[A53G-2570] Investigation of NO_2 measurements made during DISCOVER-AQ and KORUS-AQ Campaigns in conjunction with NO_2 tropospheric column from the Ozone Monitoring Instrument (OMI) and High-resolution Community Multi-scale Air Quality (CMAQ) model simulation

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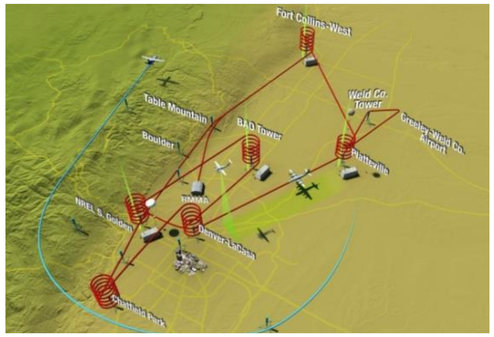
Overview

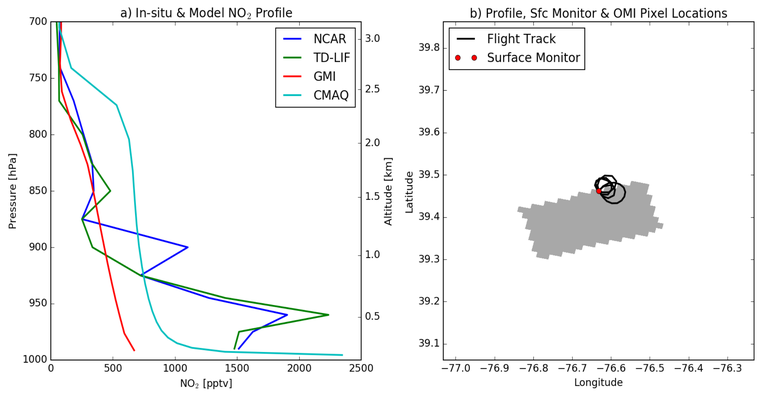
- Atmospheric NO_2 is produced by combustion, lightning, and in soil. NO_2 affects ozone production and criteria pollutant itself. It also has indirect radiative impacts in the troposphere, since ozone has largest warming effect in upper troposphere.
- Tropospheric vertical column densities (VCD) of NO_2 are available from satellites (GOME, OMI, SCIAMACHY, GOME-2)
- DISCOVER-AQ and KORUS-AQ aircraft campaigns were conducted to improve the use of satellites to monitor air quality for public health and environmental benefit in United States and South Korea.
- In this study, we investigate 1) How do these measurements compare? 2) What is the best way to make comparisons of space- and ground-based measurements?

- Summary:
  1. OMI NO_2 tropospheric column using in-situ profiles as a priori agree reasonably well with in-situ obervations during the five campaigns (r ~ 0.8)
  2. Downscaled of OMI pixels using high resolution CMAQ simulations agree better with in-situ observation than the native spatial resolution.

NO_2 Measurements during DISCOVER-AQ & KORUS-AQ

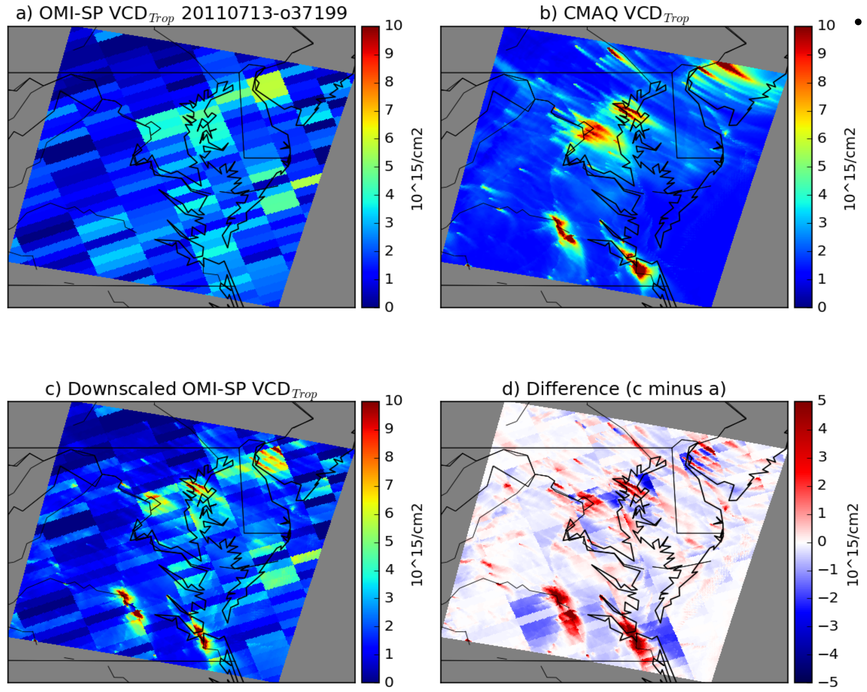


- DISCOVER-AQ and KORUS-AQ are five near monthly field deployments (MD, TX, CA, CO, and South Korea, 2011-2016)
- Various NO_2 measurements
  - Ground monitor (surface conc.) / − Pandora (total column)
  - Two types of airborne instruments:
    - **NCAR** (photolytic converter)
    - **TD-LIF** (laser-induced fluorescence)
- NO_2 vertical profiles Aircraft (P3B) spirals with ~4 km diameter during DISCOVER-AQ, and DC-9 ascents/descents during KORUS-AQ



