The oceanic heat budget and the transport across 30S

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Boccaletti et al, JPO, 2004
Fedorov et al JPO, 2004

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Two main oceanic circulations: the circulation of the ventilated thermocline and the thermohaline circulation = MOC

One way to unify the two circulations is based on a balanced oceanic heat budget.

The surface shallow circulation transports as much heat as the deep (Boccaletti et al 2005)
Heat budget tends to balance on interdecadal time scales.

Corr EXP & OUT_EX are similar

Corr EXP & IN_T are large only in CM2.1
Time series of heat import across 33S in Atlantic basin 50-year smoothed.

ECBILT-CLIO

Mean ~ 0.31 PW
Peak-to-peak variability ~ 10%

GFDL CM2.1

Mean ~ 0.42 PW
Peak-to-peak variability ~10%
Correlation of MOC and import of heat across 33S (C.I.=0.2)

ECBILT-CLIO

GFDL-CM2.1

Largest correlation at depth, and both models show very similar structure. The main differences are at the surface in the South Atlantic.

Corr=0.7
SST and import of heat across 33S

Even though the sign is similar, in ECBILT-CLIO largest corrs are in the N.H., in GFDL CM2.1 the much larger corr are in the equatorial and South Atlantic.

=> The largest impact of THC on climate may be through changes in the STC and reinforced through air-sea feedbacks. How do these circulations interact?
How will a freshening of the high latitudes of the North Atlantic affect the ocean circulation?

The equatorial response is largest in the high resolution model because the equatorial region is a special place of ocean heat gain.

The atmospheric teleconnections will be different because the ocean is more sensitive in the equatorial region.
Why does the equatorial region warm up?

- Freshening the North Atlantic
- Freshening the subtropical Pacific

FRESH-I
- a. SST anomaly
- b. RHO, V anom
- c. MOC anomaly

FRESH-II
- d. SST anomaly
- e. RHO, V anom
- f. MOC anomaly

$H \sim (1/\Delta \rho)^{1/2}$