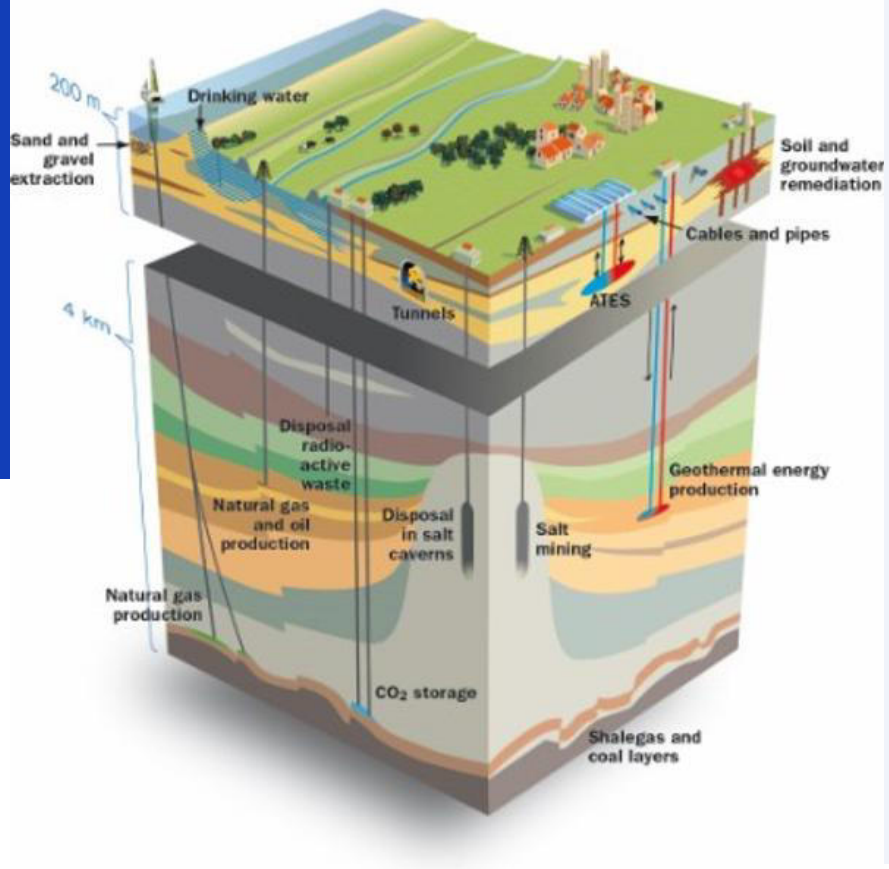
3D modelling in the Dutch subsurface

Data, Dimensions & Differences

TNO GDN | Romée Kars, Jan Stafleu, Suzanne Nelskamp, Johan ten Veen, Ronald Vernes, Willem Dabekaussen



Data, Dimensions and Differences



- Data driven modelling
- Nation wide modelling
- Expanding across various depth domains
- Various resolution
- Tailored to various applications
- Differences or difficulties?

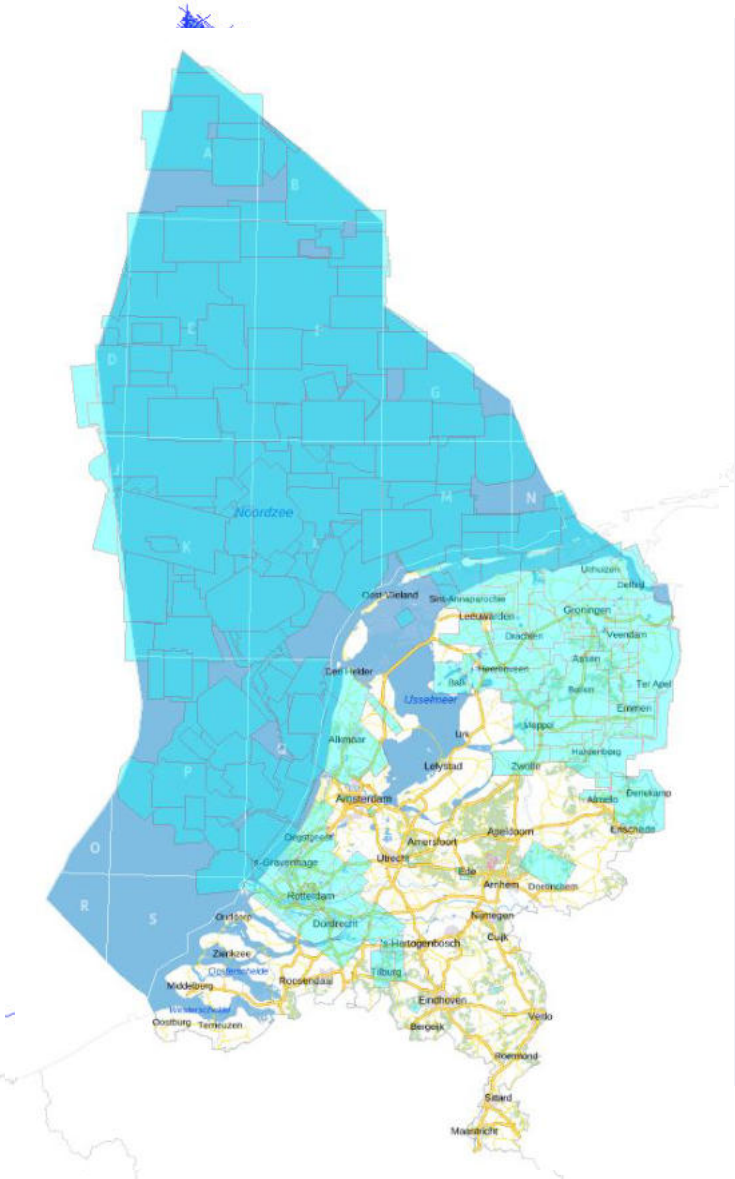
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Subsurface data in the Netherlands

