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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ambient black carbon particle hygroscopic properties controlled by mixing state and composition" *by* D. Liu et al.

Anonymous Referee #2

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This paper presents measurements of the hygroscopic properties and the composition of black-carbon-containing particles using a combination of a HTDMA, a SP2, and a SP-AMS instrument. The particle samples were collected in the ambient atmosphere at a coastal site in the UK during the month of June/July 2011, and different air masses were sampled. One less hygroscopic mode and one more hygroscopic mode of BC-containing particles were identified, with the hygroscopicity depending on the coating material (inorganic versus organic). One interesting outcome of this study is the importance of ammonium nitrate as a substance responsible for an effective conversion of BC particles from hydrophobic to hydrophilic.

General comments: This study is within the scope of ACP and presents interesting results regarding the mixing state of BC particles in the ambient atmosphere. The

quantitative characterization of the BC coating (including the type of coating) for different environmental conditions throughout the month is a valuable contribution to the body of literature on BC mixing state. Observational evidence that nitrate is a potentially important BC "aging agent" is useful information for modelers. The paper is clearly structured and well written, and I recommend it for publication after some clarification and minor revisions have been done as suggested below.

Specific comments:

1. page 28960, first paragraph: It would be helpful to add a few sentences on how the categorization of air masses was done (even though the procedure is described in Fleming et al., 2012). I assume that the pathway of an air mass would often pass over several sectors. How is the air mass assigned in such a case?

2. It would be interesting to see how large the fraction of BC-containing particles is, and how this varies over the course of the experiment. I suggest that you consider adding such a time series to Figure 3, for example.

3. Is it possible to separate the whole data into day versus night datasets? For example, it would be interesting to see if the hydrophobic BC mode is stronger during nighttime or not. (Difficult to tell from Figure 5). Likewise, it would be interesting to see if the coating material of the BC particles shows a day/night difference.

4. The role of nitrate for BC aging has been pointed out by a few modeling studies on the mesoscale as well as the process scale, for example by Riemer et al. (2004) and Riemer et al. (2010). I suggest including these references in the manuscript.

5. p. 28964, l. 10: "Note that like the standard AMS, the SP-AMS quantifies particulate matter in bulk, as opposed to analysing individual particles": This statement is somewhat confusing because, in general, both instruments are capable of producing size-resolved composition information. Later in the manuscript you mention that the SP-AMS was in fact not used in size-resolving mode because of signal to noise prob-

lems, but I suggest that you rephrase this sentence on page 28964 to "... in bulk or at best size-resolved". 6. Fig 4: What do you mean by "raw number concentration"?

7. Fig. 5 and 6: The phrase "inverted concentration" as y-axis label sounds strange (although it may be a common phrase in the HTDMA community?). I assume you want to indicate that the this is a result from applying the inversion method, but you do mention this in the text, so simply "concentration dC/d(gf)" sounds much clearer. The same comment applies to the term "inverted gf" later in the text.

8. Fig. 6, top graph: Are these fractions averaged over all BC-containing particles (hydrophobic and hydrophilic)?

9. What about the contribution of sodium chloride? I would assume that sea salt contributes to the inorganic mass of the particles. If it does and if it is not included in the growth factor modeling, this will also contribute to the differences between observation and model result.

Technical comment: Page 28973, line 16: Should read "2.1".

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 28955, 2012.