Construction of WRF/CAM two-way coupling system and preliminary results

Juanxiong He¹, W. Lin¹,², M. Zhang¹, Y. Chen¹, A. M. Vogelmann², R. Leung³
1. Stony Brook University/SUNY, Stony Brook, NY
2. Atmospheric Sciences Division, Brookhaven National Laboratory, NY
3. Atmospheric Sciences & Global Change, Pacific Northwest National Laboratory, WA

Introduction-Objectives

• Created a WRF/CAM two-way inline coupling system within CCSM4 framework.
• The CAM along with other CCSM4’s components drives WRF.
• The WRF feeds back by exporting state variables, heat and moisture fluxes at fine scale to the CAM.
• The essential WRF Processing System (WPS) and REAL program are integrated in WRF components.
• New conservative and noise resistant method is employed to improve the remapping precision.
• WRF has ability to perform nested domain and separated multiple geophysical domain simulations.

Model Design

• WRF, based on ARW v3.2, becomes a component of CCSM4.
• WRF can have a two-way interaction in line with CAM/CLM/POP/CICE.
• WRF can initialize and reinitialize inline in the WRF/CAM coupling system.
• WRF can have a separated multiple domain simulation in the WRF/CAM coupling system.
• WRF keeps its own parallel mechanism.
• WRF has its communication subgroup in CCSM4.
• WRF associated with CPL has a shared communication subgroup in CCSM4.
• WRF can use all processors or part of processors to make a parallel run according to the parallel strategy of CCSM4.

Data exchange between WRF and CCSM4

• Realize the 3-dimension transfer and remapping in the coupler.
• State variables from WRF can be reestablished into CAM and flux variables from WRF can be injected into CAM.
• The geogrid, metgrid, and REAL are integrated into WRF and can run inline with the main WRF program.
• Conservative and noise resistant remapping method is being added into WRF.
• CAM is modified to import and export data from WRF, and to relaxlax the data from WRF.
• The coupler is modified to import and export the 3-dimensional data exchange between WRF and CCSM4.

Preliminary results and summary

• Begin at March 1, 2000, integrate 5 days.
• The configuration of CAM/CLM/POP/CICE is F_2000 case. The Qian atmosphere input dataset for 2000 is used to spin up CLM for 500 years T42 resolution.
• CAM drives inline WRF based on WRF/CAM coupling system for a one-way test and WRF feeds back to CAM for two-way test.
• WRF offline simulation is performed by using the offline CAM and CLM dataset and 1x1 GFS analysis dataset.
• All WRF simulations have two domains with the size of 80x80x41, 102x102x41, with the same center located at (47N, 177E), and the ratio of grid distance and time step between the two domains is 3:1. The outside domain is with 60 kilometer resolution and 180 seconds time step, WRF physical parameterizations use CAM long wave and short wave radiation scheme, Monin-Obkuhov scheme, YSU PBL scheme, Kain-Fristch scheme, and WSM 3-class scheme. The inner domain turns off the cumulus scheme.
• Summary: Preliminary tests verify the inline one-way simulation and the feasibility of two-way coupling.

Reference


Acknowledgements

The first author expresses the thanks to Dr. Ping Liu for his great technical assistance.