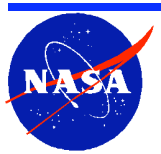
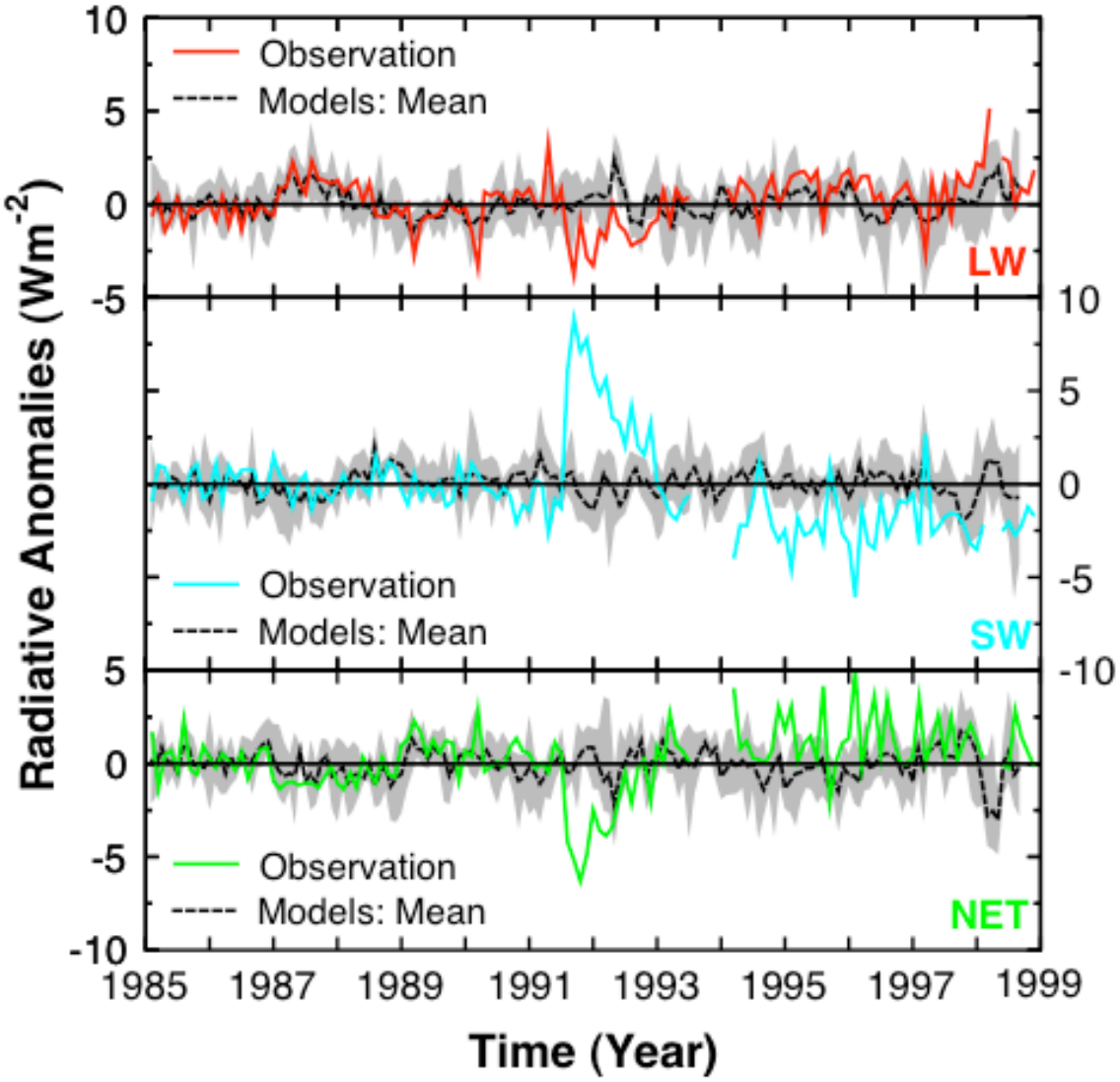
Global Ocean Heat Storage & Net Radiation: Interannual Variations

