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Atmospheric
Chemistry
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Discussions

Interactive comment on "Composition and properties of atmospheric particles in the eastern Atlantic and impacts on gas phase uptake rates" *by* J. D. Allan et al.

Anonymous Referee #2

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Allan et al. describe ambient measurements from two locations of aerosol size distributions, chemical composition, and subsaturated hygroscopic growth during the ACCME and RHAMBLE campaigns, to investigate marine aerosol chemistry. This topic is well suited for the scope of ACP. The experimental methods used are entirely appropriate and the data analysis appears to have been carefully and thoroughly performed. In general the measurements present a consistent picture of the aerosol's chemistry. The manuscript is also clear and well written for the most part, providing the appropriate level of detail. While I have no major concerns with the paper, I did not find it to present any significantly new findings that would advance the field's understanding or address key outstanding questions. It appears to mostly serve as a future reference for other

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papers from the same study. It is unfortunate that such a well conducted campaign appears to have produced so few significant results; the measurements and analysis read as very “routine” to me as currently presented. This could potentially be improved if the major questions that are being investigated were stated up front, and then addressed using the measured dataset. Nonetheless, this manuscript is acceptable for publication with minor revisions once the following issues are addressed, but could be significantly improved by the authors beyond these minor issues.

General comments

The abstract states “Marine aerosol composition continues to represent a large source of uncertainty in the study of climate and atmospheric chemistry”, and some of these issues are discussed in the Introduction, but these questions are then never explicitly addressed in the manuscript’s Discussion. This really leaves me wondering what was learned from this dataset, and how does it address some of the issues presented in the Introduction? As currently presented I don’t feel this paper will significantly contribute to the field’s understanding of marine aerosol chemistry.

For example, the importance of marine sources of organic aerosol are discussed in the Introduction, but then barely mentioned in the Discussion. There are several other similar disconnects.

In general, the paper could be significantly improved if novel and significant results obtained from this study were more clearly stated and presented, and then summarized in the Conclusions.

The final section, regarding the feedbacks between aerosol hygroscopicity and multiphase chemistry had the most potential, but in the end did not seem very well developed or interesting. Why was the uptake of HOI the only compound that was studied using this analysis?

Some of the findings presented here have been observed in other marine studies. In particular the influence of mineral dust on the heterogeneous chemistry and chloride displacement of sea salt (pg. 18349) was observed during the ACE-Asia campaign in a polluted marine air mass (Bates et al., 2004; Sullivan et al., 2007; Tang et al., 2004).

Specific comments

Page 18333, line 17: Marine sources of organics – extensively studied by Kawamura's group, e.g. (Kawamura and Gagosian, 1987; Mochida et al., 2003; Mochida et al., 2007).

Page 18334, line 15: Particle phase also important for determining reaction pathways and kinetics.

Page 18334, line 22: Particle must deliquesce before undergoing hygroscopic growth. Should be some discussion of phase transitions in this section.

Page 18334, line 24: This muddles the differing roles of solubility and hygroscopicity on a particle's hygroscopic growth, see for example (Hori et al., 2003; Petters and Kreidenweis, 2008; Sullivan et al., 2009).

Page 18342, line 11: Calcite has a very low solubility. You can use this to estimate what mass of total calcium was present in the aerosol based on the fraction of soluble calcium that is measured, for the extreme forms of insoluble calcite, and soluble calcium nitrate.

Page 18342, line 12: Calcium sulfate is not soluble, it is as insoluble as calcium carbonate.

Page 18342, line 22: What about uptake of nitrate (and chloride, and SOA) by mineral dust when it is present?

Page 18343, line 25: The mass absorption efficiency of 6.67 m2/g is a bit low, Bond & Bergstrom (2006) recommend 7.5 m2/g at 550 nm for uncoated soot.

Page 18349, Line 1: Could the greater chloride depletion in submicron sea salt also be attributed to the larger surface area to volume ratio of smaller particles? (Song and Carmichael, 1999) As you are sampling directly above the ocean I would not expect the sea salt particles to have a widely different residence time versus particle size when sampled.

Page 18349, Line 6: Compare the influence of dust on chloride displacement from sea salt with ACE-Asia, and possibly other dust-influenced marine studies.

Table 1: "(2300)" is repeated.

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