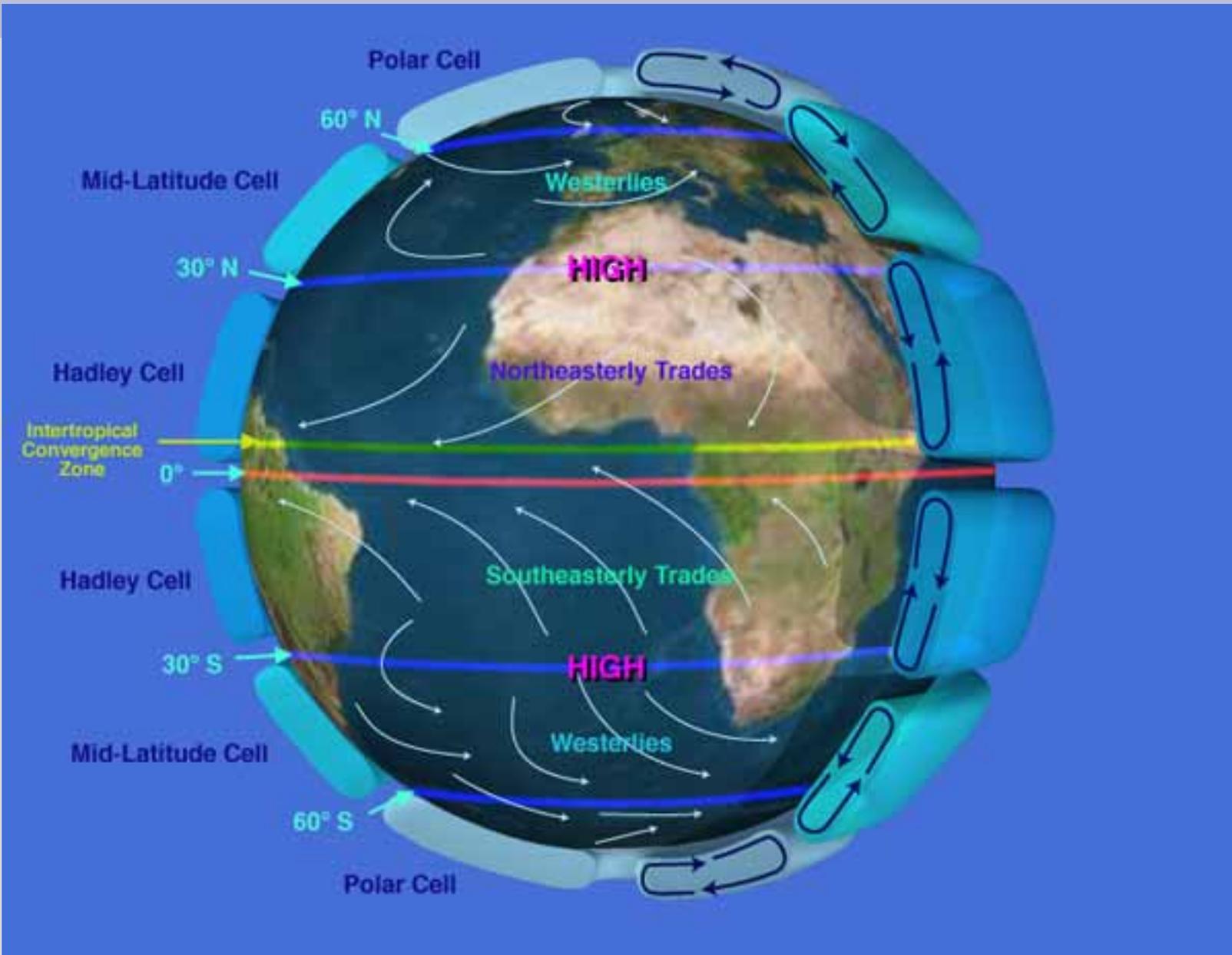


# Climate and Human History

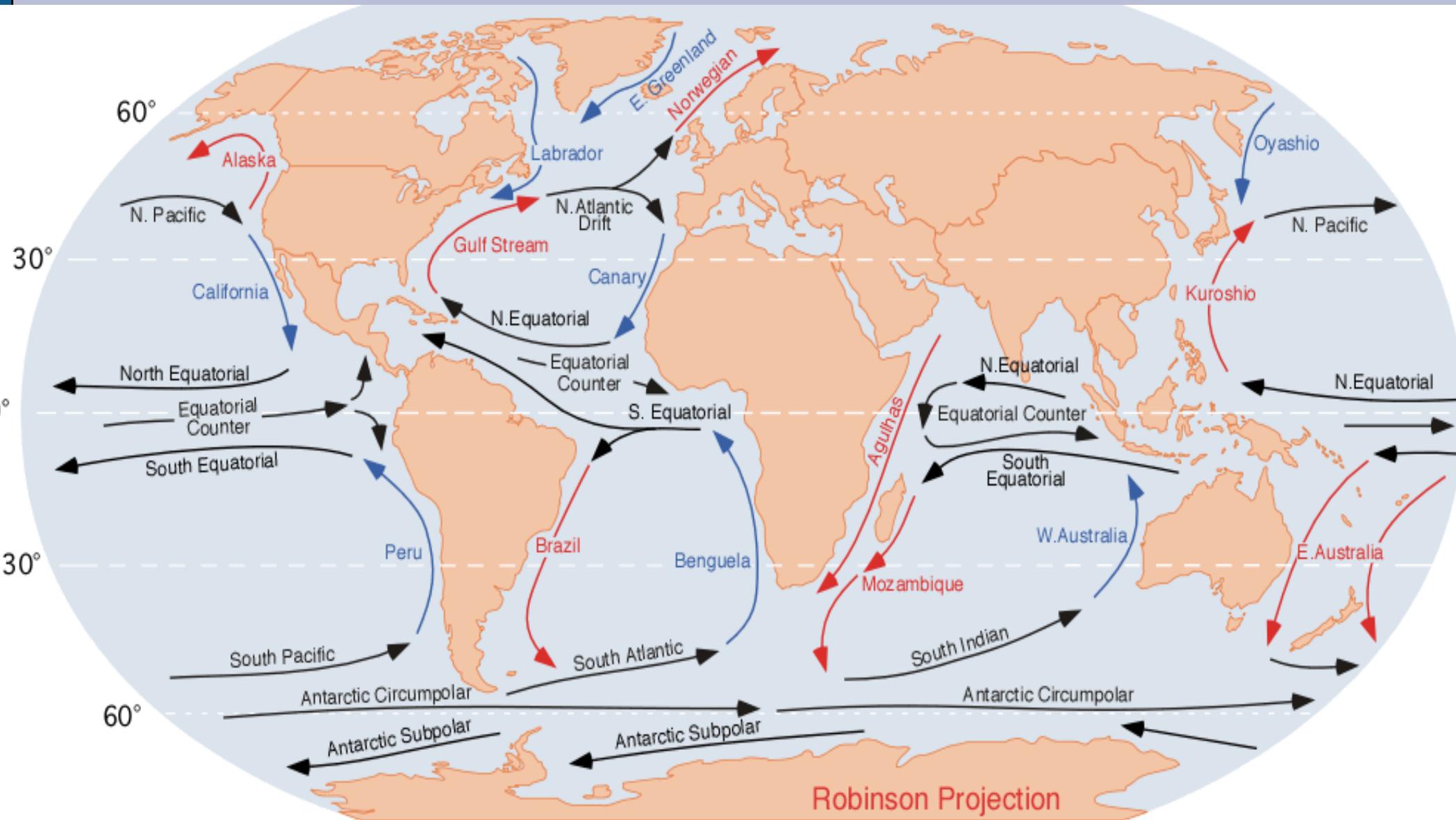
## Stephan Matthiesen

1. Climate and climate history
2. The Ice Age
3. Farming and City States
4. The Roman Empire
5. Tang and Maya in the 10th century
6. Mediaeval Optimum and Little Ice Age
7. **El Niño through the ages**
8. Miscellaneous topics
9. Current and future changes
10. Summary and re-cap

