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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Potential impacts of $CF_3I$ on ozone as a replacement for $CF_3Br$ in aircraft applications" *by* Y. Li et al.

**Anonymous Referee #1**

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Review of "Potential impacts of CF3I on ozone as a replacement for CF3Br in aircraft applications" by Patten, Wuebbles and Youn

This paper presents calculations using a 2D model to assess the impact of replacing a current bromine-based fuel-inerter and firefighting compound on aircraft with an iodine-based compound. Since the atmospheric chemical lifetime of the replacement compound is much shorter than that of CF3Br it is expected that it would not build up to levels in the atmosphere that could impact stratospheric ozone; however, on a per molecule basis in the stratosphere is more efficiently destroyed by iodine than other halogens. Also because of its shorter lifetime the stratospheric impact is somewhat sensitive to the location of release, both height and latitude in the troposphere. They used updated rate data for iodine reactions to improve the results from earlier studies

and found that in spite of the greater efficiency of the iodine catalytic cycles compared to Bry and Cly cycles based on a per molecule of halogen basis that the replacement, CF3Br could safely be used.

I consider that this is a useful contribution but I would prefer is some of the more qualitative and emotive language was replaced! 

I have made some suggestions below.

Page 5169, section 3.2. The assumption is made that rain out of IONO2 , HI and HOI is efficient. But I have not seen any discussion in the literature regarding the possible (probably) evolution of dissolved species such as HI and HBr from rain water in a fashion that occurs in MBL and Arctic/snow chemistry. Is this likely to be a limitation? I mention this because of the uncertainty of the Bry stratospheric budget which is likely subject to similar problems regarding short lived bromine-containing compounds and rainout.

Page 5170, line 11. Figure 1. This Figure needs cleaned up. For example, a species I2O2 is listed in the topmost box. The HO2 arrow from HOI to IO is the wrong direction. The HOI photolysis to IO is not listed in Table 1. Please check others.

Page 5172, line 6ff. The discussion here on the temperature dependence of the reactions is a bit misleading and possibly wrong. There is no discussion about the availability of [O] and the fact that the O + O2 +M -> O3 + M reaction is faster at lower temperatures so limiting the availability of [O] for the same amount of ozone. And since the reaction O + IO -> I + O2 is important and also rate limiting this will modify the discussion.

Page 5176, line 10. See above. I don't think that the rationale for the larger polar ozone loss is correct. (1) as the authors note there is more Iy due to transport, similar to NOy, Cly etc. {A 2D zonal plot of Iy might be appropriate here.} (2) There is also more [O] since there is more O3 in polar regions at lower altitudes.



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Page 5178, line 10. “We find that iodine self-catalytic cycles dominate the ozone depletion mechanisms in the stratosphere” As it stands this is incorrect. I assume that the authors mean to say that the efficiency of the iodine catalalytic cycle on a per unit Xy (total inorganic halogen) basis is the largest.

Table 1. It would be very useful for the Table to have rates at 300K and perhaps even more importantly if J values were given at 3 heights, say 0, 20 and 50 for overhead Sun.

Minor stuff

Page 5164, line 26. “that could destruct ozone dramatically” sounds excessively hyperbolic! Better to just remove or replace with something like “with a lifetime of about 65 years (WMO) so that tropospheric release will make its way into the stratosphere”

Page 5166, line 1. Perhaps add after “in aircraft uses” “particularly as usage is increasing.

Page 5167, line 24 (see also p5169, line 8). “efficiently” I + ozone is slower than Br + ozone which is slower than Cl + ozone. I would prefer that efficiently is kept until there is some explanation of “rate limiting reactions” and halogen reservoir fraction etc.

Page 5171, line 3-4; “due to the fact that”ĚĚprefer “because the”

Page 5171, lines 15-17. “Catalytic cycles refer to Ě..linked with ozone.” I don’t see (a) the point of and also (b) the necessity for the previous sentence.

Page 5171, lines 25ff. Loss by catalytic cycles. Evaluation of the cycles is not always straightforward due to possible problems in identifying rate limiting steps and also the possibility of several channels. How were the cycle-strengths evaluated?

Page 5172, line 3. “Products with iodine will be removed” suggest “Products containing iodine are removed”

Page 5172, line 24. “tiny fraction”. Can this be made a wee bit more quantitative?



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Page 5172, line 28ff. Exactly how is ODE defined? It is a big vague here.

Page 5173, line 24. “favorable” suggest “useful”

Page 5174, line 18. “strongly”. The difference in ozone depletion versus latitude etc is only a factor of two. Strongly seems a bit qualitative.

Page 5174, section 4. Is it worth to briefly describe “fuel-inerting”?

Page 5176, Figure 6. The scale of the figure and the contours are impossible to read (leastwise I had problems).

Page 5176, line 10. “Due to the nature that ” try “Because”

Page 5177, line 2. “The calculation results” why not simply “The results”?

Page 5177, line 3. “tropicAL” “resultANT” spelling

Page 5177, line 8. Very qualitative wording used again “deplete ozone severely etc”

Page 5177, line 17. It is mentioned that OIO photolysis is uncertain - however this should be mentioned in the discussion on rate data at the beginning but detailed in the current section (6).

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Interactive comment on Atmos. Chem. Phys. Discuss., 6, 5163, 2006.



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