



IF Technology
introduction for the NGCBP Jakarta,
Indonesia, June 14th, 2013

Guus Willemsen, IF Technology



IF Technology

- Consultancy & engineering in Arnhem, The Netherlands
- One of Europe's largest geothermal consulting/engineering offices
- 70 employees, Bachelor+, International expansion

Services

- Geothermal exploration: geology, geophysics (MT), geochemistry...
- Reservoir engineering, Licensing, Planning, project management
- Geothermal installation design, engineering, Monitoring, Maintenance
- Energy integration of geothermal heat & cold (direct use)
- Low & medium enthalpy geothermal electricity



IF Technology international

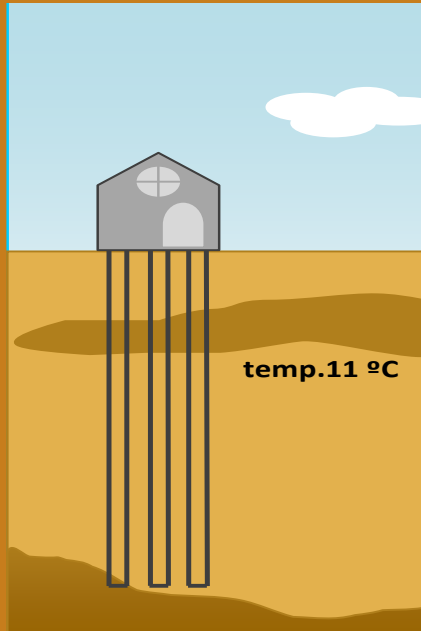
Offices

- Arnhem, The Netherlands (Head office)
- Aartselaar, Belgium
- Madrid, Spain
- London, United Kingdom

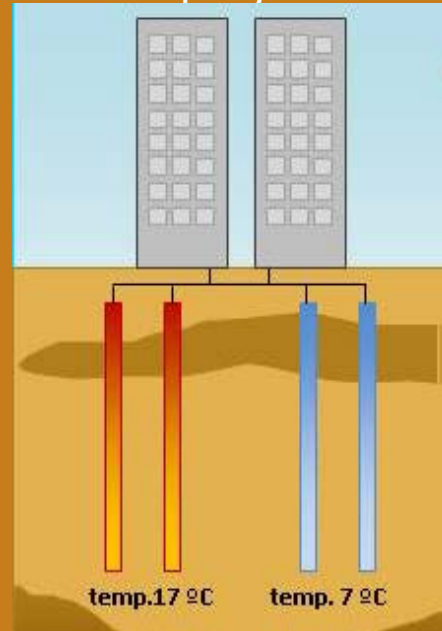


Low enthalpy geothermal systems

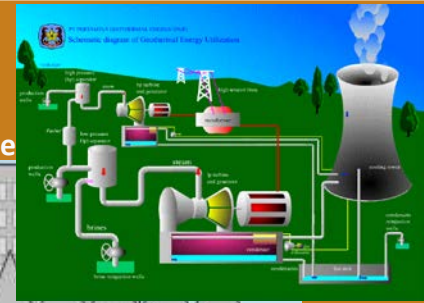
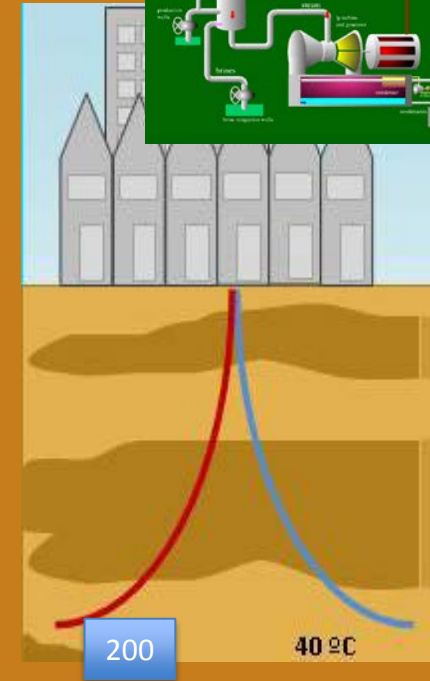
Closed



