3D modelling of the Cenozoic groundwater resources of Mecklenburg-Western-Pomerania (NE Germany)

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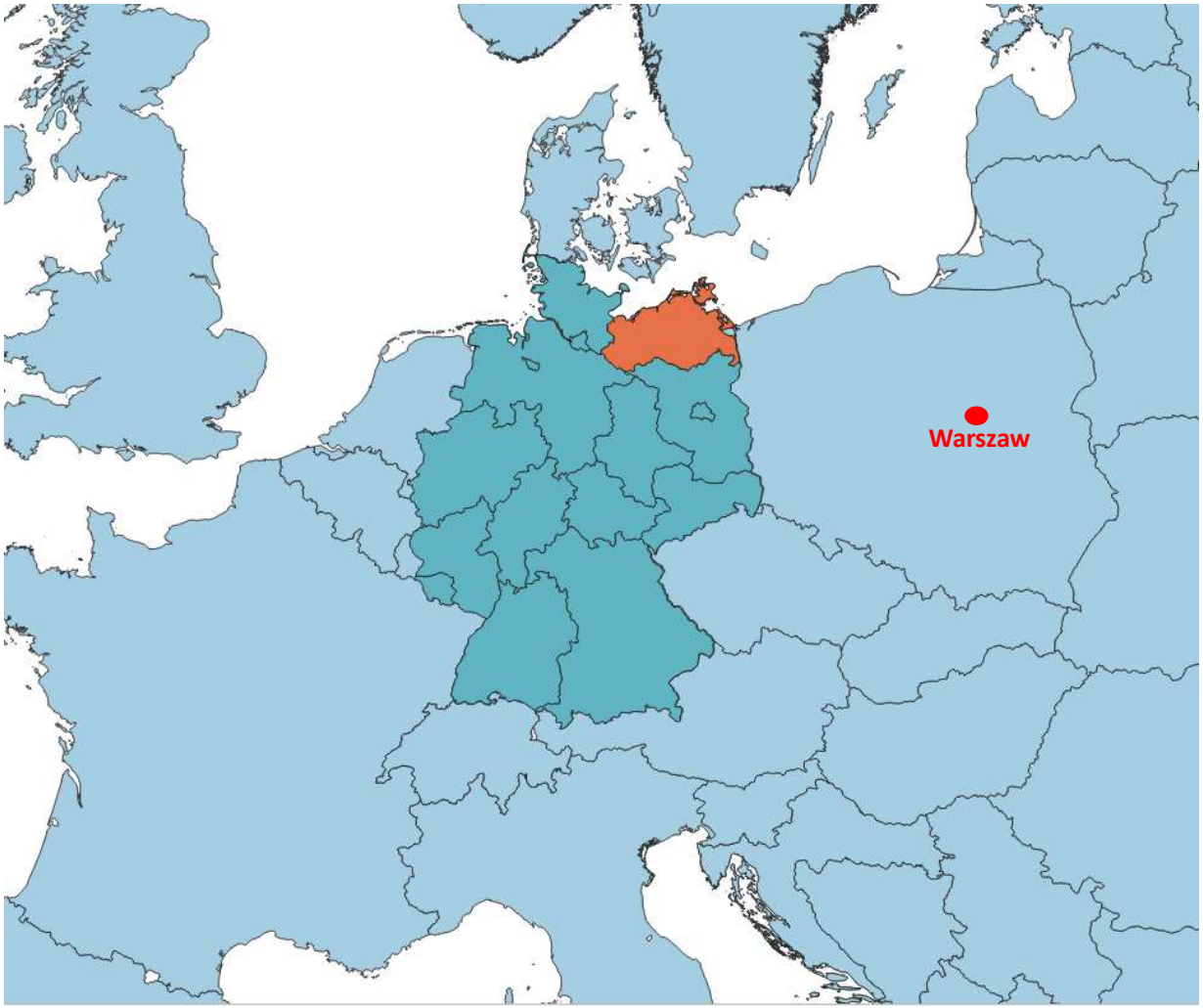
7th European Meeting on 3D Geological Modelling
New frontiers and challenges in geomodelling
8.-11.04.2025, Warsaw



