Comparisons of In-Situ and Remote Estimates of Extinction

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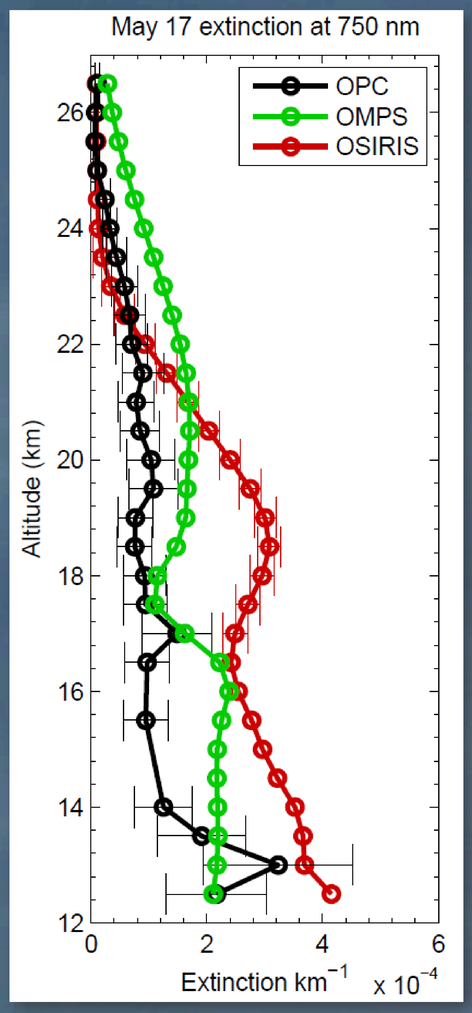
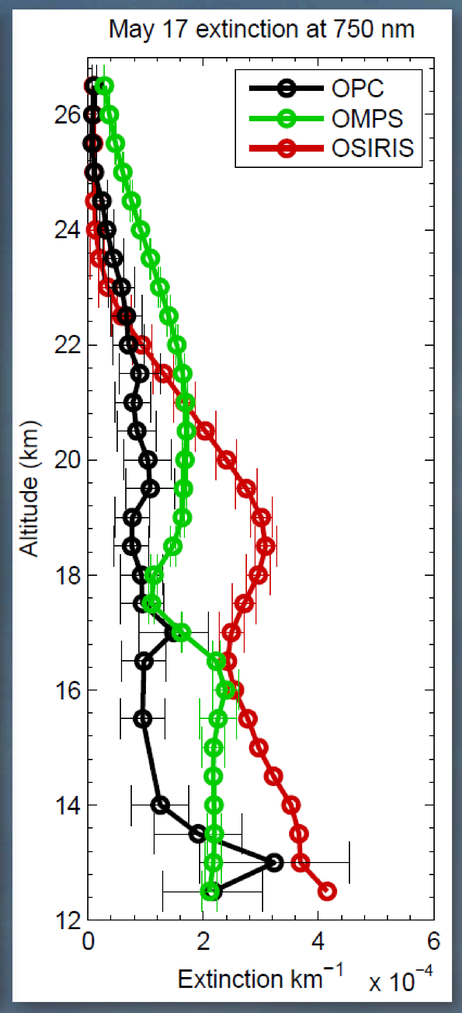
The University of Wyoming has been conducting in-situ measurements of the size distribution of Stratospheric aerosol since 1971 above Laramie, Wyoming (41 N). Occasional aerosol profile measurements have been made as well from Antarctica, Sweden, New Zealand, Australia, Brazil, Niger, and France. Two Optical Particle Counters (OPCs), carried on a balloon, are used to measure particles between 0.01 and 2.0 µm in 8-12 channels up to altitudes of ~30 km. Unimodal or bimodal lognormal size distributions are fit to the measurements and used to calculate surface area, volume, and extinction at selected wavelengths. The aerosol profiles and the lognormal fits to the size distributions are publicly available through the University of Wyoming Atmospheric Science Department website. The OMPS satellite was launched in 2011 to measure, among other things, ozone and aerosol extinction at several channels. Since the fall of 2012, the University of Wyoming has been making a concerted effort to coordinate their bi-monthly flights with an OMPS overpass of Laramie. The calculated extinction profiles from the in-situ measurements can then be compared to extinction derived from the OMPS measurements, allowing for direct comparisons between in-situ and remote measurements.



