Response to referee #2's comments

General comments

This is a well-written paper giving a fairly thorough description of a snow model and evaluating its performance in comparison with point observations, but there have been many such papers; this one combines components of existing snow models and takes datasets that have already been heavily used in evaluating snow models. To convince the reader that another paper on this subject is worthwhile, there needs to be a unique contribution, perhaps by discussing the model's performance in relation to the requirements of its intended applications. Another major concern is that the albedo values chosen for fresh and melting snow in the unmodified model appear very low, a suspicion which is confirmed by the comparison with observations in Figure 9. I understand that these values were taken from SiB, but if the authors wanted to make the unmodified model look bad, then this would be a good way of going about it. Section 4.5 then reveals that an albedo parameter in the improved model was calibrated for the test sites, which invalidates any suggestion that the improved SWE simulations are due to changes in the model physics; we really need to see results from the unmodified model with more realistic parameters.

Answer: We agree that the realistic snow parameterization and validation dataset have been taken from published literatures but we confirm that the snow physics of WEB-DHM has been improved. Many models with realistic parameterization are basically developed for climate model or one dimensional land surface model and we coupled SSiB3 snow physics to 2-D distributed hydrological model which considers lateral flow distribution. From this point, it has a significant contribution; however, the model is validated for one dimensional only. We believe that spatial modeling of snow cover with poor snow physics may not provide correct results. Before application to 2-D, we would like to validate our system on point scale to understand the snow processes more accurately. The simulation results can be improved by calibration/optimization of parameters in old WEB-DHM but the model may not be able to simulate internal physics of snow processes well at all. Hence we believe the importance of physics is utmost. We appreciate the reviewer's question about the scientific contribution of this paper. However, scientific contribution includes innovative application of existing knowledge too. We would like to thank you for constructive comments/suggestions.

We intend to upgrade the existing manuscript quality fulfilling the requirements of a scientific paper with some uniqueness for publication in HESS. The revised manuscript will include the inter-annual variability of snow process, simulation at two more SnowMIP sites (Goosebay and Sleepers). In addition, the forest snow processes will be evaluated using one SnowMIP2 site. Sensitivity analysis for incremental process representation and its thorough evaluation will be made. Regarding the realistic parameterization to old model, the sensitivity of parameterization will be added in the revised manuscript which will give more insight. The old model with realistic albedo parameter will also be driven and results will be discussed in the revised manuscript.

Minor comments

2.2.1 The information on layer subdivision is largely repeated from 2.2

Answer: The manuscript will be revised to remove the repetition.

2.2.2 Give some reference on how the surface fluxes are calculated. This will have a large influence on the surface temperature. How is the grain size used in the radiation extinction coefficients specified? Equations (11) and (12) for the canopy and surface snow layer temperatures contain another unknown: the snow layer 2 temperature. Show how the full system of equations is solved.

Answer: Surface fluxes are calculated using the formulations of SiB2 (Sellars et al., 1996). Grain size diameter is specified as a function of density following Anderson (1976). Above references will be quoted in the revised manuscript showing the solution for full system of equations.

2.2.3 It is not clear here how IFj and Rj are calculated.

Answer: The details will be presented in the revised manuscript.

2.2.5 Snow albedos are given for direct and diffuse illumination in visible and near infrared bands. How are they used, since these radiation components are not available in the forcing data?

Answer: They are used according to SiB2 (Sellers et al., 1996)

4.2 Are the UDG or snow pit measurements of snow depth used in calculating the error statistics? What is the "desired accuracy"?

Answer: UDG is used for Snowdepth and snow pit measurements are used for snow density in calculating the error statistics. "Desired accuracy", the qualitative expression will be presented quantitatively in the revised manuscript

4.4 Figure 8 does not show energy conservation, which should be exact in both models.

Answer: In the revised manuscript, the text will be reorganized.

4.5 Against what criteria was the fresh snow albedo calibrated?

Answer: Manual calibration of fresh snow albedo was done to minimize the difference of simulated and observed snow depth.