Geomodelling for Reservoir Engineers

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Course Agenda

- Basic Concepts
  - Geological modelling
  - Geostatistics
  - Upscaling
  - Uncertainties in reservoir modelling
- Geomodelling Capabilities in Builder
  - Mapping
  - Property distribution though geostatistics
  - Upscaling/up-layering
  - Rescue import/Export
- Exercise

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CMG Workflow

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Geological Modelling

Basic Concepts

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What is Geomodelling?

- All mathematical methods used to produce a geological model of a subsurface object

- Object modelled can describe:
  - Topology
    - history of a region
  - Geometry
    - size, shape, and position in space
  - Physical properties
    - static formation properties

What is Geomodelling?

Primary objective:

- Predict the spatial variation of geological variables

Variable

- Properties of the geological subsurface that exhibit spatial variability and can be measured in terms of numerical values

Spatial Variation

- When a quantity that is measured at different spatial locations exhibits values that differ across the locations

Why Build a Geomodel?

- Handles large amount of data
- Analysis in three dimensions
- Test/visualize multiple geologic interpretations
- Estimate in-place volumes of hydrocarbons in a subsurface reservoir
- Gain an understanding of physical properties of the reservoir
- Input framework for a numerical reservoir simulation
- Development drilling and well planning scenarios
- Exploration
- Surface mine planning
- Assess uncertainty

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Background

- Modern reservoir characterization started due to:
  - Deficiency of oil recovery techniques
    - inadequate reservoir description
  - Aim → predict inter-well property distributions (φ, K)
- Inter-well heterogeneity cannot be measured:
  - Seismic data (large support, low resolution)
  - Well data (small support, high resolution)
- Complementary sources of information:
  - Geological models
  - Statistical models
- Need to combine all info → static reservoir model

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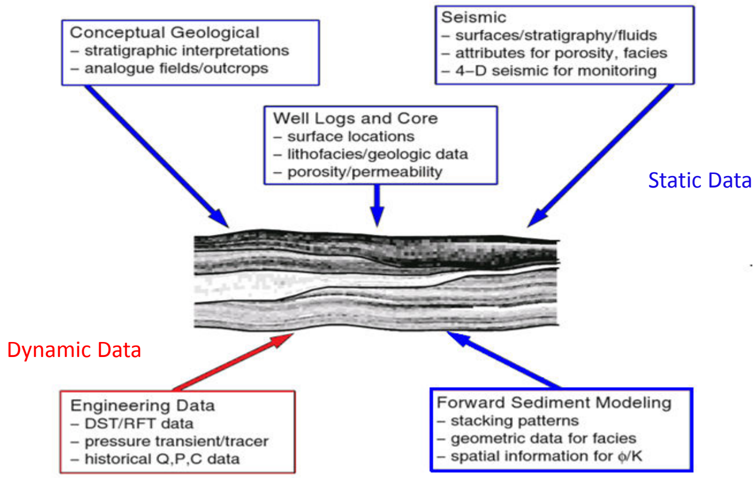
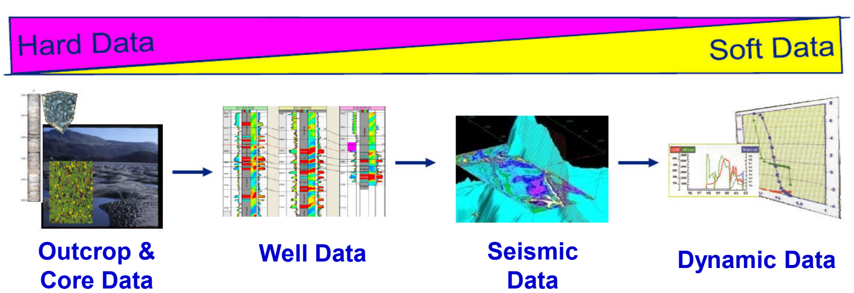
Basic Concepts (Geological Model)



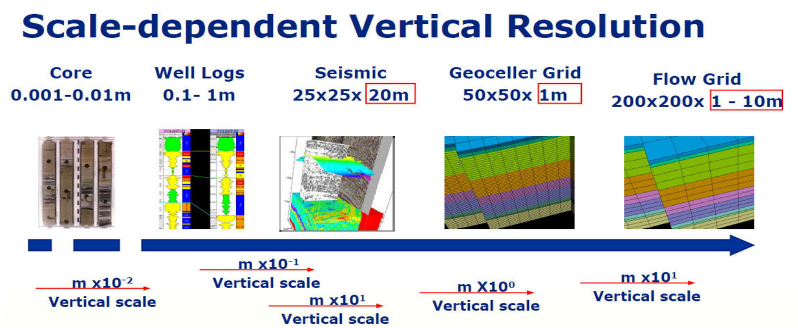
Basic Concepts (Geological Model)

- Typical Data Information
  - Hard or Soft Data



  - In geological model construction, soft data can be used as trend or co-variance data to decrease the geological uncertainty

Basic Concepts (Geological Model)



- Heterogeneity lost
- Sub-seismic faults undetected
- Internal horizontal/vertical barriers missed
- Average properties maintained
- Need to account for all relevant geological, geophysical, and engineering data of varying degrees of resolution, quality, and certainty
  - ❖ A "shared earth model"

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Basic Concepts (Geological Model)

- How can data with different resolutions be merged?
  - Data integration and consistent interpretation
  - Make geological sense of all interpreted data
  - Regional trends and local variations
  - Use hard data to constrain soft data
  - Use seismic for constraining the spatial distribution
  - Layer geometry honours stratigraphic bedding structure

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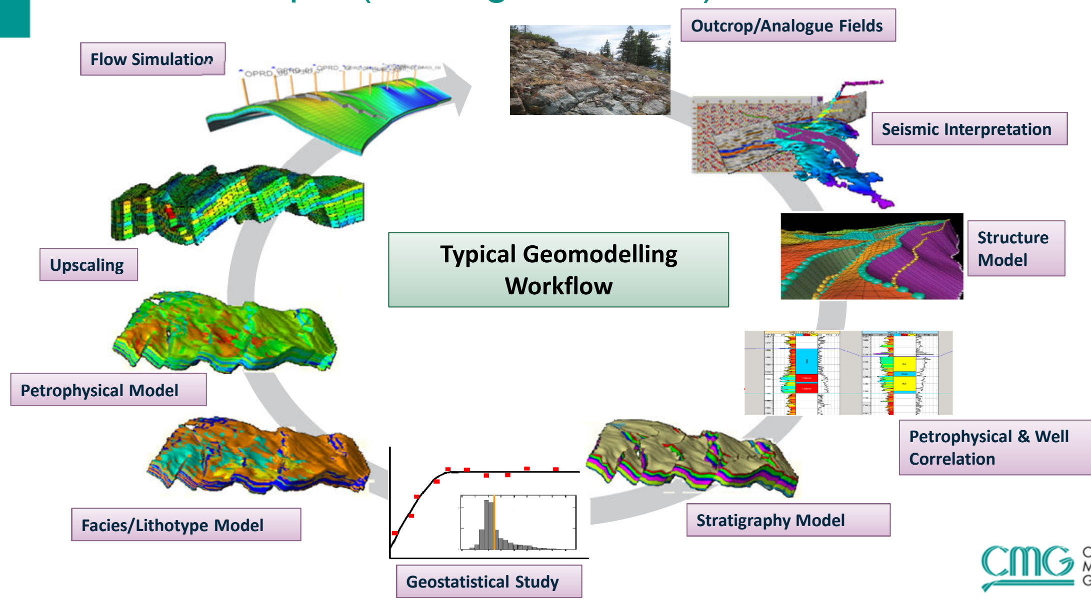
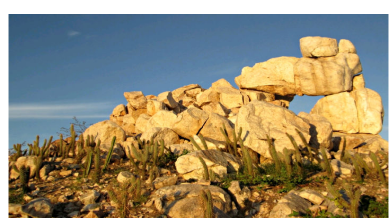
Basic Concepts (Geological Model)



Basic Concepts (Outcrop/Analogue)

- Outcrop is a visible exposure of bedrock on the surface of the earth
- Does not cover the majority of the Earth’s surface as in most places the bedrock is covered by soil and vegetation
- Rock may be exposed due to erosion or tectonic uplift
- Outcrops are visually inspected and analyzed to get an idea of the subsurface formation and bedding



Basic Concepts (Outcrop/Analogue)

- Analogue data is made up from nearby fields with similar rock characteristics and distributions
- Outcrop and analogue field data may provide:
  - Trends and stacking patterns
  - Size distributions
  - Variogram measures of lateral continuity
  - Other translatable spatial statistics
  - Knowledge of geological process/principles established through accepted theories in the area of interest

