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Monitoring Land Based Sources of Pollution over Coral Reefs Using VIIRS Ocean Color Products

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Introduction

Land based sources of pollution (LBSP) are a major threat to corals that can cause disease and mortality, disrupt critical ecological reef functions, and impede growth, reproduction, and larval settlement.

NOAA's Coral Reef Watch (CRW) program and the NESDIS Ocean Color Team are developing new products to monitor LBSP over coral reef ecosystems using the **Visible Infrared Imaging Radiometer Suite** (VIIRS) onboard the S-NPP satellite.

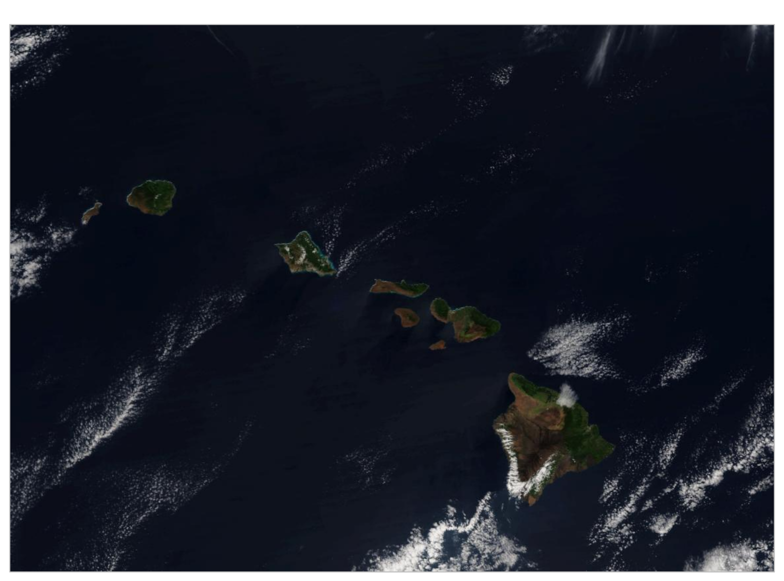
From VIIRS, near-real-time satellite products of **Chlorophyll-*a*** and **K_d(490)** are being developed for three U.S. Coral Reef Task Force priority watershed sites - Ka'anapali (West Maui, Hawai'i), Faga'alu (American Samoa), and Guánica Bay (Puerto Rico).

How Can Ocean Color Help Coral Reef Managers?

The color of coastal water is related to water quality.

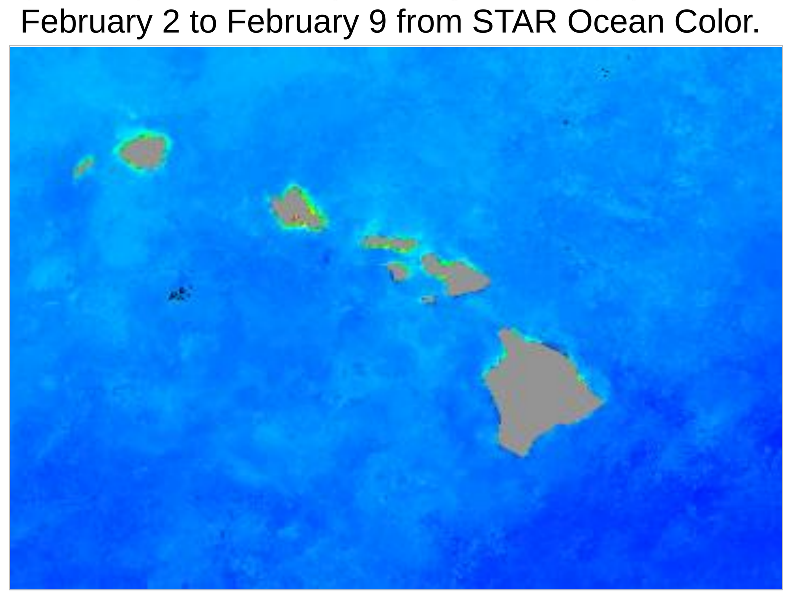
Satellite ocean color data provide a synoptic view of water quality.

