



## Modeling contaminant transport in limestone aquifers

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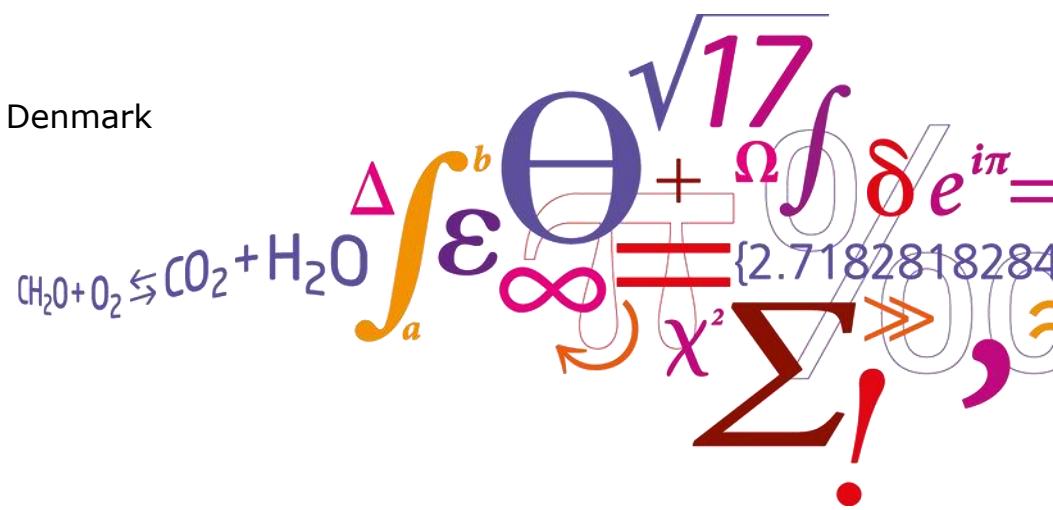
# Modeling contaminant transport in limestone aquifers

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and **Philip J. Binning<sup>1</sup>**

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2 – The Capital Region of Denmark

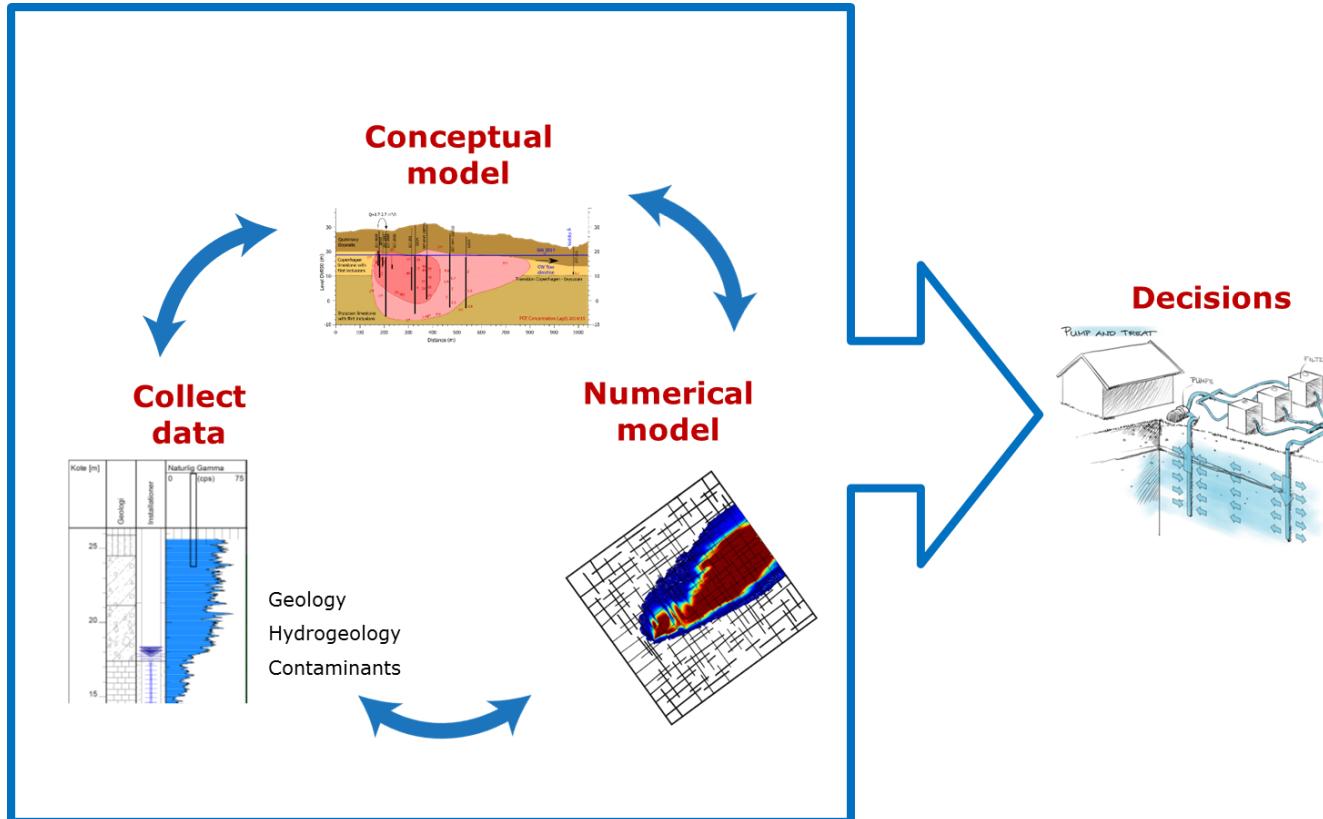
3 - GEO

$$\text{CH}_2\text{O} + \text{O}_2 \rightleftharpoons \text{CO}_2 + \text{H}_2\text{O}$$


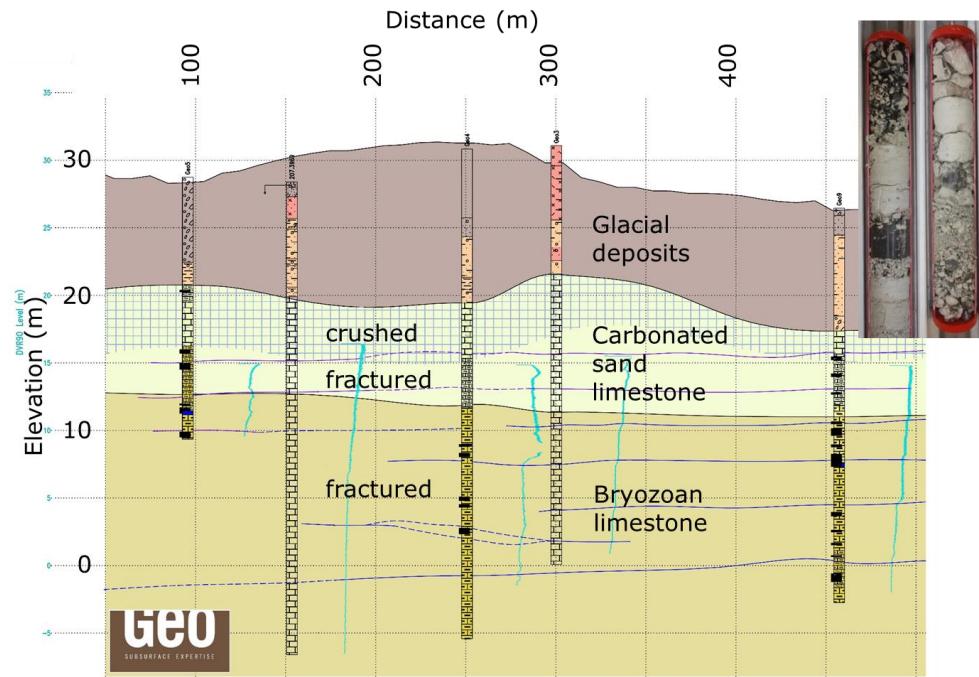
# Objectives

Modeling of contaminant plume migration in fractured limestone

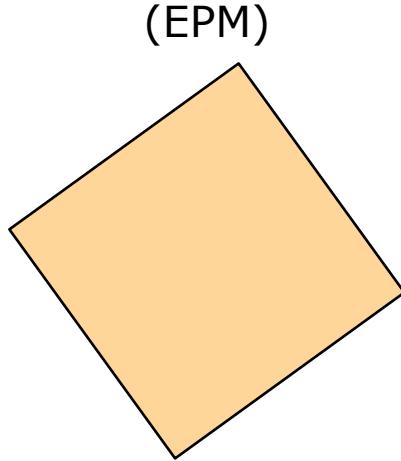
→ **Improved risk assessment, site monitoring and remediation design**



