Integration of Multiple Perspectives: Trace Gases

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Summary of Ongoing Work

• **Air quality model evaluation** -- NOAA CMAQ forecasts:
  Tim Canty – comparing 2007 CMAQ simulation and 2011 CMAQ forecasts with DOMINO V1 and V2 and NASA V1 and V2 tropospheric NO2; model overestimates in urban areas and underestimates in rural areas; going to V2 reduced rural discrepancy

  Melanie Follette-Cook – comparing with P-3B trace gas data; found high biases for boundary layer O3, but low biases in the free trop; NO2 compared well with observations, but peroxynitrates were overestimated; isoprene and formaldehyde underestimated in BL

  Chris Loughner – comparing with surface ship data over Chesapeake Bay; showed model overestimates of O3 on some days when the BL height in the model was low compared with HSRL estimate; model mixing in marine BL is too rapid; high NOy bias from surface to 700 hPa.

  Youhua Tang – comparing CMAQ run with WRF-NMM and WRF-NMMB with P-3B data; NMMB run with and without day-specific fire emissions; fires improved CO forecast, but insufficient to match observed O3

  Greg Garner – comparing diurnal and vertical biases in operational and experimental forecasts at Beltsville and Edgewood. MOS product reduced false alarm rate for ozone exceedances
Summary of Ongoing Work

- **Multiple-Perspective Analyses**
  - Ron Cohen -- performing high-resolution OMI tropospheric NO2 retrievals, using WRF-Chem (4 km) profiles, MODIS cloud and albedo products, and detailed terrain height information; comparing OMI retrievals with P-3B column integrations
  - Clare Flynn – comparing time series of tropospheric column NO2 from P-3B integrations, Pandora, OMI, and CMAQ; OMI and Pandora generally compare well; CMAQ has high bias relative to Pandora; correlations between surface and trop column are larger for O3 than for NO2; surface vs. column correlations are larger in CMAQ than in observations
  - Bob Chatfield – performing correlations between “relevant layer” (0.2 -0.5 km) to the “retrievable layer” (0-3km); found reasonably good correlations between these layers for O3, NO2, and HCHO; examined change in correlation with distance from retrieval site – NO2 correlations drop off rapidly and O3 and HCHO are good over D-AQ land region
  - Andra Reed – examining differences in total column O3 and NO2 at Edgewood between OMI and Pandora
**Work in progress**

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<th>Air Quality Model Simulations</th>
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| CMAQ                         | Horizontal Resolution: 36, 12, 4, and 1.3 km  
Time Period: Late May through July |
| WRF-Chem                     | Horizontal Resolution: 36, 12, and 4 km  
Time Period: Late June through July |
| WRF-Chem (at NCAR)           | Horizontal Resolution: 12 km domain covering the entire continental US  
Time Period: Late June through July |
| NASA Unified WRF (NU-WRF)    | Horizontal Resolution: 36, 12, 4 km  
Initial run completed          |
|                              | Time period: Late June through July |
Work Needed

- Filling gap between bottom of P-3B profiles and surface
  Chen, Fuentes, Clark, Flynn, Pickering
- Comparison of Lenschow, HSRL, MPL boundary layer heights with trace gas profiles
  Knepp, ???
- Trace gas variability analysis
  Silverman, Crawford, Tzortziou
- Introduce ACAM retrievals into multi-perspective analyses
  Janz, Liu, Flynn, Follette-Cook, Pickering
- Comparison of D-AQ observations with high-resolution WRF-Chem and CMAQ simulations
  Follette-Cook, Loughner, Duncan, Flynn, Pickering
- Improvement of regional air quality models based on D-AQ data
  Dickerson et al.
- Development of V2 of emissions, incorporating 2011 major point source emissions and highway traffic patterns
  Loughner, Pickering
Manuscripts

Clare Flynn, Melanie Follette-Cook -- Integration of NO2 column estimates from aircraft, Pandora, OMI, ACAM, CMAQ; column vs. surface correlations
Melanie Follette-Cook -- Evaluation of CMAQ and WRF-Chem with P-3B obs
Chris Loughner -- Evaluation of CMAQ over Chesapeake Bay and Bay-breeze development with multiple data sets
Pickering, Loughner -- Evaluation of WRF BL parameterizations using aircraft data
Ron Cohen -- High-res OMI NO2 retrievals vs. P-3B columns and other products
Fried, Janz, Liu -- Formaldehyde – ACAM, vs. P-3B vs. satellite
Bob Chatfield -- ozone layer correlations
Maria Tzortziou, Travis Knepp -- Pandora vs. OMI vs. sfc. NO2
Travis Knepp -- trace gas scale heights vs. met. PBL and aerosol-based heights
Maria Tzortziou -- Integration of data sources over Bay as related to ocean color
Maria Tzortziou, Yonghoo Choi -- Ocean color from HSRL in context of NOAA ship obs
Russ Dickerson -- SO2: OMI vs. Cessna
Anne Thompson -- Ozone – multiyear perspective from sondes
Russ Long, Jim Szykman -- NO2 observations – Moly vs. Photolytic
Tim Canty -- Urban/Rural NO2 ratios in CMAQ vs. obs
Tianfeng Chai -- CMAQ chemical data assimilation using DISCOVER-AQ data