

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

E. P. Maurer, H. G. Hidalgo

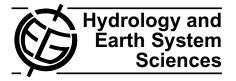
▶ To cite this version:

E. P. Maurer, H. G. Hidalgo. Utility of daily vs. monthly large-scale climate data: an intercomparison of two statistical downscaling methods. Hydrology and Earth System Sciences Discussions, 2008, 12 (2), pp.551-563. hal-00305155

HAL Id: hal-00305155 https://hal.science/hal-00305155

Submitted on 18 Jun 2008

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



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

Received: 16 August 2007 – Published in Hydrol. Earth Syst. Sci. Discuss.: 12 September 2007 Revised: 20 December 2007 – Accepted: 5 February 2008 – Published: 13 March 2008

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 repro-



Correspondence to: E. P. Maurer (emaurer@engr.scu.edu)

duced for some applications. The ability to produce skillful downscaled daily data depends primarily on the ability of the climate model to show daily skill.

1 Introduction

Climate models are the primary tool to evaluate the projected future response of the atmosphere-land-ocean system to changing atmospheric composition (MacCracken et al., 2003; Stocker et al., 2001), and they underpin most climate change impacts studies (Wilby and Harris, 2006). However there is a mismatch between the grid resolution of current climate models (generally hundreds of kilometers), and the resolution needed by environmental impacts models (typically ten kilometers or less). Downscaling is the process of transforming information from climate models at coarse resolutions to a fine spatial resolution. Downscaling is necessary, as the underlying processes described by the environmental impact models are very sensitive to the nuances of local climate, and the drivers of local climate variations, such as topography, are not captured at coarse scales.

There are two broad categories of downscaling: dynamic (which simulates physical processes at fine scales) and statistical (which transforms coarse-scale climate projections to a finer scale based on observed relationships between the climate at the two spatial resolutions) (Christensen et al., 2007). Dynamic downscaling, nesting a fine scale climate model in a coarse scale model, produces spatially complete fields of climate variables, thus preserving some spatial correlation as well as physically plausible relationships between variables. However, dynamic downscaling is very computationally intensive, making its use in impact studies limited, and essentially impossible for multi-decade simulations with