

# **Southern Ocean air-sea buoyancy flux estimates**

*The Southern Ocean State Estimate (SOSE): Mazloff,  
Wunsch, Heimbach (2009)*

Ivana Cerovecki

Lynne Talley

Matt Mazloff

- **Inter-comparison** of annually-averaged air-sea buoyancy fluxes in the SO for years **2005-2007**
- The impetus came from SOSE
- **NCEP1, ECMWF, SOSE and Large and Yeager (2009)**
- LY09 do not use NCEP1 heat flux and precipitation in deriving their heat flux product
- Do SOSE adjustments of the NCEP1 atmospheric state, made as part of SOSE optimization procedure represent a true improvement of the NCEP1?

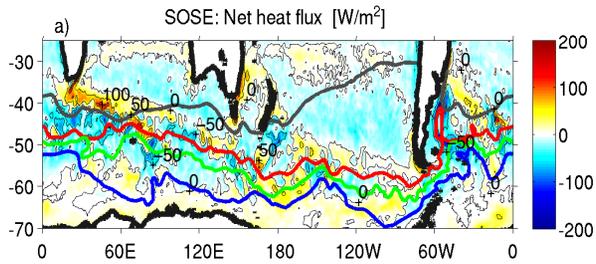
Years 2005 - 2007

Large, Yeager (2009) / Stammer et al. (2004)

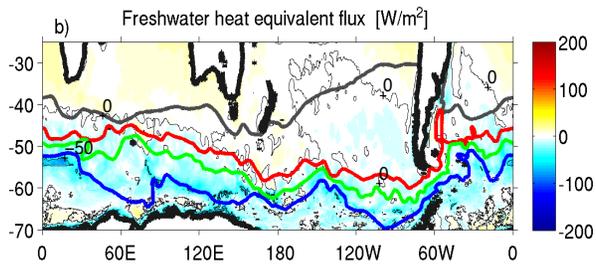
SOSE

LY09

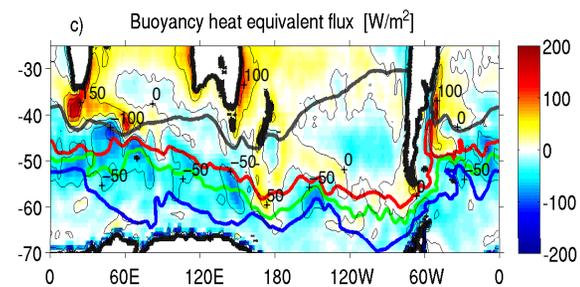
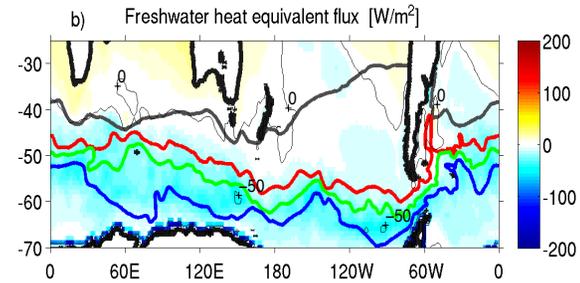
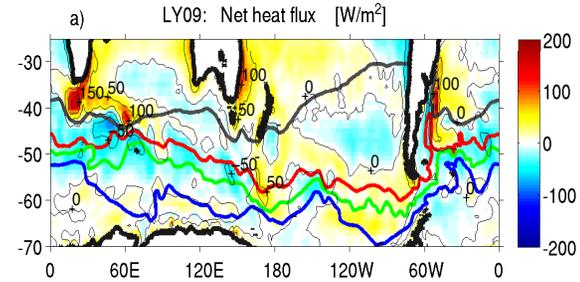
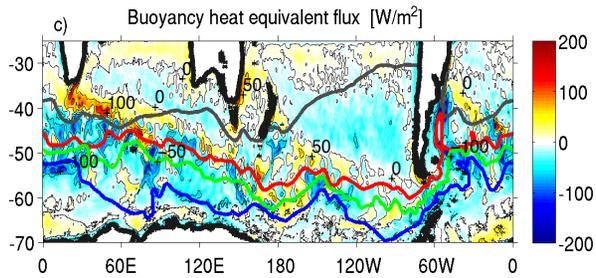
HF