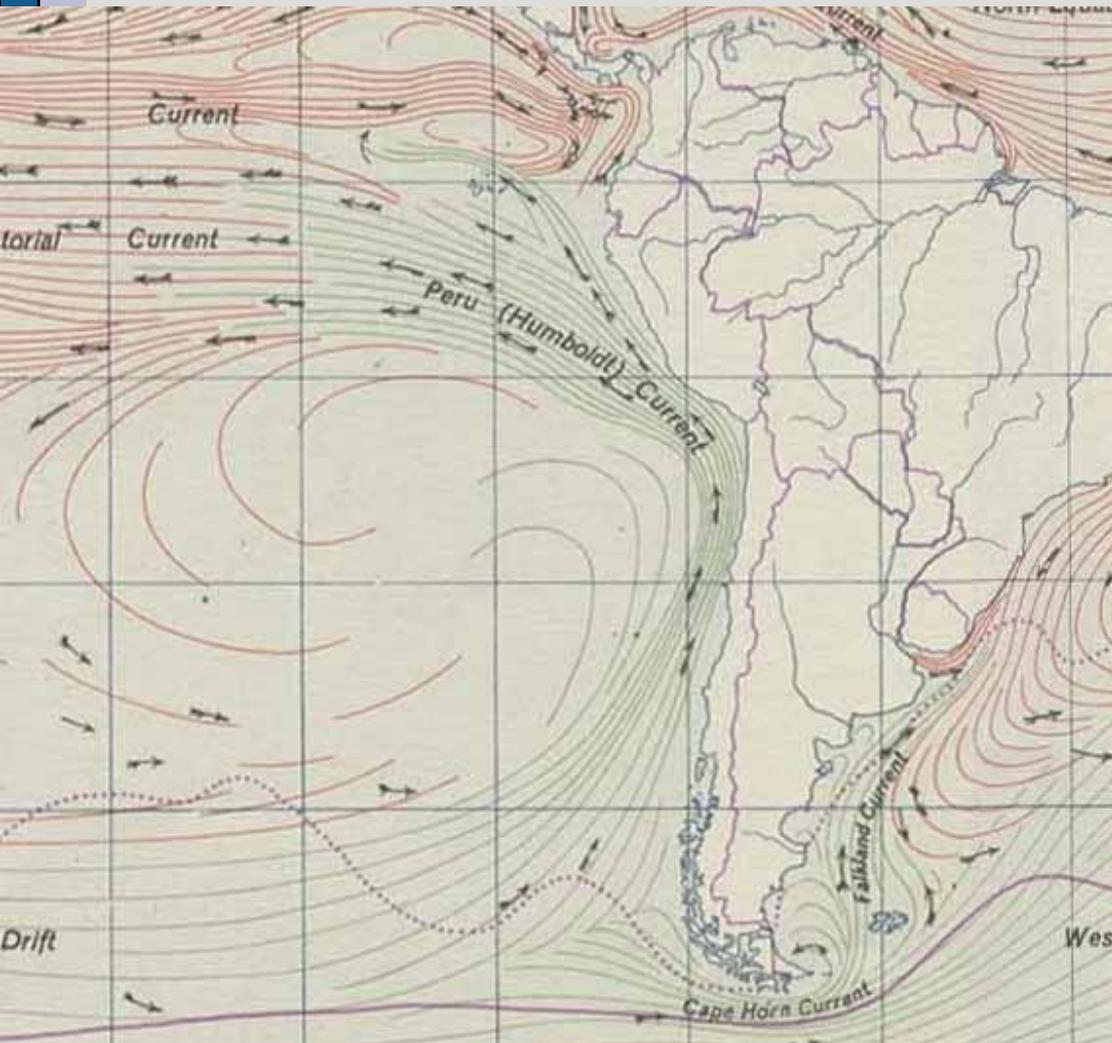
# Atmospheric Circulation



# Ocean currents



# The Peru (Humboldt) current

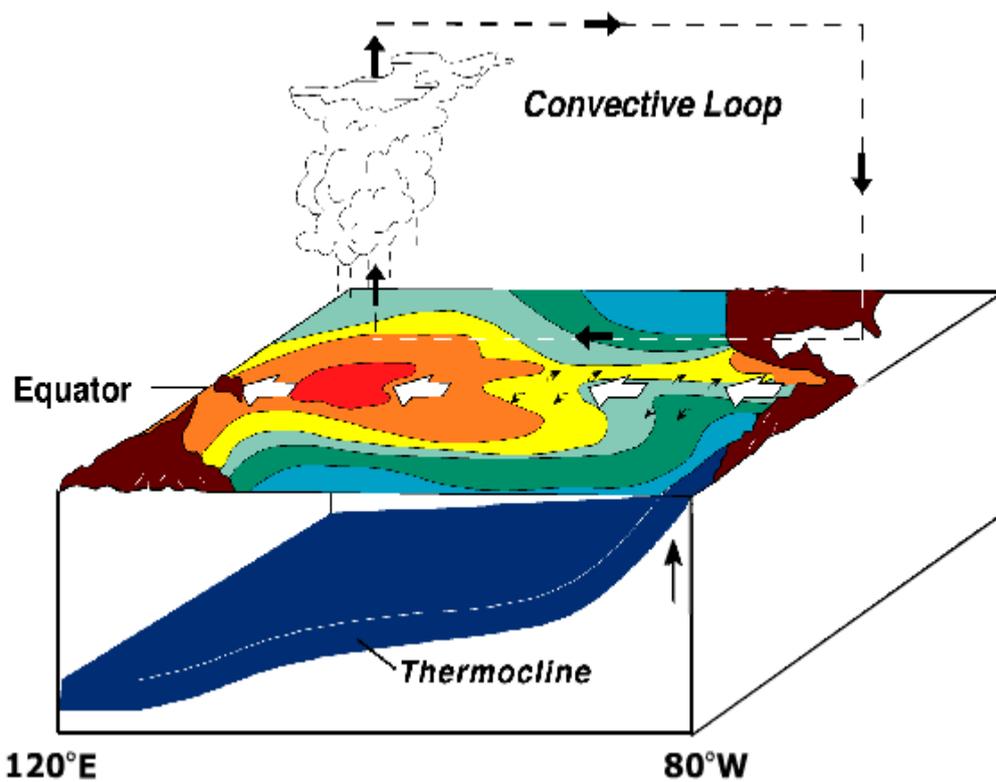


Anchovy



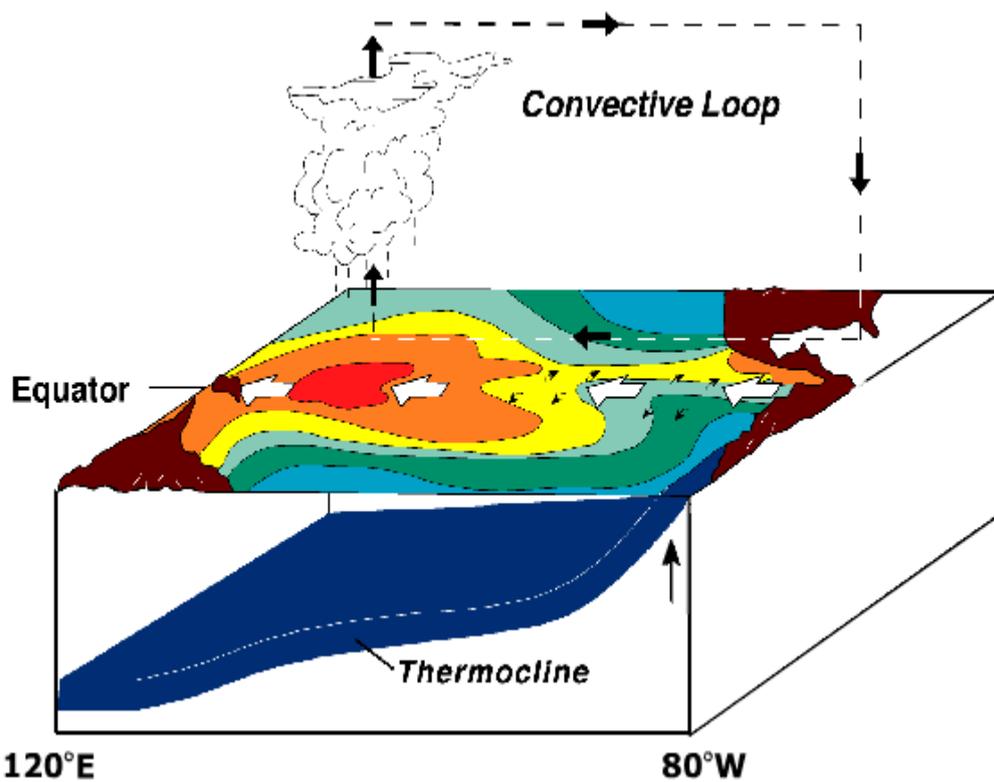
# “Normal” Pattern

“Normal”