Bruce Wielicki and Takmeng Wong

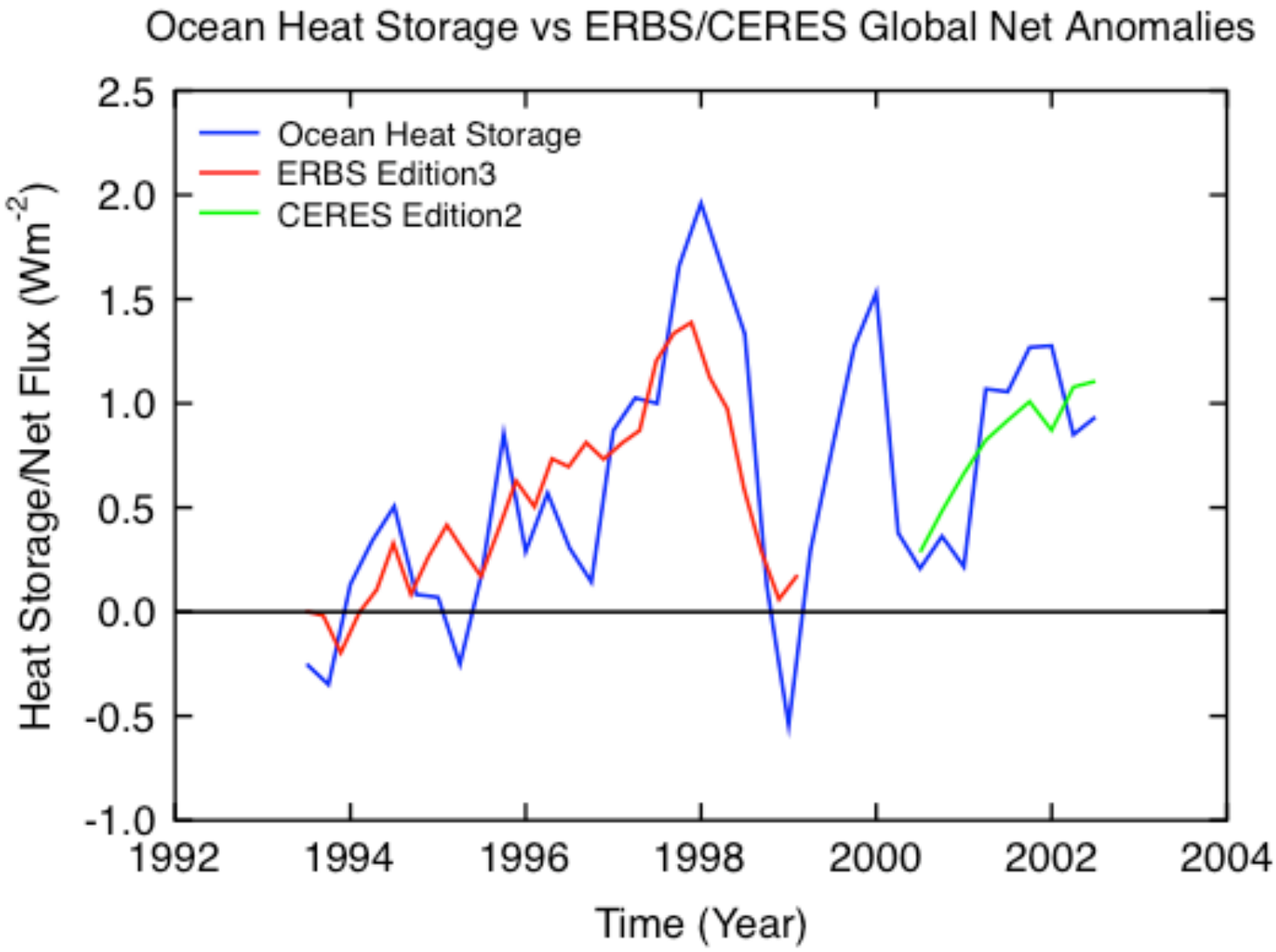
LaRC





Tropical (20S - 20N) TOA Radiation Anomalies: Observations (color) vs. Climate Models

- Climate noise 0.3 Wm^{-2}
- SW reflected lower 90s
- Global dimming recovery?
- Net heating in 90s
- Opposite sign of Iris negative cloud feedback hypothesis
- Surface heating would be 3% in tropical mean precipitation
- Climate models driven with observed SSTs, not Pinatubo
- Pinatubo signal cooling
- Missing cloud feedbacks?
- Natural variability?


