Online measurements of aerosol composition at GAW measurement site Hohenpeißenberg, Germany and local wood waste burning emission

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Aerosols have an important effect on climate and human health. In order to investigate observations with respect to these topics long-term measurements and case studies are indispensable. The Hohenpeißenberg meteorological observatory records meteorological data since 1781 and investigates particle processes within Global Atmosphere Watch (GAW) since 1995. In addition to long-term measurements it is an important task of the observatory to document special emission events like desert dust outbreaks or volcanic ash events and to identify the origin of the aerosol.

Some specific aerosol sources originate from typical activities in the rural landscape around Hohenpeißenberg, e.g. livestock farming, agricultural or forestall work. Traditional for this rural region is the controlled burning of the local wood waste as part of the forest management, which helps e.g. reducing the impact of the bark-beetle. These fires typically occur every fourth day during the winter period (Oct-Apr) within a visible distance of 80 km around the observatory (Mayer, 2015).

The measured data used in this study are derived from an Aerosol Chemical Speciation Monitor (ACSM) which allows monitoring the chemical composition of atmospheric aerosols. Since 2014 the ACSM measures continuously the particle composition at the Hohenpeißenberg observatory.

The measured data were analysed for seasonal dependencies and especially during events such as biomass burning in the nearer area around the observatory. We took into account both the particle mass and the composition and performed source apportionment of the organic fraction by positive matrix factorization (PMF) analysis. The particle concentration shows a pronounced seasonal cycle for the year 2014 with a minimum during winter (4.6 µg/m^3), a maximum during spring (11.4 µg/m^3) and similar values of 8.1 µg/m^3 and 8.3 µg/m^3 for summer and autumn, respectively. Although the particle composition changes during the seasons, the organic fraction is dominant throughout the year and especially during the summer time. We observed a particularly high amount of oxygenated organic aerosol (OOA) in the summer months. In contrast to the summer maximum of the organic fraction the nitrate component reveals high concentrations during the winter season. Additional filter measurements show an impact up to one third of organo-nitrate on the nitrate observations measured by the ACSM. Here, the rural character with forests, meadows and limited emission sources around Hohenpeißenberg is mainly responsible for the observed distribution and composition of aerosols.

Several times in 2015 emissions from wood waste burning reached the observatory. PMF analysis was applied to identify the impact of these biomass burnings on the measured organic fraction and its frequency of occurrence. We concentrated on a period of short-term emission events of grubbing work next to the observatory and a wood waste burning event in March 2015 with high particle mass of around 80 µg/m^3. Especially, this huge emission event demonstrates the impact of such fires on the particle concentration. Figure 1 describes the characteristic of these fires by comparing the mass spectra of the wood waste burning event with PMF mass spectra derived from a wood combustion experiment during the combustion phase of a burnout (Elsasser et al. 2013). The wood waste burnings are more typical for combustion processes rather than the ignition or ember processes during a fire. More toxic particles are emitted under these combustion conditions and affecting the human health.

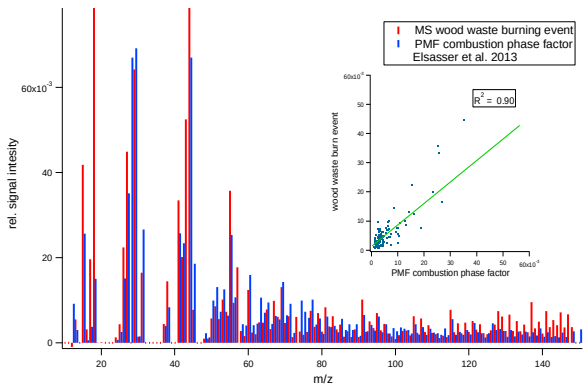

Figure 1. Separated mass spectra of a wood waste burning event measured by the ACSM at the Hohenpeißenberg site in 2015, which is compared with a PMF factor of the combustion phase during a wood combustion experiment in a logwood stove measured by an aerosol mass spectrometer.

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