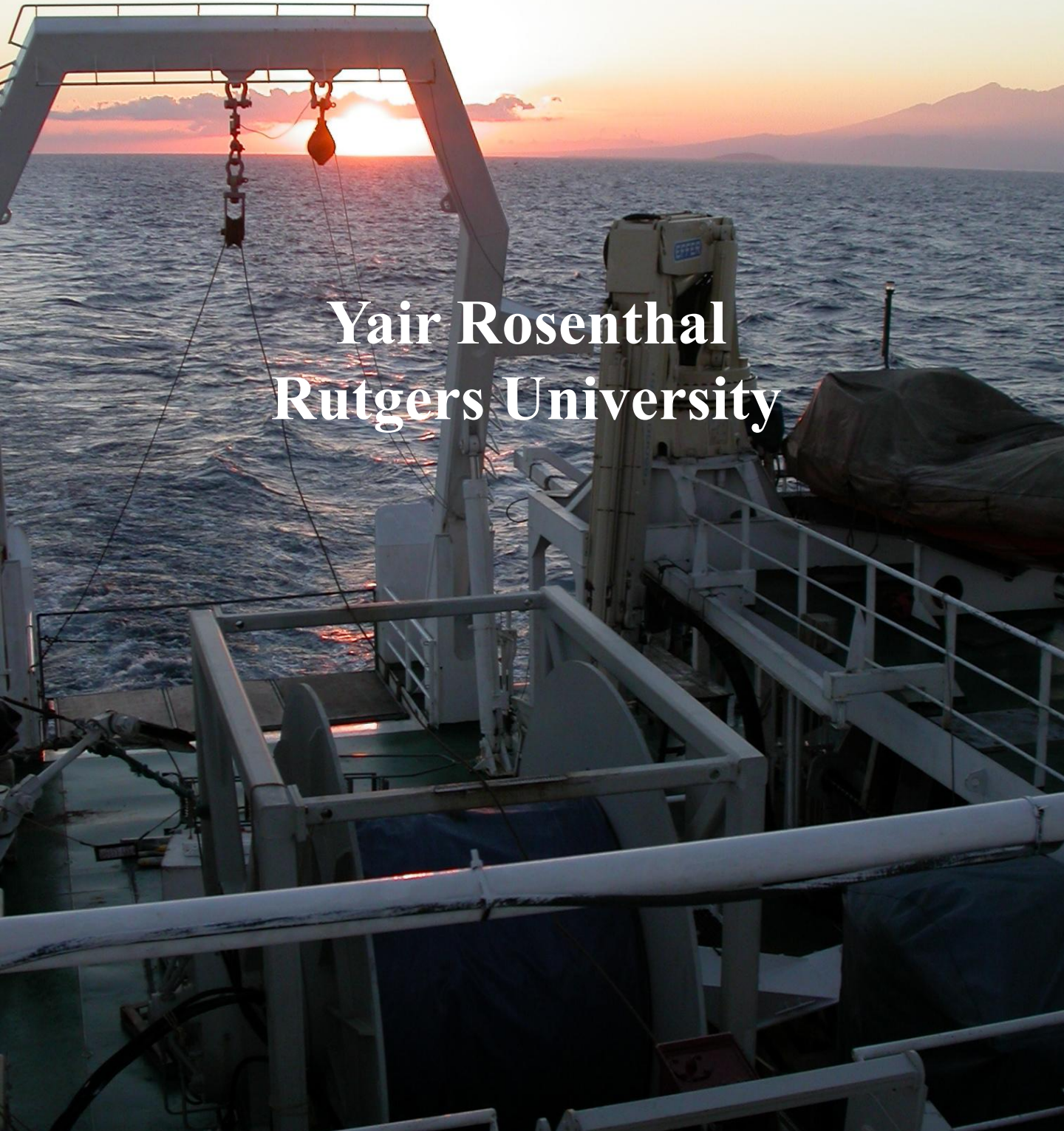
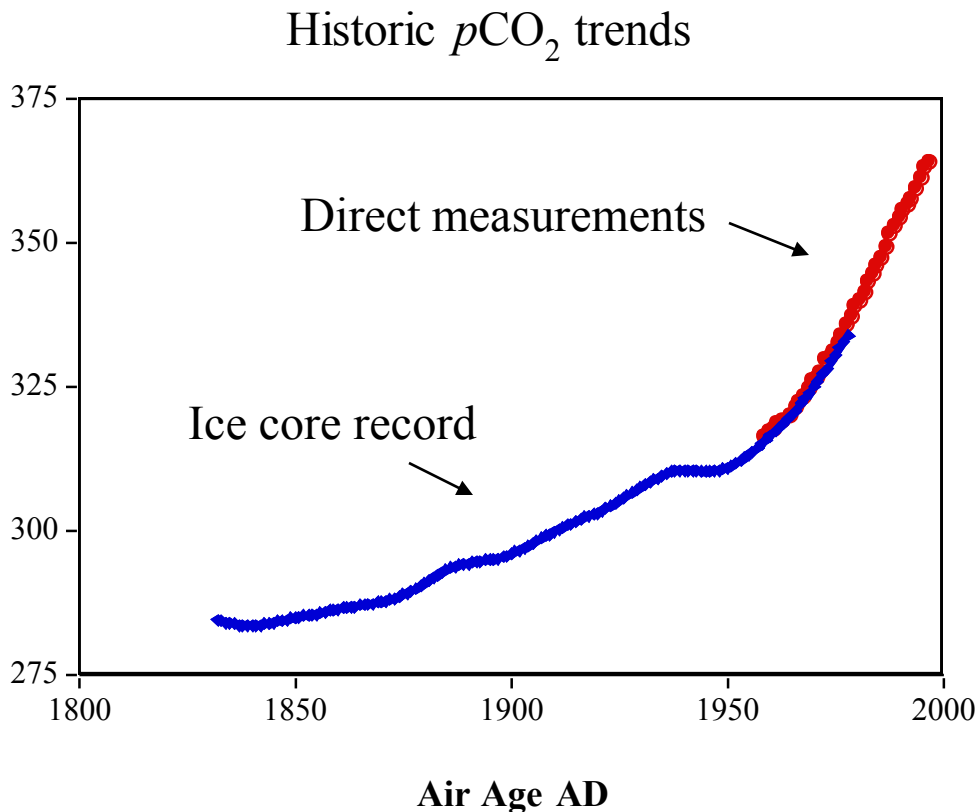


# **A tropical Pacific role in global climate change: lessons from the past.**

**Yair Rosenthal  
Rutgers University**



# Historic record of atmospheric $p\text{CO}_2$



- ◆ Law Dome (Antarctica Ice Core); Etheridge et al.
- Keeling's Mauna Loa, Hawaii

