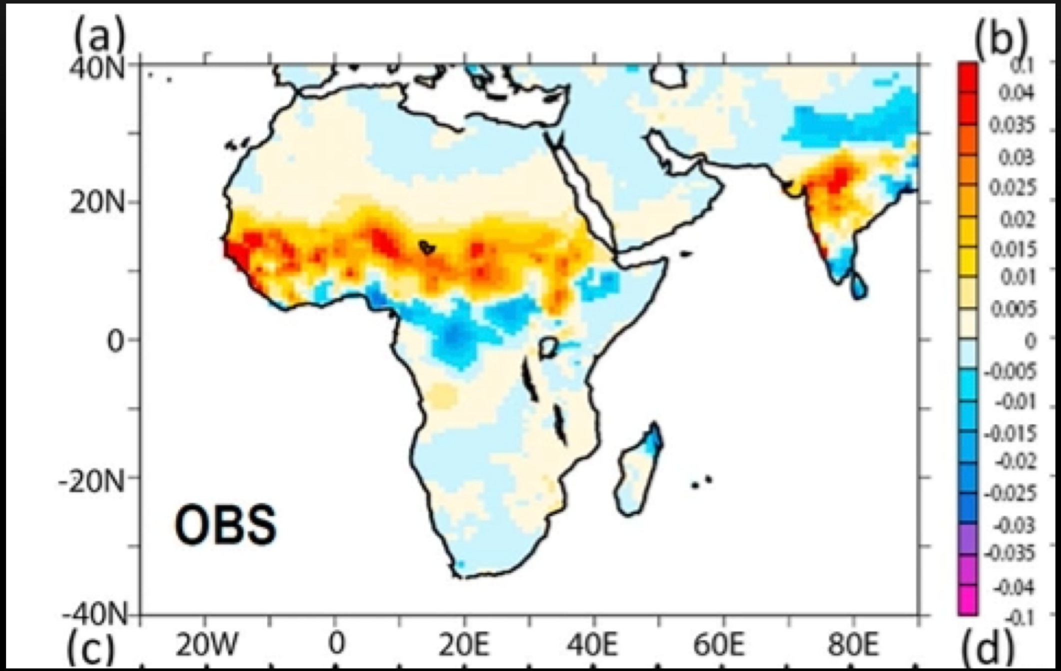
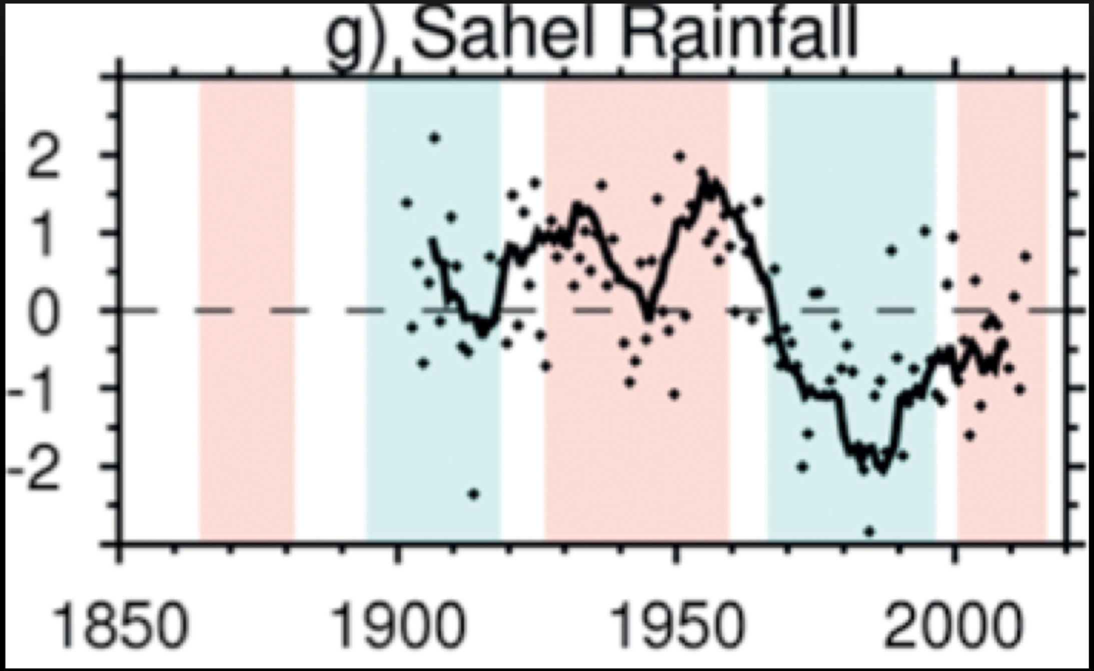
Impacts of the AMV

