

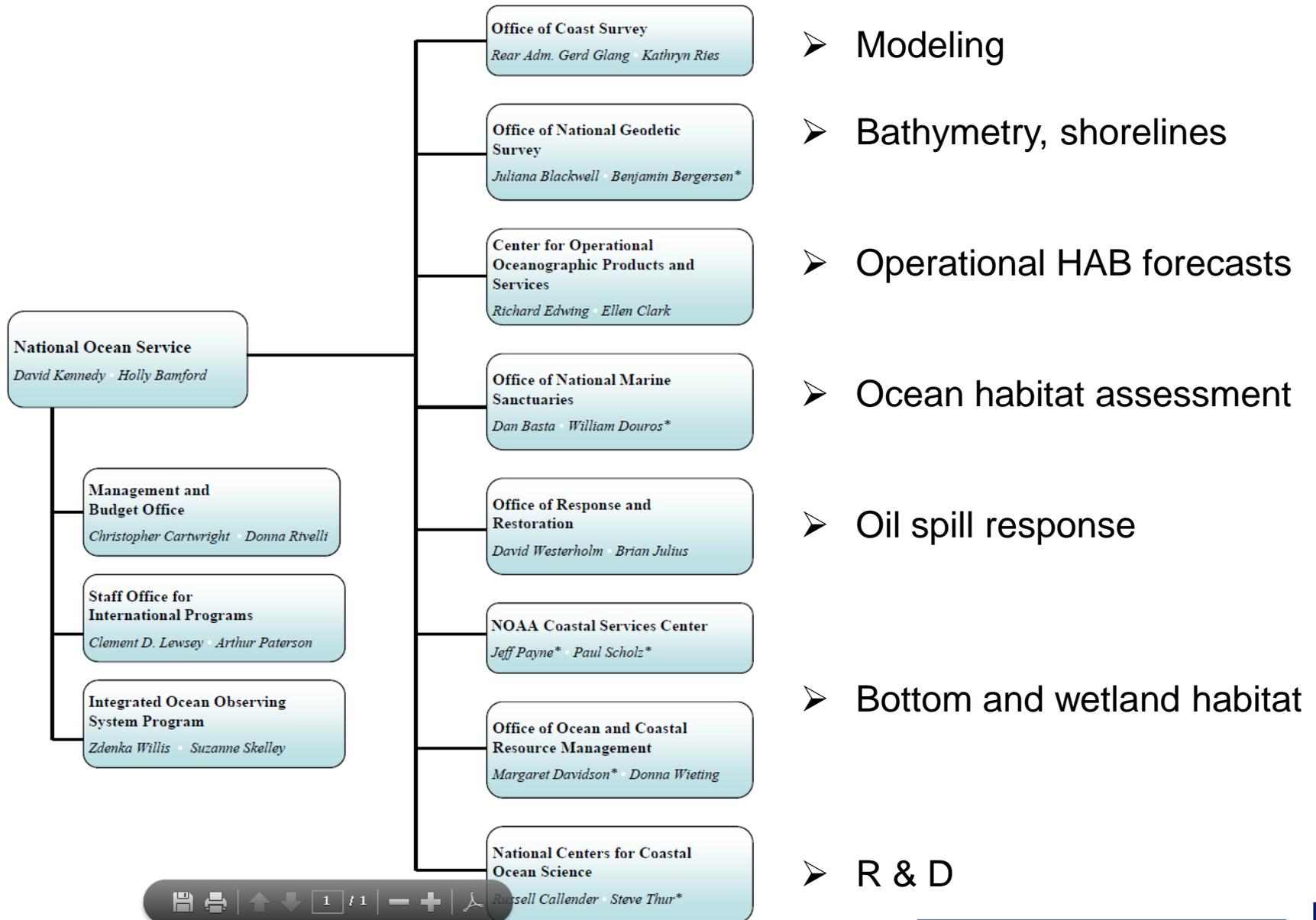
Remote Sensing Applications in NOS

- All resolutions
- High resolution (WorldView etc.)
 - coral habitat, bathymetry
- Medium resolution (Landsat)
 - wetlands/coastal habitat, some bathymetry
- Moderate to low resolution (300-1 km)
 - Water quality, SST, algal blooms, etc.

Ocean applications discussed here.



NOS Organization and Working Relationships



Ocean Satellite data types

SST (VIIRS)

Visible imagery, with glint (VIIRS)

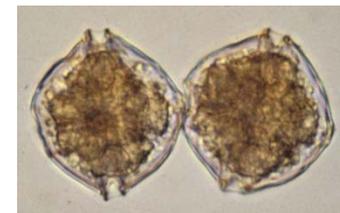
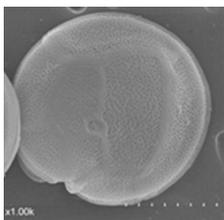
Ocean color for chlorophyll (VIIRS)

Higher spectral/spatial (OLCI/Sentinel-3)