- Large quantity of publicly available data
- ~600.000 soft sediment geological boreholes
- ~300.000 CPTs
- ~6000 deep wells
- Seismic: 2D, 3D, deep, shallow
- Other datasources: EM, magnetometer, soil samples







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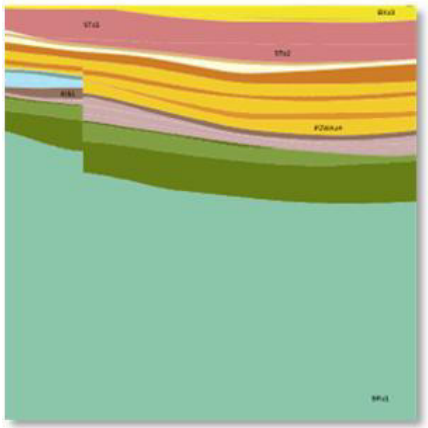
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Nationwide models in the Netherlands

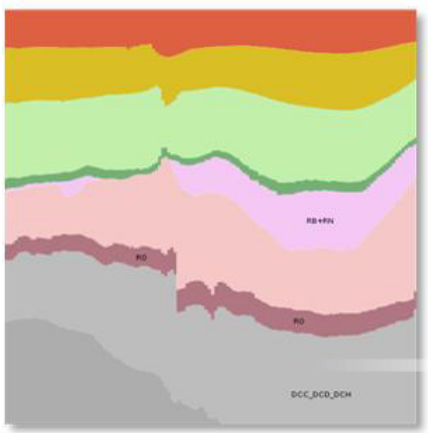
- Shallow subsurface: GeoTOP
- Moderate depth domain: DGM and REGIS II
- Deep domain: DGM deep



