Further remarks:

1. Had our proposed model been oversimplified, we would not have been able to validate our numerical results with the semi-analytical solution suggested by Guppy et al. (1981b) for the bilinear flow regime. As demonstrated in our work, as a first step we validated our numerical results with the semi-analytical solution introduced by Guppy et al. (1981b) for the bilinear flow regime.

2. Had our proposed model not considered flow in fractured and porous media (dual permeability model), it would not have been possible to obtain bilinear flow. As it has been proven in our work, we were able to numerically simulate bilinear flow regime.

3. Validated physical models that credibly simulate physical reservoir processes such as groundwater flow in fractured porous media with COMSOL Multiphysics have been successfully documented and published in international, peer-review journals (see item 5. below). From the point of view of the authors, what matters is a rigorously formulated, mathematically validated simulator that reliably represents the physics of the reservoir processes. As a matter of example: tested, benchmarked and generally validated reservoir models, including a variety of coupled reservoir processes have been simulated with COMSOL Multiphysics, e.g.

https://www.comsol.de/blogs/modeling-geothermal-processes-comsol-software/

We kindly ask the Referee #2 to have a look at a large list of validated models in different research fields that have been simulated with COMSOL Multiphysics and the corresponding published literature on the following link (COMSOL Verification and Validation Models):

https://www.comsol.com/verification-models/?sort=popularity

In addition, we kindly ask the Referee #2 to check an extensive literature on published works, documenting modeling and simulation of reservoir processes with COMSOL Multiphysics on the following link:

https://www.comsol.de/papers-presentations

(Relevant contributions can be filtered by the Referee #2 by entering the concerned keywords)

Multiphysics is certainly one of the strengths of COMSOL. Rigorously modeling and simulating the multiphysical nature of reservoir processes in fractured porous geologic media constitutes one of the strengths of COMSOL Multiphysics. Slightly different PDEs, e.g. for heat and solute transport, are coupled with the flow equations, both in porous and fractured geologic media.

4. Alternatively, and/or additionally, benchmarking our model has been an important step to show that the simulation software COMSOL Multiphysics is suitable. Generally speaking, various sources for benchmarking fracture-flow can be found e.g.:

https://git.iws.uni-stuttgart.de/benchmarks/fracture-flow

(see also “Benchmarks for single-phase flow in fractured porous media" by B. Flemisch et al. 2017.)

As mentioned previously, as a first step we have corroborated our numerical results concerning the bilinear flow regime with the semi-analytical solution suggested by Guppy et al. (1981b).

5. Further, we kindly encourage the Referee #2 to check numerous published works in reservoir engineering that address flow in fractures and matrix formation using COMSOL Multiphysics as reservoir simulator:

https://www.onepetro.org/search?q=COMSOL+Multiphysics&peer_reviewed=&published_between=&from_year=&to_year=&rows=25

(COMSOL Multiphysics as keyword)

The robustness of the simulation software COMSOL Multiphysics for groundwater flow in fractured porous media has been shown in several works published in international and peer-reviewed journals, e.g.:

- Zhang, Q., Ju, Y., Gong, W., Zhang, L., Sun, H.: Numerical simulations of seepage flow in rough single rock fractures, Petroleum, Vol. 1, Issue 3, pp. 200-205, https://doi.org/10.1016/j.petlm.2015.09.003, 2015.

- Qu, Z.-q., Zhang, W., Guo, T.-k.: Influence of different fracture morphology on heat mining performance of enhanced geothermal systems based on COMSOL, International Journal of Hydrogen Energy, Vol. 42, Issue 29, pp. 18263 – 18278, https://doi.org/10.1016/j.ijhydene.2017.04.168, 2017.

- Wang, L., Cardenas, M. B., Slottke, D. T., Ketcham, R. A., Sharp, J. M.: Modification of the Local Cubic Law of fracture flow for weak inertia, tortuosity, and roughness, Water Resources Research, 51, pp. 2064–2080, https://doi.org/10.1002/2014WR015815, 2015.

- Chen B., Song E., Cheng X.: Plane-Symmetrical Simulation of Flow and Heat Transport in Fractured Geological Media: A Discrete Fracture Model with Comsol, In: Laloui L., Ferrari A. (eds) Multiphysical Testing of Soils and Shales, Springer Series in Geomechanics and Geoengineering, Springer, Berlin, Heidelberg, https://doi.org/10.1007/978-3-642-32492-5_17, 2013.

- Saeid, S., Al-Khoury, R., Barends, F.: An efficient computational model for deep low-enthalpy geothermal systems, Computers & Geosciences, 51, pp. 400 – 409, https://doi.org/10.1016/j.cageo.2012.08.019, 2013.

- Ekneligoda, Th. Ch. & Min, K.-B.: Determination of optimum parameters of doublet system in a horizontally fractured geothermal reservoir, Renewable Energy, 65, pp. 152 – 160, https://doi.org/10.1016/j.renene.2013.08.003, 2014.

- Kristinof, R., Ranjith, P.G. & Choi, S.K.: Finite element simulation of fluid flow in fractured rock media, Environ Earth Sci, 60, pp. 765–773, https://doi.org/10.1007/s12665-009-0214-2, 2009.

- Li, Q., Ito, K. Wu, Z., Lowry, Ch. S., Loheide, S. P.: COMSOL Multiphysics: A Novel Approach to Ground Water Modeling, Ground Water, Edi. Zheng, Ch, Vol. 47, No. 4, https://doi.org/10.1111/j.1745-6584.2009.00584.x, 2009.

