

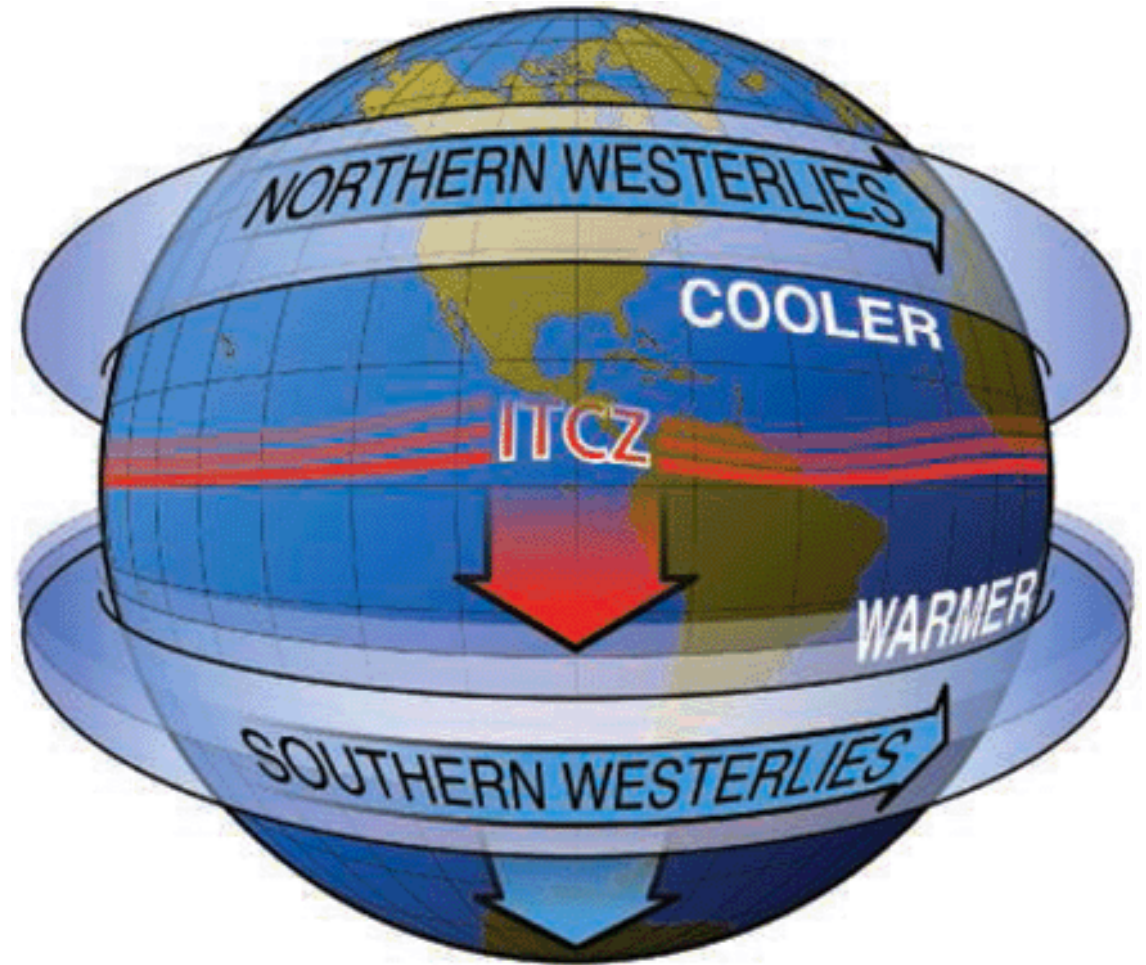
The Relationship Between the ITCZ and the Southern Hemispheric Eddy-Driven Jet

Paulo Ceppi, Yen-Ting Hwang, Xiaojuan Liu,
Dargan M. W. Frierson, Dennis L. Hartmann

University of Washington

Department of Atmospheric Sciences

ITCZ and midlatitude jet shifts



ITCZ and midlatitude jet shifts

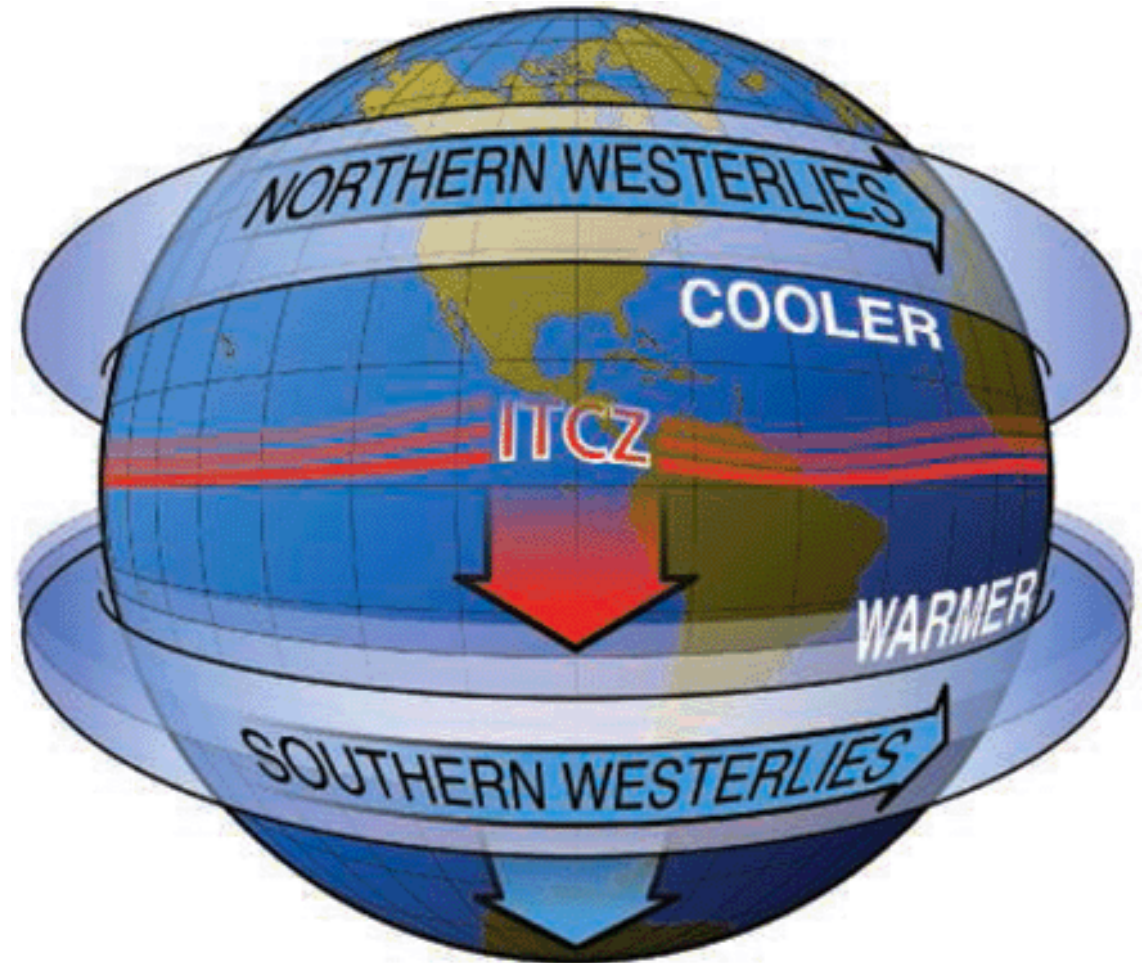
bipolar seesaw



ITCZ shift



SH jet shift?

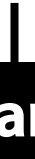


ITCZ and midlatitude jet shifts

bipolar seesaw



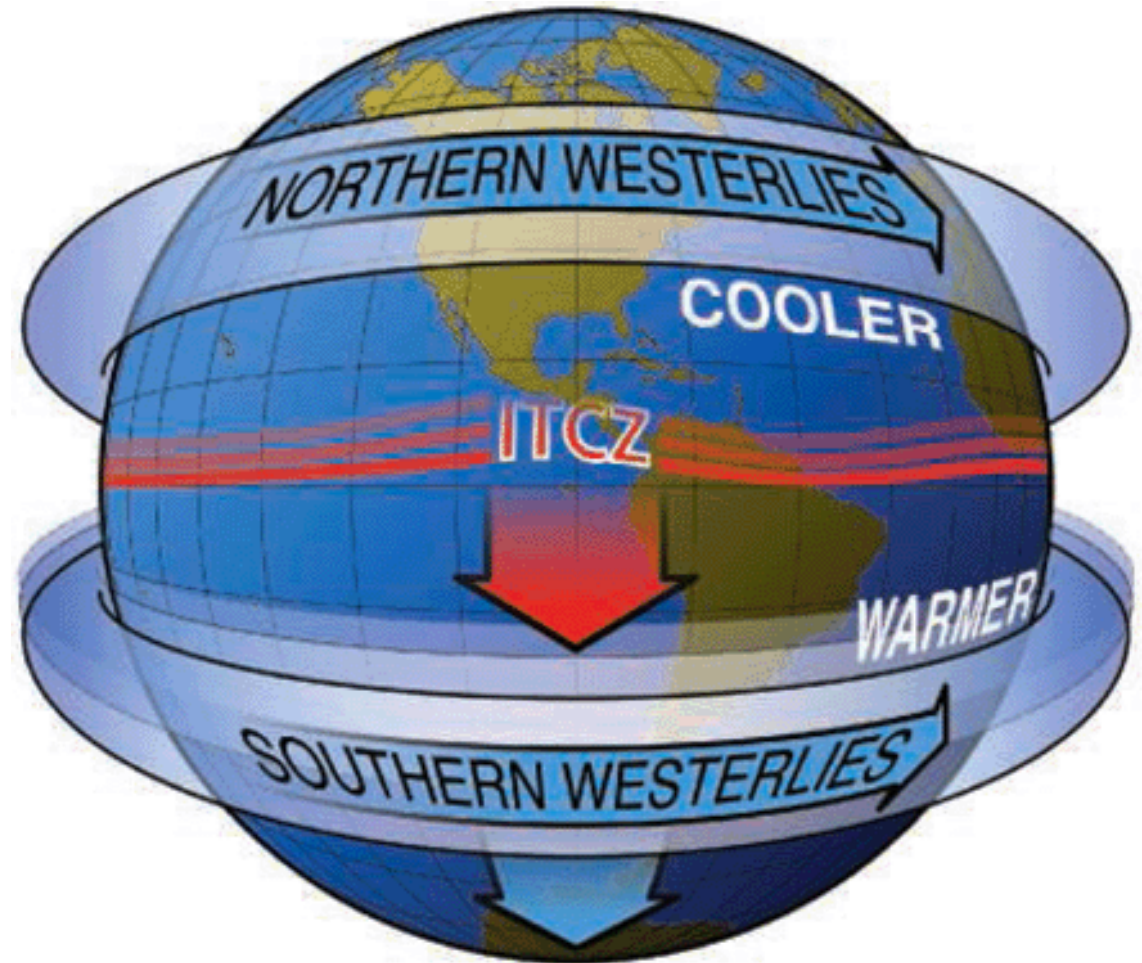
ITCZ shift



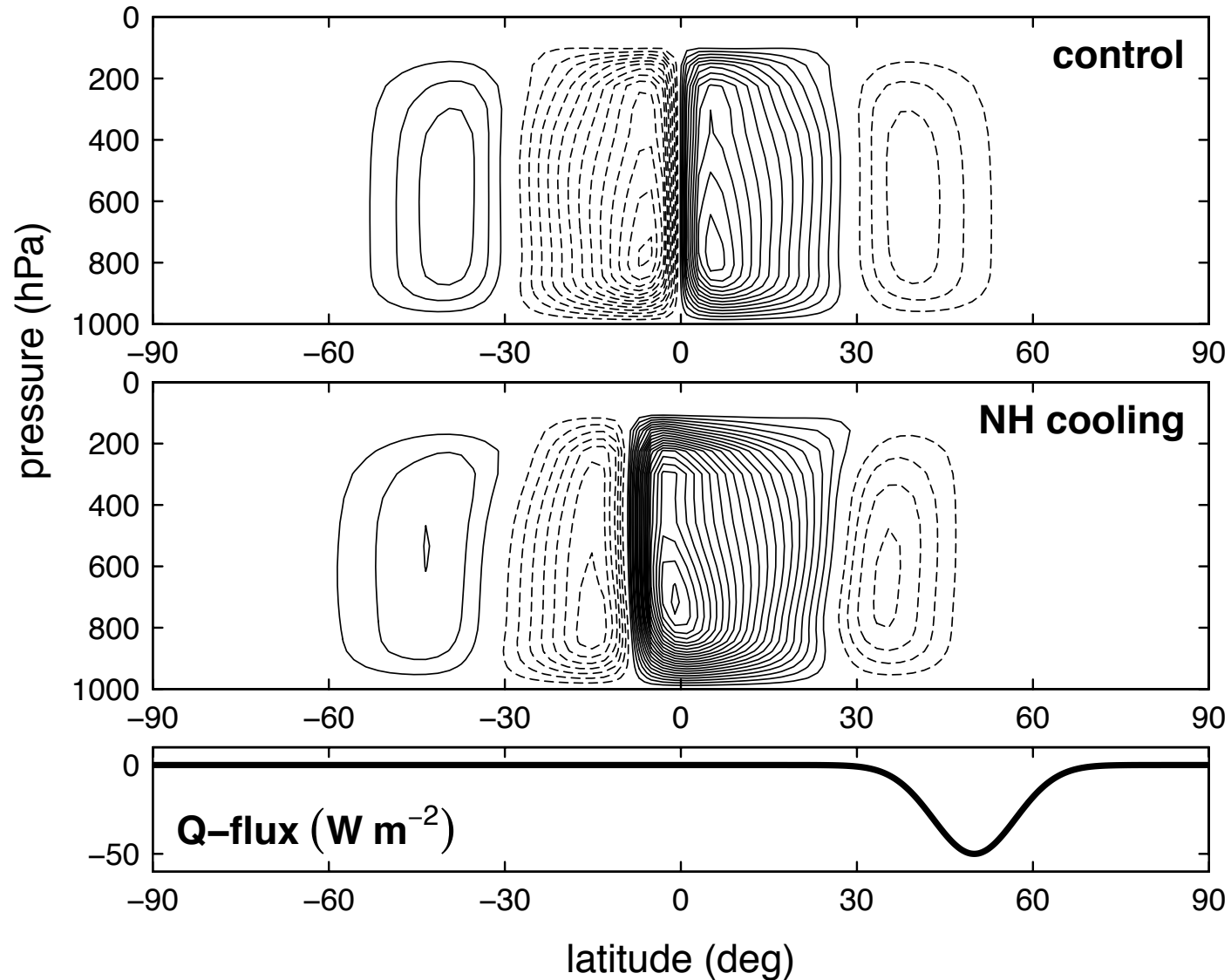
mechanism?



