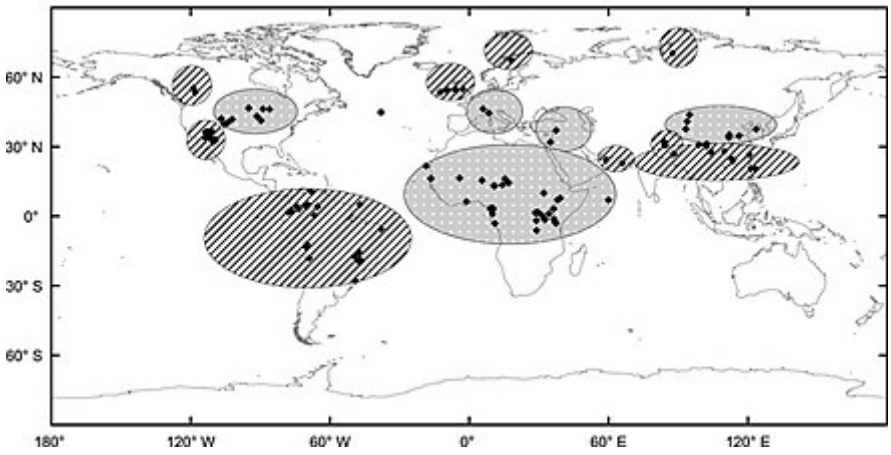
4.2-kiloyear event

The **4.2-kiloyear BP aridification event** was one of the most severe climatic events of the Holocene epoch.[2] It defines the beginning of the current Meghalayan age in the Holocene epoch.



Global distribution of the 4.2 kiloyear event. The hatched areas were affected by wet conditions or flooding, and the dotted areas by drought or dust storms.[1]

Starting around 2200 BC, it probably lasted the entire 22nd century BC. It has been hypothesised to have caused the collapse of the Old Kingdom in Egypt as well as the Akkadian Empire in Mesopotamia, and the Liangzhu culture in the lower Yangtze River area.[3][4] The drought may also have initiated the collapse of the Indus Valley Civilisation, with some of its population moving southeastward to follow the movement of their desired habitat,[5] as well as the migration of Indo-European-speaking people into India.[6]

Some scientists disagree with that conclusion, citing evidence that the event was not a global drought and did not happen in a clear timeline.[7]

Contents

Evidence

Effects

- Iberian Peninsula
- Ancient Egypt
- Arabian Peninsula
- Mesopotamia
- South and Central Asia
- Ancient China

See also

Notes

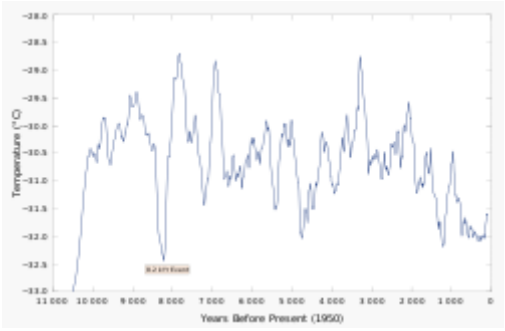
References

Further reading

External links

Evidence

A phase of intense aridity about 4.2 ka BP is recorded across North Africa,[8] the Middle East,[9] the Red Sea,[10] the Arabian Peninsula,[11] the Indian subcontinent,[5] and midcontinental North America.[12] Glaciers throughout the mountain ranges of western Canada advanced about that time.[13] Evidence has also been found in an Italian cave flowstone,[14] the Kilimanjaro ice sheet,[15] and in Andean glacier ice.[16] The onset of the aridification in Mesopotamia in about 4100 BP also coincided with a cooling event in the North Atlantic, known as Bond event 3.[2][17][18] Despite the geographic diversity of these examples, evidence for the 4.2 kyr event in Northern Europe is ambiguous, which suggests that the origins and effects of the event are spatially complex.[19]



Central Greenland reconstructed temperature. Unlike the 8.2-kiloyear event, the 4.2-kiloyear event has no prominent signal in the Gisp2 ice core that has an onset at 4.2 ka BP.

