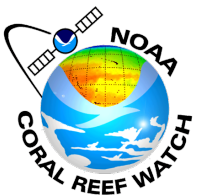
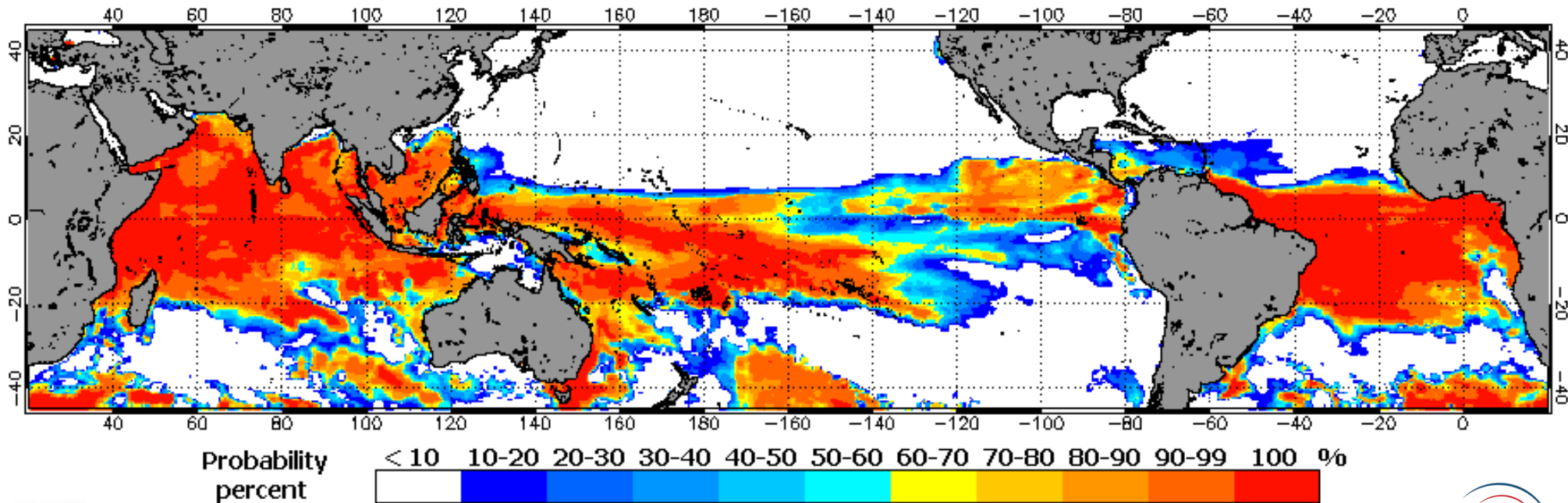


Record-Setting Heat Stress on Coral Reefs in 2023-2024: Current Patterns of Heat Stress and Future Outlook

Derek Manzello, Ph.D.
NOAA Coral Reef Watch

2024 Mar 5 NOAA Coral Reef Watch Bleaching Heat Stress Probabilities (Alert 1 & 2) for Mar–Jun 2024
Experimental, v5.0, CFSv2–based, 28 to 112 Ensemble Members



