Response to editor and reviewers comments for the manuscript "Identification of Parameter Importance for Benzene Transport in the Unsaturated Zone Using Global Sensitivity Analysis" submitted to *Hydrology and Earth System Sciences* (all authors' answers are in blue font, all editor's and reviewers' comments are in black font).

Editor comments: While I do agree with the Reviewer, I would suggest the Authors to carefully check their manuscript also with reference to proper usage of English and in light of the very final comments provided by the Reviewer. I will then be in a position to make final assessment.

We agree with the editor's comment. The manuscript was sent for final English and scientific revision these changes can be found in the manuscript track changes version across the text. Also a rerun of the heterogeneous media Morris analysis was conducted as detailed below.

Please find the comments given by the reviewer and our response below.

Reviewer comments:

Dear Editor
I have once again reviewed the manuscript titled 'Identification of Parameter Importance for Benzene Transport in the Unsaturated Zone Using Global Sensitivity Analysis.' The authors have addressed the majority of the comments, and I believe the manuscript is now ready for publication.

We thank the reviewer for his positive evaluation.

However, I did notice a few mistakes and typographical errors, as outlined below. Moreover, I do suggest that the authors add a short discussion (no more than four lines) on why they think the λ is the most sensitive and under what conditions it would be so sensitive. I think it would draw more attention.

The following text was added: "λ_k the rate of benzene removal from the media by biological degradation. This rate can vary greatly from extremely fast to very slow rates, depending on parameters such as initial benzene concentration and soil water content (Table S1). In general, the degradation rate is lower for higher concentrations and lower water content, and vice versa." (lines 621-624 of the revised manuscript).

Following the reviewer's comment the manuscript was sent to professional English editing. We believe the manuscript is now ready for publication.
Specific comments:

1. Line 182: The q is separately calculated using the Darcy-Buckingham? The q is calculated by solving the Richards equation. I understand that the Darcy-Buckingham is a component within the Richards equation, but technically you don't solve the Darcy-Buckingham directly.

We agree with the reviewer. q is calculated by solving the Richard's Equation. The definition of q is given here for completeness.

$$\theta D^w = \alpha_L q + \theta D^M \tau_w \quad (1)$$

where D^M is the benzene's molecular diffusion coefficient in the aqueous phase [L^2T^{-1}], q is the absolute value of the Darcian fluid flux [LT^{-1}] evaluated using the Darcy–Buckingham law, $q = -K(\frac{dh}{dz} + 1)$. "

Table 2: the range of the n parameter for clayey soil is wrong (0.13-1.31). We know that n cannot be smaller than 1.

It is true and we would like to thank the reviewer for this important comment. Following this comment the lower value of n_2 for the clayey soil was updated in Table 2 to a range of 1.09-1.31 (Carsel and Parrish, 1988). Also we reran the Morris sensitivity analysis for heterogeneous media with the updated values. The parameters ranking came up a bit different, with higher weight of some of the clay soil parameters, smaller error bars, more cases of the model incovergence and results that were overall more coherent with the homogenous media results and the literature.

The corrected results are presented in section 3.2 and are also addressed in the abstract (lines 34-38 and lines 40-42 of the revised manuscript) and in the summary and conclusions (lines 655-658 of the revised manuscript).

2. Line 491: revise the capital T to small t.

Corrected, thank you (line 499 of the revised manuscript).

References

Carsel, R. F. and Parrish, R. S.: Developing joint probability distributions of soil water retention characteristics, Water Resour. Res., 24, 755–769, https://doi.org/10.1029/88WR01772., 1988.