

COMMENTS BY AKIRA OSAWA TO A MANUSCRIPT BY HOHL AND NICCOLAI ENTITLED  
“WILDFIRE IN THE CHERNOBYL EXCLUSION ZONE: A WORST CASE SENARIO”

This manuscript describes results of a relatively simple simulation study on the potential effects of forest fires in Chernobyl Exclusion Zone on additional human mortality due to exposure to radionuclides. The study has found that even the worst case scenario (by intentionally over-estimating the effects at various components of the source, transport, exposure, and mortality) suggested an outcome not so catastrophic. It is comforting. The paper is relatively easy to follow, and it will be able to send a strong message to the world that, perhaps, there is no need to worry too much about the fires in CEZ. However, I feel that the paper can become even better if the authors also consider the following.

First, it is probably necessary to mention that somewhat unexpected extreme cases can occur in reality. Although, the model is conservative, and generally assigns over-estimates in the components, it deals only with the mean values after all. The model does not take into account variability of each component. So, we do not have information on the possibility of occurrence of extreme cases (e.g. mortality of unexpectedly many individuals). One way to cope with this is to modify the model so that it includes variability of various components explicitly. (Even the IPCC report on global warming for policy makers talks about likelihood and probability.) It will make the model somewhat more complex, but is worth considering. Then you could say something about the probability of having X number of additional deaths due to fires in CEZ. That will be the useful information to political leaders and policy makers.

Second, I feel that expression at the end of Discussion should probably be changed. It says “Given these background rates of cancer mortality, the additional cancers would not be distinguishable from normal occurrences.” The last two paragraphs of Discussion indicate that the number of increased cancer deaths due to forest fires will be 81 persons. In contrast, the number of deaths without fires is expected to be 396 (= 158 + 238) persons. The ratio 81/396 is considered “not distinguishable” by the authors; however, it will be 20% increase in cancer deaths, and may be considered “significant.” It is a matter of human life. So, if it is stated that the condition is “distinguishable” or “not distinguishable”, at least some statistical tests should accompany the statement. Alternatively, the judgment of its being distinguishable or not should be left to the policy makers.

Third, I feel that the intended audience of this report is not clear. If this is to be presented to scientifically oriented communities, there should be more description and discussion of the results. For example, Tables 6, 7, 8, and 9 present various results in relation to distance from the source. However, there is little description and discussion of the contents of the Tables. Also, scientists would probably want to know variability of various factors and effects, not just means. On the

other hand, if the intended audience is the general public and policy makers, list of numerous numbers as Tables 6, 7, 8, and 9 should probably be omitted. No one would look at the fine print of those numbers in detail, and it is also not easy to understand what they mean. A better way of presentation is the use of graphs that depict general patterns clearly. Important general patterns should also be explained in words in the text. Otherwise, there is no point in presenting those results.

Following is a list of minor points, but things I noticed while reading the manuscript.

Line 65:“From 1992 to 1994, 200 forest fires occurred in the CEZ”: It will be helpful to briefly describe general characteristics of forest fires in the vicinity of CEZ. It is somewhat hard to grasp the nature of 200 forest fires in an area of 30 km radius in a few-year period. There are many fires in the boreal zone, but they often become huge fires, consuming areas much larger than CEZ in one fire. What would be the major cause of those 200 fires? What is the average size of fires in CEZ? Is there anything left to burn after having 200 fires in recent years?

Line 81:“during and for the first year”: The effect of possible fires in CEZ was assessed for a period of one year after the event. I wonder if consideration of cumulative effect of exposure to isotopes for more than one year makes a difference in possible effects. Table 1 suggests that the half life of the isotopes is not short, and people will be irradiated for extended periods. What would be the reasons to limit the discussion to one year? Would it make analysis much more difficult if you consider longer periods?

Lines 96-97:“transport of the discharged materials”: The analysis considers the transport of the discharged materials through atmosphere only. I agree that it would be the major one. However, I can imagine that streams and rivers collect the radioactive materials that are washed away from the ground surface, and may let them concentrate in sediments somewhere. Do we also need to worry about biological concentration of some of the materials in e.g. fish in the waters? In this regard, I also wonder how important the fishes are in the diet of Ukrainians. I know that Russians consume fair amount of fresh water fishes in some regions.

After Line 119; in the footnote 1: “independent estimates for were” should probably be “independent estimates were”.

Line 122:“fuel radionuclides in the upper 30-cm soil” should probably be “fuel radionuclides in 2000 in the upper 30-cm soil” by specifying the year.

Line 139: "two grassland plots and one forest plot": It would be desirable to indicate how representative the data from these sites are. It would be better to show sensitivity analysis of possible variation in the stock data.

Line 160: "burn over a five day period"; How realistic is the assumption of using the five-day burning period? Many fires in the boreal forests keep burning for months.

Lines 166 and 170: Definition of  $C_A$  should be changed. Later in the manuscript,  $C_A$  is expressed as "radionuclide concentration in the air" on Line 196. Also on Line 170, it is not clear what "sector" is. Perhaps additional explanation is helpful.

Line 181: "ground concentration" does not convey meaning of the variable correctly. Use "deposition density of radionuclide" as it appears on Line 185 or something like "isotopic concentration on the ground".

Line 188: The expression "(d-1)" should be " $(d^{-1})$ ".

Line 247: "Equation [1]" must be "Equation [3]".

Line 248: "Bq/m" must be " $Bq/m^3$ ".

Lines 261, 274, 275, and 303: The unit "Sv/e" should probably be "Sv/a" as it appears on Line 225, 260, and later on Line 352. What does "e" in "Sv/e" mean?

Line 264: "Equation [3]" should be "Equation [4]".

Line 304: "Equations [4,5,6, and 9]" should be "Equations [9,10,11, and 12]".

Line 307: The Equation number "[11]" should be "[14]".

Line 318: The Equation number "[11]" should be "[15]".

After Line 319, in Footnote 11: "applicable to U.S. populations rather than Ukrainian populations": How would the difference in the availability in medical treatment affect the possible error in the estimate of mortality between the populations?

Line 324: The expected does “D”: I think that the result of Equation [14] (total does for all radionuclides considered” was used for “D”. It should be stated as such clearly.

Line 336:”(Table )” should be “(Table 6)”.

Line 457:”ratio of radionuclides in vegetation and litter to soil” sould probably be “ratio of radionuclides in the combustibile material in vegetation and litter to soil”.

After line 459, in Table 1: Heading “Ratio Combustible/Soil” may be changed to “Concentration factor (CF)” since it is referred to this way in the text.

After line 467, in Table 4: What does the unit (d/L) mean, particularly “d”? It is not clear to me.

Tables 6, 7, 8 and 9: Detailed results are shown as Tables, but they are not described sufficiently in the text. I would think that it would be better to use Figures, instead of Tables, and give some more descriptions of the results in words in the text.

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