2023 Rainfall in Review, ENSO Status & a Look to 2024

NATIONAL WEATHER SERVICE

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Weather Forecast Office, Guam

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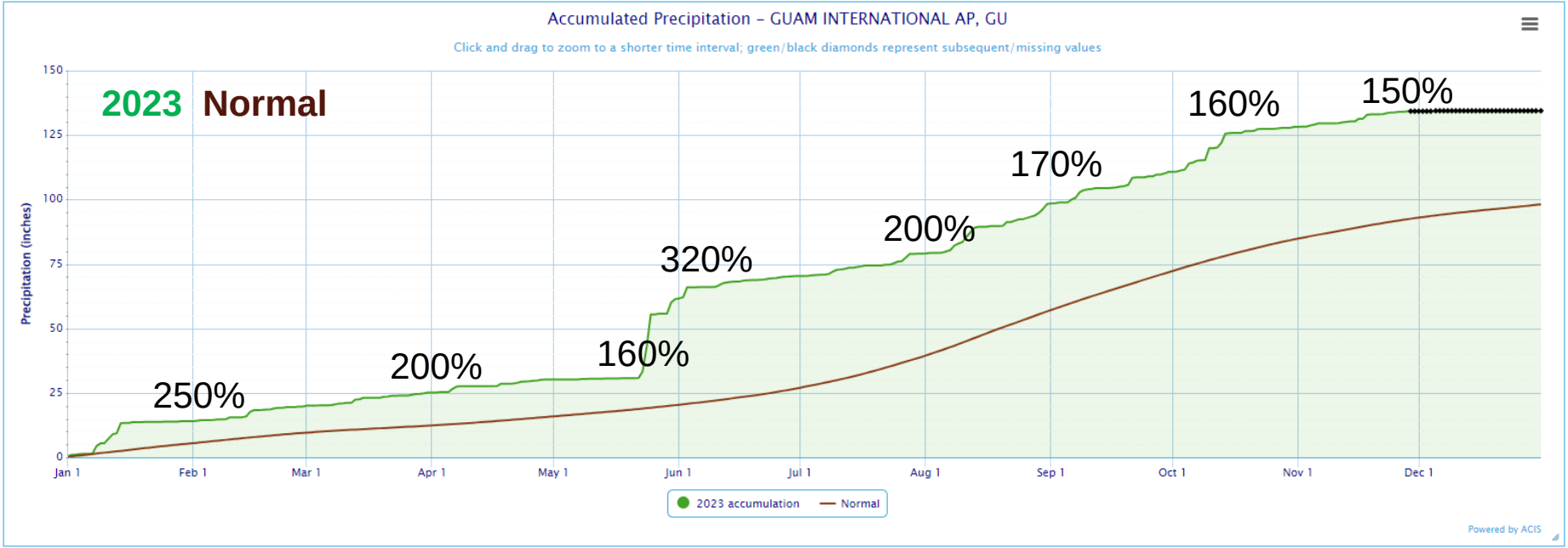
Special thanks for contributions on rainfall climatology & ENSO inputs:

Brandon Bukunt
Climate Science & Services
NWS Pacific Region Hdqtrs, Honolulu, HI

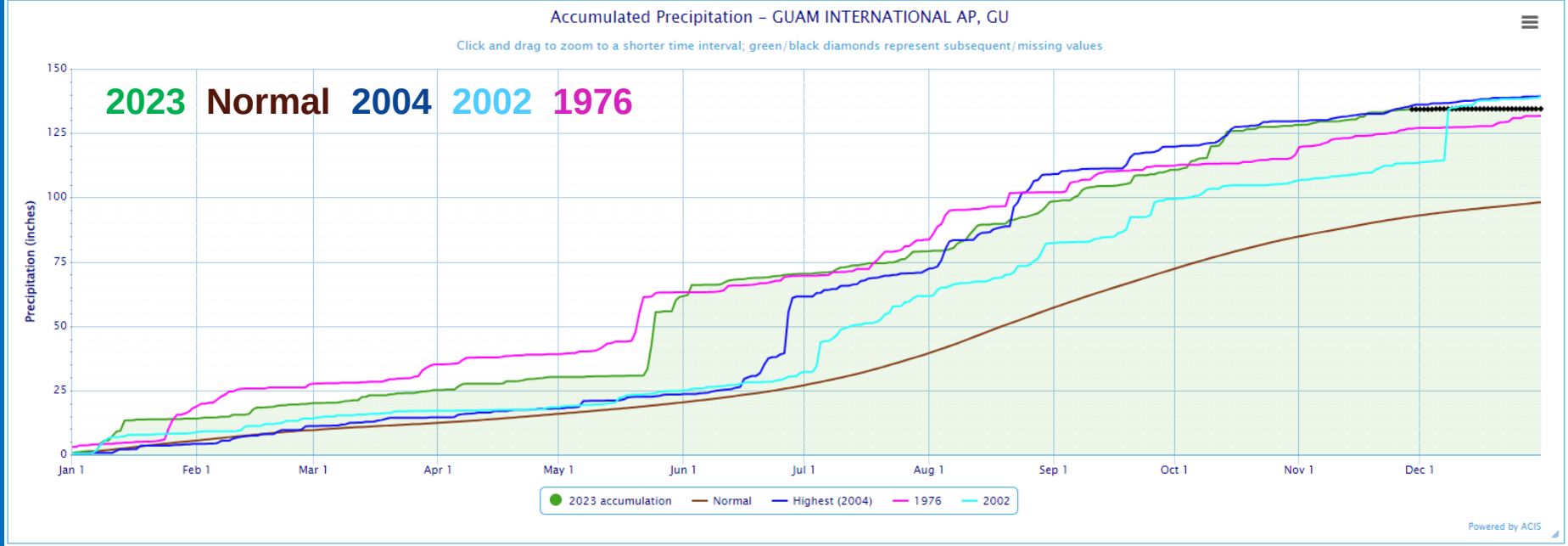
2023 Rainfall: A Wet Year!

- 2023 is on track with the wettest years on record! (77years of daily data)
- 1976, 1997, 2002, 2004 were all very wet years with notable TCs
- As of Wed Nov 29th:
  - 134.46” for the year
  - 42.12” above the normal of 92.34”
  - 2022, through Nov 29th: 79.88”
- Sep 1st – Nov 29th:
  - 2022: 35.65”
  - 2023: 35.71”

2023 Rainfall: % of Normal

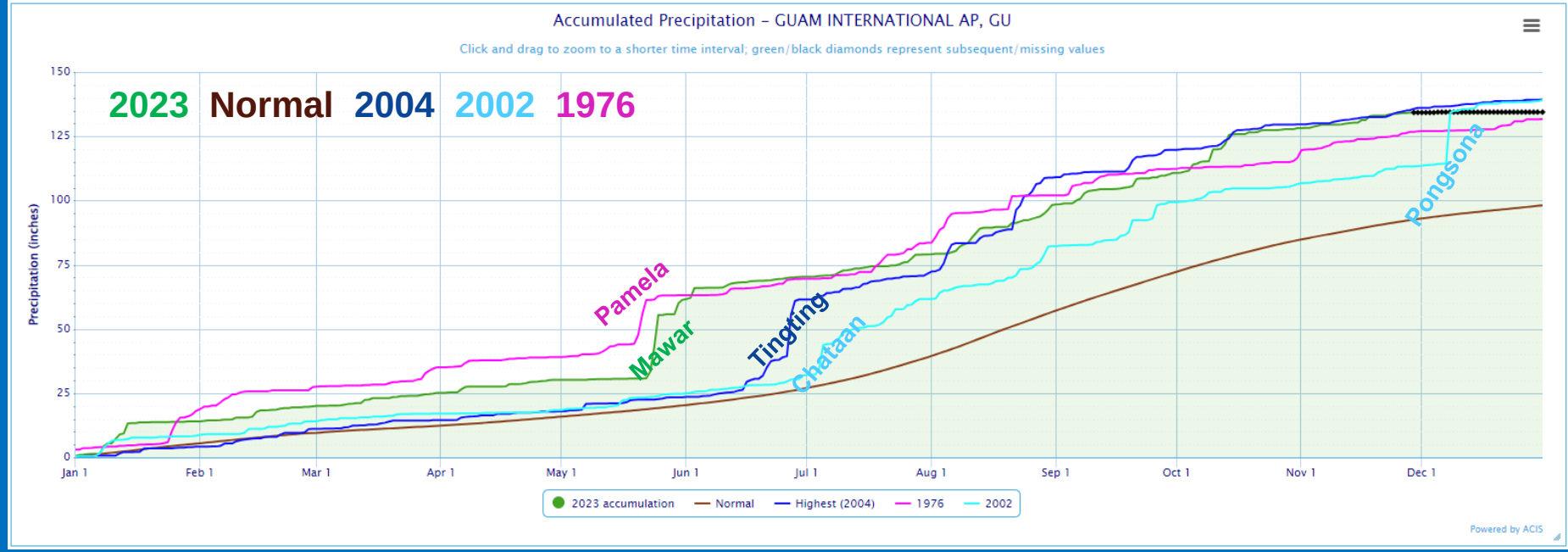


2023 Rainfall Compared to Other Very Wet Years



1997 not shown, but ended with 131.74"

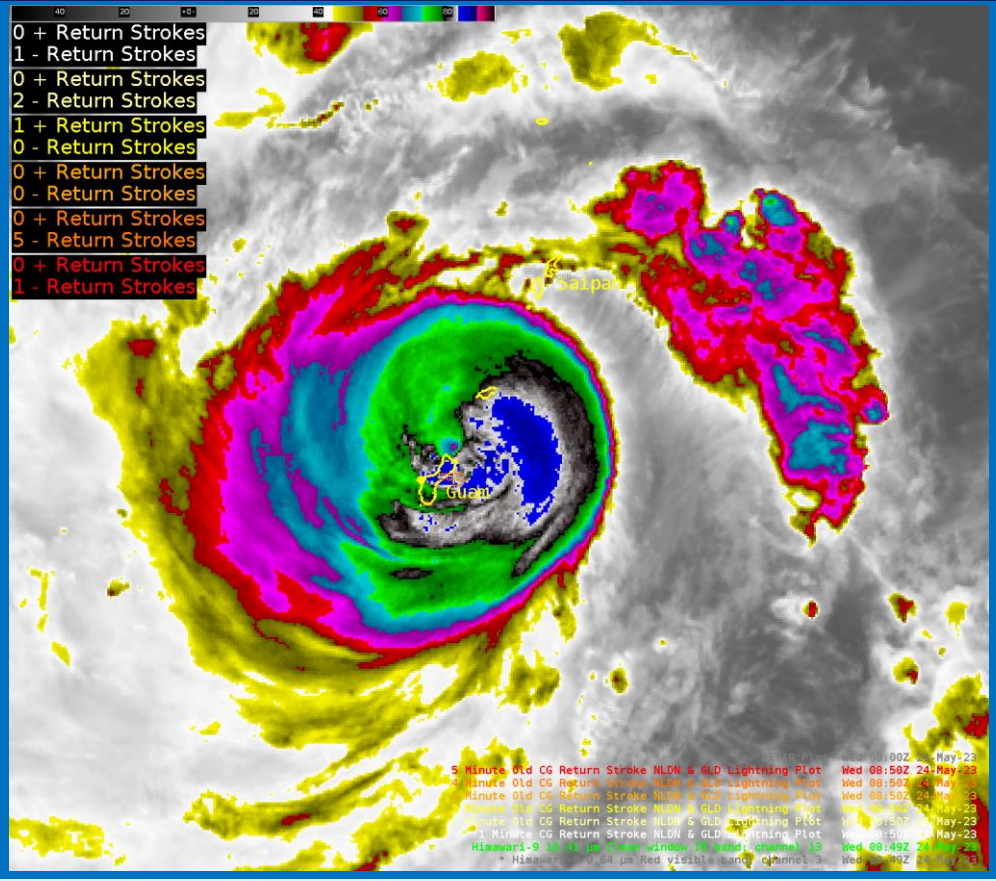
Yearly Rainfall: Tropical Cyclones Matter!