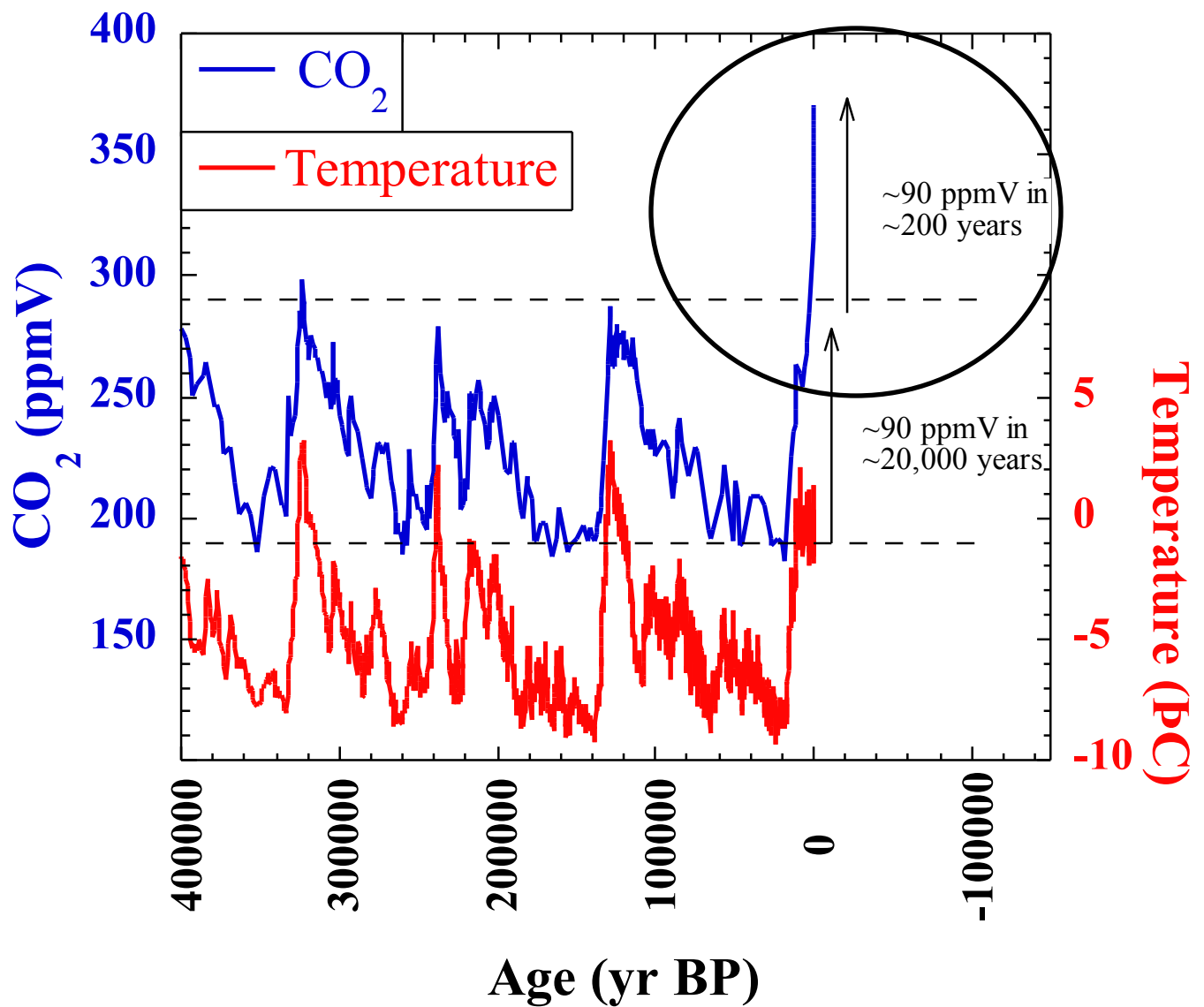
The recent increase in atmospheric  $\text{CO}_2$  concentration due to human activities raise concern about the possibility of global warming

**Why should we care  
about  
Paleoceanography  
and  
Paleoclimatology?**



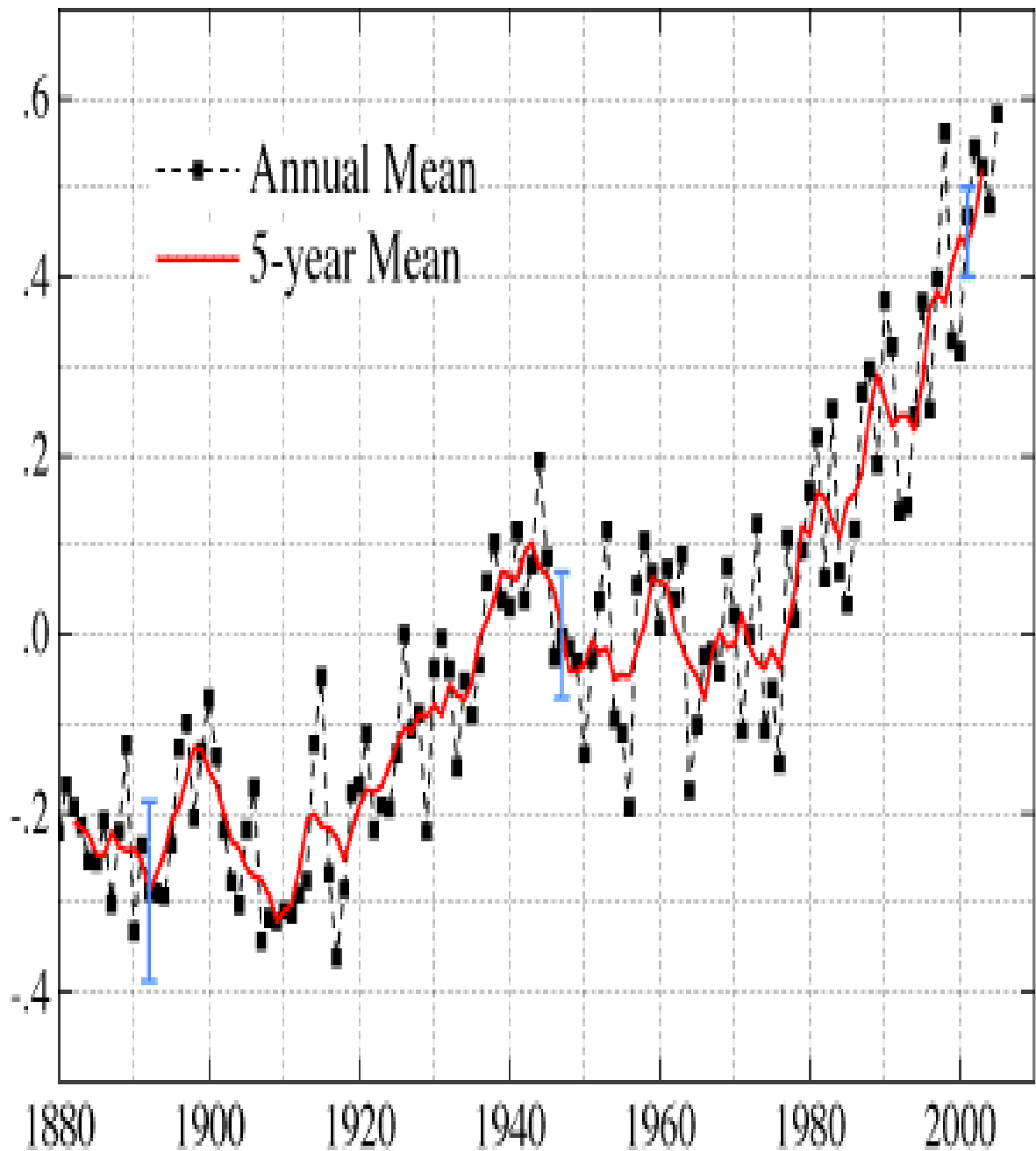
**To know better  
about the day  
after  
tomorrow!**





CO<sub>2</sub> and climate:  
Tales from an Ice Core

(a) Global-Mean Surface Temperature Anomaly ( $^{\circ}\text{C}$ )

