Single particle analysis of cloud residuals sampled at the research station Schneefernerhaus (2650 m) during ACRIDICON-Zugspitze 2012

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During the ACRIDICON-Zugspitze campaign (17.09.2012 - 04.10.2012) at the research station Schneefernerhaus (German Alps, 2650 m a.s.l.) we investigated the chemical compositions of cloud residuals as well as the composition of the atmospheric background aerosol with a single particle mass spectrometer.

The cloud residuals were sampled with a counterflow virtual impactor (CVI; Mertes et al., 2005). During non-cloud periods this inlet was used as an aerosol-inlet to sample and analyse the background aerosol.

The chemical analysis of the cloud residuals and the background aerosol particles was done with the bipolar single particle mass spectrometer ALABAMA (Aircraft-based Laser Ablation Aerosol Mass Spectrometer) with a particle size range of 150 to 900 nm (Brands et al., 2011). Additionally the particle size was measured by an optical particle counter (OPC, Grimm 1.129) with a particle size range from 0.25 to 52 µm.

Over the whole time period about 3300 useable spectra were acquired during background aerosol measurements and about 5500 useable spectra of cloud residuals during cloud events. For further investigations only those spectra that have both polarities were used, in order to facilitate the assignment of these particles to distinct particle types. The evaluation of the data was done with the software package CRISP (Klimach et al., 2010) which contains three different sorting algorithms. This program allows for assignment for the mass spectra into different clusters that contain similar mass spectra. In this case the spectra were separated with the fuzzy c-means algorithm (Hinz et al., 1999).

The comparison of the chemical compositions of the cloud residuals and the particles of the background aerosol does not show any significant differences. This suggests that in the analysed size range all particles are activated as cloud droplets independent of their chemical composition. In both cases the main clusters contain particles with secondary inorganic compounds like sulphate and nitrate and potassium. For the cloud residuals this particle type represents 28% and for the background aerosol particles 24% of all investigated mass spectra.

Additionally, both the cloud residuals and the background aerosol particles show mainly particle types with secondary inorganic components internally mixed with organic compounds and/or carbon fragments.

The main difference between cloud residuals and background aerosol is that more particles containing lead were found in the cloud residuals (36 spectra in cloud residuals and only 3 in background aerosol). Whether the lead containing particles are preferably activated as cloud droplets or this finding is a result of different air mass origin has to be investigated.

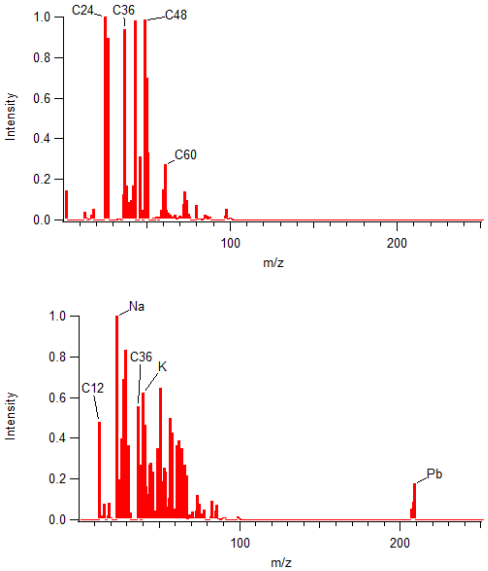

Fig. 1: Average spectra from the particle type which include lead of the background aerosol; above: anions, below: cations.

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