

Dear Editor,

We are so appreciated for your letter on our manuscript “Reduction Evaluation and Management of Agricultural Non-Point Source Pollutant Loading in the Huntai River Watershed in Northeast China”, Reference No: hess-2018-339. We are also extremely grateful to the editors’/reviewers’ comments on our manuscript and carefully considered every comment and made cautious revision accordingly. Based on their suggestions, we have answered the questions in detail one by one. If you have any other questions about this paper, I would quite appreciate it if you could let me know them in the earliest possible time.

Most sincerely,

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Additive list

We have studied the valuable comments from you, the assistant editor and reviewers carefully, and tried our best to revise the manuscript. The point to point responds to the reviewer's comments are listed as following.

Reviewer's Responses to Questions

Generally, the manuscript addresses an important topic. The work in the manuscript is sufficient to be a publication. However, the writing needs to be improved in some sections of the manuscript. Please see specific comments below.

(1) Please write full words of abbreviations before using them. For example, NPS, SWAT in the abstract. The authors should check abbreviations throughout the manuscript.

Answer: Thanks for your very thoughtful suggestion.

We have made serious changes to the expression of abbreviations in the whole paper, such as NPS (Non-point source), SWAT (Soil and Water Assessment Tool), TN (Total Nitrogen), TP (Total Phosphorus), HTRW (Huntai River Watershed), environmental protection scenario (EPS), DEM (Digital Elevation Model), and BMPs (Best Management Practices scenarios).

The revised contents could be found in the file of "paper revised version (clean)".

(2) L16: "The study topics is mainly focus on", correct to "The study topic mainly focuses on". The purpose of the study is very general. I prefer specific objectives of the study.

Answer: Thanks for your very thoughtful suggestion.

We have revised the "The study topics is mainly focus on" to "The study topic mainly focuses on".

In order to make the article clear, we have revised the ""The study topic" to "The focus point". This section is the application scope of SWAT model, which was not the specific objectives of the study. The study objectives of the paper was "The model was used to quantify the spatial loading intensities of NPS nutrient TN (Total Nitrogen) and

TP (Total Phosphorus) to HTRW (Huntai River Watershed) under two scenarios (without & with buffer zones). The NPS pollutant loading decreased under the EPS, which showed that environmental protection measure could effectively cut down NPS pollutant loading in HTRW. SWAT was used to assess the reduction of agricultural NPS pollutant.”

The revised contents could be found in the file of “paper revised version (clean)” & paper revised version (with track changes).

(3) L17-18: " SWAT model was constructed based on rainfall runoff and land use type": SWAT model also uses soil types and slope information.

Answer: Thanks for your very thoughtful suggestion.

We have improved SWAT model information, and have added the soil types and slope information to the SWAT. The revised contents could be found as the followed,

“SWAT model was constructed based on rainfall runoff, land use type, soil types and slope information.”.

(4) L20: What do you mean by systematically analyzed? Can you describe what you did?

Answer: Thanks for your very thoughtful suggestion.

The systematically analysis contained three parts, which were (1) scenarios setting of SWAT; (2) modelling validation of SWAT in HTRW; (3) NPS pollutant loading calculation under status quo scenario & EPS.

The revised section was as followed,

Besides, the loadings and distribution traits of NPS pollutants were also systematically analyzed based on the model (scenarios setting, modelling validation, and pollutant loading calculation under status quo scenario & EPS).

(5) L24: What you mean by "scenario settings" in your study?

Answer: Thanks for your very thoughtful suggestion.

The “scenario settings” is the mean of “Land use types differences”.

The revised contents could be found in the file of “paper revised version (clean)” & paper revised version (with track changes).

(6) In the Results and Discussion of the abstract, you should mention your results for calibration and validation before discussing about the results from scenarios.

Answer: Thanks for your very thoughtful suggestion. We added the following contents,

The E_{NS} (Nash-Sutcliffe efficiency coefficient) & R^2 (certainty coefficient) of stream & nutrients (TN & TP) in typical hydrological station were both greater than 0.6, and the $|Dv|$ (relative deviation) was less than 20%. The SWAT could be used in HTRW.

The revised contents could be found in the file of “paper revised version (clean)” & paper revised version (with track changes).

(7) Introduction, L53-54: "The concentrate...between different areas". Grammar is not right. Please rewrite.

Answer: Thanks for your very thoughtful suggestion.

We carefully devised the expression of the sentence. The revised contents were followed,

The NPS pollutant concentrate in water is dependent on the discharge intensity and pollutant treatment rate, therefore, which was difficult to make a fair comparison between different areas (Tucci 1998; Dingman 2002; de Oliveira et al.,2016).

