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Linking ITCZ migrations to the AMOC and North Atlantic/Pacific SST decadal variability

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EERIE

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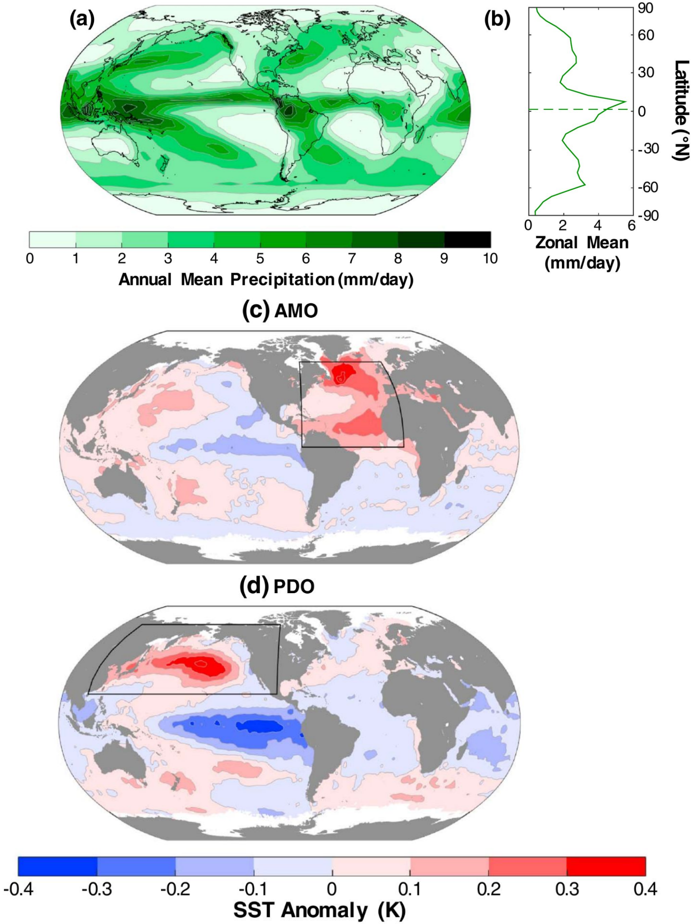
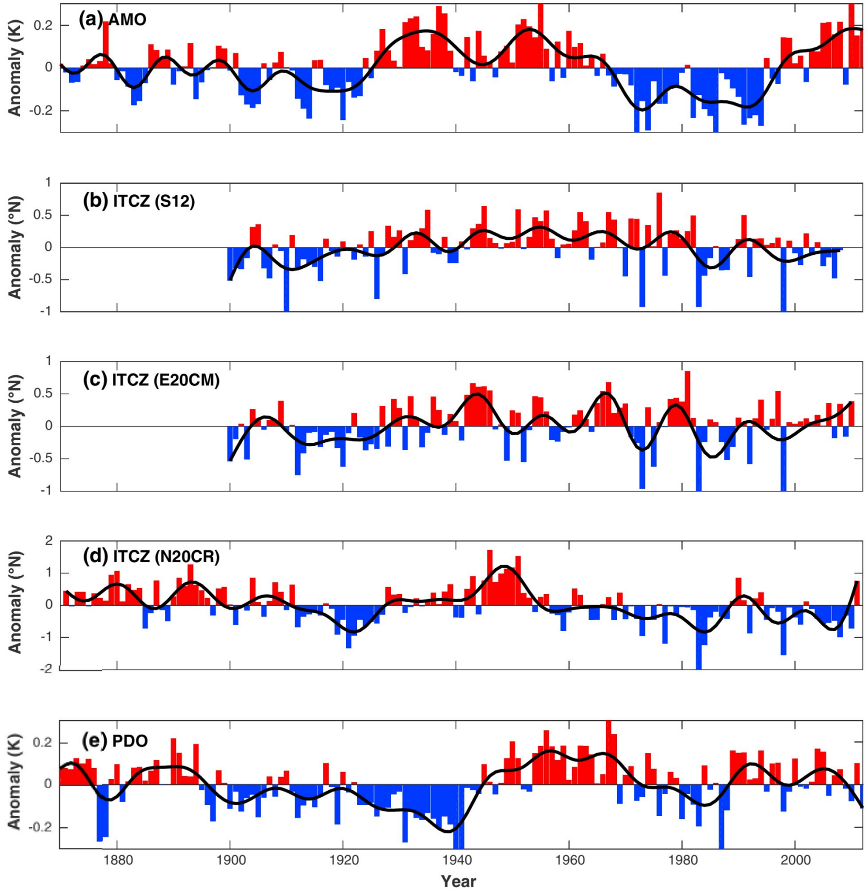
Link between the AMV/PDO and ITCZ variability in observations





