Future Projections and Uncertainty Assessment of Extreme Rainfall Intensity for Las Vegas Region

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Abstract: Changes in climate are expected to lead to changes in the characteristics of rainfall events, such as extreme rainfall frequency and intensity in many regions. In this study, we explore potential change and associated uncertainty in extreme precipitation from possible future climate scenarios. In particular, we investigate possible changes in intensity-duration-frequency (IDF) relationships for the Las Vegas region. IDF relationships are often used for planning and design studies aimed at flood mitigation, runoff conveyance, and channel restoration projects etc. An integrated approach is presented that incorporates uncertainties due to both the short simulation periods of regional climate models (RCMs) in representing rare long return-period rainfall intensities, and differences in IDF curves derived from different RCMs in the North American Regional Climate Change Assessment Program (NARCCAP). The approach combines the likelihood of individual RCMs according to the goodness of fit between the extreme rainfall intensities from the RCMs' historic runs and those from the National Centers for Environmental Prediction (NCEP) North American Regional Reanalysis (NARR) data set and Bayesian model averaging (BMA) to assess uncertainty in IDF predictions for the Las Vegas region. We also partition overall uncertainties into within-model uncertainty and among-model uncertainty. Results illustrate that among-model uncertainty is the dominant source of the overall uncertainty in simulating extreme rainfall, pointing to the difficulty of predicting future climate, especially extreme rainfall regimes. For Las Vegas region, the calculated change of extreme rainfall intensity from future scenario runs compared to historic runs ranges from -3.4% to 34.3% with increase mostly in the short-duration high-intensity regimes.