(8) Materials and Methods. Section 2.1 about description of study area is too long. Please shorten it and only mention necessary information.

Answer: Thanks for your very thoughtful suggestion. We have shortened the length of Section 2.1. We only provided the necessary information of study area. The contents were been found as following,

The HTRW (40°27'~42°19'N, 121°57'~125°20'E) is in Liaoning province (Northeast China), and the watershed area is 2.73×10^4 km², which takes about 1/5 of the area of Liaoning province (Fig 1). The HTRW is a tributary of Liaohe River Basin (The Liaohe River Basin is one of China's larger water systems) and is consist of Hunhe River, Taizi River, and Daliao River. The Hunhe River, Taizi River, and Daliao River watershed is HTRW's sub-watershed. The HTRW has varied topography, low mountain is located in eastern part, and the other parts are alluvial plain. The elevation of

northeast region is high. Loamy soils are mainly distributed in alluvial plain, and the average grade of lower HTRW is about 7%. HTRW area includes the cities of Fushun, Shenyang, Benxi, Liaoyang, Anshan, and Yingkou, most of Panjin city, some portions of Tieling city and a minor portion of Dandong city. The stream flow and nutrient were validated based on the five monitoring stations, Beikouqian, Dongling Bridge and Xingjiawopeng are located in Hunhe River, Xialinzi and Tangmazhai are in Taizi Rive. HTRW has temperate continental climate, the average annual temperature is 7°C, and precipitation is 748 mm.

(9) L141-L147 " For the calculation process ... farmers status quo". I think these sentences should belong to the model setup section.

Answer: Thanks for your very thoughtful suggestion. We have put the " For the calculation process ... farmers status quo" to the model setup section.

(10) The description about SWAT model is too long. Since we can find these information in many previous studies and in the manual of SWAT, there is no need to describe them in detail. Please shorten it and only choose the necessary information to describe.

Answer: Thanks for your very thoughtful suggestion. We have shortened the length of SWAT model description. We only provided the necessary information of SWAT model. We supplied some information of SWAT in the form of figure, such as Figure 1, and Figure 2.

(11) L184-185: " We used 30×30 grid data (elevation) as the basis for DEM operation". What did you do to prepare the DEM data?

Answer: Thanks for your very thoughtful suggestion.

We download the DEM data of HTRW from the SRTM (Shuttle Radar Topography Mission) data pack, the free data can be obtained on the website of <http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp>. With GIS (Geographic Information System) platform, we obtained the DEM data of HTRW, as well as hydrological station & weather station distribution, by using the technology of DEM data projection transformation, splicing and cutting.

(12) L193-195 " The database of the underlying substrate was constructed based on the database of soil types using the soil properties & land development data as underlying substrate parameters". I don't understand what you want to say here. What are substrate parameters here?

Answer: Thanks for your very thoughtful suggestion.

The underlying substrate parameters means the data of topography characteristics, surface vegetation and soil types & distribution characteristics. These data were the basic to calculate NPS pollutant loading and distribution intensity changes.

(13) L204-205 "All the data were validated by the standard procedures used by the SWAT". Can you specify the standard procedures?

Answer: Thanks for your very thoughtful suggestion.

We added the related contents were as followed,

The SWAT uses the LH-OAT (Latin Hypercube One-factor-At-a-Time) sensitivity analysis method & SCE-UA (Shuffled Complex Evolution Algorithm) automatic calibration analysis method to determine the value of sensitive parameters.

The revised contents could be found in the file of “paper revised version (clean)” & paper revised version (with track changes).

(14) L228-229: Which period is used for calibration, and for validation?

Answer: Thanks for your very thoughtful suggestion.

We added the related contents were as followed,

The runoff, TN & TP loadings data used for calibration & validation were from 1992 to 2009, from 2006 to 2008, respectively.

In L287, to the stream flow, “For the simulation, 1990-1994 was the model preparation period, 1995-2001 was the model calibration period, and 2002-2009 was the model validation period.” The contents could be found in the file of “paper revised version (clean)” (L296-L297).

In L304-306, to the nutrients, “Beikouqian, Xingjiawopeng, Xiaolinzi and Tangmazhai four hydrological stations had a continuous monthly water quality monitoring data from 2006 to 2007. Only the monthly data of TN & TP in Beikouqian

were validated from 2008 to 2009 for the insufficient of water quality monitoring data.”. Therefore, the 2006-2007 was the model calibration period, and 2008-2009 was the model validation period.

