

On the thermally-driven ocean circulation with realistic bathymetry

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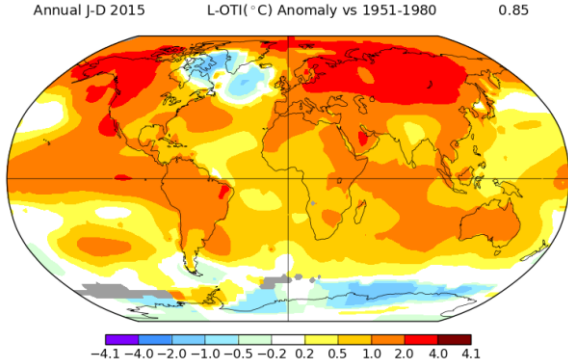
March 23, 2017

Motivation



- The ocean is primarily driven by wind, differential heating by the sun and E-P.
- As opposed to the wind-driven ocean circulation, there is no commonly accepted dynamical framework for rationalizing the buoyancy-driven circulation.
- Our main goal is to investigate the thermally-driven ocean circulation using both idealized and more complex models.

Motivation

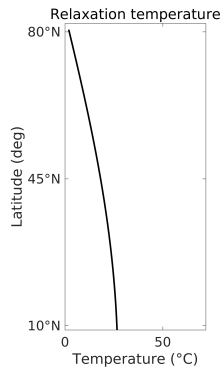
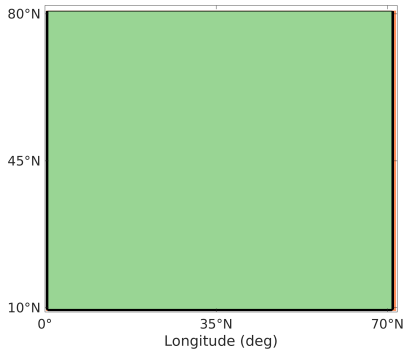


Surface temperature anomaly for Feb 2017 (Source: NASA GISS)

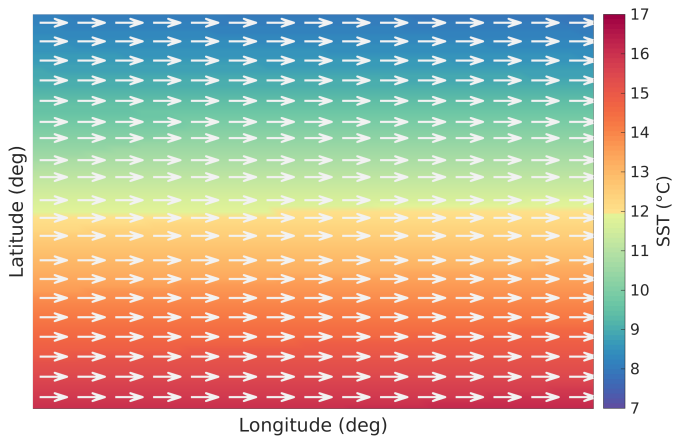
Method

- Massachusetts Institute of Technology general circulation model (MITgcm)
- Idealized and Realistic bathymetry (ETOPO5)
- Salinity effects are not considered
- Forced by restoring boundary conditions on surface temperature

