Improving integration in societal consequences to climate change

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Recreating fine-resolution dating of an increase of dust and stable isotopes captured in two stalagmites in northern Iran, Carolin et al. (1) in PNAS argue for close coincidence and a causal link with the decline of the Akkadian Empire at ∼4.2 ka.

The integration of high-resolution climate datasets with historical and archaeological data is a desirable tool for increasing the synergy between archaeology and planetary sciences and for better exploration of both the climatic events themselves and their societal consequences (2). However, we point out that true consilience in research on historic collapse and climate change will only be achieved when more sophisticated approaches are developed for integrating the climatic and societal records. The results of Carolin et al. (1) exemplify these challenges:

i) Presently, the question of the 4.2 ka Akkadian collapse is highly controversial among historians and archaeologists, with the exact chronology of Akkadian evolution and decline remaining deeply contested (3). The authors rely solely on the results of the archaeological sites of Tell Leilan in the Khabur region (4), yet recent data have led to broad reevaluations of the temporal frame and dynamic of Akkadian decline and question whether we can identify societal collapse at all (5).

ii) The discrepancy between the ways archaeologists and earth scientists define fine temporal and geographic resolution has been emphasized as a major hurdle to linking on-site evidence with off-site climate proxies (6). The reconstructed speleothem records are located 800 km from Tell Leilan where the 4.2 ka event was studied, further limiting the ability to understand the regional-specific social dimensions of climate change (7).

iii) Minimizing the range of years a climate event occurs before political collapse is crucial for assessing the impact of a climate anomaly and how it, alongside other factors, pushed sociopolitical systems beyond their resilience threshold (8). The authors persuasively show that an ∼300-y long-term period of drought overlapped with ∼290 y of post-Akkadian change. However, the relatively short-term cultural collapse event, which probably lasted less than the multidecadal error range of the radiometric dating, is nested in the data provided by Carolin et al. (1). Thus, the purported indistinguishability of correlation between the onset of drought and the quick demise of Akkad, essentially reveals scenarios ranging from 150 y of drought until the Akkadian collapse to one in which collapse takes place 13 y before the drought event.

iv) Social reactions to climatic stress are complex and vary cross-culturally. In fact, resilience, rather than wholesale collapse, is often the observed outcome (9). Indeed, recent investigation of the long-term correspondence between climate and settlement dynamics in Mesopotamia show that although earlier developments of settlement expansion and urbanization occurred mostly in periods of increased rainfall, after 2000 BCE, spurts of settlement growth coincided more with periods of marked aridity (10).

Whereas high-resolution climate proxy records are pertinent to multidisciplinary consilience equations, these equations remain unresolved as long as we continue to lack equably detailed evidence for the nature and magnitude of societal response from the social record of both history and archaeology.

1 Carolin SA, et al. (2019) Precise timing of abrupt increase in dust activity in the Middle East coincident with 4.2 ka social change. *Proc Natl Acad Sci USA* 116:67–72.
2 Izdebski A, et al. (2016) The environmental, archaeological and historical evidence for climatic changes and their societal impacts in the eastern Mediterranean in Late Antiquity. *Quat Sci Rev* 136:189–208.
3 Middleton GD (2017) *Understanding Collapse: Ancient History and Modern Myths* (Cambridge Univ Press, Cambridge, UK).

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4 Ur JA (2010) Cycles of civilization in northern Mesopotamia, 4400-2000 BC. *J Archaeol Res* 18:387–431.
5 Weiss H, et al. (1993) The genesis and collapse of third millennium north mesopotamian civilization. *Science* 261:995–1004.
6 Butzer KW, Endfield GH (2012) Critical perspectives on historical collapse. *Proc Natl Acad Sci USA* 109:3628–3631.
7 Haldon J, et al. (2018) History meets palaeoscience: Consilience and collaboration in studying past societal responses to environmental change. *Proc Natl Acad Sci USA* 115:3210–3218.
8 Ellenblum R (2012) *The Collapse of the Eastern Mediterranean: Climate Change and the Decline of the East, 950-1072* (Cambridge Univ Press, Cambridge, UK).
9 McAnany PA, Yoffee N (2009) *Questioning Collapse: Human Resiliency, Vulnerability, and the Aftermath of Empire* (Cambridge Univ Press, New York).
10 Lawrence D, et al. (2016) Long term population, city size and climate trends in the Fertile Crescent: A first approximation. *PLoS One* 11:e0152563.