

# Long Term Trends of Tropical Pacific Sea Surface Temperature in SODA 1871-2008

*Chunxue Yang*  
*Benjamin Giese*  
*Department of Oceanography*  
*Texas A&M University*

Cane-Zebiak model

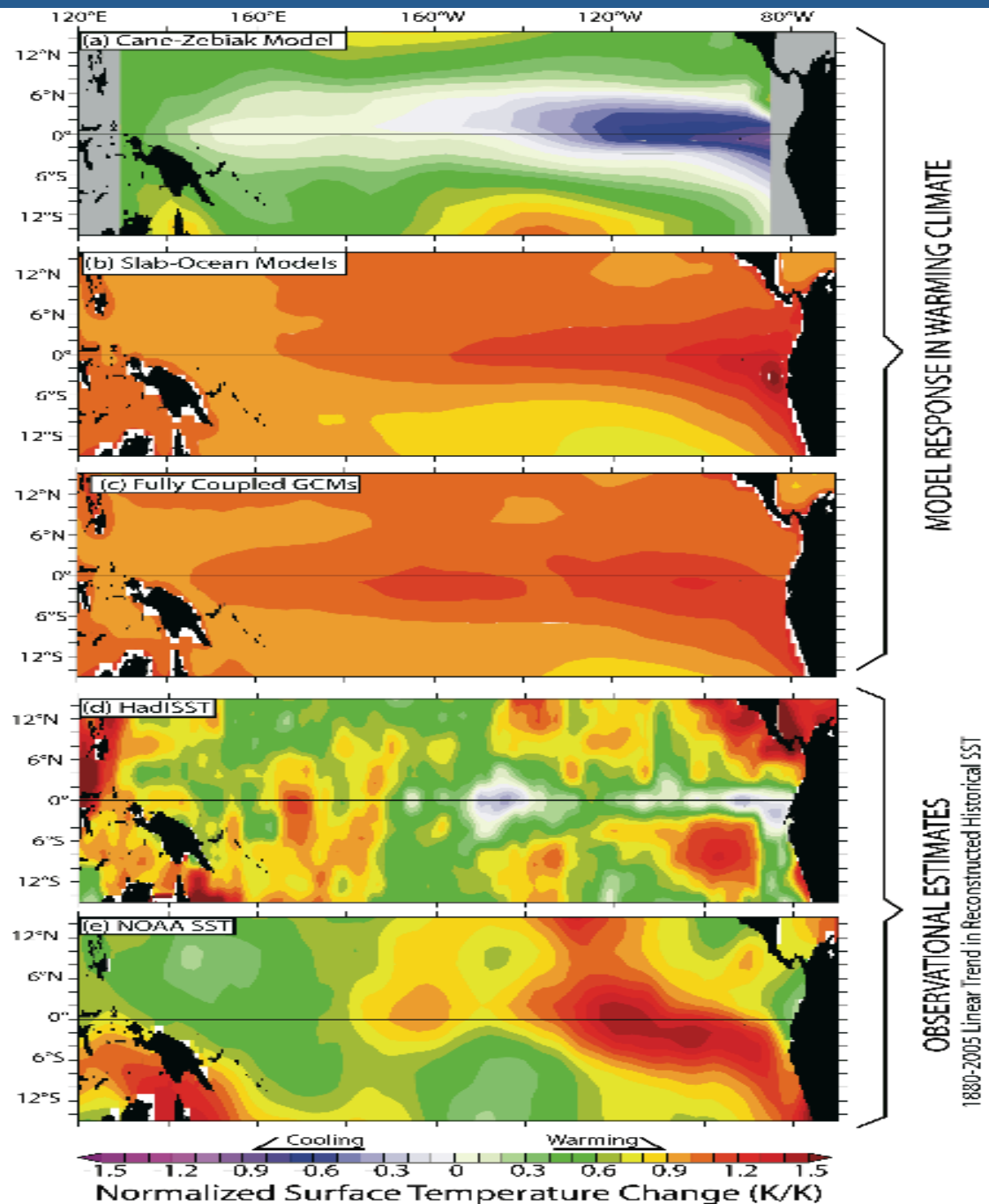
Slab-Ocean models

Fully Coupled GCM

HadISST (1880-2005)

ERSST (1880–2005)

*Vecchi, et al., 2008*



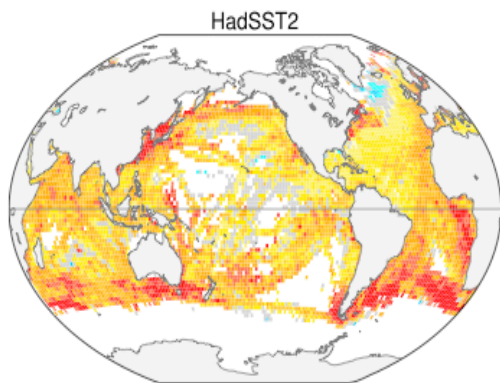
## El Nino-like Pattern Response

- ◆ Weakening of atmosphere circulation (Walker Circulation) (Held and Soden, 2006; Vecchi and Soden, 2007).
- ◆ Reduction of equatorial wind stress due to weakening of atmospheric circulation, results in decline of Tropical Pacific SST gradient (Knutson and Manabe, 1995).

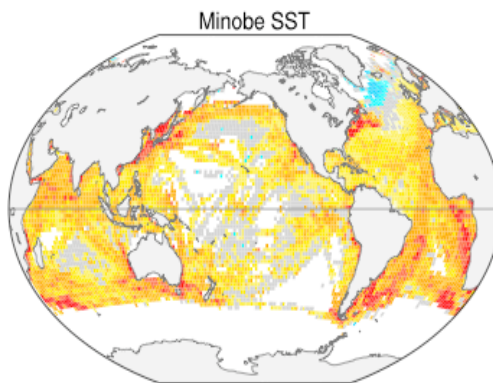
## La Nina-like Pattern Response

- ◆ Smaller temperature change over eastern tropical Pacific due to upwelling results in enhanced tropical SST gradient. (Clement et al., 1996; Cane, et al., 1997)
- ◆ Strengthening of tropical easterly winds due to increasing tropical SST gradient brings more cold water from deep ocean through upwelling and further cooling SST .

