Multi-Sensor Satellite Data and Products in Support of NOAA Ocean Research and Applications: VIIRS et al.

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Center for Satellite Applications & Research
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2015 NOAA Satellite Conference
Greenbelt, MD USA
28 April 2015

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STAR Satellite Oceanography & Climatology Division (SOCD)

SOCD Organization

SOCD Chief: *Dr. Paul M. DiGiacomo*

Ocean Sensors Branch

Chief: *Dr. Alexander (Sasha) Ignatov*

- Sea Surface Temp, Ocean Winds, Ocean Optics & Water Quality (e.g. Chesapeake Bay)

Marine Ecosystems & Climate Branch

Chief: *Dr. Menghua Wang*

- Ocean Color, Coral Reefs, Sea Ice, Synthetic Aperture Radar, Blended SST

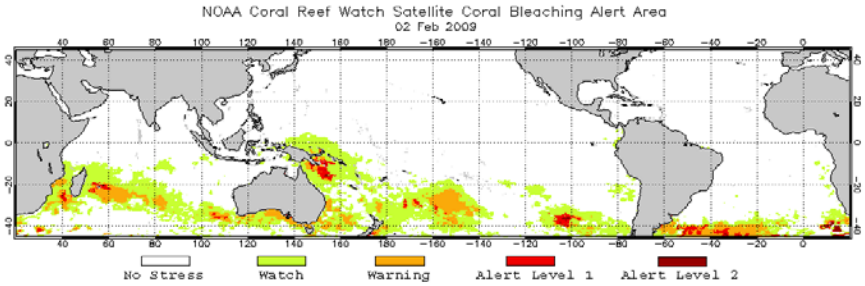
Laboratory for Satellite Altimetry

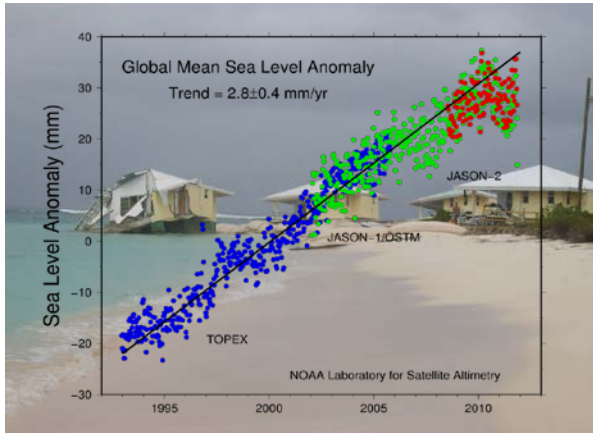
Chief: *Dr. Laury Miller*

- Sea Level, Bathymetry, Waves, Sea Ice/Climate

Science Teams: R&O

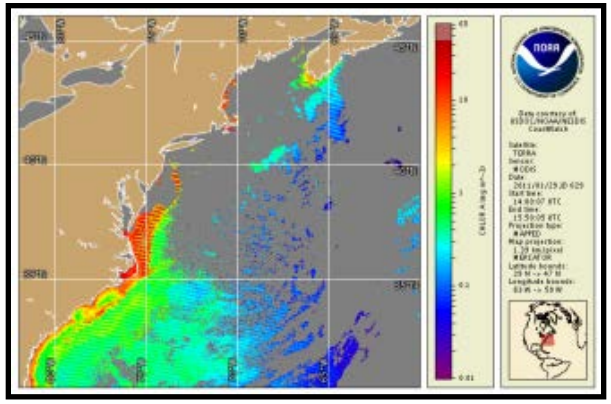
- Sea Surface Height
- Sea Surface Roughness
- Sea Surface Salinity
- Sea Surface Temperature
- Ocean Color Radiometry
- Ocean Surface Vector Winds
- CoastWatch/OceanWatch
- Coral Reef Watch
- Sea Ice and Polar Dynamics





Major Programs/Activities

- JPSS: Ocean Color & SST EDRs
- GOES-R: SST (& Ocean Dynamics)
- JASON Satellite Radar Altimeter Program
- NOAA GCOM Program Scientist
- National Ice Center Chief Scientist
- Foreign Sensors: Winds, SAR, etc
- Marine Optical BuoY (MOBY)
- Coast/OceanWatch & Coral Reef Watch



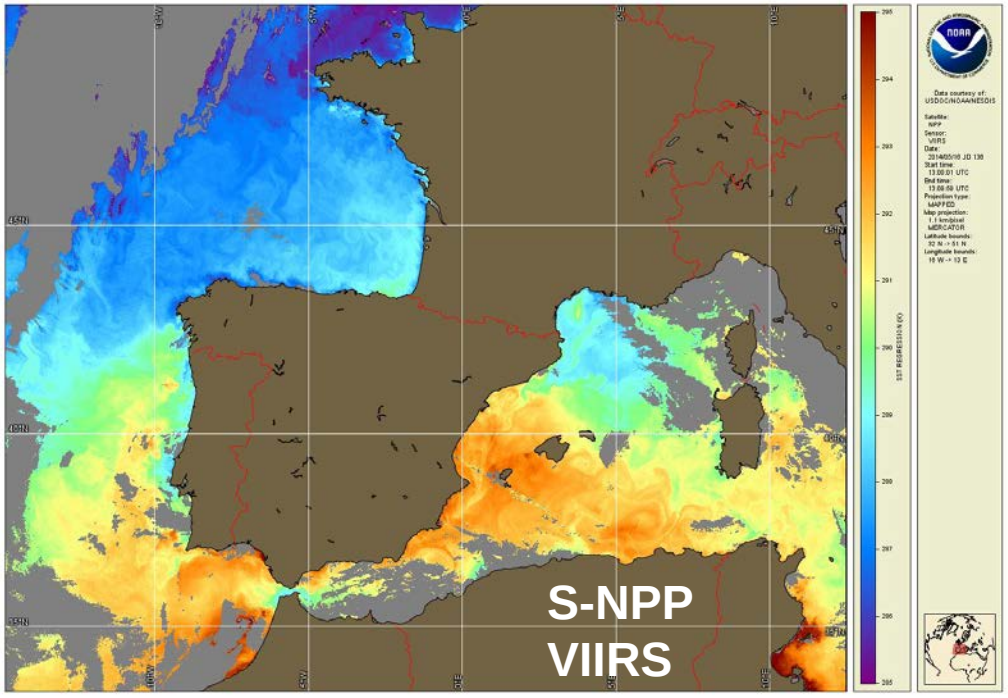
NOAA (VIIRS, GOES) SST and Ocean Color Radiometry Data

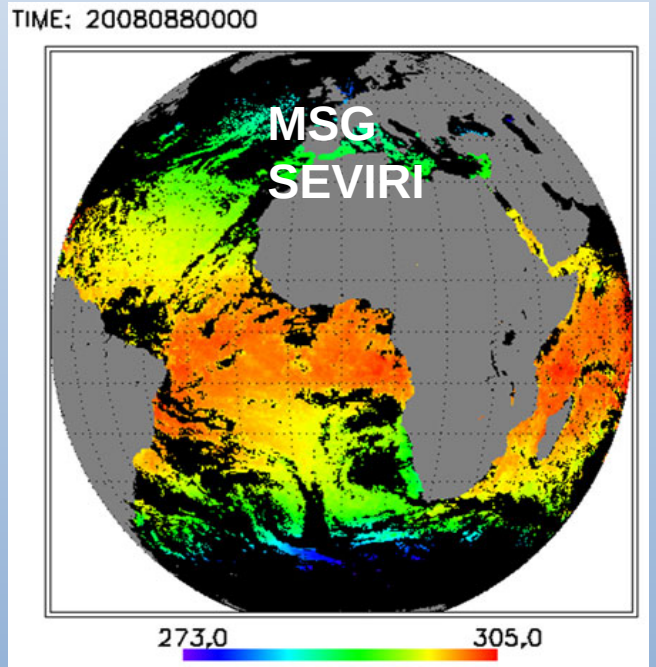
SST – Flagship NOAA Product

Today, NOAA Leads JPSS and GOES-R

In 1970s, STAR pioneered global polar SST products from NOAA AVHRR, and in 1990s, from GOES satellites.

NOAA produces JPSS SST using the new Advanced Clear-Sky Processor over Ocean (ACSPO) system.



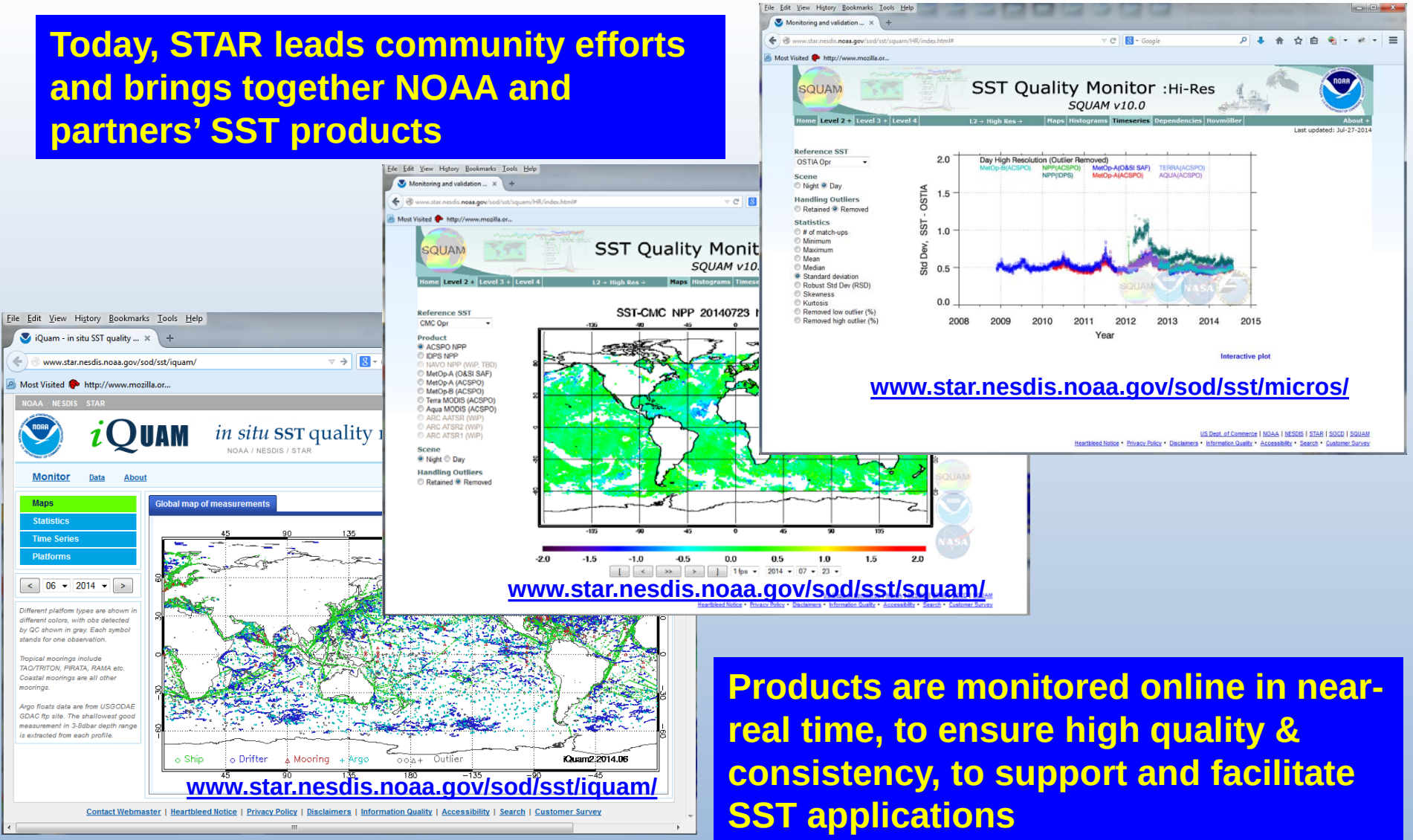


Data of Himawari-8 and MSG are used to provide expanded geographical coverage as well as prototype SST products from GOES-R planned for launch in 2016.

Improved SST analyses, forecasts and blended products are produced for wide range of users.

NOAA SST Monitoring: Bringing Community Together

Today, STAR leads community efforts and brings together NOAA and partners' SST products



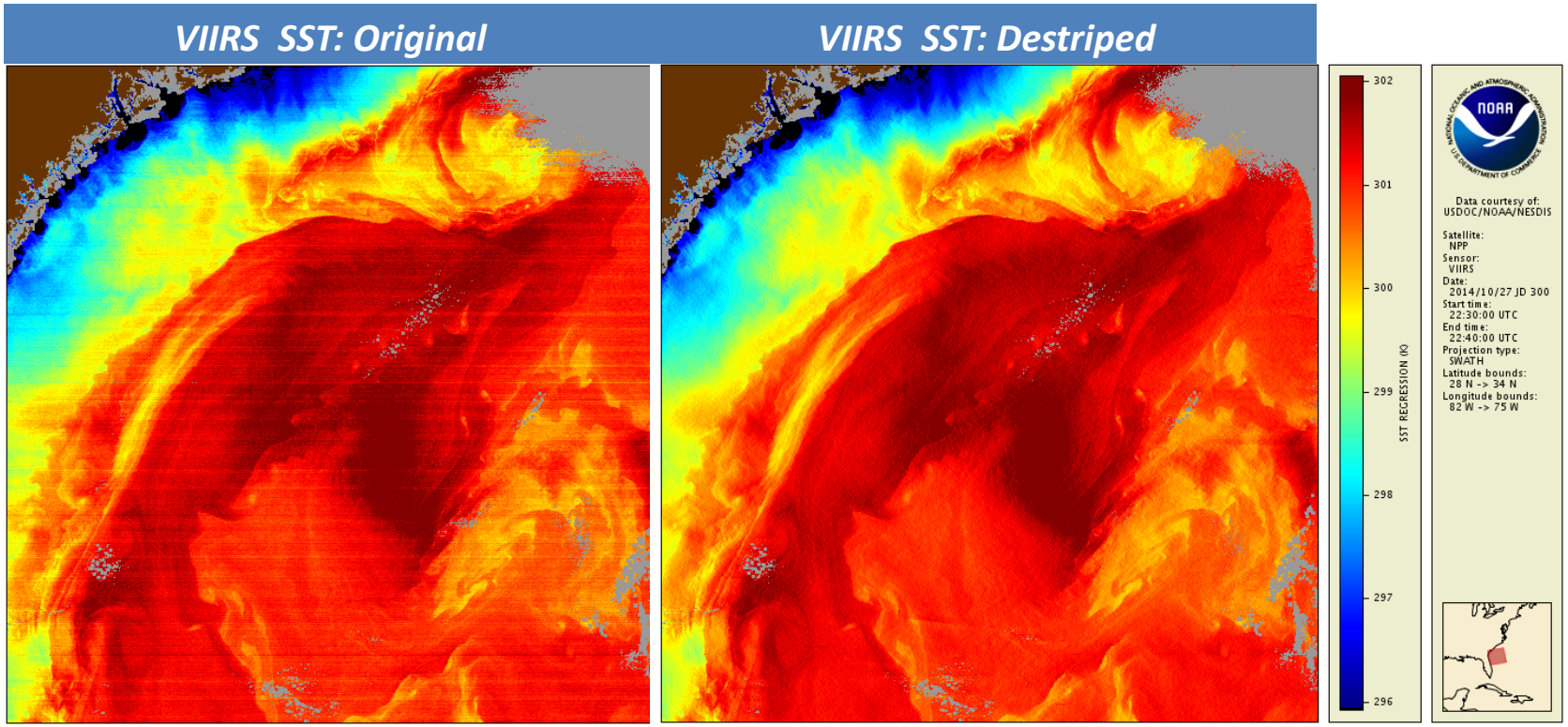
www.star.nesdis.noaa.gov/sod/sst/micros/

www.star.nesdis.noaa.gov/sod/sst/squam/

www.star.nesdis.noaa.gov/sod/sst/iquam/

Products are monitored online in near-real time, to ensure high quality & consistency, to support and facilitate SST applications

Destriping of VIIRS Sea Surface Temperature



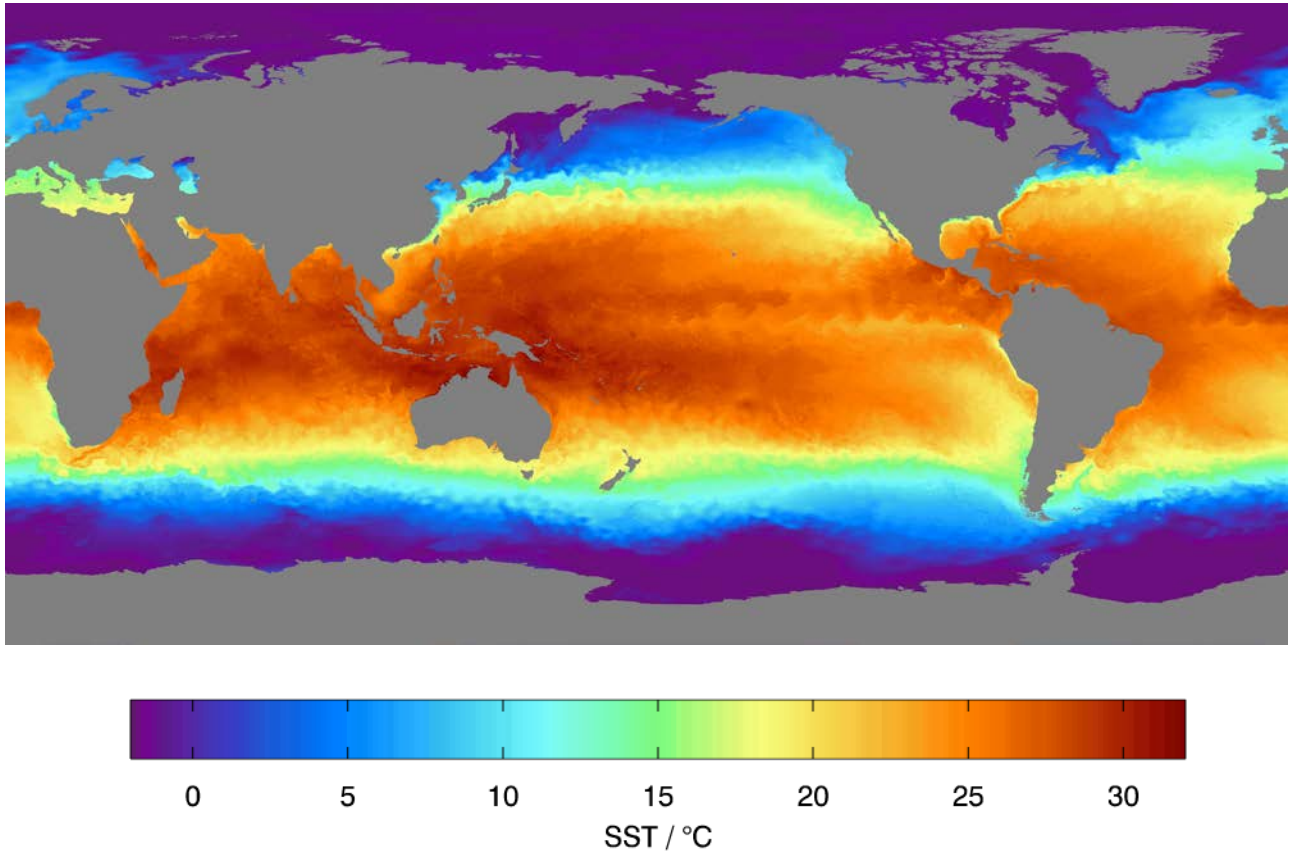
FY15 Milestone Test VIIRS Destriping in the NOAA Advanced Clear-Sky Processor for Oceans (ACSPO) SST system

Accomplishment Destriping fully tested and integrated in the NOAA ACSPO v2.40

Significance NOAA pioneers production of destriped SST from multi-detector VIIRS and MODIS sensors. This is critically important for SST imagery users (fisheries, coastal management, ocean dynamics)

