SpannEnD –
Modelling the 3D stress state of Germany

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1. The problem

Let's make an educated guess: About how many percent of problems related to the disposal of nuclear waste in an underground repository depend on the tectonic stress field (Fig. 1)?

Fig. 1 Pin a pin into one container for each ten percent of problems you think depend on the tectonic stress field. See bottom right for answer*.

While the Swiss NAGRA relates that many (Fig. 1) site selection indicators in the disposal of nuclear waste to the tectonic stress field, there is only little known about it, especially about its magnitude (Fig. 2).

Indeed, the stress field is crucial not only in terms of finding a repository for nuclear waste – it is also important for hydrocarbon and geothermal wells, long term save storage of oil and gas and other geomechanical operations.

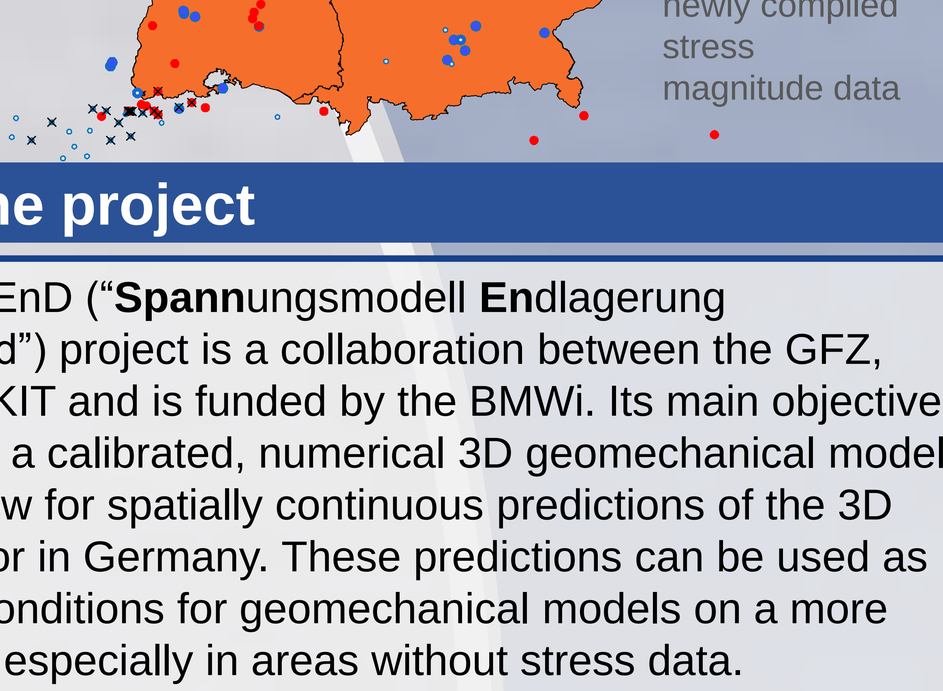

Fig. 2: The newly compiled stress magnitude data

2. The project

The SpannEnD ("**Spann**ungsmodell **En**dlagerung **D**eutschland") project is a collaboration between the GFZ, TUDA and KIT and is funded by the BMWi. Its main objective is to set up a calibrated, numerical 3D geomechanical model that will allow for spatially continuous predictions of the 3D stress tensor in Germany. These predictions can be used as boundary conditions for geomechanical models on a more local scale, especially in areas without stress data.
To calibrate this model, a database for magnitudes of tectonic stresses in Germany will be compiled.

