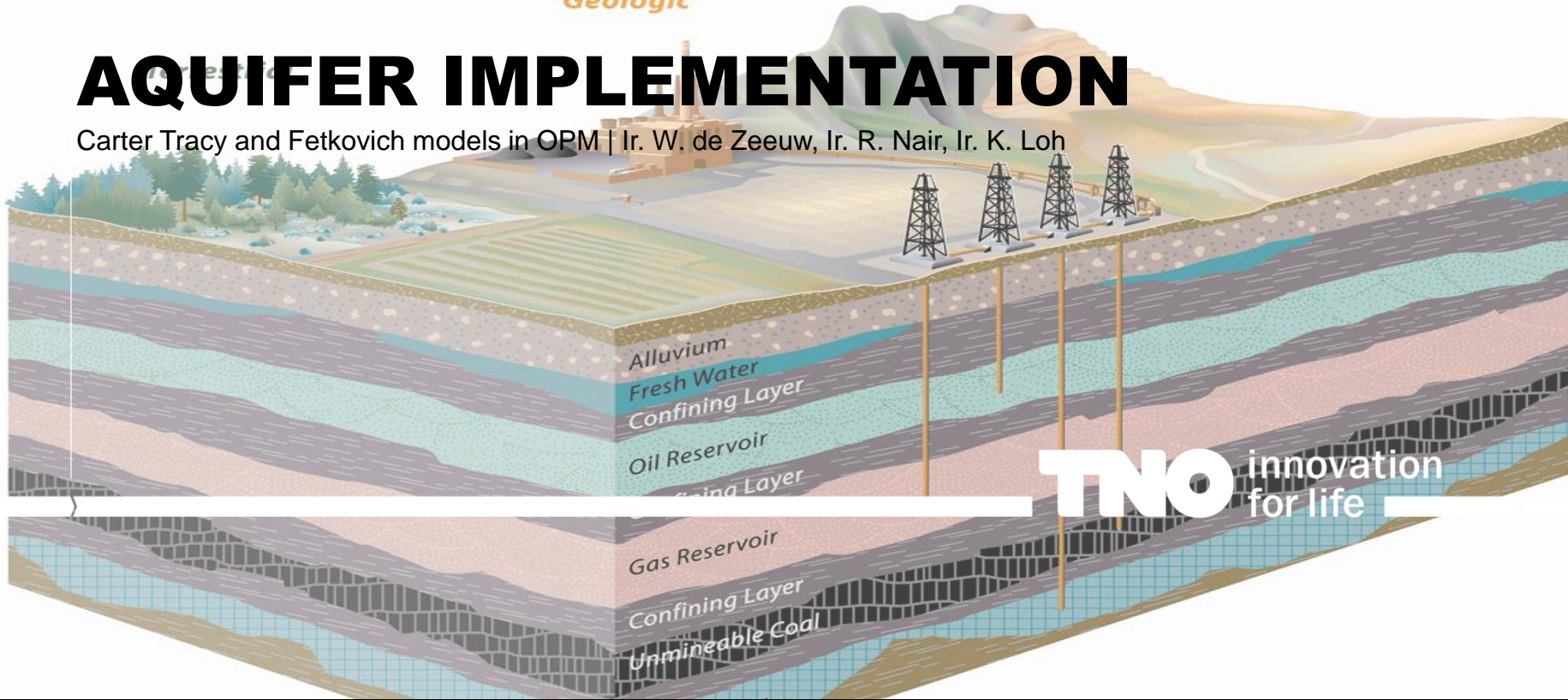


Geologic

AQUIFER IMPLEMENTATION

Carter Tracy and Fetkovich models in OPM | Ir. W. de Zeeuw, Ir. R. Nair, Ir. K. Loh

Geologic (Subsurface) Sequestration



INTRODUCTION

- › Introduce different types of Aquifers available in OPM
- › Flow Chart
- › Input Deck
- › Results
- › What remains to be done

AQUIFER TYPES IN OPM

- › Carter-Tracy aquifers
- › Fetkovich aquifers
 - › Not available, but available in ECLIPSE: Numerical-, Constant Flux-, Constant head-, Multi-component aquifers.

