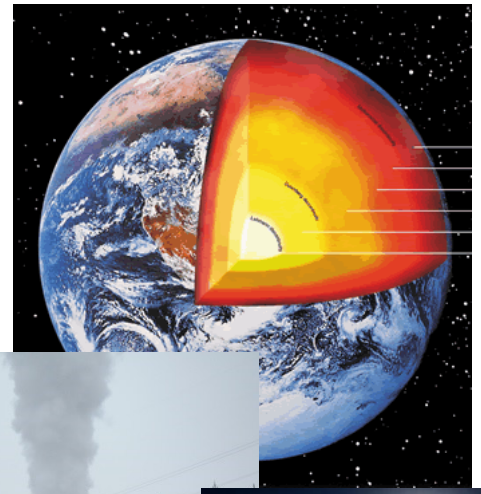
4000 experts

Geo-Energy

150 employees



50% contract research

Oil and Gas → CCS/ Geothermal


Main activities/scope in geothermal

Exploration

- Resource mapping
- Information systems
- Performance and resource potential assessment
- Project strategies for public acceptance

Production, reinjection of brine

- coupled models, Hydraulic stimulation and induced seismicity
- Monitoring and optimisation of production
- Well integrity & flow performance &well monitoring

- Co-Leading in JPGE in EERA (harnessing research institutes in EU)
- Co-Leading major EU funded research projects

TNO innovation for life

NL Olie- en Gasportaal

- Boreholes
- Seismic surveys
- Fields
- Production
- Infrastructure
- Licences
- Publications and Data sets
- Legislation
- Administrative procedures
- Fees, taxes and state participation
- Seismicity and subsidence
- Contacts

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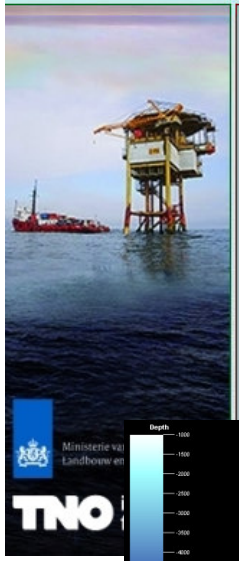


Welcome to the NL Oil and Gas Portal

This site provides information about oil and gas exploration and production in the Netherlands and the Dutch sector of the North Sea continental shelf.

It aims to help users access information furnished by the Dutch government in an easy, comprehensible fashion.

This site was produced at the request of the Dutch Ministry of Economic Affairs, Agriculture and Innovation and is being managed by TNO, *Geological Survey of the Netherlands*.

Recent changes

We keep this site continually up-to-date. Click here for an overview of recent changes.

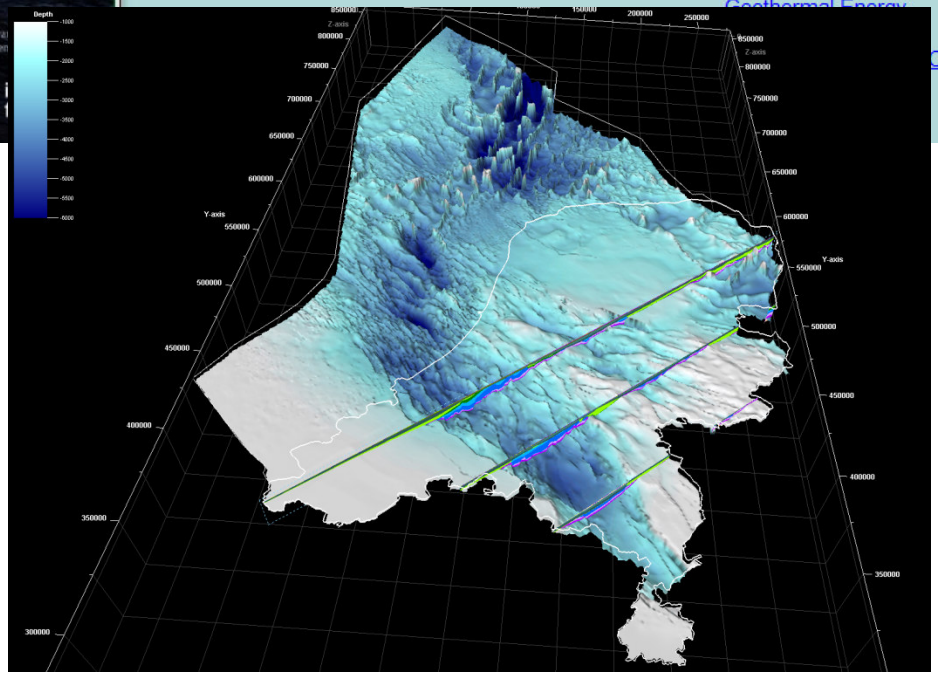
Other topics

Salt production

Underground gas storage

Geothermal Energy

CO2



Resource mapping
Information systems

NL one of few countries
With public data access
to almost all E&P data

>20 years experience
State of the art 3D
subsurface mapping

TNO innovation for life

National geothermal infosystem
www.thermogis.nl

ThermoGIS

TNO.nl | Basic Tool | Expert Tool | World Tool | Contact

Publications

Although the ThermoGIS applications are described on this website and although the outcomes are represented as good as possible by the people working on ThermoGIS, we do not want to reserve the scientific background of ThermoGIS. Apart from the ThermoGIS Expert application, also latest version of DoubletCalc is made available. DoubletCalc is the basis for the economic models in ThermoGIS.

Publications

Below you can find a series of publications which are the basis of ThermoGIS.

Subsurface temperature of the onshore Netherlands: new temperature dataset and modelling
D. Bonté, J.-D. van Wees & J.M. Verweij
Netherlands Journal of Geosciences – Geologie en Mijnbouw, 91-4, 491-515, 2012

Reservoir characterisation of aquifers for direct heat production: Methodology and screening of the potential reservoirs for the Netherlands
M.P.D. Pluymaekers, L. Kramers, J.-D. van Wees, A. Kronimus, S. Nelskamp, T. Boxem & D. Bonté
Netherlands Journal of Geosciences – Geologie en Mijnbouw, 91-4, 621-636, 2012

Direct heat resource assessment and subsurface information systems for geothermal aquifers; the Dutch perspective
L. Kramers, J.-D. van Wees, M.P.D. Pluymaekers, A. Kronimus & T. Boxem
Netherlands Journal of Geosciences – Geologie en Mijnbouw, 91-4, 637-649,2012

Geothermal aquifer performance assessment for direct heat production - Methodology and application to Rotliegend aquifers
J.-D. van Wees, A. Kronimus, M. van Putten, M.P.D. Pluymaekers, H. Mijnlieff, P. van Hooff, A. Obdam & L. Kramers
Netherlands Journal of Geosciences – Geologie en Mijnbouw, 91-4, 651-665, 2012