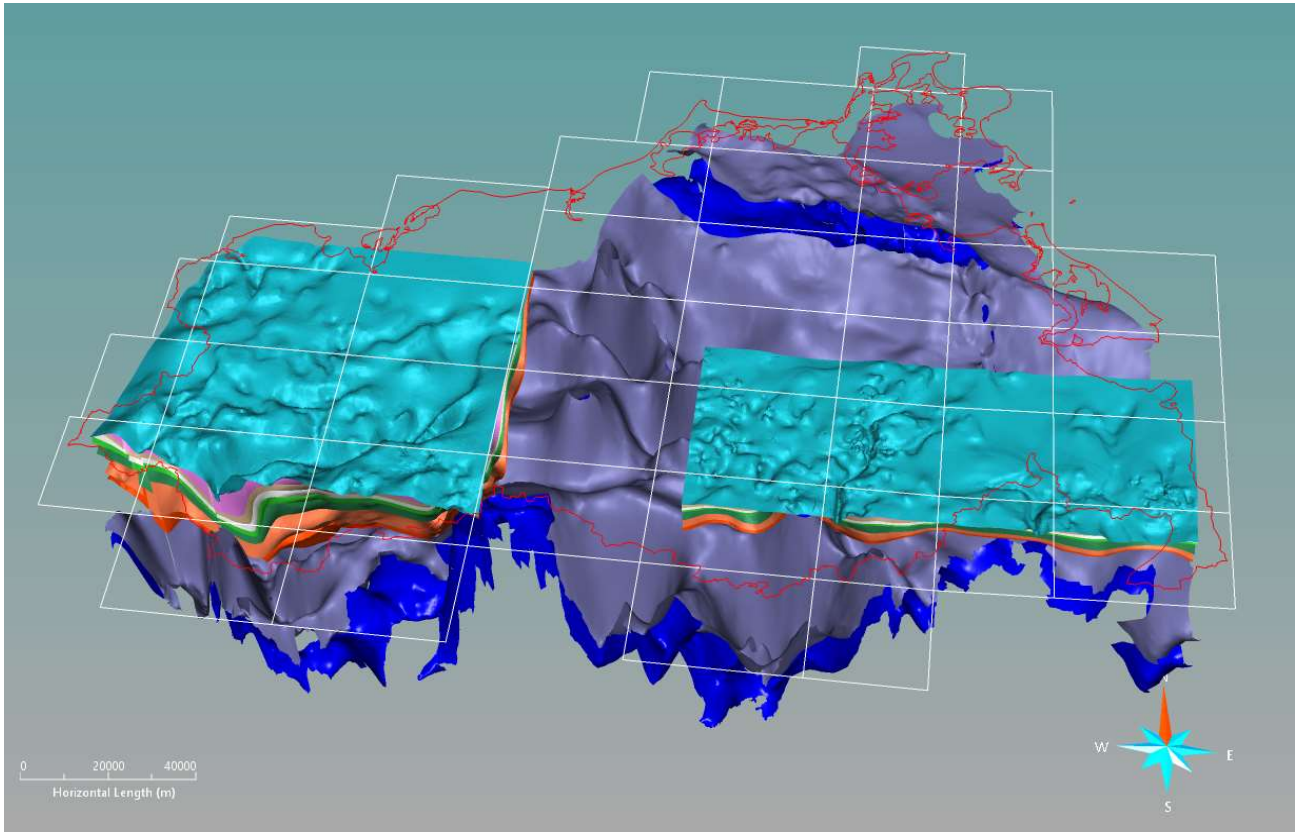
3D-model of the Cenozoic groundwater ressources in Mecklenburg-Western Pomerania

Why ?

- complete covering with cenozoic sediments (approx. 23.000 km²)
- water supply uses mostly groundwater (>95%) in Cenozoic aquifers
  - Especially shallow Quaternary aquifers (depth: some dekameters up to 100-150m)
- increasing interest in the use of deeper Tertiary aquifers (depth 100-250m)
  - increasing demand (irrigation)
    - locally no productive Quaternary aquifers
  - increasing polution of shallow aquifers (fertilizers, pesticides, herbicides)

- development of the model in 2 parts that are finally merged (technical aspects)
  - Tertiary model
  - Quaternary model

