Supplement of Saf. Nucl. Waste Disposal, 2, 73–73, 2023
https://doi.org/10.5194/sand-2-73-2023-supplement

Supplement of

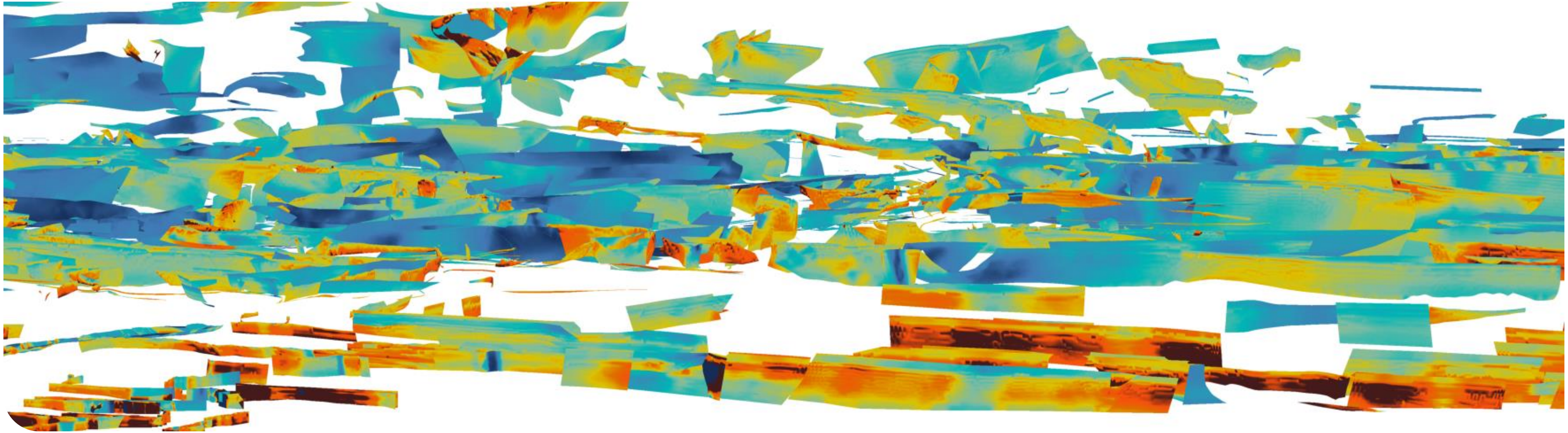
The slip tendency of 3D faults in Germany

Luisa Röckel

Correspondence to: Luisa Röckel (luisa.roeckel@kit.edu)

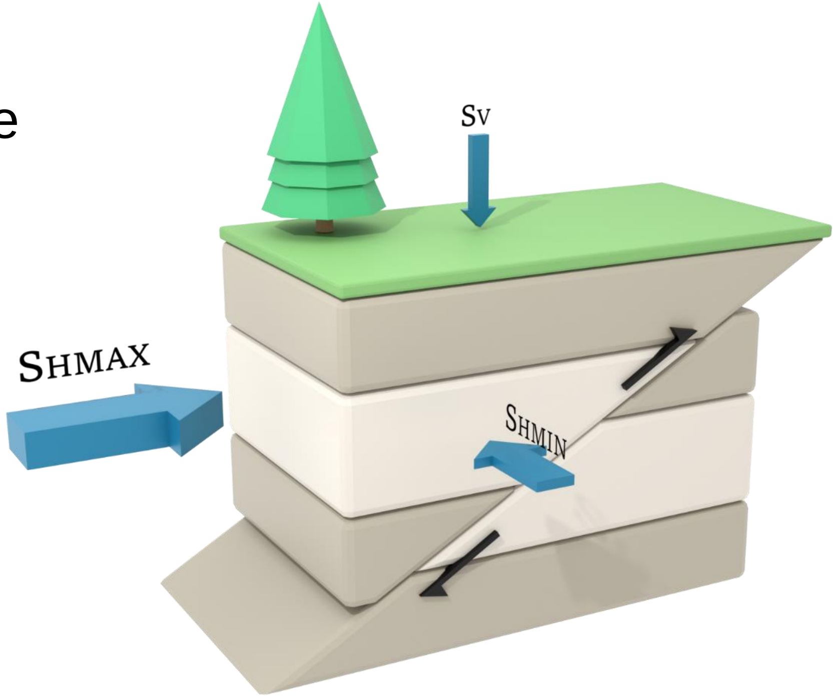
The slip tendency of 3D faults in Germany

