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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Analytical and Numerical Solutions of Radially Symmetric Aquifer Thermal Energy Storage Problems" *by* Zerihun K. Birhanu et al.

Anonymous Referee #3

Received and published: 30 September 2017

The authors used analytical and numerical methods to investigate heat transport in saturated porous media. An approximate solution for 1D case and both analytical and numerical solutions for 2D case are presented. Case studies are also given to show temperature profile near a well in an ATES system.

The manuscript is poorly written. The structure of this manuscript is difficult to follow. The authors do not show clearly what are done by this study.

The authors did not cite any paper from this journal. The reviewer doubts where this study fits the aim and scope of this journal or not. There should be some of the papers in the journal have done research work similar to this study. The authors should at

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Discussion paper

least cite a few most related papers.

The symbolic system in the manuscript is chaotic, the formula are logically unconnected and adds an additional reading burden.

The time scale in the models and solutions are not reasonable. Many of them are less than 1 s. Such times are not comparable to real systems. The authors should clarify this point.

There are many unphysical parameters in the manuscript. For example, a 500 mm grain size in Table 2 and a k1=1 m/s in Figure 1. Both of them are too large. The authors should use reasonable parameter values in order to make the results useful.

Specific comments: (1) Equation (31): As the exact solution already exists, there is no need to derive an inaccurate approximate solution. Comparing equations (31) and (32), one can find that equation (31) is just the first term of equation (32). As can be seen from Figure 1, equation (31) is inaccurate and it is not a good approximation.

(2) Figures 1, 2, 4, 5: The temperature T ranges from 0 to 1 °C. Such temperatures are too low for a thermal energy storage problem. The authors should explain why the temperatures are so low. These temperatures are not reasonable and unphysical.

(3) Since an exact solution equation (39) is already exist, there is no need to present the numerical solutions. If the Lagrangian solution is used to examine the correctness of the exact solution, then why the authors also present the upwind solution here?

(4) Page 5 Line 9: The author use “may”. It increases the uncertainty of the model. Whether the two are equal also need to be discussed.

(5) Page 5 Line 9: in "q = qi" formula the variable i does not have a proper description, it is puzzling.

(6) Page 12 Line 22: The unit for t should be given. Is it in seconds? If yes, then t in Figure 5 is also in seconds. In Figure 5, the authors stated that "Hot water is injected

for t<0.5 and pumped for t>0.5". The hot water injection is only 0.5 s. Such a short time is unphysical. Why the author did not use time scales in the analytical and numerical solutions comparable to real cases? For example, 12 hours used in Section 5. Or the analytical and numerical solutions are incorrect and cannot be used for real cases?

(7) Page 15 Line 13: "can me" should be "can be"

(8) Page 15 Lin 24: dp=1 mm is a reasonable value, why the authors use it as an extreme case?

(9) Figure 6: The upper right corner of the sub-figure is puzzling. Why it is so difficult from the other sub-figures?

(10) The conclusion section should be rewritten. The authors should put main conclusions here.

In conclusion, the reviewer suggest rejecting this manuscript.

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