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Research Plan: Machine Learning in Oil and Gas Industry

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World hydrocarbon resources

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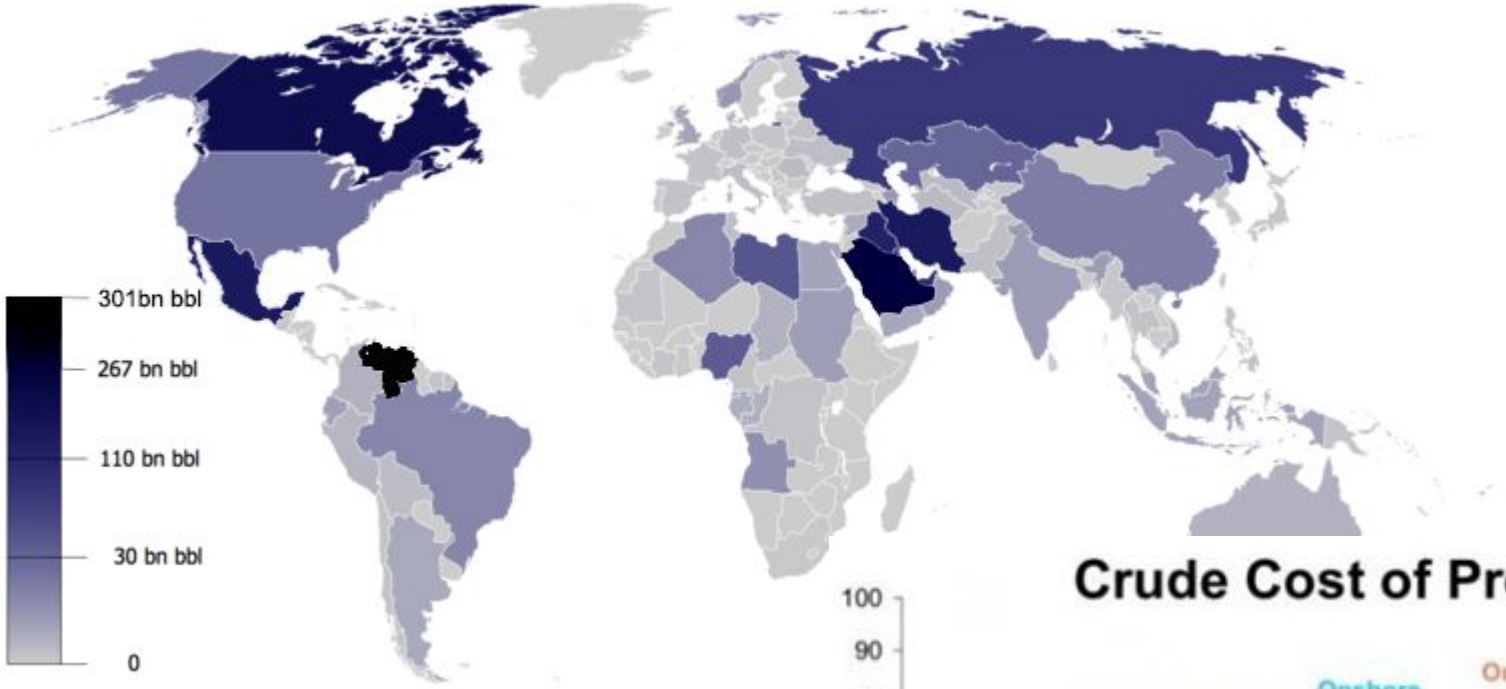
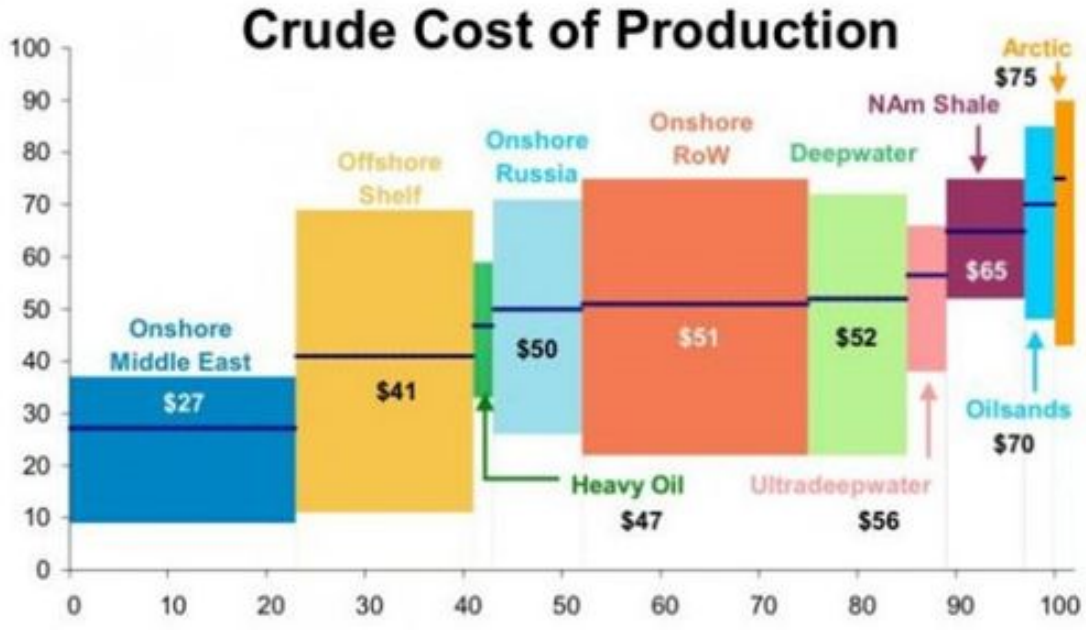
A map of world oil reserves, 2013.





https://www.reddirtreport.com

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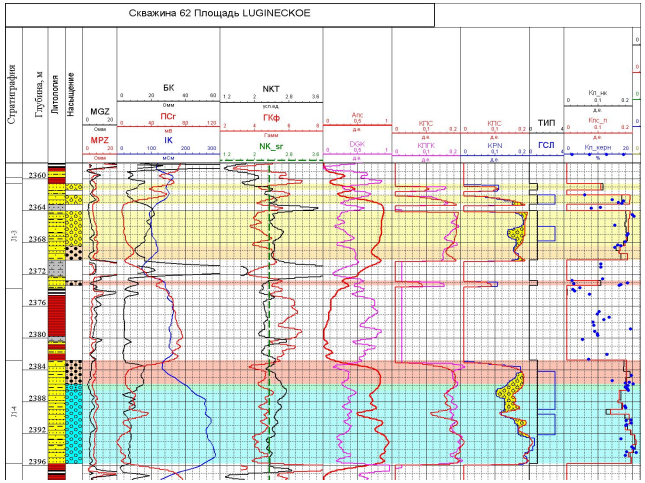
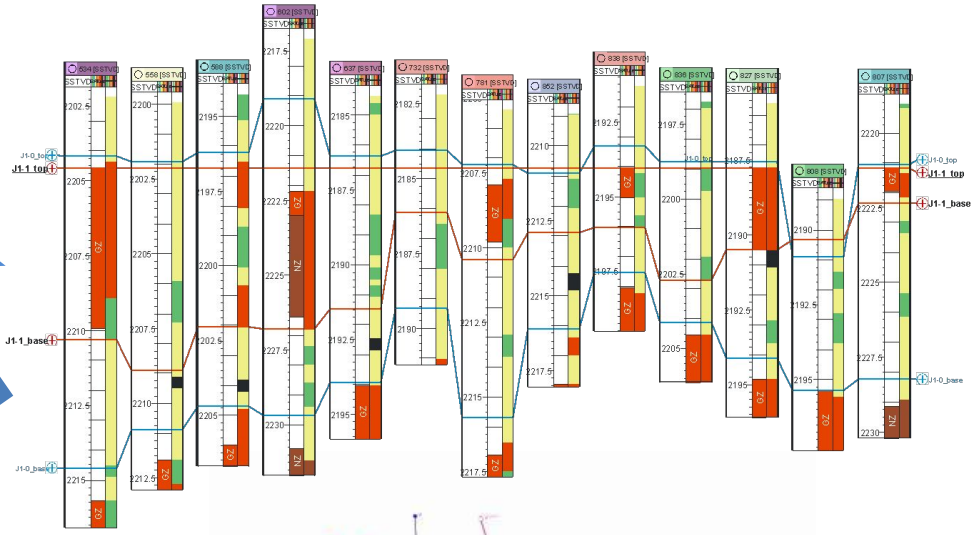
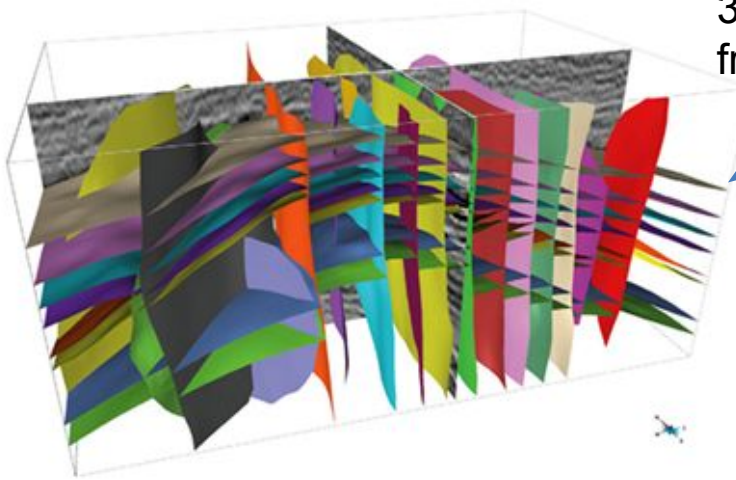


