

Integration of Multiple Perspectives: Trace Gases

**Ken Pickering
Melanie Follette-Cook**

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 peroxy nitrates 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 NO_y 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

Air Quality Model Simulations

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) Initial run completed	Horizontal Resolution: 36, 12, 4 km 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