



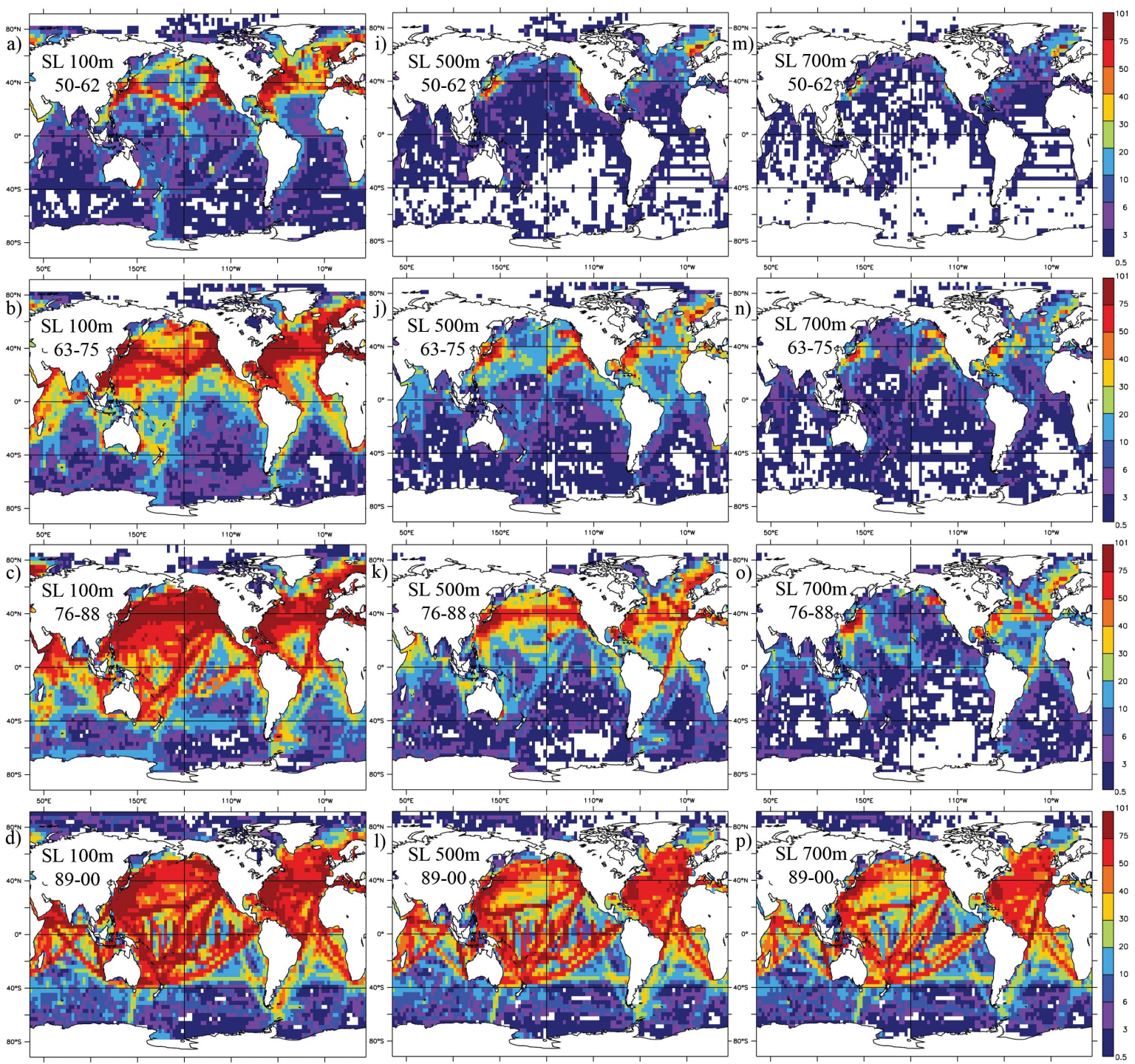
**Near surface ocean  
temperature: Trends and  
interdecadal variability**

**Mark Carson (U. of Washington / JISA0)  
and Ed Harrison (NOAA/PMEL)**

# Outline

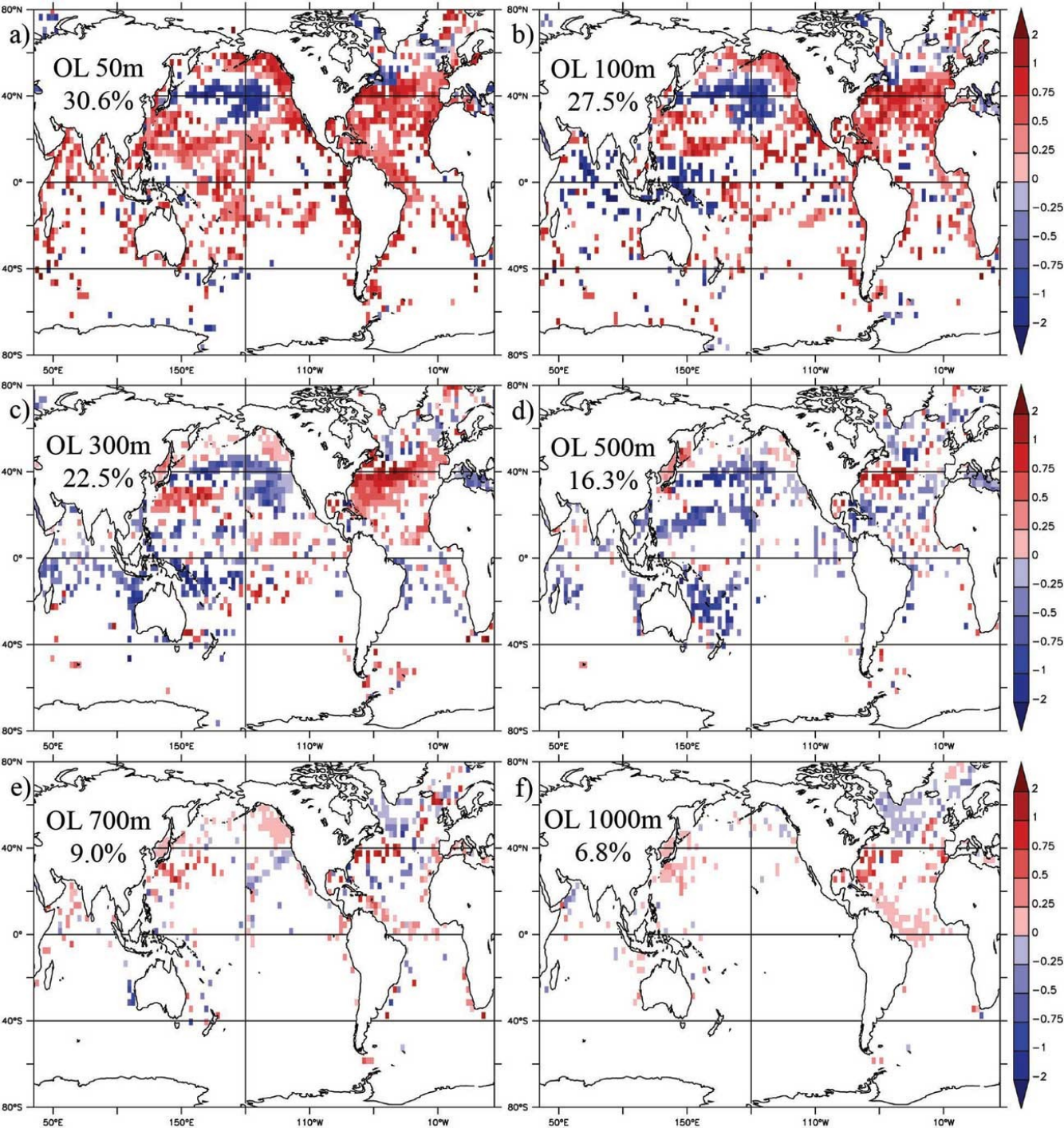
- Observationally-based exploration (World Ocean Database 2005, ICOADS r2)
- Visit spatial and temporal patterns of surface and subsurface temperature data and trends
- Where is the ocean poorly measured, relative for calculating long-term trends?
- What variability seems inherent in the ocean climate system?