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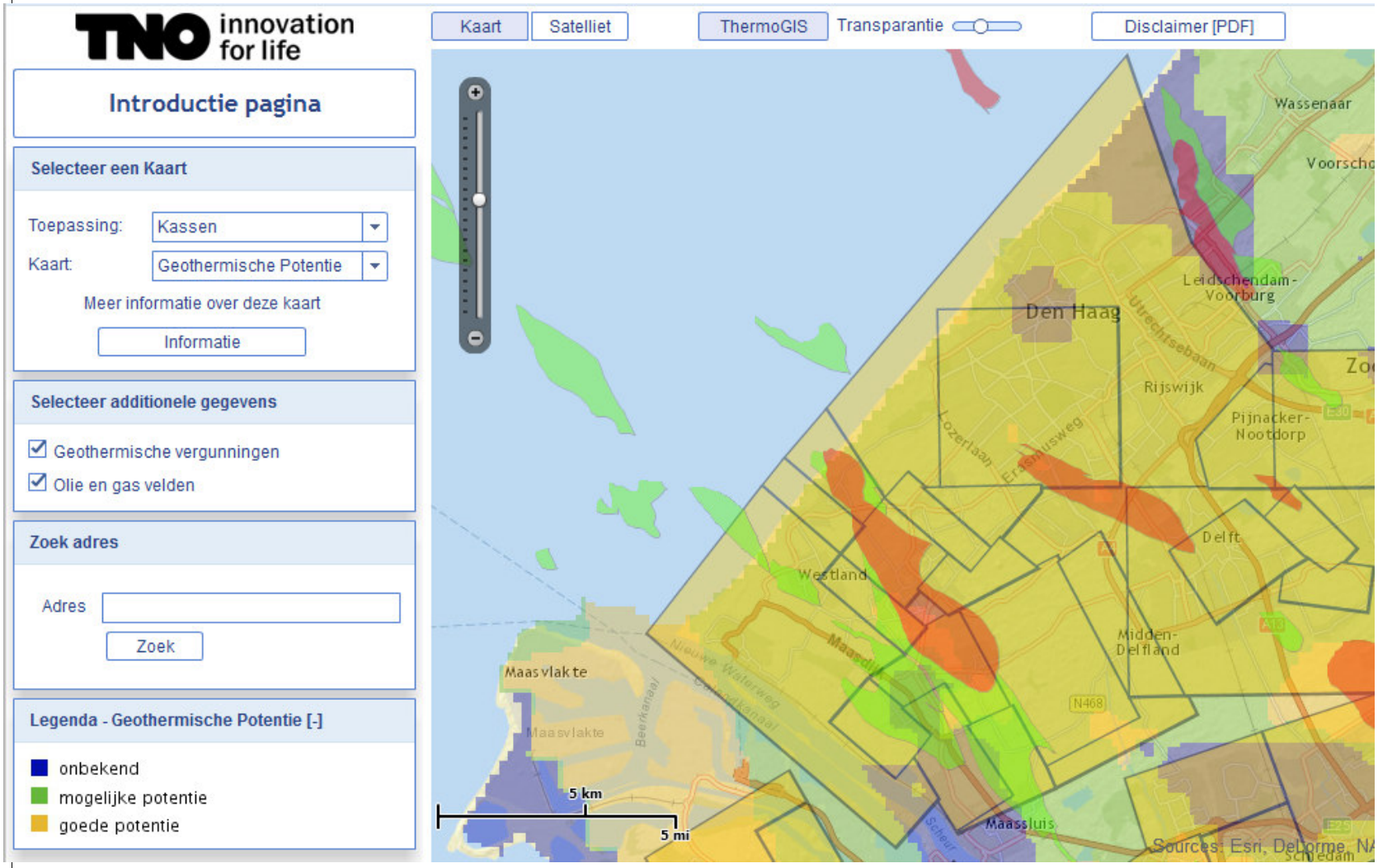
DINOloket
NL Olie- en Gasportaal
Ministerie van Economische Zaken

Platform Geothermie

TNO innovation for life

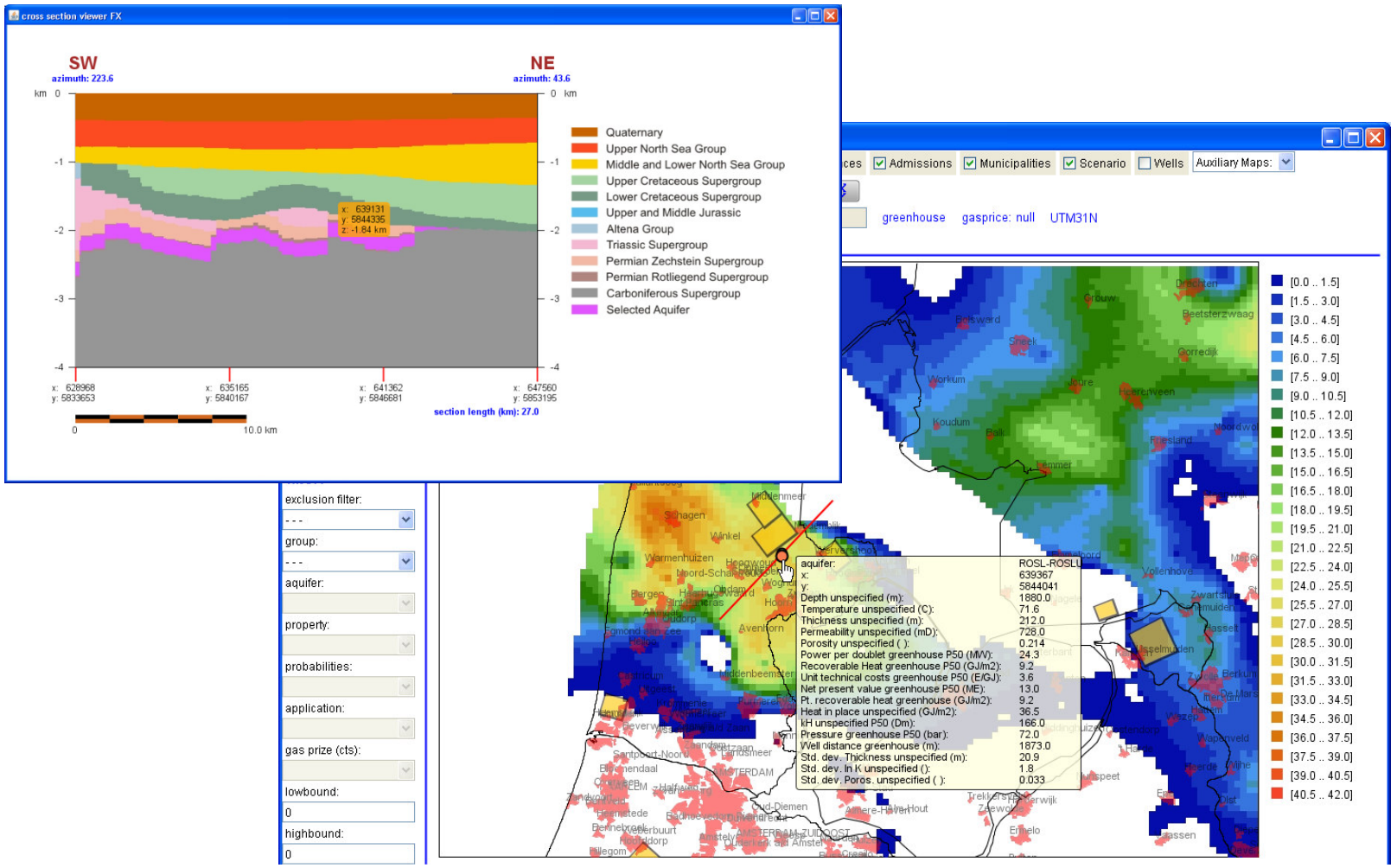
National geothermal infosystem
www.thermogis.nl



