

Beyond Collapse: Climate Change and Causality During the Middle Holocene Climatic Transition, 6400-5000 Years Before Present

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Abstract

“The twenty-first century is likely to be characterised by large changes in regional climatic and environmental conditions, with implications for the availability and distribution of key resources such as water and productive land. While the implications of such changes for human societies are potentially profound, the empirical evidence base for understanding human–environment interactions focuses largely on the relatively recent past, during which examples of rapid and severe climate change are lacking. While there are no precise past analogues for twenty-first century climate change, the Middle Holocene Climatic Transition (MHCT), from about 6400–5000 years before present, provides us with an example of a period of large-scale global climatic reorganisation, punctuated by episodes of rapid and severe climate change, at a time when human societies were beginning to resemble those of today. A survey of archaeological and palaeo-environmental data from the northern hemisphere subtropics and other regions provides us with evidence for linked climatic, environmental and societal change during the MHCT. This evidence, the strength of which varies with location, allows us to construct convincing narratives of linked climatic, environmental and societal changes that accommodate a variety of responses and outcomes, and that are much more nuanced than narratives of the proposed climate-induced collapse of individual societies. Such synthetic studies that compare contexts across time and space can help us understand human–environment interactions during times of climatic disruption, while allowing for diverse outcomes and avoiding the pitfalls of climatic determinism.”

Introduction

-there is a high probability that the Earth’s surface temperature rise over the next few decades/century will be equivalent to the rise that takes place during a glacial-interglacial transition, only much more rapidly and possibly reaching a temperature not seen for millions of years

-while exact consequences for oceanic and atmospheric circulation are not fully understood, evidence based upon previous climatic transitions suggests that there will be impacts upon regional climates, landscapes, ecosystems, and the availability and distribution of key resources—especially important to humans will be fresh water and arable land

-a question for our modern context is how will resource availability changes due to climate change and other variables (e.g., population growth, economic development) alter society in terms of migration, conflict, social organisation, etc.

-current debate about the societal impacts of a changing climate have been characterised as ‘minimalist’ and ‘maximalist’

- maximalist narratives argue that climate change causes societal shifts but these have been criticised for being simplistic and deterministic, ignoring non-climate factors
- minimalist arguments favour the idea that climate changes are not a significant driver of societal shifts
- this increasingly dominant view is seen by some as being nihilistic as it discourages investigating the role of climate and environmental changes on societies
- minimalist narratives are also problematic in that they primarily rely upon recent historical data (since about 1950)
- the environmental changes expected over the next few decades/centuries are likely to fall well outside that experienced in the last few decades upon which minimalist arguments are based, and perhaps even outside that of all recorded history
- analogues for societal reactions to these changes, therefore, should not be drawn from such limited data

Past analogues for twenty-first century climate change

- our geologic history contains periods that match what is projected for the decades ahead; some of these were even warmer but those significantly predate modern human existence
- the current planet's geography and topography is very different from these past times so true past analogues for our future do not exist
- in the recent geologic past there are, however, periods when climate disruptions have occurred, with several in the past 10,000 years
- these shifts tend to appear every 1000-2000 years and last for 100-300 years, involving "...a transient pattern of cooling at middle and high latitudes, and enhanced aridity at lower latitudes, the latter particularly in the northern hemisphere subtropics and adjacent regions" (p. 94)
- research has linked these climate shifts to societal changes:
 - 1) 8200 BP, warfare and population collapse at sites in Turkey
 - 2) 4200 BP, collapse of the Arkkadian Empire, Egyptian Old Kingdom, Neolithic cultures in north-central China, and others
- the idea that these are climate-induced collapses has been challenged, perhaps because the collapse paradigm overpowers the research into human environment interactions
- this paper seeks to provide a multi-dimensional approach "based on comparative approaches examining a range of diverse linkages between climatic, environmental and cultural processes across different geographical regions and periods." (p. 95)

The Middle Holocene climatic transition

- the Middle Holocene (specifically 6500-5000 BP) witnessed a profound reorganisation of the global environment, particularly an increase of arid conditions in the northern hemisphere subtropics, cooling of middle and high latitudes and altitudes, and El Niño regularity after a prolonged period of its absence/rarity
- this change was an acceleration of millennial-long trends towards drier and cooler conditions that were periodically punctuated by abrupt changes:

