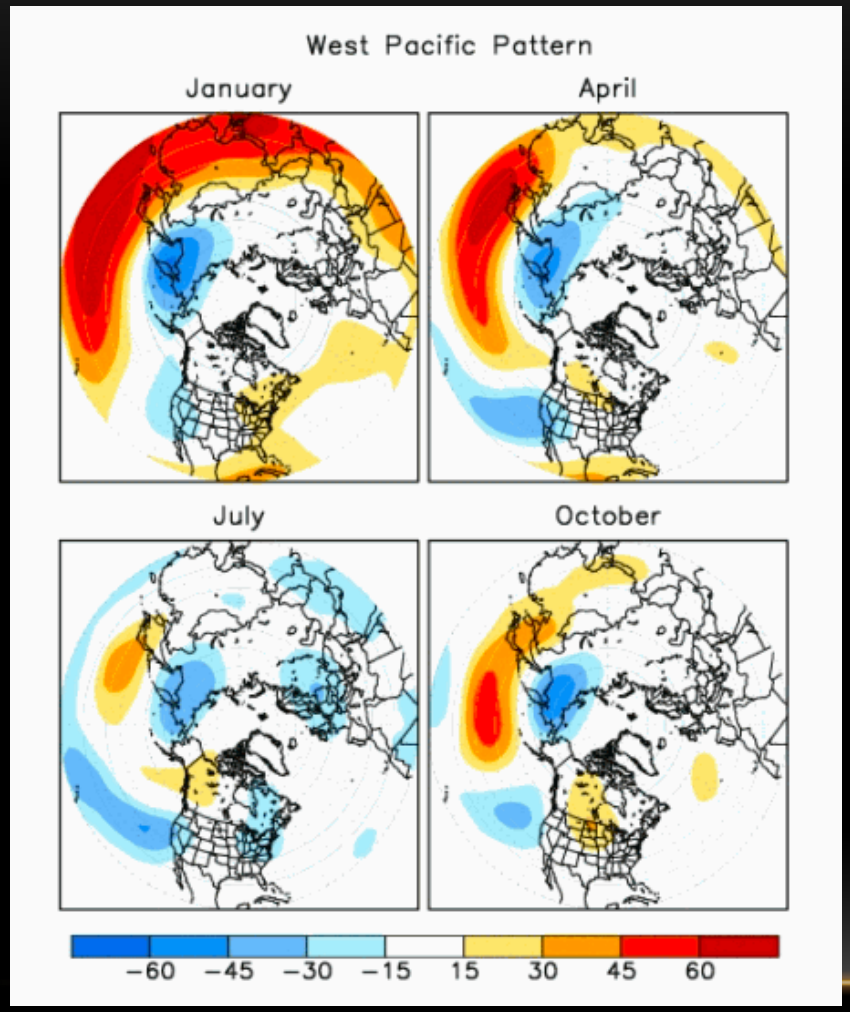
Other Climate Modes and Teleconnection Patterns