Percentage of months having obs for each period listed.

WOD05 standard-level profile counts binned into 3° grid boxes



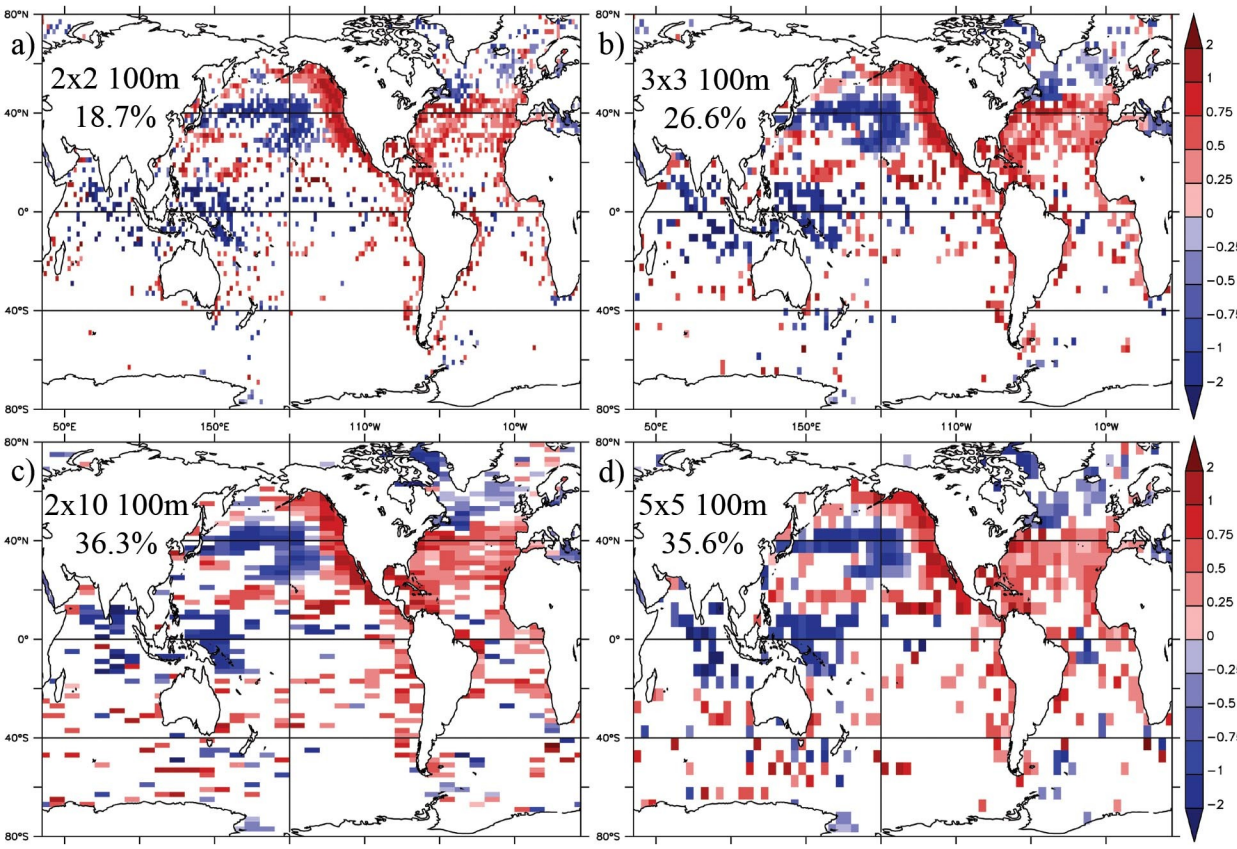
Temperature trends passing a 90% statistical confidence limit.  $\Delta T$  of 1955-2003 plotted.

Percentages are of global ocean covered by statistically significant trends.

