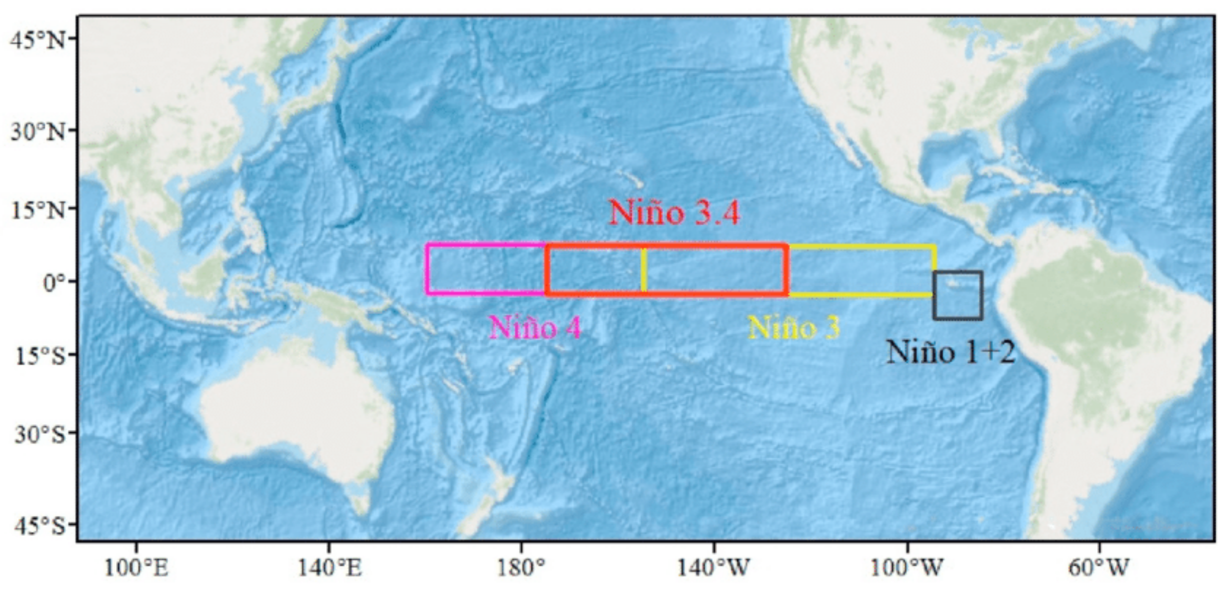
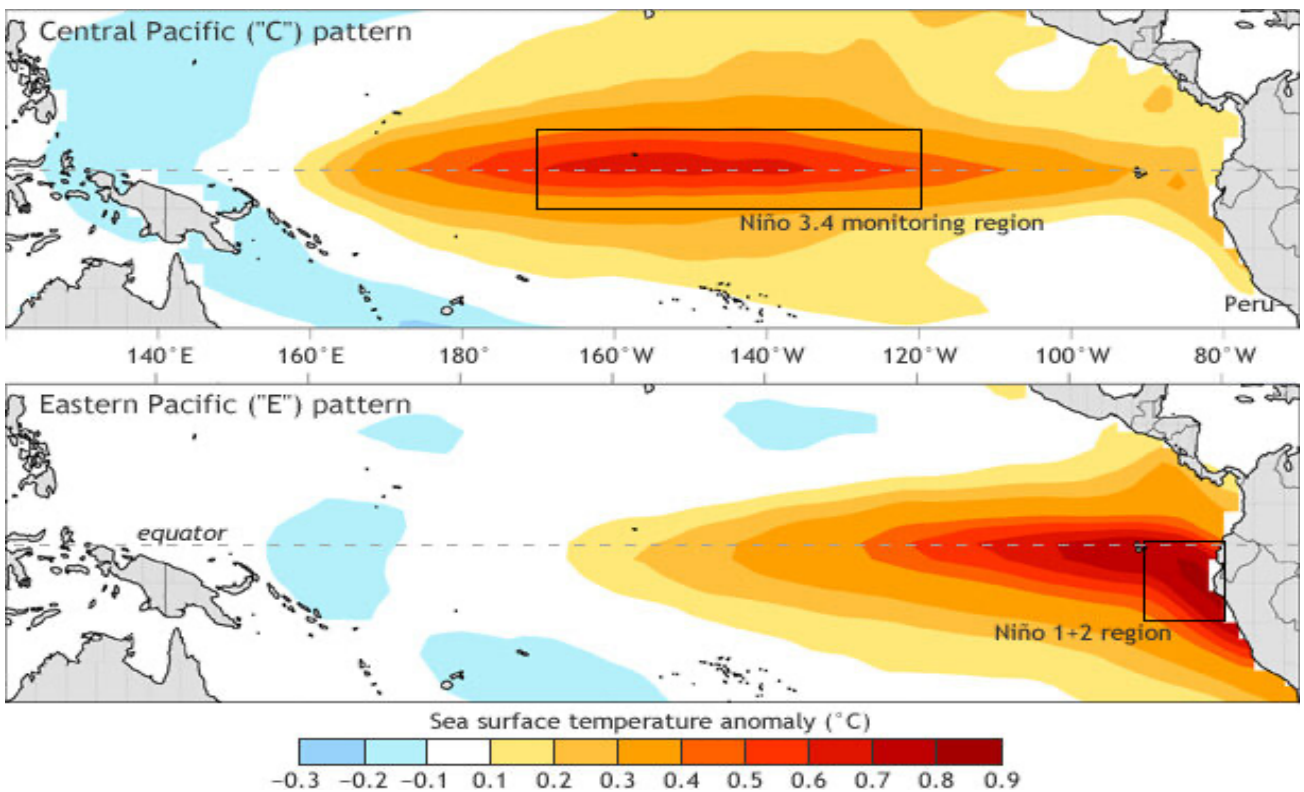
# The Two Main "Flavors" Of El Nino: Central vs. East-Based

