Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-78

Anonymous Referee #1

Referee comment on "Technical note: Introduction of a superconducting gravimeter as novel hydrological sensor for the Alpine research catchment Zugspitze" by Christian Voigt et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-78-RC1, 2021

Continuously measuring gravity changes in a high altitude Alpine site is a première, and these integrative measurements will provide new information on the ice-snow-water mass balance. More specifically, the combination of continuous, relative measurements with the superconducting gravimeter and occasional ones with an absolute instrument should provide valuable information on long-term changes informing about erosional processes, and ice and water mass changes.

Such a study is in principle worth publishing in HESS, but presently, it suffers from different shortcomings.

- The bibliography is not complete.
- Some parts are wordy; the information could be better structured. Often the authors beat around the bush, go back and forth, making it difficult to focus on the main project that is, I presume, constraining the snow mass model. Overall, this paper rather looks like a field report, a plea for funding or in the best case, a feasibility study, which is not the purpose of a scientific paper. For example, do we need the details on the way the instrument was moved? Moreover, some parts are probably interesting for an audience of geodesists, but here, one should not forget that the paper will be mostly read by hydrologists.
- It is very necessary to dispose at the very least of two absolute gravity measurements to determine the drift of the superconducting gravimeter and incidentally, confirm the calibration factor. The authors and colleagues have the skills and material to do the job, so, I urge the authors to perform the absolute measurements that will provide the healthy and solid foundations required to support their case. Without this, the inferred gravity changes will remain speculative, especially when those changes are discussed at the nm/s² level.
- What is exactly the scientific question? Installing an SG in Alpine context? This is not a scientific goal. Evidencing the ability of an SG to monitor changes in water mass balance? Building a terrain model of the Newtonian effect of snow? This has been done in numerous studies. Instead, you should modify the title and focus on the investigation

of the snow and water mass balance, and the novel results one could infer from it. But, this can only be achieved with a longer time series, appropriate modelling (e.g., the authors propose to build a model as SNOWPACK -do it!) and appropriate ancillary measurements (e.g. LIDAR for snow thickness).

See also my numerous comments in the annotated pdf.

I recommend rejection as presently, much more work should be done but I would be pleased to revise an improved version of this work when (1) the absolute gravity measurements are performed and (2) a more comprehensive investigation of the snow and water mass balance is done. Of course, more time is needed but this is often the case in geodesy, where one looks at slow processes.

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2021-78/hess-2021-78-RC1-supplement.pdf