The Cryosphere Discuss., 7, C2237–C2239, 2013
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Interactive comment on "Implementation and evaluation of prognostic representations of the optical diameter of snow in the detailed snowpack model SURFEX/ISBA-Crocus" *by* C. M. Carmagnola et al.

Anonymous Referee #2

Received and published: 31 October 2013

This study incorporates four different representations of snow specific area (SSA) into the Crocus model, and evaluates simulated snow states against observations from Greenland and the French Alps. One of the SSA representations is new, and essentially updates earlier representations of snow grain characteristics from Brun to provide the more relevant quantity of SSA. Overall I think this is a very useful study that includes both new measurements of SSA and evaluation of multiple SSA parameterizations. Several minor issues should be addressed before publication.

General comments:

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The paper needs a clear and concise description of how the SSA representations differ between B92 and C13. Some information on this is contained in sections 2.1 and 2.3, but the differences are still unclear to me. The issue I am most confused about is how SSA is determined from B92, given that SSA was not a prognostic quantity from the original representation, as indicated in Table 1.

Minor comments:

Use of "d" to describe dendricity and "d_opt" to describe a diameter is a bit confusing. The authors might consider an alternative symbol for one of these quantities.

All acronyms should be defined (e.g., TEB on p.4448,10).

p.4449,21: "Snow layer settling upon the combined effect..." is unclear.

section 2.3.1: To me, it would make logical sense to begin this section by describing the new prognostic representation of d_opt, listed in Table 2. This is the quantity of focus in the paper, and also the heading of section 2.3.

p.4453,6: I suggest that the authors briefly describe, either here or elsewhere in the paper, how albedo is related to d_opt in Crocus. This is relevant because model albedo is evaluated against observations (e.g., Fig. 10). How sensitive is the model snow albedo to d_opt?

p.4454,11: Number is missing a "times" symbol.

p.4458,12: The meaning of this passage is unclear to me: "this distinction remains true only for the time evolution of sphericity, which is left unchanged."

p.4458,16: Number is missing a "times" symbol.

p.4467,8: Do "these results" pertain to the RMSD values?

Section 4.2.2: The authors refer in several places to times and locations that experience snow melt. It should be noted again in the intercomparison of model SSA that

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all representations include the same formulation for wet metamorphism from Brun et al (1992), suggesting that we should expect less model diversity in the simulation of wet snow states.

p.4471,16-18: "F06 makes the SSA decrease faster in the case of low density": This is only true with non-zero temperature gradients. Hence, the finding that the rate of SSA change under isothermal conditions is independent of snow density (Schleef and Loewe, 2013) is actually consistent with the F06 model. The passage should be re-worded to reflect this.

Grammar: The following phrases are grammatically incorrect: "allows to write" (4446,20), "allows to simplify" (4447,17), "allowing to test" (4448,3), "allowed to formulate" (4450,7), "allows to compute" (4453,5), "allows to predict" (4454,9).

Interactive comment on The Cryosphere Discuss., 7, 4443, 2013.