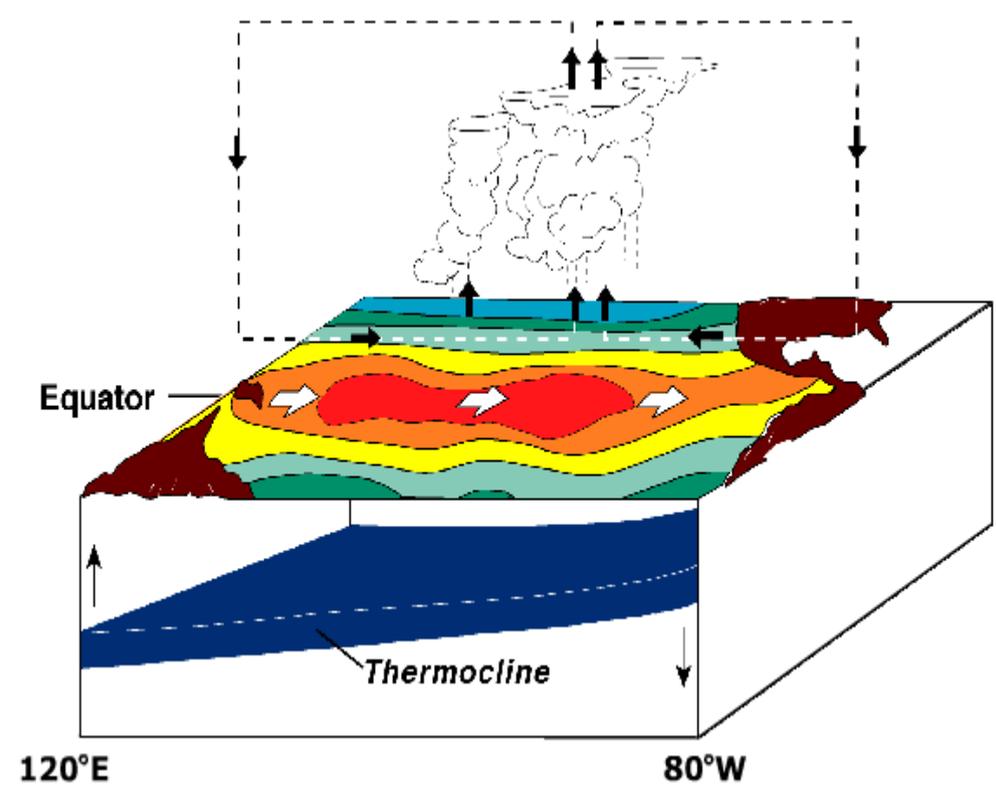


# El Niño Pattern

“Normal”



El Niño



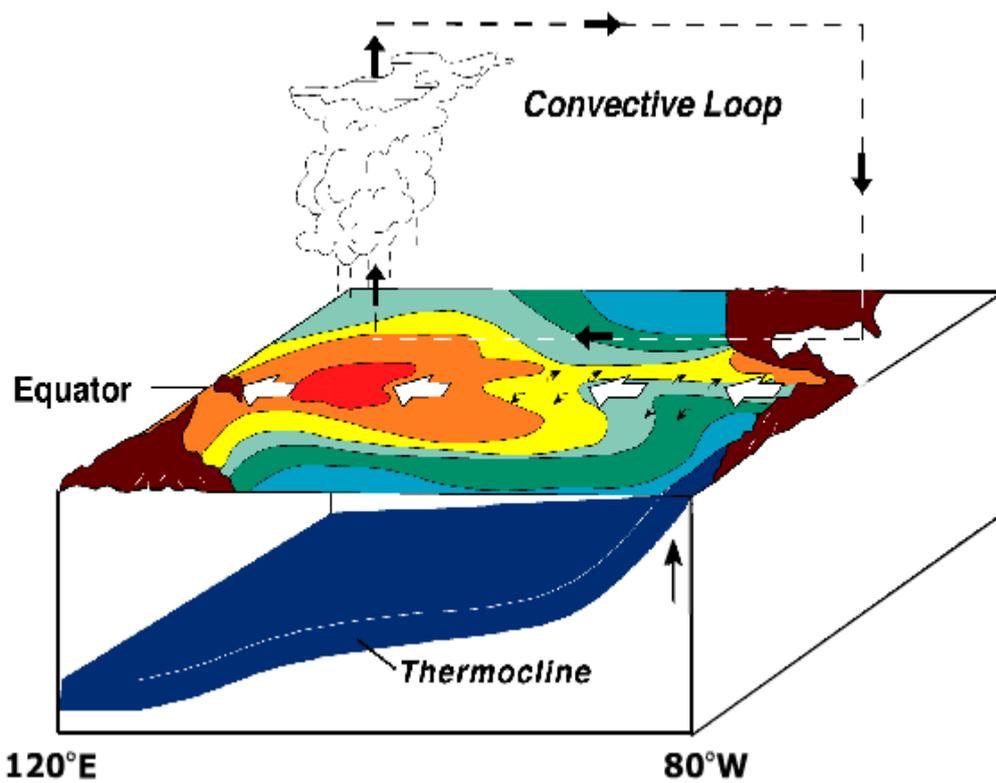
El Niño / Southern Oscillation (ENSO)

Warm ocean current

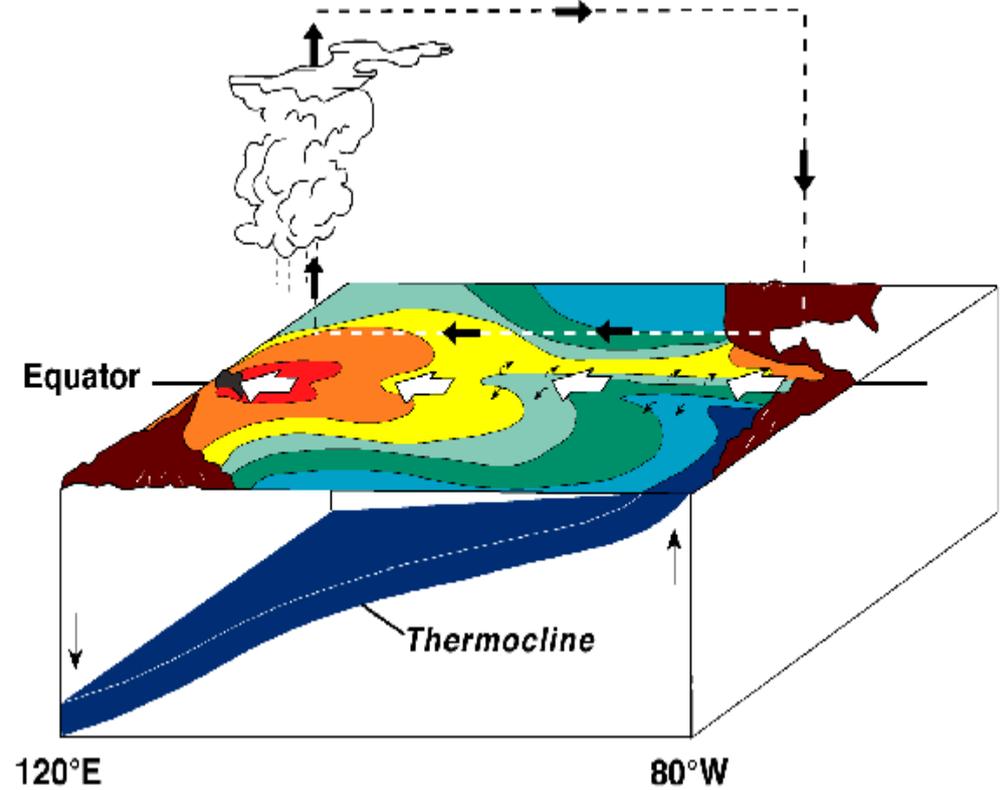
Air pressure change

# El Niño Pattern

“Normal”