Ocean Heat Storage vs ERBS/CERES Global Net Anomalies
Ocean Heat Storage
ERBS Edition3
CERES Edition2
Heat Storage/Net Flux (Wm-2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1992
1994
1996
1998
2000
2002
2004
Time (Year)

Globally Averaged Ocean Heat Content Variability

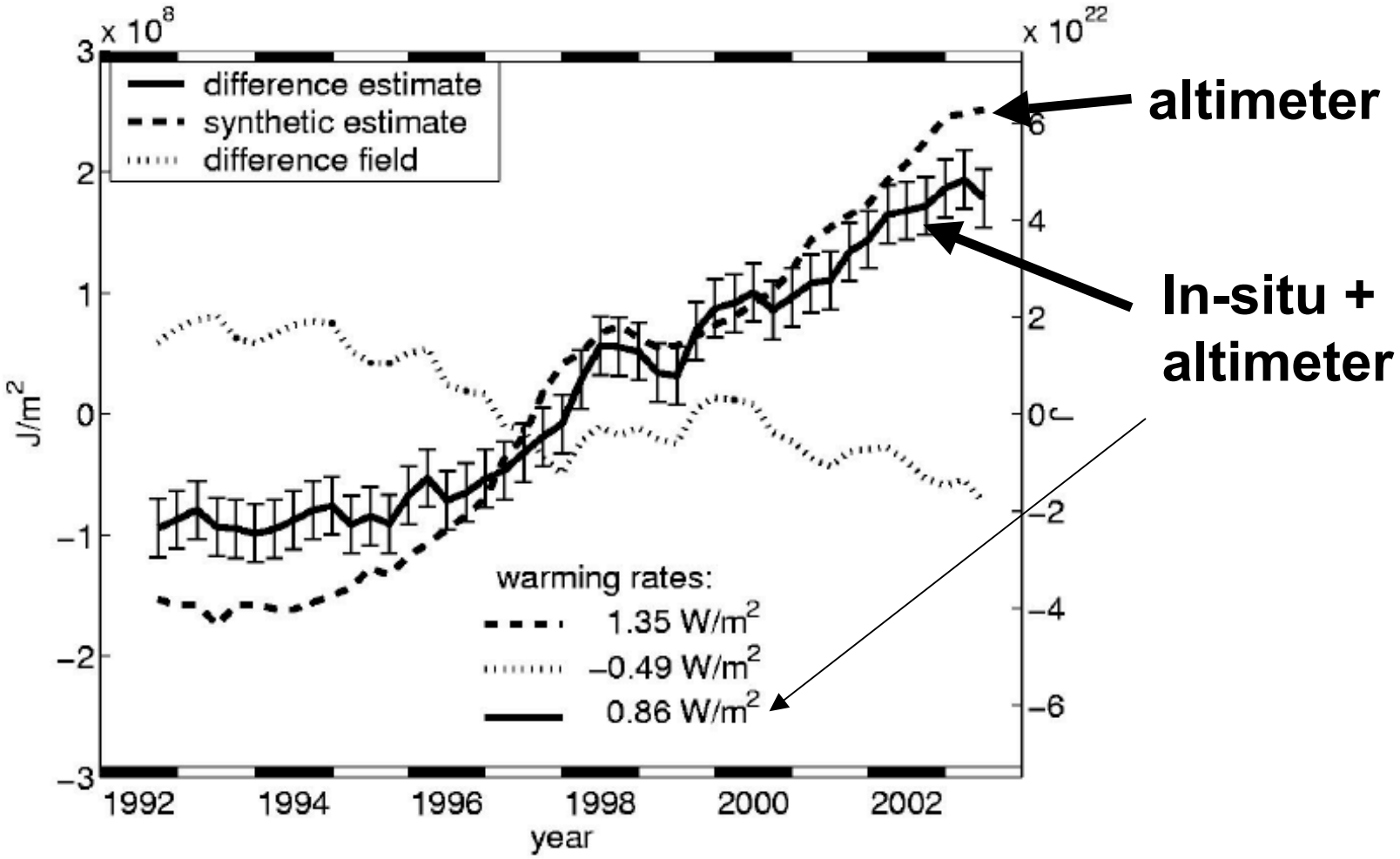


Figure 3. Globally averaged heat content variability. Error bars on the difference estimate (combined altimeter and in situ data) are 2.4×10^7 J/m^2 as described in the text. Warming rates are calculated from the 10-year changes in heat content.

