Atmos. Chem. Phys. Discuss., 11, C13964–C13969, 2012
www.atmos-chem-phys-discuss.net/11/C13964/2012/

Interactive comment on "Bromine and iodine chemistry in a global chemistry-climate model: description and evaluation of very short-lived oceanic sources" *by* C. Ordóñez et al.

C. Ordóñez et al.

carlos.ordonez@ciac.jccm-csic.es

Received and published: 9 January 2012

Anonymous Referee #1

RC: Referee comments - AR: Author replies

This article presents a major step towards global modelling of VSL halocarbons. Previous model studies suffered from very crude emission estimates. The authors provide new emission estimates and evaluate these and the applied halocarbon chemistry mainly based on air craft and some cruise data. I'd fully approve publication of this article mainly as it is. Only a few minor comments / revisions remain:

Scientific comment(s):

RC1: From your text and tables it is not clear to me which data you used to construct the emission fluxes and which one you used for the evaluation. Could you indicate (esp. in Table 1), which data set is used for what? If you use the same data for the construction of the emission fluxes and for the evaluation, wouldn't this be a self-fulfilling prophecy? Add a respective discussion to the article.

AR1: In Table 1 we now indicate that observations of VSLs bromocarbons (i.e. CHBr3, CH2Br2, CH2BrCl CHBrCl2, CHBr2Cl) were used to create and evaluate the emission datasets of these species. There we also mention that observations of CH3Br and CH3I were only used for the evaluation of these two species in the model since we did not create emissions for them.

To our knowledge we have gathered the most comprehensive set of observations used so far in a global modelling study of VSL halocarbons. Following previous modelling studies quoted in the manuscript (Warwick et al., 2006a; Liang et al., 2010) we have used the same compilation of observations for the construction and evaluation of emission fluxes in the case of VSL bromocarbons. We have also shown that our global annual fluxes are within the range of values estimated by those studies (see Table 3). Ideally, independent data sets should be used for a validation of our emission parameterisation, but there are hardly any other data sets with global coverage than those used here.

In the text we indicate that the observations available at present are too sparse in space and time. They are basically concentrated over the Pacific Ocean and the American continent as well as in summer-spring, and there are more observations in the Northern Hemisphere than in the Southern Hemisphere. In section 5.1 we wrote: "Data from on-going and future aircraft campaigns such as the HIAPER Pole-to-Pole Observations (HIPPO) programme ... will be very valuable to improve the current emission estimates of VSL bromocarbons, in particular over the SH". To deal with the referee's suggestion and also avoid very long discussions, in the revised version we have simply added the following sentence after the previous one: “Since data from the same aircraft campaigns have been exploited both to estimate and to evaluate VSL bromocarbon emission fluxes in this study, new observational datasets could also be used for an independent validation of the emission parameterisation presented here”.

Note that no further clarification is needed for CH2IX species in Table 2, where we already indicated that observations were only used for the evaluation of their emissions. As mentioned in the text such emission fluxes are constrained to follow those estimated by Jones et al. (2010).

RC2: p. 27444, second paragraph: a known shortcoming of convection schemes in global models is the vertical extent of the convection. As convection is a major point of your reasoning you should comment on which convection scheme you use and if it reaches high enough (esp. in the tropics).

AR2: The parameterisation of convection in previous versions of CAM (Zhang and McFarlane, 1995) presented significant deficiencies to simulate the climate over the tropics. Among other things it exhibited excessive Pacific trade winds and lacked intraseasonal variability. Changes were made to the deep convection scheme by including the effects of deep convection in the momentum equation (Richter and Rasch, 2008) and using a dilute, rather than an undilute, approximation in the plume calculation (Neale et al., 2008). Including convective momentum transport in the convective parameterisation weakens the trades. The dilute plume approximation allows any ascending air parcel to mix with the free troposphere; this improves some patterns of the Madden-Julian oscillation (MJO) (Neale et al., 2008, Subramanian et al., 2011), the dominant mode of intraseasonal variability in the tropical atmosphere. These changes lead to a more realistic simulation of many aspects of El Niño–Southern Oscillation (ENSO) (Neale et al., 2008).

Both the interim version of CAM-Chem presented in this manuscript and CAM-Chem

version 4 (Lamarque et al., 2011) include the above mentioned improvements. This results in a much improved representation of deep convection that occurs considerably less frequently, but is much more intense in CAM4 compared to CAM3 (Gent et al., 2011). In addition, Lamarque et al. (2011) do not show any bias in the tropical upper-troposphere that would indicate a lack of deep convection.