In 2018, the International Commission on Stratigraphy divided the Holocene epoch into three periods,[20] with the late Holocene from approximately 2250 BC onwards designated as the *Meghalayan stage/age*.[21] The boundary stratotype is a speleothem in Mawmluh cave in India,[22] and the global auxiliary stratotype is an ice core from Mount Logan in Canada.[23] However, justification for this division is debated as the event was not a global drought and did not happen within a clear timeframe. Jessica Tierney, a paleoclimatologist at the University of Arizona in Tucson, states that proponents of the new partitioning mistakenly "lumped together evidence of other droughts and wet periods, sometimes centuries away from the event."[7]

Effects

Iberian Peninsula

On the Iberian Peninsula, the construction of motillas-type settlements in the period after 2200 BC is believed to be the consequence of the severe aridification that affected this area.

According to Mejías et al., who reported the first palaeohydrogeological interdisciplinary research in La Mancha, Spain,

> Recent studies show that the "motilla" sites from the Bronze Age in La Mancha may be the most ancient system of groundwater collection in the Iberian Peninsula.... These were built during the Climatic Event 4.2 ka cal BP in a time of environmental stress due to a period of severe, prolonged drought.[24]

The authors' analysis verified a relationship between the geological substrate and the spatial distribution of the motillas.

Ancient Egypt

In c. 2150 BC, Egypt was hit by a series of exceptionally-low Nile floods that may have influenced the collapse of the centralised government of the Old Kingdom after a famine.[25]

Arabian Peninsula

In the Persian Gulf region, there is a sudden change in settlement pattern, style of pottery and tombs. The 22nd century BC drought marks the end of the Umm Al Nar culture and the change to the Wadi Suq culture.[11]

Mesopotamia

The aridification of Mesopotamia may have been related to the onset of cooler sea-surface temperatures in the North Atlantic (Bond event 3), as analysis of the modern instrumental record shows that large (50%) interannual reductions in Mesopotamian water supply result when subpolar northwest Atlantic sea surface temperatures are anomalously cool.[26] The headwaters of the Tigris and Euphrates rivers are fed by elevation-induced capture of winter Mediterranean rainfall.

The Akkadian Empire in 2300 BC was the second civilisation to subsume independent societies into a single state (the first being ancient Egypt in around 3100 BC). It has been claimed that the collapse of the state was influenced by a wide-ranging, centuries-long drought.[27][28] Archaeological evidence documents widespread abandonment of the agricultural plains of northern Mesopotamia and dramatic influxes of refugees into southern Mesopotamia, around 2170 BC.[29] A 180-km-long wall, the "Repeller of the Amorites," was built across central Mesopotamia to stem nomadic incursions to the south. Around 2150 BC, the Gutian people, who originally inhabited the Zagros Mountains, defeated the demoralised Akkadian army, took Akkad and destroyed it around 2115 BC. Widespread agricultural change in the Near East is visible at the end of the 3rd millennium BC.[30]

Resettlement of the northern plains by smaller sedentary populations occurred near 1900 BC, three centuries after the collapse.[29]

A study of fossil corals in Oman provides evidence that prolonged winter shamal seasons, around 4200 years ago, led to the salinization of the irrigated field, which made a dramatic decrease in crop production trigger a widespread famine and eventually the collapse of the ancient Akkadian Empire.[31][32]

South and Central Asia

In the 2nd millennium BC, widespread aridification occurred in the Eurasian steppes and in South Asia.[6][33] On the steppes, the vegetation changed, driving "higher mobility and transition to the nomadic cattle breeding."[33][note 1][note 2] Water shortage also strongly affected South Asia:

> This time was one of great upheaval for ecological reasons. Prolonged failure of rains caused acute water shortage in large areas, causing the collapse of sedentary urban cultures in south central Asia, Afghanistan, Iran, and India, and triggering large-scale migrations. Inevitably, the new arrivals came to merge with and dominate the post-urban cultures.[6]

