Ai4 Society

Bringing together interdisciplinary researchers and partners to innovate in artificial intelligence research and teaching, for the public good.

0714 DATASET FOR ML

Instructor: Dr. Leung

Ziming & Yao

Highlights

- Sandstone reservoir
- Single layer with thickness
- Heterogenous rock properties
- Signal-phase flow
- 5-spot injection pattern, 36 injectors and 25 producers
- All wells start to operate at the same time
- 10 similar reservoir models

Reservoir information and Rock properties

- Considering a shallow marine deposit
- Reservoir Rock type: **Sandstone**
- Constant initial pressure: 33095 kpa
- Geological model generation
  1) Use gaussian to generate a field (assume a random field);
  2) Assign 61 observation points (from the well locations);
  3) Plot the variogram;
  4) Apply kriging on the observation points regenerate the map.

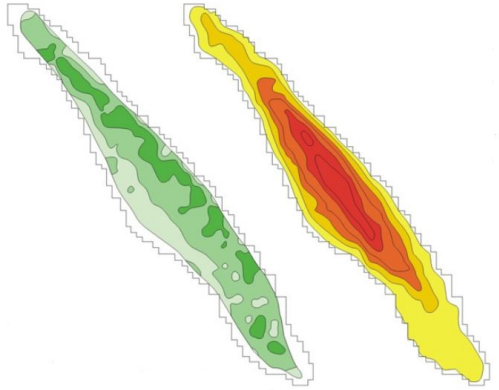


Fig. 1 Reservoir porosity heterogeneity (green) and thickness(red). (Referenced taken from the Hartzog Darw Field, a shallow marine deposit, Tillman,1987)

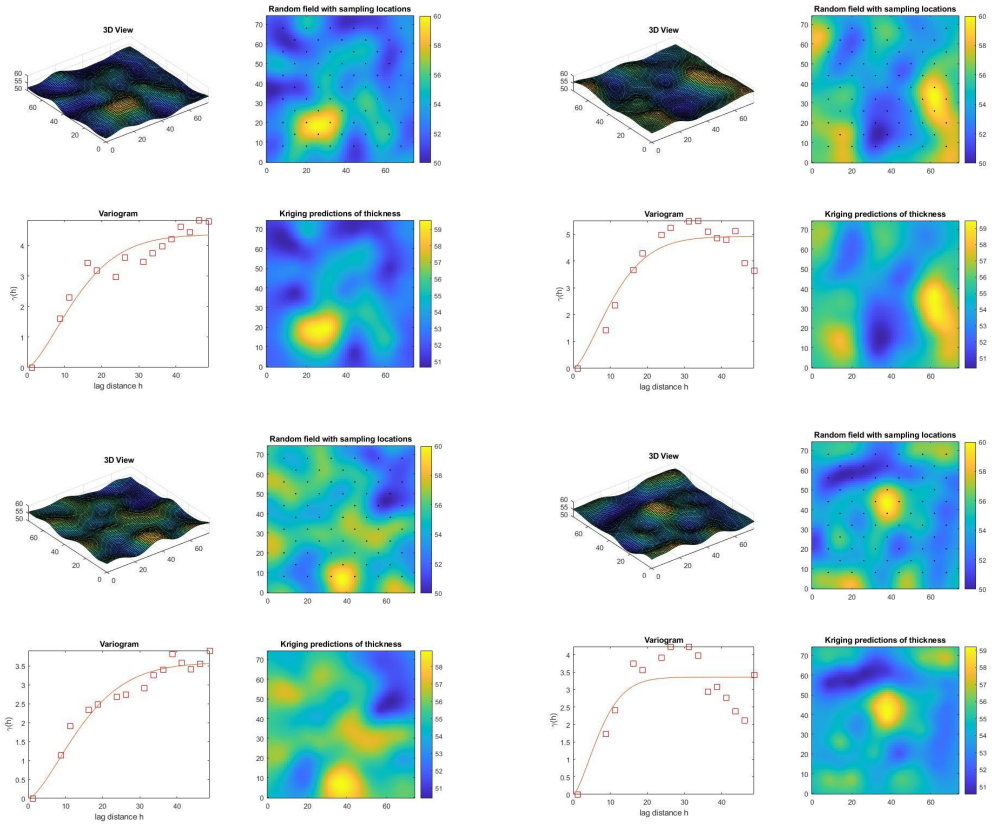
Properties	Value
Thickness	Mean: 50
Porosity	Mean: 0.27
Permeability	Correlation (Neithalath et al. 2010)

