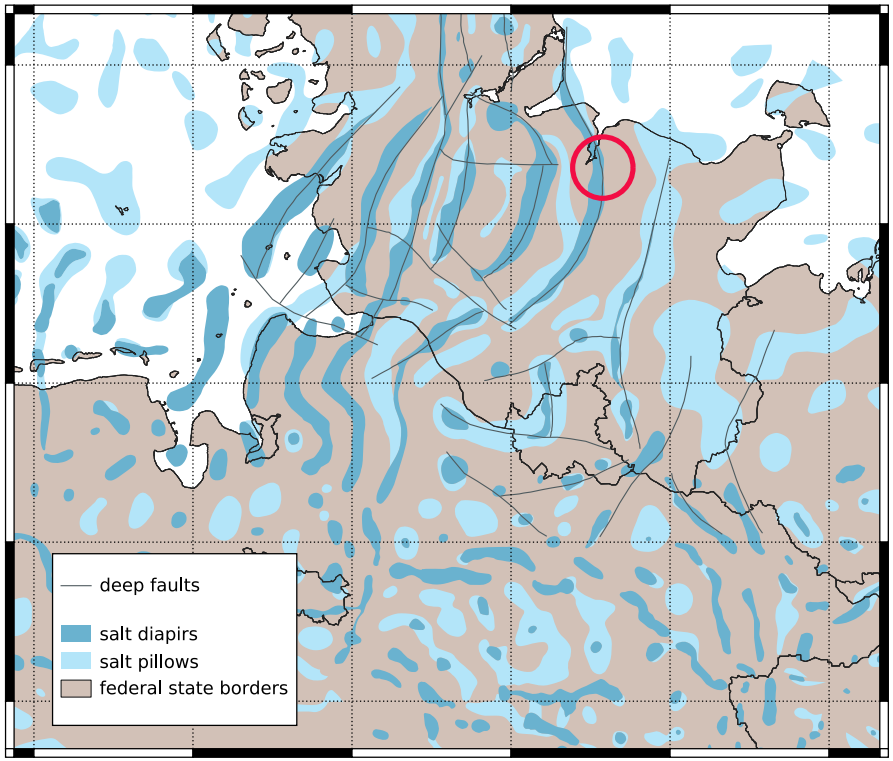
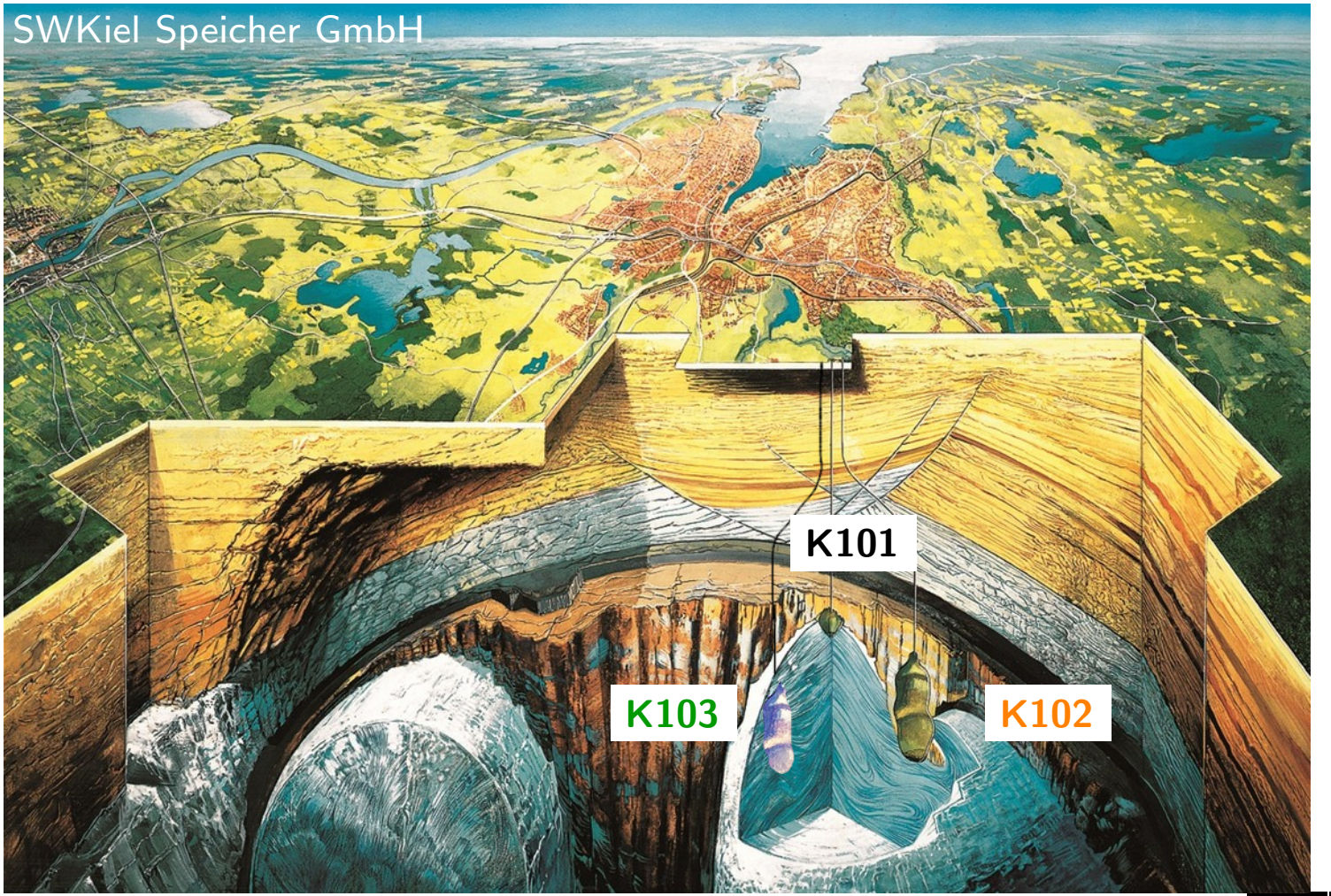
A kinematic model for observed surface subsidence above a salt cavern gas storage site in Northern Germany

Henriette Sudhaus, Noemi Schulze-Glanert & Alison Seidel



Salt caverns near Kiel (Germany)



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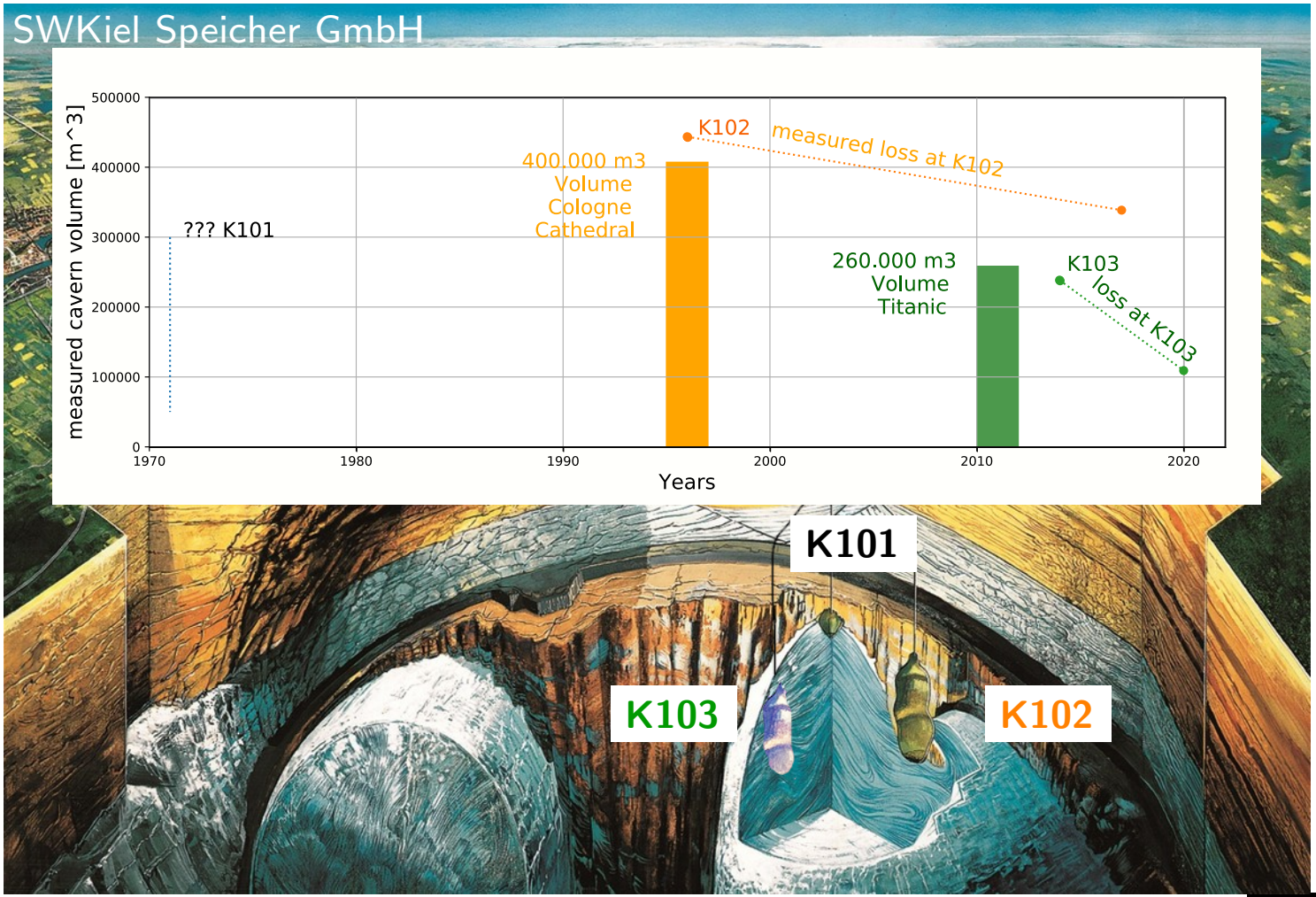

