Geophysical Research Abstracts
Vol. 18, EGU2016-15045, 2016
EGU General Assembly 2016

How much rainfall sustained a Green Sahara during the mid-Holocene?

Peter Hopcroft (1), Paul Valdes (1), and Anna Harper (2)

(1) School of Geographical Sciences, University of Bristol, Bristol, U.K. (peter.hopcroft@bristol.ac.uk), (2) College of Engineering, Mathematics, and Physical Sciences, University of Exeter, Exeter, U.K.

The present-day Sahara desert has periodically transformed to an area of lakes and vegetation during the Quaternary in response to orbitally-induced changes in the monsoon circulation. Coupled atmosphere-ocean general circulation model simulations of the mid-Holocene generally underestimate the required monsoon shift, casting doubt on the fidelity of these models. However, the climatic regime that characterised this period remains unclear. To address this, we applied an ensemble of dynamic vegetation model simulations using two different models: JULES (Joint UK Land Environment Simulator) a comprehensive land surface model, and LPJ (Lund-Potsdam-Jena model) a widely used dynamic vegetation model. The simulations are forced with a number of idealized climate scenarios, in which an observational climatology is progressively altered with imposed anomalies of precipitation and other related variables, including cloud cover and humidity. The applied anomalies are based on an ensemble of general circulation model simulations, and include seasonal variations but are spatially uniform across the region.
When perturbing precipitation alone, a significant increase of at least 700mm/year is required to produce model simulations with non-negligible vegetation coverage in the Sahara region. Changes in related variables including cloud cover, surface radiation fluxes and humidity are found to be important in the models, as they modify the water balance and so affect plant growth. Including anomalies in all of these variables together reduces the precipitation change required for a Green Sahara compared to the case of increasing precipitation alone. We assess whether the precipitation changes implied by these vegetation model simulations are consistent with reconstructions for the mid-Holocene from pollen samples. Further, Earth System models predict precipitation increases that are significantly smaller than that inferred from these vegetation model simulations. Understanding this difference presents an ongoing challenge.