Hydrology and Earth System Sciences Discussions

Interactive comment on "Phreatic surface fluctuations within the tropical floodplain paddy field of the Yom River, Thailand" *by* S. Chuenchooklin et al.

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GENERAL COMMENTS

Rationale and Performance

1. The aim of this article was to explain the behaviors of groundwater level in unconfined aquifer within flat floodplain in tropical monsoon zone through field observation and presented by using simple water budget model in flooded case. The case study was focused to the Yom River's floodplain in Phichit Province, Thailand. Because of this area (most farmland is paddy field) is normally inundated by river overflowing during monsoon season in September to October. In contrast during the drought period, there is lack of surface water to be survived crops especially for paddy. The groundwater source is alternately taken by farmer to the farm area in case of no rain or surface

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water. The declining of groundwater table was obviously seen in most years. Over groundwater withdrawal through many tube wells during drought period especially in non-irrigated area which can be seen because it is lack of surface water in this area. From the existing soil log data, the site selection for this study was done due to its geomorphology was rather high infiltration which might effect to the raising of phreatic surface. Therefore, field measurement of infiltration points, and long period of observation of flood and phreatic surface through those relationships were carried out. The reason why the water table is raised up during flood or fallen down during drought was investigated in this area and presented them in this study. Recharge to the groundwater was also studied using simple water balance model. The assumption in this study was for the basis analysis of observed data of current in flood conditions during inundated period, estimation of groundwater consuming for paddy filed, and water table fluctuations according to such events during the study period in 2001 to 2003. Some parameters in the water balance budget model would be estimated using available weathering data such as evapotranspiration and mean aerial rainfall. Some parameters were measured and observed from the field such as points of infiltration testing during sometimes and continuously water table recorded. Surface flux by infiltration varied by the depth of ponding water seeps to subsoil, stores in the soil, and moving downward as subsurface flow would be considered as the recharge to groundwater. During flooded period, the assumption of groundwater would be recovered. If there is no flood, the continuously decreasing of groundwater level would be seen. Therefore, the simulation of recharge volume using water budget was done in such period. In other periods, there is not much volume of water to be recharged to the groundwater due to its poor soil conditions with low infiltration. Moreover, the final objective is to develop the conjunctive mathematical model that will explain the behaviors of subsurface flow accompanied by flooding in this area which will be presented in the near future. The recommendations for further improvement of regional water management would be discussed after the development of conjunctive surface and subsurface model was presented.

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In these comments, the introduction part and discussion part will be improved as the mentions above.

Water Balance Model

2. The main part of this study was to show how much the change of water table and flood condition particular in flooded area through the parameters in water budget model from surface boundary. But for unflooded case, mostly amount of groundwater is withdrawal for paddy field consuming during drought period. The amount of recharge to groundwater from the ground is less than flooded case due to its lower head resulting lower infiltration. Therefore, the continuously decreasing of water table during dry season was obviously seen, according to the observed data.

The deeply explanation of the model will be rewritten in the revision manuscript as the mentions above.

3. In this study, each of polygons used only averaged value of each physical parameter. Those were the altitude of ground surface, flood level or flooded depth, and infiltration or percolation rate. If there is flooded in some part of a polygon's area or unflooded in the left area, the averaged flood depth using weighted by gross area of such polygon will be applied in this case. An example of 50% area in a polygon with flooded of 1.00 m; the averaged flood depth of 0.50 m would be estimated. The procedures of using Thiessen polygons were presented by Ichikawa (Ichikawa et al. 2004, and Mekpruksawong et al., 2004).

In this part, it will be rewritten as the mentions above.

4. The lateral fluxes of groundwater flow were also included in the model during the computation processes based on Darcy flow (Ichikawa et al. 2004, and Mekpruksawong et al., 2004). The slope of phreatic surface level between 2 observation wells was known from the daily observation of groundwater change over the length between them through the flow area between those 2 blocks divided by Thiessen polygons.

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However, the slope of the groundwater flow in this area was very flat; the result of computing lateral flow was less than the vertical recharge which could be negligibility.

5. In this study, the observation data of daily rainfall, water level change in the river, flooded depth, and water table were carried out. The amount of stream flow as inflow and outflow from surface boundaries were estimated by using the synthesized as inflow hydrograph and existing observation through structure calibrations as outflow, respectively. Lateral inflow and outflow of groundwater flow could be estimated from the difference between the observations of water table and flow area in the considered polygons. It was small amount compared to other parameters in flat basin which could be neglected. The remaining one would be the amount of recharge to phreatic surface which came from surface flux resulted by infiltration and percolation. For the valid of this model, the observation and calculation of some parameters were fit using linear regression analysis.

