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Millennial-scale record in European eolian deposits: Data-model comparison (ACTES & EOLE projects)

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The intensive field analysis of European loess sequences, from Western Europe to Eastern Europe along a transect at about 50° latitude North, demonstrates the record of abrupt climate changes by this eolian sediment, in conjunction with the millennial-scale variability observed in the North Atlantic and in Greenland. This includes rapid warmings named Dansgaard-Oeschger (DOE) events, described in Greenland ice cores and marine cores in the North Atlantic, but also the Heinrich (HE) events described from marine records occurring during particular stadials. These events are recorded in European loess by alternating loess-soil doublets whose thickness and properties depend on the length and intensity of the associated climate change. The modeling of the cycle of dust (emission, transport, deposition) is used to understand how such continental records have been built considering the millennial scale variability. In a first phase, dust emission is addressed, and shows the crucial role of vegetation in the modulation of the emission during glacial period based on simulations of a reference glacial state, assimilated to a stadial (DOS) interval, a cold perturbation resembling a HE, and a warm perturbation assimilated to a DOE using the LMDZ AGCM. SST changes associated to North Atlantic millennial changes result in enhanced dust emission (DOS and HE emission fluxes more than twice higher than DO fluxes), the long distance dust transport being more effective in cold states due to reduced precipitation. The model-data comparison suggests that the climate variations are the cause for variability recorded in European loess deposits. Finally the comparison points to the vegetation control of dust emission as a key mechanism in the observed millennial and sub-millennial timescale variations of the loess sedimentation process in Europe.