Figure: Lukas van de Wiel

Finite element modeling with GTECTON; improvements and applications

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1 SIGNIFICANT IMPROVEMENTS

During the past 4 years

- I completed the mass parallellisation; tested to 256 cores.
- the parallel code is thoroughly benchmarked.
- I improved the tooling that comes with GTECTON to help set boundary conditions.
- I transformed the code to modern and transparant standards.
- I built a fully automated nightly test suite.
- the user base has been expanded across five countries.

2 BOUNDARY CONDITIONS

Types of boundary conditions supported by GTECTON:

Pressure	Stress
Forces	Winkler Forces
Displacement	Velocity
Slip	Differential displacement on a fault
Differential forces	Differential Winkler forces
Gravity	Euler Angles
Temperature	Heat Flux
Periodicity	

Benchmarks

A Plane

Beam pulled out of stationary mass, by differential forces on one plane. Differential Winkler forces on the other plane forces the beam back:

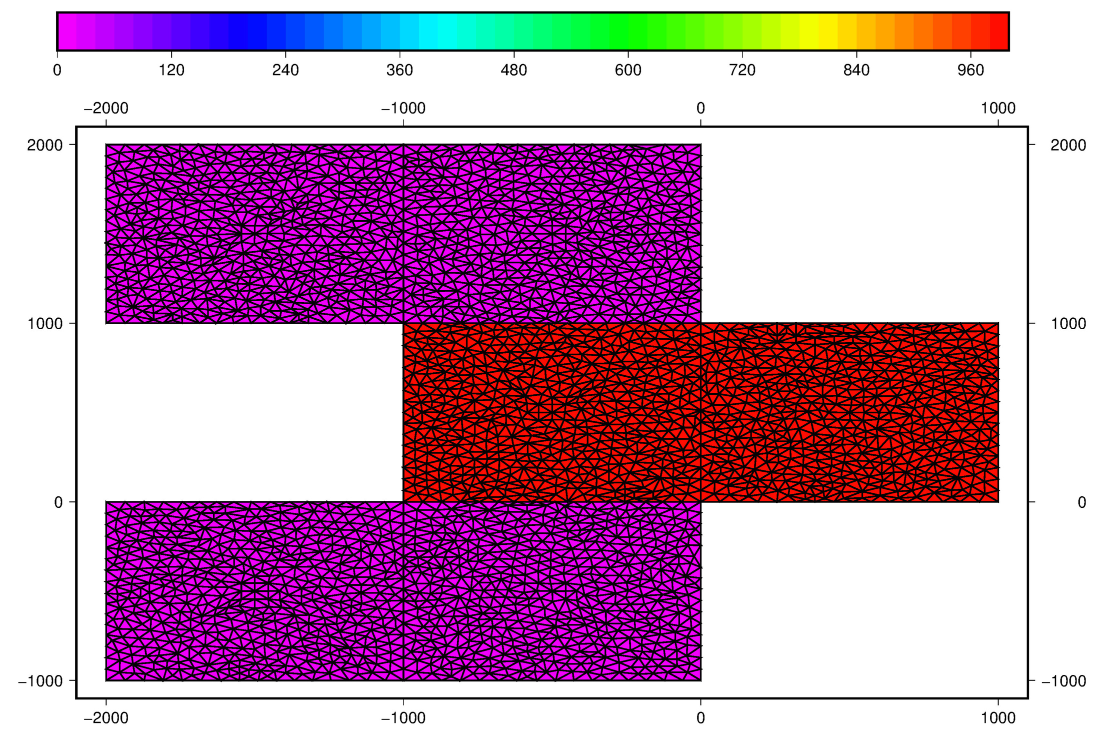

Figure: Differential displacement on slippery nodes.

Thermal advection diffusion in a flow with a very high Reynold's number:

