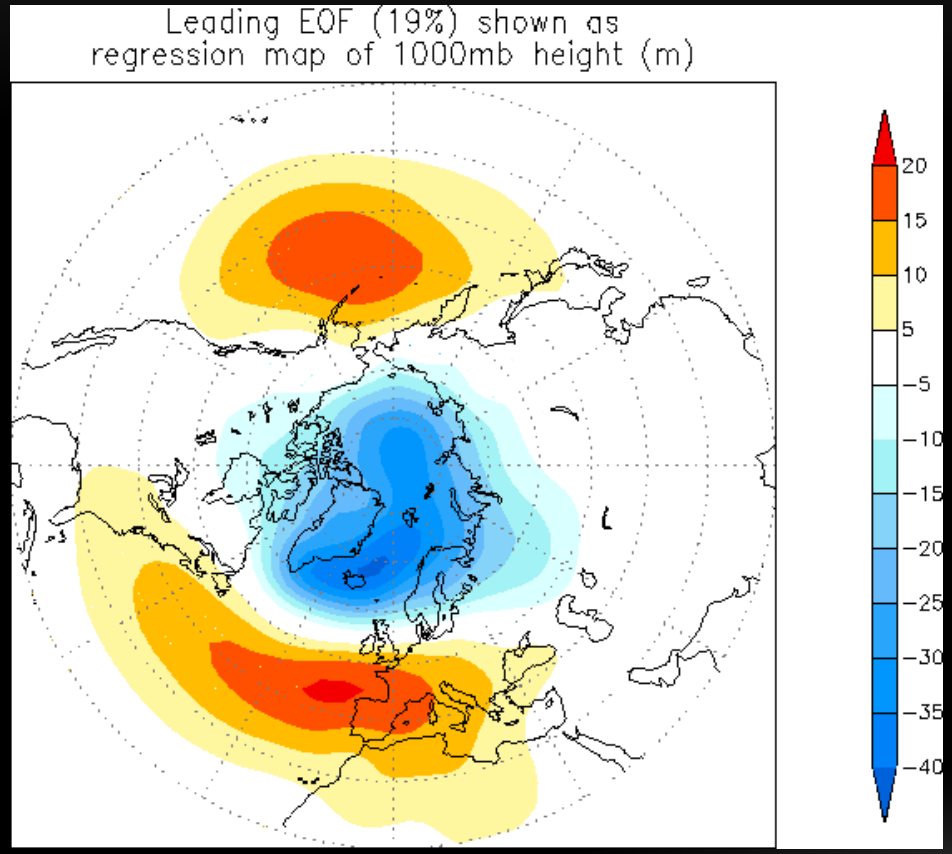
Other Climate Modes and Teleconnection Patterns

Teleconnection

- A linkage between weather changes or climate anomalies occurring in widely separated regions of the globe.
- In climate analysis, it is manifested as significant positive or negative correlations in the fluctuations of a field at widely separated points.
- Teleconnection implies that information is propagating between the distant points.

AMS Glossary: https://glossary.ametsoc.org/wiki/Teleconnection

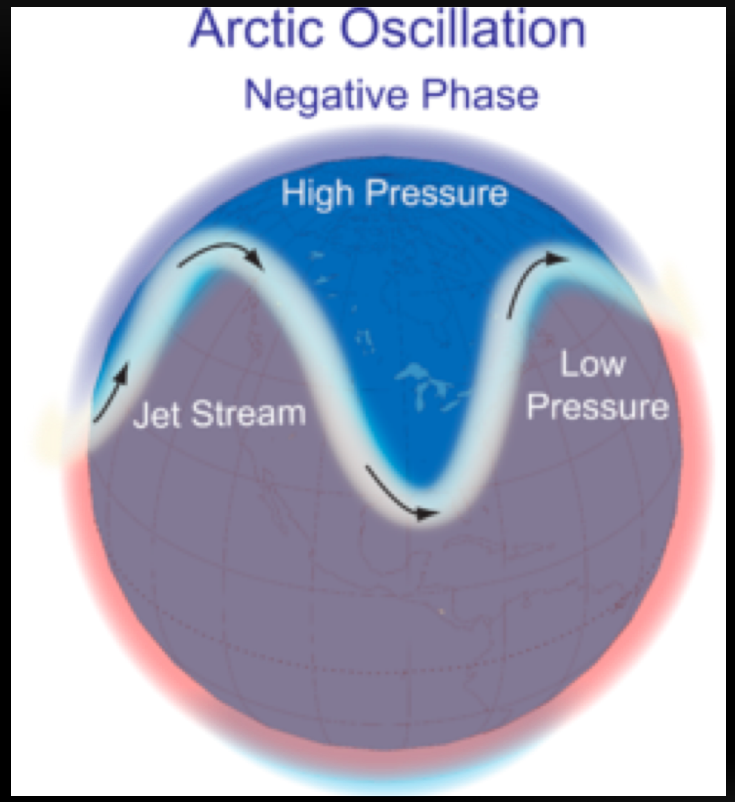
Arctic Oscillation (AO)

