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Hydrology and Earth System Sciences Discussions

Interactive comment on "Incorporating infiltration modelling in urban flood management" *by* A. S. Jumadar et al.

Anonymous Referee #2

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Referee Comment: MS-NR: hessd-2008-0057 Title: Incorporating Infiltration Modelling in Urban Flood Management Author(s): A. Pathirana, A.S. Jumadar, B. Gersonius, and C. Zevenbergen

A.) General comments

In general the present manuscript falls into the scope of HESS, since it tries to reach general conclusions important for urban flood management. However these general conclusions are only based on very theoretical simulations, since (a) the storage volumes simulated are not attributed to real locations in a city, (b) the model is not based on any measurement of urban flow. Hence, as it stands, the paper shows only sensitiv-

ity tests of a modified, widely used simulation tools for urban storm water drainage and requires major improvements in several aspects, before publication in HESS should be considered. Ways for improvements are detailed in C. below.

B.) Specific comments addressing various aspects

1.) Does the paper address relevant scientific questions within the scope of HESS? Principally yes. The paper deals with the implementation of a physically based (Green&Ampt) approach into storage components of EPA-SWMM, a widely-used urban stormwater drainage model. The paper has mainly practical focus, but due to general conclusions it principally fits into HESS.

2) Does the paper present novel concepts, ideas, tools, or data? Only partly. The novelty of the paper lies in the fact that includes infiltration losses into the storage component of the EPA-SWMM-model, which are then used to study sustainable urban drainage systems. In principle this opens new venues in urban modelling for practitioners. The presented data are only simulation results (tests of model sensitivity). In the two case studies presented no measured data is presented and possible storages are not localized.

3) Are substantial conclusions reached? Principally yes. The study reaches three main conclusions: a.) The modifications were successful and work with the original user interface b.) Source control storage has greater efficiency in urban flood retention compared to regional systems of equal capacity c.) Urban source control storage can mimic natural catchment conditions Especially the latter two conclusions are relevant in a general sense, however all three conclusions are problematic and not sufficiently supported by data in the present manuscript as outlined below.

4) Are the scientific methods and assumptions valid and clearly outlined? They are clearly outlined but not 100% sound. To incorporate infiltration into SWMM only simple modifications were carried out. An already existing routine from another part of the original model was simply transferred to its storage components. Technically this was

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carried out by “fake subcatchments” that in the modified model version act as data linkage to storage components. The functionality of this technique was proven comparing model results with another well-known model (HYDRUS 1-D). Still the modification is not 100% sound and was made in this way mainly due to the fact that the user interface could be left unchanged. However, for a scientific paper, modifications in a model should be technically 100% sound at least in a study that in centered around these modifications.

5) Are the results sufficient to support the interpretations and conclusions? Not fully. This point is the main criticism for the present manuscript: Conclusions b.) and c.) in point 3 above are not sufficiently supported by the given data:

Conclusion b.): Source control storage has greater efficiency in urban flood retention compared to regional systems of equal capacity. This statement is based on simulation results where multiple source control storages were compared to single regional systems with equal capacity (i.e. VOLUME). However for infiltration not the volume of the storage is important, but the area where infiltration can take place. This fact needs clarification in the paper. If the regional storages should have less area with the same cumulative capacity, less infiltration losses are self evident and do not need simulations runs of a sophisticated rainfall runoff model. Also the sensitivity of different infiltration characteristics (which is high as stated in Fig. 4) needs more real world discussion in a case study: what are realistic and reported infiltration rates of urban storage systems and how do they affect the obtained results? In both case studies the storages are not assigned to real places in the urban drainage network. In the second case study this is not possible, because a catchment is selected that will never be urbanized in reality (see below). For the first case study real locations for urban storages (at least in the regional level) could be defined. Then at least the geometry of these could be described and a more realistic simulation could be reached.

Conclusion c.): Urban source control storage can mimic natural catchment conditions This conclusion is based on a comparison of “natural” SWMM results

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with those applying the source control option for a hypothetic urbanized catchment. However no information is provided on the hydrology of the natural catchment used for the simulation: What are the fundamental basin characteristics: geology, landuse, soils, rainfall and, most important, water balance and dominating runoff generation processes? Also no measured hydrograph is presented. As a baseline to represent natural behaviour only a simulated catchment response by SWMM is shown. This is based on the assumption that runoff is only generated by overland flow. The given model parameters (e.g. width of overland flow 9 km) suggest that this assumption is not very realistic. And in general it seems unfortunate why a catchment is used for the present study where urbanization will never take place, since it is a protected area upstream a (drinking water?) reservoir.

6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes: Since the produced modified version of SWMM is open source as the original fellow scientists could use it in a similar context, once it its technically sound (see above).

7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Not fully. No application of the SWMM model to other cities is cited (there are many), and only one paper of urban hydrology measurements. More credit to existing knowledge is required in two main fields: (i) real measurements of urban runoff in different scales (ii) application of urban rainfall runoff models

8) Does the title clearly reflect the contents of the paper? Yes.

9) Does the abstract provide a concise and complete summary? Yes.

10) Is the overall presentation well structured and clear? Yes.

11) Is the language fluent and precise? Language needs to be improved: e.g. “pristine” catchment, etc.

12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and

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used? Yes, but not all is needed, see down below

13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Yes. Richards Equations is not needed, because the Grenen & Ampt approach for ponded infiltration is well known in literature. The tables contain strange units (e.g. ml), and the numbers of decimals need to be unified. The figures in general are rather poor: Fig. 8-10: change format, the different hydrographs can hardly be distinguished. Fig. 11: give more information of the basin, topography, landuse, etc.

14) Are the number and quality of references appropriate? Not enough credit is given to existing studies, hence also the numbers of references needs to be increased.

C.) Main fields for improvement:

1.) Include more literature knowledge on (i) real measurements of urban runoff in different scales (ii) application of urban rainfall runoff models:

2.) Improve the language

3.) Modify the model and the user interface by including a real Green & Ampt equation to the storage components of the model with separate, clear and sound way of data input for characteristics of the storage units (geometry, infiltration characteristics, etc.).

4.) Improve the case study 1: Define exactly the locations for urban storage units in the urban drainage network. Specify exactly their geometry and present sensitivity runs with different geometries, and different, realistic infiltration rates of urban storage systems (from literature) and not with theoretical infiltration rates for soil types. Give the difference for regional versus local storage for these different sensitivity runs e.g. in a dotty plot: x-axis: local storage, y-axis regional storage with same capacity and (!) same area. If possible present real data of rainfall / runoff events. If measured runoff data are not available, at least use real rainfall data.

5.) Improve case study 2: Since the selected catchment will never be urbanized, it does not seem appropriate for the present context. Rather select a different basin, where

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urbanization is already ongoing or probable in future. To compare urban response with natural response describe in detail the hydrology of a natural catchment, including basic catchment characteristics, water balance and main runoff generation processes (e.g. relevanbce of surface flow). And, most important, include real measured runoff data.

6.) Improve the figures and tables as outlined above.

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