Applications of Geostationary Aerosol Retrievals on PM2.5 Forecasting: Increased Potential from GOES-15

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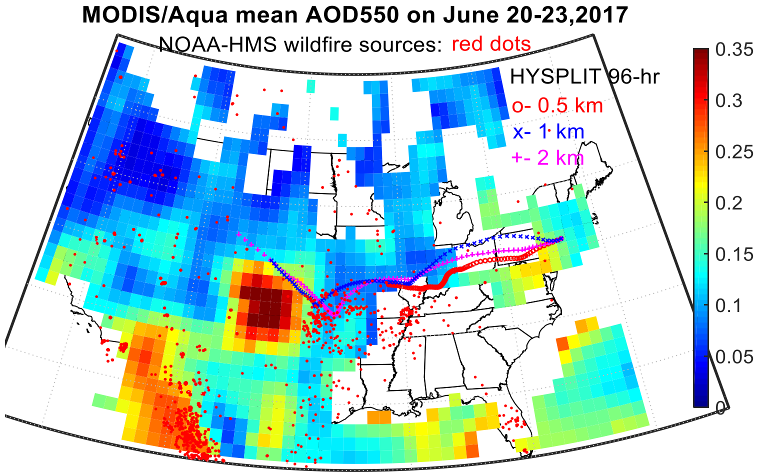
See the following posters:

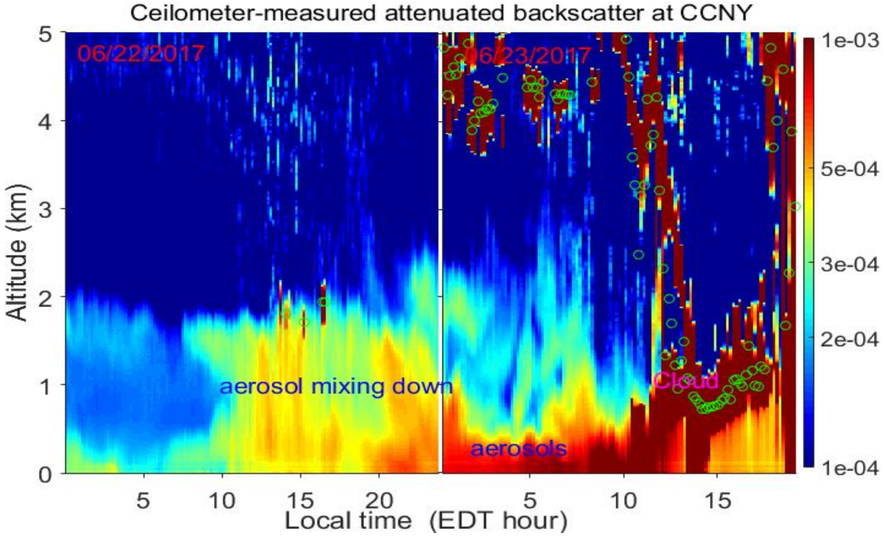
1) **Continental Transport of Wildfire Smoke and Impact on Air Quality observed by ground-based and satellite sensors in New York**
2) **Comparing CMAQ Forecasts with a Neural Network Forecast Model for $PM_{2.5}$ in New York**

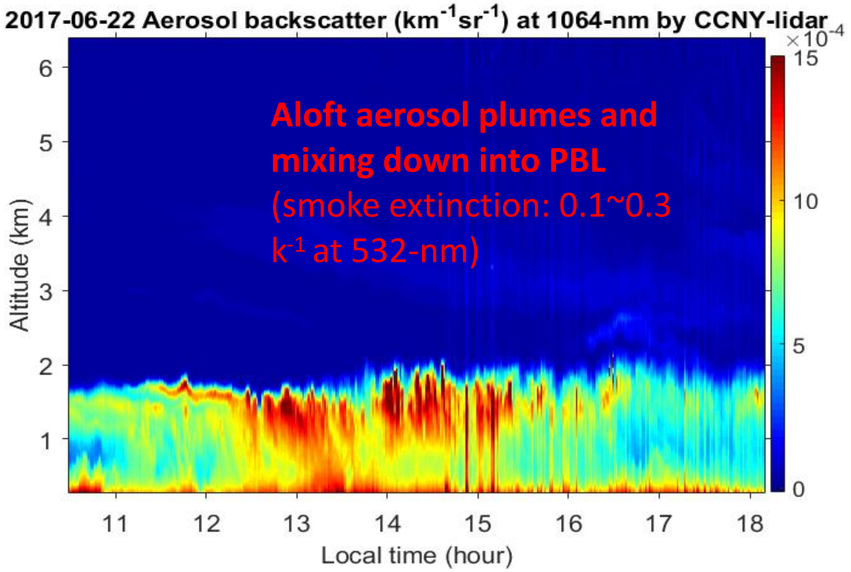
Connections between Transported Smoke Plumes and PM25

