Conference Volume | 5th Symposium for Research in Protected Areas, 10 to 12 June 2013, Mittersill | pages 343 - 344

Aerosol Measurements at the Sonnblick Observatory On-line Identification of Long-Range Transport of Particulate Matter

Anne Kasper-Giebl[1], Ingrid Meran[1, 2], Ulrike Nickus[2], Regina Hitzenberger[3], Anna Wonaschütz[3], Grisa Mocnik[4], Luka Drinovec[4], Gerhard Wotawa[5], Gerhard Schauer[5]

[1] Institute of Chemical Technologies and Analytics, TU-Vienna, Austria
[2] Institute of Meteorology and Geophysics, University Innsbruck, Austria
[3] Aerosol Physics and Environmental Physics, University Vienna, Austria
[4] Aerosol d.o.o., Slovenia
[5] Central Institute for Meteorology and Geodynamics, Wetterdienststelle Salzburg, Austria

Abstract

Absorption and scattering of light by aerosol particles influence the radiation transfer in the atmosphere. Aerosols can thus affect the Earth's climate and influence visibility. At the Sonnblick Observatory, number concentrations of aerosol particles as well as mass concentrations are generally very low, reflecting the global background status of the site with prevalent clean air conditions. Nevertheless air quality at high alpine sites can be impacted by long range transport of Saharan dust or by biomass burning, an ubiquitous source of particulate matter in Europe.

The instrumental setup operated at the Sonnblick Observatory during two field campaigns in 2012 and 2013 allows the on-line characterization of periods with elevated concentrations of aerosols. Here we present results of these measurement campaigns and discuss the potential of the on-line identification of transport phenomena of particulate matter.

Keywords

atmospheric aerosols, Saharan dust, biomass burning, optical parameters

Introduction

Aerosolized particulate matter is highly relevant for air quality and related topics such as human health, but also climate issues. While health issues are more often discussed for highly polluted regions, characterization of aerosols in clean environments is urgently needed to investigate their effect on the climate, atmospheric visibility or the formation of precipitation. It has already been shown that mountain observatories can be used as platforms for the long term investigation of background concentrations and even free tropospheric air masses (Galasyn et al. 1987). More recently this approach has been extended to more comprehensive sampling programs for particulate matter (e.g. Weingartner et al. 1999, Collaud Coen et al. 2004) focusing on variations in aerosol concentrations due to transport phenomena as well as particle formation during nucleation events. Earlier aerosol sampling at the Sonnblick Observatory illustrated the seasonal cycles of major ions (Kasper and Puxbaum 1998) as well as implications for scavenging processes (Kasper-Giebl et al. 2000) and radiative forcing (Iorga et al. 2007). The characterization of carbonaceous aerosol particles underlined the marked impact of particulates originating from wood burning (Puxbaum et al. 2007) or living biomass (Sanchez-Ochoa et al. 2007). Event based studies showed the influence of long range transport of Saharan dust (Koller et al. 2009).

Methods

Aerosol characterization at the Sonnblick Observatory is performed routinely by two condensation particle counters (TSI, CPC 3022A) for monitoring of the total number concentration, an optical particle counter for the determination of particle size distribution in the size range between 0.3 and > 5 µm (Klotz, TCC-3) and a SHARP monitor (Sharp 5030, Thermo) for the determination of aerosol mass concentration. The set-up was extended temporarily by two three wavelength Nephelometers (TSI 3563, Ecotech Aurora 4000), a Scanning Mobility Particle Sizer (Vienna Type DMA) and an Aethalometer (Magee Scientific AE 33). Thus a comprehensive picture of the physical characteristics of the particulate matter prevailing at the site can be given. Long-range transport can be identified as well as daily variations of concentration values due to the uplifting of boundary layer air masses or an increase of particle number concentrations due to nucleation events. The set-up also allows to identify Saharan dust events on-line based on the approach given by Collaud Coen et al. (2004) and Fialho et al. (2005) and to characterize periods of elevated concentrations of black and brown carbon – tracers for biomass combustion. To highlight the potential of further evaluations most of the data is made accessible on-line via the Sonnblick Observatory homepage - www.sonnblick.net.

Results

During the field campaign conducted from October to December 2012 daily average number concentrations generally were in the range of 450 to 600 cm^{-3}. As expected these values are quite low, reflecting the clean air status of the site. Nevertheless they are slightly higher than determined in previous winter measurements in the years 2005 to 2008 (KOLLER et al. 2009). Looking at diurnal daily cycles more variations could be observed in the recent measurements as well. Number concentrations determined with the CPCs were compared with the overall signal of the SMPS to account for methodological differences.

Daily mean mass concentrations measured with the Sharp 5030 are in the range of 2 $\mu g/m^3$, but sometimes were found to be < 1 $\mu g/cm^3$. Thirty-minute average mass concentrations up to > 6 $\mu g/m^3$ were observed during a number of consecutive days in December 2012. These increases of mass concentrations coincided also with elevated number concentrations determined with the CPC. Size resolved measurements showed an increase of number concentrations in the particle size classes >0,3 µm and >0,5µm.

