Solid Earth
Discussions

Open Access

EGU

Interactive comment on "Spatio-temporal dynamics of sediment transfer systems in landslide-prone alpine catchments" *by* François Clapuyt et al.

Luca C Malatesta (Referee)

luca.malatesta@unil.ch

Dear editor,

Clapuyt and colleagues present new constraints on geomorphic activity in an alpine catchment from cosmogenic radionuclides and from drone surveys (structure for motion). This new data complements existing constraints on sediment fluxes and allows a view across timescales from 10^0 to 10^3 yrs. The authors observe that the episodic activity of one earthflow leads to the production of a volume of sediment equivalent to that of the entire catchment, but that the evacuation of this material is limited by transport efficiency through the catchment such that earthflow activity is unlikely to imprint

the stratigraphic record.

The science in this paper seems sound. I simply have one concern regarding potential recycling of glacial sediment for the cosmogenic radionuclide erosion rates. And I am confused by the interpretation of the catchment as a supply-limited vs. transport-limited system.

The language and the figures of the article are good. Though the dynamics of the earthflow are too summarily described and I have not really understood what is actually measured.

The manuscript, however, could be much improved by reworking its structure. At the moment, the novel contribution of the authors is somewhat buried under a discussion of known elements. I strongly encourage the authors to rethink the introduction and the motivation of their study to increase its impact. I provide some suggestions below.

All in all I recommend to accept this manuscript once the issue of potential sediment recycling is addressed and after 1) the sediment dynamics of the earth flow are more clearly defined and 2) the novel elements of the article are better highlighted.

Sediment recycling: Figures 3 and 4 show a downstream increase in erosion rates and sediment fluxes once the Entle river flows in the inner gorge. The authors attribute this to the fast rate of postglacial incision in the gorge. To me, it however seems that the recycling of buried glacial sediment could be at least in part responsible for the trend of apparent increase in erosion rates caused by the increasing admixture of sediment with lower CRN concentration. If that is not a driver behind the increase in incision rate it should be explained. And if, on the contrary, this plays a role, this should be quantified.

Meaningfulness of the earthflow sediment dynamics: I do not think that I correctly understood what was being surveyed and what that entails for the sediment cascade. I have commented several parts of the manuscript (attached) where I might have been

confused by a lack of clarity. Surface lowering on the earthflow is described as being the result of erosion (p. 6 l. 10-13). Isn't it also due to subsidence of the surface? I would expect erosion to mainly affect the bulging parts of the flow and mitigate the rate of surface uplift. Are subsidence and erosion differentiated? The lowering and rising parts of the flow both do so at the exact same mean rate. This is a rather arresting coincidence. It could be useful to add one sentence to explain/confirm this to avoid it being perceived as a red flag! The net mass flux of the earthflow is close to zero. This implies a constant volume though time. Then wouldn't the throughput flow, instead of the net balance, be the quantity that matters for sediment yield from the earthflow? Or alternatively, considering firstly the flux from bedrock to sediment (production) and secondly the loss of sediment from the earthflow to the channel (transfer). It would be potentially useful to reproduce a figure of deformation (bulging/lowering) on the earthflow in the manuscript to contextualize the values.

Sediment system: transport-limited or supply-limited? The catchment is framed as being supply-limited (p. 4 l. 24 and p. 17 l. 6-7). But it seems that the authors provide arguments for it being transport-limited âĂŤ at least in the first orders tributaries (p. 15 l. 25) âĂŤ the two conflicting accounts need to be reconciled. It is possible that a supply-limited catchment switches to being transport-limited when a landslide pulse overwhelms the transport paths.

Structure: As it stands, I find that the article fails to properly motivate the study and to highlight the novelty the authors provide. In the discussion section, the authors use a significant amount of space to present already well-established conceptual models (sediment cascades, buffering of sediment pulses, stochasticity of landslides). The effect is to dilute the author's work. I believe it would be much more effective to introduce all these known/established elements at the beginning of the manuscript. This would allow the authors to explicitly define the gap in knowledge that their work directly addresses: a dataset across timescales, and not a conceptualisation of sediment transfer. I believe this would make it easier for the reader and increase the impact of the

C3

presented work. This section would also be the good place where to describe how the different processes affecting earthflow dynamics contribute to the sediment routing system.

I would like to encourage the authors to make better use of their data. Instead of synthetic data on the last figure, why don't they actually plot a distribution of erosion rates vs. timescale of integration (not time!) to present what is their truly significant contribution (data across timescales)? See Fig. 1 of Sadler 1981 for reference.

The authors will find my line-by-line comments in the annotated pdf file hereby.

If any of my comments are unclear, the authors are welcome to contact me for clarification.

Kind regards, Luca Malatesta

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2018-139/se-2018-139-RC1-supplement.pdf