rough volume loss estimate (in-situ data): $26.500\,m^3/yr$

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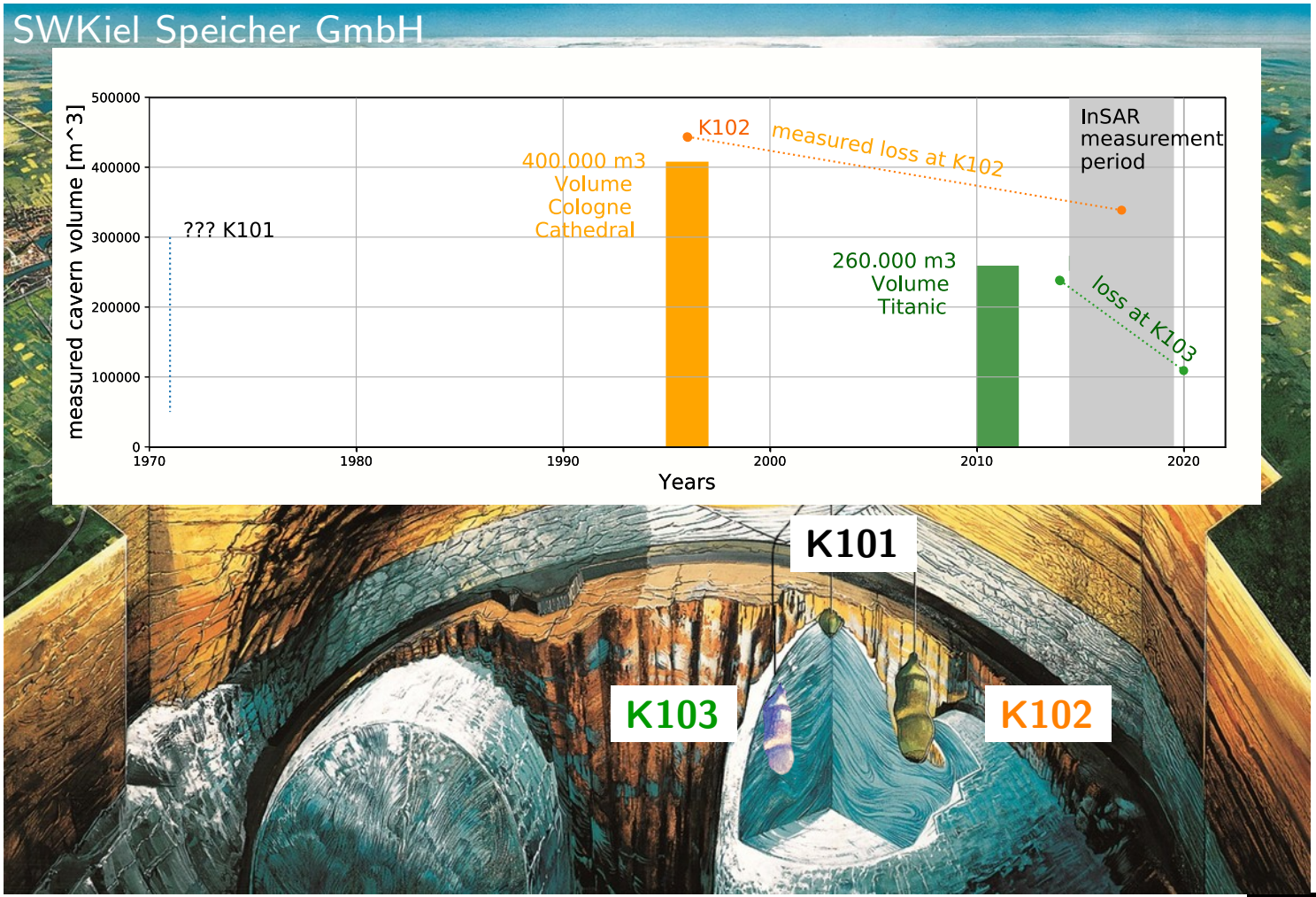

