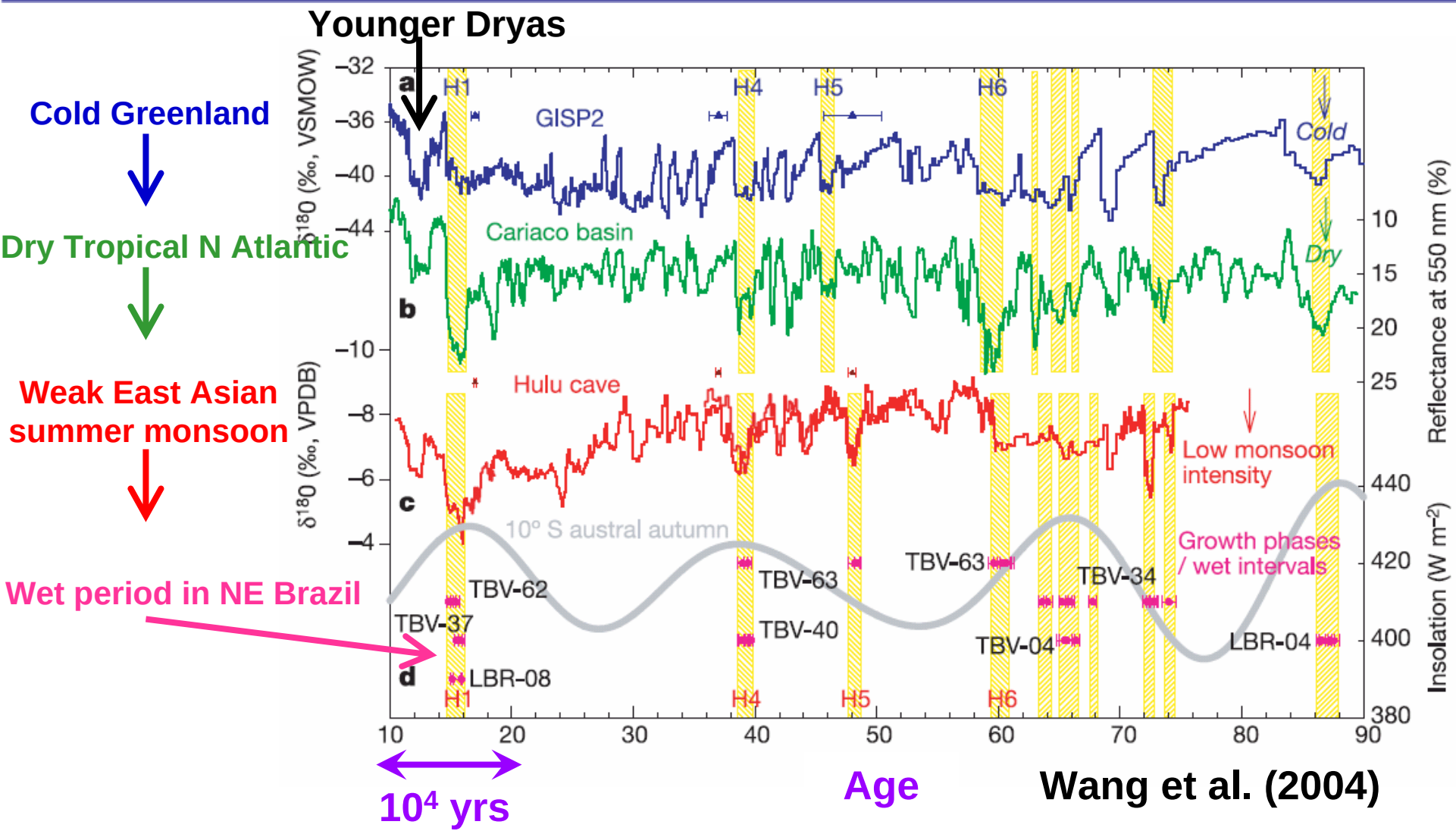
# Shutdown of the Atlantic Thermohaline Circulation and its Impact on North Pacific Climate

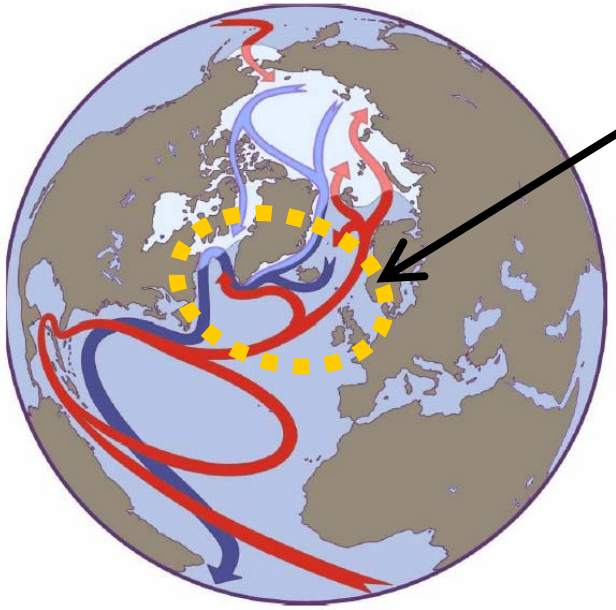
Yuko Okumura, Clara Deser, Aixue Hu (CGD/NCAR)
Axel Timmermann, Shang-Ping Xie (IPRC/Univ. of Hawaii)

# Abrupt Climate Changes in Paleorecord




**These millennial variations in global climate are related to sudden changes in the Atlantic thermohaline circulation.**

