

Hawaii

Climate Indicators Summary

March 2021

PMNM Climate Change Working Group

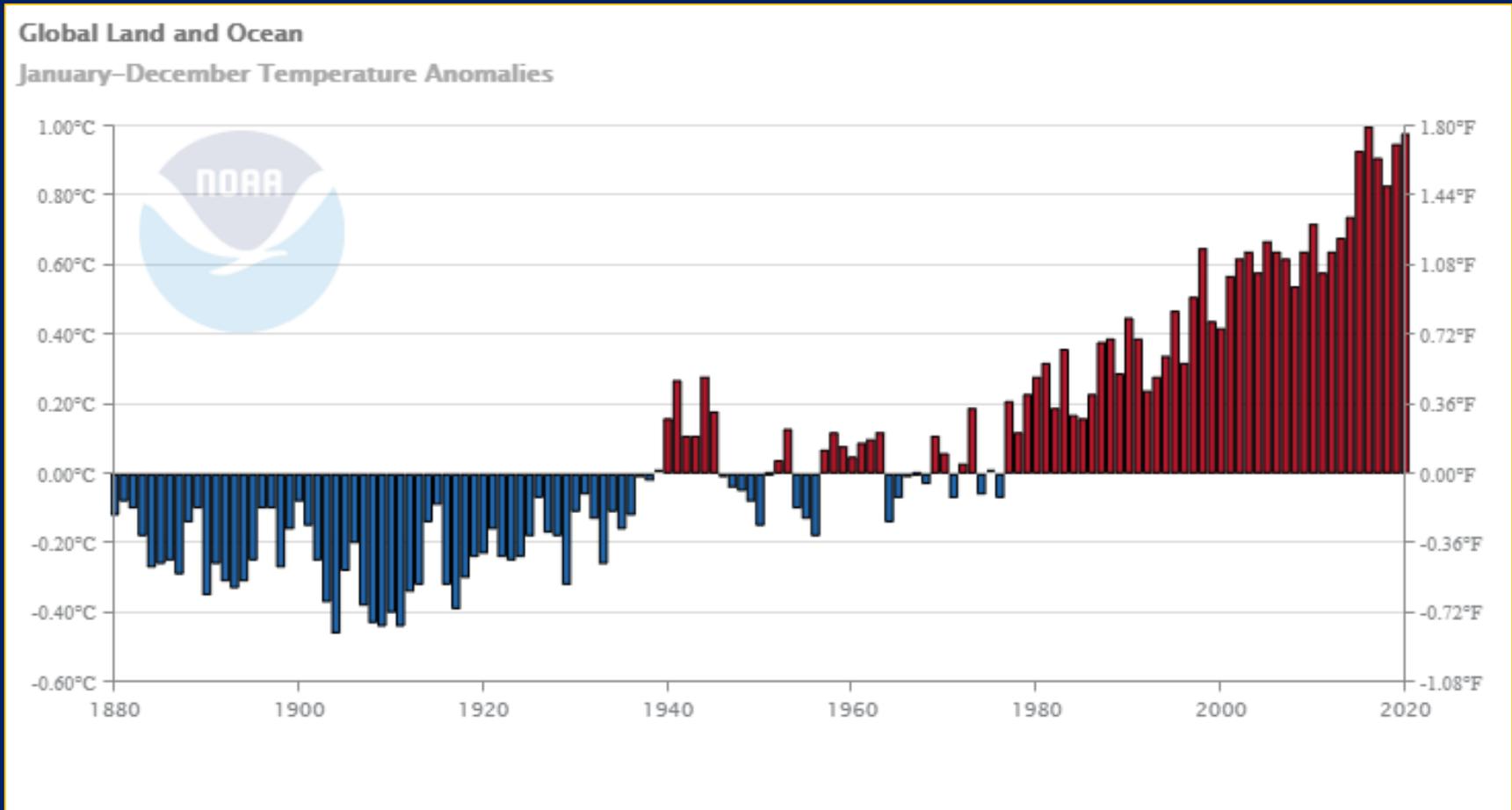
Dan A. Polhemus

U. S. Fish & Wildlife Service

Honolulu, HI

2020 basically tied 2016 as the hottest year on record

Finishes off the hottest decade ever observed since records began in the late 19th Century

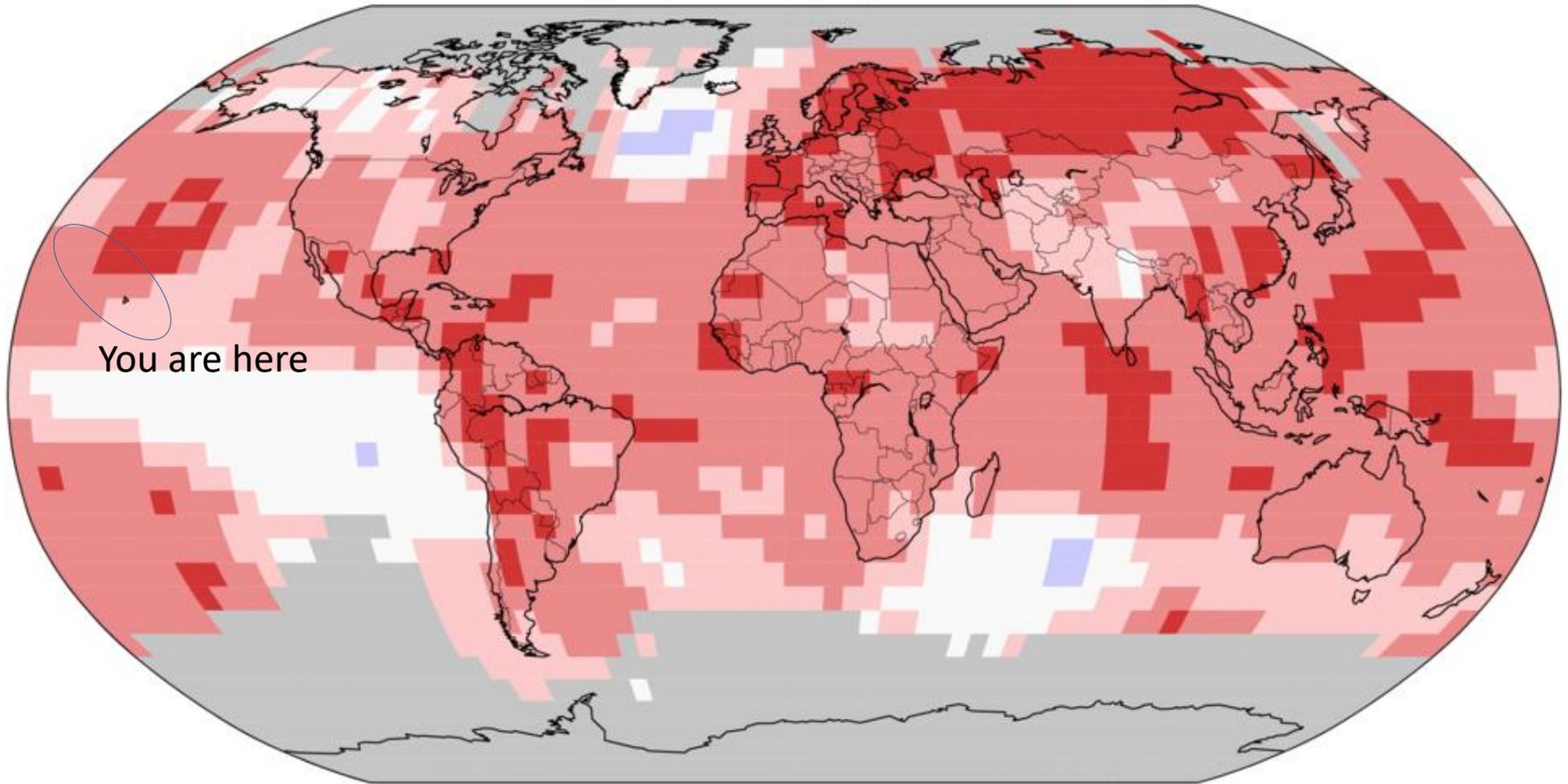


This very hot year was not correlated with an El Niño, unlike previous such years
This is not a good sign...