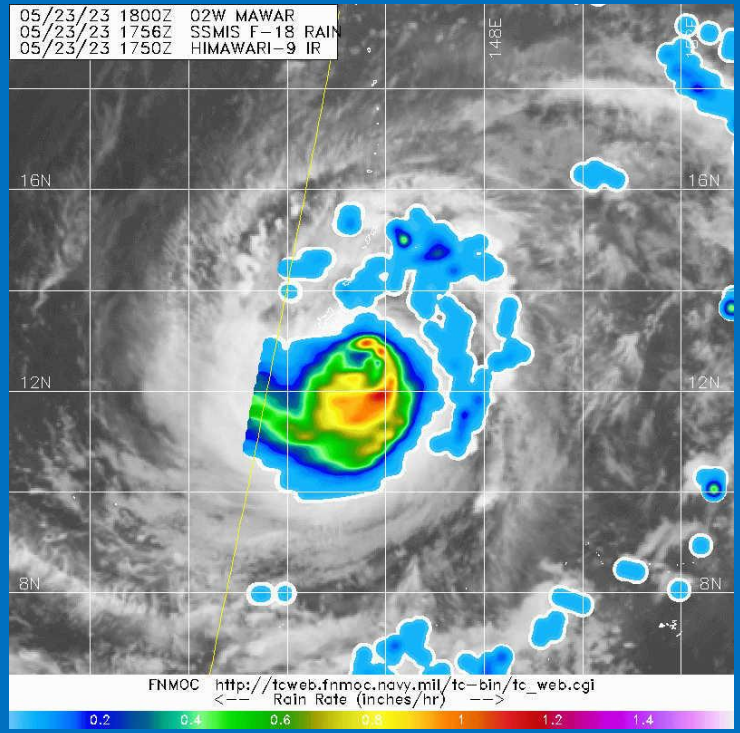
1997 not shown, but ended with 131.74"

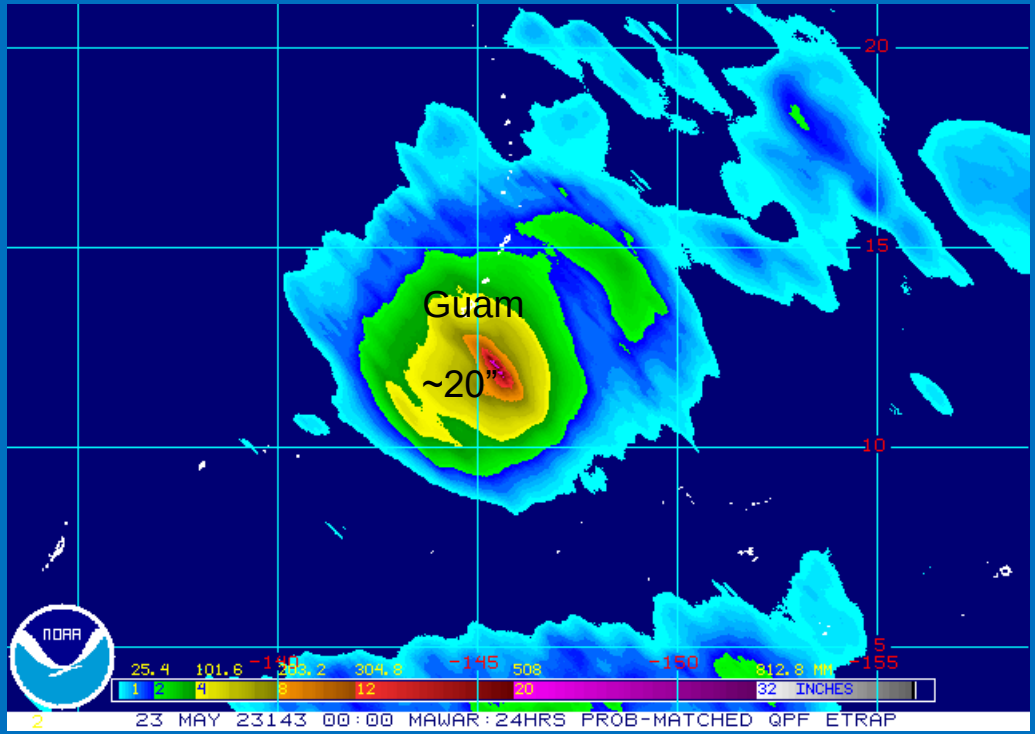
Super Typhoon Mawar

STY Mawar Infrared Satellite

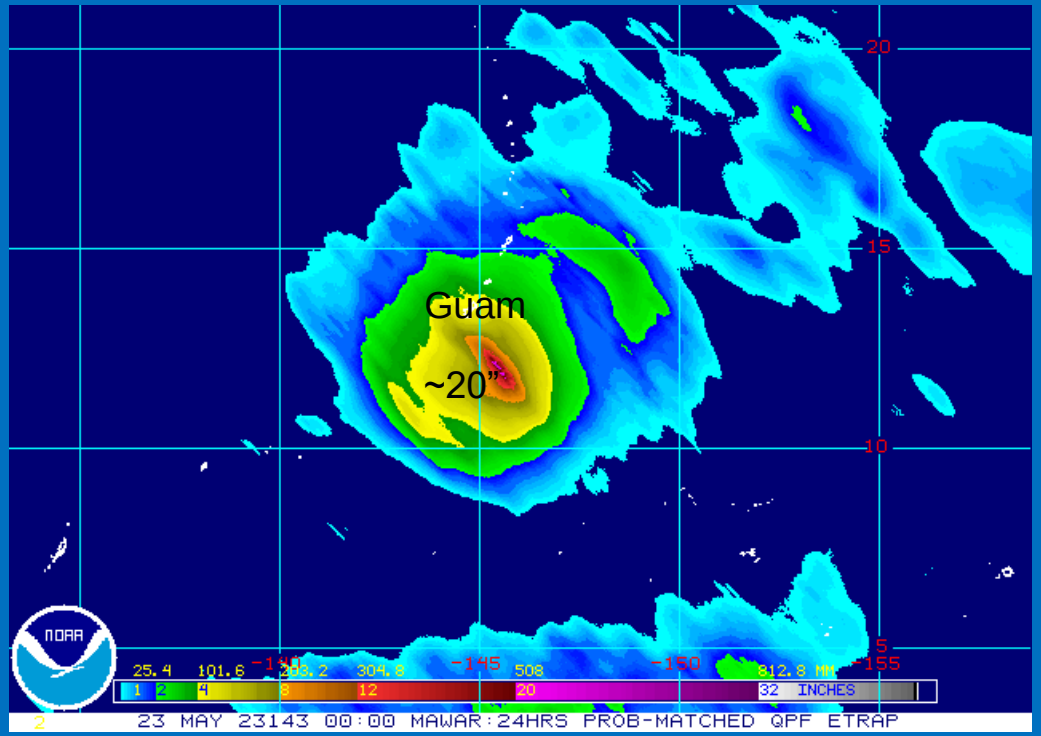


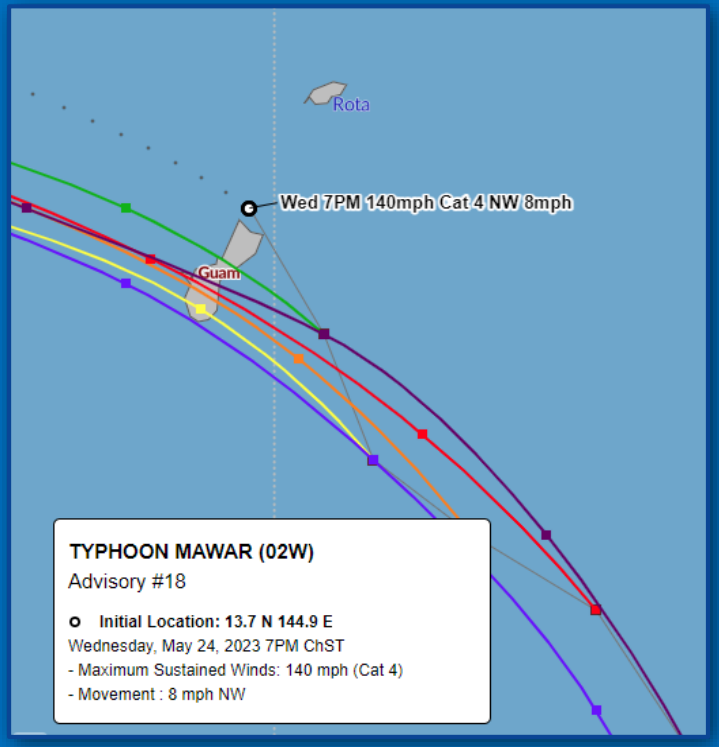
STY Mawar Satellite Rain Rate & 24hr Accum Fcst