Urban centers of the Indus Valley Civilisation were abandoned and replaced by disparate local cultures because of the same climate change that affected the neighbouring regions to the west.[34] As of 2016, many scholars believed that drought and a decline in trade with Egypt and Mesopotamia caused the collapse of the Indus Civilisation.[35] The Ghaggar-Hakra system was rain-fed,[36][37][38] and water supply depended on the monsoons. The Indus Valley climate grew significantly cooler and drier from about 1800 BC, which is linked to a contemporary general weakening of the monsoon.[36] Aridity increased, with the Ghaggar-Hakra River retracting its reach towards the foothills of the Himalayas,[36][39][40] leading to

erratic and less-extensive floods, which made inundation agriculture less sustainable. Aridification reduced the water supply enough to cause the civilisation's demise, and to scatter its population eastward.[5][41][42][43]

Ancient China

The drought may have caused the collapse of Neolithic cultures around Central China in the late 3rd millennium BC.[44] At the same time, the middle reaches of the Yellow River saw a series of extraordinary floods related to the legendary figure of Yu the Great.[45] In the Yishu River Basin, the flourishing Longshan culture was affected by a cooling that severely reduced rice output and led to a substantial decrease in population and to fewer archaeological sites.[46] In about 2000 BC, Longshan was displaced by the Yueshi culture, which had fewer and less-sophisticated artifacts of ceramic and bronze.

See also

- 8.2-kiloyear event
- African humid period
- Bond event
- Climate variability and change
- Great Flood (China) (c. 2300–2200 BC)
- Late Bronze Age collapse § Environmental (c. 1200-1150 BC)
- Timeline of environmental history

Notes

1. Demkina et al. (2017): "In the second millennium BC, humidization of the climate led to the divergence of the soil cover with secondary formation of the complexes of chestnut soils and solonetzes. This paleoecological crisis had a significant effect on the economy of the tribes in the Late Catacomb and Post-Catacomb time stipulating their higher mobility and transition to the nomadic cattle breeding."[33]
2. See also Eurogenes Blogspot, *The crisis* (http://eurogenes.blogspot.nl/2017/07/the-crisis.html).

References

1. Another map for reference (https://ars.els-cdn.com/content/image/1-s2.0-S027737911731003X-gr1.jpg) in Railsback, L. Bruce; Liang, Fuyuan; Brook, G. A.; Voarintsoa, Ny Riavo G.; Sletten, Hillary R.; Marais, Eugene; Hardt, Ben; Cheng, Hai; Edwards, R. Lawrence (15 April 2018). "The timing, two-pulsed nature, and variable climatic expression of the 4.2 ka event: A review and new high-resolution stalagmite data from Namibia" (https://doi.org/10.1016%2Fj.quascirev.2018.02.015). *Quaternary Science Reviews*. **186**: 78–90. Bibcode:2018QSRv..186...78R (https://ui.adsabs.harvard.edu/abs/2018QSRv..186...78R). doi:10.1016/j.quascirev.2018.02.015 (https://doi.org/10.1016%2Fj.quascirev.2018.02.015). ISSN 0277-3791 (https://www.worldcat.org/issn/0277-3791). The initial source where this map comes from had the map caption the wrong way around: Wang, Xinming; Wang, Yuhong; Chen, Liqi; Sun, Liguang; Wang, Jianjun (10 June 2016). "The abrupt climate change near 4,400 yr BP on the cultural transition in Yuchisi, China and its global linkage" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4901284). *Scientific Reports*. **6**: 27723. Bibcode:2016NatSR...627723W (https://ui.adsabs.harvard.edu/abs/2016NatSR...627723W). doi:10.1038/srep27723 (https://doi.org/10.1038%2Fsrep27723). ISSN 2045-2322 (https://ww

w.worldcat.org/issn/2045-2322). PMC 4901284 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4901284). PMID 27283832 (https://pubmed.ncbi.nlm.nih.gov/27283832).

