

## ***Interactive comment on “Sensitivity of Greenland Ice Sheet surface mass balance to surface albedo parameterization: a study with a regional climate model” by J. H. van Angelen et al.***

### **Anonymous Referee #1**

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This paper presents a sensitivity analysis of the surface mass balance of GrIS, after implementation of a new albedo calculation in the climate model RACMO2. While the work is important, and I see no major issue with the science undertaken, the description of results and conclusions is often too vague to be convincing. Adding precisions and discussions throughout the text will address this issue.

Specific comments:

-p34, l.6: IMAU has been doing work on K-transect since early 1990, surely there is earlier work than Van de Wal 2005, to credit on this?

-p36, l.10-12: rephrase to avoid repetitions of "new albedo", "RACMO2" and "dis-  
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cussed/discusses". If the new albedo scheme is fully presented elsewhere, make it clear where (e.g., Kuipers Munneke, or Gardner and Sharp??)

-p36, eq 1: consider giving an expression for  $\alpha_S$ ?

-p36, eq2: specify what "t" is.

-p38: How is the bare albedo related to the model described in section 2.4? A word of introduction/explanation would be useful.

-p38, l.21: What is the justification for taking the averaged of the lowest 5% of data to define the BIA - and what is the sensitivity of the BIA field to this value?

-p39, l.1: "reasonable stable" is vague. Consider providing a range of values?

-p40, l.1: Check units in table 1, which indicate a change from 1000 to 2000 mm.

-p41, l.1-3: the authors are comparing their results with those using the density dependent albedo scheme: would it be possible to show the latter on Figure 6a? Alternately, why not showing the results using the previous albedo scheme for year 2007 and/or timeseries 2004-2009, on Figure 3 (consistently with figures 5-6), rather than for year 2006?

-p41, l.4: how much higher is the minimum albedo?

-p42, l.7: be more precise ("too high")

-p42, l.26-27: shame that no more is said on that point! If the authors were able to quantify this a bit more, it would be a great addition to the paper. Right now, it sounds interesting, but "probably" make it sound speculative.

-p43, l.2: "almost 20%", or 18%? ...

-p.43, l.11: again, total melt increases 5%, runoff increases 7%. Suggest using "similar amount", rather than "same".

-p.45, l.1: "somewhat underestimated" => be more precise. Also, the justification for the  
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underestimated SMB not being related to albedo is incomplete: how about the albedo at S6 (1000m)? Figure 5 show that for year 2007, it is lower than observed. How much of the underestimation can be attributed to this? By how much is the sensible heat flux overestimated at S6 and S9?

-p.45; l.24: use a more objective statement than "well represented". Figure 10 shows an improvement in the gradient for the lower region of GrIS (<900m), it also shows very little difference at higher elevations: any insights into why this is? Is that directly related to the use of BIA?. The authors need to add some discussions to convince that the new albedo scheme is what led them to this improvement. For instance, they state earlier (p.45, l.11) that "the use of a background ice albedo field improves the results in the lower ablation region". So, what does Figure 10 becomes, for any other of the sensitivity runs?

-conclusions: it would be nice to have a clearer statement of which parameter is the most important in assessing the albedo.

-Again, a lot would be gained from exploring more the interaction between albedo/refreezing/retention of melt water. But if it is not feasible to run one more simulation (to check how much more melt would be produced the following year), then, as it stands, there isn't much point bringing this point back into the conclusion (and in the abstract, for that matter).

Typos etc:

-p33, l.11: "balance"

-p35, l.5: replace "by" with "at"

-p35, l.7: replace "the implementation" with "implementing"

-p37, l.11: suggest using " ... Summit, Greenland (Flanner et al, 2007)

-p37, l.21-23: suggest removing the sentence "The colored lines show ..... and

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0.2ppmv (red)", belongs to figure captions.

-p38, l.16: add a dash to "16-day"

-p38, l.27: delete 0.52 (already specified in that sentence).

-p41, l.1-2: shorten or remove first sentence (figure caption).

-p41, l.24-27: suggest removing this broad description of what to find on figures 7 and 8. A reference to appropriate figures (as is done on line 9, p42) seems sufficient.

-p.44, l.21: insert "rather" after correctly.

-Label S5 / S6 /S9 on Figure1 and Figure 9?

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Interactive comment on The Cryosphere Discuss., 6, 1531, 2012.

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