

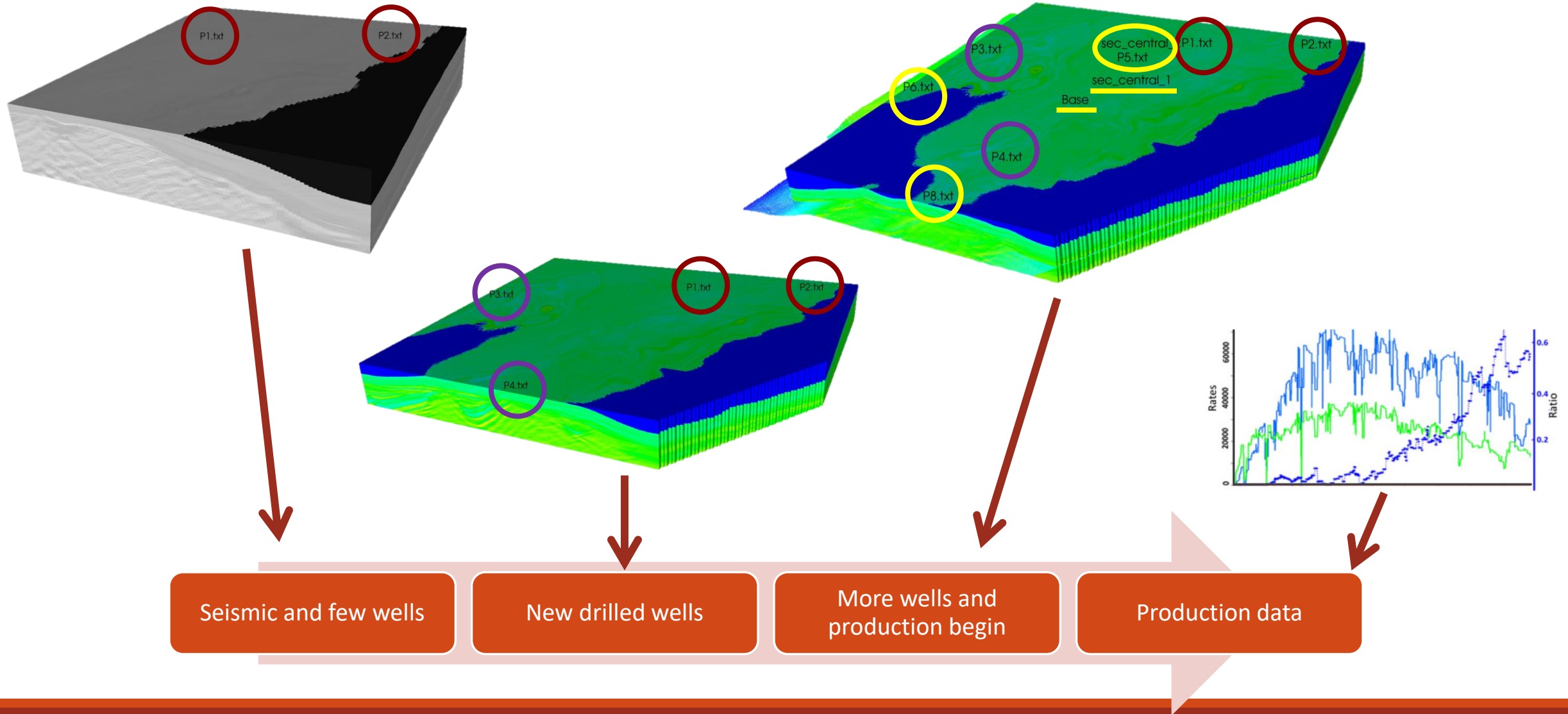
Synthetic Case Study | 06/01/2022

Jonas Kloeckner



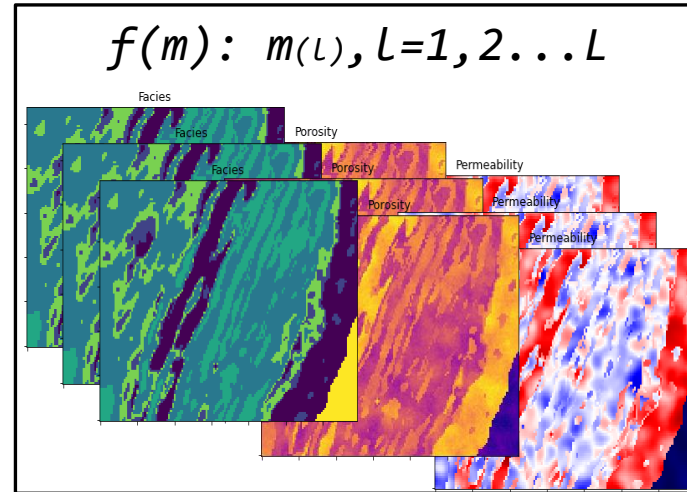
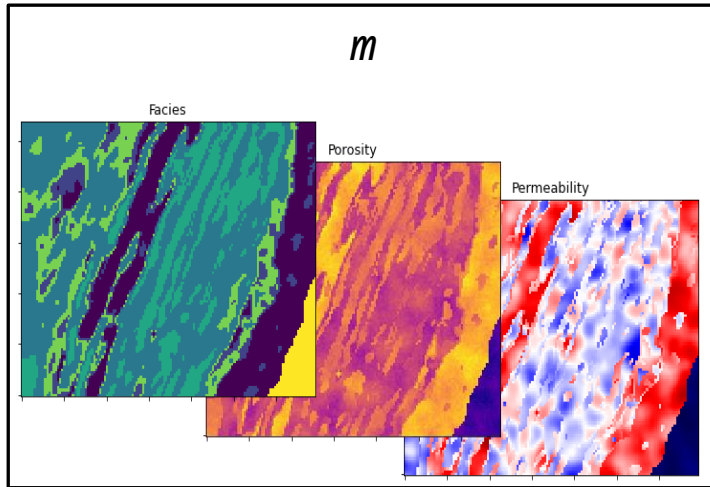
Decision Making in Reservoir Production in Brazil

Motivation: UQ in reservoir modeling

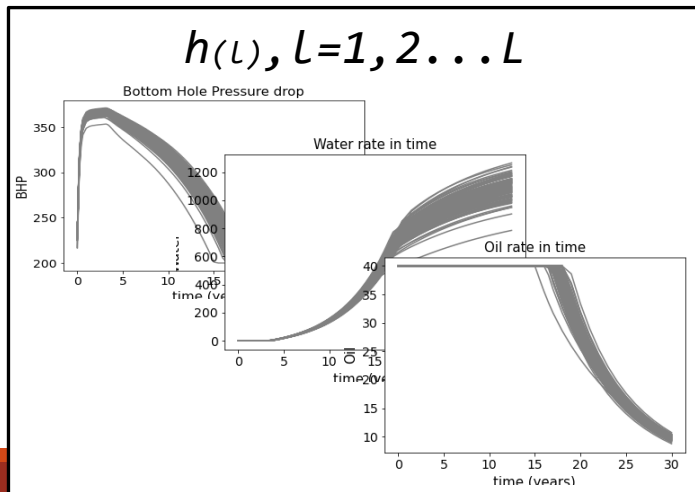


How to solve the problem?

