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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Impact of deep convection and dehydration on bromine loading in the upper troposphere and lower stratosphere" *by* J. Aschmann et al.

**R. Schofield (Referee)**

robyn.schofield@awi.de

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This paper presents a study of the effects of deep convection and dehydration upon the bromine that enters the lower stratosphere. It is a well focused and detailed study, the paper is clearly structured and written. A very novel aspect of this study is the sea surface temperature linkage (ENSO) for Bry, and how Bry might be expected to respond in a changing climate - though perhaps the authors may wish to reiterate this component more in their conclusions (i.e. providing some outlook). This study on the whole makes an important contribution to the field, in particular it challenges the accepted view that inorganic bromine washout in the TTL region is important, I look forward to many follow up studies in the community to verify (or not) this finding. I recommend publication in ACP once the following, mostly very minor, details are attended to.

Minor Comments

Page 126, line 11 an appropriate reference for the entrainment or convective dilution of the boundary layer component is [Romps and Kuang, 2010] where they discuss how most detraining air contains maximally a 30% boundary layer component. In general the discussion in the paper as it stands reads as though detraining air contains mostly boundary layer air (affected slightly by convective dilution) but this is not the current 'state-of-science' and maybe the ERA-Interim entrainment rates (i.e. boundary layer versus free troposphere) could also provide some support for the your choice of 1 ppt etc (otherwise some qualifying statements should be added).

Page 126, line 14, the assumption is made that detrained air is saturated with respect to the ambient conditions. However, since the convectively detraining air is likely to be cooler it would in reality be sub-saturated with respect to ambient conditions. Conversely, as ice lofting also is thought to occur in deep convection (then evaporates) this is likely to balance the sub-saturation making the 100% RH assumption valid, maybe some discussion of this assumption could be added here.

Page 126, line 16, is it correct that the model does not allow supersaturation? Since we know that in the TTL supersaturated air parcels do exist, i.e. up to 130-160% RH [Gettelman et al., 2000; Koop et al., 2000] how might this assumption affect the results presented here? I can imagine that ice may form too quickly in this model, perhaps it has no overall bearing on the results presented – but has this been tested for?

Minor corrections

Page 123, line 7 replace 'whether this will respond' to 'the response of this'

Page 123, line ∼15, here in general (i.e. seasonality if any) and in the discussion page



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Interactive Comment

138 first paragraph, discussion of modelling studies relevance for washout Bry ranges, the recent study of [Schofield et al., 2011] would add to the ranges given here, and the discussion.

Page 125, line 7 the slow ascent and convection being super-imposed is rather typical of most recent trajectory modelling studies, not ‘A distinctive feature of our model’ i.e. [Dessler et al., 2007] , perhaps a qualifying statement if you are referring to CTMs only?

Page 125, line 15 replace ‘scheme which are’ with ‘scheme, these are. . .’

Page 126, line 20 insert a comma between ‘model’ and ‘the soluble’

Page 128, line 6, After one model timestep all dissolved and adsorbed species are released . . . I am unclear in what this means – is this describing the evaporation of sedimented particles?

Page 130, line 19 Another aspect of the idealized setup that influences our results is. . .

Page 134, line 25 replace raises (sic) with increases

Page 134, line 28 insert comma: Interestingly, the mixing. . .

References:

Dessler, A. E., T. F. Hanisco, and S. Fueglistaler (2007), Effects of convective ice lofting on H2O and HDO in the tropical tropopause layer, Journal Of Geophysical Research-Atmospheres, 112(D18309), D18309, doi:18310.11029/12007JD008609.

Gettelman, A., J. R. Holton, and A. R. Douglass (2000), Simulations of water vapor in the lower stratosphere and upper troposphere, Journal of Geophysical Research-Atmospheres, 105(D7), 9003-9023.

Koop, T., B. P. Luo, A. Tsias, and T. Peter (2000), Water activity as the determinant for homogeneous ice nucleation in aqueous solutions, Nature, 406(6796), 611-614.



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Romps, D. M., and Z. M. Kuang (2010), Do Undiluted Convective Plumes Exist in the Upper Tropical Troposphere?, Journal of the Atmospheric Sciences, 67(2), 2, 468-484, doi:410.1175/2009jas3184.1171.

Schofield, R., S. Fueglistaler, I. Wohltmann, and M. Rex (2011), Sensitivity of stratospheric Bry to uncertainties in very short lived substance emissions and atmospheric transport, Atmos. Chem. Phys., 11, 1379-1392, doi:1310.5194/acp-1311-1379-2011.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 121, 2011.