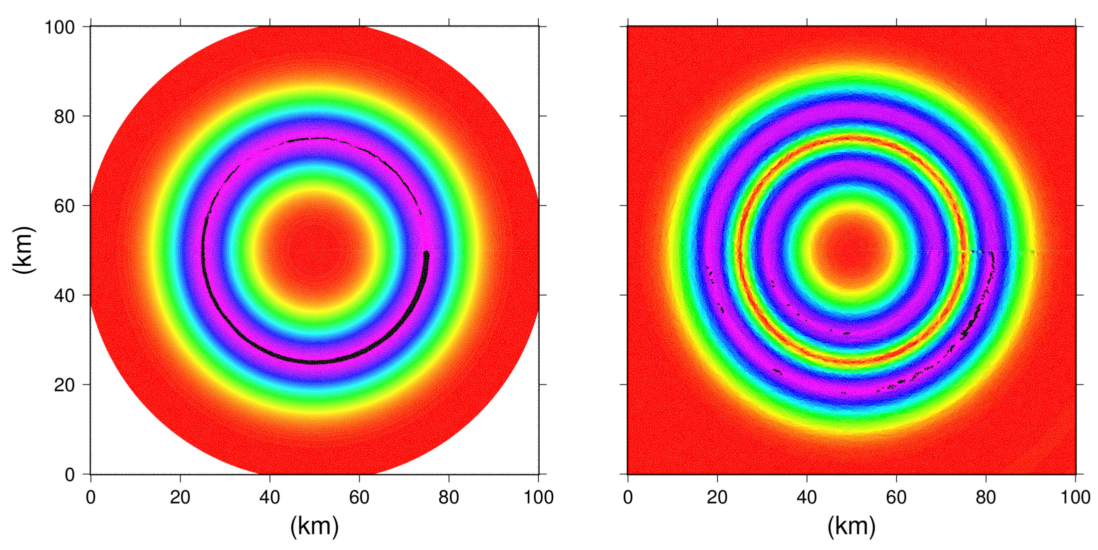

Figure: Temperature and heat flux of a very fast circular flow; $Pe = 5 \times 10^9$

B Axisymmetric

Finite spherical pressurised cavity:

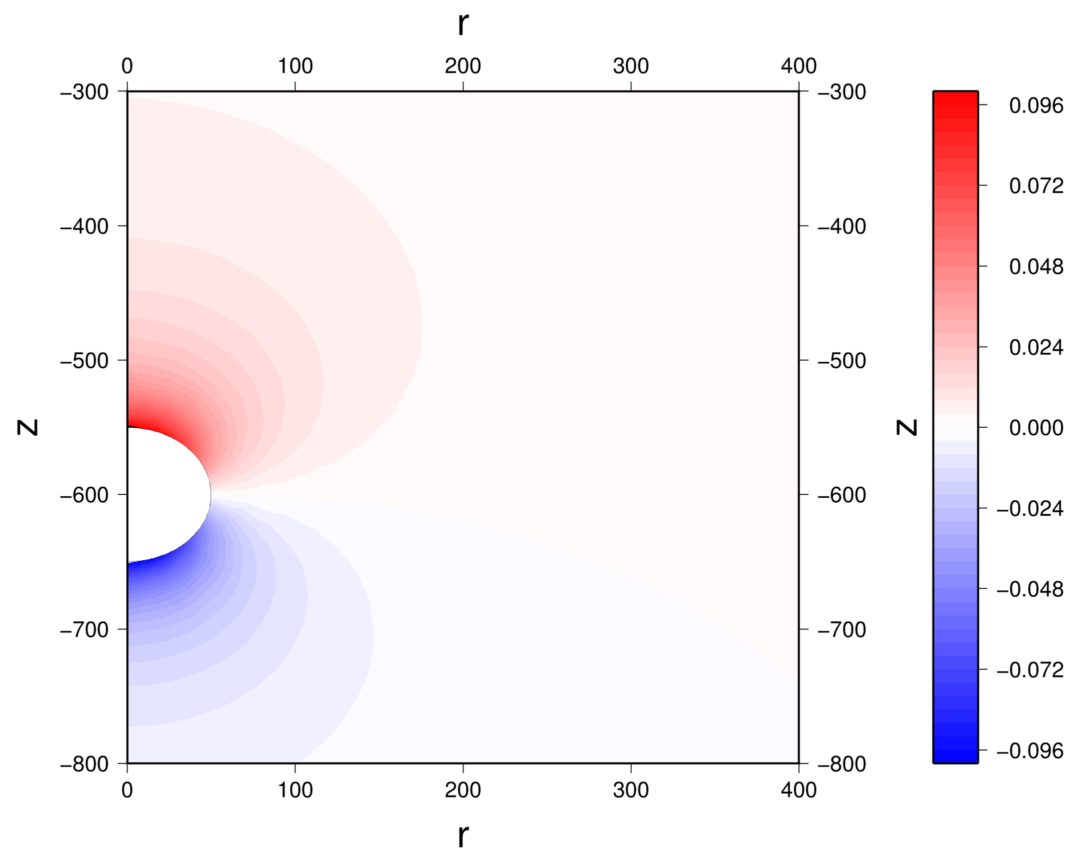

Figure: Vertical displacement induced by a spherical cavity under pressure.