Impact on the ITCZ and monsoons



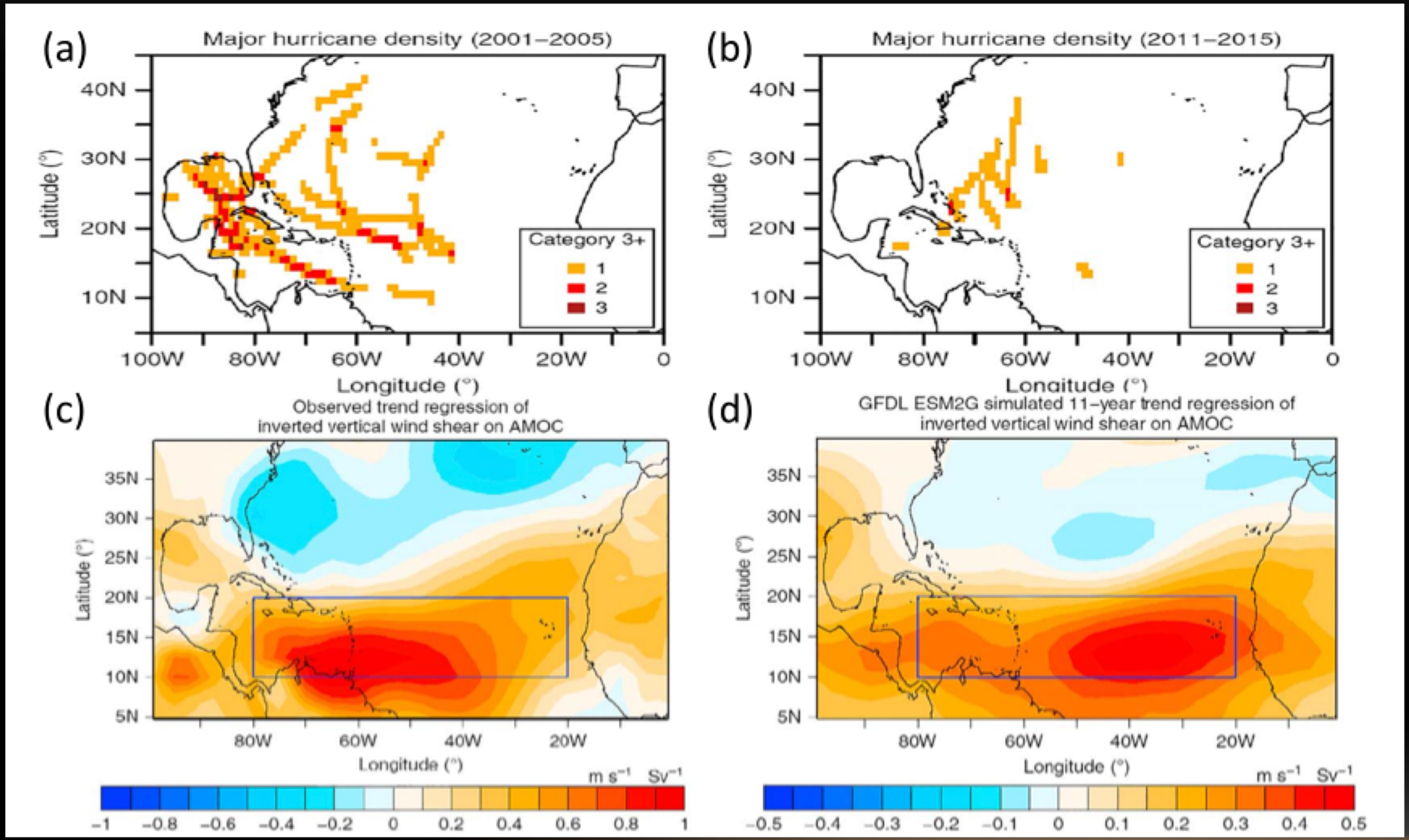
The left figure shows Regression of observed 10-year low-passed summer (JJAS) rainfall anomalies on the AMV Index (From Zhang et al. 2019; Fig. 11).



