

- **6.1 NRL base projects**

- Global predicted bathymetry
- Observations of Aeolian sediment transport
- Effects of biological cohesion on seafloor evolution
- Modeling sediment sorting in sand-shell environments
- Predicting Arctic seabed instability

- **6.2 NRL/ONR projects**

- ML approach for estimating global LFBL
- Riverine bathymetry

- **6.3 DARPA**

- Ocean of Things

- **6.4 ONR**

- Global Predictive Seabed Model
- Grain Size Database Estimated from Acoustic Sonar Imagery
- Physics-Based Coastal Bathymetry

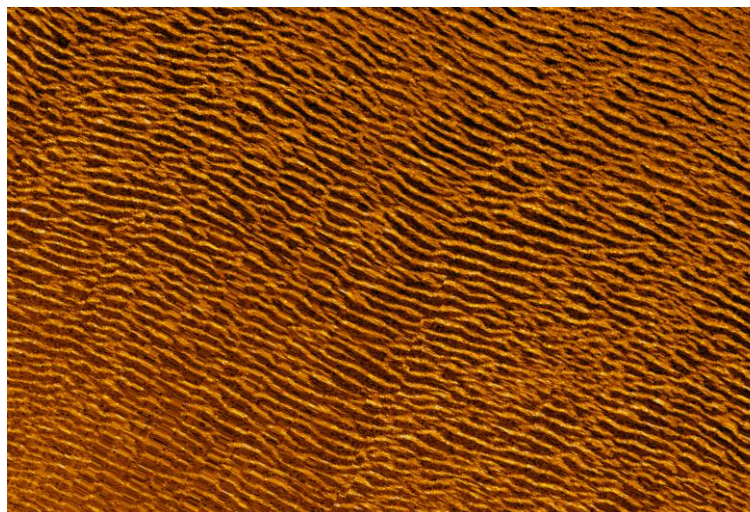
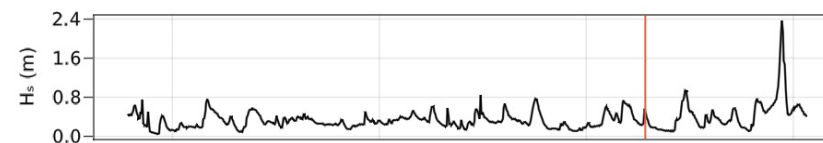
- **Focus areas in seafloor and littoral**
 - Global seabed modeling
 - Coastal and riverine sciences
 - Seabed sensing technologies
- **Core capabilities**
 - Machine learning applications
 - Shallow hydro-morphodynamics observations and modeling
 - Bathymetry
 - Remote sensing applications
 - Sediment physics (w/geoacoustics)
- **Equipment and Facilities**
 - UxS
 - ROV
 - MSCL (GeoTek) - FY21 CIP
 - ADCPs, ADVs, CTDs, Blueviews
 - PIV/PTV/SfM lab and field
 - Small oscillatory flow tunnel
 - Electronics and machine shops



Chris J. Michael, et al. 2019. *A General Framework for Human-Machine Digitization of Geographic Regions from Remotely Sensed Imagery*. In Proceedings of the 27th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (SIGSPATIAL '19).

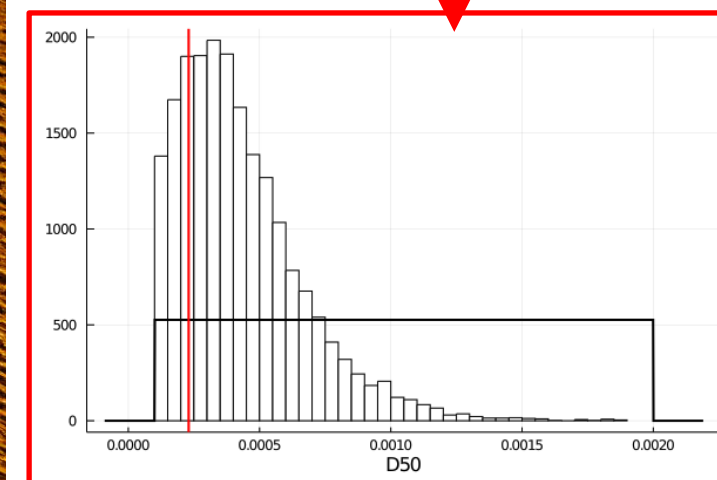
INPUTS:

- Wave data & sonar imagery



OUTPUT:

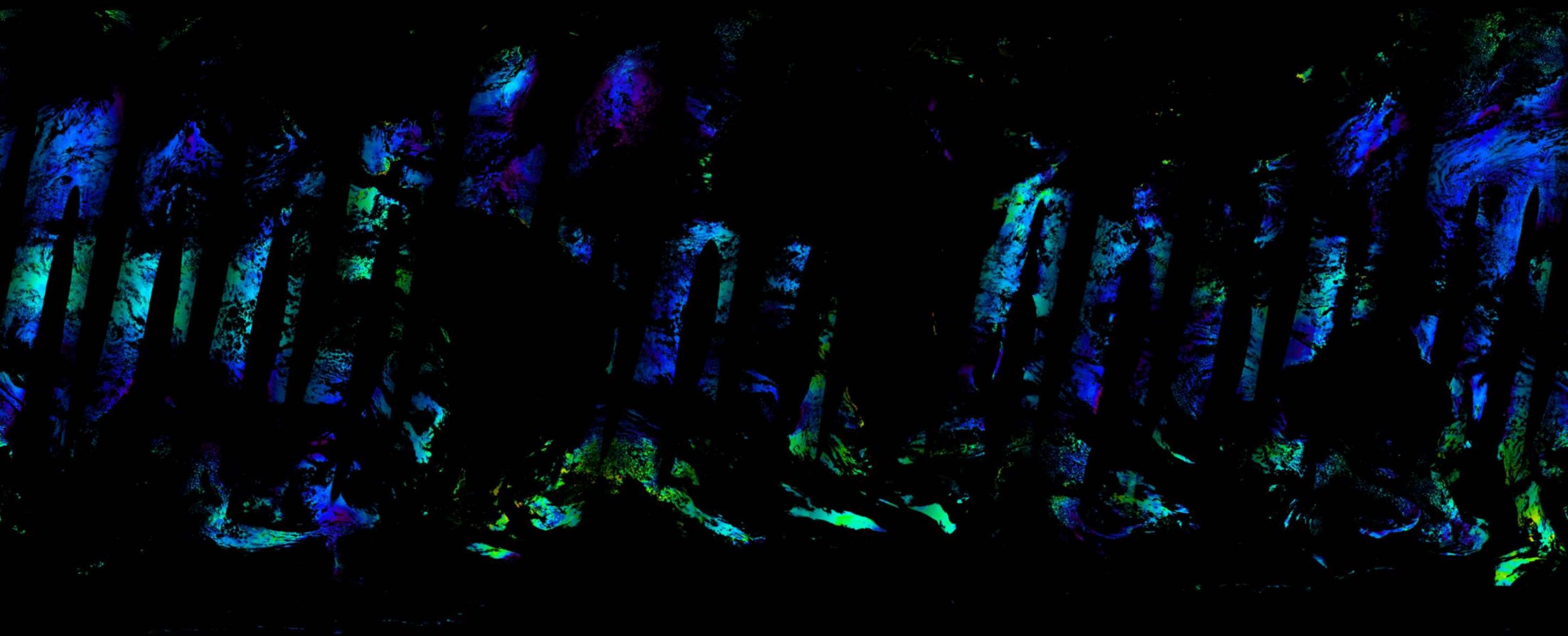
- Grain size probability distribution



Questions/Comments

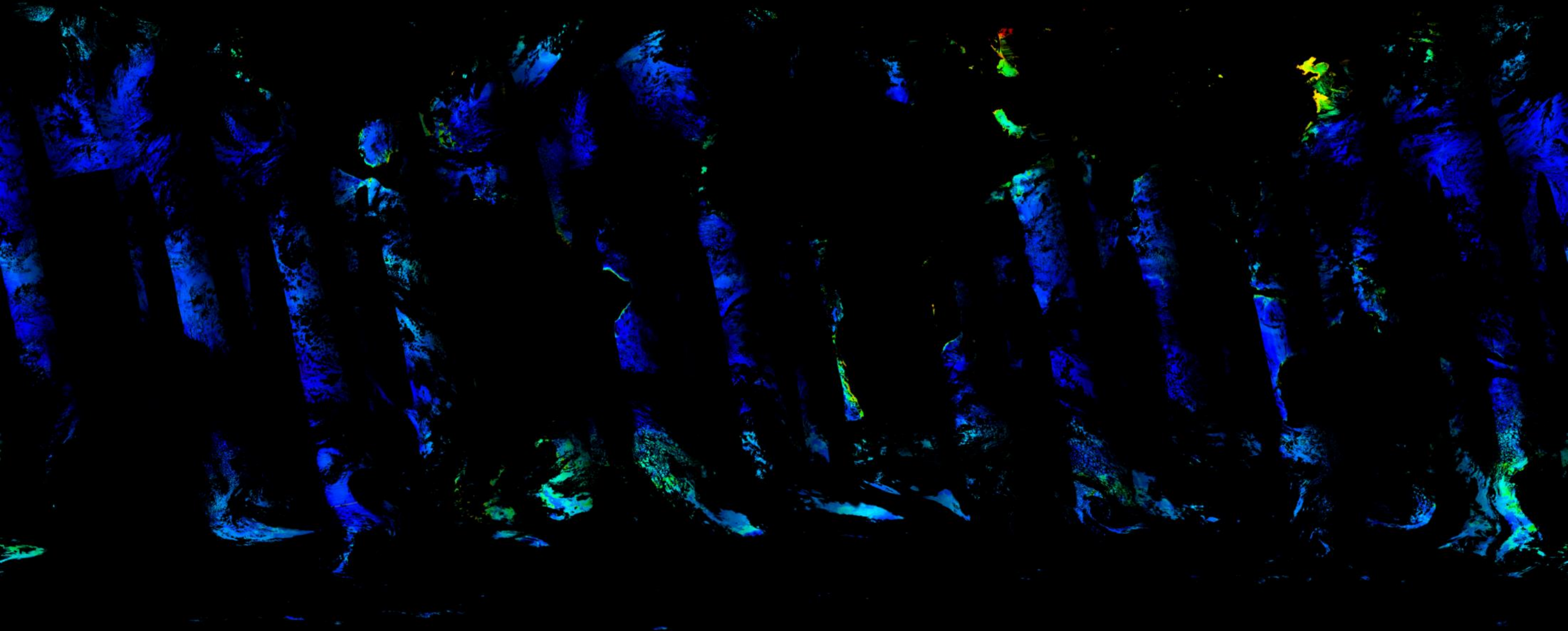
MODIS Terra November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



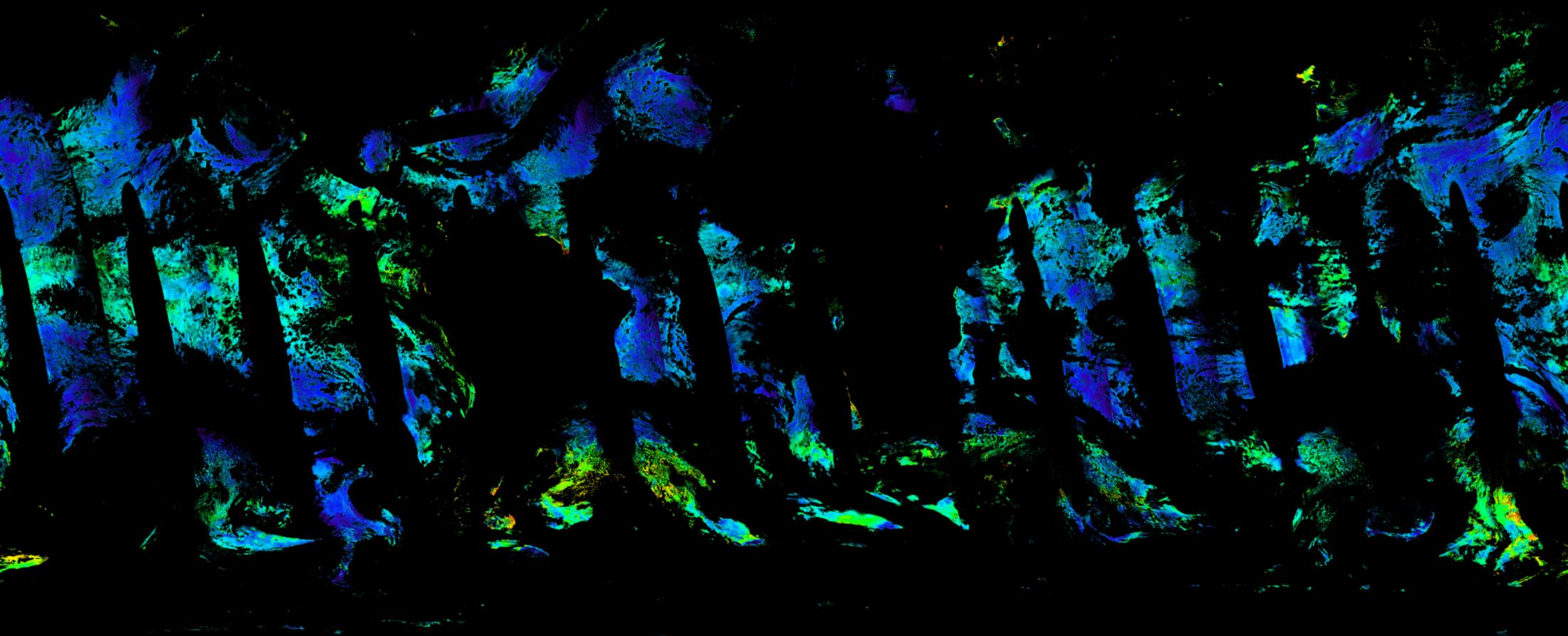
MODIS Aqua November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



