The climate of the past 10 millennia, the Holocene, has been portrayed as uniquely benign and stable, with no past equivalent in the Pleistocene. In the core from the Greenland Ice Core Project (GRIP), the temperature proxies of the interval representing the last interglacial, around 125,000 years ago, fluctuate wildly, in striking contrast to the uniform Holocene section of the same core (1). Observations supporting large variability of the last interglacial are reported from around the world. But there are also plentiful arguments to the contrary. Other ice cores in Greenland and Antarctica (2) show little difference in the variability of the Holocene and the older interglacial sections. North Atlantic waters stayed uniformly warm, and temperate flora flourished in interglacial forests in Europe. So who is right?

At a symposium held last October at Columbia University (3), several questions were asked to resolve the dilemma. Are the geologic records continuous and the sedimentation rates reasonably uniform? Is the interpretation of the climate proxies correct? Most importantly, do the periods ascribed to the last interglacial at different locations refer to the same time interval? And did the last interglacial last as long as the elapsed part of the Holocene?

The best information on past global climates comes from deep-sea sediments. Isotopic oxygen ratios in the carbonate shells of bottom dwelling foraminifera document the amount of seawater removed from the oceans and stored as ice on land. Time is divided into episodes with relatively high and relatively low global ice volume, with lowest ice storage during interglacials. The last episode showing a low ice volume similar to that of today is marine isotope stage (MIS) 5e, which designates the last interglacial. It started 130,000 years ago, peaked at 125,000 years ago, and terminated 116,000 years ago (4). During the next substage, MIS 5d, sea level was low and ice volume was high. MIS 5d culminated at 111,000 and lasted until 106,000 years ago (see the figure).

Emerging views on the last interglacial. (Left) Marine substages MIS 5e and 5d and the cold water indicator *Neogloboquadrina pachyderma sinistra* in the deep-sea core V29-191 off the Irish coast (7). (Right) Percentage of nontree pollen in Grande Pile, France (10). Duration of MIS 5e, of the Eemian in Grande Pile, France, and in Bispingen, Germany, is shown in red. Equivalent duration of the Holocene is shown in yellow. Time scales were obtained independently by interpolation between 74,000- and 130,000-year-old tie points (4) and are untuned. (ka, thousands of years ago.)

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Given that only MIS 5e can be justly compared with the elapsed part of the Holocene (see the figure), there is little basis to conclude that the Eemian climate in Europe was more variable than that of the Holocene (13).

If this alternative interpretation of the Eemian demise is correct, the transition into the glacial was quite different from the conventional model. Climate in Europe remained stable during the first 10,000 or 12,000 years of the interglacial. The central North Atlantic remained warm throughout much of the initial ice buildup. Iceberg surges, at first minor and limited to high latitudes, were accompanied by cold and dry spells over land. The environmental gradient in the surface ocean as well as in land increased in several pulses. Steppes expanded earlier in Germany than in France. The end of the Eemian forest in Grande Pile came when icebergs surged into the central North Atlantic during the dissipation, not the growth, of the ice sheets.

Current interpretations depend heavily on indirect time estimates based on sedimentation rates and links to astronomic chronology. More absolute ages and annually resolved data sets are needed to replace climatostratigraphic timelines in long-distance correlations. The reconstruction of the processes that drove the interglacial Earth from a period that resembles that of today into a glacial can teach us a lot about how climate may change in the future.

References

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