December 31, 14

Dear Reviewer,

Thank you for all your very helpful comments. We have revised the paper based on the suggestions. Please refer to the attachment below for the specific changes.

Sincerely yours,

Lin Liu, Yong Liu

General comment

In this work the Authors present a new cellular automata (CA) model to simulate inundation dynamics in urban areas in case of extreme storm events. The Authors present the model calibration and validation and compare the model performances with those obtained by using a 2-D physically-based hydraulic model. The analysis matches the journal scope, the paper is well organized and, in my opinion, it is suitable for the publication even though there are some issues that need to be addressed.

Comments:

- Abstract-L10: When you say 3x3 cell I suppose it refers to meters. I think it is better to explicitly define the unit of measure.

Re: The "3x3 cell" indicates that the CA rules are applied to a rectangular template of 3 cells by 3 cells. The sentence has been changed to "In this model, a set of gravitational diverging rules are implemented in a cellular automation (CA) model to govern the water flow in a rectangular template of 3 cells by 3 cells of a raster layer."

- P6177-L3: Please correct Zanobetti.

Re: Corrected to Zanobetti.

-P6178-L21: Please notes that T, here indicated to represent the transition rules, may be confused with T adopted in Table 1 as the time step of the model. I would suggest to use "t" for the CA time step as adopted in other parts of the manuscript (see e.g. P6179-L15).

Re: Corrected "*T*" to "*t*" in table 1.

- P6179-L7: "urban object" sounds not very appropriate in this case; may be land-cover or land-use should be more adequate.

Re: Changed "urban object" to "land-cover".

- P6179-L8: Please reword this sentences, it's a little bit confusing: 16.57% seems to be the infiltration rate, not the pervious area.

Re: Changed the sentence to "Because the percentage of pervious land is very small (only 17% of the study area) and the duration of storm is relatively short, the following simple function is used to represent the infiltration rate

in the model for more efficient calibration."

- P6179 Eq. (2): at line 4 Authors say that the infiltration process is represented by a temporally-varying infiltration rate for each pixel but in the eq. (2) Ra is not represented as a function of t. Furthermore, looking at Table 2 Ra seems to be constant during the simulation. If I am not wrong it should be stated that the infiltration process is only a "spatially-varying" process, whereas the only temporal limit is due to the presence of the infiltration threshold. Finally, since I suppose Ra is defined at each computational cell, it would be more clear refer to "cell a" instead of "object a" at Line 15.

Re: The infiltration rate of each land cover type is a constant during the simulation. Based on the suggestion, "temporally-varying" in L4 has been corrected to "spatially-varying", and "object a" has been changed to "cells of land-cover type a".

- Eq. 6: What does the term A refer to?

Re: Added a sentence stating "Term A refers to a set of neighboring cells that receive water from the central cell."

- P6181-L7: Are you sure that the total number of cell involved in water re-distribution are 6? Looking at figure 1 and P6181-L2 I would say they are 5.

Re: Changed "6" to "5". Thanks for spotting this typo.

- Eq. 7: Please take care of the consistency of the variable names in the overall manuscript. Here n and S are used to indicate the roughness coefficient and the surface slope, respectively, while Table 1 reports a different meaning for S and a different name for the roughness coefficient.

Re: Changed "S" to "side" in table 1.

- Table 1: infiltration rate is indicated as "Ir" while in the text is used "Ra".

Re: Corrected "Ir" to "Ra".

- Figure 1: It will be more clear if you add the cell numbers.

Re: Yes, add a cell number at the lower-right corner of every cell in figure 1.

- Figure 2: The width of the study area is very small. Are there some reasons for that? How did you define the catchment contours? Since the slope of the area seems not trivial I wonder if and how the water run-off over the roads are considered. In other terms, does the model consider eventual lateral water inflows coming into the study area through the streets? Which hydraulic conditions did you define at the catchment outlet? Can the water flow outside the system? I think a deeper description of these aspects should be provided.

Re: Our study area is relatively small and is determined by the drainage area in the downtown area. Common flooding events in a natural watershed inundate large areas and last for hours and days. In contrast, urban flooding events usually occur in a small and even in a tiny sub-catchment and on discrete sites with lower elevation due to natural topology or civil engineering projects. Most urban flooding events normally last for tens of minutes. The pour point of our study area is one of the frequently flooding spots. It is located at a low-cross section of the main avenue in the downtown area and often causes serious traffic jam. There is a CCTV camera 24-hour monitored on site and a rain gauge nearby, thus providing us good rainfall data and water inundation (depth and volume) data on the street.

The study area is a catchment area extracted from a larger digital elevation model (DEM) using the spatial analysis tools in ArcGIS 10.1. Any lateral water inflows coming into the study area through the streets are automatically considered in this model.

There exists no backward water observed at the catchment outlet from the video capturing (CCTV) of two storm events. There are 96 inlets by the street curb draining water to undergraduate pipeline network. In our simulation water drains to the inlets as constrained by their capabilities. The drained water is removed from the surface water accumulation.

-P6185-L3: How do you define the outlet capability? It influences the water depth into the study area and need to be clearly described.

Re: There is no traditionally defined outlet (or sink) for the study area. Water is drained to the 96 inlets by street curb. The drainage capability (discharge rate) of a single inlet is calculated by Equations 3, 4 and 5.

- P6182-L22: Usually Figures are reported in the order they are referred to into the manuscript (Figure 5 should become Figure 3; please consider the possibility to reorder the positions). In any case, in Figure 5 it is not clear what are the points to which observed and simulated water depths refer to. Please correct the caption adding also the simulated water depth.

Re: Reference to Figure 5 is removed, as it is unnecessary.

Corrected the caption of figure 5 to "Time series of precipitation (mm h^{-1}), observed and simulated water depth (cm), measured from the lowest point of the catchment, during the (a) 19 April and (b) 5 September 2012 events."

- P6182-L25: The first time an acronym is used is better to fully describe it.

Re: Corrected "CCTV" to "Closed Circuit TV(CCTV)".

- Chapter 4: Considering the discussion reported into this chapter I would suggest to rename it as "Results and Discussion", while chapter 5 may simply be renamed as "Conclusions".

Re: Corrected as suggested.

- Figure 3: as for Figure 5 there are no indications about the point of interest for the simulated and observed water depth (see e.g. points in Figure 6a).

Re: A point marking the lowest point (traditionally referred to as the outlet) of catchment area is added on Figure 2. Water depth (observed and simulated) is measured using this point as the reference.

- P6183-L14: Are there some references concerning those typical infiltration values?

Re: we choose this typical infiltration values from the Storm Water Management model (SWMM) manual (5.0). So we added a reference here: "Rossman, L., Storm Water Management Model (SWMM version 5.0) user's manual. United States Environment Protection Agency, 2004."

-Table 2: Are those simulations enough to evaluate the sensitivity of the model? Impermeable land and road always adopt the same Manning's coefficient, is it necessary to distinguish those elements? What is the difference? Please, add also the variable names to the table.

Re: Roughness values and infiltration rates are identified as the key parameters in the CA model. Citing SWMM manual (5.0) and relevant literatures, we first set the parameters range (Manning's n for each land use: 0.01-0.04, infiltration rate of grassland: 2.4 - 22.5mm/h), and then tested numerous combinations of the parameters in our experimental stage through over 500 simulation runs. The 9 combination runs presented in the text are the best calibration results.