Forward Modelling of Electrical Resistivity Tomography Monitoring Salt Tracer Tests (Master Thesis)

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Introduction

We need a computationally **fast** forward model for...

- groundwater **flow**
- solute **transport**
- electrical resistivity tomography (**ERT**)

Desired output: mean times of electrical potential change due to salt tracer movement.

Methods

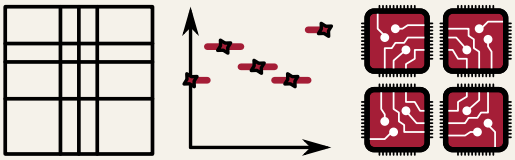
Use **DUNE** as a modelling framework. Characteristics:

- PDE libraries in **C++**
- **parallelization** possible (domain decomposition)
- very **flexible** (grid, solver, forward method, ...)

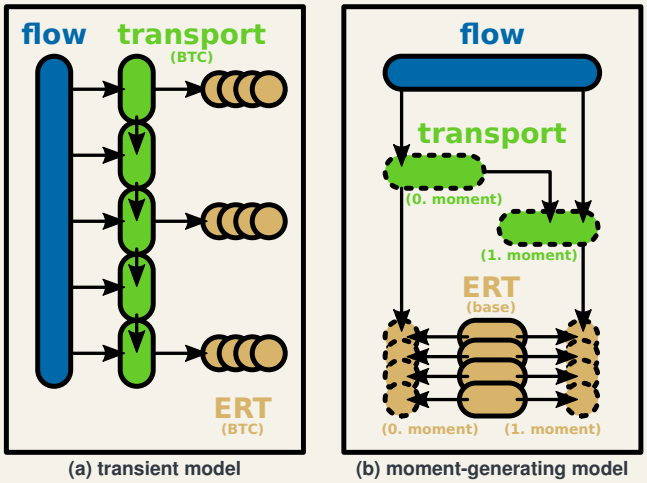
Two implementations:

- fully **transient** model ↔ implicit PDE solution
- **moment-generating** model ↔ stationary PDEs

Both share FVM on 3D rectilinear non-equidistant grid with approximately two million cells.



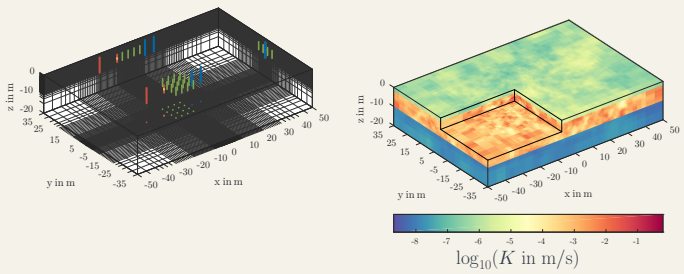
The models differ substantially in their internal design.



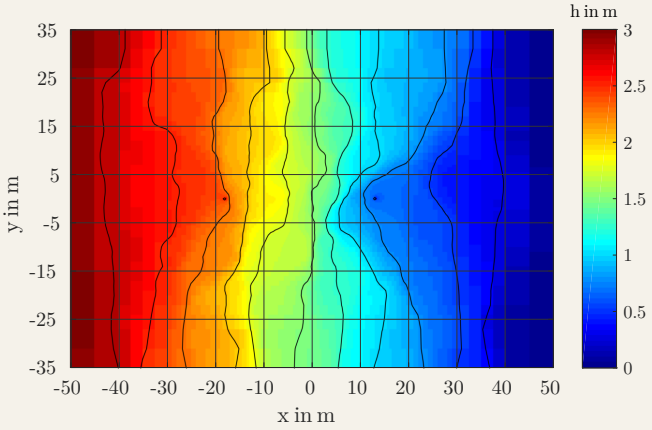
(a) transient model (b) moment-generating model

Simulations based on the **Lauswiesen** site (Neckar valley):

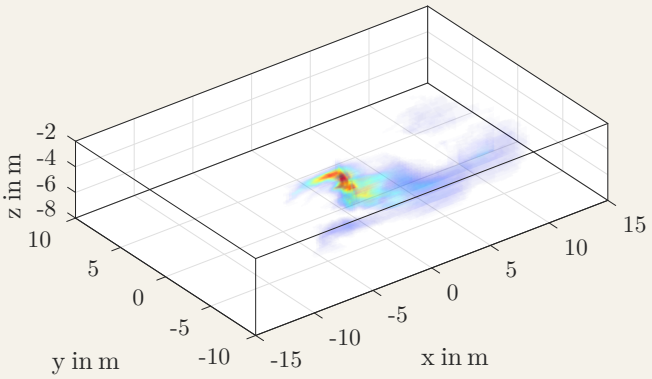
- groundwater injection wells
- groundwater and tracer injection well screen
- groundwater extraction wells
- electrodes
- layered random **hydraulic conductivity** field K



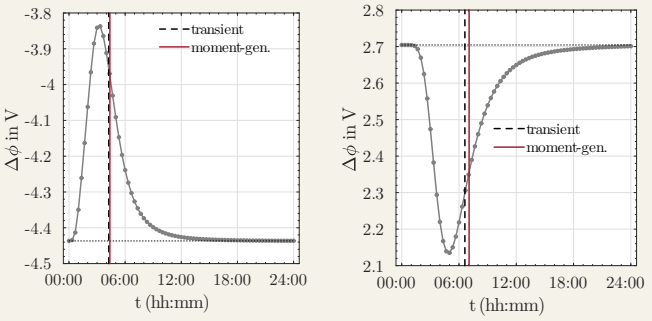
Results



flow field
(hydraulic head h)



transport
(tracer plume development)



ERT
(mean arrival times)

Conclusion

✓ transient and moment-generating models produce **consistent** results
✓ results compare well to a FEM Matlab model
✗ desired speed-up was not achieved for small models...
✓ ...but using **many processors** is simple now

Outlook

This model is going to be used for a **fully coupled inversion** of data from a ERT monitored salt tracer test to obtain the K field.

← Check out the **DUNE** code, the **pdf** of the thesis or a miniature version of this **poster**!

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