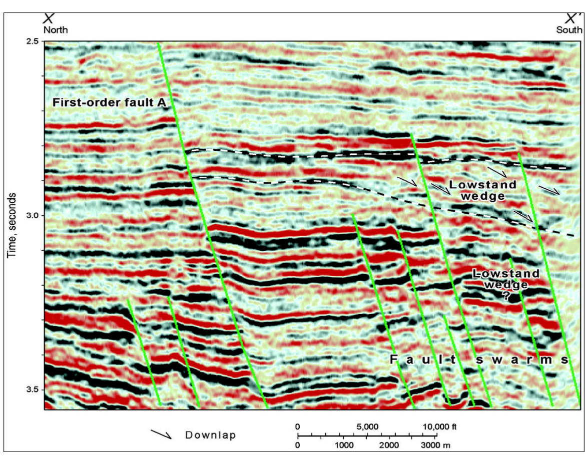
Basic Concepts (Seismic Data)

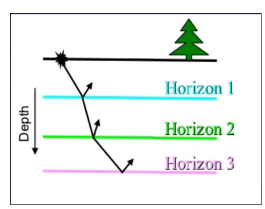
- Seismic data is found by estimating the properties of the Earth's subsurface from seismic testing
- Shock waves are sent into the earth and the data is generated by the sound waves
- The sound waves reflect off the rock formations and are then captured by geophones on the surface
  - A geophone is a device that converts ground movement (velocity) into voltage
  - The deviation of the measured voltage from the base line is called the seismic response
- The acoustic properties of the rock can help determine the type of rock and geological structure
- Seismic Interpretation is the extraction of subsurface geologic information from seismic data

Basic Concepts (Seismic Data)

- The aim of seismic interpretation is to produce structural maps that reflect the spatial variation in depth of certain geological layers
- Seismic data can be used to infer:
  - Structure
    - Faults
    - Fractures
  - Depositional Settings
    - Channels
    - Turbidite system
  - Sand Continuity/Variation
  - Bed Thickness
  - Depositional Facies
  - Reservoir Properties (Φ)
  - Fluid Type Identification

Basic Concepts (Seismic Data)

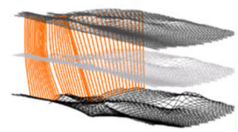




Vertical Seismic Slice Showing Faulted Stratigraphic Features

Structure Model

- Horizons picked on seismic interpretation and well data
  - In absence of seismic data, possible to be based off well data only
- Only faults with sufficient throw that may impact reservoir performance continuity, fluid distribution etc. should be incorporated
- Four main sections of structure modelling:
  - Fault Modelling
  - Pillar Gridding
    - ❖ Faults used as the “skeleton” for generating the 3D grid
    - ❖ Skeleton is grid consisting of a Top, Mid, and Base
  - Surfaces
    - ❖ Full surfaces added to model
  - Depth Conversion
    - ❖ Converts the acoustic wave travel time to actual depth
    - ❖ Based on seismic and well tops



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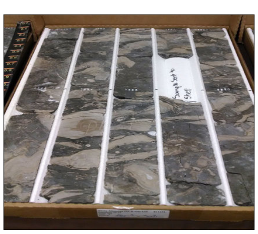
Petrophysical and Well Correlation

- Petrophysics
  - Study of physical and chemical properties of rocks and their contained fluids
  - Emphasizes properties relating to the pore system and its fluid distribution and flow characteristics
  - Highlights the integration of core data with log data; adjustment of core data to reservoir conditions; and the calibration and regression line-fitting of log data to core data
    - ❖ Statistical correlation and calibration of core and log data requires that the data is properly depth aligned, have outliers deleted, and can be mathematically transformed
    - ❖ A variety of line-fitting techniques are available



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Petrophysical and Well Correlation

- Properties to be determined:
  - Thickness (bed boundaries)
  - Lithology (type of rock)
    - Determined by working with cores and rock cuttings
    - Can be combined with log characteristics to identify depositional environments and characterize how these change throughout the reservoir
  - Porosity
    - Computed from well logs in combination with routine-core data adjusted to reservoir conditions
  - Fluid saturations
    - Core analysis and well logs (sw found from resistivity logs)
  - Fluid identification and characterization
  - Permeability (absolute)
    - Calculated from Φ logs through a permeability/porosity transform
  - Fractional flow (oil, gas, water)
    - Core and SCAL analysis

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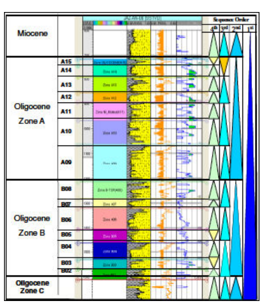
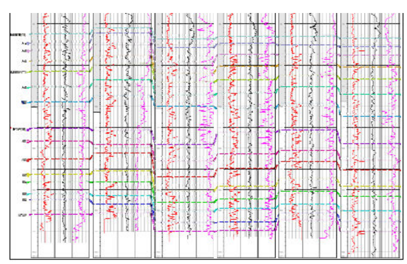
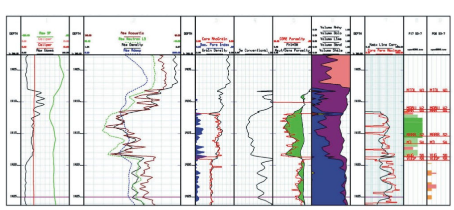
Petrophysical and Well Correlation







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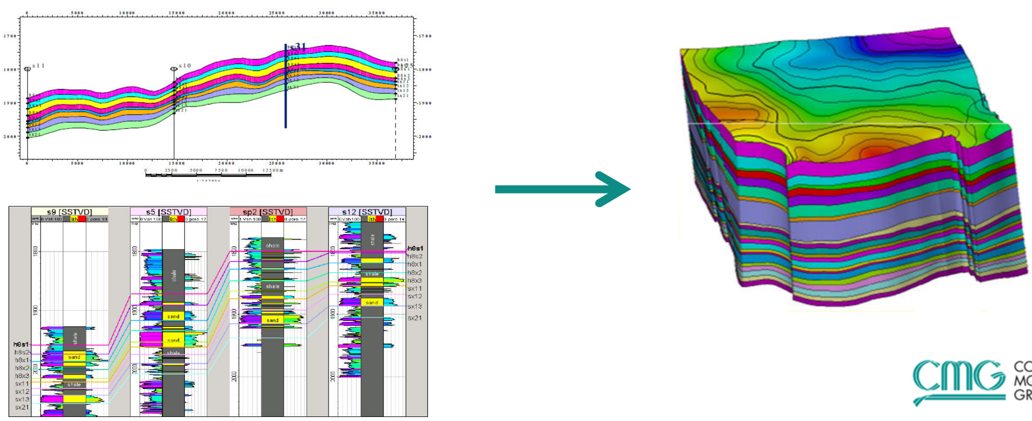
Stratigraphy Model

- Use info from well log and core correlation along with seismic depth conversion to determine stratigraphy
- Subdivide reservoir in zones based on sub-surface horizons and seams



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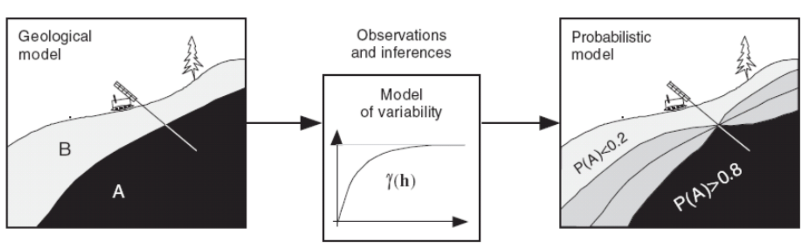
Geostatistical Study

- Statistical method accounting for spatial variability
- Goal:
  - Utilize wide variety of data, in different scales and accuracies, to construct reservoir models
  - Models are able to represent geological heterogeneities
  - Quantifying uncertainties by producing many equiprobable models



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Facies Model

- Facies:
  - A mass of rock that can be recognized by its composition, structures or fossil content and mapped on the basis of those characteristics
  - Within a given faces the reservoir properties can vary significantly
    - ❖ Leads to a further subdivision known as Flow Units
- *Flow Units*
  - Regions in the sedimentary sequence that are judged to control the movement of injected and produced fluids within the reservoir
- Facies Model Integrates
  - Geological Study
  - Geostatistical Study
  - Geophysical Interpretation

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Facies Model (Integration)

- Three main ways to integrate interpretations:
  - Flow Units:
    - Differentiate flow units using relative permeability/SCAL data
    - Model flow units will hopefully align with log properties
      - ❖ Possible correlation to non-cored wells across the field
    - Model network of rock using flow units
      - ❖ Production characteristics of hydrocarbons or water vary by flow unit
  - Log Facies:
    - Separate the reservoir into Φ classes possibly linked to Vshl or other logs curves
      - ❖ Calibrated to core properties or depositional facies
      - ❖ This model may reflect production characteristics
  - Depositional Facies:
    - Rarely link to logs perfectly
    - Dependant on core interpretations → arguable
    - Too many facies = a complicated answer