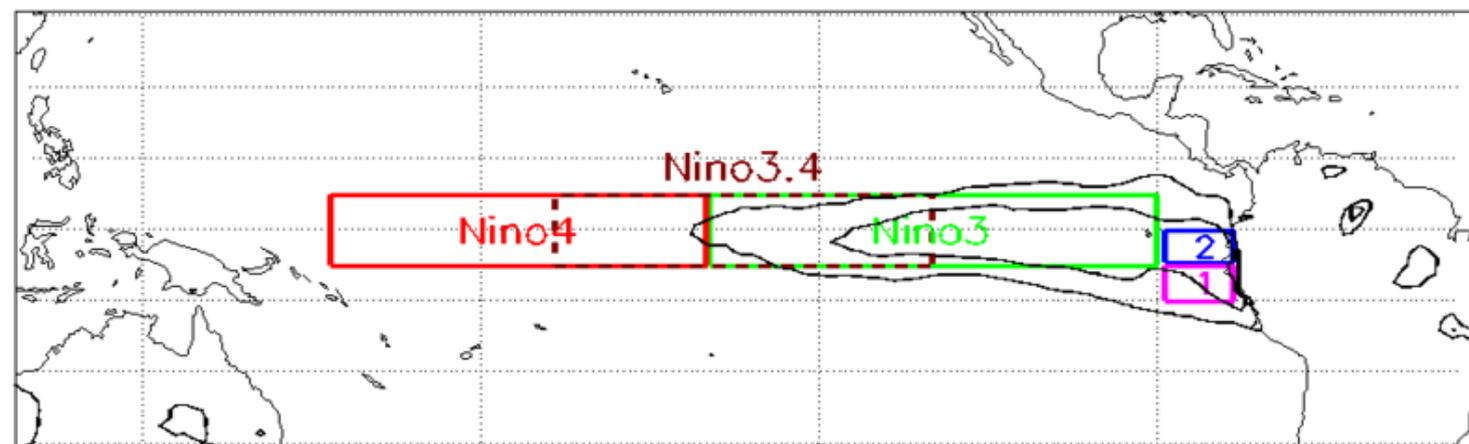
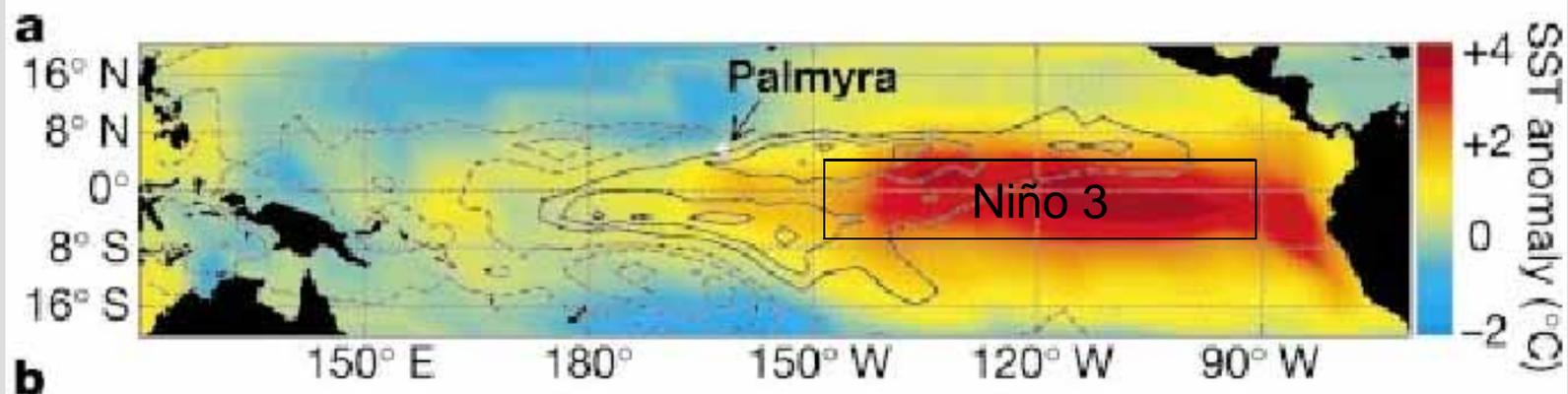


La Niña or Anti El Niño



# The Niño-3 Index

Average sea surface temperature (SST) over the eastern tropical Pacific (5°S-5°N; 150°-90°W)





# Major ENSO events

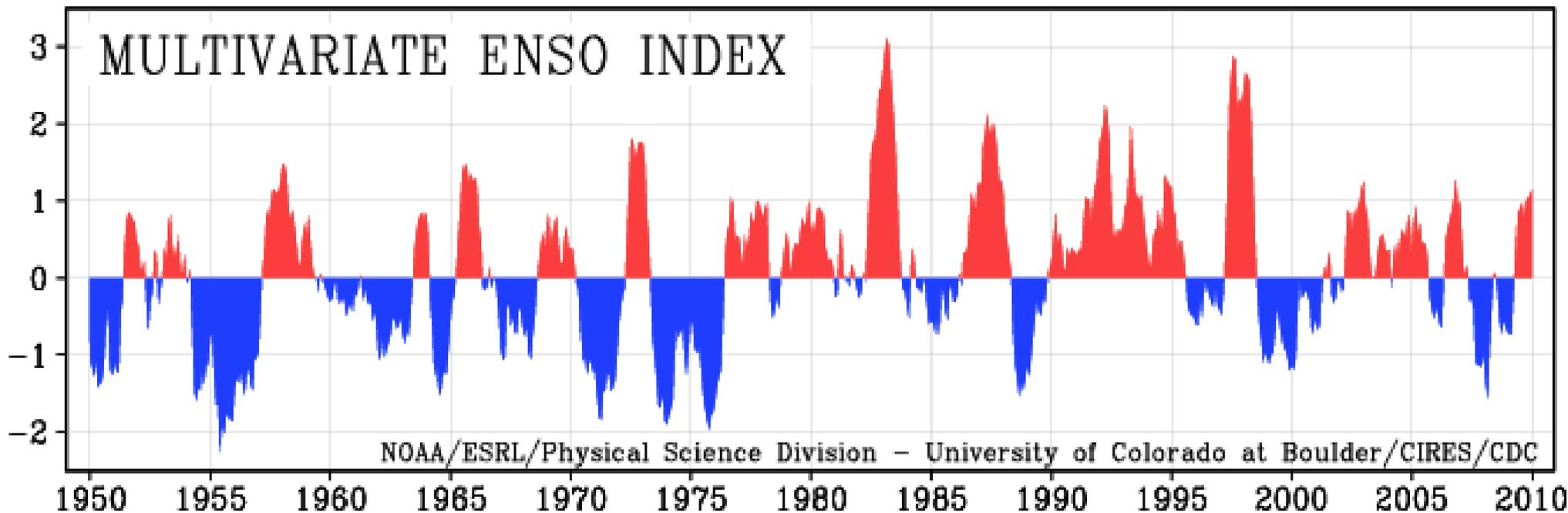
- 1790-93
- 1828
- 1876-78
- 1891
- 1925-26

