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Interactive comment on "Ecosystem model-based approach for modelling the dynamics of ^{137}Cs transfer to marine plankton populations: application to the western North Pacific Ocean after the Fukushima nuclear power plant accident" *by* M. Belharet et al.

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General comment

This paper clarifies the bio-environmental-kinetics of radiocesium in plankton community by application of developed dynamic model binding with ecosystem model. It is challenging and original that this new complex model application to off Fukushima environment. Derived conclusion based on modeling analysis exhibits possible theoretical explanation of the temporal and special change of radiocesium concentration in plankton community of the western North Pacific Ocean. Evaluated dose rate to plankton community of this area demonstrates currently up to date information of radiation effect on ecosystem. Though it is not yet clarified all of contamination sources from the Fukushima nuclear power plant, this paper is important to open the latest estimation of radiation dose on wild-life caused by the Fukushima accident.

The paper is valuable because of its theoretical explanation of radiocesium dynamics in plankton community of the western North Pacific Ocean. To make clear the logic structure and rationale for model validation, following points are recommended to be reconsidered or corrected. In addition, editorial arrangement are suggested to help reader's understanding,.

1) The output from simulated result is regulated by contamination source input to the model. Thus it is necessary to show the information of what kind/amount of radiocesium source (e.g. atmospheric: 2.0?? PBq within radius ??km, initial liquid release 3.5?? PBq) introduced to the model as source input in this study. At the same time, it should be declared what possible sources (e.g. redistributed by river discharge, late continuous release etc.) were out of concern in this study. Otherwise, reader cannot identify limitation of the result applicability which regulated by the source given in this study.

2) Bio-kinetics parameters in the model are calibrated by analyzed concentrations in zooplankton collected at Sendai Bay (MEXT?). As Kaeriyama et al., (2015) discussed about the biota data in this coastal water, the analyzed values of zooplankton collected by Bongo/sledge net collection were understood as higher deviated by probably containing suspended particle with or within zooplankton. Similar higher deviation tendency in collected plankton samples were pointed out by the conference presentation by Aono (NIRS) and Ishimaru (Tokyo Univ MST)(unpublished data). The effect of this kind of deviation of the data on model calibration is more or less significant to the final calculated output. One may use bias-based calibrated parameter as an apparent

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(calibrated) value, especially in the model simulation carrying out at area of similar condition such as coastal waters around Fukushima. However, in contrast, the application of bias-based calibrated parameters will generate overestimation in case applied to North Pacific Ocean at where the contribution of contaminated suspended particles is negligible. Thus this paper should make remark that the result of Ocean simulation may be overestimated. Or if possible, it is encouraged to derive correction factor (see. Tateda et al., 2015). In case if not, the remark or showing assumed error extent is helpful to avoid reader's misunderstanding the result that being at maximum or bias-based estimation.

3) The significant findings in this paper are that the time-dependent radiocesium concentration in zooplankton is theoretically explainable by temporal change of plankton biomass and food ingestion/composition rates reconstructed from the ecosystem model. In addition, it is worth to report that depressed oceanic winter food condition reduces the radiocesium concentration in zooplankton, though it should be evaluated by multi-year simulation by validation with observation (Kitamura, Nishikawa unpublished data). On the other hand, sensitivity of model output affected by parameter deviation (Fig. 5), ratio of concentration in phytoplankton and zooplankton (Fig. 7), and seasonal dynamics of concentration in non-accident (Fig. 10) etc. are understood as just the calculated results defined by model characteristics without no validation data compared with. Since they are just functions of given input, and not the proven findings, these discussions are recommended to reconsider its necessity in this paper.

4) The order of appearance of tables and figures are not corresponded the order discussed in the text. Fig. 2, Since tables and Fig. 2 are not necessarily shown in the main text, it is suggested to show as Appendix in the last of the paper, or supplementary material.

Specific comments

9499 21 "assess the radionuclide concentration in marine biota" -> "assess the ra-

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dionuclide distribution between marine biota and environment"? or "reconstruct the radionuclide concentration in marine biota"?

9502 5 missing (ZP) in "predatory zooplankton (ZP) such as krill and/or jellyfish"

9505 6 The source information used for the simulation has to be shown, such as atmospheric, initial effluent and continuous release (if included in this paper).

