Answer to Reviewer#1

General comments

The manuscript is based on the results of assessing the erosion/deposition rates using FRN as markers. The following questions arise when reading the manuscript:

1/ Based on Figure 4, we can conclude that the variability of 137Cs on a forested slope is higher than on vineyards. This clearly indicates that the Chernobyl fallout was extremely uneven in the area. It is obvious, that the initial 137Cs spatial variability of Chernobyl fallout too high for using the 137Cs technique for evaluating the soil losses based only on one reference location. It is necessary to evaluate 137Cs initial inventory minimum at three reference locations for the evaluation of the trend of initial fallout (See: Handbook for the Assessment of Soil Erosion and Sedimentation Using Environmental Radionuclides, F.Zapata for details). So authors aren't able to confirm the correctness of their evaluation of soil losses, based on Chernobyl-derived 137Cs because they have only one reference location on the distance of about 1 km from the studied site.

At the study site, the variability of the 137Cs baseline reference inventory was estimated at 21% (11 samples). This is not an exceptionally high value and there, in fact, were many studies applying FRNs in the areas with a higher spatial variability of 20% e.g., Nagle et al. (2000), Sutherland (1991), Meusburger et al. (2016), Teramage et al. (2015).

The spatial variability of 137Cs inventories in forests is high (expressed by a CV of 41.3); however, it was equal to vineyard site (see table below and 4.1.2. Fallout radionuclides inventories and soil redistribution rates at slope transects section in the MS line 255). The variability in the forest may be the result of initial fallout heterogeneity but also from actual soil redistribution at the steep slope. Thus, from the heterogeneity in an erosional site it cannot be deduced whether the 137Cs technique is applicable or not.

Table- Average, standard deviation (SD), and coefficient of variation (CV) of 137Cs inventories in two hillslopes

Land-use	Average ($Bq\ m^{-2}$)	SD ($Bq\ m^{-2}$)	CV (%)
Forest	5389.94	2227.97	41.34
Vineyard	4646.61	1921.82	41.35

2/ On the other hand, if the mean 210Pb inventories values ââare approximately the same for the forested slope and vineyard (see bottom of page 9: 210Pbex inventories at 4068.3±2345.8 and 3990.1±2892.2 Bq m-2, respectively for forested and vineyard hillslopes) , then it is completely incomprehensible how such a large difference in net erosion rates (calculated based on 210Pbex) between the forested area and the vineyards was received (see Table 2). It is quite obvious that this is a very gross error in the calculations.

Both land use types are subject to very different cultivations: the vineyards are regularly ploughed, while the forest is not. In fact, similar inventory values in the upper most soil represent very different erosion rates. At the vineyard, deposited FRN will be mixed by ploughing into deeper soil layers, down to a depth of 30 cm. Thus, different conversion models should be applied at the uncultivated and cultivated sites. As asserted by F. Zapata in his book "*Handbook for the Assessment of Soil Erosion and Sedimentation Using Environmental Radionuclides",* since FRNs are mixed and diluted in tillage depth at the cultivated sites, its loss in cultivated lands corresponds with a higher amount of soil loss compared to uncultivated lands in which FRNs are concentrated in the upper parts of the soil profile (Zapata, 2002). Therefore, the conversion models developed for cultivated lands consider the above-mentioned fact and predict higher amount of soil loss/gain for the similar amounts of FRNs in cultivated lands. Thus, the difference in erosion rates is not due to a calculation error.

3/ The local spatial variation of the 137Cs fallout, as well as the other radionuclides, is >20% on the reference location. Isn't recommended to use FRD for evaluation of soil loss/gain in areas where initial fallout variability > 20% due to very high uncertainty of the results (see papers written by D. Walling and the other experts in the application of FRN for the evaluation of soil redistribution rates).

137Cs, 239+240Pu, and 210Pbex variability at the reference site were 21, 23, and 25% respectively; however, there are many examples of FRNs usage in areas with relatively higher CVs in the literature (see the answer to question 1). Furthermore, IAEA (2014) suggested that if the coefficient of variation (CV) of the FRN inventory at a specific reference site exceeds 30%, this is an indication of its unsuitability and reference sample numbers should be increased.

- *IAEA (2014), Guidelines for using fallout radionuclides to* assess *erosion and effectiveness of soil conservation strategies, International Atomic Energy Agency, IAEA-TECDOC-1741. Vienna, Austria, 1-213, 2014a.*

"Page:39: If the standard deviation obtained for this sample set proves too high (CV% > 30%), more samples should be taken (Mabit et al., 2014)". So, our CVs are clearly lower than this value. Therefore, the sentence (in line:364) was modified as follows:

-Mabit, L., Chhem-Kieth, S., Dornhofer, P., Toloza, A., Benmansour, M., Bernard, C., Fulajtar, E. and Walling, D.E., 2014. 137 Cs: A Widely Used and Validated Medium Term Soil Tracer. IAEA TECDOC SERIES, p.27.

"Different percentages have been reported in the literature for the allowable CV of FRNs at the reference site; for instance, Sutherland (1996) and Mabit et al. (2012) suggested it to be 20% at 90% level of confidence, while in IAEA (2014) the figure was declared to be below 30%. The selected reference site here met the criteria of the FRNs' CVs, i.e. below 30%."

