

Response to reviews on manuscript egusphere-2024-3780

We appreciate the insightful comments from the editor that have remarkably improved the quality of our manuscript. Please find below:

- our point-to-point responses (Sans Serif font in blue) to editor comments (ECs); and
- excerpts of revisions in salmon with a grey background, where necessary.

Editor Comment — The reviewers suggest accepting the paper in its current form, but I do have some suggestions and edit requests from my own reading that I would like the authors to consider before the paper can be accepted for publication in HESS.

Reply: We appreciate your recognition of our work!

EC1 Section 2.1: This section is somewhat difficult to follow. I suggest expanding the explanation of the example given, and better aligning it with the text. Please also enhance the caption of Figure 1 with more descriptive information to help readers follow the formulation more easily.

Reply: Thank you for your suggestion. We have revised the caption of Figure 1 as follows:

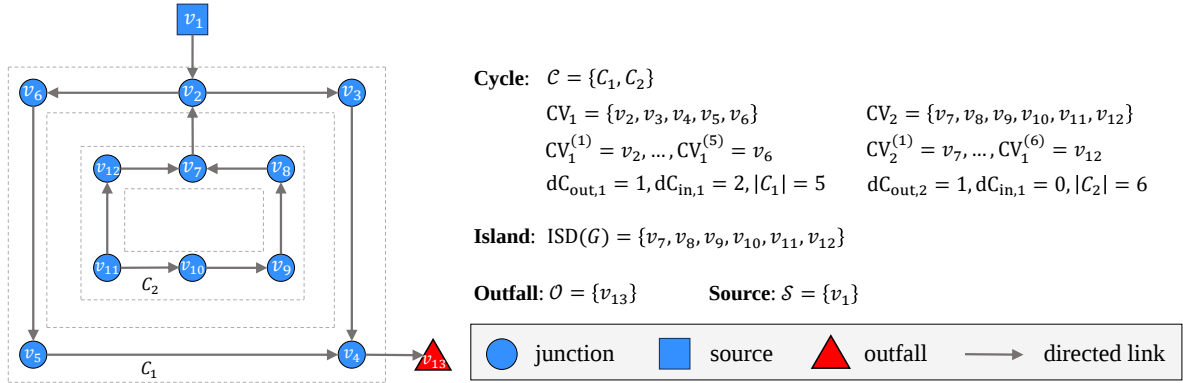


Figure 1: Cycles, islands, outfalls and sources in the graph-based sewer network representation.

Furthermore, we have revised the introduction of graph representation of sewer networks with necessary explanation of Figure 1, e.g., Line 86-88:

Considering the potential cycles in the geometric layout of G , we identify the set of simple cycles $\mathcal{C} = \{C_k\}$ defined as the set of closed paths where no node appears twice (Johnson, 1975), such as C_1 and C_2 in Fig. 1.

Line 94-95:

According to Eq. 3, we define a cycle C_k as an "island" if the sum of its in-degree and out-degree is equal to 1, such as C_2 in Fig. 1.

Line 98-99:

For a node $v_i \in V$, we include it in the set of outfalls (denoted as $\mathcal{O}$) if its out-degree is 0 and in-degree is 1, such as v_{13} in Fig. 1, or in the set of sources (denoted as $\mathcal{S}$) if its in-degree is 0 and out-degree is 1, such as v_1 in Fig. 1

By expanding the explanation of the example given as above, we hope we can make this section easier to follow.

EC2 The meaning of constraints 4 and 5 (Section 2.2) is not entirely clear. Please revise the explanation in the text for clarity. In addition, I recommend summarizing Equations 8a–8h in a table format, which could help the reader better understand the logic of the constraints.