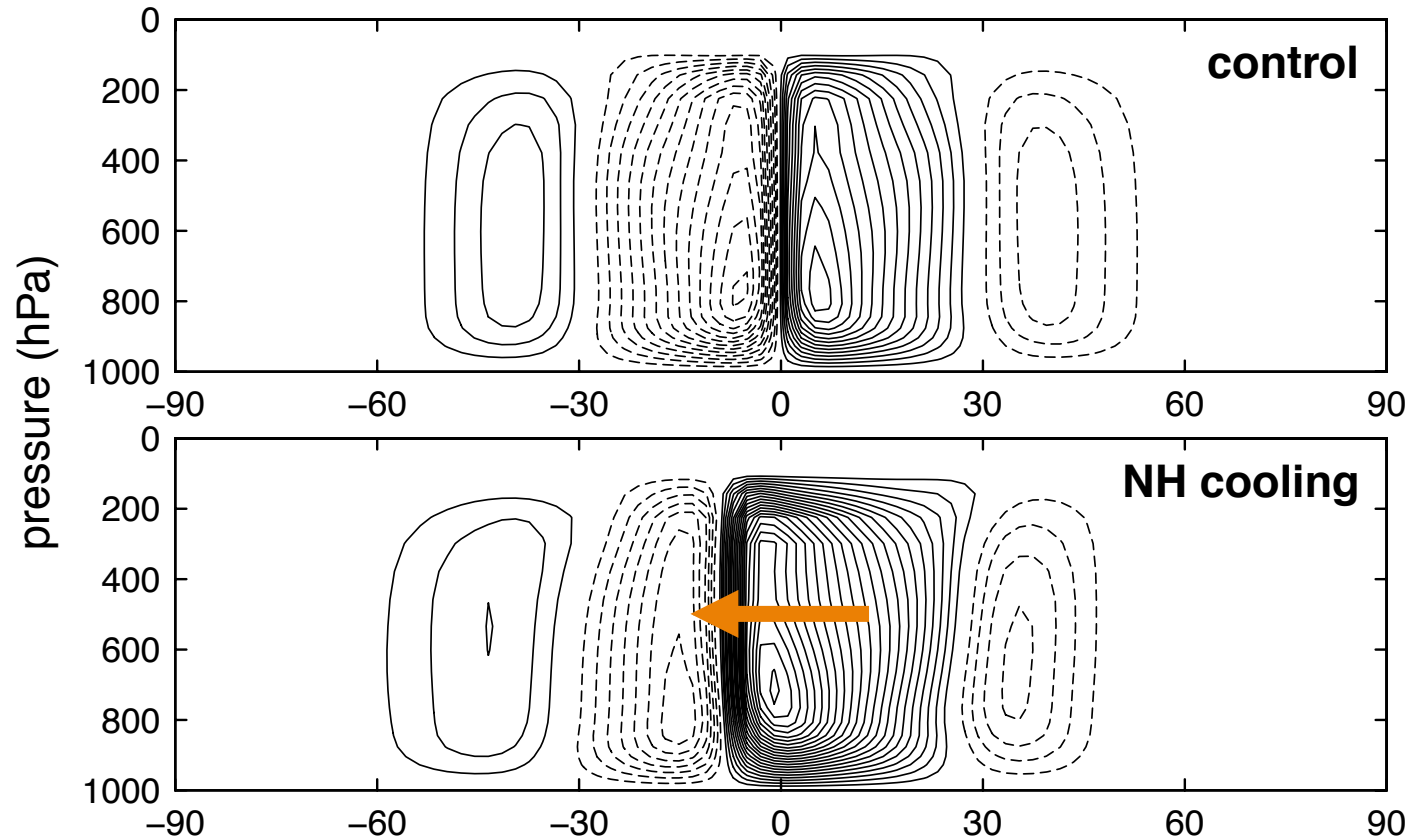
SH jet shift?



Aquaplanet GCM experiments

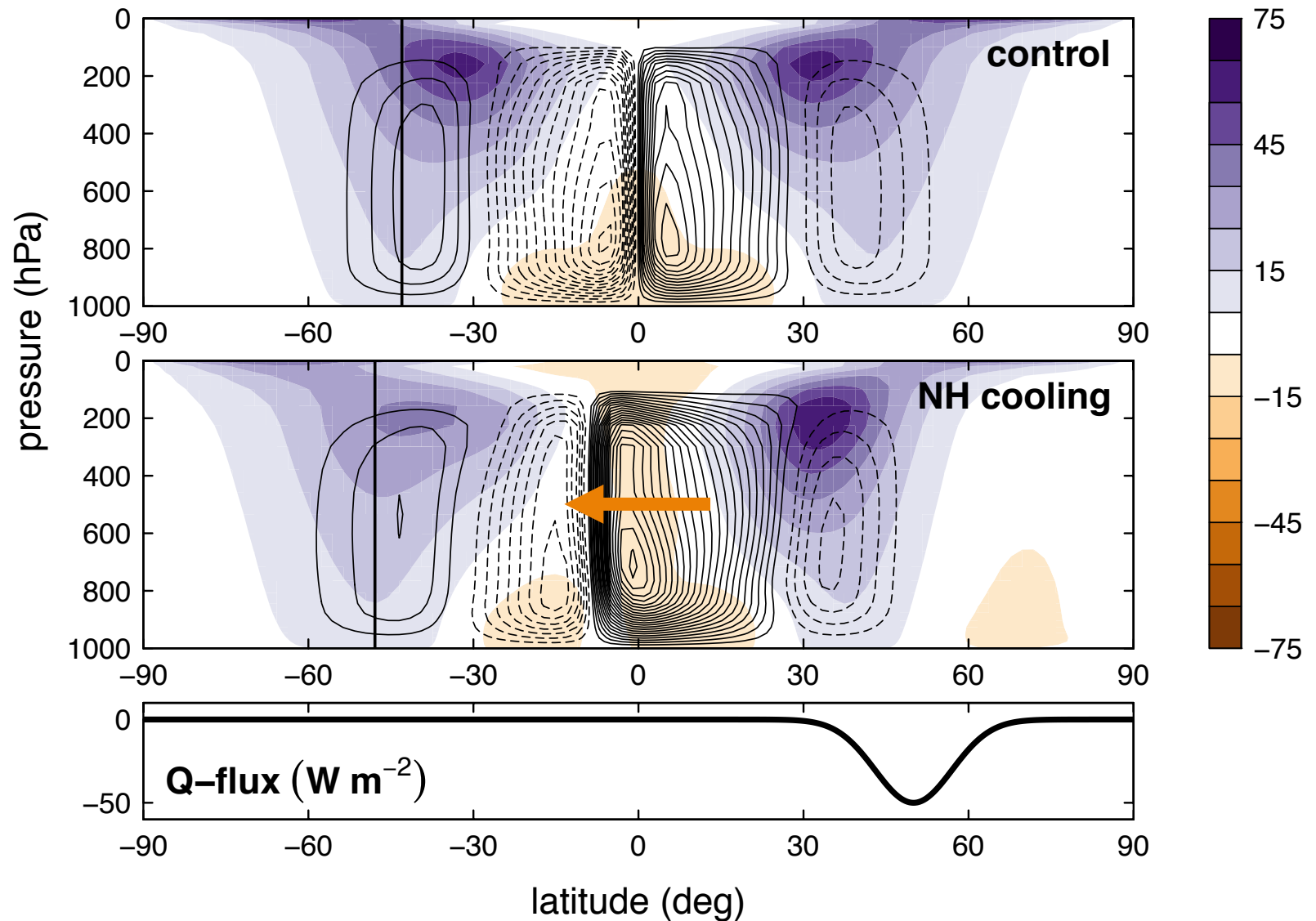


Aquaplanet GCM experiments

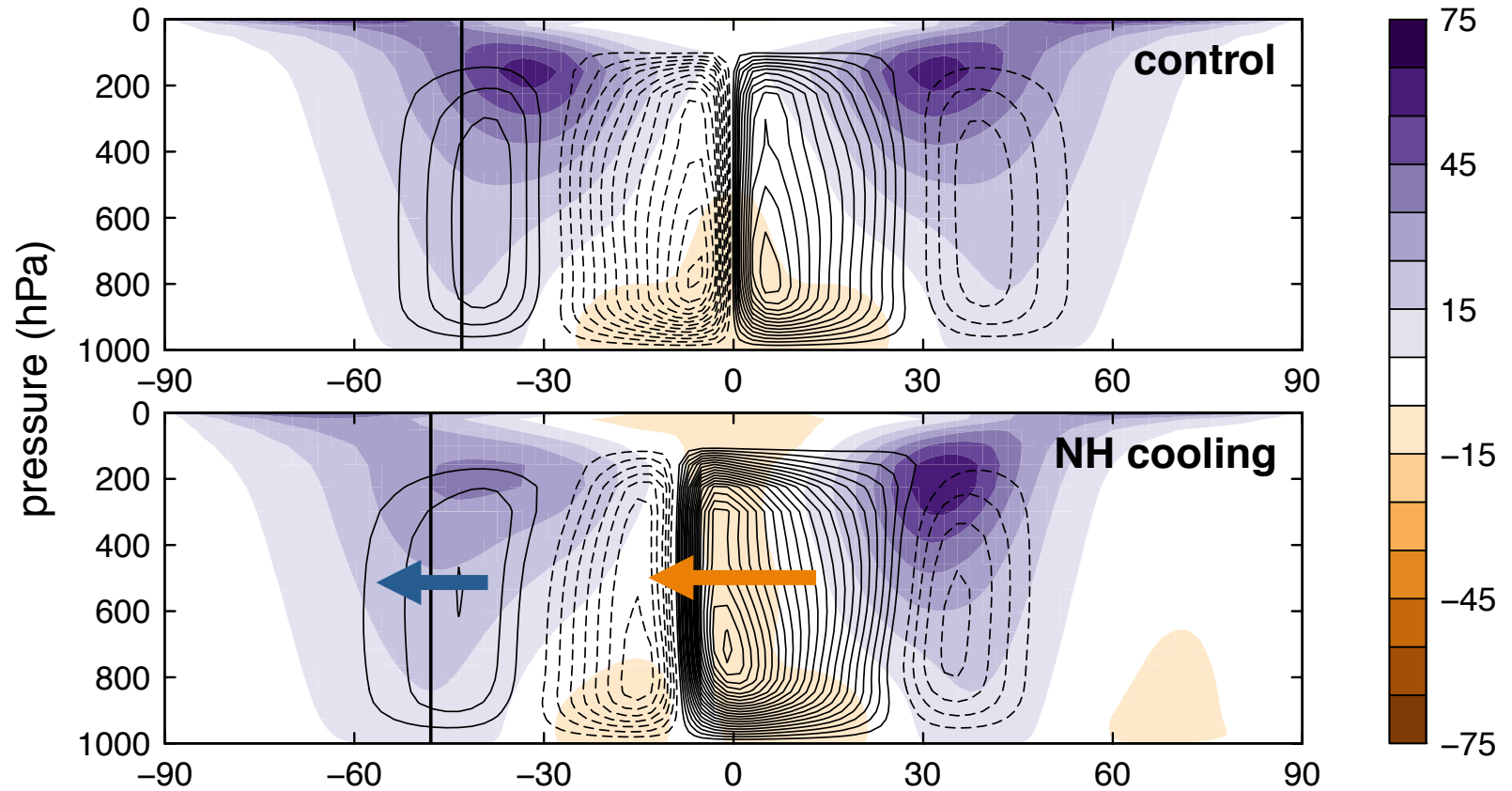


ITCZ shift (see e.g. Broccoli et al., 2006; Kang et al., 2008)