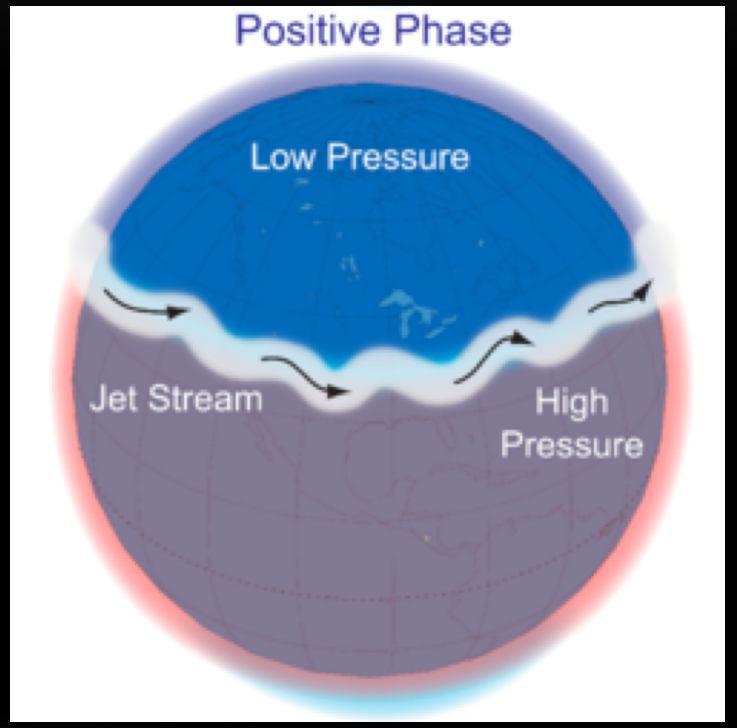


- The AO is a large-scale mode of climate variability, also referred to as the Northern Hemisphere annular mode (NAM).
- The AO is a characterized by wind anomalies around the Arctic around 55°N.
  - AO+: a stronger polar jet acts to confine colder air across polar regions.
  - AO-: a weakened jet, which allows an easier southward penetration of colder, arctic airmasses and increased storminess into the mid-latitudes.
- The NAO can be regarded as a regional component of the AO or NAM.
- Deser (2000) showed that the temporal coherence of the midlatitude signals between the Atlantic and the Pacific was very weak, and suggested that the annular appearance of the AO was an artifact of the EOF analysis.

https://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/ao.shtml
https://www.ncdc.noaa.gov/teleconnections/ao/