$$k = 0.4e^{11.3\varphi}$$

*Neithalath, N., Sumanasooriya, M. S., & Deo, O. (2010). Characterizing pore volume, sizes, and connectivity in pervious concretes for permeability prediction. *Materials characterization*, *61*(8), 802-813.

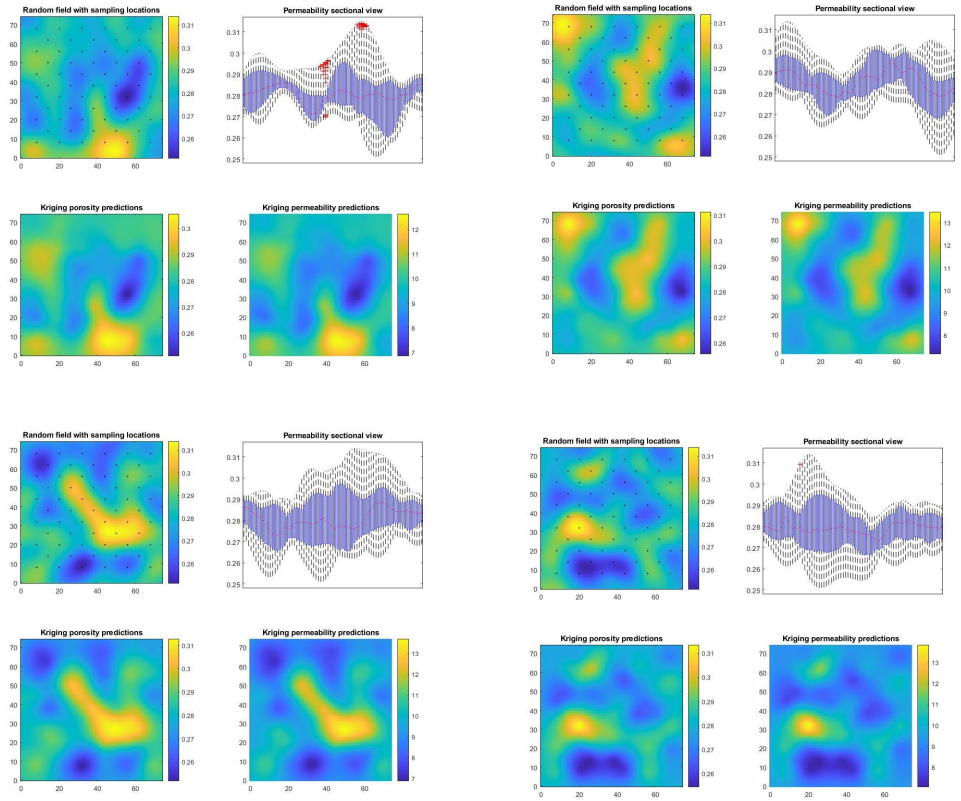
Reservoir realizations

- Realizations of: Thickness



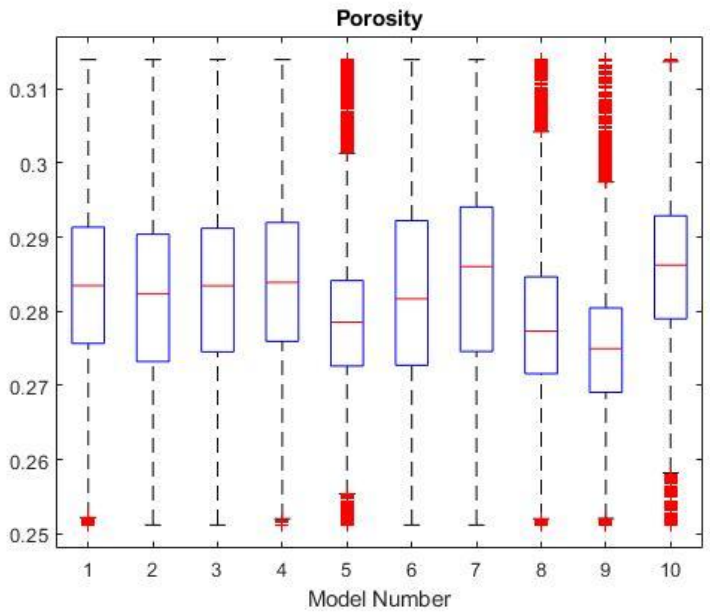
