Aerosol mass spectrometry on a Zeppelin NT in the planetary boundary layer

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The airship Zeppelin NT is an airborne platform capable of flying at low speed throughout the entire planetary boundary layer (PBL). Equipped with a high scientific payload of more than 1 ton, the Zeppelin is an ideal platform to study regional processes in the lowest layers of the atmosphere with high spatial resolution. Here, we will focus on secondary aerosols

Atmospheric aerosols are medium long lived and are of particular interest due to their influence on the global radiation budget. Measurements on board the Zeppelin NT can serve to separate processes of local production from transport processes.

For aerosol measurements on the Zeppelin NT, a High-Resolution Time-of-Flight Aerosol Mass spectrometer (DeCarlo *et al*, 2006) was adapted to the requirements of the an airborne platform. A weight reduction of over 20 % compared to the commercial instrument was achieved, while space occupation and footprint were each reduced by over 25 %. The instrument is now certified to withstand an emergency landing scenario with forces of over 4 kN acting on it.

Within the PEGASOS project (Pan European Gas-AeroSOl-climate interaction Study), the instrument took part in 10 measurement flights over the course of seven weeks. Three flights were starting from Rotterdam, NL, seven flights were starting from Ozzano, IT near Bologna in the Po Valley. Flight patterns included vertical profiles to study the dynamics of the PBL and cross sections through regions of interest to shed light on local production and transport processes.

Exemplary, data obtained during such cross sections on 21 June 2012 were used in conjunction with backward trajectories calculated using the HYSPLIT web-interface (Draxler and Hess, 1997) with meteorological data from GDAS (Parrish and Derber, 1992) to estimate the aerosol production rate of the Po Valley as a source region (see Fig. 1). The aerosol production rate found for nitrate aerosol was the highest, followed by the organic aerosol formation rate. Sulfate aerosol exhibited a low formation rate.

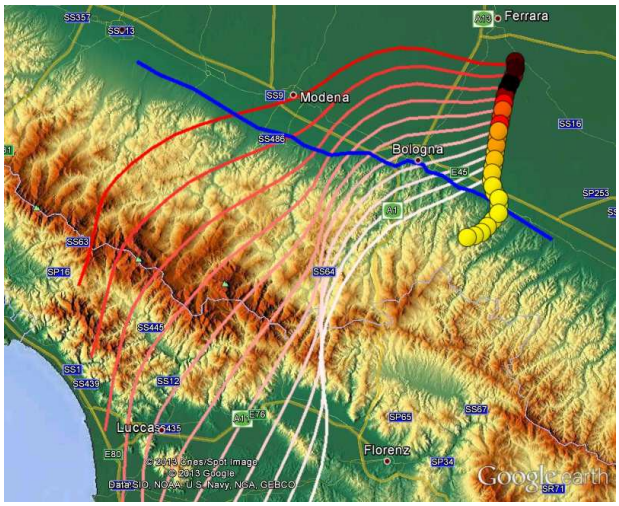

Figure 1. Comparison between nitrate aerosol mass concentration and air mass residence time in Po Valley, IT. Darker dot colours correspond to higher nitrate mass concentration. The highest values were observed crossing the trajectory with the longest residence time in the Po Valley.

The new instrument was operated successfully on nine out of ten measurement days under at times harsh conditions with ambient temperatures of up to 40°C and relative humidities of up to 90 %.

New insights into the aerosol chemical composition as a function of height were gained from regional sections as well as vertical profiles. Furthermore, a new method to elucidate the functionalization of organic aerosol was developed.

These findings will be presented in detail.

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