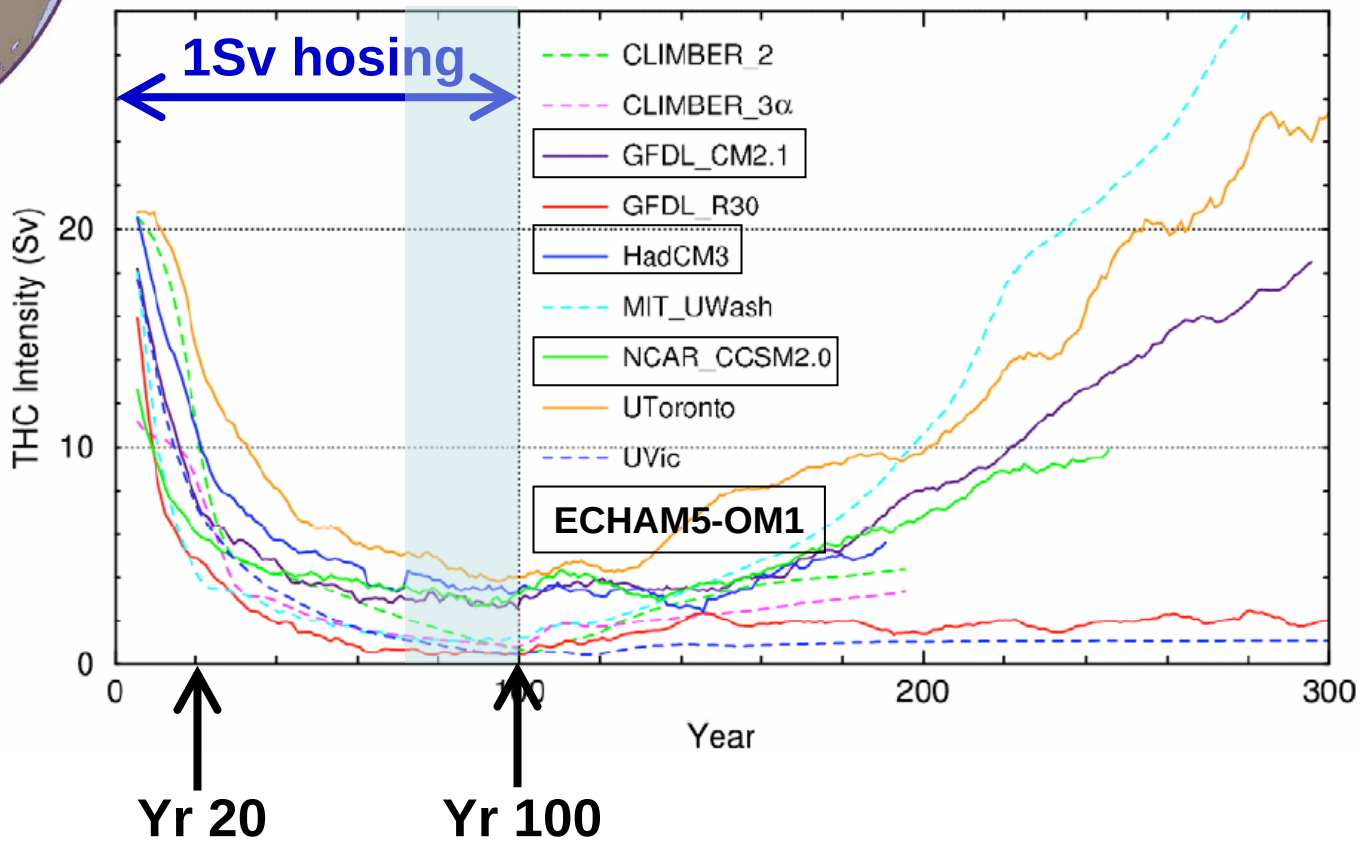
# Coupled GCM Hosing Experiments (CMIP/PMIP)



