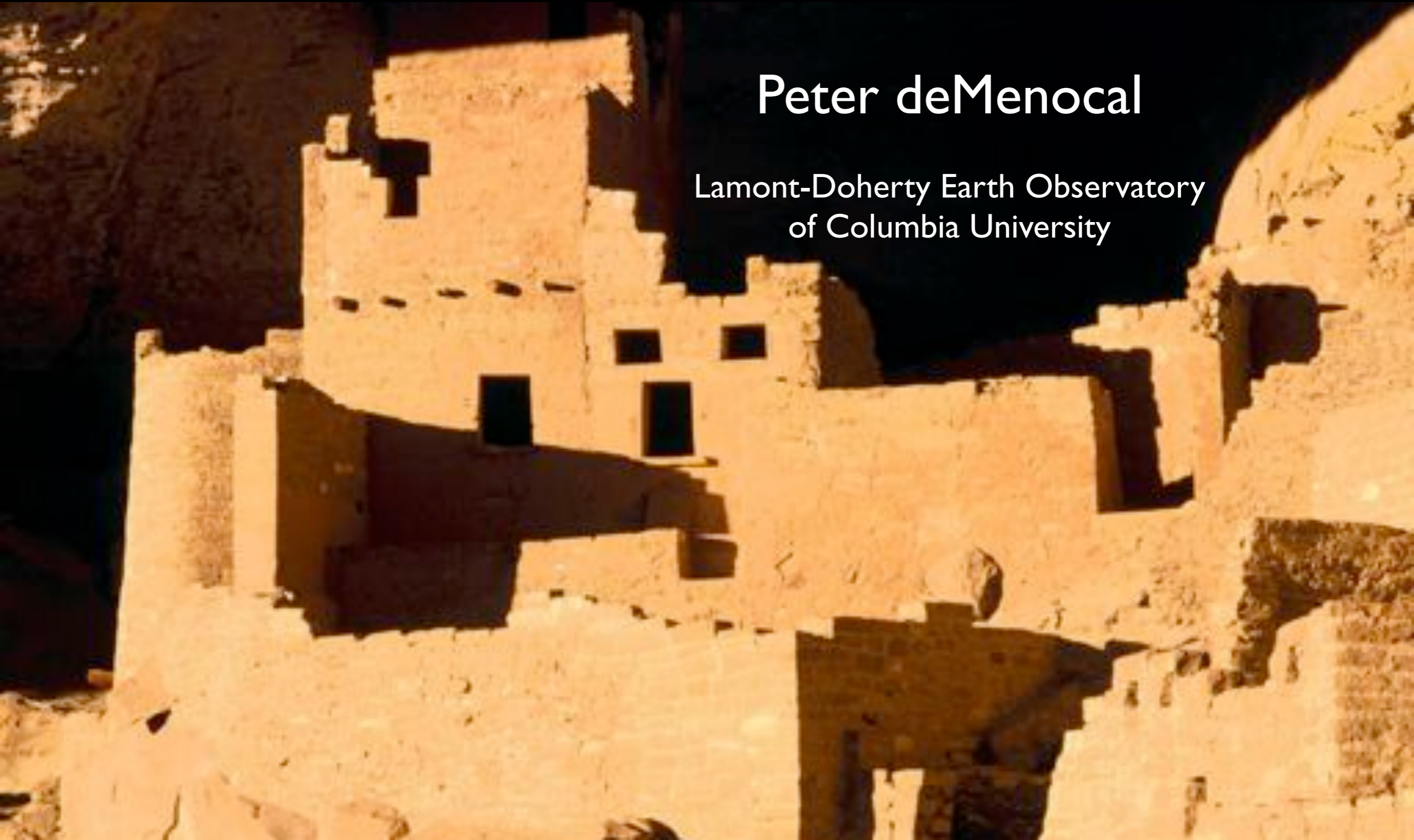


Cultural Responses to Climate Change: Taking the long view

Peter deMenocal

Lamont-Doherty Earth Observatory
of Columbia University



Why do cultures collapse ?

“Civilizations die from suicide, not by murder”
- A.J. Toynbee (*A Study of History*, 1961)

Key factors are the security of food, water, resources as well as political, military, and economic influences.

- J. Diamond (*Collapse*, 2005)

Some responses to environmental change

- **Adaptation:** US Drought



- **Migration:** Predynastic Egypt



- **Collapse:** Anasazi



Some common themes

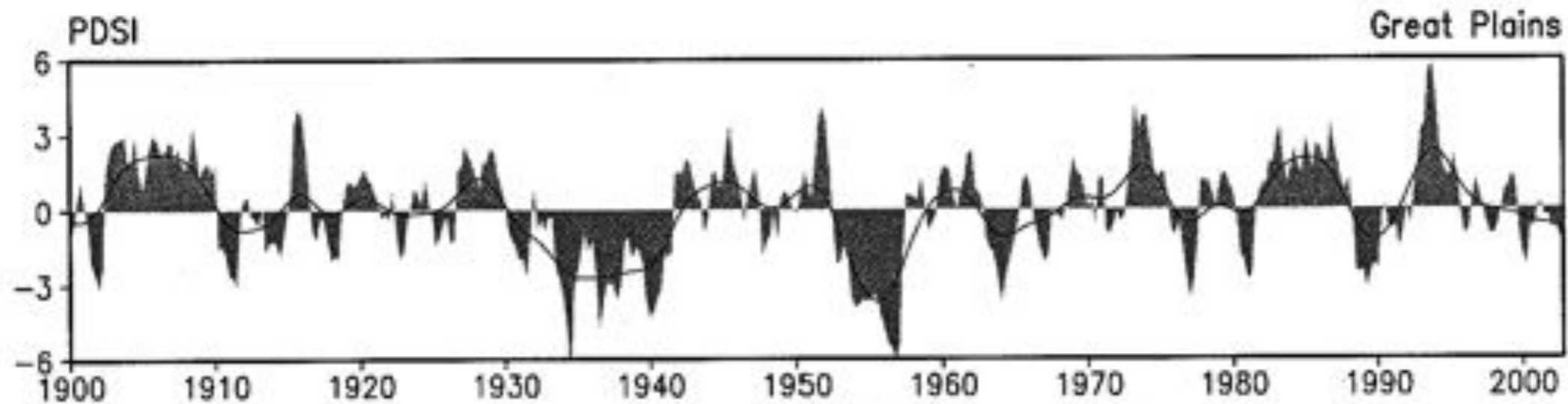
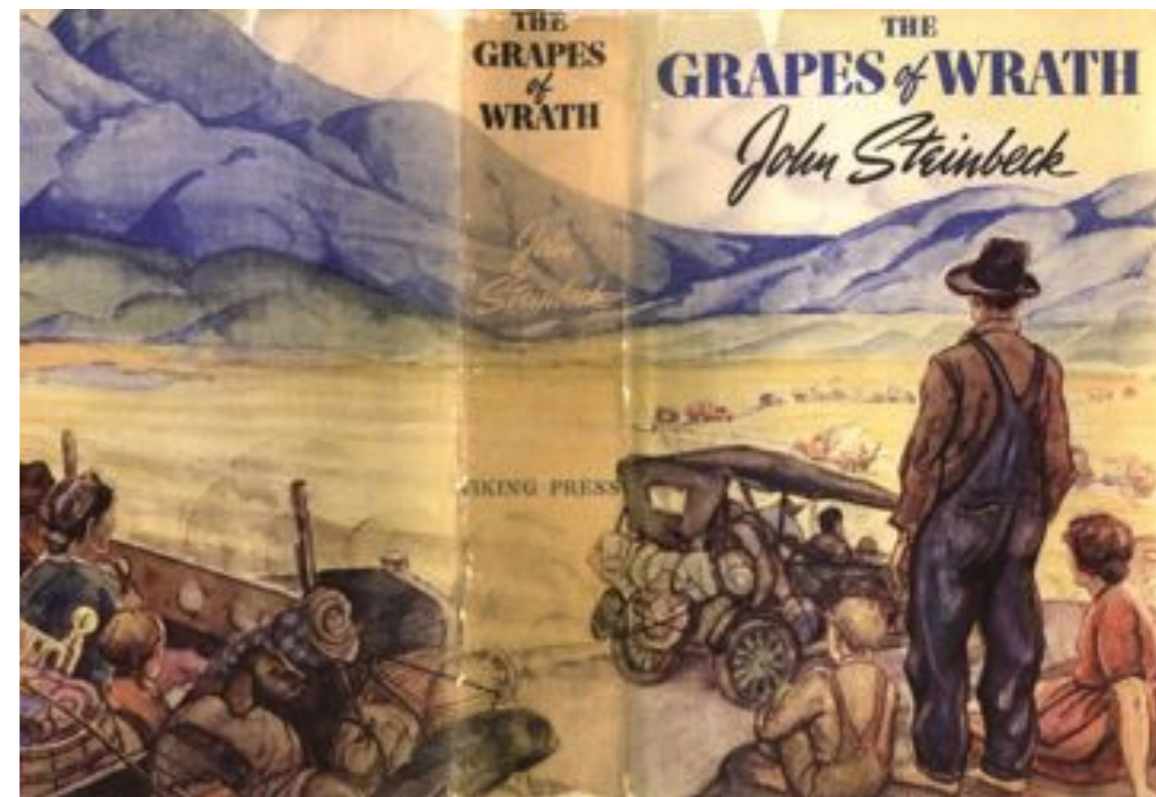
Climate constrains resource availability

Environment + Population constrain sustainability

years long; \$1 Billion

Adaptation: Dust Bowl Drought (1930s)

4-8 year drought
\$1 Billion loss (1930s value)

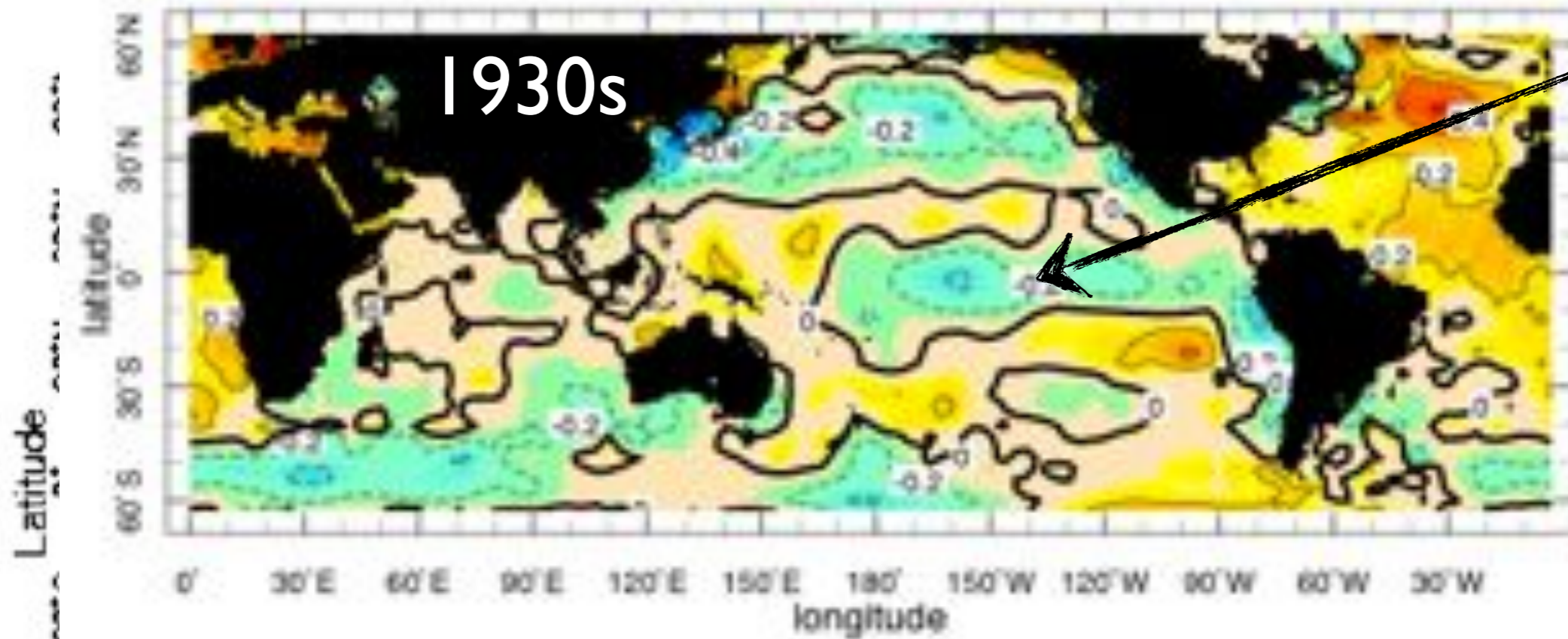


wet

dry

What caused the Dust Bowl ?

