

## ***Interactive comment on “Seasonal variation of tropospheric bromine monoxide over the Rann of Kutch salt marsh seen from space” by C. Hörmann et al.***

### **Anonymous Referee #1**

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Hörmann et al. report seasonal variations of tropospheric BrO abundances over the Rann of Kutch (salt desert/seasonal lake at the border of India and Pakistan) using BrO tropospheric column retrieved using OMI UV measurement during 2005-2014. This is a first attempt to quantify tropospheric BrO over salt lakes using satellite measurements. This study agrees well with the scope of Atmospheric Chemistry and Physics. I recommend this article to be published in ACP given that the following major and minor concerns are addressed.

Major comments:

1) Total column BrO retrieval using DOAS (Differential Optical Absorption Spectroscopy) has significant uncertainty depending on selection of fitting window, up to

~50% or higher, which may affect the magnitude of tropospheric column BrO and thus the BrO mass abundance quantified using that column. The tropospheric column BrO and BrO mass abundance is as correct as the magnitude of total column BrO retrieved in the given fitting window, and it should be mentioned in the manuscript (in Sect. 3). In addition, comparing the BrO mass abundances from authors' retrieval and those from the OMBRO operational product (using the same approach) will give a good, solid example to show possible uncertainties in mass abundances calculated from satellite BrO measurements.

2) Although stratospheric column BrO has little variations at the region of study, the "magnitude" of assumed stratospheric column BrO can affect the magnitude of tropospheric column BrO and thus the magnitude of mass abundances of tropospheric BrO. Such uncertainties in the magnitude are particularly important in this study, since this study aims "quantification" of BrO mass abundances instead of merely tracking the seasonal and temporal variations. How does the estimate of stratospheric column BrO compare with the other estimates using models, such as Theys et al. 2009b and Salawitch et al., 2011? How much can the estimated tropospheric BrO abundances change along with the assumed loadings of stratospheric column BrO? These points need to be addressed in the manuscript (probably in Sect. 3.2).

3) Sect 4.5: Authors used a geometrical AMF for tropospheric BrO over the Kutch of Rann using GOME-2 data. However, I do not agree with that the BrO column retrieved using nadir-viewing UV measurements and a geometrical AMF over not-so-bright surfaces (albedo  $\sim 0.15$ ) has the capability to distinguish tropospheric BrO contribution. If authors cannot prove that using a geometrical AMF has such capability or provide the GOME-2 BrO analysis using tropospheric AMF from reasonable radiative transfer calculation, the entire section need to be removed.

Minor comments:

1) Latitude and longitude of the Rann of Kutch need to be specified in the early part of

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the manuscript for readers who are not familiar with the area of study.

2) Page 2 line 6: “an overall picture of the BrO horizontal distribution” need to be “an overall picture of BrO horizontal distribution in the troposphere” to be clear, since the mentioned satellite measurements of BrO (GOME) primarily provide the the total column BrO.

3) Page 2 line 8: Due to the large variations in stratospheric column BrO in high latitudes, polar tropospheric ozone depletion can be identified by satellite measurement only if stratospheric BrO loading is properly addressed, which should be mentioned here.

4) Page 6 line 8: “The stratospheric BrO distribution varies little with latitude and even less with longitude (Theys et al., 2009b).” It is the case only for the low latitude regions; stratospheric column BrO has large longitudinal and latitudinal variations in middle and high latitude regions.

5) Sect 4.3: Choi et al. (2012) have reported the high BrO abundances associated with high planetary boundary layer height in the Arctic region, which can be a relevant reference here.

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