New Bleaching Alert Levels

Bleaching Alert Level 1 ($4 < \text{DHW} < 8$)
Reef-Wide Bleaching

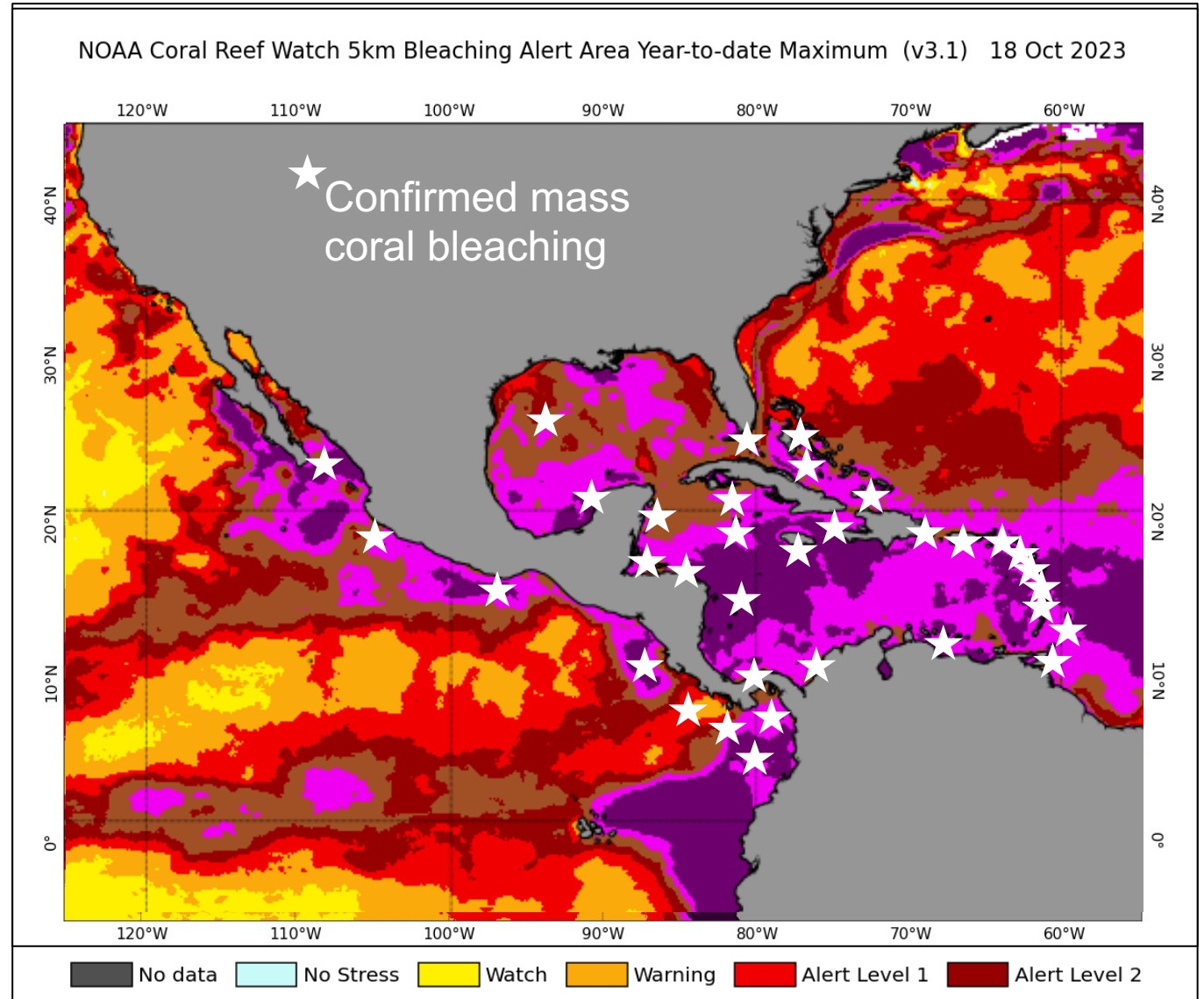
Bleaching Alert Level 2 ($8 < \text{DHW} < 12$) *
Reef-Wide Bleaching with Mortality of Heat-Sensitive Corals

Bleaching Alert Level 3 ($12 < \text{DHW} < 16$)
Multi-Species Mortality

Bleaching Alert Level 4 ($16 < \text{DHW} < 20$)
Severe, Multi-Species Mortality (> 50% of corals)

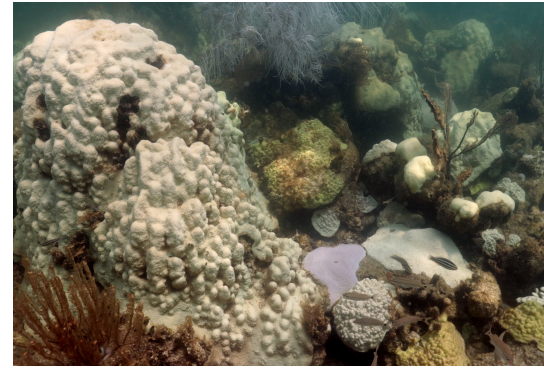
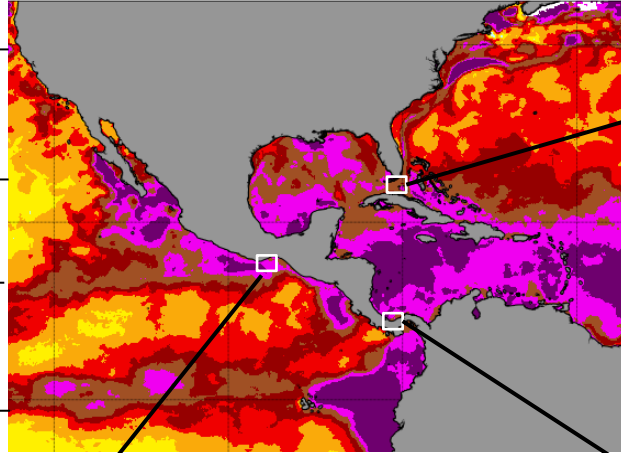
Bleaching Alert Level 5 ($\text{DHW} > 20$)
Near Complete Mortality (> 80% of corals)

* Severe coral mortality can occur at AL2:
-for heat sensitive species (*Acropora*)
-when a reef experiences 1st event (e.g., NGBR, 2016)

