

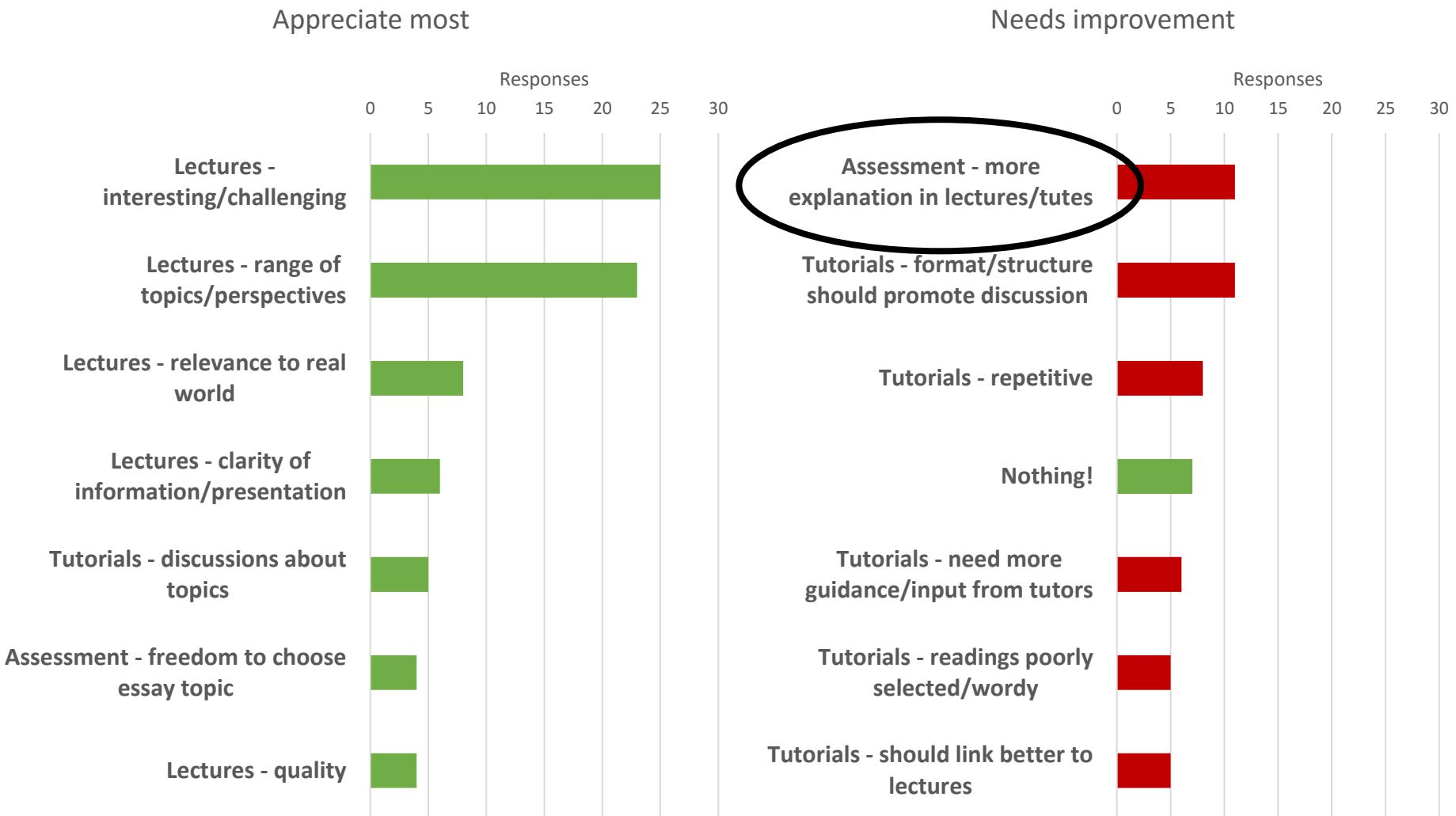


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# Famine: the Geography of Scarcity

## Collapse of Civilizations

# Survey results



# You asked for it...

- **New essay deadline – 3<sup>rd</sup> May at 11:59 pm**
- Essay question: *Does Karl Butzer's model for historical collapse (Butzer 2012, Fig. 1) adequately account for the factors involved in **more recent** food security crises, or are other explanations, such as environmental determinism, more relevant to the newer famines?*
  - Butzer's model – theory based on historical data
  - Environmental determinism – competing theory
  - Your case study – a ‘new’ famine to test theories

# Butzer's model

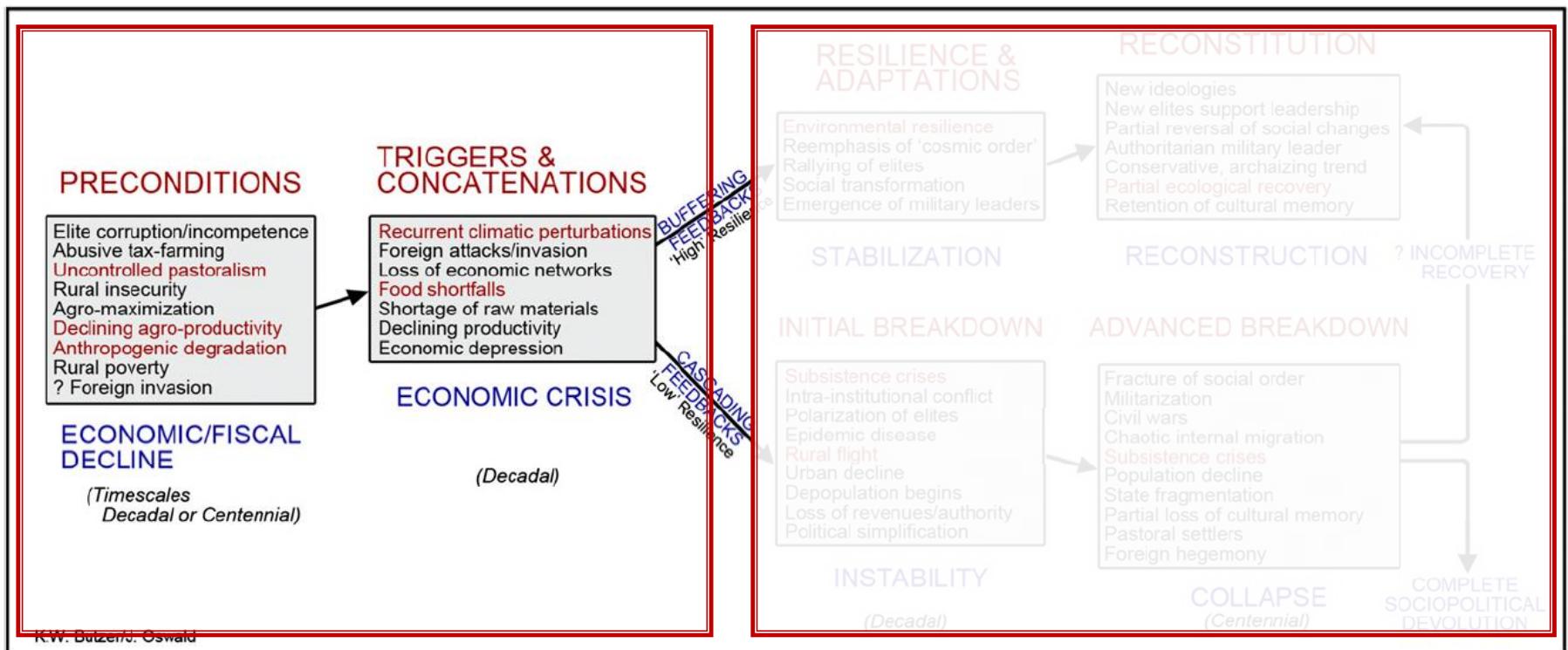


Fig. 1. A conceptual model for historical collapse, situating the variables and processes of stress and interaction discussed in the text. Timescales range from multidecadal to centennial. Alternate pathways point to important qualities of resilience. Red superscripts identify stages that are elaborated by blue subscripts. Environmental components (red within boxes) are secondary to sociopolitical factors.

# Suggested structure

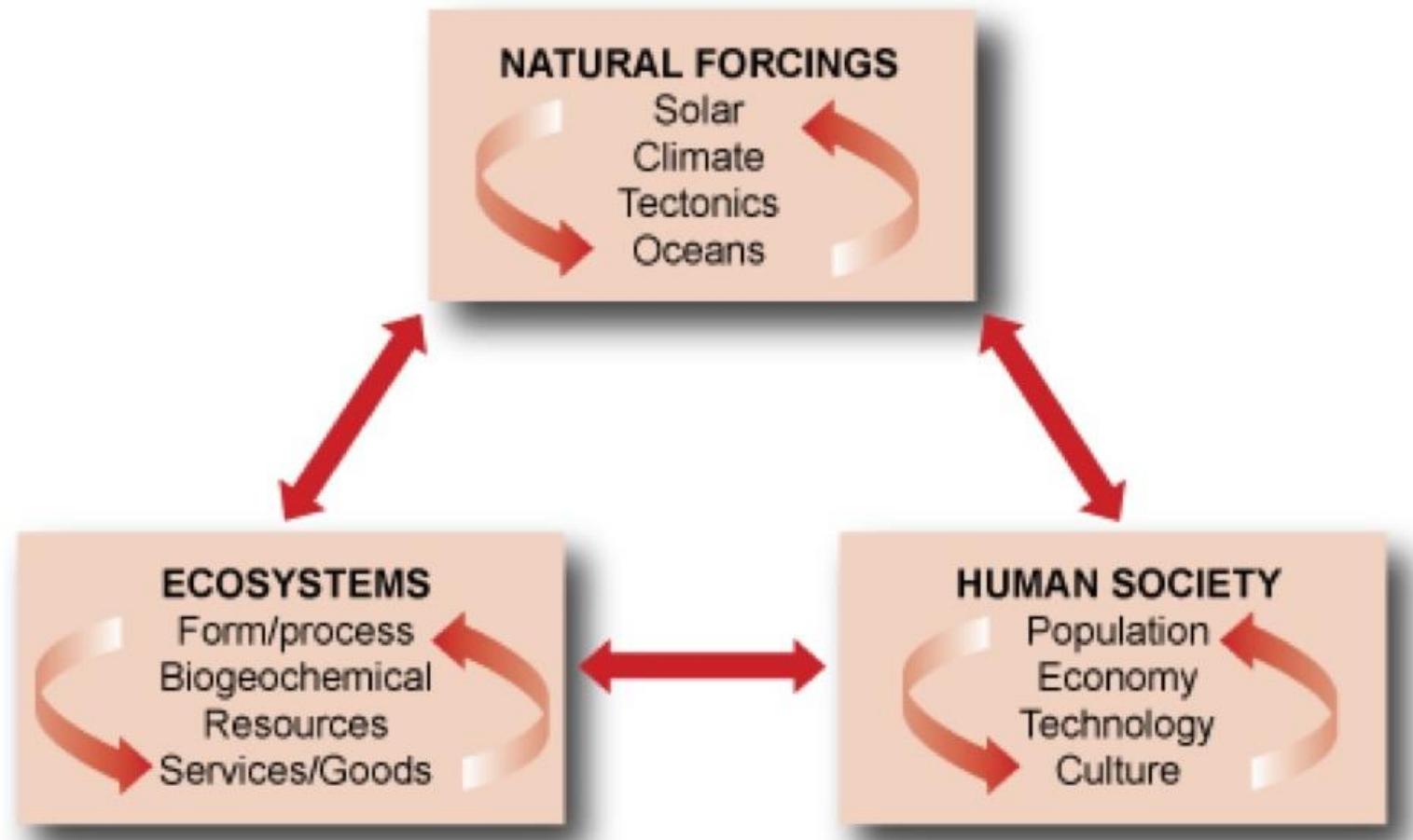
You may structure your essay as a scientific report:

1. Aim – What is the **big** question? What are the competing theories?
2. Methods – Which famine did you research? How?
3. Results – What does the literature say about it?
4. Discussion – Which theory best explains the famine? Are important aspects missing?
5. Conclusion – How do your findings link to the Aim?