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Petrophysical Model

- Petrophysical data needs to be upscaled to the geomodel
- Properties from log interpretation:
  - Volume shale
  - Effective Porosity
  - NTG
  - SW
- Log data should honor core analysis and geomodel should honor log data
- Fluid contacts (GOC, WOC) also need to be identified to incorporate into the model

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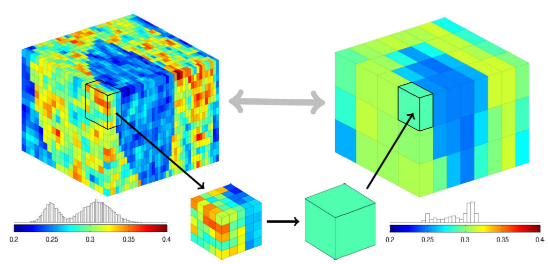
Upscaling

- Geological characterizations typically contain on the order of 10^7 - 10^8 cells
  - This is impractical for flow simulation
  - Long simulation run times
- Upscaling involves reducing the amount of cells by amalgamating the data
- Smaller sets of characteristics to represent the most significant aspect of the reservoir



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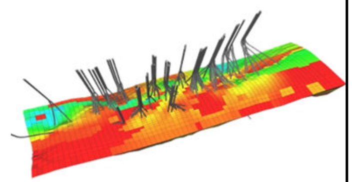
Flow Simulation

- A numerical reservoir simulation model is a grid block model of petroleum reservoirs where each of the blocks represents a local part of the reservoir
- Within a grid block the properties are uniform
  - Porosity, permeability, relative permeability, etc.
- The model incorporates data on:
  - Reservoir fluids (PVT)
  - Reservoir description (porosities, permeability, etc.)
  - Property distribution in space
  - Individual well pressure and flowrates with time



- The purpose of simulation is estimation of field performance (e.g., oil recovery) under one or more producing schemes

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Geological Model Summary

- Reservoir geology is the science of building predictive reservoir models from the foundation of geological knowledge
  - data, interpretations, and models
- Reservoir models represent spatial variation of lithology
  - φ, K distributions $\rightarrow$ static model
- Flow simulations (dynamic models) require high-quality static reservoir models
- Static reservoir models are improved through analysis of dynamic data
  $\rightarrow$ iterative process

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Geostatistics

Basic Concepts

Geostatistics

- What is Geostatistics?
  - Statistical methods accounting for spatial variation
  - Spatial correlation among sample data
  - Science of estimation and simulation for spatial data
  - Data integration

Geostatistics

- Why Geostatistics?
  - Integrate geological knowledge and depositional environment interpretation
  - Predict petrophysical parameters away from well location
  - Identify geological trends
  - Uncertainty analysis

Geostatistic Concepts

- Deterministic
  - All data known beforehand
  - No representation of uncertainty
  - Always reproducible given same starting conditions
- Probabilistic (Stochastic)
  - Element of chance involved
  - Know likelihood something will happen, but don't know when
  - A random probability distribution or pattern that may be analyzed statistically, but may not be predicted precisely

Geostatistics (Deterministic or Probabilistic?)

- Oil reservoirs are physical systems that are perfectly deterministic
  - There is a finite value for all properties in the reservoir
  - However, the problem is sampling
- Geological systems were created by many processes at different scales
- Only have few measurements
  - Lack a great deal of information to fully determine those systems
- Impossible to write the deterministic equations that will calculate the property value observed at any given location in the system
  - e.g. porosity in the reservoir

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Geostatistics (Deterministic or Probabilistic?)

- We do NOT know the behaviour of the system in terms of mathematical equations
- Based on sampling, we can still describe its behavior in terms of statistics and probabilities
- Stochastic = Deterministic + Random
  - Noise is random by definition, most data are stochastic
  - Apparent randomness implies sensitivity to initial conditions
- Stochastic simulation:
  - Generation of hypothetical data (realizations) with certain probabilities by providing (pseudo) random input values

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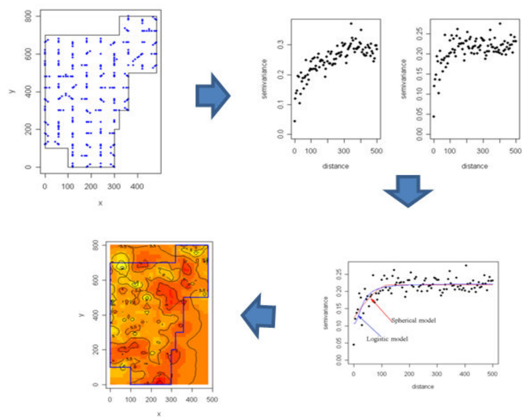
Basic Concepts (Geostatistics)

In general, geostatistical estimation consists of 3 steps:

1. Examine the similarity between a set of sample (known) data points via an experimental variogram analysis
2. Fit a permissible mathematical function to the experimental variogram
3. Conduct an interpolation method based on this function



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Basic Concepts (Geostatistics)

- Geostatistical methods are optimal when data are:
  - Normally distributed
  - Stationary (mean and variance do not vary significantly in space)
- Significant deviations from normality and stationarity can cause problems
  - Always best to begin by looking at histogram or similar plot to check for normality

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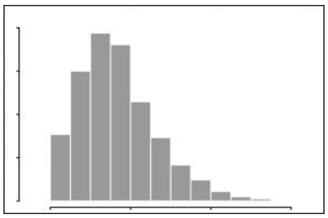
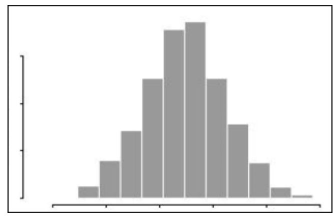
Basic Concepts (Geostatistics)

- Histogram
  - Graphical representation of the distribution of numerical data



Skewed



Normal

Geostatistic Terms

- Variance
  - Numerical value indicating how widely individuals in a group vary
  - The average of the squared differences from the mean

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(xi - \mu)^2$$

N = number of samples
x_i = sample value
μ = mean

Geostatistic Terms

- Standard Deviation
  - Measure used to quantify the amount of variation/dispersion for a set of data values
  - Square root of the variance

$$\sigma = \sqrt{\sigma^2} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(xi - \mu)^2}$$

N = number of data points
x_i = data value
μ = mean

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Geostatistic Terms

- De-clustering
  - Assignment of weights whereby redundant data are given less weight in the construction of a representative probability distribution or the calculation of summary of statistics
    - Used to reduce possible bias in the data histogram
    - Reduces the influence of over sampling in sweet spots (wells drill in good quality reservoir)
    - Clustered data will have lesser weights than isolated data points
    - If not used, the data are all equally weighted
- Normal Scores Transformation
  - Way to normalize data which may otherwise yield a very erratic variogram
  - Useful with any interpolation method when the data histogram is highly skewed
  - Results are transformed back into the original histogram or into the declustered histogram after estimation

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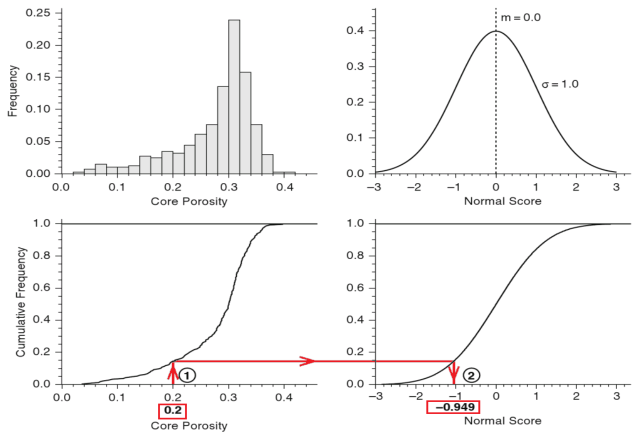
Geostatistic Terms

- Normal Scores Transformation



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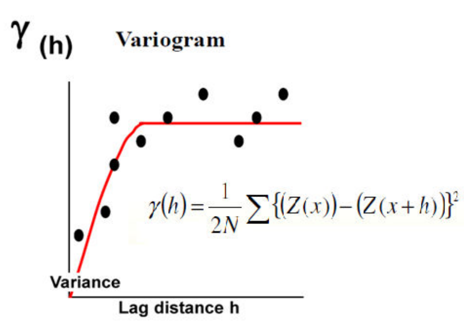
Variogram

- Is a function of the data variance against the distance between the data locations
- Describes the spatial structure and used to model spatial correlation in the data
- May vary with direction
- Each dataset is characterized by its own spatial structure, thus has its own variogram



