Impacts of ENSO

Composite Mean of 250-hPa Geopotential Height Anomalies in El Nino Years

- ENSO impacts weather and climate on the global scale.
- The teleconnection associated with the ENSO can be regarded as stationary Rossby waves.
- ENSO also impacts the Indian Ocean and the Atlantic by modulating the Walker circulation.

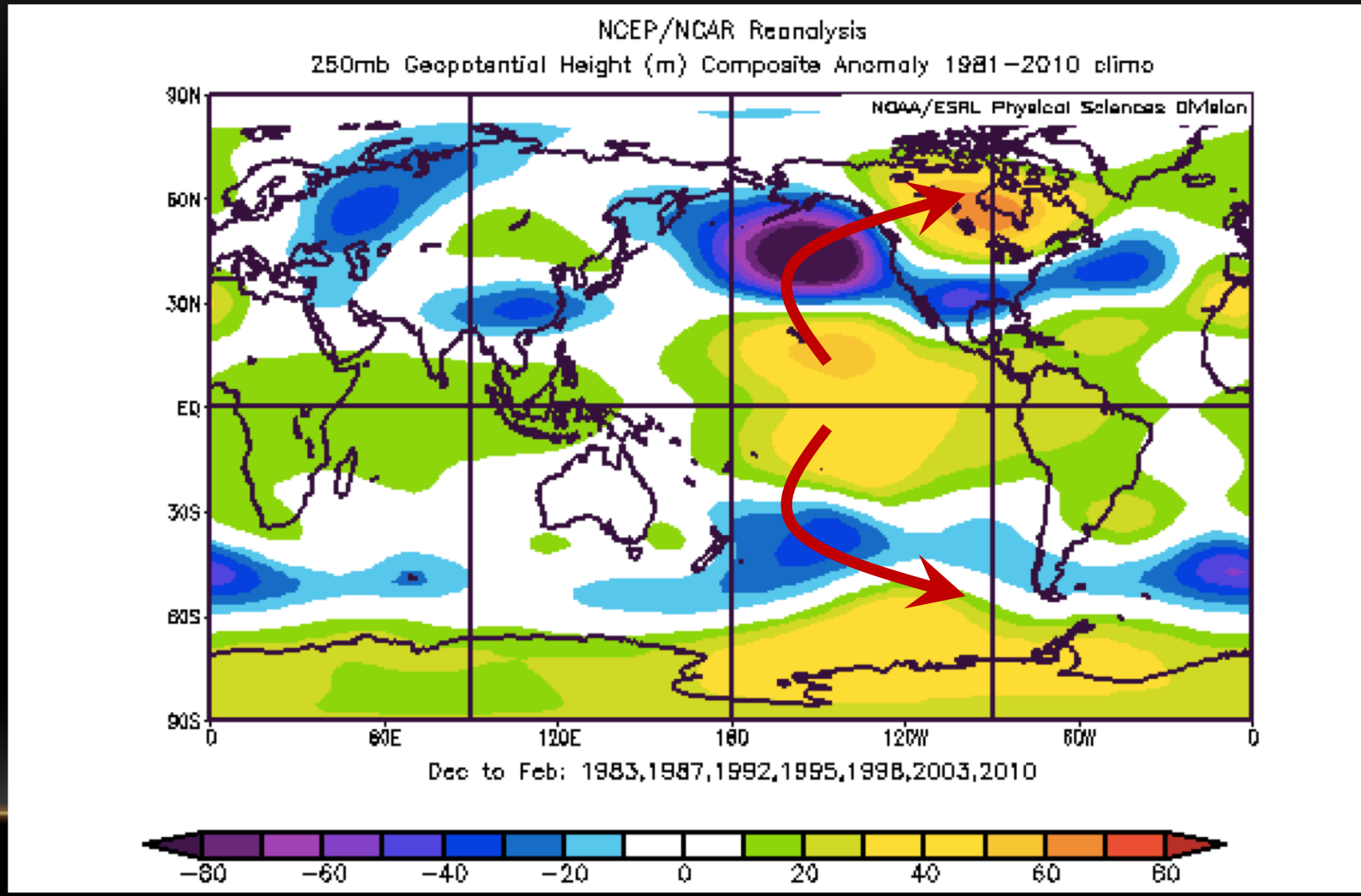
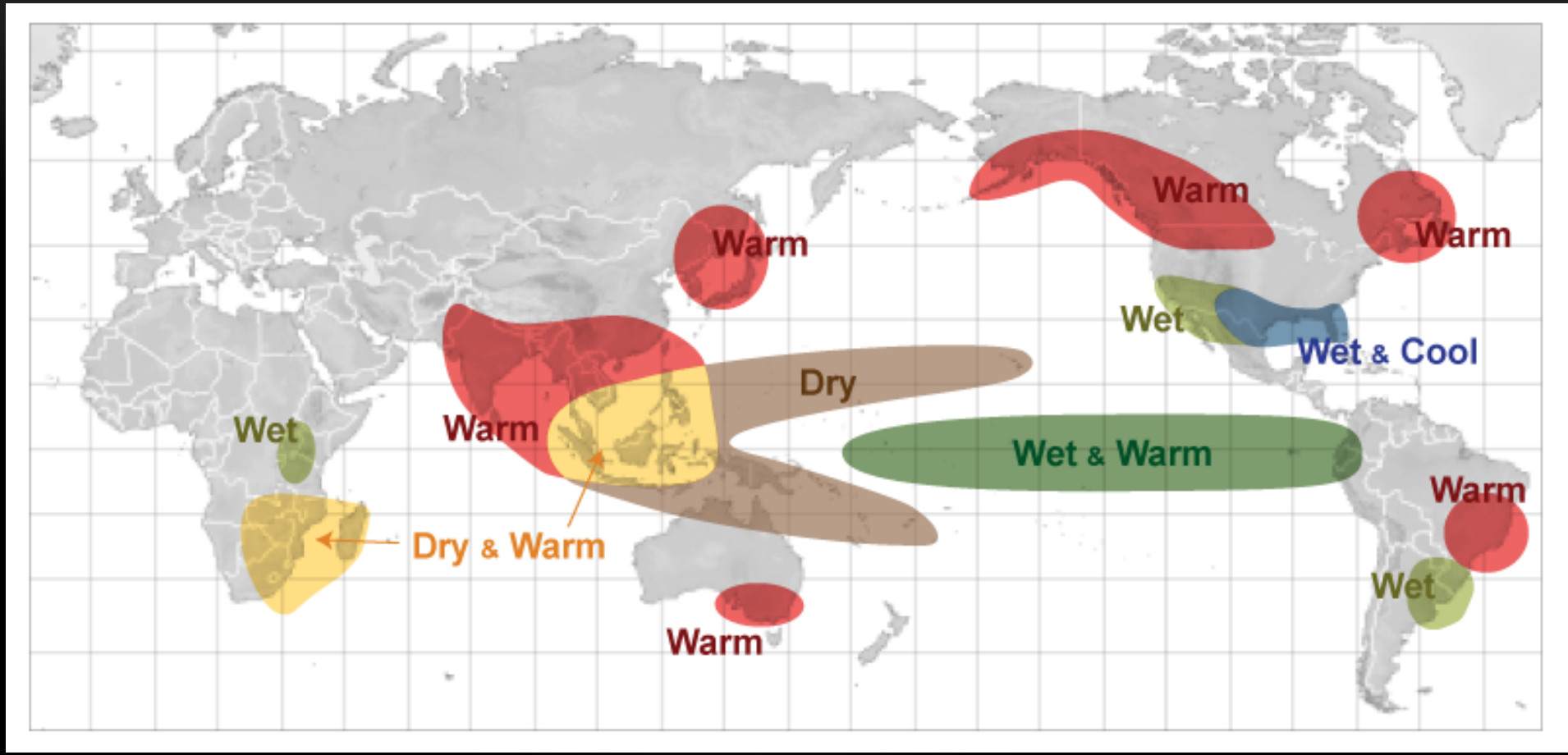