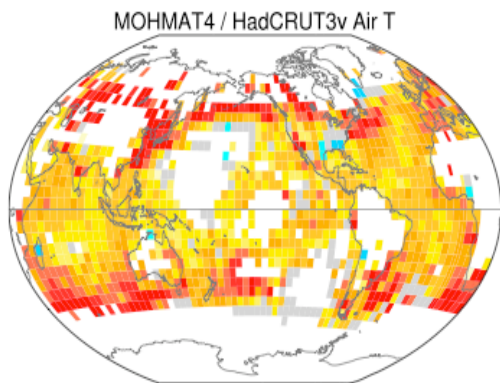
HadSST2



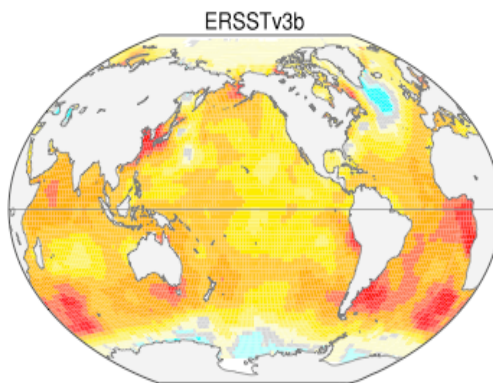
Minobe SST



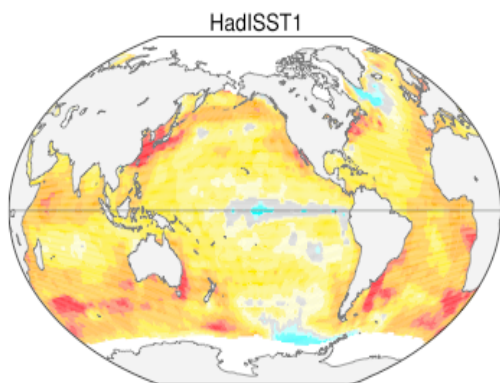
Air Temp



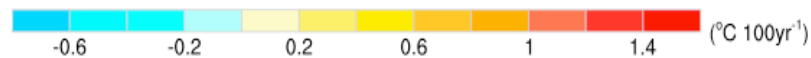
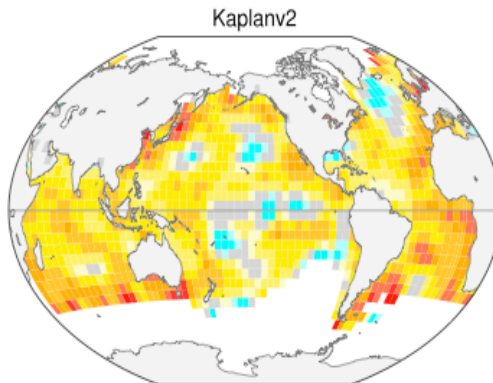
ERSST