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Variogram (terms)

- Sill
  - Semivariance value at which the variogram levels off
- Range
  - Lag distance at which the semivariogram reaches the sill value
  - No correlation of data beyond the range
- Lag
  - Separation distance when comparing pairs of data value
- Nugget
  - Semivariogram value at the origin
  - Variability at distances smaller than typical sample spacing, including measurement error
  - Noise level

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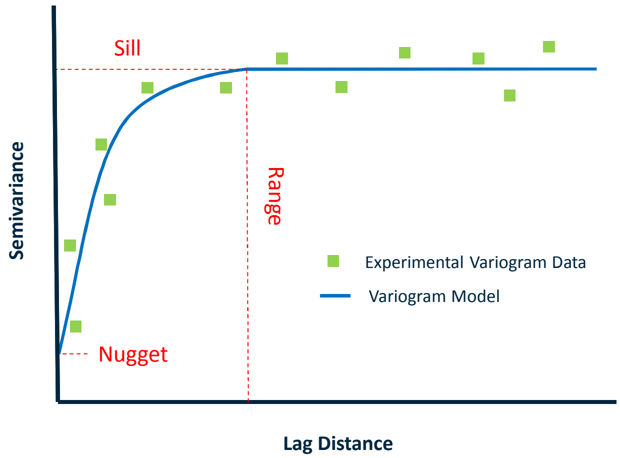
Variogram



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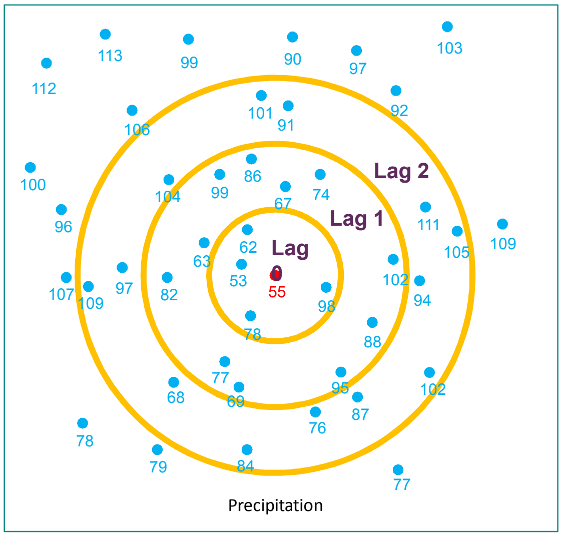
Variogram – Lag



- Pairs of values with respect to point 55 for **Lag 0**:

55	62
55	53
55	78
55	98

- Pairs for **Lag 1**:

55	99
55	86
55	67
55	74
55	…

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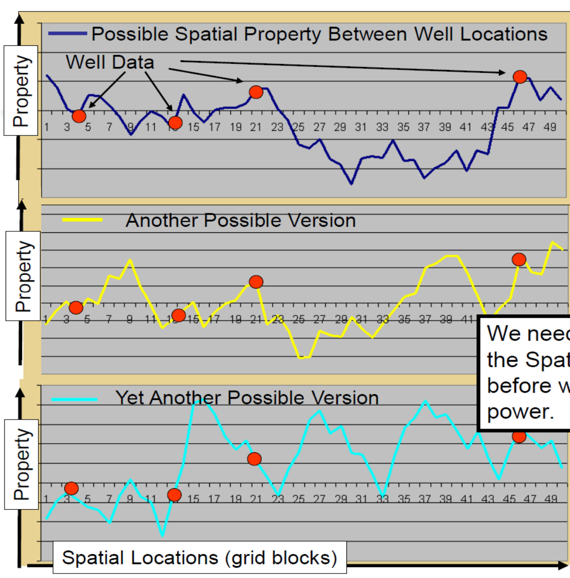
Variogram and Uncertainty



Uncertainty

3 possible and equi-probable versions of same reservoir property among an infinite number

Spatial Random Function

We need to characterize the Spatial Random Function before we can use its predictive power.

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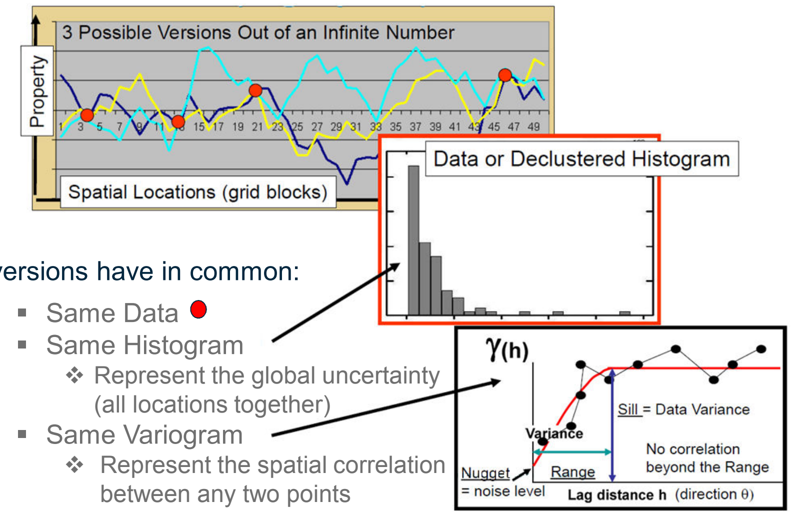
Variogram and Uncertainty



All possible versions have in common:

- Same Data
- Same Histogram
  - Represent the global uncertainty (all locations together)
- Same Variogram
  - Represent the spatial correlation between any two points

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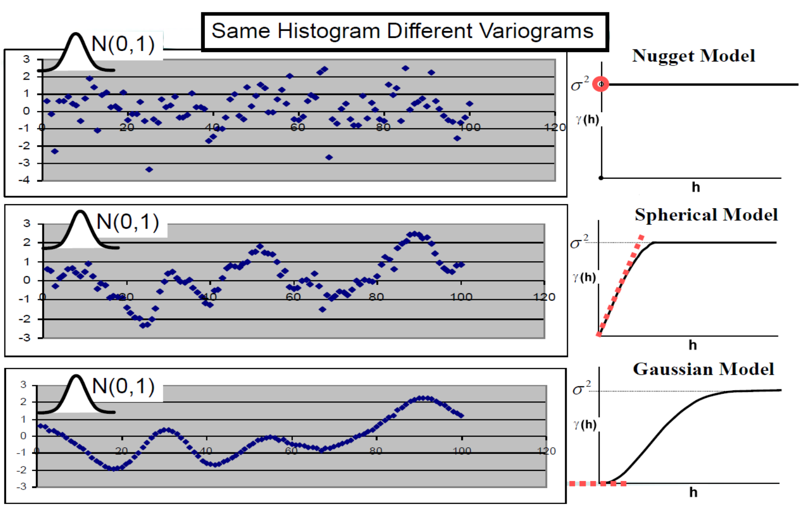
Variogram and Spatial Heterogeneity



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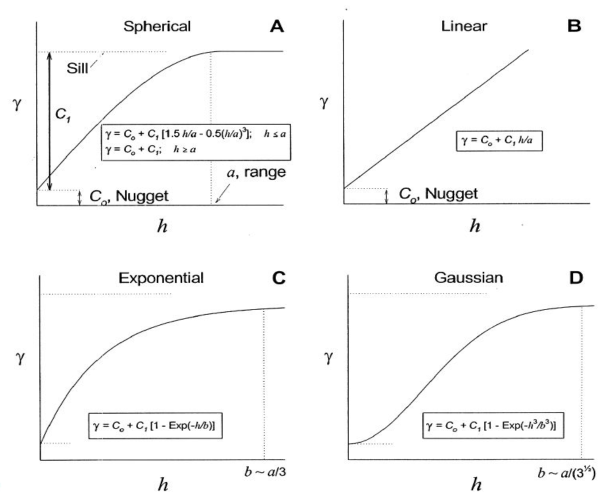
Variogram Models



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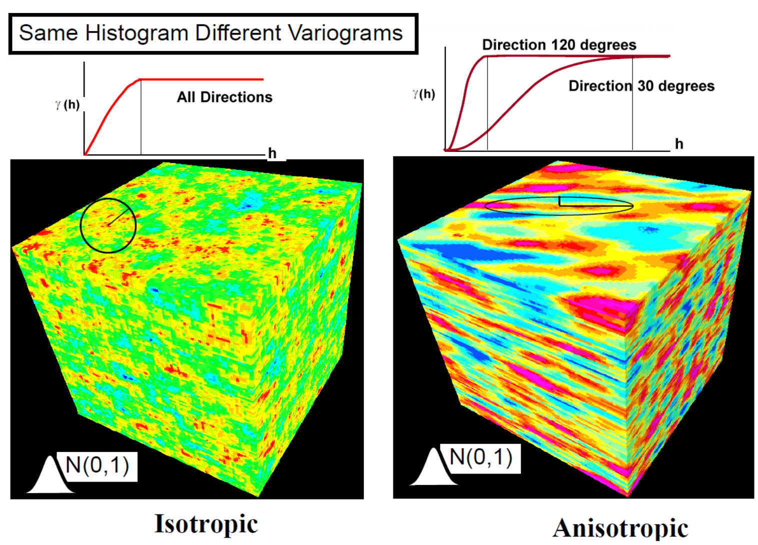
Variogram (Isotropic vs Anisotropic)