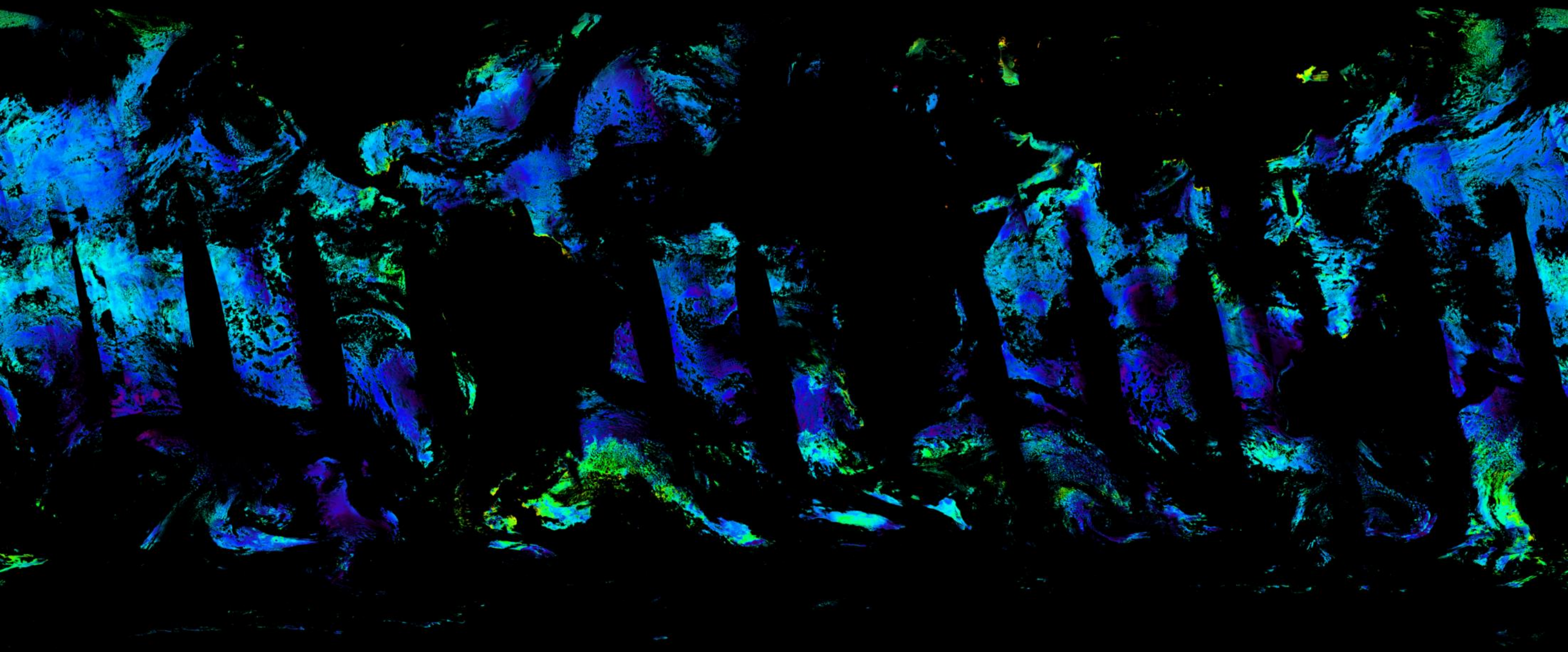
SNPP VIIRS November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



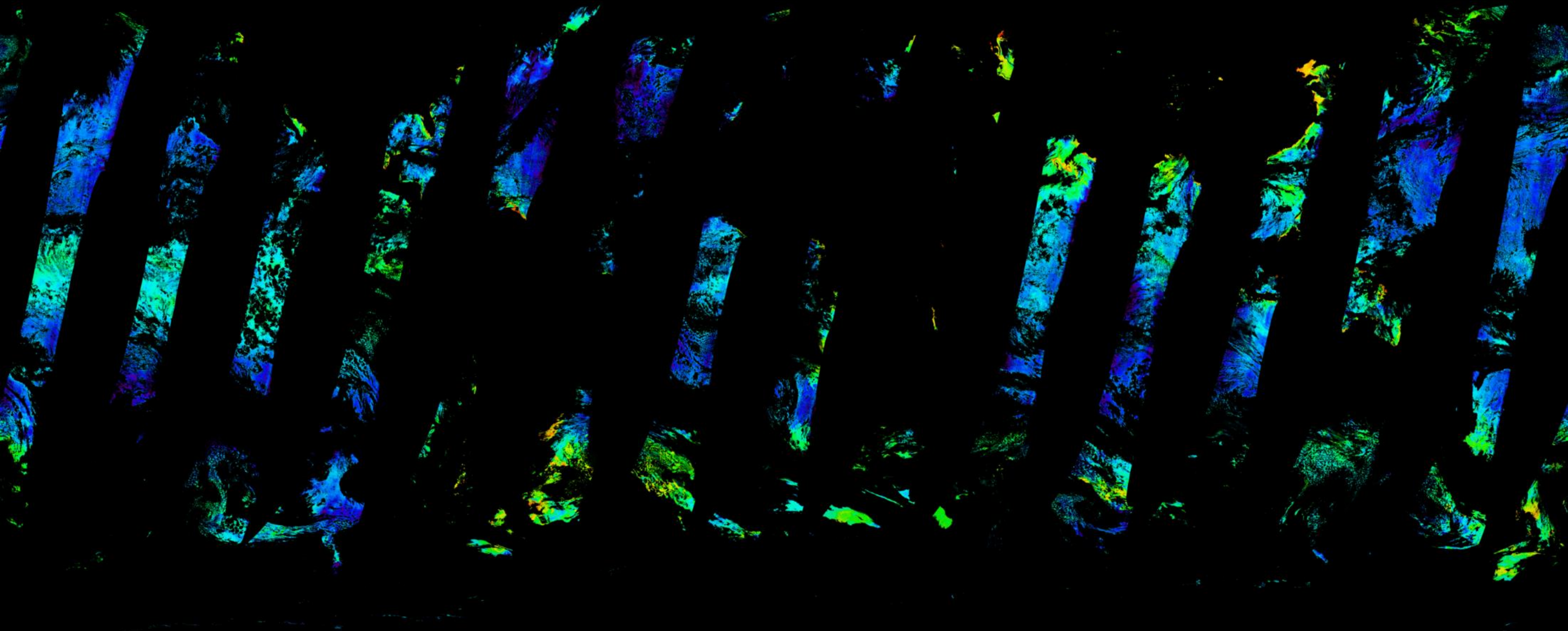
J01 VIIRS November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