**Freshwater flux anomaly**
**in the North Atlantic (50-70N)**
**(1Sv X 100 yrs; ~9m increase in sea level)**

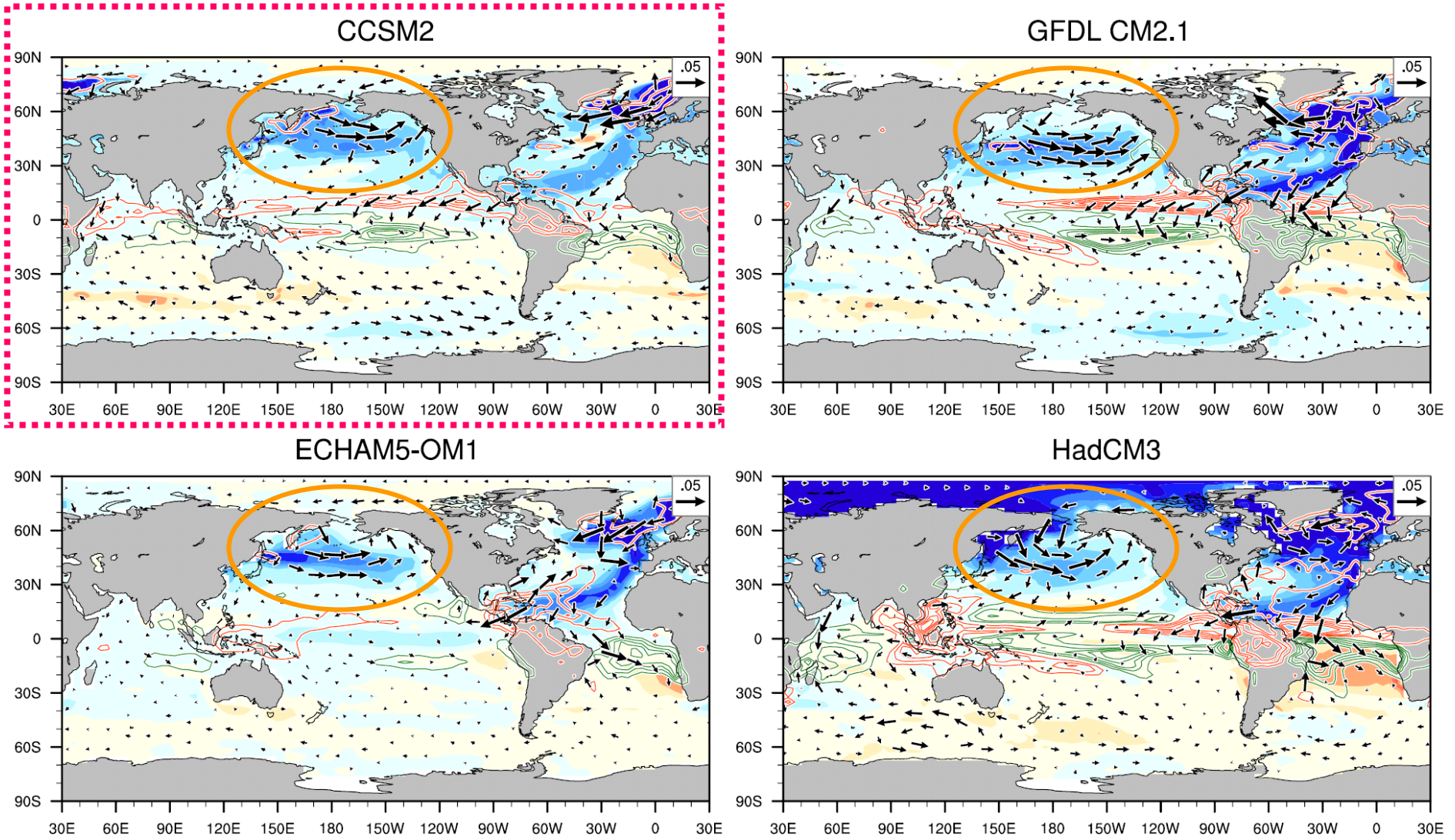
**Stouffer et al. (2006)**

## Thermohaline Circulation Intensity

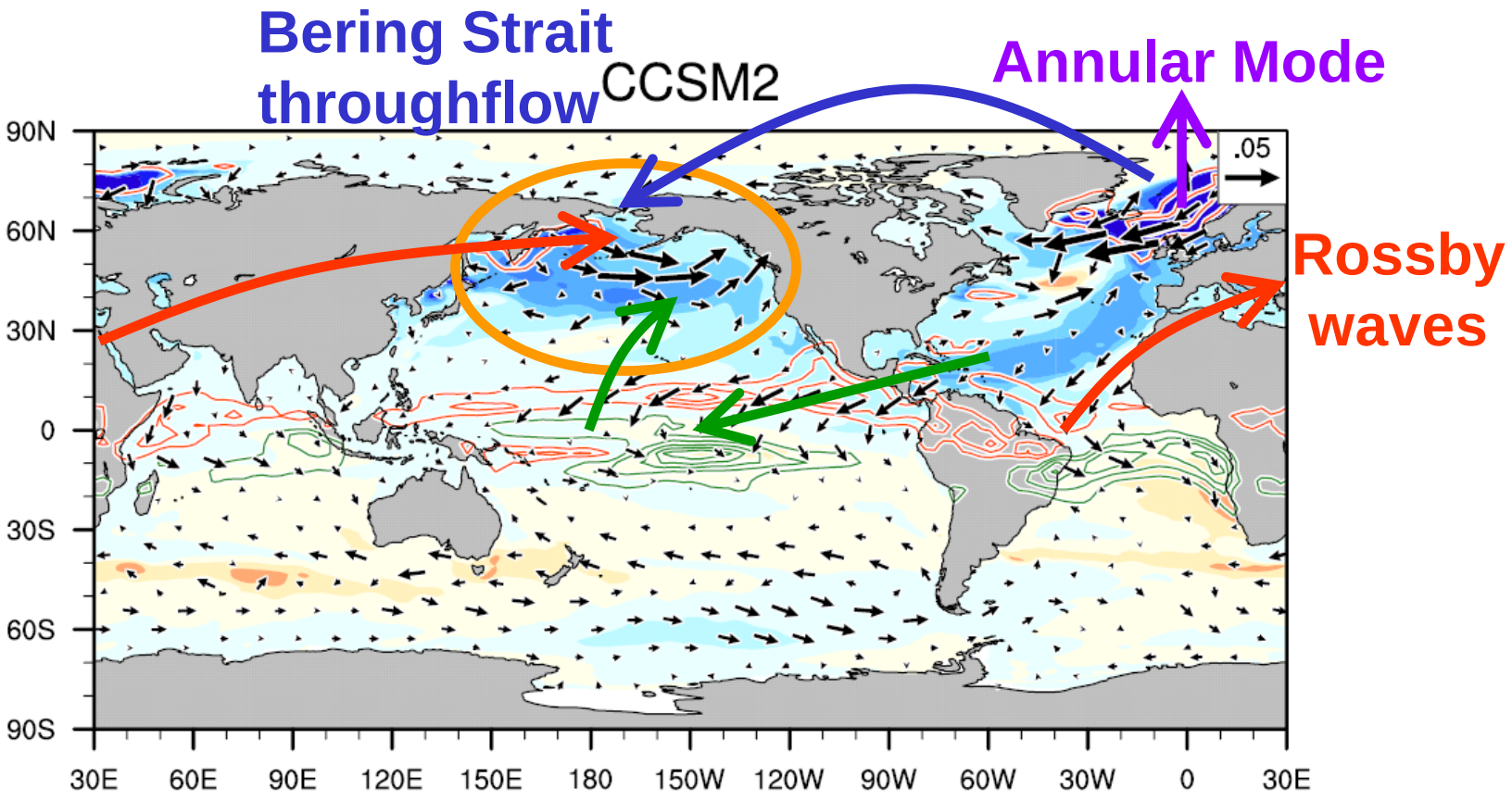


# CGCM Response to THC Shutdown (Yr 71-100, Oct-Feb)

## SST/TS (1K), Rain (-1, +1mm/day), Wind stress (N/m²)

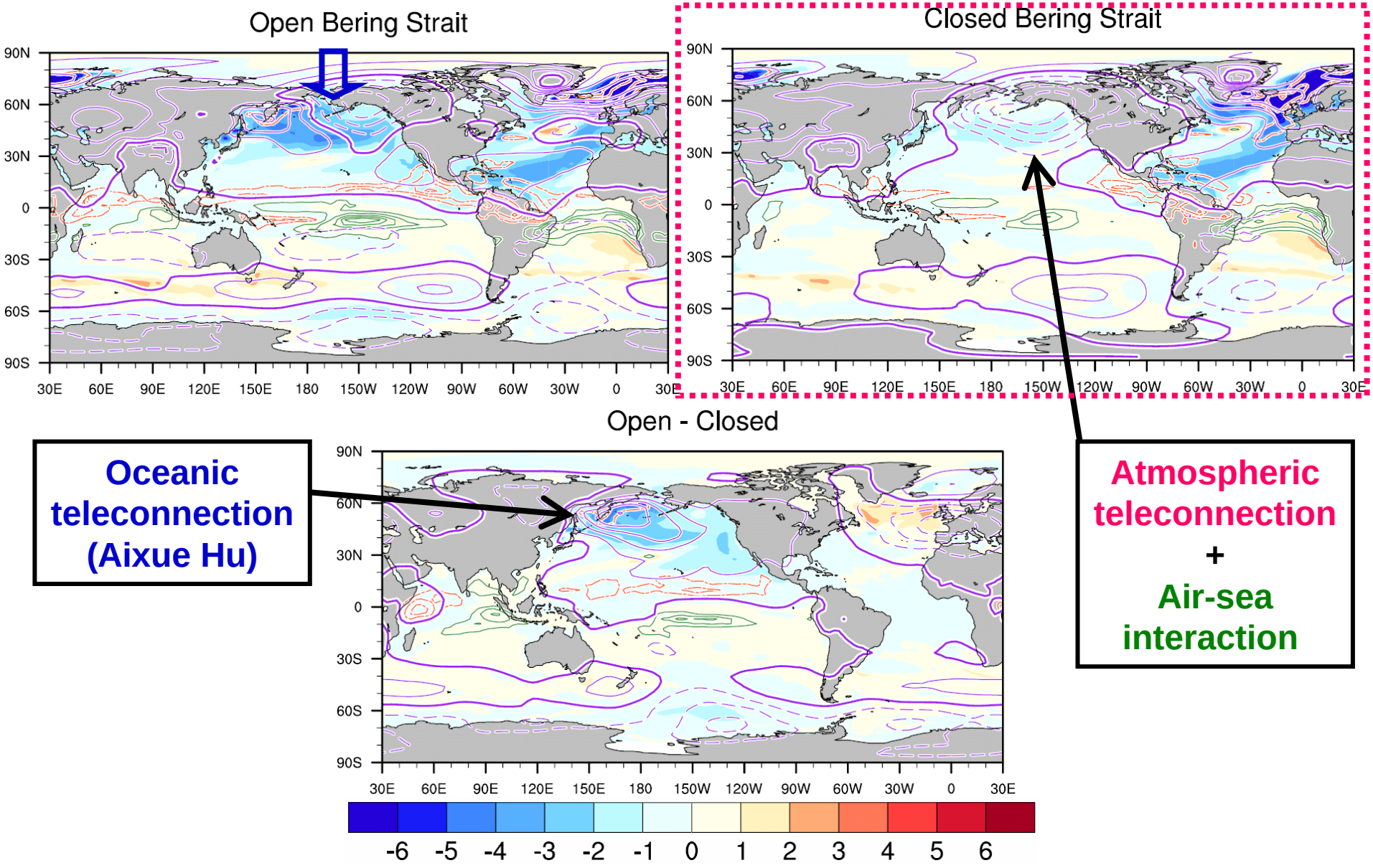


# Oceanic and Atmospheric Teleconnections



# Oceanic Teleconnections: Role of Bering Strait

**SST (1K), Rain (-1, +1mm/day), SLP (1hPa), Yr 71-100, Oct-Feb**

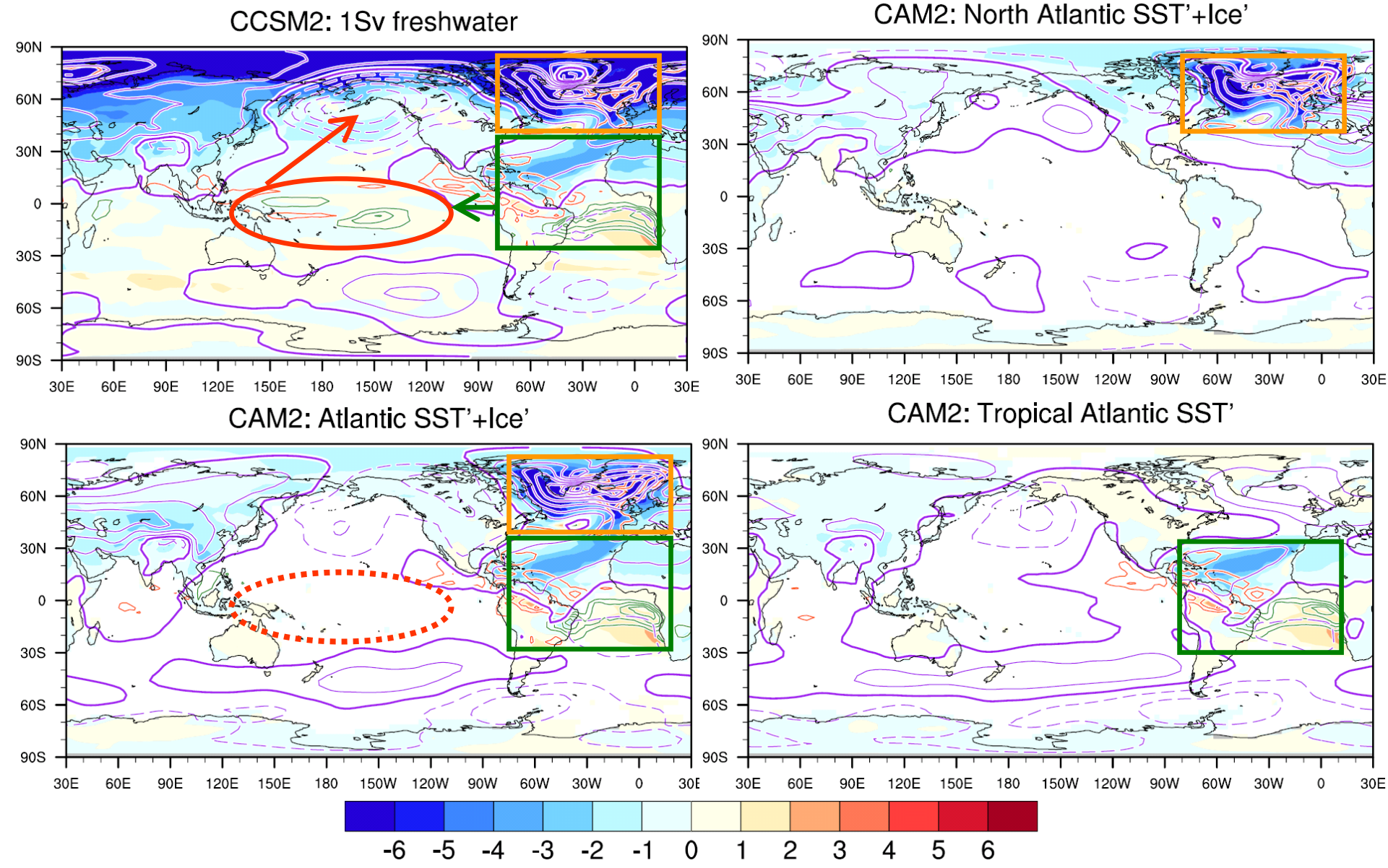



