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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric effects and societal consequences of regional scale nuclear conflicts and acts of individual nuclear terrorism" *by* O. B. Toon et al.

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This is an interesting analysis, though I, as an active researcher of the "nuclear winter" issue, do have a few comments (mostly on the scenarios and the smoke aspects of the paper):

1. As a general comment, I found it quite confusing to have the reference be to Pittock et al., 1989 rather than the 1985 edition–it just fouls up the time history of the storyline through the nuclear winter period. I would strongly recommend using the date of the first edition of the book, and then if you want note the date of the second edition (which, as I recall had few changes) in the references. Same goes for Harwell et al. references–

using the later date really throws off the reader to when the studies were actually done.

2. Bottom of page 11747-top of 11748: Regarding this indication that a region would be uninhabitable, I think it would be helpful to make very clear that this is for surface/near-surface bursts, given that Hiroshima and Nagasaki, for which there were air bursts, were rather quickly reinhabited. I certainly agree that terrorist-caused explosions might well be surface bursts, so this is quite plausible.

3. Page 11754 and following: Regarding the various scenarios, this notion that the regional conflicts (so presumably one nation attacking another) will focus on centers of population seems to me rather far-fetched–it is essentially suicidal to go after the population centers instead of the other side's weapons. The original scenarios considered by TTAPS (done as is noted by others on page 11757) targeted, as I recall, the cities of the world by order of population–and was considered so implausible a scenario that I think it really caused much more of an adverse reaction to the paper than was justified by the issue being raised. I worry about that for this analysis as well–while terrorists might go for population centers, it seems to me very unlikely they would have access to the number of weapons being suggested as ultimately causing the climatic influence, and I just don't think nations are really suicidal (though the rhetoric of some leaders is certainly disturbing). It seems to me it would help the paper to be more nuanced on this.

4. Page 11756: On this issue of city fires being ignited, across the Middle East with its dry climate, the buildings are mainly concrete and adobe and not wood. During massive earthquakes, fires are not getting ignited, and I really wonder if in such cities there is anywhere near the concentrated fire load being assumed. In developed world cities, again, there is much more concrete and many taller buildings–while lots of damage can be done, can massive fires get ignited? Consider the World Trade Center–sure, there were fires while the building was standing, but none once it collapsed or in adjacent buildings, etc., and a nuclear explosion would likely knock the nearby buildings down.

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5. Page 11758, first paragraph: While it may be true in a numerical sense that the superpowers have enough weapons to explode one in all the major cities of the world, such a scenario is implausible in the extreme–there would be no reason for it and I really think it damages the credibility of the analysis to make such statements–it sounds like naive scientists considering military scenarios that just would have no real world credibility. And it is not at all clear, in any case, that there are enough deliverable weapons for Russia and the US to successfully hit all significant military targets, given needs for multiple targeting, mobile systems, etc. (that was the whole basis of MAD–even if one fired all one's weapons, there would be a massive retaliation on the other side's cities, etc.–so I do not think the comment makes any military sense–in any case, the comment really does not serve much purpose. I just find the writing about these war strategies as not very well thought through if the intent is to really communicate with leaders of the world instead of simply trying to stir up a controversy.

6. Page 11758: Just to note that in the second paragraph, line 10, it should be "principle"

7. Page 11761: The comment about rainout seems pretty well hidden. This was an issue a number of scientists at Livermore raised in the 1970s or 80s (or maybe earlier) about what would happen in the event of a so-called tactical war in Europe–one would have really severe contamination. I would think that issue might well be much more serious than the climatic effects that are postulated.

8. Page 11766: I am a bit surprised at this notion that inhabitants might not return to a blast area (presuming it was not a surface burst and there was no rain)–certainly the residents of Hiroshima and Nagasaki did. Cities are generally there for a reason, and the blast does not destroy that reason–just the facilities developed and a lot of people. But others seem likely to come back. It might well be appropriate to analyze what this might mean.

9. Page 11766: On this notion of economic consequences and national and interna-

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tional economic disruption, that was, I thought, one of the key points in the studies in the 1980s–that is, after the direct effects, the main consequence might well be the breakdown of national economies and international trade. I would think that point should be made more forcefully.

10. Page 11770 and following: I think this issue of fuel load and the likelihood of it burning intensely over a short time is a real question–are the materials mentioned really in close proximity or spread out, will they be covered by debris or available to burn, etc.? The numbers that result just seem very high.

11. Page 11778: Is there any evidence that the smoke from the Hamburg and major forest fires lofted into the stratosphere. It would be helpful to give an indication (and on page 11780, line 3, what is the "deep stratosphere"?).

12. Page 11781: As I recall, there were a number of model experiments done of burning cities in various cloud models, yet I did not see a reference to these.

13. Page 11783: I don't quite understand what is meant by saying that the CO emissions represent about 2% of the "global inventory"–is this the amount in the atmosphere on average? Comparing to estimates of global emissions might be more useful.

14. Page 11786, top lines: This sentence summarizing your targeting assumptions again seems to me to make the scenario quite implausible. And to suggest that, except for a US-Russia war, that explosion of 50 to 100 nuclear weapons represents only a small number -for any other power, this would be a very large number (well, maybe not for China). And to say it is a small fraction of the total yield also seems to be mixing things up–sure, a global war between the US and Russia would be terrible, and this is the only way to get to a large fraction of the yield going off. For terrorists or small nations, these would be huge undertakings–not a pittance.

15. I also was surprised that the paper had no references to a number of the major climate papers–e.g., of the NCAR and LLNL groups–but did cite the Aleksandrov study,

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which was much more limited.

16. Table 2: This table really seems a bit over the top–suggesting that Belgium or Switzerland has the potential for of order 2000 Pu weapons just seems to make even more clear how far out the consideration is in this paper of what is being analyzed. To sort of imply that Brazil and Argentina might have a regional conflict of the type being considered, etc. is really reaching. Just having plutonium is not really the issue–it is having the capability and intent to use it. Why not say that there is enough plutonium for every person on Earth to die from inhaling it–again, likely true, but rather irrelevant in any logical sense as there is no delivery system to make this come close to happening.

In general, I thought that by jumping to a rather extreme worst case presumptions (or even possibilities), the paper tended to obscure the point that the explosion of only one or a few could have devastating consequences–especially for a surface burst or in situations that would lead to early rainout (or even distant rainout, as happened with Chernobyl). I thus think that the paper is more likely to be dismissed for considering such unrealistic scenarios than for carefully documenting how even a single explosion could cause widespread death and devastation–and quite possibly have long-range environmental and economic impacts as well.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 11745, 2006.