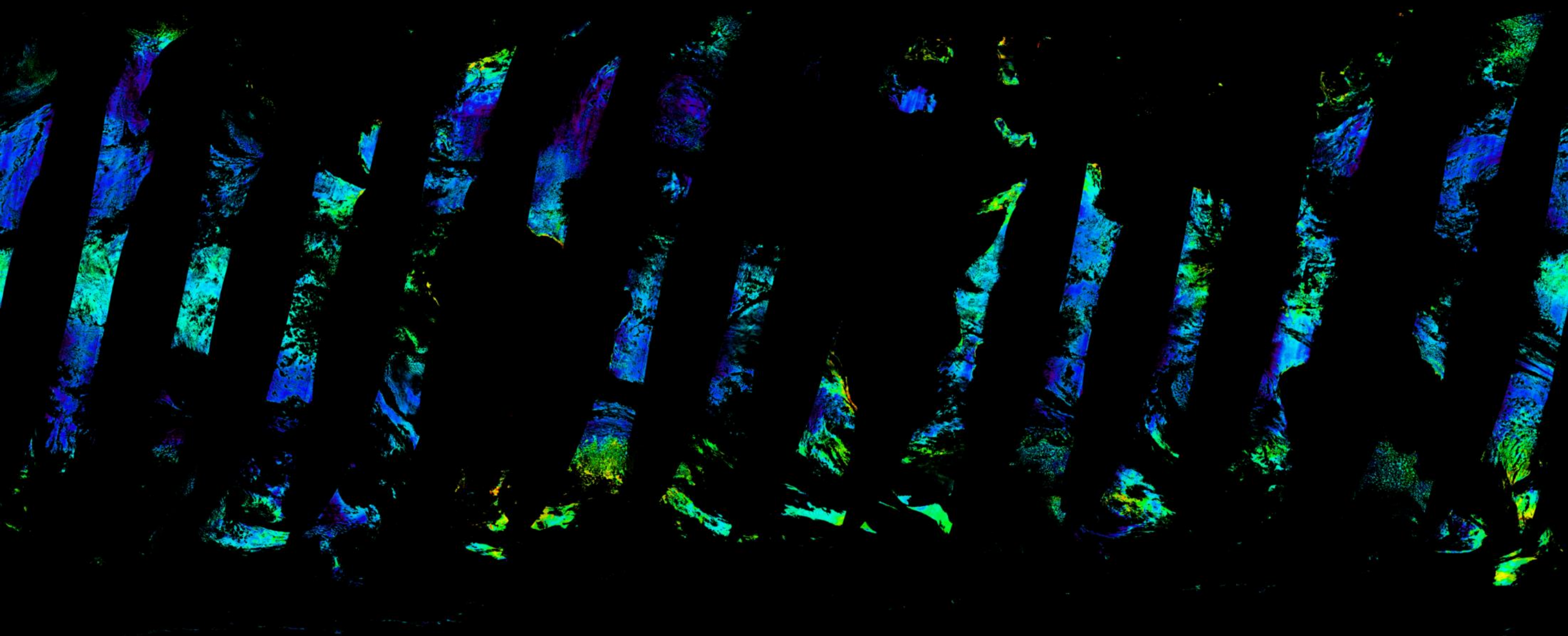
S3A OLCI November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



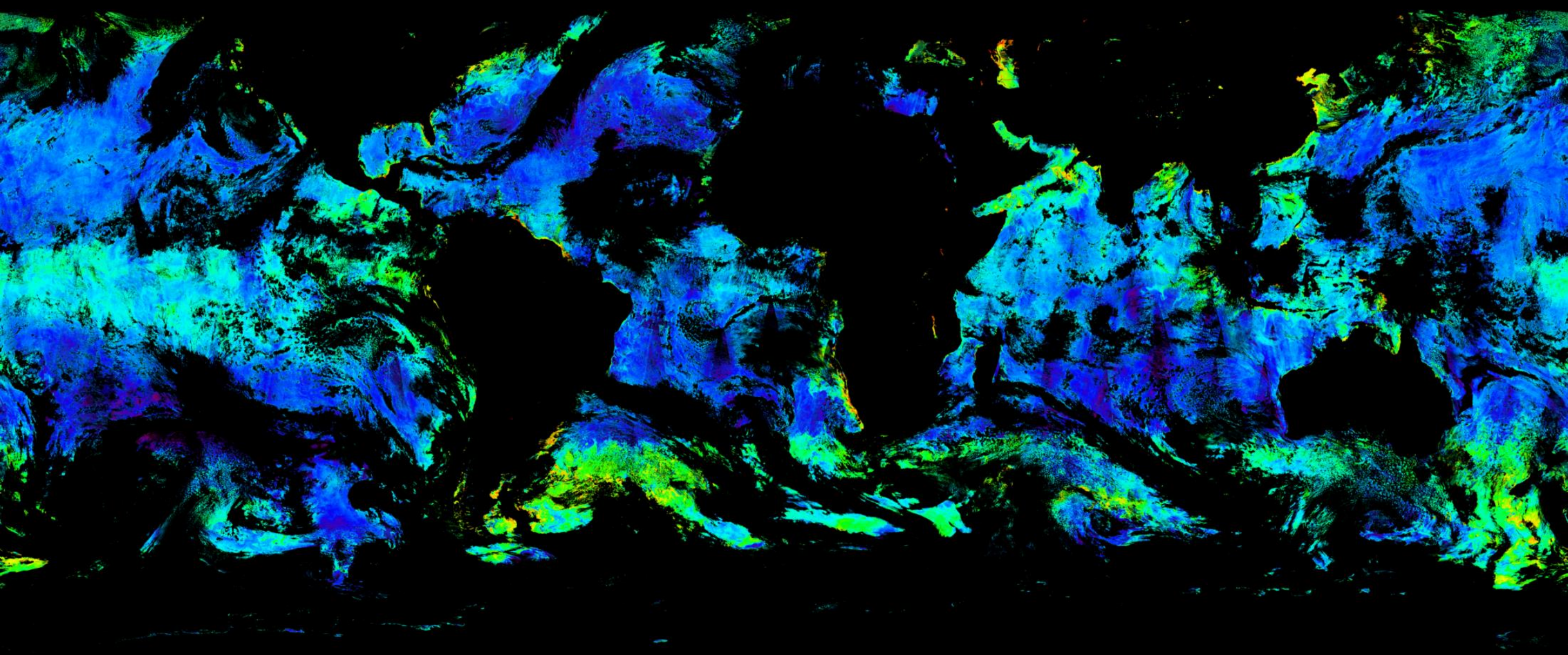
S3B OLCI November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