82/83

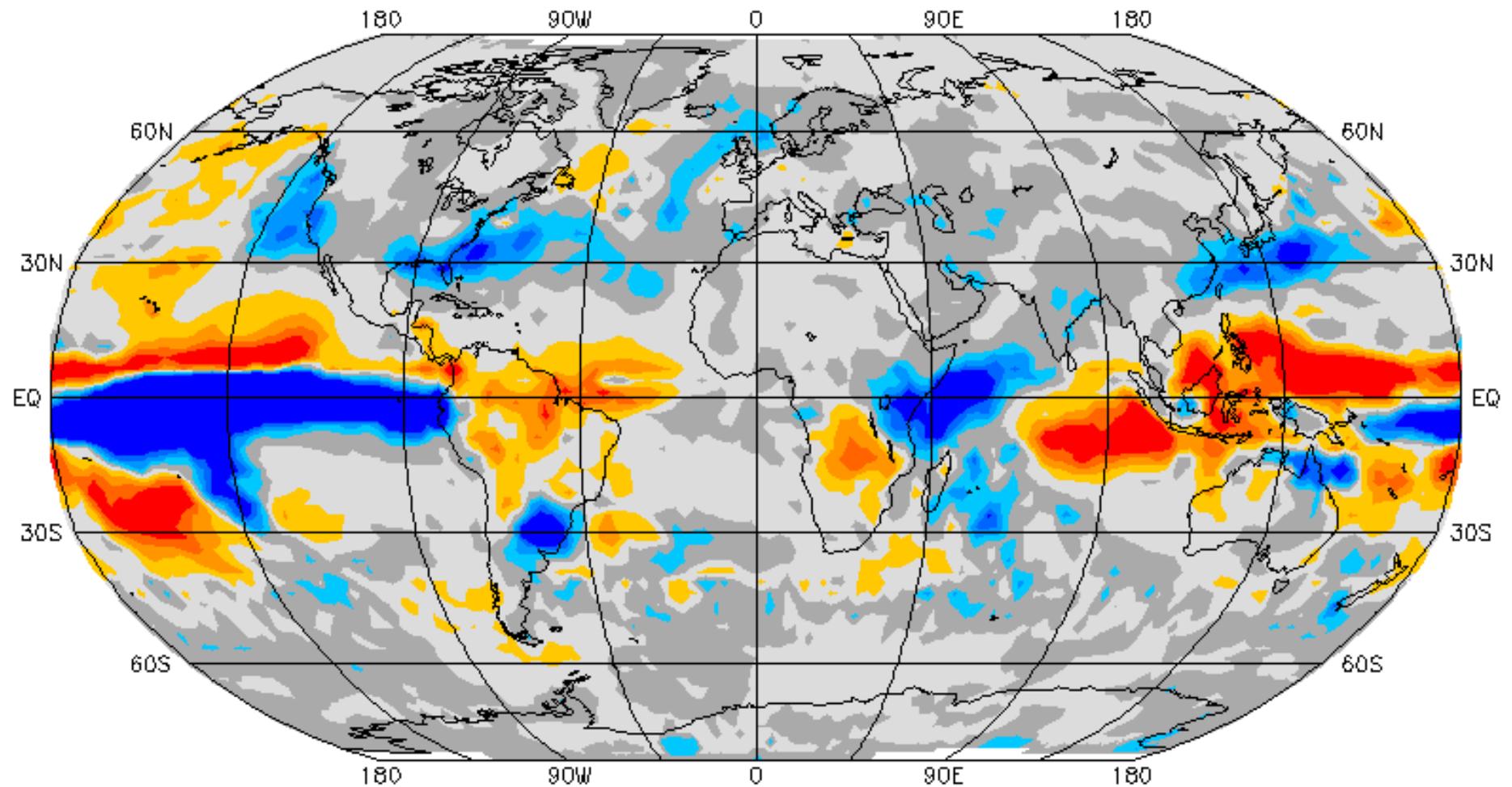
86/87

97/98

Standardized Departure



# Precipitation change in period Dec 1997-Feb 1998



(c) GPCC 2005/10/7



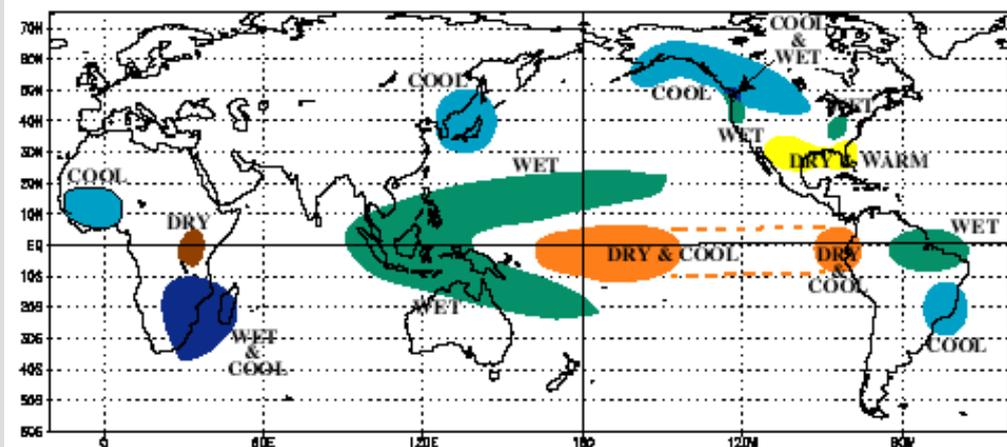
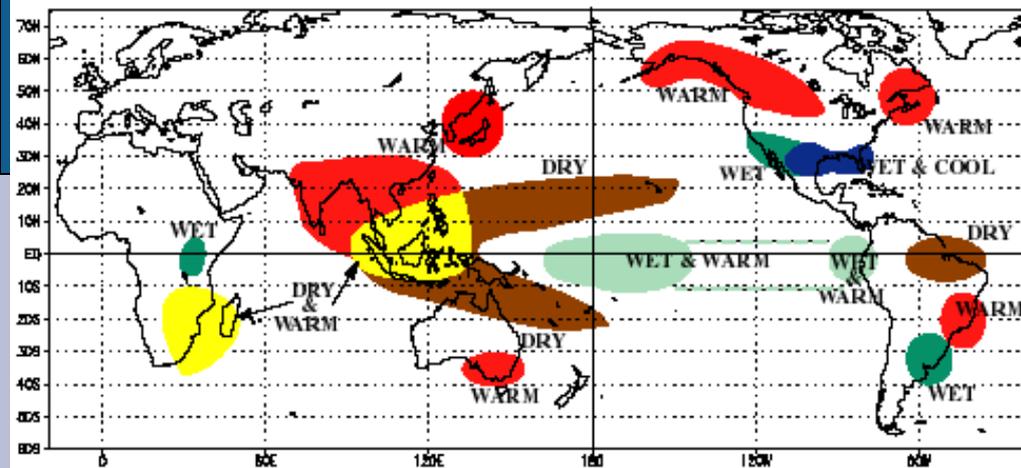
# Teleconnections

## El Niño

## La Niña

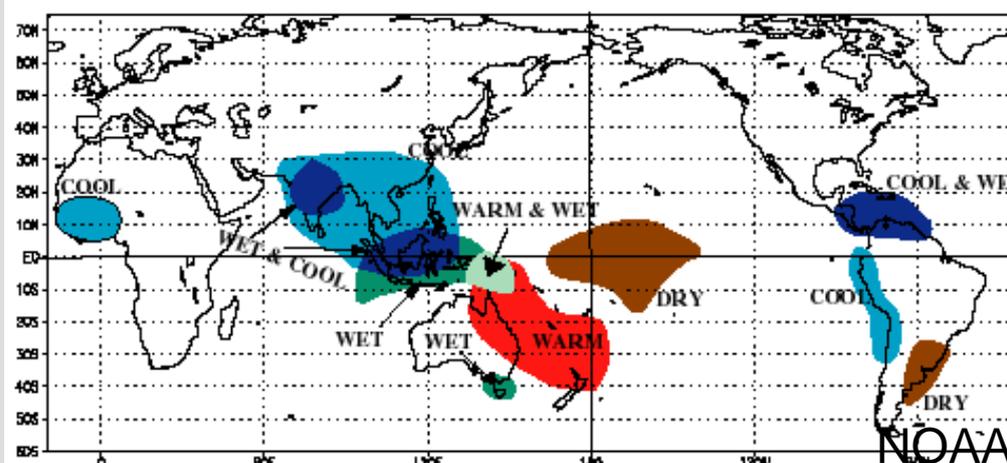
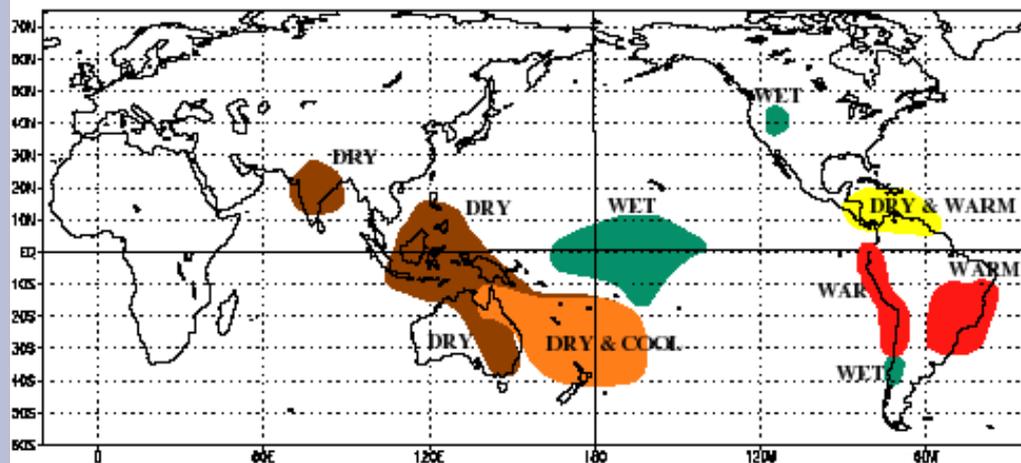
WARM EPISODE RELATIONSHIPS DECEMBER - FEBRUARY

