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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 #1

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This manuscript presents vertical profiles that show enhancements of ammonium nitrate and organics in the cooler, humid region at the top of the boundary layer. These enhancements are large enough to significantly affect the aerosol optical depth. The data add to the literature on the expected enhancement of ammonium nitrate. The enhancement of organics is interesting and points to the importance of semivolatile organics.

Qualitatively, these data are convincing. Quantitatively, there are significant questions related to inlet transmission and especially aerosol bounce in the AMS. These should be addressed before publication. Also, some measured size distributions should be

shown since these are crucial to assessing the nephelometer and AMS performance.

Inlet transmission: The manuscript states that the AMS inlet was not pressure controlled. Under these circumstances both the aerodynamic sizing and the inlet transmission will be a function of pressure. According to Appendix A, only the sizing was corrected. The statement that the mass measurement will not be affected "unless the lens performance is altered beyond the transmission envelope of the lens" is at best confusing. Since lens transmission is to first order controlled by the Stokes number and the Stokes number is pressure-dependent in the AMS inlet regime, the first-order response of the lens to pressure is that the entire transmission function will shift to smaller sizes at higher altitudes. The error in the mass measurement depends on how the size distribution overlaps the lens transmission.

Aerosol bounce: First, the collection efficiency factor used to reduce the AMS data must be stated. Different authors use varying factors. Second, collection of the moist, nitrate-rich particles at the top of the boundary layer is likely to be significantly higher than the drier particles with relatively more sulfate at the surface. Since the AMS collection efficiency for dry ammonium sulfate is 20 to 25% and is near 100% for moist ammonium nitrate, this could be significant. Organic coatings reduce but generally do not eliminate this spread. How was the collection efficiency assessed?

Two ways both the inlet and collection terms might be bounded are (1) assume that sulfate was well-mixed in the boundary layer and use it to correct the relative profiles of the other species or (2) compare the AMS data to the PCASP data. Figure 7 compares AMS mass to PCASP number. A comparison to PCASP volume would be more useful, perhaps with a correction for estimated water uptake from the f(RH) data.

p. 10662 lines 5+: Did the size distributions show that the humidified particles were still small enough for the Anderson and Ogren nephelometer truncation correction to be valid? Also, the nephelometer truncation error is slightly sensitive to the assumed refractive index, and water uptake will lower the refractive index (Massoli et al., AS&T,

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42, 1064, 2009).

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