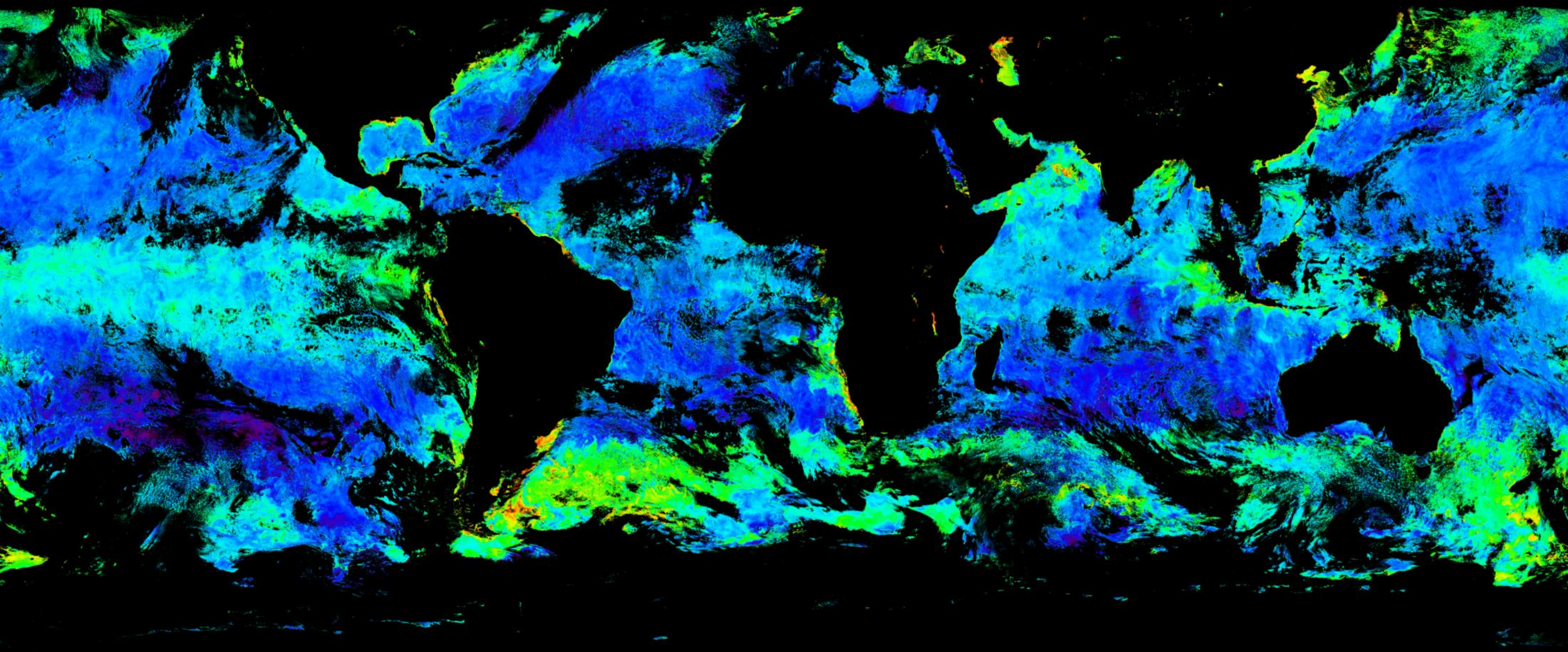
Sensor Merge (Days=1) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



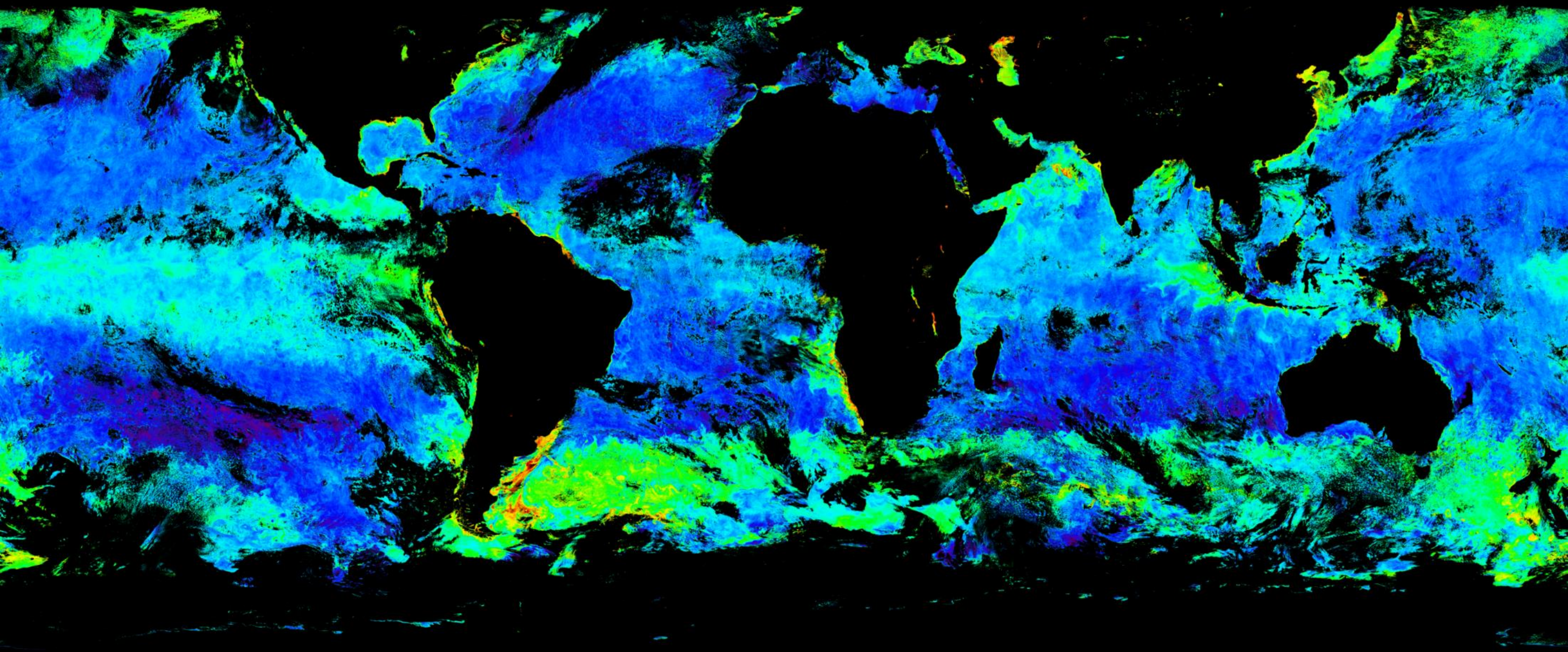
Sensor Merge (Days=2) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



