



Update on NOAA Ocean Color Activities: Research to Applications

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¹along w/NOAA Ocean Color Coordinating Group

2nd International Ocean Colour Science Meeting
San Francisco, CA USA
16 June 2015



NOAA Satellites and Information

National Environmental Satellite, Data, and Information Service



On behalf of NOAA, welcome to
San Francisco, California, USA
for the 2nd International Ocean
Colour Science Meeting!

Second International Ocean Colour Science Meeting 2015



15-18 June



International
Ocean Colour Science
Meeting 2015

San Francisco

This is the second in a series of biennial IOCS meetings designed to foster exchange between the research community and space agency representatives. The primary focus of the IOCS meeting is to build and strengthen the international ocean colour community by providing a forum to collectively address common issues and goals. The aim is to achieve the best quality ocean colour data that meet scientific, environmental, climate and operational needs through international collaboration and scientific and technological innovation.



For more information
and a Call for Session Topics

IOCS IOCCG.ORG
IOCS-2015@IOCCG.ORG



Overview:

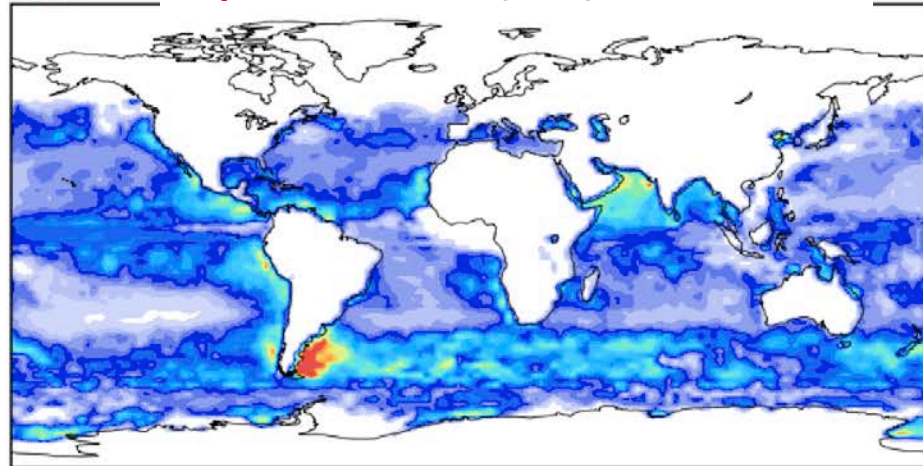
- 1) NOAA Ocean Color Applications and Research
- 2) NOAA Ocean Color Data, Products, & Distribution
- 3) NOAA Ocean Color Calibration & Validation Activities

OAR/ARL: Global Distribution of Marine Isoprene Emission

Tong, Wang et al. (NOAA JPSS Proving Ground Project)

JAN

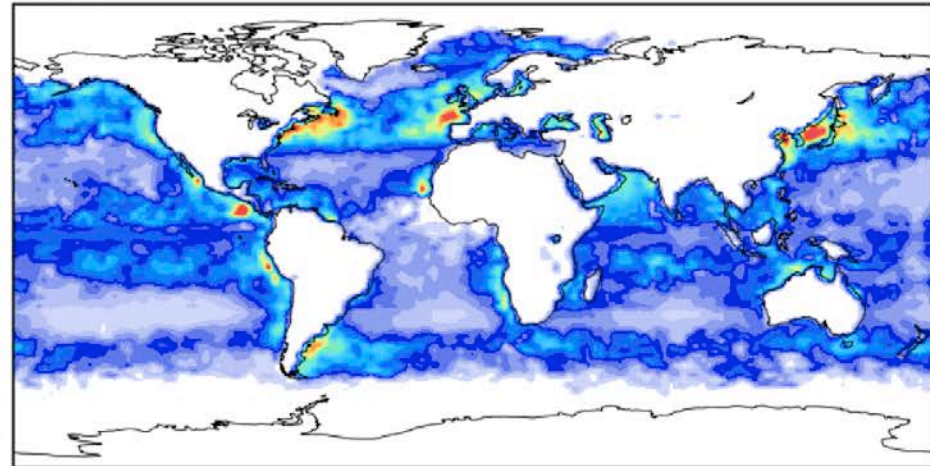
Inputs: Chl-a, $K_d(490)$, PAR



Marine Isoprene Emissions (molecules/cm²/s)

0.0E+00 1.0E+05 2.0E+05 3.0E+05

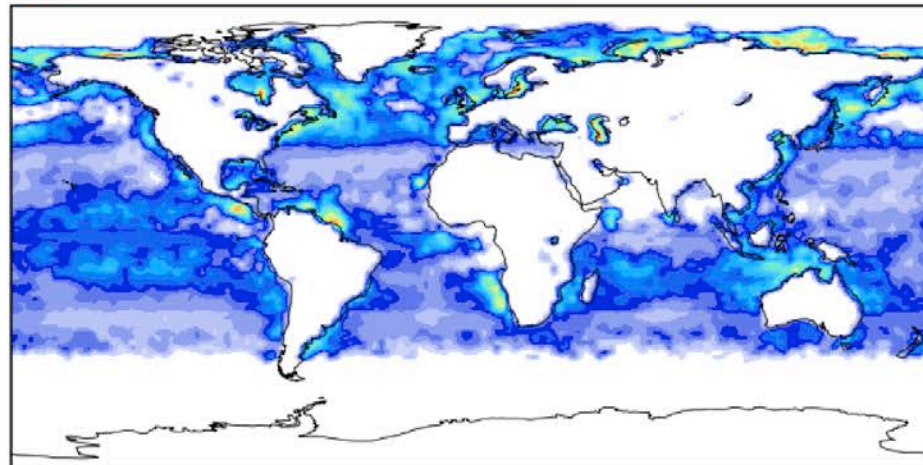
APR



Marine Isoprene Emissions (molecules/cm²/s)

0.0E+00 1.0E+05 2.0E+05 3.0E+05

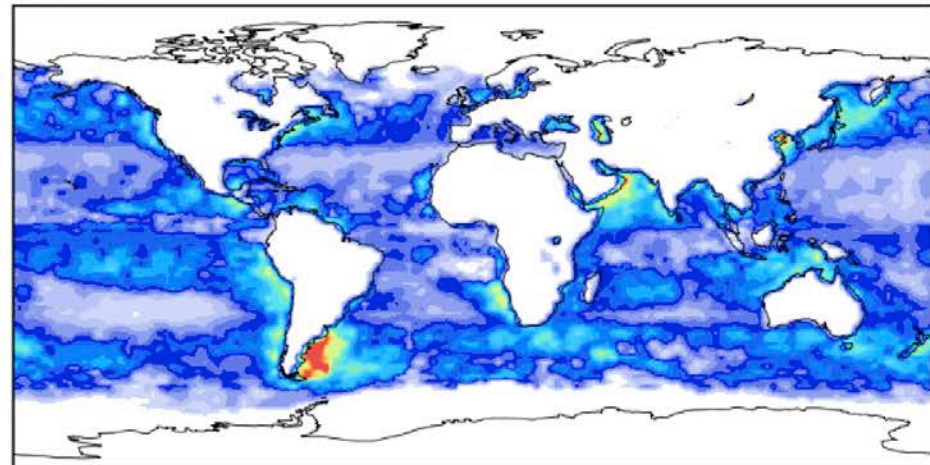
JUL



Marine Isoprene Emissions (molecules/cm²/s)

0.0E+00 1.0E+05 2.0E+05 3.0E+05

OCT



Marine Isoprene Emissions (molecules/cm²/s)

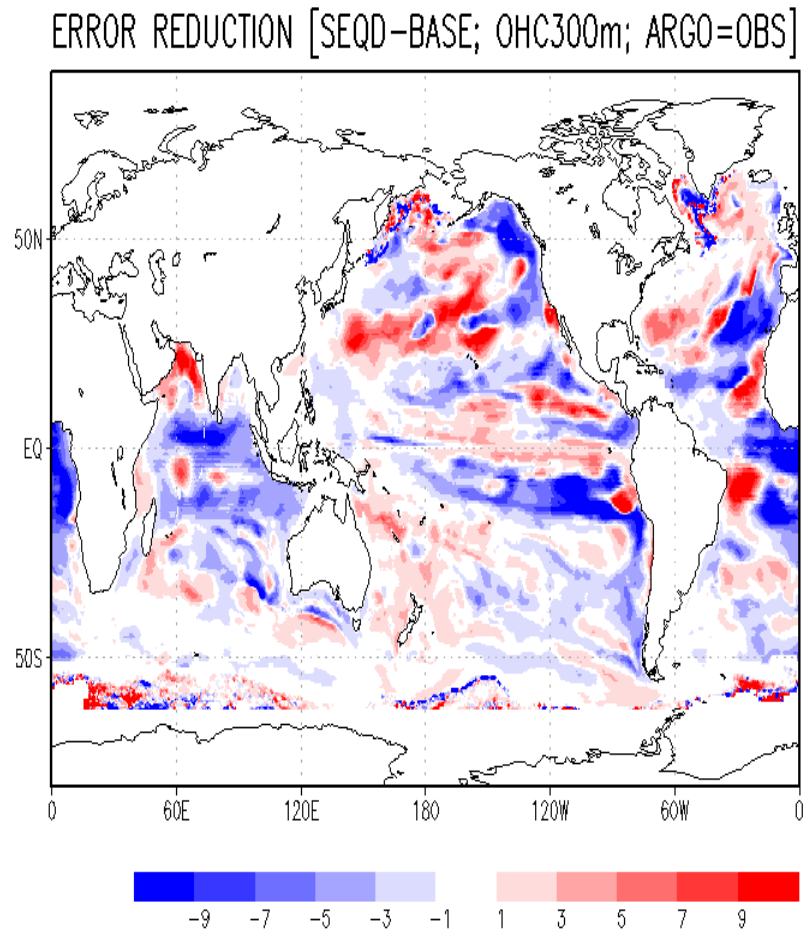
0.0E+00 1.0E+05 2.0E+05 3.0E+05

NWS/NCEP/EMC: Use of NRT Ocean Color data for improved air-sea fluxes

- Using composited daily ocean color fields, instead of the existing operational framework (i.e., monthly climatology), reduces ocean heat content (0-300 m) errors.
- Facilitates NOAA's advancements to coupled ocean-atmosphere modeling.
- Intentions are the eventual assimilation of operational VIIRS ocean color data.

NCEP/EMC Collaborators:

STAR-NESDIS, JCSDA



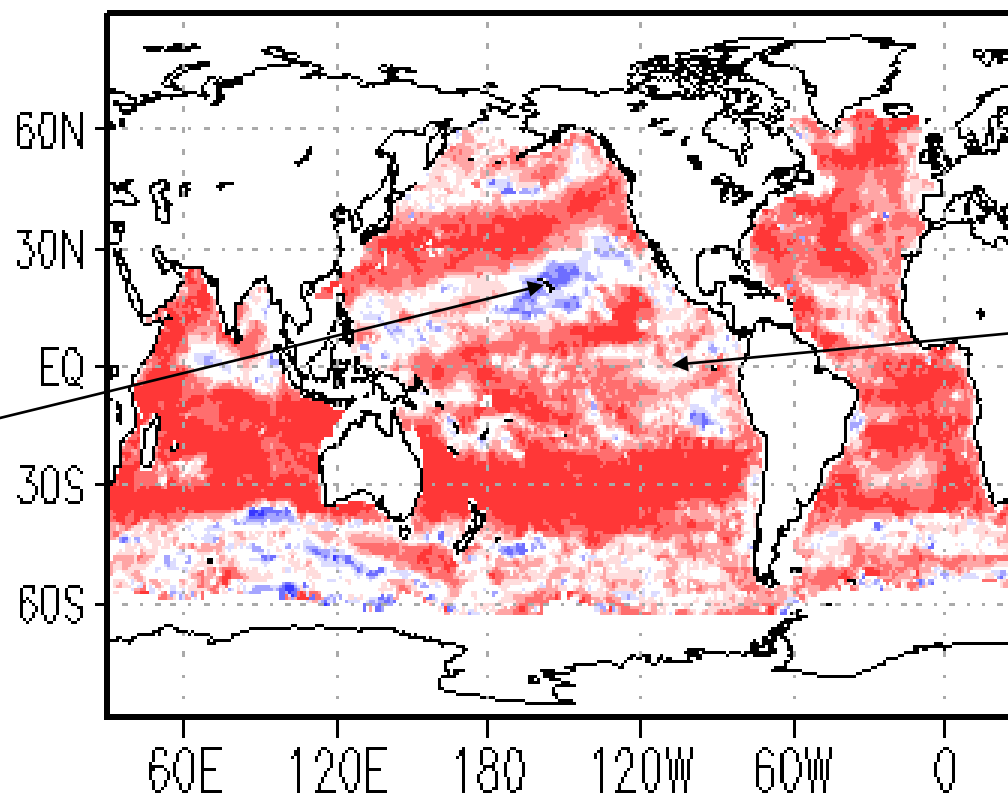
Neural Network Technique for Gap-Filling of Satellite Ocean Color Observations for Use in Numerical Ocean Modeling

NWS/NCEP/EMC: Sudhir Nadiga et al.

Ensemble NN Cross-Corr (%) To VIIRS OBS

Training Period:
2012-2013

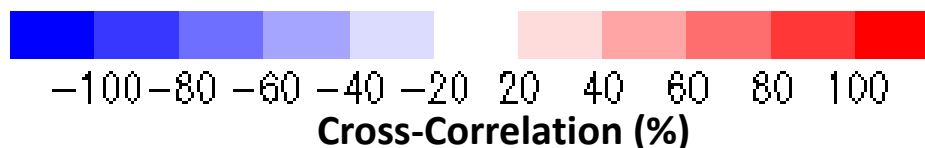
Validation Period:
2014



High Cross-Corr in
mid-latitudes

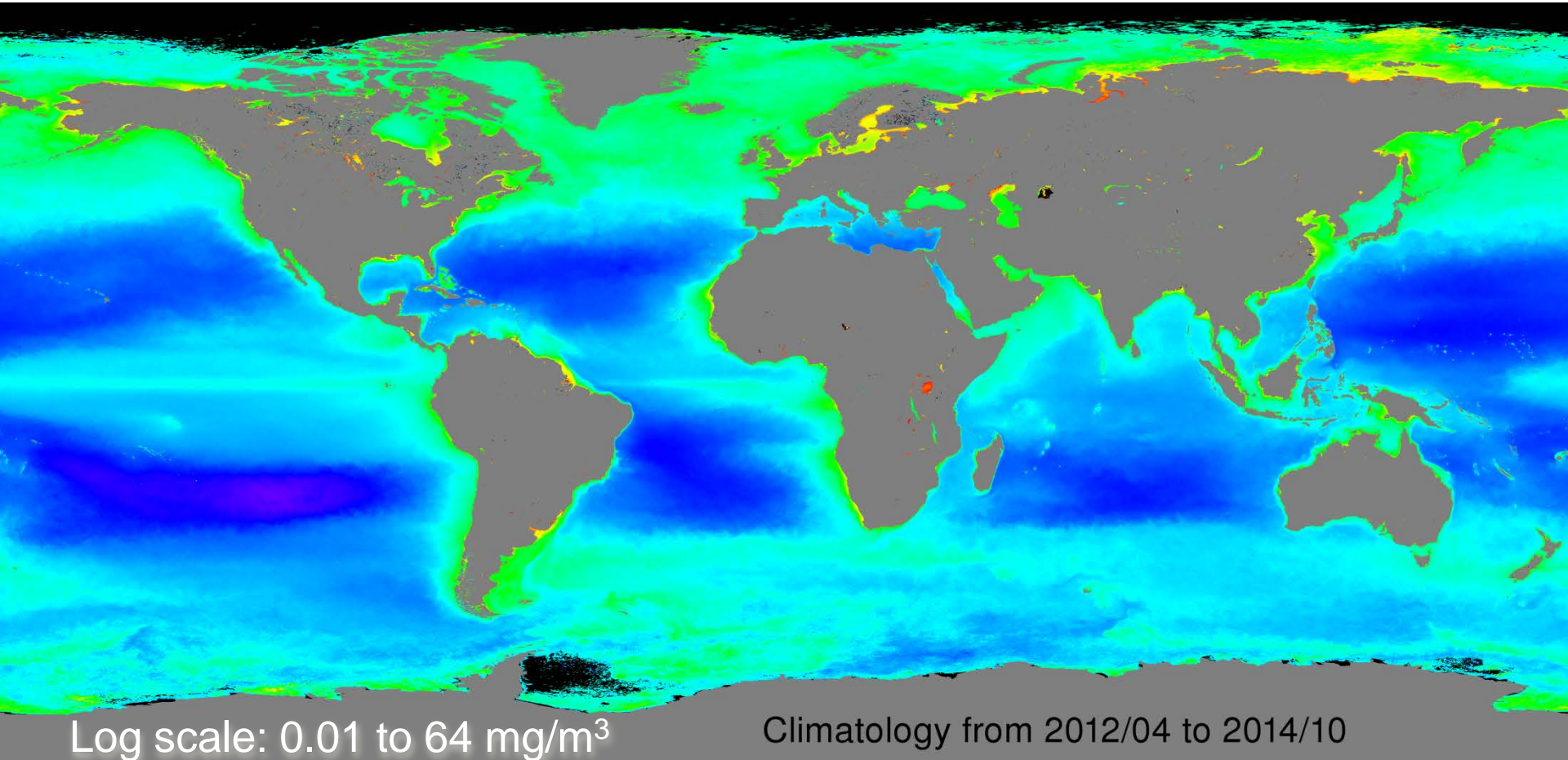
Low Cross-Corr in
equatorial eastern
Pacific

Blue Color may be
phase errors due
to noise, subgrid-
scale processes in
data?



VIIRS Climatology Chlorophyll-a Image

(April 2012 to October 2014)



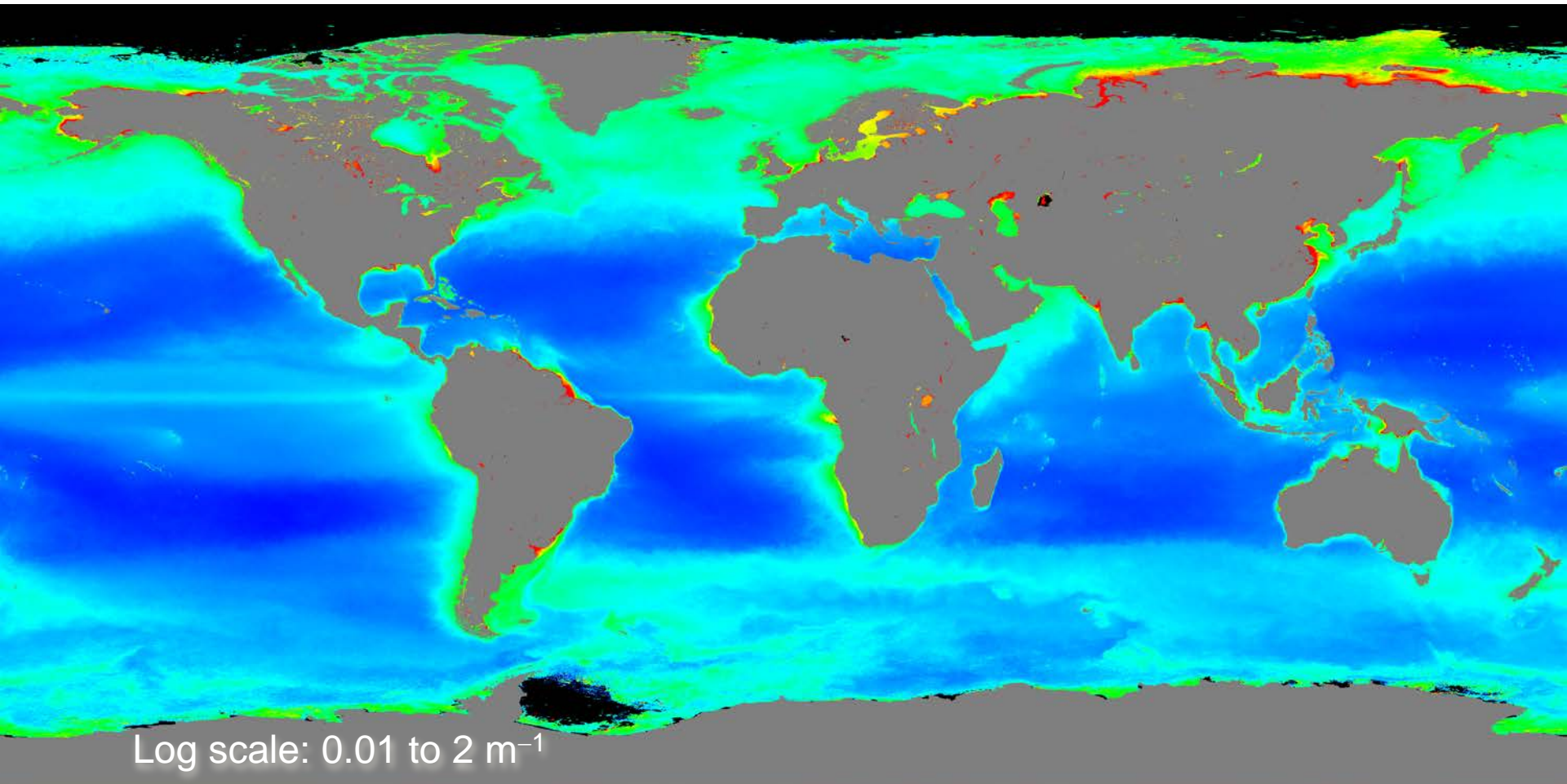
Generated using NOAA-MSL12 for VIIRS ocean color data processing

Wang, M., X. Liu, L. Tan, L. Jiang, S. Son, W. Shi, K. Rausch, and K. Voss, "Impacts of VIIRS SDR performance on ocean color products," *J. Geophys. Res. Atmos.*, **118**, 10,347–10,360, 2013. <http://dx.doi.org/10.1002/jgrd.50793>

Menghua Wang, NOAA/NESDIS/STAR

VIIRS Climatology $K_d(490)$ Image

(March 2012 to February 2015)