When it comes to atmospheric events like a nor'easter or a hurricane for example, we tend to group and categorize them accordingly. No two events are ever the same; however, that doesn't mean they're dissimilar. When it comes to macro-scale events like the different phases of the El Nino-Southern Oscillation (ENSO), no two El Nino's or La Nina's are ever the same either but can render striking similarities. In this article, we'll examine two types of El Nino's: An East Pacific-Based (EP) El Nino and a Central Pacific-Based El Nino (CP). Then, we'll compare their similarities and differences for the North American winter season.

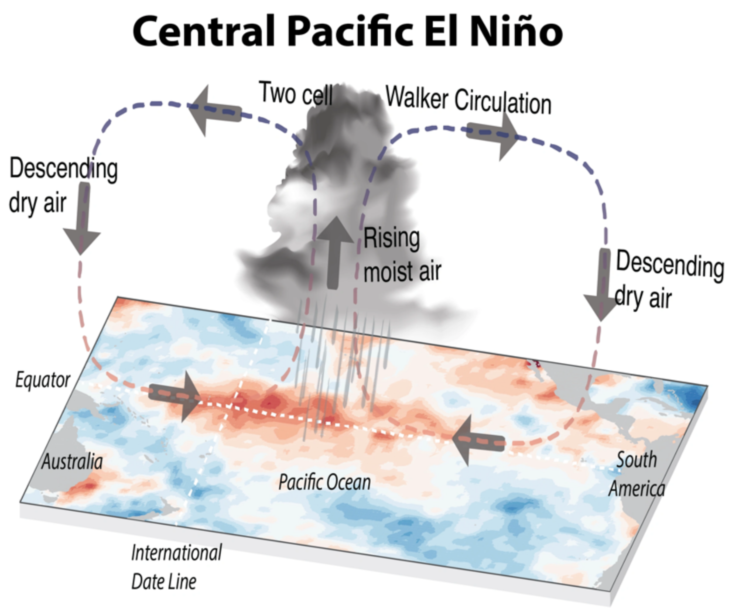
Below encompasses the entire basin of where atmospheric scientists, meteorologists, and forecasters alike look at to track the constant changes and fluid adjustments that the El Nino Southern Oscillation undergoes (Link). It's broken up into four main regions below for the essential purpose to quantify the type of event that will manifest by analyzing sea surface temperatures. From there, data can then be compiled into certain numerical weather models and utilized to make future forecasts and garner a sense of where we can see potential climate and weather implications. For instance, the "Oceanic Nino Index" is an index used to monitor how strong or weak an El Nino may be, by closely watching the region coined "Nino 3.4" over the span of three consecutive months.



