

Response to referee 1

We appreciate the thoughtful and constructive review of referee 1. Find below a list of referee comments in italics and our response.

Major issues:

- 1. The reviewer asks for a comparison with Mernild and Hasholt (2009) and an updated version of this manuscript currently in review for Journal of Glaciology. The reviewer says that a comparison of the data published here with the data published by Hasholt and others would add value to this manuscript.*

We agree that comparing our data with Hasholt and other's data is of interest. Indeed, we have initiated collaboration with Hasholt's group to do exactly this. However, we argue that a comparison with Hasholt and others data is beyond the scope of this study. First, a comparative studies is beyond the scope of aim of the Earth System Science Data Journal, which is:

“Articles in the data section may pertain to the planning, instrumentation and execution of experiments or collection of data. Any interpretation of data is outside the scope of regular articles. Articles on methods describe nontrivial statistical and other methods employed, e.g. to filter, normalize or convert raw data to primary, published data, as well as nontrivial instrumentation or operational methods. Any comparison to other methods is out of scope of regular articles.”

Thus, this scope of this journal is to present the creation of high quality dataset and to disseminate them to a wider group of scientist. Second, our dataset has value as a stand-alone dataset independent of the dataset collected by Hasholt and others. Our data is representative of a different part of the ice sheet than what is monitored by Hasholt and others. We have clarified the difference between our observations and other studies throughout the revised manuscript.

- 2. More observations are needed to have confidence in Q/h relationship*

Although we believe that our uncertainty analysis provides some information about how much confidence can be put into the data, we have collected additional data in summer of 2011 and can update the dataset with those data to increase confidence in the Q/h relationship.

Minor issues:

- 1. L. 30: Not only melt water, also precipitation.*

The sentence has been edited so that it is clear that the dataset is of river discharge, and we have removed words mentioning of where this river discharge is coming from. Although most of the river discharge is ice sheet meltwater, we recognize that some discharge originates from precipitation, snow and groundwater sources.

2. L. 35: *What does that mean - near-ideal locations?*

Near ideal has been exemplified where it appears in the text as requested. Furthermore, a new table has been added that includes a comprehensive list of criteria for ideal sites defined by the World Meteorological Organization and how they compare to our sites.

3. L. 37: *If, considerable uncertainty, how then near-ideal properties?*

See point 2 for how this has been addressed.

4. L. 62: *Don't have references, which are not accepted or published. Erase.*

The reference has been removed as requested

5. L. 74: *How rare?*

The exact number of peer-reviewed studies presenting observed river discharge and water level data has been provided as requested.

6. L. 80: *Here, should be a figure reference to Fig 1.*

We believe it is more appropriate to first introduce the Figure 1 reference in the Site description section, and keep the introduction free of references to figures.

7. L. 85: *Again, what is a near-ideal site?*

See point 2 for how this was addressed here and at other places.

8. L.101: *How is the watershed estimated? And based on what DEM and tool? What are the uncertainties for the location of the watershed divide, and the area?*

We have clarified exactly how the watersheds were estimated and also provided insights into uncertainties of this delineation as requested

9. L. 140: *How often did the sensor fail to record?*

A new table (table 4) has been added that details data record length and percent data gaps for each variable.

10. L. 147: *What does a 'relatively' stable river cross section mean?*

The text has been rewritten to clarify what stable cross section mean.

11. L. 151: *How come you didn't use the same interval for each river?*

The text now explains why different intervals were used as requested.

12. L. 160: *Did you compare velocity observations for sites 3 and 4, both due to the 0.6*depth method and the method used for turbulent water? What was the difference between these two methods?*

We did not compare the observations at 3 and 4 with the 0.6*depth methods. However, as described, double velocity measurements at the same vertical showed minor variability. Thus, this confirms a near-vertical velocity profile suggesting that 0.6*depth would be similar to our measurements

13. L. 207: *Now you are stating that discharge measurements are difficult making accurate and precise, and you are measuring near ideal conditions (see further up in the paper). Something is unclear.*

How precise are the observed data?

