

Review of “A high-resolution pan-Arctic meltwater discharge dataset from 1950 to 2021”

by Adam Igneczi et al.

This is my second review of the manuscript by Igneczi et al. Overall, the authors well addressed my previous concerns, but some clarifications are still required. The authors can find my comments below.

Response letter

Reviewer #1 L124: I understand that the authors prefer using a binary mask retrieved from a nearest neighbor interpolation over creating a fractional mask. However, at high-resolution, binary masks may lead to large area discrepancies, notably for small glaciers and ice caps. Table 1 suggests relatively small area differences between original and downscaled MAR, but this does not imply that these areas compare well with GIMP/RGI reference masks. To address this, the authors could report in Table 1 the difference in integrated ice mask area between GIMP/RGI, and the original (5 km) and downscaled (250 m) MAR grids for each investigated region. See also my comment on Table 1 below.

Point comments

My comments are based on the line numbering of the tracked-change document.

L20-21: As mentioned in my previous review, and to avoid being misleading, I strongly recommend clarifying that daily runoff data are spatially integrated over relevant catchments/basins, i.e., not gridded at 250 m.

L71-77: Same comment here, it would be beneficial to clarify that the final data set is spatially integrated over catchments/basins.

L260-262: From Fig. 3, it looks like large areas are locally discarded from the study based on your 90% threshold. At least, it would be interesting to give (1) insight on the discarded area fraction compared to the total area, i.e., discarded area / total area (%); (2) briefly elaborate on why spatial extrapolation is not suitable over these discarded areas, e.g., are the neighboring estimated gradients not representative/suitable enough?

L307: “Ice and land runoff were handled separately.” Please, briefly elaborate on why doing so is important as you did in your response letter, e.g., large runoff contrast at the ice/land interface. Same comment in L351-352.

L312-314: Please give an example of what you mean by “elevation independent variance” as in the response letter, e.g., firn retention processes nearby the equilibrium line.

L366-367: Are annual data gridded at 250 m? Are they part of the published data set? Please clarify.

L449: Could you explicitly write down your R^2 values in the text (Fig. 8) to facilitate interpretation/comparison. It would be good to list mean bias and RMSE (model vs. measurements) in Figs. 8a-b, and report the values in the main text.

L468-513: I do not think that using “over or underestimate” is correct when comparing downscaled and original MAR data, as this comparison does not involve observations. Please replace “overestimate” by “is larger than” and underestimate by “is smaller than” (or equivalent) where appropriate, e.g., L468, 471, 477, 492,499, and 510.

L479-482: “However, this is ... also need to be considered.” These sentences are unclear, please reformulate. Do you mean that ice area between downscaled and original MAR does not change much except for the Russian Arctic? This is surprising, especially when comparing the ice/tundra area difference at 5 km and 250 m in, e.g., Figs. 5a-c and 6a-c in Canada and Fig. S1a-c in Greenland.

Table 1: This is an interesting comparison; however, I miss the difference in ice mask area between reference GIMP/RGI ice masks, and those from downscaled and original MAR for all regions. I

recommend adding this information as additional columns in Table 1, and briefly report the outcome in the main text, e.g., near L479-481.

L582: What do you mean by “static”, a fixed topography and ice mask in MAR? Please, clarify.

Style

L14-15: I suggest “To date, meltwater discharge data at Arctic coastlines are only available from two datasets that are limited by their spatial resolution and/or coverage.”

L71-77: You could split this long sentence at L75 after “1950-2021” as “... for the period 1950-2021. Our database is publicly available, efficiently stored, and covers the most important ...”. Do you mean “publicly available” by “easily accessible”? Please clarify.

L286: “MAR variables within an 8-neighbourhood (8-N) moving window.” And then in L304: “..., first, an 8-N moving window was applied ...”

L418 and 420: I would recommend “5.1 Evaluation against ...” and “To evaluate our product ...”.

L464: “specific” instead of “characteristic”?

L 477: “Lower ice runoff in downscaled MAR mostly stems from reduction in ice area ...”

L597-598: “... is difficult to estimate as localized in-situ runoff measurements are extremely sparse.”

L604: “... against in-situ measurements collected in the field, and found that ...”

L615: “... but not in terms of predictive performance ...”

L641: “For instance, the duration of buffered ...”

Figures

Fig. 9 caption in L476 “... for (a) ice and (b) land areas ...”

Supplement

Fig. S2 caption: “However, it is important to note that the edges of the integrated basins were ...”, and “one third of the aggregated ...”

Fig. S4 supplement text: What do you mean by “We propose that this is due to the topographical configuration of the ice coverage”? This is vague, please clarify.

Fig. S5: “COP-250 DEM is lower than MAR DEM towards lower elevations and vice versa.” From the graphs, it looks like the opposite, i.e., positive values in lower areas ($COP-250 > MAR$) and negative values higher up ($COP-250 < MAR$). Please verify this carefully here, in Fig. S4 and in the main text when referring to these Figures.

Fig. S6 supplement text: In the last line of the paragraph, do you mean “more intensive runoff per unit area”?