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# Uncertainty in 3-D seismic interpretation: Informing stochastic structural geomodeling efforts

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In recent years uncertainty has been widely recognized in geosciences, leading to an increased need for its quantification. Predicting the subsurface is an especially uncertain effort, as our information generally comes from spatially highly limited direct (1-D boreholes) or indirect 2-D and 3-D sources (e.g. seismic, gravity). And while uncertainty in seismic interpretation has been explored in 2-D, we currently lack both qualitative and quantitative understanding of how interpretational uncertainties of 3-D datasets are distributed.

In this work we analysed more than 78 seismic interpretations done by final year undergraduate (BSc) students of a 3-D seismic dataset from the Gullfaks field (North Sea, W Viking Graben). The Gullfaks field represents a NNE-SSW-trending domino fault system topped by a Base Cretaceous Unconformity. The students interpreted interlinked faults, as well as Base Cretaceous and Ness (Brent Group) horizons. This statistically relevant dataset allowed us to first quantify the spatial distribution of uncertainties in 3-D seismic interpretation. For this we developed custom open-source Python tools to explore and visualize the spatial uncertainty of fault stick interpretations, fault plane orientations and fault networks. Top Ness horizon picks were used to quantify uncertainty in fault throw and to analyse the impact of seismic data quality and presence of wells on interpretation uncertainty.

Additionally, we bring forward ideas on how the encountered interpretation uncertainties could be incorporated into a Bayesian geomodeling approach (probabilistic machine learning of stochastic geomodels), both as informed prior parameter distributions or geological likelihood functions, to improve propagation of uncertainties from the seismic interpretation into the subsequent geomodel.