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The Cryosphere Discussions

Interactive comment on "Increasing runoff from the Greenland Ice Sheet at Kangerlussuaq (Søndre Strømfjord) in a 30-year perspective, 1979–2008" *by* S. H. Mernild et al.

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Mernild et al., (2010) examine the hydrologic and meteorologic records of the Kangerlussuaq, West Greenland watershed for the 1979-2008 period. The key finding based on this data is the substantial increase in runoff and the percent of this increase due to glacier melt. They also developed a surface mass balance model that reconstructs the mass balance of this watershed for the same period. The paper provides an important and unique assessment of the long term changes in runoff from the GrIS and relates this to the previously reported increasing melt extent. To enhance the value of this contribution a few overall and specific recommendation are enumerated below. I look

forward to the final result of this important paper.

Greater attention should be given to the hydrologic record in the paper. The title of the paper focuses on this, but the paper spends more time on mass balance. Further comparison of simulated and observed variables utilizing additional figures will better define the observed changes and the accuracy of the simulations. Further exploration of the melt intensification would be valuable, including additional figures providing the reader with a more complete picture of the hydrologic changes in the watershed. The mass balance record is an indirect product of the hydrologic and meteorologic data set and should be the secondary focus. The reconstructed surface mass balance(SMB)product is of very limited value without: 1) independent verification, 2) further explanation of adjustments and errors, 3) a reported mass balance gradient and glacier hypsometry. Certainly the reader cannot have confidence in the SMB output based on the presented material. The model setup appears quite sound and the results may be spot on, this just needs to be better demonstrated. At present the melt season conditions have some verification; however, the precipitation-accumulation simulation appears more problematic.

323-21 Odd sentence ending. . ."in different way."

324-16: A photograph of river gaged at Station K would be quite useful.

326-19: The 230% overestimate of runoff based simply on Station K data is a substantial issue that must be explored. How did the error occur temporally? Was it consistent, was the error greater in a particular period of the summer? Why was the error large? What was the key adjustment utilized and why was this valid?

327-22: Comparison of simulated and observed values indicates a 10-25% maximum difference in simulated versus observed values. Does this encompass all of the variables from the previous sentence? A figure exploring these is necessary. Are there any consistent over or underestimates for a variable. Simulation versus observed snow depth at S5, S6 and S9 should be shown in a figure or table. Same with simulated

versus observed summer runoff.

328-2: Why is S9 snow accumulation overestimated by 50%? This belies the earlier statement of 10-25% maximum difference. The earlier statement probably applies to the corrected value, clarify this. Why does this difference exist? What does this say about the accuracy of the precipitation scheme? What does the Liston system do that makes the adjustment such an improvement?

329-22: The basis for almost any surface mass balance scheme is the mass balance gradient and the hypsometry for the glacier. Neither is shown here. In particular the mass balance gradient used can be compared to others for west Greenland both for verification and comparison. A comparison of the simulated versus observed gradient based on results from S5, S6 and S9 would identify areas where the simulated gradient curve deviates from the albeit limited observations. A figure similar to that of Figure 10 from van den Broeke et al (2009) for these same stations for accumulation and ablation simulation versus observed would be most valuable.

332-12: Simulated surface mass balance is of little value unless it is independently verified. The results here must be compared to the results from Box et al. (2004 and 2006) or some other mass balance estimate for the region. A glance at the results of Box et al (2006), Velicogna (2009) or Khan et al. (2010) suggest to me a more negative surface mass balance for the watershed, though it is hard to tell at the GrIS wide scale, and these are for specific time periods within the overall data set. Can the model replicate the observed ELA from selected years where satellite imagery or field data exist?

332-final paragraph: This to me is the most important finding of the paper. It quantifies the runoff intensification in large part due to enhanced glacier melt, the expanding extent of which is well documented. The tie between the runoff and the changing melt extent record is the new piece offered by this paper and we would benefit from more attention to this aspect.

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