FWF

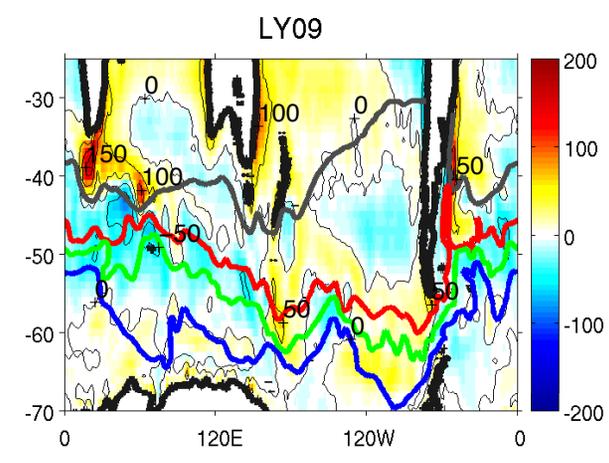
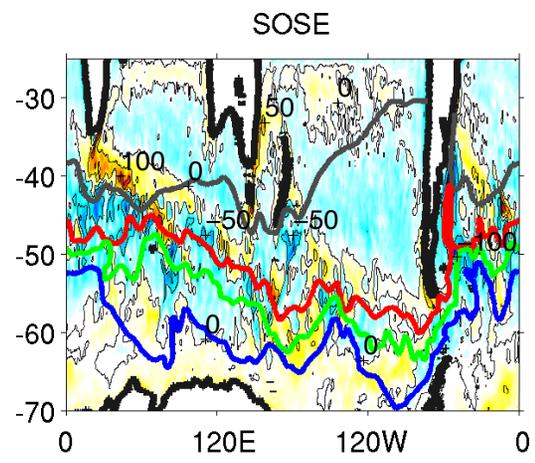
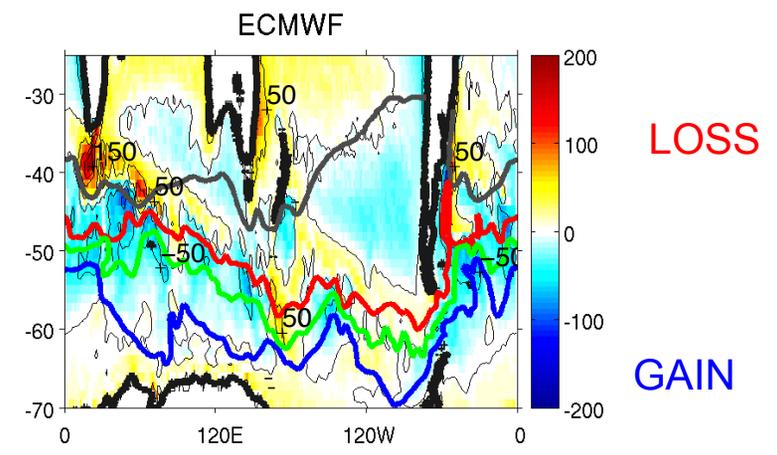
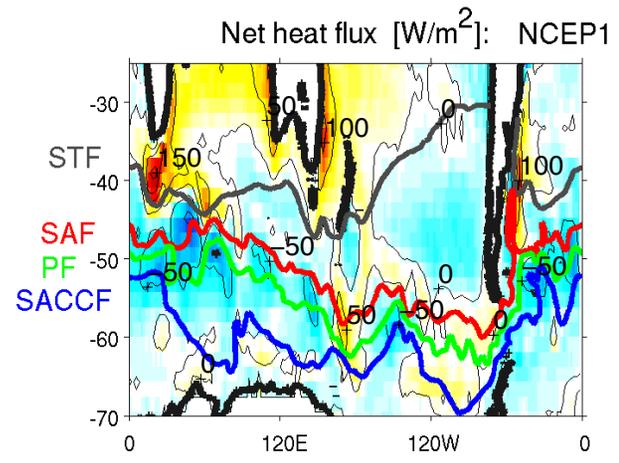


