Real Time Detection of Primary Biological Aerosol Particles (PBAP) in the context of atmospheric ice formation

Primary Biological Aerosol Particles (PBAP) include several microorganisms either dead or alive. That the most ice active substances are the biological ones makes the PBAP important, not in global scale but maybe in regional scale. They can act as giant cloud condensation nuclei (GCCN) or ice nuclei (IN). There is still ongoing research about the diversity of biological aerosols. Their complex structure makes it difficult to detect and characterize with high time resolutions. Ultra violet light/laser induced fluorescence (UV-LIF) method has been used lately for detection of PBAP. Although the UV-LIF method does not provide information in species level it is a great tool to gain information about biological aerosols in real time. In this presentation some important results from three consecutive field campaigns at different locations and different altitudes and as well as laboratory tests performed by using the latest version of the wideband integrated bioaerosol sensor (WIBS4) will be shown.

At each location spatial and temporal variability of fluorescent biological aerosols have been studied. Starting with laboratory tests including real time detection of several biological aerosols (i.e., bacterial strains, fungal spores, Snomax) and non-biological aerosols (i.e., ammonium sulfate, Saharan dust, cast soot, Arizona Test Dust) sensitivity of the WIBS has been inspected. After that three field campaigns (each for almost one year) have been performed. Sampling locations are a semi-rural site near Karlsruhe (Germany), at Zugspitze research station (near Austria border), and at Jungfraujoch (JFJ) research station (high alpine research station in Switzerland) respectively. During each field campaign single particle fluorescence data were collected. A new data analysis routine has been written and applied to all data. It has been found that in Karlsruhe the biological aerosols are strongly correlated with relative humidity. The maximum has been observed in summer and the minimum in winter season. At Zugspitze no seasonality has been seen. However similar dominating mode for biological aerosols was seen especially in summer season when the sampling site was lying below planetary boundary layer. As expected the number concentration of biological particles was the lowest at the JFJ station since the sampling site lies most of the time in free troposphere.

Following the results of cloud activation experiments conducted at the AIDA cloud simulation chamber, Saharan dust events (SDE) at the JFJ station were observed. Bioaerosol number concentration increased clearly during the SDE. Finally by using the new ice selective inlet and the WIBS4, during a SDE the bioaerosols have been investigated for the ice residuals. The ratio of number of fluorescent particles to total aerosol concentrations have also been calculated. This study clearly shows the first indication for the enrichment of biological particles in the ice phase, especially for particles between 1 and 5 μm.