Willis et al, JGR, 2004

Heat Content Variability: Global and Tropical

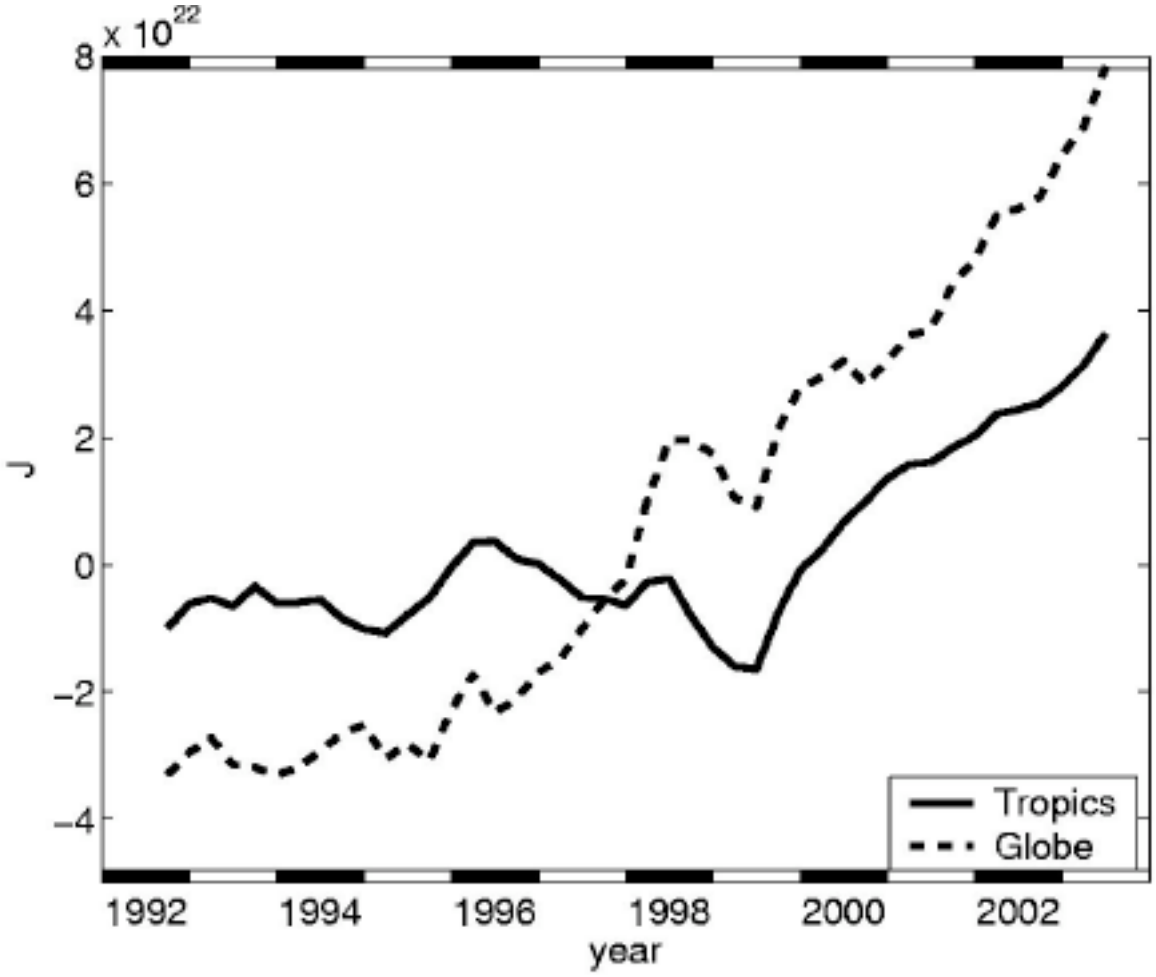


Figure 8. Interannual variability in heat content integrated over the region from 20° N to 20° S (solid line) and over the entire globe (dashed line).