WOD05 observed-level data binned into 3° boxes

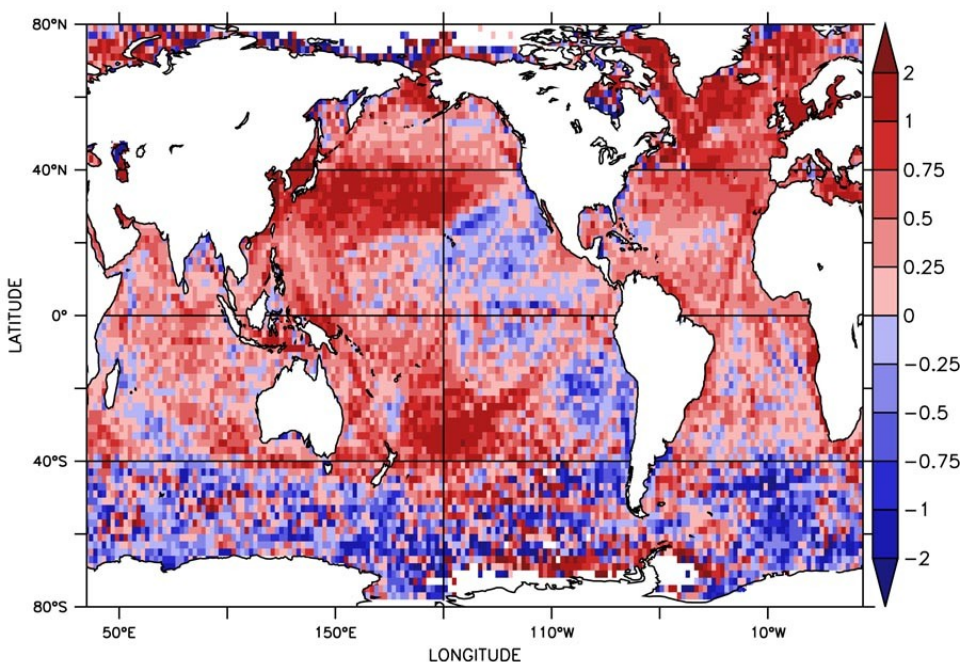
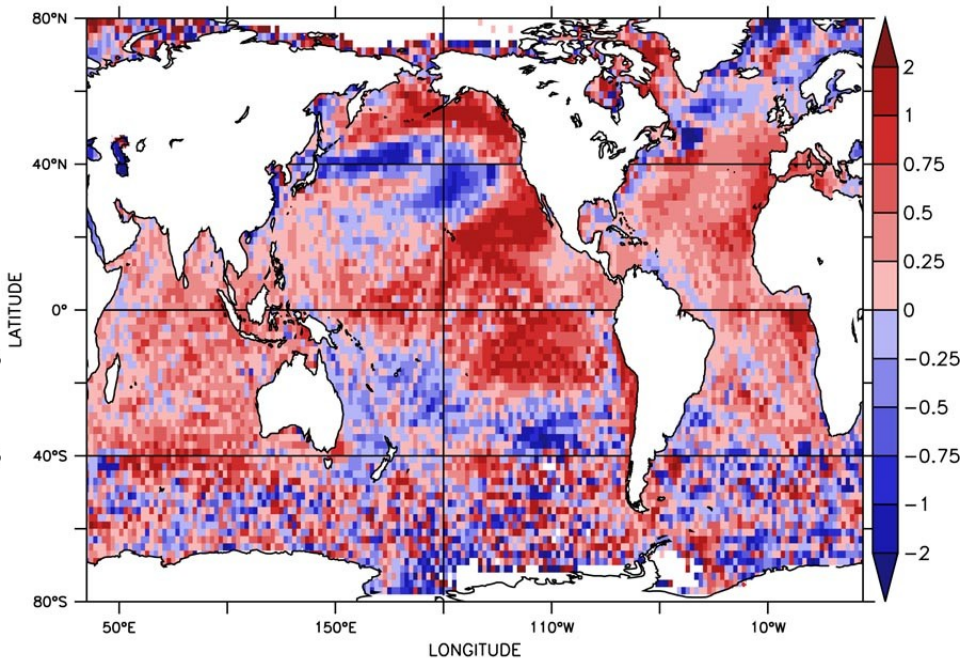
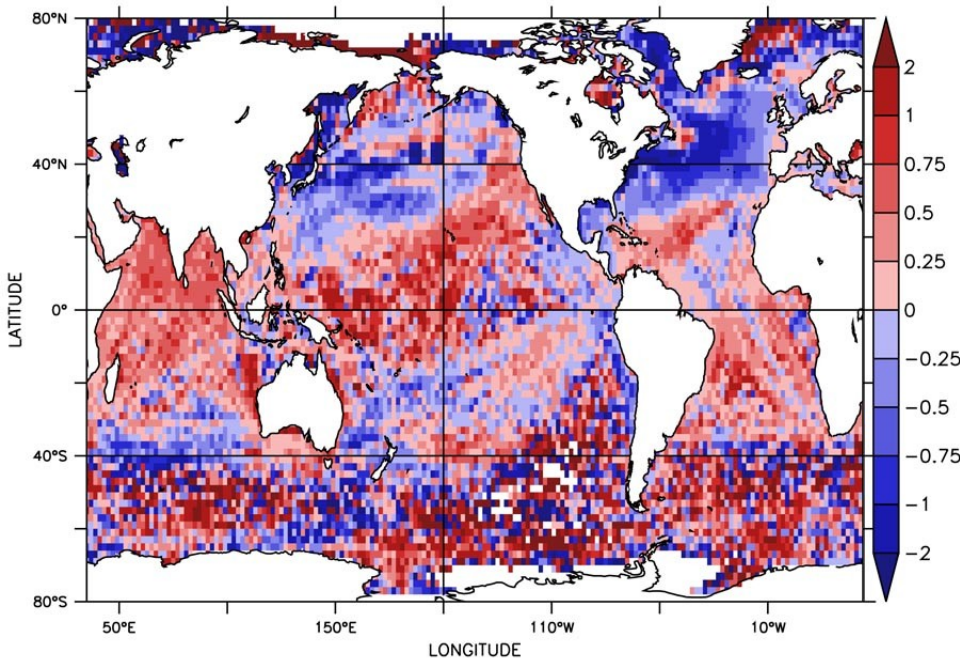


# An aside: binning data in different size grid boxes.



Few additional regions of the ocean gain significant trends with bigger box sizes. Some expansion of “coverage” is merely due to spreading significant trends over larger grid boxes.