Green and Marshall, 2017

Link between the AMV/PDO and ITCZ variability in observations

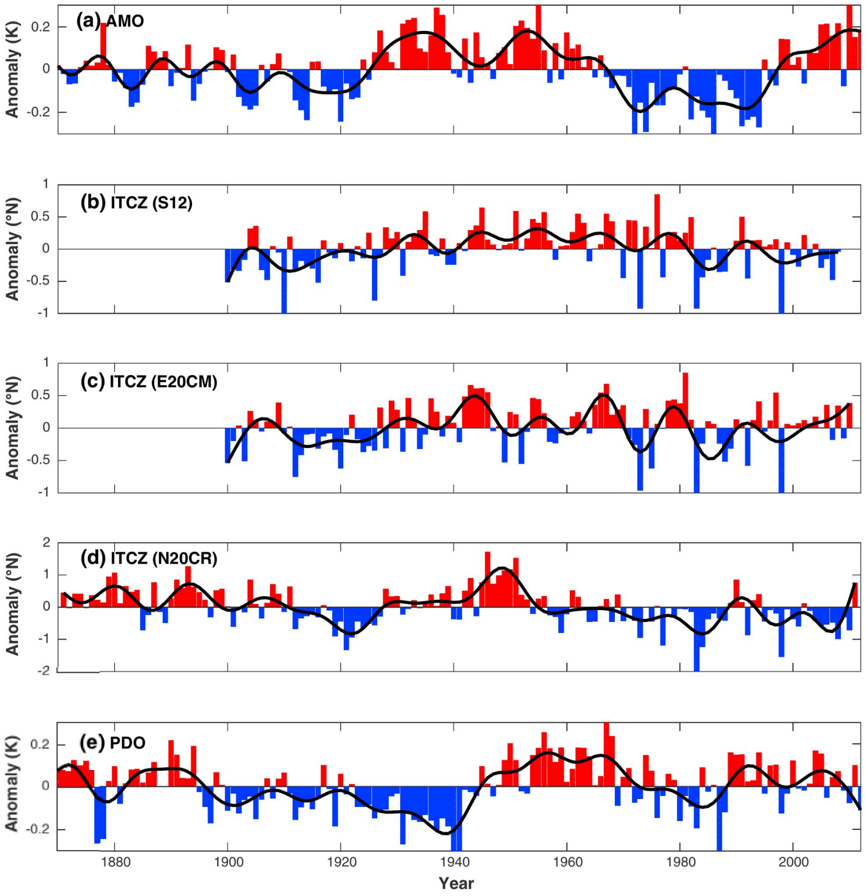
Open questions:

Inadequate observational record to extend observed AMV–ITCZ link to AMOC

1. Can such a link be made?

Tenuous ITCZ–PDO link in observations

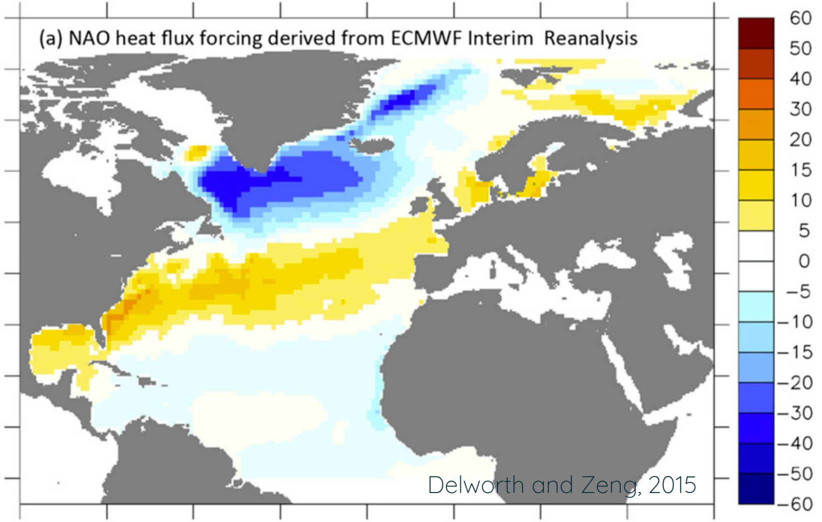
2. Can it be confirmed?



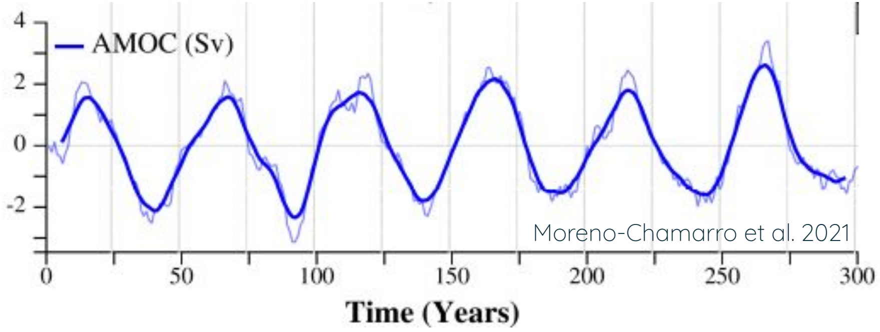
Simulations with the GFDL's CM2.1 coupled climate model

1. 4000-year-long control:
   1860's constant forcings

2. 10-member forced ensemble:
   Winter NAO-derived heat flux anomaly
   No net heating/cooling
   50-year-long sinusoidal 1stdv amplitude