Sponsored by JPSS

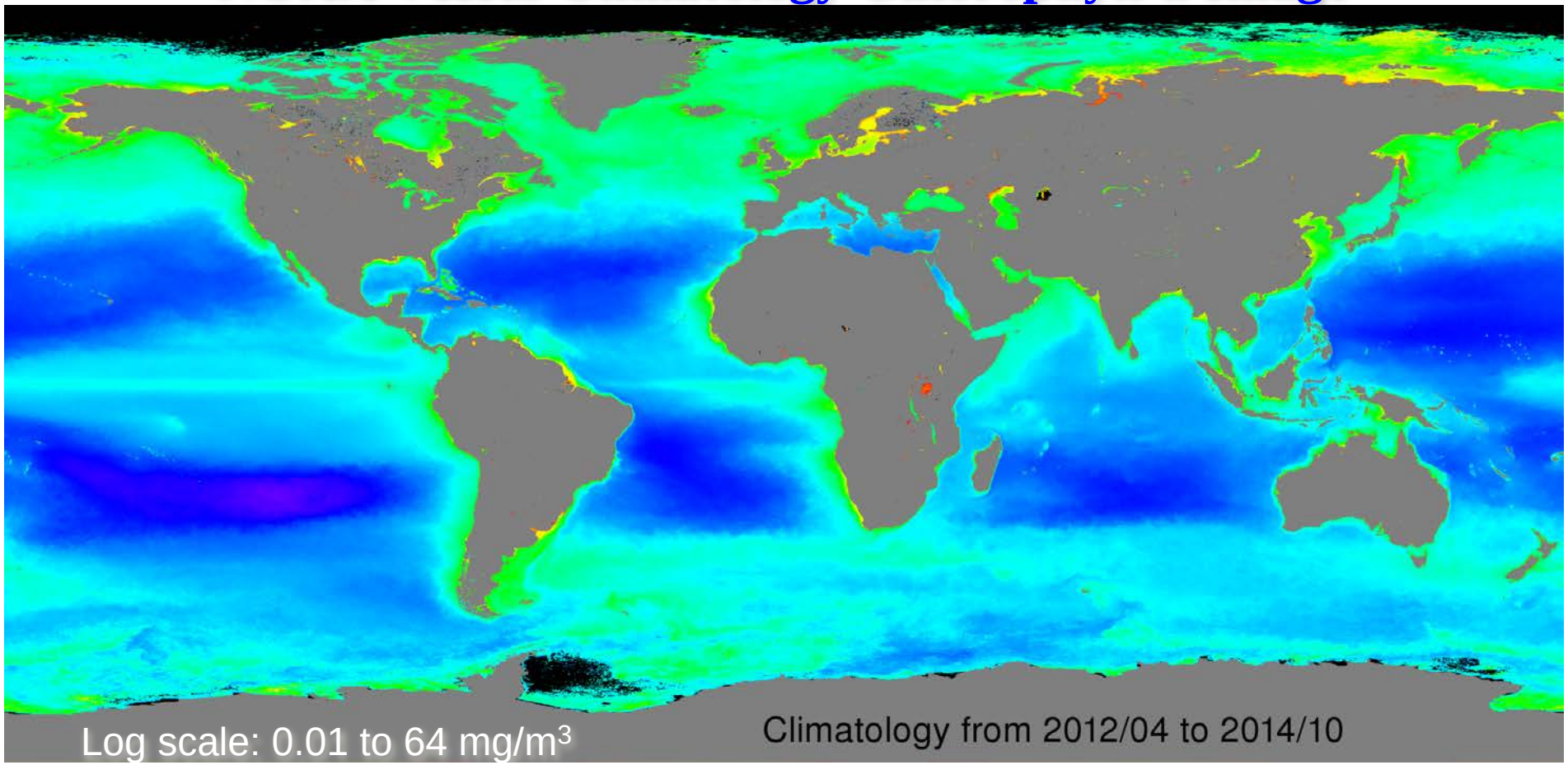
5-km Global Blended SST Analysis



- **Produced daily from operational Polar and Geo-SST data.**
- **Product benefits from available non-NOAA SST data, especially for other basins**

http://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html

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

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

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

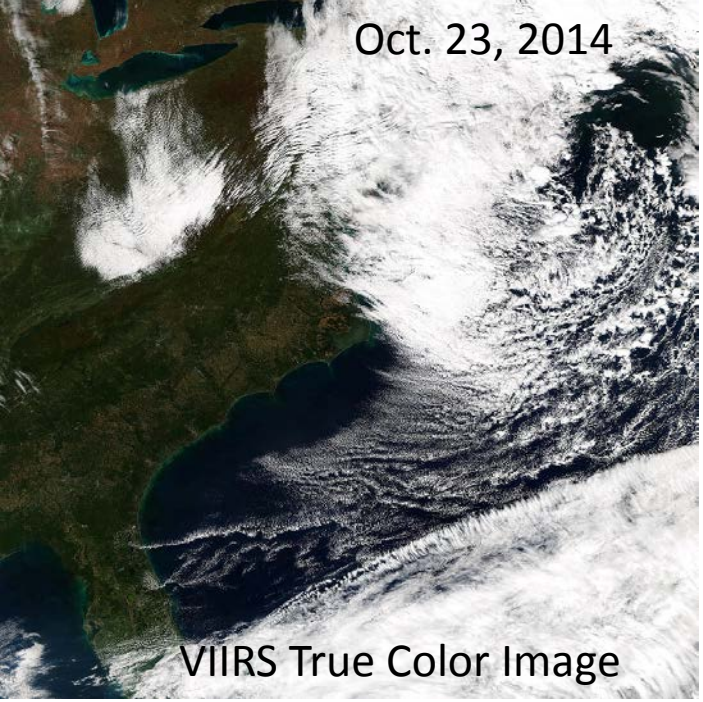
Calibration/Validation ← Link to calibration/validation page

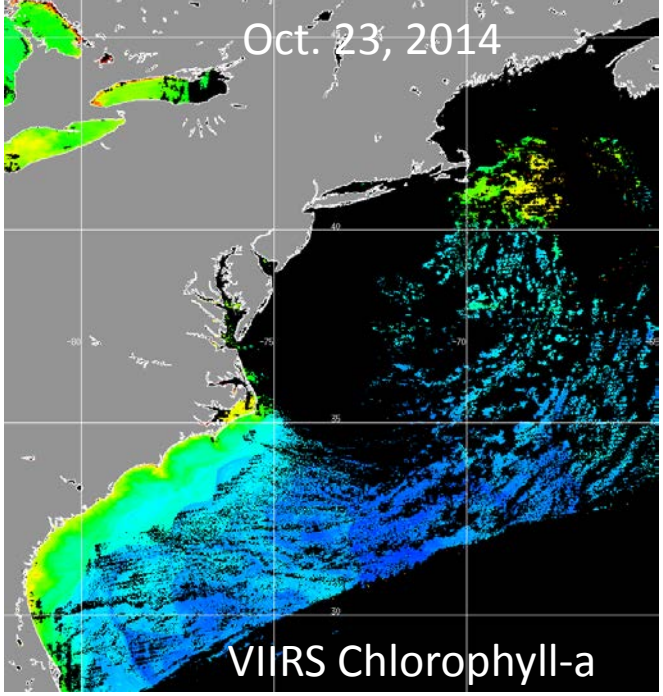
Team Publications ← List of the team publications

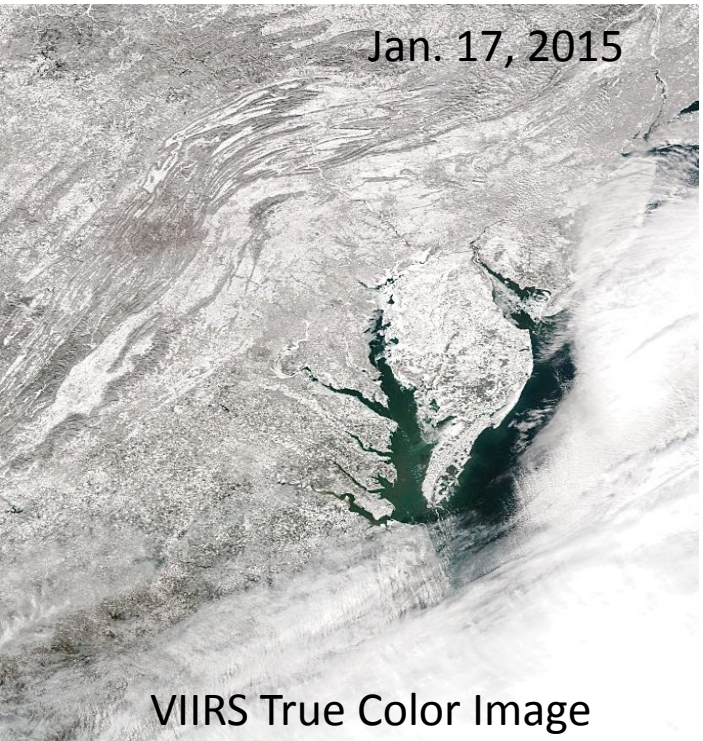
Software Download

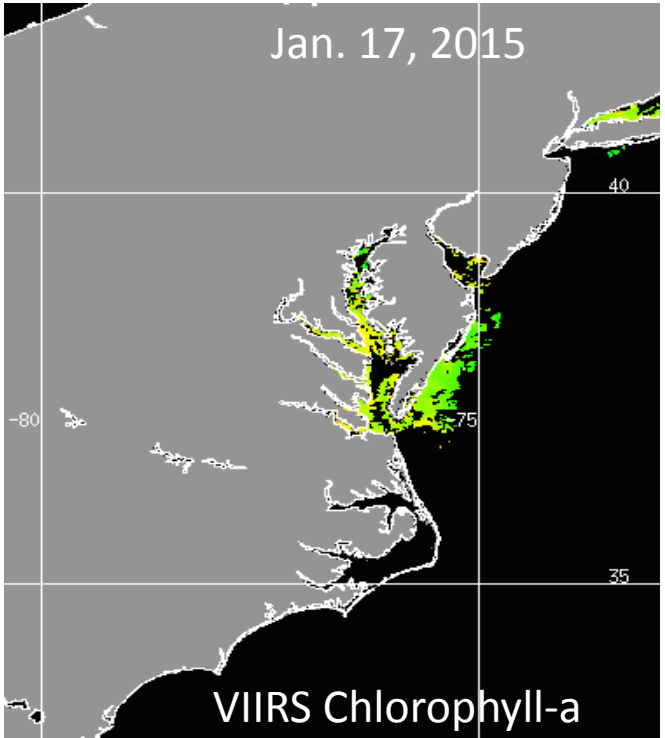
Internal Access (password protected)

For detailed information about this site, please refer to the descrption pdf file. ← Website description









VIIRS OCR Data Monitoring:

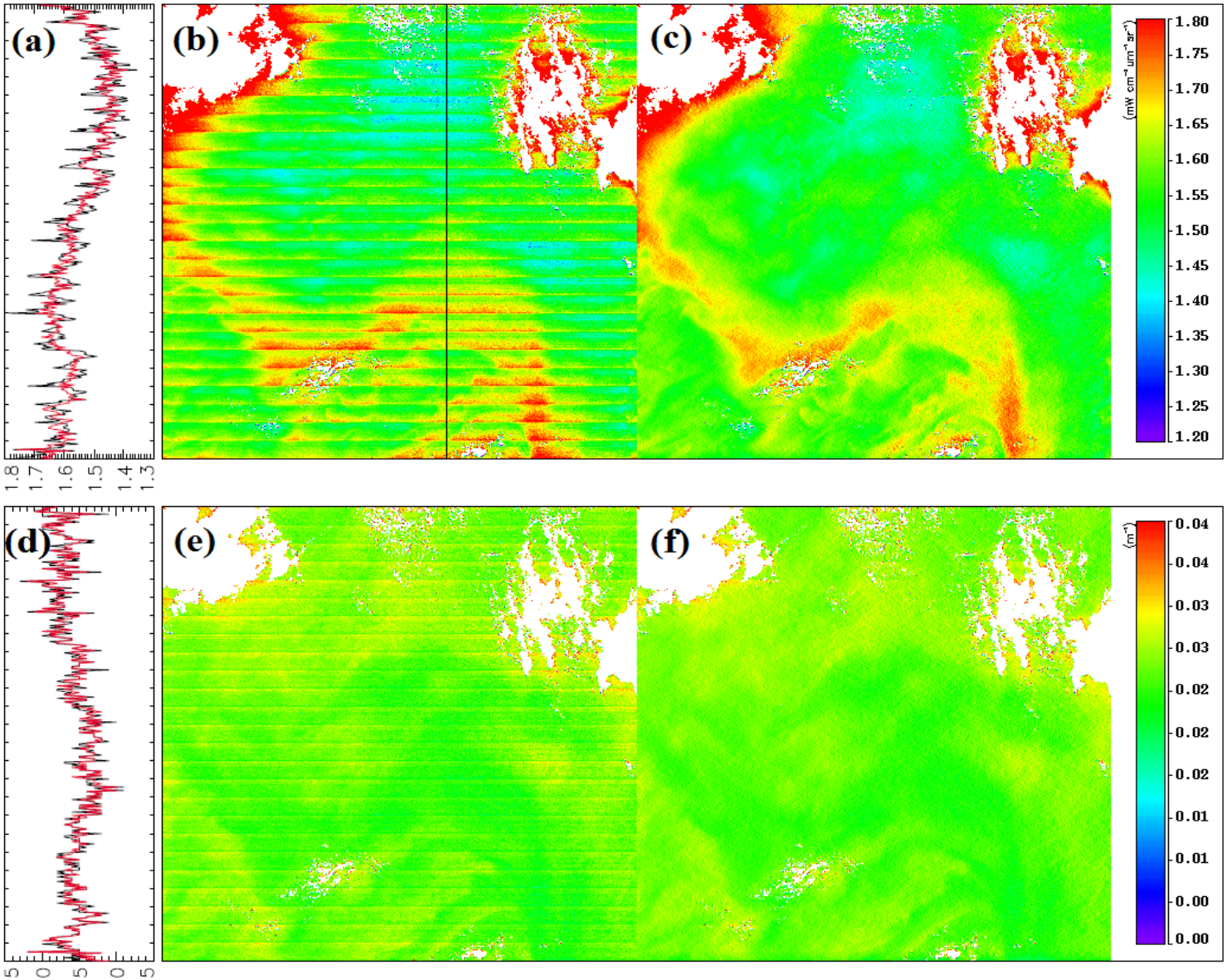
US East Coast

(Routine Daily Images for Various Coastal Sites)

Destriping of VIIRS Ocean Color Products
(Examples)

$nL_w(412)$

$K_d(490)$



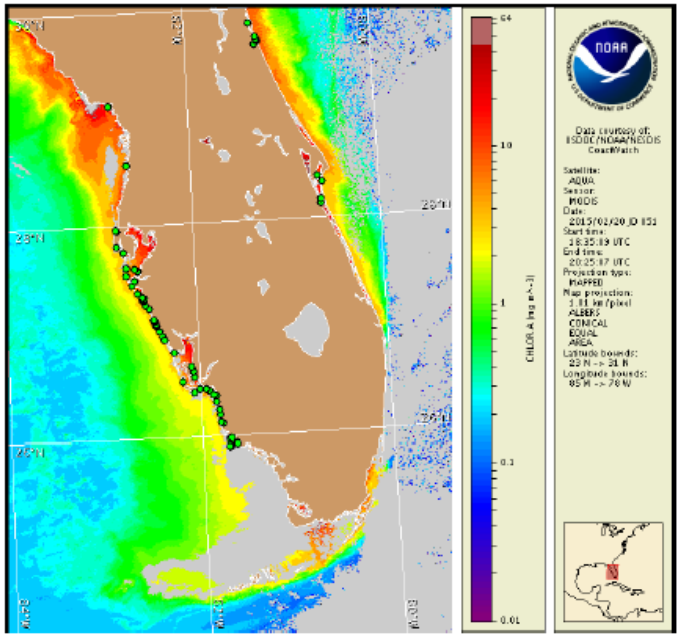
Mikelsons, K., M. Wang, L. Jiang, and M. Bouali, "Destriping algorithm for improved satellite-derived ocean color product imagery," *Opt. Express*, **22**, 28058-28070, 2014. http://dx.doi.org/10.1364/OE.22.028058

Users and Applications: VIIRS et al. data and products

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.

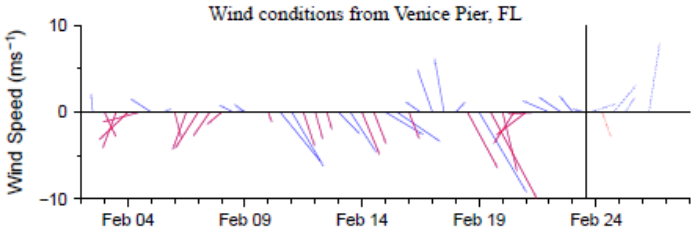
Analysis

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 μg/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).

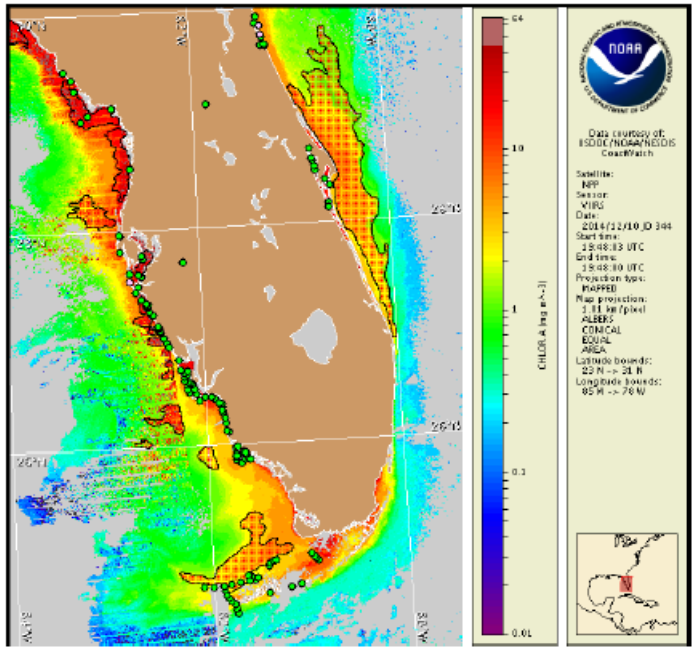
Wind Analysis

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



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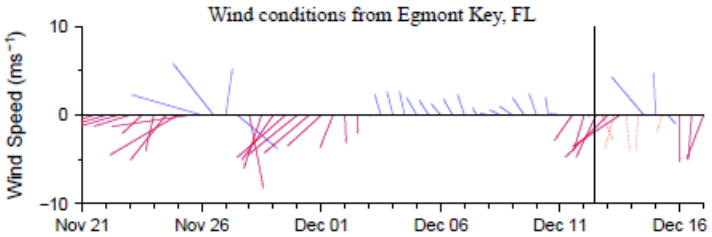
Conditions Report

Does the image look good to you?

