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Meteorological and trace gas factors affecting the number concentration of atmospheric Aitken (D_p = 50 nm) particles in the continental boundary layer: parameterization using a multivariate mixed effects model

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Abstract. Measurements of aerosol size distribution and different gas and meteorological parameters, made in three polluted sites in Central and Southern Europe: Po Valley, Italy, Melpitz and Hohenpeissenberg in Germany, were analysed for this study to examine which of the meteorological and trace gas variables affect the number concentration of Aitken (D_p= 50 nm) particles. The aim of our study was to predict the number concentration of 50 nm particles by a combination of in-situ meteorological and gas phase parameters. The statistical model needs to describe, amongst others, the factors affecting the growth of newly formed aerosol particles (below 10 nm) to 50 nm size, but also sources of direct particle emissions in that size range. As the analysis method we used multivariate nonlinear mixed effects model. Hourly averages of gas and meteorological parameters measured at the stations were used as predictor variables; the best predictive model was attained with a combination of relative humidity, new particle formation event probability, temperature, condensation sink and concentrations of SO_2, NO_2 and ozone. The seasonal variation was also taken into account in the mixed model structure. Model simulations with the Global Model of Aerosol Processes (GLOMAP) indicate that the parameterization can be used as a part of a larger atmospheric model to predict the concentration of climatically active particles. As an additional benefit, the introduced model framework is, in theory, applicable for any kind of measured aerosol parameter.

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