HadISST1

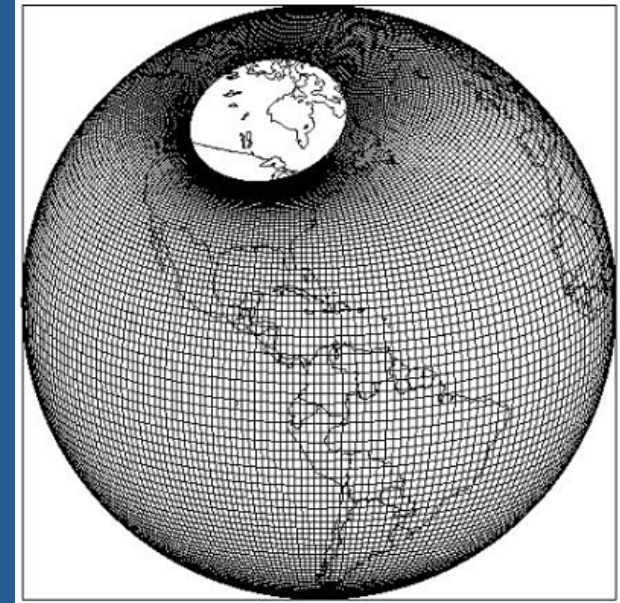


Kaplan

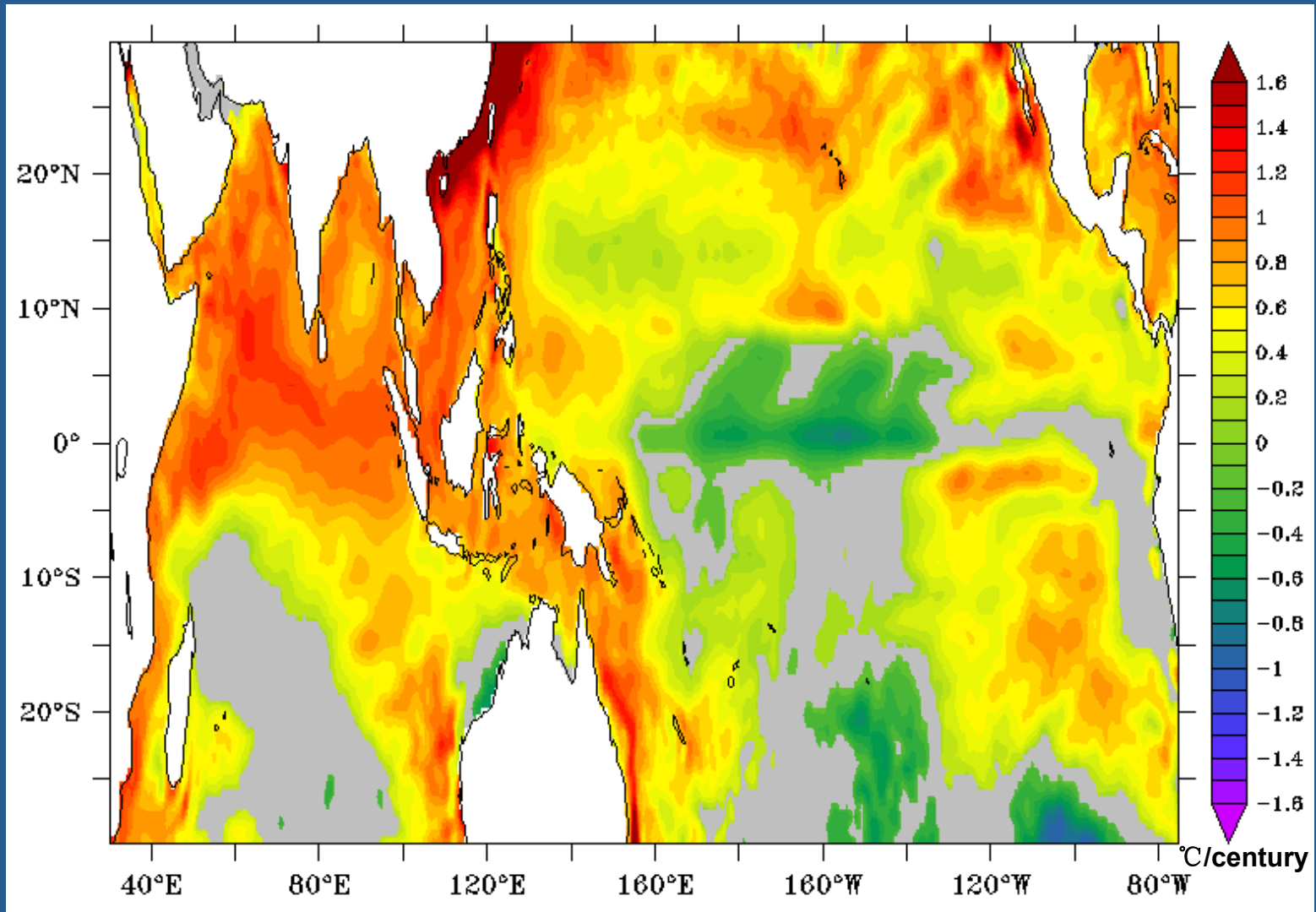


## SODA 2.2.4

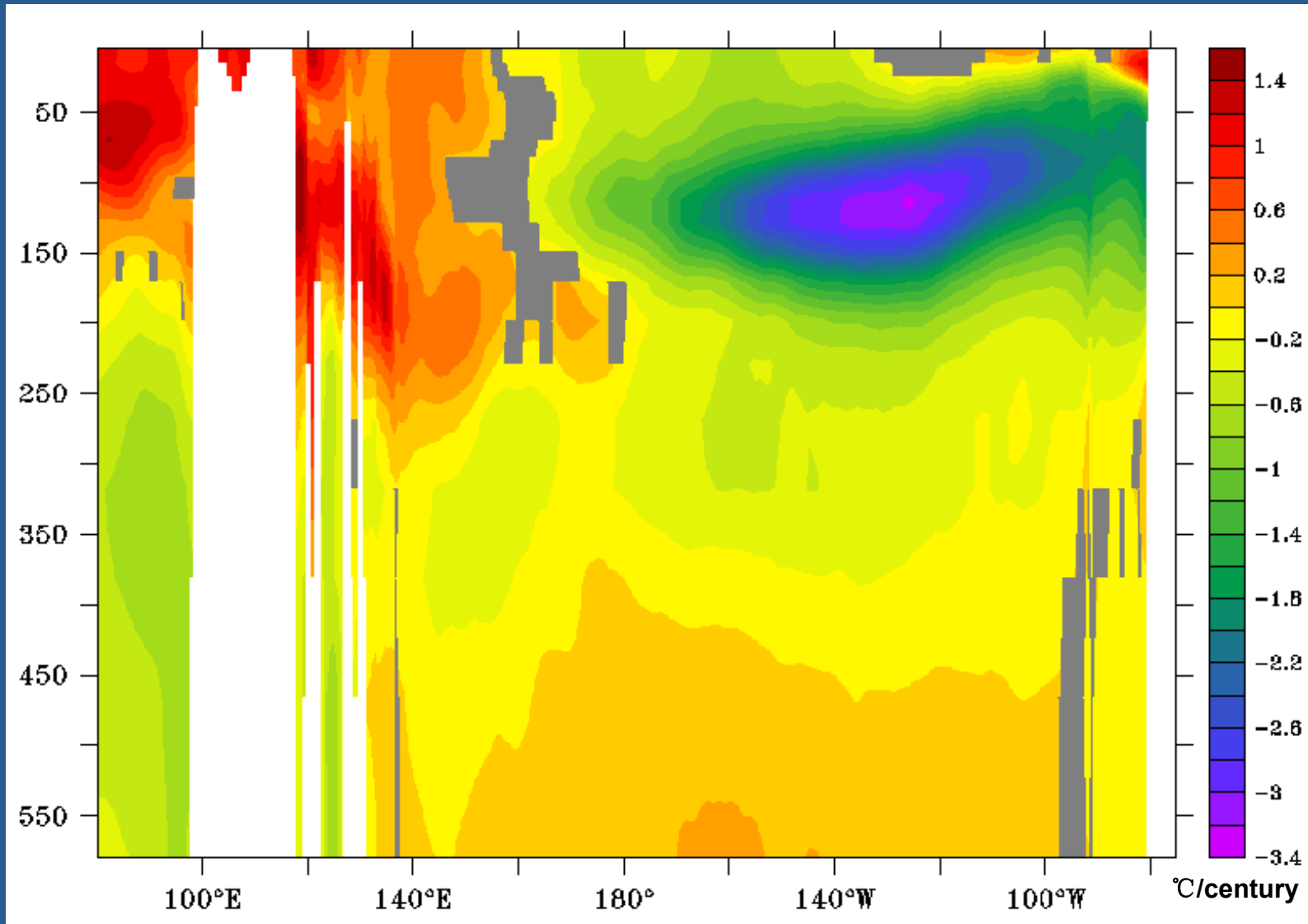
- **Numerics**
  - Parallel Ocean Program
- **Domain**
  - Global (including Arctic)
- **Resolution**
  - 0.4x0.25 average on eq. (~25km x 25km midlat) horizontal
  - 40 levels: 10m near surface to 450m in deep ocean
- **Winds**
  - 20CRv2 daily stress 1871 – 2008
- **Heat and Salt fluxes**
  - Bulk formulae using 20CRv2 daily variables
- **SODA Data Assimilation**
  - WOD09 Hydrographic and ICOADS 2.5 SST data



