

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2021-45

Mauro Cacace (Referee)

Referee comment on "RHEA v1.0: Enabling fully coupled simulations with hydro-geomechanical heterogeneity" by José M. Bastías Espejo et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-45-RC2>, 2021

Dear Sir/Madam,

I read with great interest the manuscript entitled "RHEA v1.0: Enabling fully coupled simulations with hydro-geomechanical heterogeneity" by Espejo and co-workers. In the study, the authors presented an automatic workflow (at least that is my impression) to create input files to be used by an existing physics module developed within the MOOSE framework.

Despite I acknowledge the efforts from the authors, I am advising for a major revision before the paper can be considered for its publication in GMD. The main criticism is that the paper lacks the scientific novelty required to make a major contribution to the related community. This is not a limitation of their approach (I think), but rather stems from the authors' choice of the examples discussed in the paper. Indeed, while claiming that their workflow contributes to advance the scientific computing efforts for complex subsurface applications, they limited their discussion to simplistic analytical examples. Terzaghi consolidation is a relatively simple benchmark, which should only be used to validate the physics implementation of their numerical tool. However, this is not the topic of the manuscript, given that the authors relied on existing modules (Porous Flow and Tensor Mechanics). Their realistic example is also a synthetic and simple one, 2 dimensional and with no clear tangible application.

I am saying this, because the reader is left with the (wrong?) impression that the main contribution of the manuscript is the development of a python script binding MOOSE's objects, which to my opinion does not satisfy the minimum scientific level for a publication (it would rather fit as an internal report). This said, I would warmly advise the authors to re-organize the manuscript in a way to better convey the main message of their work, and, in doing so, to prove their generic sentencing as "... Our work is a valuable tool to assess challenging real world hydro-geomechanical systems that may include different levels of complexity like heterogeneous geology with several time and spatial scales and sharp gradients produced by contrasting subsurface properties. ...", for which I could not

find any concept of proof in the text.

More specific comments:

* Abstract - sentence at lines 4-5 - it requires some reworking. Stating that there are no simulations considering heterogeneity in the subsurface is simply not true (an extensive literature research is required here). In addition, it is not clear what they mean by "verification".

* Introduction - sentence at lines 26-27 - also this sentence is not true ("infeasible").

*Introduction - sentence at lines 65-67 - The coupling among physics is not done automatically but via off-diagonal components in the system's Jacobian matrix.

* Paragraph 3 - sentence at line 136 -Material properties are defined at the element level by default in any FEM application.

* Paragraph 3 - sentence at line 155 - Why the size of the mesh needs to match the coverage of the sampling data? Is that a limitation of a naive implementation of the interpolation routine used within the workflow?

* Why rephrasing equation 8 in terms of the hydraulic conductivity? It does not match the formalism used in the previous paragraph ...