Shallow open systems



Deep



Plastic closed pipes

Up to 200 m depth

For cooling & heating with heat pump

1 – 1000 kWth; large existing global market

Wells

Up to 500 m deep

For direct cooling & heating w heat pumps

100 – 10.000 kWth; common in NL

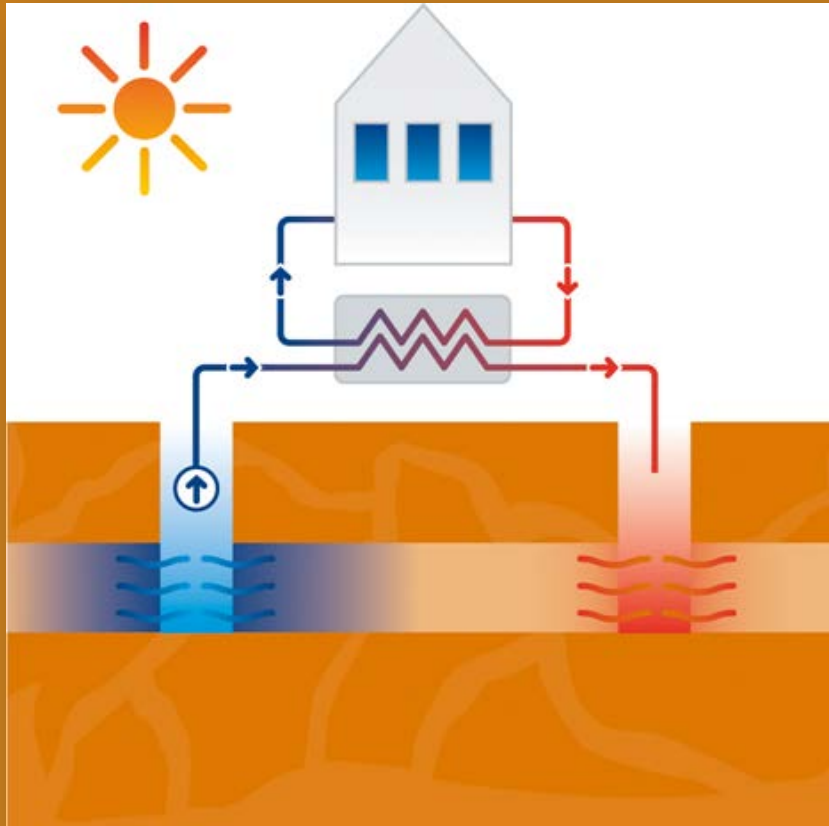
Wells

From 500 to 5000 m deep

One way flow, heating

5 – 200 MWth

Shallow geothermal with open loop



- Wells up to 500 m depth (< 25 C)
- Mainly for cooling of buildings in summer



Shallow geothermal projects in The Netherlands

1990



2000



2008

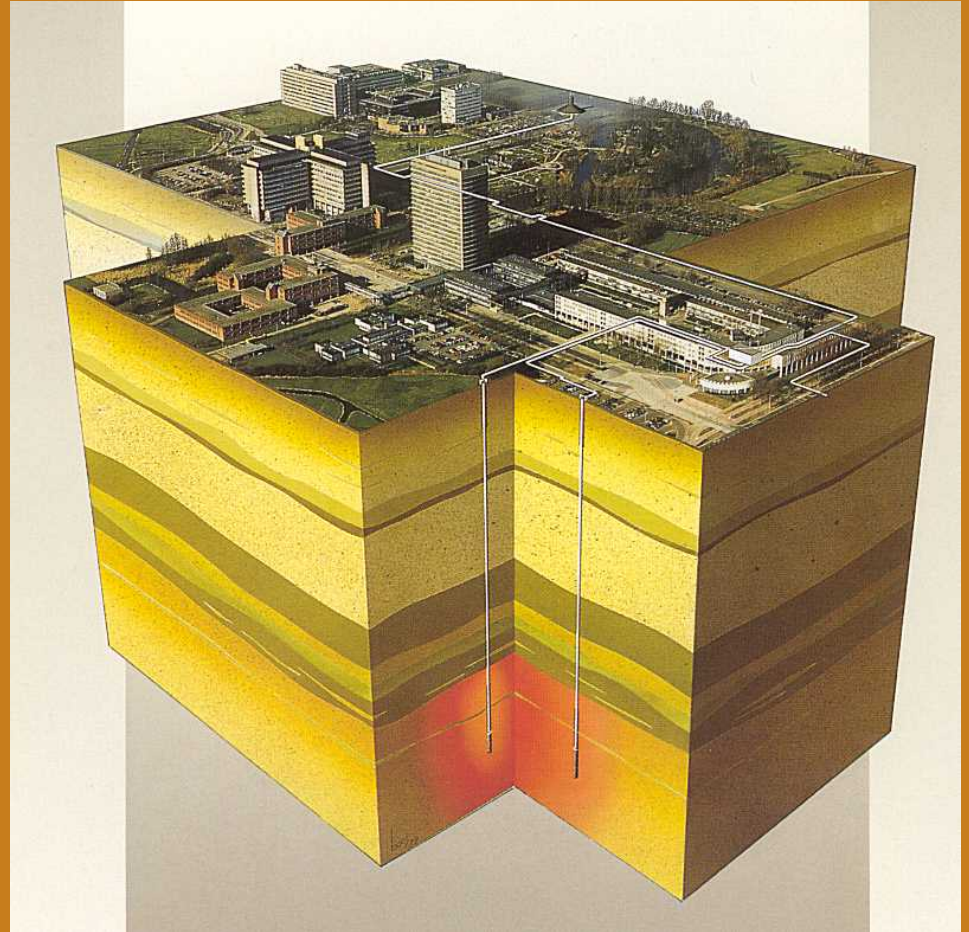


Green Winter Olympics in 2014, Sochi, Russia

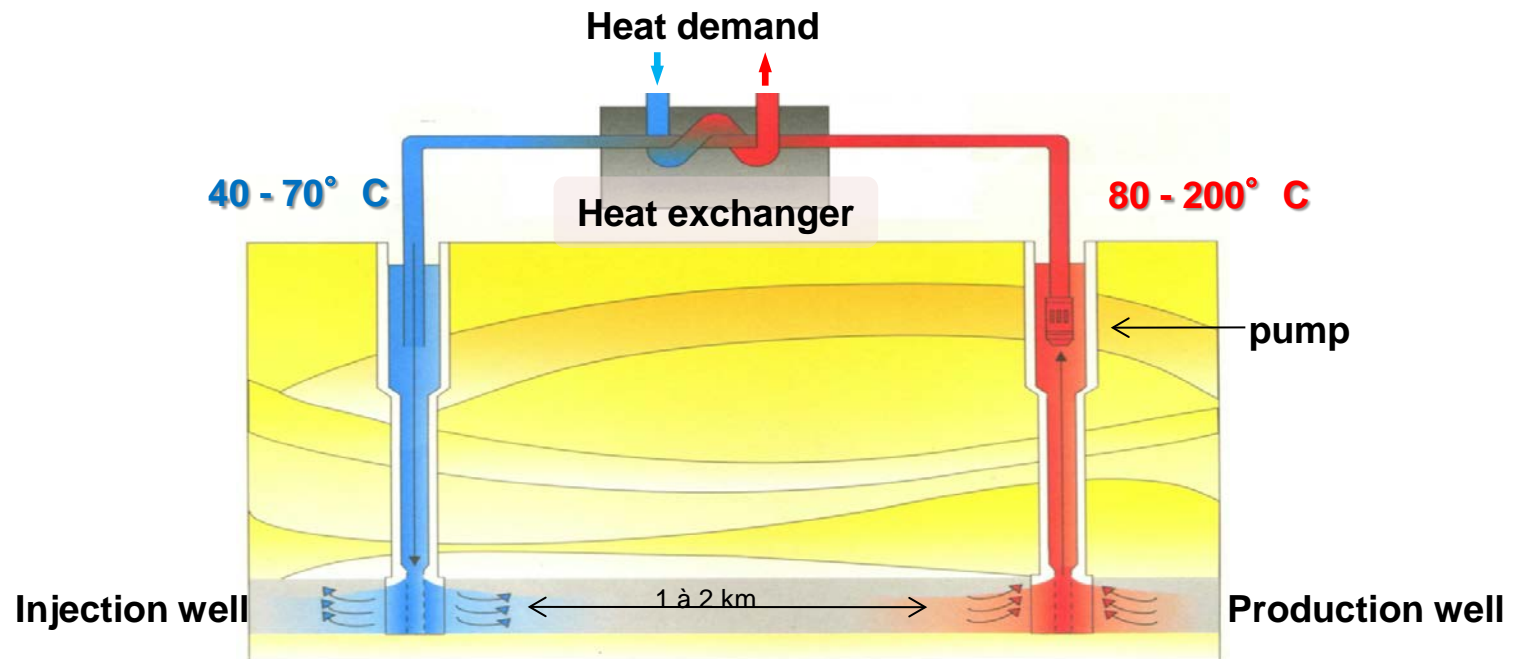


High temperature heat storage

- Storage temperature up to 90 C
- Storage of waste heat, solar heat, geothermal heat, biomass heat
- Depth 100 to 500 m

