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How much can we trust a geological model underlying a subsurface hydrological investigation?

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Geological models often provide an important basis for subsequent hydrological investigations. As these models are generally built with a limited amount of information, they can contain significant uncertainties – and it is reasonable to assume that these uncertainties can potentially influence subsequent hydrological simulations. However, the investigation of uncertainties in geological models is not straightforward – and, even though recent advances have been made in the field, there is no out-of-the-box implementation to analyze uncertainties in a standard geological modeling package.

We present here results of recent developments to address this problem with an efficient implementation of a geological modeling method for complex structural models, integrated in a Bayesian inference framework. The implemented geological modeling approach is based on a full 3-D implicit interpolation that directly respects interface positions and orientation measurements, as well as the influence of faults. In combination, the approach allows us to generate ensembles of geological model realizations, constrained by additional information in the form of likelihood functions to ensure consistency with additional geological aspects (e.g. sequence continuity, topology, fault network consistency), and we demonstrate the potential of the method in an exemplified case study. With this approach, we aim to contribute to a better understanding of the influence of geological uncertainties on subsurface hydrological investigations.