Analysis

Blah blah blah



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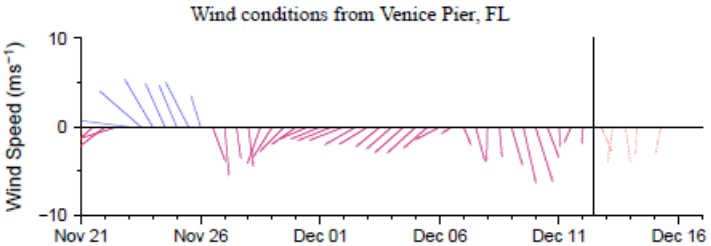

Wind Analysis

Test for VIIRS products

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

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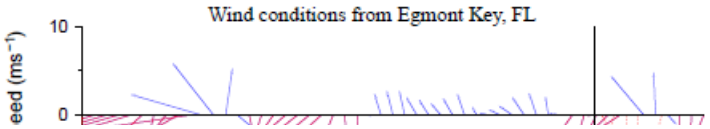

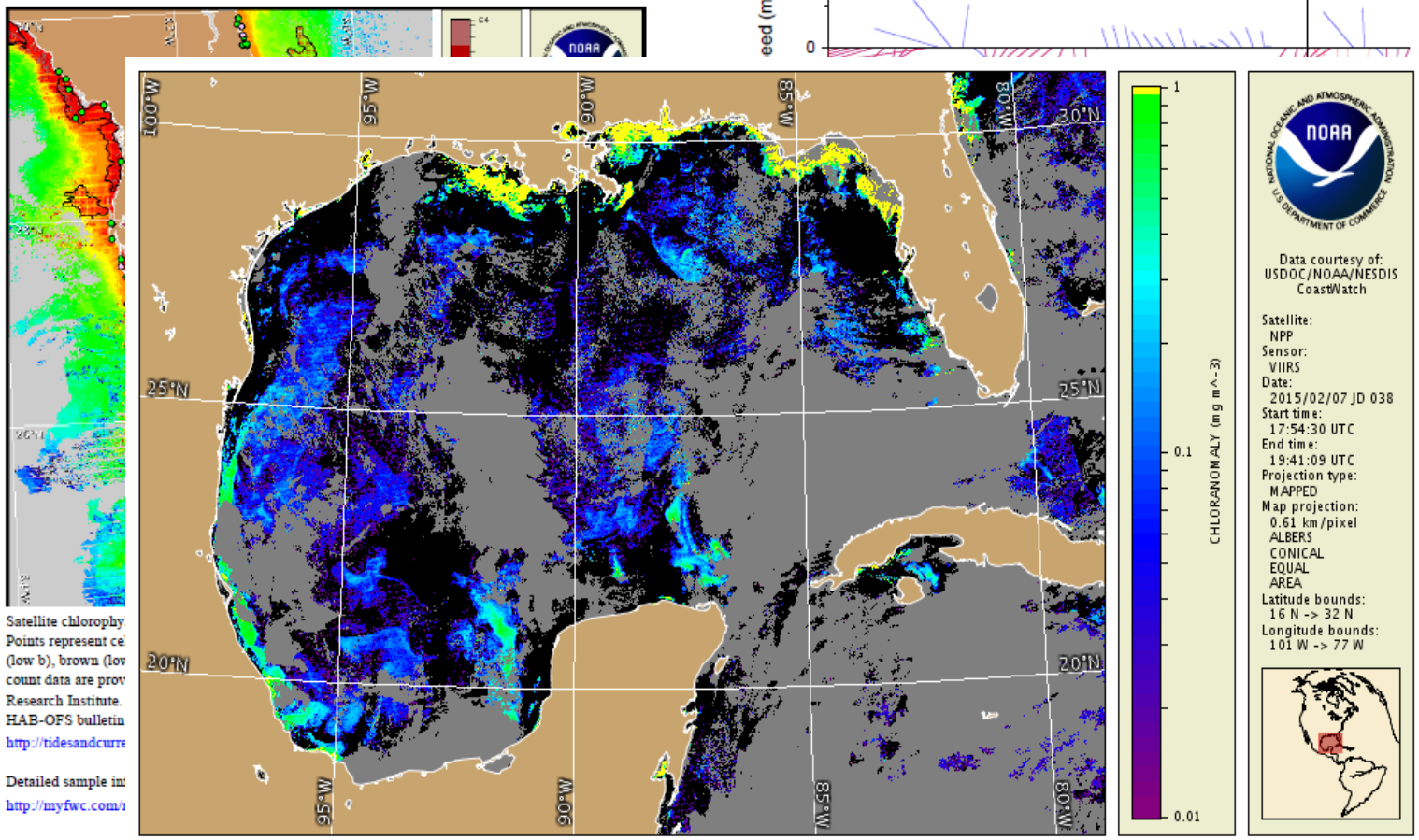

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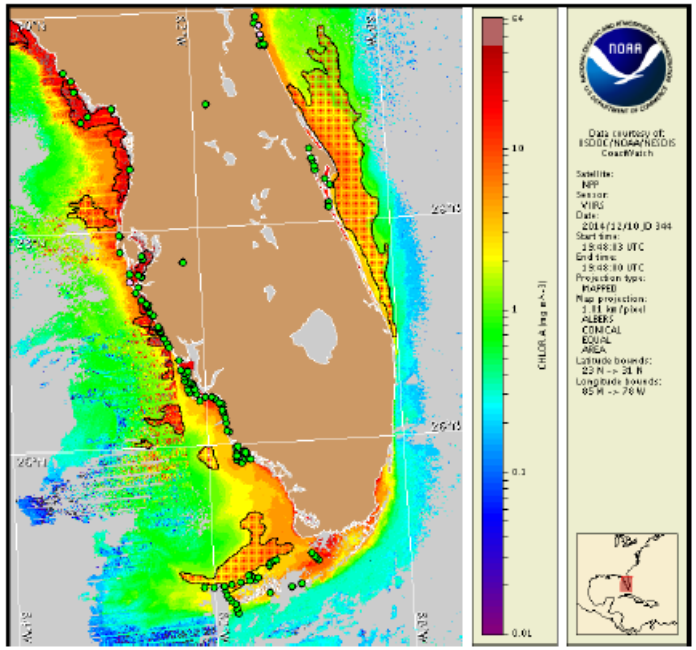

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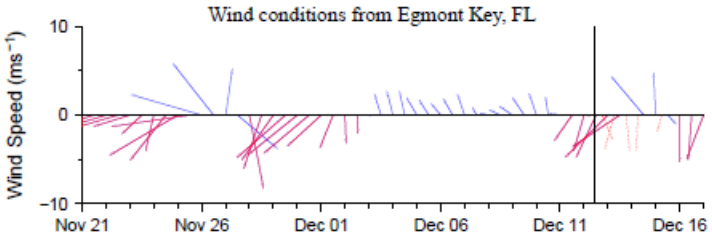

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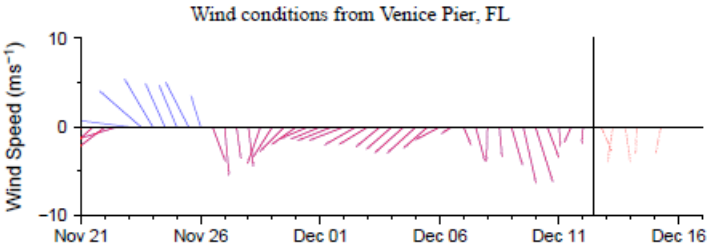


Wind Analysis

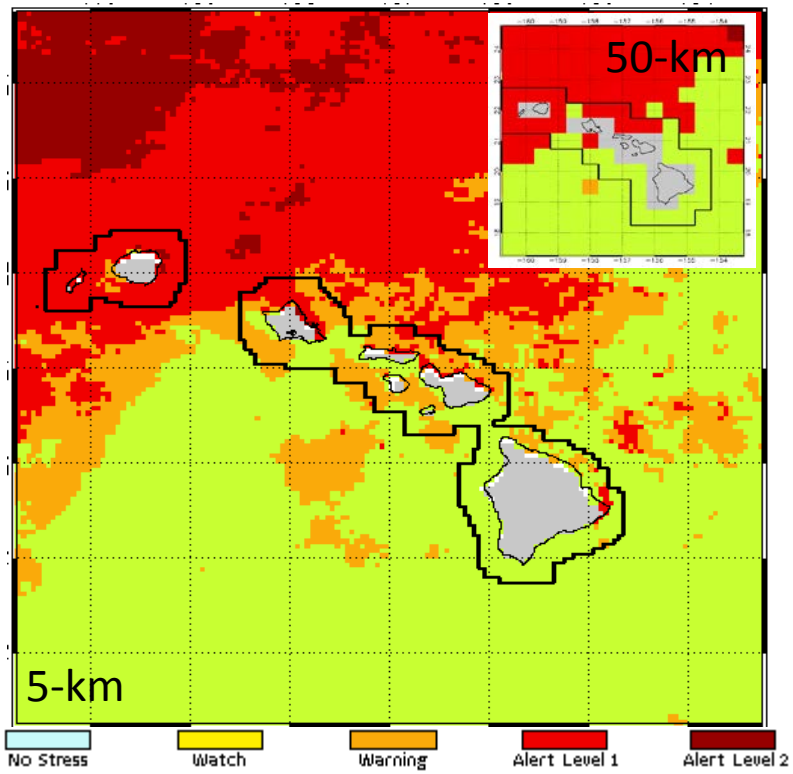
Test for VIIRS products

- 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 Initative

Addressing User Demands: Enhancing NOAA Coral Reef Watch's Satellite Decision Support System for Coral Reef Managers

Erick F. Geiger, C. Mark Eakin, Gang Liu, Jacqueline L. De La Cour, Scott F. Heron, William J. Skirving, Alan E. Strong

- CRW's new Decision Support System improvements include:
  - Using NESDIS operational Geo-Polar Blended daily SST Analysis at 5-km spatial resolution to produce bleaching thermal stress products.
  - An improved SST climatology derived from the Pathfinder SST climate data record.
  - More accurate alerts at or near reef scale.
- Future direction to push monitoring products to 1-km scale for regions in the Caribbean, Coral Triangle, and Great Barrier Reef:
  - To include the use of sub-km SSTs from VIIRS and 2-km SSTs from Himawari-8 and GOES-R to develop a new blended product.

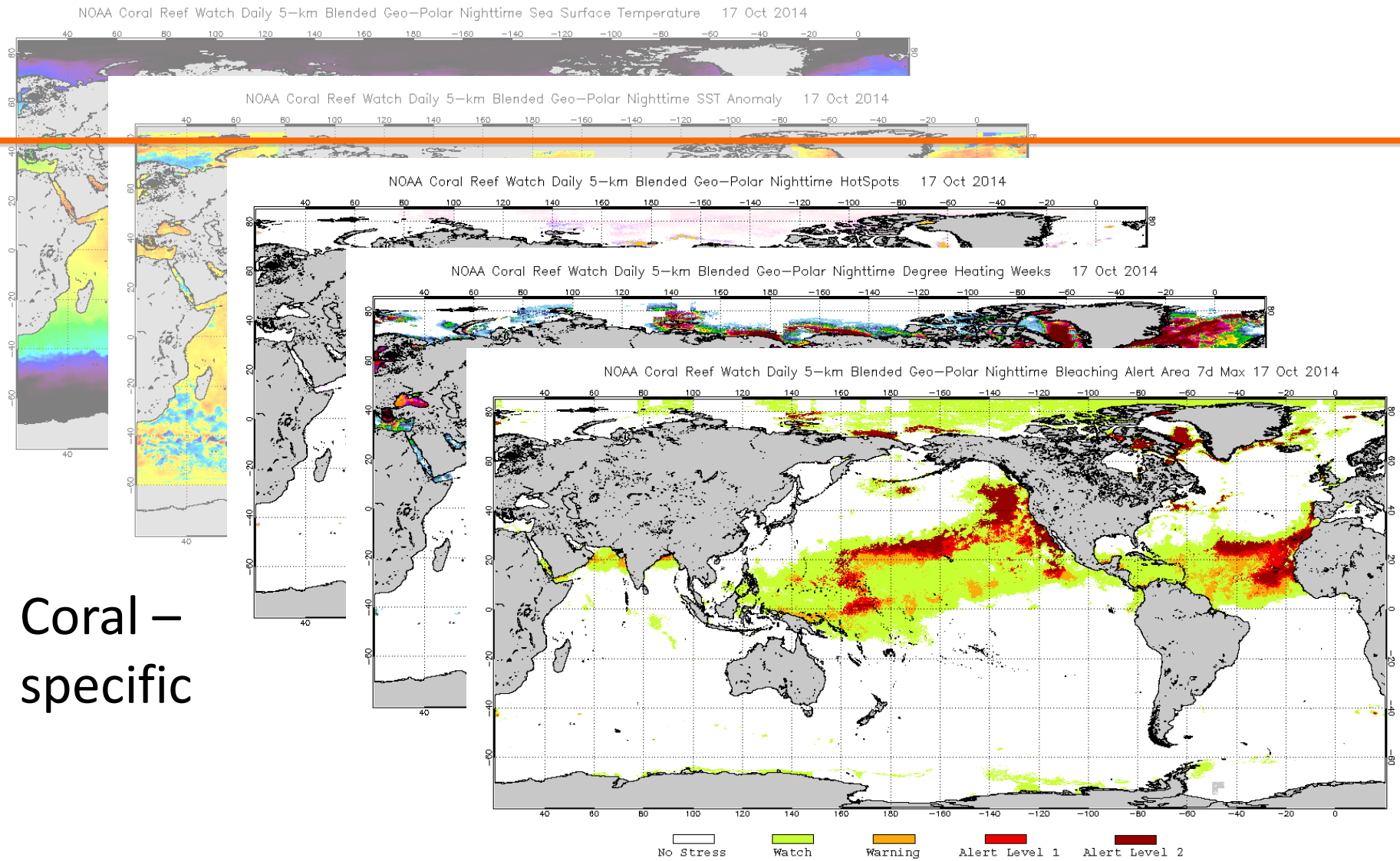


New 5-km versus heritage 50-km Bleaching Alert Area product for Hawaii

Coral Reef Watch

Poster # 2.35

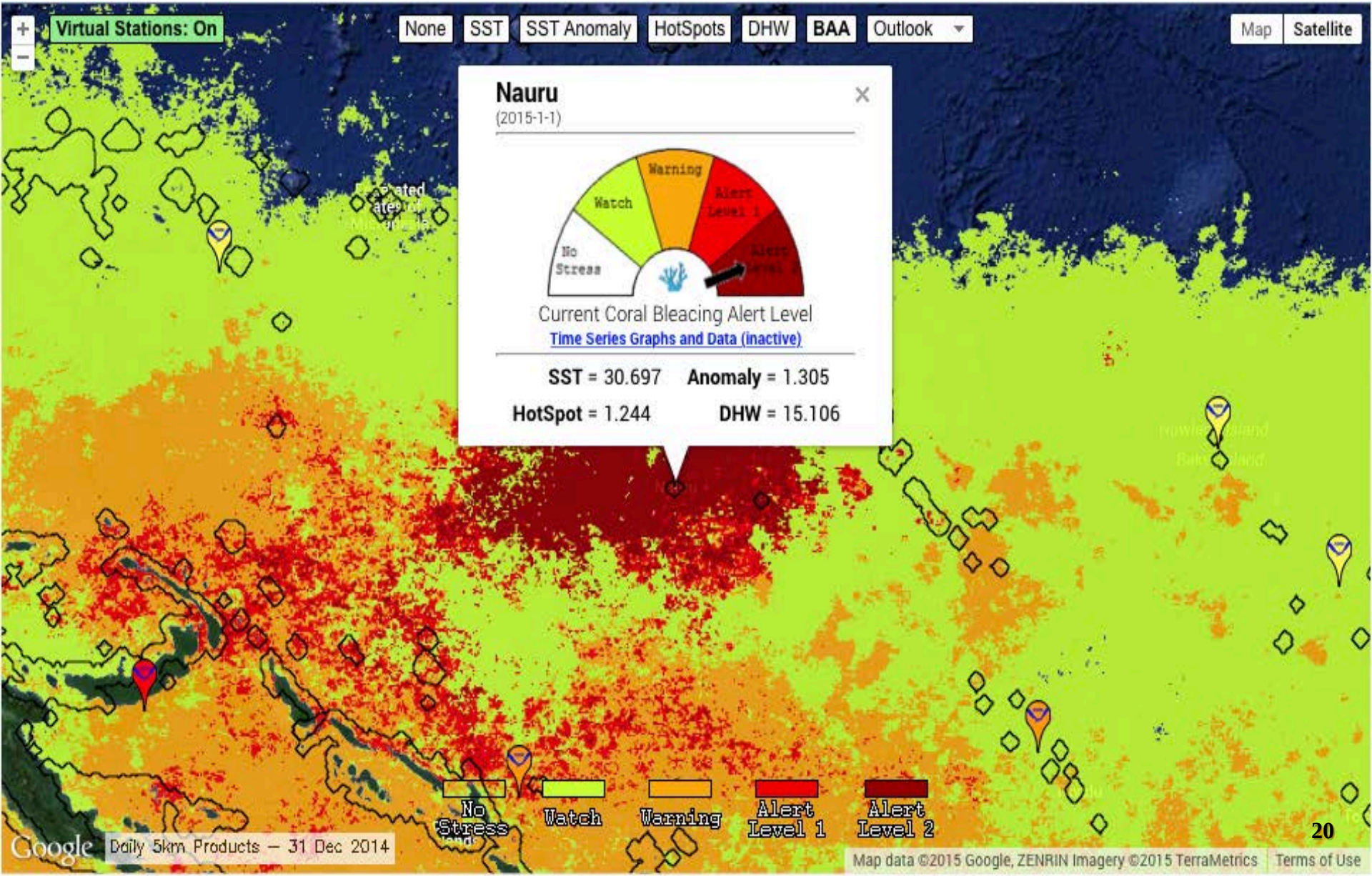
2014: Coral Reef Watch Launched 5 km Global Products



Coral – specific

Bleaching Alert Area

CRW 5 km Global Products: Google Maps Interface



Ocean Color Tools for Reef Managers

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

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

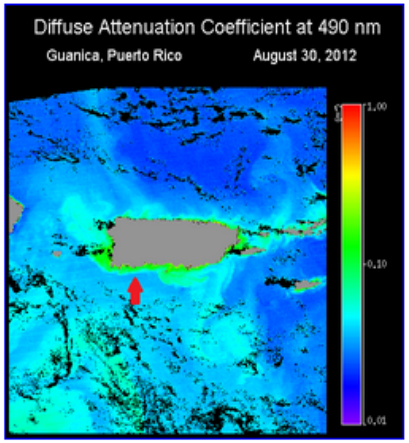
Coral Reef Watch

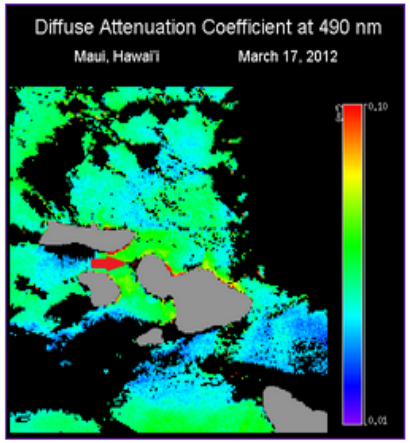
DOC > NOAA > NESDIS > STAR > CRW

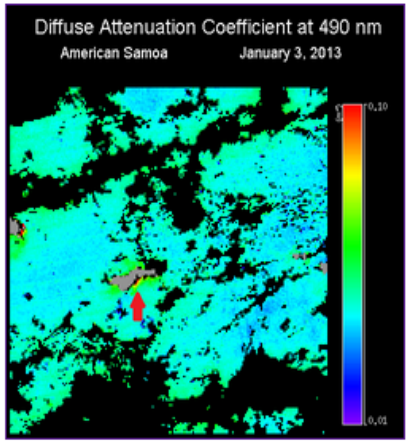
CRTF | CRCP | CREIOS | CoRIS

- 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

Satellite Ocean Color Product Development







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).