JJAS rainfall anomalies over the Sahel (10°–20°N, 20°W–40°E) from the GPCC dataset. Dots show the annual means and the black curve shows the 10-yr running mean. Periods where the AMV index is larger than 0.5 or smaller than −0.5 are highlighted with red and blue filled sections, respectively. From Sutton et al. 2018 (Fig. 1)

- The positive phase of the AMO is associated with enhanced monsoon precipitation over Sahel and India.

Impacts on Atlantic Tropical Cyclones



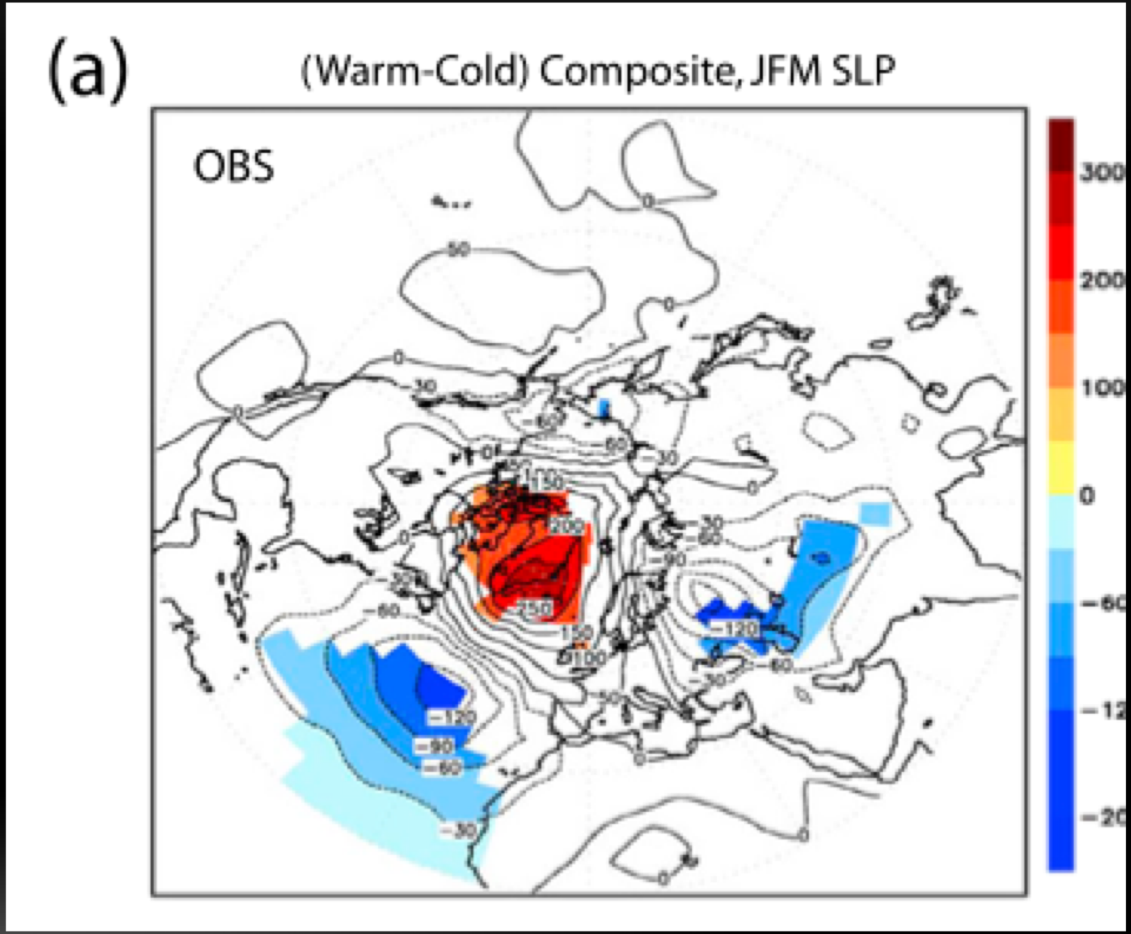
- The frequency of major hurricanes is enhanced during the positive phase of the AMV (when the tropical and subtropical Atlantic is characterized by warm SST anomalies).
- The increase in Atlantic hurricane frequency can be attributed to changes in vertical wind shear, tropospheric humidity and possibly also tropical easterly wave frequency.