3D model of the Cenozoic
1. Tertiary strata and aquifers



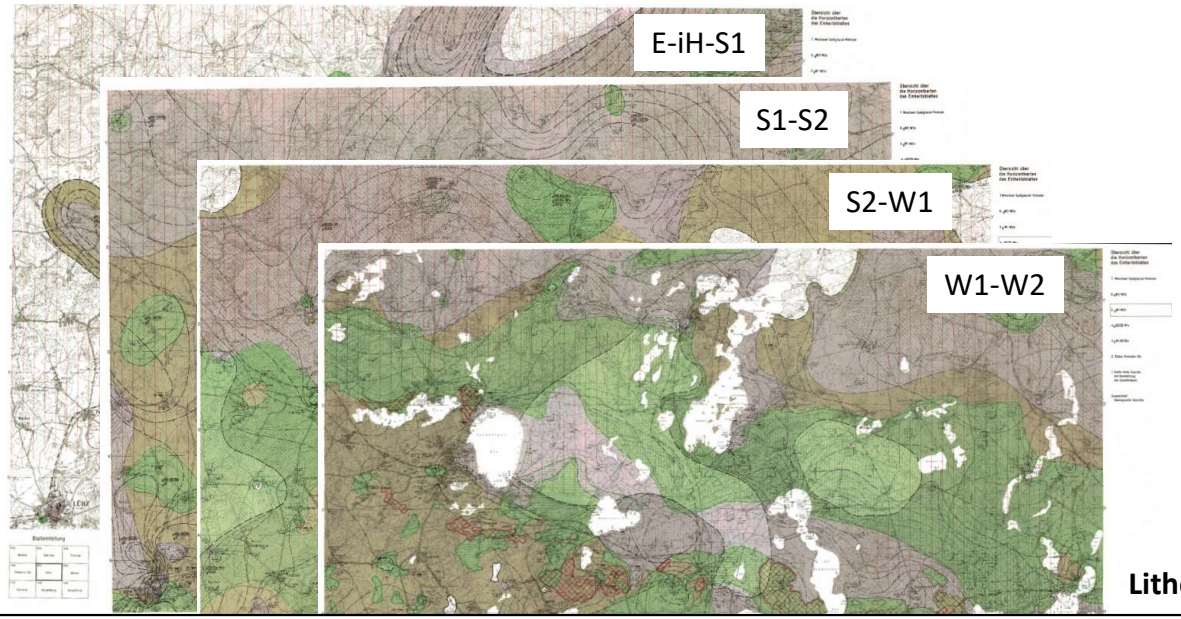
Model of the Tertiary aquifers

- Structure of Tertiary strata follow the Mesozoic structures
  - structure of Mesozoic is controlled dynamics of Permian salt
- Oligocene Rupelian Clay important barrier between the saltwater in the Pre-Oligocene and the Freshwater in the Post-Oligocene
- usable aquifers exist only in the Upper Tertiary (especially in the Miocene)
- affected by deep Quaternary channels
  - connect Tertiary and Quaternary aquifers
  - connect saline and freshwater aquifers

- data base for the model of Tertiary
  - wells
  - seismics (depth > 200-300m)

3D model of the Cenozoic
2. Quaternary strata – lithostratigraphic maps of the 70th & 80th of Eastern Germany, scale 1:50,000

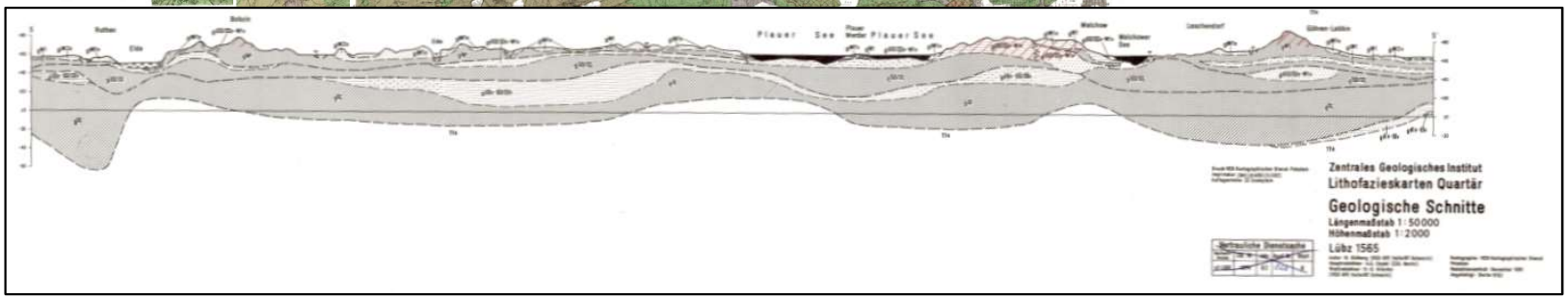
Separate maps for the different glaciation periods



Quaternary strata:
Interlayering of glacial & interglatial deposits

E – Elsterian glaciation (500.000-420.000 years b.p.)
iH – Holstein interglacial (420.000-390.000 years b.pp.)
S – Saalian glaciation (390.000-130.000 years b.p.)
iE – Eem ianinterglacial (130.000-115.000 years b.p.)
W – Weichselian glaciation (115.000-11.000 years b.p.)

