HESS-2016-649-R1

We thank the reviewer for his constructive review and intend to address all of his comments. We would like to state that the presented paper included various study such as models, algorithm and regression analysis. In this paper, WATEM/SEDEM algorithm was firstly introduced to South Korea. Also, we think that KTC empirical equation would be useful at ungauged watershed. For resubmission of improved paper, we think that all the following comments went through from the previous reviews.

1) The paper structure is a bit confused, the main objective of the study or the scientific question is not clear enough. Further, what are actually the main conclusions of the study, what is the take home message of this paper? Moreover, the language should be significantly improved (grammar, overall style and structure because some sentences are not clear). In its current form the paper is not suitable for the Hydrology and Earth System Sciences journal.

- **Answer: We consent to your comments. For language problems, we plan to get the native English speaker review/proofread through American Journal Experts (payment is about $ 500). We will attach editing invoice.**
- **Answer: The paper is outlined as follows: Sect. 1 described application of WATEM/SEDEM algorithm in South Korea. However, KTC (Transport Capacity Coefficient) is necessary for application of WATEM/SEDEM algorithm in South Korea. So, Sect. 2 traced KTC by the sediment delivery of SWAT model determined as comparing MUSLE (Modified USLE) based SWAT (Soil Water Assessment Tool) simulated sediment yield. The SWAT model results reflected observed suspended solid. Sect. 3 find out KTC empirical equation by linear regression analysis. The KTC equation is going to be commonly used for accurate sediment delivery at a ungauged watershed in South Korea. Finally, calibrated spatial sediment delivery from WATEM/SEDEM algorithm is estimated using obtained KTCs by KTC empirical equation.**
- **The objective of this study is to estimate KTC empirical equation for calibrated spatial sediment delivery and to prove accuracy of sediment delivery by KTC empirical equation. Therefore, we consent to reviewer's comments. We are going to rewrite paper structure according to above purpose.**

2) The paper is a bit short and from my point of view there is nothing wrong if the paper is short, in case that all the steps are correctly explained. In the presented paper a lot of steps are not explained, for example: how was the rainfall erosivity determined based on the 1-minute rainfall data, what method was used to determine the spatial distribution of rainfall erosivity, how was the calibration of SWAT model carried out, more details about the data (sediment, soil moisture,...) used should be provided. Thus, I believe that the

study is not reproducible.

- **Answer: We consent to your comments. This paper was not explained about generation of 1 minute data and rainfall erosivity, calibration of SWAT model. Because methods for estimating rainfall erosivity and SWAT calibration are generally known in hydrology field, we don't mention detailed process. Also, we suggested a previous study thesis instead of detailed explanation, for example, the Ahn and Kim (2016). According to reviewer comment, we can give all the process in detail. Therefore, we will certainly explain generation of rainfall erosivity, data used in this study, and method of SWAT calibration in part of 2 Materials and methods.**

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3) The discussion of the results is poor and should be improved (e.g., what transport capacity parameters were used in previous WATEM/SEDEM model studies).

- **Answer: We consent to your comment. By reflecting 1 and 2 comments, discussion about results will be improved. Also, we will additionally analyze cause of error according to each sector. So, we will make up for the weak points in this paper.**

4) The discussion Specific comments and technical corrections: Page 1, line 27: Which soils are susceptible to rill erosion? Please add more details.

- **Answer: Thank you for your comment. We consent to your comment. We will certainly explain soil characteristics in regard to rill erosion factor.**

5) The discussion Specific comments and technical corrections: Page 2, line 4: Some references should be added to confirm this statement.

- **Answer: Thank you for your comment. We consent to your comment. So, we will add references about results in soil and hydrologic change by climate change in South Korea.**

6) The discussion Specific comments and technical corrections: Page 2, lines 4-5: I would suggest replacing "will" with "may", "might" or "could"

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**

7) The discussion Specific comments and technical corrections: Page 2, line18: Why is only Ethiopia mentioned here? These kinds of models were also used in other countries.

- **Answer: Thank you for your comment. We consent to your comment. So, we will add more literature from other countries.**

8) The discussion Specific comments and technical corrections: Page 2, line 33: This sentence should be rephrased because the TC equation is defined on the next page of the manuscript.

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct WATEM/SEDEM algorithm instead of TC equation.**

9) The discussion Specific comments and technical corrections: Page 3, line 8: Which spatially semi-distributed model?

