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Multivariate statistical analysis of the factors affecting to the number concentration of atmospheric aerosol particles

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In order to study which of the meteorological and trace gas variables affect to the number concentration of 50nm particles, more than three years of measurements of aerosol size-distribution and different gas and meteorological parameters conducted in Po Valley, Italy were analysed. Due to the complex structure of processes affecting the concentration of small particles it is not reasonable to use general linear effect models in the analysis. We chose to use generalized linear models with logarithmic link function and combine it with mixed model structure. The main idea of a mixed model is to estimate not only the mean of the measured response variable y, but also the variance-covariance structure of the data. Modelling the (co-)variances of the variables reduces the bias of the estimates and prevents autocorrelation of the residuals.

Hourly averages of gas and meteorological parameters measured at San Pietro Capofiume (SPC) station were used as predictor variables; the best predictive model was attained with a combination of relative humidity, nucleation event probability, concentrations of SO2 and ozone, local wind speed and condensation sink. Seasonal variation and the effect of wind direction were also taken cognisance in the mixed model structure. Partly the same variables which control the occurrence of nucleation events appeared to influence or indicate also the growth of the particles into 50nm size. The model predicts adequately even the highest peaks of the number concentration and it can also be used for forecasting the particle concentration with the estimated regression coefficients. The same model framework can be used for any other particle size and in any other location but the parameterization may vary and the regression coefficients are probably site-specific.