Expérimentations et suivis long terme sur la Zone Critique fracturée de Ploemeur

L. Longuevergne

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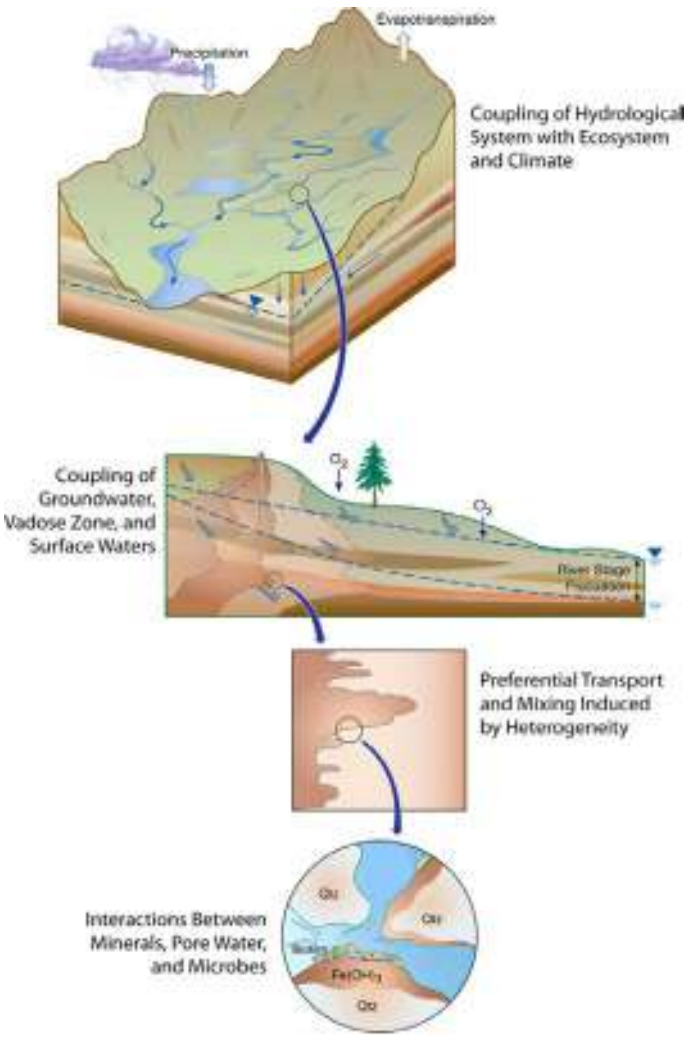
On the role of groundwater within the Critical Zone



Multiples challenges :

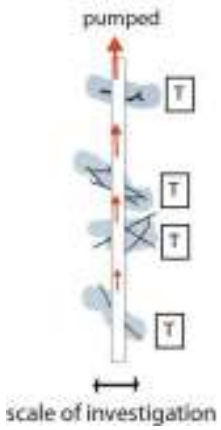
- Understanding local scale processes (flow, reactivity)
- Defining high spatial and temporal variability and its impact on flow, mixing, reactivity
- Defining relationships with other compartments (Unsaturated zone, River)

What we need

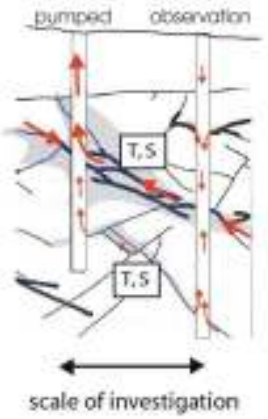
- Estimate relevant parameters
- Image relevant flow pathways