## Linear trend of SST in SODA 2.2.4

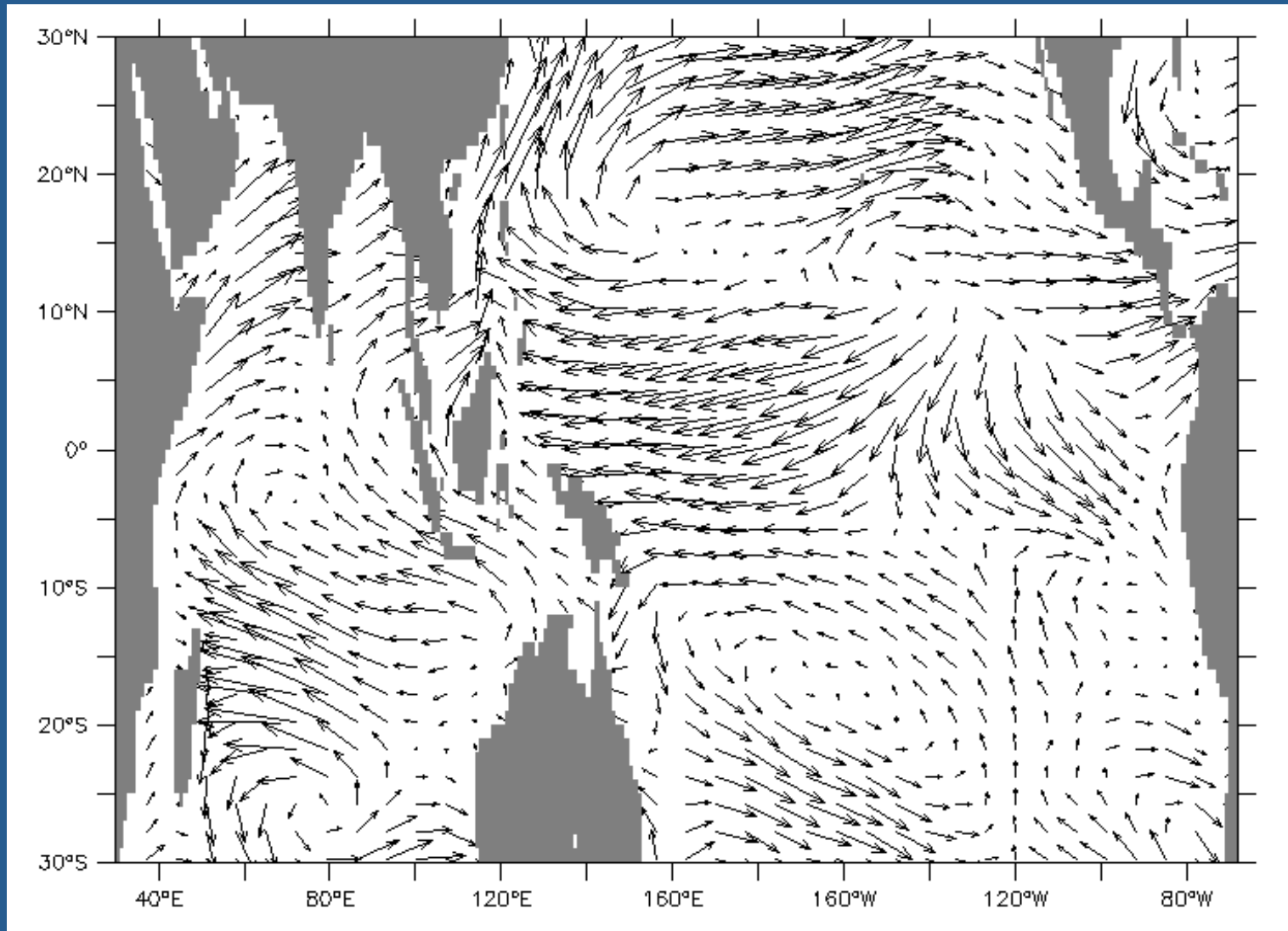


# Linear Trend of Temperature on the Equator



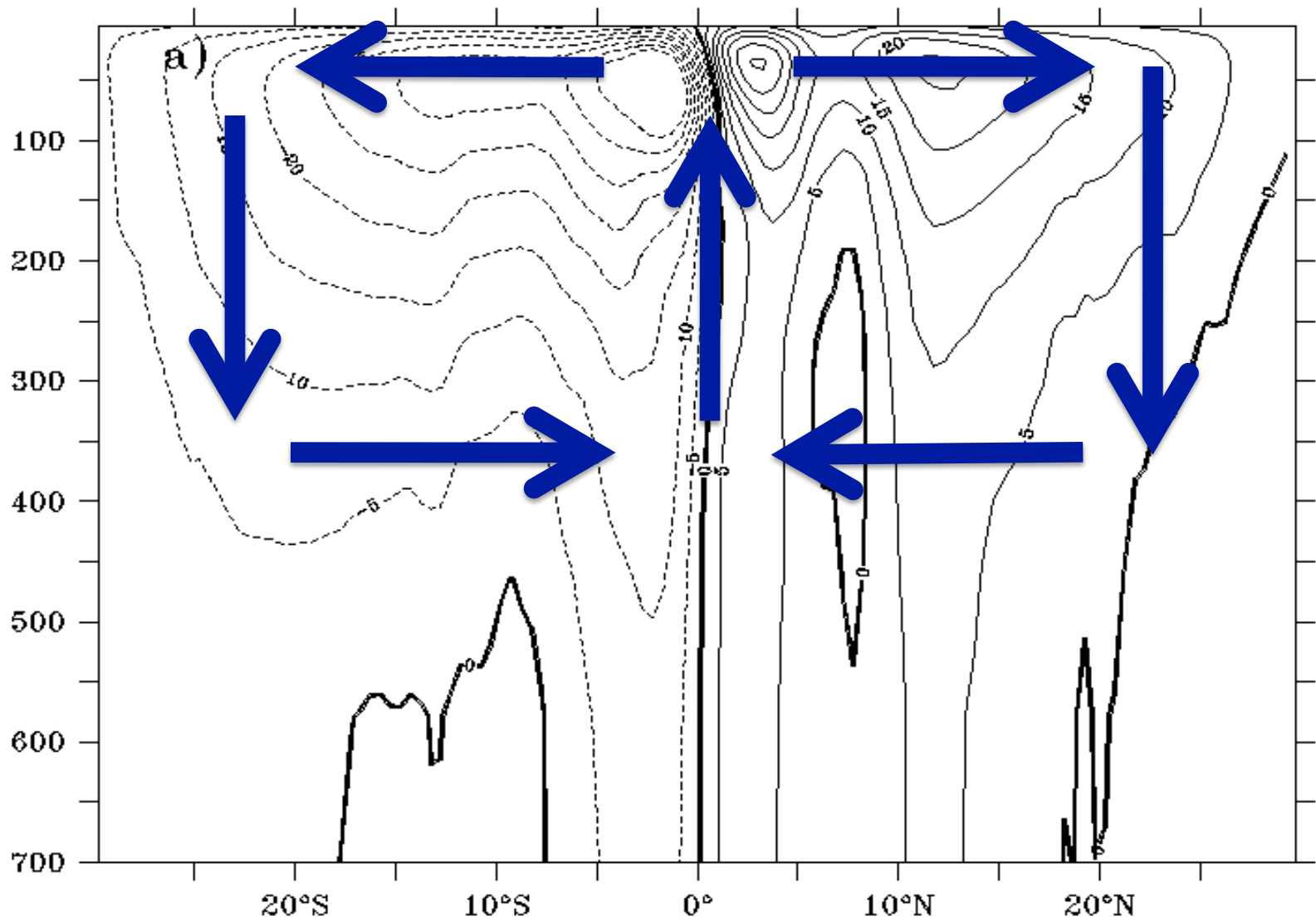