Using this knowledge, we can now group a El Nino by where exactly the deepest and prevalent "warm pool" is, or the location of where the warmest sea surface temperatures are. Visually appealing graphics created from a research scientist Ken Takahashi, reveals the two El Nino distinctions and categorization. The image above shows the Central Pacific El Nino (also coined as "Modoki" El Nino) and the bottom is the classic East-Pacific El Nino. The latter is the canonical El Nino, with the greatest warmth in both magnitude and amplitude covering mainly the Nino 3 and 1+2 regions. The former type of El Nino has the greatest warmth across mainly Nino 3.4 but expands across the dateline in the Pacific and typically is characterized with weaker warm sea surface temperatures. These two main types of El Nino's and their structures with respect to where the warm pool is, has shown to result in distinct global weather and climate patterns.



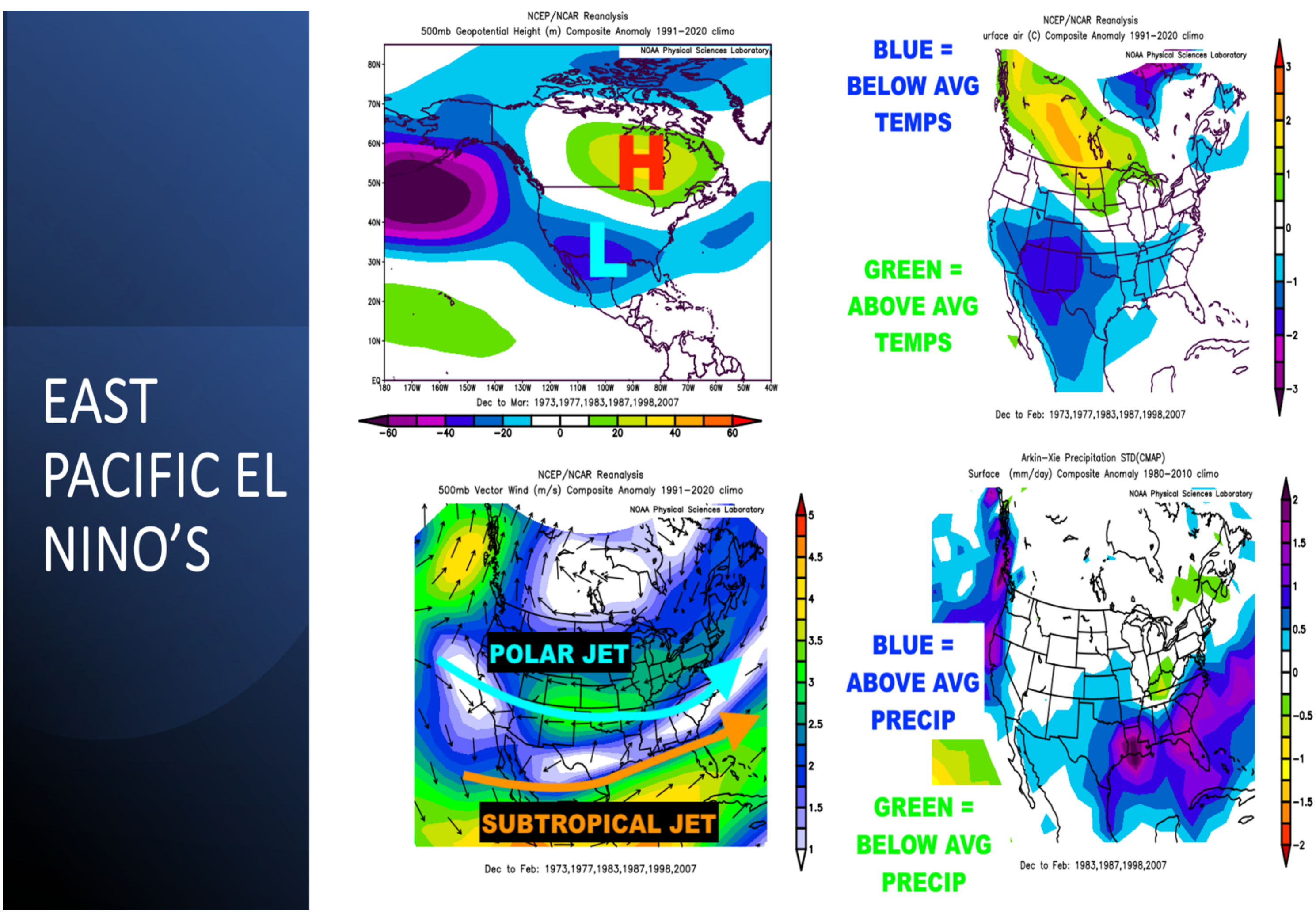

Chaos theory was developed by meteorology professor Edward Lorenz when he discovered the "butterfly effect", where one small adjustment in one area led to a near inconceivable consequence in another. This is relevant, why? Because clouds in one area like an area of convection (thunderstorms) has a profound trickle-down-effect somewhere else from a global perspective by completely adjusting the jet stream for example. This is why we look to see exactly where the placement of the warmest water is because as we all know this is where we'll find rising motion, which in turn will influence weather patterns elsewhere. These two types of events come with differences in the location of The Walker Circulation, as presented below from a research scientist Mandy Freund published in [Springer Nature](). The Central-Pacific El Nino shows rising air over the warmest waters across the Central Pacific whilst the East-Pacific El Nino has the vertical rising air centered in the East.




Between 1971 – 2010, there have been six East Pacific El Nino's and six Central Pacific El Nino's (based on Yu et al. 2012). Below, we'll analyze the weather pattern during the winter months that span Dec – Feb. Below we'll compare the mid-level height pattern that span Dec – March (500mb, or 18,000 ft), surface air temperatures (DJF), precipitation (DJF), and the zonal winds outlining the jet stream (DJF) of each type of El Nino.

