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Smoothing of millennial scale climate variability in European Loess (and other records)

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Millennial scale climate variability is seen in various records of the northern hemisphere for the last glacial cycle. Their expression represents a promising stratigraphic correlation tool beyond the temporal resolution of numerical dating, e.g. luminescence dating. Highest (correlative) dating accuracy is a prerequisite of comparing different geoarchives, especially when related to archaeological findings or outstanding environmental events, e.g. volcanic ashes, dust storms, floods. Here we attempt to constrain the timing of loess geoarchives in south-eastern Europe, and discuss the challenge of dealing with smoothed records.

In this contribution, we use several paleoenvironmental proxy datasets from the middle and lower Danube catchment, which may be interpreted as showing smoothed millennial scale climate variability. A comparison of these loess data to the Greenland ice cores records indicates a rather unusual expression of millennial scale climate variability shown in these records, possibly due to smoothing of proxy signals by various processes.

To explain the observed patterns, we experiment with low-pass filters of reference records to simulate a signal smoothing by natural processes such as e.g. bioturbation and pervasive diagenesis. Low-pass filters avoid high frequency oscillations and focus on the longer period (lower frequency) variability, here using cut-off periods from 1-15 kyr. In our opinion, low-pass filters represent simple models for the expression of millennial scale climate variability in low sedimentation environments, and in sediments where signals are smoothed by e.g. pedogentic processes.

Using different low-pass filter thresholds allows to (a) explain observed patterns and their potential relation to millennial scale climate variability, (b) propose these filtered/smoothed signals as correlation targets for records lacking millennial scale recording, but showing smoothed climate variability on supra-millennial scales, and (c) determine which time resolution specific (loess) records can reproduce when sampled at a specific resolution, despite of pervasive signal smoothing. Comparing smoothed records to reference data may be a step forward especially for last glacial stratigraphies, where millennial scale patterns are certainly present but not directly recorded in some geoarchives.

Last year, a concept was presented at the EGU. This poster focuses on the applicability, and presents several case studies.