Introduction

The Global Modeling and Assimilation Office (GMAO) is currently using an IAU-based 4D-Var data assimilation system. GMAO has been experimenting with a 3D-Var-hybrid version of its data assimilation system (DAS) for over a year now, which will soon become operational and it will rapidly progress toward a 4D-EnVar. Concurrently, the machinery to exercise traditional 4D-Var is in place and it is desirable to have a comparison of the traditional 4D approach with the other available options, and evaluate their performance in the Goddard Earth Observing System (GEOS) DAS. This work will also explore the possibility for constructing a reduced order model (ROM) to make traditional 4D-Var computationally attractive for increasing model resolutions. Part of the research on ROM will be to search for a suitably acceptable space to carry on the corresponding reduction. This poster illustrates how the IAU-based 4D-Var assimilation compares with our currently used IAU-based 3D-Var.

4D-Var Development at GMAO

IAU Based Variational Data Assimilation

The assimilation process used to work rely on the incremental analysis update (IAU) approach of Rinehart et al. (1990), to 3D-3V IAU assimilation from MERRA to Fortuna. Technical Report Series on Global Modeling and Data As-

Joanna S. Pelc**, Ricardo Todling**, and Amal El Akraoui**
*NASA Goddard Space Flight Center, USA, *NASA Postdoctoral Program, Oak Ridge Associated Universities, USA

Goddard Earth Observing System Data Assimilation System (GEOS DAS)

The Goddard Earth Observing System is an integration of models using the Earth system modeling framework. The two major components of GEOS are the Atmospheric General Circulation Model (AGCM) and the Global Statistical Data Assimilation System (GSDAS). IAU and hybrid 4D-Var and hybrid 3D-Var are feasible for use at Fortuna.

Results

Experiments use a slightly simplified configuration of GEOS DAS. Comparisons are for 3D-Var versus 4D-Var. The experiments were conducted when inner and outer loops are both at low resolution (2 degrees), and when inner-loop is at 2 degrees and outer-loop is at 1/2 degree. Experiments cover March 2014.

Figures display monthly mean difference of experiments with ECMWF analysis mean for March 2014. Monthly means for temperature (left panel: 300 mb; right panel: zonal means). Top panels correspond to 3D-Var, and bottom ones to results from 4D-Var. Above, low resolution experiments; below, high-resolution experiments.

Conclusions

The purpose of this work is to evaluate IAU-based 4D-Var performance in GEOS DAS. In comparison to currently used IAU-based 3D-Var system, results showed that 4D-Var is able to perform at least as well as 3D-Var, often showing slightly better results than 3D-Var. This work establishes that 4D-Var results are reliable and serve as the base for further extension to 4D-hybrid and development of reduced-order model approaches.

References