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Atmospheric
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Discussions

Interactive comment on “Precipitation of salts in freezing seawater and ozone depletion events: a status report” *by* S. Morin et al.

S. Morin et al.

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We thank L. Kalnajs for his detailed and careful evaluation of our work, and we hope that he will appreciate the revised manuscript likewise, even though, modifications larger than requested were performed to this manuscript. This follows directly from the implications of the publication by Dieckmann et al. (2008), that ikaite was identified in Antarctic brines (see also the response to E. Wolff and R. Sander).

Response to general comments

Carbonate/halogen redissolution : L. Kalnajs makes a point that redissolution of carbonate (claimed by us to flaw - or at least alter - pH measurements carried out on melt frost flowers) should be accompanied by a redissolution of halogen-containing salts as well, which Kalnajs and Avallone (2006) did not observe since they found evidence for chemical fractionation between bromide and chloride in frost flowers. In the revised version of our manuscript, we have removed this section of the initial manuscript, given the large impact of the nature of the calcium carbonate which precipitates on the alkalinity of the solution, which we feel should be the main message of our revised work. The discussion on the implications of our previous conclusions on sampling methodology does not rest on bases solid enough to justify a distinct paragraph. Experimental work must first be carried out to address these issues in a quantitative manner.

Acidification of the aerosols : To our knowledge, the depletion of alkalinity in aerosols (or any surface available for the bromine activation reaction to occur) has only been viewed as a way to speed up its acidification by atmospheric acids such as HNO_3 or H_2SO_4 (Sander et al., 2006, Piot and von Glasow, 2008). We have not stated that alkalinity depletion was a necessary condition for the onset and sustainment of bromine activation (hence, ozone depletion events). It was simply hypothesized, and tested using atmospheric models (Sander et al., 2006, Piot and von Glasow, 2008), that a depletion of the alkalinity of aerosols would greatly facilitate their acidification.

Description of FREZCHEM : As stated in the manuscript (see also the reply to E. Wolff), we have preferred keeping our manuscript short and concise, focused on atmospherically relevant issues. Details on the FREZCHEM models are available in specialized, technical papers cited in our manuscript (e.g. Marion et al., 1999, Marion, 2001, Marion and Kargel, 2008).

Temperature range : it is now explained in the revised manuscript why the range extends only to 253 K, as far the carbonate system is concerned. This is the range in which the extrapolation of the thermodyanmic "true" constants is the safest (Marion, 2001). Below 253 K, we only show results relevant to halogen species (bromide/chloride ratio), which have no interaction with the carbonate system, but only depend on the concentration of major species in the brine. Also, as it is repeatedly

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stated in the revised manuscript, FREZCHEM is a purely *thermodynamic* model, so that all the results presented in the manuscript apply for thermodynamic equilibrium only. It is discussed in the paper how kinetic effects such as meta-stability towards nucleation interferes with the results of the thermodynamic model FREZCHEM.

Technical notes : fixed as requested.

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