Land & Ocean Temperature Percentiles Jan–Dec 2020

NOAA's National Centers for Environmental Information

Data Source: NOAA GlobalTemp v5.0.0–20210106



You are here



**Record
Coldest**



**Much
Cooler than
Average**



**Cooler than
Average**



**Near
Average**



**Warmer than
Average**



**Much
Warmer than
Average**

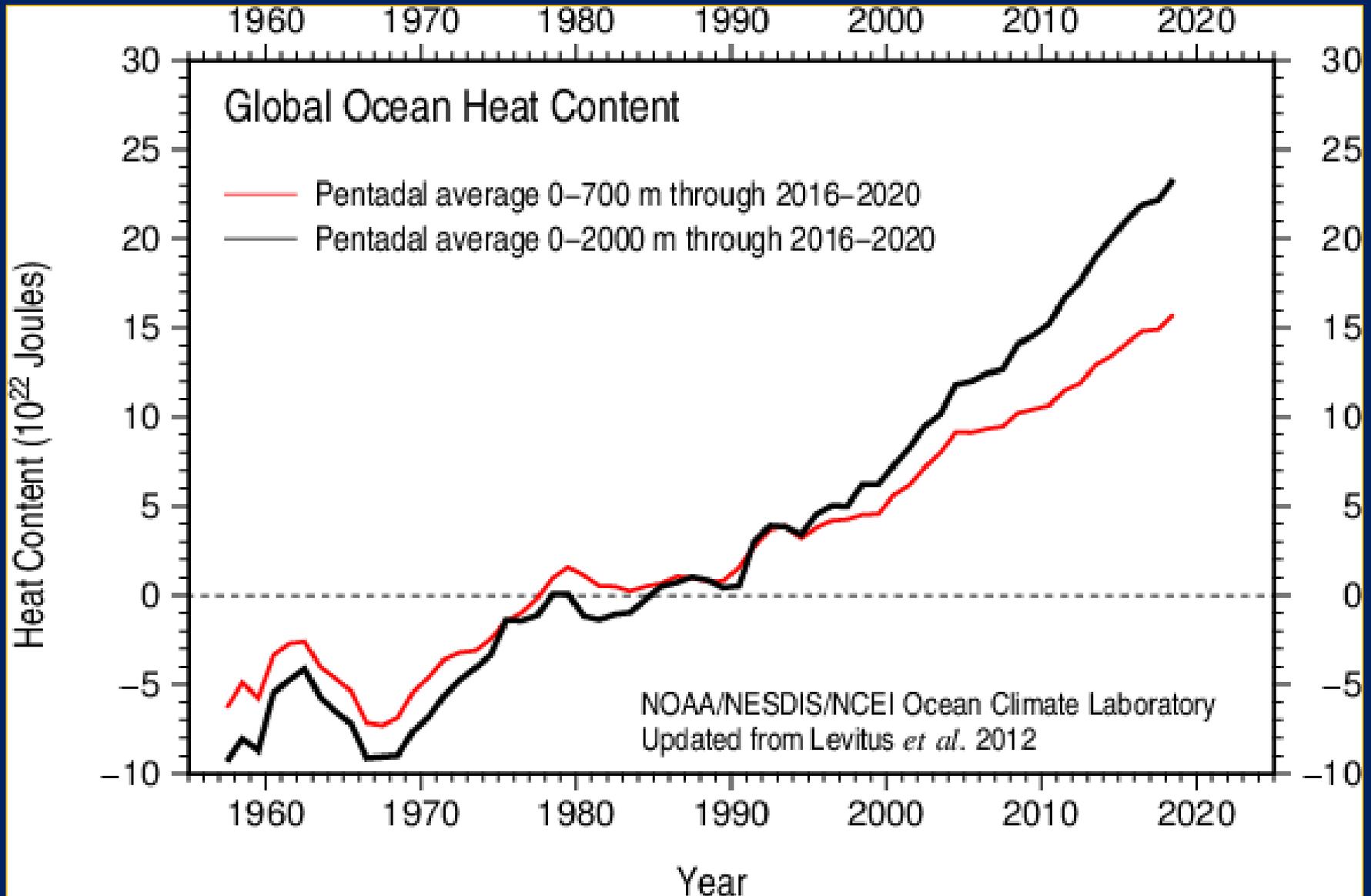


**Record
Warmest**



Ocean heat content also continued a sharp rise

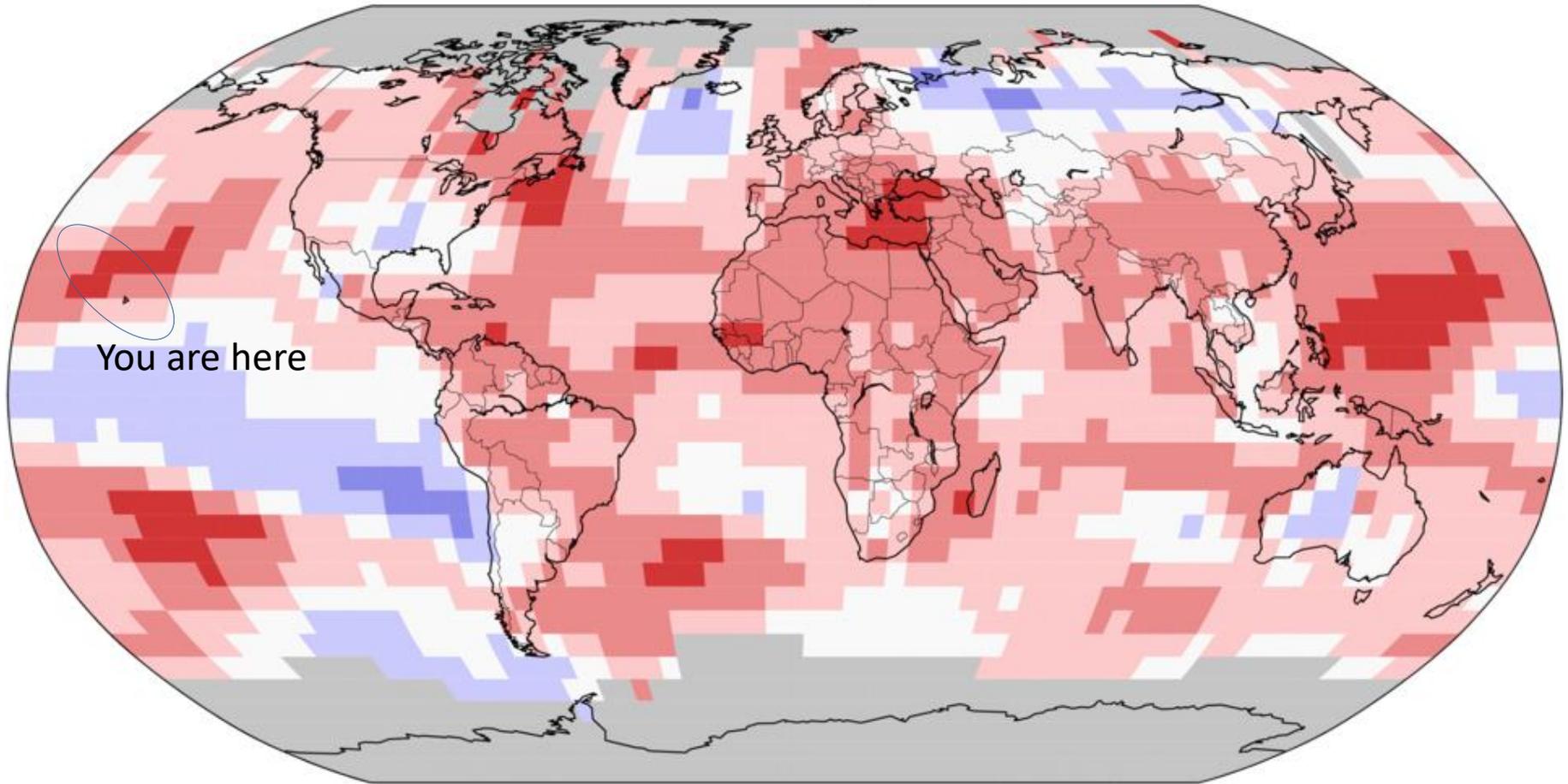
This trend is seen across multiple depth ranges



Land & Ocean Temperature Percentiles Dec 2020–Feb 2021

NOAA's National Centers for Environmental Information

Data Source: NOAA GlobalTemp v5.0.0–20210308




Record Coldest


Much Cooler than Average


Cooler than Average


Near Average


Warmer than Average

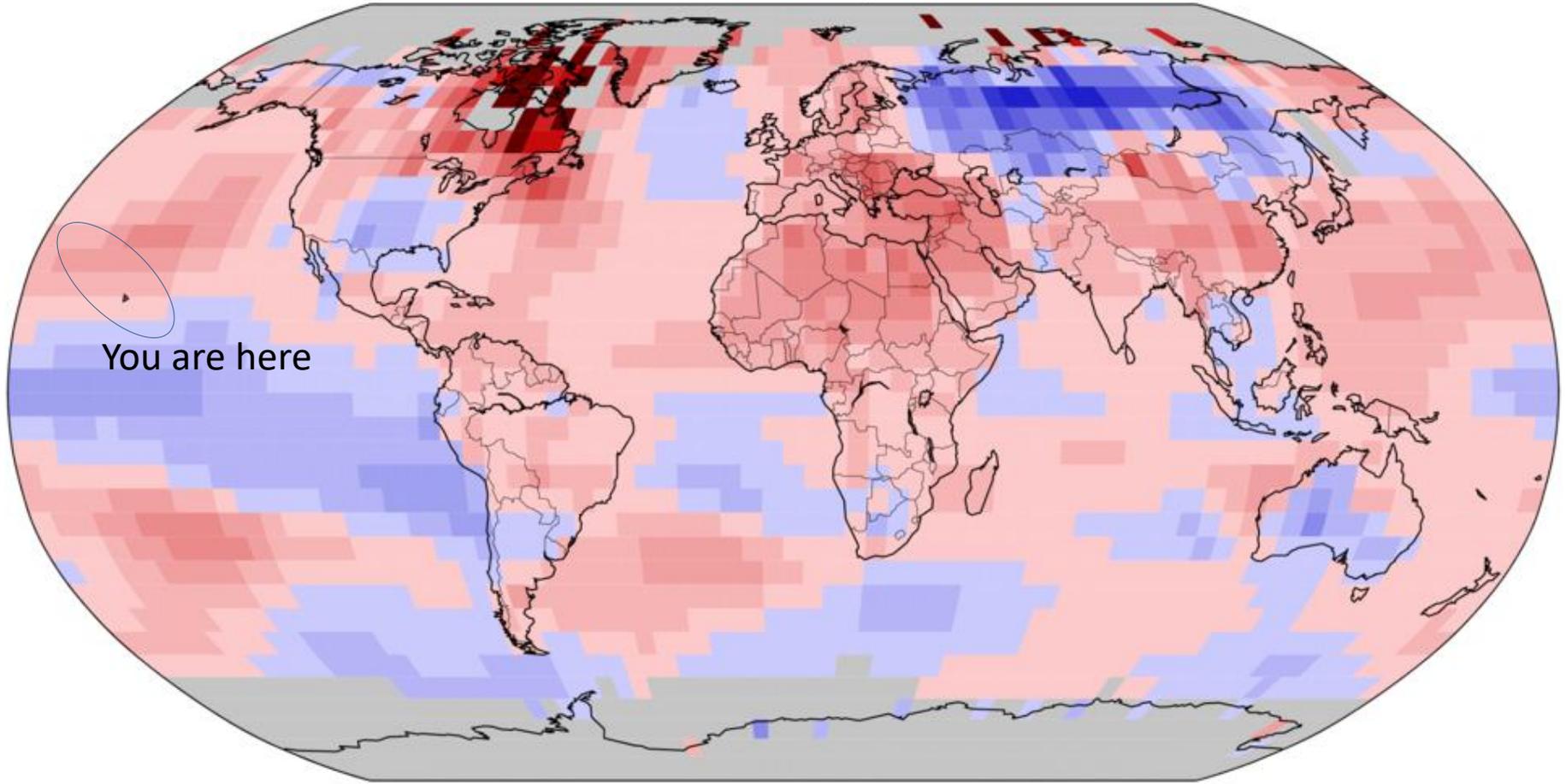

Much Warmer than Average


Record Warmest



Land & Ocean Temperature Departure from Average Dec 2020–Feb 2021 (with respect to a 1981–2010 base period)

Data Source: NOAA GlobalTemp v5.0.0–20210308



Degrees Celsius



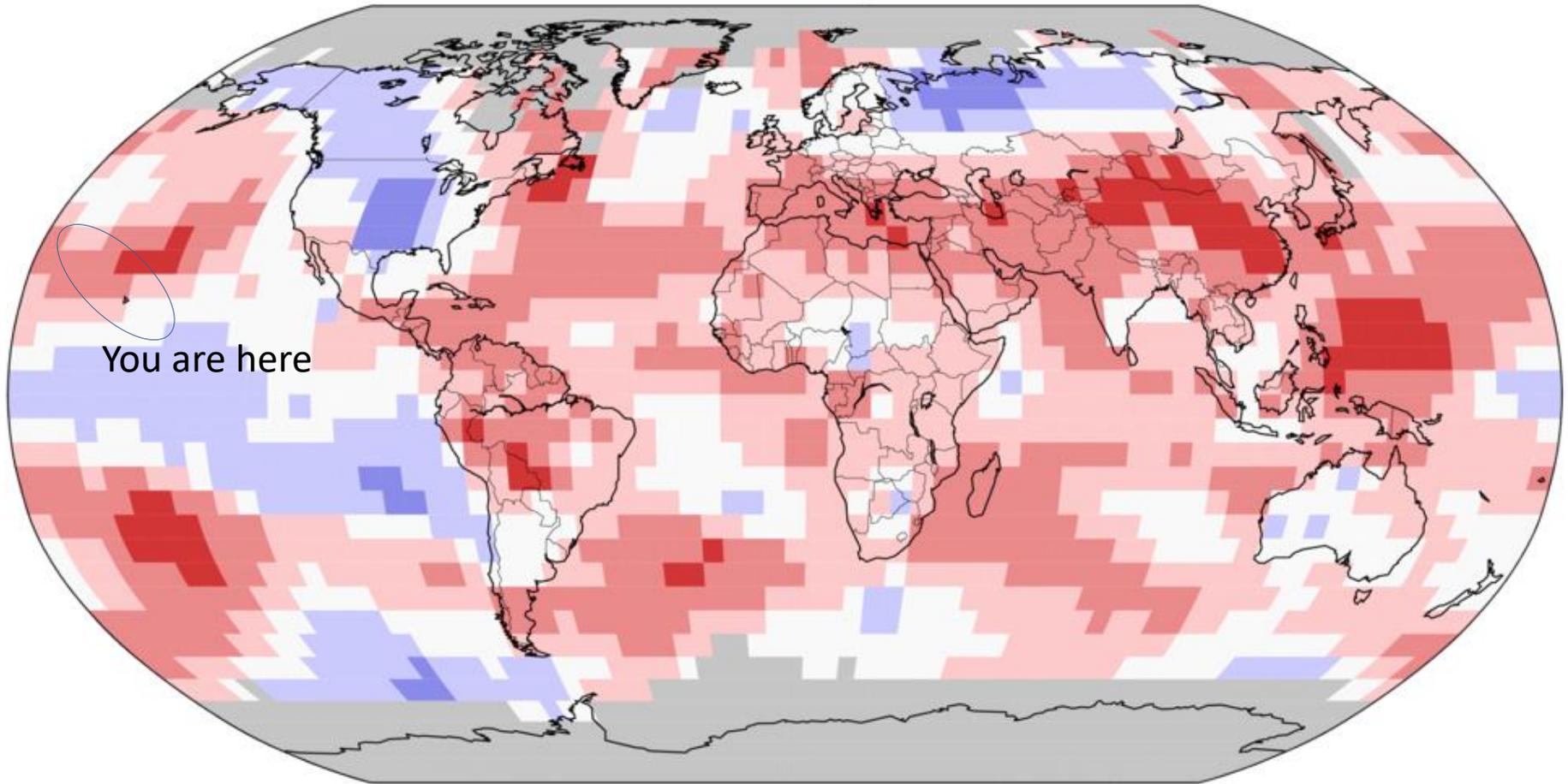
National Centers for Environmental Information
GHCNM v4.0.1.20210307.qfe

