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Uncertainty analysis of statistically downscaled temperature and precipitation regimes in a semi arid catchment

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Uncertainty analysis is used to make a quantitative evaluation of the reliability of statistically downscaled climate data representing local climate conditions. Nevertheless, the assessment of uncertainties linked with climatic variables is essential to climate impact studies. This study presents a procedure to characterize the uncertainty in regression-based statistical downscaling of daily precipitation and temperature over a highly vulnerable area (semi-arid catchment) in the west of Iran, based on two downscaling models: a Statistical Down-Scaling Model (SDSM) and an Artificial Neural Network (ANN) model. Biases in mean, variance and wet/dry spells are estimated for downscaled data using vigorous statistical tests for 30 years of observed and downscaled daily precipitation and temperature data taken from NCEP (National Center for Environmental Prediction) reanalysis predictors for the years of 1961 to 1990. In the case of daily temperature, uncertainty is estimated by comparing monthly mean and variance of downscaled and observed daily data at a 95% confidence level. In daily precipitation downscaling, as well as by comparing means and variances, uncertainties were evaluated from comparing monthly mean dry and wet spell lengths and their confidence intervals, cumulative frequency distributions (CFDs) of monthly mean of daily precipitation, and the distributions of monthly wet and dry days for observed and modeled daily precipitation. Results show that uncertainty in downscaled precipitation is high but simulation of daily temperature can reproduce extreme events accurately. Based on this comprehensive and rigorous assessment of uncertainty of downscaled daily precipitation and temperature, it can be concluded that the SDSM is capable of reproducing almost all statistical characteristics in its downscaled information at a 95% confidence level. The ANN is also capable of reproducing statistical characteristics of the observed data in its downscaling results but not at the same level as the SDSM projections. Therefore, the SDSM is the most proficient model at reproducing various statistical characteristics of observed data at a 95% confidence level while the ANN model is the least capable in this respect. Moreover the SDSM performed better than ANN in relation to small daily precipitation in this case study based on a semi arid climate. The discussion considers the performance of each statistical characteristic for each downscaling technique at catchment scale as well as the relationship between atmospheric processes and catchment response in the future.