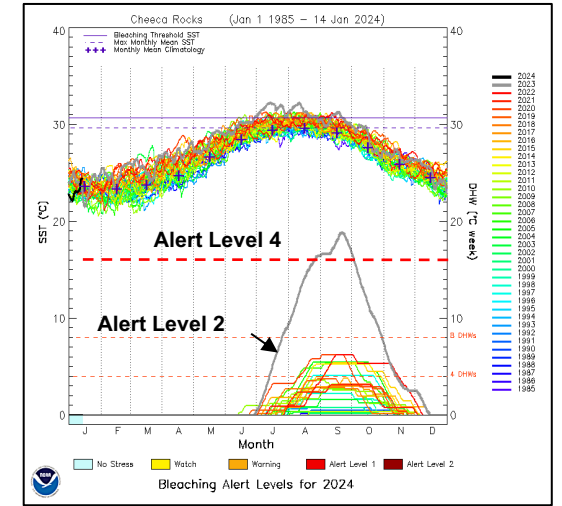


2023 Max Bleaching Alert Area

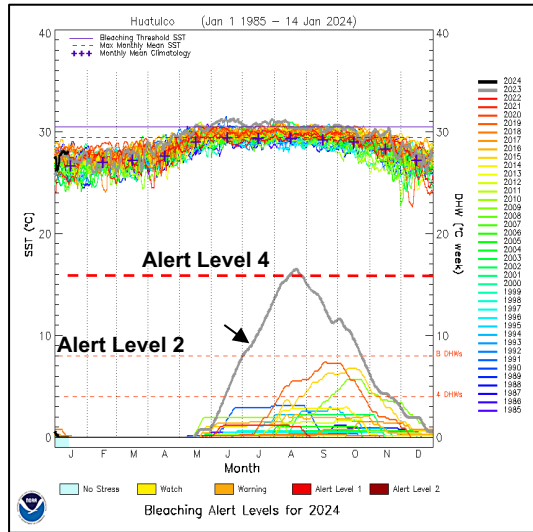
- **Alert Level 1**
Reef-Wide Bleaching
- **Alert Level 2**
Reef-Wide Bleaching, Mortality of Heat-Sensitive Corals
- **Alert Level 3**
Multi-Species Mortality
- **Alert Level 4**
Severe, Multi-Species Mortality (> 50% of corals)
- **Alert Level 5**
Near-Complete Mortality (> 80% of corals)



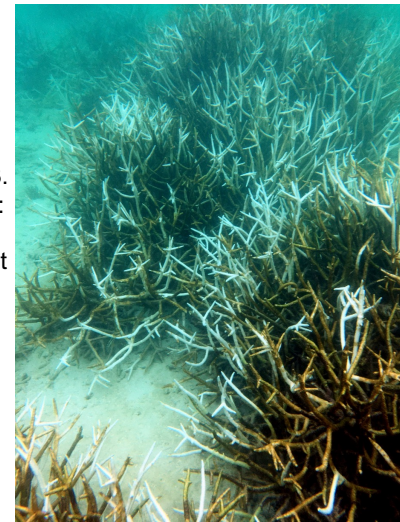
Cheeca Rocks, Florida Keys. 24 July 2023. Image credit: G. Kolodziej/NOAA. Arrow on plot shows when photo was taken.



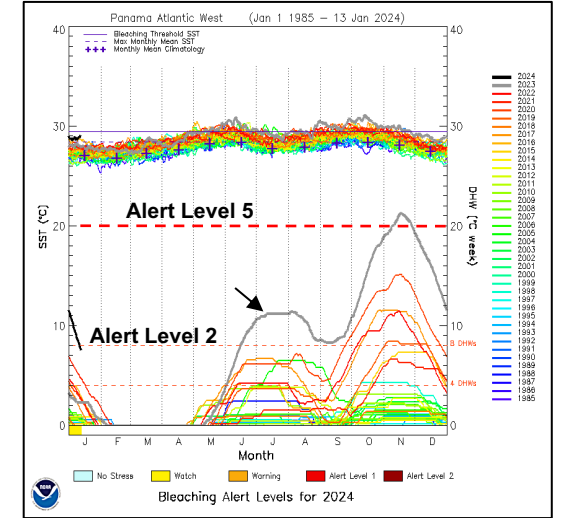
Huatulco Reef, Mexican Pacific. 13 July 2023. Mass bleaching of *Pocillopora* reef. Image credit: A. Lopez-Perez. Arrow on plot shows when photo was taken.



Bocas del Toro, Caribbean Panama. 14 July 2023. Image credit: J. Sanchez. Arrow on plot shows when photo was taken.

