Utilizing Remote Sensors to evaluate WRF-CMAQ model in urban environment
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Motivation

• Air quality models (WRF-CMAQ) are commonly used in air quality applications.
• In urban environments, these models become more complex due to the inherent complexity of the land surface coupling and the enhanced pollutants emissions.
• Clear model performance anomalies are seen in urban area.
• Use Vertical Profiling tools to assess root cause of anomalies.

Overview

• We explored the usefulness of vertical sounding measurements on assessing meteorological and air quality forecast models.
• Particularly, we focused on assessing the WRF model (12km x 12km) coupled with the CMAQ model for the urban New York City area using multiple vertical profiling and column integrated remote sensing instruments.
• In addition, this study includes a mathematical method using a direct Mie scattering approach to convert aerosol microphysical properties from CMAQ model into optical parameters for direct aerosol model and surface reflection.

Summer PM2.5 Anomalies

• The PM\textsubscript{2.5} spike is less intense in the observation of summer 2010.
• The summer 2010 PBL heights are significantly larger on average for summer 2010 during the sunrise / sunset periods, in comparison to the more compressed PBL height of summer 2007.

Satellite Retrieval using Geostationary satellites (GOES)

• Satellite observations can be used to measure column integrated Aerosol Optical Depth (AOD).
• Current GOES sensors can produce 30 minute retrievals but use a single wavelength
• This forces significant assumptions that might not be met in urban environments.
• Preliminary efforts are to baseline retrieval performance of AOD and to assess feasibility of using AOD to help retrieve PM2.5
• Future efforts will allow for refinement over urban areas accounting for better assumptions on aerosol model and surface reflection

PM2.5 capability from GOES:

• Summer retrievals with high correlation possible
• This is in part due to better solar geometry in summer allowing measurements to be more accurate and better mixing of aerosols in the PBL layer

Connection between PM2.5 distribution and PBL

• The Nearest GASP AOD assessment

AOD Assessment:

• Summer retrievals with high correlation possible
• This is in part due to better solar geometry in summer allowing measurements to be more accurate and better mixing of aerosols in the PBL layer

Summary

• The strong surface emission behavior in the diurnal pattern predicted by CMAQ are not seen in the ceilometer observation as these actual emissions are evenly distributed in the PBL.
• CMAQ primary emissions are not properly distributed vertically which may caused by the very low PBL of the model during predawn and post-sunset period.
• On the other hand, for summer 2010, the expansion of the PBL height seems to allow at least partial venting of the pollutants, which is more in line with ceilometers based observations.
• These results seem to be consistent with further matchups for summer 2011 data
• Preliminary comparisons of GOES AOD with ground based AOD shows that satellite performance is generally sufficient bit extra dispersion is seen in Urban areas.
• Preliminary PM25 matchups against GOES illustrate general feasibility for summer months using 3 x 3 (12km) averages with correlations R\textsuperscript{2} > .7
• Newer algorithms which will be applied to urban areas may further improve these preliminary results.