

# Web-Based Visualization of (nearly) Live 3D Earthquake Data



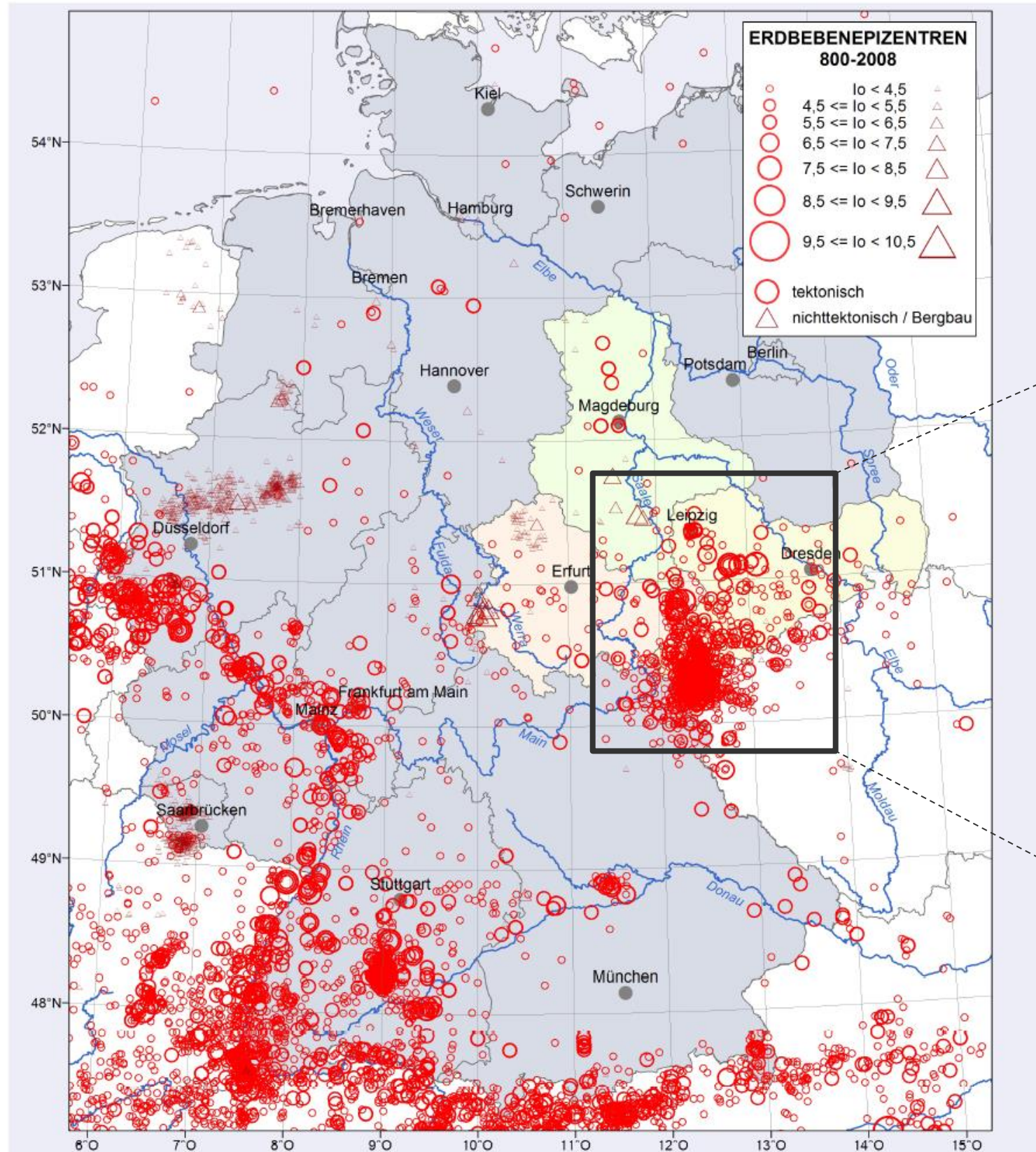
image AI generated

**Sascha Görne**, Dr. Lutz Sonnabend | Geological Survey in Saxony @ State Office for Environment, Agriculture and Geology

7<sup>th</sup> European Meeting on 3D Geological Modelling | 8-11 April 2025 | Warsaw



# Earthquakes in Germany ...and Saxony



- Seismic activity in Germany predominantly occurs along young fault zones
- northern Alpine margin, the Upper Rhine Graben, and the Vogtland
- Vogtland: recurring earthquake swarms, driven by geological stress and the ascent of crustal fluids and gases
- automatic registration of seismic signals from appr. 50 stations across Central Germany and Northwest Bohemia