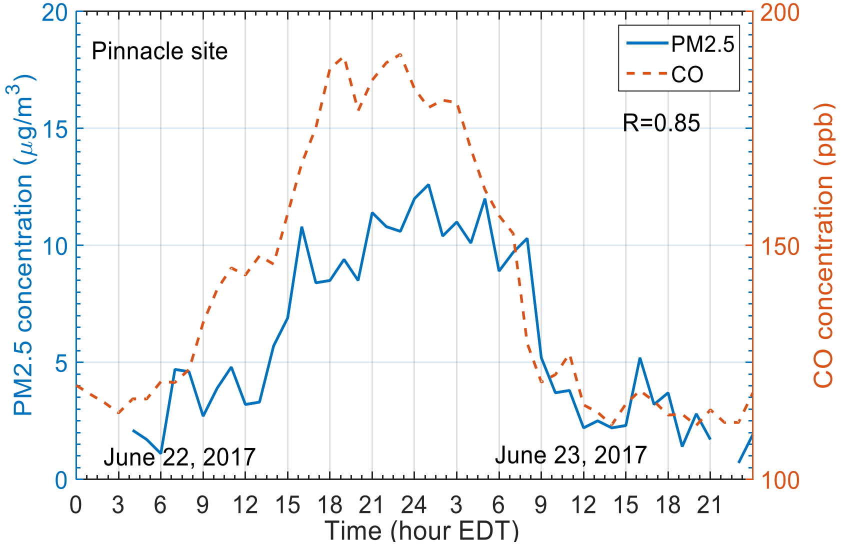
- In multiple cases, mixing down of aloft transported smoke plumes have resulted in strong increases in PM25 which were observed dynamically using a combination of Lidars and Ceilometers located at CCNY
- The $PM_{2.5}$ concentrations indicate coincident increase from 5- to 20~30 $\mu g/m^3$ and good correlation (R=0.8) in the NYC urban and upwind rural area which implies the regional transport.
- At the upwind rural Pinnacle site, the PM2.5 and CO indicate consistent enhancement and strong correlation (R=0.85-0.93) which demonstrates that PM25 enhancement is due to the smoke-associated transport.
- The wildfires sources and smoke transport path are demonstrated from the satellite and HYSPLIT product