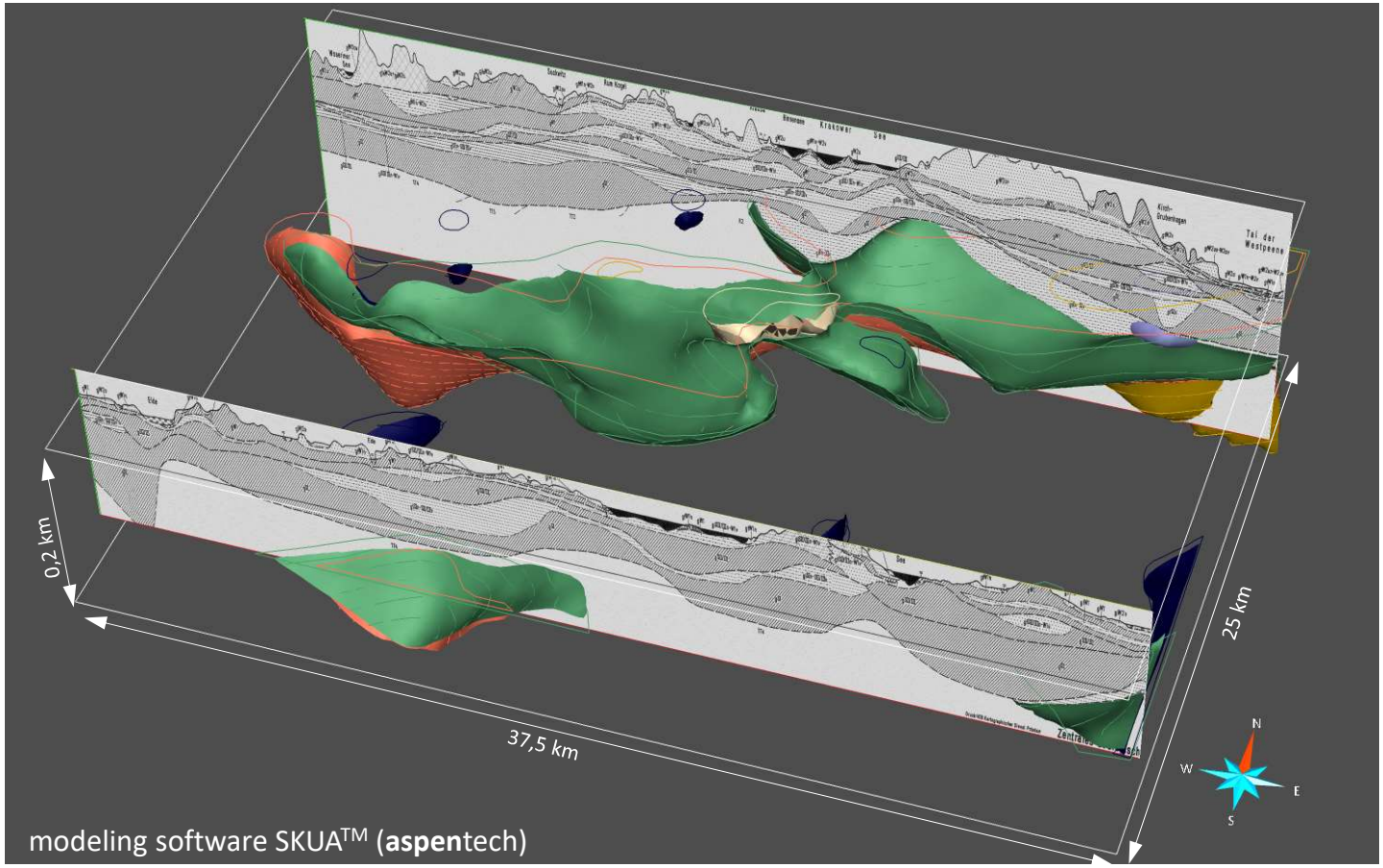
Lithostratigraphic cross sections



- maps with a 2,5D concept
- covering the whole Eastern Germany
- based on well data
- stratification based on analyses of the gravel fraction in tills

3D model of the Cenozoic
2. Quaternary strata – lithostratigraphic maps of the 70th & 80th of Eastern Germany, scale 1:50,000

3D-Model developed from a single map (example Map No. 1565, Lübz)