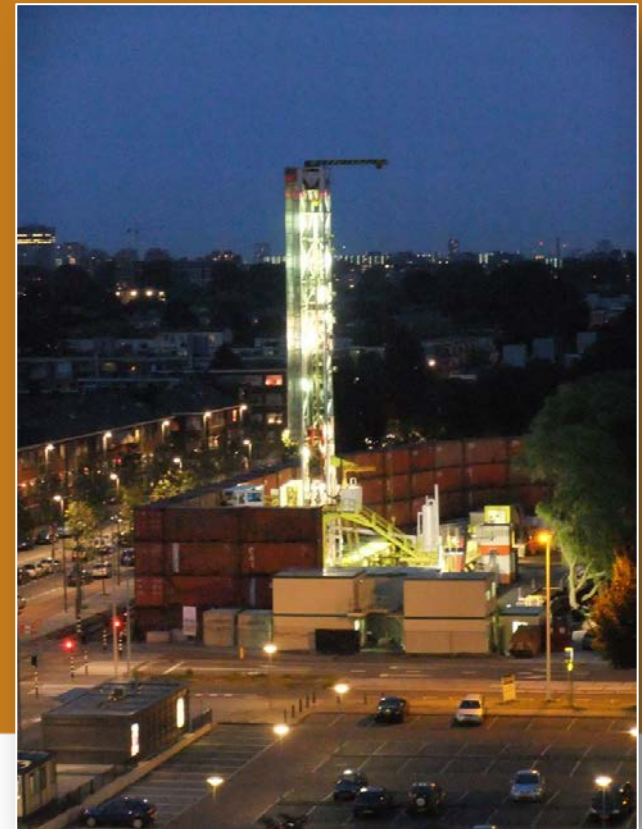


Deep low enthalpy geothermal heat



Deep geothermal in NL; 2 to 3 km depth

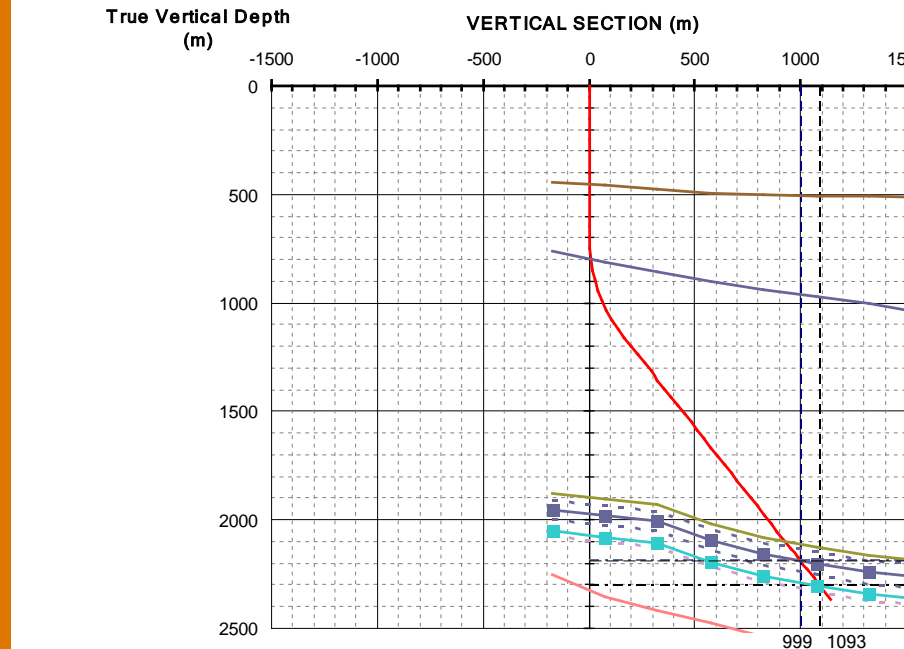
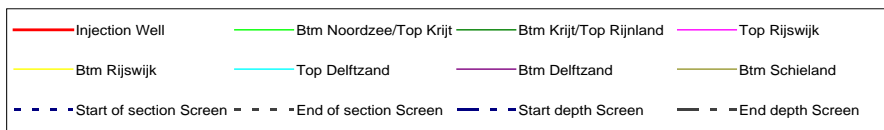
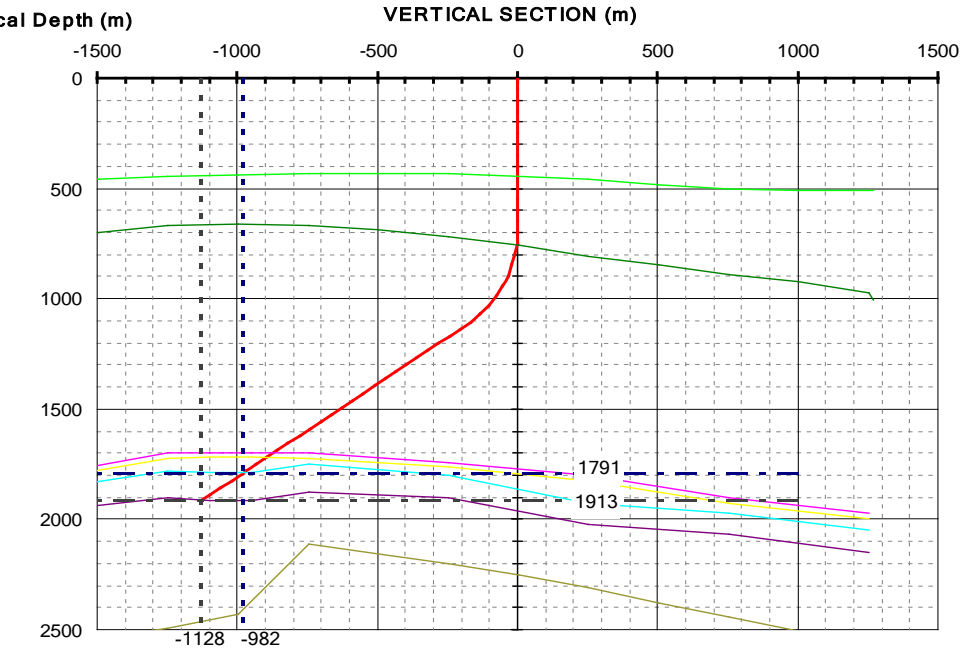
- 8 projects drilled:
 - Vd Bosch Bleiswijk (greenhouses)
 - Vd Bosch Berkel & Rodenrijs
 - Ammerlaan Pijnacker (greenhouses)
 - Den Haag (district heating)
 - Duijvesteijn (greenhouses)
 - Koekoekspolder (greenhouses)
 - Green wells Westland (greenhouses)
 - California Venlo (greenhouses)