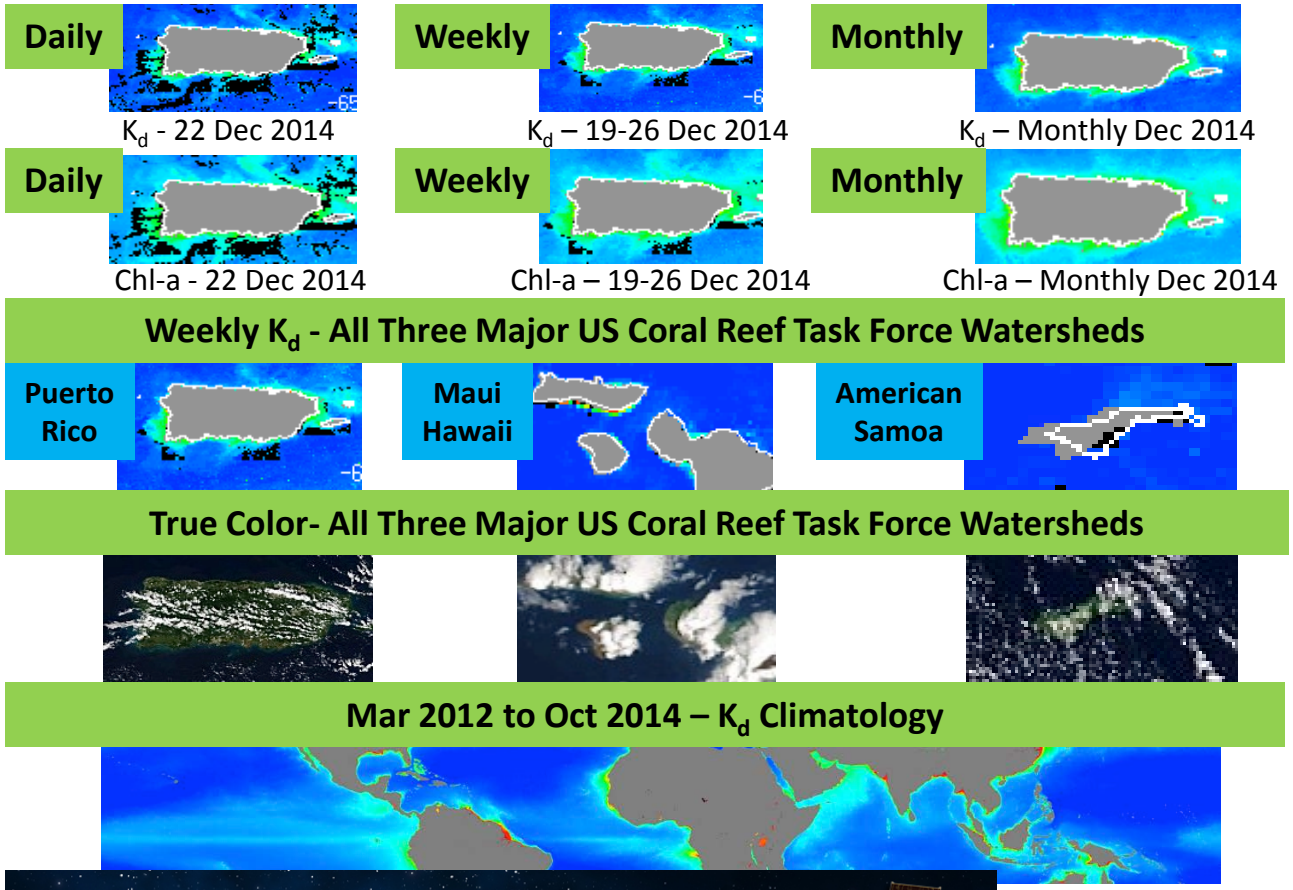
*From **Coral Reef Watch***

Developing VIIRS Ocean Color Products for Coral Reef Ecosystem Managers

AE Strong[1], M Wang[2], CM Eakin[1], W Hernandez[3], M Cardona[3] and E Geiger[1]
NOAA/NESDIS/STAR Coral Reef Watch[1] & VIIRS Ocean Color Team[2]
With University of Puerto Rico's Bio-Optical & Oceanography Lab[3]

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



Poster # 2.29

Oil Spill Mapping using VIIRS Imaging Channels

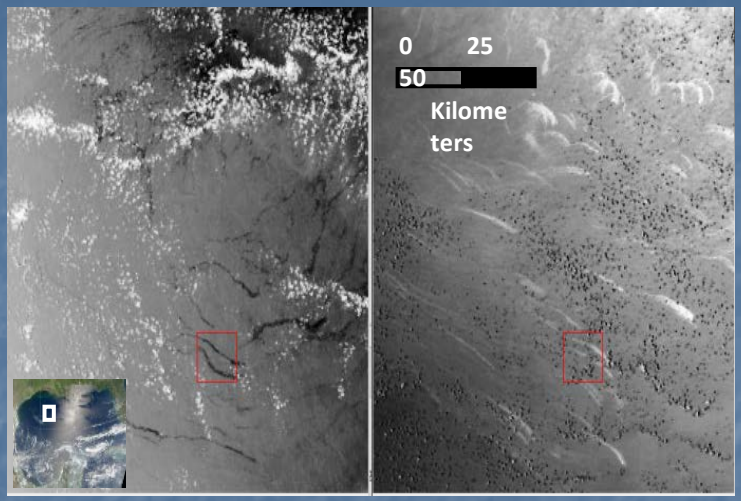


Fig. 2. VIIRS 865-nm images (imaging band #2) on (left) 15 and (right) 21 June 2013 from the same location in the northwest Gulf of Mexico (location shown in the inset figure) showing surface oil slicks due to natural seeps. Depending on the relative solar/viewing geometry (and therefore sun glint strength), the slicks can appear as both dark features (left) and bright features (right). Figure adapted from Hu et al. (2015, in press).

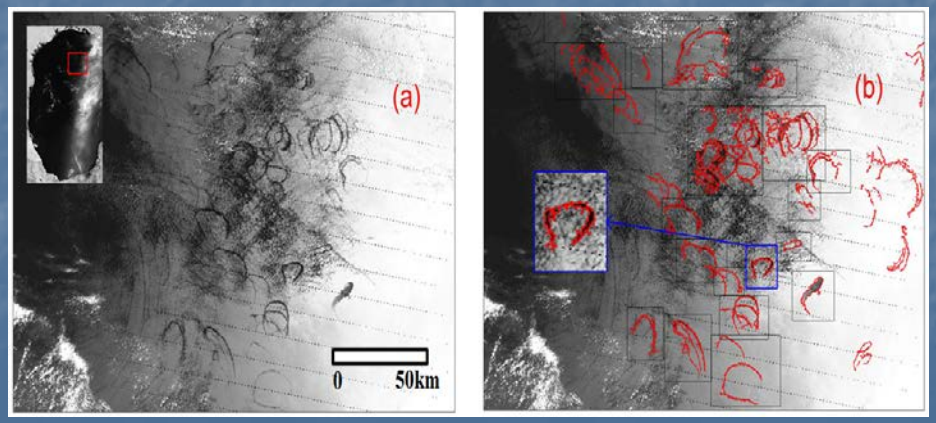
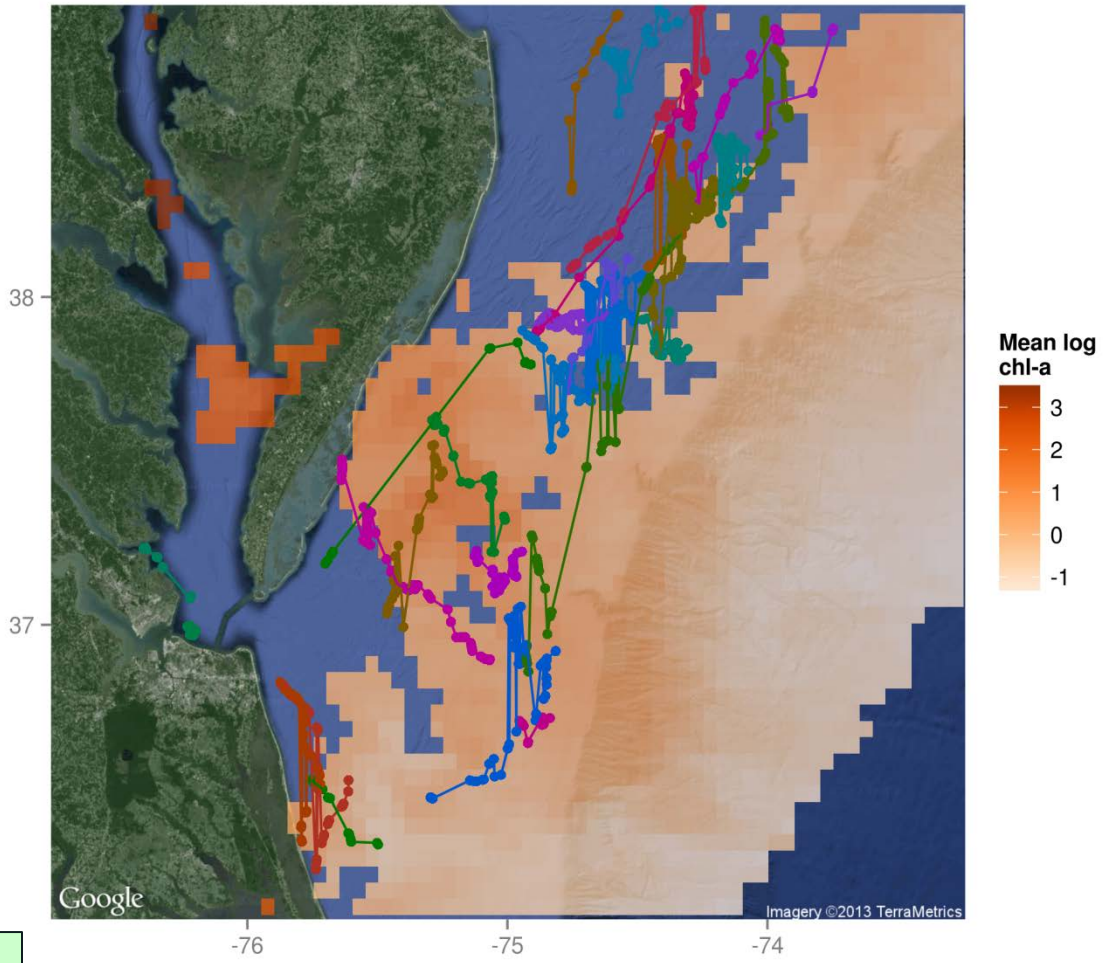


Fig. 4. Preliminary results of oil slick delineation from MODIS sun glint imagery on 2 June 2005. The parameters in the algorithm need to be fine tuned with VIIRS.

NPP
We VIIRS!!!
JPSS
Thanks to the JPSS Proving Ground & Risk Reduction initiative for making this class possible!
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
The 2013 NOAA Ocean Satellite Data Class

Is chlorophyll-a correlated with loggerhead sea turtle distribution?

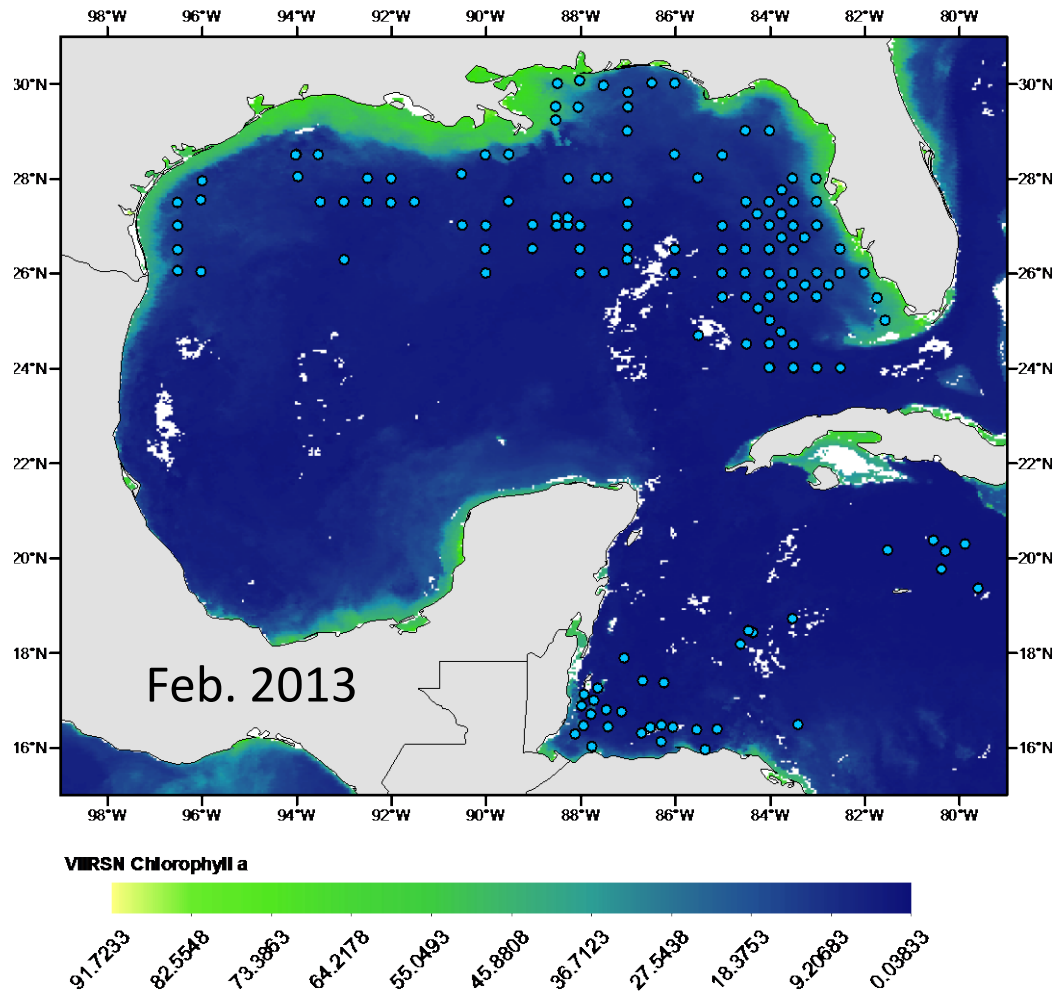
- VIIRS chlorophyll-a 8-day average for 06-01-2013
- Tracks of tagged loggerhead sea turtles for the same week



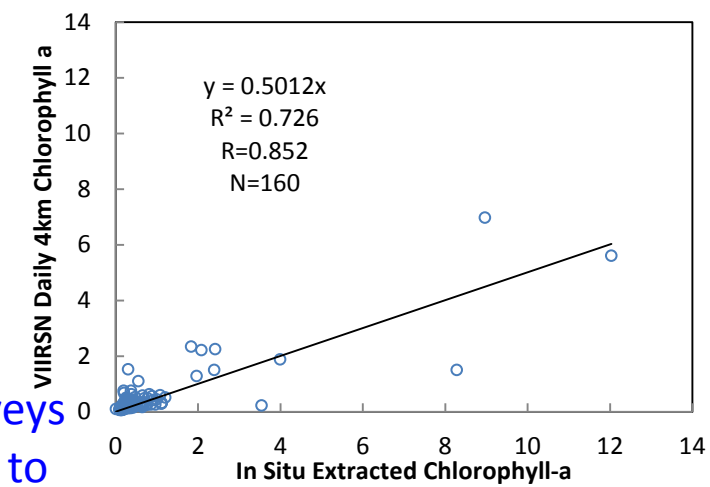
Melissa Warden, NMFS/NEFSC

Comparison of In-situ Chl-a and VIIRS Chl-a

David S. Hanisko and John Quinlan, NOAA/NMFS/SEFSC



In-situ chlorophyll (chl-a) data was collected during Spring and Fall SEAMAP (Southeast Area Monitoring and Assessment Program) Plankton Surveys conducted by the NMFS Southeast Fisheries Science Center. Surface chl-a was extracted from triplicate 200 ml seawater subsamples at each station using a modified Welshmeyer method and was reported as the average value of the subsamples. 562 observations of in-situ chl-a from the 2012 and 2013 surveys coincided with the operational status of the VIIRS sensor from the Suomi National Polar-Orbiting Partnership (NPP) Mission. Daily observations from 160 in-situ chl-a samples were matched in time and space with VIIRS daily sensor data. In-situ and VIIRS chl-a data were highly correlated (r=0.852). The majority of samples available for comparisons were primarily from open ocean observations with low chl-a values and very few observations from areas of high primary productivity.



NMFS/SEFSC collects chl-a data as part of plankton surveys every spring and fall. They are willing to give their data to the VIIRS cal/val effort if additional data is needed.

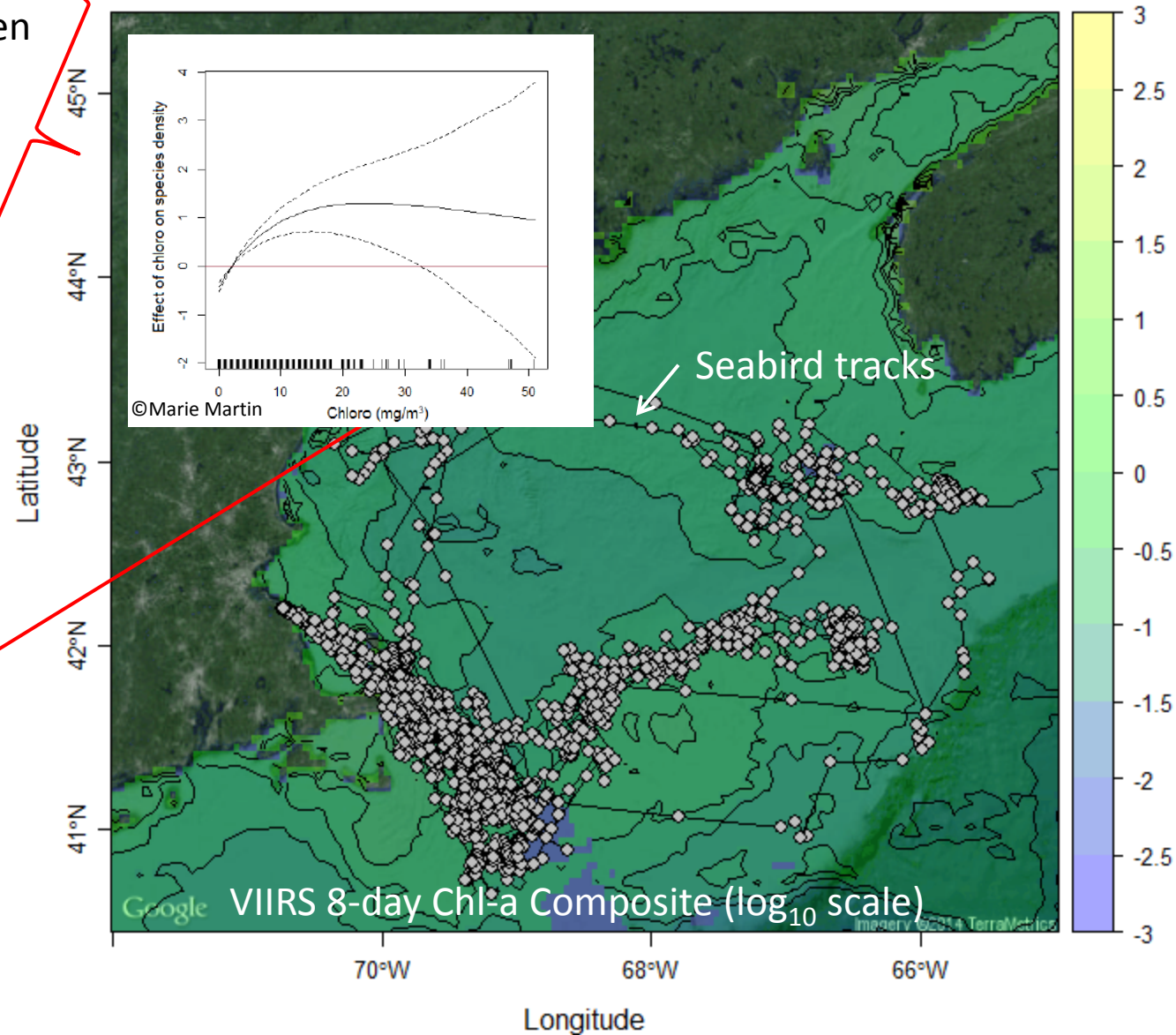
Joshua Hatch

NOAA/NEFSC, Resource Evaluation and Assessment Division

Chlorophyll-a has been shown to influence seabird densities (Martin 2013)

