3.057 Simulation of carbon dioxide transport and variability with the NASA-Unified WRF regioal model.

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Abstract:

Knowledge of carbon cycle science, especially spatial-temporal variability of carbon sources/sinks, is vital to understand the carbon-climate interaction that remains the major source of uncertainty in future climate prediction. Part of the problems arises that mechanisms and processes controlling CO_2 fluxes and variability occur at relatively small spatial and/or rapid temporal scales. Thus, a high-resolution regional model may help filling the knowledge gap and reduce the uncertainty. With the support of NASA's Modeling Analysis and Prediction program, the NASA-Unified Weather Research and Forecasting model (NU-WRF) has been coupled with the Carnegie-Ames-Stanford Approach (CASA) biogeochemical model and the Parameterized Chemistry Transport Model (PCTM) to simulate CO_2 transport and variability at fine spatial resolutions. The coupling model system (NU-WRF-CASA) was designed to operate in an internally consistent manner in which NASA's Goddard Earth Observing System Model, version 5 (GEOS-5) that included the production of NASA's Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2) can be applied to drive each model component. A 3-year simulation was carried out to evaluate its performance under various landscapes, topographies, and environmental conditions. Observational CO_2 data from tower, flask, and flight measurements were used for model evaluations. The results show that NU-WRF-CASA can reproduce the spatial-temporal transport and variability reasonably well. The simulation demonstrates the model skills in resembling inter-annual, seasonal, daily, and diurnal variabilities in atmospheric CO_2 distribution under both drought and normal conditions.