Towards a European Fault Database

TOWARDS A EUROPEAN FAULT DATABASE

Johan ten Veen, Serge van Gessel, Harry Middelburg, Maryke den Dulk

TNO – Geological Survey of the Netherlands

HISTORY

TNO innovation for life

TNO' pilot database (started in 2010)

Cross-border harmonisation

European Fault Database

The widely available fault information (GSO's etc.)

Importance: Resources, hazards and impacts

Credits: ideas presented here benefited from invaluable discussions with experts from European GSO's (LfU, RNSB, LBEG, BGR, ISPRA, BRGM, ...) either in the context of GeoERA or beyond

APPLICATION OF FAULTS

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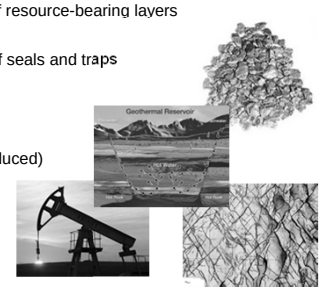
- Occurrence and thickness of resource-bearing layers
- Formation and destruction of seals and traps
- Migration of fluids
- Hazards/impacts (natural/induced)
- Framework for geomodels



A database should support multiple applications

FAULT DATA TYPES

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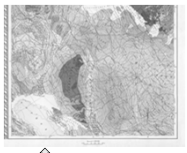
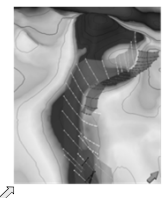
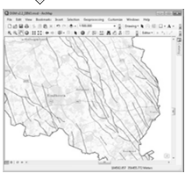


Paper

A database should support different fault types & input formats

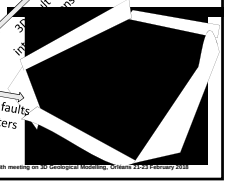




2D digital

Fault Database

3D Modeled faults with parameters



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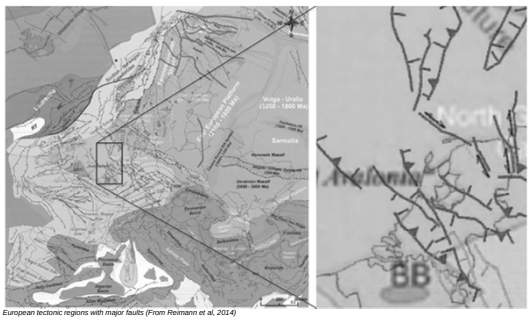
FAULT DATA SCALES



European tectonic regions with major faults (From Reimann et al, 2014)

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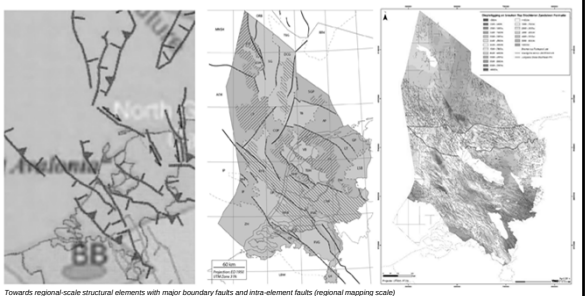
4th meeting on 3D Geological Modelling, Orléans 21-23 February 2018

FAULT DATA SCALES



Towards regional-scale structural elements with major boundary faults and intra-element faults (regional mapping scale)

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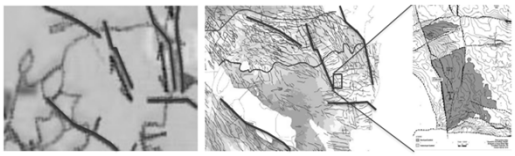
FAULT DATA SCALES



Towards local structural domains, reservoir faults and reservoir segments

A database should contain faults at various scales that link back to regional scale tectonic features

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FAULT DATA PARAMETERS

- Geometric properties (from 2D / 3D fault geometries)
- Modelled properties (lateral variation along fault plane)
- Relation between layer and fault model (juxtaposition, gaps)
- Fault offset (amount, timing, stratigraphy involved)
- Static properties, permeability, temperature, fluids, Geological/mechanical states, stress, pressures, etc.
- Dynamic (seismicity, fluid flow, etc.)
- Production/engineering data