COLD EPISODE RELATIONSHIPS DECEMBER - FEBRUARY

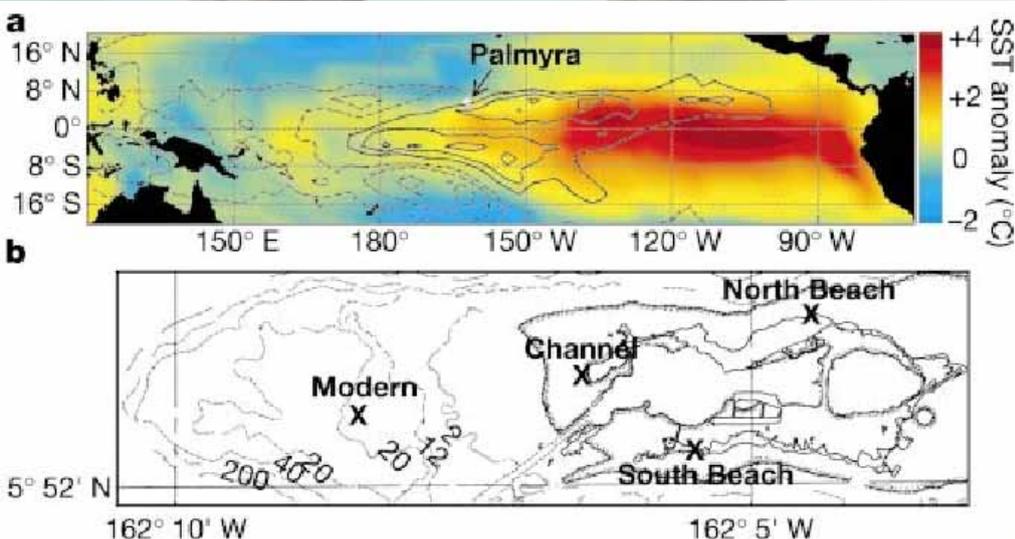
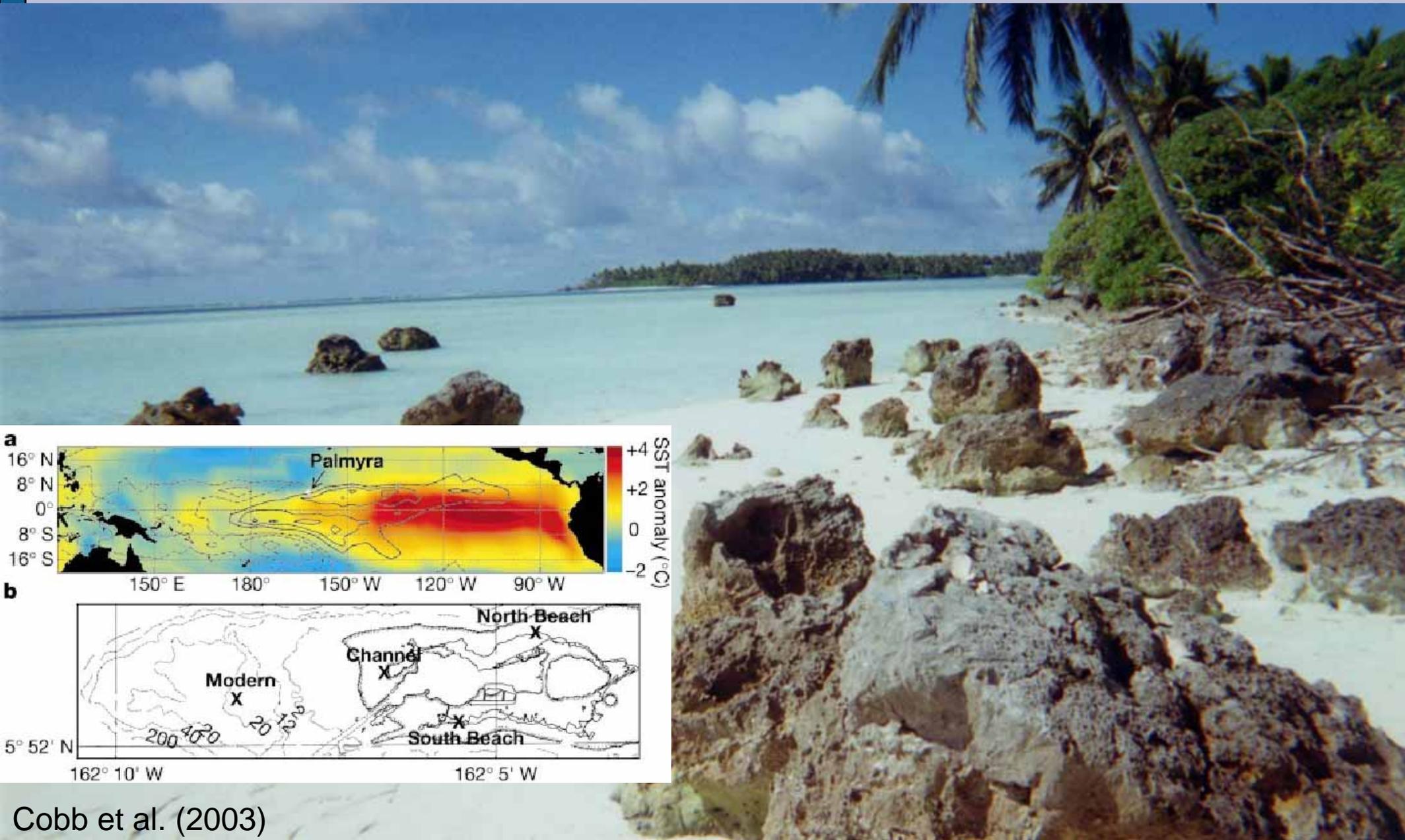


WARM EPISODE RELATIONSHIPS JUNE - AUGUST

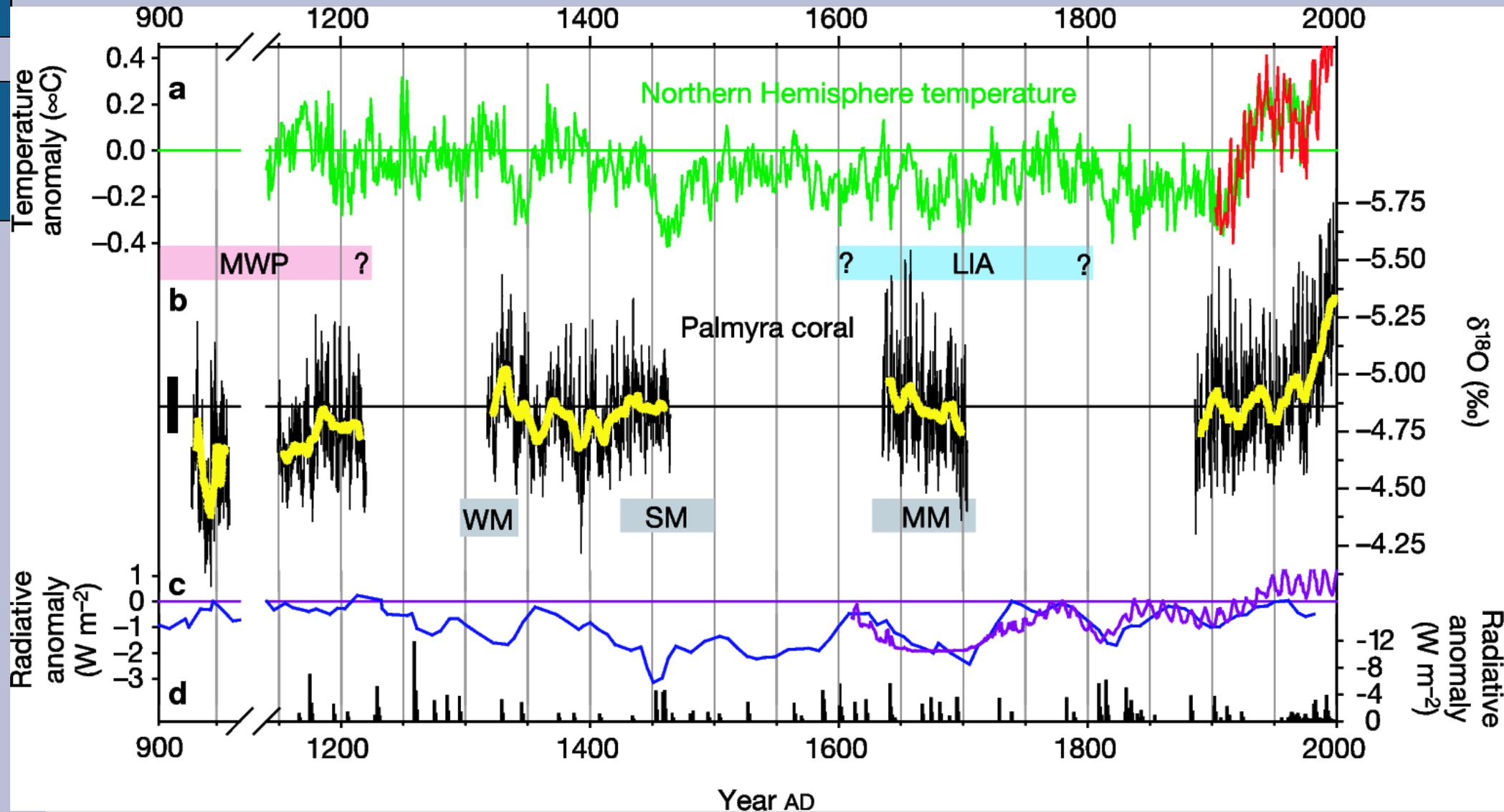
COLD EPISODE RELATIONSHIPS JUNE - AUGUST