- **Answer: Thank you for your comment. We consent to your comment. As you know, WATEM/SEDEM is a spatially-distributed soil erosion and sediment transport model based on the RUSLE model plus a sediment transport capacity equation. We will removal semi distributed model and write spatially-distributed model. But, What we expressed the model as semi distributed model is because WATEM/SEDEM model used input R factor as single value. That is why we explain WATEM/SEDEM model as semi-distributed model.**

10) The discussion Specific comments and technical corrections: Page 3, line 9: Replace "TC equation given" with "TC equation is given".

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**

11) The discussion Specific comments and technical corrections: Page 3, lines 14-15: This modification of the algorithm should be described.

- **Answer: Thank you for your comment. Original algorithm did not use spatial KTC and R factor data. The factors only used single factors on WATEM/SEDEM model. So. original algorithm was modified for using spatially distributed KTC and R factor. And then, we developed automatic pre-processing algorithm about spatial input data for TC equation by Python code. Also, we developed TC equation by Python code for spatially calculating all the input data. We consent to your comment. So, we will correct this. We will describe the modification of algorithm in part of 3 Results and discussion.**

12) The discussion Specific comments and technical corrections: Page 4, line 21: Replace "stations locate" with "stations are located".

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**

13) The discussion Specific comments and technical corrections: Page 5, first paragraph of

section 2.4: This paragraph should be rewritten because it is not clear.

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this. As we are mentioned at comment 1, model implantation is divided into 4 sectors. So, we will rewrite model implantation by dividing it into four section in detail.**

14) The discussion Specific comments and technical corrections: Page 5, lines 9-10: How does the SWAT model verify measured suspended solids? Please rephrase this sentence.

- **Answer: Thank you for your comment. We consent to your comment. The whole SWAT model calibration process were proceeded by LH-OAT and OAT (One Factor At a Time) methods. SWAT calibration methods are explained by sensitivity parameters and evaluation. In part of 3 Results and discussion, we will add contents of sensitivity analysis and calibration process. In this parts, we will explain model verification using OAT method about streamflow, evapotranspiration, soil moisture and suspended solid.**

15) The discussion Specific comments and technical corrections: Page 6, line 5: Replace "The yearly" with "the yearly".

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**

16) The discussion Specific comments and technical corrections: Page 6, line 5: It should be described how was the rainfall erosivity calculated (which equations were used, how was the data measured, was 1-minute data really used or was the data aggregated,...).

- **Answer: Thank you for your comment. We consent to your comment. This paper was not explained about generation of 1 minute data and rainfall erosivity, calibration of SWAT model. Because methods for estimating rainfall erosivity and SWAT calibration are generally known in hydrology field, we don't mention detailed process. Also, we suggested a previous study thesis instead of detailed explanation, for example, the Ahn and Kim (2016). According to reviewer comment, we can give all the process in detail. Therefore, we will certainly explain generation of rainfall erosivity, data used in this study, and method of SWAT calibration in part of 2 Materials and methods.**

17) The discussion Specific comments and technical corrections: Page 6, second paragraph of section 3.1: This part should also be rewritten because several things are not well explained, for example: what is meant by yearly distributed sediment delivery? When you are referring to sediment delivery, is this the sediment delivery ratio or something else because the sediment delivery ratio should not have any units? The TC parameter in the

WATEM/SEDEM is the transport capacity parameter of each grid cell? How did you take into account the fact that the WATEM/SEDEM model should be used with grid resolution of 20 by 20 m and using different resolutions may cause problems (e.g., LS factor)? How was the LS factor calculated? How did you determine the soil erodibility factor?