2. deMenocal, Peter B. (2001). "Cultural Responses to Climate Change During the Late Holocene". *Science*. **292** (5517): 667–673. Bibcode:2001Sci...292..667D (https://ui.adsabs.harvard.edu/abs/2001Sci...292..667D). doi:10.1126/science.1059827 (https://doi.org/10.1126%2Fscience.1059827). PMID 11303088 (https://pubmed.ncbi.nlm.nih.gov/11303088).
3. Gibbons, Ann (1993). "How the Akkadian Empire Was Hung Out to Dry". *Science*. **261** (5124): 985. Bibcode:1993Sci...261..985G (https://ui.adsabs.harvard.edu/abs/1993Sci...261..985G). doi:10.1126/science.261.5124.985 (https://doi.org/10.1126%2Fscience.261.5124.985). PMID 17739611 (https://pubmed.ncbi.nlm.nih.gov/17739611).
4. Li, Chun-Hai; Li, Yong-Xiang; Zheng, Yun-Fei; Yu, Shi-Yong; Tang, Ling-Yu; Li, Bei-Bei; Cui, Qiao-Yu (August 2018). "A high-resolution pollen record from East China reveals large climate variability near the Northgrippian-Meghalayan boundary (around 4200 years ago) exerted societal influence". *Palaeogeography, Palaeoclimatology, Palaeoecology*. **512**: 156–165. Bibcode:2018PPP...512..156L (https://ui.adsabs.harvard.edu/abs/2018PPP...512..156L). doi:10.1016/j.palaeo.2018.07.031 (https://doi.org/10.1016%2Fj.palaeo.2018.07.031). ISSN 0031-0182 (https://www.worldcat.org/issn/0031-0182).
5. Staubwasser, M.; et al. (2003). "Climate change at the 4.2 ka BP termination of the Indus valley civilization and Holocene south Asian monsoon variability". *Geophysical Research Letters*. **30** (8): 1425. Bibcode:2003GeoRL..30.1425S (https://ui.adsabs.harvard.edu/abs/2003GeoRL..30.1425S). doi:10.1029/2002GL016822 (https://doi.org/10.1029%2F2002GL016822). S2CID 129178112 (https://api.semanticscholar.org/CorpusID:129178112).
6. Rajesh Kochhar (2017), *The Aryan chromosome* (http://indianexpress.com/article/opinion/columns/aryans-dna-genetics-archaeology-4765740/), The Indian ERxpress
7. Paul Voosen (August 8, 2018). "Massive drought or myth? Scientists spar over an ancient climate event behind our new geological age" (https://www.sciencemag.org/news/2018/08/massive-drought-or-myth-scientists-spar-over-ancient-climate-event-behind-our-new). *Science*. Retrieved 9 January 2020.
8. Gasse, Françoise; Van Campo, Elise (1994). "Abrupt post-glacial climate events in West Asia and North Africa monsoon domains". *Earth and Planetary Science Letters*. **126** (4): 435–456. Bibcode:1994E&PSL.126..435G (https://ui.adsabs.harvard.edu/abs/1994E&PSL.126..435G). doi:10.1016/0012-821X(94)90123-6 (https://doi.org/10.1016%2F0012-821X%2894%2990123-6).
9. Bar-Matthews, Miryam; Ayalon, Avner; Kaufman, Aaron (1997). "Late Quaternary Paleoclimate in the Eastern Mediterranean Region from Stable Isotope Analysis of Speleothems at Soreq Cave, Israel". *Quaternary Research*. **47** (2): 155–168. Bibcode:1997QuRes..47..155B (https://ui.adsabs.harvard.edu/abs/1997QuRes..47..155B). doi:10.1006/qres.1997.1883 (https://doi.org/10.1006%2Fqres.1997.1883).
10. Arz, Helge W.; et al. (2006). "A pronounced dry event recorded around 4.2 ka in brine sediments from the northern Red Sea". *Quaternary Research*. **66** (3): 432–441. Bibcode:2006QuRes..66..432A (https://ui.adsabs.harvard.edu/abs/2006QuRes..66..432A). doi:10.1016/j.yqres.2006.05.006 (https://doi.org/10.1016%2Fj.yqres.2006.05.006). S2CID 55910028 (https://api.semanticscholar.org/CorpusID:55910028).
11. Parker, Adrian G.; et al. (2006). "A record of Holocene climate change from lake geochemical analyses in southeastern Arabia" (https://web.archive.org/web/20081029174631/http://www.gulfnexus.org/articles/geo/2006a%20Parker%20et%20al.pdf) (PDF). *Quaternary Research*. **66** (3): 465–476. Bibcode:2006QuRes..66..465P (https://ui.adsabs.harvard.edu/abs/2006QuRes..66..465P). doi:10.1016/j.yqres.2006.07.001 (https://doi.org/10.1016%2Fj.yqres.2006.07.001). S2CID 140158532 (https://api.semanticscholar.org/CorpusID:140158532). Archived from the original (http://www.gulfnexus.org/articles/geo/2006a%20Parker%20et%20al.pdf) (PDF) on October 29, 2008.

