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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Modelling and assessment of urban flood hazards based on rainfall intensity-duration-frequency curves reformation" *by* Reza Ghazavi et al.

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First of all, we should thank very much for your great effort regarding our manuscript. Thank you very much for your great favor regarding our manuscript. The scientific comments and suggestions on the language and structure of the manuscript were really helpful. We have modified the manuscript accordingly, such that the detailed corrections are listed below point by point. Please do not hesitate to inform us regarding any extra comments/considerations

Interactive comment on "Modelling and assessment of urban flood hazards based on rainfall intensity-duration-frequency curves reformation" Referee #1: nhess-2016-304-RC1

Referee #1: The authors use the word flooding many times throughout the study but never actually assess flooding, neither theoretically, nor in the case study. This is probably because they use a model for sub-surface piped sewer systems using 1D simulations without capabilities of simulating flooding. They may use the tool for modelling on-ground runoff in channels? Please justify your modelling approach, either by explaining how you have adapted/used the software or by shifting to one of the many 1D2D tool available. Please also choose a suitable title:

Authors answer: As you know Flooding in urban areas can occurred via flash floods, or coastal floods, or river floods, but there is also a specific flood type that is called urban flooding. Urban flooding is specific in the fact that the cause is a lack of drainage in an urban area. In this study, this kind of flood was investigated. As you write, SWMM is a 1D model that used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of sub catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators. This model can also simulate the flow rate and flow volume of sub catchments that arrived to the channels. Based on the flow rate or volume and the dimensions and transfer capacity of channels, model indicate that where nodes or conduit may surcharged or flooded. The objective of this study was to investigate the effects of rainfall IDF curves change on the flood properties (runoff peak and volume). We change paper title as you suggested. "The effects of rainfall intensity-duration-frequency curves reformation on urban flood characteristics in semi-arid environment" As we write in the discussion, in our study area, peak and volume of runoff decreased in the recent years due to climate change, so urban drainage system has enough transfer capacity against the flood condition. It means that based on the results, the urban drainage system of Zanjan city watershed don't have a problem in the terms of flooding or surcharging condition.

Referee #1: According to the authors one of the key objectives is to update and improve previous work on IDF-relationships for the region. However, in the end I cannot derive if new data were used or not – and what the findings were

Authors answer: Old rainfall IDF curves were prepared based on Sherman method using rainfall data of 1972-1993 (P4, L125 - P5, L126). At the first step, design hyetographs of the study area was prepared via this method .This hyetographs was used as the input of SWMM model for estimating peak and volume of runoff. In 2004, rainfall IDF curves were updated by Ghahreman and Abkhezr (2004), using long term rainfall data (1972-2004). A new general relationship for rainfall IDF curves was introduced. According to Ghahreman and Abkhezr method, previous relationship is not useful for estimating 10-year hourly rainfall. At the second step, design hyetographs of the study area was prepared via IDF curve generated via Ghahreman and Abkhezr method .This hyetographs was also used as the input of SWMM model for estimating peak and volume of runoff. This information was added to the paper (page 5 Line 80-90) When we used Ghahreman and Abkhezr method, peak of the rainfall hyetograph increased while the depth of rainfall decreased (Compare to Sherman method). This information was added to the paper (Conclusion) Referee #1: You claim that the model is calibrated and performs well. Your watershed is 39 km2 and your peak discharge is less than 0.1 m3/s in the largest of the three events you have measured. These are very small events that are not representative for the flows you are trying to model. Hence the model is NOT calibrated

Authors answer: In this study, runoff measurement was done manually via field measurements for three events in one sub basin and the calibrated model was used for the study watershed. The area of this sub basin was only 4.6 km2. So peak discharge of this sub-basin was 0.1 m3/s. Furthermore, calibration files normally contain measurements of only a single parameter at one locations that compared with simulated values in Time Series Plots. At this research, in order to enhance the accuracy of the model calibration, we register three calibration data (Link flow velocity, link flow depth and link

flow rate). So, flow rate in any measured runoff event, flow velocity and flow depth were compared with simulated runoff velocity and depth. This explanation was added to the text (Page11, Line190-195)

Referee #1: You compare two methods to estimate design storms. I miss a discussion about which method you prefer and why?

Authors answer: The main objective of this study was to compare the flood properties (flow rate and volume) in two time steps. According to results, more accuracy was observed between simulated and real condition when Ghahreman and Abkhezr method was used. When we used Ghahreman and Abkhezr method, peak of the rainfall hyetograph increased while the depth of rainfall decreased (Compare to Sherman method). This dissection was added to the text

Referee #1: There is a very non-linear response between peak precipitation and peak runoff that are not justified based on the manuscript. You have a high degree of urbanization and hence the response should be more linear. Also, there are some things that makes me wonder if the results are realistic at all. The non-linearity could be the result of low degree of non-permeable surfaces in spite of the high degree of urbanization and hence a response from the previous surfaces. However, if this is the case then the time of concentration should be higher than 40 minutes from a watershed of the size studied. In conclusion it is absolutely impossible to replicate the study even if all data were presented because critical information is missing.