# Linear Trend of Wind Stress

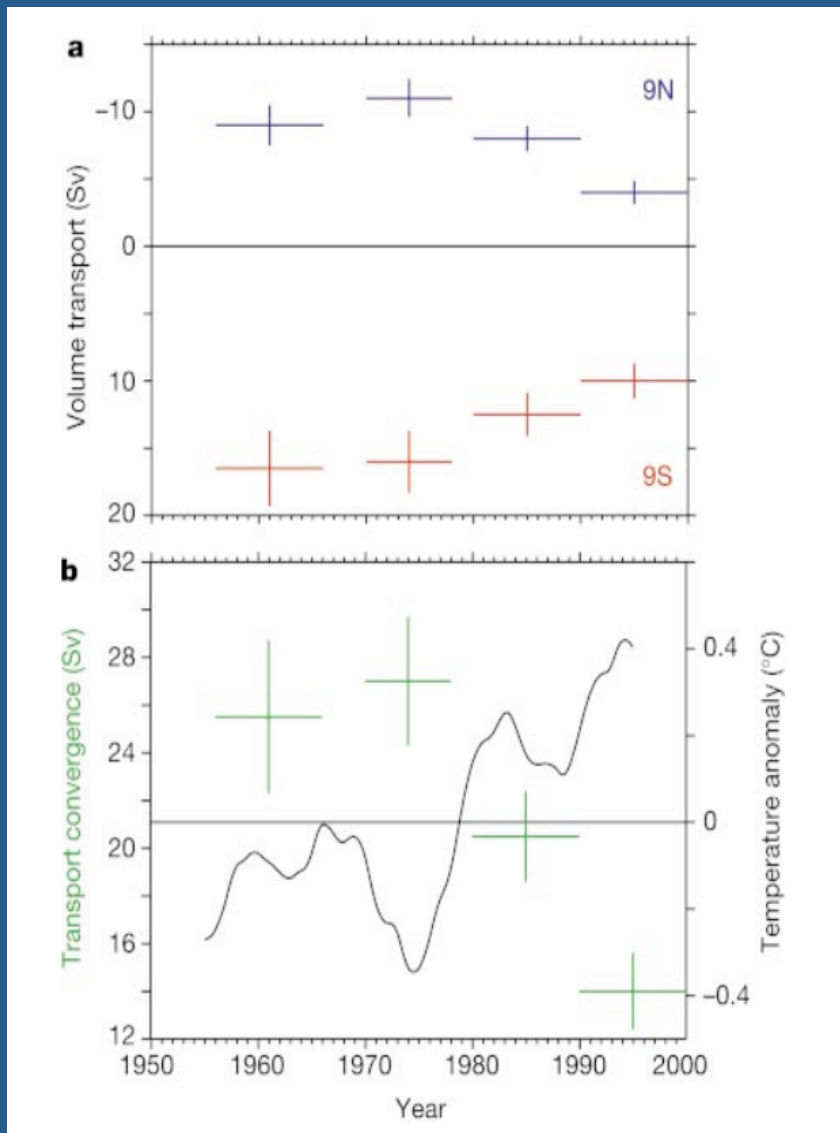




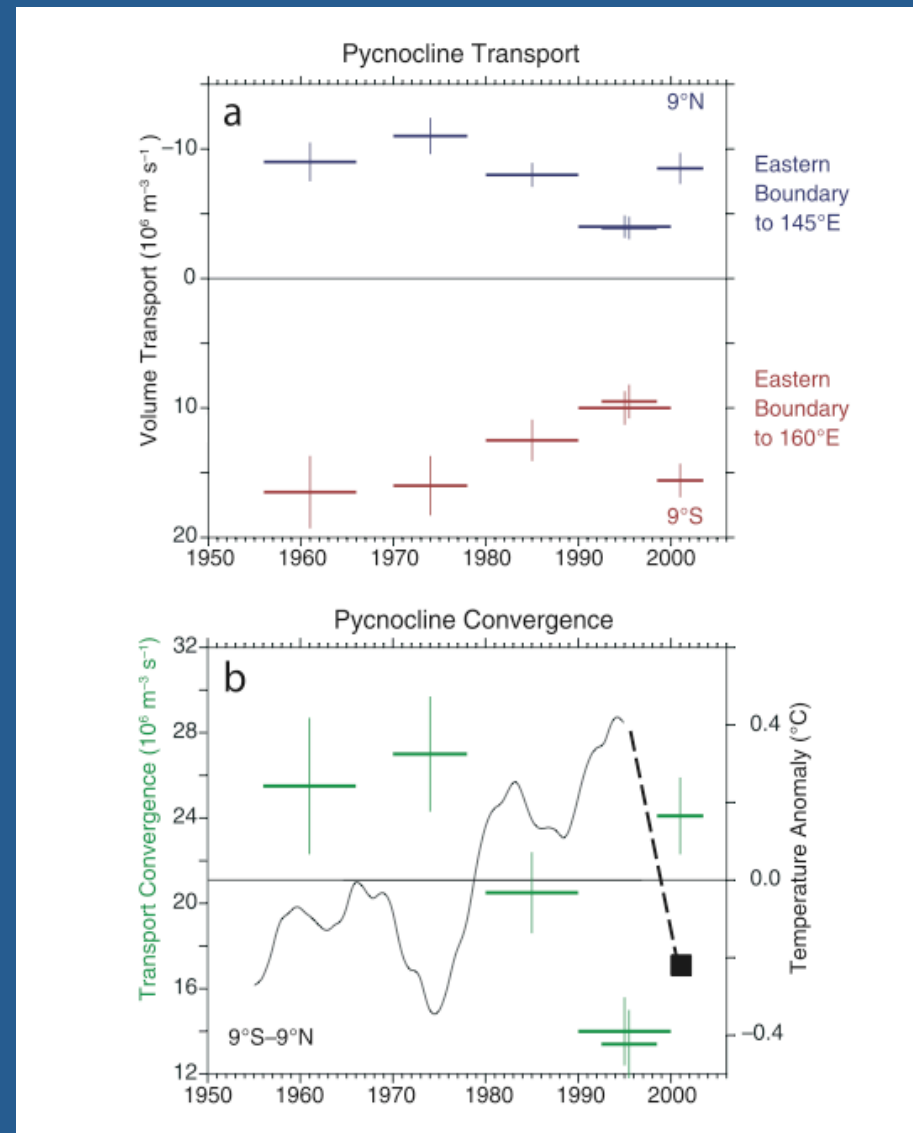
# Pacific Subtropical Cell (STC)