12. Booth, Robert K.; et al. (2005). "A severe centennial-scale drought in midcontinental North America 4200 years ago and apparent global linkages". *The Holocene*. **15** (3): 321–328. Bibcode:2005Holoc..15..321B (https://ui.adsabs.harvard.edu/abs/2005Holoc..15..321B). doi:10.1191/0959683605hl825ft (https://doi.org/10.1191%2F0959683605hl825ft). S2CID 39419698 (https://api.semanticscholar.org/CorpusID:39419698).
13. Menounos, B.; et al. (2008). "Western Canadian glaciers advance in concert with climate change c. 4.2 ka". *Geophysical Research Letters*. **35** (7): L07501. Bibcode:2008GeoRL..3507501M (https://ui.adsabs.harvard.edu/abs/2008GeoRL..3507501M). doi:10.1029/2008GL033172 (https://doi.org/10.1029%2F2008GL033172).
14. Drysdale, Russell; et al. (2005). "Late Holocene drought responsible for the collapse of Old World civilizations is recorded in an Italian cave flowstone". *Geology*. **34** (2): 101–104. Bibcode:2006Geo....34..101D (https://ui.adsabs.harvard.edu/abs/2006Geo....34..101D). doi:10.1130/G22103.1 (https://doi.org/10.1130%2FG22103.1).
15. Thompson L.G.; et al. (2002). "Kilimanjaro Ice Core Records Evidence of Holocene Climate Change in Tropical Africa". *Science*. **298** (5593): 589–93. Bibcode:2002Sci...298..589T (https://ui.adsabs.harvard.edu/abs/2002Sci...298..589T). doi:10.1126/science.1073198 (https://doi.org/10.1126%2Fscience.1073198). PMID 12386332 (https://pubmed.ncbi.nlm.nih.gov/12386332). S2CID 32880316 (https://api.semanticscholar.org/CorpusID:32880316).
16. Davis, Mary E.; Thompson, Lonnie G. (2006). "An Andean ice-core record of a Middle Holocene mega-drought in North Africa and Asia" (https://doi.org/10.3189%2F172756406781812456). *Annals of Glaciology*. **43** (1): 34–41. Bibcode:2006AnGla..43...34D (https://ui.adsabs.harvard.edu/abs/2006AnGla..43...34D). doi:10.3189/172756406781812456 (https://doi.org/10.3189%2F172756406781812456).
17. Bond, G.; et al. (1997). "A Pervasive Millennial-Scale Cycle in North Atlantic Holocene and Glacial Climates" (https://web.archive.org/web/20080227192411/http://rivernet.ncsu.edu/courselocker/PaleoClimate/Bond%20et%20al.%2C%201997%20Millenial%20Scale%20Holocene%20Change.pdf) (PDF). *Science*. **278** (5341): 1257–1266. Bibcode:1997Sci...278.1257B (https://ui.adsabs.harvard.edu/abs/1997Sci...278.1257B). doi:10.1126/science.278.5341.1257 (https://doi.org/10.1126%2Fscience.278.5341.1257). Archived from the original (http://rivernet.ncsu.edu/courselocker/PaleoClimate/Bond%20et%20al.,%201997%20Millenial%20Scale%20Holocene%20Change.pdf) (PDF) on 2008-02-27.
18. "Two examples of abrupt climate change" (https://web.archive.org/web/20070823214001/http://www.ldeo.columbia.edu/res/pi/arch/examples.shtml). Lamont-Doherty Earth Observatory. Archived from the original (http://www.ldeo.columbia.edu/res/pi/arch/examples.shtml) on 2007-08-23.
19. Roland, Thomas P; et al. (2014). "Was there a '4.2 ka event' in Great Britain and Ireland? Evidence from the peatland record" (https://ore.exeter.ac.uk/repository/bitstream/10871/30630/1/4.2%20Symplectic.pdf) (PDF). *Quaternary Science Reviews*. **83**: 11–27. Bibcode:2014QSRv...83...11R (https://ui.adsabs.harvard.edu/abs/2014QSRv...83...11R). doi:10.1016/j.quascirev.2013.10.024 (https://doi.org/10.1016%2Fj.quascirev.2013.10.024). hdl:10871/30630 (https://hdl.handle.net/10871%2F30630).
20. "Meghalaya Age: Newest phase in Earth's history named after Meghalaya rock | - Times of India" (https://timesofindia.indiatimes.com/home/science/newest-phase-in-earths-history-named-after-meghalaya-rock/articleshow/65046837.cms). *The Times of India*.
21. Amos, Jonathan (2018-07-18). "Welcome to the Meghalayan Age a new phase in history" (https://www.bbc.com/news/science-environment-44868527). *BBC News*.
22. "Collapse of civilizations worldwide defines youngest unit of the Geologic Time Scale" (http://www.stratigraphy.org/index.php/ics-news-and-meetings/119-collapse-of-civilizations-worldwide-defines-youngest-unit-of-the-geologic-time-scale).
23. "Formal subdivision of the Holocene Series/Epoch" (https://www.qpg.geog.cam.ac.uk/news/formalsubdivisionoftheholoceneseriesgeogr18.pdf) (PDF).