Optical Vertical Observations of Mix-Down



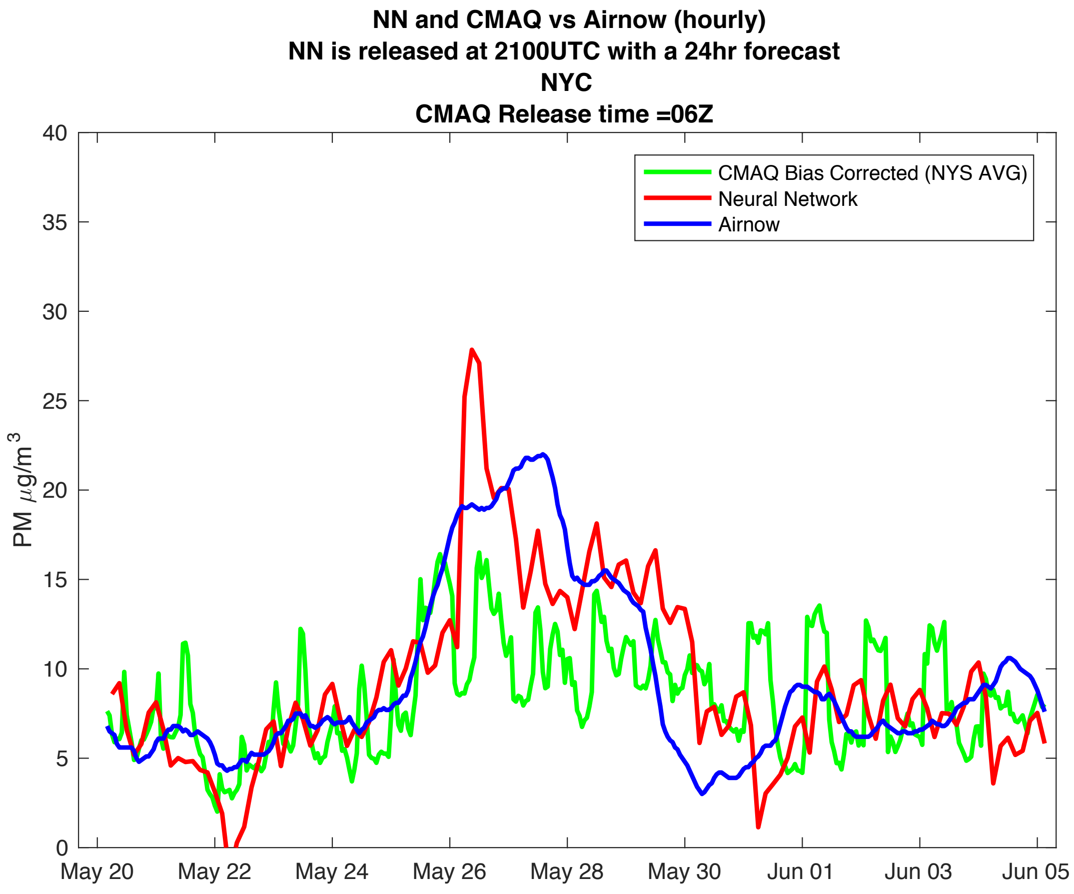






PM25 Forecasting

- Previous Slides show strong smoke plumes have significant satellite AOD signatures which can be used to identify plume transport into our area.
- Differential NN approach can be used to help forecast such events in comparison to existing CMAQ forecasts although initial increase is often overshot.
- Using Satellite AOD (MODIS-OMI), we can identify plume AOD pixels which can be transported using HYSPLIT forward trajectories over the NY region to estimate potential enhanced PM25 intrusion