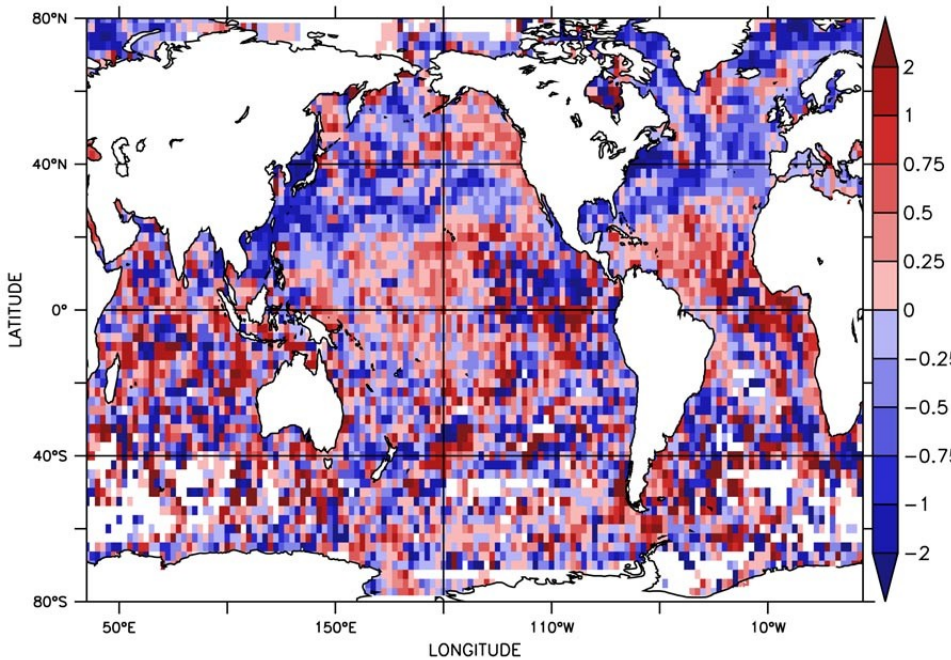


coads sst trend from Jan 1950 to Dec 1970

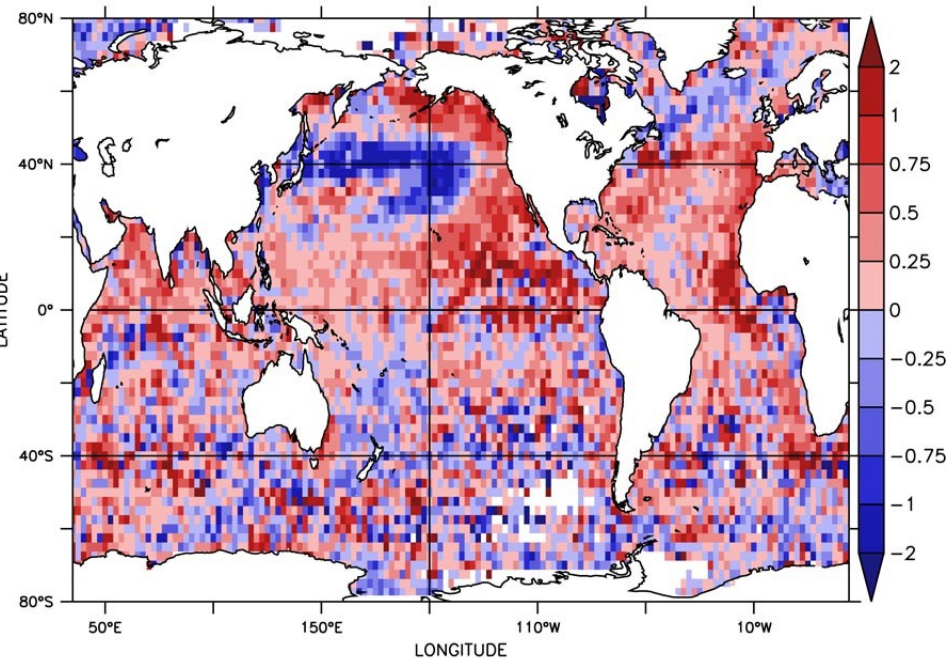
coads sst trend from Jan 1970 to Dec 1990