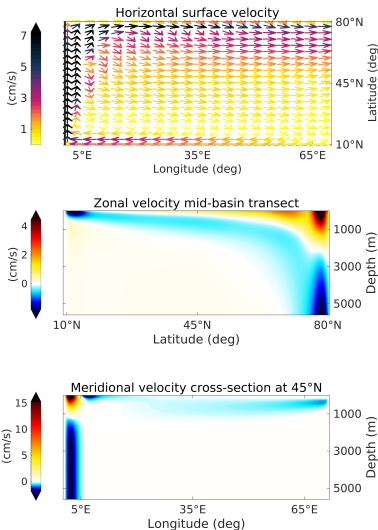
A square ocean



Thermal flow

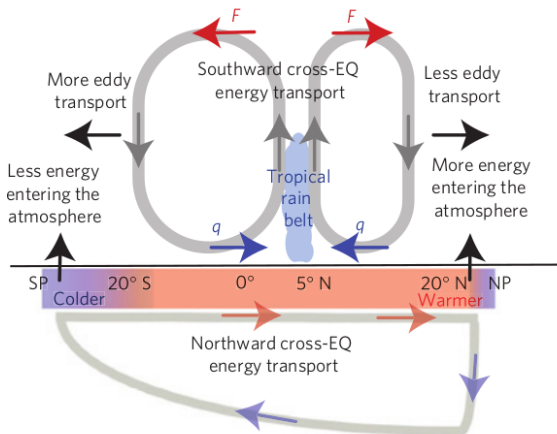


Results from a square basin simulation



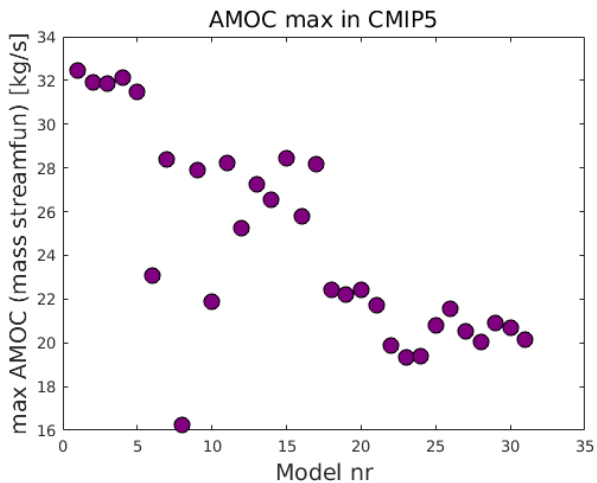
Gjermundsen and LaCasce (2017), Tellus A

The importance of Western Boundary Currents

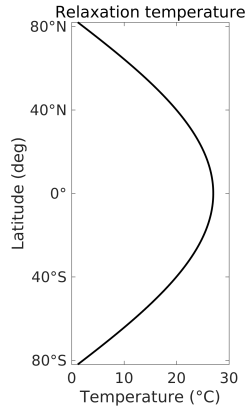
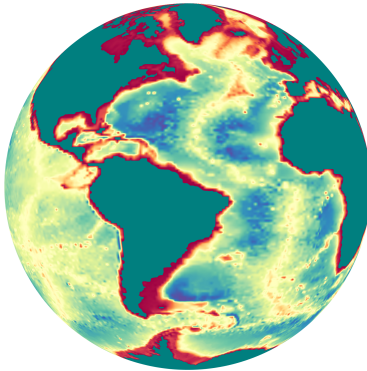


Frierson et al (2013), Nature

CMIP5 - max AMOC

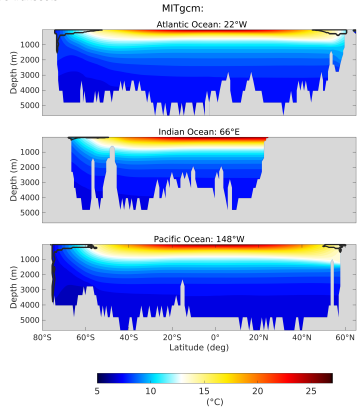
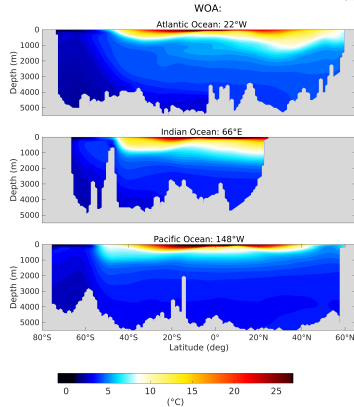