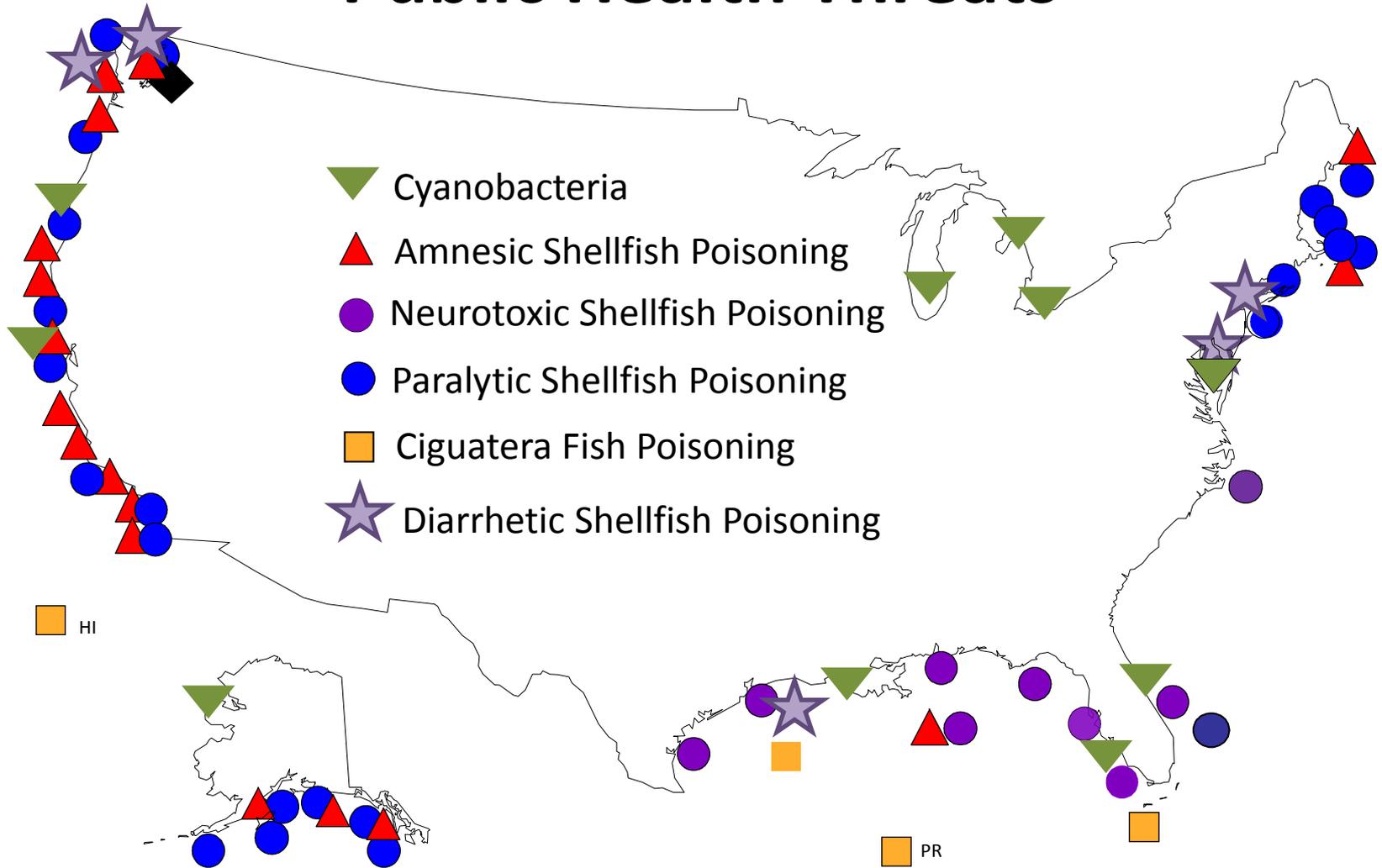
Applications:Harmful Algal Blooms (HABs)

- Harmful impacts human health, ecosystems, economies
- Algae—base of marine & aquatic food chains
 - Includes micro-, macroalgae, & Cyanobacteria (aka blue green algae)
 - Marine HABs: Mostly dinoflagellates
 - Freshwater HABs: Mostly cyanobacteria
- Bloom—“excessive” growth
 - May or may not discolor water, red, brown green, purple, white
 - 10^2 to 10^7 cells/liter may be “bloom” depending on species



Coastal HABs

Public Health Threats



What is the Harm?

- **Animal illness and death**

- **Fish**
- **Endangered and protected species: mammals, birds, turtles, fish**
- **Livestock and pets**



Examples

- HAB Operational Forecast, Gulf of Mexico. Ensemble of algorithms being used.



Gulf of Mexico Harmful Algal Bloom Bulletin

Region: Southwest Florida

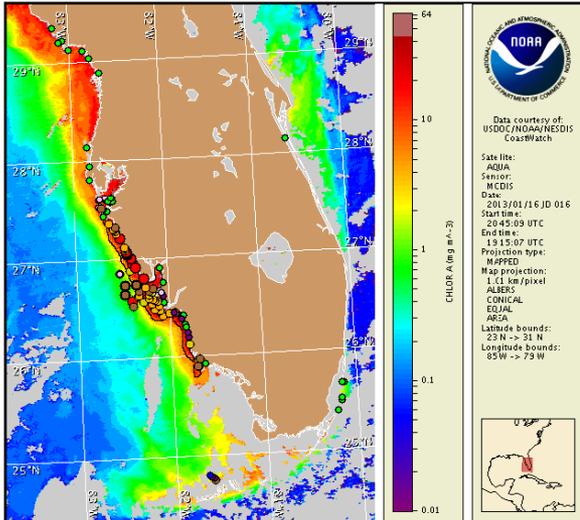
Thursday, 17 January 2013

NOAA National Ocean Service

NOAA Satellite and Information Service

NOAA National Weather Service

Last bulletin: Monday, January 14, 2013



Satellite chlorophyll image with possible *K. brevis* HAB areas shown by red polygon(s). Cell concentration sampling data from January 7 to 15 shown as 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 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://hidesandcurrents.noaa.gov/hab/habfs_bulletin_guide.pdf

Detailed sample information can be obtained through the Florida FWC Fish and Wildlife Research Institute at: <http://myfwc.com/research/redtide/events/status/statewide/>

