Week daily variation of PM_{10} depending on air mass origin at German lowlands (Melpitz site) – a four year study

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PM_{10} concentration measurements were performed at the IfT-research station Melpitz (12°56' E, 51°32' N, 86 m asl.). This grassland site is located about 50 km northeast of Leipzig near the city of Torgau in a representative rural region in the German low-lands (Spindler *et al*., 2004). The distance to the Polish border in the East is about 120 km. The Melpitz site is an EMEP level 3 station (Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe) and provides results of complex scientific evaluation of measurements (EMEP, 2007). For this study quasi continuous half-hourly PM_{10} mass-concentration measurements provided by a TEOM® (Type 1400a, Rupprecht & Patashnick Co., Inc., USA) over four years are used. The TEOM® was operated at 50 °C collecting particles on an oscillating microbalance. This operating temperature is necessary to avoid the condensation of water vapour (positive artefact) but can also generate systematic errors by evaporating volatile compounds (negative artefacts). Therefore the mean mass for 24 hours was corrected by a daily comparison with the mean PM_{10} mass, detected gravimetrically from quartz fibre filters (Munktell, S). This daily PM_{10} filter samples were collected using a high volume samplers (DHA-80, DIGITEL Electronic AG, CH).
The corrected half-hourly means were sorted for the seven weekdays and additionally separated for two mean air mass transport pattern. Under the dominating wind direction Southwest to Northwest (W) air masses from the Atlantic Ocean with integrated showers are transported to Meloitz, often during low pressure situations with relatively high wind velocities. They pass large parts of Germany. The second main wind direction is East (E). Then dry air masses are transported with moderate wind velocity during high pressure situations over long distances to Melpitz. The main sources regions for these continental air masses are in Russia, Poland, Belarus, Ukraine, and the North of Czech Republic. For identifying air mass source regions 96 hours backward trajectories (www.arl.noa.gov) were used.
In Figure 1 the week daily mean PM_{10} concentrations are shown for all data (100 % of time) and for the days with air mass transport from E and W (about 19 % and 66 % of time, respectively).

The concentration course for all data shows a typical increase of PM_{10} influenced by anthropogenic caused emissions from Monday to Friday, with lowest concentrations on Sunday. The mean PM_{10} concentration pattern for air mass transport from W is similar to that but 5 to 8 µg/m³ lower. The PM_{10} concentration for air mass transport from E is about 13 µgm^{-3} higher as for W. The concentration course shows a time shift of three days (minimum concentration for W at Sunday and for E at Wednesday). This is a hint for long range transport of anthropogenically emitted fine particles and precursor gases (particle mass formation during transport) in Eastern Europe. For a mean wind velocity range from E of 1.0 to 2.5 ms^{-1} these anthropogenic emissions are 250 to 650 km away from Melpitz. The results are in agreement with former findings of higher parts of sulphate, organic and black carbon during air mass transport from E in particles of different size range at Melpitz site (EMEP 2007).

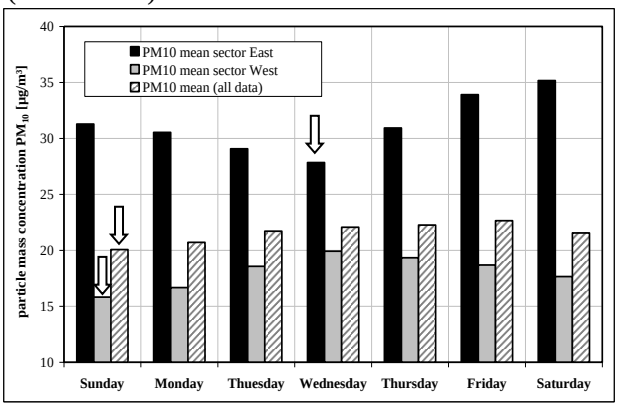

Figure 1. Week daily means for PM_{10} based on half hourly PM_{10} concentration measurements by a TEOM® (May 2004 until April 2008), hatching bars mean of all data, black bars and grey bars mean of data for days with air mass transport from East (E) and West (W), respectively. Minimum concentrations are marked by arrows.

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Spindler, G., Müller, K., Brüggemann, E., Gnauk, T., Herrmann, H. (2004). *Long-term size-segregated characterization of PM_{10}, $PM_{2.5}$ and PM_1 at the IfT research station Melpitz downwind of Leipzig (Germany). Atmos. Environ.*, 38, 5333-5347.