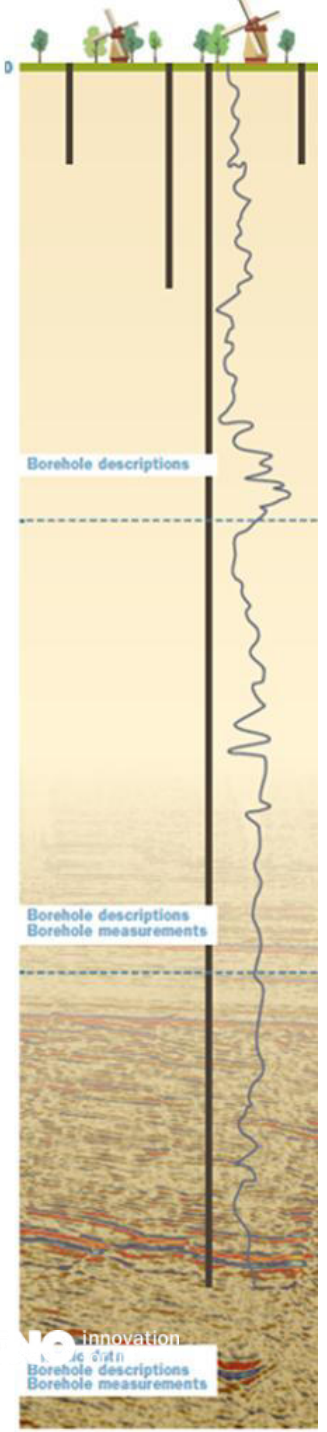






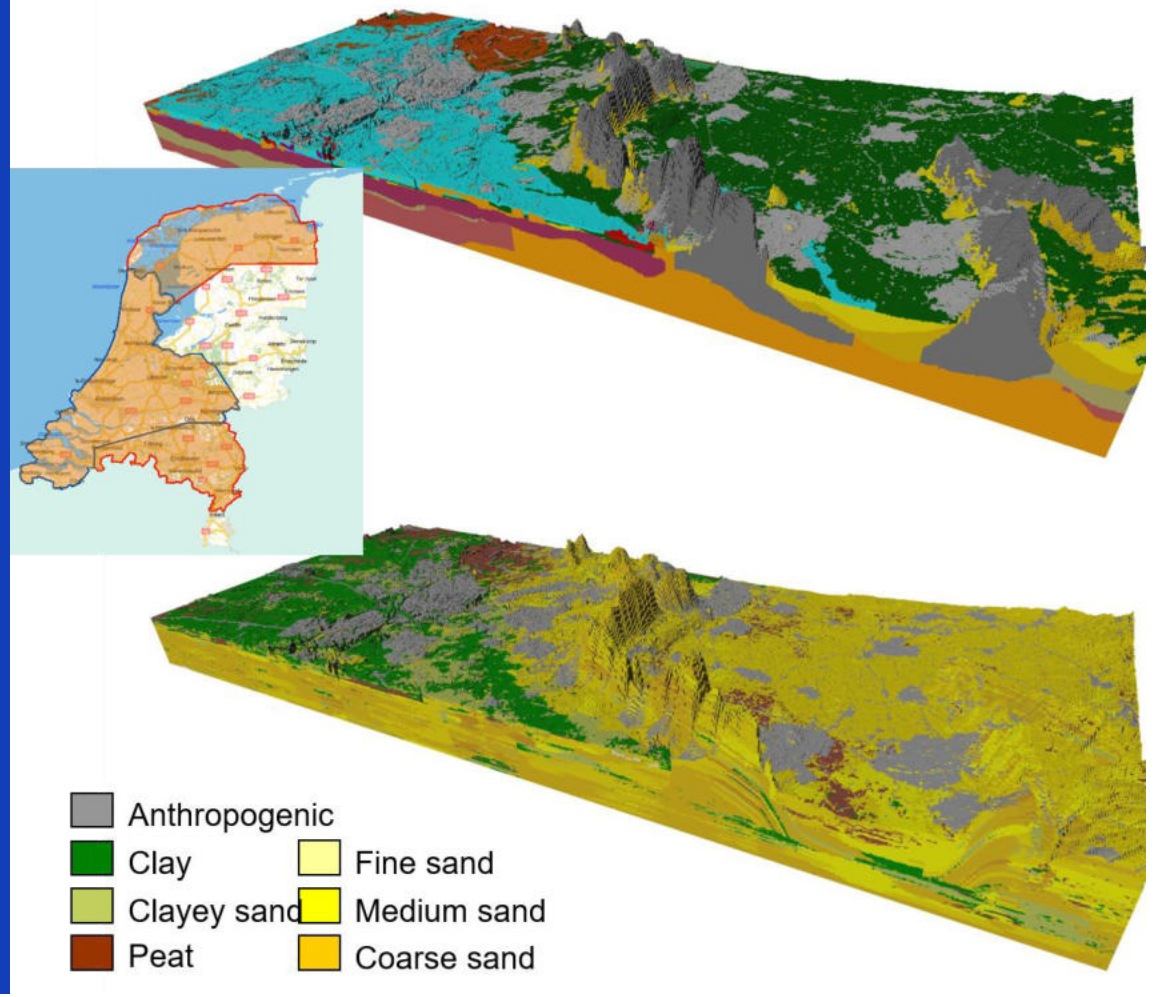




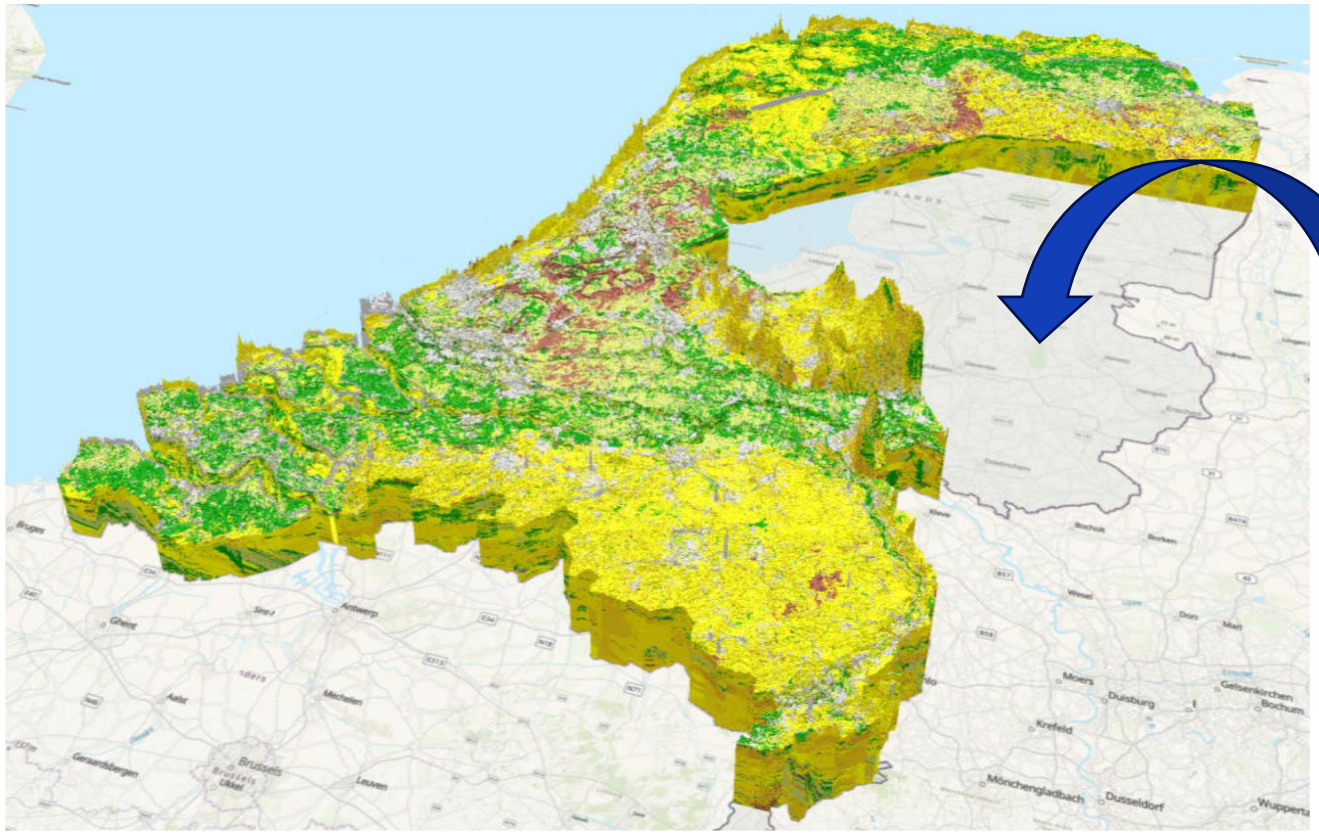


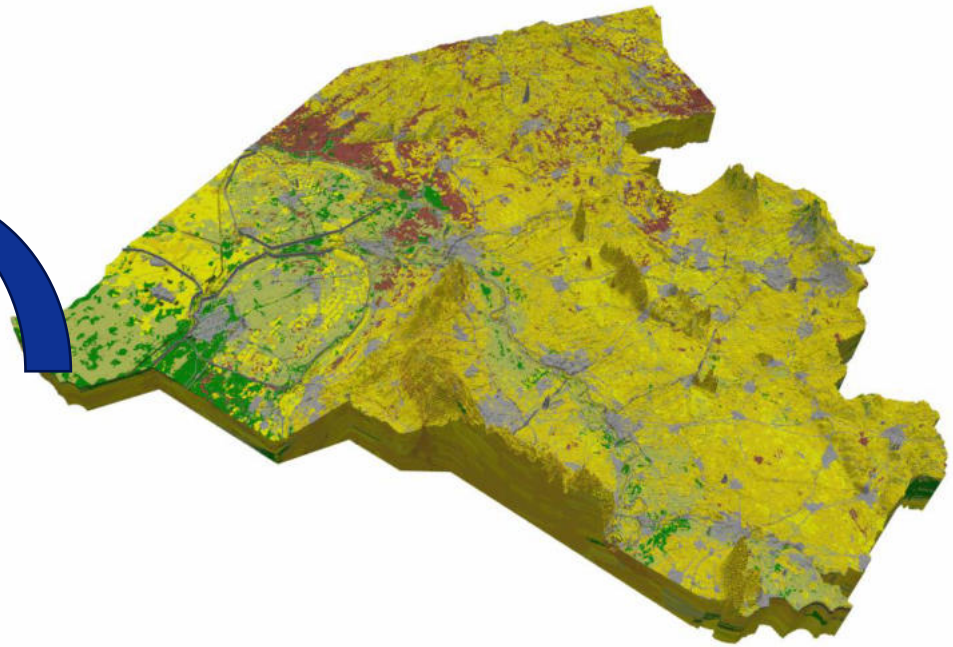
GeoTOP domain

- ~600.000 shallow boreholes
- Automated interpretation of Holocene units
- Voxelmodel up to 50 m –NAP
- Resolution 100 x 100 x 0.5 m
- Each voxel contains:
  - Stratigraphic unit
  - Most probable lithoclass
  - Probabilities
  - Model uncertainties