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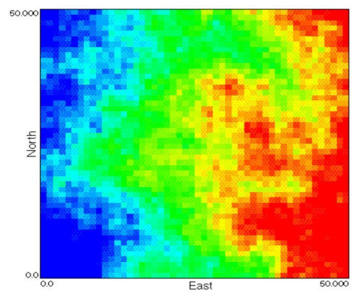
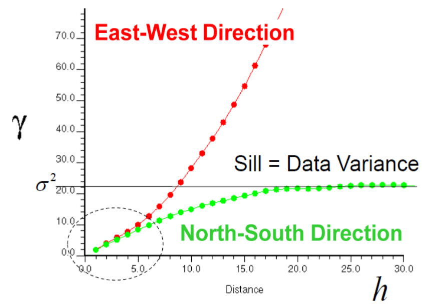
Variogram and Trend

- Variogram does not reach a sill, instead it increases above the data variance level





- If possible, remove trend before computing variogram
  - Compute variogram in a direction where the trend is not present
  - Use only the beginning of the variogram

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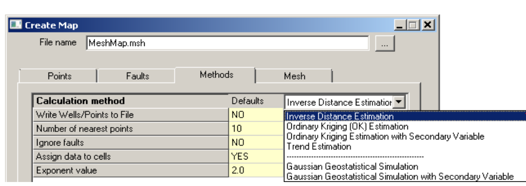
Geostatistical Modelling Methods

- Estimation
  - Use method when a smooth interpolation across the data is needed
  - Can generate one result
    - At least two wells needed for data input

- Simulation
  - Use when the variability observed in the data needs to be reproduced
  - Can generate multiple results
  - Important for uncertainty analysis



ESTIMATIONS

A. **Inverse Distance Estimation**
B. **Ordinary Kriging Estimation**
C. **Ordinary Kriging with secondary variable**
D. **Trend Estimation**

SIMULATIONS

E. ***Gaussian Geostatistical Simulation.***
F. **Gaussian Geostatistical with secondary variable**

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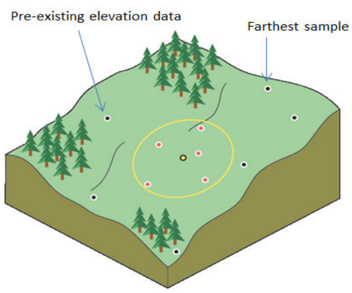
Estimation - Inverse Distance Estimation

- Interpolation estimates made based on values at nearby locations weighted <u>only</u> by distance from the interpolation location
  - Assume that sample values closest to the prediction location will be similar
  - As move farther away from prediction location, influence of points will decrease



$$z_0 = \sum_{i=1}^{n} w_i z_i \qquad (estimate)$$

$$w_i = \frac{1/d_i}{\sum_{i=1}^{n}(1/d_i)} \qquad (weight)$$

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Estimation - Kriging

- Is a weighted-average mapping technique that uses the variogram as the weighting function
- Locally accurate and smooth (underestimates variability)
- Appropriate for visualizing trends
- Inappropriate for flow simulation where extreme values are important
- Does not assess for global uncertainty
  - Produces one map –> Deterministic
- Good for <u>Tops</u> and <u>Thickness</u>

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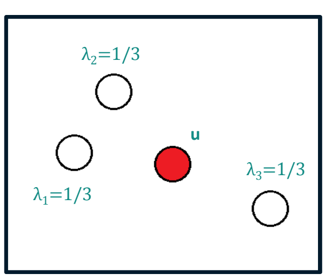
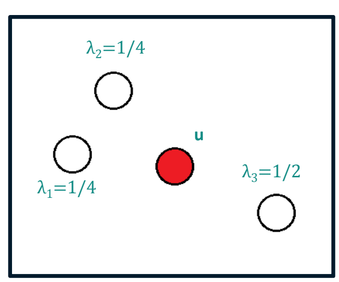
Estimation - Kriging

- Basic Principles
  - Search is made around the area of the point being estimated
  - Samples are assigned weights that reflect their spatial variability using the variogram model
  - A weighted average is calculated to estimate the value of the point
  - Kriging minimizes the variance of the estimation error
  - This technique provides the best average distribution
    - ❖ High values will be underestimated
    - ❖ Low values will be overestimated
    - ❖ Average will be as predicted
    - ❖ Honors data points, but does not reproduce global statistics
      - ➢ Histogram, variance, and covariance

Estimation - Inverse Distance vs Kriging



Inverse Distance



Kriging

- ID gives same weight for equal distances

- Kriging gives shared weight to the two clustered data points

Geostatistical Simulation

- Gaussian Geostatistical Simulation
  - Used to generate multiple versions (realizations) of grid values
  - All realizations reproduce:
    - Data
    - Histogram
    - Variogram of the data
  - Appropriate for flow simulation
  - Contrary to Kriging, adds an element of randomness
  - Accounts for the uncertainty associated with some reservoir properties
  - Small scale variability may mask large-scale trends

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Geostatistical Simulation

- Gaussian Geostatistical Simulation
  - Averaging multiple realizations will generate results very close to Kriging
  - However, the average behavior of multiple realizations may be different from the kriged model

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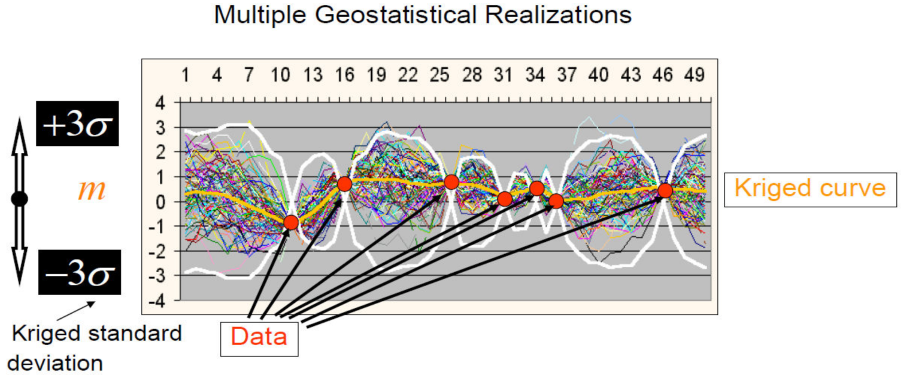
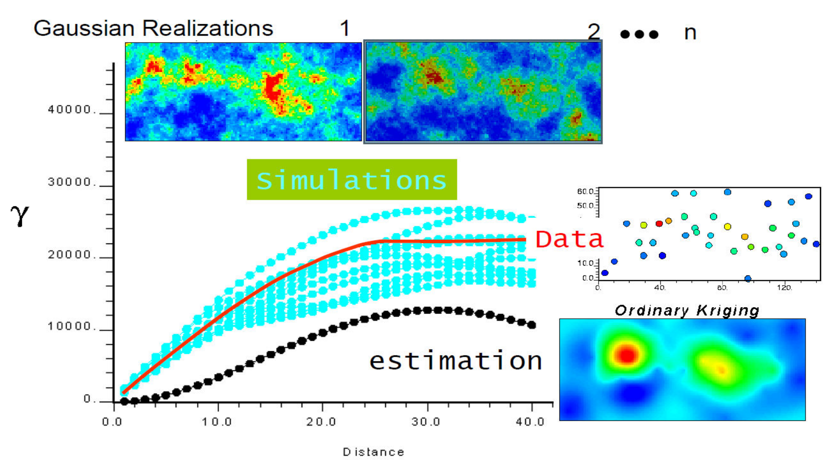
Estimation vs Simulation