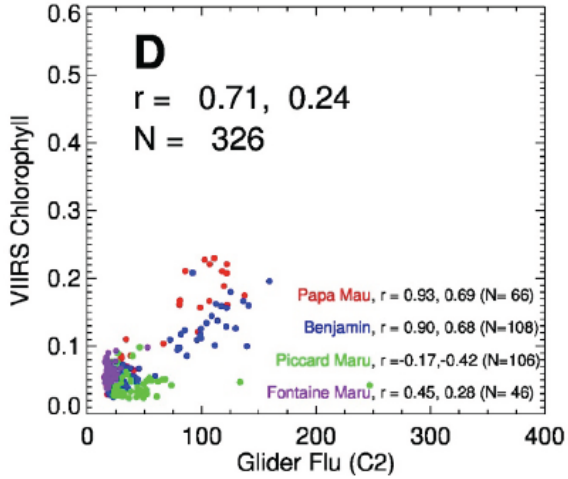
Several species of seabirds can smell dimethyl sulfide (DMS), a compound released by phytoplankton during zooplankton grazing, which may correlate with Chl-a

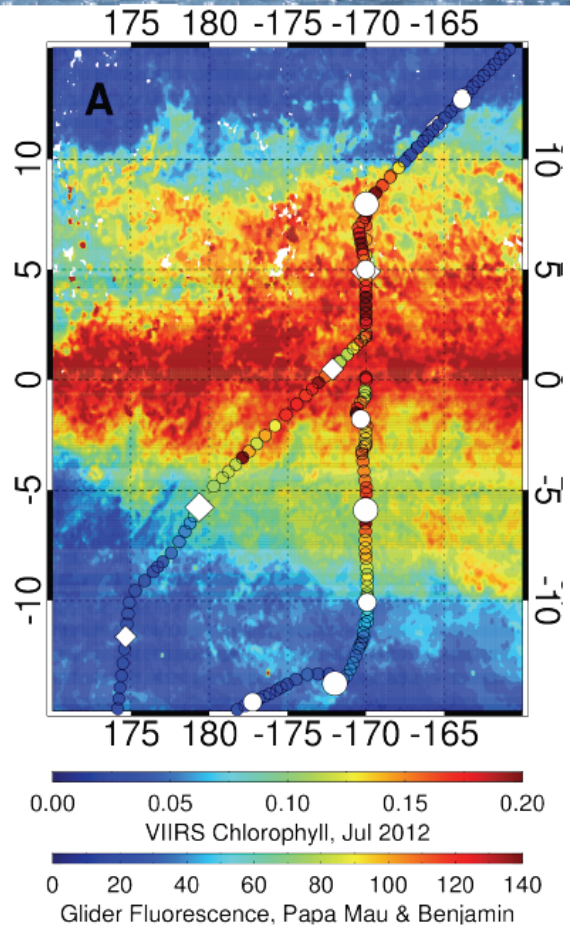
Chl-a may then be a useful metric to assess seabird presence, as they seek out productive areas to forage



Comparison with glider data

Comparison of Pac-X trans-Pacific wave Glider fluorescence data to VIIRS chl-a data





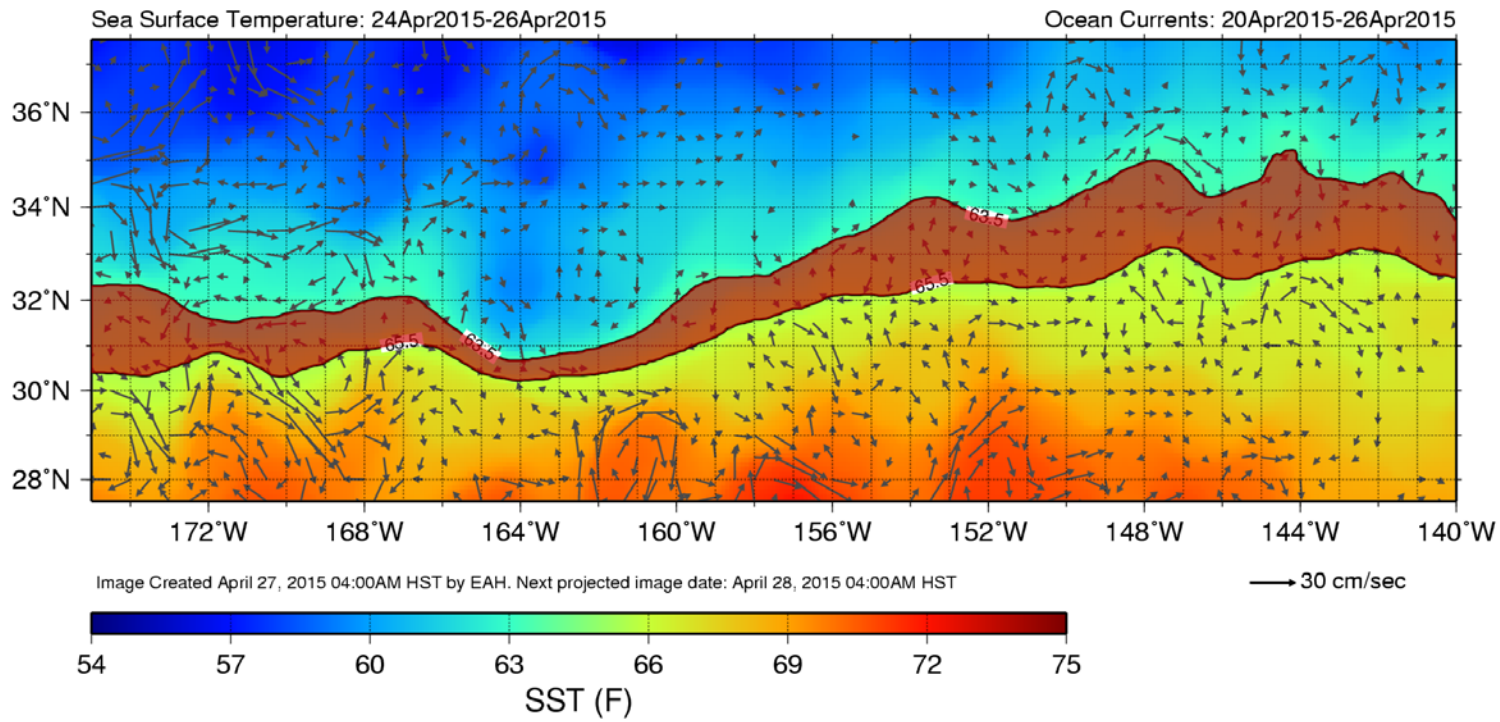
Villareal & Wilson, A comparison of the Pac-X trans-Pacific Wave Glider data and satellite data (MODIS, Aquarius, TRMM and **VIIRS**), *PlosOne*, 9(3): e92280. doi:10.1371/journal.pone.0092280.

Cara Wilson, NMFS/SWFSC/ERD

This research recognized as the Grand Prize winner of the Liquid Robotics PacX Challenge!

EXPERIMENTAL PRODUCT

avoid fishing between solid black 63.5°F and 65.5°F lines
to help reduce loggerhead sea turtle interactions



PACIFIC ISLANDS FISHERIES SCIENCE CENTER
ECOSYSTEMS AND OCEANOGRAPHY DIVISION
2570 Dole Street, Honolulu, HI 96822
http://www.pifsc.noaa.gov/eod/turtlewatch.php
contact: Evan.Howell@noaa.gov

Data provided by Central Pacific CoastWatch node

TURTLEWATCH

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

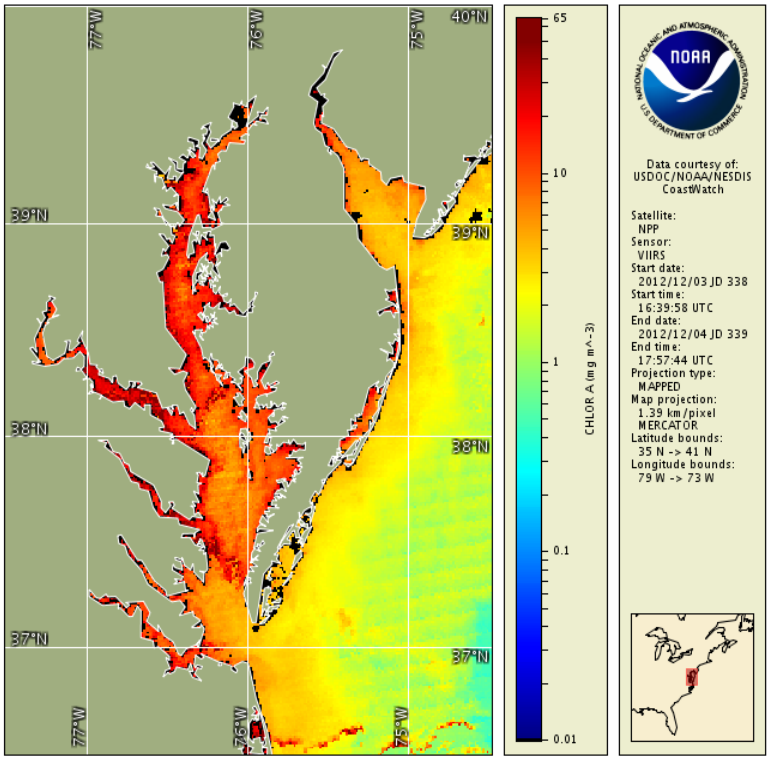
Fisheries
- ✓Multiple sectors
- ✓Gears
- ✓Seasons
- ✓Spatially explicit

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

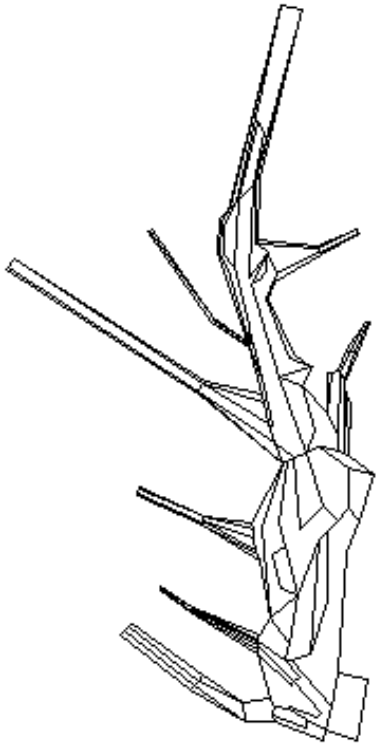
Conversion of VIIRS data to Ecosystem Model Grid

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



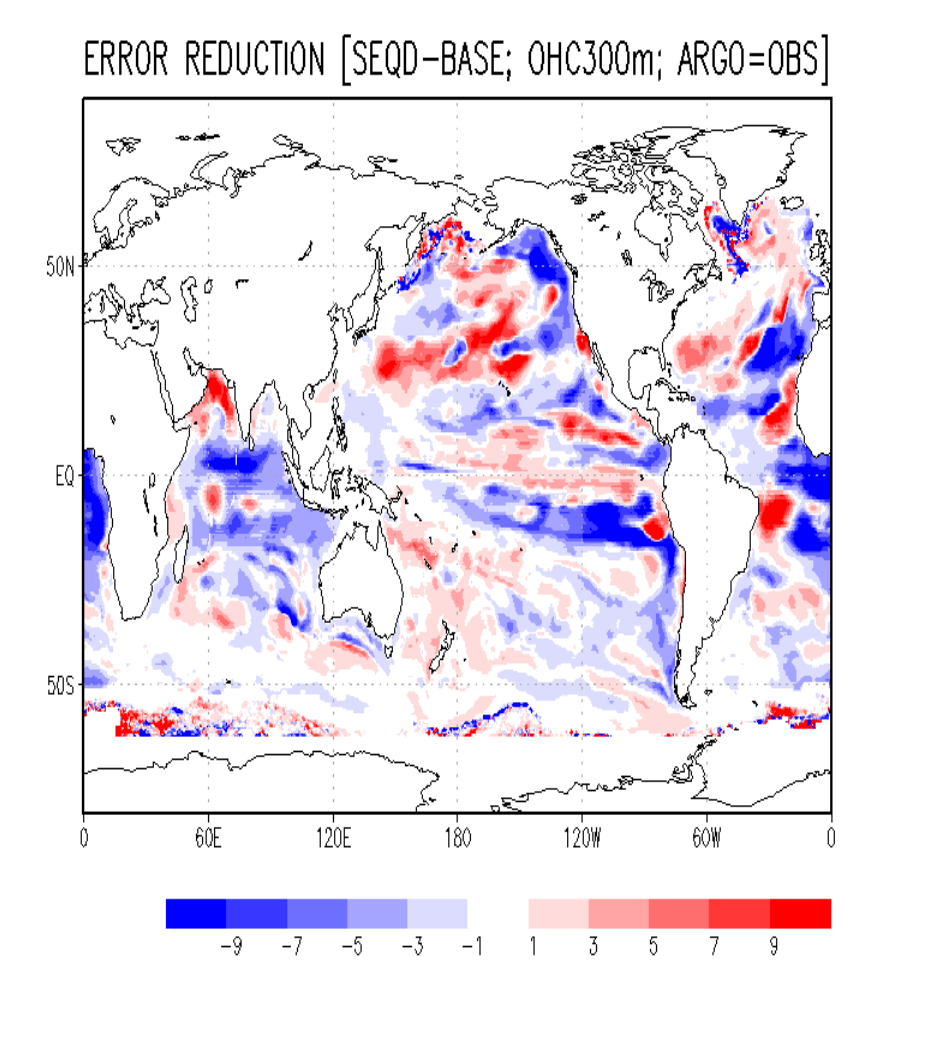
NOAA/NMFS/NCBO
Atlantis Ecosystem Model
97 polygons
Aggregated from 8,282

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

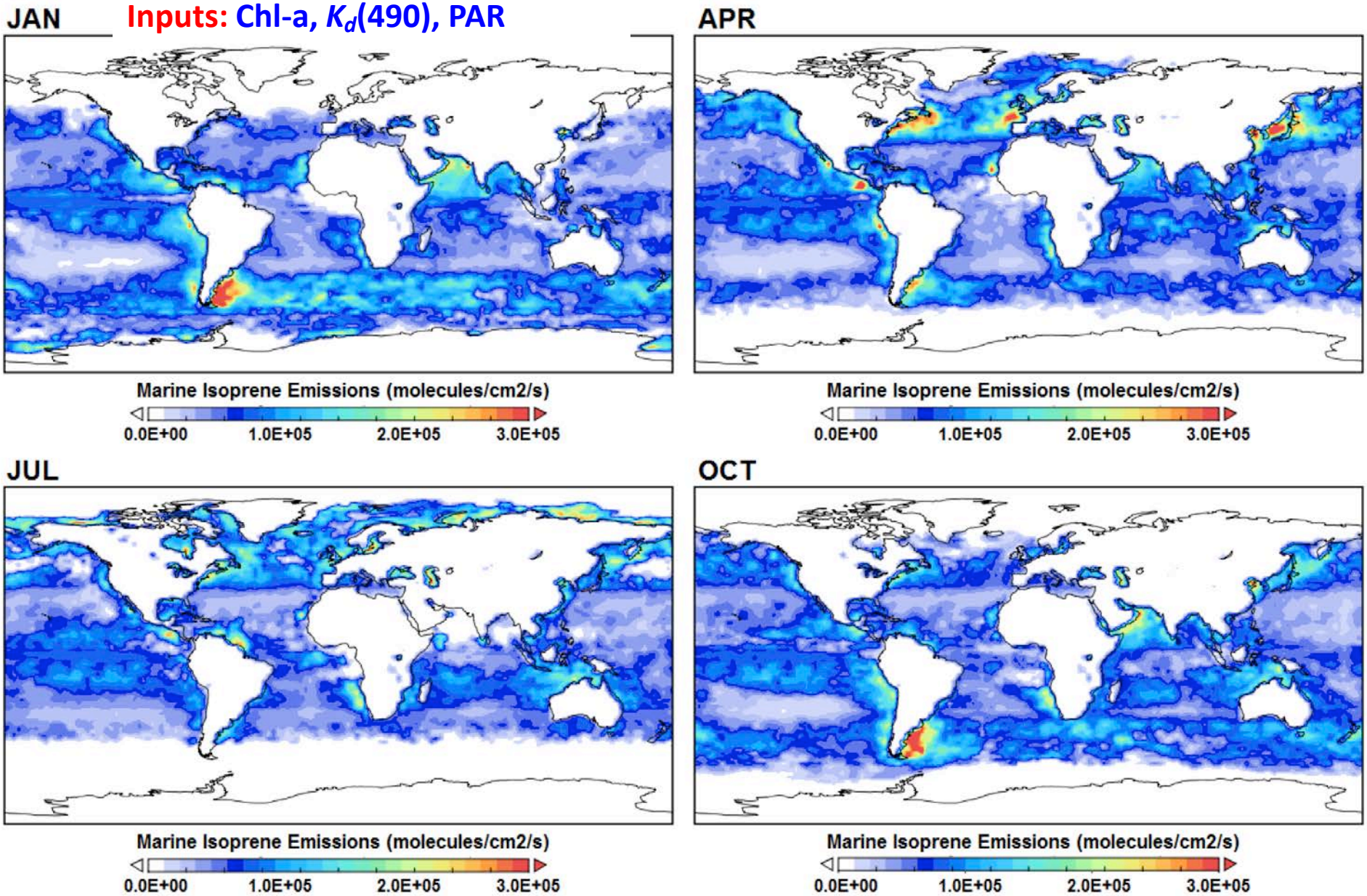
- Using composited daily ocean color fields, instead of the existing operational framework (i.e., monthly climatology), reduces ocean heat content (0-300 m) errors.
- Facilitates NOAA's advancements to coupled ocean-atmosphere modeling.
- Intentions are the eventual assimilation of operational VIIRS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

NCEP/EMC Collaborators:

STAR-NESDIS, JCSDA



OAR/ARL: Global Distribution of Marine Isoprene Emission



Access to VIIRS Ocean Data: Ocean Color and SST

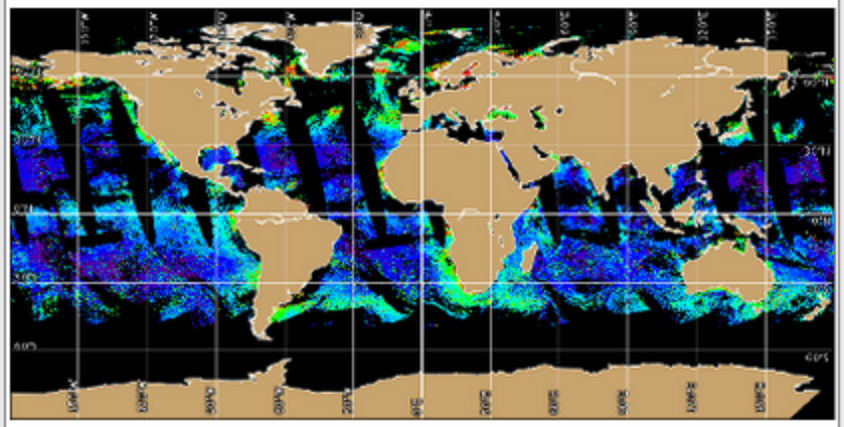
NOAA CoastWatch

- Home
- History
- Regional Nodes
- Data Access
- Data Products
- Applications
- Science
- Reports
- Resources

Search
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.

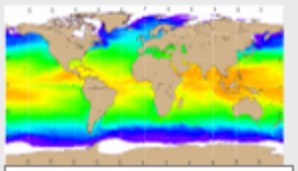
Global 4km chlorophyll-a (single file) and 750m (24 sector tiles) and CONUS (CoastWatch regions) are produced daily. Both CONUS and GLOBAL 750m (L2,L3) products are available through the CoastWatch THREDDS Server.