Willis et al, JGR, 2004

10-yr Temperature Trends versus Ocean Depth

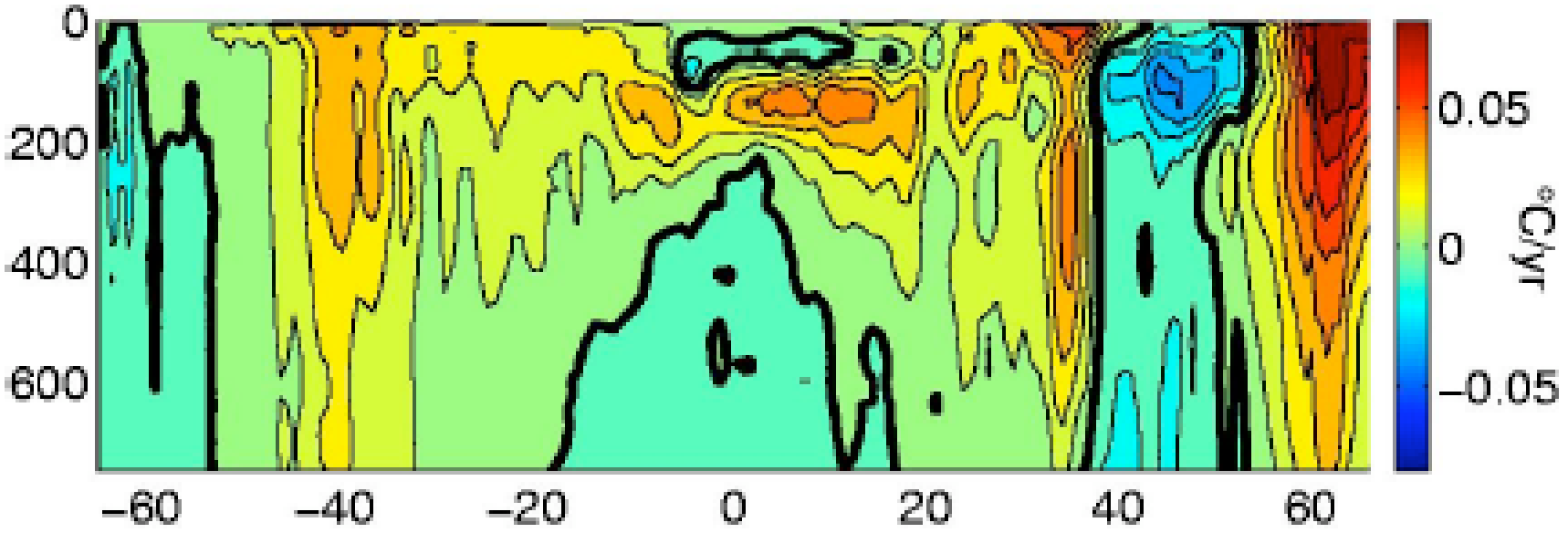
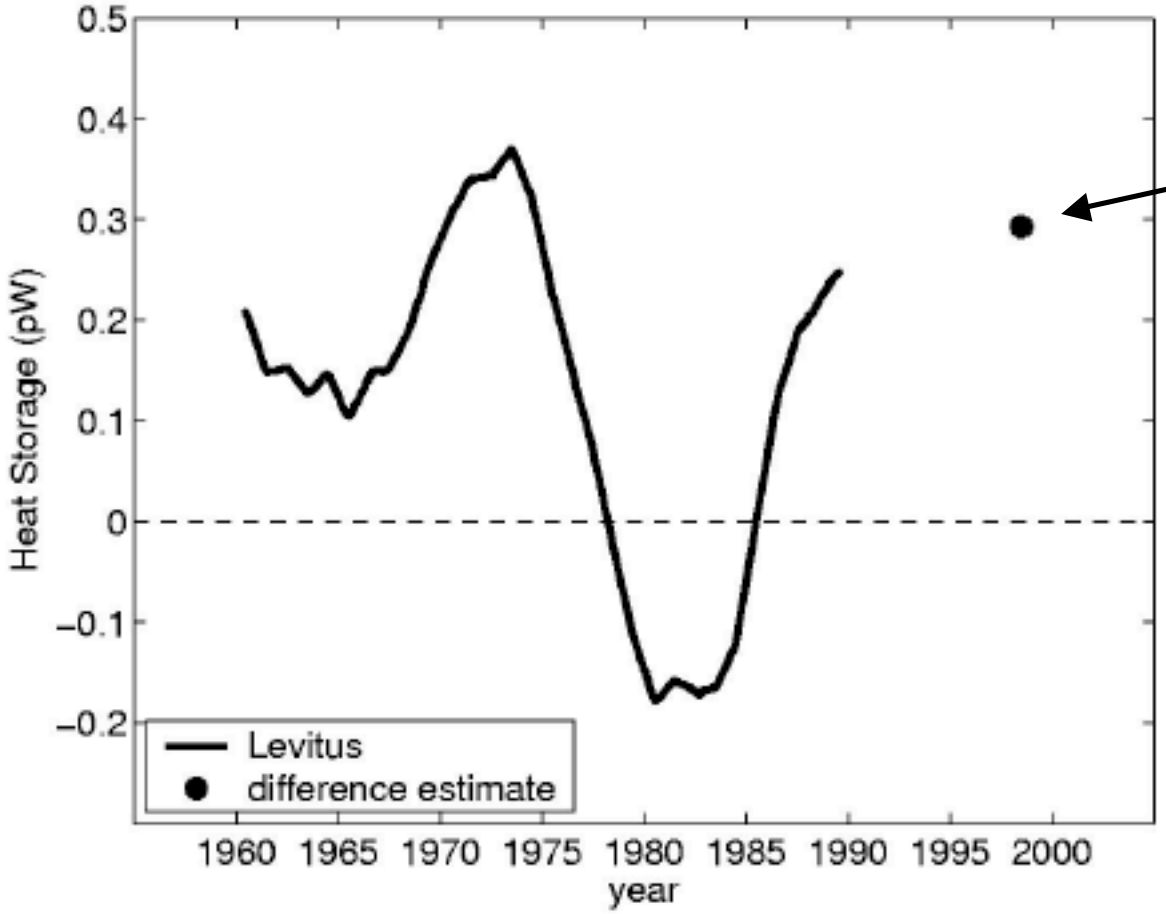