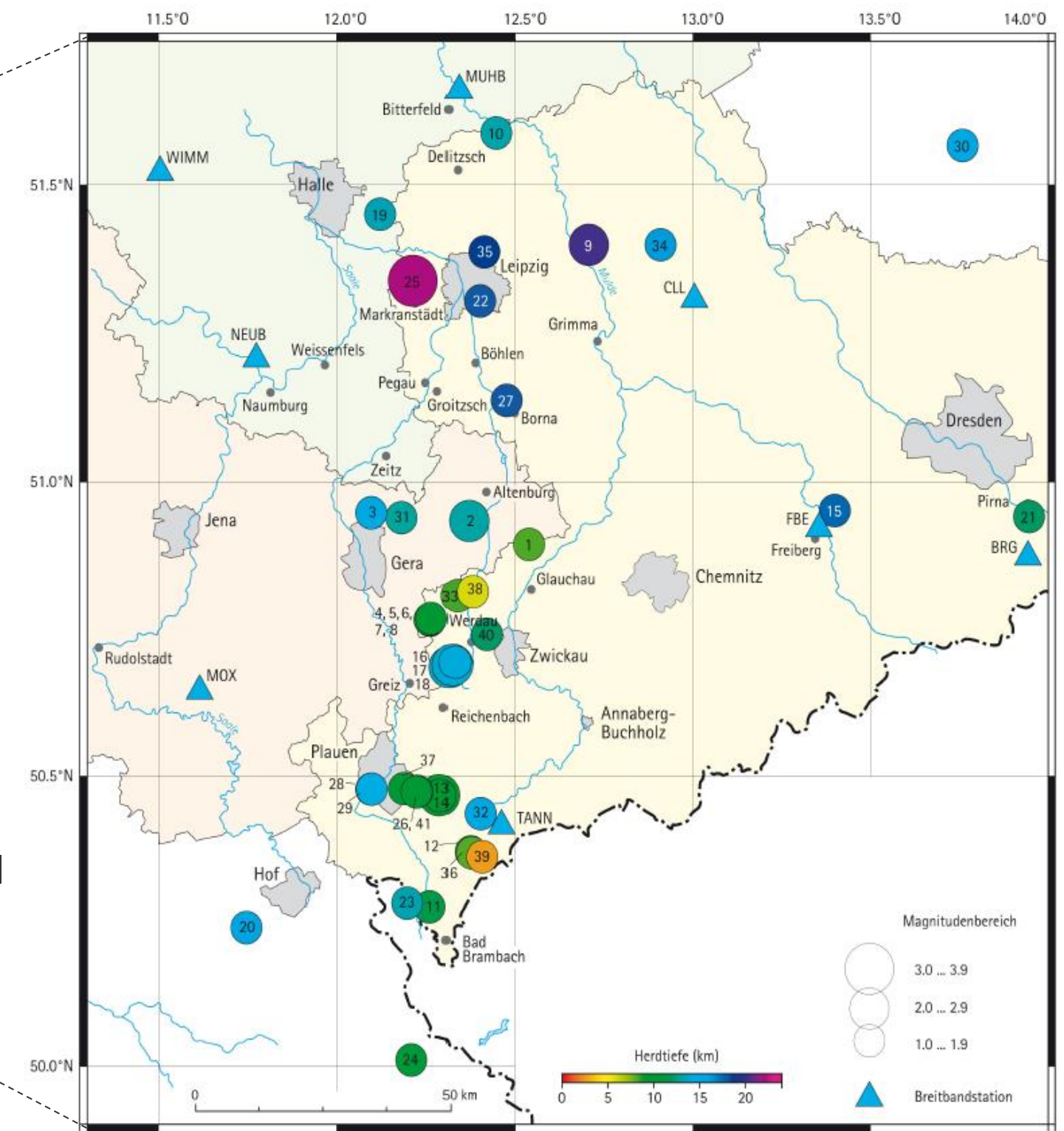


Fig. 1: Seismicity in Germany and neighboring regions for the years 800 to 2008, based on Leydecker, G. (2011).

Fig. 2: Map of the epicenters of earthquakes with local magnitude  $M > 1.0$  in Central Germany from 2016 to 2018 - excluding the earthquakes in the Czech Republic.



# Cartographic representation of earthquakes

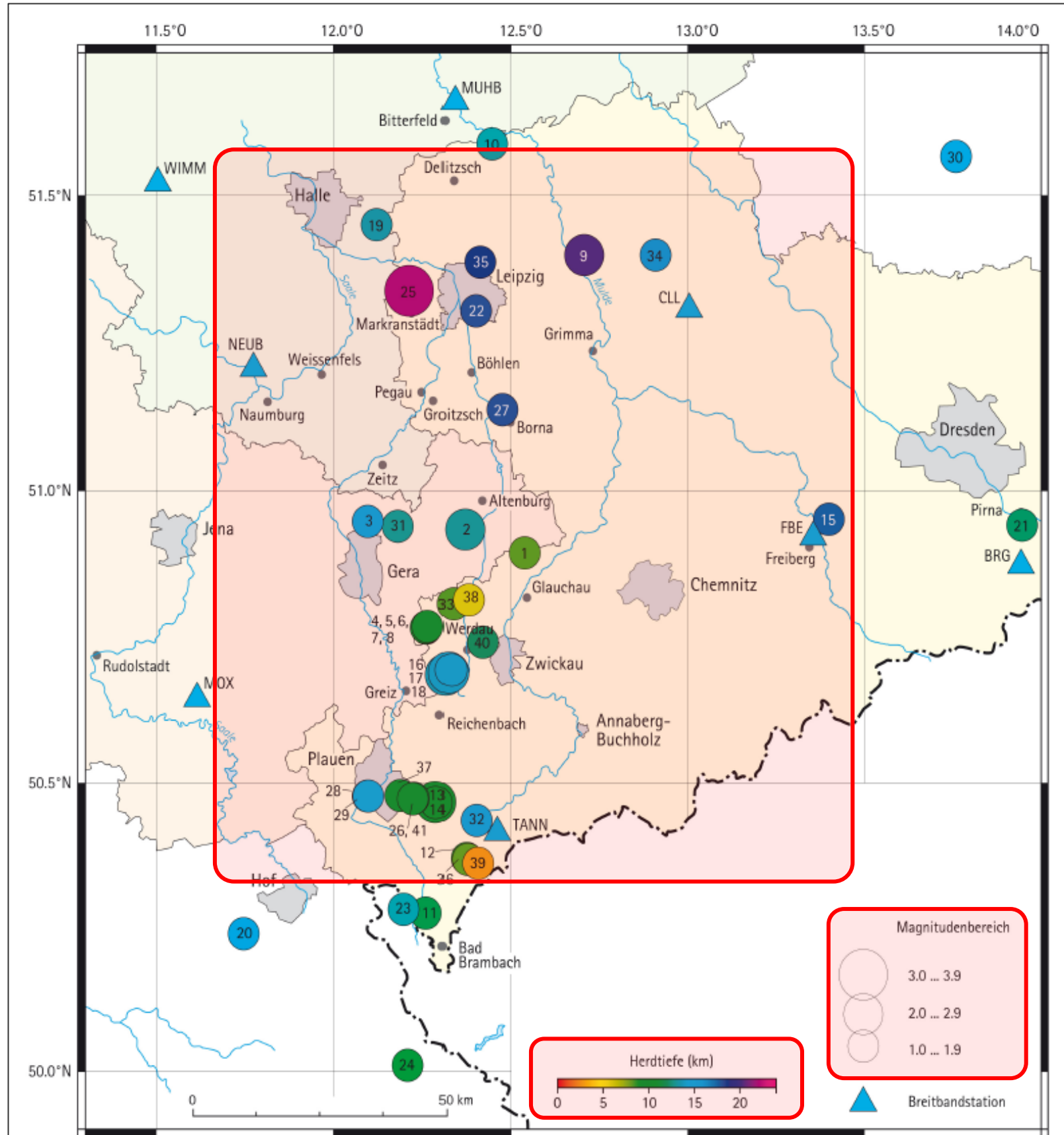


Fig. 2: Map of the epicenters of earthquakes with local magnitude  $M > 1.0$  in Central Germany from 2016 to 2018 - excluding the earthquakes in the Czech Republic.

