

Interactive comment on “Water displacement by sewer infrastructure in the Grote Nete catchment, Belgium, and its hydrological regime effects” by D. Vrebos et al.

Anonymous Referee #1

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General comments: The paper presents an interesting study aiming at quantifying how sewer network infrastructure and waste water treatment plants (WWTP) modify the catchment water balance due to transfer of water from or to neighbouring catchments. This point is seldom addressed in hydrological studies and models. The paper is divided into two parts. First the impact of sewer network and WWTP is quantified using measured discharge data, as well as by delineating the areas which are affected by the sewer network and WWTP, based on very high resolution (VHR) aerial photographs (1 m resolution). Second, a modelling study, using the MIKE-SHE model couple with the MIKE-11 hydraulic model is presented. The model is modified to account for the diver-

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sion of part of the water by the sewer infrastructure. The case study is a catchment located in Belgium. The discussion of the results focuses mainly on low flows. The study is of interest for HESS readers and is original. The study has been made possible thanks to the availability of detailed data about the connection of building to a sewer network, as well as on the evolution of this connection in the future. The availability of a very detailed land use map is also quite rare. This makes this study quite unique but shows the accuracy of the information which is required if the impact of sewer networks on the water balance is to be addressed. The paper is relatively well structured. However, the methods are sometimes described too shortly for the reader to fully understand the methods (see details below). I have also some concerns about the use of the model. It is said that the MIKE-SHE model is calibrated, without saying very precisely how and which parameters are calibrated. The performance of the model is likely to be very sensitive to the estimated imperviousness, and in particular effective impervious area (the area actually connected to a sewer). Although a VHR image has been used (1 m resolution), the model mesh has a 250 m resolution, which, as acknowledged by the authors, leads to an overestimation of imperviousness in the model. The bias in the definition of imperviousness may be partly compensated by the calibration. Therefore, the quantification of the impact of the sewer infrastructure may be biased. In such a case, it could be more interesting to use the model as a “hypothesis testing tool” (e.g. Clark et al., 2011). It means setting the parameters using the available information and running it as it, before comparing it to the observations. Then sensitivity studies can be performed in order to see which the sensitive parameters are, and how they affect the hydrological response, in order to converge towards the simulated response which is the most consistent with the observations. In this case, it is possible to understand and trace the impact of the various modelling choices. In this case also, the impact of scenarios is more easily quantified as there is more control on the model parameter specification.

The discussion section is interesting, but the authors do not compare their work with previous work. This would better highlight what is general in their study. Some figures

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are of poor quality.

In terms of bibliography, the paper could be enriched using references from a recently published special issue of *Journal of Hydrology* about the hydrology of periurban catchments (J. Hydrology, volume 485, 2013), which is highly relevant for this study.

As a conclusion, the paper is interesting but needs to be improved before possible publication in HESS. A major revision is recommended.

Specific comments:

1) Abstract and along the whole paper: avoid the presentation of figures with two decimals. Given the uncertainties, one decimal is certainly enough. 2) Abstract, lines 10-12. The quantification of changes using % may sometimes be misleading, especially if they refer to very small quantities. 3) P.7426, line 25 "more important in urban settings than the vertical" 4) P.7427, lines 3-6. There is a review about low flows by Hamel et al. (2013) in the special issue of J. Hydrology about periurban catchments. 5) P. 7427, lines 15-25. Jankowsky et al. (2012) also discusses a method for periurban catchments delineation, which could be cited. 6) Study area. Could the authors provide more details about the sewer network infrastructure? Is the whole sewer a combined sewer network collecting both waste water and rainwater? If this is the case, is this combined network equipped with sewer overflow devices (SODs) which could overflow within the natural river streams? In addition, if the new sewer network consists in a combined sewer network, this would be quite uncommon, as the policy is now to go towards separated networks for waste water and rainwater. 7) P.7430, line 19. The authors mention they collected daily discharge data, but in section 2.6, they say that the model was calibrated using hourly data. 8) P.7431, land use mapping. The authors mention that the aerial photograph is from 1998, and that is had been updated. Are they able to quantify the urbanisation increase between 1998 and 2007? 9) P.7431, line 14. How do the authors define "imperviousness"? Does it include only roads, parkings, buildings? Or is part of gardens and urban parks included, as they do not have a class

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for this land cover. The definition is important as if gardens are included, it means that part of runoff could be reinfiltred into the gardens and not conveyed to the sewer network. 10) P.7431, line 22-23. The sentence describing how EIA is estimated is very short. Provide more details. 11) P.7432, section 2.4. To better understand the methods described in this section, it is important to give more details about the type of sewer network: only combined sewer? SODs?, etc. 12) P.7432, line 25. The MIKE-SHE model mesh is a grid of 250x250m. Is only one land cover associated to each grid? As mentioned by the authors, the original information has a resolution of 1 m. So the information would be highly degraded when aggregated at the 250m resolution. Do the authors specify a %imperviousness threshold to determine if a grid mesh is impervious or not. 13) P.7433, lines 10-30. MIKE-SHE is a well-known model, but a scheme would help the reader understand better which configuration has been retained in the study. In addition, the description of the model parameters and their meaning is missing. 14) P.7434, section MIKE-SHE calibration. The way the calibration is performed is not presented clearly. Which parameters are calibrated and how? Are the criteria calculated using hourly data? 15) Section 2.7. This is probably the most original section of the paper, but the presentation is not very clear. A figure may help. If I understood correctly, the authors chose to lower rainfall proportionally to the % of EIA. The implicit hypothesis is therefore that the runoff coefficient is 100% on EIA. Is it correct? The relevance of the assumption depends on the definition of imperviousness (see comment n°9). If gardens may form part of "impervious" surfaces, then the hypothesis may be questionable. 16) P.7437, lines 17-21. The presentation of the results in % is not very easy to follow. 17) P.7438, line 8. At which time step are the data used for the statistics calculations? 18) P.7439, line 16. Even if the model has been calibrated the agreement between observation and simulation is not very good. What would be the results without calibration, but using all the available information? 19) P.7442, line 23. What does the sentence "...to evaluate the impact of the EIA situated outside the catchmen"? Does it mean that impervious areas, draining within the catchment are not considered in the modelling? 20) In the discussion, the authors could compare their results to other

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studies. This would help to show what is general in their study and what is particular to their case study. 21) Table 2 caption: give the time step used in the calculation. 22) Figures 5 and 6. Why two grey levels in the histograms? These two figures are not easy to understand. What is shown here? 23) Figure 7 is not readable. Provide data averaged over a larger time step or only part of the time series. 24) Figure 9. What is shown in this figure? The unit sounds strange. 25) Same comment for Figure 11. 26) Figure 12 is not readable.

References Braud, I., Fletcher, T.D., Andrieu, H.: Preface: Hydrology of peri-urban catchments: processes and modelling, *Journal of Hydrology*, 485, 1-4, 2013. Clark, M. P., Kavetski, D., and Fenicia, F.: Pursuing the method of multiple working hypotheses for hydrological modeling, *Water Resources Research*, 47, W09301 10.1029/2010wr009827, 2011. Jankowsky, S., Branger, F., Braud, I., Gironas, J., Rodriguez, F.: Comparison of catchment and network delineation approaches in complex suburban environments. Application to the Chaudanne catchment, France, *Hydrological Processes*, 2012, in press, doi: 10.1002/hyp.9506

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