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**
- **The transport capacity parameter in TC equation consist of each grid cell (1km by 1km) because of other grid cell parameters. According to your comment, it might cause some problems. I thought what you consider LS factor experimental field of 22.13 m by Wischmier & Smith(1965). So, you might mention cell size of 20 by 20m. I think that this problem will be solved by suggesting detailed method and equation for estimation of LS factor.**
- **In (R)USLE equation, L is a slope length factor and S is a slope factor. This equation was tested based on standard slope such as slope length(22.13m) and slope grade(9%). The LS factor at this time defined 1.0 value. For application of other conditions, Wischmier & Smith(1965) proposed the equation which can find out LS factor by changes of relative length and slope compared as standard condition.**

- $\mathbf{LS} = (\boldsymbol{\gamma}/\mathbf{22.13})^{\boldsymbol{m}} \cdot (\mathbf{65.41}\boldsymbol{sin}^{\mathbf{2}} + \mathbf{4.56}\boldsymbol{sin\theta} + \mathbf{0.065})$
  Where, $\boldsymbol{\gamma} = \mathbf{slope\ length}, \boldsymbol{\theta} = \mathbf{slope\ grade}, \mathbf{m} = \mathbf{slope\ index}$
- **We consent to your comment. So, we used this equation. we will add LS factor method and results in detail as paragraph.**
- **Also, we will correct yearly distributed sediment delivery and sediment delivery ratio.**

18) The discussion Specific comments and technical corrections: Page 6, line 5: It should be described how was the rainfall erosivity calculated (which equations were used, how was the data measured, was 1-minute data really used or was the data aggregated,...).

- **Answer: We consent to your comments. This paper was not explained about generation of 1 minute data and rainfall erosivity. Because methods for estimating rainfall erosivity is generally known in hydrology field, we don't mention detailed process. According to reviewer comment, we can give all the process in detail. Therefore, we will certainly explain generation of rainfall erosivity, data used in this study in part of 2 Materials and methods. Also, we will suggest a previous study literature.**

19) The discussion Specific comments and technical corrections: Page 8, line 2: How was the calibration carried out? Page 8, lines 6-7: NSE and PBIAS acronyms should be defined.

- **Answer: Thank you for your comment. We consent to your comment. This paper was not explained about calibration of SWAT model. Because methods for**

estimating SWAT calibration are generally known in hydrology field, we don't mention detailed process. The whole SWAT model calibration process were proceeded by LH-OAT and OAT (One Factor At a Time) methods. SWAT calibration methods are explained by sensitivity parameters and evaluation. In part of 3 Results and discussion, we will add contents of sensitivity analysis and calibration process. In this parts, we will explain model verification using OAT method about streamflow, evapotranspiration, soil moisture and suspended solid.

- **We will add definition and application of NSE and PBIAS. Also, we will suggest a detailed previous literature about NSE and PBIAS by moriasi(2007).**

20) The discussion Specific comments and technical corrections: Page 8, lines 10-11: More information should be provided about the soil moisture data. It is stated that detailed results are available in the paper that is currently under review, but this paper is publically not available.

