Local Land-Atmosphere Coupling (LoCo): Acquiring indicators of land-atmosphere coupling from reanalysis datasets

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Identification of areas around the globe where precipitation and the land-surface are strongly coupled is of interest for both meteorological and hydrological applications. Of particular interest are areas with a two-way coupling between the land-surface and precipitation, that is, areas with land-surface - precipitation feedbacks (LSPF). LSPF have traditionally been studied within a modelling framework, by comparing output from one or more models for runs with differing levels of land-atmosphere coupling. The GEWEX-LoCo (Local Coupling) working group has formulated and/or tested several indicators for the influence of the land-surface moisture state on the atmospheric boundary layer and convective precipitation. The first is a diagnosis of the convective triggering potential and moisture conditions in the lower atmospheric layers, up to pressure levels of 700 hPa (CTP-HIlow). This CTP-HIlow framework assesses the potential for the land-surface to influence convective precipitation, but only from an atmospheric point of view. Therefore, CTP and HIlow are combined with an assessment of the surface wetness state, using either soil moisture content or evaporative fraction, and of planetary boundary layer (PBL) development during the day. The second set assesses the sensitivity of the near-surface equivalent potential temperature to evaporative fraction from a description of the development of the convective PBL during the day. It includes the impact of temperature and humidity gradients in the lower free atmosphere on PBL development. The diagnostic assesses to what extent changes in surface wetness would be able to sustain convective precipitation. In the present study, both indicators are diagnosed from reanalysis datasets (ERA-interim and MERRA). For cases in which the indicators expect an influence of land surface on convection, the relation between land surface state (soil moisture and evaporative fraction) and convective precipitation is determined. The quality of the regression between land surface state and precipitation is a measure for the quality of the indicator. Using a random walk through the parameter space of the integration bounds of the indicator definitions (the atmospheric pressure levels), the quality of the indicator using these integration bounds is assessed. Thus, for each geographic location, three aspects of land-atmosphere coupling can be determined: (1) the optimal LSPF-indicator definition and the part of the atmosphere that determines the potential for LSPF, (2) the predictability of precipitation based on land surface conditions and (3) the climatology of LSPF-situations. Preliminary results for India show that convective potential and humidity between 100 and 200 hPa above the land surface determine the potential of LSPF. Given these atmospheric conditions, the land surface state improves the predictability of precipitation with about 50%. These results will be extended globally to asses their spatial differences.