9505 13 If the terrestrial runoff contribution is not estimated and included in this simulation, the remark has to be announced. (See Nagao, S., Kanamori, M., Ochiai, S., Tomihara, S., Fukushi, K., Yamamoto, M., 2013. Export of 134Cs and 137Cs in the Fukushima river systems at heavy rains by Typhoon Roke in September 2011. Biogeosciences 10, 2767-2790.; Tateda, Y., Tsumune, D., Tsubono, T., Aono, T., Kanda, J., Ishimaru, T., 2015. Radiocesium biokinetics in olive flounder inhabiting the Fukushima accident-affected Pacific coastal waters of eastern Japan. J. Environ. Rad. 147, 130-141)

9505 17 Instead MEXT (2014), Kaeriyama et al., (2015) should be cited. See "Kaeriyama, H., Fujimoto, K., Ambe, D., Shigenobu, Y., Ono, T., Tadokoro, K., Okazaki, Y., Kakehi, S., Ito, S., Narimatsu Y., Nakata K., Morita, T., Watanabe T., Fukushi-maâĂŚderived radionuclides 134Cs and 137Cs in zooplankton and seawater samples collected off the JobanâĂŚSanriku coast, in Sendai Bay, and in the Oyashio region Fish Sci (2015) 81, 139–153"

9505 20 For the geographical positions, see the above paper.

9507 25 Corresponding wet weight should be shown in the text, to compare with those of zooplankton (approximately, 200–600 ? mg w.w.m-3). In case that, please show the reference of Organic matter/Chl-a ratio used for wet weight calculation.

9509 13 Calibrated elimination rate 0.03 – 0.11 d-1 for zooplankton is likely to be smaller than the experimentally derived elimination rate 0.8 d-1 in zooplankton (Brachionus plicatilis) in Japan (Aomori Prefecture. 1990. Heisei-gannen Marine environmental radioactivity general review report. Aomori Prefecture, Aomori, 91pp. (in Japanese).

9509 10 Calibrated accumulation 5 x 10-4 L g-1 d-1 (being approximately equivalent to 1.0 d-1 if assuming 500 mg w.w.m-3) for zooplankton is also likely to be smaller than the experimentally derived elimination rate 50 d-1 in zooplankton (Brachionus plicatilis) in Japan (Aomori Prefecture. 1990). If the calibrated transfer rates in Table 1 are derived by fitting simulated result to observed result, they should be described as “apparent”.

9509 26 Unify the term to “accumulation rate” instead “uptake rate”.

9512 7 “the simulated zooplankton” -> “simulated large ? zooplankton”

9512 10-16 Are these discussion for “large” or weight averaged ZS, ZL and ZP?

9512 22 Missing (R) in “a ratio (R) of the 137Cs concentration. . ..

9513 23 The vertical removal and transport to bottom layer are important process in open ocean as written in this paper. However there are no quantitative proof for the significant contribution of this process around 1FNPP. Other process is suggested as critical in the Fukushima coastal waters, e.g. continuous release, river discharged particle from highly contaminated land area, etc. Delete the description or discuss further.

9513 25 Is “Concentration ratio” is appropriate to use as term in the dynamic model study paper? Under the dynamic simulation, the obtained ratio is considered as apparent concentration ratio (aCR) as suggested by Kaeriyama et al., (2015).

9514 24 “poor” ->”oligotrophic”?

9515 8 “The time needed for . . .”-> “The time derived by the modeling analyses . . .

9516 3.8 Is the term “TTF” is worth to discuss? Discussed here is the apparent TTF (aTTF) under transition condition. In addition, the TTF for Hg is completely different characteristics. The transfer time constant of Hg are extremely long or infinite. Thus

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TTF is appropriate concept for Hg transfer in marine ecosystem, while TTF concept is not useful for Cs.

9522 17 Add JODC data archive location in the web.

9523 23 MEXT should be replaced by Kaeriyama et al., 2015.

Fig. 3. Unify the case of letter in fig (A – F) and in figure caption (a - f). Add legend for three different taxonomic compositions (ZS,ZL, ZP?) in subfigures B, D, F.

Fig. 4. Reference Kaeriyama et al., (2015) should be shown as data source in foot note.

Fig. 5. Title of X-axis are small and are unreadable. Add title as PS, PL, ZS, ZL, ZP for sub-figures instead.

Fig. 6. Unify the case of letter in fig (A – D) and in figure caption (a - d). Show the unit (Bq kg d.w.-1) for the contour legend. For sub-figure B, Buesseler et al., (2012), and for C, Kitamura et al., (2013) aren't they?

Fig. 8. Missing (PS)(ZL)(ZP) in "... small phytoplankton (PS), large zooplankton (ZL) and predatory zooplankton (ZP) in the .....". Scale of Y-axis in subfigure ZP is different from others. Unify the Y-scales of all subfigures.

Fig. 11. Y-scale in subfigure ZP are different. Unify the whole study area and 0-30 km from 1FNPP.

Fig. 12. What are red bars and marks representing?

Interactive comment on Biogeosciences Discuss., 12, 9497, 2015.