

# **A Comparison of Statistical and Dynamical Downscaling for Surface Temperature in North America**

**Scott Spak<sup>1</sup>, Tracey Holloway<sup>1</sup>, Barry Lynn<sup>2</sup>, Richard Goldberg<sup>3</sup>, Christian Hogrefe<sup>4</sup>**

To assess regional impacts of climate change, General Circulation Model (GCM) results must be downscaled to higher resolutions. Both statistical and dynamical methods have been widely applied in past climate change impact assessments. However, formal comparisons between the two methods are scarce, and the factors that contribute to agreement between them have not been quantified. A multiple linear regression statistical downscaling model is applied to estimate summer monthly mean surface temperatures over eastern North America. The model is calibrated with time series of 0.5 x 0.5 degree gridded observations from the University of Delaware (the predictand field) and a transient climate simulation with the NASA Goddard Institute for Space Studies 4° x 5° resolution Global Atmosphere-Ocean GCM, using forcings from the SRES A2 scenario (the predictor field). Three scales of predictor domain, two training periods, two predictors, and alternative sources for predictor and predictand are assessed at regional and urban scales. Performance is compared to dynamical regional climate simulation with the PSU/NCAR mesoscale regional climate model (MM5) for both current conditions (1990s) and future projections (2020s, 2050s, 2080s). The statistical and dynamical models exhibit comparable skill, and consistently project greater warming than the host GCM. Projections from statistical and dynamical models approach convergence when adjusted for model bias. This experiment presents physical arguments for apparent similarities and differences between regional dynamical and statistical downscaling results, illustrates a methodology for generating and selecting plausible downscaled scenarios from GCM results using multiple downscaling paradigms, and highlights the importance of uncertainty analysis of downscaling methodology in impact assessment. In considering air pollution effects on climate, our approach would facilitate a detailed analysis of local impacts associated with regional patterns in radiative forcing, including extension to local changes in temperature and precipitation associated with high levels of black carbon over Asia and Europe.

<sup>1</sup>Center for Sustainability and the Global Environment, University of Wisconsin Madison

<sup>2</sup>Center for Climate Systems Research, Columbia University

<sup>3</sup>NASA Goddard Institute for Space Studies

<sup>4</sup>Atmospheric Sciences Research Center, State University of NY at Albany