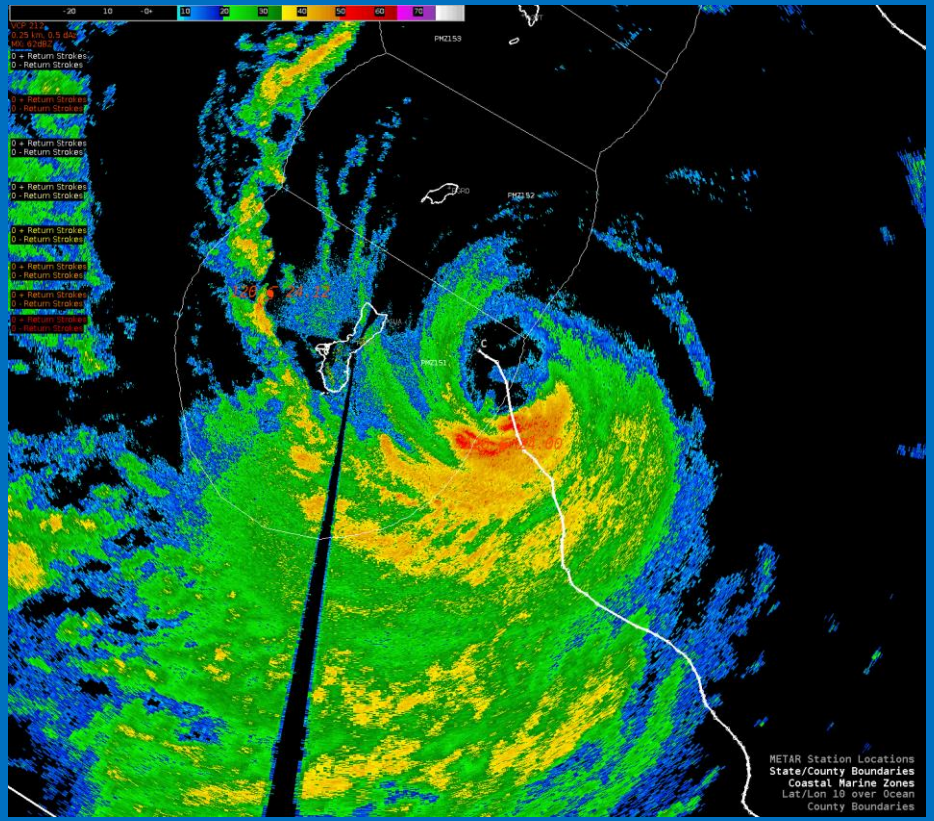
STY Mawar 24hr Accum Fcst



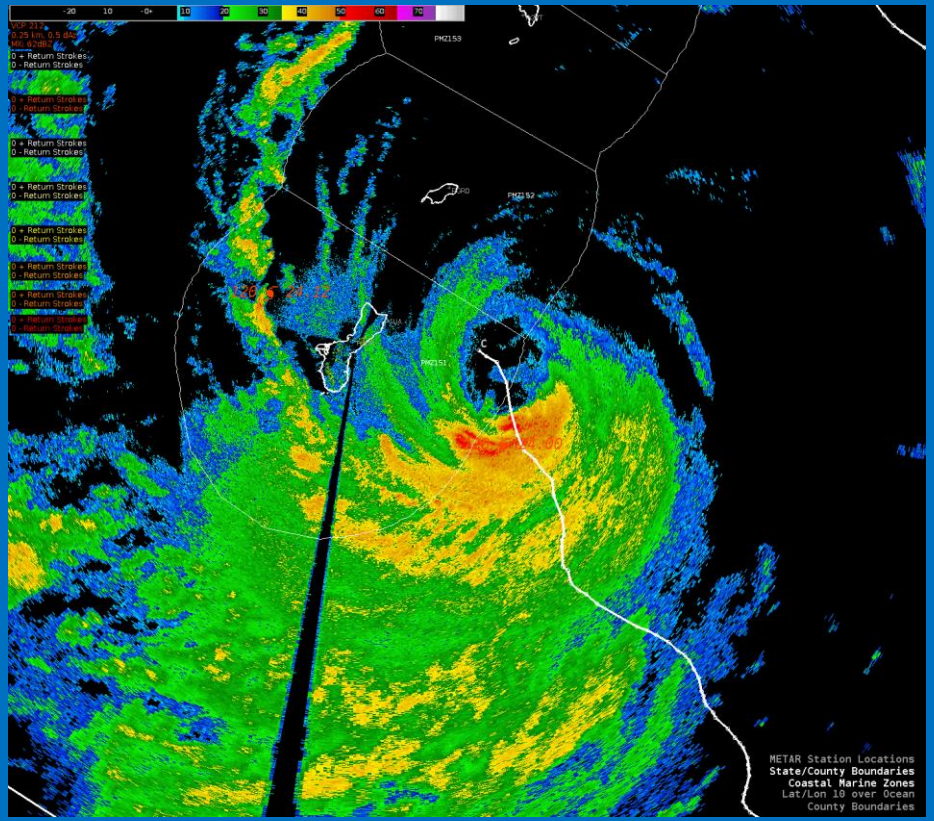


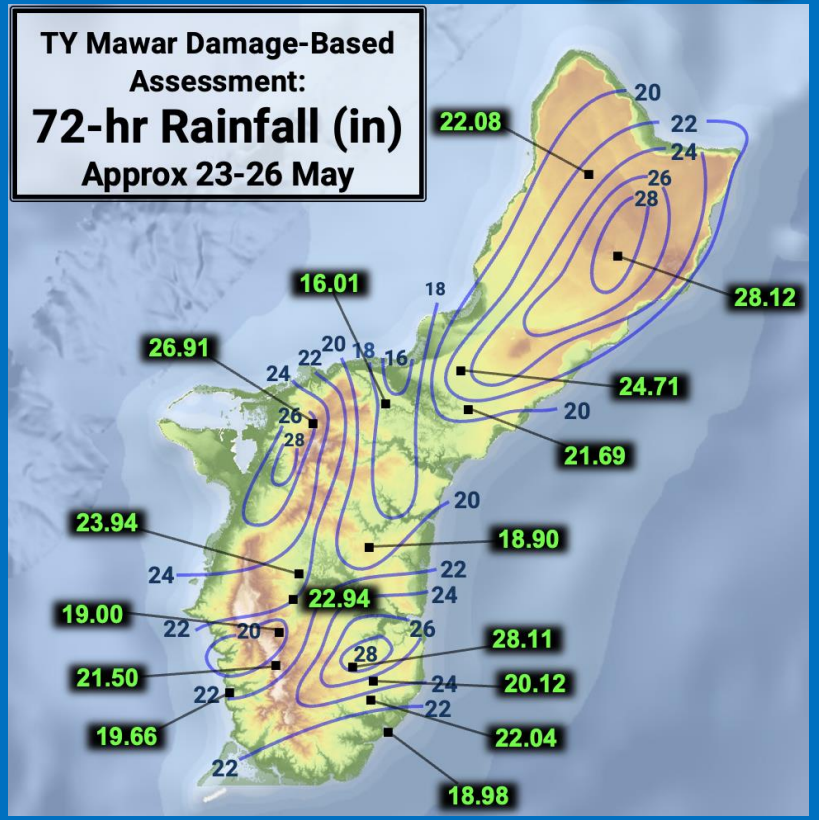
Advy 18, 7PM Wed May 24th

Radar Data & Eye Track



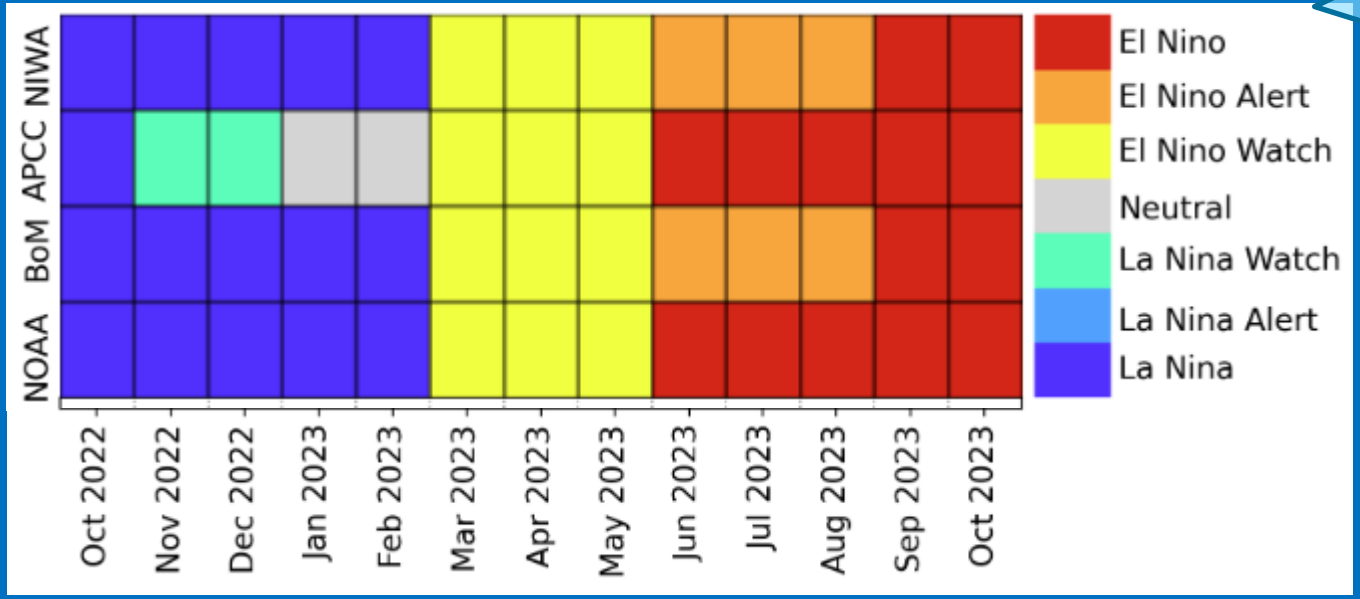
Radar Data & Eye Track; NWS Rain Assessment





2023: An El Nino Year

El Niño declared by NOAA, BOM, APEC Climate Center and NIWA

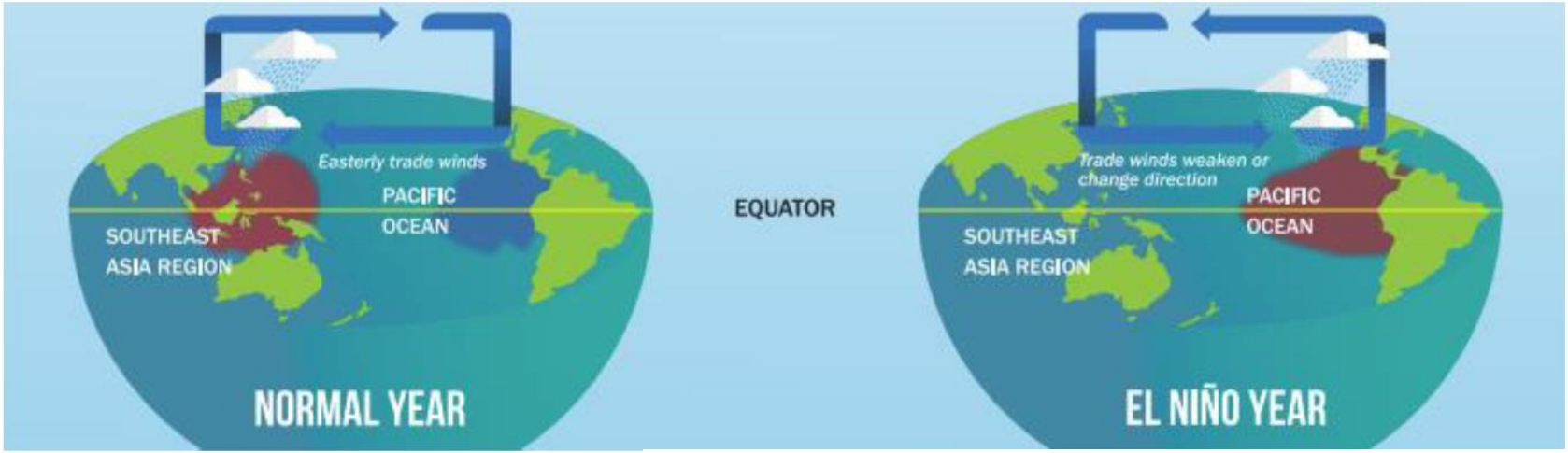


NOAAs CPC: 1 in 3 chance of historically strong El Niño a la 1997/1998 or 2015/2016

