Evaluation of Air Quality Model Performance during the 2011 DISCOVER-AQ Campaign

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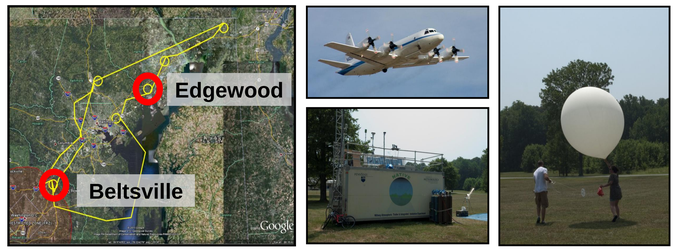
DISCOVER-AQ

"**D**eriving **I**nformation on **S**urface conditions from **Co**lumn and **Ver**tically Resolved Observations Relevant to **A**ir **Q**uality"

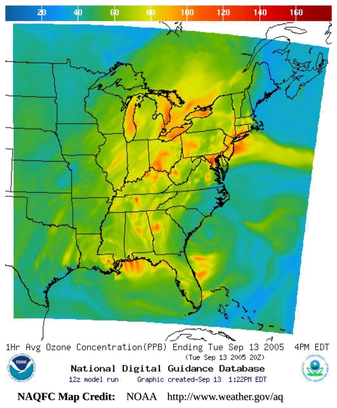
- Mission Objectives:
  1. Connections between surface conditions and column observations for next-generation remote sensing.
  2. Factors contributing to daily AQ variability that can improve modeling efforts.
  3. Regions with steep fine-scale gradients to improve data interpretation and assimilation



2011 DISCOVER-AQ Map Credit: NASA http://www.nasa.gov/images/content/558805main2_maryland-flights-226x170-words.jpg
P3 Aircraft Credit: NASA http://www.nasa.gov/images/content/561449main_p-3b-1067_full.jpg
NATIVE Trailer Credit: Doug Martins Used with permission
Ozonesonde Launch Credit: Doug Martins Used with permission

AQ Model Descriptions

- Three models provided AQ forecasts
  1. National Air Quality Forecast Capability (**NAQFC**)
  2. Experimental Chemistry Model (**Exp-CMAQ**)
  3. Statistical Post-Processing of NAQFC (**NAQFC-MOS**)



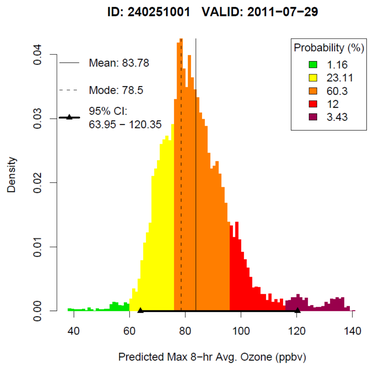
NAQFC Map Credit: NOAA http://www.weather.gov/aq

Numerical Models

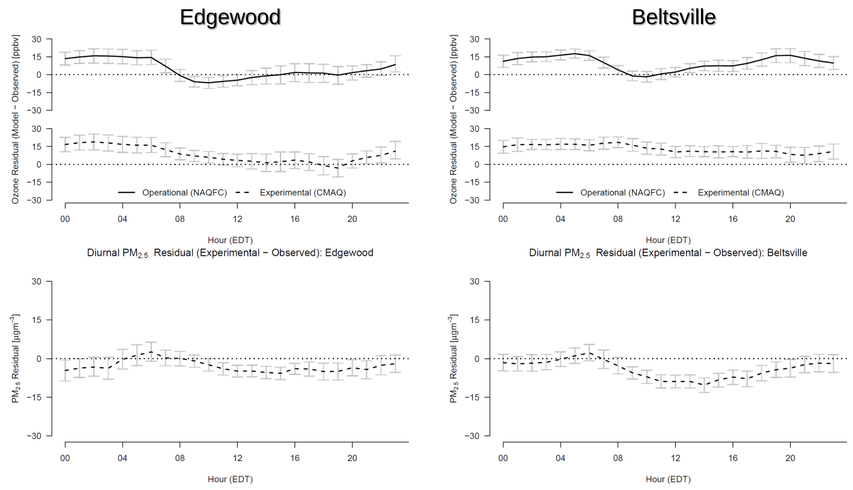
- NAQFC = Weather (WRF-NMM) + Chemistry (CMAQ) models
- 12 km grid, 22 layers, 48-h forecasts of 1-h and 8-h average ozone
- Exp-CMAQ includes updated chemical mechanism and forecasts particulates ($PM_{2.5}$)

