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Hydrogeology: planning and progress from EMR regional model to local measurements

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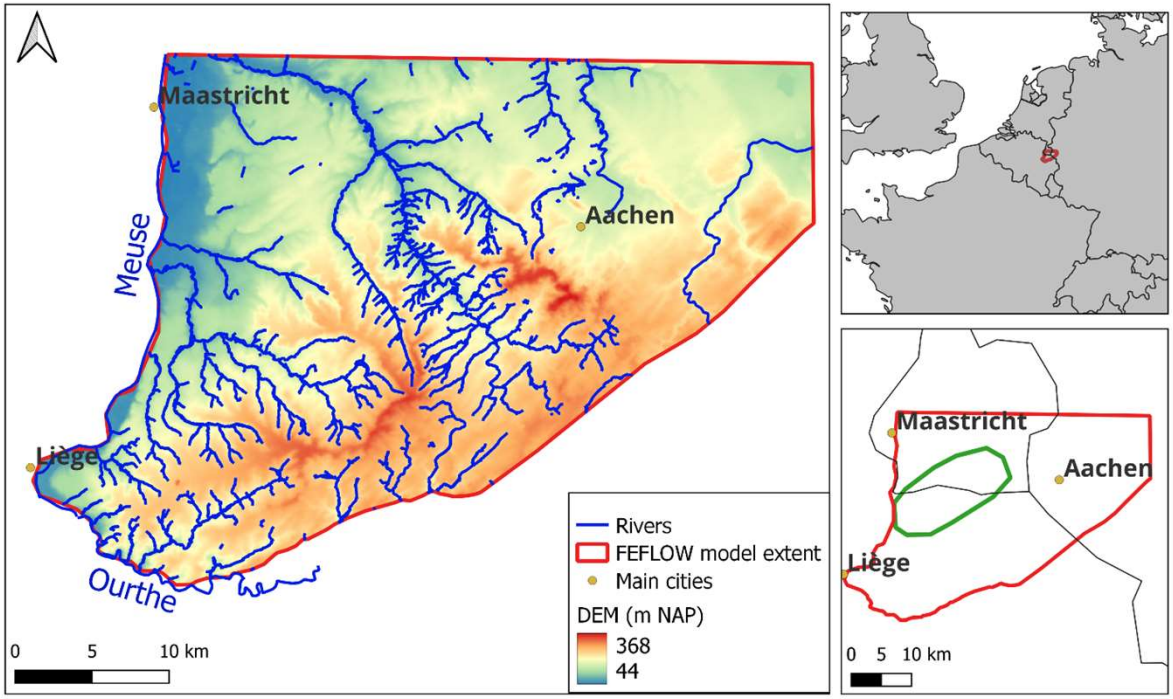
First hydrogeological approach for ET in the EMR … reminder



Exact location of the ET remains unknown => development of a regional approach based on :

- an inventory of existing data
- the development of a 3D numerical groundwater flow model

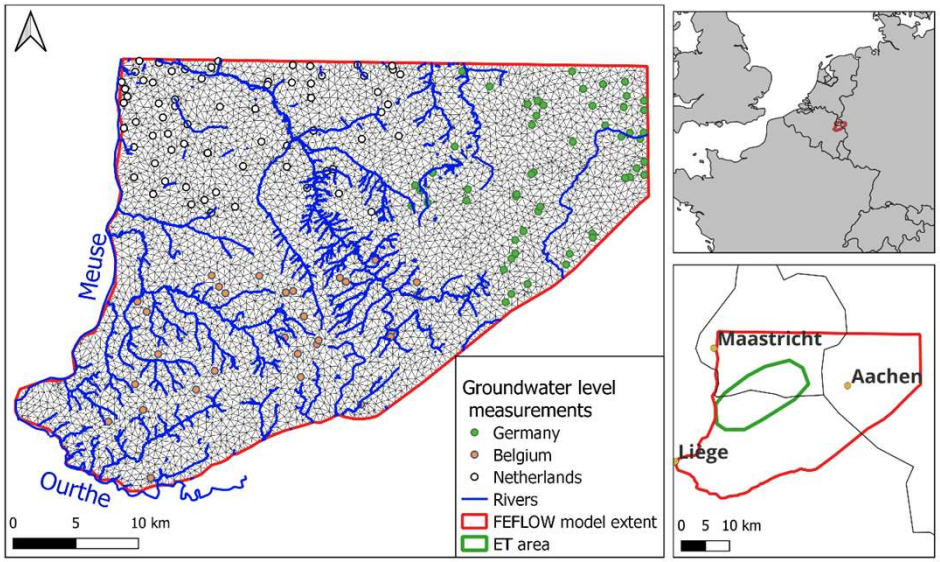
First hydrogeological approach for ET in the EMR … reminder