Generated using NOAA-MSL12 for VIIRS ocean color data processing

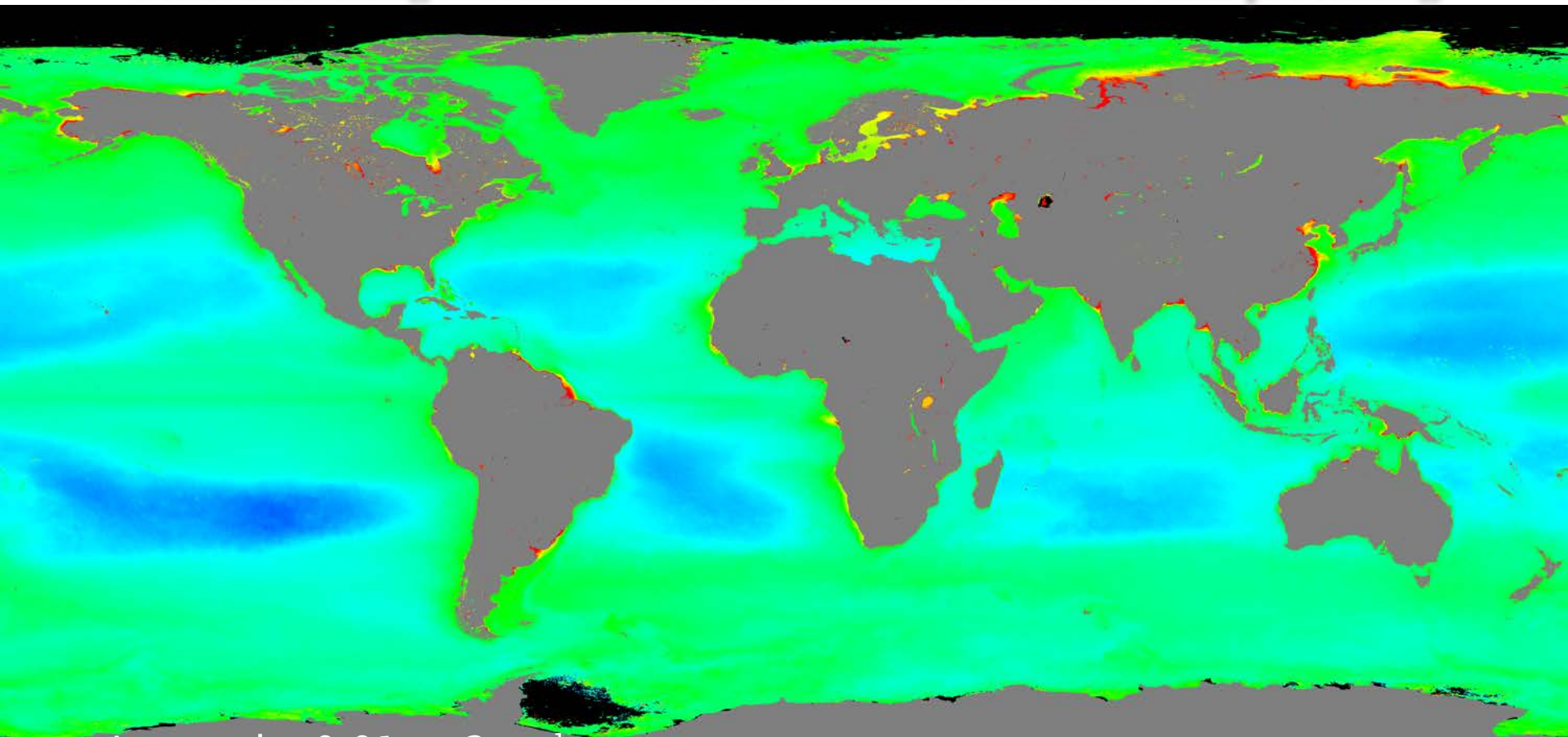


New VIIRS OC Product: Satellite-derived $K_d(\text{PAR})$ Data

VIIRS Climatology $K_d(\text{PAR})$ Image

(March 2012 to February 2015)

Generated using NOAA-MSL12 for VIIRS ocean color data processing



Log scale: 0.01 to 2 m^{-1}

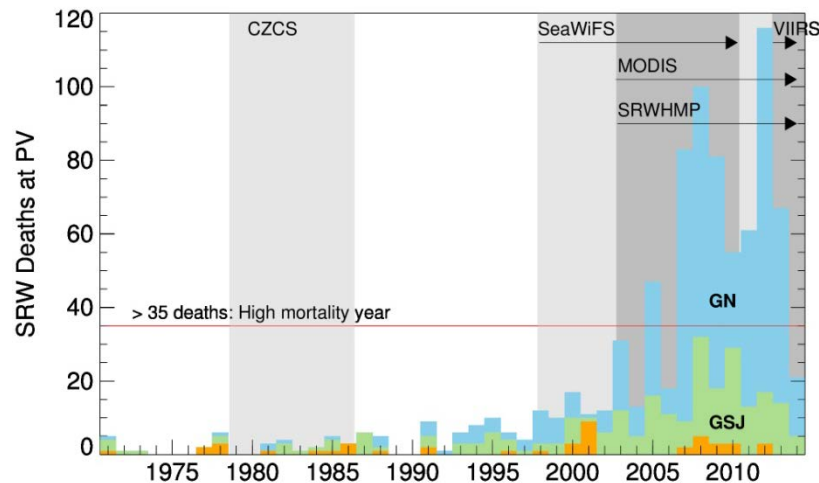
Son, S. and M. Wang, "Diffuse attenuation coefficient of the photosynthetically available radiation $K_d(\text{PAR})$ for global open ocean and coastal waters", *Remote Sens. Environ.*, **159**, 250-258 (2015).



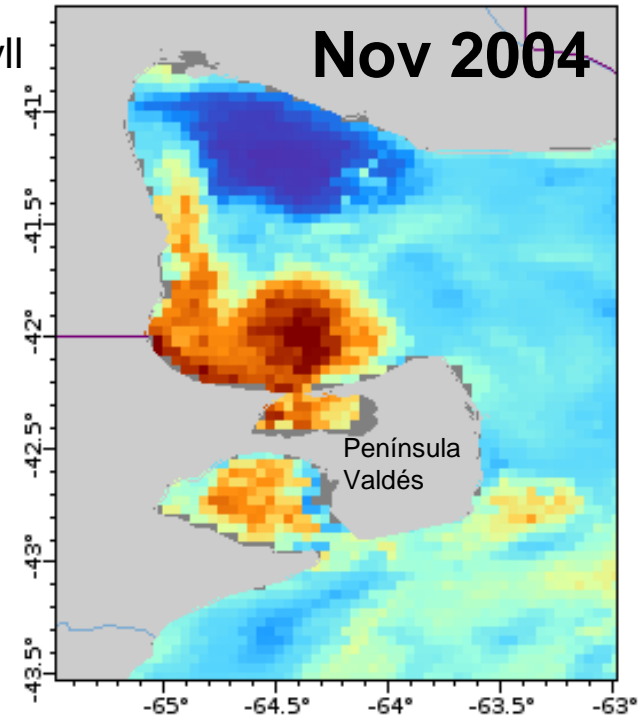
NMFS: HABs & mortality events



Are southern right whale calf deaths at Península Valdés caused by HABs?

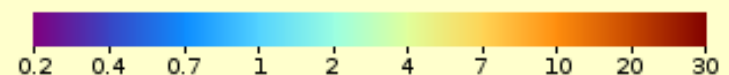


The chlorophyll maximum of the spring phytoplankton bloom at PV has increased by an order of magnitude in the past 10 years.



In the past 10 years there has been a dramatic increase in the number of SRW deaths at their calving ground in Argentina. Most of the deaths (~90%) are calves less than 3 months old.

See Wilson *et al.* poster under review for *Marine Mammal Science*

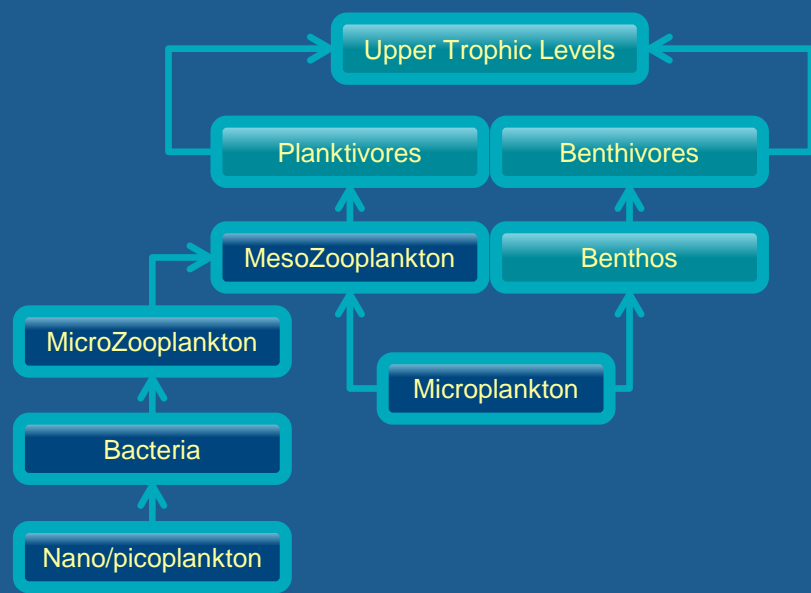


Mean Chlorophyll a Concentration (mg m⁻³)
Chlorophyll-a, Aqua MODIS, NPP, L3SM1, Global, Science Quality (Monthly Composite)
(2004-11-16T00:00:00Z)
Data courtesy of NASA/GSFC OBPG

Ecosystem Production Potential Modeling

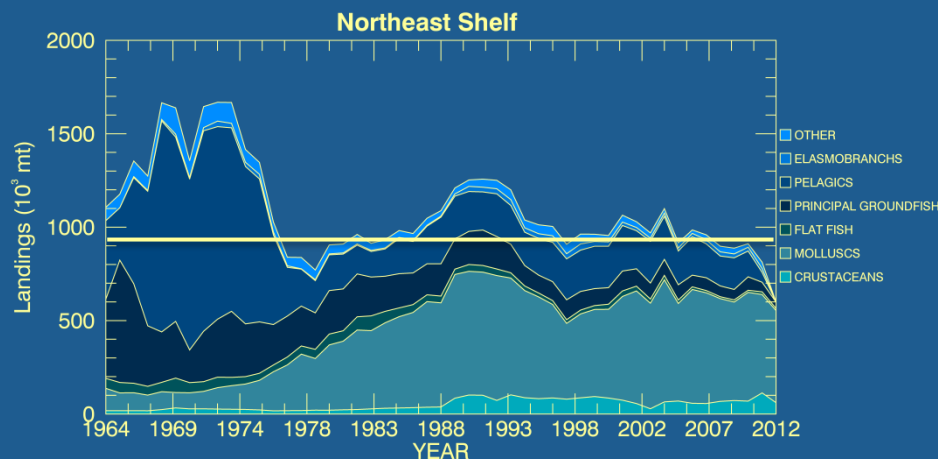
NMFS Northeast Fisheries Science Center - Kimberly Hyde & Michael Fogarty

The NEFSC is using a (satellite derived) bottom-up approach to determine fisheries production potential and exploitation for various ecosystem components.



Trace size fractionated primary production through the food web to determine the amount of upper trophic level production that can be extracted at sustainable levels.

The proposed ecosystem limit reference point is that the exploitation rate should not exceed the fraction of microplankton production (~20-30%).



Fishery removals exceeded recommended levels (~935,000 t) in the past, but are now close to estimates of sustainable extraction rates.

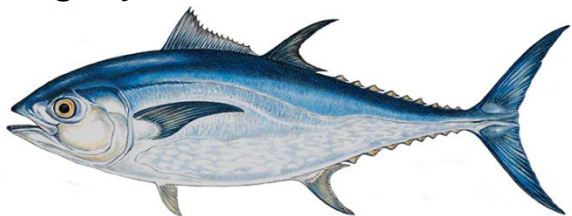




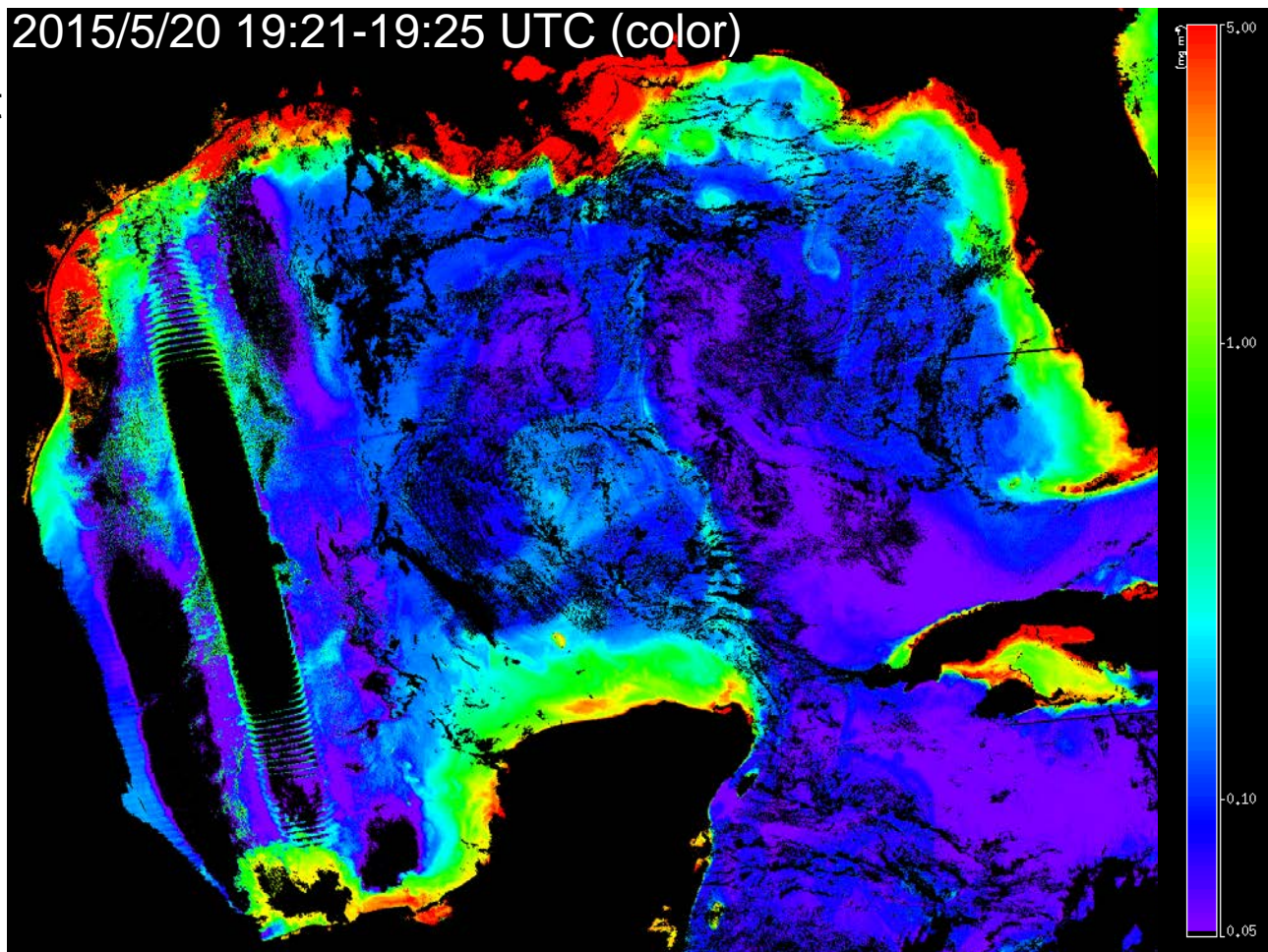
NRT Cruise support



- VIIRS chl image generated by NESDIS-STAR in support of a SEFSC survey cruise looking for bluefin tuna larvae.
- Images are used to position stations to cover frontal features, small and mesoscale oceanographic features, and to ensure as many different water masses as possible are sampled.
- They requested the images in gray scale.



2015/5/20 19:21-19:25 UTC (color)



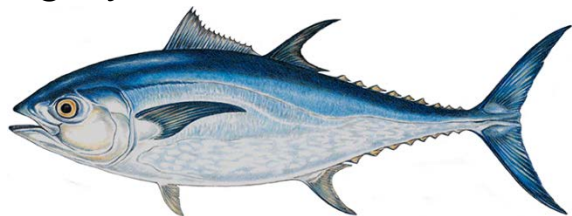
John Lamkin, NOAA/NMFS/SEFSC



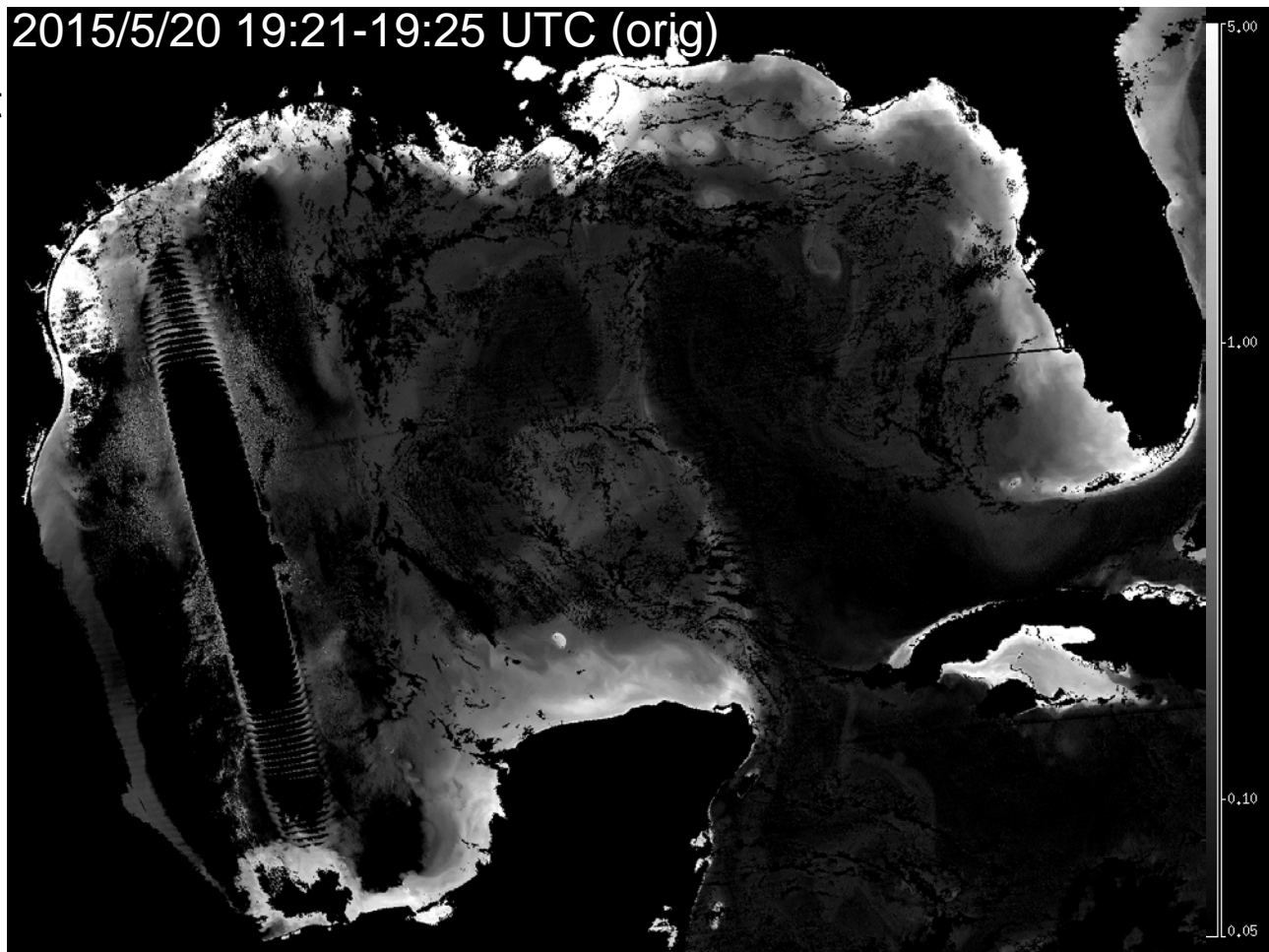
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2015/5/20 19:21-19:25 UTC (orig)



John Lamkin, NOAA/NMFS/SEFSC

NMFS/NCBO

The Chesapeake Atlantis Model (CAM)

A Holistic Ecosystem Model

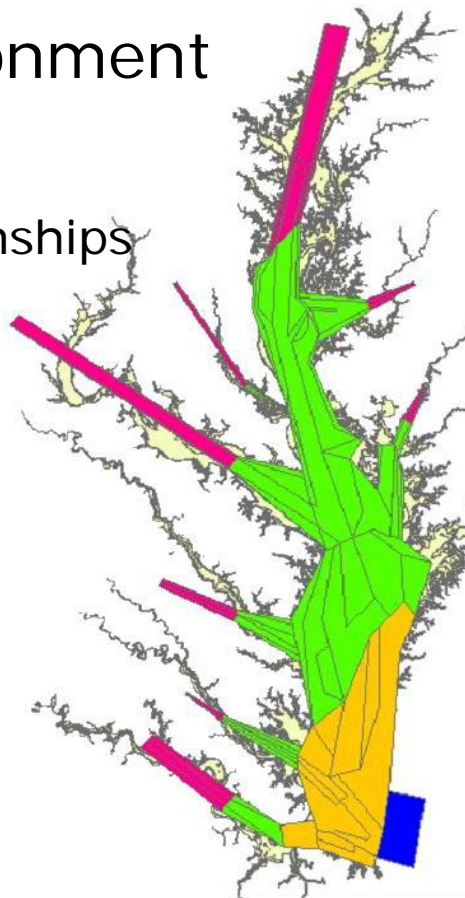
Incorporating:

Biological environment

- ✓Primary production
- ✓Trophic interactions
- ✓Recruitment relationships
- ✓Age structure
- ✓Size structure
- ✓Life History

Fisheries

- ✓Multiple sectors
- ✓Gears
- ✓Seasons
- ✓Spatially explicit



Physical environment

- ✓Geology
- ✓Chemistry
- ✓Circulation & currents
- ✓Temperature
- ✓Salinity
- ✓Water clarity (TSS)
- ✓Climate variability