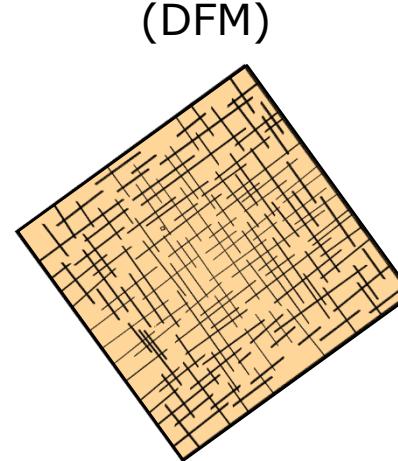
# Site Assessment Geology



Equivalent Porous Media

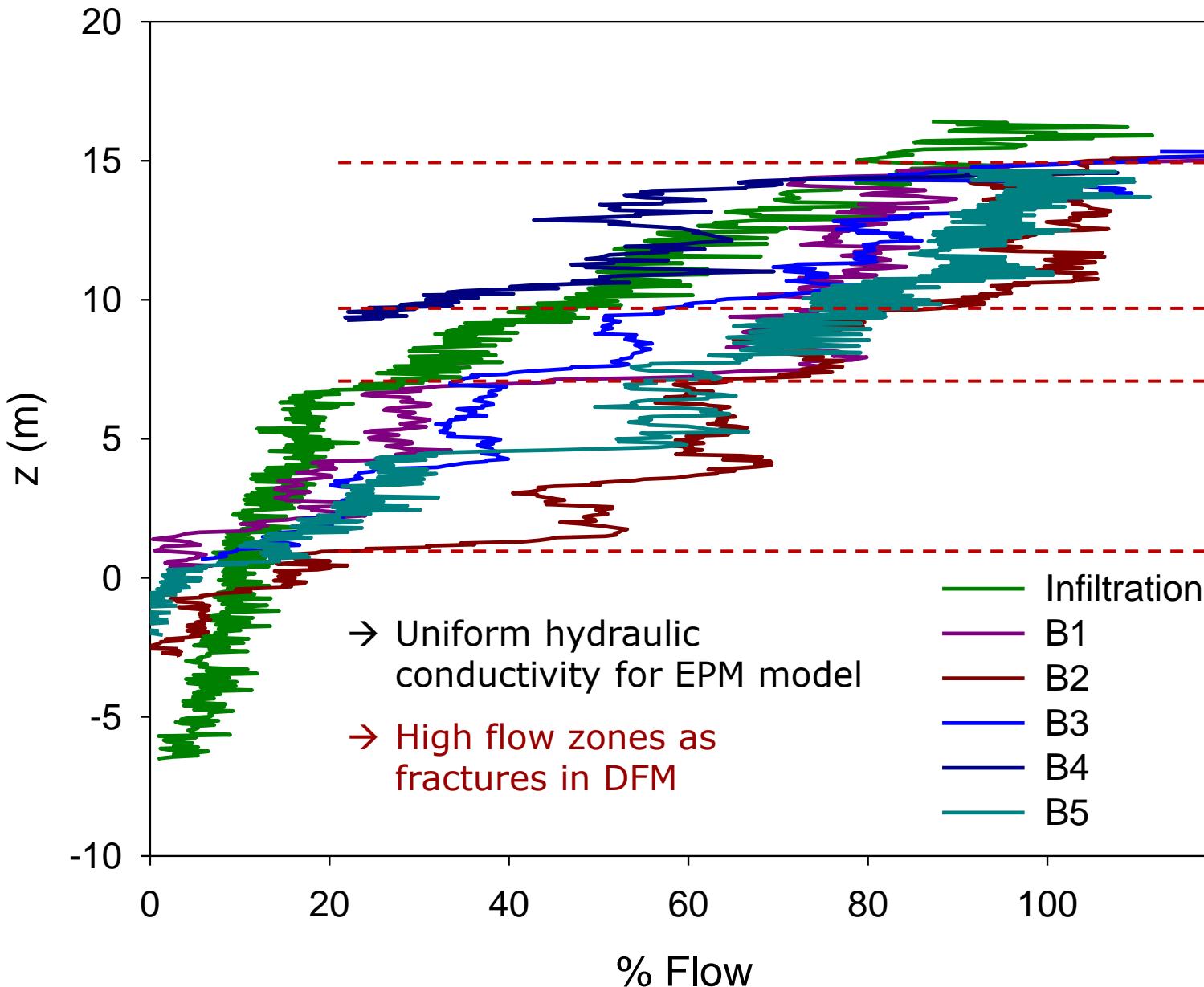


Discrete Fracture Model

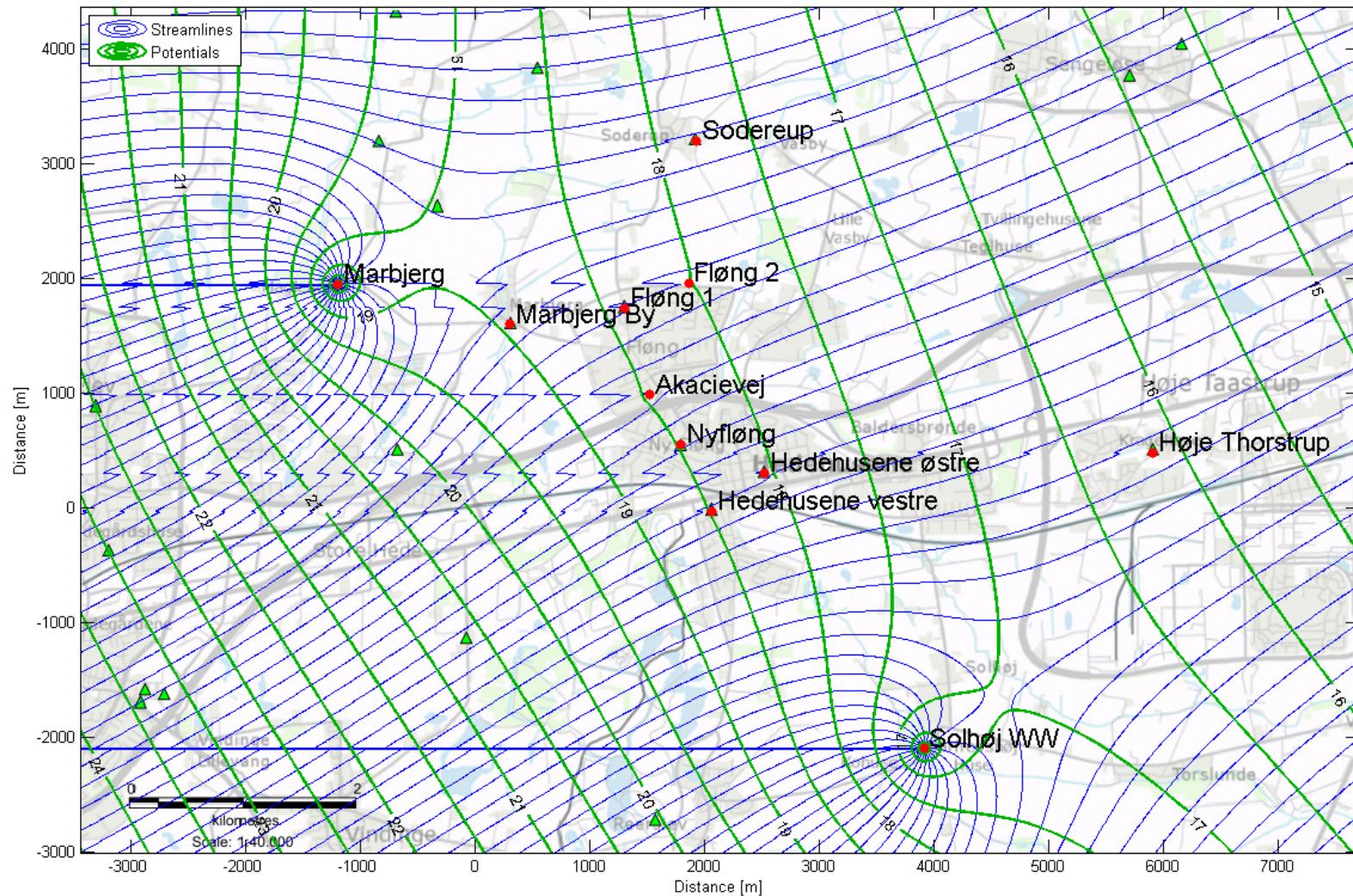


**Which model is right?**

# Flow log data – high conductive zones

