Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-386-AC2, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Effect of restoration vegetation on the stochasticity of soil erosion in a semi-arid environment" *by* Ji Zhou et al.

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Received and published: 28 November 2016

Dear Prof. Puigdefábregas:

We very thank for your suggestion to our manuscript. Your comments and suggestion give us great inspiration and help to improve the quality of this paper greatly.

We also appreciate and admire the accomplishments you and your colleagues have achieved in the soil erosion science, and specially, the vegetation-driven spatial heterogeneity (VDSH) theory proposed by you in 2005, give us deep impression for studying the relationship between soil erosion and vegetation patterns. Because we believe this theory provides a new perspective for exploring the role of vegetation acting on the erosion processes in water-limited environment. Moreover, some of your other studies conducting in Spain also enlighten our study focusing on the soil erosion in the Loess

Plateau. It is a great honor for us to get your guidance and suggestion for our erosion study.

We have carefully read all the comments and suggestions, and also have gathered together to discussed some of suggestions very carefully. According to your and another anonymous referee suggestions, we will rewrite and restructure the original manuscript. At first, we make some brief responses by point to point to your suggestion and comments as follows:

Comment 1: Their measure of stochasticity is a measure of probability of extreme values or of the classes of frequency values, and ignore memory of the system, which lacking characterizes true stochasticity.

Response 1: In the original manuscript, the probability of soil erosion was measured by the frequency values of runoff and sediment events generating over five rainy seasons depending on the observational data.

The frequency value could be regarded as some of properties of erosion stochasticity, because all the erosion events were triggered by stochastic rainfall events, and to some extent, the generation of soil erosion could be regarded as a result of how the random signals of rainfall to be transmitted into the soil system and finally generate erosion events.

Prof. Puigdefábregas mentioned the ignorance of memory of the system in this paper, which gave us a very important suggestion to improve our original manuscript.

According to our field observation, we believed that, besides the randomness of rainfall events, the properties of plants and soil could also be the main factors to impact on the probability of soil erosion, and further affect the memory of the system, therefore, we will modify the original manuscript from the following aspects: 1. Make clear clarification of the stochasticity of soil erosion in the revised manuscript. 2. Reclassify and redefined all the observed rainfall events types to highlight their roles playing on the

quantifying the probability of soil erosion in the revised manuscript. (more explanation is in supplementary) 3. Highlight the effects of the properties of plant and soil on the randomness of runoff and sediment events generating in different vegetation types.

Comment 2: The approach lacks explicit of any theory and totally relies on empirical ad hoc information from small plots. And the method is designed to be used in restorations, and as such it should deal with different vegetation, topographies and soil attributes. How to deal with this issue should be commented by the authors

Response 2: In the revised manuscript, we will introduce the logistic regression method to analyze the effect of vegetation and soil hydrological properties on the probability of soil erosion.

In the method section of revised manuscript, we will highlight that why the theory of binomial and Poisson distribution function could be used to describe the randomness of soil erosion, and what the difference is between binomial and Poisson distribution applied on the calculation of erosion stochasticity.

Actually, in this paper nearly all the empirical ad hoc information from small plots were quantified by the probability theories from Bayes theories to binomial-Poisson theories as well as to a series of point estimation theories.

In revised manuscript, we will hope to explore a method to systematically describe the probability of soil erosion by using Binomial-Poisson method, as well as to make attribution-analysis of randomness of erosion phenomenon by using Bayes and logistic regression method. Consequently, the combination of probability theories and model could form an integrated exploring framework to analyze the erosion randomness in different vegetation types.

Secondly, we admitted the limitation of the experiment design in the study. Just as Prof. Puigdefábregas' mention, the increasing of vegetation, topographies and soil attributes will increase the numbers of small plots as well as increase the cost of operation,

we will comment our experimental limitation in the discussion section of the revised manuscript.

According to Prof. Puigdefábregas' suggestion, in the next step of erosion stochasticity study, we will try to construct some bare plots in the study area to collected more random information of soil erosion to enrich the understanding of stochastic property of erosion in different land covers.

Comment 3: The parameter used in the transfer probability functions comes from the plots, where the application is performed. This seems incurring in circularity. The authors should clarify that in the interpretation of results.

Response 3: The circularity of argument could probably related to our unclear expression in paper. When we received this comment of Prof. Puigdefábregas, we came together and carefully discussed the meaning of application of binomial and Poisson distribution function in original manuscript, and finally concluded that:

1.The application of binomial and Poisson probability function could act as an important role on detailing the stochastic information of soil erosion in different restoration vegetation types under month scale, rather than on predicting randomness of soil erosion mentioned by THE original manuscript. Therefore in the revised manuscript, we will modified former expression.

2.The purpose of application binomial and Poisson probability function is to select more appropriate method to describe the stochastic property of erosion in detail. According to the point estimation depending on the maximum likelihood estimator and uniformly minimum variance unbiased estimator, Poisson probability function was found to be more appropriate for describing the probability of erosion generation in long-term monitoring period. Consequently, we re-establish the whole logical structure in revised manuscript as follows:

(1)Proposing hypothesis: Randomness of soil erosion is one of important properties

of erosion phenomenon, how to systematically describe the stochasticity of erosion depending on long-term field observations? And how the rainfall, vegetation and soil properties affects the stochasticity of erosion?

(2)Testing hypothesis: First, take the conditional probability to describe the probability of runoff and sediment events under rainy season scales; secondly, apply binomial and Poisson probability function to describe the randomness of soil erosion in detail on month scale, and compare the observed frequency distribution with probability distribution; Thirdly, analyze the effect of properties of rainfall, vegetation and soil saturated hydraulic conductivity on the random runoff and sediment events by using logistic regression models; finally propose that the multiple-probability models could be regarded as an integrated probabilistic assessment to analyze stochasticity of soil erosion.

(3)Discussing hypothesis: First, make the parameter estimation to compare the appropriative of application of binomial and Poisson probability distribution on stochascity description. Secondly, explain the role of vegetation and soil properties acting on affecting the probability of soil erosion in different restoration vegetation types. Thirdly, mention the meaning and application of the integrated probabilistic assessment on soil erosion study, and the limitation of the experiment design. Consequently, the adjusted logical structure in revised manuscript may be avoid the circularity in whole argument processes.

Comment 4: The author don not mention the spatial stochasticity of rainfall and of the land attributes. The references almost lack mentioning the efforts done since the eighties in the same direction by combining temporal and spatial stochasticity.

Response 4: Thanks for Prof. Puigdefábregas' suggestion. We will supplement the contribution and efforts of temporal and spatial stochasticity in introduction section of revised manuscript. As Prof. Puigdefábregas' mention, there exist spatial stochasticity of rainfall and of the land attributes, however, we mainly focused on the plot scale, and to same extent, assume precipitation and soil characteristics in plot scale are con-

tinuous. The properties of different soil saturated hydraulic conductivity in the three vegetation types could probably affect the stochasticity of soil erosion, which will be discussed by using logistic regression method in the revised manuscript.

Finally, we thank again for Prof. Puigdefábregas' great help and guidance for improving our study on soil erosion.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-386/hess-2016-386-AC2-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-386, 2016.