BF

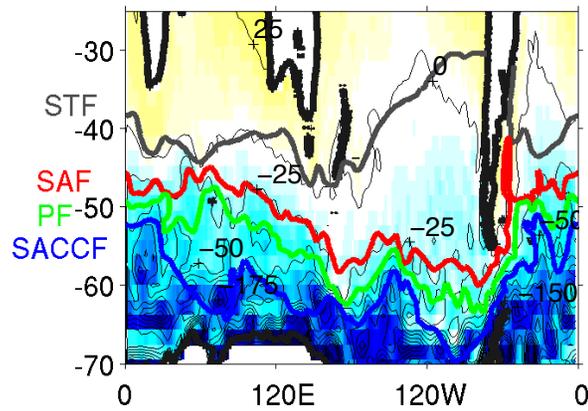


LOSS

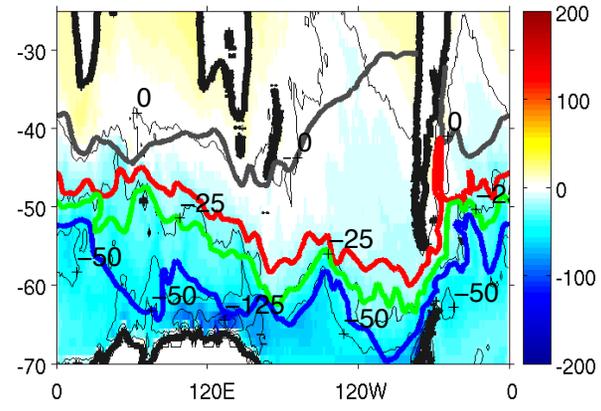
GAIN



Freshwater heat equivalent flux [ $\text{W/m}^2$ ]: NCEP1



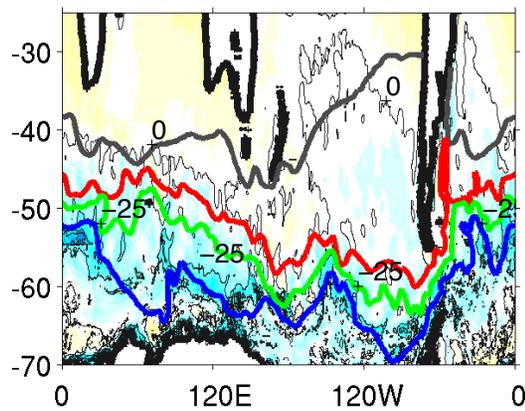
ECMWF



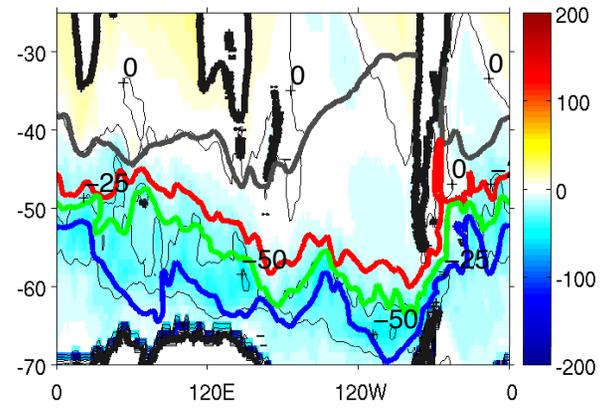