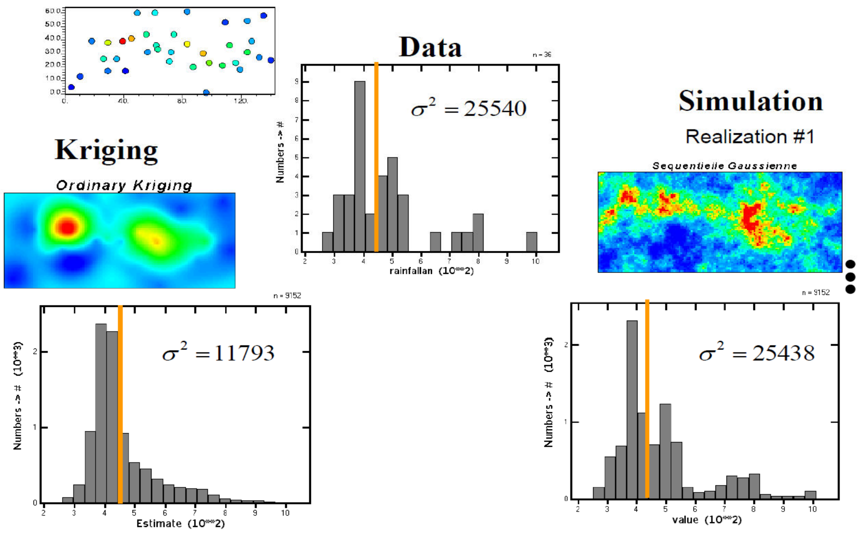
Kriged curve = Average of all simulated curves

Simulated curves = All curves found from Gaussian method

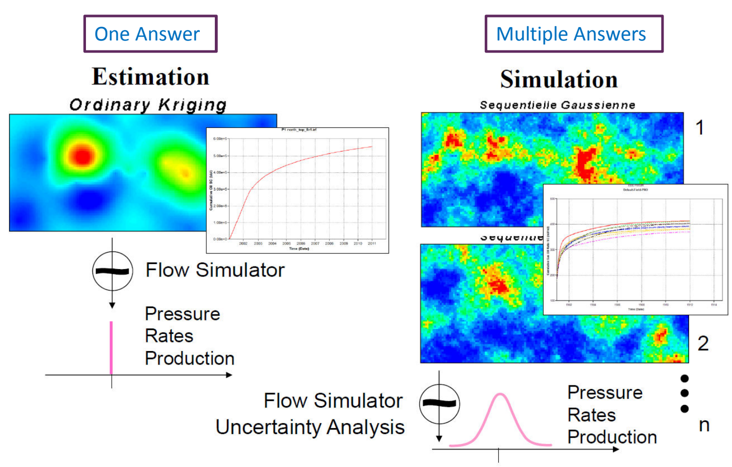
Estimation vs Simulation (Variogram)



Estimation vs Simulation (Histogram)

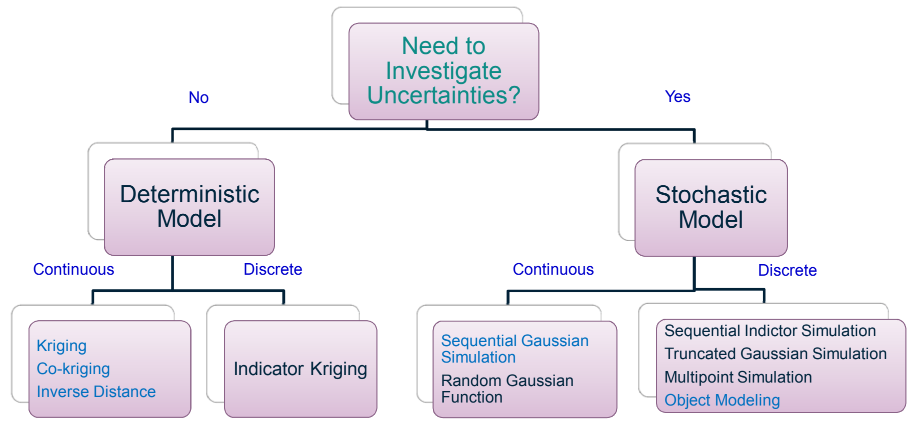


Estimation vs Simulation (Flow Simulation)



- Generally, Flow on Kriged map ≠ Averaged Flow of Simulated Maps

Choosing a Modeling Method



Upscaling

Upscaling

- What is upscaling?
  - Process in which a very heterogeneous region of reservoir rock described with a large amount of fine grid cells is replaced by an equivalent less heterogeneous region (coarse gird cells)
  - Assign effective static properties to coarse scale cells
  - Essentially an averaging procedure
  - Coarse grid model should maintain the same storage and transport properties of the reservoir rock of the fine scale model

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Upscaling

- Why Upscale?
  - Infeasible to run flow simulations directly on the geological model
  - Reduce CPU time for flow simulation
  - Make fine grid simulation practical
    - Geological model ~ 10-100 million grid cells
  - Reduce number of cells but preserve accuracy in prediction
  - Will be the starting point for prediction in the absence of historical data
  - Will be the starting point for history matching if historical data is available

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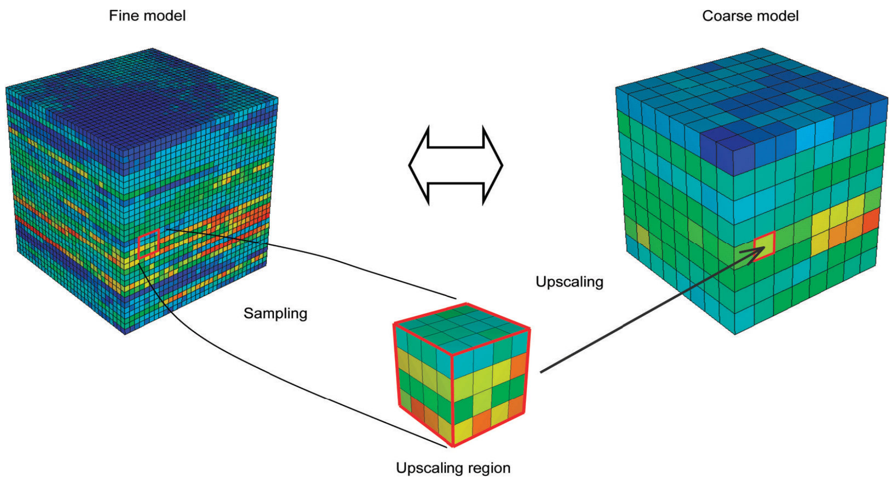
Upscaling



Upscaling

- How QC and Verify:
  - Visual QC
  - Initial Volume check
    - Pore Volume (POVO)
    - Hydrocarbon Pore Volume (HC POVO)
  - Spatial Check
    - Histogram
    - Mean
    - Variance and Standard Deviation
  - History Matching through flow simulation

Upscaling

- Difficulties of upscaling:
  - Bottleneck in the workflow
  - Loss of details
    - Dominated by loss of vertical resolution
  - Lack of robustness
    - Applicability to models with different global boundary conditions and well locations
  - How well does the upscaled model represent the fine scale geological model?
    - Won't know fully until flow simulation is preformed
    - Can be time consuming

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Uncertainties in Reservoir Modelling

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Uncertainty

- Includes:
  - Measurement accuracy
  - Incomplete or missing data
  - Computation approximations
  - Stochastic systems

Geophysical Uncertainties

- Acquisition
- Processing and interpretation
- Migration
- Time to depth conversion
- Horizon picking
- Fault position
- Well ties

Geological Uncertainties

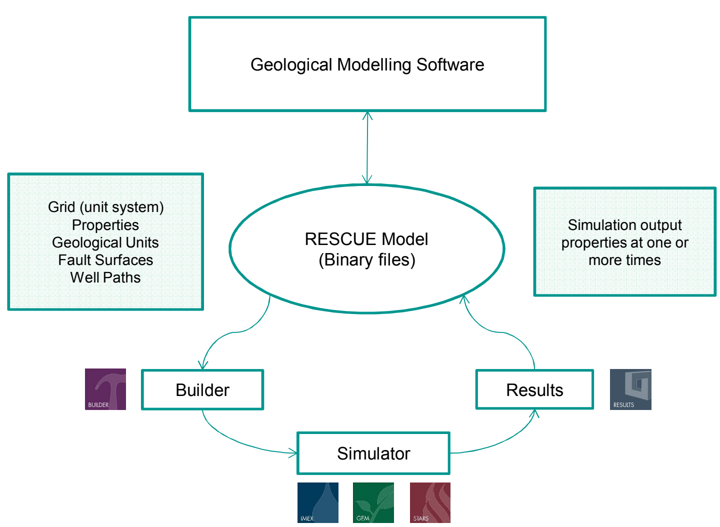
- Sedimentary depositional environments
- Rock type and associated heterogeneities
- Spatial distribution
- Sediment supply and particle size
- Geological markers

Petrophysical Uncertainties

- Net reservoir thickness
- Volume of shale
- Porosity
- Permeability
- Water saturation
- Fluid contact locations (GOC & WOC)

