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The lab above the clouds
Particle Number Concentrations at the Sonnblick Observatory

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Introduction

Atmospheric aerosols (particulate matter) are a complex mixture of particles of different size, shape and chemical composition. Consequently various methods for the characterization of atmospheric aerosols exist and have to be used to tackle different problems.

Since daily average mass concentrations are given as limit values in air, quality standards set for particulate matter (PM10; particulate matter smaller than 10 µm a.d.) measurements in monitoring networks often are based on the gravimetric determination of aerosol mass. A further advantage of this method is the possibility to do chemical analysis subsequent to the actual sampling process on filters. If higher time resolution is needed, other procedures yielding data representative for mass concentrations (e.g. TEOM, β-gauge) are used.

The size of particles ranges across several orders of magnitude starting from several nanometers up to several tenth of micrometers. Obviously single large particles contribute more significantly to aerosol mass than small particles. Consequently even a strong increase of small particles might not influence aerosol mass severely. Thus the determination of aerosol mass does not necessarily reflect changes in particle number concentrations. The number concentration of aerosol particles can be determined as an overall number or segregated in different sizes classes, in an ideal case in terms of size distributions.

Small particles are generated during combustion events and thus can be used as a tracer for freshly contaminated air masses. Thus the CP-count has already been used to classify the 'air status' for other measurements more than twenty years ago (GALASYN et al. 1987). Furthermore elevated concentrations of small particles can also be found during nucleation events in background environments induced by photochemistry.

Here we describe the data set of particle number concentrations measurements conducted at the Sonnblick Observatory and show selected results to demonstrate how these measurements can be used for further investigations.

Methods

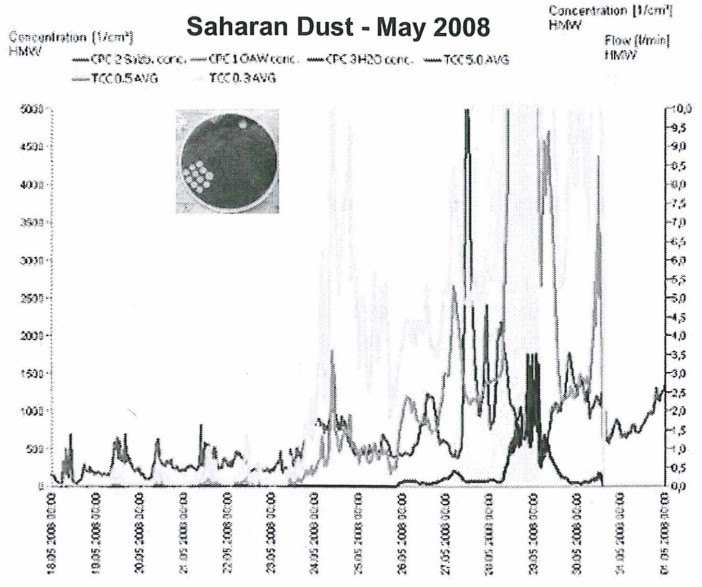
Monitoring of particle number concentrations at the Sonnblick Observatory started in 2004 and is performed with a condensation particle counter (CPC; TSI 3022A) using 1-butanol as a condensation liquid. The instrument has a lower cut-off point of 10 nm. In January 2008 another counter (TSI 3781) using water as condensation liquid was operated in parallel. In addtion to the CPCs an optical particle counter (Klotz TCC-PSS air) was installed in 2007 to determine particle number concentrations in three size classes.

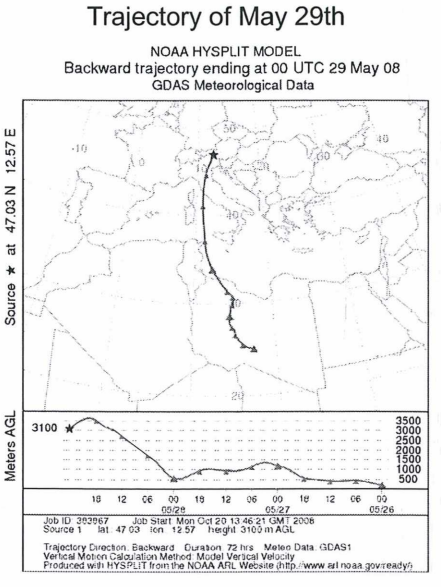
Results

Condensation particle counts determined at the Sonnblick Observatory cover a wide range but generally remain below or close to 1000 cm^{-3}. In accordance with mass concentations of major air constituents average concentrations are higher in summer than in winter. Thus monthly values of condensation particle counts average at 811 cm^{-3} in June 2005 and 440 cm^{-3} in December 2005. These values are characteristic for background air. A first comparison with data given for other alpine stations the sites Jungfraujoch (NYEKI et al. 1998) and Zugspitze (BRIMILI et al. 2009) show that concentrations at Sonnblick are close to data reported for these sites.

It has already been shown that mountain sites can be used as plattforms to monitor free tropospheric air masses (e.g. GALASYN et al. 1987, KASPER & PUXBAUM 1998, NYEKI et al. 1998). However these clean conditions do not prevail for the whole time and especially during the spring and summer season boundary layer air masses can be transported up to the site. Measurements of the condensation particle count allow to identify ‚polluted' and free tropospheric air masses. In the poster we show the possibilities and limitations of this approach for the Sonnblick Observatory.

Regarding single events a period of long range transport of Saharan dust to Salzburg occured in early summer 2008. The increase in aerosol mass as well as particle number concentrations, and the differences observed for the various size classes, could be observed at the Sonnblick Observatory as well and is presented in the poster.





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