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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.**

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The authors gratefully thank to the anonymous referee #2 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. Nevertheless, I would suggest the authors provide deeper insight into the scaling

behavior of runoff generation in this area.

The original purpose of this study is about the scaling behavior of runoff generation. But the study was limited by current data. Only one plot and one filed were included in the comparisons of different scales. At the plot only surface runoff was collected and measured. Since subsurface flow played a great role in streamflow in this area, the result from the comparisons between the plot and the other scales would not be convinced on scaling behavior. The preliminary result on scale effect is that: runoff coefficient at the catchment was smaller than that at the field. So this manuscript focused on the runoff generation processes at first. In the next, we plan to get deeper insight into the scaling behavior with detailed observation and modeling.

2. The results show that the event runoff coefficients are highest at the medium scale, while lowest at the plot scale. This is not completely consistent with the previous studies which suggested the decreasing of runoff coefficient with area (e.g., Cerdan et al., 2004). The authors need to better articulate the underlying processes.

In the study area of our research, as stated in the manuscript, saturation-excess surface flow controlled the surface flow response, especially when water table is shallow, and subsurface flow took a great role in the total flow. For the plot, only surface runoff was collected and observed. Therefore the runoff at the plot would be smaller than the runoff at other scales included both surface and subsurface flow. Therefore, the comparison between the plot and the field or catchment can not be used to illustrate the scale effect.

Runoff coefficient at the catchment was smaller than that at the field. The comparison between the field and catchment can be used to study the scale behavior. It is consistent with previous studies (Cerdan et al., 2004). Nevertheless, for the studies of Cerdan et al. (2004), Hortonian overland flow is the dominant processes. The runoff coefficient is suggested to decrease with area (Stomph et al., 2002;Cerdan et al., 2004;Van de Giesen et al., 2010). In this study area dominated by saturation-excess surface flow



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and subsurface flow, the scale effect needs further study in the future.

3. Also, the authors need to provide more details on the runoff volume measurement, i.e., starting/ending of a rainfall event and subsequent runoff event. This will very often affect the relative contribution of subsurface runoff.

The rainfall in the catchment was measured by a rain gauge located west of the study area. After a rainfall event, the measurement of runoff was started when observable streamflow was found at the outlet of catchment, field and plot. The measurement was continued until there was no observable streamflow. The measurement was conducted according to observed changes of the flow. When obvious changes were observed, it was measured intensively. The smallest time interval was 20 minutes. The largest time interval was more than two hours.

The starting/ending of a rainfall event was determined when the runoff was not influenced by last event. The runoff events were divided when the measured streamflow was less than around 0.08m3/s at the outlet of the catchment, 0.003m3/s at the outlet of the field, and there was no flow at the outlet furrow of the plot.

4. In Figure 8, the runoff difference between plot and field is used to roughly estimate the subsurface runoff at the field scale, and the same for the small catchment scale. Could the authors directly separate the baseflow (here mainly due to subsurface runoff) from the observed hydrographs, and see if the same conclusions can be reached?

We separated the baseflow from the observed hydrographs using the traditional "constant slope" method (McCuen, 1989) for the field. The separated baseflow as well as the runoff differences of the field and plot vs average water table depth before and after the rainfall-runoff events are shown in the Figure 1. The runoff difference between plot and field can be used to roughly estimate the subsurface runoff at the field scale. The same conclusions can be reached that: when the initial water table is deep, significant linear relationships between the estimated subsurface flow and the average water table depth were found, and the subsurface flow decreased with the average water



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table depth. For the events with shallow initial water table all the time, the roughly estimated subsurface flow was between 10∼60 mm, and there is no significant correlation between the subsurface flow and average water table depth.

5. Moreover, the writing could be significantly improved. The examples include, but not limited to, the following:

The authors feel really sorry for the nonproficient English, the vague statements and some typing errors. The manuscript has been edited by an English speaker to correct the English problems.

1). P4236, Line 8-9. Have the surface and subsurface runoff been collected separately or together as total runoff? Rewording is needed here for clarification; otherwise one has to go to Section 2 to find out.

At the drainage ditches outlets of the field and the small catchment, the total runoff were collected.

2). Past and present tenses have been used in a mixed way. For example, P4236, Line 17-18.

Revised as "These imply that saturation-excess surface flow dominated the runoff response, especially when water table was shallow."

3). P4238, Line 19-20. What do "field" and "fields" mean here? Please use different words. "field", "slope" and "hillslope" (e.g. Figure 3) all have been used to denote the medium scale in this paper, which is somehow confusing. Please be consistent.