Flexure induced by a circular loading:

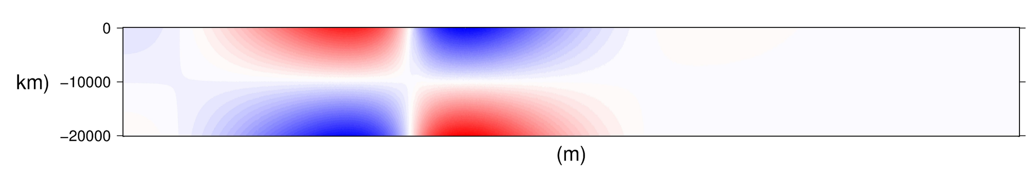

Figure: Radial strain in a supported lithosphere under a circular load. Soure: Bob Sluis

C Full 3D

Rectangular fault area in an infinite halfspace

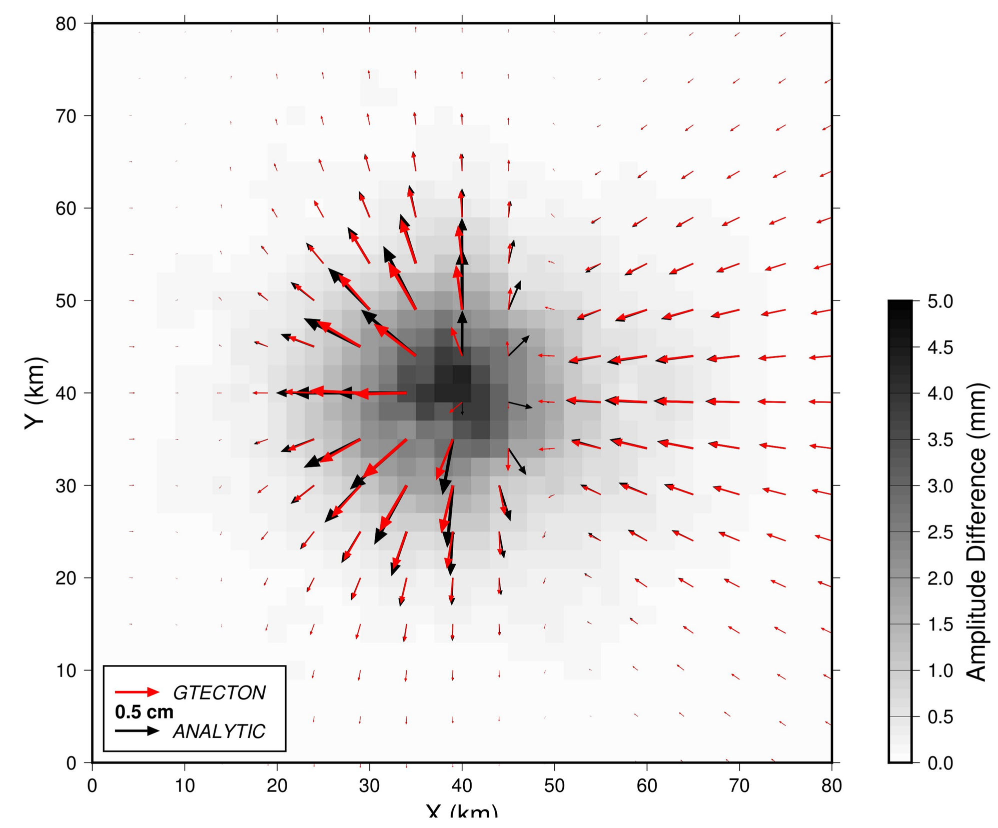

Figure: Difference between analytical and numerical displacement on a slice through the fault plane. Source: Matt Herman

Rectangular pressure area causing deformation in an infinite halfspace.