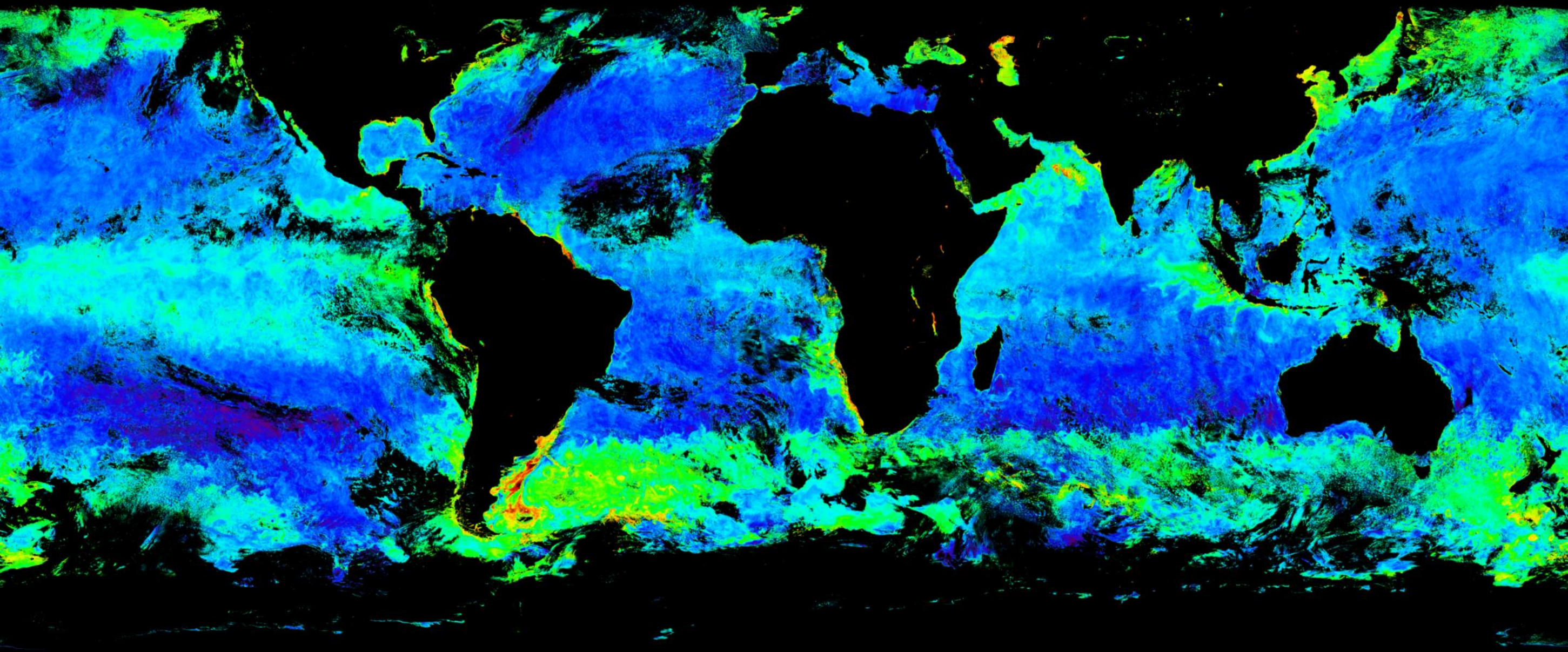
Sensor Merge (Days=3) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



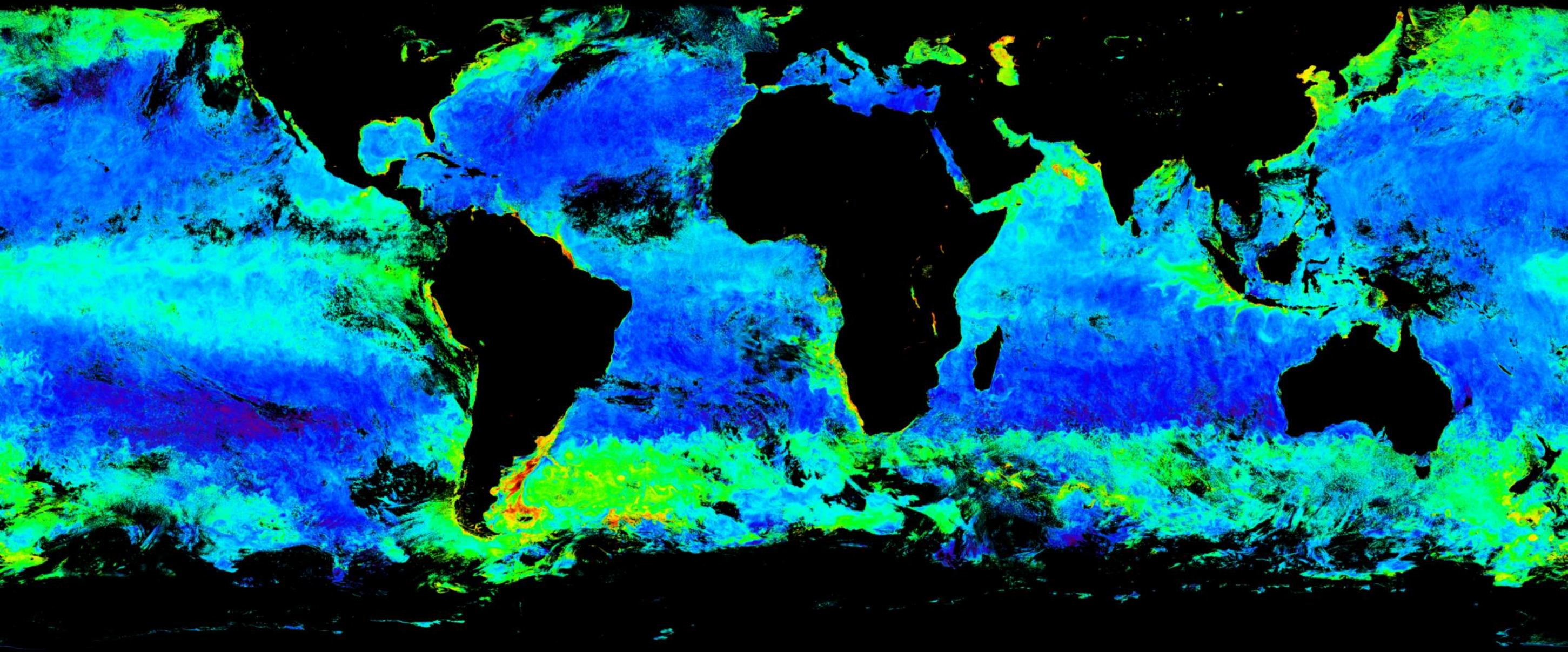
Sensor Merge (Days=4) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