From Yan et al. 2017

Impacts on North Atlantic Atmospheric Circulation

- Strengthened AMOC and enhanced northward heat transport by ocean →
- AMV+ and North Atlantic warming →
- Weakened lower tropospheric baroclinicity →
- weakened eddy activity →
- weakened storm track→
- the negative phase of the NAO and more midlatitude blocking

Bjerknes compensation: enhanced meridional heat transport by ocean is accompanied by reduced meridional heat transport by the atmosphere



Observed winter (JFM) SLP anomalies (in pascals) associated with AMV (positive minus negative AMV phase), regions with anomalies significant at the 90% level are shaded. From Zhang et al. 2019

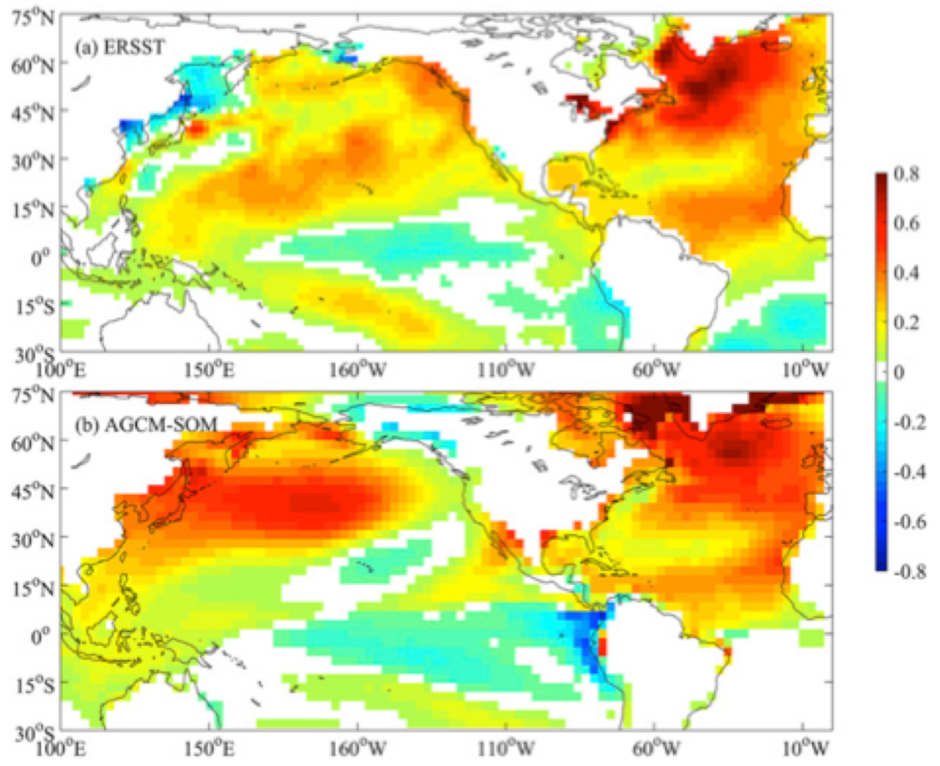


FIG. 2. The AMO-related winter SST anomalies (°C) from (a) the ERSST dataset and (b) the AGCM–SOM experiment, calculated as differences between the AMO positive and negative periods for observations or between the AMO positive and negative runs for the model experiment. Note that in (b) the North Atlantic SST anomalies were prescribed based on the regressions onto the AMO index.