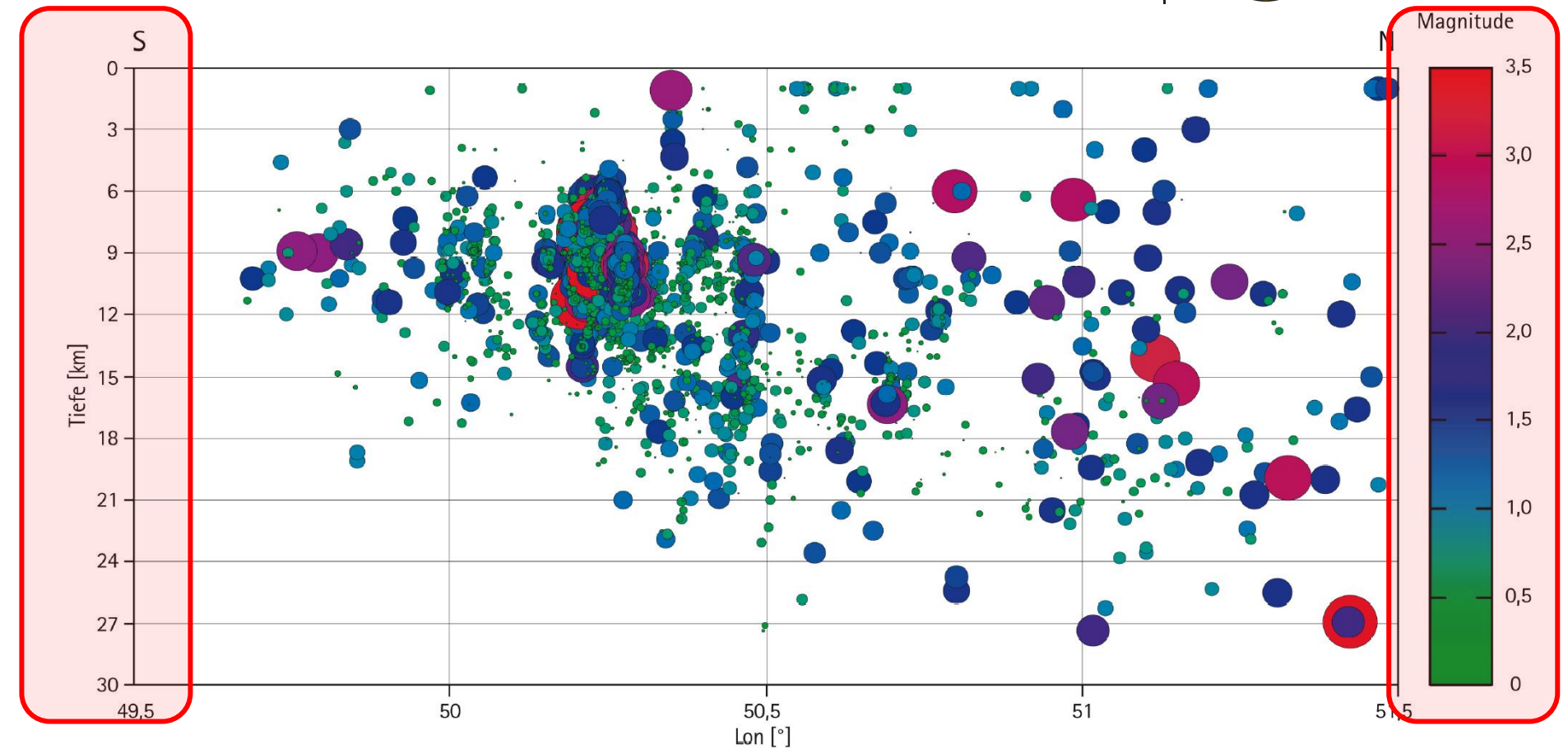


Fig. 3: Depth and magnitude of earthquakes along the Leipzig-Regensburg zone. The depth of the earthquakes increases towards the north.

## Requirements for 3d visualization:

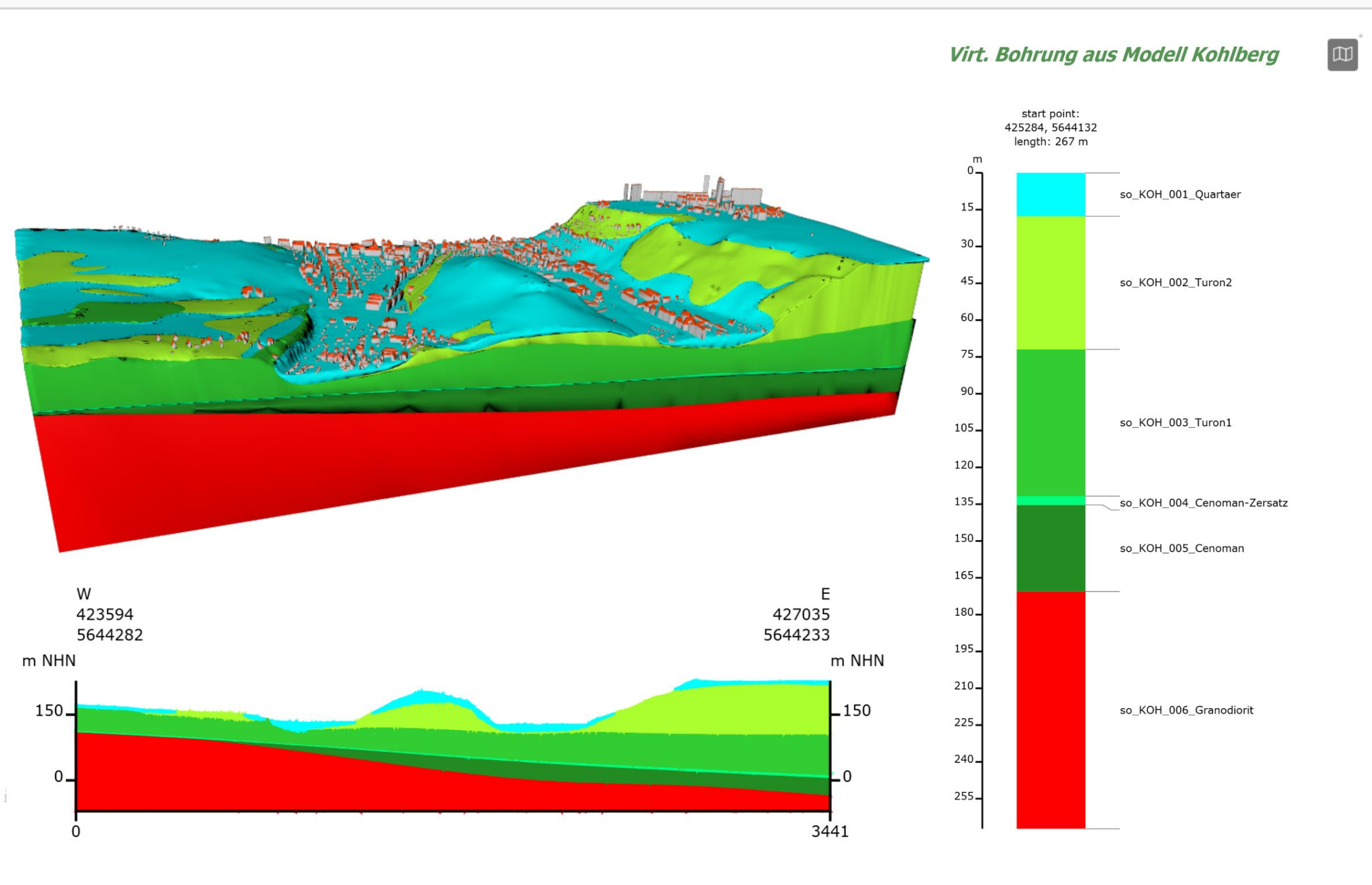
- **Location** of epi- and hypocenters
- Representation of the **magnitude**
- **Focal depth**
- **Color Map**
- **Filtering by time**