West Pacific (WP) Pattern

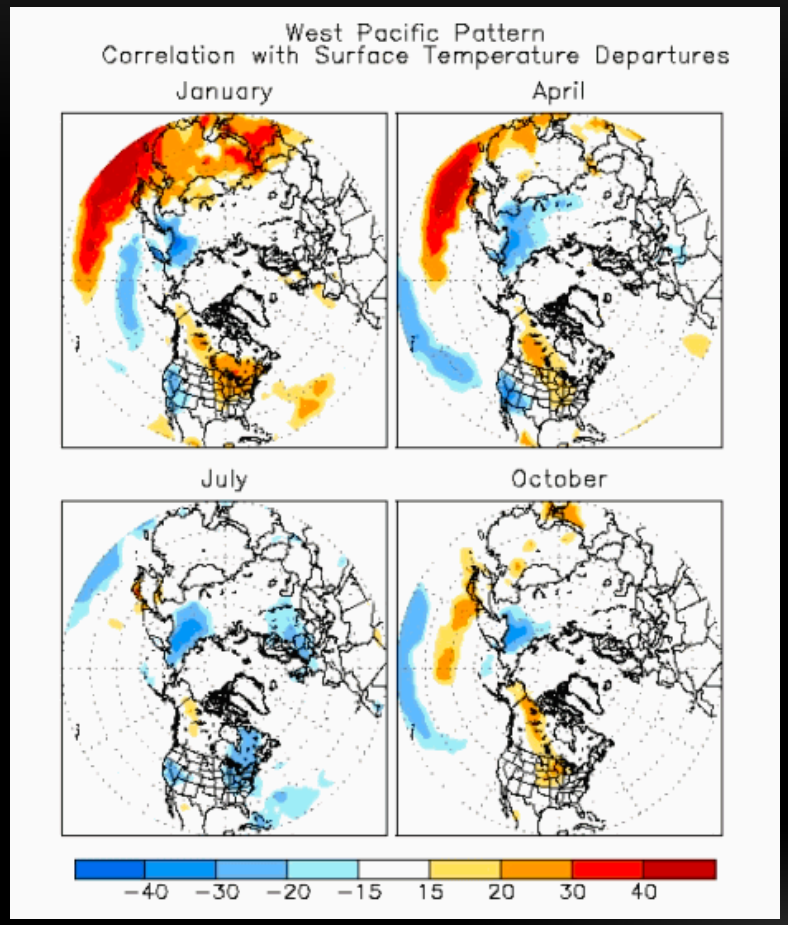


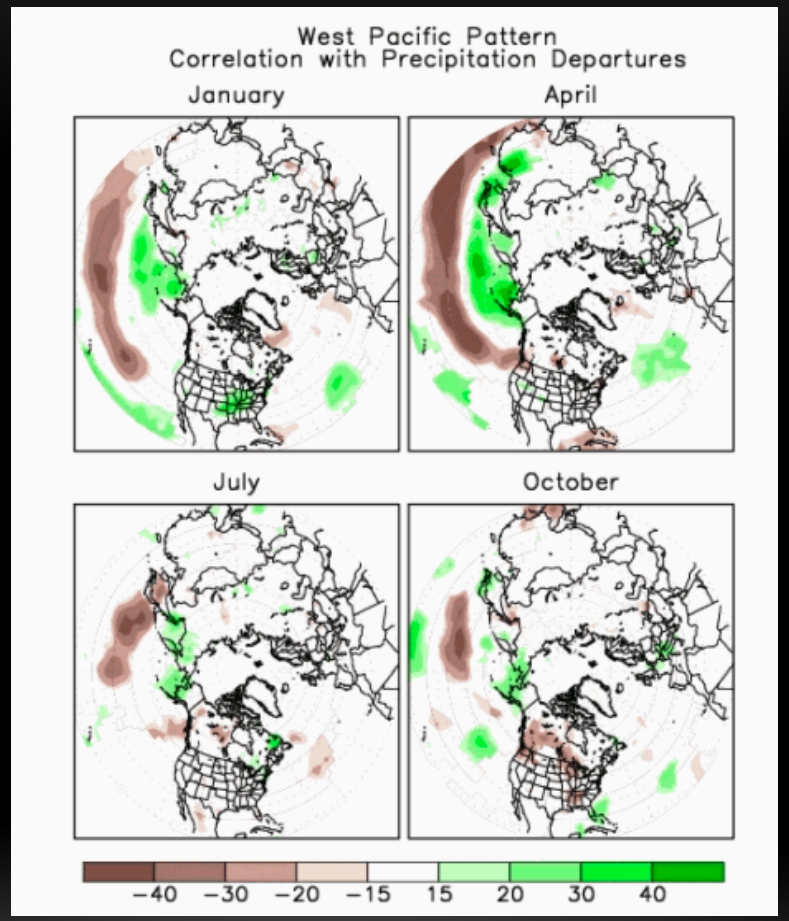
Correlation between the monthly standardized height anomalies and the teleconnection pattern time series for the specified month.

From the CPC (https://www.cpc.ncep.noaa.gov/data/teledoc/wp.shtm)

- A primary mode of low-frequency variability over the West Pacific in all months
- During winter and spring, the pattern consists of a north-south dipole of anomalies; associated with pronounced variations in the location and intensity of the Pacific (or East Asian) jet steam.
- These anomalies exhibit a strong northward shift from winter to summer, consistent with the observed northward shift of the PacificS jet stream.
- A third anomaly center is located over the eastern North Pacific and southwestern United States in all seasons.