Impacts on the Pacific Decadal Variability

- Observational analysis shows that the AMV leads the PDO by about a decade.
- Lyu et al. (2017) carried out numerical model simulation using an atmospheric GCM (AGCM): the AGCM is forced by the prescribed AMO SSTs in the North Atlantic (0°–70°N) but is coupled to a mixed layer slab ocean model (SOM) in other ocean basins. It was shown that the AMO SSTs lead to PDO- like SST anomalies over the Pacific.
- The AMV thus provides a source of multidecadal variability to the Pacific.

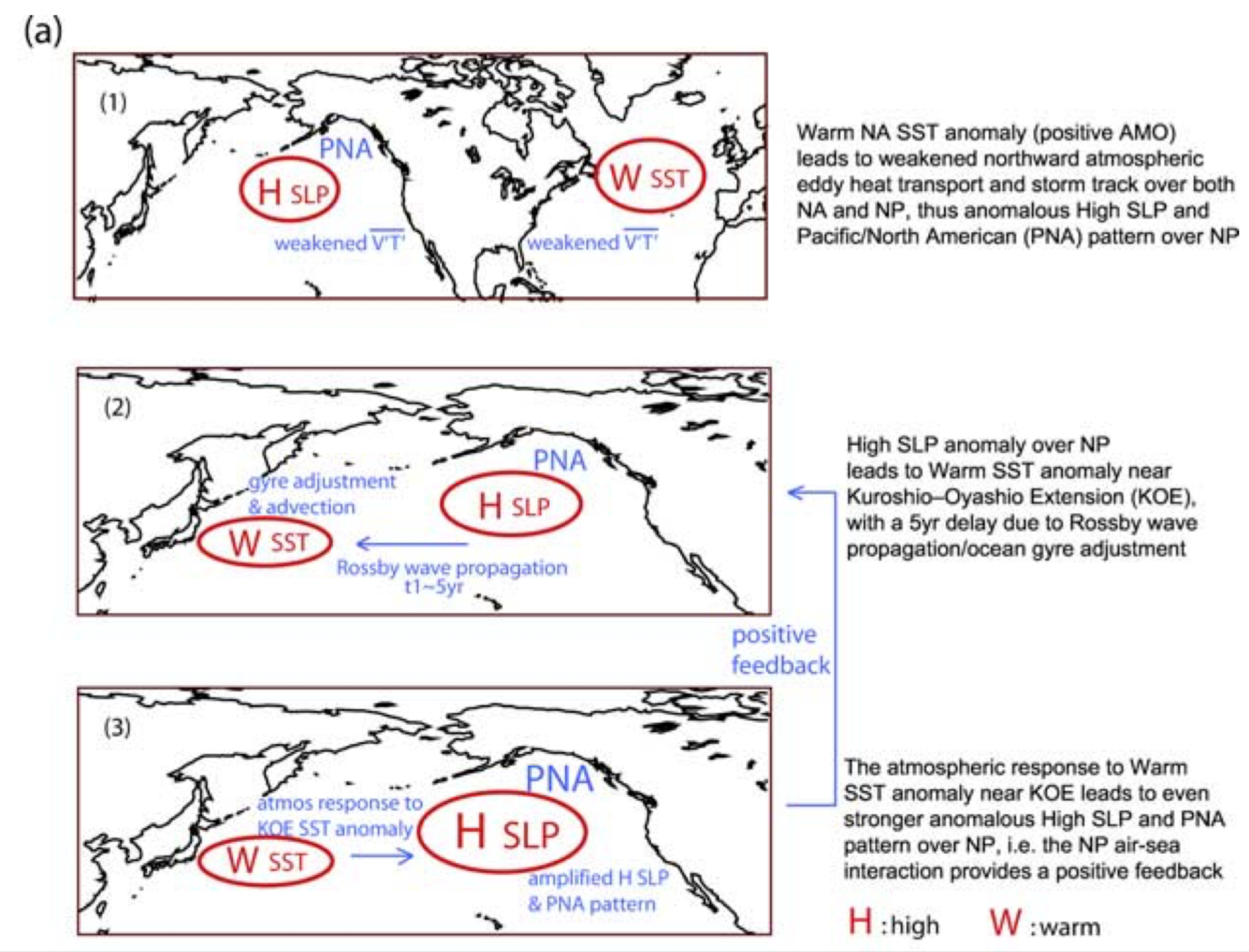
How does the AMV affect the Pacific?