Feflow® hydrogeological flow model construction:

- finite element mesh
- steady flow model
- based on 2018 data

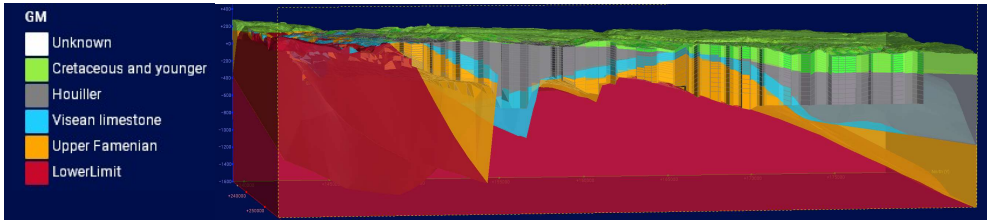
Regional database used in the model:

- groundwater water level observations, groundwater abstractions (Wallonia, Germany, The Netherlands)
- hydraulic conductivities
- topography
- geology



River network, groundwater level measurements and mesh of the finite elements model

Element sizes about 500 meters length

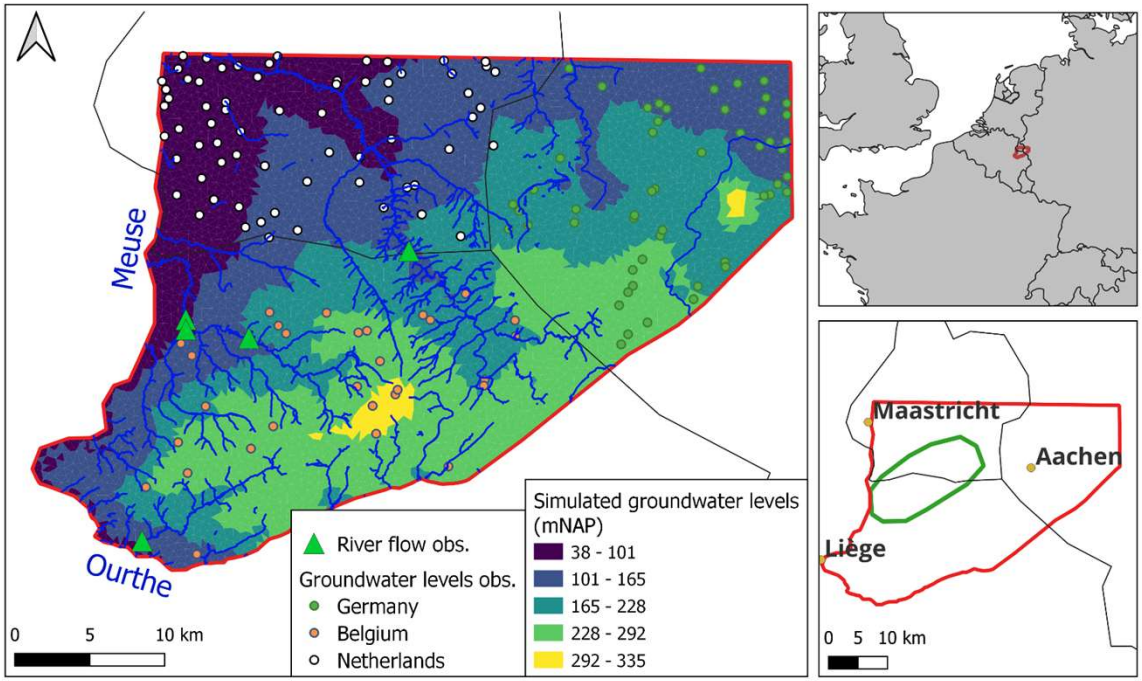


Hydrogeological model according to regional geological model

Interreg Euregio Maas-Rijn

E-TEST Einstein Telescope EMR Site & Technology

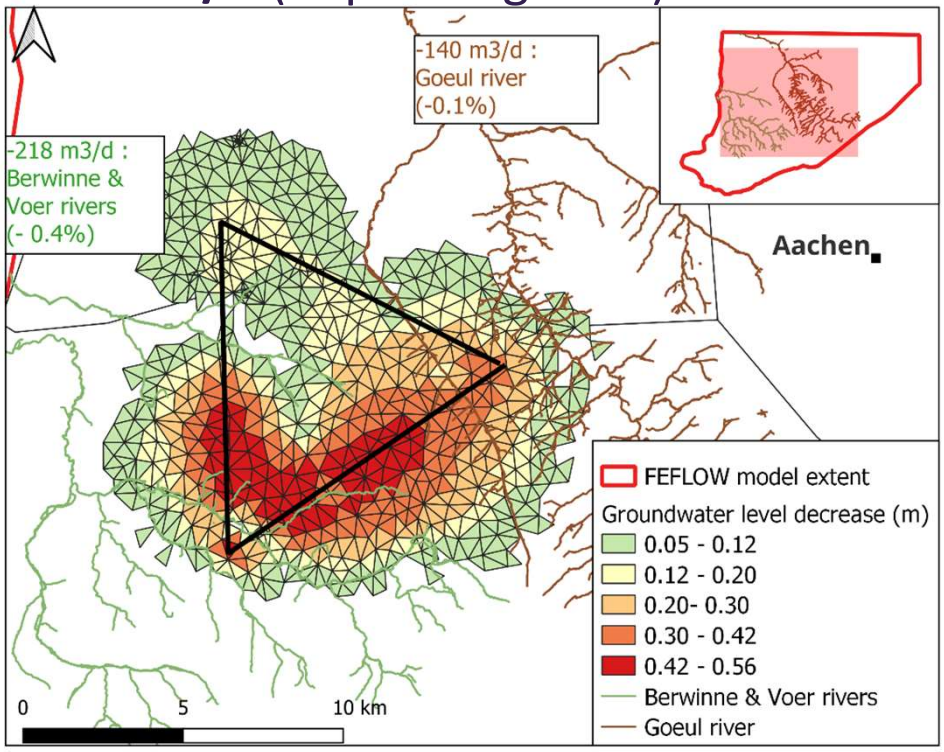
First hydrogeological approach for ET in the EMR … reminder