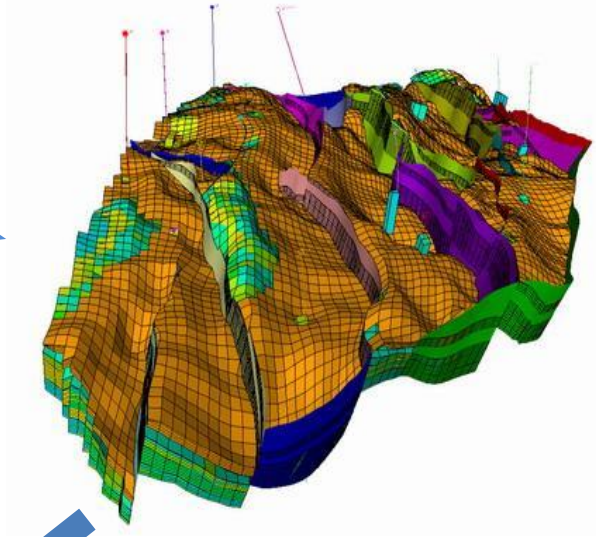
well correlation



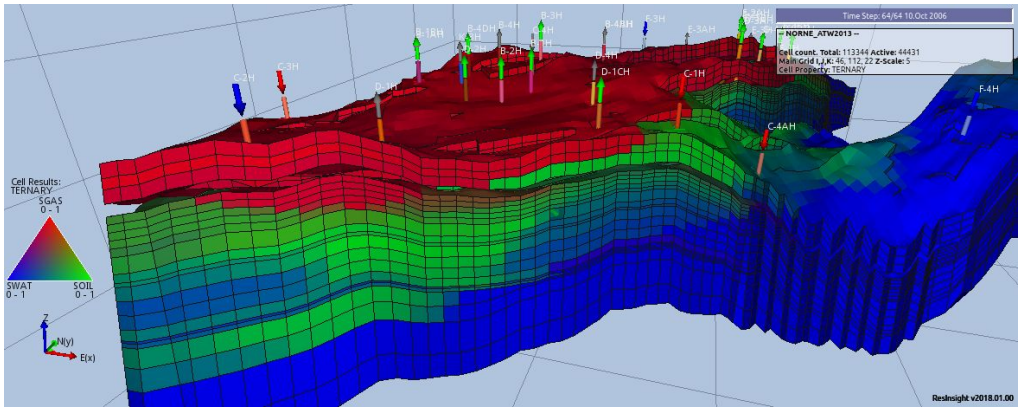
3d model frame



3d physical model



hydrodynamic simulation



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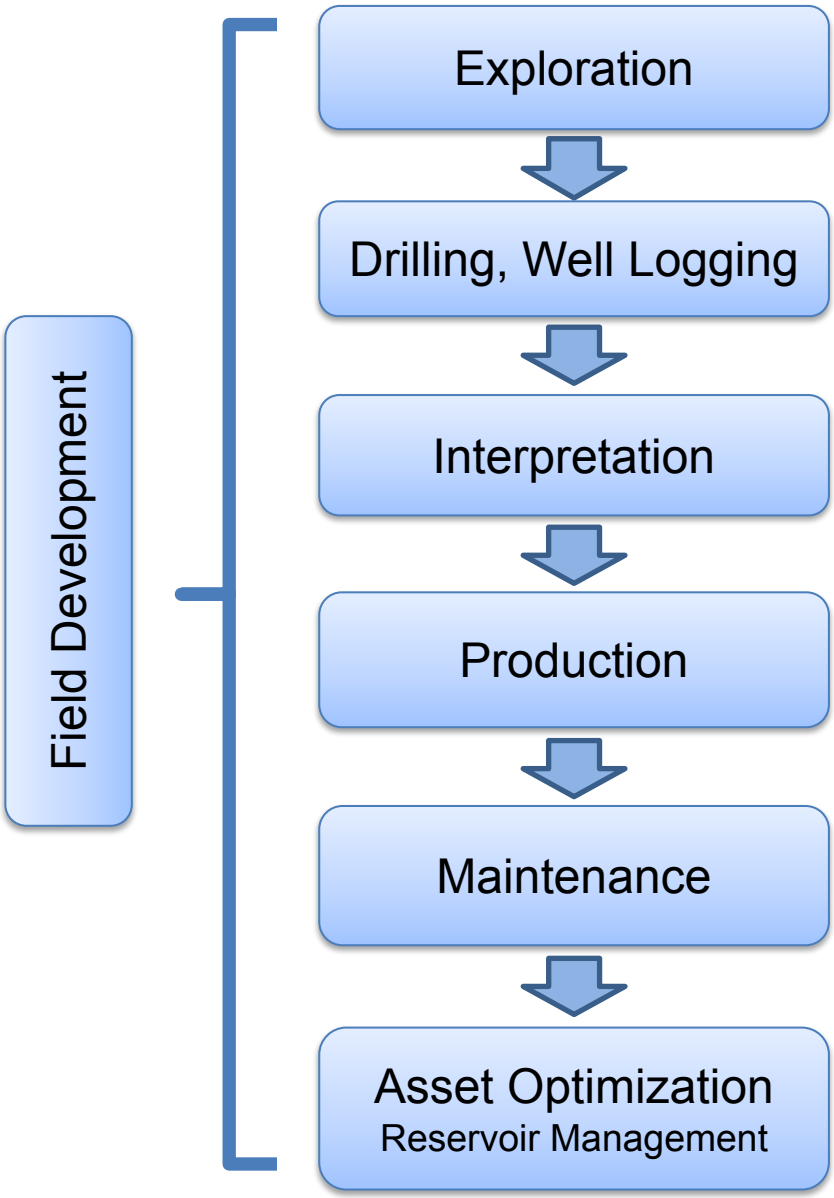
Machine Learning in Oil & Gas



- Image Recognition
- Generative Models
  GAN, VAE, Bayesian
- Physical Systems
- Reinforcement Learning

Partnership

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Новосибирский государственный университет
*НАСТОЯЩАЯ НАУКА

IPGG SB RAS

Laboratory on Machine Learning in Oil & Gas Industry

Research and Innovation Projects:

- applied projects
- partnership with oil/gas companies

Student Training:

- student thesis projects
- publications
- student professional activities

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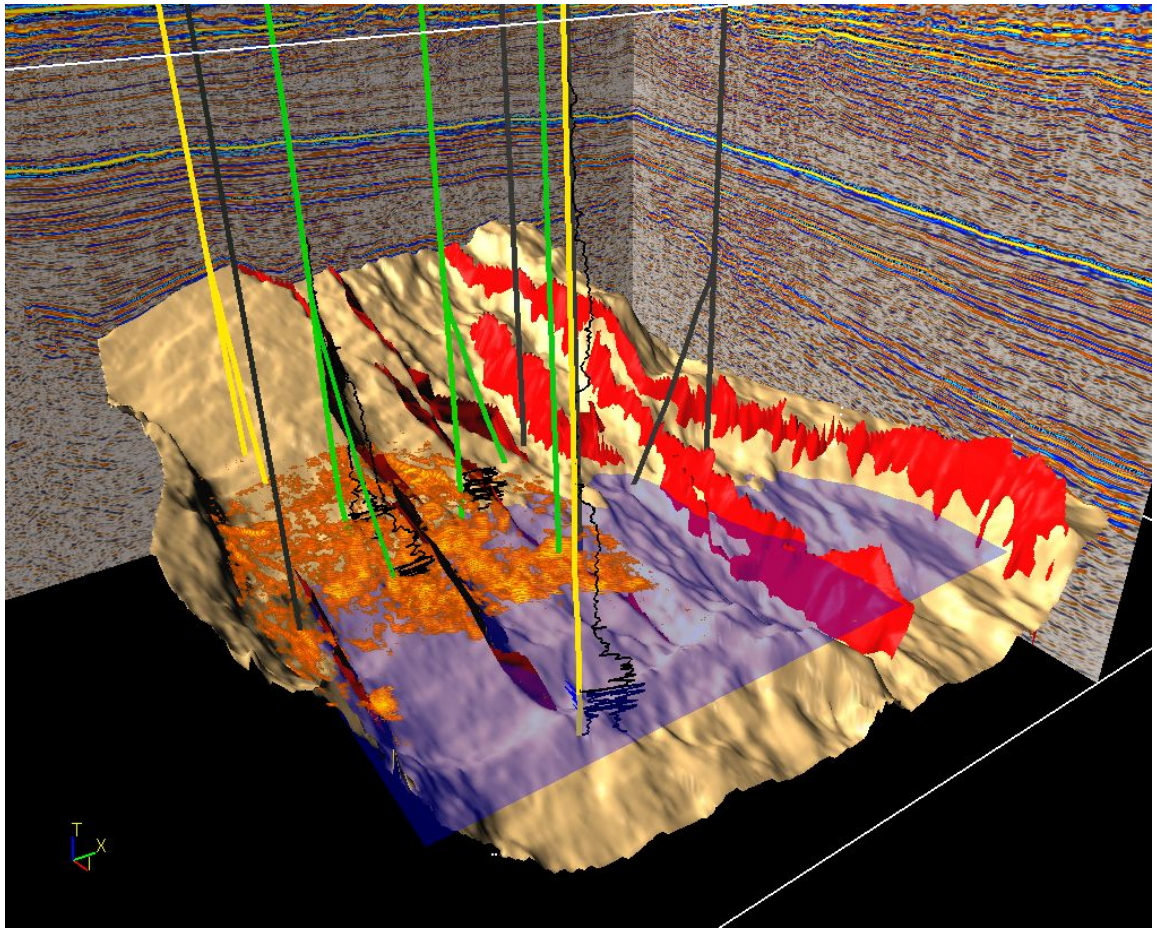
Interpretation



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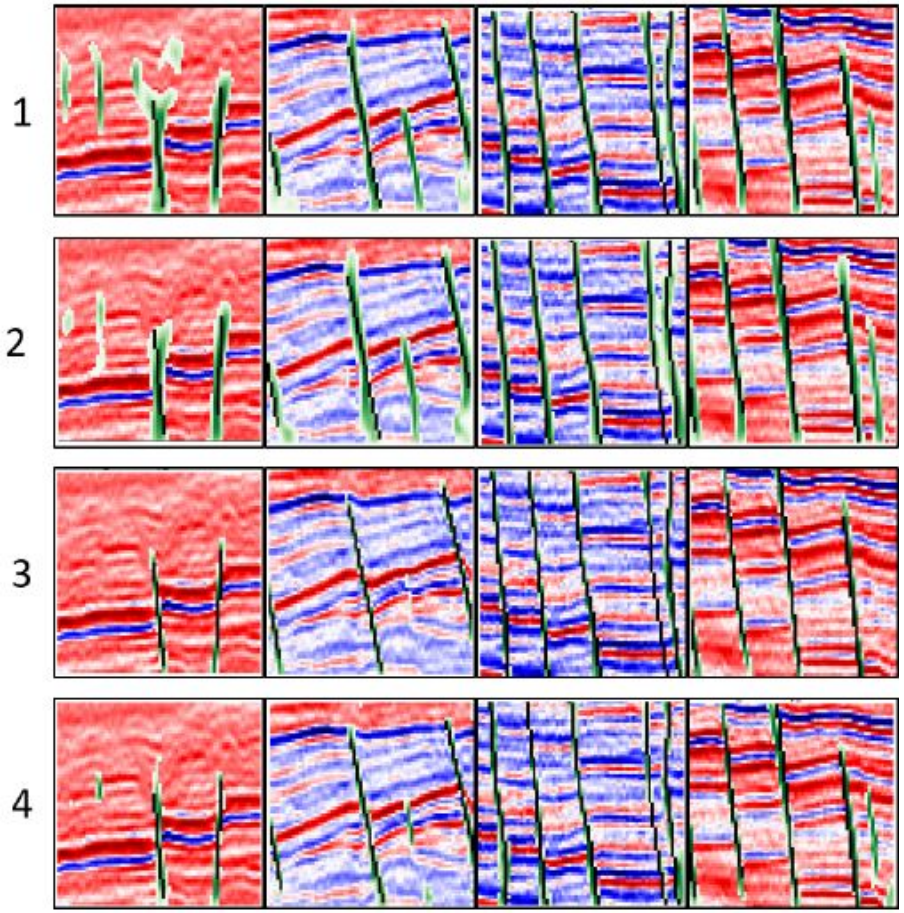
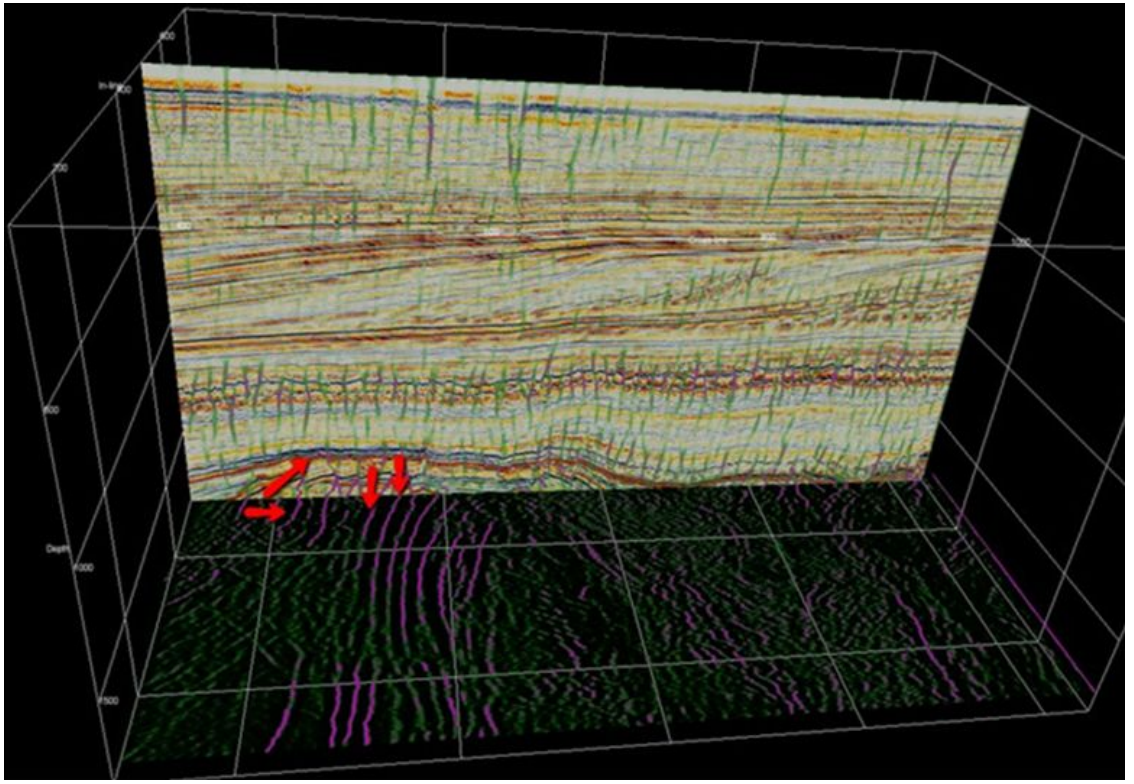
Fault Detection 0

Image Recognition
(CNN)

