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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.

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Comments from Referee # 2: I think scientific merit of this paper can be improved from its current form by showing how (under changing climate and irrigation practices) contamination of water has changed owing to tile drainage; after setting up well calibrated routines and simulating N-contamination for long-term till last year or so.

R: We thank the referee # 2 for valuable suggestions to our manuscript. We agree that the scientific merit of our manuscript need to be well described. We have discussed 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

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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). We will incorporate more discussion about impacts of tile drainage systems on water quality such as nitrate losses under changing climate, especially under changing precipitation across years.

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on streamflow, tile flow, sediment and nitrate losses in the LVR watershed from 1990 to 2008 (Guo et al., 2017, unpublished).

ii) Author can try to discuss on how modified curve number improves SWAT 2012 tile drainage routines. R: Yes, the newly added curve number calculation retention parameter adjustment factor in Rev.645 calculates curve numbers reasonably well based on the soil moisture retention curve from field capacity to saturation, and can partition surface runoff and tile flow well. Thus, the modified curve number improve surface runoff simulation and this improve tile drainage simulation in SWAT 2012 (Figs. 2c and 3c).

iii) Fig 3c and d, Tile flow simulated from Rev.528 show constant overestimation at E and hence I feel still there is scope of improving (calibration) parameters. This may be leading to following conclusion on page 19 line4-5: old routine were better at site B, while new routine were better as site E. Difference in performance of different routines at B and E should be discussed. Is this based on different routines performing differently in different land-use at B and E or is there other physical process of routines linked to this difference. R: We thank the referee # 2 for this thought-provoking suggestion. Sites B and E have similar land use, corn and soybean, but with different rotations. Difference in performance of different routines at B and E may be mainly caused by different climatic characteristics of two sites, and physical process in the old routines. 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 no matter how intense the rainfall. Moreover, when water table was lower than tiles, the old routine could not calculate tile flow. Thus, Rev.528 has the potential to underestimate tile flow during dry periods. Thus, Rev.528 could not simulate tile flow peaks and tile flow during dry periods at stie E. As I discussed on page 12 line 28, "However, Rev.528 simulated tile flow was overestimated at tile flow peaks in November 1992, May 1996, March 1997 (Fig. 3c), May and June of 1998, December 2001, and February, April and May of 2002 (Fig. 3d). Rev.528 simulated tile flows were underestimated from May to October in 1992, from June to November in 1994, from July in 1995 to March in 1996 (Fig. 3c), from May in 1999 to February in 2000, from May to August in 2001, and from July to December in 2002 (Fig. 3d).".

iv) The area covered by surface and sub-surface station is as low as in range of 0.05 km2. What is HRU size corresponding to drainage area for B and E? This information will reveal how well drainage is simulated in the considered drainage area. R: Yes, we have the same concern. HRU size in SWAT is 14.18 and 0.72 km2, respectively. HRU size in SWAT is larger than the size of station, which could not represent the size of each individual tile. 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.

v) Leave-few-year out approach may be more suitable for calibration and validation. R: Does leave-few-year out approach mean leaving out few year, such as one year monthly observed data, to use as the validation data, and using the remaining observed data for calibration? If so, this approach will be suitable for our study, and we will not expect obvious differences between statistics for model evaluation for the approach used in this study (7 and 6 years of monthly data for calibration and validation, respectively) and for leave-few-year out approach.

vi) Introduction can be reconstructed. In current form science question are repeated at two places on page 2 line 5 and page 4 line 32. R: We thank the referee # 2 for the detailed suggestions to the structure and description of this manuscript. We are very grateful about it. The Science question on page 2 line 5 has been removed. The introduction will be reorganized to improve the flow of the manuscript.

vii) (line 20) Explanation is required on how uncalibrated routines give 'reasonable but unsatisfactory' performance. 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."

viii) Page 5 line 25 citation is improper R: Citation on page 5 line 25 has been corrected.

ix) Page 9 line 27 variables of equation are not properly defined. R: I have change "Where Obs and Sim represent observed and simulated data, respectively." to "Where Obs and Sim represent the ith observed and simulated monthly data, respectively. And n is the total number of months. (Obs) ÌĚ and (Sim) ÌĚ represent the average values of the observed and simulated monthly data, respectively."

x) Repetition: Page 14 line 13-14, Two sentences can be merge in 1. Page 14-19 looks like repetition of sentences. R: The sentence on page 14 line 13-14 has been condensed to "Performance of the modelled monthly surface runoff from Rev.645 at site Bs during calibration and validation was satisfactory from Rev.645 and unsatisfactory from Rev.615.".

The sentences from page 14 to 19 will be reorganized to avoid repetition.

xi) Page 18 line 31, 'both routines' which two? Is not clear. R: Both routines represented the old tile drainage routine in SWAT2009 (Rev.528) and the new tile drainage routine in SWAT2012 (Rev.615 and Rev.645), which was mentioned in the last sentence. I have changed 'both routines' to both the old and new routines'.

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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