Response to Reviewer #1

The authors are most grateful to the reviewer for thorough analysis of manuscript and for constructive criticism and suggestions. We have taken his remarks into account, and the paper has been revised in many places accordingly.

General comments

This paper reported the idea of radionuclide kinetic transfer model of tissue compartments (muscle, bone and organ) associated with growth of fish (multi-compartment kinetic allometric model: MCKA). The result of modelling tests demonstrated that the simulated temporal changes of ^{134}*Cs,* ^{57}*Co,* ^{54}*Mn and* ^{65}*Zn levels in whole bodies and muscle of juvenile/adult sea bream, turbot and spotted dog fish reconstructed well the experimental results by Mathews and Fisher, 2008 and Mathews et al., 2008. The test result also exhibited that the bioconcentration factor (BCF) derived by simulation for* ^{134}*Cs,* ^{57,60}*Co,* ^{54}*Mn and* ^{65}*Zn levels in whole bodies of juvenile sea bream and turbot agreed to the experimental results by Mathews and Fisher, 2008 and Jeffree et al., 2006. The applied results by MCKA model for temporal levels changes in fish of* ^{60}*Co and* ^{54}*Mn at the vicinity of the Forsmark nuclear power plant of Baltic Sea, and* ^{90}*Sr at Fukushima coasts were shown as being comparatively close to the measured wholebody concentrations in predator fishes than those generated from one-compartment model and tissue target model. The paper demonstrated that the MCKA model applicability to calculate the temporal changes of radionuclide levels in whole body of fish during 20 years. The approach method for evaluation of radionuclides levels in whole body was valuable to assessment of seafood safety in case of whole fish consumption, and possibly the radiation dose to wild life in the environment. The presented result may be worth to publish. However, the values of key parameters were not shown in the paper, which made reader being difficult to understand the rational sequence of modelling procedure. Especially of those bio-chemically different parameters for Cs, Sr and Co, Mn, Zn were not shown. It was insufficient only demonstrating the assimilation efficiency and the allometric parameters in the results. Because of these, the modeling methodology was not easy to understand and also the paper contents being vague. Therefore, the following four points are strongly recommended to revise before publish, to make the paper as being scientifically correct, and also helping reader's understanding.*

Answer. We modified accordingly Table 2 including data for AE_w . The tables with MCKA model parameters and transfer rates for each laboratory experiment and for case studies were added in the Supplemenary Material (Tables S1-S8). The content of these tables is discussed below.

1) Line 70: To help the reader's understanding, the resulted specific parameter values of ïA¿n˘ ïA¿l'ïA˘ ¡1-5. K_w, K_f, k_{1i}*=3-5,* k_{2i}*=3-5 for Cs, Co, Mn, Zn, Sr has to be shown in supplementary Table. The parameter values of ïA¿n˘g for sea bream, talbot, spotted dog fish, herring, pike also have to be shown in supplementary Table if they were decided as similar to* AE_w *and* AE_f *referred in line 214.*

Answer. We added tables with MCKA model parameters (Tables S1 and S5) and transfer rates $k_{2,\mathrm{i}}$ and $k_{1,\mathrm{i}}$ (Tables S2-S4 and S6-S8) for each fish in laboratory experiments and Table S11 with parameters of MCKA model for prey fish and predator fish in the marine case studies. The text was changed accordingly:

Line 201 "Parameters of MCKA model for fish from experiments (Mathews and Fisher, 2008; Mathews et al., 2008) are given in Table S1, whereas Tables S2-S4 show dependence on radionuclides of the transfer rates $k_{2,\mathrm{i}}$ in different fishes."

Line 215 "Parameters of MCKA model for these fishes are given in Table S5, whereas Tables S6-S8 show dependence on radionuclides of the transfer rates $k_{2,\mathrm{i}}$ in different fishes."

Line 296 "Therefore, we can apply the model parameters defined for marine environment (see Table S11) to reconstruct the herring and pike contamination by the above-mentioned radionuclides in the area near the Forsmark NPP with low salinity (3-5 PSU)."

Line 356 "Parameters of MCKA model for these fishes are given in Table S11."

2) Line 115: The referred MCKA parameter values in Table S1 has to be associated with Cs, Co, Mn, Zn and Sr, because each metabolism was different resulting specific values.

Answer. Parameter values in Tables S1, S5 and S11 (food uptake rate K_f, water uptake rate K_w and elimination rates λ_i) depend on the mass of fish and do not depend on radionuclide, whereas an activity is distributed between different tissues/organs according to assimilation efficiencies (Table 2), which are different for different radionuclides. The combination of all these parameters defines the processes of radionuclides uptake, retention and elimination that leads to the differences of fish contamination by each radionuclide. The text was added accordingly:

Line 364 "The food and water uptake rates, elimination rate and growth rate depend on the metabolic rate, which is scaled by fish mass to the 3/4 power, but do not depend on the radionuclide. At the same time, the activity is distributed between different tissues/organs according to the tissue assimilation efficiencies, which are different for different radionuclides

(Table 2), but does not dependent on fish mass. Therefore, the transfer rates can be associated with specific radionuclide and fish mass as shown e.g. in Tables S2-S4."