Nutrient Inputs

- ✓Currency is Nitrogen
- ✓Oxygen
- ✓Silica
- ✓3 Detrital forms
- ✓Bacteria-mediated recycling

Conversion of VIIRS data to Ecosystem Model Grid

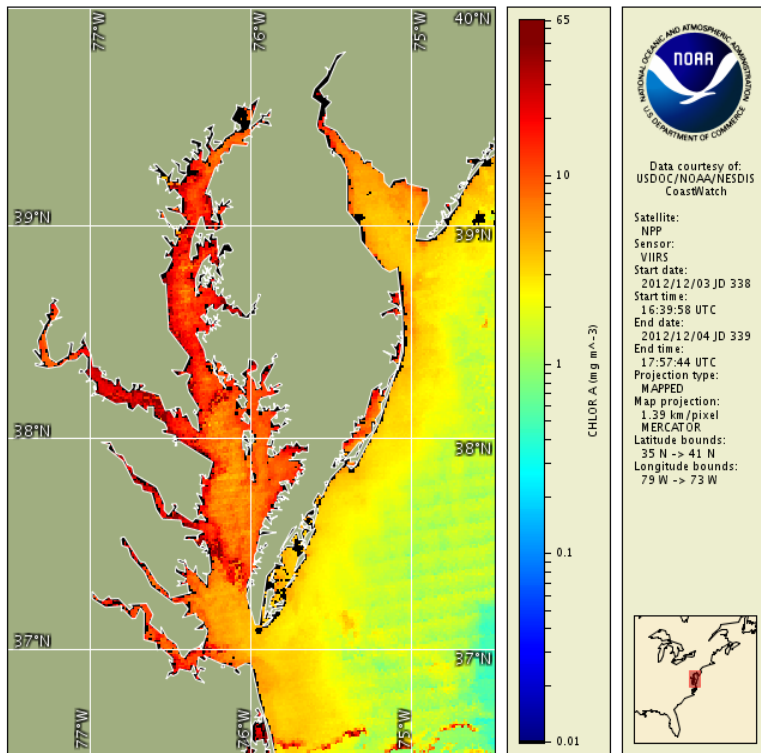
VIIRS satellite chlorophyll



Georeferenced
grid



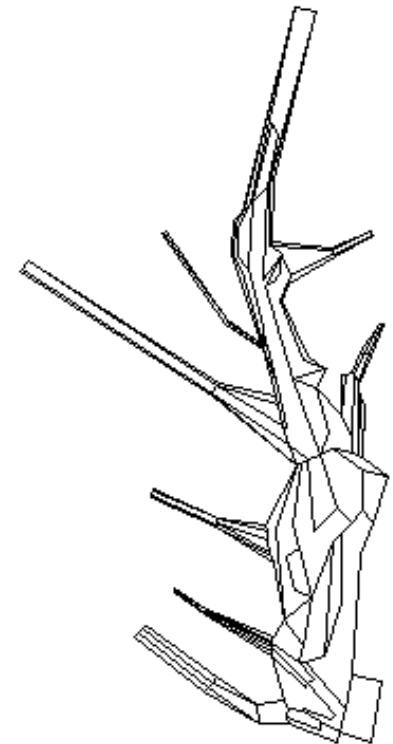
Ecosystem model
grid



S-NPP VIIRS chlorophyll
CoastWatch 2-day avg (Dec 3-4, 2012)
Raster data: UTM coordinates



Chesapeake Bay Program
Georeferenced polygonal grid
8,282 polygons



NOAA/NMFS/NCBO
Atlantis Ecosystem Model
97 polygons
Aggregated from 8,282

NOAA/NOS Harmful Algal Bloom Bulletins



Gulf of Mexico Harmful Algal Bloom Bulletin

Region: Southwest Florida

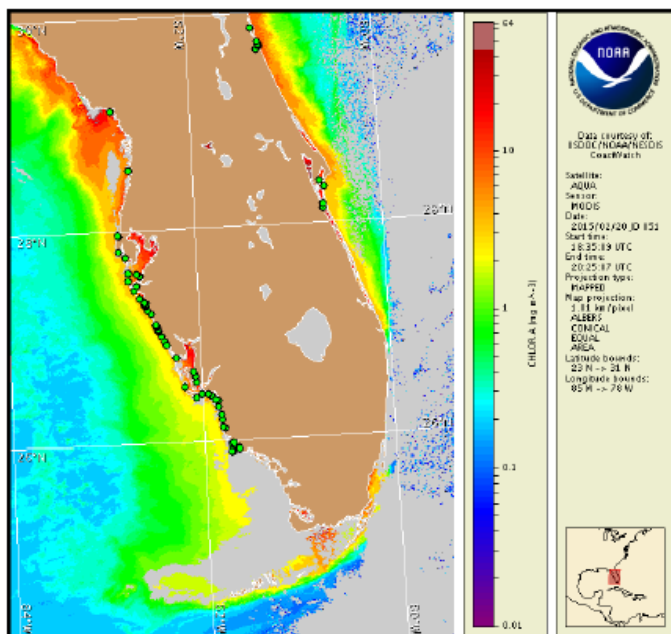
Monday, 23 February 2015

NOAA National Ocean Service

NOAA Satellite and Information Service

NOAA National Weather Service

Last bulletin: Tuesday, February 17, 2015



Satellite chlorophyll image with possible *K. brevis* HAB areas shown by red polygon(s), when applicable. Points represent cell concentration sampling data from February 13 to 20: red (high), orange (medium), yellow (low b), brown (low a), blue (very low b), purple (very low a), pink (present), and green (not present). Cell count data are provided by Florida Fish and Wildlife Conservation Commission (FWC) Fish and Wildlife Research Institute. For a list of sample providers and a key to the cell concentration categories, please see the HAB-OFS bulletin guide:

http://tidesandcurrents.noaa.gov/hab/habfs_bulletin_guide.pdf

Detailed sample information can be obtained through FWC Fish and Wildlife Research Institute at:

<http://myfwc.com/redtidestatus>

To see previous bulletins and forecasts for other Harmful Algal Bloom Bulletin regions, visit at: <http://tidesandcurrents.noaa.gov/hab/bulletins.html>

Conditions Report

There is currently no indication of *Karenia brevis* (commonly known as Florida red tide) along the coast of southwest Florida, including the Florida Keys. No respiratory irritation is expected alongshore southwest Florida Monday, February 23 through Monday, March 2.

Check http://tidesandcurrents.noaa.gov/hab/beach_conditions.html for recent, local observations.

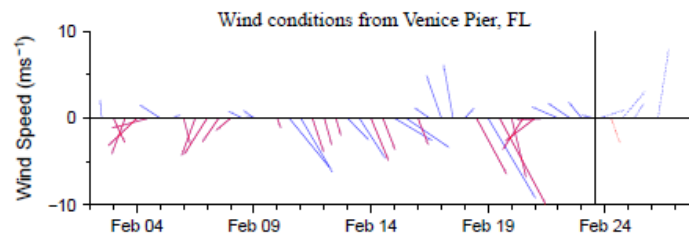
Analysis

The most recent samples received from along- and offshore southwest Florida, from Pinellas to Collier counties, all indicate that *Karenia brevis* is not present (FWRI, MML, SCHD, CCPCPD; 2/14-19).

Recent MODIS Aqua imagery (2/20, shown left) is obscured by clouds from alongshore Collier County to the Florida Keys, limiting analysis. Elevated chlorophyll ($2-4 \mu\text{g/L}$) is visible along- and offshore the coast of southwest Florida from Pinellas to Collier counties.

Harmful algal bloom formation at the coast of southwest Florida is not expected today through Monday, March 2.

Kavanaugh, Davis



Wind speed and direction are averaged over 12 hours from buoy measurements. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts. Wind observation and forecast data provided by NOAA's National Weather Service (NWS).

Wind Analysis

Englewood to Tarpon Springs (Venice): Variable winds (5-10kn, 3-5m/s) today through Tuesday. Southerly winds (5-20kn, 3-10m/s) Wednesday becoming northerly winds (10-15kn, 5-8m/s) Thursday through Friday.

NOAA/NOS Harmful Algal Bloom Bulletins



Gulf of Mexico Harmful Algal Bloom Bulletin

Region: Southwest Florida

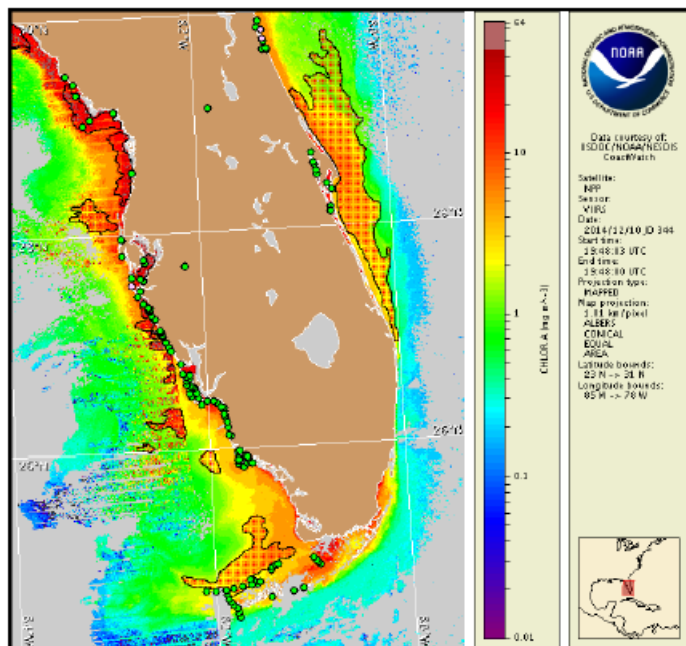
Friday, 12 December 2014

NOAA National Ocean Service

NOAA Satellite and Information Service

NOAA National Weather Service

Last bulletin: Tuesday, May 27, 2014



Satellite chlorophyll image with possible *K. brevis* HAB areas shown by red polygon(s), when applicable. Points represent cell concentration sampling data from December 2 to 11: red (high), orange (medium), yellow (low b), brown (low a), blue (very low b), purple (very low a), pink (present), and green (not present). Cell count data are provided by Florida Fish and Wildlife Conservation Commission (FWC) Fish and Wildlife Research Institute. For a list of sample providers and a key to the cell concentration categories, please see the HAB-OFB bulletin guide:

http://tidesandcurrents.noaa.gov/hab/habfb_bulletin_guide.pdf

Detailed sample information can be obtained through FWC Fish and Wildlife Research Institute at:

<http://myfwc.com/redtidesatus>

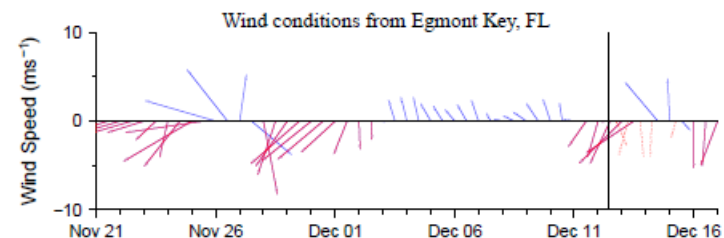
To see previous bulletins and forecasts for other Harmful Algal Bloom Bulletin regions, visit at: <http://tidesandcurrents.noaa.gov/hab/bulletins.html>

Conditions Report

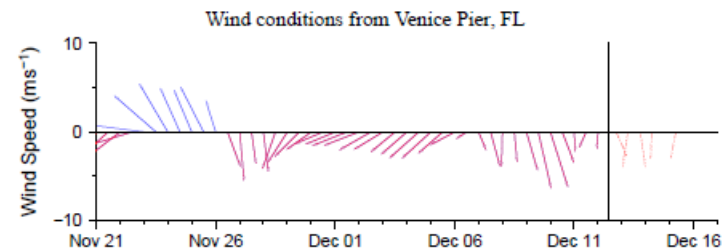
Does the image look good to you?

Analysis

Blah blah blah



Wind speed and direction are averaged over 12 hours from buoy measurements. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts. Wind observation and forecast data provided by NOAA's National Weather Service (NWS).



Wind Analysis

Test for VIIRS products

- JPSS PGRR Program has supported integration of VIIRS ocean color data into HAB bulletins
- CoastWatch is working with NOS & NWS as part of the NOAA Ecological Forecasting Initiative

NOAA/NOS Harmful Algal Bloom Bulletins



Gulf of Mexico Harmful Algal Bloom Bulletin

Region: Southwest Florida

Friday, 12 December 2014

NOAA National Ocean Service

NOAA Satellite and Information Service

NOAA National Weather Service

Last bulletin: Tuesday, May 27, 2014

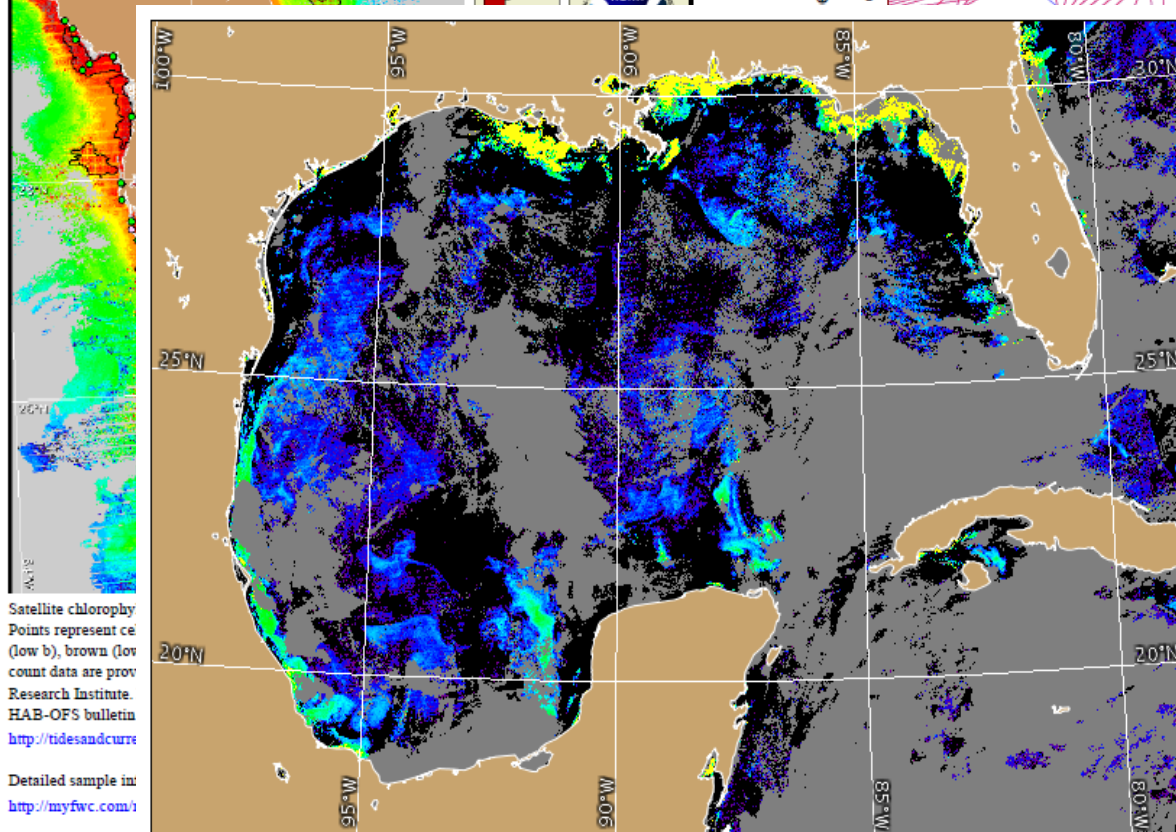
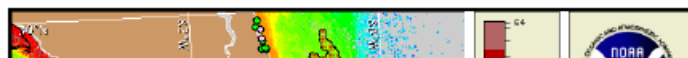
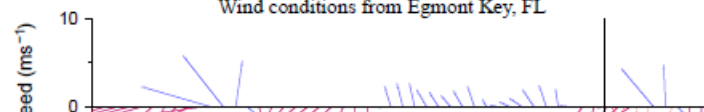
Conditions Report

Does the image look good to you?

Analysis

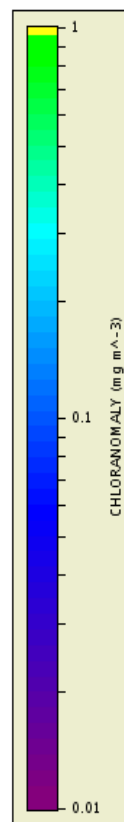
Blah blah blah

Wind conditions from Egmont Key, FL



Satellite chlorophyll
Points represent ce
(low b), brown (low
count data are prov
Research Institute.
HAB-OFS bulletin
<http://tidesandcurrents.noaa.gov/hab/bulletins.html>

Detailed sample in:
<http://myfwc.com/>



Data courtesy of:
USDOC/NOAA/NESDIS
CoastWatch

Satellite:
NPP
Sensor:
VIIRS
Date:
2015/02/07 JD 038
Start time:
17:54:30 UTC
End time:
19:41:09 UTC
Projection type:
MAPPED
Map projection:
0.61 km/pixel
ALBERS
CONICAL
EQUAL
AREA
Latitude bounds:
16 N -> 32 N
Longitude bounds:
101 W -> 77 W



To see previous bulletins and forecasts for other Harmful Algal Bloom Bulletin regions, visit
at: <http://tidesandcurrents.noaa.gov/hab/bulletins.html>

NOAA/NOS Weekly Lake Erie HAB Bulletin (MERIS 2009-2011, now MODIS, soon OLCI)



**Experimental
Lake Erie Harmful Algal Bloom Bulletin**
2011-008
08 September 2011
National Ocean Service
Great Lakes Environmental Research Laboratory
Last bulletin: 22 July 2011

**Bloom
from
MERIS**

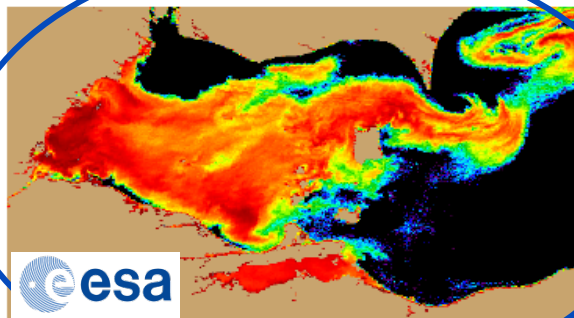


Figure 1. MERIS image from the European Space Agency. Imagery shows the spectral shape at 681 nm from September 03, where colored pixels indicate the likelihood of the last known position of the *Microcystis* spp. bloom (with red being the highest concentration). *Microcystis* spp. abundance data from shown as white squares (very high), circles (high), diamonds (medium), triangles (low), + (very low) and X (not present).

**Forecast
(with Great
Lakes CFS)**

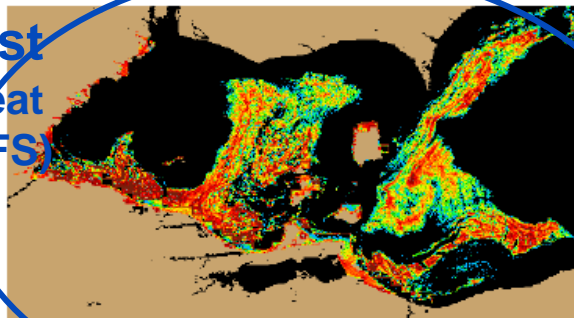


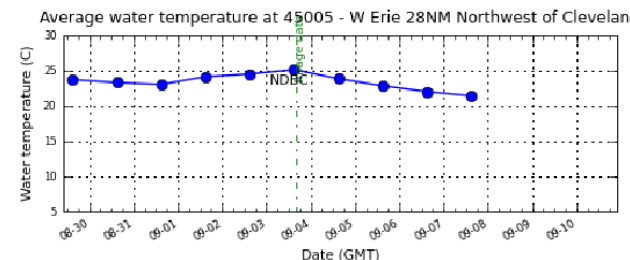
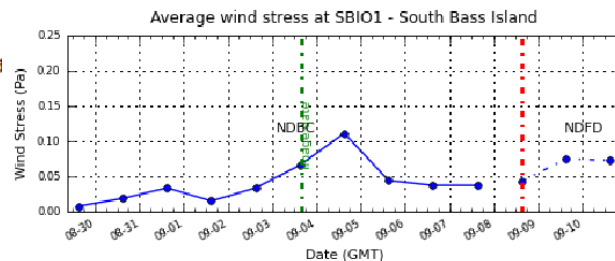
Figure 2. Nowcast position of *Microcystis* spp. bloom for September 08 using GLCFS modeled currents to move the bloom from the September 03 image.

Conditions: A massive *Microcystis* bloom persists throughout most of Lake Erie's Western Basin.

Analysis: As indicated in satellite imagery from Saturday (9/3/2011), an enormous *Microcystis* bloom was present in western Lake Erie. The southern extent of the bloom was remotely observed along the coast of Ohio from Maumee Bay to Catawba Island. The northern extent of the bloom was observed to be consistent along the Michigan coast from Northern Maumee Bay to the mouth of the Detroit River. The eastern-most portion of the bloom was observed past Point Pelee and to the northeast up in to Rondeau Provincial Park.

At the mouth of the Detroit River, a five day nowcast shows a southward suppression of the western-most portions of the bloom. However, the bloom is likely to still persist in much of the Western Basin. The nowcast also suggest the bloom has spread to the east of Sandusky and into the Cleveland area. (Note: Due to a lack of clear imagery the bloom has not been remotely observed in the Cleveland area.) A three day forecast also suggests that the bloom will persist to the north of Cleveland through the weekend. Water temperatures remain above 20 degrees Celsius and are forecast to decrease into the weekend; however, conditions remain favorable for bloom growth.