Reply: Thank you for your suggestion. We have summarized Equations 8a-8h as Table 1 with rephrased descriptions of physical meanings of Equations 8f-8g as follows:

Table 1: Optimization constraints of gravitational flow direction derivation. $|C_k|$ is the number of nodes in C_k ; $\mathcal{E}_D^*$ is the set of links with known directions (denoted by $\vec{e}_{i,j}^*$); $\vec{e}_{\text{CV}_k^{(|C_k|)}, \text{CV}_k^{(1)}} + \sum_{i=1}^{|C_k|-1} \vec{e}_{\text{CV}_k^{(i)}, \text{CV}_k^{(i+1)}}$ is the sum of consecutively connected direction values along C_k .

Constraint	Description
$\vec{e}_{i,j} = 1 - \vec{e}_{j,i}$	No bi-directional links between consecutive nodes
$\vec{e}_{i,j} = 1, \forall v_j \in \mathcal{O}$	Outfalls must have zero out-degree
$\vec{e}_{i,j} = \vec{e}_{i,j}^*, \forall \vec{e}_{i,j} \in \mathcal{E}_D^*$	Preserves known link directions
$d_{\text{in},i} \geq 1, \forall v_i \notin \mathcal{S} \cup \text{ISD}(G)$	Nodes except for sources and those located in the islands must have positive in-degrees (Eq. 4)
$d_{\text{out},i} \geq 1, \forall v_i \notin \mathcal{O}$	Nodes except for outfalls must have positive out-degrees
$dC_{\text{out},k} \geq 1, \forall C_k \in \mathcal{C}$	Cycles must have positive out-degrees for flow passage
$\vec{e}_{\text{CV}_k^{(C_k)}, \text{CV}_k^{(1)}} + \sum_{i=1}^{ C_k -1} \vec{e}_{\text{CV}_k^{(i)}, \text{CV}_k^{(i+1)}} \leq C_k - 1, \forall C_k \in \mathcal{C}$	No recirculation within cycles

EC3 It would be helpful to include a schematic figure that illustrates a typical TSU and the fluxes computed by AUTOSHED, as described in Sections 3.1 and 3.2.

Reply: Thank you for your suggestion. We have added one schematic figure (Fig. 3) to illustrate the computation procedures within one TSU with related fluxes as follows:

EC4 Sections 3.3 and 3.4 describe the study area and baseline configurations, and are not directly related to the description of AUTOSHED in the earlier subsections. I suggest moving them to a new section (e.g., Section 4.1 and 4.2).

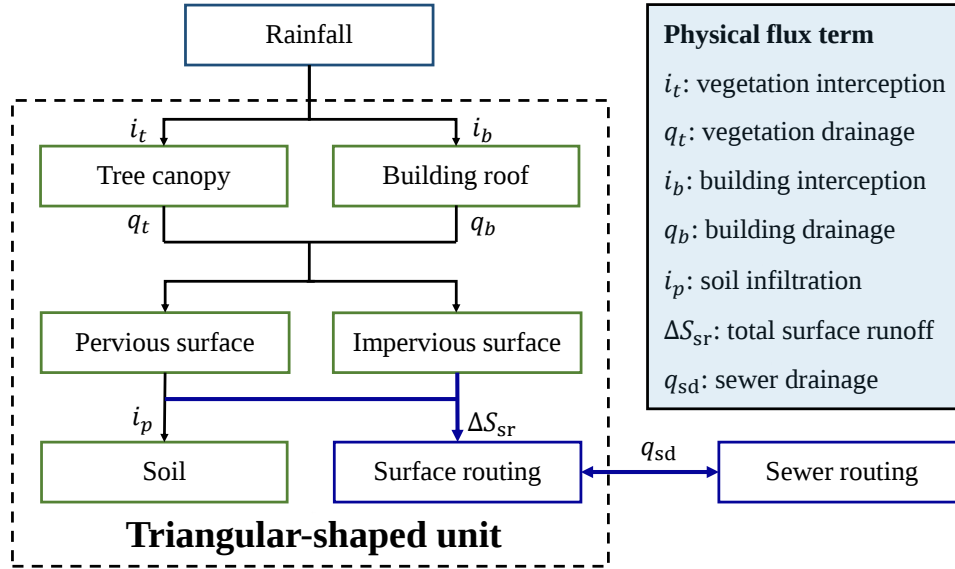


Figure 3. Flux calculation within a typical triangular-shaped unit and between surface-sewer system.