# Previous Studies about the STC



McPhaden and Zhang (2002)

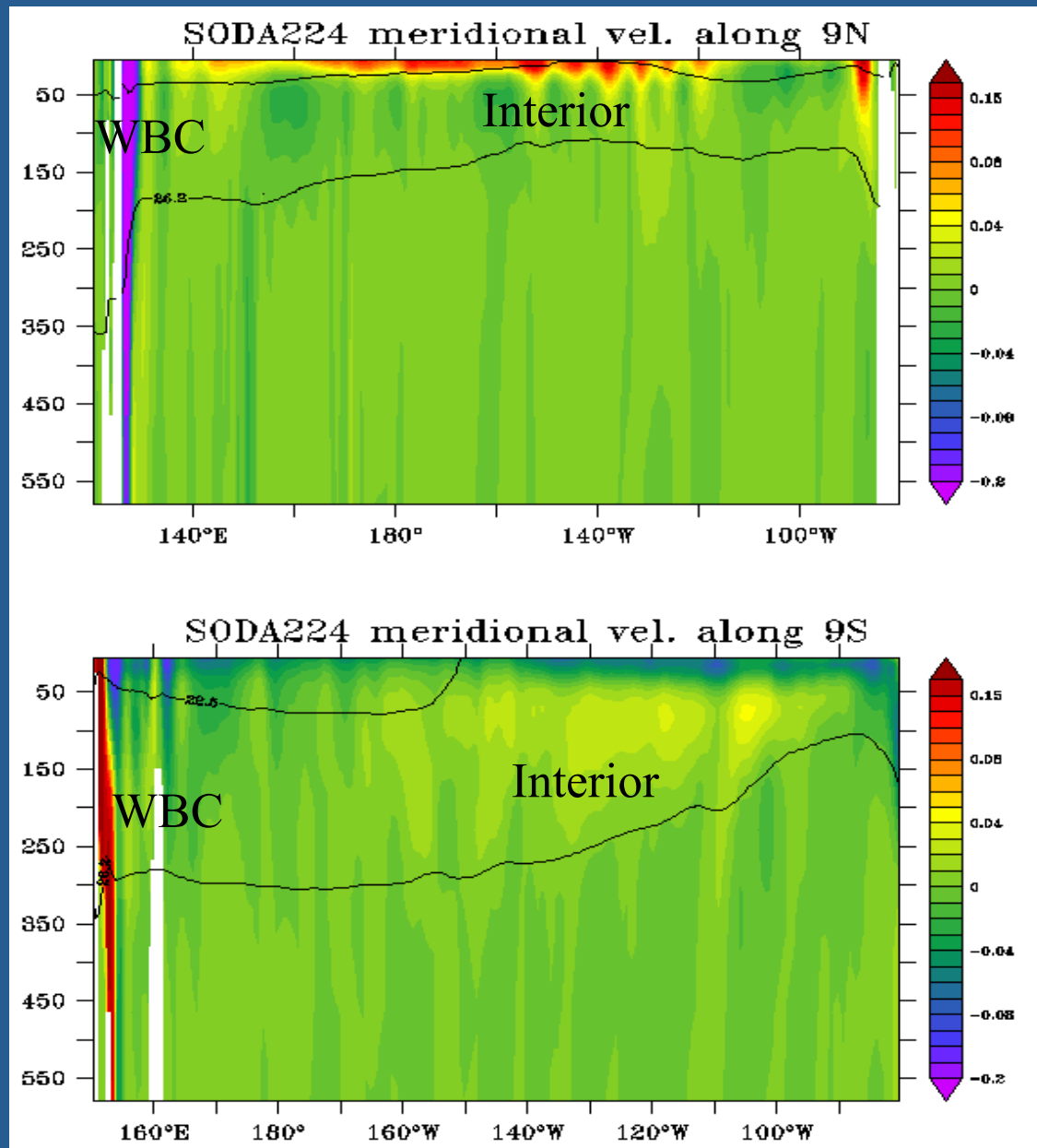


McPhaden and Zhang (2004)

