

Public justification (visible to the public if the article is accepted and published):

In the referee's opinion, chapter 2.7 contains essential information on this study and is only incompletely described. The author has revised the chapter accordingly. Unfortunately, the new text is insufficiently understandable linguistically. For example, the first sentence from line 340 with various text inserts stretches over 5 lines. The equation can hardly be captured. Now, what is the message of the chapter regarding mass balance and inflow and outflow? Are figures referred to and, if so, which ones? This text needs to be revised again before publication

Dear Prof. Dagmar Hainbucher

Thank you very much for your comment and your decision.

I modified the chapter 2.7.

In this mass balance equation, I was estimated the net outflowed ^{137}Cs from each box. In the surface sea water, ^{137}Cs activity concentrations (or inventory) are controlled by radioactive decay, inflow from the upstream box, outflow to the downstream box, and downward transport below the surface mixed layer.

$$[^{137}\text{Cs inventory}]_{\text{box},t_i+5} = [^{137}\text{Cs inventory}]_{\text{box},t_i} - [\text{radioactive decayed } ^{137}\text{Cs}]_{\text{box},\Delta t} - [\text{net outflowed } ^{137}\text{Cs}]_{\text{box},\Delta t} \quad (8)$$

Because estimates of ^{137}Cs transport amount in these processes were very difficult in this study, outflowed ^{137}Cs by these processes were represented as “net outflowed ^{137}Cs ” in each box. In this study, I showed the estimation in every 5 years after 1975 by using the previous 5 years inventory value. In the case of 1970, ^{137}Cs deposition amount until 1970 was used as an initial value.

I modified this chapter as follows.

2.7. Mass balance; inflow and outflow of ^{137}Cs from each box

In the marine environment, ^{137}Cs activity concentrations after 1970 were dominantly controlled by radioactive decay and physical ocean processes, except for the release by accident and reprocessing plants. As the physical oceanographic processes, ^{137}Cs in the surface seawater in each box receive inflow from the upstream box, outflow to the downstream box, and downward transport below the surface mixed layer. In fact, estimates of ^{137}Cs transport amount in these processes were very difficult in this study. Therefore, outflowed ^{137}Cs by these processes were represented as net outflowed ^{137}Cs in each box. Mass balance of ^{137}Cs in the surface mixed layer was considered as following equations.

$$[^{137}\text{Cs inventory}]_{\text{box}, \text{ti}+5} = [^{137}\text{Cs inventory}]_{\text{box}, \text{ti}} - [\text{radioactive decay } ^{137}\text{Cs}]_{\text{box}, \Delta t} - [\text{net outflowed } ^{137}\text{Cs}]_{\text{box}, \Delta t} \quad (8)$$

$$[\text{radioactive decay}]_{\text{box}, \Delta t} = [^{137}\text{Cs inventory} \times \exp(-0.693/T_{1/2} \times \Delta t)]_{\text{box}} \quad (9)$$

$$[\text{net outflowed } ^{137}\text{Cs}]_{\text{box}, \text{ti}+5} = [\text{inflowed } ^{137}\text{Cs}]_{\text{box}, \text{ti}} + [\text{outflowed } ^{137}\text{Cs}]_{\text{box}, \text{ti}} + [\text{downwards transport of } ^{137}\text{Cs below the surface mixed layer}]_{\text{box}, \text{ti}} \quad (10)$$

where,

Δt : 5 years

ti : $1970+i \times 5$ ($i=0,1,\dots, 9$).

$[^{137}\text{Cs inventory}]_{\text{box}, \text{ti}}$ is the value at initial year and $[^{137}\text{Cs inventory}]_{\text{box}, \text{ti}+5}$ is the ^{137}Cs inventory after the Δt year in each box. In this study, this mass balance was estimated to every 5 years from 1970 to 2015. In the case of 1970, ^{137}Cs deposition amount until 1970 was used as the value of the initial year in each box. In the northern North Atlantic Ocean and Arctic Ocean, an extremely large inflow was estimated in 2000 due to the extremely large values included in the dataset. These data in 2000 and 2005 were removed from the figures.

Thank you very much again.

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