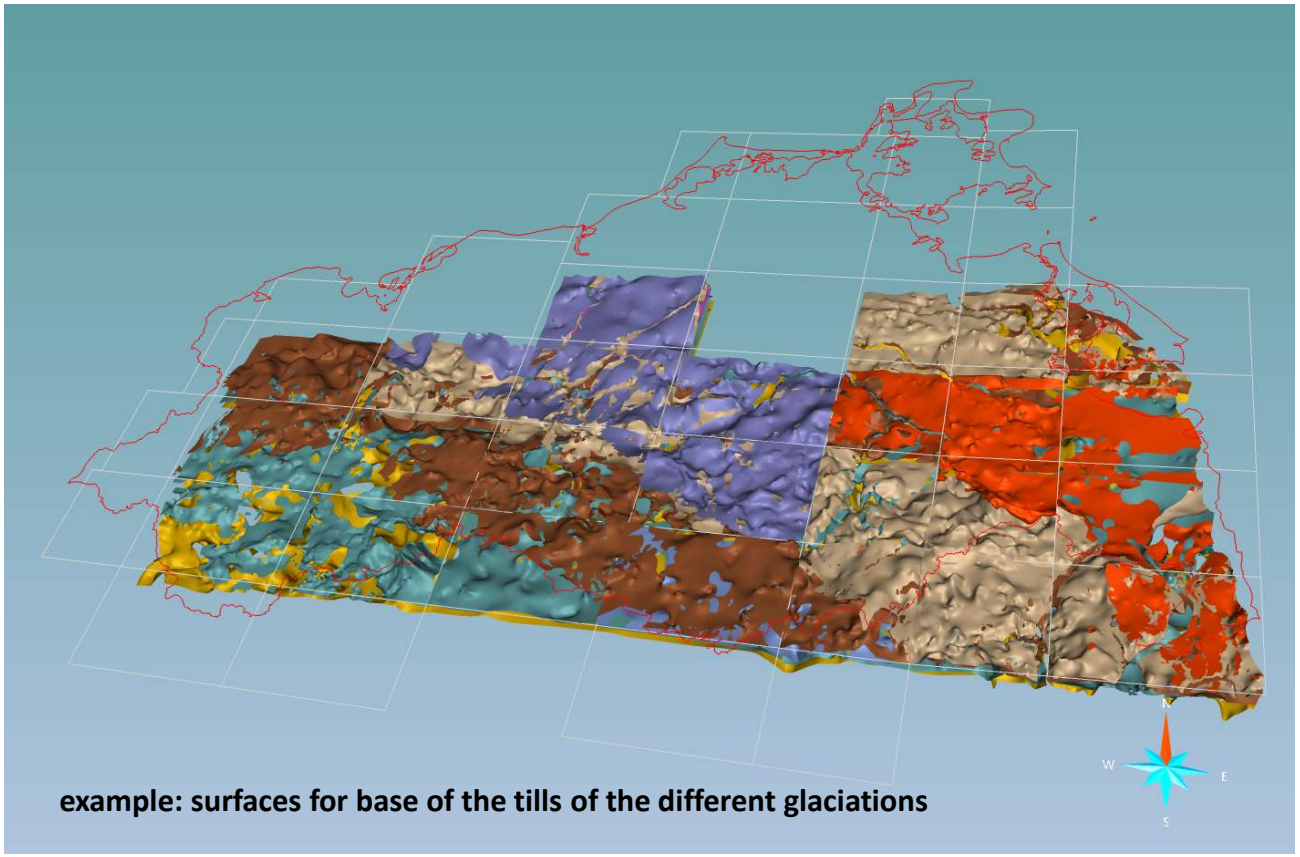
modeling software SKUA™ (**aspen**tech)

from 2,5D map data to a 3D model

consistent model for every single map, but …

3D model of the Cenozoic
2. Quaternary strata – lithostratigraphic maps of the 70th & 80th of Eastern Germany, scale 1:50,000

joining of the single models



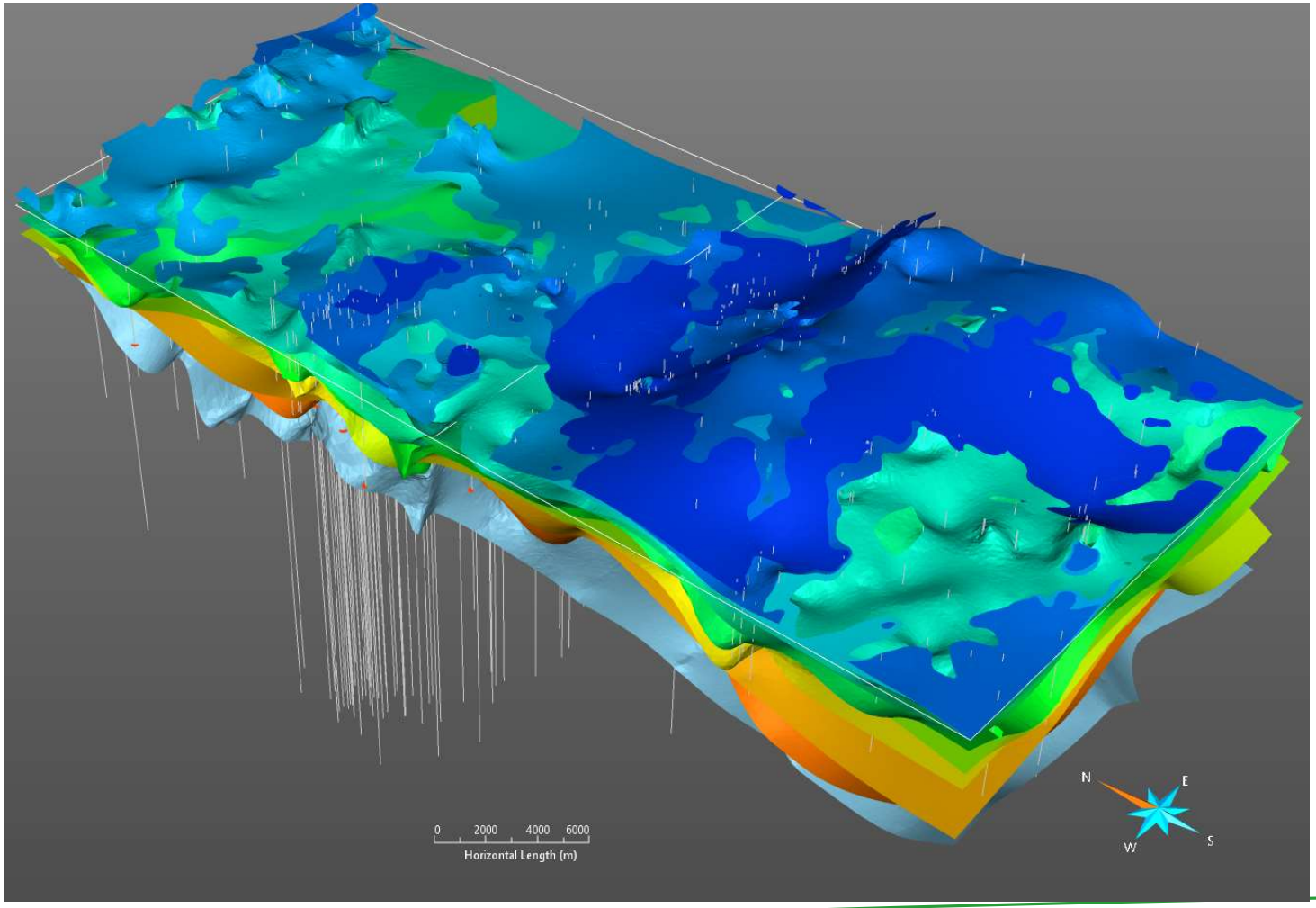
example: surfaces for base of the tills of the different glaciations