Please Note: Gray areas represent missing data
Map Projection: Robinson

Land & Ocean Temperature Percentiles Feb 2021

NOAA's National Centers for Environmental Information

Data Source: NOAA GlobalTemp v5.0.0-20210308




Record Coldest


Much Cooler than Average


Cooler than Average


Near Average


Warmer than Average

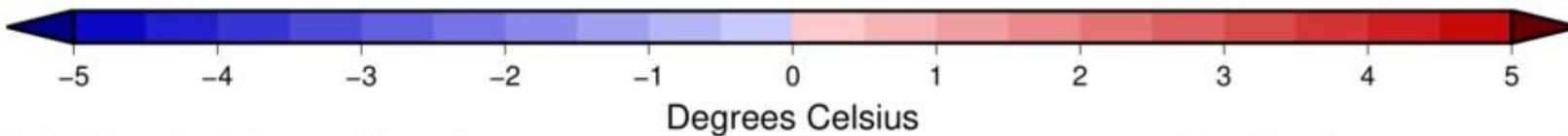
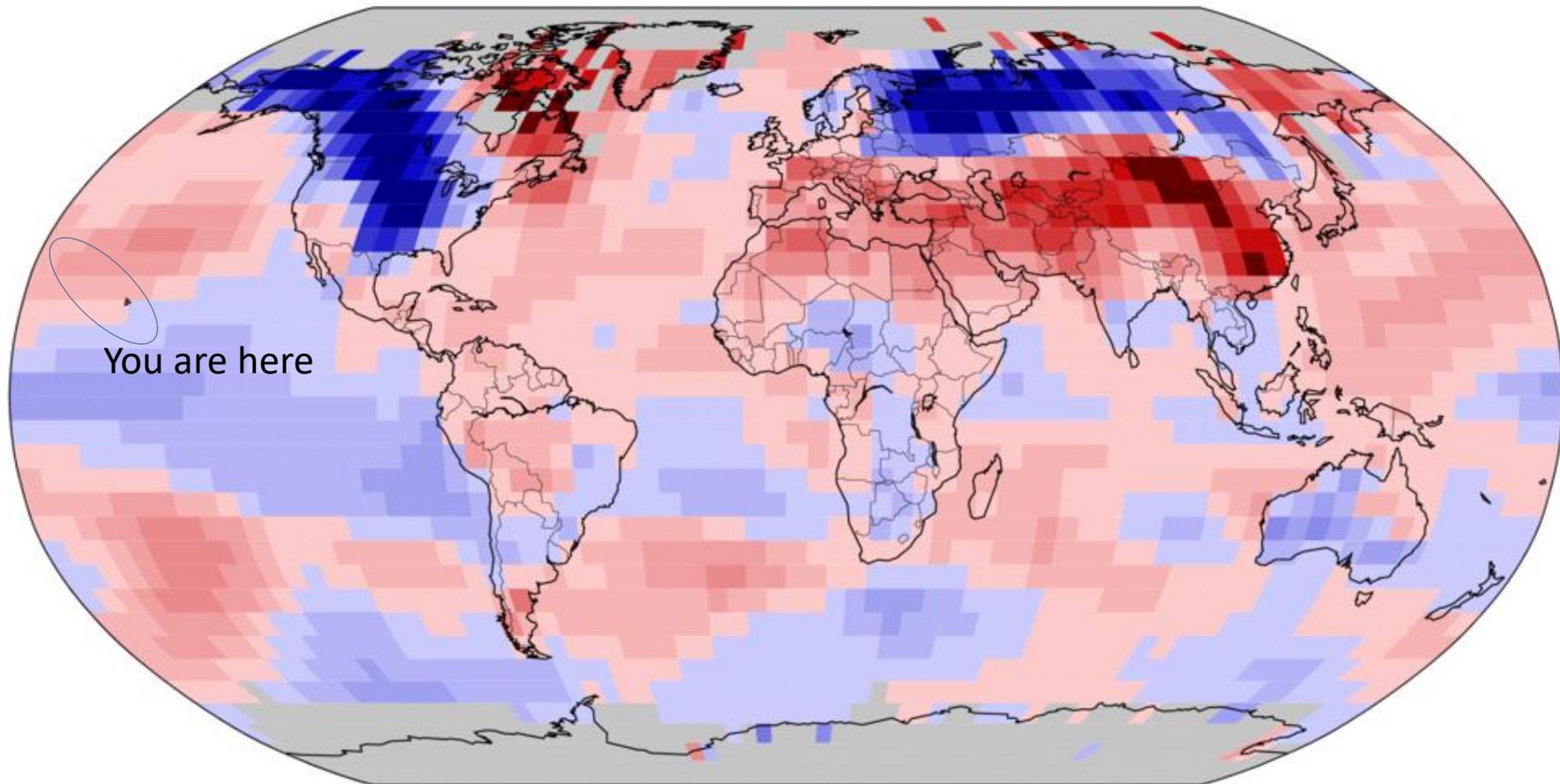

Much Warmer than Average


Record Warmest



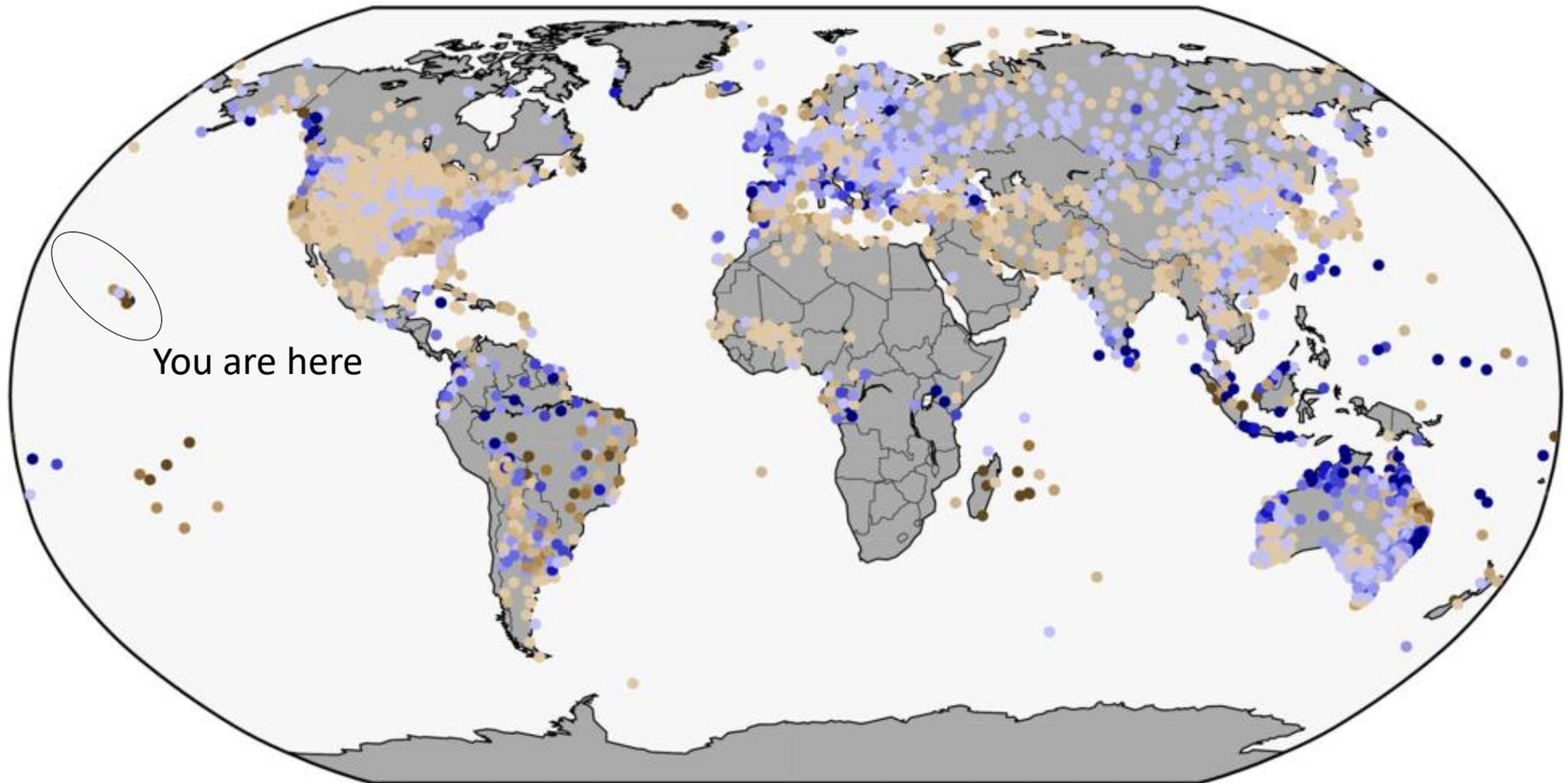
Land & Ocean Temperature Departure from Average Feb 2021 (with respect to a 1981–2010 base period)

Data Source: NOAA GlobalTemp v5.0.0–20210308

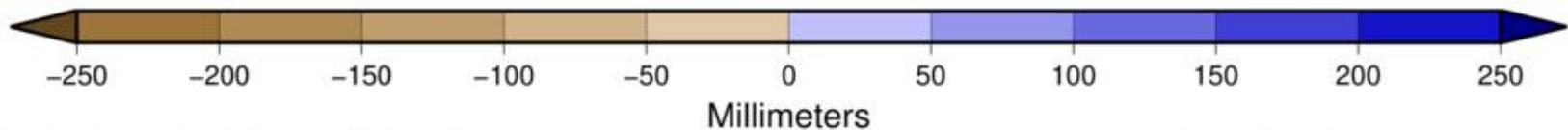


Land-Only Precipitation Anomalies Dec 2020–Feb 2021 (with respect to a 1961–1990 base period)

Data Source: GHCN-M version 4beta



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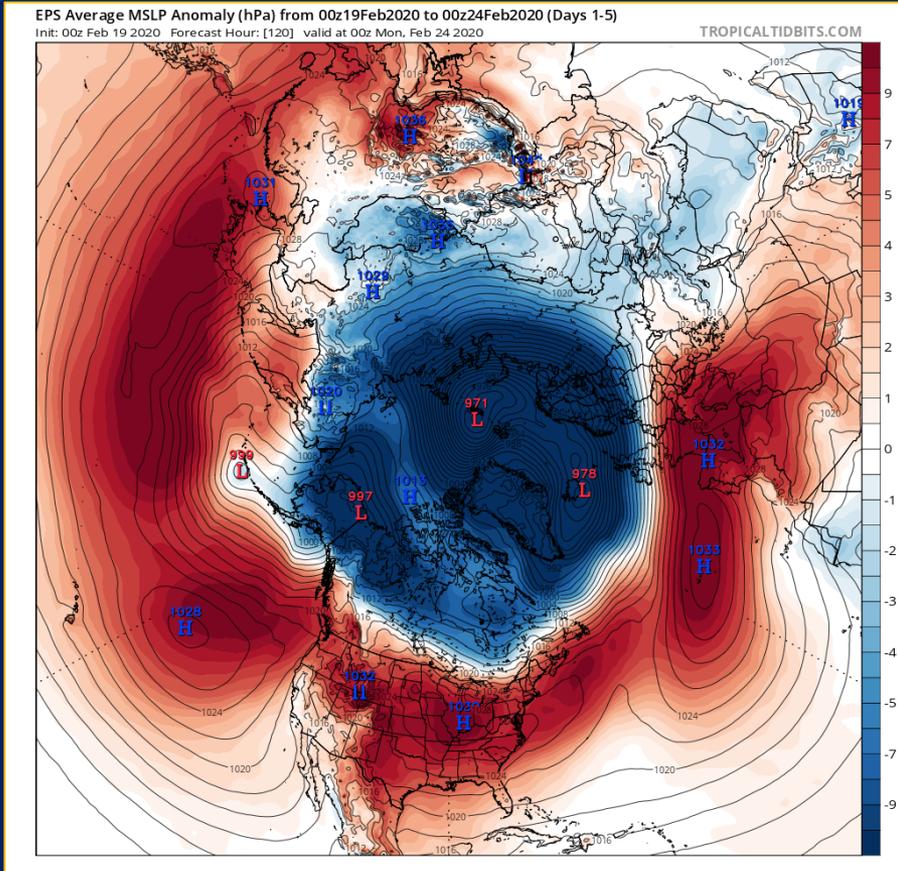


National Centers for Environmental Information

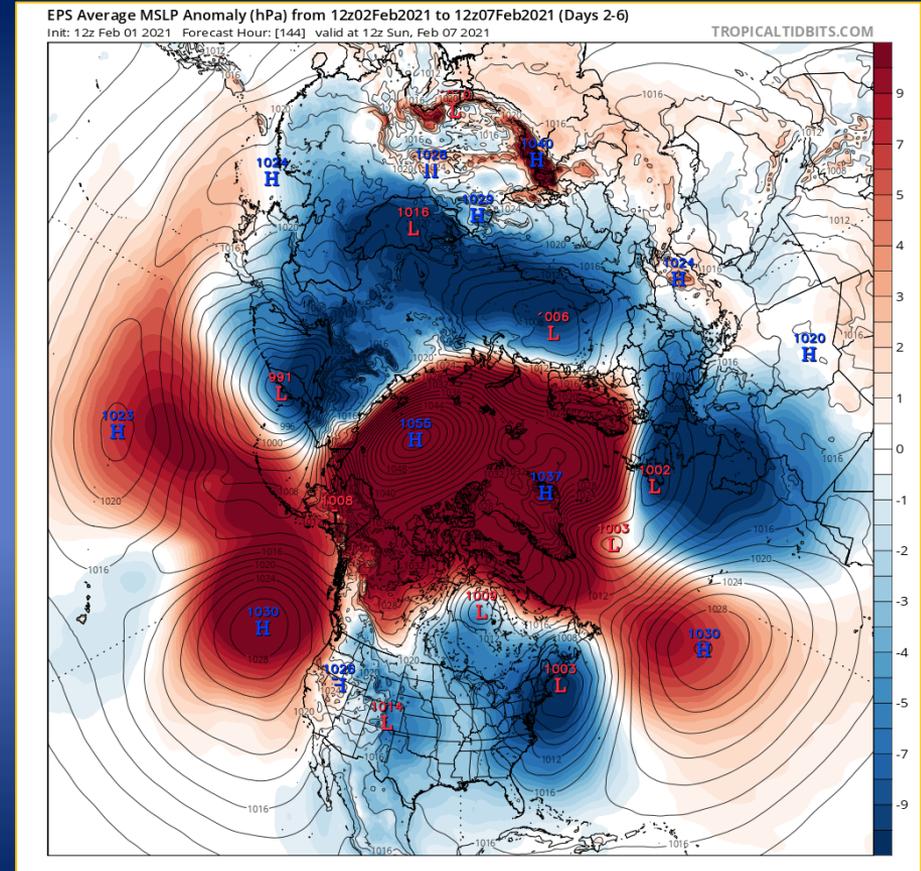
Please Note: Gray areas represent missing data
Map Projection: Robinson

Digression #1

The Polar Vortex flips, with record warmth in the Arctic...



