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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Systematic investigation of bromine monoxide in volcanic plumes from space by using the GOME-2 instrument" *by* C. Hörmann et al.

**R. Campion (Referee)**

Robin.Campion@ulb.ac.be

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I've read the paper "Systematic investigation of bromine monoxide in volcanic plumes from space by using the GOME-2 instrument" by C. Hörmann et al.. This paper, definitely within the scope of ACP, presents an abundant and original dataset about BrO in volcanic plumes. The methodology is well presented and seems both innovative and statistically solid. The amount of work necessary to obtain such a dataset over such a long period of time is quite impressive. The paper is well written, with good data presentation and interpretation. As the authors underlined, this paper and its associated dataset will certainly constitute a solid basis for further studies aimed at modeling the



BrO chemistry in the atmosphere and in volcanic plumes, as well as understanding the Br behavior during magma differentiation and volcanic degassing. Before publication in ACP, the authors should however consider addressing the following minor points. General comment : Error on retrievals is poorly discussed. If error on SO2 retrievals has already been discussed elsewhere, BrO retrievals from satellites are new enough so that their associated error be discussed here. The authors should add error bars to the the SO2 vs. BrO correlation plots plot (possibly one per plot). Specific comments: 107-108: I suggest mitigating the statement that SO2 is the third most abundant gas emitted by volcanoes. This is usually true but not always. The authors should also consider adding to the reference list another review article on the chemistry of volcanic gases. This applies also to lines 196 172-173: please clarify: times or orders of magnitude , 312-318 It would be nice to mention here the magnitude of the variability of the non volcanic BrO VCDs that is usually observed on satellite data. This would help the reader to figure out how important is the correction of the "background BrO" compared to the "volcanic BrO" 355-360 How was this 1018 mol/cm$^2$ threshold chosen? The use of two different fitting windows is certainly a good choice. However, to convince the reader that the two retrievals are coherent between each other, the authors could show correlation plots of the SO2 VCD retrieved with the two fitting windows for pixels having a VCD around the threshold. This could be placed in the supplementary material if the authors estimate that it deviates from the scope of the present article. Figure 6: It seems in figure 6 that a part of the plume (the one drifting eastwards from the summit) has enhanced BrO without SO2. This seems to occur also for the Ambrym (#48) case shown in the supplementary material. Please comment. Is this one of the "very unlikely cases" that you mention at line 203. Section 5.3 and figure 15. Unlike the first reviewer, I believe these parts are useful and necessary because the majority of the plumes studied by the authors showed no measurable BrO. This is an important result in my opinion 690 and supplementary material page 40: The attribution of plume event #706 seems dubious. This volcano, although experiencing continuous small scale vulcanian activity, is usually not a strong SO2 emitter. No unusual activity was reported for Karim-

sky volcano over this period, while the neighboring Kizimen volcano was in continuous and strong activity. 725-750 The authors should also consider chemical zonation of the plumes as a possible cause for different BrO/SO2 ratio within VPE. Especially for the cases of Dalaffila and Nabro parts of the plume drifting at different altitudes originate probably from different processes: Energetic lava fountains for the highest plume and residual degassing of lava flows for the lowest plume. These mechanisms are known to produce distinct SO2/HCl and SO2/HF ratio (e.g. Burton et al. 2003) so it's probably also the case for the S/Br ratio. In the case of Kasatochi and Sarychev, where no lava flow was documented, the lower parts of the plume may come from the interaction between sea-water (rich in Br) and pyroclastic flows.

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