A realistic ocean

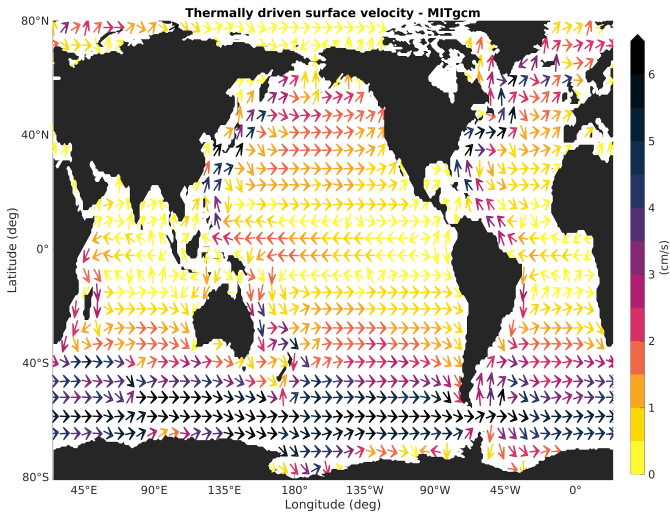


Temperature transects

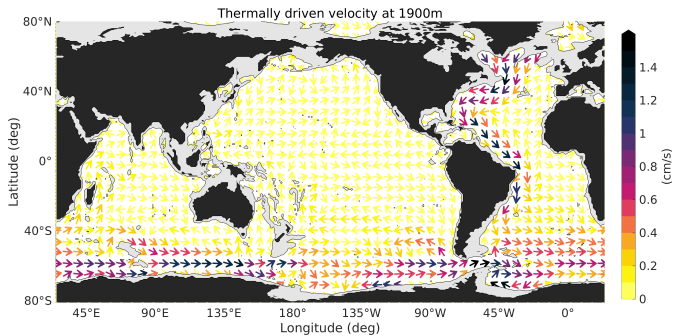
Temperature transects



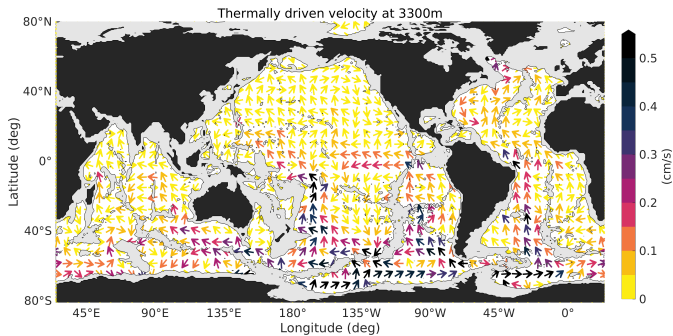
Surface velocity



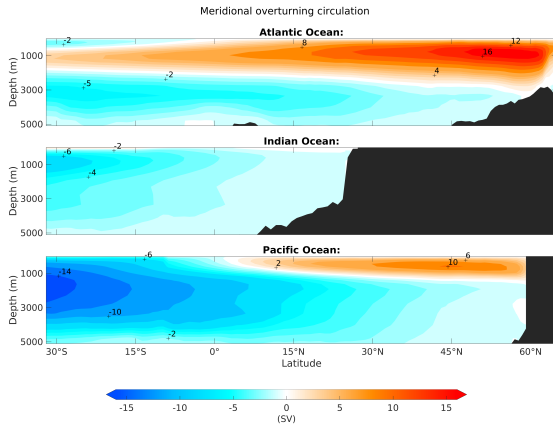
1900 m velocity



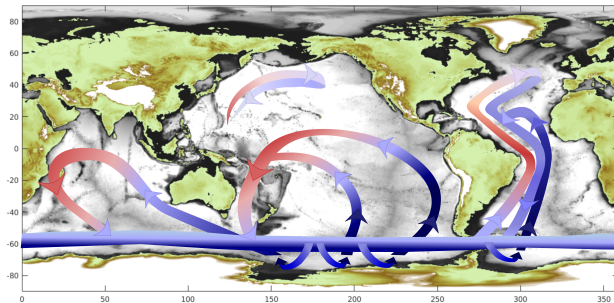
Abyssal velocity



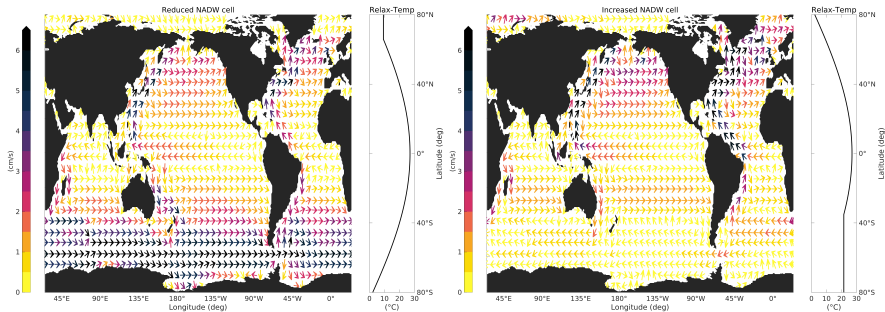
Meridional Overturning Circulation (MOC)



Conveyor disaster



NADW cell sensitivity to temperature forcing



NADW cell sensitivity to temperature forcing