# Environmental Determinism

- *Environmental determinism* – cultures are the product of their environment
- *Cultural determinism* – cultures exploit their environment, but are not shaped by it
- Haven't you heard this kind of thing before?

# A minefield of interactions



# Nelson et al. (2016)

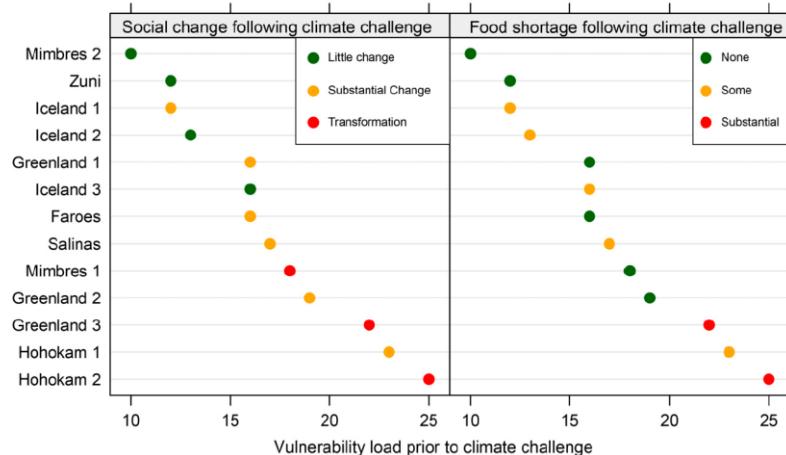
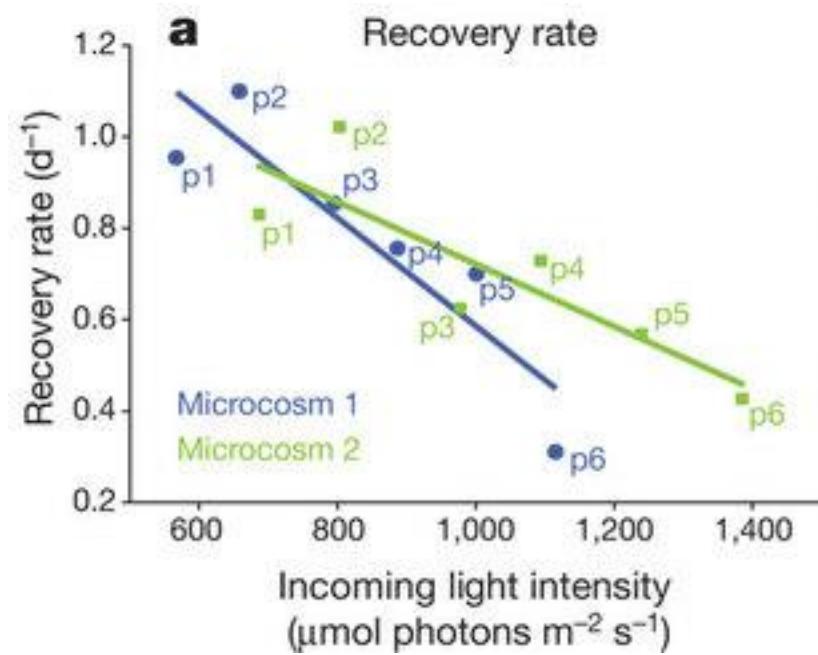
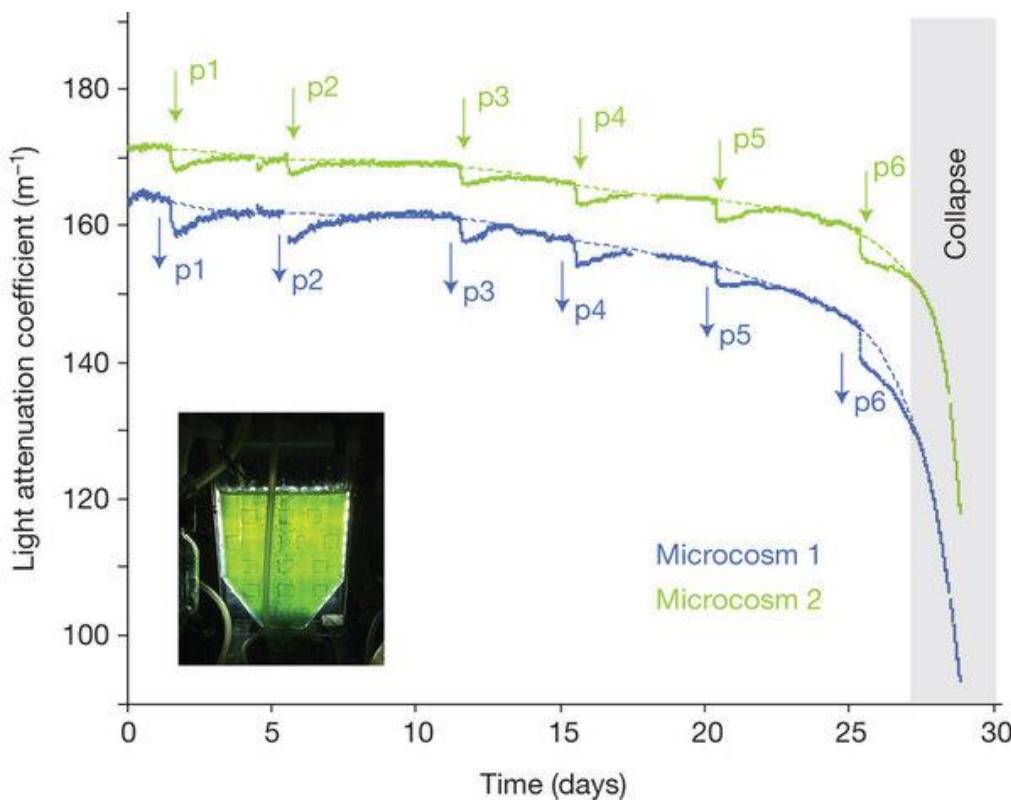


Table 2. Variables contributing to vulnerability load to food shortage

Vulnerability variables	Evidence for vulnerability	Value of variable for resilient food system
Population–resource conditions		
Availability of food	Insufficient calories or nutrients	Balance of available resources and population size reduces risk of shortfall
Diversity of available, accessible food	Inadequate range of resources responsive to varied conditions	Diverse portfolio reduces risk, increases options (9)
Health of food resources	Depleted or degraded resources, habitats	Healthy habitats contribute to managing risk and change (26, 49)
Social conditions		
Connections	Limited connections with others experiencing different conditions	Social networks expand access to food and land (26) and are sources for risk pooling (49)
Storage	Insufficient, inaccessible storage	Stored foods reduce risk in times of shortage
Mobility	Inability to move away from challenging food conditions	Movement to alternative places, landscapes, and social groups offers potential for addressing resource shortfall through access to food/land (49)
Equal access	Unequal control and distribution of land, water, and food resources	Equal access avoids challenges to coping and adaptive capacity in disaster risk management
Barriers to resource areas	Physical barriers limiting access to key resource areas	Lack of barriers enhances capability of people to provision themselves with food