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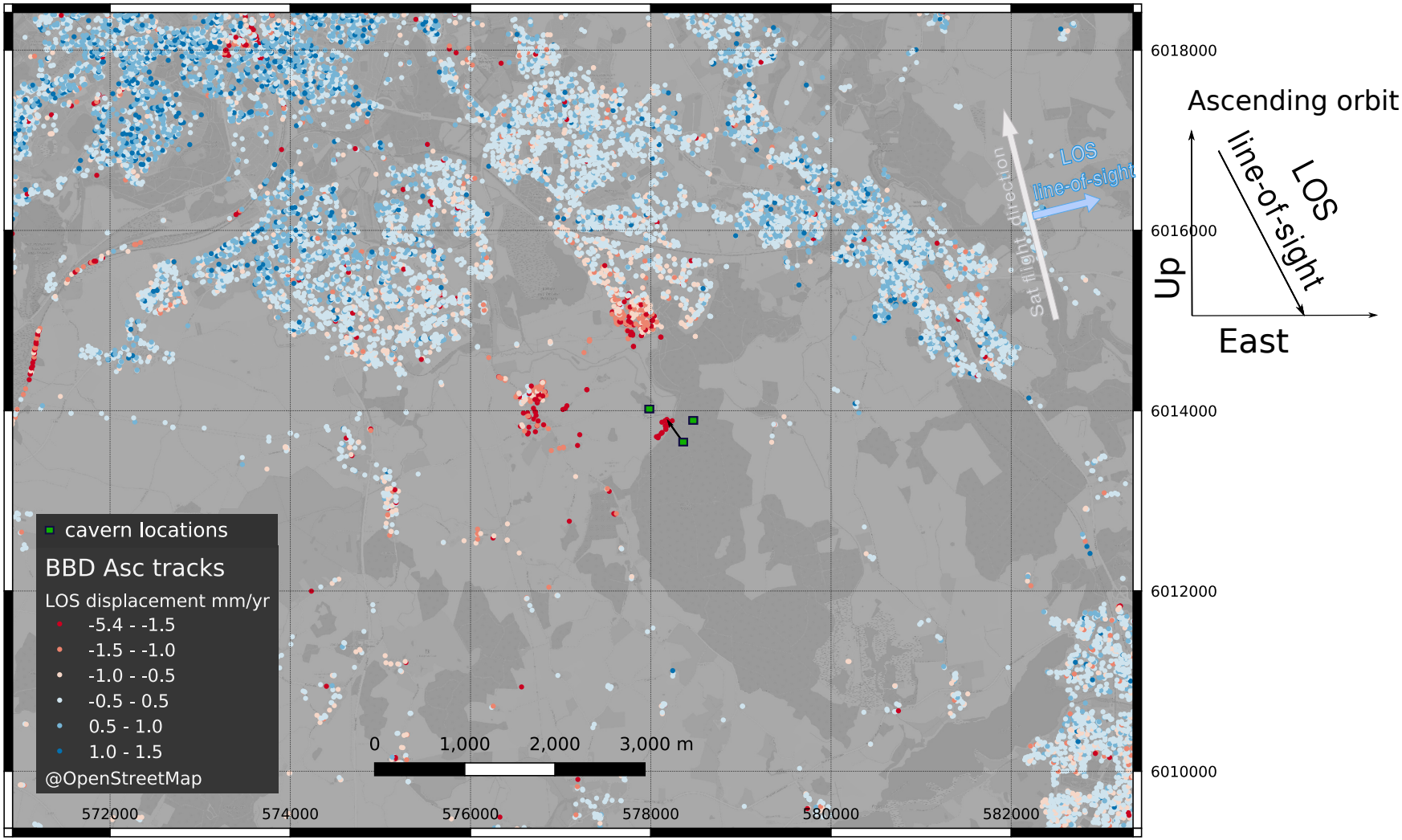
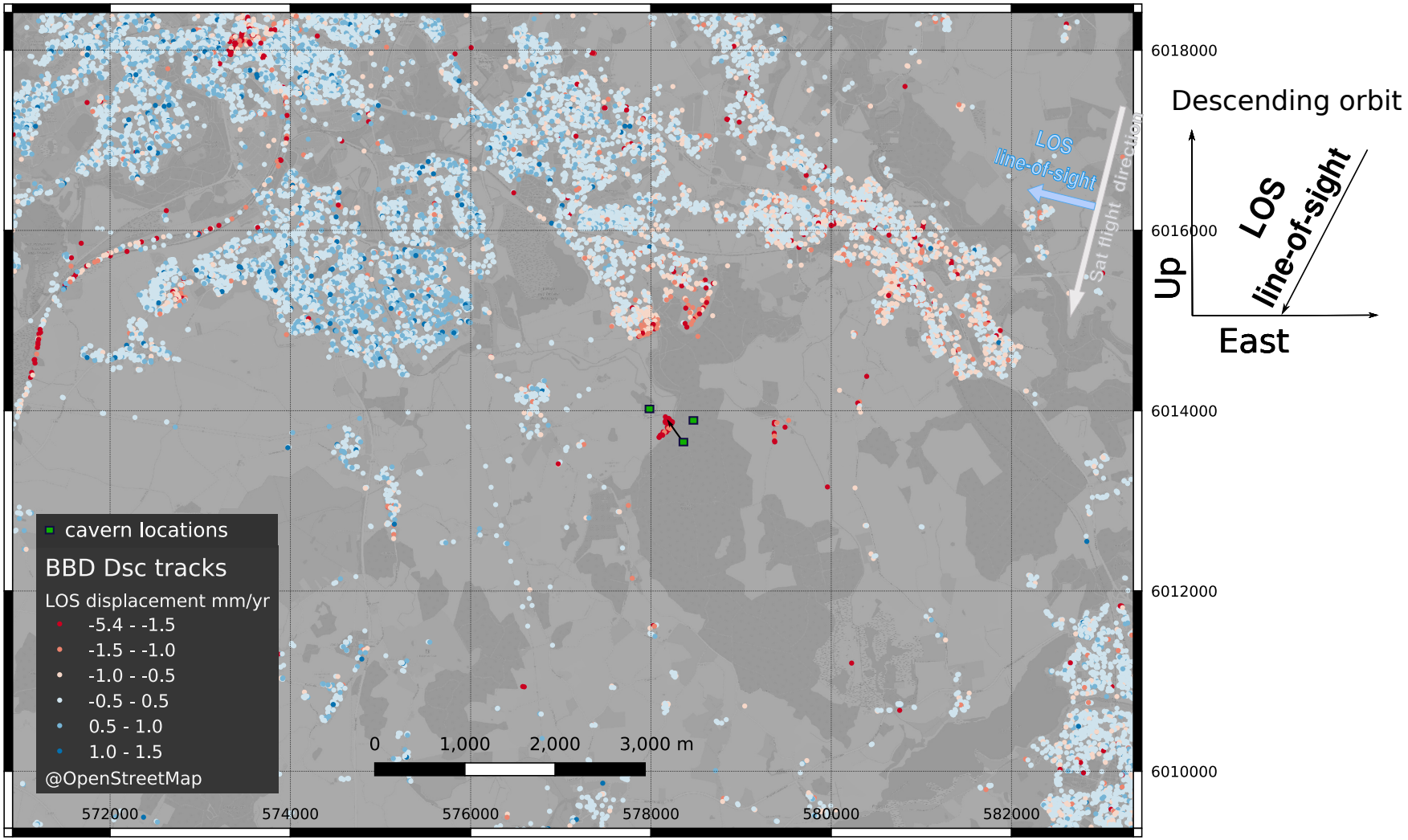
InSAR surface velocities - ascending line-of-sight



Sentinel-1 time series data of the German ground motion service (BBD).

InSAR surface velocities - descending line-of-sight



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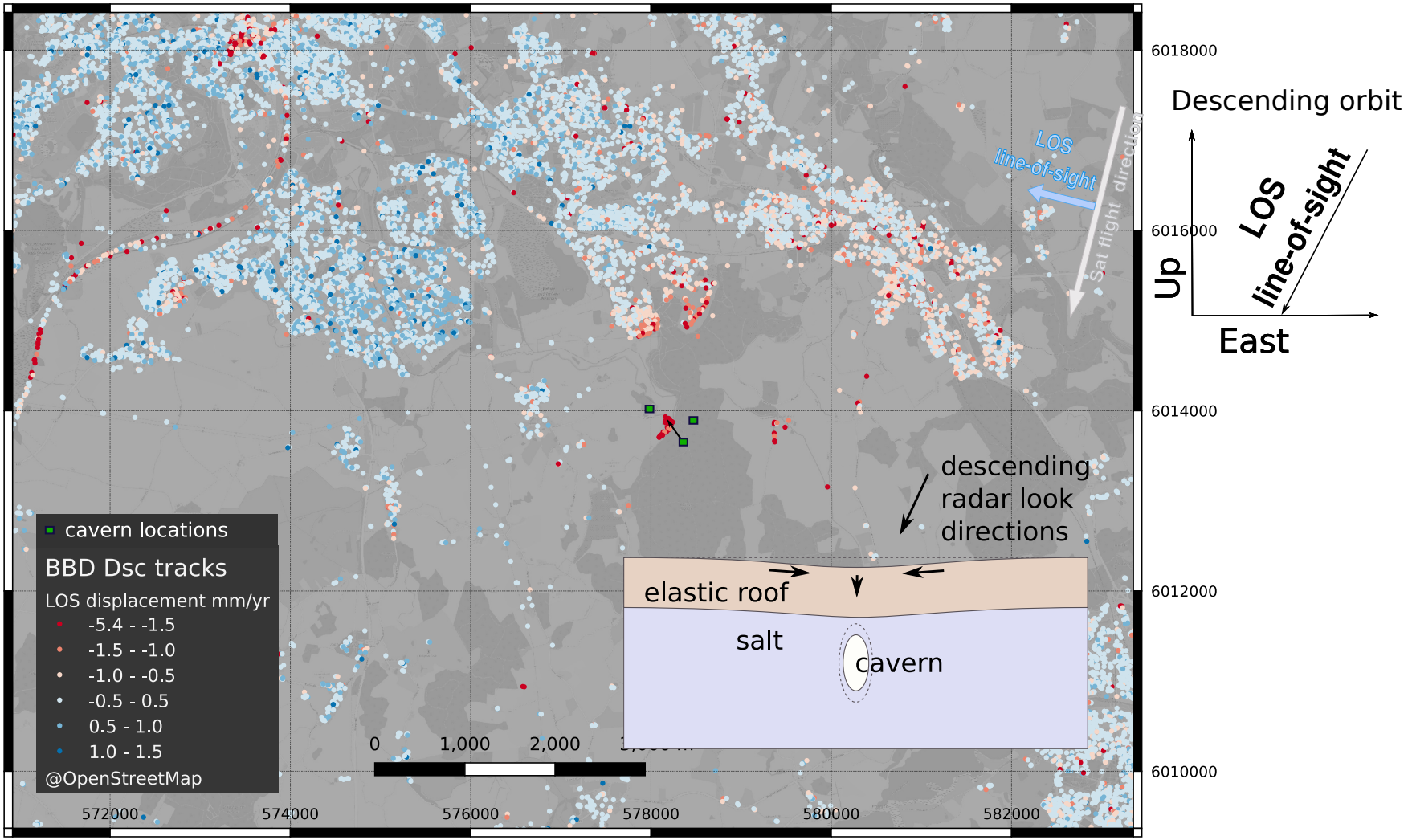