Pacific Region Climate Center (RCC) https://www.pacificmet.net/enso-tracker

El Nino Basics

Requires a coupling or linkage between the ocean **AND** the atmosphere



https://www.weather.gov.sg/wp-content/uploads/2015/03/El-Nino-Infographic.pdf

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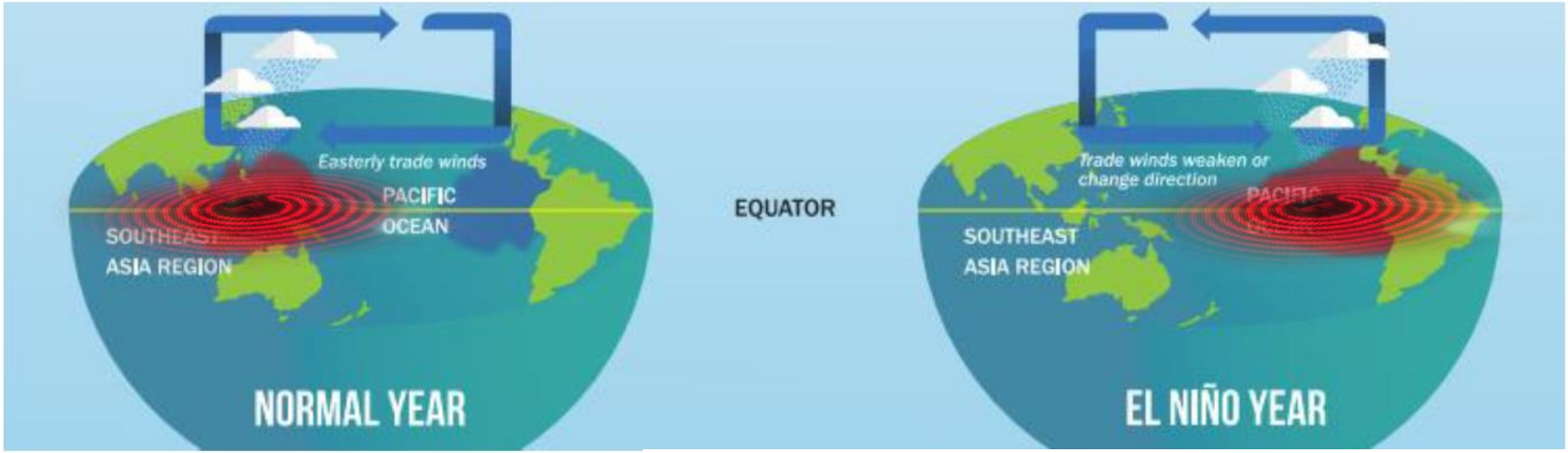
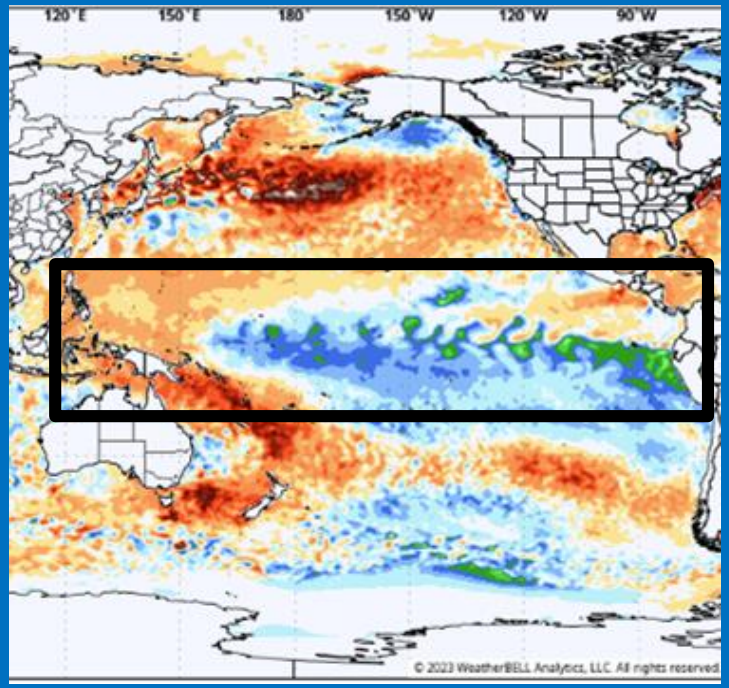