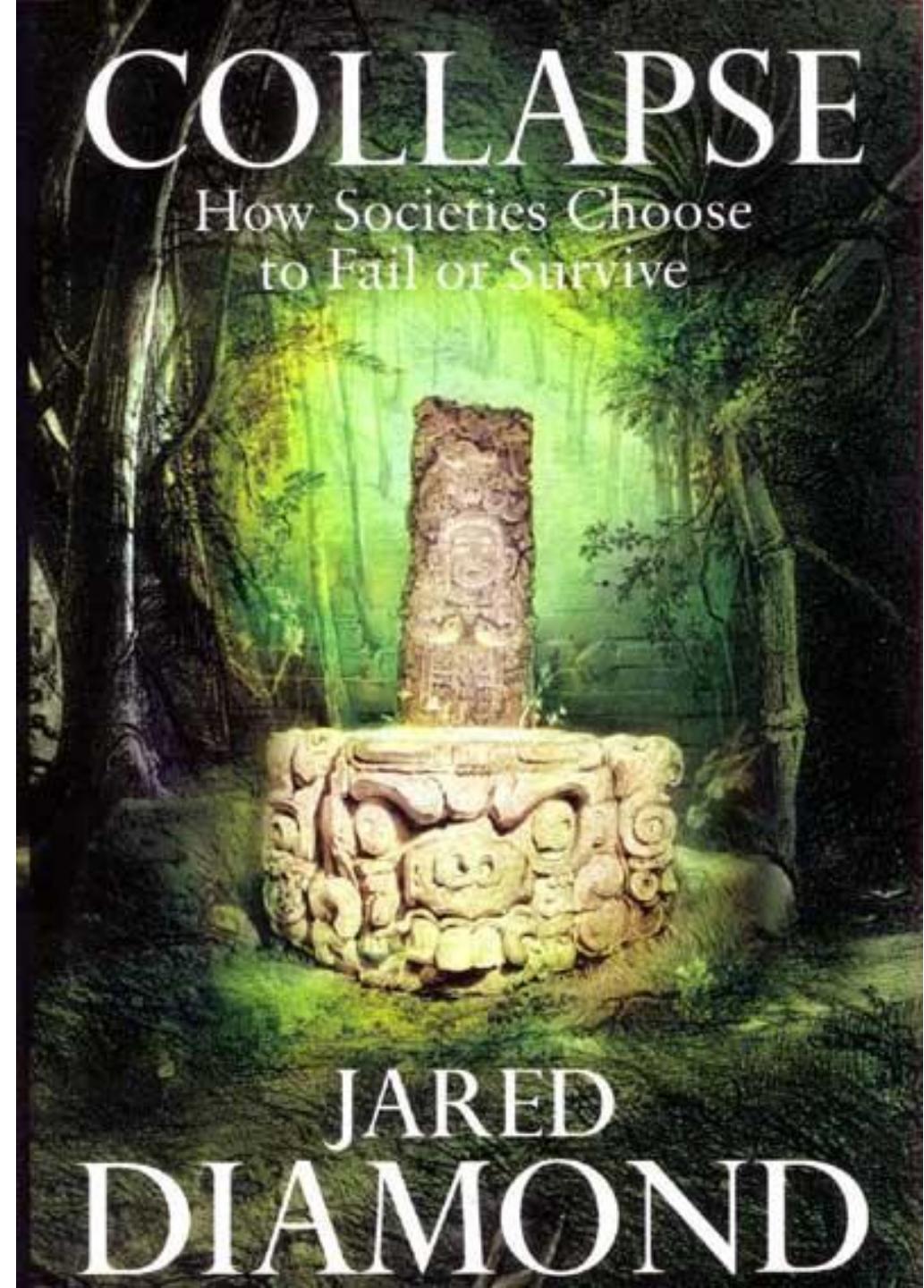
# Resilience

- Even the simplest ecosystems are resilient to disturbance, but there are limits!



# Today's lecture

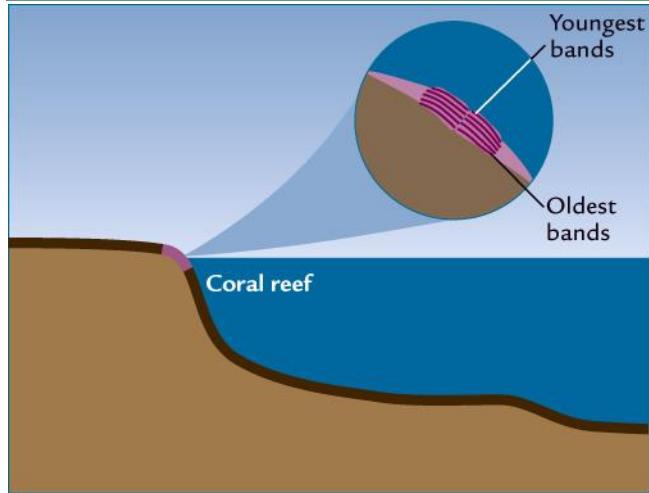
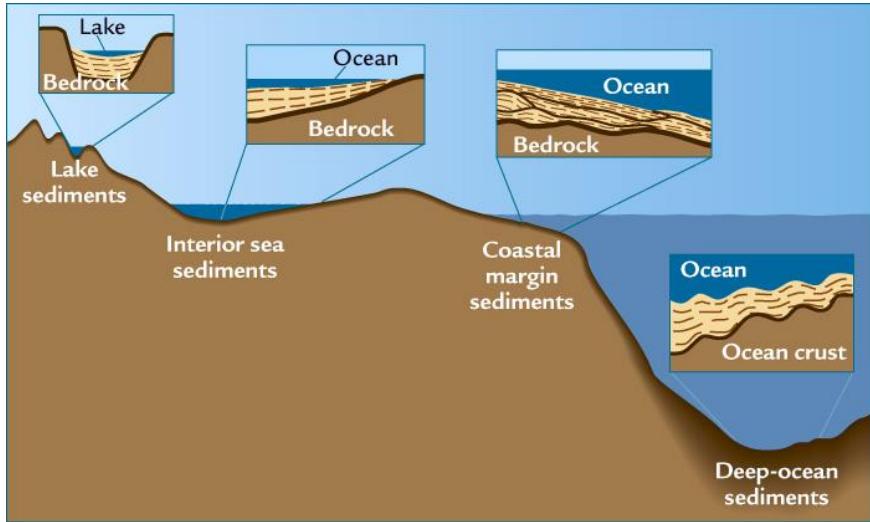
- Climate change, famine and the collapse of civilisations
- How do we know?
- Examples from the past
- Lessons for the future



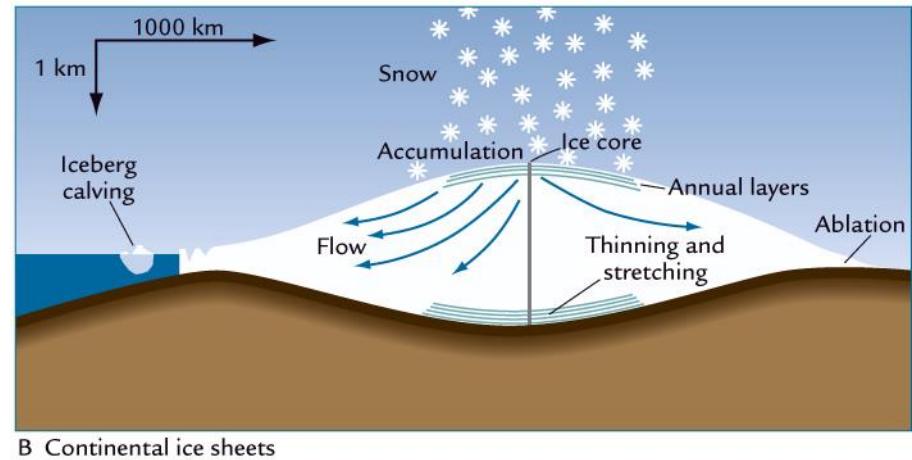
# How do we know what the climate was doing before we started collecting weather data?



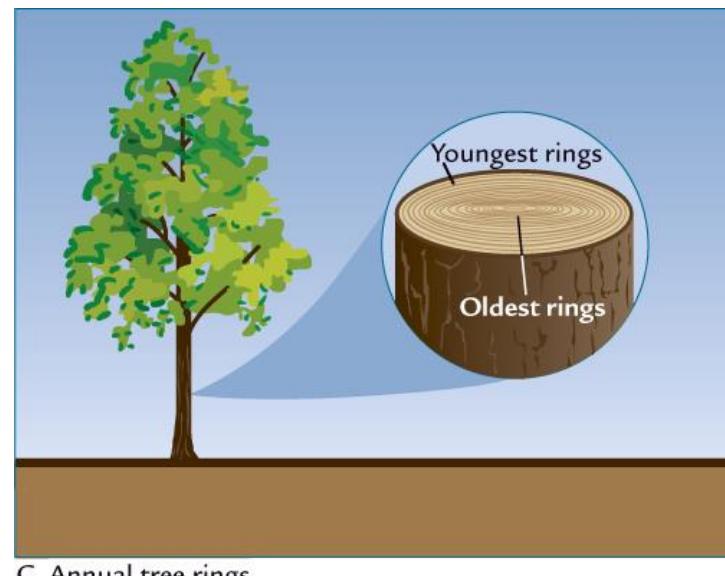
# Our knowledge of past climate is derived from ‘natural archives’