(Right) A photo taken in January 2015 shows brown water in Honokahua Bay, West Maui. Photo credit: Bill Rathfon.



(Top) VIIRS true color image over Hawai'i on February 8, 2016 taken from NOAA View.

(Bottom) VIIRS 8-Day average Chlorophyll-*a* from February 2 to February 9 from STAR Ocean Color.



Of the many ocean color products, two are most commonly used for monitoring water quality:

Chlorophyll-*a*

Phytoplankton biomass and nutrient status (**productivity**) as an index of water quality.

K_d(490)

The diffuse attenuation coefficient at 490nm (or light blue in the visible spectrum).

Total organic and inorganic matter held in solution and suspension (**turbidity**) within the water column.

Ocean Color Tools for Reef Managers

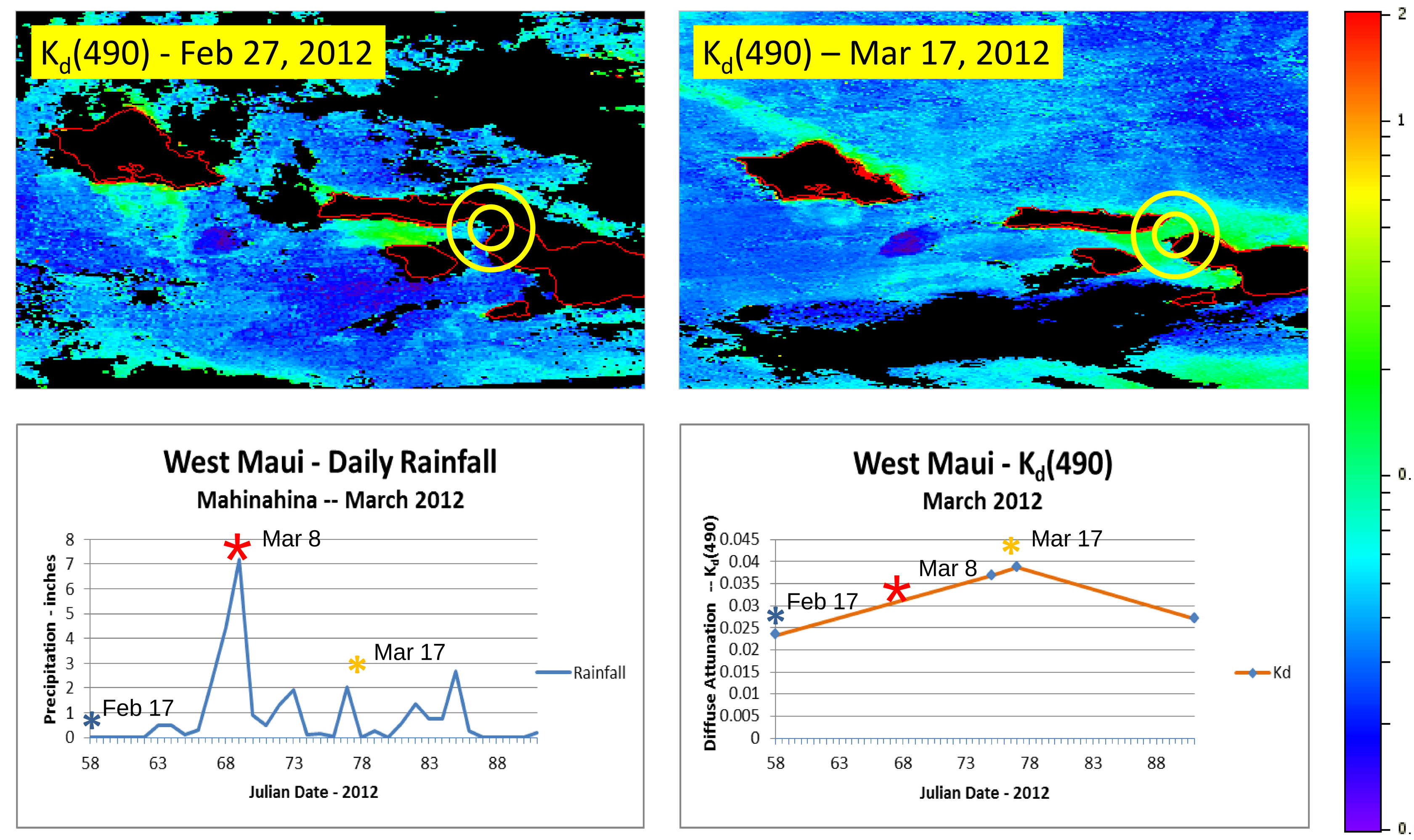


Figure 1. (Top left and right) VIIRS K_d(490) images for February 27 and March 17, 2012. Yellow circles indicate the West Maui watershed. (Bottom left) Daily rainfall amounts in Mahinahina from February 27 to March 31, 2012. (Bottom right) K_d(490) values near West Maui watershed for the same time period. The large rainfall event is associated with a local rise in K_d(490) or turbidity.

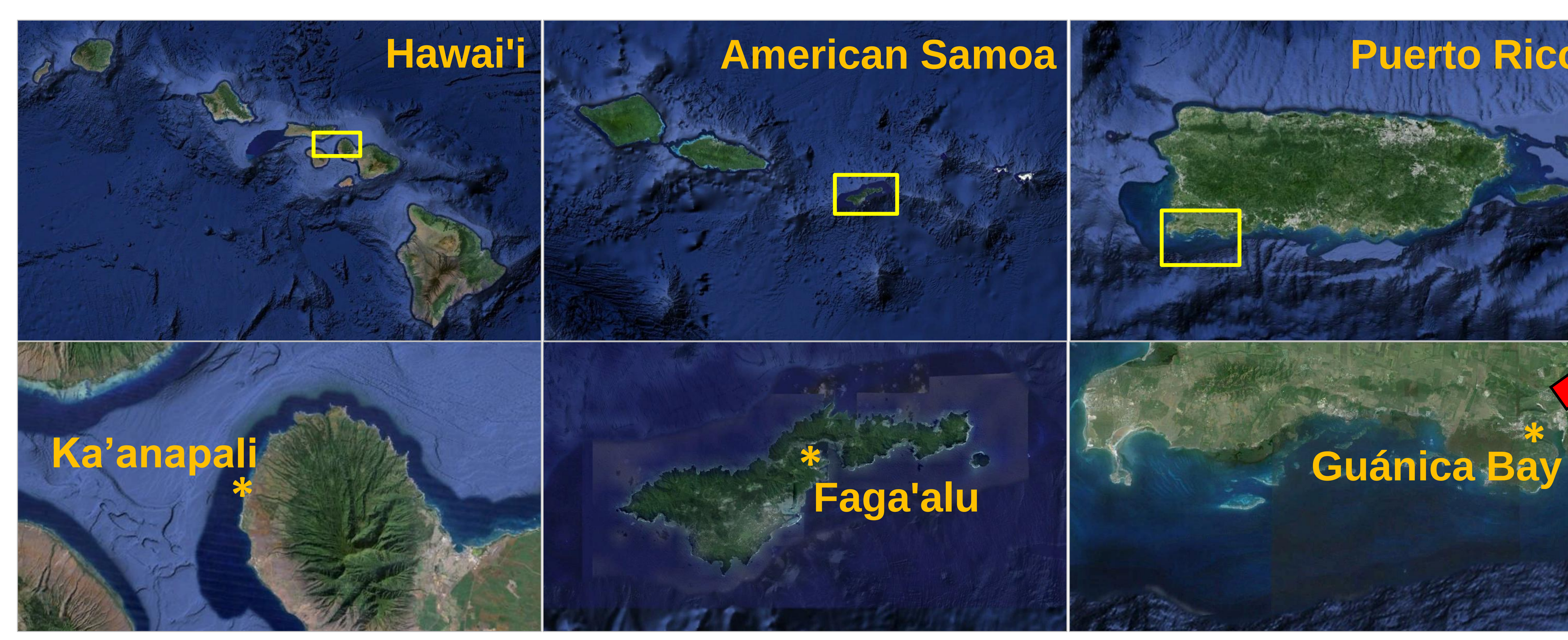
◂ Matching large rainfall events to satellite derived measurements for inspection by reef managers led to the development and refinement of the three priority watersheds and associated "Virtual Areas".