WP+: Surface Temperature and Precipitation

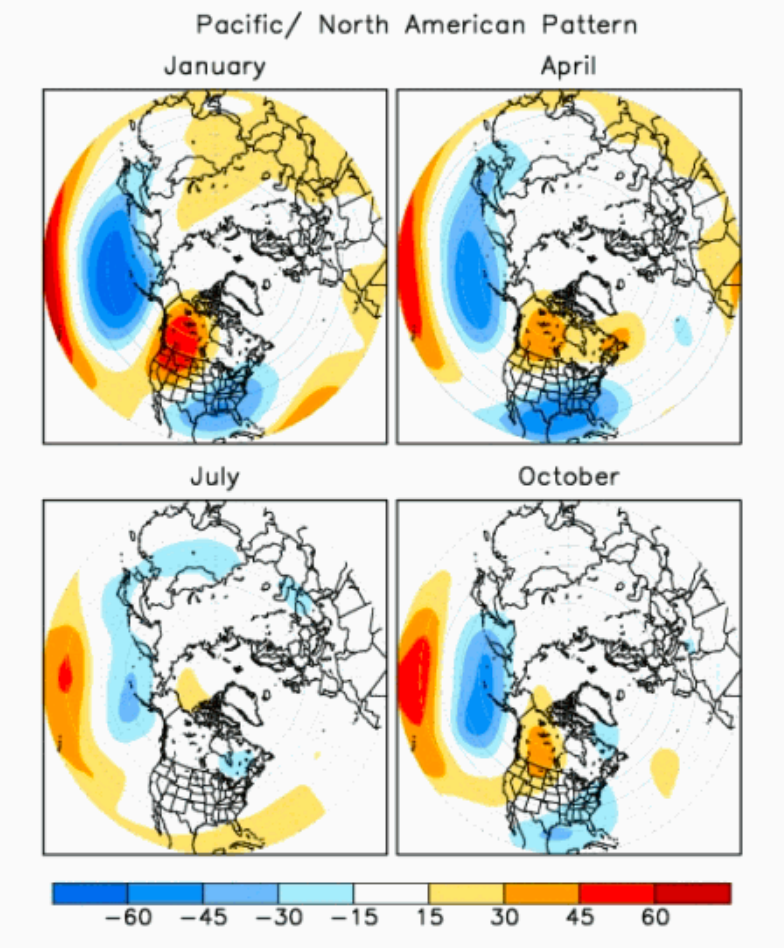




- WP+ is associated with positive temperature anomalies over the lower latitudes of the western North Pacific, and with negative temperature anomalies over eastern Siberia.
- WP+ is also associated with positive precipitation anomalies in all seasons over the high latitudes of the North Pacific, and negative precipitation anomalies across the central North Pacific.
- Strong correlations during the winter and spring.