**Oceanic teleconnection (Aixue Hu)**

**Atmospheric teleconnection + Air-sea interaction**

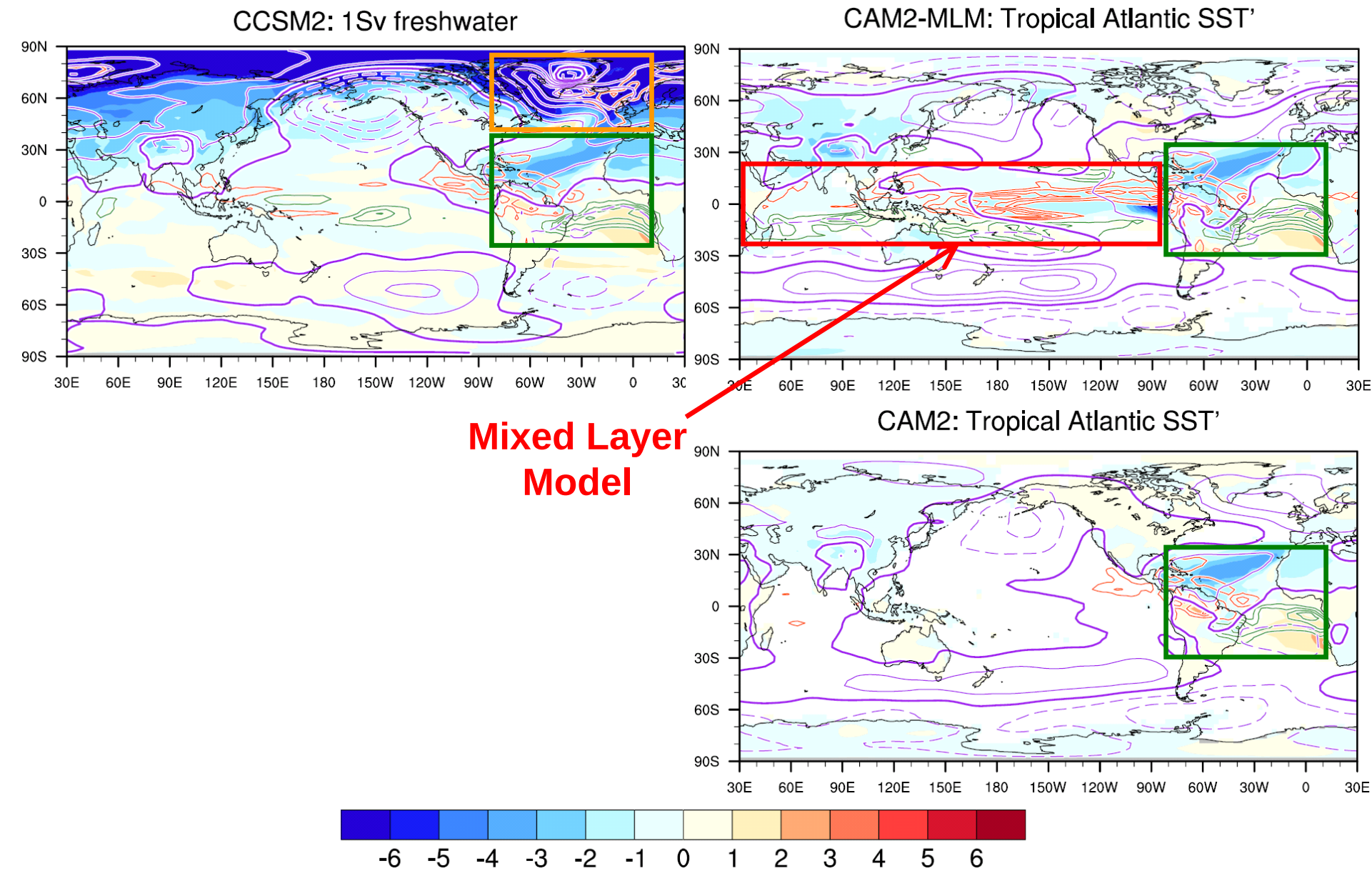
# Atmospheric Teleconnections: Role of Atlantic SSTAs

## TS (1K), Rain (-1, +1mm/day), SLP (1hPa), CAM2: Yr 1-30, Oct-Feb



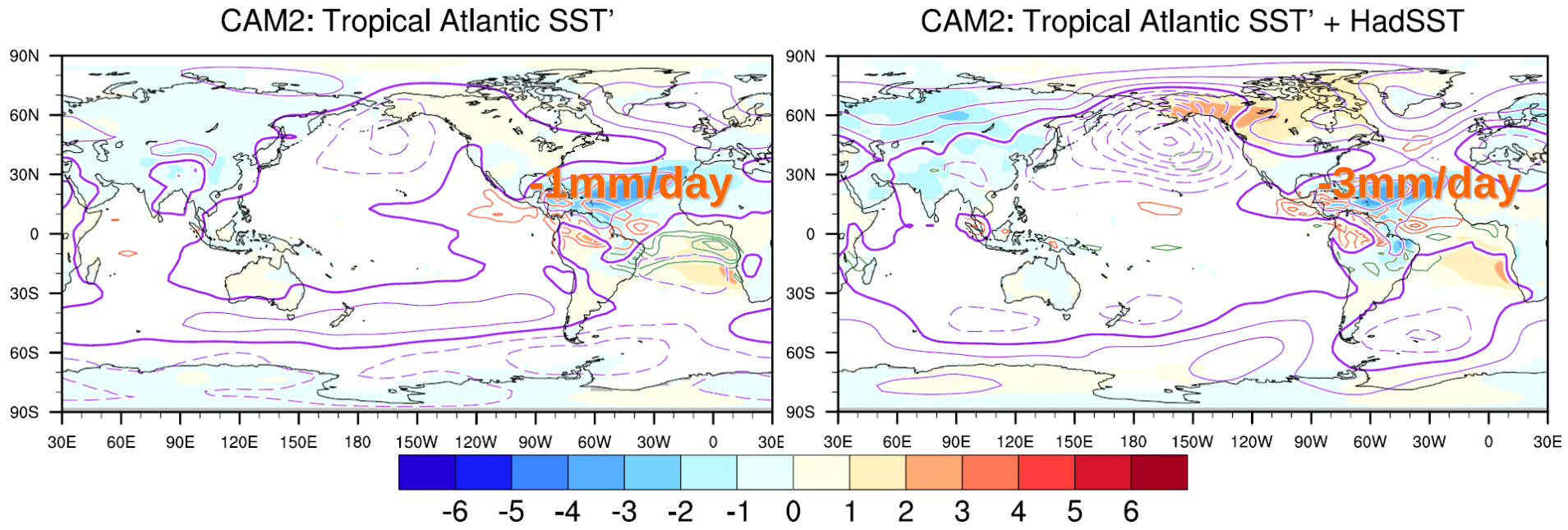
# Atmospheric teleconnections via Tropical Pacific

