Department of Geography Giessen
Climatology, Climate Dynamics & Climate Change

Mediterranean Climate and Societal Resilience in the Last Millennium

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Quaternary Science Reviews 2016, *Human Ecology* 2018, *Climate and Society* 2019

Outline of the talk

- Consilience: understanding the impact of climate on past complex societies, a joint interdisciplinary approach
- A common research agenda towards the identification of causal relationships between climatic and socio-economic changes
- The Ottoman crisis and Celâlî Rebellion; AD 1580-1610, a case study
- Conclusions

Consilience: understanding the impact of climate on complex societies

Theoretical, methodological and practical issues involved in the collaboration among social and scientific disciplines focused on the study of human past and its environmental context

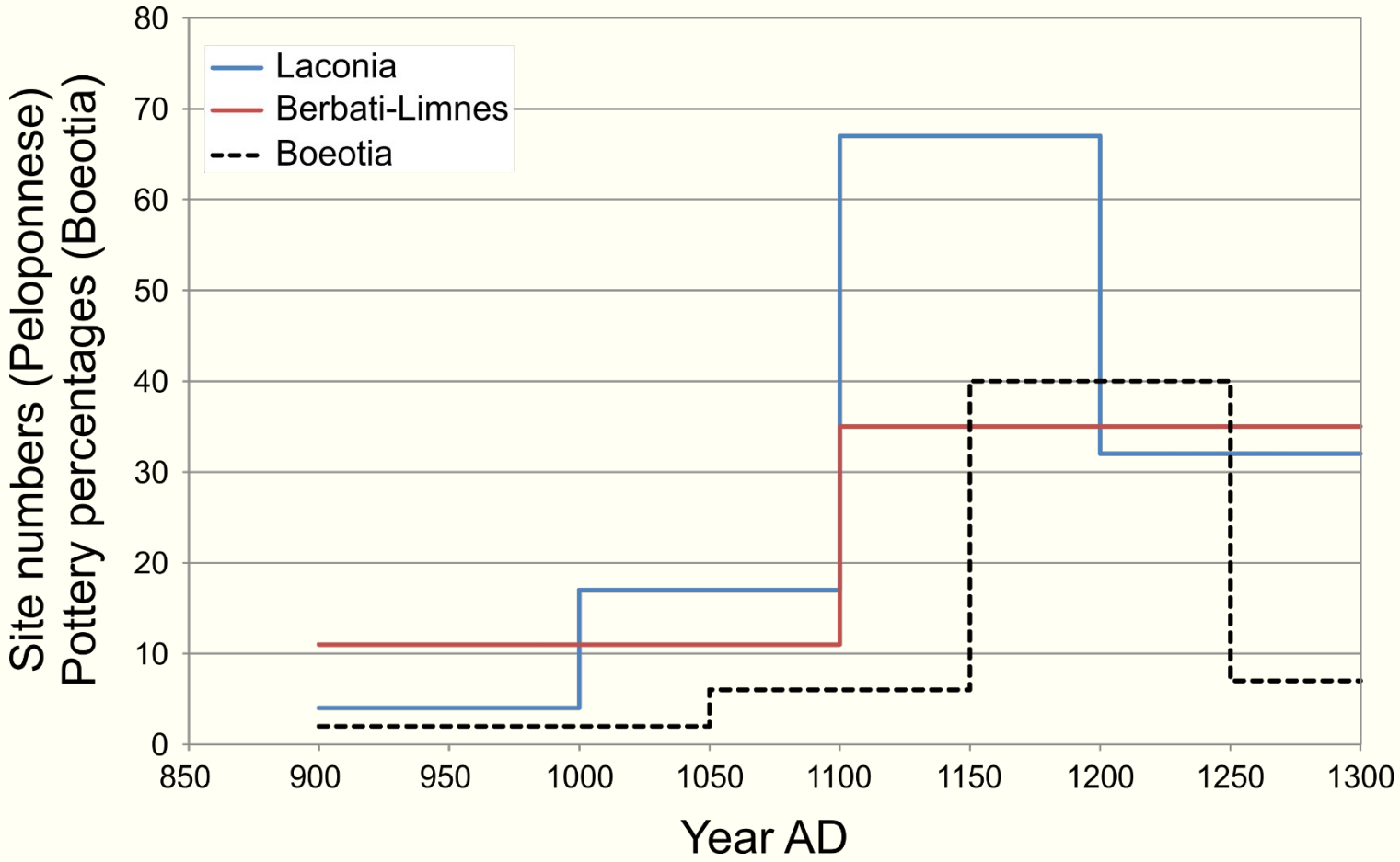
- **The foundations of collaboration**:
  how do we use and implement methodologies from the different sciences to address interdisciplinary questions?
- **The different narratives**:
  how do history, archaeology and natural sciences conceive the impacts of climate change?
- **Communication and the use of data**:
  how to “speak the same language” and address different data types in a joint approach?
- **Actions and mutual expectations**:
  how can interdisciplinary work fulfil expectations and what is the added values of joint work/publications?

 Establishing firm links between climate change and societal behaviour is challenging due to the complexity & heteroger of climatic and societal data

 Towards a common research agenda

Looking for traces

Settlement density from the archaeological survey evidence



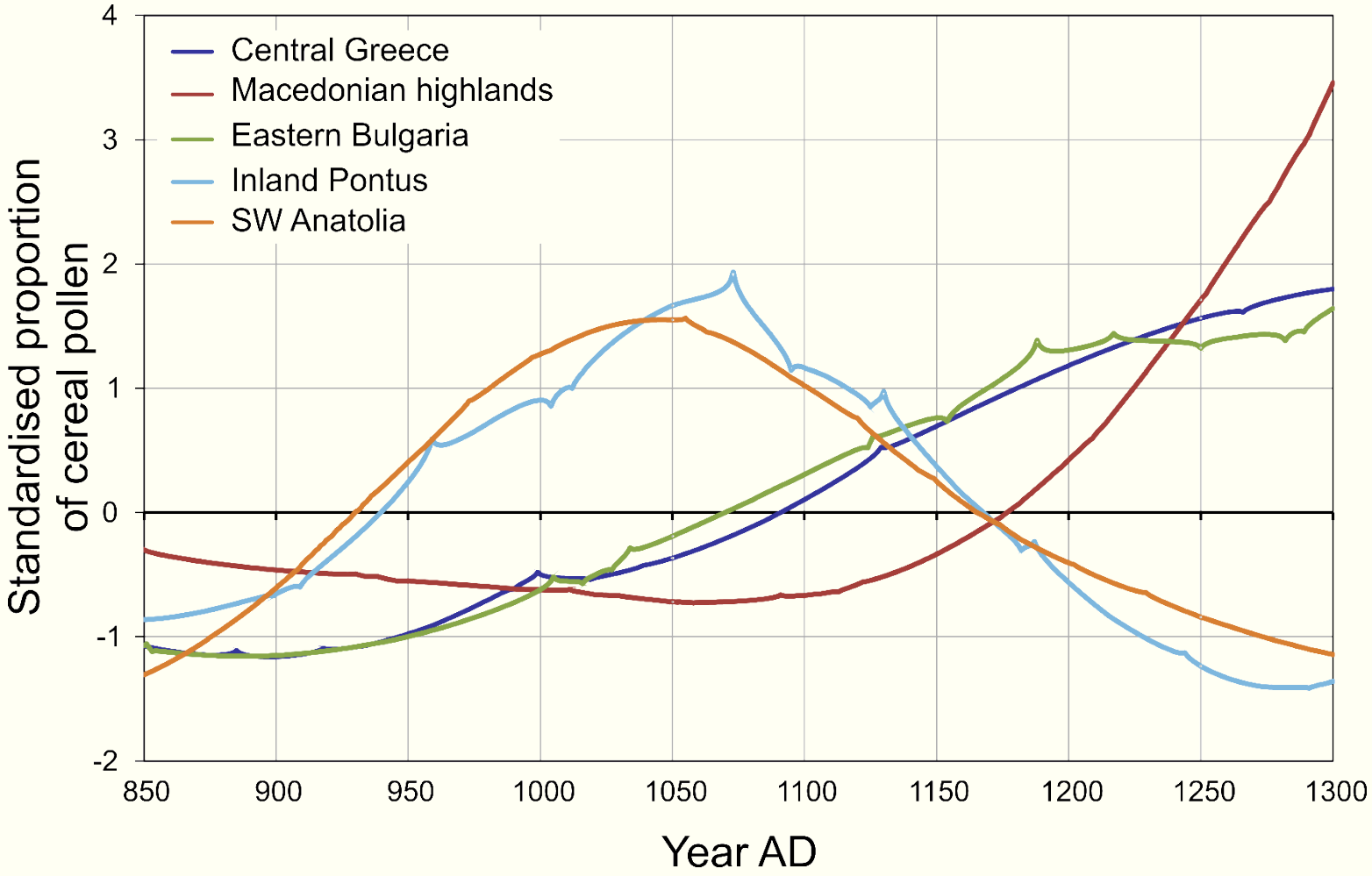
Laconia
Southeastern Peloponnese (Armstrong, 2002)

Berbati-Limnes
Northeastern Peloponnese (Hahn, 1996)

Boeotia
Central Greece (Vionis, 2008)

