Regional and Global Evaluation of CFS-R and 20th Century Reanalysis for the Terrestrial Water and Energy Cycles

Justin Sheffield
Department of Civil Engineering, Princeton University

Reanalysis data sets offer homogeneous, gridded data products that have found wide application as input forcing data for off-line hydroclimate models and regional coupled models, for carrying out diagnostic analysis for climate studies and for bias correcting and downscaling coarse-scale climate models. However, they contain inherent biases and spurious trends because of model errors and simplifications and changes in observing systems, which need to be characterized for future improvements and for guidance for applications. Recently, the global high resolution Climate Forecast System Reanalysis (CFS-R) has been completed at NCEP/NWS for 1979-2009, as well as the 20th Century Reanalysis (20CR) at ESRL. These new reanalyses need to be evaluated both in absolute terms against observational data of specific variables and for consistency with previous reanalysis products.

This study applies three levels of evaluation for different variables and space-time scales with a focus on the terrestrial water and energy cycles. The first level is traditional error and bias analysis using regional and global data sets, including in-situ measurements, satellite remote sensing products, and our off-line, long-term, land-surface model simulations that are constrained by observations. The second level focuses on consistency between CFS-R, 20CR and recently completed reanalyses, including ERA-40, ERA-interim, MERRA and NARR. The third tier evaluation focuses on higher-level products important to hydroclimate analysis and modeling. Evaluations include such variables as the trends and variability in CFS-R and 20CR time series, rain-day frequency statistics (critical to hydrologic modeling and applications), reproduction of large-scale climate events (such as drought) and the frequency of heavy precipitation, and reproduction of observed teleconnections such as ENSO and western U.S. precipitation.

Corresponding Author:

Name: Justin Sheffield
Organization: Department of Civil Engineering, Princeton University
Address: Princeton, NJ 08544
USA