...×10

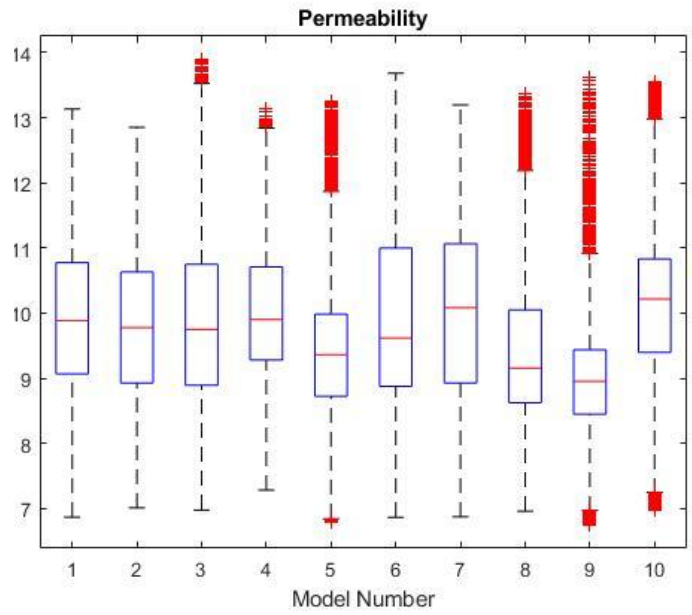
- Porosity and Permeability

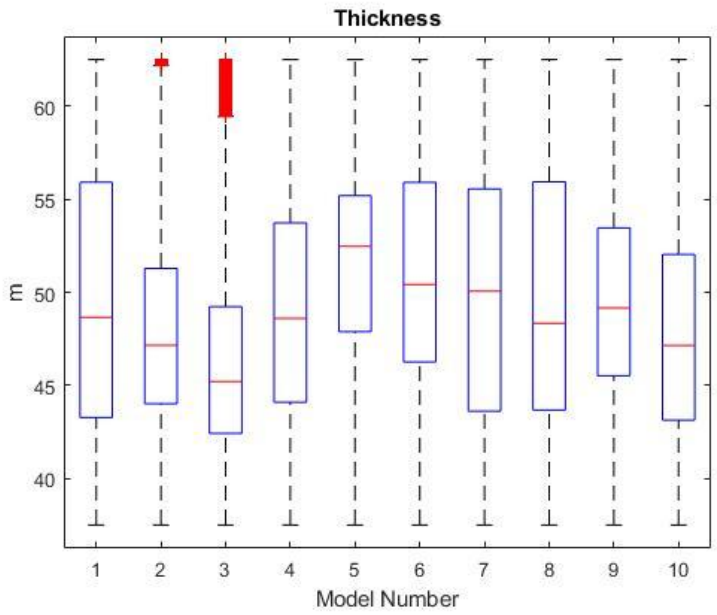


...×10

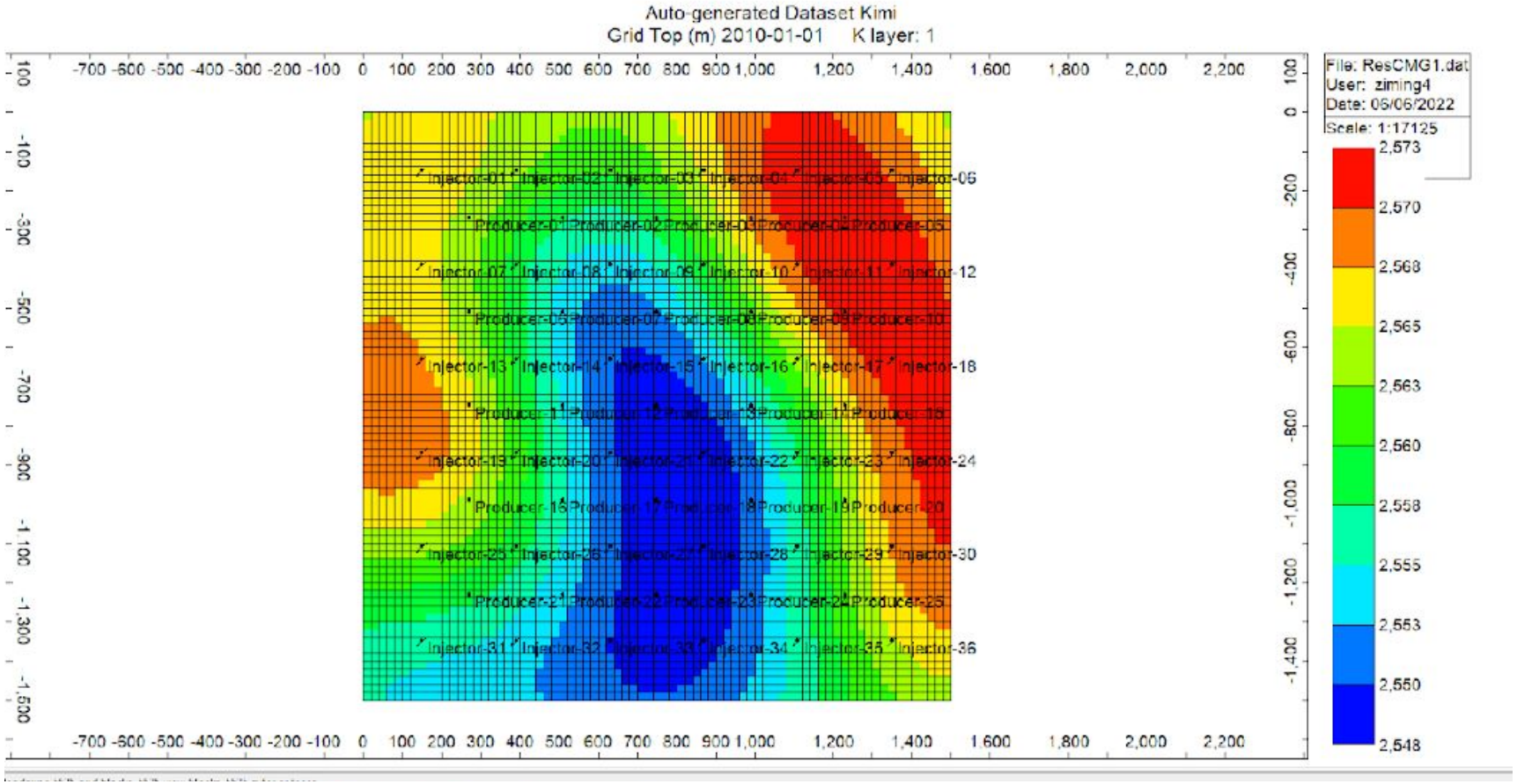
Statistics


Porosity
0.31
0.3
0.29
0.28
0.27
0.26
0.25
1 2 3 4 5 6 7 8 9 10
Model Number


Permeability
14
13
12
11
10
9
8
7
1 2 3 4 5 6 7 8 9 10
Model Number

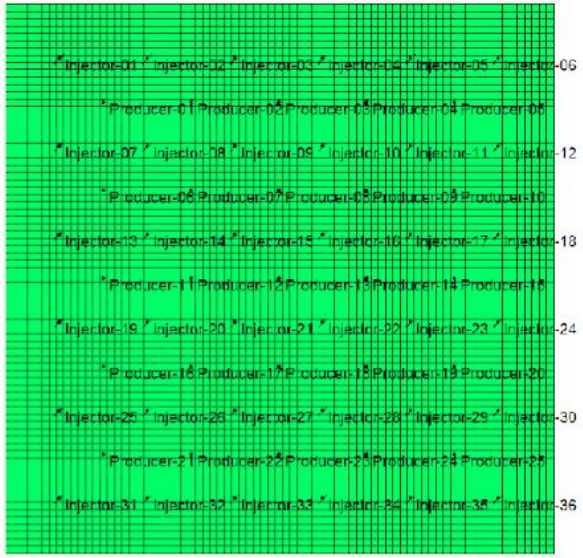

