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Representativeness of records: Large-scale climate modes

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Proxy climate reconstructions are generally based on a present relationship between the proxy and particular climate variables over a calibration period. Subsequently, it is a fundamental assumption in palaeoclimate research that this relationship remains constant in time to interprete the large-scale climate. In the ideal case, this provides a reconstruction for past climate variability putting recent climate variability into a long-term context. Here, the hypothesis is tested using atmospheric circulation model experiments. For interglacials, model simulations show that European winter temperatures are related to a Northern Hemisphere circulation similar to that found today. For climate conditions with other ice sheet distributions on the Northern Hemisphere, such as the last glacial maximum and the Tortonian climate, considerable changes are detected in the atmospheric variability pattern compared to the present day. Composite maps of pseudo proxy records over Europe and the Red Sea area indicate that the associated wind pattern can change drastically. During glacial times, Greenland ice cores indicate cold and warm phases in the northern North Atlantic. When looking in detail for the interannual variability for these phases, model simulations indicate that Greenland temperature variations are linked to distinct large-scale Northern Hemisphere circulation patterns and associated local wind directions. It is argued that such analysis provides a dynamical interpretation of past climate variability. With the combined use of models and data, one can examine the representativeness of sites where the reconstructions are available.