Geological Modelling Capabilities in Builder

Geological Modelling: Typical Workflow

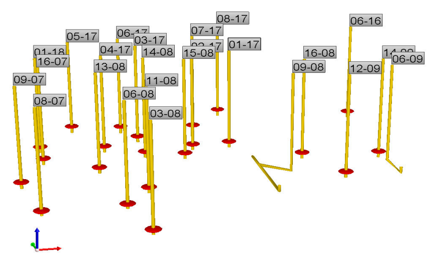


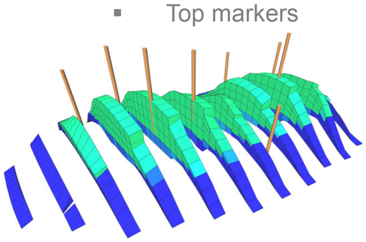
Builder Geomodelling Capabilities

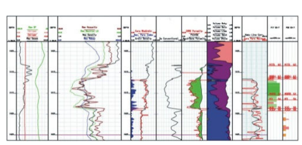
- Import well data
  - Trajectories, well log information, and top markers
- Create horizons
  - Create 2D maps based on well trajectories and top markers
- Create 3D grid
  - Create radial, cartesian, and corner point grid systems
- Create and distribute static properties
  - User input
  - Predesigned property map
  - Geostatistics
- Formula based property distribution based on correlations
- Property statistics
- Up-layering grid for flow simulation
  - Builder can combine layers in the vertical direction
  - Builder can also split layers if required
- Rescue import/export
  - 3rd party geomodelling software
- Scripting Tool

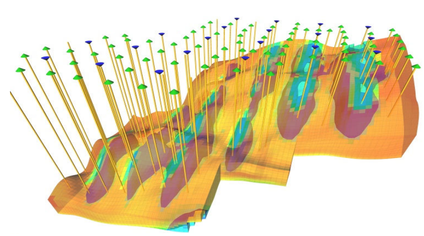
Import Well Data

- Can Import:
  - Well trajectories
  - Well log information
  - Top markers



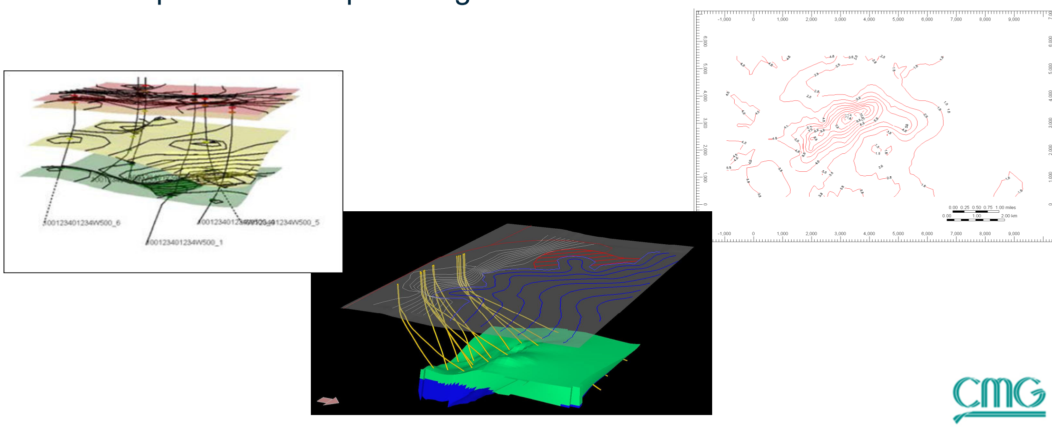






Maps

- Import Maps and display map over simulation model
- Create maps with well top and log information



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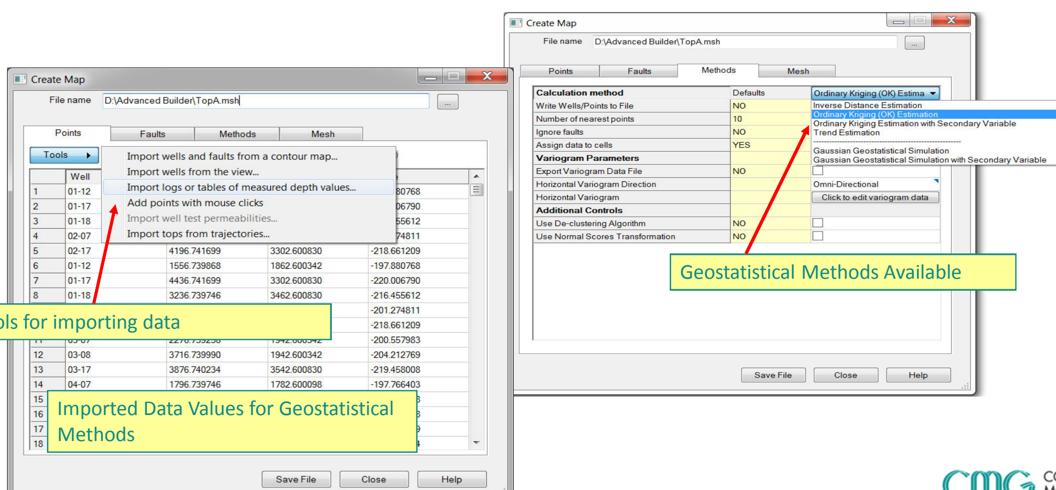
Creating Maps in Builder



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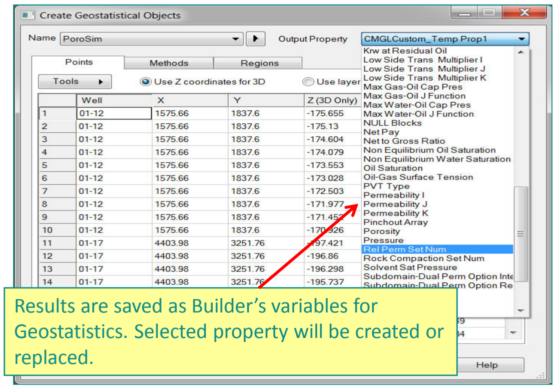
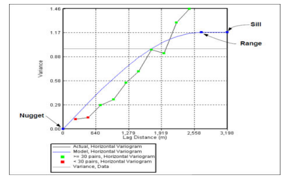
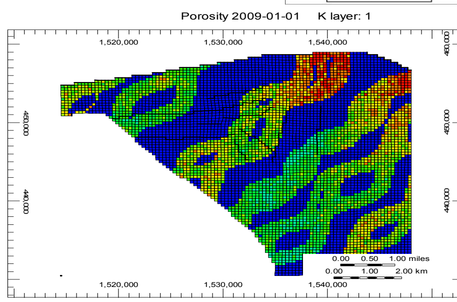
Geostatistics in Builder

- Geostatistics on 3D Properties (Reservoir Menu)
  - Object Modeling (Geological Bodies)
  - Gaussian Geostatistical Simulation

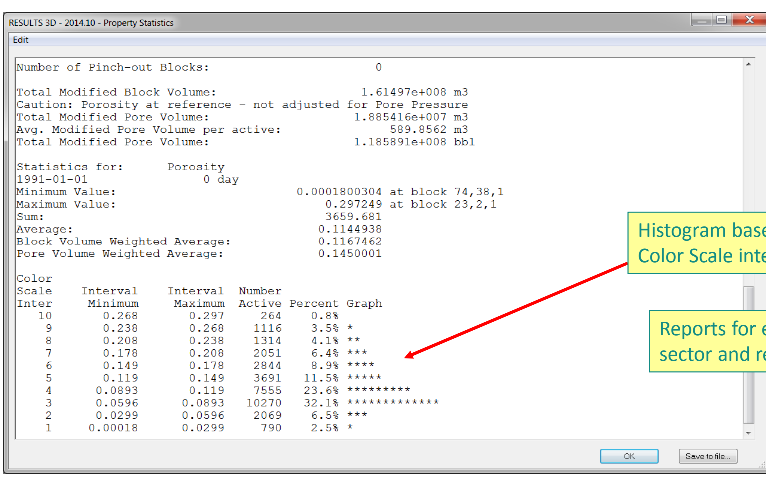


Results are saved as Builder's variables for Geostatistics. Selected property will be created or replaced.





