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Utility of daily vs. monthly large-scale climate data: an intercomparison of two statistical downscaling methods

E. P. Maurer¹ and H. G. Hidalgo²

¹Civil Engineering Department, Santa Clara University, Santa Clara, CA, USA

²Scripps Institution of Oceanography, Div. of Climate Atmospheric Sciences & Physical Oceanography, La Jolla, CA, USA

Abstract. Downscaling of climate model data is essential to local and regional impact analysis. We compare two methods of statistical downscaling to produce continuous, gridded time series of precipitation and surface air temperature at a 1/8-degree (approximately 140 km² per grid cell) resolution over the western U.S. We use NCEP/NCAR Reanalysis data from 1950–1999 as a surrogate General Circulation Model (GCM). The two methods included are constructed analogues (CA) and a bias correction and spatial downscaling (BCSD), both of which have been shown to be skillful in different settings, and BCSD has been used extensively in hydrologic impact analysis. Both methods use the coarse scale Reanalysis fields of precipitation and temperature as predictors of the corresponding fine scale fields. CA downscales daily large-scale data directly and BCSD downscales monthly data, with a random resampling technique to generate daily values. The methods produce generally comparable skill in producing downscaled, gridded fields of precipitation and temperatures at a monthly and seasonal level. For daily precipitation, both methods exhibit limited skill in reproducing both observed wet and dry extremes and the difference between the methods is not significant, reflecting the general low skill in daily precipitation variability in the reanalysis data. For low temperature extremes, the CA method produces greater downscaling skill than BCSD for fall and winter seasons. For high temperature extremes, CA demonstrates higher skill than BCSD in summer. We find that the choice of most appropriate downscaling technique depends on the variables, seasons, and regions of interest, on the availability of daily data, and whether the day to day correspondence of weather from the GCM needs to be reproduced for some applications. The ability to produce skillful downscaled daily data depends primarily on the ability of the climate model to show daily skill.

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