The revised contents could be found in the file of “paper revised version (clean)” & paper revised version (with track changes).

(15) L283-288: Your description on streamflow calibration is not clear about how you did for annual calibration and how you used the annual calibration to do monthly calibration. Did you use SWAT-CUP for this calibration?

Answer: Thanks for your very thoughtful suggestion.

We added the related contents were as followed,

(1) First, we dealt with the meteorological data and retained the 1990-2001 data series, then supplied the meteorological data simulation value from 1990 to 2001 by SWAT;

(2) We input into the runoff data of 1995-2001 to SWAT-CUP model to calibrate the runoff parameters;

(3) We took the (2) parameters into the database of SWAT, then extended the series of meteorological data to 1990-2009 and simulated runoff again.

(4) At last, we compared the runoff simulation values with monitoring value from 2002 to 2009.

The added contents could be found in the file of “paper revised version (clean)” & paper revised version (with track changes).

(16) Is the SWAT setup you used for calibration called the status quo scenario described in the Scenarios setting?

Answer: Thanks for your very thoughtful suggestion.

The scenarios setting for calibration was called the status quo scenario.

(17) L271-272: 29 smaller modeling units, are they sub-basins in SWAT? Or HRUs? Then after that you mentioned 184 HRUs. But with the number of soil types (26 types) and land use types (27 types), the number of HRUs (184) seems to be a very small number.

Answer: Thanks for your very thoughtful suggestion.

We added the related contents as followed,

To simulate the hydrological characteristics by SWAT, firstly, we divided the HTRW into a certain number of sub-basins according to DEM data, the sub-basins have the same characteristics of soil & land use; then we divided sub-basins into HRUs.

(18) I think the results are valuable, however, I don't feel they have been presented well to the reader.

Answer: Thanks for your very thoughtful suggestion.

In order to increase the readability of the paper, we reduced the number of pictures, and increased the number of tables to describe the reduction of agricultural NPS pollution loading. The spatial distribution of the mean annual TP and TN loading in the HTRW were 19, and 7 kg/ha, respectively. The region with a high NPS pollution loading is located in the middle and lower the HTRW, which included the urbanization and population density highly areas of Shenyang, Liaoyang and Anshan. Under the EPS, the TN and TP per unit area were 14, and 6 kg/ha, respectively. The output of NPS pollutant production, the loading intensities of TN & TP was reduced by 21.9%, 25.9% and 10.4% compared with the status quo scenario, respectively. The NPS pollution occurring within different sub-basins and regions located in the watersheds varied greatly, and the loading intensities of different pollutant types in the given sub-basin were slightly different. Land eco-restoration measures should be implemented to control agricultural NPS pollution from croplands. Therefore, SWAT simulation results provide a reference for the prevention of agricultural NPS pollution in agricultural watersheds.

(19) Conclusion

I feel that the conclusion is just repetition of the results and discussion. I don't think you should repeat the number of TN and TP loads under two scenarios. You should summarize what you learn from the results and discuss about them.

Answer: Thanks for your very thoughtful suggestion.

We have deleted the number of TN and TP loads under two scenarios. And

summarized the contents that we learn from the results and discuss. We revised the contents as followed,

The NPS pollution is prone to cause in dry farmland, paddy, rural & urban areas. The SWAT model has been applied to study NPS in China by numerous research literature, they were mainly focuses on scenario simulation of NPS pollution and management in agricultural areas with rich hydrological and meteorological data. The basic monitoring data of HTRW were deficient, we selected the SWAT as the feasible method to access NPS pollutant loading in watershed level. We applied certain practices based on EPS to reduce the NPS pollutant loading in the Hunhe River, Taizi River and Daliao River watershed. The status quo scenario and EPS were used to calculate the output of NPS pollutant production. The output of NPS pollutant production, the loading intensities of TN & TP was reduced by 21.9%, 25.9% and 10.4% compared with the status quo scenario, respectively. In different regions of NPS pollutant loading in the HTRW changes greatly, and the pollutant loading intensity of different nutrients in the same region is slightly different. Land eco-restoration and land development mode adjustment measures should be practiced reducing NPS pollutant loading of cultivated land.

The revised contents could be found in the file of “paper revised version (clean)” & paper revised version (with track changes).

We tried our best to improve the manuscript and made some changes in the manuscript. These changes will not influence the content and framework of the paper. And here we did not list the changes but marked in red in revised paper (Revision, changes marked).

We appreciate for Editors/Reviewers’ warm work earnestly, and hope that the correction will meet with approval.

Once again, thank you very much for your comments and suggestions.