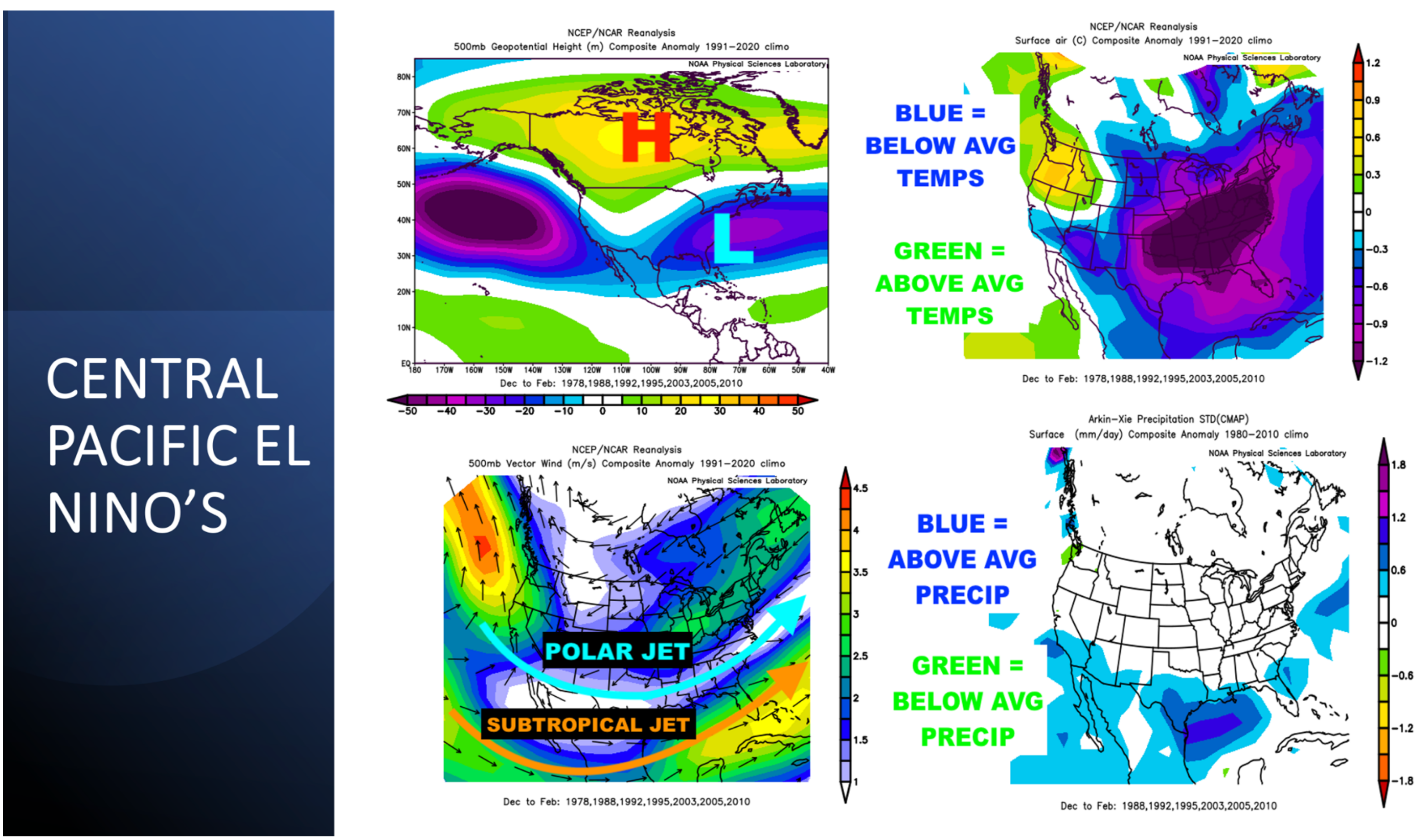
**East Pacific El Nino**

With this sample size, we find that during East Pacific El Nino's, this represents the more classic mid-level height configuration. This means a ridge that extends across southern Canada with below average heights (i.e., troughiness) centering across the Deep South and toward the Southeast. The air temperature response reveals below average temperatures centering out across the Southwest, South, and toward the Mid-Atlantic with above average temperatures mainly in the northern Plains. In terms of precipitation, we see typically a surplus of above average precipitation along the West Coast especially California. Another area of above average precipitation extends from the Southwest up the East Coast into the Mid-Atlantic. The polar jet is pushed south across the Midwest and into the Mid-Atlantic with an active Subtropical jet extending across southern Texas into Florida.