1930s

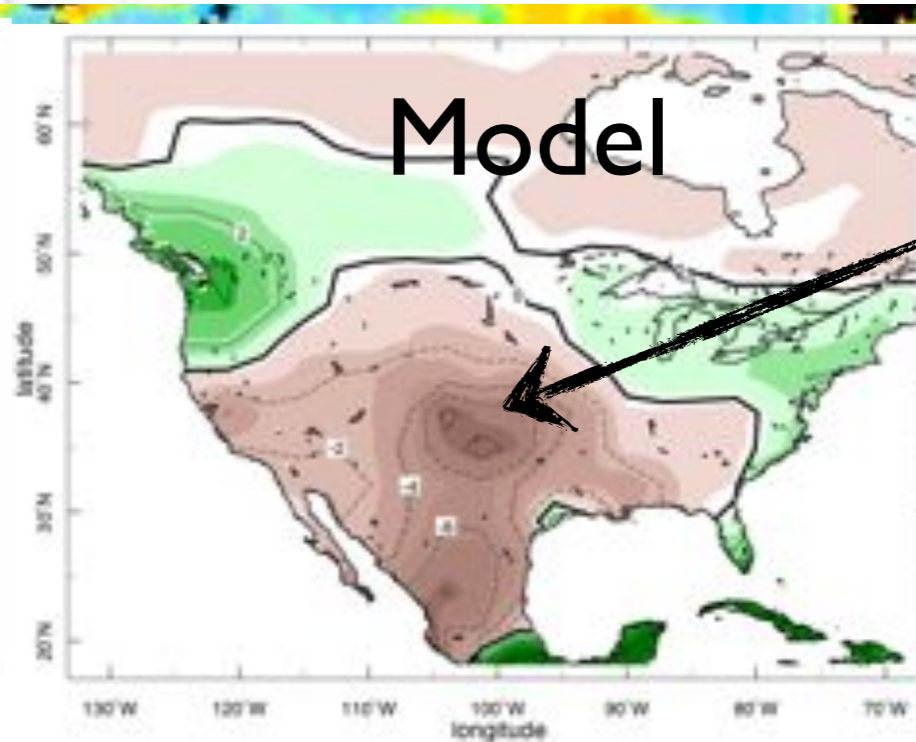
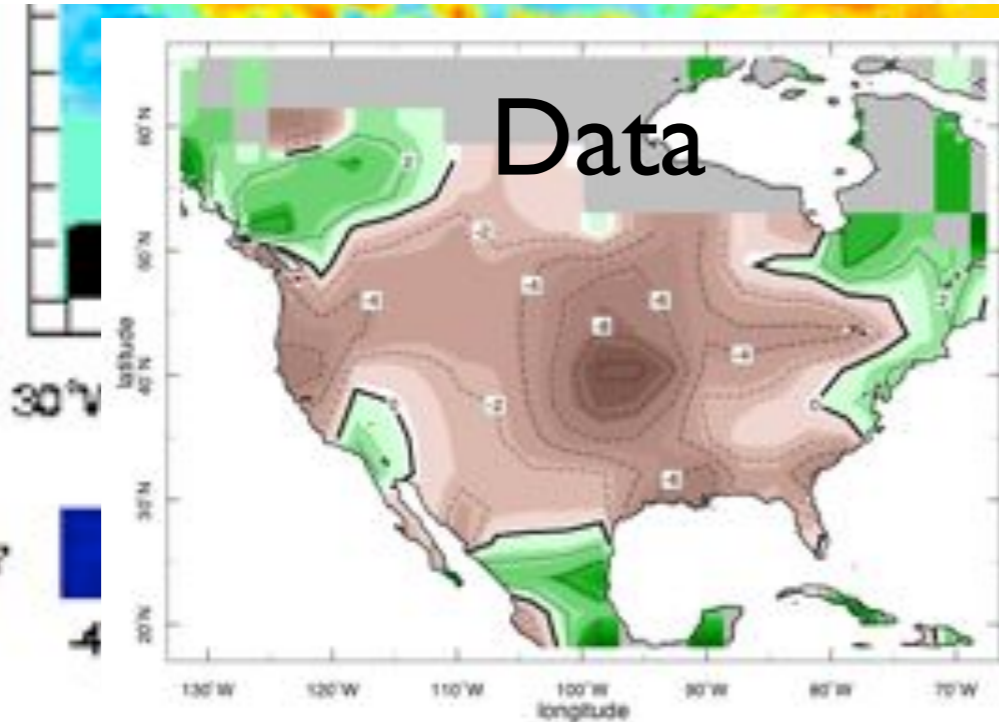


cold
SSTs

Data

Model

Oct 1997



Dry

4°C

years long; \$1 Billion

Dust Bowl Societal Impacts

A combined agricultural, economic, and social disaster.



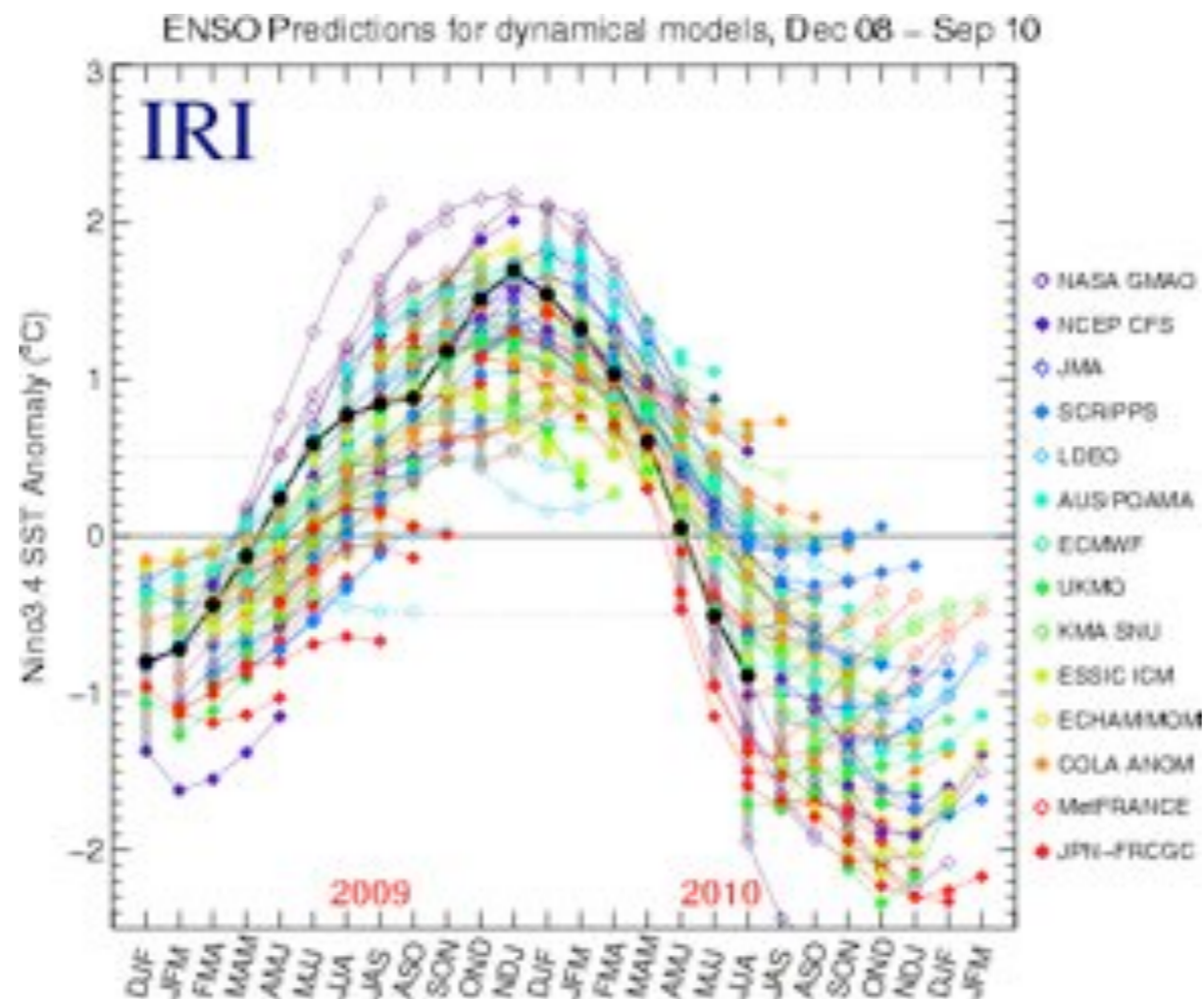
The result: **Adaptation** and Improved resilience

Adaptation through prediction

Would Advance Knowledge of 1930s SSTs Have Allowed Prediction of the Dust Bowl Drought?* **Yes !**