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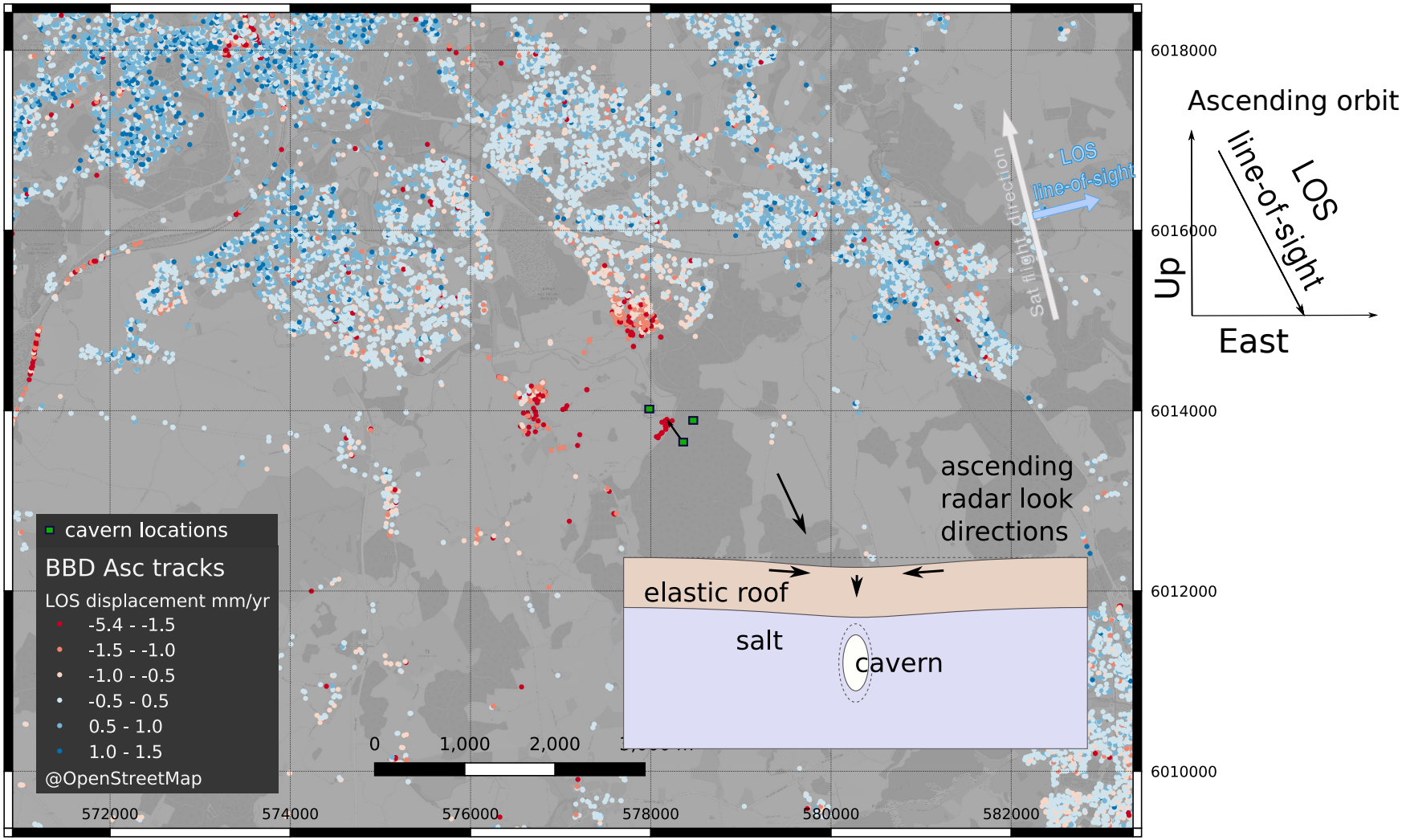
InSAR surface velocities - ascending line-of-sight



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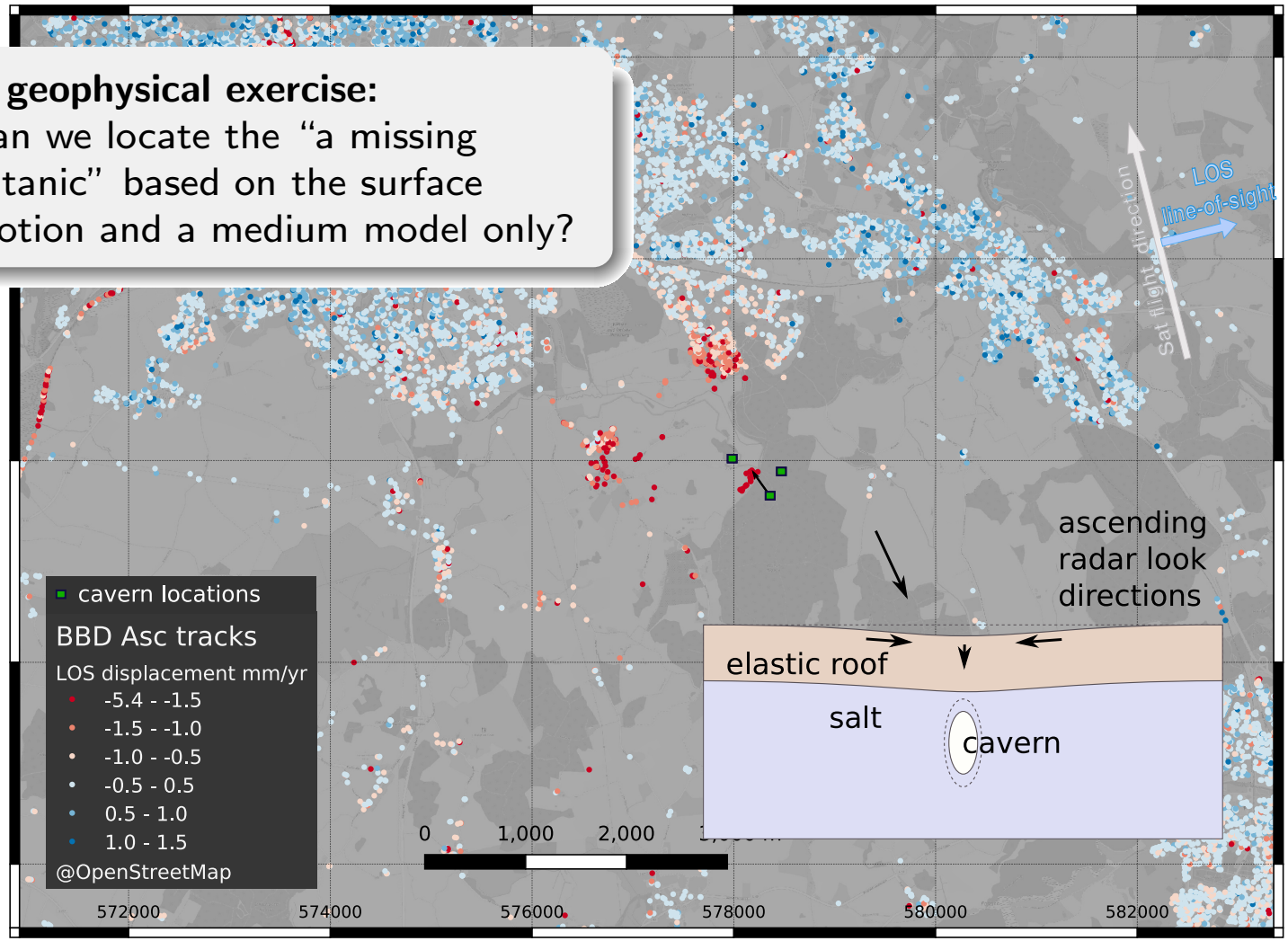
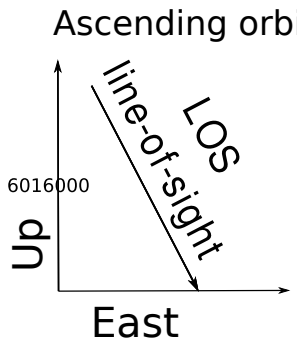
InSAR surface velocities - ascending line-of-sight

A geophysical exercise:
Can we locate the "a missing Titanic" based on the surface motion and a medium model only?