Figure produced at https://psl.noaa.gov/cgi-bin/data/composites/printpage.pl

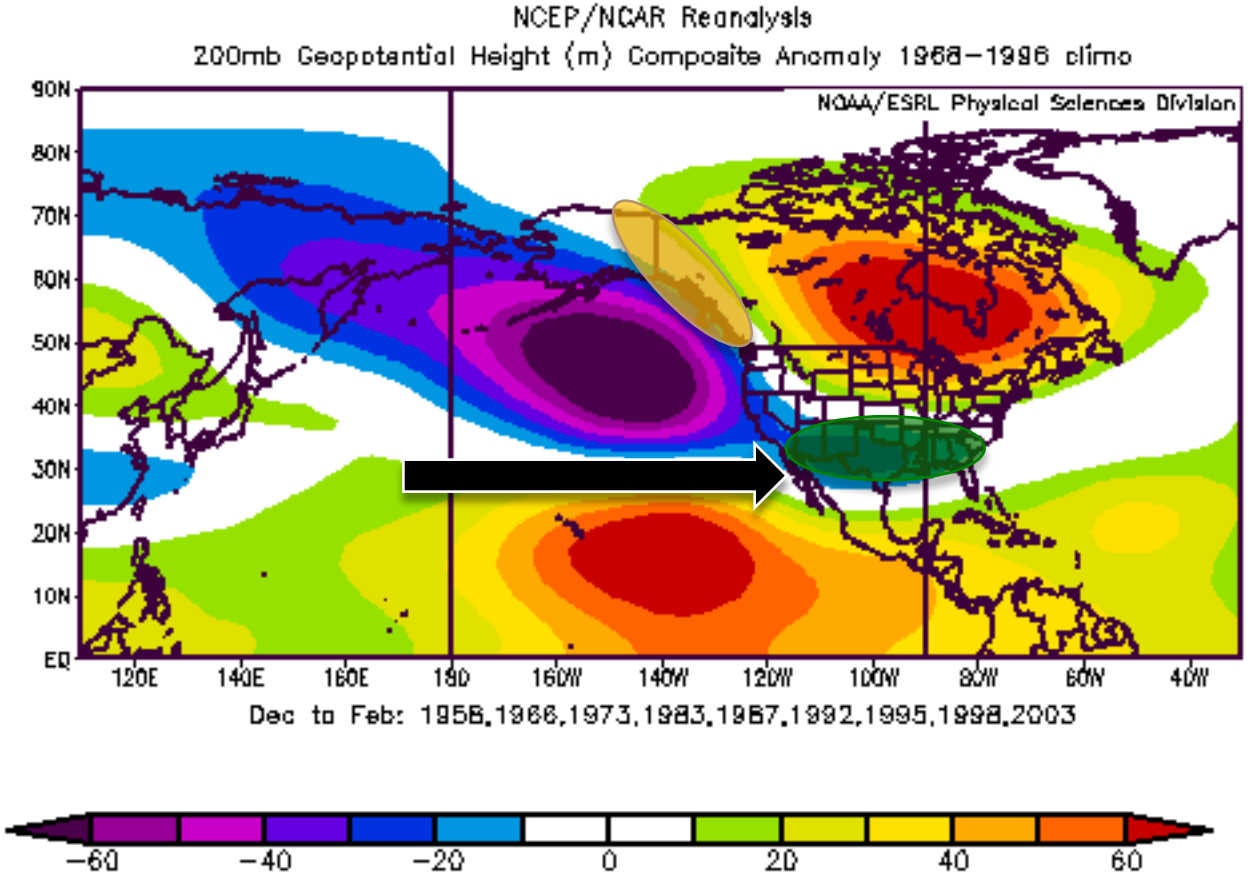
Climate Impacts of El Nino



- ENSO produces large-scale changes in global temperature and precipitation, which make ENSO an important source for seasonal to interannual predictability.

Figure from https://www.weather.gov/jetstream/enso_impacts

200 hPa Geopotential Height Composite during El Nino Events: The Pacific-North American (PNA) Pattern



Positive PNA; enhanced and more extended jet

ENSO can affect the extratropical climate through Rossby wave trains that modulate the Pacific-North American (PNA).