AO and the Jet Stream





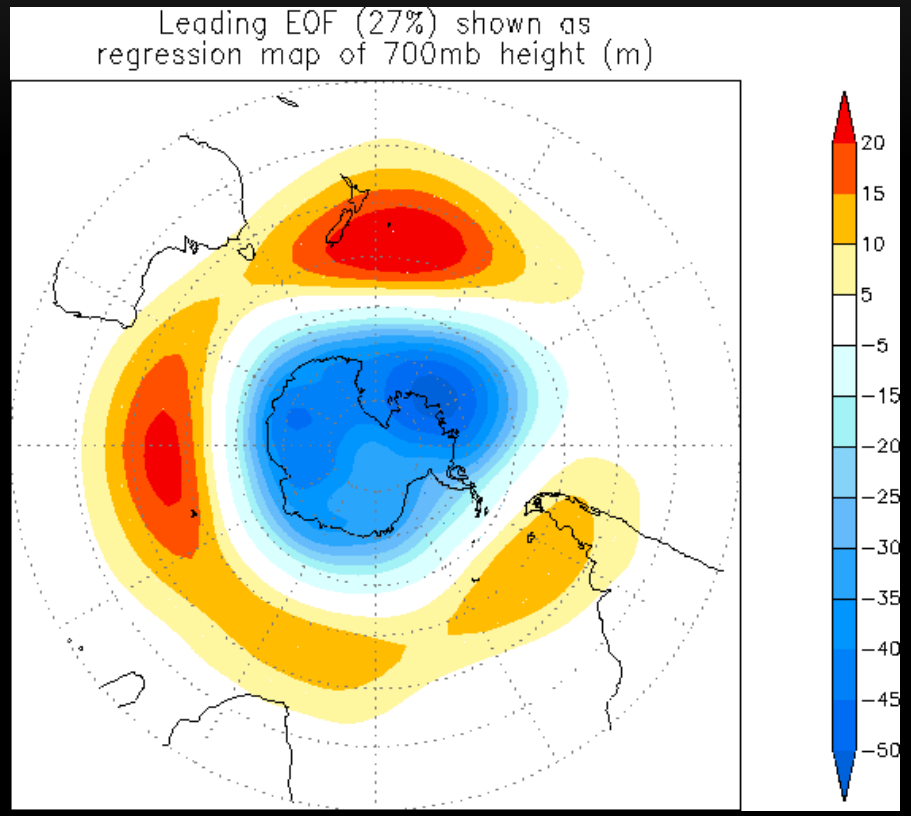
- Blocking occurs more frequently in the AO- phase and the polar jet is wavier.

From https://energyeducation.ca/encyclopedia/Northern_Annular_Mode

Antarctic Oscillation (AAO)

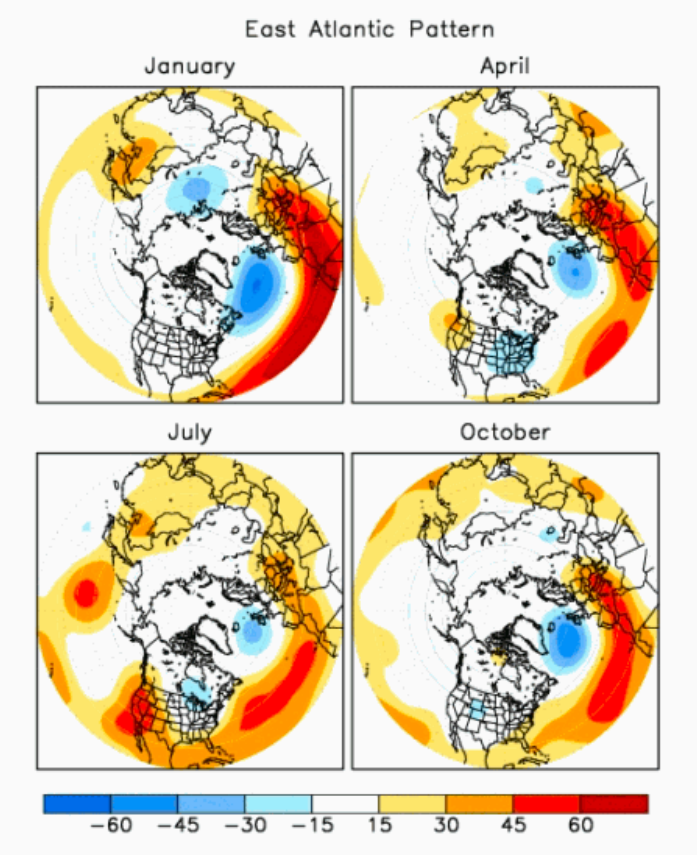
- The Antarctic Oscillation (AAO), also known as the Southern Annular Mode (SAM), is the counterpart of the AO in the Southern Hemisphere. It is characterized by the north–south movement of the westerly wind belt that circles Antarctica, dominating the middle to higher latitudes of the Southern Hemisphere.
- During the AAO+ phase, the westerly jet contracts towards Antarctica. This results in weaker than normal westerly winds and higher pressures over southern Australia, restricting the penetration of cold fronts inland.
- During the AAO- phase, the westerly jet is displaced equatorward, which results in more (or stronger) storms over southern Australia.
- Positive AAO was dominated during autumn–winter from 1997 to 2010 and was a significant contributor to the 'big dry' observed in southern Australia.

http://www.bom.gov.au/climate/enso/history/ln-2010-12/SAM-what.shtml



The AAO pattern derived as the leading EOF mode of monthly mean 700 hPa height poleward of 20°S during 1979-2000 period (https://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/aao/aao.shtml).

