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## On the hydrology of soils in the Earth System

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Soil hydrological processes play an important role in the Earth System. As part of the Critical Zone, they support ecosystem services, modulate the impact of climate change on terrestrial systems and control feedback mechanisms between water, energy and biogeochemical cycles. They act at multiple scales, ranging from the pore scale to the continental scale. Despite the fact, that the first meters of the critical zone only store a small amount of water, about 60% of the terrestrial rainfall is being transpired by plants through the root zone or evaporated by the soil, the remaining part is mainly diverted into groundwater recharge and runoff. This lecture will address some of the current challenges that hydrological research of soils and the critical zone face. These include the high nonlinearity in soil hydrological processes, the multi-scale heterogeneity in hydraulic properties, the provision of hydraulic parameters across scales, the role of soil structural properties and improving rhizosphere process descriptions. Finally, the importance of observing hydrological states and fluxes and their role in understanding and predicting soil hydrological processes will be addressed.