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The Cryosphere Discussions

Interactive comment on "Glaciohydraulic seismic tremors on an Alpine glacier" *by* Fabian Lindner et al.

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Author Response to RC2 (Alex Brisbourne)

Dear Reviewer, many thanks for your comments. In the following, we provide the corresponding author comments in a point-by-point style.

- There is no discussion of the uncertainties associated with Bartlett and MVDR locations. Given the methodology and the tight array aperture, these could be significant. However, there is a reasonable degree of clustering and results are comparable and as such appear reliable. There certainly appears to be a statistical significance to the results. It does not appear that the authors have overinterpreted the results by ignoring uncertainties. However, for reference, and

certainly for workers building on this study, it would be useful to quantify these uncertainties and discuss in context.

→ Thank you for bringing up this point. To our knowledge, there is no standard way or best practice of quantifying these uncertainties. One way would be to measure the width of the maxima, e.g. at 95% of the maximum value as is done in Eibl et al. (2017). Still, such uncertainty measurements are not comparable for Bartlett and MVDR processor or for different frequencies. In addition, results from matched-field processing which is used in our study strongly differ for cases where the source is located in the array ("point source") or outside the array (smeared lobe). A solution could be to show the contour lines of the Bartlett/MVDR values which would at least give a sense of the spatial uncertainties between subsequent measurements. Nevertheless, we would be very open for suggestions on other approaches.

Eibl, E. P. 7 others (2017). Tremor-rich shallow dyke formation followed by silent magma flow at Bárdarbunga in Iceland. Nature Geoscience, 10(4), 299.

- When measuring seismicity rates with an STA/LTA, is it necessary to account for variation in background noise? Could the masking of events during periods of high background noise lead to a reduced measured seismicity rate and vice versa?

→ As shown by Walter et al. (2008), the STA/LTA trigger sensitivity can indeed be influenced by variations in the background noise. However, even though our icequake detections could be biased, we do not see restrictions on our conclusions for the following reasons. (i) We show that high icequake rates, independent whether under- or overestimated, may affect the tremor amplitude. (ii) We focus on times with high discharge, which are expected to lower the trigger sensitivity. (iii) Similarly, our main observation – icequakes from the lake direction just prior to the drainage – falls in the daytime of a warm day with pronounced melt cycle

which is expected to decrease the trigger sensitivity. Additionally, no sustained icequake occurrence from this direction is observed beforehand where different background levels are observed.

Walter, F., Deichmann, N., Funk, M. (2008). Basal icequakes during changing subglacial water pressures beneath Gornergletscher, Switzerland. Journal of Glaciology, 54(186), 511-521.

- I recall that Lennartz LE3D are flat from 1-80Hz but may be wrong (P3L26)

→ According to the Lennartz specifications listed on their webpage, the response is flat up to 100 Hz. Could it be that an earlier sensor version was flat from 1-80Hz?

- Technical corrections
  The manuscript would benefit from a careful reading to identify a number of grammatical errors and referencing format issues. I highlight a number of minor issues below. (22 comments)

→ Many thanks for carefully reading the manuscript. We will implement these comments.