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Capturing the contribution of groundwater dynamics on land-atmosphere feedbacks at continental scales by implementing a coupled soil-vegetation-atmosphere-system

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At the continental scale, the impact of land-surface processes on climate has been studied intensively. Yet, in these studies, the connection to three-dimensional groundwater dynamics is less common. The hydrologic cycle is key in the interaction between different climate subsystems and, as a major compartment, groundwater resources contribute to feedbacks involving processes, such as evapotranspiration. Particularly, land-energy feedbacks, have been shown to be sensitive to groundwater dynamics along hillslopes. Additionally, while the influence of the subsurface hydrodynamics is more often studied at relatively small spatial and temporal scales over regional catchments, its contribution at continental scales has to be quantified. Consequently, groundwater dynamics need to be incorporated and analyzed in climate simulation studies.

In the present study, the hydrological components of the integrated terrestrial simulation platform TerrSysMP (ParFlow and CLM3.5) are implemented over the European CORDEX domain with a spatial resolution of 0.11°. This novel modeling platform accounts for an integrated representation of surface-subsurface water dynamics with land surface energy processes. Simulations are performed over events, such as the 2003 European heat wave, and over extended time periods on the order of 10 years. State and flux variables of the terrestrial hydrologic and energy cycle are analyzed and compared to both in situ (e.g. stream and water level gauge networks, FLUXNET) and remotely sensed observations (e.g. GRACE and SMOS). In future, it is planned to apply TerrSysMP in fully coupled mode incorporating the atmosphere (COSMO) and to study the influence of groundwater dynamics on water and energy transfers from the bedrock into the atmosphere over continental terrestrial systems.