Luisa Röckel, Steffen Ahlers, Tobias Hergert, Birgit Müller, Karsten Reiter, Moritz Ziegler, Victoria Kuznetsova, Oliver Heidbach, Andreas Henk, Frank Schilling



Faults & their reactivation

- A fault is a discontinuity in the rocks of the underground that separates discrete units.
- Stresses acting in the underground can lead to movement along these faults.
- This fault reactivation can lead e.g. to earthquakes or the change of fluid pathways.

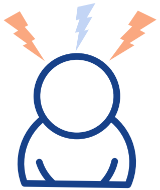


Faults & their reactivation

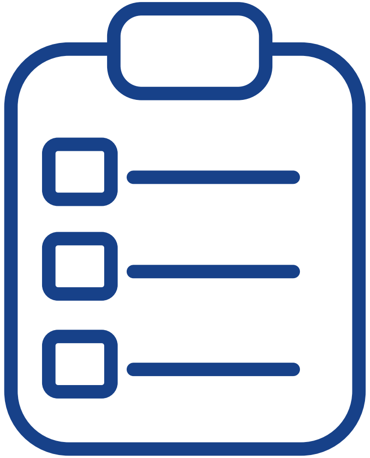
- The reactivation potential of a fault depends on many factors:

  - The fault geometry

  - The initial stresses (orientations and magnitudes) acting on the faults

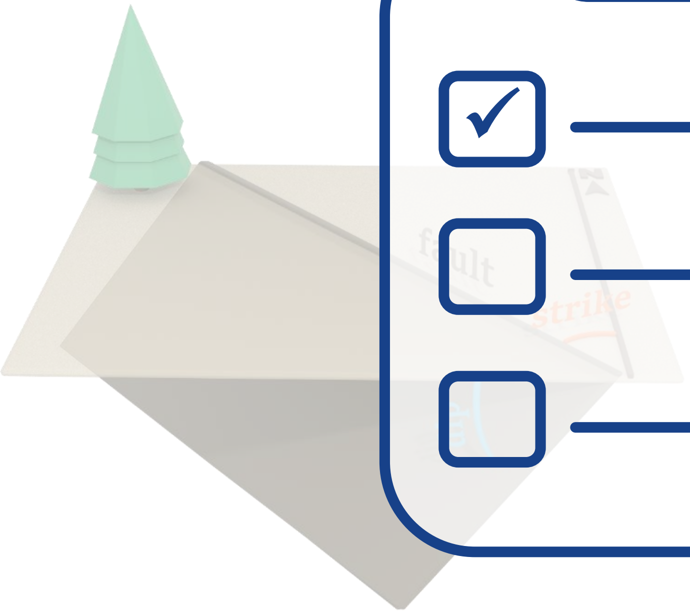


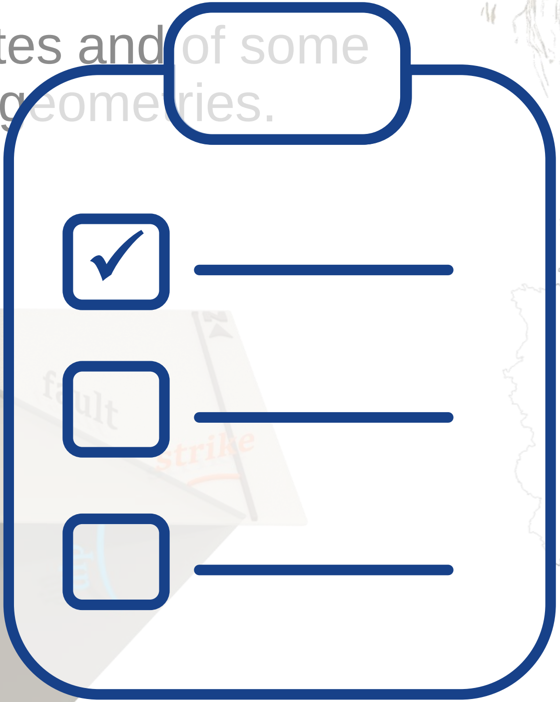
  - The frictional properties of the fault



