A European aerosol phenomenology-6: scattering properties of atmospheric aerosol particles from 28 ACTRIS sites

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This paper presents the light-scattering properties of atmospheric aerosol particles measured over the past decade at 28 ACTRIS observatories, which are located mainly in Europe. The data include particle light scattering (sigma(sp)) and hemispheric backscattering (sigma(bsp)) coefficients, scattering Angstrom exponent (SAE), backscatter fraction (BF) and asymmetry parameter (g). An increasing gradient of sigma(sp) is observed when moving from remote environments (arctic/mountain) to regional and to urban environments. At a regional level in Europe, sigma(sp) also increases when moving from Nordic and Baltic countries and from western Europe to central/eastern Europe, whereas no clear spatial gradient is observed for other station environments. The SAE does not show a clear gradient as a function of the placement of the station. However, a west-to-east-increasing gradient is observed for both regional and mountain placements, suggesting a lower fraction of fine-mode particle in western/south-western Europe compared to central and eastern Europe, where the fine-mode particles dominate the scattering. The g does not show any clear gradient by station placement or geographical location reflecting the complex relationship of this parameter with the physical properties of the aerosol particles. Both the station placement and the geographical location are important factors affecting the intraannual variability. At mountain sites, higher sigma(sp) and SAE values are measured in the summer due to the enhanced boundary layer influence and/or new particle-formation episodes. Conversely, the lower horizontal and vertical dispersion during winter leads to higher sigma(sp) values at all low-altitude sites in central and eastern Europe compared to summer. These sites also show SAE maxima in the summer (with corre-

sponding g minima). At all sites, both SAE and g show a strong variation with aerosol particle loading. The lowest values of g are always observed together with low sigma(sp) values, indicating a larger contribution from particles in the smaller accumulation mode. During periods of high sigma(sp) values, the variation of g is less pronounced, whereas the SAE increases or decreases, suggesting changes mostly in the coarse aerosol particle mode rather than in the fine mode. Statistically significant decreasing trends of sigma(sp) are observed at 5 out of the 13 stations included in the trend analyses. The total reductions of sigma(sp) are consistent with those reported for PM2.5 and PM10 mass concentrations over similar periods across Europe.
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