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# Surface energy balance and climatology changes from WRF simulations with different horizontal resolutions and soil configurations

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Interactions between the lower atmosphere and the shallow continental subsurface govern several surface processes important for ecosystems and society, such as extreme temperature and precipitation events. Transient climate simulations performed with climate models have been employed to study the water, mass and energy exchanges between the atmosphere and the shallow subsurface, obtaining large inter-model differences. Understanding the origin of differences between climate models in the simulation of near-surface conditions is crucial for restricting the inter-model variability of future climate projections. Here, we explore the effect of changes in horizontal resolution on the simulation of the surface energy balance and the climatology of near-surface conditions over North America (NA) using the Weather Research and Forecasting (WRF) model.
We analyzed an ensemble of twelve simulations using three different horizontal resolutions (25 km, 50 km and 100 km) and four different Land Surface Model (LSM) configurations over North America from 1980 to 2013. Our results show that increasing horizontal resolution alters the representation of shortwave radiation, affecting near-surface temperatures and consequently the partition of energy into sensible and latent heat fluxes. Thus, finer resolutions lead to higher net shortwave radiation and temperature at high NA latitudes and to lower net shortwave radiation and temperature at low NA latitudes. The use of finer resolutions also leads to an intensification of the terms associated with the surface water balance over coastal areas at low latitudes, generating higher latent heat flux, accumulated precipitation and soil moisture. The effect of the LSM choice is larger than the effect of horizontal resolution on the representation of the surface energy balance, and consequently on near-surface temperature. By contrast, the effect of the LSM configuration on the simulation of precipitation is weaker than the effect of horizontal resolution, showing larger differences among LSM simulations in summer and over regions with high latent heat flux. This ensemble of simulations is then compared against CRU data. Comparison between the CRU data and the simulated climatology of daily maximum and minimum temperatures and accumulated precipitation indicates that enhancing horizontal resolution marginally improves the simulated

climatology of minimum and maximum temperatures in summer, while it leads to larger biases in accumulated precipitation. The larger biases in precipitation with the use of finer horizontal resolutions are likely related to the effect of increasing resolution on the atmospheric model component, since precipitation biases are similar using different LSM configurations.