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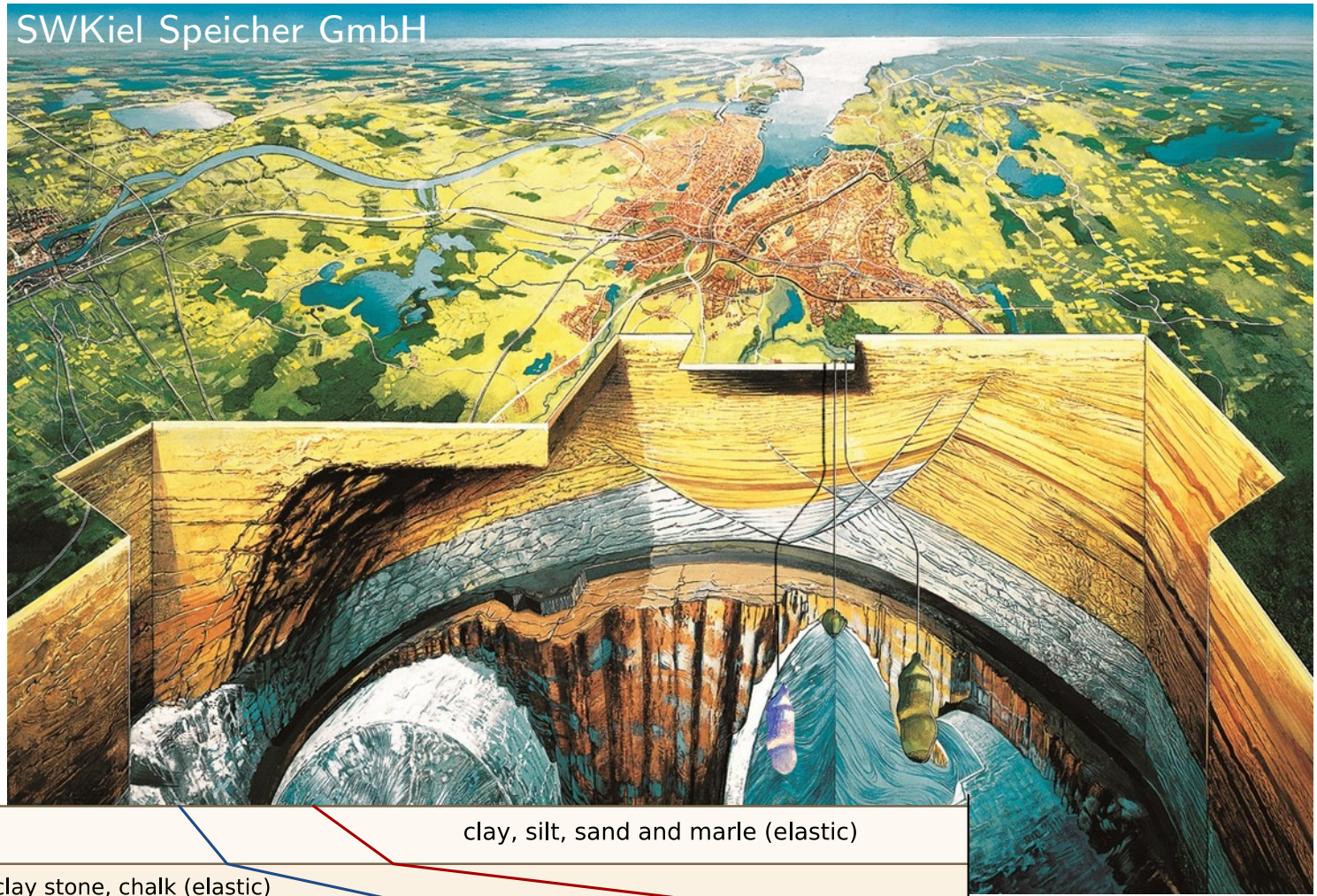
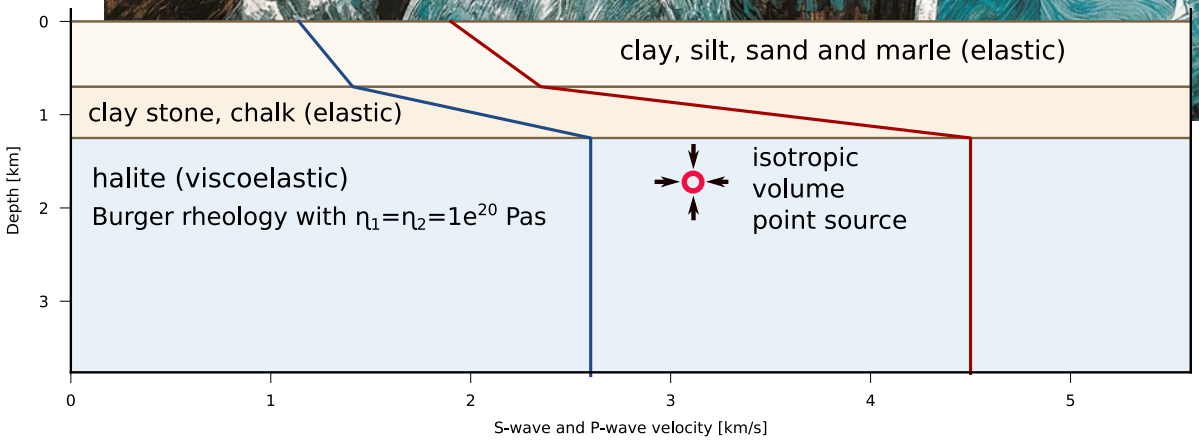
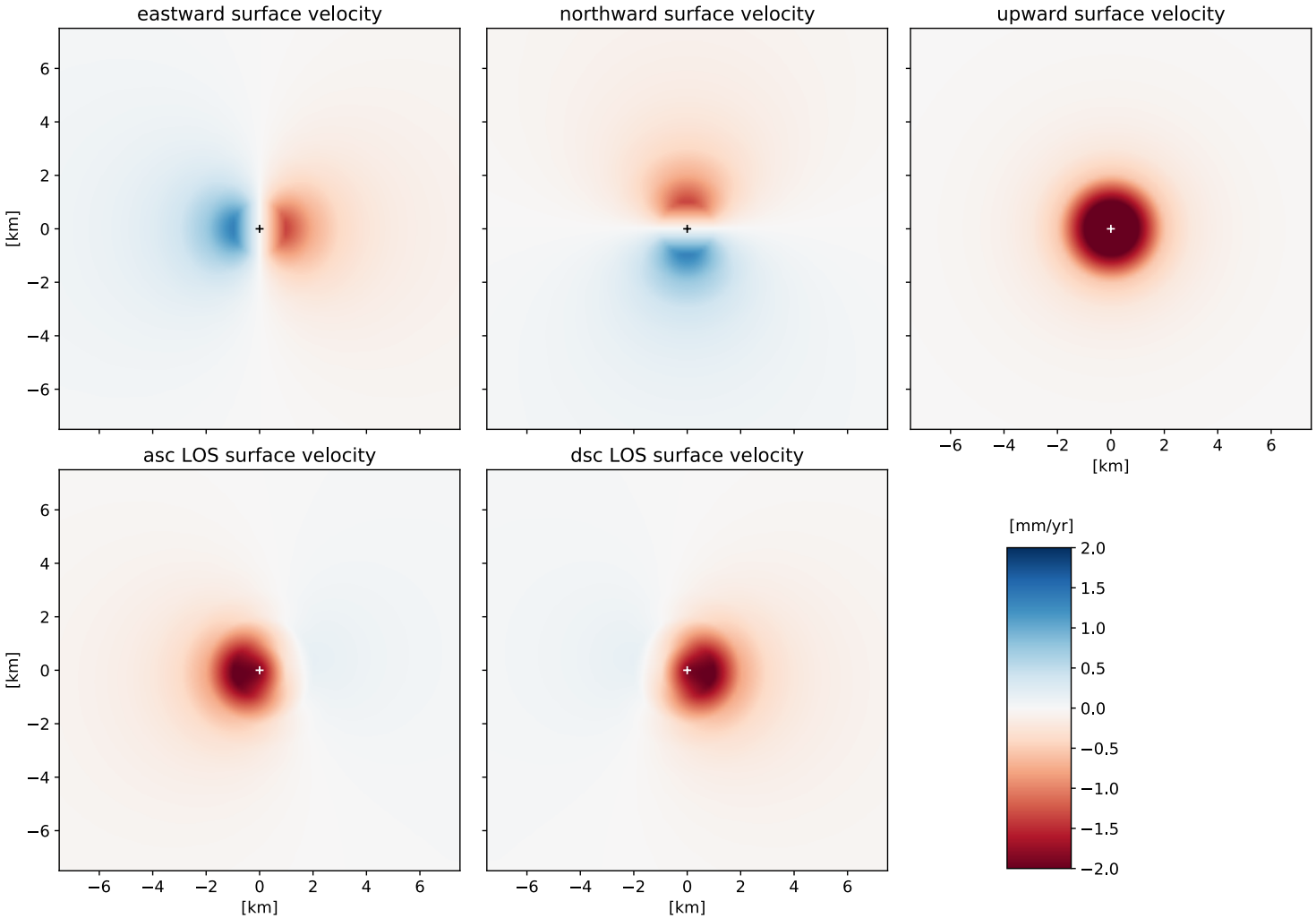