Figure produced at https://psl.noaa.gov/cgi-bin/data/composites/printpage.pl

Climate Impacts of La Nina

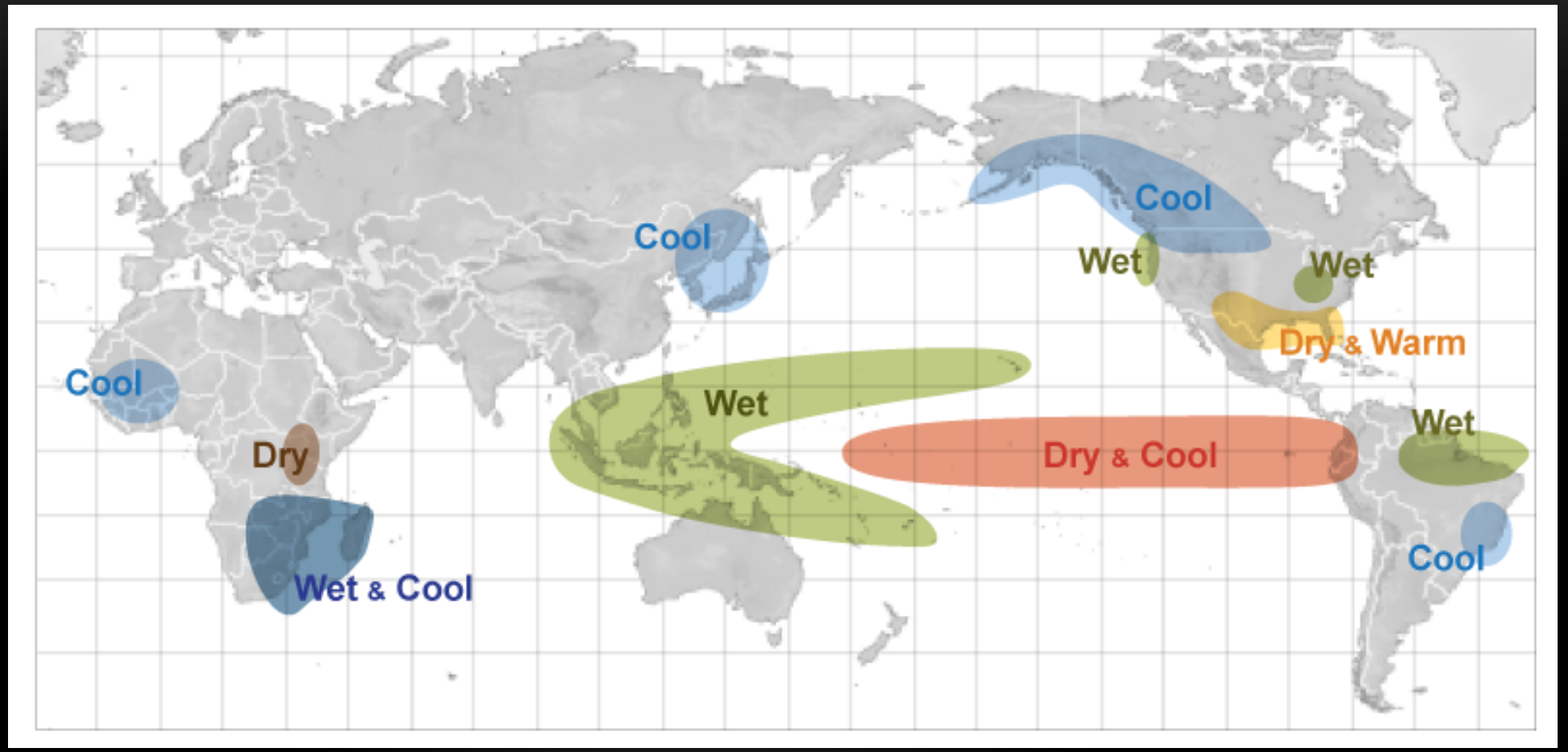