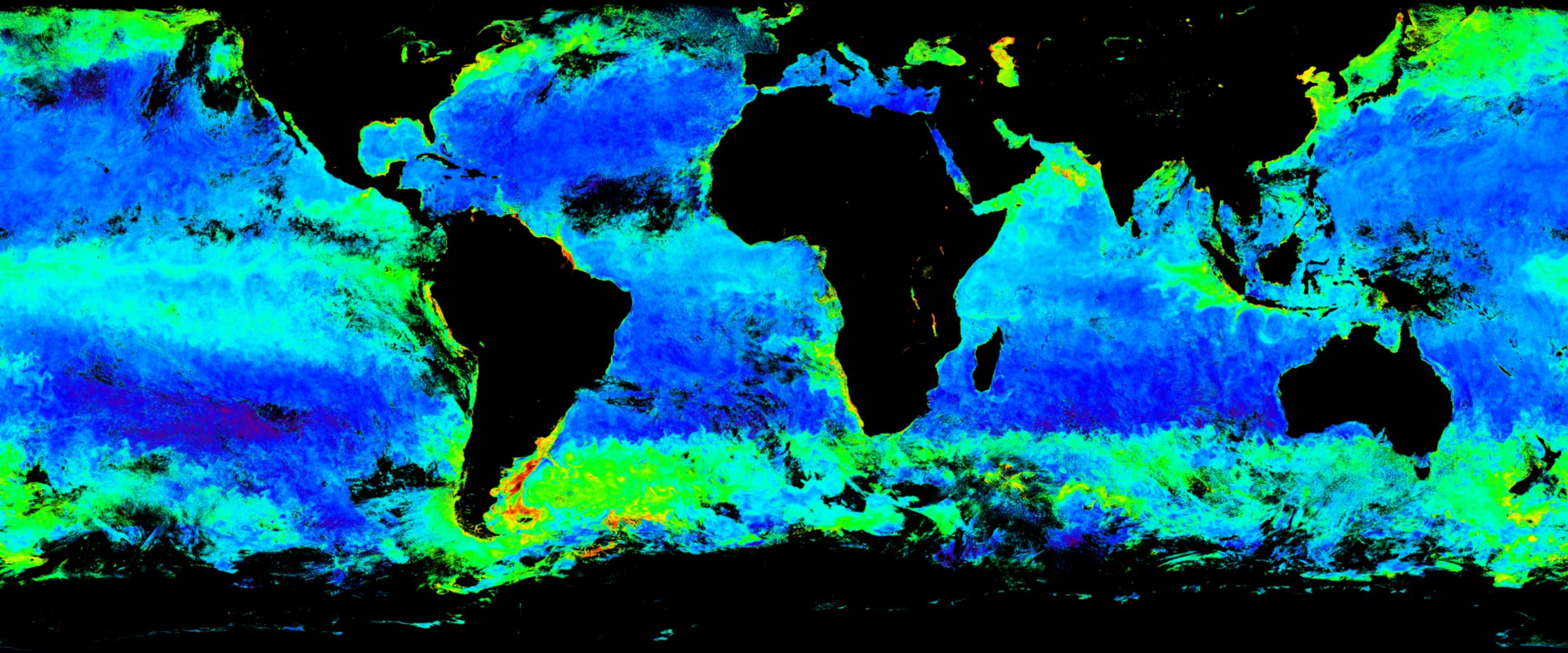
Sensor Merge (Days=5) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



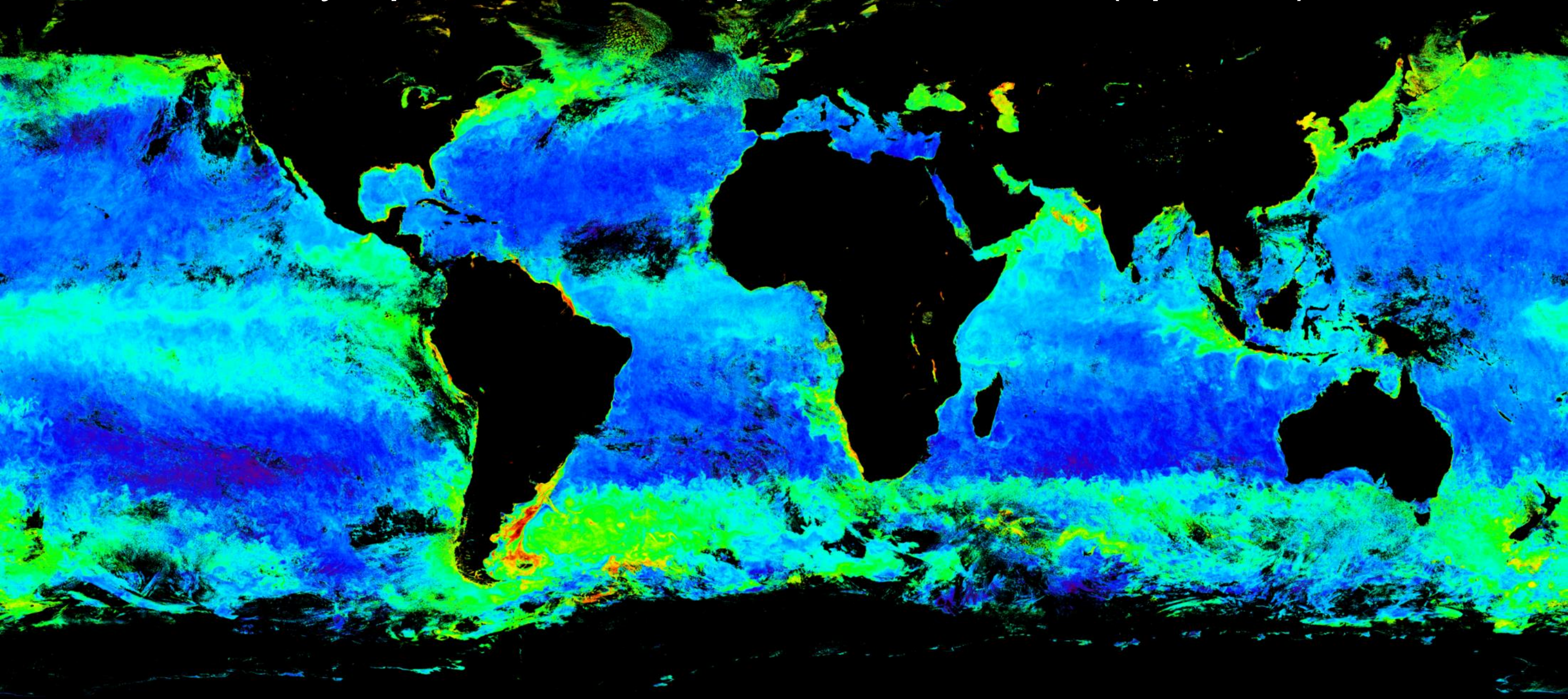
Sensor Merge (Days=6) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