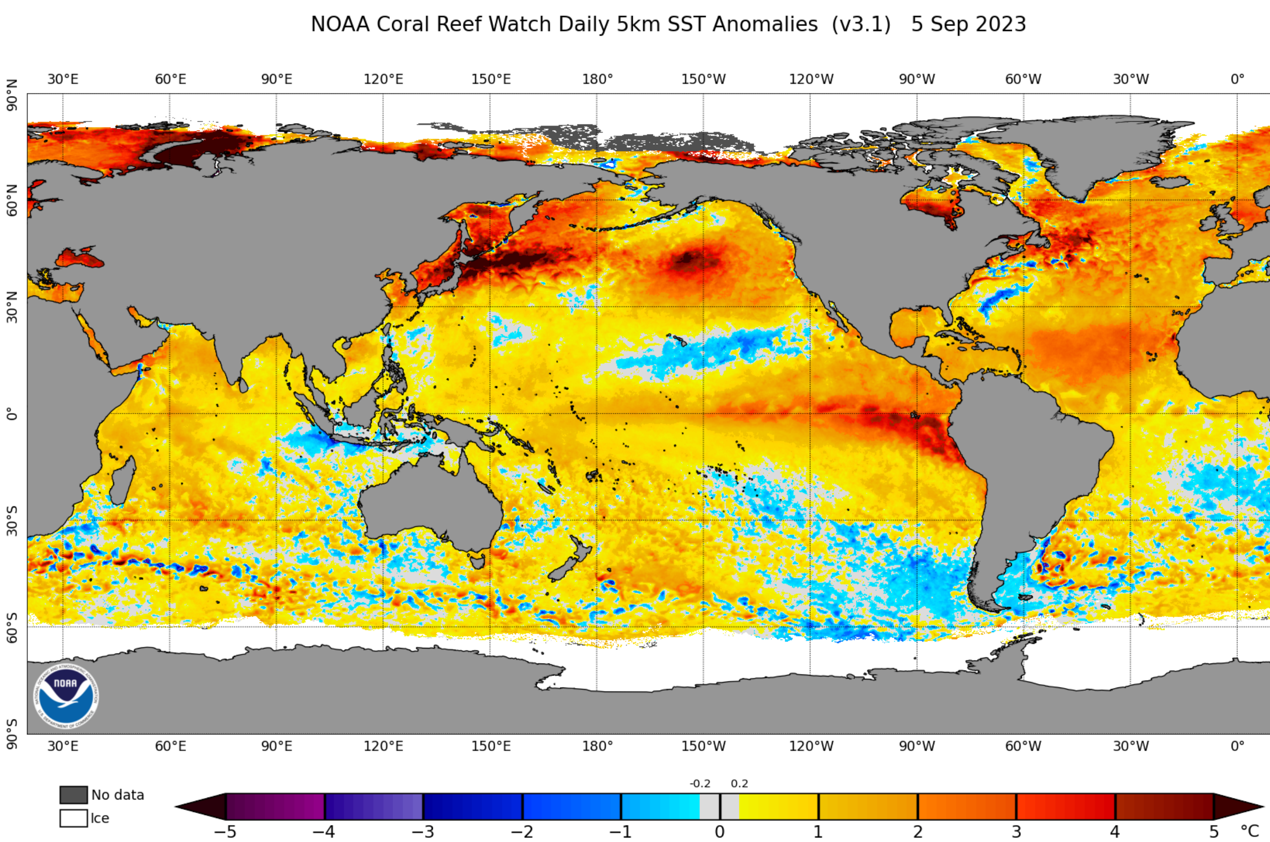

**Central Pacific El Nino**

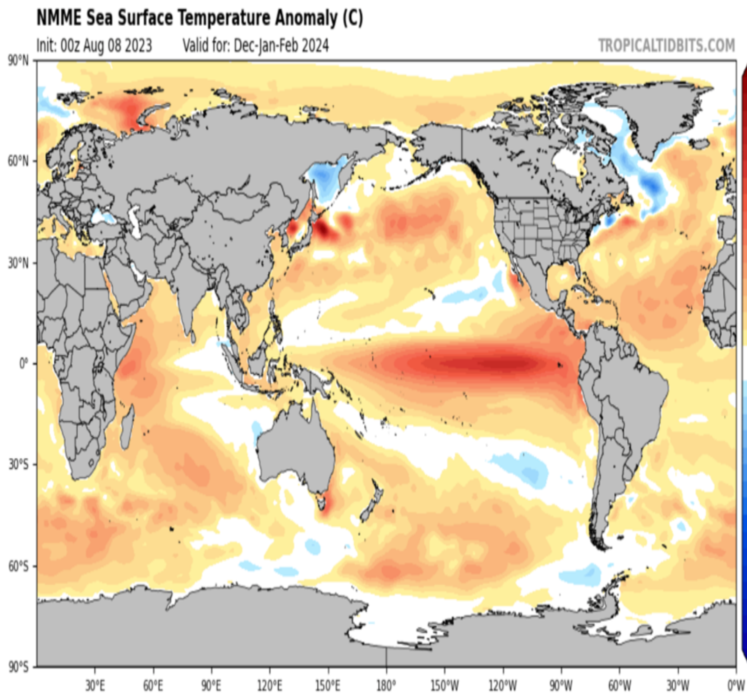
Again, with an even distributed sample size of six, we see averaged during the winter months of Dec-Feb,  a more notable expansion of positive heights (ridging) across Canada and into Alaska. This has a bit more profound implications for the U.S. With more ridging across Alaska and especially across the Intermountain West (i.e., +PNA for those who know), this facilitates a more southward polar jet stream thereby allowing a conducive setup for colder air masses to spill into the U.S. east of the Rockies. This is backed by the glaring “bullseye” of well below average temperatures denoted by the deeper purple and blue that spans from the Midwest to the East Coast. With any El Nino in general, the subtropical jet will be active and in the case of a Central Pacific Nino, here the subtropical jet is directed further southward relative to the East Pacific Nino. This makes sense given the that the bulk of the above average precipitation is shown to expand across the southern regions and along the Gulf Coast, while subtly also reaching up the Eastern Seaboard. Any winter weather fan, especially those that reside in the Northeast and is familiar with “Modoki” Nino, gets quite antsy in their anticipation for the winter coinciding with these events. It’s shown through Central Pacific Nino’s we tend to see colder airmasses flood into the U.S., which in general will produce more in the way of snowfall opportunities.

