Atmos. Chem. Phys. Discuss., 11, C8606–C8610, 2011
www.atmos-chem-phys-discuss.net/11/C8606/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Scattering and absorption by aerosols during EUCAARI-LONGREX: can airborne measurements and models agree?" *by* E. J. Highwood et al.

Anonymous Referee #2

Received and published: 6 September 2011

GENERAL COMMENT

The manuscript presents results from optical closure studies for anthropogenically influenced aerosol over Central Europe, based on data collected by the FAAM research aircraft during EUCAARI-LONGREX 2008. The paper tackles the highly relevant topic of deriving aerosol optical properties from airborne measurements of aerosol chemical composition and size distribution by means of optical closure. This approach is widely used for providing input data to global climate models based on observations.

The manuscript claims a very general approach of determining aerosol scattering and absorption from airborne measurements. However, the core part of the manuscript fo-

cuses exclusively on the abilities of the FAAM instrumentation, neglecting data which were collected during EUCAARI-LONGREX by other airborne platforms. The authors correctly state the need for more reliable airborne data on aerosol absorption and relative humidity, but they do not refer to full extend to the work conducted on this topic by other research groups. It is therefore suggested to modify the title of the manuscript accordingly, or to extend the scope of the manuscript.

One key shortcoming of the results presented is lack of precise aerosol absorption measurement data. This lack of data however is mainly due to the instrumentation operated on board of FAAM instead of a general weakness of available measurement techniques. Performing optical closure of aerosol extinction based on absorption data which show deviations of 50% and higher between observation and model result is debatable. I highly recommend discussing at least the papers by Schmid et al., (2006), Fiebig et al., (2002), Petzold et al., (2002), and Weinzierl et al. (2009). In all these publications, optical closure of extinction is performed based on airborne measurements and Mie theory. Hence, the level of precision reported in these publications should form the benchmark for results from FAAM measurements. Furthermore, the paper by Hamburger et al., (2011) also reports black carbon measurements from an airborne platform during EUCAARI-LONGREX which are compared to observations at the EUCAARI ground stations. Additionally, extinction measurement data are available for EUCAARI-LONGREX from the DLR Falcon High Spectral Resolution Lidar (HSRL). I suggest extending the data analysis and to include all these data fro other platforms.

In summary, the manuscript makes a significant contribution to the topic of aerosol-radiation interactions and deserves publication in ACP. However, major revisions are requested, as outlined previously. Specific comments are discussed in the following section.

SPECIFIC COMMENTS

1. Section 2.1. The overall meteorological situation is described extensively by Ham-

burger et al. (2011). Please refer to this paper when discussing meteorological situations.

2. Section 2.2.1. Mass extinction is inferred from AMS data for the non-refractory components and from SP-2 data for absorbing components. This approach misses any non-absorbing or weakly absorbing refractory particles like sea salt and dust. Please discuss the expected uncertainties. Sea salt is of particular importance, because some of the selected flight levels were conducted over sea. For a potential different approach see the inversion scheme developed by Petzold et al. (2009) for the combination of airborne PSAP and size distribution data using Mie theory.

Furthermore, a brief description of the inversion of particle size distribution data including resulting uncertainties is required. Please refer to Hamburger et al. (2011) instead of McMeeking et al. (2010) for the instrumentation of the DLR Falcon.

3. Section 2.2.3 and Section 3.2. I am surprised to see absorption contributions to extinction of 1% even over polluted regions. This is in contrast to other observations during EUCAARI. I suggest a discussion of the low level of absorption in the presented data. Furthermore, I suggest presenting observational data as median, 25-percentile and 75-percentile instead of average and standard deviation. This is particular valid for the campaign average of the single-scattering albedo which is given as 0.93 +/- 0.37.

4. Section 5. Subsection 5.1 can be omitted because there is no Subsection 5.2. As discussed previously, DLR Falcon HSRL data for aerosol extinction should be used for comparison. The conclusions drawn from the highly uncertain absorption data should be discussed also in comparison to other observations because an uncertainty of 50% for absorption is not the ultimate limit achievable with current instrumentation.

5. Figure 9: Please add error bars to the data points.

6. Table 2. Please reference the work by Virkkula et al. (2005; 2010) on PSAP inversion.

TYPOS

1. Throughout the text: I suggest writing “coefficient” instead of “co-efficient”. 2. Page 18491, line 2: correct “SP-2”.

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