Identification of parameters influencing the variability of particle number size distributions in Europe - a multi-site study

Clemens von Bismarck-Osten[1], Stephan Weber[1]

[1] Institute of Geoecology, Climatology and Environmental Meteorology, Technische Universität Braunschweig, Langer Kamp 19c, 38106 Braunschweig, Germany
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Author email: c.von-bismarck-osten@tu-bs.de, s.weber@tu-bs.de,

Three years of aerosol measurements from four European cities were analysed to identify and quantify the parameters influencing the particle number size distribution (NSD) at different measurement sites (Copenhagen, Helsinki, Leipzig, London). A 'triple-site' approach was established with data from a roadside, an urban background and a rural measurement station, which were available for each city. The NSD measurements were conducted over a diameter size range of 8 to 700 nm.

Average hourly total number concentrations varied between 3.300 cm^{-3} (Copenhagen rural) and 23,000 cm^{-3} (London roadside). Highest variability on the diurnal course was found for the roadside sites and on the seasonal course for the rural sites.

A first identification of the influencing parameters was found using correlation analysis pointing out wind speed, wind direction, temperature, shortwave downward solar radiation, daytime and season as most dominating factors. These were then quantified using a multiple linear regression approach with a partially non-linear treatment of input data documenting the highest influence for daytime (45%) followed by wind direction (18%), season (12%), wind speed (11%), temperature (8%) and solar radiation (6%) on average.

The variation of influence between the different cities are analysed and discussed. Subsequently NSDs were modelled using the regression approach in order to verify how well the parameters are capable of 'explaining' the actual NSD, showing best performance for roadside NSD with correlation coefficients between 0.65 and 0.8 (average COD of around 0.2 to 0.3, Fig.1) and with correlation coefficients of 0.5 to 0.6 only limited performance for the rural sites (COD of around 0.3 to 0.4 on average).

Finally the data was classified into a limited number of characteristic cluster size distributions using unsupervised and semi-supervised cluster analysis approaches. After a first source assignment of each cluster (e.g. on the basis of daytime and seasonal occurrence, wind sector, mean diameter or total number concentrations) the main information about the influence of the local (meteorological) conditions on the particle number size distribution can be derived. This way the main connections and interactions between the ambient environment and particles are reduced and compressed to a manageable minimum which makes it easier for a near-future forecasting of particle number size distributions.

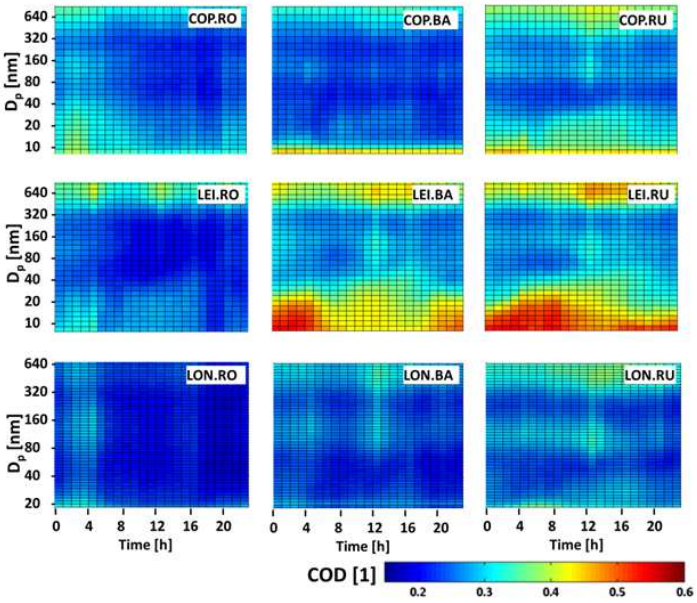

Fig.1: *Coefficient of Divergence (COD) for comparison of modelled and measured number size distribution. The smallest values indicate the highest conformity at a specific daytime and per particle size; the highest values indicate heterogeneous conditions. RO represents the roadside measurement site, BA the urban background and RU the rural site within Copenhagen (COP), Leipzig (LEI) and London (LON).*

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