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2023

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Atmospheric aerosols have a significant impact on the Earth's radiative forcing.[1] They affect the Earth's climate system directly by scattering or absorbing incoming solar and outgoing infrared radiation, and indirectly by altering cloud properties and their lifetime.[2] The reasons for the large uncertainty of aerosols in climate modeling are not yet fully understood. Although there are studies that address the effects of aerosols on local climate,[3–5] there are few long-term series measured at rural background sites.

The aim of this study is to characterize the light scattering properties of aerosols at the rural background site National Atmospheric Observatory Košetice (NAOK; 49°34'20.787"N, 15°4'48.155"E) in Central Europe, namely the coefficients of total light scattering (σ_{sp}) and backscattering (σ_{bsp}), the Ångström exponent (SAE), the backscattering ratio (b), and the asymmetry factor (g), with special attention to the influence of meteorology and aerosol size distribution on these properties. We measured σ_{sp} and σ_{bsp} at three wavelengths (450, 550, and 700 nm) using the Integrating Nephelometer TSI 3563 (PM_{10} inlet). The measurements were performed from August 16, 2012 to December 31, 2019.

The results show an interannual downward trend in σ_{sp} and σ_{bsp} associated with a shift toward larger particles and an enhanced aerosol cooling effect during the observed period. Increased SAE values in summer indicate increased SOA formation, while the decrease in b in winter indicates increased concentrations of carbonaceous aerosols. The σ_{sp} and σ_{bsp} values were higher during fog events, medians 76.71 Mm^{-1} and 8.57 Mm^{-1} compared to no fog events, with 34.82 Mm^{-1} and 5.21 Mm^{-1} at 550 nm, respectively, due to increased particle size during fog events. The value of g showed a decreasing scattering potential of particles during fog events, possibly due to multiple scattering of light by the particles. Higher values of σ_{sp} and σ_{bsp}

were observed during overcast and fine days compared to cloudy or partly cloudy days ($p < 0.05$). The optical properties of aerosols correlated most strongly with the presence of particles between 200 and 800 nm, close to the wavelength of visible light.

The research leading to these results was funded by the National Research Infrastructure Support Project ACTRIS Participation of the Czech Republic (ACTRIS-CZ LM201822), supported by the Ministry of Education, Youth and Sports of the Czech Republic, the Czech Science Foundation (GJ18-15065Y) and the Ministry of Education, Youth and Sports of the CR within the CzeCOS program (LM2018123).

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