Generative Models
GAN, VAE, Bayesian





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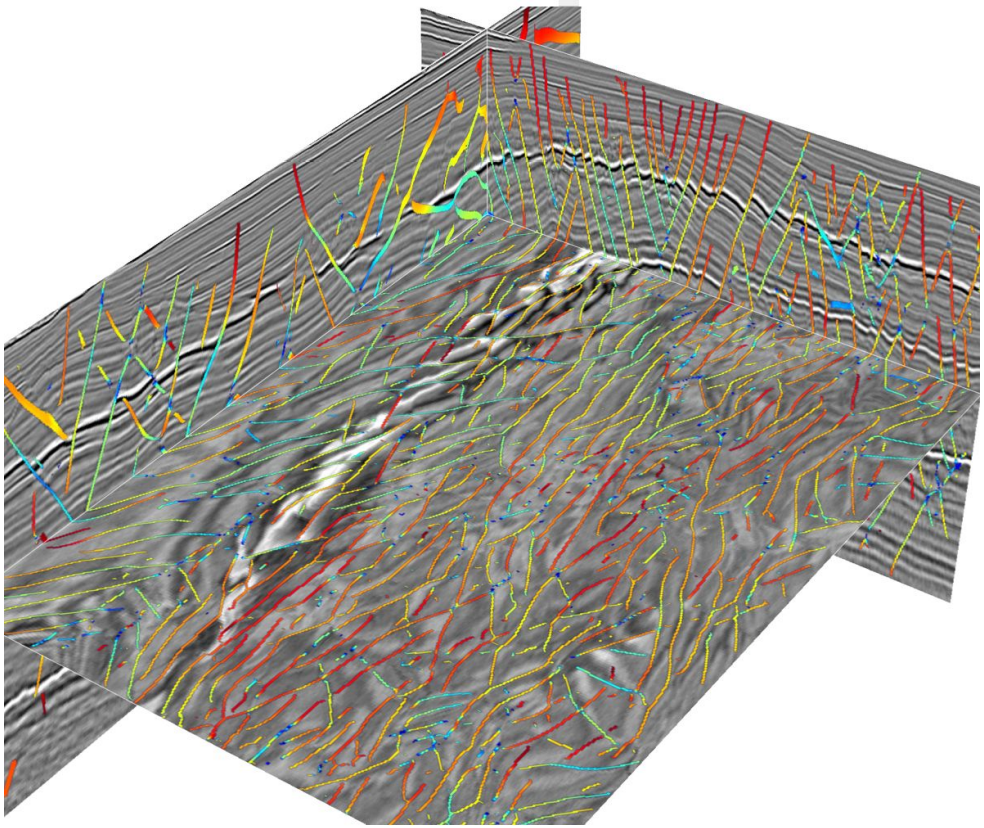
Fault Detection 1

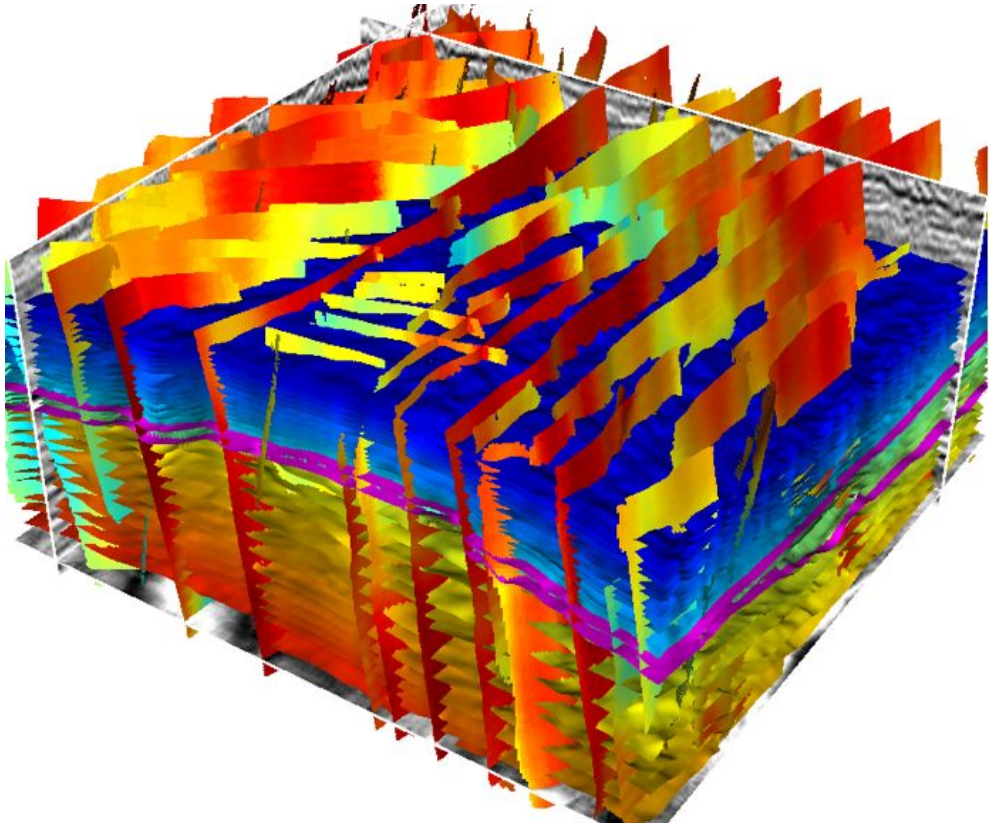
Image Recognition (CNN)

Generative Models
GAN, VAE, Bayesian

Fault detection in slices



Fault surface construction



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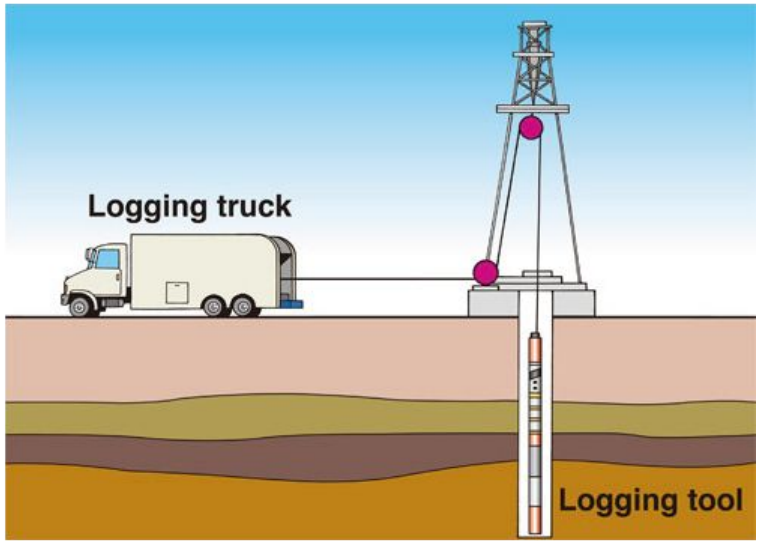
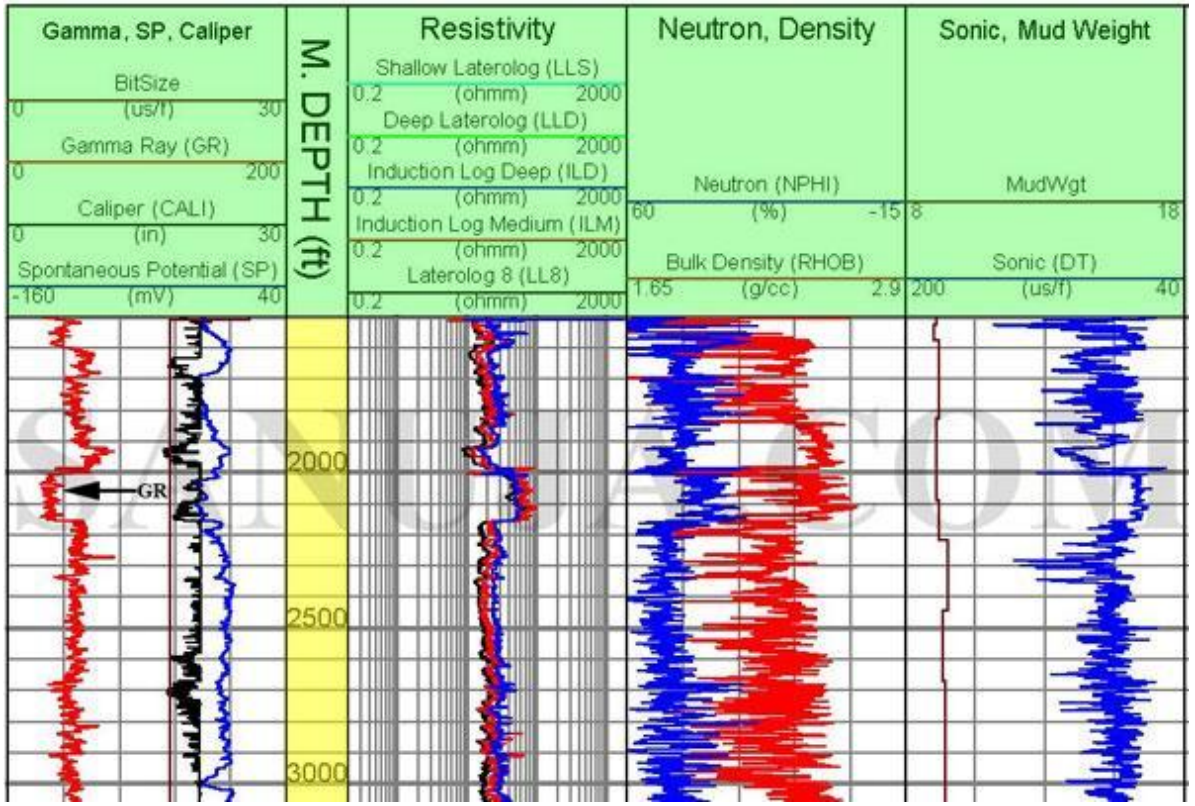
Well logging