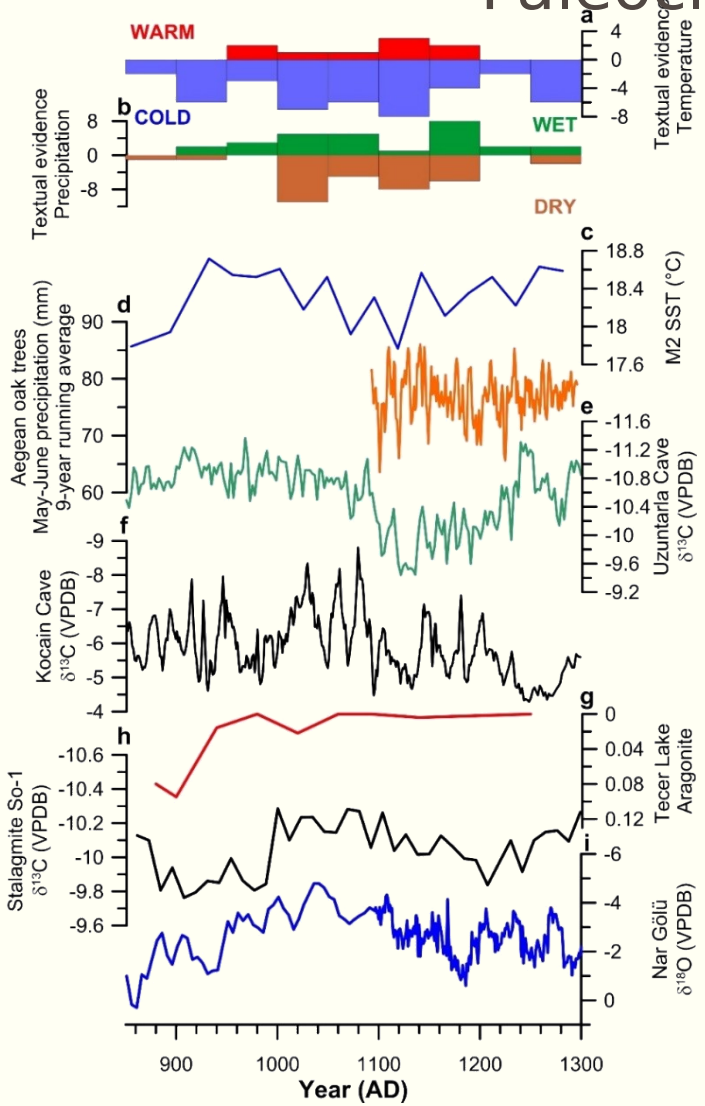
Looking for traces

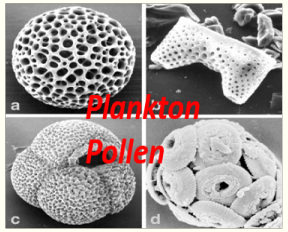
Proportions of cereal pollen (Izdebski et al. 2014)

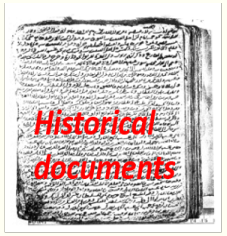


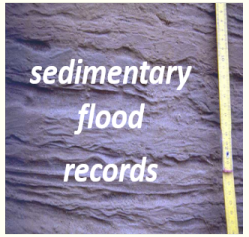
Looking for traces

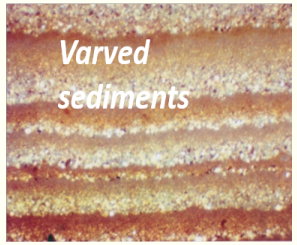
Paleoclimate and models

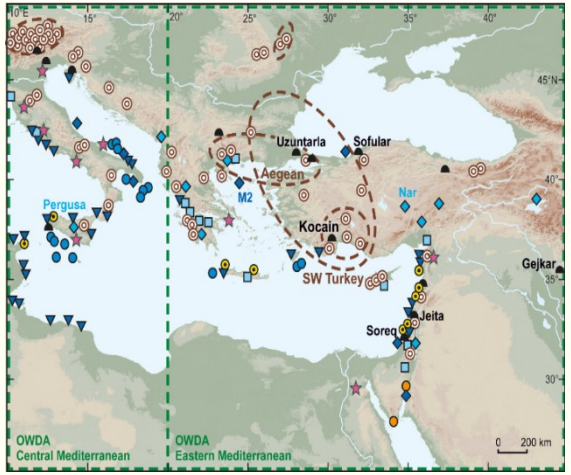


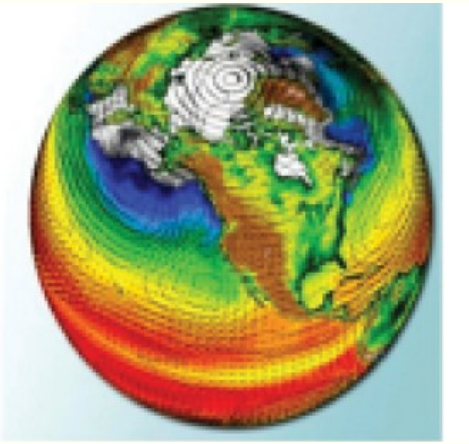


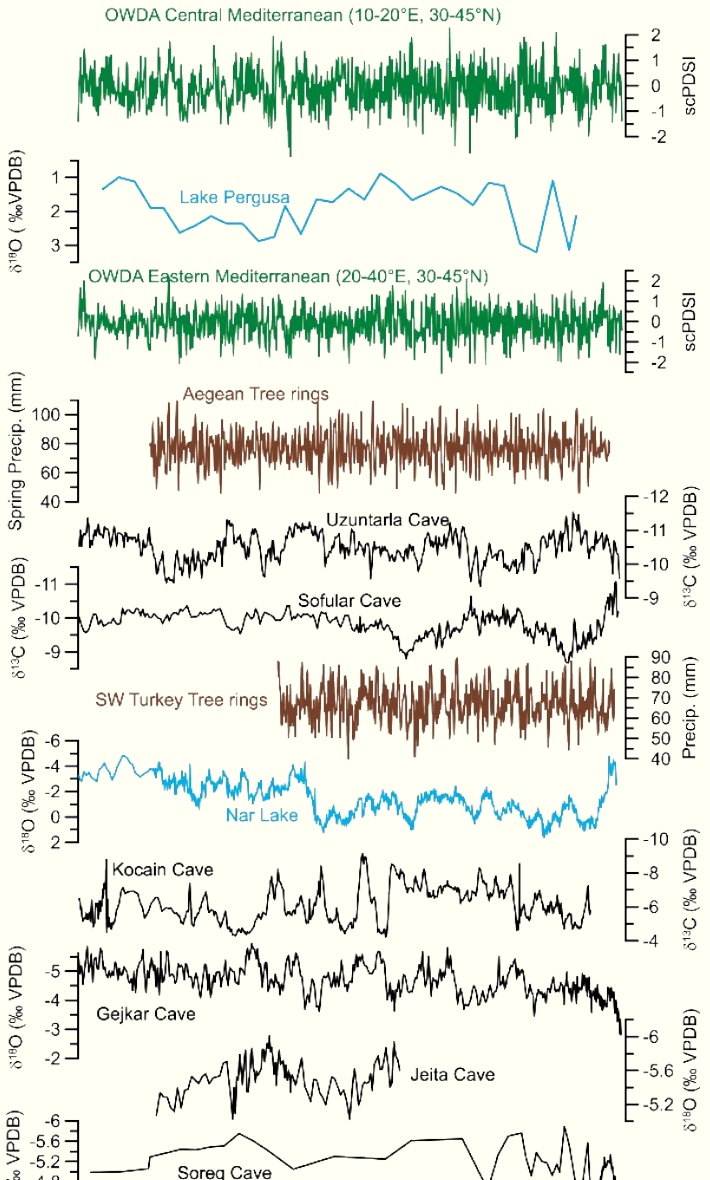












A common research agenda

- Interdisciplinary analysis that combines paleoclimatological information, historical, environmental and climate-model evidence with societal/economical evidence

- Contribution towards the identification of causal relationships between climatic and socio-economic changes within specific periods in the past millennium

- 4 case studies from the E Mediterranean to study the resilience/vulnerability of complex societies experiencing climatic & environmental stress:
  the medieval Byzantium (850–1250); the Crusader Levant (1095–1290); the Mamluk regime in Transjordan (1260–1516); the Ottoman Little Ice Age crisis, the Celâlî Rebellion (1580–1610)

Resilience

- The capacity to recover quickly from difficulties; toughness – *Oxford Dictionary*

- Resilience of a socio-cultural system: the degree to which the political structures, the economic relationships and the cultural habits of the system respond to environmental (and climatological) stimuli

- The mechanisms through which the impact of such environmental pressures or stresses are mediated

- During the 4 case studies, environmental and climatic stress tested the resilience of complex societies; here exemplified for the Celâlî Rebellion (AD 1580–1610)

The Ottoman crisis and Celâlî Rebellion; AD 1580-1610

- A major crisis was triggered by multiple environmental and human stressors including population, agricultural production, political stability and military power
- Major source of the Empire’s resilience was its size
- The empire’s growth generated vulnerabilities at household and imperial scales:
  - shrinking agricultural production per capita
  - large urban areas and major military campaigns generated larger demands on resources and dependence on extraordinary taxation and requisitions

The Ottoman crisis and Celâlî Rebellion; AD 1580-1610

- The Ottoman system of resource, labour and military mobilization was able to bounce back from small impacts but increasingly risked systemic breakdown in the face of multiple, large shocks
- One additional factor was the anomalous climatic condition…