- 1) 6400-6300 BP, some locations experienced sudden arid conditions while others witnessed glacial advance;
- 2) 5900 BP, cold-arid conditions arose
- 3) 5800/5700 to 5200/5000 BP, aridification intensified
- 4) 5200 BP, abrupt cold-aridity

-this transitional period also showed a global weakening of monsoons with their rains moving southwards
-outside the monsoon belt was the reappearance of El Niño and shifts in middle and high latitude climates
-the main driver of these changes appears to have been the decline of summer solar radiation outside the tropics due to rotational axis angle changes creating non-linear feedback loops in the climate system

Comparing the MHCT with twenty-first century climate change

-the MHCT is different from our 21st-century changes that:

- 1) In the present day there is a warming trend whereas the MHCT saw a cooling;
- 2) Changes in solar insolation distribution drove MHCT shifts versus increasing greenhouse gasses causing increased atmospheric absorption of outgoing longwave radiation;
- 3) A retreat of ice and snow increasing atmospheric water vapour in the present because of a warmer surface versus a decline in atmospheric moisture due to glacial advance and cooler oceans

-impact distribution will also be different but the MHCT does provide a glimpse of the widespread changes due to a rapid climate shift

-the 21st century is expected to experience greater aridity due higher temperatures, increased evapotranspiration, rainfall declines; particularly for regions outside present day monsoon regions (e.g., North Africa, Middle East, Central Asia, and the southwest US)

Societal contexts in the Middle Holocene and present day

-can historic periods provide a valid analogue for our environmental future and human responses
-conditions are very different nowadays (e.g., social condition, population densities and distribution) but there are some similarities with 6000 years ago such as large urban centres and state-level societies with hierarchical organisation and political institutions that struggle to maintain social stability, secure resources, and manage and feed everyone in light of resource scarcity and a deteriorating environment
-outside of our urban centres, many place in our modern world continue to rely upon small-scale agriculture and pastoralism as the people of the Middle Holocene did

Climatic, environmental and cultural trajectories during the MHCT

-research has been carried out by the author on the development of social complexity and the role of environmental and climatic change in it for a number of diverse regions

Cultural transitions at the beginning of the MHCT

-all of the regions studied exhibit cultural transitions that coincide with or occur shortly after rapid climatic shifts

-the following occurred during the 6300-5900 BP time period:

- 1) the Ubaid culture terminal phase where egalitarian village-level farming communities coalesced into the hierarchical Uruk culture; abandonment of agricultural settlements in Northern Mesopotamia and the rise of urbanism; non-irrigated agriculture in steppe environments along with animal husbandry;
- 2) the Egyptian Predynastic Period also aligns with this acceleration of aridity and was characterised by migration to the Nile River Valley; the summer monsoons of southwestern Egypt collapsed as well; the rapid increase in cattle herding occurred in eastern areas where increased aridity was less severe, but witnessed a lot of movement as populations sought pastures in increasingly unpredictable environments;
- 3) a shift during the Indus Age from Stage 1 to 2 saw pastoral societies emerged with reliance upon cyclical migration.

Cultural trajectories throughout the 6th millennium BP

-a variety of regions appear to have responded to increased aridity through changes in migration patterns, settlement and occupation patterns, and livelihoods

-increasing aridity appears to have led to:

- 1) Movement to southern Sahara as water sources retreated and disease barriers for cattle husbandry disappeared;
- 2) Nomadic pastoralism (transhumance) arose in the central Sahara (5850-5600 BP);
- 3) The beginning of herding stations as a sedentary lifestyle emerged in association with a hyperarid period and the abandonment of key pastoral sites (5500 BP);
- 4) Southern Asia saw an increase in riparian environment use during the later part of Stage 2 of the Indus Age as well as movement east from arid regions occupying the Indus plains;
- 5) 5800-5200 BP witnessed a flourishing of the Uruk culture in Mesopotamia as people expanded north; in the south, cities and states emerged—this development has been characterised as ‘violent’, perhaps as farmers sought new arable lands, refugees fled elite demands, and competition and conflict created mass displacement; village abandonment in the south coincides with Uruk expansion; river course changes were accompanied by areas shifting to pastoralism and foraging

