

Interactive comment on “Greenland liquid water runoff from 1979 through 2017” by Kenneth D. Mankoff et al.

Anonymous Referee #2

Received and published: 29 April 2020

This study provides high-resolution datasets of Greenland hydrologic outlets, basins, and streams, and a 1979 through 2017 time series of Greenland liquid water runoff for each outlet. This is a timely and important contribution for the Greenland hydrology community and I'm happy to see the paper and the associated datasets to be published. That said, I think some important issues need to be solved before it can be considered for publishing in ESSD.

General comments:

1. The result section does not highlight the main contribution of this study very well. It includes numerous numbers of basins, outlets, streams, runoff but their importance is not well demonstrated. Furthermore, this section focuses on the total ice and land runoffs which can be easily derived from RCMs and have been well reported in previ-

ous studies. I suggest the result section should focus on what we can learn from runoff partitions in different basins, which is the new contribution of this study.

2. The discussion section is too long and not easy to follow, particularly "6.2 Validation against observations". Most parts of section 6.2 should be removed to the result section. I suggest the authors only highlight the most important implications of their datasets and shorten this section.

3. It is important to mention that moulins are not identified so stream networks are delineated to continuously flow from inland to ice edge outlets. Therefore, the stream product may not represent the actual hydrological environments where moulins are widely distributed and fragment drainage networks, such as southwest GrIS. In contrast, the stream product may reasonably predict northwest GrIS drainage pattern since no moulins form there. Moreover, the contributing area threshold should be better illustrated since it determines the extent of streams. It may be useful to state that the derived stream product aims to represent the general meltwater flow pattern rather than the actual spatial distribution of supraglacial rivers and streams.

4. The quality of the main figures should be improved. Currently they are not satisfactory for publishing. Also, the main point of each figure should be highlighted.

5. More previous similar studies should be included. In the paper, the authors only compare their results with Lewis and Smith (2009). However, at least two important similar studies, Andersen et al (2015) and Pitcher et al (2016), should be added as comparison results.

Andersen, M.L., Stenseng, L., Skourup, H., Colgan, W., Khan, S.A., Kristensen, S.S., Andersen, S.B., Box, J.E., Ahlstrøm, A.P., Fettweis, X., Forsberg, R. Basin-scale partitioning of Greenland ice sheet mass balance components (2007–2011). *Earth Planet. Sci. Lett.* 2015(0): 89-95. Pitcher, L.H., Smith, L.C., Gleason, C.J. CryoSheds: a GIS modeling framework for delineating land-ice watersheds for the Greenland Ice Sheet. *Glsci. Remote Sens.* 2016(6): 707-722.

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Minor comments:

P1 L17, in this paragraph, I think it is necessary to say surface runoff contributes very importantly to Greenland mass balance (along with ice discharge).

P2 L4, it is not straightforward to understand "liquid runoff form surface melt, condensation, and rainfall".

P2 L22, why is 100 m ArcticDEM used to do the analysis?

P3 L5, it may be worthy to mention that weathering crust of bare ice layer can store meltwater. Citation is required for this sentence.

P3 L7, citation is required for this sentence.

P3 L10, it is not common to use the term "hydrologic head elevation".

P3 L11, it is unclear how outlets are determined.

P3 L13, it is unclear what "major streams" means, some specific channel initiation thresholds (i.e. contributing area thresholds) are used to extract streams? It may be useful to call these "major streams" as rivers.

P3 L17, why is 1 km² used as threshold to merge small basins?

P3 L20, "When this value is negative, it indicates submarine (subglacial) discharge", this sentence is not clear.

P3 L21, this section is too long. I suggest it should be shorten or some parts can be put into SUPP.

P4 L24, see my general comment, more explanations should be provided for the stream product.

P5 L8, it is not easy to understand what these numbers mean and why they are important.

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P5 L15, what does "adjusts" mean here?

P5 L21, 4380 m³ rather than 4380 m⁻³.

P5 L23, which basin? also report the similar value in Lewis and Smith (2009).

P5 L26, Mt. Pinatubo eruption, add a citation to support this result.

P5 L27, the land runoff is considerably large. It is useful to further illustrate its meaning.

P6 L7, "Routing with a 5 km DEM is likely to cause some basins and outlets to drain into an incorrect fjord", what is the reason for this?

Fig 2 is not easy to understand. What is the main point of this figure? Perhaps remove it to the SUPP?

Fig 4, it is not clear why runoff from the Watson River basin plus the two large basins immediately to the south performs better.

Insets are required to show the location of Fig 5 -9 in Greenland.

Fig 6 is not easy to follow. What is the meaning to change outlet locations?

Fig 7 is not easy to follow. What is the main point of this figure?

Merge Figure B1-B8 into one figure.

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