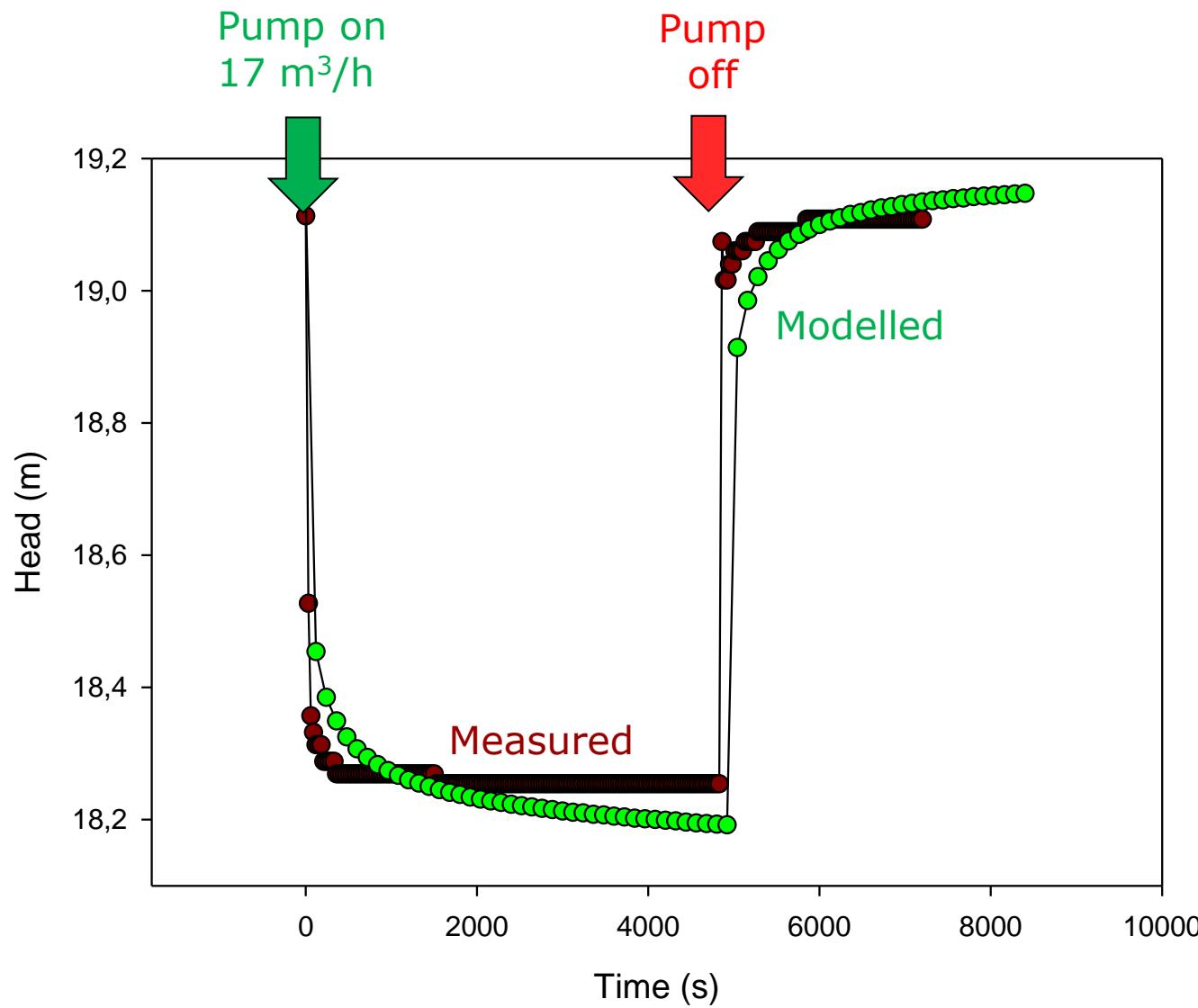


# Site Assessment - Hydrogeology



**Matlab model** after Göltz et al.

# Site Assessment - hydrogeology

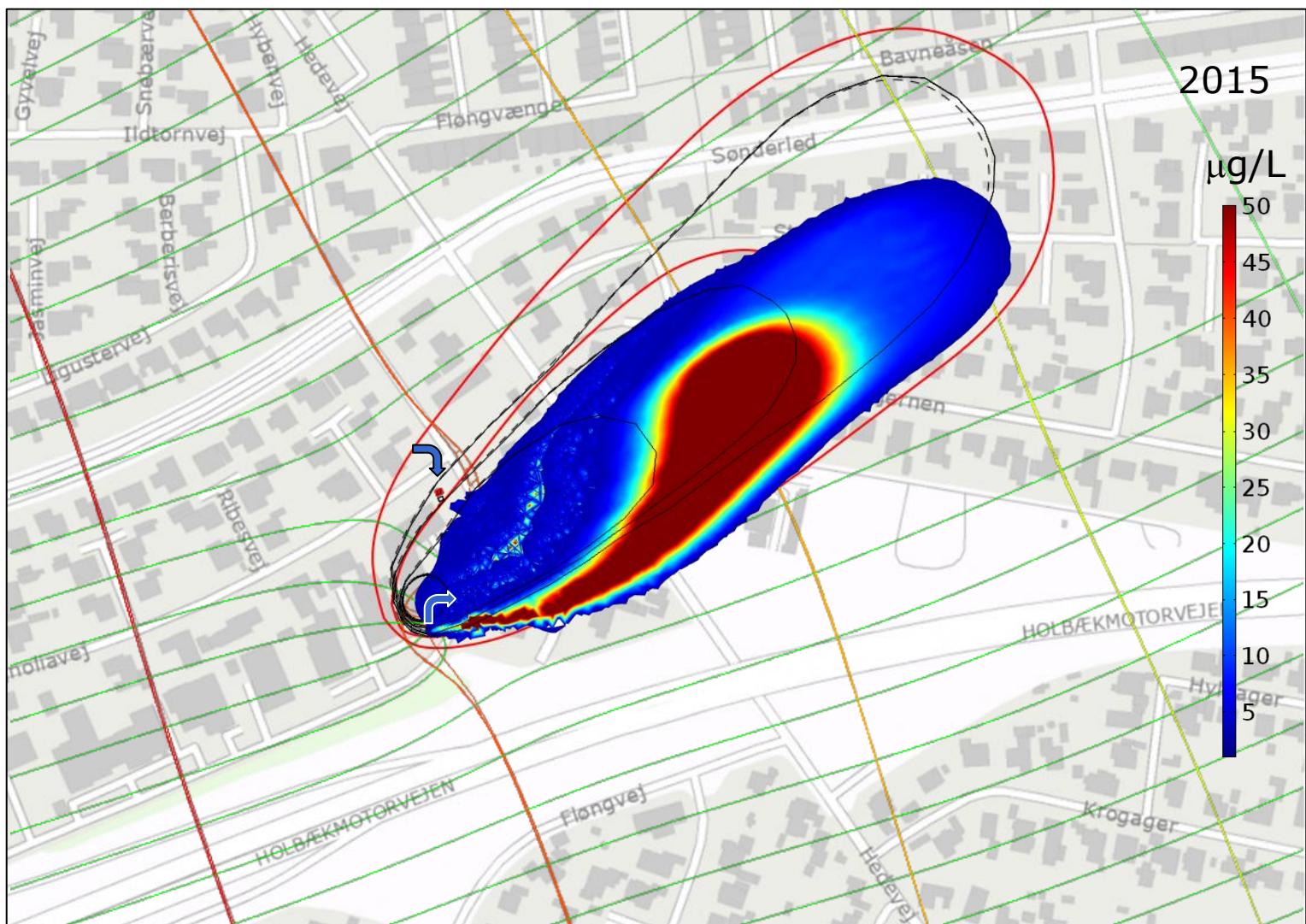
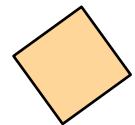


Smart pump tests – (almost) zero cost!