D Annual coral bands



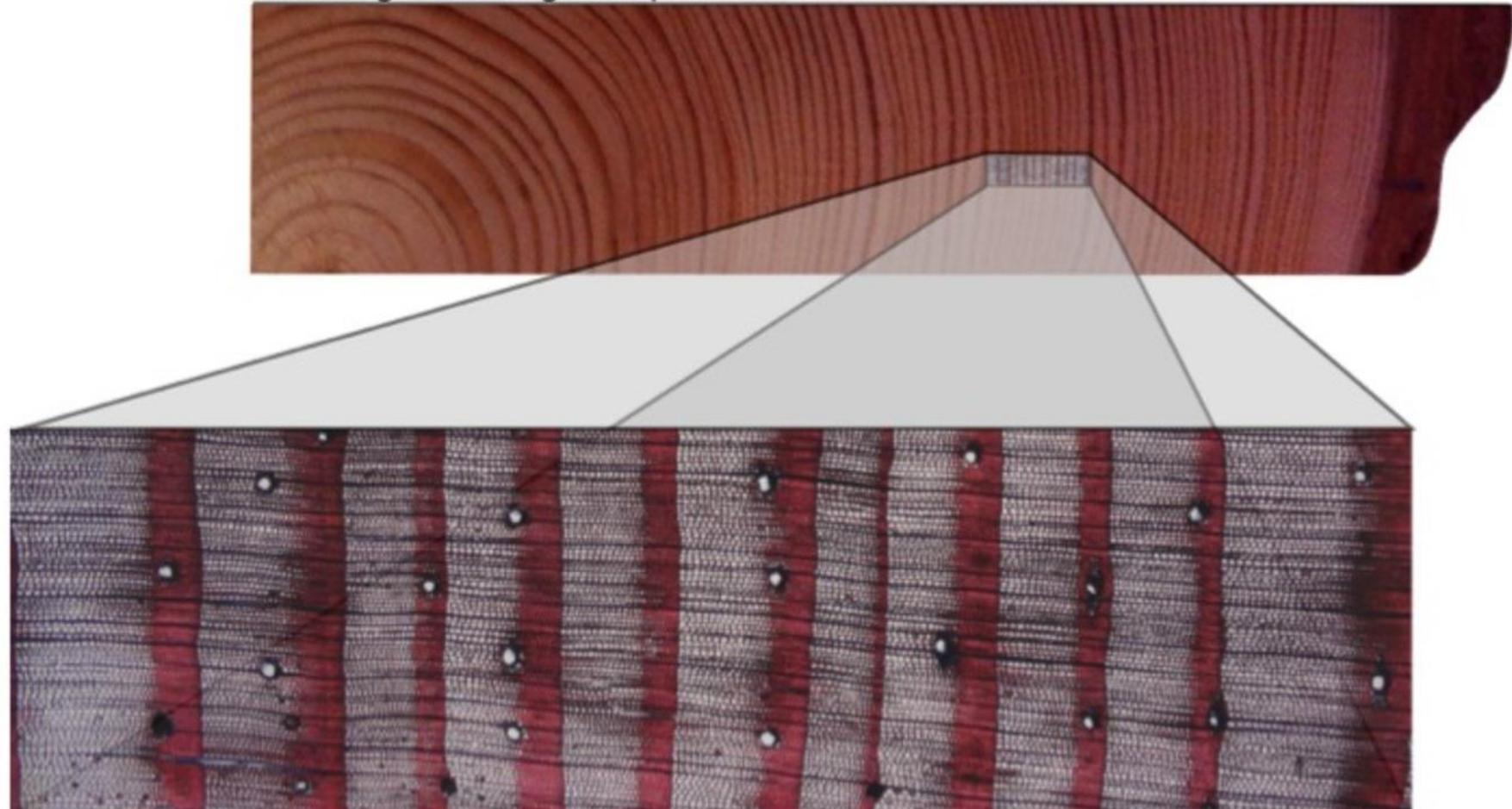
B Continental ice sheets



C Annual tree rings

# Tree rings

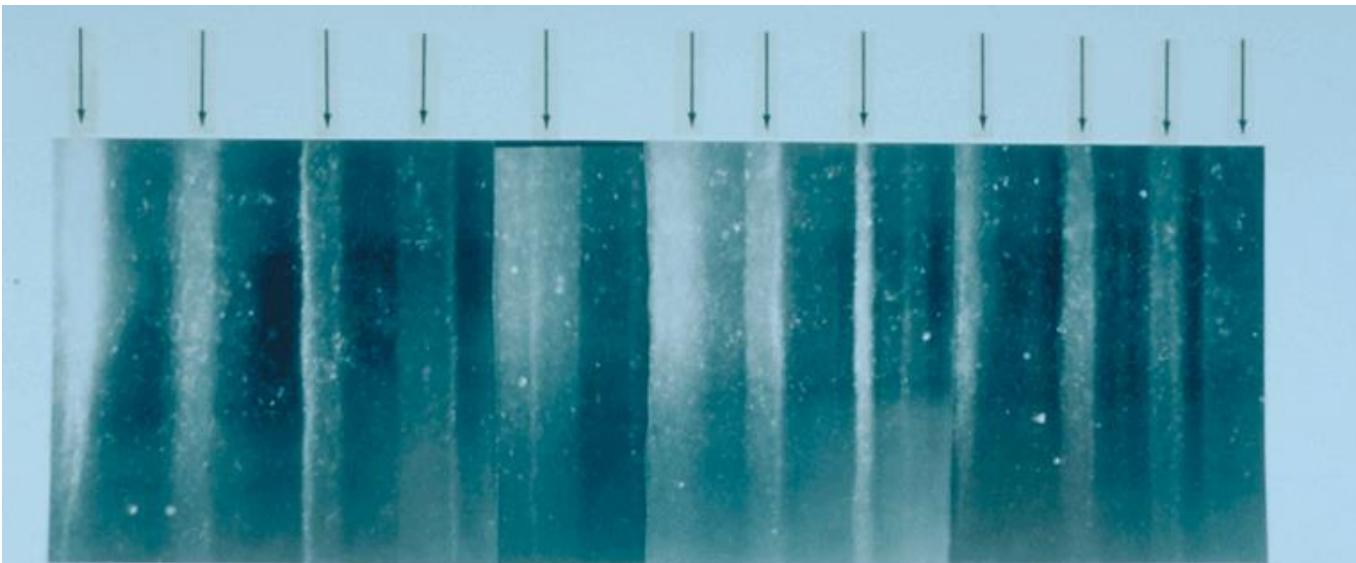
Annual growth rings of a pine tree from Switzerland.



1970

1980

# Ice cores

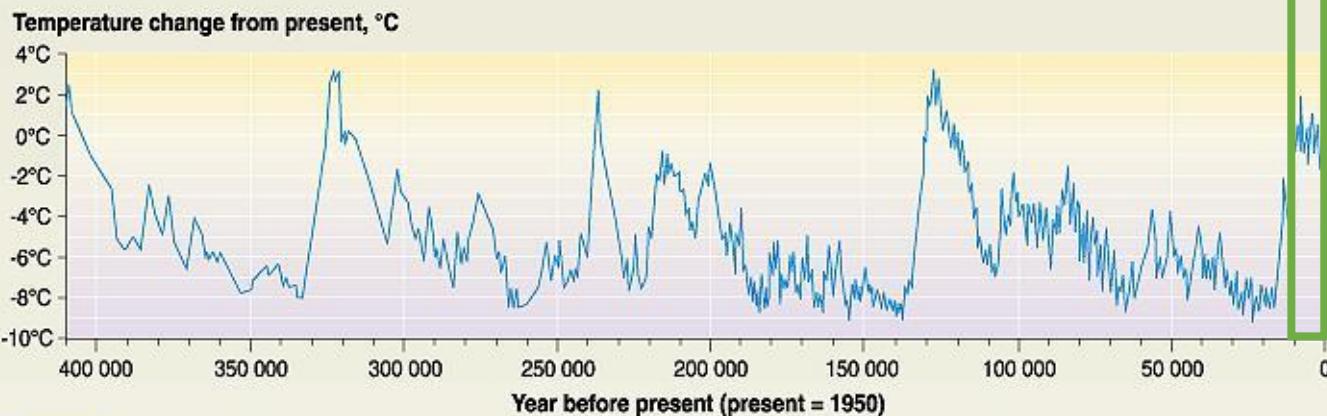
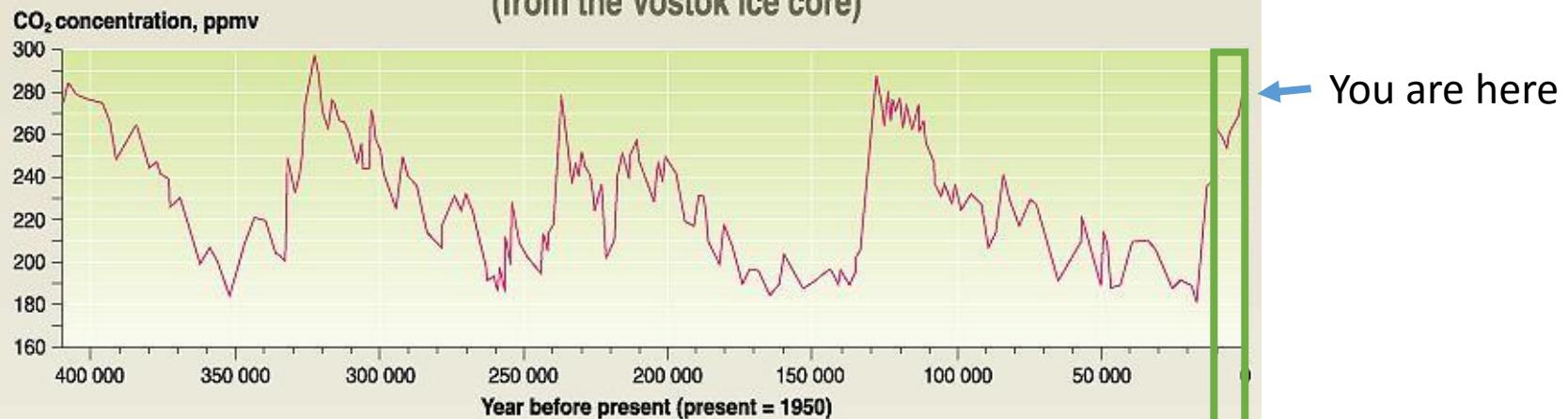


19 cm long section of GISP 2 ice core from 1855 m showing annual layer structure illuminated from below by a fiber optic source. Section contains 11 annual layers with summer layers (arrowed) sandwiched between darker winter layers.

# Past variability

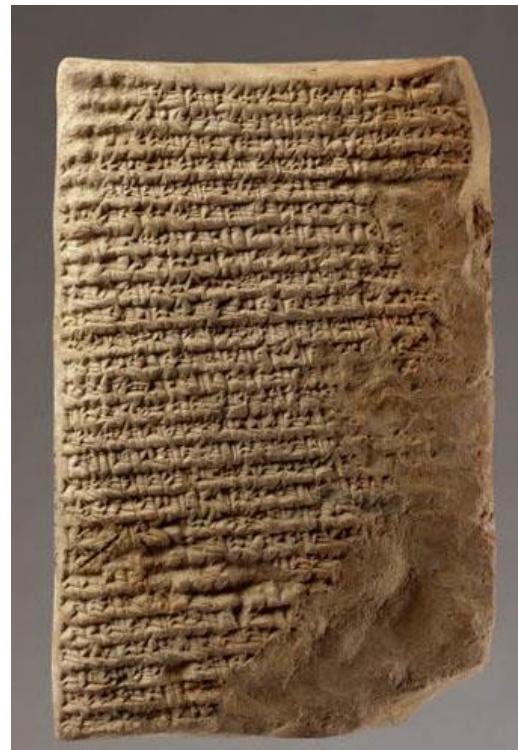
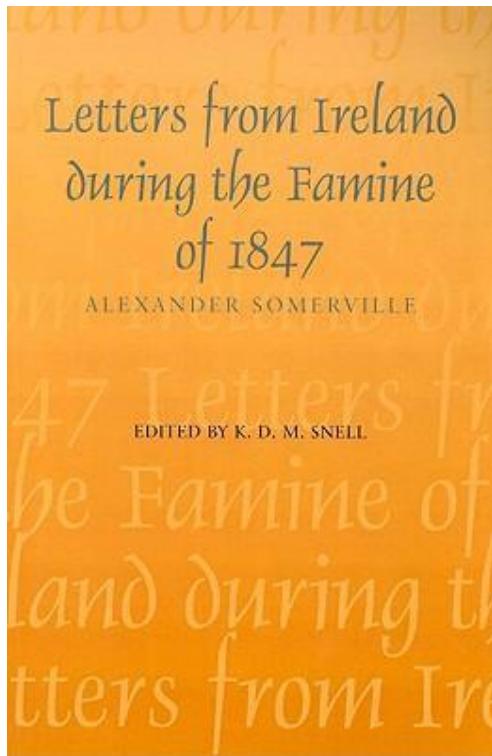


Temperature and CO<sub>2</sub> concentration in the atmosphere over the past 400 000 years  
(from the Vostok ice core)



# Historical records

- Documents, photos, sketches, diary entries, etc. provide important evidence for past climate (and the human condition, including famine and its social context)



Musée du Louvre/Raphaël Chipault.