Bridge Winds



Over 700 subscribers to bulletin

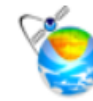
OCEAN COLOR TOOLS FOR REEF MANAGERS

NOS CORAL REEF CONSERVATION PROGRAM & NESDIS

<http://coralreefwatch.noaa.gov/satellite/research/oceancolor.php>



NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)



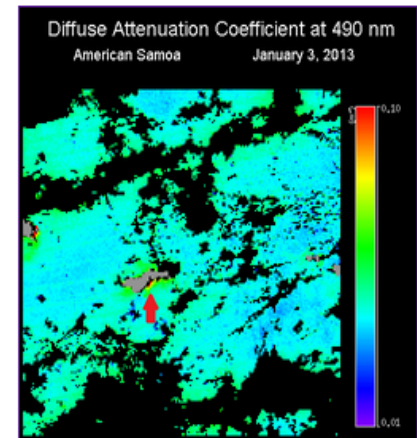
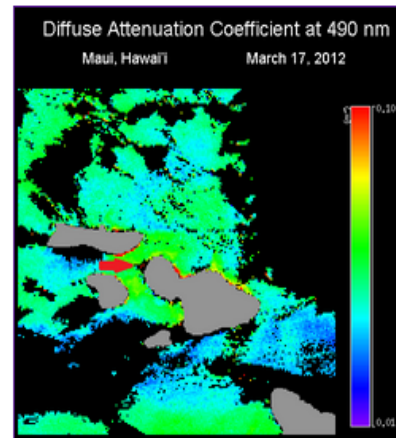
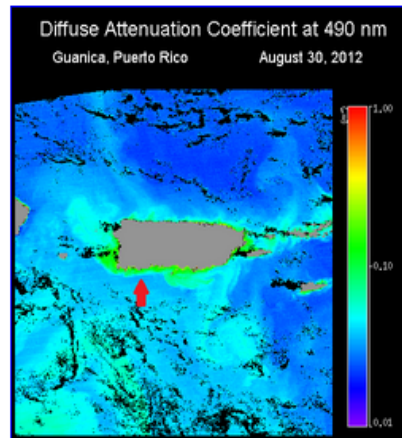
Coral Reef Watch

CRTF | CRCP | CREIOS | CoRIS

DOC > NOAA > NESDIS > STAR > CRW



Satellite Ocean Color Product Development



[CRW Home](#)

[Product Overview](#)

[Near-Real-Time Data](#)

[Experimental Products](#)

[Research Activities](#)

[Ocean Color](#)
[Projections: OA/Bleaching](#)
[Ocean Acidification](#)
[Hydrodynamic Modeling](#)
[Paleoclimatology](#)
[High-resolution SST](#)
[Decision Support System](#)
[QCed Bleaching Obs](#)

[Outreach/Education](#)

[NOAA Coral Reef Watch](#) and [NOAA/NESDIS' Ocean Color Team](#) are working closely with partners in the U.S. Coral Reef Task Force (USCRTF) Watershed Working Group (WWG) to develop pilot satellite ocean color products using data from the [Visible Infrared Imaging Radiometer Suite \(VIIRS\)](#) aboard the [Suomi National Polar-orbiting Partnership \(S-NPP\)](#) [satellite](#) operated by the [NASA-NOAA Joint Polar Satellite System \(JPSS\)](#).

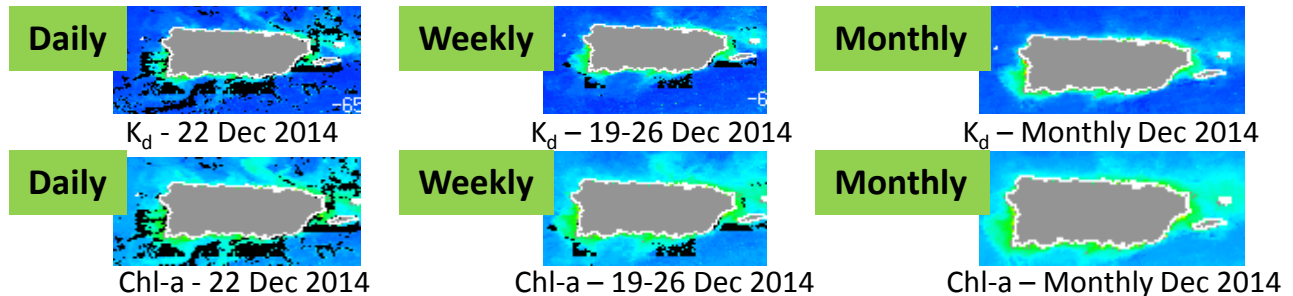
From [Coral Reef Watch](#)

Developing VIIRS Ocean Color Products for Coral Reef Ecosystem Managers

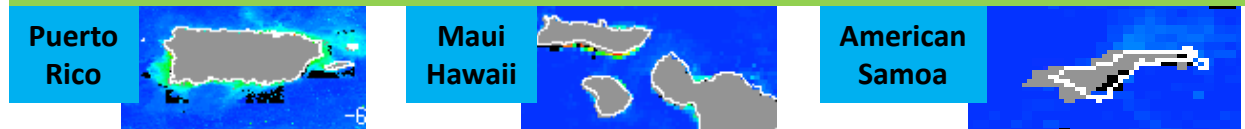
AE Strong¹, M Wang², CM Eakin¹, W Hernandez³, M Cardona³ and E Geiger¹
NOAA/NESDIS/STAR Coral Reef Watch¹ & VIIRS Ocean Color Team²
With University of Puerto Rico's Bio-Optical & Oceanography Lab³

VIIRS will be used
to help coral reef
managers assess
land-based pollution
flowing over reefs in
Puerto Rico, Hawaii,
and American
Samoa using:

- Anomalies of $K_d(490)$, Chl-a, and SST
- Virtual Areas (VA) established defining stream outflow over reefs



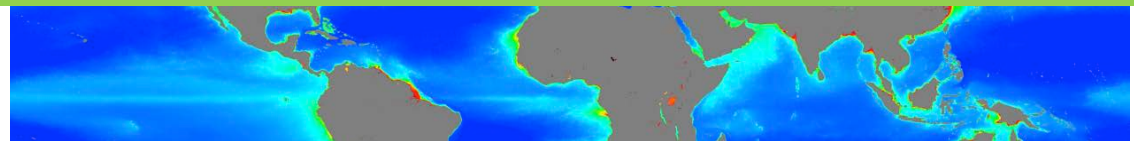
Weekly K_d - All Three Major US Coral Reef Task Force Watersheds



True Color- All Three Major US Coral Reef Task Force Watersheds

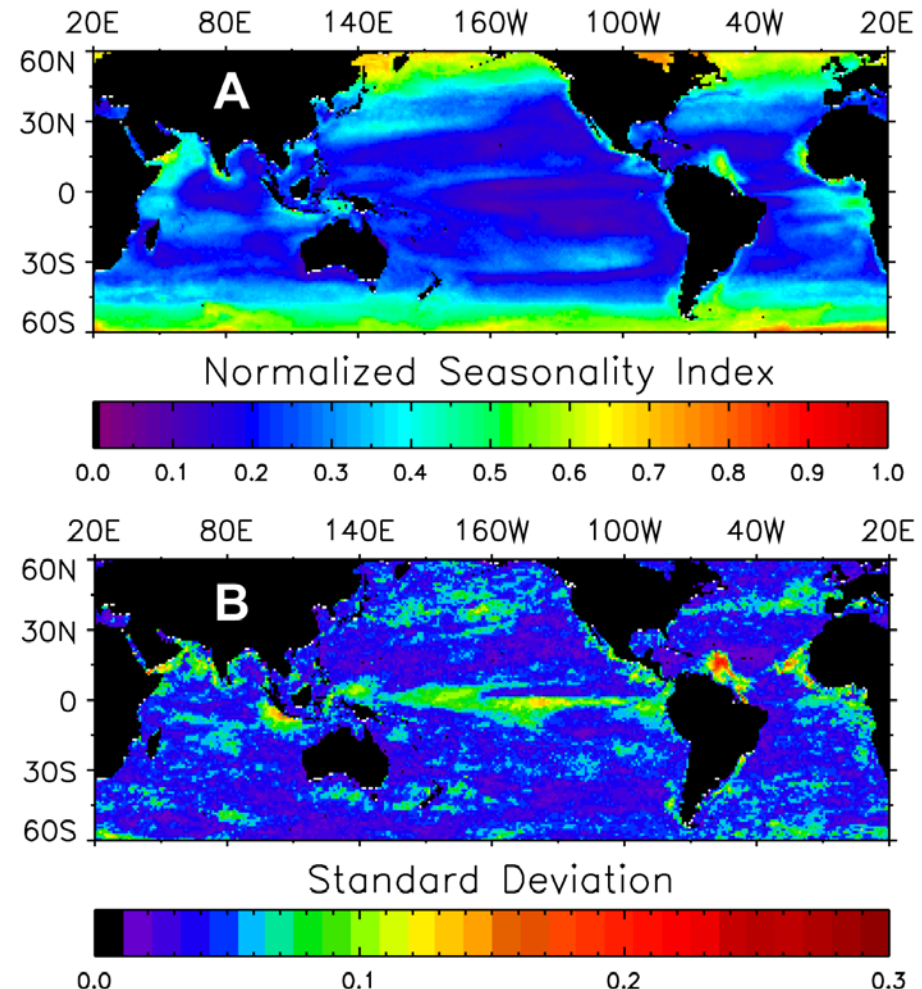


Mar 2012 to Oct 2014 - K_d Climatology



NESDIS Climate Research: Episodicity of Oceanic Primary Productivity

- Documented the intermittency of satellite-derived, oceanic net primary production (NPP) and its interannual variability quantified from 1998 to 2007
- Useful in assessing the response of marine ecosystems to environmental change
- Calculated a normalized seasonality index (NSI), which is based upon production half-time, from 8-day NPP
- First global images of the mean distribution pattern of intermittency of NPP and its interannual variability
- Establishes a baseline from which to assess future changes and relate to oceanic variables and climate indices

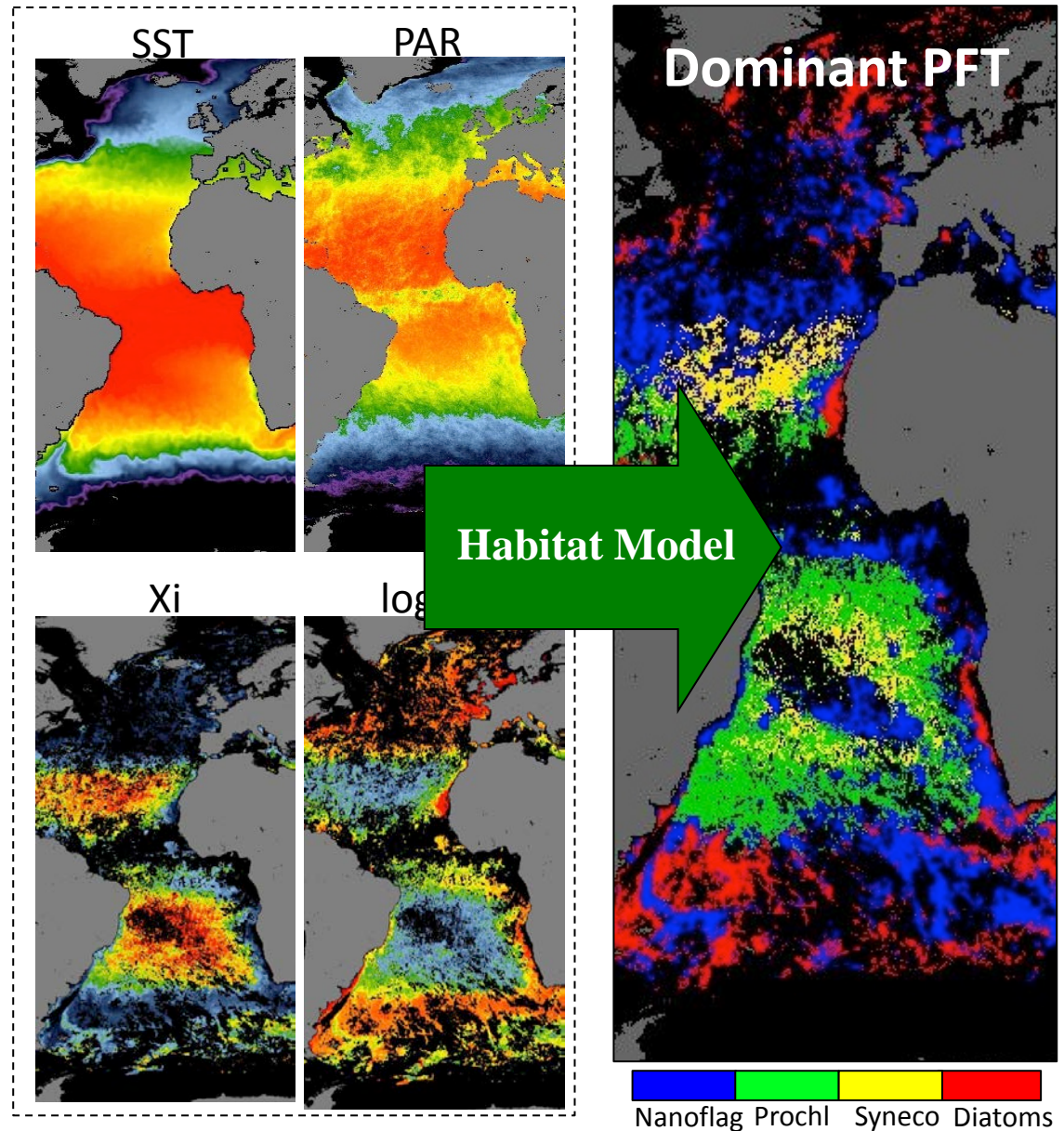


(A) Mean and (B) standard deviation of the normalized seasonality index calculated from VGPM net primary production from 60°S – 60°N for the years 1998 to 2007. Polar latitudes were excluded because of inadequate sample size. VGPM = Vertically Generalized Production Model.

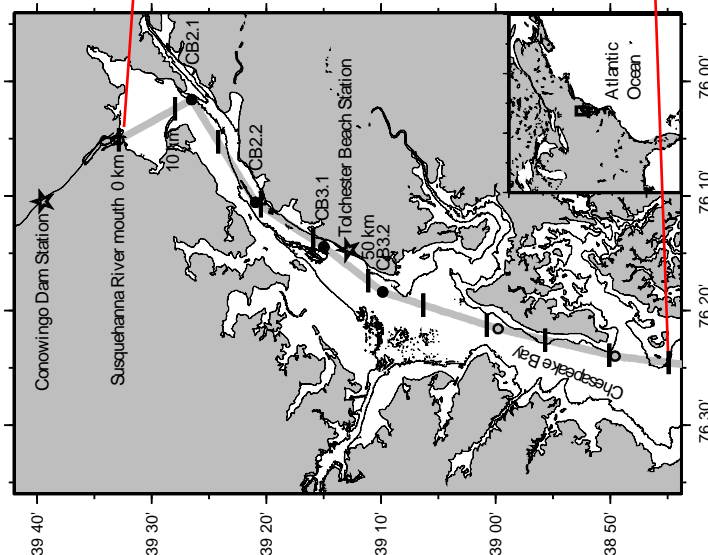
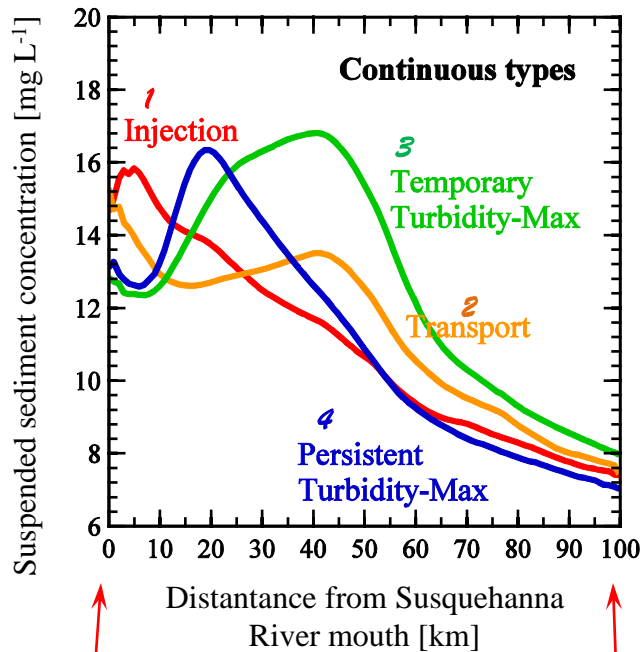
Brown et al., 2014, Seasonality of oceanic primary production and its interannual variability from 1998 to 2007 DSR I Vol 90: 166-175.

Predicting PFTs Using Habitat Models

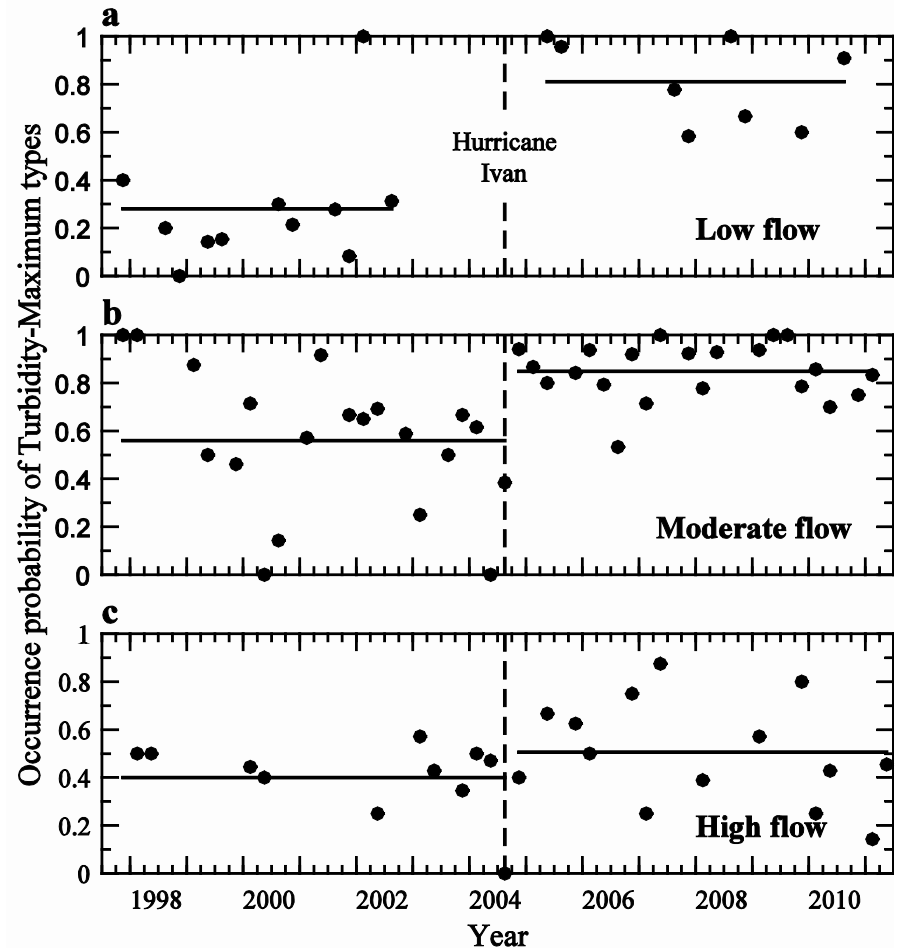
- UNH and NESDIS are developing method to predict PFTs
- Apply empirical habitat model to satellite- and model-derived variables, e.g. SST and PSD
- Generate map of the probable distribution of four PFTs. Map displaying dominant group shown.



Evolution of sediment plumes in the upper Chesapeake Bay



- Sediment plumes in the upper Chesapeake Bay can be categorized into four types.
- Sediment plumes evolve in a consecutive fashion into one of these types after flood events in the Susquehanna River.



- The probability of seeing the Turbidity-Max types were elevated to a new level after Hurricane Ivan (2004).



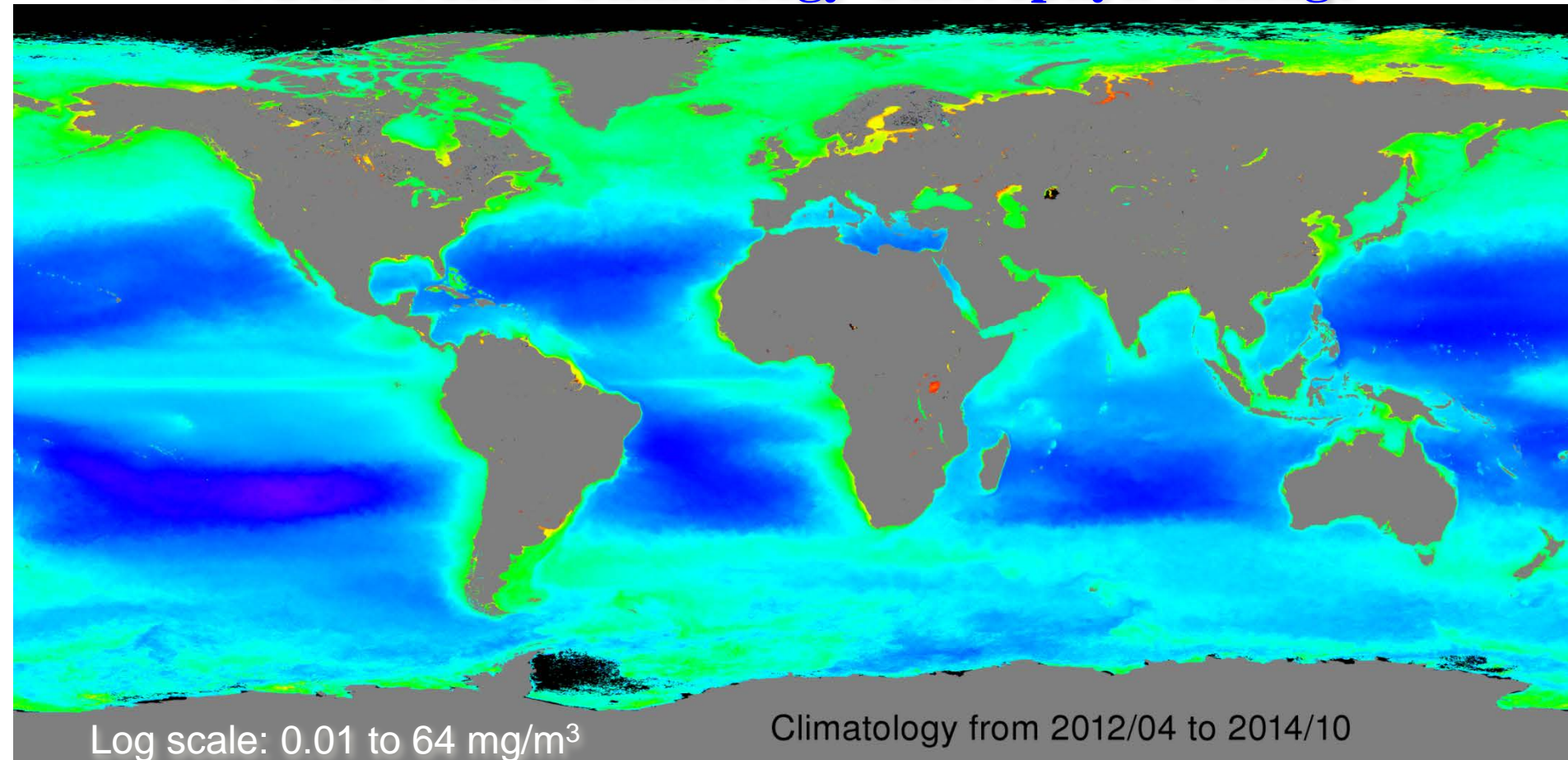
Gilfillan
Auditorium

 **We ❤️ VIIRS!!!** 
Thanks to the JPSS Proving Ground & Risk Reduction
initiative for making this class possible!

The 2013 NOAA Ocean Satellite Data Class

Not a complete photo – 9 people missing

NOAA VIIRS Climatology Chlorophyll-a Image



- NOAA Ocean Color Team has been developing/building the capability for the **End-to-End** satellite ocean color data processing including (<http://www.star.nesdis.noaa.gov/sod/mecb/color/>):
 - Level-0 to Level-1B (or Raw Data Records (RDR) to Sensor Data Records (SDR)).
 - Level-1B (SDR) to ocean color Level-2 (Environmental Data Records (EDR)).
 - Level-2 to global Level-3 (**routine daily, 8-day, monthly, and climatology** data/images).
- Capability for on-orbit instrument calibration (MODIS, VIIRS, etc.).
- Support of in situ data collections for VIIRS Cal/Val activities, e.g., **MOBY, AERONET-OC** sites, **NOAA dedicated cruise**, etc.