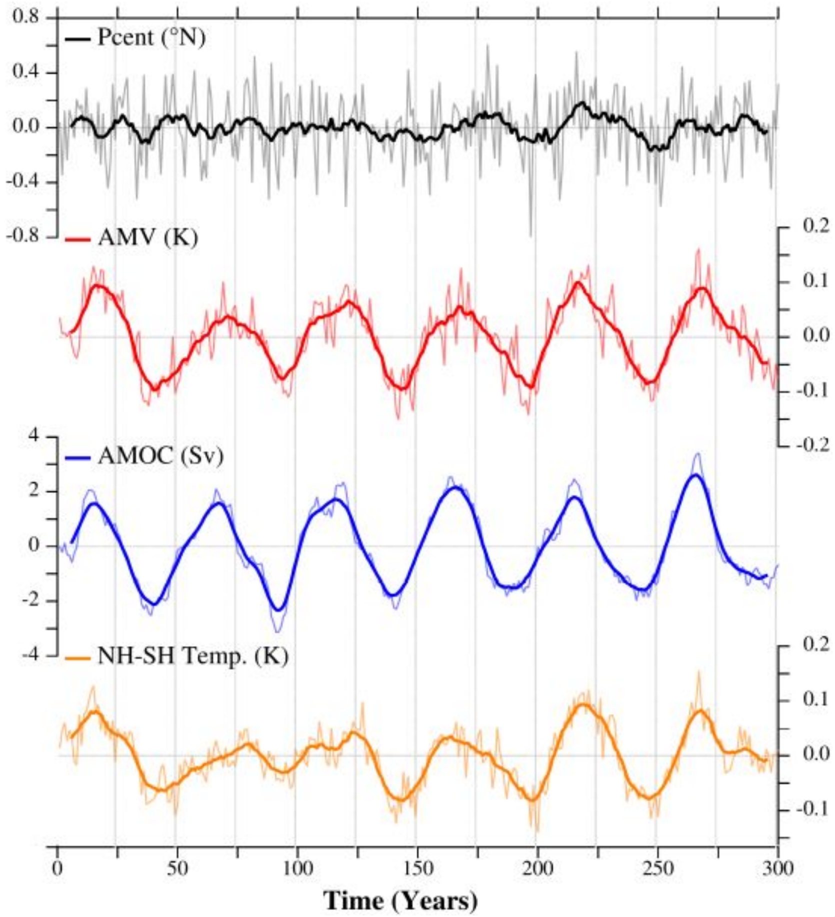
Delworth and Zeng, 2015



Moreno-Chamarro et al. 2021

ITCZ position, AMV, and AMOC variability in the forced ensemble

- NAO-sinousoidal forcing drives regular AMOC/AMV variability
- NH warming associated with AMV warming
- ITCZ variability synching with AMV and AMOC after year 150. Adjustment period before