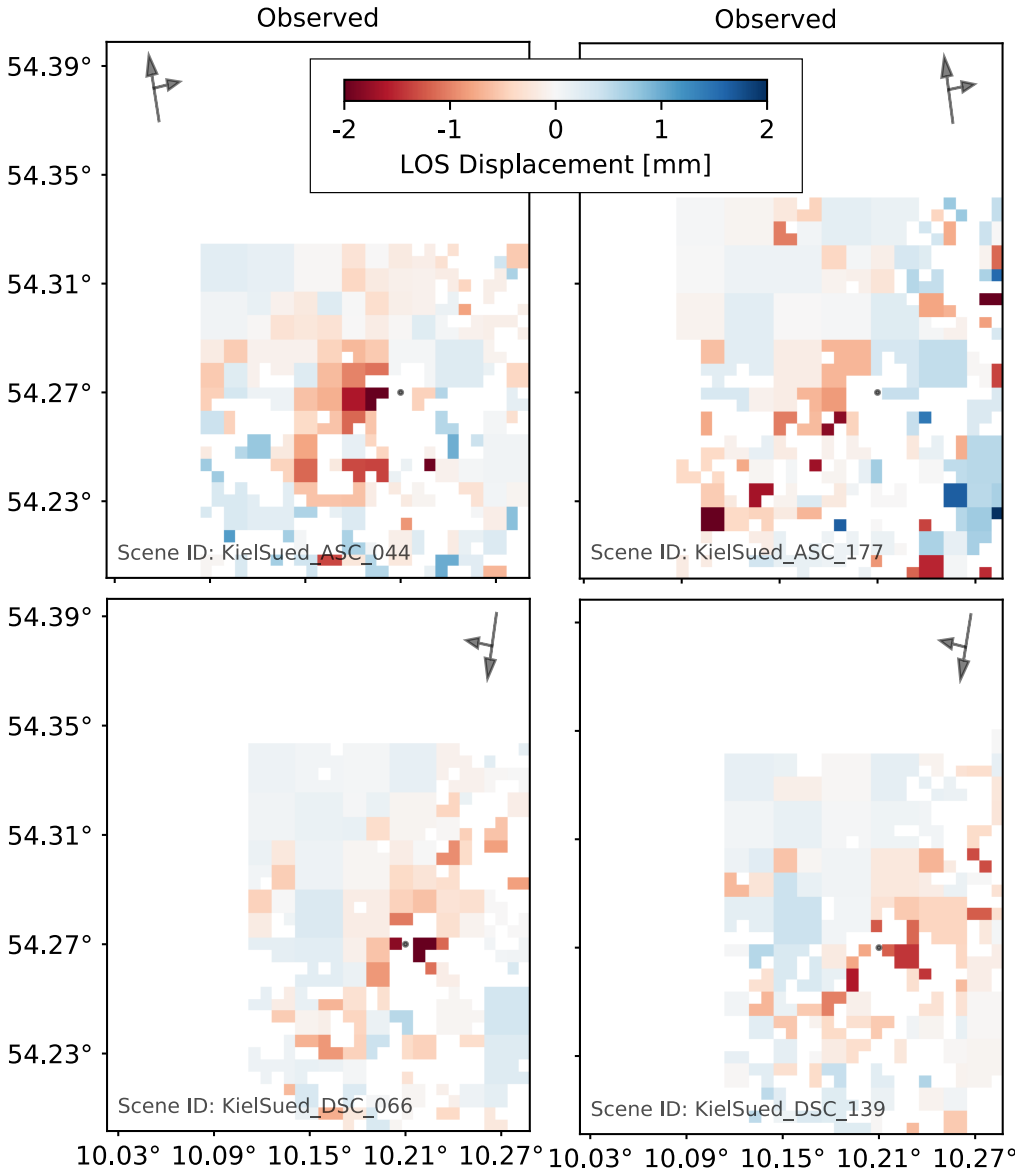
1D medium model based on refraction seismics and single volume point source