https://www.weather.gov.sg/wp-content/uploads/2015/03/El-Nino-Infographic.pdf

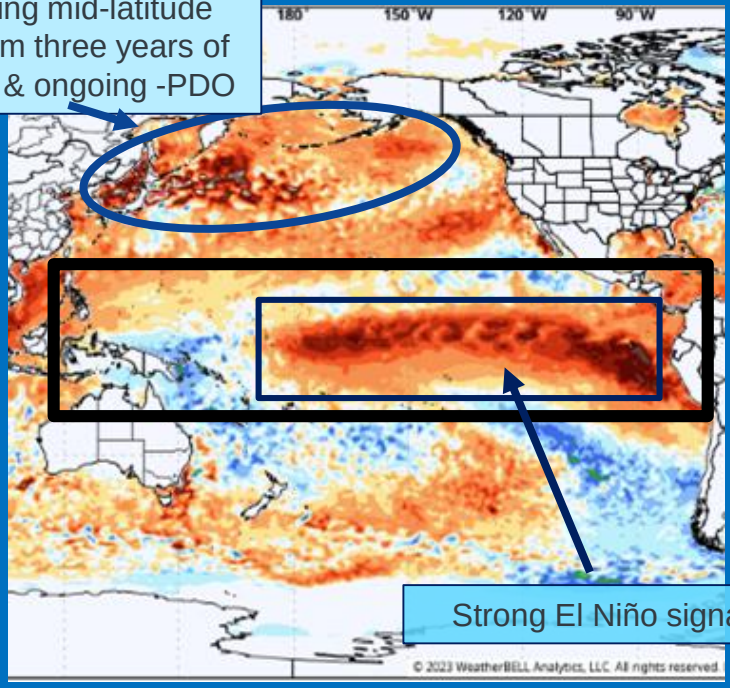
Sea Surface Temp Anomalies – 2022 & Now

Nov 2022



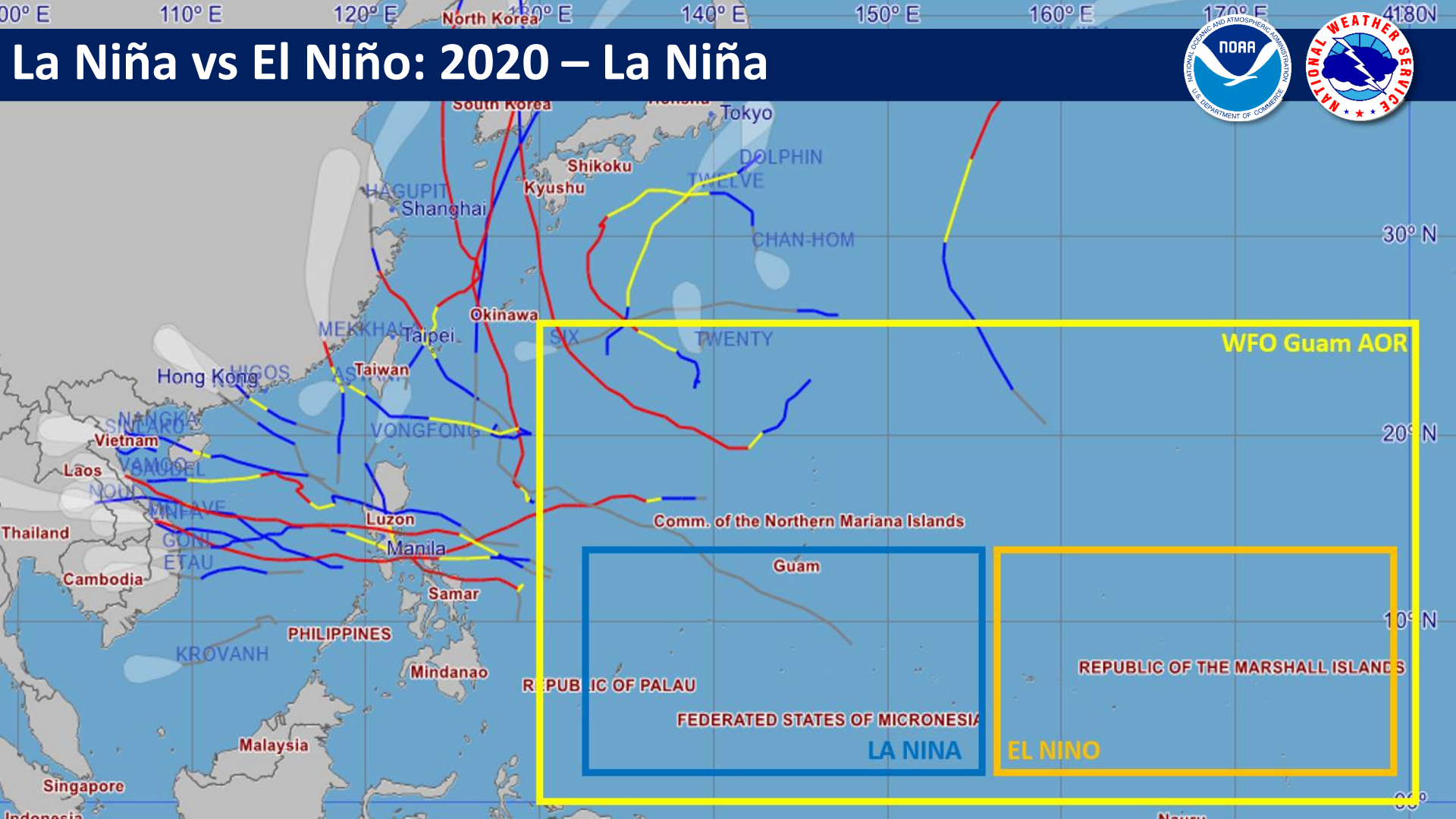
Nov 2023

Lingering mid-latitude heat from three years of La Niña & ongoing -PDO

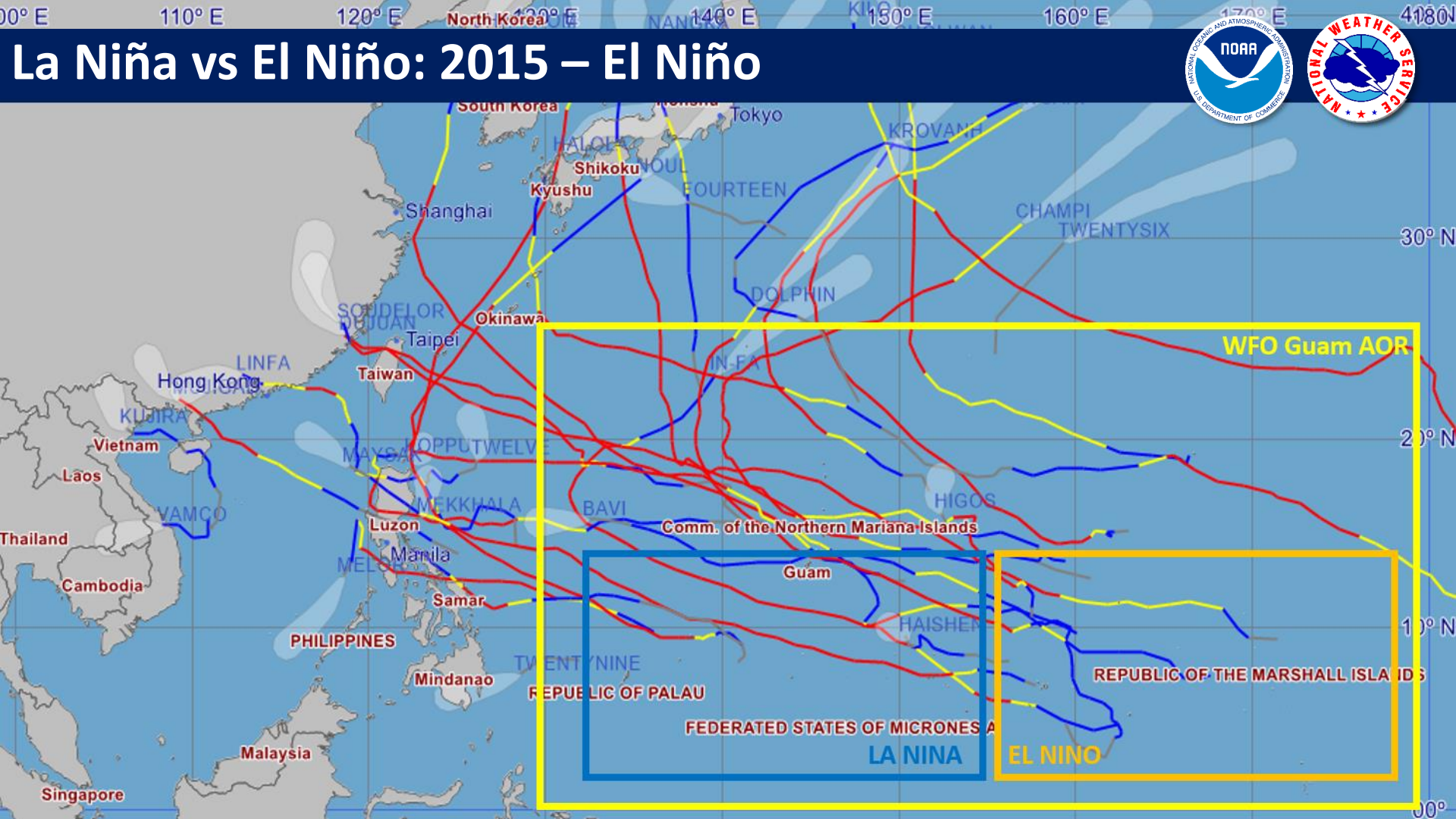


Strong El Niño signal

La Niña vs El Niño: 2020 – La Niña



La Niña vs El Niño: 2015 – El Niño

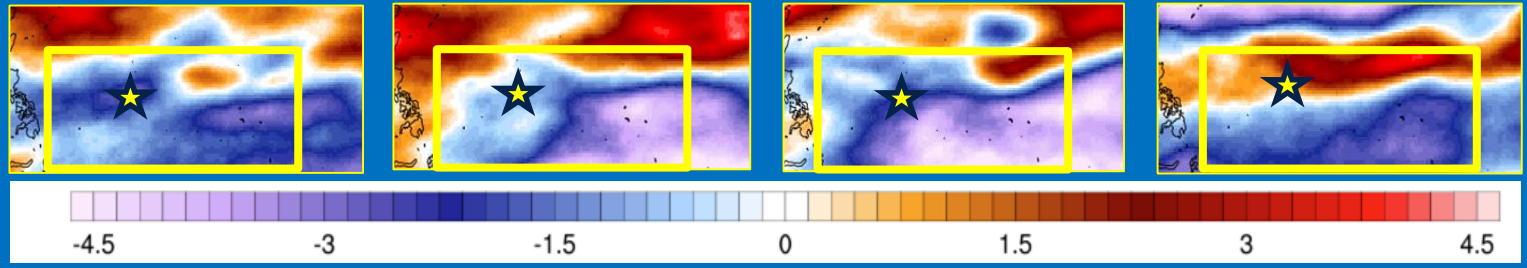


La Niña vs El Niño: 2023 – El Niño??

2023: Where's the Tropical Cyclones?

250mb Zonal Wind Anomaly, May-Sep

1982 (++El Niño) **1997** (++El Niño) **2015** (++El Niño) **2018** (- El Niño)



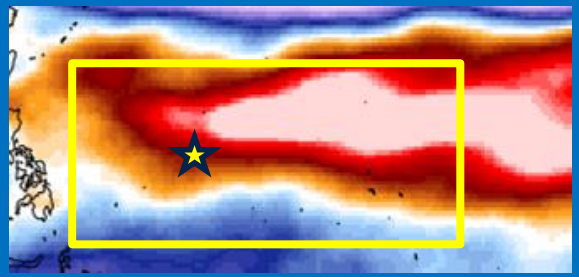
Weaker wind shear

More favorable for TCs

Stronger vertical wind shear

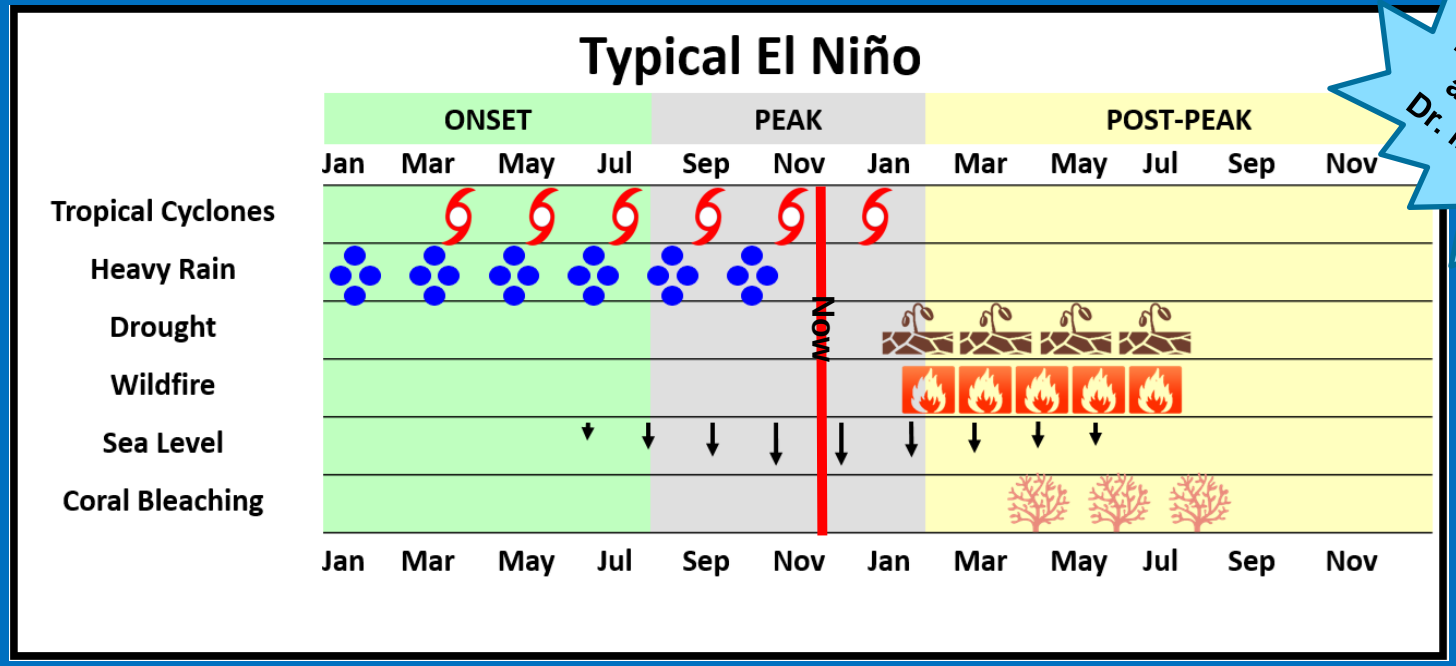
Less favorable for TCs

2023 (+El Niño)



A Look Ahead to 2024…

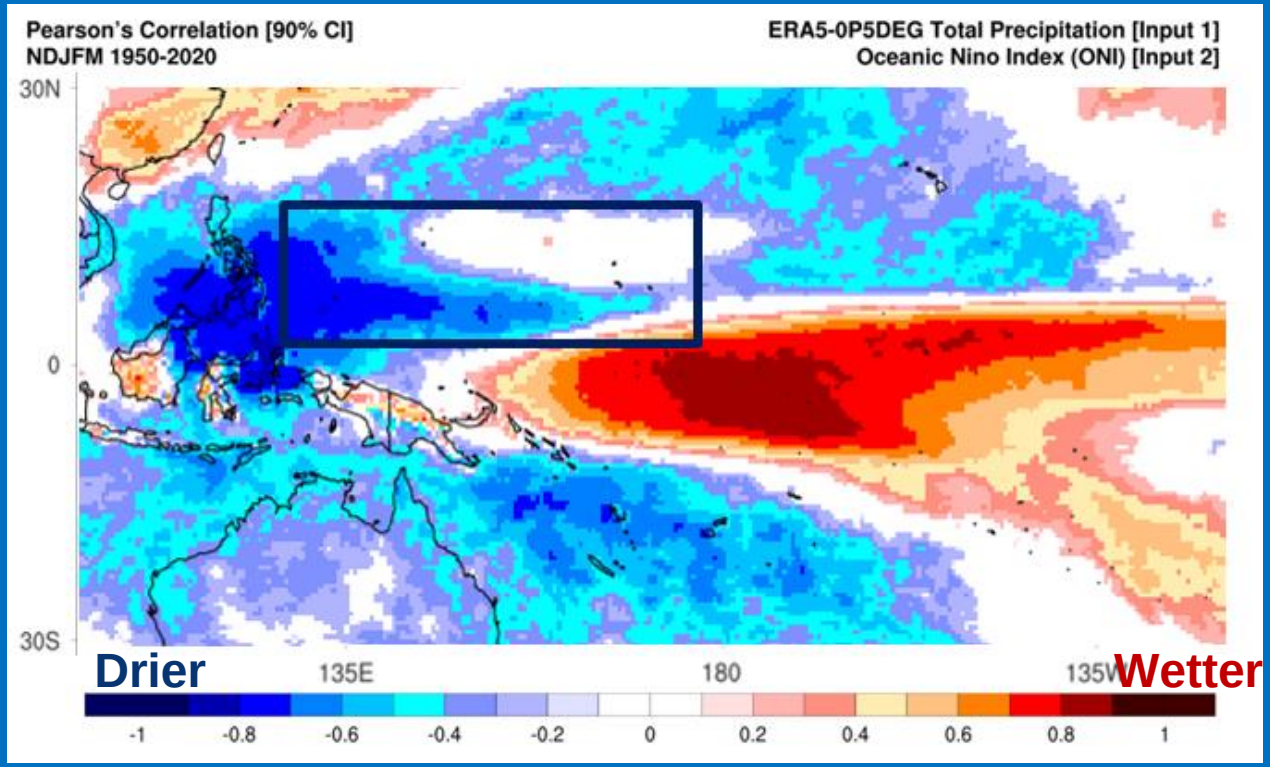
El Niño General Expectations: Typical Timeline