ThermoGIS basic no subsurface technical details

TNO innovation for life

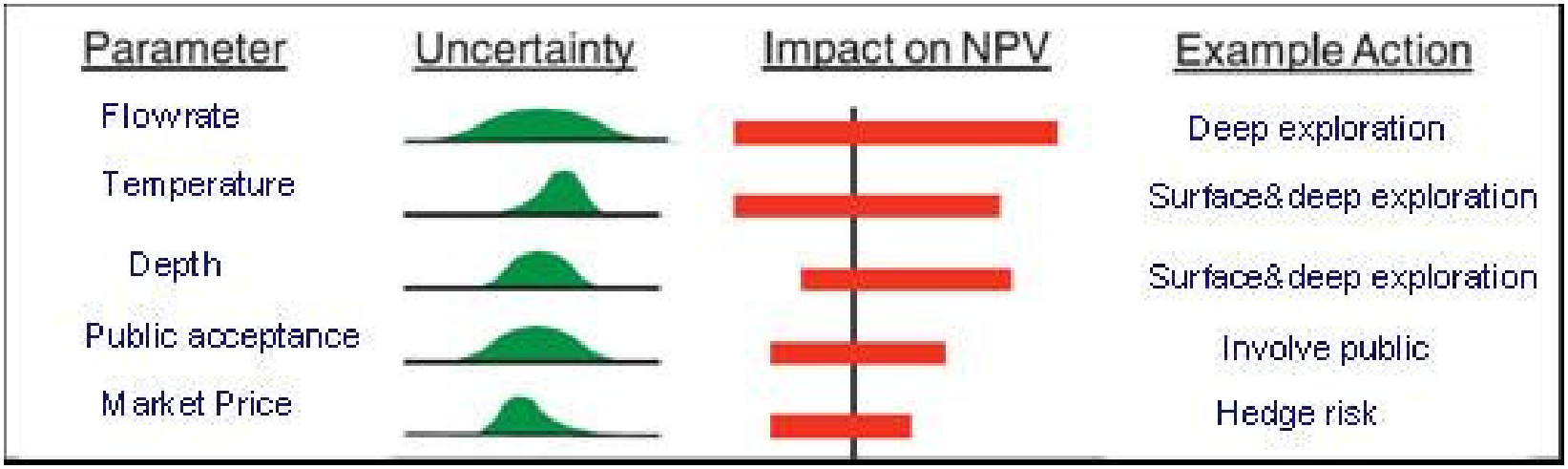
National geothermal infosystem
www.thermogis.nl



THERMOGIS expert : doublet thermal Power [MWth], site specific information

Decision and risk management: Value chain fast models

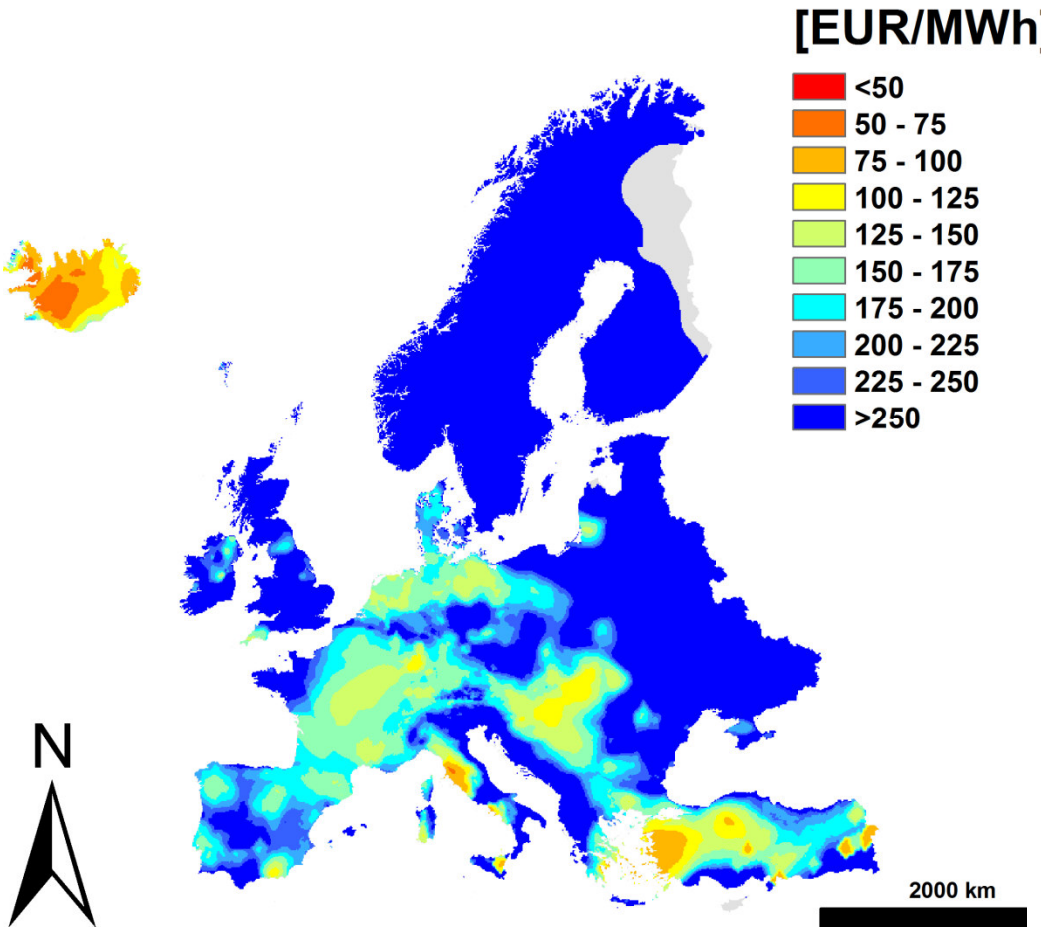
Resource assessment
Performance assessment