2020 – The cold air stays bottled up around the North Pole



2021 – Warmer air sits over the pole, and the continents become frigid

A classic case of the warm poles-cold continents phenomenon

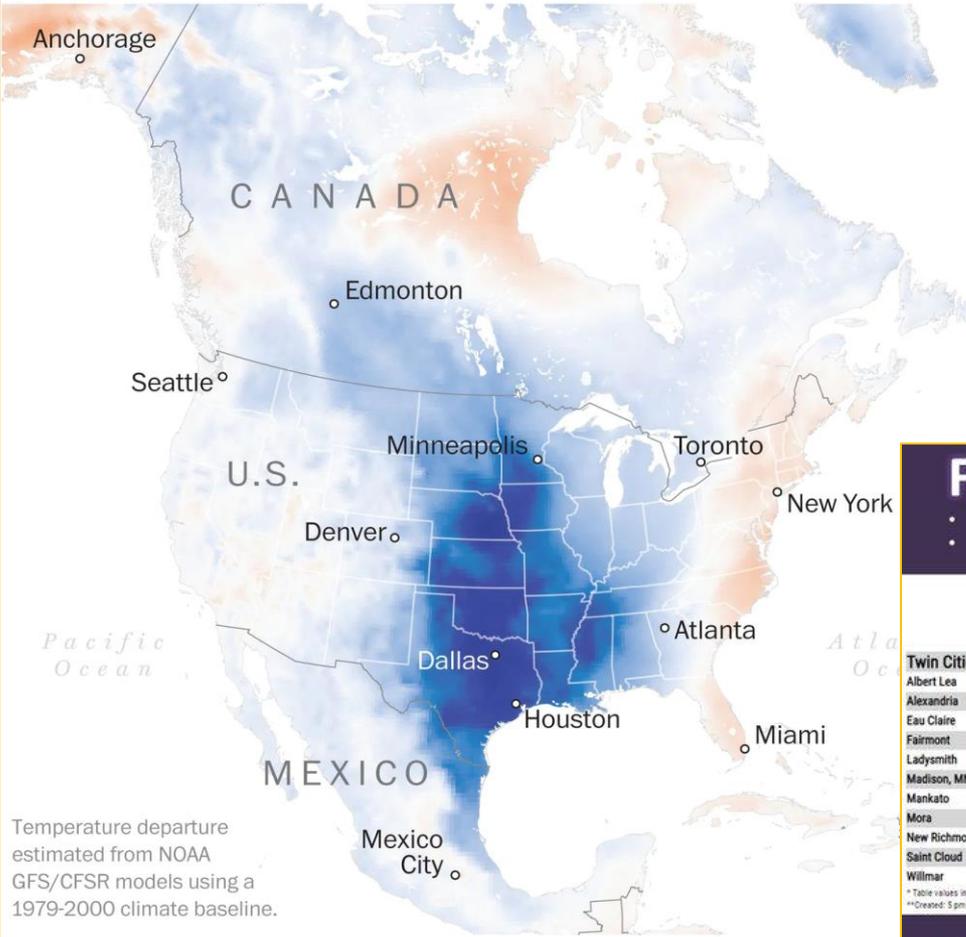
Digression #1

...leading to record cold in Texas and the central US

Temperature anomaly
Feb. 16

Colder than average ← → **Warmer than average**

-50° F / -28° C Average +50° F / +28° C



Woodlands, Texas on 15 February 2021

FRIGID WEEK AHEAD

National Weather Service – Twin Cities
Updated: 5:18 PM February 9, 2021

- Wind chills colder than the teens and 20s below zero are expected all the way through this weekend.
- The coldest air is set to arrive this weekend with wind chills possibly in the -40s.

Wind Chill Forecast

	2/9 Tue		2/10 Wed		2/11 Thu		2/12 Fri		2/13 Sat		2/14 Sun		2/15 Mon		2/16 Tue		Minimum													
	6pm	12am	6am	12pm	6pm	12am	6am	12pm	6pm	12am	6am	12pm	6pm	12am	6am	12pm	6pm													
Twin Cities	-19	-20	-17	-11	-23	-25	-23	-13	-19	-25	-26	-22	-27	-29	-19	-26	-32	-34	-24	-25	-27	-27	-13	-11	-15	-15	-3	0	-34	
Albert Lea	-16	-17	-9	-6	-19	-23	-23	-15	-20	-28	-30	-22	-24	-28	-31	-25	-34	-41	-42	-32	-32	-37	-38	-20	-19	-20	-21	-9	-3	-42
Alexandria	-27	-33	-33	-25	-30	-32	-30	-21	-30	-35	-36	-29	-31	-35	-38	-30	-39	-46	-47	-32	-32	-39	-39	-21	-21	-24	-25	-12	-8	-42
Eau Claire	-17	-17	-17	-12	-18	-13	-22	-8	-14	-20	-23	-16	-21	-27	-29	-18	-25	-30	-31	-21	-27	-31	-31	-12	-10	-12	-15	-1	6	-31
Fairmont	-21	-21	-19	-8	-24	-27	-29	-21	-26	-32	-35	-27	-26	-34	-36	-27	-38	-47	-48	-33	-34	-39	-41	-22	-21	-24	-25	-10	-6	-48
Ladysmith	-18	-20	-20	-12	-24	-27	-17	-9	-14	-20	-23	-15	-22	-29	-31	-17	-23	-29	-30	-16	-26	-30	-32	-8	-10	-11	-15	0	6	-32
Madison, MN	-19	-20	-22	-12	-21	-24	-25	-18	-24	-29	-30	-21	-25	-31	-34	-26	-32	-41	-42	-26	-26	-32	-33	-16	-16	-20	-21	-6	-2	-42
Mankato	-16	-17	-12	-8	-20	-24	-23	-13	-20	-27	-30	-21	-23	-30	-32	-23	-35	-42	-43	-30	-30	-36	-37	-18	-18	-20	-23	-8	-2	-43
Mora	-22	-17	-24	-16	-26	-28	-18	-10	-19	-26	-26	-20	-23	-30	-33	-21	-27	-35	-36	-21	-25	-34	-35	-13	-14	-15	-17	-4	1	-36
New Richmond	-22	-23	-20	-13	-26	-26	-25	-15	-22	-27	-30	-21	-26	-32	-33	-21	-29	-35	-37	-24	-29	-36	-37	-15	-15	-17	-19	-6	-1	-37
Saint Cloud	-22	-24	-24	-16	-26	-27	-16	-12	-22	-29	-31	-21	-25	-32	-34	-23	-31	-39	-40	-26	-27	-33	-33	-17	-15	-19	-20	-7	-2	-40
Willmar	-20	-24	-23	-15	-27	-29	-26	-16	-25	-30	-31	-23	-27	-32	-35	-26	-35	-42	-44	-28	-31	-37	-38	-19	-19	-20	-23	-10	-5	-44

* Table values in °F
** Created: 9:30m CST Tue 2/9/2021

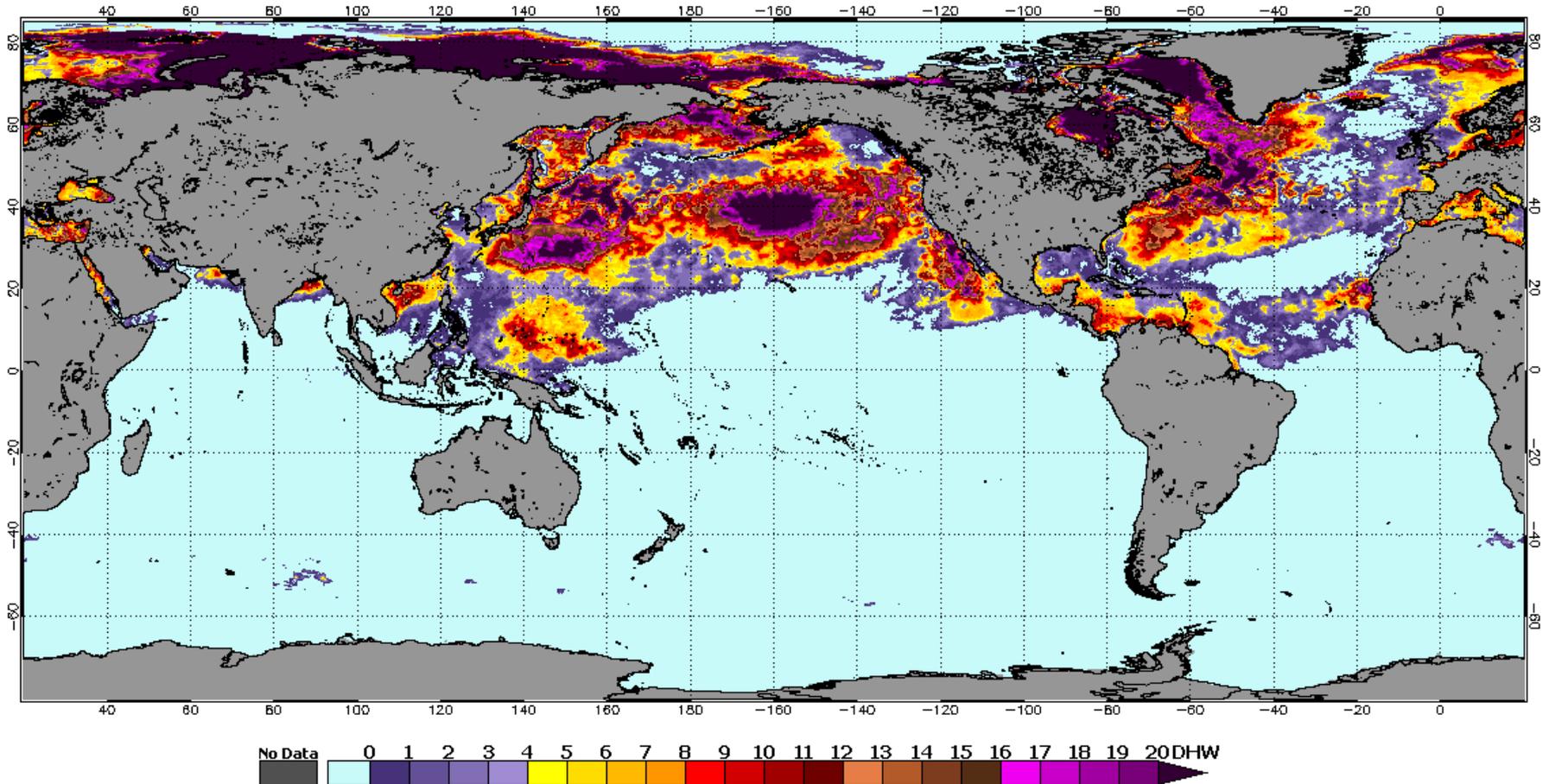
Take Action: Dress in layers. Wear a hat and gloves. Limit time outdoors. Bring outdoor pets inside.

Source: ClimateReanalyzer.org, University of Maine, Climate Change Institute
THE WASHINGTON POST

Back here in the Pacific

Degree Heating Weeks – 18 October 2020

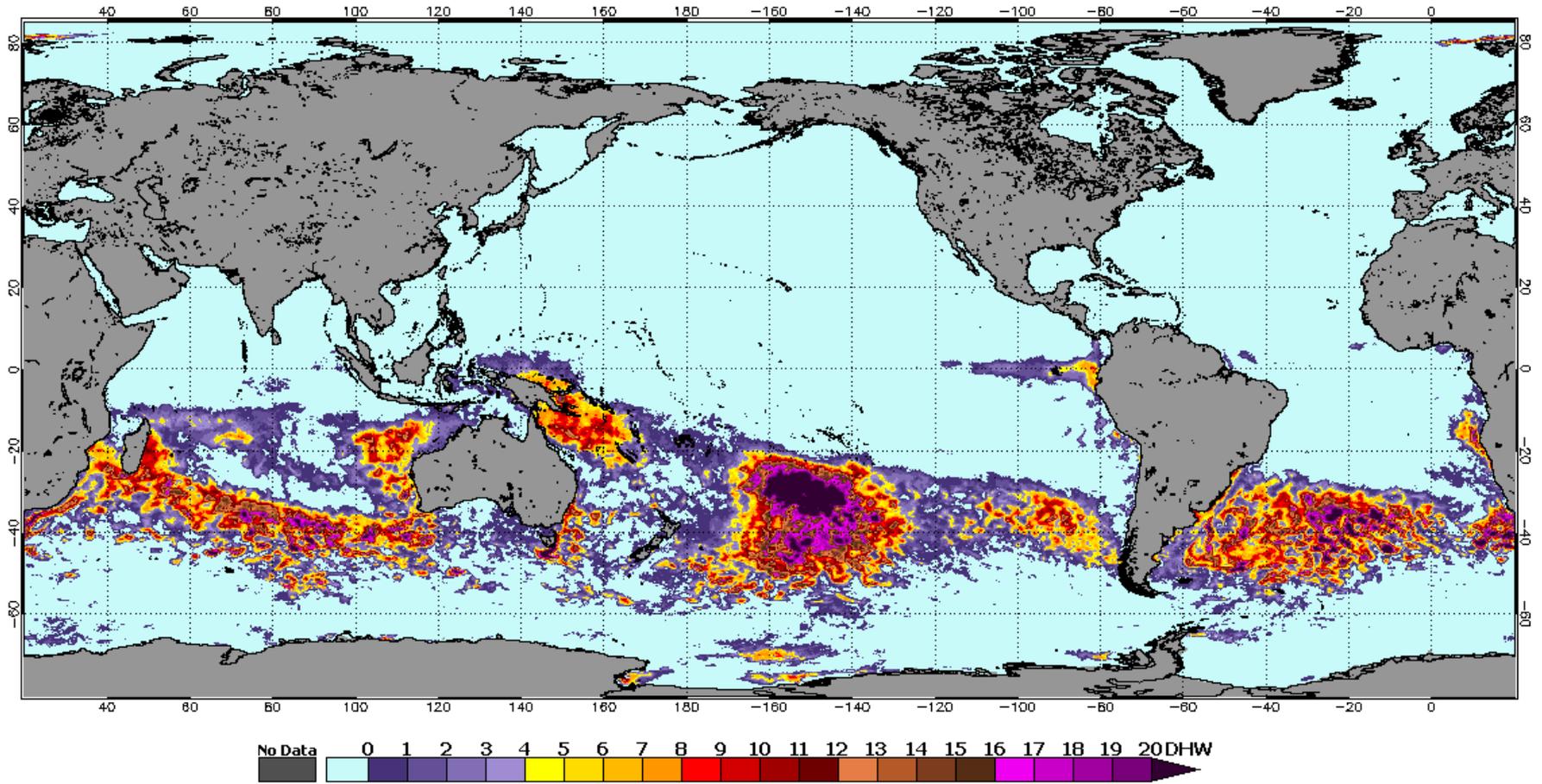
NOAA Coral Reef Watch Daily 5km Degree Heating Weeks (Version 3.1) 18 Oct 2020