## Previous Studies about the STC

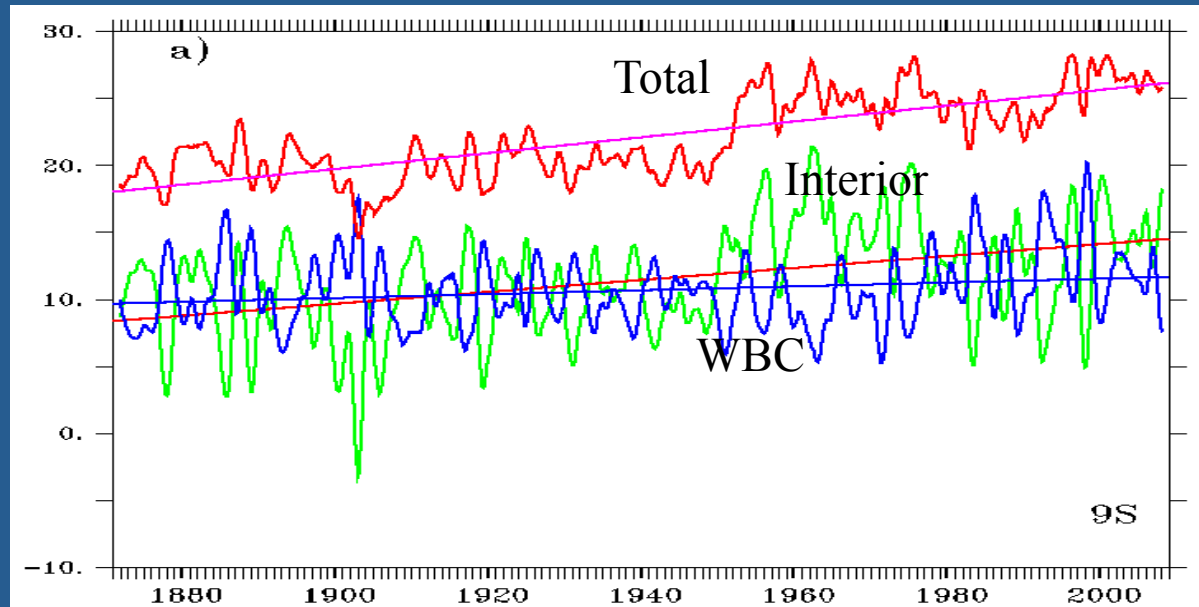
- ❖ **With numerical models, the STC starts to be weakened in the 1970s, but rebounds in 1990s. (Lee and Fukumori, 2003; Captondi et al., 2005; Cheng et al. 2006)**
- ❖ **Results from assimilations data GECCO and SODA are consistent with results from observations and numerical models (Schott et al., 2007; Schott et al., 2008)**

# Vertical Profile of Meridional Velocity



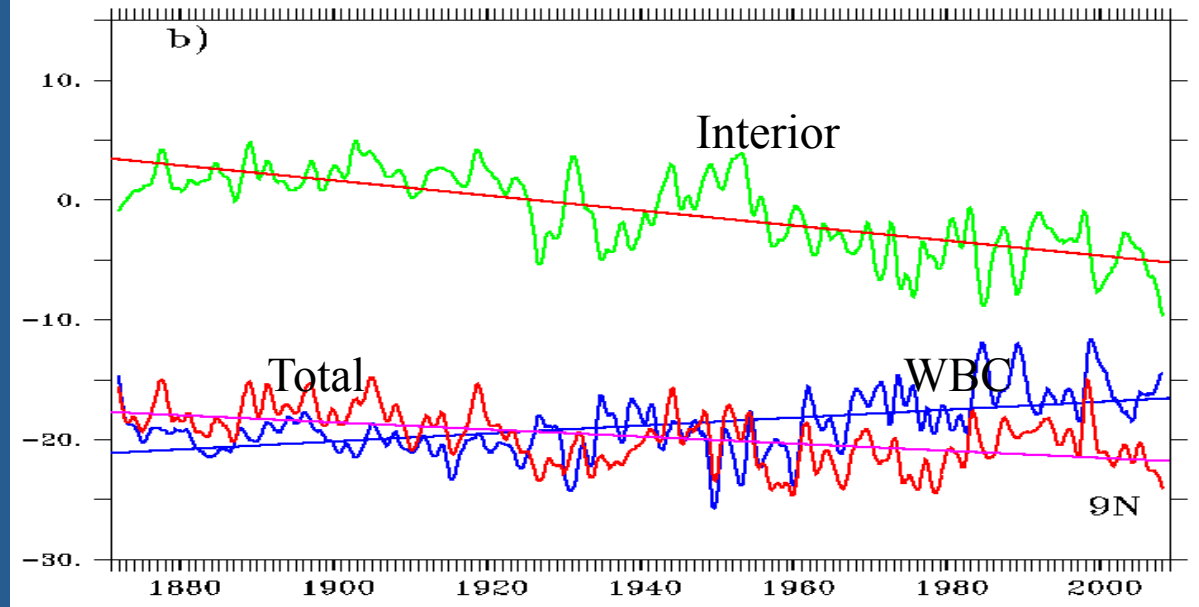
# Transport of the STC at 9°S and 9°N

9°S



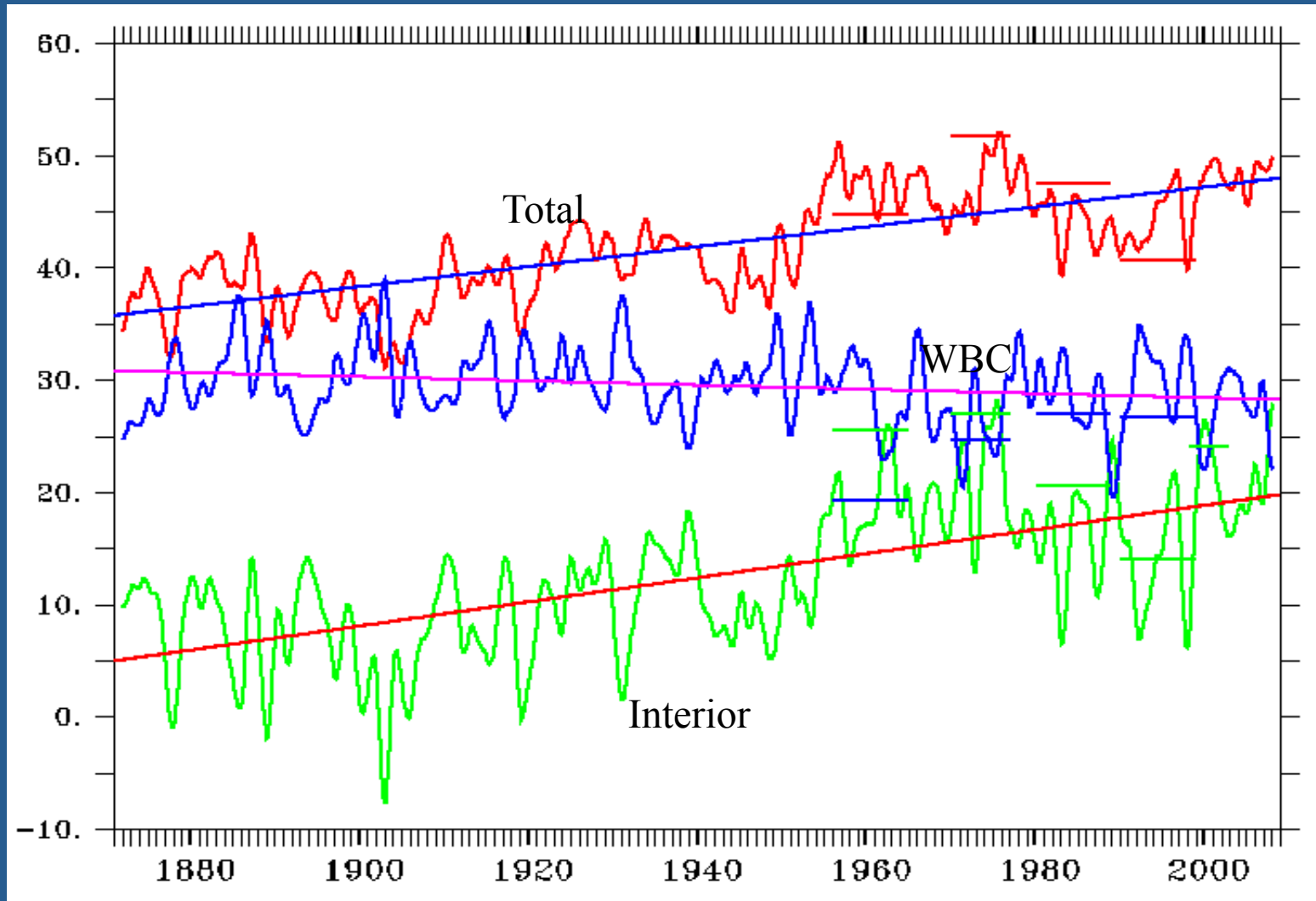
**Interior:**  
4.46Sv/century  
**WBC:**  
1.44Sv/century  
**Total:**  
5.9Sv/century