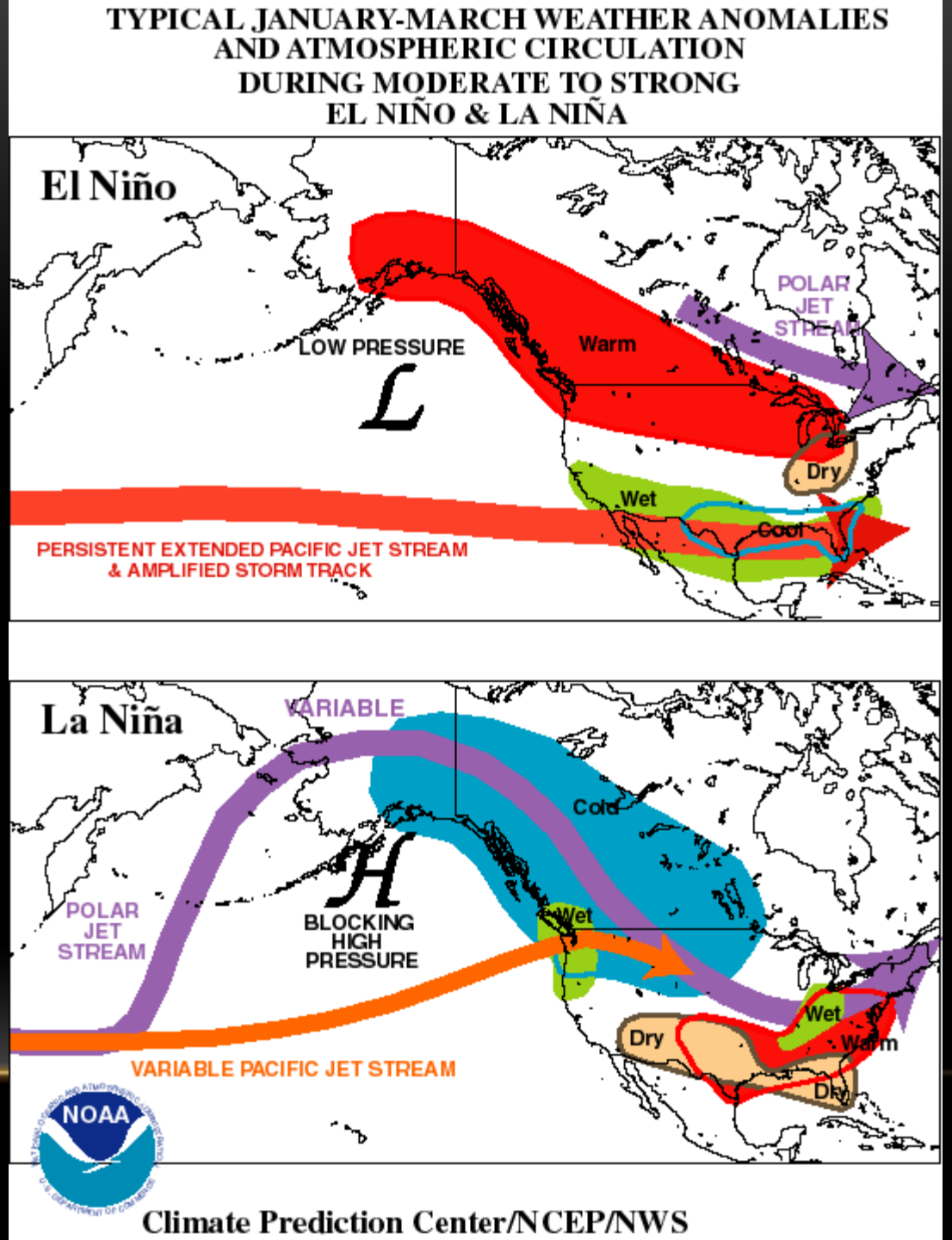
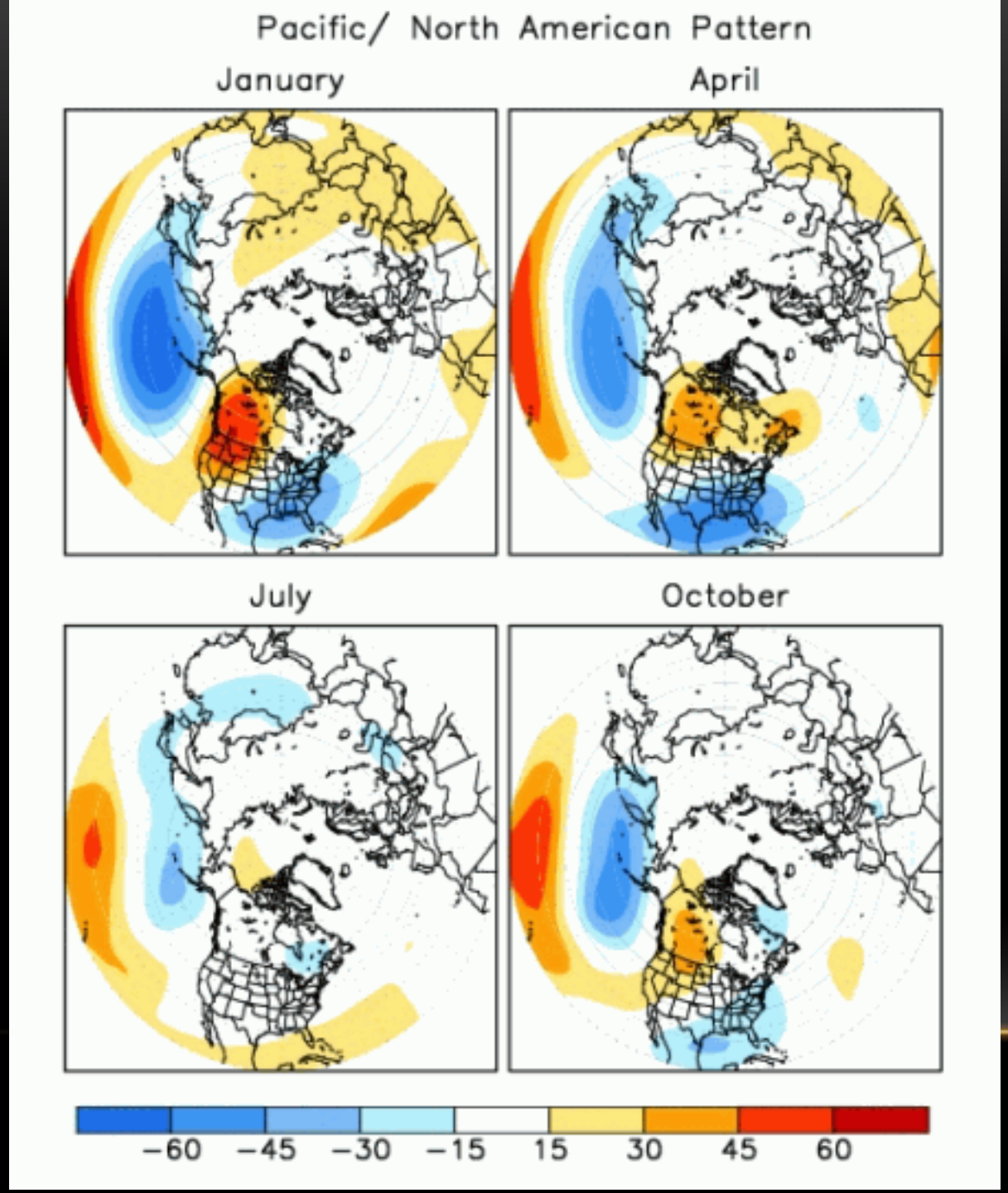


