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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Comparison of performance of tile drainage routines in SWAT 2009 and 2012 in an extensively tile-drained watershed in the Midwest" *by* Tian Guo et al.

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Interactive comment on "Comparison of performance of tile drainage routines in SWAT 2009 and 2012 in an extensively tile-drained watershed in the Midwest" by Tian Guo et al.

Received and published: 19 February 2017 Interactive comments # 1ïijŽ Based on this review, the following comments are made: 1) From the reader's point of view, the current version of the manuscript does not have a scientific merit. This manuscript is yet another research work from SWAT community on calibration, validation, and application of SWAT. The following questions are raised: a) Does this manuscript develop/devise a new methodology? b) Does this manuscript develop/devise a new tool?

c) Does this manuscript develop/propose a new theory? R: We thank Dr. Mylevaganam for the detailed and valuable suggestions to our manuscript. We agree that the scientific merit of our manuscript needs to be well described. However, we do not agree that the manuscript does not have scientific metric. The SWAT calibration, validation and application research has scientific metric. We have discussed the importance in the Introduction section, "Subsurface tile drainage systems could move out of the soil surface and convey soluble nitrate-N from the crop root zone. Nitrate coming from tile drains has been considered the main source of nitrate in rivers and streams in the Midwestern US. Additionally, 89 % - 95 % of nitrate losses in a ditch catchment were transported by the tile drainage system of the catchment." (page 2 line 24-27). Moreover, the research results in this manuscript could provide guidance for selection of tile drainage routines and related parameter sets for tile drainage simulation at both field and watershed scales. For example, well calibrated routines and related parameter sets in this study have been used for modeling of the impacts of bioenergy crop scenarios on streamflow, tile flow, sediment and nitrate losses in the LVR watershed from 1990 to 2008 (Guo et al., 2017, unpublished). Thus, this study is innovative and important.

Interactive comments # 1ïijŽ 2) From the reader's point of view, it is hard to understand the motivation of this paper. As per the current version of the paper, referring to line number 27 on page number 18, in this study the old tile drainage routine in SWAT2009 (Rev.528) and the new tile drainage routine in SWAT2012 (Rev.615 and Rev.645) were used in the simulations to evaluate the performance of both tile drainage routines. The following questions are raised: a) Did the developers of SWAT released a revision (645 or 615) without evaluating the model outcome? b) Did the developers of SWAT released a revision (645 or 615) with an anticipation of getting poor model outcome? c) Why did the developers include new routines (Rev.615 and Rev.645)? R: Rev. 615 has been extensively tested in previous studies and provided satisfactory outcomes. However, curve number needs to be reduced tremendously to obtain acceptable flow results in mildly-sloped areas. This is the first manuscript to test Rev. 645. We did not

expect poor model outcomes from revision 645, which provided satisfactory surface runoff, and sediment and nitrate in surface runoff results at site Bs and Es. Rev.615 incorporates a new tile drainage routine (from DRAINMOD) to better represent physical process of tile drainage, and Rev.645 incorporates an improved curve number calculation method to improve surface runoff simulation in mildly sloped areas. That is why we included these two versions.

Interactive comments # 1ïijŽ 3) In the current version of the paper, the authors state that SWAT2012 revision 645, which "improved" the soil moisture based curve number calculation method, has not been fully "tested". Why did the developers improved the soil moisture based curve number calculation method? Was it to get poor model outcome? Did the developers improve the method without testing? R: The original soil moisture based curve number calculation method did not reasonably simulate surface runoff, unless curve number was reduced significantly for mildly sloped areas. This manuscript tested the modified curve number calculation method.

Interactive comments # 1ïijŽ 4) From the reader's point of view, the introduction of the manuscript needs to rewritten. In the current version of the manuscript, the introduction is built with many equations. From the reader's point of view, a section with all these equations need to be introduced after the introduction. This will help the authors to have an introduction to highlight the need of the research. R: We thank Dr. Mylevaganam for valuable suggestions to our manuscript. The introduction can be reorganized and focus on the importance of the research, and the equations can be mentioned after the introduction.

Interactive comments # 1ïijŽ 5) From the reader's point of view, some of the paragraphs in the introduction are not coherent. R: We kindly ask Dr. Mylevaganam which paragraphs are not coherent in the introduction. We can remove/condense them.

Interactive comments # 1ïijŽ 6) From the reader's point of view, the conclusions need to be re-written. Some of the words (e.g., site B, site E, and R5) in the current version of

the paper need to be deleted. The actual locations of the sites need to be mentioned in the conclusion. R: We thank Dr. Mylevaganam for the constructive suggestions about improving the structure of the manuscript. We will reorganize the results and discussion and remove the information of site number, to improve flow of the manuscript.

Interactive comments # 1ïijŽ 7) In the abstract, the authors claim that both the routines provided reasonable but unsatisfactory uncalibrated flow and nitrate loss results. The authors should clearly state the meaning of "reasonable but unsatisfactory". Moreover, the authors need to state the temporal scale of their statement. R: "Both routines provided reasonable but unsatisfactory uncalibrated flow and nitrate loss results." has been changed to "Both routines provided reasonable but unsatisfactory (NSE < 0.5) uncalibrated flow and nitrate loss results for a mildly-sloped watershed with low runoff."