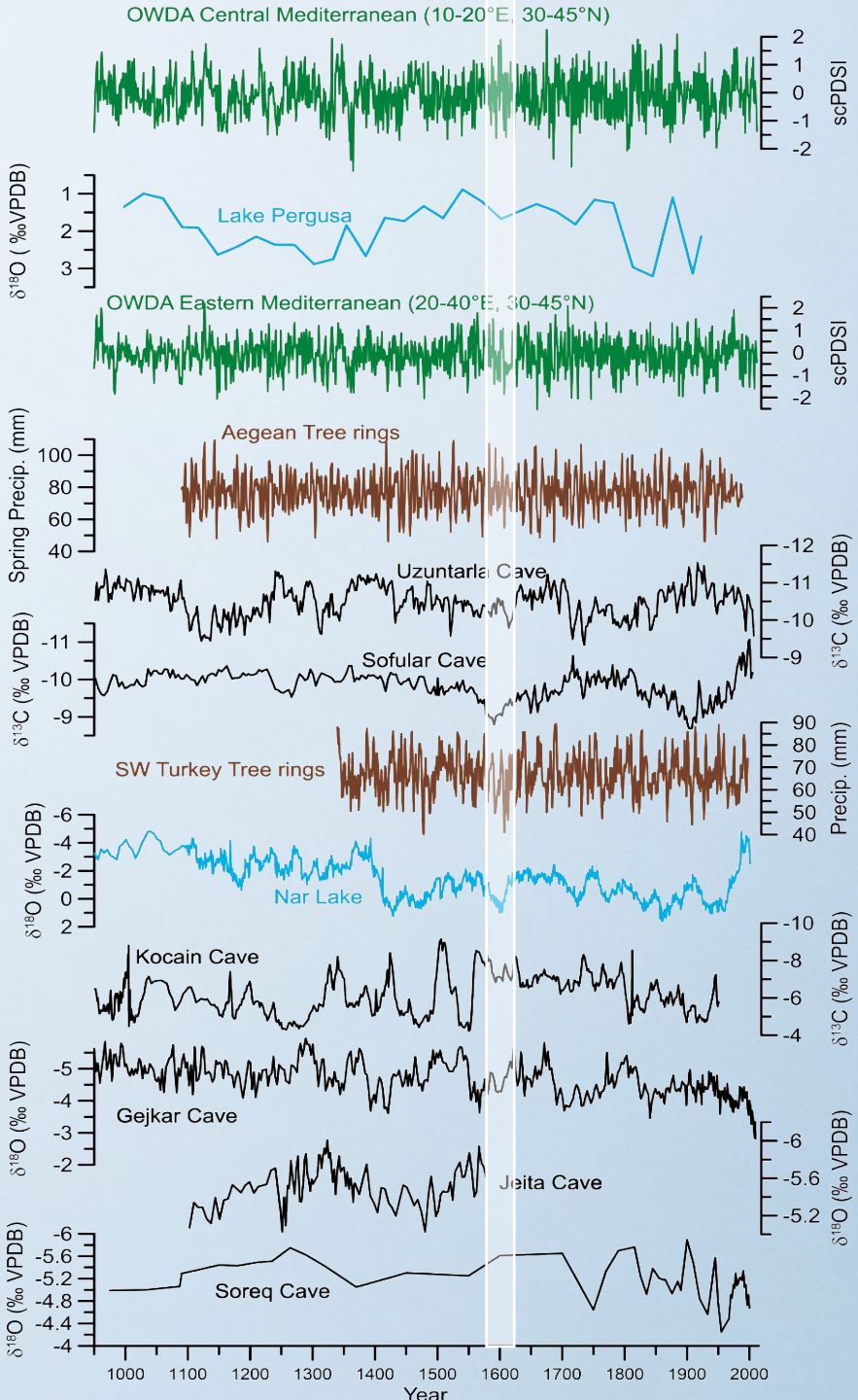
The Ottoman crisis and Celâlî Rebellion
Proxy evidence and impacts

Periodic cold and dry weather conditions caused local harvest failures and resource shortages

The major drought in 1591-1596 led to shortage/ widespread starvation and contributed to the outbreak of a major epizootic

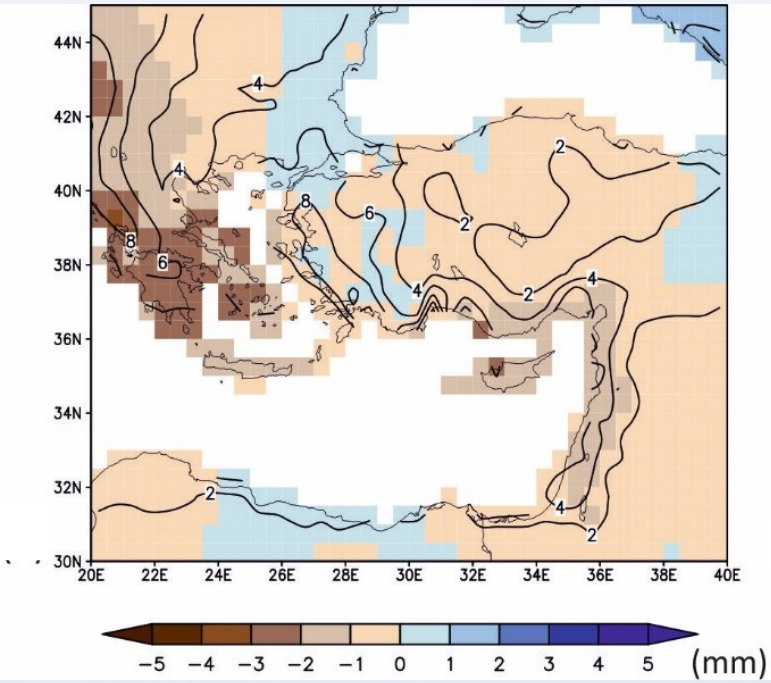
Positive feedback between famine, violence, population displacement and disease increased mortality by up to 50% in parts of the empire between the 1580s and 1630s.

Unusually cold winters and variable rainfall continued into the first decade of the 17th century.