www.saltworkconsultants.com
sanuja.com
infolupki.pgi.gov.pl

Petrophysical model

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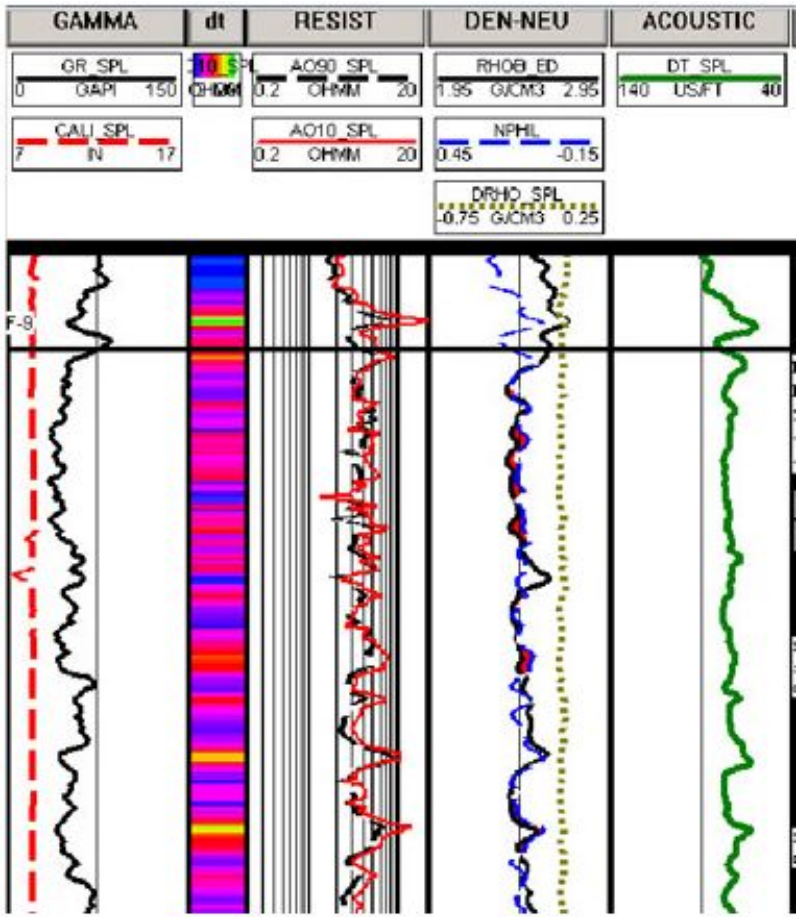
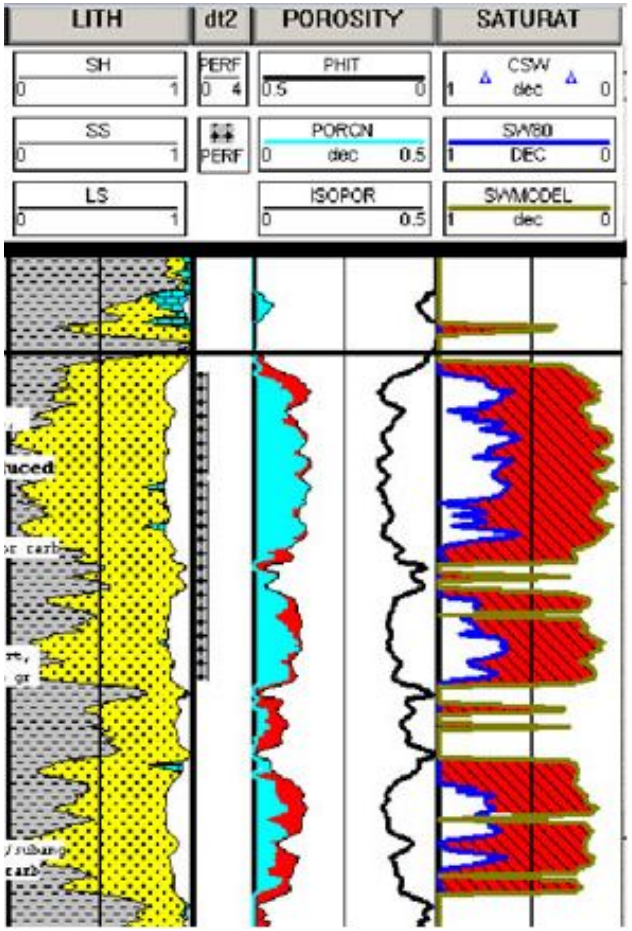
Image Recognition (CNN)

Generative Models
GAN, VAE, Bayesian

Convert well logs to petrophysical models





http://wallace-international.com/

Lithological model

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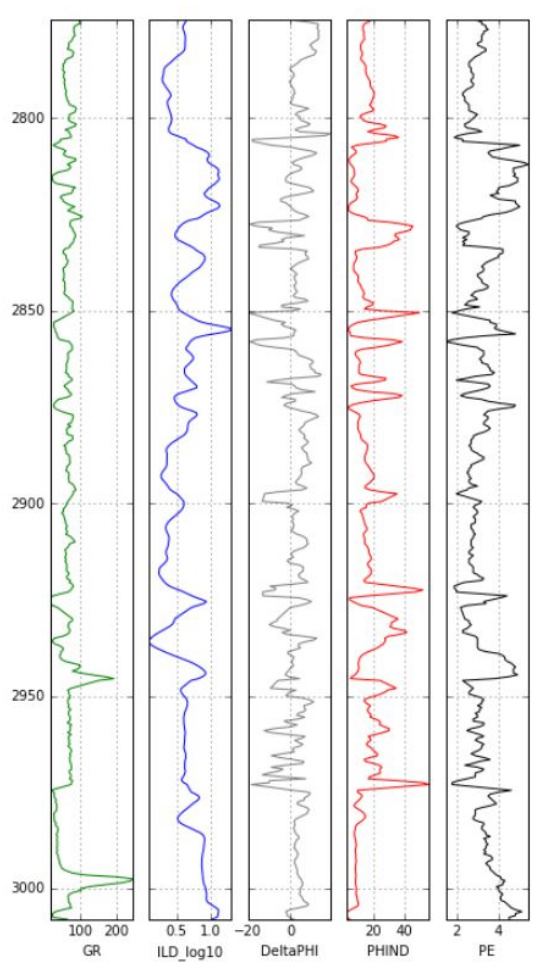
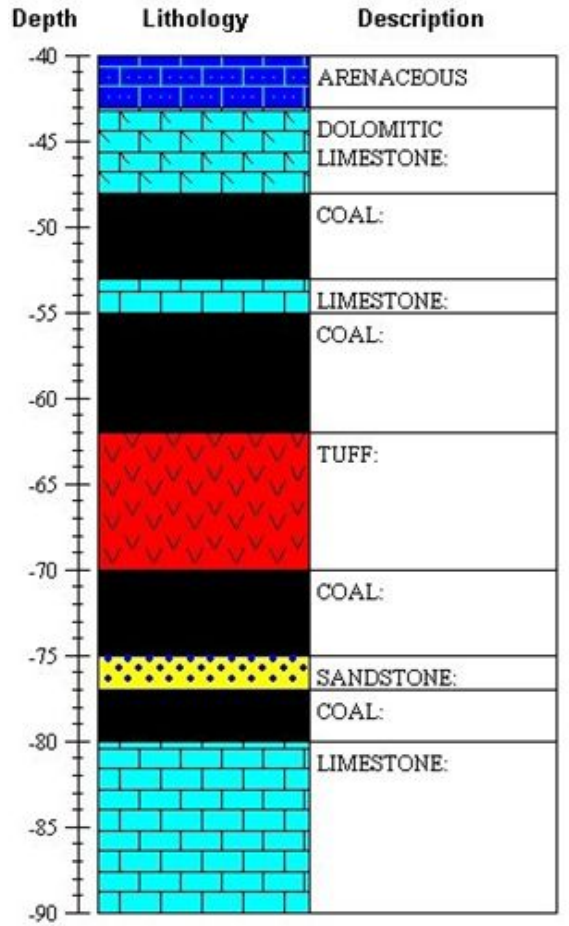
Image Recognition (CNN)