https://www.cpc.ncep.noaa.gov/data/teledoc/wp.shtm

Pacific/North American (PNA) Pattern

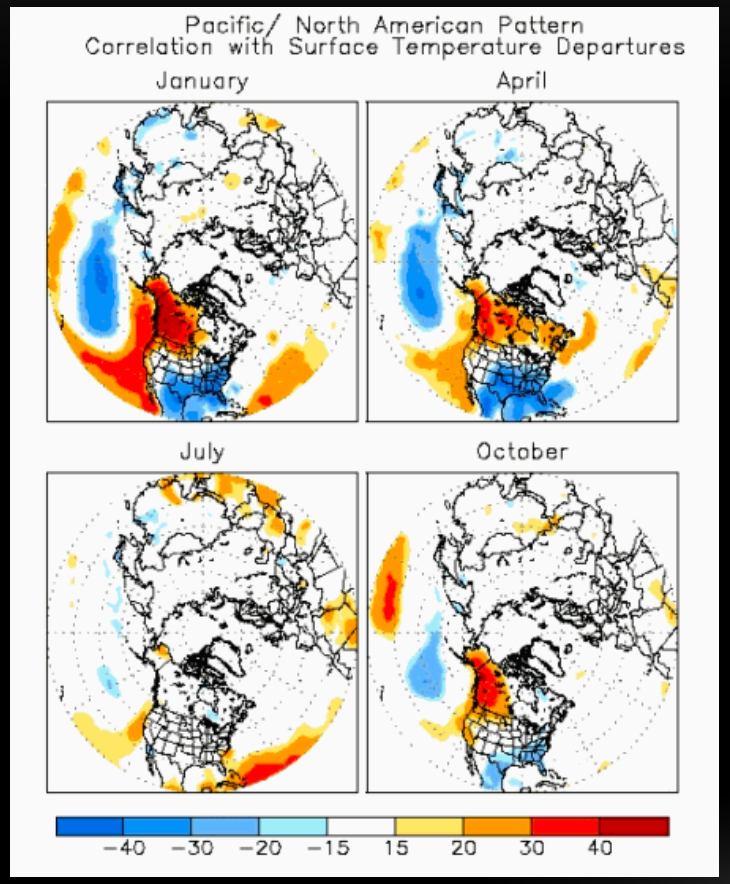


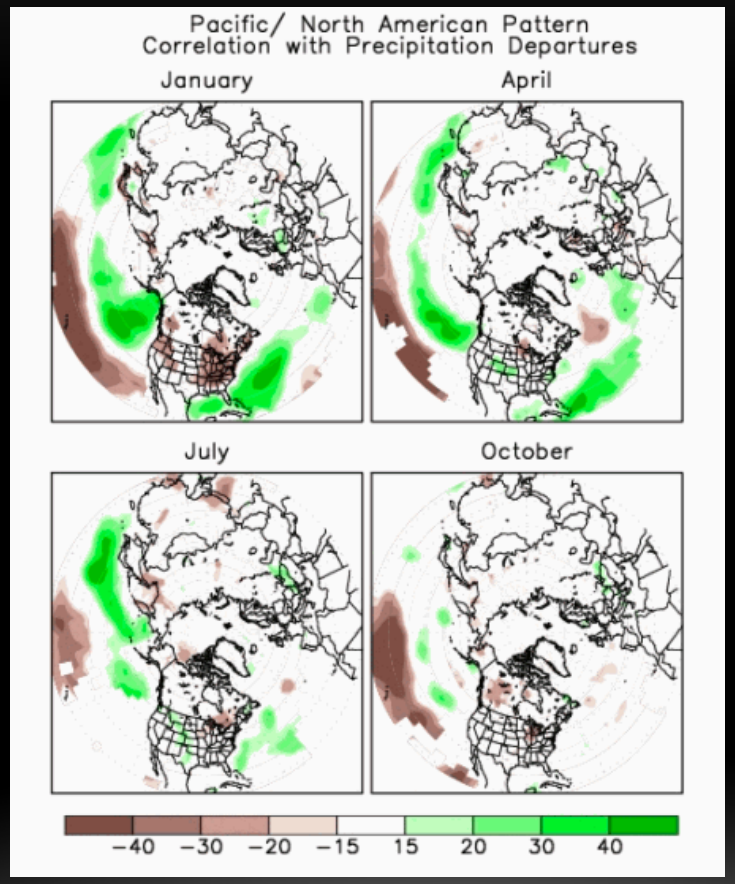
Correlation between the monthly standardized height anomalies and the teleconnection pattern time series for the specified month.

From the CPC (https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml)

- PNA is one of the most prominent modes of low-frequency variability in the Northern Hemisphere extratropics.
- The PNA pattern is associated with strong fluctuations in the strength and location of the East Asian jet stream.
  - The positive phase is associated with an enhanced East Asian jet stream and with an eastward shift in the jet exit region toward the western United States.
  - The negative phase is associated with a westward retraction of that jet stream toward eastern Asia, enhanced blocking activity over the high latitudes of the North Pacific, and a split-flow configuration over the central North Pacific.
- The PNA is strongly influenced by the ENSO. The positive phase of the PNA pattern tends to be associated with the warm phase of ENSO.