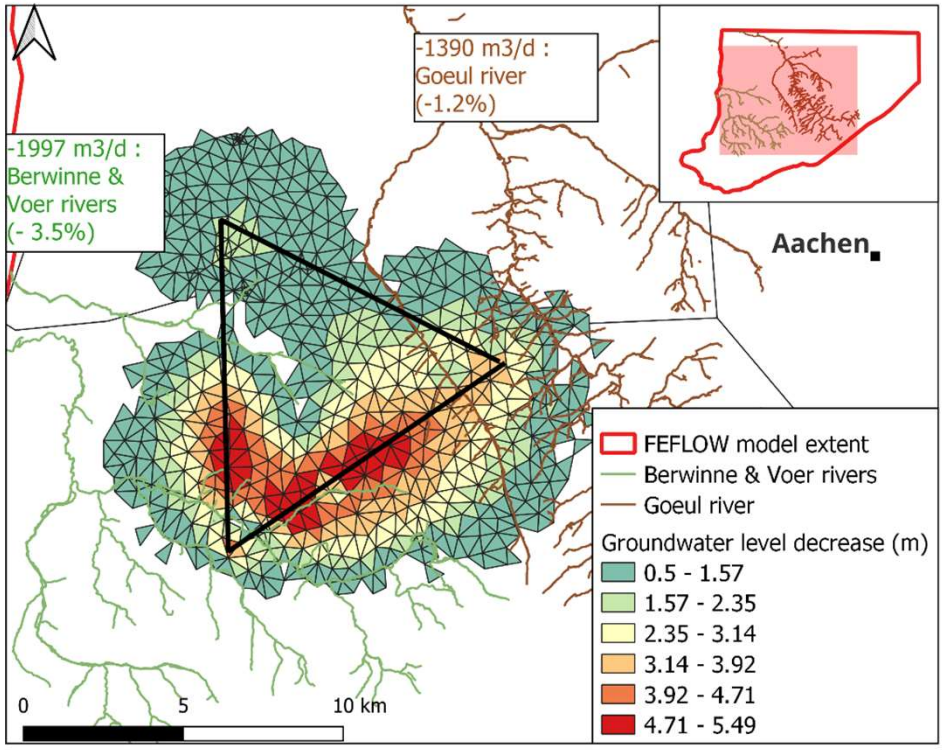
- Calibrated in steady state based on groundwater levels and base flow in rivers
- First simulations of the impact of ET infrastructures on the groundwater
- First estimations of groundwater inflows in tunnels

First hydrogeological approach for ET in the EMR … reminder

In the case of $K_{aq}=10^{-8}$ **m/s** conductivity, calculations with analytical solution: **380 m³/d -> 4850 m³/d** (depending on H)