Generative Models
GAN, VAE, Bayesian

Convert well logs to rock types





http://www.reddoggeo.com/

[Hall, 2016]

Well Correlation

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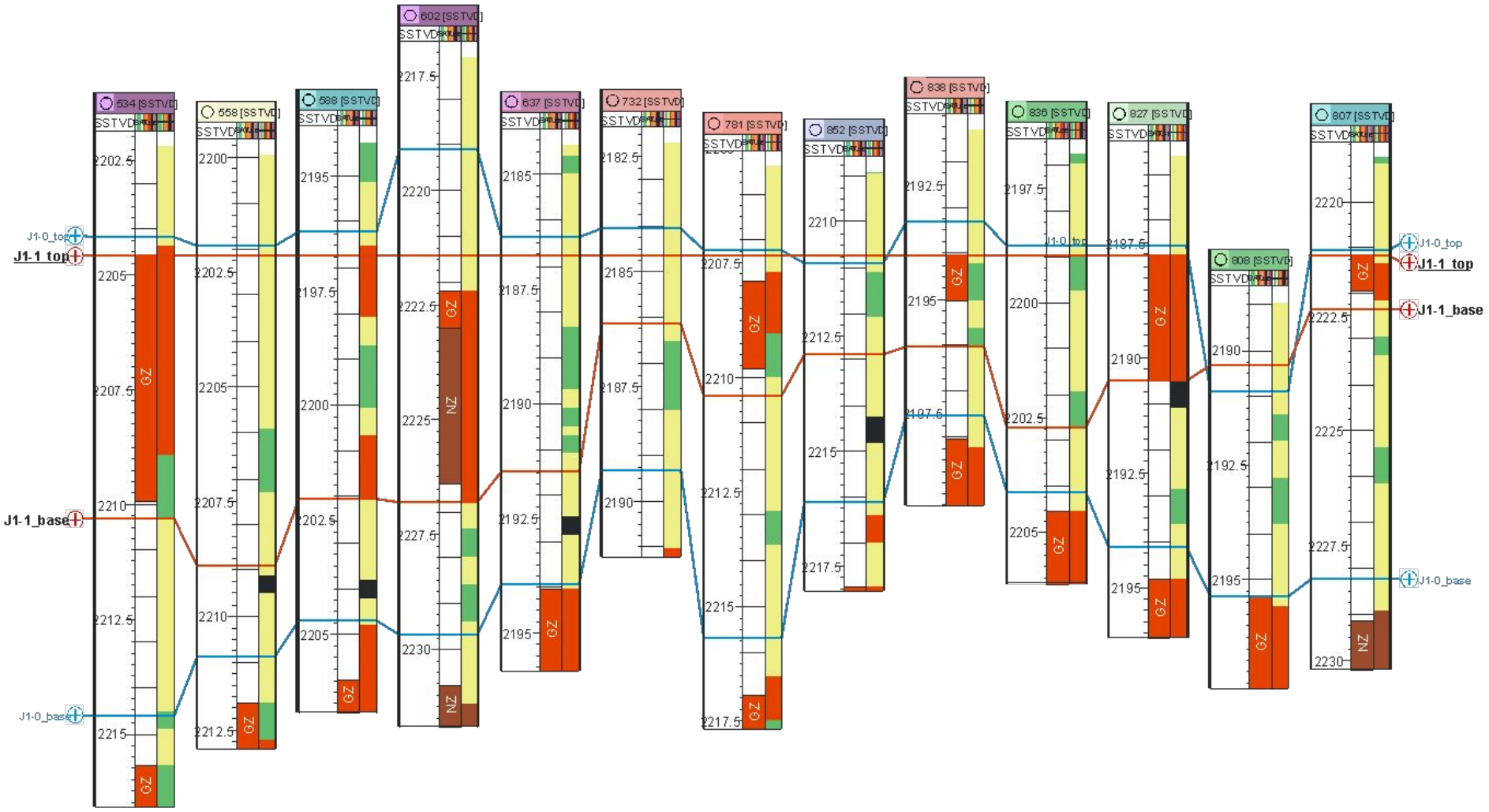
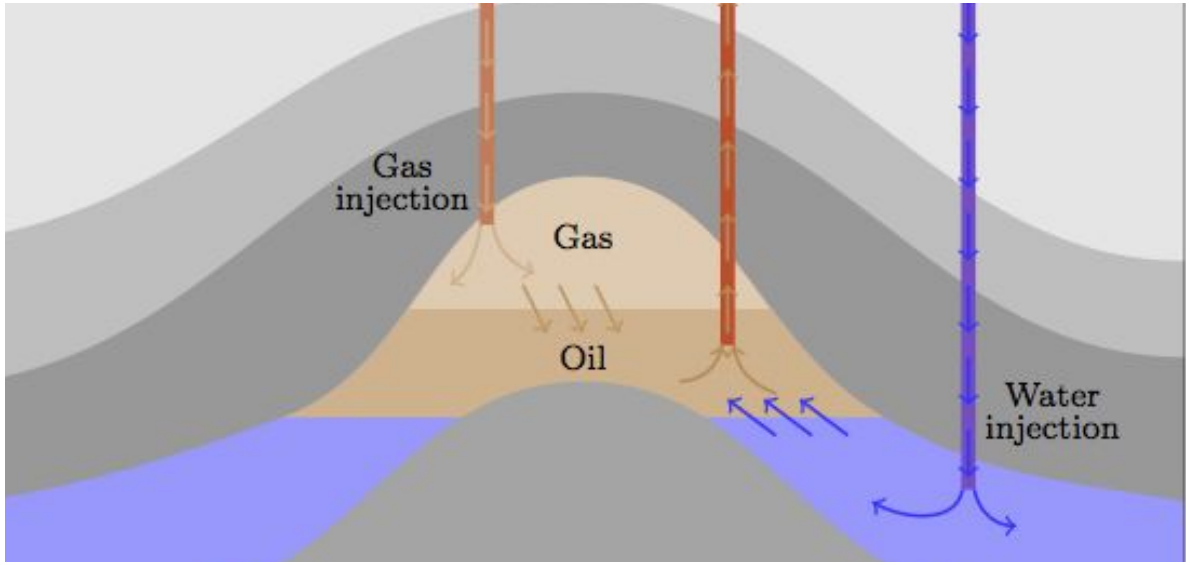
Image Recognition (CNN)