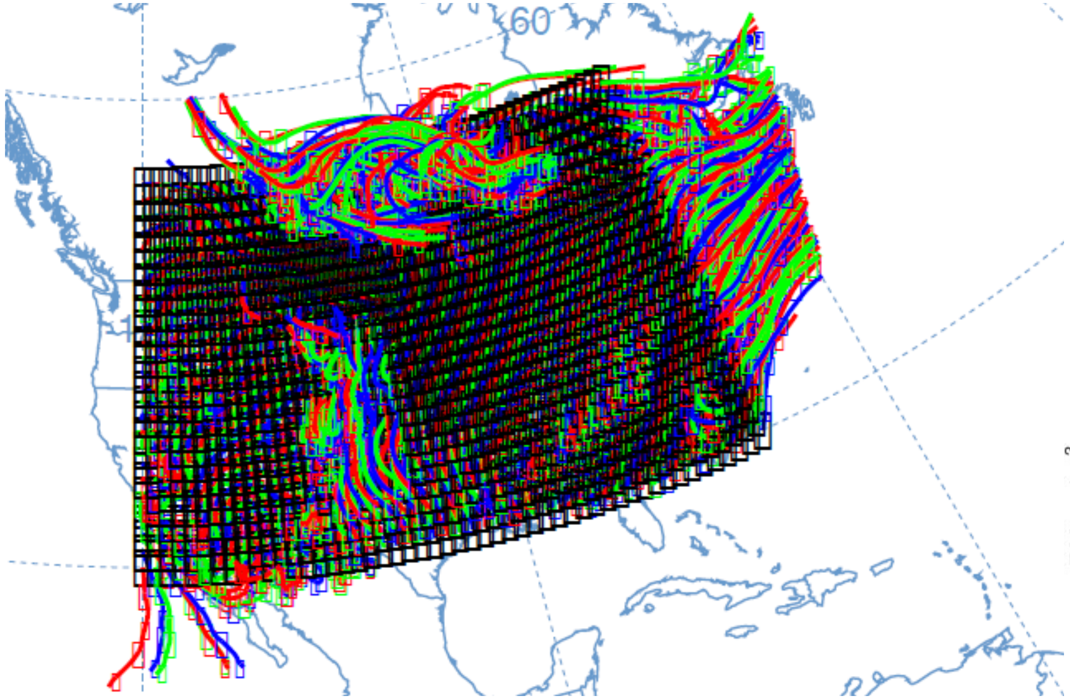


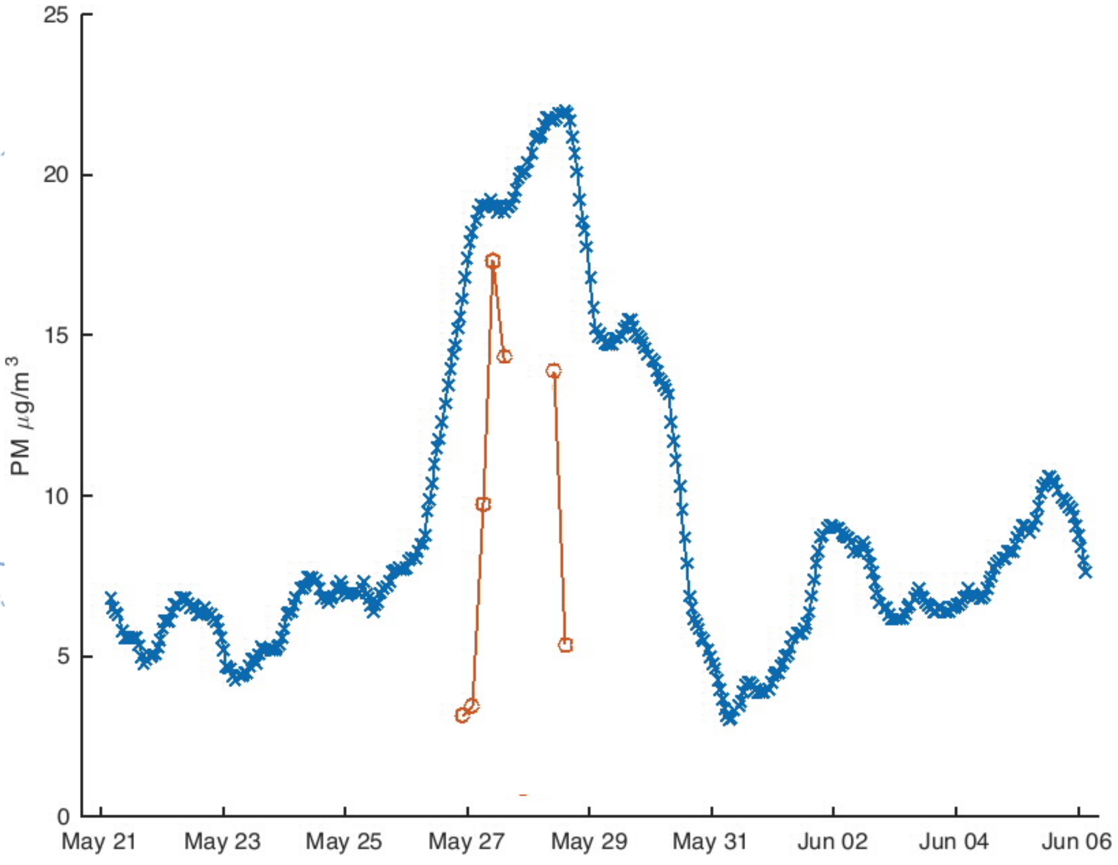
Explore use of Strong Smoke Plume AOD as forecast factor

