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Impact of Surface Heterogeneities on Convective Initiation in the Sahel

Amanda Gounou (1), Christopher Taylor (2), Francoise Guichard (1), Phil Harris (2), Richard Ellis (2), Fleur Couvreux (1), and Martin De Kauwe (2)

(1) CNRM Meteo France, Toulouse, France (amanda.gounou@cnrm.meteo.fr), (2) CEH, Wallingford, United Kingdom

During the monsoon season over the Sahel, precipitation is primarily delivered by Mesoscale Convective Systems (MCS) that typically occur every 3 or 4 days. These systems leave strong soil moisture imprints and impact the surface fluxes during the following 1 or 2 days due to the sparseness of the vegetation. The soil moisture controls the partitioning between latent and sensible heat fluxes and hence influences the development of daytime convective boundary layers as evidenced by previous studies based on airborne measurements and other observations over the Sahel during the AMMA campaign.

In this study, we use satellite data to investigate the links between the triggering of daytime MCS and the underlying mesoscale surface features over the Sahel. A tracking method was developed based on thermal infrared imagery from MSG to precisely locate the initiation of MCS. It was done for 5 consecutive wet seasons corresponding to more than 2000 cases. The atmospheric environments associated with the convective initiations were extracted from the ECMWF analysis. Land Surface Temperature Anomalies (LSTA) derived from MSG data were used to locate transient surface features associated with rainfall events with a fine resolution on the order of 3km.

At the mesoscale (1deg x 1deg), the analysis indicates that deep convection is initiated preferentially over dry soil. This is in agreement with the few previous observational studies. In addition, some seasonal variations are highlighted as well as a tendency for MCS to develop over surfaces presenting more variability, with initiation twice more likely over strong heterogeneities. At a finer scale (on the order of a few tens of km), this study shows that there is a tendency for systems to initiate over strong LSTA gradients. More precisely, there is an increase in initiation over strong negative for approximately 1 in 8 of all the initiations in the dataset. This corresponds to the triggering on the warm side of a warm to cold transition aligned with the mean low-level flow. This result suggests the influence of mesoscale circulations on the triggering of MCS.