Thickness
m
60
55
50
45
40
1 2 3 4 5 6 7 8 9 10
Model Number

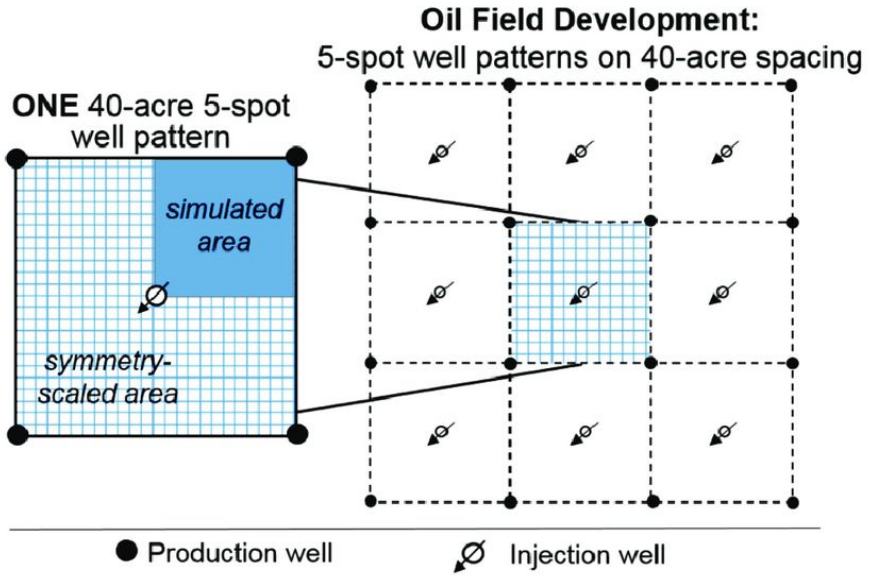
CMG View


Auto-generated Dataset Kimi
Grid Top (m) 2010-01-01 K layer: 1
File: ResCMG1.dat
User: ziming4
Date: 06/06/2022
Scale: 1:17125
2,573
2,570
2,568
2,565
2,563
2,560
2,558
2,555
2,553
2,550
2,548

Operation

- Well Locations



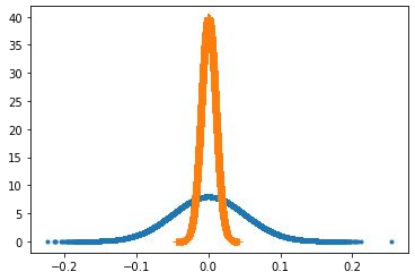