Batini and Van Wees (2010)

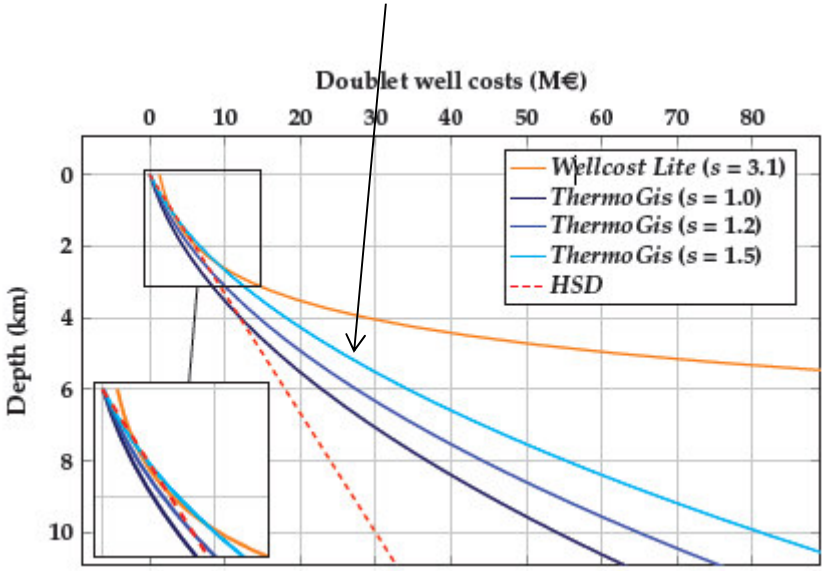
Appropriate exploration steps

Minimal LCOE EGS 2020



Assumptions:

- Doublet
- COP = 50
- Tmin = 100°C
- Flow rate = 70 l/s
- Welcost scaling = 1.5
- Zmax = 7km
- Stimulation costs = 20M euro