EVAP

PRECIP

SOSE



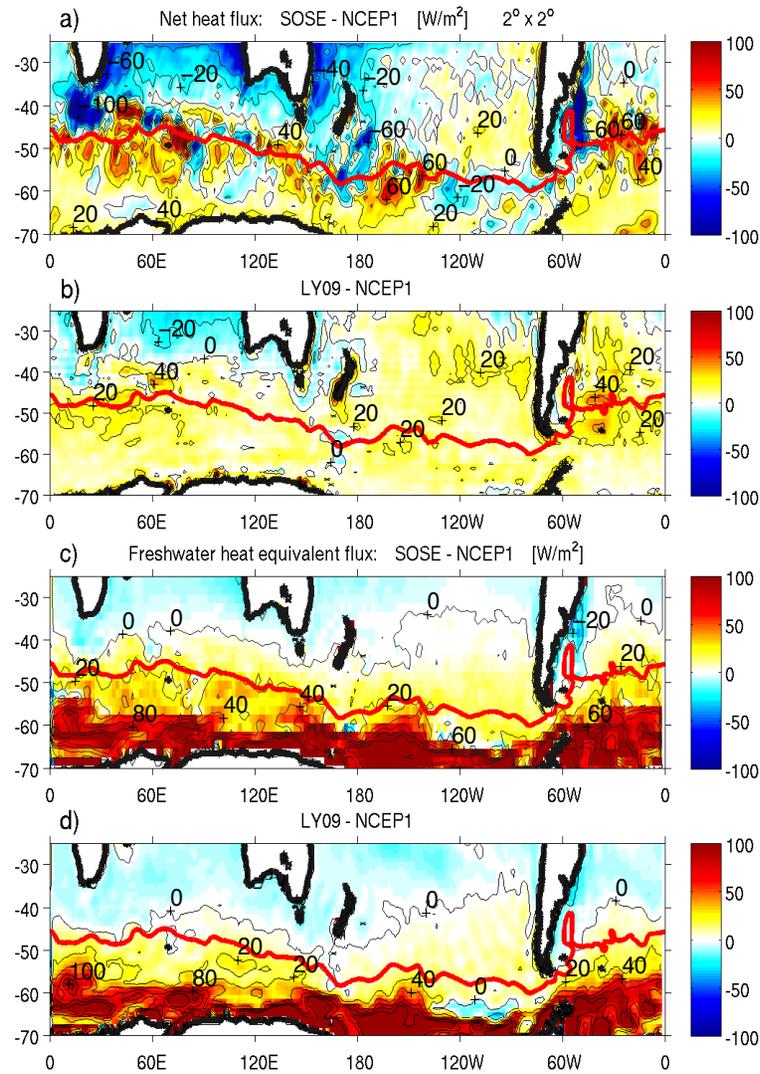
LY09



# Adjustments:

Positive: SOSE/LY09  
increased ocean heat loss/  
decreased ocean heat gain.

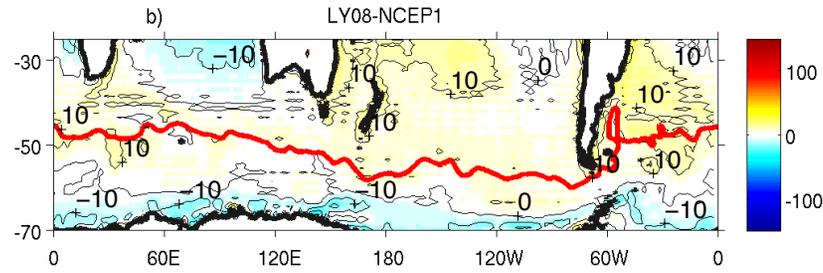
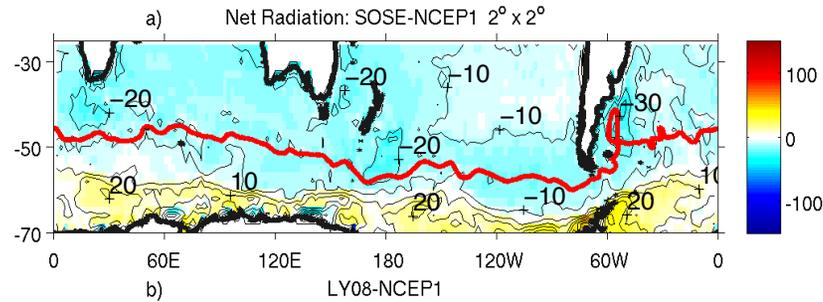
HF