RICHARD SEAGER, YOCHANAN KUSHNIR, MINGFANG TING, MARK CANE, NAOMI NAIK, AND JENNIFER MILLER

Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York



Migration: North Africa during the late Holocene

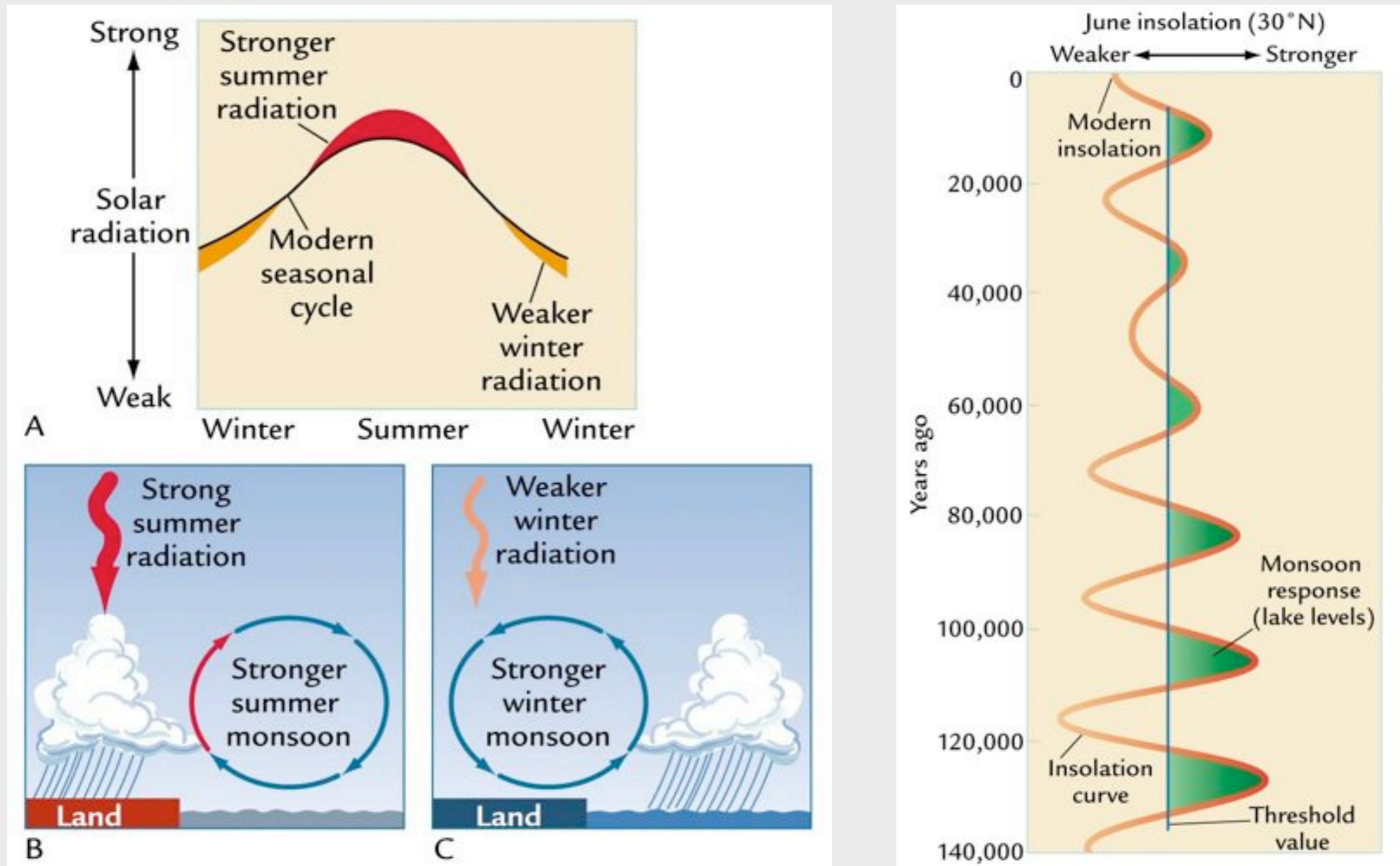


The African monsoon



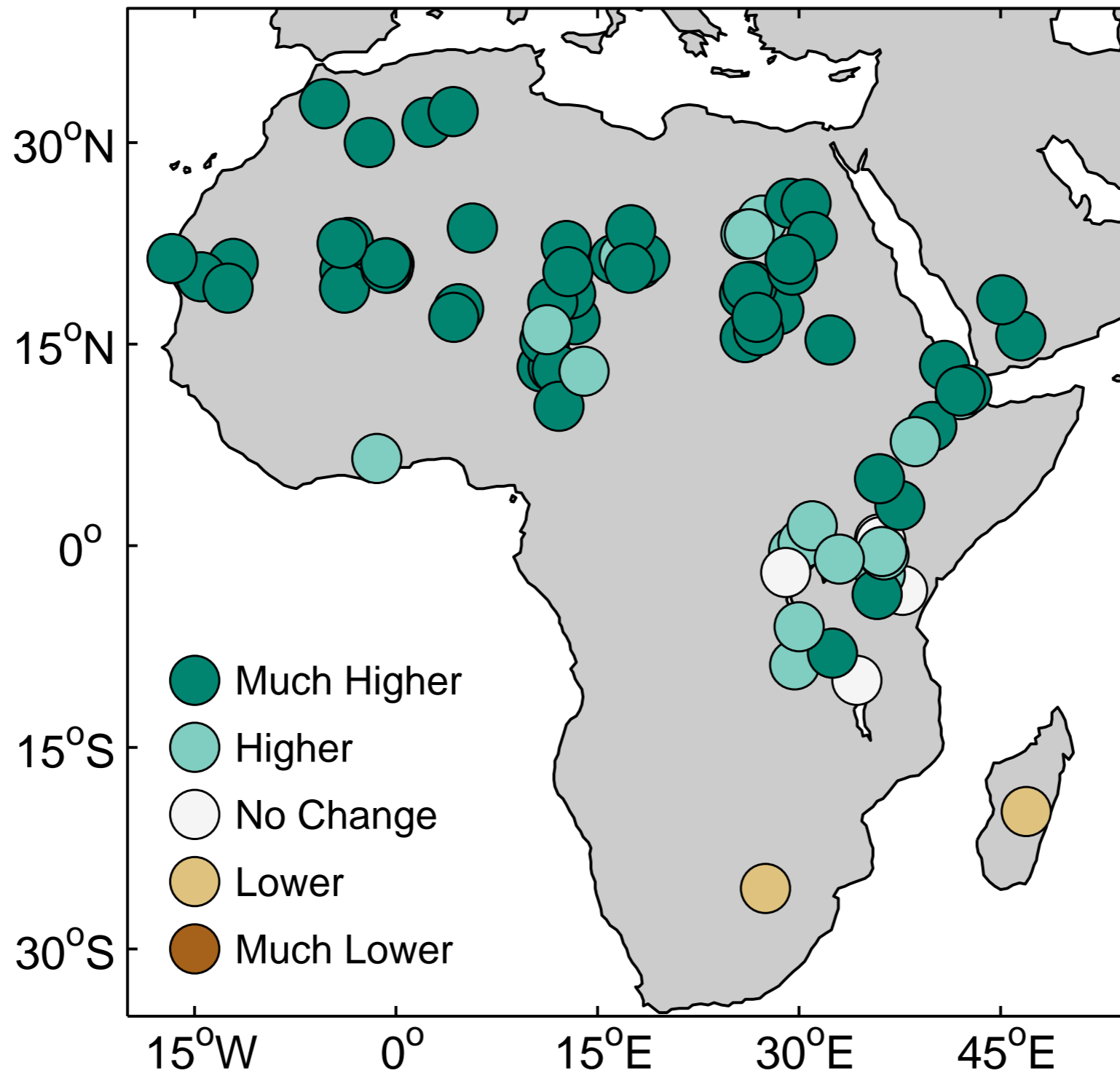
NASA NDVI satellite

Orbital Precession and the Monsoon

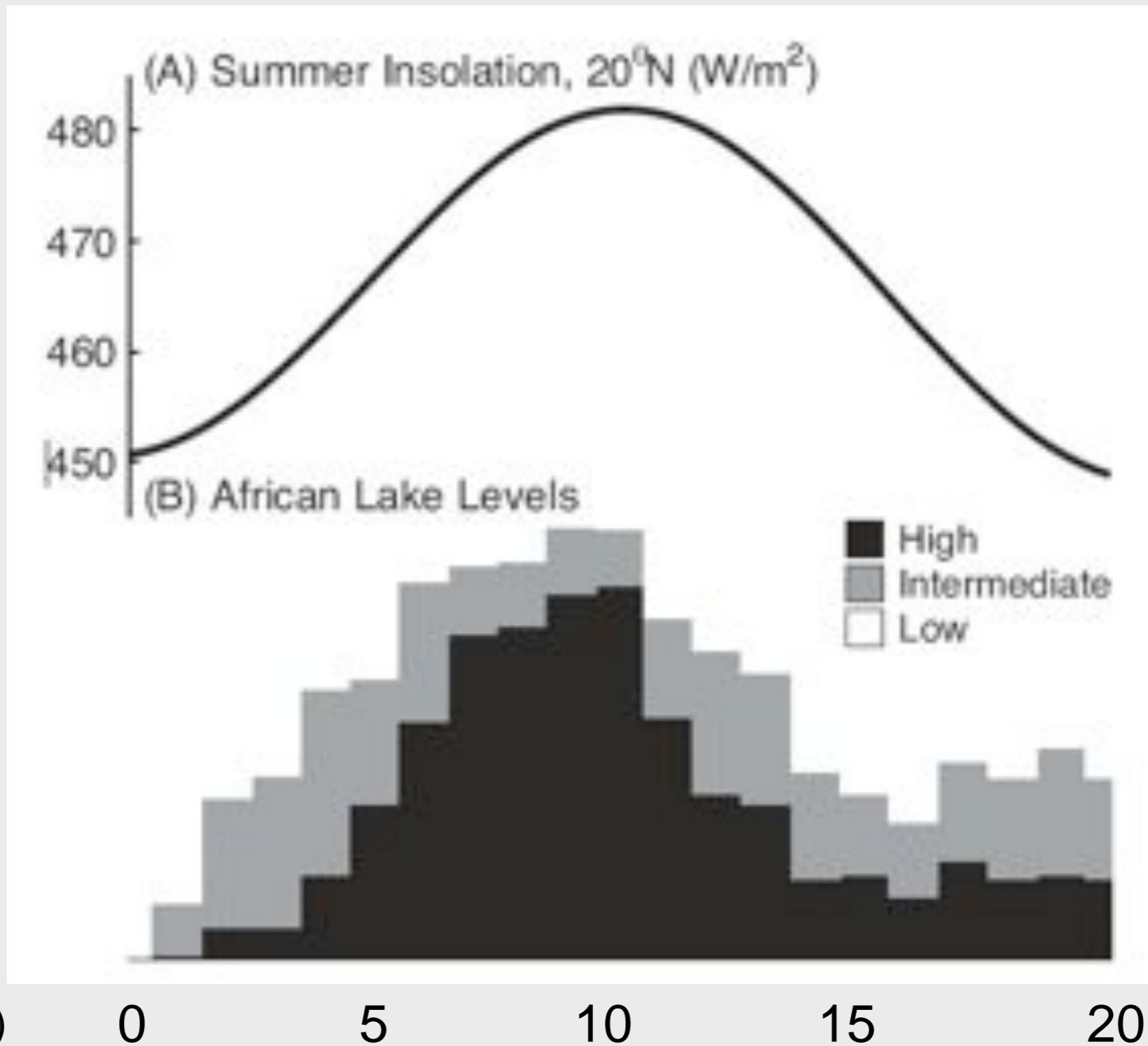


