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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Natural new particle formation at the coastal Antarctic site Neumayer" *by* R. Weller et al.

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We thank referee #1 for his constructive and detailed comments and suggestions, which added to improve and clarify our manuscript (ms).

* 5 day trajectories. The decision on the length of trajectories used should be discussed here in terms of the uncertainty. Authors have mentioned this in passing but a more thorough discussion of the topic should be performed given the high uncertainties present in the input meteorological datasets in this region.

We agree that the limitations of our backward trajectory approach should be stated more clearly. Respecting revisions are now included in chapter 2.1. However, it is inherently difficult to provide a reliable uncertainty assessment. We carefully used tra-

jectory analyses in our evaluation to avoid any over-interpretation. In summary trajectories did neither indicate a pronounced impact of marine nor of descending air masses from the free troposphere. Hence in our case, trajectory analyses appeared equivocal in evaluating a rather local process like NPF, probably because of their inherent spatial uncertainty particularly in regions sparsely supported by meteorological data (this conclusion is now added in chapter 3.2).

* Detailed analysis/interpretation of the particle formation event isn't presented and would be useful, particularly for the single particle formation event that the authors pick out as a case study.

We added now a detailed case study (new chapter 4.1 in our revised ms).

* Discussion about precursors and conditions leading to NPF events is minimal, and given the other measurements available at Neumayer, could be significantly strengthened. This would significantly strengthen the precursor discussion presented in the paper.

Referee #2 raised the same point and in this regard we revised our ms, especially by the inserted new chapter 4.1.

* Discussion of iodine oxide nucleation requires a consideration of the seasonality of the IO concentrations. It should also be described what concentrations are required for nucleation to occur so that the reader is able to determine for themselves if the Antarctic concentrations are high and/or sufficient.

We provided more information on IO measurements at NM in chapter 4.4. In fact IO concentrations required for observed NPF at NM cannot be assessed on the base of our measurements. Considering the available laboratory-, field- and model results, it appears difficult to estimate IO concentrations needed to provoke significant particle nucleation but it seems that several pptv IO or OIO would be necessary (we remarked this in the revised version in chapter 4.4).

Specific minor concerns:

* Page 15657, Line 1 - the sentence starting with “One focus of interest. . .” should begin a new paragraph

Corrected

* Page 15657, Line 7 – sentence beginning “Concerning the marine troposphere. . .” should be revised, this currently does not flow nicely.

We revised the sentence.

* Page 15659, Line 22 – please give a reason as to why 4 consecutive spectra were averaged.

It is just a reasonable compromise between time resolution and noise level.

* Page 15660, Line 3 – change “referred to Dal Maso . . .” to, “As in Dal Maso. . .”

Changed.

* Page 15660 Line 8 – why are ionic composition measurements introduced in the methods section? They are not utilised at all throughout the study. These should be removed.

The ionic composition of the aerosol is now involved in the discussion (new chapter 4.1).

* Page 15661, Line 15-19 – please revise this sentence, currently it does not make sense. It may also be worth defining what the particle growth criterion is that you are getting rid of and why the spatial distribution of the event is relevant here.

Originally Dal Maso et al. (2005) defined a NPF event exclusively when particle growth could be detected. But as already mentioned in Dal Maso et al. (2005) and O’Dowd et al. (2002a), this criterion seems not to be appropriate in case of more local sources. We deleted this passage, because it does not add much to the case.

* Page 15661, Line 23-25 – revise sentence grammar.

Corrected

* Page 15663, Line 2 – please define the units of cvapour and γ

Units are now defined; γ is dimensionless

* Page 15663, Line 15 – “striking NPF event happened in 27 January, where a simultaneous” should be changed to “striking NPF event that happened in on 27 January, where a simultaneous”

Changed.

* Page 15664, Line 14 – please define “bright”. Does this mean “cloud-free”? What were the solar radiation levels?

These terms are now specified.

* Page 15664, Line 18 – “5 days” should be “5 day”

Corrected.

* Page 15666, Line 4 – total particle number concentration increased up to 3000 cm-3 from a background of what?? What was your average?

This chapter is now completely rewritten.

* Page 15666, Line 10 – Notwithstanding should have a comma after it, so it should become “Notwithstanding, some . . .”

Corrected.

* Page 15667, Line 27 – define a scale for NH4+, and whether 10 ng/m3 is high enough to be involved and Page 15668, Line 2 – as for previous comment, but for WSOC

The role of NH3 and WSOC in nucleation is highly complicated and to assess their importance in our specific case is virtually impossible due to the lack of appropriate

data. Apart from the fact, that we just measured ammonia (NH4+) and not (gaseous) NH3, one has to know the amount and preferably also the nature of low volatile organic compounds (LVOC) involved.

* Page 15669, Line 5 – please rephrase this to include the idea that this conclusion is achieved primarily through ancillary data, rather that online measurements.

This point is now added.

* Figure 1 – labelling the x axis and the color bar. Color bar should be relabelled in linear, rather than logarithmic units.

As for the contour plot a linear size distribution scale is not appropriate (we checked this), so we persist on the logarithmic scale.

* Figures in general – it may be useful to include legends, or axis color coding in the figures to enable quick interpretations of the figure (e.g. in Figure 1c, the right axis would be blue).

Changed.

Finally we redrew Fig. S1d in the Supplementary Material due to a scaling error.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 15655, 2015.