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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Explicit calculation of indirect global warming potentials for halons using atmospheric models" *by* D. Youn et al.

D. Youn et al.

wuebbles@uiuc.edu

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Anonymous Referee 1

The authors discuss explicit calculations of the indirect global warming potentials of the two most important halons and compare the results with the traditional strongly parameterized method of calculation. Their results are smaller than previously published with the traditional method. The methods employed are sound. I find the paper well organized, mostly easy to read, and interesting to be published.
→ We thank the reviewer for the positive and supportive comments.

A few specific comments on the manuscript:

1. The abstract contains the sentence “State-of-the-arts global CTMs were used . . . to derive more realistic ozone depletion changes.” Although it is clear that this is what is needed to obtain better results that with the EESC method, the manuscript contains no comparison of modeled and measured ozone concentrations. The EESC method uses a realistic total ozone column change since it is based on observations, but it uses no time series. The results of the UIUC 2D CTM and 3D CTM MOZART have been compared with observed ozone columns time series in other papers. A paragraph discussing these results is important here to substantiate the statement above.

→ We agree with the reviewer’s comment. However, for this study, we also believe it is more important to be concerned about realistic changes in ozone more than concerns about details in the ozone distribution. In the last of section 2.1, we added a paragraph discussing the comparisons between simulated and observed ozone columns at the text: Both models have been extensively evaluated relative to available measurements of ozone and other relevant gases in the troposphere and stratosphere (e.g., Kinnison et al., 2007; Pan et al., 2007). Comparisons of monthly zonal mean total column ozone simulated by the UIUC 2-D model with the Solar Backscatter Ultraviolet Ozone Sensors (SBUV and SBUV/2) measurements indicate good agreement in the variation with time and the model is generally within 1

2. It is mentioned that EESC method depends on “the emission scenarios assumed” and “an unchanging atmosphere”. This is true, but this is in part also the case for the calculations with the CTMs. A scenario is assumed for the ODSs, while the background values for other gases are representative for 1999. Changing CO_2, CH_4 and N_2O emissions are not taken into account.

→ Agreed. In the conclusion section, we modified a sentence to clearly include the limitations in our current calculation as follows:

However, it is worth noting that this study is affected by uncertainties in the reported CO_2 AGWP and by uncertainties associated with the models adopted for this study,

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for example in the use of fixed surface boundary conditions for long-lived gases and in the use of climatological meteorological fields.

3. Understandably, it is almost impossible to reach a steady state for halons with a 3D CTM. The method employed to get around this, parallel simulations and curve fitting, seems very good. The results also point in this direction. Since the use of a steady state initial condition is mentioned in section 3.2 as a prerequisite, it would be good to add some extra support for the method employed. This could be done by applying the parallel simulations and curve fitting method, as an example, also to their 2D CTM calculation. This should be an easy exercise which does not require reprogramming their model.
→ Good suggestion. We have applied the the approach with our 2D CTM, and find almost perfect agreement with calculations starting from a steady state as shown in the figure below. In Figure 1 below, changes in RFs for three experiments using our UIUC 2-D CTM are shown to give the same result, demonstrating the robustness of our method. We included discussions with a Figure in section 3.2 as follows:
The robustness of our proposed method has been checked further by perturbation simulations for Halon-1211 using the 2-D model. Three Halon-1211 experiments using the UIUC 2-D CTM were done, including: (1) a 100-year simulation starting from a steady-state atmosphere, (2) two parallel 100-year simulations starting from an arbitrary atmosphere, and (3) two parallel 23-year simulations plus curve fit resulted in almost same RF changes in a 100-year time horizon (Figure 1). The resulting indirect GWPs are in almost perfect agreement, with values of 16294, 16402, and 16322, respectively.

Minor points:

1. Abstract and Page 15514, line 14-15: The abstract and text do not mention why indirect GWPs of halons are particularly significant. I suggest to add a sentence to

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mention the larger bromine efficiency over chlorine for ozone destruction.
→ We modified abstract and added a sentence as suggested.

2. Page 15514, line 11-12: The sentence seems grammatically incorrect, with “cooling” and “opposite direction”.
→ We modified the sentence as below:
The cooling effect through ozone destruction can even exceed the direct warming effect of the halocarbons as GHGs (Lacis et al., 1990; Ramaswamy et al., 1992) and could possibly lead to net cooling of the climate system.

3. Page 15514: EESC is defined as Eq. Eff. Stratospheric Chlorine (not Eff. Eq.).
→ We corrected the statement.

4. Page 15520: There are only very limited “future policy decisions” possible with respect to halons. The current use of halons if small and there is a global ban on production and consumption starting Jan. 1, 2010.
→ We deleted “future policy decisions” in the sentence.

5. Table 1. I suggest to round off the numbers of the 2D and 3D models runs, similar to the other numbers (to “tens”).
→ We changed the numbers in Table 1 as suggested.

Figure 1. Time-series of RF changes at the tropopause by three Halon-1211 perturbation experiments: 1) a 100-year simulation starting from a steady-state atmosphere (red), 2) two parallel 100-year simulations starting from an arbitrary atmosphere (blue cross), and 3) two parallel 23-year simulations and curve fit (orange dot).

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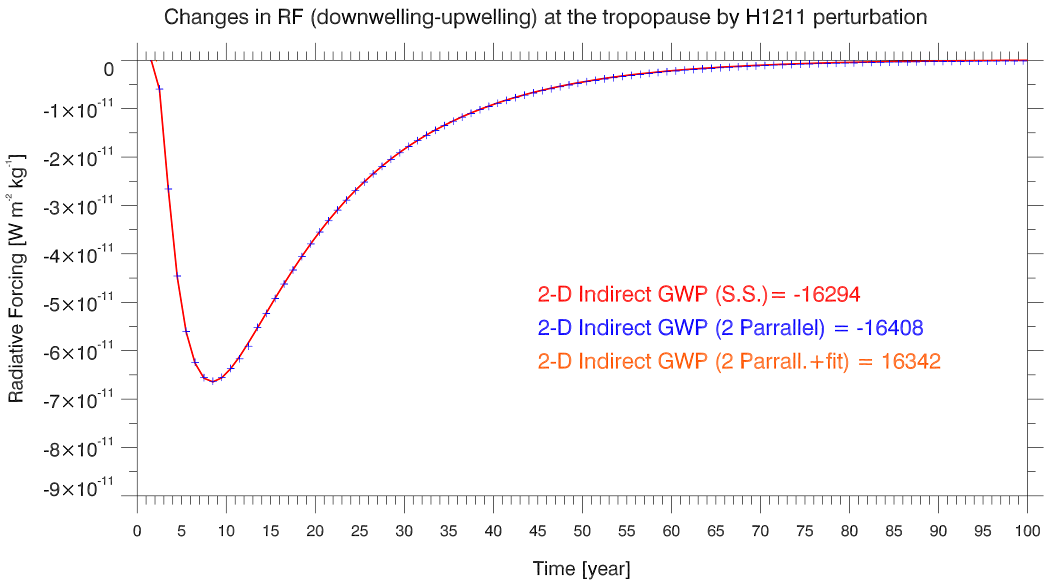

Fig. 1. Time-series of RF changes at the tropopause by three H1211 perturbation experiments

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