24. Mejías Moreno, M., Benítez de Lugo Enrich, L., Pozo Tejado, J. del y Moraleda Sierra, J. 2014. *Los primeros aprovechamientos de aguas subterráneas en la Península Ibérica. Las motillas de Daimiel en la Edad del Bronce de La Mancha*. (http://www.igme.es/boletin/2014/125_4/5_%20Articulo%203.pdf) Boletín Geológico y Minero, 125 (4): 455–474 ISSN 0366-0176 (https://www.worldcat.org/search?fq=x0:jrnl&q=n2:0366-0176)
25. Stanley, Jean-Daniel; et al. (2003). "Nile flow failure at the end of the Old Kingdom, Egypt: Strontium isotopic and petrologic evidence" (https://www.research.manchester.ac.uk/portal/en/publications/short-contribution-nile-flow-failure-at-the-end-of-the-old-kingdom-egypt-strontium-isotopic-and-petrologic-evidence(2a75c9be-5939-467a-b08f-6f08e9bfb86d).html). *Geoarchaeology*. **18** (3): 395–402. doi:10.1002/gea.10065 (https://doi.org/10.1002%2Fgea.10065).
26. Cullen, Heidi M.; deMenocal, Peter B. (2000). "North Atlantic influence on Tigris-Euphrates streamflow". *International Journal of Climatology*. **20** (8): 853–863. Bibcode:2000IJCli..20..853C (https://ui.adsabs.harvard.edu/abs/2000IJCli..20..853C). doi:10.1002/1097-0088(20000630)20:8<853::AID-JOC497>3.0.CO;2-M (https://doi.org/10.1002%2F1097-0088%2820000630%2920%3A8%3C853%3A%3AAID-JOC497%3E3.0.CO%3B2-M).
27. Kerr, Richard A. (1998). "Sea-Floor Dust Shows Drought Felled Akkadian Empire". *Science*. **279** (5349): 325–326. Bibcode:1998Sci...279..325K (https://ui.adsabs.harvard.edu/abs/1998Sci...279..325K). doi:10.1126/science.279.5349.325 (https://doi.org/10.1126%2Fscience.279.5349.325). S2CID 140563513 (https://api.semanticscholar.org/CorpusID:140563513).
28. Cullen, H. M. et al., "Climate change and the collapse of the Akkadian empire: Evidence from the deep sea", *Geology*, vol. 28, iss. 4, pp. 379-382, 2000
29. Weiss, H; et al. (1993). "The Genesis and Collapse of Third Millennium North Mesopotamian Civilization" (http://revistas.ucm.es/index.php/ILUR/article/view/61022). *Science*. **261** (5124): 995–1004. Bibcode:1993Sci...261..995W (https://ui.adsabs.harvard.edu/abs/1993Sci...261..995W). doi:10.1126/science.261.5124.995 (https://doi.org/10.1126%2Fscience.261.5124.995). PMID 17739617 (https://pubmed.ncbi.nlm.nih.gov/17739617). S2CID 31745857 (https://api.semanticscholar.org/CorpusID:31745857).
30. Riehl, S. (2008). "Climate and agriculture in the ancient Near East: a synthesis of the archaeobotanical and stable carbon isotope evidence". *Vegetation History and Archaeobotany*. **17** (1): 43–51. doi:10.1007/s00334-008-0156-8 (https://doi.org/10.1007%2Fs00334-008-0156-8). S2CID 128622745 (https://api.semanticscholar.org/CorpusID:128622745).
31. Watanabe, Takaaki K.; Watanabe, Tsuyoshi; Yamazaki, Atsuko; Pfeiffer, Miriam (2019). "Oman corals suggest that a stronger winter shamal season caused the Akkadian Empire (Mesopotamia) collapse". *Geology*. GeoScienceWorld. **47** (12): 1141–1145. Bibcode:2019Geo....47.1141W (https://ui.adsabs.harvard.edu/abs/2019Geo....47.1141W). doi:10.1130/G46604.1 (https://doi.org/10.1130%2FG46604.1).
32. "Strong winter dust storms may have caused the collapse of the Akkadian Empire" (https://www.global.hokudai.ac.jp/blog/strong-winter-dust-storms-may-have-caused-the-collapse-of-the-akkadian-empire/). *Hokkaido University*. 24 October 2019.
33. Demkina, T.S. (2017). "Paleoecological crisis in the steppes of the Lower Volga region in the Middle of the Bronze Age (III–II centuries BC)". *Eurasian Soil Science*. **50** (7): 791–804. Bibcode:2017EurSS..50..791D (https://ui.adsabs.harvard.edu/abs/2017EurSS..50..791D). doi:10.1134/S1064229317070018 (https://doi.org/10.1134%2FS1064229317070018). S2CID 133638705 (https://api.semanticscholar.org/CorpusID:133638705).
34. "Decline of Bronze Age 'megacities' linked to climate change" (https://phys.org/news/2014-02-decline-bronze-age-megacities-linked.html). *phys.org*.
35. Lawler, Andrew (6 June 2008). "Indus Collapse: The End or the Beginning of an Asian Culture?". *Science*. **320** (5881): 1282–3. doi:10.1126/science.320.5881.1281 (https://doi.org/10.1126%2Fscience.320.5881.1281). PMID 18535222 (https://pubmed.ncbi.nlm.nih.gov/18535222). S2CID 206580637 (https://api.semanticscholar.org/CorpusID:206580637).

