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Validation of statistical downscaling methods in terms of weather and climate: Surface temperature in Southern Ontario and Quebec

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NCEP/NCAR reanalysis inputs were downscaled using a variety of linear and nonlinear machine learning/statistical methods including linear regression and Bayesian neural networks, to obtain daily station values of maximum temperature (TMAX) and minimum temperature (TMIN) for 10 weather stations located in Southern Quebec and Ontario. Mean absolute errors (MAE) between the downscaled data and the observations were used to determine the models performance in simulating day by day variability (i.e. "weather"), and indices of agreement calculated from annual STARDEX climate indices used to determine performance in simulating longer time scale variability (i.e. "climate"). The results show that although the linear models can successfully model daily temperature variations, the nonlinear models usually outperform their linear counterparts in terms of climate indices and daily variability MAEs. The validation methodology also suggests that the final users should select downscaling models based on their particular needs, as the best models for representing day by day variability need not necessarily be the best at simulating climate like variables such as heat wave duration, the number of frost days in a given year, or intra-annual extreme temperature range, etc.