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Positive impact of the new 5-layer soil-hydrology scheme on seasonal prediction skill of 2-meter air temperatures over Europe

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Recent studies show that the initialization of soil moisture has the potential to improve the skill of seasonal predictions with coupled climate models. Particularly, soil-moisture memory in the root zone is found to affect the predictability of surface state variables. However, in order to simulate the connection between root-zone soil-moisture and the near-surface atmospheric state realistically, the soil-hydrology scheme implemented in a coupled climate model requires a certain level of complexity.
In this study, we first compare the quality of soil-moisture simulation in full-field assimilation experiments performed with the Max Planck Institute Earth System Model (MPI-ESM) in two different setups, one using the old bucket-type soil scheme and one using the new 5-layer soil-hydrology scheme. We find soil moisture to be more realistically simulated when MPI-ESM is used with the new 5-layer soil scheme.
In a second step, from each of the two assimilation experiments a set of seasonal hindcast simulations is started. Each hindcast set consists of 10-member ensembles initialized on 1 May and 1 November each year within 1981-2012 with a hindcast length of 6 months each. We find the new 5-layer soil-hydrology scheme to improve the hindcast skill of both summer and winter 2-meter air temperatures over Europe compared to the old bucket-type soil scheme. In order to find possible sources for the improvement, land-atmosphere coupling is analyzed in the two hindcast sets, and a potential link to the atmospheric blocking frequency is investigated.