Hydrol. Earth Syst. Sci. Discuss., 9, C2374–C2380, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C2374/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Runoff formation from plot, field, to small catchment with shallow groundwater table and dense drainage system in agricultural North Huaihe River Plain, China" *by* S. Han et al.

S. Han et al.

hansj@iwhr.com

Received and published: 20 June 2012

The authors gratefully thank to the anonymous referee #3 for his critical comments on our manuscript which drives us to improve the manuscript greatly.

Major improvements have been made in the revised manuscript according to the Referee's comments.

1) Abstract, Page 4236, lines 12-14, this is very confusing.

It is revised as “The difference of rainfall and runoff amounts was regressed against the changes in water table, and significant linear relationship was found.”

2) Fig.1, adding a photo may help to understand this schematic diagram.

It is a helpful advice. But there is no appropriate photo at present. We plan to take photos this summer when a storm-runoff event is happening.

3) The information in Table 1 is important, but other statistics of the hourly data reflecting the distributions are as important as those. Maybe design a figure to show how those hourly rainfall and discharge data are distributed for each event. This information would be much helpful for other studies.

In Table 1, the information of total rainfall, rainfall duration, and maximum intensity is listed, and average intensity can be calculated according to the total rainfall and duration. In our manuscript, only the influences of total rainfall on runoff response were analyzed. Rainfall exhibits temporal variation in intensity, the temporal distributions of rainfall may be important for runoff response. According to the comments, the possible influences of average and maximum rainfall intensity, as well as the distributions on runoff response were analyzed: 1) The relationship between runoff and rainfall duration, average and maximum intensity were weak; 2) We analyzed the statistics of hourly rainfall data of the thirty events. 16 of the thirty rainfall events obey the gamma distribution by using Kolmogorov-Smirnov test. But there was no obvious relationship between rainfall distribution and runoff response.

The antecedent wetness indicated by groundwater table depth and total rainfall were the two main characteristics control hydrological response in the study area. And there was no obvious relationship between rainfall intensity and runoff response. The conclusions can be detected from the typical events shown in Figure 2, where the distribution of the hourly rainfall and discharge data are shown. For the event began at DOY 180 with deep initial groundwater table (initial depth 2.38 m), the total rainfall of 115.2mm was characterized with maximum rainfall intensity (92.5mm/h) at the first

HESSD

9, C2374–C2380, 2012

hour. But small runoff was generated (12.8 mm at the catchment with runoff coefficient 0.11). Contrastively, for the next event with initial groundwater table depth 1.08m, the total rainfall of 129.9 mm was characterized with maximum intensity 73.7 mm/h at the eighth hour, and large runoff was generated (113.3 mm at the catchment with runoff coefficient 0.87). For the event began at DOY 198 with initial groundwater table depth 0.29 m, the total rainfall of 197.2 mm was characterized with maximum intensity 73.7 mm/h at the fifth hour, and runoff of 188.4 mm was generated at the catchment with runoff coefficient 0.96.

The reason would be that saturation excess flow dominated the surface runoff and subsurface flow played a great role in total streamflow. In previous studies, it is suggested that rain intensity was the major rainfall characteristic regulating runoff response when infiltration excess flow dominated, while total rainfall was the major characteristic regulating runoff response when saturation excess flow dominated (Martinez-Mena et al., 1998). In the next, we will study the influence of rainfall intensity distribution in detail.

4) Table 3, I am surprised that the relationship between P-R and initial depth and that between P-R and the change of depth are very similar. And the relationship does not show much difference among the three experiments. I wonder why.

The simple linear regression method was used to describe the relationships. As pointed out by the referee, the relationship between P-R and initial depth and that between P-R and the change of depth are all linear (at the catchment, y = 34.23x + 3.533, and y =54.925x + 8.094 (It is should be noted that it is a little different from Table 3 in the former manuscript as the data of certain event was reevaluated). The reason is that the change of water table depth is highly correlated with the initial water table. (y = 0.5892x - 0.0427, R2 = 0.9236). For the event with deep initial water table, the water table rose more obviously afterward. While for the event with shallow initial water table, the water table changed a little.

P-R reflects water stored in the catchment after the event. It is related to the initial water

HESSD

9, C2374–C2380, 2012

table (indicating available water storage) and the changes in water table (indicating changes in water storage). According to the relationship, P-R=f(gw), and R=P-f(gw) (gw: groundwater table). The slopes of the linear relationship of the three scales are similar, but the intercepts differs much. The reason may be that when the ground water table goes up or down, the water storages of the three scales changed similar values. But the differences of the water storages of the three scales may be constant. This can also be found in Figure 3 that the runoff at the three scales are linear correlated.

Nevertheless, only the monitoring well located near the center of the catchment was used. We are trying to apply a new project to do detailed spatial research with more TDR sensors and groundwater monitoring wells. Then, we can do a more detailed analysis.

Minor comments: 1) The title is too detailed. Experiment or observation is a key word, which is missing.