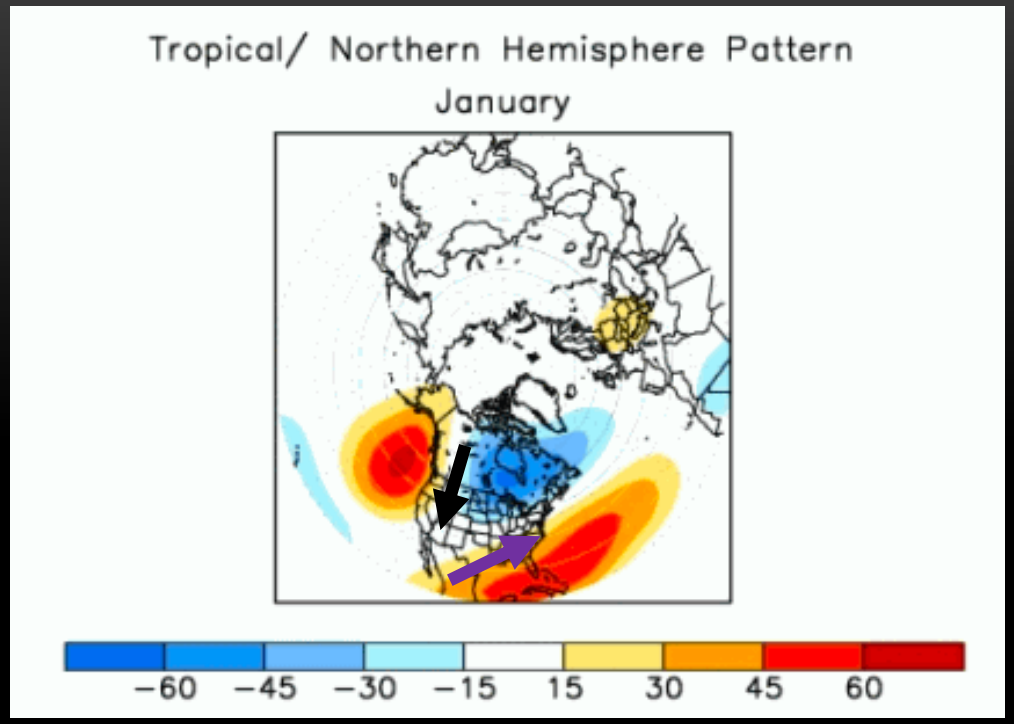
PNA+: Surface Temperature and Precipitation

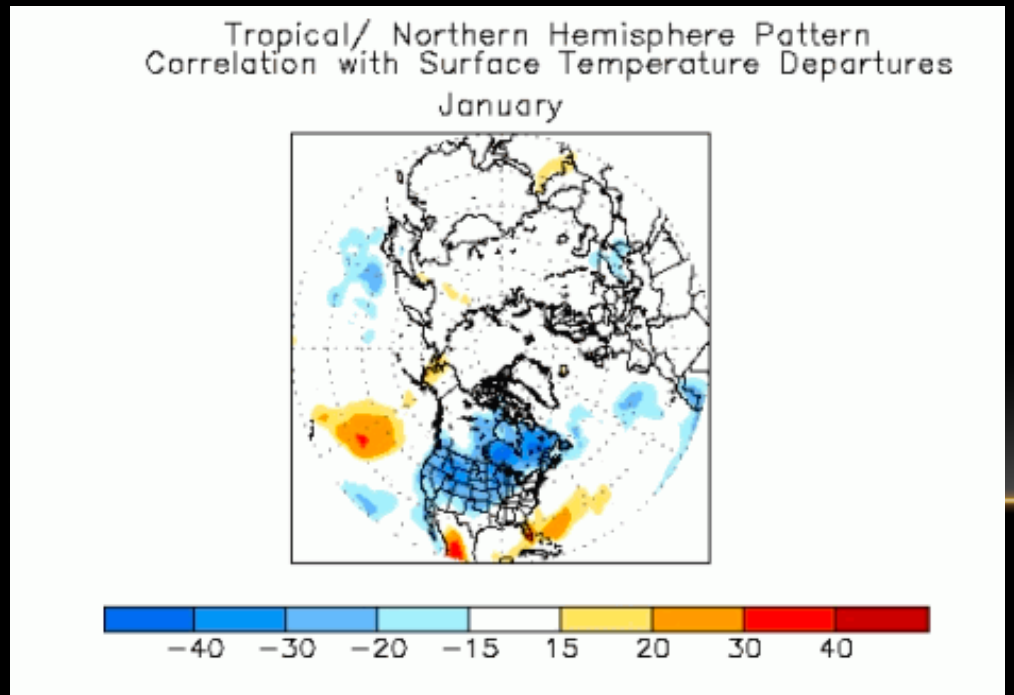




- The positive phase of the PNA pattern is associated with above-average temperatures over western Canada and western United States, and below-average temperatures across the south-central and southeastern United States in winter. The PNA tends to have little impact on surface temperature variability over North America during summer.
- The associated precipitation anomalies include above-average totals in the Gulf of Alaska extending into the Pacific Northwestern United States, and below-average totals over the upper Midwestern United States.