coads sst trend from Jan 1980 to Dec 2004

SST trends with  $\Delta T$  over period plotted

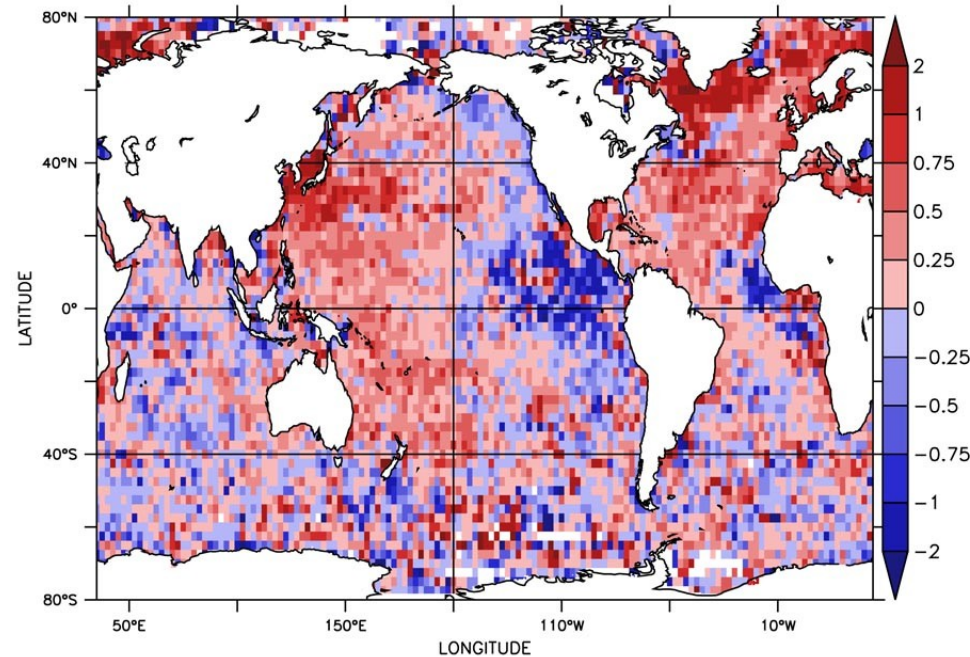


50m trend from Jan 1950 to Dec 1970

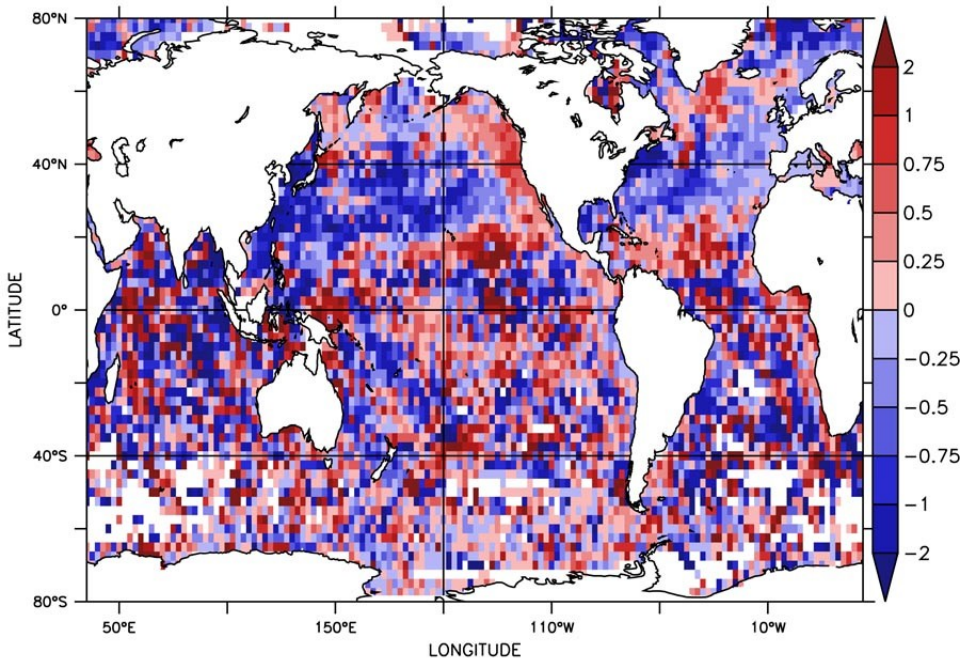


50m trend from Jan 1970 to Dec 1990

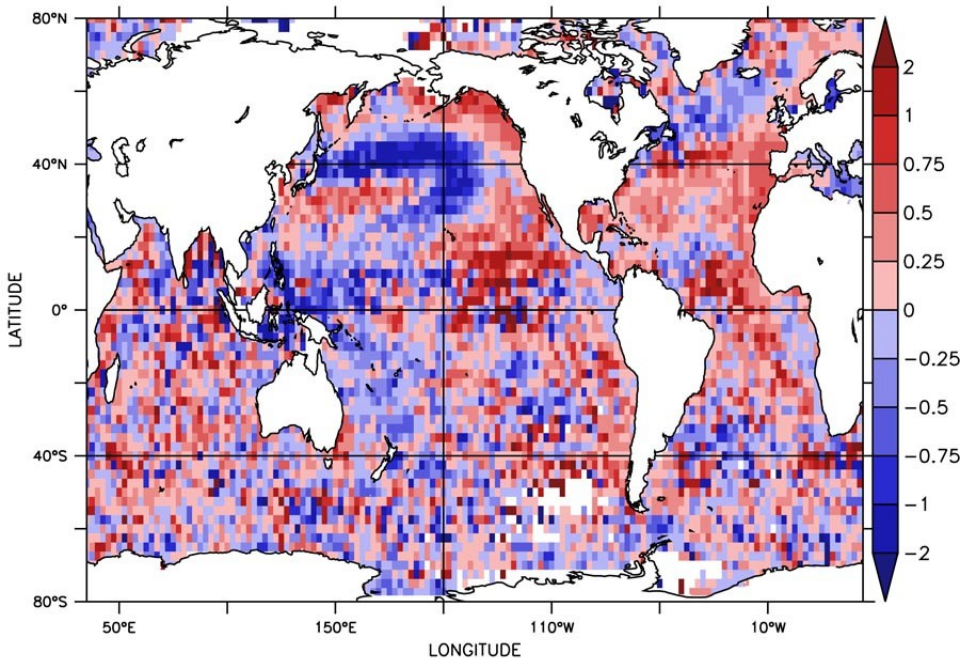
50 m trends with  $\Delta T$  over period plotted