Early Holocene Lake Levels

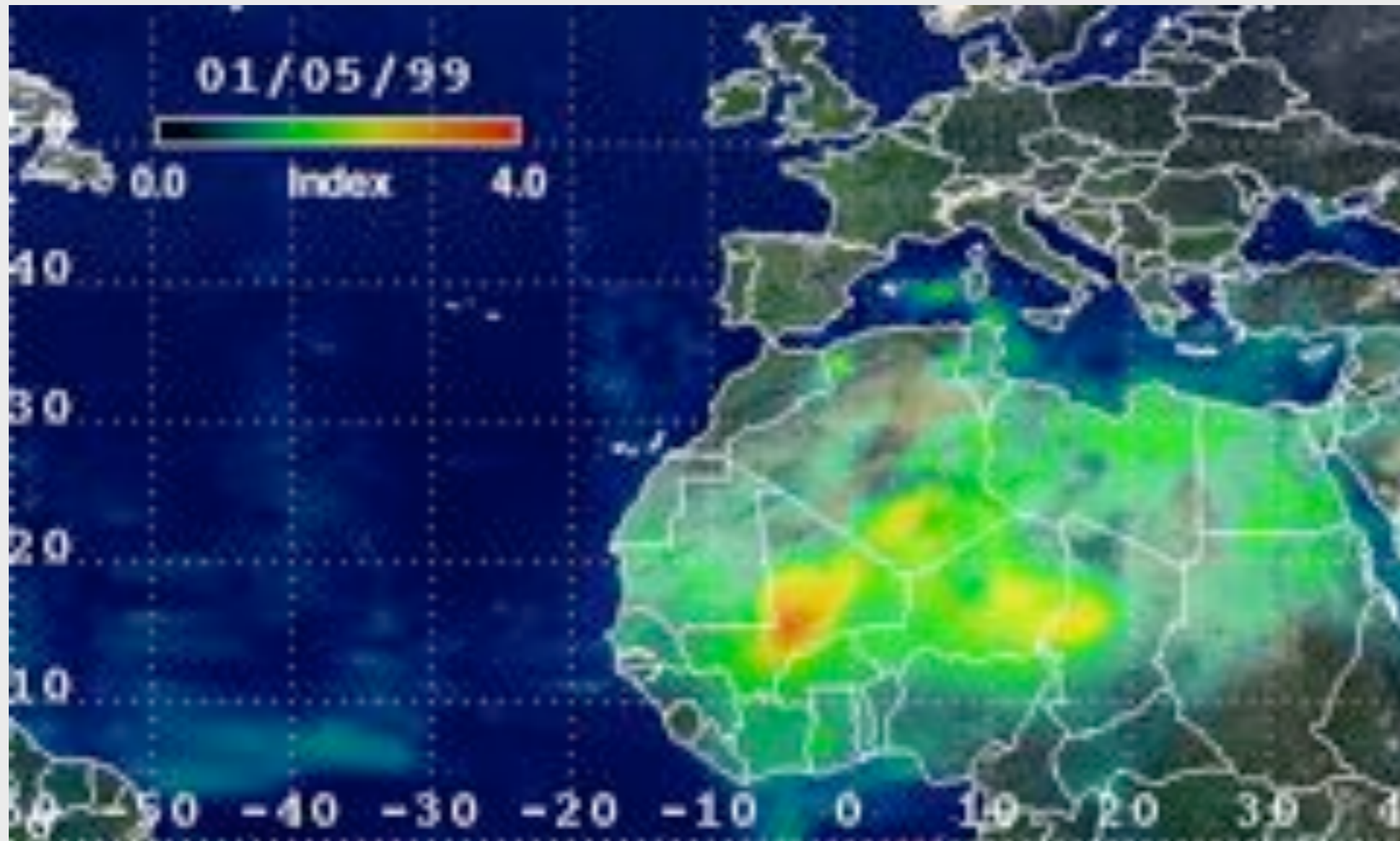
African Lake Levels, 9,000 yr BP vs. Present



Widespread Saharan lakes during the Holocene

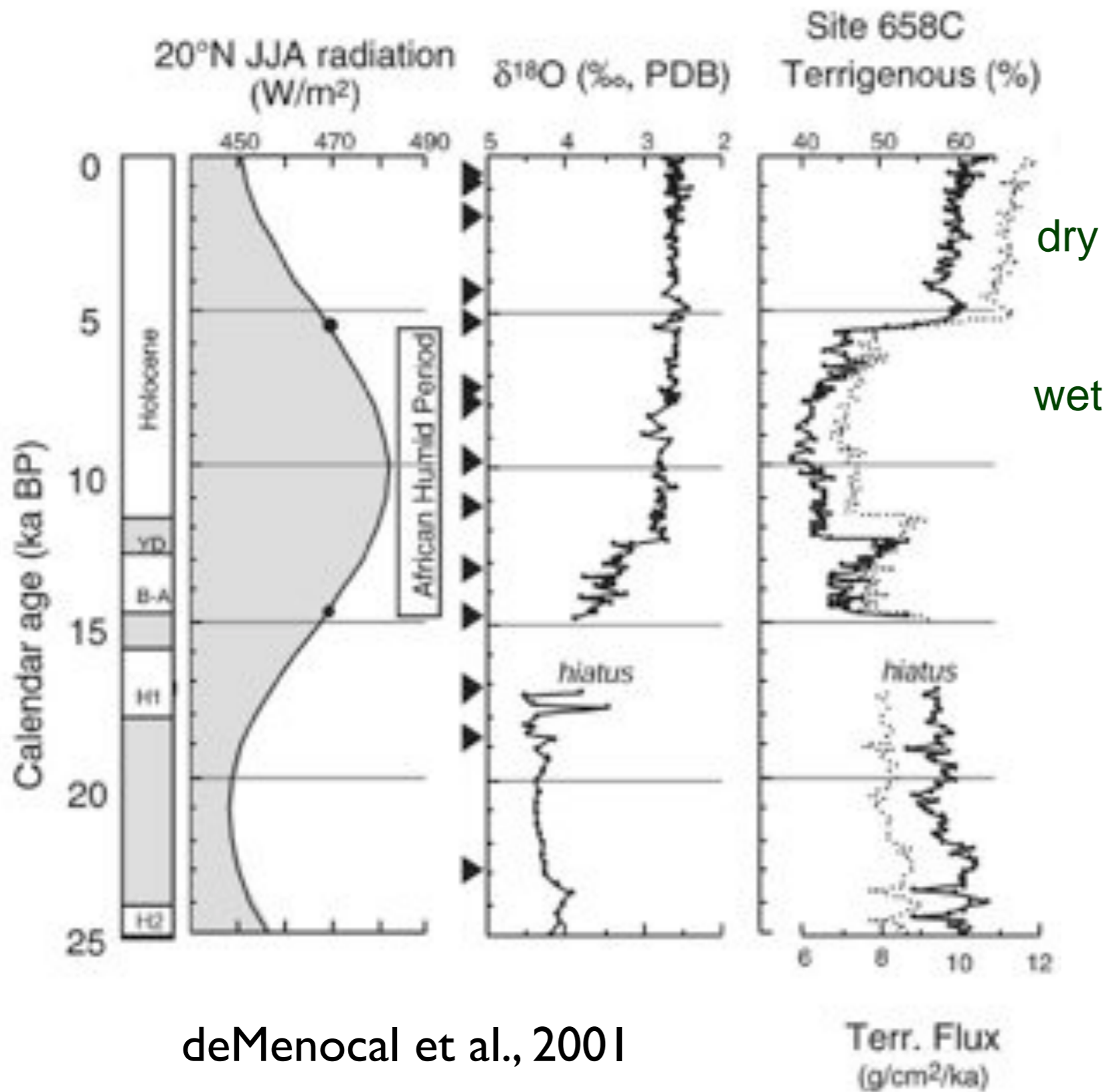


African Dust as a proxy for climate change



NASA TOMS May-Sept., 1999

Abrupt AHP transitions

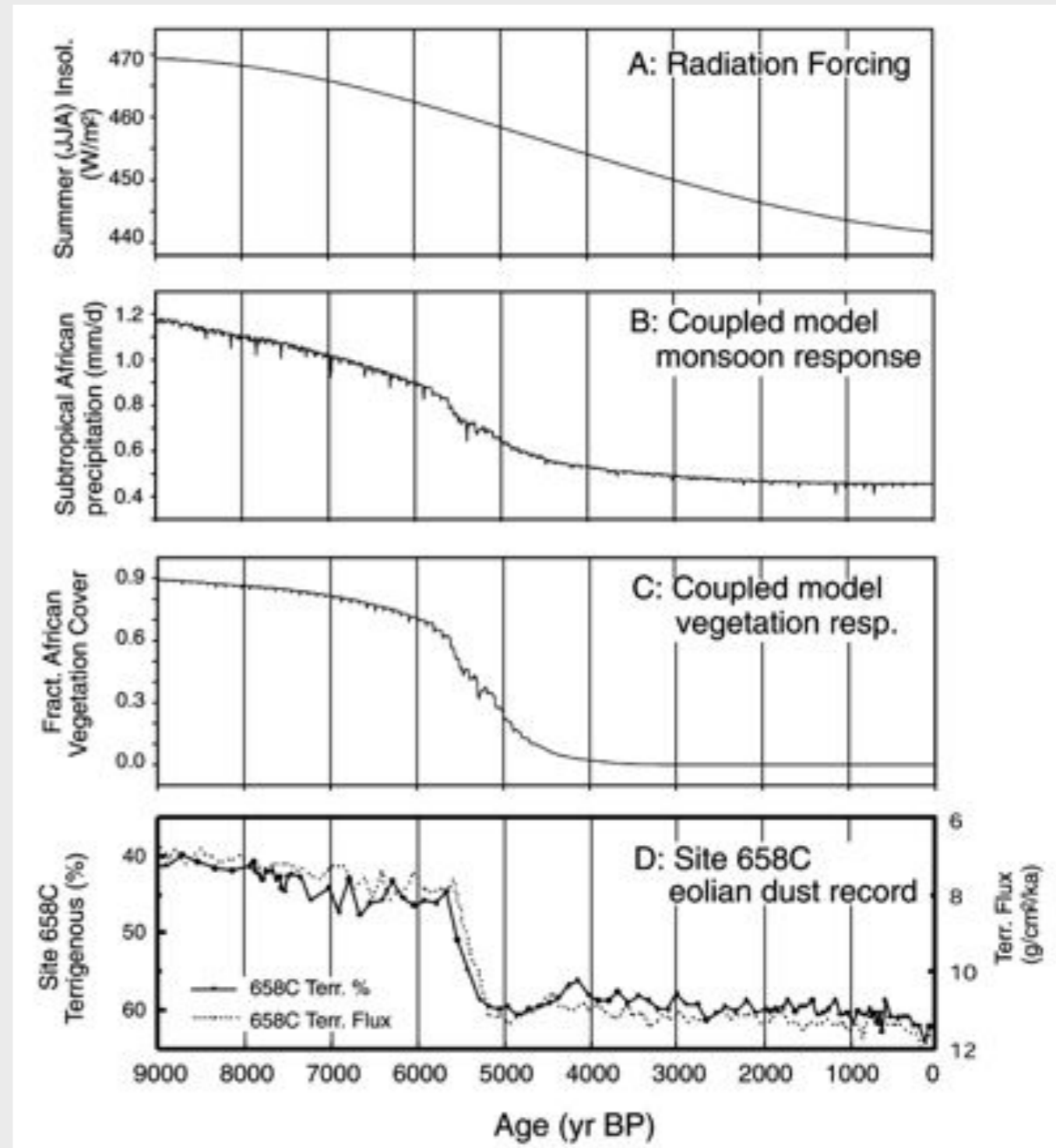


deMenocal et al., 2001



Why so abrupt ?