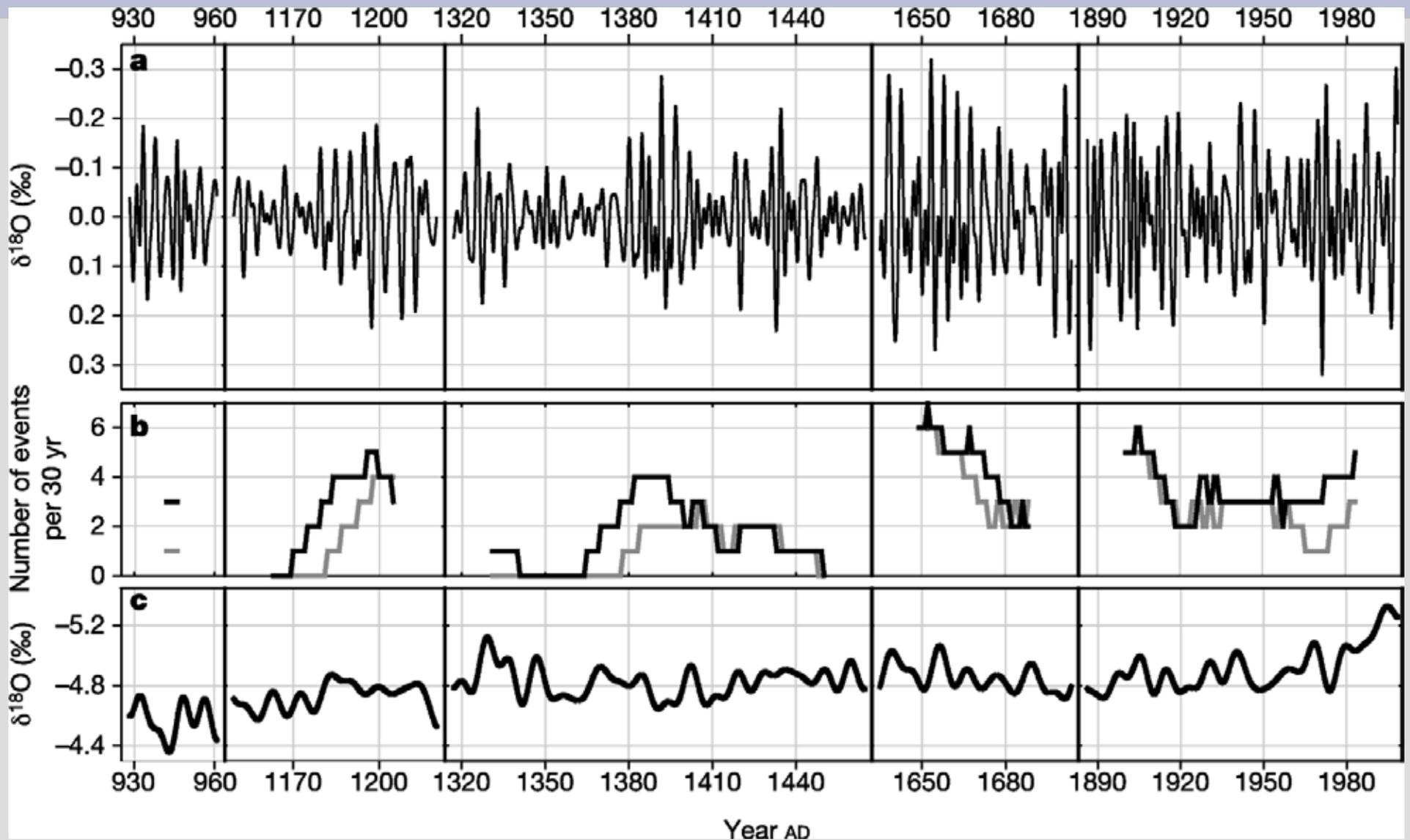
# ENSO reconstruction



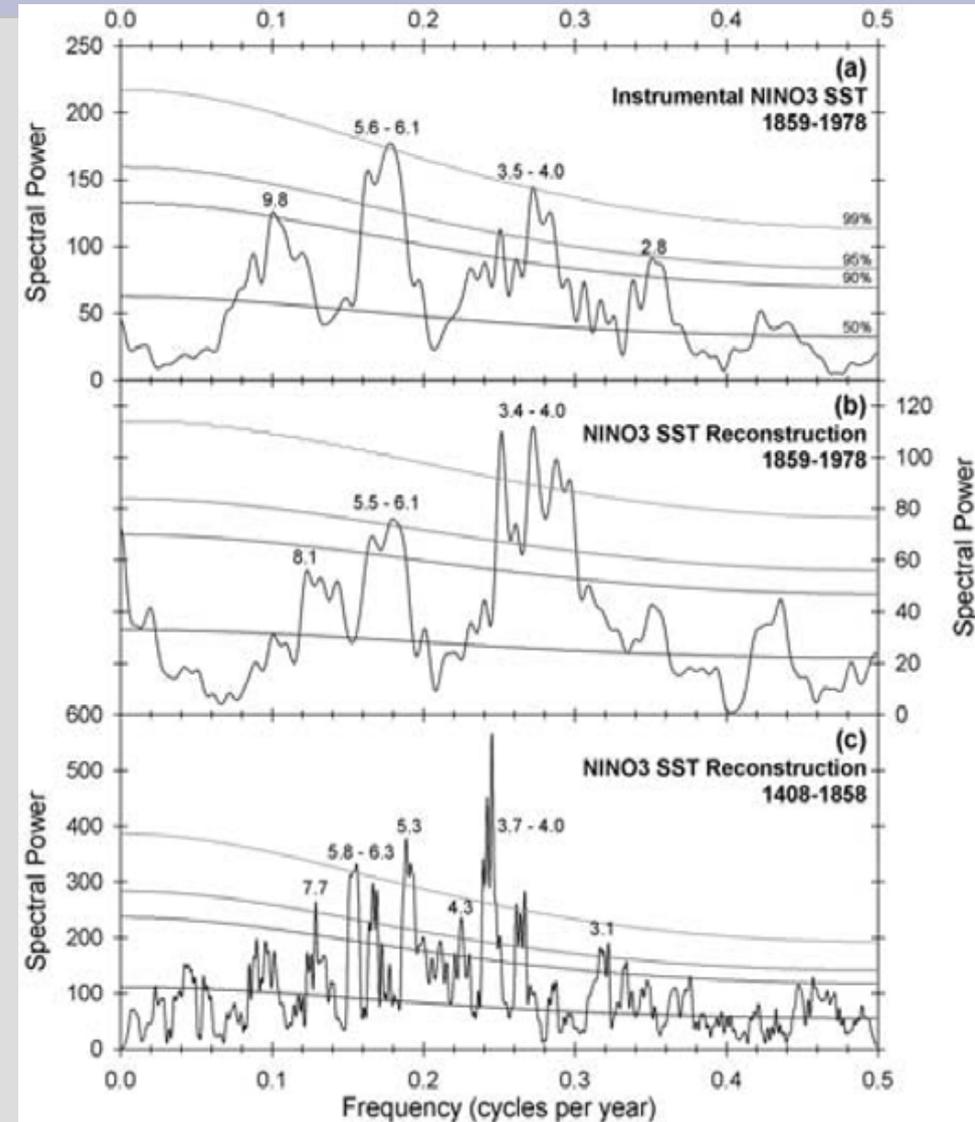
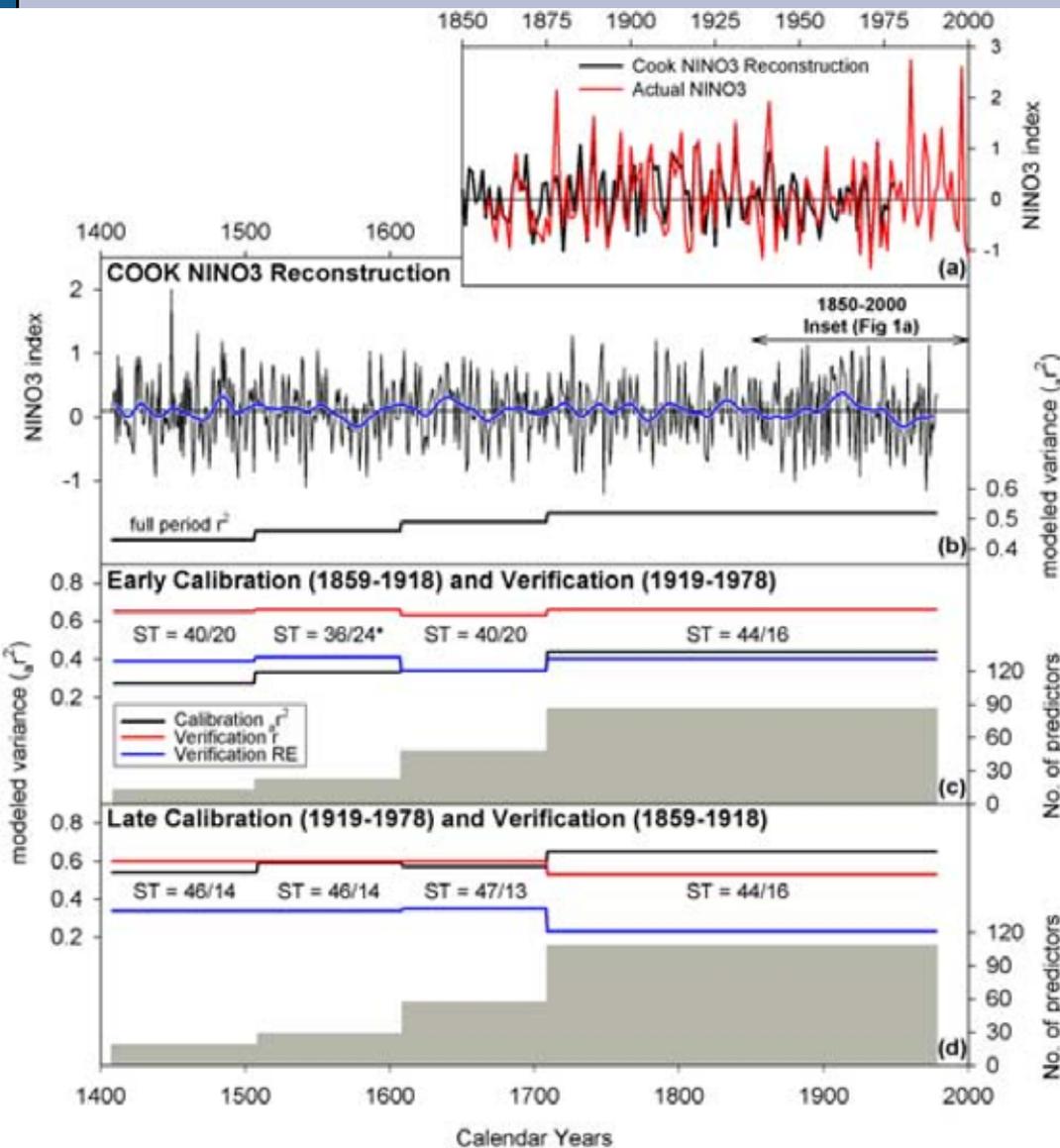
# ENSO reconstruction