3) Line 115: if Table S1 values only derived by mass difference of fish size, it has to be mentioned that "We did not consider the change of prey preference along growth in this study", which was referred in line 163-165.

Answer. The text was changed accordingly:

Line 165 "The BAF in larger and older fish of the same species can differ from smaller and younger fish due to the change of habitat and diet with age (e.g. Kasamatsu and Ishikawa, 1997; Ishikawa et al., 1995; Kim et al., 2019), however, in this study we did not consider the change of prey preference along the fish growth."

4) Fig. 7 and 8: The salinity of area studied was 3-5 PSU, suggesting the estuary being close to freshwater environment. The description about how the author parameterize to simulate 60Co and 54Man level reconstruction marine fish herring and freshwater fish pike under such low salinity brackish water environment.

Answer. We added text accordingly:

Line 295 "According to Jeffree et al. (2017), the uptake and depuration kinetics of ^{60}Co and ^{54}Mn for fish species in marine, brackish and freshwater environments are similar.

Therefore, we can apply the model parameters defined for marine environment (see Table S11) to reconstruct the herring and pike contamination by the above-mentioned radionuclides in the area near the Forsmark NPP with low salinity (3-5 PSU)

Minor comments

Line 15: "Predicted" read as "Reconstructed" or "Computed".

Answer. Done

Lune 16: "predicted" read as "calculated" or "computed".

Answer. Done

Line 27: "effective recession times" read as "effective half-life".

Answer. Done

Line 29: "Tateda et al., 2013" has to be deleted from citation, because of the model is for target tissue (muscle).

Answer. Done

Line 35: "Tateda et al., 2013" has to be added in citation, because of the model is for target tissue (muscle).

Answer. Done

Line 38, Fig. 1: There were no data of body tissue mass in the referred Yankovitch et al., 2010 (no kidney CR data and body tissue ratio data). The exact citation has to be shown, or the calculation process for Fig. 1 has to be shown in the paper as supporting material.

Answer. Data for kidney were removed from the Fig. 1. We added reference on Yankovich (2003) where detailed data on tissue mass fractions are reported. The percentage of activity in a given tissue F_i was calculated as a ratio of tissue mass fraction to whole body μ_i to tissue concentration ratio CR_i multiplied by 100%: $F_i = \mu_i / CR_i \cdot 100\%$. Corresponding changes were made on the Fig. 1 and in the text.

Line 38 "Distribution of accumulated activities of isotopes Cs, Sr and Co in muscle, bone and liver estimated from previously reported data (Yankovich, 2003; Yankovich et al., 2010) are shown in Fig. 1. The accumulated activity in a given tissue was calculated as a ratio of tissue mass fraction (%) (Yankovich, 2003) to body-to-tissue concentration ratio (Yankovich et al., 2010).

Table 2: The values for Ag, Cu, Cd and Cr may be not necessary in this paper because of this paper result only demonstrated the simulations of Cs, Co, Mn, An and Sr.

Answer. Done.

Line 163-165: The description of "The BAF : : :our findings" has to be re-considered, because the modelling in this paper seems not include the change of prey-type associated with fish growth.

Answer. See answer on General comment #3.

Line 165: "1999" read as "1995"

Answer. Done

Line 189: "however, : : :greater in the muscle" has to be reconsidered, because the retained levels of blue line A3/Af (muscle) were higher than A4/Af (bone) and A5/Af (organs) for all four nuclides in Fig. 2.

Answer. The curves in Fig. 2 represent activity in the tissues normalized on the total amount of ingested activity. Most of the activity is contained in muscle (blue line in Fig. 2). However, first 5 days after feeding the concentrations of ^{60}Co and ^{54}Mn in organs are much greater than concentrations in the muscle. We have adjusted the description of the figure accordingly:

Line 190 "However, the first 5 days after feeding the concentrations of ^{60}Co and ^{54}Mn in the organs are much greater than in the muscle."

Fig. 4: “Co” read as “57Co and 60Co”.

Answer. Done

Fig. 4: The model simulated results of dog fish were not shown.

Answer. Parameters of MCKA model for *Psetta maxima* and *Scyliorhinus canicula* from experiments for uptake of activity from sea water (Table S5) are very close, therefore computed curves for *Psetta maxima* and *Scyliorhinus canicula* in Fig. 4 almost coincide.

Line 425: “1999” reads as “1995”

Answer. Done

Line 359: “may biologically magnify when transferring upwards into the food chain” read as “level may elevate in the predator fish of the food chain“, because Cs was not accumulative element compared to Hg and Cd.

Answer. Done.