*for a **380 m³/d** tunnel water inflow*

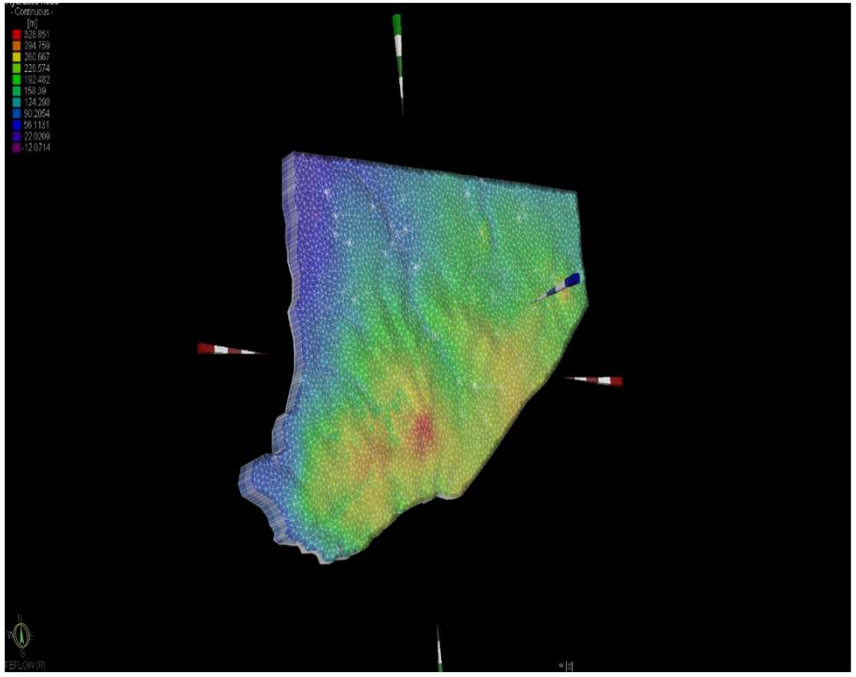


*for a **4850 m³/d** tunnel water inflow*

First hydrogeological approach for ET in the EMR … reminder

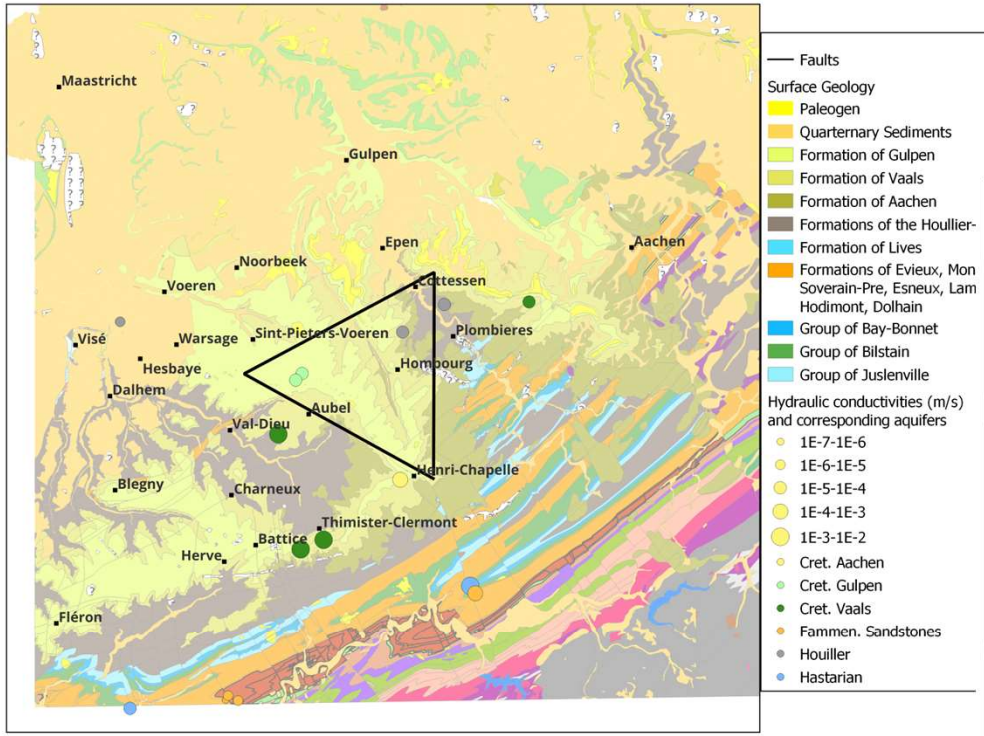
