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Understanding the mechanisms behind the West African Monsoon northward extension during Mid-Holocene

Marco Gaetani (1), Gabriele Messori (2), Qiong Zhang (3), Cyrille Flamant (1), Amato T. Evan (4), and Francesco S.R. Pausata (5)

(1) Universite Pierre et Marie Curie, Institut Pierre Simon Lapalce, LATMOS, Paris, France (marco.gaetani@latmos.ipsl.fr), (2) Hadley Centre, Met Office, Exeter, UK, (3) Department of Physical Geography and Bolin Centre for Climate Research, Stockholm University, Sweden, (4) Scripps Institution of Oceanography, University of San Diego, USA, (5) Department of Meteorology and Bolin Centre for Climate Research, Stockholm University, Sweden

Understanding the West African monsoon (WAM) dynamics in the mid-Holocene (MH) is a crucial issue in climate modelling, because numerical models typically fail to reproduce the extensive precipitation suggested by proxy evidence. This discrepancy is largely due to unrealistic imposed land surface cover and aerosols. Numerical experiments are conducted by imposing a “green Sahara”, along with a reduced dust concentration in the atmosphere, coherently with the MH environment in the region, and the atmospheric dynamics response and impact on precipitation are investigated. The response of the WAM system to the imposed conditions shows a dramatic augmentation of the precipitation across West Africa up to the Mediterranean coast. This follows a substantial reorganization of the regional circulation, with some monsoonal circulation features (Saharan heat low, African easterly jet, African easterly waves) weakened in favour of deep convection development over land. The simulated response is dominated by land cover changes, and the reduction in dust concentration further enhances the changes induced by the “green Sahara”. The intensity and meridional extent of the WAM is fully consistent with proxy evidence. The results for the MH WAM present important implications for understanding future climate scenarios in the region, in the perspective of projected wetter conditions in West Africa.