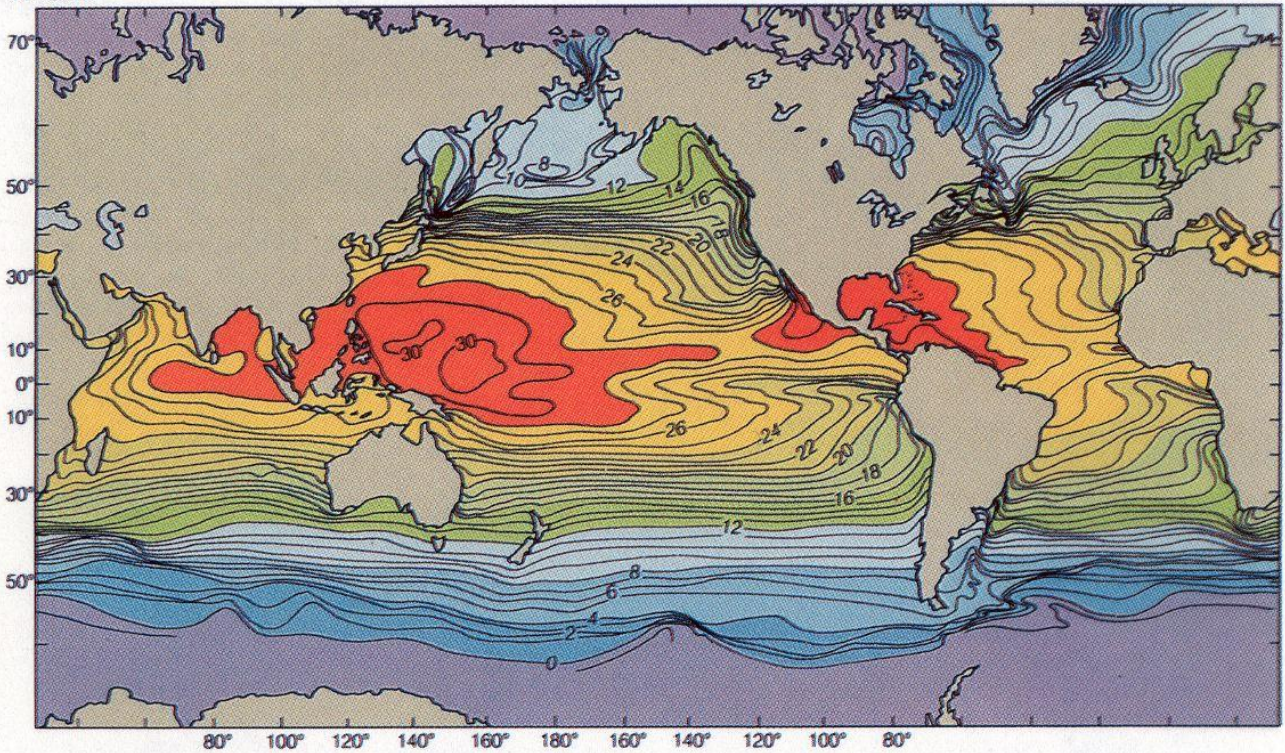




# The CLIMAP Paradigm

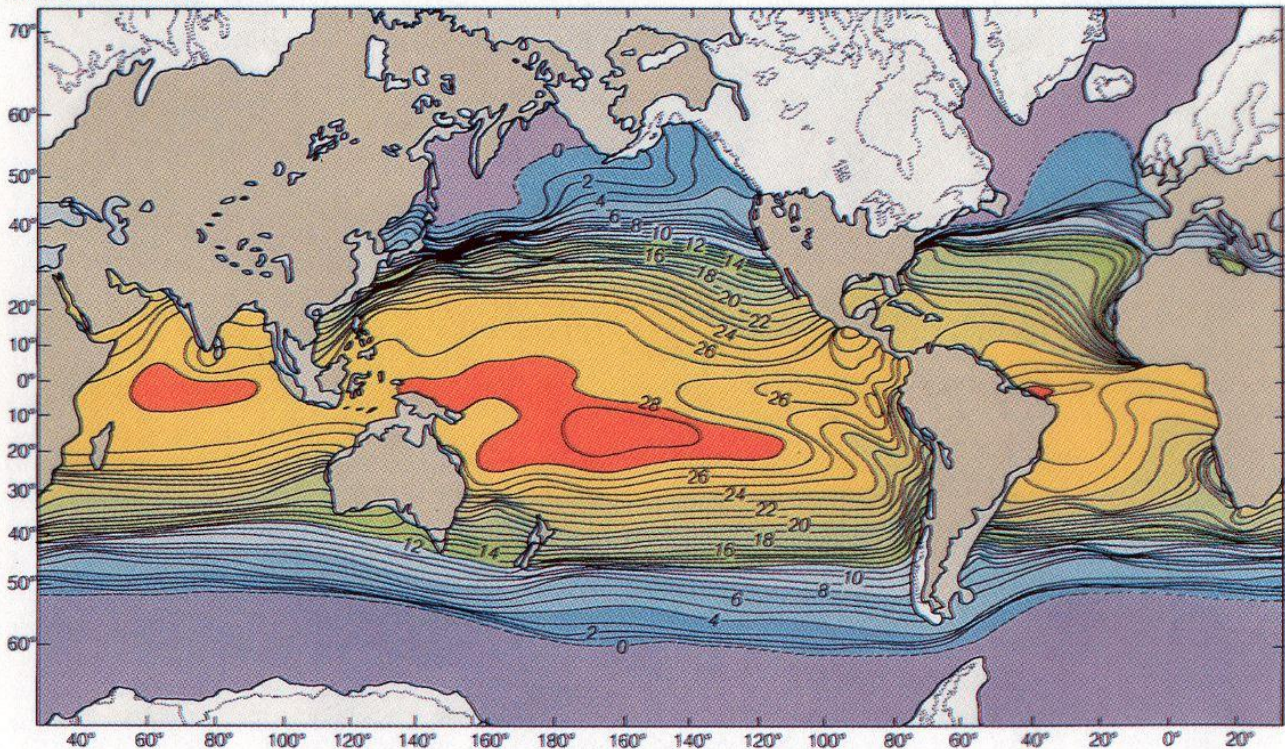
Modern

A. TODAY



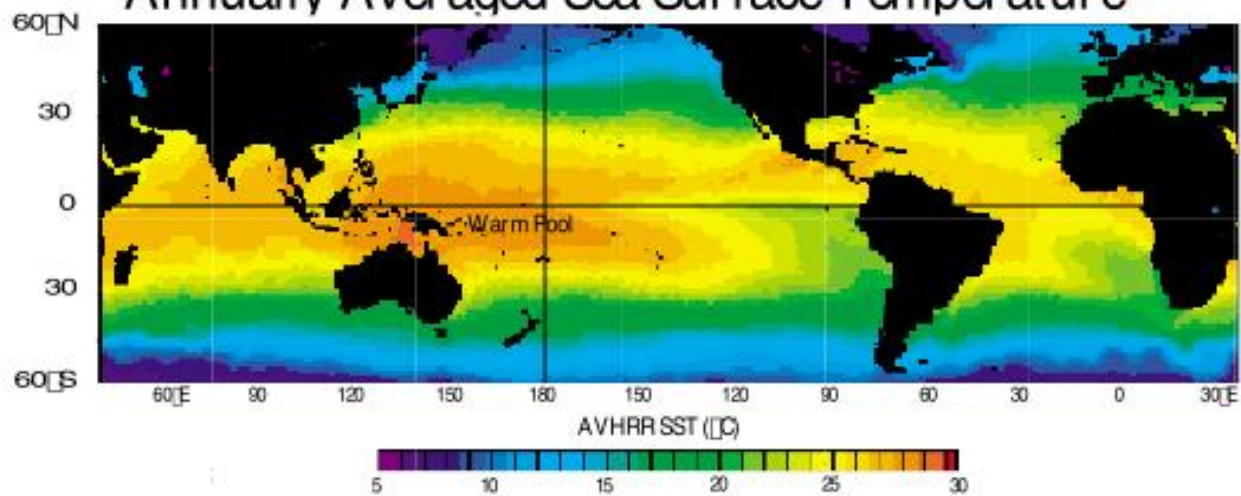
Last Glacial Maximum

B. LAST GLACIATION

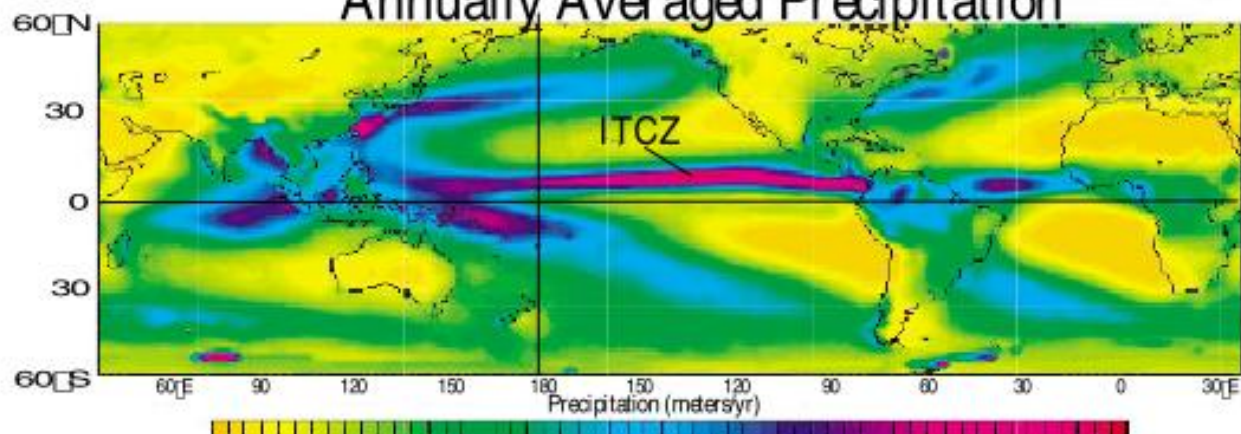




# Annually Averaged Sea Surface Temperature

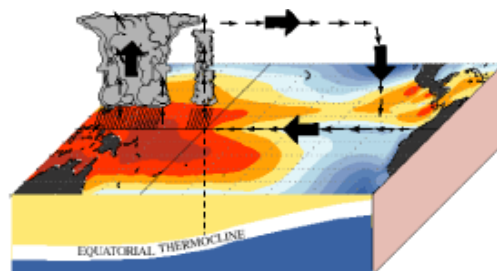


# Annually Averaged Precipitation

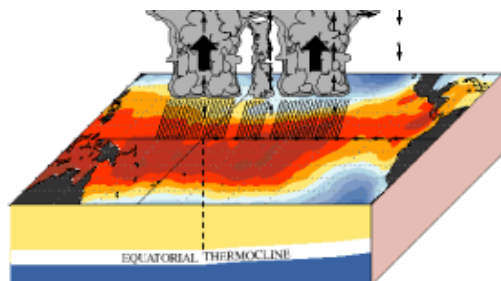