- Charney (1975) biogeophysical feedback
- Positive feedback between rainfall, **vegetation**, and convection.
- Drying > less vegetation > higher albedo > less convection > Drying
- Observed in (some) climate model simulations (Liu et al., 2009; Claussen et al., 1999).

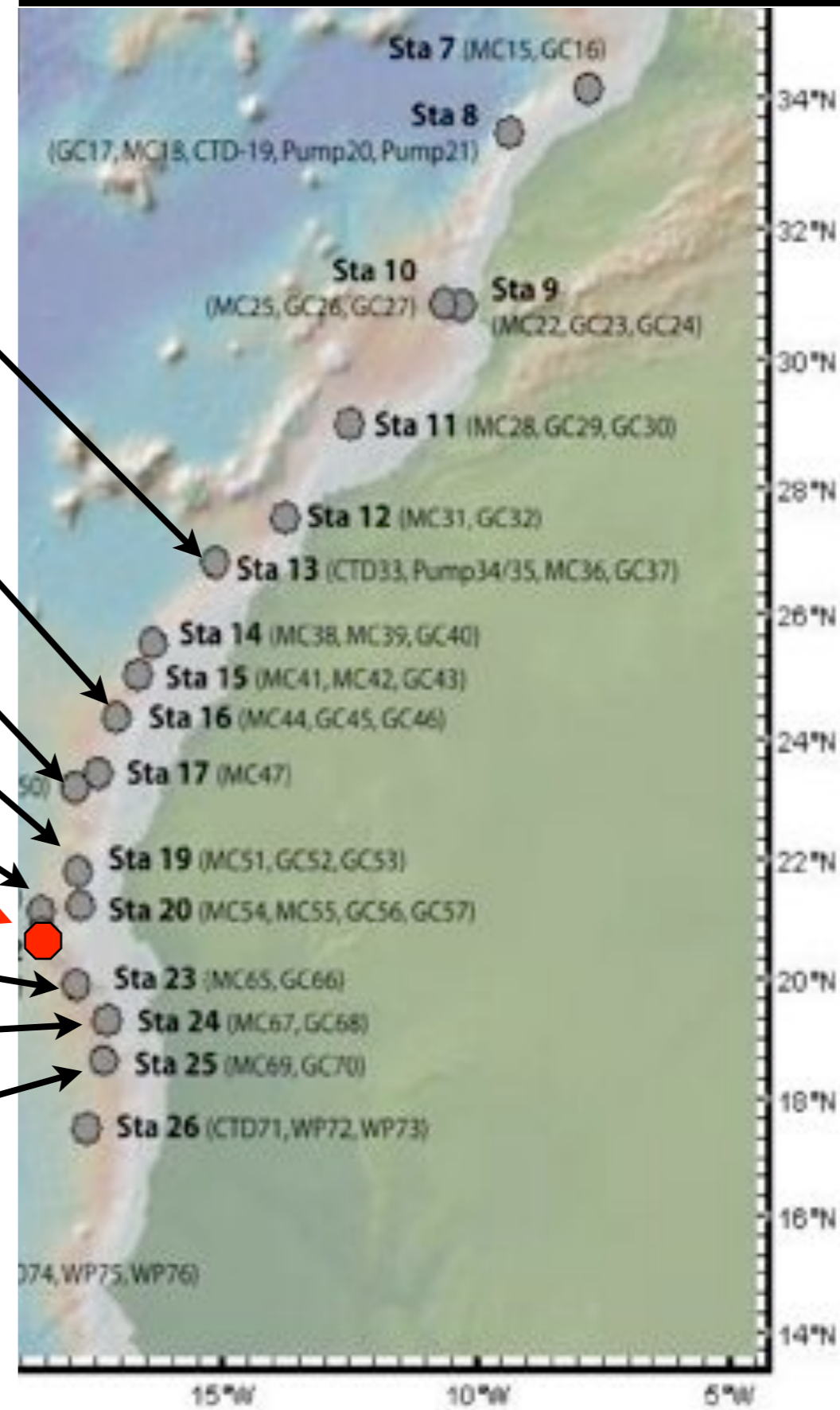
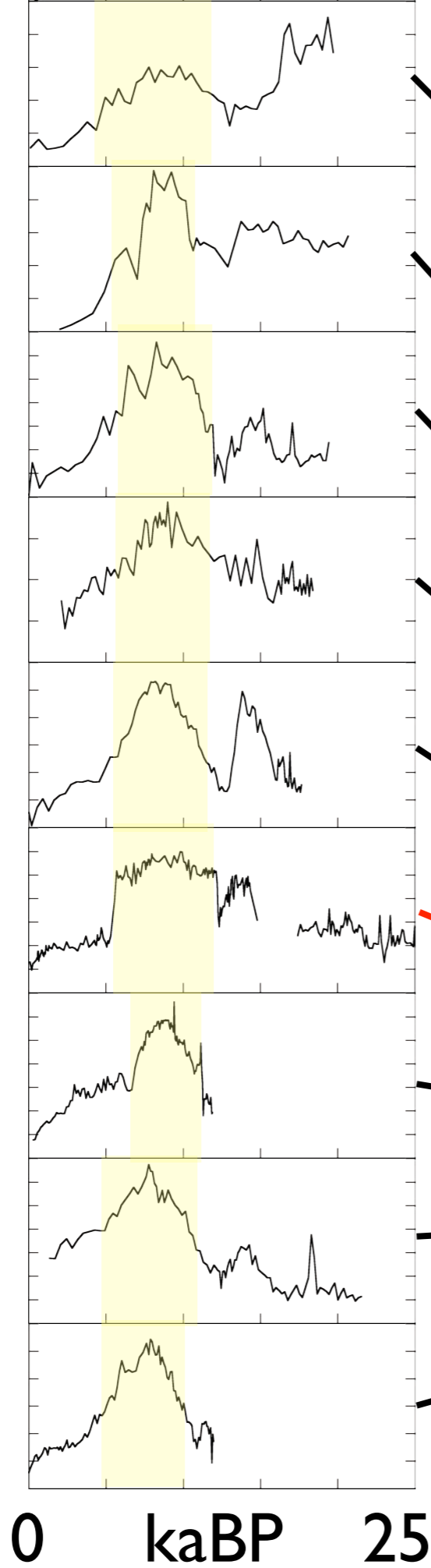


27°N

CaCO₃ %

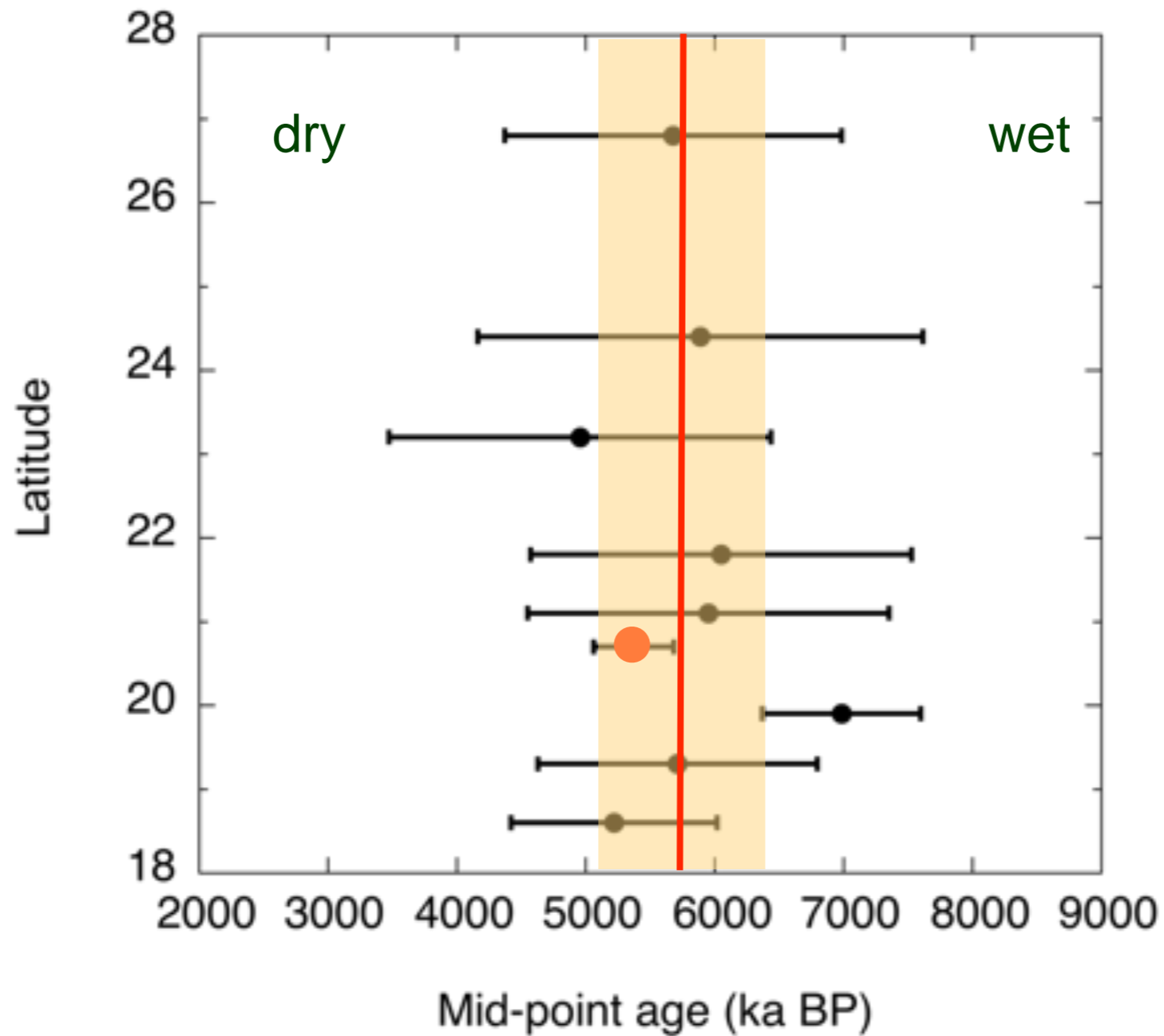
Site 658

19°N



Green-to-desert transition ~5.7 ka

5750 yr BP (± 600)



Life in North Africa during the Holocene



Gobero (ca. 10 ka; Niger)



Tessili n'Ajjer (Algeria)



