Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-362-RC3, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Urban sewershed overflow analysis using super-resolution weather radar rainfall" *by* J. Y. Hyun et al.

S. Thorndahl (Referee)

st@civil.aau.dk

Received and published: 20 October 2016

The manuscript consists of two different parts. The first part is on adjusting Z-R relationships for radar rainfall estimation, and the second part analyses and identifies relations between rainfall characteristics and combined sewer overflow. Having conducted research with in both radar rainfall estimation and urban drainage, I initially thought the combination of the two interesting. Paper is well written and the approach is clear and understandable, there is however some major issues, explanations and assumptions that the authors in my opinion need to address, before the manuscript it is publishable in HESS.

1. Despite both subjects of the paper being very interesting, I don't see the point of joining them in one paper. Reading the paper there are in my opinion little that justifies

the use of radar rainfall. Same analysis of overflows could have been conducted with rain gauge data with similar or same results. I would suggest dividing the paper in two. One on the optimization of Z-R relationships and rainfall estimates, and one on the analysis of rainfall-overflow relationships. The objective of each paper would be much clear in this way.

2. You use a spatial resolution of 220 m of radar data, but a temporal resolution of 15 min. I would expect that a coarser spatial resolution is fairly sufficient, when you are using a temporal resolution of 15. min. or you should increase the temporal resolution in order to benefit from the fine spatial resolution. Since the radar data consists of instantaneous values every 15. min., an individual rain cell can move a large distance (and much more than the spatial resolution) within the time step of 15 minutes. Your estimation of the total precipitation over 15 minutes is thus probably not very accurate. See e.g. paper from this HESS special issue on "Rainfall and urban hydrology": Thorndahl et al. (2016) and references herein on the relationship between spatial and temporal resolution of radar rainfall data. In this paper there are also given references for advection interpolation (or downscaling) methods, which can convert the spatial resolution into temporal resolution, creating better volumetric rainfall estimates (e.g. Nielsen et al., 2014). Furthermore, I am missing the reason for looking at the adjacent 8 pixels. Why not just use one?

3. In the evaluation of Z-R relationships you discard rainfall intensities less than 5 mm/15 min. This is still a significant rainfall intensity, and I think this is problematic in terms of estimating lower rainfall intensities later on in the paper and especially since you have CSO spills generated with less rain than 5 mm. The large variability of the small intensities in figure 1 bottom right is probably related to the point above, that your intensity is not a sum over 15 minutes but a random instantaneous intensity within the 15 min window – and that the coincident rain gauge observation has a much better volumetric estimate of the rainfall over 15 minutes.

4. I am surprised that you don't consider traditional bias adjustment (e.g. Mean field

Bias) of radar rainfall data against rain gauges rather than adjusting Z-R relationship. There is substantial research conducted on this, applying different methods. I think you could get equally good estimates using a simple bias adjustment, without having to divide in different rainfall types, eg. as presented in Fig. 2.

5. Section 3: How is the overflow estimated? Is it measured? In that case I would be relevant to describe how and with some specifications of equipment. – Or is it modelled? Also it would be interesting to know how you define the overflow depth. I guess the overflow volume, per event divided by the contributing catchment area, e.g the impervious area. Is this the case? Please clarify. It could be relevant to discuss the timescale/timestep of the CSO estimates.

6. I am missing the point of using radar rainfall estimates to compare to the overflow depths. In fig. 6 it is evident that the 15 min. radar estimates have some spatial variability, but since the catchment you analyze is very small, I would not expect any significant spatial variability of rainfall within the catchment. In that case you could just use the rain gauge. – or do you think that the areal estimates are better provided by the radar?

7. I like the idea to try to characterize the rain producing overflow. I did similar analysis, based on modelling, e.g. trying to identify the impact of duration in CSO-volumes (Thorndahl, 2009). This might be relevant to compare to, even though the catchment characteristics and the upstream storage volume plays important roles. It could be relevant to mention the design criteria, if any, for CSO structures in terms of frequency of overflow, overflow volumes, etc?

References

Nielsen, J. E., Thorndahl, S. and Rasmussen, M. R.: A numerical method to generate high temporal resolution precipitation time series by combining weather radar measurements with a nowcast model, Atmospheric Research, 138, 1–12, doi:10.1016/j.atmosres.2013.10.015, 2014.

Thorndahl, S.: Stochastic long term modelling of a drainage system with estimation of return period uncertainty, Water Science and Technology, 59(12), 2331–2339, doi:10.2166/wst.2009.305, 2009.

Thorndahl, S., Einfalt, T., Willems, P., Nielsen, J. E., ten Veldhuis, M.-C., Arnbjerg-Nielsen, K., Rasmussen, M. R. and Molnar, P.: Weather radar rainfall data in urban hydrology, Hydrology and Earth System Sciences Discussions, 1–37, doi:10.5194/hess-2016-517, 2016.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-362, 2016.