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Forecasting smoke, visibility and smoke-weather interactions using a coupled meteorology-chemistry modeling system: Rapid Refresh and High-Resolution Rapid Refresh coupled with Smoke (RAP/HRRR-Smoke)

Ravan Ahmadov (1,2), Eric James (1,2), Georg Grell (2), Curtis Alexander (2), Stan Benjamin (2), Stuart McKeen (1,2), Gabriel Pereira (3), Saulo Freitas (4), Ivan Csiszar (5), Marina Tsidulko (6), Shobha Kondragunta (5), Chuanyu Xu (5), Ka Yee Wong (7), and Steve Albers (7)

(1) CU Boulder/CIRES, Boulder, United States, (2) NOAA/ESRL, Boulder, United States, (3) Federal University of São João del-Rei, MG, Brazil, (4) USRA/GESTAR & NASA Goddard Space Flight Center, Greenbelt, MD, USA, (5) NOAA/NESDIS, College Park, MD, USA, (6) I.M. Systems Group, Inc, Rockville, MD, USA, (7) Cooperative Institute for Research in the Atmosphere, Fort Collins, CO, USA

The western US experienced one of the worst fire seasons in 2018. During summer 2018 air quality in the northwestern US was dramatically affected by the large wildfires in the western US and Canada. It is a huge challenge to accurately forecast biomass burning emissions from rapidly changing wildland fires across the US and surrounding regions, the transport of smoke near the surface and aloft on local and regional scales, and the impact of smoke on visibility and weather.

We present an experimental smoke forecasting system, which leverages the existing Rapid Refresh (RAP) and High-Resolution Rapid Refresh (HRRR) numerical weather prediction models running operationally at NOAA/NWS. The RAP domain (13.5 km resolution) covers all of North America, and other regions. The HRRR model is nested within RAP and runs on a very high resolution (3km) domain over CONUS. The RAP-Smoke model enables simulation of smoke over Canada, thus providing boundary conditions of smoke to the HRRR domain. The RAP/HRRR-Smoke modeling system is simulated in real time by ingesting the real-time satellite (Suomi-NPP, NOAA-20 and MODIS Aqua/Terra) fire radiative power data. The rapidly updated forecast products of smoke (near surface and aloft), visibility and other related variables are provided to a wide range of operational users and researchers across the US.

Here, we discuss RAP/HRRR-Smoke simulations for August, 2018 over the northwestern US. The smoke and visibility forecasts are evaluated using the available ground particulate matter and satellite based (e.g. VIIRS AOD) measurements. Additionally, detailed verification of the meteorological forecasts for the case study is presented. We demonstrate the improvements in weather forecasting, when smoke feedback on meteorological processes is enabled in the coupled HRRR-Smoke model.