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# Satellite Cloud Assimilation in the Weather Research & Forecasting (WRF) Model and its Impact on Air Quality Simulations

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Clouds have a significant role in air quality simulations as they modulate biogenic hydrocarbon emissions and photolysis rates, impact boundary-layer development, lead to deep vertical mixing of pollutants and precursors, and induce aqueous phase chemistry. Unfortunately, numerical meteorological models still have difficulty in creating clouds in the right place and time compared to observed clouds. This is especially the case when synoptic-scale forcing is weak, as often is the case during air pollution episodes in the Southeast United States. Thus, poor representation of clouds impacts the photochemical model's ability in simulating the air quality. However, since satellites provide the best observational platform for defining the formation and location of clouds, satellite observations can be of great value in retrospective simulations.

Here, we present results from a recent activity in which the Geostationary Operational Environmental Satellite (GOES) derived cloud fields are assimilated within Weather Research and Forecasting (WRF) model to improve simulated clouds. The assimilation technique dynamically support cloud formation/dissipation within WRF based on GOES observations. The technique uses observations to identify model cloud errors, estimates a target vertical velocity and moisture to create/remove clouds, and adjust the flow field accordingly. The technique was implemented and tested in WRF for a month-long simulation during August 2006, and was tested in an air quality simulation over the period of August-September 2013 (NASA's Discover-AQ field campaign). The cloud assimilation on the average improved model cloud simulation by 15%. The cloud correction not only improved the spatial and temporal distribution of clouds, it also improved boundary layer temperature, humidity, and wind speed. These improvements in meteorological fields directly impacted the air quality simulations and altered trace gas concentrations. For air quality simulations, WRF/SMOKE/CMAQ modeling system was used. Cloud correction reduced isoprene and monoterpene emissions over the southeastern U.S. by 10-20% and improved ozone predictions. Preliminary results from this activity will be presented.