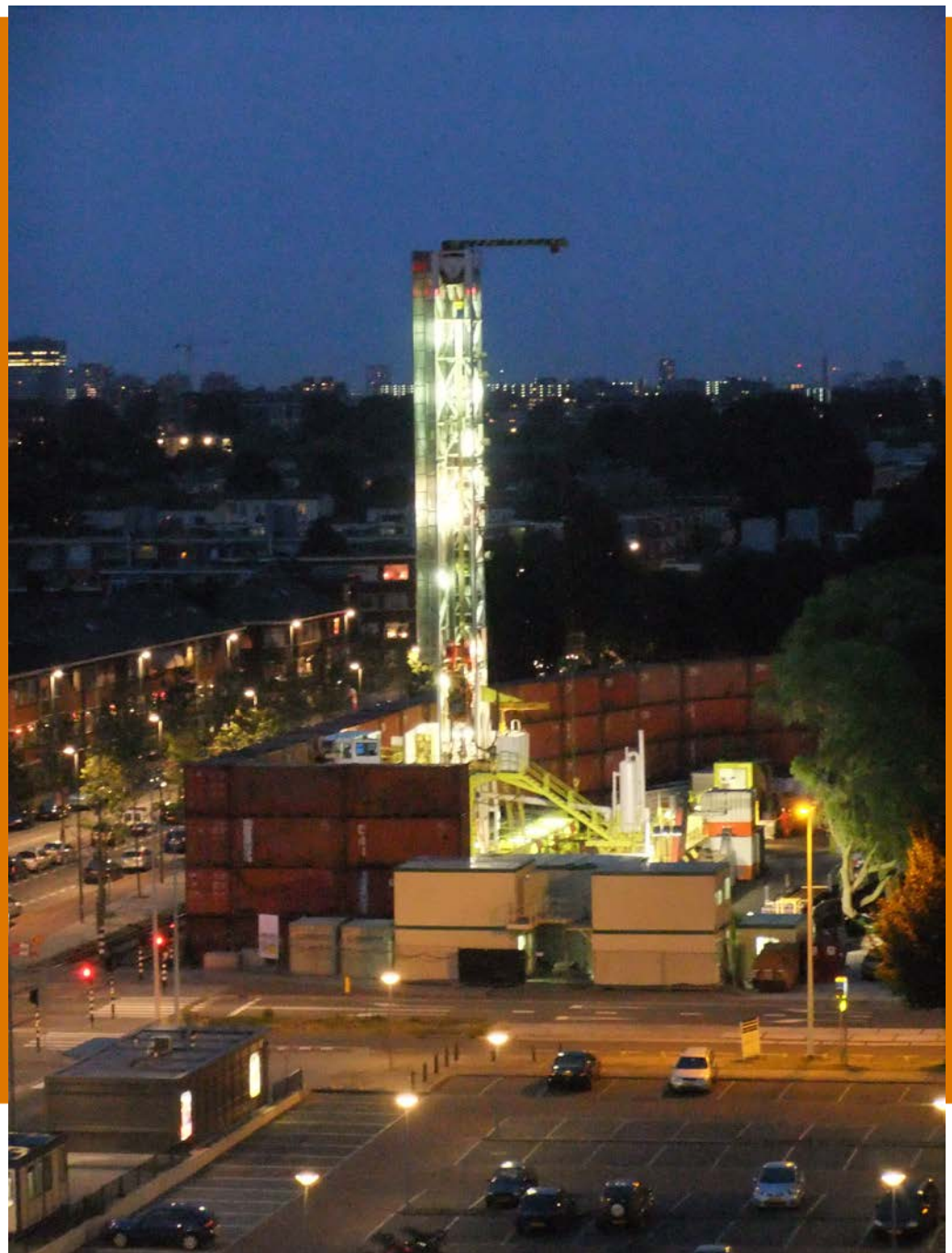
Status of geothermal energy in NL

- All projects that have been drilled are successful
- Geothermal largest share in renewable energy applications in 2012 (larger than wind, larger than biomass)
- > 4 projects will be realized in 2013
- IF also working on several projects at > 4 km depth, > 160 C
 - Active fault zones required, similar exploration as for volcanic
 - First to use Magneto-Telluric in NL

Well trajectories



Drilling 24/7
very close to
houses....



**Location after drilling with heating central
in background**



Basis for succes

- Low enthalpy: low value: risk MUST be low!; success rate MUST be high!
- Create a full 3D model of the subsurface using all available data before drilling
- Only GO when the p90 (90 % chance of success) is economically sound: thorough statistics required
- Know where you are during drilling: use the model as basis for the well site geology
- Update model constantly, based on drilling and well testing

Example projects

- Direct use: For process heat in industries like VOPAK, Heineken, FrieslandCampina, Pulp&paper factories, absorption cooling for food storage
- Medium enthalpy electricity: Texel, Hoogeveen, Apeldoorn, Schiphol Airport
- Enhanced Geothermal projects (EGS): design and reservoir engineering of hydraulic fracturing

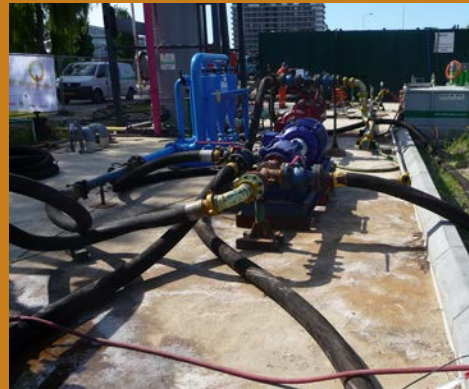
Example projects

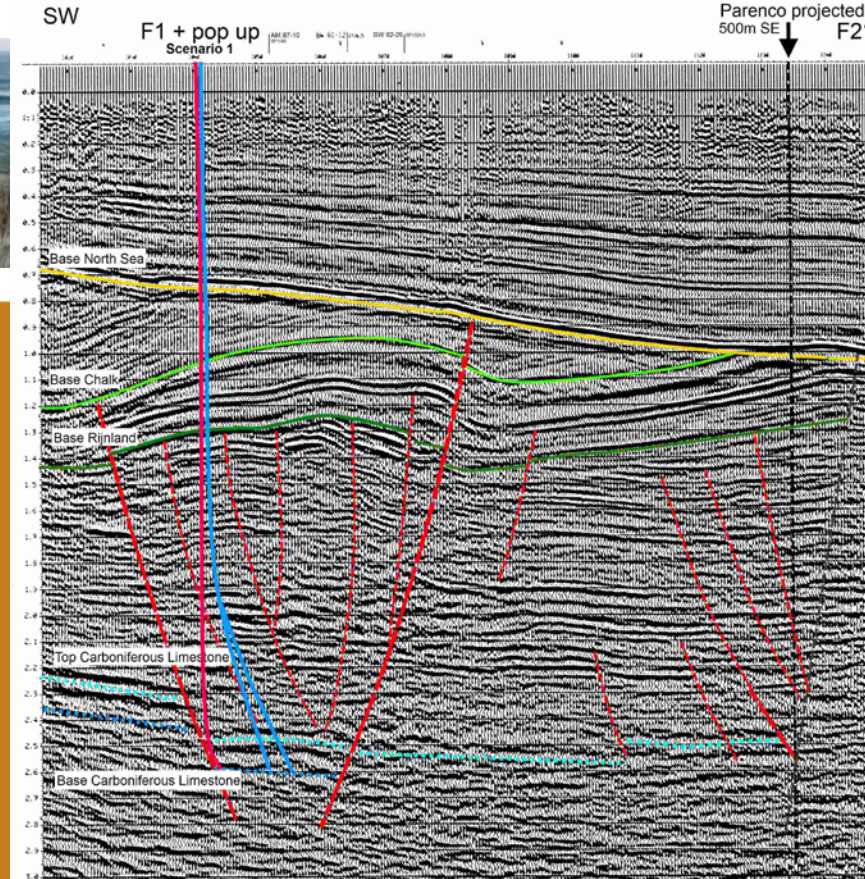
- Direct use: For process heat in industries like VOPAK, Heineken, FrieslandCampina, Pulp&paper factories; also for absorption cooling (!)
- Medium enthalpy electricity: Texel, Hoogeveen, Apeldoorn, Schiphol Airport
- Enhanced Geothermal projects (EGS): design and reservoir engineering of hydraulic fracturing
- Advanced drilling: remote view

