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Evaluation of soil moisture droughts under climate change in Germany

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It is projected that the likelihood and duration of extreme soil moisture (SM) droughts will increase in Germany under future warming scenarios. Annual precipitation changes are small under climate change in Germany with increases in winter and decreasing precipitation in summer for some parts of Germany. Generally, the climate ensemble spread in the future precipitation signal is large. Furthermore, impacts of SM droughts depend largely on the soil volume evaluated. We identified a gradient of stronger soil drying in shallow SM compared to deeper SM under global warming, leading to different effects on shallow-rooted vegetation compared to deep-rooted vegetation (agriculture versus forestry). In addition, spatial characteristics such as soil properties can strongly influence the dynamics of SM and thus shape the response of SM drought to changing meteorological conditions.

In this work we evaluate the impact of the considered soil depth and spatial features on simulated changes in SM droughts in Germany. We compare this influence to the uncertainty in meteorological changes. We use a large climate ensemble based on Euro-Cordex regional climate model simulations, which were bias-adjusted and spatially disaggregated to run the mesoscale hydrological model (mHM) (mhm-ufz.org) with a high spatial resolution of 1.2x1.2km.

This work aims to expand the picture of climate change impacts on SM droughts in Germany. The results can contribute to an improved definition of sector-specific drought indicators that will support national efforts to ensure climate change resilient water management.