

Earth Surf. Dynam. Discuss., referee comment RC2
<https://doi.org/10.5194/esurf-2021-90-RC2>, 2022
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Comment on esurf-2021-90

Anonymous Referee #2

Referee comment on "Spatio-temporal variability and controlling factors for postglacial denudation rates in the Dora Baltea catchment (western Italian Alps)" by Elena Serra et al., Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2021-90-RC2>, 2022

Review Serra et al. ESurf

General comments:

This paper provides new ^{10}Be measurements in the Dora Baltea catchment located in the Italian Alps. The authors offer a well-thought analysis of the potential controlling factors of the variability of denudation rates in the studied catchment. Overall, the study is well constructed and well written, providing a new dataset and an interesting discussion. The study is presented logically and the authors make convincing arguments for their interpretation.

I have one general comment and a few minor comments that should be easily addressed by the authors. I think this paper would make a good contribution to the scientific community and recommend its publication with minor corrections.

The only general comment is concerning the way the topographic, environmental, and geological metrics have been calculated. Page 5, line 136, the authors write that they excluded non-quartz-bearing bedrocks for the ^{10}Be production rates because they do not contribute quartz to the sedimentary system which is the correct way to approach this calculation. However, on page 5 line 155, when discussing the aforementioned metrics, the authors do not specify if they excluded non-quartz-bearing bedrocks and leave the impression that they indeed included all lithologies in their calculations. If this is the case, I recommend that the authors also exclude non-quartz-bearing lithologies in all their metric calculations (topographic, environmental, and geological); otherwise Mafic and Sedimentary areas can potentially skew the values.

Specific comments:

Erosion and denudation are both used in this paper. I would advise to either define both terms as they are *stricto sensu* not the same thing or pick one term and stick with it.

page 1, line 28: a few major citations are missing. It is considerate to cite Brown et al. (1995), Granger et al. (1996), and Bierman and Steig (1996) when the method regarding ^{10}Be derived denudation rates is brought up.

page 1, line 33: you provide citations later on for climate and tectonic forcings but not for anthropogenic forcing. Please add some or modify the sentence.

page 1, line 38: clarify what you mean by "recent timescales".

page 2, line 60: "relatively similar climatic conditions" is at odd with page 3 line 75 "mean annual temperatures range from -10°C (high elevation zones) to 15°C " and page 3 line 76 "precipitations are spatially variable". Please rephrase.

page 3, line 65: there is an issue with the legend of figure 1: the elevation color ramp is wrong because of the hillshade. You could also add more information to this figure like the location of quartz-bearing rocks or replace this figure with the figure S1.

page 6, line 184: specify the type of uncertainties.

page 5, line 149: add in the methods the equation used to derive denudation rates from ^{10}Be concentrations. A reader should be able to reproduce the data from the raw values (^{10}Be concentration and production rates).

page 7, line 212: "integration time" would be a more meaningful heading than "apparent ages". Also please be mindful of the significant figures, the "apparent ages" values are too precise.

page 8, line 215: would it be better to add the contributing quartz surface area of each tributary by varying the size of each circle? It could help drive the point that the DB01 sample is the main contributor to the overall ^{10}Be signal in the sedimentary system. Please change the symbol of the sample T12 from a circle to something else.

page 8, line 230: please add in this table the km² or % of quartz-bearing rock in each drainage area.

page 8, line 231: I'm curious as to why the authors didn't check for temperatures as a controlling variable. It is mentioned on page 3 line 75 that "mean annual temperatures range from -10°C (high elevation zones) to 15°C" which would be partially compatible with the frost cracking window proposed by Delunel et al., 2010.

page 10, line 264: did you check for a correlation between mean elevation and the litho-tectonics units? Looking at Figure 2, it seems like some units are only found at high elevation (External Massifs and Internal Massifs) and you also have a correlation between elevation and denudation rates in Fig. 4A. Could the high denudation rates associated with the External / Internal Massifs be related to an elevation-dependent process (like frost-cracking) rather than rock properties?

page 12, line 305: I appreciate the effort the authors made in section 5.1. Could you investigate if the corrections have a significant impact on the correlations calculated with the controlling variables?

page 15, line 385: what do you mean by "unequal sediment mixing"? The fact that there are low ¹⁰Be concentrations along the DB river compared to the tributaries does not mean that the mixing is inefficient, especially because the tributaries are relatively small (from 54 km² to 450 km² - these values are from table 2, please make sure to add the % of contributing quartz-bearing rocks in each catchment) and thus might not have the capacity to drive the ¹⁰Be concentrations up. One way to strengthen your argument is to check the measured ¹⁰Be concentrations vs the expected ¹⁰Be concentrations along the DB river (see Mariotti et al., 2019 for another example of sediment mixing in the Alps).

page 17, line 461: you should also discuss here the fact that the ¹⁰Be denudation rates are calculated on quartz-bearing rocks only while the modern rates are not lithology-dependent.

page 17, line 487: I don't agree with the assessment that one sub-catchment contributing to 77 % of the ¹⁰Be signal implies poor mixing. The ¹⁰Be signal can be driven by one part of the catchment and still be well mixed if the other sub-catchments export low sediment fluxes. Please rephrase or strengthen your argument.