Engineering the earth

Example case: The Hague

geology, reservoir engineering, drilling, well testing, permits





Parento case

- Large paper mill
- 40 MWth geothermal direct use
- 160 C low pressure steam
- From fault zone or EGS

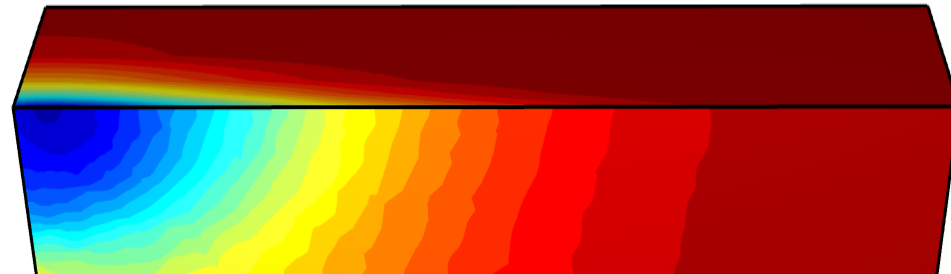
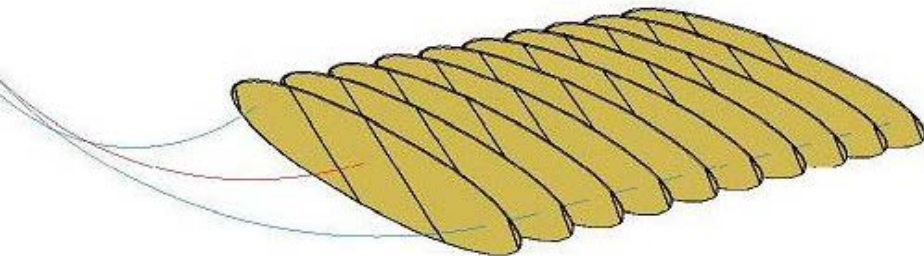
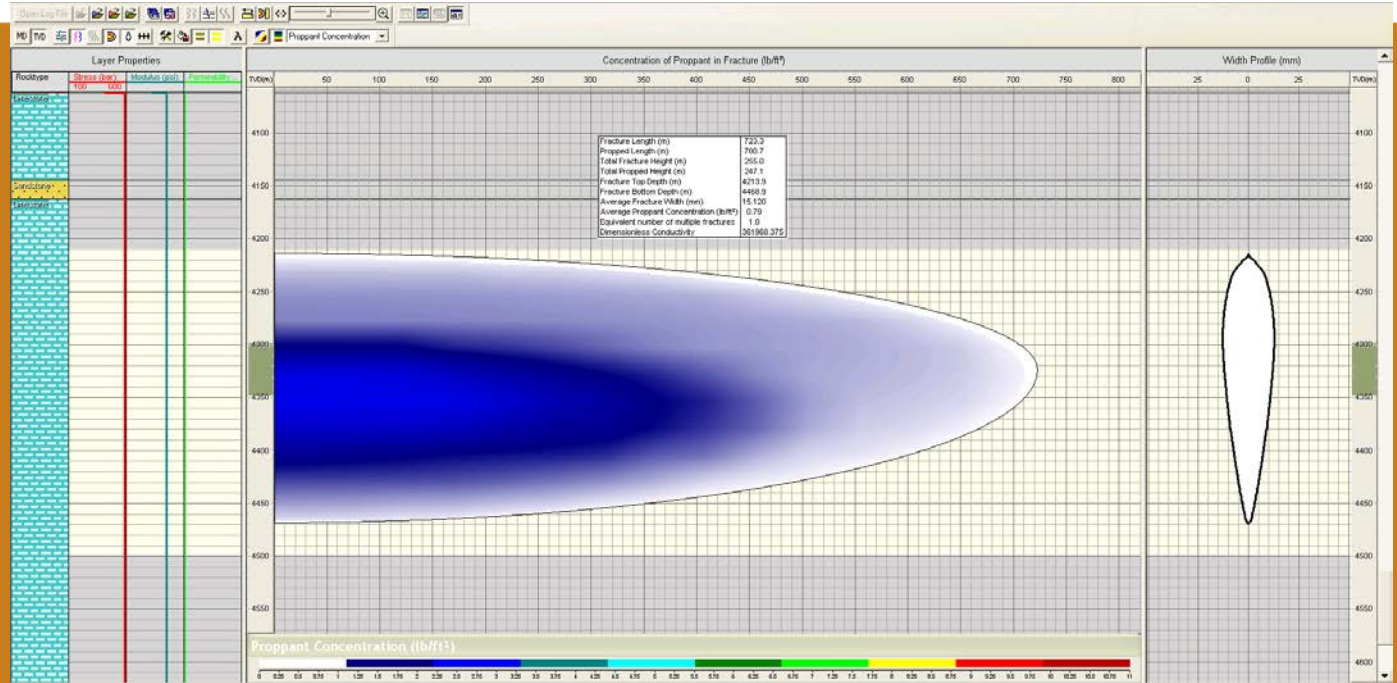
Hoogeveen case (together with DNVKEMA)

- Renewable electricity for the city of Hoogeveen
- 14 MWe from 6,5 km deep limestone
- 250 C expected
- Binary cycle best option
- From fault zone or EGS



