

Time series of correlation coefficients of atmospheric PM

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1. Overview

A new application of the correlation coefficient to atmospheric PM data, developed under the AUPHEP project of the Clean Air Commission (see this compendium, pp. 130 ff), has been presented by Berner et al. (2004).

While traditional use of correlation coefficients will apply the method to a complete data set, the correlation coefficient can also be calculated for subsets of data. Here a window of only a few, three or more subsequent data points are selected out of time series, e.g. of 12h PM concentrations measured by cascade impactors. Moving this time window over a series of data yields a time series of short-term correlation coefficients (Figure 1). These coefficients as a function of time can be called a correlation function, $R(t;w)$. This function depends to some degree on the size of the window, w . The method can be applied to time series of different PM parameters measured at a single station or to time series measured at several stations that may be separated by distances of several tens of kilometers or more.

First results obtained for PM series at two stations (Berner et al. 2004) are surprising (see Figure 1). In PM₁₀, periods of time with highly positive correlation are interrupted by minima of short duration and also by periods of neutral or negative correlation. Similar structures occur in PM_{2,5}, and in other seasons (Berner et al. 2004). They also occur in the data of other PM instrumentation, and are therefore of more general character. At present these structures are only partially understood, though it is safe to say:

- Minima of short duration, like those on 24.1.2000 (14:00), 28.1.2000 (2:00) and 31.1.2000 (2:00) (figure 1), are related to changes of the weather situation
- The linear regressions of PM, belonging to time periods enclosed by such minima, differ. Therefore the weather related minima separate different PM regressions
- In some respect this result already underlines the usefulness of correlation functions $R(t;w)$
- Periods of neutral or negative correlation indicate other situations. Investigations into the reasons, among them strong effects of local sources at a sampling site, can be concentrated on well defined periods of time, as indicated by the correlation function

- Strong effects of local sources at both sampling sites can lead to very high correlation coefficients running up close to unity for some time

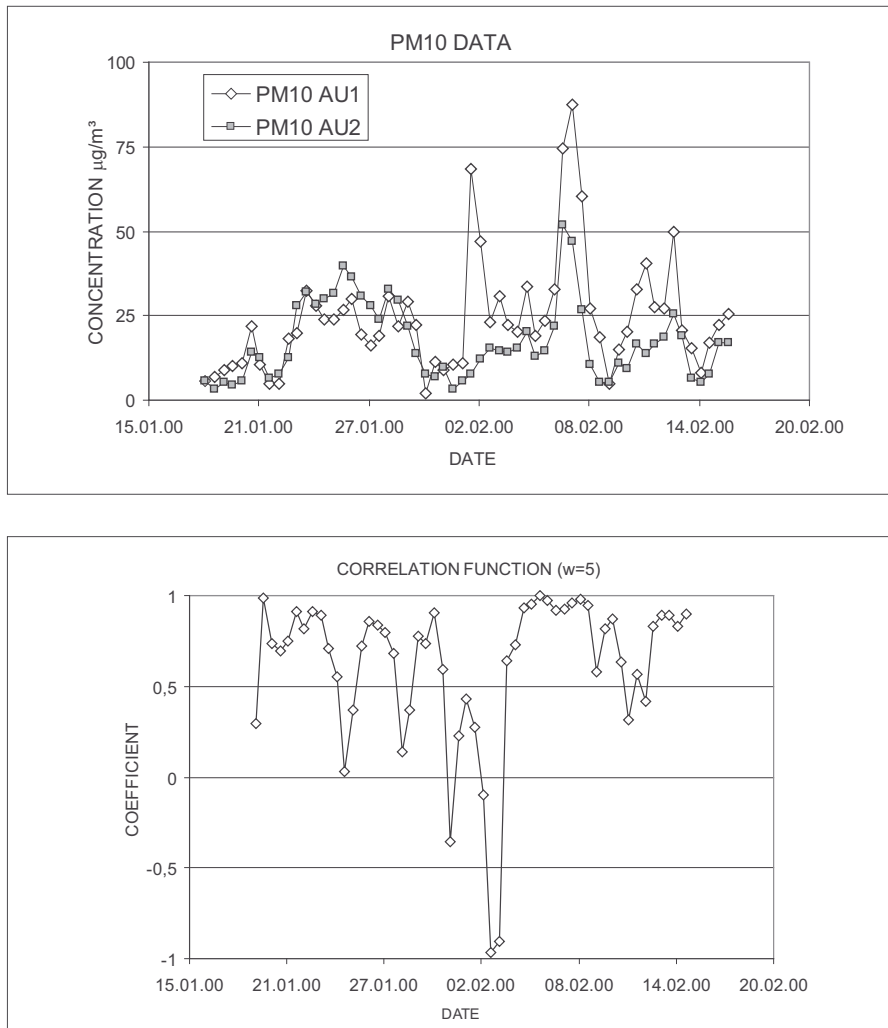


Figure 1. PM10 concentrations at two sampling sites, AU1 and AU2 of the AUPHEP project, together with their correlation function, $R(t;5)$. This function has been calculated for five subsequent pairs of data points of the PM10 time series.

2. References

Berner, A., Galambos, Z., Ctyroky, P., Frühauf, R., Hitzenberger, R., Gomišček, B., Hauck, H., Preining, O., and H. Puxbaum. 2004. "On the correlation of atmospheric aerosol components of mass size distributions in the larger region of a central European city." *Atmospheric Environment* 38: 3959–3970.

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