Norsk Regnesentral (NR) Norwegian Computing Center

Petter Abrahamsen

Joining Forces 22-23 Mai 2013





NR is an applied research institute

- Established by the government in 1952 to run NUSSE
- Private non-profit foundation since 1985
- Financed by:
 - Domestic private companies
 - Public sector
 - Norwegian Research Council
 - EU
 - International companies
- 69 research scientists and 9 staff
- Revenue 82 mill. NOK (11 mill. EUR)





NR has three main activities

 Statistical and mathematical analysis and modeling

Image analysis and pattern recognition

 Information and communication technology (ICT)



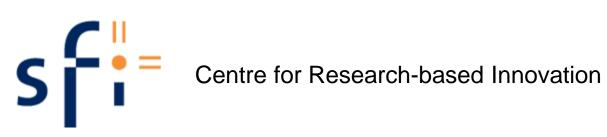




NR works in six main application areas



Statistics for Innovation (sfi)²



UiO : Universitetet i Oslo







The SAND (Statistical Analysis of Natural Resources) group

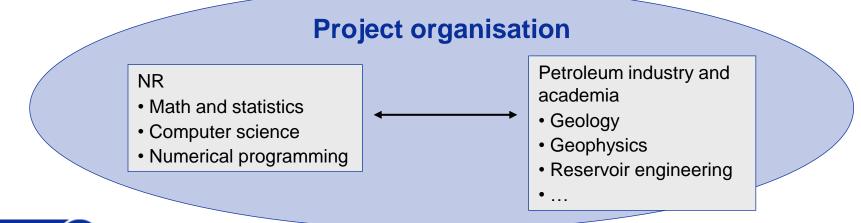
- One of 3 research groups at NR
- Currently 18 persons
 - 9 PhD's
 - 2 PhD students
 - Background from math, statistics, physics, and computational chemistry
- 350+ conference contributions and journal articles
- Main markets are
 - National oil companies
 - International oil companies
 - Roxar Software Solutions
 - National research institutes
 - Public science funding including EU





Key competence

- Math, statistics and stochastic modelling
 - Geostatistics, spatial statistics, stochastic simulation, data analysis, data integration, Bayesian methods, Markov chain Monte Carlo
- Software implementation
 - C++, Matlab, R, Excel (+@Risk)





Main research areas



Petroleum reservoir models



Structural geology



Inversion of geophysical data



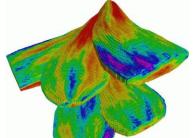
History matching and dynamic data



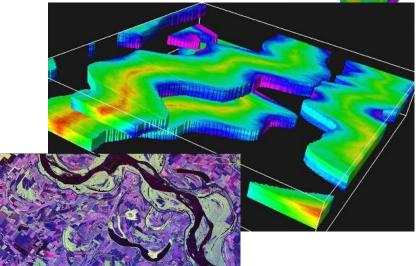
Decision support and data analysis

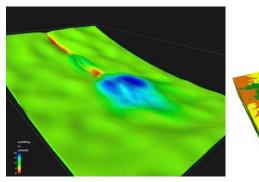


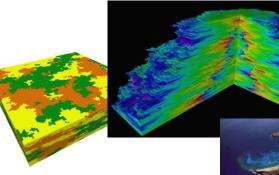
Petroleum reservoir models

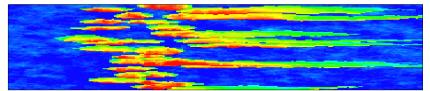


- ► 3D heterogeneity models for
 - Fluvial deposits
 - Shallow marine
 - Turbidites
 - ...
- Consistent with data
 - Wells
 - Seismic data
- ► Challenges:
 - Process models
 - Speed
 - Ease of use



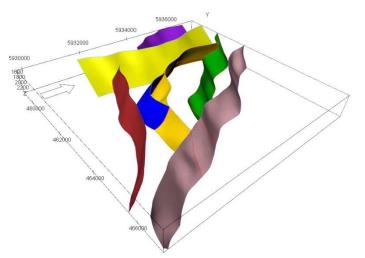


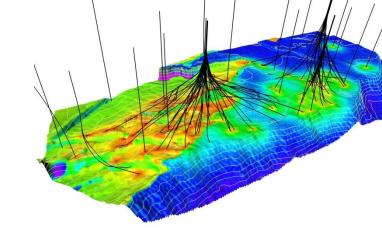


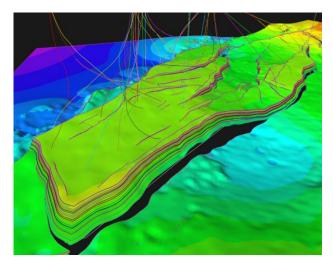


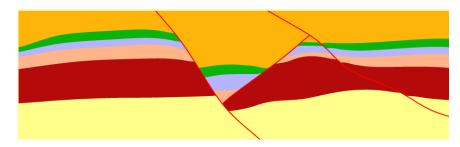
Structural geology

- Surface modelling
 - Depth conversion
 - Horizontal wells
 - QC
- ► Fault modelling
 - Uncertainty
 - Perturbations
 - Automatic