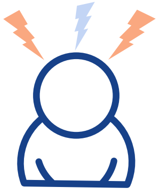
Fault Geometries

- Models of the federal states and of some projects provide 3D fault geometries.

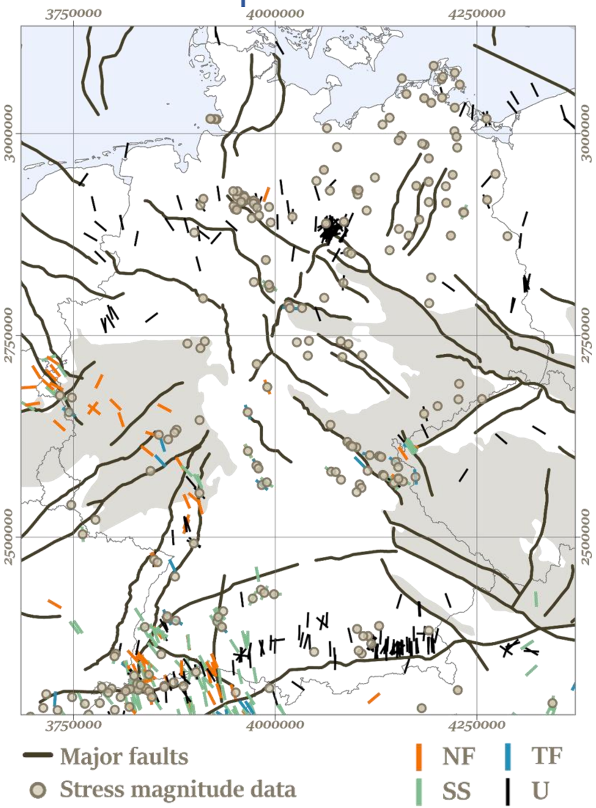




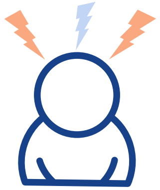
The initial stress



- Stress data are only available pointwise and not for all regions of Germany.
- Only parts of the relevant stress information are available (e.g. only orientations or one magnitude).
- These data do not suffice for the assessment of the fault reactivation potential throughout Germany.



The initial stress



- The geomechanical-numerical model of Germany by Ahlers et al. (2022) provides the required stress magnitudes and orientations

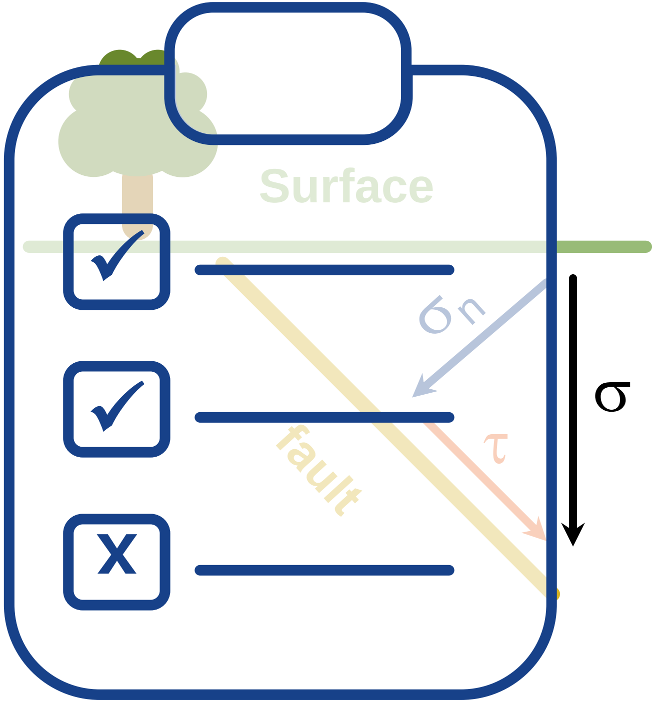
See Ahlers et al. 2022 and poster by Ahlers et al. in Poster Session I for more details