Relevant parameters at different scales

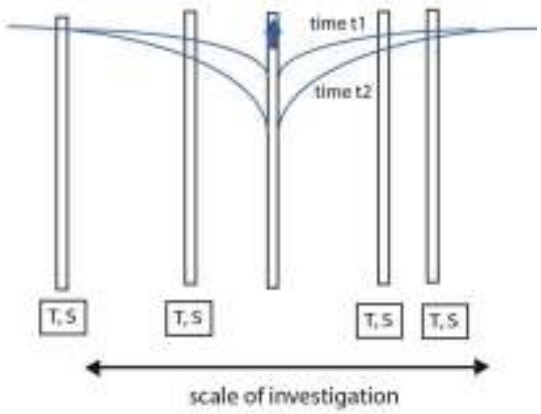
~ 1 m



~ 10 m

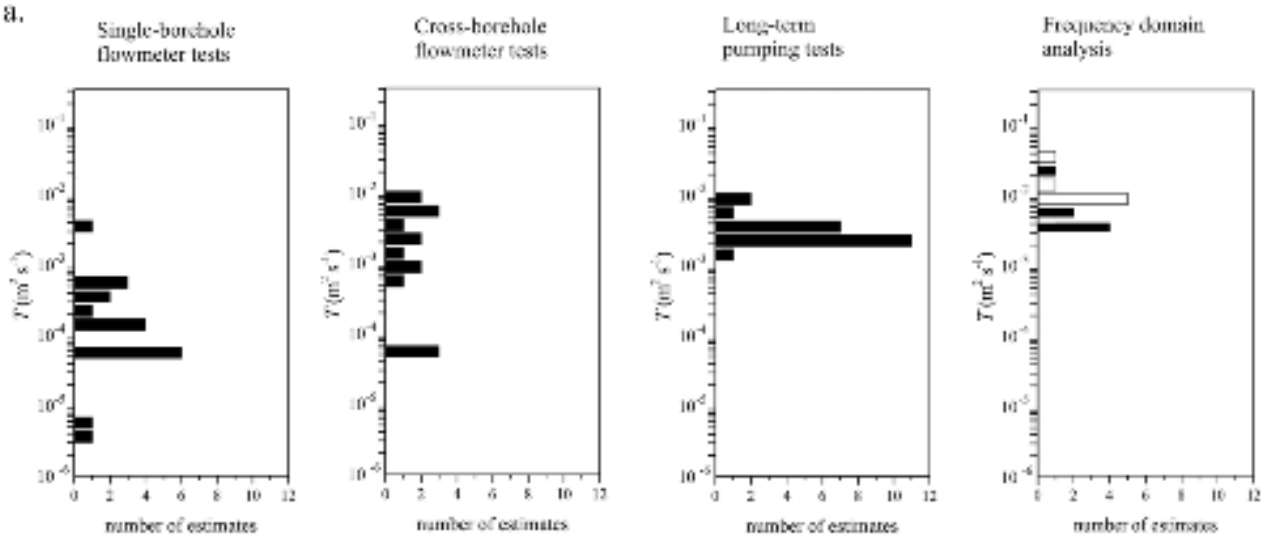


~ 1 km



~ 10 km

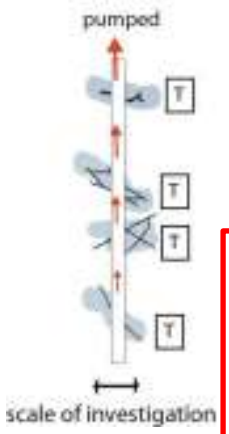
Transmissivity (m^2/s)

