

Interactive comment on “Australian net (1950s–1990) soil organic carbon erosion: implications for CO₂ emission and land–atmosphere modelling” by A. Chappell et al.

Anonymous Referee #1

The authors provide a very useful contribution to the literature by quantifying and mapping soil organic carbon erosion between 1950s-1990 in Australia. The paper is concise, well written and the methods followed by the authors are well explained and documented. Moreover, in my opinion, the authors' hypotheses regarding the use of Cs-137 -derived data and enrichment/selectivity processes during erosion are fully relevant.

Most importantly, the authors acknowledge the main limitations of their study (i.e. the need to conduct additional studies at the catchment scale, in order to take further the depositional and riverine processes into account). They also report their findings accurately and replace them in a factual way in the ongoing debates regarding the role of soil erosion in the global carbon cycle.

Thank you for these comments. We agree that a frank, factual description of the findings and an explicit description of the limitations is useful for the development of this topic.

I therefore recommend the publication of this manuscript after the authors address the very minor following points: *P.6794/L.10: replace redistribution with redistribution;

Agreed. Typographic error replaced.

*P.6796/L.16: greenhouse, not Greenhouse;

Agreed. Error replaced as suggested.

*P.6803/L.15: It would be helpful to add references quantifying sediment delivery ratios in Australia;

Agreed. References by Lu et al., Wasson et al, Walling and Roehl have been included.

*P.6804/L.1-5: there are also papers showing that, at least in some regions, the implementation of no-tillage may induce an increase in runoff that concentrates across hillslopes and may generate rill or gully erosion. This may also be helpful to add references dealing with this issue in the discussion.

Agreed. A new sentence has been included to describe this issue.

Anonymous Referee #2

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This is an estimate of the net amount of organic carbon lost by the continent as eroded soil material in the last decades. Such studies are very useful, due to the great uncertainty on the actual role of erosion in the global carbon cycle. The authors make simple hypotheses (that may omit more complex processes associated to the erosion/deposition process, such as associated biodegradation changes or burial), but the study benefits from important and solid datasets obtained by national reconnaissance surveys of soil erosion and soil carbon inventories. This is finally a very valuable contribution to the debate on the possible role of soil carbon erosion in the present carbon balance. I therefore consider this manuscript as acceptable for publication in Biogeoscience discussions.

Thank you for your comments. We found them to be balanced and incisive and agree that more work is required to more precisely determine the fate of the eroded carbon.

I suggest minor revisions: - More clarity on the spatial calculations is needed. How were the terms OC_d and Pd (eq 2) determined at net deposition sites outside the large dust-deposition area (Figure 2 shows median net soil redistribution but we imagine that the median value hides locally net deposition and net erosion sites).

We included a new statement at this section of the text to direct the reader to “A justification for the values used in these terms is provided in section 2.5.”

The section 2.5 "Estimation of net (1950s–1990) soil organic carbon redistribution" should therefore be expanded beyond the sentence "the depositional locations to be linked to their sources". - The sum of eroded C of the net erosion pixels, and the sum of deposited C in the net deposition pixels could be added in the text to enlighten the reader and facilitate the critical reading of the data.

In section 2.5 we have not included the suggested values because the proportion of deposition is very small and a breakdown of the contributions for the main land use is provided in Table 1. We have taken the opportunity to clarify in the related text the description and justification of the values used.

– Unit of SOC net redistribution as a proportion of SOC stock (f in fig. 2) is apparently $\% \cdot \text{yr}^{-1}$.

Agreed. Thank you for pointing out that important oversight. We have modified the caption of figure 2 and changed the text at P. 10 L. 16.