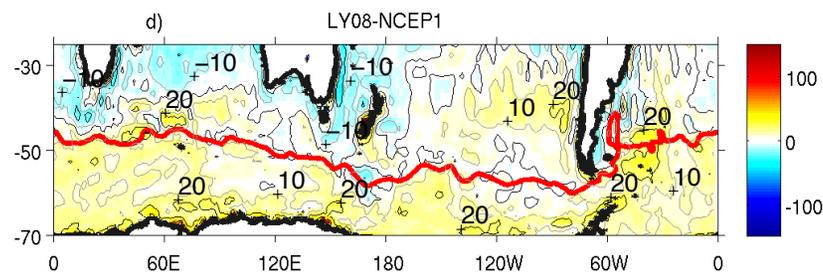
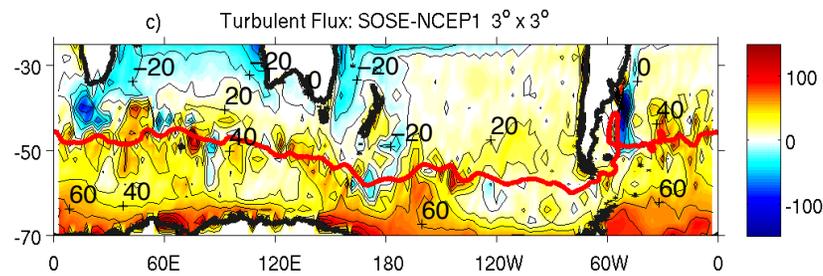
Positive: SOSE/LY09  
increased ocean buoyancy  
loss/decrease precipitation.

FWF

Radiation  
Adjustment:  
NSW+NLW



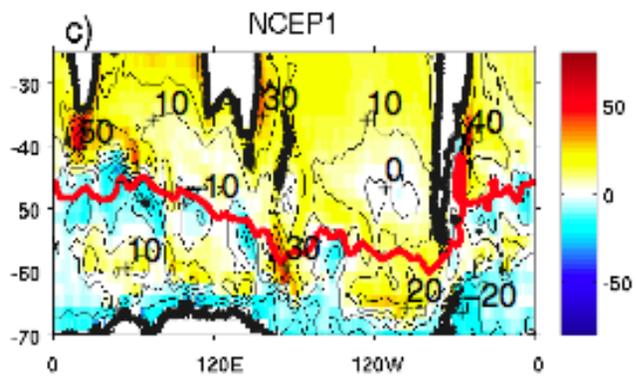
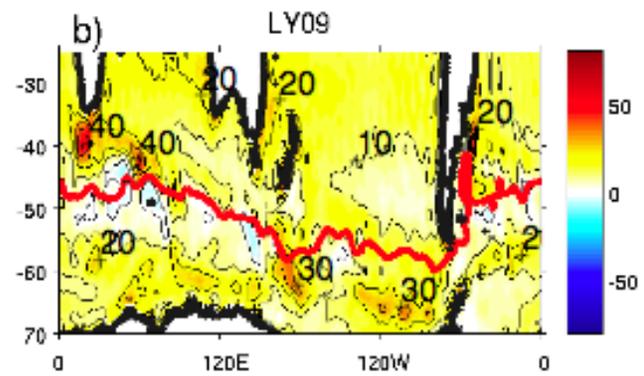
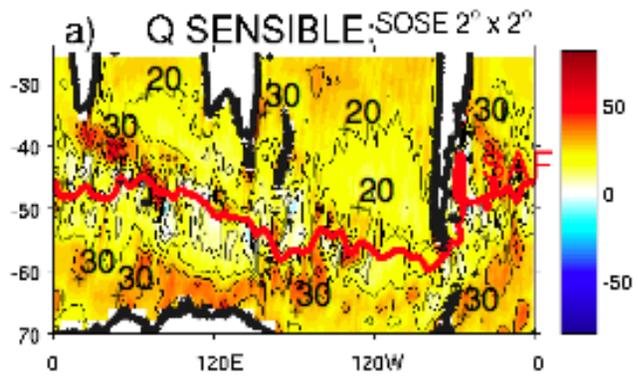
Turbulent HF  
Adjustment:  
Latent+Sensible



