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Land Surface Model influence on the simulated climatologies of extreme temperature and precipitation events within the WRF model over North America

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The representation and projection of extreme temperature and precipitation events in climate models are of major importance for developing polices to build communities' resilience in the face of climate change. However, state-of-the-art global and regional climate model simulations yield a broad inter-model range of intensities, durations and frequencies of these extremes.

Here, we present a modeling experiment using the Weather Research and Forecasting (WRF) Regional Climate Model (RCM) to determine the influence of the choice of land surface model (LSM) component on the uncertainty in the simulation of extreme event statistics. First, we evaluate land-atmosphere interactions within four simulations performed with the WRF model coupled to three different LSMs from 1980 to 2012 over North America. Results show regional differences among simulations for the frequency of events when surface conditions are altered by atmospheric forcing or by land surface processes. Second, we find a large inter-model range of extreme statistics across the ensemble of WRF-LSM simulations. This is particularly the case for indices related to the intensity and duration of temperature and precipitation extremes.

Regions displaying large uncertainty in the WRF simulation of extreme events are also identified in a model ensemble experiment carried out with three different RCMs participating in the Coordinated Regional Climate Downscaling Experiment (CORDEX) project. This agreement between the model simulations performed in this work and the set of CORDEX simulations suggests that the implications of our results are valid for other model ensembles. This study illustrates the importance of supporting the development of new multi-LSM modeling studies to understand inter-model differences in simulating extreme events, ultimately helping to narrow down the range across climate model projections.