36. Giosan, L.; et al. (2012). "Fluvial landscapes of the Harappan Civilization" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3387054). *Proceedings of the National Academy of Sciences USA*. **109** (26): E1688–E1694. Bibcode:2012PNAS..109E1688G (https://ui.adsabs.harvard.edu/abs/2012PNAS..109E1688G). doi:10.1073/pnas.1112743109 (https://doi.org/10.1073%2Fpnas.1112743109). PMC 3387054 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3387054). PMID 22645375 (https://pubmed.ncbi.nlm.nih.gov/22645375).
37. Clift et al., 2011, "U-Pb zircon dating evidence for a Pleistocene Sarasvati River and capture of the Yamuna River", *Geology*, 40, 211–214 (2011). [1] (http://geology.gsapubs.org/content/40/3/211.short)
38. Tripathi, Jayant K.; Tripathi, K.; Bock, Barbara; Rajamani, V. & Eisenhauer, A. (25 October 2004). "Is River Ghaggar, Saraswati? Geochemical Constraints" (http://www.ias.ac.in/currsci/oct252004/1141.pdf) (PDF). *Current Science*. **87** (8).
39. Rachel Nuwer (28 May 2012). "An Ancient Civilization, Upended by Climate Change" (http://green.blogs.nytimes.com/2012/05/29/an-ancient-civilization-upended-by-climate-change/?_r=0). LiveScience. Retrieved 29 May 2012.
40. Charles Choi (29 May 2012). "Huge Ancient Civilization's Collapse Explained" (http://www.livescience.com/20614-collapse-mythical-river-civilization.html). *The New York Times*. Retrieved 18 May 2016.
41. Madella, Marco; Fuller, Dorian (2006). "Palaeoecology and the Harappan Civilisation of South Asia: a reconsideration". *Quaternary Science Reviews*. **25** (11–12): 1283–1301. Bibcode:2006QSRv...25.1283M (https://ui.adsabs.harvard.edu/abs/2006QSRv...25.1283M). doi:10.1016/j.quascirev.2005.10.012 (https://doi.org/10.1016%2Fj.quascirev.2005.10.012).
42. MacDonald, Glen (2011). "Potential influence of the Pacific Ocean on the Indian summer monsoon and Harappan decline". *Quaternary International*. **229** (1–2): 140–148. Bibcode:2011QuInt.229..140M (https://ui.adsabs.harvard.edu/abs/2011QuInt.229..140M). doi:10.1016/j.quaint.2009.11.012 (https://doi.org/10.1016%2Fj.quaint.2009.11.012).
43. Brooke, John L. (2014), *Climate Change and the Course of Global History: A Rough Journey* (https://books.google.com/books?id=O9TSAgAAQBAJ&pg=PA296), Cambridge University Press, p. 296, ISBN 978-0-521-87164-8
44. Wu, Wenxiang; Liu, Tungsheng (2004). "Possible role of the "Holocene Event 3" on the collapse of Neolithic Cultures around the Central Plain of China". *Quaternary International*. **117** (1): 153–166. Bibcode:2004QuInt.117..153W (https://ui.adsabs.harvard.edu/abs/2004QuInt.117..153W). doi:10.1016/S1040-6182(03)00125-3 (https://doi.org/10.1016%2FS1040-6182%2803%2900125-3).
45. Chun Chang Huang; et al. (2011). "Extraordinary floods related to the climatic event at 4200 a BP on the Qishuihe River, middle reaches of the Yellow River, China". *Quaternary Science Reviews*. **30** (3–4): 460–468. Bibcode:2011QSRv...30..460H (https://ui.adsabs.harvard.edu/abs/2011QSRv...30..460H). doi:10.1016/j.quascirev.2010.12.007 (https://doi.org/10.1016%2Fj.quascirev.2010.12.007).
46. Gao, Huazhong; Zhu, Cheng; Xu, Weifeng (2007). "Environmental change and cultural response around 4200 cal. yr BP in the Yishu River Basin, Shandong". *Journal of Geographical Sciences*. **17** (3): 285–292. doi:10.1007/s11442-007-0285-5 (https://doi.org/10.1007%2Fs11442-007-0285-5). S2CID 186227589 (https://api.semanticscholar.org/CorpusID:186227589).