## Atmosphere and ocean conditions during ENSO

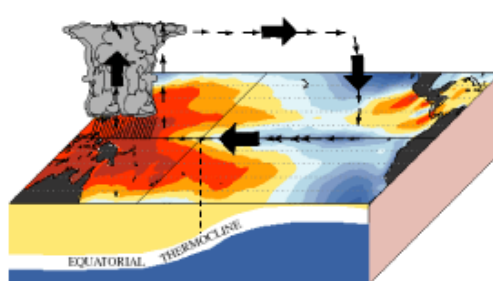
### Normal



### El Niño



### La Niña



# Tropical forcing, regional impacts

## 1. Tropical forcing, regional impacts

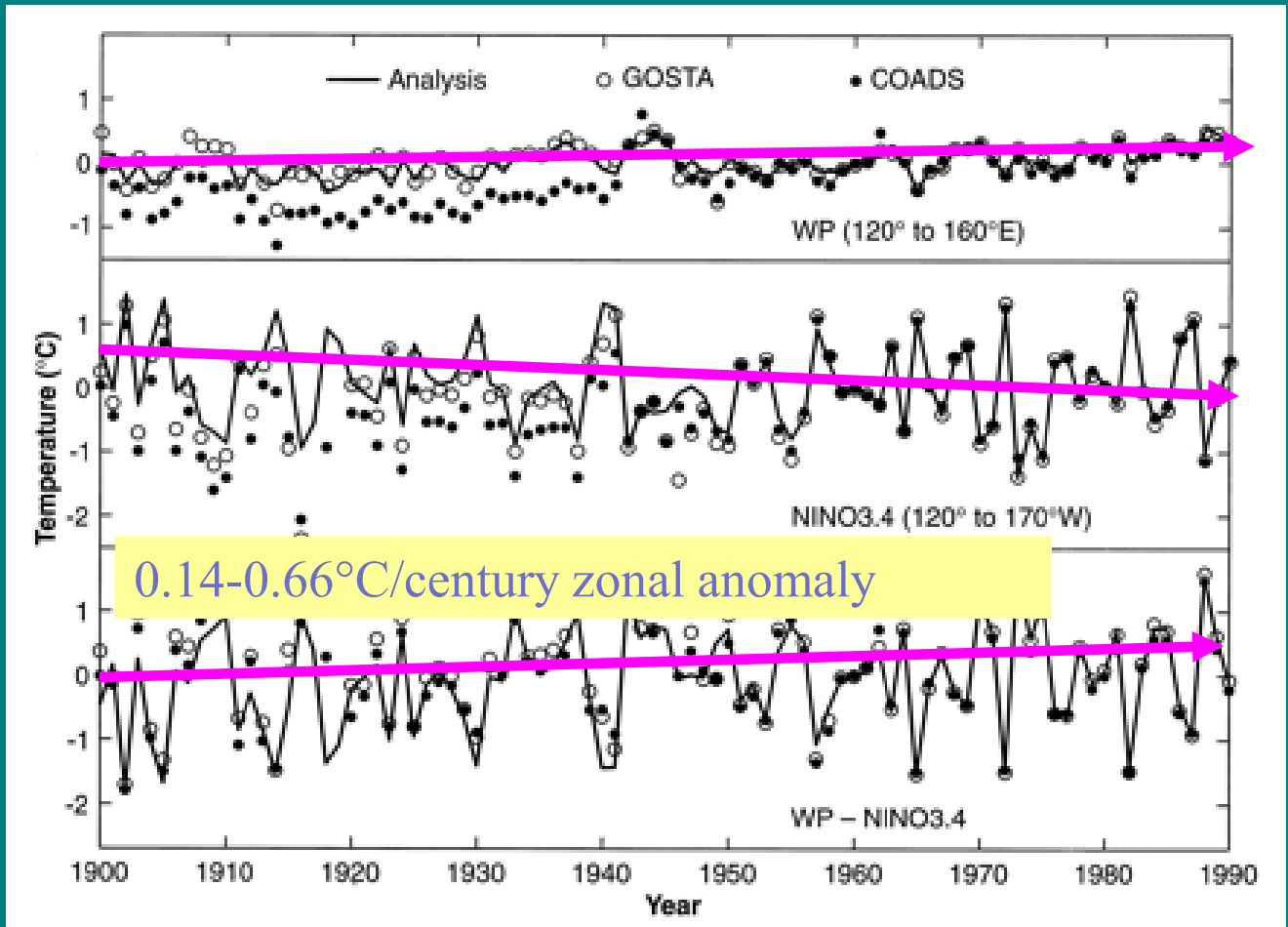
## 2. Tropical forcing, regional impacts

## 3. Tropical forcing, regional impacts



# Twentieth-Century Sea Surface Temperature Trends

Mark A. Cane et al.,  
Science 275, 957-960. 1997



So.....

Is El Niño Changing?