NOAA Ocean Color Team

Welcome to VIIRS Ocean Color EDR Team Web Site



STAR Center for Satellite
Applications and Research **VIIRS Ocean Color EDR Team**

The ocean color research team in the Center for Satellite Applications and Research (STAR) of NOAA/NESDIS seeks to develop improved ocean color products from the current and future ocean color satellite sensors including the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), the Moderate Resolution Imaging Spectroradiometer (MODIS) on the both Terra and Aqua, and the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi National Polar-orbiting Partnership (SNPP) and the Joint Polar Satellite System (JPSS), as well as various satellite sensors from other countries, e.g., the Medium Resolution Imaging Spectrometer (MERIS), Geostationary Ocean Color Imager (GOCI), Ocean Land Colour Instrument (OLCI), Second-Generation Global Imager (SGLI), etc. The ocean color research team is currently focusing on (1) satellite ocean color instrument (e.g., VIIRS, MODIS) characterization and calibration, (2) understanding, evaluation, and refining satellite ocean color data processing system, (3) routine global ocean color data processing from Level-1, Level-2, and Level-3, (4) development and improvement of satellite retrieval algorithms in global open ocean and coastal and inland water regions, (5) in situ data processing, evaluation, and improvement, (6) implementing and transition research algorithms to the NOAA operational data system, and (7) various ocean color data applications in global open ocean and the inland and coastal waters.

Here we show results from VIIRS-SNPP.

Please select the page to visit:

[VIIRS EDR Composite Images](#) ← Link to composite image page

[Calibration/Validation](#) ← Link to calibration/validation page

[Team Publications](#) ← List of the team publications

[Software Download](#)

[Internal Access \(password protected\)](#)

For detailed information about this site, please refer to the [description pdf file](#). ← Website description

Summary of NOAA VIIRS Ocean Color EDR Products

- **Inputs:**
 - VIIRS M1-M7 and the **SWIR M8, M10, and M11** bands SDR data
 - Terrain-corrected geo-location file
 - Ancillary meteorology and ozone data
 - **Operational (Standard) Products (8):**
 - Normalized water-leaving radiance (nL_w 's) at VIIRS visible bands M1-M5
 - Chlorophyll-a (Chl-a) concentration
 - Diffuse attenuation coefficient for the downwelling spectral irradiance at the wavelength of 490 nm, $K_d(490)$ (**New**)
 - Diffuse attenuation coefficient of the downwelling photosynthetically available radiation (PAR), $K_d(\text{PAR})$ (**New**)
 - Level-2 quality flags
 - **Experimental Products:**
 - Inherent Optical Properties (IOP-a, **IOP-a_{ph}**, **IOP-a_{dg}**, **IOP-b_b**, **IOP-b_{bp}**) at VIIRS M2 or other visible bands (M1-M5) from the Quasi-Analytical Algorithm (QAA) (Lee et al., 2002)
 - Photosynthetically Available Radiation (PAR) (R. Frouin)
 - Chlorophyll-a from ocean color index (OCI) method (Hu et al., 2012)
 - Others from users requests
- Data quality of ocean color EDR are extremely sensitive to the SDR quality. It requires **~0.1%** data accuracy (degradation, band-to-band accuracy...)!

NOAA Multi-Sensor Level-1 to Level-2 (MSL12)

Ocean Color Data Processing

➤ Multi-Sensor Level-1 to Level-2 (MSL12)

- ✓ MSL12 was developed during NASA SMIBIOS project (1997-2003) for a consistent multi-sensor ocean color data processing (Wang, 1999; Wang and Franz, 2000), i.e., it is measurement-based ocean color data processing system.
- ✓ It has been used for producing ocean color products from various satellite ocean color sensors, e.g., SeaWiFS, MOS, OCTS, POLDER, MODIS, GOCI, etc.

➤ NOAA-MSL12 Ocean Color Data Processing

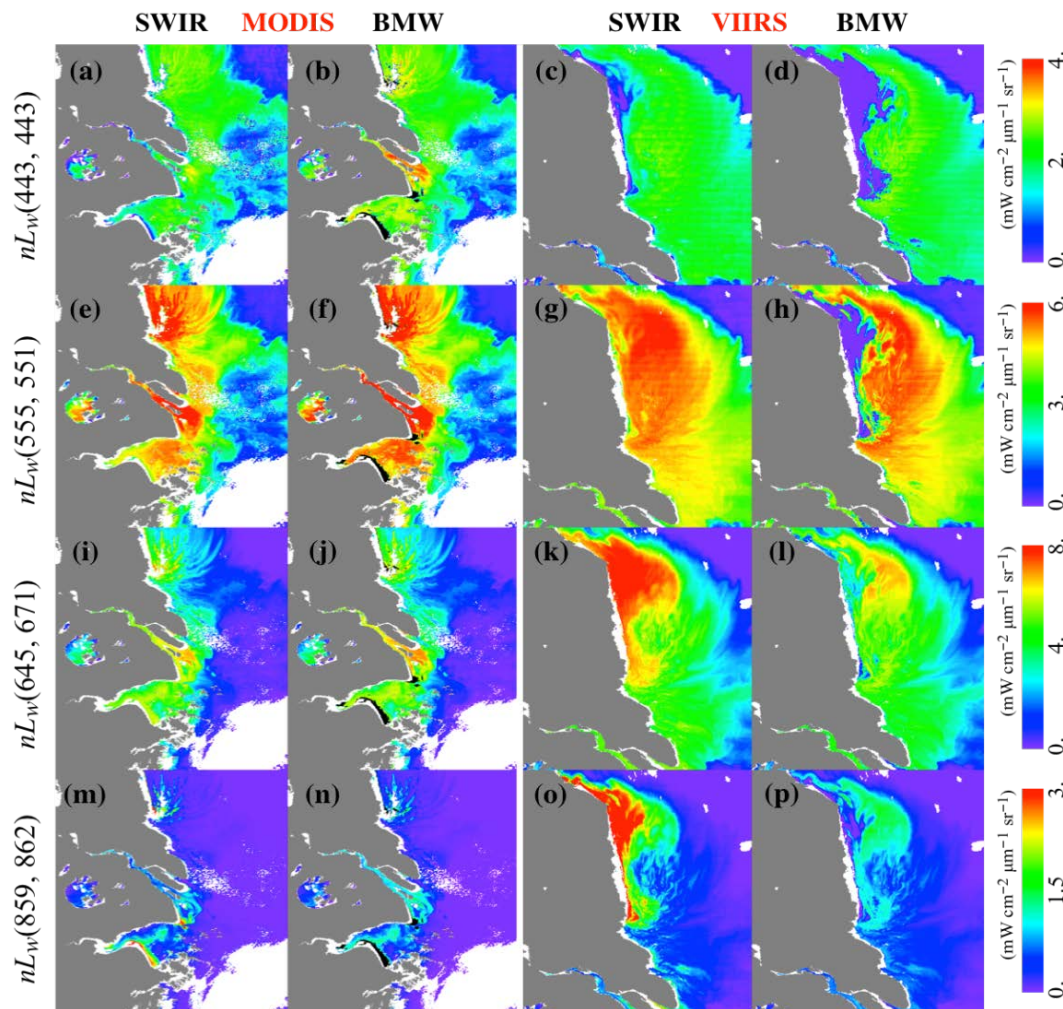
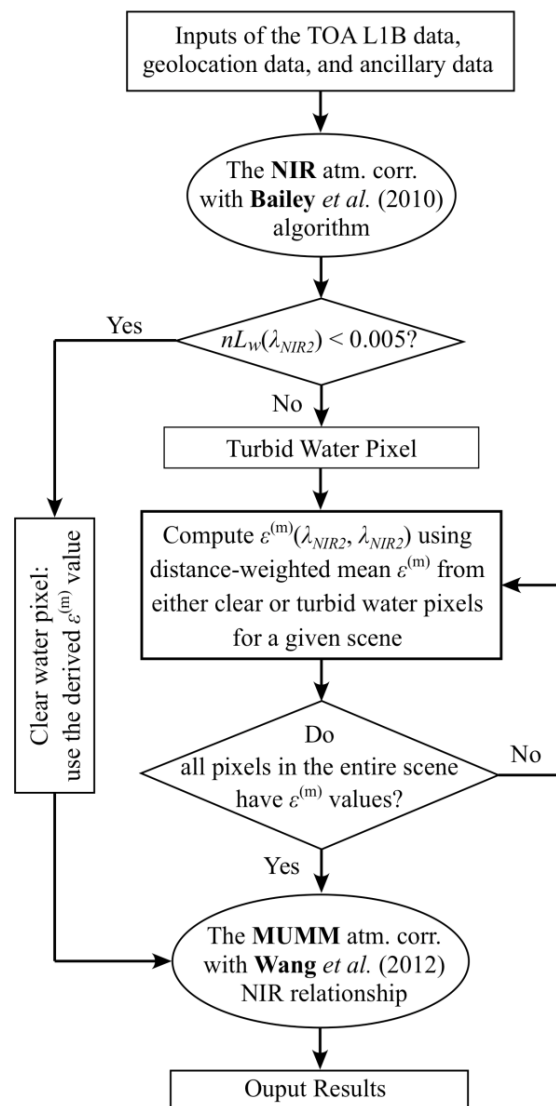
- ✓ NOAA-MSL12 is based on SeaDAS version 4.6.
- ✓ Some significant improvements: (1) the SWIR-based data processing, (2) Rayleigh and aerosol LUTs, (3) algorithms for detecting absorbing aerosols and turbid waters, (4) ice detection algorithm, (5) improved straylight/cloud shadow algorithm, & others.
- ✓ In 2014, some new algorithms (BMW–new NIR reflectance correction, Destriping, $K_d(\text{PAR})$, etc.)

➤ NOAA-MSL12 for VIIRS (and others) Ocean Color Data Processing

- ✓ Routine ocean color data processing (daily, 8-day, monthly) since VIIRS launch.
- ✓ Coastal turbid and inland waters from other approaches, e.g., the **SWIR approach**, results in the US east coastal, China's east coastal, Lake Taihu, Lake Okeechobee, Aral Sea, etc.
- ✓ Capability for multi-sensor ocean color data processing, e.g., MODIS-Aqua, VIIRS, GOCI, and will add J1, OLCI/Sentinel-3, and SGLI/GCOM-C data processing capability.

Developed a new NIR ocean reflectance correction algorithm: BMW (*Bailey* (2010), *MUMM* (2000), and *Wang* (2012))

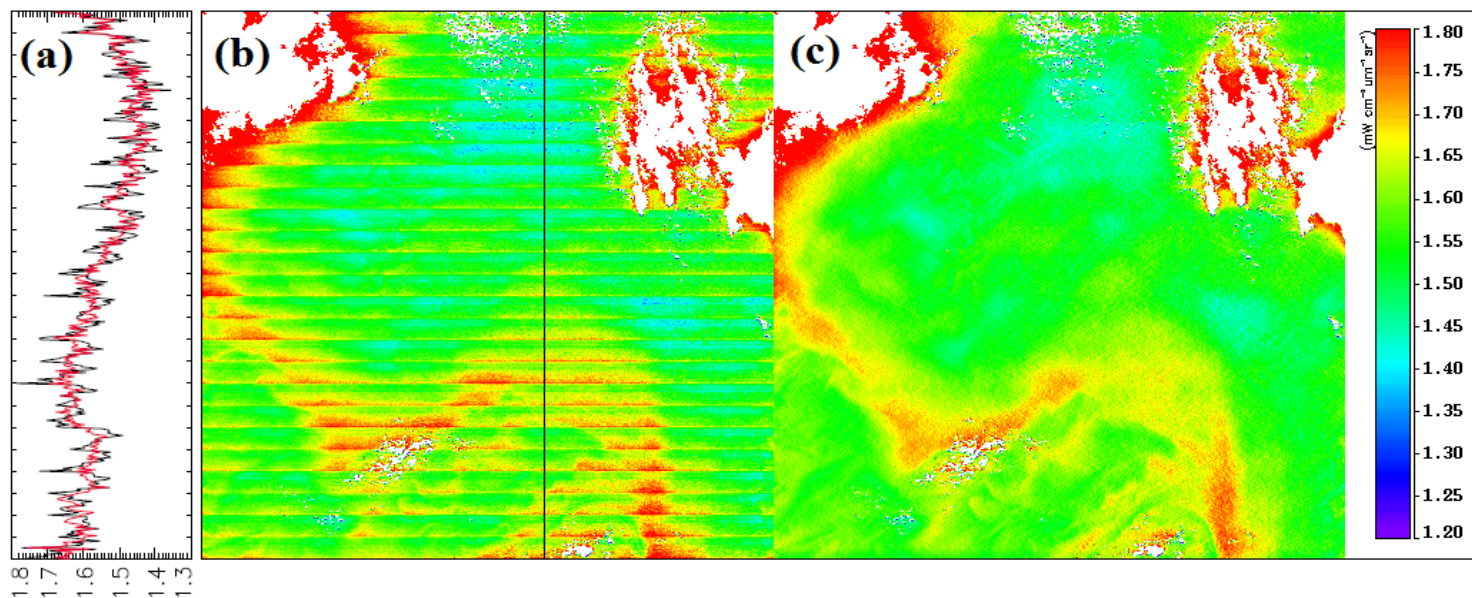
The BMW Algorithm for Ocean Color Data Processing



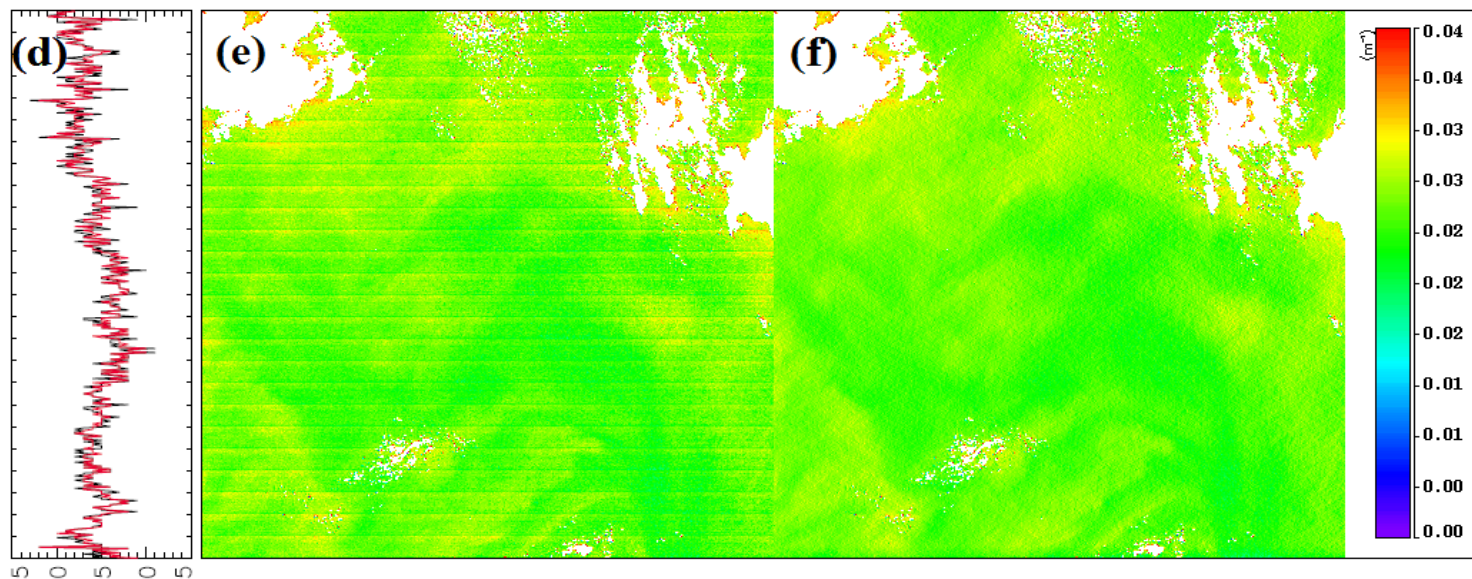
Comparisons of MODIS and VIIRS-derived $nL_w(\lambda)$ images at four selected bands.

Destriping of VIIRS Ocean Color Products (Examples)

$nL_w(412)$

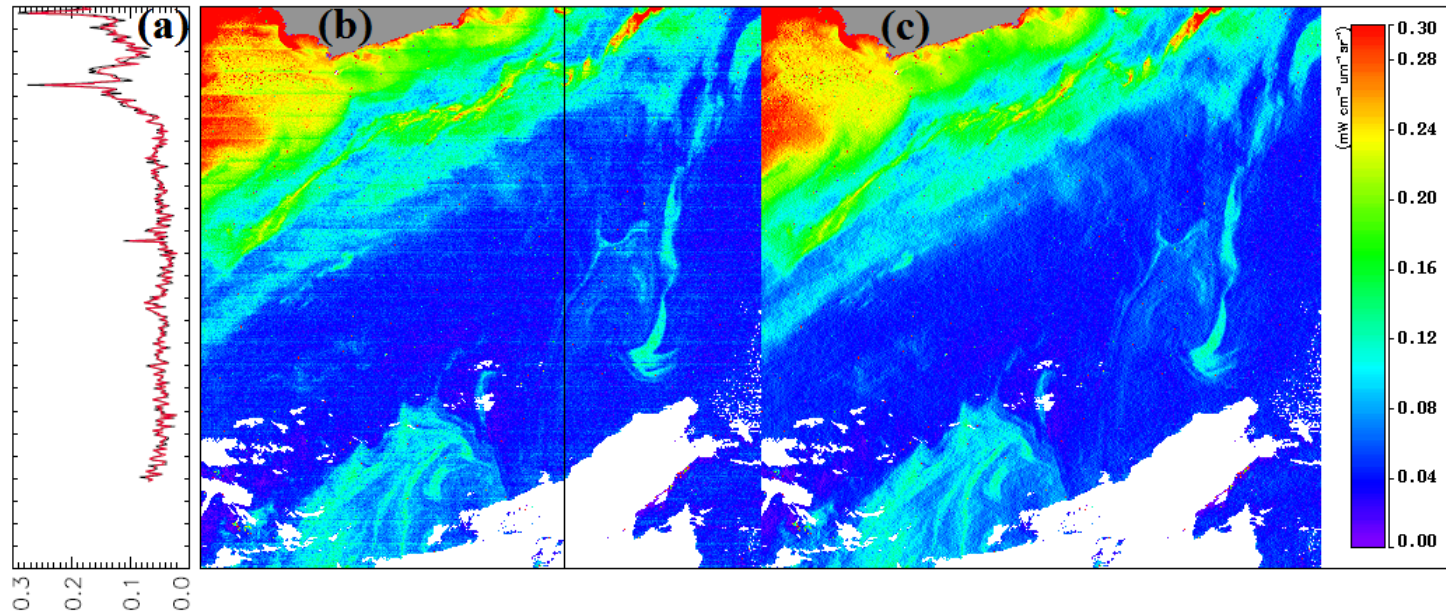


$K_d(490)$

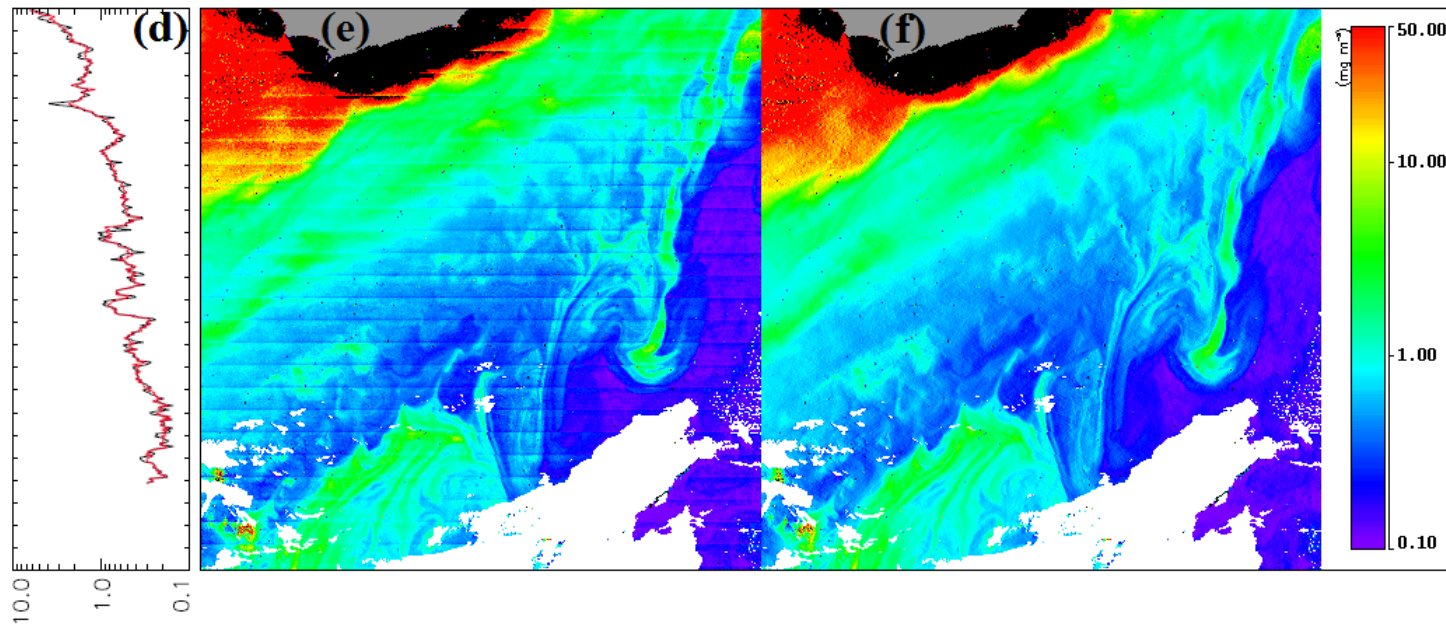


Destriping of VIIRS Ocean Color Products (Examples)

