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Modeling the climate of the past 130,000 years to understand the evolution of humans

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Climate change, characterized by the glacial-interglacial cycle of the past 130,000 years, has shaped the environment in which homo sapiens have evolved. An important feature during this period is the climate fluctuations known as the Dansgaard-Oeschger events which brought about rapid warming episodes, followed by cooling over longer periods. In order to understand how this global climate change affected both the landscape and local climate over Africa and Eurasia and also how these factors in turn may have influenced the migratory patterns of homo sapiens and neanderthals, general circulation models (GCM) can be used to produce numerical simulations of the past climate.

To perform such simulations, certain conditions which vary according to the period of interest are specified in the models. These conditions include the orbital parameters (Milankovitch forcing) which control the insolation, the atmospheric concentration of greenhouse gases such as carbon dioxide, and ice sheet extent. Meltwater from ice sheets can also induce abrupt climate changes by affecting the global ocean circulation and these can be modeled by so-called water-hosing experiments.

Modeling experiments have been run using the MIROC atmosphere-ocean-land GCM at various intervals of the past glacial-interglacial cycle, for example, the mid-Holocene (6ka before present) and the Last Glacial Maximum. Simulations can be validated by comparing in detail with proxy data, where available. We will discuss the various types of models available and how they can be used to give a complete picture across the various climatic states. How the climate evolves to affect human migration in terms of seasonal precipitation and changes in forests and deserts will also be discussed.

Keywords: paleoclimate, climate model, glacial-interglacial cycle