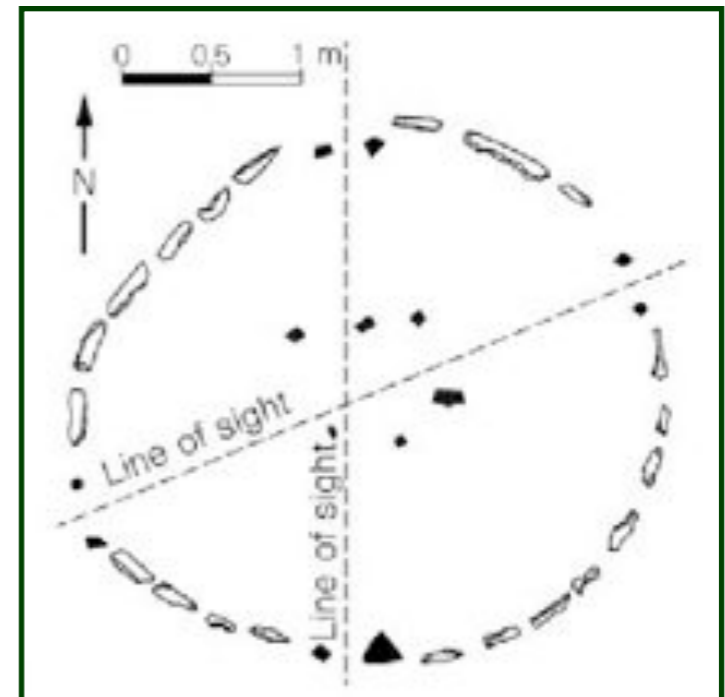
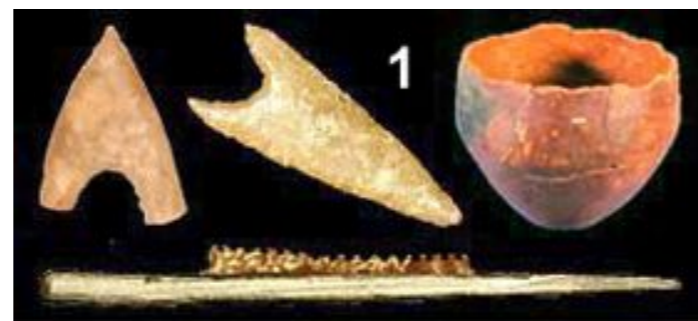
Nabta Playa (ca. 7 ka; Egypt)



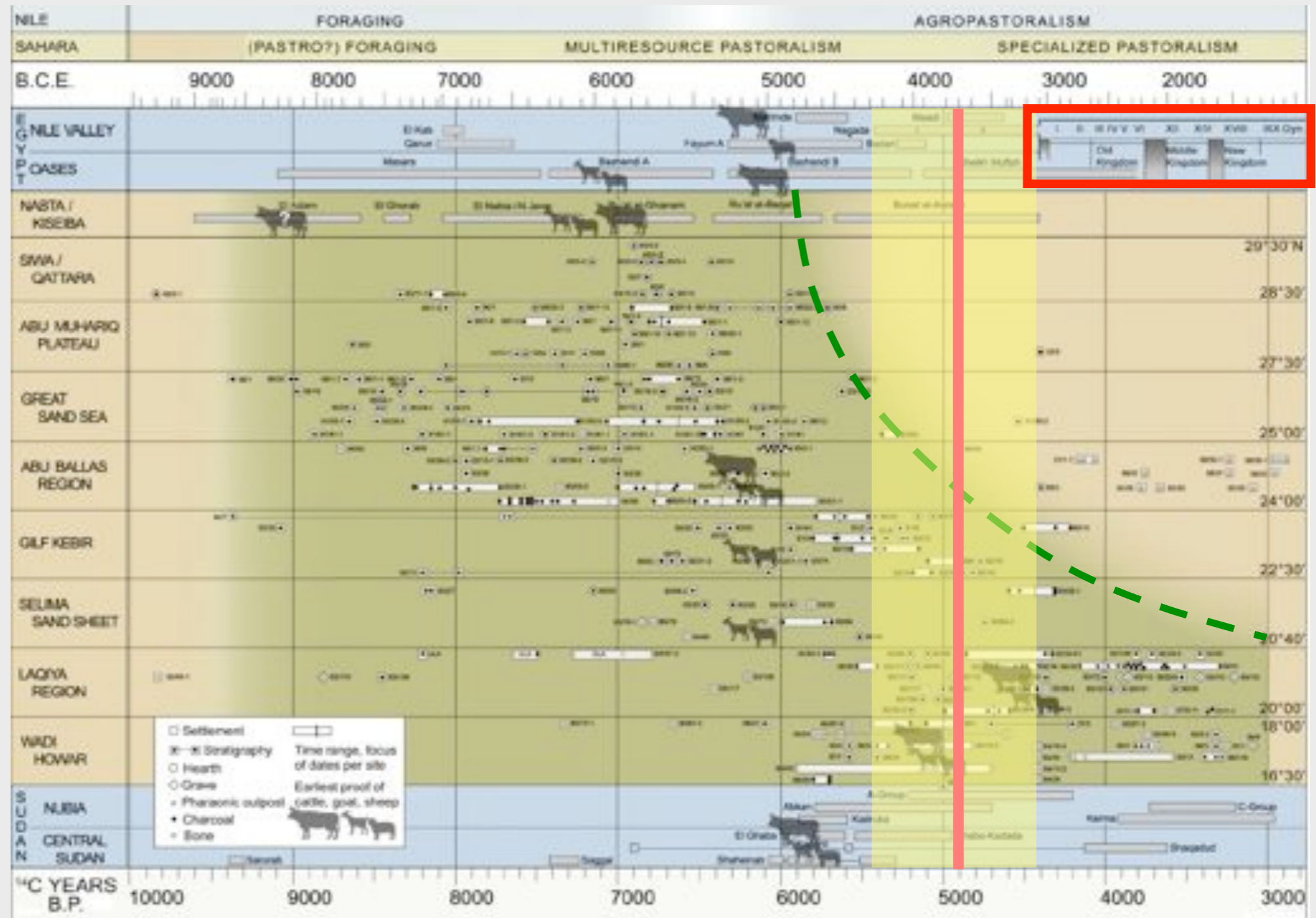
Egypt



Tadrart Acacus (Libya)



Human occupation in the eastern Sahara



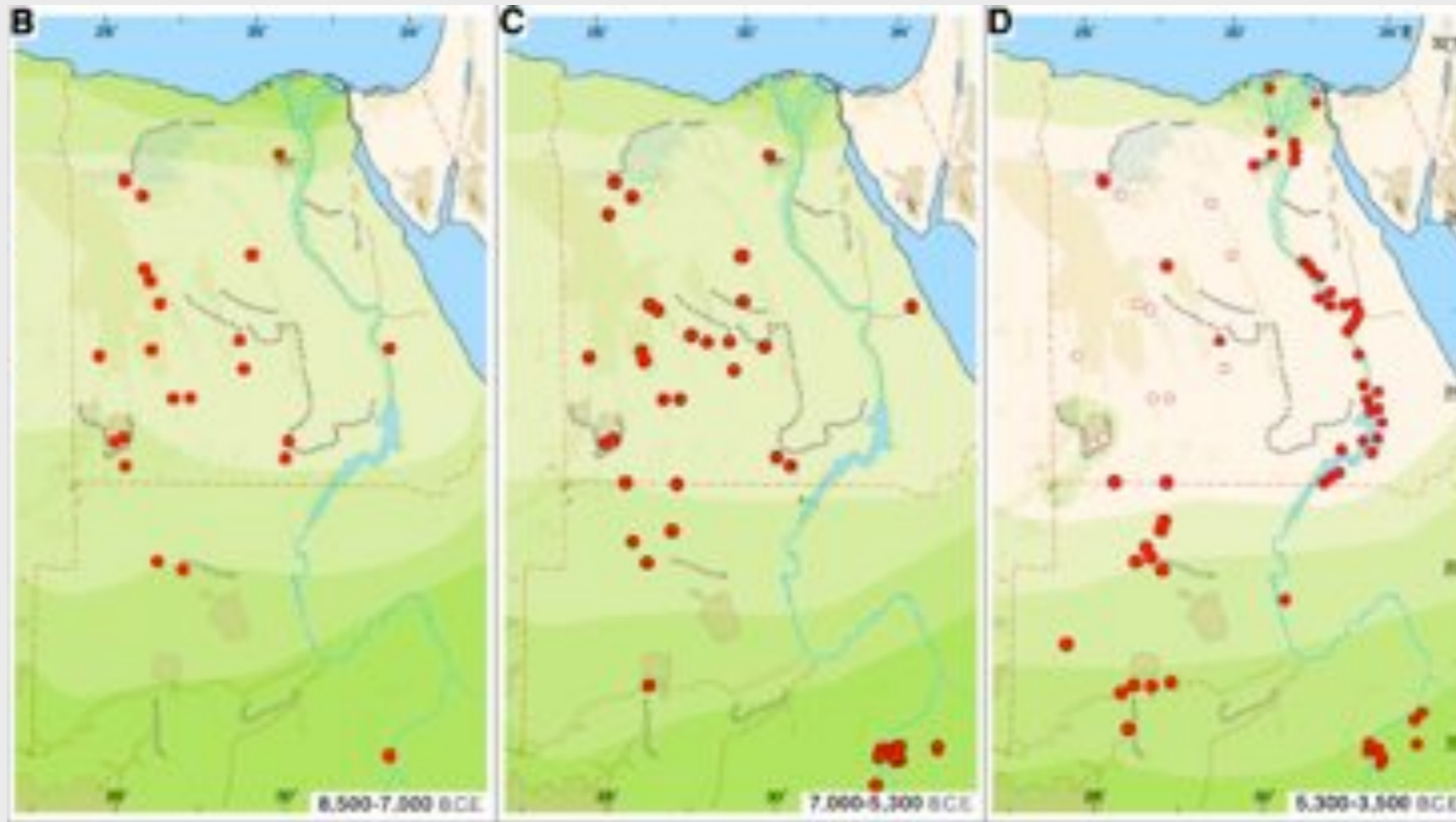
¹⁴C years BP

Kuper and Kroepelin, 2006

Migration to Nile Valley after 5 ka BP

African Humid Period

...to the Nile



10,000 yrs BP

Hunter-Gatherer
Pastoralism

8,000 yrs BP

Multiresource
Pastoralism

5,000 years BP

Sedentary
Specialized
Pastoralism

Predynastic Egypt (5200-5000 yr BP)

Naqada III period

Named Kings, State formation, political unification

- The first hieroglyphs
- The first graphical narratives on palettes
- The first regular use of serekhs
- The first royal cemeteries
- Possibly, the first irrigation

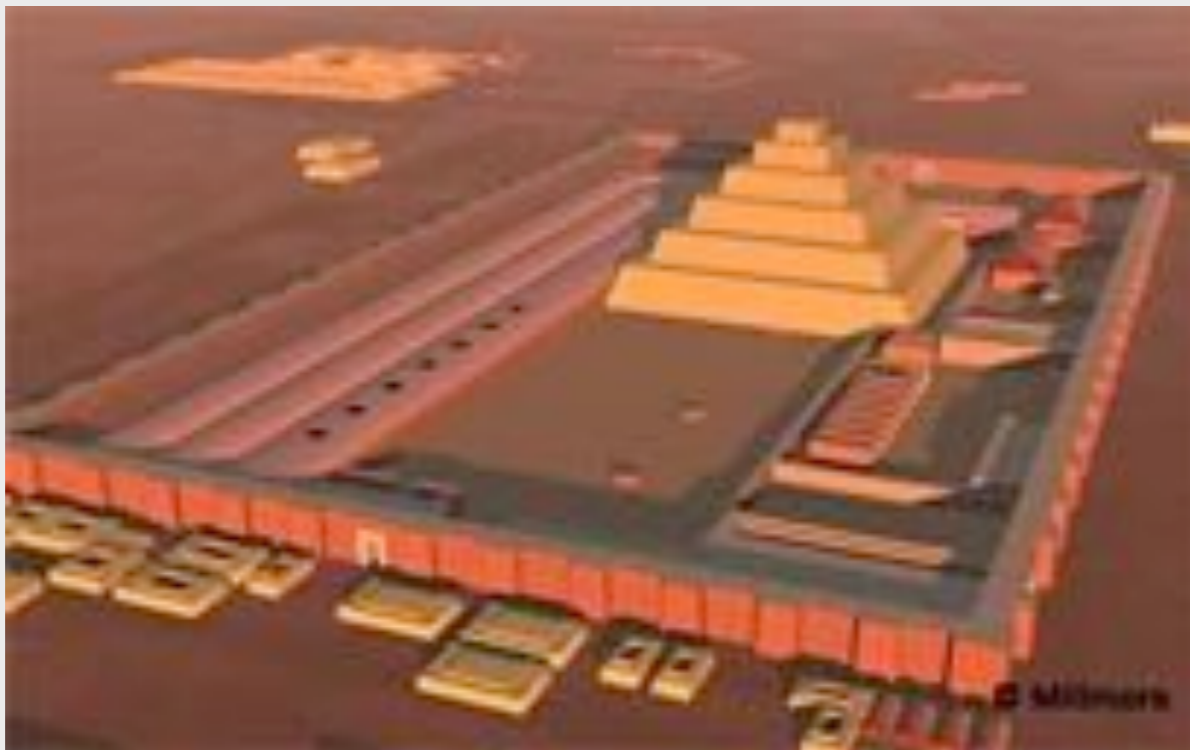


Narmer Palette



Serekh of Pharaoh Djet

Oldest known stone building complex (ca. 4700 y BP)



Necropolis complex
(Djoser) at Saqqara.