Property Statistics


RESULTS 3D - 2014.10 - Property Statistics

Edit

Number of Pinch-out Blocks: 0

Total Modified Block Volume: 1.61497e+008 m3
Caution: Porosity at reference - not adjusted for Pore Pressure
Total Modified Pore Volume: 1.885416e+007 m3
Avg. Modified Pore Volume per active: 589.8562 m3
Total Modified Pore Volume: 1.185891e+008 bbl

Statistics for: Porosity
1991-01-01 0 day
Minimum Value: 0.0001800304 at block 74,38,1
Maximum Value: 0.297249 at block 23,2,1
Sum: 3659.681
Average: 0.1144938
Block Volume Weighted Average: 0.1167462
Pore Volume Weighted Average: 0.1450001

Color Scale Inter	Interval Minimum	Interval Maximum	Number Active	Percent	Graph
10	0.268	0.297	264	0.8%	
9	0.238	0.268	1116	3.5%	*
8	0.208	0.238	1314	4.1%	**
7	0.178	0.208	2051	6.4%	***
6	0.149	0.178	2844	8.9%	****
5	0.119	0.149	3691	11.5%	*****
4	0.0893	0.119	7555	23.6%	*********
3	0.0596	0.0893	10270	32.1%	*************
2	0.0299	0.0596	2069	6.5%	***
1	0.00018	0.0299	790	2.5%	*

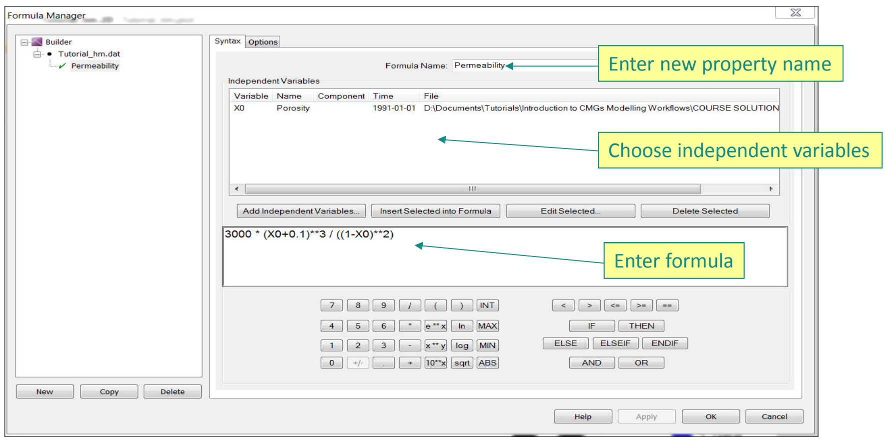
OK Save to file...

Histogram based on Color Scale intervals

Reports for each sector and region

Array Calculator (Formulas)

- Builder/Results 3D has an array calculator
- Can calculate new properties based on other properties

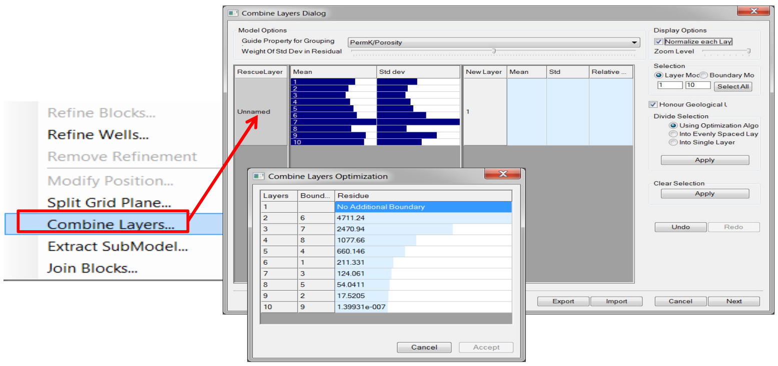


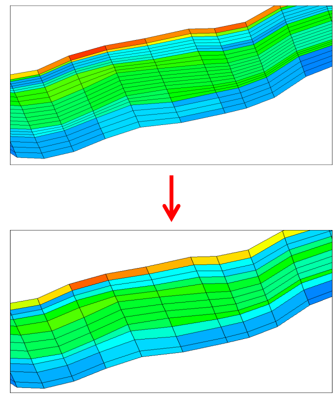
Up-layering in Builder

- Options in CMG
  - Can be done manually or automatically in Builder
    - *Note*: Builder can only upscale in the vertical direction (up-layer)
  - Manual:
    - Builder provides mean and standard deviation of selected property
    - Helps decide which layers to combine
    - Guild property is typically porosity, permeability K, or combination
    - Manually choose number of layers after upscale
    - Manually choose which layers to combine
  - Automatic:
    - Builder can suggest the optimal layers to combine given the desired number of layers and property
    - Method based on “residue optimization” (SPE paper #57273)
    - A table of residues is produced from analysis of all possible layering combinations
    - Can determine number of simulation layers needed based on table

Up-layering in Builder

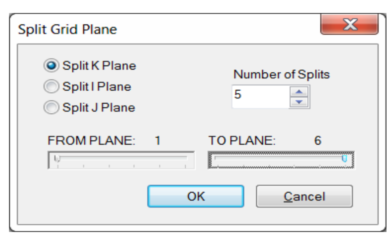
- Can amalgamate layers
  - Property variability calculations allow Builder to aid in up-layering process
  - Builder can suggest the optimal combination of the layers
    - ❖ Method based on "residue optimization"
    - ❖ SPE paper #57273



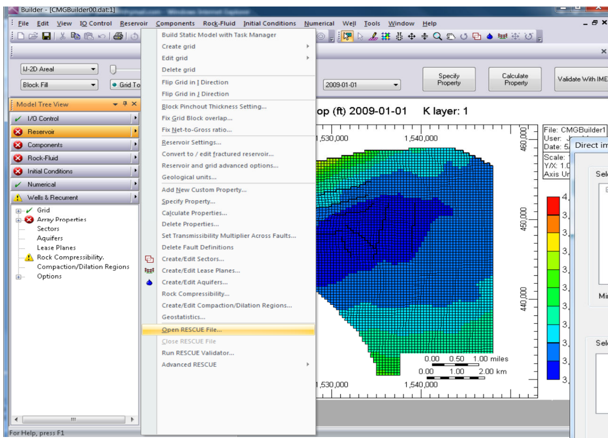


Additional Grid Modifications

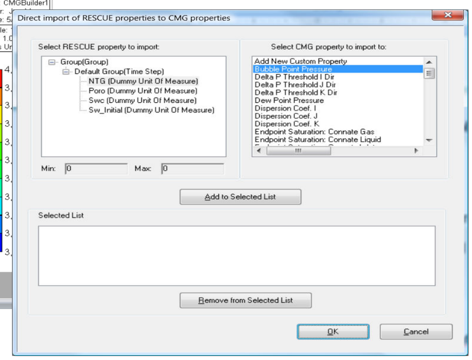
- Splitting Layers, Grid Refinement, and Submodel Extraction
  - Layers can be split or combined
  - Can also divide a grid in I or J planes
  - Similar approach for sub-models or refinement



Rescue Format



Import Rescue File Format



Export Properties to Rescue Model

- Builder can read grid from Rescue model
- Results 3D can add simulation output properties to Rescue model
  - Tools → Export Properties to Rescue model
  - Grid in Rescue model must match grid in simulation run
- Results 3D can write new Rescue model
  - With more detail than previous model

Builder: Scripting Tool

- Powerful tool that supports automation of workflows and calculations
- Used to create multiple geostatistical realizations
- Automatically re-calculate predefined property formulas
- Save multiple datasets
- Initialize and run simulation datasets

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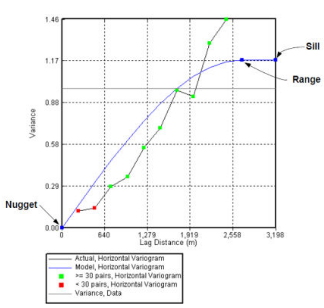
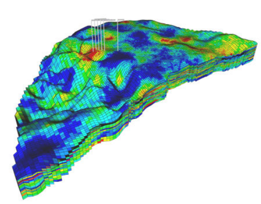
Builder: Geostatistics





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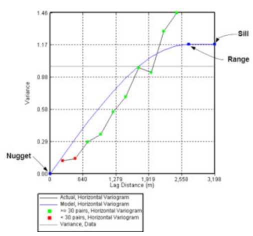
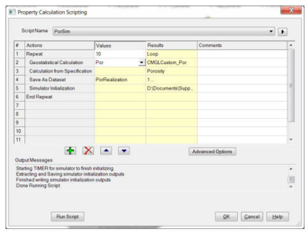
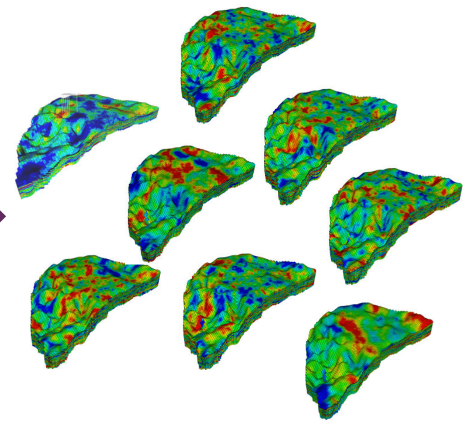
Builder: Geostatistics with Scripting Tool







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Exercise

Geological Modelling using Builder

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