Nano-particle measurements downstream Vienna in the direct surroundings of an oil refinery and the Vienna airport

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Keywords: urban aerosol, anthropogenic, new particle formation, sulphuric acid.
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New particle formation from gas-to-particle conversion from trace gases emitted by anthropogenic sources are of scientific interest since atmospheric aerosols influence global climate and strongly affect human health. First test measurements of particle size distributions in the range between 3 and 40 nm were carried out at a measurement site in a Vienna suburb, Schwechat, situated close to an oil refinery and the Vienna airport over the course of one month in spring 2016. The federal environmental agency of Lower Austria provided the measurement site as well as data from their continuous measurement of trace gases (SO_2, NO_x), particle mass (PM_{10}, $PM_{2.5}$) and meteorological parameters (temperature, wind speed and wind direction). Total particle concentration was measured using a CPC with 2.5 nm cut-off and particle size distribution was determined by a DMPS system.

The location of the measurement site between Vienna city (North-West from the site) and the industrial area consisting of the oil refinery and the airport (South-East) allows to investigate the particle population in air masses coming from different kinds of sites (urban, industrial, rural). Additionally, continuous particle measurements are carried out in the roof top laboratory of Vienna University situated close to the city centre which allows to compare results, i.e. identify regional nucleation events. A dense network of measurement stations of the federal environmental agency and the ZAMG provides detailed regional meteorological data.

Sulphur dioxide is the main precursor of gaseous sulphuric acid which plays a key role in new particle formation. An enhancement in the sulphur dioxide concentration (see panel a) in figure 1) from 1.5 ppbV to peak concentrations up to 5 ppbV in some cases was observed when the air mass was coming from the industrial site (SE). The study of Sarnela et al. (2015) found a similar pattern in the SO_2 concentration for air mass coming from an oil refinery. Figure 1 shows the typical nanoparticle size distribution observed during test measurements for wind coming from SE. Particles between 5 and 40 nm appear simultaneously with changing wind direction. High concentrations of particles below 40 nm size are observed correlated with elevated levels of SO_2 which can be associated with a combustion plume originating from the oil refinery.

New particle formation events were not observed for wind coming from the industry but e.g. for air mass coming from Vienna city. Sulphuric acid concentrations were not directly measured but can be estimated using a proxy calculation that is described in Mikkonen et al. (2011) assuming a H_2SO_4 steady state and taking into account SO_2 concentration, global radiation, relative humidity and a condensation sink calculated from the measured particle size distribution.

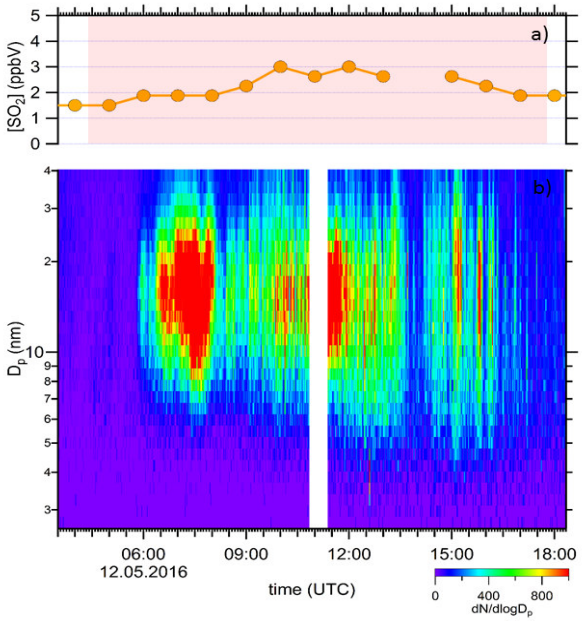

Figure 1. Particle population when air masses are coming from the oil refinery and Vienna airport (SE). The red shaded area in panel a) designates the time window when the wind has changed to SE.

A future study over the course of several months during spring and summertime on particle population and new particle formation in the surroundings of the industrial area in Schwechat is planned. Multiple measurement sites are to be equipped with instruments for obtaining information about the particle population as well as trace gases, such as sulphuric acid, ammonia and organic vapours potentially taking part in the formation and growth of particles in order to investigate air masses originating from different sites.

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