Statistical Model

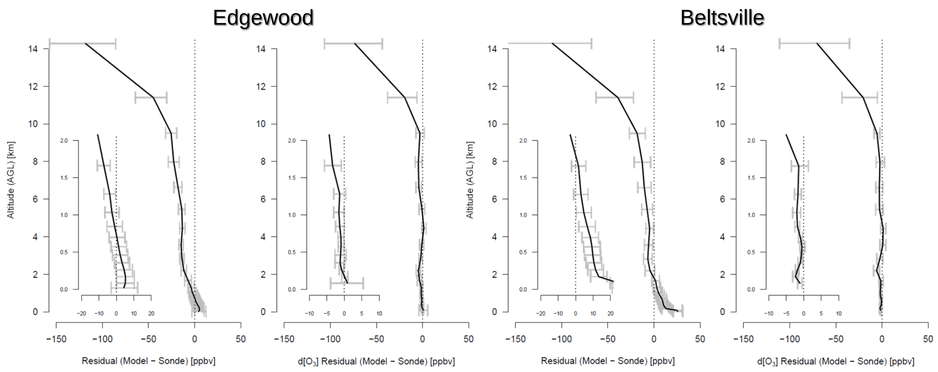
- Post-processed NAQFC
  - Regression Trees
  - Error-Perturbations
  - "Extreme Value"
- Distribution of max 8-h average ozone for sites in DISCOVER-AQ domain



Numerical Model Performance

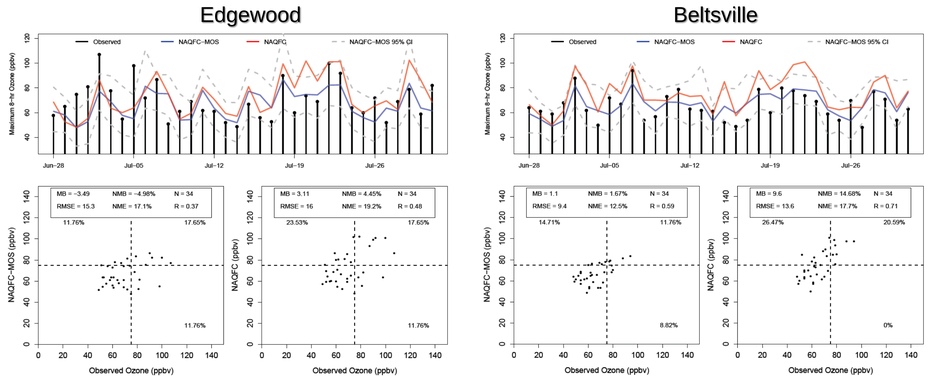


- Exp-CMAQ and NAQFC pos. bias in ozone, Exp-CMAQ neg. bias in $PM_{2.5}$
- Morning to afternoon transitions and variability in ozone are better handled in the Exp-CMAQ than in the NAQFC



- Exp-CMAQ profiles indicate tending neg. bias with height
- Shape of model profiles consistent with observations up to ~10 km

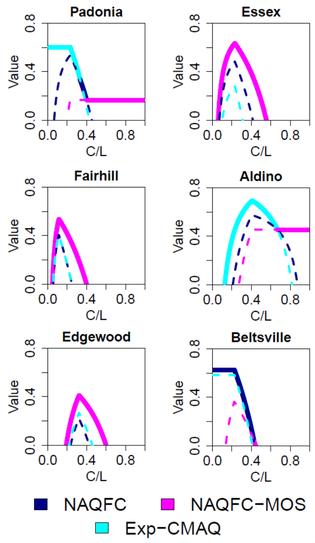
Statistical Model Performance



- NAQFC-MOS Edgewood
  - Accuracy unchanged
  - Forecasts frequently outside confidence intervals
  - False-alarms halved while keeping hit/miss ratio the same
- NAQFC-MOS Beltsville
  - Improved accuracy
  - Forecasts well-bounded by confidence intervals
  - False-alarms decreased, though the hit/miss ratio decreased too

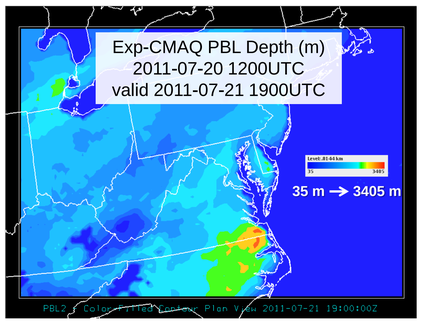
Value of Information

- Both the Exp-CMAQ and the NAQFC-MOS provide significant value over the NAQFC (Exception Beltsville)
- NAQFC-MOS provides double the maximum value of the NAQFC and increases the range of protective measures (C/L) at Edgewood
- No clear "best model"



...to be continued

- Verification of other Exp-CMAQ parameters
  - Cloud Fraction
  - Sfc. Temperature
  - Wind Spd & Dir
  - AOD
  - Non-criteria Pollutants
  - Boundary Layer



- Strengthen statistical model performance through improved model development and optimization

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