interactive

# GST-Web for visualization and provision of 3d geological data



- virtuelles Erzgebirge (NUTS3 3.1) (3)
- Altenberg-Teplice-Caldera (2)
- Kohlberg (4)**
  - Geländemodell (2)
  - Gebäudemodell (3)
  - Horizonte (2)
    - Grenzflächen (19)
    - Körpermodell (6)
      - so\_KOH\_001\_Quartaer
      - so\_KOH\_002\_Turon2
      - so\_KOH\_003\_Turon1
      - so\_KOH\_004\_Cenoman-Ze
      - so\_KOH\_005\_Cenoman
      - so\_KOH\_006\_Granodiorit
  - Störungen (1)



**THEMEN**

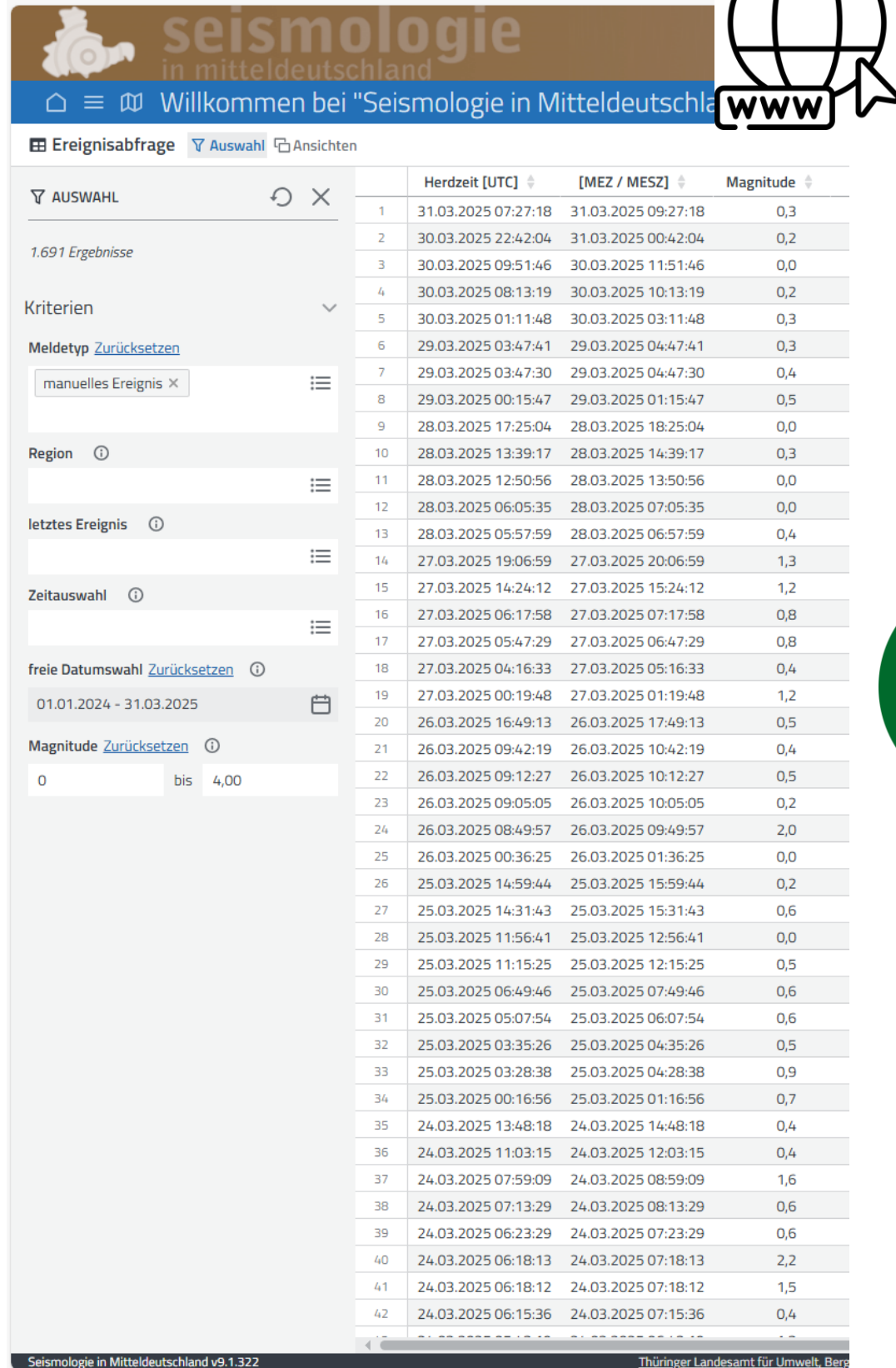
Ohne Thema

Rechtswert: 423592.1  
Hochwert: 5643595.3  
Überhöhung 2.5



# From online earthquake catalog to 3d point clouds

seismology catalog (https)...



seismologie  
in mitteldeutschland

Willkommen bei "Seismologie in Mitteldeutschland"