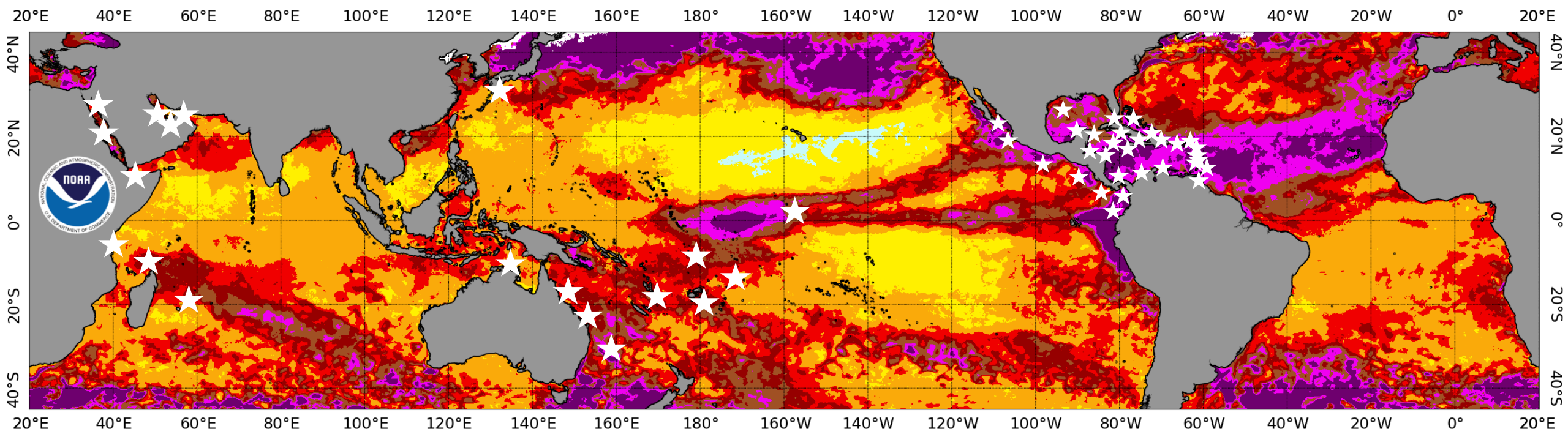


All unbleached areas are recent, heat-driven mortality of *Acropora cervicornis*, which is listed as threatened under the Endangered Species Act.



Max Bleaching Alert Area: 2023 -2024

NOAA Coral Reef Watch 5km Bleaching Alert Area Maximum (v3.1) 1 January 2023 - 29 February 2024

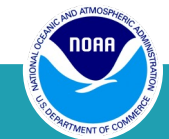
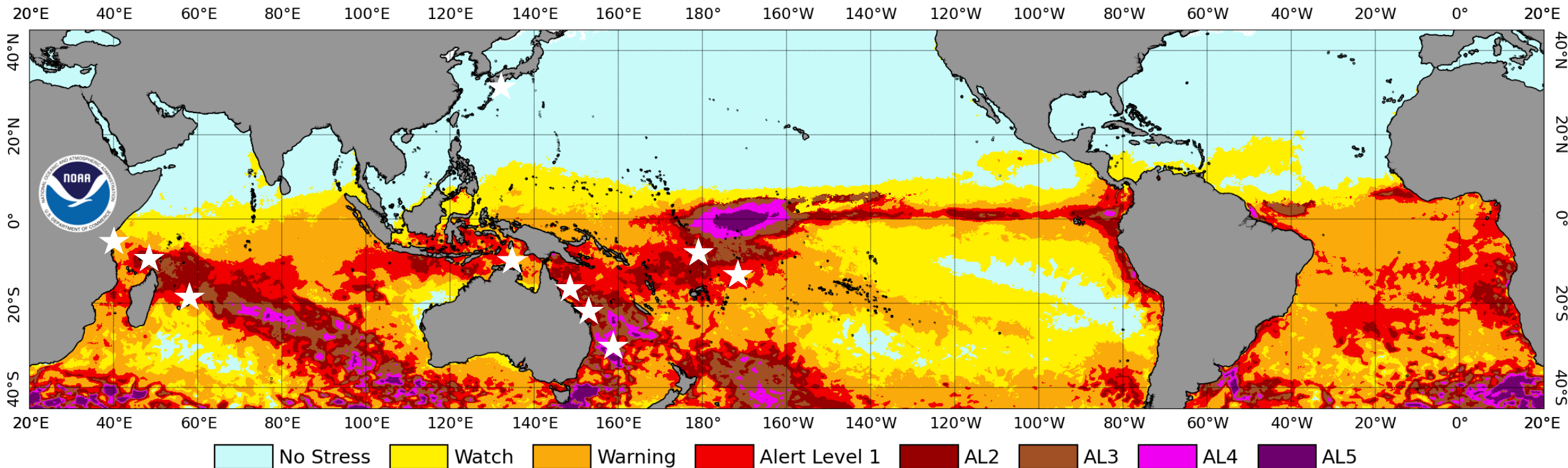


Near-global mass bleaching event in 2023-2024
At least 42 countries/territories in 5 different oceans/seas

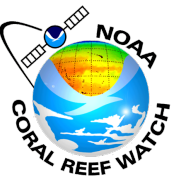


Current Heat Stress Patterns and Active Bleaching

NOAA Coral Reef Watch 5km Bleaching Alert Area Year-to-date Maximum (v3.1) 5 Mar 2024



