In Situ Aerosol Profiles Over the Southern Great Plains CART Site

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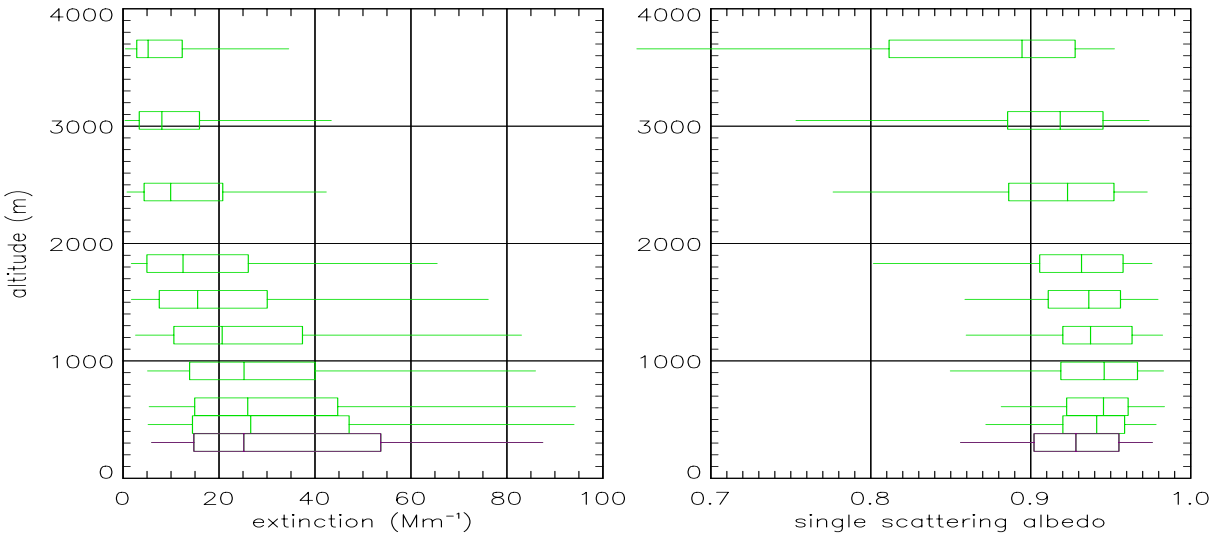
Aerosol optical properties were measured over the Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site using a light aircraft (Cessna C-172N). The aircraft flew level legs at altitudes between 150 m and 3500 m agl two-three times per week between March 2000 and March 2001 in order to obtain a statistically representative data set of in situ aerosol vertical profiles. Instrumentation on the aircraft was similar to that at the surface site that allowed for direct comparisons. Measured parameters included total light scattering, hemispheric backscattering and absorption, while calculated parameters included single scattering albedo, backscatter fraction, and Ångström exponent. Statistical plots of aerosol optical properties and their variation in the lower column showed that, over the course of the year, single-scattering albedo, backscatter fraction, and Ångström exponent were relatively invariant with altitudes up to 1800 m. Despite the vertical consistency, the correlation between column average and surface values for single scattering albedo, backscatter fraction, and Ångström exponent tended to be quite low with R^2 ranging from 0.2 to 0.5, and linear regression slopes ranging from 0.3 to 0.7. These results suggest that long-term surface aerosol measurements at SGP capture the statistical properties of aerosols in the column above the site but are not representative of day-to-day variations in the column. Comparison of aerosol optical depth (AOD) calculated from the in situ vertical profiles with other measurements of AOD made at SGP (i.e., by the Cimel sun/sky radiometer and the multifilter rotating shadowband radiometer (MFRSR)) showed fair correlation (R^2 ~0.4, Cimel; R^2 ~0.8, MFRSR). The aircraft AODs tended to be 50–75% less than those derived from the radiation instruments, even after incorporating corrections for particles not sampled by the airplane (i.e., particles above 3.5 km altitude, and particles larger than 1 micrometer diameter).



Box-whisker plots showing light extinction and single scattering albedo (at STP, low RH, Dp < 1 μm) obtained at the surface and during vertical profiling flights. The line in the center of the box represents the median, while the edges of the box give the 25 and 75 percentiles and the whiskers are the 5 and 95 percentiles.