Alexey V. Fedorov and S. George Philander  
Science 288, 1997-2002, 2000

# Geochemical Proxies

## Foraminifera



Mg/Ca

$\delta^{18}\text{O}$

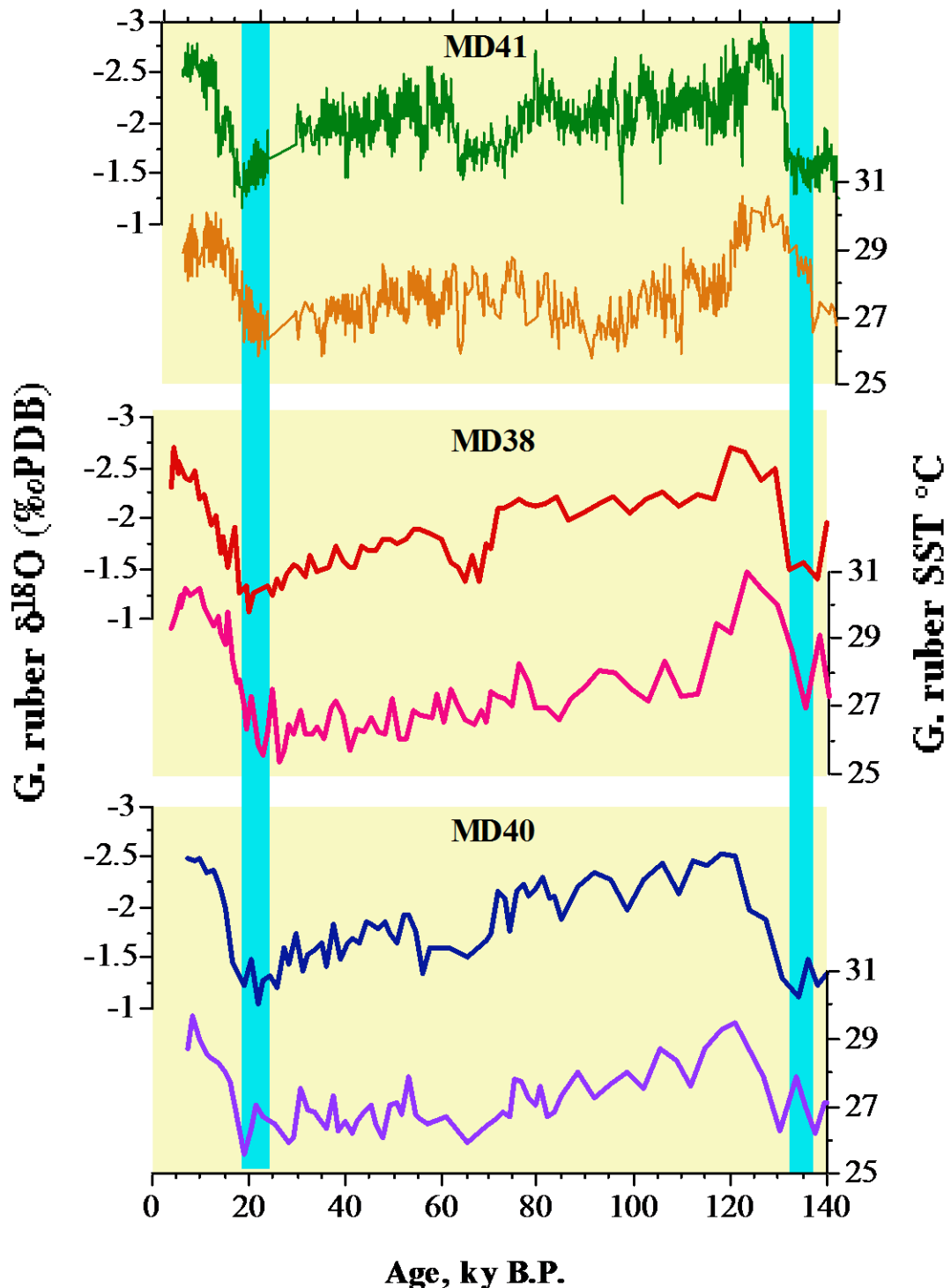
$\delta^{18}\text{O}_{\text{sw}}$

Temperature  
&  $\delta^{18}\text{O}_{\text{sw}}$

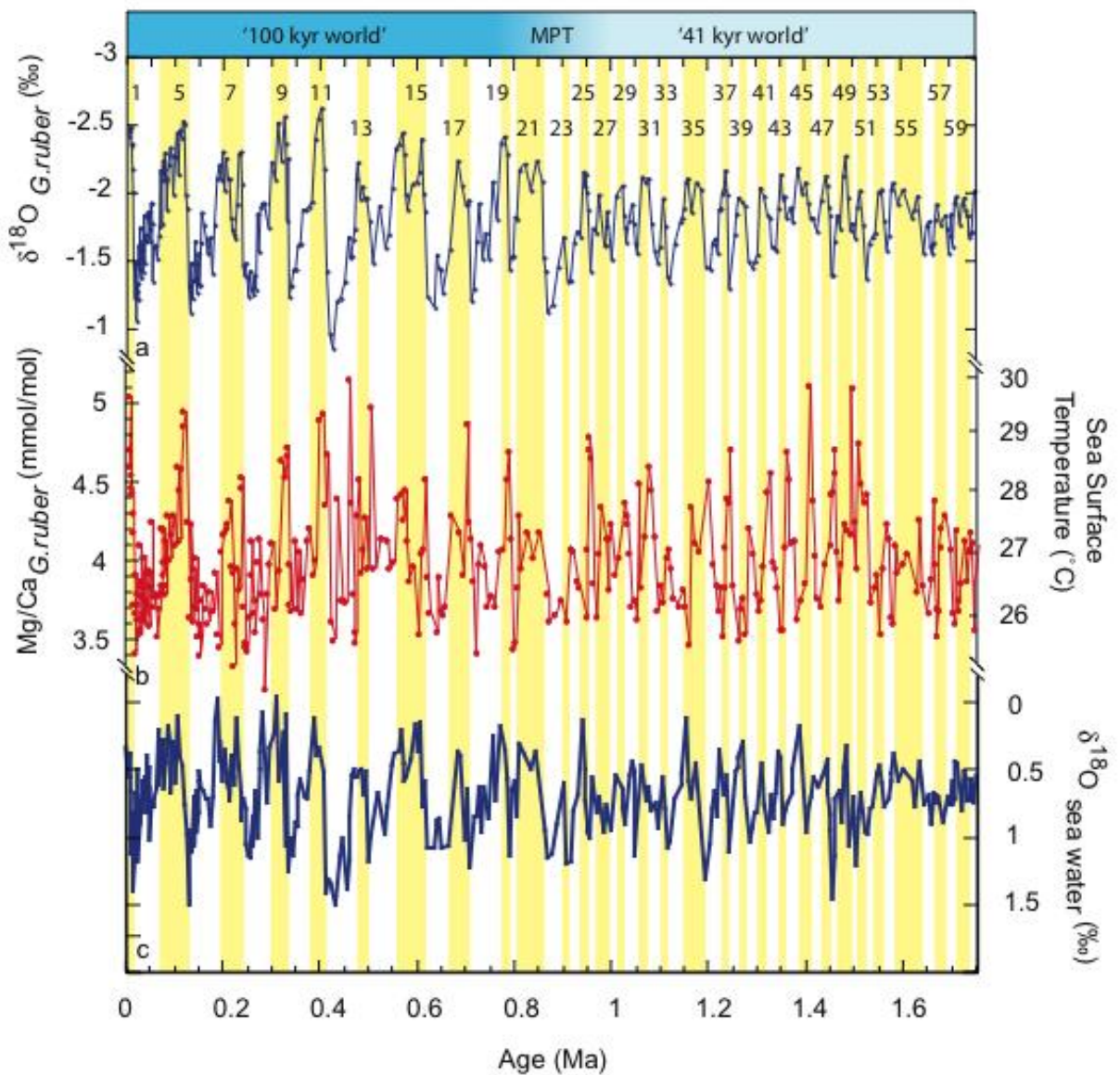
Salinity



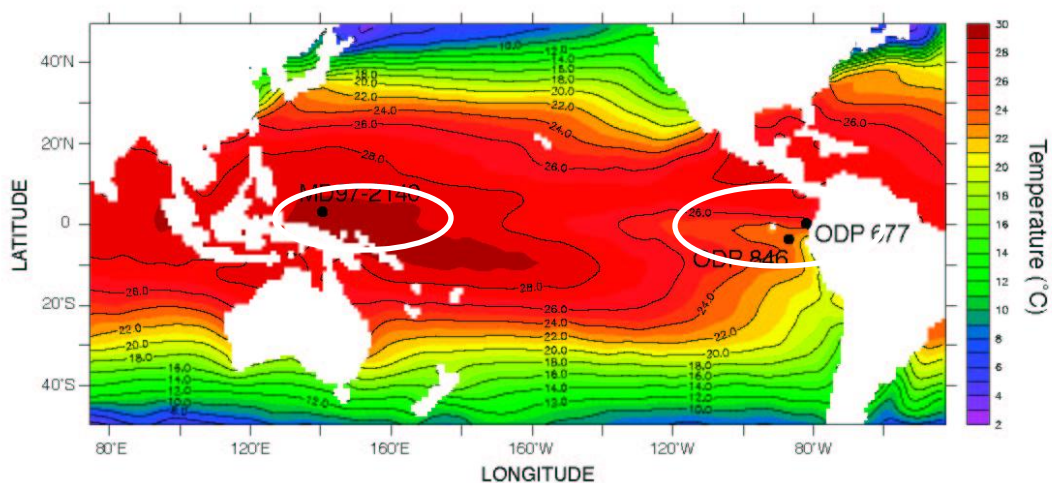
# Equatorial Pacific SST during glacial maxima were $\sim 2\text{-}3^{\circ}\text{C}$ colder than at present