Aquaplanet GCM experiments

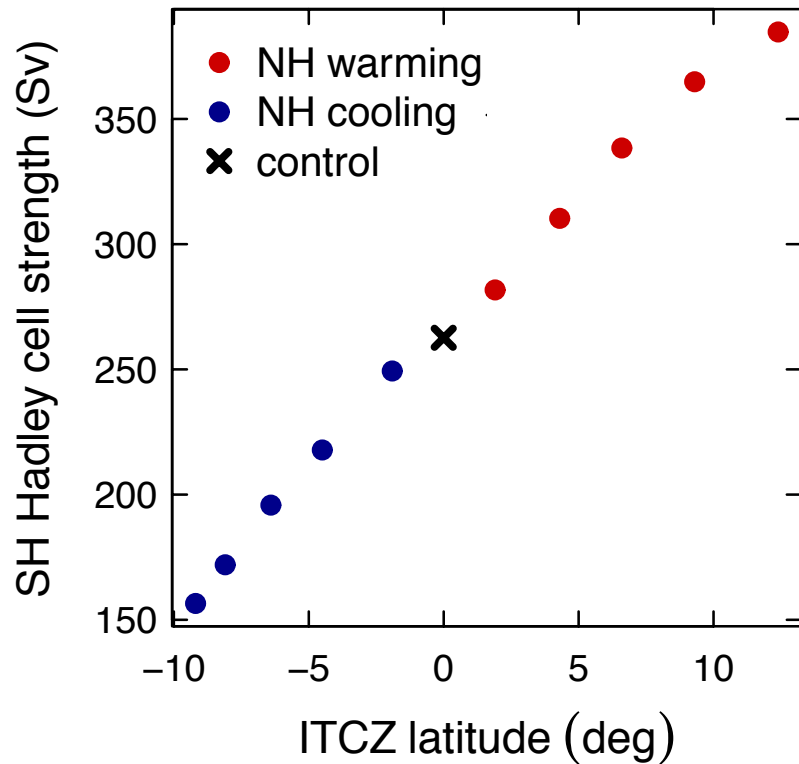


Aquaplanet GCM experiments

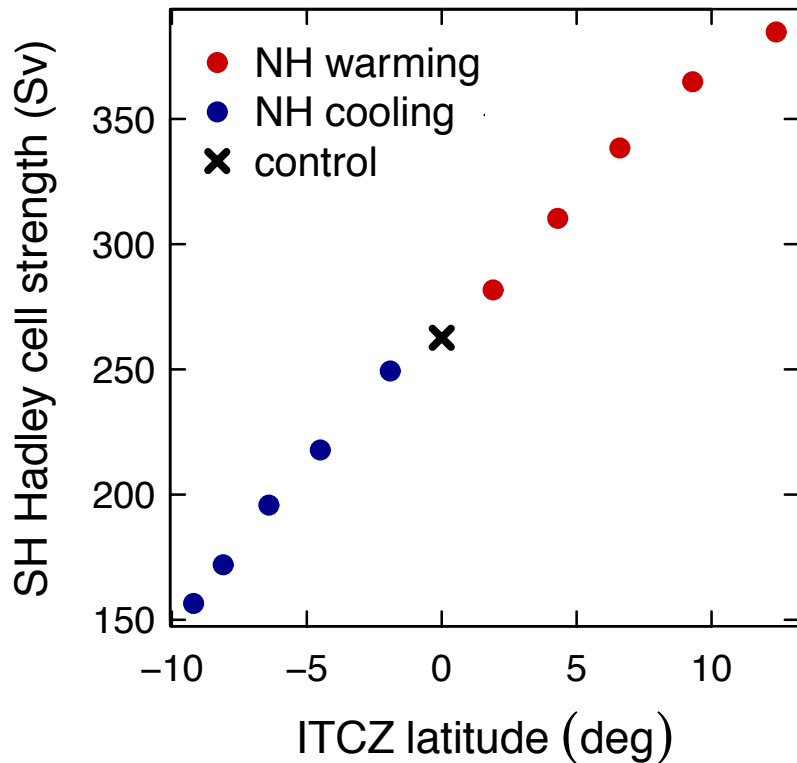


eddy-driven jet shift in the opposite hemisphere

Shift of the ITCZ and SH jet



Shift of the ITCZ and SH jet



NH warming

→ northward ITCZ shift

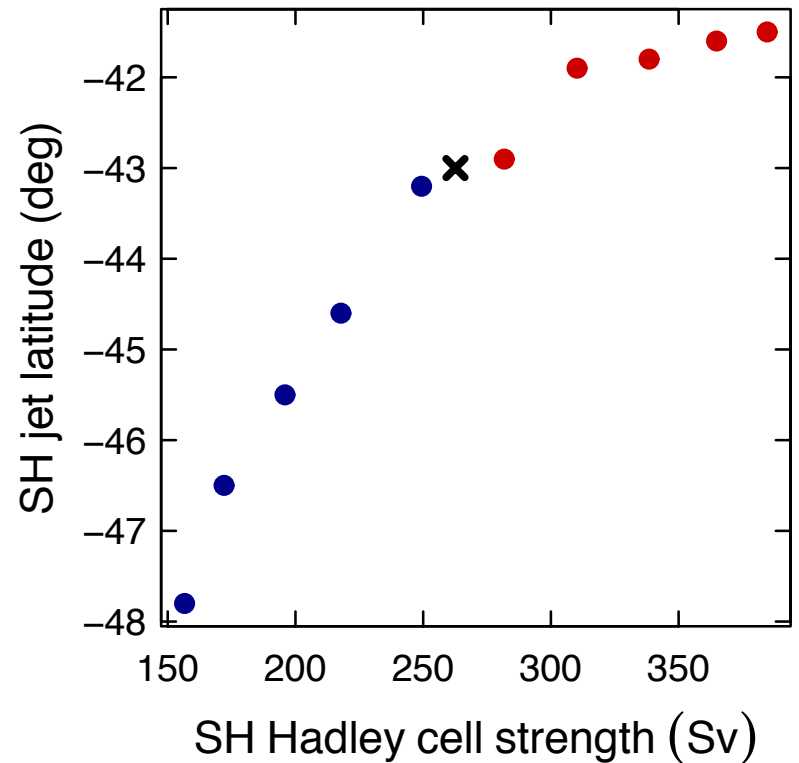
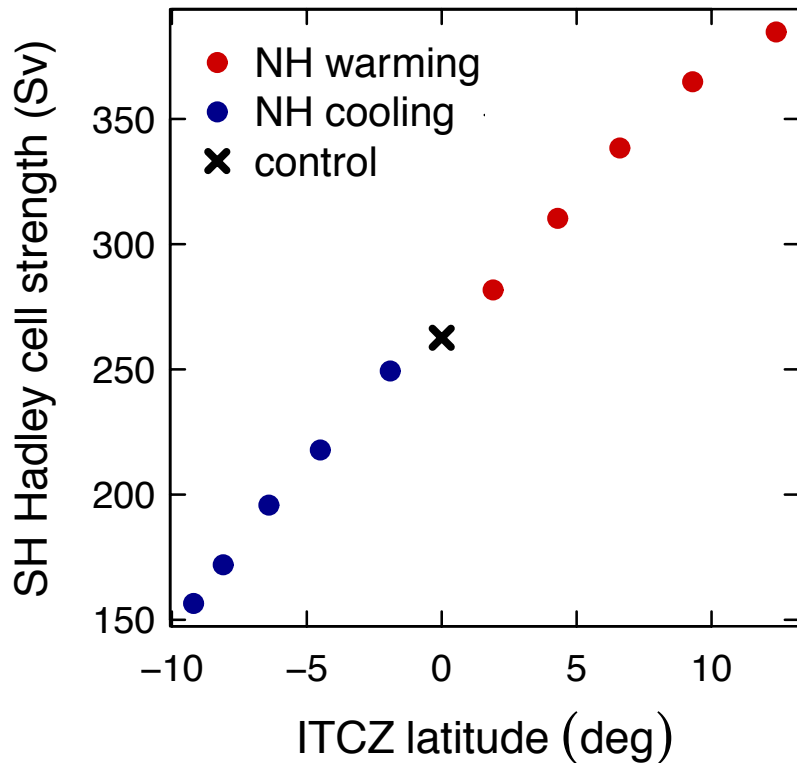
→ strengthening of SH Hadley cell