GSEU

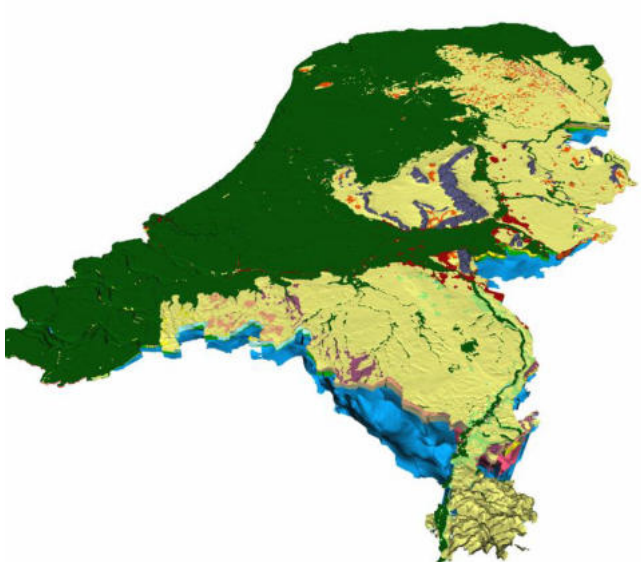


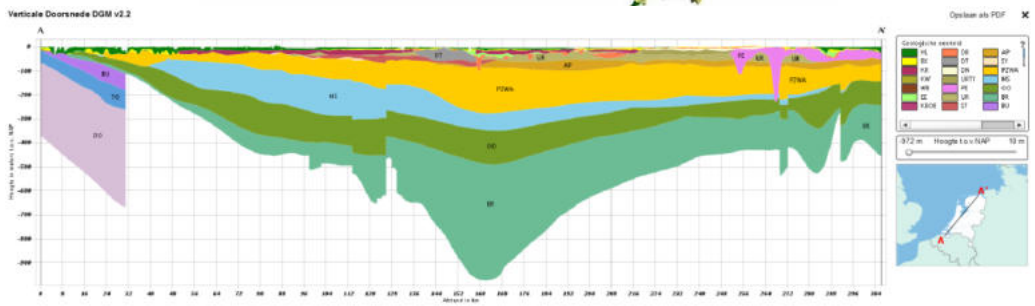


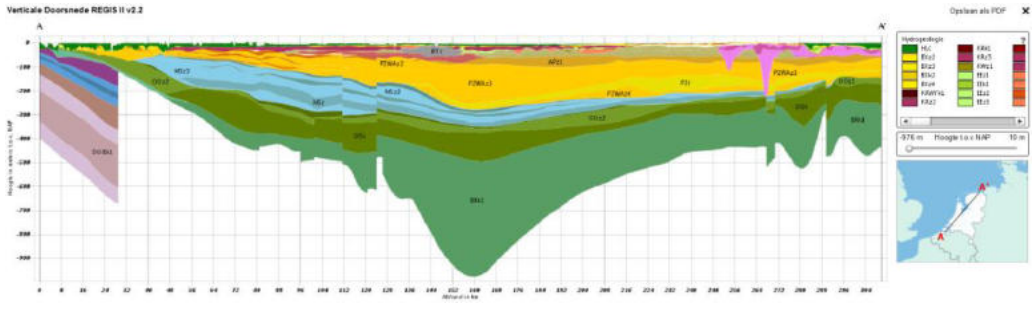
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DGM and REGIS domain

- ~26.500 boreholes
- Manual data interpretation
- Top ~500 m (Neogene and Quaternary)
- Layer model: raster stack
- Resolution 100 x 100 m
- (Hydro)geological units with:
  - Top, base, thickness
  - Uncertainties
  - Hydraulic parameters