The title was revised as " Runoff formation from experimental plot, field, to small catchment in agricultural North Huaihe River Plain, China"

2) Page 4236, lines 2-3, at an experimental: : : a field: : : a small catchment: : :

It was revised in the manuscript according to the comment.

3) Page 4236, line 21, surface runoff

It was revised in the manuscript according to the comment.

4) Page 4236, line 24, catchments

It was revised in the manuscript according to the comment.

5) Page 4237, line 2, over past decades: : :

It was revised in the manuscript according to the comment.

6) Page 4237, lines 22-23, a distinction between the two mechanism in a quantitative

HESSD

9, C2374–C2380, 2012

way may help.

It was revised as “At the hillslope or field, the mechanisms whereby rainfall appears as runoff are infiltration-excess overland flow when rainfall exceeds the rate at which the unsaturated soil can absorb water (Horton, 1933), saturation-excess overland flow when the soil is saturated (Dunne and Black, 1970), and subsurface flow (Mosley, 1979;Hewlett and Hibbert, 1967)."

7) Page 4238, line 14, “runoff circulation networks”?

It was deleted and the sentence was revised as “. . .hydrological connectivity is influenced. . .”

8) Page 4238, line 19, distance between

According to the reference (Moussa et al., 2002), it was revised as “the average distance and slope between”

9) Page 4239, line 13, depend: : :

It was revised in the manuscript according to the comment.

10) Page 4238, lines 16-17, delete “(the : : : China)”

“(the : : : China)” was deleted in the manuscript

11) Page 4238, line 25, delete “in the study area”

“in the study area” was deleted in the manuscript

12) Page 4240, lines 5-7, 60-80% of the annual precipitation falls in summer: : :. Then delete “which: : : precipitation”

It was revised as “60-80% of the annual precipitation falls in summer from June to September”

13) Page 4240, line 13, divide the “site”? which site?

HESSD

9, C2374–C2380, 2012

"site" was replaced by "catchment"

14) Page 4242, line 18, "15-30 m". Unit is meter?

In the revised manuscript, it is revised as "15-30 cm"

15) Page 4245, lines 12-15, previous studies cannot confirm yours. Yours is consistent to theirs.

It was revised as "This finding was consistent with the previous studies using hydro-chemical traces (Tan et al., 2008). The hydrological mode based on the concept of saturation-excess surface runoff and considers the influences of groundwater table, performed well in this catchment (Wang et al., 2004)."

16) Page 4247, line 6, scattered. Line 21, found, Line 22, these imply

It was revised in the manuscript according to the comment.

17) Page 4248, line 6, total runoff? (runoff generally means for the surface)

"runoff" was replaced by "streamflow"

18) Fig.2, colour lines would be better. (HESS would not charge you more anyway)

Colour lines was used in the revised manuscript

20) Fig.3, figs.5-8, delete "Plots of"

"Plots of" were deleted in the revised manuscript.

21) Fig.7, "early growth". Define the early/late growth here. It is really hard to find in the text.

In the text, "early growth stage (before 22 July), and 7 events occurred at the later growth stage (from 2 August to 19 September)." We define the early/late growth stage in the figures captions.

22) Fig. 8, difference between the catchment and plot. It was revised in the manuscript

HESSD

9, C2374–C2380, 2012

according to the comment.

References Dunne, T., and Black, R. D.: An experimental investigation of runoff production in permeable soils, Water Resour Res, 6, 478-490, 1970. Hewlett, J. D., and Hibbert, A. R.: Factors affecting the response of small watersheds to precipitation in humid areas., Forest Hydrology. Proceedings of the International Symposium on Forest Hydrology„ 1967, 275-290, Horton, R. E.: The role of infiltration in the hydrologic cycle, Transactions, American Geophysical Union, 14, 446-460, 1933. Martinez-Mena, M., Albaladejo, J., and Castillo, V. M.: Factors influencing surface runo generation in a Mediterranean semi-arid environment: Chicamo watershed, SE Spain, Hydrol Process, 12, 741-754, 1998. Mosley, M. P.: Streamflow generation in a forested watershed, New Zealand, Water Resour Res, 15, 795-806, 1979. Moussa, R., Voltz, M., and Andrieux, P.: Effects of the spatial organization of agricultural management on the hydrological behaviour of a farmed catchment during flood events, Hydrol Process, 16, 393-412, 2002. Tan, Z., Lu, B., and Wang, J.: Hydrograph Separations Based on Isotopic-chemical Mixing Models, Advances in Water Resources and Hydraulic Engineering–Proceedings of 16th IAHR-APD Congress and 3rd Symposium of IAHR-ISHS, Nanjing, China, 2008, 231-235, Wang, F., Song, J., and Zhang, Q.: Wudaogou hydrologic model, Research Basins and Hydrological Planning Proceedings of the International Conference, Hefei/Anhui, China„ 2004, 355-359,

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 4235, 2012.