Geophysical Research Abstracts
Vol. 12, EGU2010-14934, 2010
EGU General Assembly 2010

The impact of soil moisture on convective initiation in the Sahel

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In many parts of the world, soil moisture exerts a strong influence on the fluxes of sensible and latent heat, and thereby the properties of the Planetary Boundary Layer (PBL). During the wet season in the Sahel, this influence is pronounced due to a combination of sparse vegetation, and the frequent passage of Mesoscale Convective Systems (MCS). Observations taken during the Special Observing Period of the African Monsoon Multidisciplinary Analysis (AMMA) demonstrated that the result is a PBL which exhibits substantial space-time variability linked to antecedent rainfall.

In this presentation, satellite data are used to examine the potential feedback between mesoscale soil moisture features and the initiation of new MCS. Previous analysis using coarse resolution passive microwave data to map soil moisture features (Taylor and Ellis, GRL, 2006) had shown a strong preference for convective cloud to develop in the afternoon over dry soil. Here Land Surface Temperature data, with a resolution of 3 km, are used to identify wet and dry surfaces. This permits a more detailed examination of the location of convective initiation with respect to the underlying soil moisture.

Using a storm tracking algorithm based on thermal infra red imagery from Meteosat, the initiation of over 300 storms from the 2006 wet season were analysed. The vertical structure of the atmosphere for each storm was documented using data from ECMWF analyses. The results indicate a marked preference for initiation associated with strong gradients in soil moisture. In particular, there is a tendency in the dataset for storms to develop during the afternoon on the upwind side of transitions from dry to wet surfaces. These findings are consistent with previous modelling studies which have shown a preference for convective initiation where soil moisture gradients induce a mesoscale circulation. This study provides important observational evidence of the process in a region where such feedbacks could have significant consequences for rainfall at the larger scale.