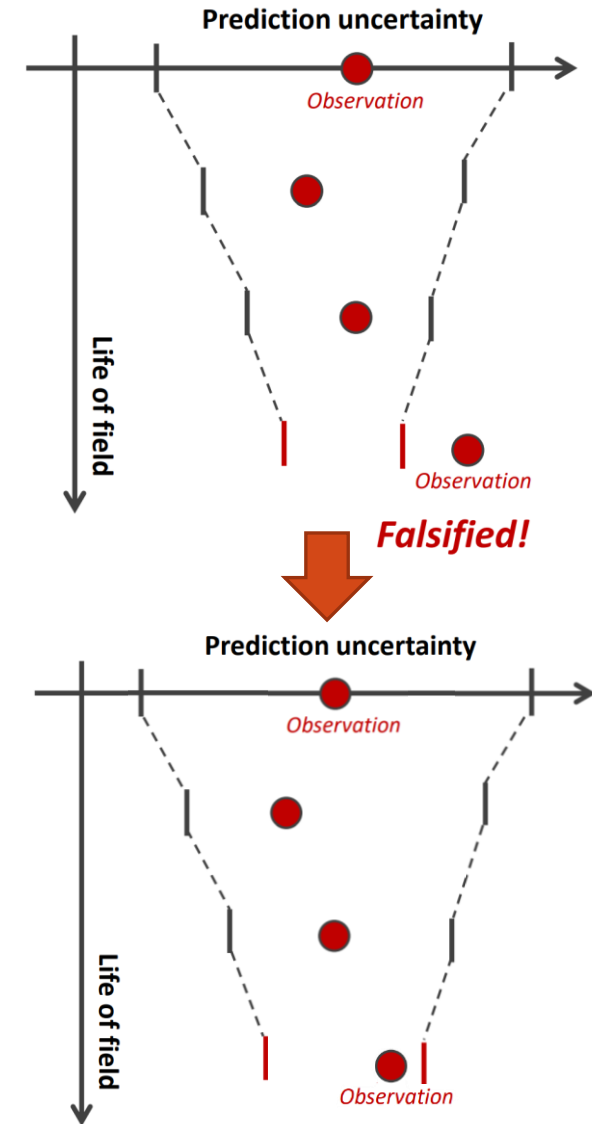
- Bayesian Evidential Learning!



$gh(m)$
FLOW SIMULATION



What we get X what we want

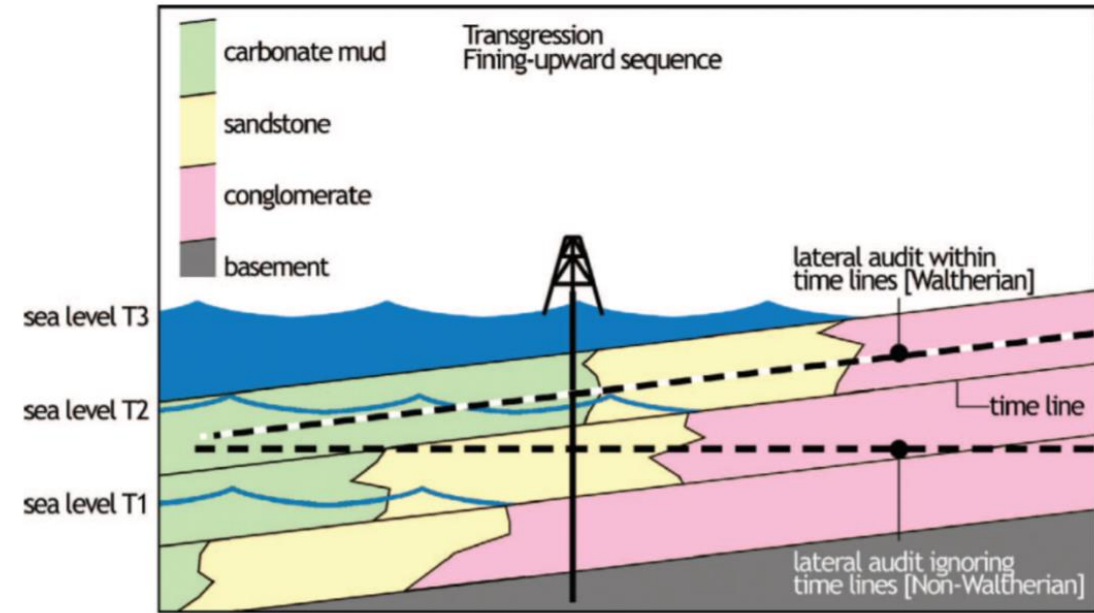


Methodology assumptions

- **Markov chains;**
- *Facies sequences observed follow a Markov chain sequence*
- **Walther's law of facies;**
- *"Facies sequences observed vertically are also found laterally"*
J. Walther (1894)

$$P(H|E) = \frac{P(E|H)}{P(E)} P(H)$$

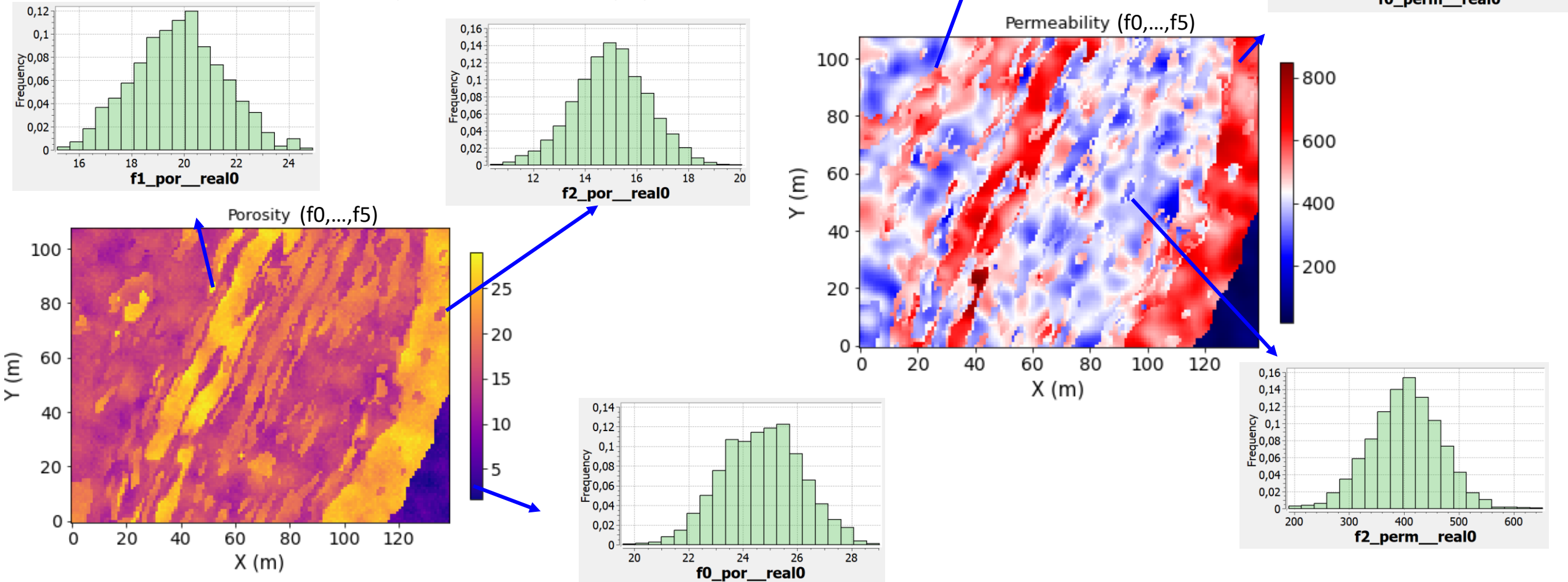
- H1: Markov chain hypothesis;
- H2: Walther's law hypothesis;
- E1: New wells with Markov chain sequences;
- E2: New wells that falls under Walther's law assumption;



