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Annual to decadal variability of Sahelian rainfall – does the land surface matter?

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Many studies have documented and investigated the existence of strong inter-annual to decadal scale rainfall anomalies over sub-Saharan West Africa. Most prominent is the pronounced drought in the 1970ies and 1980ies and the subsequent recovery afterwards. While early studies (e.g. Charney et al., 1977) have already discussed the importance of land surface-albedo feedback in amplifying regional droughts in semi-arid areas, recent studies have mainly focused on the importance of sea surface temperature (SST) on Sahelian rainfall anomalies (e.g. Lu et al, 2005, Bader & Latif, 2009, Rodriguez-Fonseca et al, 2011). Using dedicated GCM experiments, the role of SST anomalies on Sahelian rainfall and various kinds of processes could be identified, relating SST anomalies in different oceans to the West African rainfall regime. In all these studies, the importance of land-surface albedo has not been analyzed.

Novel long-term satellite climate data records of surface albedo observations allow for the first time to make a joint assessment of the role of the land surface albedo as well as SST on West African rainfall dynamics using observational data. This includes an analysis of the influence precipitation anomalies take on the evolution of land surface albedo.

We also present results from a simulations conducted with the Earth System Model developed at the Max Planck Institute for Meteorology (MPI-ESM). On the basis of these experiments we first analyze the sensitivity of MPI-ESM to changes in surface albedo using bright (1984) and dark (2000) observed albedo values from METEOSAT satellite observations. We then further conduct an ensemble series of simulations which are tailored to disentangle the effects of SST and surface albedo forcing on the West African rainfall regime. A series of experiments is performed, which prescribe the observed surface albedo anomalies from a novel satellite based data set (Loew & Govaerts, 2010). Thereby, the contribution of surface albedo to the overall Sahelian rainfall variance compared to SST only forced simulations is quantified. The model results are validated using independent rainfall observations.

References:
* Bader, J. & Latif, M., 2009. The 1983 drought in the West Sahel: a case study. Climate Dynamics, 36(3-4), pp.463-472.

* Charney, J. et al., 1977. A Comparative Study of the Effects of Albedo Change on Drought in Semi–Arid Regions. Journal of the Atmospheric Sciences, 34(9), pp.1366-1385.

* Loew, A. & Govaerts, Y., 2010. Towards Multidecadal Consistent Meteosat Surface Albedo Time Series. Remote Sensing, 2(4), pp.957-967.

* Lu, J. & Delworth, T.L., 2005. Oceanic forcing of the late 20th century Sahel drought. Geophysical Research Letters, 32(22), pp.1-5.

* Rodríguez-Fonseca, B. et al., 2011. Interannual and decadal SST-forced responses of the West African monsoon. Atmospheric Science Letters, 12(1), pp.67-74.