Aerosol Optical and Microphysical Properties from Passive Remote Sensing during CARES: Temporal and Spatial Changes

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1. Motivation

Recently conducted Carbonaceous Aerosol and Radiative Effects Study (CARES) includes retrievals of aerosol size distribution and optical properties, such as column aerosol optical depth (AOD), single-scattering albedo (SSA), asymmetry parameter (ASP).

✓ How large are temporal/spatial variations of aerosol optical properties?

✓ How large is contribution of coarse mode to these properties?

Vertical/Horizontal Changes

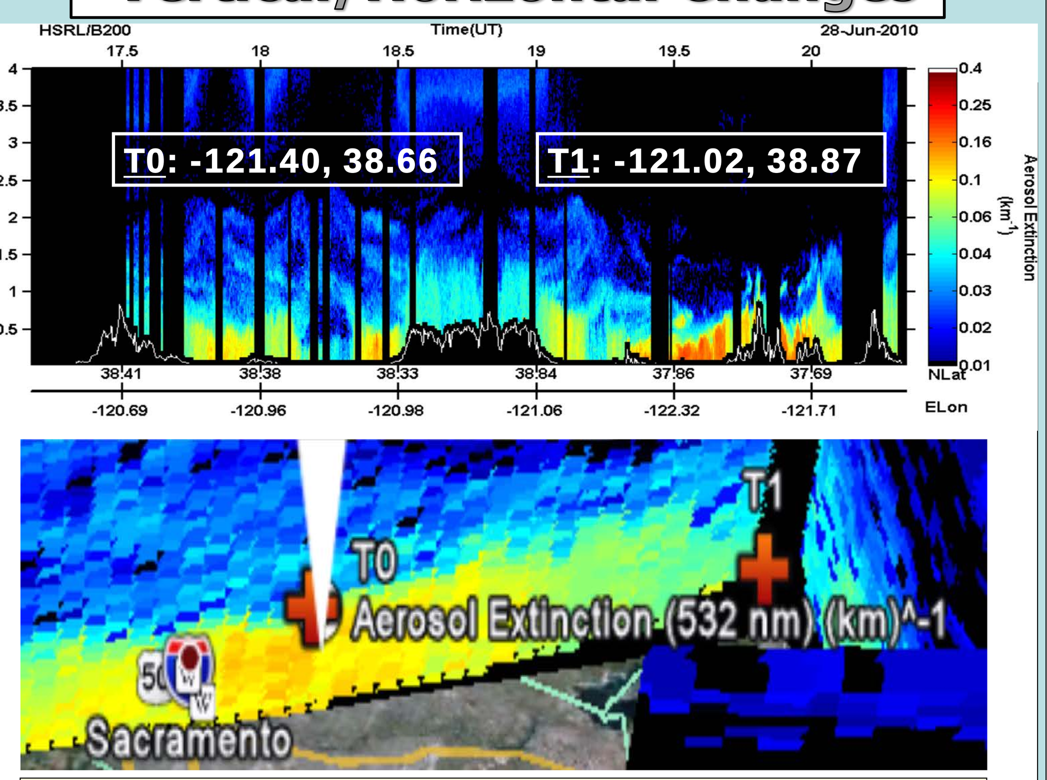

Fig.1 Two-dimensional **HSRL**-based images of aerosol extinction coefficient at 532 nm

4. Summary

✓ Remote sensing data (MFRSR, AERONET) capture large spatial, diurnal and day-to-day variations of aerosol properties. For example, wide ranges of daily-averaged AOD (0.05 - 0.15) and SSA (0.80 - 0.98) values at 500 nm are observed.

✓ The coarse mode is sometimes so large that it may exert a powerful influence on aerosol optical properties. On average (over CARES campaign), coarse mode contributes noticeably (~ 20 %) to these properties.