50m trend from Jan 1980 to Dec 2004

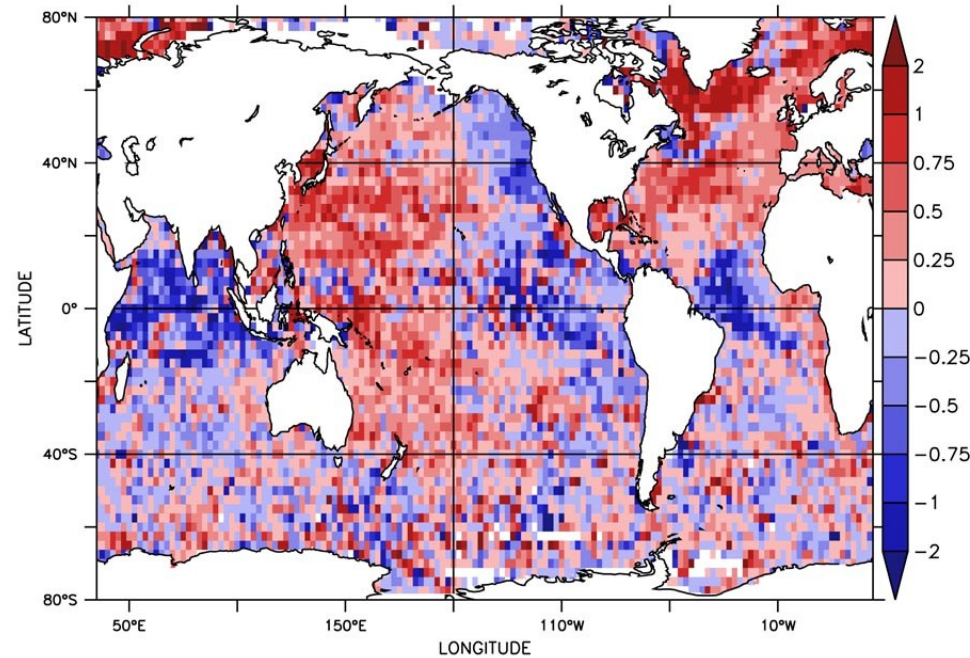


100m trend from Jan 1950 to Dec 1970



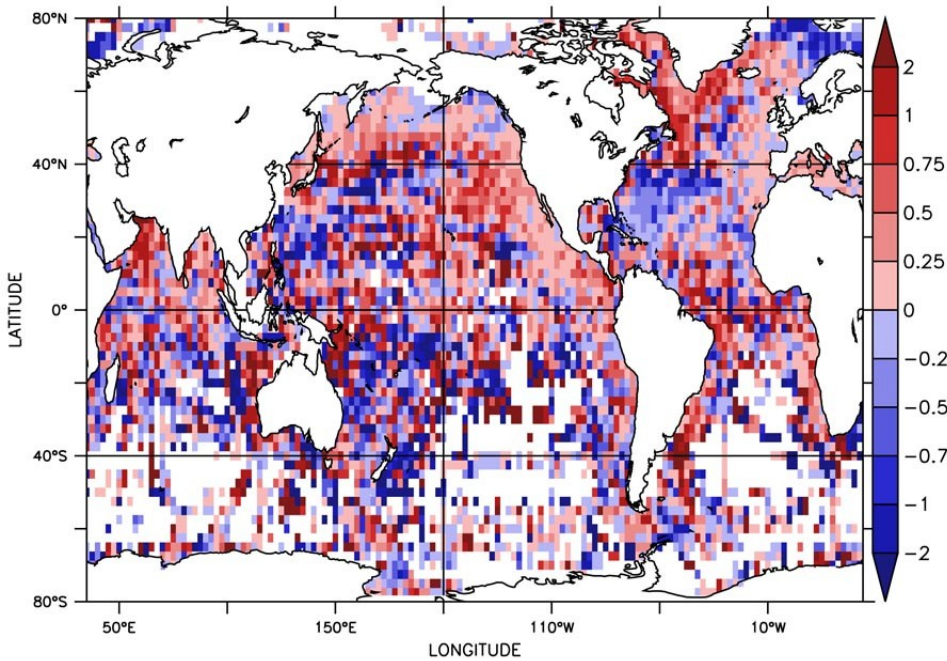
100m trend from Jan 1970 to Dec 1990

100 m trends with  $\Delta T$  over period plotted

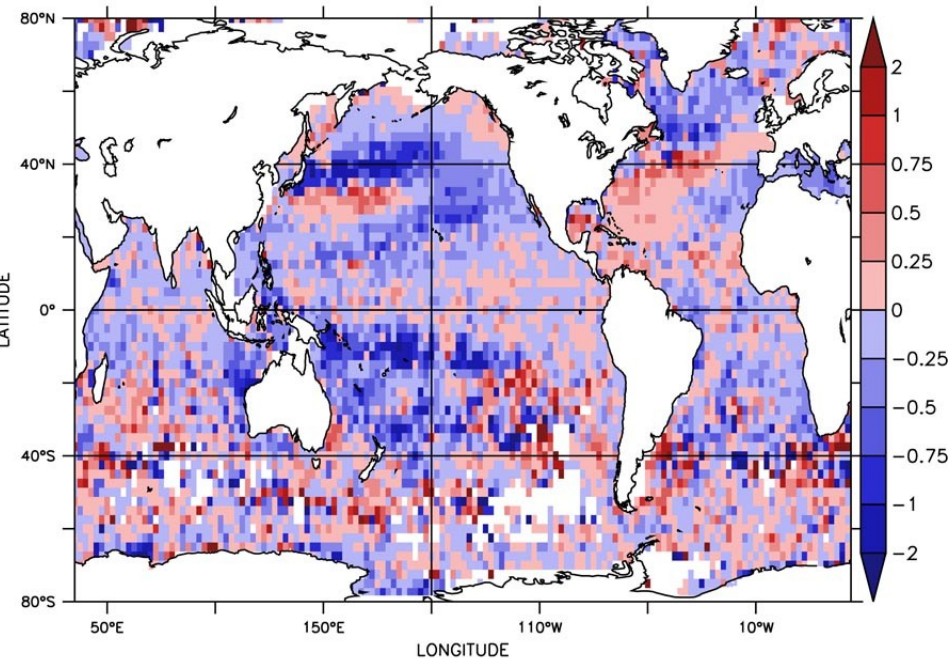


100m trend from Jan 1980 to Dec 2004