Interactive comments # 1ïijŽ 8) In the abstract, the authors claim that the new routine provided acceptable simulated tile flow and nitrate in tile flow for both field sites with random pattern tile and constant tile spacing. However, in the current version of the paper, the reader is unable to find more detail about the random pattern. Moreover, it would be more meaningful if the authors relate these patterns to the adopted equations shown in equations (3-5). R: The selected sites incorporated both random pattern tile and constant tile spacing. However, random tile spacing is still represented as a constant tile spacing in the model currently. As we mentioned in the Limitation section, there is an opportunity to improve the representation of tile drainage systems in SWAT, especially for individual tiles. We believe that better representation of size and spatial information of tile drainage systems can improve simulation of tile drainage.

Interactive comments # 1ïijŽ 9) In the current version of the paper, it is understood that there exists a coefficient named "drainage coefficient" (DC in equation-5) in SWAT 2009 and SWAT 2012. The authors also state that a coefficient named "drainage coefficient "(DRAIN_CO) was included in the new tile drainage routine in SWAT2012. Does SWAT2012 in its tile drainage routine have two drainage coefficients? R: No, DC and DRAIN_CO are the same. We have improved the description to be consistent.

Interactive comments # 1ïijŽ 10) The authors need to clearly state the difference between SWAT2012 Rev.615 and SWAT2012 Rev.645. R: Compared to SWAT2012 Rev.615, SWAT2012 Rev.645 incorporated a new retention parameter adjustment factor (R2ADJ) to modify the soil moisture retention parameter calculation method. R2ADJ was used to modify shape coefficients, and curve number was calculated from capacity to saturation. This method is more reasonable than decreasing curve number directly (page 6, line 29).

Interactive comments # 1ïijŽ 11) As per the current version of the paper, a coefficient named drainage coefficient (DRAIN_CO) was included in the new tile drainage routine in SWAT2012 to "control "peak drain flow. However, in the current version of the paper, the old tile drainage routine in SWAT2009 (Rev.528) and the new tile drainage routine in SWAT2012 (Rev.615 and Rev.645) were used to simulate monthly tile flow, nitrate in tile flow, surface runoff, and sediment and nitrate in surface runoff at field sites, and monthly flow, sediment and nitrate in flow at a river station. Therefore, it is unclear about the motivation of this research work. Moreover, it would be meaningful if the authors show the equation that uses DRAIN_CO. R: The old routine in Rev.528 has the potential to overestimate tile flow peaks, since simulated tile flow by the old routine was controlled by a simple drawdown time parameter (TDRIAN), and tiles were allowed to carry an unlimited maximum of water. Thus, Rev.528 has the potential to overestimate tile flow peaks and nitrate in tile flow at site E. On the contrary, simulated tile flow peaks and nitrate in tile flow peaks from the new routine in Rev. 615 and Rev. 645 captured the observed values fairly well. The motivation of this research is to compare the performance of different tile drainage routines in simulating water quantity and quality at field and watershed scales, and determine the most suitable model for further simulation in the extensively tile-drained watershed. The drainage coefficient represents the maximum amount of water that can be drained from tiles. The tile flow is set equal to the drainage coefficient once tile flow is greater than drainage coefficient (See page 4, line 9).

Interactive comments # 1ïijŽ 12) The Fig 1 needs to be checked by a GIS professional. From the reader's point of view, the Fig 1 is meaningless. Moreover, there is an asterisk within the IL boundary. This asterisk should be related to the main figure. The abbreviation "Co." is not understood. The caption of the figure needs to be self-illustrative. The county borders also need to be checked. Do they intersect orthogonally? R: We have improved Fig.1 to better present study area information.

Interactive comments # 1ïijŽ 13) In Fig 1, is the river station R5 shared by both the counties (i.e., Vermillion and Champaign counties)? R: Yes, the river station R5 is on the county line and shared by both counties.

14) The authors need to state few lines about the methodology used to get the drainage areas of subsurface stations and surface runoff stations. R: We will consultant with data provider and add more information about how the drainage areas were determined.

Interactive comments # 1ïijŽ 15) As per the current version of the paper (line number five on page number six), daily nitrate and sediment load was computed by multiplying water discharges with nitrate concentration (Yuan et al., 2000). How did the authors compute the daily sediment load? R: "daily nitrate and sediment load was computed by multiplying water discharges with nitrate concentration" has been changed to "daily nitrate and sediment load was computed by multiplying water discharges with nitrate and sediment concentration, respectively.

Interactive comments # 1ïijŽ 16) As per the current version of the paper (line number eight on page number six), nitrate and sediment loads were computed by multiplying the concentration at a specific time by half the flow volume since the last concentration measurement plus half the flow volume from the concentration measurement to the next concentration measurement (Kalita et al., 2006; Yuan et al., 2000). The authors also state that nitrate and sediment concentration data were not available for "every day" that water discharge occurred. Therefore, the adopted methodology is not understood. Do the authors have nitrate and sediment concentration data every two days?

R: No, we do not have nitrate or sediment concentration data every two days. Nitrate and sediment concentration data collection was sparsely distributed. Sometimes there were concentration data for several continuous days, but sometimes there were no concentration data for a week. Generally, the nitrate and sediment concentration data were collected twice each month during the study period.

Guo, T., Raj, C., Chaubey, I., Gitau, M., Arnold, J. G., Srinivasan, R., Kiniry, J. R. & Engel, B. A. (2017). Evaluation of bioenergy crop growth and the impacts of bioenergy crops on streamflow, tile drain flow and nutrient losses in an extensively tile-drained watershed using SWAT (under review).

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