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# Comparing uncertainty quantification methods based on distributions or statistical moments in thermal design calculations

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The presented work investigates aspects of uncertainty quantification in thermal design calculations of deep geological repositories for nuclear waste. The expected evolution of thermal conditions is a key element in the design process of the repository layout. Due to the radioactive decay and the associated emission of heat, temperatures increase in the repository system, potentially affecting processes relevant to the repository negatively. In order to quantify the temperature evolution and assess its effects on the various barriers, such as the host rock, models are set up and thermal calculations are conducted. Often specific distributions are assigned to model parameters, which are not known precisely.

To achieve a robust understanding and design despite this limited knowledge, it is necessary to assess the uncertainties associated with both parameters and models as part of these calculations. However, an uncertainty quantification, which includes calculations based on full distributions is expensive. To compare different uncertainty quantification methods applied to thermal design calculations, a benchmark is created. This benchmark is based on an analytical solution for a 1-D, thermal heat conduction problem using Python. Results of uncertainty quantification calculations based on full distributions, utilizing statistical moments or employing series expansion such as the first-order-second-moment method are compared.

This benchmark can help assess methods of uncertainty quantification in context of thermal design calculations.