Response to Interactive comment Anonymous Referee #2

We heartily appreciate the reviewer's assessment on this study and the valuable suggestions provided to improve this manuscript. We hereby provide our point by point responses how the comments by referee #2 will be addressed in the revised manuscript.

Comment: General Comment: I would expect that in 2017 SWAT modeller would use the newest version of SWAT 2012 especially as next year SWAT+ a new generation of the model will be presented. However I can understand that simpler structure of the 2005 version is easily manageable and modified when you start with this kind of research. Introduction P3, L13-14: Please better justify selection of SWAT 2005. Current justification is not satisfactory.

Reply: We propose to add the following for justification:

"The SWAT2005 version has an existing calibration module while the SWAT2009 and the SWAT2012 have removed the autocalibration routines. The integrated design of model simulation and autocalibration in the SWAT2005 is easily manageable and modified since there is no need to couple other algorithms. According to the revision history of the SWAT model, revisions after the SWAT2005 aims mainly at the water quality simulation and has little effect on runoff simulation. Thus the SWAT2005 is employed in this study."

And the revision history will be provided as the attachments.

Comment: 2.2 Model dataset P4, L18-21: I am surprised that you used Weather generator. That is really rare. The area is very large I would expect to have at least some data. Did you also use it for precipitation? And why data back to 1979 if you're modelling period 1991 – 2010.

Reply: Thanks for the comments. We want to make some explanations here. Weather generator is only used in the case of missing climate data. In this study only the observed rainfall data were available while the other climatic data such as relative humidity, wind speed, solar radiation and the minimum and maximum air temperatures were unavailable. Therefore we did not use weather generator for precipitation and we downloaded those unavailable climatic data from the Climate Forecast System Reanalysis (CFSR) during the time period 1979-2010 to calculate the statistical characteristics for weather generator. And we modeling the period 1991-2010 because the observed rainfall and flow data were available in that period. We think the last paragraph in section 2.2 has illustrated the usage of the observed rainfall data.

We suggest the following statement to illustrate the usage of the weather generator in the fourth paragraph in section 2.2:

"The SWAT model has developed a weather generator (WXGEN) to fill the missing climate data by the use of monthly statistics."

Comment: How did you model land use management (.mgt) where did you obtain the data.

Reply: We think that the land use management is not within the scope of this study. The land use management (.mgt) file contains input data for planting, harvest, irrigation applications, nutrient applications, pesticide applications, and tillage operations. We used the default setting for these operations in .mgt file.

Comment: Please add table with data used in the model. For example refer to this manuscripts: Glavan, M., Ceglar, A. and Pintar, M., 2015. Assessing the impacts of climate change on water quantity and quality modelling in small Slovenian Mediterranean catchment - lesson for policy and decision makers. Hydrological Processes, 29(14): 3124-3144.

Reply: Thanks for your good suggestion. The following table is added to the section 2.2-Model dataset:

Data	Resolution	Source	Description
DEM	90m×90m	http://srtm.csi.cgiar.org/	Digital Elevation Model
Land use	1km×1km	http://www.landcover.org/	Land use classification
Soil	30 arc-second	http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/	Soil type classification and characterization of soil parameters
Global weather data	30 stations	https://globalweather.tamu.edu/	Relative humidity, wind speed, solar radiation and the minimum and maximum air temperatures
Observed rainfall	138 gauges	Hydrologic Bureau of Huaihe River Commission	Daily data: 1991-2010; subdaily data: flood periods during 1991-2010
Observed streamflow	1 gauge	Hydrologic Bureau of Huaihe River Commission	Wangjiaba station, daily data for 1991-2010, sub-daily data for flood periods during 1991-2010

Comment: 3.1 Development of: : : P5, L4: If you are following the method proposed by Jeong et al. (2010) please describe why and for what purpose was it made or used.

Reply: Thank you for your valuable suggestion. We will explain specifically the model modification of Jeong et al. (2010) in the revised manuscript. I still need time to organize this part.

Comment: 3.3 Model calibration Please introduce table with parameters used in calibration. Include also default value, range, final value. For example refer to this manuscripts: Glavan, M., Ceglar, A. and Pintar, M., 2015. Assessing the impacts of climate change on water quantity and quality modelling in

small Slovenian Mediterranean catchment - lesson for policy and decision makers. Hydrological Processes, 29(14): 3124-3144. This manuscript should also be part of introduction or discussion chapters as it clearly describes the process that need to be followed while using SWAT model.

Reply: Thanks for your good suggestion and we would like to refer to the suggested manuscript. Since there are three calibrated parameter sets in this study (i.e., SWAT model, SWAT-EVENT model with basin level UH parameter, SWAT-EVENT model with sub-basin level UH parameter), we intend to add the calibrated values in the attachments. And the following table is added to section 3.3.1 to denote the model parameters:

Parameters	Definition	lower bound	upper bound
ALPHA_BF	Baseflow alpha factor (days).	0	1
BIOMIX	Biological mixing efficiency.	0	1
BLAI	Maximum potential leaf area index.	0	1
CANMX	Maximum canopy storage (mm H2O).	0	10
CH_K(2)	Effective hydraulic conductivity in main channel alluvium (mm/hr).	0	150
CH_N	Manning's "n" value for the main channel.	0	1
CN2	Initial SCS runoff curve number for moisture condition II.	-25	25
EPCO	Plant uptake compensation factor.	0	1
ESCO	Soil evaporation compensation factor	0	1
GW_DELAY	Groundwater delay time (days).	-10	10
GW_REVAP	Groundwater "revap" coefficient.	-0.036	0.036
GWQMN	Threshold depth of water inthe shallow aquifer required for return flow to occur (mm H2O).	-1000	1000
REVAPMN	Threshold depth of water in the shallow aquifer for “revap” or percolation to the deep aquifer to occur (mm H2O).	-100	100
SMTMP	Snow melt base temperature (ºC).	0	5
SLOPE	Average slope	-25	25
SLSUBBSN	Average slope length (m).	-25	25
SMFMN	Melt factor for snow on December 21 (mm H2O/ºC-day).	0	10
SMFMX	Melt factor for snow on June 21 (mm H2O/ºC-day).	0	10
SMTMP	Snow melt base temperature (ºC).	-25	25
SOL_ALB	Moist soil albedo.	-25	25
SOL_AWC	Available water capacity of the soil layer (mm H2O/mm soil).	-25	25
SOL_K	Saturated hydraulic conductivity (mm/hr).	-25	25
SOL_Z	Depth from soil surface to bottom of layer (mm).	-25	25
SURLAG	Surface runoff lag coefficient.	0	10
TIMP	Snow pack temperature lag factor.	0	1
TLAPS	Temperature lapse rate (ºC/km).	0	50

Comment: Please clearly describe what the scenarios were. I assume you had three scenarios as follows out from Table 3 where you presented for certain version (I assume SWAT-EVENT, please write

this in title of the table) three scenarios Daily simulation, Basin level UH parameter simulation and Sub-basin level UH parameter simulation. From Figure & I can see you had two scenarios Simulated daily discharge SWAT and simulated sub-daily discharge SWAT-EVENT. In methodologies clearly describe what is base scenario and to which scenario is it compared.

Reply: Yes, three scenarios are:

(a) daily simulation with SWAT model;

(b) SWAT-EVENT model with basin level UH parameter (t_{adj}) for even-based simulation;

(c) SWAT-EVENT model with sub-basin level UH parameter (t_{subadj}) for event-based simulation.

We assume the referee is here referring Figure 6. This paper used a two-step comparison to prove that: (1) taking (a) as the base scenario and (b) as the compared scenario, temporal modification enabled the original SWAT model to simulate flood events and the improvements of the aggregated daily performances of the SWAT-EVENT model in Figure 6 were due to the higher temporal resolutions for input rainfall and the simulation time step; (2) taking (b) as the base scenario and (c) as the compared scenario, spatial modification improved the simulation accuracy for even-based floods (Table 3 and Figure 8).

The title of Table 3 is changed to "Performance evaluations for the daily with the SWAT model and sub-daily simulations for specific flood events with the SWAT-EVENT model"

We suggest to add a section in methodologies to describe the two-step comparison as follows:

"3.4 Improvement for even-based flood simulation

A two-step comparison was used to verify the improvement of the SWAT model for event-based flood simulation. Firstly, the aggregated daily results of the SWAT-EVENT model with default basin level UH parameter (t_{adj}) was compared to the original SWAT model to test the effectiveness of improvement at the temporal scale. Secondly, the SWAT-EVENT model with sub-basin level UH parameter (t_{subadj}) was compared to that with basin level UH parameter (t_{adj}) to assess the improvement effect at the spatial level."

Comment: 5 Discussion P10, L28-30: Sentences from previous chapters are often repeated.

Reply: We delete this part to avoid repeated.

Comment: Conclusions P12, L16-30: All the text in the conclusions is just repeated from previous chapters. Delete existent text and please write down answers to this questions in conclusions: Why is this research unique? What are the shortcomings/uncertainties of this research? What did us and science

community learned from it? Future work?

Reply: We will rework the whole conclusion section as follows:

"Flood forecasting is a synthetic system that integrates the data acquisition and processing, rainfall-runoff modeling and warning information release etc. Hydrological models are always the core part of the forecasting system. Model structures and model parameters are one of the most important issues for accurate flood forecasting (Noh et al., 2014). The original SWAT model was not competent to flood forecasting due to its initial design of long-term simulations with daily time-steps. This paper mainly focused on the modification of the structure of the original SWAT model to perform event-based simulation, which was applicable for the area without continuous long-term observations. The newly developed SWA-EVENT model was applied in the upper reaches of the Huaihe River. Model calibration and validation were made by the using of historical flood events, showing good simulation accuracy. To improve the spatial representation of the SWA-EVENT, the lumped UH parameters were then adjusted to the distributed ones. Calibration and validation results revealed the improvement of event-based simulation performances. This study expands the application of the original SWAT model in event-based flood simulation.

The determination of hydrological model parameters is an inevitable process before flood forecasting. Parameter estimations of distributed or semi-distributed hydrological models commonly depend on automated calibration procedure due to overparametrization. The optimal parameters of the SWAT-EVENT model were obtained by the automatic parameter calibration module that integrated SCE-UA algorithm in this study. However, serveral factors such as interactions among model parameters, complexities of spatio-temporal scales and statistical features of model residuals may lead to the parameter non-uniqueness, which is the source of the uncertainty in the estimated parameters. Uncertainty of model parameters will be finally passed to the model results, hence leading to certain risks in flood forecasting. In the future, emphasis will be placed on the quantification of the parameter uncertainty to provide better supports for flood operations.

Event-based runoff quantity and quality modeling has become a challenge task since the impact of hydrological extremes on the water quality is particularly important. The improvement of the SWAT model for event-based flood simulation will lay the foundation for dealing with the event-based water quality issues."

References

Jeong, J., Kannan, N., Arnold, J., Glick, R., Gosselink, L., and Srinivasan, R.: Development and Integration of Sub-hourly RainfallRunoff Modeling Capability Within a Watershed Model, General Information, 24, 4505-4527, 2010.

Noh, S. J., Rakovec, O., Weerts, A. H., and Tachikawa, Y.: On noise specification in data assimilation schemes for improved flood forecasting using distributed hydrological models, J. Hydrol., 519, 2707-2721, 2014.