Purkis et al. (2012)

Case study: Uncertainties

- Porosity and permeability per facies



Case study: 2D synthetic dataset

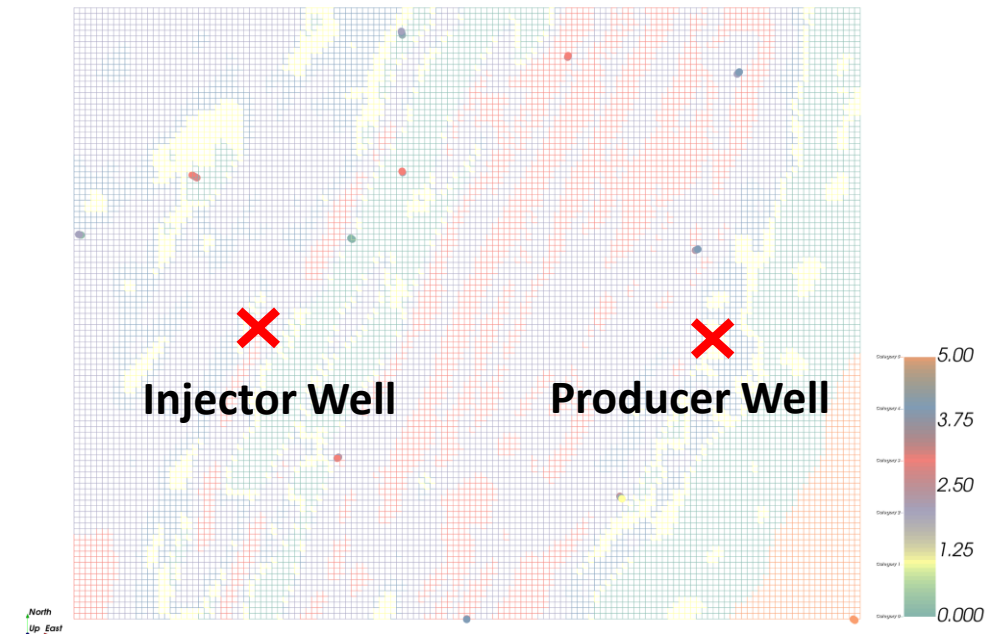
- 2D Synthetic data created using real data
- Possibility to compare with the ‘true model’

Distributions:

Parameter	Unit	Distribution
Porosity	%	G[2,30]
Permeability	mD	G[20,800]

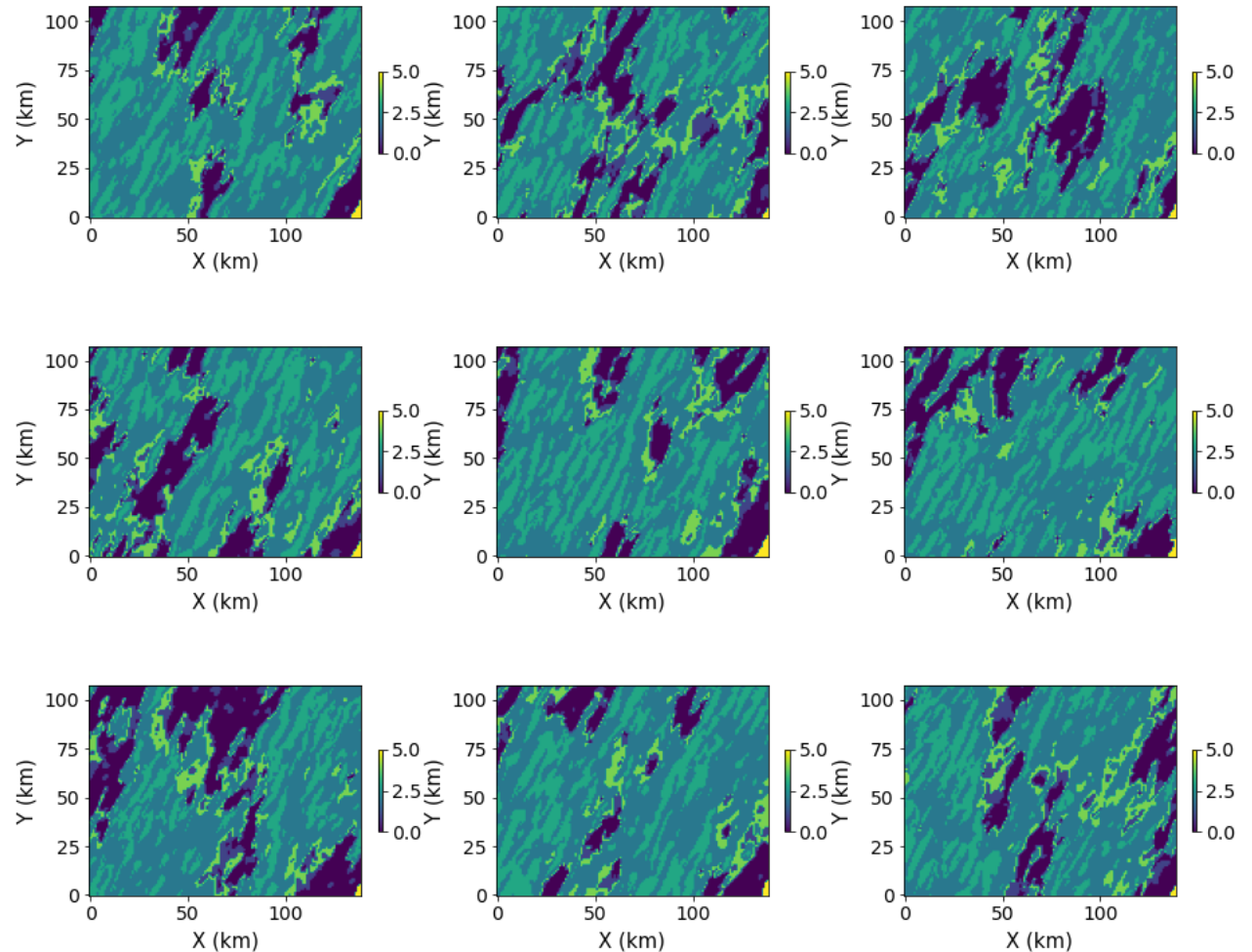
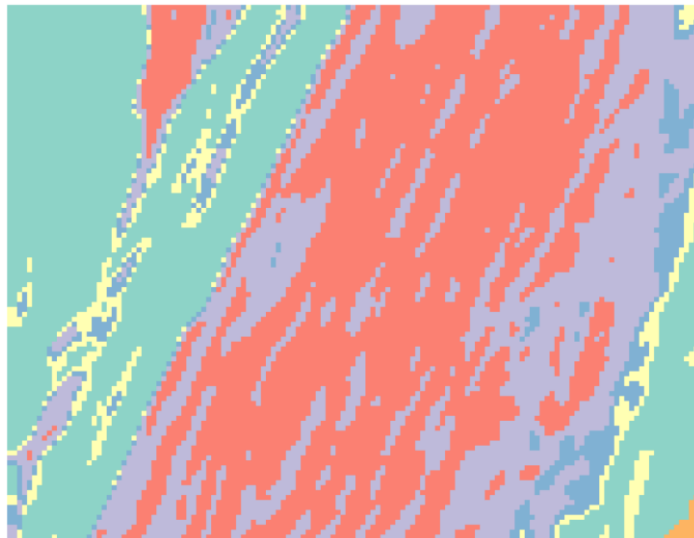
Global Parameters:

