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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comment on "Global risk of radioactive fallout after major nuclear reactor accidents" by J. Lelieveld et al. (2012)" *by* J. Lelieveld et al.

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We thank Dr. Ehlermann for his comment and are happy to clarify some aspects of our original publication and our comment.

We reiterate that the emissions by Fukushima are not yet well known, although evidence is indeed growing that they were smaller than of Chernobyl (see also our reply to Kleinknecht). If the Fukushima emissions of 137Cs were about 37 PBq, as estimated by Stohl et al. (2012) and confirmed by our model calculations (Christoudias and Lelieveld, 2012), and if the Fukushima emissions are more representative than those of Chernobyl, the deposition risk presented in our original work would scale by

about a factor of 7 (see also our reply to Kleinknecht). However, other factors are expected to have made our deposition risk assessment a conservative estimate, so that the overall difference due to these opposing effects will be smaller, as also discussed in Sec. 8 of our original publication.

The emissions of 131I, though important for the assessment of nuclear accidents and hence relevant in the discussion, were not included in our deposition risk assessment and do not influence the results. We merely presented the 131I simulation results to show that the deposition patterns over land are similar to 137Cs, even though the emissions and removal processes are very different.

Further, we doubt that nearly no iodine was emitted by Fukushima, as indicated by our new model calculations and comparing the results to measurements by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) (Christoudias and Lelieveld, 2012). Significant amounts of 131I were also reported by Chino et al. (2011).

It seems that Ehlermann confuses arguments to make his final point in Q1. He states that: "It's not a problem, as the authors state, that not enough reliable data have been published; the fundamental differences in both accidents are well documented." It is correct that the differences between the two major INES 7 accidents are documented, but our argument emphasizes that reliable data is missing for the release of radioactivity for events below INES 7.

The 60 m surface layer addressed in Q5 (not Q3) is not in the soil but rather refers to the depth of the lowest model layer in the atmosphere. Our publication does not address the fate of radionuclides after they have been deposited.

We are aware that the three reactor accidents had a common cause, as discussed in our original publication and our comment. However, one must also be aware that three of the 5 reactor blocks in the compound suffered a meltdown, so it would also be incorrect to treat them as a single unit. We could have also computed the statistics using plants as the unit, rather than blocks, counting Fukushima as a fractional plant melt-

down. Then scaling by capacity as we have done would give us principally the same answer, but be less transparent in the computation. It is worth noting that NRC (1990) also assumed that reactors are independent, i.e., following the method by NRC (1990) leads to an underestimate of the risk of nuclear power plants with multiple reactors. There are many nuclear power plants worldwide with multiple reactors, and it will be important to establish independent safety provisions to reduce the risks.

We disagree about the fundamental flaws in the statistics. We do agree that it is generally difficult to estimate the occurrence of INES 7 events, for the simple reason that they are rare. We have alternatively considered a Pareto type extreme value distribution, and have collected information about all type of nuclear accidents (INES 0 – 7). Unfortunately, we find that the smaller incidents (INES 0 – 3) are strongly underrepresented, suggesting that they often remain undisclosed. Even though nuclear power companies and countries should report incidents and accidents to the International Atomic Energy Agency, the fact that this has often not happened hampers the use of advanced statistical methods.

Referring to Q8, it seems that German insurance companies estimate the probability of a core meltdown higher than in our original publication (Günther et al., 2011). It would be interesting to learn which methods or professional tools would be more appropriate.

References

Chino, M., Nakayama, H., Nagai, H., Terada, H., Katata, G., and Yamazawa, H. : Preliminary estimation of the release amounts of 131I and 137Cs accidentally discharged from the Fukushima Daiichi nuclear power plant into the atmosphere, J. Nucl. Sci. Technol., 48, 1129-1134, 2011.

Christoudias, T.,and Lelieveld, J.: Modelling the global atmospheric transport and deposition of radionuclides from the Fukushima Dai-ichi nuclear accident, Atmos. Chem. Phys., 12 (submitted).

Günther, B., Karau, K., Kastner E.-M., and Warmuth, W.: Calculating a risk-appropriate insurance premium to cover third-party liability risks that result from operation of nuclear power plants,Versicherungsforen Leipzig, 2011.

Nuclear Regulatory Commission (NRC):Severe Accident Risks – An Assessment for Five U.S. Nuclear Power Plants, NUREG 1150, 1990.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 19303, 2012.