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Interactive comment on "Modeling bulk density and snow water equivalent using daily snow depth observations." *by* J. L. McCreight and E. E. Small

T. Jonas (Referee)

tobias.jonas@wsl.ch

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General comments:

This work presents an interesting new approach for estimating snow bulk density from snow depth. Existing approaches have either significantly larger input data requirements (physically-based models) or neglect the variability in bulk density at short time scales (parametric models such Sturm et al. or Jonas et al). The authors achieve their model improvements by disaggregating daily time series of snow depth into a temporally-averaged component and positive and negative deviations thereof. This allows them to separately account for correlation between snow depth and bulk density at two distinct time scales. The resulting model seems to feature a good balance between model simplicity, data demand, and prognostic capabilities for a range of potential ap-

plications, even if the authors had one particular application in mind.

Overall, the topic is relevant, the study contains novel material, and the manuscript is generally both well written and organized. I also agree with the conclusions and many of the specific comments made by the first reviewer. To avoid redundancy, there are only a few additional minor points I'd like to add as specific comments below.

Specific comments:

Page 5013, line 23-25. In fact, month is an implicit predictor by using separate parameterizations per month. Moreover, the model can be used for any singular snow depth measurement, and multiple observations within a given month are neither assumed nor required.

Page 5015, line 23-24. Maybe nitpicking, but using the given accuracy values in the error analysis may not represent a realistic scenario. I suspect these values represent resolution, not accuracy.

Page 5018, line 26-27 / Page 5021 line 20-22. As correctly cited, the Jonas model was never intended to be applied to daily time series. However, in cases where this is done nevertheless, best practice for a given HS measurement is to calculate SWE for the 15th day of each month and then interpolate the resulting SWE time series to the specific date at which the HS value was measured. This simple procedure allows to get completely rid of the jumps in bulk density between months. I realize that this procedure was not mentioned in the original publication, but it is common practice in all applications I am aware of. For obvious reasons I will not ask the authors to adopt this practices and redo the analysis, but I'd appreciate if the authors would manage to include this information as a short note.

Page 5022, line 10, and similar occurrences. I'm probably biased here, but I think the authors could refer to "structural errors" if they'd find bad model performance in cases where these models where used as intended (c.f. page 5028, line 9). How about

"structural simplicity" or "simple model structure"?

Page 5029, line 4-7. An interesting topic that is brought up here. Probably content for future research, but adding a retrospective variant of the full model in Appendix B would certainly serve readers that deal with real-time applications.

Interactive comment on The Cryosphere Discuss., 7, 5007, 2013.