Parameter	Type	Unit
Azimuth	Continuous	°
Variogram Major Dir	Continuous	m
Variogram Minor Dir	Continuous	m
Nugget Effect	Continuous	%



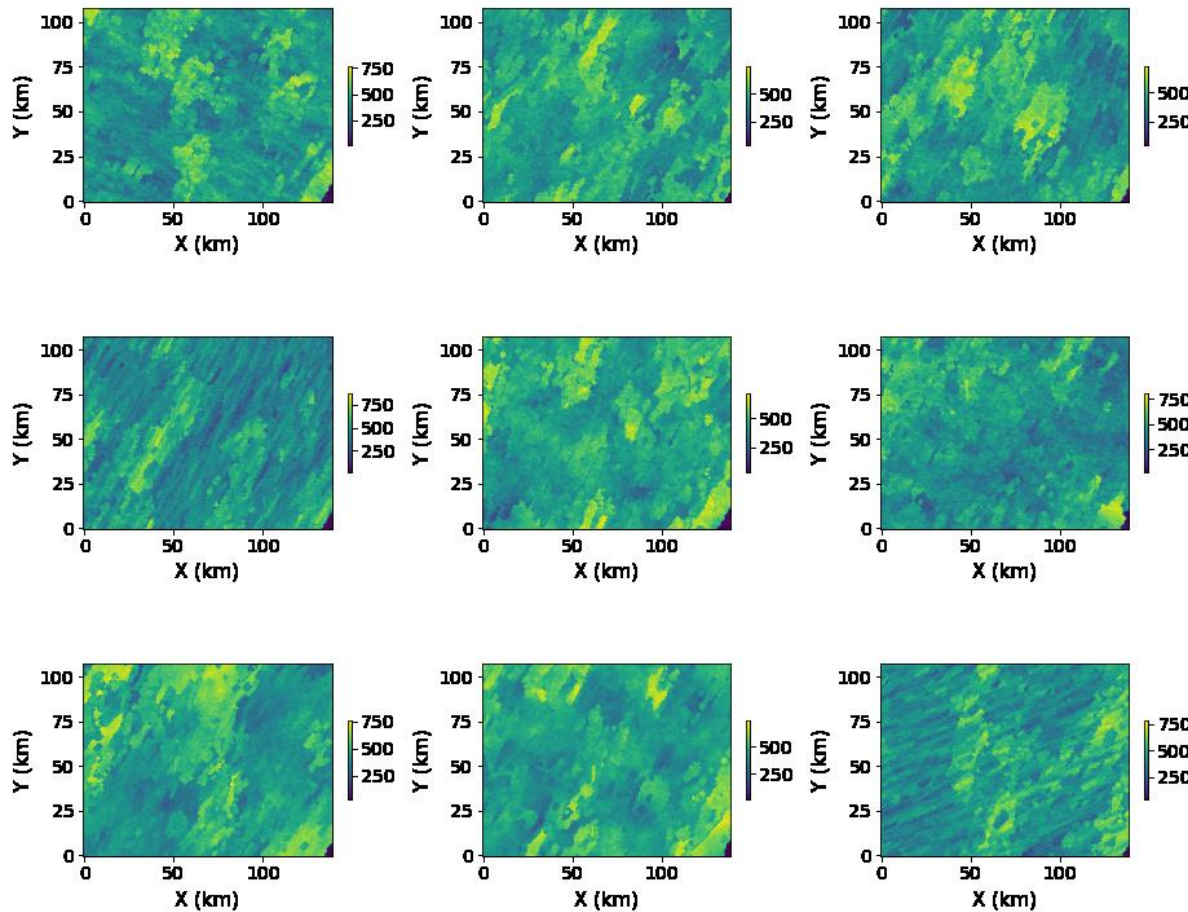
Case study: 2D synthetic dataset

- Training Image
- Multi points geostatistics
- Multiple facies realizations
- Conditionate to the wells

