

Augmenting Ecosystem Monitoring and Management of Coral Reefs

Coral reef managers use environmental information to monitor conditions and threats to reef ecosystems, taking actions where possible to minimize human impact and support reef health. Increased ocean temperature is an important factor in bleaching, a threat to coral health. Broad-scale temperature data helps reef managers assess regional conditions and trends, and finer-scale data gives them insights for targeted actions, such as redirecting divers and snorkelers to suitable reefs.



With coral bleaching, corals lose the symbiotic algae that give them their distinctive colors. If a coral is severely bleached, disease and partial mortality become likely, and the entire colony may die. CRW assesses the intensity of potential bleaching based on a combination of a) instantaneous thermal stress and b) cumulative thermal stress and duration during the most recent 12-week period. CRW introduced its 5-km Bleaching Alert Levels in October 2013 with Bleaching Watches, Warnings, and Alert Levels 1 and 2. At Alert Level 1, bleaching is likely; at Alert Level 2, mortality is likely.

“Reef managers can implement various strategies during times of coral bleaching to reduce or mitigate the potential negative impacts additionally caused by human use,” said Scott Donahue, science coordinator at the Florida Keys National Marine Sanctuary.

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Mark Eakin, Coral Reef Watch

Coral Reef Watch (CRW) is an online tool that provides near-real-time and long-term monitoring, forecasting, and reporting of environmental conditions of coral reef ecosystems. Operated by NOAA, CRW uses satellite data, climate models, and *in situ* tools to provide bleaching alerts to the public and reef managers.

The University of South Florida and CRW staff led an Applied Sciences-sponsored project to apply *Terra, Aqua*, and other satellite data to enhance the spatial and temporal resolution and density of temperature data in the tool. The top need identified in user surveys was higher resolution information, and the project has since achieved 100-times greater spatial resolution.

Water temperatures that exceed thresholds for sustained periods lead to thermal stress in corals, and the CRW system helps pinpoint reefs likely to bleach. “Coral Reef Watch is very informative for what we are trying to do,” said Karen Bohnsack, [Southeast Florida] BleachWatch Program coordinator for the Florida Department of Environmental Protection’s Coral Reef Conservation Program.

The project team developed global, 5-kilometer sea surface temperature (SST) products based on combinations of data from NASA, NOAA, and foreign geostationary and polar-orbiting satellites, including *Suomi NPP*, *GOES-East*, *GPM*, *NOAA-19*, *MSG*, *MTSAT*, and *Metop-A*. The combination helps users better visualize and quantify thermal stress conditions around the world. The team also created a 1-kilometer product using *Aqua/MODIS* and *AVHRR* imagery for the Gulf of Mexico and reefs in the Florida Keys, Caribbean Sea, and off Mexico.

CRW’s new products build on the 50-kilometer products it has provided, which allow reef managers to understand conditions of offshore waters around the

resources under their jurisdiction. The new products show what is happening closer to shore and within actual reef ecosystems. The new products also provide 25 to 100 times more satellite data per pixel than the old products. The new products also directly cover up to 95 percent of coral reefs around the world.

“The new data products provide observations closer to the scale of coral reefs,” explained Mark Eakin, CRW coordinator at NOAA. “Managers want to know as much as we can tell them to help their management of reef resources. . . . Even without bleaching, higher temperatures endanger coral health.”

Enhancing Decisions, Public Support, and Research

As a result of the CRW improvements, reef managers can now make more informed decisions, including taking steps to protect coral ecosystems or target monitoring. In the short term, there are actions managers can take for immediate effect, such as reducing allowable pollutant loads or alerting recreational dive vessels to change locations.