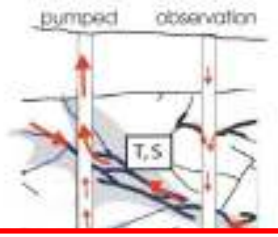


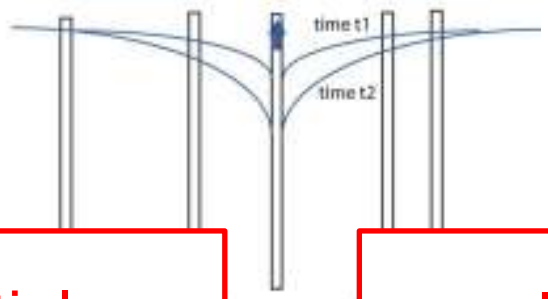
Jimenez-Martinez et al., WRR, 2013

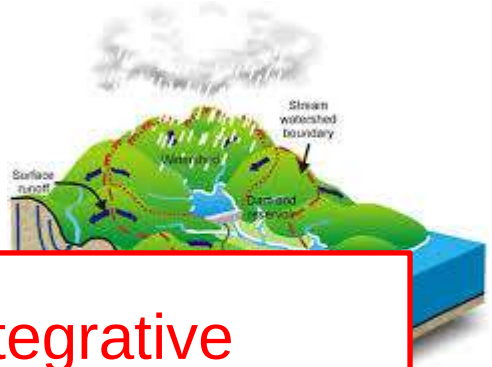
Relevant parameters at different scales

~ 1 m | ~ 10 m | ~ 1 km | ~ 10 km





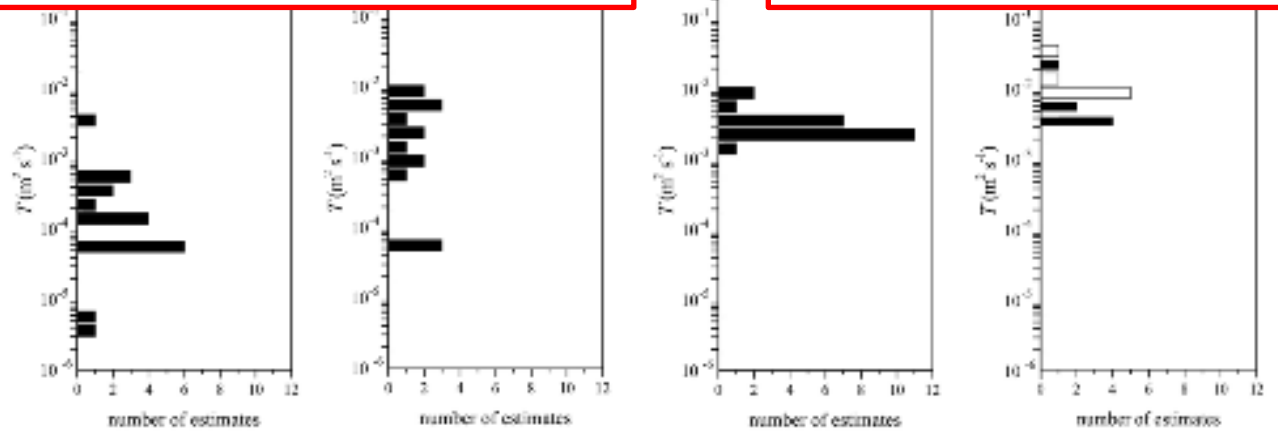




High Spatial frequency and water pathways

Integrative observations and internal processes

Transmissivity (m^2/s)