Figure from https://www.weather.gov/jetstream/enso_impacts

Related winter features over North America

- El Niño: a strong jet stream and storm track across the southern part of the United States, and less storminess and milder-than-average conditions across the North.
- La Niña: a very wave-like jet stream flow, with colder and stormier than average conditions across the North, and warmer and less stormy conditions across the South.



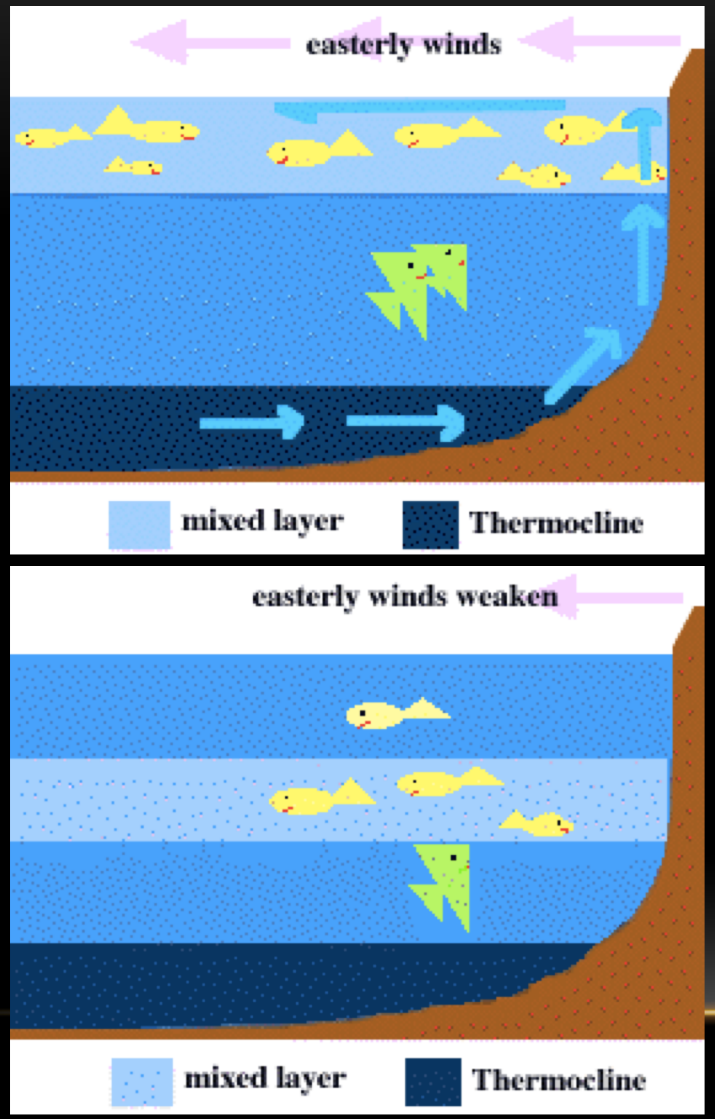


PNA and ENSO

- The Pacific/ North American teleconnection pattern (PNA) is one of the most prominent modes of low-frequency variability in the Northern Hemisphere extratropics.
- The positive phase of the PNA pattern features above-average heights in the vicinity of Hawaii and over the intermountain region of North America, and below-average heights south of the Aleutian Islands and over the southeastern U.S.
- The PNA pattern is associated with strong fluctuations in the strength and location of the jet stream and storm track.

https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml

Impacts on Fisheries



During non-El Niño years, upwelling brings up colder waters from depths of 40-80 meters or more. This deep sea water is rich in nutrients which can sustain large fish populations.