Parameters are spatially variable and scale dependent

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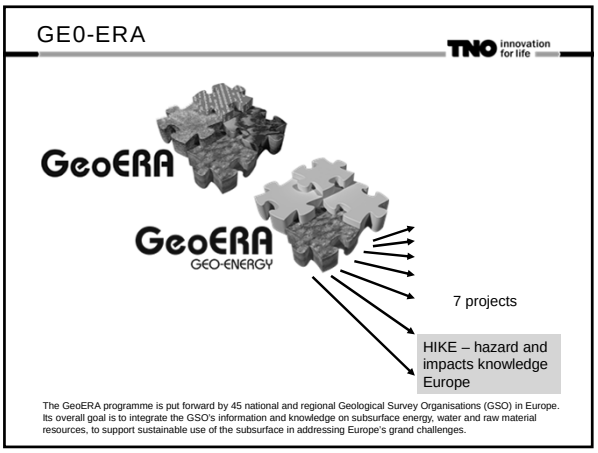

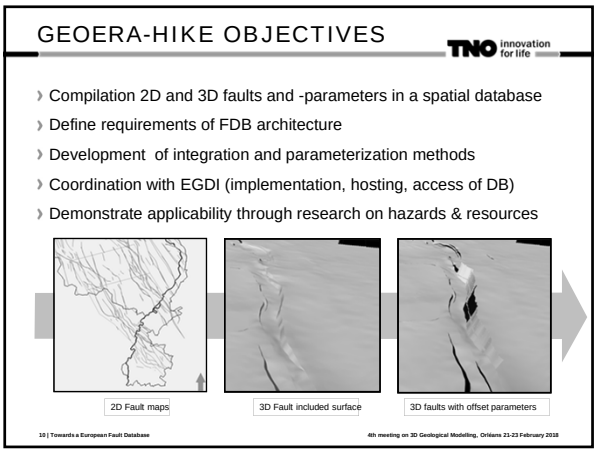

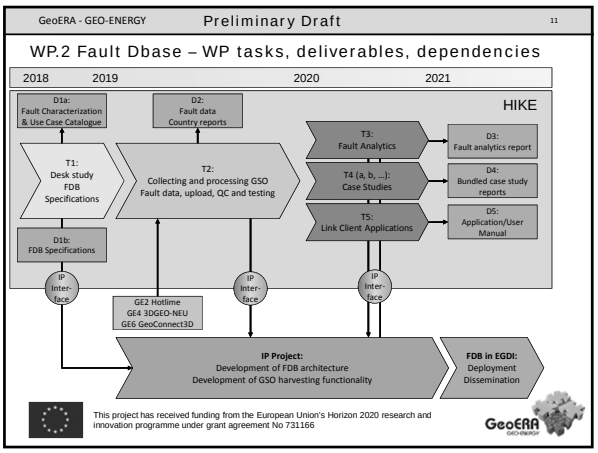

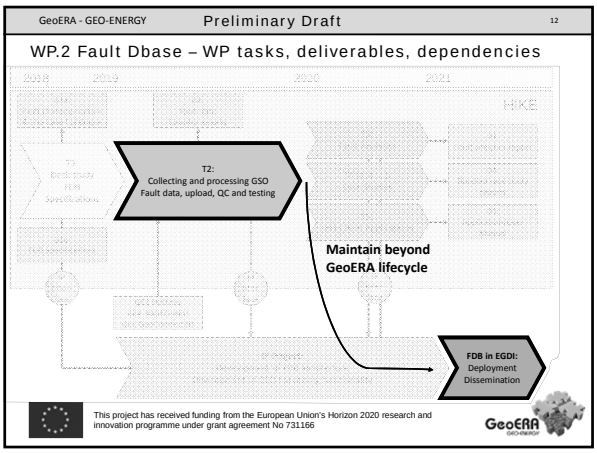

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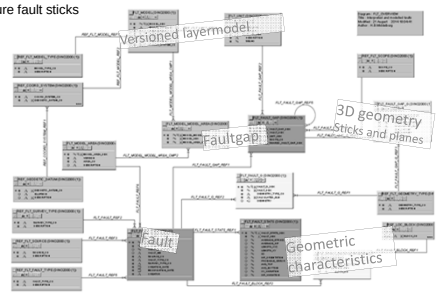
DATABASE DESIGN

TNO innovation for life

A Dutch pilot fault database since ~2010:

- Oracle spatial database
- Upload procedure fault sticks
- Query tool



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- Upload procedure for fault sticks (time & depth)
- Reads (Kingdom Charisma) Faults Sticks
- Creates planes from stick (triangulation)
- Relates geometries in distance and time units
- Calculates geometric characteristics
- Average strike / dip orientation
- Average dip angle
- Length
- Vertical depth / Average top- and bottom depth
- Strike / dip Variation

