A twenty-six year long-term trend for particulate matter (PM) at the rural background in Germany

– influence of air mass inflow and season

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Long-term studies help to quantify the influence of decreasing emissions on the concentrations. The TROPOS research site Melpitz is located in the rural-background in Germany (12°56' E, 51°32' N, 86 m asl.). The highest annual mean temperature was registered in 2018 with 11.1°C (Trend since 1993 0.07 Ka^{-1}). The Melpitz station is representative for a large area in central Europe and is integrated in EMEP (European Monitoring and Evaluation Program) and ACTRIS (Aerosol, Clouds, and Trace gases Research Infra Structure Network).

High-Volume (HV) quartz filter-samples for particles < 10 µm aerodynamic-diameter (PM10) were collected daily since January 1993. PM2.5 and PM1 were collected since January 2003. The determination of the particle mass was performed gravimetrically. The main water-soluble ions (Nitrate, Sulfate, Chloride, Natrium, Ammonium, Potassium, Magnesium and Calcium) were analyzed by ion chromatography. The determination of organic (OC) and elemental carbon (EC) was measured by carbon analyzers (thermographic and thermo-optical method).

Spatial and seasonal influences of the daily means by air mass transport from a western sector (W, 210-320°, mostly marine origin) and a broad eastern sector (E, 35-140°, continentally influenced) were investigated using backward trajectories (96 h). The additional seasonal discrimination in winter (W, November-April) and for summer (S, May-October) resulted in four categories WW, WE, SW and SE covering 70.3 % of the complete time.

The PM10 concentration decreases since 1993 and remains constant in the last 18 years with 21.96 ± 3.15 µg/m^3. However, nitrate concentrations remained more constant. A strong decrease of sulfate was observed from 1993-2000. Afterwards, the decrease was less pronounced. Reasons were fast local emission reductions in the region during the first period and additional continuous emission reductions in Europe since 2000. The highest EC concentrations were found for WE (coal combustion and long-range transport). In general, EC and OC show a decreasing trend and only OC for WE remains constant.