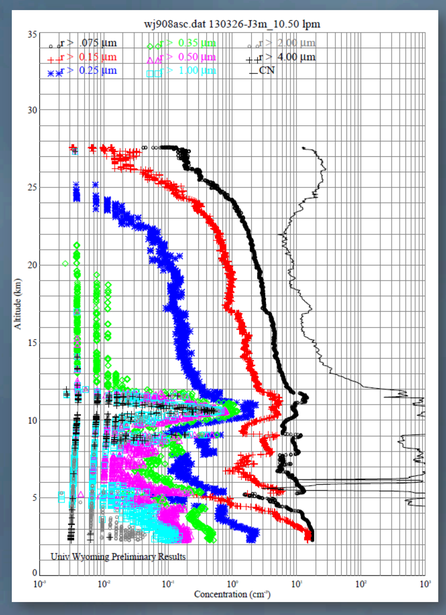


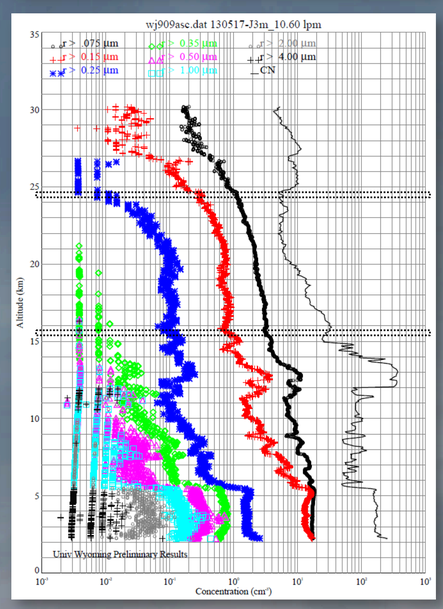
Above: Extinction estimates at 750 nm from Optical Particle Counter compared with remote sensing instruments OMPS and OSIRIS for March 26 and May 17 of this year. The *in-situ* measurements were made over Laramie, WY (42° N), and both satellite profiles are from approximately the same location. In the case of the OPC data, the extinction at each altitude is calculated from the size distributions shown to the right, with the relationship:

$$B_{ext} = \pi \int_r^\infty r^2 \frac{\partial N}{\partial \ln r} Q_{ext} \; d\ln r$$

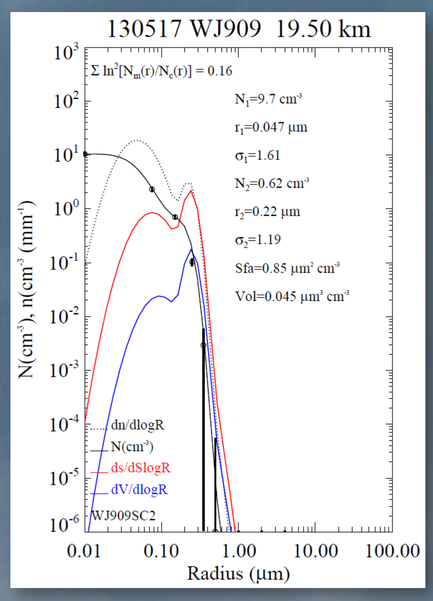
$$\frac{\partial N}{\partial \ln r} = \sum_i \frac{N_i}{\sqrt{2\pi} ln\sigma_i} \exp\left(\frac{-ln^2 \frac{r}{r_i}}{2ln^2\sigma_i}\right)$$