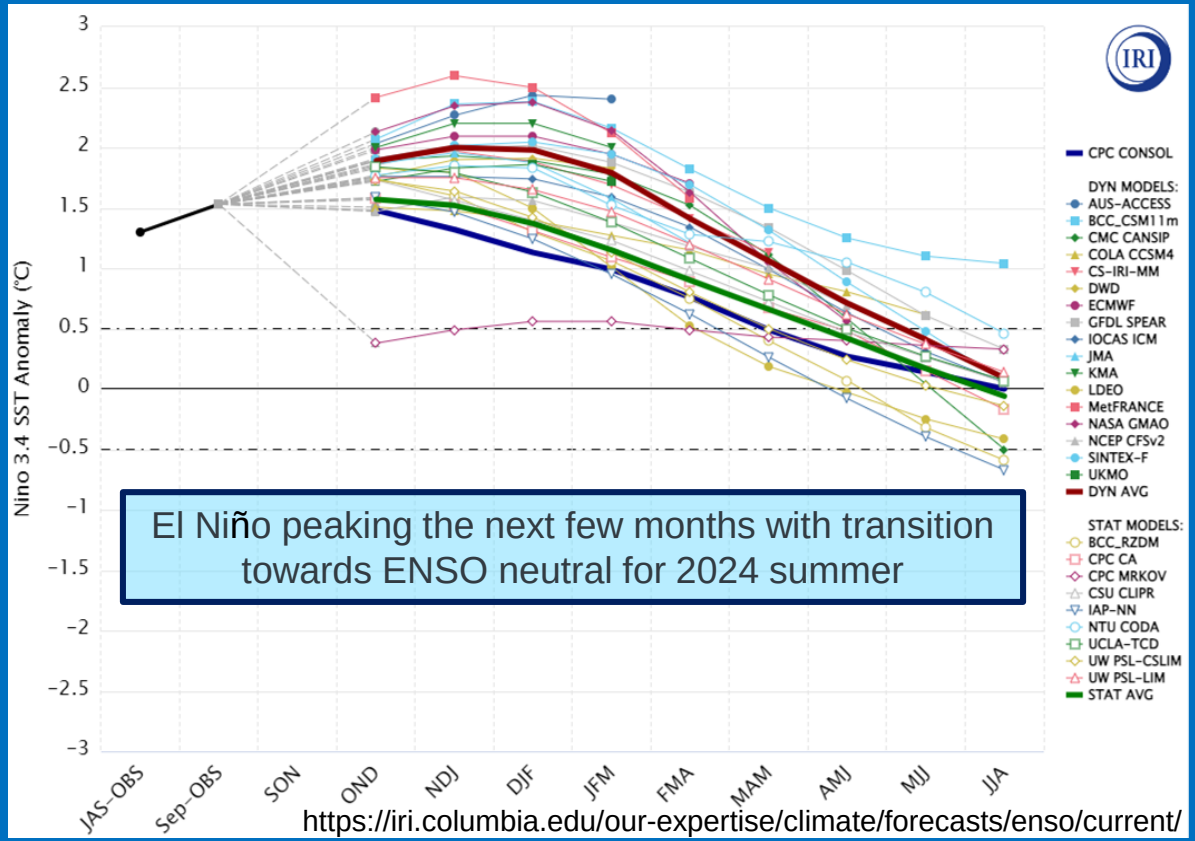
El Niño timeline adapted from Dr. Mark Lander

El Nino General Expectations: Rainfall/Drought

Correlation between Nov-Mar Rainfall



Latest IRI Projections

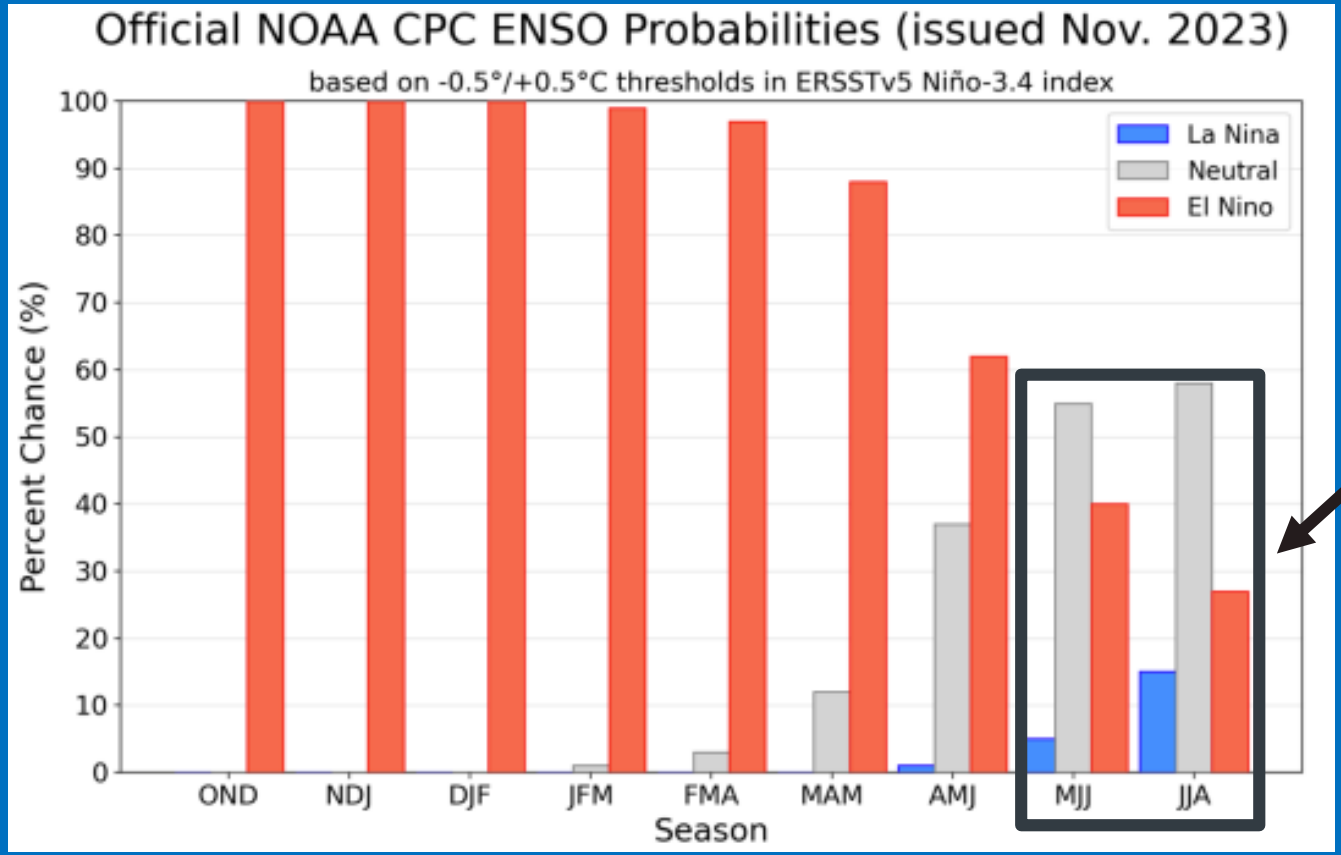


El Niño peaking the next few months with transition towards ENSO neutral for 2024 summer

https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

NOAAs CPC: 1 in 3 chance of historically strong El Niño a la 1997/1998 or 2015/2016

Latest CPC Outlook

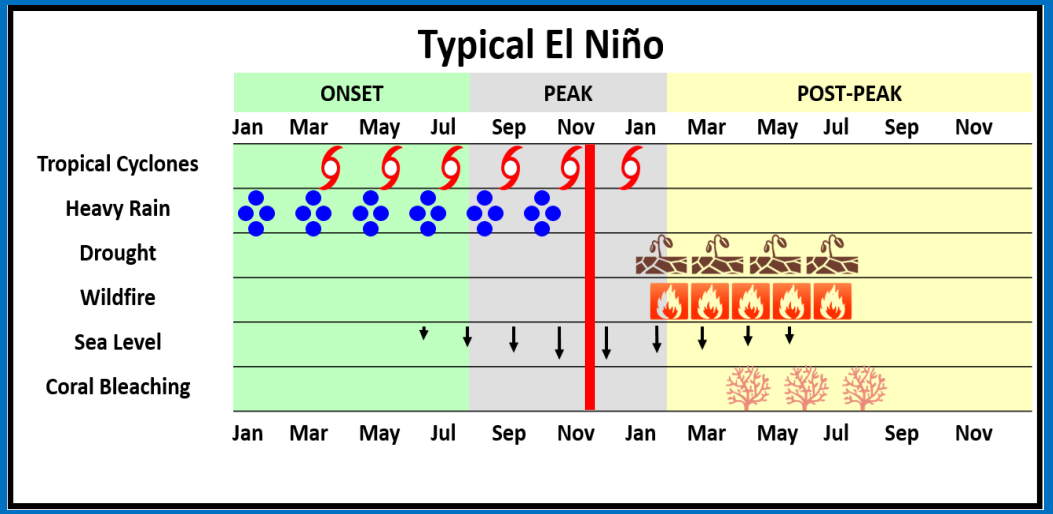


ENSO Neutral favored for summer 2024

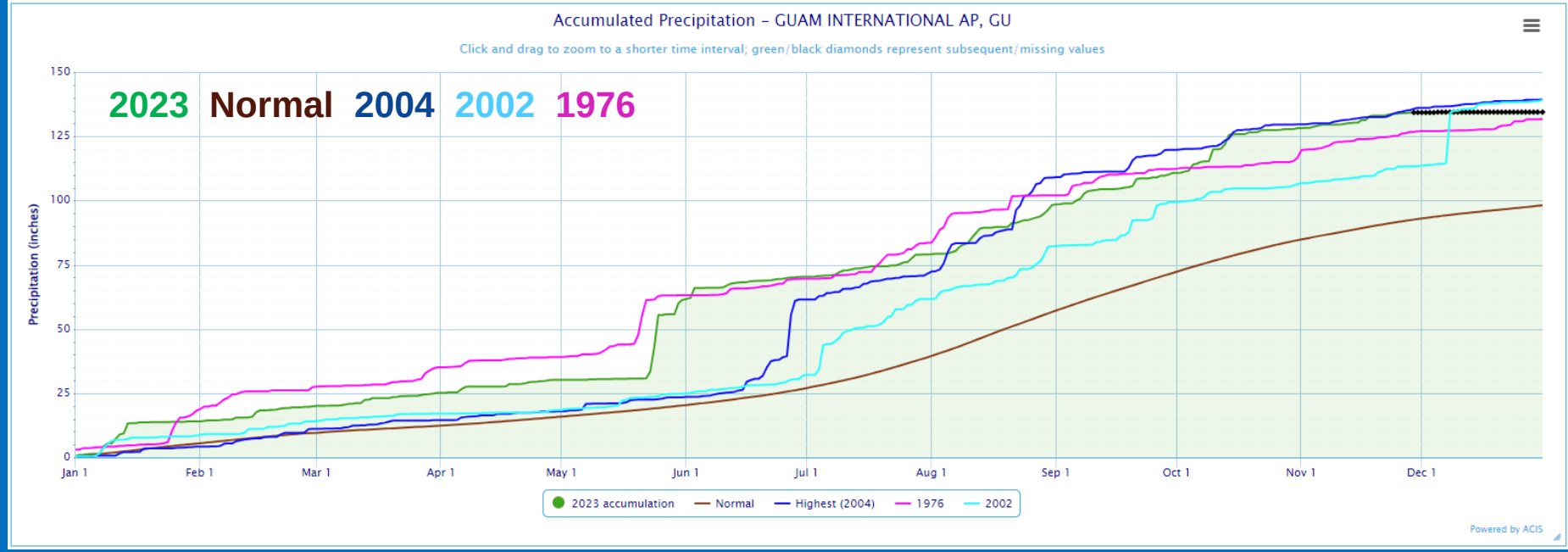
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.pdf

