Evolution of mass- and ion concentration in PM_{10} during the last 17 years depending on meteorology and air mass origin at the IfT research station Melpitz (German lowlands)

Spindler, Gerald, Grüner, Achim, Müller, Konrad, Schlimper, Susan and Herrmann, Hartmut

Leibniz-Institut für Troposphärenforschung e.V. (IfT), Permoserstrasse 15, 04318 Leipzig, Germany

Keywords: PM_{10}, long time study, long-range transport, tropospheric Aerosol, trajectory

The field research site of the IfT near Melpitz (12°56'E, 51°32'N, 86 m a.s.l.) lies on a flat meadow, surrounded by agricultural land without any wind obstacles. The distance to the polish border in the East is about 120 km. Under the dominating wind direction from the South-West to Northwest (sector W, about 60 % of time), maritime air arrives Melpitz after crossing a large area of Germany and the city of Leipzig (distance of about 50 km). Showers are transported to Melpitz, often during low pressure situations with relatively high wind velocities. The second main wind direction maximum is East (sector E, about 17 % of time). Dry continental air masses were transported with moderate wind velocity during high pressure situations over long distances to Melpitz (long-range transport). The main source regions for these continental air masses are Poland, Belarus, Russia, Ukraine, Slovakia, and the Czech Republic. For more details see *Spindler et al., 2010*.
Melpitz is an EMEP level 3 station (Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe) in the urban background of Europe and provides results of complex scientific evaluations of measurements (*EMEP, 2007*).
Filter samples were taken daily by a modified high-volume (HV) Anderson Sampler (1993 until 2002) for PM_{10} only and since 2003 by three HV-DIGITEL DHA-80 samplers collecting daily PM_{10}, $PM_{2.5}$ in parallel and PM_1 (every sixth day). The used filter material in both HV sampler types is quartz fibre MK360 by Munktell (Sweden). The particle mass was determined gravimetrically with a microbalance AT 261 Mettler Toledo (Germany) The conditioning time is 48 h (50% relative Humidity and (20 $\pm$ 2 °C)). Main water soluble anions and cations (Cl^-, SO_4^{2-}, NO_3^-, NH_4^+, Na^+, K^+, Ca^{2+} and Mg^{2+}) were analyzed after water extraction by ion chromatography with a Metrohm System 690 (Switzerland). The daily PM measurements was separated for air mass inflow from W and E using 96 hours backward trajectories (www.arl.noa.gov) for two times a day (10 a.m. and 6 p.m. MEZ and three hights above ground (200, 500 and 1500 m)
The long-time data set was analyzed for the influence of source regions, season, temperature and precipitation as well for weekday and weekend.
Selected mean results presented in Figure 1. (i) The PM_{10} mass concentration for sulphate shows a decreasing trend for long range transport from W as well for E (Figure 1). The reason are decreasing anthropogenic SO_2 emissions. The mean concentration ratio for W/E is approximately (0.44 $\pm$ 0.07) and so nearly constant over the 17 years. However, the concentration scatter for air mass transport from W is smaller due do better turbulent mixing conditions and a higher number of days available for calculation of the concentration mean compared with inflow from E. (ii) For nitrate no trend and no difference between air mass transport from E or W is recognizable. This result is in agreement with nearly constant NO_x emissions in sum for mobile and stationary sources over the last two decades. The pattern can be explained due do different processes during the transport in the atmosphere (e.g. chloride-nitrate-exchange) and the influence of temperature and humidity (e.g. deliquescence of ammonium nitrate).

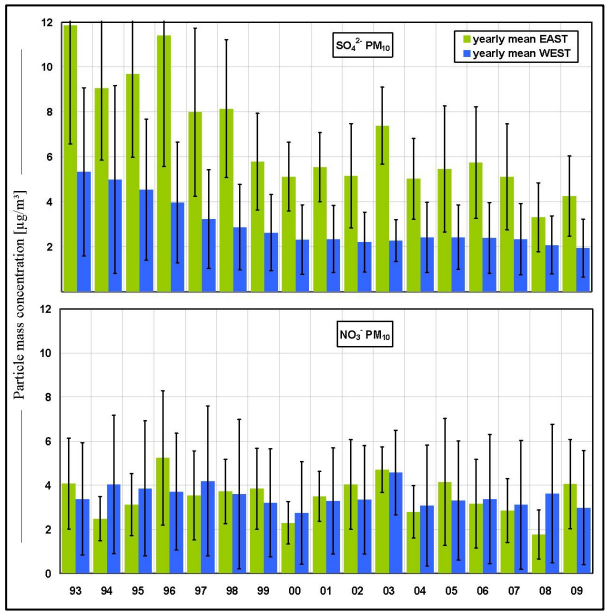

Figure 1. Long-time evolution (1993 until 2009) of the yearly mass concentration for sulphate and nitrate in PM_{10} separated for transport from E and W respectively. The error bars represent the standard deviation of daily mass concentration.

EMEP (2007) *Transboundary particulate matter in Europe.* Status report 4/2007 Ed.: Yttri, K.-E., Aas, W., Tarrason, L., Vestreng, V., Tsyro, S., Simpson, D., Putaud, J.,P., Cavalli, F., NILU reference O-98134, ISSN: 1504-6109 (http://www.emep.int/publ/common_publications.html).

Spindler, G., Brüggemann, E., Gnauk, T., Grüner, A., Müller, K., Herrmann, H. (2010). *A four-year size-segregated characterization study of particles PM_{10}, $PM_{2.5}$ and PM_1 depending on air mass origin at Melpitz.. Atmos. Environ.*, 44, 164-173.