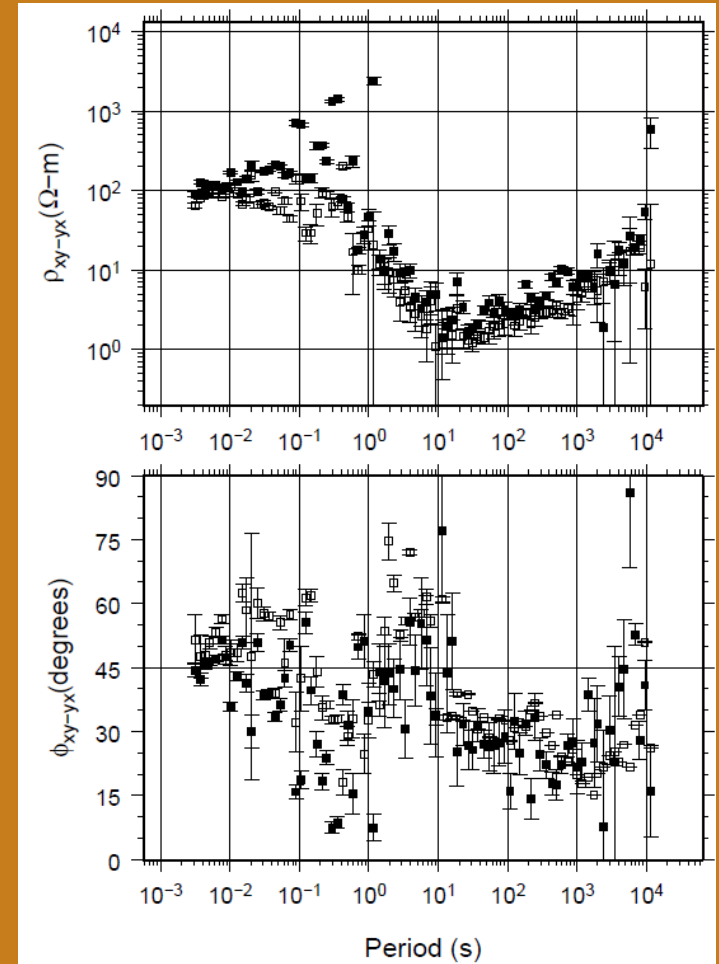
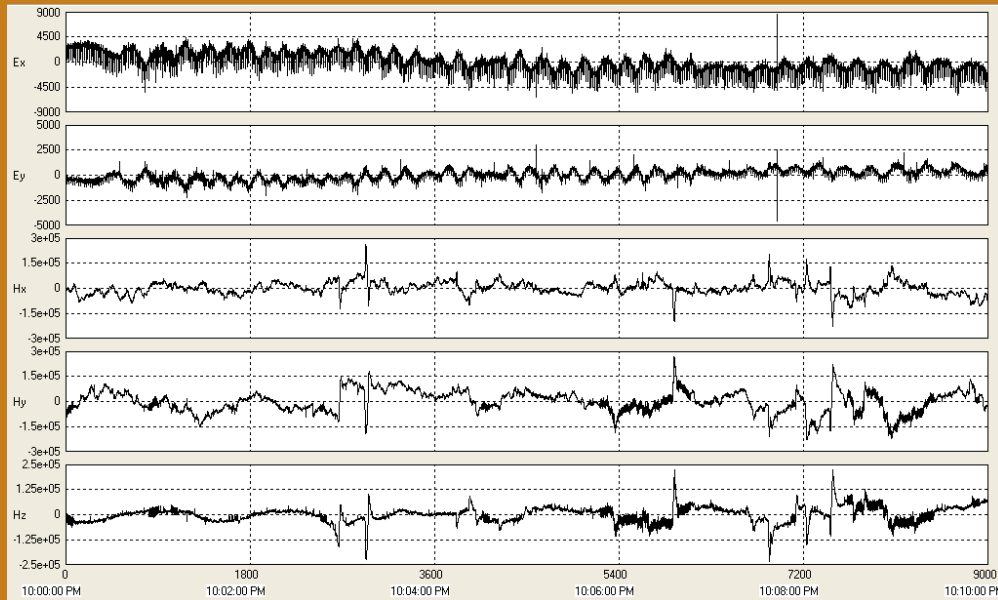
Engineering the earth

EGS



MT: processing of noisy data & inversion

Example of noisy data

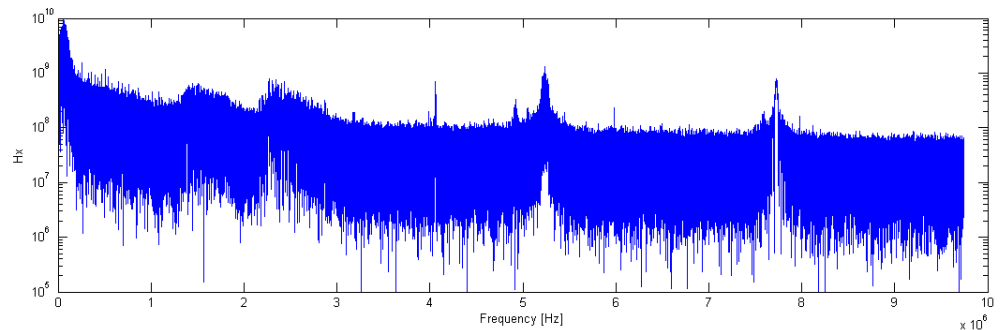
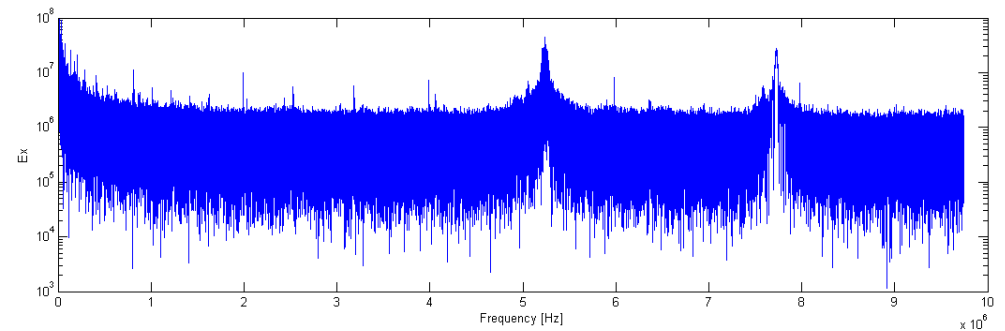


Visualisation of noise (1)