- **Regional numerical model adapted to predict regional impacts of ET infrastructures on regional groundwater resource**

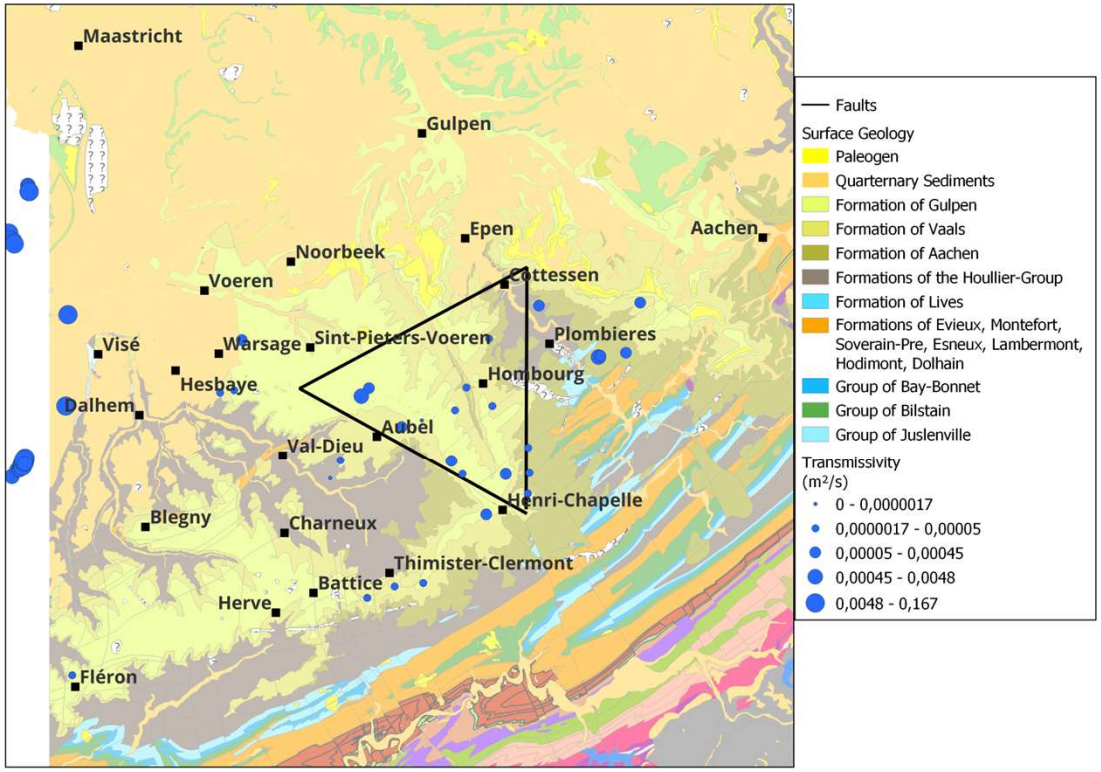
- **Hydraulic conductivities are key parameters and have to be determined locally near the future ET infrastructures**



