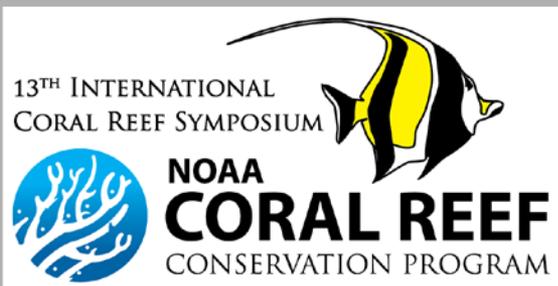


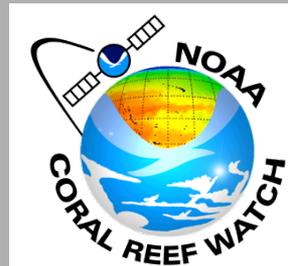
Two Years and Counting: Monitoring and Documenting the Ongoing Global Coral Bleaching Event (2014-2016 and Beyond?)



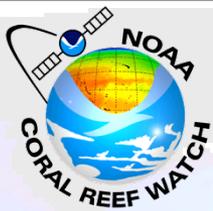
Dr. C. Mark Eakin

NOAA Coral Reef Watch

<http://coralreefwatch.noaa.gov>



2015 Coral Bleaching: American Samoa



December 2014

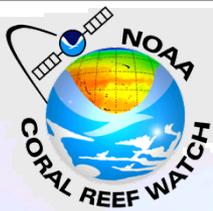


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SURVEY



<http://coralreefwatch.noaa.gov>

2015 Coral Bleaching: American Samoa



February 2015

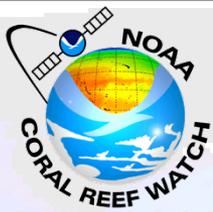


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SEAVIEW™
SURVEY

<http://coralreefwatch.noaa.gov>



2015 Coral Bleaching: American Samoa



August 2015



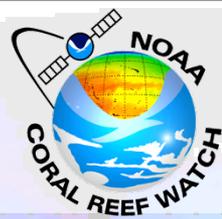
XL CATLIN
SEAVIEW™
SURVEY

<http://coralreefwatch.noaa.gov>

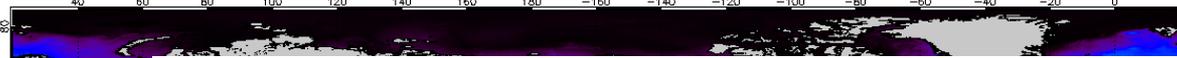


Coral Reef Watch

5-km Satellite-Based Products



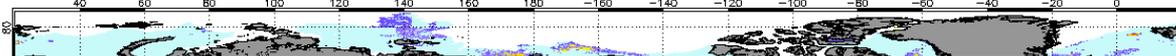
NOAA Coral Reef Watch Daily 5-km Blended Geo-Polar Nighttime Sea Surface Temperature 17 Oct 2014



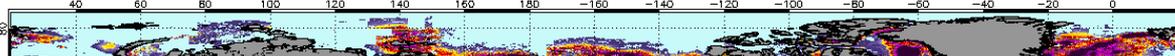
NOAA Coral Reef Watch Daily 5-km Blended Geo-Polar Nighttime SST Anomaly 17 Oct 2014



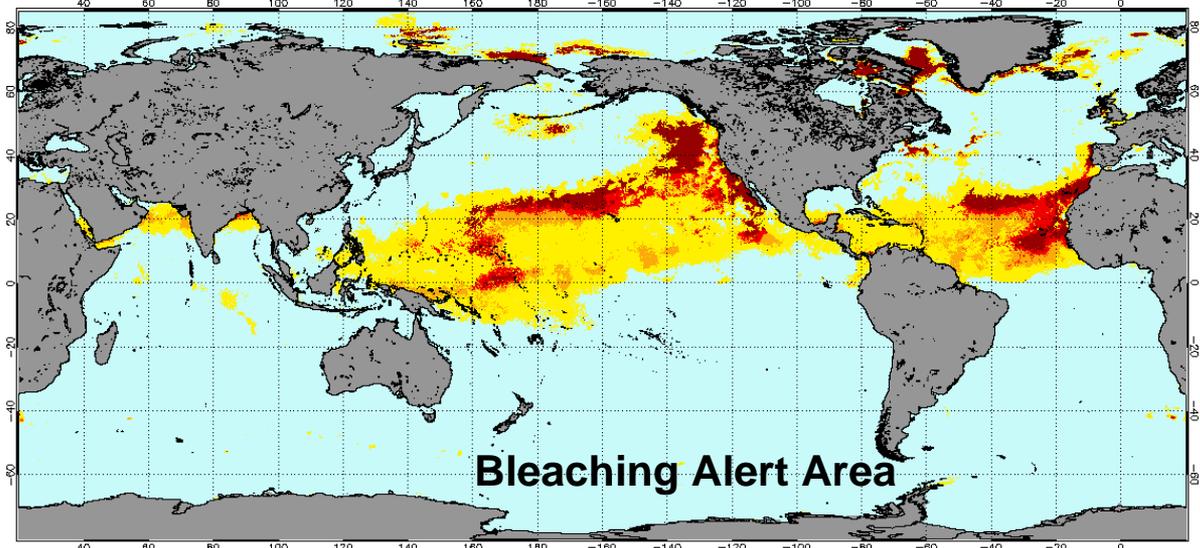
NOAA Coral Reef Watch Daily 5-km Geo-Polar Blended Night-Only HotSpots 17 Oct 2014



NOAA Coral Reef Watch Daily 5-km Geo-Polar Blended Night-Only Degree Heating Weeks 17 Oct 2014



NOAA Coral Reef Watch Daily 5-km Geo-Polar Blended Night-Only Bleaching Alert Area 7d Max 17 Oct 2014



Bleaching Alert Area

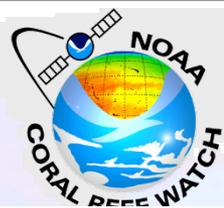


Coral –
specific

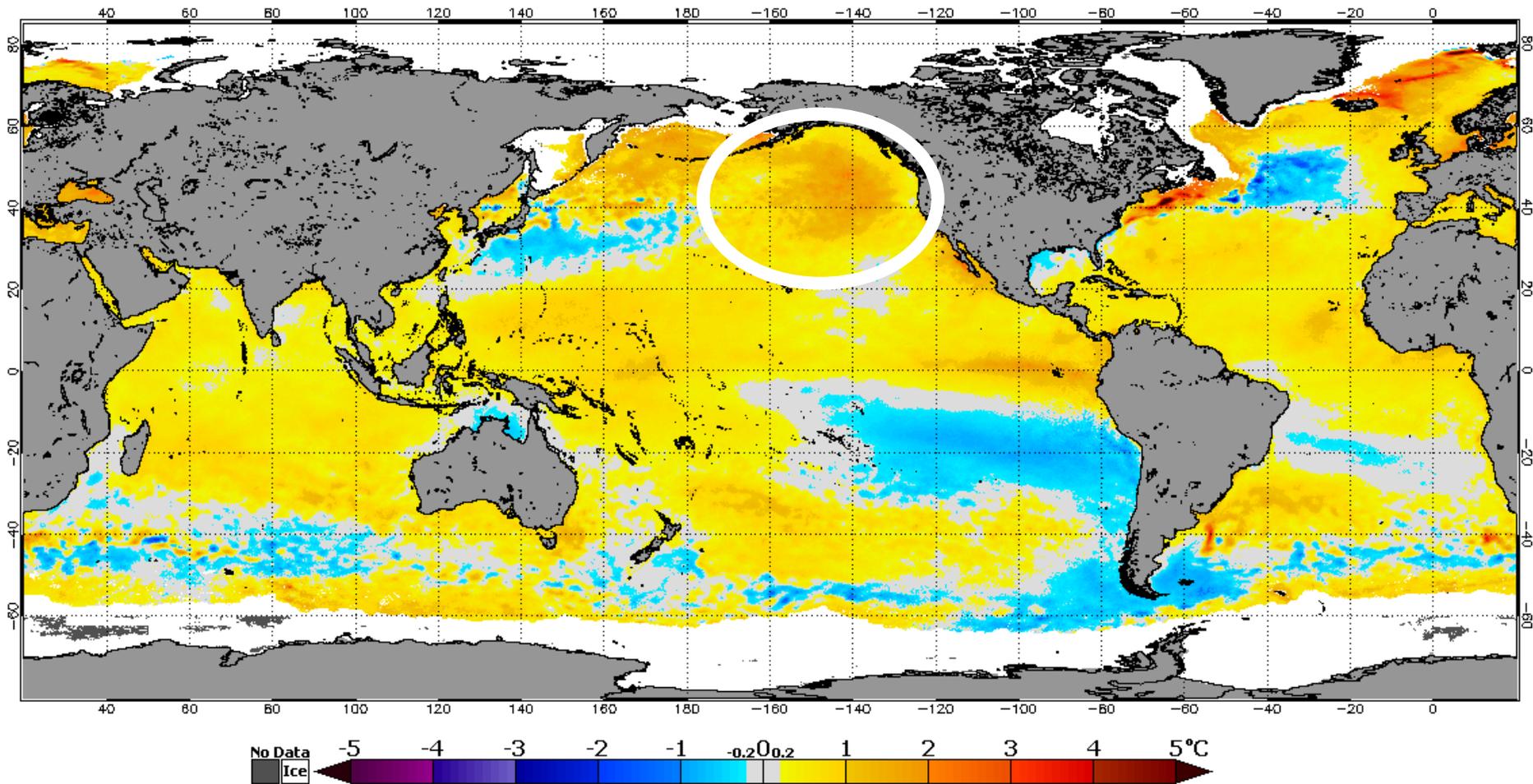


NOAA
CORAL REEF
CONSERVATION PROGRAM

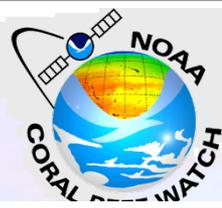
2014: Warmest Year Ever Pacific Dominated by “The Blob”



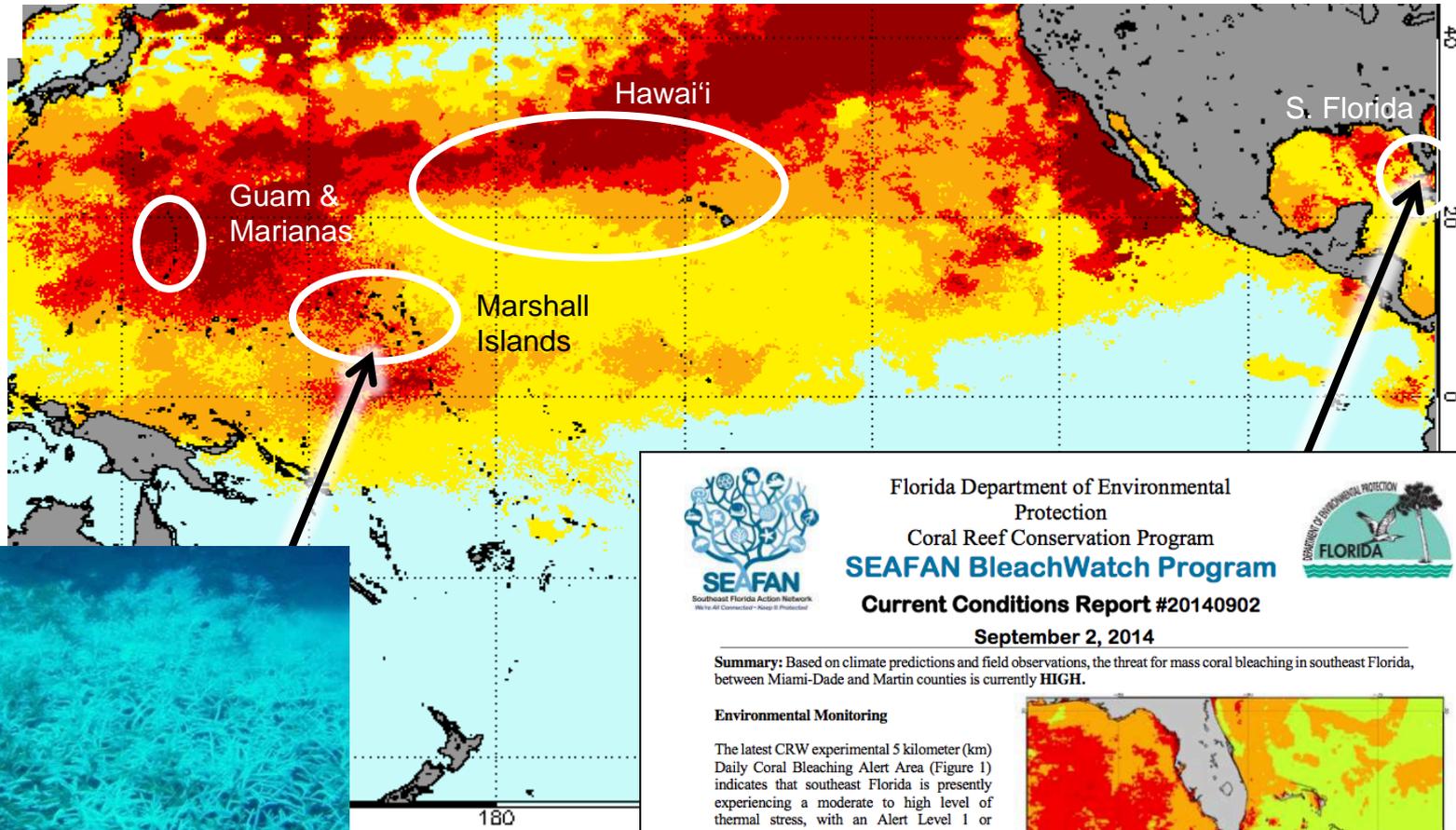
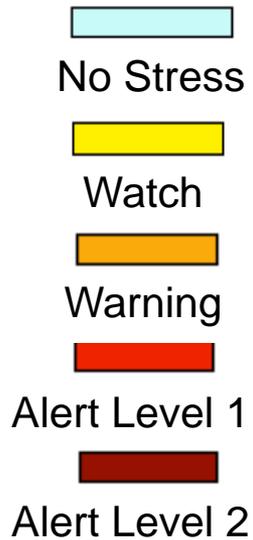
NOAA Coral Reef Watch Annual Mean SST Anomaly 2014



Global Bleaching: Last Half of 2014



NOAA Coral Reef Watch Annual Maximum Satellite Coral Bleaching Alert Area 2014





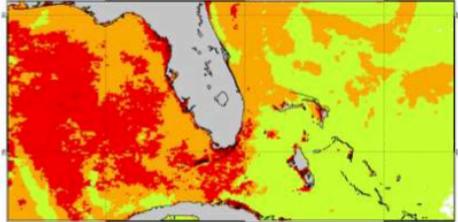
Florida Department of Environmental Protection
Coral Reef Conservation Program
SEAFAN BleachWatch Program
Current Conditions Report #20140902
September 2, 2014



Summary: Based on climate predictions and field observations, the threat for mass coral bleaching in southeast Florida, between Miami-Dade and Martin counties is currently **HIGH**.

