Reservoir Model Design (G025)

Tutor(s)

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Overview

This course offers a software-independent view on the process of reservoir model design and simulation model-building, addresses the underlying reasons why some models disappoint and offers solutions that support the building of more efficient, fit-for-purpose models.

Considerable time is dedicated to reservoir model and simulation exercises in many companies but the results often disappoint: the time taken to build models is often too long, the models too detailed and cumbersome and the final model is ultimately not fit-for-purpose. This course examines the reasons why and offers remedies to fix these problems.

Duration and Logistics

Classroom version: 4 days; a mix of classroom lectures (60%), case studies (20%) and exercises (20%). The manual will be provided in digital format and participants will be required to bring a laptop or tablet computer to follow the lectures and exercises.

Virtual version: Four 4-hour interactive online sessions presented over 4 days, including a mix of lectures (60%), case studies (20%) and exercises (20%). A digital manual and hard-copy exercise materials will be distributed to participants before the course.

Level and Audience

Advanced. The course is aimed at geoscientists with knowledge of reservoir modeling software, petrophysicists who provide input to static reservoir models and reservoir engineers involved in simulation work who deal with the static-dynamic interface on a regular basis. The course is also of benefit to team leaders who wish to have a deeper understanding of the principles behind modelling and how to QC models made by others. The ideal group is an asset team who can join the course together.

Objectives

You will learn to:

1. Create a fluid-sensitive conceptual model for a heterogeneous reservoir, built from a selection of elements and placed in a realistic architectural framework: the “sketch”.
2. Guide the use of geostatistical tools intuitively, balancing deterministic and probabilistic components with awareness of the limits of the tools.
3. Select appropriate methods for modeling of matrix properties, including the handling of net (cut-off’s vs total property modeling).
4. Evaluate fracture properties, covering both faults and fault seal, and also flow through open fracture systems – understand how to model these practically.
5. Understand issues surrounding permeability modeling and why this differs from the handling of

other properties.

6. Learn a rule of thumb (“Flora’s rule”) to help assess what level of static model detail matters to flow modeling and forecasting.
7. Review how to use well test analysis to constrain models.
8. Review options for model-based uncertainty handling (base case led, multi-deterministic scenarios, multi-stochastic ensembles), learn how to post-process the results and how to select an appropriate workflow which minimizes impact of behavioral bias.

Course Content

Course Details

The central theme of the course is Reservoir Model Design, on the premise that it is design rather than software knowledge that typically distinguishes “good models” from “bad models”. The advice is based on the experience of the course originators, who have been involved in excess of 100 reservoir modeling and simulation projects over the last 30 years.

The course is organized around the following five themes, issues within which are often the cause of poor model outcome:

- **Model purpose**
  Why are we logged on in the first place and what is the question we are specifically trying to address? What do we really mean when we say “fit for purpose”?
- **Elements and architecture**
  How much detail should be incorporated into the models? From the rich spectrum of potential lithofacies, electrofacies, biostratigraphic and analogue data inputs, how do we select the “right” number of components (elements) to take forward into the modeling process? Once selected, how do these elements combine into a realistic description of length scales and reservoir architecture? How to capture this in an interpretative sketch that can be used as a cross-discipline communication tool.
- **Probability and determinism**
  Is the balance of probabilistic and deterministic components appropriate given the model purpose? Should heterogeneities be handled implicitly or explicitly in the static and dynamic models and if implicitly, then how should we average their properties? What are our expectations of geostatistics and how do we control the algorithms intuitively to replicate a sketched reservoir concept? This applies both to modeling of the matrix and also fractures, and we explore how we can use well test data to place deterministic constraints on our models.
- **Multi-scale modeling**
  What scale should we be modeling and simulating at, given the fluid type and model purpose? Can everything be modeled at one scale, or are static/dynamic multi-scale models required? We address the full spectrum of heterogeneity using the concept of Representative Elementary Volumes and conclude that traditional static-dynamic upscaling is only part of the story and not always the main part. Illustrations of fine-scale “Truth” models will be used to illustrate where we sometimes go wrong when we over-simplify a design.
- **Model-based uncertainty-handling**
  How to really go wrong. What are the tools we can use to identify natural bias (heuristics) in the modeling process and select workflows that capture useful ranges in a practical way, minimizing bias in the process. We summarize the current range of stochastically and deterministically led options, including the current trend towards “ensemble” modeling and the use of machine learning and AI. We discuss which techniques are appropriate to use and when, and how to post-process the results and communicate them usefully to colleagues.