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A statistical analysis of soil moisture influence on convective systems in West Africa

Thierry Pellarin (1), Arona Diedhiou (1), Luc Descroix (1), Theo Vischel (1), Claire Gruhier (2), and Mireille Tomasini (3)

(1) LTHE/CNRS, Grenoble Cedex 9, France (thierry.pellarin@ujf-grenoble.fr), (2) CESBIO, Toulouse (claire.gruhier@cesbio.cnes.fr), (3) CNRM/Meteo-France, Toulouse (mireille.tomasini@meteo.fr)

Studying surface–atmosphere feedback is often limited by the accuracy of the land surface observations (particularly soil moisture estimates) or the performance of the land surface models. In West Africa, the monsoon regime is considered to exhibit strong sensitivities to the land surface at a range of time and space scales. To further our understanding of soil moisture effects on land–atmosphere fluxes, significant efforts were made during the AMMA campaign to accurately measure soil moisture from the local scale, using ground-based measurements, to the regional scale, using satellite-based observations. Particularly, a new methodology was recently developed to map soil moisture over West Africa with a high accuracy and a suitable temporal and spatial resolution to study the soil moisture influence on convective systems (Pellarin et al., HESS, 2009).
In the present study, we investigate the influence of the surface soil moisture patterns on the initiation and the trajectories of convective systems in West Africa. The approach is based on simultaneous observations of surface soil moisture and convective systems. Soil moisture maps were obtained at the 3-h and 25-km temporal and spatial resolution based on AMSR-E passive microwave measurements and a satellite precipitation product. The cloud monitoring product, called ISIS, was developed at Meteo-France and is based on Meteosat geostationary measurements. The studied period is 2005-2009.
Putting together these two products allows to statistically analysing the relationship between soil moisture and convection in West Africa. About 6.000 convective systems are observed each year in this region. First results (2006) tend to show that soil moisture patterns can play a strong role on the initiation of convective systems at the beginning of the rainy season. Convective cells mostly develop along a sharp soil moisture gradient before expanding over dry areas. The most surprising result is the strong influence of soil moisture pattern in the trajectories of convective systems. Numerous system trajectories were found to be strongly correlated with soil moisture patterns. A statistical analysis of all convective systems during 2005-2009 is presented.

Pellarin T., T. Tran, J.-M. Cohard, S. Galle, J.-P. Laurent, P. de Rosnay, and T. Vischel, 2009 : Soil moisture mapping over West Africa with a 30-min temporal resolution using AMSR-E observations and a satellite-based rainfall product, Hydrol. Earth Syst. Sci., 13, 1887–1896.