Environmental Monitoring

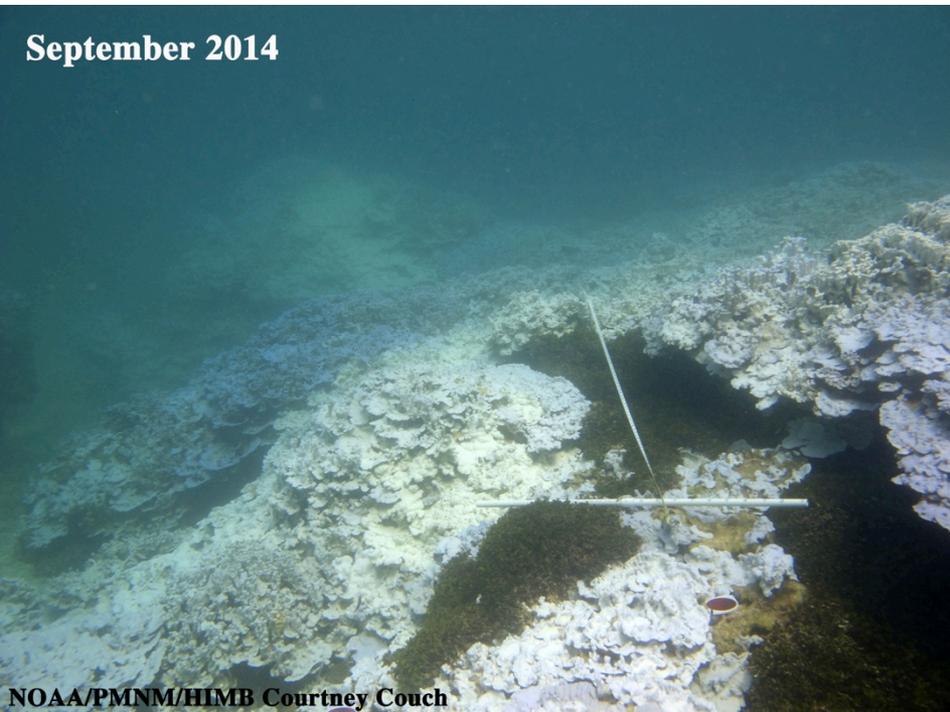
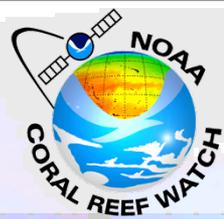
The latest CRW experimental 5 kilometer (km) Daily Coral Bleaching Alert Area (Figure 1) indicates that southeast Florida is presently experiencing a moderate to high level of thermal stress, with an Alert Level 1 or Bleaching Warning present throughout the region. This indicates that bleaching is likely in southeast Florida and additional alerts are possible if current conditions continue or worsen.



No Stress
 Watch
 Warning
 Alert Level 1
 Alert Level 2

Figure 1. NOAA CRW Experimental Daily 5 km Blended Geo-Polar Nighttime Blended Bleaching Alert Area; August 31, 2014
<http://coralreefwatch.noaa.gov/satellite/bleaching5km/index.php>

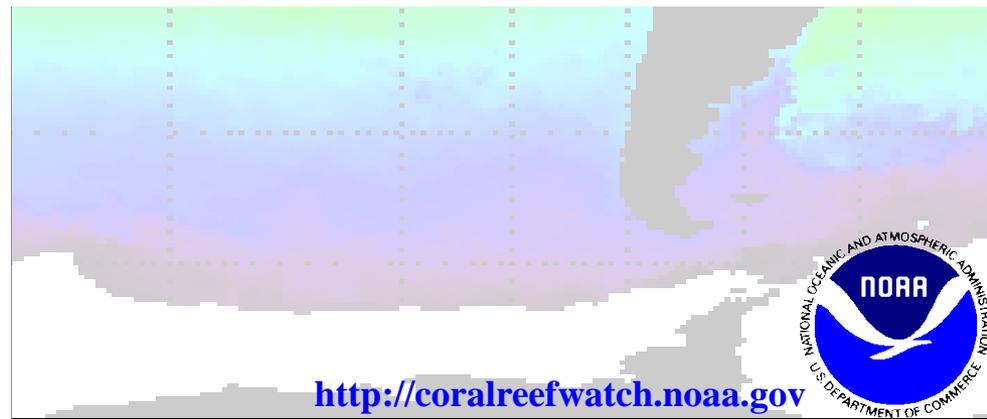
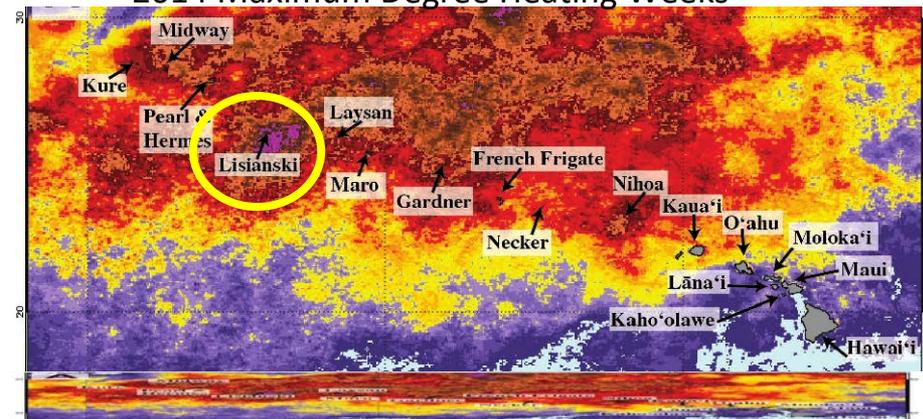
2014 NWHI Bleaching: Lisianski Island



NOAA/PMNM/HIMB Courtney Couch

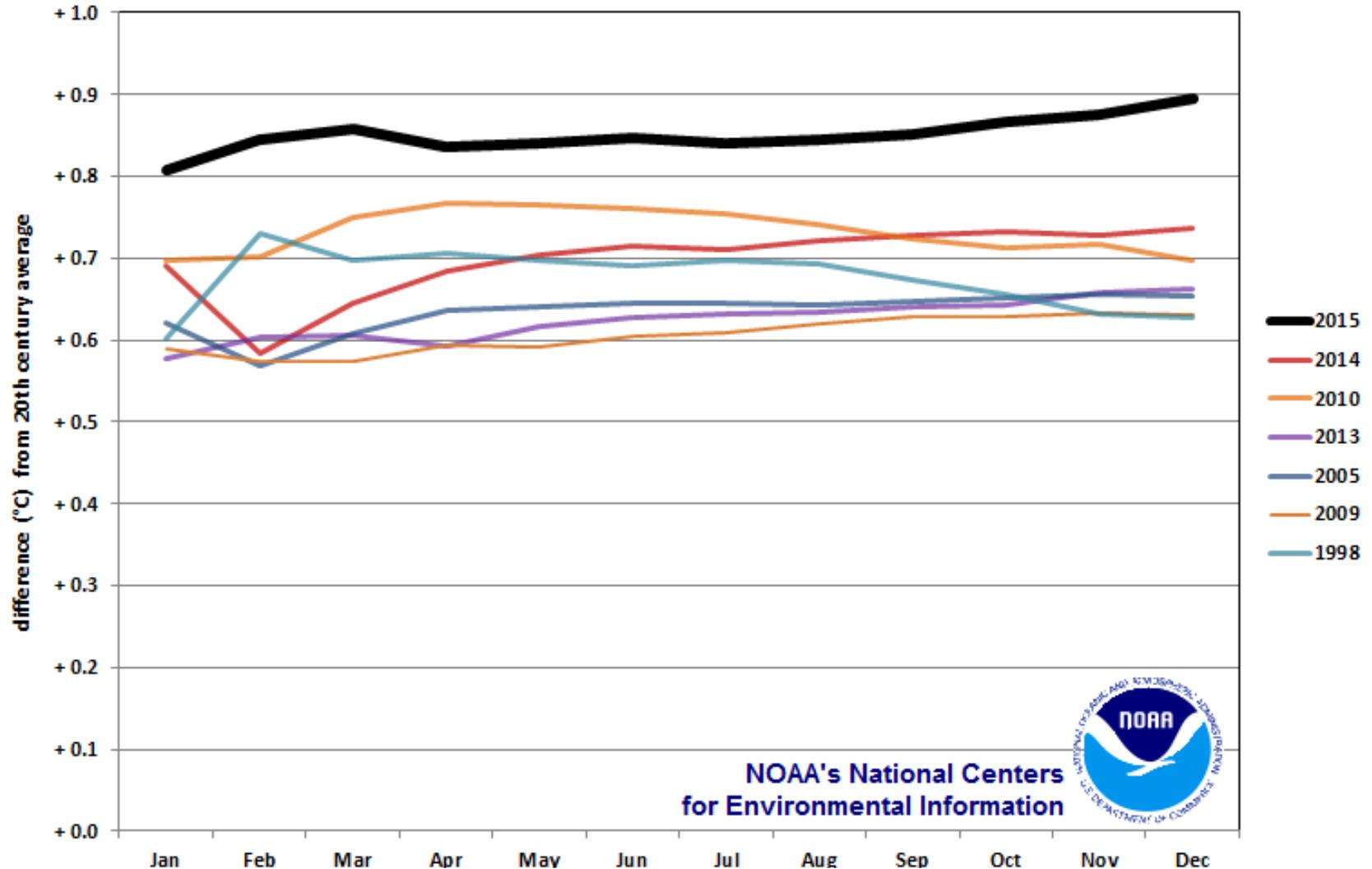


2014 Maximum Degree Heating Weeks



2015: Warmest Year Ever – Again

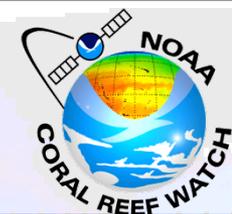
Year-to-Date Global Temperature
for 2015 and the other six warmest years on record



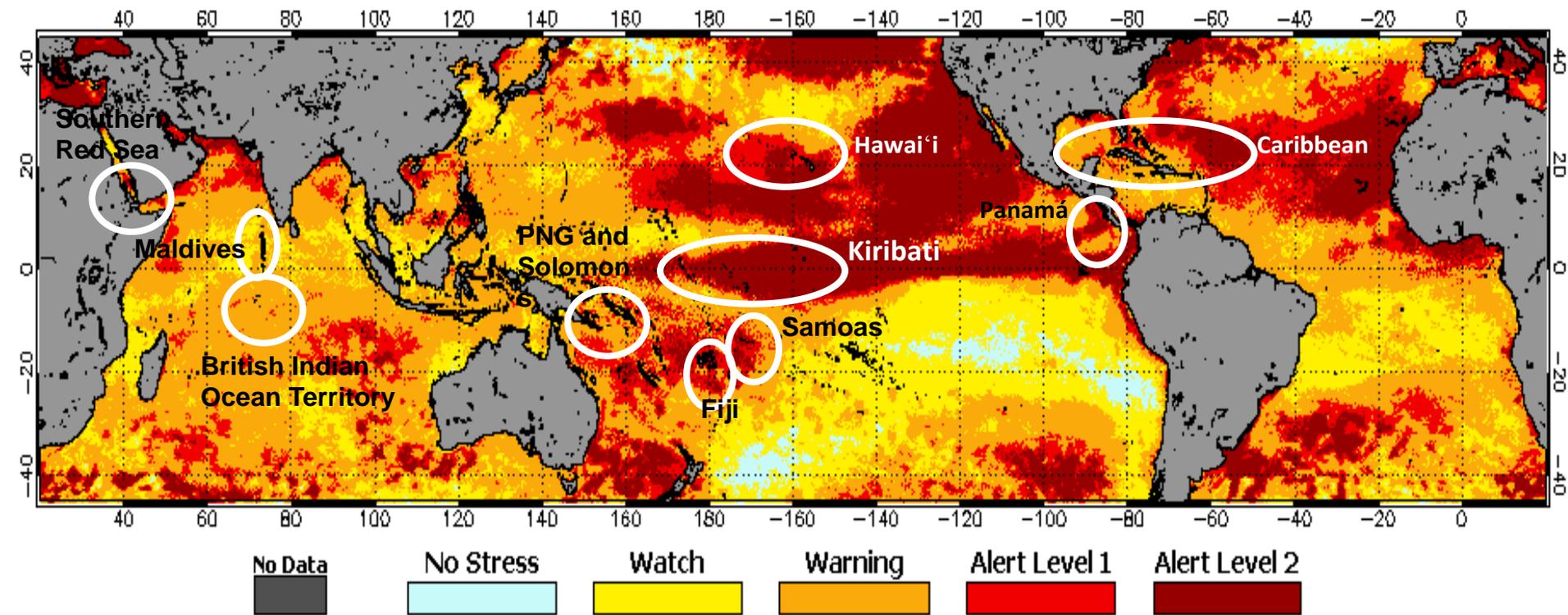
NOAA's National Centers
for Environmental Information



