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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Considering rating curve uncertainty in water level predictions" *by* A. E. Sikorska et al.

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General comments

The manuscript describes the investigation of the uncertainty of parameters of hydrological model and the effect of errors contained in stage discharge relationships, called rating curve model by means of a case study in Poland. The case study deals with a densely urbanised catchment, i.e. with an urban drainage problem. The case study has been published previously (Sikorska et al.(2012)). Such segmentation of articles is neither helpful for their analysis nor generally recommended in peer reviewed publications.The uncertainty analysis uses approaches transfered from mathematics which have been most freqently applied in hydrological modelling during the last two

decades, in fact without any visible consequence for modelling in practice. Overall, the research study is an interdisciplinary approach covering environmental science (mixed rural and urban hydrology and hydrodynamics), and mathematics (models based on linear differential and non linear empirical equations and statistics). Although not in the center of hydrology, the manuscript is still in the scope of HESS.

The reviewer has considerable concerns against the publication of the manuscript, which will be explained below according to the recommendations for reviewers of HESS.

1. Does the paper address relevant scientific questions within the scope of HESS?

The paper adresses relevant scientific questions, but is of very limited practical relevance. The paper deals with a highly urbanised small river basin, which has been dealt with by urban drainage modelers so far. Existing knowledge from this scientific area is hardly addressed.

2. Does the paper present novel concepts, ideas, tools, or data?

The paper uses uncertainty analysis approaches which have been most frequently presented in literature; there is no need to cite them (Baysian statistics, Marcov Chain Monte Carlo, Box-Cox), it would count to several tens. The paper contains no innovative issues except for the analysis of the stage-discharge relationship. However, a very similar paper has been published by McMillan (2010), which is cited but not discussed at adequate depth. Also the paper largely ignores heuristic knowledge about the determination of stage-discharge relationships which are in the focus of hundreds of operational hydrologic institutions. Sikroska et al (2012) say that usually modellers do not give sufficient attention to errors contained in stage discharge relationships which is a hypothesis without any prove. In contrast responsible modellers in practice will analyse the plausibility of the stage discharge relationship in the first step of a study. Building up an adequate data base in applied modelling often requires about 60% of the project duration.

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It is obvious that the model applied is inadequate. First of all, linear model have been frequently critised as inappropriate and such a model is definitely not suitable in this case. (See Ostrowski, (2003)). Also, the manuscript lacks an assessment of the simulation quality e.g. by showing the Nash and Sutcliffe criterion.

The catchment investigated is a highly complex system, as it is very flat and directly connected to the Vistula River flood plain. It contains many hydrologically dominating elements of civil infrastructure (a large airport, several highways, industrial and domestic buildings, etc) as well as hydraulic infrastructure such as reservoirs, culverts, pipes, canals etc. The catchment properties are hardly explained neither in this manuscript nor in the underlying paper from 2012. The reviewer had to use Internet resources (Google Earth) to identify the particular structure of the catchment. Also the hydrograph in Figure 5a shows that the flow is highly influenced by in-system storage effects.

For the simulation of highly urbanised catchments in science and practice much more appropriate models such as the open source Stormwater Management Model (SWMM) by the US Environmental Protection Agency (2013) is readily available which has a history of some fourty years and is frequently updated and improved. For this model quite well funded prior parameter distributions are available. The study is based on a partial series of rainfall- runoff events. As an analytic simulation algorithm is used and the record period is only three years it is hard to understand, why this limitation was chosen. A continuous simulation over the full observation period would have been appropriate and would provide the opportunity for detailed plausibility assessment. It must be concluded that the modelling approach is definitely behind the standards applied in most industrial states and regions which is a continuous, non-linear modular model structure at high spatial (few hectares) and temporal (5 minutes) resolution. Increasingly, the setup of urban drainage models is supported by specific measurement campaigns, when high resolution rainfall and runoff is measured for optimum parameter estimation. The most critical point, however, is the stage-discharge relationship used, which is in the centre of the paper. This relationship has been established by the

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authors themselves. Internationally (ISO (2007)) and normally nationally, e.g. USGS (see Buchanan et al (1969)) standards have been set up to minimise error impacts. For the gauge discribed only a first estimate for the relationship has been set up with respect to the number of required stage- velocity measurements. Also, the hydraulic regime requires a deeper discussion of the unsteady flow impacts and nonstationarity of the relationship. As the relevant information is missing, the author estimated e.g. the stream bed slope which might be well below the threshold defined by Dottori et al. (2009) to apply more sophisticated approaches. Also the vicinity of the Vistula Rives gives rise to the hypothesis that backwater effects are relevant here.

3. Are substantial conclusions reached? There are very limited general conclusions reached. The results can hardly be transfered to other applications (models, measurements and catchments)

4. Are the results sufficient to support the interpretations and conclusions? The results led to quite vague and partly contradictive conclusions

5. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? As the data collection methods, the model and uncertainty analysis applied have been known for long it is easy to follow the theory and its application. No reference is made where the data could be received to do experiments by other scientists with the same data

6. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? The credit being given to former work is insufficient. This manuscript is a representative example for the research depths being applied at present. More information is given below. It is common understanding that a convincing paper must be built upon a solid literature review. Describing the historical development of theory and methods including the most important milestones and the inclusion of relevant non commercial literature are compulsory requirements for successful research. It is the observation of the author that rules of scientific conduct

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are increasingly violated. In this manuscript, e.g. all relevant publications stemming from the urban drainage community have been ignored (see below), but this seems to occur vice versa. Such processes obstruct the urgently required integration of water modelling disciplines and would be harmful for successful scientific development.

7. Are the number and quality of references appropriate?

The reference list seems to be quite incomplete. As for general uncertainty issues the manuscript fails to give an overview of the temporal development of uncertainty analysis. In this context, the early contributions by M.B. Beck (1983) should be listed aswell as the white paper by the same author(2009) should be given appropriate credit. They allow an assessment of the progress in environmental modelling and related uncertainty. Also the contributions of authors from the field of urban drainage modelling such as Lei & Schilling (1996) should be briefly discussed. The recent work by Deletic et al (2012) and Dotto et al (2012) need consideration. As stated above, several authors have investigated the uncertainty related to the SWMM model such as Muleta (2012). These are only a few examples.

8. Is the amount and quality of supplementary material appropriate? The supplementary material does not contain the required information on the case study to understand the particular characteristics of the catchment investigated. References

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2955, 2013.