Virtual Areas

Establishing virtual areas around watersheds will enable calculation of plume statics such as:

- Maximum and average levels of Chlorophyll-*a* and K_d(490)
- Monthly climatologies
- Variations from "normal" levels through time

US Coral Reef Task Force Priority Watersheds



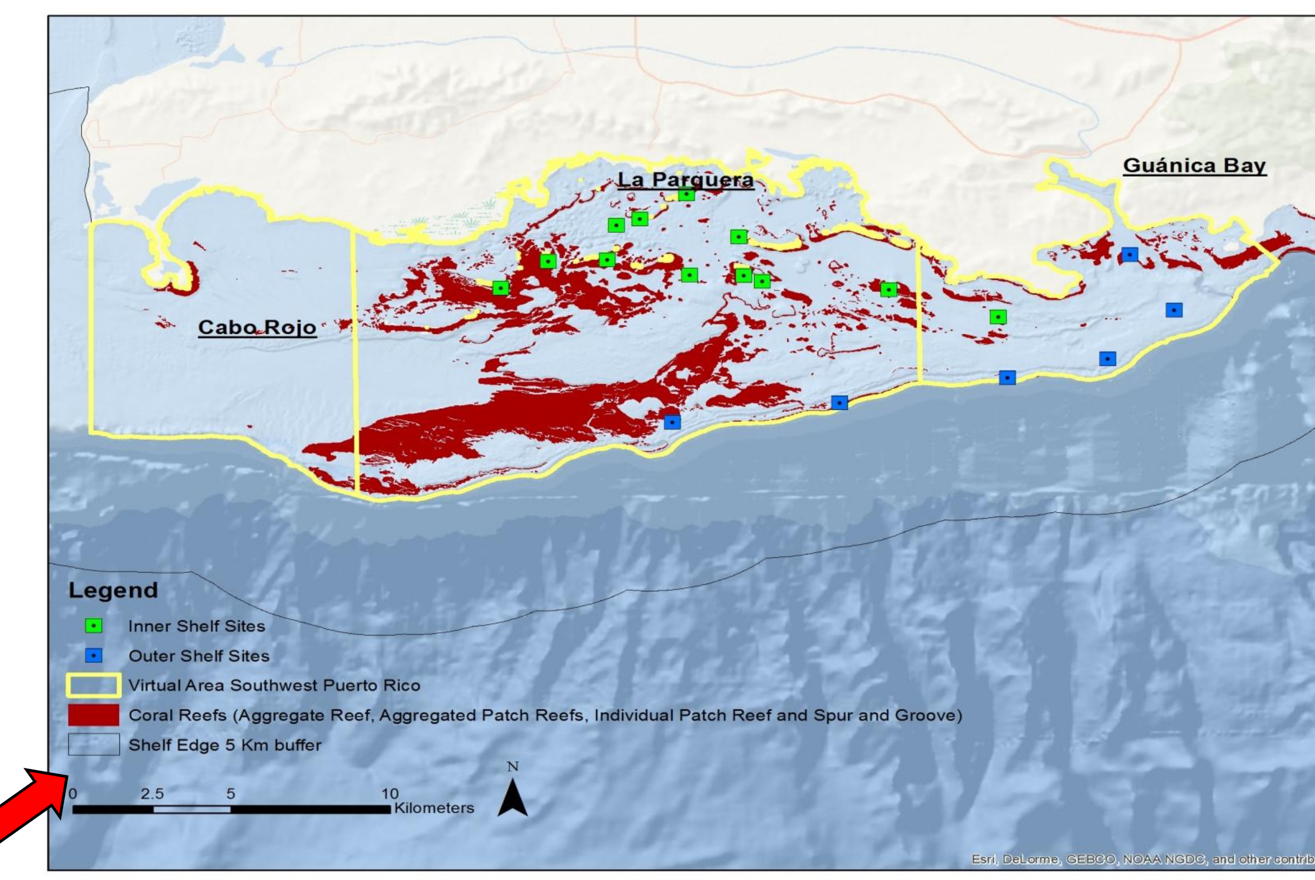


Figure 2. Southern Puerto Rico Virtual Area development at Guánica Bay (yellow outline). Also shown are the coral reef areas (red) and sites where *in situ* measurements for validation are scheduled (blue and green squares). The current area for Guánica was developed after dialog with the Guánica Watershed Coordinator and analyzing K_d(490) and Chl-a from VIIRS. Virtual Areas are in development for all three U.S. Coral Reef Task Force priority watersheds. Figure credit: William Hernandez.

Climatology

Derived anomalies of Chlorophyll-*a* & K_d(490) will be generated over virtual areas in each watershed to analyze variations from "normal" levels through time, allowing managers to gauge the severity of events.