S. Hemisphere Locations Experiencing Record Heat Stress



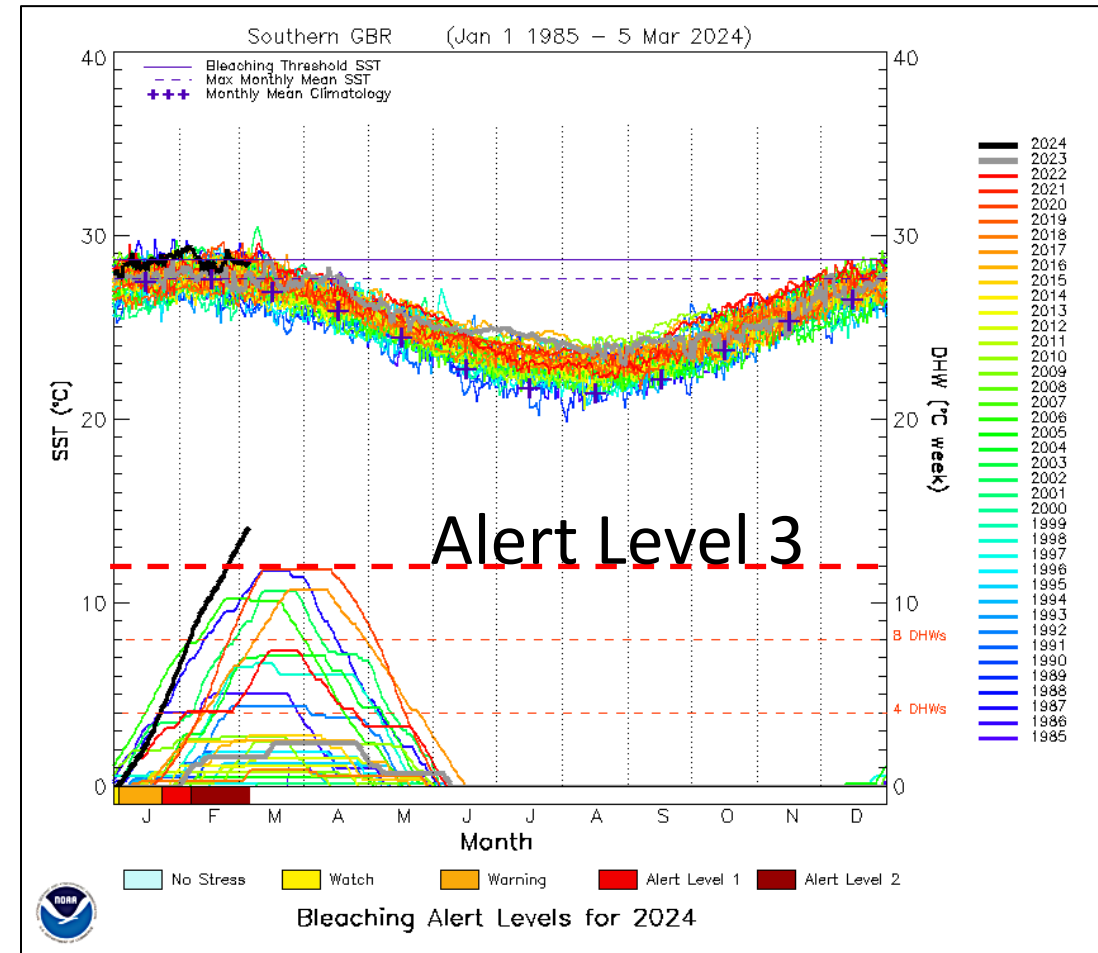
- Pacific Ocean

- Southern Great Barrier Reef
- Central Great Barrier Reef
- Moreton Bay, Australia
- Chesterfield Islands
- Tuvalu
- N. Cook Islands
- Howland and Baker



- Indian Ocean

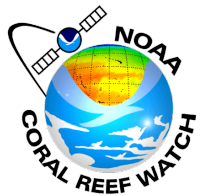
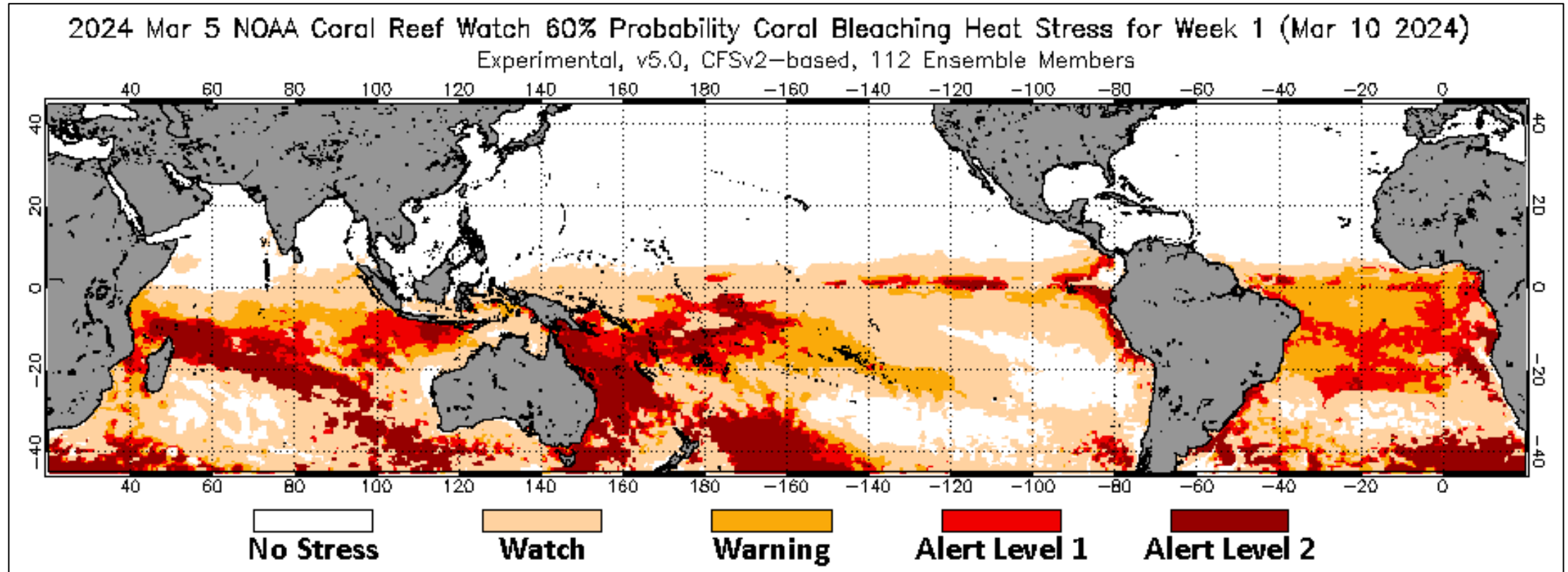
- Seychelles
- N. Mozambique
- NW, W, NE Madagascar