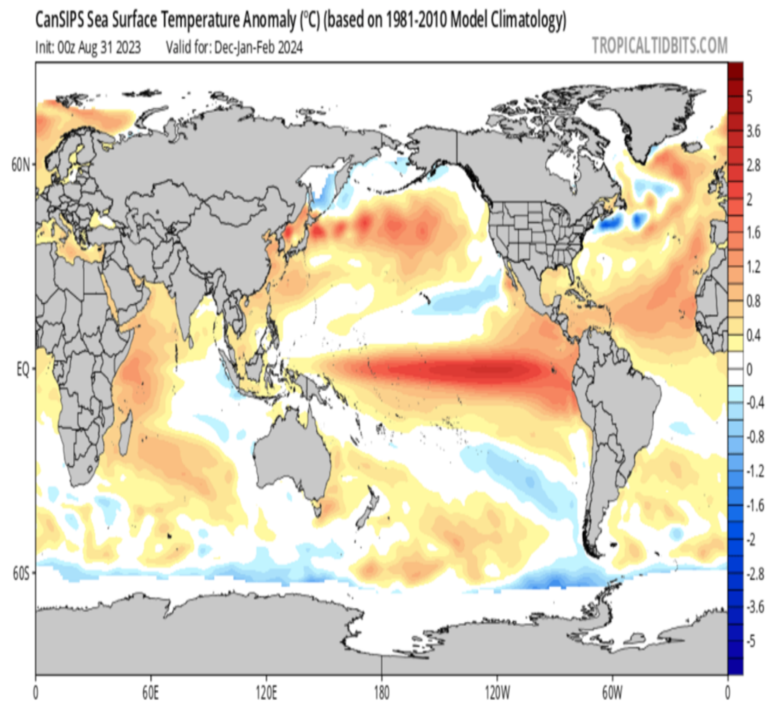


# Current El Nino Status and Winter 23-24

The current snapshot as of early September 2023 reveals a more canonical El Nino, where it's mainly east based. We see the warmest anomalies extend just off Ecuador (Nino 1+2) and toward about 150*W longitude (Nino 3, eastern portion of Nino 3.4). We're going to be observers and watch to see how this unfolds as we enter the winter months especially since the latest ONI for the June-July-August average increased up to 1.1*C, with the previous three-month average value recorded at 0.8*C. Dynamical models have this event remaining a moderate to strong El Nino through winter. Below, however, are climate models of the NMME and CanSIPS for the Dec-Feb timeframe. Interestingly enough, both those the warm pool developing more toward the dateline with some weakening in the Eastern Pacific. As aforementioned, we're just going to sit back and watch this unfold since it's the location of where the warmest sea surface temperatures are that have implications for the North American winter season.






# Conclusion

- **East Pacific El Nino's are known as the classic types where the warmest waters are located off South America and toward about 150*W longitude. This promotes rising motion mainly in this area, causing differences in climate and weather patterns globally.**
- **Central Pacific El Nino's have the warmest waters mainly across the International Dateline, though tend to be weaker in magnitude. Rising motion across this region facilitates different weather and climate patterns as well, especially across North America.**
- **IMPORTANT: Given how chaotic and unpredictable the atmosphere is regardless that ENSO is the leading mode of air-ocean interactions, and its influence globally; there can be "more at work". Just because there's a specific type of El Nino, it doesn't mean the following season follow's suit accordingly. Additional intraseasonal variations (i.e., tropical forcing, stratospheric phenomenon, etc.) add high uncertainty in long-range forecasts and simply can alter weather patterns quite drastically.**