

Reviewer #2 (doi.org/10.5194/egusphere-2024-3933-RC2) :

The paper concerns the novel use of time-lapse microgravimetry to investigate changes in water/ice storage in an already well studied rock glacier. The paper reads well, the topic is well introduced, and somehow becomes a review paper, thanks to the relevant and correct reference list. Some parts are perhaps too extended, as in Chapter 6.1, where the discussion is processed. I think that one of the main stability constraints remains in the gravimetric reference point near the site. This strengthens the results of the authors, but on the other hand may strongly limit the application of such a methodology elsewhere. This aspect is mentioned, but not emphasised as it should be, especially in chap. 6.3.

We thank the reviewer for the time and effort he or she has put into providing us with an encouraging and thorough review. We believe that a good Introduction section should serve as a mini-review, so we are particularly happy to receive the comment on our completeness in introducing the topics.

Murtèl is, we agree, somewhat exceptional in that a high-quality absolute gravimetric reference station is accessible within a reasonably short travel-time. Regarding this limitation in potential applications to other rock glaciers, we have discussed this in the first paragraph of S6.3, but we will consider strengthening the language in the final manuscript

My main concern relates to the comparison with data from the 1990s. Although the authors correctly point out the great uncertainty of such an operation, I believe that this approach remains a great danger. Even though preliminary corrections are well explained, a simple but crucial argument like atmospheric pressure conditions is not considered. The authors rely on the atmospheric isolation of the CG-6 for their time series, but the same cannot be said for the data of the 90s. This aspect can strongly influence the resulting comparison and should at least be mentioned in the text. My suggestion is to limit the relevant results to the 2024 double surveys, avoiding an ambitious multi-decadal approach. This would also significantly shorten the paper and reinforce the message of model TLG potentials by focusing on the authors' relevant results.

Atmospheric pressure variations influence terrestrial gravity with an admittance of $\sim 0.3 \mu\text{Gal/hPa}$ (e.g., doi.org/10.1016/j.jog.2009.09.010). Under calm conditions, i.e., when gravimetric surveys are usually performed (windy days are avoided as they result in noisier data due to vibrations), daily variations in atmospheric pressure on the order of a few hPa are typical. Thus, the impact of atmospheric pressure would be on the order of $1 \mu\text{Gal}$. As this is well under the accuracy of any gravimeter available in the early 1990s, it is clear that atmospheric pressure effects can be safely ignored. Furthermore, gravity surveys, including those of Von de Mühl & Klingelé (1994), are conducted in "loops", returning to a reference location in order to correct for drift. Thus, the corrected drift will include the effect of atmospheric pressure changes and consequently only the non-linear portion remains. This further reduces any residual effect of atmospheric pressure on the data. Consequently, while we thank the reviewer for raising these concerns, we unreservedly reject the idea of completely getting rid of the portion of our manuscript that compares our data with those of the 1991 survey. We will nonetheless ensure that we reinforce the cautious wording in

our manuscript related to quantitative interpretation of the 2024 vs. 1991 results (this also links to your comment below re: Sections 3.4, 3.5, 5.2 & 6.2).

Minor comments below:

Chap.2 the description of the site stratigraphy 91-95 is not clear and should be rewritten.

We will modify this section for clarity (another reviewer also suggested this).

Chap 3.1 statement on ice melt/gravity reduction needs to be better introduced, as you correctly state that several processes can explain the same results. I would avoid presenting this aspect here.

The final sentence in S3.1 links the basic theory to the relevant cryo/hydro application. We will consider rephrasing.

Chap 3.2 ln 133 <5h20m ?

Less than 5 hours and 20 minutes.

Ln 135 what it means manually measured ?

We will clarify this.

Chap. 3.3 Atmospheric pressure is not given, neither for the historical nor for the recent measurements. I suppose the authors rely on the fact that cg-6 should be compensated, but they discuss temperature and tilt drift in detail without ever mentioning barometric issues. This should be clarified.
We will mention barometric considerations (see comment above).

Chap 3.4;3.5;5.2;6.2 As explained, I find this temporal comparison too ambitious for quantitative estimation due to the large unresolved uncertainties.

While we have already taken great care to highlight the limits of the 1991 dataset and to only draw qualitative conclusions when comparing the 1991 and 2024 data, we will reinforce the text as necessary in the revision to ensure readers do not try and draw quantitative conclusions.

Chap 5 Before presenting the results, the authors should logically present how they installed the gravimeter, as this is a crucial part of gravity measurements. For example, was the gravimeter installed on blocks? Digging snow? How was it fixed? Some pictures might help the readers, especially the non-experts.

It is true that most readers of The Cryosphere will not be experienced in performing gravimetric surveys. We will add additional explanations (potentially including a photo figure) of these practical aspects.

LN270-280 Again, no corrections for atmospheric changes are given.
See above comments.

Ln 313 typo (-)

This is an "em dash"—a versatile and completely valid punctuation mark that is nowadays underused!

In 328 double brackets

We will fix this.

Chap 6.4 In this clear hydrological presentation, talking about permafrost aquitards, I would also add <https://doi.org/10.5194/tc-17-1601-2023>

Thank you for this reference. We have actually both already seen this paper and appreciated the approach the team carried out. We agree it makes sense to cite it in this section.
