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A high-resolution coupled meteorology-smoke modeling system HRRR-Smoke to simulate air quality over the CONUS domain in real time

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In this talk we discuss a new smoke modeling system High Resolution Rapid Refresh (HRRR-Smoke) to simulate biomass burning (BB) emissions, plume rise and smoke transport in real time. The HRRR (without smoke) is run operational at the National Weather Service, and includes an aerosol aware microphysics scheme. It is NOAA/ESRL's version of the Weather Research and Forecasting (WRF) model. Here we make use of WRF-Chem (the WRF model coupled with chemistry) and simulate fine particulate matter (PM2.5 or smoke) emissions emitted by BB as well as anthropogenic sources. The model also includes dry and wet deposition of aerosols.
The modeling system ingests fire radiative power (FRP) data from the Visible Infrared Imaging Radiometer Suite (VIIRS) sensor to calculate BB emissions. Using the FRP data and simulated meteorology the model calculates plume rise in an online mode. The HRRR-Smoke model has been running in real-time, originally without any feedback effects, since June 2016 on 3km horizontal grid resolution over the contiguous US (CONUS) domain by NOAA/ESRL Global Systems Division.
We simulate HRRR-Smoke for August 2015 and 2016 time periods over the CONUS domain to conduct the model evaluations. Simulated smoke concentrations are evaluated using hourly PM2.5 measurements from EPA's Air Quality System network. The HRRR-Smoke model uses a double moment aerosol aware microphysics scheme, which enables an efficient coupling between smoke and meteorology. We explore the impact of smoke on radiation, cloud and precipitation fields, whether the inclusion of the feedback processes improves the weather prediction skill of the model.