T0: MFRSR-derived Optical Properties

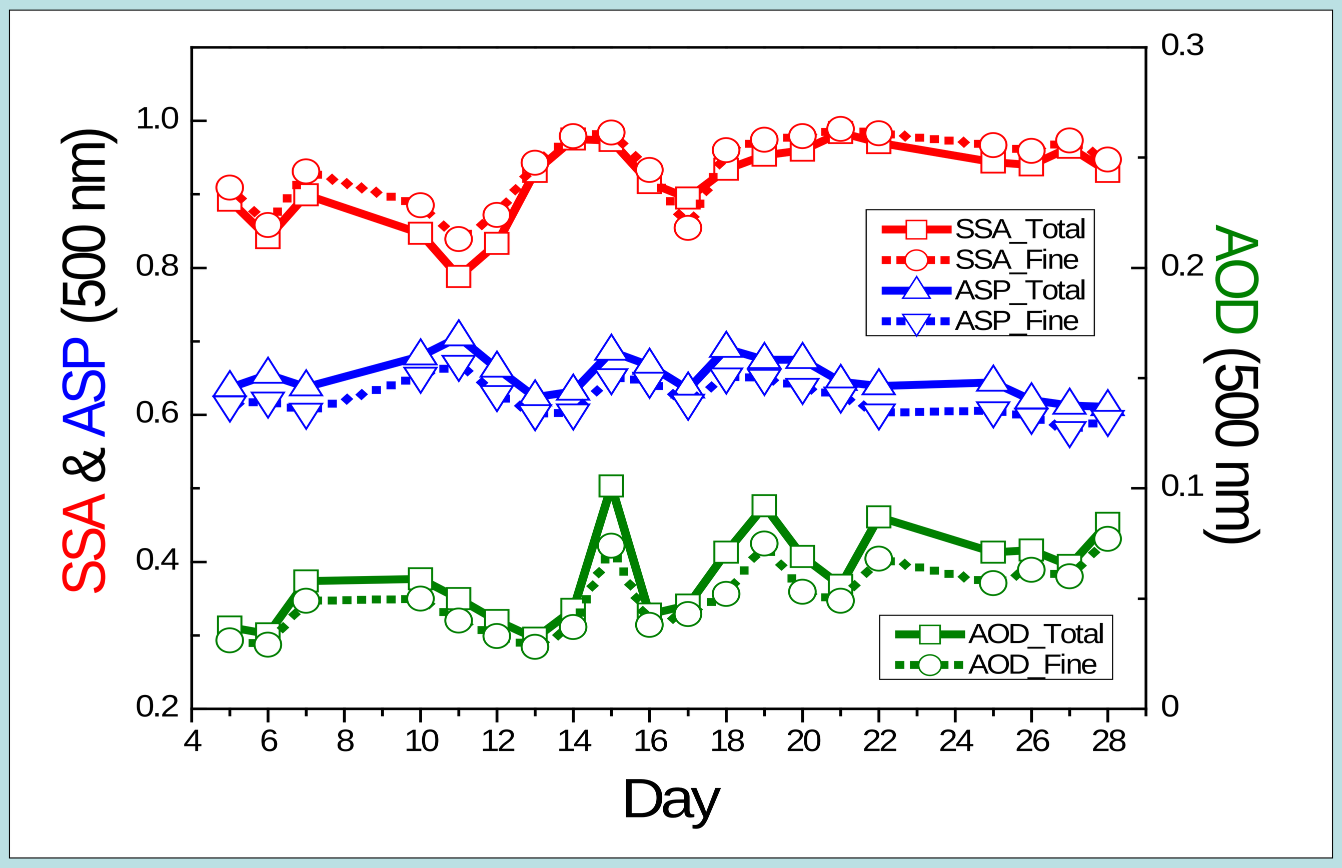

Fig.2 Variability of daily-averaged MFRSR-based optical properties obtained for Fine (dotted) and Total = Fine + Coarse (solid) modes

● There are large day-to-day variations of aerosol optical properties: AOD (0.05 - 0.15) and SSA (0.80 - 0.98)

