

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 #2

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General comments

This paper provides an interesting case study into the impacts of impervious surfaces and sewer related infrastructure on catchment water balances and extreme low/high flows. The implicit consideration that sewer and storm drain related infrastructure alters catchment boundaries and impervious area (and that the two are related) makes for a novel investigation and provides an important case study as the interaction and impact of such infrastructure is not often addressed in urban hydrological modelling. However the design of the study is limited by the simplified approach employed to determine the impact of water displacement. While a distributed model approach and spatial data are

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available the analysis is reduced to simply subtracting rainfall from the model input and then analysing the results. Another approach could have been selected that met the study design and data/tools available. Perhaps even a semi-distributed model would have been more suitable? It is recommended that the study design and analysis be revised to reflect the limitations noted.

The paper requires considerable work on making it more readable and the presentation of figures could be improved. The catchment set up is complex as is the analysis - and the writing and presentation do not make this complexity any easier to understand for the reader. Many of the figures require some revision or omission. The conclusions are clear but require setting against the available evidence and study limitations.

Specific comments

The total impervious area (TIA) is determined from high resolution imagery, while the effective impervious area (EIA) is from connection information applied to the TIA. The authors do not however consider that just because an area of mapped impervious area is in an area of connectivity – that it is perhaps not completely impervious per se. Other studies have identified this to be the case – and the presence of SUDS would further reduce EIA if in place. Some consideration of this should be given before providing detailed estimates of EIA to 2 decimal places – itself a little too detailed considering the uncertainty. Similarly the baseline impervious map was based on information collected over 9 years – this could affect the accuracy- and may include gravel areas as impervious. How did they define impervious cover?

The results section is poorly written and contains far too many numerical details (and decimals) for the reader to clearly follow the results and how they relate to the study design. One reason is the difficulty in communicating the various changes in catchment area by including sewer networks and EIA. A better figure that shows each step – rather than all at once would assist here.

For the calibration and validation of extreme events – how where these selected and

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are they representative of truly extreme events when considering the d/s flow data?

The use of the 250m resolution grid meant that option 1 simulating the impact of sewer infrastructure – whereby surface runoff is removed by removing impervious area – was not possible as each grid contains a fraction of impervious cover. So, option 2 is used – reducing the rainfall input by the proportion of sewer runoff contribution. This however neglects the spatial configuration and location of impervious areas and simply deducts a quality of input rainfall – which is not what has happened. More needs to be made of this in the discussion, especially when the use of an ‘Advanced spatially distributed physical model’ is detailed as ‘required’. It would seem a more lumped model could be sufficient. Also - could the model not be set up for a reduced spatial resolution?

The discussion section makes statements that the alteration of drainage impacts upon groundwater and vice versa – but no data is provided in the study to support this or referenced values used from other studies. If groundwater level data were included then some analysis of whether the systems drain away groundwater during dry periods could be assessed. This is important if climate models predict lower future summer flows. Some observations of sewer flows in dry period would provide a valuable data set to develop this study further.

Also this section does not discuss any limitations with the TIA and EIA estimates – this should be considered as well as spatial configuration of the EIA – especially when we are considering a distributed data set and model.

The model impact results discussion requires careful reading and could be more clearly communicated. The number of catchments and various alterations from WWTPs can be confusing. Essentially the model impacts section is discussing hypothetical impacts rather than real impacts – and this should be more clearly acknowledged. This study design of ‘model functioning’ versus impact of surface runoff from impervious areas via transfers – enabled by rainfall reduction – does not provide a clear enough hypothesis to be tested and the results cannot be used to determine impacts. As noted – the

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results were expected – of course – the rainfall was reduced. I would recommend the authors re-think how to package their results by implicitly considering the study design and its physical limitations. Also – the statement that surface losses are compensated by overestimation of TIA – is not backed up by any other research (no reference provided) - and also there could be gains if the groundwater contributes during the long distances. The conclusion section provides a clear and concise summary of the study and the results are important considerations for hydrological modelling of urban areas where water is displaced between catchments and impervious areas are present. Some note of limitations should however be included.

What is Box-Cox transformation – some more information would assist the reader understand the resulting plots.

Fig 1. What does the legend show – two shades for what? Catchment boundary – physical or sewer? Fig 5 & 6 – Unclear what these show, why included, and why two shades of grey. Fig 7 – Unreadable. Fig 8 – What does the mean error line show? Model fit? How come it's perfectly straight and aligned to the 1:1 line? Also extra bracket on axis title required. Clarify BC. Fig 9. Not communicative or useful plot. Why the choice of units – and why cumulative? If rain reduced so will flow – what more does this plot show? Fig 11. Distribution or contribution (axis title)? Also this plot needs river flows so that dry periods are evident – the reader does not know when these are without referring to other plots. Fig 12-13. How were return periods calculated with limited years data and what hourly flow data is now available? Also not very clear plots – suggest different scale.

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