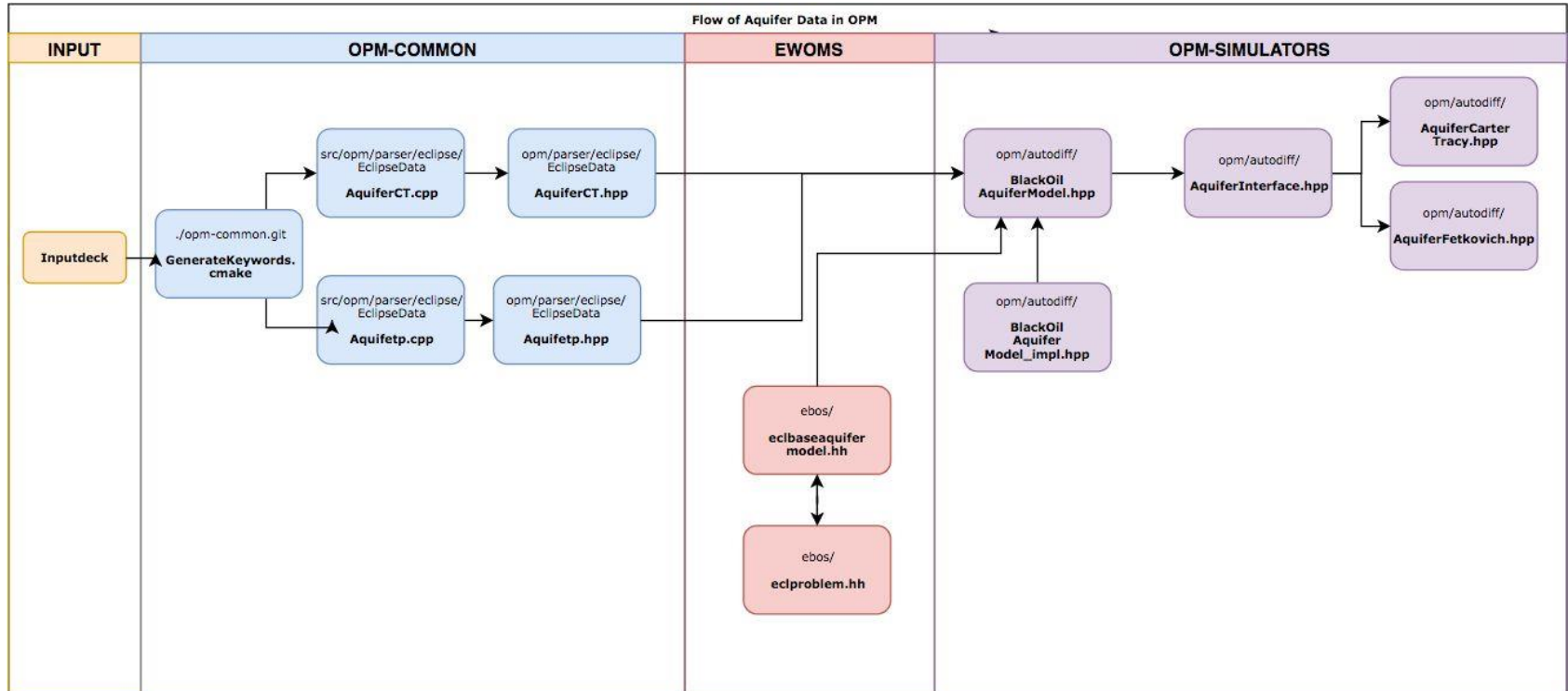
Carter-Tracy

- Simplifies the tedious calculations fully transient model by removing the superposition.
- Approximation of the diffusivity equation
- Assumes constant water influx rates over each finite time interval
- Uses dimensionless time and dimensionless pressure influence as by EH.
- Accuracy depends on time step
- Excellent match with EH-method

Fetkovich

- Simplifies the tedious calculations fully transient model by removing the superposition.
- Approximation of the diffusivity equation
- Water influx rates are proportional to pressure drop of average aquifer pressure and pressure at aquifer front.
- Neglects effect of any transient period. Based on pseudo-steady state

FLOWCHART



CARTER-TRACY AQUIFERS IN INPUT DECK

Required Keywords:

AQUDIMS defines the number of aquifers and max. number of grid block connections

AQUANCON defines the aquifer connections to one or more faces of the reservoir

AQUTAB defines the influence function table as by van Everdingen and Hurst

- User can also supply custom influence functions

AQUCT defines all aquifer properties

- Aquifer ID number, Datum Depth, Initial aquifer pressure, permeability, porosity, compressibility, external radius, angle of influence, table number for water properties, table number for influence function, *initial salt concentration*, *temperature*

Keywords that yet are not available

AAQR, AAQT, AAQP, AQANTRC

FETKOVICH AQUIFERS IN INPUT DECK

Required Keywords:

AQUDIMS defines the number of aquifers and max. number of grid block connections

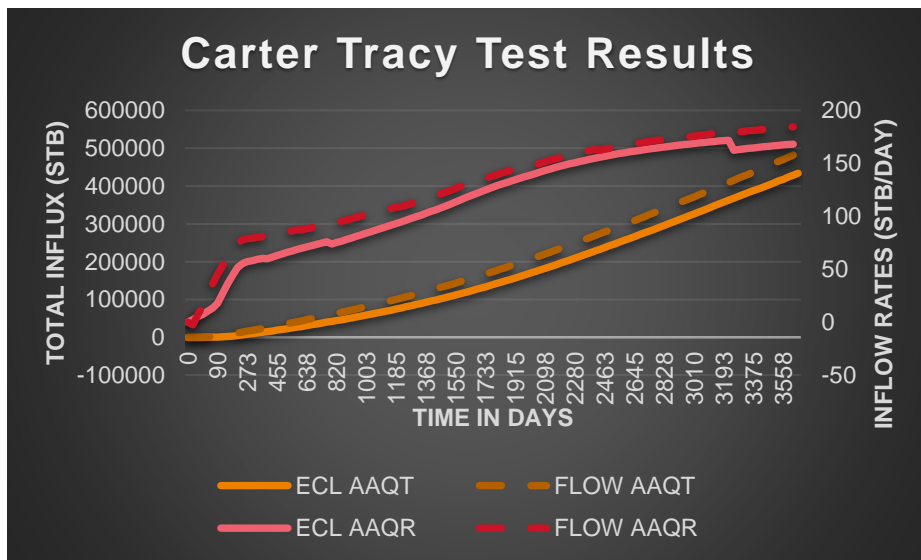
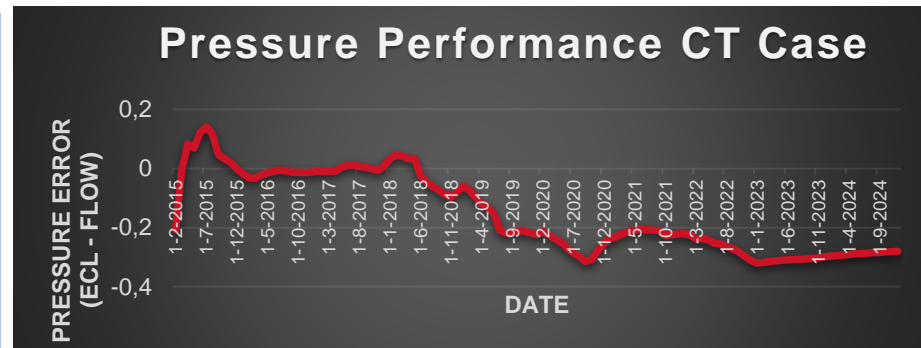
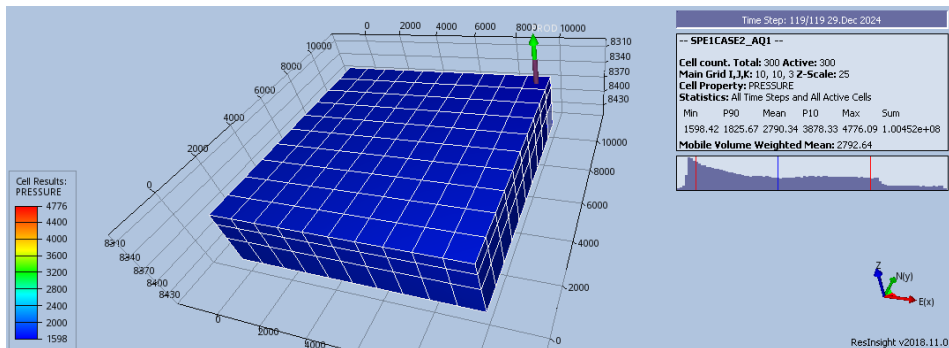
AQUANCON defines the aquifer connections to one or more faces of the reservoir

- Datum depth, Initial aquifer pressure, initial water volume, compressibility, aquifer productivity index, table number for water pressure properties, *Initial salt concentration, temperature in aquifer*