The text has been rephrased to make it clear that quantifying data uncertainty in this dataset is an objective given the potential difficulties despite near-ideal conditions. No such uncertainty analysis has previously been performed for Greenland data, thus knowledge about accuracy and precision of this kind of data is unknown.

14. *L 234: What are the uncertainties on cross-section measurements at each location across the stream?*

To address the reviewer comment we have edited the first paragraph in the result section to more clearly state that cross sectional data range is independent of location, and also present compare the total data range with the data range within deployments.

15. *L 272: How does this affect your Q/h-relation? And the uncertainties in calculating discharge? What is the reduced precision based on that?*

We have clarified that channel deepening trend may reflect both actual channel morphology change as well as measurement uncertainty. In the following paragraph the influence on discharge uncertainty, and the reduced precision are presented. Furthermore, we have added a subplot to figure 5 to illustrate that channel deepening has insignificant impact on rating curve relationships.

16. *L. 303: How reliable? Add a value.*

The text has been rewritten to clarify that 'reliable' refers to the fact that these sensors were unaffected by extreme pressure variations during freezing conditions.

17. *L. 344: Do you have any knowledge about when freeze-up occurred?*

Freeze up can be deduced from the temperature observations provided in this dataset.

18. *L. 385: Why is it new insight, also related to observations from Mernild and Hasholt (2009), and Hasholt et al (in review). Please explain why and what is new?*

We have rewritten the text to clarify that the data is from sites that never have been observed before. A new paragraph has been added at the end of the discussion section to clarify the contribution of this study.

19. *L. 459: Don't use submitted material as reference. Only published and accepted.*

Reference is removed as requested

20. *L 489: How is the watershed estimated? Which DEM and program were used? What are the uncertainties in location of the watershed divide and in the estimated drainage area?*

This information is now provided in the site description as requested in point 8 above.

21. *Table 2: Why is R2-value for Site 2 so low compare to the other sites? If not stated in the text, then please explain.*

We have explained by R2 for Site 2 is lower as requested.

22. *Figures 3 and 4: This figure is very small. Please make it greater.*

We would be happy to make the figure larger, however, it was scaled at typesetting. Editor please advice how to proceed.

23. *Figure 5: Site 2: How trustful is the Q/h relation, since it is only based on four values between 10 and 22 m/s-1. The relation seems weak. If not explained in the text, please explain uncertainties related to few observations. Normally more than five observations are used.*

See response to major point 2

24. *Figures 7 and 8: Both are very small. Please make them greater.*

We would be happy to make the figure larger, however, it was scaled at typesetting. Editor please advise how to proceed.

Response to R.S.W. van de Wal

We appreciate the thoughtful and constructive review of Dr. van de Wal. Find below a list of referee comments in italics and our response.

Major comments

1. *Compare the link between discharge and ice sheet melt*

See point 1 in the response to referee 1. Although we believe this type of investigation is important, such analysis is beyond the scope of the Earth System Science Data Journal. However, we have rewritten the introduction to mention this important potential use of this dataset.

2. *Other science questions: 2010 an outlier? Phase relation between ice sheet melting and discharge, distinction between englacial lake drainage and ice sheet melting as contributing to river discharge*

See above. We agree that these are important science questions, but they are beyond the scope of the Earth System Science Data Journal.

3. *Are the measurements more accurate than the ones made in the 90's by Russell and co-workers? Did Russell neglect some errors? Have the community made progress in the measurement technique itself or have we made progress with understanding/quantifying uncertainties*

We have rewritten the text to make it clear that this study is the first to present a statistical data uncertainty analysis. A new paragraph is added at the end of the discussion section where this dataset is compared with other dataset collected downstream in the same river system. It is made clear that while the methodology has not changed or improved from previous studies, the statistical error analysis is new.

