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CLEAR COLUMN CLOSURE STUDIES OF URBAN-MARINE AND MINERAL-DUST AEROSOLS USING AIRCRAFT, SHIP, AND SATELLITE MEASUREMENTS IN ACE-2

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During the second Aerosol Characterization Experiment (ACE-2) of the International Global Atmospheric Chemistry Project (IGAC), measurements of both European urban-marine and African mineral-dust aerosols were made simultaneously by in situ and remote sensors on the Pelican (modified Cessna) aircraft of the Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS), the Research Vessel Vodyanitskiy, and the NOAA-12 and NOAA-14 satellites.

Specifically, the Pelican made measurements of aerosol optical depth and extinction spectra, water vapor columns and vertical profiles using a 14-channel sunphotometer (Schmid et al, this conference), aerosol absorption coefficient and light scattering coefficients at three wavelengths using an absorption photometer and nephelometer (Noone and Ostrom, this conference), aerosol humidification factors using a passive humidigraph (Gasso et al., this conference), and aerosol size distributions using a differential mobility analyzer and two optical particle sizers (Collins et al., this conference). The R/V Vodyanitskiy measured optical depth spectra and water vapor columns using a six-channel tracking sunphotometer (Livingston et al., this conference) and aerosol size distribution and chemical composition using the NOAA-PMEL suite of shipboard aerosol instrumentation (Quinn et al., *J. Geophys. Res., 101*, 6931, 1996). The NOAA-12 and NOAA-14 satellites measured upward-scattered radiances using the Advanced Very High Resolution Radiometer (AVHRR), from which aerosol optical depths at two wavelengths were derived (Durkee et al., this conference).

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The purpose of this paper is to show results of a variety of comparisons between properties measured by different techniques or derived from other measurements using models. Examples include:

- Optical depth spectra
  - Measured by sunphotometer,
  - Derived by integrating vertical profiles of humidified scattering coefficient and absorption coefficient
  - Derived by integrating vertical profiles of size distribution, hygroscopic growth factors, and model refractive index spectra (combined according to internal and external mixing models)
  - Derived from AVHRR radiances
- Extinction spectra
  - Derived by vertically differentiating sunphotometer optical depth spectra,
  - Derived from in situ measurements of scattering coefficient, absorption coefficient, and humidification factor,
  - Derived from in situ measurements of size distribution, hygroscopic growth factors, and model refractive index spectra
- Particle size distributions
  - Measured in situ,
  - Derived by inverting optical depth or extinction spectra,
  - Derived from AVHRR spectral radiance ratios using the bimodal model employed in retrieving optical depths
- Single-scatter albedo spectra
  - Calculated from measured size distributions and model refractive index spectra, using various internal and external mixing models
  - Derived from measured aerosol absorption and scattering coefficients
  - Used in retrieving optical depths from AVHRR spectral radiances
- Scattering phase functions
  - Calculated from measured size distributions and model refractive index spectra, using various internal and external mixing models, including possible shape effects
  - Calculated as above, but using size distributions retrieved from optical depth or extinction spectra
  - Used in retrieving optical depths from AVHRR spectral radiances
- Water vapor column contents
  - Derived from sunphotometer transmission spectra
  - Derived from satellite-measured radiances
  - Derived by integrating in situ water vapor profiles

Initial comparisons have shown that achieving closure, or mutual consistency, depends critically on the methods used to account for aerosol hygroscopic growth, scattering humidification factors, and the particle-size cutoffs of different sampling instruments. Results will be shown from several Pelican flights, which sampled both urban-marine aerosols in the boundary layer and mineral-dust aerosols in the free troposphere. One flight included a vertical profile coordinated with the R/V Vodyanitskiy, and several flights include satellite intercomparisons.