Geophysical Research Abstracts
Vol. 19, EGU2017-15374, 2017
EGU General Assembly 2017

Investigating Uncertainties in a Geothermal Basin Simulation: Case Study of the Perth Basin, Australia

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Hydrothermal convection can strongly influence the spatial and temporal distribution of temperatures. This is particularly relevant when large-scale geothermal simulations are calibrated with temperature measurements which provide punctual or one-dimensional information of temperature in space and time. We present here an approach based on the analysis of entropy production to quantify expected nonlinearities due to convection, as a first step to adjust subsequent calibration procedures. We then apply this approach to investigate the effect of hydrothermal convection, specifically with respect to applied boundary conditions, in a large-scale simulation of the Perth Basin, Australia.

Previous work on the Geothermal System of the Perth Basin, Australia, showed significant lateral changes of temperatures measured in boreholes. Those differences in measured temperatures can hardly be explained with a purely conductive heat transport model and suggest existence of advective heat transport by convection. In addition, a detailed calibration suggested a general North-South trend of basal heat flux in the basin, a phenomenon that is not explained to date. We present here a novel approach to investigate these aspects in more detail. Specifically, we show first results to address the question of uncertainties due to the potential effect of hydrothermal convection in this basin, especially in relation to the possibility for model calibration.

First results suggest that the method provides a step forward to investigate uncertainties in basin-scale geothermal simulations. Further work will comprise the application of the approach to also analyze the effect of forced convection on model certainty.