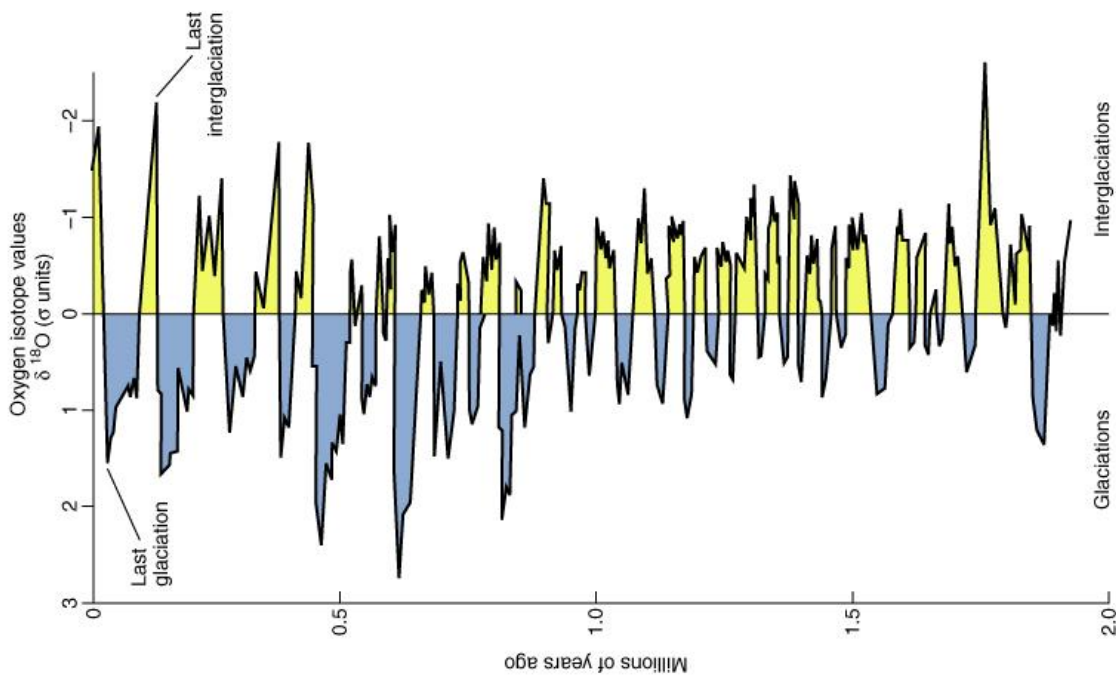
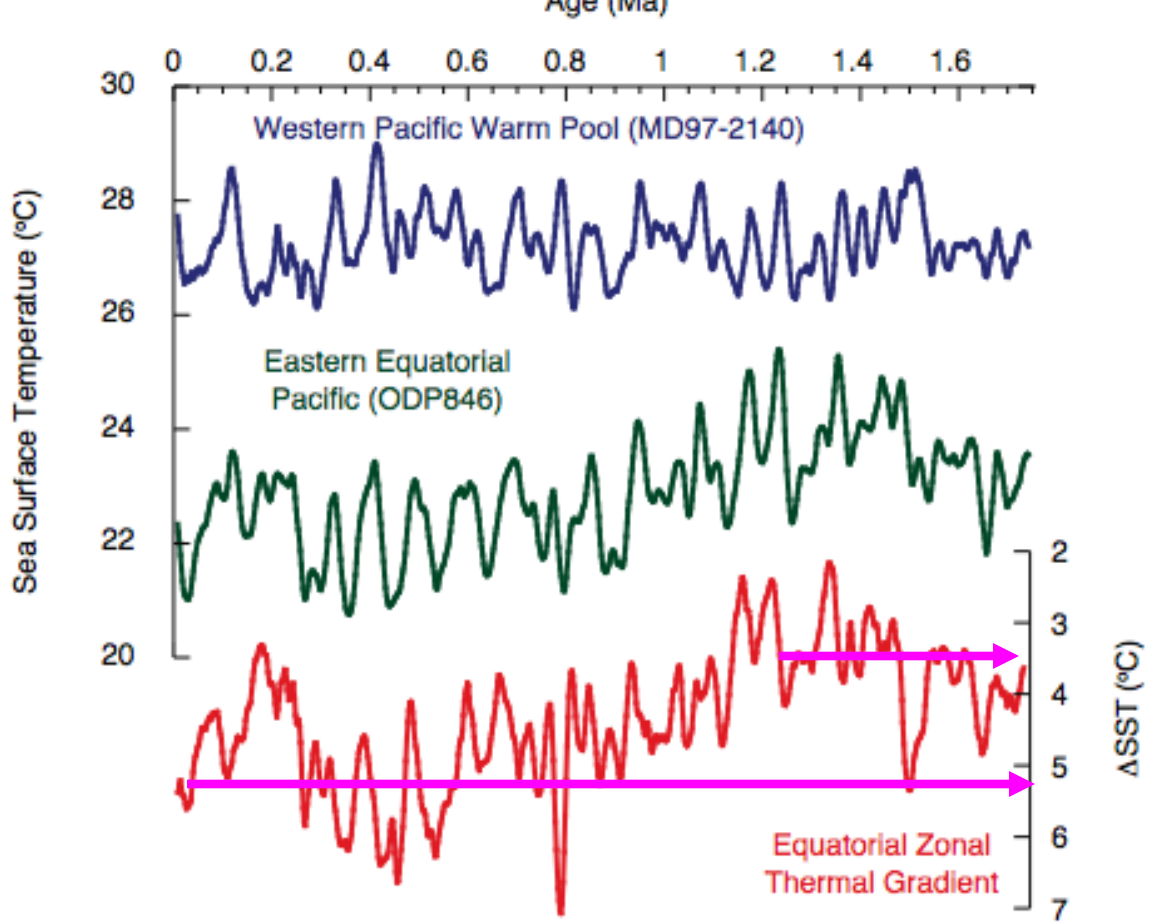
Rosenthal et al., (2003); de Garidel et al., (2006)



*de Garidel, Rosenthal, et al., Stable sea surface temperatures in the western Pacific warm pool over the past 1.75 million years. Nature (2005)*





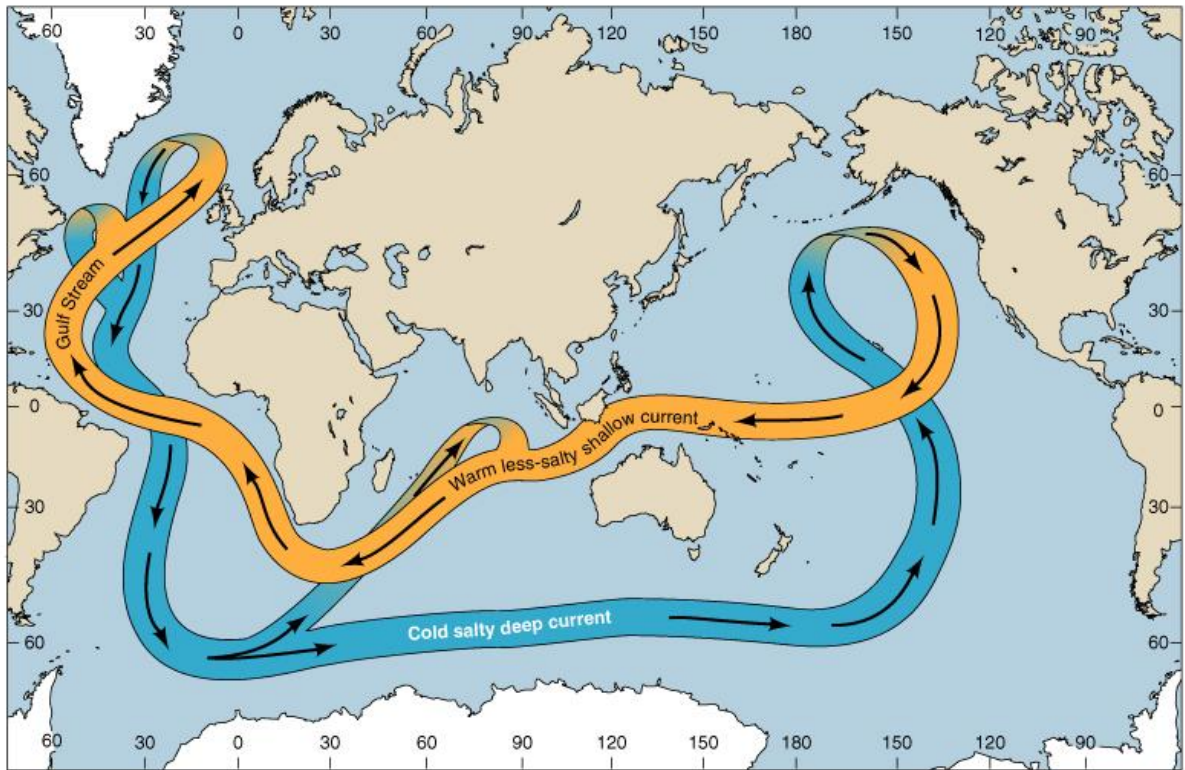


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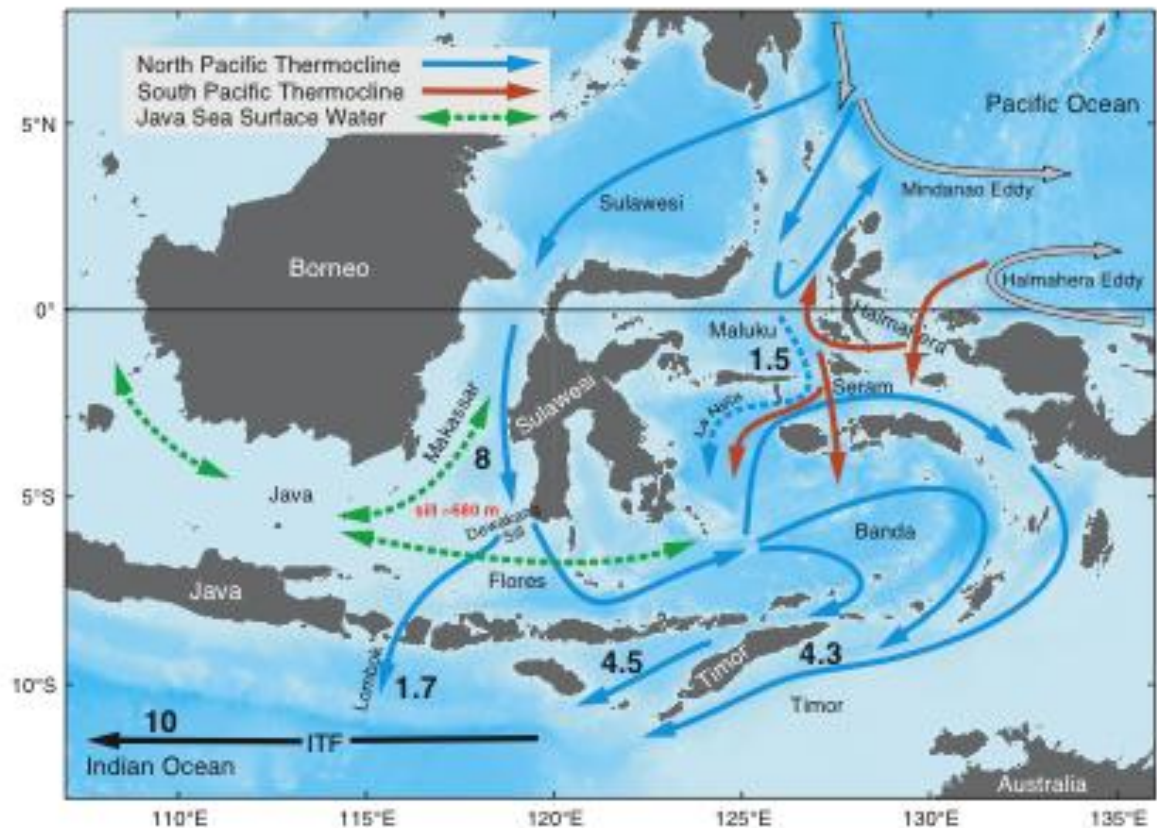
Present