- to mention a few).

6. Other reservoir simulators widely used in academics and industry for one-phase, compressible groundwater flow in saturated, confined aquifers, that use the same formulation for the description of flow in fractures and formation matrix in terms of the storage coefficient as COMSOL Multiphysics, are FEFLOW® (developed by DHI WASY) and MODFLOW (developed by the USGS) – to mention a few. We kindly ask the Referee #2 to have a look at, e.g.:

- Diersch 2014, Chapter 9 *Flow in Saturated Porous Medium: Groundwater Flow*, and more specifically Subchapter 9.2.1 *Basic Equations*, Eqs. 9.1 – 9.2; and Chapter 4 *Discrete Features*. (Diersch, H.-J.G.: FEEFLOW: Finite Element Modeling of Flow, Mass and Heat Transport in Porous and Fractured Media, Springer Science + Business Media B.V., https://doi.org/10.1007/978-3-642-38739-5, 2014.)

- https://www.usgs.gov/mission-areas/water-resources/science/modflow-and-related-programs?qt-science_center_objects=0#qt-science_center_objectsc and the documentation for the MODFLOW 6 Groundwater Flow Model (Chapter 55 of Section A, *Groundwater*, Book 6 *Modeling Techniques*, Eq. 2-2, https://pubs.usgs.gov/tm/06/a55/tm6a55.pdf)

- Vázquez-Báez, V., Rubio-Arellano, A., García-Toral, D., Rodríguez-Mora, I.: Modeling an Aquifer: Numerical Solution to the Groundwater Flow Equation, Mathematical Problems in Engineering, Vol. 2019, Article ID 1613726, https://doi.org/10.1155/2019/1613726, 2019.

- Kumar, C. P. & Singh, S.: Concepts and Modeling of Groundwater System, International Journal of Innovative Science, Engineering & Technology – IJISET, Vol. 2, issue 2, 2015.

7. Although the Referee #2 suggests using another reservoir simulator where the diffusivity equation for transient flow is explicitly expressed in terms of porosity and compressibility and where dual-porosity dual permeability models can also be designed, no concrete reservoir simulator is proposed by the Referee #2. In case more commercial reservoir simulators, perhaps more widely used in petroleum engineering for multi-phase flow of black oil and gas such as MultiSim™ and Schlumberger Eclipse are meant, we want to refer to the strengths and limitations of those simulation software. We kindly ask the Referee #2 to have a look at, e.g.:

- Chin, W. C. & Zhuang, X. 2020, Chapter 3 *Reservoir Simulation – Strengths, Limitations and Strategies*. (Chin, W. C. & Zhuang, X.: Reservoir Simulation and Well Interference: Parent-child, Multilateral Well and Fracture Interactions, Handbook of Petroleum Engineering, Scrivener Publishing LCC, First Edition by John Wiley & Sons, Inc, 2020.)

- EGL Eclipse Reservoir Simulation Software, Eclipse Reference Manual, Version 2018.1.

The strengths and limitations of different simulation software for fluid flow in fractured porous geologic media are attributed to numerous aspects, such as: Assumption and approximations in the mathematical physics considered, implementation of the specific numerical method used (FDM, FEM, VEM, etc..), space and time discretization algorithms, mesh generator capabilities (Cartesian, rectangular or curvilinear coordinates), linearization techniques, stabilization, convergence, speed, visualization techniques, test, validation, etc..). It is beyond the scope of our answer to compare several reservoir simulators in terms of their strengths and limitations.

Although some industries claim to have developed “All-purpose”, “comprehensive” reservoir simulators, for every application there are several reservoir simulators revealing advantages and disadvantages. Every simulation study (experiment design) of fluid flow in fractured porous media constitutes a unique series of actions, initiating from the aquifer characterization to the ultimate examination of results. We kindly ask the Referee #2 to have a look at, e.g.:

- Islam, M. R., Hossain, M. E., Moussavizadegan, S. H., Mustafiz, S., Abou-Kassem, J. H.: Advanced Petroleum Reservoir Simulation: Towards Developing Reservoir Emulators, Second Edition, Scrivener Publishing LLC, Co-published by John Wiley & Sons, Inc. Hoboken, New Jersey, 2012.

- Chin, W. C.: Reservoir Engineering in Modern Oilfields: Vertical, Deviated, Horizontal and Multilateral Well Systems, Handbook of Petroleum Engineering Series, Vol.1, Scrivener Publishing LCC, Co-published by John Wiley & Sons, Inc. Hoboken, New Jersey, 2016.

- Chin, W. C. & Zhuang, X.: Reservoir Simulation and Well Interference: Parent-child, Multilateral Well and Fracture Interactions, Handbook of Petroleum Engineering, Scrivener Publishing LCC, First Edition by John Wiley & Sons, Inc, 2020.

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2. Maliva, R. G.: Aquifer Characterization Techniques, Schlumberger Methods in Water Resources Evaluation, Series No. 4, *c*, Springer International Publishing Switzerland, https://doi.org/10.1007/978-3-319-32137-0, 2016.

3. Bear, J. and Cheng A. H.-D.: Modeling Groundwater Flow and Contaminant Transport, *Theory and Applications of Transport in Porous Media*, Springer Science + Business Media B.V., https://doi.org/10.1007/978-1-4020-6682-5, 2010.

4. Bear, J.: Hydraulics of Groundwater, Manufactured in the United States of America Dover Publications Inc., 31 East 2nd Street, Minoela, N.Y. 11501, 2007.

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