NH cooling

→ southward ITCZ shift

→ weakening of SH HC

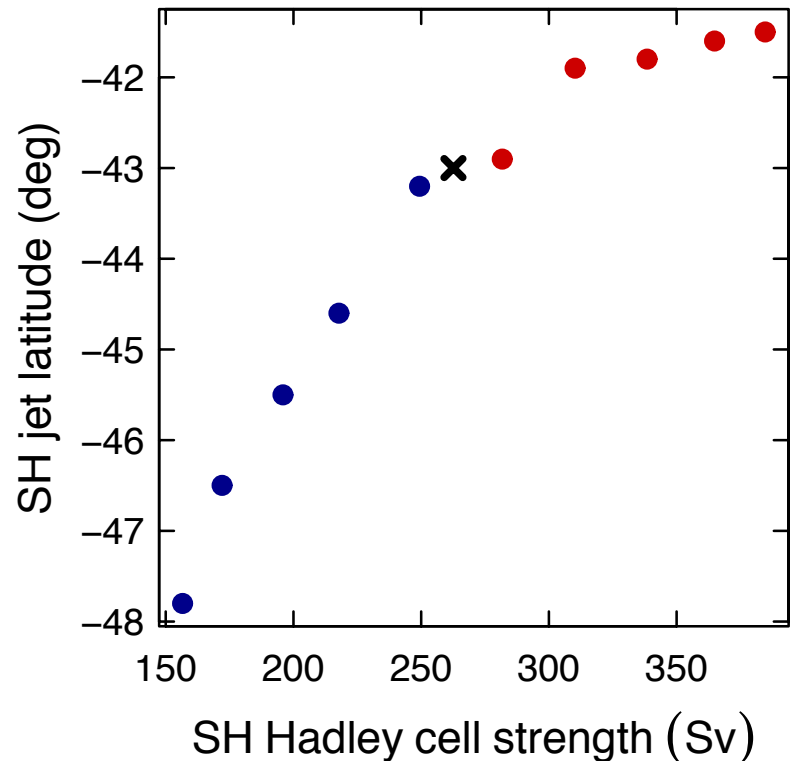
Shift of the ITCZ and SH jet



Shift of the ITCZ and SH jet

strengthening of SH
Hadley cell
→ equatorward jet shift

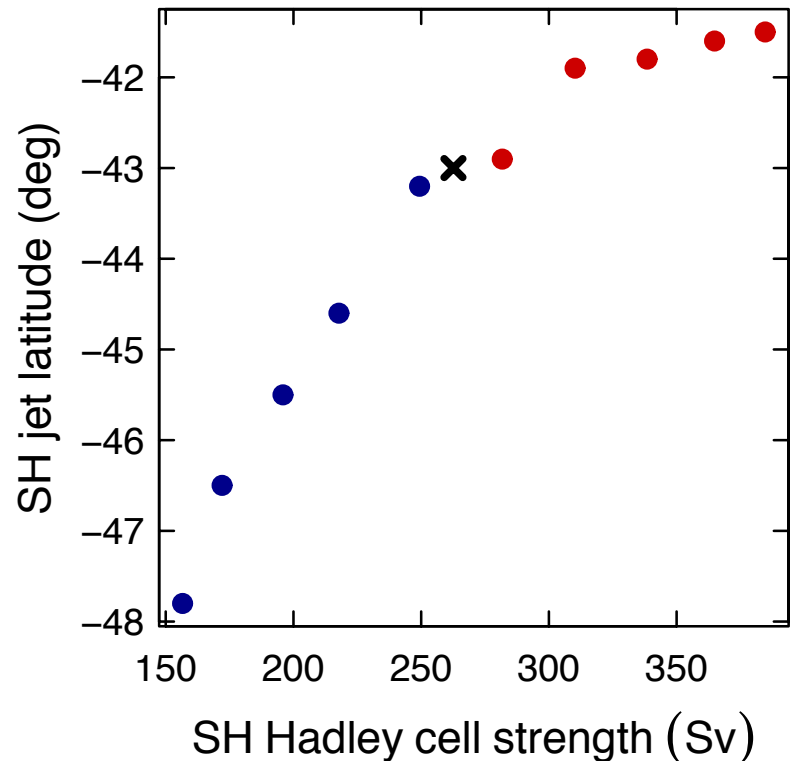
weakening of SH HC
→ poleward jet shift



Shift of the ITCZ and SH jet

strengthening of SH
Hadley cell
→ equatorward jet shift

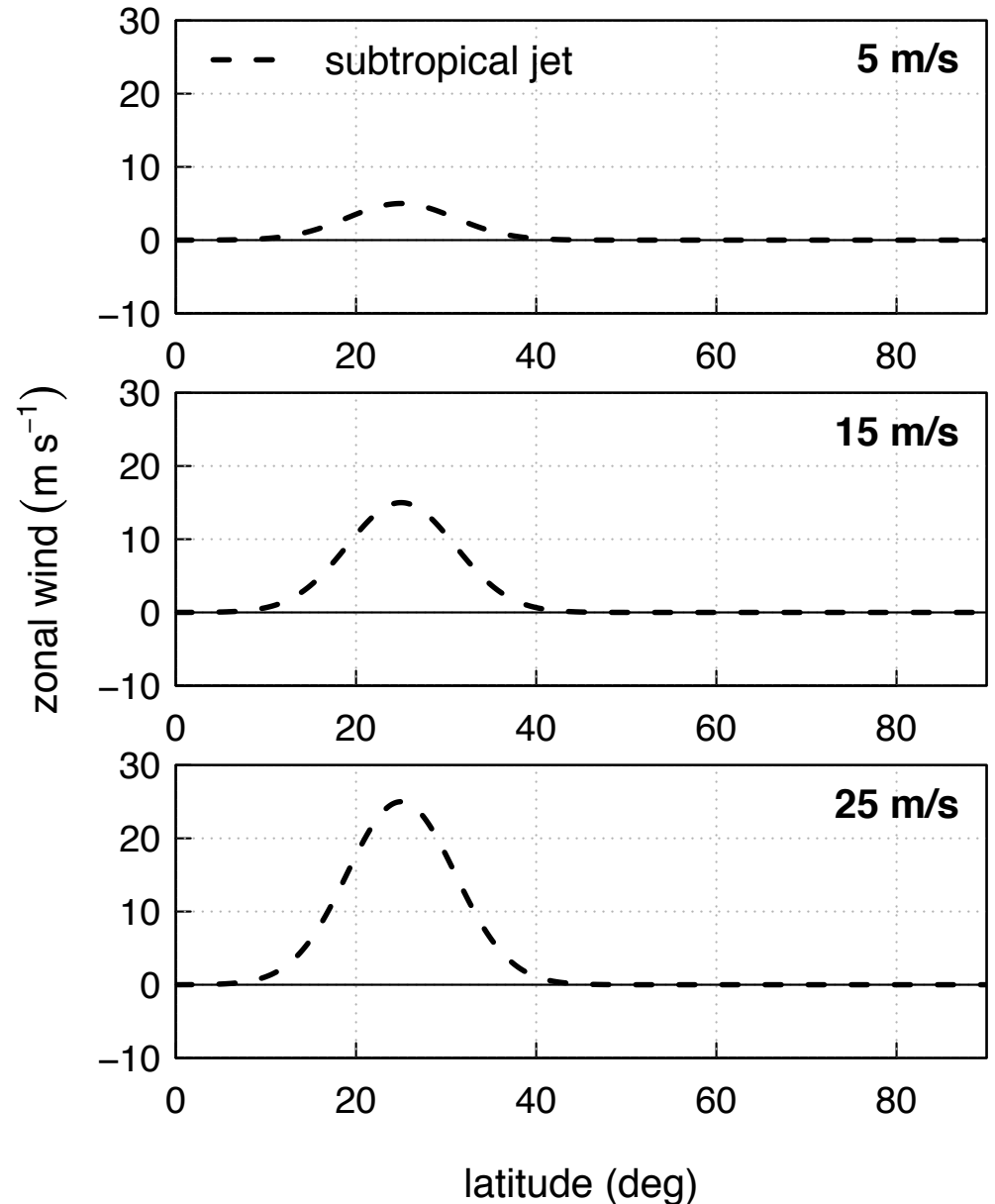
weakening of SH HC
→ poleward jet shift



what is the role of the change in **subtropical jet strength**?

Barotropic model experiments

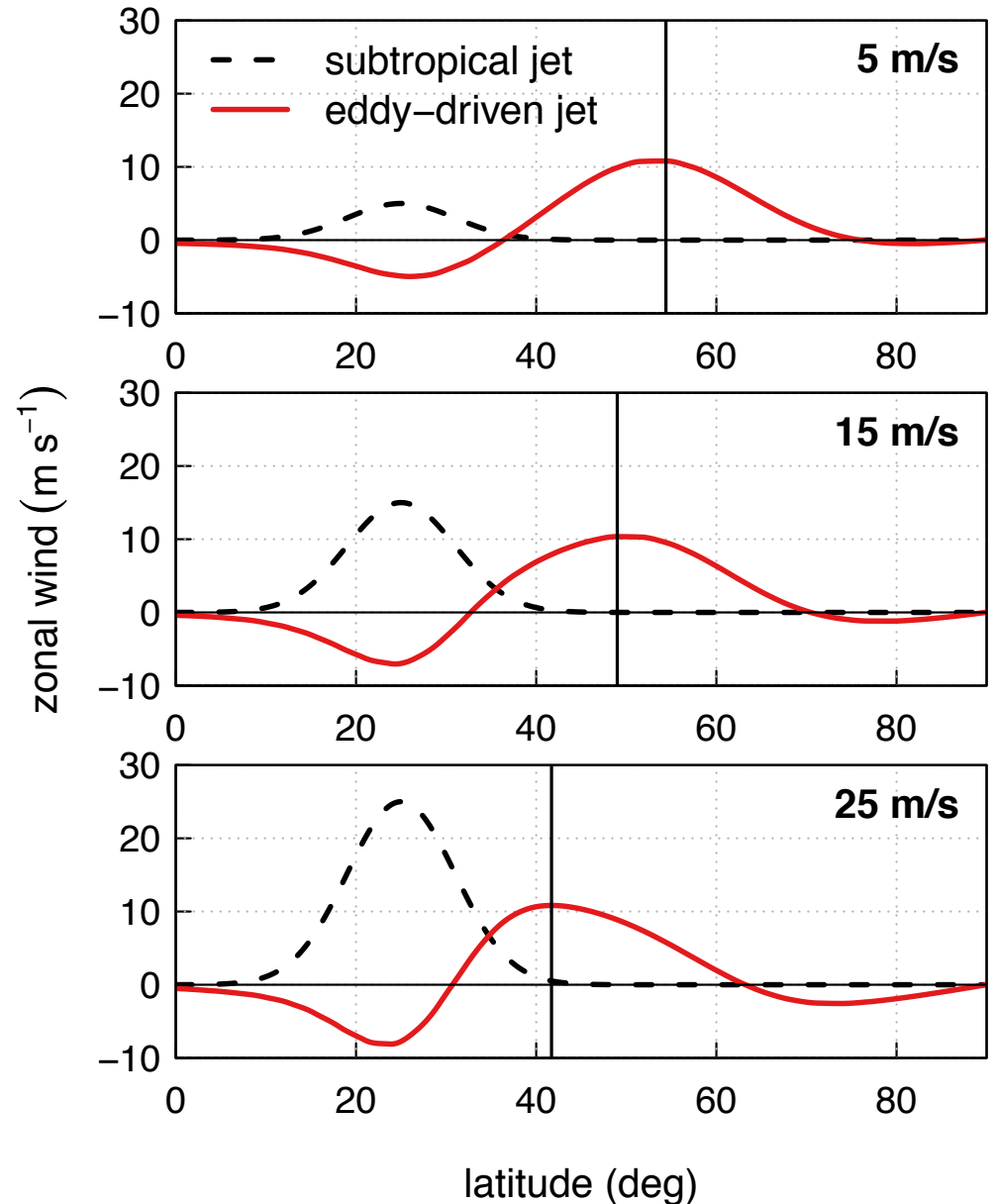
simulations with a
**prescribed subtropical
jet** of varying strength
at **25° latitude**



Barotropic model experiments

simulations with a **prescribed subtropical jet** of varying strength at **25° latitude**

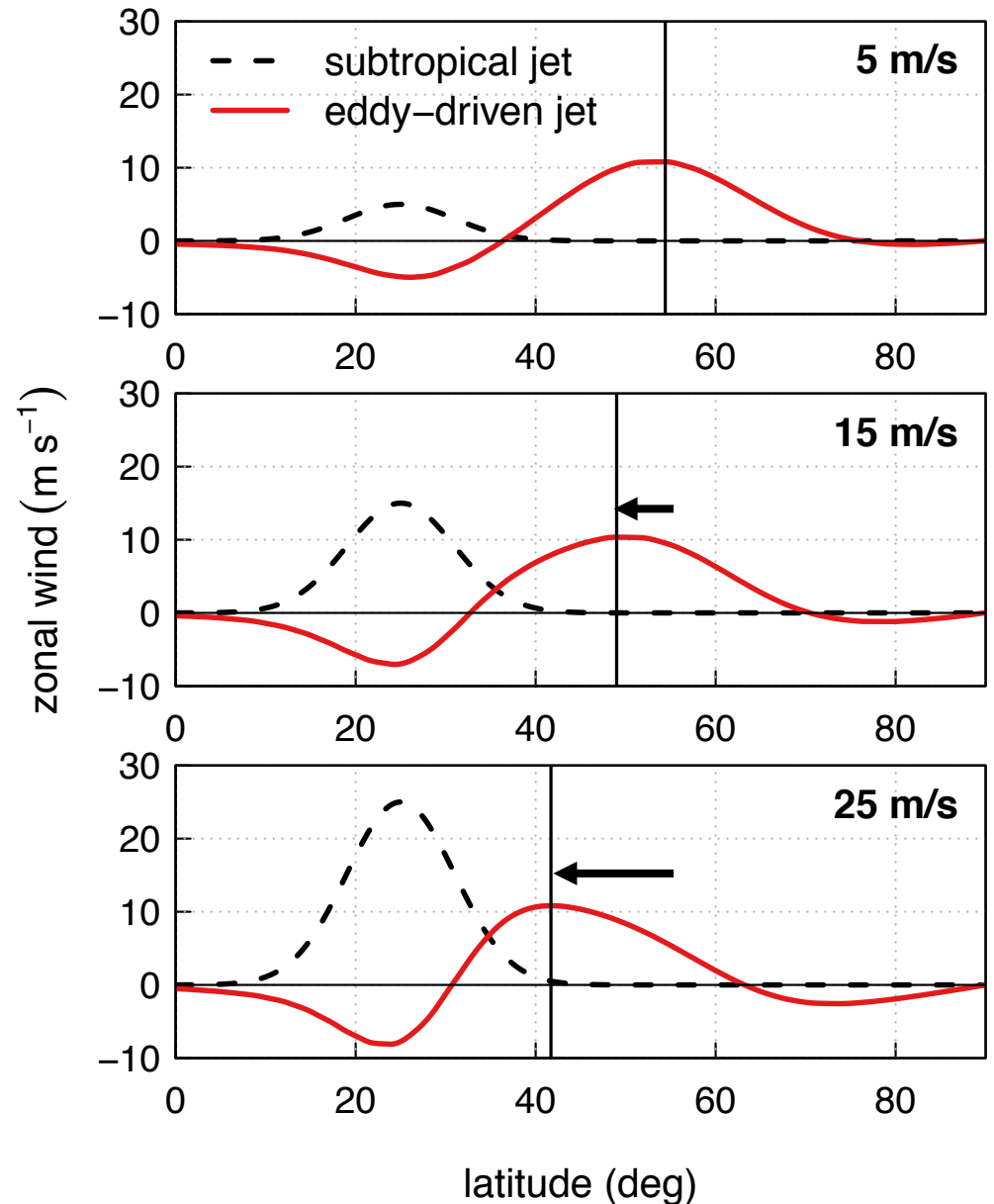
add **eddy stirring** at **50° latitude**



