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# Quantifying (and Reducing) Uncertainty in Stratospheric Aerosol Extinction Profiles Retrieved from Limb Scattering Measurements

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The solar radiation scattered by the limb of the Earth's atmosphere shows sensitivity to the presence of aerosols in the upper troposphere and stratosphere. This effect has been clearly observed by numerous sensors following volcanic eruptions that perturb the stratosphere (including recent examples such as Nabro, Kelud, and Calbuco), as well as during the aftermath of the Chelyabinsk meteor explosion. However, correctly identifying the cause of an observed change is not as straightforward for limb scattering (LS) measurements as it is for occultation measurements: Occultation measurements depend solely upon the line of sight extinction, but LS radiances also depend upon the aerosol phase function (as determined by aerosol size distribution, refractive index and shape).

Stratospheric aerosol extinction profiles have been retrieved from LS radiances measured by several instruments, including OSIRIS, SCIAMACHY, SAGE III (Meteor 3M) and OMPS LP. These retrievals generally assume a simple model of the aerosols: Spherical droplets of sulfuric acid with a single-mode, log-normal size distribution that does not vary with height, latitude, or time. Independent measurements of stratospheric aerosol size distributions (from aircraft measurements and balloon campaigns, for example) indicate a far more complex picture, with aerosol size, shape and composition varying both spatially and temporally. The OMPS LP mission provides daily, global measurements with high vertical and spatial sampling, which allows one to track aerosol events such as volcanic eruptions and meteor explosions as they evolve in the stratosphere. In this presentation, we will attempt to quantify the uncertainty of LS aerosol extinction retrievals due to aerosol phase function variations, and to define a promising approach for merging the information contained in LS radiance measurements with other data to improve our stratospheric aerosol knowledge.

Future work to sharpen our understanding of stratospheric aerosol must focus on combining the best aspects of each type of measurement into a coherent global picture: For example, one can merge the accurate extinction values obtainable from occultation measurements with the phase function sampling that LS measurements can provide, as well as the sensitivity to aerosol shape and horizontal variations that lidar observations contribute. To assess our understanding of the transport and microphysical evolution of the aerosols, we must then compare conclusions derived from measurements to the output provided by models such as the NASA Goddard Earth Observing System (GEOS-5) chemistry-climate model. The upcoming launch of SAGE III on the International Space Station holds particular promise, because of two unique aspects of the mission:

1. The instrument can operate in both occultation and LS modes.

2. Its precessing orbit also allows SAGE III to view the same latitude in LS mode at multiple scattering angles, in contrast to previous LS missions that were locked into repetitive viewing geometries.

We anticipate that SAGE III occultation and LS observations will complement existing LS measurements, similar to the complementary roles played by AERONET and MODIS observations for troposphere aerosol retrievals.