Jimenez-Martinez et al., WRR, 2013

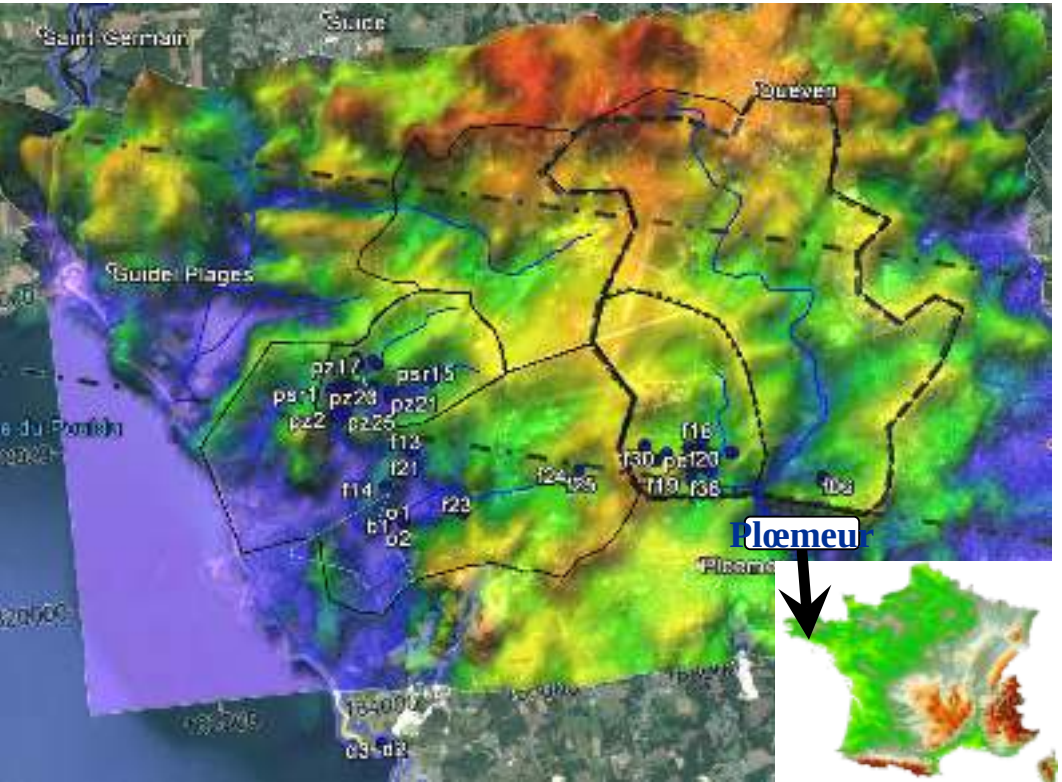
Ploemeur observatory: 3 sites

Natural system,
GDE, Natura 2000

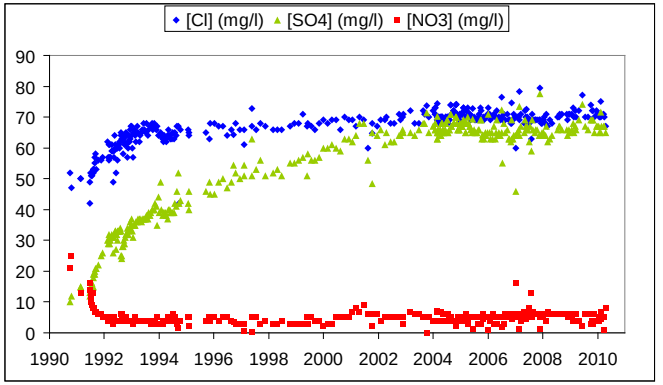
Pumped system
Since 1991

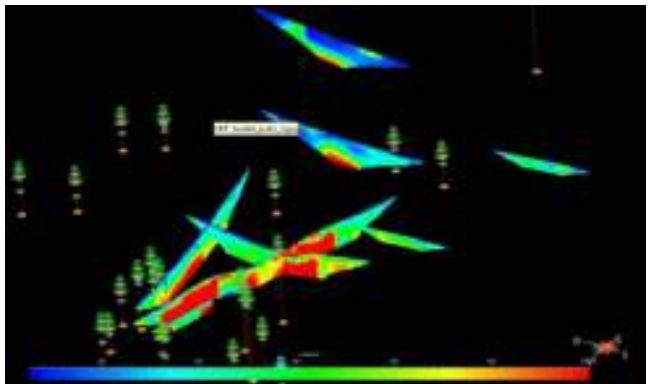
Experimental site

Facilities and infrastructures



Long-term monitoring & database



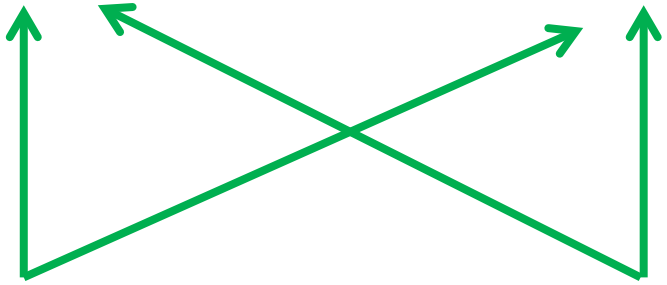


Setting up CRITEX tools on the Ploemeur site

Approaches

High Spatial frequency and water pathways

Integrative observations and internal processes



Tools

WP 3 Fiber optics
WP 6.1 Seismic methods

WP 2.2 Hydrogeodesy
WP 7.3 Reactive tracers
WP 8.1 Dissolved gases

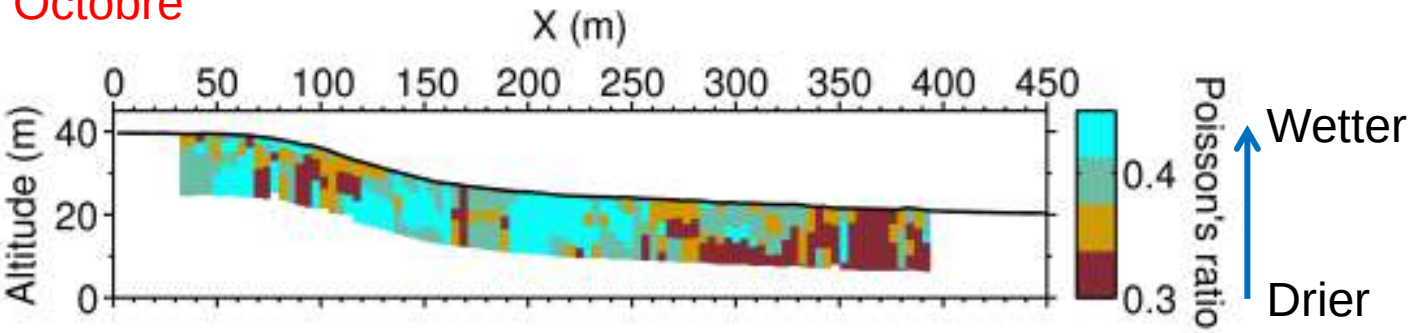
What are the information content of such observations ?

Sensing the rock response (HSF)

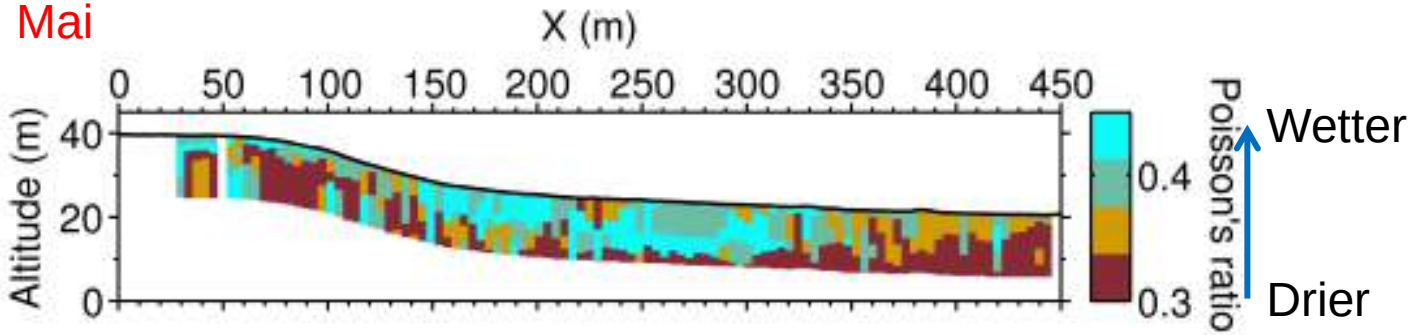
Seismic methods to capture infiltration spatial patterns

See Marine Dangeard's poster !