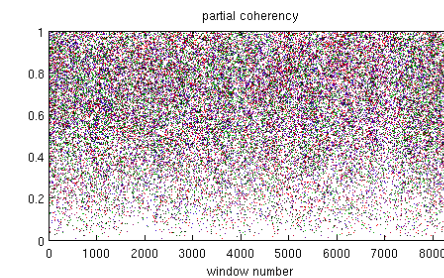
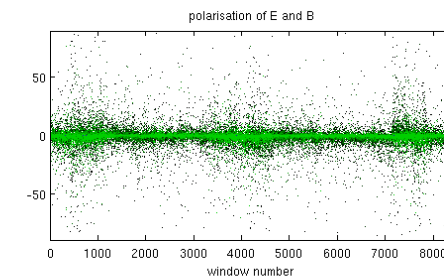
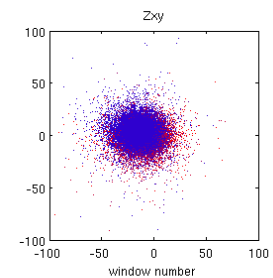
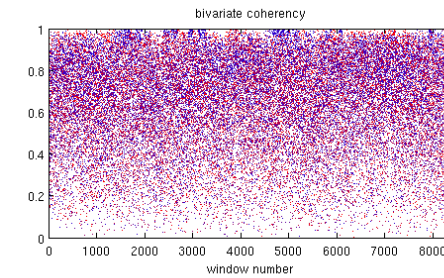
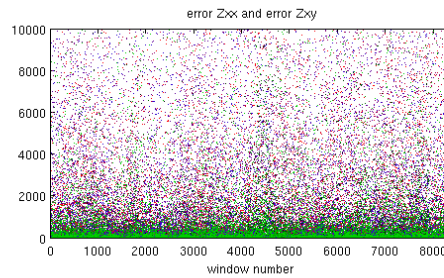
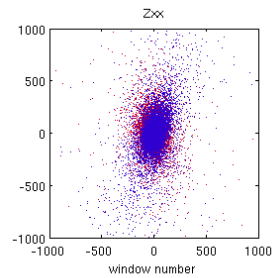
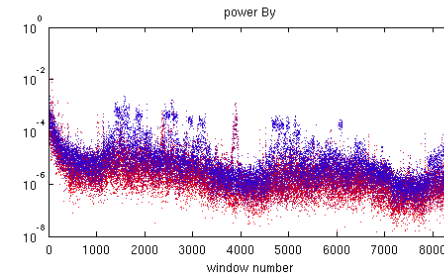
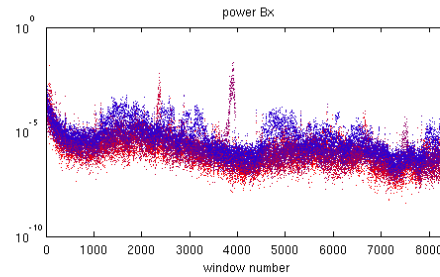
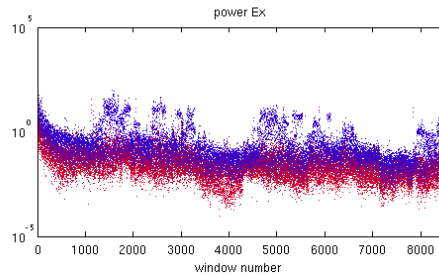
- Time series and spectra of horizontal electrical and magnetic north-south orientated fields.
- By looking at different statistical parameters, the noise can be characterized and eliminated.

(Terschelling data)

(Terschelling data)

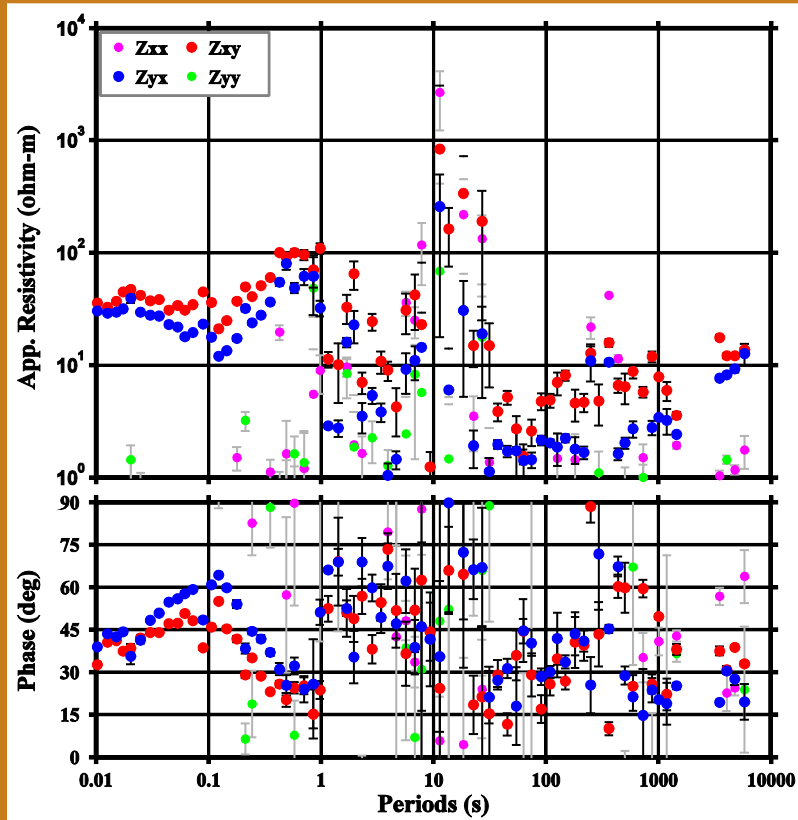


Visualisation of noise (2)