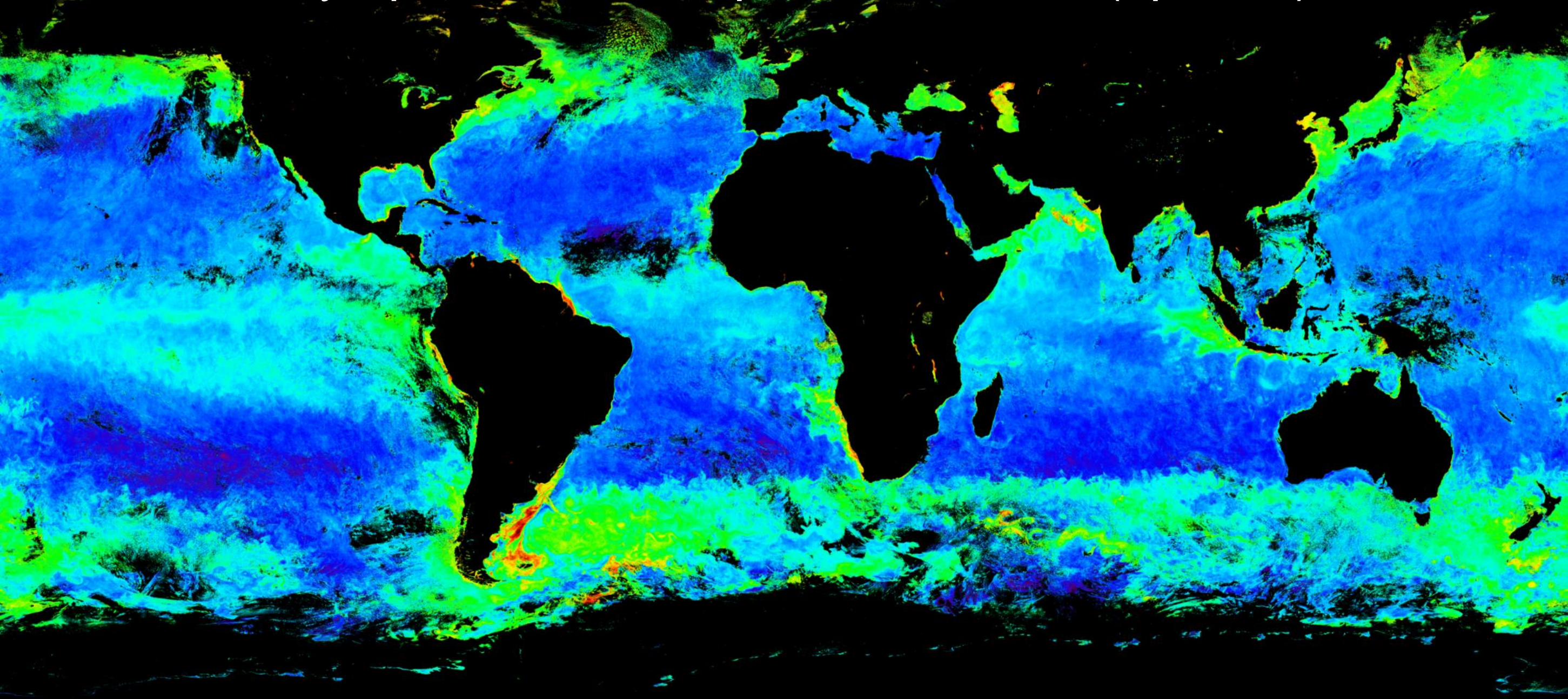
Sensor Merge (Days=7) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



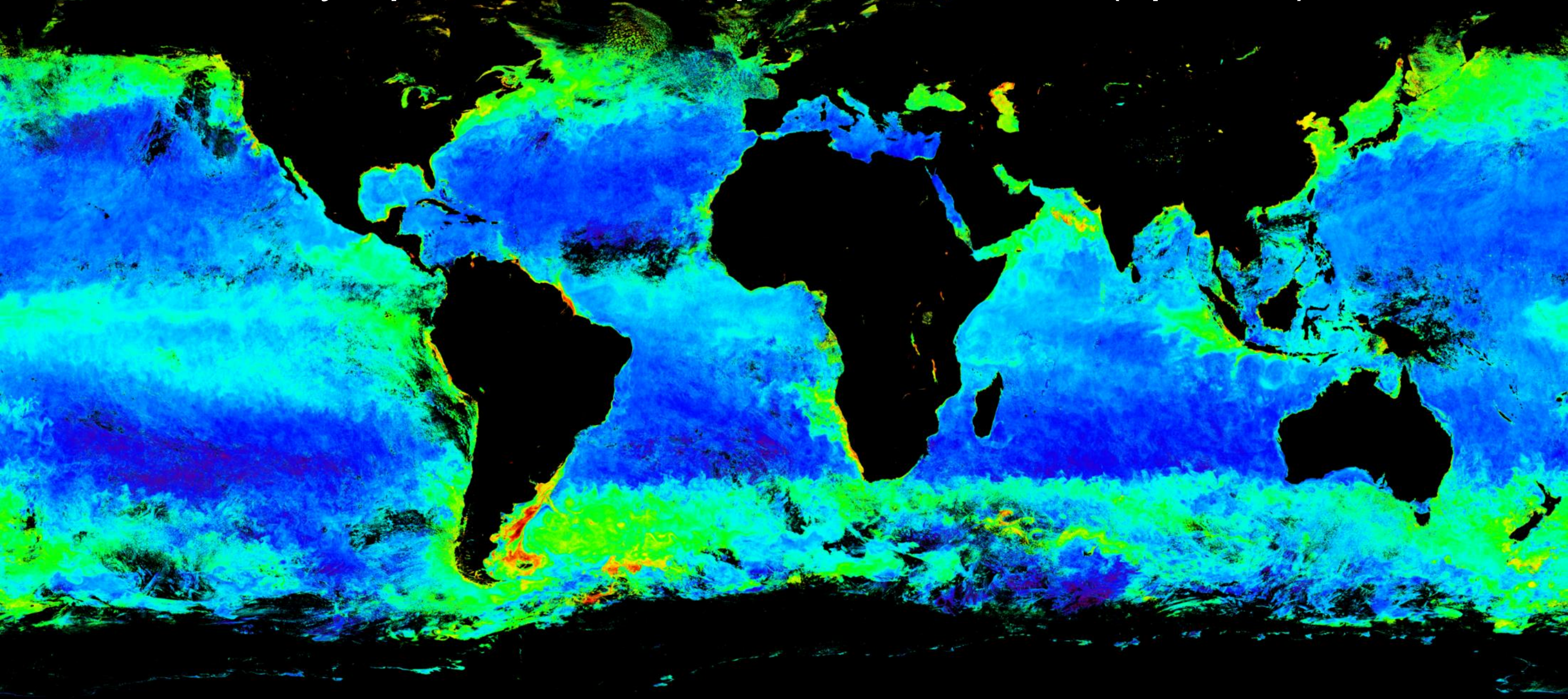
Sensor Merge (Days=8) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



Sensor Merge (Days=9) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)



Sensor Merge (Days=10) November 11, 2019 (GOPS v19.0)

Phytoplankton Absorption @ 490nm (aph490)