4/ Authors indicate that …The soil redistribution rates were, therefore, estimated using the Diffusion and Migration Model 185 (DMM) (Walling et al., 2002, 2014) in forested hillslope, Mass Balance Model II (MBM II) (Walling et al., 2002, 2014) in cultivated hillslope, and Modelling Deposition and Erosion rates with RadioNuclides (MODERN; Arata et al., 2016a, 2016b) – It is necessary to present the equations for all conversion models and to explain how you determine the parameters for each model.

As suggested, the parameters for each model have been added to the MS (see below). Since the conversion models have been described in numerous publications, we prefer to refer to these studies instead of providing the equations to keep this manuscript as concise as possible. However, if you or the editor prefer to have this information, we could provide it in the supplementary material.

We thus will change the paragraph to:

"For ^{137}Cs and ^{210}Pb$_{ex}$ the MODERN and the DMM were applied at the forested site, while at the vineyard site, the MBM II (i.e. without tillage component) was used (Table 2). Particle size factor was taken to be 1 for all models. For DMM, the migration rate (V), the diffusion rate (D), and the relaxation depth (H) were determined using the depth profile of ^{137}Cs and ^{210}Pb$_{ex}$ at the reference site. For MBM II, a value of 4 kg m^{-2} for H and a value of 0.5 for proportion factor (γ) were set (Walling et al., 2002; 2014). To estimate the soil redistribution rate at each sampling point, the Excel Add-in Bradiocalc.xla (see http://www-naweb.iaea.org/nafa/swmn/models-tool-kits.html) was used for executing the DMM and MBM models. For more details on equations of the models and definitions of their parameters, readers are referred to Walling et al. (2002; 2014). Furthermore, the MATLAB code (https://duw.unibas.ch/de/umweltgeowissenschaften/forschung-fg-alewell/modern/registration/) was applied for executing MODERN, find more details on the model and its parameters in Arata et al. (2016a; 2016b)."

5/ In addition application FRN for evaluation soil erosion rates in the forest isn't possible at all due to the influence of the crown of trees on the initial spatial variability.

We totally agree with you, that due to the influence of interception deposition, canopy throughfall, stemflow and general canopy heterogeneity the interpretation of the data has to be done with caution. However, as the CV of FRN was similar in forests as it was in vineyards, we do think it is acceptable to apply this method to our forested areas. As reported in the MS, there are many studies in which FRNs have been used in the forested areas worldwide (e.g. Gaspar et al., 2013; Wakiyama et al., 2010; Gharibreza et al., 2013; 2020). Commonly, it is proposed to collect samples as far away from the tree trunks as possible to avoid the influence of stem flow. We followed this advice. Furthermore, we collected >30 samples within the forested site, enabling us to successfully gain such comparable CVs between forests and vineyards and average out some of the small-scale variability caused by the throughfall pattern.

Specific comments

1/ Are you sure that sampling only 40 cm layer is enough for determination of FRN total inventory in deposition location? How you can confirm that?

Thank you for this comment and sorry to be imprecise. We added this statement to the MS: "in locations where deposition was expected, whenever the soil was deep enough, the samples were collected up to 40 and 50 cm in forest and vineyard hillslopes, respectively."

2/ In the Supplementary Material, the 137Cs depth distribution in the lake is presented. But it is completely incomprehensible how it was obtained?

The presented graph was meant to confirm whether or not the study site was affected by Chernobyl (according to the number of the peaks); sorry for the confusion, we will not present the lake core data in this manuscript.

3/ Figure 5 – how do you construct both maps with so high spatial resolution? Why was the total precipitation in April and May used to construct these maps? The accident at the Chernobyl nuclear power plant occurred on April 26 and the bulk of the Chernobyl fallout was observed until May 15 and was associated with the fallout of only one rain at a distance from Chernobyl.

We are sorry, but these monthly datasets had to be used since no local daily precipitation data was recorded in the site at the time of the expected Chernobyl fallout. The graphs presented in the MS have the original resolution provided by the data source mentioned in the MS (https://chelsa-climate.org/).

As elaborated in the MS and in other studies (Meusburger et al., 2020), there is a significant correlation between mean annual precipitation and the FRNs inventories. We also showed the maps to evaluate whether there was a heterogeneous rainfall distribution in the time frame of the possible Chernobyl fallout.

4/ In the references, there are practically no papers on the use of 137 for assessing the erosion/sedimentation rates, prepared on the basis of research in the Chernobyl-affected areas (the UK, Poland, Belarus, Russia, Ukraine, Scandinavia, the Baltic States).

We cited several studies that have been conducted in areas with Chernobyl-derived 137Cs, e.g. in Germany (Schimmack et al., 2001; 2002), Switzerland (Alewell et al., 2014; Meusburger et al., 2016; 2018), and Austria (added in the revised version, Meusburger et al., 2020). Switzerland and Austria experienced very high Chernobyl contributions as compared to the global fallout. As our study is not a review, it is beyond the scope of this paper to consider all publications on this topic. However, we followed your advice and included some research in the areas closest to our study site e.g. Gharibreza et al. (2021) and Vahabi-Moghaddam and Khoshbinfar (2012) (following the advice of Reviewer #3 as well).

5/ It is not specified anywhere in the ms when the forest was cut down and vineyards were planted on the studied site.

Sorry, this information was placed in the wrong section (i.e. 2.3 Soil sampling and soil physicochemical properties line:189) and now is mentioned in the appropriate paragraph (i.e. 2.1. Study area).

Technical corrections:

1/ Introduction … than five times, increasing from 2.6 million ha (Wilber, 1948) to 18.5 million ha – should be more than seven times

Profound thanks, this is a mistake. We did correct it in the revised MS.