# Breakout Group on Aerosol Optical Properties & Radiative Effects

Chair: Phil Russell

Co-Chair: Manvendra Dubey

Scribes: Yohei Shinozuka, Nancy Marley

MILAGRO Science Meeting
24 Oct 2006
Boulder, Co

# Breakout Group on Aerosol Optical Properties & Radiative Effects

-Including:

--in situ measurements (optics, size, composition, mixing state, single particle properties, consistency of all these)

-- spectral radiation, at surface & in vertical profiles (& closure with in situ measurements)

--comparison to satellite observations

--aerosol effects on clouds

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Megacity Initiative - Local and Global Research Observations

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# Breakout Group on Aerosol Optical Properties & Radiative Effects

• <u>Purposes of breakout groups (agenda):</u>

Identify nuggets (major findings) & major unanswered questions our data and models can address

Generate a draft list of potential papers (helped by the posters)

Identify cross-cutting issues

Identify future collaborations (within the breakout group & beyond)

# Breakout Group on Aerosol Optical Properties & Radiative Effects

## Major findings (nuggets):

• UV absorption of Mexico City aerosol is larger than expected from the black carbon $1/\lambda$ dependence (N. Marley, P. Arnott). This fits with:

- At $T_0$ BC particles are coated with organics (T. Onasch, Slowik, Dubey): TEM (Adachi), SPMS (Moffet).
- Absorption amplification on A/C (Shinozuka, Clarke et al.)
- SSA near UV (Jim Barnard)
- Plotting data by wavelength dependence of absorption and scattering produces clustering, with clusters probably dependent on sources and ageing (Clarke)

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## Major findings (nuggets, cont'd):

- Sun photometer (Microtops) network that operated during MILAGRO experiment helped to raise the importance of a better estimation of surface reflectance over urban area (is converging to higher values than assumed nowadays). This assumption can improve the AOD satellite products (MODIS algorithm with finer spatial resolution). (Castanho)

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## Major findings (nuggets, cont'd):

• Over ocean, 98% of MODIS-Terra near-IR (855-2119 nm) aerosol optical depth (AOD) values differed from airborne sunphotometer (AATS) values by < ±0.03 ±0.05AOD. For MODIS-Aqua the % was 100%. These %s exceed the 66% expected if ±0.03 ±0.05AOD is $\pm 1\sigma$. Does this reflect:

- Favorable conditions (MODIS & AATS cloud screens, wind speeds)?
- ±0.03 ±0.05AOD is > $\pm 1\sigma$ and should be reassessed? (Redeman, Russell)

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## Major findings (nuggets, cont'd):

- Over land, air & ground lidars show abrupt changes in BL depth. Similar rapid changes seen in airborne AOD transects (Eichinger, Lewandowski, Hair, Livingston). What causes these? Individual convective plumes? "River" advection from different sources in complex terrain?

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<u>Unanswered questions our data and models can address:</u>

- What microphysical property information do MISR and MODIS data contain about urban pollution plumes over land?

- How do we integrate satellite regional scale aerosol optical depth and air mass type spatial distributions with suborbital measurements and regional transport models?

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<u>Unanswered questions our data and models can address:</u>

- Can we differentiate between contrails and cirrus from multiangular, multispectral data? (Try adding tempearature and moisture data)
- How can we identify subvisible cirrus?
- How can we best identify plumes in studies of evolution?

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<u>Unanswered questions our data and models can address:</u>

- Can the observed enhanced UV absorption be correlated with the weather changes? (organics/sulfate and SSA variation)

- What are organic aerosols' refractive indices and densities, hygroscopicity, mixing state?

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- <u>Potential papers:</u>

**See list in MSWord file**

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## Cross-cutting issues:

**• What's responsible for the enhanced UV absorption? Organics? Gas?**
**- It's important for UV satellite AOD retrievals (OMI, TOMS) + many other issues**

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## Cross-cutting issues:

• How do we distinguish between Megacity & Regional (background) effects for:
- aerosol radiative forcing
- trends,
- less ozone than expected,
- reduction of reactive VOCs with time,
- PANs, …

(Be explicit in defining regional/background: boundary layer vs. free troposphere, etc.)

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## Cross-cutting issues:

- What are aerosol physical, chemical and optical properties? What data and models can provide accurate clocks to quantify their evolution?

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## -Future collaborations (within the breakout group & beyond):

J31 RSP-AATS:
- Validate RSP retrieved spectral optical depth
Atmospheric correction of low altitude measurements to provide accurate surface polarized BRDF

J31 RSP-AATS-SSFR: Evaluate remote sensing methods (RSP + lidar) for determining the aerosol radiative forcing profile against the measured spectral optical depth and radiative flux profile

J31 CAR-AATS: Retrieve BRDF and aerosol optical properties simultaneously from combined data sets: CAR, AATS, and AERONET.

Continue/extend satellite validation studies: OMI, MODIS, MISR, POLDER

DC-8/J31 AATS: Does DC-8 lidar-observed convective plume structure predict AATS-observed AOD variability?

King Air B200/J31: Compare more extinction profiles (x flights)

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## Future collaborations (beyond the breakout group)

- Clocks, evolution of aerosol properties
- Ask modelers for their consensus on priorities (Steve Ghan, Greg Carmichael, others). Did they get optics right: mass absorption efficiency, SSA after humidification based on chemistry? What processes are most important? Regional vs global.

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## Future collaborations (beyond the breakout group)

- Background lidar, MISR, other vertical profile measurements for March 6 plumes. Collaboration with Bob Yokelson, Ernesto Alvarado
- Impact/interaction of aerosols on/with photochemistry (including ozone production), radiation, surface reactions and cloud?

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## Future collaborations (beyond the breakout group)

- BC vs. organic effects on SSA spectra (esp UV)
- Comparison of AOD from satellite (fine spatial resolution, i.e., 1.5 km) with $PM_{2.5}$ concentration measured at RAMA stations. This also includes the lidar information on the aerosol layer heights.