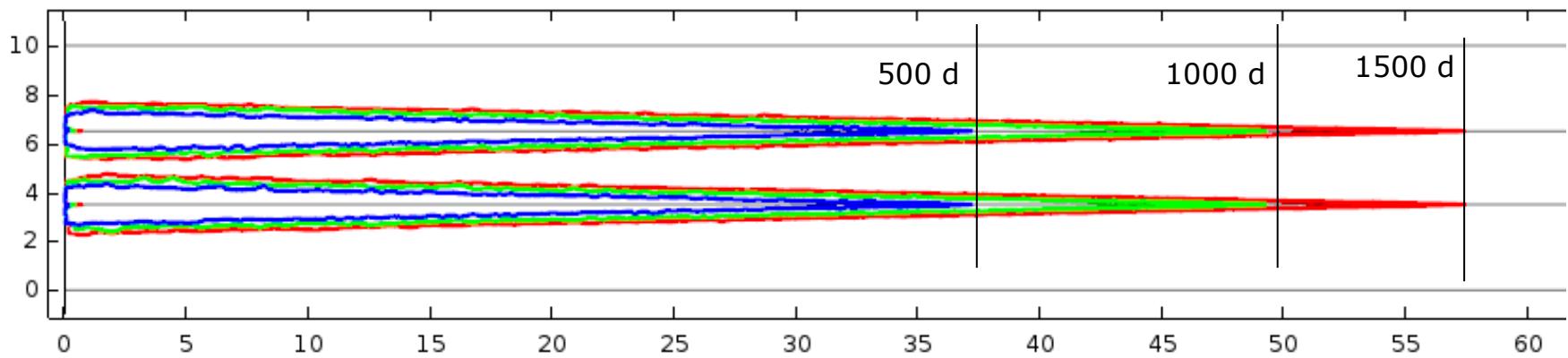
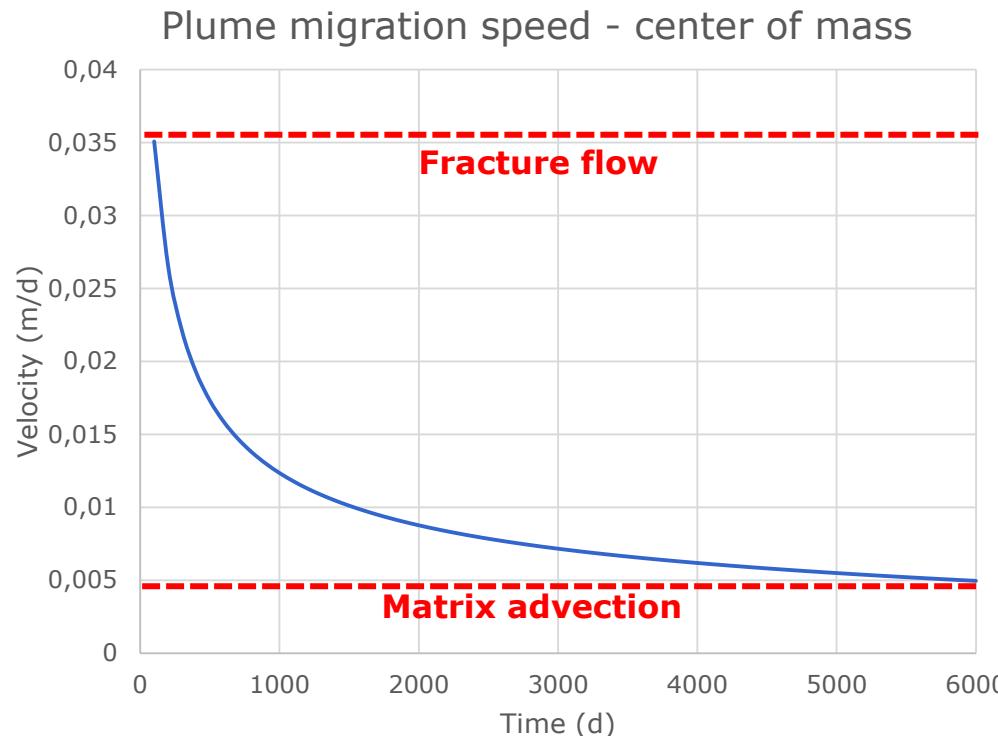
# Site Assessment – contaminant distribution

Modeled plume propagation 2007-2015

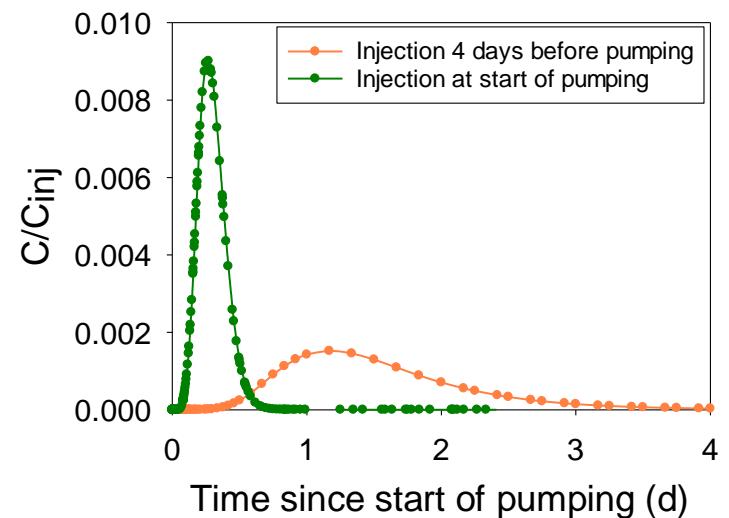
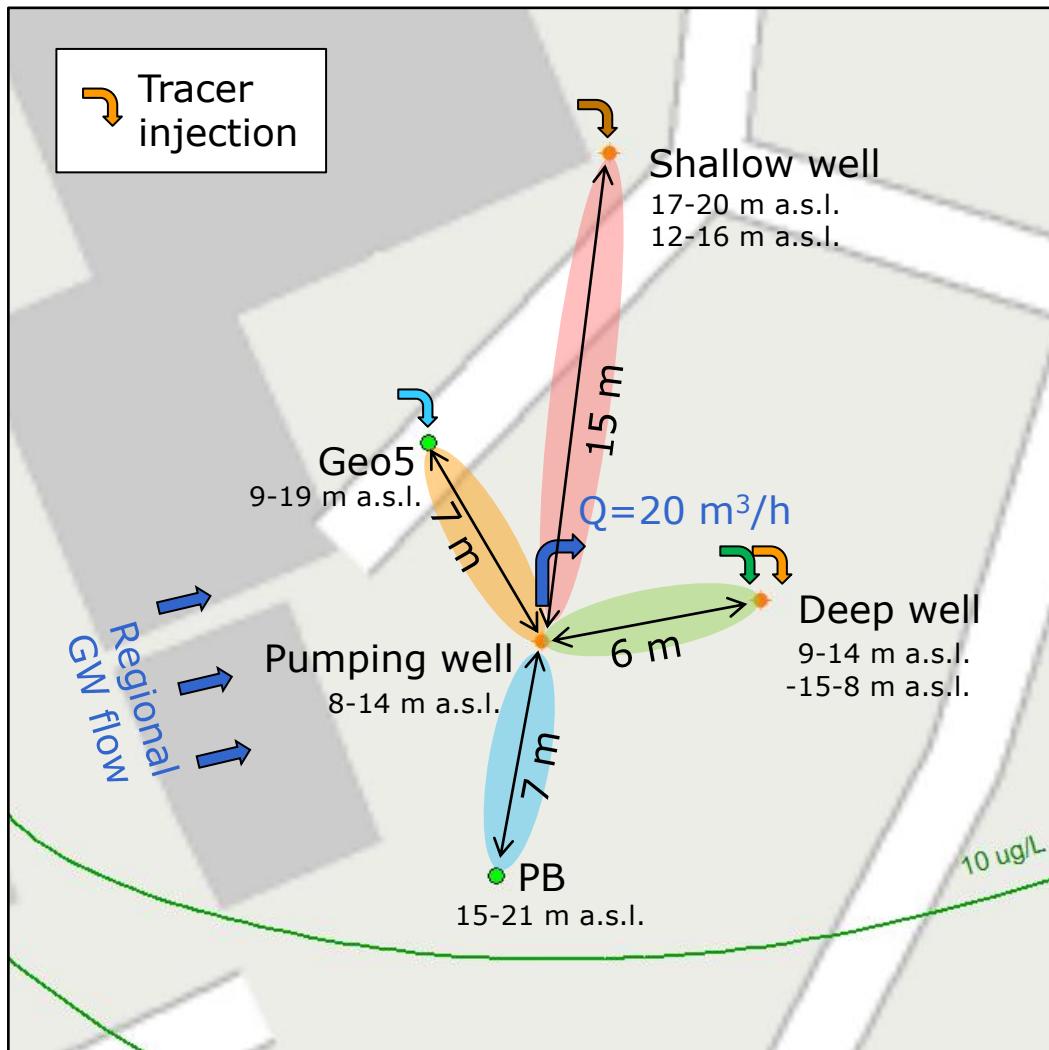
(equivalent porous medium model)