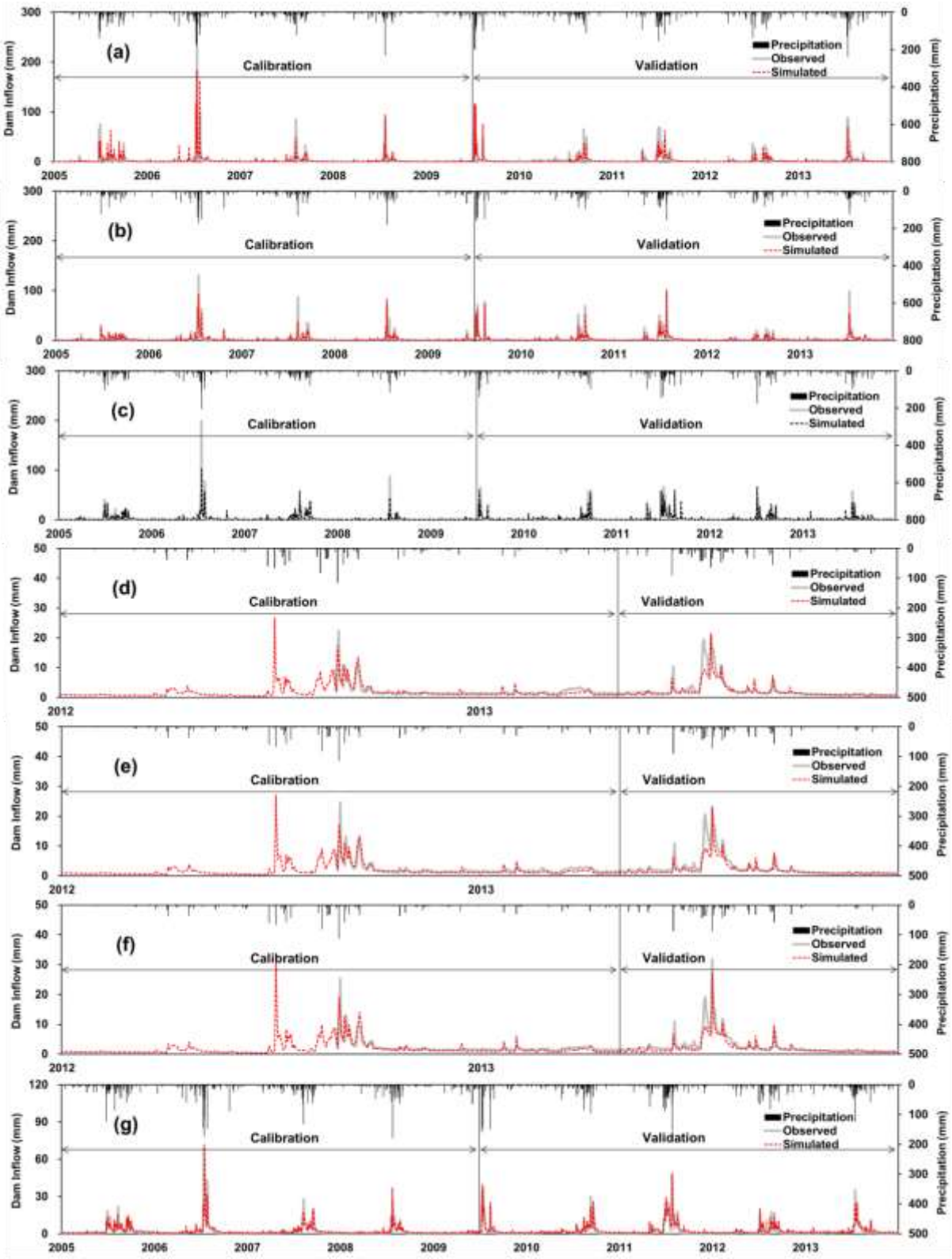
- **Answer: We consent to your comments. We used soil moisture data at observed flux data by KICT (Korea Institute of Civil engineering and building Technology). So, we will correct this and add sentences in part of 2 Materials and methods.**
- **Also, paper by Ahn and Kim (2016) was finally accepted. So, we will correct this.**

21) The discussion Specific comments and technical corrections: Page 8, line 15: What is meant by "eight days intervals"? Please explain. Page 8, line 18: "indicates a satisfactory simulation". This is very subjective and I would suggest avoiding this kind of statements.

- **Answer: We consent to your comments. The eight days interval mean measured interval or cycle. Sediment data is not daily measured data. Therefore, It is measured every eight day. So, we will correct this and add sentences in part of 2 Materials and methods.**
- **Also, we used R^2, NSE and PBIAS index for assessment of model results. We consent to your comments about subjective satisfactory of model results. The index evaluation of R^2 are NSE are generally known in hydrology field. Donigian (2000) reported that a R^2 for daily flow less than 0.6, from 0.6 to 0.7, from 0.7 to 0.8, and greater than 0.8 are classified as poor, fair, good, and very good, respectively. Moriasi et al. (2007) recommended the performance ratings of NSE for monthly flows less than 0.5, from 0.5 to 0.65, from 0.65 to 0.75, and greater than 0.75 are unsatisfactory, satisfactory, good, and very good, respectively. We will add definition and application of NSE and PBIAS. Also, we will suggest a detailed previous literature about NSE and PBIAS by moriasi(2007).**