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





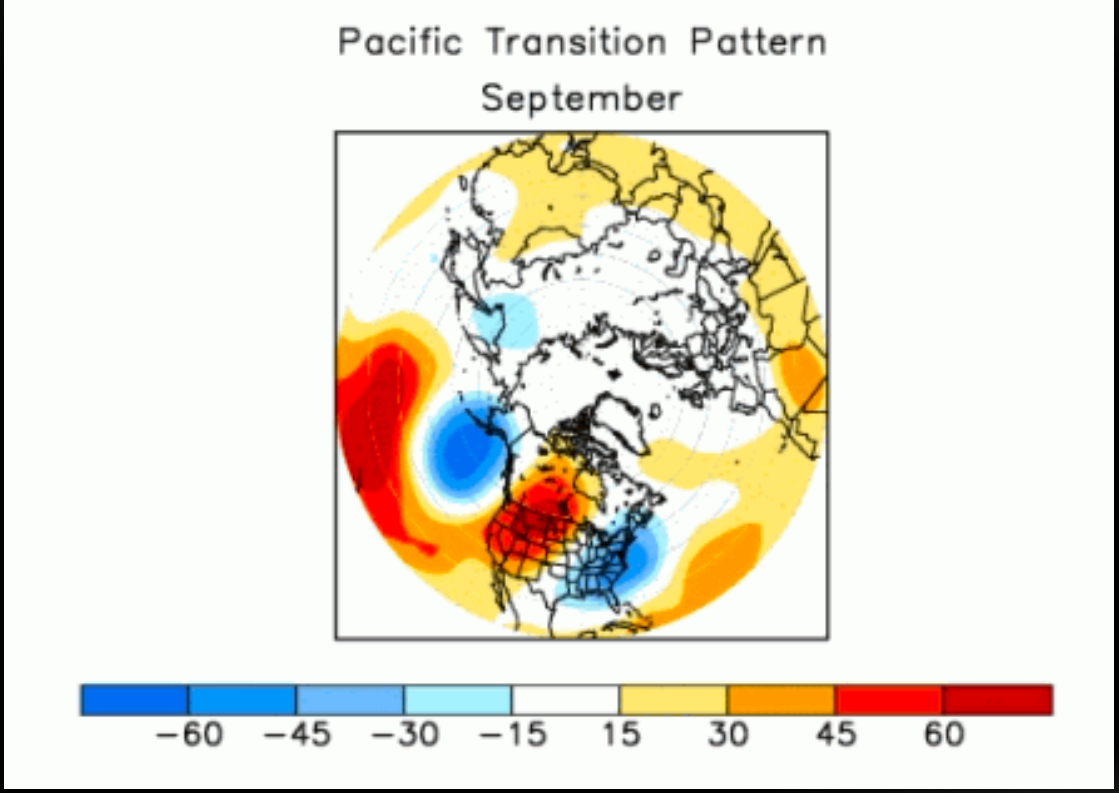
Tropical/Northern Hemisphere (TNH) pattern

From the CPC (https://www.cpc.ncep.noaa.gov/data/teledoc/tnh.shtm)

- The TNH pattern is a prominent wintertime mode during December-February.
- The positive phase of the TNH pattern features above-average heights over the Gulf of Alaska and from the Gulf of Mexico extending northeastward across the western North Atlantic, and below-average heights throughout eastern Canada.
- The TNH pattern reflects large-scale changes in both the location and eastward extent of the Pacific jet stream.
- The pattern significantly modulates the flow of marine air into North America, as well as the southward transport of cold air from Canada into the north-central United States.

Correlation between the monthly standardized height (top)/precipitation (bottom) anomalies and the teleconnection pattern time series for the specified month.

