Aerosol decadal trends - Part 1: In-situ optical measurements at GAW and IMPROVE stations

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Currently many ground-based atmospheric stations include in-situ measurements of aerosol physical and optical properties, resulting in more than 20 long-term (>10 yr) aerosol measurement sites in the Northern Hemisphere and Antarctica. Most of these sites are located at remote locations and monitor the aerosol particle number concentration, wavelength-dependent light scattering, backscattering, and absorption coefficients. The existence of these multi-year datasets enables the analysis of long-term trends of these aerosol parameters, and of the derived light scattering Angstrom exponent and backscatter fraction. Since the aerosol variables are not normally distributed, three different methods (the seasonal Mann-Kendall test associated with the Sen's slope, the generalized least squares fit associated with an autoregressive bootstrap algorithm for confidence intervals, and the least-mean square fit applied to logarithms of the data) were applied to detect the long-term trends and their magnitudes. To allow a comparison among measurement sites, trends on the most recent 10 and 15 yr periods were calculated. No significant trends were found for the three continental European sites. Statistically significant trends were found for the two European marine sites but the signs of the trends varied with aerosol property and location. Statistically significant decreasing trends for both scattering and absorption coefficients (mean slope of -2.0% yr(-1)) were found for most North American stations, although positive trends were found for a few desert and high-altitude sites. The difference in the timing of emission reduction policy for the Europe and US continents is a likely explanation for the decreasing trends in aerosol optical parameters found for most American sites compared to the lack of trends observed in Europe. No significant trends in scattering coefficient were found for the Arctic or Antarctic stations, whereas the Arctic station had a negative trend in absorption coefficient. The high altitude Pacific island station of Mauna Loa presents positive trends for both scattering and absorption coefficients.

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