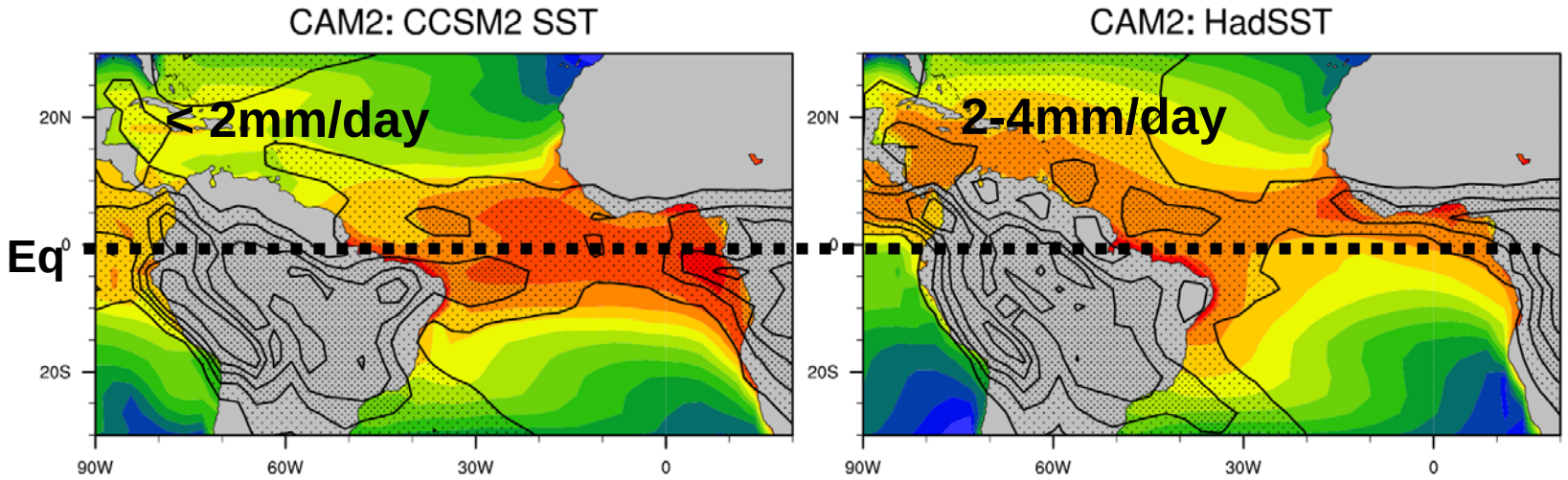
## TS (1K), Rain (-1, +1mm/day), SLP (1hPa), CAM2-MLM: Yr 1-20



# Atmospheric Teleconnections from the Tropical Atlantic: Sensitivity to Mean Convection

## SST (1K), Rain (-1, +1mm/day), SLP (1hPa), CAM2: Yr 1-30, Oct-Feb



# Summary

- In response to a shutdown of the Atlantic THC, CGCMs predict deepening of the wintertime Aleutian low and SST cooling along the oceanic frontal region in the North Pacific.

- This Atlantic-North Pacific connection is caused by both oceanic and atmospheric teleconnections:

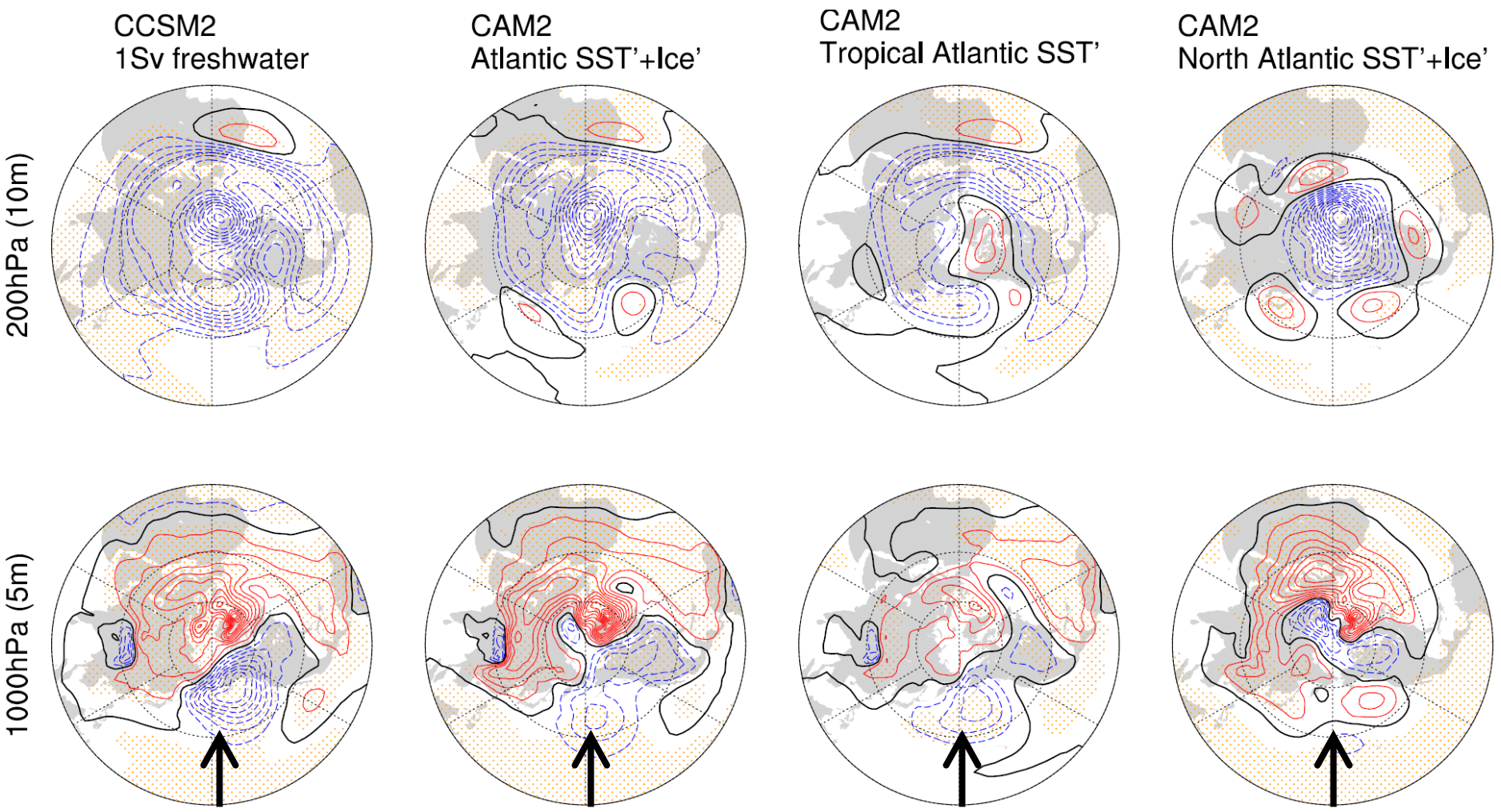
  - For oceanic teleconnections, the reversal of Bering Strait throughflow causes significant cooling in the North Pacific.

