Statistical Downscaling of Indices of Temperature Extremes Based on Percentiles in North China

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Two approaches of statistical downscaling were applied to indices of temperature extremes based on daily maximum and minimum temperature observations at Beijing station in North China in summer during 1960-2008. These indices included the 92-day mean value of daily maximum and minimum temperatures, the 90th percentile of 92-day maximum temperatures, and the 10th percentile of 92-day minimum temperature of each summer. One approach was to downscale daily maximum and minimum temperatures by using EOF analysis and stepwise linear regression at first, then to calculate the indices of extremes by daily downscaled data; the other was to directly downscale the percentile-based indices by relating summer large-scale climatic variables by using EOF analysis and stepwise linear regression. The two approaches both used geo-potential heights and temperatures at 850hPa as large-scale predictors which were derived from the NCEP/NCAR reanalysis data with a resolution of 2.5 degrees in latitude and longitude in summer during 1960 and 2008, but the types of NCEP/NCAR reanalysis data used by two approaches were different, the former used daily large-scale climatic variables as predictors while the latter used monthly data. Geo-potential heights and temperatures at 850hPa from NCAR/NCEP reanalysis data were combined by using EOF analysis with the two fields combined. The cross-validation procedure was used to validate and compare the model skills of the indices of extreme temperatures between the two approaches. The comparative results showed that the latter approach had a better performance than the former and the two indices based on mean values were better than on percentiles. The latter approach was applied to 48 stations in North China. The cross-validation results indicated good correlation between the percentile-based indices and summer large-scale variables. The conclusion would be made that the indices of temperature extremes could be downscaled by directly relating large-scale variables on a seasonal scale with the historical indices of extremes without downscaling daily data.

Future scenarios of temperature extremes indices in North China were projected by applying the statistical downscaling models to CMIP5 HadCM3 historical (1960-2005) and RCP4.5 (2006-2035) simulations in summer. The common EOF analysis was used for finding the common EOFs of NCAR/NCEP reanalysis and the HadCM3 output. The PCs of NCEP/NCAR reanalysis data were used to establish the statistical downscaling models and the PCs of HadCM3 output for forecasting the indices of temperature extremes. The results indicated that In the present climate, the four downscaled indices could be well modeled by the latter approach and for RCP4.5 scenario, their area-average values would increase during 2006-2035. The summer means of daily maximum and minimum temperature and the 90th percentile of daily maximum temperatures would increase by about 1.5

degree, and the 10th of daily minimum temperatures would increase by about 2 degree during the period of 2016 -2035 in North China.

KEY WORDS: Indices of temperature extremes, Percentiles, Statistical downscaling, Future scenarios projection, North China

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