During the spring campaign which started in February 2013 particle mass concentrations as well as number concentrations are increasing, due to the changing meteorological conditions. The occurrence of a Saharan Dust event (26.4.2013 until 6.5.2013) allows to investigate the influence of such a long range transport phenomenon on the changing aerosol size distributions, the absorption and scattering coefficients as well as the single scattering albedo. Sampling will be continued until summer 2013.

Acknowledgements

Thanks go to the Austrian Academy of Science, Clean Air Commission and the Local Authority of Salzburg, Referat 16-02 Immissionsschutz, for providing the CPCs and to EcoTech for loan of the Aurora 4000. Further thanks go to the colleagues working at the Sonnblick Observatory for maintenance of the instruments and support.

References

COLLAUD COEN, M., WEINGARTNER, E., SCHAUB, D., HUEGLIN, C., CORRIGAN, C., HENNING, S., SCHWIKOWSKI, M. & U. BALTENSPERGER 2004. Saharan dust events at the Jungfraujoch: Detection by wavelength dependance of the single scattering albedo and first climatology Analysis. Atmos Chem Phys 4 2465-2480

FIALHO, P., HANSEN, A.D.A & R.E. HONRATH 2005. Absorption coefficients by aerosols in remote areas: a new approach to decouple dust and black carbon absorption coefficients using seven-wavelength Aethalometer data. Aerosol Science 36 267-282

GALASYN, J.F., TSCHUDY, K.L. & B.J. HUEBERT 1987. Seasonal and diurnal variability of nitric acid vapor and ionic aerosol species in the remote free troposphere at Mauna Loa, Hawaii. J Geophys Res 92 3105

IORGA, G., HITZENBERGER, R., KASPER-GIEBL, A. & H. PUXBAUM 2007. Direct radiative effect modeled for regional aerosols in central Europe including the effect of relative humidity. J Geophys. Res. 112 (2007) D01204, doi:10.1029/2005JD006828

KASPER, A. & H. PUXBAUM 1998. Seasonal variation of SO_2, HNO_3, NH_3 and selected aerosol components at Sonnblick. Atmos. Environ. 32 (1998) 3925-3939

KASPER-GIEBL, A., KOCH, A., HITZENBERGER, R. & H. PUXBAUM 2000. Scavenging efficiency of aerosol carbon and sulfate in supercooled clouds at Mt. Sonnblick (3106 m a.s.l.). J Atmos. Chem. 35 (2000) 33-46

KOLLER, M., EFFENBERGER, Ch., SCHAUER, G. & A. KASPER-GIEBL 2009. Particle Number Concentrations at the Sonnblick Observatory. Poster contribution, 4. Symposium of the Hohe Tauern National Park for Research in Protected Areas, 17.-19.September 2009, Kaprun, Salzburg

PUXBAUM, H., CASEIRO, A., SANCHEZ-OCHOA, A., KASPER-GIEBL, A., CLAEYS, M., GELENCSER, A., LEGRAND, M., PREUNKERT, S. & C. PIO 2007. Levoglucosan levels at background sites in Europe for assessing the impact of biomass combustion on the European aerosol background. J Geophys Res 112, D23S05, doi:10.1029/2006JD008114

SANCHEZ-OCHOA, A., KASPER-GIEBL, A., PUXBAUM, H., GELENCSER, A., LEGRAND, M. & C. PIO 2007. Concentration of atmospheric cellulose: A proxy for plant debris across a west-east transect over Europe. J of Geophys. Res 112 (2007) D23S08, doi:10.1029/2006JD008180

WEINGARTNER, E., NYEKI, S. & U. BALTENSPERGER 1999. Seasonal and diurnal varaition of aerosol size distributions (10<D<750 nm) at a high-alpine site (Jungfraujoch 3580 m asl) J Geophys. Res. 104, D21, 26809-26820

Contact

Anne Kasper-Giebl
akasper@mail.tuwien.ac.at

Vienna University of Technology
Institute of Chemical Technologies and Analytics
Getreidemarkt 9/164 UPA
1060 Vienna
Austria

Institute of Meteorology and Geophysics,
University Innsbruck
Innrain 52
6020 Innsbruck
Austria

Aerosol Physics and Environmental Physics
University Vienna
Boltzmanngasse 5
1090 Vienna
Austria

Aerosol d.o.o.
Kamniska ulica 41
1000 Ljubljana
Slovenia

Central Institute for Meteorology and Geodynamics
Wetterdienststelle Salzburg
Freisaalweg 16
5020 Salzburg
Austria

Zeitschrift/Journal: Nationalpark Hohe Tauern - Conference Volume

Jahr/Year: 2013

Band/Volume: 5

Autor(en)/Author(s): Kasper-Giebl Anne, Meran Ingrid, Nickus Ulrike, Hitzenberger Regina, Wonaschütz Anna, Mocnik Grisa, Drinovec Luka, Wotawa Gerhard, Schauer Gerhard

Artikel/Article: Aerosol Measurements at the Sonnblick Observatory On-line Identification of Long-Range Transport of Particulate Matter. 343-344