Title: Regional Climate and Variability of the Summertime Continental United States in Reanalyses

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Abstract

Understanding climate variability at regional scales is an important for research and societal needs. Atmospheric retrospective-analyses (or reanalyses) integrate multitudes of observing systems with numerical models to produce continuous data that include variables not easily observed, if at all. The breadth of variables as well as observational influence included in reanalyses make them ideal for investigating climate variability.

In this paper, we assess NASA's Modern Era Retrospective-analysis for Research and Application (MERRA) regional variability in North America, specifically the United States, in conjunction with current satellite data reanalyses. Emphasis is placed on summertime precipitation because 1) it is a difficult parameter to capture in the most difficult season, 2) significant observational resources exist to benchmark comparisons, and 3) accurate assessment of precipitation variability is crucial to a multitude of sectors and applications. Likewise, we have also begun to evaluate surface air temperature.

While precipitation biases are identified, year to year variability of the precipitation variations, in many cases, are quite reasonable. However, some spurious long term trends and sudden shifts in the time series are also identified. In surface air temperature, analysis of station observations provides ERA Interim a clear overall advantage. However, in a number of regions, all the reanalyses are quite comparable in variability and trend. In other regions, significant precipitation biases may occur, which has implications for the ancillary process data in a reanalysis, such as surface fluxes.

We also characterize the reanalyses ability to capture variability related to ENSO. In general, the summertime variations of precipitation in the reanalyses are more highly correlated (positively) to ENSO (using ENSO34) than are the observations. The Northwestern US shows the largest positive correlations to ENSO34, and reanalyses agree with that, and correlate highly with the gauge observations there. Additional evaluation of the data assimilation using the MERRA Gridded Innovations and Observations (GIO) data, which consists of the assimilated observations as well as forecast an analysis error fields. This work represents an initial evaluation of using the MERRA reanalysis to study regional climate variations of the United States, and identifying its applied limitations.