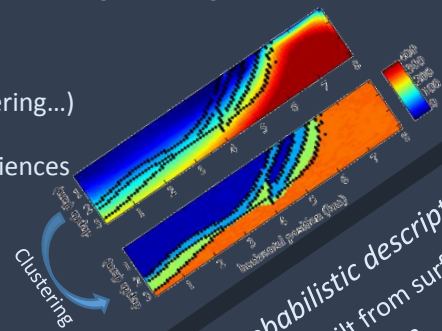


Use of Data Sciences in geophysical exploration to interpret and integrate geophysics, petrophysical and geology

Contributors: Jeremie Giraud, Mark Jessell, Mark Lindsay, Roland Martin, Pakyuz-Charrier and Vitaliy Ogarko

Geophysics: Measure response of earth to calculate bulk physical properties of subsurface through geophysical inversion

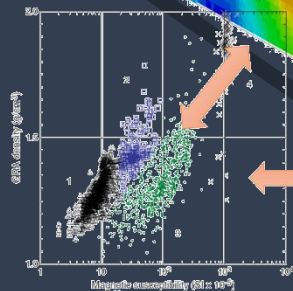
- Non-unique solution to math. problem → explore solution space using random forest, genetic algorithms, MCMC, Bayesian methods
- AI and deep learning to process complex raw field data
- Ambiguous results → classification (k- or c- means, SOM, clustering...)
- Multi-physics, multi-scale integration with other geosciences



Petrophysics: local properties

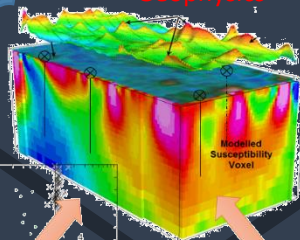
- Discriminate between rock types:
- Voronoi diagrams
- Mixture models
- K-means, SOM, Generative topo. Mapping...
- Spatial Extrapolation/Interpolation
- SOM
- Priors for geological and Geophysical modelling

Petrophysics

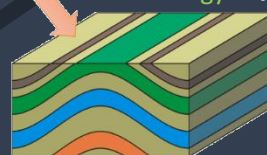


$$P(m) = \sum_{k=1}^K \omega_k N(m|\mu_k, \sigma_k)$$

Geophysics

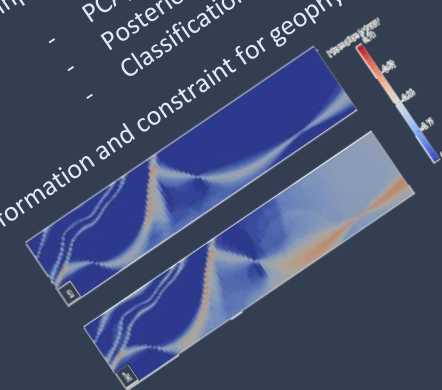


Geology



Geology: probabilistic description of subsurface

- Reference model built from surface measurements
- Monte Carlo on input data
- PCA/NLPCA
- Posterior statistics
- Classification of output models
- Prior information and constraint for geophysics



Concluding remarks

- AI for data processing; Clustering and classification for interpretation
- Deep learning for interpretation – can use large amounts of existing data
- Promising for cross-disciplinary work – between the geosciences and beyond.
- Can play role at each stage of workflow but need to account for specificities of geosciences
- Process of inversion - links with ML and data sciences in general.

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