Barotropic model experiments

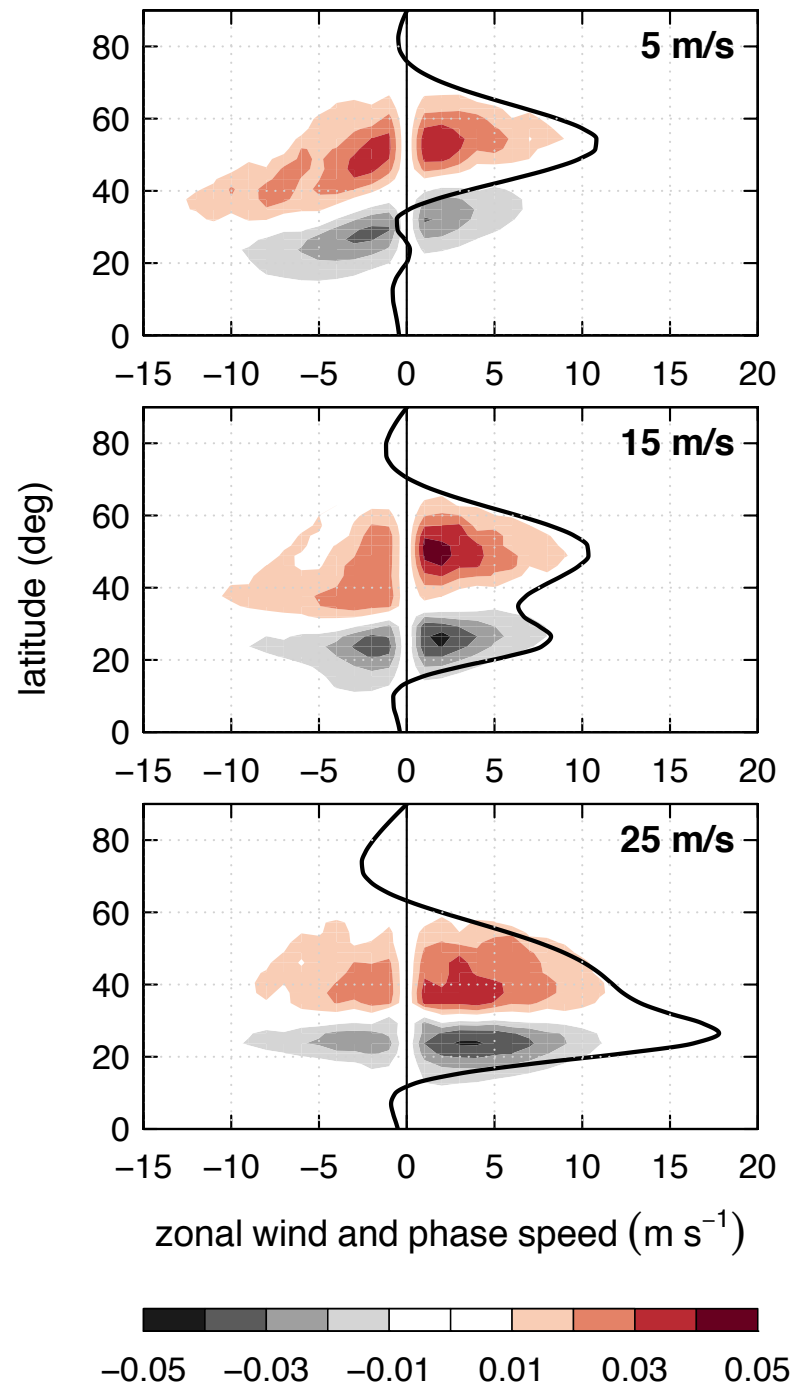
simulations with a **prescribed subtropical jet** of varying strength at **25° latitude**

add **eddy stirring** at **50° latitude**



Phase speed spectra

eddy momentum flux power spectra



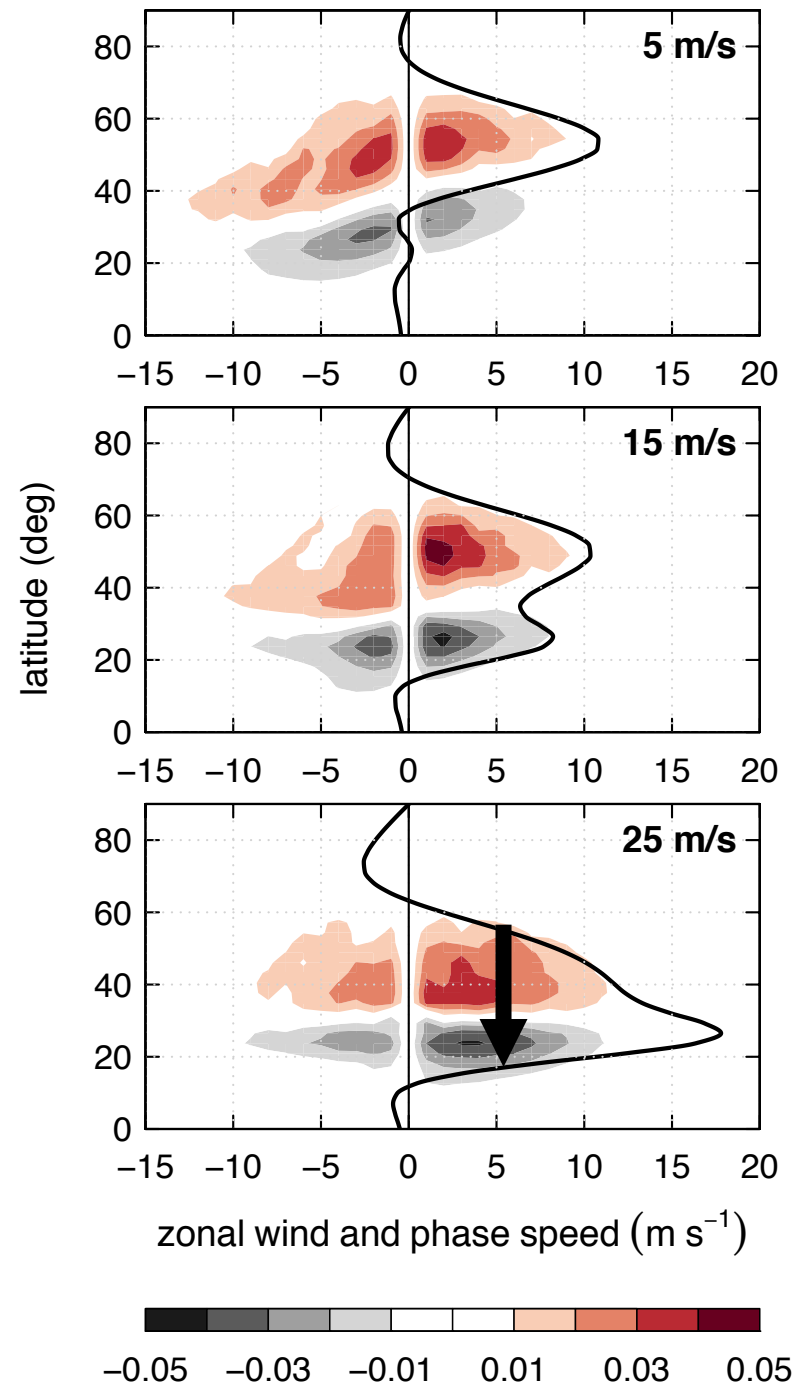
Phase speed spectra

eddy momentum flux power spectra

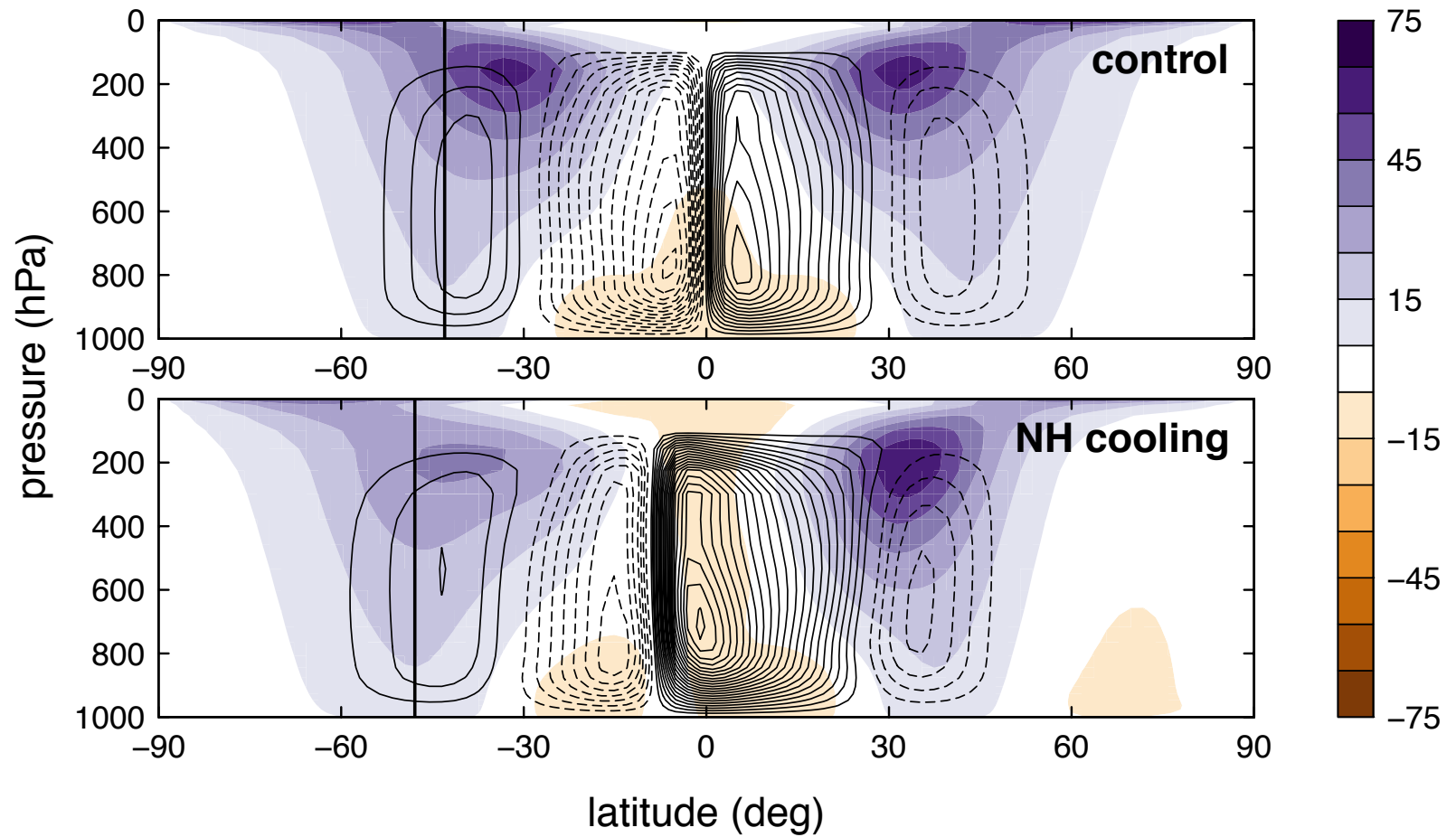
Subtropical jet strengthening

→ waves propagate deeper into tropics

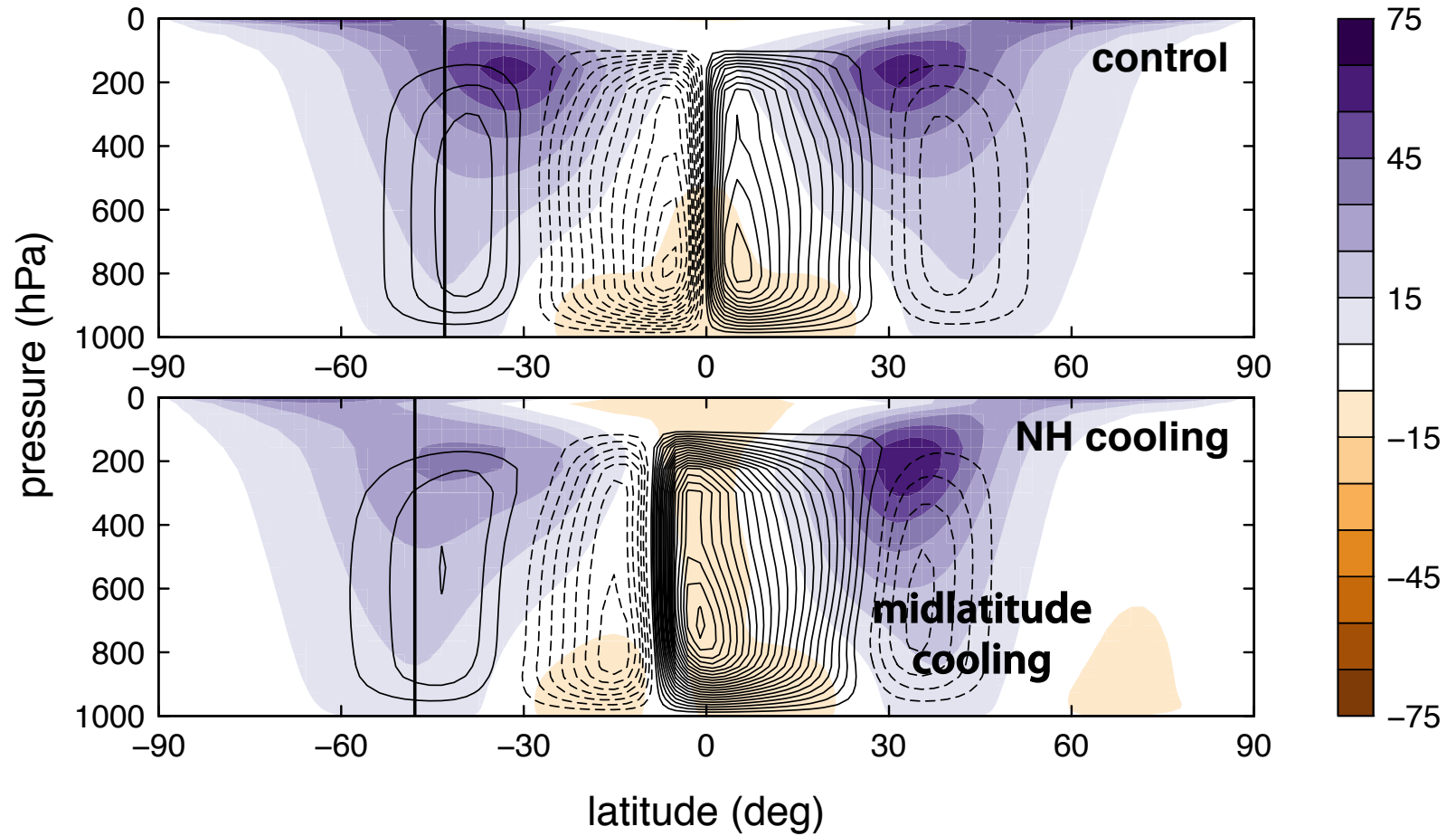
→ **eddy momentum flux divergence and convergence shift equatorward** (especially for faster waves)



