Investigating stadial-interstadial climate changes with the MIROC climate model

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The Late Pleistocene was a period which started about 126,000 years ago and, in the northern hemisphere, was mostly characterized by glaciation across much of North America and Eurasia. Ice core data from Greenland show a series of abrupt climate changes known as Dansgaard-Oeschger events within that period. These events begin with a relatively rapid warming giving rise to the milder climates of the interstadials, followed by progressive cooling over 1,000 years. Some of these cool states, known as stadials, coincide with Heinrich events during which large amounts of freshwater from melting icebergs were released into the North Atlantic Ocean, altering the global ocean circulation and climate. These abrupt changes may have had a profound effect on the lives of early modern humans, both directly and indirectly through changes in vegetation and the environment.
To investigate how these two extreme climates differed, we used results from a coupled atmosphere-ocean model (MIROC) experiment to run further experiments using a stand-alone atmospheric model, in particular a high-resolution version, with the advantage that these types of models perform faster than the coupled ones. The effects of large freshwater discharge into the Atlantic Ocean are taken into account by specifying the corresponding sea ice and sea surface temperature. The freshwater forcing leads to a bipolar climate pattern with cooler and drier conditions across most of the northern hemisphere and warmer and wetter conditions in parts of the southern hemisphere. We compare with a variety of proxy data globally, for example speleothems which can act as markers of long-term changes in paleomonsoons. Furthermore, we apply our climate model results to a separate dynamical vegetation model to assess how vegetation, especially across Europe, responds to such climate changes. Access to a variety of proxy data can increase confidence in model results while model results are of particular use in locations where proxy data are sparse.

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