

## ***Interactive comment on “Hydrologic Flowpath Development Varies by Aspect during Spring Snowmelt in Complex Subalpine Terrain” by Ryan W. Webb et al.***

**Anonymous Referee #1**

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In this paper, authors measured temporal changes of soil water content and snow water equivalent to estimate the influences of surrounding topography. This study is important to estimate lateral flow in the snowpack and at the snow soil interface. It is expected that this study estimate the amount of lateral flow under the provided topography, snow and meteorological conditions. In my opinion, analysis and discussion in this paper remains qualitative discussion without quantitative estimation. Perhaps, quantitative analysis is performed in another paper referred in the manuscript as Webb et al. (in review). If so, division of the paper reduces the impact of this paper. Even so, quantitative analyses from the observation results are necessary. For example, if the ratio of water for lateral flow and infiltration into the soil is added in Fig. 6 based on the result of

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observation, this paper can provide scientific valuable information. In this paper, lateral flow is considered to be main cause of the increase of SWE at the toe. However, I think the authority of this consideration is not sufficient. If there are other evidence of large lateral flow (e.g. water saturated layer observed by snow pit observation), it should be shown.

minor comments

In introduction, one of the objectives is to investigate if preferential flowpath in snow can be observed in P3 L24. So observation of preferential flow should be described in detail in the body text.

P4 L25 According to this sentence, authors measured snow pit. Did authors measure not only SWE but also profiles of snow density and grain size? Depending on grain size and density profile, capillary barriers formed at the boundary of snow layers and provides lateral flow in the snowpack. Ice layers also provide lateral flow. If snow profiles are measured, observed result should be shown and used in the discussion of the lateral flow. Also, measuring method of SWE should be described. In this manuscript, lateral flow at snow-soil interface is considered main cause of the increase in SWE. So I guess the snowpack at the toe includes large water saturated layer. But water saturated layer make accurate SWE measurement more difficult. Therefore, more detailed description for observation is necessary.

P7L6 Ice veins were not observed in 2015. Is there a significant difference between 2014 and 2015? Comparison between 2014 and 2015 may suggest the influence of ice vein for lateral flow.

P8 L33-36 The last, “where observations of ice veins were made at the SSI.”. Do authors think that the cause of lower water content at 20 cm depth in north facing slope is the existence of ice vein? But ice veins were not observed in 2015 according to P7 L6. I think that the slope affects water content. Lateral flow in soil prevents deep infiltration and leads to small water content at the depth area in north aspect slope.

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P9 L14 Is Fig 4 a reference mistake of Fig 3? In the body text, Fig. 4 is sometimes referred in unnatural context (e.g. P10L3).

P9 L20-22 Is this discussion for only in 2014 or both in 2014 and 2015?

P9 L25 Fig. 4 is just a photo of ice vein. Do authors mean that this ice vein produces lateral flow? If so, it should be written in the caption of Fig. 4.

P9 L28-31 As this sentence show, increasing snow depth with SWE means less certainty of lateral flow. So figures of snow depth and discussion with snow depth are necessary. Also, if the snow profile was observed by pit observation, details of snow density profile should be shown.

P9 L32-34 Is this less stratified snowpack due to strong radiation in south facing slope confirmed by pit observation?

P9 L34-35 In author's opinion, which is the main reason of large lateral flow in north facing slope, ice vein, stratified snowpack or small hydraulic conductivity of soil?

P10 L20 Increase of 250 mm in SWE is too large to consider caused by lateral flow. Change in snow depth should be also shown to discuss.

P10 L32 Did the author observed preferential flow visually? In this paper, preferential flow formed in early snowmelt season on north facing slope and south facing slope displayed matrix flow in this time. However, preferential flow may form on south facing slope in earlier period before this observation. Snowmelt starts earlier on south facing slope than on north facing slope.

P11 L1-7 In this paragraph, cause of increase in SWE is considered lateral flow. But the authority of this seems insufficient. Especially, increase of 250 mm in 2014 is too large even if the effect of rising water table is considered. I wonder this discussion is based on the confirmation by snow pit observing large water ponding layer. Therefore, discussion about the reason why the cause of SWE increase is lateral flow is necessary. Description of "Wind is not likely causing increased deposition on any particular

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part of a hillslope since winds run perpendicular to slopes." is not sufficient to determine lateral flow as cause. Explanation of confirmed fact by observation and authority of the cause are necessary.

P11 L12 Is Fig.4 reference mistake of Fig. 3?

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