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Interactive comment on "Modeling liquid water transport in snow under rain-on-snow conditions – considering preferential flow" *by* Sebastian Würzer et al.

Anonymous Referee #2

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Implementation of preferential flow process into one-dimensional model is challenging and important research. Accuracy of hydrological process will be enhanced by this improvement. Concepts and mechanisms of dual domain approach are described in more detail in the companion paper, Wever et al. (2016). Therefore, the main focus of this paper is the validation of the preferential flow model in terms of accuracy of runoff simulation. In this paper, authors performed the comparison with field data and showed the enhancement of accuracy in runoff by implementation of dual domain approach. The product of this study is appropriate to publish for HESS. On the other hand, although many contents of this paper described the success of this improvement, detailed analysis of the improved results are not sufficient. For example, information

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[Discussion paper]

of snowpack was not shown and not considered in the discussion despite it affects significantly of the relationship between water supply and runoff. Information of snow stratigraphy helps to understand when and why PF model obtained better accuracy than RE model. In this study, authors used the SNOWPACK model. Therefore, it is not difficult to add the snowpack information. If there are observed data by snow pit observation, showing observed data is desirable. As well as showing snow stratigraphy, quantitative estimation of snowmelt amount is also necessary to discuss runoff as a response of the liquid water input. It can also be estimated from the output of the SNOWPACK model.

Minor comments

P5 L18: This sentence describes Equation (1) is determined by Katsushima et al. (2013) and field observation data. Can you add the data used here (field observation data) in this paper? If it is already shown in previous paper, it should be referenced.

Fig 1 Please indicate the position of the sections of Fig. 1 (b) and (c) in the Fig. 1 (a)

P8 L16 Snowmelt amount should be considered in the analysis. It can be estimated from output data of the SNOWPACK.

Fig 3-5 Information of snow stratigraphy had better be added in these figures because it affects the relationship between input water supply and runoff. Although snow depth, averaged snow temperature and water content are shown in Table 2, it is not sufficient because water infiltration process is affected by more complicated snow conditions such as existence of ice layer, grain size contrast and ratio of wet snow to dry snow.

p9 L10-12 I guess that the reason of grater variability of snowpack runoff in highest located site is the existence of lateral flow due to ice layer or capillary barrier. In snowpack observation, are ice layer or capillary barrier existed?

P10 L20 This sentence indicated that snowmelt affected runoff significantly. Therefore, snowmelt amount should be estimated. Analysis considering snowmelt amount will

make better discussion.

P11 L4 RMSE(d,e) -> RMSE (b,e)

P11 L10 R2 value in WFJ was improved by PF model more significant than that in CDP. This result implies preferential flow predominated more in WFJ. Does the ratio of dry snow in WFJ was larger than that in CDP?

P12 In the discussion section, success of PF model was discussed mainly. However, discussions about shortcomings of the model and suggestion of required improvement are also important for future research.

P14L1 This sentence indicated that snow densities were spread from below 200kg m-3 up to 500 kg m-3 in CDP. But the accuracy of hydrological parameters (e.g. suction and hydraulic conductivity) of low-density snow in numerical snowpack model are insufficient because measurement of them is difficult. They are estimated using equations formulated based on the measured results using high-density snow. For this reason, inadequate accuracy is anticipated when low-density snow comprises a portion of snowpack. Can you add the discussion about the accuracy of runoff simulation in the case of snowpack with low-density snow? It may provide the information whether hydrological parameters of low-density snow should be measured in some way or is not important for runoff estimation.

P14 L30 Do you have any suggestion to improve the model? The companion paper, Wever et al., suggested some ideas to enhance the accuracy of ice layer formation. Suggestion to enhance the accuracy of runoff is welcome in this paper. Discussions considering snow stratigraphy help to provide idea for further improvement.

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