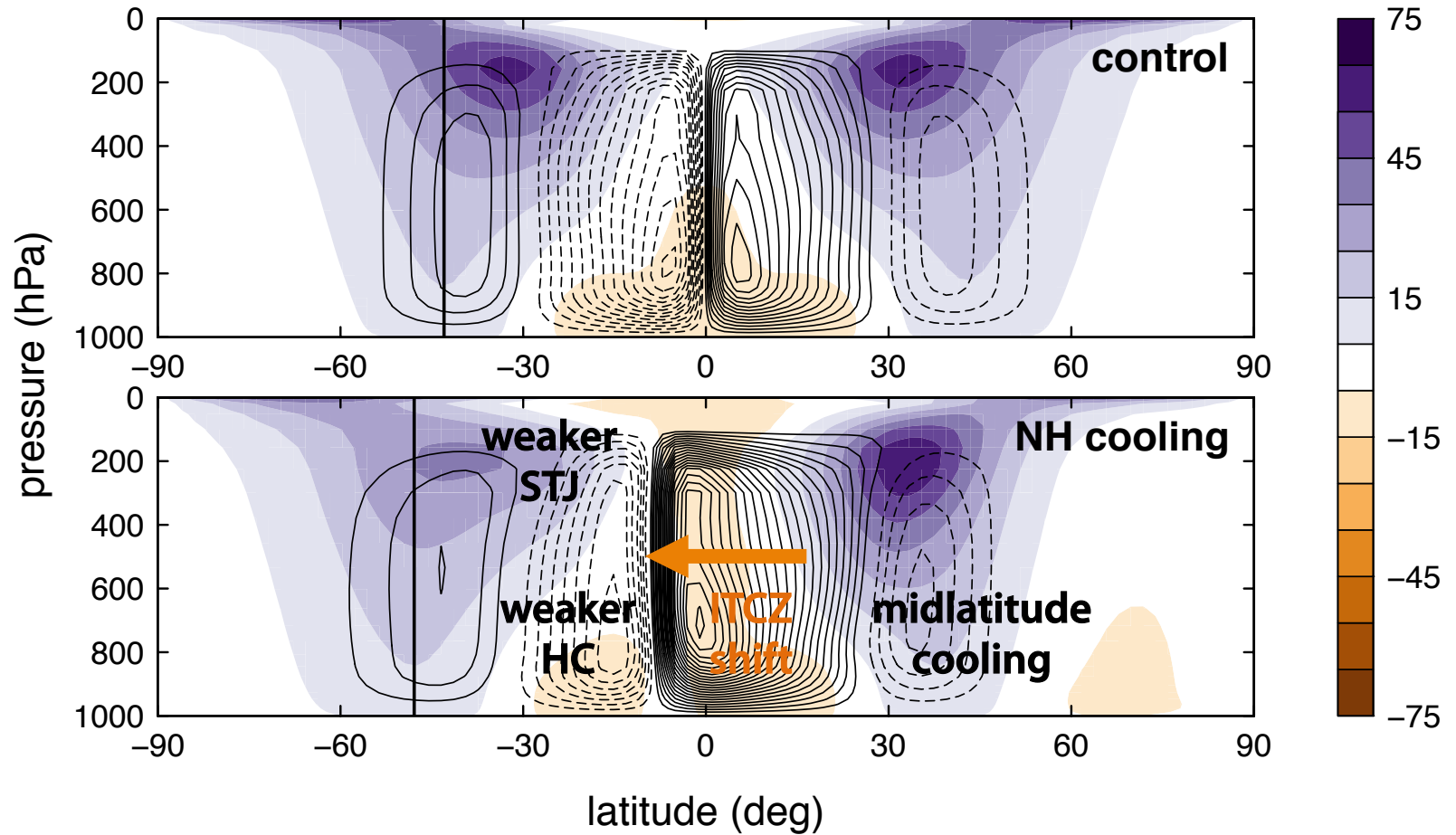
Summary of the mechanism



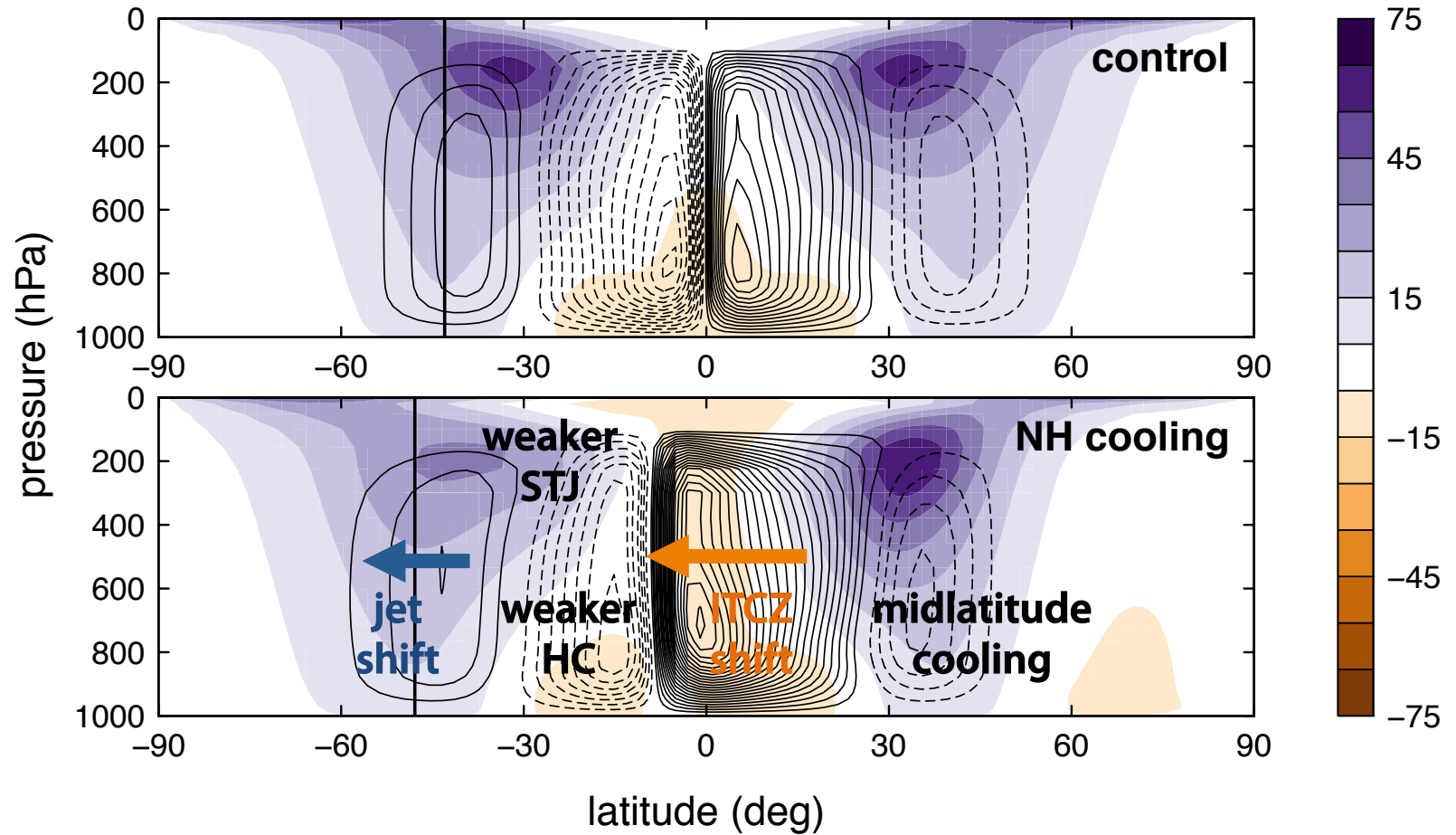
Summary of the mechanism



Summary of the mechanism

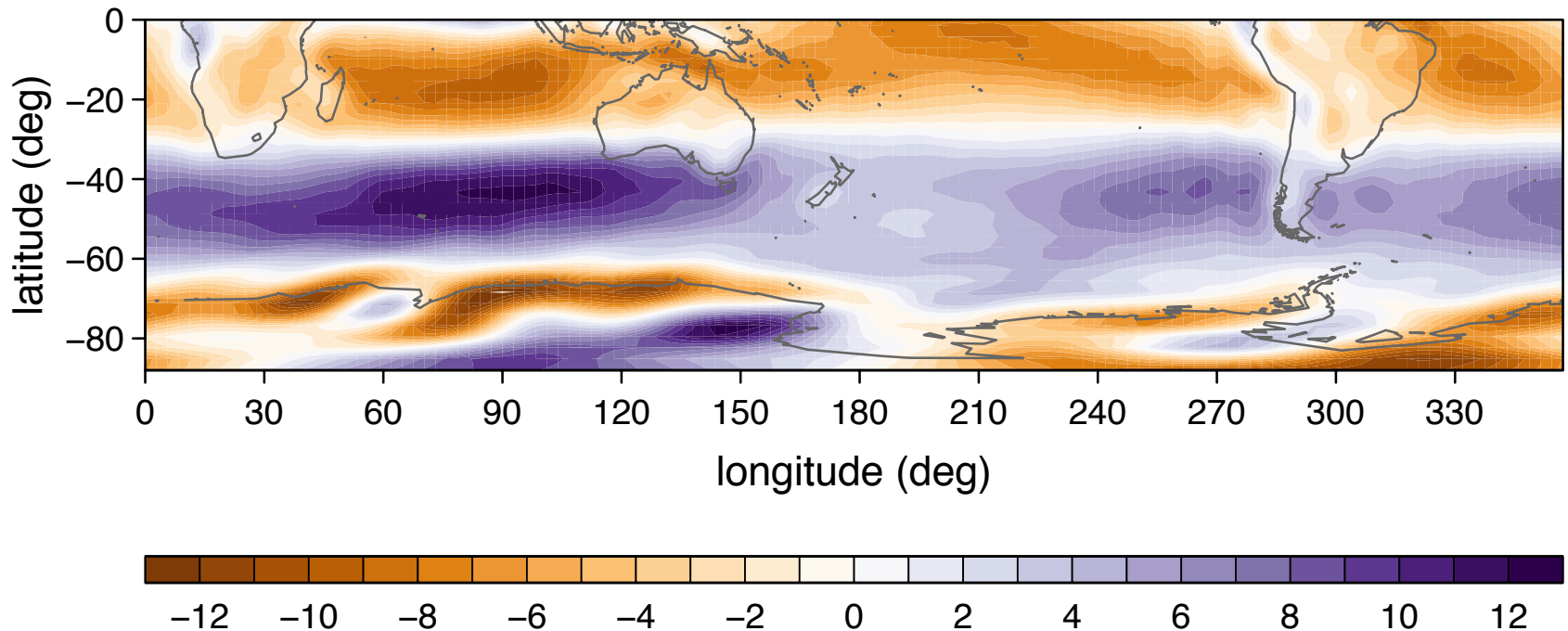


Summary of the mechanism



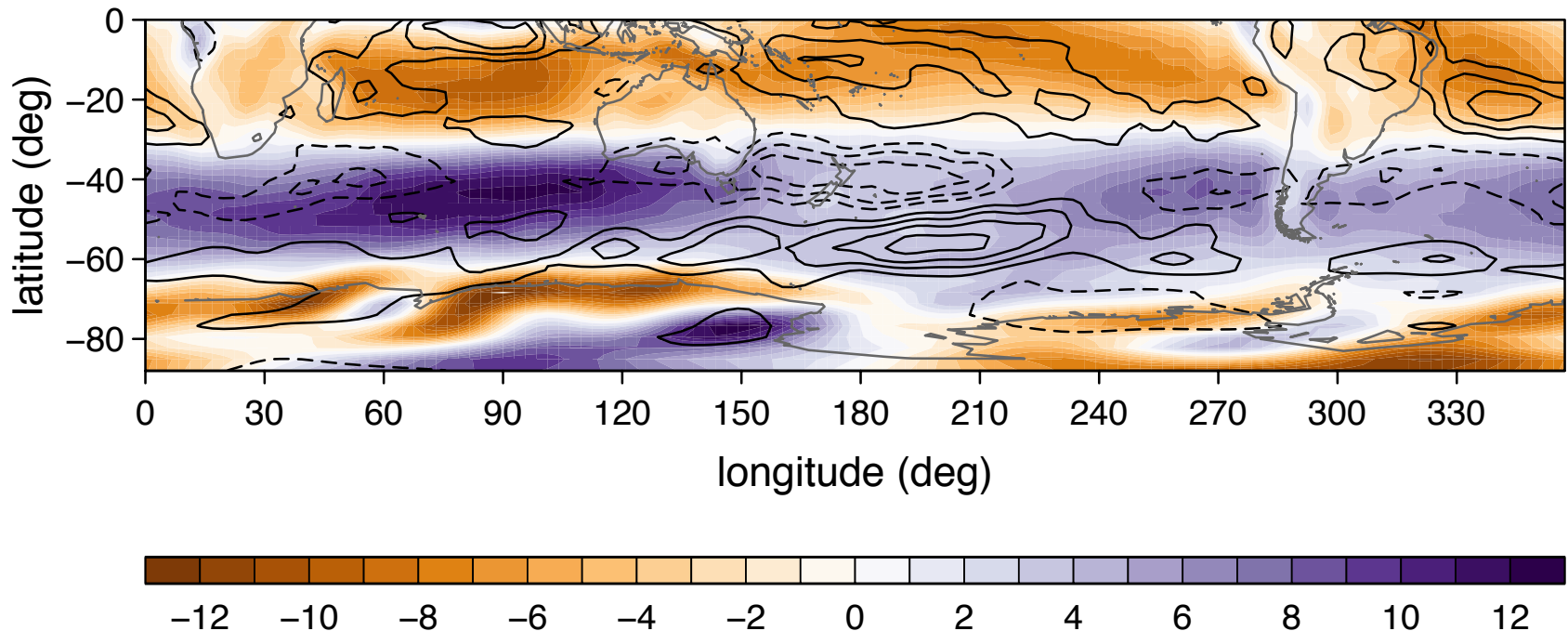
Full-geography ECHAM4.6 runs

shading: **June-July-August** surface zonal wind climatology



