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Land Surface Model Contribution to the Simulation of Extreme Events within the WRF Model over North America

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The simulation of temperature and precipitation extreme events within regional and global climate models is of major importance for the development of useful and realistic strategies for adapting and mitigating impacts of climate change. However, climate model simulations yield a broad range of intensity, duration and frequency of extreme events. Here, we present the results of a modelling experiment using the Weather Research and Forecasting (WRF) model to determine the contribution of the land surface model (LSM) component, and their associated representation of land-atmosphere interactions, to the spread of the simulated extreme events. Four simulations performed by the WRF model coupled to three different LSMs were evaluated using the Vegetation-Atmosphere Coupling (VAC) index at a monthly resolution from 1980 to 2012. Results from the simulations yield differences in the probabilities of events when surface conditions are influenced by atmospheric or land processes. The VAC indices indicative of atmospheric control events are significantly correlated with the annual means of daily maximum and minimum temperatures at high latitudes of North America. Meanwhile, the VAC indices indicative of land control events are significantly correlated with the annual mean of daily accumulated precipitation, minimum temperature and maximum temperature at low latitudes. We find that the contribution of the LSM choice to the differences in extreme events obtained is important. The effect of changing the LSM on the range of the simulated extreme events is comparable to those obtained from three CORDEX RCM simulations. These results support the ongoing development of LSM components given their importance in representing land-atmosphere interactions and, consequently, in the simulation of extreme events.