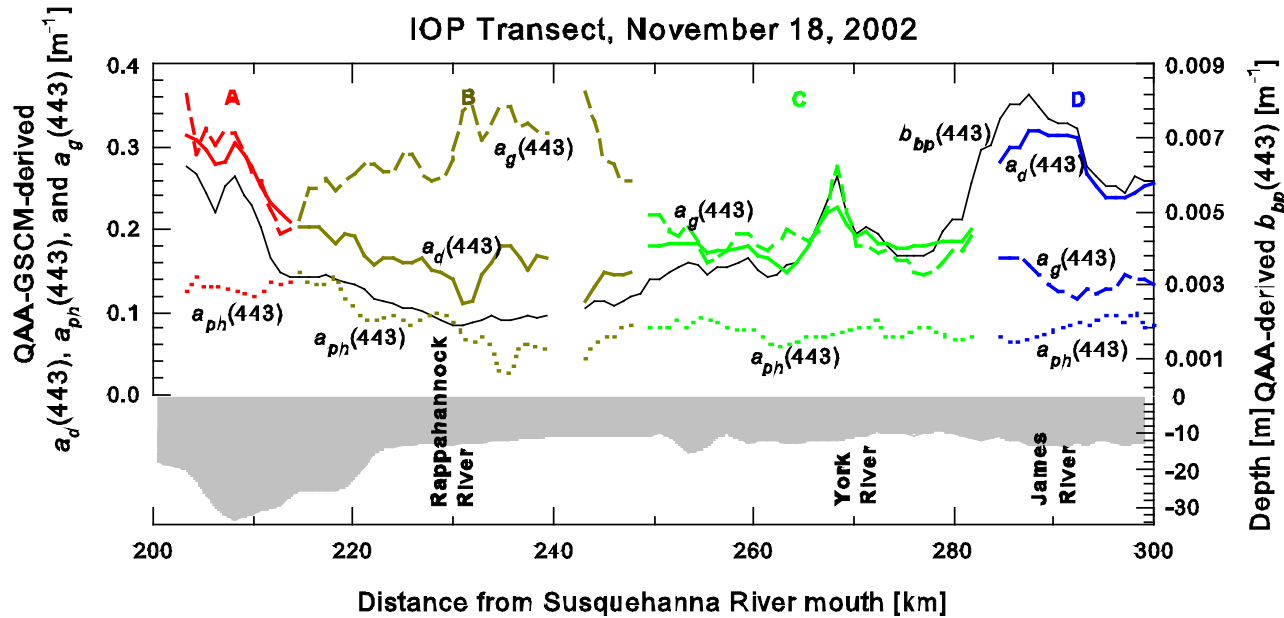
$nL_w(671)$



Chlorophyll-a



Water mass identification in the lower Chesapeake Bay



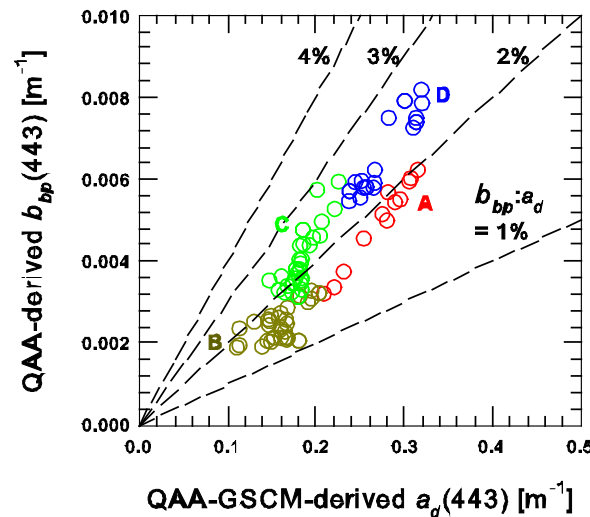
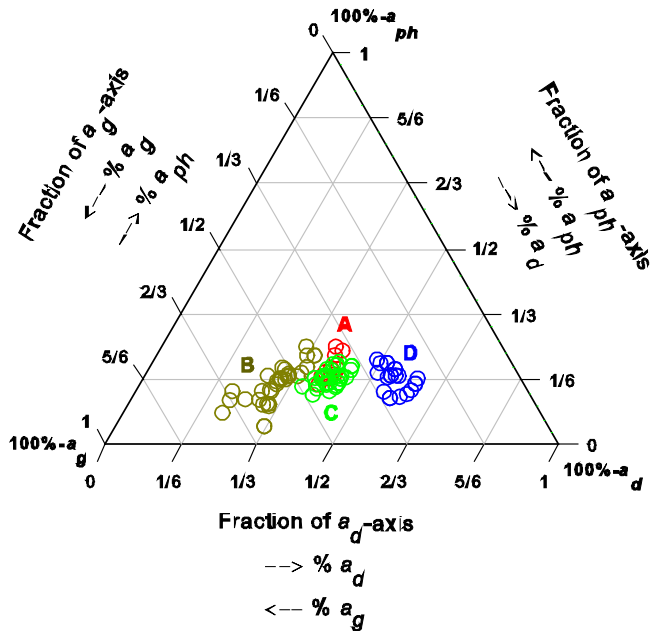
- Water masses were identified based on proportions of phytoplankton, detrital, and CDOM absorption coefficients as well as the ratio between particulate backscattering and detrital absorption coefficients.

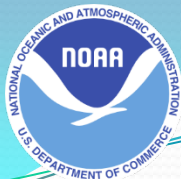
On this snapshot:

- The Rappahannock River plume (B) appear to be a “Tea-colored” type with high CDOM absorption and low backscattering.

- In contrast, the James River plume (D) is a “Turbid” type with high detrital absorption, high backscattering, but low CDOM absorption.

- The Potomac and York River plumes appear to be similar and a mixture of “Tea-colored” and “Turbid” plumes.



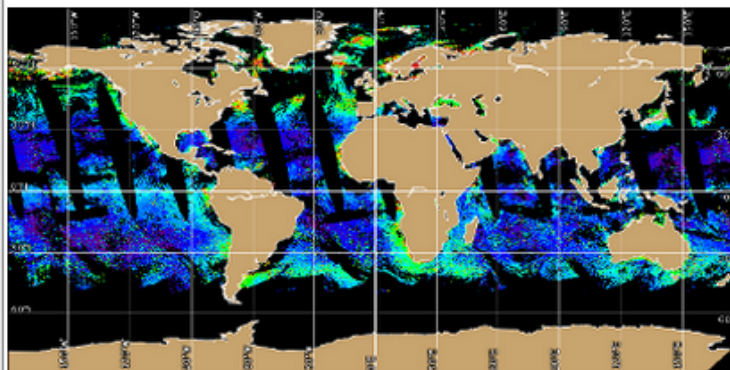


NOAA CoastWatch

[Home](#)[History](#)[Regional Nodes](#)[Data Access](#)[Data Products](#)[Applications](#)[Science](#)[Reports](#)[Resources](#)☒ CoastWatch ☐ NOAA

NOAA CoastWatch
NCWCP E/RA3
College Park, MD 20740
301.683.3335
coastwatch.info@noaa.gov

Central Operations & Regional Nodes



VIIRS ocean color data products are being processed by NOAA CoastWatch on an experimental basis.

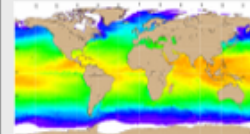
Global 4km chlorophyll-a (single file) and 750m (24 sector tiles) and CONUS (CoastWatch regions) are produced daily. Both CONUS and GLOBAL 750m (L2,L3) products are available through the CoastWatch THREDDS Server.

Level-2 granules can be browsed by using the CoastWatch Granule Selector. The selector allows visualization of a granule's geographic coverage with quick access to the Level-2 dataset.

Sentinel-3

NOAA OceanWatch and other US partners are in discussions with EUMETSAT to develop pre-operational support for Sentinel-3 data and products. [\[more\]](#)

Featured Image



Global daily 5km SST product is now available.

[More Information](#)

Applications



News

GOES SST filenames have changed to be consistent with other geostationary products. Files now include the satellite in the filename: sst3b_[goes,mtsats,msg]_YYYY [DEC 2014]

MODIS ~250m True Color and GOES SST products are now available on [ftpcoastwatch.noaa.gov](http://coastwatch.noaa.gov) [FEB 2014]



NOAA Satellites and Information

National Environmental Satellite, Data, and Information Service



[PRIVACY](#) | [CONTACT US](#)

Department of Commerce

<http://coastwatch.noaa.gov/>
coastwatch.info@noaa.gov

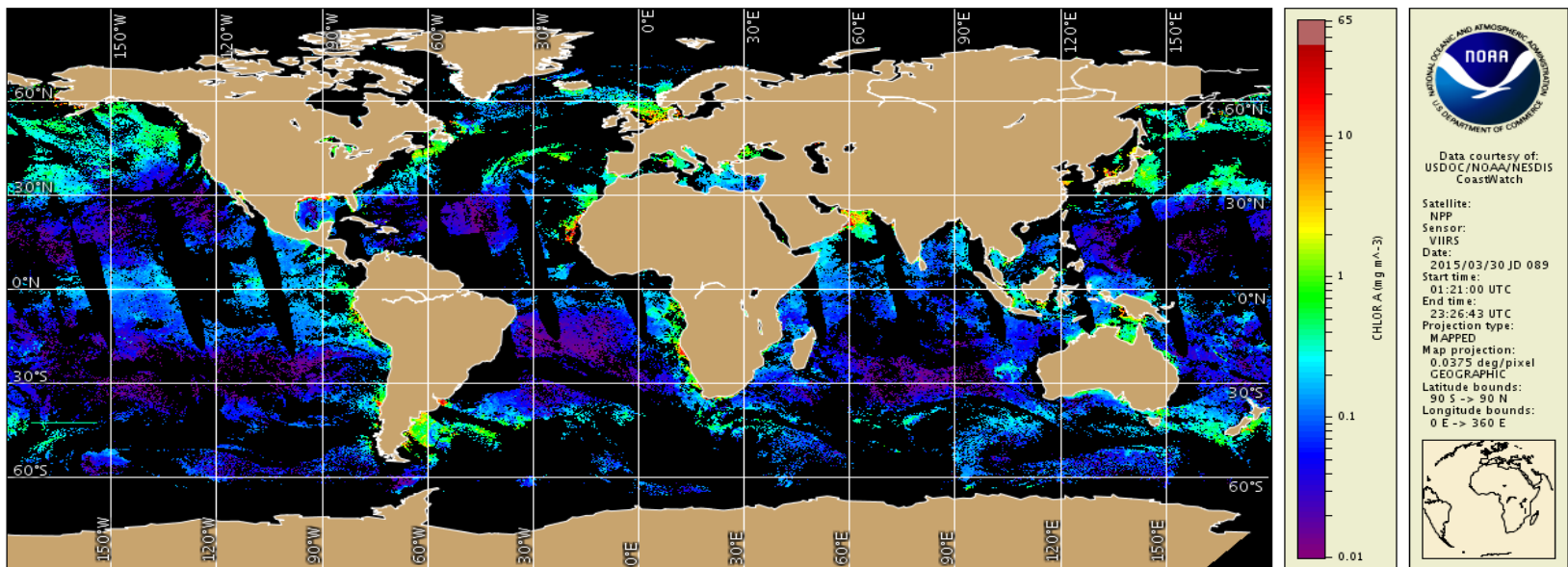


CoastWatch/OceanWatch

Ocean Color Processing & Distribution



- CoastWatch/OceanWatch is now generating and distributing global MSL12 VIIRS ocean color products
 - nLws for M1–5 bands, chlorophyll-a, Kd490, et al.
 - L2 granule files, 24 mapped global sector L3 files with 750m resolution (daily and weekly composite), and mapped global L3 files with 4km resolution (daily and weekly composites)
 - NetCDF format data products served via STAR/CoastWatch Web and FTP servers; also our THREDDS Data Server (TDS):
<http://www.star.nesdis.noaa.gov/thredds/catalog.html>



March 30, 2015 global Chlorophyll-a concentration image from SNPP VIIRS



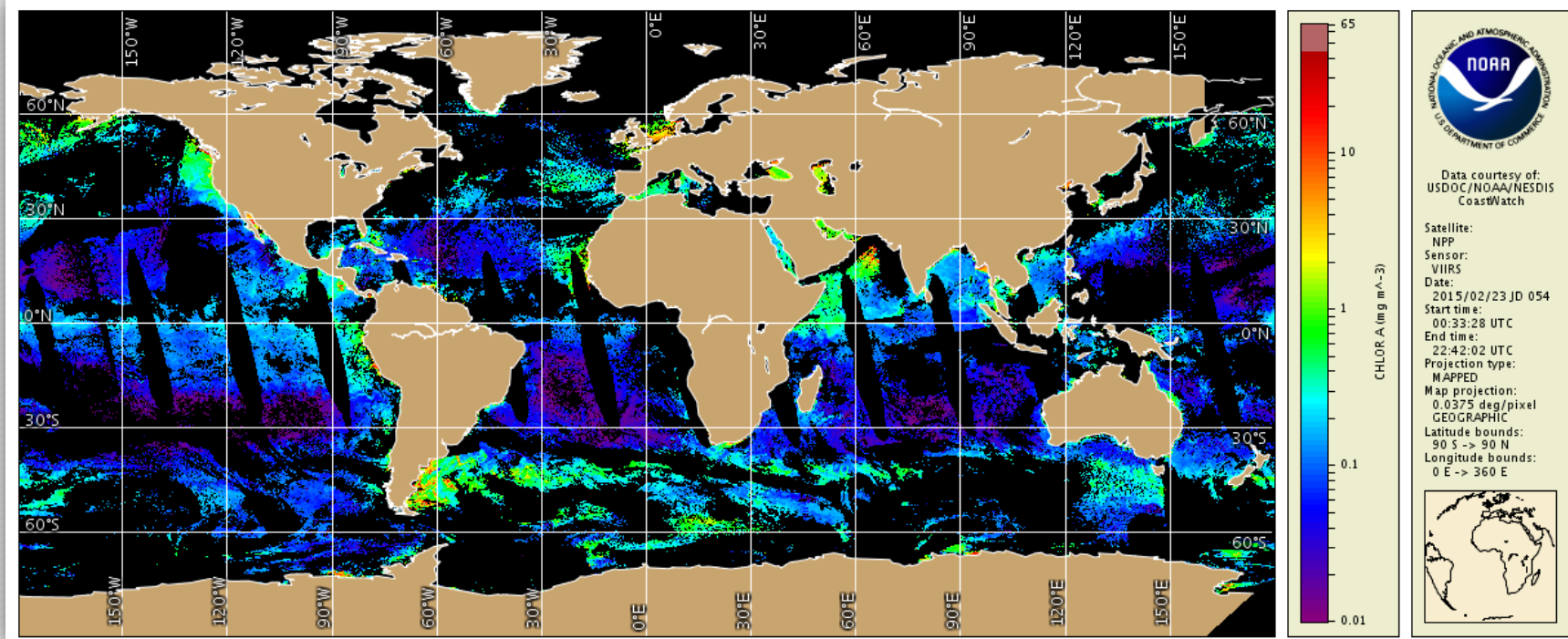
NOAA VIIRS Ocean Color EDR: NRT and Science Quality Products



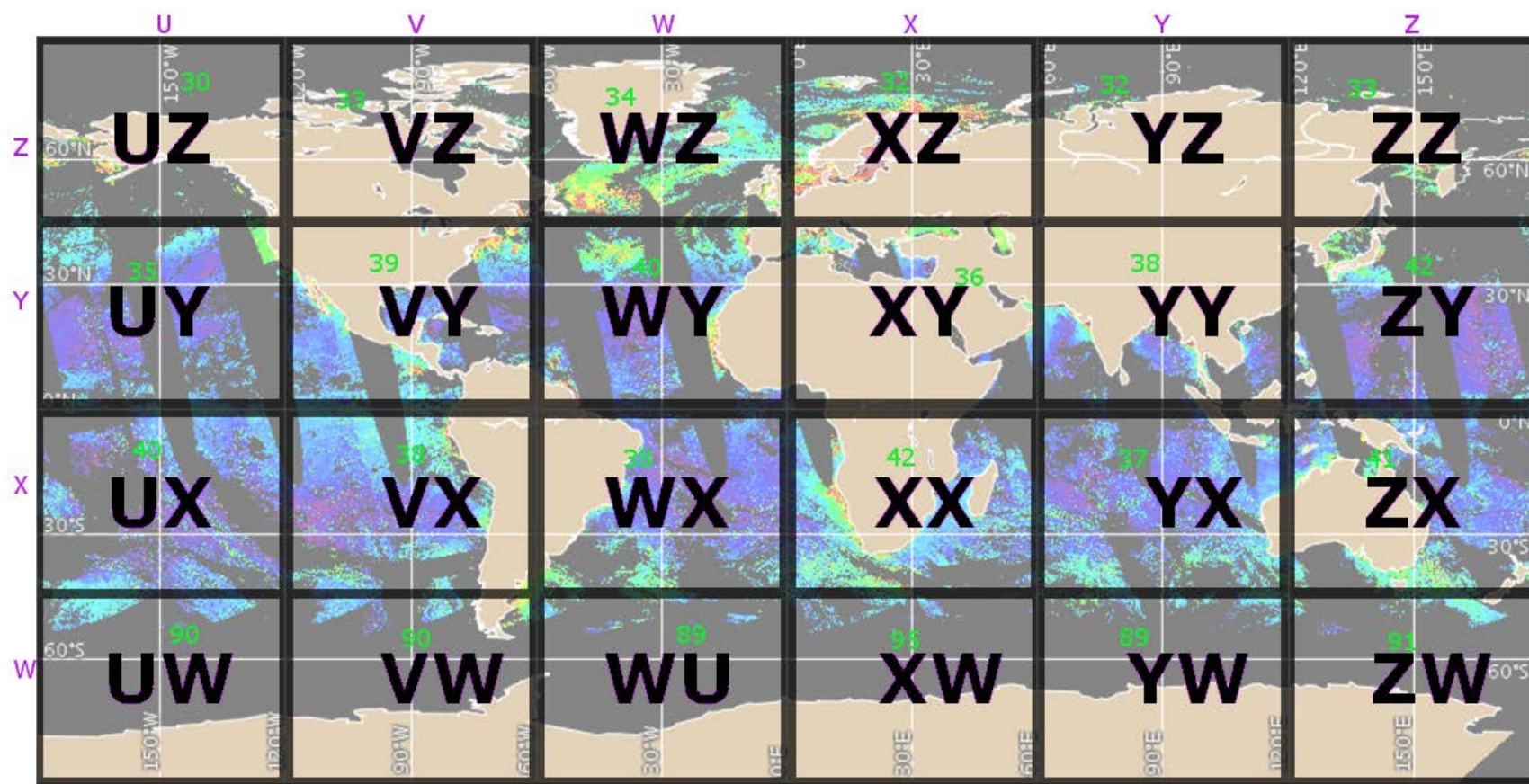
To meet requirements from **All** users (operational, science research, modeling, etc.), we will be producing VIIRS ocean color products in two data streams:

- **Near-Real-Time (NRT) Ocean Color Data Processing (12-24 hours):**
 - Quick turn around with ~12-24 hours latency (operational)
 - Using standard IDPS SDR data
 - Ancillary data using the Global Forecast System (GFS) model
 - Data may not be completed due to various issues (SDR missing, computer, etc.)
 - Data will be processed in NOAA **CoastWatch** and **OSPO**
- **Science Quality Ocean Color Data Processing (1-2 weeks delay):**
 - About one-two weeks delay
 - Reprocessed mission-long ocean color data and continue-forward data stream
 - Using improved SDR (based on IDPS SDR data)
 - Science quality (assimilated) NCEP ancillary data
 - Complete global coverage
 - May expand to more experimental products & test with improved algorithms
 - Ocean color EDR will be reprocessed (mission-long) about every two-three years (or as needed, e.g., short-term data reprocessing, error fixing, etc.)
 - Data will be processed in **NOAA/STAR** and transferred to CoastWatch

