Review on 'Erosion, deposition and replacement of soil organic carbon' by Nadeu et al.

Below you will find some specific remarks: others can be found annotated on the pdf of the MS. A general appraisal is given at the end of this document.

Replace Fig. 1 with one containing a more detailed topographic map of the subcatchments that were selected

P 8356: the catchments you selected are still quite large (over 10 ha); yet the number of eroding profiles that was sampled is only four. Their location is not adequately described. I think you need to show a map with their exact locations (see remark above) and you need to justify as to why you took them at these locations. The same is, to a lesser extent, true for the depositional sites. We also need land use information on these sites.

p. 8357 As far as I can see the delta 14C values are not reported: add them to table 2. Also provide the ages calculated from the 14C data. Make sure the reader has all the data necessary to replicate the calculations you describe in paragraph 2.6. The reader now has to believe you and has no insight into the quality of the data behind the estimation of *I* and *k*.

p. 8358: we do need more information on this methodology to calculated carbon decomposition rates: am I right in supposing that the 14C age is taken as the average carbon age at a given point. Is this correct? Please use a couple of extra sentences to explain this more clearly. Then, I have two additional questions:

- What about contamination with bomb 14C ? Is this not a problem, especially when taking samples in arable land where this bomb 14C can be mixed into the topsoil?

- How do you deal with the fact that these are eroding/depositing profiles so that there are lateral losses/gains of SOC ? Is this important in your calculations? I would think so, because erosion and deposition change the input term in your calculations.

p. 8365: I do find the discussion on C replacement to be too speculative and not very well focused. If you state that 'enough plant dericed-OC input was produced' you should refer to the hard, quantitative data you have to (i) calculate erosion rates of sediment and carbon and (ii) calculate OC input. Furthermore, I do have a fundamental problem with the concept of over-replacement. If you take it literally, it would mean that once you start eroding a slope you will automatically gain in carbon storage as the carbon will be more than replaced. That will definitely not be the case as the equilibrium SOC inventory will not be larger under eroding conditions as compared to stable conditions. So, you need to frame this discussion differently: the question on replacement can be solved by comparing how the profile actually looks now with how it would look if there would not be any erosion. This can be simulated by using your decay values and imposing different eroision conditions on the profile and comparing the results (seel also Van Oost et al., 2007).

Overall I would say that this study contains valuable data (especially the 14C data are quite unique, I believe) but there needs to be more work done before this paper can be finally accepted for publication:

- We need more information on the location of the profiles and the reasons why these locations were selected as they will affect
- The paper lacks analytical rigour on some important points.
    - We do need detailed information on how the values of the crucial SOC model parameters were derived for each profile (*k and* I). See also the remarks above and in the text.
    - The paper is based on a (very) limited number of data on soil profiles on eroding sites: for a first study this may be OK, but the implications of this should be discussed. How representative are your profiles ? What kind of variability would you expect within your catchments and what may be the implications of this variability for SOC dynamics?
    - The discussion on carbon replacement needs to be further fleshed out: I cannot see (but I may be wrong) another way of doing it as by running model simulations whereby you simulate inventories with and without erosion effects (over a relevant timescale) so that you can see how much replacement may indeed have taken place. Stating that there is over-replacement because the input is (as expected) much larger than the amount of SOC that is eroded does not solve the issue (in my opinion). You should run a series of scenario's, whereby you may investigate what would happen to the SOC inventory in the soils in the catchment if you would assume that they are eroded at the average catchment erosion rate (which you know) and/or whereby you vary erosion rates through time (as LU has changed).
    - On various locations throughout the MS you refer to dominant erosion processes and changes in those processes: however, you do only report a map of these processes: are there any quantitative data available? If so, could they be discussed? In any case you do have an idea of average catchment erosion rates and they should be reported.
    - The discussion on SOC mineralization in the deposits contains a number of valuable elements but there needs to be additional discussion on the fact that a lot of SOC is lost with the sediment that is leaving the catchments, despite the presence of check dams.
    - The discussion on the differences in delta 14C profiles in the sediments of C51 and C24 is very interesting and shows how 14C data may potentially become a powerful tool in diagnosing where sediment is coming from. However, your explanations do to fully match the observations. The temporal evolution of LU in C51 may indeed be reflected in changes in the delta 14C values that you observe. You also state that C24 has had a relatively stable LU, reflected in a stable delta 14C profile in the sediment. However, if you take these two observations together you would expect that, at present the sediments of both C51 and C24 should have a similar signature and that is clearly *not* the case. On the contrary, both catchments appear to diverge at the moment. So you are clearly missing a *crucial* point in explaining SOC dynamics. I find this a fascinating observation, but you do not provide an explanation nor a hypothesis as to why this is the case. If we want to explain this we need to look at

differences between the catchments. I think that an important reason why older carbon is exhumed from C51 is the difference in stream behavior: the stream in C51 is incising (as a response to LU change) thereby mobilizing old SOC stored on the alluvial valley floor and in the banks (as a result of centuries of deposition of sediments eroded on the hillslopes). The stream in C24 is aggrading, thereby acting as a filter letting the SOC coming from the slopes through (to a large extent) and retaining part of the sediment. This may also explain the high ER for sand in the B-profile of C51 ;-).

In short, I believe this can be made into a paper that may be published in Biogeosciences, but you need to be more rigorous in your analysis. Also, you may consider to redirect its focus somewhat: I think the most interesting observation coming out of your data is the diverging 14C profiles in both catchment, *despite* their similar LU at the moment and I would propose to center the paper around the use of delta14C as a tool to understand (the evolution of) sediment sources and the implications of your (first) findings. As I tried to indicate, I think this can be only understood by looking at the river dynamics. Analysis of one or more profiles taken in the river banks for 14C might help tremendously to make the paper more rigorous and therefore increase its impact.