2 Ma

# The global conveyor belt

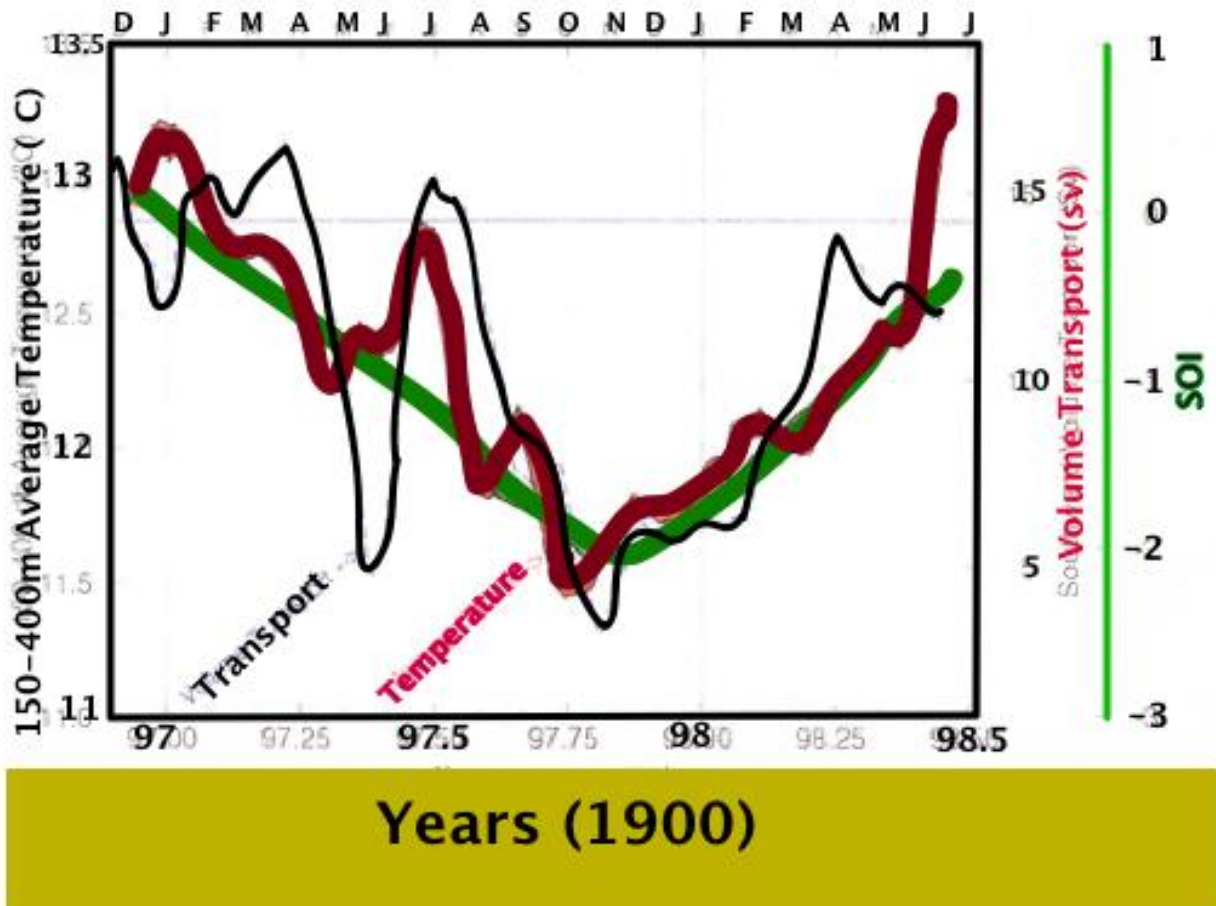


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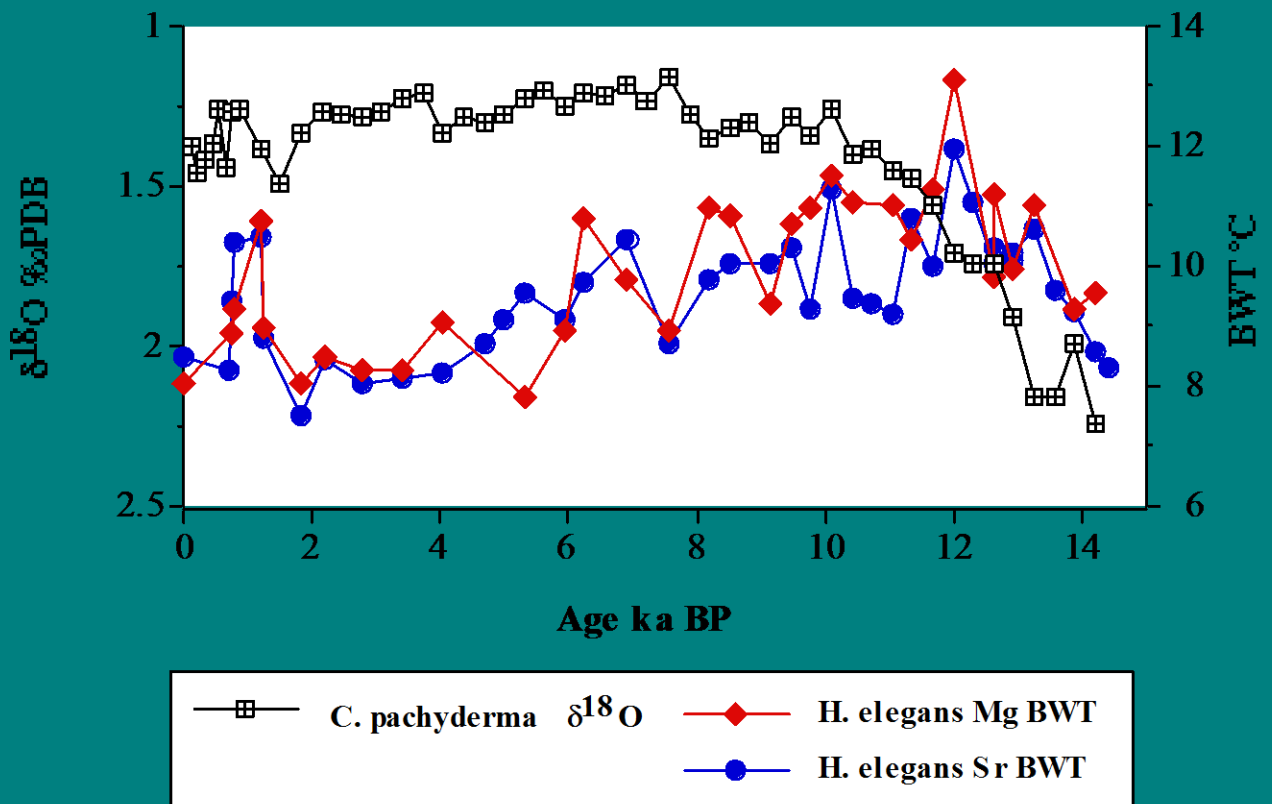
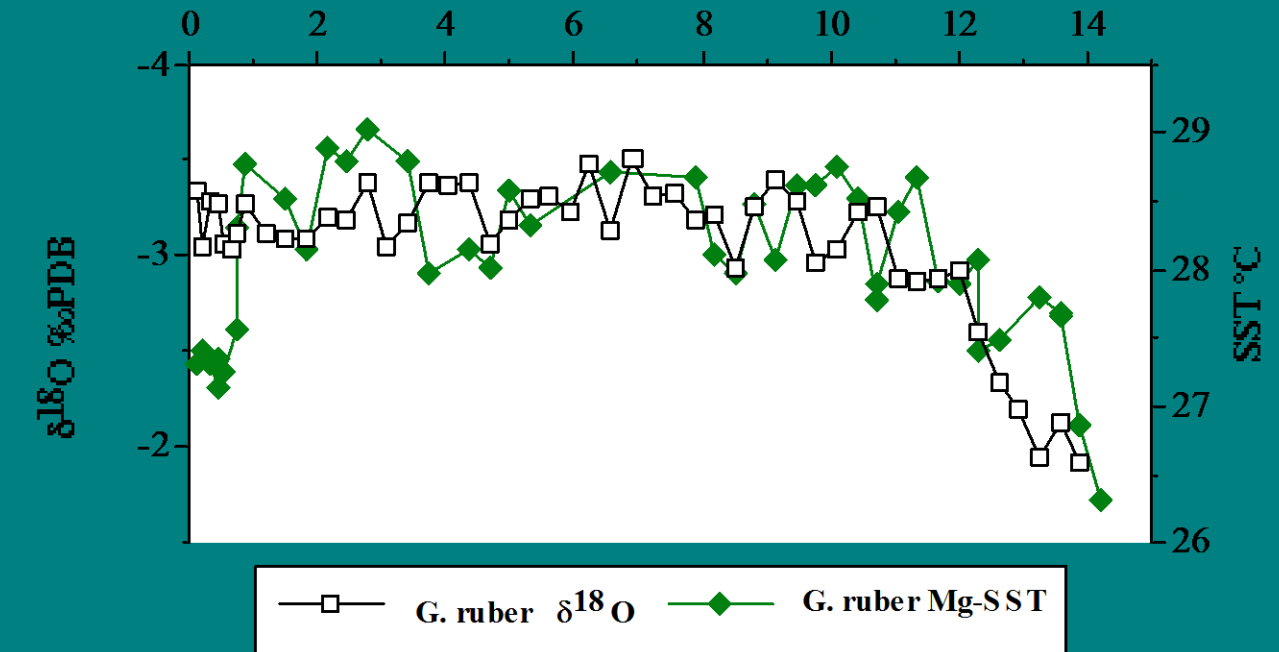
# Relationships among SOI, thermocline average temperature and volume transport of the ITF through the Makassar Strait



