

## **Water Vapor Tracers in MERRA Replay mode using the NASA/GSFC GEOS-5 GCM**

David M. Mocko  
SAIC at NASA/GSFC/Global Modeling and Assimilation Office (GMAO)  
Michael G. Bosilovich  
NASA/GSFC/Global Modeling and Assimilation Office (GMAO)  
Arlindo da Silva  
NASA/GSFC/Global Modeling and Assimilation Office (GMAO)  
Paul A. Dirmeyer  
George Mason University (GMU) Department of Atmospheric, Oceanic, and Earth Sciences &  
Center for Ocean-Land-Atmosphere Studies (COLA)  
Jiangfeng Wei  
Center for Ocean-Land-Atmosphere Studies (COLA)

The NASA GEOS-5 GCM was configured to run water vapor tracers (WVTs) to allow the calculation of source regions of evapotranspiration (ET) for precipitation and precipitable water. In addition to the surface ET, the WVTs also consider condensation, rain evaporation, and redistribution by convection in the atmosphere. A prognostic three-dimensional variable is associated with each source region, determined by up to 50 basin/regional surface masks. The WVT gridded component in GEOS-5 is a sub-component of the GEOS-Chem chemical transport model. The Catchment hydrology land surface model is the land component in the GEOS-5 GCM.

For a preliminary study, WVTs were calculated for a “replay” of the MERRA (Modern Era Retrospective-Analysis for Research and Applications) reanalysis, also developed by NASA/GSFC’s GMAO. The replay is initialized using MERRA restart files and is “replayed” to the existing MERRA analysis by simulating the Incremental Analysis Updates (IAU) process. The MERRA reanalysis extends from Jan 1979 to present, and adjusts the GEOS-5 model states towards the observed states by applying the data assimilation system, which includes numerous and modern observation platforms and systems.

A “replay” of MERRA, with an updated version of the GEOS-5 GCM with the water vapor tracers, was performed for the month of April 2011. This month was notable in the United States for above-average temperatures in the south and eastern sections, as well as heavy rainfall amounts in the Midwest and Northeast. A record-breaking tornado outbreak occurred in the Southeast towards the end of the month, and the prolonged severe drought in Texas continued as well. Source regions for this month are calculated by the WVTs, including both local (several basins/regions over land) and remote (Gulf of Mexico, Baja and Pacific Ocean, etc.) regions. The amount of recycling will be presented, along with other aspects of the hydrologic cycle for this month.

### **Corresponding Author:**

**Name:** David M. Mocko  
**Organization:** SAIC at NASA/GSFC  
**Address:** NASA Goddard Space Flight Center  
Code 610.1  
Greenbelt MD 20771  
**Email Address:** David.Mocko@nasa.gov