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Detailed vegetation processes within a regional climate model impact the representation of land-atmosphere feedbacks

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European summer climate, especially events such as heat waves and droughts, are impacted by processes acting at the interface between the land surface and the atmosphere. These processes are to a large extent associated with soil moisture (SM) dynamics, but also with vegetation processes, since plants' transpiration is the largest contributor to evapotranspiration in many regions.

An approach to investigate land-atmosphere interactions is to run climate model experiments with prescribed SM values (e.g. *Seneviratne et al. 2006, Jaeger and Seneviratne 2010, Lorenz et al. 2010*). This removes the two-way SM-climate interactions and allows to investigate solely the one-way impact of SM on climate. In this study, we use the COSMO-CLM regional climate model (RCM) to investigate the role of soil moisture-atmosphere coupling for the European summer climate and the impact of the representation of vegetation processes for land-atmosphere feedbacks.

We use two different versions of the COSMO-CLM model driven with $ERA_{Interim}$ data to study the role of vegetation-atmosphere coupling in particular for droughts and resulting feedbacks to the regional climate: 1) the standard version of COSMO-CLM, which includes a very simple 2nd-generation land surface parameterization; 2) a new version, referred to as COSMO-CLM^2, which includes the more advanced 3rd-generation Community Land Model (CLM). COSMO-CLM^2 allows for a comprehensive representation of vegetation-climate interactions at the regional scale (including effects of photosynthesis), and also includes a detailed soil hydrological module. With both versions we perform a control run and a wet and dry experiment to evaluate how the representation of land surface processes in the two different land surface models influence the representation of land-atmosphere coupling in coupled mode.

The results show marked differences in the representation of land-atmosphere coupling in the two model versions. Regions of strong land-atmosphere coupling are clearly limited to southern Europe in COSMO-CLM^2, whereas they are more extended in COSMO-CLM. The patterns in COSMO-CLM^2 are found to be more realistic in comparison with ground observations from the FLUXNET network. A smaller North-South gradient in latent and sensible heat flux is found as the most likely cause for this clearer distinction between regions with and without strong land-atmosphere coupling. These results highlight the importance of the correct representation of vegetation processes and soil hydrology for land-atmosphere feedbacks in a regional climate model.

References:
Seneviratne, S. I., Lüthi, D., Litschi, M., Schär, C., 2006. Land-atmosphere coupling and climate change in Europe. *Nature*, **443** (14), 205–209.
Jaeger, E. B., Seneviratne, S. I., 2010. Impact of soil moisture-atmosphere coupling on European climate extremes and trends in a regional climate model, *Clim. Dyn.*, doi:10.1007/s00382-010-0780-8.
Lorenz, R., Jaeger, E. B., Seneviratne, S. I., 2010. Persistence of heat waves and its link to soil moisture memory, 2010, *Geophys. Res. Lett.*, **37**, L09703.