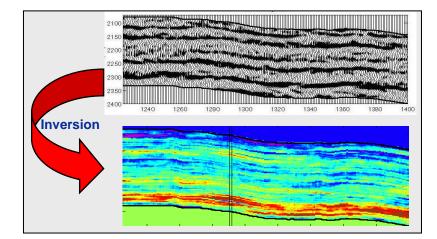


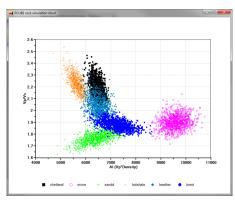


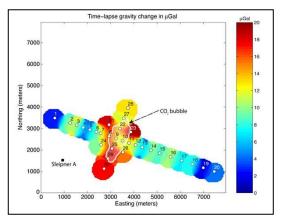


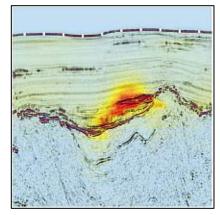
Inversion of geophysical data

- Inversion
- Rock physics
- ► Time lapse
- ► Challenges:
 - Resolution
 - Ambiguity
 - Consistency
 - Uncertainty





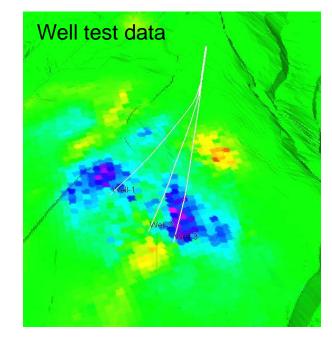


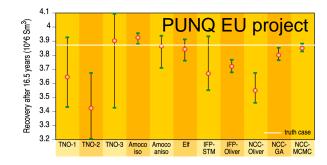




History matching and dynamic data

- Major challenge:
 - Condition 3D geomodels to dynamic data (history matching)
 - Well tests
 - Reproduce connectivity
- Some approaches:
 - Ensemble Kalman filter (and other smoothers)
 - Modify geomodel in near-well area





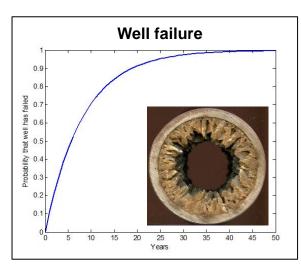


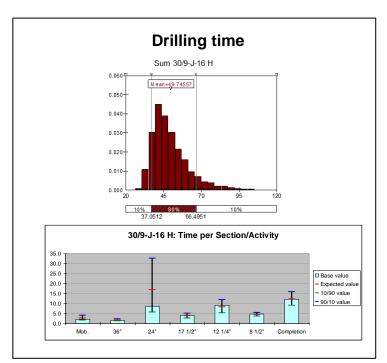
Decision support and data analysis

- Uncertainty modelling
 - Combine scenario and Monte Carlo analysis
 - Correlations in portfolios
 - Time dependency

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Data analysis

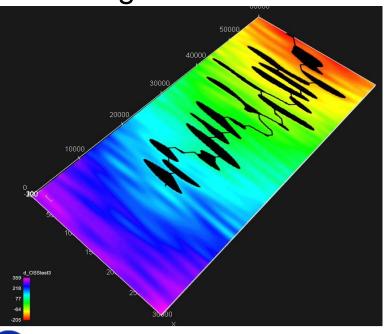






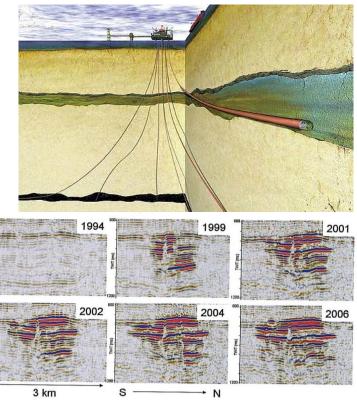
CO₂ storage

- Predict capacity
- Leakage risk
- Monitoring









So we know math/statistics but work in G & G applications...

Cooperate with vendors, oil companies, research institutes and universities









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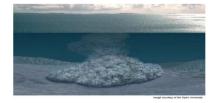
Institutt for energiteknikk

UiO : Universitetet i Oslo

SINTEF



TuMod – Turbidite Modelling



🔀 The **Research Council** of Norway

Objectives:

- Develop methodologies, algorithms, and software tools for modelling deep-water (turbidite) reservoirs.
- Combine stochastic modelling approaches with process based models that describe the appropriate sand-body geometries.



