Atmos. Chem. Phys. Discuss., 10, C6154–C6157, 2010
www.atmos-chem-phys-discuss.net/10/C6154/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Enhancement of the aerosol direct radiative effect by semi-volatile aerosol components: airborne measurements in North-Western Europe" *by* W. T. Morgan et al.

Anonymous Referee #2

Received and published: 6 August 2010

This study presents the aerosol vertical profiles and their radiative properties during the EUCAARI-LONGREX campaign in May 2008. The manuscript focuses on the semi-volatile aerosol species such as nitrate and organic aerosols. The authors conclude that the concentration of nitrate aerosol increases with height within PBL because lower temperature and higher relative humidity there shift the gas-aerosol partitioning of semi-volatile aerosols. They also conclude that this increase in semi-volatile aerosol significantly contributes to the column aerosol optical properties and radiative forcing. The topic of this study is very interesting, and the aircraft data obtained during this campaign are valuable. However, some parts of the results and interpretations (especially in sections 4 and 5) are insufficient and inconsistent. The following comments

should be addressed before this manuscript is accepted for publication.

1.Gas-aerosol partitioning of nitrate and organics

The vertical profiles of total nitrate (gaseous HNO3 + aerosol nitrate) and organics (volatile organic compounds (VOCs) + aerosol organics) are unknown with the lack of the data of HNO3 and VOCs. Therefore, there are no observational evidences of gas-aerosol partitioning of nitrate and organics (temperature and RH are indirect evidences). The discussion of the gas-aerosol partitioning should be toned down in the manuscript.

2.Mie calculation

Because the authors assume volume-mixing refractive indices, the absorption coefficient is probably overestimated, resulting in the underestimations of scattering coefficient and single scattering albedo in the Mie calculation. In addition, the treatment of same chemical composition and mixing states (well-mixed internally) for all particles is quantitatively problematic (especially for absorption coefficient and single scattering albedo) [e.g., Oshima et al., JGR, 2009; Zaveri et al., JGR, in press]. In section 5.3, the authors conduct the sensitivity calculation of water uptake by ammonium nitrate (NH4NO3) using the Mie calculations. However, the agreement between measurements and the Mie calculations is not so good (section 5.3). Since the two nephelometers were used (dry and ambient), the effect of water uptake by NH4NO3 (majority of total dry aerosol) can be derived solely from these measurements without making sensitivity calculations. The importance of the Mie calculations should be explained.

3.Consistency between aerosol mass (section 4) and its optical property (section 5)

In section 4, the authors discuss the increase in NH4NO3 with height within PBL using the vertical profile of B366 (Figure 6a). On the other hand, in section 5, the scattering coefficient does not so increase with height (Figure 9a). From the viewpoint of aerosol mass-optical closure, the consistency between Figures 6a and 9a should be explained

in the manuscript. In addition, the authors mainly focus on B366 (the vertical profile of B379 is not shown) in section 4, while they use both B366 and B379 in section 5. Especially, B379 is quite important in terms of the increase in scattering coefficient with height within PBL. Therefore, to discuss the results of B379 in section 5, the vertical profile of aerosol mass concentration of B379 should be also shown in section 4, even though the vertical coverage is not enough.

4.Consistency between surface and aircraft measurements

The consistency between surface and aircraft (lowest altitude) measurements should be discussed quantitatively in the manuscript. In Figures 6 and 9, the values of ground-based measurements and aircraft measurements around 500 – 1000m are very different. It is not clear whether this difference is fully from the increase in NH4NO3 with height or due to the uncertainties in the measurements (surface and aircraft measurements). This point influences the whole results presented in section 5.

5.AMS instrument (P10660, Line 10∼)

The information of measured size range should be given.

6.Nephelometer measurement at Cabauw (P10662, Line 11∼)

It should be clarified that the Nephelometer at Cabauw measured aerosol scattering coefficient on dry condition.

7.Vertical profile of SV-OOA (P10667, Line 21)

If the gas-aerosol partitioning of SV-OOA is important, it should be directly shown in Figure 6a (not using LV-OOA mass fraction).

8.Number of data points of individual altitudes in Figure 6a

The number of the data points should be given for individual altitudes. Especially, it is important to show the number of the data points between 1700 – 2200 m (the layer of nitrate enhancement) to confirm statistical reliability.

9.Number concentrations at surface (L10669, Line 1)

Is the aerosol number concentration derived from AMS measurement at ground-based site? The procedure to derive the number concentration should be mentioned.

10.Caption of Figure 9

It should be mentioned in the caption of Figure 9 that the scale of x-axis (Figure 9b) is different between aircraft and lidar measurements.

11.P10672, Line 3: “with agreement to within 30% compared with the measured values”

It is not clear that which parameter is discussed in this sentence (extinction, scattering, absorption coefficients, or others).

12.Fig. 5b should be changed to Fig. 5c. (P10667, Line 2)

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 10653, 2010.