East Atlantic (EA) pattern

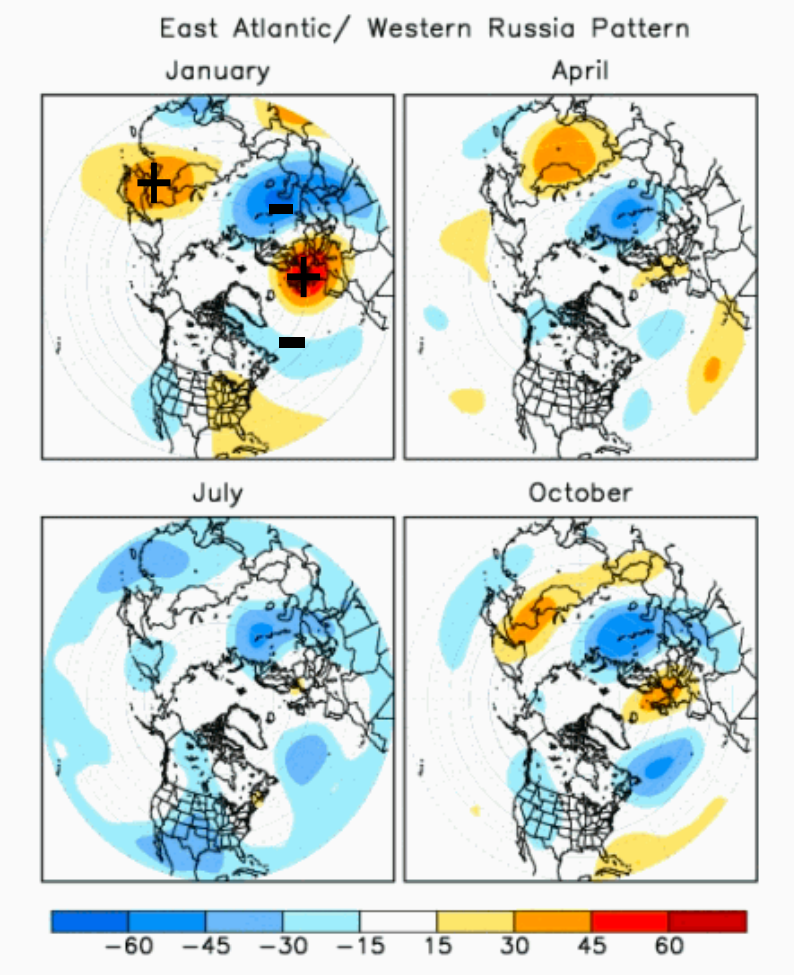


Correlation between the monthly standardized height anomalies and the teleconnection pattern time series for the specified month.

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

- The East Atlantic (EA) pattern is the second prominent mode of low-frequency variability over the North Atlantic and appears as a leading mode in all months.
- Similar to the NAO, the EA pattern consists of a north-south dipole of anomaly centers spanning the North Atlantic from east to west. The anomaly centers of the EA pattern are displaced southeastward to the approximate nodal lines of the NAO pattern.
- The lower-latitude center contains a strong subtropical link in association with modulations in the subtropical ridge intensity and location. This subtropical link makes the EA pattern distinct from its NAO counterpart.

East Atlantic/West Russia (EATL/WRUS) Pattern



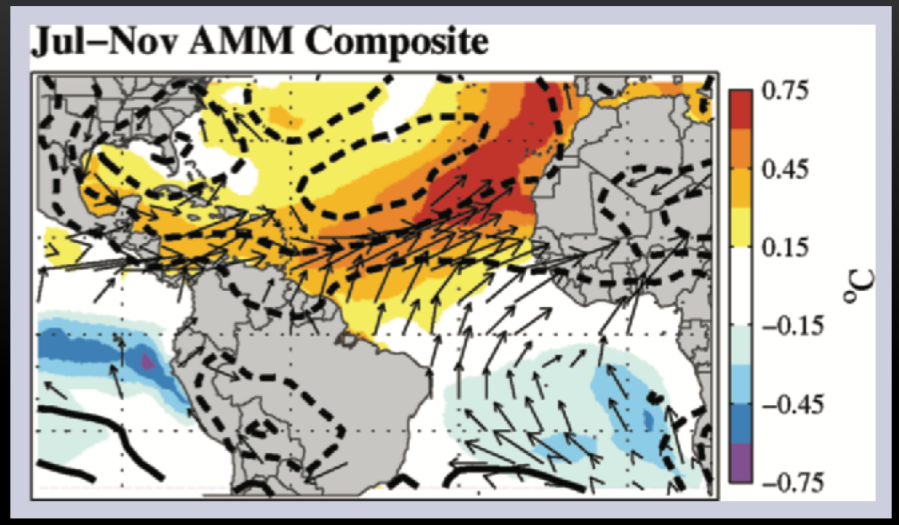
From the CPC (https://www.cpc.ncep.noaa.gov/data/teledoc/eawruss.shtml)

