

Interactive comment on “Characterization of soluble bromide measurements and a case study of BrO observations during ARCTAS” by J. Liao et al.

Anonymous Referee #1

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Summary:

This paper deals with measurements arising from the ARCTAS campaign. A major part of the paper deals with laboratory measurements used to characterise the mist chamber (MC) operating on the NASA DC-8 aircraft. The authors use this characterisation, combined with MC observations of soluble bromide and CIMS observations of BrO, to derive some partitioning of reactive bromine compounds. The final section uses the CIMS BrO data to derive a tropospheric BrO vertical column density which the authors then compare with a trop BrO(VCD) column derived from satellite data. The work falls within the subject area of ACP and should be published once revised.

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Specific comments:

i) Methods: please state up front that CIMS suffers an interferent from HOBr conversion, but that that is dealt with in your analysis. This just reassures the reader that it's not been ignored. Some mention of this should be included in Section 2.1 (where CIMS is introduced) and 2.1.1 (where CIMS is described) – for the latter, particularly important where estimates are presented of measurement accuracy (line 6).

ii) Explain why the soluble bromide detection limit varied with altitude (Section 2.2)

iii) The value of this work is that the authors have characterised their MC set up, as used on the NASA-DC8, to be able to derive reactive bromine compounds. However, the key word here is “their” MC set-up. The analysis is very clearly specific to the instrument set-up, critically, the length of the inlet line (upon which HOBr can convert to Br₂). There are statements in the text (4 Summary) that this characterisation enables better use of soluble bromide data from previous field missions – this would only be the case if the instrument set-up could be exactly replicated. Throughout the authors need to be more stringent that the results are very specific to their experimental set-up, and do not all represent generalised conversion factors.

iv) Section 3.1.3 Why was BrO only detected in the MC in Setup B..?? Some additional experiments that systematically varied the inlet line length and assessed the BrO detection would seem an obvious thing to try (although clearly not for this paper). Also, please be careful to put statements into the right context – in section 3.1.3, the ratio of BrO to Br⁻ was only found to be 0.4 with setup A, implying that this number depends on additional factors, and is not fixed. Also makes this clear for the equation (1).

v) Section 3.1.5 Include the major implication also in the Abstract – that a well-characterised MC can be used to derive mixing ratios of some reactive Br compounds.

vi) Section 3.2 the model chemistry scheme was appropriate to conditions where NO₂ was less than 5 pptv. But for the case study, unpolluted conditions are described as

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$\text{NO} < 100$ pptv. NO_2 will then be higher than 5 pptv – so is the model still appropriate, or ought it to include BrONO_2 chemistry?

vii) Figure 4, right panel. Are these data for daytime only so that we don't need to think about Br_2 ? Please clarify in the text and figure caption. Also, in what way is the X-axis the "lower limit" of $\text{HOBr} + \text{Br}_2$?

viii) The Summary is basically a repeat of the text. A conclusion would be more helpful, discussing applications and provisos, i.e. the instrument set-up would need to be fully characterised in the lab before a field application, but then it opens some possibilities.

Typos/minors:

P 27003 line 6: hydrogen bromide should be lower case

P 27003 line 9: bromine nitrate should be lower case

P27003 line 26: "high latitudes, particularly during boreal spring" – either specify which high latitude (Arctic/Antarctic) or don't mention "boreal" which is obviously specific to the Arctic case

P27005 line 16: don't need the "s" after PAN

P 27009 line 18: reference Bauguitte et al. 2009, given they showed BrONO_2 formation was very important for their field conditions

P27014 line 22: please amend to "... BrO and $\text{HOBr} + \text{Br}_2$ were detected by CIMS".

P27015 line 21: Arctic spelled incorrectly

Caption for Fig 1: "the solid inlet line represents"

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 26999, 2011.

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