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Comment on essd-2021-176

Anonymous Referee #2

Referee comment on "Kinematic observations of the mountain cryosphere using in-situ GNSS instruments" by Jan Beutel et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-176-RC2, 2021

The paper entitled 'Kinematic observations of the mountain cryosphere using in-situ GNSS instruments' by Beutel et al. introduced GNSS data and complementary in-situ measurements at 54 locations in the Swiss Alps. The observations are spanning ten years (2011 to 2021) and document the kinematics of various mountainous landforms at high altitude (primarily rock glaciers and unstable rock slopes). The dissemination of the dataset is relevant both for future research studies focusing on documenting the evolution of the periglacial environment in a changing climate and for operational purposes such as geohazard management.

This extensive dataset is surely valuable and appropriate for ESSD, but the current version of the manuscript is not ready for publication to my opinion. Important information regarding the documented sites, the technique limitations and data accuracy are missing. The paper is poorly structured, and the English writing definitively needs improvement. In the current version, it is hard to follow the workflow and understand the data/site properties.

In the following, I explain the major points. **Many detailed comments have also been added in the attached pdf**. Note that I am not a native English either, so my editorial corrections are clearly not exhaustive and in some cases need to be verified.

1. Documented landforms and general relevance:

The landforms that are instrumented must be clearly defined from the start and for each location, for the dataset to become useful for future users. The title is fuzzy: Mountain cryosphere is a very wide domain, it could theoretically include snow, glaciers, ice on

lakes, etc. If you mean permafrost, just say it so. If many sites are not in permafrost zone (which is btw fuzzy in the paper): 'periglacial landforms' / 'slope movements' / 'gravitational landforms' could be used. A list of elements is provided at l.37-38 and l.59, but it lacks clarity: What is the difference between a rockfall site and a single unstable block? Or between a large rockfall site and a landslide? What do you mean by 'fractures' (l.59): it does not fit in a list of landform types I think. In general, I would suggest that you simplify by using 'rock glaciers' and 'unstable rock slopes' (all along the manuscript, also in Section 6). The terminology must also be briefly defined in the introduction to understand what we are speaking about. In tables 3 and 4, please add a column documenting the landform type / context. If not, potential future users will have a hard time to use the data in a meaningful way. Section 6 provides a rough number / landform types (except for landslides, l.452), but it is really hard to have an overview of what is documented and where. Maybe additional regional maps with sites categorized by landform types could help? The relevance description could also be improved. There are numerous vague statements regarding the link with climate (l.148-151, l.494-497) and mixing hazard assessment & risk mitigation (l.79, l.153-154) (see also comments in pdf).

2. Description of the technology, limitations and data accuracy:

GNSS and GPS terminology, as well as the references to the different generations of sensors are used in an inconsistent way all along, without actually explaining the differences (e.g. l.106, l.185, fig.6 caption, tables 3-4: L1/L2-GNSS vs L1-GPS). In general, it looks like the authors assume that the technology is an obvious background knowledge for all readers. As a result, some theoretical explanations are just spread in the manuscript without clear references and explanations (e.g. in 3.1, 3.4, 3.7). What we mean by data expressiveness (l.152, l.193) is not explained. Explanations regarding the sampling, the schedule, the granularity are really unclear (l.273-279) (probably party due to English). I think one solution would be to have a section early enough in the manuscript that briefly explains the main theoretical elements for nonexperts (as a method section in a traditional article structure). The expected/estimated accuracy of the GNSS data is never explained (n.a. in Table 2). Instead, there are very vague words/statements such as 'very small displacements' (l.78), 'high accuracy' (l.304), 'highest fidelity' (l.487), etc. The quality measure 'ratio of fixed ambiguity' is never explained (l.309, Table 5). Some limitations of the method are presented (for ex. Section 3.7) and solutions to mitigate them introduced (for ex. Section 5.2) but it is scattered in the paper. I would suggest adding a section on limitations/uncertainties that regroup all these elements.

3. Manuscript structure and figures:

The structure is not traditional, and it makes it hard to follow. There are also many subsections and I must admit I got a bit lost along the way. So here is a suggestion (there are surely other alternatives - it is just an example, a way to illustrate my thought):

- Introduction: The current intro is quite fuzzy. It could go directly to the point, explain the project background and relevance.

- Methodology/Technology: Technical knowledge on the sensors, explanations of the main terminology and the different generations of integrated system.
- Data/Products: 3.1. Site description (that should include information about which landform is documented), 3.2. Primary data, 3.3. Derived products.
- Limitations/Uncertainties: The problem of tilting / site challenges (current 3.7) could come here. It also should include an accuracy estimation and explanation of the quality measures.
- Applications: Here come the examples of previous exploitation as in the current Section 6, but maybe reorganized as 5.1 rock glaciers / 5.2. unstable rock slopes?

The figures could also benefit from some work to be more readable / useful. For example:

- Figure 2: hard to see what we are looking at without help (delineated landform, arrow to point out the described elements).
- Figure 5: the third plot is dominated by the extreme increase of LS05, such as we don't see anything for the others. Two scales maybe?
- Figure 6: without explanation, this figure is not very informative to be honest...
- Figure 7: missing unit on y-axis and unclear legend of colors.
- Figure 10: a zoom on one local cluster would help to read it.
- Figure 14: it includes many elements that are never explained in the paper. I would suggest simplifying it (or explain it better in the text and/or in the figure caption).
- Figure 15: where is the blue line (raw data)?

More detailed comments in the attached pdf.

Please also note the supplement to this comment:
https://essd.copernicus.org/preprints/essd-2021-176/essd-2021-176-RC2-supplement.pdf