Review of DAQ Aerosol Objectives

1: Relate column observations to surface conditions for aerosols….

A. How well do column and surface observations correlate?

B. What additional variables (e.g., boundary layer depth, humidity, clouds).. appear to influence these correlations?

C. On what spatial scale is information about these variables needed (e.g., 5 km, 10 km, 100 km) to interpret column measurements?

***2*: Characterize differences in diurnal variation of surface and column observations for aerosols**

A. How do column and surface observations differ in their diurnal variation?

B. How do emissions, boundary layer mixing, synoptic transport, and chemistry interact to affect these differences?

C. Do column and surface conditions tend to correlate better for certain times of day?

3: Examine horizontal scales of variability affecting satellites and model calculations

A. How do different meteorological and chemical conditions cause variation in the spatial scales for urban plumes?

B. What are typical gradients in key variables at scales finer than current satellite and model resolutions?

C. How do these fine-scale gradients influence model calculations and assimilation of satellite observations?

DISCOVER-AQ Aerosol Data and Model Simulations

Site	POC	AOD	PM2.5	Scat	Abs	Ext	Bscat Profiles	dPol	f(RH)	BC	Size	Composition	PBL Height
MODIS	Chu	X											
OMI	X. Liu/ Torres	X											
MISR	Kahn	X											
GOES	Kondragunta	X											
Calipso	Ferrare						X	X					X
UC-12 HSRL	Ferrare/ Hostetler	X				X	X	X					X
P-3B LARGE	Anderson/ Thornhill	X	X	X	X	X			X	X	X	X	X
UMD Cessna	Dickerson/ Stehr	X		X	X	X				X			
Beltsville	Joseph	X	X	X	X	X	X						X
Fairhill	Tsay	X	X	X	X	X	X				X		X
UMBC	Hoff/ Delgado	X	X	X			X						X
MDE Sites	Hains	X	X										
NATIVE/MU Edgewood	Martins/ Clark	X	X, profiles?	X			X						X
MPL	Berkoff						X	X					X
Ship	Jordan	X					X					X	X
AERONET	Holben	X			X						X		
GOCART	Chin	X	X	X	X	X	X		X	X	X	X	X
GEOS-5	Silva	X	X	X	X	X	X		X	X	X	X	X
WRF-Chem	Pickering/ Cook	X	X	X	X	X	X		X	X	X	X	X
NU-WRF	Tan/Tao	X	X	X	X	X	X		X	X	X	X	X

Data Availability Questions/Comments

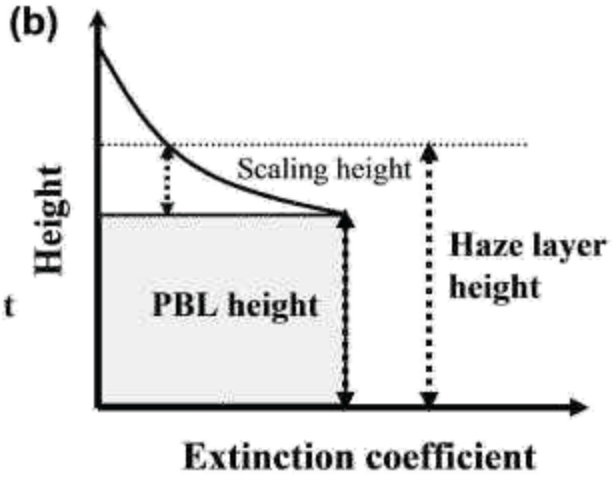
- Mobile (car) lidar – data available from Lille – when available via DAQ website?
- OMI – aerosol index vs. AOT – use both?
- Water leaving radiance and surface reflectance from ship – potentially useful for assessing satellite aerosol retrievals (Jordan)
- Surface in situ composition measurements – available from SMART/COMMIT? (Tsay)
- Does balloon dustsonde provide PM2.5? (Clark)

Relate column observations to surface conditions…

- Retrieving PM2.5 from AOT
  - Ferrare – showed correlations between AOT, extinction, PM2.5 and impact of layer heights and f(RH) and how these are addressed using HSRL data
  - Chu – similar studies + satellite AOD and MPL data
    - Also showed strong impact of layer height and f(RH)
    - Found varying correlation at different DAQ surface sites
    - Examined spatial correlation