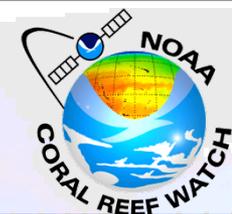
Global Bleaching: 2015



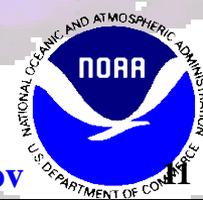
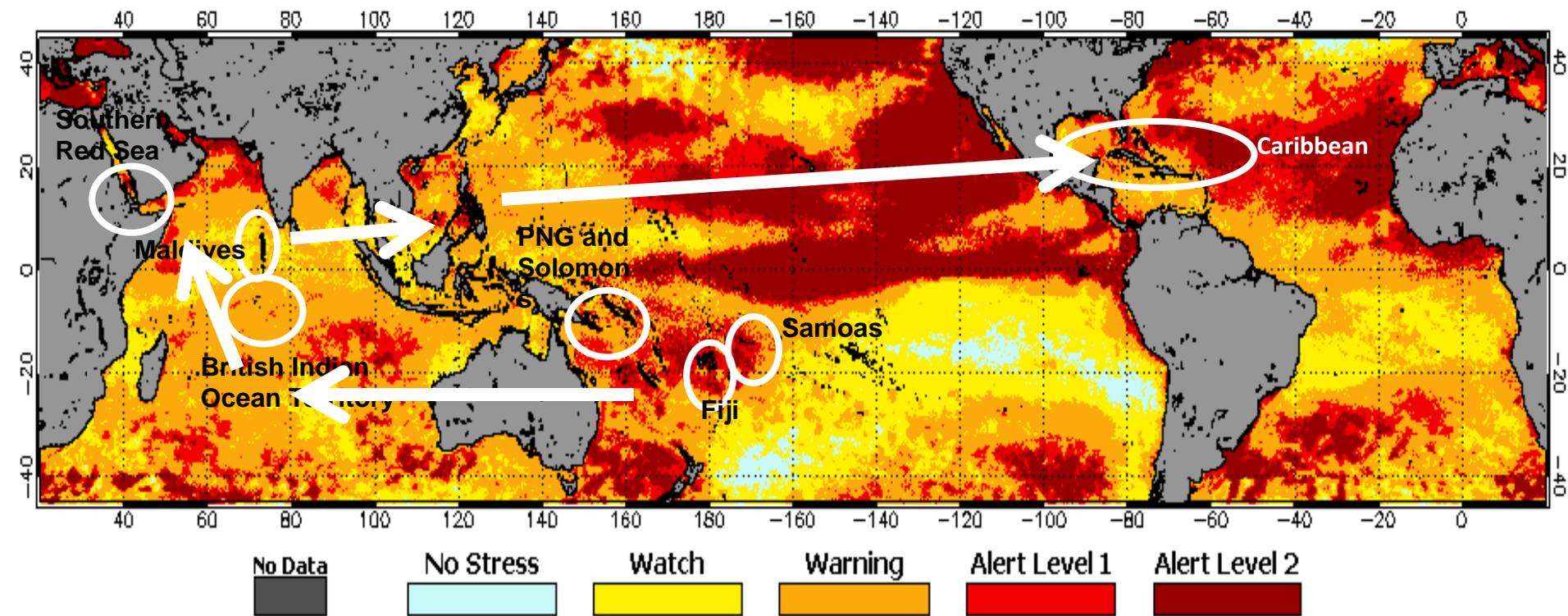
NOAA Coral Reef Watch Annual Maximum Satellite Coral Bleaching Alert Area 2015



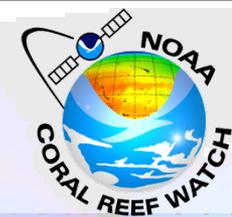
Global Bleaching: 2015



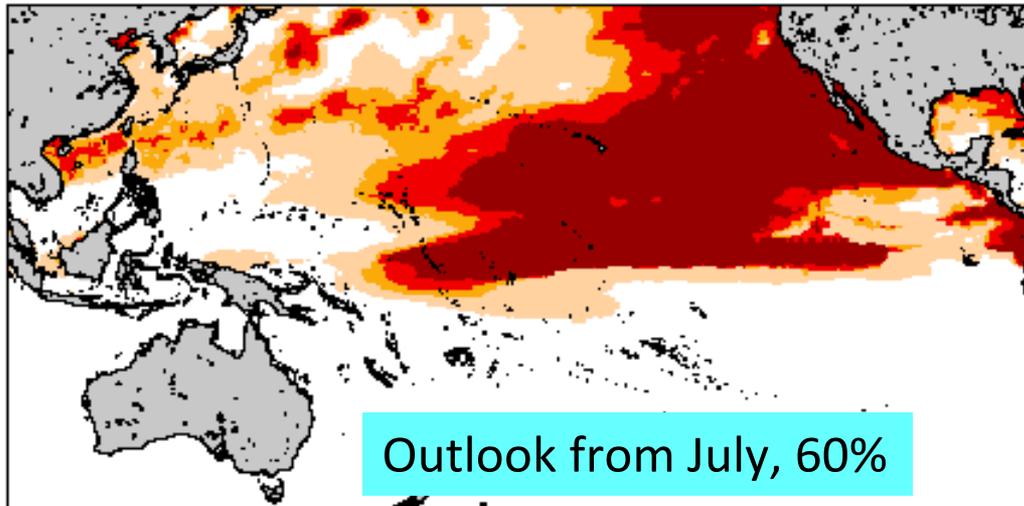
NOAA Coral Reef Watch Annual Maximum Satellite Coral Bleaching Alert Area 2015



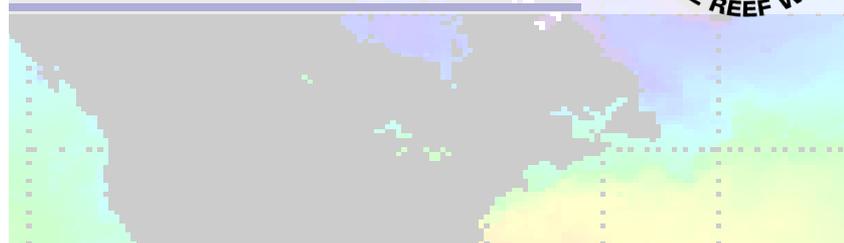
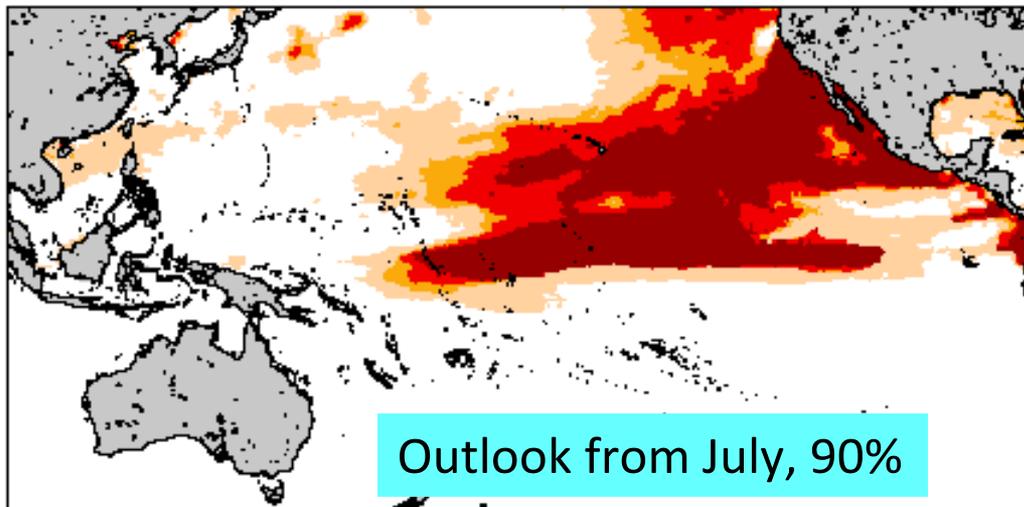
2015 4-Month Bleaching Outlook: Hawai'i



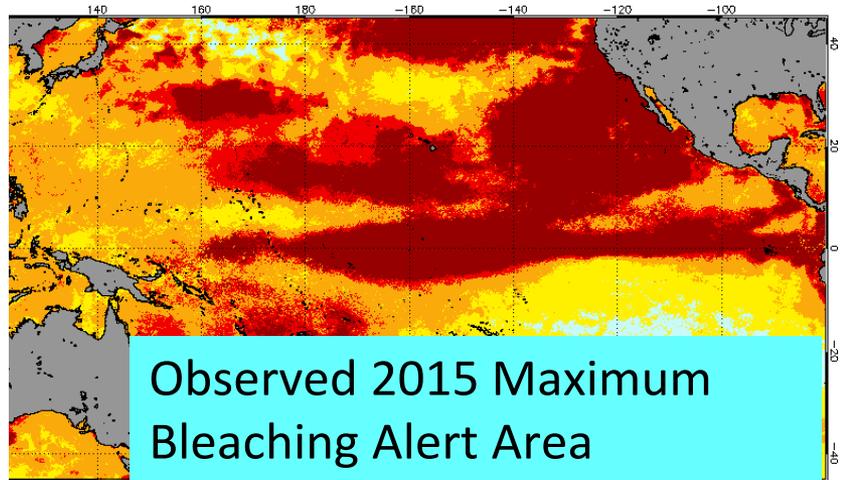
2015 Jun 30 NOAA 60% Probability Bleaching Thermal Stress for Jul–Oct 2015
Experimental, v3.0, CFSv2–based, 28–member



2015 Jun 30 NOAA 90% Probability Bleaching Thermal Stress for Jul–Oct 2015
Experimental, v3.0, CFSv2–based, 28–member



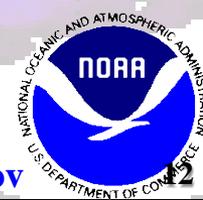
5–km Night–Only Bleaching Alert Area Annual Maximum 2015