A measure for fault reactivation:
The Slip Tendency

- The slip tendency can be calculated as the ratio between the shear stress τ and the normal stress σ_n:

$$T_s = \frac{\tau}{\sigma_n}$$

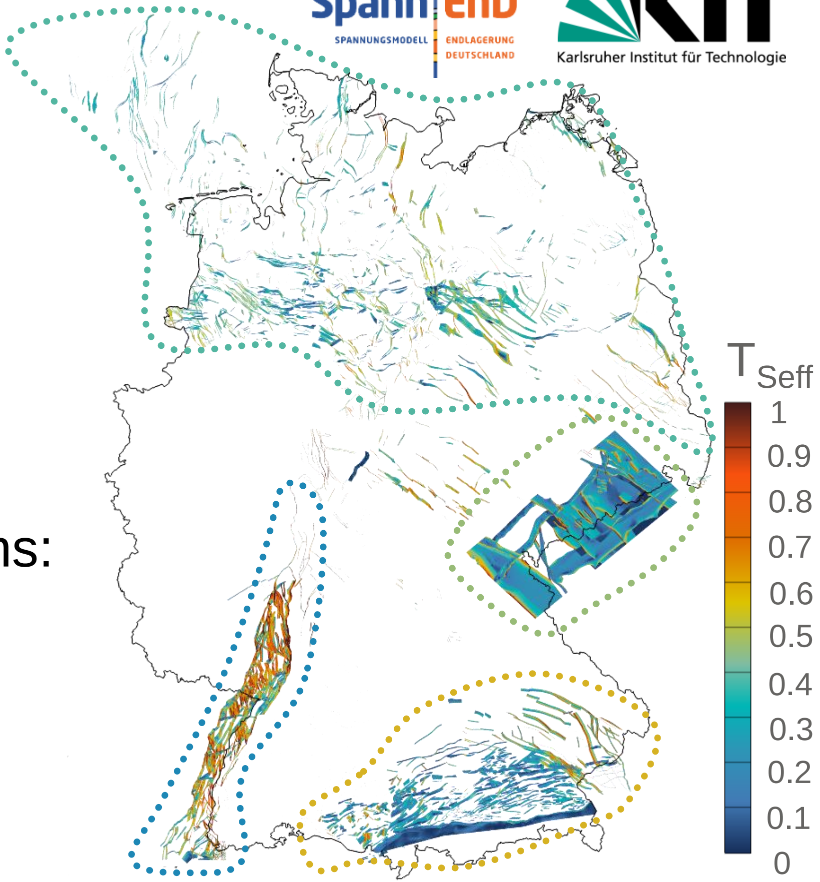
- Reactivation is likely when the T_S exceeds the frictional strength of the fault.