a lot of misfits at the borders …

development of the maps in
a timespan of 20 years:

- development of the databases
- development of stratigraphic concepts

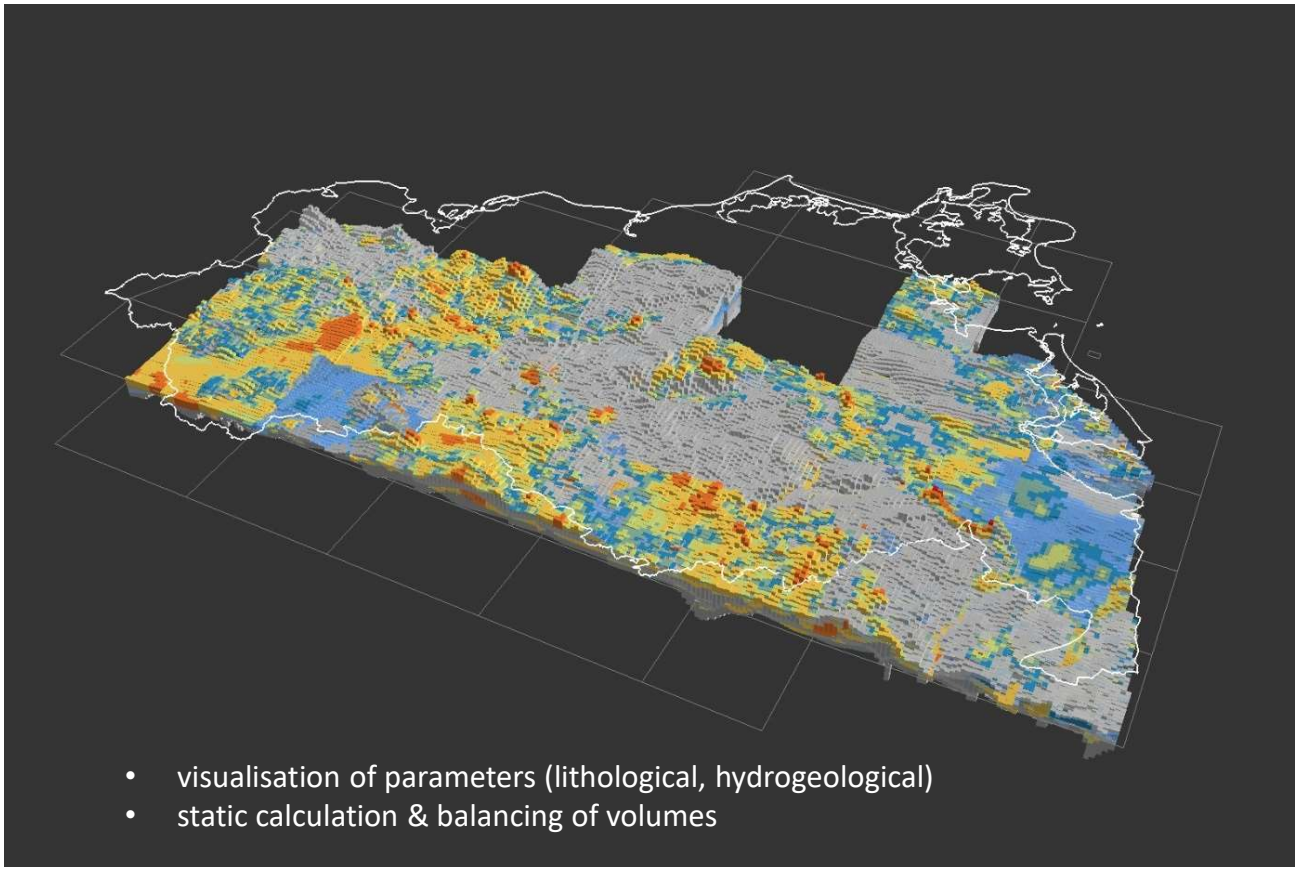
3D model of the Cenozoic
2. Quaternary strata – update of the models, scale 1:50,000