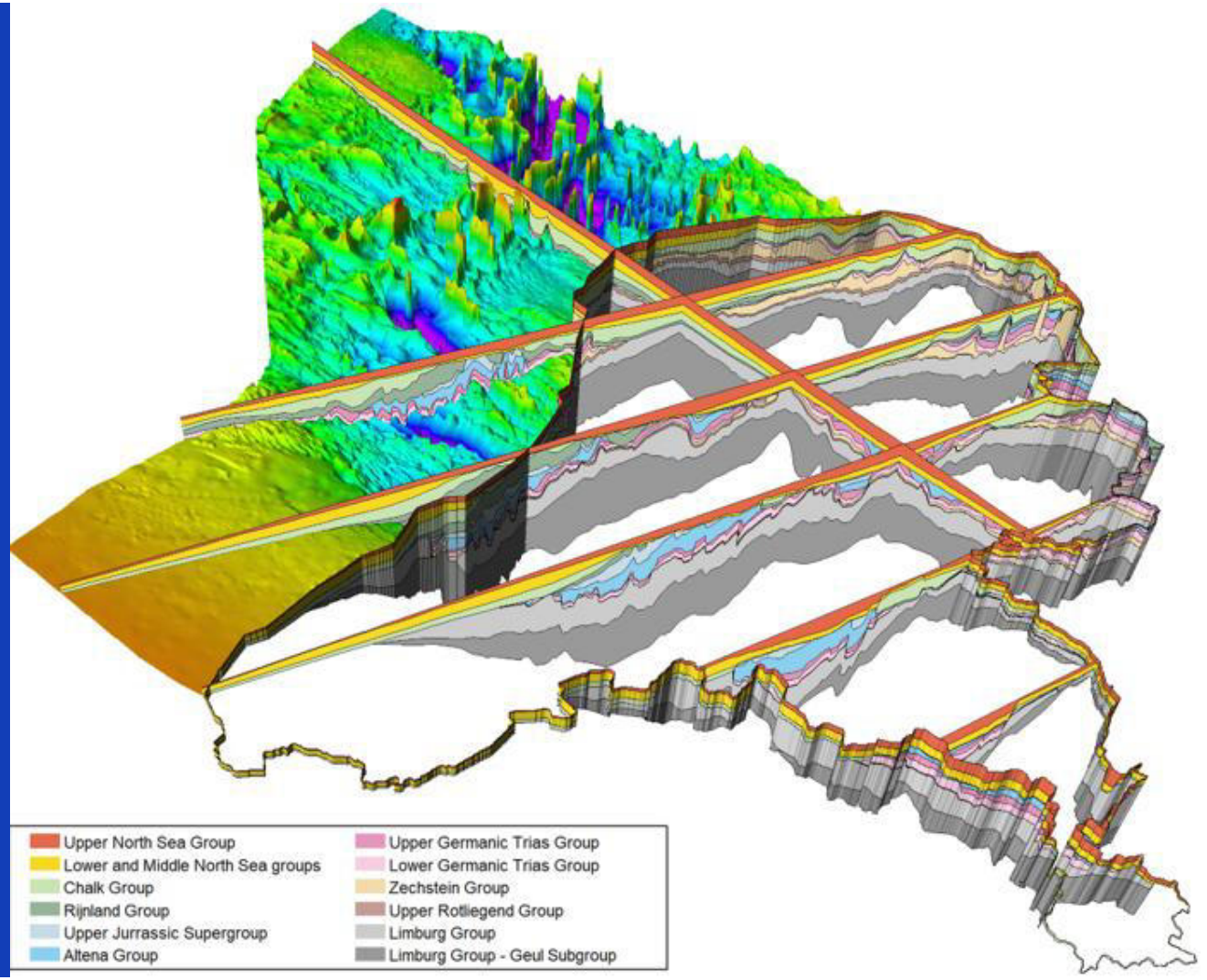






DGM deep domain

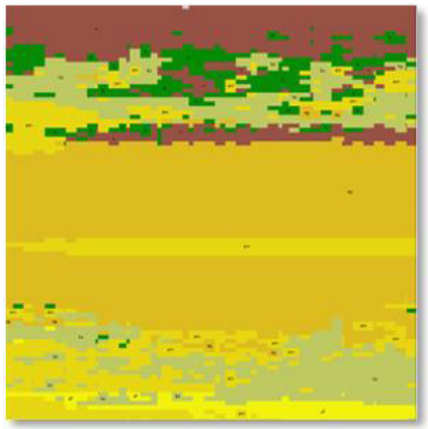
- Seismic data and ~3500 wells
- Manual data interpretation
- Partially automated workflow
- Layer model
- 13 layers: Cenozoic – Carboniferous
- Resolution 250 x 250 m
- On and offshore



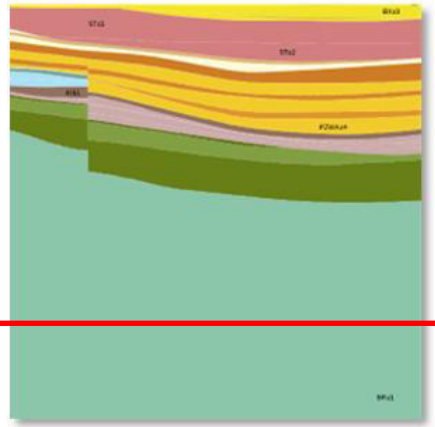
GSEU

Nationwide similarities and differences

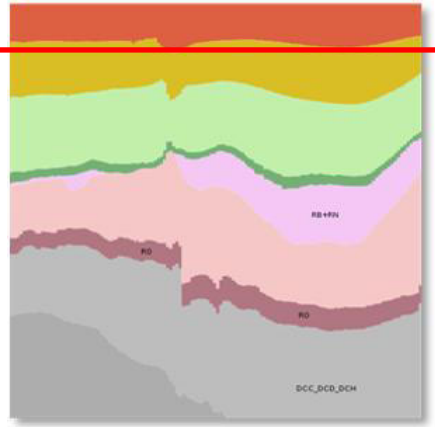
- Similarities:
  - Nationwide
  - Partially automated workflow
  - High quality
  - Regional model
  - Publically available
  - Updates take a long time
- Differences:
  - Data (type, density)
  - Level of automisation
  - Software
  - Resolution
  - On- and offshore vs onshore only
  - Teams of geologists