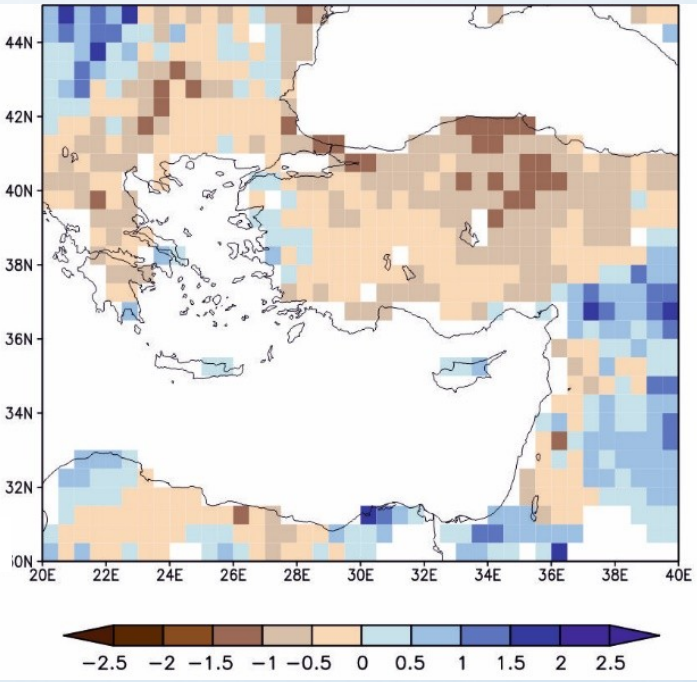


The Ottoman Crisis in winter climate reconstructions

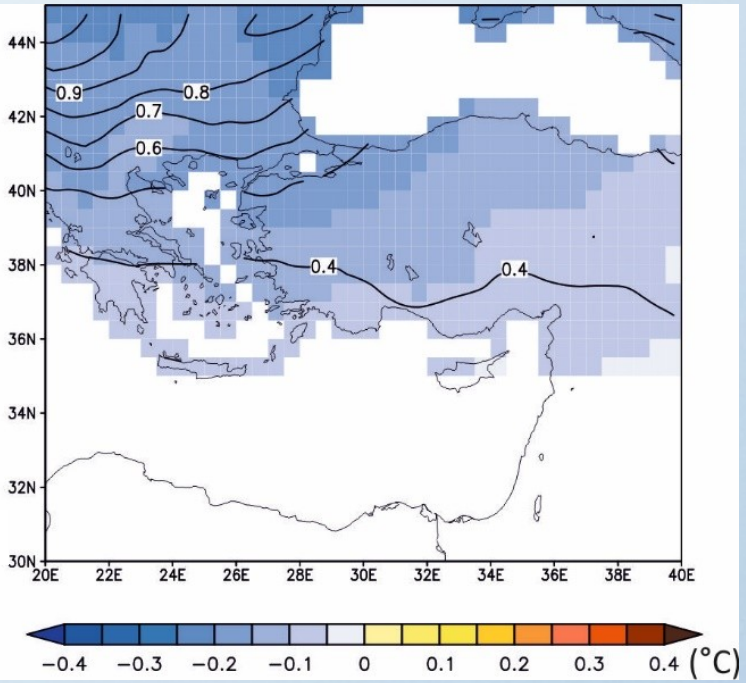
Rainfall reconstruction



Drought scPDSI



Temperature reconstruction

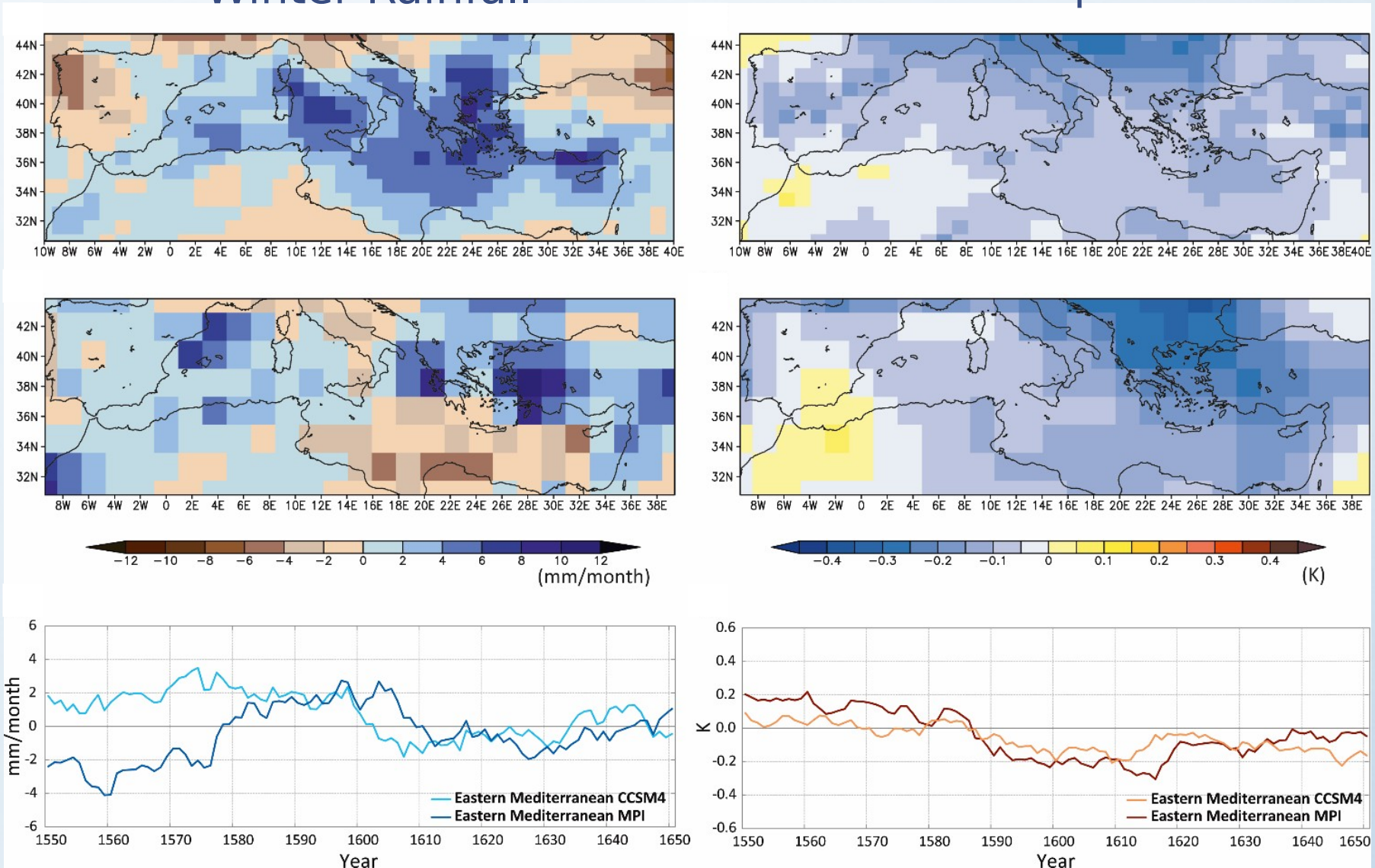


Increase in the frequency of severe droughts and colder conditions

The Ottoman Crisis in models

Winter Rainfall

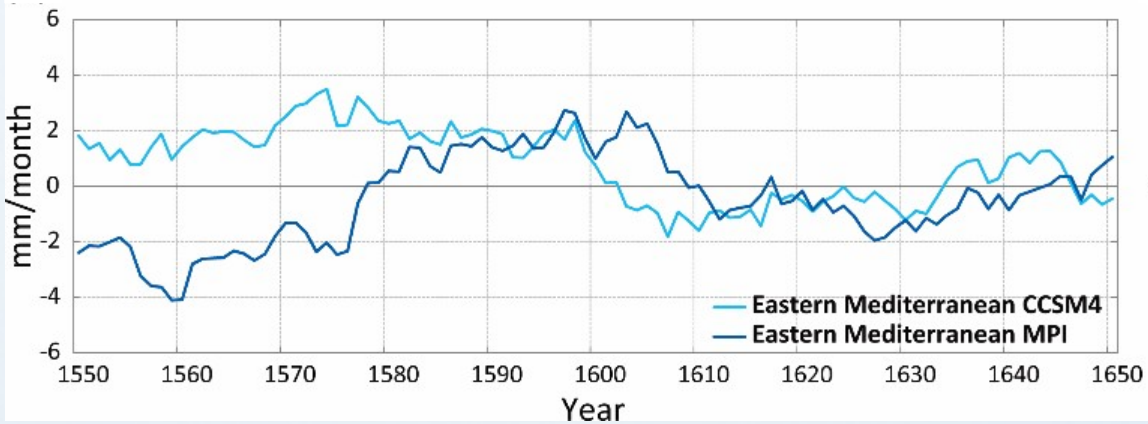
Winter Temperatur



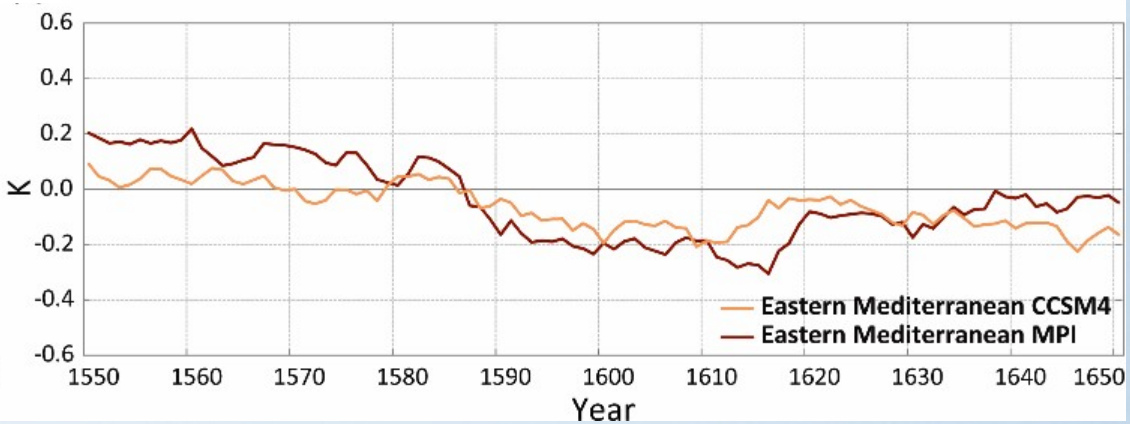
Contrasting hydrological conditions to reconstructions and historical evidence

The Ottoman Crisis in models

Winter Rainfall



Winter Temperatur



A drying trend of winter rainfall at the end of the 16th century is slightly later than historical evidence and reconstructions

Generally cooler winter conditions over the Eastern Mediterranean in agreement with reconstructions

Climate during Ottomann crisis mostly internally driven, cold years can partly be attributed to strong tropical volcanoes

Conclusions

- Twofold palaeoclimatic and archaeological-historical approach; palaeoclimatic: addressing the events and assessing the temporal and spatial characterisation of climatic changes; archaeological-historical: discussing the complex dynamics in different areas of the Mediterranean

- Comparative use of palaeomodels in combination with palaeoclimate information and societal evidence; natural and textual proxies, palaeoenvironmental, archaeological data, better knowledge of the drivers behind the climate system and the coupled climate-society system, internal versus forced response (solar, land use change, volcanoes)

- Climate-society interactions in pre-modern times: Cultural systems produce different responses to climate change and indicate varying degrees of socio-economic and political flexibility or resilience/vulnerability

- The case of the Ottoman Crisis: Several factors were responsible for Central Anatolia's vulnerability: the area's population growth, its agricultural system that heavily focused on winter wheat and barley, its role in providing additional taxes and provisions for the empire during military campaigns as well as the cold/dry conditions and the avariable

Thank you!

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Can medieval societies teach us how to adapt to climate change?

This mosaic from the Hagia Sophia in Istanbul depicts the 12th Century Byzantine emperor John II (left). A new interdisciplinary study suggests that medieval Constaninople likely fell because of political rifts, not food insecurity. Photo: Myrabella via W

APR 2016 6

by Michelle Kovacevic

A new study takes a comprehensive look at the fall of Constantinople, and if climate change contributed to the collapse.

In AD 1204, Constantinople fell. That year, tens of thousands of Latin crusaders on their way to conquer Muslim-controlled Jerusalem made a side trip to the Eastern Roman Empire, or Byzantium, where they had made a deal to help prince Alexios IV become emperor. The Byzantine elite at Constantinople, not happy with these backroom wheelings and dealings, rebelled, and Alexios was strangled to death.

At least that's the story that the history books tell you. What's not really been explored is how much the increasingly arid weather contributed to Constantinople's unrest during this time.

Just over 800 years later, neighbouring Syria is seeing similar societal unrest, exacerbated by drought. It begs the question: What might we learn from the way climate affected Byzantine political, economic and social systems so that we can better manage similar conditions today?