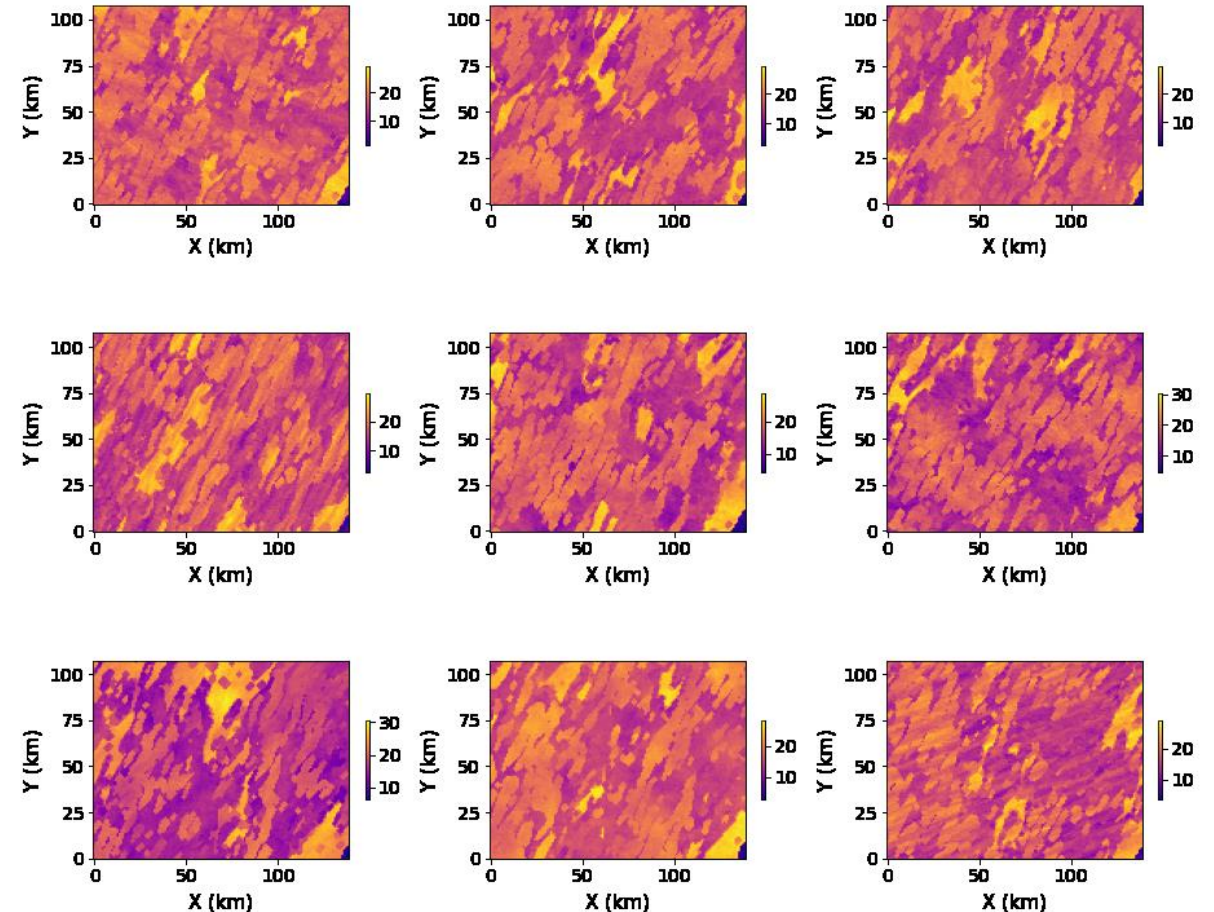


Case study: Permeability and porosity results

Permeability (mD)

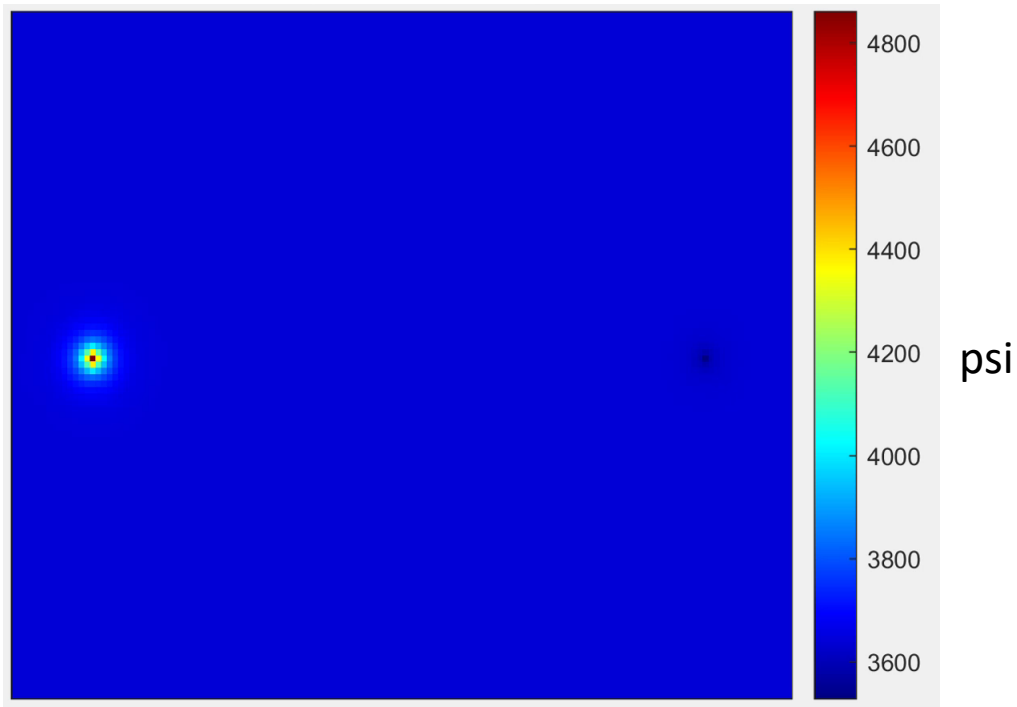


Porosity (%)