  - For atmospheric teleconnections, the southward shift of the Atlantic ITCZ acts to deepen the Aleutian low.

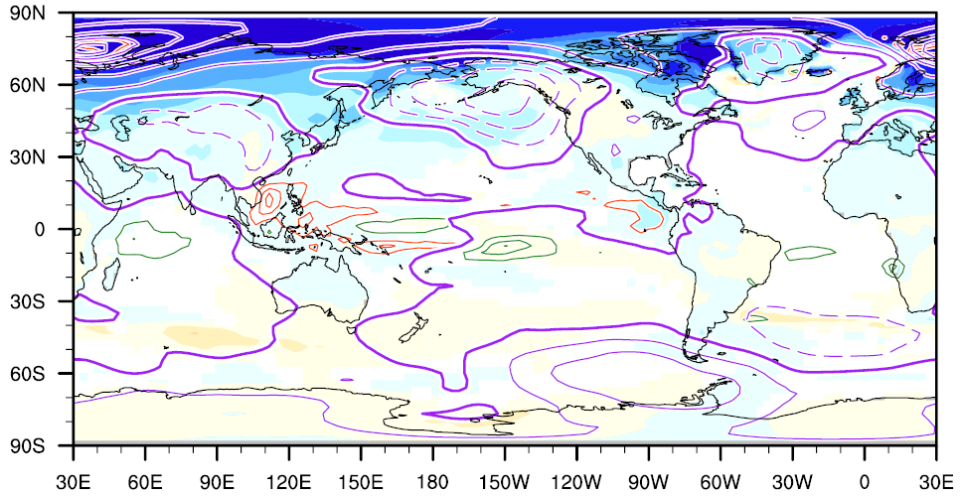
  - This tropical Atlantic-N Pacific teleconnection is sensitive to the mean convection in the tropical North Atlantic, which many CGCMs underestimate.

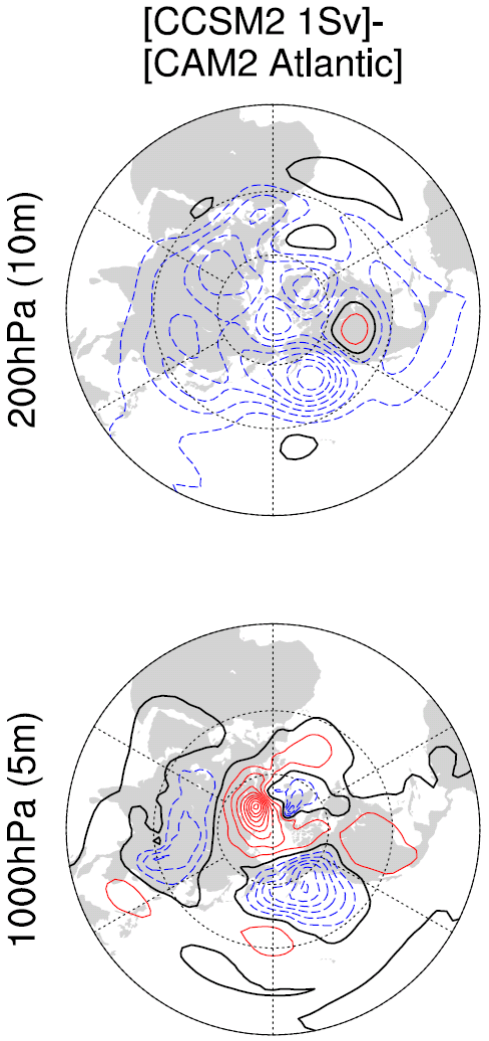
  - The southward shift of the Atlantic ITCZ may trigger changes in tropical Pacific convection that further deepens the Aleutian low.