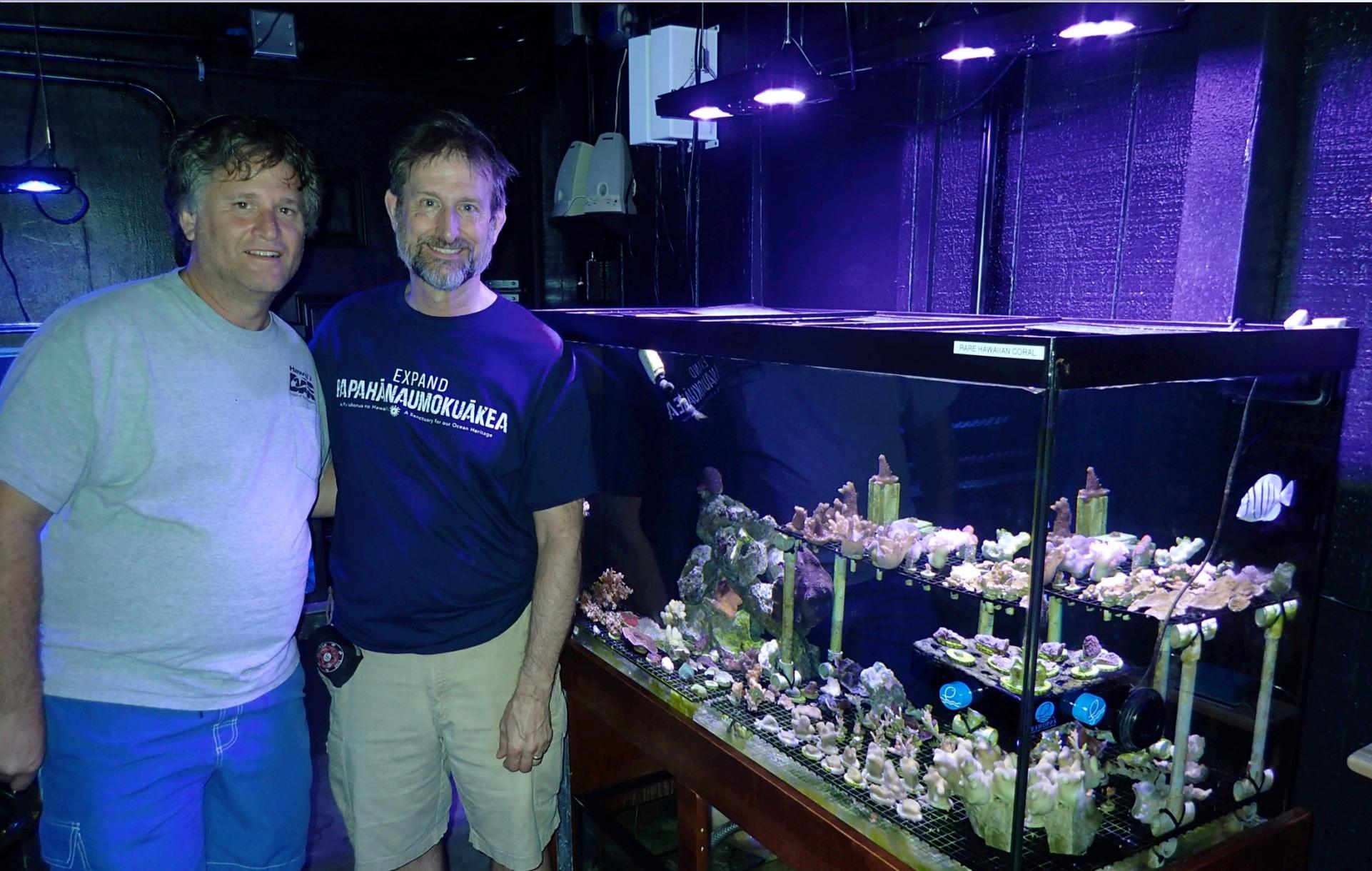
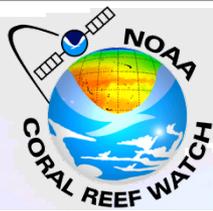
No Data No Stress Watch Warning Alert Level 1 Alert Level 2

Outlook based on 28 member SST ensemble from NCEP CFSv2

Potential Stress Level: Watch Warning Alert Level 1 Alert Level 2

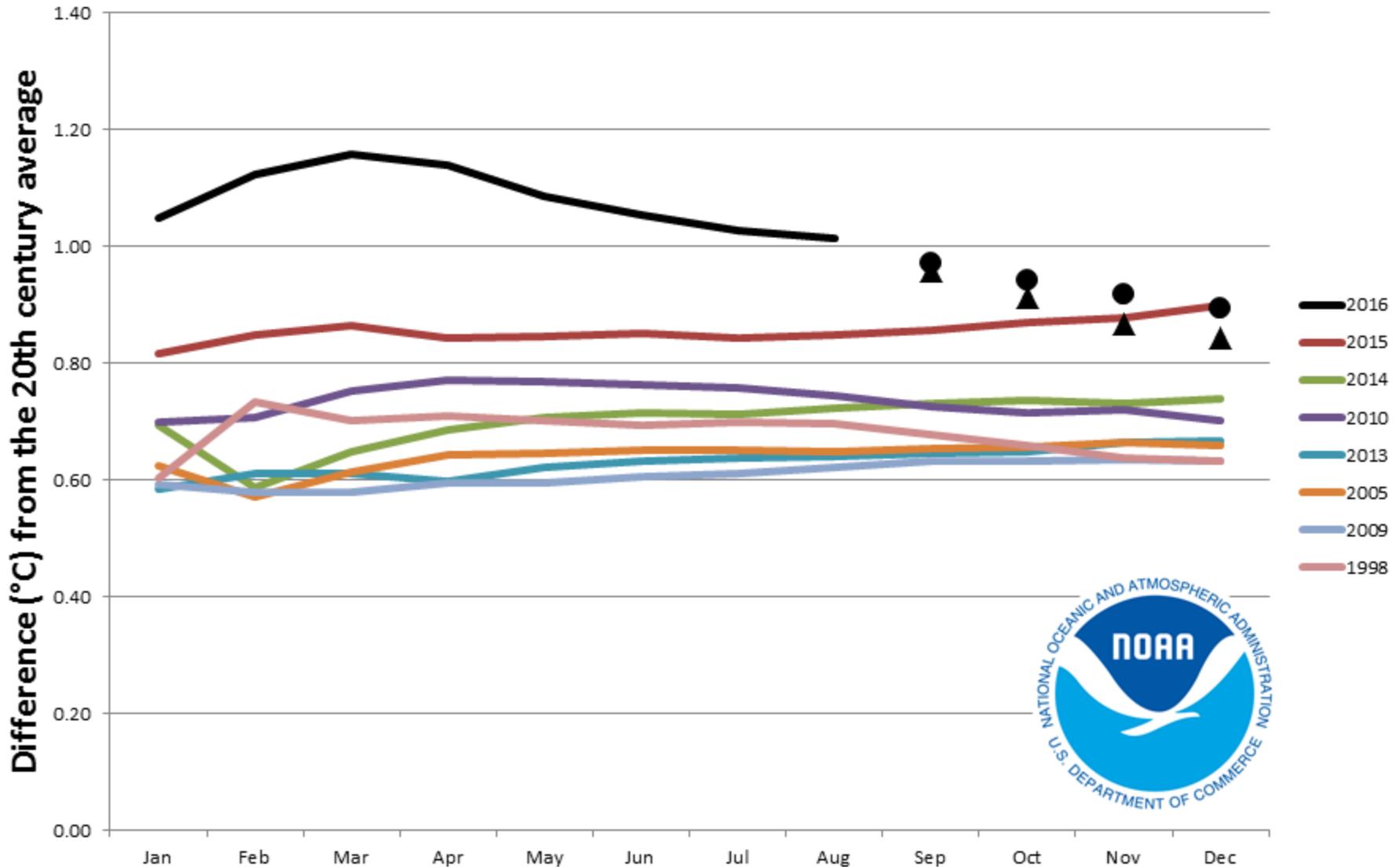


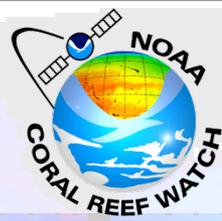
Management Response: 2015 Hawai'i Bleaching – DAR “Ark”



2016: Probably in Top Two Warmest Years

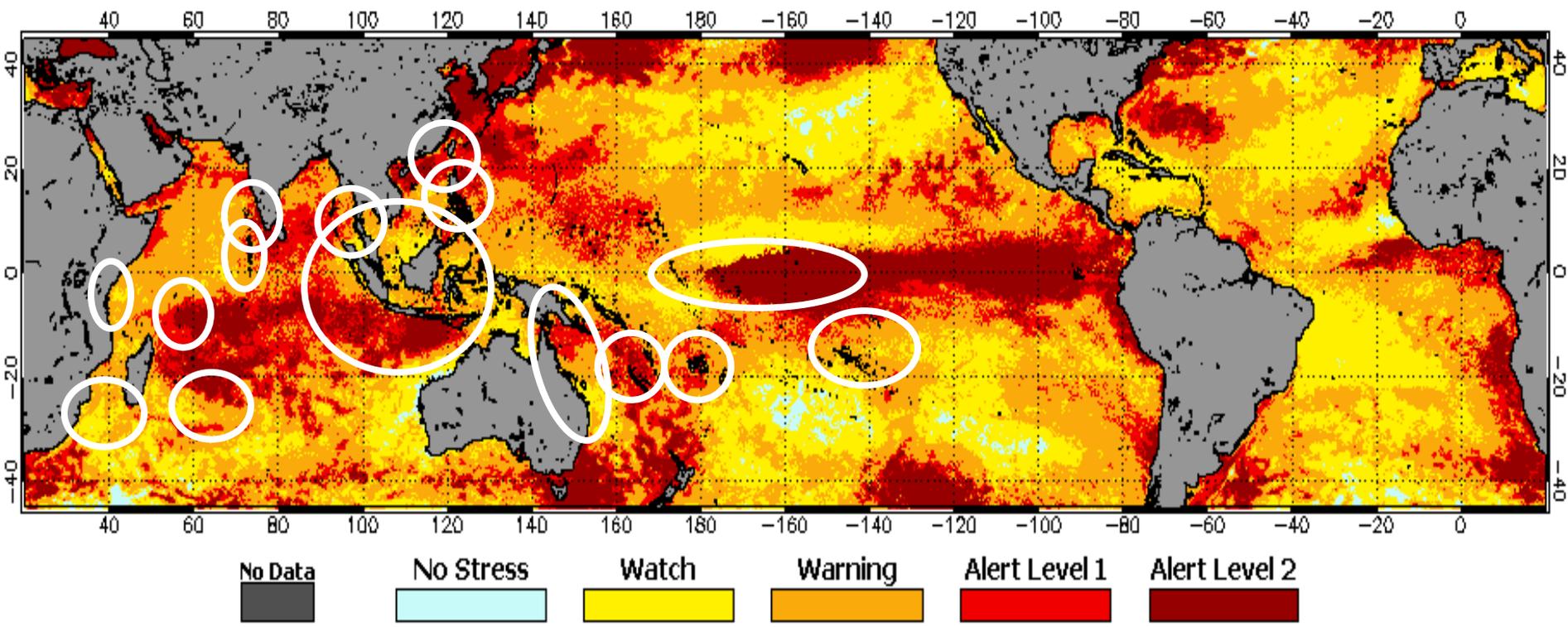
Year-to-Date Global Temperatures for 2016 and the other seven warmest years on record





Global Bleaching: 2016 to date

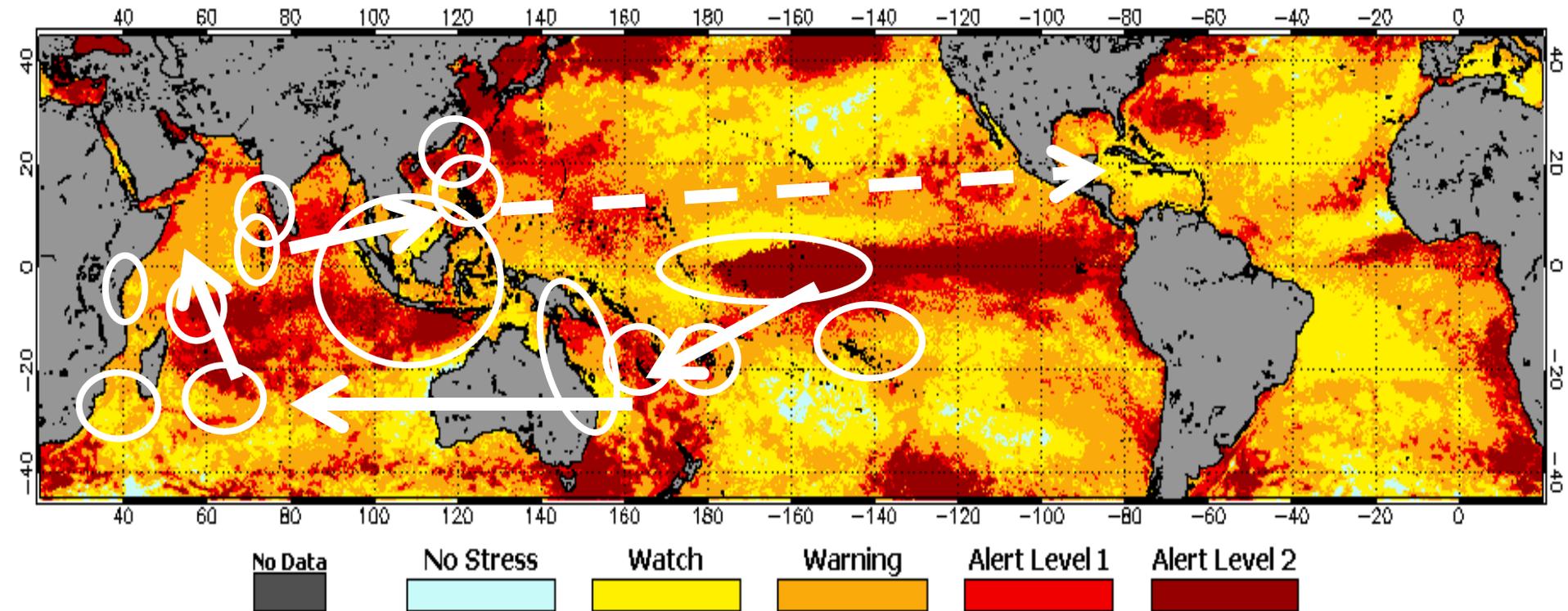
NOAA Coral Reef Watch Maximum Satellite Coral Bleaching Alert Area 1Jan.-19Sep 2016



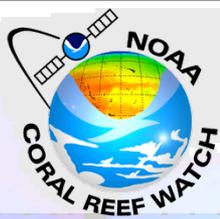
- | | | | | |
|-----------------------|-------------------|---------------------|-------------------------|-----------------|
| Western India | | Taiwan | Vietnam | Japan |
| Seychelles | Maldives | Philippines | New Caledonia | Marianas |
| Kenya/Tanzania | Réunion | Thailand | Fiji | Palau |
| Mozambique | Mauritius | Indonesia | Kiribati | |
| | Madagascar | E. Australia | French Polynesia | |