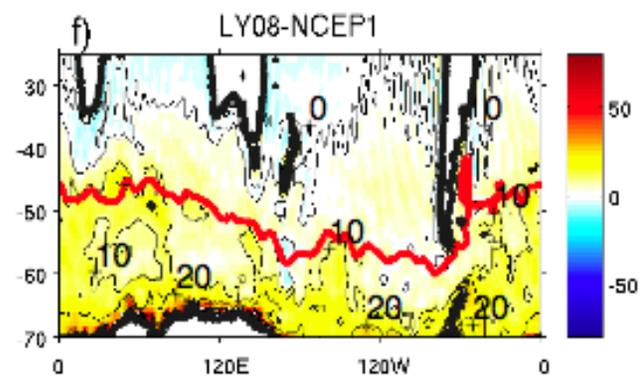
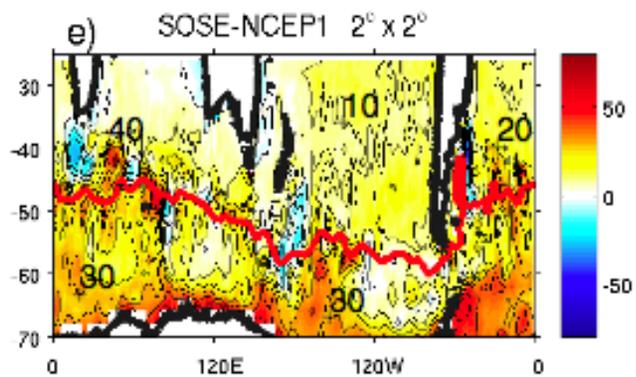
# Conclusions

