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Reply on CC1

Anis Younes et al.

Author comment on "A robust upwind mixed hybrid finite element method for transport in variably saturated porous media" by Anis Younes et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-153-AC1, 2022

CC1: 'Comment on hess-2022-153', Thomas Graf, 25 May 2022

This manuscript introduces a new upwind Mixed Finite Element (MFE) method to solve for solute transport under saturated and unsaturated conditions. The new scheme is shown to avoid unphysical oscillations that is otherwise potentially caused by advection.

The manuscript is clearly written, and the mathematical context is sound and complete. The two illustrative results are useful and demonstrate very well the capabilities of the new method.

Answer: We highly appreciate the Reviewer's positive appraisal of our work as well as careful reading of the paper. As detailed below, all comments are accounted for in the new revision.

There are some minor comments that I ask the authors to address:

- There are a number of filling words (especially "indeed") that need to be removed. It is also uncommong to use "the" in e.g. line 129 when generally addressing water content etc.

Answer: Corrected in the entire document.

- Description of boundary conditions of the two examples in section 4. is not complete. Both figures 4 and 7 should show all BCs for both flow and transport. As is, this is not the case and must be changed. Also, the text does not give the full description of all BCs for both flow and transport, which also has to be completed.

Answer: Figures 4 and 7 have been changed to include all flow and transport boundary conditions. A full description of all BCs is also given in the text of the revised version.

A figure that shows the meshes for both examples is missing and would be very helpful. I understand it is an unstructured mesh which explains the fact that result in Fig. 5 is not symmetric. This should be mentioned.

Answer: Although we have used an unstructured mesh, the results of Figure 5 show almost symmetrical results, except the unphysical oscillations obtained with the standard

MFE scheme.

Note that in the revised version, the first test problem is also simulated using different mesh refinements to investigate time and space convergence of the new developed method.

For simplicity, it would have been more efficient to use only the upper half of the domain due to symmetry reasons. The authors should give a reason why they did not do so.

Answer: Yes, it is more efficient to simulate only the upper half of the domain because of symmetry, but we prefer to simulate the whole domain to have more representative results and show the capability of the new upwind MFE model to reproduce symmetrical results.