Global Bleaching: 2016 to date

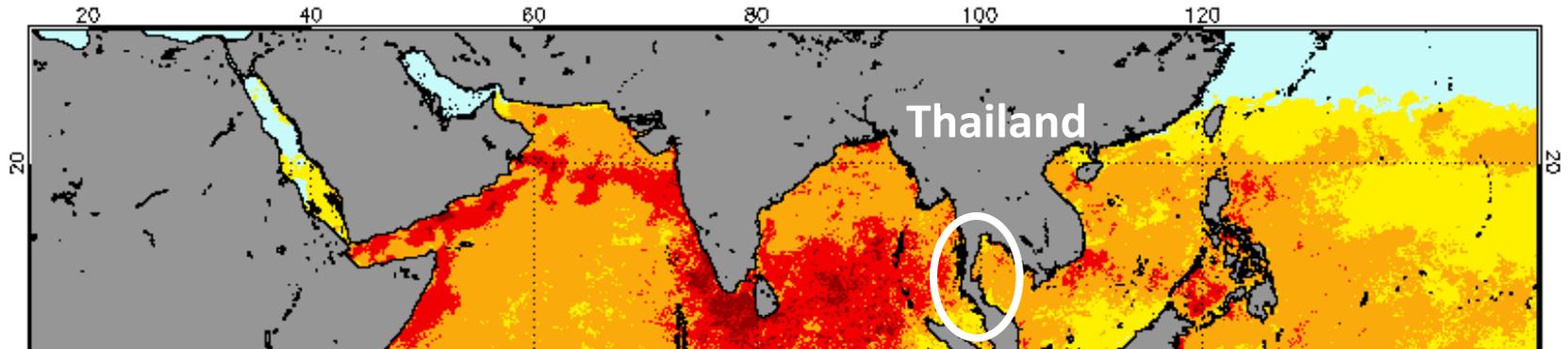
NOAA Coral Reef Watch Maximum Satellite Coral Bleaching Alert Area 1Jan.-19Sep 2016



Management Response: Thailand Reef Closures



NOAA Coral Reef Watch Maximum Satellite Coral Bleaching Alert Area YTD 18 June 2016



theguardian
website of the year

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[energy](#) [pollution](#) [climate change](#)

[UK](#) [world](#) [all](#)

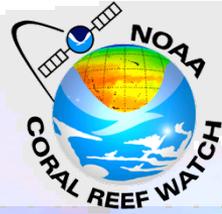
[Coral](#)

Thailand closes dive sites over coral bleaching crisis

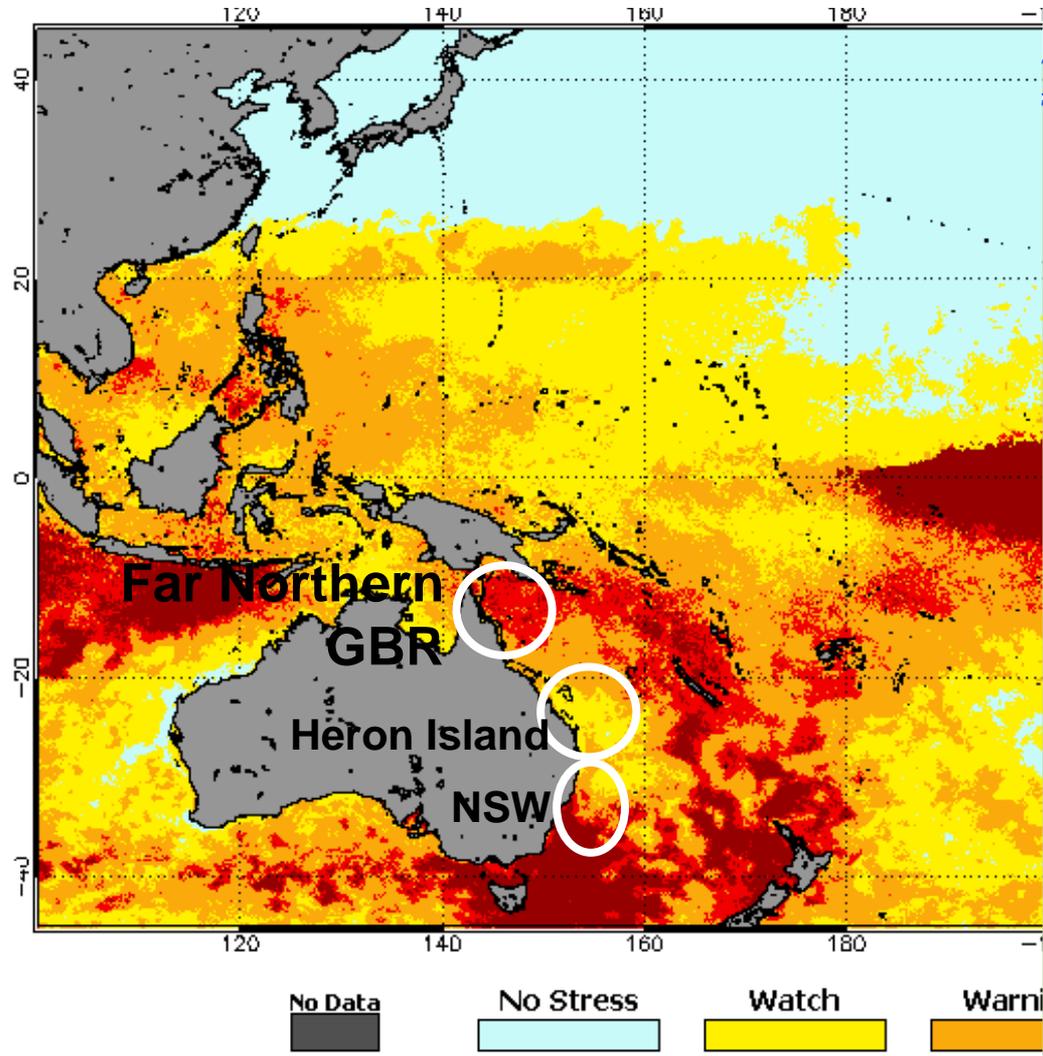
Thursday 26 May 2016
14.11 BST

In a rare move to shun tourism profits for environmental protection, 10 popular dive sites have been shut down in a bid to slow a coral bleaching crisis

Global Bleaching: First Half of 2016



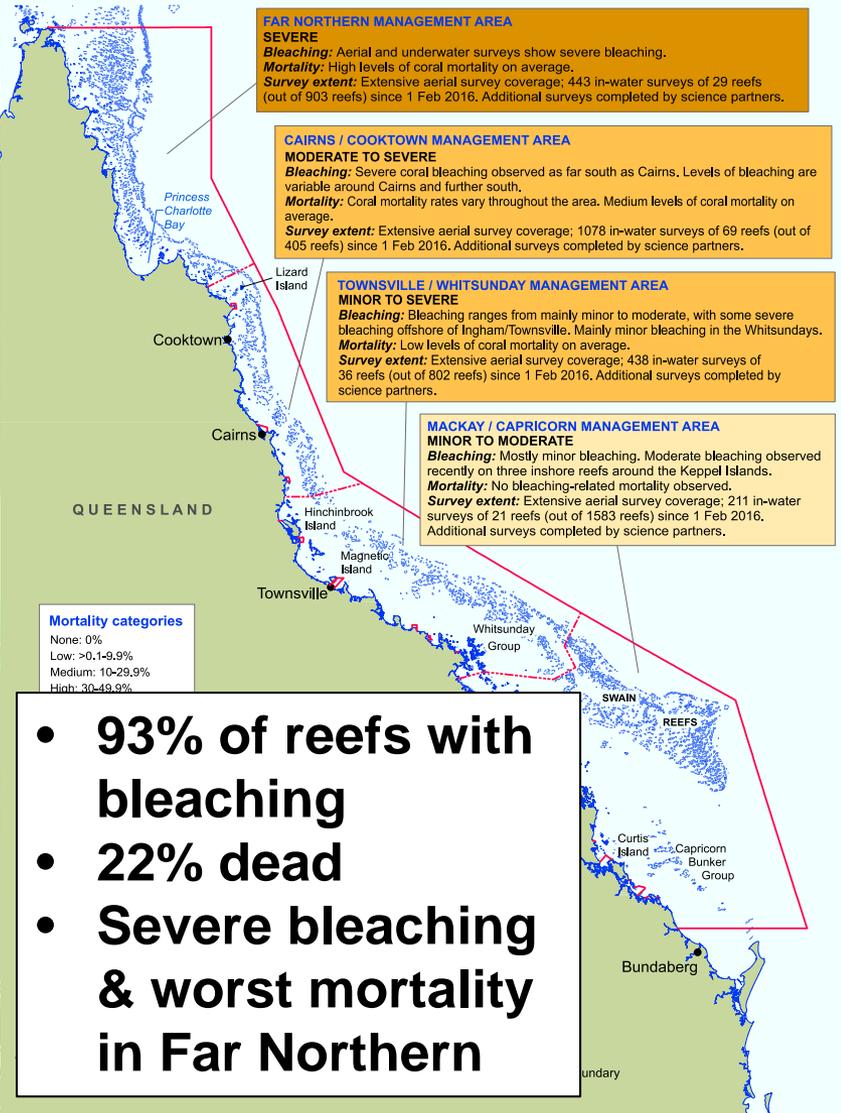
NOAA Coral Reef Watch Maximum Satellite Coral



Australian Government
Great Barrier Reef
Marine Park Authority

Observed bleaching
as at 13 June 2016

Queensland
Government



GBR Bleaching



Justin Marshall, Coral Watch

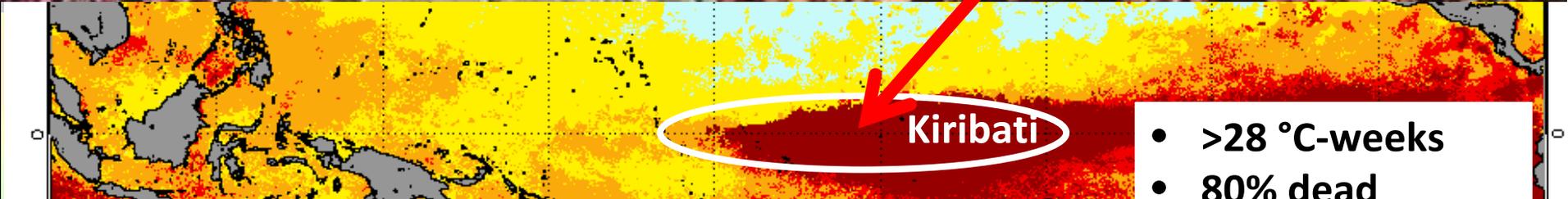


Lizard Island Mortality: 2016

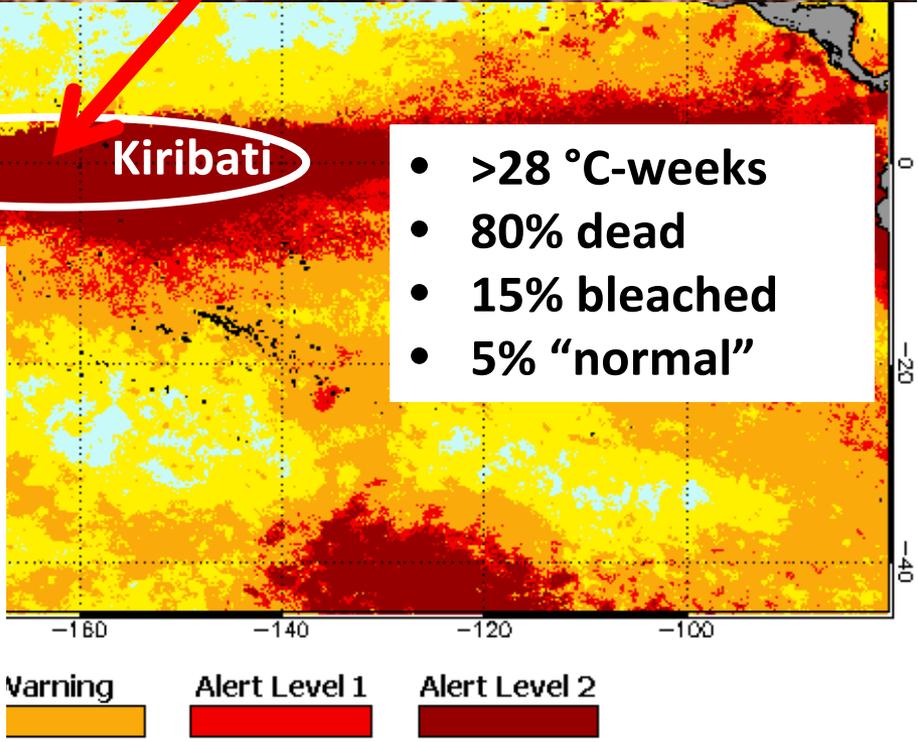
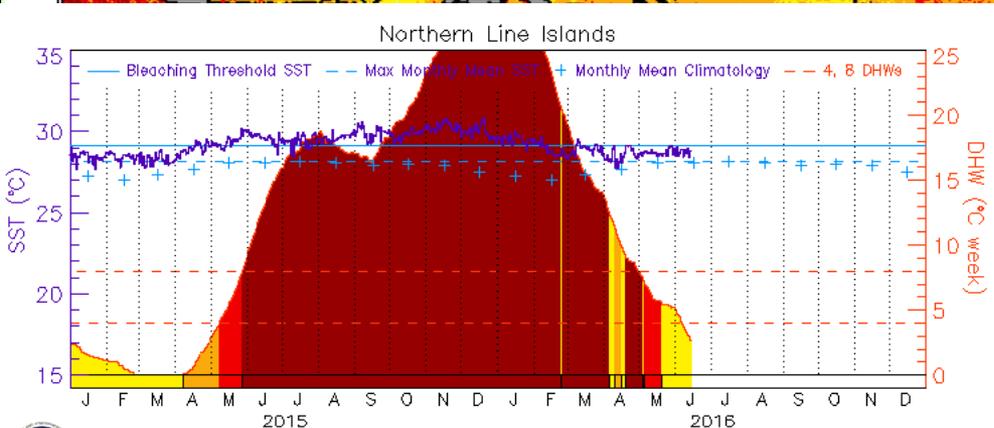
XL CATLIN
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SURVEY



