

Review paper submitted to Biogeosciences Discussions entitled “Erosion, deposition and replacement of soil organic carbon in Mediterranean catchments: a geomorphological, isotopic and land use change approach” by Nadeu E. et al.

General comments:

I like the topic presented by the authors as it is indeed one of the rare studies focusing on the effects of soil erosion and deposition on organic carbon (OC) stocks and mineralization on a small catchment scale. This is the type of study which should help to close the gap in process understanding of the interaction of soil erosion and C fluxes. However, two major aspects of the paper must be improved before publication:

- 1) The description of the isotopic approach is weak and hence the results and their discussion are very difficult to review and interpret. Starting in the introduction a short state-of-the-art regarding the methodical approach is needed. More information in the methods section should be given, e.g. are the percent modern carbon data measured with an AMS ^{14}C approach? In detail what kind of mass spectrometry is used for $^{14}\text{C}/^{13}\text{C}$ analysis? What is the uncertainty in these data? Precision of measurements etc.
- 2) The calculation of the C input / replacement by plants and C storage is not clear and hence the interpretation of replacement of eroded C is unclear.

Methods: the described approach is not very well elaborated and/or important information is missing, e.g. is a constant input assumed over the years with a constant ^{14}C signature? Is one C decomposition rate (expressed by the coefficient k) assumed in all soil layers?

Results/Discussion: If the method used to estimate the net C input by plants is correct it would indicate that the soils are heavily depleted in C due to earlier erosion or C loss via intensive harvest and/or grassing. To some extent the importance of different erosion and C loss via harvest might be indicated by the more pronounced replacement at the formerly cropped areas in C24. However, an 11- or 4-time over compensation of lateral C loss seemed to be somewhat unrealistic. Assuming that the catchment C51 is more or less in a C input/output equilibrium this would lead to higher C contents at eroded sites compared to all other sites. Hence, I strongly suggest re-thinking the net C input calculation. At least a comparison with a calculated C input for a reference site (no erosion and no deposition) is needed.

The C input by plants should be also discussed for the depositional sites. It is somewhat unclear how the vegetation behind the check-dams looks like. If this is different from the eroding sites or if there is more or less no vegetation due to regular flooding it seems to be difficult to compare the soil C pools of both sites without taking the potentially different inputs through vegetation into account. If the vegetation is less dense or there is more or less no vegetation the depositional sites must be C sources as the deposited C will be (slowly) mineralized without being replaced by plant C inputs. Again a comparison with a reference site would be very helpful.

Specific comments:

P 8354. L 1: In general decomposition rates at depositional sites are in most cases not smaller (e.g. see Van Hemelryck et al. 2010. The effect of soil redistribution on soil organic carbon: an experimental study, BG 7, 3971-3986.) but the buried soil is protected from decomposition.

P8354. L 8. Here a short state of the art regarding the use of stable isotopes in erosion studies would be helpful for the reader.

P 8354. L 9-14: I suggest to focus here on the main aims (i) identify sources and fate of OC as affected by soil erosion processes in two Mediterranean catchments and (ii) analyze the implications of OC redistribution on C sequestration at different landscape positions. The rest of the paragraph should be omitted as it is more confusion and weakening the aims (especially the questions are partly not included in the aims which is confusing, e.g. if the question of importance of land use change is raised it should also part of the aims). In general I suggest to address the land use change aspect more under the view of two systems one in a more or less equilibrium status regarding C sequestration and mineralization (C51) and the other not in an equilibrium (C24).

P 8356. L 28: change to 'at a scale of 1: 50 000 in combination with own field observations.

P 8357. L 3 and 4: How was the dispersion of the samples done? Which diffractometer was used (give specification of instrument, company and country with all important equipment)

P 8357. L 6: 'passed through a 2 mm sieve..' is already indicated above and could be therefore omitted.

P 8357. L 14: The enrichment ratios calculated are very sensitive to the reference taken from the catchment. If the upper 0-30 cm are used as standard the enrichment, especially in case of interrill erosion as C source, might be strongly overestimated. This should be at least discussed or if possible the associated uncertainty in enrichment should be later on calculated.

P 8357. L 16-29: As stated in the general comments more information is needed here.

P 8357. L 22: Give more details regarding the removal of roots (e.g. was this always done for a defined time by the same person?), as this is very important for the isotopic composition of the samples.

P 8358. L 7: I suggest using C_{in} instead of I (which is traditionally infiltration)

P 8358. L 12: It should be $\sum_{i=1}^n \dots$ in equation (1)

P 8358. L 13: ΔZ instead of Δz

P 8360. L 3: The fact that the bottom of the slopes act as sediment traps can hardly be seen in the photos.

P 8360. L 9: As bulk density was also measured I would prefer if the authors would use C amount in each soil layer and not C concentration.

P 8360. L16-17: Instead of giving max and min of POC an average plus standard deviation would be more informative.

P 8361. L 21: I suggest using percent modern carbon (PMC) instead of $\Delta 14C$ throughout the text.

P 8361. L24 ff: Are there any reason for the difference between the different A profiles?

P 8363. L 1-7: See general comments

P 8363. L 10-15: not as obvious as indicated here.

P 8363. L 16 ff: OC characteristics might be also affected by different or missing plant C input (see general comments).

P 8365. L 19ff: See general comments. Moreover it might be interesting to estimate the time necessary to replace all carbon lost by erosion compared to a reference site.

P 8366. L 19: See also Van Hemelryck et al. 2010

P 8367. L 19: I suggest using equilibrium status instead of land use change here, as this should be clearer regarding soil C dynamics.

P 8368. L 4 ff: See general comments. These conclusions are due to my opinion all based on a somewhat questionable approach to estimate soil C inputs by plants (without giving data from a reference profile without erosion and deposition). Hence, before drawing such conclusion the C input at erosional and depositional sites must be re-evaluated.

Table 1: I guess average slopes and average elevation is given here. For clarity this should be indicated.

Table 2: In the caption it should be ...in brackets... instead of ...between brackets....

Fig. 1: It would be better if the sub-catchments would be given in more details (enlarged; including contour lines etc.) instead of giving details of the overall catchment.

Fig. 6: FM_w should be briefly explained in the figure heading.