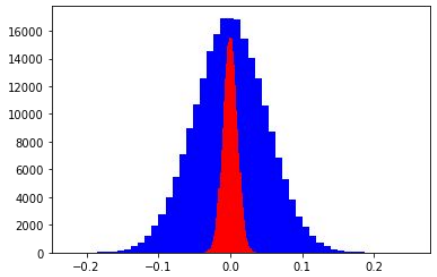
- Well Descriptions
  - Producers
    - Pressure constrained (bph: 5000 kpa)
  - Injectors
    - Pressure constrained (q_{inj}: 1000 m3/day)

$$\frac{P}{J} = \frac{1}{1}$$

Noise

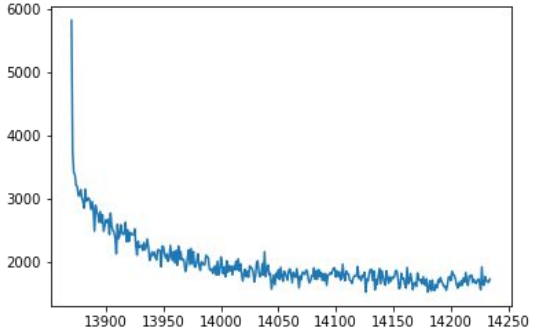
- Gaussian, Normal distribution
- Production rate: Mean = 0, std = 0.05
- Pressure: Mean = 0, std = 0.01