Vast burial ground for the
first Pharaohs.

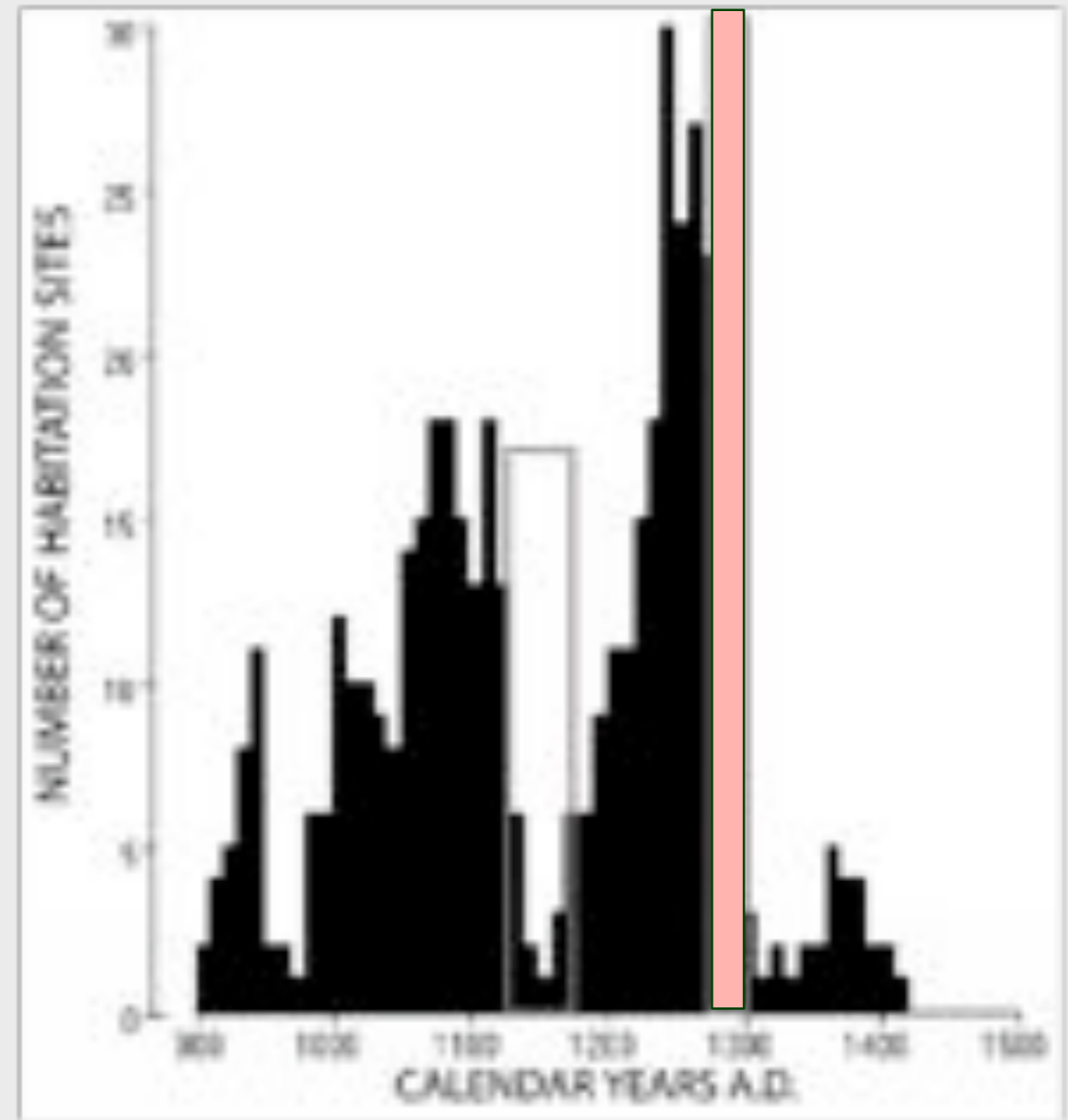
<http://www.saqqara.nl>

Collapse: The Anasazi



“Four Corners” region of the SW United States
Ancestors of modern Pueblo people

Collapse: The Anasazi



terminal collapse
~1280 AD

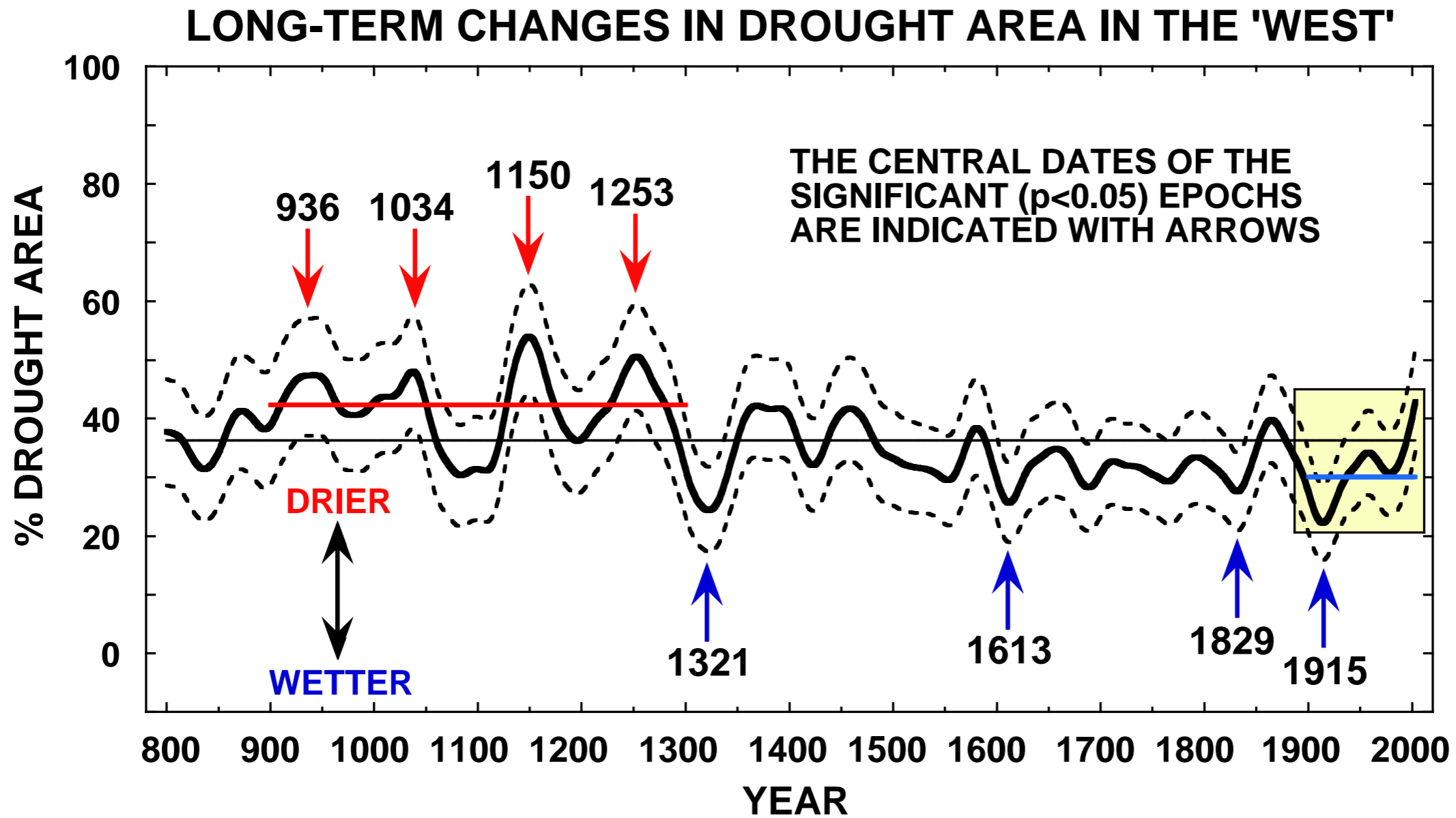
What happened?



