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Interactive comment on "Sea ice and pollution-modulated changes in Greenland ice core methanesulfonate and bromine" *by* O. J. Maselli et al.

Anonymous Referee #1

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General comments:

Present and past sea ice conditions play a decisive role assessing climate history and predicting future developments. Accordingly it is of pivotal importance to identify correspondingly reliable proxies. To this end this manuscript (ms) investigates the use of methansulfonic acid (MSA) and bromine records retrieved from two Greenland ice cores (Summit-2010 and Tunu) as a potential proxy for historic sea ice conditions in the Arctic. In addition pollution affected bromine deposition changes are considered. Both ice cores were analysed by current cutting-edge methods, followed by an elaborate and sound evaluation. The authors found that MSA can be primarily used as a proxy for the size of the marginal sea ice zone along specified regions of the Greenland coast line.

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The same is true for bromine regarding the preindustrial era, while afterwards bromine records are significantly influenced by human activities. On the whole the ms at hand is a nice piece of work and an important contribution on this field of research. It is well written and structured and all parts, including figures, are essential. It clearly addresses the scientific scope of CP. I recommend a final publication after some (minor) revisions specified below.

Specific comments:

Chapter 2.1: Accurate absolute dating is pivotal for the subsequent correlation analyses. Please provide a reasonable error estimate for both ice cores and assess the potential impact on the correlations shown in Figs. 5-7.

Chapter 2.4, page 7, line 146-150 and Fig. 5: Did you use 10 day back trajectories (as stated in chapter 2.4) or 10 hr back trajectories as mentioned in Fig 5 (the latter seems unreasonable unless extremely high wind velocities prevailed) – please clarify.

Chapter 3.1, page 8, line 179-182 and Fig. 2 and Table S1: Please briefly describe the way you performed the "3 step linear regression" and how you identified the points of inflection.

Chapter 3.1, page 9, line 224-232 and Fig. S2: Albeit unusual, negative bromine enrichment relative to chlorine might as well be caused by a (positive) Cl enrichment relative to Na. Corresponding Cl vs. Na scatter plots could be instructive.

Chapter 4.2: While the increase of nss-related bromine (exBr) in the industrial era is scrutinised at length, I am missing an explanation for the late summer bromine maximum in the preindustrial era (although this point is insinuated in chapter 4.2.3 line 512-517). Note that this interesting finding is in contrast to the observed BrO concentration maximum in coastal Antarctic regions occurring mainly in spring (at Halley around October/November with an apparent small secondary maximum in March/April; Saiz-Lopez et al., Science, 317, 348-351, doi:10.1126/science.1141408, 2007). Sur-

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prisingly, however, in both Polar Regions bromine activation seems to roughly coincide with the respecting seasonal nitrate maximum (i.e. October/November for coastal Antarctica, see Wagenbach et al., J. Geophys. Res. 103(D9), 11007-11020, 1998). Do you think, a similar mechanism is valid in (still pristine) coastal Antarctica?

Chapter 4.2.3, page 18, line 518-519: To be honest, I cannot realize from these figures that nitrate and bromine records “differ dramatically” in the industrial era! An additional plot showing explicitly Br vs. nitrate could be enlightening.

Minor points: Page 4, lines 63-65: write Br-/Na+ or Br/Na (but not Br-/Na).

Page 9, line 226: Sander et al. (2003).

Page 11, line 296: It is actually Fig. 5b (and not Fig. 6b).

Page 15, line 400 and 407: The correct name is 1,2 dibromethane or 1,2 dibromethylen (i.e. BrH2C-CH2Br, abbreviated DBE) – 1,2 diethyl bromide nonexistent.

Page 25, line 725-728: Please refer to the respecting final paper (not the discussion paper): Sander, R., Keene, W. C., Pszenny, A. A. P., Arimoto, R., Ayers, G. P., Baboukas, E., Cainey, J. M., Crutzen, P. J., Duce, R. A., Hönninger, G., Huebert, B. J., Maenhaut, W., Mihalopoulos, N., Turekian, V. C., and Van Dingenen, R.: Inorganic bromine in the marine boundary layer: a critical review, Atmos. Chem. Phys., 3, 1301-1336, doi:10.5194/acp-3-1301-2003, 2003.

Table S1 (caption): inflection (not infection – witty typo!)

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