Reply: Thank you for your suggestion. We have moved Sect. 3.3 and 3.4 as Sect. 4.1 and 4.2.

EC5 Figure 5 could be moved to the supporting material, as it is mostly illustrative and not essential for understanding the main text.

Reply: Thank you for your suggestion. We have moved Figure 5 as Figure S1 in the Supplementary Material and revised the related sentence.

EC6 Figure 7 is currently not referenced in the main text. Additionally, it should be moved to the supporting material.

Reply: Thank you for your suggestion. This is due to one typo in Sect. 4.3. We have corrected the related reference to Figure 7 as follows (Line 251-252):

According to reconstructed flow directions, nodal invert elevation is further derived from values initialized by a constant cover depth (Eq. 6) and the slope distributions before / after adjustment are summarized in Fig. 7.

EC7 Rather than referring to the storm as “20220711”, please consider using a more intuitive name, such as “the July 2022 storm” or simply “the case study storm”.

Reply: Thank you for your suggestion. We have revised the related sentences as follows (Line 267-268, Line 278-280):

To facilitate the comparison of pluvial flood simulation performance using different approaches, we first calibrate the model parameters with a severe storm hitting CYC on 11 July 2022 (denoted as the July 2022 storm).

Fig. 8 shows the inundation map simulated by AUTOSHED with the sewer hydraulic module reconstructed from the FSR approach under the July 2022 storm.

EC8 Table 2 can be moved to the supporting material, as it contains standard parameter values and is not central to the main findings.

Reply: Thank you for your suggestion. We have moved Table 2 as Table. S1 in the Supplementary Material.

EC9 Figure 9 can be made smaller. The three subplots can be arranged in a single row. Aim for an overall size of approximately 8–10 cm height and 14–16 cm width.

Reply: Thank you for your suggestion. We have resized the figure into one row.

EC10 Figure 10 should be placed in the supporting material.

Reply: Thank you for your suggestion. We have moved Figure 10 as Figure S2 in the Supplementary Material and revised the related sentence.

EC11 Lines 346–356: The text in this paragraph is more appropriate for the Methods section and should be relocated accordingly.

Reply: Thank you for your suggestion. We have moved related sentences to Sect. 4.2 as follows (Line 239–242):

In order to quantify the simulation performance of different approximation methods under design scenarios, we select the Probability of Detection (POD), False Alarm Rate (FAR), Critical Success Index (CSI) and Bias (BIAS) of inundation area simulations (McGrath et al., 2018), using results from the FSR approach as the reference (see Sect. S3 in the Supplementary Material).

EC12 Equations 18–21 are standard and do not necessarily need to appear in the main text. I suggest moving them to the supporting material.

Reply: Thank you for your suggestion. We have moved Equations 18–21 to Sect. S3 in the Supplementary Material.

EC13 Figure 13: Consider resizing this figure to a smaller format. All four subplots can fit into one row, with a maximum height of 8–10 cm.

Reply: Thank you for your suggestion. We have resized the figure into one row.

EC14 Figure 14 is detailed but not essential to the main discussion; it can be moved to the supporting material.

Reply: Thank you for your suggestion. We have moved Figure 14 as Figure S3 in the Supplementary Material and revised the related sentence as follows (Line 356-357):

Thus, we further compare the discharge processes at outfalls simulated by different physical approaches (see Fig. S3 in the Supplementary Material).

References

- Johnson, D. B.: Finding All the Elementary Circuits of a Directed Graph, *SIAM Journal on Computing*, 4, 77–84, <https://doi.org/10.1137/0204007>, 1975.
- McGrath, H., Bourgon, J.-F., Proulx-Bourque, J.-S., Nastev, M., and Abo El Ezz, A.: A comparison of simplified conceptual models for rapid web-based flood inundation mapping, *Natural Hazards*, 93, 905–920, <https://doi.org/10.1007/s11069-018-3331-y>, 2018.