Full-geography ECHAM4.6 runs

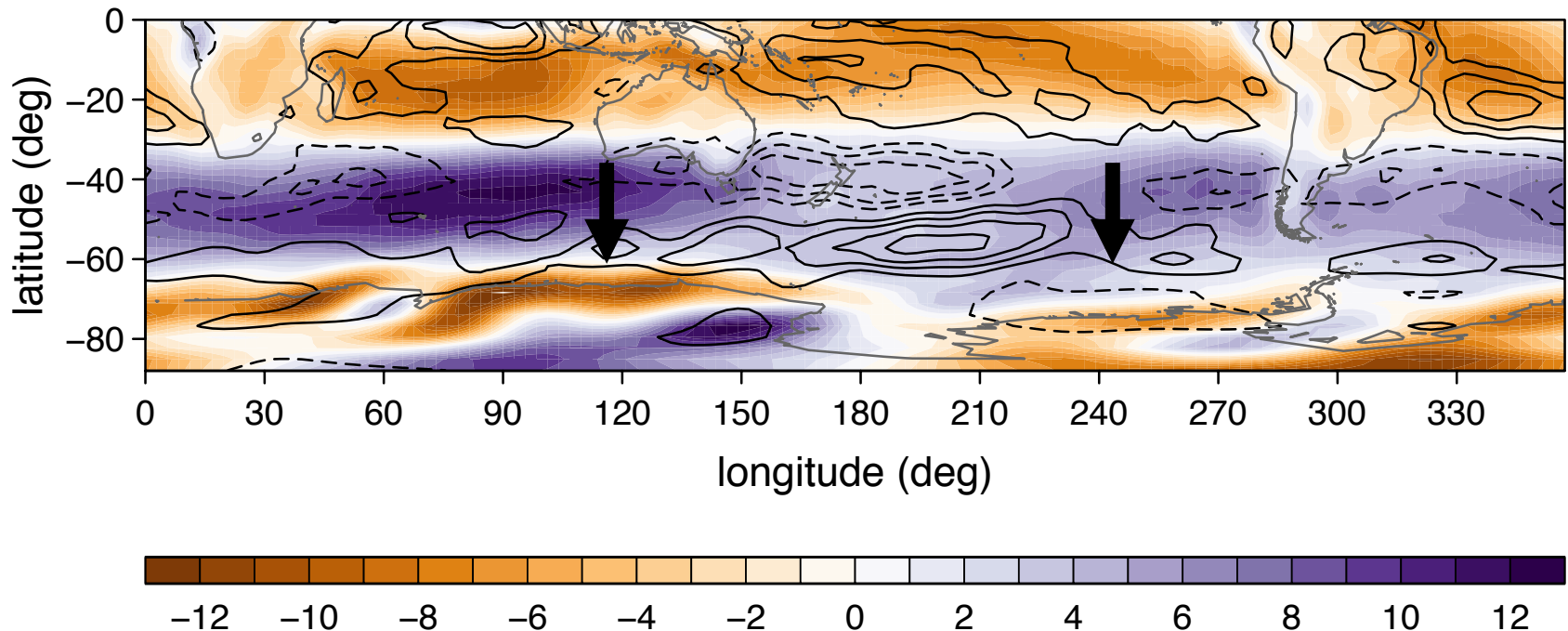
shading: **June-July-August** surface zonal wind climatology
contours: JJA response to 100 W m^{-2} cooling in NH ocean basins



Full-geography ECHAM4.6 runs

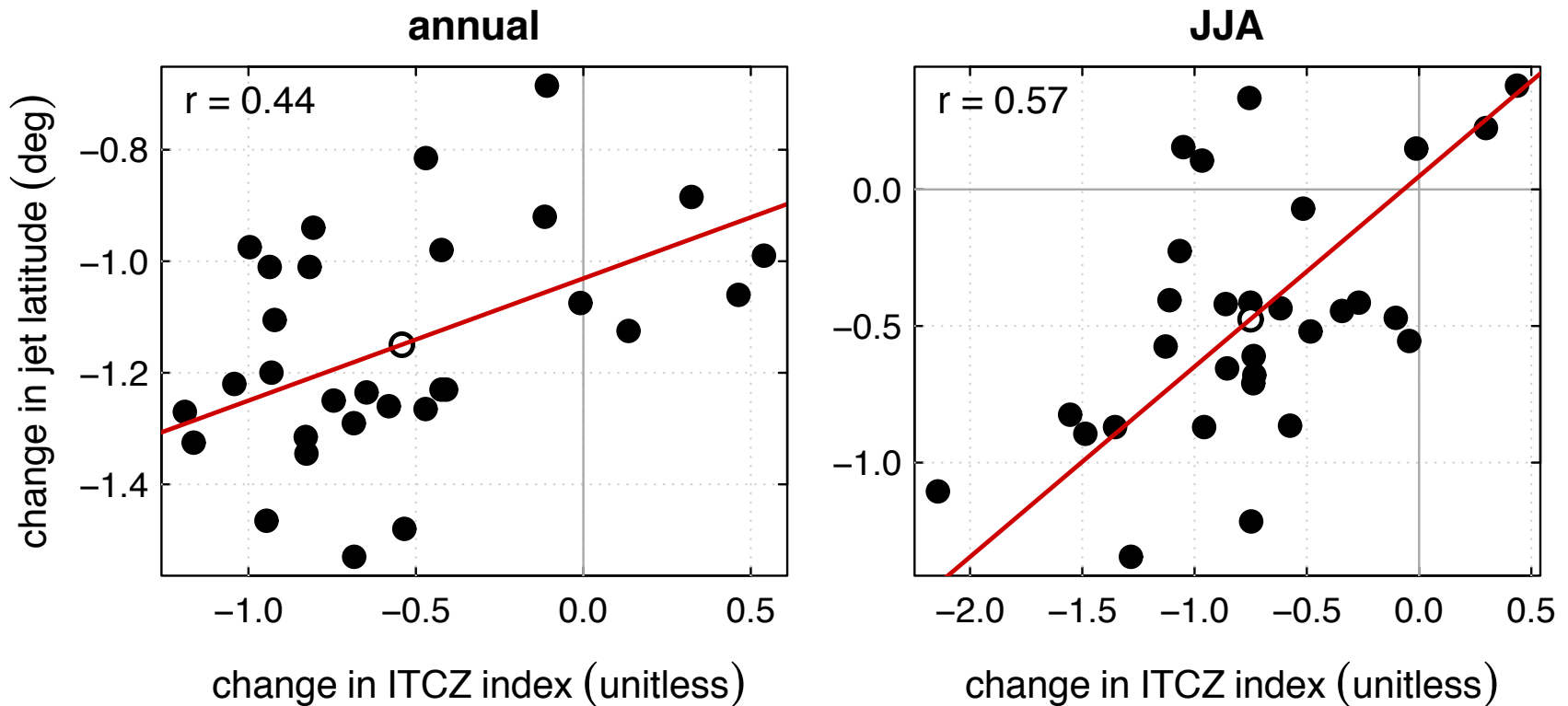
poleward shift of the surface (eddy-driven) westerlies

