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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "First direct observation of sea salt aerosol production from blowing snow above sea ice" *by* Markus M. Frey et al.

**Anonymous Referee #1**

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Source assignment of proxies is a basic prerequisite for interpreting climate archives in terms of past climate as well as climate change. Concerning polar ice cores, ionic impurities originate primarily from aerosol deposition. Amongst them, interpretation of sea salt aerosol deposition archived in ice cores is especially challenging and controversial because the contribution of two different and competing sources - viz. open water versus sea ice - is up for debate. In addition it became apparent that sea salt aerosol production over ice-covered oceans may contribute significantly to the global sea salt aerosol budget. The manuscript at hand addresses this pivotal subject and provides thorough and direct observational evidence of sea salt aerosol production from blowing snow above sea ice. The important conclusions drawn are based on comprehensive state of the art ship-borne aerosol and snow measurements during



winter / early springtime in the Weddell Sea region. Although the main conclusions are primarily restricted to the chosen site, there are certainly strong implications for climate research in the Southern Ocean realm and climate related interpretation of sea salt profiles from ice cores in general.

The authors have accomplished a clear, well-organized and concise paper. The methodology is sound and assumptions are identified clearly and conscientiously. From my point of view, all parts, including figures, are essential. The manuscript certainly addresses the scientific scope of ACP and I recommend a final publication after some minor revisions I specified below.

1. Abstract, page 1, line 13 and Conclusions, page 24, line19: The authors state that bromine enrichment was typical at 29 m height, but from Chapter 3.4.2 and Fig. 15, bromine depletion is evident. Please clarify.

2. Chapter 2.3, Aerosol chemical composition: Could you assess the impact of pollution on chemical aerosol composition? Was the bulk aerosol sampling contamination controlled?

3. Chapter 3.2: Impact of snow precipitation on blowing/drifting snow: Did you access the regular weather reports from the ships meteorological office in this case?

4. Pages 12/13 and Fig.7: Regarding the salinity (Sp) of blowing snow, corresponding Sp-values of the uppermost surface snow layer are decisive. Did you take samples from surface snow; say < 1 cm deepness below surface? Figure 7: The reader cannot get an idea about the salinity of the surface snow layer from this graph. It would be informative as well to specify the total depth of the snow layer shown here, not just the snow height above sea ice.

5. Chapter 3.3.2, Snow particle size distribution: Is it possible to rate the impact of the ships profile on the local wind field and eventually on the measured snow particle size distribution? 6. Chapter 3.4.1, page 19, lines 28-30: As for Antarctic winter, acid in-

duced Cl- loss is rather extraordinary because production of acidic sulphur compounds usually cease at the end of summer / fall. Are there any indications for alternative HNO3 induced Cl- loss in your data?

7. Chapter 3.4.2, Chemical fractionation of Br-, lines 28-33 and Fig. 15: There is strong bromine depletion during polar night in July when global radiation was about zero (Fig. 15b). This peculiarity deserves some discussion.

8. Figure 5 and page 12, lines 8-9: By the way: During late afternoon of the 11 July, there is an outstanding Na+ peak associated with corresponding sulphate depletion, while the wind speed seemed just close to the threshold value (well below 10 m/s throughout the whole day). Any ideas?

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