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Biogeosciences Discussions

Interactive comment on "Radium-based estimates of cesium isotope transport and total direct ocean discharges from the Fukushima Nuclear Power Plant accident" *by* M. A. Charette et al.

Anonymous Referee #1

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The paper presents an interesting estimation of the offshore and vertical 134Cs fluxes from the Fukushima Nuclear Power Plant that followed the earthquake and resulting tsnunami of 11 March 2011. The radium-based methodology is appropriate to attain the objectives of the study, allowing to estimating water apparent ages as well. The manuscript is well written and structured and the covered issue is of undoubtedly relevance within the scope of BG. However, there are some general and specific comments that should be addressed before publication.

The major comment is that basic information on sampled stations and the obtained radium concentrations (not available in the cited BCO-DMO website) are missing, while

there are crucial for the good comprehension of the paper and the traceability of the results. Radium isotopic activities should be explicitly given in the paper. In addition: where were the radium profiles been collected? which are the dates of sample collection? which are the surface samples processed with MnO2 acrylic fibers and those processed with cartridges?...

Specific comments

P16142, L10: "Radium samples" should we replaced by "Seawater samples for radium analysis"

P16142, L11: Figures 1a, b and c are not large enough to correctly see the stations.

P16143, L21: Results section. Radium concentrations for the four isotopes (at least three, if Ra-224 is below detection limit) and all the stations should definitely be included in this section in a table. The authors do not even mention 223Ra data here while they use them to estimate the water apparent age.

P16144, L14-15: Could the authors give a more detailed description of the detected eddy at station 29? The paper by Rypina et al., 2012 is only submitted and the eddy structure is an important feature for the interpretation of the results.

P16144, L19-20: I would rephrase the sentence "While 228Ra/226Ra is expected to decrease with distance from shore, we found many exceptions to this rule". This is only true when diffusion dominates advection and this is clearly not the case in the present study.

P16144, L20-23: Still concerning the eddy, according to the coordinates of the semipermanent eddy detected by surface drifter data (Buesseler et al., 2012), it is centered on 37°N 142.5°E and thus, closer to station 31 than station 29. If higher radium activity ratios trace larger proportions of coastal (vs open) seawater, could the authors give any explanation of why AR close to the center of the eddy (i.e. station31) are remarkably lower than in st. 29? Could it exist any other justification for the high AR in st. 29?

P16145, L9-13: The authors invoke the shoreline as the radium source but which are the processes governing the radium input to the water column? Is the dissolution of sedimented material? Are there porewaters playing a role? What about potential groundwater discharge in the region? I would recommend to better constraining their shoreline argument, what allows using the crustal average 223Ra/228Ra ratio to derive water ages.

P16146, L20-P16147, L6: Comparison between Ra-based and numerically simulated water ages should be done more cautiously since when considering associated uncertainties, the two averaged ages are not different, with a Ra-based estimate that could be either higher or lower than the oceanographic water age.

P16147, L13-P16148, L2: I found a bit surprising to estimate the vertical Cs flux due to diapycnal mixing, which is driven by intermittent patches of small scale turbulence, through an approach that only accounts for diffusion. Could the authors use a method similar to that in Li and Cai (2011) to estimate both (diffusion and advection) terms? (Li, C. and Cai W.-J., 2011. On the calculation of eddy diffusivity in the shelf water from radium isotopes: High sensitivity to advection. Journal of Marine Systems 86, 28–33.

P16148, L14: Are the authors referring to “228Ra data” or “228Ra/226Ra data”? Actually, the reader cannot reproduce the estimation of the Kz (0.7 m2d-1) with the data supplied in the manuscript.

P16149, L27: The term “It” should be replaced by “Ii” according to the definitions given in the text. Again, data on collection time is required for the reproduction of the calculations made.

Interactive comment on Biogeosciences Discuss., 9, 16139, 2012.