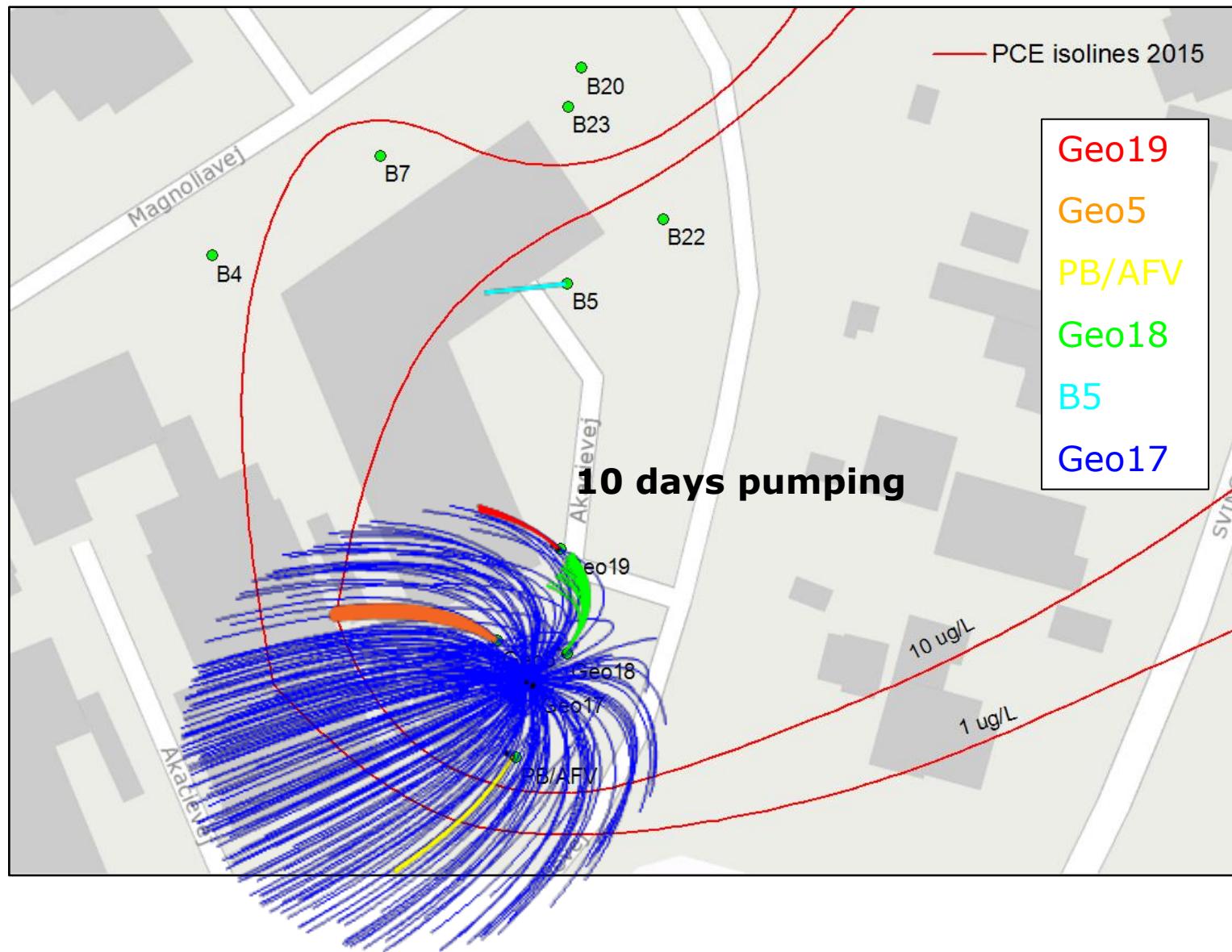
# Site assessment - Contaminant distribution