Ereignisabfrage Auswahl Ansichten

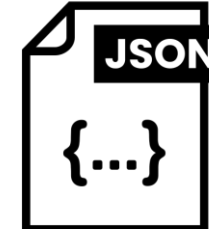
AUSWAHL	Herdzeit [UTC]	[MEZ / MESZ]	Magnitude
1	31.03.2025 07:27:18	31.03.2025 09:27:18	0,3
2	30.03.2025 22:42:04	31.03.2025 00:42:04	0,2
3	30.03.2025 09:51:46	30.03.2025 11:51:46	0,0
4	30.03.2025 08:13:19	30.03.2025 10:13:19	0,2
5	30.03.2025 01:11:48	30.03.2025 03:11:48	0,3
6	29.03.2025 03:47:41	29.03.2025 04:47:41	0,3
7	29.03.2025 03:47:30	29.03.2025 04:47:30	0,4
8	29.03.2025 00:15:47	29.03.2025 01:15:47	0,5
9	28.03.2025 17:25:04	28.03.2025 18:25:04	0,0
10	28.03.2025 13:39:17	28.03.2025 14:39:17	0,3
11	28.03.2025 12:50:56	28.03.2025 13:50:56	0,0
12	28.03.2025 06:05:35	28.03.2025 07:05:35	0,0
13	28.03.2025 05:57:59	28.03.2025 06:57:59	0,4
14	27.03.2025 19:06:59	27.03.2025 20:06:59	1,3
15	27.03.2025 14:24:12	27.03.2025 15:24:12	1,2
16	27.03.2025 06:17:58	27.03.2025 07:17:58	0,8
17	27.03.2025 05:47:29	27.03.2025 06:47:29	0,8
18	27.03.2025 04:16:33	27.03.2025 05:16:33	0,4
19	27.03.2025 00:19:48	27.03.2025 01:19:48	1,2
20	26.03.2025 16:49:13	26.03.2025 17:49:13	0,5
21	26.03.2025 09:42:19	26.03.2025 10:42:19	0,4
22	26.03.2025 09:12:27	26.03.2025 10:12:27	0,5
23	26.03.2025 09:05:05	26.03.2025 10:05:05	0,2
24	26.03.2025 08:49:57	26.03.2025 09:49:57	2,0
25	26.03.2025 00:36:25	26.03.2025 01:36:25	0,0
26	25.03.2025 14:59:44	25.03.2025 15:59:44	0,2
27	25.03.2025 14:31:43	25.03.2025 15:31:43	0,6
28	25.03.2025 11:56:41	25.03.2025 12:56:41	0,0
29	25.03.2025 11:15:25	25.03.2025 12:15:25	0,5
30	25.03.2025 06:49:46	25.03.2025 07:49:46	0,6
31	25.03.2025 05:07:54	25.03.2025 06:07:54	0,6
32	25.03.2025 03:35:26	25.03.2025 04:35:26	0,5
33	25.03.2025 03:28:38	25.03.2025 04:28:38	0,9
34	25.03.2025 00:16:56	25.03.2025 01:16:56	0,7
35	24.03.2025 13:48:18	24.03.2025 14:48:18	0,4
36	24.03.2025 11:03:15	24.03.2025 12:03:15	0,4
37	24.03.2025 07:59:09	24.03.2025 08:59:09	1,6
38	24.03.2025 07:13:29	24.03.2025 08:13:29	0,6
39	24.03.2025 06:23:29	24.03.2025 07:23:29	0,6
40	24.03.2025 06:18:13	24.03.2025 07:18:13	2,2
41	24.03.2025 06:18:12	24.03.2025 07:18:12	1,5
42	24.03.2025 06:15:36	24.03.2025 07:15:36	0,4



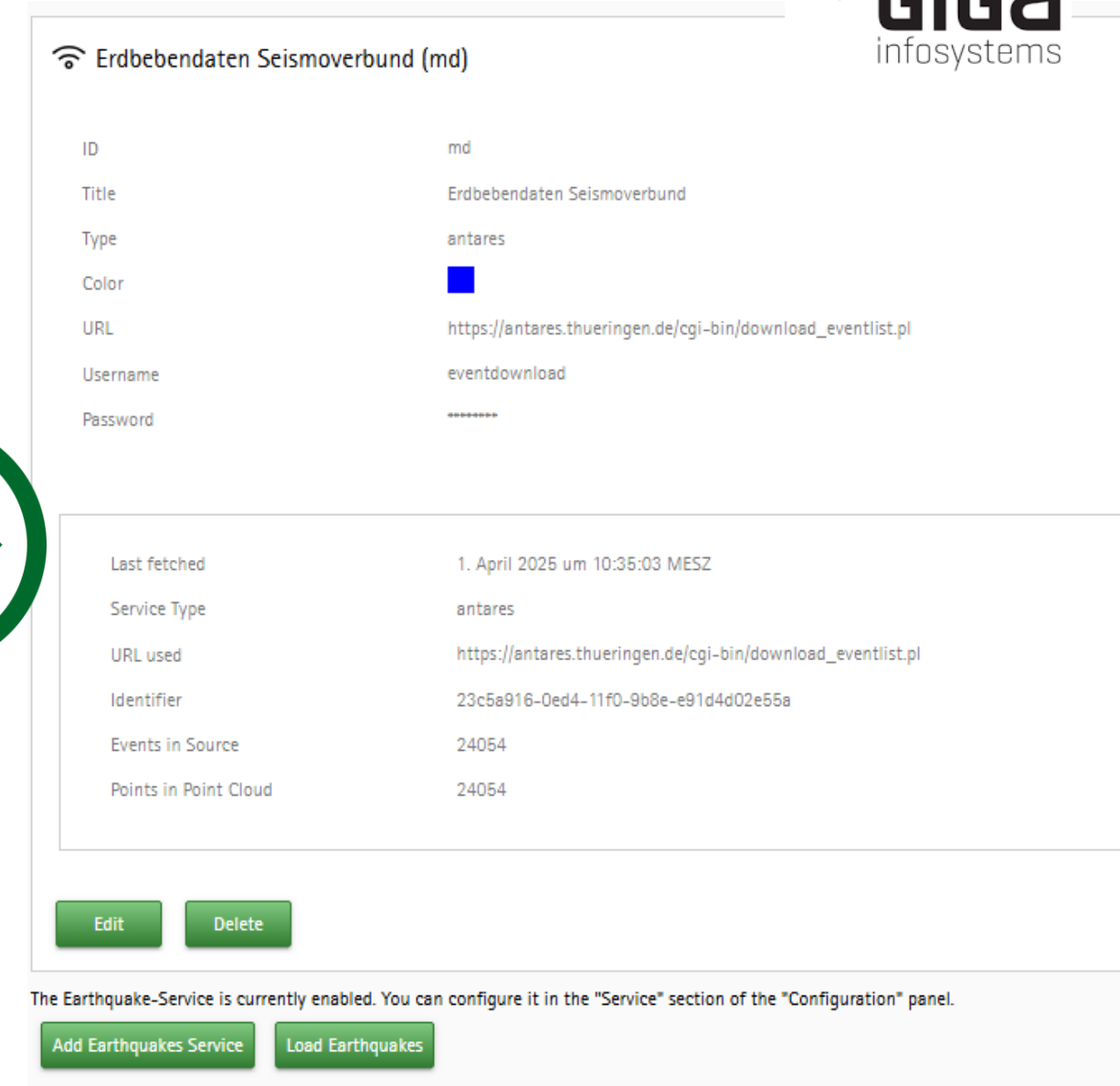
...provided as Service (JSON)...

