Assimilation of Aerosol Optical Depth (AOD) retrievals and PM2.5 in NCEP's Next-Generation Regional Air Quality Forecasting System

Hongli Wang*[1,2], Stephen Weygandt[2], Mariusz Pagowski[1,2], Ruifang Li[1,2], Raffaele Montuoro[1,2], Quanhua Liu[3], Cheng Dang[4], Yingtao Ma[3,5], Rajesh Kumar[6], Shobha Kondragunta[3], Cory Martin[7], Jianping Huang[8], Jeffery Mcqueen[9], Ivanka Stajner[9], and Brian Hughes[8]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder – Boulder, CO, United States
[2]NOAA Global Systems Laboratory – Boulder, CO, United States
[3]NOAA NESDIS STAR – College Park, MD, United States
[4]UCAR Joint Center for Satellite Data Assimilation – Boulder, CO, United States
[5]CSU CIRA – Fort Collins, CO, United States
[6]NCAR RAL – Boulder, CO, United States
[7]Redline at NOAA/NWS/NCEP/EMC – College Park, MD, United States
[8]IMSG at NOAA/NWS/NCEP/EMC – College Park, MD, United States
[9]NOAA/NWS/NCEP/EMC – College Park, MD, United States

Abstract

Wildfires provide a major source of emissions contributing to poor air quality in the United States. Current operational models at the National Centers for Environmental Prediction (NCEP) show large uncertainties in the analysis and prediction of wildfire emissions with respect to emission strength, composition, duration, diurnal evolution, as well as to what altitude smoke plumes rise. This presentation describes efforts to improve wildfire smoke forecasting capabilities for air quality applications by assimilating satellite retrievals of Aerosol Optical Depth (AOD) and PM2.5 in-situ measurements into NCEP's Next-Generation Regional Air Quality Forecasting System, which consists of a Limited Area Model version of FV3 (FV3LAM) coupled with the Community Multi-scale Air Quality Model (CMAQ) to provide inline atmospheric chemistry.

The ability to assimilate AOD and PM2.5 has been developed for FV3LAM-CMAQ within the Gridpoint Statistical Interpretation (GSI) 3-dimensional variational data assimilation system (3DVar). The Community Radiative Transfer Model (CRTM) AOD module is used as an observation operator for AOD assimilation. The control variables are individual aerosol species, with associated background error statistics derived via the NMC method. The diurnal variations of background error statistics are examined and discussed. The VIIRS smoke and dust mask products are used to help produce physically reasonable aerosol analysis increments in smoke and dust areas. The performance of the developed GSI 3DVar data assimilation system will be presented and limitations will be discussed.

*Speaker

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