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The linkage between marine sediment records and changes in Holocene Saharan landscape: simulating the dust cycle

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Marine sediment records reveal an abrupt and strong increase in dust deposition in the North Atlantic at the end of the African Humid Period about 4.9 ka to 5.5 ka ago (deMenocal et al., 2000; McGee et al., 2013). The change in dust flux has been attributed to varying Saharan land surface cover. Alternatively, the enhanced dust accumulation is linked to enhanced surface winds and a consequent intensification of coastal upwelling.

We present simulation results from a recent sensitivity study, where we demonstrate for the first time the direct link between dust accumulation in marine cores and changes in Saharan land surface during the Holocene. We have simulated timeslices of he mid-Holocene (6 ka BP) and pre-industrial (1850 AD) dust cycle as a function of Saharan land surface cover and atmosphere-ocean conditions using the coupled atmosphere-aerosol model ECHAM6.1-HAM2.1. We prescribe mid-Holocene vegetation cover based on a vegetation reconstruction from pollen data (Hoelzmann et al., 1998) and mid-Holocene lake surface area is determined using a water routing and storage model (Tegen et al., 2002).

In agreement with data from marine sediment cores, our simulations show that mid-Holocene dust deposition fluxes in the North Atlantic were two to three times lower compared with pre-industrial fluxes. We identify Saharan land surface characteristics to be the main control on dust transport from North Africa to the North Atlantic. We conclude that the variation in dust accumulation in marine cores is likely related to a transition of the Saharan landscape during the Holocene and not due to changes in atmospheric or ocean conditions alone.

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