# Historical records – Rhone Glacier

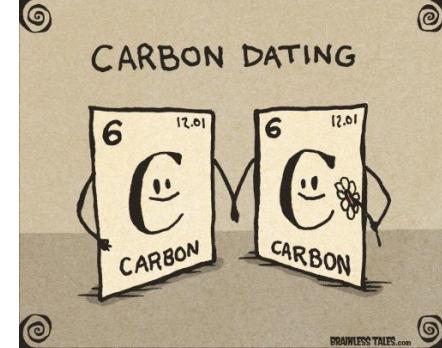


# Archaeology

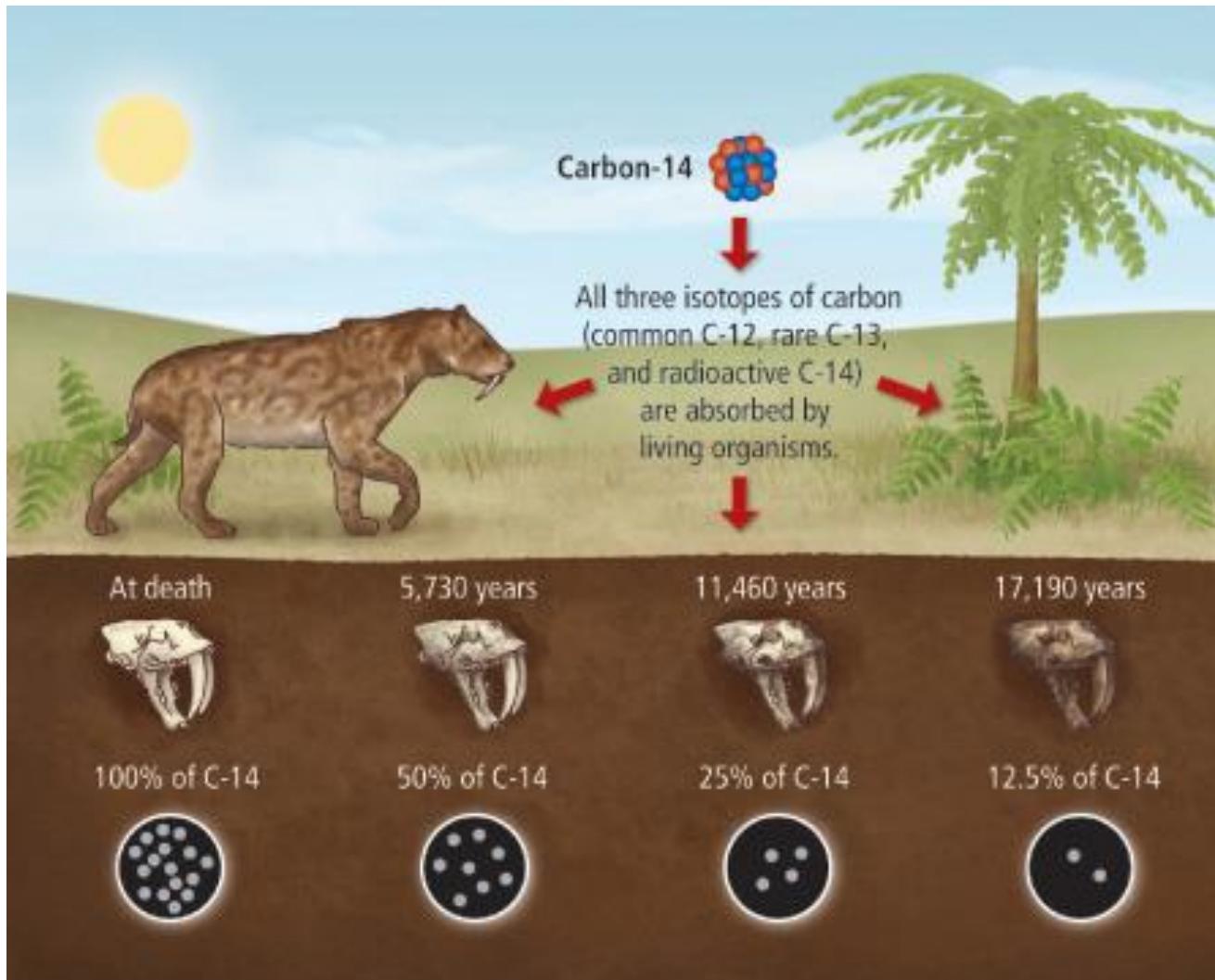
- Evidence of how human populations lived can be inferred from the archaeological record
- Palaeoanthropologists can deduce population nutrition and disease
- Palaeobotanists and palaeozoologists can reconstruct diet
- Cultural changes can be compared to palaeoclimatic data to decide whether famine has occurred



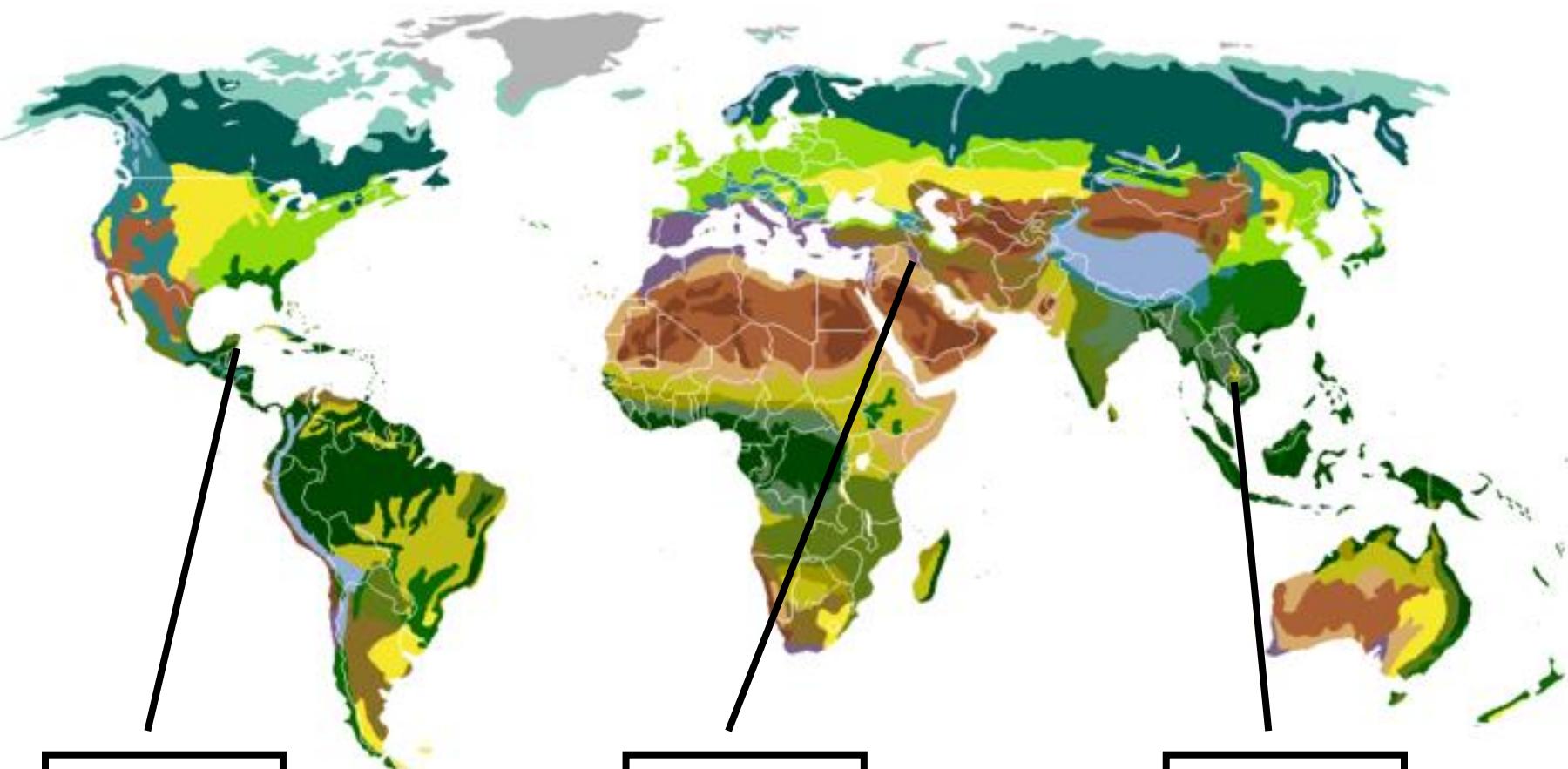
# Archaeology – dating



- Archaeological sequences are usually dated by radiocarbon methods ( $^{14}\text{C}$ ), which is performed on carbon-bearing remains buried with artifacts
- Problems with contamination, cost and calibration