As we wrote, this urban watershed has 16 sub-basin (Table 1). Hyetograph of each hydrological unit was prepared separately (16 hyetograph based on Sherman method and 16 hyetograph based on Ghahreman and Abkhezr) and presented to model. For each outlet, a separated hydrograph were created via SWMM model. Estimated maximum runoff of one sub- basin (Sub-basin number 16) was indicated in figure 7. The presented time of concentration (40min) is also time of concentration of this sub basin. We have an acceptable agreement between peak precipitation and peak runoff .In this

sub-basin, based on the design hyetographs, for 40 minute precipitation, peak precipitation has been occurred in the first twenty minutes for both Sherman and Ghahreman and Abkhezr methods and peak runoff was occurred after 30min (with 10 minute delay) . Maximum flow (peak runoff) and maximum runoff volume for urban watershed was calculated as the sum of the sub-basins outlet. Table 5 indicate the estimated maximum runoff of urban drainage system based on two made hyetograph in different return period for total of the urban watershed drainage system (sum of the 16 sub basin). We didn't present a single time of concentration or hydrograph for studied watershed due to several out let of the watershed (Figure 2). explanation was added to the text

Authors answer:

Referee #1: The authors claim that they do the study because they wish to study the impacts of further urbanization and climate change impacts and cite the works by e.g. Willems and Semadeni-Davies. However, the paper contains no attempt to make projections into the future, nor how to manage current deficiencies (if any). By the way, if you wish a more recent and white publication for the work by Willems you can cite the open source publication where Willems is also author (Arnbjerg-Nielsen et al 2013).

Authors answer:

In this study, the effect of climate change on urban runoff was investigated considering the effects of climate change on rainfall properties (Rainfall hyetograph). According to results, rainfall distribution pattern was changed when recent rainfall data used for preparation of hydrograph (via climate change), consequently urban runoff characteristics were changed. This paragraph was added to conclusion Both Semadeni-Davies et al., 2008 and Willems, 2011, investigated the effects of climate change (rainfall properties) on the runoff generation (flooding conditions). So in this paper, we cited these works because they were related to main objective.

Referee #1: It is very difficult to follow the line of thought several places because of

poor language. Not even the first sentence in the abstract is proper English.

Authors answer: We edit our manuscript for a better language condition. Referee #1: P2, L63: You cannot use the rational method to determine the flooded urban area directly. The title of the work by Asgari et al also suggests that the statement does not reflect the content of what is cited

Authors answer: This sentence was improved.

Referee #1: P5, L127: Please present the Sherman equation the first time it is mentioned or give a reference. If you assume it known the first time there is no need to write it out on page 8. Authors answer: The Sherman equation was presented at the first time it is mentioned.

Referee #1: P6, L163: Since you have DEM data available it would be possible to extend the analysis to cover flooding.

Authors answer: As we explain in the first comment, Storm water management model is a 1D model that cannot do flood zoning simulation . For analysis cover flooding, in addition to DEM data, the Geometry data, Flow data, and Plan data are also need.

Referee #1: P7, L201: Correct citation is to Butler and Davies.

Authors answer: What you think is right and in the final files of this paper will be edited and modified.

Referee #1: P11, Table 3: The numbers in columns three to six does not have the unit (min). Table should be rearranged.

Authors answer: Table was rearranged as below

Table 3. Design rainfall hyetograph developed in 10-minute increments for different return periods using Sherman and Ghahreman and Abkhezr equations Method Return Period(year) Rainfall Incremental Depth(mm) Time(min) Rainfall Depth(mm) 0-10 10-20 20-30 30-40 Sherman 2 Incremental Depth(mm) 1.2 1.6 1.4 1.1 5.3 5

2.1 3.1 2.5 1.8 9.6 10 2.7 4.3 3.3 2.2 12.5 20 3.2 5.4 4.1 2.5 15.2 50 3.8 6.9 5.0 3.0 18.7 Ghahreman and Abkhezr 2 Incremental Depth(mm) 0.9 2.8 1.2 0.7 5.6 5 1.3 4.3 1.7 1.1 8.5 10 1.6 5.2 2.1 1.4 10.3 20 1.9 6.1 2.5 1.6 12.1 50 2.3 7.3 3.0 1.9 14.5

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-304/nhess-2016-304-AC1-supplement.pdf

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