Data

Airborne HSRL measurements
HSRL, a compact and robust – designed sensor onboard small aircraft such as the NASA Langley King-Air 200 when deployed in DISCOVER-AQ field experiments. This HSRL instrument is an innovative technology that is similar to radar, however, with lidar, radio waves are replaced with laser light. Lidar allows researchers to see the vertical dimension of the atmosphere, and the advanced HSRL makes measurements that can even distinguish among different aerosol types and their sources. The HSRL technique takes advantage of the spectral distribution of the laser return signal to discriminate aerosol and molecular signals and thereby measure aerosol extinction and lidar backscatter independently. It measures aerosol backscatter and depolarization at 0.532 and 1.064 µm and aerosol extinction at 0.532 µm.

DRAGON sunphotometer observations
Large number of AERONET sunphotometer measurements during DISCOVER-AQ in BWC (Baltimore Washington Corridor; July 2011), SJV (San Joaquin valley; January 16 –February 4, 2013), Houston Metropolitan Region (September 2013). The DISCOVER-AQ Sun Photometry Network (BACON) shows 6,500, 22,000, 14,000 km², in BWC, SJV, HMR, respectively.

Surface in-situ PM2.5 and meteorological measurements
Hourly PM2.5 (Particulate Matter with aerodynamic diameter 2.5 µm) relative humidity (RH), wind speed, wind direction, and surface temperature. Measurements of these (Beltsville, Edgewood, Fair Hill), four (Bakersfield, Fresno, Clovis, Porterville), and four (Clinton, Aldine, Deer Park, Galveston) surface stations, along with corresponding DRAGON and HSRL observations, serve the baseline relationship for satellite AOD retrievals.

Approach

\[ \tau_{0.55 \mu m} = \int \rho(z) \sigma_{0.55 \mu m}^\text{GOT}(z) dz \]

Assumption 1: homogeneously mixed within mixing layer height

\[ \tau_{0.55 \mu m} \approx \frac{\tau_{0.55 \mu m}}{\frac{f(RH)\sigma_{0.55 \mu m}^\text{dry}}{\sigma_{0.55 \mu m}^\text{ext}}} HLH \]

Assumption 2: \( \rho(z) \approx 1 \) over the planetary boundary layer height (PBLH) and scale height (H); scale height is derived by assuming exponential decrease of extinction with height above PBL

\[ \tau_{0.55 \mu m} \approx \frac{f(RH)\sigma_{0.55 \mu m}^\text{GOT}^{\text{dry}}}{\sigma_{0.55 \mu m}^\text{ext}} HLH \]

Where \( \tau_{0.55 \mu m} \) = AOD at 0.55 µm wavelength; \( f(RH) \) is aerosol mass concentration (µg/m³); \( \sigma_{0.55 \mu m}^\text{GOT} \) is aerosol extinction cross section per unit mass (m²/µg) at 0.55 µm; \( \sigma_{0.55 \mu m}^\text{ext} \) is hygroscopic growth factor; \( \tau_{0.55 \mu m} \) aerosol extinction cross section per unit mass at surface relative to dry particles at 0.55 µm wavelength; \( \tau_{0.55 \mu m} \) is aerosol mixing layer height (km); HLH is estimated haze layer height.

Spatial Variability of AOD

Fitted (power or linear) functions on correlation vs. distance (km) with respect to HSRL-DRAGON and DRAGON-DRAGON. More isolated pollution emission in SJV as opposed to HMR and BWC. Large differences shown in SJV due to coarser distribution of sunphotometers.