- Run ensemble forward trajectories for different vertical heights within realistic plume heights and determine which trajectories lie within +0.25/- 0.25 degree of NYC and bin into transport time with vertical mixing into the PBL (<3km)
- Calculate the weighted average of the AOD bins, and project the AOD forecast onto the PM forecast using a reasonable scale factor (PM25 ~ 50*AOD)

$$\frac{1}{N_j}\sum_{i} AOD_{i,j}$$

Preliminary Results (May 25-May 31 2016)





Conclusions and Future Work

- Use of MODIS high AOD + Transport can potentially identify likelihood of strong smoke events that can be used in a transport model to identify potential PM25 mix down events.
- Unfortunately, MODIS data has strong cloud contamination and OMI footprint is poor so actual points that are valid for transport are often very sparse
- Future GOES-15 (Geostationary with MODIS like channels) + Enhanced OMI (TROPOMI) offer dramatic enhancements of spatial / temporal resolution and data frequency allowing better forecast potential.

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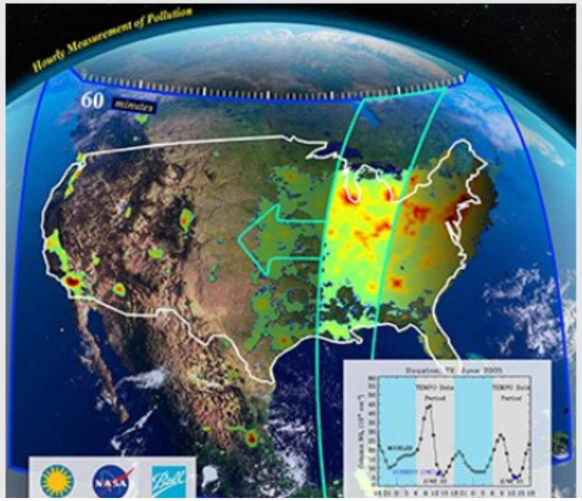
Scope

With the continued increase of urbanization around the globe, the emission and transport of a wide range of gases and aerosol particulates continues to pose significant potential health risks. To better understand and mitigate the air-quality risks using informed scientifically based protocols, we need to further continue to improve our observational and analysis capabilities to identify and quantify these atmospheric components and their sources. In order to provide a comprehensive survey of existing capabilities and potential improvements using remote sensing, this special section of the *Journal of Applied Remote Sensing* seeks to collect and organize papers addressing the latest state of the art in air quality monitoring and assessment from a diverse set of instrumental platforms and technologies including satellite sensors as well as ground-based and air-borne active and passive remote sensors. Studies using multiple instruments and platforms which improve interpretation of pollution mechanisms are of special interest.



Suggested topics may include but are not limited to

- Observational and algorithmic approaches to quantifying pollutant gases including nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ammonia (NH_3), carbon monoxide (CO), methane (CH_4), carbon dioxide (CO_2), ozone (O_3) etc.
- Retrieval of aerosol optical properties including aerosol optical depth (AOD), angstrom exponent (AE), albedo and particle modes, and the use of these products to better quantify $PM_{2.5}$ and/or PM_{10} levels
- Use of integrated remote sensing tools to better constrain and improve current atmospheric pollution modeling methodologies
- Assimilation of air quality remote sensing retrieval products and profiles into existing operational meteorological chemical transport models
- Innovative use of GIS and and/or machine learning tools like source apportionment to better integrate remote sensing data for a better understanding of pollution sources, transport mechanisms, and potential health effects
- Improved tracking and quantification of both natural and anthropogenic pollutant plumes
- Reports and assessments of next-generation air pollution sensors such as TEMPO (Tropospheric Emissions: Monitoring of Pollution), TROPOMI (TROPOspheric Monitoring Instrument) and IASI-NG (Infrared Atmospheric Sounding Interferometer Next Generation)
- Characterization of temporal and spatial air pollution trends and coupling at local, regional, and global scales
- Novel sensor designs and applications
- Regional studies in stressed environments.