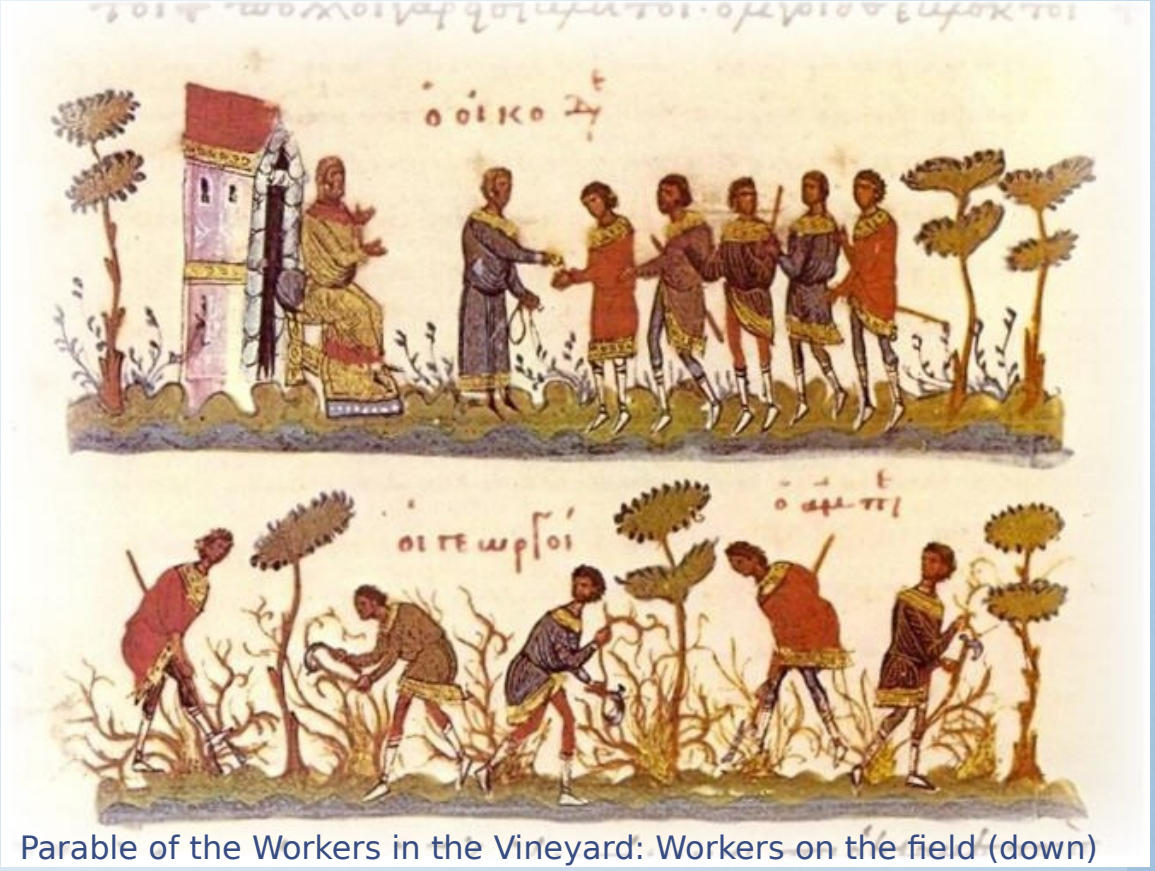
A recent study led by Elena Xoplaki in *Quaternary Science Reviews* examines

Byzantium

- A stable and expanding society with a thriving economy and complex political-cultural institutions, and societal organisation among the most sophisticated achieved by pre-modern societies
- Recovery after the early medieval crisis until the period that followed the fall of Constantinople in AD 1204
- The Byzantines produced written and material evidence that can be used to study potential societal impacts of climate variability during a period of prosperity, 9th to 12th century AD
- Northern regions of the Eastern Mediterranean

Climate impact on Byzantine society

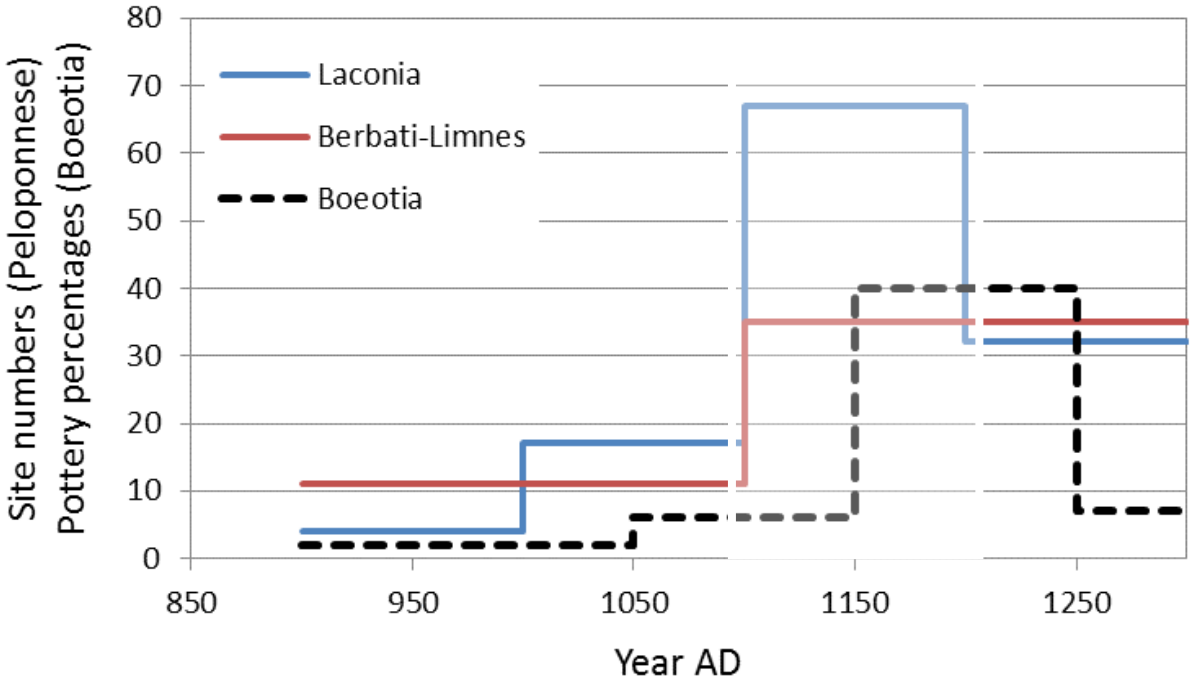
- Preindustrial society, dependent on agriculture
- Cereal cultivation
- Vine and olive cultivation
- Weather variability,
  agricultural output, tax income

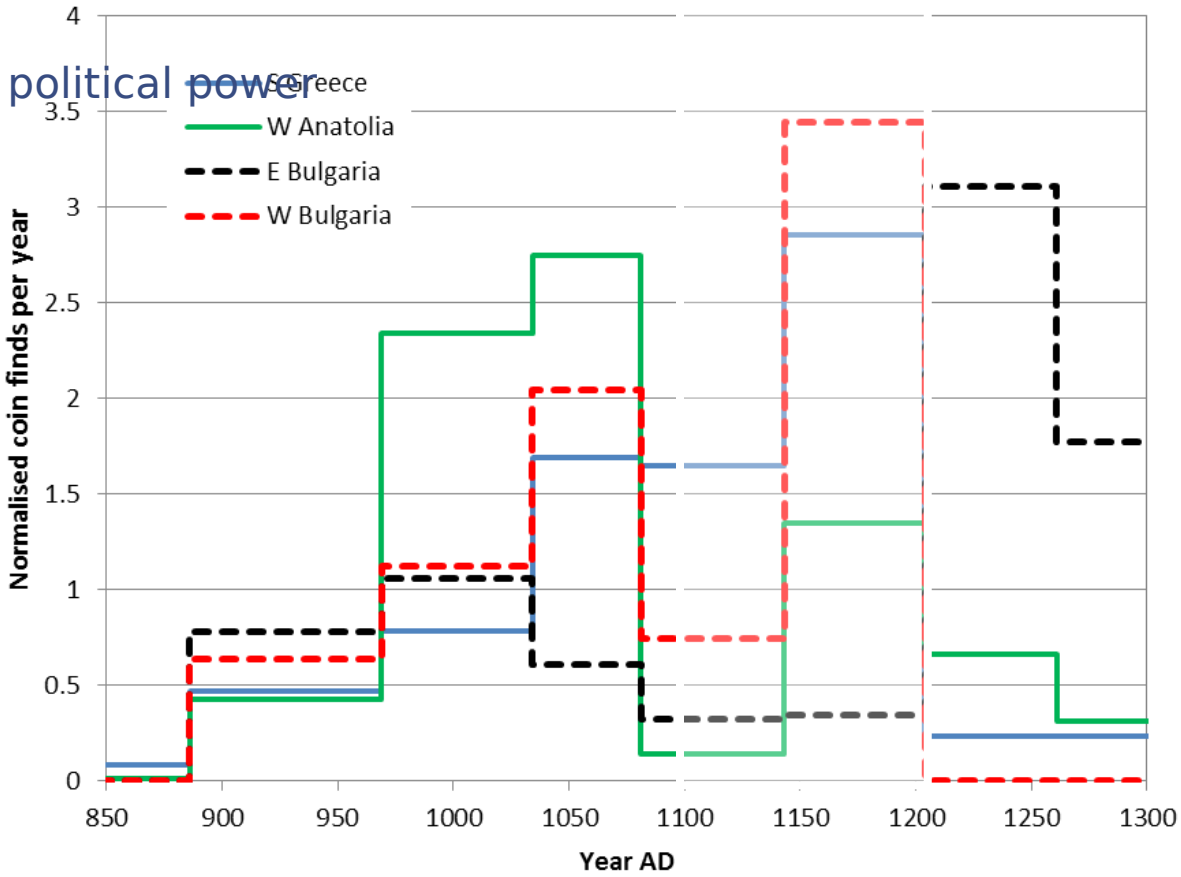


Parable of the Workers in the Vineyard: Workers on the field (down) and pay time (up), Byzantine Gospel of 11th century.

