Atmos. Chem. Phys. Discuss., 14, C683–C689, 2014
www.atmos-chem-phys-discuss.net/14/C683/2014/

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Composition of 15–80 nm particles in marine air" *by* M. J. Lawler et al.

Anonymous Referee #1

Received and published: 24 March 2014

General comments

This paper presents aerosol chemical composition at Mace Head, Ireland inferred by hygroscopic tandem differential mobility analysis (HTDMA) and measured by a thermal desorption chemical ion mass spectrometer (TDCIMS) during the second half of May, 2011. The primary observation is the sudden occurrence of particles 10-60 nm in diameter. These events are dominated by sulphate, as measured by the TDCIMS and inferred by the HTDMA. The authors attribute these events to particle nucleation over open oceans from biogenic sources. They also measured detectable chloride ion levels throughout the study for particles $<$ 80 nm, demonstrating that sea-salt can be present in even the smallest particles.

These are perhaps the first in-situ measurements of the composition of marine aerosol $<$ 80 nm in diameter and represent an exciting new addition to our under-

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

standing of aerosol in these environments. While these measurements alone would merit publication in this journal, the discussion section should be expanded and the results interpreted at greater depth. Much of this manuscript is devoted to describing the observations without much accompanying analysis.

The language could use more polish and was imprecise in the authors' discussion of events. Five types of events are presented, however, the text often refers to "an event" without specifying the type. This made it difficult to follow some of the arguments.

Overall, I recommend that this manuscript be published if the comments below are adequately addressed.

Specific comments
Page 2089, line 8
It is important to note that particle growth can only occur if these compounds do not fragment and revolatilise.

Page 2091, line 15-17
The text states that the SMPS is comprised of a long DMA with a model 3010 CPC. According to the manual from the manufacturer, this combination of instruments only measures particles with diameters larger than 10 nm. However, the size distributions shown in Figure 1 panel b show measurements for particles as small as 4 nm. Was there a second instrument used? If so, the details should be included here.

Page 2092, line 7
Can the authors elaborate on how they are able to measure sodium chloride from sea salt when its melting point is $800°$C but the wire is only heated to $600°$C?

Page 2091, line 11 and Page 2097 lines 9-13
The terminology throughout the paper is unclear. On page 2091, “nanoparticle enhancement events” are described, but on page 2097, four other types of events are described. Do the “nanoparticle enhancement events” include the sub-50 nm and 50 nm events in the latter cateogrisation? Subsequent paragraphs refer simply to “the events” which is ambiguous. Please clarify this throughout the manuscript.

Page 2096, lines 14-15
Please be more quantitative. How many of these events occurred during the two weeks of sampling? Of these, how many were associated with polar marine air? Including a sample trajecotry for these periods would also be helpful.

Page 2097, line 1
From Figure 1, it would appear that no HTDMA data were collected during the background aerosol event. However, data are shown in Figure 3. It would be helpful if data from the entire two weeks of sampling were shown in Figure 1 and then averages for specific periods shown in separate figures (see below).

Page 2097, lines 8-10
It would be helpful to include average SMPS distributions for the four periods, similar to Figure 3.

Page 2098, line 23
Can the authors be more quantitative? What does the scatterplot look like? What is the r^2?

Page 2099, lines 10-15
Figures showing the average ion signal fraction (both negative and positive), as well as chloride to sulphate ratio for each of the periods would be helpful. That way they

can be objectively compared instead of trying to estimate their differences based on the time series.

Page 2099, lines 12-14
Based on the discussion on page 2097, it would make sense that these sulphate-rich particles were smaller than 51 nm and therefore not detected by the HTDMA.

Page 2099, line 14
Providing a study-long chloride to sulphate ratio and comparing it to the two periods that are specified would be more quantitative.

Page 2099, lines 19-23
Are the relative sensitivity of the instrument to chloride and sulphate expected to vary throughout the study? A calibration in the laboratory using an artificial sea water solution should be able to determine the actual sensitivity, so that the authors can be more specific than “slightly higher”, as stated on line 21. This way the non-sea salt sulphate contribution can be better understood.

Page 2100, line 23
The plots in Figure 4 and the associated r^2 show the explanatory power of collected mass on the selected ions, not the other way around, as implied by this sentence.

Page 2100, line 24
Which events are referenced here? The sea salt events? The sub-50 nm events? Or the 50 nm events?

Page 2101, line 5
The discussion section should be its own section and should be expanded. For example, the results in the last paragraph of section 3.2 could be moved here and the

measurements from the TDCIMS incorporated in the discussion. Putting these results in context to past measurements would also be helpful.

Page 2101, line 7
Can the authors rule out the possibility that the aerosol were primary organic particles that are coated by sulphate, as suggested by Leck and Bigg (2005)? It would appear that the TDCIMS is not necessarily sensitive to these primary organics. They could also contribute to the reduced growth factor observed in the HTDMA.

Page 2102, line 3
Please quantify “essentially always”. Was it 50% of all measurement times? 90%? And please be specific about the particle size fraction. According to the HTDMA data for 51 nm particles, the 50 nm event did not contain any sea salt.

Page 2102, line 9
It seems like a big leap to extrapolate the observations from these two weeks in May. Some qualifications should be included and the language relaxed.

Technical corrections

Page 2091, line 15
Change to “**a** Scanning Mobility”.

Page 2095, line 14
Change to “measurements **are** given”.

Page 2097, line 1
Why is Figure 3 mentioned before Figure 2? The figure order should be updated.

Page 2098, line 17

The sentece could be improved by rewording it to “the volume and mass increase as the particle diameter cubed”.

Page 2100, line 18
Change the wording to “Sulphate signal . . . was best explained by collected mass”.

Page 2100, line 18
The r^2 in the figure is 0.37 but is 0.36 in the text.

Page 2100, lines 19-21
Reword this sentence so that it is clearer. Something along the lines of “This can be explained by the fact that the mass collected was highest during the nanoparticle enhancement events, which generally contained significant fractions of sulphate.”

Page 2100, line 23
Add “(not shown)” after 0.08.

Page 2101, line 9 and 17
Change idea to “hypothesis”.

Page 2101, line 16
Change operate to “occur”.

Figure 1
This figure is referenced throughout the text. However, the numerous panels can be difficult to locate and it would help if the panel letter could be included every time it is discussed. That way the reader can easily determine the relevant part of the referenced figure.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

References

Leck, C. and Bigg, E.K.: Source and evolution of the marine aerosol–A new perspective, J. Geophys. Res., 19(32), 28–31, 2005.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 2087, 2014.