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ebd-ereignisse.json
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...parsed by GiGa GST (pointcloud)



GiGa  
infosystems

Erdbebendaten Seismoverbund (md)

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Title	Erdbebendaten Seismoverbund
Type	antares
Color	<span style="color: blue;">■</span>
URL	https://antares.thueringen.de/cgi-bin/download_eventlist.pl
Username	eventdownload
Password	*****
Last fetched	1. April 2025 um 10:35:03 MESZ
Service Type	antares
URL used	https://antares.thueringen.de/cgi-bin/download_eventlist.pl
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Points in Point Cloud	24054

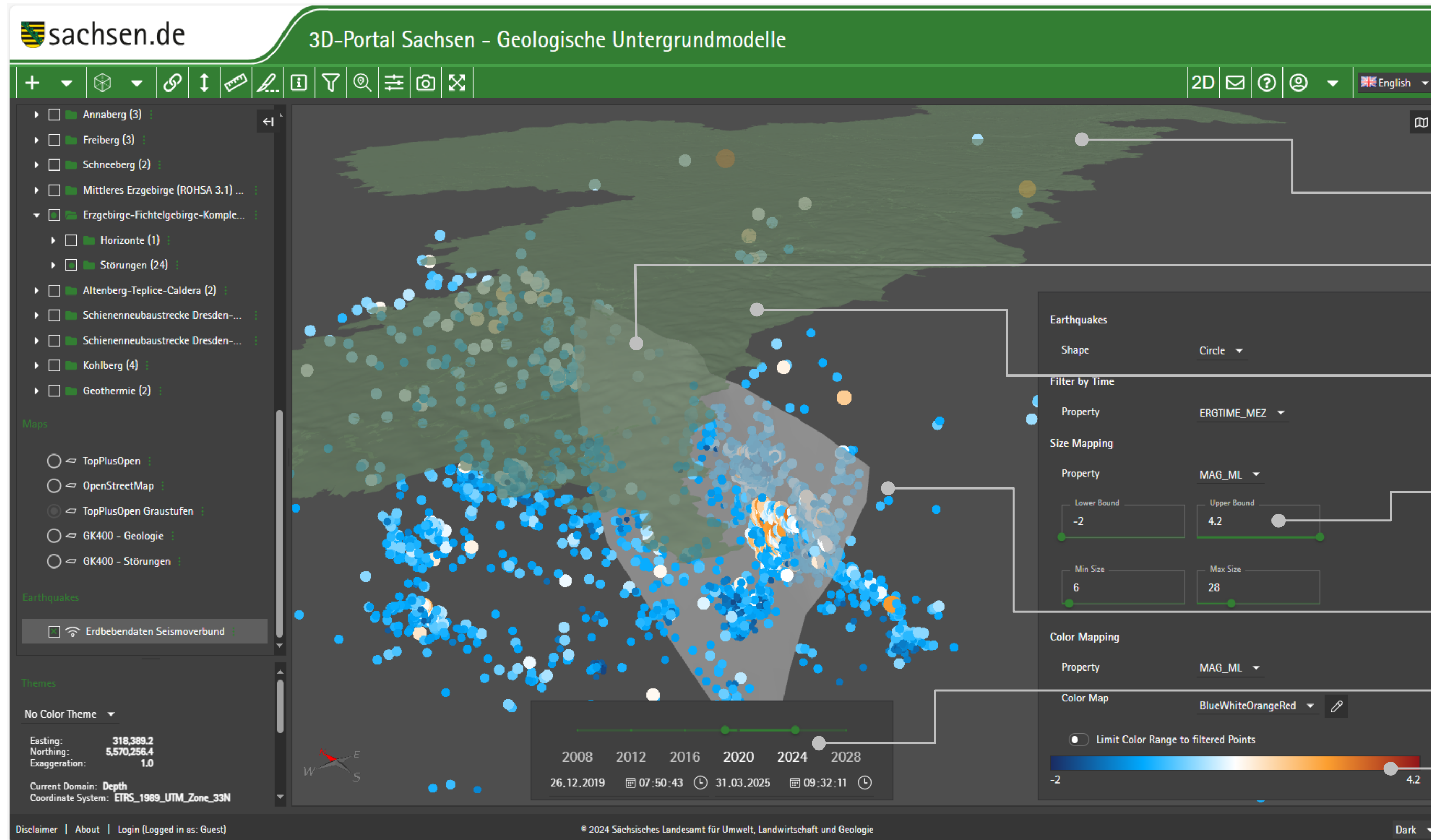
Edit Delete

The Earthquake-Service is currently enabled. You can configure it in the "Service" section of the "Configuration" panel.