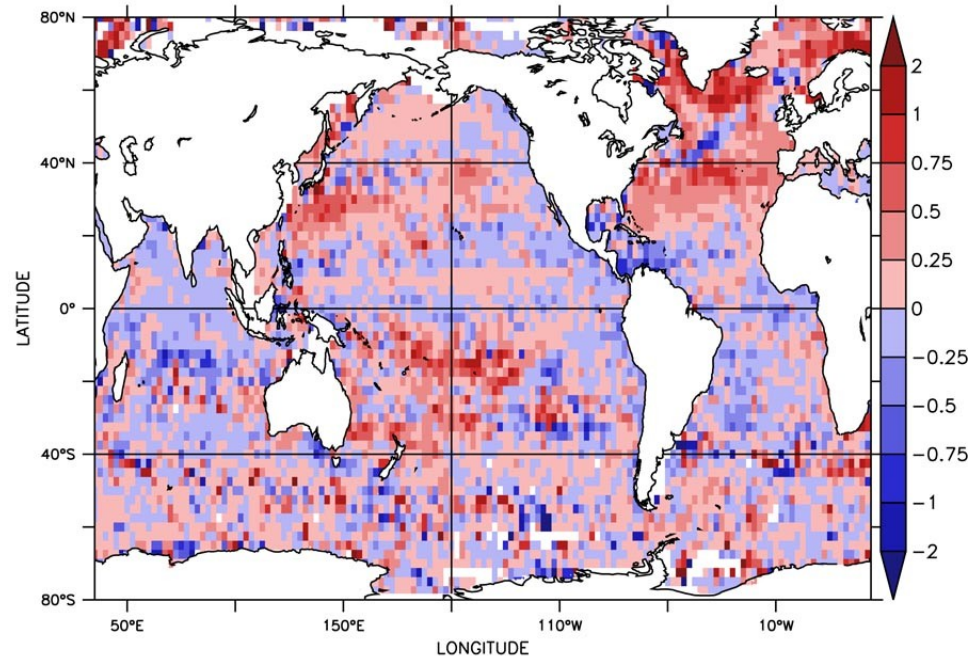


300m trend from Jan 1950 to Dec 1970



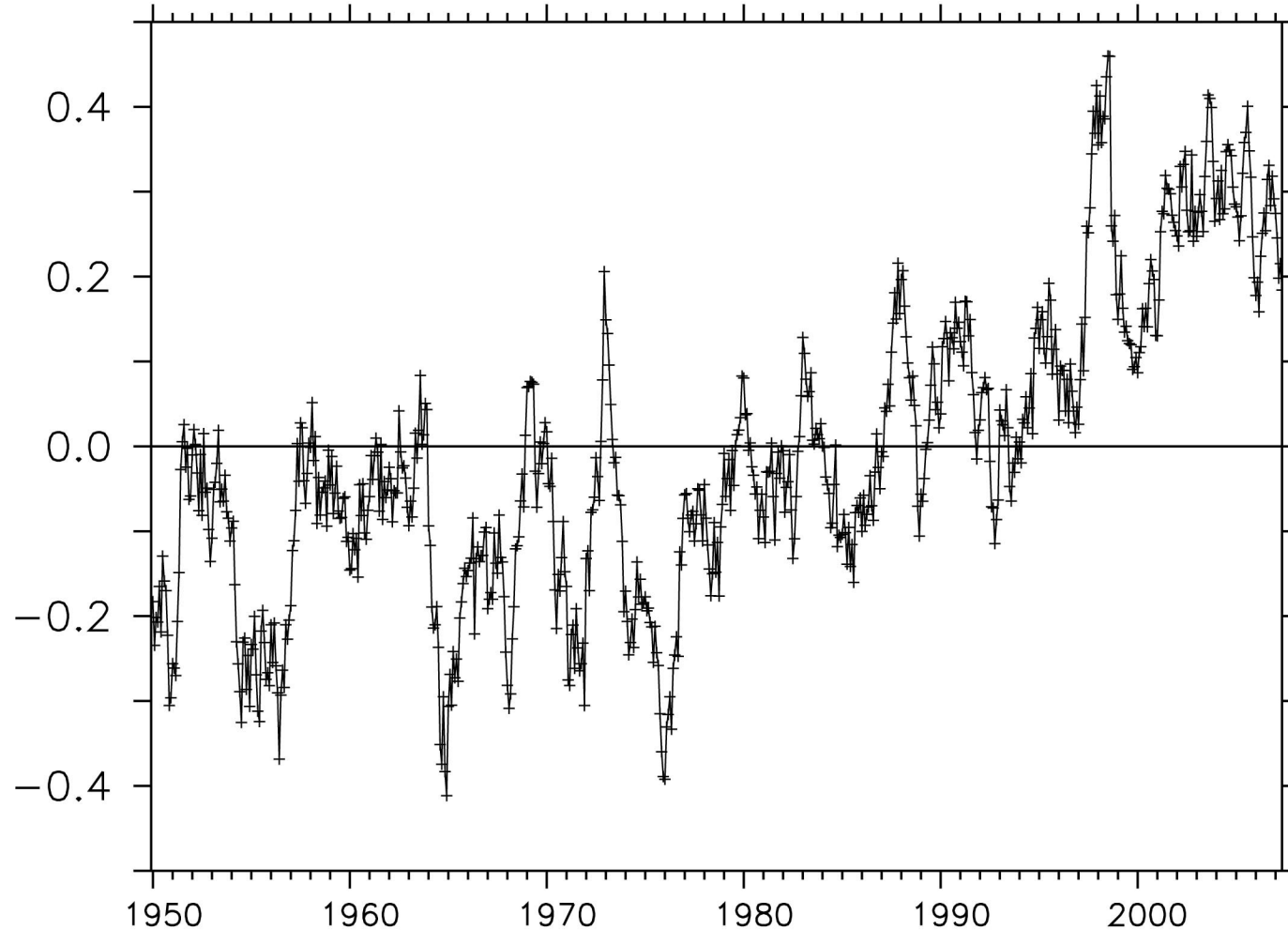
300m trend from Jan 1970 to Dec 1990

300 m trends with  $\Delta T$  over period plotted

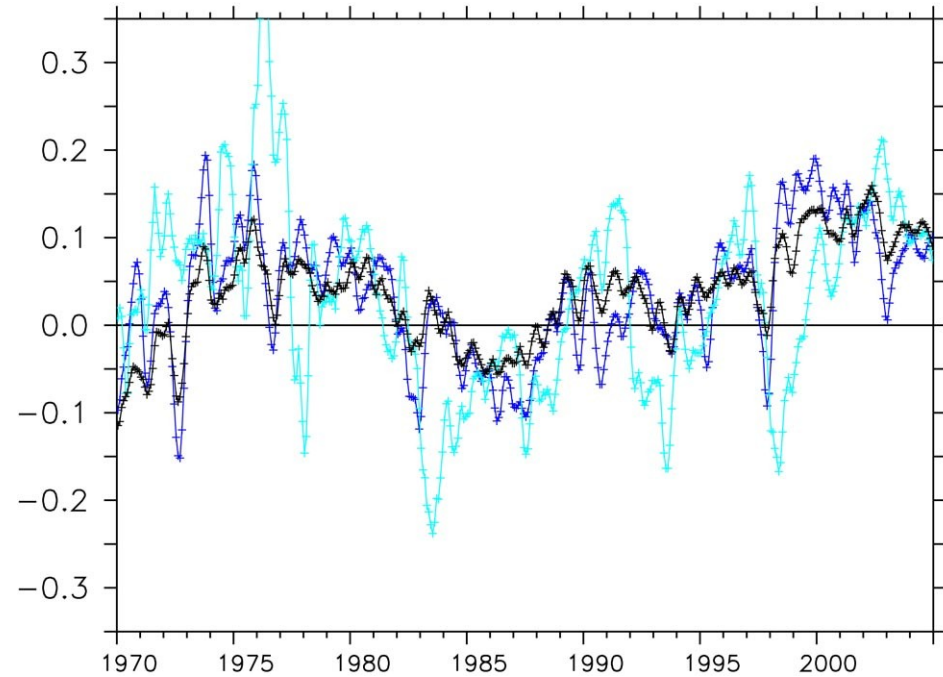
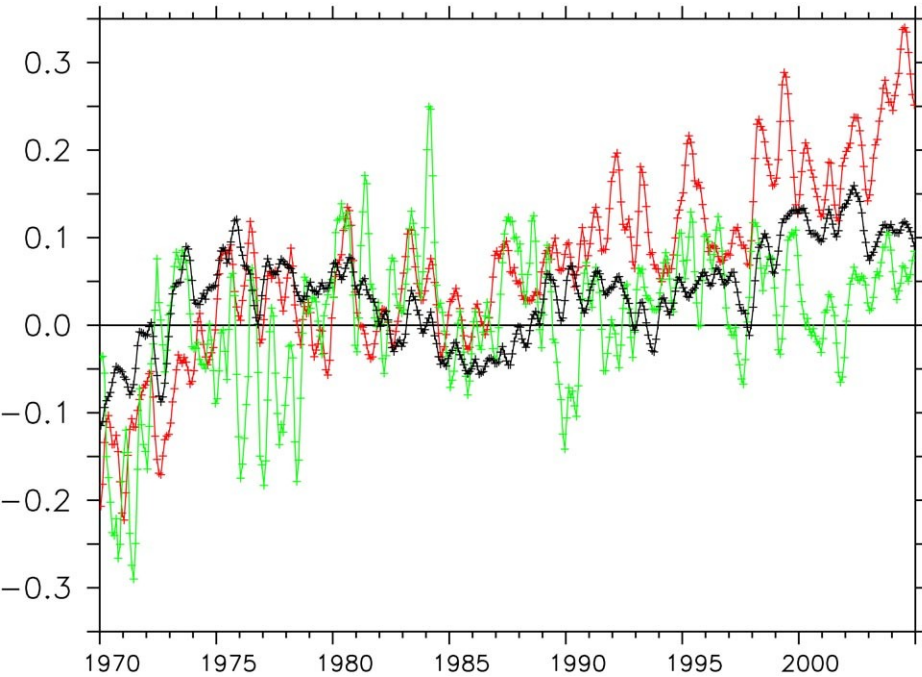