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

Conditions Report

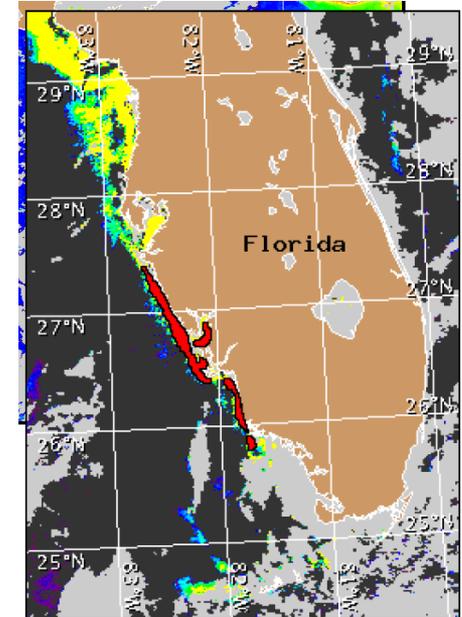
Very low to high concentrations of *Karenia brevis* (commonly known as Florida Red Tide) are present along- and offshore from southern Pinellas to Collier counties, as well as offshore the gulfside of the lower Florida Keys. In the bay regions of southern Manatee and northern Sarasota counties, patchy low respiratory impacts are possible today through Monday. Alongshore Sarasota and northern Charlotte counties, patchy high respiratory impacts are possible today, with patchy moderate respiratory impacts possible Friday through Monday. In the bay regions of Charlotte, Lee, and Collier counties, patchy high respiratory impacts are possible today through Monday. Alongshore southern Lee County, patchy low respiratory impacts are possible today, with patchy very low respiratory impacts possible Friday through Monday. Alongshore northern Collier County, patchy moderate respiratory impacts are possible today, with patchy very low respiratory impacts possible Friday through Monday. No respiratory impacts are expected elsewhere alongshore southwest Florida, including the Florida Keys, today through Tuesday, January 22. Over the past few days, reports of respiratory irritation were received from Manatee, Sarasota and Charlotte counties. Reports of dead fish were received from Manatee, Sarasota, Lee, and Collier counties.

Analysis

****Due to the upcoming federal holiday, the next bulletin will be issued on Tuesday, January 22.****

Southwest Florida: A harmful algal bloom of *Karenia brevis* is present along- and offshore southwest Florida from southern Pinellas to Collier counties, with *K. brevis* concentrations ranging from 'not present' to 'high'. Samples received this week indicate that *K. brevis* concentrations have increased along the coast of Sarasota County, with 'medium' to 'high' concentrations identified alongshore northern to southern Sarasota, and 'low a' concentrations identified at the Ringling Causeway and Lido Beach (SCHD, FWRI; 1/14). Samples also indicated increased *K. brevis* concentrations in Charlotte County, with 'high' concentrations identified at Englewood Beach and at the northern end of Gasparilla Sound (FWRI; 1/15). Samples collected throughout the Pine Island Sound region of Lee County identified 'low a' to 'medium' *K. brevis* concentrations, with background to 'very low a' concentrations identified alongshore central Lee County (FWRI; 1/14). 'Very low a' to 'low b' concentrations were identified alongshore northern Collier County, and one 'low a' sample was collected along South March Beach in southern Collier (FWRI; 1/14). One 'low a' sample was collected alongshore School Key in Manatee County, and samples continue to indicate not present to background concentrations in Pinellas County (FWRI; 1/13-1/15). Respiratory irritation continues to be reported at several beaches along Sarasota County; reports were also received from Manatee (Manatee Beach, Coquina Beach) and Charlotte (GI South Bridge) counties (MML; 1/13-1/17). Numerous fish kills have also been reported over the last several days in Manatee, Sarasota, Lee, and Collier counties (FWRI; 1/13-1/16).

In recent MODIS Aqua imagery (1/16, shown left), elevated to high chlorophyll (4-20 µg/L) is visible stretching along- and offshore the southwest Florida coastline from Pinellas to Collier counties, with patches of very high chlorophyll (>20 µg/L) visible alongshore Sarasota and southern Lee to Collier counties. Imagery is obscured by clouds along- and offshore Monroe County, limiting analysis in this region.



Verified and suspected HAB areas shown in red. Other areas of high chlorophyll concentration shown in yellow (see p. 1 analysis for interpretation).





Experimental Lake Erie Harmful Algal Bloom Bulletin

National Centers for Coastal Ocean Science and Great Lakes Environmental Research Laboratory

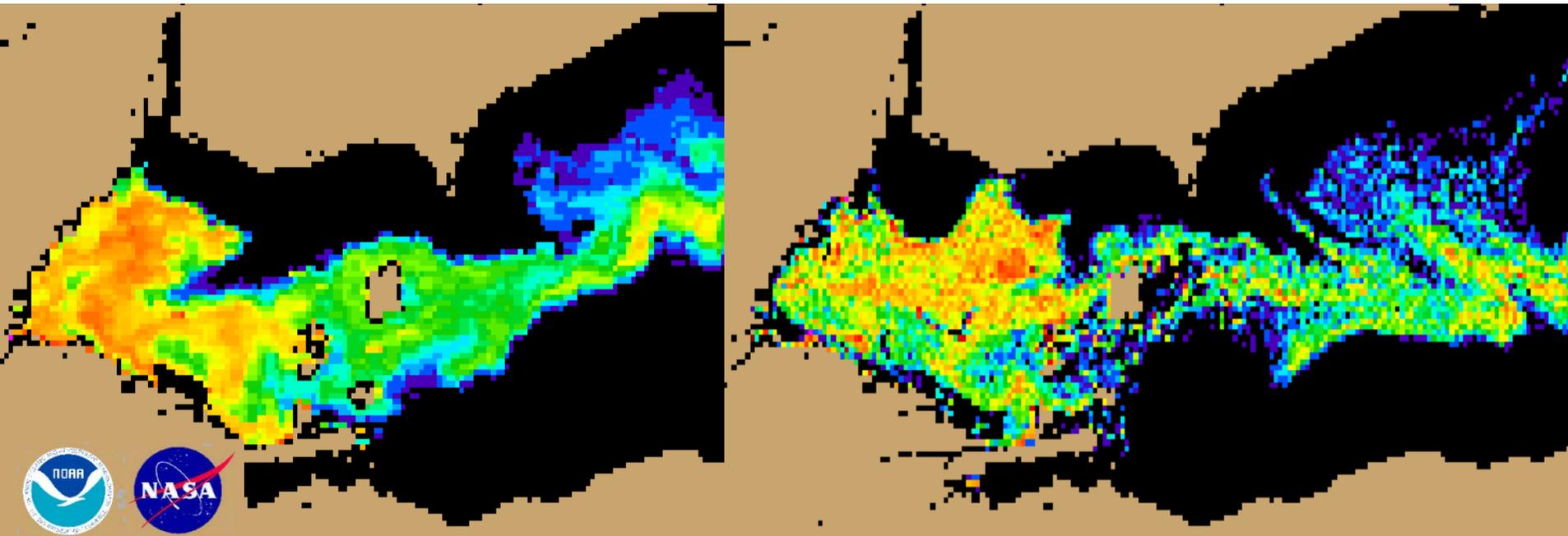
24 August, 2015, Bulletin 13

The *Microcystis* cyanobacteria bloom continues across a large part of the western basin along the Michigan and Ohio coasts and into

Over 1500 subscribers by Aug 2015

1 km MODIS Aug 22

Aug 26 forecast



Extensive use of MERIS for monitoring

(Lake Erie example). Algorithm moved to 1 km MODIS in 2012.



