Dear Editor,

First of all, thank you for your time and effort in getting this article published.

Below, you can find our line-by-line responses to your helpful comments.

I have now read the revised manuscript and responses to reviewers. The two reviewers were quite positive about the manuscript and requested minor changes, all of which the authors have addressed rigorously. I have a few comments asking for clarification, which should not trouble the authors, and I look forward to seeing this paper in print.

We thank the editor for the positive reply and for the useful comments.

Line 15: You are using the term "physical models" but what you mean is "numerical models". To me a physical model is a laboratory experiment. Also a citation would be useful here.

Thank you. I changed it to "numerical models". There are already the citations to Poesen, 2018 and Borrelli et al., 2021.

Line 58-60: Consider ordering here. You say your model is a hybrid approach of different models before you say what your model does. Perhaps insert two or three sentence prefacing your approach above these lines?

I tried to address this by adding "where we infer a continuous field of erosion rates starting from detrital data, lithological information and spatial smoothing"

Lines 93-94: Apologies if this is a silly question, but I'm afraid I don't understand why you take the log of a erosion normalised erosion and then take its exponent. Why not just use the erosion rate? Add a sentence of explanation. The positivity is a given since erosion is a positive number.

In our ESPL article, we explain the linear version of the problem, where we solve for e_dot immediately, which sometimes yields negative erosion rates for some pixels. To avoid this, we solve for epsilon, which is log(e_dot). Since we're solving the problem in log space, e_dot cannot be negative. This is explained in line 99 – 101. I have added: Indeed, the linear version of this problem, as explained in De Doncker et al. (2020) , sometimes yields negative values for ˙e, which we avoid here by solving for ε.

Line 153-154: You explain why the QN approach is better. You don't say what the trade-off is. Explain why you would use the SD approach when you know QN converges faster?

Thank you for this comment. I have added "The advantage of this method is that it does not require the resolution of a linear system at each iteration (Tarantola, 2005)"

Lines 186-187: we haven't really had a site description, so the transition from the theory behind the method and this mention of the field site is a bit jarring. I would add some more context here. Also, you might say something about spatial availability in the source XRD data: how do you know your source sampled are representative?

I have tried to address these points by adding the following sentences in the text:

Added (line 197): The steps that are described below can be applied to varying field sites, therefore, the descriptions are as general as possible. In Section 3.2, we demonstrate these by applying our method to the Gornergletscher catchment, Switzerland.

Added (line 200): Note that multiple samples can be collected per source area, and the intra-source variance of the XRD signal can be propagated into the posterior solution by adding it in the data covariance matrix.

Line 365: On the basis of these previous studies how much variability in the XRD data would you expect in each lithological unit?

I have added this sentence: Bearth (1953); Steck et al. (2015) further indicate that the Zermatt Saas-Free ophiolites (metabasites & eclogites) potentially have the strongest internal mineral variability, due to the unit spanning different metamorphic facies, as confirmed in Figure 11.

Line 380: It is somewhat strange to say this without saying if a zero erosion rate from this unit is realistic.

Because the ZSF sediments unit is outside of the subcatchment, the erosion rates predicted for this unit should effectively be zero, as explained in the paragraph. This is indeed what we see in Fig. 13 (subcatchment = dashed line).

To clarify this, I have added: In other words, the model correctly attributes the sediment data from the subcatchment to the lithologies present within the subcatchment and it

does not attribute it to the Zermatt Saas-Fee sediments unit which is not present in the subcatchment.