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Biogeosciences Discussions

Interactive comment on "Spatiotemporal distributions of Fukushima-derived radionuclides in surface sediments in the waters off Miyagi, Fukushima, and Ibaraki Prefectures, Japan" *by* M. Kusakabe et al.

Anonymous Referee #2

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General comments: This ms reports concentrations and inventories mainly for radiocesium in sediment off the coast of three prefectures near the Fukushima Dai-ichi Nuclear Power Plant (FDNPP). Sediment contamination is an important issue to assess (address) since numerous organisms are closely linked to sediment and indeed it has been reported that benthic fish appear to be more contaminated than pelagic fish off FDNPP. In addition sediment compartment represents a possible delayed source in time for the overlying-water contamination as it has been previously observed especially in the Irish Sea. It is therefore valuable to see data made available on the MEXT

website concerning such an important issue stressed by Japanese scientists in the scientific literature.

Specific comments: A paragraph on regional settings presenting sediment characteristics (grain size if available, typical sedimentation rates and suspended matter concentrations) in this area is really lacking (at least data available before the tsunami, if some are available after the tsunami it is even better). In this part the authors should underline the parameters that could be subject to deep disturbances by such a very high energy event. The possible effect of the tsunami is mentioned only in the conclusion (lines 16-18 page 4833) it should come first. I am not familiar with tsunami but I guess that sediments were deeply disturbed especially surface layer in the coastal zone. Indeed, tsunami led to strong sediment mobilisation, possibly scouring and I was wondering how long it takes to these sediments to consolidate again. In the mean time re-suspension processes on these disturbed sediments should be far easier. The coastline in the area studied is rich in small rivers that could have an effect on suspended matter content as well as radionuclide input after wash out of the catchment basins enriched both in sediment after the tsunami and in radionuclides after the accident. . .especially in an area subject to heavy rains.

Samples dealt with in this paper concern the first 3cm of sediment. This may be one factor for explaining the quite low radionuclide concentrations reported in this ms. Indeed, it is likely that the surficial sediment is the most contaminated, therefore taking 3cm induces a signal dilution (The dilution is all the greater as the sedimentation rate is low). Please add a comment on that point.

Relationships between 137Cs concentration and bulk density (grain size) is not that simple. They are especially highly correlated when dealing with homogeneous sources such as global fallout (for a given concentration in the overlying water the concentration in fine sediment is higher than in sands). It is not necessarily the case when having non-homogeneous sources and /or dynamic events or both : in these cases the influence of grain size on 137Cs concentration can be masked by field factors such as

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fluctuations in the discharges, and/or in the plume characteristics (i.e. direction, thickness..) so it is not surprising that fig 9 shows large variations for a given bulk density and to observe large variations for a given location (station D).

In the abstract authors mentioned “no obvious correlation between 137Cs concentration and the proximity of the sampling location to the site of the accident”. I think the preceding remark can help to answer why. However it appears that globally the higher contents are generally found in the coastal stations (stations with index 1) though it is difficult to clearly answer this point since the stations, index 3 and others, were only sampled after September 2011.

Several times the authors report average inventories ($3.3, table 1) without giving standard deviation. Due to the very high variability in the results it appears compulsory to mention it in precising if it is given with 1 or 2 sigma.

The global inventory is calculated in a very crude way i.e. using the surface area 22 177km2 and a single value (averaged) for the whole area 0.161 Bq cm-2. The authors should at least give a range using the standard deviation of the average inventory used. I recommend also to calculate inventories for various areas (for example <200m and > 200m) and to see how they match with the inventory calculated with the average inventory based on a single average value.

Other comments Figure 4. This figure is very difficult to read since close curves have close colours. Please change the colours or the type of line (dotted lines..).

P4824 The explanation about local heterogeneity should come first. In addition to local heterogeneity in sediment characteristics, heterogeneity in seawater contents should be mentioned as well

Same page: Regarding the topmost layer. “Because the surface sediment layer enriched with 137Cs”. Please specify the most enriched since on page 4826 it is mentioned that Osaka and Kobayashi detected Fukushima derived rn below 3cm.

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Page 4826: Line 11 about B3 inventory : . . .”not particular high compared to the inventories at the other stations” please specify : due to its high water contents. Do the authors have explanations about these high water content values in B3?

Last §about releases of FNDPP: the authors quote Masumoto et al., 2012, please mention the different papers having dealt with this topic (there are not many).

Page 4826 “Sediment bulk density and 137Cs concentration were inversely correlated”: it is not so obvious in the fig. 9 even if a ‘trend’ appears and I am not sure that this would be statistically significant. Please moderate the sentence which is in contradiction with the last sentence of this §, lines 14-15 where the scatter of the data in fig. 9 is underlined.

page 4829 and fig10 lines 7 The data in the figure suggest that almost all the 137Cs in the sediment had accumulated by the end of july 2011: can the authors explain how they reach this conclusion?

Fig 10 in the legend the period indicated is May to June 2011 and in the text p4829 line 2 May to July 2011

In figure 10: 18 stations out of 30 are presented, can you explain why.

Same page last §, the Cs removal might have been enhanced by increase in suspended matter contents due the tsunami.

Page 4832 last §It is not surprising that the activity ratios did not necessarily agree with the blue lines fig. 13 since these radionuclide do not have the same behaviour than 137Cs.

Interactive comment on Biogeosciences Discuss., 10, 4819, 2013.