In this manuscript, the medium scale is referred as "field". It is approximately equal to "hillslope" in the references. We think that 'field' is preferred to 'hillslope', as hillslope implies this site was steeper than the others. Line 19-20 was revised as "the average distance and slope between fields and catchment outlet are modified by ditch networks (Moussa et al., 2002).", where "slope" means "gradient". In the revised manuscript, we modified the confusing terms.



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4). P4238, Line 25-27. This sentence does not read well. Please rephrase.

It was rewritten as “When the water table is low, the runoff produced at the field may re-infiltrate at the ditch networks, while the ditch network drains the groundwater when the water table is high (Moussa et al., 2002;Armstrong, 2000).”

Rerferences

Armstrong, A.: DITCH: a model to simulate field conditions in response to ditch levels managed for environmental aims, Agriculture, Ecosystems & Environment, 77, 179-192, 2000. Cerdan, O., Bissonnais, Y. L., Govers, G., Lecomte, V., and Oost, K. v.: Scale effect on runoff from experimental plots to catchments in agricultural areas in Normandy, J Hydrol, 299, 4-14, 2004. McCuen, R. H.: Hydrologie analysis and design, Prentice Hall, Hall. Englewood Cliffs, New Jersey, 1989. 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. Stomph, T. J., De Ridder, N., Steenhuis, T. S., and Van de Giesen, N. C.: Scale effects of Hortonian overland flow and rainfall runoff dynamics: Laboratory validation of a process based model, Earth Surf Proc Land, 27, 847-855, 2002. Van de Giesen, N., Stomph, T. J., Ajayi, A. E., and Bagayoko, F.: Scale effects in Hortonian surface runoff on agricultural slopes in West Africa: Field data and models, Agriculture, Ecosystems & Environment, 142, 95-101, 2010.

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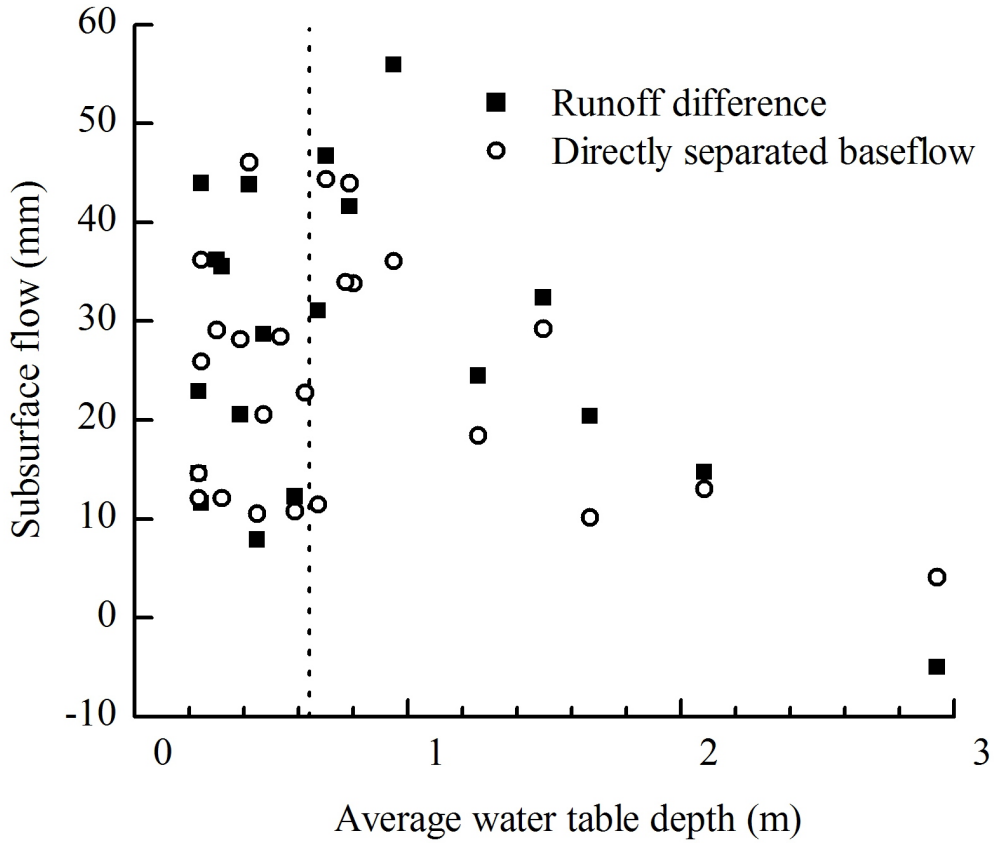


**Fig. 1.** Runoff difference between the field and plot, and directly separated baseflow vs average water table depth before and after the rainfall-runoff events



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