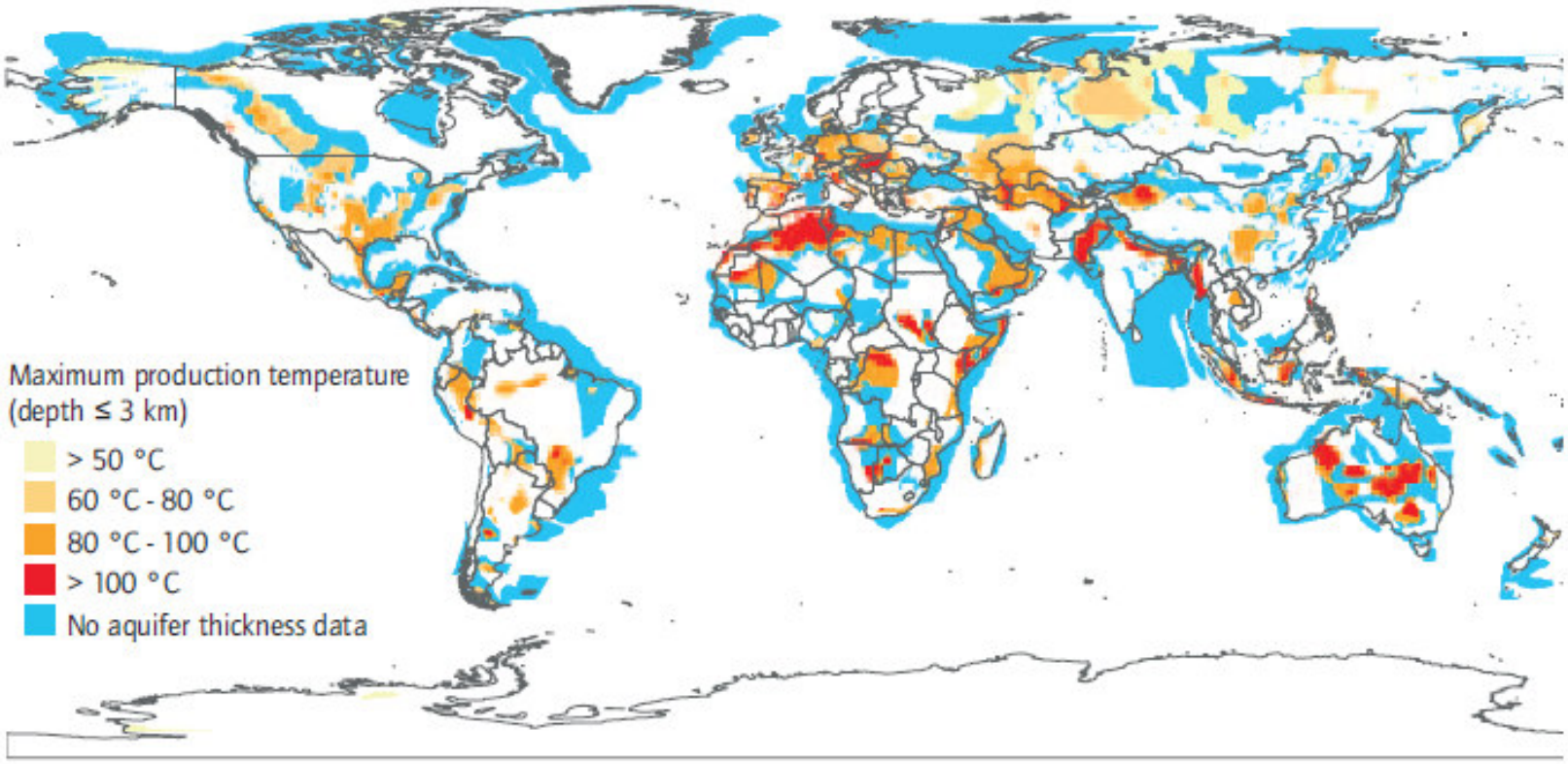


+20mln stimulation

TNO innovation for life

Resource assessment
Information systems

Figure 3: World map of deep aquifer systems

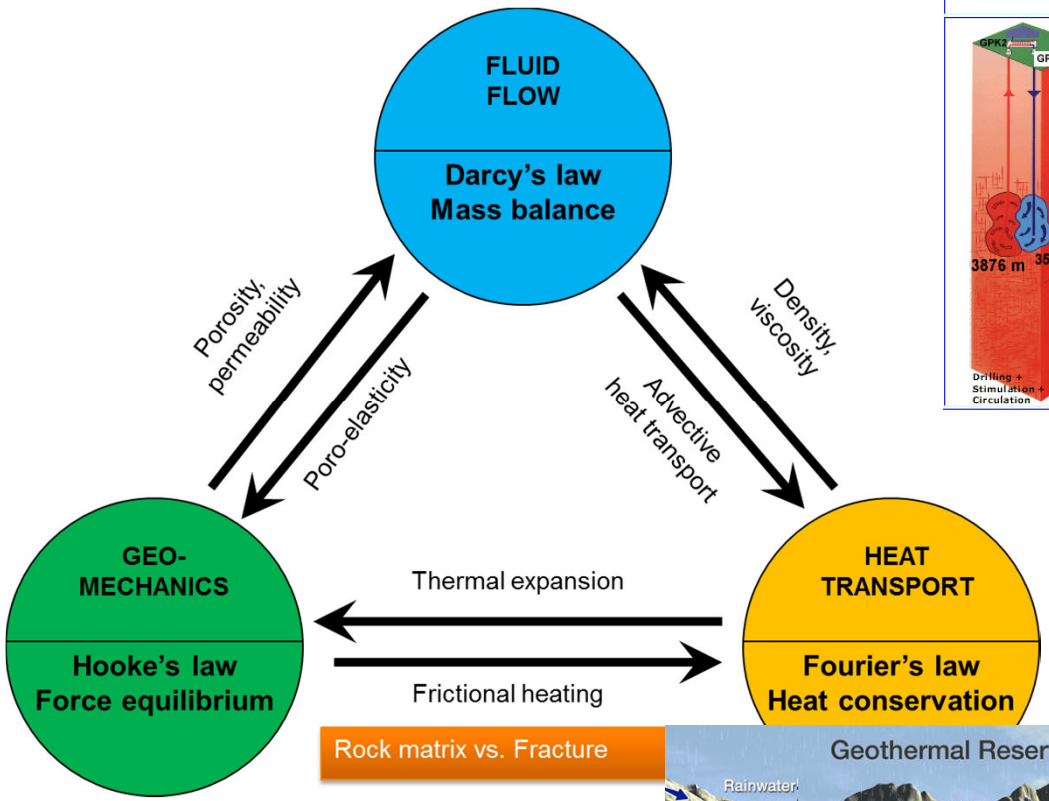


Note: World map of deep aquifer systems modified from (Penwell, 1984). Overlain are expected average production temperatures for a depth interval starting at excess temperatures of 40°C relative to surface, and ranging to a maximum depth of 3 km. The map is based on heat flow data from Artemieva (2006) and sediment thickness information from Laske and Martens (1997). Local performance strongly depends on natural heat flow conditions and surface temperature.

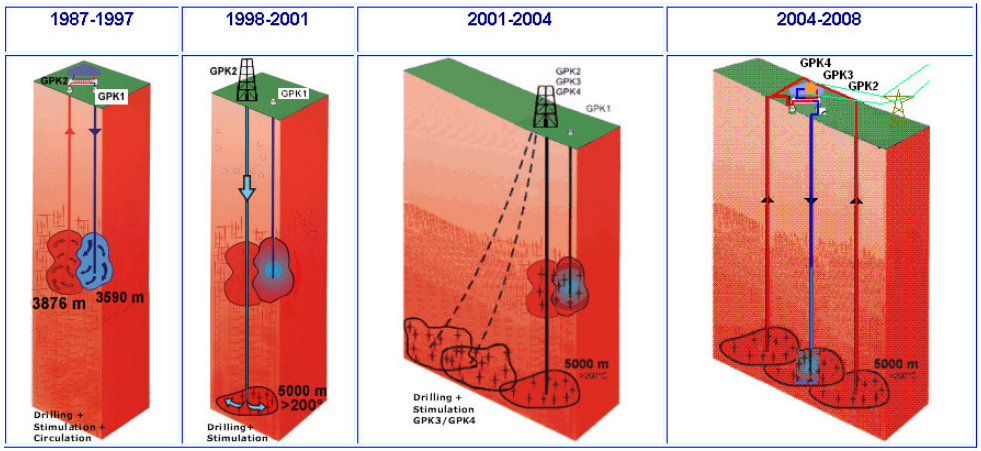
Source: TNO, www.thermogis.nl/worldaquifer.