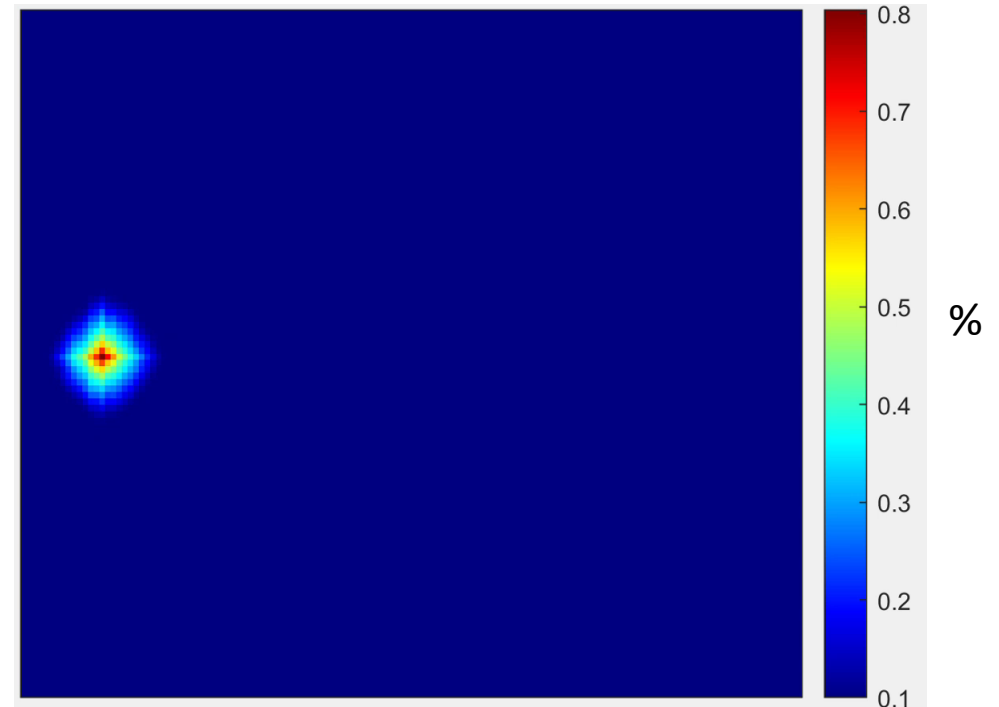


Case study: Flow Simulation – 1st year

Pressure over 30 years

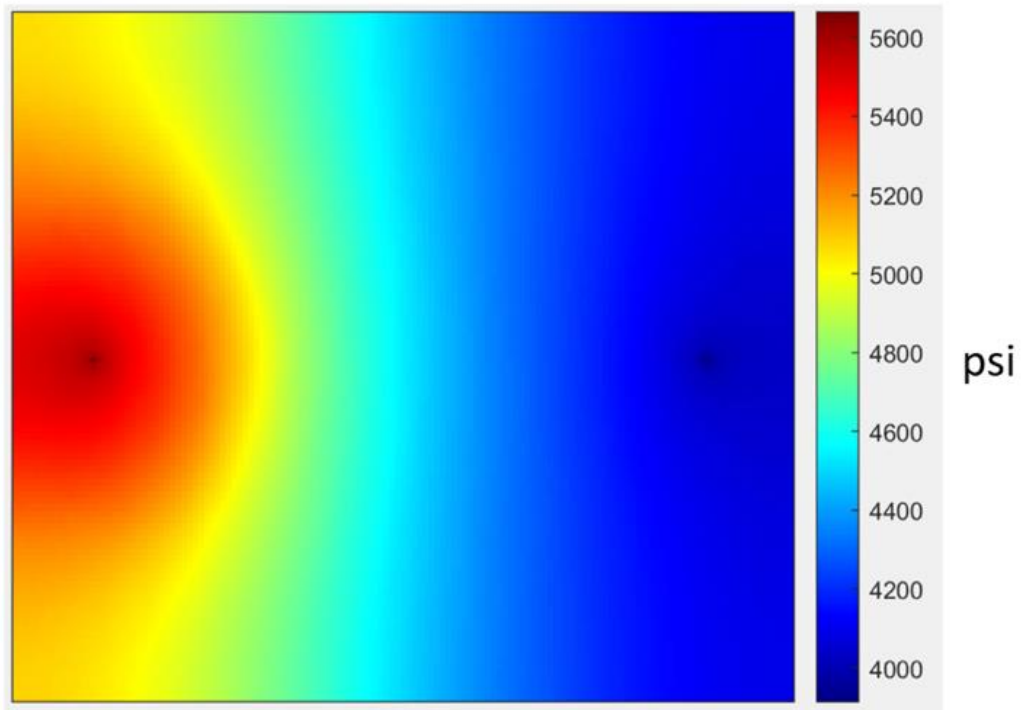


Water saturation over 30 years

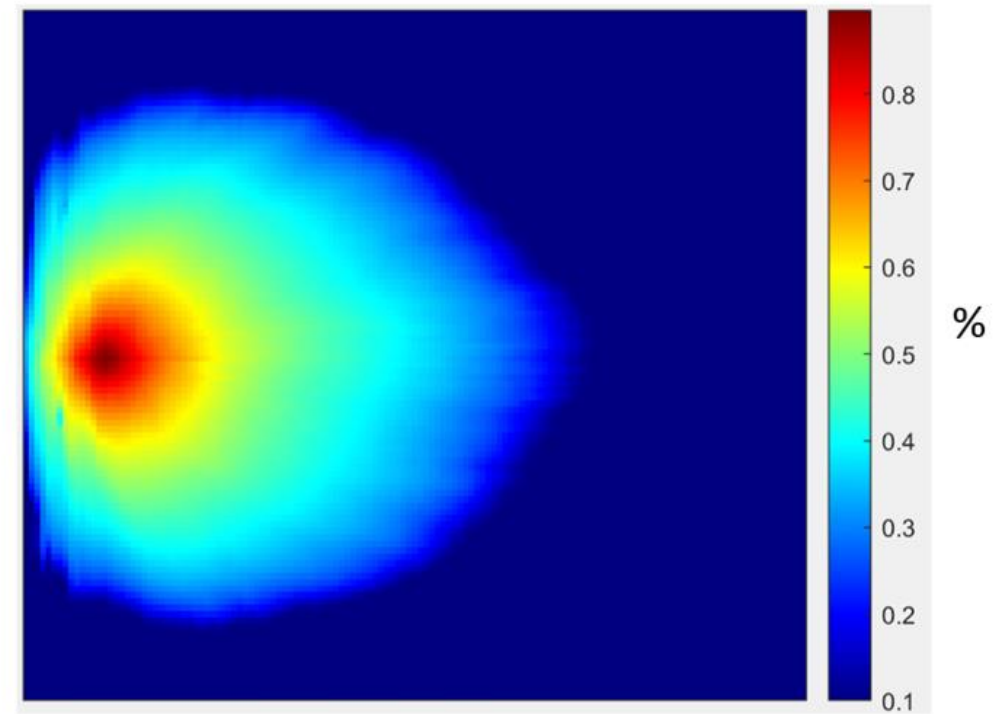


Case study: Flow Simulation – 5th year

Pressure over 30 years

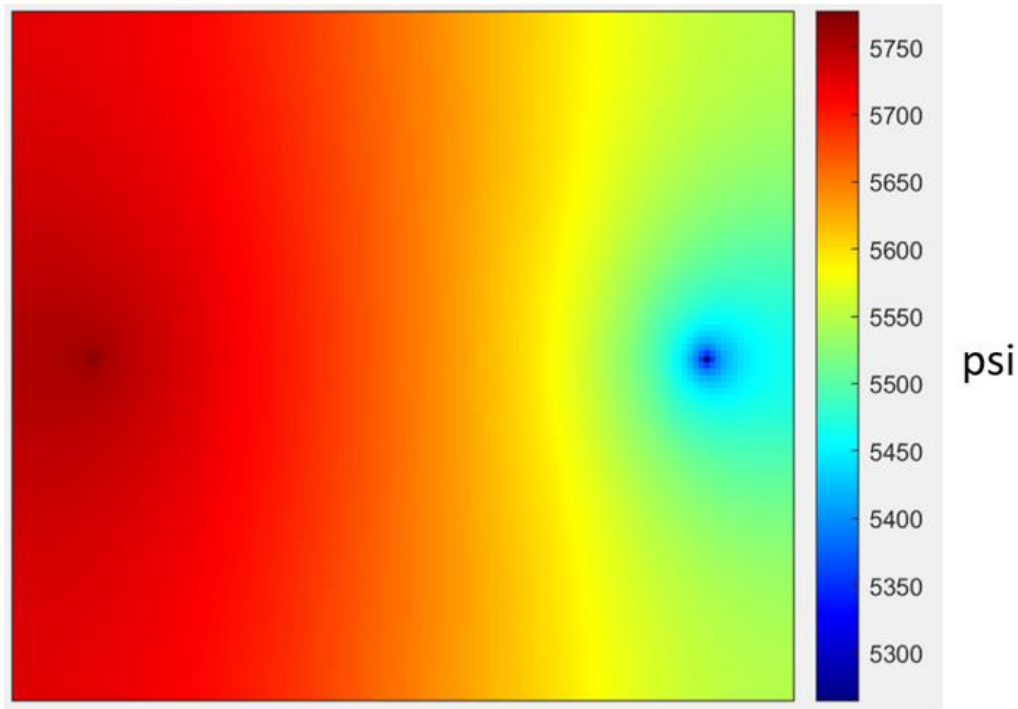


