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Comment on gmd-2021-163

Anonymous Referee #1

Referee comment on "Implementing the Water, HEat and Transport model in GEOframe (WHETGEO-1D v.1.0): algorithms, informatics, design patterns, open science features, and 1D deployment" by Niccolò Tubini and Riccardo Rigon, Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-163-RC1>, 2021

This paper does a very good job of describing the design idea, software engineering, and the technical issues about implementing a physically based model—WHETGEO, to simulate the water and energy budgets in a soil column. All the text is easy to follow and understandable. The figures, tables, and equations are well prepared and organized. The authors gave a good review on the mathematical and numerical issues involved in solving the Richardson-Richards equation. However, what's new in this paper is not easy to find. Some ideas and proposals mentioned in the front part are not well addressed in the latter. The purpose of incorporating heat transport and surface energy budget and their advantages are not well demonstrated. The overall impression of this paper is about assembling some available models or parameterizations in a new style. There can be some improvements on the science part and I hope the authors put more attention on the science part instead of the software engineering in writing, especially for the scientific significance and internal logics.

- In the conclusion part, it reads that "The implementation has been shown to solve the issues presented in 7 observations, 3 requirements, and A to H design specifications". There is no problem with "A to H design specifications". But for the "7 observations, 3 requirements", they are not well "solved", or not easy to find at least, in the current presentation. This is one major concern of this paper.
- Following point 1, there are "7 observations, 3 requirements" which have been solved as mentioned. Are they all unique features of the currently proposed model? Since there is no comparison with other existing models.

- What's the new development of the model in physical about this paper? Besides the software engineering or technical part. As the paper said in the abstract "a new, physically based..."

- If the purpose of this paper is to assemble some models already developed, the test cases in the appendix are very common. More importantly, there is no comparison with other models. So the advantages are not well demonstrated. The resolution of the time step (60 s) and soil grids are all very small. For the energy budget and phase change (Appendix D), only the result and difference are presented. The energy budget and phase change are common functions in land surface modeling or hydrological modeling. Because there is nothing special in the case design in the appendix, many other models may also reproduce such a result.

- Eq. (8) (Line 105) is not further mentioned.

- Please check with (26), (27), (29) and (30) about the sign of operation.

- Some units in Figs. 2, C2, C4, C9, C11, D1, D2, and D3 are missing.

- Please unify the soil layer index, k or i . Such as i in Eq. (21), k in Figure 1, and some other places.