Octobre

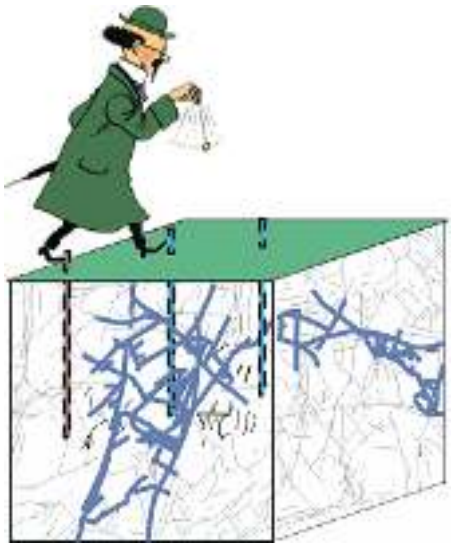


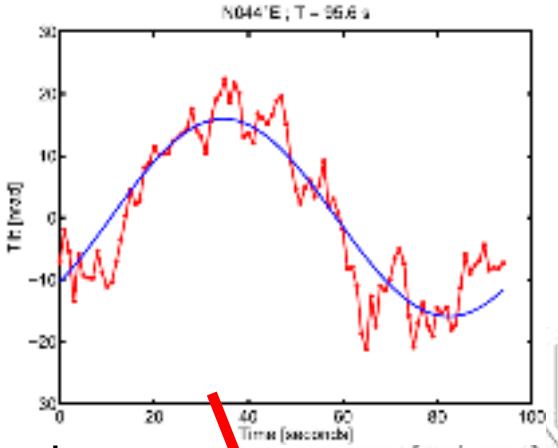
Mai



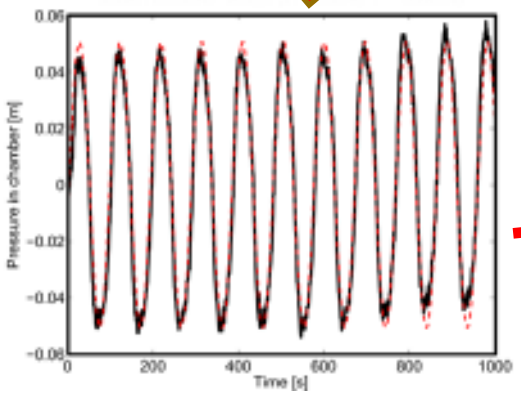
Sensing the rock response (IO)

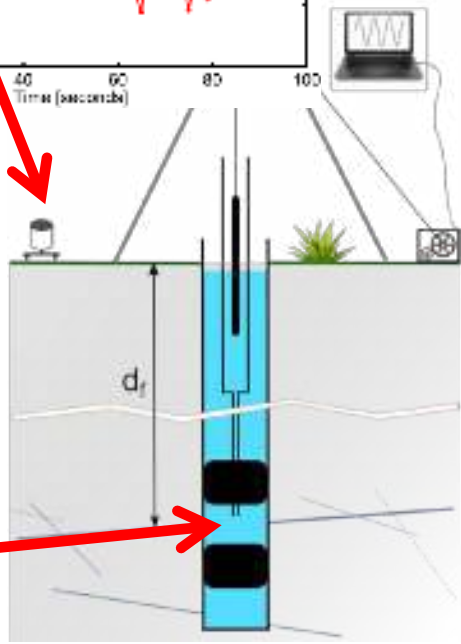
Deformation as a tool to highlight active structures





Hydromechanical properties

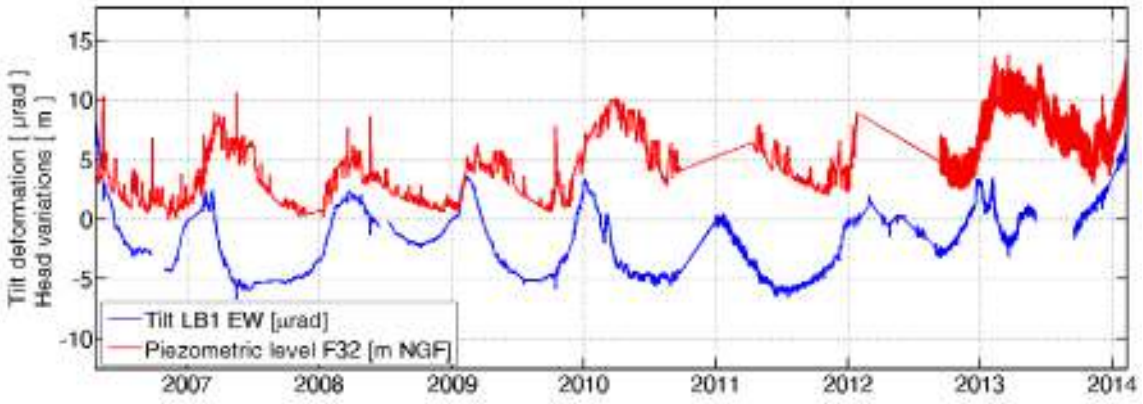




See Jonathan Schuite and Nicolas Lavenant posters!