Tree ring records of past hydroclimate changes



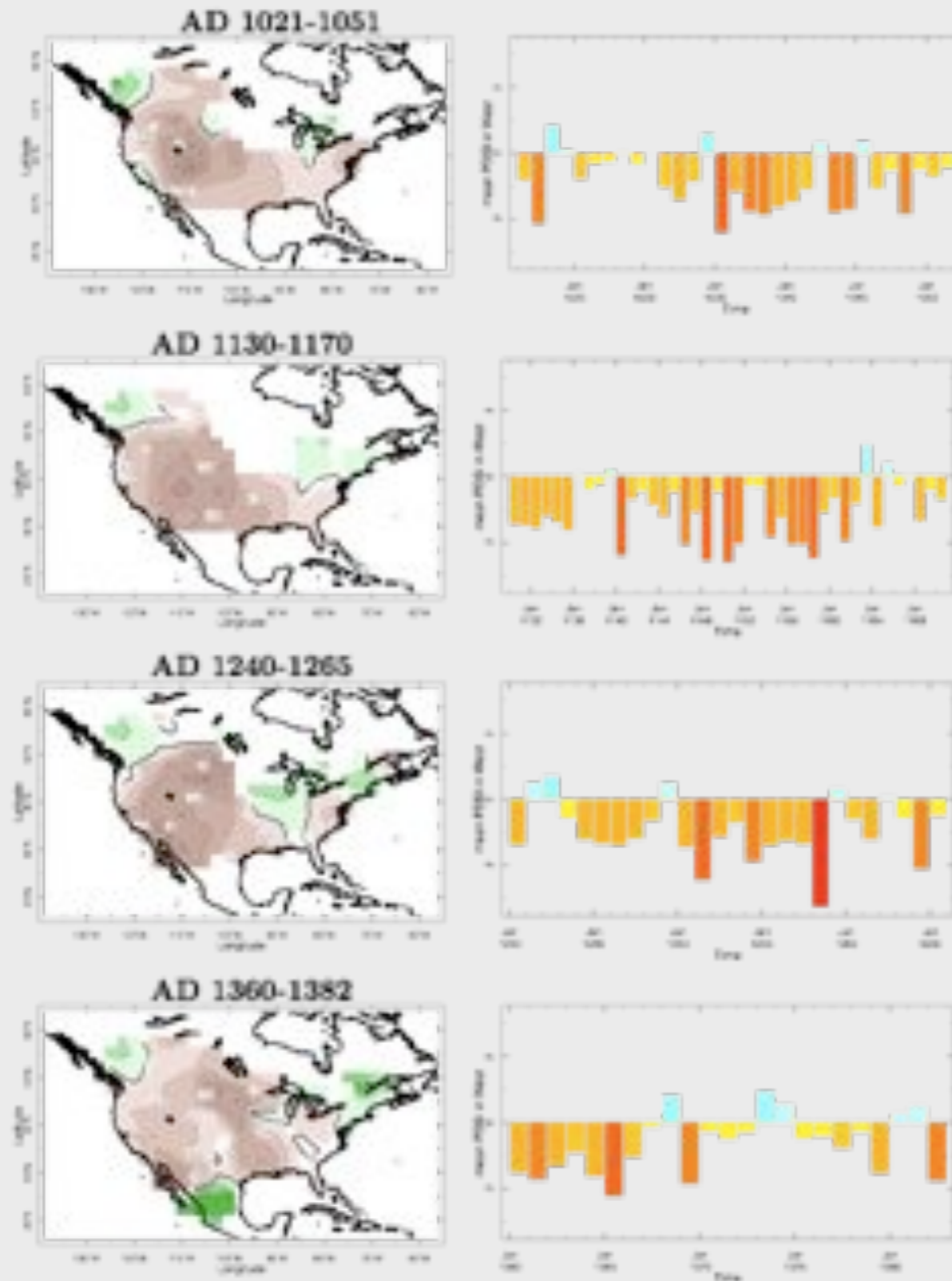
Megadroughts



Medieval Droughts: Many decades long !

Megadroughts

MCA droughts

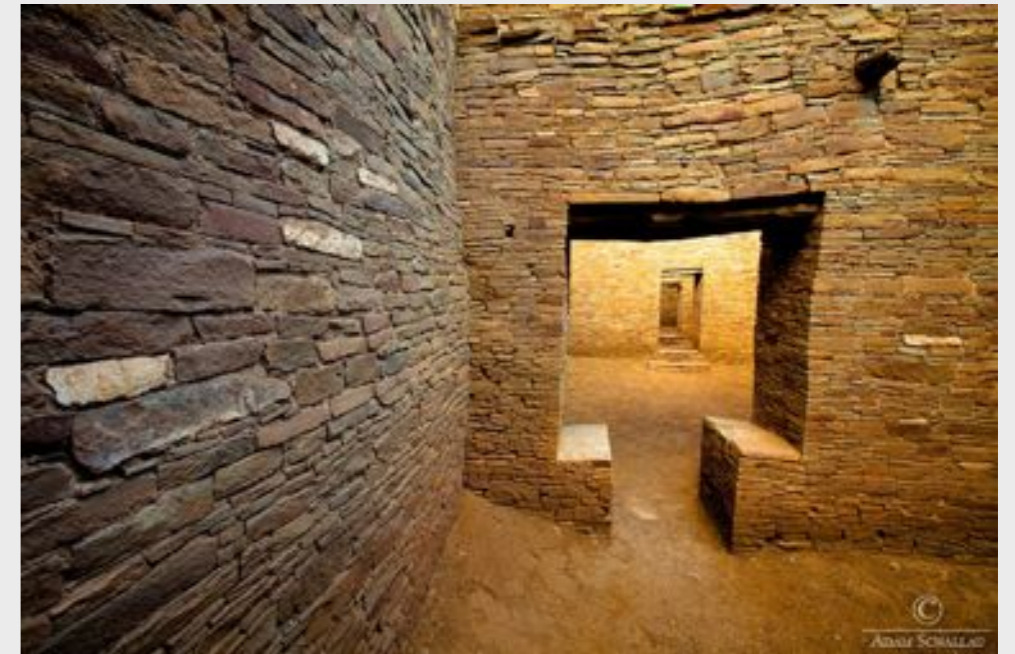


Droughts lasted 20-40 years.

The “Great Drought” in late 1200s lasted 26 years



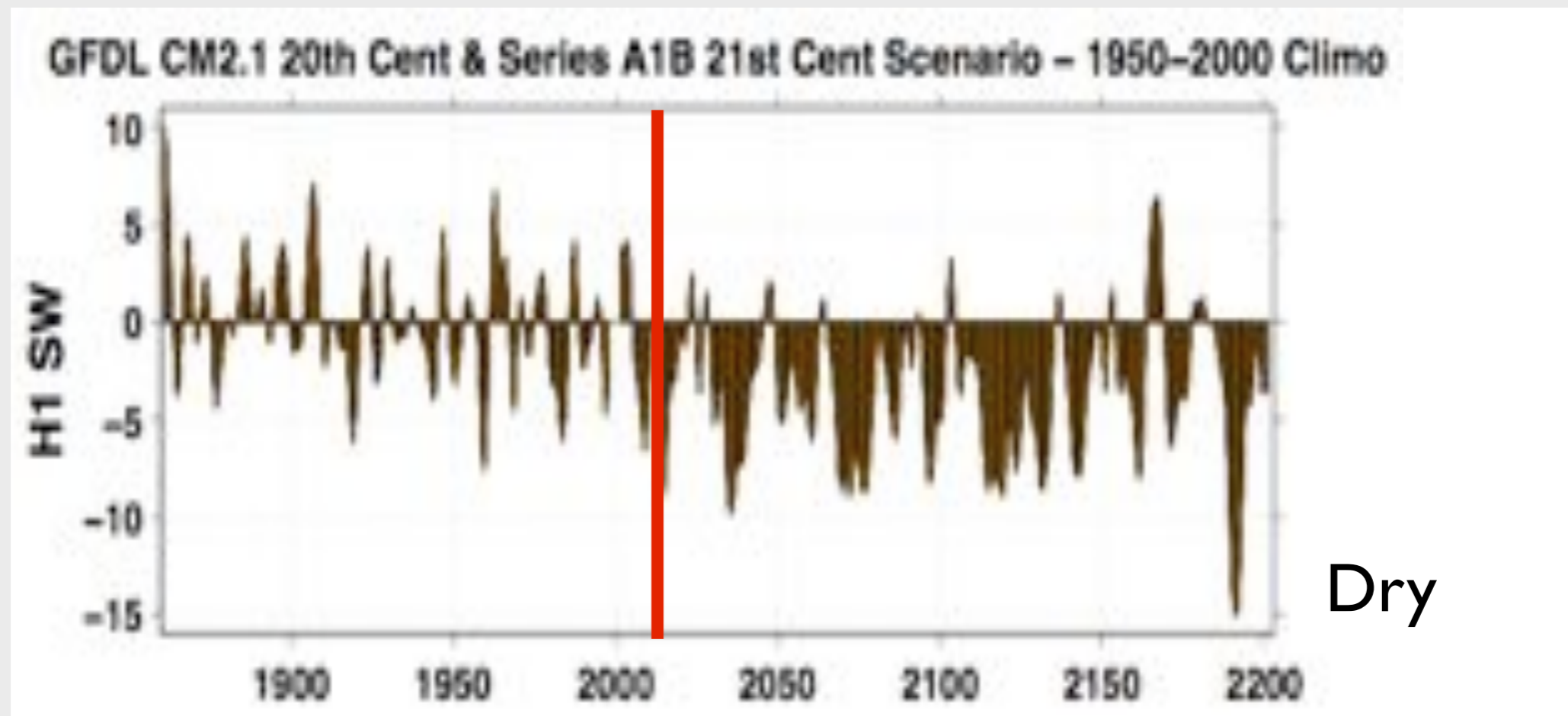
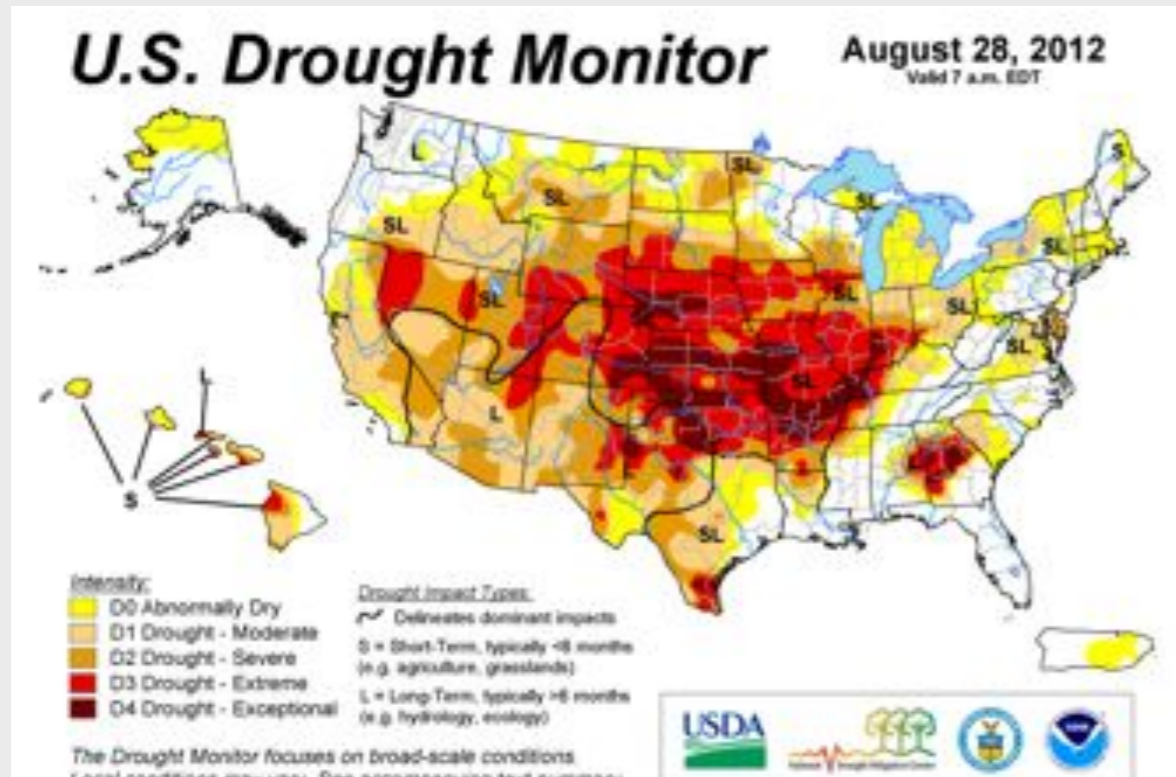
Pueblo Bonito (New Mexico)



Abandoned 1126 AD



Fast forward to the Present !



- Civilizations responded to climate change:
 - adaptation, migration, or collapse

Merci !