An extratropical pathway (schematic on the right):

- North Atlantic warming during the AMV+ →
- Weakened poleward eddy heat transport → weakened midlatitude storm tracks →
- Weakened Aleutian Low, which triggers oceanic Rossby waves →
- Western Pac warming due to oceanic Rossby waves →
- Enhanced positive SLP anomalies (further weakening of Aleutian low)

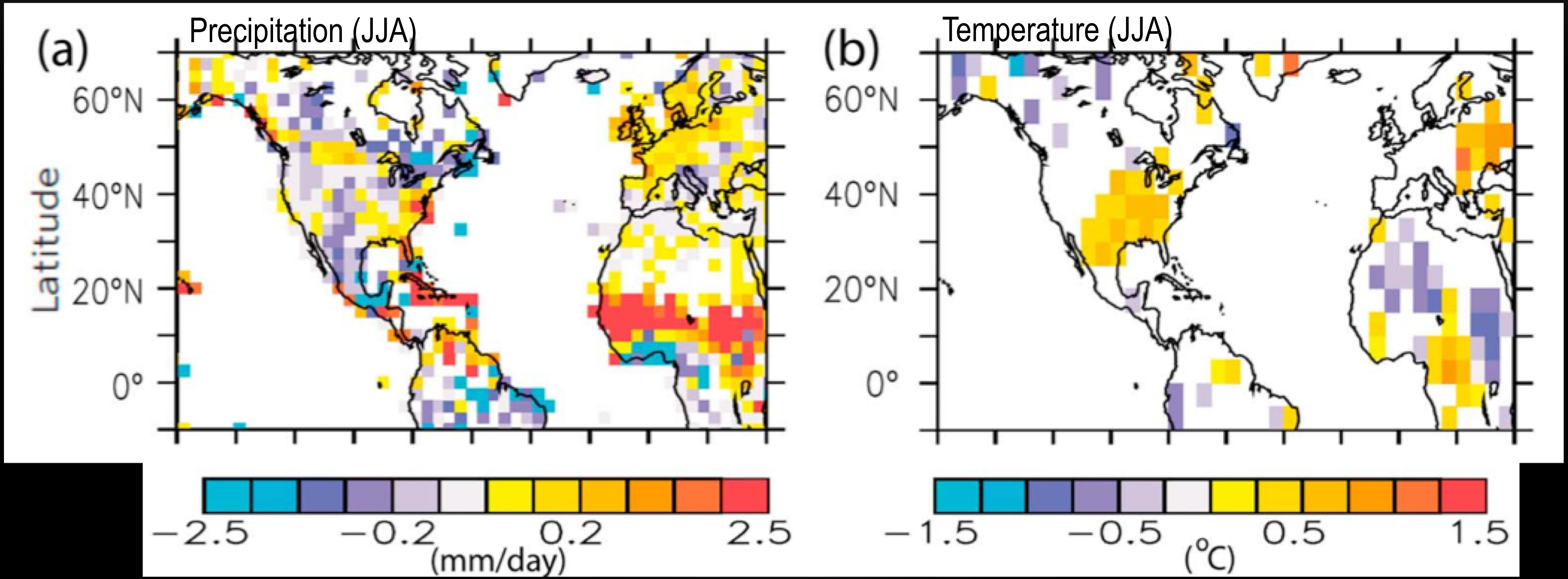
A tropical pathway:

- Tropical Atlantic warming →
- descending motion over the Central tropical Pacific →
- an atmospheric Rossby wave train which strengthens the subtropical high and weakens the Aleutian Low



From Zhang and Delworth 2007

Impacts over Europe and North America



Observed summer (JJA) climate associated with AMV (positive minus negative AMV phase). From Zhang et al. 2019

The positive phase of the AMV is characterized by

1) Warm and wet summer in Europe
2) Warm and dry conditions over central U.S.

Impacts on High-latitude Climate

- The AMV is significantly correlated with the Arctic surface air temperature and anticorrelated with the Arctic sea ice extent on the multidecadal time scale (Chylek et al. 2010; Mahajan et al. 2011)
- The AMV is negatively correlated to the Antarctic temperature on the multidecadal time scale and contributes to the anticorrelation of surface air temperature between the two poles (Chylek et al. 2010).
- The North Atlantic subpolar warming associated with the AMV may contribute to the rapid mass loss of the Greenland ice sheet in the mid-1990s (Holland et al. 2008).

