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Biogeosciences Discussions

Interactive comment on "Integrating Multi-Media Models to Assess Nitrogen Losses from the Mississippi River Basin to the Gulf of Mexico" *by* Yongping Yuan et al.

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GENERAL COMMENTS:

It's an interesting paper. You tested a new integrated modeling tool (IMS) and compared IMS with other modeling approaches. A new method could significantly improve the strength of the modeling approach on examining environmental problems. However, several revisions are needed to clarify your work in the paper.

Response from AUTHORS: Dear Referee, first of all, we would like to thank you for the time you devoted to reviewing this manuscript. Secondly, we would like to thank you for

your compliments and your helpful comments on the paper. We carefully considered your comments and took them into account for further revisions.

Comment 1: Please clearly explain your research design. After reading the introduction, I expected that since you proposed IMS by integrating SWAT into FEST-C and will only show results from IMS. Your method section suddenly stated that SWAT-HAWQS and SWAT-HAWQS WRF were tested together. At least, you should briefly introduce SWAT-HAWQS and SWAT-HAWQS WRF and simulations from those two methods will be compared with IMS.

Response from AUTHORS: You are right that we could only show results from IMS since we proposed IMS by integrating SWAT into FEST-C; we showed SWAT-HAWQS to demonstrate if IMS has any advantages over SWAT-HAWQS, which essentially is the SWAT. Sorry for the confusion. HAWQS was descript under section 2.3 Soil and Water Assessment Tool and Hydrologic and Water Quality System on page 10 "The Hydrologic and Water Quality System (HAWQS 1.0) (https://epahawqs.tamu.edu/) was recently developed by the USEPA Office of Water to enhance usability of SWAT in simulating effects of land management practices based on an extensive array of crops, soils, natural vegetation types, land uses, and climate change scenarios on hydrology and water quality... HAWQS is a web-based, interactive water quantity and quality modeling system that employs SWAT as its core engine (Yen et al., 2016). It provides interactive web interfaces, maps, and pre-loaded input data including NHD Plus; land use/land cover (NLCD 2006 combined with CDL 2010 and 2011 crop data layer from USDA National Agricultural Statistics Survey (NASS) to differentiate agricultural land use); soil; climate; atmospheric deposition of N; and USGS data of streamflow and pollutants. Daily weather data implemented in HAWQS is from the the National Oceanic and Atmospheric Administration - National Centers for Environmental Information (NOAA-NCEI); the atmospheric deposition implemented in HAWQS is from the National Atmospheric Deposition Program which monitors precipitation chemistry (http://nadp.sws.uiuc.edu/NADP/). In addition, SWAT default parameters used by

HAWQS have been preliminarily calibrated. HAWQS serves three different spatial resolutions (8-digit, 10-digit, and 12-digit HUCs) and varying temporal scales (time steps in daily/monthly/annual) (Yen et al., 2016)". Essentially, HAWQS is a more advanced user interface for SWAT (robot version of SWAT).

Regarding to SWAT-HAWQS WRF, SWAT-HAWQS WRF is also SWAT simulation using weather data produced by WRF. As descript under "2.4.2 Weather and Atmospheric N Deposition for the Integrated Modeling System", the IMS simulation uses climate-forcing by WRF . . .it would be interesting to see how SWAT does with climate-forcing by WRF. Otherwise, readers would question the impact of using climate-forcing by WRF on model results. Please also see page 15 and 16:

2.6. Model Simulations for the MRB:

To evaluate the IMS, the following model simulations were performed: 1. HAWQS-SWAT: All SWAT inputs including climate (daily precipitation, maximum and minimum air temperature) were directly extracted from HAWQS system; the simulation was performed from 1999 to 2010 (weather in HAWQS 1.0 ends in 2010), with the first three years as a warm-up period. HAWQS-SWAT uses area-weighted NOAA-NCEI observations as climate input for each subbasin (8-digit HUC); these data are interpolated using the Theissian polygon method to create a pseudo station for each 8-digit HUC. Air deposition used in this simulation is from the National Atmospheric Deposition Program (http://nadp.sws.uiuc.edu/).

2. HAWQS-SWAT WRF: for this simulation, climate input (daily precipitation, maximum and minimum air temperature) were replaced with WRF-produced daily precipitation, maximum and minimum air temperature, solar radiation; the rest of the inputs remain the same as the above simulation (HAWQS-SWAT). This simulation was performed because the FEST-C system were driven by process-based WRF weather simulations.

Comment 2. This comment is related to the comment above. I have a confusing on terms. FEST-C is equal to EPIC+WRF+CMAQ and to improve FEST-C, SWAT was

added. Is SWAT+FEST-C equal to IMS? Is IMS equal to the integrated multi-media modeling system? SWAT-HAWQS and SWAT-HAWQS-WRF mean the integrated multi-media modeling system? It seemed to me that you used the multiple terms that have the same meaning. Please simplify it.

Response from AUTHORS: FEST-C is an advanced interface, which is equal to EPIC+WRF+CMAQ (line 7 to 14 on page 4). To develop an integrated multi-media modeling system, which is IMS as abbreviation, as stated at the end of the second paragraph in Introduction, SWAT was integrated with FEST-C. Yes. SWAT+FEST-C equal to IMS and IMS is the abbreviation for the integrated multi-media modeling system. We have thoroughly revised the terminology throughout the paper to increase clarify of the paper.

Comment 3. Section 2.2 is too lengthy. Make sub-sections for 2.2 and explain each model at each section.

Response from AUTHORS: Changes were made following your advices.

Comment 4. Please show the climate comparison results first and then streamflow. Streamflow pattern is mainly affected by climate data. If the climate results are first shown, it would be easier to understand streamflow results.

Response from AUTHORS: Changes were made following your advices.

Comment 5. You should add any fertilizer application timing information for IMS and HAWQS. Fertilizer is a major N source. Comparing timing and amount of fertilizer between IMS and HAWQS is vital for this paper. At least, you must mention any differences or similarity on fertilizer between IMS and HAWQS based on literature.

Response from AUTHORS: You made an excellent point! We originally attempted to compare fertilizer application information between IMS and SWAT-HAWQS because we all realized their impact on simulation results (as we wrote in the paper: line 21 on page 21 under section 3.3 Dissolved N Evaluation). However, we soon realized that

providing this information is almost impossible or very difficult: 1) IMS used EPIC for agricultural land simulation and fertilization in EPIC was configured based on the plant demand using computed N stress level during simulation and they varied for each grid cell (12 km by 12 km) depending on crop type and location et al. For HAWQS - SWAT, fertilizer sales information from each county were configured for each subwatershed (821 HUC8 in this study). Adding this information would add a lot of explanation, but adding little information for the focus of this paper, which is to describe integration of SWAT with FEST-C (EPIC/WRF/CMAQ) and 2) demonstrate application (proof of concept). For a future work, we plan to calibrate the model and plan to process fertilization information into a more interpretative format to be included in the paper. We welcome any comments on this.

Regardless, we agree with you and we added more explanations on fertilization to show differences between IMS and SWAT HAWQS based on your comments.

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