# ENSO reconstruction

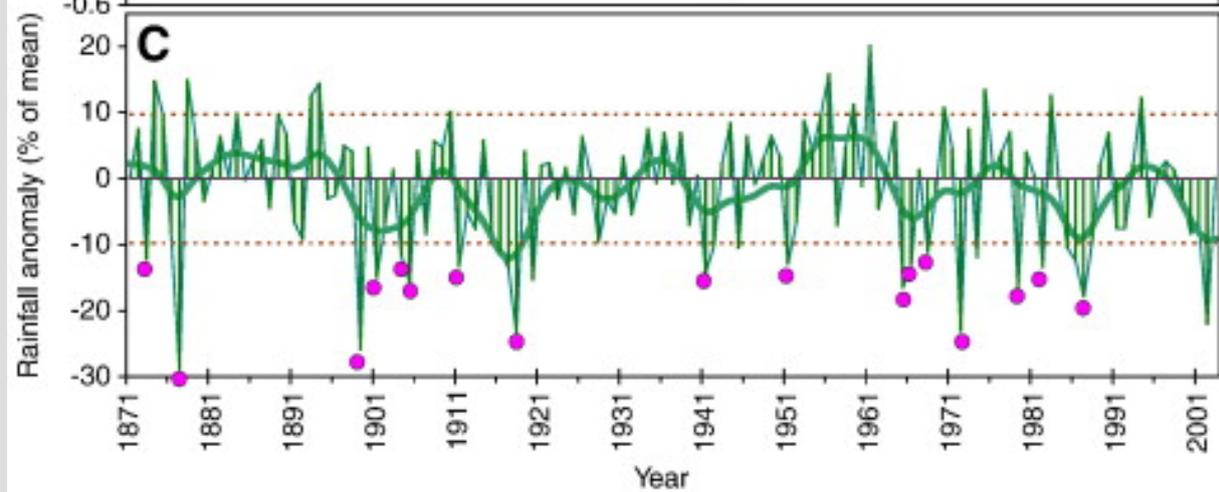
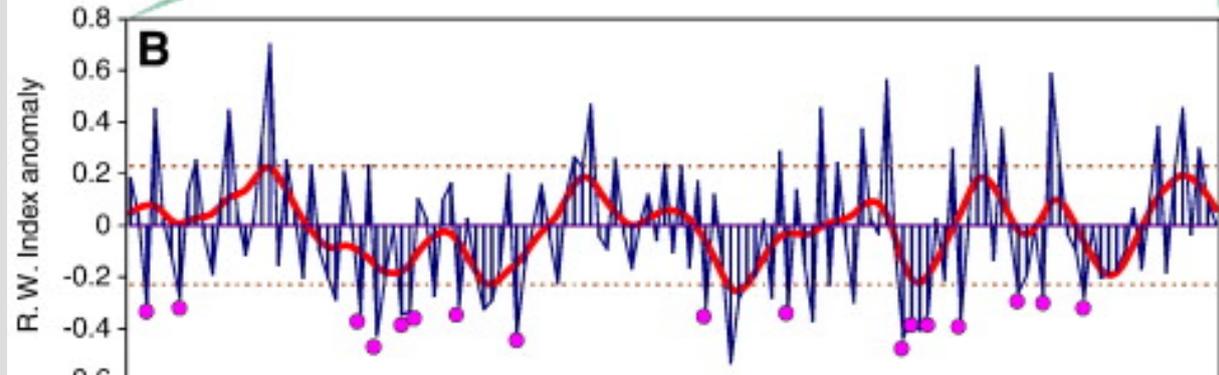
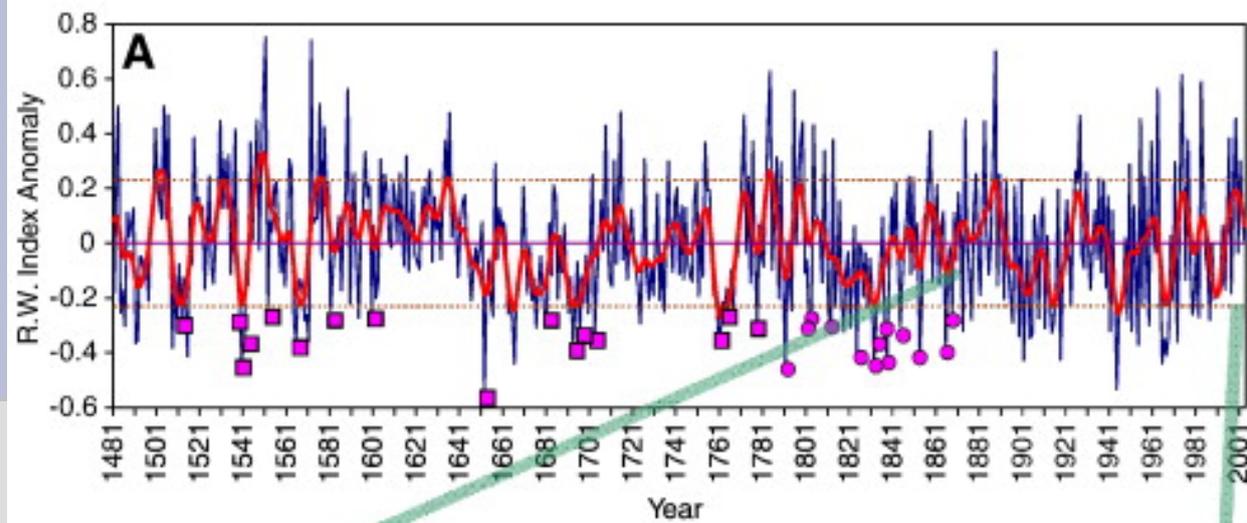
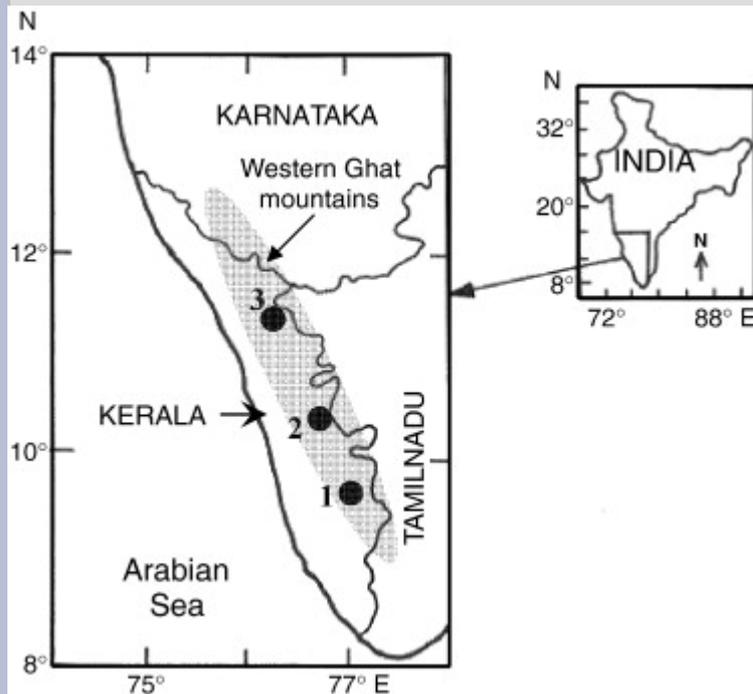


# ENSO Reconstruction



# Stop press Tree rings from India

(published January 2010)



# ENSO in the Past

Comparing reconstructed Nino 3 SST with global temperature patterns suggest

- that some features are robust through time, such as the warming in the eastern tropical Pacific and the western coasts of North and South America,
- whereas teleconnections into North America, the Atlantic and Eurasia are variable.

# Literature

- Fagan (1999): Flood, Famines and Emperors. El Nino and the fate of civilisations (but doesn't contain much El Nino...)
- IPCC (2007): Ch. 3.6: Patterns of Atmospheric Circulation Variability. IPCC WG1 AR4 Report  
(online: <http://www.ipcc.ch/>)