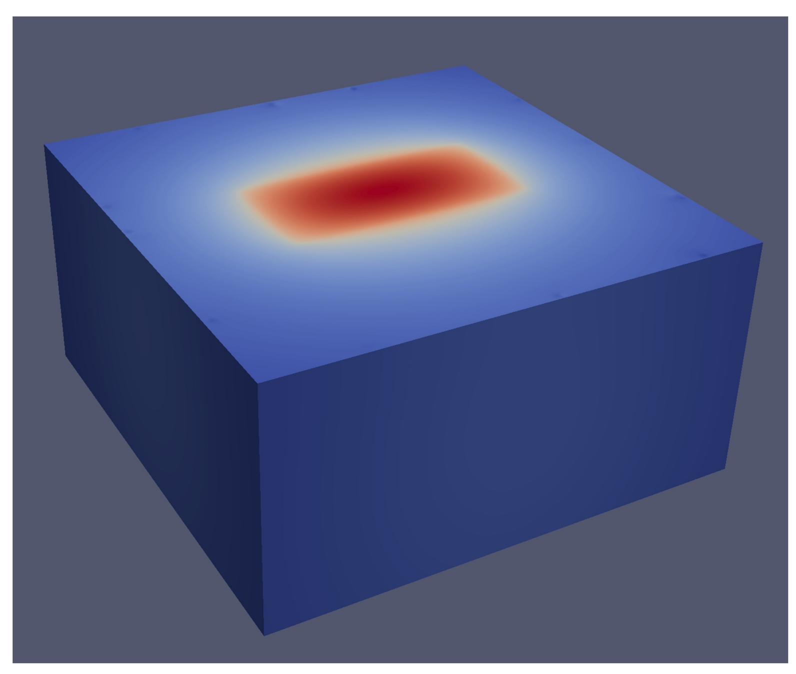

Figure: The surface of an infinite halfspace is displaced due to a rectangular area of pressure.

