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The soil-moisture precipitation feedback in cloud-resolving models

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Although many studies have documented the sensitivity of the summer climate to land-atmosphere interactions, the strength of the coupling seems to vary between models, as seen e.g. in GLACE. Uncertainties arise due to the complexity and to the small-scale nature of the simulated phenomena. Several recent process studies have been dedicated to the soil-moisture precipitation feedback. Such studies have used either regional climate models of relatively coarse horizontal resolution, which cannot explicitly resolve some of the involved processes (e.g., convection), or highly simplified models (e.g. conceptual boundary layer models). Here, we investigate the soil-moisture precipitation feedback in cloud-resolving regional climate simulations. We use the regional climate model CLM integrated for one full month on a grid of 2.2-km mesh size spanning the Alpine region. Initial and lateral boundary conditions stem from a coarser 25-km CLM integration. Three sensitivity experiments have been conducted, one control simulation and two integrations with perturbed soil-moisture initial conditions. The use of very high resolution allows a better representation of moist convection (explicitly resolved rather than parameterized), topography and surface fields, which are important players in land-atmosphere interactions.

Results demonstrate that the control cloud-resolving integration is able to realistically reproduce the mean precipitation distribution, and its representation of the diurnal cycle is improved in comparison to a low-resolution simulation. Hence, the different sensitivity experiments can and are then used to assess and highlight the different mechanisms controlling the soil-moisture precipitation feedback. The results are further compared against a similar set of experiments using coarser resolution. Comparison reveals differences, with the cloud-resolving model favoring a less uniformly

positive feedback.