Water saturation over 30 years

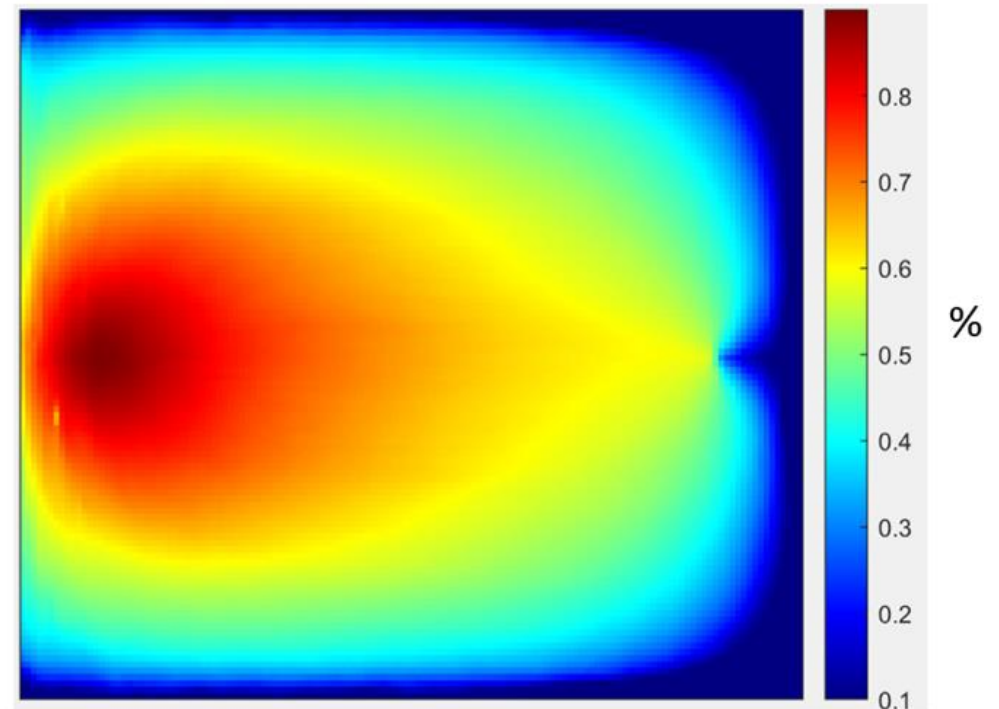


Case study: Flow Simulation – 15th year

Pressure over 30 years

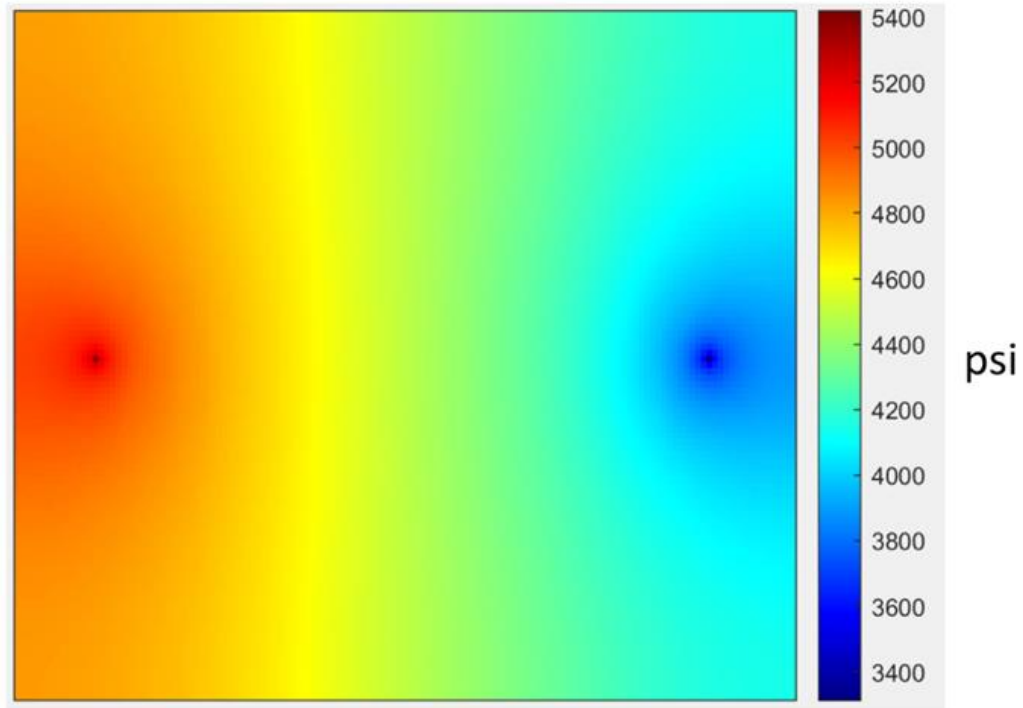


Water saturation over 30 years

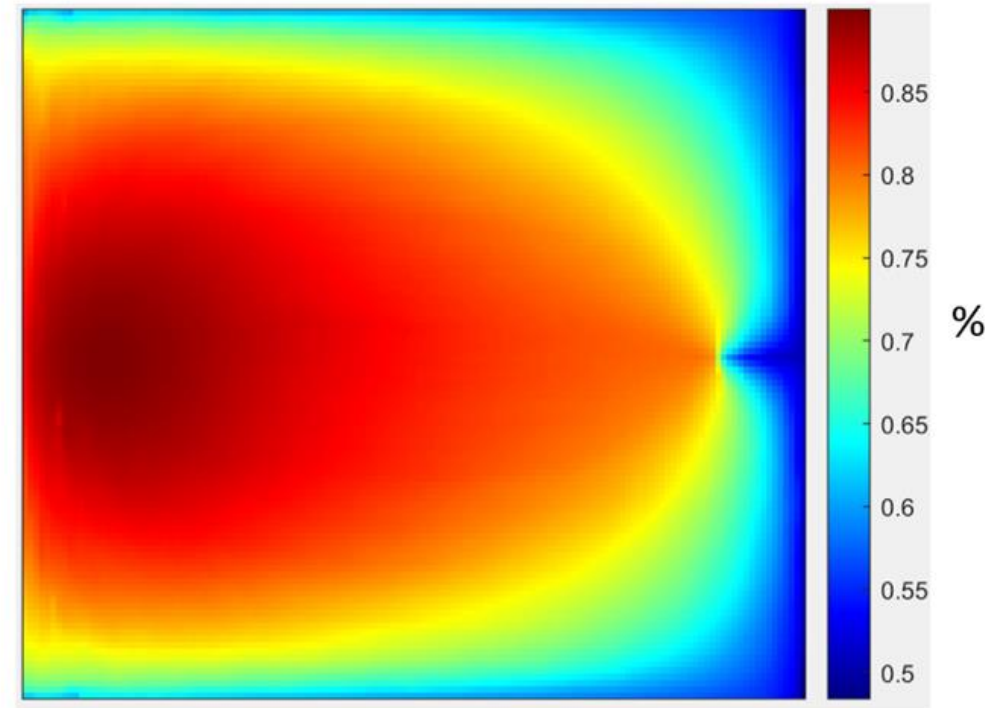


Case study: Flow Simulation – 30th year

Pressure over 30 years

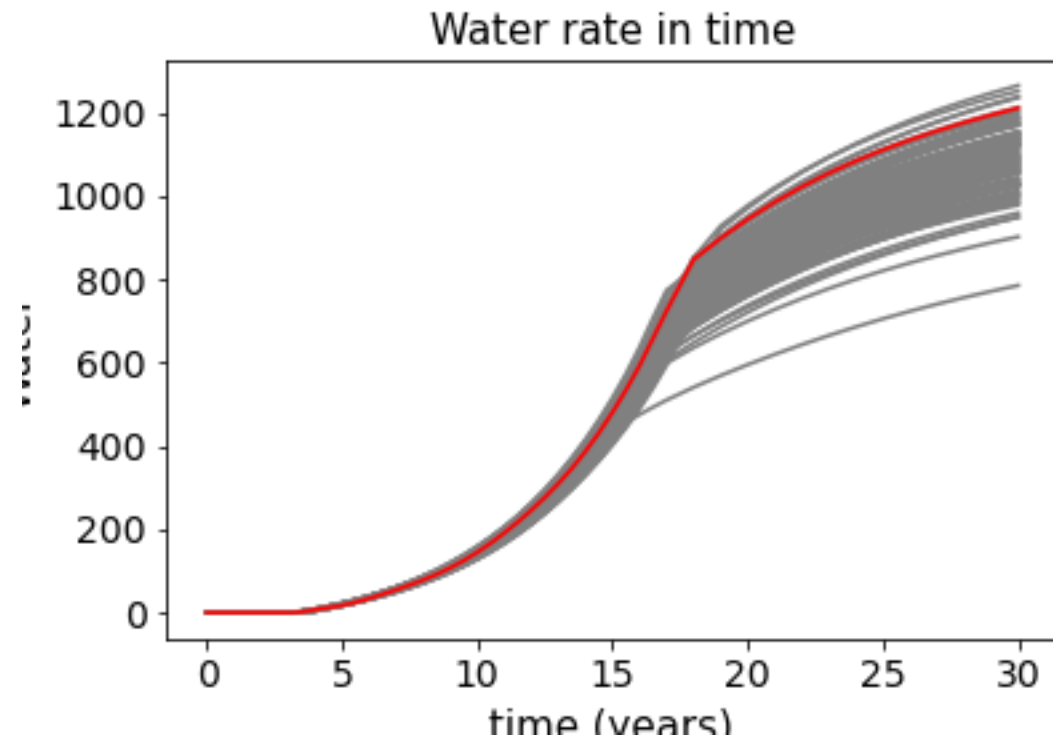