AERONET & APS: Coarse Mode

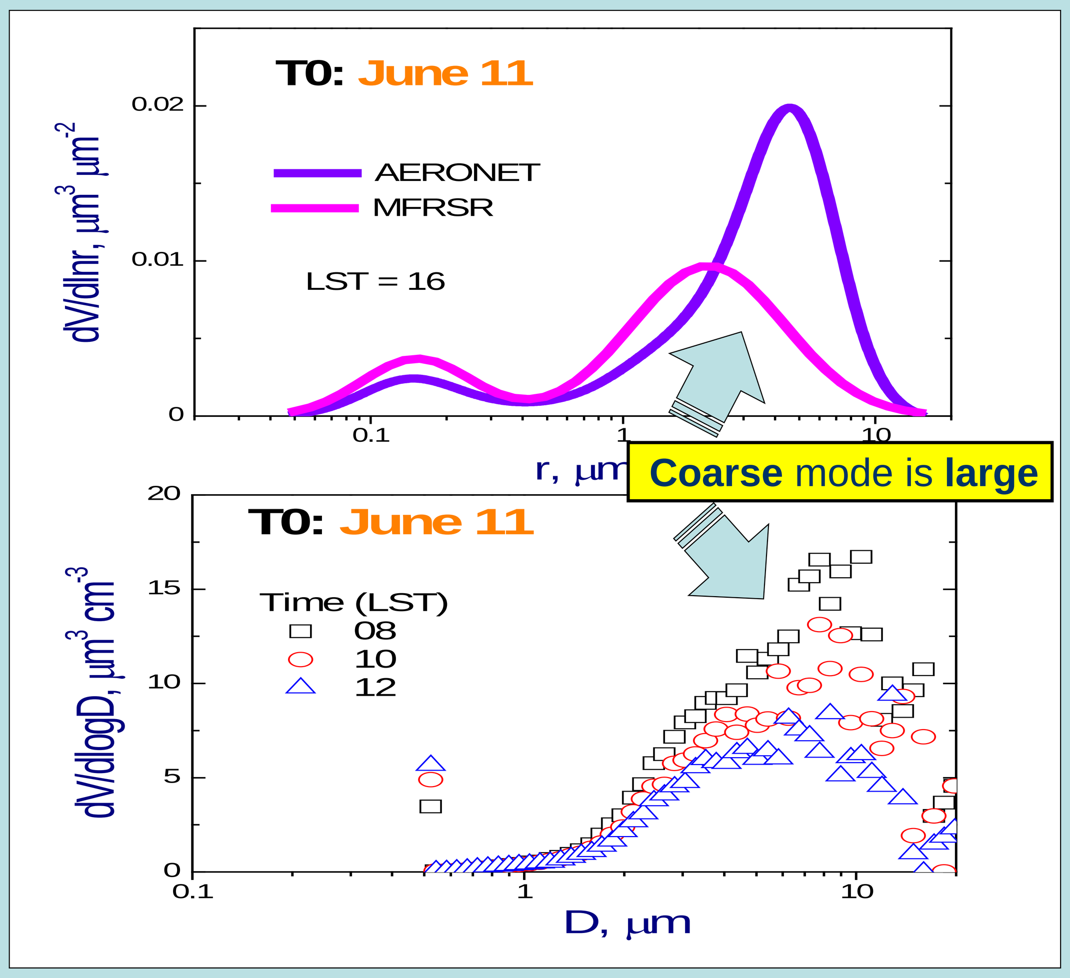

Fig.3 *Column* MFRSR- and AERONET-based (top), and *surface* **APS**-based (bottom) size distributions

● For a given day / time, contribution of coarse mode to size distributions is large