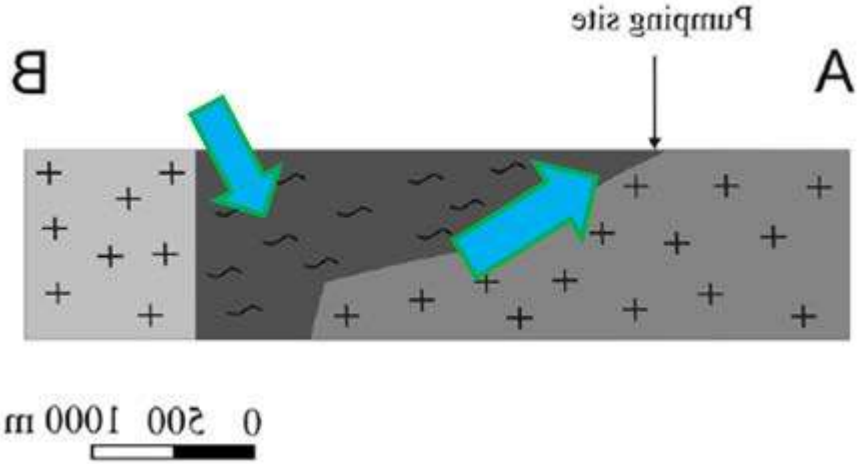
Sensing the rock response (IO)

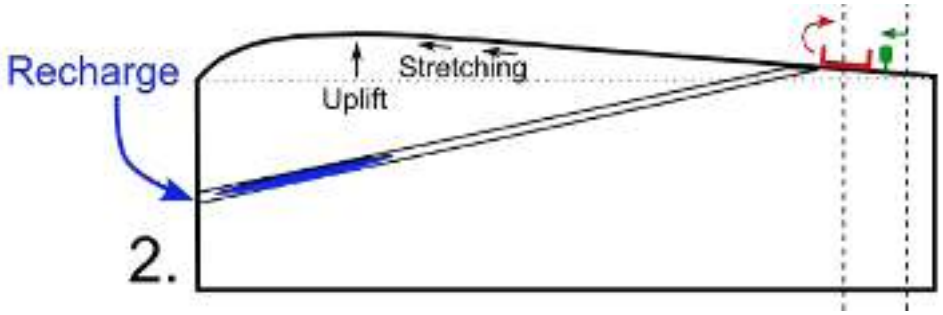
Deformation as a tool to monitor deep water transfers



GW head variations

Tilt deformation

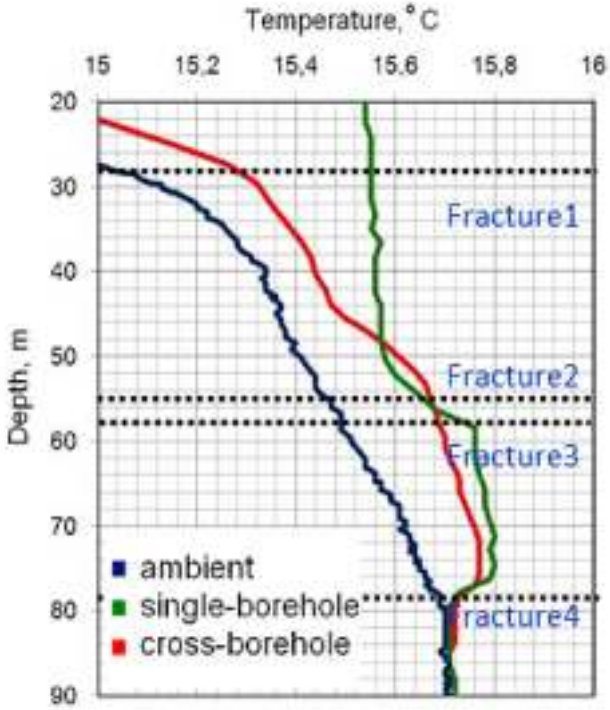




See Jonathan Schuite and Nicolas Lavenant posters!