A large amount of heat accumulated to the northeast of the Monument in 2020
But fortunately not *in* the Monument

Degree Heating Weeks – 21 March 2021

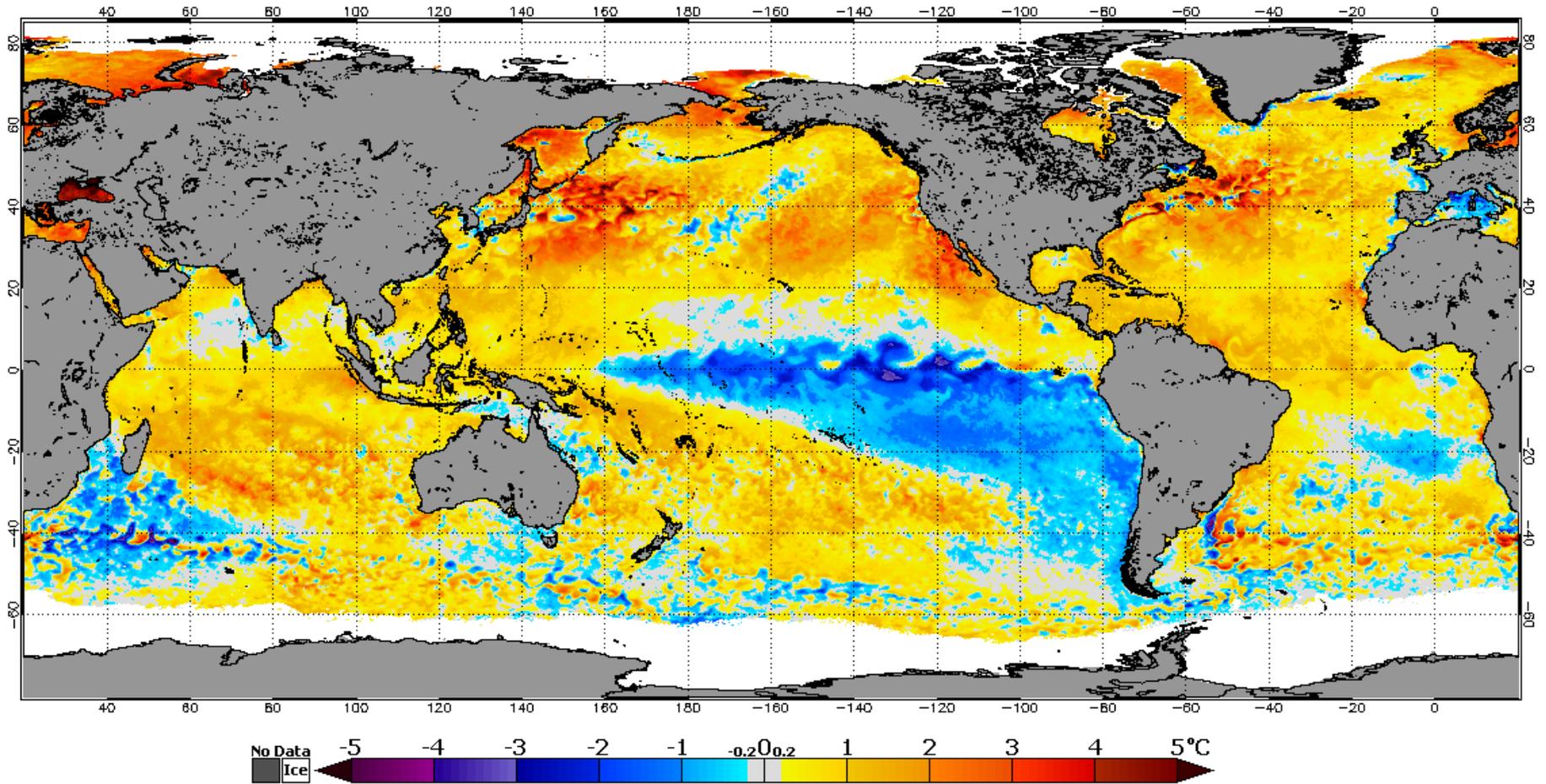
NOAA Coral Reef Watch Daily 5km Degree Heating Weeks (Version 3.1) 21 Mar 2021



Last year's heat is now gone, and the Northern Hemisphere still cool coming out of winter, while south of the equator, the Great Barrier Reef barely dodged a predicted bleaching event

Global Sea Surface Temperature Anomaly – 18 October 2020

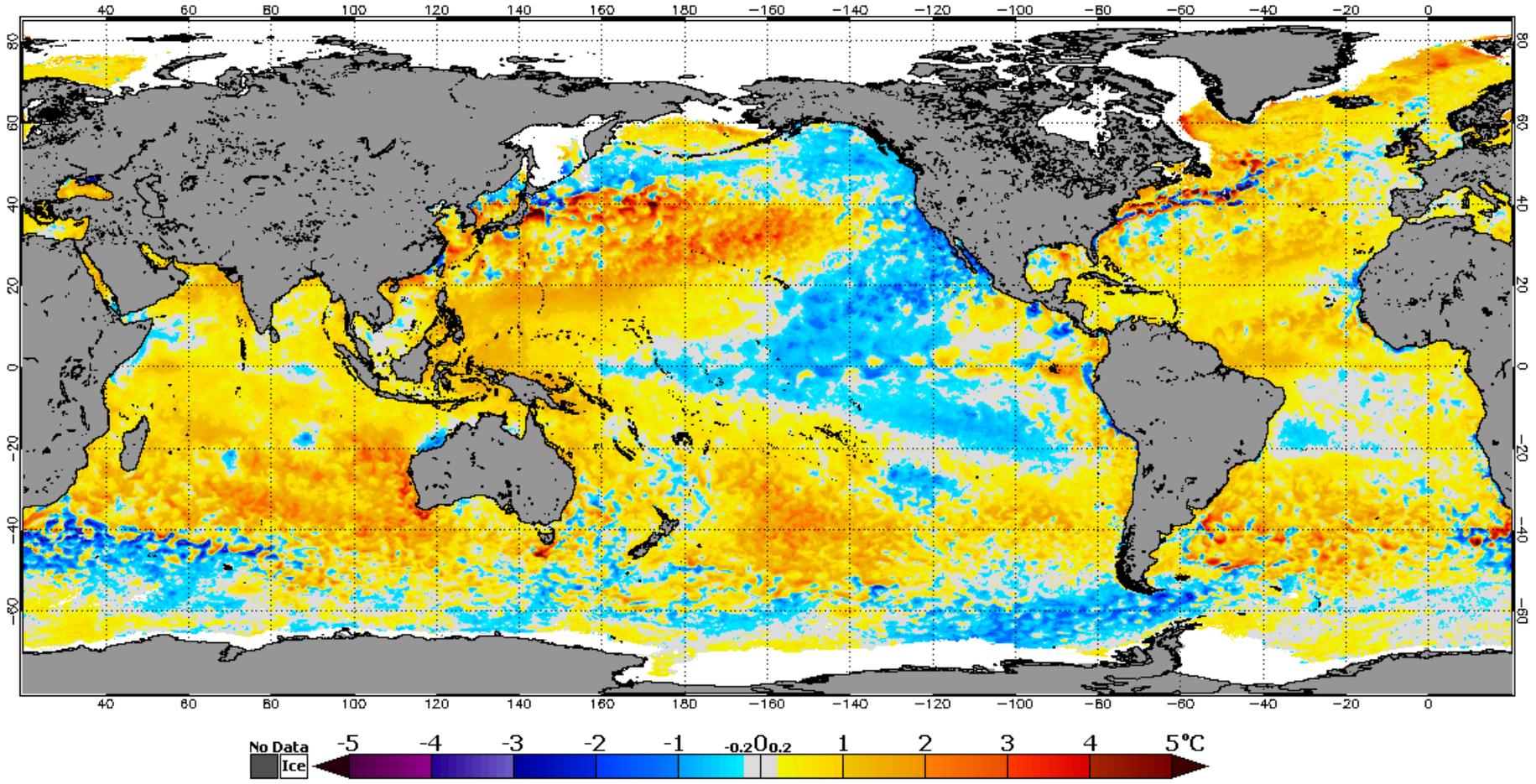
NOAA Coral Reef Watch Daily 5km SST Anomalies (Version 3.1) 18 Oct 2020



The area of higher ocean heat content northeast of Hawaii had shifted and abated slightly by October
Also note strong La Niña pattern off South America

Global Sea Surface Temperature Anomaly – 21 March 2021

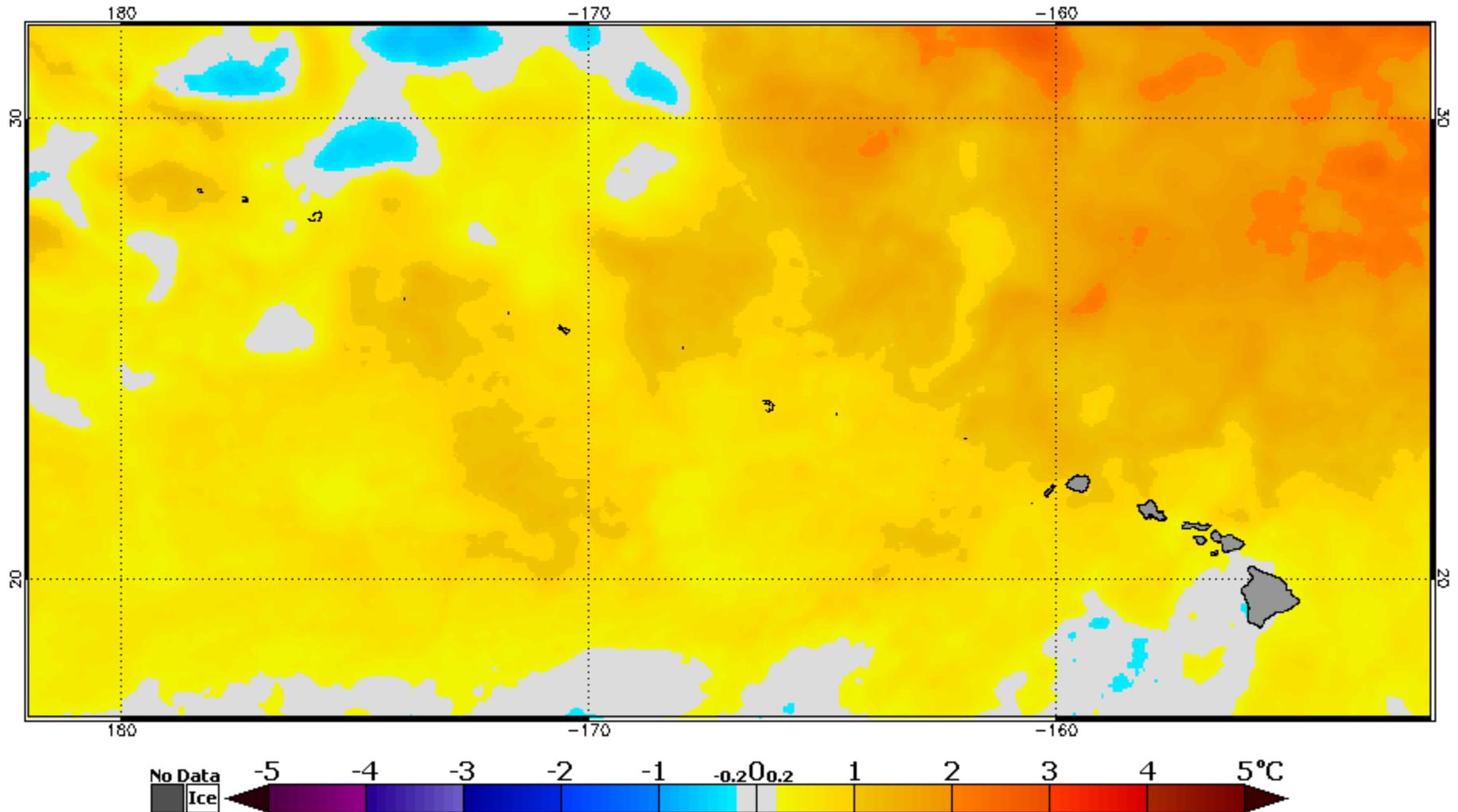
NOAA Coral Reef Watch Daily 5km SST Anomalies (Version 3.1) 21 Mar 2021