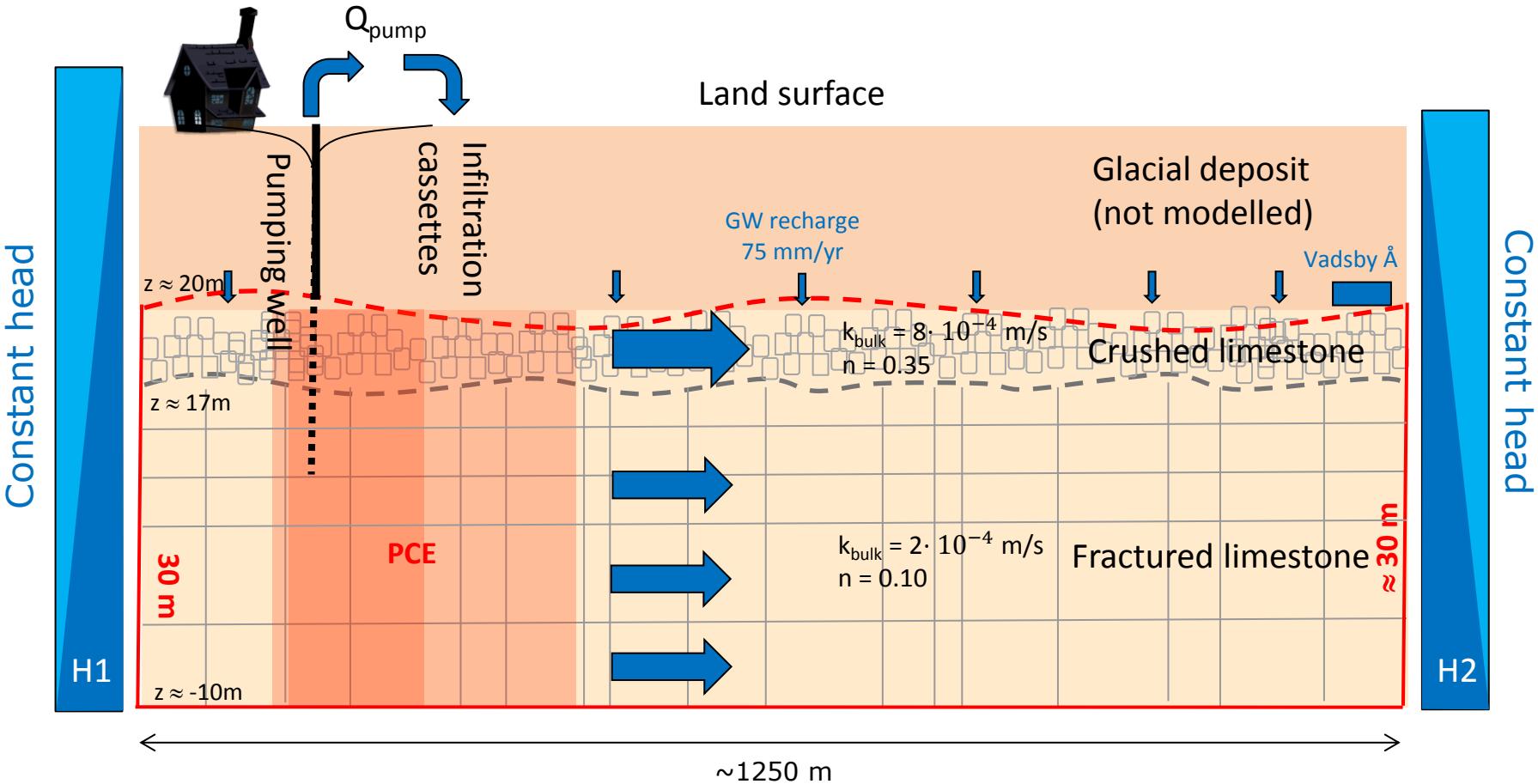
# Site Assessment: field work planning



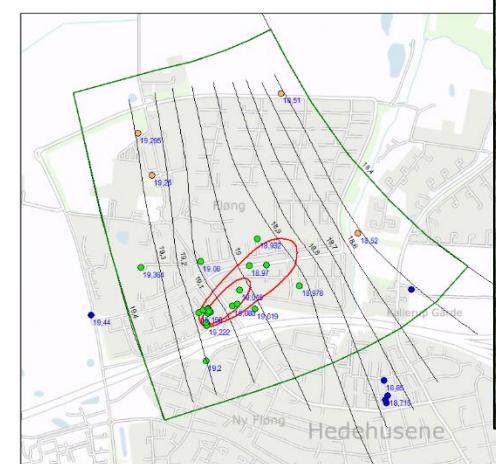
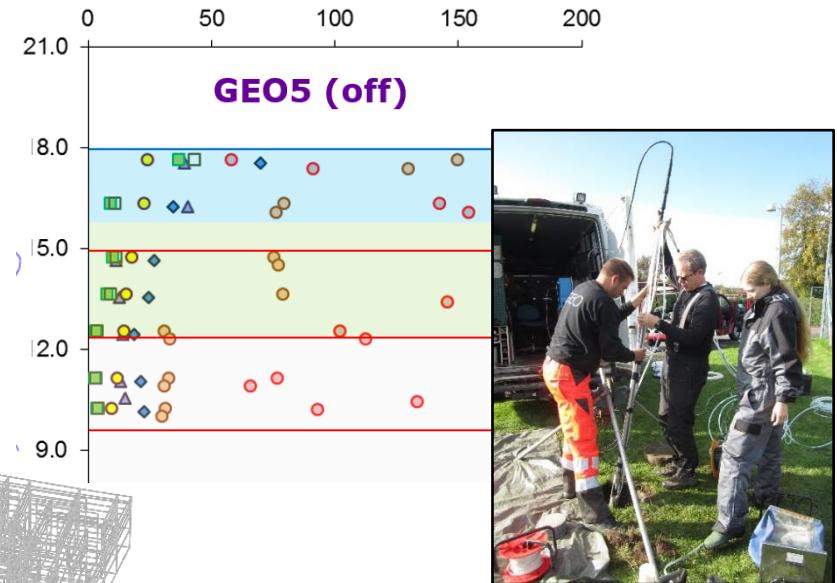
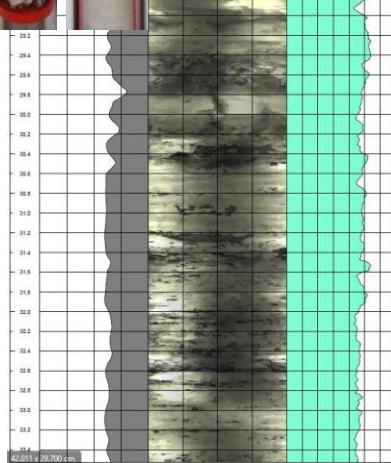
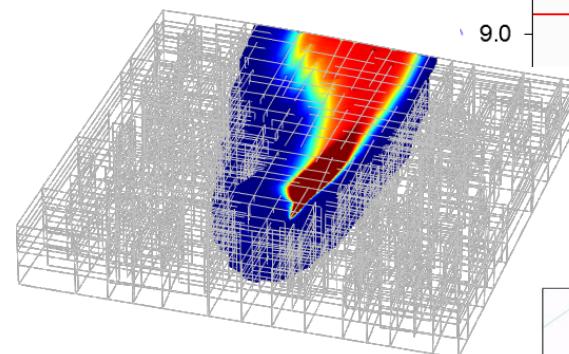
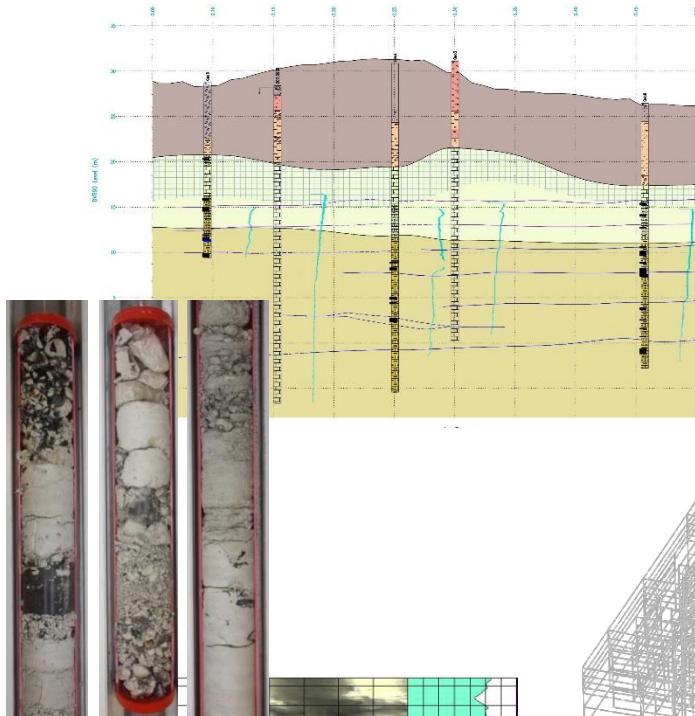
# Site assessment – field work planning