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,mtsat,msg]_YYYY [DEC 2014]

MODIS ~250m True Color and GOES SST products are now available on ftpcoastwatch.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/

ACSPO JPSS SST L2 Product archived

Product is available via JPL PO.DAAC and NODC

FY15 Milestone:
ACSPO VIIRS L2 product archived at JPL/NODC; NRT via CoastWatch

Accomplishments:

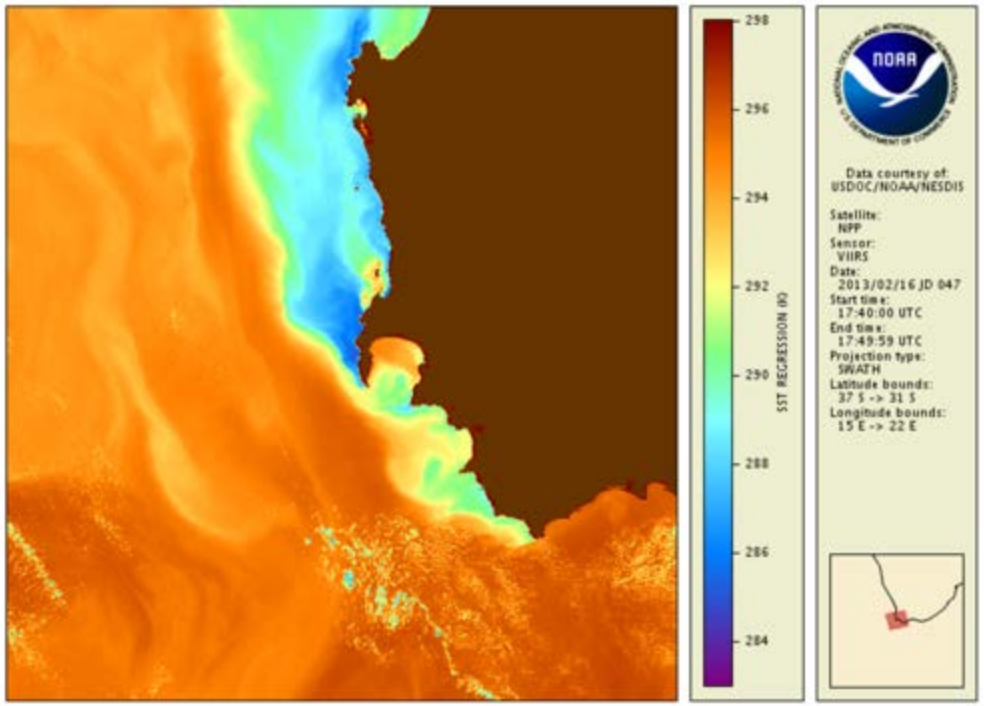
ACSPO SST archived at PO.DAAC podaac.jpl.nasa.gov/dataset/VIIRS_NPP-OSPO-L2P-v2.3 and NODC data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:GHRSST-VIIRS_NPP-OSPO-L2P-v2.3

Significance

NOAA heritage ACSPO SST product is fully functional and available to users from May 2014-onward .

Work is underway to reprocess back to Jan 2012. ACSPO SST is superior to the IDPS SST, which will be now discontinued.

Example ACSPO VIIRS SST over S. Africa



ACSPO SST provides unprecedented coverage, resolution, mage quality and retrieval accuracy

Sponsored by JPSS

VIIRS OC Processing and User Engagements

- Started generating and distributing global MSL12 VIIRS ocean color products
  - chlorophyll-a, Kd490, nLws for M1-5 bands
  - 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 THREDDS Data Server (TDS)
  - Global 4km Chlorophyll-a and Kd490 netcdf data been used by EMC for their climate modeling development efforts.

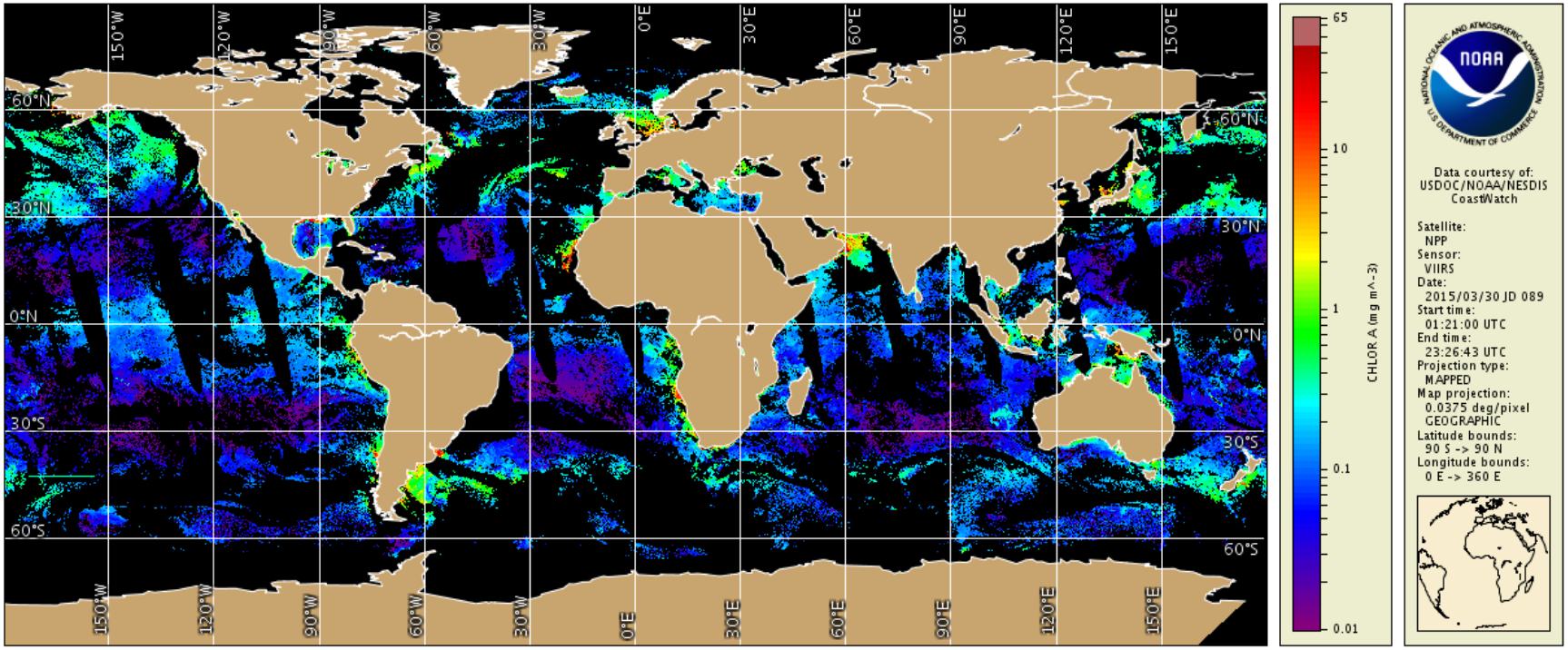
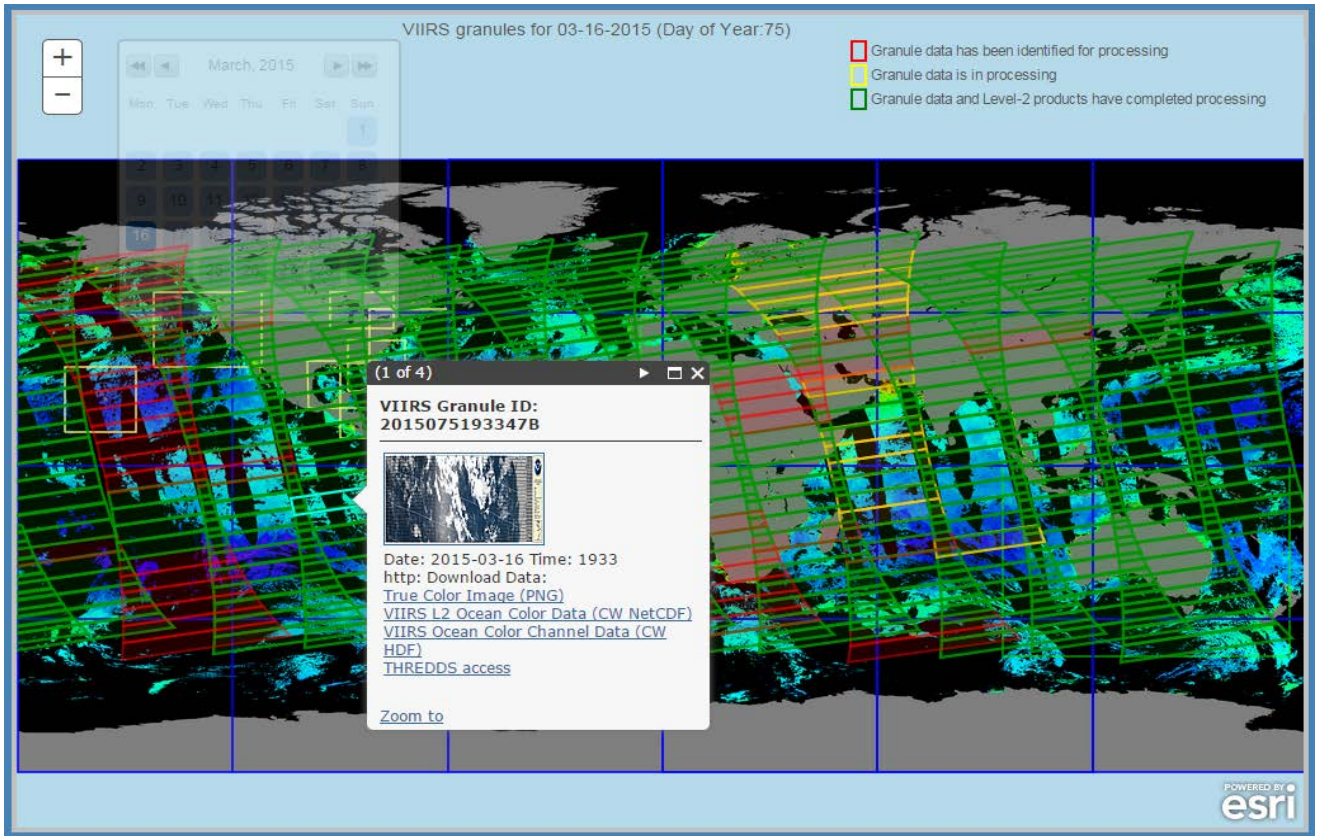


Figure 1. March 30, 2015 global Chlorophyll-a concentration image from SNPP VIIRS

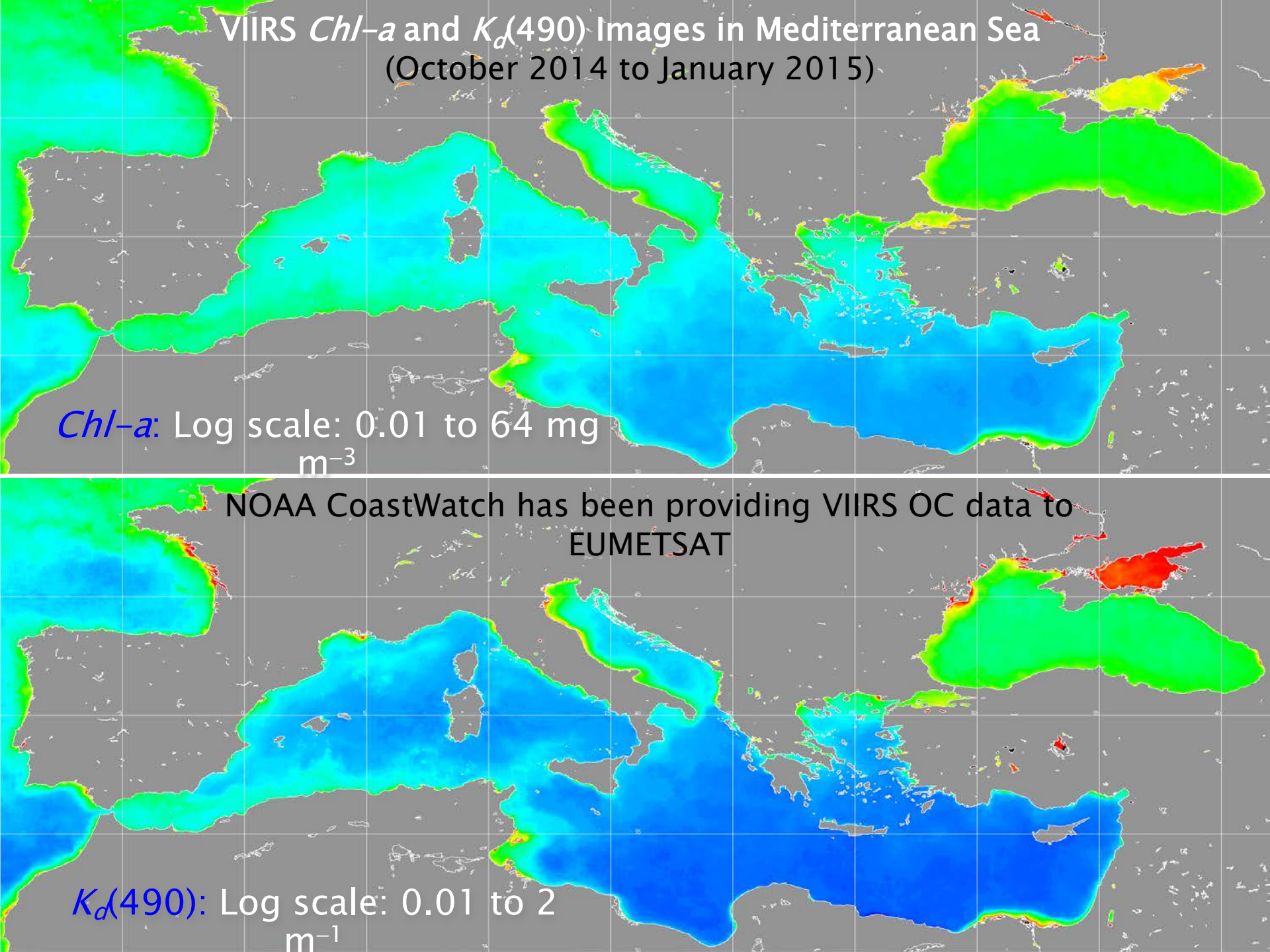
CoastWatch VIIRS Ocean Color Portal

- 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
  - When finished, the portal will provide direct access to NRT, Science Quality, and Mission Reprocessed Level 2 data



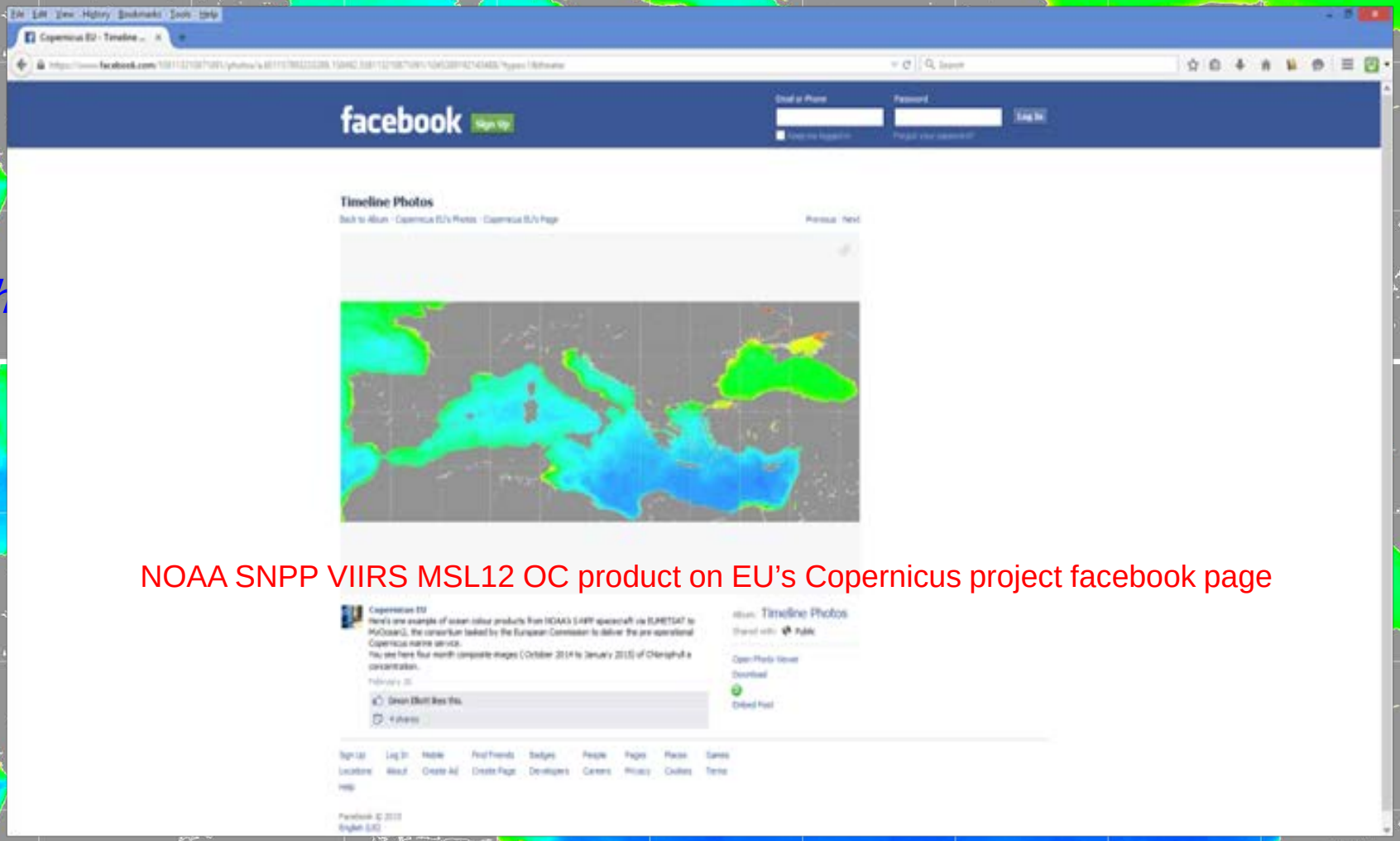
Global Map-based granule display of VIIRS true color images (granule selector)

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



NOAA CoastWatch has been providing VIIRS OC data to EUMETSAT

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



NOAA SNPP VIIRS MSL12 OC product on EU's Copernicus project facebook page

$K_d(490)$: Log scale: 0.01 to 2 m^{-1}

Other NOAA Satellites/Data Products

Jason Satellite Radar Altimeter Program

22+ year CEOS global reference record of sea level

Jason-3: led by NOAA and its operational partner, EUMETSAT, in collaboration with NASA, CNES (and soon ESA and the EC for Jason-CS in 2020).

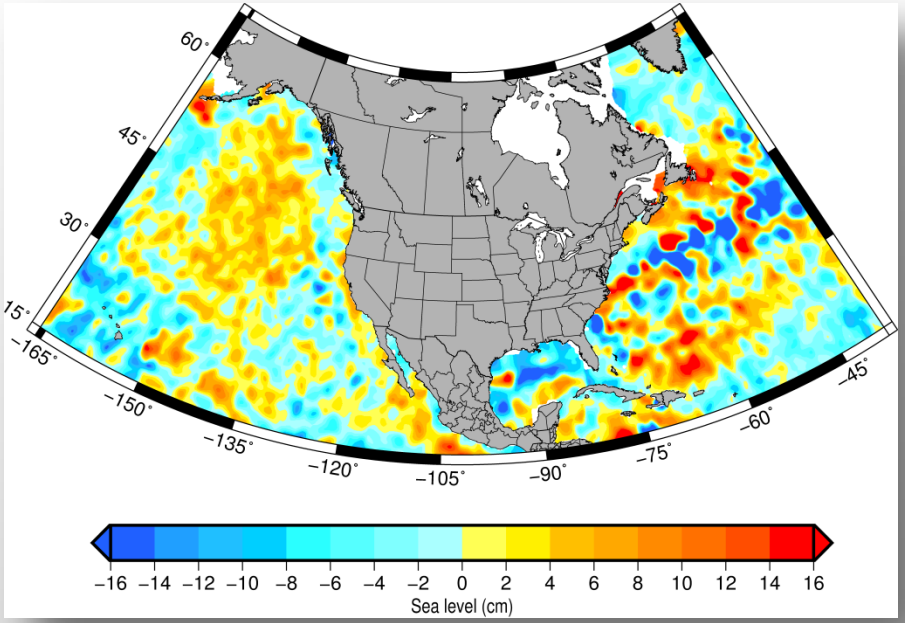
Jason-3 Launch Scheduled for July 22, 2015

- FY15 Funding secured by NOAA
- NASA Launch vehicle certification ongoing
- Space-X Falcon-9: 16 successful launches including DSCOVR Launch (shown below)
- Jason-3: 2015-07-22 - Vandenberg, CA

- During first 6 months of operation, Jason-3 will fly 1 minute behind Jason-2 to allow for precise inter-comparison.
- Following tandem mission, Jason-2 will be moved to new orbit, splitting Jason-3 ground track in space/time.