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



Experimental Lake Erie Harmful

National Centers for Coastal Ocean Science and Great Lakes
24 August, 2015, Bulletin 13

The *Microcystis* cyanobacteria bloom continues across a large part of the western basin

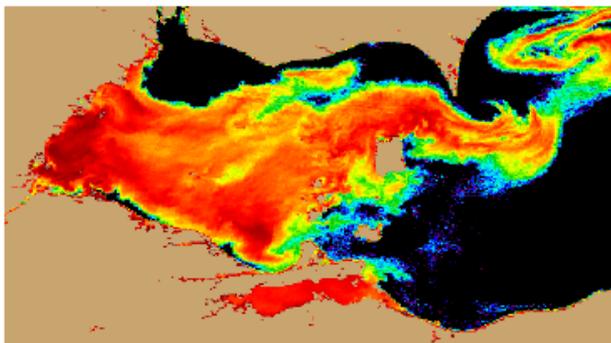
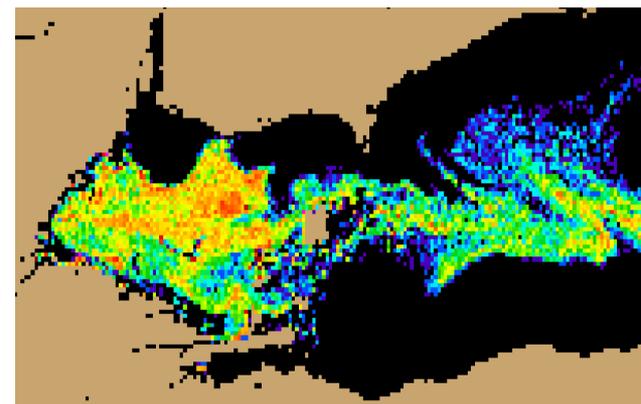
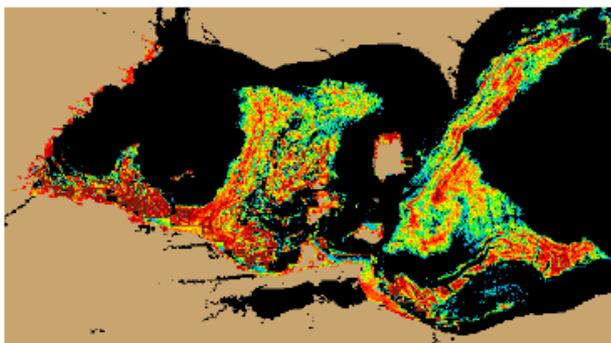
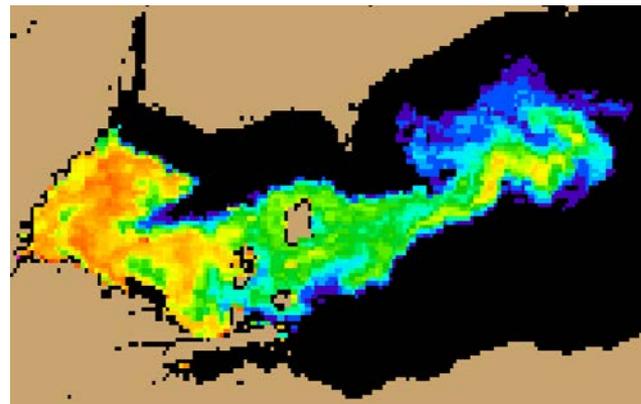
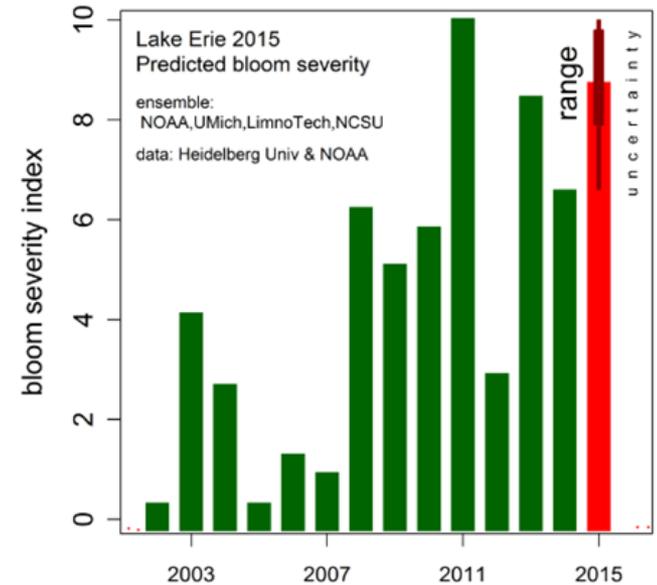
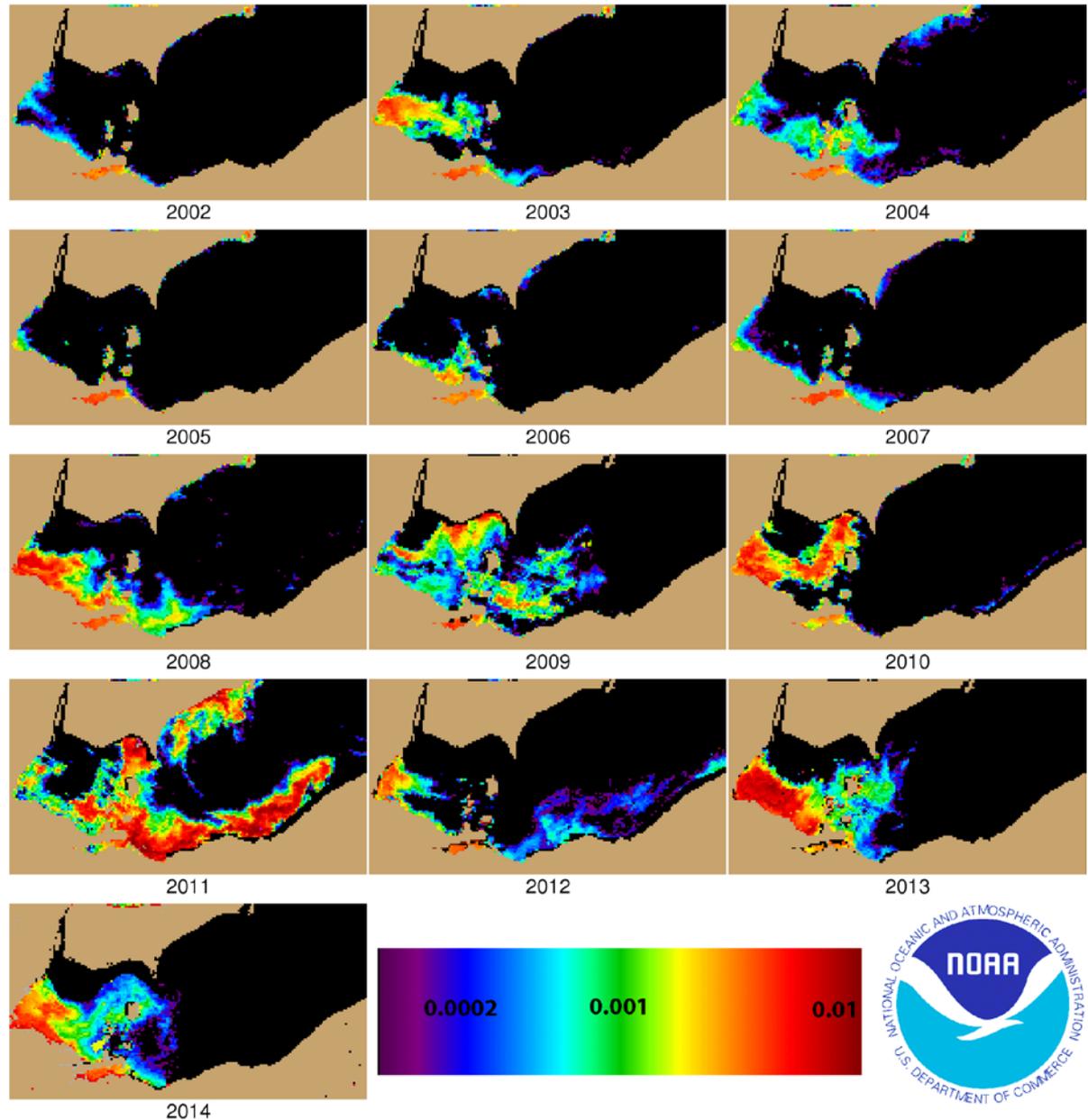


