EGU21-4301
https://doi.org/10.5194/egusphere-egu21-4301
EGU General Assembly 2021

Benefit of poroelasticity for geothermal research

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For geothermal purposes (heat and electricity generation) it is necessary to have an aquifer from which the contained hot water can be lifted by drilling. The exchange of the hot water against some cooled off water has an effect on the surrounding material and displacement of the material has an influence on the pore pressure and the water. Poroelasticity can model these influencing effects by partial differential equations.

We want to apply poroelasticity in geothermal research by so-called multiscale modelling. Scaling functions and wavelets are constructed with the help of the fundamental solutions. A related method has been previously used for the Laplace, the Helmholtz and the d'Alembert equation (cf. [2],[4],[5]) as well as for the Cauchy-Navier equation, where the latter requires a tensor-valued ansatz (cf. [3]). We pursue this concept to develop such an approach for poroelasticity, where a fundamental solution tensor is known (cf. [1]).

The aim of this multiscale modelling is to convolve the constructed scaling functions with the data of the displacement u and the pressure p. With this, we have the opportunity to visualize structures in the data that cannot be seen in the whole data. Especially, the difference of the convolution of two consecutive scaling functions is expected to reveal detail structures.

For the theoretical part, we can show that the scaling functions fulfill the property of an approximate identity. Furthermore, with numerical results we want to show the decomposition.

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