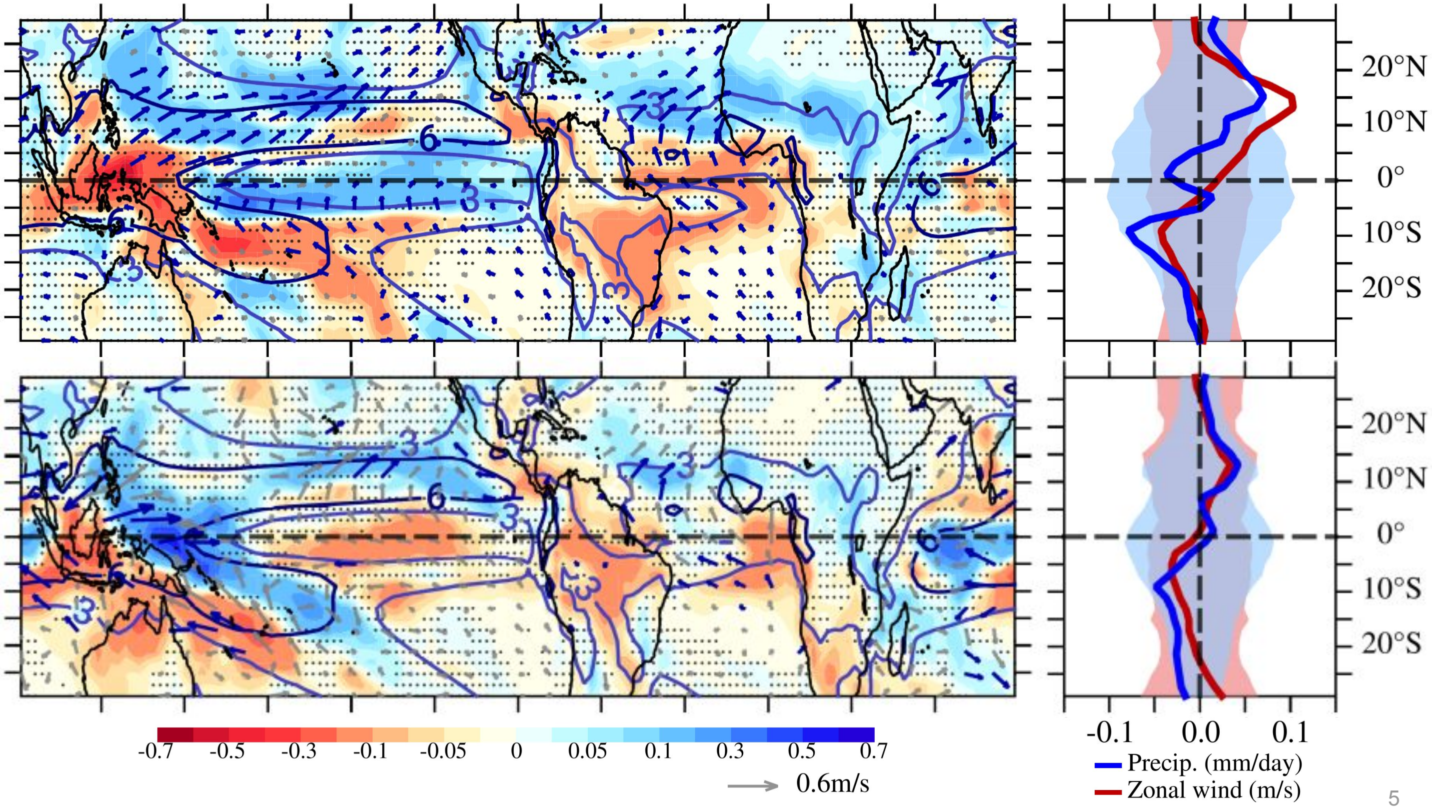


Northward ITCZ shift for a warm AMV at different timescales

Anomalies between years above and below 1stdv in AMV:
Precipitation (shading; mm/day) and 1000-hPa winds (arrows; m/s).
Mean precipitation in contours (mm/day)

Forced ensemble: Multidecadal timescale

Control: Multicentennial timescale

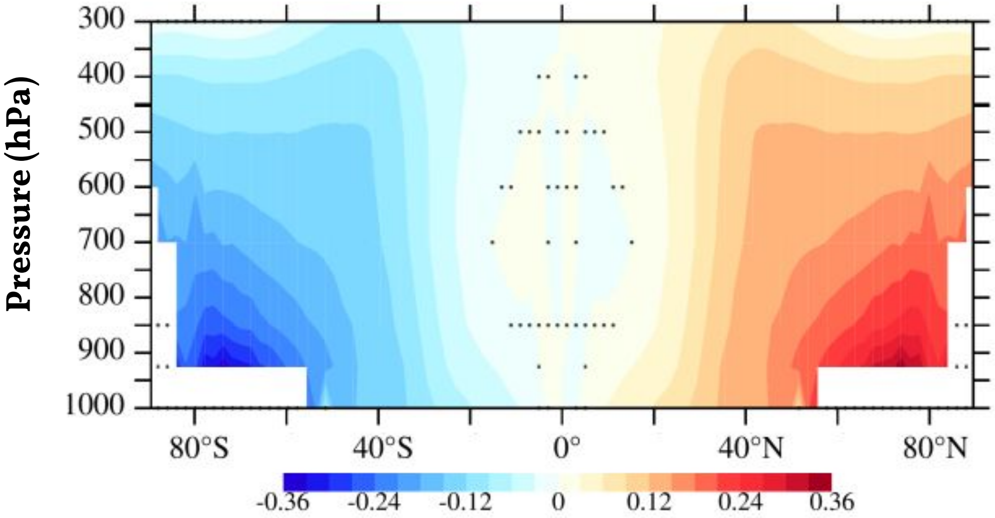


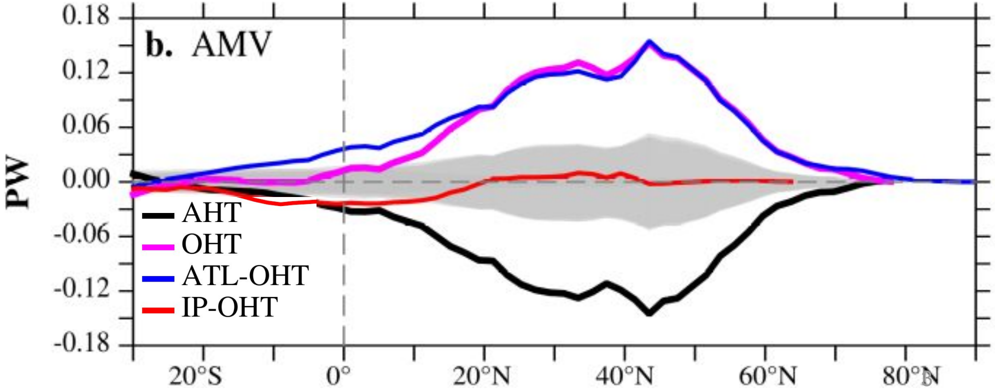
Northward ocean heat transport, NH warming, northward ITCZ shift

Anomalies between years above and below 1stdv in AMV in the forced ensemble
top) in the zonally averaged asymmetric temperature (K)
bottom) In components of the northward heat transport

AMOC strengthening drives increase in the northward oceanic heat transport in the Atlantic, warming the NH compared to the SH.

