The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2019-75-RC1, 2019

The Cryosphere Discussions

Interactive comment on "Contribution of calving to frontal ablation quantified from seismic and hydroacoustic observations calibrated with lidar volume measurements" *by* Andreas Köhler et al.

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Received and published: 17 May 2019

The manuscript by Dr. Andreas Kohler et al. presents a new empirical model for estimating calving flux. The model is using seismic and hydro-acoustic records as a proxy for calving, which was calibrated on precise, frequently repeated lidar scans and time-lapse imagery. The uncertainty of the calibrated model is thoroughly assessed before employing it to long-term seismic records of a permanent seismic station (for studying multi-year variations of frontal ablation at the Kronebreen glacier, Svalbard).

The model is based on a short, but very comprehensive field campaign using multiple sensors (seismic, hydro-acoustic, lidar, time-lapse) and diverse methods for signal /

image processing, supported with various statistical models and tests. The manuscript is well written, easy to follow and should be of general and practical interest to the cryospheric community.

As I answer the questions guiding TC referees in their evaluations (https://www.the-cryosphere.net/peer_review/review_criteria.html), there are only two major aspects I would like to comment on:

1) "Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?"

There are multiple places there descriptions could be improved/completed/corrected as I have specifically listed in MINOR details (e.g., 3 hydrophones deployed, yet locations of only 2 shown; how time-stamping was done underwater to be synced with seismics? hydro-acoustic units are in nm s-1? how signal duration is obtained without "unflag" threshold indicated? and etc.).

Moreover, it would be informative to provide a new figure showing the observed calving statistics in a way similar to recent studies trying to find which law (exp, power, etc.) represents best such distributions as inter-event time and event size? For examples, see Chapuis & Tezlaf, JG, 2014; Petlicki & Kinnard, JG, 2016; Minowa et al., JG, 2018, Minowa et al., EPSL, 2019. I guess, such plots will also better expose completeness issues of the dataset.

2) "Do the authors give proper credit to related work and clearly indicate their own new/original contribution?"

To my knowledge, the contribution is indeed novel. However, as it comes to Introduction and Discussion, I would like to point out the following. There are more recent studies than those "qualitatively estimating the relation between ... calving ... and ...volume" [p.14, Line 3]. For example, continuous high-res. calving records were recently obtained by using another calibrated model, which is linking water-surface waves

with time-lapse- or UAV- derived calved ice volumes (Minowa et al., J. Glaciol., 2018 & EPSL, 2019). The latter studies are of a high relevance to presented here analysis, because they report very comparable findings (for example, the calved volume is up to 10ˆ5 m3 and contribution of calving to frontal ablation is 20% at another arctic tide-water glacier, while subaqueous calving is negligible).

Also, calibrated seismic models for a particular glacier/site are not “The only successful approach so far” [p. 2, line 11]. Because recently there was a progress in developing seismo-mechanical approaches, for example, for glacial earthquakes by Sergeant et al. (Ann. Glaciol. 2019). Moreover, it is not correct to associate glacial earthquakes with tabular icebergs in Greenland; those are usually nontabular.

MINOR

p.1 affiliation #3: missing city, country

p.2, line 1: please, provide literature examples to “radar and liar surveys”

p.2, line 5: “Calving events are also successfully detected from . . .”/ . . . and water surface (or tsunami) waves (Minowa et al., 2018 & 2019)

p.2, line 6: “Seismic and hydroacoustic methods have the advantage to produce continuous calving records. . .”/ -> please consider "Seismic, hydroacoustic and water-wave methods"

p.2, line 10: for glacial earthquake signals from tabular iceberg calving such as observed in Greenland (Murray et al., 2015)

-> it is misleading to use “tabular iceberg” here, because usually tabular icebergs do not capsize and do not generate significant glacial earthquakes (Sergeant et al., 2019). Consider re-writing as:

“for glacial earthquake signals from buoyancy-driven nontabular iceberg calving such as observed in Greenland (Murray et al., 2015; Sergeant et al., 2019).”

p.2, line 11: iceberg impact on the sea surface -> please consider re-writing serac impact on the sea/lake surface

p.2, line 11: “The only successful approach so far” -> see my comment above (about Sergeant et al. 2019)

p.2, line 27: Ny Alesund or Ny-Alesund? -> please, use consistent dash/no dash through out the manuscript.

p.2, line 29: with more than 1 km -> {for} more than 1 km?

p.2, line 31: (Nuth et al., in preparation) ->Please, note that according to TC guide for authors [Works "submitted to", "in preparation", "in review", or only available as preprint should also be included in the reference list.]

p.3, lines 8-16:

->3 hydrophones deployed, yet locations of only 2 shown. I could not follow the destiny of the third recorder.