Slip Tendency Results

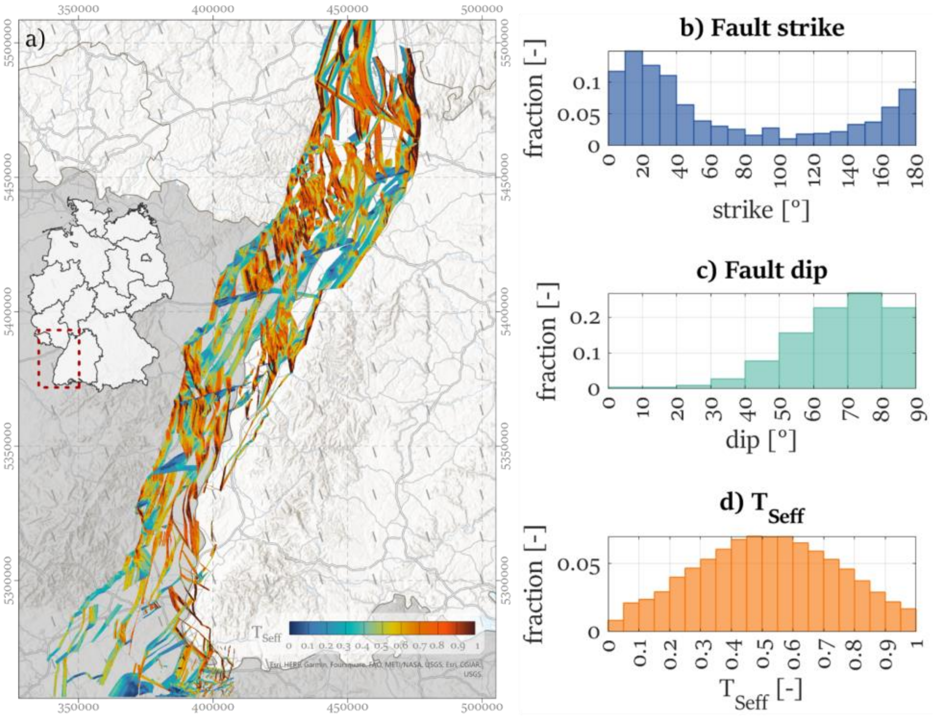
- Slip tendency of 12.000 faults and fault segments were calculated.
- Slip tendency mostly ranges between 0 and 1.
- Big differences between different regions:

  Upper Rhine Graben (URG)
  North German Basin (NGB)
  Saxony & Ore Mountains
  Molasse Basin