300m trend from Jan 1980 to Dec 2004

# COADS SST time series (1950-2006)



# Depth averaged time series 0-300 m



Black: Global monthly anomaly average (40S – 70N)

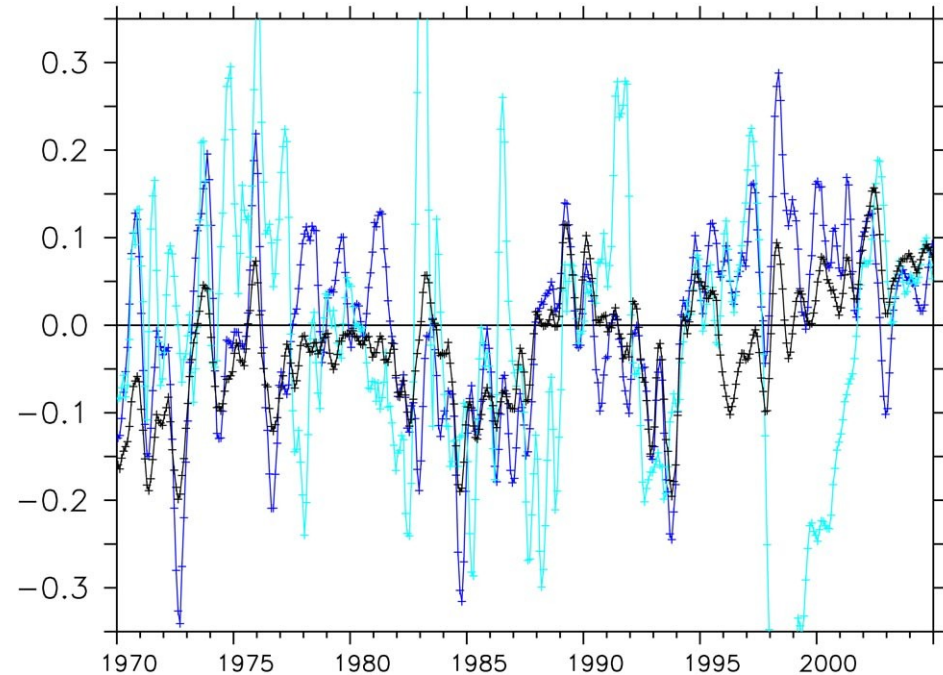
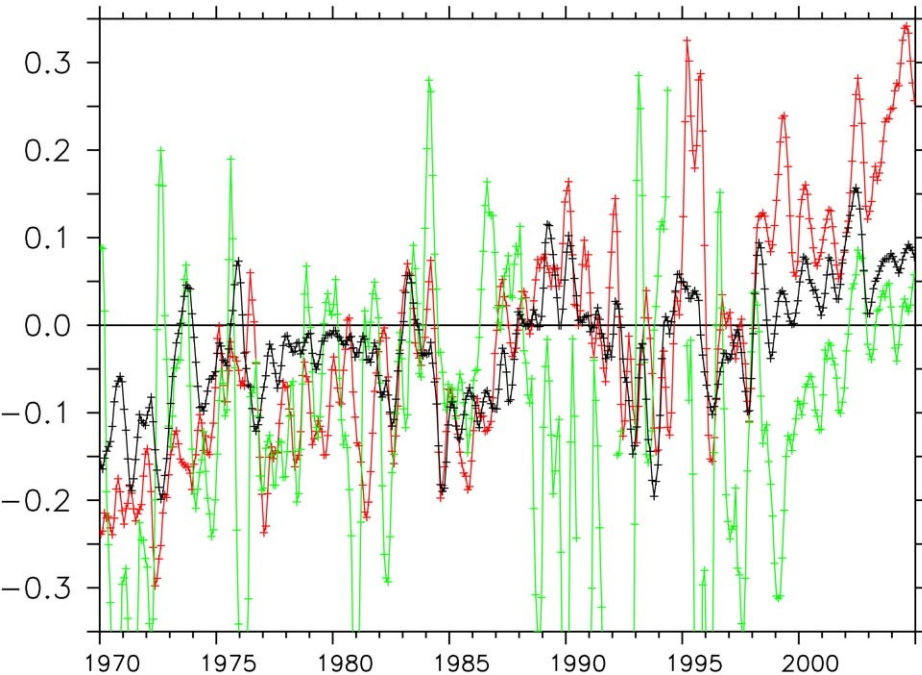
Red: North Atlantic (0 – 70N)

Green: South Atlantic (40S – 0)

Blue: North Pacific (0 – 70N)

Light blue: South Pacific (40S – 0)

# Depth averaged time series 0-300 m (all instruments but XBTs )



Black: Global monthly anomaly average (40S – 70N)

Red: North Atlantic (0 – 70N)

Green: South Atlantic (40S – 0)

Blue: North Pacific (0 – 70N)

Light blue: South Pacific (40S – 0)

# Conclusions

- **Interdecadal temperature variability exists – surface and subsurface – and is not just an artifact of instrument bias and changes**
- **Strong warming events in many regions coincide with ENSO 97-98**
- **Influence of interannual and interdecadal variability on temperature trends can be large**
- **Sustained warming may be present too (temperatures recently cycle up over interannual and interpentadal variability; also overall 35-yr warming trend of about 0.1°C).**

