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Divergent projections for precipitation in Central Europe explain uncertainties in extreme temperatures

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Extreme temperatures in Central Europe are projected to change more strongly than global mean temperatures. Soil moisture-temperature feedbacks contribute to this regional amplification but uncertainties remain large. We analyze global climate models from the CMIP5 ensemble for the business-as-usual high-emission scenario (RCP8.5) and find divergent behavior in long-term projection of summer precipitation until the end of the 21st century, resulting in a trimodal distribution of precipitation. Wet, dry and very dry models are identified according to precipitation changes at the end of the 21st century. All model groups show distinct characteristics for latent heat flux, top soil moisture in summer, and temperatures on the hottest day of the year (TXx) indicating the importance of land-climate interactions, whereas for net radiation and large-scale circulation no clear trimodal behavior is detectable.

Wet models tend to show less strong increase of TXx in comparison to dry and very dry models. This divergence is amplified until the end of the 21st century. While all model groups are largely overlapping for the next few decades, they diverge after global mean warming exceeds 1.5°C to pre-industrial levels. Current observations for precipitation and TXx are within the range of the whole ensemble but showing features (probably related to global dimming and brightening), which are not captured in models and are thus of limited use for model constraining.Other process based constraint capturing land-atmosphere feedbacks such as the correlation of precipitation and TXx (cor(p,TXx)) might be more useful and allow for distinguishing between the three models group. We find that for constraining with cor(p,TXx) we can exclude most of the very dry and wet models.
This suggest that long-term changes in TXx in Central Europe are close to the multi-model mean and Europe will become drier and hotter in the future but the most extremes are less likely.