Tracing methods - heat (HSF)

Temperature anomalies

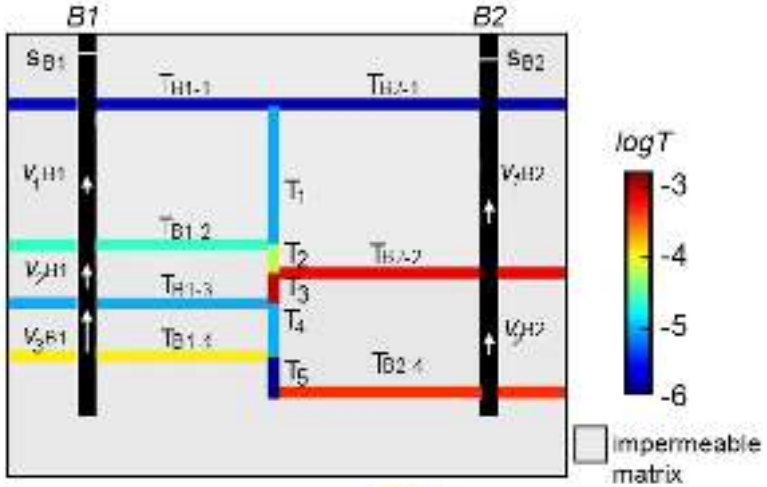


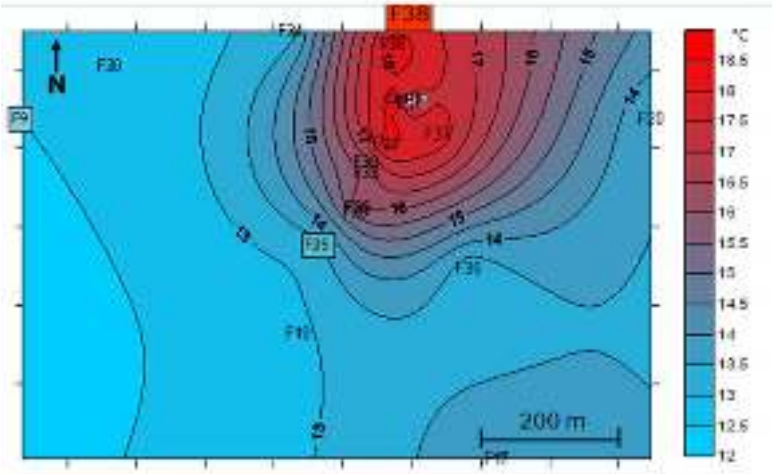
Flow profile inversion
Klepikova et al., JH 2011

Experimental

Monitoring

Flow tomography, *Klepikova et al., WRR 2013*



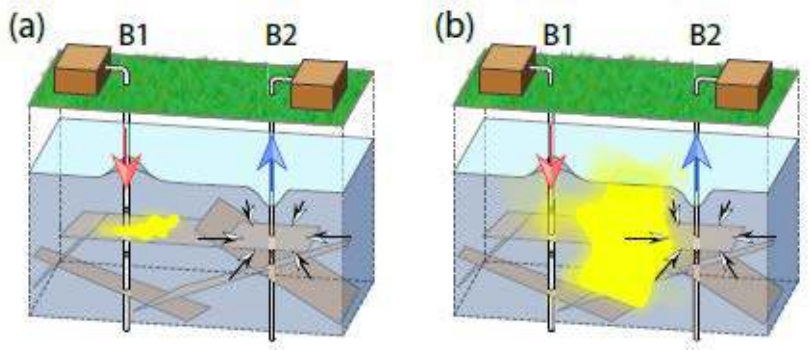


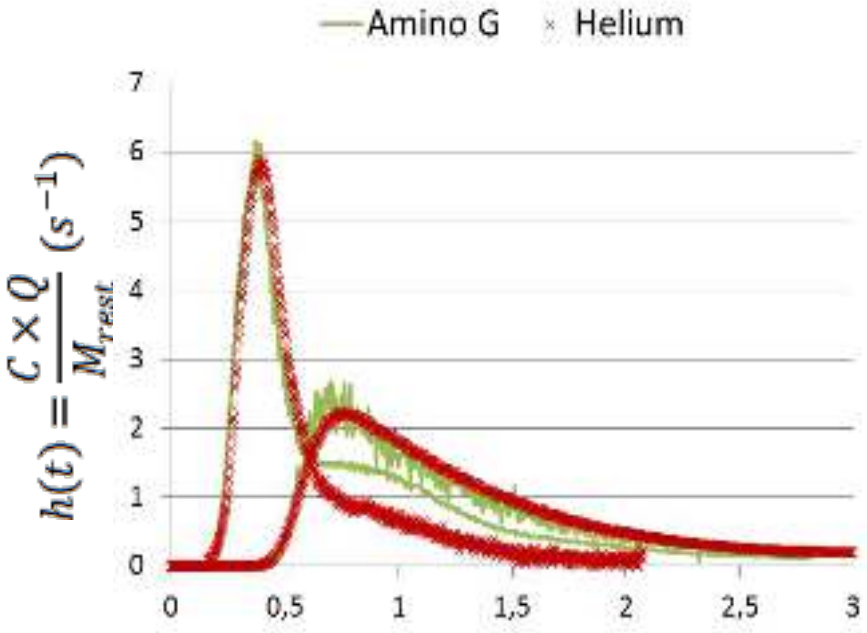
Groundwater temperature in a water supply site

See Nataline Simon's poster!