# Three examples of collapse



Classic  
Maya

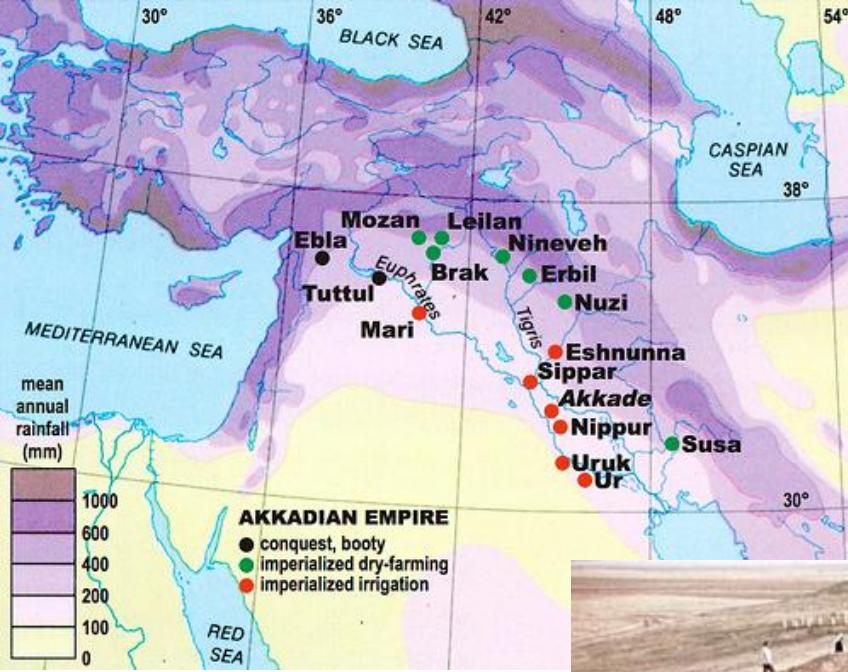
Akkadian  
Empire

Khmer  
Empire

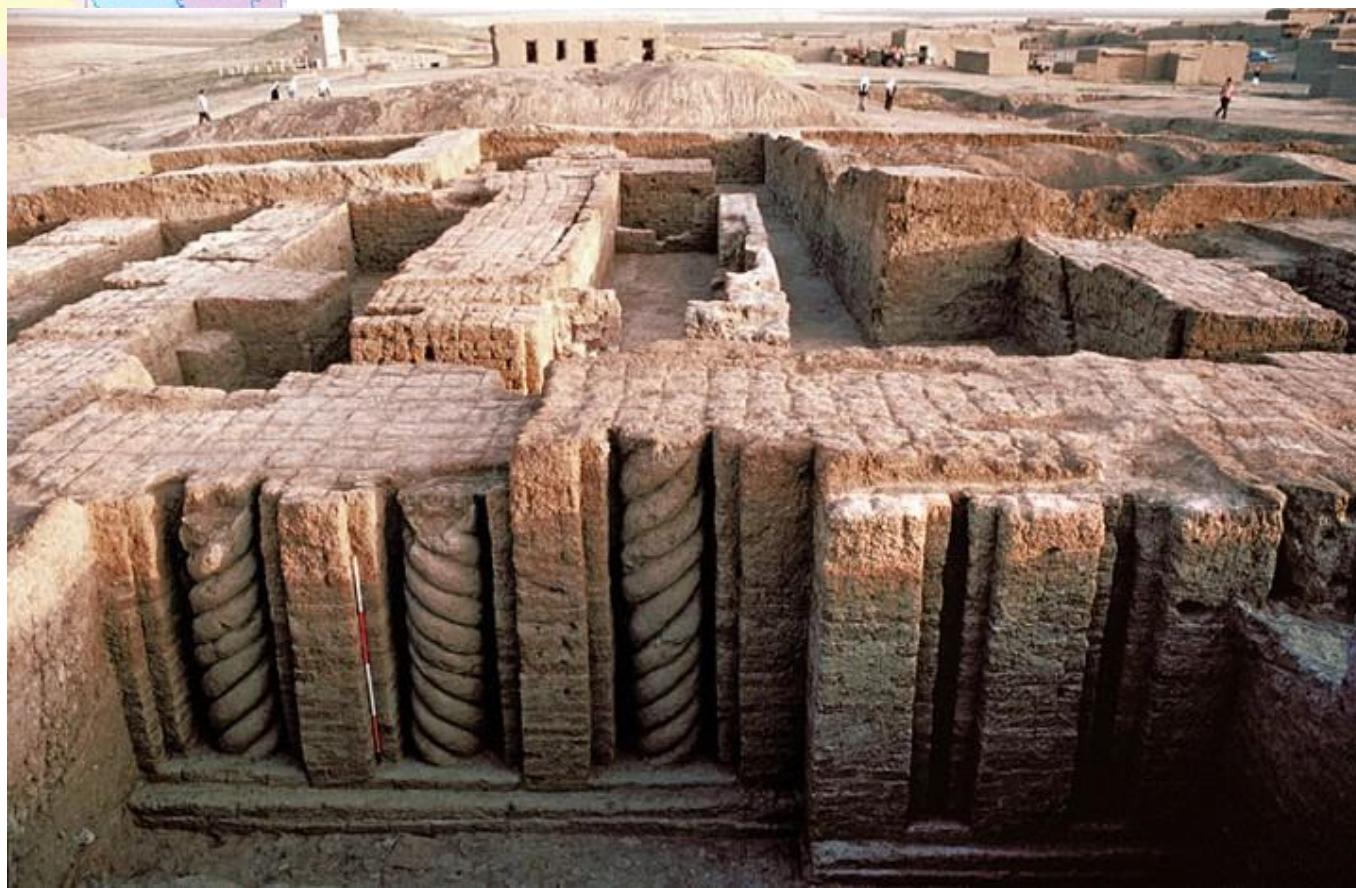
# Collapse of the Akkadian Empire

- Akkadian Empire flourished in Mesopotamia (Iraq) under the reign of Sargon (2334-2279 BC)
- Economy based on raid-fed agriculture in the north and irrigation in the south
- Collapse of the Empire 2154 BC
- Coincides with abandonment of Tell Leilan, Syria





# Tell Leilan, Syria



# Tell Leilan (northern Syria)



Cooking ovens



Excavated house foundations  
Main street near the Acropolis

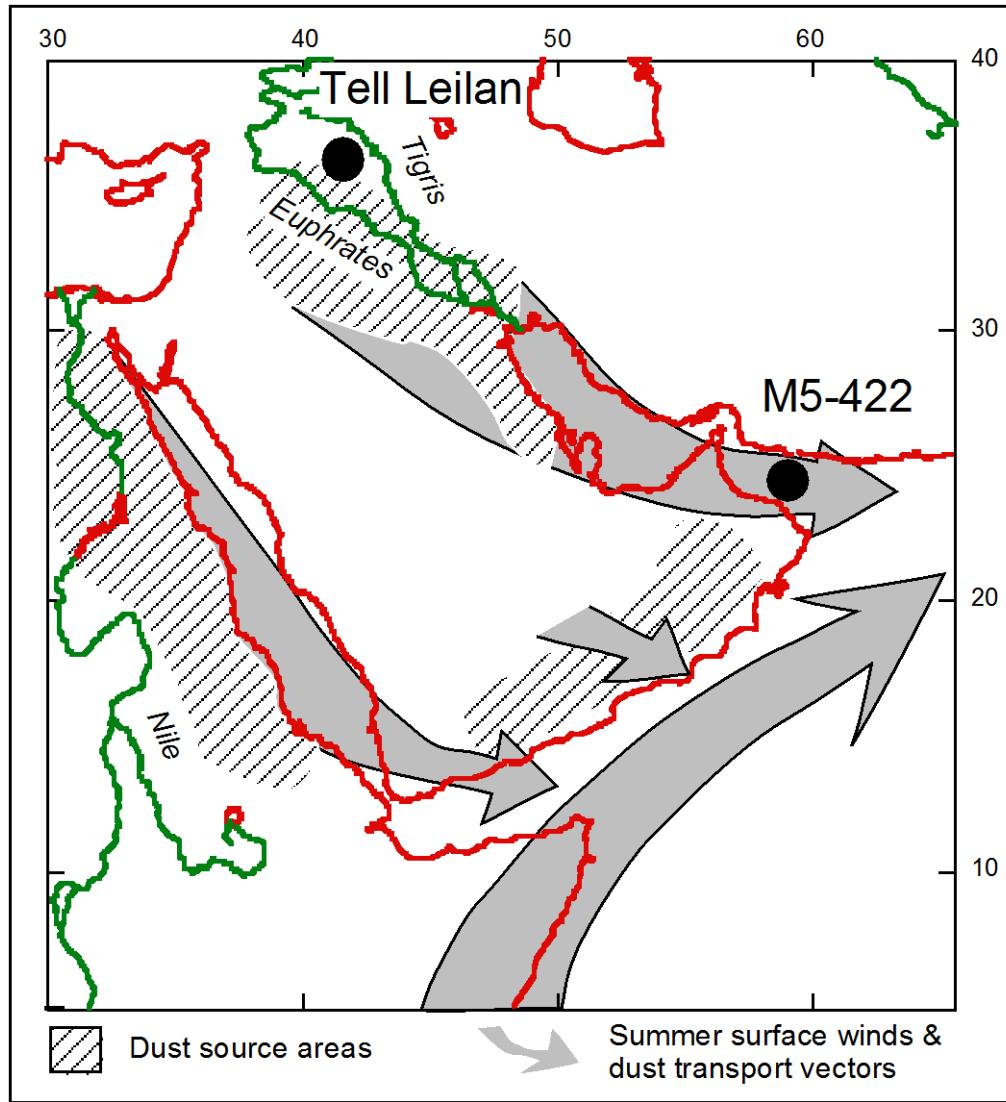


Photos courtesy of H Weiss, Yale University

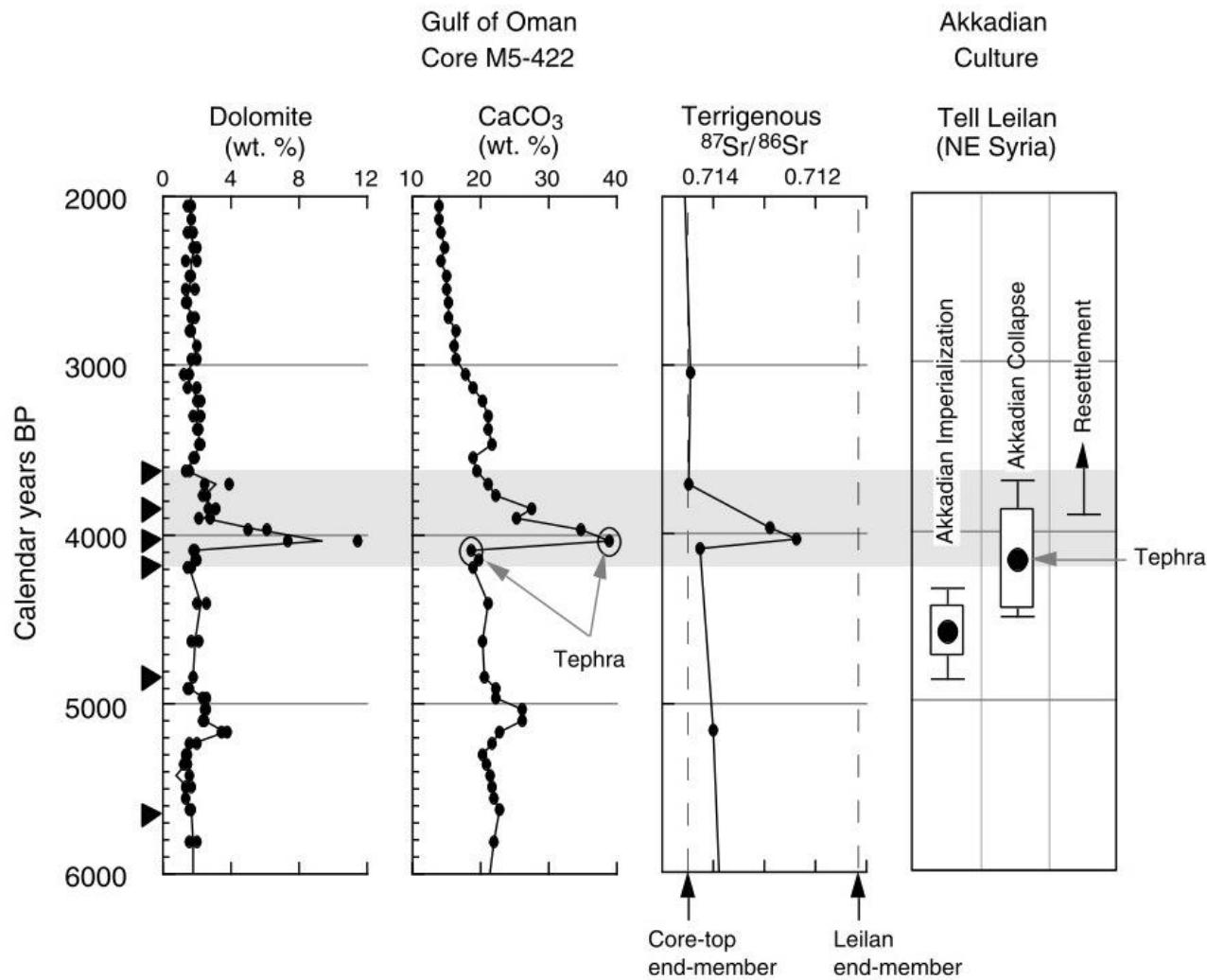
# The story of Tell Leilan

- Tell Leilan was home to 20,000 people
- A walled city with palace, temple and substantial granaries
- Excavated since 1979 by Harvey Weiss and teams from Yale University
- Settlement layers covered in a 1-m thick layer of sand and dust, containing no signs of habitation
- Abandonment dated to  $4170 \pm 150$  yr BP
- Political disintegration or environmental change?