The lack of fish was an indication that there was “complete ecosystem collapse”
Justin Marshall, Univ. of Queensland
The Guardian 21 July 2016



- >28 °C-weeks
- 80% dead
- 15% bleached
- 5% "normal"



April 2015



May 2016



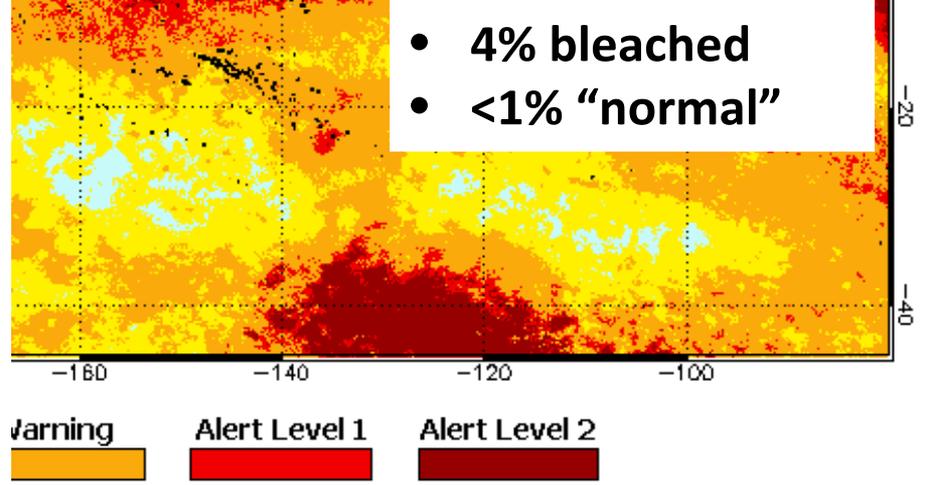
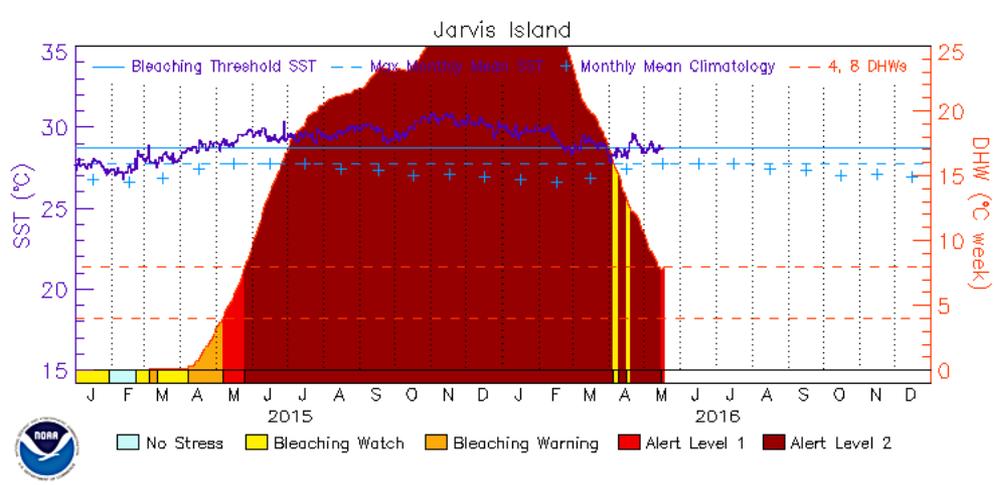
NOAA Coral Reef Ecosystem Program

NOAA Coral Reef Ecosystem Program



Jarvis I.

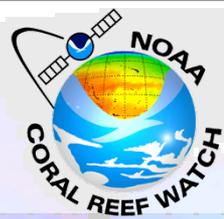
- >31 ° C-weeks
- 95% dead
- 4% bleached
- <1% "normal"



Warning Alert Level 1 Alert Level 2



June 2014-June 2016 Thermal Stress



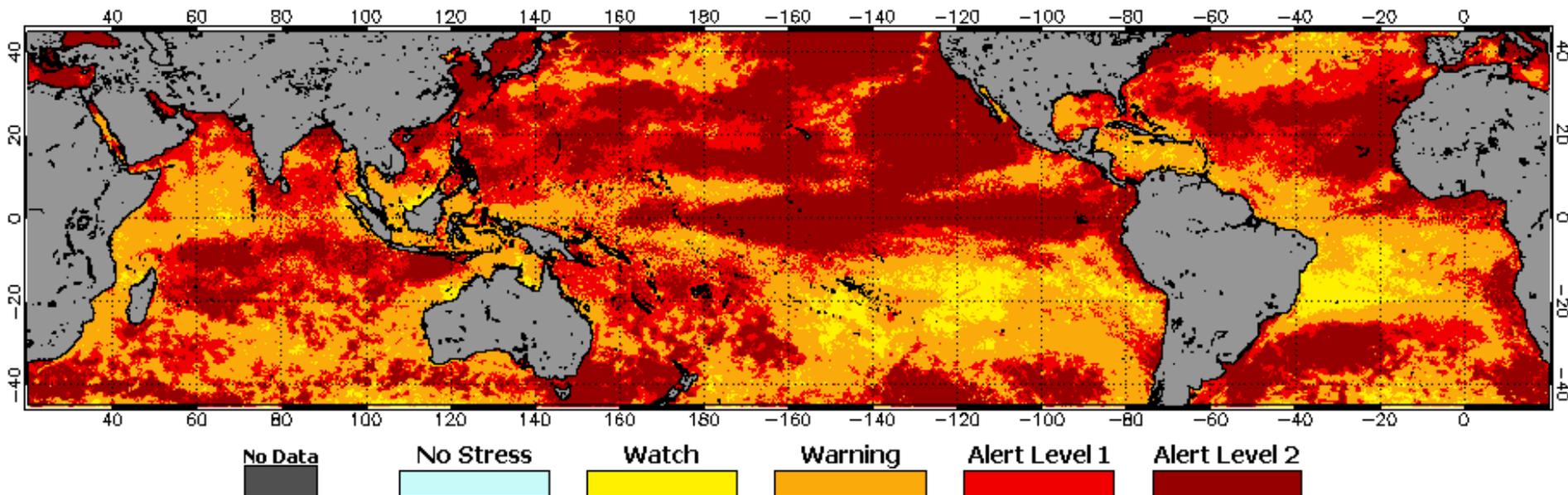
Global Reefs:

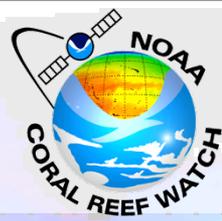
- 42% @ Alert Level 1 or 2
- Level 2 Area > Massachusetts
- Over ½ exposed twice
- ~100% stressed

US Reefs:

- 72% Alert Level 1 or 2
- Over ½ exposed twice
- 100% stressed

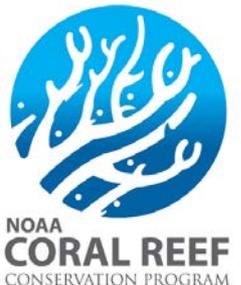
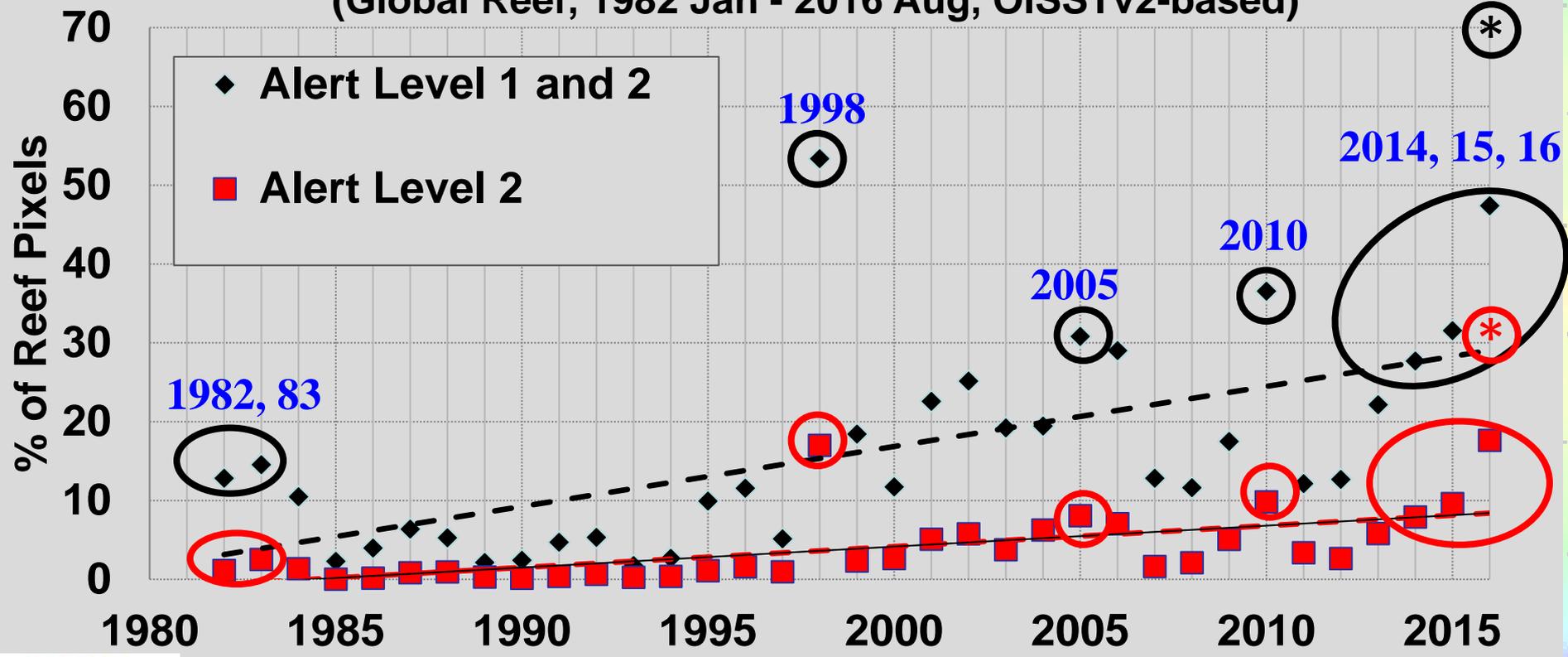
NOAA Coral Reef Watch Maximum Satellite Coral Bleaching Alert Area Jan. 2014-Aug. 2016