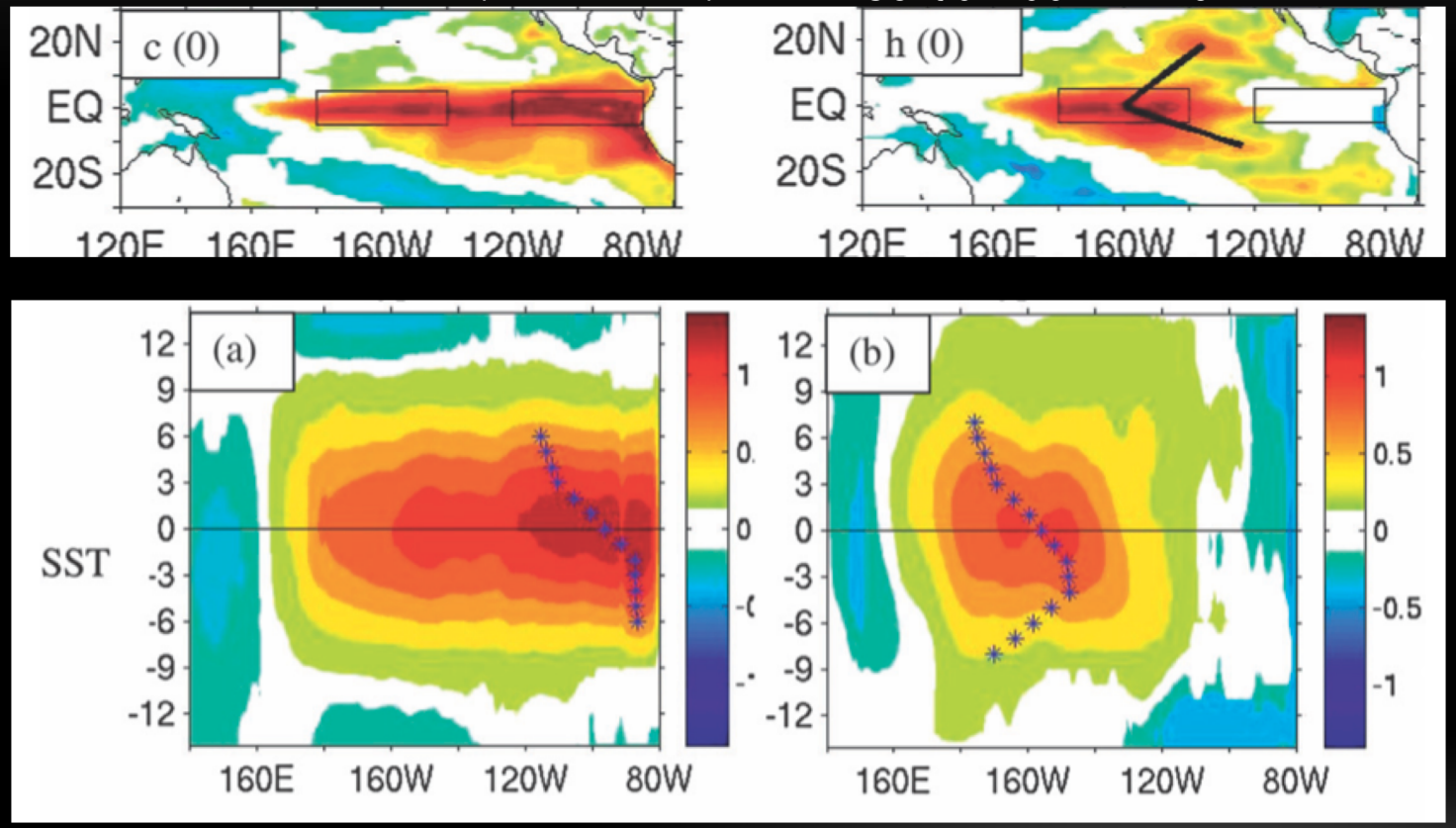
During an El Niño event, the southeast trade winds weaken and so does the upwelling in the eastern Pacific. The thermocline deepens. Any upwelling that does occur is unable to tap into the rich nutrients found in deeper waters. Consequently, warm nutrient-poor water predominates the region and a decrease in the fish population is observed.

http://www.pmel.noaa.gov/elnino/impacts-of-el-nino

Two Types of El Nino

Eastern Pac El Nino (conventional)

Central Pac. El Nino



(Top) SST anomaly patterns and (Bottom) time-longitude evolution of SST anomalies along the equator for the two types of El Nino (from Yu et al. 2010 © American Meteorological Society. Used with permission)

The two types of El Nino have different impacts:

Eastern Pacific El Nino (EPE) is characterized by warming over the eastern Pacific, which extends to the Central Pacific; For Central Pacific El Nino (CPE), warming is confined to the Central Pacific

The EPE affects winter temperatures primarily over the Great Lakes, Northeast, and Southwest US, while the largest impact from CPE is on T in the northwestern and southeastern US. (Yu et al. 2012)

CPE is associated with a greater-than-average frequency and increasing landfall potential of TCs along the Gulf of Mexico coast and Central America, in contrast to the reduced TC activity during EPE.

References

- NOAA CPC the ENSO Cycle: https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensocycle/enso_cycle.shtml
- ENSO impacts: https://www.weather.gov/jetstream/enso_impacts
- Yu, J., Kao, H., & Lee, T. (2010). Subtropics-Related Interannual Sea Surface Temperature Variability in the Central Equatorial Pacific, *Journal of Climate*, *23*(11), 2869-2884.