Figure 1. MERIS image from the European Space Agency. Imagery shows the spectral shape at 681 nm from September 03, where colored pixels indicate the likelihood of the last known position of the *Microcystis* spp. bloom (with red being the highest concentration). *Microcystis* spp. abundance data from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



13 years of data provide data to model seasonal forecast



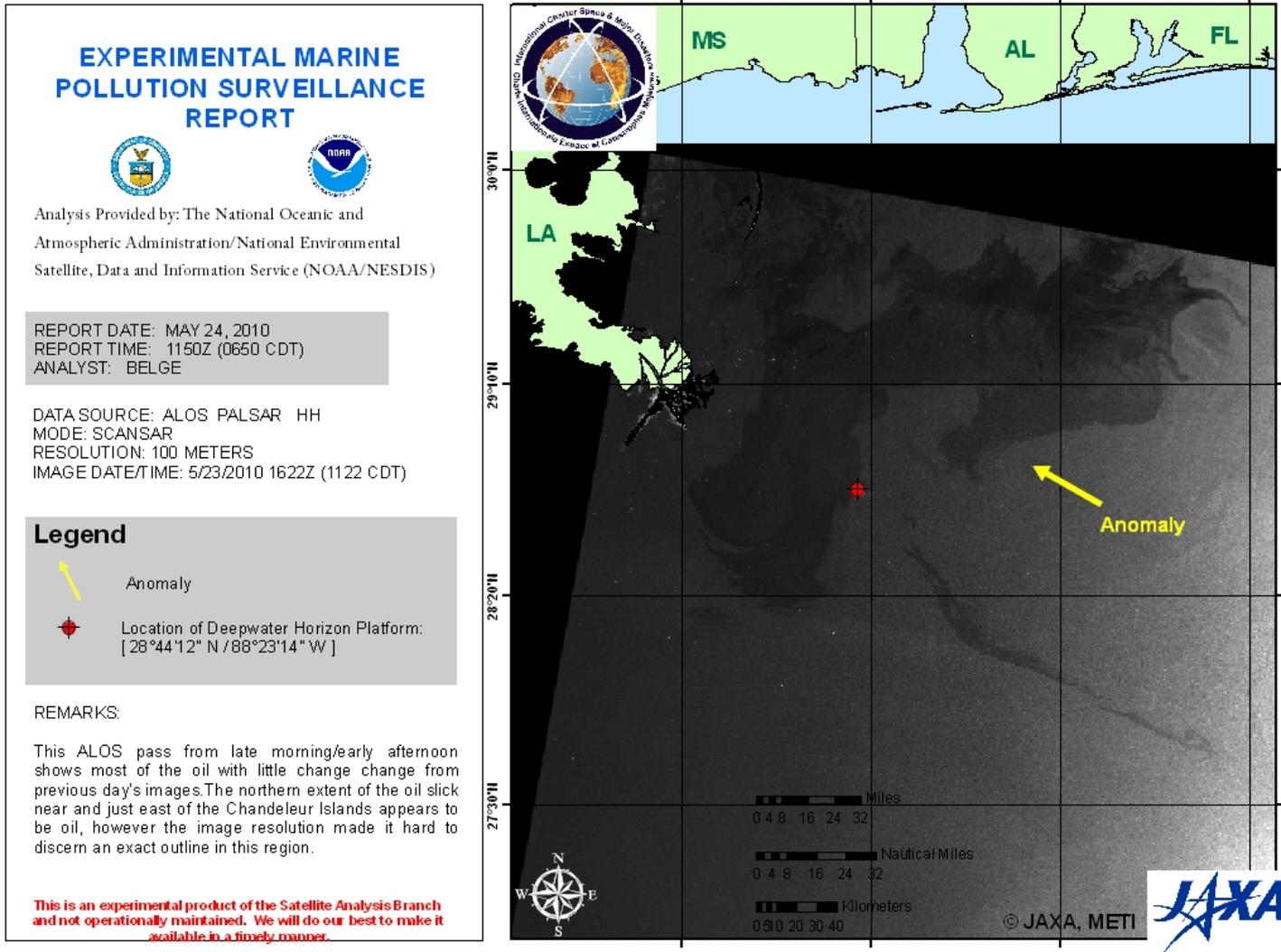
Data from
 MERIS 2002-2011,
 MODIS 2012-2014;
 (MODIS forced to MERIS;
 loss in sensitivity & resolution)