Acquisition of hydraulic conductivity values

- Inventories of existing data

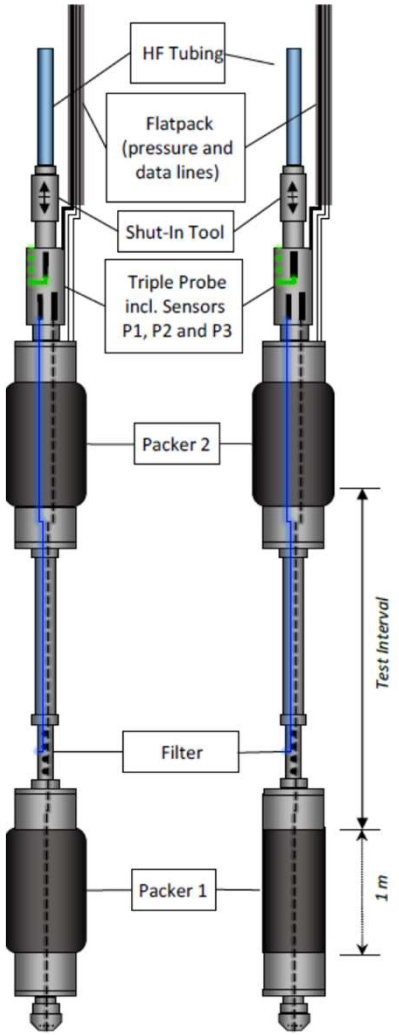




Acquisition of hydraulic conductivity values

- Hydraulic packer tests

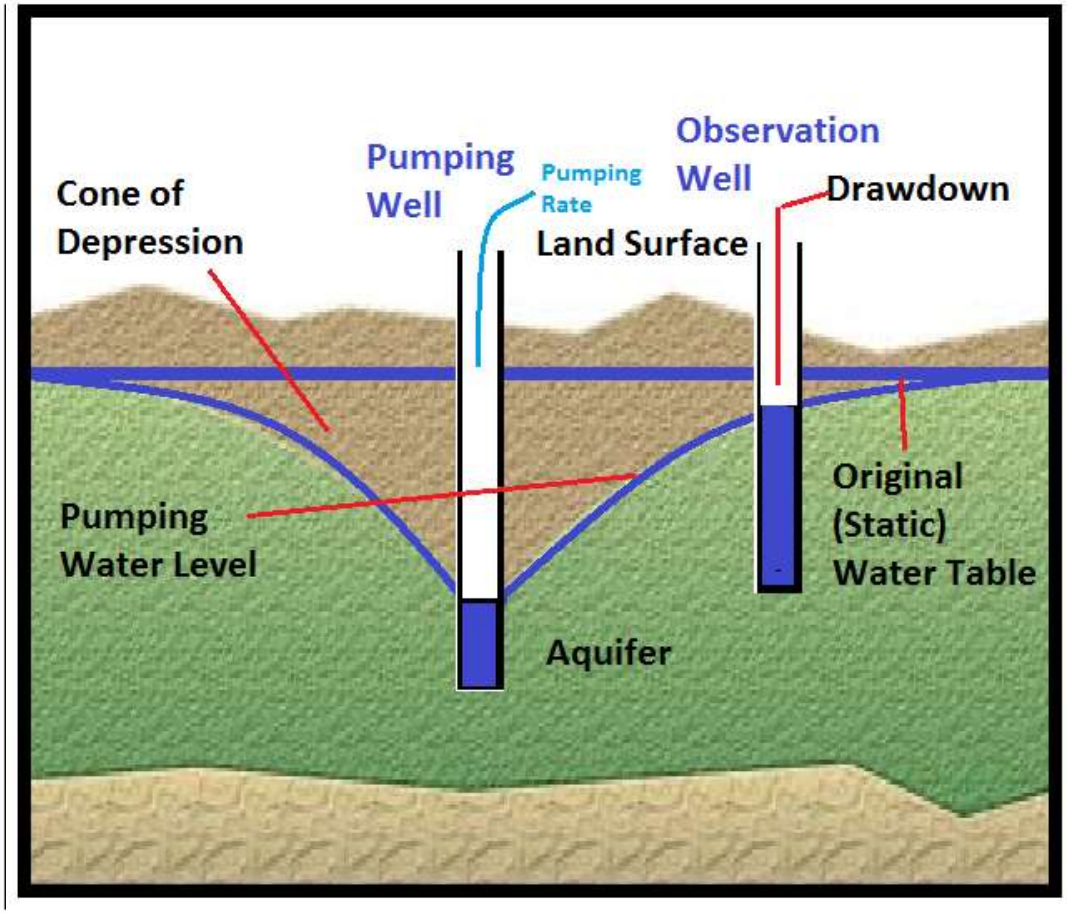
  - Carried out along the new boreholes
  - Testing of different parts of the borehole (faulted zones, fractured zones, intact zones, …)
  - Local estimations of the hydraulic conductivity values
  - Example: Aubel K : $[1\times10^{-5} – 1 \times 10^{-8}]$ m/s



Acquisition of hydraulic conductivity values

- Pumping tests

  - Allow the investigation of larger volume of underground (by comparison with packer tests)
  - Allow to characterize interactions between aquifers…
  - Interpretations give values of K, Storage coefficients