9°N



**Interior:**  
6.28Sv/century  
**WBC:**  
-3.31Sv/century  
**Total:**  
2.97Sv/century

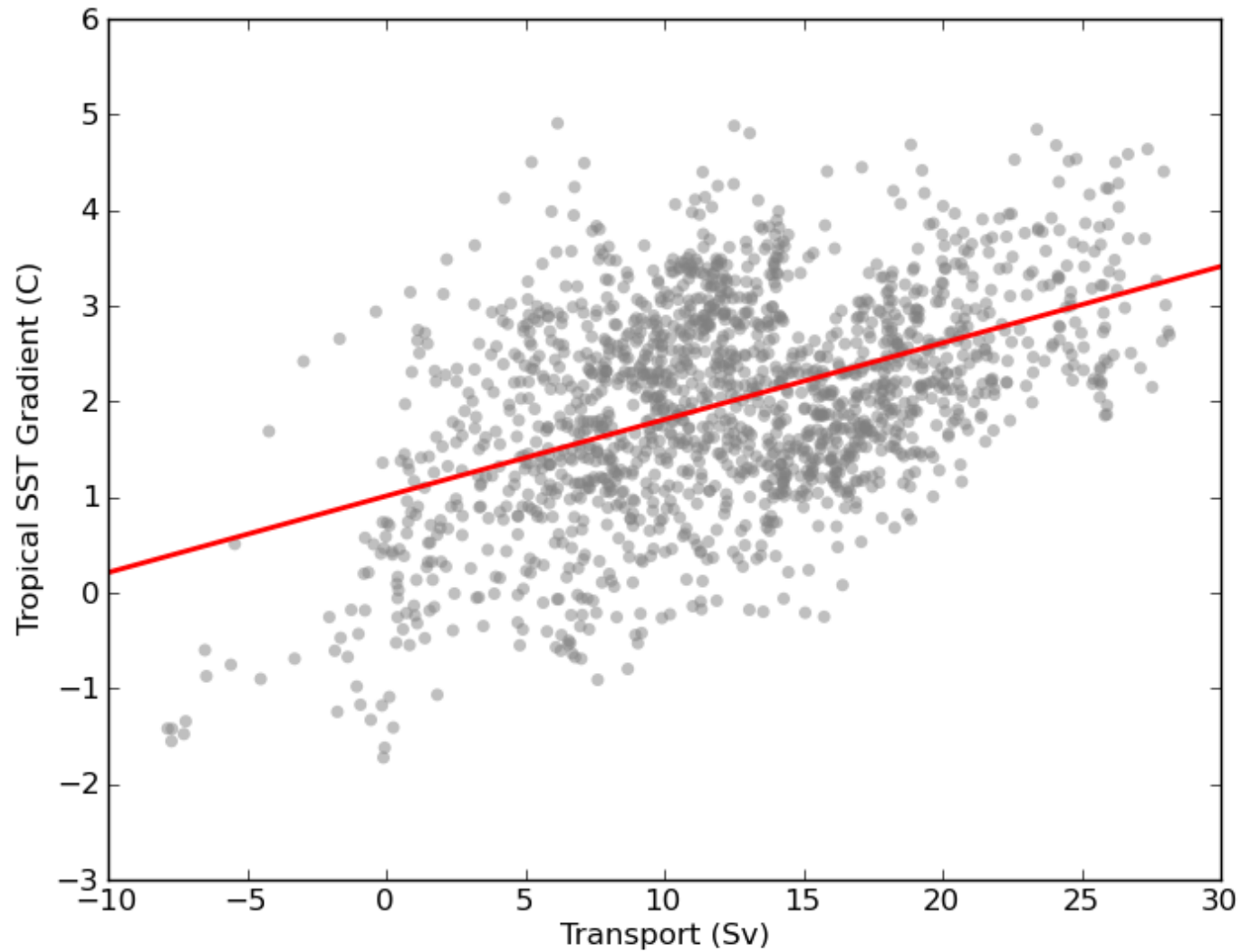
# Convergence transport of the STC across 9°S/9°N



**Interior:10.75Sv/century, WBC:-1.87Sv/century, Total:8.87Sv/century**

**Bars indicate observations in McPhaden and Zhang (2002, 2004)**

# Transport of the STC vs Tropical SST Gradient





## Conclusions

- ❖ **Significant cooling trends over central tropical Pacific.**
- ❖ **Wind stress over tropical Pacific is strengthening, which will affect tropical ocean circulation.**
- ❖ **Strengthening of the STC, due to change of wind stress, is consistent with cooling of SST over central tropical Pacific Ocean through enhanced equatorial upwelling.**

Thank You!