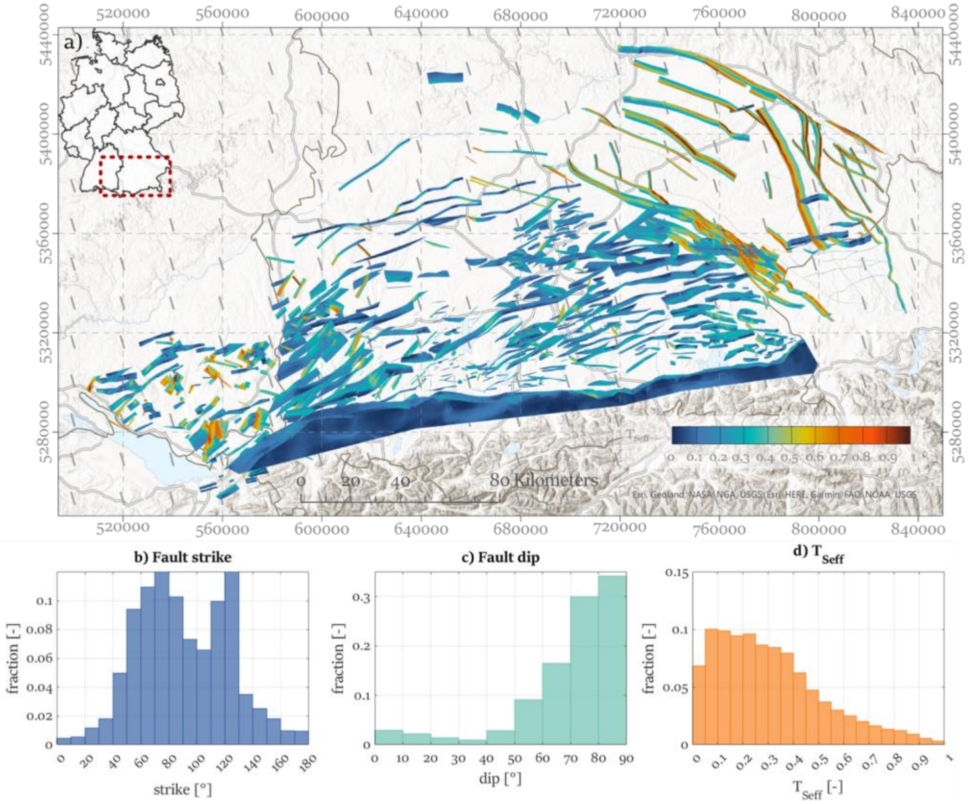


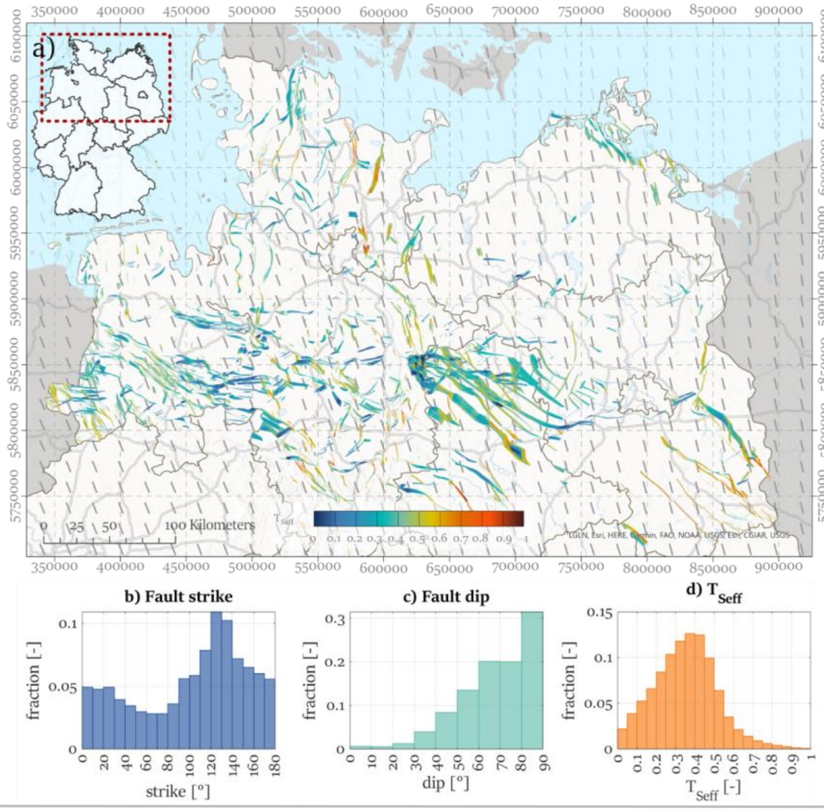
Results: Upper Rhine Graben

- Faults strike mostly N – S to NNE – SSW and NNW – SSE.
- Faults dip quite steeply (60° – 90°).
- Slip tendency regularly exceeds values of 0.7.
- Median slip tendency is the highest for faults striking in N – S and in NW – SE to NNW – SSE direction (Median > 0.6).