Synthetic displacements of shrinking point source

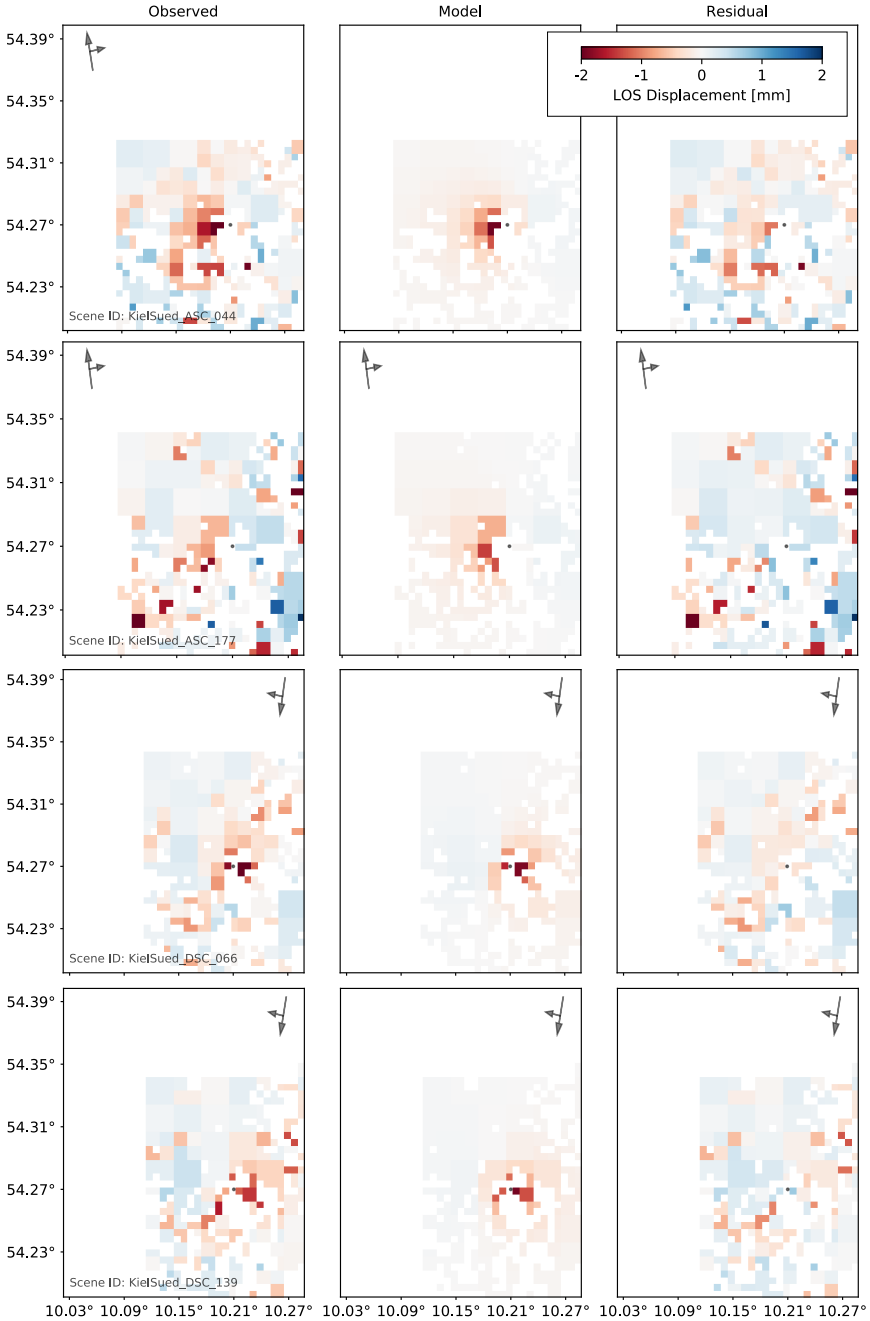


Point source shrinking at 1200 m depth

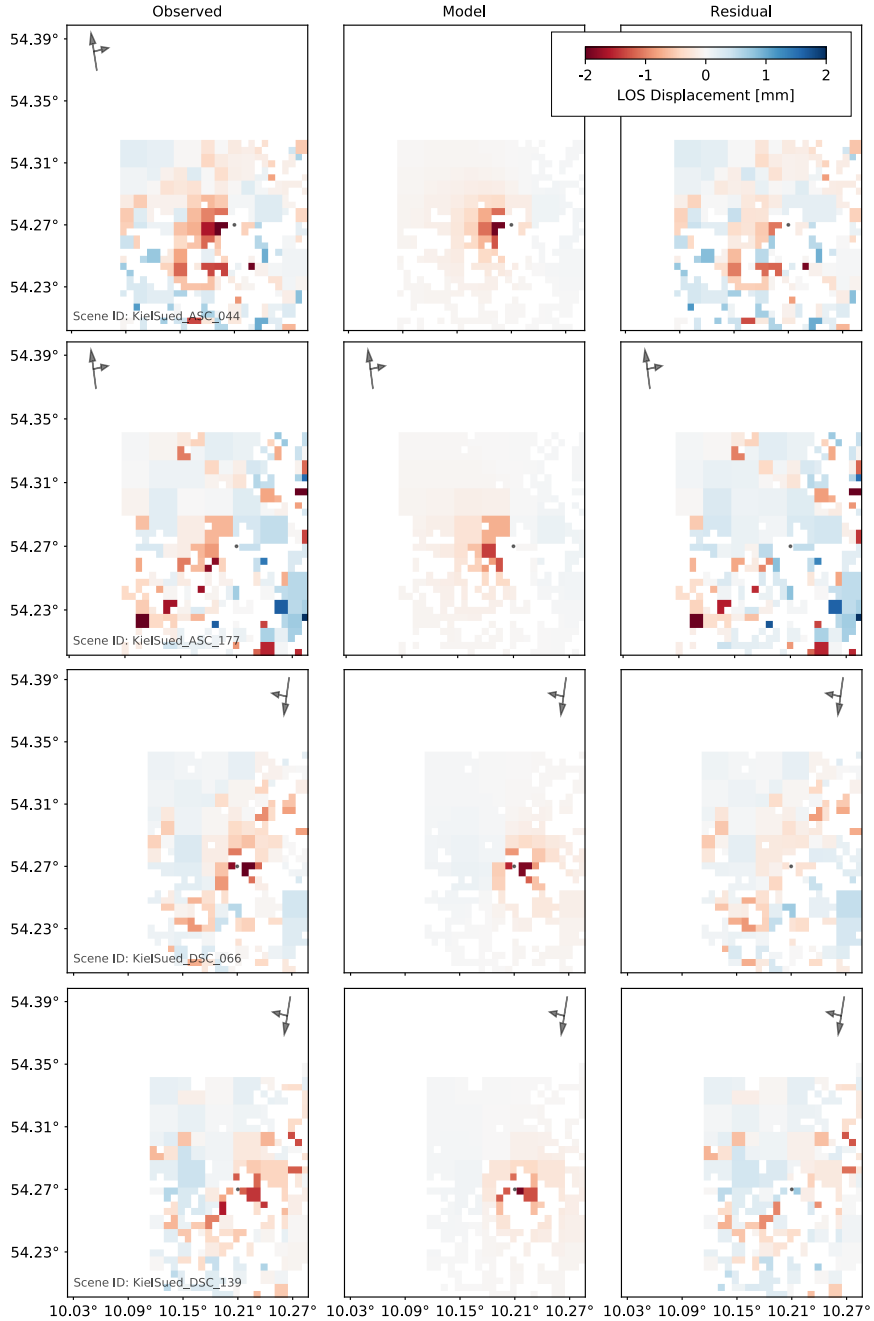
Observed data on a coarse and irregular grid



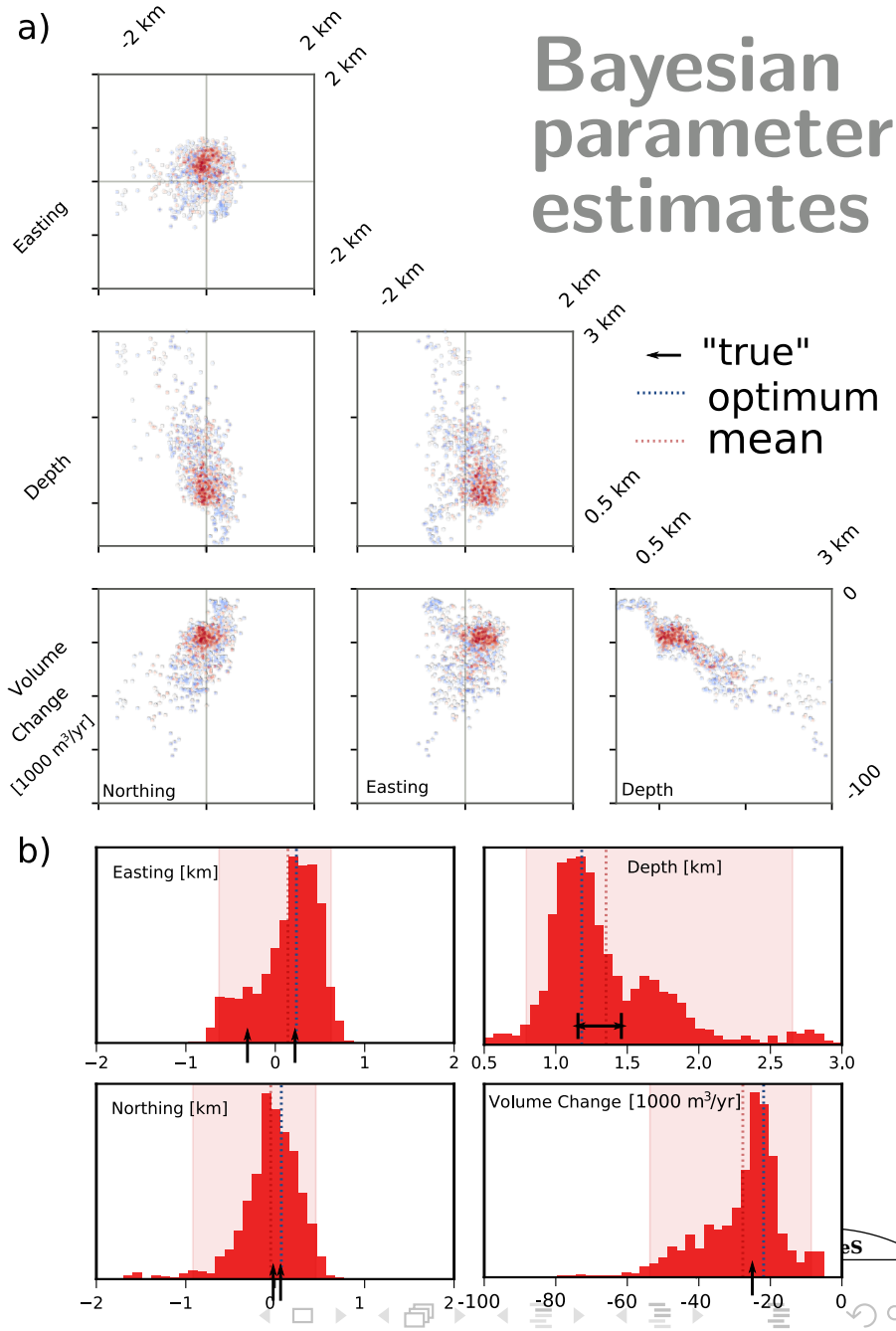
We reduce the number of data points by applying a Quadtree subsampling. We estimate and propagate the noise characteristics, which are significant here.



