Geophysical Research Abstracts, Vol. 9, 07741, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07741

Millennial-timescale climate changes in western Europe during the last glaciation: loess records and numerical simulations

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European loess deposits built up during the last glacial cycle show an alternation of loess and paleosol layers developed in response to rapid climate changes. A particularly interesting site is Nussloch, Germany, where loess deposition has been mainly determined by wind dynamics, and sedimentation rates are generally very high. The multidisciplinary study of four loess sequences from Nussloch suggests that the phases of loess deposition correspond to periods of cold, arid climate, with strong eolian activity, whereas phases of decrease (or even a stop) in sedimentation, allowing soil development, are related to intervals not necessarily warmer, but more humid and less windy. Based on the striking similarity between variations of the grain-size index at Nussloch (reflecting changes in wind strength) and variations of dust concentration in Greenland ice in the interval 40,000 to 15,000 years BP (for which high-resolution sedimentary data could be obtained), it was suggested that the climate fluctuations recognized in loess sequences were the counterpart on continents of the millennial-timescale variations in the North-Atlantic area: Dansgaard-Oeschger (DO) and Heinrich (HE) events. Phases of strong loess deposition were associated to Greenland DO stadials or to HE events, and intervals of paleosol development, to DO interstadials. This work is a first step in correlating information from loess data with climate modeling results. The LMDZ.3.3 general circulation model in a version with a stretched grid over Europe (resolution down to 50 km) is used to simulate the impact on western Europe of abrupt changes in the North Atlantic area such as those associated with the

DO and Heinrich events. A reference glacial state is obtained by prescribing boundary conditions (sea-surface temperatures (SSTs), orbital parameters, ice-sheet configuration, sea level, CO2, vegetation) specific to the Last Glacial Maximum. Cold and warm anomalies symmetrical to the reference values are applied to the North-Atlantic SSTs in order to simulate a HE-like and, respectively, a DO-like perturbation. The three climatic states are analyzed and compared for the western Europe from the point of view of the main factors having an impact on dust cycle (wind, precipitation, soil moisture, snow cover) taking into account that for the Nussloch deposits the source areas seem to have been the dried-out English Channel and southern North Sea for the fine dust grains, and the dry braided Rhine Valley for the coarse material.