But a large pool of anomalously warm surface water is present in the northwest portion of the Monument, and compared to last fall, La Niña is waning

Sea Surface Temperature Anomaly, Hawaii Sector – 18 October 2020

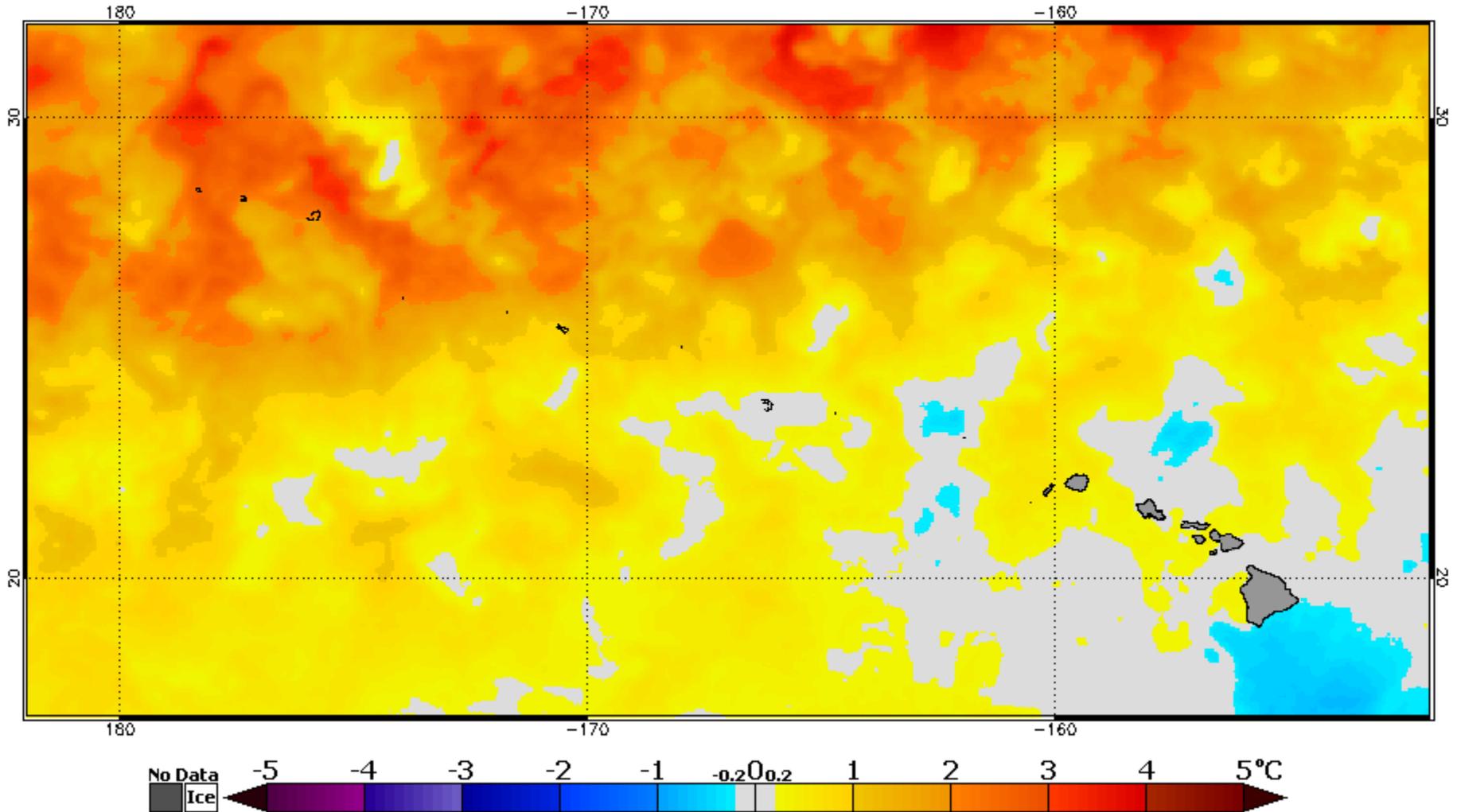
NOAA Coral Reef Watch Daily 5km SST Anomalies (Version 3.1) 18 Oct 2020



By fall 2020, the Midway sector was returning to more normal conditions

Sea Surface Temperature Anomaly, Hawaii Sector – 21 March 2021

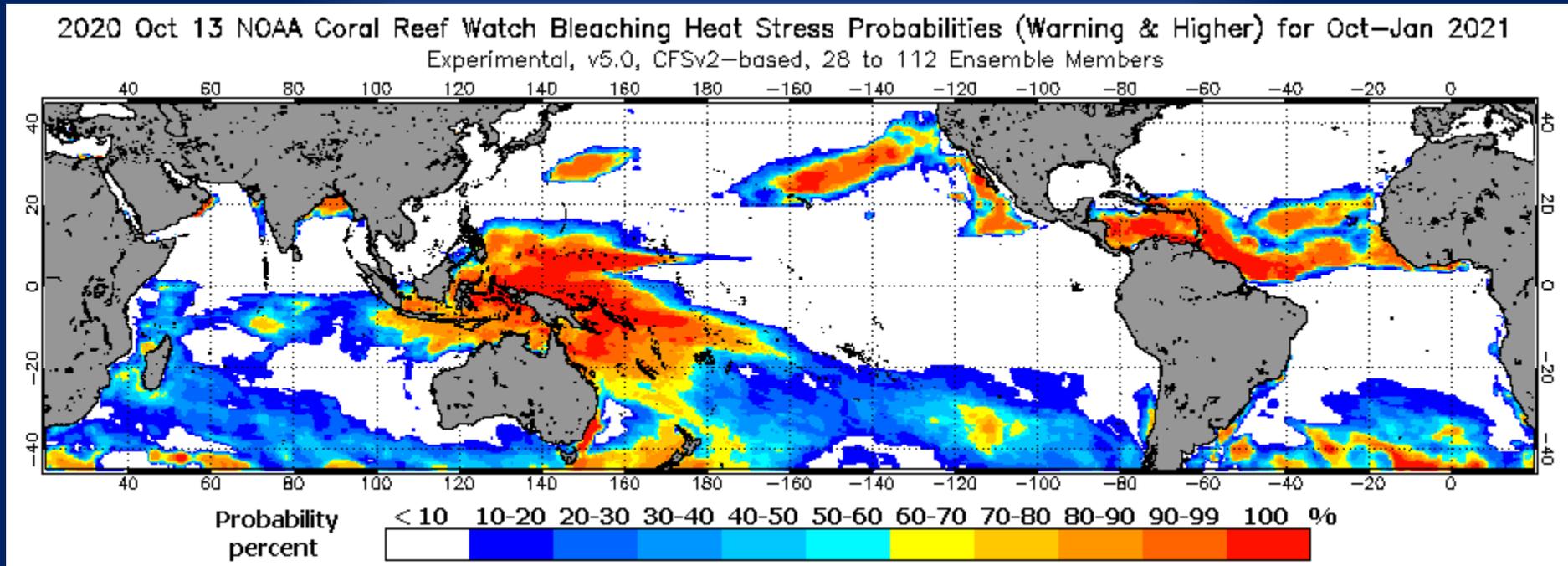
NOAA Coral Reef Watch Daily 5km SST Anomalies (Version 3.1) 21 Mar 2021



But now sea surface temperatures near Midway are 3-4 °C above normal

Bleaching Stress Probability – October 2020-January 2021

Prediction as of 13 October 2020

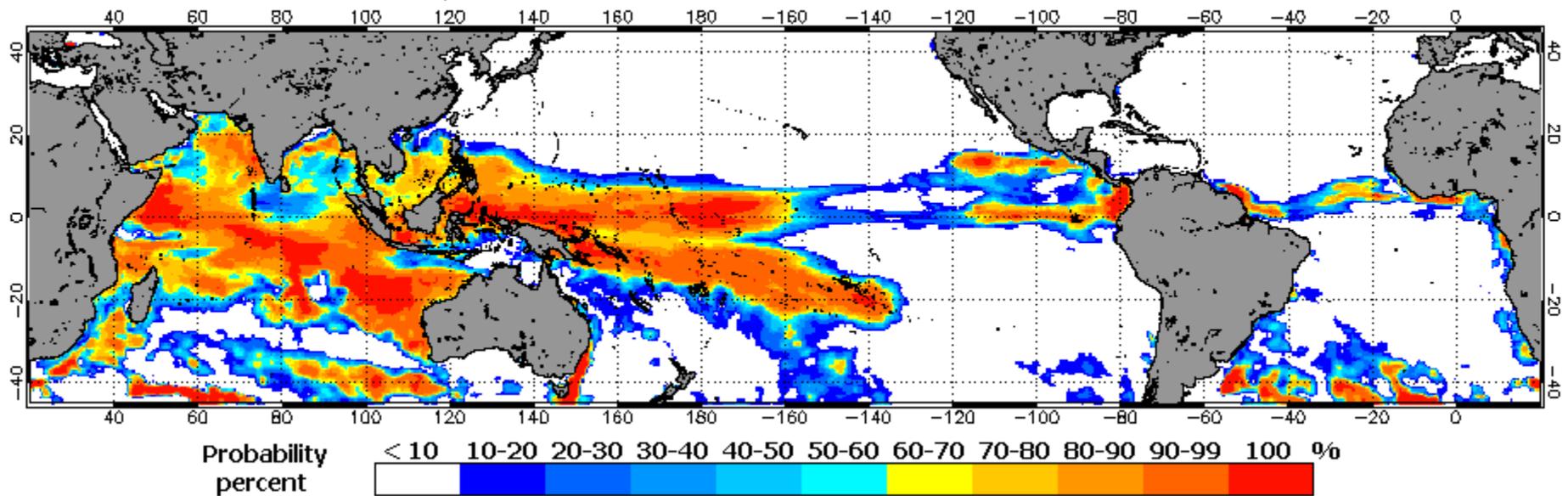


Going into last fall, the potential for heat stress in the Monument had significantly receded

Bleaching Stress Probability – March-June 2021

Prediction as of 16 March 2021

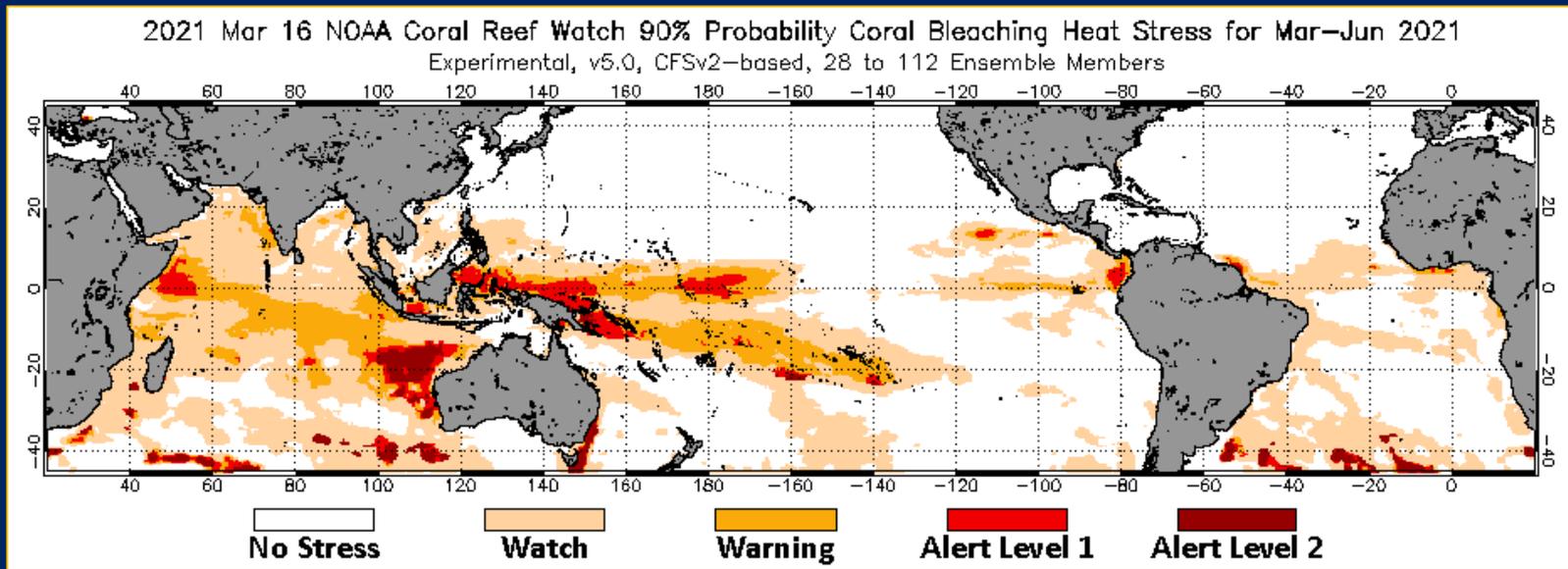
2021 Mar 16 NOAA Coral Reef Watch Bleaching Heat Stress Probabilities (Warning & Higher) for Mar–Jun 2021
Experimental, v5.0, CFSv2-based, 28 to 112 Ensemble Members