AD 1100-1200, Southern Greece

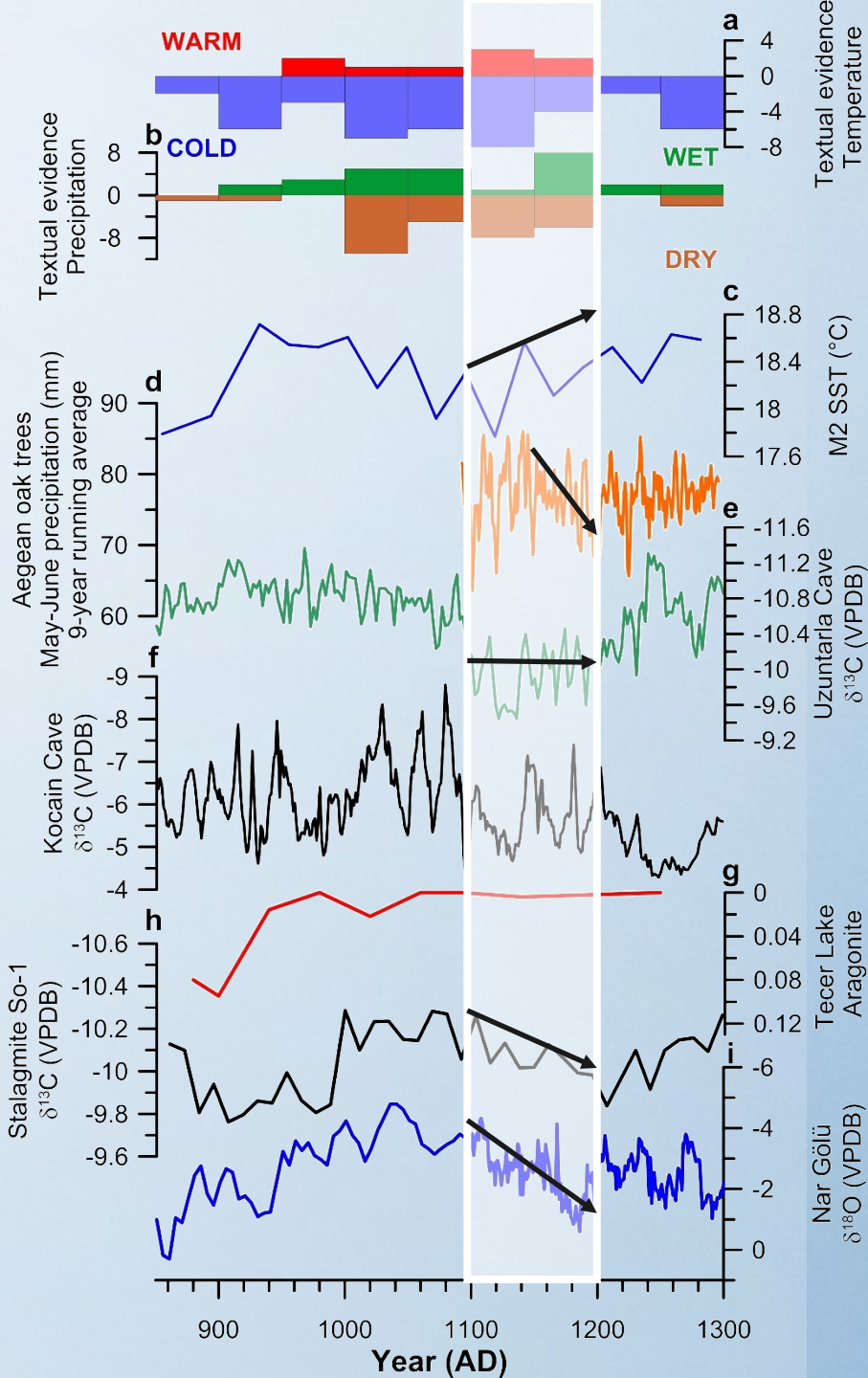
- most prosperous times
- demographic expansion
- significant monetary exchange
- Byzantine Empire was relatively strong in terms of political power





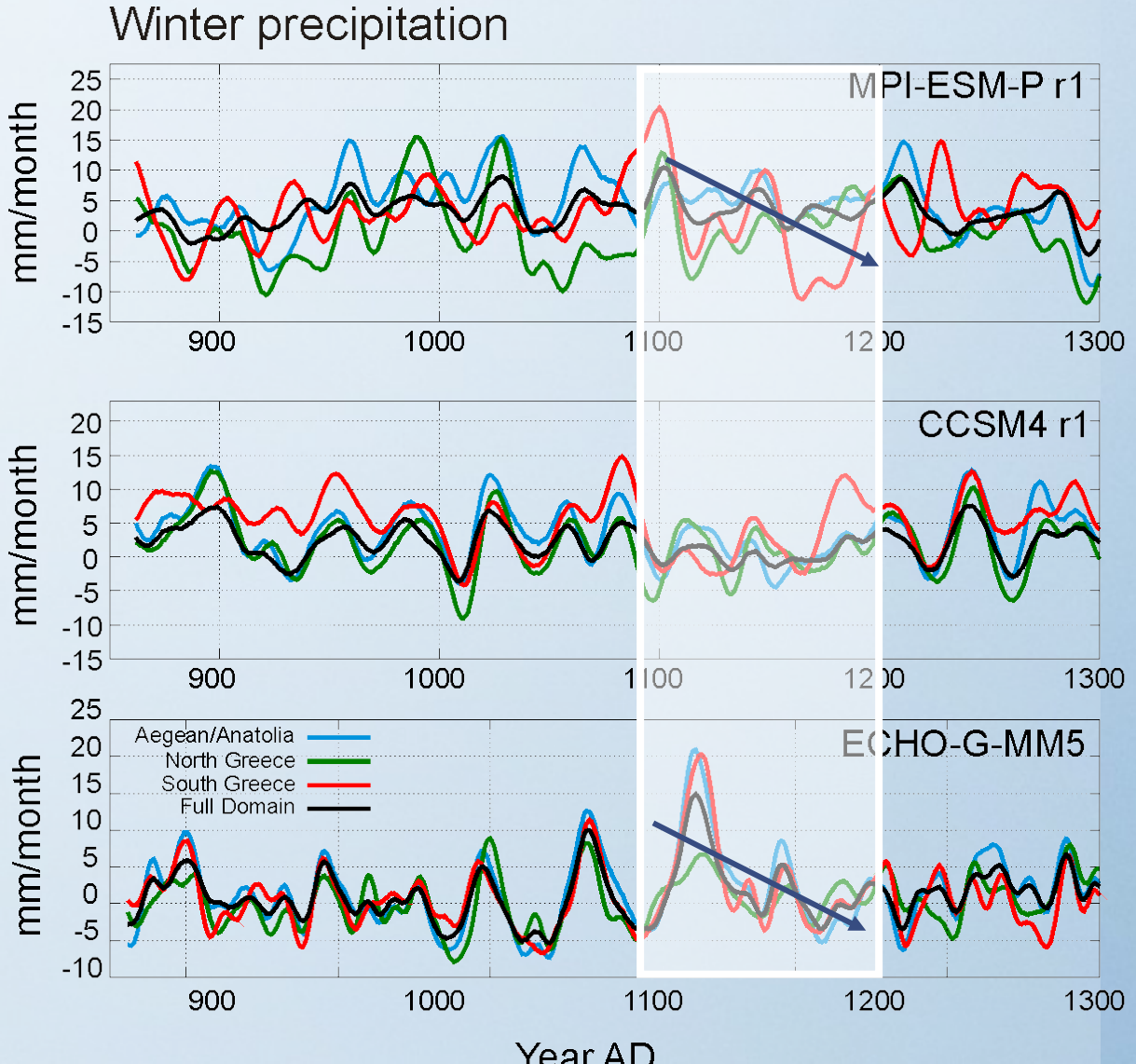
AD 1100-1200, Greece

- Warmer Aegean Sea
- Documentary evidence, tree rings and lake sediments show lower rainfall across the Eastern Mediterranean



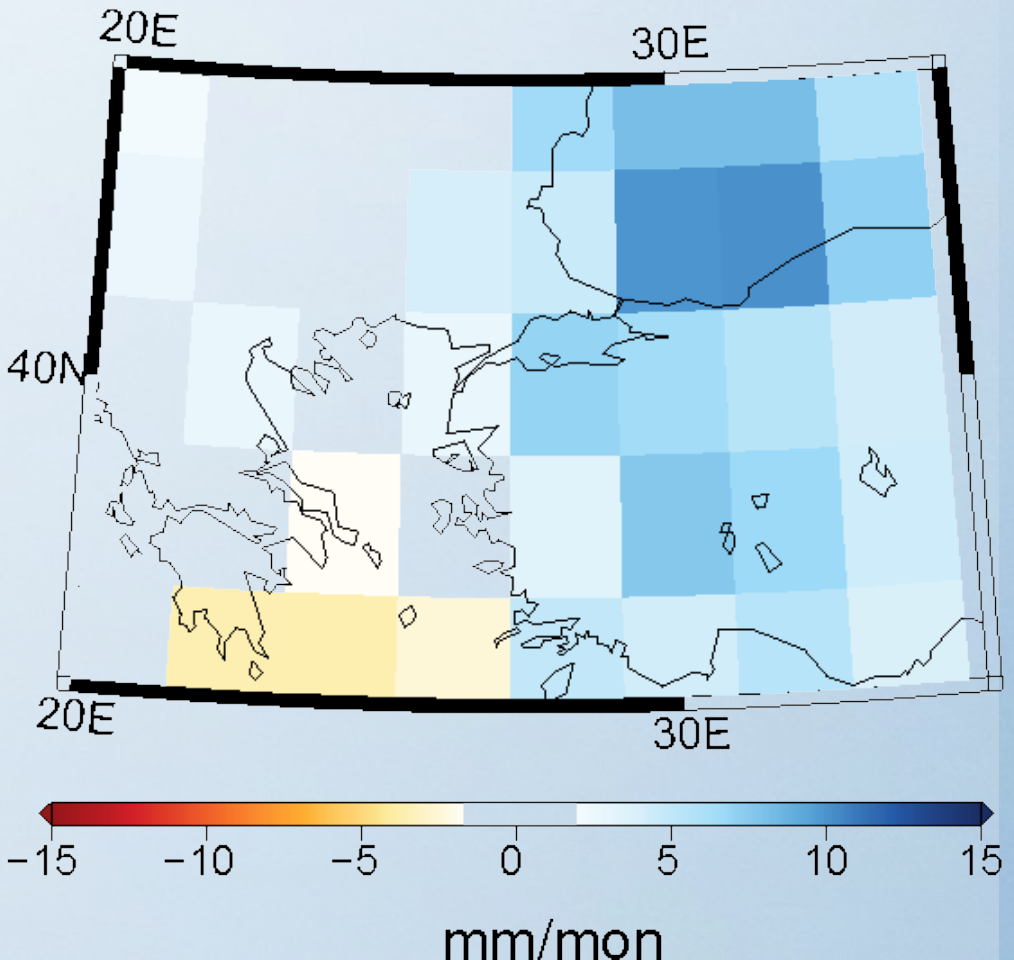
AD 1100-1200, S. Greece

- higher SSTs
- overall reduced precipitation
- winter dryness
- Supported by paleo models