Further reading

- Kaniewski, D.; et al. (2008). "Middle East coastal ecosystem response to middle-to-late Holocene abrupt climate changes" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2544558). *PNAS*. **105** (37): 13941–13946. Bibcode:2008PNAS..10513941K (https://ui.adsabs.harvard.edu/abs/2008PNAS..10513941K). doi:10.1073/pnas.0803533105 (https://doi.org/10.1073%2Fpnas.0803533105).

PMC 2544558 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2544558). PMID 18772385 (https://pubmed.ncbi.nlm.nih.gov/18772385).
- Weiss, H., ed. (2012). *Seven Generations Since the Fall of Akkad*. Wiesbaden: Harrassowitz. ISBN 9783447068239.
- Weiss, H. (2000). "Beyond the Younger Dryas: Collapse as Adaptation to Abrupt Climate Change in Ancient West Asia and the Eastern Mediterranean". In Bawden, G.; Reycraft, R. M. (eds.). *Environmental Disaster and the Archaeology of Human Response*. Albuquerque, NM: Maxwell Museum of Anthropology. pp. 63–74. ISBN 0-912535-14-8.

External links

- The Egyptian Old Kingdom, Sumer and Akkad (http://www.friesian.com/notes/oldking.htm)
- The End of the Old Kingdom (https://web.archive.org/web/20121231174140/http://www.reshafim.org.il/ad/egypt/the_end_of_the_old_kingdom.htm)