To compensate for the warming, the atmosphere transport heat southward across the Equator, leading to a northward ITCZ shift.





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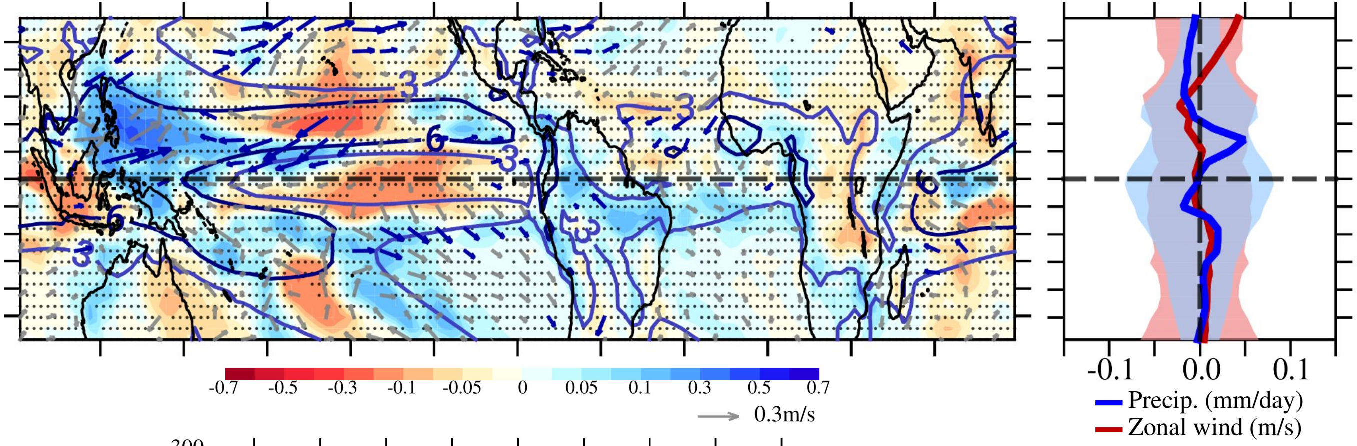
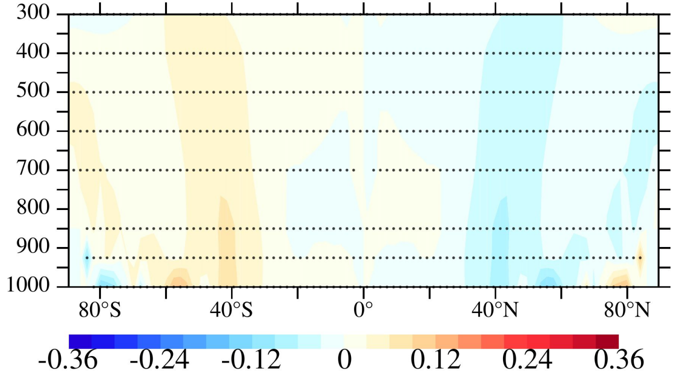
No ITCZ shift related to PDO

Anomalies between years above and below 1stdv in PDO:
Precipitation (shading; mm/day) and 1000-hPa winds (arrows; m/s).
Mean precipitation in contours (mm/day)

Control simulation



Anomalies in the zonally averaged asymmetric temperature (K)



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SUMMARY

- **Experiments confirmed a linkage between the AMOC, AMV, and ITCZ variability detected in observations**

- **Linkage connected with changes in cross-equatorial heat transport**
  1. Increase in AMOC, leading to AMV and NH warming due to increase in oceanic heat transport in the Atlantic.
  2. Southward cross-equatorial heat transport in the atmosphere to compensate for the NH warming. This leads to a ITCZ northward shift
  3. Interhemispheric asymmetry in the response of the trade winds: weakening in the NH, strengthening in the SH. Reflection of the changes in the Hadley Circulation.

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