

## ***Interactive comment on “Temperature and sunlight controls of mercury oxidation and deposition atop the Greenland ice sheet” by S. Brooks et al.***

**Anonymous Referee #2**

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General:

The paper presents for the first time measurements at Summit, Greenland of GEM, RGM and FPM. The results give important contributions of the understanding of the dynamics of mercury in the atmosphere and the fate of mercury in the Arctic. The paper is well structured and straight forward to read. However, I miss a few things in the paper that would improve it. There is not any discussion of the uncertainty of measurements and of the assumptions of e.g. made in the paper. As a consequence the paper present  $\sim 13$  tons/year deposited as a final estimate of mercury accumulation to the Greenlandic ice sheet. It would be better make uncertainty budgets and then

C1065

come with a range of deposition, re-emission and of the final net accumulation.

I recommend that the paper is accepted with minor though substantial corrections.

Specific comments:

Page 3667 to 3669. A presentation of the uncertainties of the measurements is needed and has to be applied in the following interpretation of results.

page 3669. The lifetime of GEM is said to be  $\sim 1$  year (Schroeder and Munthe, 1995). This is a too old reference and the lifetime of GEM from the latest results is most likely shorter (only a few month). The term background concentration can also be disputed. Sorensen et al. 2010 EST, Vol. 44, 7425-7430 demonstrated that GEM has a strong seasonal behaviour in the marine boundary layer, which fit with a lifetime of a few month. The modelling results of Holmes et al. 2006 as you cite yourself also found lifetimes of GEM in the order month and that complies also well with the latest experimental data.

Line 15. e.g.  $\text{HgCl}_2$  is not extremely water soluble e.g.  $0.0002 \text{ g}/100 \text{ cc}$  and  $\text{HgBr}_2$  is  $0.61/100 \text{ cc}$ . For comparison is  $\text{Hg}(\text{NO}_3)_2$  is very soluble (Handbook in Chemistry and Physics, CRC press). Therefore delete extremely  $\Rightarrow$  RGM is water soluble.

page 3672 Use chemical equilibrium versed signs for  $\text{Hg} + \text{Br} \rightleftharpoons \text{HgBr}$

Counted Line 12 from the top There is one study of the dry deposition of RGM to snow surfaces Skov et al. 2006, *Atm. Env.* 40, 5452-5463 where a  $V_d$  was found to be  $\sim 1 \text{ cm}/\text{sec}$ , therefore a ref. to this paper should be given (By the way Brooks is co-author on that paper?). This will also improve the confidence in the indicated  $V_d$ .

Page 3673 The reference to the figures have to be corrected as there are some confusion here. There is more reference to Figure 3 but in some cases it is Fig. 4. I cannot see the anti-correlation between RGM and T in Fig. 6 where T is not appearing? I cannot see such a connection in fig. 7 but maybe in fig. 8.....

C1066

Page 3675 3 line 3.0 g l-1 should be 3.0 ng l-1

In the discussion it is important as already mentioned that the range of the estimates are given e.g. the accumulation range  $\sim 300 \text{ kh m}^{-2} \pm 200\%$ ?

The conclusion has to be updated according the changes in the presentation and discussion of data.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 3663, 2011.

C1067