Author Comment on „Space based observation of volcanic iodine monoxide“ by A. Schönhardt et al. (acp-2016-619)

Referring to the Interactive Comment of Referee #2, from 25 August 2016.

We are grateful for the comments and suggestions of Referee #2.

In the following, we address all the comments. Original comments are shown in black italics, our answers in black normal font and new text for the revised manuscript in blue.
Page and line references refer to the original ACPD online version, i.e. locations for added text. The page/line numbers may differ in the revised version.

Comment

The authors make the point in several places that the atmospheric chemistries of iodine and bromine (and their behaviour in the magma) are different, which probably explains why the IO and BrO do not correlate perfectly in time and space. Given that iodine oxides polymerize into particles - and bromine oxides do not - it is likely that the IO/BrO ratio is underestimated. However, it is striking that Figure 4 shows little change in the ratio as the plume ages. I find that particularly interesting, since it suggests that the higher iodine oxides are photochemically labile, thereby enabling the IO to persist in the plume. If the IO mixing ratio is around the estimated 3 ppt, then formation of I2O2, I2O3 etc. should be quite fast. This might be worth mentioning in a revised manuscript.

Answer to Comment

The reviewer mentions an important point – and an important difference between iodine and bromine. Iodine oxides in contrary to bromine oxides may polymerize to form particles. This is one of the reasons, why the observed ratio of IO/BrO may only serve as a rough estimate for the iodine/bromine ratio. We will mention this more explicitly in the revised version. As Reviewer #1 raised the point that Murphy and Thomson (2000) observed enhanced iodine content in aerosol mass spectra in the UTLS region, reference to this study is made in a new paragraph in the discussion (Sec. 4).
The observation that IO is present in the plume for a comparably long time is now emphasized in the revised manuscript, and we also mention the fact that higher oxides should be formed quickly at large IO mixing ratios.

Section 3.3, p.8, l. 12:
In addition to the presence of other iodine species, iodine oxides may polymerize into particles, while there is no evidence that bromine oxides do under atmospheric conditions. This might lead to an underestimation of the iodine to bromine ratio if only gas phase species are considered.

Section 4, p.10, l.23:
Overall, it is interesting to note that the ratio of observed IO and BrO (Fig. 4) shows little change during the aging of the plume within the five analysed days. This observation may imply that higher iodine oxides which are formed more rapidly at larger IO concentrations (cf. estimation of IO mixing ratios below) are photochemically labile inside the volcanic plume. Thereby the IO may persist in the plume for a longer time period than what would be expected from the atmospheric lifetime of IO. The evolution of iodine species in the volcanic plume may be further affected by particle formation and heterogeneous reactions. Murphy and Thomson (2000) measured enhanced iodine content in aerosols in the upper troposphere and lower stratosphere (UTLS) region. This finding has two further implications. Particles may serve as a sink for iodine reducing the availability of reactive iodine, and on the other hand they may provide pathways for heterogeneous reactions from which reactive iodine compounds may be released again.