IEA roadmap of geothermal Energy

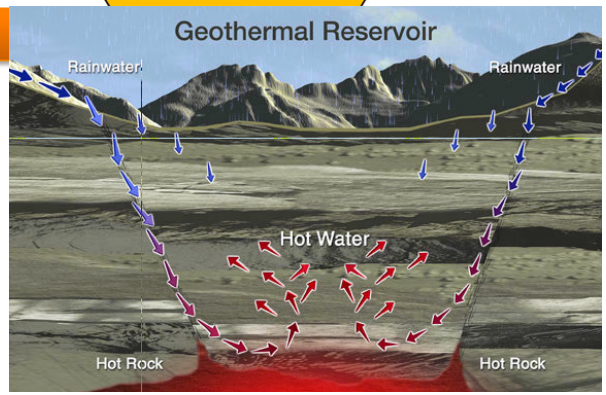
Coupled reservoir models



Engineered geothermal systems



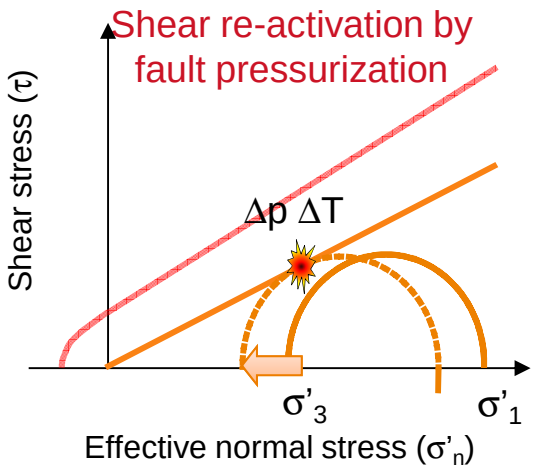
Stimulation, induced seismicity



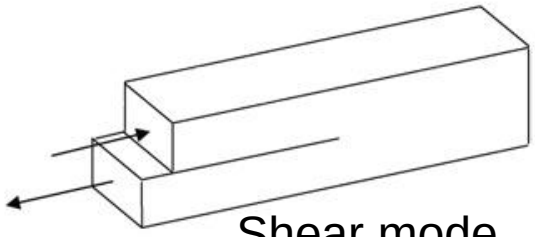
Re-injection of brines

Reservoir sustainability and mechanical compaction

Natural stress



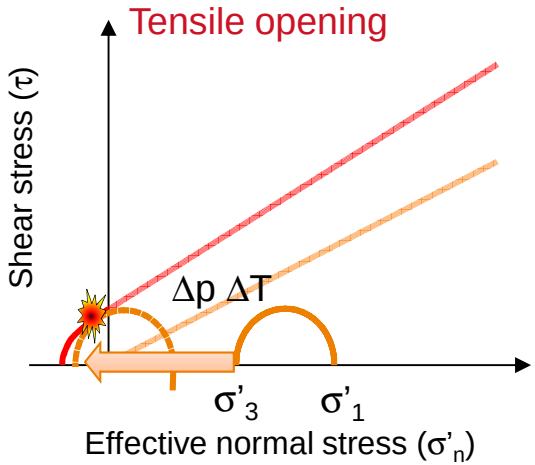
Shear stimulation



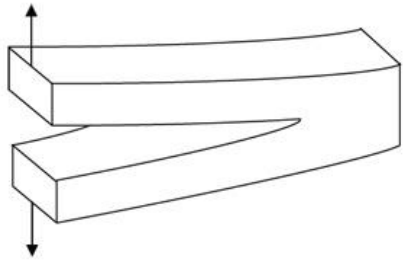
Shear mode

Hydraulic conductivity

dilatancy

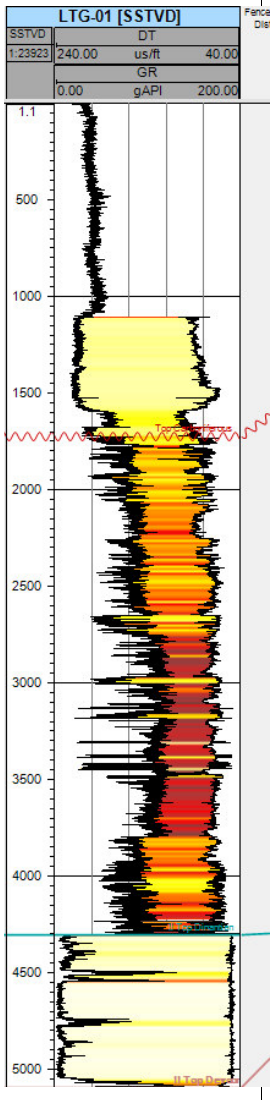


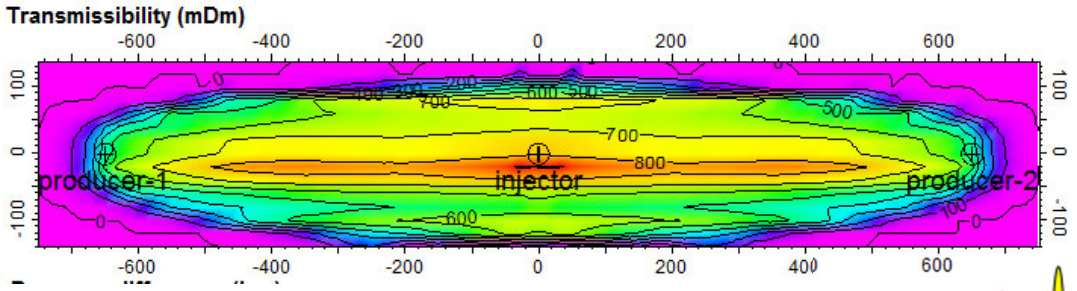
hydraulic "soft" stimulation



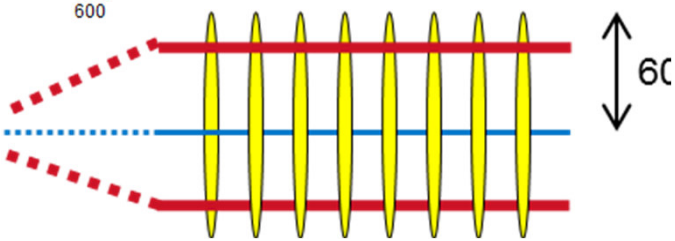
Tensile mode

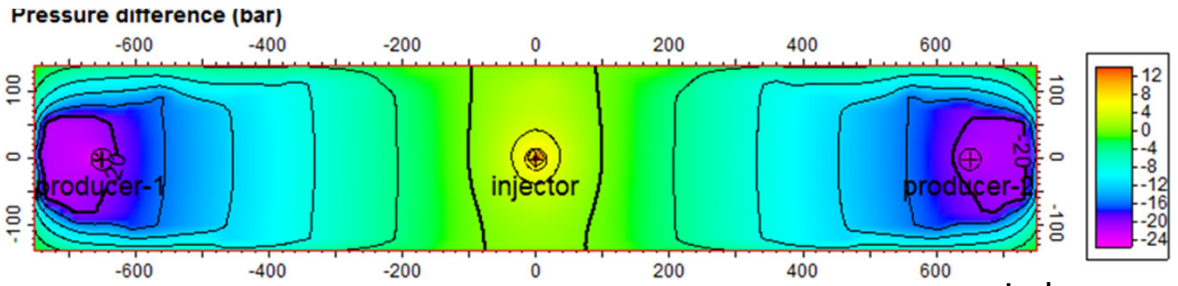
proppant

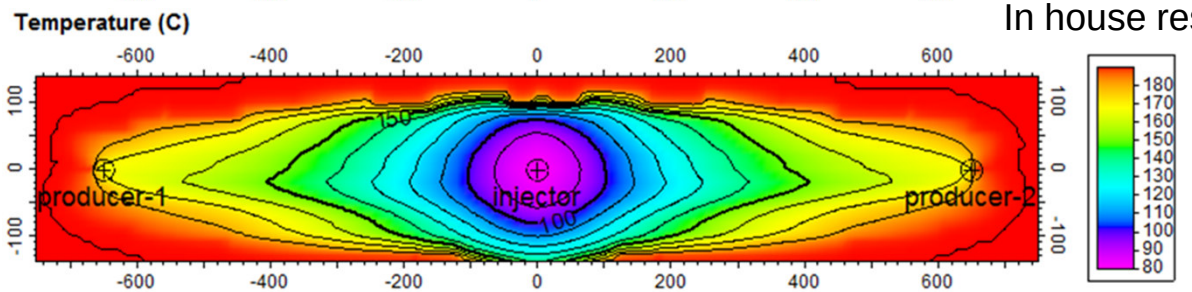





Mfrac







In house reservoir simulator

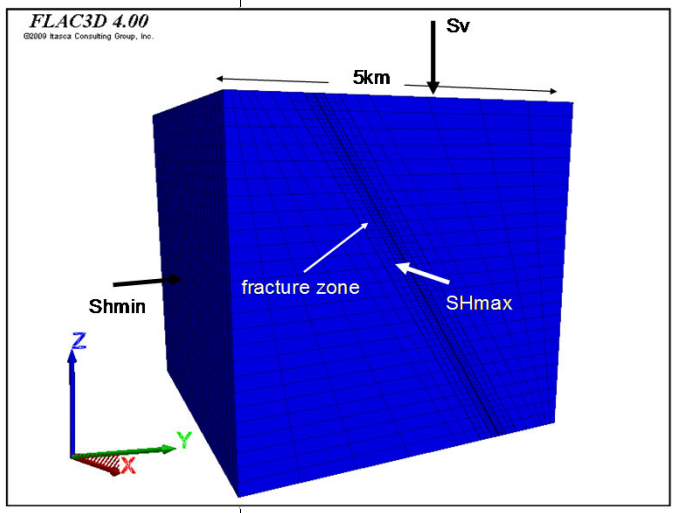
Early temperature short cut → >10 fractures → huge amount of proppant

