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The crucial role of the Green Sahara in damping ENSO variability during the Holocene

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Several paleoclimate records show that the ENSO variability may have been remarkably smaller during the mid Holocene (MH) relative to today; however, MH model simulations in which only the orbital forcing is taken into account are not able to fully capture the magnitude of this change. We use a fully coupled simulation for 6000 yr BP (MH) in which we prescribed not only the MH orbital forcing but also Saharan vegetation and reduced dust concentrations. By performing a set of idealized experiments in which each forcing is changed in turn, we show that when accounting for both vegetated Sahara and reduced dust concentrations, the amplitude of the ENSO cycle and its variability are remarkably reduced (∼25%) compared to case when only the orbital forcing is prescribed (only 7%). The changes in ENSO behavior are accompanied by damping of the Atlantic El Niño variability (almost 50%). The simulated changes in equatorial variability are connected to the momentous strengthening of the WAM monsoon, which extents all the way to the northernmost part of the Sahara desert. Such changes in the WAM and in the atmospheric circulation over the equatorial Atlantic led to a reduction of the Atlantic El Niño variability and affect ENSO behavior through the atmospheric circulation bridge between the Atlantic and the Pacific. Hence, our results suggest orbital forcing is likely not the only forcing at play behind the changes in ENSO behavior and point to the changes over equatorial Atlantic connected to the Sahara greening as a crucial factor in altering the ENSO spatiotemporal characteristic during the MH.