**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "A mechanism for biologically-induced iodine emissions from sea-ice" *by* A. Saiz-Lopez and C. S. Boxe

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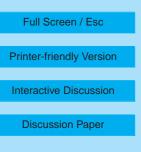Received and published: 26 March 2008

First, I would like to thank the authors for their reply to my comments. My responses to each point are listed below:

1. As far as I understand, the authors use Fick's law to describe the correlation between the aqueous-phase diffusion coefficient D_{aq} and the iodine flux J:

$$J \ = \ -D_{aq}\frac{d\phi}{dx} \tag{1}$$

$$-10^{12}cm^{-2}s^{-1} \ \approx \ -8 \times 10^{-3}cm^2s^{-1} \times \frac{6 \times 10^{15}cm^{-3}}{50cm} \tag{2}$$

Unfortunately, I am still unable to understand how this very high value of D_{aq} has

been derived. In the ACPD paper (page 2962, line 24) it is said that the flux J is obtained by incorporating D_{aq} into Fick's equation. However, in their reply (page S752), Saiz-Lopez and Boxe write that a given flux $J = 10^{12}$ was used to calculate D_{aq}. Thus, I still don't know if J is derived from D_{aq} or if D_{aq} is derived from J. Also, I cannot see how D_{aq} was derived from Fick's 2nd law (equation (9) in the ACPD paper).

In addition, the authors claim that D_{aq} changes with time because of a changing concentration gradient. I do not think that this is correct. It is the flux J that should depend on the concentration gradient, not the thermodynamic constant D_{aq}.

I still think that a value around $D_{aq} \approx 10^{-5} cm^2 s^{-1}$ would be more appropriate. This would lead to a flux of $J \approx 10^9 cm^{-2} s^{-1}$, i.e. 1000 times slower than in the current calculations.

2. I agree that choosing 3 times the seawater value is a good choice for the concentration of the brine layer.

3. I have checked the additional references (Dash et al., 2006, Sadtchenko and Ewing, 2002, Doppenschmidt and Butt, 2000, and Wettlaufer et al. 1999) that Saiz-Lopez and Boxe mentioned in their reply. Indeed, these papers show that the thickness of a quasi-liquid layer (QLL) can reach several micrometers. However, closer inspection revealed that this is only the case when the temperature is very close to the melting point of ice. For example, Wettlaufer et al. show in their Fig. 1c that a thickness of 100 μm can only be reached if the temperature is less than 0.0001 K away from the melting point. I cannot see how this applies to the ambient conditions described by Saiz-Lopez and Boxe.

Still, I would like to point out that this is a question about terminology which does not affect the results of the model calculations. I agree with Saiz-Lopez and Boxe that 500 μm is a reasonable value for the thickness of the aqueous phase on the ice. However, I think it is a truly liquid brine and calling it a QLL is not correct.

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To summarize, I think that the second point has been resolved but I cannot recommend publication in ACP until the first and the third point have been settled as well. Nevertheless, since there are colleagues in our scientific community with better knowledge about QLLs and aqueous-phase diffusion coefficients, it may be wise to solicit their comments on this discussion.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 2953, 2008.