In-situ absorption measurement of HULIS and mineral dust components as well as winter time ambient aerosol using multi-wavelength photoacoustic instrument. A laboratory and a field study

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Aerosol can interact with solar radiation via absorption and scattering. While backward scattering directly cooling the atmosphere, forward scattering redistribute the electromagnetic energy without affecting the annual global average of atmospheric temperature. The absorption processes directly heat the atmosphere. The net effect is cooling, but the accuracy of its amplitude is really questionable, in part since, the lack of the reliable instrumentation for in-situ absorption measurement (Lack et al., 2006). The only method which could directly measure light absorption by aerosol is photoacoutic, but it is not widespread in its application yet (Meinrat. O. Andreae, 2005). Very recently, multi-wavelength photoacoustic instruments become available for in-situ spectral characterisation of aerosol and open up a new perspective for reliable and selective in-situ carbon content identification (Lewis et al, 2008 , Ajtai et al, 2010).

In this study we present mass specific light absorption coefficient of re-dispersed dust components such as illit, caolinite, quartz, calcite, rutile, hematite as well as HULIS aerosols in the whole climate relevant and the photochemically active UV region. The measurements were made by our state-of-the-art multi-wavelength photoacoustic instrument (4λ-PAS, Ajtai et al, 2010). Based on the photoacoustic absorption measurement we calculated the two wavelengths Absorption Angström Exponent (AAE) of the investigated aerosols refer to UV, VIS, and Near-IR spectral region. We experimentally demonstrated that the absorption feature of mass specific aerosol absorption (MAC) could be used as chemically selective parameter. We also demonstrated that the selectivity of the composition identification through in-situ measured absorption feature might be increased by taking into account the wavelength dependency of AAE. Moreover, we demonstrate that forcing calculation based on the wavelength dependent AAE is more accurate than forcing calculation used the commonly applied single wavelength AAE approach.

We also present here results of in-situ spectral responses of ambient aerosol under wintry conditions in urban environment. The hourly concentration of gaseous pollutants (CO and NOx), trace elements (i.e. K, Ca, Fe, and Si) as well as the size distribution of ambient aerosol were also analyzed during the whole measurement campaign. The levoglucosan measurement was made to confirm that the daily fluctuation of ambient AAE governed by the changes in the relative strength between the traffic and residential heating emission. Finally, we demonstrate correlations between the measured two wavelengths AAEs and the concurrently measured other aerosol variables such as size distribution, gas and trace elements concentrations. All the correlations are quantified using both single wavelength and wavelength dependent AAE.

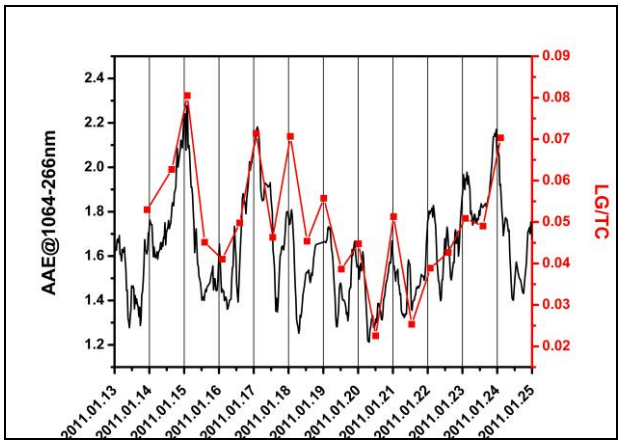

Figure 1. The time series of AAE and the relative strengths of levoglucosan/TC concentration

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