Add Earthquakes Service Load Earthquakes

→also suitable for FDSN-Services

# GST-Web visualization of earthquake hypocenters along with geological structures



+ Topography

+ Structures: faults & geological horizons

Location of epi- and hypocenters

Representation of the magnitude

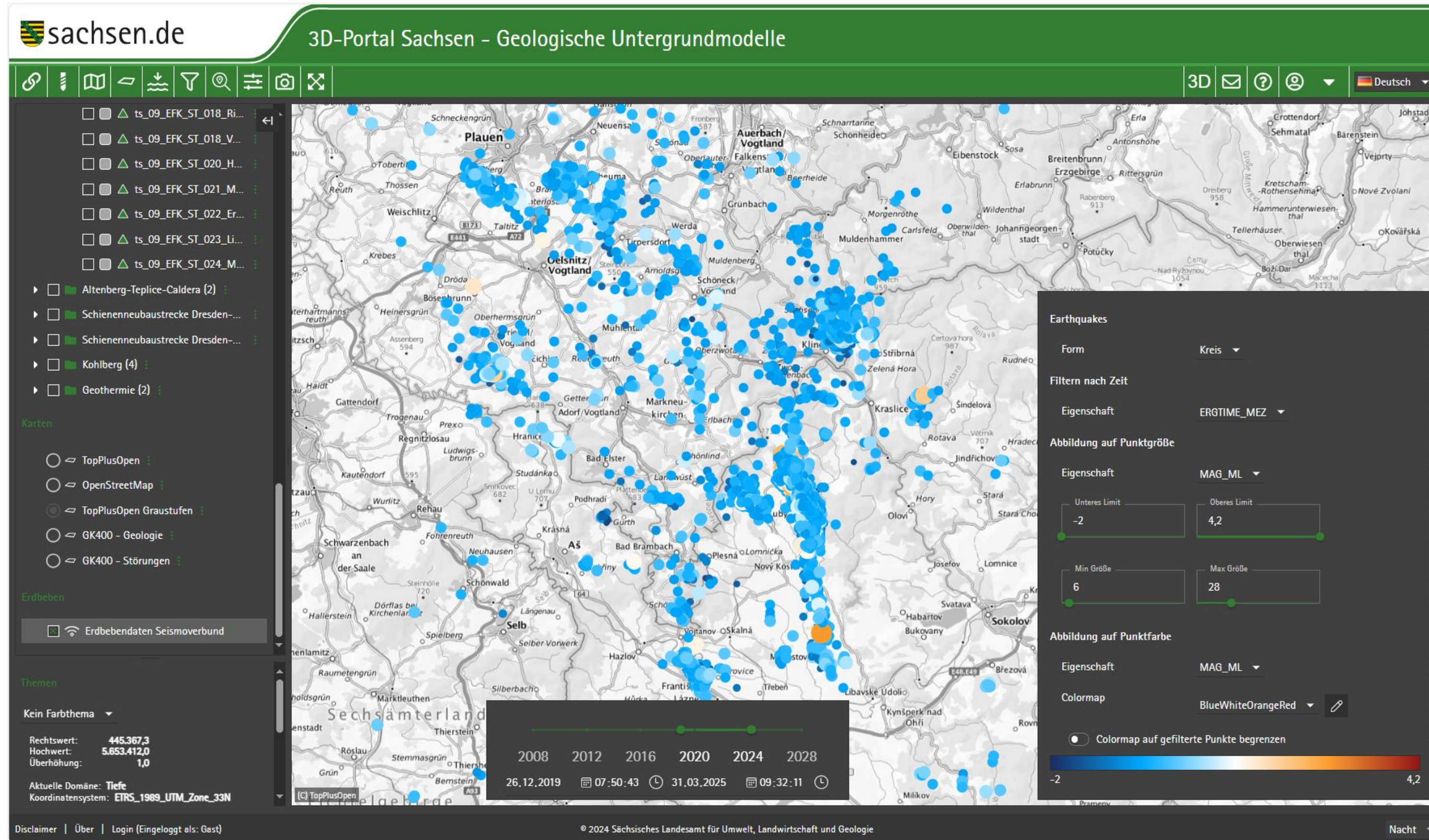
Focal depth

Filtering by time

Color Map



# Detailed views of web visualization tool: 2d map view



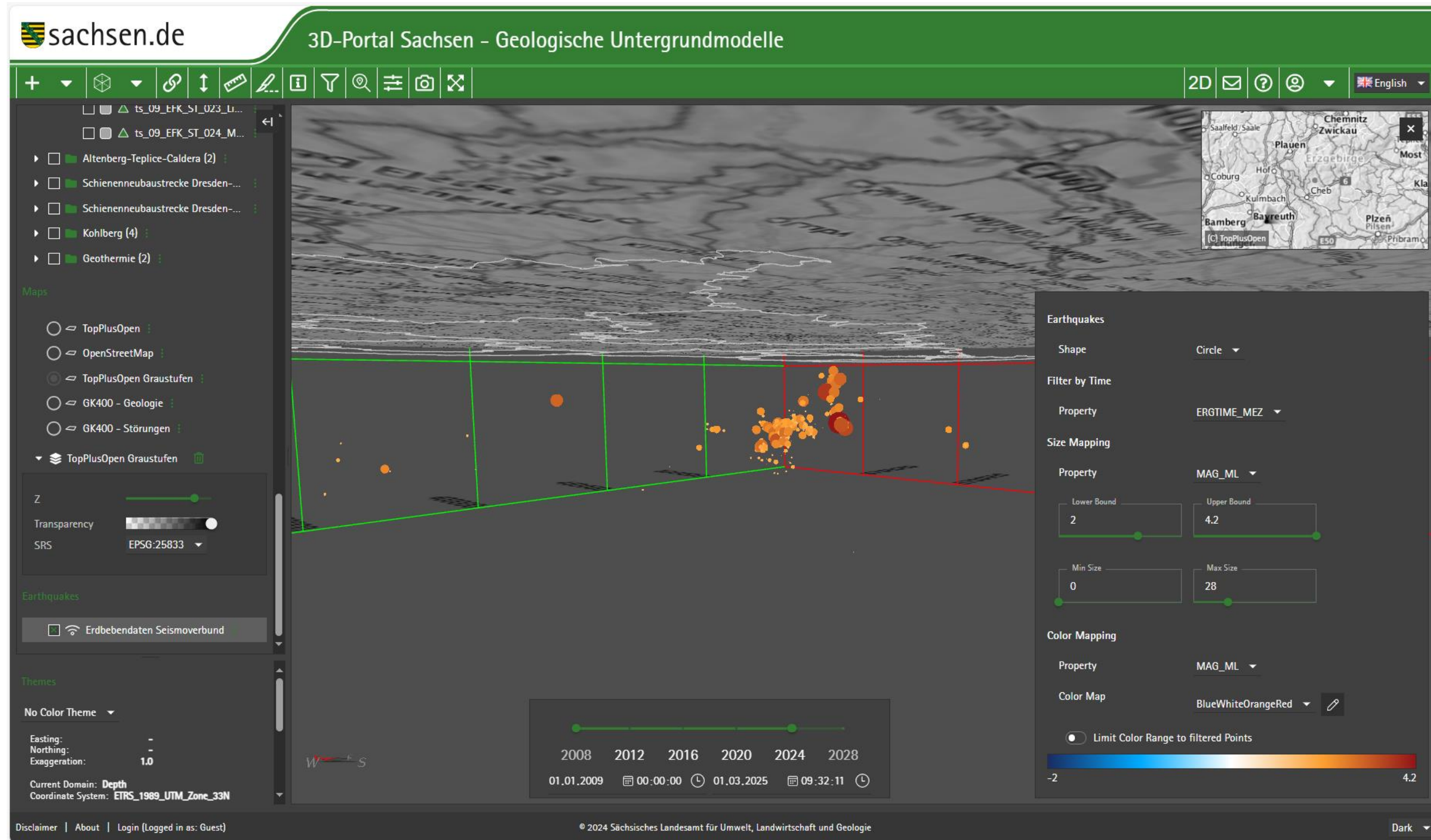


# Detailed views of web visualization tool: earthquakes in march 2025

The screenshot displays the '3D-Portal Sachsen - Geologische Untergrundmodelle' web application. The main view is a 3D map showing a geological cross-section with blue circles representing earthquakes. A calendar overlay is centered on the map, showing the month of March 2025 with the 1st and 3rd highlighted. The right sidebar contains configuration options for the 'Earthquakes' layer, including shape (Circle), filter by time (ERGTIME\_MEZ), size mapping (MAG\_ML), and color mapping (BlueWhiteOrangeRed). The left sidebar shows a list of layers and maps, including 'Altenberg-Tepllice-Caldera (2)', 'Schienenneubaustrecke Dresden...', 'Kohlberg (4)', and 'Geothermie (2)'. The top toolbar includes navigation and interaction tools. The bottom of the interface shows a disclaimer, login information, and a copyright notice for the Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie.