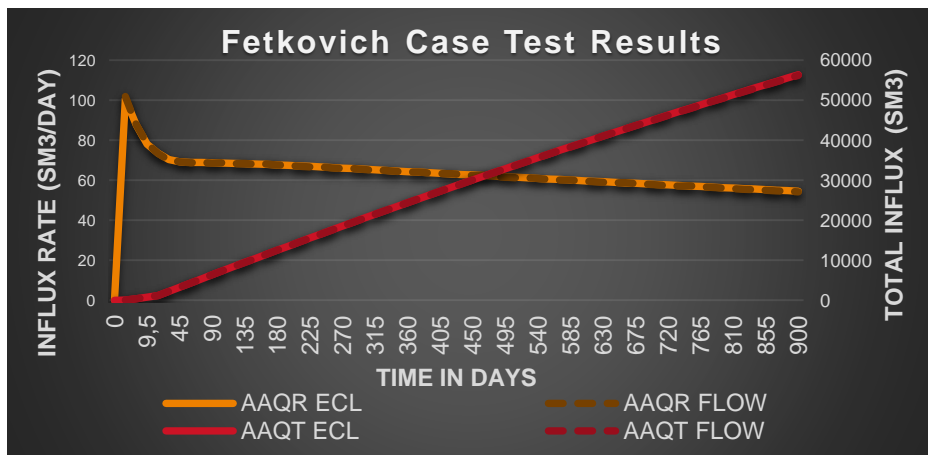
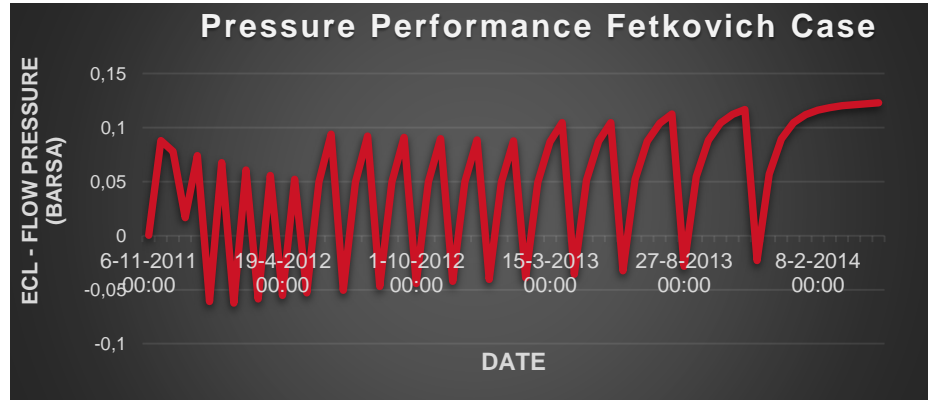
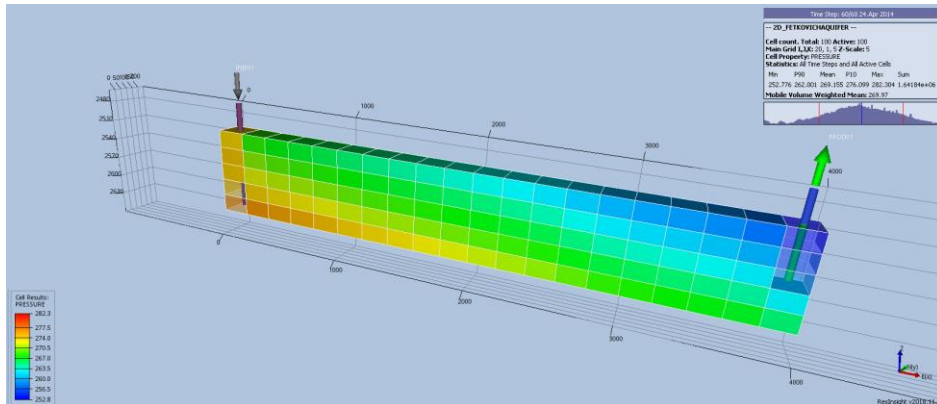
Keywords that yet are not available

AQUFET, AAQR, AAQT, AAQP, AQANTRC

CARTER TRACY PERFORMANCE



FETKOVICH PERFORMANCE



RESULTS AND CONCLUSION

- › Carter Tracy results are accurate according to pressure difference
 - › However, inflow rates are quite different
 - › Implementation of summary keywords is beneficial
- › Fetkovich Results are accurate but must be tested on more complex models
- › Models work on all flows (solvent, polymer, normal, geothermal)
- › Final implementation for the AquiferInterface class
- › Easily extendible framework for aquifers in OPM

Terrestrial

THANK YOU FOR YOUR ATTENTION

Take a look:

[TNO.NL/TNO-INSIGHTS](https://www.tno.nl/tno-insights)

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Confining Layer

Gas Reservoir
Confining Layer

Gas Reservoir
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