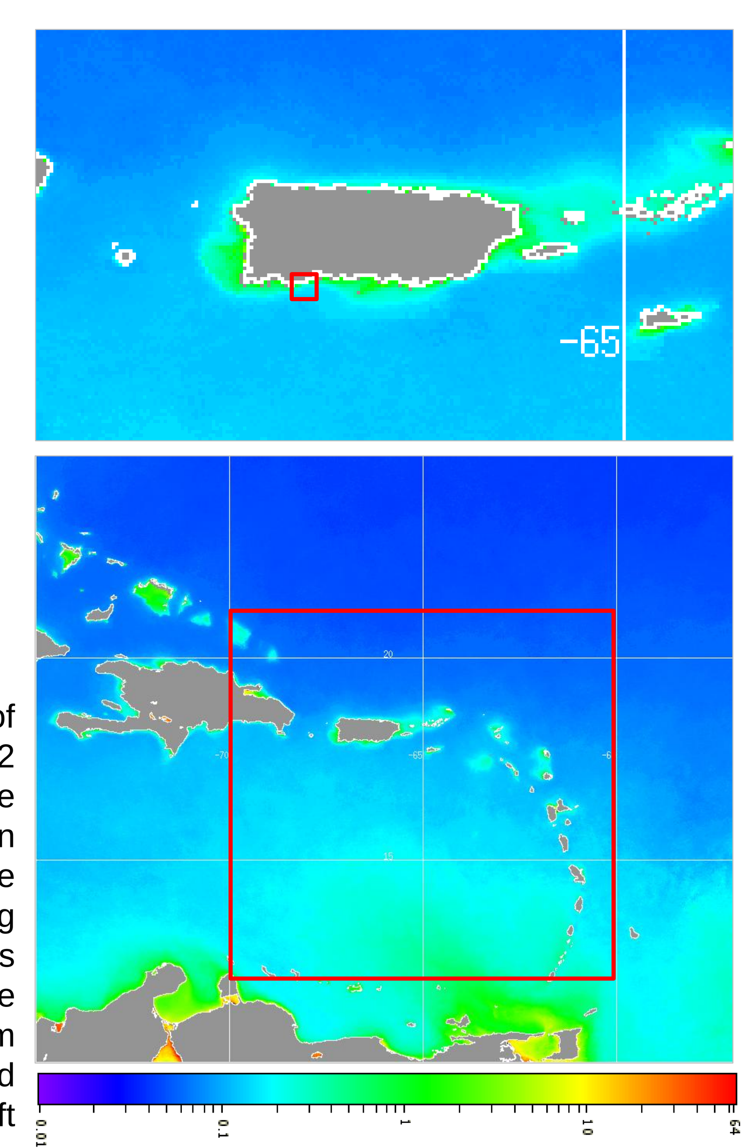
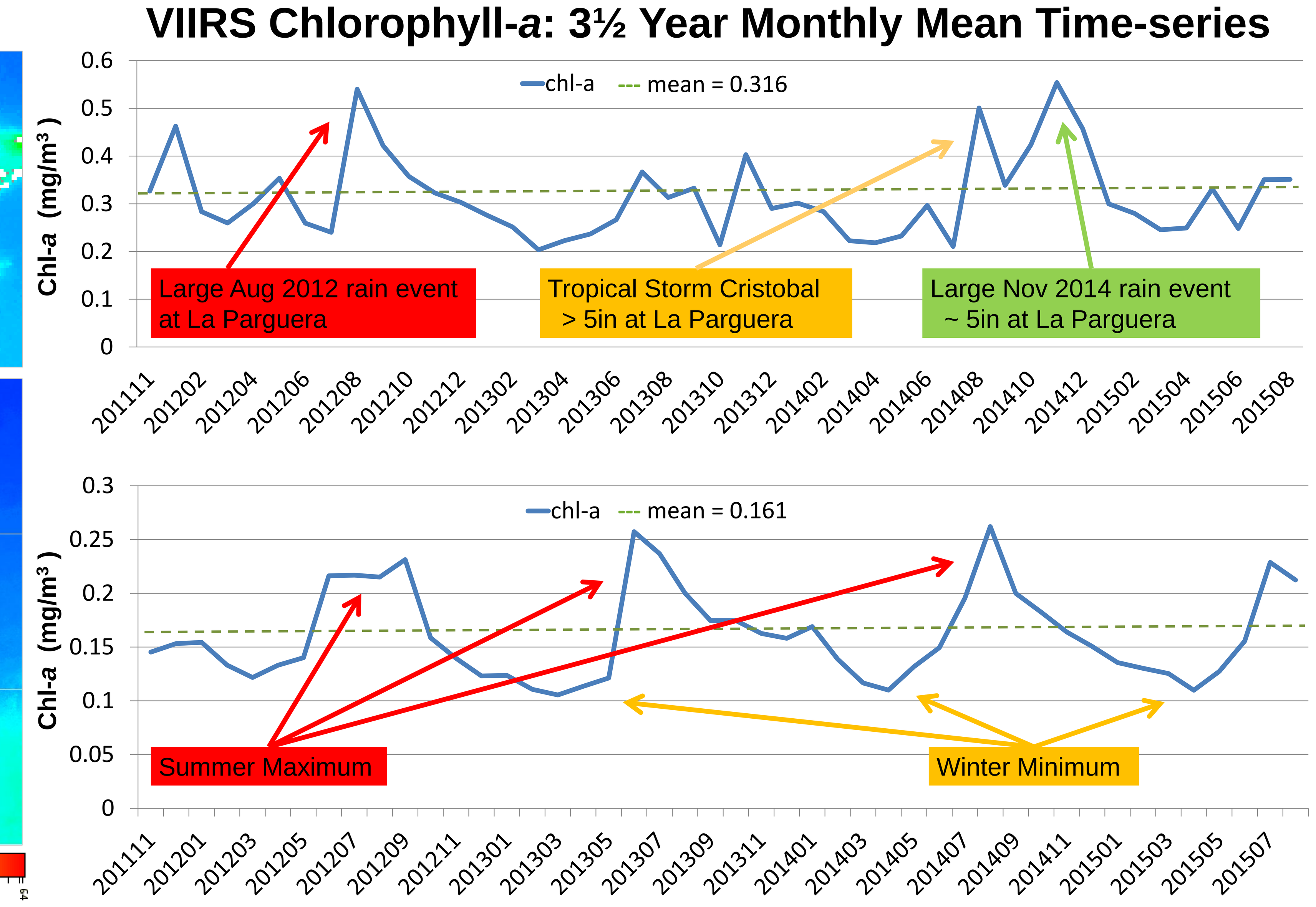


Figure 3. (Top and bottom left) Average of monthly mean Chlorophyll-*a* from Jan 2012 – Aug 2015. (Top and bottom right) Time series of averaged monthly mean Chlorophyll-*a* values and the mean value across all years from Nov 2011 to Aug 2015. The top time series monthly means were averaged in the 10x10 km area of the red box in the top left image. The bottom time series monthly means were averaged in the 10x10 degree box in the bottom left image.

VIIRS Chlorophyll-*a*: 3½ Year Monthly Mean Time-series



http://coralreefwatch.noaa.gov

The only satellite-based system available for U.S. and global coral reef management