harmonized, consistent and seamless horizons at the borders …

3D model of the Cenozoic
2. Quaternary strata – from model surfaces to model volumes

- model volumes (voxels/blocks) for parametrization and balancing of volumes
  - example: block dimension 1x1 km: thickness of productive Quaternary aquifers – condition/restriction for groundwater abstraction



Aquitards/Aquicludes

Tills/Moraines

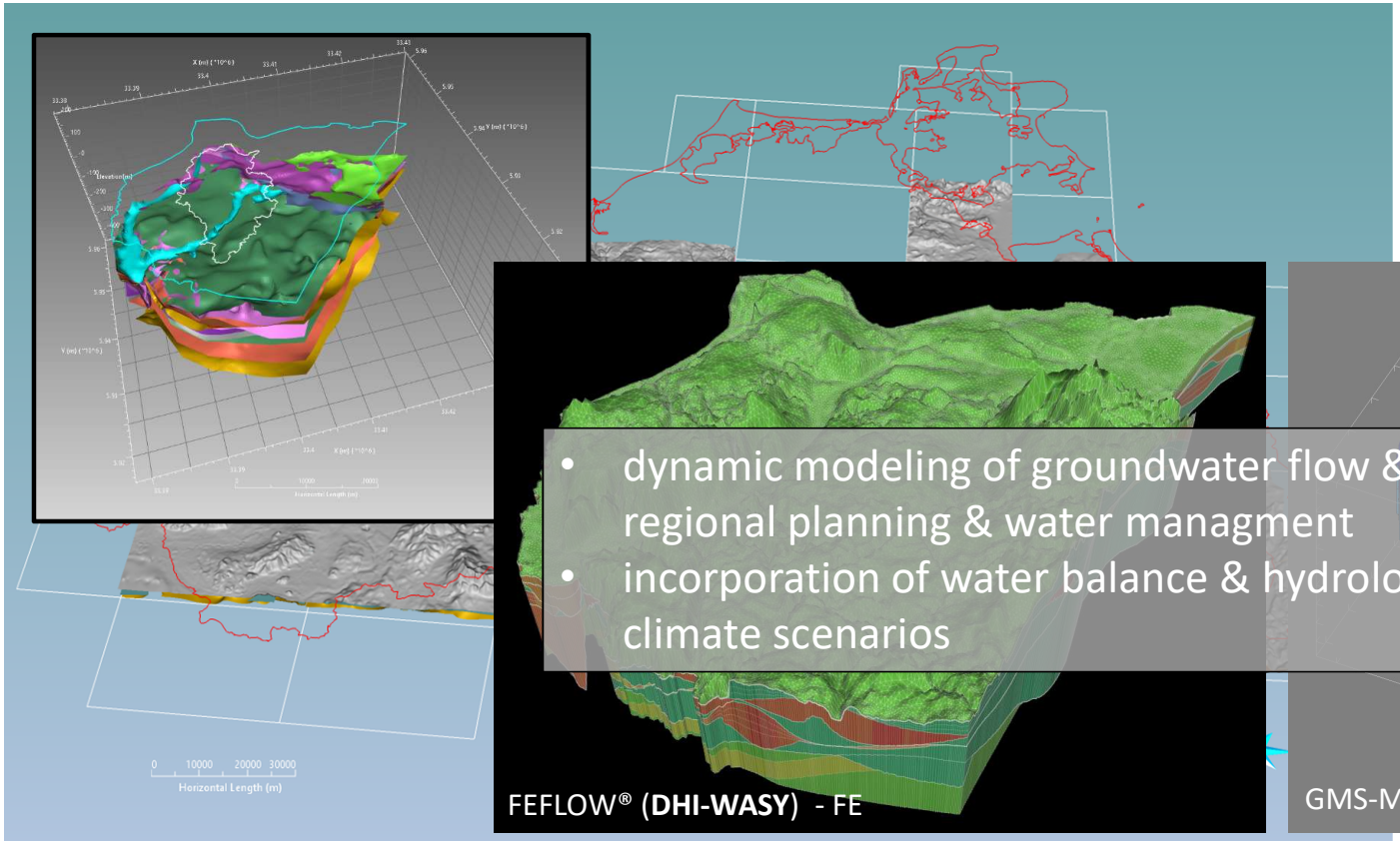
Aquifers

thickness of productive Aquifers (sand/gravel)