# Enter the scientists



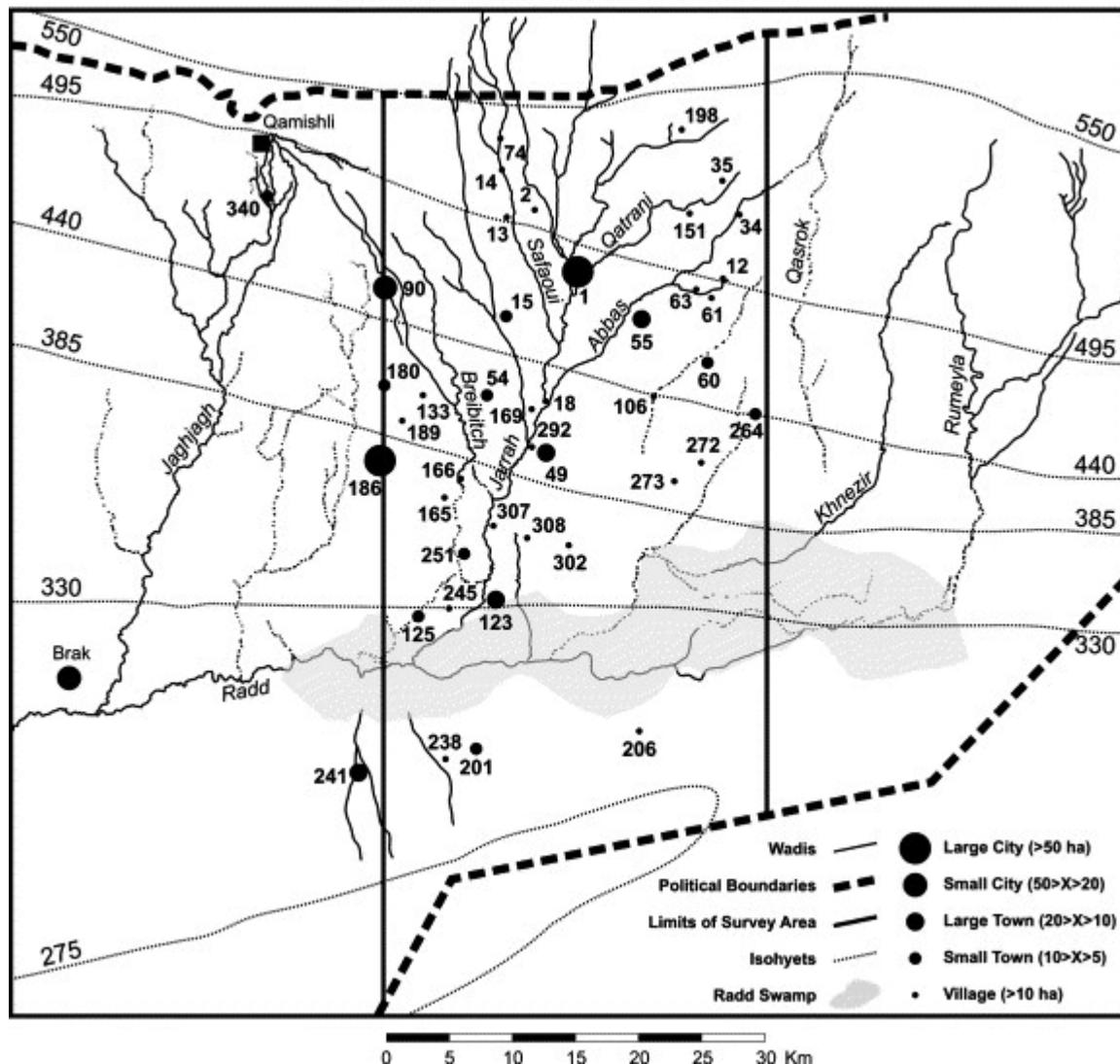
# Marine core M5-422



# Tell Leilan (northern Syria)

Leilan Period IIb (ca. 2300-2200 BC)

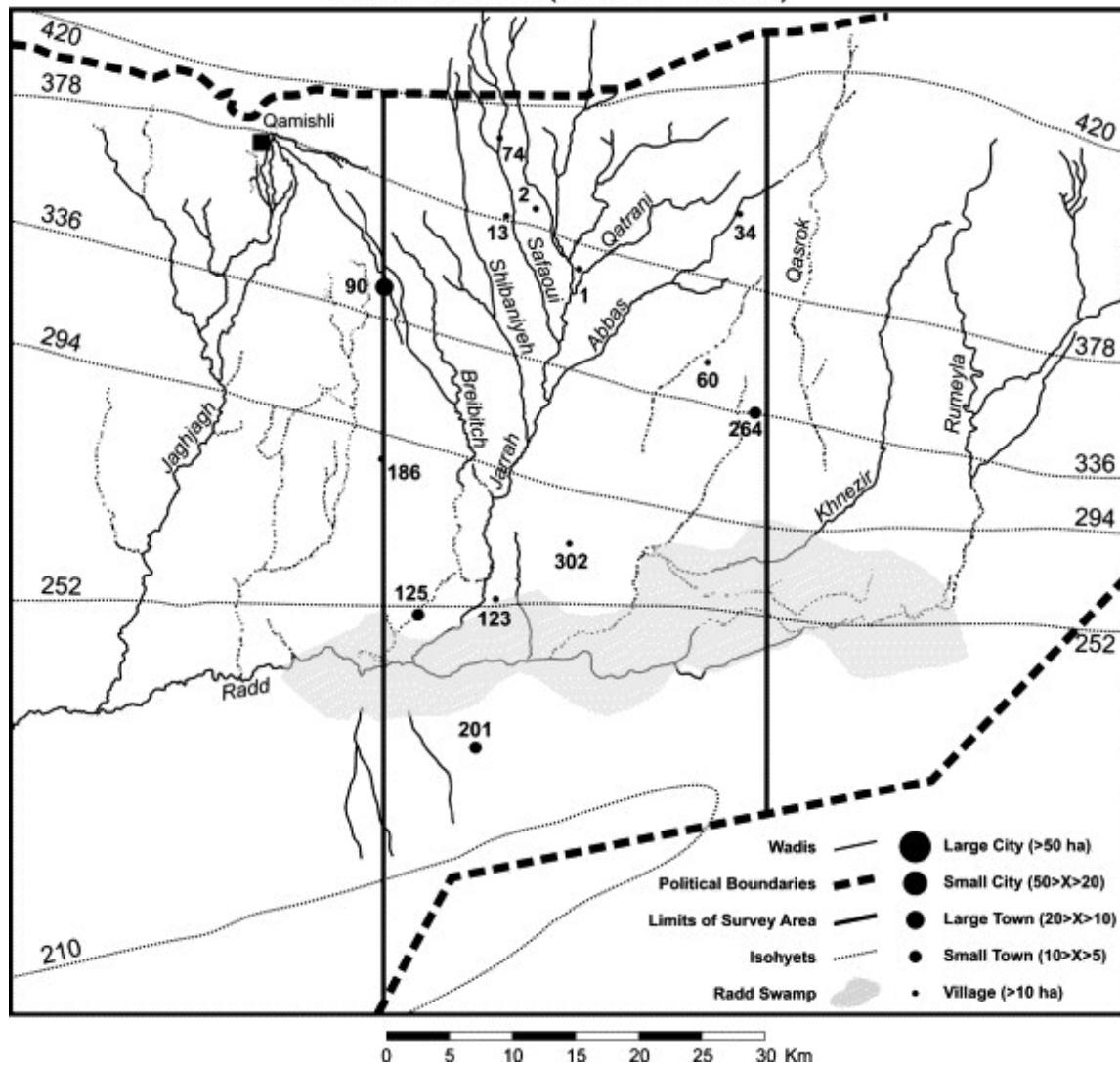
From: Staubwasser & Weiss  
(2006) *Quaternary Research*



# Tell Leilan (northern Syria)

Leilan Period IIc (ca. 2200-1900 BC)

From: Staubwasser & Weiss  
(2006) *Quaternary Research*



# The Curse of Akkad

“As if it had been before the time when cities were built and founded, the large arable tracts yielded no grain, the inundated tracts yielded no fish, the irrigated orchards yielded no syrup or wine, the thick clouds did not rain, the *mašgurum* plant did not grow... people were flailing at themselves from **hunger**.”



# Was climate change the cause?

- No doubt that increasing aridity – lasting ~300 years – was a contributing factor
- Over-reliance on rain-fed agriculture?
- Destabilisation of trade networks?
- Political turmoil?
- Inability to adapt?
- Lack of technology?
- Disease?