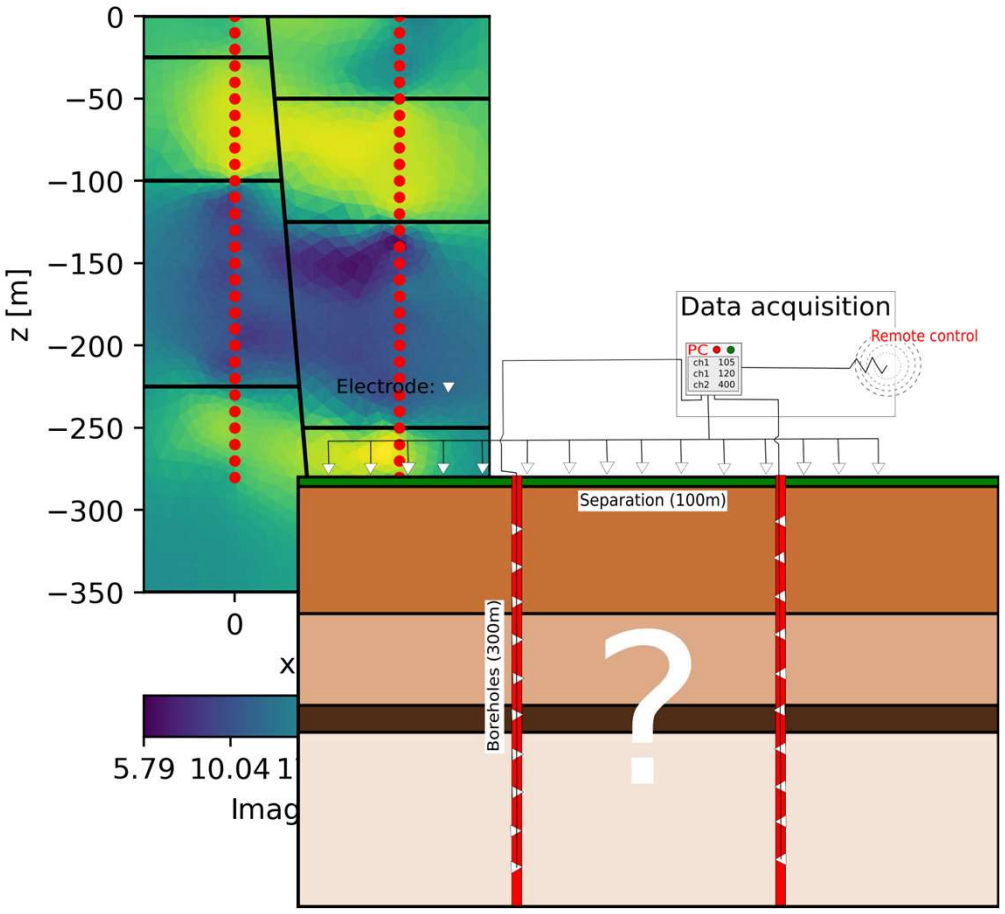


Allwell Drilling

Acquisition of hydraulic conductivity values

- Testing of the hydraulic behaviour of faults

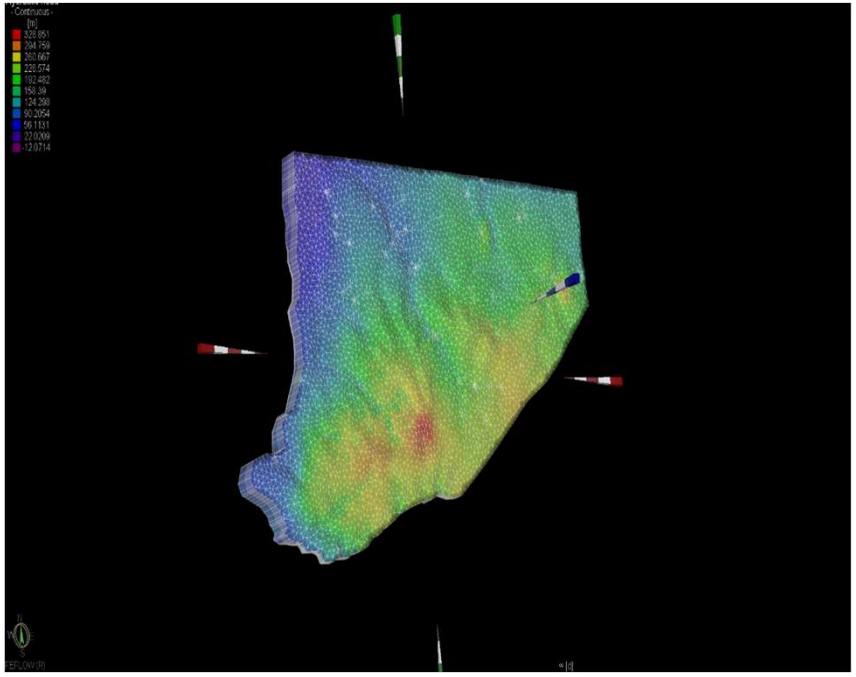
  - Detection of faults
  - Drilling of boreholes on each side of the fault
  - Characterization of the faults using pumping tests, tracer tests, geophysics…



Improvement of the regional model

- Use of this new data to improve the regional model

- sensitivity of model results to hydraulic conductivity values (inflows, regional impacts)



Development of local models

Taking into account :

- local geological features
- local values of hydraulic properties
- the detailed design of the infrastructures
- ….
- and results of the regional model, for example, for prescribing the boundary conditions and values