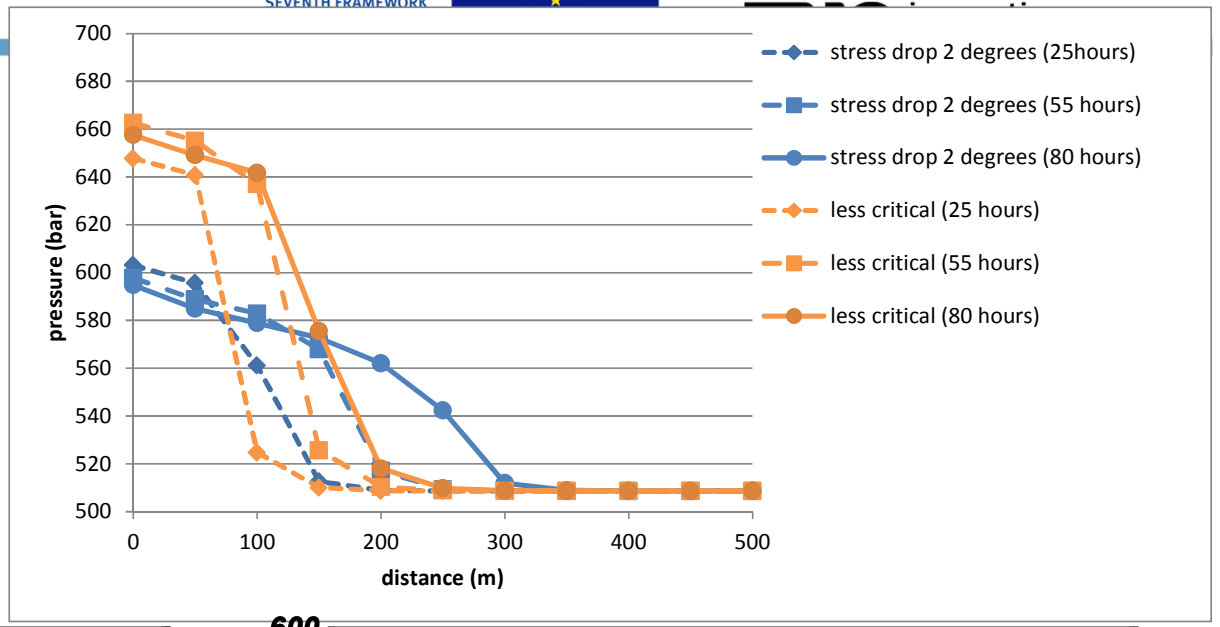
GEISER

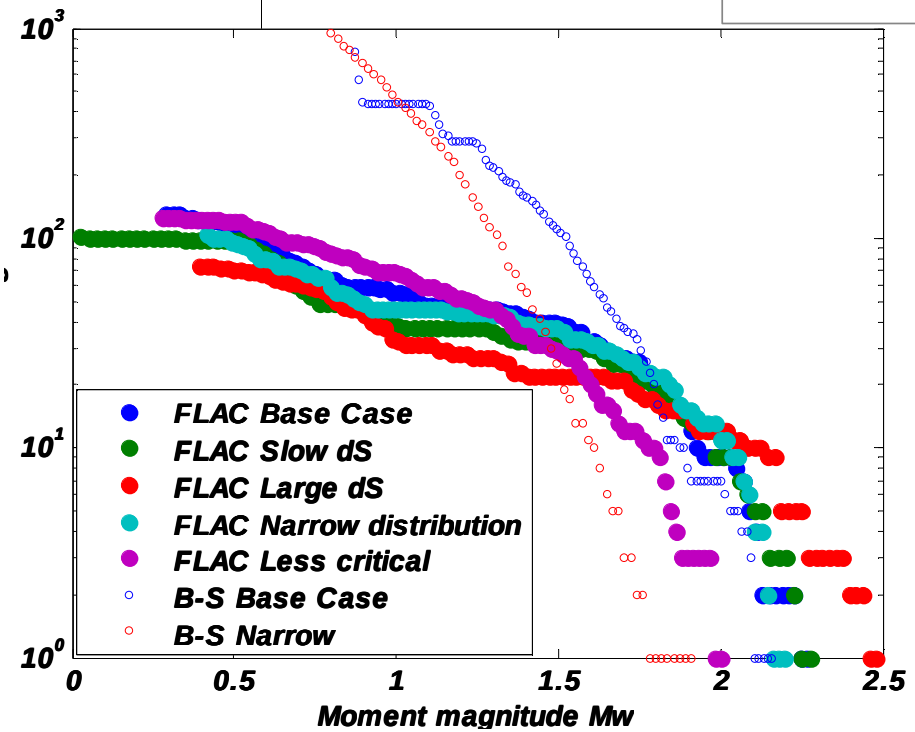
GEOTHERMAL ENGINEERING INTEGRATING MITIGATION OF INDUCED SEISMICITY IN RESERVOIRS

