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The dependence of land-atmosphere interactions on atmospheric parametrizations in the JULES/UM modelling system

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It has been understood for a while now that atmospheric behaviour is affected by land surface processes, modelling this relationship however still presents challenges. Most numerical weather prediction (NWP) models couple an atmospheric model to a land surface model in order to forecast the weather and/or climate. The Global Land-Atmosphere Coupling Experiment (GLACE) demonstrated that soil moisture variability has considerable control over atmospheric behaviour, particularly impacting on precipitation and temperature variability. The study also suggested that differences in coupling strengths between models may be due to differences in atmospheric parametrizations. There have since been other studies which support this claim but it is not yet clear which parameters control the land-atmosphere coupling strength or indeed what it should be.

In this study we investigate whether certain atmospheric parameters hold more control than others over model sensitivity to land surface changes. We focus on the interaction of the JULES (Joint UK Land Environment Simulator) land surface model with the Met Office Unified Model (UM) that is used for operational NWP and climate prediction. For computational efficiency we ran the UM at a single site using a single column model (SCM) rather than running a global model simulation. A site in the Sahel region of West Africa was chosen as this is an area that was identified by GLACE as being especially responsive to changes in soil moisture.

JULES was run several times with various different initial soil moisture profiles to create an ensemble of surface sensible and latent heat fluxes that could be used to force a set of different SCM runs in order to simulate a range of different atmospheric conditions. Various atmospheric parameters in the SCM were then perturbed to create additional sets of SCM runs with different sensitivities to soil moisture changes. By analysing the difference in spread between the standard configuration and the perturbed parameter sets of SCM runs, we gain insight into which atmospheric parameters have the most control over land-atmosphere interactions. The methodology for this experiment shall be introduced and initial results presented.