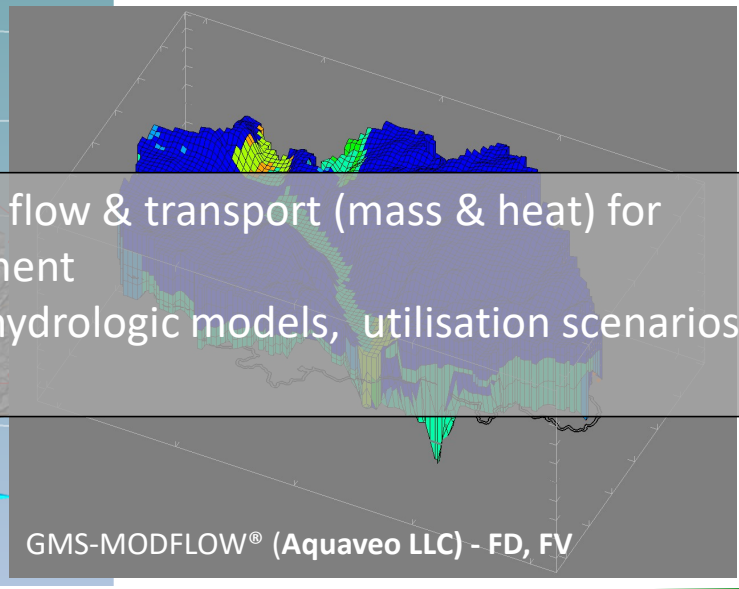
- < 2 m
- 2 - 5 m
- 5 - 10 m
- 10 - 25 m
- 25 - 50 m
- > 50 m

3D Hydrogeological models of the Cenozoic
3. Dynamic models

- definition von pilot areas - groundwater bodies / river catchments (size of 500-2.500 km²)
- dynamic hydrogeological models for water managment and regional planning



FEFLOW® (**DHI-WASY**) - FE

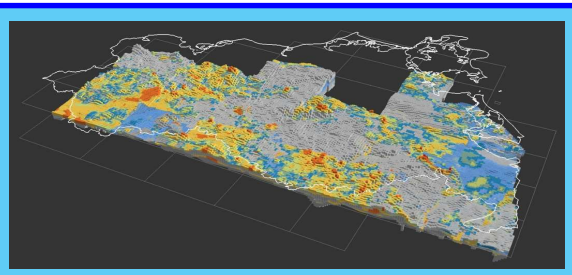


GMS-MODFLOW® (**Aquaveo LLC**) - **FD, FV**

- dynamic modeling of groundwater flow & transport (mass & heat) for regional planning & water managment
- incorporation of water balance & hydrologic models, utilisation scenarios, climate scenarios

3D model of the Cenozoic – geological and hydrogeological model
4. Hierarchical model structure

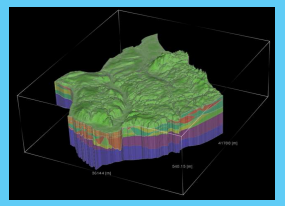
state-wide static structur & balance model

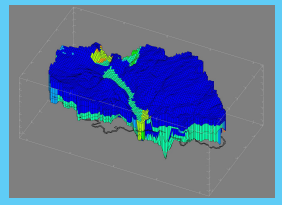


data supply

update

dynamic hydrogeological/hydrological models for the management of groundwater bodies / river catchments

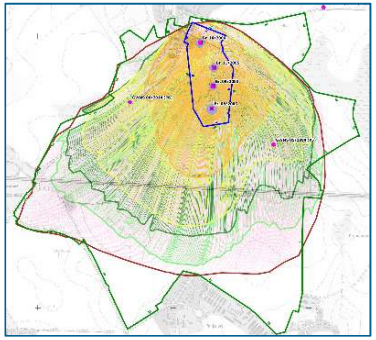




data supply

update

local detailed models e.g. for water supply (mostly external models)



Outlook

- work starts in 2020 and is in progress
  - estimate for a first complete model: 2030 (state-wide balance model and dynamic models of the groundwater bodies/catchments)
- model is mostly based on well data at the time
  - in future probably integration of shallow geophysics (geoelectrics, electromagnetics)
- harmonization with neighbouring countries
  - crossborder groundwater bodies and catchments
    - harmonisation starts at time in the western part, similar projects at the time in Schleswig-Holstein & Lower Saxony