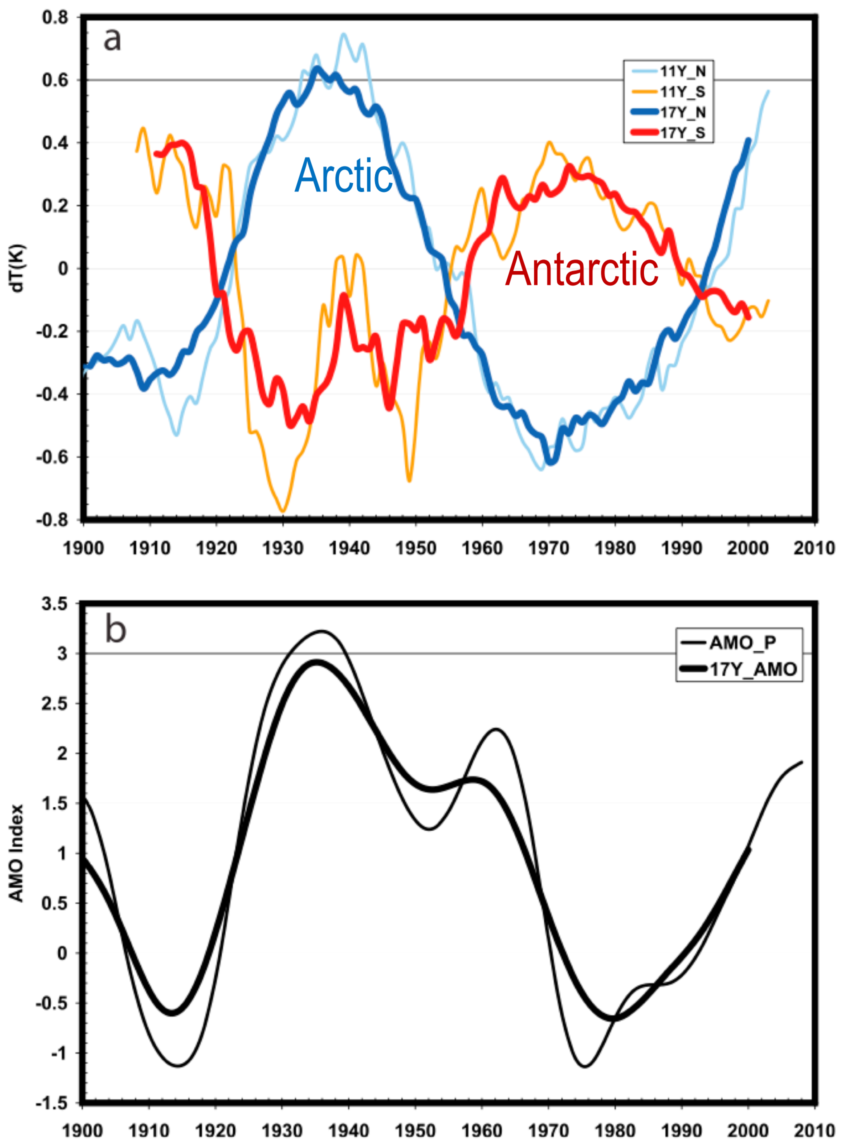


Figure 2. (a) De-trended Arctic (blue) and Antarctic (red) temperature time series smoothed by a 11 year running average (thin lines) or 17 year running average (thick lines), and (b) the AMO index [after *Parker et al.*, 2007] annual values (thin line) and 17 year running average (thick line).

