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Evaluating the ability of NA-CORDEX to simulate the seasonal modes of precipitation variability across the Western United States: Does resolution matter?

Jonathan Meyer[1], Shih-Yu (Simon) Wang[1,2], Robert Gillies[1,2], and Jin-Ho Yoon[3]
[1]Utah Climate Center, Logan, United States of America (jon.meyer@usu.edu)
[2]Utah State University Dept. of Plants, Soils & Climate, Logan, United States of America
[3]Gwangju Institute of Science and Technology School of Earth and Environmental Engineering, Gwangju, South Korea

The western U.S. precipitation climatology simulated by the NA-CORDEX regional climate model ensembles are examined to evaluate the capability of the 0.44° and 0.22° resolutionensembles to reproduce 1) the annual and semi-annual precipitation cycle of several hydrologically important western U.S. regions and 2) localized seasonality in the amount and timing of precipitation. Collectively, when compared against observation-based gridded precipitation, NA-CORDEX RCMs driven by ERA-Interim reanalysis at the higher resolution 0.22° domain resolution dramatically outperformed the 0.44° ensemble over the 1950-2005 historical periods. Furthermore, the ability to capture the annual and semi-annual modes of variability was starkly improved in the higher resolution 0.22° ensemble. The higher resolution members reproduced more consistent spatial patterns of variance featuring lower errors in magnitude—especially with respect to the winter-summer and spring-fall seasonality. A great deal of spread in model performance was found for the semi-annual cycles, although the higher-resolution ensemble exhibited a more coherent clustering of performance metrics. In general, model performance was a function of which RCM was used, while future trend scenarios seem to cluster around which GCM was downscaled.

Future projections of precipitation patterns from the 0.22° NA-CORDEX RCMs driven by the RCP4.5 "stabilization scenario" and the RCP8.5 "high emission" scenario were analyzed to examine trends to the "end of century" (i.e. 2050-2099) precipitation patterns. Except for the Desert Southwest's spring season, the RCP4.5 and RCP8.5 scenarios show a consensus change towards an increase in winter and spring precipitation throughout all regions of interest with the RCP8.5 scenario containing a greater number of ensemble members simulating greater wetting trends. The future winter-summer mode of variability exhibited a general consensus towards increasing variability with greatest change found over the region's terrain suggesting a greater year-to-year variability of the region's orographic response to the strength and location of the mid-latitude jet streams and storm track. Increasing spring-fall precipitation variability suggests an expanding influence of tropical moisture advection associated with the North American Monsoon, although we note that like many future monsoon projections, a spring "convective barrier" was also apparent in the NA-CORDEX ensembles.