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Authors reply to comment by Michio Aoyama on "Development of a gamma ray dose rate calculation and mapping tool for Lagrangian marine nuclear emergency response models" by Little et al.☆

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We thank Michio Aoyama for their comments and appreciate the opportunity to clarify the issues they raise.

The figure of 12.8–20.3 PBq for direct releases to the marine environment was derived as a sum of the nuclides listed in table 2 of the given reference UNSCEAR (2020), likewise the value of 62–111 PBq for atmospheric deposition in the marine environment reflects the summation of those nuclides listed (only isotopes of iodine and caesium).

We recognise that this could have been more clearly expressed in the original text and apologise for this confusion.

The original text could be better stated "For example, analysis following the Fukushima Daiichi nuclear disaster by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) estimate total direct releases to the marine environment of 12.8–20.3 PBq (the sum of estimates for isotopes 137Cs, 131I, 129I, 90Sr & 3H) and atmospheric deposition of 62–111 PBq (sum of estimates including only 137Cs & 131I) (UNSCEAR, 2020).

We are grateful for the commenter highlighting that the values in the table should effectively be doubled for 134Cs and 137Cs as this was not made clear in the body of the UNCSEAR report table referenced above.

If 134Cs were treated in this manner and included in the figures above the total values presented would be 16.3–25.9 PBq for direct releases and 67–122 PBq for atmospheric deposition.

The authors would like to re-iterate that this summation was only intended to be illustrative of the scale of releases to support an introductory motivating discussion, and the figures quoted in this introduction were not used in any analysis within the paper.

We agree fully with the commenter that if the intention is to derive the *impact* of these releases more information would need to be known. The authors recognise that not only do the different radionuclides listed have different chemical, physical and dosimetric properties as the commenter raises but we would also like to further raise the points that there will be significant temporal and spatial variation within the releases, and inherent associated variations in dose exposure pathways and occupancy factors. Combined with the levels of uncertainty in the data, it was for these reasons that we did not try to derive any impact assessment from these estimates and chose to present the data in terms of a broad summation to illustrate the scale, rather than impact, of the relative pathways.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Reference

UNSCEAR, 2020. UNSCEAR 2020 report - annex B: levels and effects of radiation exposure due to the accident at the Fukushima Daiichi Nuclear Power Station: implications of information published since the UNSCEAR 2013 report. In: Technical Report Advance Copy. United Nations Scientific Committee on the Effects of Atomic Radiation.

☆ Note: to be published alongside comment by Michio Aoyama (MPB-D-22-01468)

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