Tracing methods – conservative and reactive tracers (IO)

Dissolved gases (N20, CO2, He, …) and « smart tracers » to capture water flow path and reactivity

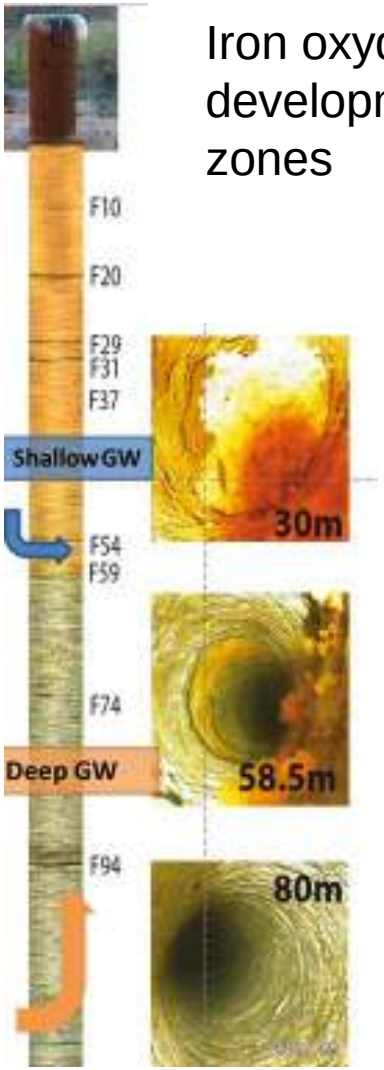




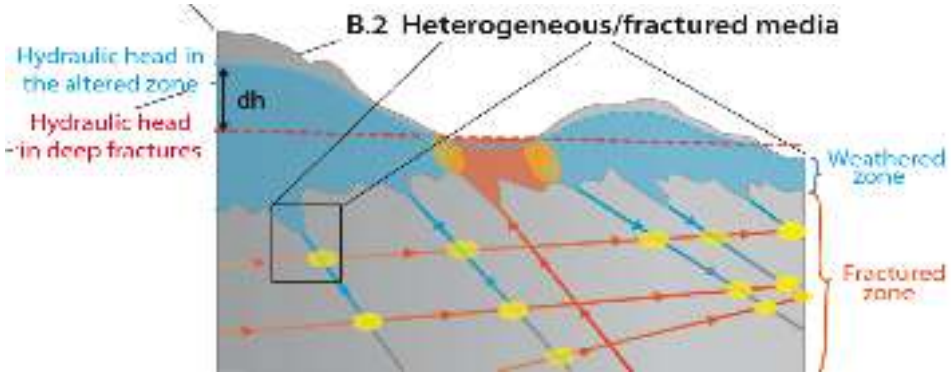
See Eliot Chatton's poster!

Reactive hotspots in the Critical Zone

Iron oxyde biofilm development at mixing zones

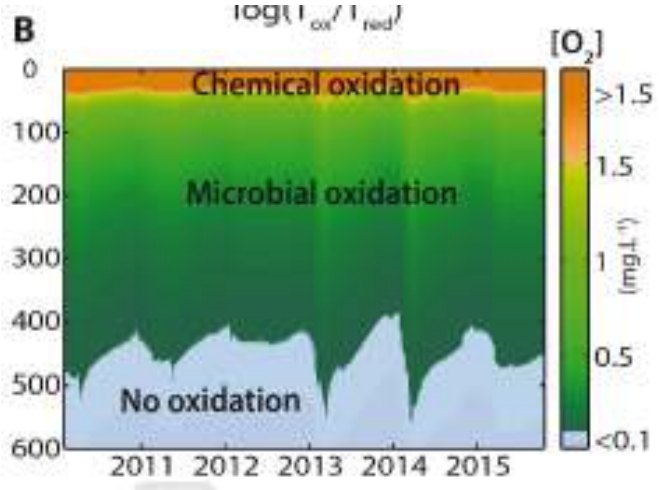


Fractures as short-circuits mixing different waters



Competition between biotic and abiotic oxydation

Potential reactive hotspot in the deep



See Tanguy Leborgne's poster!

Concluding remarks

- CRITEX makes available this new toolbox to characterize flow, transport and reactivity in heterogeneous reservoirs at different spatial and temporal scales
- Instrumental setup is surely as important as the instruments themselves
- In most cases, both experiments and monitoring are required to cover the different time and spatial scales

Key issue :

- What is the information content of such observation to improve system modeling ?

See Luca Guillaumot and Charlotte Le Traon's poster

The next step: Guidel Long-term experiment

Starting pumping in a natural system: a large-scale physical destabilization

An opportunity to work on the trajectory of complex systems under non-stationnary constrains