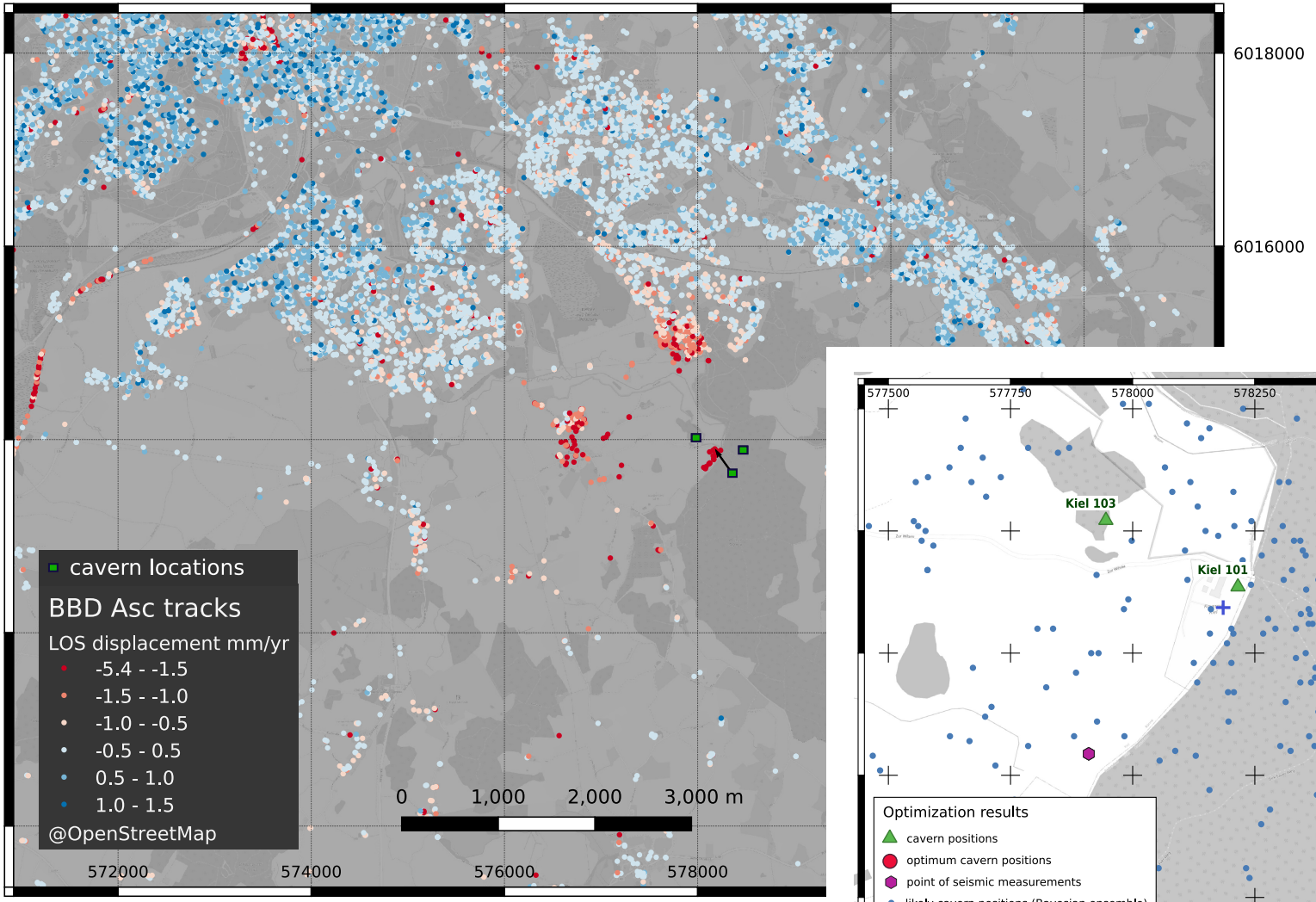
Results - data fit



Bayesian parameter estimates



Lokalization of cavern(s)



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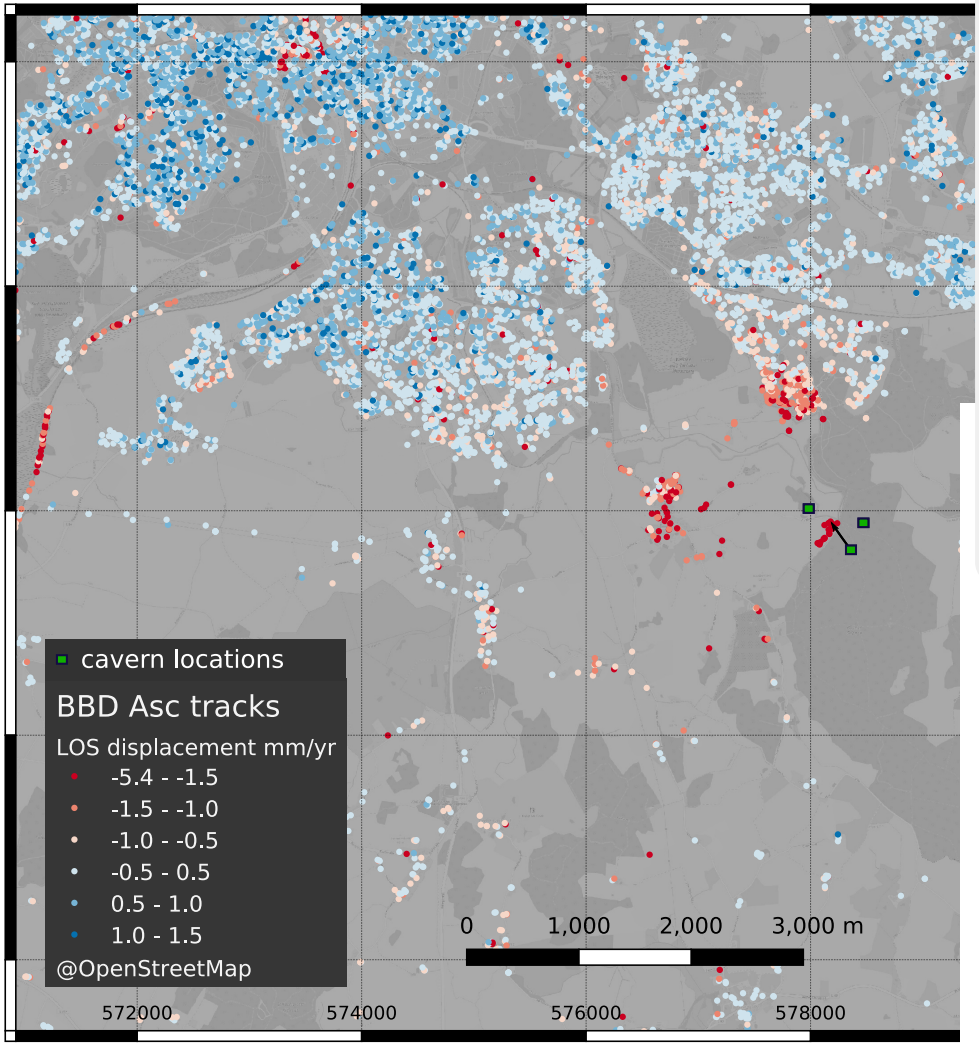

Take aways

Despite strong simplifications in our model:

- Predicted coordinates correspond well to the known cavern locations
- depth range fits well, if with a tendency to shallow locations
- volume change is well imaged, too.

In general, this "exercise" gives confidence in other models of natural processes with unknown characteristics, e.g. sinkholes, modelling volcanoes.

Find methods and codes at pyrocko.org.