Highlights of Aerosol Research at CMDL

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The goal of aerosol research at CMDL is to obtain measurements of aerosol properties that, when combined with chemical transport models, radiative transfer models, and global satellite observations, will allow evaluation of the anthropogenic climate forcing by aerosols. Aerosol radiative, chemical, and microphysical properties are measured in a variety of locations so that a wide range of aerosol types are included, allowing the radiative properties of the particles to be linked to chemical sources. Most of the observations are made at fixed ground stations that operate continuously on decadal time scales, such as the CMDL baseline station at Barrow, Alaska, and the regional aerosol station at Bondville, Illinois. These long-term observations are supplemented by year-long deployments of a movable aerosol sampling system, by routine vertical profiling from light aircraft, and by shorter-term intensive field programs. Identical sampling protocols and instrumentation are used to ensure that results from the different locations can be compared quantitatively. Taken together, CMDL's worldwide observations of the radiative climate-forcing properties of aerosols form a unique data set needed to derive aerosol effects on climate.

The sign of the aerosol forcing at the top of the atmosphere is largely determined by the relative magnitudes of aerosol scattering and absorption. Strongly absorbing aerosols, such as diesel soot, yield a positive forcing (warming), while nonabsorbing aerosols, such as sulfates, yield a negative forcing (cooling). The transition point between warming and cooling is controlled by the reflectivity of the underlying surface and the aerosol single-scattering albedo, which is the fraction of aerosol light extinction due to scattering. Over land surfaces, this transition point occurs for single-scattering albedos of 0.85-0.90. Figure 1, which summarizes CMDL's measurements at a variety of stations, shows that aerosols most frequently cause a negative forcing at the top of the atmosphere.

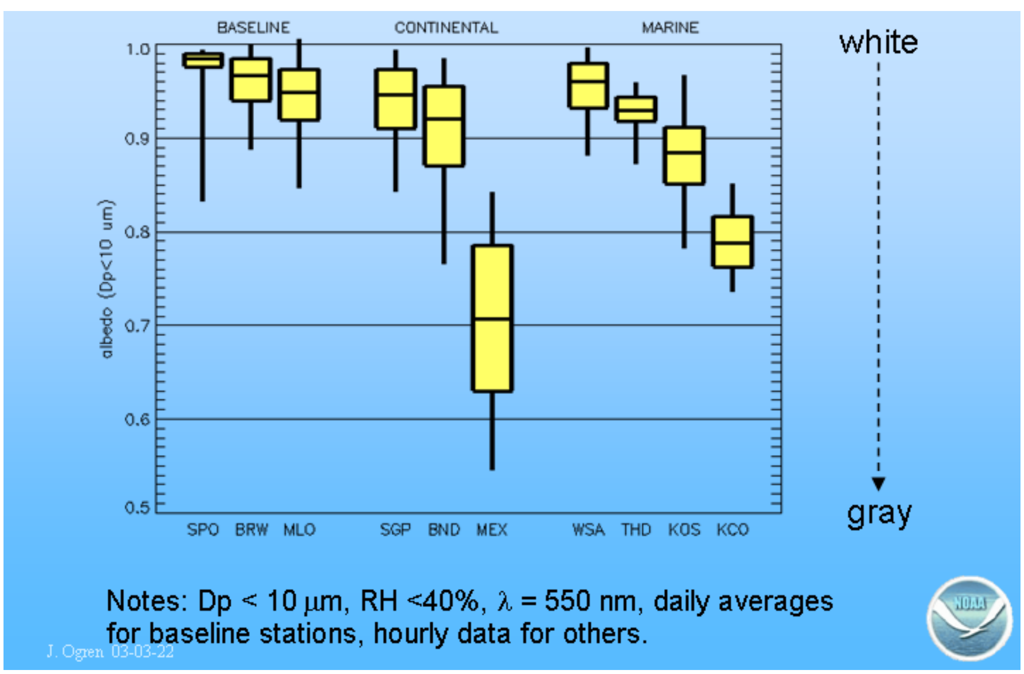

Figure 1. Statistics of single-scattering albedo.