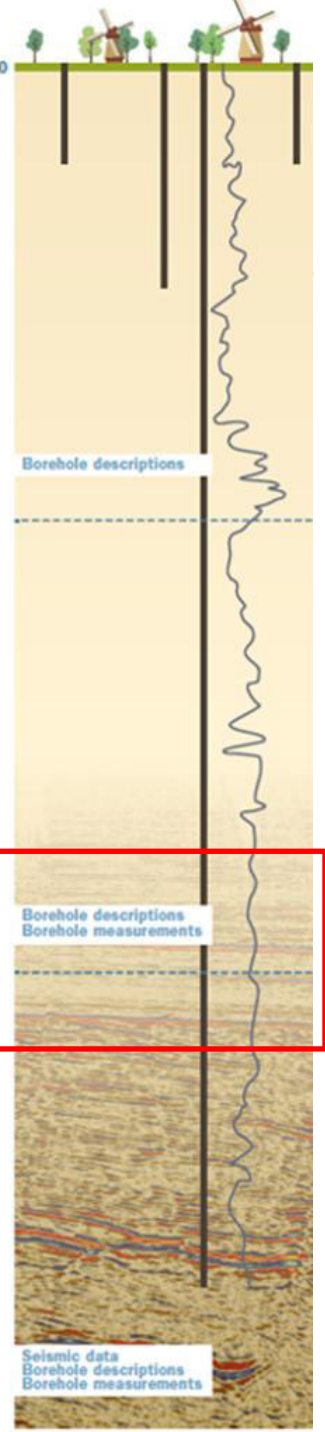






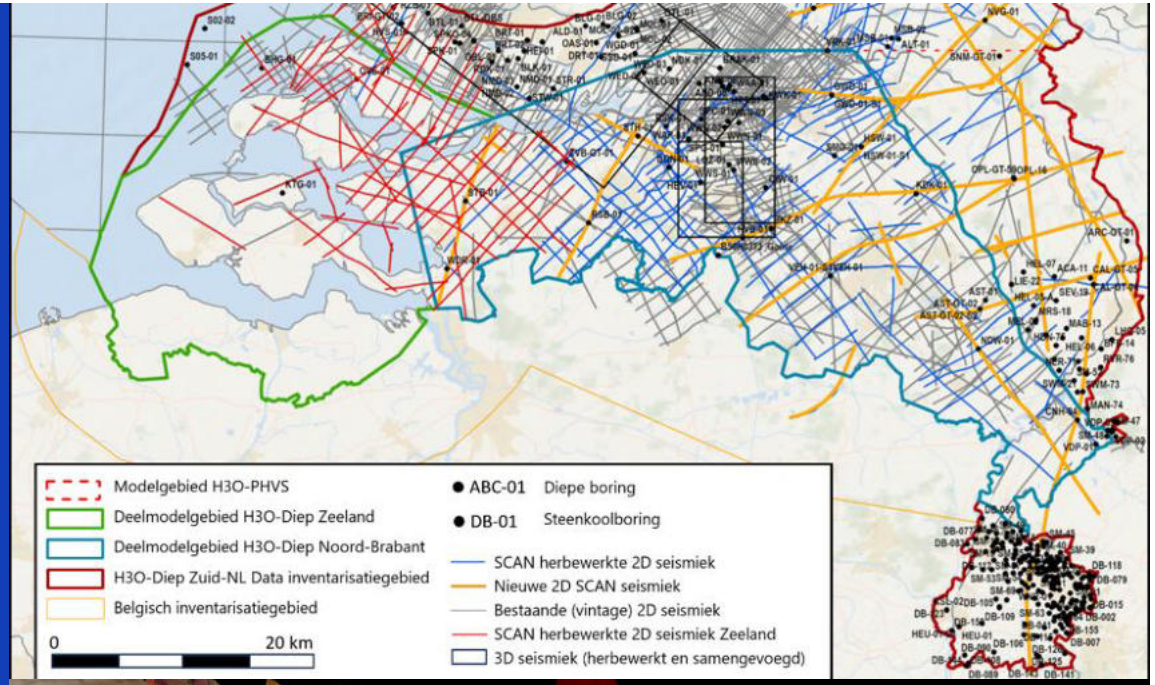


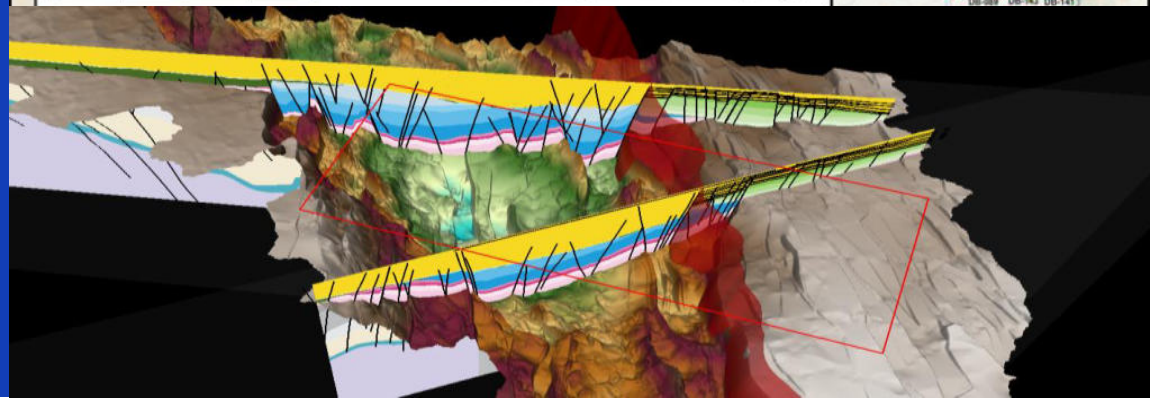




Model integration – an example: H3O

- South of the Netherlands, border Belgium and Germany: cross border
- User need: groundwater and geothermal energy
- **Collaboration** between different depth domains:
  - Data
  - Interpretation
  - Teams
  - Culture