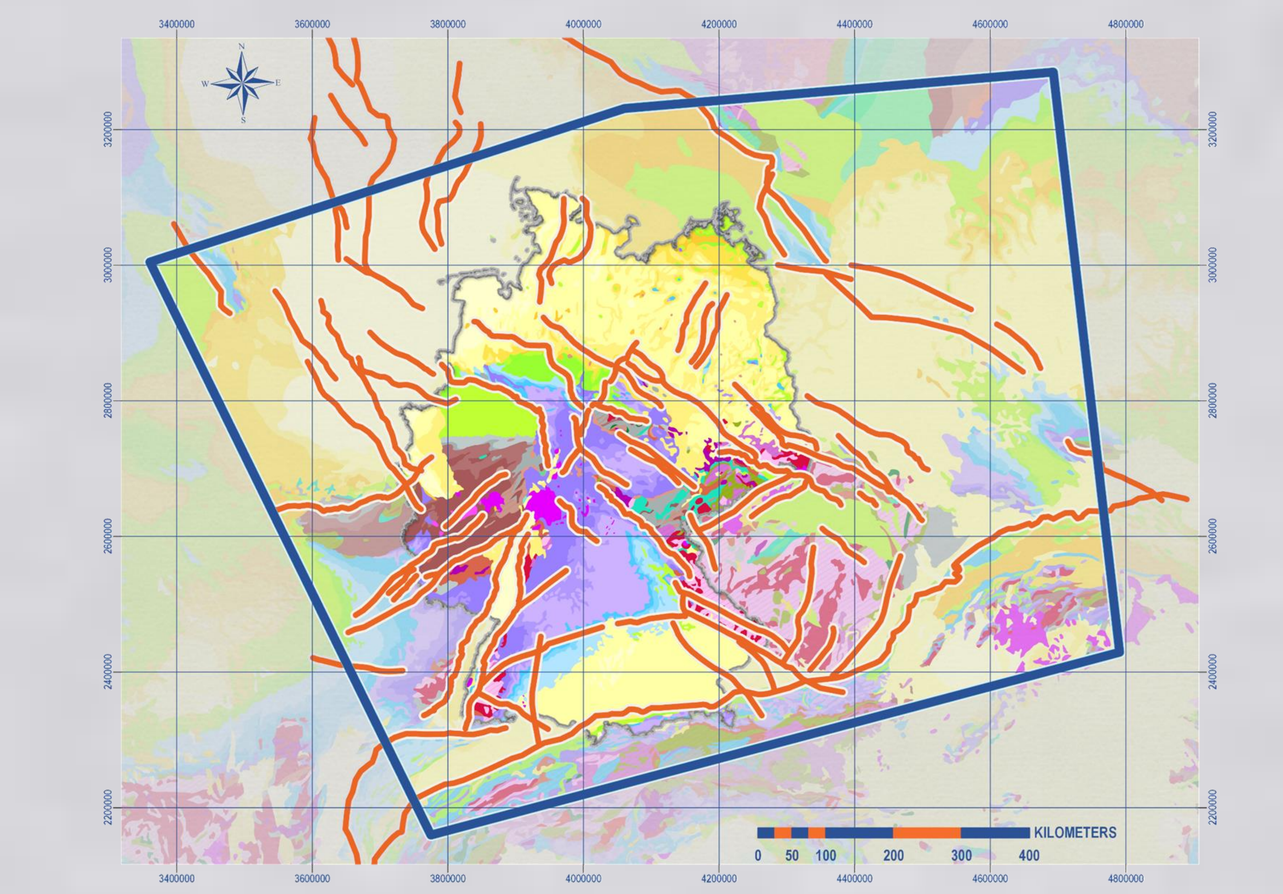

Fig. 3: Model area with major faults on a geological overview map of Europe.

3. The road to the model

The boundaries of the modelling area (Fig. 3) were chosen perpendicular or parallel to known stress orientations and to major tectonic features. Most of the modelling area is covered by pre-existing models[2,3,4] which will be altered to satisfy the needs of a geomechanical model. Furthermore, crucial faults have to be identified and implemented (Fig. 3). The model will be discretized in *Hypermesh* and *Abaqus* will be used to calculate the tectonic stresses.

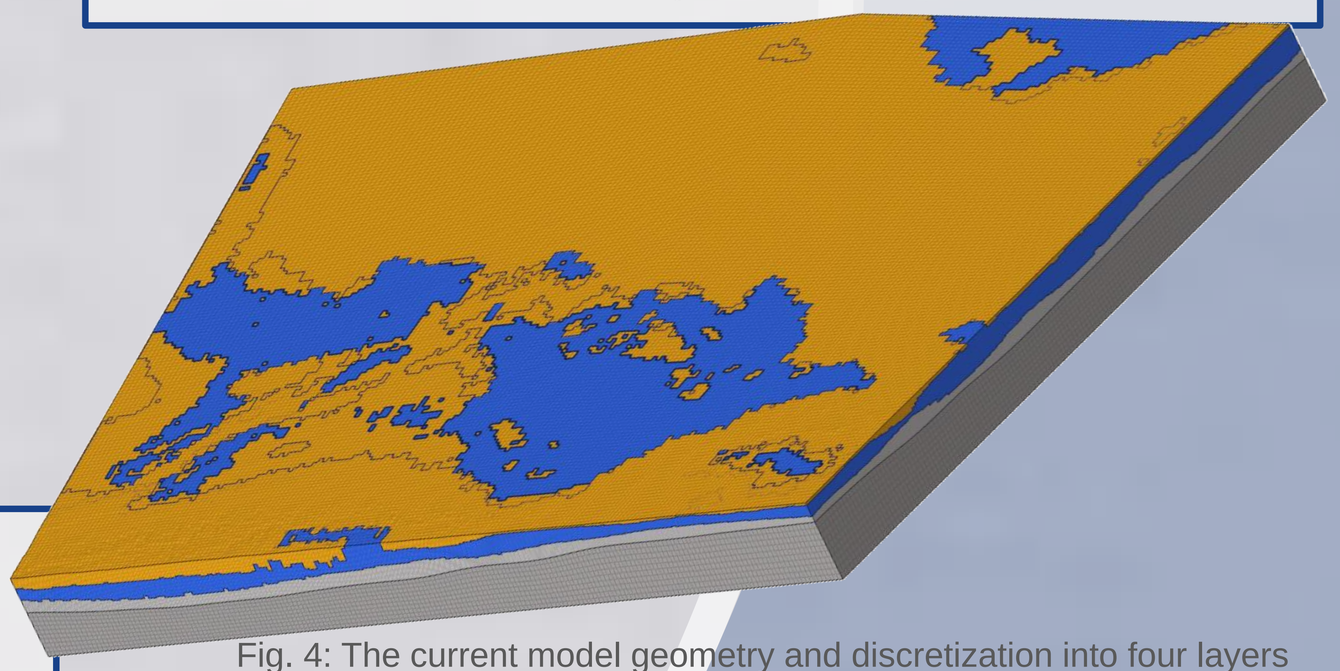

Fig. 4: The current model geometry and discretization into four layers

4. The model

The model's dimensions are 1000 km x 1400 km x 100 km. At the moment it comprises approximately 1.600.000 elements and while the lateral resolution is 6 km x 6 km, the vertical resolution decreases with increasing depth. Currently, the model consists of four layers: sediments, the crystalline basement, the crust and the lithospheric mantle (Fig. 4).
Important parameters will be density and stiffness of the layers. Displacements will be used as boundary conditions.

Future work on the model will include increasing complexity of the sediment layers, a final fault selection and the calibration of the model with stress magnitude data.

5. Summary

The SpannEnD project aims to set up a 3D geomechanical numerical model of Germany to allow for predictions of the 3D stress tensor in Germany. A newly compiled database for tectonic stresses will be used for the model calibration

* Answer to Fig. 1: Count the dots! ····· ····· ····· ····· ····· ····· ····· ····· %

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www.Spannend-Projekt.de

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