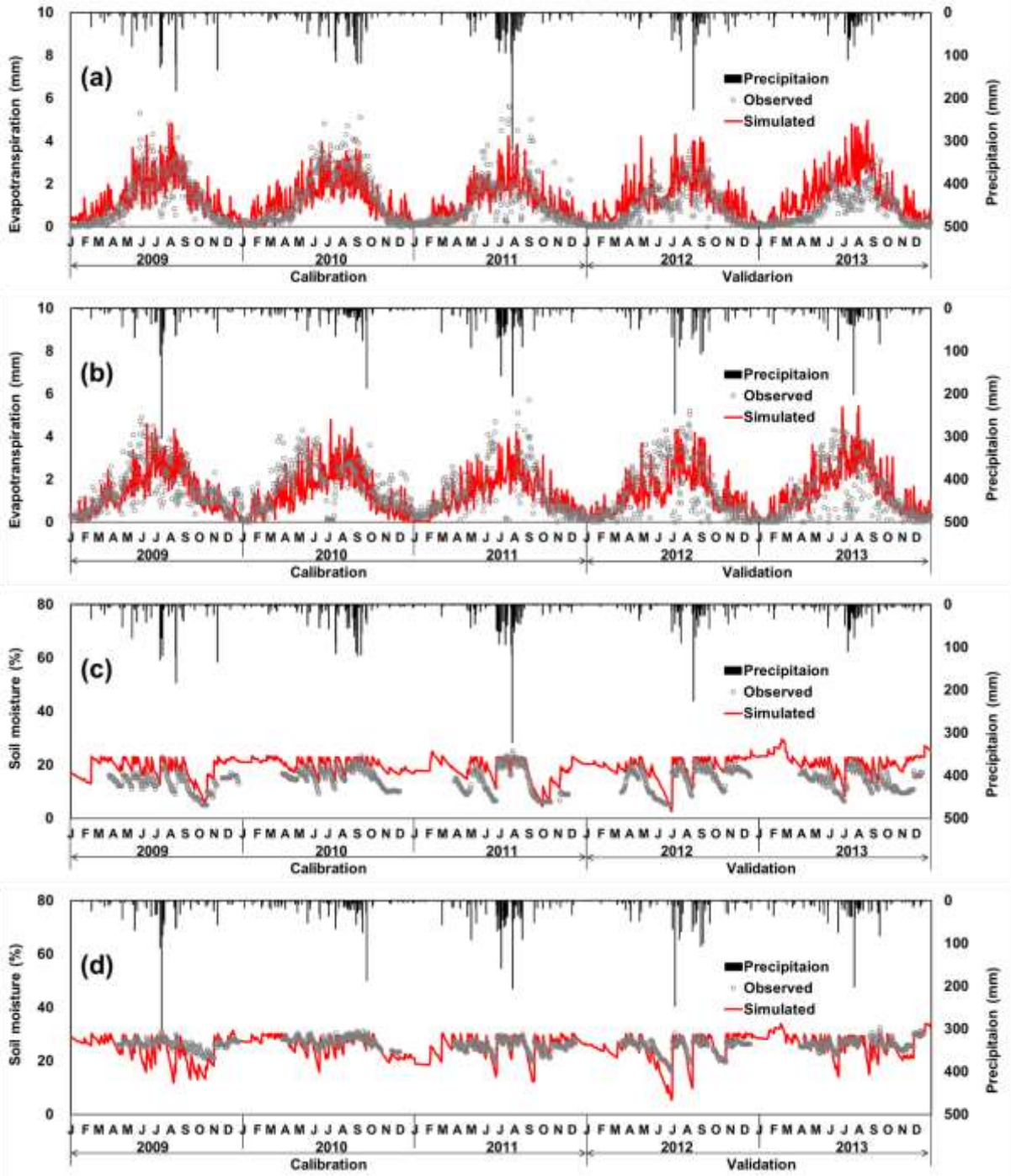
22) The discussion Specific comments and technical corrections: Page 9, Fig. 5: I would suggest using different colours for observed and simulated data(one could be red and the other one grey or black; or something similar).

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**



23) The discussion Specific comments and technical corrections: Page 9, Page 10, Fig. 6: I would suggest using different colours for observed and simulated data (one could be red and the other one grey or black; or something similar).

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**



24) The discussion Specific comments and technical corrections: Page 11, Fig. 7: Are these really daily suspended solids because the density of points is a bit low (e.g., c) case). How were suspended solids measured and how reliable are measurements?

- **Answer: Thank you for your comment. We consent to your comment. As I was mentioned, the eight days interval mean measured interval or cycle. Suspended solid data is not daily measured data. Therefore, It is measured every eight day.**
- **Suspended solid data have be collected from the monitoring network operated by Ministry of Environment in South Korea. By law article 22 of environmental policy and water quality monitoring network, these data actually use basic data for analyzing the effect of environmental policy and establishing policy at the national level in South Korea. Also, this data are verified to two levels by NIER (National Institute of Environmental Research). NIER classify of measured Suspended solid outlier by statistical analysis and continually improve the problem(Ministry of Environment, 2016). So, suspended solid data which we used verified reliability up to 90%. We consent to your comment. We will add a sentence above and suggest a detailed literature about Suspended solid reliability by Ministry of Environment(2016).**
- **Ministry of Environment (2016). "Water quality monitoring program".**

25) The discussion Specific comments and technical corrections: Page 12, first paragraph of section 3.3: This section should be better explained.