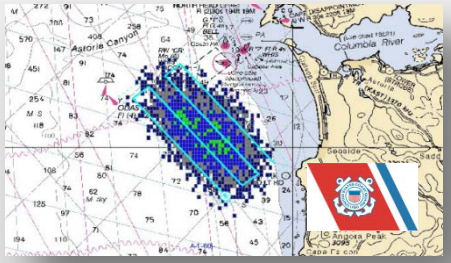
Jason Applications & End Users

Sea Level Anomaly –"Ocean Weather"- Feb 3-13, 2014

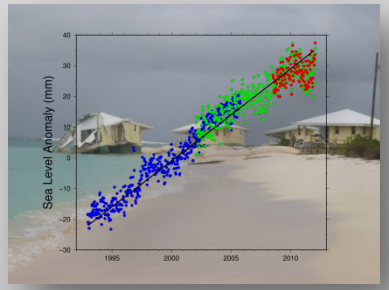


High Wave Forecasting

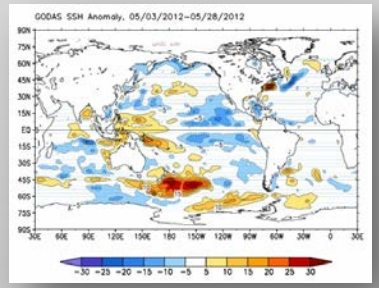
Coast Guard Search & Rescue



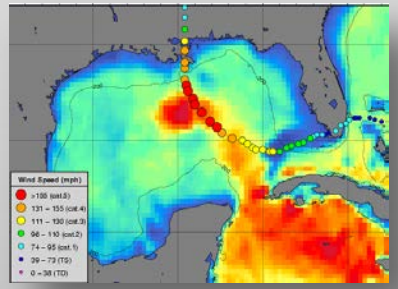
Global & Regional Sea Level Rise



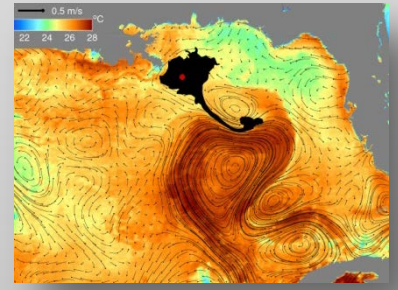
El Nino Forecasting



Hurricane Intensity Forecasting



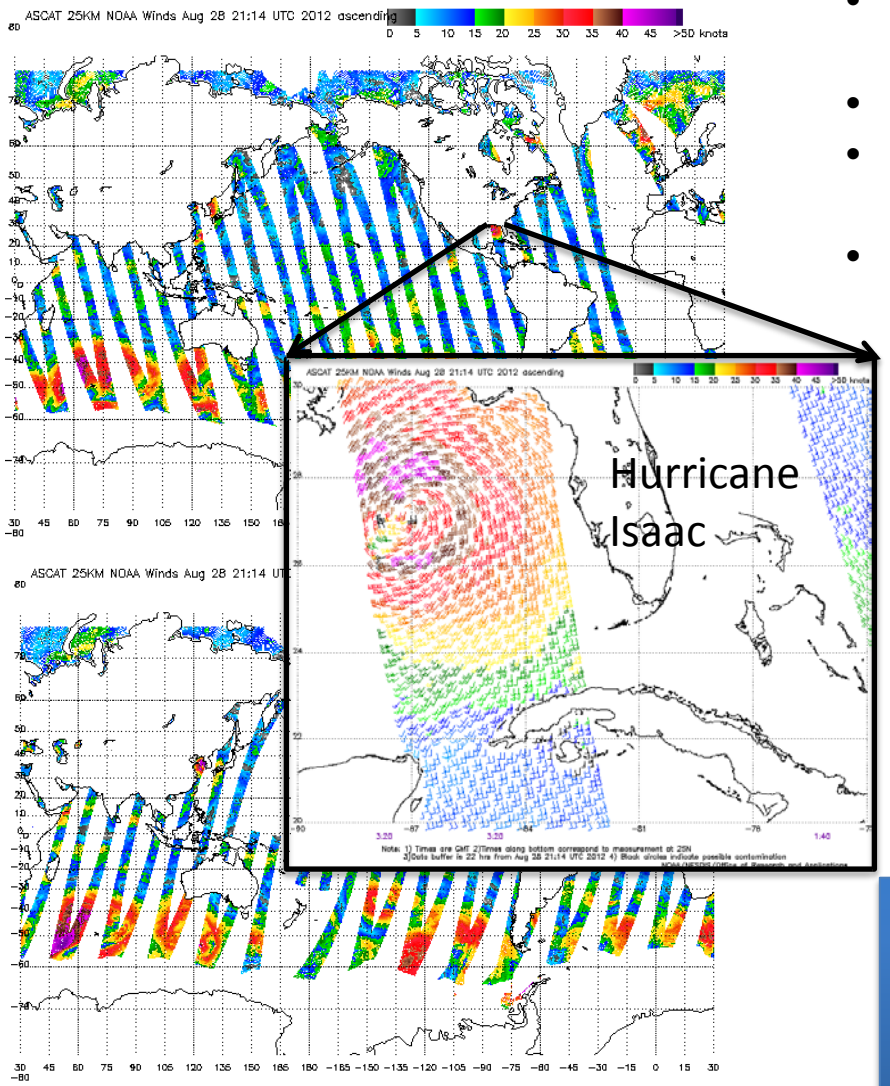
Oil Spill Monitoring



Non-NOAA Sensors, Data Products, and User Applications

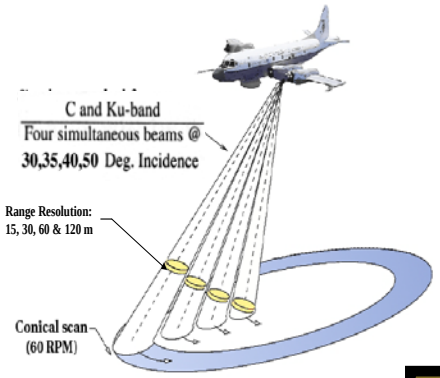
Satellite Ocean Surface Vector Winds

ASCAT Daily Coverage Example



NOAA Satellite Ocean Surface Winds Science Team
http://manati.star.nesdis.noaa.gov/

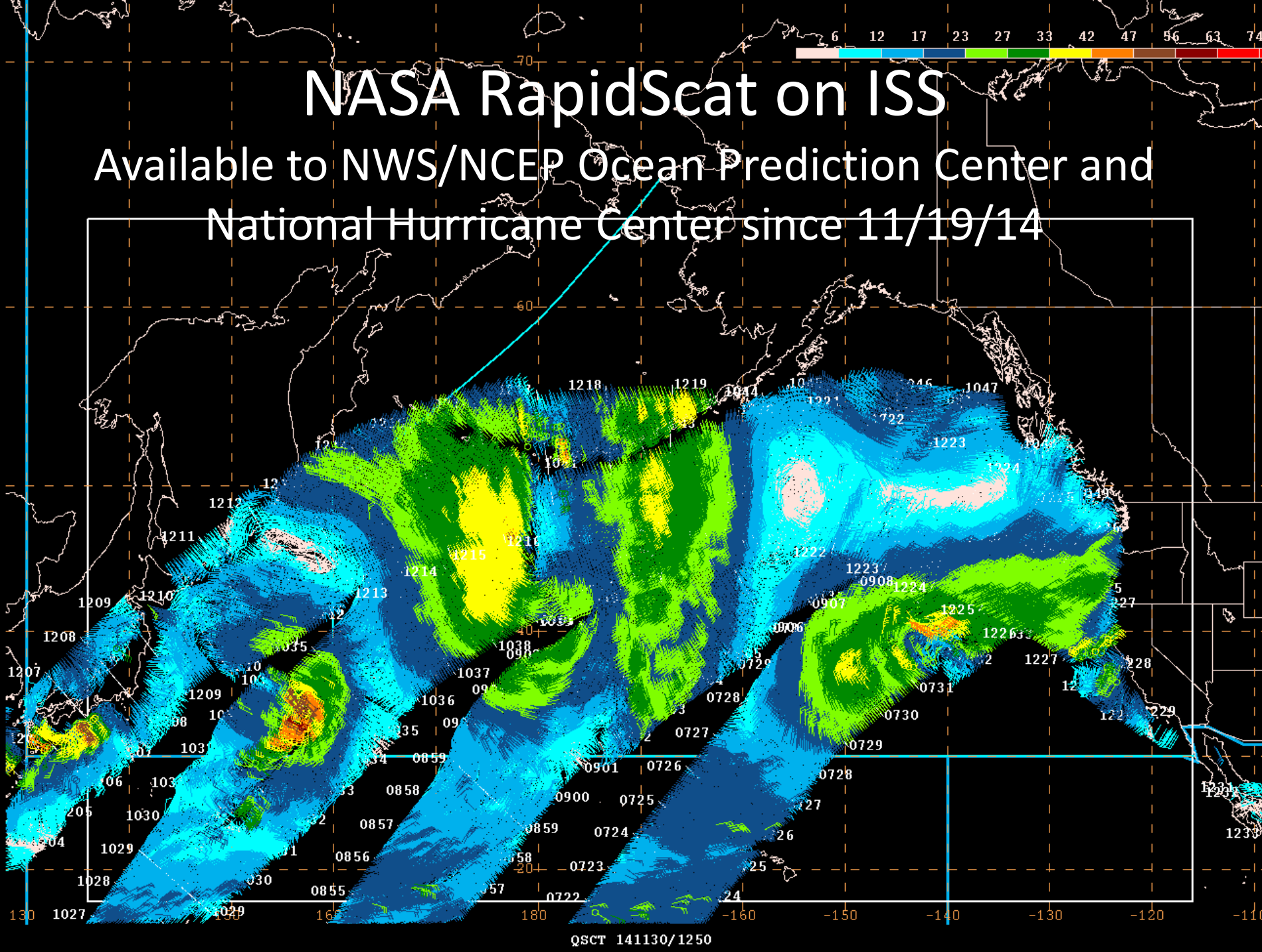
- OSVW data supports wind and wave warning and forecasting
- ASCAT data from EUMETSAT operational at NOAA
- OSCAT data from ISRO was in operational demonstration phase prior to its failure in 2014
- NOAA P-3 used to fly a profiling scatterometer system (IWRAP) for validation and improvement of satellite algorithms in tropical (hurricanes) and extratropical cyclone conditions



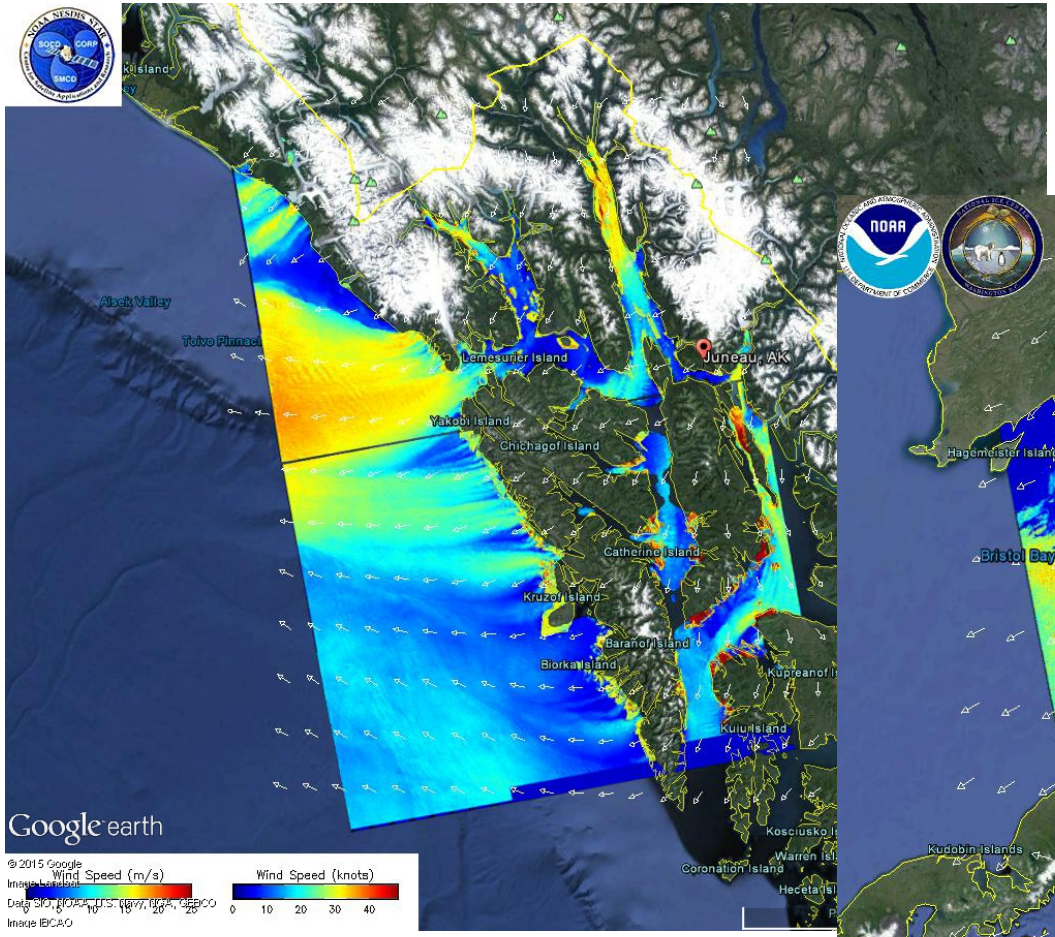
Goal: Provide the best possible product and training to end users

NASA RapidScat on ISS

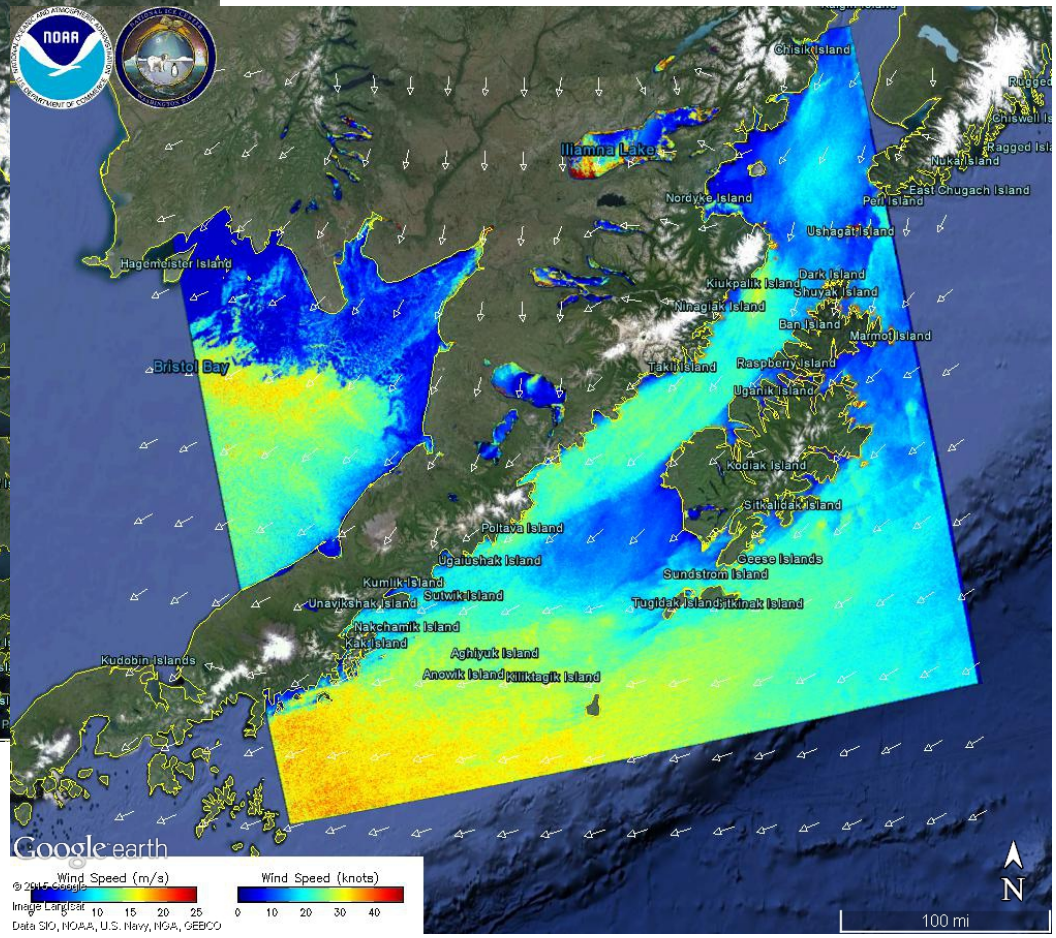
Available to NWS/NCEP Ocean Prediction Center and National Hurricane Center since 11/19/14



High-Resolution SAR-Derived Wind Speed Products



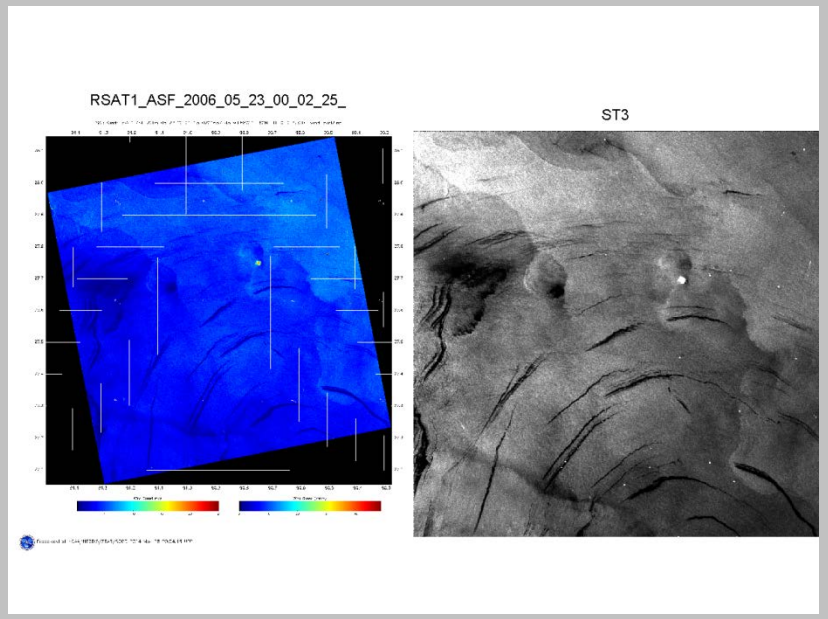
Operational Radarsat-2 wind speed
2015-02-04 04:05 UT

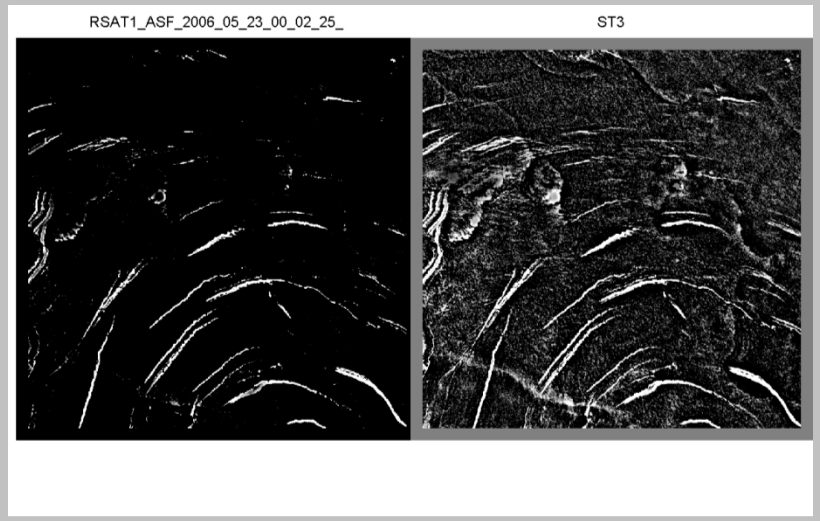


Pre-operational Sentinel-1A wind speed
2015-01-08 02:46 UT

Training of Oil Spill Analysis System with Sentinel-1 SAR Data: Begin Routine Experimental Production in STAR

Progress has been made in implementing the Texture Classifying Neural Network Analysis (TCNNA) oil spill mapping code as a new product within the SAR Winds System (now called the SAR Operational Products System or SAROPS). The SAROPS product template is being used and tested for the TCNNA product.