A Look Ahead to 2024…

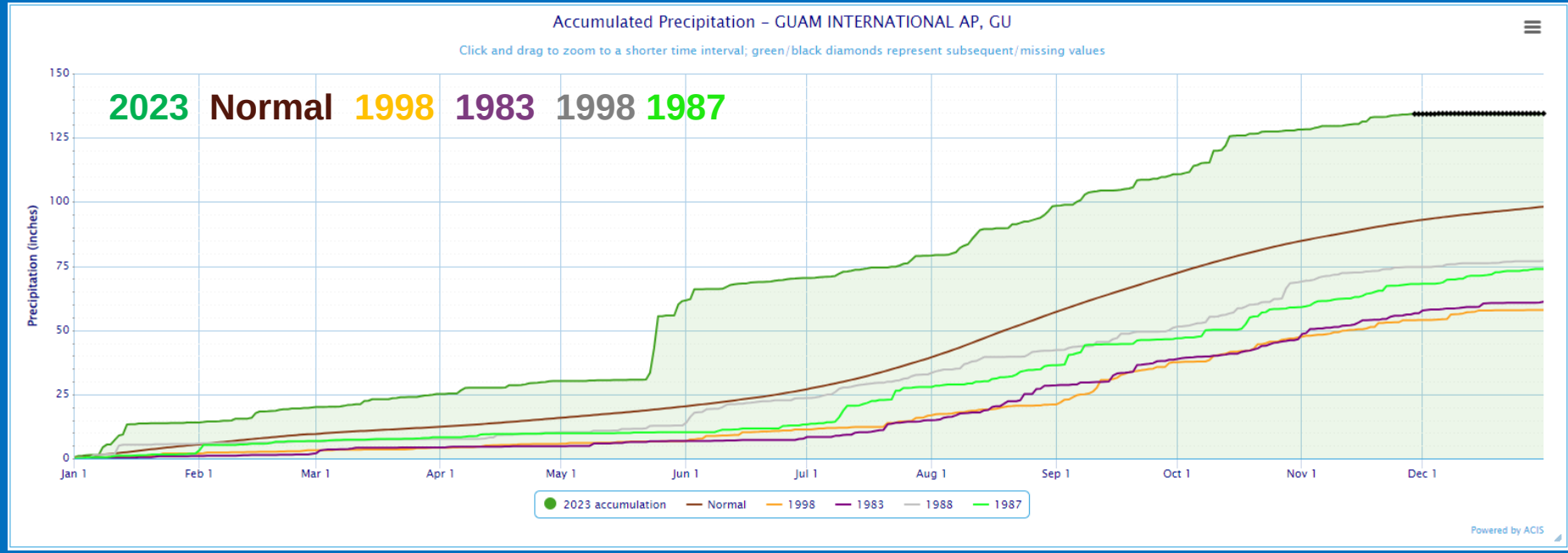
- Increasingly likely we'll see drought developing across parts of Micronesia in early 2024
  - Worst threat likely for far Western Micronesia
- Lingering late-season TC risk (Dec-Jan)
- Lower sea levels due to El Nino could lead to increased coral bleaching in shallow reef areas



2023 Rainfall & Other Very Wet Years



2023 Rainfall & El Nino *Dry Phase* Years



Questions?

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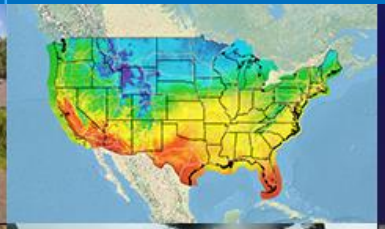
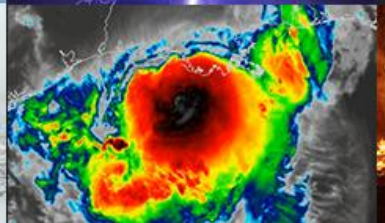
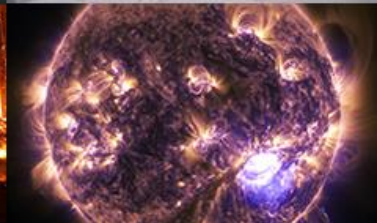
EXTRA SLIDES









Slow Atmospheric Response to SSTs

Other strong to very strong El Niño events have seen the atmosphere respond and link to the El Niño SST pattern earlier in the year (e.g. 82/83, 97/98, 15/16)

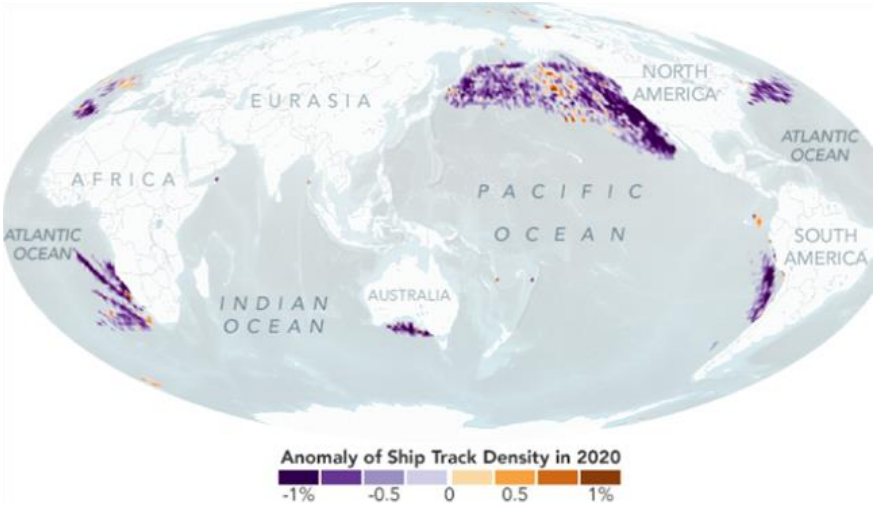
The ongoing event has been a little slower to respond. This may lead to a shift in impacts and expectations

It’s not allllllll about ENSO…

…Other Players Muddying Our Traditional Expectations

Active Area of Research - Aerosols

International Maritime Organization 2020 Regulation

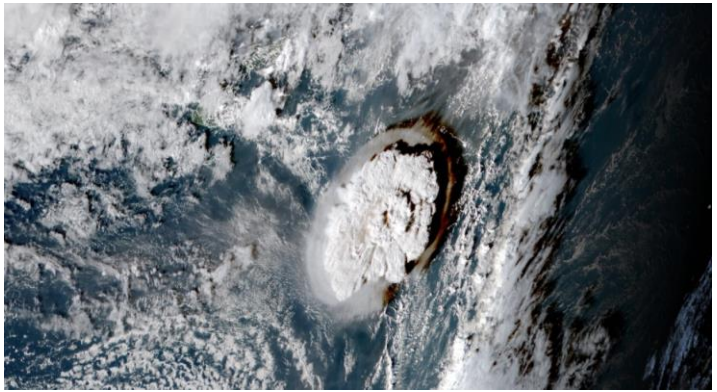


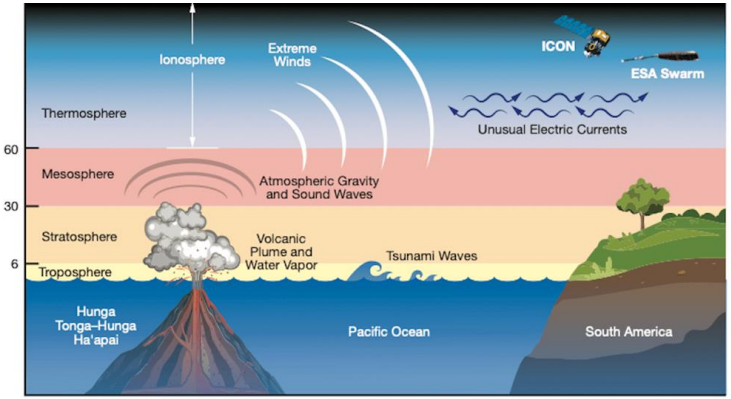
https://www.nasa.gov/missions/aqua/nasa-study-finds-evidence-that-fuel-regulation-reduced-air-pollution-from-shipping/

Jan 1 2020: The International Maritime Organization (IMO) lowered the maximum allowable amount of sulfur in shipping fuels from 3.5% to 0.5%. Most shipping vessels operate between latitudes of 30N-55N…

- increased amount of solar radiation reaches the oceans between 30N-55N
- SSTs increase, especially with lighter winds

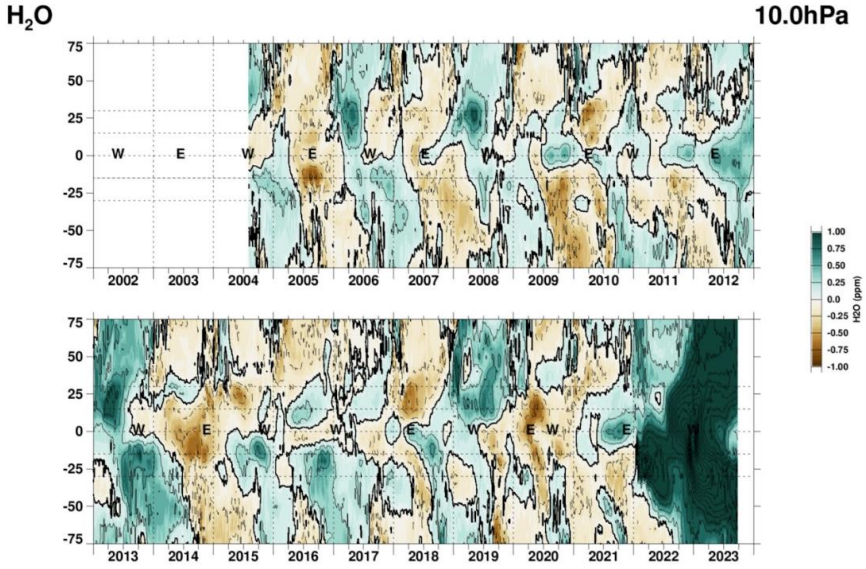
Active Area of Research





Credit: NASA's Goddard Space Flight Center/Mary Pat Hrybyk-Keith

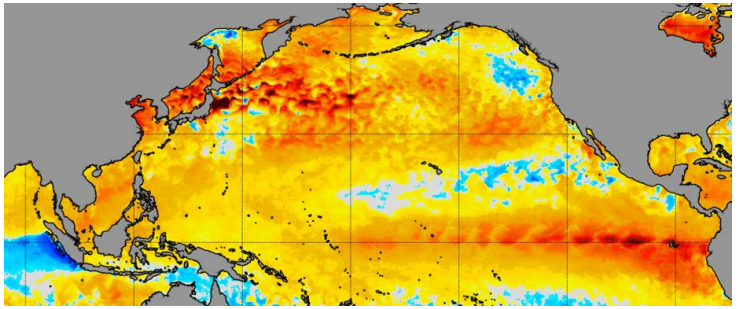
Tonga's Hunga Tonga-Hunga Ha'apai Eruption (Jan 2022)