Alert Level 3 reached on 25 Feb 2024



Four-Month Coral Bleaching Outlook (Updated weekly)



[NOAA Coral Reef Watch](#)

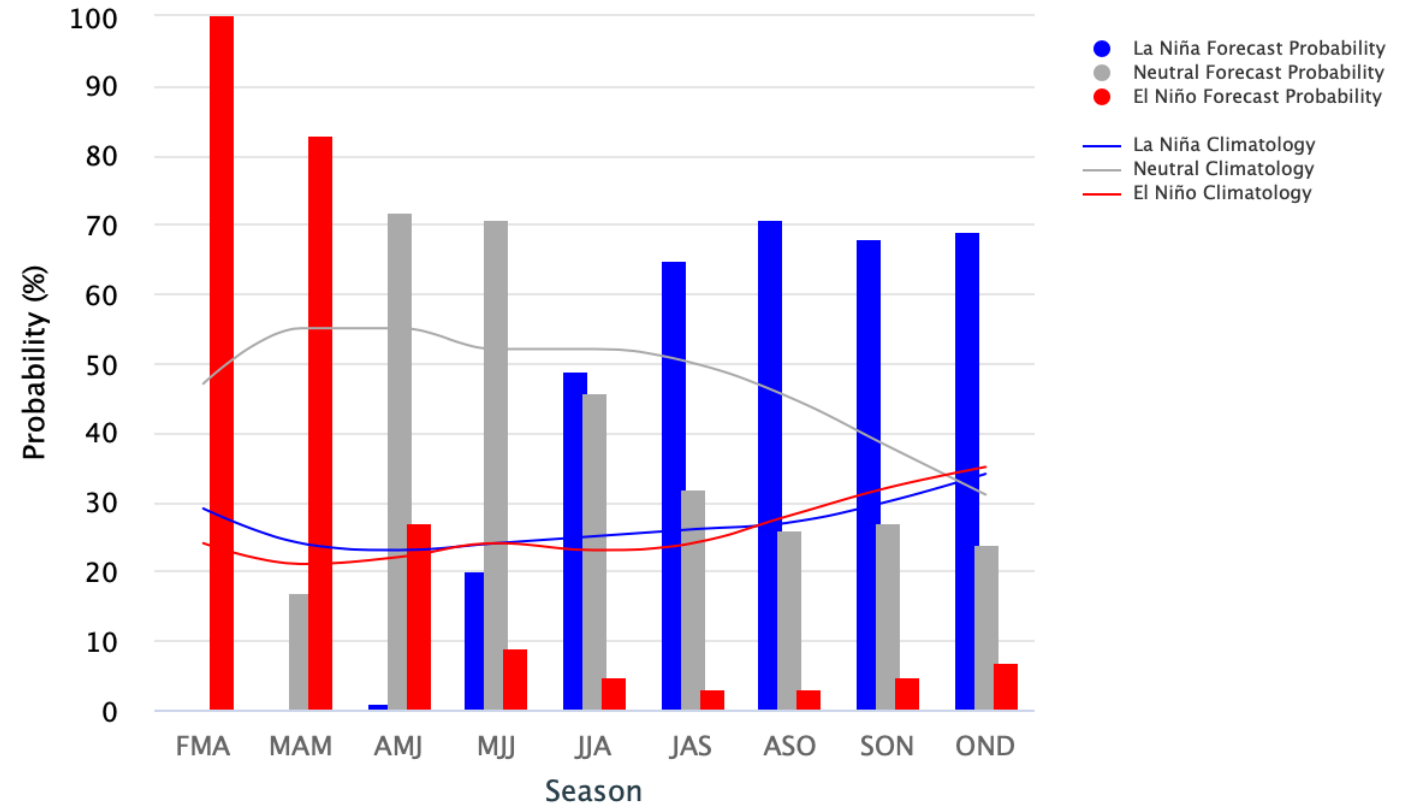


El Niño Forecast

“A transition from El Niño to ENSO-neutral is likely by April-June 2024 (79% chance), with increasing odds of La Niña developing in June-August (55% chance).”

