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Study of the sensitivity of land-convection coupling in the European summer

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The state of the land surface can have a crucial influence on the triggering of convection. Investigations of the land-atmosphere coupling strength on the regional scale are still rare, and have been mainly performed using global climate models with coarse resolutions. Increasing the horizontal resolution and the concomitant improved representation of the land surface are expected to refine the representation of feedbacks. A strong limiting factor, especially for process-based studies of the link between surface moisture availability, land cover properties, and convection triggering, is the availability of data with sufficient vertical resolution and temporal coverage. A convenient metric to investigate this link is the 'Convection Triggering Potential'-'Low-Level Humidity Index' framework, which is applied in this study. This process-based coupling metric examines the boundary layer structure based on temperature and humidity profiles to draw conclusions on the potential strength of interactions. However, increasing the resolution of a simulation usually aggravates the amount of storage capacity needed, and in practice the number of vertical levels written out is often decreased to a handful over the total column. Consequently, a comprehensive regional model intercomparison targeting land-convection coupling strength is challenging.

In this study, a perturbation approach was applied as an attempt to overcome this limitation. Differences in the choice and configuration of models cause a spread in mean and variance of atmospheric temperature and humidity between models that in turn may impact the outcome of the framework. Perturbation factors of different magnitudes were added to modify summer atmospheric temperature and humidity from a WRF simulation over the entire column on a daily basis. The simulation covered the period 1986-2015 over the EURO-CORDEX domain. The perturbations were chosen to approximate a potential model spread to some extent. Sensitivity in the coupling strength was assessed in relation to the unperturbed case by applying the framework to a range of perturbation cases with differently strong combinations of temperature and humidity changes.

We will present results 1) of how warmer, cooler, dryer or moister conditions in the atmosphere changed the frequency of summer days with high feedback potential, 2) how the different conditions influenced the occurrence of positive relative to negative feedbacks, and 3) of spatial differences in the sensitivity of the coupling strength to temperature or humidity modifications, respectively, over Europe.