AD 1100-1200, S. Greece, spatial model output

- higher SSTs
- overall reduced precipitation
- winter dryness
- relatively drier AD 1175-1200



AD 1100-1200, Southern Greece

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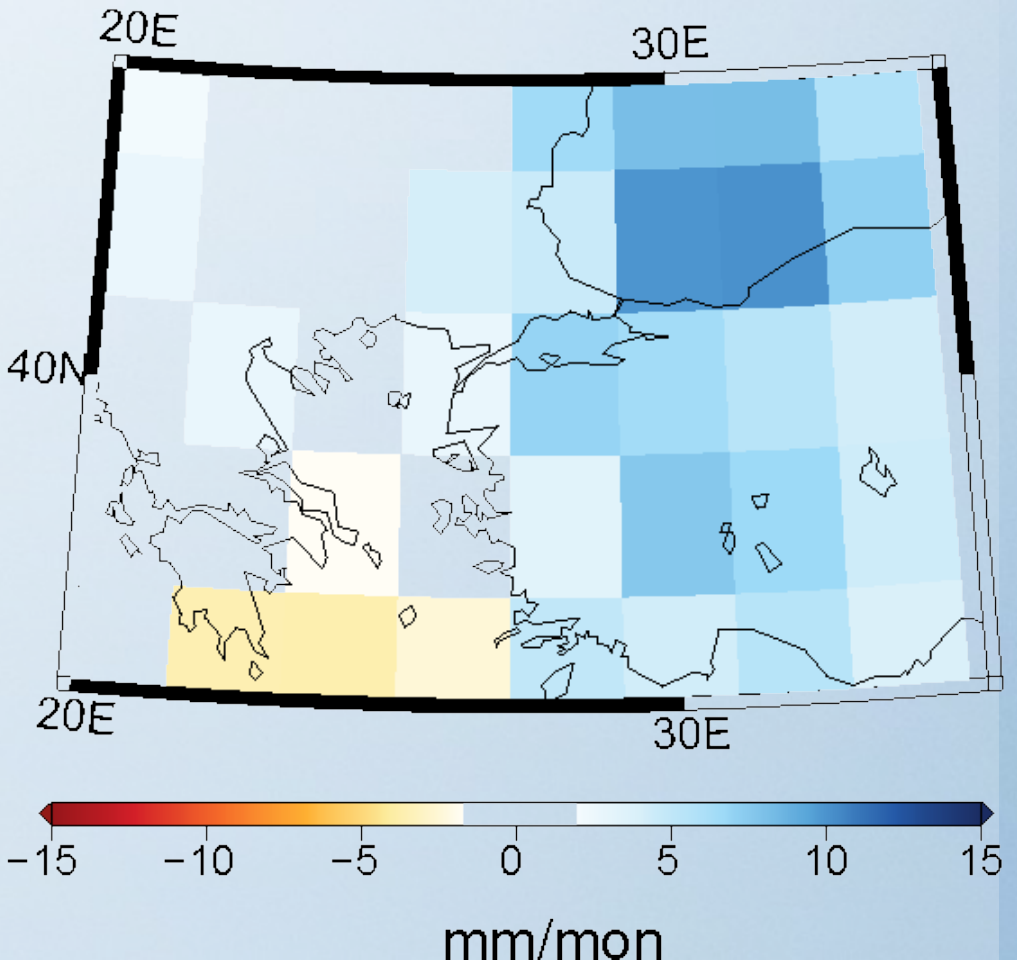
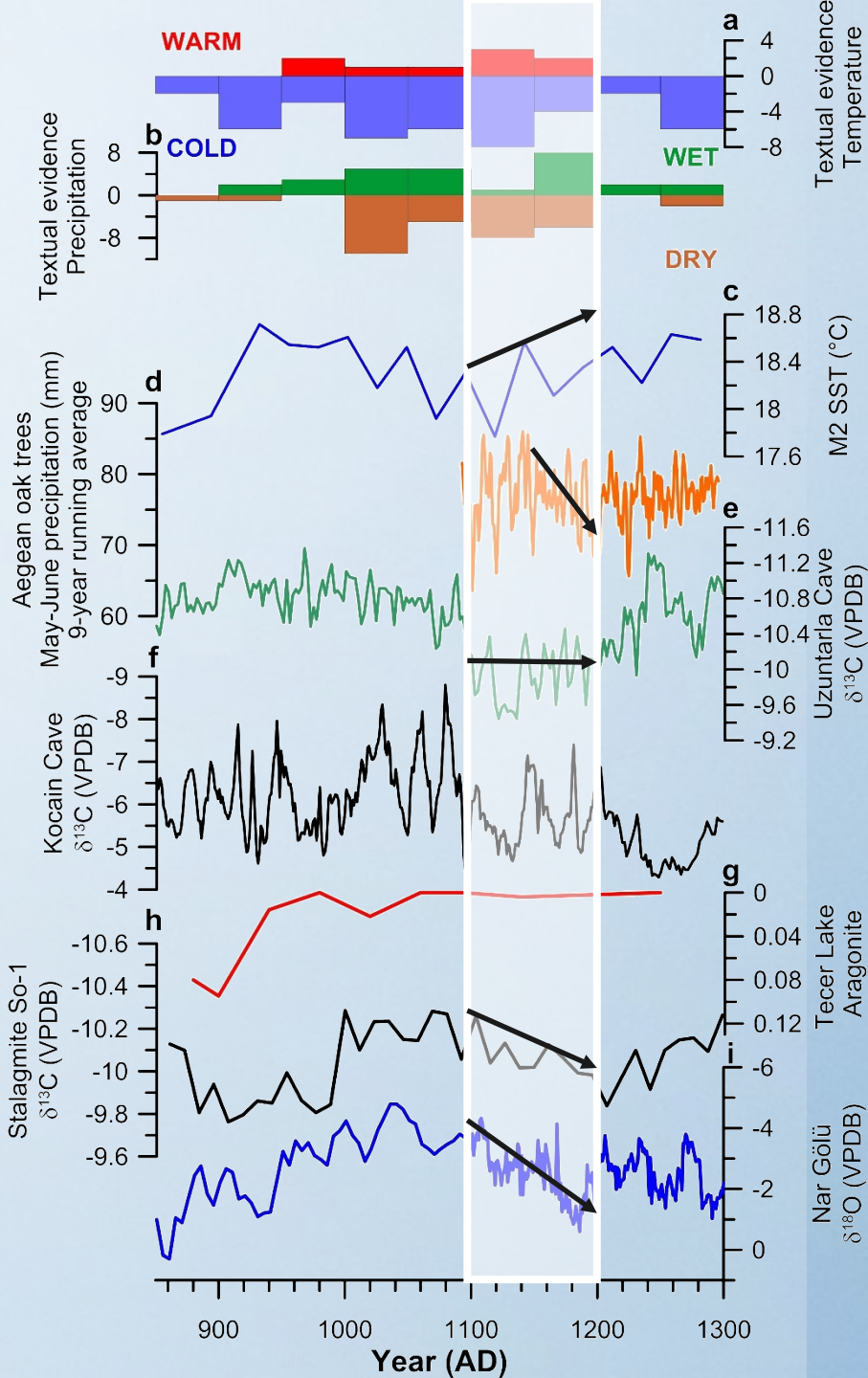
- relatively drier 1175-1200 AD

↳ resilient Byzantine society of Southern Greece to the 12th century unfavourable climatic conditions



AD 1100-1200, Anatolia

- After the Turkish conquest, drier conditions prevailed almost everywhere across the Byzantine Empire