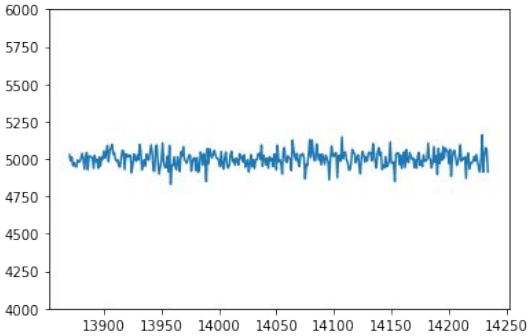


Producer

Production rate

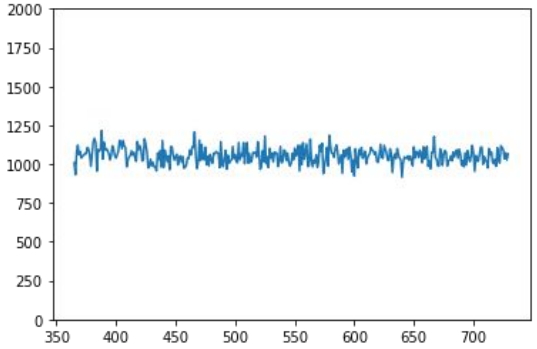


Bottom hole pressure

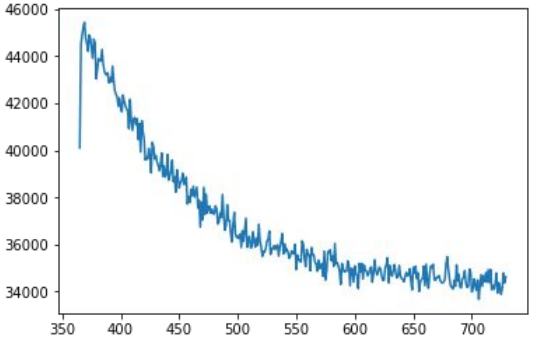


Injector

Injection rate

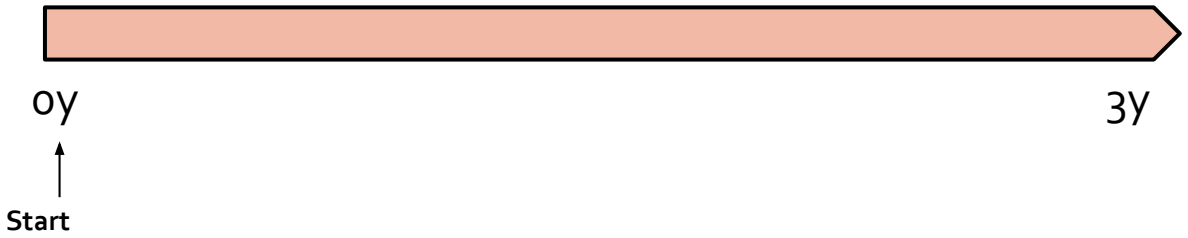


Bottom hole pressure



Production plan

- **Schedule**
  - 3-year production
  - All wells start to operate at the same time



1	2	3	4	5	6
1	2	3	4	5	
7	8	9	10	11	12
6	7	8	9	10	
13	14	15	16	17	18
11	12	13	14	15	
19	20	21	22	23	24
16	17	18	19	20	
25	26	27	28	29	30
21	22	23	24	25	
31	32	33	34	35	36

Problem Set for ML

- What will be given:
  - Production profile of each well.
  - Porosity/permeability map
  - Thickness map
- **Problem:** Make prediction of the production profile of a producer with a given permeability, porosity and thickness.