T1: MFRSR-derived Optical Properties

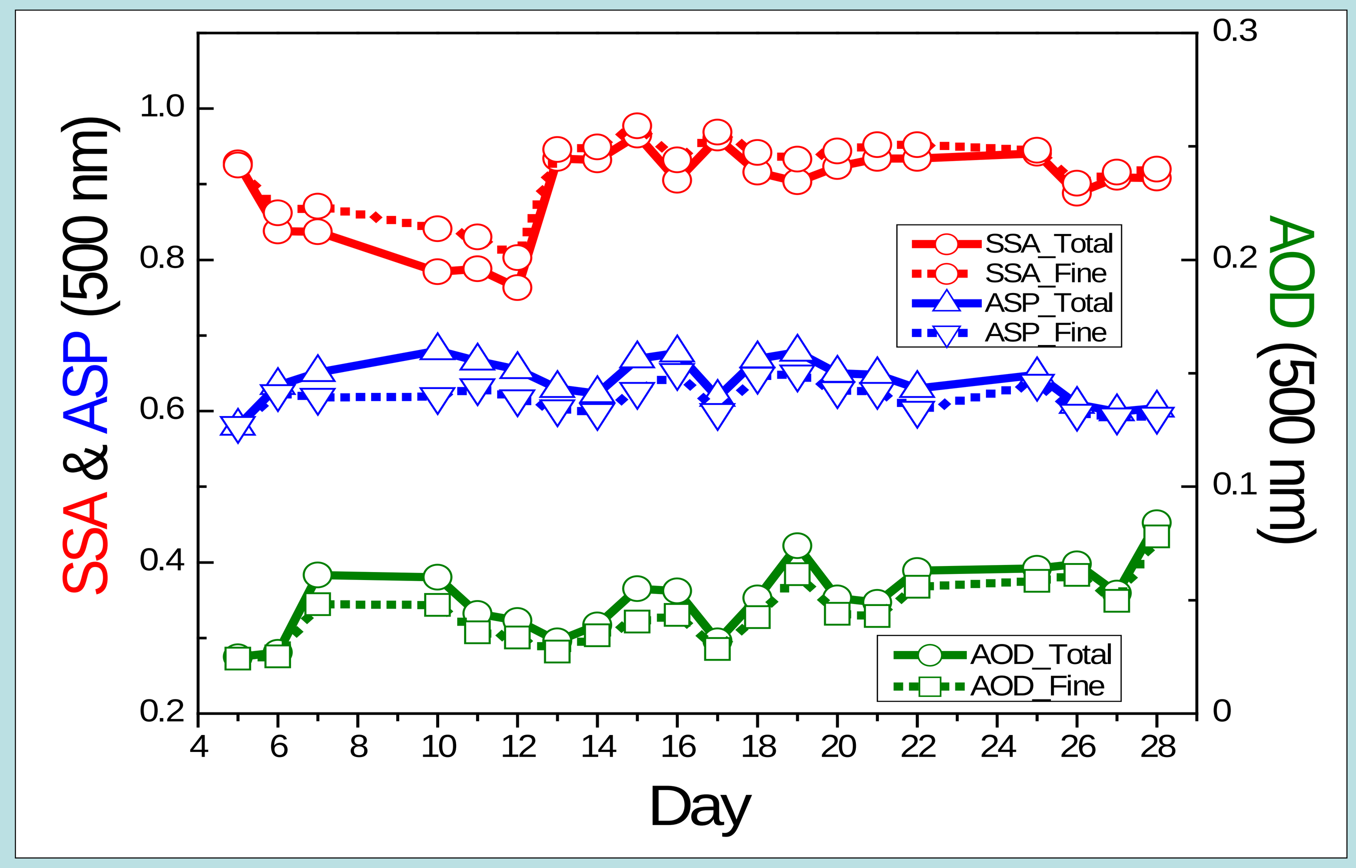

Fig.4 Variability of daily-averaged MFRSR-based optical properties obtained for Fine (dotted) and Total = Fine + Coarse (solid) modes

● Contribution of coarse mode to aerosol optical properties can be large (~ 20% over CARES campaign)

2. Approach

✓ Apply MFRSR retrieval [1] to obtain aerosol optical properties (Figs. 2,4), size distribution (e.g., Fig. 3) for two sites (T0 and T1).

