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Impact of Glacial–Interglacial Cycles on Transient 3D Thermophysical Models of Salt-Dominated Areas within the North German Basin.

Understanding the underground temperature distribution is required to determine geothermal energy potential, heat flow, mechanical behaviour of lithological units, and also the long-term safety of heat-producing waste in repositories. As temperature observations in the subsurface are sparse, numerical modelling is utilized to make predictions and risk-assessments. In contrast to statistical models, numerical physical approaches can account for contrasts in thermal properties, given well informed structural and parametrical models of the subsurface.
Recent studies suggest that the Last Glacial Period and the Holocene Climate Optimum present the largest contribution to the climate impact on the modern subsurface temperature distribution in Germany. Previous studies, mainly in Northern Europe, have shown, that an additive effect of the Pleistocene Glaciations can be observed, with a total cooling of several Kelvin in up to two kilometer depth.

In the NGB, complex salt dynamics shape the structure of overlying sediment layers. Given the spatial orientation and contrast in thermal parameters, heat refraction may play a significant role on how the paleoclimatic imprint is distributed in the subsurface thermal field. To understand the influence of transient processes we discretized the stratigraphic succsession in the NGB to thermally relevant units. We create 3D structural models of regions with salt-dominated areas. The structural models are discretized into unstructured 3D finite element meshes and the model units are parametrized considering regional constraints. We apply a heatflow dervied from boreholes in the model regions as lower thermal boundary condition. The upper boundary condition is derived from soil temperatures in transient global circulation models starting at the last glacial maximum and scaled $\delta^{18}O$ as a proxy for the time prior.

The results indicate a clear correlation between the complex structural configuration of the model and the transient effects of the applied boundary conditions. The predicted subsurface thermal field is discussed and compared to temperature observations and statistical models of the temperature field in the model region.

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