RADARSAT-1 experimental oil spill product.
Far left: wind image showing oil from oil seeps as darker blue steaks.
Left center: SAR backscatter image showing oil from oil seeps as dark streaks.
Right center: Output of oil detection algorithm showing oil from oil seeps as bright streaks.
Far right: Output of oil detection as a probability of oil – the brighter the pixel, the higher the probability.

Once routine production of oil spill mapping is running in NESDIS/STAR, the experimental products will be evaluated by the NESDIS/OSPO Satellite Analysis Branch (SAB).

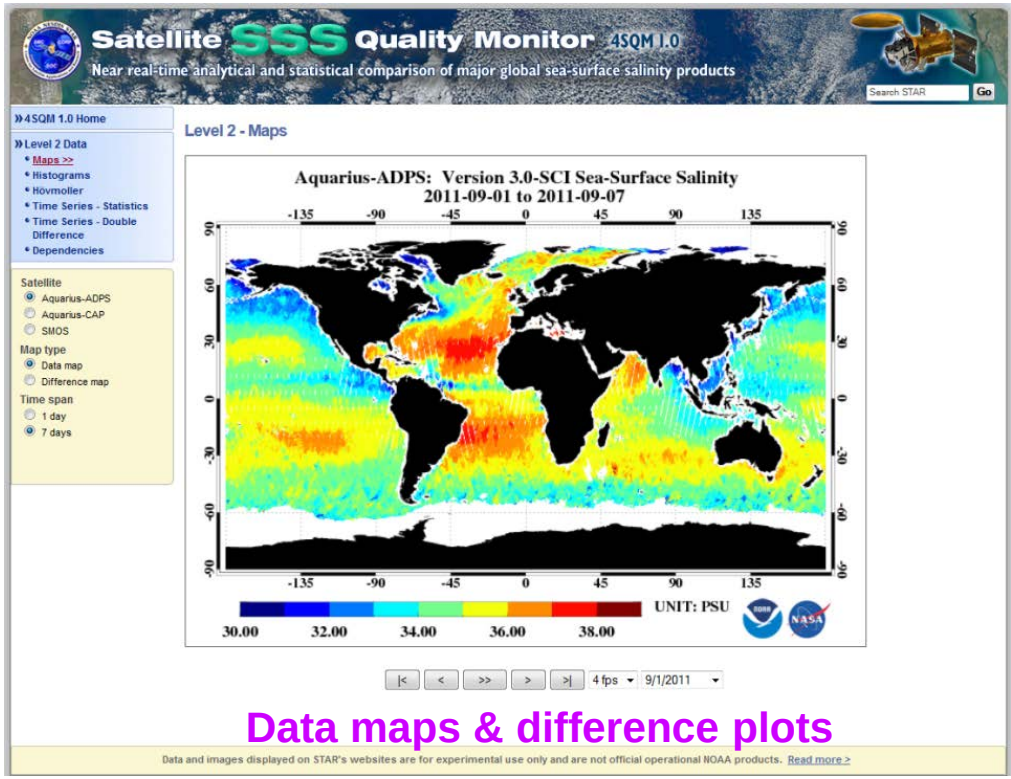
NOAA Sea-Surface Salinity Activities

- **Observations**
  - SSS data streams: Aquarius (ADPS, CAP), SMOS, SMAP
  - NOAA SSS products:
    - NESDIS/NODC bin-averaged
    - NWS/NCEP/Climate Prediction Center (CPC) blended analysis of surface salinity (BASS)
  - SSS data quality assessment
  - Reconcile satellite skin SSS values with *in situ* near-surface salinity observations

- **Modeling**
  - SSS data assimilation:
    RTOFS, GODAS/CFS, WCOFS
  - Improved radiative transfer
    modeling for MW Radiometry

- **Climatology**
  - Global SSS baseline (NODC)
  - SSS for computing global upper-
    ocean heat content
  - SSS for virtual rain gauge

- **Ecosystems**
  - Ocean acidification
  - Specie domains and food webs



Data maps & difference plots

http://www.star.nesdis.noaa.gov/socd/sss/4sqm/

NOAA 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

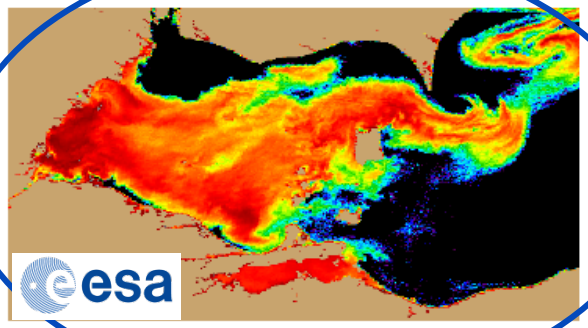


Figure 1. MERIS image from the European Space Agency. Imagery shows the spectral shape at 681 nm from September 03, where colored pixels indicate the likelihood of the last known position of the *Microcystis* spp. bloom (with red being the highest concentration). *Microcystis* spp. abundance data from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

Forecast (with Great Lakes CFS)

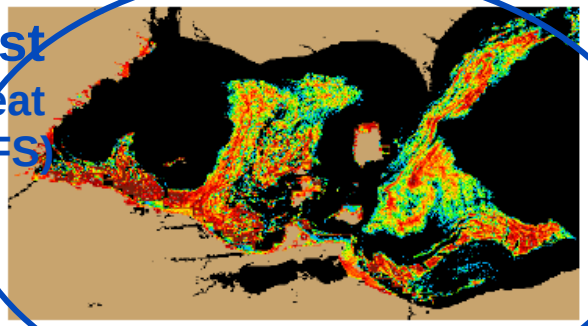


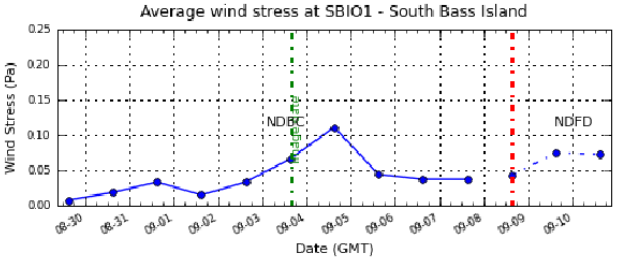
Figure 2. Nowcast position of *Microcystis* spp. bloom for September 08 using GLCFS modeled currents t move the bloom from the September 03 image.

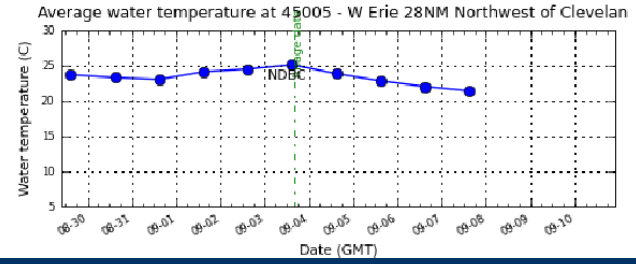
Conditions: A massive *Microcystis* bloom persists throughout most of Lake Erie's Western Basin.

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.

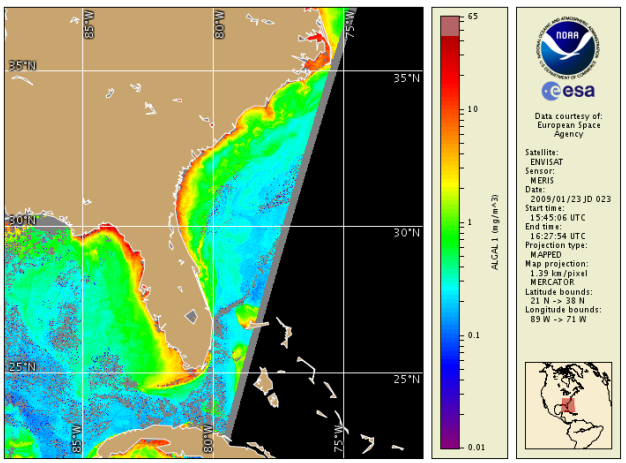
Briggs, Wynne





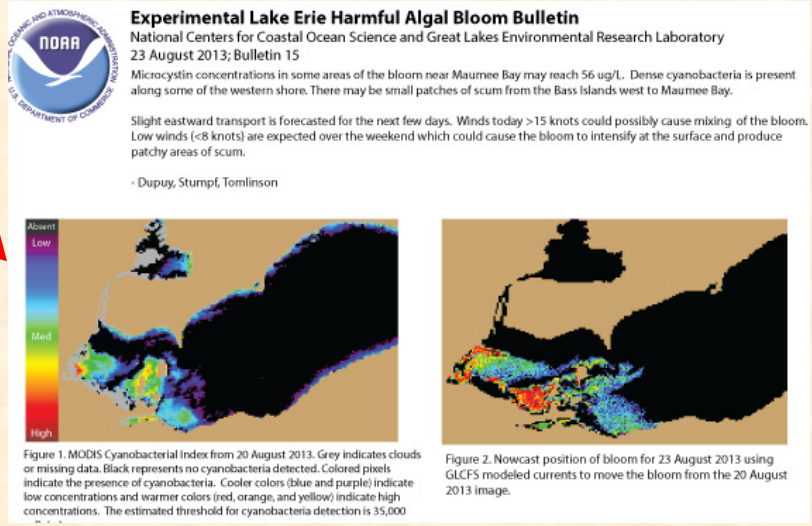
NOAA Utilization of European Ocean Color Data: Way forward for Sentinel-3/OLCI

- MERIS data declared operational by SPSRB in Jan 2009; however, Envisat failed in 2012.
- Chlorophyll-a/anomalies were generated from MERIS amongst other ocean color products, supporting NOS 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.



Experimental Lake Erie Harmful Algal Bloom Bulletin
National Centers for Coastal Ocean Science and Great Lakes Environmental Research Laboratory
23 August 2013; Bulletin 15

Microcystin concentrations in some areas of the bloom near Maumee Bay may reach 56 ug/L. Dense cyanobacteria is present along some of the western shore. There may be small patches of scum from the Bass Islands west to Maumee Bay.

Slight eastward transport is forecasted for the next few days. Winds today >15 knots could possibly cause mixing of the bloom. Low winds (<8 knots) are expected over the weekend which could cause the bloom to intensify at the surface and produce patchy areas of scum.

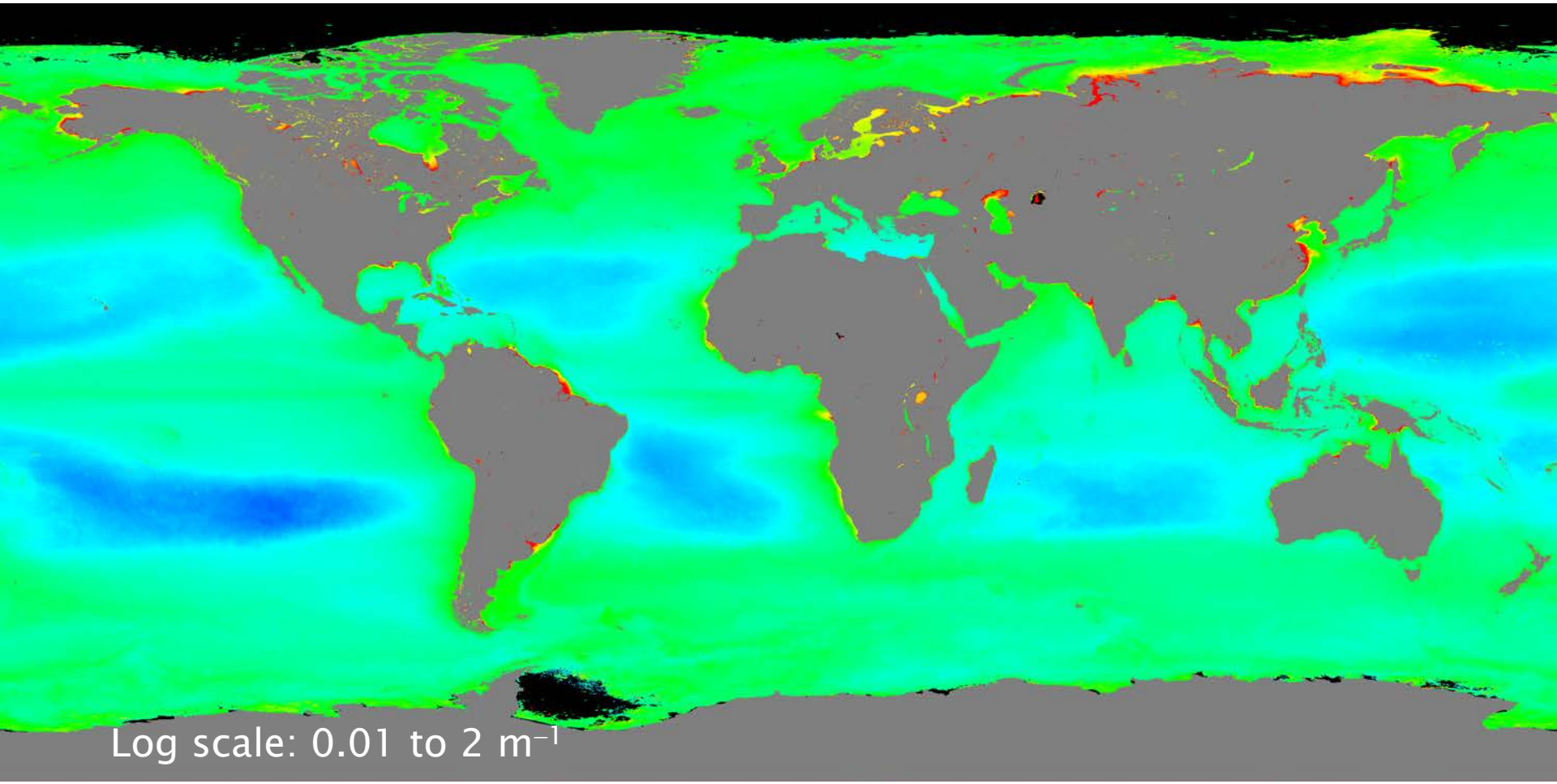
- Dupuy, Stumpf, Tomlinson

Figure 1. MODIS Cyanobacterial Index from 20 August 2013. Grey indicates clouds or missing data. Black represents no cyanobacteria detected. Colored pixels indicate the presence of cyanobacteria. Cooler colors (blue and purple) indicate low concentrations and warmer colors (red, orange, and yellow) indicate high concentrations. The estimated threshold for cyanobacteria detection is 35,000

Figure 2. Nowcast position of bloom for 23 August 2013 using GLCFS modeled currents to move the bloom from the 20 August 2013 image.

New VIIRS OC Product: Satellite-derived K_d(PAR) Data

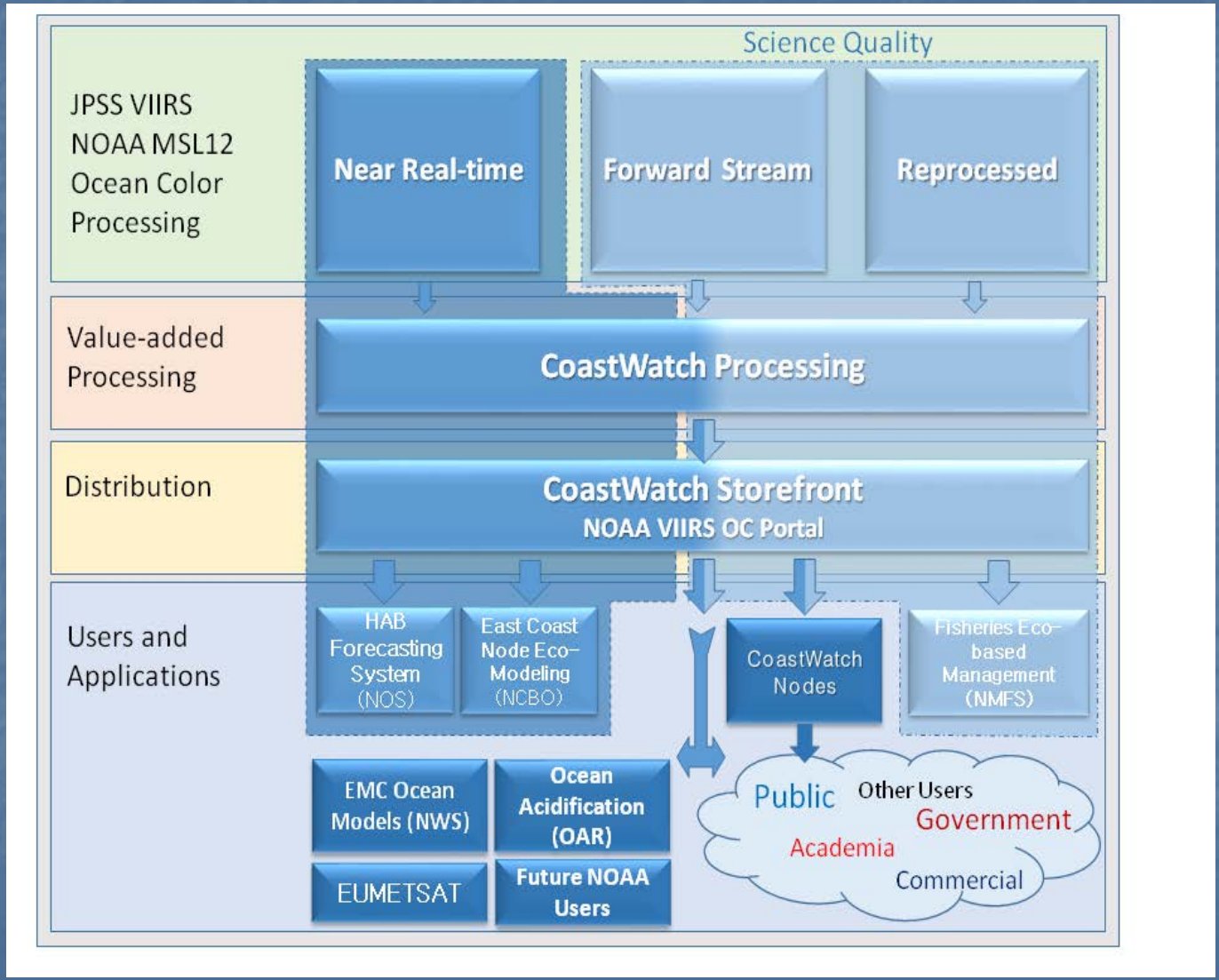
VIIRS Climatology K_d(PAR) Image
(March 2012 to February 2015)



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

Thanks for listening!

Thanks for listening!

….and hopefully Mitch is happy ☺

Anticipated CoastWatch/OceanWatch VIIRS Ocean Color Data Flow