From Chylek et al. 2010 (GRL)

The role of tropical vs. extratropical SSTA

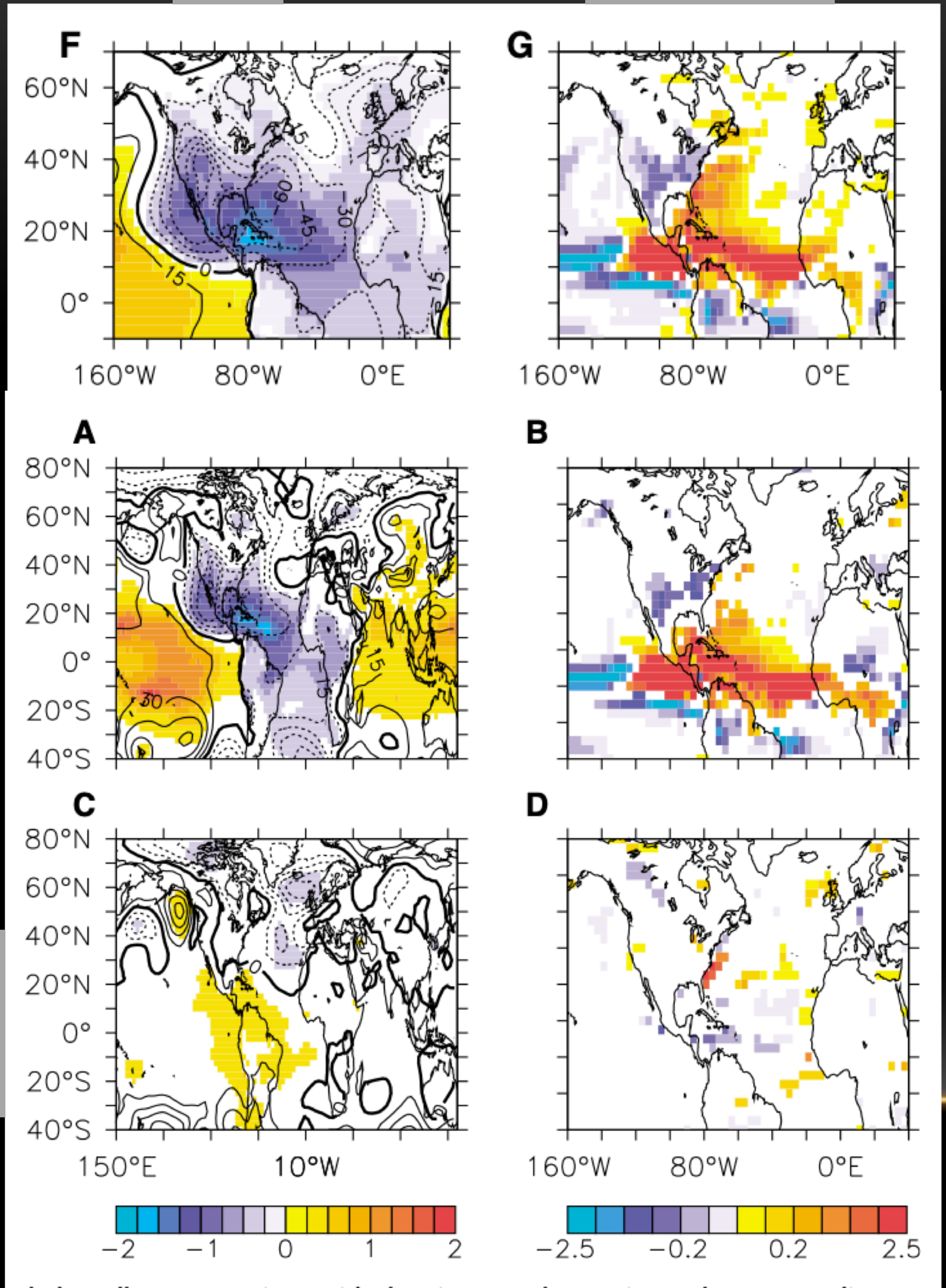
Full AMO SST forcing

Tropical parts of the AMO SST

Extratropical parts of the AMO SST

SLP

Precipitation



HadAM3 Atmospheric model is forced by specified SST anomalies

- The SLP anomalies have two low pressure centers, one over the southern US and the other west of the UK.
- Enhanced precipitation was found over the west Caribbean and the Sahel.
- The anomalies over the tropical/subtropical Atlantic and the southern US are mainly driven by the tropical parts of the AMO SST, while the response to the extratropical parts of the AMO SST is mainly confined to the extratropics (including the SLP anomalies west of the UK).

Sutton and Hodson 2005

References

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