# Vertical Structure of Geopotential Height Anomalies

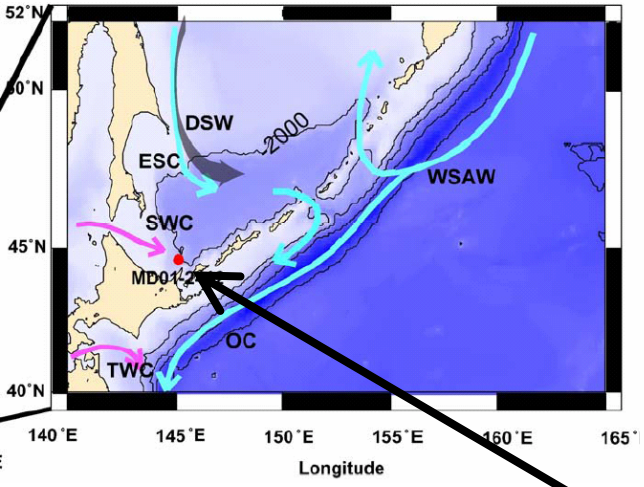


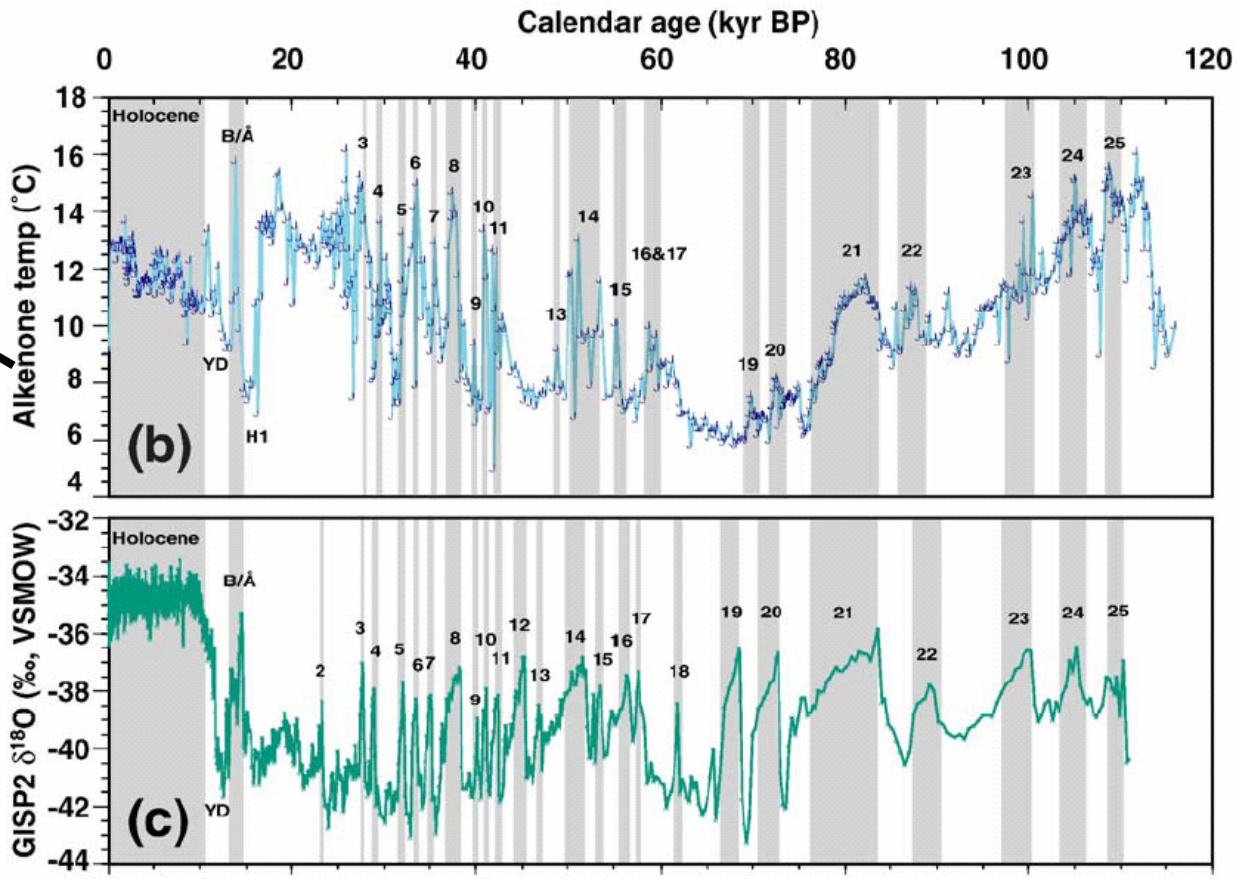
# Atmospheric Teleconnections



# Atlantic–N Pacific Connection in Paleoclimate?



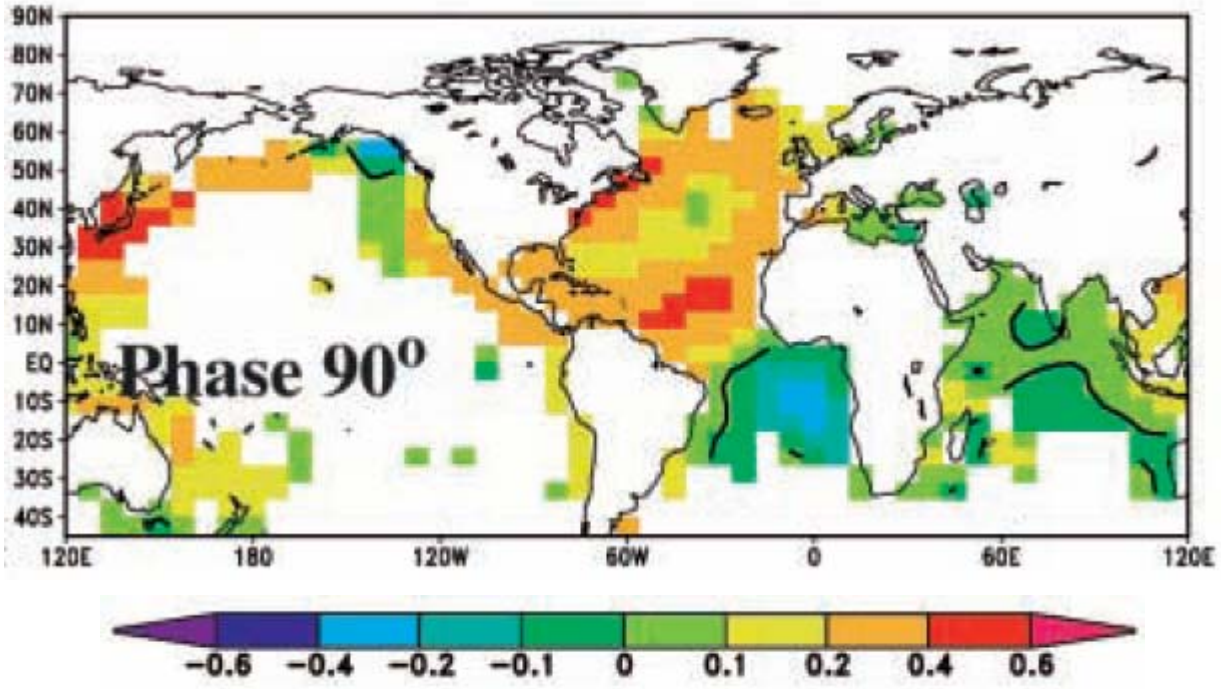




**Greenland temperature**

**Harada et al. (2006)**

# Atlantic–N Pacific Connection in Reconstructed Data

**Multi-decadal (~70 yrs) oscillation in proxy-based SST**




**Delworth and Mann (2000)**