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Interactive comment on "A new probability density function for spatial distribution of soil water storage capacity leads to SCS curve number method" *by* Dingbao Wang

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Dear Reviewer: Thank you. My responses to your comments are listed below.

1. Inconsistent numbers ('one' in line 11, but '1' in line 351; similarly for other numbers such as 'zero'.

Thanks. I will correct them for consistency.

2. The motivation of this research is not strong, i.e., why the new distribution function is needed? Or what is the consequences of the mismatch of SCS-CN method and VIC type of model's boundary conditions. All those questions are not addressed in the

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introduction part. This is very important, since it can justify the value of this manuscript.

The motivation of this research is to unify the SCS-CN method and saturation excess runoff models (such as VIC). When the proposed distribution is used for representing the spatial distribution of soil water storage capacity, the SCS-CN method is obtained. Therefore, the purpose for proposing the new distribution function is to show that SCS-CN method can be derived as a saturation excess runoff. The purpose for discussing the mismatch of SCS-CN method and VIC type of model's boundary conditions is to show the difference of these two models. This mismatch needs to be resolved for unifying SCS-CN and VIC type of model. The motivation of this research will be clarified in the introduction section.

3. With the proposed distribution, when storage index approaches infinity, soil wetting ratio approaches a certain value ($\leq$1) depending on the initial storage. Will this be satisfied in application?

For a given initial storage, a certain percentage of catchment area is saturated at the beginning of rainfall event. When rainfall occurs, the saturated areas (e.g., wetlands) response quickly and runoff response to rainfall is almost instantaneous (Gao et al., 2018). Therefore soil wetting ratio approaches a certain value ($\leq$1) depending on the initial storage when storage index approaches infinity. Particularly, soil wetting ratio approaches to a lower value for higher initial storage (i.e., higher initial saturated area).

4. The assumption used in deriving the probability density distribution is that the spatial distribution of precipitation is assumed to be uniform. This might need further explanation or justification.

Both SCS-CN method and VIC-type of model are lumped (or semi-distributed) models. The runoff calculation is based on the scale of sub-catchment or grid cell. If the spatial distribution of rainfall is not uniform, the average rainfall depth within the modelling sub-catchment or grid cell is used. This will be clarified in the revised manuscript.

References: Gao, H., C. Birkel, M. Hrachowitz, D. Tetzlaff, C. Soulsby, and H. H. G. Savenije (2018). A simple topography driven and calibration-free runoff generation module, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-141

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