

Interactive  
Comment

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

### **Anonymous Referee #3**

Received and published: 22 December 2013

#### -General Comment

This manuscript presents the development of the empirical model for bulk snowpack density at daily scale throughout the season using extensive snow dataset across the western United States, and then estimates daily SWE from modeled snow density and observed snow depth data. The bulk density model was built on the previously developed density model (Jona et al 2009), but in very creative way, and new model substantially reduce error in daily density and SWE from the previously developed models. The results are very promising for SWE estimates over the large scale. I can clearly see a value of the SWE estimation method presented in this paper, particularly for western United States (SWE distribution information is extremely important to water resources management. However, SWE observation network- SNOTEL, does not cap-

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ture full picture of daily SWE distribution over the West). The approach makes sense given great potential of snow depth measurements (i.e., GPS, LiDAR, etc.). The model presented by the authors could potentially provide additional method of SWE estimates (in addition to snow model).

The paper is well written and provides substantial literature reviews and analyses are also quite thorough. I have only several minor comments below.

-Specific comment

Section 4.1. Page 5021. Line 22. Missing "and" between "density" and "SWE"

Section 4.2. Page 5024. Line 2. Sentence starting "However, ...". I don't understand meaning or implication of this sentence. Maybe restate different way, or can be deleted?

Section 4.3. Page 5025, Line 18 - . The figure shows pdf of the coefficients of your model is quite tight (which is good) compared to the others. Maybe worthwhile stressing that this supports transferability of model coefficient.

Section 5.1, page 5026, line 19 - . It sounds like the authors did not use cross-validation (e.g., develop the model with one-year-out and applied the model one year)?? If I am right, I wonder why you did not do cross-validate at single site.

Appendix A. page 5031, lines 2-5. This sentence intrigues readers. Wondering about the proportions of each phase at the other sites. Might be good to state approximate range of percentages over all the sites.

Appendix B. page 5032, line 20. I would delete this sentence. Slight increase in RMSE on 31th day seems to happen by accident, and I don't think it is statistically significant. Furthermore, RMSE decrease again after 31th day.

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