Generative Models
GAN, VAE, Bayesian



Production



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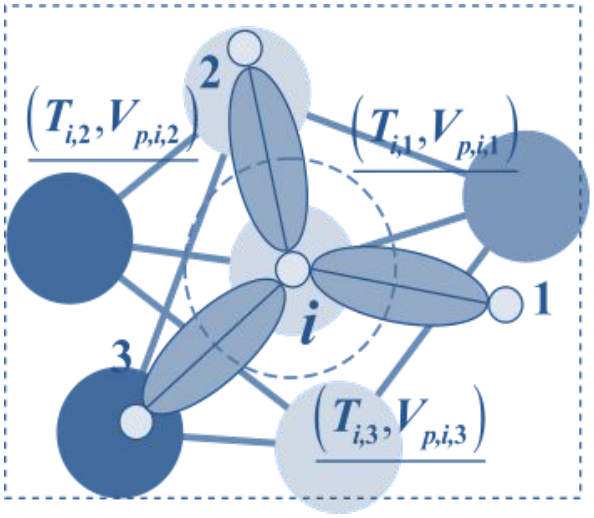
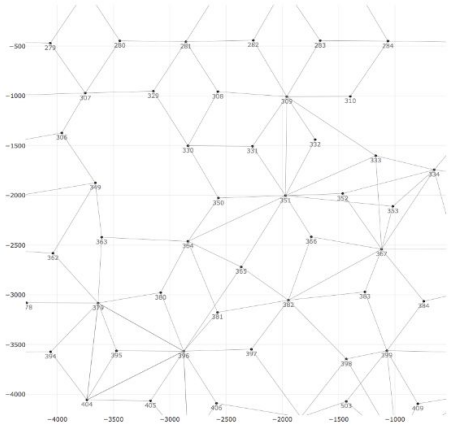
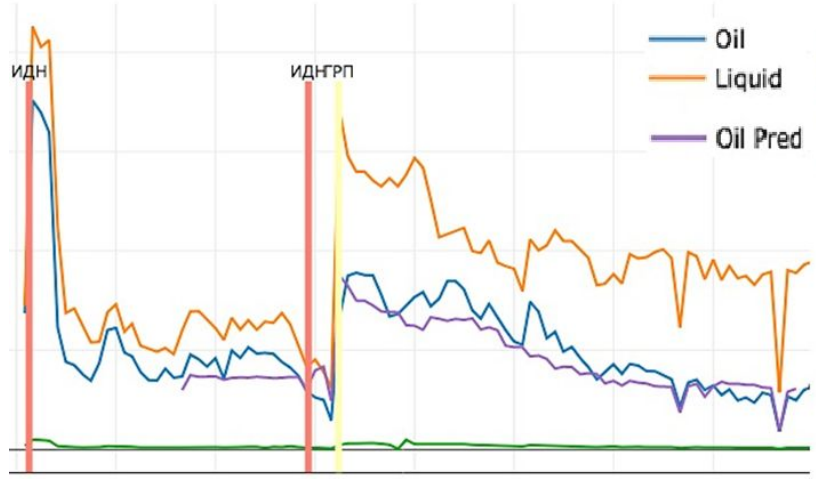
Production 0

Physical Systems
(explicit PDE)

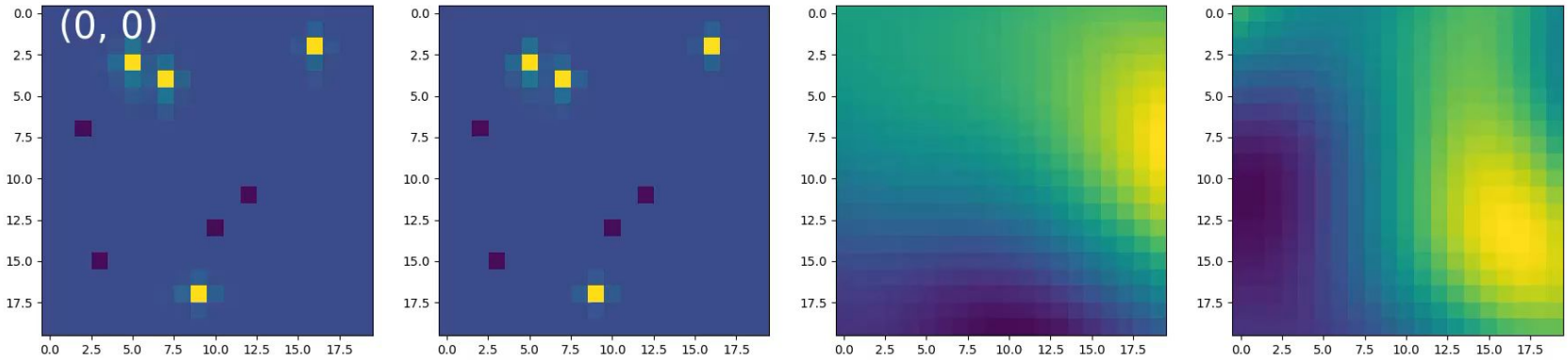
Production Modelling using Proxy Models. History matching of physical Proxy Models to production data.







Simple equations: $$cV_i \frac{dp_i}{dt} = \sum_j T_{ij}(p_j - p_i) + q_i$$


(0, 0)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

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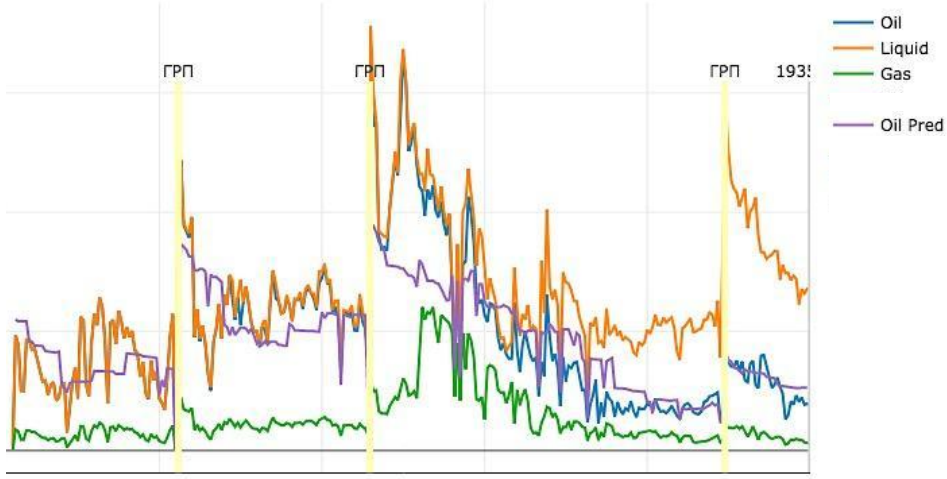
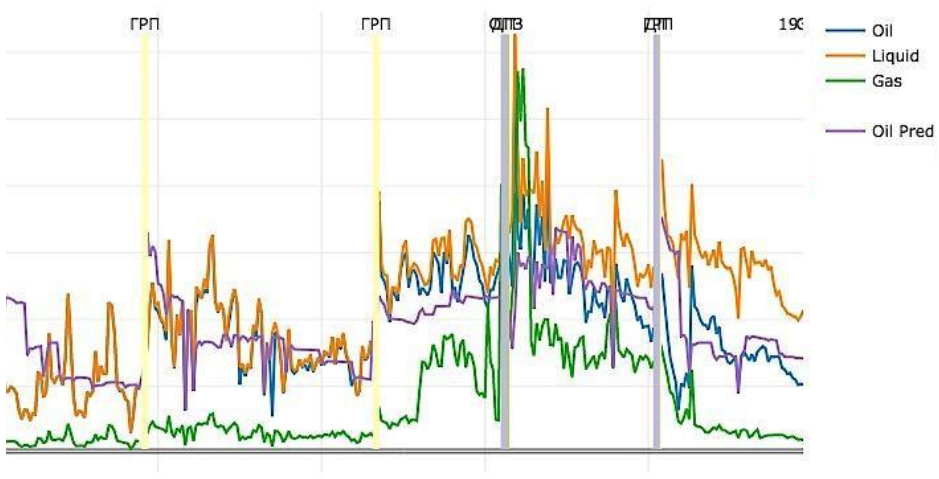
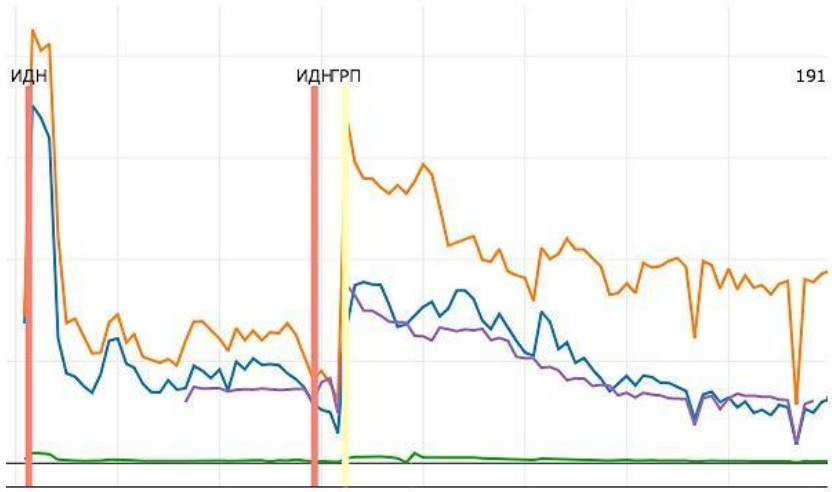
Examples. Monthly well production.