Results: Molasse & North German Basin

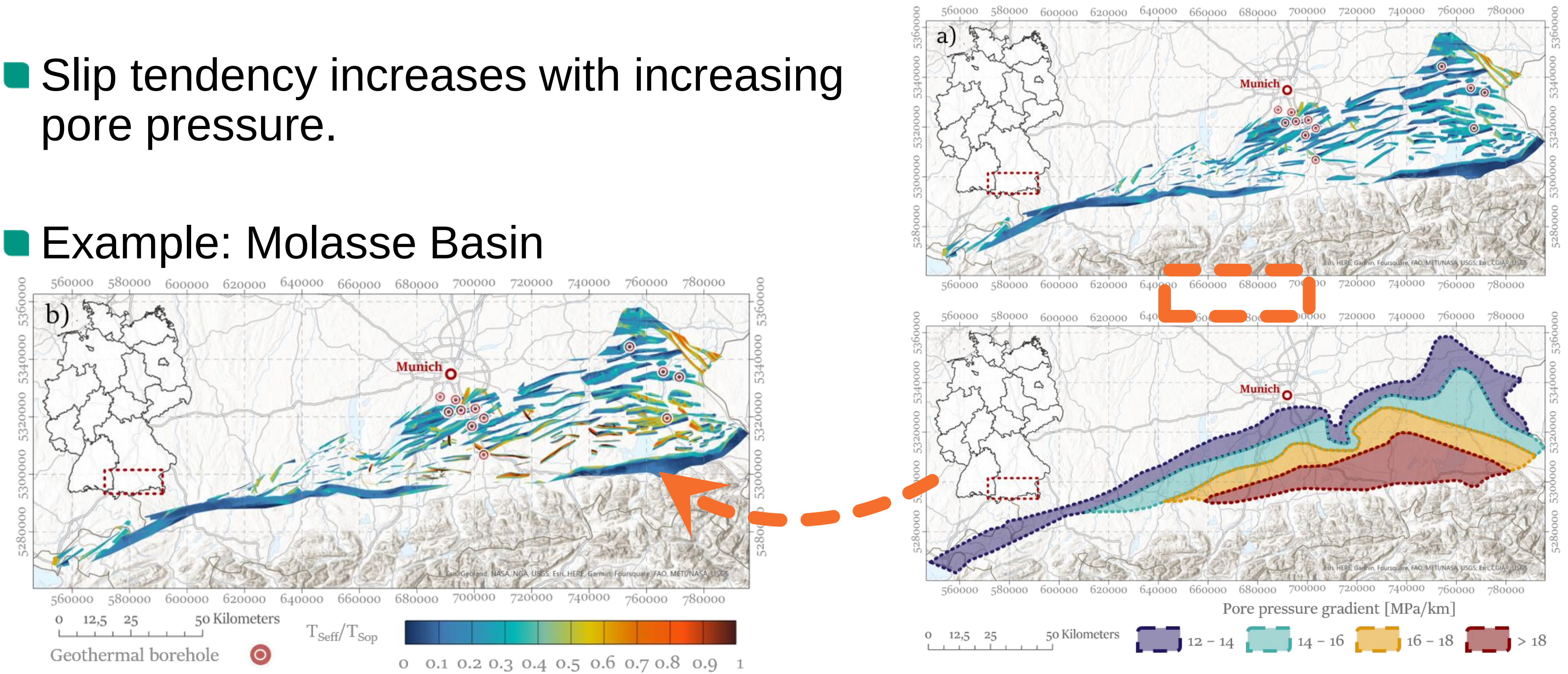




Results: Pore Pressure

- Slip tendency increases with increasing pore pressure.