Real World models

A Temperature in the Eurasian Plate

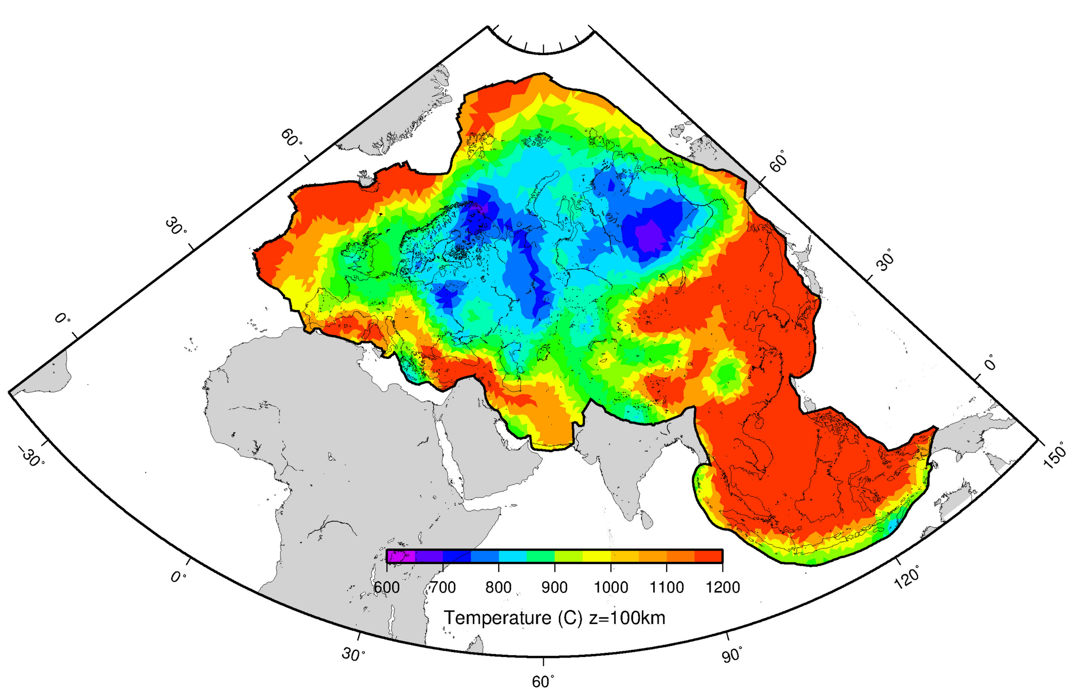

Figure: source: Candela Garcia Sancho

B Subduction in Sumatra

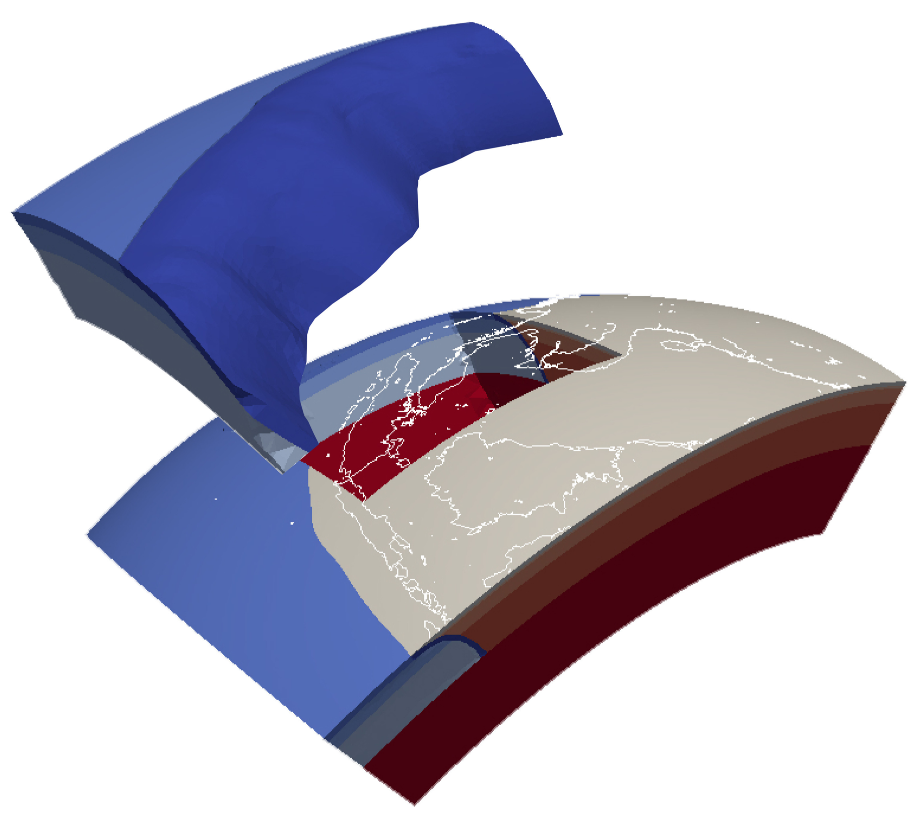

Figure: source: Taco Broerse

C Fault system in Sicilia

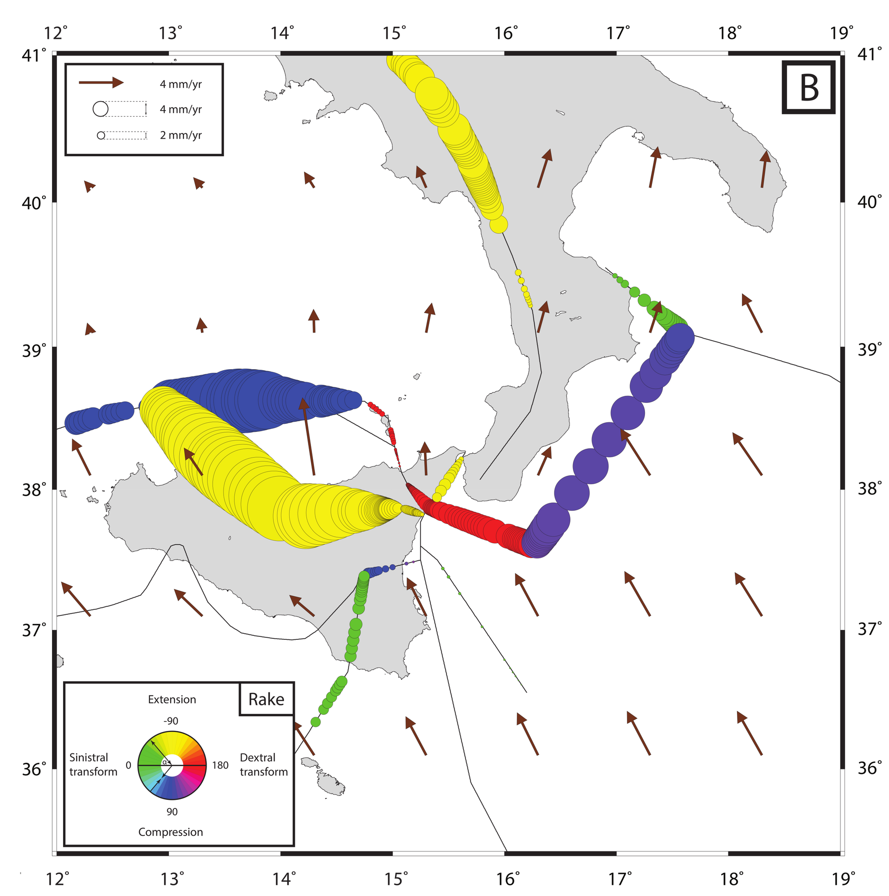

Figure: source: Nicolai Nijholt

3 Plans for the future

- Improve memory scaling
- Complete benchmark suite

4 Acknowledgements

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