# Conceptual model development

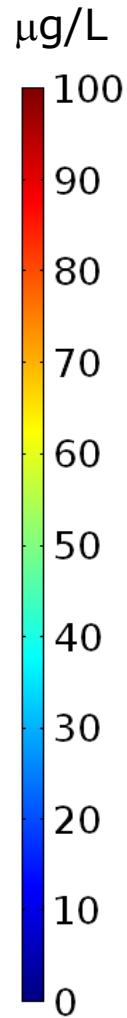
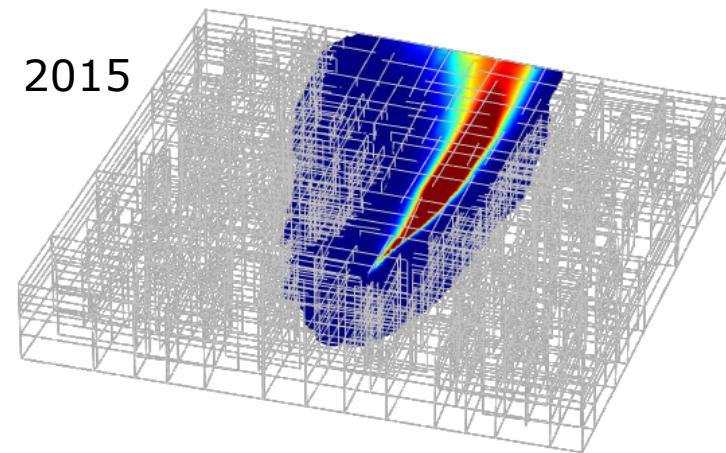
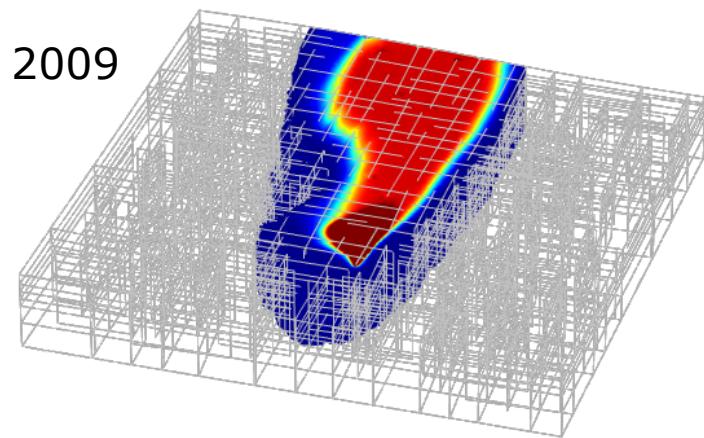
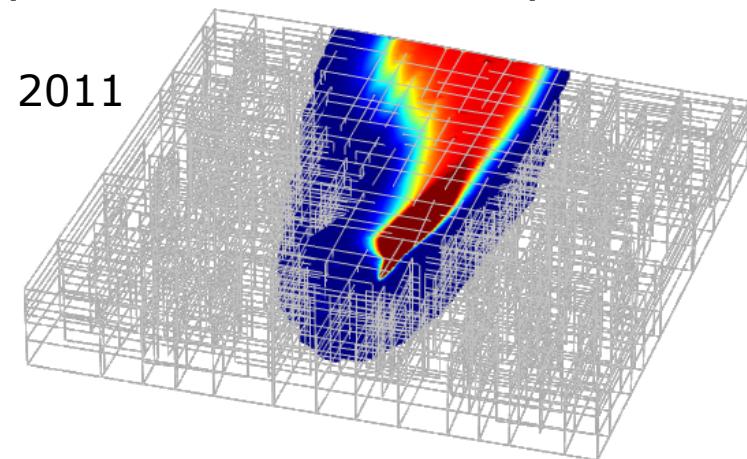
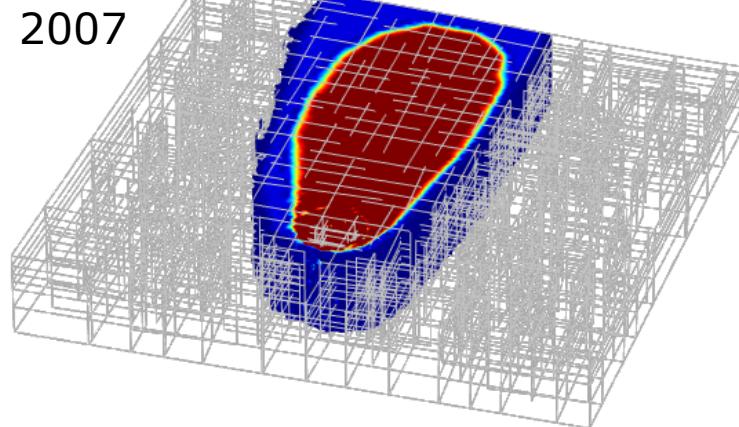


# Conceptual model development



# Models

Simulated plume migration 2007-2015 (Discrete-fracture model)



$$\frac{k_{\text{matrix}}}{k_{\text{fractures}}} = 1/4000$$

# Models

None

Medium

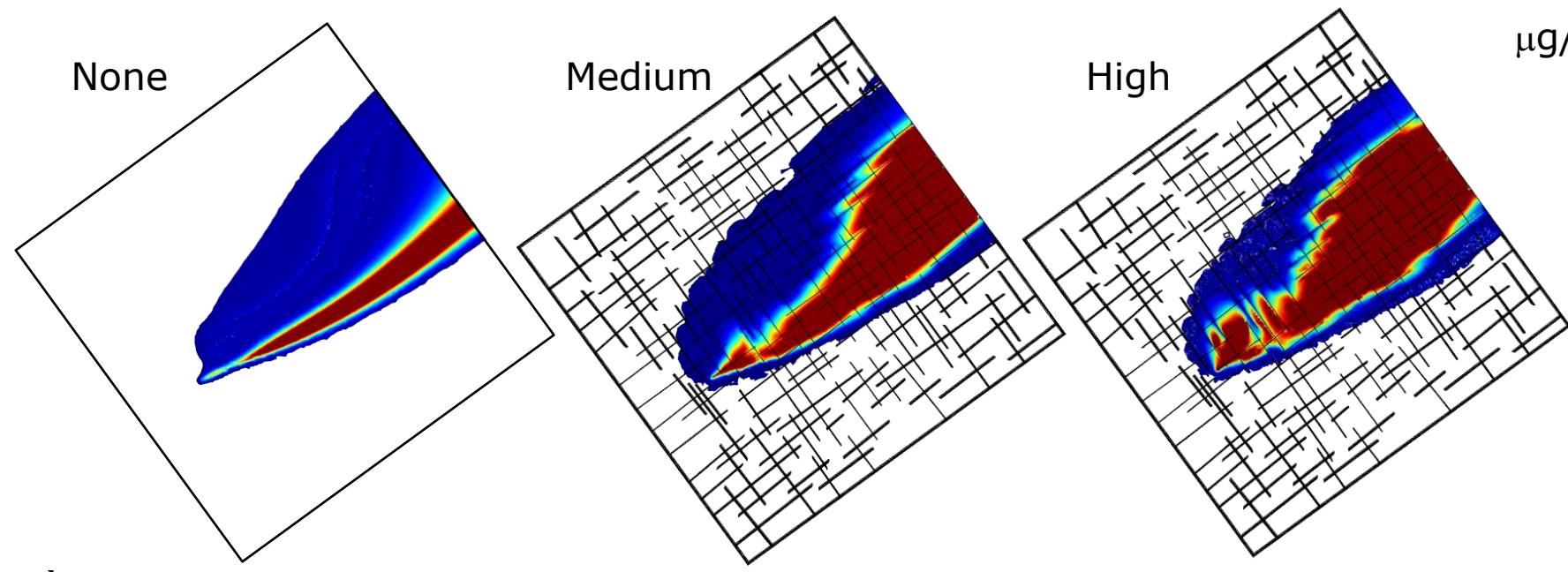
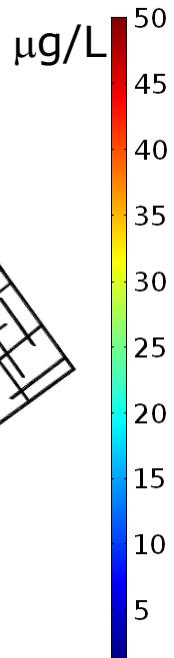
High