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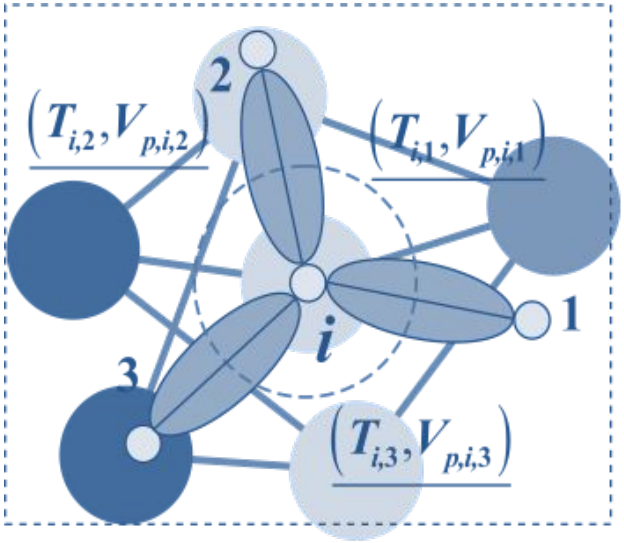
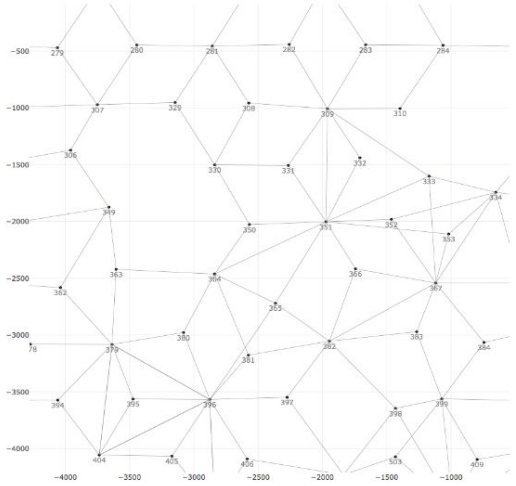
Production 1

Generative Models
(GAN, VAE, Bayesian)

Physical Systems
(explicit PDE)

Production Modelling using Proxy Models. History matching of physical Proxy Models to production data with uncertainty.





Simple equations: $$cV_i \frac{dp_i}{dt} = \sum_j T_{ij}(p_j - p_i) + q_i$$

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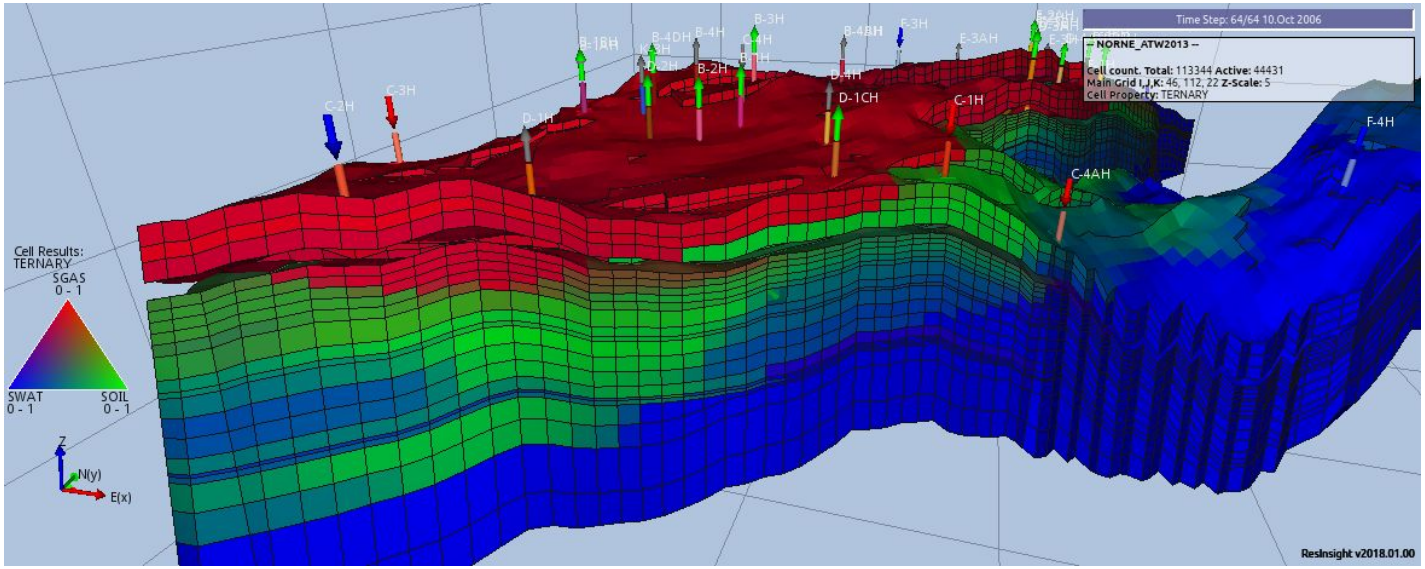
Production 2

Generative Models
(GAN, VAE, Bayesian)

Physical Systems
(learn from simulator)

Production Modelling using simulator. History matching of simulator models to production data with uncertainty.



Pressure equation: $$c\phi\rho\frac{\partial p}{\partial t} = \nabla\frac{\rho K}{\mu}\nabla p + \rho q$$

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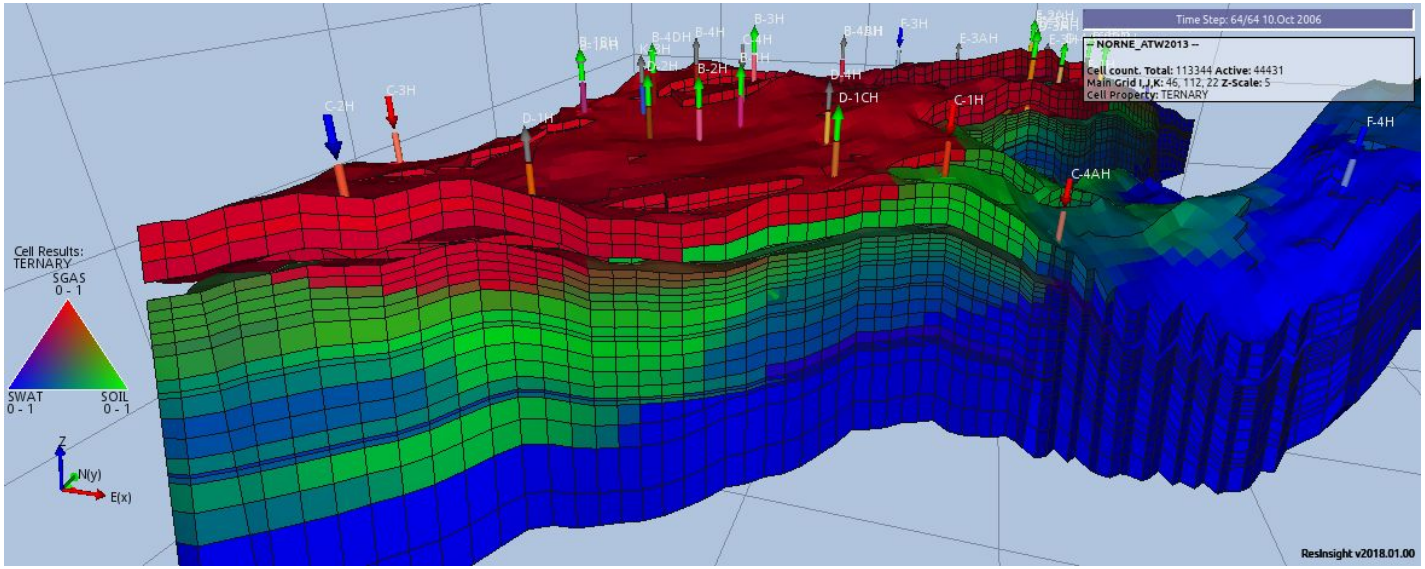
Production 3

Generative Models
(GAN, VAE, Bayesian)

Physical Systems
(explicit PDE)

Reinforcement
Learning

Optimization of production using simulator with uncertainty.



Pressure equation: $$c\phi\rho\frac{\partial p}{\partial t} = \nabla\frac{\rho K}{\mu}\nabla p + \rho q$$

Partnership

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Новосибирский государственный университет
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SB RAS

Laboratory on Machine Learning in Oil & Gas Industry

Research and Innovation Projects:

- applied projects
- partnership with oil/gas companies

Student Training:

- student thesis projects
- publications
- student professional activities

Anton Duchkov
DuchkovAA@ipgg.sbras.ru