The revision manuscript in this part will be improved as the mentions above.

6. The method of the analysis for the most relevant parameters was used the least square method on linear regression analysis. The revision manuscript in this part will be improved as the mentions above.

Infiltration Experiments

7. During the measurement if it was using single-ring infiltrometer, the lateral flow would be gone out from the tank and seem to be overestimation. But double-ring infiltrometer was equipped in the field testing in order to get rid of such the overestimation from the side leakage. Moreover, the soil condition in the tank of the equipment was saturated by ponding water, the flow rate of water through soil that can be considered as the seepage discharge which related by the head of water. Therefore Ac [mm/d/m] was represented as the rate of infiltration or percolation [mm/d] over the ponding depth of head of water above ground [m]. It could be used for resolving the problem overestimation of flux. Moreover, the testing of the percolation in larger area as ponding basins

in paddy field was applied and compared to the testing by infiltrometer. The results from both testing in paddy field were closely compared to 1-3 mm/d. Unfortunately, this basin method for testing of percolation in bare land with looser soil could not be done due to lack of water. Infiltrometer was used to apply in this case. Some higher spots of the results were shown because those were tested in the location of sandy-loam soil or sandy-silt soil layer on the ground.

The lateral fluxes of groundwater flow were also included during the computation processes. Darcy flow was used to compute lateral groundwater flow. The slope of phreatic surface level between 2 observation wells was known from the daily observation of groundwater change over the length between them through the flow area between those 2 blocks divided by Thiessen polygons. The soil surface conditions during flooded period will be saturated as same as pond's bottom.

The revision manuscript in this part will be rewritten.

Instantaneous Unit Hydrograph

8. Snyder synthetic hydrograph using basin lag based on existing topographic characteristics (referred to page 212-213 in "Hydrology for Engineer" international edition written by Linsley et al., 1988) is generally used in most catchments in Thailand with flat basin too. It was used to synthesize the shape of hydrograph with 1 cm of excess rainfall and used to compute surface runoff and stream flow at upstream catchments entering the considered boundary of study area through the stream flow routing method. The revision manuscript in the reference part will be given.

Language

9. The manuscript will be revised by the native speaker.

Figures

10. Those fonts will be revised in the revision manuscript.

Final Remarks

11. Thank you very much for your kind valuable suggestion and comments. The revision manuscript will be rewritten as your comments.

SPECIFIC COMMENTS to issues in order of occurrence in the text:

"Material and methods: topographical map and conceptual model":

1. The conceptual model was using water balance technique applied to both larger area in Fig. 6 and each polygon divided in this area in Fig. 5. The revision manuscript in this part will be improved.

2. Those were collected from existing data included the location of each bench mark elevation point (in UTM-grid) and altitude values. Some ground elevation and coordination data nearby the study area were gathered from the drawing maps such as dike along the Yom River gathering from the Royal Irrigation Department (RID). Moreover, the existing data during construction period of the observation wells and bore wells with real surveying was used to present the contour lines. Those data were based on the same datum above mean sea level (MSL) with precise enough for flat land.

The specification in this part will be added in the revision manuscript.

"Material and methods: Model description and existing parameters":

3. That case, infiltration was the loss of surface water to the ground as the abstraction from the system's boundary.

The revision manuscript in this part will be corrected.

4. That case, Pe was the rainwater which would be utilized by paddy field according to crop water requirement estimation method based on FAO's irrigation and drainage paper volume 24 (Doorenbos et al., 1977). The remaining water would be not used by paddy field but flood or outflow from the system boundary. The revision manuscript of Pe and the meaning in such equation will be changed to excess rainfall or direct runoff

according to the hydrological part not crop water as your mentions above.

5. Actual and potential infiltrations were different. Actual infiltration was measured from the field experiment. However, the potential infiltration was resulted by the relationship between ponding depth and time (graph). The specification in this part will be added in the revision manuscript.

6. K is the minimum value resulted by relationship between ponding depth and time after long time of infiltration experiments in the graph (Chow et al., 1988).

The deeply explanation in this part will be added in the revision manuscript.