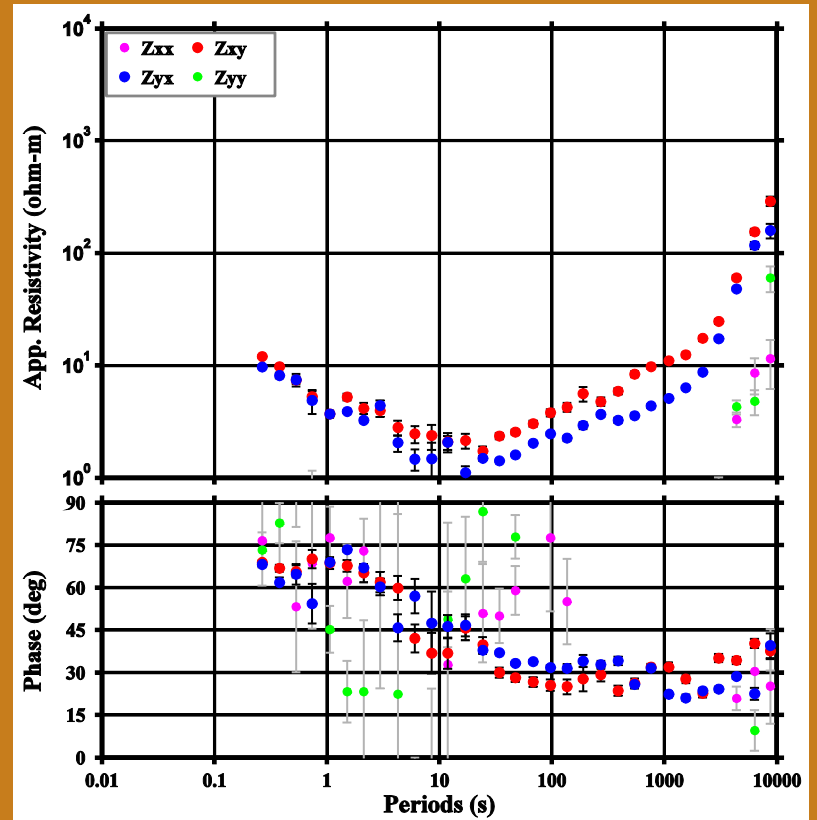


Inversion codes

Cascade decimation scheme

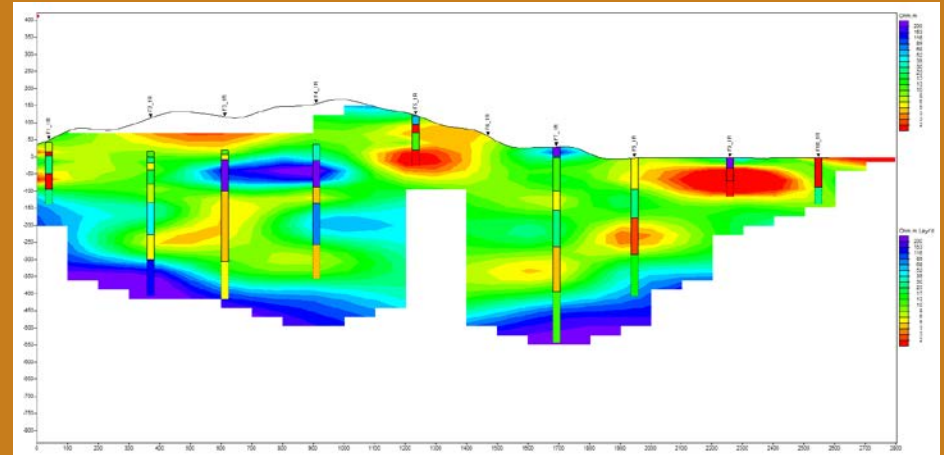


Egbert Processing (robust)

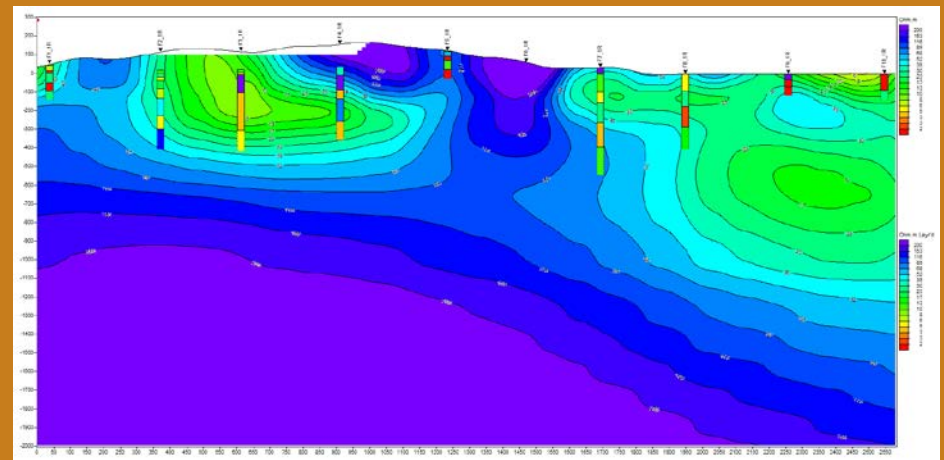


2-D modeling or 2-D inversion

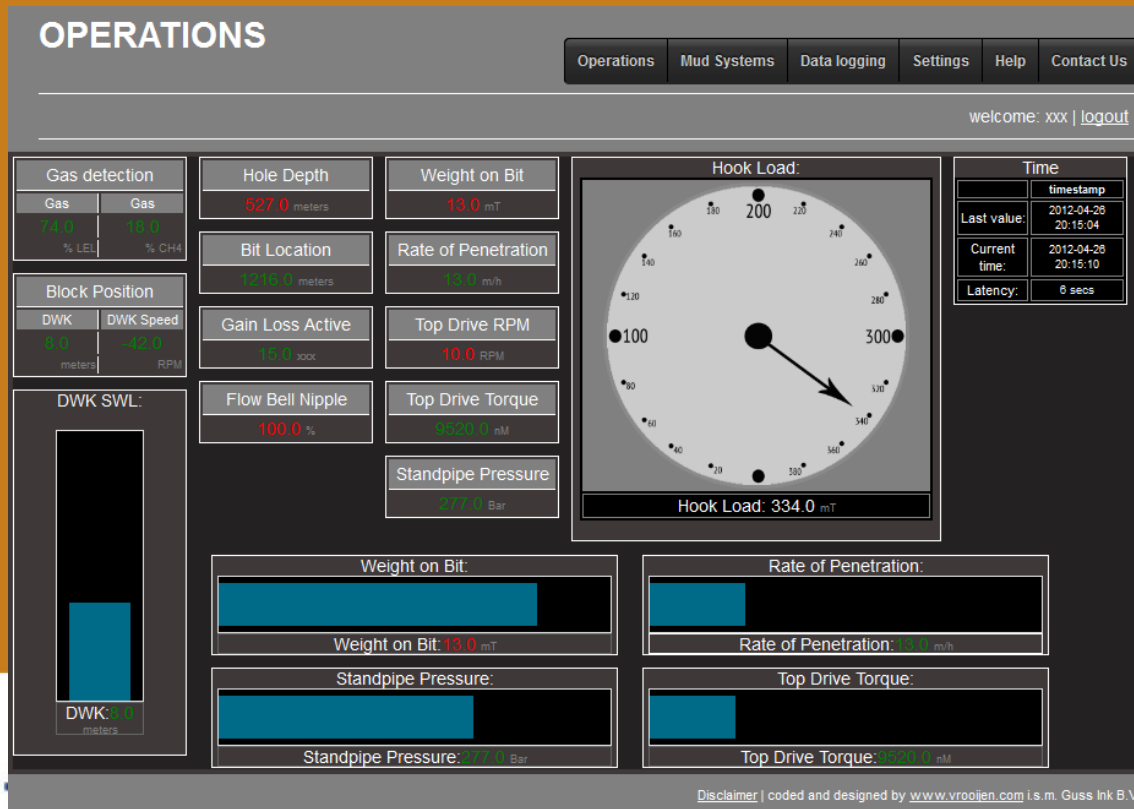
>> 2-D modeling based on
1-D models



>> 2-D inversion



Advanced drilling, drilling management from the office





Engineering the earth

Thank you

IF Technology

Velperweg 37

6800 AP Arnhem

The Netherlands

www.iftechnology.com

g.willemsen@iftechnology.nl