A summary of these arguments is included in the corresponding part of the text. There we also introduce some additional comments on the potential importance of emissions (suggestion made by Lucy Carpenter in a short comment) and other factors such as photolysis for the modelling of CH3I in the UTLS.

Typos + friends:

RC3: Bottom page 27430: Please provide the list of the studies which used background concentrations, as you also provide the list for the investigations using top-down methods.

AR3: In that part of the text we now indicate “(e.g. Yokouchi et al., 2005, and references therein; Carpenter et al., 2009, and references therein)”. Both articles have been previously quoted.

RC4: The beginning of Sect. 4.2 would be easier to read if you use a bulleted list instead of enumerating the different sources within the continuous text.

AR4: It is not clear to us what the referee means by “sources”. That might be either the different sources of information we use for constructing our emissions (i.e. what we call “literature reports” at the very beginning of that section), or the different emission sources of halocarbon species we include in the model (listed a bit later in the same paragraph). Since this not so clear and it is only a minor comment, we have decided to leave the text as it was. We have checked the first paragraph and the whole section and think they are readable.

RC5: p. 27442, l. 10: I assume the first “that” should be a “than”?

RC6: p. 27443, l. 16: "in the globe" –> "on the globe"

AR5 & AR6: Both errors have been corrected.

RC7: Figs. 3 + 4: At least in the "printer-friendly" version of the paper, the dots are so small that it is hard to compare the different panels to each other. As there are no data about Africa, Europe and Antarctica, I recommend to enlarge the important parts of the graphics by showing more or less only those areas where data is available.

AR7: We have produced Pacific views of these figures for the revised version of the manuscript. We do not show Africa and large parts of Eurasia to focus on the area with data available. However we keep the whole range of latitudes for aesthetic reasons related to the map projections in the software we used to produce these figures. We will make sure the figures look fine in the ACP version of the article.

RC8: Fig. 5, 7-10: These figures should be larger in the final version of the article, as the axis labels are on the edge of being too small.

AR8: We have slightly increased the size of the fonts in Figs. 7-10. We have carefully checked the original Figure 5 and think that its size is fine; the main problem is that it is considerably reduced on the half page of the ACPD version. We will make sure that these figures cover the whole width of an ACP page and also that their fonts look big enough.

RC9: caption Fig. 11, line 5: H2ICl –> CH2ICl

RC10: caption Fig. 11, line 12: moths –> months

AR9 & AR10: Both typos have been corrected.

References:

Gent, P. R., Danabasoglu, G, Donner, L. J., Holland, M. M., Hunke, E. C, Jayne, S. R., Lawrence, D. M., Neale, R. B., Rasch, P. J., Vertenstein, M, Worley, P. H., Yang, Z.-L., and Zhang, M: The Community Climate System Model Version 4, J. Clim., 24,

4973–4991, 2011.

Lamarque, J.-F., Emmons, L. K., Hess, P. G., Kinnison, D. E., Tilmes, S., Vitt, F., Heald, C. L., Holland, E. A., Lauritzen, P. H., Neu, J., Orlando, J. J., Rasch, P., and Tyndall, G.: CAM-chem - description and evaluation of interactive atmospheric chemistry in CESM, Geosci. Model Dev. Discuss., 4, 2199–2278, doi:10.5194/gmdd-4-2199-2011, 2011.

Neale, R. B., Richter, J. H., and Jochum, M.: The impact of convection on ENSO: From a delayed oscillator to a series of events, J. Clim., 21, 5904–5924, 2008. Richter, J. H. and Rasch, P. J.: Effects of convective momentum transport on the atmospheric circulation in the Community Atmosphere Model, version 3, J. Clim., 21, 1487–1499, 2008.

Subramanian, A. C., Jochum, M., Miller, A. J., Murtugudde, R., Neale, R. B., and Waliser, D. E.: The Madden–Julian Oscillation in CCSM4, J. Clim., 24, 6261–6282, 2011. Zhang, G. J. and McFarlane, N. A.: Sensitivity of climate simulations to the parameterization of cumulus convection in the Canadian Climate Centre general circulation model, Atmos.–Ocean, 33, 407–446, 1995.

Zhang, G. J. and McFarlane, N. A.: Sensitivity of climate simulations to the parameterization of cumulus convection in the Canadian Climate Centre general circulation model, Atmos.–Ocean, 33, 407–446, 1995.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 27421, 2011.