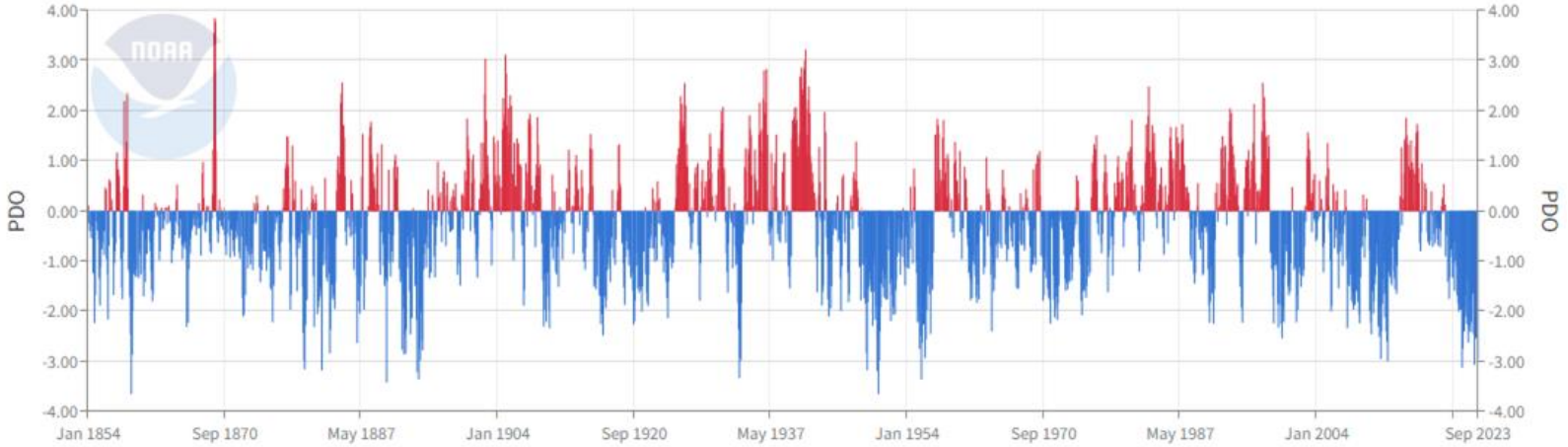


Negative Pacific Decadal Oscillation (PDO)

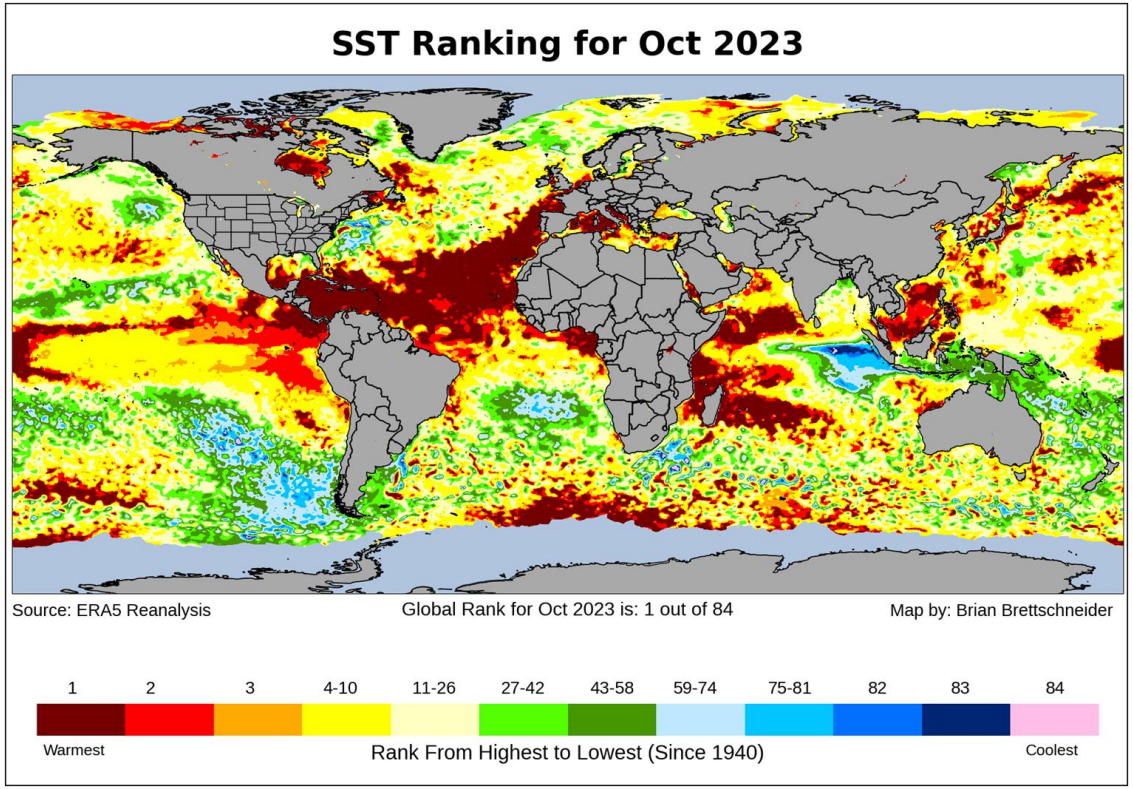
A negative PDO is characterized by warmer waters east of Japan/north of Hawaii with higher SLPs, and cooler waters off the US West Coast

- **- PDO = La Niña-like pattern**
- **+ PDO = El Niño-like pattern**





Fingerprints of Climate Change?: Record Heat

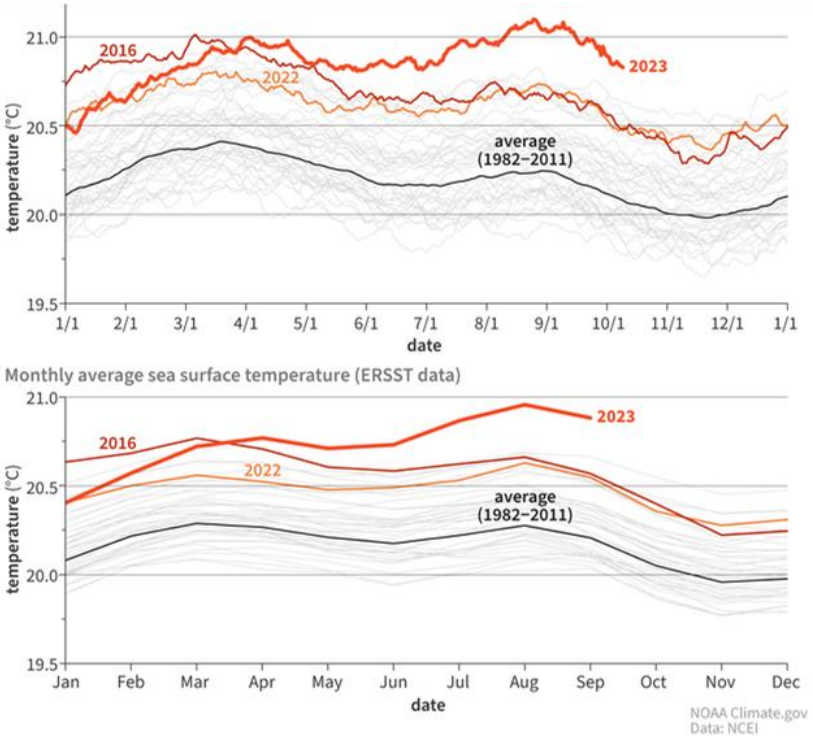


Map via Brian Brettschneider (NWS Alaska Region Climate Services Program Manager)

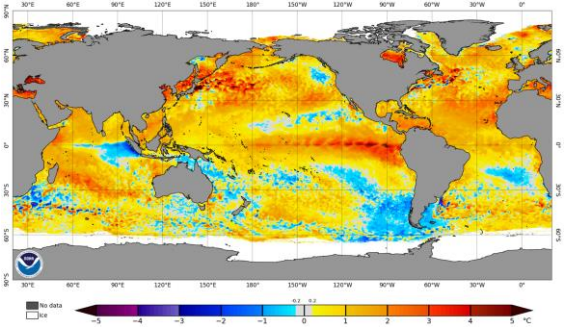
Much of the tropical and subtropical waters of the Atlantic were warmest on record for October (ERA5 Reanalysis data)

Also note the extremely impressive +IOD upwelling signal off of Sumatra, Indonesia

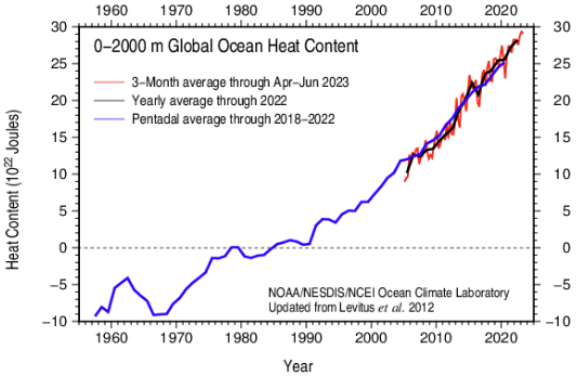
Fingerprints of Climate Change?: Record Heat



Record heat in global oceans during Sep & Oct 2023 (60°N-60°S)



1991-2020 Climatology

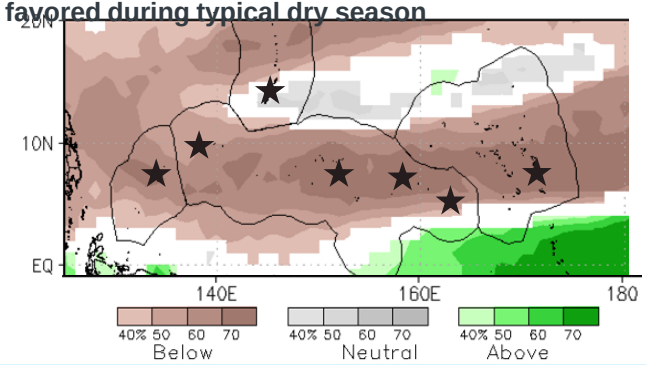


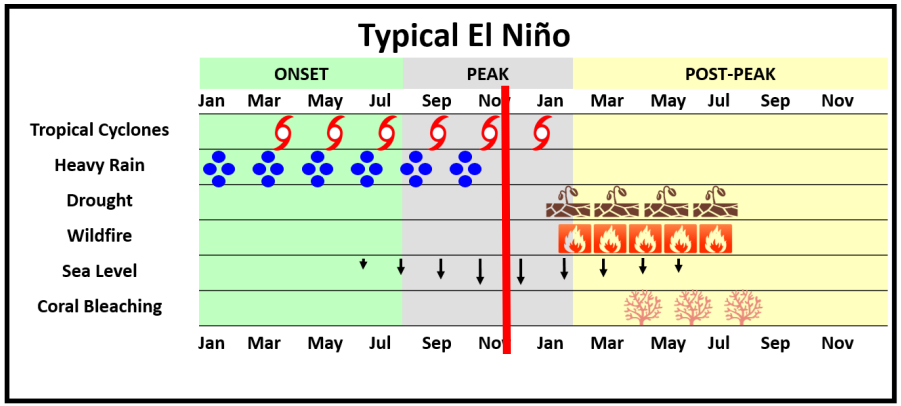
https://www.climate.gov/news-features/blogs/october-2023-el-nino-update-big-cats

Micronesia: (Guam/CNMI/ROP/FSM/RMI)

- Portions of Micronesia likely to see D2 severe drought during first half of 2024
  - Residents encouraged to protect fresh water supplies, especially atolls/smaller islands
  - Model support for a more typical dry season pattern around the Marianas
- Lingering “late season” tropical cyclone/typhoon risk
- Lower sea levels and dry phase may lead to coral bleaching in shallow reef areas (lagoons and reef flats)

NMME Model Guidance: Below normal rainfall favored during typical dry season





Takeaways

- El Niño to peak ~January 2024… with ENSO neutral favored by summer 2024
  - Historically…east-based El Niño events of this magnitude with the strength of the ongoing positive Indian Ocean dipole would lean towards La Niña late in 2024
- Although 2023/2024 El Niño is likely to be strong or even historically strong, unusual warmth of the global oceans may muddy traditional expectations and timing