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**

26) The discussion Specific comments and technical corrections: Page 14, lines 2-3: Why is it difficult to estimate the KTC and what is the uncertainty related to this estimation?

- **Answer: Thank you for your comment. We consent to your comment. As KTC is empirical coefficient, KTC was estimated by comparing observed sediment at small experimental field in previous study or uniformly used as 1.0 or 100 value at overall watershed. But, measurement of sediment in all areas is impossible. Therefore, we think that KTC need a method for estimation depending on different land uses and watershed characteristics at small watershed. We will add a sentence above.**
- **Also, we think that uncertainty related to this estimation depend on calibration result of SWAT model. So, We will add a sentence above.**

27) The discussion Specific comments and technical corrections: Page 14, lines 3-4: Please rephrase this sentence. Page 14, lines 9-10: Please rephrase this sentence, because it is not clear.

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this.**

28) The discussion Specific comments and technical corrections: Page 15, lines 15-16: This is subjective (what is high and what is low?). Page 15, lines 15-16: This is subjective (what is high and what is low?).

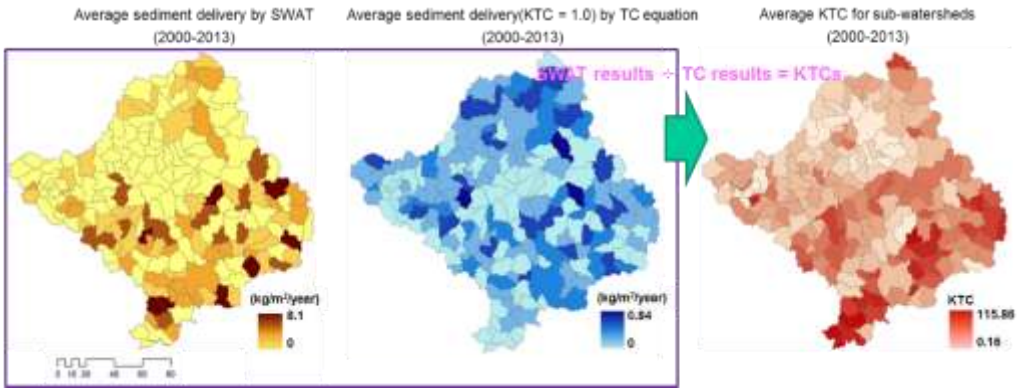
- **Answer: Thank you for your comment. We consent to your comment. We used R^2 for assessment of KTC equation. We consent to your comments about subjective satisfactory of model results. The index evaluation of R^2 are NSE are generally known in hydrology field. Donigian (2000) reported that a R^2 for daily flow less than 0.6, from 0.6 to 0.7, from 0.7 to 0.8, and greater than 0.8 are classified as poor, fair, good, and very good, respectively. Moriasi et al. (2007) recommended the performance ratings of NSE for monthly flows less than 0.5, from 0.5 to 0.65, from 0.65 to 0.75, and greater than 0.75 are unsatisfactory, satisfactory, good, and very good, respectively. We will add definition and application of NSE and PBIAS. Also, we will suggest a detailed previous literature about NSE and PBIAS by moriasi(2007).**

29) The discussion Specific comments and technical corrections: Page 17, section 3.6: This section should be moved before the results and discussion part. From my points of view this should go into the methodology. More information about the software could be provided (e.g., is it publically available,. . .).

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this. We will add input/output algorithm regarding to rainfall erosivity program and TC modeling program respectively.**

30) The discussion Specific comments and technical corrections: Page 17, line 17: "The KTC was traced" this is not clear, please rephrase.

- **Answer: Thank you for your comment. We consent to your comment. So, we will correct this and add figure for trace process below.**



31) The discussion Specific comments and technical corrections: Page 20, lines 7-8: This reference is not mentioned in text.

- **Answer: Thank you for your comment. We consent to your comment. So, we will remove this reference.**