

Holocene climate change – facts and mysteries

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At the millennial timescale, the key mechanisms determining climate variability and change during the recent interglacial, the Holocene, are satisfactorily understood. Most likely due to the high summer insolation in the Northern Hemisphere (NH), a warm mid-Holocene period – called Hypsithermal, Altithermal or Holocene Climate Optimum – followed the periods of the Preboreal and Boreal after about 9-8 ka BP. With the decreasing summer insolation in the NH and the slightly increasing winter insolation in the Southern Hemisphere (SH), the Intertropical Convergence Zone shifted progressively southward after about 5 ka BP, causing a weakening of the summer monsoon systems in Africa and Asia, and an increasing dryness and desertification on both continents. Due to the summer cooling in the NH, a series of glacier advances took place after about 4.5 ka BP. Therefore, this period, which ended with the recent global climate change, was mainly called Neoglacial.

The spatiotemporal structure and the corresponding processes that caused decadal- to multi-centennial-scale climate variability are less well understood. Firstly, precise reconstructions of the important natural forcing factors (solar activity and large tropical volcanic eruptions) are still under debate. Secondly, the so-called “Bond cycles” which were often called the Holocene equivalent of the glacial Dansgaard-Oeschger cycles, show interesting correlations with climate fluctuations in the North Atlantic – Eurasian area (e.g., with glacier dynamics). But a plausible mechanism for the transmission of their signal to the SH has only been postulated for the period with strong meltwater fluxes during the early Holocene. Decadal to multi-centennial-scale variability is also reproduced by ensembles of long-term simulations with Earth System Models, but it is still questioned whether the cold relapses during the Holocene were triggered by natural forcing, or just the consequence of internal variability.

Ref.: Wanner, H. et al., 2008: Mid- to Late Holocene climate change: an overview. *Quaternary Sci. Rev.* 27, 1791-1828.