Hydrology and Earth System Sciences Discussions

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Comment on hess-2022-422

Anonymous Referee #1

Referee comment on "MOIST: a MATLAB-based fully coupled one-dimensional isotope and soil water transport model" by Han Fu et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-422-RC1, 2023

I suggest rejection for the following reasons:

Equation (1) is the water content-based Richards equation. It is well known that this kind of formulation cannot handle saturated problems and is not well posed at the interface between two layers, because water content is discontinuous. The mixed form of Richards equation should be used.

The heat transfer equation (2) is not correct. Csoil depends on the water content and should be embed in the time derivative.

More information should be provided concerning the solvers (ode113, ode23tb).

The tests 1 to 6 are very qualitatively discussed. Only different types of processes are checked. Physical processes can be verified but it does not mean that the computed variables and the process kinetics are correct. Moreover, these tests are development tests. They do not provide any new information on processes and therefore, should not be part of the manuscript. It is expected that models overcome these kinds of tests before publication.

L479-480: the reason for poor MAE value is unclear to me.

L521-540: The analysis of the difference between fully coupled or sequential approach (segregation) is convincing but it applies for an explicit time scheme discretization whereas HYDRUS and SiSPat use an implicit scheme. Moreover, the flow equation is written in terms of water content for MOIST, the other codes are using pressure based or a mixed form of Richards equation.

L608-610: The discussion about boundary conditions and intermodal conductivity is very popular. There are key papers not cited in the manuscript that review some of the techniques (see for example Belfort et al.,. On equivalent hydraulic conductivity for oscillation–free solutions of Richards equation. Journal of Hydrology, 2013, 505, pp.202-217).

MOIST was used to simulate two types of experiments and the authors concluded that MOIST is more accurate and reliable. This is not supported by the provided results. These results only show that MOIST might be better calibrated not that the numerical scheme –

fully coupled- is better than other schemes. Parameters used by MOIST and the other models should be given.

The comparisons do not provide any information on the code accuracy and efficiency. To demonstrate the 'excellent performance of the MOIST,' the authors should compare their code with other existing codes (for example looking at breakthrough curves at different locations) and check detailed mass balances, time and space discretization sensitivity and computer time.