Figure 9. Ten-year trend in zonally averaged temperature vs. depth and latitude.

Willis et al, JGR, in press

New Ocean Heat Storage Versus Levitus Data

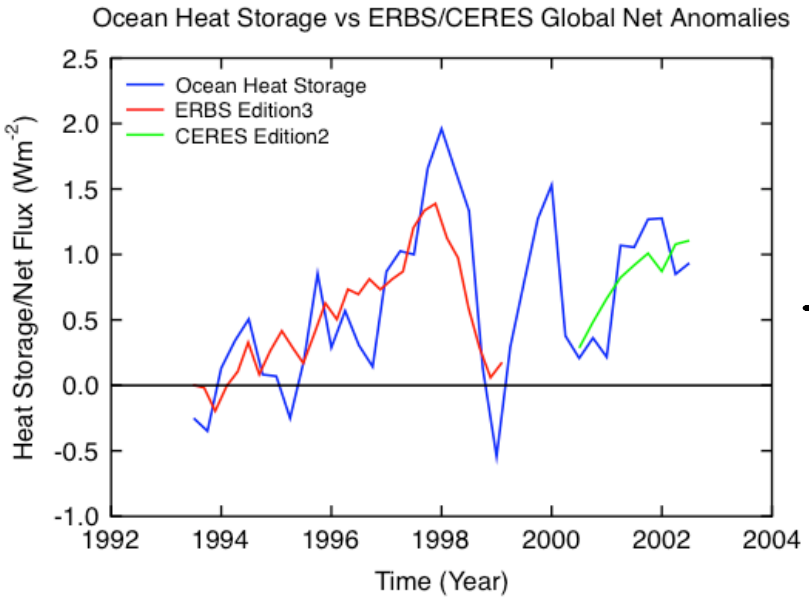


0.85 Wm^{-2} ocean, 0.6 Wm^{-2} globe

Figure 12. Decadal heat storage calculated as the 10-year difference of the 40-year time series of heat content published by *Levitus et al.* [2000a]. The single point represents the 10-year heat storage rate from the present analysis, as calculated in Section 3.1.

Willis et al, JGR, in press

Global Radiation and Ocean Heat Storage: What does it mean?



- Climate atmos. noise only 0.3 Wm^{-2}
- Ocean/Rad diff = 0.4 Wm^{-2} 1σ = ocean spatial sampling noise
- ERBS cavity radiometer gain change = 0.1% or 0.2 Wm^{-2}
- 1.5 Wm^{-2} variations larger than expected
- IPCC forcing = 0.6 Wm^{-2}/decade
- All other heat storage mechanisms are smaller by factor of 10 or more
- Aerosol/greenhouse forcing changes small except Pinatubo in 91-93
- Large changes = variations in net cloud radiative forcing
- Not clear if ocean => cloud or cloud => ocean
- Non-equilibrium link of ocean/cloud must be unscrambled in model/data

What about 1 Wm^{-2} CERES SW Flux Change?