$$\frac{k_{\text{matrix}}}{k_{\text{fractures}}}$$

1:1

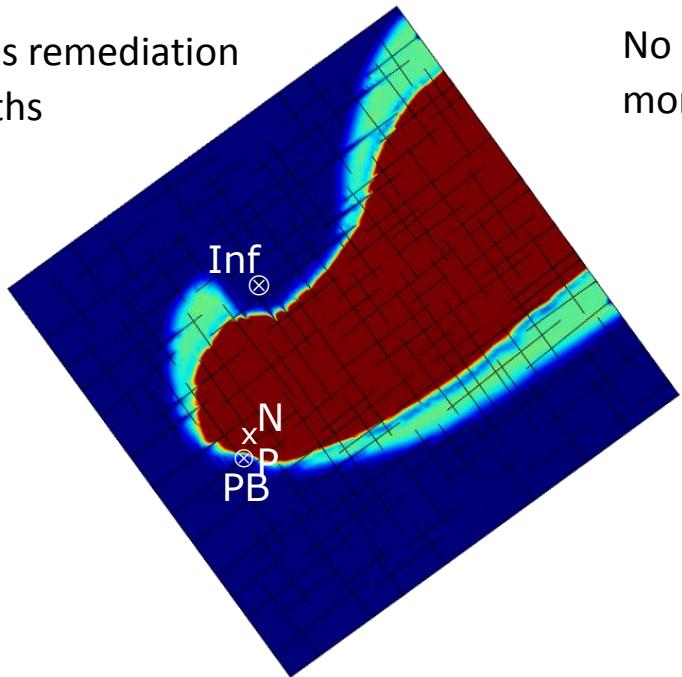
1:12000

1:15000

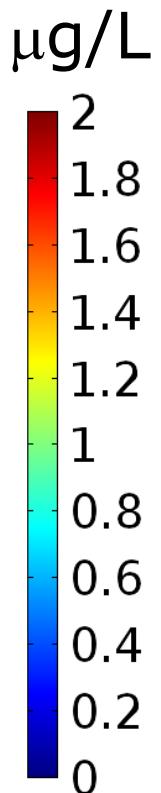
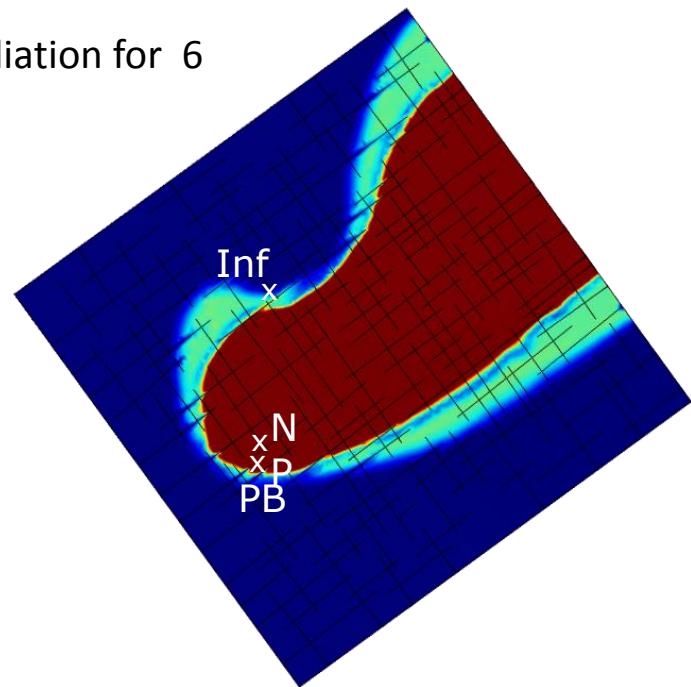


# Decisions

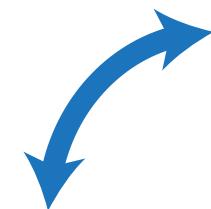
Continuous remediation  
for 6 months



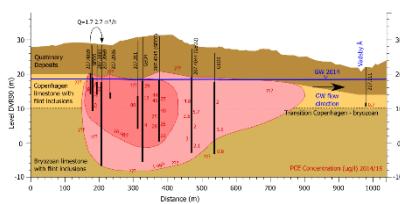
No remediation for 6  
months



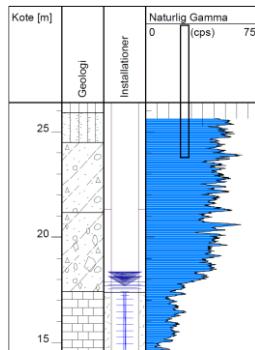
# Improved site investigation



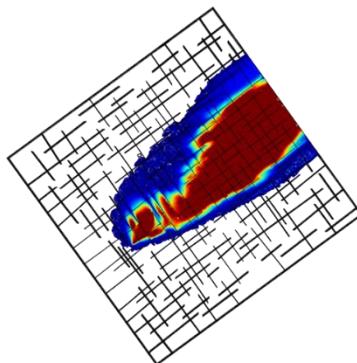
## Conceptual model



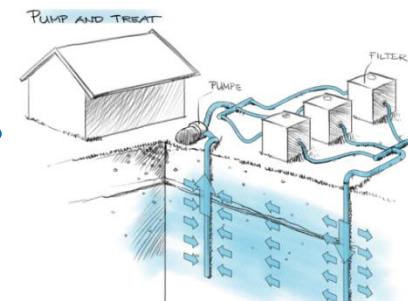
## Collect data

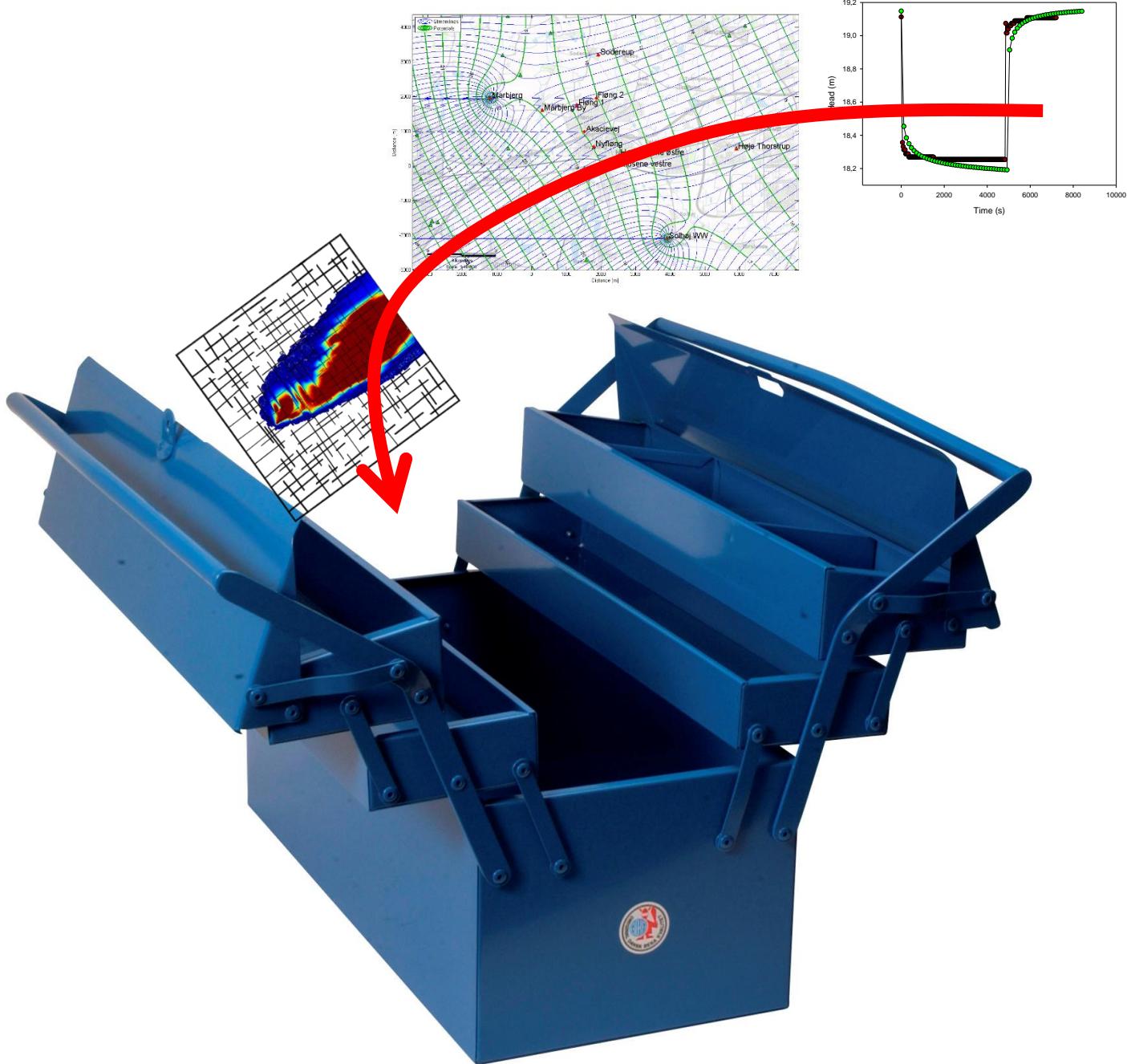


## Numerical model



## Decisions





# Acknowledgements



The Capital Region  
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