Pacific Transition (PT) Pattern

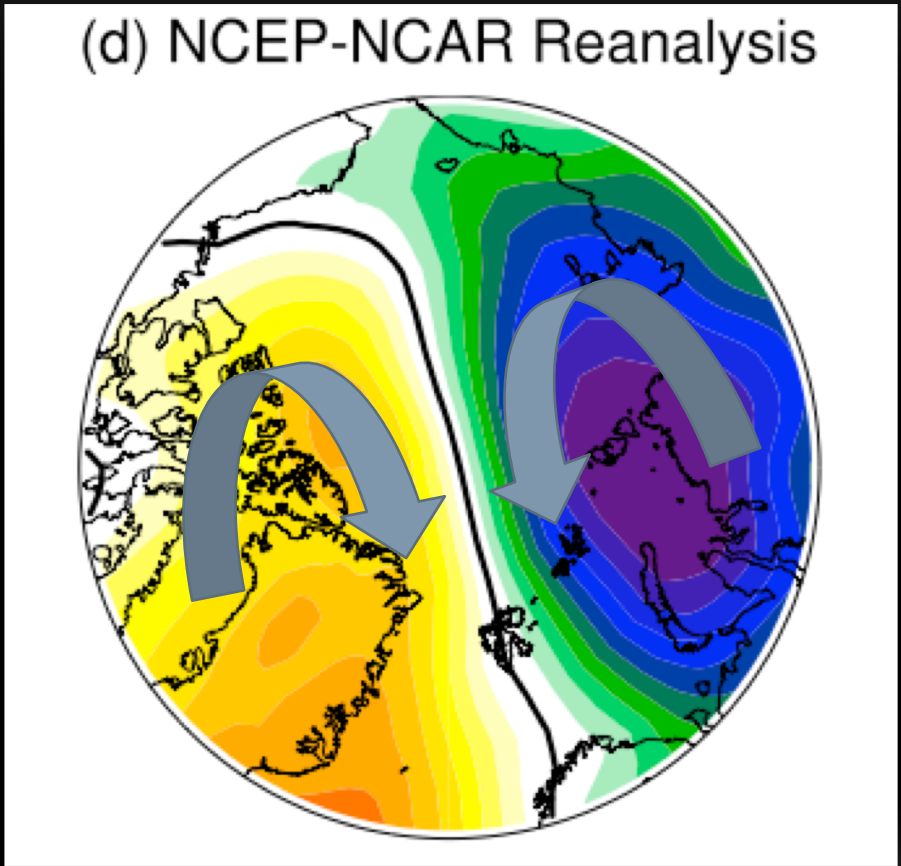


Correlation between the monthly standardized height anomalies and the teleconnection pattern time series for the specified month.

From the CPC (https://www.cpc.ncep.noaa.gov/data/teledoc/pt.shtml)

- The Pacific Transition (PT) pattern is a leading mode during August and September.
- It is characterized by an anomalous wave-train of 500-hPa heights from the central subtropical North Pacific to the eastern United States.
- The positive phase of the PT pattern features above-average heights west of Hawaii and across western North America, and below-average heights in the Gulf of Alaska and over the southeastern United States.

Arctic Dipole (AD) Pattern



Positive phases of the AD defined as the EOF2 of the AMJJ SLP anomaly north of the Arctic Circle. (Li et al. 2018 © American Meteorological Society. Used with permission)