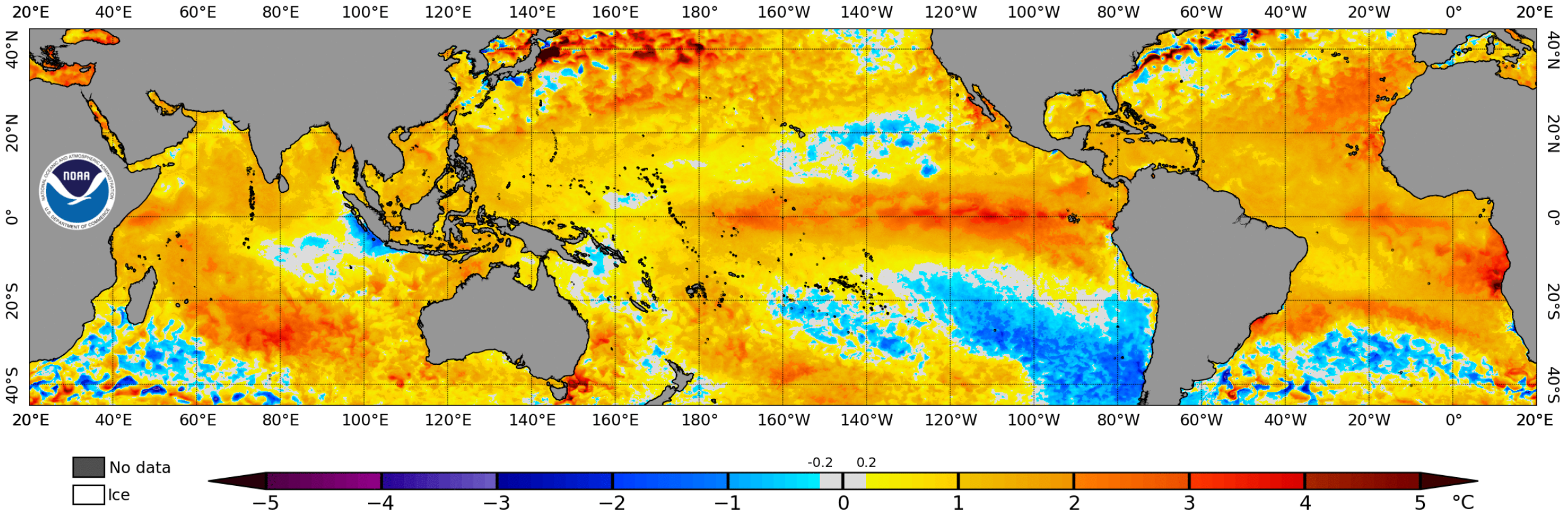
Mid-February 2024 IRI Model-Based Probabilistic ENSO Forecasts

ENSO state based on NINO3.4 SST Anomaly Neutral ENSO: $-0.5\text{ }^{\circ}\text{C}$ to $0.5\text{ }^{\circ}\text{C}$



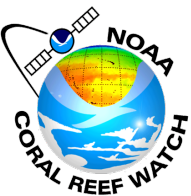
...But, the ocean is still running a serious fever...