+ weakening of the subtropical easterlies



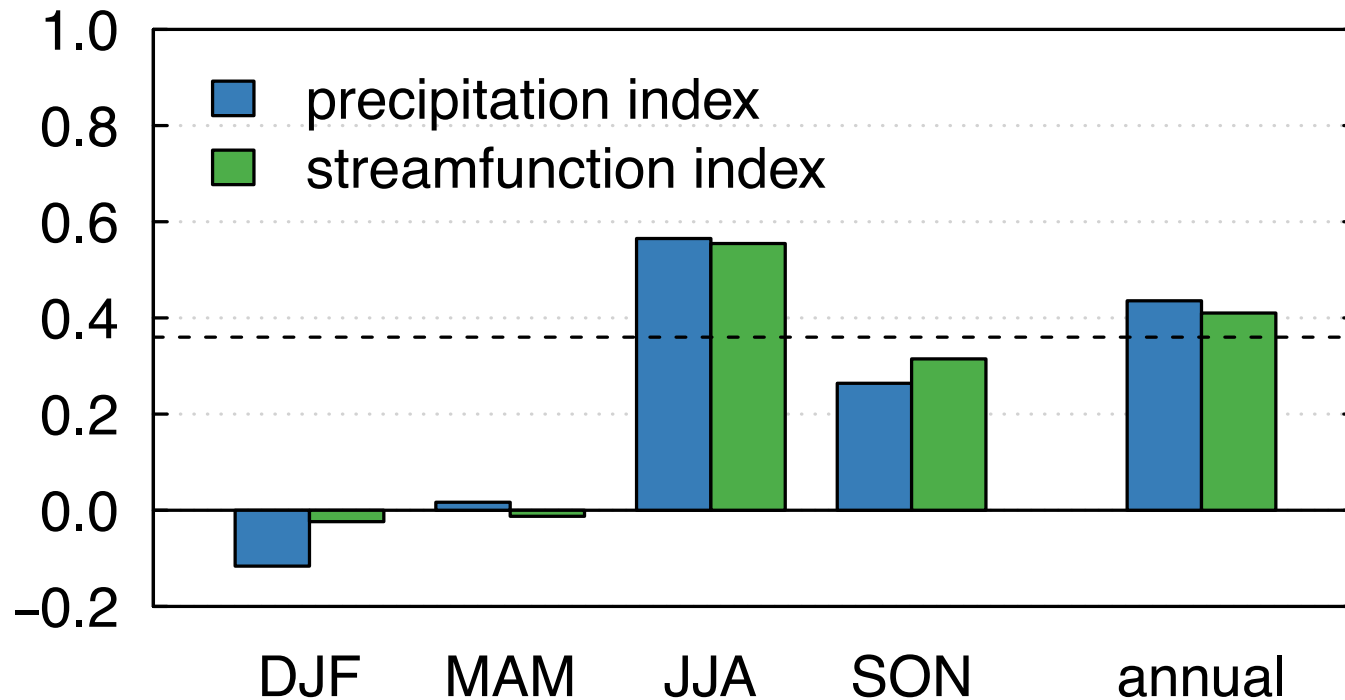
CCSM3 30-member ensemble

ITCZ and SH jet shift, 2043-2062 minus 1980-1999



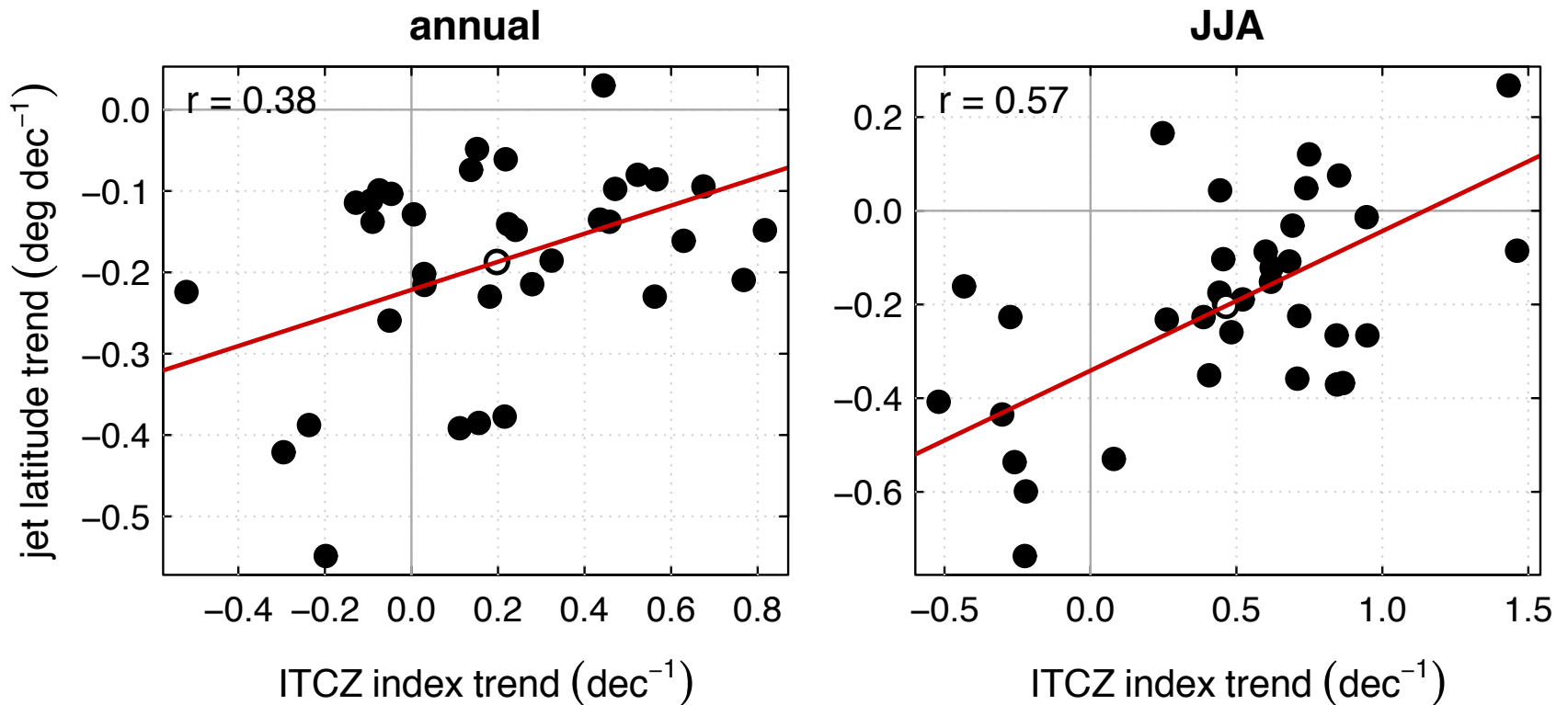
CCSM3 30-member ensemble

correlations between ITCZ shifts and jet shifts



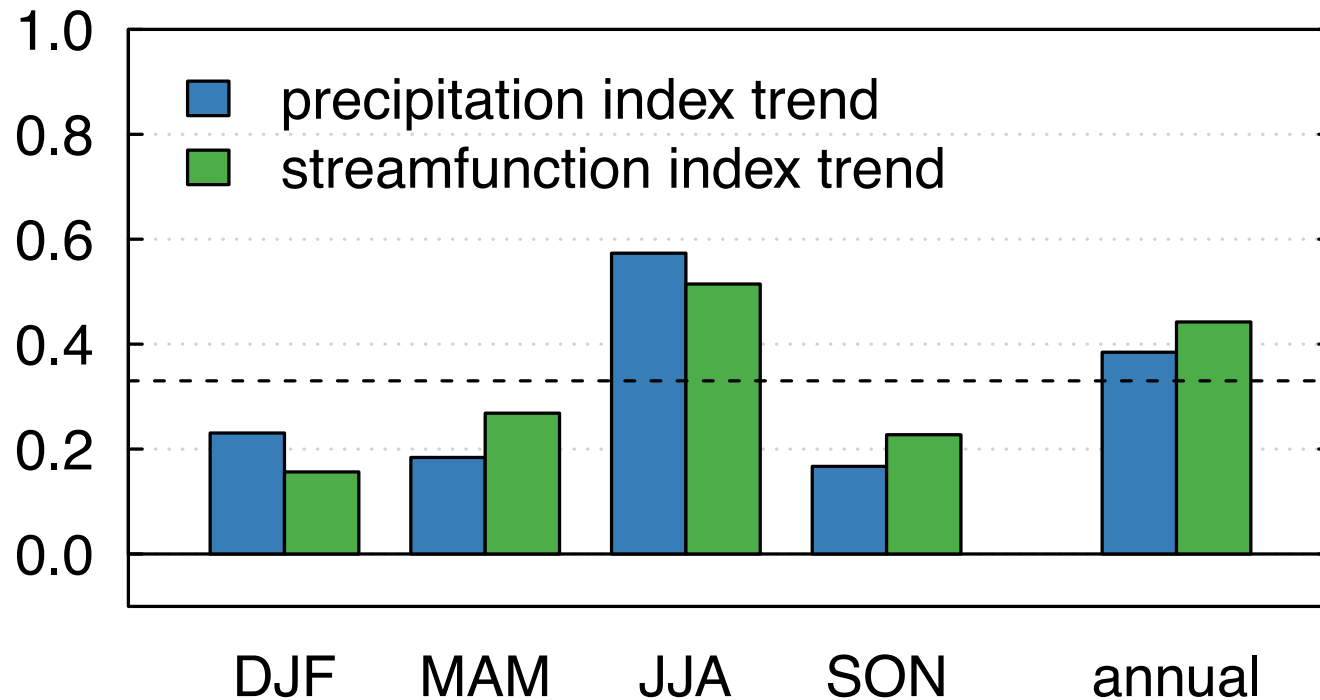
CMIP5 RCP8.5 simulations

21st-century decadal trends in ITCZ and SH jet latitude



CMIP5 RCP8.5 simulations

correlations between ITCZ shifts and SH jet shifts



Conclusions

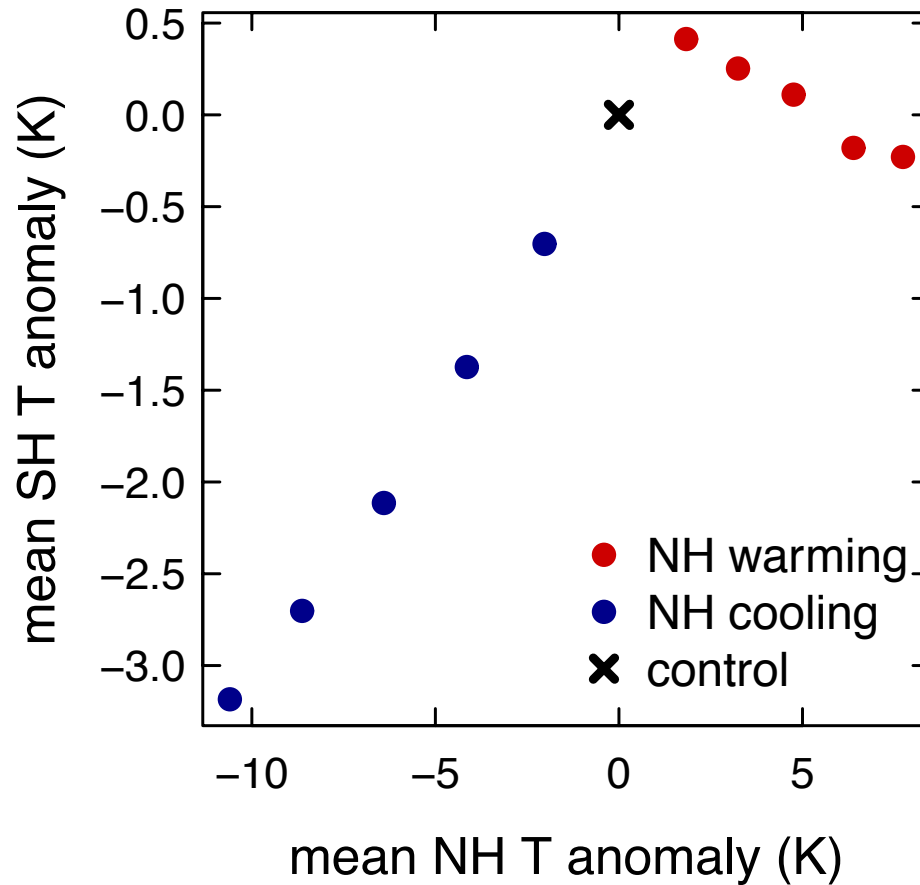
- Midlatitude jet can respond to a forcing from the extratropics of opposite hemisphere
 - **“interhemispheric teleconnection”** via changes in Hadley circulation and subtropical jet strength
- ITCZ and jet tend to shift in **same direction**
- Possible implications for **paleoclimates** and **future climate change**

Thank you!

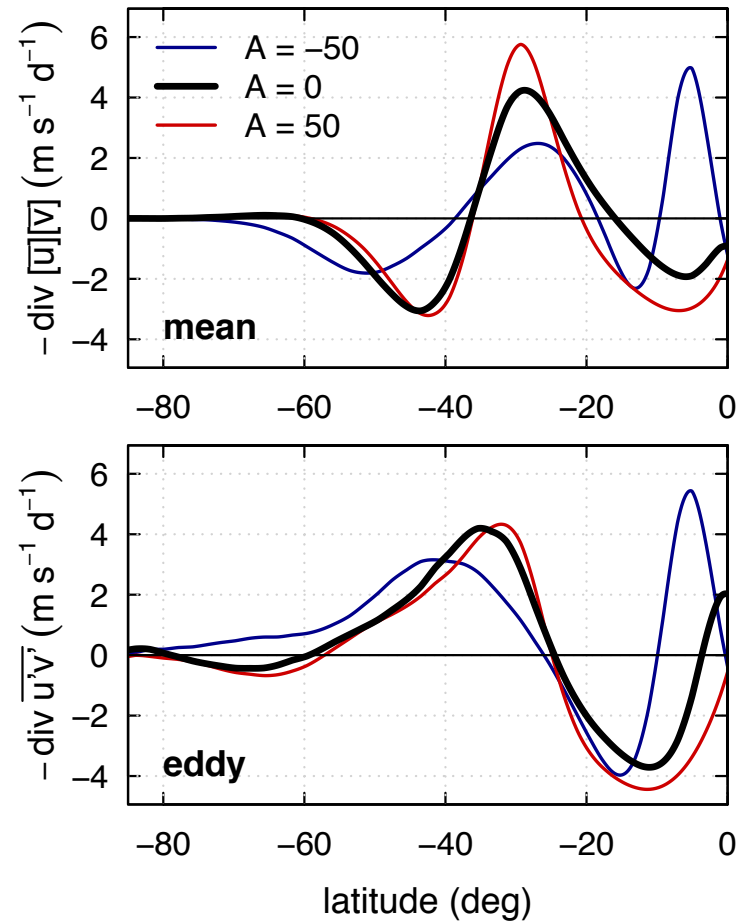
Reference:

Ceppi, P., Y.-T. Hwang, X. Liu, D. M. W. Frierson, and D. L. Hartmann (2013).
The Relationship Between the ITCZ and the Southern Hemispheric Eddy-Driven Jet, *J. Geophys. Res.-Atmospheres*.

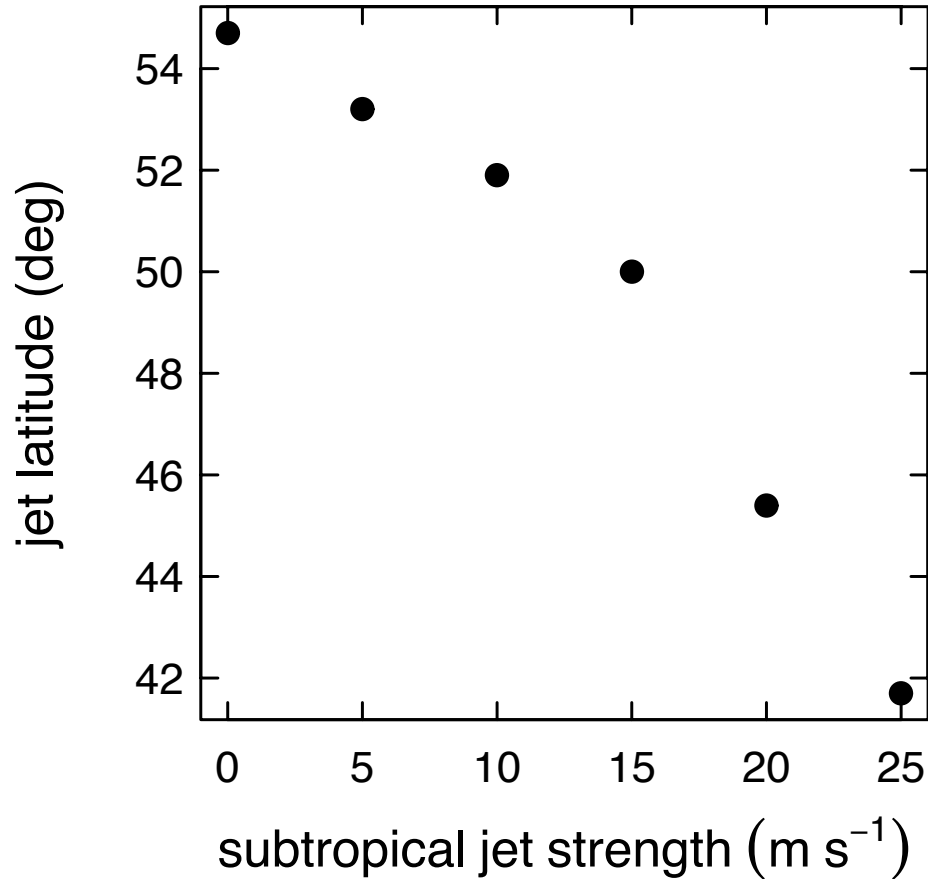
Hemispheric mean temperatures



Momentum fluxes



Jet latitude vs subtropical jet strength



Phase speed spectra (aquaplanet)

weak subtropical jet

strong subtropical jet

same process occurs in
aquaplanet experiments