7. Qp was assumed to be amount of crop water requirement in unflooded area which considered as evapotranspiration (Et), crop coefficients (Kc), and effective rainfall for plants (Pe) [Qp = (Et*Kc/-Pe)]. The leakage between river and groundwater thorough the river bed was already considered according to Darcy flow (Ichikawa et al. 2004).

The deeply explanation in this part will be added in the revision manuscript.

8. The Delta S could be zero or negative values in non-flooded area within cultivated area which could be taken into account as the amount of groundwater withdrawal.

The explanation in this part will be added in the revision manuscript.

9. The model considered the delaying time resulted by data.

The explanation in this part will be added in the revision manuscript.

10. Unfortunately due to lack of budget and period of study, we used secondary data of daily rainfall from existing rain-gauges outside boundary of the study area belonged to the meteorological department. The errors were belonged to the recorded data depending on the type of recorded equipments with mostly simple rain-gauges not automatically ones. However, an existing precise set of automatically rainfall recorded with 5 minute of interval was installed at the middle part of study area which was used to study the pattern, intensity, and other rainfall analysis represented in this area.

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The deeply explanation in this part will be added in the revision manuscript.

11. The application of Snyder synthetic hydrograph with basin lag based on existing topographic characteristics (referred to page 212-213 in "Hydrology for Engineer" international edition written by Linsley et al., 1988) was used to synthesize the shape of hydrograph with 1 cm of excess rainfall and used to compute surface runoff and stream flow at upstream catchments entering the considered boundary of study area through the stream flow routing method. The revision manuscript in the reference part will be given.

12. The surface runoff was involved in amount of rainfall, infiltration, and evapotranspiration. However, in the cultivation catchments with variety of crop water requirements depending on what kind of crops to be grown, crop area: Ag, cropping period or calendar: T, crop stages and crop coefficients in each crop stages. Therefore, the volume or amount of crop water requirements: Vc could be estimated using those data included weather data, infiltration, applied water depth, and runoff. The water requirement during land preparation phase for paddy field prior crop starting was included in this study. In case of a flood, no any plant will be grown. Only surface flux based on ponding depth will be considered.

The definition of Vc in this box in Fig.7 will be corrected in the revision manuscript.

13. The main objective of this paper presented the data of phreatic surface levels changed by the surface water levels and some analysis. The second paper will be explained more using mathematical model as the focus for studying the recharge over the effective porosity.

The definition in Fig. 7 will be corrected and the amount of recharge in this part will be shown in the revision manuscript.

"Results and discussions":

14. The names of those lines were resulted by the relationship between stages and

time using linear regression analysis.

The revision manuscript in this part will be corrected.

15. Those numbers were averaged values. All numbers will be changed to 2-3 decimals such as 3 decimals for area (A) and unit change to km2, 3 decimals for elevation, and 2 decimals for the remaining values.

The revision manuscript in this part will be rewritten.

16. Because the result of field testing on previous presentation in reference paper was presented as the percolation [mm/d] which was considered as constant rate at each point (neglect ponding depth). Referring the Darcy flow in saturated condition, the flow rate of water through soil that can be considered as the seepage discharge which related by the head of water. In this paper, however, Ac [mm/d/m] was the rate of infiltration or percolation [mm/d] over the ponding depth of head of water above ground [m]. Some differences in the peak of Ac and percolation in both Figures were resulted by those reasons. Moreover, Ac's Figure was followed by topographical contours; it was higher rate in higher land with the typically higher soil permeability rate. The higher spots were represented as the location of sandy-loam soil or rather sandy silt soil layer on the ground, according to the field surveyed. The deeply explanation in this part will be shown in the revision manuscript.

17. No, Y17 (RID's gauging station) was located at the upstream most of the study area. Only Wangjik, Phopratabchang (Dlog), and Phaitapho were situated in the inner zone of study area (in Fig. 2).

The deeply explanation in this part will be given in the revision manuscript.

18. It can be calculated using existing data of daily river stage, and flood level over the study area (and refer to the existing constructed topographical contours in Fig. 2, and its characteristic chart in Fig. 12). Moreover, the flow passing via cross structures such as road culverts and bridges were measured using flow velocity equipment (current

meter) in sometimes and presented as the relationship as the structure calibration curve for each structure. Therefore, the amount of runoff volume can be estimated. The deeply explanation in this part will be given in the revision manuscript.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 731, 2005.

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