

Exploration of California Wintertime Model Wet Bias: Sensitivity of WRF Physics and Measurement Uncertainty

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Abstract

The strong scale interaction between atmospheric circulation, ocean and topography in the Western United States provides a challenging testbed for regional climate models (RCMs). Although many regional climate features have been successfully captured in RCMs, obvious biases in simulated precipitation remain, particularly the wintertime wet bias commonly seen in mountain regions of the Western United States. This bias can arise from the quality of large-scale forcing, imperfect lateral boundary conditions in RCMs, and model physics and numerics. It could also be an artifact of error in the datasets used for validation.

The primary focus of this study is on WRF physics and validation uncertainty. We examine this by simulating a total of eight California winter precipitating storms from four major types of larger-scale conditions (Pineapple Express, El Nino, La Nina, and synoptic cyclones); two of each type. We adopt North American Regional Re-analysis data as inputs for WRF simulations to minimize large-scale forcing error. We test the skill of five microphysics schemes, and two options from each of the rest of physical processes (e.g., cumulus parameterizations, radiation transfer, planetary boundary layer, and soil layer) against gridded observations from the National Oceanographic and Atmospheric Administration as well as against University of Washington data with and without long-term trend adjustment. We find that validation dataset choice has a significant impact on the magnitude of apparent model bias. Control simulations are conducted with 12-km grid spacing. Additional experiments are performed at 2-km resolution to evaluate the robustness of microphysics and cumulus parameterizations in coarser-grid applications.

This work is performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-ABS-412647