Earth Surface
Dynamics
Discussions

Interactive comment on "Millennial erosion rates across the Pamir based on ^{10}Be concentrations in fluvial sediments: dominance of topographic over climatic factors" *by* M. C. Fuchs et al.

Anonymous Referee #2

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This paper by Fuchs et al. presents a new dataset for spatially-averaged denudation estimates from cosmogenic nuclides in the Pamir ranges, which is one of the first quantification of surface processes over 1-10 ka timescale for that region. After an in-depth presentation of the context, methods and data, the authors attempt to analyze the spatial pattern of denudation over their area of interest and the potential controlling geomorphic factors. The manuscript in its present form is quite tedious to read, and the extended developments of many technical parts makes it difficult to extract the key ideas. A significant amount of the material in the present ms should be moved to supplementary datasets with only a brief and synthetic presentation left in the main text. This is for example clearly an issue for large parts of sections 3 and 4. There are also

two main problems with the present analysis of the dataset by the authors, which need to be addressed: (1) The dataset is mostly composed of very large basins, that average processes over very contrasted domains, from low relief areas to very dissected landscapes. This is clearly not an ideal situation to analyze the influence of topographic or climatic parameters on denudation, as such long-wavelength averaging will blur the geomorphic signal you are interested in. This is an important issue that should be acknowledged and discussed more thoroughly in the manuscript. (2) The assumption that glaciated areas are not contributing sediments is clearly a very significant limitation of this study, as pointed by the previous reviewer. Providing more insights into the impact of glacial processes on the derived denudation rates is mandatory before any kind of parametric analysis of the data. Simple mixing calculations could deliver first-order ideas about the importance of these glaciated part of the landscape on the measured CRN concentrations.

More specific comments

P86-L11 : "The peculiar tectonic and climatic setting of the Pamir" : this is a rather vague statement

P86-L21 : "inferred roughly 0.5 mm yr-1" : of what, exhumation?

P87-L23 : "cosmogenic nuclide (CN) techniques " : you are talking specifically of CN concentration measurements in detrital sediments here

P87-L27 : "scales" : is inversely proportional

P88 : a large part of this is too detailed at the introduction stage and is redundant with section 3

P89-L5 : could you be more specific about these equivalences?

P89-L9 : "the bulk of the Pamir" : unclear (and repetition of Pamir in the sentence)

P90-L19 : these are references about the specific problem of glacial influence on CRN

derived denudation rates, for the more general problem of the "influence of glacial processes on erosion" you should use other references.

P91-L6 : "scales" : same comment as above

P91-L7 : "it may be convenient to use both terms interchangeably in the following" : I disagree, stick to the clear, usual and widely accepted definitions.

P91-L21 : Niemi et al. 2005 and Yanites et al. 2009 are appropriate references here

P95-L10 : "Assuming total shielding by permanent ice and snow cover, we excluded respective areas from further calculations of 10 Be production rates" : this clearly a weak point of your analysis. Nearly half of your catchments have >25% ice cover, you need to discuss the influence of the likely addition of glacially derived sediments. Simple mixing calculations can provide significant insights into that problem.

P96- L6 : these are interesting and informative plots but they clearly belong to the supplementary materials

P96-L20 : "The median, 0.25 and 0.75 quartiles of each parameter serve for (multiple-) linear regression analyses to infer the importance of individual parameters for explaining the variations in erosion" : As a context for such statistical analysis you should provide more information about the actual underlying physical processes you want to test.

P97-L7 : "The basins of the southern Panj and of the major Panj tributaries show strong east– west elongations (Fig. 1b). The basin elongation allow to integrate gradients from the Pamir Plateau to its western margin, while their parallel configuration enables to resolve south–north changes in controlling factors" : Most of your basins have very large areas and are averaging denudation over contrasting domains in terms of elevation, regional slope, vegetation, climate . . . This is a significant limitation for your ability to discuss the influence of these factors on denudation based on your dataset.

P99-2nd paragraph : this is typically the kind of information that could be moved to

supplementary materials

P102-L4 "The area factor a can be replaced by a slope factor s to account for morphometric differences in basin portions. The factor s describes the ratio of the sub-basin slope scaled the slope of the entire basin and normalized to 1 …." : the relationship between hillslopes angles and denudation can be strongly non-linear, how do you account for that in this calculation?

P103-L6 "We performed a multiple linear regression analysis with two components as predictors for erosion. Including more components result in multi-collinearity and insignificant effects on the goodness of correlation" : Based on the available information in the paper it is difficult to assess how your best correlation results with slope and precipitation stand out with respect to other possible combinations of predictors.

P104-L25 : "The low abundance of such events in the study area (e.g. Lake Yashilkul) indicates their minor relevance" : what would be the most exposed basin to such events? Did you perform a systematic inventory of landslide related landforms along the main rivers for these basins?

P106-L15... : "Overall, the 10 Be-based basin-wide erosion rates are 10 times lower than OSL-based incision rates. …." : this paragraph would be more relevant to the previous section (5.1) dealing with time-scales of integration.

P110-L10 : "In the much drier Pamir, this adjustment is not reached. Incision clearly exceeds uplift. Basin-wide erosion rates do not balance the up to 10 times faster OSL-based incision rates measured along the Panj river". From Fuchs et al. (2014, Geomorphology) it seems that most of these terraces are fills (but I could be wrong about that). If this is the case it is not surprising to find strong discrepancies between the landscape-averaged denudation and the local rates of incision into usually poorly consolidated sediments. Incision rates into fill material does not provide much information about long-term bedrock incision and its relationship with uplift rates.

P106-L25 : "VSR, Hack index" : you need to define these metrics and their usefulness at some point.

P108-L10 : "that are basically comprise the Cenozoic domes" ?

Figure 1 : the samples labeling using their full name and the color code (in following figures) is quite cumbersome. You could just use an alias (a letter or a number) for each sample and directly plot that at the outlet or the symbol location for example for figure 4 or 6.

Figure 2 : this is an interesting plot, but it should be moved to supplementary materials

Figure 3 : same as figure 2

Figure 5: should come before figure 4 when presenting the data

Figure 7 : I do not see the point of using a color coding for the lower panel (especially if no color-scale is provided), just stack additional graphs with regular Y-axis and same X-axis.