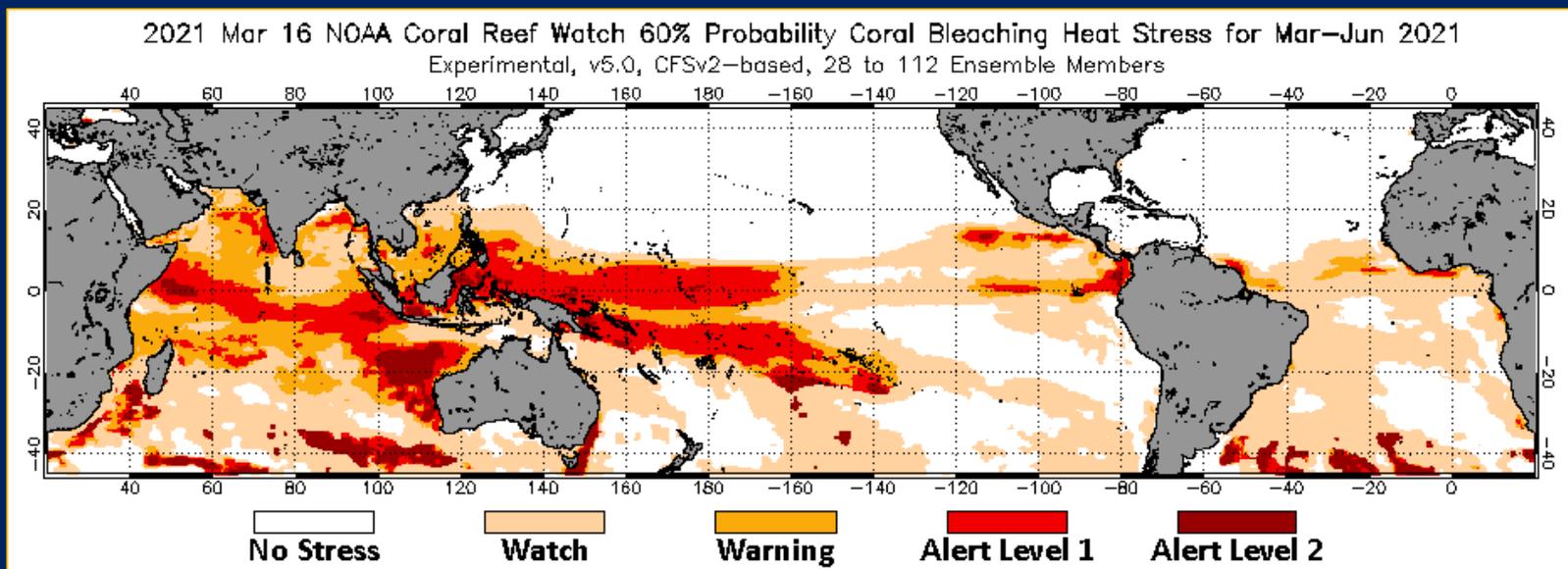
At present, no significant thermal stress is predicted in the Monument through June of this year

There is some potential for thermal stress in the Mariana Islands, Samoa and Palau

90% Stress Level Probability – March-June 2021



60% Stress Level Probability – March-June 2021



Zero probability of bleaching watch conditions in the Monument through June

Digression #2

Megadrought continues in the southwestern US

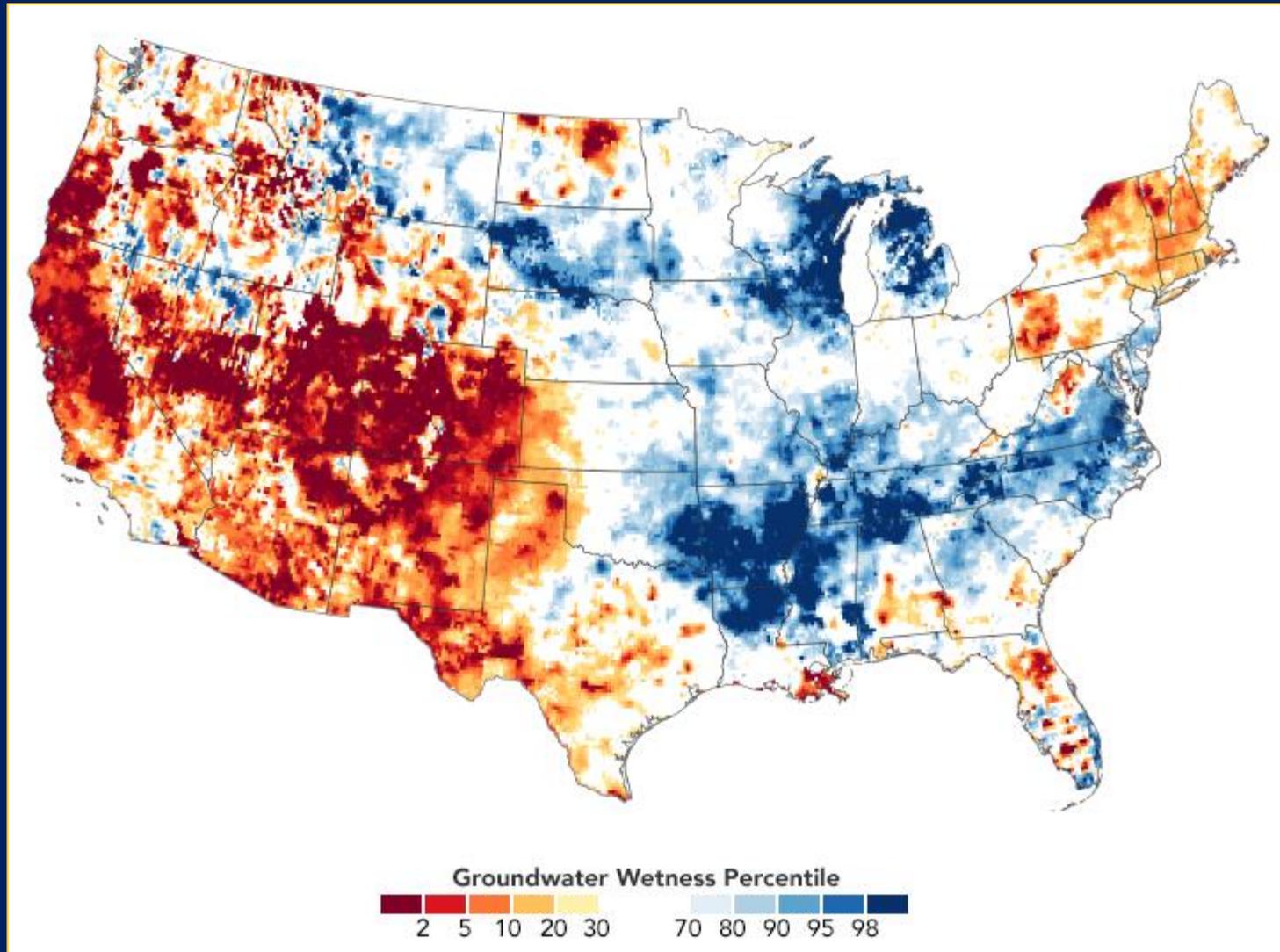
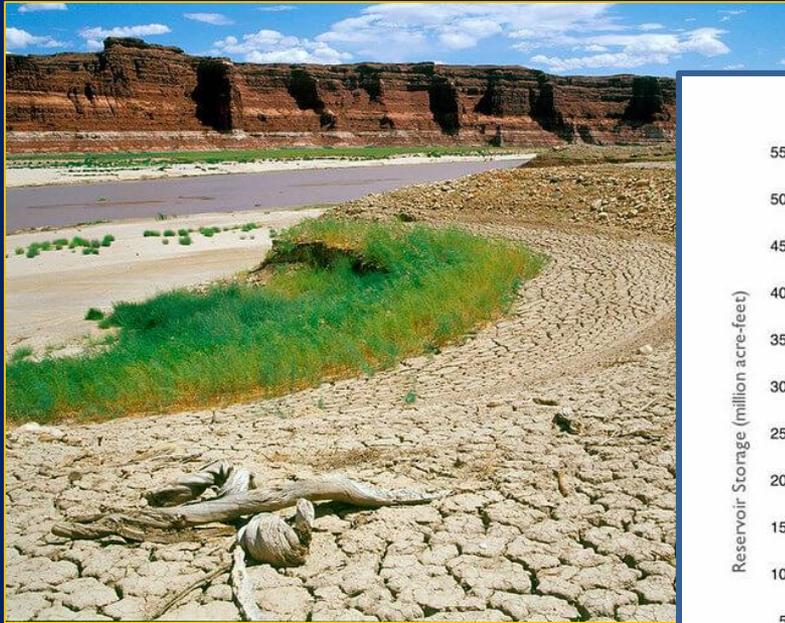


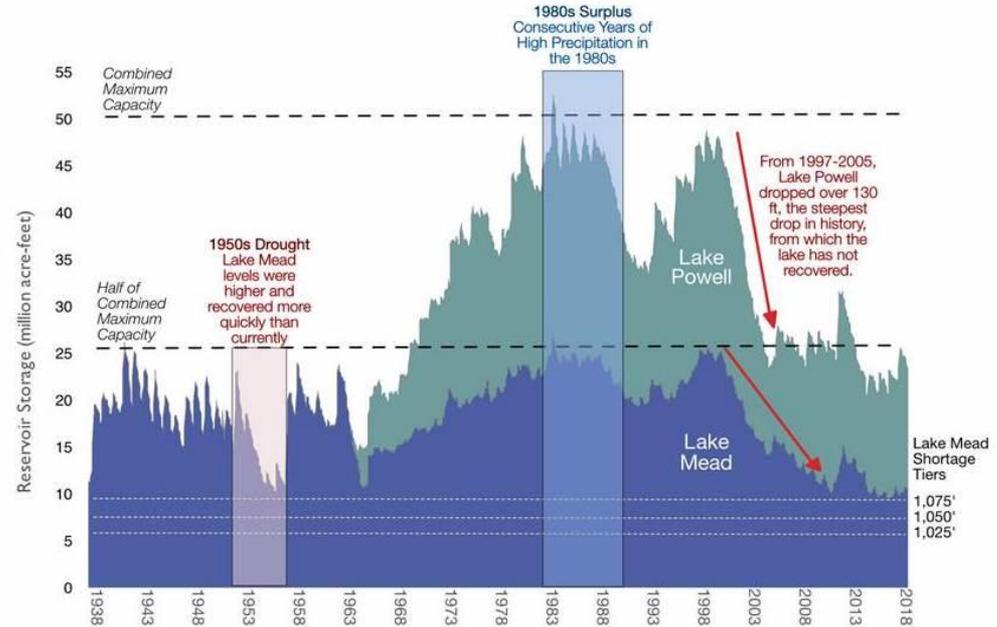
Image courtesy NASA Earth Observatory

Digression #2

The Colorado River basin is running out of water

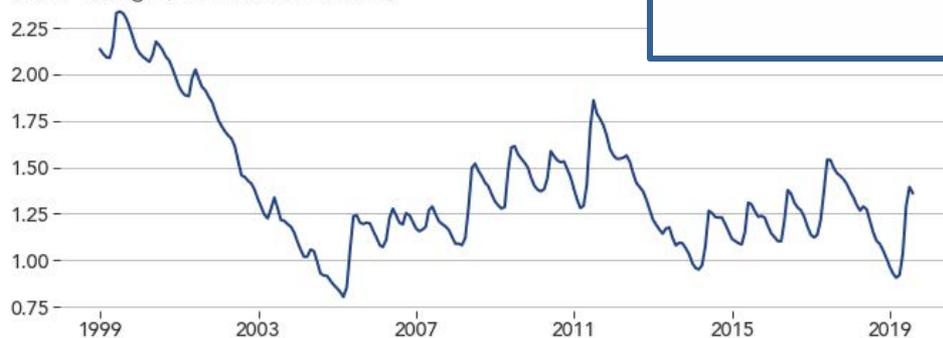


No longer possible to keep the big dams full



Lake Powell's Decline

Water storage (acre-feet x 10 million)

