Application of Satellite and ARM simulators to ACME Model Evaluation: Progress, Problems, and Plan

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Overview

Given the different definitions of clouds among climate models and between models and observations, the instrument simulators are developed to facilitate an “apple-to-apple” comparison of modeled clouds with detailed observations. The simulator approach accounts for observational limitations of the instruments and bridge the scale gaps between observations and climate models. In the ACME project, the simulators will be applied to perform meaningful testing for new or improved parameterizations. To facilitate the comprehensive assessment for the cloud simulations, we implemented the ACME Tier 1b cloud collection of satellite simulator diagnostics in UVCDAT through the collaboration with the workflow team. We performed an initial assessment of the candidate convection schemes for the next generation of CAM by applying these simulator diagnostics to their AMIP simulations. The results will provide useful information for ACME since these schemes are also being tested in ACME model. In addition to the comparison with satellite observations, this poster will also present initial assessment of ACME model simulated clouds with high frequency and high vertical resolution ARSCL data by using a newly developed ARM lidar simulator for the DOE ARM program.

Method

COSP – the CFMIP Observation Simulator Package

COSP development team:
- Met Office Hadley Centre
- LMD/IPSL
- Lawrence Livermore National Laboratory
- Colorado State University
- University of Washington

COSP Flow Chart

“down-scaler”
forward models retrieval algorithms

ACC - POST - Iking

MODIS

ACME - Model Evaluation Through ARM Simulator

The millimeter-wavelength radars operated at the ARM sites measure clouds and precipitation with high frequency and high vertical resolution. These observations provide detailed information on vertical structure of cloud systems and unique opportunity for model evaluation on diurnal cycle of cloud systems.

Aerosol lidar simulator

For aerosol simulator, the 180-degree backscatter at 532nm will be written out by RRTMG as a new radiation diagnostics, using the pre-generated look-up table. The attenuated backscatter (ATB) can then be computed by solving the lidar equation. Cloud masking is considered for each subcolumn.

ACME Model

Real Atmosphere

Aerosol Simulator - Lidar equation

Fair comparison

Problems

Task R1, AMIP ensemble runs with ACME v0.1 at ne30 and ne120 resolutions is the first major simulation campaign conducted by ACME. COSP v1.3 is already in the module and we tried to turn on the COSP for cloud output.
- COSP + OpenMP works fine on Titan and LC, but specifically has problems on Miran.
- Without OpenMP the model slows down by a factor of 2-5.
- The memory requirements in COSP are too large for ne120 resolution. (sub-column number has been reduced to the minimum at 10.)

Plan

- Upgrade COSP in ACME model
- Implement aerosol lidar simulator for ACME
- As part of Metrics Activity in tuning and evaluation task, make cloud collection of COSP diagnostics functioning and perform the testing for the AMIP ensemble runs of ACME model v0.1
- As part of Convection task, examine the cloud simulations from the candidate convection schemes through simulator diagnostics and using global and field observations.

Acknowledgment

This research was conducted by the Accelerated Climate Modeling for Energy (ACME) project, supported by the Office of Biological and Environmental Research in the DOE Office of Science. The work on the ARM simulator is supported by the DOE ARM program.