

Interactive comment on “Comparing SWAT with SWAT-MODFLOW hydrological simulations when assessing the impacts of groundwater abstractions for irrigation and drinking water” by Wei Liu et al.

Anonymous Referee #1

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The main objective of the manuscript “Comparing SWAT with SWAT-MODFLOW hydrological simulations when assessing the impacts of groundwater abstractions for irrigation and drinking water” was to evaluate watershed simulations between the SWAT and the coupled SWAT-MODFLOW models in which groundwater extractions are important. Specific objectives were to incorporate the MODFLOW Drain package, SWAT auto-irrigation, and a coupled calibration capability using PEST within the SWAT-MODFLOW modeling framework. The authors concluded that the SWAT-MODFLOW model calibrated by PEST shown better performance when compared with SWAT.

C1

Aside from incorporating PEST to calibrate the coupled model the manuscript does not support additional novelty. Note that in the publication “A model integration framework for linking SWAT and MODFLOW” the MODFLOW drainage package, SWAT auto-irrigation, and the MODFLOW NWT was already integrated into the SWAT-MODFLOW framework. However, using PEST to simultaneously calibrate both models may be of interest for the SWAT modelers community. The introduction needs extensive revision. I recommend that the authors refocus and simplify the objectives of the manuscript.

As the extent of both watersheds were different, how do the authors estimated the percolating fluxes in the groundwater extent that were not simulated by SWAT?

Line 74: Are the authors refereeing to conceptual models? What is an analytical model? I think SWAT as well as MODFLOW fall in the category of analytical models.

Line 79: The authors should be more precise in the model terminology when referring to hydrologic models. This is somewhat confusing.

Lines 120-159: The authors should revise these two paragraphs in a way that clearly illustrate readers the difficulties of coupling a semi-distributed surface model (SWAT) with a fully distributed groundwater model (MODFLOW). In addition, the authors should help the reader to realize that the spatial discretization that results from SWAT HRUs result in clustering hydrological processes that are geographically disconnected but grouped by slope, land use and “soil type”, as an example of this are fundamental processes such as evapotranspiration and irrigation. Note that irrigation is applied to the HRU level regardless if the area that is represented is contiguous or spatially disconnected and so, infiltration fluxes. This is a major model structure uncertainty in the SWAT model that pass unnoticed when simulated surface processes but problematic when integrating or coupling it with groundwater fully distributed model.

Line 137: I think that the correct sentence must acknowledge that the mentioned authors already integrated or coupled SWAT and MODFLOW instead of they try.

C2

Lines 160-174: The full story is interesting but the claim that SWAT may a suitable model to represent these hydrological features with accuracy for comparison is non-sense. The coupled SWAT-MODFLOW model may be a better approach that is able to capture this surface-subsurface interaction but the MODFLOW spatial discretization of 100x100m is quite coarse for these complex surface-subsurface water interactions. I recommend the authors to focus on illustrating the weakness and advantages of the NIRAS MODFLOW model and where the coupled version may be able to advance this model.

2.1. Study Area Is there water intrusion and lunar tidal influence at the watershed outlet? I recommend to include the groundwater watershed in this section

228-232: Can the author expand or provide a short explanation in regards these gridded datasets. Is this data the result of spatial interpolation from ground-based stations or there is a gridded network of stations? Also, if there is an additional step to generate the gridded datasets, can the authors illustrate the limitations and report the methodology behind it?

247: Is this not the opposite. Please correct me if I am wrong, the Well package in MODFLOW need the extraction volumes' as an input data which it was estimated by the SWAT auto-irrigation module.

248: Where did the authors collect the drinking water data?

254: Can the authors provide a figure that illustrates the hydrogeology of the study area?

398: I don't find this a large number of cell

399-401: I am not sure if this is relevant here. If the manuscript was intended for algorithms and cyber optimization it may be relevant.

411-427: I think here is where the manuscript totally misses the focus.

C3

657-659: This is not true, in fact, the authors will have a hard time demonstrating this. What is important is here is the proper representation in space and time of the hydrological processes occurring in the two domains (water circulation), for instance, feedback fluxes from the groundwater domain, infiltration fluxes from irrigated areas, and the correctness of estimated extracted volumes by the auto-irrigation module. In addition to this, the constraints set by the modelers, and the spatial discretization of the input data.

667: groundwater in SWAT is referred to as the processes occurring to the 6m soil dept. This is just confusing in the SWAT literature. On the other hand, in SWAT the deep percolating water and the deep aquifer is what in MODFLOW is referred to groundwater processes which SWAT model it as a loss in the system.

285-292: From what I had read to this point, I will say that this may be the contribution of this manuscript as all the rest is already published except PEST to calibrate both models simultaneously. Why no focusing in demonstrating that groundwater feedback fluxes were incorporated in the model and how irrigation was narrowed in the fuzzy HRU-MODFLOW cell definition?

301: I don't get this. . . why SWAT-cup, when the authors are claiming the use of PEST for calibration?

Figure 3. I recommend replacing "coverage" by domain or extent.

Figure 4. This figure does not properly represent the process representation of the SWAT model. Note that the SWAT model is semi-distributed and remains semi-distributed even though it is coupled with MODFLOW.

Figure 5. The authors MUST acknowledge that this figure was modified from Zhulu Lin document (<https://www.ndsu.edu/pubweb/~zhulin/pdf/teaching/starting%20pest.pdf>)

Figure 8. Please rank the x-axis in figures (a) and (b) in identical order. This will facilitate comparison.

C4

Figure 9. This figure is useless. If the authors' find that there is something that is necessary to communicate to the reader, they need to find a different way to illustrate the changes.

Figure 10. It seems like simulations in Well A poorly represent the dynamic. Well B seems to have a systematic bias.

The authors should include some model performance metrics when comparing the models

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