Session: C27 Poster: W163A

Improved dynamical downscaling of climate projections for the Western United States

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The objectives of this study are to reduce uncertainties in regional climate simulations by 1) calibrating an advanced regional climate model for a realistic seasonal cycle, 2) correcting the forcing data of a global climate model to remove any climatological biases, and 3) generating regional downscaling simulations from 1 and 2. In this study, we use the latest version (3.2) Weather Research Forecasting (WRF) model and couple it with the Community Land Model (CLM) version 3.5 to produce climate projections for the western U.S. at 30 km resolution. The model is referred to as WRF-CLM hereafter. Our analyses show that the adoption of state-of-the-art bulk microphysical and convective parameterizations has successfully reduced overprediction of windward precipitation and noticeably enhanced monsoon precipitation. In addition, we correct climatological biases in the forcing data from the Community Climate System Model (CCSM) with the National Centers for Environmental Prediction Reanalysis data I (NCEP-1), through modifications of regression functions that have been broadly used in statistical downscaling. We produce regional simulations for the western U.S. using calibrated WRF-CLM driven by bias-corrected CCSM output as boundary conditions. Our simulations are evaluated against available observations. The results show that the calibrated WRF forced with the bias-corrected CCSM data significantly improves the precipitation simulations over the western U.S. These results provide a better understanding of uncertainties in the climate simulations for water managers, local governments, and other stakeholders.