Modelling Abrupt Glacial Climate Change

van Meerbeeck, C.J.V.C.

2010

document version
Publisher's PDF, also known as Version of record

Global Warming probably leads to a global temperature rise of about 1.5-4.5°C by 2100, but could it be accompanied by abrupt climate shifts? To find out, we must look into the past. During the last Ice Age, frequent shifts occurred between cold stadials and mild interstadials in the North Atlantic region. Climate models and the geological archive suggest that the thermohaline circulation (THC) – transporting warm water northward in the Atlantic Ocean – repeatedly shifted between a sluggish stadial and a strong interstadial mode, thus warming interstadial climate in Europe. However, with a fragmentary European climate archive, the THC hypothesis has not compellingly been tested. By comparing new climate model simulations with proxy reconstructions of stadial-interstadial transitions during Marine Isotope stage 3 (MIS3, 60-27,000 years ago), my thesis addressed this caveat as I investigated the time-interval with most frequent shifts. The explanation for varying frequencies may be slow changes in the earth's orbit around the sun, which caused mild northern hemisphere summers during MIS3 by enhancing summer insolation. With mild summers the conveyor more frequently becomes sluggish than with cold summers. Regarding past abrupt climate change, the European archive supports the THC hypothesis. A stadial-interstadial transition was characterised by warming winters, prolongation of the growing season and increasing precipitation. This allowed forests in Europe to expand northwards, although tree-growth was regionally impeded by frequent killing frosts and summers remaining too cool and dry. To draw these conclusions, I developed a model-data comparison approach that focuses on seasonality changes captured by most proxies.