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Vegetation-atmosphere feedbacks in West Africa on time scales of weeks to months

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Rainfall exerts a strong control on the seasonal evolution of vegetation across West Africa. In turn vegetation, and the root zone soil moisture which influences its growth, controls the fluxes of water and heat back into the atmosphere. This provides a mechanism for the land to feed back on the large-scale circulation over the course of the annual cycle. In this study, satellite data are combined with the outputs from land surface models and atmospheric reanalysis to develop an overview of where and when such feedbacks can occur in the region. The influence of rainfall on vegetation cover is re-examined using satellite data from the period 2000-8. MODIS Normalised Vegetation Difference Index (NDVI) data are used to characterise the strong seasonality of leaf area, and the seasonally varying control of antecedent rainfall is assessed with the TRMM 3B42 precipitation product. Significant correlations between NDVI and antecedent rainfall are found throughout the year on the northern side of the Intertropical Convergence Zone, with lags from days to up to a year at some latitudes.

The feedback of vegetation on the atmosphere is assessed through spatial correlations between NDVI and atmospheric temperature, as represented in the ECMWF ERA-Interim reanalysis product. Significant negative correlations between NDVI and temperature are found for a majority of latitudes and times of year between 6 and 16.5degN. Similar analysis correlating sensible heat flux and temperature data shows consistency with this feedback, though surprisingly, the land models were less successful than the NDVI data in producing significant correlations with temperature during the months either side of the Sahelian wet season. These results suggest that there is the potential for improved predictability in the simulation of the monsoon through better land initialization in forecasts, though the representation of vegetation processes is still lacking if improvements to GCMs are to be made on an interannual time scale.