High resolution (3km) smoke forecasting for the US using satellite data

Ravan Ahmadov\(^1,2\)  (ravan.ahmadov@noaa.gov)

Acknowledgement: G. Grell\(^2\), E. James\(^1,2\), C. Alexander\(^2\), S. Benjamin\(^2\), B. Jamison\(^1,2\), T. Alcott\(^2\), M. Pagowski, J. Stewart\(^1,2\), S. Freitas\(^3\), G. Pereira\(^3,4\), I. Csiszar\(^5\), M. Tsidulko\(^8\), B. Pierce\(^6\), S. McKeen\(^1,2\), S. Peckham\(^7\), S. Kondragunta\(^8\), A. Edman\(^8\), M. Goldberg\(^10\), B. Sjoberg\(^10\)  

JPSS proving ground and risk reduction program

1 Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder, Boulder, CO, USA
2 Earth System Research Laboratory, NOAA, Boulder, CO, USA
3 NASA Goddard Space Flight Center & USRA/GESTAR, Greenbelt, MD, USA
4 Federal University of São João del-Rei, MG, Brazil
5 Center for Satellite Applications and Research, NOAA/NESDIS, College Park, MD, USA
6 Advanced Satellite Products Branch, Center for Satellite Applications and Research, NOAA/NESDIS, Madison, WI, USA
7 Cold Regions Research and Engineering Laboratory, US Army Corps of Engineers, Hanover, NH, USA
8 I.M. Systems Group, Inc, Rockville, MD, USA
9 National Weather Service, NOAA, USA
10 NOAA’s Joint Polar Satellite System Program Office
The primary advantages of the HRRR-Smoke modeling system:

- High spatial resolution to allow simulation of mesoscale flows and smoke dispersion over complex terrain.
- Full coupling between meteorology and smoke: feedback of smoke on predicted radiation, cloudiness, and precipitation (using double moment microphysics).
- Biomass burning emissions and inline plume rise parameterization based on the satellite FRP data.
- A rapidly updating data assimilation cycle for meteorology;
- HRRR-Smoke uses meteorological input data prepared by the GSI data assimilation system and boundary conditions from another weather forecast model: Rapid Refresh (RAP).
- The forecast lead time is 36 hours. Four times a day (00, 06, 12 and 18UTC) a new forecast starts.
The clustering procedure performs a combination of all detected fires from VIIRS according to the model spatial resolution and grid configuration.

Averaged satellite FRP data mapped over 3x3km HRRR CONUS grid pixels for May 3, 2017.
This plot shows simulated fine particulate matter (PM2.5 or fire smoke) concentrations at the first model level (~8m above ground). The following plot shows forecast of near-surface fire smoke for May 4, 8am EDT over the CONUS and its subdomain. This forecast is based on the model simulation of 36 hours from the model initialization time, which is 8pm EDT, May 2, 2017.

Smoke forecast for May 4, 2017 (rapidrefresh.noaa.gov/hrrr/HRRRsmoke/)
Vertically Integrated Smoke (mg/m²)

HRRR-SMOKE 09/04/2017 (00:00) 0h fcst - EXPERIMENTAL
Valid 09/04/2017 00:00 UTC

https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke/
AOD from HRRR-Smoke and VIIRS, September 4, 2017
Health Impact Forecast Tool (developed by Gan et al., CSU)

Currently it uses the BlueSky PM2.5 forecasts. HRRR-Smoke PM2.5 will be added in near future.
A QUESTION FOR THE DISCUSSIONS: WHAT ARE THE UNCERTAINTIES ASSOCIATED WITH THE SATELLITE (MODIS, VIIRS, GEOSTATIONARY) FIRE RADIATIVE POWER DATA AND HOW BEST WE CAN USE THIS INFORMATION IN SMOKE MODELS?

THANK YOU FOR YOUR ATTENTION