NOAA Coral Reef Watch Daily 5km SST Anomalies (v3.1) 7 Dec 2023



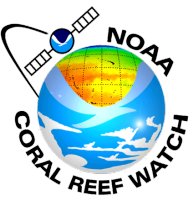
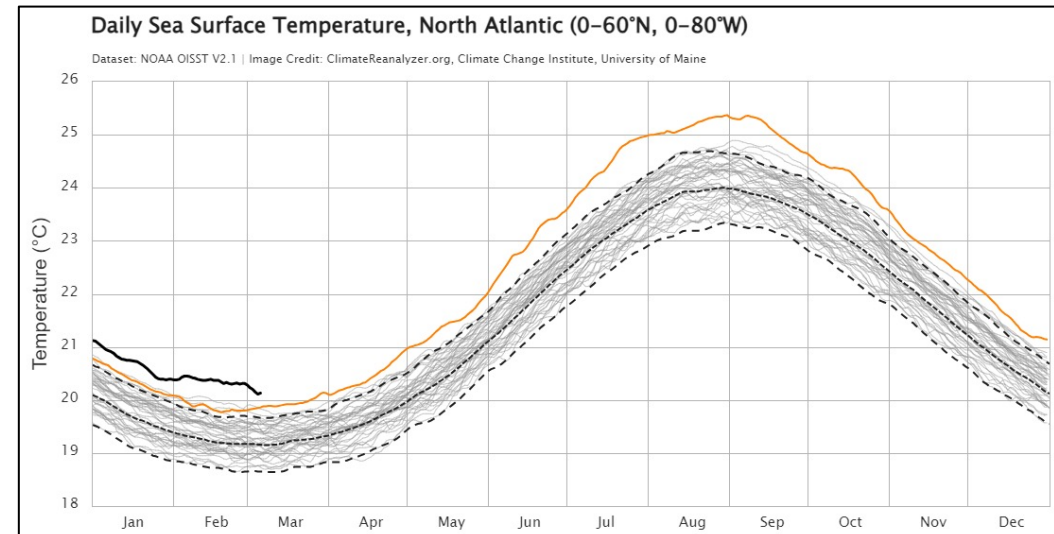
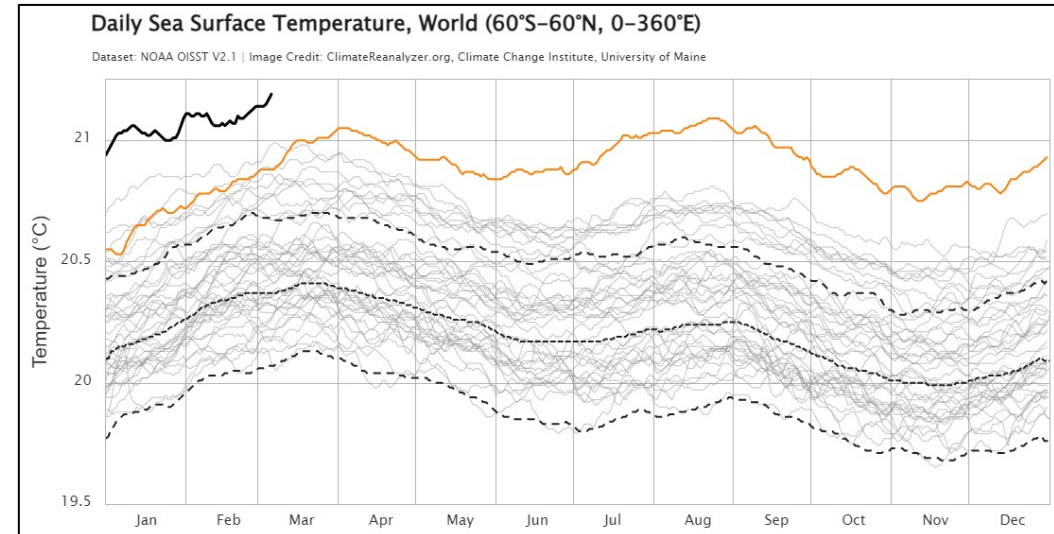
Summary and Conclusions

- Record-setting heat stress for NW Atlantic and eastern Pacific in 2023
 - Impact of these events still being analyzed
- Multiple locations in Southern Hemisphere currently experiencing record heat stress
 - **But luckily NOT ALL!!**
- Monitoring data needed during bleaching and 1-2 years after heat stress subsides!
 - Allows identification of resilient reefs, species, and genotypes
 - Provides blueprint for how to save corals during the next, inevitable coral bleaching event
- To save bleaching survivors, important to understand the timing of subsequent disease and corallivore outbreaks
 - Many corals can survive bleaching, but later die from disease or predation
 - Preventing a local extinction could be as simple as picking snails off recovering corals!!

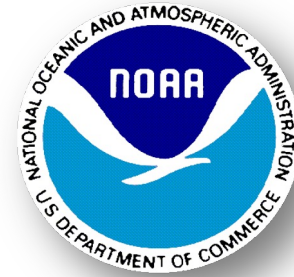
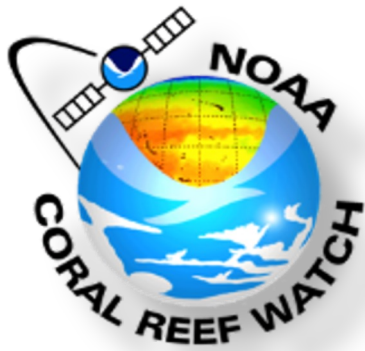


Summary and Conclusions II

- Outlook
 - Most S. Hemisphere reefs will experience bleaching-level heat stress
 - Entirety of Indian Ocean should be on high alert!
- Dissipating El Nino is good news...
 - ...but ocean still running a serious fever, so we must prepare for possibility of 2nd year of widespread bleaching in Northern Hemisphere
- May be on cusp of 4th global bleaching event



Thank you from the NOAA Coral Reef Watch Team!!



Derek Manzello (NOAA/NESDIS)
Federal Coordinator



Gang Liu (NOAA/NESDIS)



Jacquie De La Cour
(UMD-CISESS)



Erick Geiger (UMD-CISESS)



William Skirving (ReefSense)



Blake Spady (ReefSense)



Andrew Norrie (ReefSense)



<https://coralreefwatch.noaa.gov>
coralreefwatch@noaa.gov



Coral Reef Watch



@CoralReefWatch

Coral Reef Watch: A NOAA/NESDIS program, funded predominantly by the NOAA/NOS Coral Reef Conservation Program (CRCP), through a cooperative agreement with the University of Maryland.