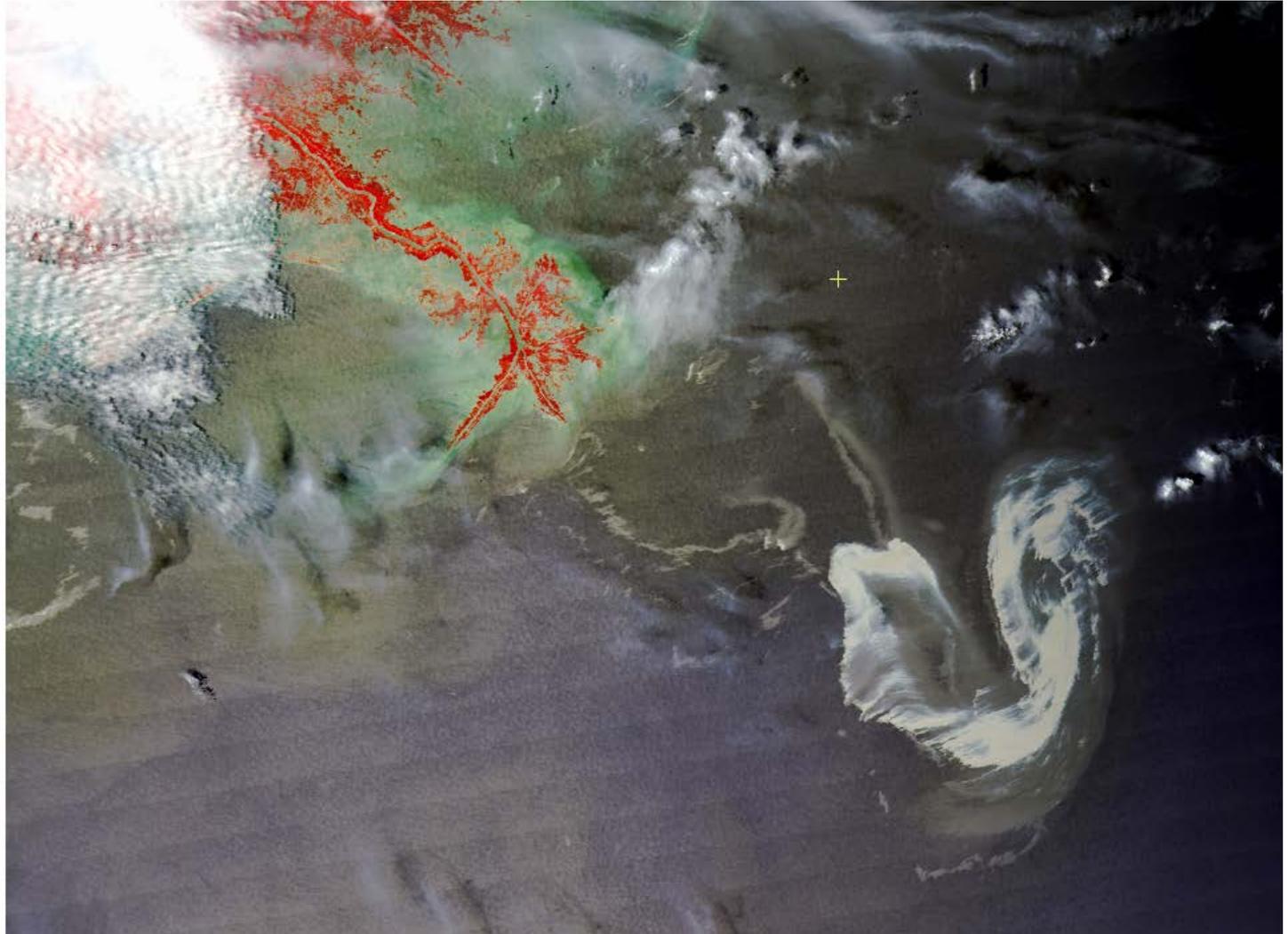
Examples

- Oil spill response



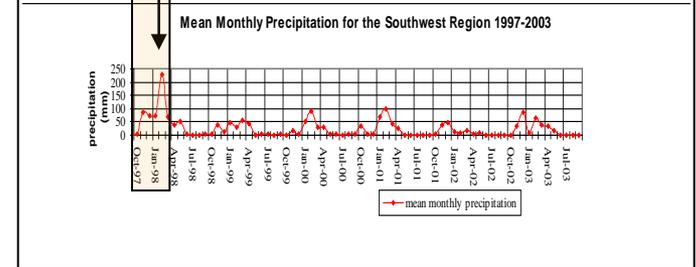
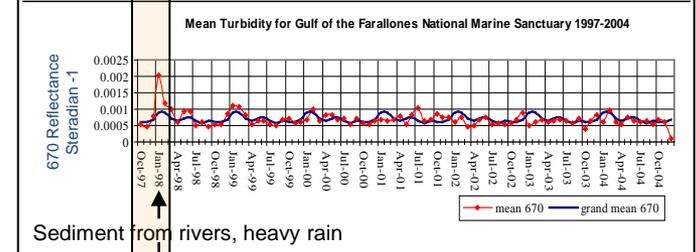
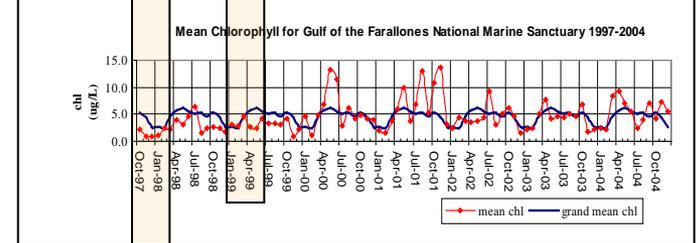
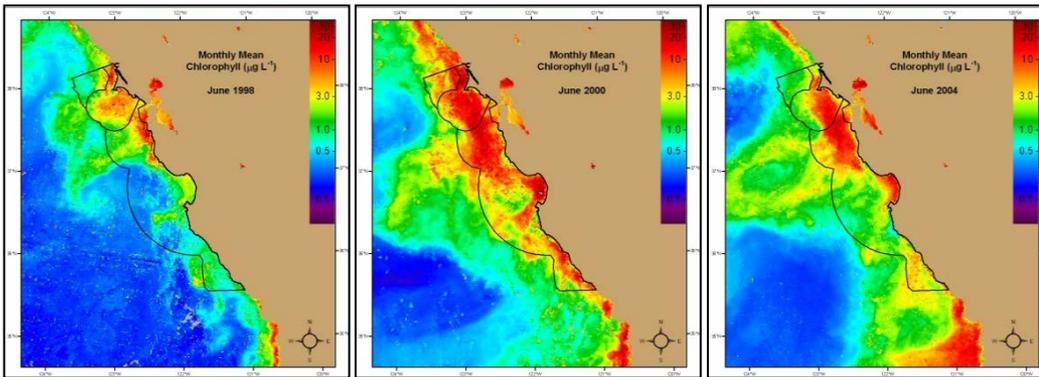
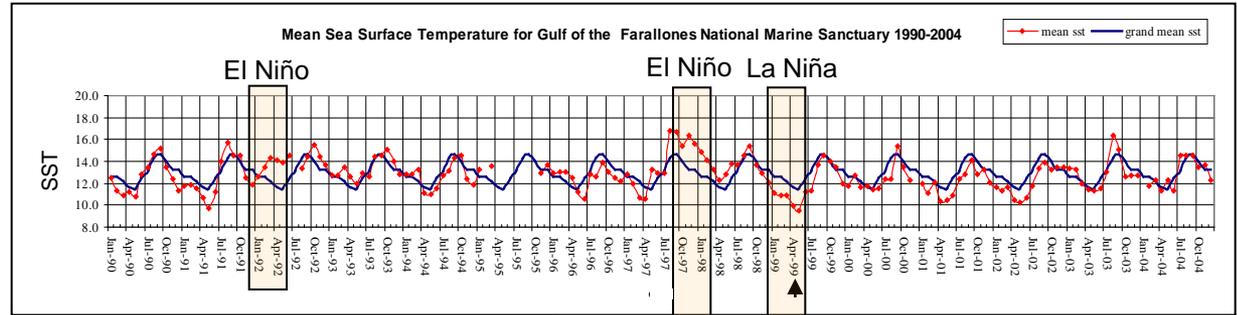
Examples

- Oil spill response, MODIS image



National Marine Sanctuaries, habitat characterization (Gulf of the Farallones, Cordell Bank, Monterey Bay)

Time Series Imagery and Analysis



- Time-series imagery show the dynamic nature of the spatial oceanographic patterns. Ex. Chlorophyll concentrations are driven by upwelling which is influenced by ENSO.

- Time series analysis can derive seasonal and inter-annual patterns. Ex. Minimum SST and maximum CHL concentrations occur in April/May. Turbidity is more variable with a tendency towards minimums in December. Coastal areas directly influenced by river plumes may show a maximum during the winter rainy season.

