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Annual cycle, seasonality and vertical distribution of aerosol optical and chemical properties observed at a continental site in Western Europe

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Airborne aerosol particles impact the climate directly though the interaction with the incident light by scattering, generating a net cooling effect or by absorbing it and reemitting infrared radiation, having a net heating effect. The key property to describe the aerosol impact on climate is the Radiative Forcing Efficiency (RFE) with its constituting aerosol intensive properties single scattering albedo (SSA) and backscattered fraction [1, 2]. The absolute effect of the atmospheric aerosol load on the global radiation budget depends on the aerosol optical depth (AOD) times RFE. Uncertainties in RFE have a direct impact on the aerosol radiative forcing [3].

The facilities of the 120 m tall meteorological tower at Forschungszentrum Juelich, which is situated in Western Germany close to the Dutch/Belgian border in an area dominated by agriculture and open-cast mining, were used to record an annual cycle of aerosol optical properties and aerosol chemical composition at three different altitudes of 10 m, 50 m, and 120 m above ground. The altitude-resolved sampling permitted the additional investigation of vertical mixing processes of the boundary layer on aerosol optical and chemical properties.

Deployed instrumentation covered the aerosol light extinction, scattering and absorption coefficients at 3 wavelengths by using a combination of Cavity Attenuated Phase Shift (CAPS) monitors, integrating nephelometers, and absorption photometers (Particle Soot Absorption Photometer PSAP, Tricolour Absorption Photometer TAP). The aerosol chemical composition was monitored by an Aerosol Mass Spectrometer (AMS) and the absorption photometers, providing equivalent black carbon. In addition aerosol physical properties like number concentration and size distribution were covered.

We will present a statistical analysis of the seasonality of aerosol optical and chemical properties at the observation site, including the vertical resolution of the lowermost planetary boundary layer, and the resulting variability of the RFE. An investigation of connections between air mass origin, aerosol chemical composition, aerosol optical properties, and RFE will be discussed.

References

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