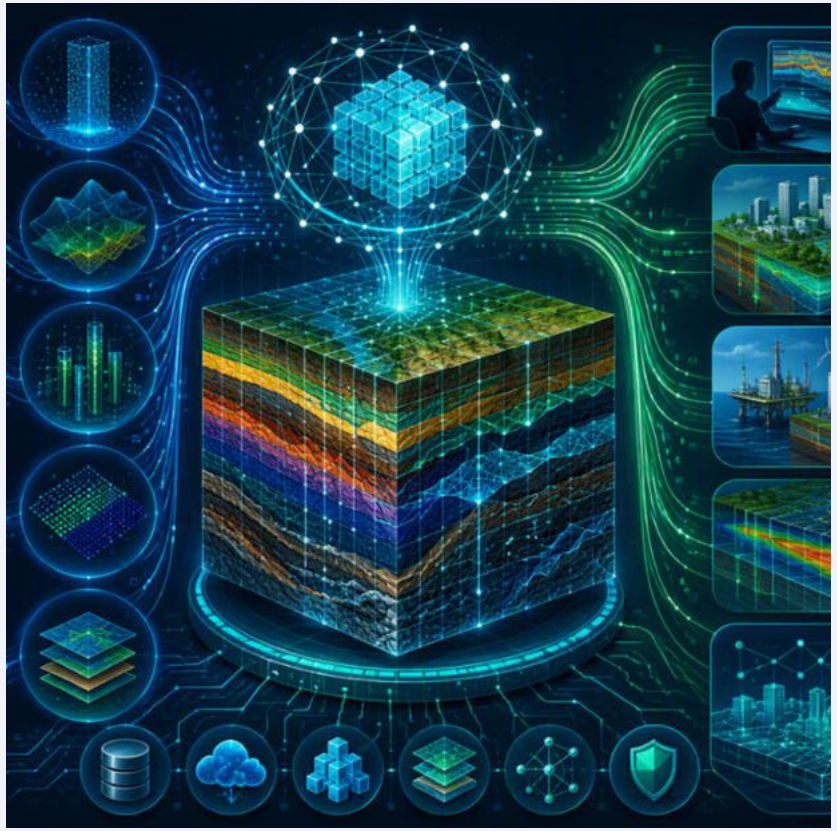




Towards a geological knowledge system

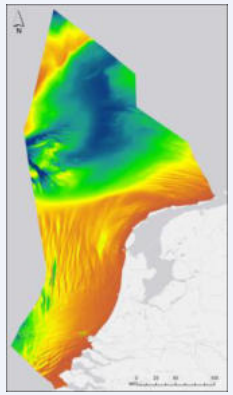
- Societal demand and technology push!

- New technologies for data fusion → use all data available
- Tying geological knowledge to existing and new data
- Harmonise working in different dimensions (time, space) → avoid inconsistencies
- New technologies enable fast updates → increase speed
- Quality control from data to model output → increase (transparency of) quality
- Results tailored to user need

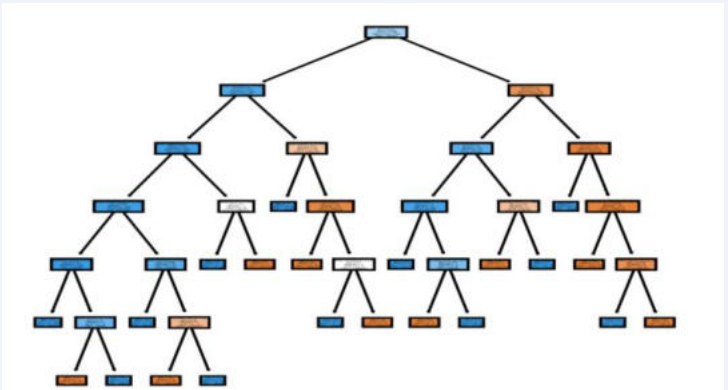


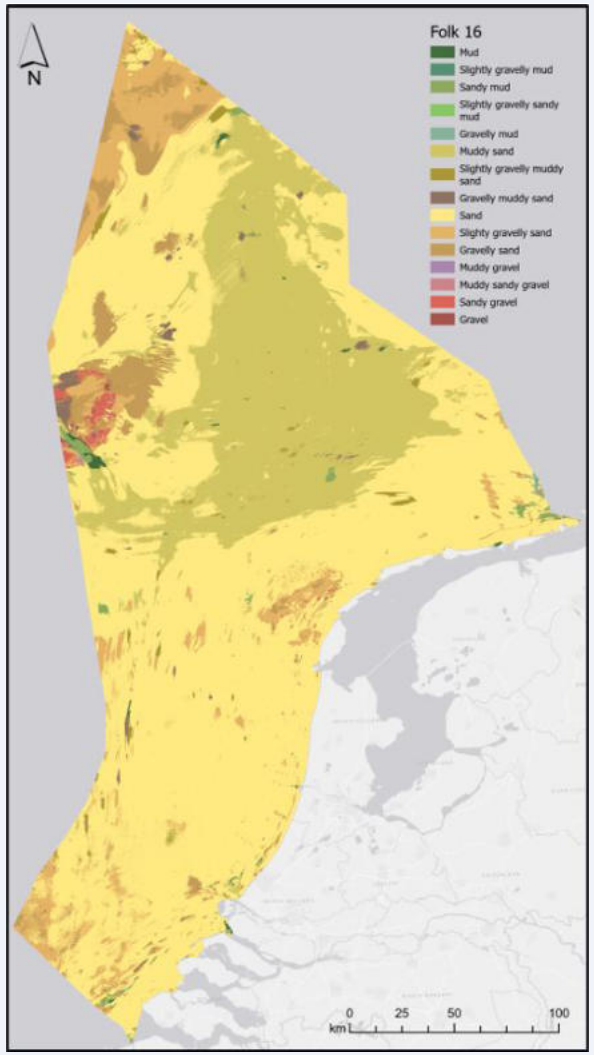
Machine learning for spatial geomodelling

- Represents geological complexity
- Easy to update
- Mixes different data into one model
- What is the best map?









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Challenges: overcome differences

- Data: management, quality, data fusion
- Dimensions: resolution, reference space, implicit and explicit modelling
- Quality vs speed
- Adding geological knowledge to the data and models
- Collaboration between different teams/countries



Theme name

Place text here



Thank you for your attention

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