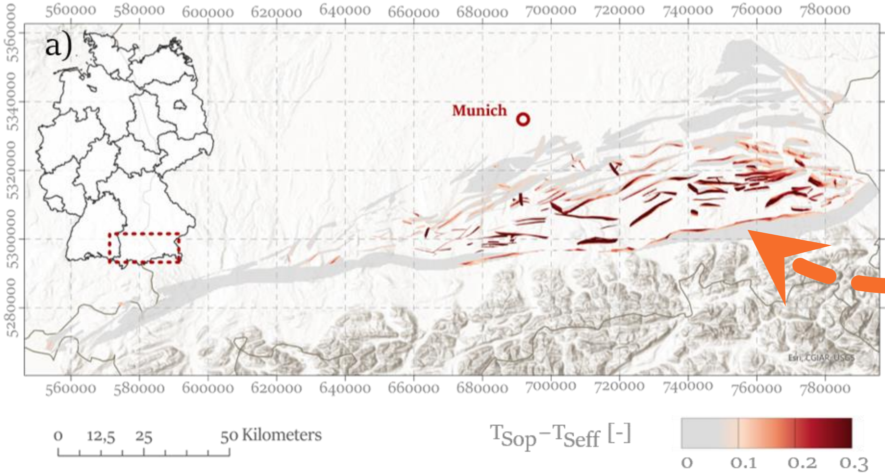
- Example: Molasse Basin

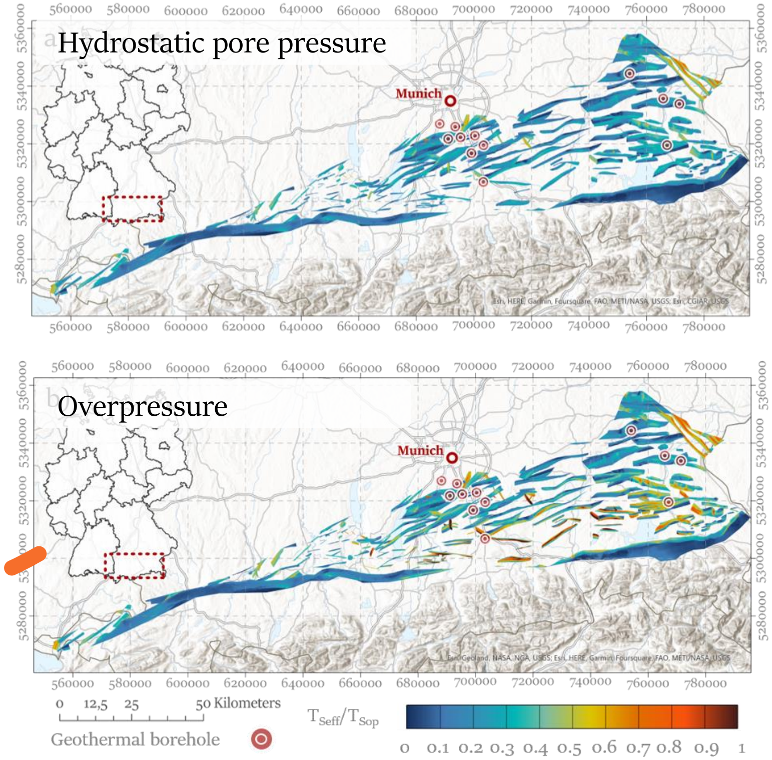


Map after Drews et al. (2018)

Results: Pore Pressure

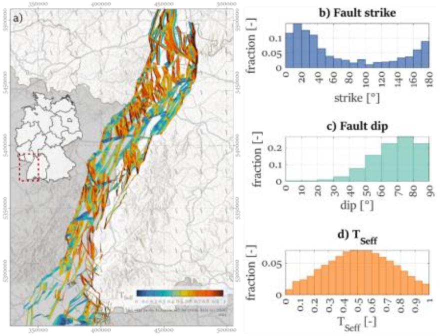
- Slip tendency increases with increasing pore pressure.
- Example: Molasse Basin

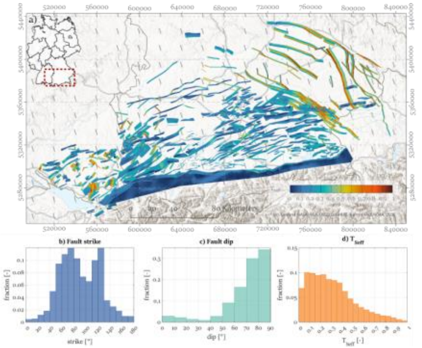


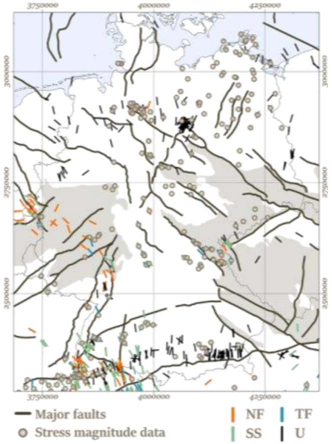


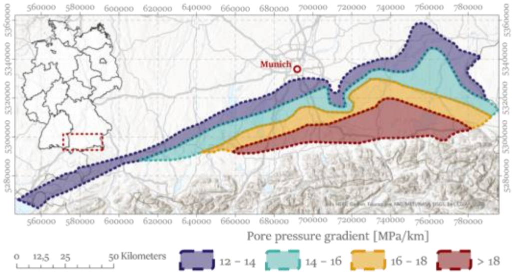
Conclusion

- Slip tendency was calculated for 12.000 faults and segments.
- Slip tendency varies considerably between different regions.
- More data are crucial for further improvements of the prediction of the fault reactivation potential!









Thank you for your attention!