-“Worsening environmental conditions may well have altered patterns of productivity, resulting in the abandonment of some areas, the agglomeration of populations in others, increased competition over resources, and widespread social disruption.” (p. 98)

Cultural transitions at the end of the MHCT

-the rapid climate change around 5200 BP also coincided with various cultural shifts:

- 1) Uruk culture collapse with northern colonies being abandoned, as well as some smaller settlements in the south, with lands being used by increasing numbers of nomadic pastoralists; the city of Uruk-Warka saw a 10-fold increase in the nearby, surrounding population—likely due to river course changes and increasing aridity;

- 2) The Nile Valley population increased along with social complexity; rainfall effectively stopped; the unification of Upper and Lower Egypt during this climatic and environmental deterioration may have been a result of resource competition between proto-states, ending in political integration; by the end of the 6th millennium BP, Egyptian cattle herders were restricted to areas of oases; the number of occupied sites in the northern Sahara decreased dramatically in an abrupt and permanent fashion; less pronounced was population decline in the south; some central regions that remained productive saw some in-migration but not enough to account for the loss elsewhere, suggesting some perished due to changes as opposed to migrated;
- 3) In the Indus Valley, the shift to Stage 3/Early Harappan was accompanied by increased transhumance in riverine zones and the initial occupation of Harappa and the ushering in of urbanisation;
- 4) 5300-5100 BP saw China experience cooling and increasing aridity during a transition from the Yangshao (early complex society) to the Longshan cultures on the north-central plains with a three-fold population increase due to migration towards the Yellow River as conditions became drier (4800-4000 BP);
- 5) Early 5th millennium BP saw large urban centres in the river valleys of northern coastal Peru during an ocean cooling linked to an El Niño onset; the colder coastal waters contributed to changing food sources (increased terrestrial and decreased marine) and migration inland, concentrating in river valleys and the emergence of initial urban centres.

Interpreting trajectories of environmental and social change in the MHCT: Robust outcomes of linked environmental and social change?

- Egypt and the Sahara demonstrate the strongest link between climatic/environmental change and societal shifts; other regions exhibit more uncertain evidence
- the environmental deterioration due to rapid climate changes during the MHCT led to significant societal shifts in some regions
- aridification drove migration as people fled decreasingly productive land moving to areas with water and more productive land
- in many regions, people gathered in river valleys and typically resulted in large, urbanised complex societies (first 'civilisations')
- with this change came increased inequality and social stratification as witnessed via burial practices; this lead eventually to formal political power and caste/class systems
- these may have arisen due to conflict and/or crisis, and/or as a result of some groups taking advantage to enhance their social status

Beyond collapse: Diverse outcomes of human-environmental interaction in the MHCT

- while climate-induced collapse is a common narrative, and may have contributed to the collapse of some complex societies (e.g., Ubaid and Uruk cultures in Mesopotamia), it also appears to have spurred the emergence of some complex societies
- so, similar environmental stressors, it appears, can result in different (even the opposite) outcomes

- what occurs depends upon various contexts: environmental, cultural, social, and economic
- in some situations, increased aridity led to pastoralism while in others to sedentism; it also led to riparian agriculture in some regions and abandonment of settlements in others
- “Whether increased aridity is (tentatively) associated with either increased or decreased social complexity in northern Mesopotamia during the early MHCT thus depends on where one looks.” (p. 100)

Conclusions

- there is strong evidence for societal change being associated with rapid climatic/environmental shifts but it depends where one looks
- “The evidence from the Middle Holocene discussed here suggests that rapid climate change played a role in the emergence of complex societies, as well as their collapse, and that similar climatic stresses might result in very different outcomes in different societal contexts.” (p. 100)
- the accommodation of divergent outcomes mediated by different contexts opens the door to models of linked changes beyond more deterministic ones
- climate change appears to be a driver that transforms society, in some instances overwhelming other forces; but in others, where contextual factors differ, societal responses allow for adaptation