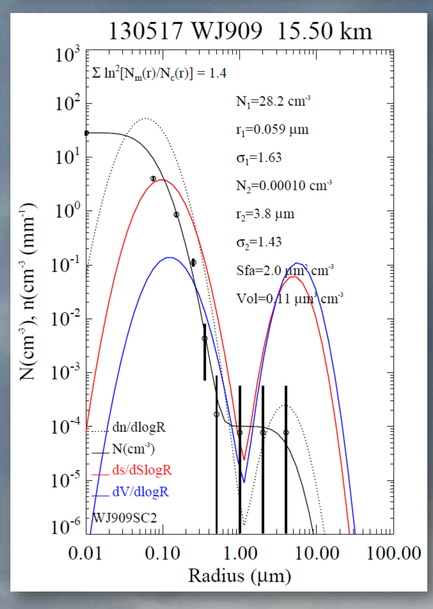
where the summation is over either one or two modes.
Error bars are plotted for OPC with ± 40% (based on Monte Carlo simulations- see *Deshler et al.,* 2003). OSIRIS error is shown where available, but the OMPS error was left off the plot due to its large magnitude at this point in time.



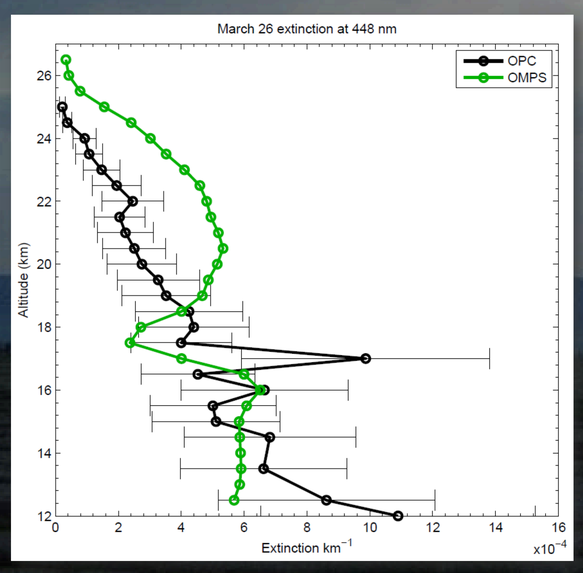


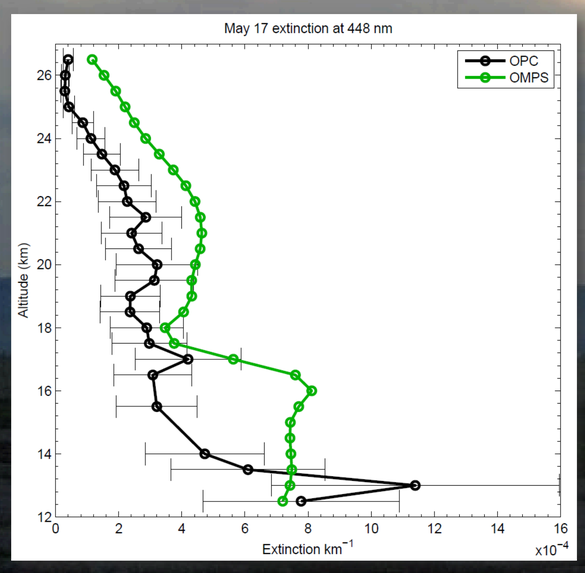
Cumulative concentration measurements from the Optical Particle Counter for aerosol with radius ≥ 0.075, 0.15, 0.25, 0.35, 0.5, 1.00, 2.00, and 4.00 µm.





Bimodal lognormal size distributions fit to the OPC concentration measurements at two example altitudes, 14.5 km (top) and 19.5 km (bottom). N_i is total number concentration, r_i the median radius, and σ_i the distribution width.





Comparison between the OPC and OMPS estimates of extinction for both March 26 and May 17 of 2013 at two additional wavelengths- 448 nm (left) and 869 nm (right). The data aspect ratio is held constant in all extinction plots, so that relative magnitude between different wavelengths can be evaluated.