✓ Compare MFRSR-retrieved aerosol properties with those provided by AERONET (Figs. 3,5), and independent measurements, such as by Aerodynamic Particle Sizer (APS) (Fig.3).

✓Perform *radiative closure* using retrieved MFRSR optical properties and measured broadband total fluxes at surface (not shown).

AERONET & MFRSR: AOD

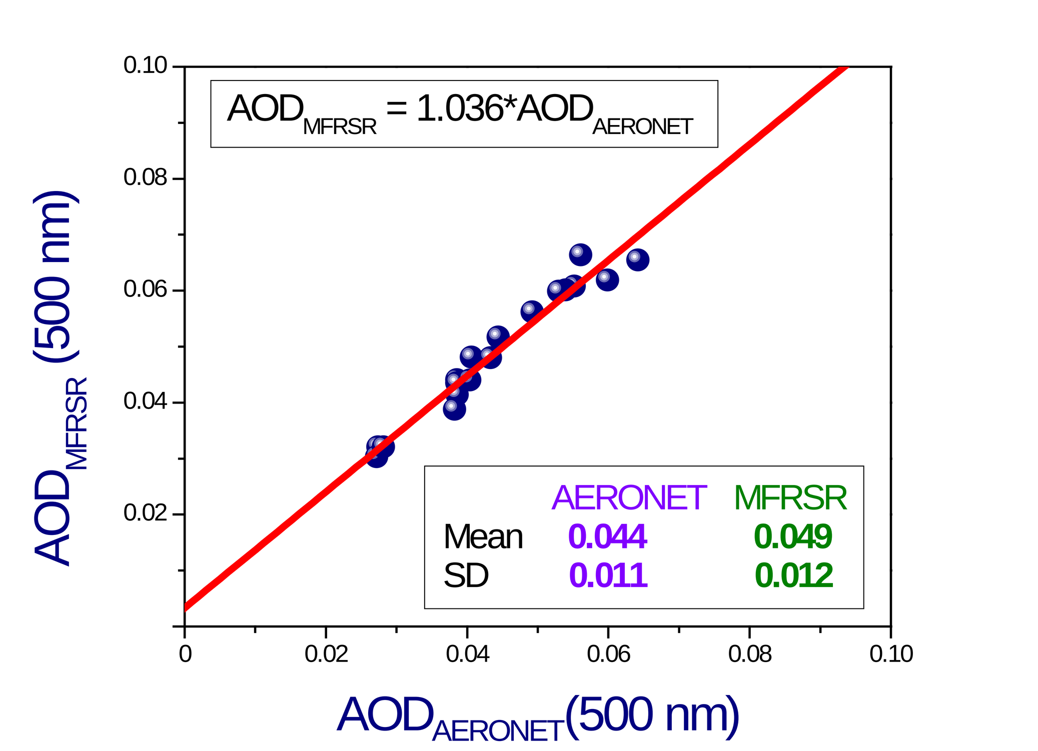

Fig.5 Scatterplot for AOD values (500 nm) obtained from MFRSR and AERONET

3. Coarse Mode

✓ Illustrate *evidence* of large coarse mode using (a) size distributions from MFRSR, AERONET, APS (Fig. 3), (b) aerosol properties from in situ data for single mode (<1 µm) and two modes (<10 µm) (not shown).

✓ Estimate *importance* of coarse mode calculating aerosol optical properties (Figs. 2,4) for single mode (Fine) and two modes (Total).

✓ Apply these aerosol properties to calculate the corresponding aerosol Direct Radiative Forcings (Fine, Total) at the TOA (not shown).

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[1] Kassianov E.I., C.J. Flynn, T.P. Ackerman, and J.C. Barnard., 2007: *Aerosol SSA and AP from MFRSR Observations during the ARM Aerosol IOP 2003*, ACP.

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