

## Reply to RC2: 'Comment on hess-2022-330'

[Reviewer comments in normal font; *Author replies in italic*]

This paper examines the impact of representation of anthropogenic urban geology and spatial resolution on the simulation of shallow groundwater levels and flows. The authors developed two geological models from an existing hydrostratigraphical model by accounting for urban subsurface infrastructure and soil material and integrated them with hydrological models of 50m and 10m resolution. The effect of geologic configuration and spatial resolution are then analyzed in terms of high-water levels and particle tracking using a case study of the city of Odense in Denmark. Overall, I find the paper well written and comprehensive. It is worthy of publication.

*Reply: We thank the reviewer for the overall positive and constructive feedback to our work. Below, We will address the reviewer's comments and how we intend to respond to the issues pointed out by the reviewer.*

The methods and results are well-explained, and I have no comments on them. Since this paper is submitted as part of a special issue ('Representation of water infrastructures in large-scale hydrological and Earth system models'), I would suggest that the authors revise the introduction, discussion, and/or conclusions to bring out the broader implications of advancing representations of human-water interactions in hydrological/geological models due to increased impacts of anthropogenic interventions.

*Reply: The main motivation of the study was to test a method of representing urban geology at the city scale and to simulate the impact of anthropogenic interventions on the interactions between the hydrological system and the engineered water infrastructures. We believe that we have already discussed this topic in the introduction, discussion, and conclusions but in the revision process, we will strive to highlight and elaborate this even further as required.*

Other comments I have are minor issues to be corrected:

Line 260: Missing reference

*Reply: The missing reference in line 260 is Table 2. This will be corrected during the revision of the manuscript.*

Line 301-302: Consider revising to "and another set of parameters selected to be tied to..."

*Reply: This will be revised as required.*

*The current sentence in line 301-302:*

*Based on the analyses across all models a set of free parameters was selected subject to calibration and a set of parameters to be tied to the free parameters.*

*The sentence will be revised as required to:*

*Based on the analyses across all models a set of free parameters was selected subject to calibration and another set of parameters to be tied to the free parameters.*

**Line 302: “and” instead of “sand”**

**Reply:** *We will change the text as suggested by the reviewer.*

**Line 315: “Eq” instead of “Ep”**

**Reply:** *We will change the text as suggested by the reviewer.*

**Line 317: “Eq. 2” instead of “Eq. 3.2”**

**Reply:** *We will change the text as suggested by the reviewer.*

**Eq. 2 and Line 325: Why do the weights have subscript  $h_i$ ,  $d_j$ , and  $h_k$ ? Do they change according to indices  $i$ ,  $j$ ,  $k$ ? Perhaps it will be clearer to specify the weights in Line 325 (e.g. state “ $w_{h_i} = 0.45$ ”)**

**Reply:** *First, we would like to correct a mistake in the notation of the mathematical expression of the measurement objective function, Eq. 2.*

*The correct expression is:*

$$\Phi_m = \alpha_h * \sum_{i=1}^h (\omega_{h,i} (h_{obs,i} - h_{sim,i}))^2 + \alpha_{ampl} * \sum_{j=1}^{ampl} (\omega_{ampl,j} (ampl_{obs,j} - ampl_{sim,j}))^2 + \alpha_d * \sum_{k=1}^d (\omega_{d,k} (d_{obs,k} - d_{sim,k}))^2$$

$\alpha$  is the group weight. The group weight was assigned as follows:

$$\alpha_h = 0.45, \alpha_{ampl} = 0.45, \text{ and } \alpha_d = 0.10$$

$\omega$  is the weight of  $i$ 'th,  $j$ 'th or  $k$ 'th observation. As a standard, all observations had a weight of 1, yet after initial calibration runs some of the head and amplitude observations located near the west boundary were assigned a value of 0.

*During the revision of the manuscript, we will correct the mistake in Eq. (2) and specify the group weight more clearly in the text as suggested by the reviewer.*

**Fig. 4: Refrain from using a rainbow colour scale as it could misrepresent data due to its non-linear change in hue**

**Reply:** *We will change the color scale to be both a perceptually uniform scale and color-blind friendly.*

Fig 5: “56%” instead of “57%” in the bar plot

**Reply:** Thank you for pointing out the inconsistency in the text and the numbers in Fig. 5. The correct value is 57% this will be corrected in the text of the manuscript during revision.

Line 438 – Line 441: Please check the subscripts of the model parameters. Some capitalisations are inconsistent with those in Fig. 10

**Reply:** The errors in the abbreviation for the parameter will be corrected as suggested by the reviewer during the revision of the manuscript:

In line 436: the parameter abbreviation will be corrected from  $K_{qbv2,h}$  and  $K_{qc,v}$  to  $K_{bv2,h}$  and  $K_{Qc,v}$

In line 437: the parameter abbreviation will be corrected from  $K_{j25,h}$  and  $dr,grass$  to  $K_{cl,h}$  and  $D_{r,grass}$

In line 438: the parameter abbreviation will be corrected from  $K_{qbv2,h}$ ,  $K_{qc,v}$ ,  $K_{qs2,h}$  and  $dr,grass$  to  $K_{bv2,h}$ ,  $K_{Qc,v}$ ,  $K_{Qs2,h}$  and  $D_{r,grass}$

In line 439: the parameter abbreviation will be corrected from  $K_{qbv2,h}$  to  $K_{bv2,h}$ .

In line 441: the model parameter will be corrected from  $K_{s70,h}$ , to  $K_{S70,h}$ .

Line 446-447: delete “4.3 Simulation of high-water levels.”

**Reply:** Thank you for pointing out this typo error. We will delete this during the revision of the manuscript.

Line 452: “V2\_50” instead of “V2\_5”

**Reply:** We will change the text as suggested by the reviewer.

Line 477: add “models” after “V2”

**Reply:** We will change the text as suggested by the reviewer.

Line 509, 517: Check capitalization and subscript of parameter “ $D_{r,grass}$ ” and “ $K_{Qs2,h}$ ”

**Reply:** This will be corrected during the revision of the manuscript as suggested by the reviewer.

In line 509: the parameter abbreviation will be corrected from  $dr,grass$  to  $D_{r,grass}$ .

In line 517: the parameter abbreviation will be corrected from  $K_{qs2,h}$  to  $K_{Qs2,h}$

In line 519: the parameter abbreviation will be corrected from  $K_{qs}$  to  $K_{Qs}$