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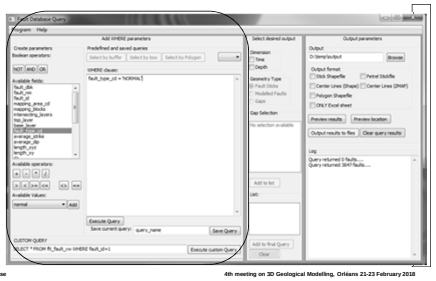

DATABASE EXAMPLE

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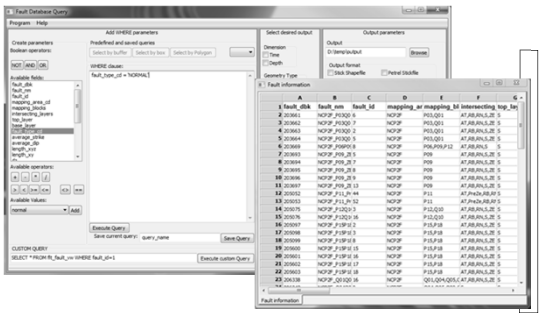
Query tool (preview tabular results)



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DATABASE EXAMPLE

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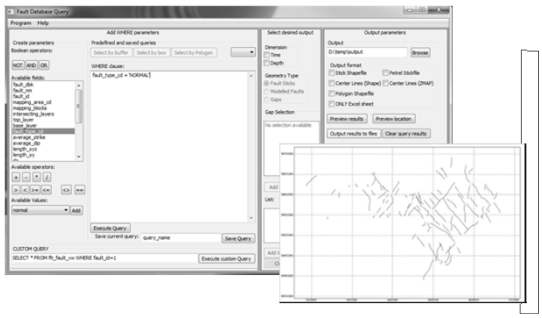
Query tool (preview location)



DATABASE EXAMPLE

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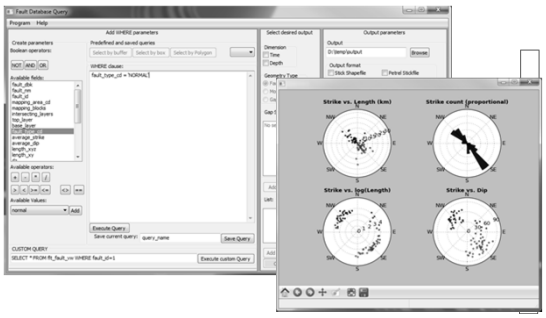
Query tool (preview orientation)



DATABASE EXAMPLE

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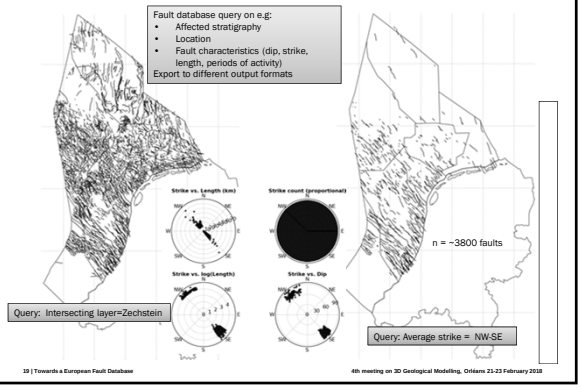
Fault database query on e.g:
- Affected stratigraphy
- Location
- Fault characteristics (dip, strike, length, periods of activity)

Export to different output formats



IMPACT & FEASIBILITY

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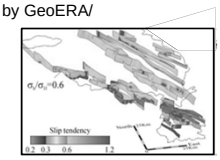
- High impact: Unique in EU brings break-through in hazard research
- Partners: Harmonization/compilation/dissemination (spatial data, parameterization)
- Achievability: Tested DB concept, off-shelf fault data from GSO's data exchange tested
- Budget: (Hopefully) partly financed by GeoERA/ partly by partners
- Entry-level: Low
- Future: beyond GeoERA



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CHALLENGES

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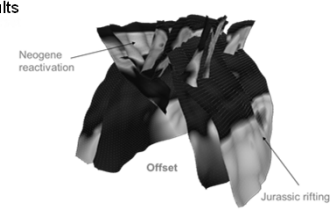
- I/O between partners (formats) needs further testing
- Understanding each other's modeling workflows
- Collate paper, 2D and 3D modeling results
- Metadata - developing common vocabulary
- How to add metadata to faults
- How to parametrize faults
- Fit for purposes
- Scalability
- Queries
- ..
- .



THANK YOU FOR YOUR ATTENTION

..and please feel free to think along

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