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Interactive comment on "Two-Dimensional Liquid Water Flow through Snow at the Plot Scale in Continental Snowpacks: Simulations and Field Data Comparisons" *by* Ryan W. Webb et al.

Anonymous Referee #2

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In this paper, simulation of liquid water infiltration in the slope snow was discussed. Water infiltration in the slope snow is an important theme for understanding the water infiltration process. The features of this simulation are two: combining SNOWPACK and iTOUGH2, and application of plot scale. Using different resolution scales for parallel and perpendicular direction for slope, it can support both detailed changes of snow layer for vertical direction and plot scale for horizontal direction. This combination of models is good work. However, this paper lacked the validation of longitudinal flow by comparing field data despite the authors working for field observation about longitudinal flow in previous study. As far as reading this paper, only the number of longitudinal flow paths was validated for three field sites. The comparison of existence

of longitudinal flow path is of validation of capillary or hydraulic barrier formation, but not longitudinal flow itself. Since simulated slope flow characteristics (e.g. distance of movement by longitudinal flow) are not authorized by real data, one of the results of this paper, the ratio 250:1 is questionable. Before accepting this paper, validation by quantitative comparison between simulation and field data in terms of longitudinal flow is necessary. Even if the simulation results don't match with the measured result well enough, discussion of the causes of the discrepancies and improvement that will be needed in the future will be useful information for the paper of slope flow with this scale.

Minor comments

P3 L75-82 Please clear what scheme did the author use for the water transport in the SNOWPACK (bucket, Richards equation or dual domain approach). According to Fig. 2a, I guess the bulk scheme was used. In this study, the water infiltration may be estimated by iTOUGH2 part and received little effect by water infiltration scheme of SNOWPACK. But even if so, the type of scheme should be written.

P4 L91-92 The resolution of elements differs 50 times between parallel and perpendicular to the slope. Does it lead any problem for correct simulation due to this large resolution difference?

P4 106-116 This paragraph describes that authors performed the snow pit observation of tracer experiment, measuring water content distribution. These data should be used for quantitative validation especially the distance of the water movement for longitudinal direction. Comparison with these observations enhances the value of simulation result.

P5 L131-135 Snow profile data should be shown in Fig. 3 especially grain size and snow density. These parameters relate the formation of capillary or hydraulic barriers which lead to longitudinal flow.

P5 148-155 The number of longitudinal flows were used for the validation of this model. Although, accuracy of longitudinal flow path means that capillary or hydraulic barrier

was reproduced correctly, it did not mean the slope flow characteristics was reproduced well. Also, authors should show figures of result of field experiments, not only reference.

P6 173-175, P7 L193-195 In my opinion, neglecting heterogeneity affects the ratio of water flow direction (parallel or perpendicular to slope) rather than the number of longitudinal flows. Heterogeneity sometimes leads the movement to a difficult direction, which leads to decreased the ratio of water flow direction. So the ratio (250:1) has the possibility to be overestimated of the ratio due to neglecting heterogeneity. Furthermore, it was not endorsed by field observation.

P7 L197-199, 205-206 Authors have several field data. But they were only used for mention for consistency of the trend. Can the author make quantitative comparison between field data and simulation?

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