- "In-situ" tropospheric Column (VCD_{Trop}) NO_2 are obtained by integrating:
  - Surface NO_2 VMR from ground-based instruments
  - Airborne in-situ NO_2 VMR from individual spirals
  - Daily composite median profiles for mid-troposphere
  - GMI model profiles for upper troposphere
- (Bottom left) An example set of collocated in-situ and model NO_2 profiles shows the models (GMI and CMAQ) may not capture the vertical structures in the real profiles
- (Bottom right) OMI footprint area (gray) and aircraft track (black) shows that the in-situ profiles cover only a small fraction of the OMI pixel.
  - The spatial resolution of OMI is 13x25 km^2 at nadir and larger at edge (~100 km)

OMI NO_2 Column Downscaled Using High Resolution CMAQ Simulation



- NASA GSFC OMI NO_2 standard product (SP) can be improved by the following methods:
  1. We use in-situ NO_2 profiles (shown above) as a priori for tropospheric air mass factor (AMF), instead of the GMI model profiles used in SP. This is to obtain the most accurate retrieval of tropospheric NO2 column.
  2. (left panels) OMI NO_2 column is downscaled using CMAQ high resolution (1km x 1km) simulation for more accurate comparison with in-situ NO2 measurements, instead of using SP as is, since OMI pixels are too large compared to aircraft spirals (e.g., H. C. Kim et al., 2016) for MD and TX campaigns.

Acknowledgement
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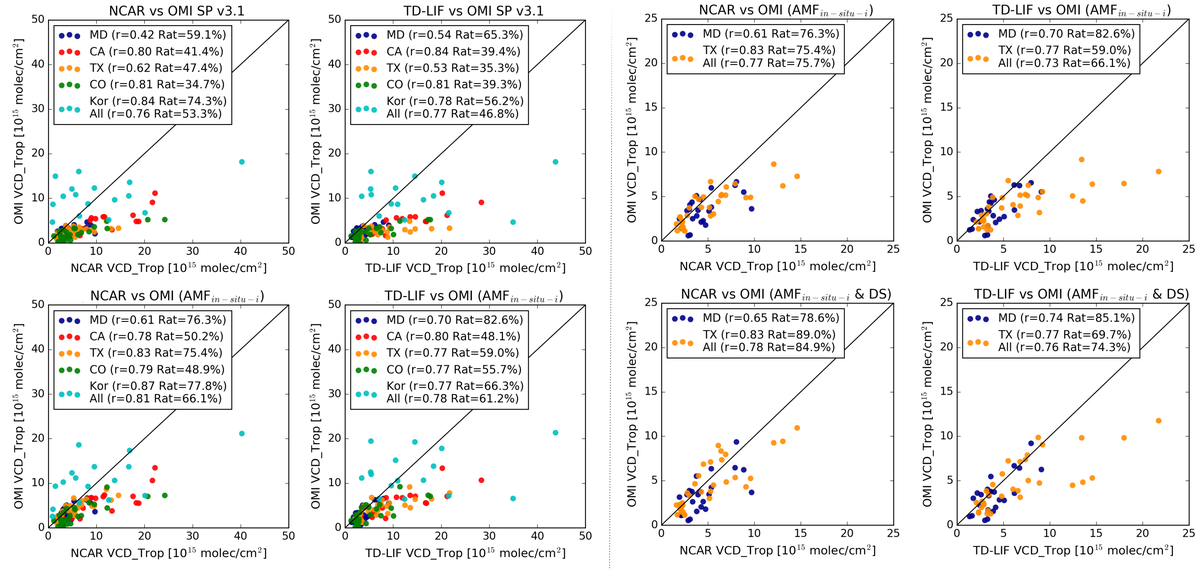
References
Kim, H. C. et al., Geosci. Model Dev., 9, 1111–1123, 2016

Comparison between OMI and In-situ Measurements



- (top) In-situ NO_2 column vs. OMI SP and (bottom) in-situ vs. OMI using AMF calculated with in-situ profiles shows that using more accurate a priori profiles makes OMI NO_2 column agree better with in-situ observations.
- (top) In-situ NO_2 column vs. OMI with in-situ a priori profiles and (bottom) in-situ vs. OMI downscaled using CMAQ simulation shows that the downscaling technique improves the agreement between OMI and in-situ columns.