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# Application of spectral analysis and filtering technique to improve representativeness of point measurements

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Exchange processes of trace gases between biosphere and atmosphere are usually analysed based on micrometeorological technique and their representativeness for local/regional/global scales is a critical issue. Therefore, development of methodologies to evaluate and to improve the representativeness of the measurements is important.

The current work proposes an approach to improve representativeness of point measurements using decomposition of the time series on deterministic and noise components. The methodology consists in two steps: (i) examination of the variance spectrum obtained for point monitoring data, and (ii) removing of noise heterogeneity from the original measurements taking into account the frequency threshold determined from the spectral analysis.

Spectral analysis is used to characterise the time series in the frequency domain. Based on the Fourier series, this method allows to determine the contribution of different frequencies to the data variance and hence to analyse the contribution of various underling processes to the concentration fluctuations. The results of the Fourier analysis are presented in the form of smoothed spectrum. The highest spectrum values reveal the most important cyclic components and a contribution of seasonal, weekly or diurnal fluctuations to the total variance of the pollutant concentration time series.

Next, the Kolmogorov-Zurbenko (KZ) filter is used to decompose the time series into the baseline and short-term components. The KZ filter is a low-pass filter that removes higher frequency variations from the data. The filter is designed taking into account the separation frequency w. The application of the KZ filter allows to decompose the original time series C(t) on baseline (CB) (deterministic component) and noise (CS) in time t: C(t)=CB(t)+ CS(t). The noise removed by the filtering is associated with influence of local heterogeneity. Therefore, the deterministic component is characterised by wider spatial and temporal representativeness than original monitoring data.
Additionally, cross spectral analysis allows to investigate how periodicities in the two datasets are interrelated. The squared coherency is used to interpret the cross-spectrum. This function measures the square of the linear correlation between the two components of the bivariate process at frequency f and is analogous to the square of the correlation coefficient. The cross spectral analysis is useful to analyse the correlation (in the frequency domain) of concentration fluctuations with meteorological or other parameters.

An example of the methodology application will be presented considering different type of air quality monitoring station. Influence of local heterogeneity considering location of the emission sources and local dispersion conditions on spatial representativeness of the monitoring data will be discussed. Application of the filtering technique to improve representativeness of the measurements will be demonstrated. Also, an example of the spectral analysis applied to the regional air quality modelling results to identify sources of the uncertainties will be presented.