->please, explain how time-stamping of the hydroacoustic data and possible time drift was dealt with for comparing with seismic data?

The recording unit was recovered -> The recording units were recovered

p.5, line 9: scans of acquired from ->{of} could be omitted?

p.5, line 10: to the west of the main camp. ->Does the reader know where is the main camp in the first place?

p.5, line 14: mismatches . . . was removed ->were removed

p.20, lines 21-22: Calving event scars have low reflectance in near infrared part of spectrum -> is it your finding? Perhaps, a reference should be helpful here?

p.20, lines 26: point cloud differences . . . is added ->are added

Figure 2: hydroacoustic pressure has nm s-1 units?

lambda/4 criterion: -> please, elaborate or reference this criterion

p.7 line 8: when for example ocean -> when, for example, ocean

p.7 line 22: signal duration ->please explain how do you define the duration - otherwise it remains unclear because earlier mentioned STA/LTA was applied to array and did not show any flag-off threshold.

Figure 3: I suggest to explain abbreviation GLM because the reader sees it before reading the text.

here, and in Fig. 5, it would not hurt to explain in the captions the dashed 1:1 lines.

p.9 line 13: using the deviance, the common -> using the deviance, d, the common

p.9 line 15: Perhaps, you could add that null deviance is the same for all models of each station?

p.9, line 26: . i.e., -> For example,

p.10, lines 16-17: Additionally to total ice volume, I suggest to show how much volume per day does it correspond to - for easier comparison with other studies.

p.10, line 18: The volumes . . . lays -> lay

Table 1: KRBN -> KRBN2 ?

KRBS -> KRBS3 ?

Figure 6, caption: Right panels shows -> panel (there is only one)

consider re-writing as: Right panel_ shows {the corresponding} box plot{s} for . . .

p.14, beginning of Discussion: see my previous comment that there are more recent calving flux estimation studies based on “tsunami” wave monitoring. As you would see from the following 5 remarks below, I believe, it is highly relevant work to your study.

p. 15 - as in other places, line numbering has collapsed here, so I just cite the place: “dynamic ice loss to frontal ablation at Kronebreen of 5-30%” ->Similarly, Minowa et al. (2019) finds 20% at another tide-water glacier.

p.15, lines 8-9: It is well-known that also submarine calving generates underwater acoustic and weak seismic signals. -> as well as water surface waves (Minowa et al., 2018).

p.15, lines 18-19: 97% of all events occurred subaerially ->Similarly, Minowa et al. (2018) finds 98%.

p.15, lines 18-19: Another possible solution is to . . . ->use UAV-derived DEM (Minowa et al., 2019)

p.16, line 1: please, consider giving an example to previous efforts like this suggestion of yours: to measure calving areas from time-lapse images (e.g., Minowa et al., 2018)..

p. 16: “calving in Greenland and Antarctica is dominated by the breakup of large tabular icebergs representing a different type of seismic source mechanism (Murray et al., 2015).”

-> in line with my previous comment, it should not be tabular here for Greenland. Moreover, Murray’s paper is not about Antarctica, you could refer to Chen et al. (JGR, 2011) for this. Therefore, please, consider correcting as:

“calving in Antarctica and Greenland is dominated by the breakup of large tabular and nontabular icebergs, respectively, representing different types of seismic source mechanisms (Murray et al., 2015; Chen et al., 2011; Sergeant et al., 2019).”

p.16, line 9: a different or more generalized approach. -> (Sergeant et al., 2019)

p.16, line 15: carried out over longer recording periods than 1–2 weeks -> carried out over recording periods longer than 1–2 weeks

p.16, line 26: to asses model -> to asses{s}

p.17, line 6: contributed with 5-30% ->do you need [with] here?

p. 18, line ? - line numbering collapsed here:

As the ice breaks off and hit -> hits

variations in pixel brightness that occurs ->variations . . . that occur

location and coordinates of calving from gifs - I am not sure how do you get location from non-geo-referenced (?) images. Manually? Elaborate, please.

Figure B1:

Grey line is results -> Grey line shows results

I also note that you keep using [grey] and [gray], why not to stick to just one spelling?

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