Global 4km

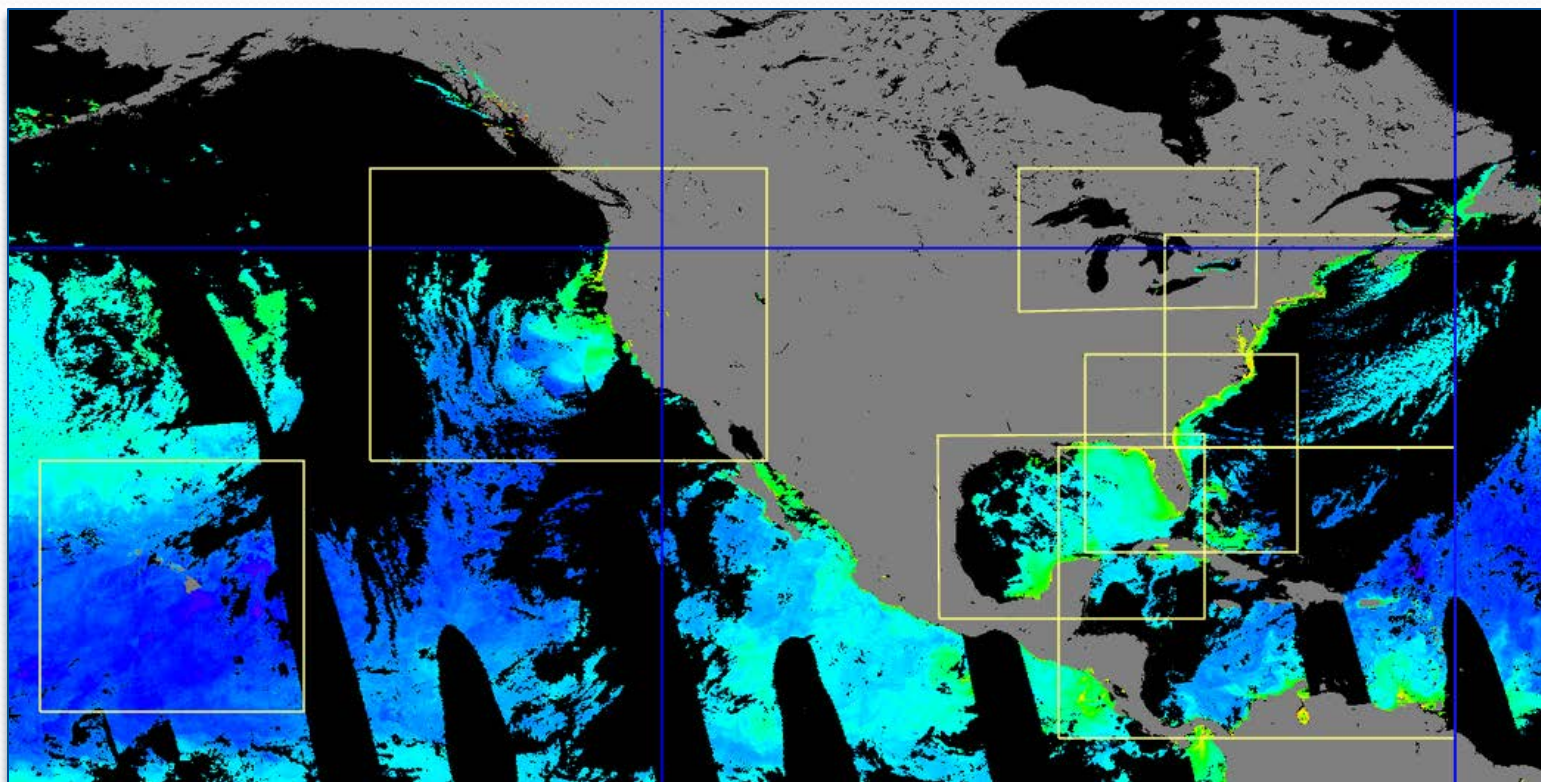


Global 750m Sectors



Regional

- “CONUS” 750m regions: Hawaii, West Coast, Great Lakes, Northeast, Southeast, Gulf of Mexico, Caribbean



VIIRS *Chl-a* and $K_d(490)$ Images in Mediterranean Sea (October 2014 to January 2015)

Chl-a: Log scale: 0.01 to 64 mg m⁻³

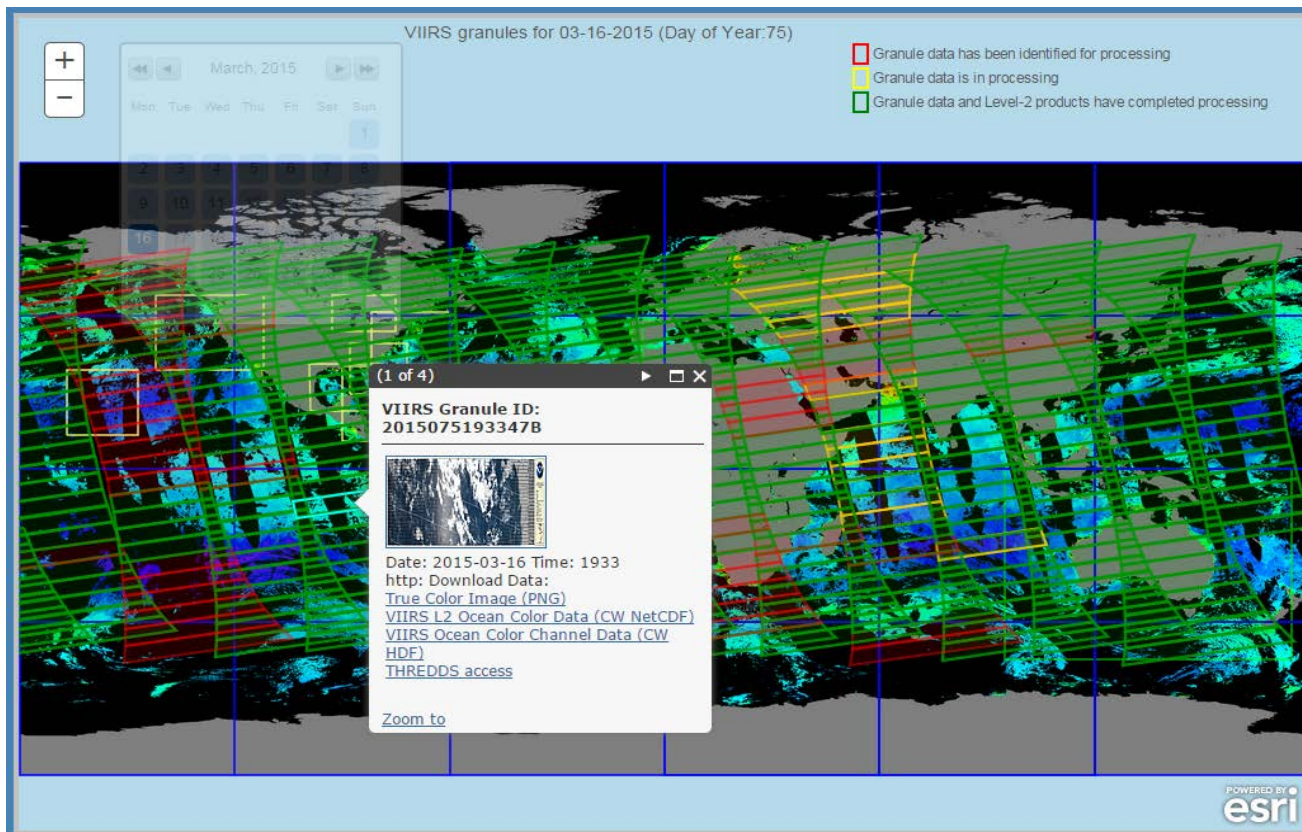
NOAA CoastWatch has been providing VIIRS OC data to
EUMETSAT

$K_d(490)$: Log scale: 0.01 to 2 m⁻¹



CoastWatch VIIRS Ocean Color Portal

- CoastWatch/OceanWatch Global Map-based granule selector for VIIRS Ocean Color Data rolled out in March 2015
 - allows a user to quickly visualize and access a specific dataset based on time & geographic coverage
 - Following reprocessing currently underway, the portal will provide direct access to NRT, Science Quality, and Mission Reprocessed Level 2 data



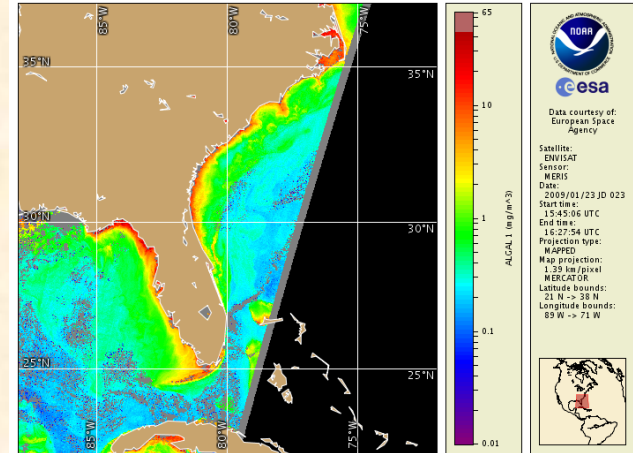
Global Map-based granule display of VIIRS true color images (granule selector)

http://coastwatch.noaa.gov/cwn/cw_granule_selector.html

NOAA Utilization of European Ocean Color Data: Way forward for Sentinel-3/OLCI

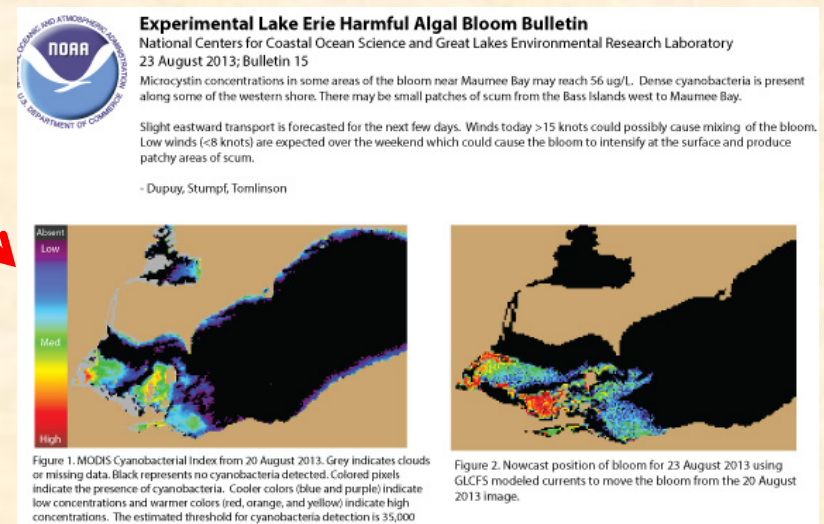


- MERIS data declared operational within NOAA in Jan 2009; Envisat failed in 2012.
- Chlorophyll-a & anomalies were generated from MERIS amongst other ocean color products, supporting NOAA et al. users
- Coastwatch/NOAA was a “Champion User” for the ESA Coast Colour Project, supporting coastal users internationally.
- STAR and others in NESDIS are now actively working to facilitate acquisition of the follow-on Sentinel-3 (OLCI et al.) data to support NOAA and other U.S. user needs.
- Sentinel-3/OLCI, like Envisat/MERIS, has improved spatial resolution (300 m), useful for coastal/inland waters, and also has additional spectral bands – and as such is a vital complementary capability to VIIRS (especially as provides mid-morning orbit).
- STAR is supporting ESA/EUMETSAT as part of the Sentinel-3 Validation Team (3 projects)

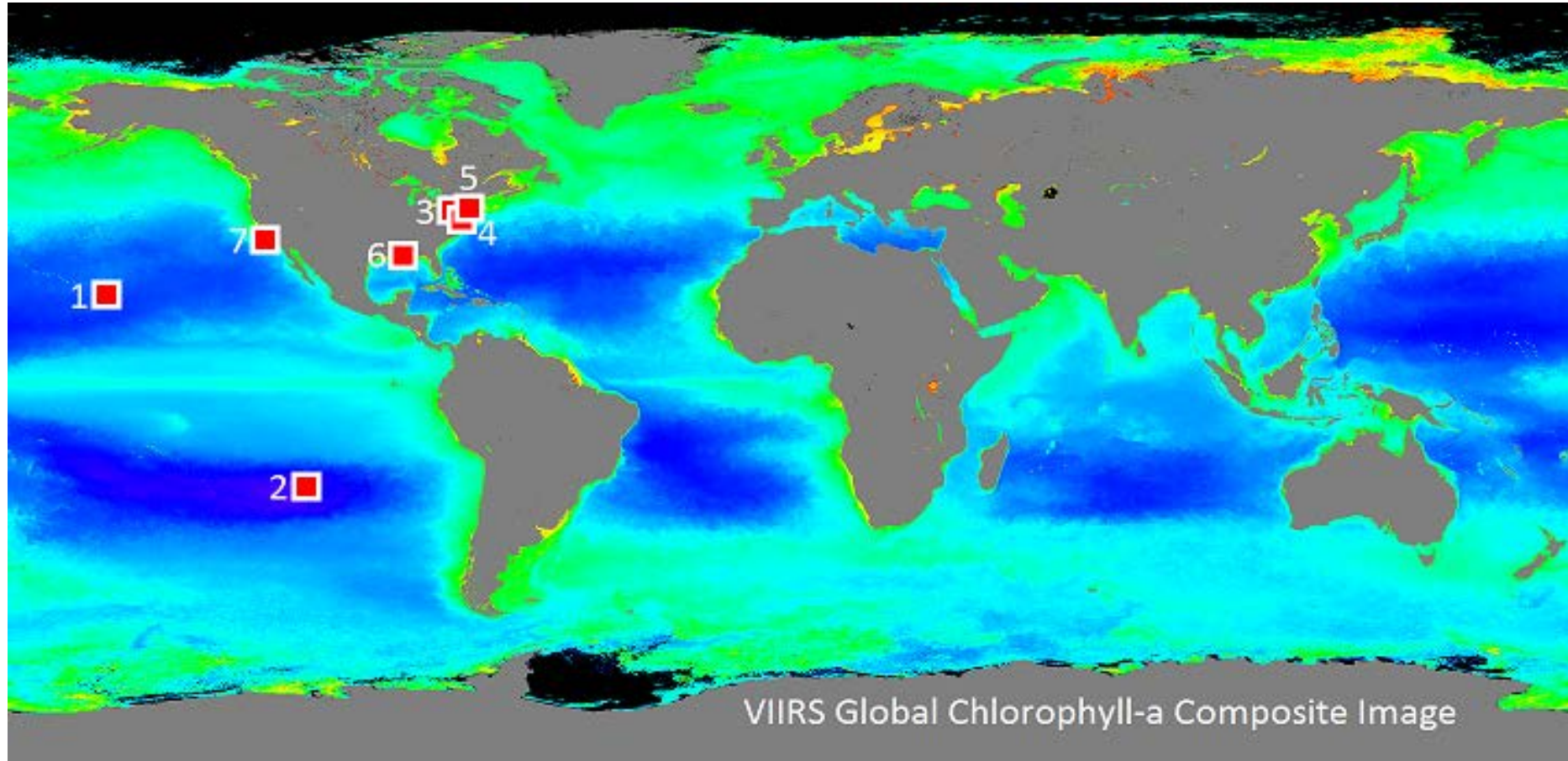


<http://coastwatch.noaa.gov>

STAR's efforts have resulted in the generation and flow of NOAA experimental and operational ocean color products to the Coastwatch user community.



VIIRS Ocean Color EDR Monitoring Sites

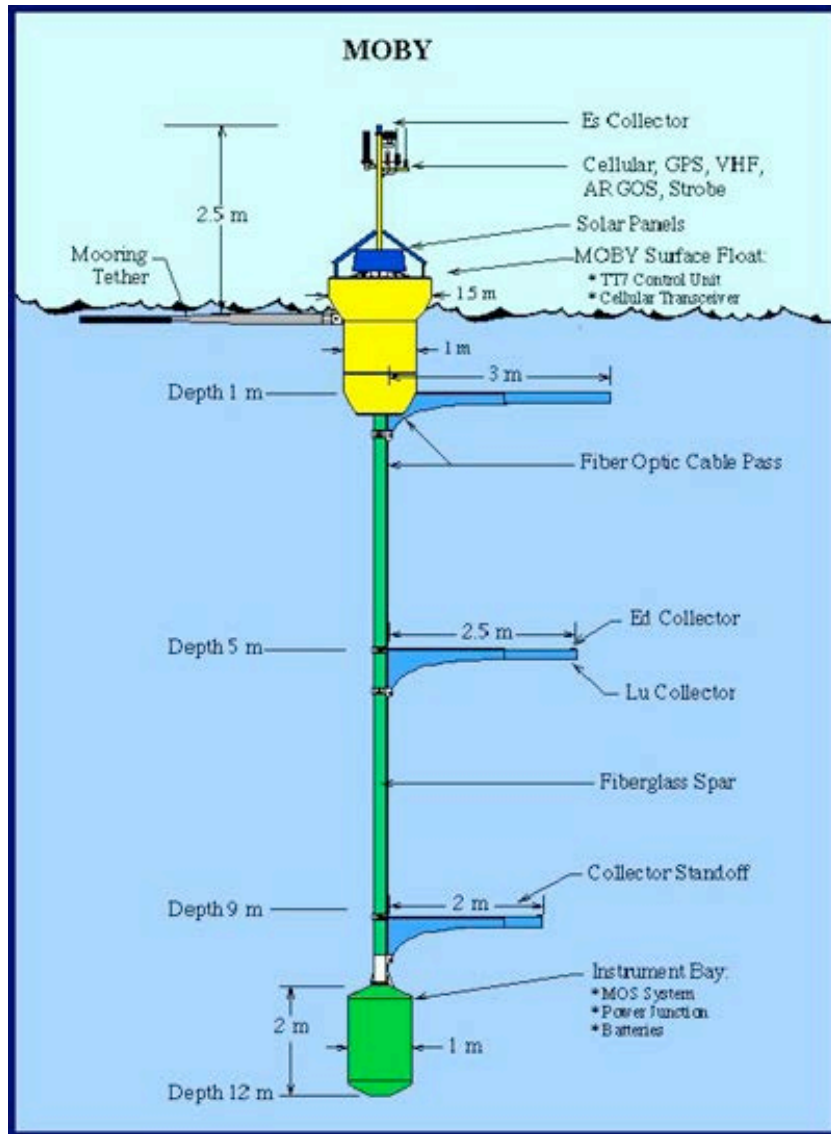


1. **MOBY Site**; 2. South Pacific Gyre; 3. Chesapeake Bay; 4. US East Coast; 5. **AERONET-OC LISCO Site** ; 6. **AERONET-OC CSI Site**; 7. **AERONET-OC USC Site**.

Website:

<http://www.star.nesdis.noaa.gov/sod/mecb/color/>

MOBY: The Marine Optical Buoy



On station since 1997. Currently undergoing a “refresh” of the MOBY system.

Goals of Refresh are:

- 1) update very outdated computer control system.
- 2) update optics to both correct degradation issues and improve system performance. Expect to start doing a cross over experiment between the new blue portion (350-700 nm) of the optical system and the old system later in 2015.
- 3) add more auxiliary data (better depth sensing, orientation sensors, etc) to reduce auxiliary uncertainties.
- 4) Add UV biofouling to reduce uncertainties during deployment.

Satellite data were extracted using 11x11-bin box average from 1-km L3 file. In Situ data: Q1 - MOBY Quality 1; Q2 - MOBY Quality 2.