4. *Summarizing paragraph stating errors at the different sites. Result section should be more of a physical interpretation of the work and comparison with melt (validation)*

A summarizing paragraph is provided in the discussion section that compares errors between sites as requested. A new table with all these data values has also been added. Furthermore, this paragraph contrasts data with that of previous studies relative to watershed areas to examine if the data values are sound.

Minor comments

1. *Abstract line 15 be more specific measurements of what??*

The abstract has been revised as requested.

2. *Abstract line 16 please rephrase now it reads if the channels deepen as a result of the statistical test*

This sentence has been removed because it was very redundant with the previous sentence on line 15.

3. *Introduction line 8 please remove reference to unpublished work where there is no extremely urgent need to do.*

Reference has been removed

4. *Introduction I think it would be appropriate to work to the older work by Russell for reference to the catastrophic events (see below).*

Thanks for sharing the older work by Russell and others. They are now mentioned at multiple places throughout the manuscript.

5. *Introduction There is definitely a need to include the paper by Van de Wal and Russell 1994 as it attempts to link river discharge to melt at the ice sheet. This is topic, which is not addressed at all which is a pity.*

See answer to major concern 1 and 2. We have included reference to van de Wal and Russell 1994 in the introduction to illustrate this important application of this dataset.

6. *Site description line 27 according to Russell there have been more outbursts in the past, I think you should mention that.*

The text has been revised as requested.

7. *It is interesting to see that there are discharge event in winter. We do also observe velocity variations in winter and it would be worthwhile to add a figure on that if you like to pursue this topic.*

Interesting! I think an analysis of velocity variations and winter discharges would be very interesting, but beyond the scope of this journal. I will contact you to follow up on this separately.

8. *Table 2 rst degree?*

Type setting error that will be corrected as requested

9. *Table 2 add a column d_0*

The column has been added.

10. *Figure 1 elaborate on how you distinguish the watershed on the ice and whether you believe that it is only this part of the ice, which drains to your discharge sites. Does the integrated melt over the drainage basin somehow match with the integrated discharge (evaporation and precipitation are small and can be corrected for)?*

We have clarified how watershed delineation was made and presented inherent uncertainty with this method. Furthermore, we have added a comparative analysis of drainage basin size and river discharge between our sites as well as sites monitored by other groups.

11. *I am somewhat puzzled by the fact that site 2 does not have the largest uncertainties. If I understand it correctly the velocity measurement with depth are carried out at this site at one depth only introducing a large uncertainty, which is not there for the other sites despite errors, are smaller. Can you clarify this? And if I am right stress this more in the text.*

We have clarified this at several places in the text and provided an explanation as requested.

12. *I don't understand why the gray shading in figure 3 and 4 is not similar; particularly site 4 fig 4 seems to deviate from site 4 fig 3.*

The gray shading in those figures represents different things. This has been clarified in the figure text.

13. *Explain the off scale peak in discharge at site 2 in 2008 in the text.*

It has been explained as requested.

14. *The time series set up in the figure 4-6 does not provide enough detail to*

observe the differences in the seasonal cycle for the different sites. Can you not plot them as a seasonal cycle for every site in a panel with three curves for the different years? One could then observe whether there are systematic differences between the years.

We agree that a seasonal comparison is of interested. However, again we refer to point 2 in our response to reviewer 1. We believe it is more important to communicate the dataset uncertainty range than making a comparative analysis of seasonal discharge. Thus, we have plotted time series are continuously with upper and lower data ranges indicated.

15. *A table with average discharge per site per year would be helpful as well.*

We have provided median melting season discharge values in a new table.

16. *Figure 8. It is odd to have water temperature along the vertical axis if temperatures go down as low as -15°C. I guess it would be better to have just temperature along the vertical axis.*

Agree, we have updated the vertical axis to reflect that they show temperature measured in the stream channel.