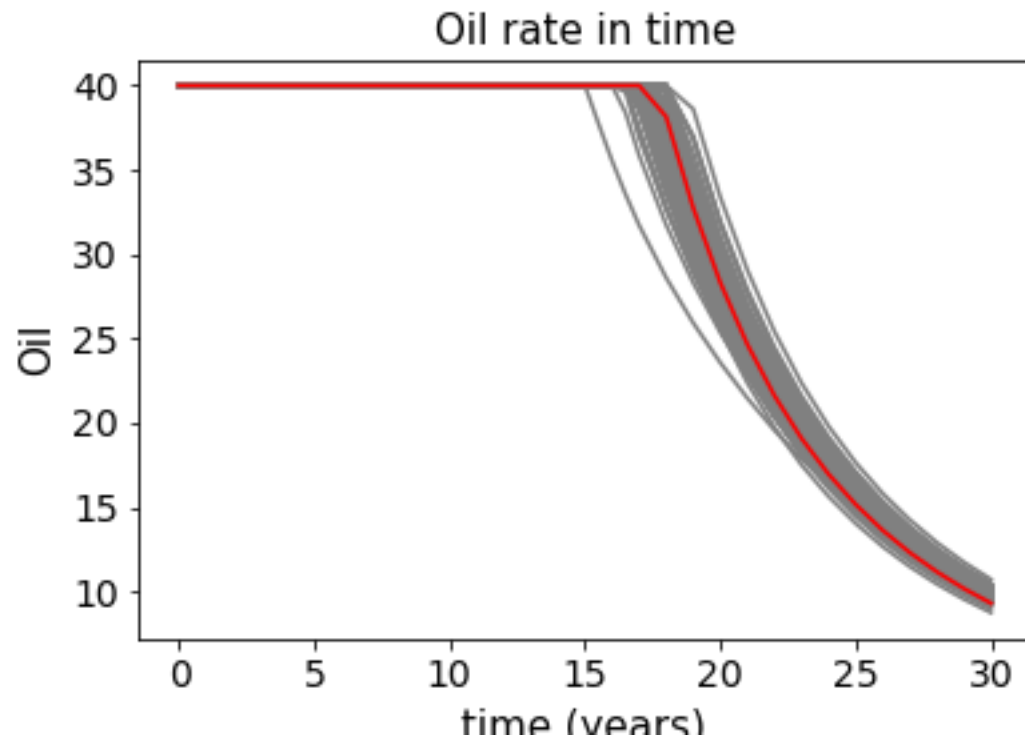


Water saturation over 30 years



Case study: Flow Simulation

- Oil and water rate for the producer well over 30 years
- Grey lines: realizations;
- Red line: true model



Case study: Flow Simulation

- Bottom Hole Pressure drop and PDF for 10 years
- Grey lines: realizations;
- Red line: true model

