The Cryosphere Discussions

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Comment on tc-2022-247

Anonymous Referee #2

Referee comment on "European heat waves 2022: contribution to extreme glacier melt in Switzerland inferred from automated ablation readings" by Aaron Cremona et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-247-RC2, 2023

Review to Cremona et al. (2022): "Heat wave contribution to 2022's extreme glacier melt from automated real-time ice ablation readings" submitted to The Cryosphere.

The authors present a study of a novel ablatometer measuring ablation at selected locations of a glacier in daily resolution. The method applies a computer-vision technique to automatically derive glacier surface elevation change from a series of time lapse images of ablation stakes marked with tapes at regular length intervals. In conjunction with a mass balance model the ablation at individual points is upscaled to glacier wide and even regional values of ablation anomalies in the past four years.

The study is well designed, thoughtful structured and easy to read. The method is novel and results may have impact on the glaciological and hydrological communities, on researchers focusing on observational techniques as well as on scientists interested in data sets at high temporal resolution for model validation. I'm looking forward seeing this manuscript published in the Cryosphere soon, as I have only minor comments to add.

Terminology: For the process that the stake melts out of the ice due to ablation and hence increasing its length of the "free end", the author use the term (vertical) displacement (L52 and others). This causes some confusion as displacement is usually connected to ice flow, which is not intended to be detected in the presented method and apart from tilting the ablation stake has no direct influence here. I suggest using the term surface elevation change (or something equivalent) instead.

Preselection of images: In the method section the authors describe that images are taken every 20 minutes. I wonder if the method analyses all images or if a preselection using which criteria was applied.

Threshold for extreme melt event (L185-196): In Tab. 1 the authors show that there is an altitude difference of almost 800 m between the stations used for deriving daily ablation values. This difference might largely explain the spread in the mass balance anomaly in Fig. 8. However, the altitudinal distribution of the stations is skewed to lower altitudes and thus taking the mean of the stations for defining the threshold should be reconsidered. I think the median is more significant than the mean, although the number of stations is low. Speaking of which, the number of observations presumably might change over the ablation period, as higher stations experience a longer snow cover. There should be a note how the number of observations affects the interpretation of the mass balance anomaly.

Specific comments:

L32-34: I do not agree with these two sentences. A number of studies assess reasonable short term mass balance variations from geodetic measurements (e.g., Klug et al., 2018; Zeller et al., 2022; Beraud et al., 2022; Vincent et al., 2021). Consider rephrasing or omitting.

L77: Please rephrase and consider the width of the tape as well.

Eq. 1: Please explain how you determine the stake inclination. Is it measured during the field visits or derived from the images or…?

L257: Consider depicting these periods also in Fig. 8.

L305-307: Please better explain how winter snow accumulation impacts melt anomalies between individual stations. Winter snow accumulation might have an influence on the length of the ablation season, but how does it alter the ablation anomaly during core summer, when winter snow has melted since long?

References:

Beraud, L., Cusicanqui, D., Rabatel, A., Brun, F., Vincent, C., and Six, D.: Glacier-wide seasonal and annual geodetic mass balances from Pléiades stereo images: application to the Glacier d'Argentière, French Alps, Journal of Glaciology, 1–13, https://doi.org/10.1017/jog.2022.79, 2022.

Klug, C., Bollmann, E., Galos, S. P., Nicholson, L., Prinz, R., Rieg, L., Sailer, R., Stötter, J., and Kaser, G.: Geodetic reanalysis of annual glaciological mass balances (2001-2011) of Hintereisferner, Austria, The Cryosphere, 12, 833–849, https://doi.org/10.5194/tc-12-833-2018, 2018.

Vincent, C., Cusicanqui, D., Jourdain, B., Laarman, O., Six, D., Gilbert, A., Walpersdorf, A., Rabatel, A., Piard, L., Gimbert, F., Gagliardini, O., Peyaud, V., Arnaud, L., Thibert, E., Brun, F., and Nanni, U.: Geodetic point surface mass balances: a new approach to determine point surface mass balances on glaciers from remote sensing measurements, The Cryosphere, 15, 1259–1276, https://doi.org/10.5194/tc-15-1259-2021, 2021.

Zeller, L., McGrath, D., Sass, L., O'Neel, S., McNeil, C., and Baker, E.: Beyond glacier-wide mass balances: parsing seasonal elevation change into spatially resolved patterns of accumulation and ablation at Wolverine Glacier, Alaska, Journal of Glaciology, 1–16, https://doi.org/10.1017/jog.2022.46, 2022.