- affects Eurasia throughout the year.
- The East Atlantic/ West Russia pattern consists of four main anomaly centers. The positive phase is associated with positive height anomalies located over Europe and northern China, and negative height anomalies located over the central North Atlantic and north of the Caspian Sea.

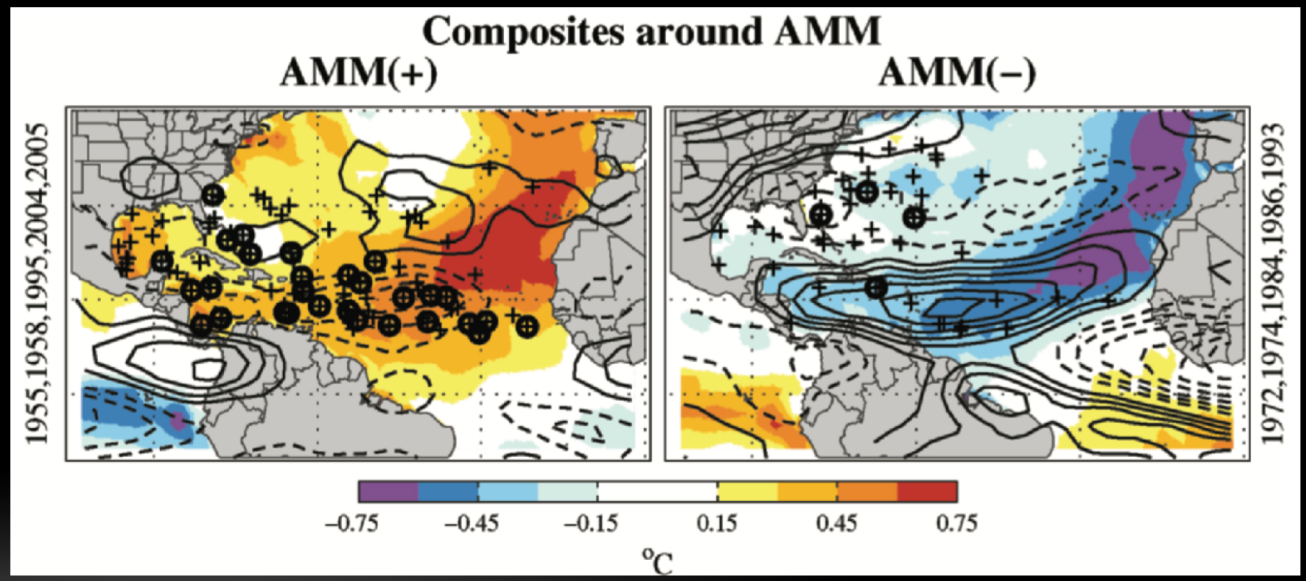
Correlation between the monthly standardized height anomalies and the teleconnection pattern time series for the specified month.

The Atlantic meridional mode (AMM)

- The AMM represents the leading mode of coupled atmosphere-ocean variability in the Atlantic, which is also known as the "gradient," "interhemispheric," or "Atlantic dipole" mode.
  - Anomalous wind is directed from cold SST anomalies to warm SST anomalies.
  - SST is influenced by surface wind anomalies via evaporation.
  - The wind-evaporation-SST (WES) feedback plays an important role in the maintenance of the AMM.
- The AMM peaks in boreal spring but also has strong signals during the Atlantic hurricane season. The AMM strongly modulates Atlantic tropical cyclone activity.



Composite anomalies of SST (shaded), 925-mb height (contour), and 925-mb wind (vectors) (AMM+ minus AMM-)



Tropical cyclogenesis points, SST (shaded) and shear (contours) anomalies for AMM+ and AMM- years. Crosses show the genesis points for tropical cyclones. Storms that reached "major hurricane" strength have a circle around their genesis point.

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