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# Discussion of "Potential Dangers of Simplifying Combined Sewer Hydrologic/Hydraulic Models" by Joshua P. Cantone and Arthur R. Schmidt

Arturo S. León  
*Boise State University*

Leonardo S. Nania  
*Universidad de Granada*

Venkataramana Sridhar  
*Boise State University*

## **“Discussion of Potential Dangers of Simplifying Combined Sewer Hydrologic/Hydraulic Models” by Joshua P. Cantone and Arthur R. Schmidt**

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Arturo S. Leon<sup>1</sup>, Leonardo S. Nania<sup>2</sup> and Venkataramana Sridhar<sup>3</sup>

<sup>1</sup> Assistant Professor, Dept. of Civil Engineering, Boise State University, 1910 University Drive, Boise, Idaho, USA, 83725-2075. Phone: (208) 426-5706; Fax: (208) 426-4800; E-mail: [arturoleon@boisestate.edu](mailto:arturoleon@boisestate.edu) (corresponding author)

<sup>2</sup> Associate Professor, Universidad de Granada, Campus de Fuentenueva, Edificio Politécnico, 18071 Granada, Spain, e-mail: [LNania@ugr.es](mailto:LNania@ugr.es)

<sup>3</sup> Assistant Professor, Dept. of Civil Engineering, Boise State University, 1910 University Drive, Boise, Idaho, USA, 83725-2075. Phone: (208) 426-3710; Fax: (208) 426-4800; E-mail: [vsridhar@boisestate.edu](mailto:vsridhar@boisestate.edu)

The authors of this paper provide a valuable discussion on the potential dangers of conduit skeletonization and subcatchment aggregation. For assessing these potential dangers, a "base model" (includes all sewers, nodes, inlets and gutters) and simplified models (successive removal of elements) of two catchments were used. The discussers congratulate the authors for their work on this relevant issue and for presenting their

results in a clear and well organized way. The discussers however would like to raise some questions and comments regarding the results and their interpretation as presented in the paper.

The paper states “in using simplified models there is a danger that the user may not correctly predict the magnitude, timing, and shape of the outfall hydrograph”. The latter assumes that as the model has a more detailed description of the catchment (closer to base model) the better are the results. It is not clear how the authors arrived to the aforementioned statement. To illustrate this point, the discussers plotted the peak outflow and time to peak versus degree of skeletonization (using Tables 3, 4 and 5 in Cantone and Schmidt 2009), which are shown in Figs. 1 and 2, respectively. The plot of peak outflow versus degree of skeletonization (Fig. 1) shows that for all programs used (e.g., InfoSWMM), the peak outflow does not behave monotonically with the degree of skeletonization. Fig. 1 also shows that the difference in peak outflow between the base models (assumed to be “correct”) can be larger than the difference between a base model and its corresponding skeletonization 4. Similar conclusions can be obtained for the plot of “time to peak” versus degree of skeletonization (Fig. 2). For illustrating better the effect of pipe skeletonization, the use of the semivariogram analysis is suggested. For instance, by simply plotting the peak outflow [or time to peak] (y-axis) versus total pipe length [or another scale for the skeletonization] (x-axis), it can be observed if the variables under analysis exhibit any scale dependencies, which may help in identifying a consistent approach for skeletonization.

In the discussers' opinion, not always a more detailed model produces better results than a less detailed model. Certainly, when using a more detailed model a better representation of the catchment will be made, however the rainfall-runoff processes such as overland flows, street flows, inlet flows among others are highly complex and in most of the cases, these processes are not well represented in the current programs. The inclusion of all elements of the catchment may lead to overparameterization of the model causing uncertainty in estimates compared to another model that has lesser elements. The uncertainty in the representation of the rainfall-runoff processes of a base model can be a concern of equal or greater importance to that of the “adverse” results of conduit skeletonization and subcatchment aggregation as can be observed in Figs. 1 and 2. Tables 3, 4 and 5 [in Cantone and Schmidt (2009)], which were used for preparing Figs. 1 and 2 herein, present the outfall hydrographs using ILLUDAS, HEC-HMS and InfoSWMM, respectively. For the ILLUDAS program the peak outflow “error” of the greatest simplification (one catchment) compared to the base model is 7%. Likewise for the programs HEC-HMS and InfoSWMM the aforementioned “error” is 16% for both programs. If we compare these errors (7% and 16%) with the difference in the base models produced by the three programs used (27%), it can be seen that the main “danger” may not necessarily be due to “skeletonization and subcatchment aggregation” but due to the simplified assumptions used in the current generation numerical models for representing the rainfall-runoff processes. It is pointed out that the 27% difference among the base models was obtained assuming that the “true” peak value is given by the average value of the three base models.

In conclusion, at the current state of Urban Hydrology research and practice, it can not be expected that by using a higher data resolution a better solution will be obtained. To better address the stormwater rainfall-runoff modeling issues, we agree with the authors that physically based hydrological models are needed. Once and again, the discussers congratulate the authors for their work on this relevant issue.

## **References**

Cantone J. P. and Schmidt A. R. (2009). Potential Dangers of Simplifying Combined Sewer Hydrologic/Hydraulic Models. *J. Hydrological. Engng.*, 14(6), 596-605.