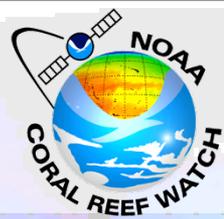


Ocean Warms, Bleaching Increases

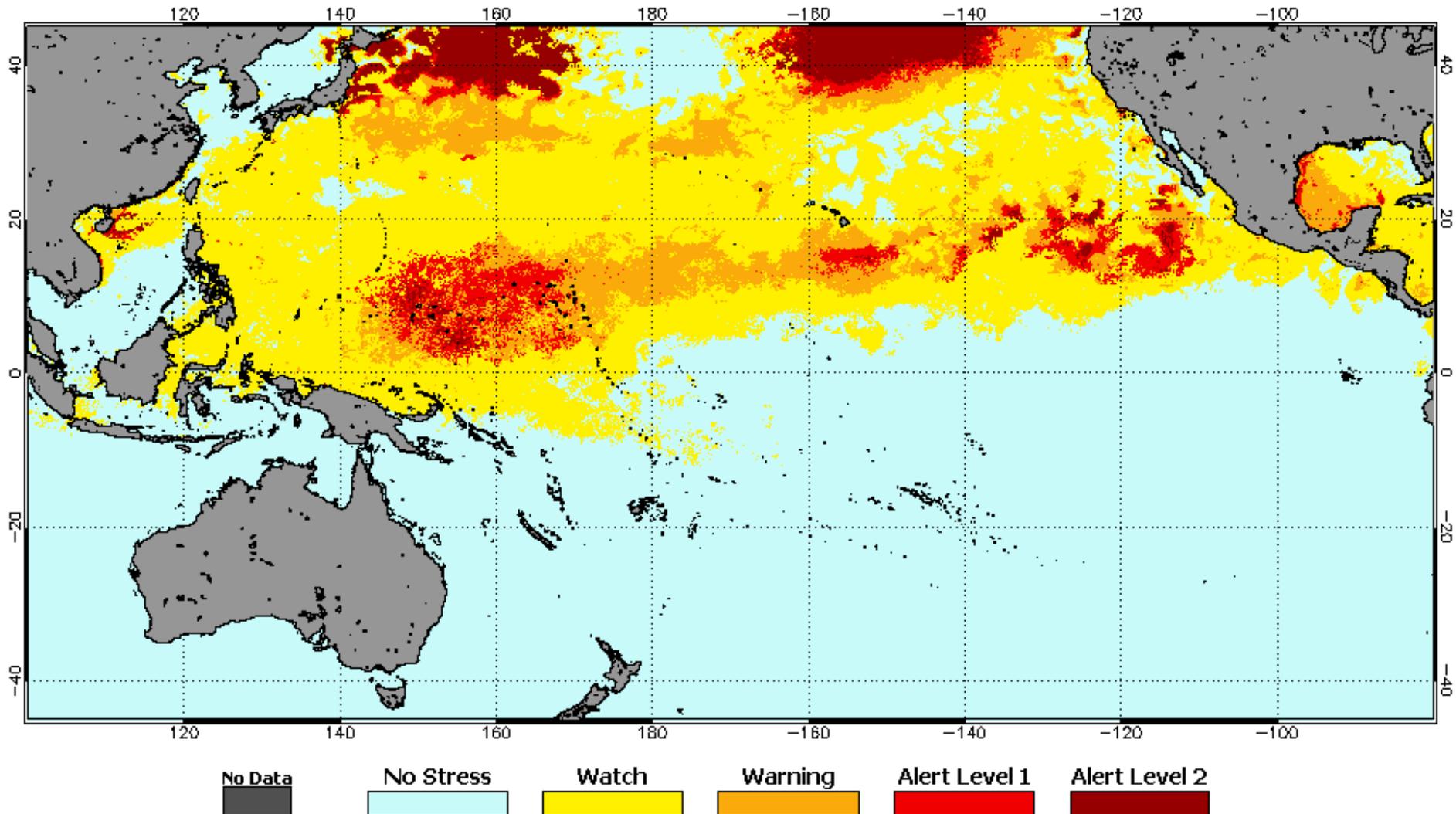
% of Reef Pixels Experiencing Bleaching Alert Level 1 & 2
(Global Reef, 1982 Jan - 2016 Aug, OISSTv2-based)



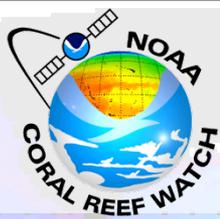
Current Conditions - Pacific



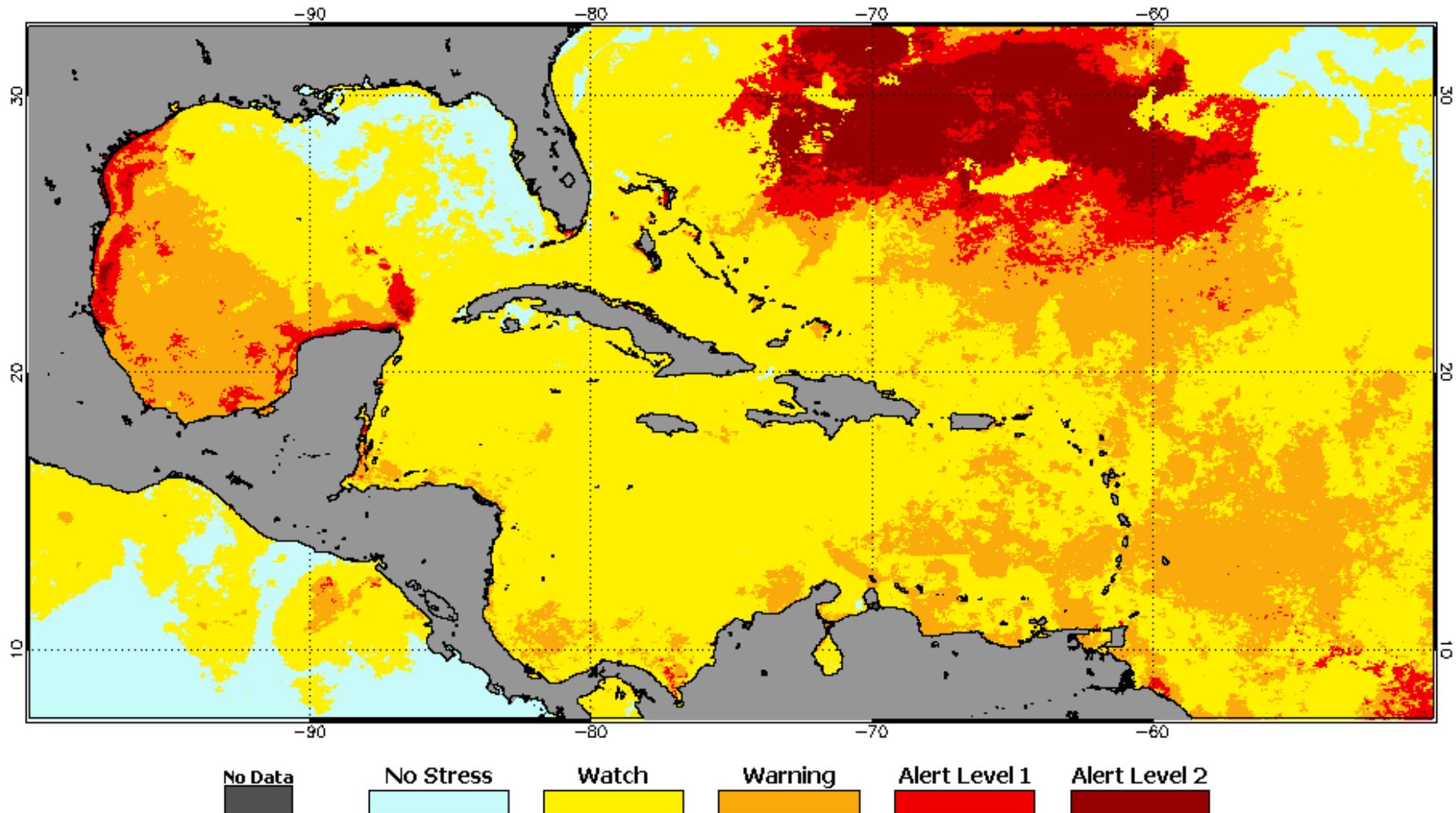
NOAA Coral Reef Watch Daily 5-km Geo-Polar Blended Night-Only Bleaching Alert Area 7d Max 19 Sep 2016



Current Conditions - Caribbean



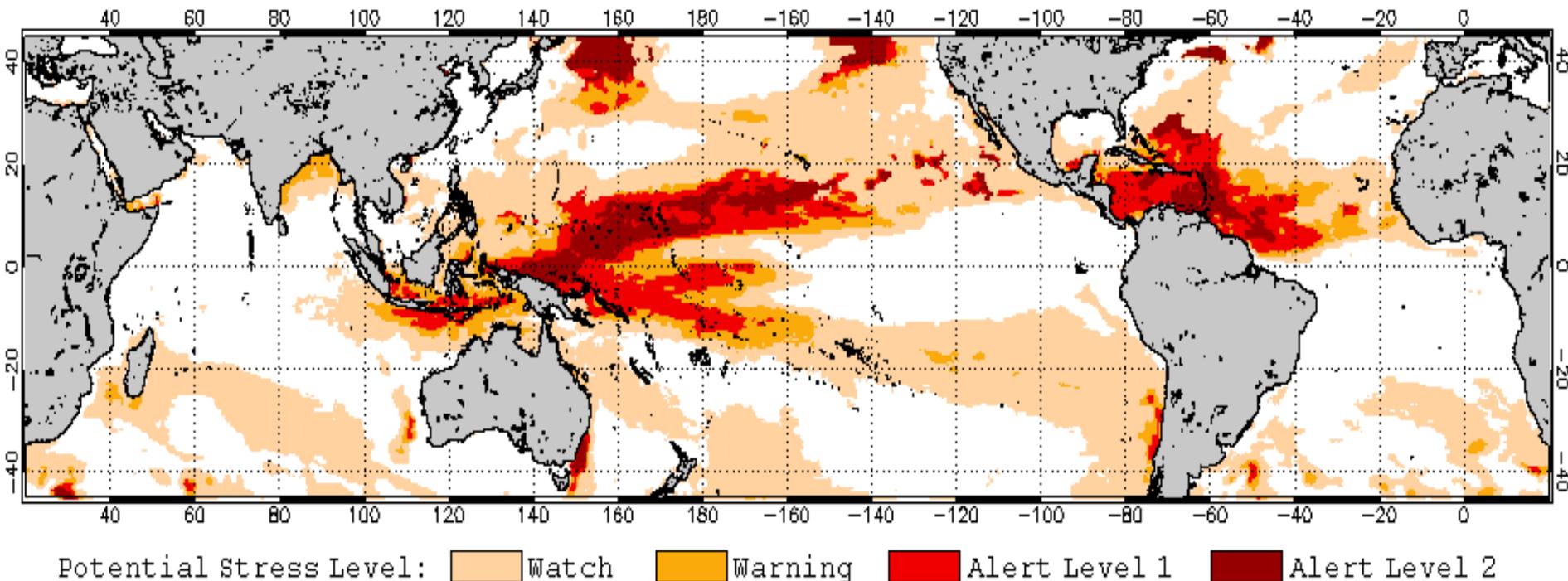
NOAA Coral Reef Watch Daily 5-km Geo-Polar Blended Night-Only Bleaching Alert Area 7d Max 19 Sep 2016



Bleaching Risk Through end of 2016

- Potential of severe bleaching likely in eastern Micronesia, Marshall Is
- Bleaching likely in Caribbean
- May see some bleaching in PR, USVI

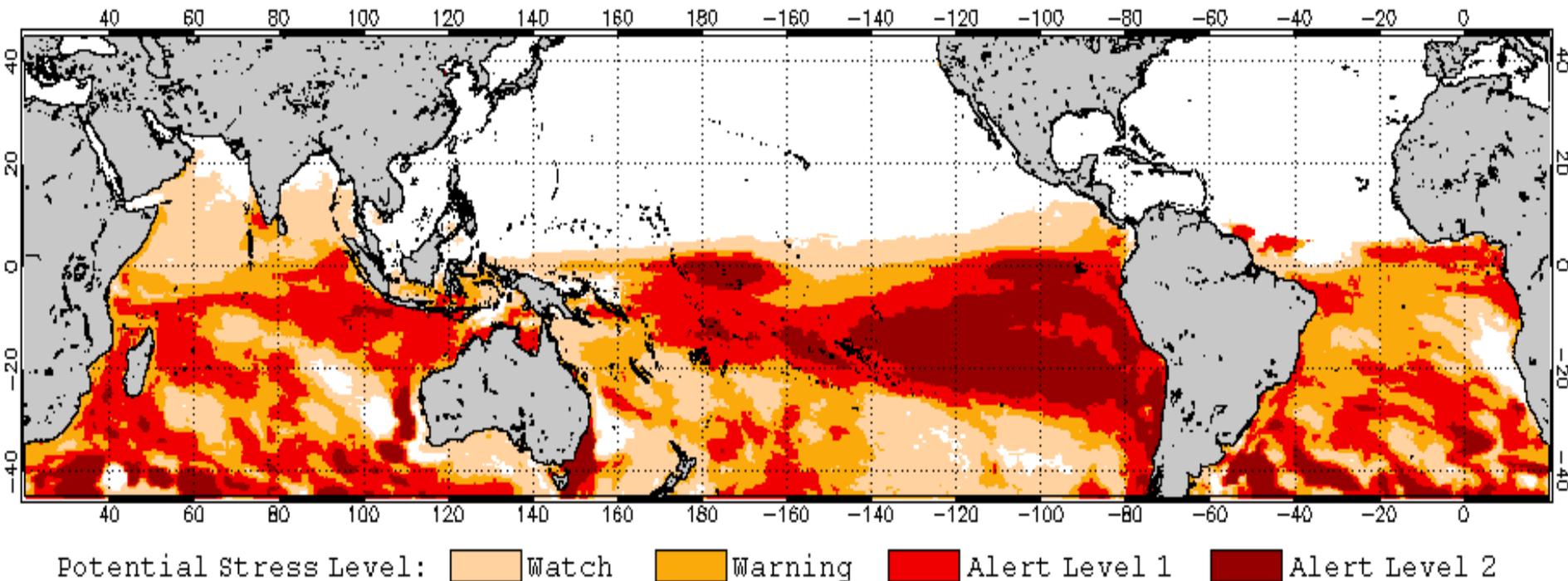
2016 Sep 20 NOAA Coral Reef Watch 60% Probability Coral Bleaching Thermal Stress for Oct–Jan 2017
Experimental, v3.0, CFSv2–based, 28–member Ensemble Forecast



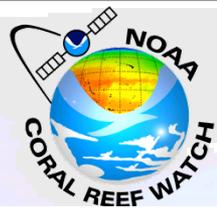
Bleaching Risk in early 2017

- Neutral ENSO conditions likely
- Some potential for bleaching in American Samoa, south Pacific

2016 Sep 20 NOAA Coral Reef Watch 60% Probability Coral Bleaching Thermal Stress for Feb–Apr 2017
Experimental, v3.0, CFSv2–based, 28–member Ensemble Forecast



Key Messages



2014-16 Bleaching:

- Longest, most widespread, often repeated bleaching
- > 40% of global reefs affected
- 72% of US reefs affected

Further 2016 Bleaching?