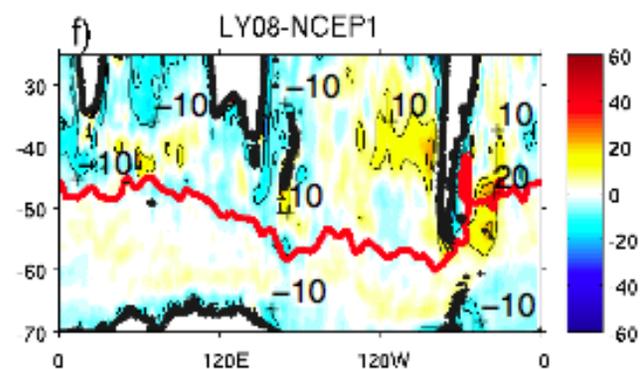
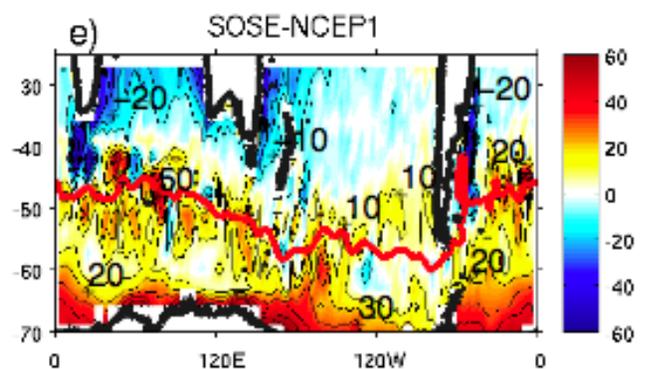
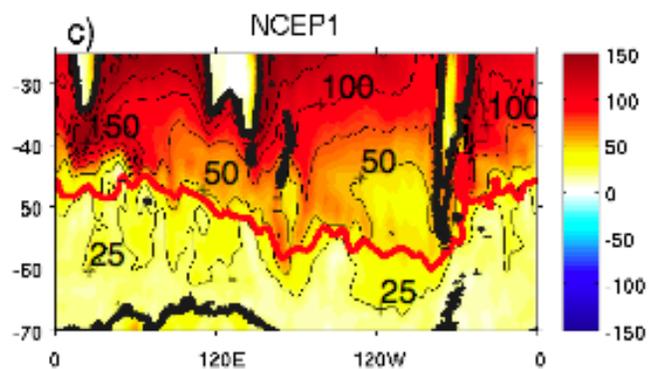
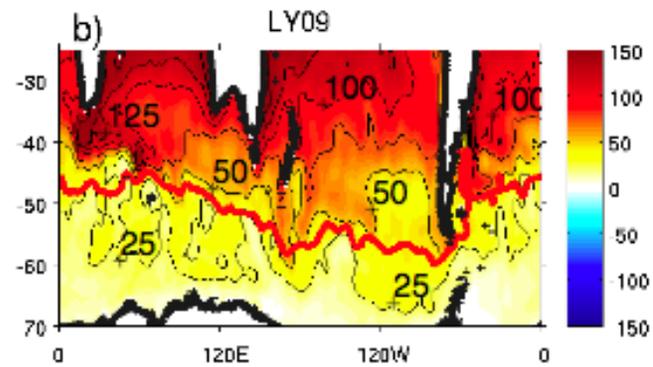
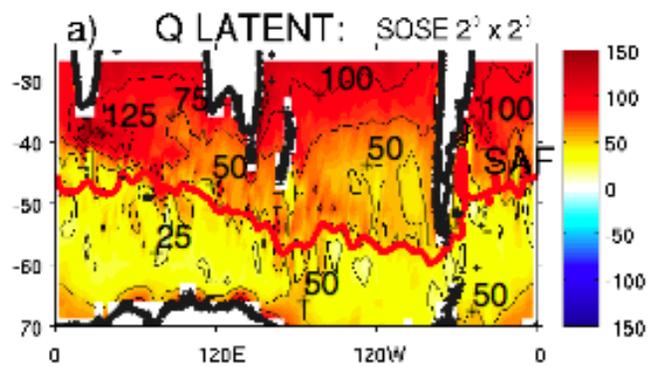
- The quality of SOSE air-sea heat flux (HF) and freshwater flux (FWF) was assessed by verifying that the SOSE adjustments: largely **correct the NCEP1 biases reported by the Working Group on Air-Sea Fluxes** and they are **largely in agreement with those of LY09** in large scale pattern, although quantitatively different.
- The major adjustments in **FWF** common to both SOSE and LY09: **decrease of net evaporation in the subtropics and decrease of net precipitation in polar latitudes**, relative to NCEP1 fields.
- **HF:** SOSE and LY09 **turbulent heat flux adjustments are similar** in large scale pattern, but quantitatively different. **Radiative adjustments differ.**
- NCEP1 ocean heat loss was decreased over the WBC and in polar latitudes; increased in subtropical Indian Ocean.

- In the southern part of the SO air-sea heat flux and freshwater flux tend to be of the **opposite sign**, making it very difficult to estimate buoyancy flux (**BF**) accurately; BF estimates from different products differ in sign.
- Accurate BF estimate critical to assess buoyancy loss in some regions and buoyancy gain in the others – **water mass formation**.
- Errors in BF estimates lead to errors in **climate models** and climate predictions.



Positive: SOSE/LY09 increase  
ocean heat loss





Positive: SOSE/LY09 increase ocean heat loss.