- Challenges:
- Diversity in phenomenon
- Scale (1km 1000 km)
- Data (none a lot)







- Buland, A., and H. Omre, 2003, Bayesian linearized AVO inversion: Geophysics, 68, 185-198
- Buland, A., Kolbjørnsen, O. Hauge, R., Skjæveland, Ø., and Duffaut, K, (2008) Bayesian lithology and fluid prediction from seismic prestack data: Geophysics 2008 ;Volum 73.(3) s. C13-C21

Probability for HC

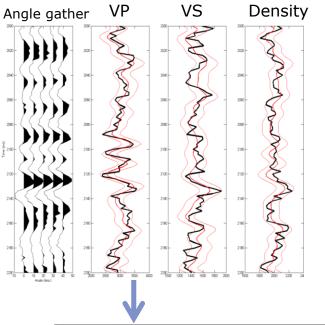


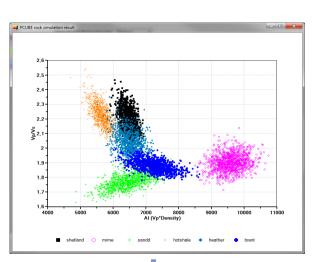
Integration of knowledge:

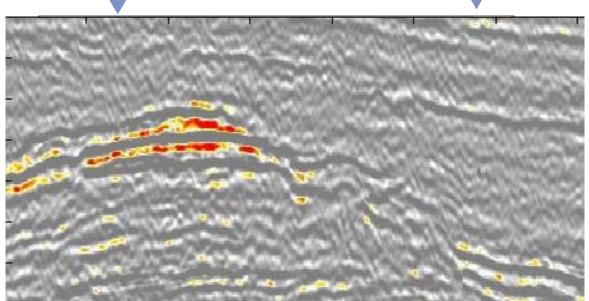
- Seismic amplitudes
- Conseptual model
- Rock physics

Output:

 Probabiility of Lithology and fluid classes.

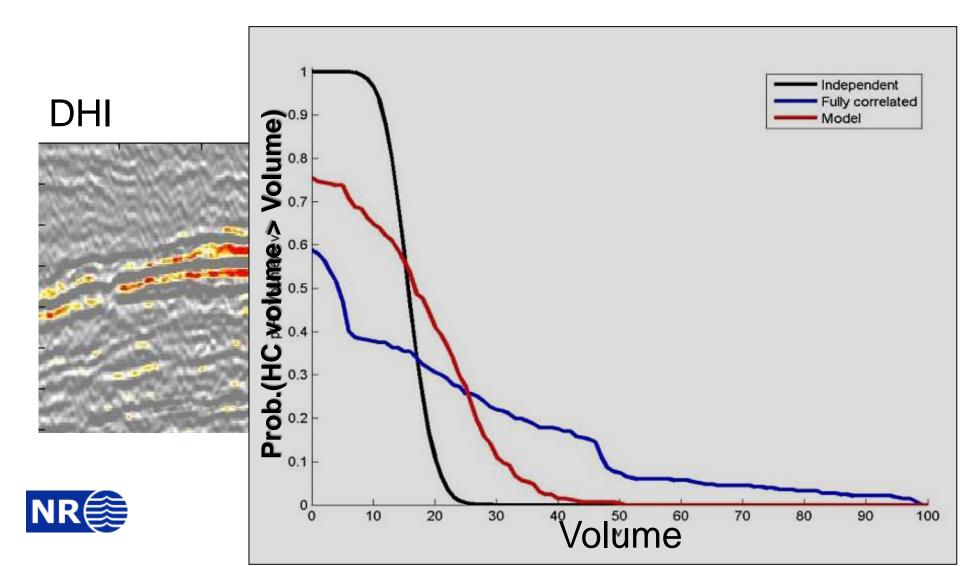








Project proposal: Using Geological 3D Models to Improve Risking of Hydrocarbon Prospects



Project proposal: Using Geological 3D Models to Improve Risking of Hydrocarbon Prospects

Objectives:

The primary objective of the project is to develop accurate methods for calculating the probability for a certain amount of oil, condensate, or gas in a given prospect constrained by geological assumptions, rock physical knowledge and data from a seismic survey.

- Secondar Ajectives: 1. Establis Val Gast A 2 Cebirt With g Span Ser Sconstrained by seismic data.
- **2. Develop methods for verifying the statistical model.**
- 3. Development d f ne é é d'veron e lo motre or general classes of discrete
- 4. Obtain volume distributions (risked volume) for specific fluid scenarios, by combining objective 3 with travel time and zone probability inversion.
- 5. Find fluid scenario probabilities.
- 6. Develop methods for assessment of the quality of algorithmic approximations.
- 7. Use the probability distributions for hydrocarbon to improve placement of drilling targets in the exploration and appraisal phase.

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8. Educate 1 PhD or postdoc.





We have

- Highly skilled professionals
- Unique competence
- Long history of successful projects
 - Research (publications, presentations, PhD's,...)
 - New methods
 - Case studies
 - Commercial software



Thank you for your time

