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Climate scenarios, groundwater models, and uncertainties in long-term safety

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Abstract. Assessing future climate scenarios plays a fundamental role in evaluating the long-term safety of a repository for high-level radioactive waste (HAW). Over the assessment period of 1 million years, the repository is affected by various processes and developments that must be considered in the design of the repository. Predictions are complicated by the dynamics of the climate and are subject to uncertainties. The aim of this study is to evaluate uncertainties for various climate-induced processes that are relevant for the safety assessment of a repository for HAW.

This research addresses fundamental questions concerning the impact of future cold stages on different regions of Germany, the differences between past and future cold stages, the transfer of future climate developments to stylized climate models, and the uncertainties resulting from these models.

The study identifies the primary climate processes that could potentially affect the evolution of a HAW repository, including the formation of glaciers or ice sheets, the development of permafrost conditions, fluctuations in sea level, erosion, and isostatic adjustment. These processes can be represented in numerical groundwater models through parameter variations. In this project, these parameter variations and the impact of climatic states on different processes will be modeled for a sensitivity study. Finally, the results will be analyzed with respect to uncertainties, and possible improvements to dealing with uncertainties will be discussed. The focus of the presentation is on the climate impacts and the implementation in the model.

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