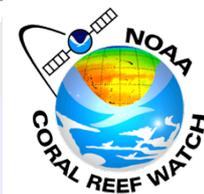
- Potential for severe bleaching in eastern Micronesia, Marshall Islands
- Potential for bleaching in Caribbean
- We need to both reduce CO₂ and take local actions
- We need to consider new approaches to protect reefs during bleaching events





NOAA Coral Reef Watch Team

<http://coralreefwatch.noaa.gov>



**Two Years And Counting:
Monitoring and Documenting
The Ongoing Global Coral
Bleaching Event (2014-2016
And Beyond)**

C. Mark Eakin, Andrea M. Gomez, **Gregor Hodgson**, **Richard Vevers**, Jacqueline L. De La Cour, Gang Liu, Erick F. Geiger, Scott F. Heron, William J. Skirving, Kyle V. Tirak, Alan E. Strong ... **and a cast of 100s**



Mark Eakin



Erick Geiger (GST)



Gang Liu (GST)



William Skirving
(GST & ReefSense)



Scott Heron
(GST & ReefSense)



Alan Strong (GST & SRI)



Kyle Tirak (GST)

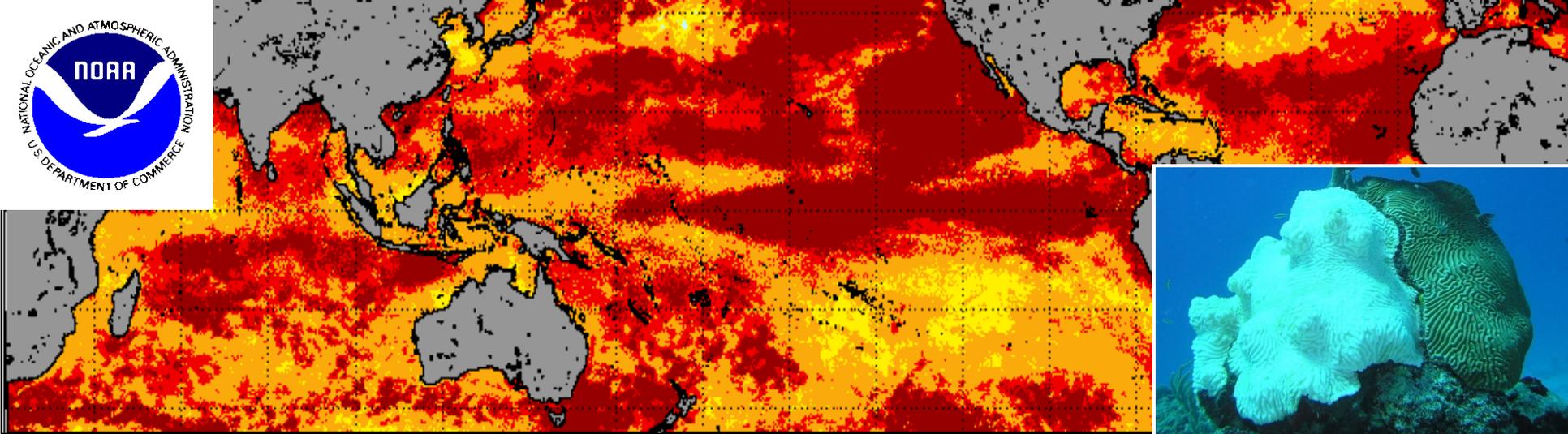


Jacqueline De La Cour (GST)



Andrea Gomez
(CCNY & NOAA-CREST)





Questions?

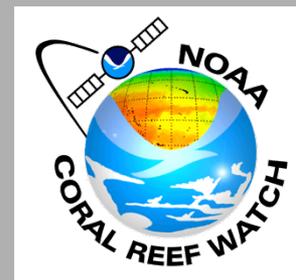
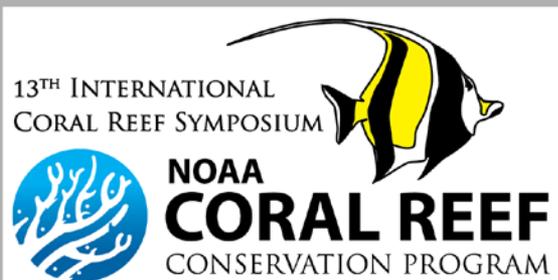
<http://coralreefwatch.noaa.gov>



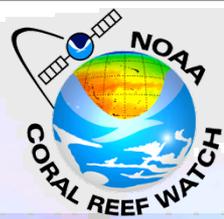
Coral Reef Watch



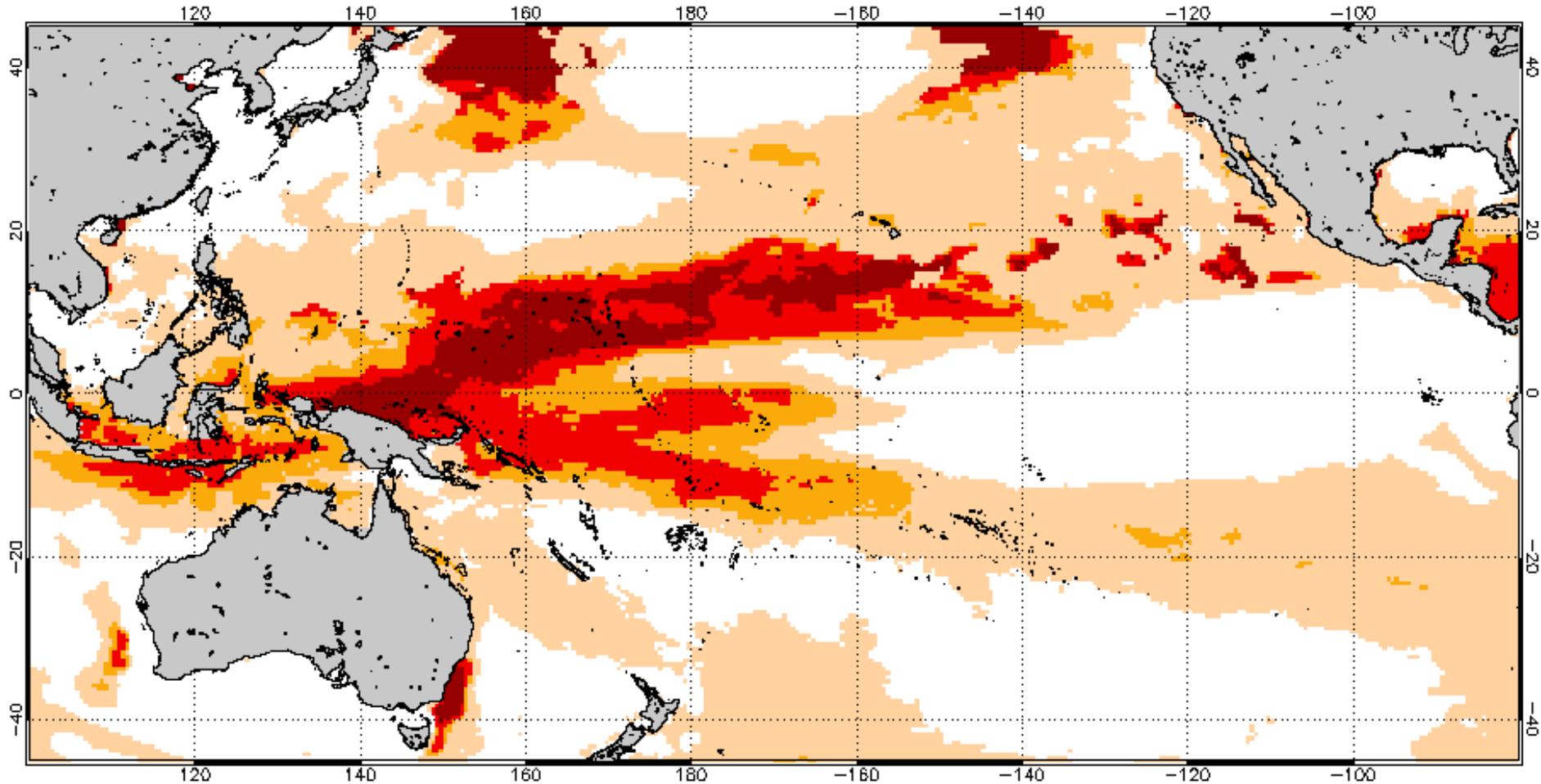
@CoralReefWatch



Pacific Bleaching Risk Through end of 2016

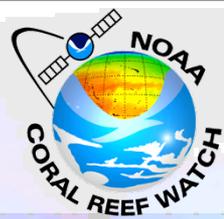


2016 Sep 20 NOAA Coral Reef Watch 60% Probability Coral Bleaching Thermal Stress for Oct–Jan 2017
Experimental, v3.0, CFSv2–based, 28–member Ensemble Forecast

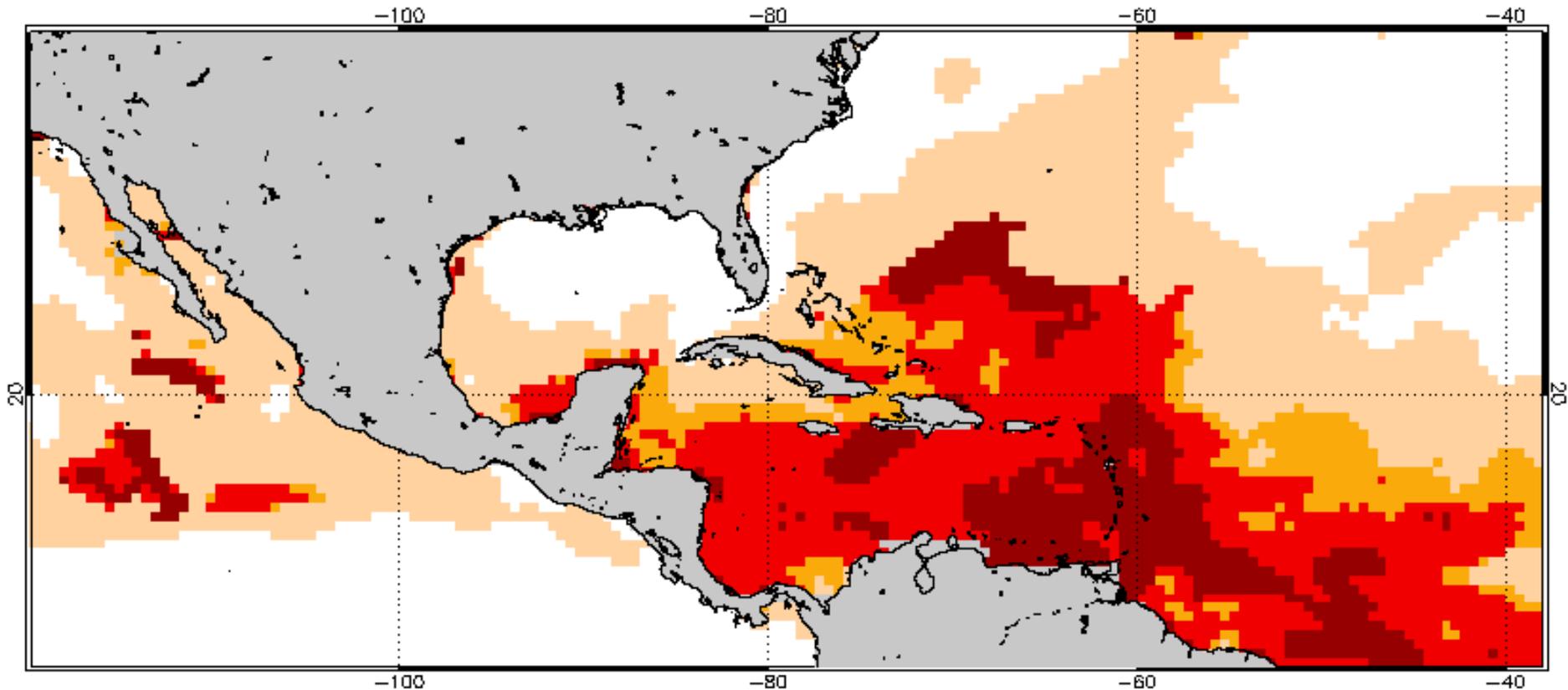


Potential Stress Level:  Watch  Warning  Alert Level 1  Alert Level 2

Caribbean Bleaching Risk Through end of 2016



2016 Sep 20 NOAA 60% Probability Coral Bleaching Thermal Stress for Oct–Jan 2017
Experimental, v3.0, CFSv2–based, 28–member Ensemble Forecast



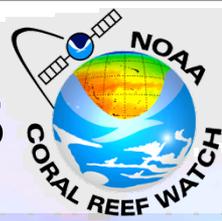
Potential Stress Level:

Watch

Warning

Alert Level 1

Alert Level 2



Guam/CNMI Thermal Stress Increases

% of Reef Pixels Experiencing Bleaching Alert Level 1 & 2
(Guam and CNMI, 1982 Jan-2016 Aug, OISSTv2-based)