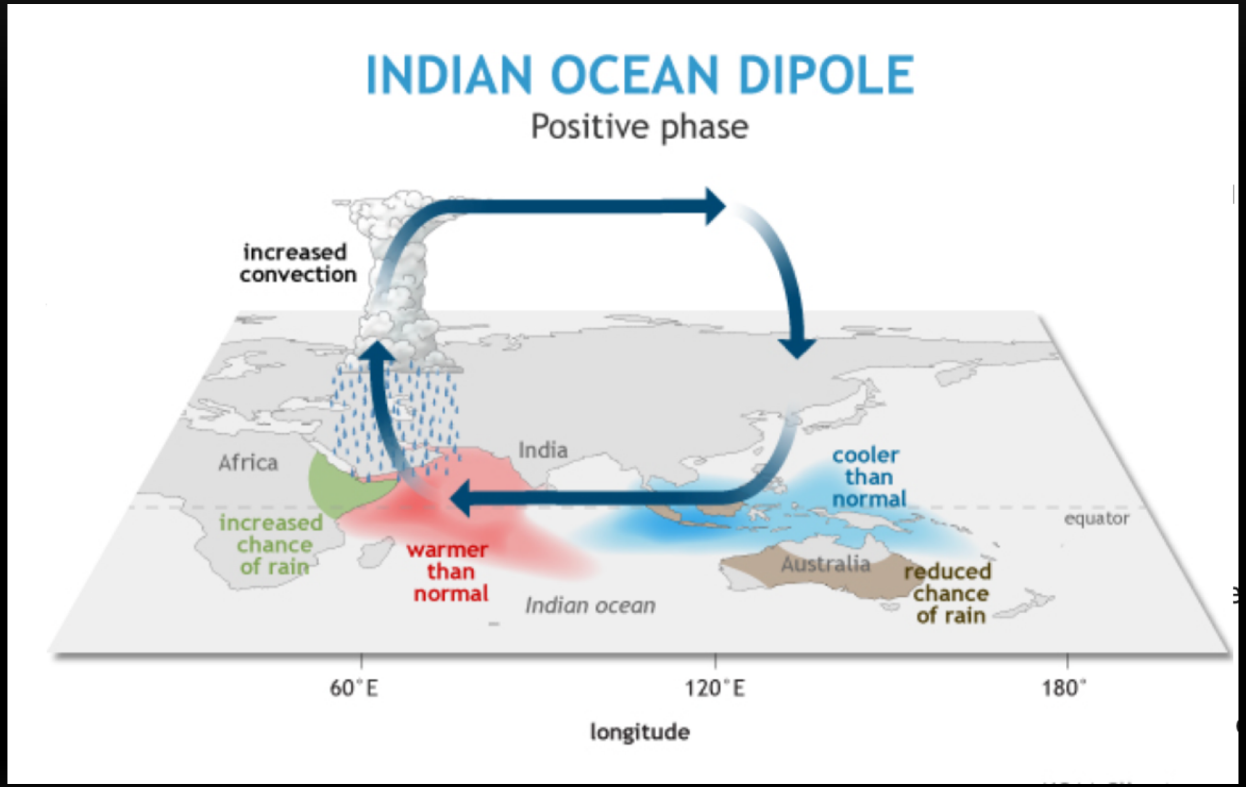
From https://www.amap.no/documents/doc/Arctic-sea-ice-movement-pattern-and-Arctic-Rapid-Change-Pattern-Arctic-dipole-anomaly/973

- AD+ is characterized by positive pressure anomalies over Greenland and north of Canada in winter, and negative pressure anomalies on the opposite side of the Arctic Ocean, off the north Russian coast.
- It is associated with anomalous winds that blow across the North Pole, weakening the ocean circulation in the Beaufort Gyre. With the weakening of the Beaufort Gyre, multi-year sea ice is more inclined to spill out through the Fram Strait into the North Atlantic and melt along the path.
- Rapid export of sea ice from the Arctic Ocean to the Atlantic has been observed in recent years associated with the AD pattern.

The Indian Ocean Dipole (IOD)

From the BOM
http://www.bom.gov.au/climate/enso/history/ln-2010-12/IOD-what.shtml

- The IOD is characterized by the difference in sea surface temperature between the western and eastern Indian Ocean.
- The IOD affects the climate of Australia and other countries that surround the Indian Ocean Basin and is a significant contributor to rainfall variability in this region.
- Some studies suggested that the IOD is linked to ENSO through an extension of the Walker Circulation to the west and associated Indonesian throughflow (i.e., the flow of warm tropical ocean water from the Pacific into the Indian Ocean).
  - Positive IOD events are often associated with El Niño and negative events with La Niña.
  - When the IOD and ENSO are in phase the impacts of ENSO are often most extreme over Australia, while when they are out of phase the impacts of ENSO can be diminished.



https://www.climate.gov/news-features/blogs/enso/meet-enso%E2%80%99s-neighbor-indian-ocean-dipole

References

- NOAA CPC Teleconnections https://www.cpc.ncep.noaa.gov/data/teledoc/telecontents.shtml
- Kossin, J. P., & Vimont, D. J. (2007). A More General Framework for Understanding Atlantic Hurricane Variability and Trends, *Bulletin of the American Meteorological Society*, *88*(11), 1767-1782
- Li, D., Zhang, R., & Knutson, T. (2018). Comparison of Mechanisms for Low-Frequency Variability of Summer Arctic Sea Ice in Three Coupled Models, *Journal of Climate*, *31*(3), 1205-1226.
- Arctic Monitoring and Assessment Programme: https://www.amap.no/documents/doc/arctic-sea-ice-movement-pattern-and-arctic-rapid-change-pattern-arctic-dipole-anomaly/973