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Interactive comment on "Pulsed carbon export from mountains by earthquake-triggered landslides explored in a reduced-complexity model" *by* Thomas Croissant et al.

Sebastien Carretier (Referee)

sebastien.carretier@get.omp.eu

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This manuscript is very well written and easy to read. It constitutes a real added value in the understanding of the CO2 budget of mountains with respect to organic carbon, taking into account the spatial and temporal variability of the competition between oxidation and physical export of OC at the scale of a catchment (landslides + rivers) and over a seismic cycle. The figures are self-explanatory. The limits of the model are clearly indicated and the conclusions are supported by the results. I think this contribution is close to being in good shape for publication.

In addition to the specific points listed below, I suggest considering the possibility of

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presenting part of the results in an adimensionalised form. For example, according to the formalism of the model, it seems that an important parameter is the dimensionless product to * kox. I therefore wonder whether the curves in Figures 2 and 3 in particular would not collapse by grouping the curves by value of to * kox and (to+tcon) * kox.

Concerning to, the time of evacuation by rivers, Thomas Croissant has shown in another paper (Croissant et al., 2017, Nat Geo) that the export time of connected landslides no longer significantly depends on the size of the landslide above a threshold, thanks to the lateral dynamics of the rivers incising these landslides. In this contribution, Thomas Croissant et al. do not seem to consider this limitation. This saturation process may reinforce their conclusion of an effective export of OC and may deserve comment.

The study of a seismic cycle seems to consider only one magnitude of earthquakes (7.9) occurring at regular intervals. What would be the contribution of other possible earthquakes to the C balance?

Specific comments

P8L20 Define better what is a “pool” (landslide? Soil layer within a landslide?)

P8L25 Not clear to me how the multi-pool approach used here relates to this observation that kox should depend on age.

P8L27 (and P7L9 and P9L8) Residence time, turn over time etc: These “times” have a precise meaning in the Reservoir Theory underlying this work, and do not necessarily match. If the distribution of OC ages is heavy-tailed, the concept of Residence Time may be not sufficient to characterise the oxidation process or any process relating to the ageing of C (e.g. Mudd and Yoo, JGRES, 2010, https://doi.org/10.1029/2009JF001591). Could you comment on this?

P10 Equations: The complete analytical solutions (by integrating the exp functions) + Taylor expansion of the Exp functions may help define non-dimensional numbers.

P14L8-9 Do you mean “storage” in the catchment?

P14L18 Croissant et al. Proposed that t0 is almost independent on Landslide size above some threshold because of river entrenchment and narrowing when they cross landslides. Would this behaviour change the main results? I am surprised that the necessarily shorter tcon of big landslides (because they likely reach the river network) and their large volume do not contribute more to the exported C, although I understand that they are less frequent.

P15L2-3 Nice result, and not so intuitive. That said, the production of C in soil also depends on mean annual runoff (and temperature) but is not taken into account in the model. I guess that this would reinforce this finding as wetter climate would generate more OC in soils. Does the dependence on mean rainfall rate mean that arid landscapes are more likely carbon sources? If this is the case, at global scale, the net budget of organic C may depend on the relative areas of arid and humid landscapes.

P18L5 pb of citation format.

P23 the Fan et al. (2019) reference is doubled.

Best wishes, Sébastien Carretier

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