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The Cryosphere Discussions

Interactive comment on "Partitioning of melt energy and meltwater fluxes in the ablation zone of the west Greenland ice sheet" *by* M. Van den Broeke et al.

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I want to thank Mauri Pelto for providing his comments and, in anticipation of the reviewers comments, will answer some of the issues raised here.

C: Are there any quantifiable observations of surface flux? Have there been any changes in surface roughness at S5 or S6 from 2003-2007? If so this could be an important potential change in the melt energy for such a region. I have noted considerable surface roughness increases after several years of persistently high ablation in various sections of the ablation zone of temperate alpine glaciers.

A: Indeed, there are direct observations of SHF and even of LHF; in spite of the considerable technical challenges, our technicians have succeeded in collecting year-round

eddy correlation data from the ablation zone at S5 and S6. These data have been partly reported in: Smeets, C. J. P. P. and M. R. van den Broeke, 2008: Temporal and spatial variation of momentum roughness length in the ablation zone of the Greenland ice sheet, Boundary-Layer Meteorology 128, 315-338. They do however only cover one year of observations so are not suitable to deduce an interannual trend. Based on those results, we are now working on a method to use our two-level measurements for z0 calculation over the longer four-year period. The first results do not suggest that there is a trend in the summertime roughness, but the results are too premature to report here.

C: 712-25: It is noted that the narrow ablation zone has been the location of the largest changes in ice flow. Must be careful with this as the greatest ice flow changes are in the ablation zone of marine terminating outlet glaciers, not simply in all areas of the ablation zone.

A: Noted, thanks.

C: 714-10: What about the surface conditions at S6. In fact I would like to see Table 2 include a measurement if one exists for surface roughness at the three locations.

A: An average value will be included in the revised version.

C: 718- 15-20: Need a Figure for this observation of M, or of the observed versus modelled Ts.

A: This would need three additional figure frames (three sites), which I think is not justified given the fact that the focus of this paper is on mass balance. During melting conditions, surface temperature is constant and does no longer relay information about excess energy used for melting. So preferably not to be included in this paper, which focuses on mass balance.

C: 720-8-10: I like the use of the 10 day average melt rates. I have found ablation difficult to quantify accurately from weather records at the daily level. Is this part of the

TCD

2, S314–S317, 2008

Interactive Comment

reason for this time period?

A: Indeed, daily melt rates are at the limit of the accuracy of the sonic height ranger and cannot be used for a proper comparison.

C: 721-20: Any measures over long period of changing surface roughness that would affect SHF at either S5 or S6?

A: Not likely, but based on the information we have it cannot be excluded either.

C: 721-: Return to the advantage of this method to the degree day model of Braithwaite.

A: Obviously, having all necessary data at hand enables us to do the full SEB calculations. The degree-day method has been designed to be used for situations that these data are not available, e.g. to calculate melt in ice sheet models. It is therefore not very useful to compare the methods, as they have very different applications.

C: Figure 1: A more zoomed view of the three measurement sites.

A: Personally I think this scale is fine, let us wait what the reviewers think.

C: Figure 4: The melt models greatest relative errors are for melt rates below 10 kg/day makes sense but explain.

A: Will be addressed in revised version.

C: Figure 5: Why is S6 melt so much lower than S5 in 2004?

A: The ratio of total melt S6/S5 is not significantly different in this year compared to the other years, about 0.35. The 10-day peak values however are lower than in other years, the main reason being the absence of a prolonged period (> 10 d) of sunny weather that coincides with a 10-day averaging period.

C: Figure 6: I doubt hourly rates are either important or reliably determined, not that this changes the results of this figure.

A: Agree, plot is meant to show that daily cycle in melt rate as suggested by the sonic

TCD

2, S314–S317, 2008

height ranger is indeed reproduced by the model. I consider to include a graph of melt-season average daily cycle of observed/modelled melt, to reduce the noise in the measurements, but am not sure it will work.

C: Figure 7: Add a figure showing the difference for 2007 surface energy balance versus the longer term results, for at least one site, this could be 7(c).

A: See earlier comment.

Interactive comment on The Cryosphere Discuss., 2, 711, 2008.