

## ***Interactive comment on “A stochastic approach for the description of the water balance dynamics in a river basin” by S. Manfreda and M. Fiorentino***

### **Anonymous Referee #3**

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Title: A stochastic approach for the description of the water balance dynamics in a river basin  
Authors: S. Manfreda and M. Fiorentino

General Comments: This paper mainly discusses the influence of the spatial heterogeneity of the soil moisture on the runoff production. A simple soil water balance equation and the parabolic curve for the distribution of the water storage capacity in Xinjiang model are employed to derive the distribution of the saturated portion and the relative saturation of a basin. It is interesting to use the parabolic curve of the water storage capacity to describe the spatial distribution of the soil moisture. This curve is widely used in humid region in China and is easy to derive the PDF. However, there are some unclear points in the paper, which are described as below.

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1) Page 725, paragraph 2-4: The previous work are mainly focused on the dynamics of soil moisture at point scale, or considering the space-time variability but neglecting the heterogeneity in some characteristics of the land surface e.g. topography, soil, and so on. The present paper tried to discuss the soil moisture evolution at the basin scale. Two lumped parameters are used to describe the variation of the water storage capacity across the basin to investigate the influence of the spatial heterogeneity of in soil dynamics. It obtains the probability distribution of the relative saturation or the portions of saturation areas, but not the spatial distribution. And the rainfall over the basin is also assumed to be spatially uniform distribution. Therefore, what is the major difference from the previous studies? And what is the major contribution in the present research?

2) Page 728, line 8-12: The author should give some explanations on using the parabolic curve form indicated by equation (2). Is there any physical meaning? Or is it only a mathematical consideration? This can give more support to the conclusion of the physical meaning of the two parameters ( $w$  &  $b$ ). The author refers the research work by Chen et al (2005). What is the relationship between the wetness index ( $W1$ ) used in Chen et al's work and storage capacity ( $W$ ) used in equation (2)? The connection in between the two researches should be further explained for understanding the physical meaning of Equation (2).

3) Page 732, line 9: There is a problem in equation (15). According to the equation (11), the 'Y' should be referred to the infiltration 'I'. The 'Y' is used to indicate the total rainfall depth. If the author uses the precipitation Y instead of the infiltration I in the water balance equation, the runoff from the direct precipitation over saturated areas is neglected. This may cause large errors in humid areas. The author should demonstrate clearly the relationship between the rainfall and infiltration.

4) In Page 731, line 19-23, the author indicates that the subsurface flow and saturated overland flow are considered in the present scheme. It is not clear in the soil water balance equation (11).

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5) Page 735, line 11-12: “The simulation has also been used for comparing with theoretical distributions obtaining a very good agreement (See Fig. 5).” This is not strange to observe a good agreement of the PDF of  $a$  &  $s$  between the numerical simulation and theoretical distribution given in equation (22) and (25) since they all derived from the soil water balance equation. The author tries to use the simulation results for validating the PDF derived from the model. If the author can compare with the simulation of the spatial distribution of  $a$  &  $s$  from a physically-based distributed model, it would provide better validation.

6) Page 737, line 1-2: “Identify the role of climatic and physical features of the dynamics of the river basin in a humid environment.” Actually, the paper focused on the influence of  $w$  &  $b$  on the soil saturation. The influence of climatic features of the river basin on the soil water dynamics is not fully discussed. In section 4 ‘results and discussion’, all the climatic conditions, mainly the distribution of rainfall, are all fixed.

7) Page 737, line 1-3: “All the adopted parameters are physically meaningful.” The parameter in Xinanjiang model,  $w$  &  $b$  (especially for  $b$ ) are used for characterizing the variation of the water storage capacity in a lumped model and is not much physically meaningful. The  $w$  &  $b$  of the basin are usually empirically calibrated by the hydrograph. They are actually semi-empirical parameters.

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