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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Transfer of organic Br and Cl from the Biosphere to the Atmosphere during the Cretaceous/Tertiary Impact: Implications for the stratospheric Ozone Layer" *by* K. Kourtidis

Anonymous Referee #2

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General Comments

This paper deals with a previously unexplored result of catastrophic meteorite impacts, namely the potential injection into the troposphere of large quantities of pyrogenic methyl halides. The calculated sudden increase in tropospheric methyl halide mixing ratios would likely induce increased stratospheric chlorine/bromine loading and result in stratospheric ozone loss. Although some post-impact ozone loss has previously been accepted, this paper identifies a plausible new cause, with potentially significant

and relatively long-lasting effects. The calculations, assumptions and caveats in the paper are clearly stated, although the discussion of the oceanic model is unnecessarily detailed and some of the more similar model runs could have been omitted. The paper is well-organised. The language would benefit from extensive minor editing. The conclusions are sound and appropriately qualitative.

Specific Comments

Assumptions about the rate of trop-strat transport under post-impact conditions are deliberately avoided, due to lack of knowledge about the dynamical state of the post-impact atmosphere. Therefore, the distinction between tropospheric mixing ratios and stratospheric halide loading should be made clearer in the text (abstract, end of pg 6773, middle of pg 7681, y-axis label on Figure 1).

6770: 11: Methyl halides are not the same thing as "active chlorine and bromine". (Active Cl & Br =[Cl + ClO + Br + BrO])

6773: 12: Fluxes are injected into the atmosphere, not mixing ratios. Please give a mass flux and/or a resulting mixing ratio.

Ocean model equations: The flux terms that are ignored should be omitted from the equations and only mentioned briefly in the discussion (as is done at the end of pg 6777). Only one of the alternatives to each of equations 1, 3 & 4 should be given - the subtle differences are already discussed in the text.

6780: 29: "Ozone loss during such episodes is not presently considered the major threat to the biosphere..." Can some comment be made as to the relative likely importance of the ozone loss postulated here, given that the biosphere is likely to have already been significantly disrupted by fires and climate-change induced by airborne soot? This reviewer suspects that while ozone loss may now be considered "a" major threat, it is still not "the" major threat. It would also be nice to see discussion of whether ozone loss due to elevated halocarbons could be a biosphere threat for lesser

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impacts than K/T. Ozone destruction by pyrogenic halogens is a potential mechanism for extending the effects of such an impact from the regional scale to the global scale. In that case, could the relative importance of ozone loss be different for different impact magnitudes? There are some relevant references which should perhaps be included in this discussion, e.g. Cockell CS (1999), Crises and extinction in the fossil record - a role for ultraviolet radiation? PALEOBIOLOGY 25 (2): 212-225; Cockell CS, Blaustein R (2000) "Ultraviolet spring" and the ecological consequences of catastrophic impacts, ECOLOGY LETTERS 3 (2): 77-81

Technical corrections, typos & language suggestions

Standard scientific notation should be used throughout, i.e. 1.1x10(superscript)n

6770: 5: "previously unaccounted<-for> emission..." (add word).

6770: 11: " more than an order of magnitude "<greater than > "their present..." (add words).

6770: 13: Replace "lead" with <led>.

6772: 28: Add full stop (period) after "respectively".

6772: 25 - 6773: 4: Emissions ratios should be expressed without units, as in the original papers.

6773: 10, 13: Replace "have been" with <were>.

6773: 22, 24: Two references to "these levels" are confusing. Please clarify, e.g. <the impact-induced halogen loadings>, <present-day levels>.

6773: 25 - 6775: 5: Use of past conditional tense throughout would help the reader understand this discussion, e.g. "...substantial amounts of smoke (etc) <would have been> emitted to the atmosphere...".

6774: 6: "fast consumption of OH <by> emitted hydrocarbons...".

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6775: 21: "..which equals <>the loss rate..." (remove word "to").

6773: 28: The phrase "if large amounts of CH3Cl and CH3Br do not reach the stratosphere soon after the impact." is distracting and seems unnecessary in points 1-3, given that the issue of direct stratospheric injection is discussed later.

6776: 12: Add hyphens <pseudo-first-order>.

6776: 15: "...H is <the> Henry's Law constant...".

6776: 18: "...loss constant for <>degradation in the atmosphere ..." (remove word "the").

6777: 14 and in reference list: Author name is N.L.Wolfe not W.L.Wolf.

6777: 20: Replace "consider" with <assume>.

6777: 25: It's a strong statement that the soil sink and newly-identified sources "were unimportant in the perturbed conditions". Perhaps "relatively/likely/probably unimportant" better explains it?

6778: 24: "...large amounts of intracellular CH3Br <are> released...".

6778: 27: Please switch numbering of scenarios 7 and 8 so that the most plausible scenario, the one introduced with the word "finally", is actually the last one in the table, and so that the scenarios are discussed in numerical order in the text.

6779: 10: "..damage <to> the ozone layer..."

6780: 13: use <would have> not "should have". ("Should have" implies that an expected event did not actually happen).

6781: 16: "Ozone depletion <would> take place...".

6781: 23: "CH3Br has a somewhat <shorter> lifetime" Please quote the lifetime for CH3Br.

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6781: 28 - 6782: 2 : Suggested re-wording for conditional tense: "...if <> ocean<ic uptake did> not <significantly reduce> their atmospheric burden. <Once> the UV-B shielding of the aerosol layer <ceased>, considerable enhancements...could then persist for decades."

6782: 6: "..as a consequence <increase> the penetration of short-wave..."

6782: 10: "constrain" => <constraint>.

6782: 11: "the K/T one" suggested re-wording: <the K/T event>.

6782: 16: "the K/T one" suggested re-wording: <that at the K/T boundary>.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 6769, 2004.