

# **The use of NASA GEOS global analysis in MM5/WRF initialization: Current studies and future applications**

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## **1. Introduction**

An effort has been made at NASA Goddard Space Flight Center (NASA/GSFC) to use the Goddard Earth Observing System (GEOS) global analyses in generating the initial and boundary conditions for MM5/WRF simulation. This linkage between GEOS global analyses and MM5/WRF model has made possible for a few useful applications. This presentation shows preliminary results from the current studies. Recent developments and future applications are also addressed.

## **2. The GEOS analysis**

GEOS global analyses are the data assimilation products from the Global Modeling and Assimilation Office at NASA/GSFC. Similar to NCEP and ECMWF global analyses, GEOS analysis runs 4 times (11Z, 06Z, 12Z, 18Z) daily. However, the gridded output files from GEOS analysis are in HDF-EOS format, which is an extension of the Hierarchical Data Format (HDF), developed at the National Center for Supercomputing Applications (NCSA). For the most recent data sets, GEOS-3 version of products began on 12/18/1999 and ended on October 31, 2002. Then, the GEOS-4

version of products began on October 1, 2002. Most GEOS-4 gridded output is on a 1.25 x 1.0 degree global longitude-latitude horizontal grid (288,181), while the GEOS-3 output is on a 1.0 x 1.0 degree global grid (360,181). Pressure level data are output on 36 pressure levels (hPa). Each GEOS-4 file contains a single HDF-EOS grid, which in turn includes a number of geophysical quantities ("variables"). Some files contain 2-D variables on a lon/lat grid and some files contain 3-D variables on the same lon/lat grid but with an additional vertical dimension.

## **3. The use of GEOS analysis in MM5/WRF initialization**

The use of GEOS data from MM5 initialization isn't a standard option in MM5 pre-process. Therefore, implementation has been made to plug the GEOS global analysis into MM5 pre-process. Specifically, a new capability of generating intermediate files in "REGRID" has been established. As a result, GEOS global analysis can be applied for generating the first guess fields and boundary conditions for MM5 simulations. Thus, in addition to the NCEP and ECMWF analyses, GEOS analysis became another optional data

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resource for MM5 pre-processes. In the same way, the GEOS analysis products can also be applied to the WRF model pre-process.

#### 4. Current studies

Studies have been conducted to test the use of GEOS analysis for MM5 mesoscale studies. As one of the sample studies, a series of MM5 simulations has been conducted to test the sensitivity of initial and boundary conditions to MM5 simulated precipitation over the eastern coast area of USA. Global analyses from NCEP, ECMWF, and GEOS systems were used to provide first guess field (in REGRID) for MM5. Numerical simulations were performed for one-week period over the eastern coast area of USA. The distribution and quantities of MM5 simulated precipitations were compared. Preliminary results show that the distributions of the forecasted precipitation are similar among the three experiments. However, discrepancies are also found in terms of the detailed precipitation patterns and quantities in the different experiments.

#### 5. Future Applications

The successful linkage between GEOS global analysis and MM5/WRF model will lead many future applications in the following fields: 1) regional studies associated with the NASA main missions supported by GEOS global data assimilation system; 2) inter-comparison between global and regional forecasts and simulations; 3) regional modeling and data assimilation development.

As one of the most recent major developments, the authors are working in progress to implement the MM5 to support a project associated with

Goddard Chemistry Aerosol Radiation and Transport (GOCART; Chin et al. 2001). Specifically, MM5 produced meteorological fields are imported into the regional chemical tracer model to drive the chemical tracer transportation. Characteristics of the tracer transportations controlled by regional model will be compared with these controlled by GEOS global model.

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