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Creating dynamically downscaled seasonal climate forecast and climate change projection information for the North American Monsoon region suitable for decision making purposes

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Current seasonal climate forecasts and climate change projections of the North American monsoon are based on the use of course-scale information from a general circulation model. The global models, however, have substantial difficulty in resolving the regional scale forcing mechanisms of precipitation. This is especially true during the period of the North American Monsoon in the warm season. Precipitation is driven primarily due to the diurnal cycle of convection, and this process cannot be resolve in coarse-resolution global models that have a relatively poor representation of terrain. Though statistical downscaling may offer a relatively expedient method to generate information more appropriate for the regional scale, and is already being used in the resource decision making processes in the Southwest U.S., its main drawback is that it cannot account for a non-stationary climate. Here we demonstrate the use of a regional climate model, specifically the Weather Research and Forecast (WRF) model, for dynamical downscaling of the North American Monsoon. To drive the WRF simulations, we use retrospective reforecasts from the Climate Forecast System (CFS) model, the operational model used at the U.S. National Center for Environmental Prediction, and three select "well performing" IPCC AR 4 models for the A2 emission scenario. Though relatively computationally expensive, the use of WRF as a regional climate model in this way adds substantial value in the representation of the North American Monsoon. In both cases, the regional climate model captures a fairly realistic and reasonable monsoon, where none exists in the driving global model, and captures the dominant modes of precipitation anomalies associated with ENSO and the Pacific Decadal Oscillation (PDO). Long-term precipitation variability and trends in these simulations is considered via the standardized precipitation index (SPI), a commonly used metric to characterize long-term drought. Dynamically downscaled climate projection data will be integrated into future water resource projections in the state of Arizona, through a cooperative effort involving numerous water resource stakeholders.