Aerosols and Climate: What We Can Say, and What We Can't

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Among the contributing factors to the overall climate change picture are the direct radiative impact of natural and anthropogenic particles in the atmosphere, and their indirect effects on clouds, the water cycle, and atmospheric circulation. Although most state-of-the-art climate models include aerosol effects, the uncertainties are large, in both the representation of aerosol-related mechanisms and the values of aerosol parameters such as single-scattering albedo and CCN concentration.

This talk will review what we know about aerosol amount and type globally, based primarily on data products from space-borne instruments such as the NASA Earth Observing System's MISR and MODIS, combined with microphysical properties and time-series obtained from suborbital platforms. The satellite data, in particular, provide significant advances in regional and global aerosol optical depth (AOD) mapping, aerosol type measurement, and source plume characterization; these products have been and are being used for many applications, ranging from regional air quality assessment, to aerosol air mass type identification and evolution, to aerosol injection height and aerosol transport model validation. However, there are still significant uncertainties in the quantitative constraints these data place on global-scale direct aerosol radiative forcing, and they provide very limited, qualitative constraints on the indirect effects aerosols have on clouds.

Some further refinement of the current aerosol products is possible, but a major advance in this area seems to require much greater integration of satellite and suborbital data with models, improved instrumentation in space, and field campaigns targeted at reducing uncertainties in particle microphysical properties and especially in the mechanisms involved in aerosol-cloud interactions. This presentation will summarize where we stand, what incremental advances we can expect in the near future, and thoughts about what must be done to address the outstanding uncertainties.