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The Cryosphere Discussions
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Interactive comment on "The surface energy balance in a cold-arid permafrost environment, Ladakh Himalaya, India" *by* John Mohd Wani et al.

Anonymous Referee #1

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Comments to the paper: The surface energy balance in a cold-arid permafrost environment, Ladakh, Himalaya, India John Mohd Wani, Renoj J. Thayyen, Chandra Shekhar Prasad Ojha, and Stephan Gruber

General comments:

This paper contains a two-year measurement series of surface energy balance (SEB) measurements at a high-altitude site in Ladakh, India and an application of an already well-tested energy balance model (GEOtop). Measured values such as the individual radiation components and the snow cover development are validated against the GEOtop model outputs. This paper represents an excellent, well-written and careful high-quality work, which is an important contribution to a better understanding of surface energy balance and heat fluxes in a very remote and high-altitude area, where not

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many of these in situ measurements exist. Therefore, I would recommend this paper for publication after having considered some minor suggestions given below:

- Page 11: When presenting the energy balance equation, the authors use in my opinion a slightly confusing convention related to the flux directions. I would suggest that they use a more common convention very often used in cryospheric research that all fluxes towards the surface are positive and negative away from the surface, because the authors used a different convention often in the paper values are not clearly presented. As an example, in Table 2: the mean value of Sout is given as a negative value and the Min and Max values are given as positive values. The same is the case for LWout.

- Page 11: The authors present as their first objective on page 5: (a) quantify the point Surface Energy Balance (SEB)! When calculating the energy balance from measurements, it is then not clear, why the authors do not use their data to calculate the melt by using their measurements of the snow cover? I understand that they use the model to calculate the melt and also the ground temperatures with their model and use the measured data of snow cover and ground temperature as validation data. However, I have the impression that through this approach the authors mix different steps in the methodology and increase the degree of freedom unnecessarily. First, the authors may simply use all the available data to determine the MEASURED SEB based on the well-known and common approaches and then in a second step they make their model exercise, which is already very well done.

- Page 22, Table 2: the given albedo values seem to be not reasonable. The authors present for example (taken from Figure 3) measured SWin values in spring (April) of around 300 W m-2 and SWout values of 250 Wm-2. A corresponding value of albedo (alpha) would be higher than 0.5. Therefore, the max value of alpha should be higher. Please clarify!

- Table S2 in supp. material: I would recommend that you send your data to the Global

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Energy Balance Archive (see also http://www.geba.ethz.ch and https://www.earth-syst-sci-data.net/9/601/2017/)

Specific comments: 1. Page 4, line 83: please cite here a text book such as Oke 1987 or Sellers 1965, because these are well-known facts since starting EB studies.

2. Page 10, line 218: what means 'controlled through parameters' -> please be more specific and explain more in detail.

3. Page 10, line 219: please delete s: . . .mountain regions. . .

4. Page 11:, line 234: replace But with However,

5. Page 11, line 240/41: equation (4): why should LWn be only a function of Ts? Please delete the dependencies to Ts in equation, because further down the authors explicitly explain that these variables are not only depending on Ts.

6. Page 12, line 257-260: this is strongly dependent on the effective soil conditions, if you have rock surfaces it is completely different from fine sedimentary material. -> please clarify! Please explain in more detail the BATS, which is used here!

7. Page 14, line 296-298: what happens if your surface is bedrock?

8. Page 16, line 360: I would also like to see an evaluation of the turbulent heat fluxes!

9. Page 17, line 387: delete s: root mean square error

10. Page 20, Figure 2: would be nice to plot snow height in figure 2 A!

11. Page 21, line 468: what do mean with non-free? clarify!

12. Page 22, line 476: please reformulate the following sentence to: . . .with higher values during summertime and low, relatively stable values during winter. . .

13. Page 22, line 481: please reformulate the following sentence to: . . . with a thick snow cover during. . .

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14. Page 22, line 483: please delete word: values

15. Page 23, Table 2: please control and adapt table 2 according to my comments under General Remarks.

16. Page 27, Table 3 and page 30 line 615: Fsurf values: please explain the signs of these values? Please also explain the variability of Fsurf in relation to your result outputs of your model? What is the meaning of Fsurf when it is negativ and there is no snow? Please clarify!

17. Page 27, line 615: please correct: available

18. Page 35, Figure 8: here it is important that most of the energy in Rn is used for melting (particularly in the year 2017) and this should be shown in the figure!

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