

Reply on RC1

Christian Voigt et al.

Author 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-AC1>, 2021

Dear Anonymous Referee #1,

Thank you very much for your high-quality and very valuable review of our manuscript. We fully agree on the necessary steps which are planned within an upcoming research project. The only disagreement is on the opinion whether the current concept status is worth to be published in HESS or not. We would like to face your several comments point by point later but comment on your major issues already now. These are:

- Missing second absolute gravity measurements: It is true that the so far missing second absolute measurements leave room for certain speculation. To be honest, these should have been carried out at end of September 2020. However, the laser of the FG5 was broken and had to be sent back to the manufacturer, while the rest of the FG5 has spent the winter up there. Finally, the second absolute measurements are scheduled for end of March 2021 and will be integrated including the SG drift estimation. With this, the gravimetric part can be regarded as finalized within a revised version of our manuscript.
- Concept status vs. final results: As we have written in the abstract "this work is regarded as a concept study showing preliminary gravimetric results and sensitivity analysis for upcoming long-term hydro-gravimetric research projects." The introduction of section 4 specifies: "The following hydro-gravimetric analysis should be regarded as a preliminary concept study to demonstrate potentials and limitations of integrating gravimetric signals into analyses of high-alpine hydrological processes." The aim of this manuscript is indeed to introduce our SG (and its publicly available dataset) as a hydrological sensor into a high-alpine research catchment (as the title says), which has never been done before because of several practical difficulties and not knowing whether such a site provides any meaningful results from the gravimeter. This interdisciplinary manuscript should help to bridge the gap between gravimetry and alpine hydrology by addressing the following important questions:
 - What are the required ingredients to set up a SG in a high-alpine area and use it as a hydrological sensor?
 - How are the gravimetric observations and the gravity residuals composed at this specific site?
 - Which hydrological masses are visible to which extent from the summit above the research catchment?
 - What are the benefits and the limitations of the hydro-gravimetric approach at this site?

In our opinion, addressing these questions is essential in terms of extent and accuracy **before** setting up a complex hydrological model of the research catchment. In addition, we strongly believe that our findings are of interest for the community of alpine hydrologists already at this preliminary state to evaluate whether the hydro-gravimetric approach could be valuable for their own research areas or not.

- Detailed methods section: This is an inherent problem of interdisciplinary manuscripts. From a geophysicist's or geodesist's perspective, the detailed explanations on the gravity observations and the signal separation procedure might be a bit boring and lengthy and there is certainly potential to shorten this section. From a hydrologist's perspective, however, this section could be very exciting providing a step by step description how to get hydrological signals out of raw gravity observations. In a revised version we will try to find a better balance between these two perspectives.

Best regards,

Christian Voigt on behalf of the team of authors