**How would Australia survive a 300-year drought?**

# Maya Civilisation

- Classic Maya civilisation of Mesoamerica declined around 800-900 AD
- Abandonment of major cities in south, such as Tikal
- Invasion, social upheaval, loss of trade routes, disease, drought, soil erosion and ecological collapse invoked

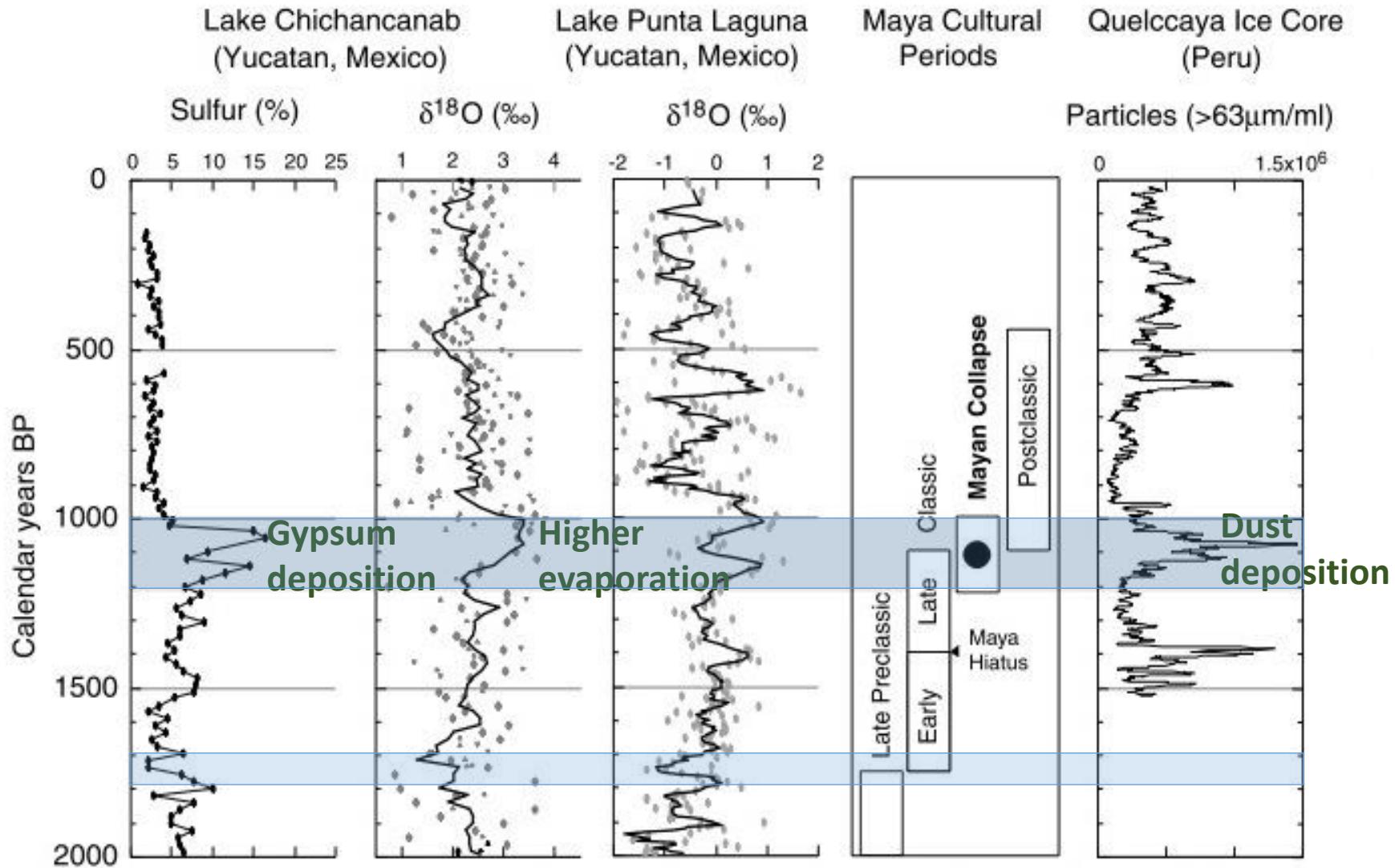




# Tikal, Guatemala



# Collapse of the Maya



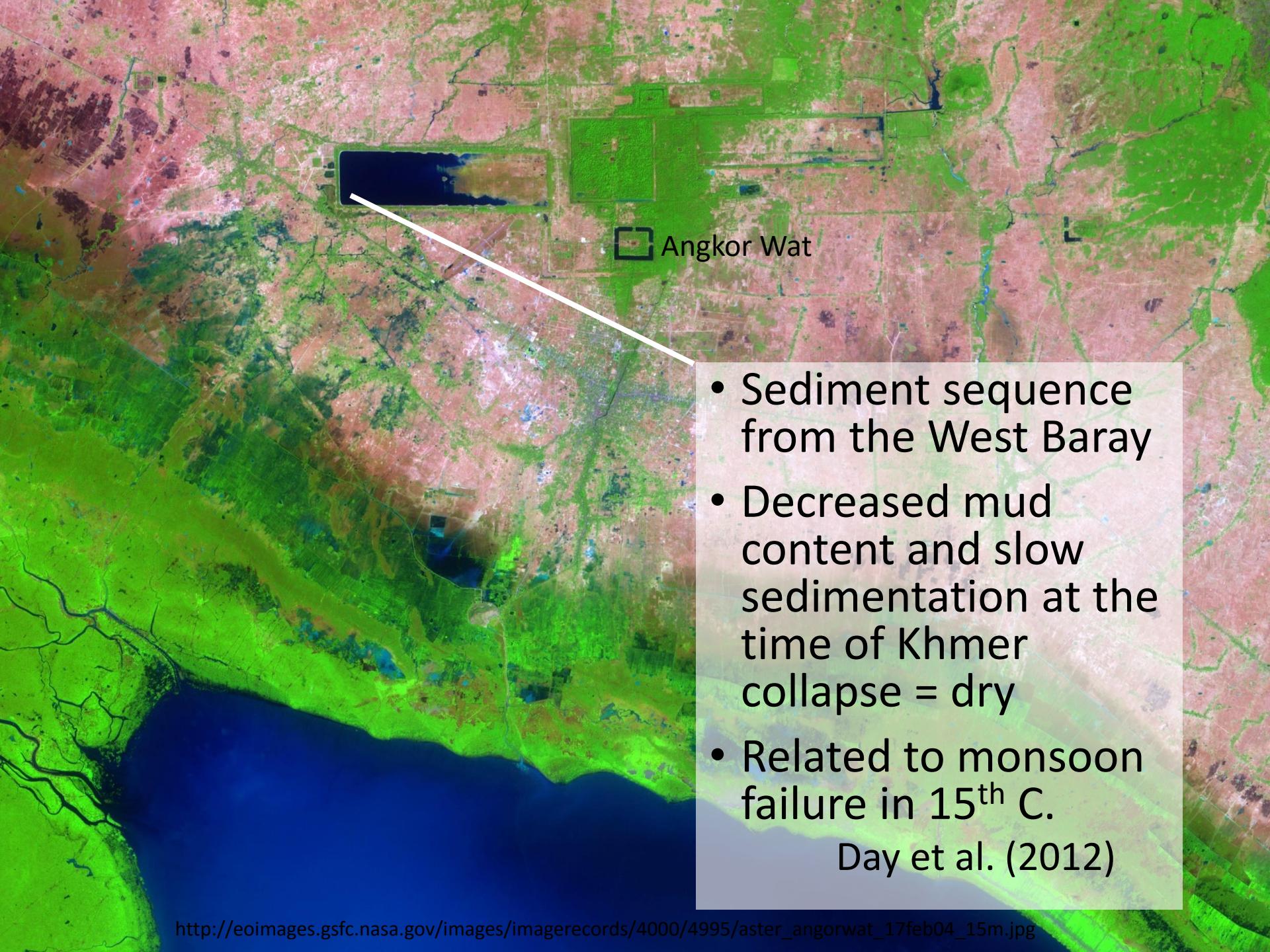
# Did climate cause the collapse?

- Abandonment of southern cities appears to coincide with evidence for ~200-year drought
- These cities relied on surface water for agricultural and urban needs
- High population density = vulnerability?
- Does *coincidence* equate to *cause*?
- And was this a ‘collapse’? Mayan civilisation continued, albeit in a different form

# Angkor

- Capital of the Khmer Empire from 9<sup>th</sup> century AD
- Largest pre-industrial urban centre in the world
- Extensive irrigation system to store monsoon rains
- Highly developed road system (= trade network)
- Collapse around 1431 AD (though monastery persisted)

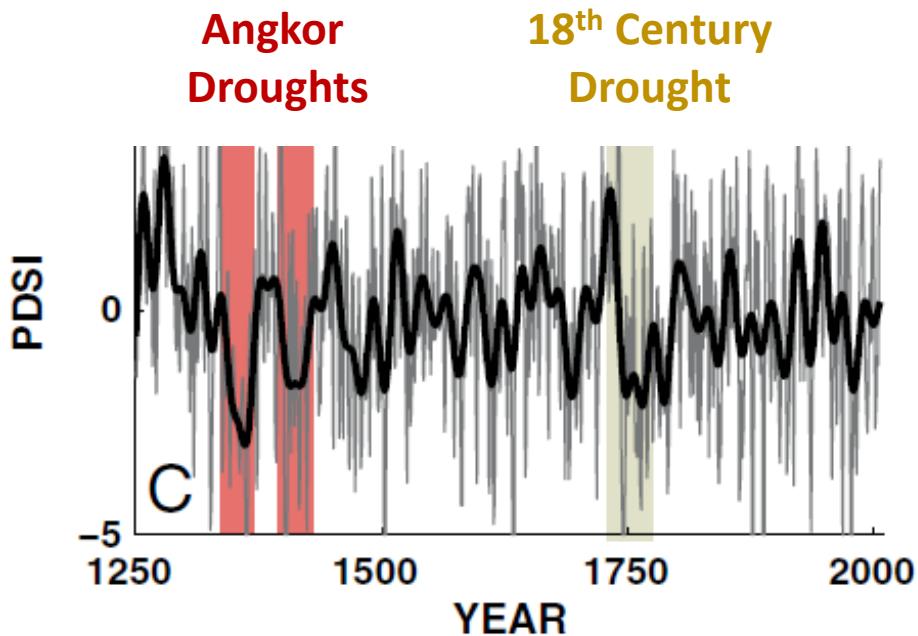




- Sediment sequence from the West Baray
- Decreased mud content and slow sedimentation at the time of Khmer collapse = dry
- Related to monsoon failure in 15<sup>th</sup> C.

Day et al. (2012)

# Tree-ring evidence



PDSI: Palmer Drought Severity Index

- Reduced rainfall linked to El Niño (ENSO)
- Could have led to Khmer collapse...
- But what about:
  - Political instability/war?
  - Religious movements?
  - Changes in trade and regional economy?

# The nature of the evidence

- Are our views of the past biased by the variable preservation of evidence?
- Physical processes preserved in natural archives
- Social processes preserved in written archives
- But what about where there is no writing?
- What if the writing was only done by elites?
- How might this bias affect our understanding?
- How could biased understanding influence policy?