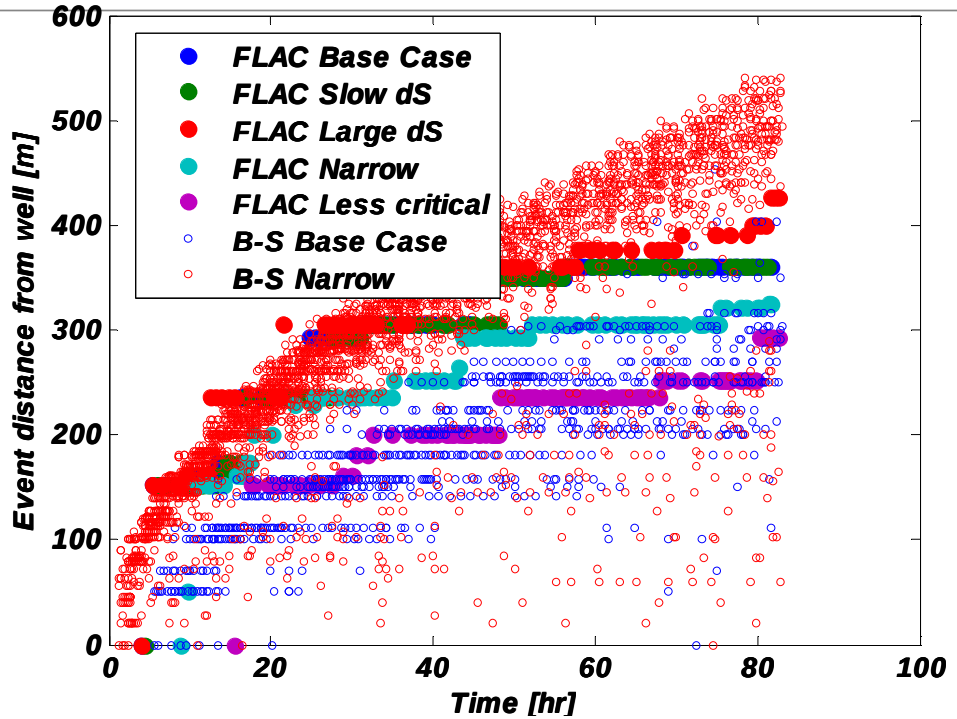
SEVENTH FRAMEWORK

Wassing et al., 2013










Monitoring and data assimilation

Ensemble Kalman approach

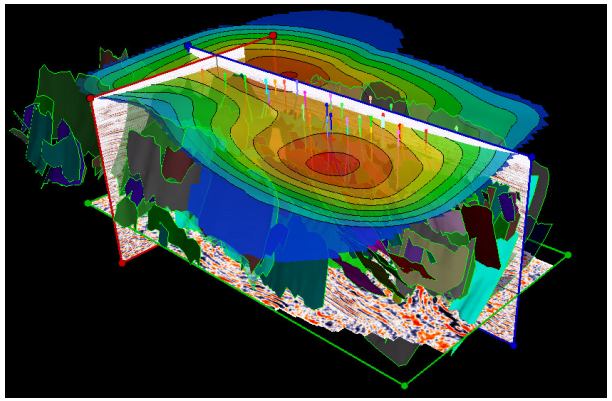
- Generic
- inversion of model parameters from observations

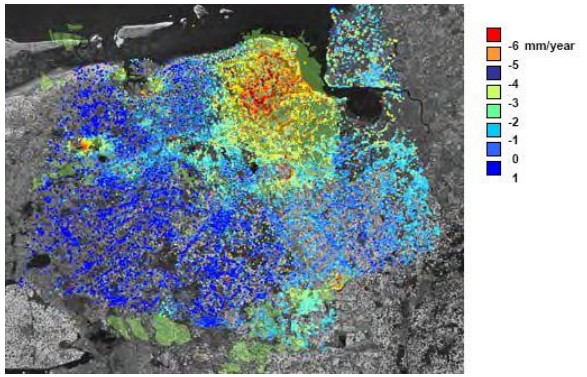
Geothermal applications

- Joint inversion (E&P)
- Well layout and operational optimisation
- Reservoir compaction

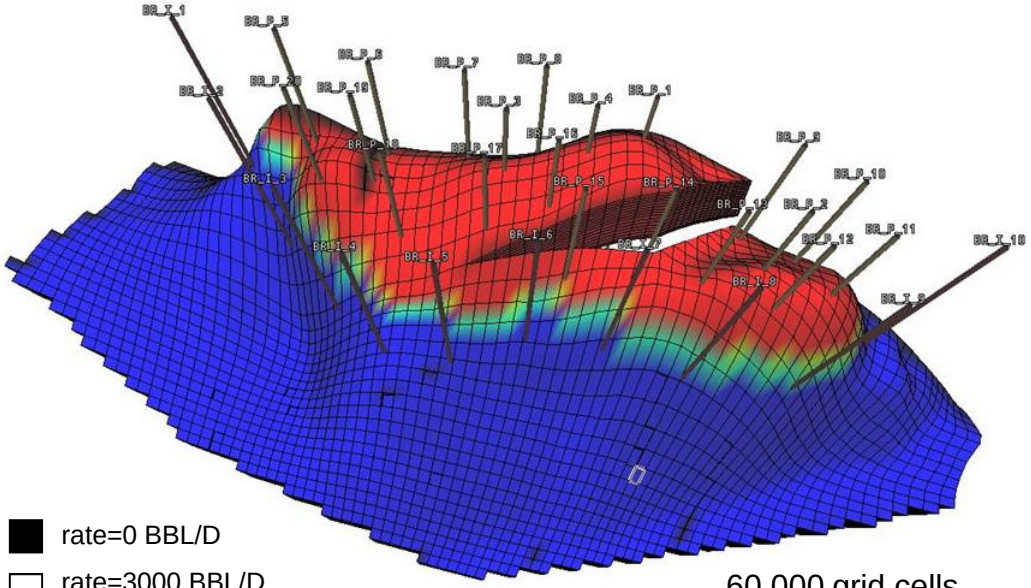
TNO niches

- Custom models
- Geomechanical/IS
- Passive seismic





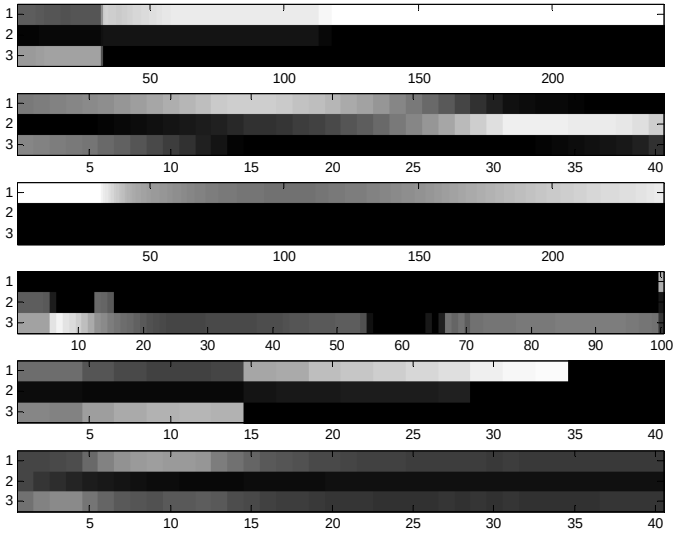

SPE workshop on Closed-Loop Reservoir Management

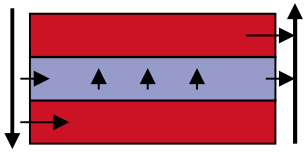


rate=0 BBL/D

rate=3000 BBL/D

60.000 grid cells





Peters, E., Arts, R.J., Brouwer, G.K., and Geel, C.R., *Results of the Brugge benchmark study for flooding optimization and history matching*, SPE 119094.