Relate column observations to surface conditions…additional work

- PBL and Aerosol layer height – how does aerosol layer height (H) relate to measured aerosol extinction profiles? (Ferrare, Chu)
- How does mass scattering efficiency change with chemical composition? How does this vary with location in DAQ area? How does this compare with model assumptions and parameterizations? (Ziemba, Beyersdorf, Chin)
- Use MPL exticntion profiles at MDE PM2.5 sites to estimate PM2.5 (Chu)
- Use MODIS AOT data to estimate PM2.5 and compare with AERONET, HSRL AOT (Chu)
- Examine impact of simple f(RH) approximation vs. airborne and in situ surface f(RH) measurements (Chu)



PBL Height Spatial Variability

- Don Lenschow discussed PBL height location and relationship to convective thermals as seen by aerosol gradients and vertical velocity
- Showed significant small-scale variability in PBL height
- HSRL PBL and aerosol layer heights can be used to characterize small scale layer height variability

Examine Horizontal Scales of Variability Affecting Satellite Aerosol Retrievals

- DISCOVER-AQ can address how well MODIS, MISR can address retrievals at scales finer that 10 km (Hoff)
  - Leigh Munchak et al. (poster) – have been examining MODIS 3 km vs. 10 km AOT retrievals during DISCOVER-AQ
  - Initial comparisons with AERONET and other data look good
  - Will be working on a paper describing results
- MISR local mode may provide another means to investigate spatial variability

Diurnal Variability

- Discussion of diurnal…(day+night) or during daytime
  - DISCOVER-AQ 2011 data…can not address (day+night) variability
  - However, data can address variability during the daytime which is important for examining most satellite datasets (GOES, A train, etc.)
  - Hoff raised the question of whether NPP can be used to look at day vs. night
  - GOES daytime performance assessed using DISCOVER-AQ data – AGU presentation from Shoba Kondragunta/Jeff Stehr showed good performance

Diurnal Variation (Qian Tan)

- Found monthly variability in diurnal variations in PM2.5, AOT in Houston – higher PM2.5 variability
- Found AOT, PM2.5 relationship varied with location, season, averaging, etc.
- Need to examine diurnal variability in PBL height, f(RH), and scattering efficiency and how these impact AOT vs. PM2.5

GEOS-5 Modeling (daSilva)

- GEOS-5 simulations of PBL height and PM2.5 concentrations
- HSRL PBL heights and extinction profiles and surface fluxes helped guide model modifications
- Future Work
  - Similar studies with airborne, sonde, MPL data
  - Evaluate GEOS-5 CO, SO2 simulations
  - Assimilate GOES AOT
  - Higher resolution models

Aerosol Issues for Models

- What is f(RH) – especially RH > 90%
  - Use P3 in situ f(RH)
  - Comparisons with HSRL extinction
  - Relationship to composition
- Hydrophobic vs. hydrophylic aerosols
- Aerosol mixing state
- Data from LARGE (Ziemba, Beyersdorf) important for addressing these issues

f(RH), Chemical Composition

- Extensive studies using P3 LARGE in situ data (Ziemba, Beyersdorf)
- Showed F(RH) from P3 in situ data and how related to chemical composition
- Validated with HSRL extinction
- Examined variation of f(RH), chemical composition during the day
- Variability in aerosol AOT, scattering dominate by changes in aerosol loading and f(RH), less from changes in aerosol composition
- Sulfate fraction (ex. surface PILS speciation) may guide estimation of f(RH)

Groups Addressing Aerosol Issues

NASA Langley

- **LARGE– a) f(RH)/composition; b) transport and variability; c) AERONET vs. In Situ**
- **HSRL – PBL/Scaling Heights, Spatial Variability**

NASA GSFC

- **AERONET – a) AERONET/In Situ; b) Cloud Interactions; c) Overview of Aerosol Retrievals**
- **MODIS – a)PM2.5 relationship to MODIS (Chu); b) validation of MODIS high res data vs. DAQ**
- **MODELING—a) GEOS-5 MODIS assimilation for PM2.5; b) GOCART/NU-WRF AOD vs. surface PM2.5; c) Chatfield Retrieval paper; d) CMAQ evaluation (UMD/EPA/Pickering)**

UMBC—a)Variability, bay breeze, source apportionment, b) optical properties vs. microphysics; MPL—a) PBL/Scaling Heights, HSRL/MPL comparison, spatial variability

UMD—a) Evaluate GOES AOD vs. in situ; b) Regional context of observations; c) Aerosol speciation

Howard—a) PBL properties – COLABORATIVE ANALYSES --have CCN data

Millersville—

NATIVE—

---OVERVIEW of GROUND SITES