Cooler / shallower thermocline = lower ITF transport

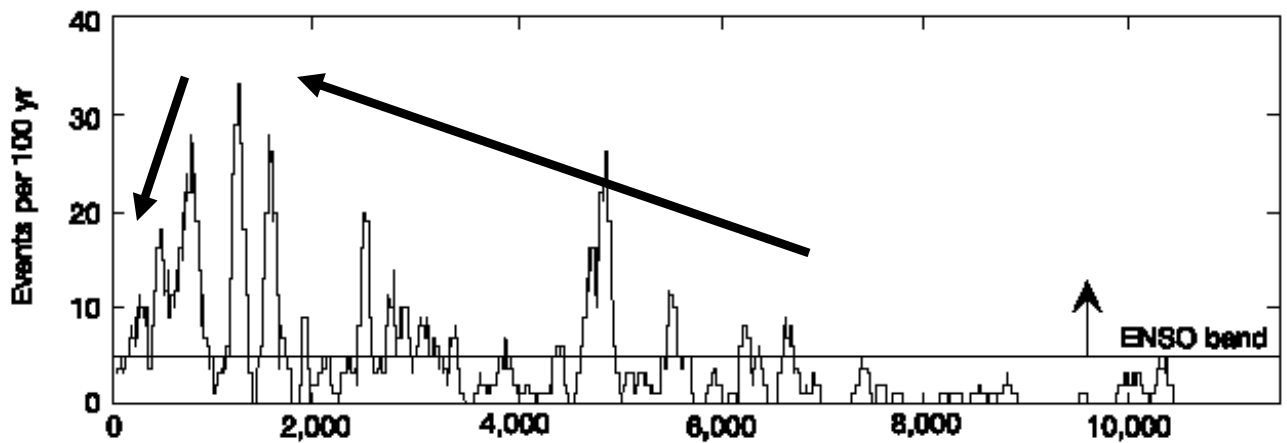
After Ffield et al., 2000

# West Sulawesi core 70GGC 482m

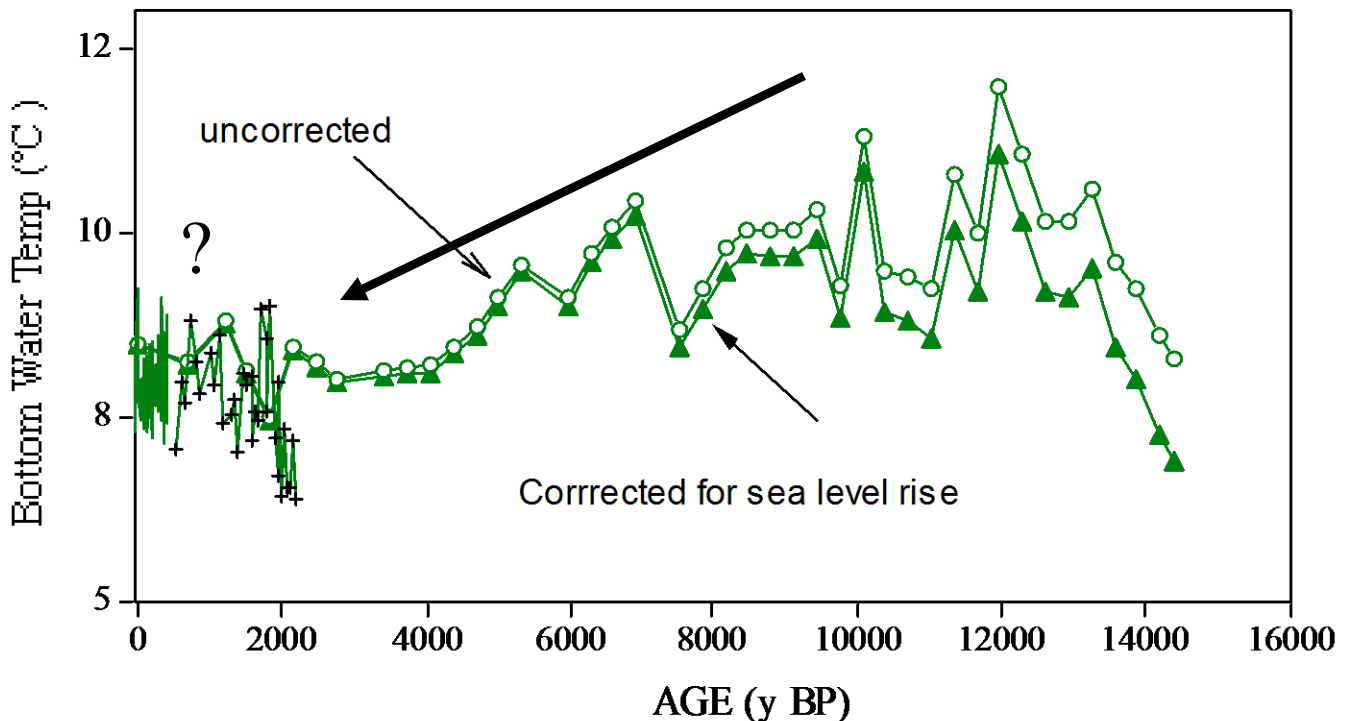




# Evidence that # El Niños increased in frequency during the late Holocene e.g. Moy et al. (2002)



Consistent with cooling/shoaling of the thermocline implying lower ITF transport



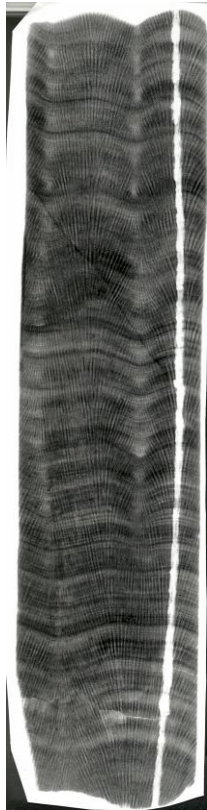


## Annual archives



Rutgers paleo-  
research:

Rob Sherrell  
Jim Wright  
Liz Sikes  
Carl Swisher





**While more research is needed to understand natural vs. anthropogenic effects, the magnitude of recent trends require us to make NOW the “SMART” Choice**