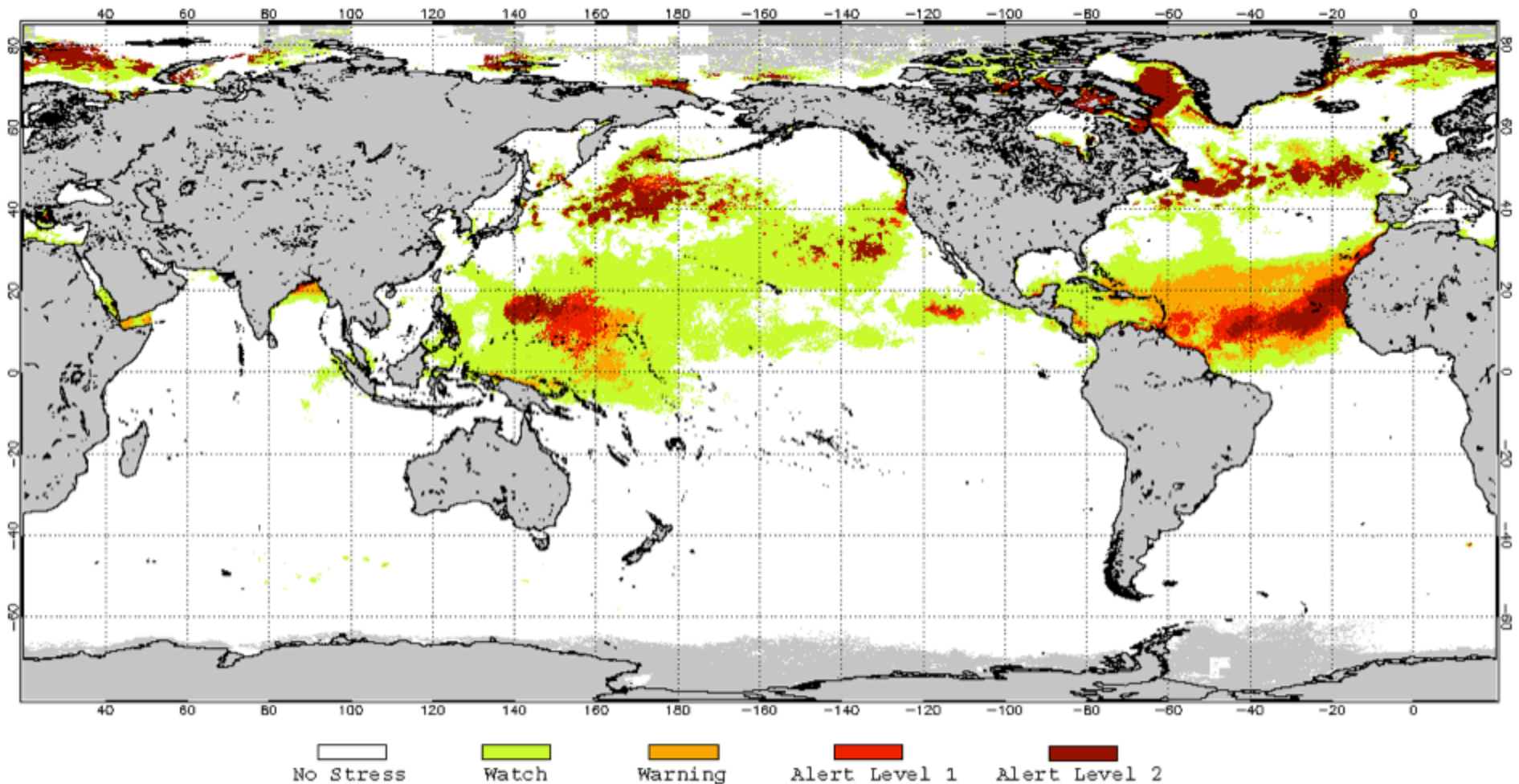
“One example would be working with local diving and snorkeling operators to redirect on-water tourist activities away from natural reef areas normally subject to high visitation to artificial reefs and shipwrecks,” said Donahue. “This could reduce unintentional physical damage to corals until favorable thermal conditions return.”

Applications of Earth observations enhanced a decision support system for management of coral reefs, which support fish and other organisms as well as economic activity.

CRW enables decisions on where to conduct extensive monitoring and ways to engage the public to support reef health and collect information. “In times of severe thermal stress, that higher [5-kilometer] resolution helps us manage where we request researchers and citizen scientists alike to look for potential thermal stress in corals,” said Donahue. “Also, over the long term, it may help reef managers refine where they place *in situ* temperature monitoring devices to help better correlate remotely sensed data with conditions experienced at depth.”

In 2013, CRW released the new products. The team will enhance its products and add new ones, including a long-term mean SST climatology product, based on user input.

NOAA Coral Reef Watch Daily 5-km Blended Geo-Polar Nighttime Bleaching Alert Area 7d Max 3 Oct 2013



The coral bleaching alert area product shows ocean regions where thermal stress is high enough to impact corals. At this time, coral bleaching was ongoing in the U.S. territories of Guam and the Commonwealth of the Northern Marianas Islands.

Climate change has contributed to rising ocean temperatures and growing ocean acidification, which affect coral reef health. People are now using space-based information from Coral Reef Watch to reduce further human impacts on the reefs—and the broader ecosystems and local economies they support.

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