AD 1100-1200, Anatolia

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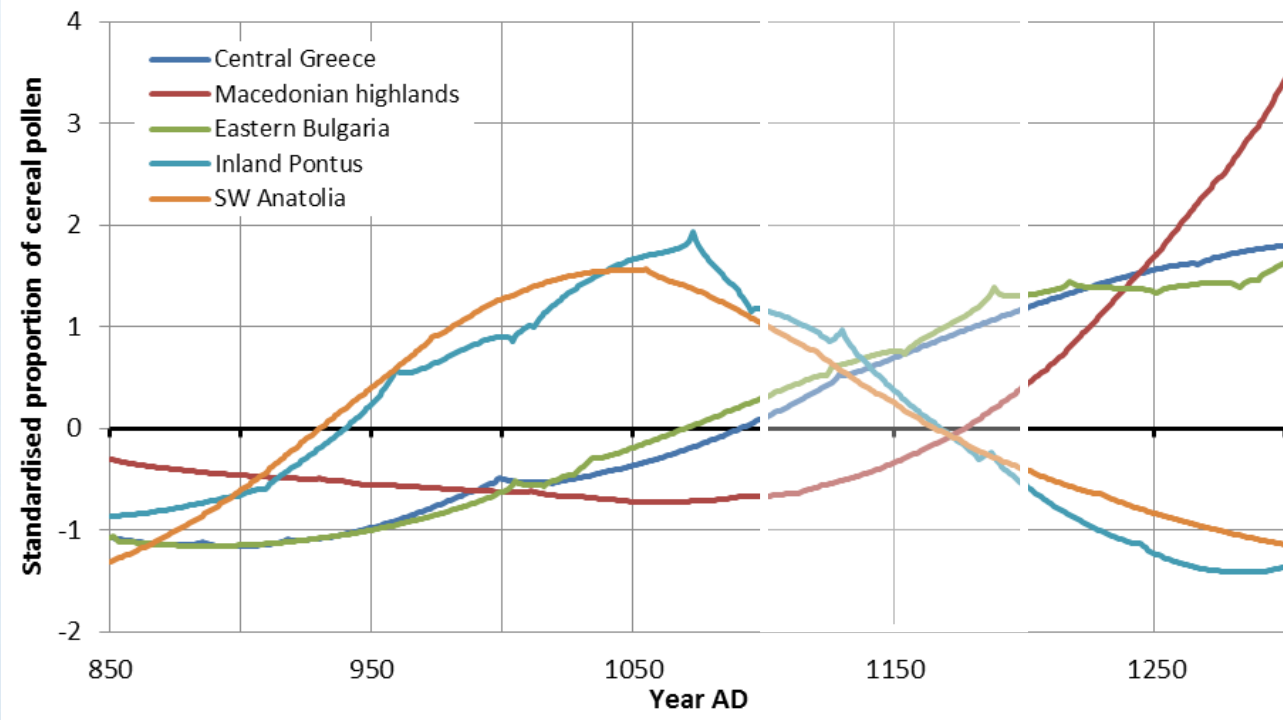
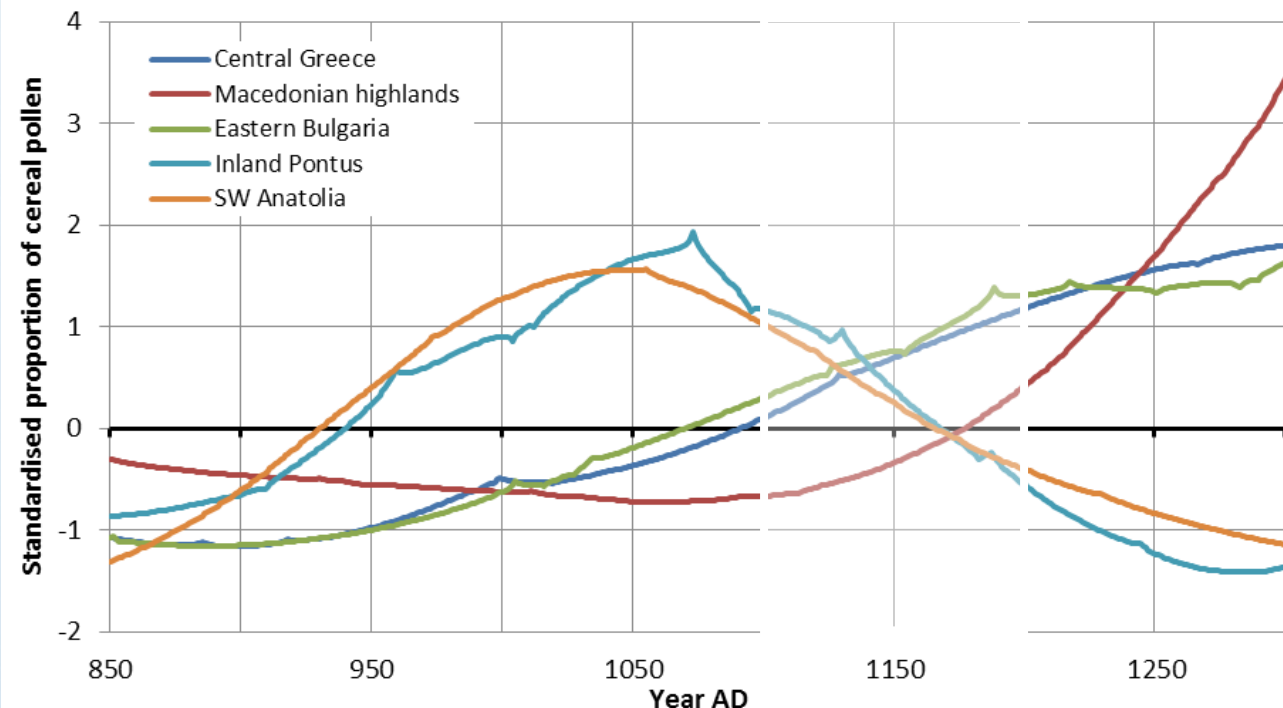
- An important decline in agricultural production occurred in Anatolia before AD 1100



AD 1100-1200, Anatolia

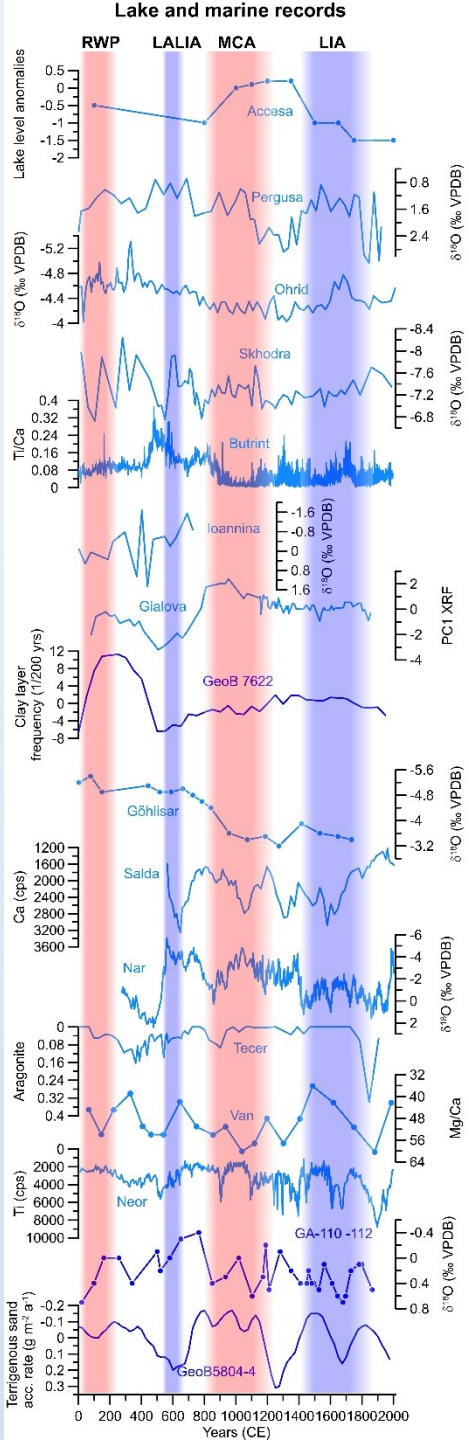
- After the Turkish conquest, drier conditions prevailed almost everywhere across the Byzantine Empire
- An important decline in agricultural production occurred in Anatolia before AD 1100
- The invasion of the Seljuk tribes and the migration of the Turkoman nomads into Central Anatolia (after AD 1071) brought the economic system of Anatolia to a collapse

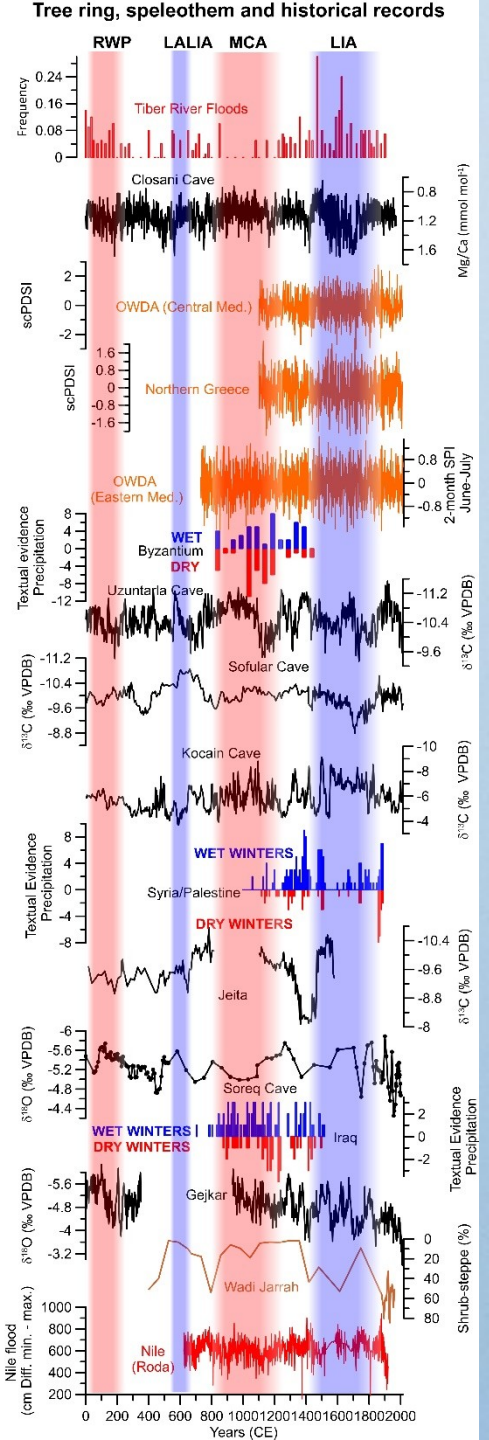
➢ What was the role of climate to the Seljuk expansion?



Looking for traces

Climate proxies





Medieval Byzantium: climatic change, extremes, economic performance, societal change, impacts