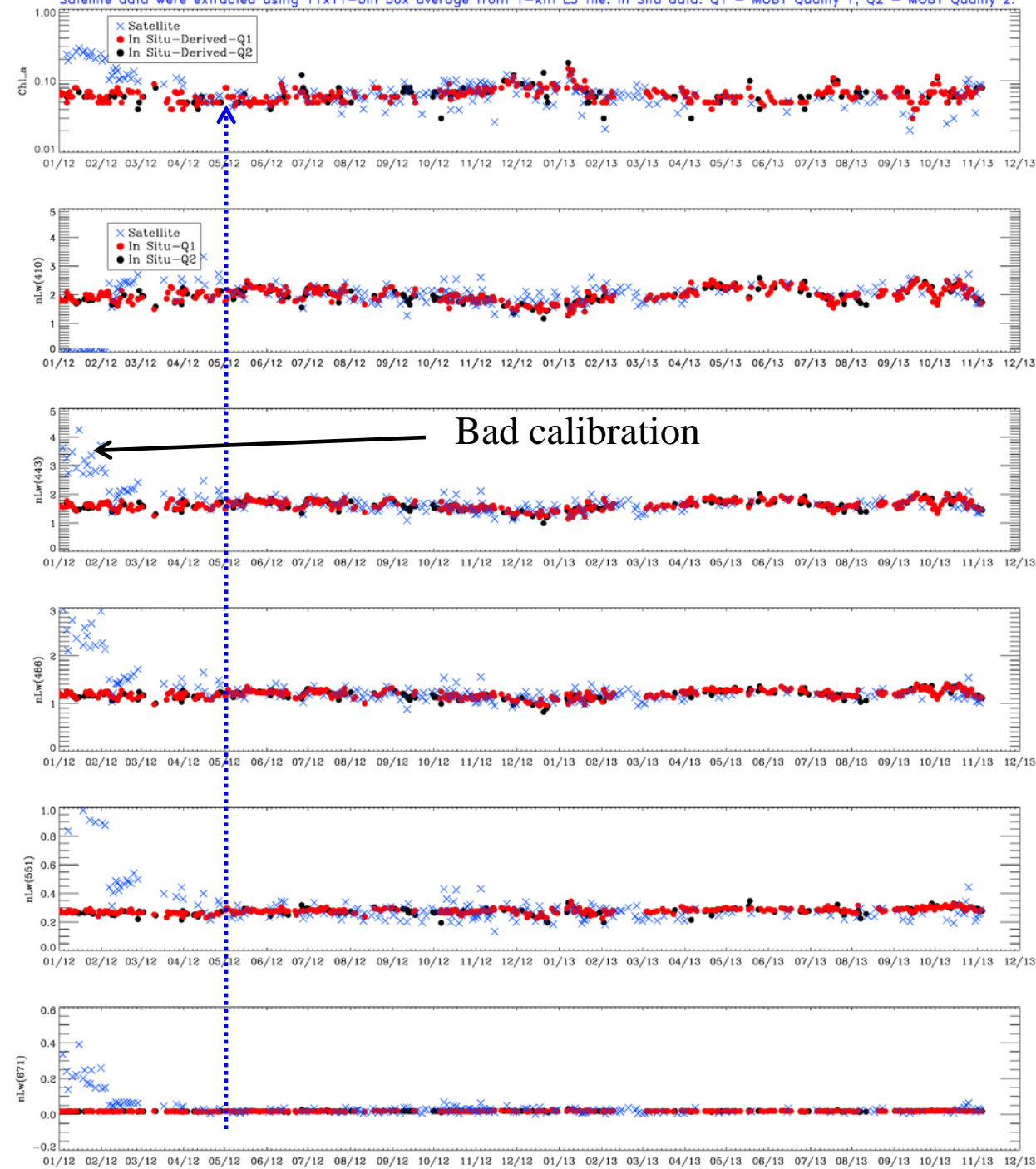
MOBY

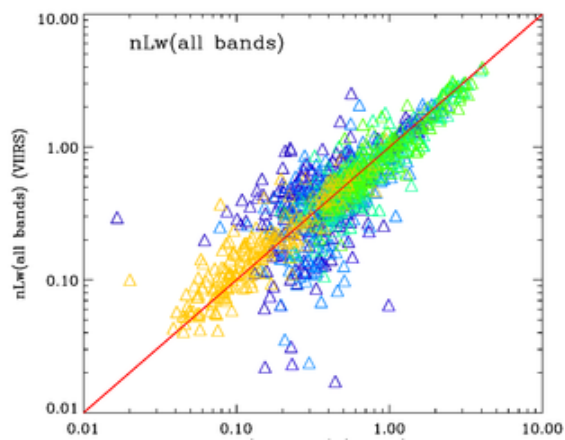
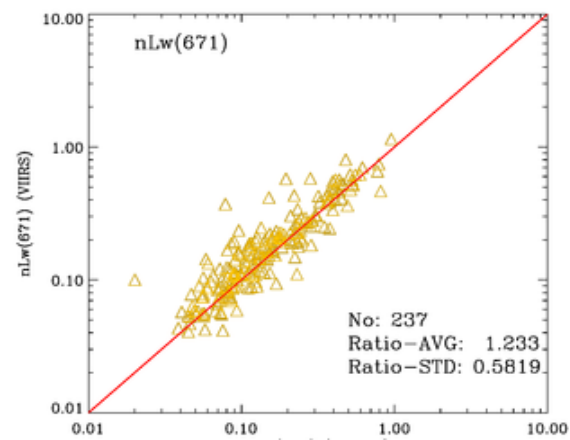
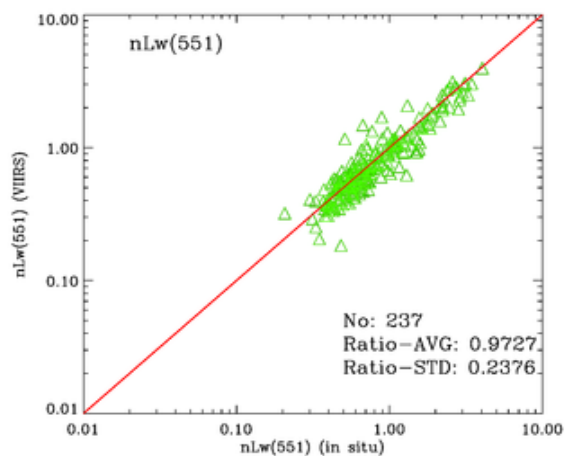
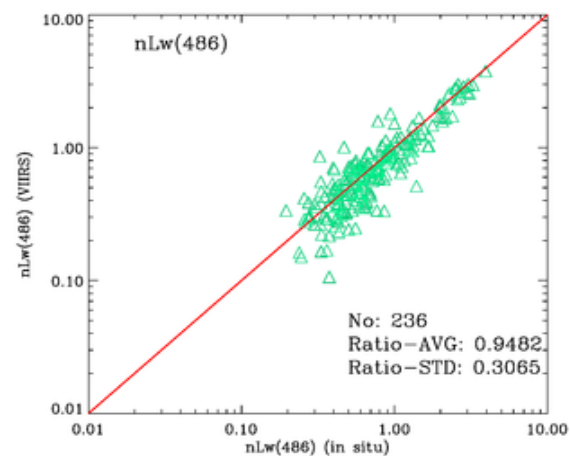
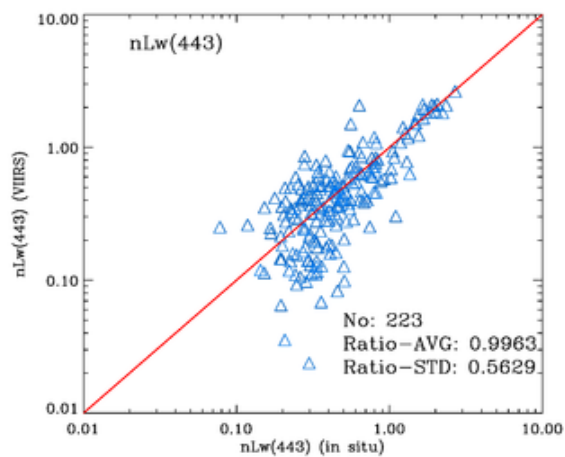
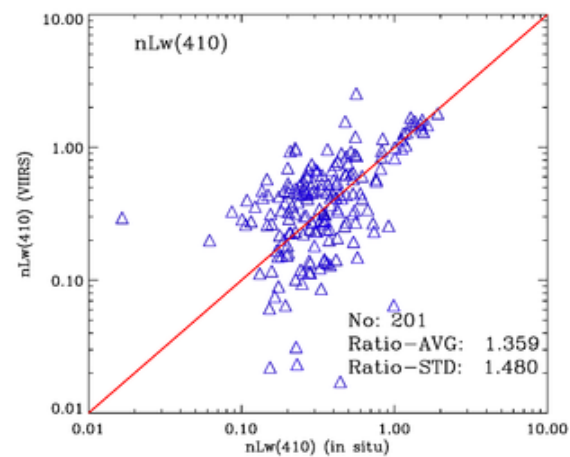
Comparison of NOAA VIIRS ocean color products with **Marine Optical Buoy (MOBY)** in situ data.

Note:
Vicarious calibration gains applied since **May 2012**.

Vicarious gains were derived using **MOBY** in situ data.

MOBY in situ optics data have been providing critical data set in support of VIIRS calibration and validation activities, including VIIRS Level-1B (SDR) data monitoring for sensor on-orbit calibration.

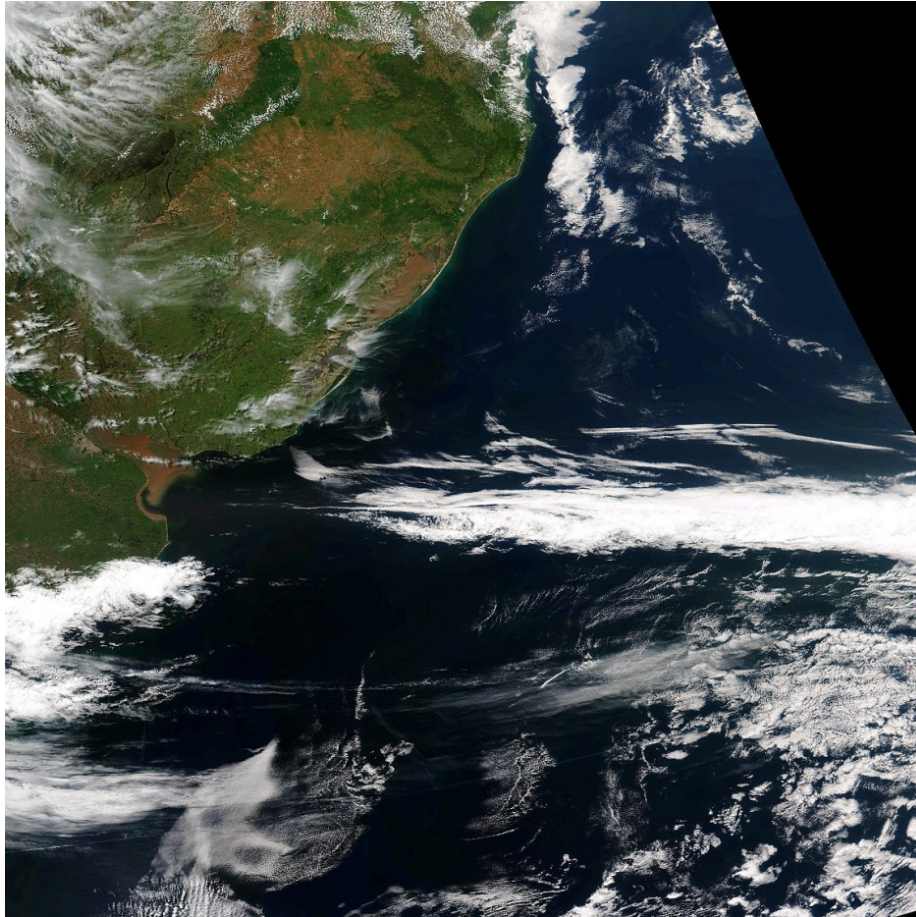




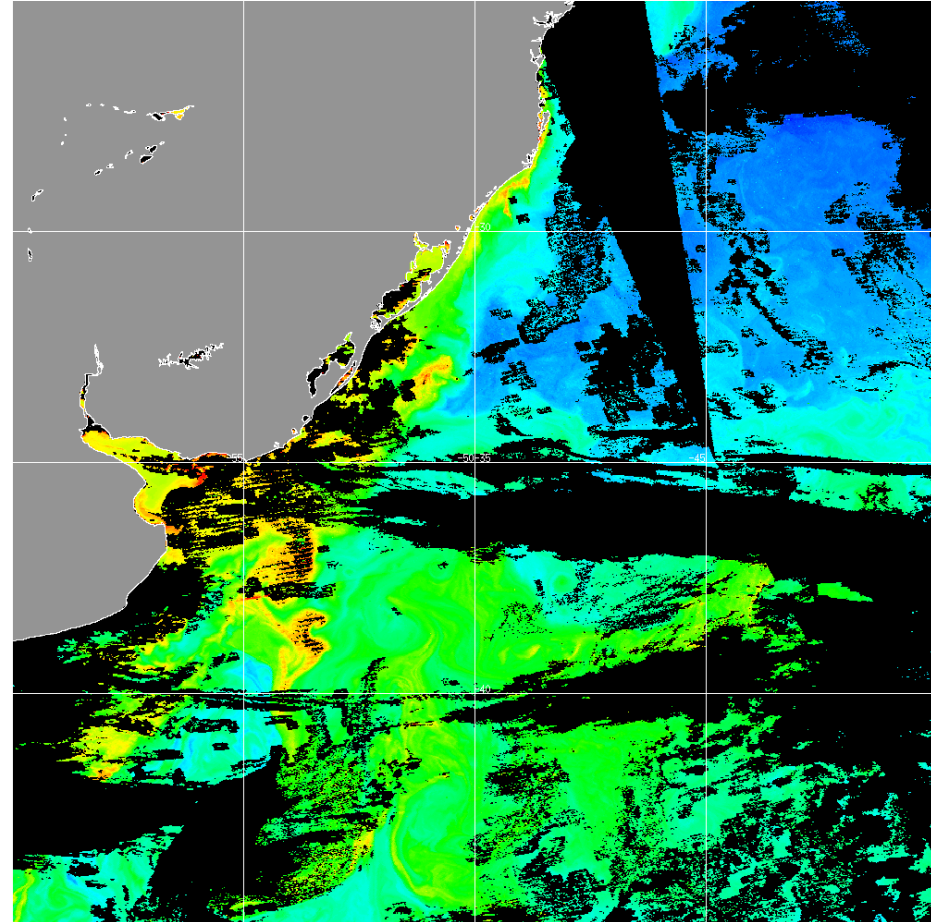
AERONET-OC
CSI Site
 nL_w scatter plot
Gulf of Mexico

Data Monitoring: **La Plata River, Oct. 23, 2014**

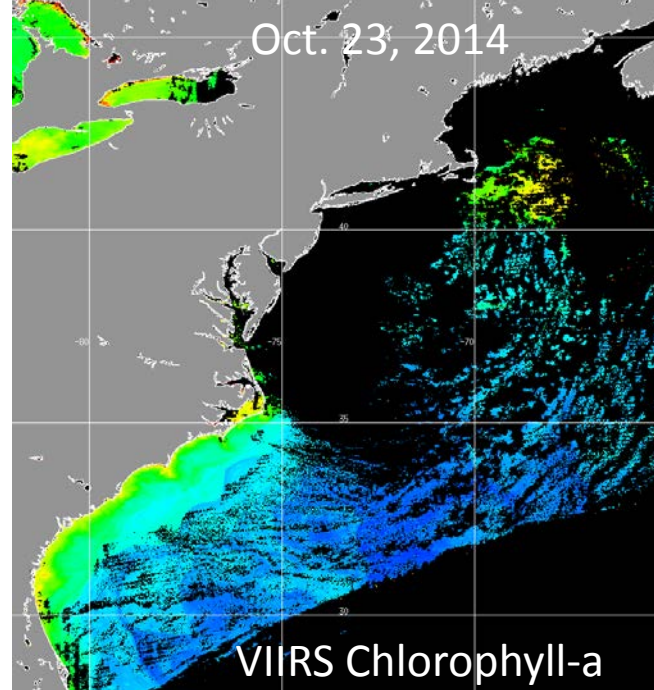
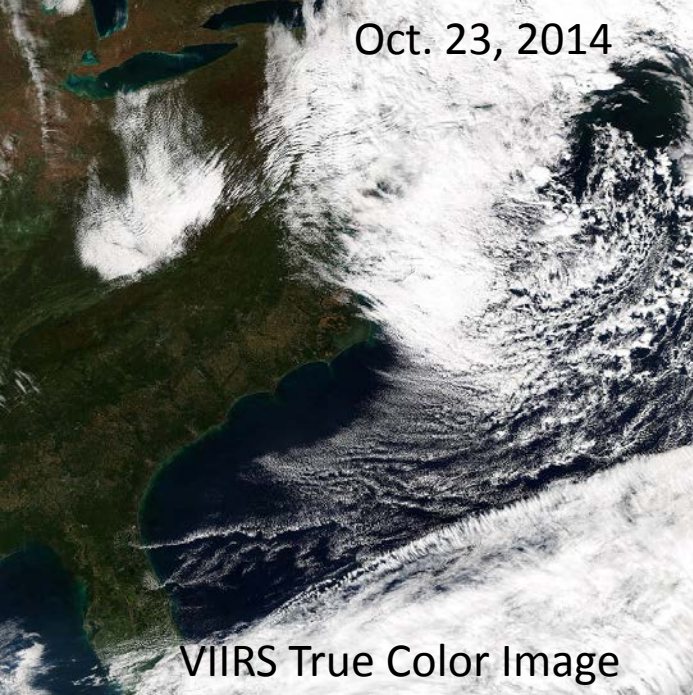
(Routine Daily Images from Various Coastal Sites)



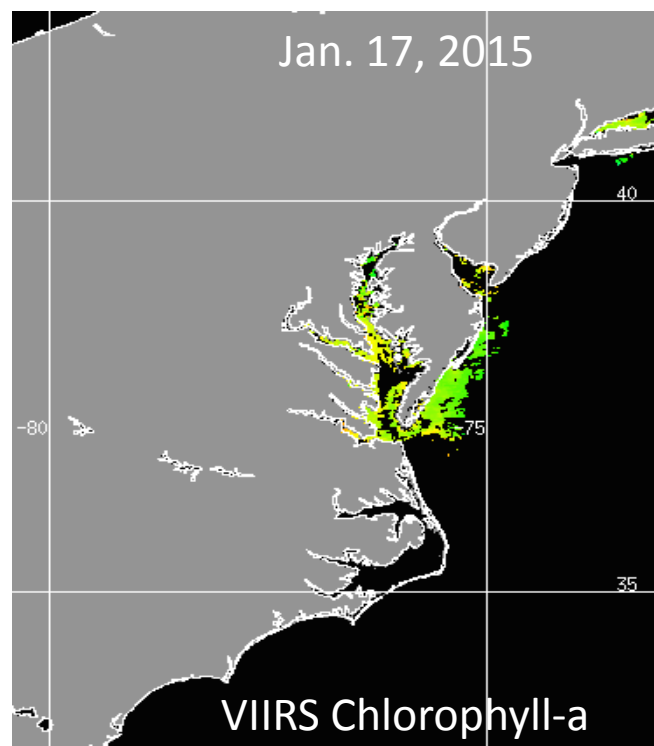
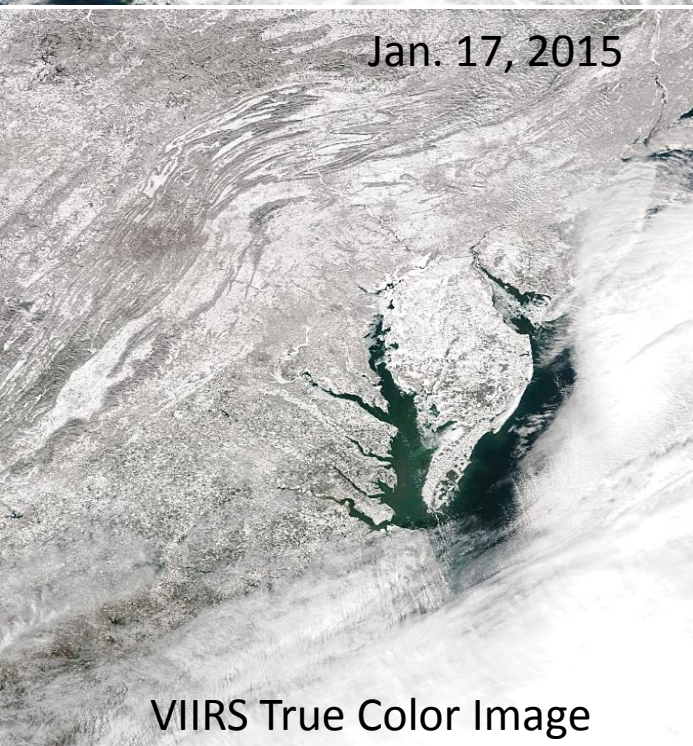
VIIRS True Color Image



VIIRS Chlorophyll-a



Data Monitoring:
US East Coast
(Routine Daily Images for
Various Coastal Sites)





Dedicated VIIRS Cal/Val Cruise

NOAA Ship *Nancy Foster*

11-21 November 2014

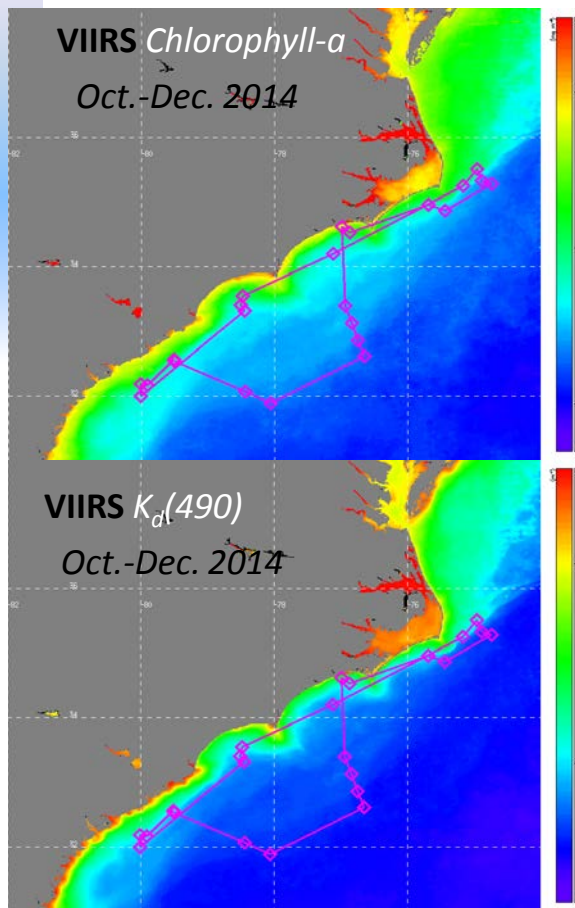


International, Interagency, and Academic Collaborations:
4 US Agencies, EU-JRC, 6 Universities

Validation Measurements

Water-leaving radiance; Chlorophyll-a; Absorption and backscattering coefficients; Bi-directional radiance distribution; Phytoplankton physiology; Carbon; Total suspended matter; Aerosol optical depth, etc.

Cruise Track



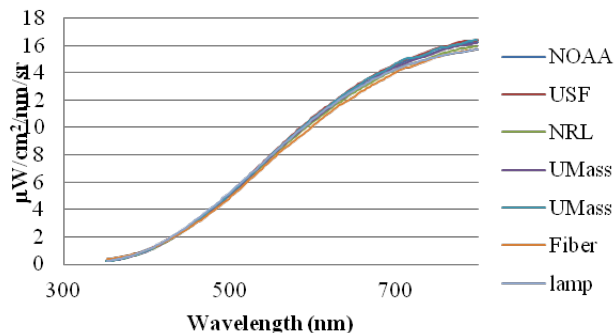
Validation Results

- Occupied 23 stations over 10 days
- Simultaneous measurements at each station for:
 - ✓ 4 profiling radiometers
 - ✓ 2 floating radiometers
 - ✓ 6 above-water radiometers
- Conducted pre- and post-cruise inter-calibrations

11 potential station matchups with VIIRS

NOAA Ocean Color Team

Lu cal 11/4/14



Pre-cruise inter-calibration results for 5 radiance sensors

NOAA IOCS Presentations

Tuesday: Kim Hyde, PFT Breakout (3:05 pm)

Tuesday: Cara Wilson, Geostationary Breakout (2:45 pm)

Thursday: Cara Wilson, Plenary Keynote (8:00 am)

Thursday: Junqiang Sun, Calibration Breakout (10:50 am)

Thursdat: Ken Voss (Univ. of Miami), Plenary Keynote (2:30 pm)

NOAA IOCS Posters (lead authors)

#63: Kim Hyde (NMFS)

#66: Carol Johnson (NIST)

#76: Veronica Lance (NESDIS-STAR)

#96: Karlis Mikelsons (NESDIS-STAR)

#106: Sudhir Nadiga (NWS/NCEP)

#107: Puneeta Naik (NESDIS-STAR)

#131: Wei Shi (NESDIS-STAR)

#135: Seunghyun Son (NESDIS-STAR)

#136: Seunghyun Son (NESDIS-STAR)

#142: Junqiang Sun (NESDIS-STAR)

#151: Menghua Wang (NESDIS-STAR)

#154: Cara Wilson (NMFS)

#155: Banghua Yan (NESDIS-OSPO)

#159: Guangming Zheng (NESDIS-STAR)

Thanks for listening!