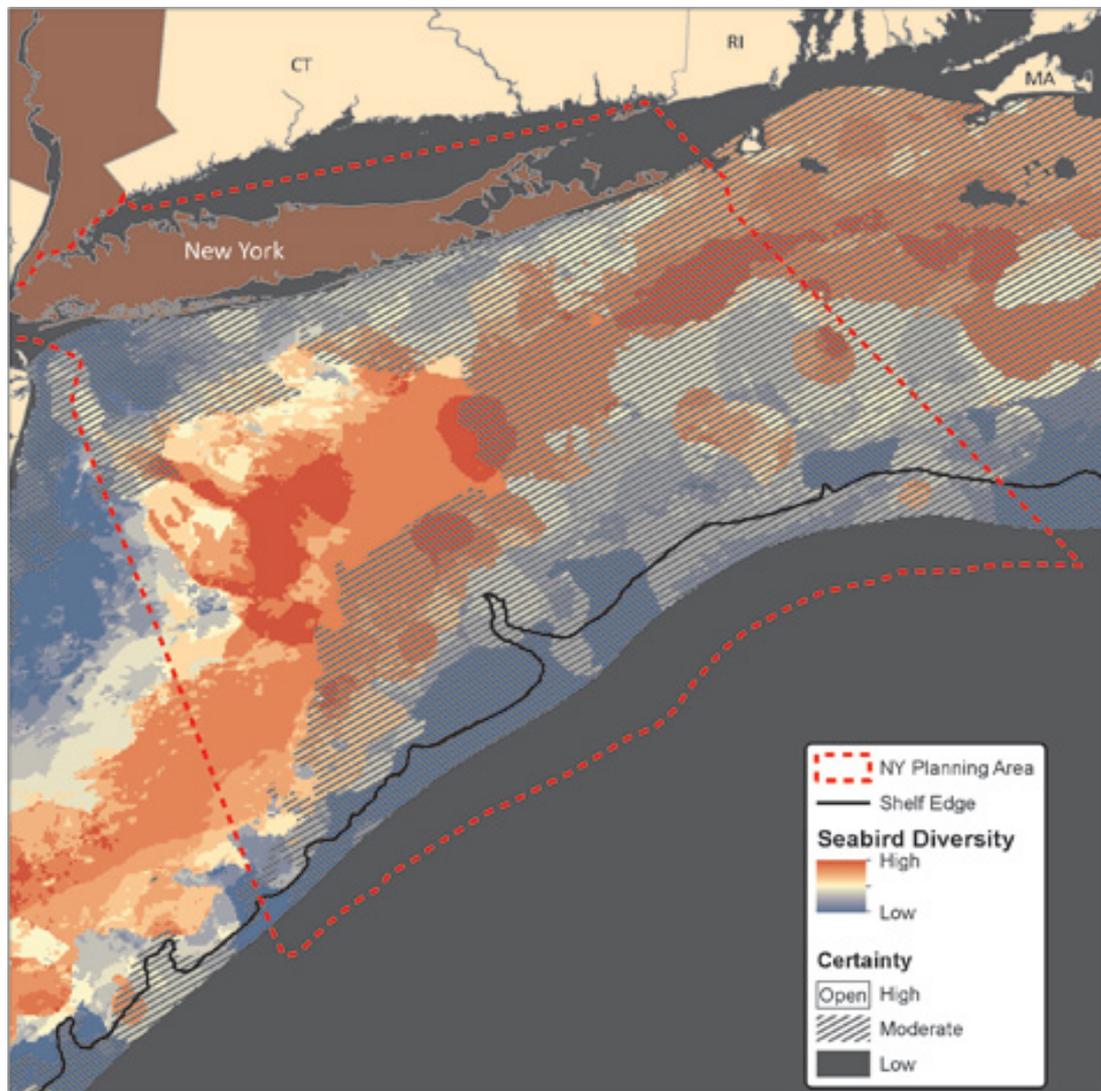


Habitats in the ocean (seabird)

NOAA Biogeography program

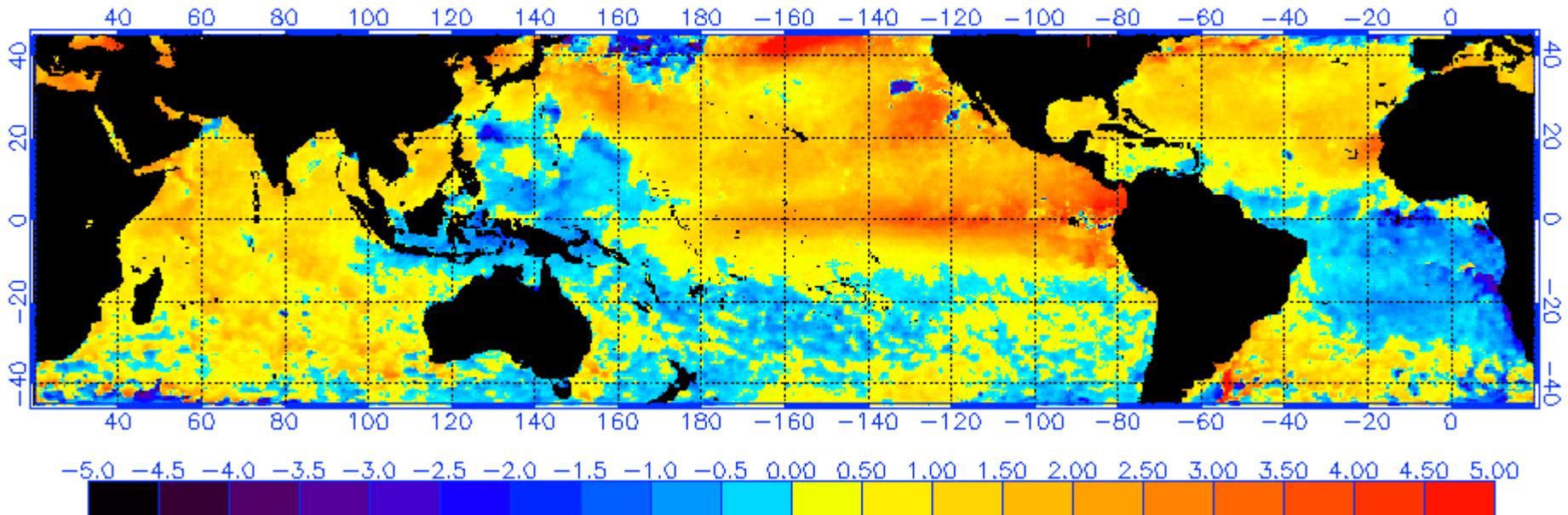
These types of maps can be used by coastal managers to protect critical seabird habitats and identify the most suitable sites for future wind farms.

Data includes SST, climatic in situ, bird reports, etc.



Coral Reef Conservation Program

NOAA/NESDIS SST Anomaly (degrees C), 8/24/2015



Summary

- NOS uses polar-orbiting data for
 - Operational harmful algal bloom forecasts
 - Response to other algal blooms
 - Oil spill response
 - Indirectly for boundary models for coastal hydrodynamic models
 - Sanctuaries and habitat assessment
- JPSS will replace MODIS/Aqua as primary monitoring tool for ocean color, with superior image quality.
 - Potential for usable data in bright targets, no sensor saturation
 - Less striping