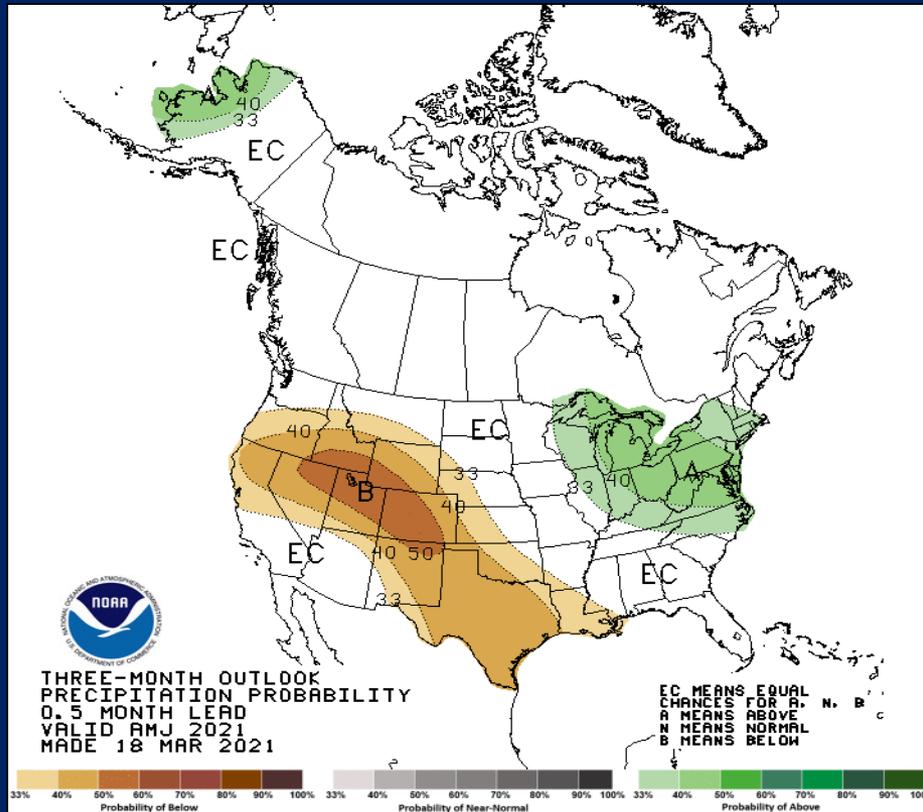


Current Colorado River basin snowpack is only 85% of average

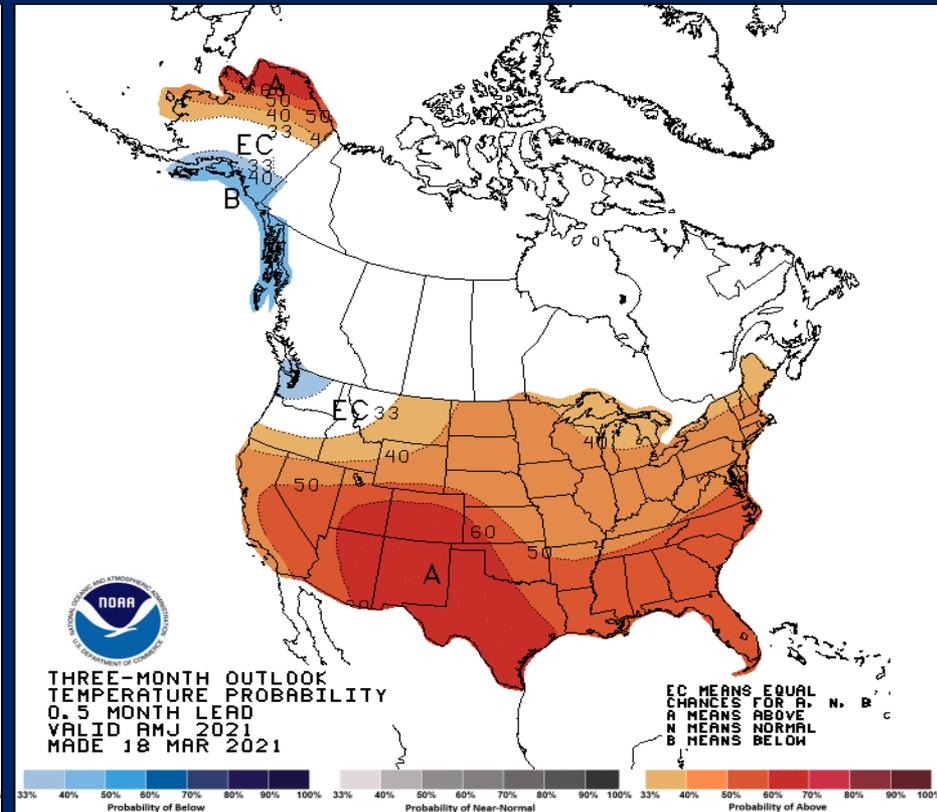
So reservoir levels will decline further until at least spring of 2022

Digression #2

And the three-month outlook is not offering any relief



Predicted Precipitation

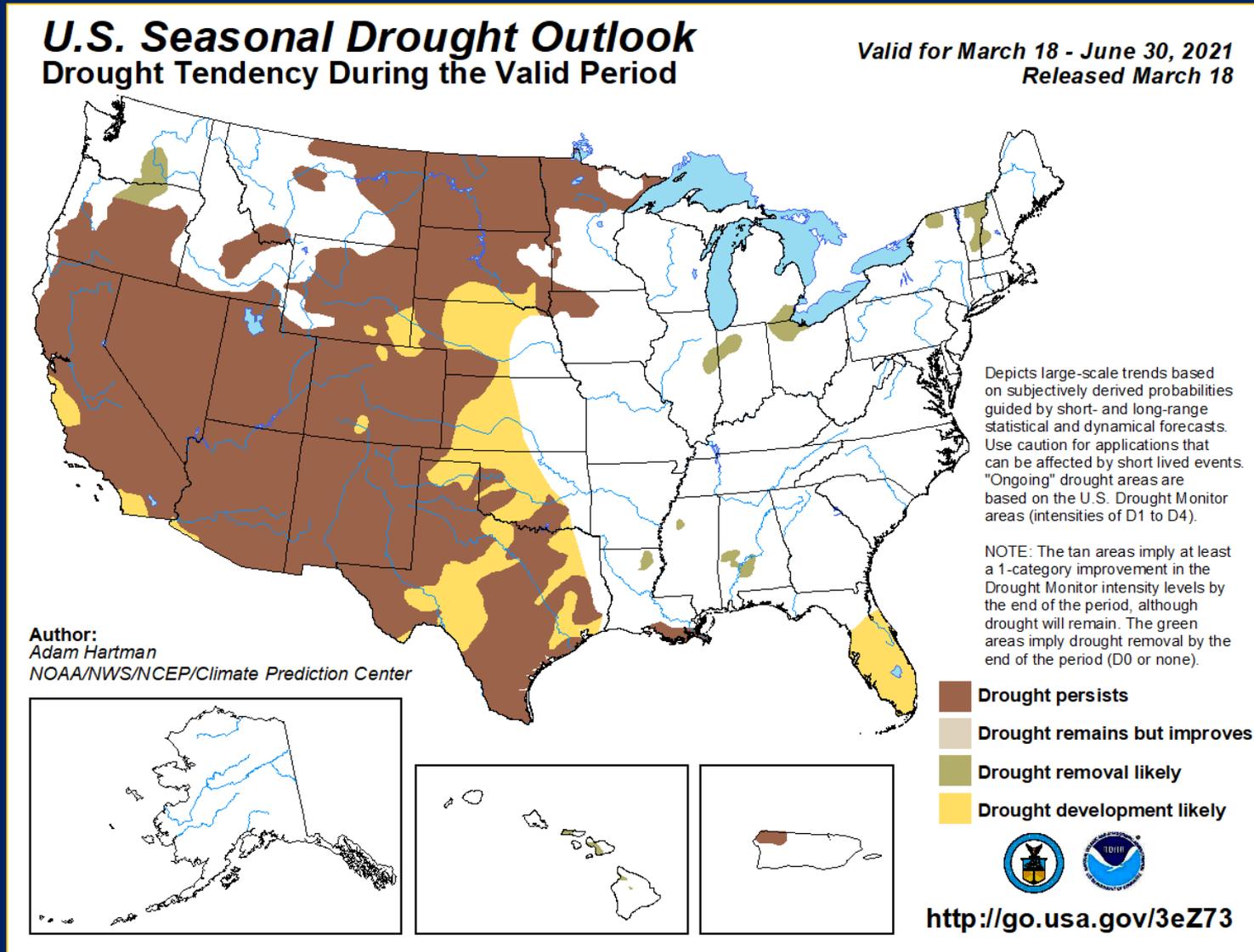


Predicted Temperature

This could lead to a difficult wildfire season across the West

Digression #2

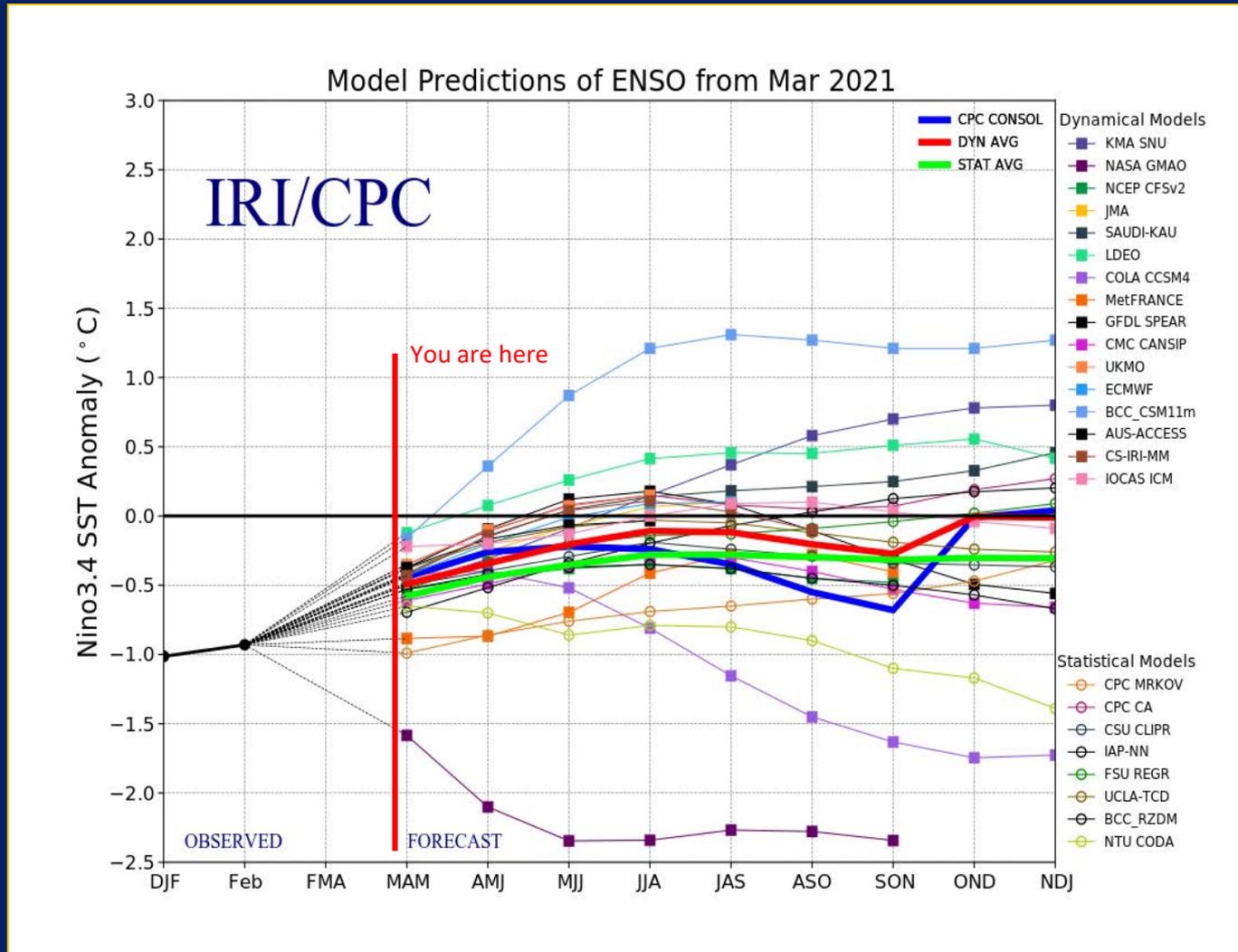
In Hawaii, drought conditions are not expected through June



Cool, wet winters in Hawaii are typical of a La Niña pattern

Looking Forward

An ensemble of 27 climate models predicts **La Niña** trending into ENSO-neutral conditions from now through early summer 2021



The range of model predictions has a wider spread than usual

Conclusions

2021 is starting out cooler than record-hot 2020, due to the polar vortex pattern
Even so, the Northern Pacific Ocean has carried excess heat content through winter, in the sector north of the Monument

La Niña conditions are present, and expected to persist through spring of 2021
There is a 65% chance we will transition to ENSO-neutral conditions by summer, with no El Niño this year

There is a zero probability of thermal stress to Monument coral reefs through June, although sea surface temperatures are significantly higher than average in the Midway sector for this time of year

We will need to see whether this residual heat is built upon going into fall

Tropical cyclone formation is generally low during La Niña, and not heavily favored during ENSO-neutral conditions predicted to follow

At the present time, risk from summer cyclones thus appears lower than average

Sea level continues to rise at 3-5 mm per year, and this trend is increasing

Inundation is a long-term problem that will not go away, and may increase over time depending on future melting trends in Greenland and Antarctica

Bonus

NOAA on Monday launched the newest version of its forecast model

American Global Forecast Model (GFS 16.0)

Improved features:

Now models up into the stratosphere, increasing from 64 to 127 vertical partitions

The cubes used to go up 34 miles, now they go up 50 miles

Coupled with the WaveWatch III ocean wave model

Allows a 16-day prediction window on strong wave events

Better ability to track hurricane tracks and intensities

Provides more accurate guidance 36 hours earlier out

All of this will be useful for Monument management

But is it better than its arch-rival, the European Model?

Time will tell...

Questions?

