**Global Modeling and Assimilation Office**

Code 610.1

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http://gmao.gsfc.nasa.gov
The Global Modeling and Assimilation Office (GMAO) has used its GEOS-5 atmospheric data assimilation system (ADAS) to synthesize the various observations collected over the satellite era (from 1979 to the present) into an analysis that is as consistent as possible over time because it uses a fixed assimilation system. This contrasts with a weather-focused analysis where the system changes over time as improvements are implemented to improve weather forecasts. The goal of this historical re-processing - called MERRA, the Modern-Era Retrospective Analysis for Research and Applications - is a climate-quality analysis that places NASA’s EOS observations into a climate context.

**The MERRA System**

MERRA is being conducted with version 5.2.0 of the GEOS-5 ADAS with a 1/2° latitude × 2/3° longitude × 72 layers model configuration. A key development in the GSI, not available for the previous generation of reanalyses, has been the online bias correction for satellite radiance observations. Such corrections are needed to compensate for sensor drifts as well as to ensure that observations from different satellites, which have been calibrated independently, provide consistent measurements of our environment.

**Products**

MERRA has completed analysis of over 30 years of data and is now proceeding forward in near real-time as a climate analysis. Products are distributed through the GES DISC (http://disc.sci.gsfc.nasa.gov/M DISC/dataprods/merra_products.shtml) with several download options.

There are 26 product collections. Products are generated on three horizontal grids:

- **Native** — (1/2° × 2/3° using model conventions)
- **Reduced** — (1° × 1°, dateline-edge, pole-edge)
- **Reduced FV** — (1° × 1° using model conventions)

3-D data are 72 model layers or 42 pressure levels.

Products include:

- **Analyzed Fields** (u, v, t, q, O3, ps): native grid, 6-hourly instantaneous fields, on model and pressure levels
- **Assimilated Fields**: reduced grid, 3-hourly instantaneous fields on pressure levels
- **3-D Diagnostic Fields**: reduced grid, 3-hourly time-averaged fields on pressure levels
- **2-D Diagnostic Fields**: native grid, hourly time-averaged fields
- **Products for Offline CTMs**: various resolutions, frequencies and grids.
- **Ocean Surface Diagnostic Fields**: native resolution, 1-hourly, 2D fields that can be used for ocean models
- **MERRA-Land Surface Diagnostic Fields**: a supplemental product from a version of the Catchment Land Surface Model driven offline with MERRA forcing except that precipitation has been corrected with a global gauge-based data set from NOAA’s Climate Prediction Center (see http://gmao.gsfc.nasa.gov/merra/news/merra-land_release.php).

Selected MERRA monthly mean products have been made available at PCMDI’s Earth System Grid for CMIP5 model evaluations.

**Resources**

An atlas of MERRA climate with comparisons with other reanalyses and with gridded observations is available at: http://gmao.gsfc.nasa.gov/ref/merra/atlas/

MERRA is documented in a set of publication that forms the **MERRA Collection** in the Journal of Climate: http://journals.ametsoc.org/page/MERRA.

**Some Results**

Since MERRA focused on the hydrological cycle, our early evaluation of the system has looked at various aspects of the moisture distribution and variability, compared with the previous reanalyses and also the more recent reanalysis (ERA-Interim) from ECMWF.

**Total Column Water Vapor**

January 1995

![Monthly mean TCWV (kg m⁻²) from reanalyses (2nd row) compared with that from SSMI (top row).](image)

The quality of the tropical (15S-15N) precipitation from the various reanalyses is evaluated by comparison with GPCP. A different observational product, CMAP, provides a baseline for the limit to how good a comparison can be expected. The comparisons are summarized in a Taylor diagram (upper plot) of the correlation and standard deviation normalized by GPCP. The dots for each system are for annual means of different years. A perfect comparison would be (1, 100). The lower plots show time series of annual means of spatial correlation and mean bias. Clearly both MERRA and ERA-Interim have improved upon earlier reanalyses.