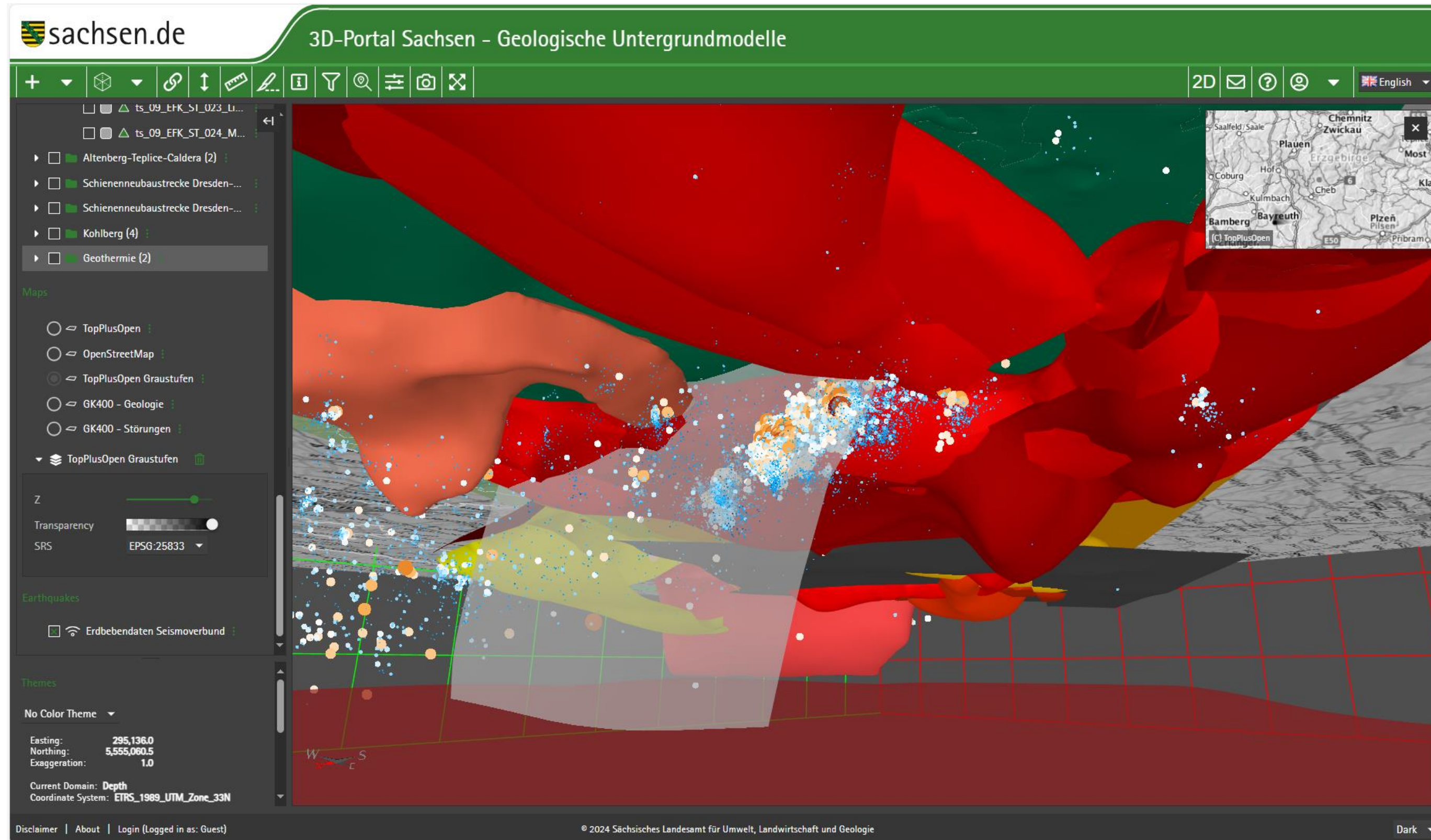


# Detailed views of web visualization tool: earthquakes > M2.0 since 2008





# Detailed views of web visualization tool: integration with 3d models





# Summary and take home message

## Usefulness of the 3D Earthquake Visualization Tool:

- Interactive Viewing: Allows users to explore seismic events in 3D and filter data by time, magnitude, and type.
- Integration with 3D Models: Combines seismic data with subsurface models to visualize fault lines and geological features.

## Advantages Over 2D Maps:

- Better Spatial Understanding: Provides a more complete view of earthquake depth and orientation.
- Dynamic Exploration: Offers interactive, engaging visuals that improve data interpretation.

## Public Outreach and Communication:

- Enhanced Awareness: Helps the public understand seismic risks and earthquake preparedness.
- Real-Time Data Access: Provides authorities and the public with current earthquake information for informed decision-making.







→ try yourself



# Thank you for your attention!



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