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Top-Down, Intelligent Reservoir Modeling (TDIRM): An Alternative Reservoir Modeling Technique; Integrating Classic Reservoir Engineering with Artificial Intelligence & Data Mining Techniques*

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Abstract

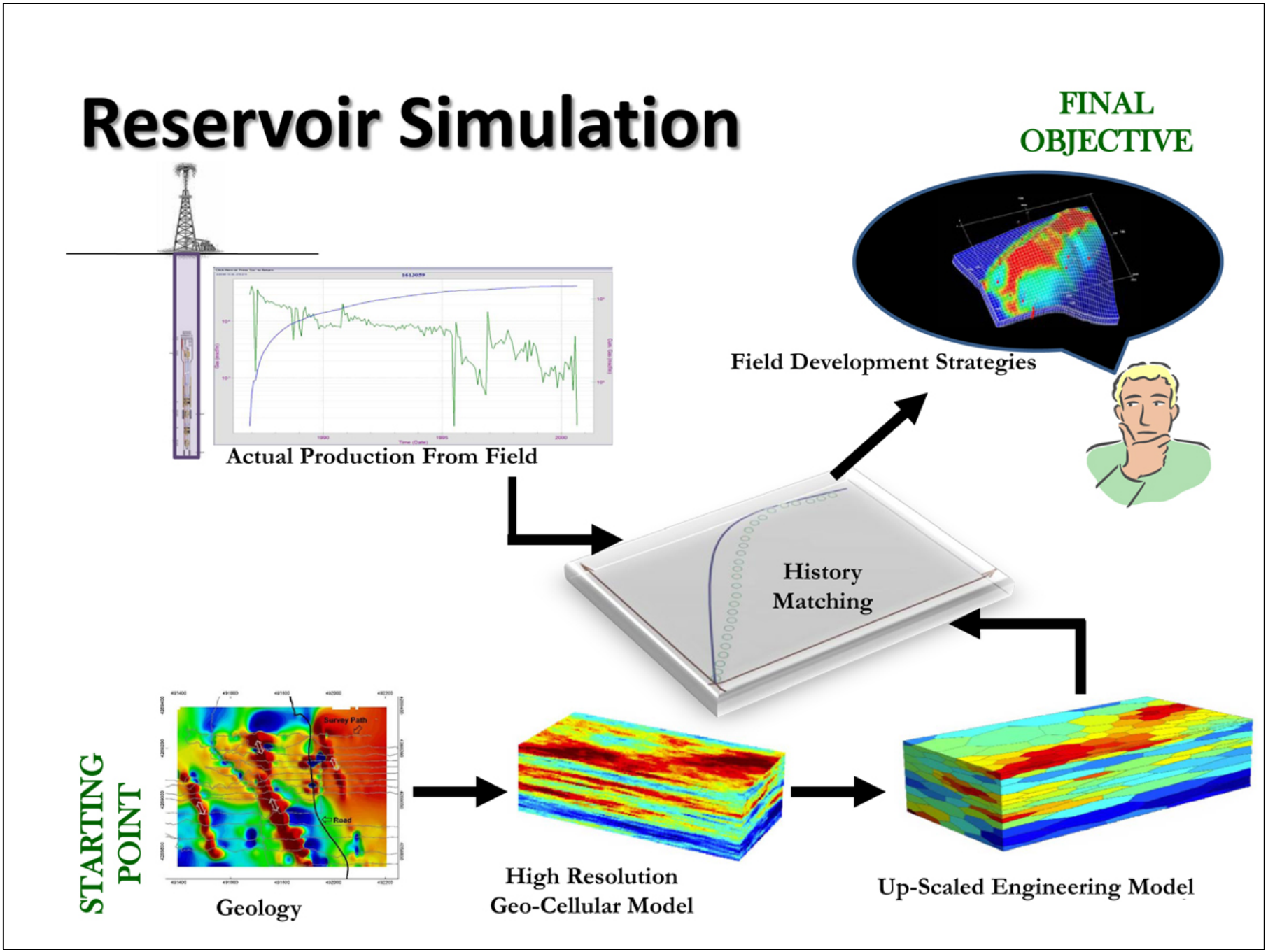
Traditional reservoir simulation and modeling is a bottom-up approach. It starts with building a geological model of the reservoir, adding engineering fluid flow principles to arrive at a dynamic reservoir model. The dynamic reservoir model is calibrated using the production history of multiple wells and the history matched model is used to strategize field development in order to improve recovery.

Top-Down full field subsurface modeling approaches the reservoir simulation and modeling from an opposite angle by attempting to build a realization of the reservoir starting with well production behavior (history). The production history is augmented by core, log, well test and seismic data in order to increase the accuracy and fine tune the Top-Down model. The model is then calibrated (history matched) using the most recent wells as blind dataset.

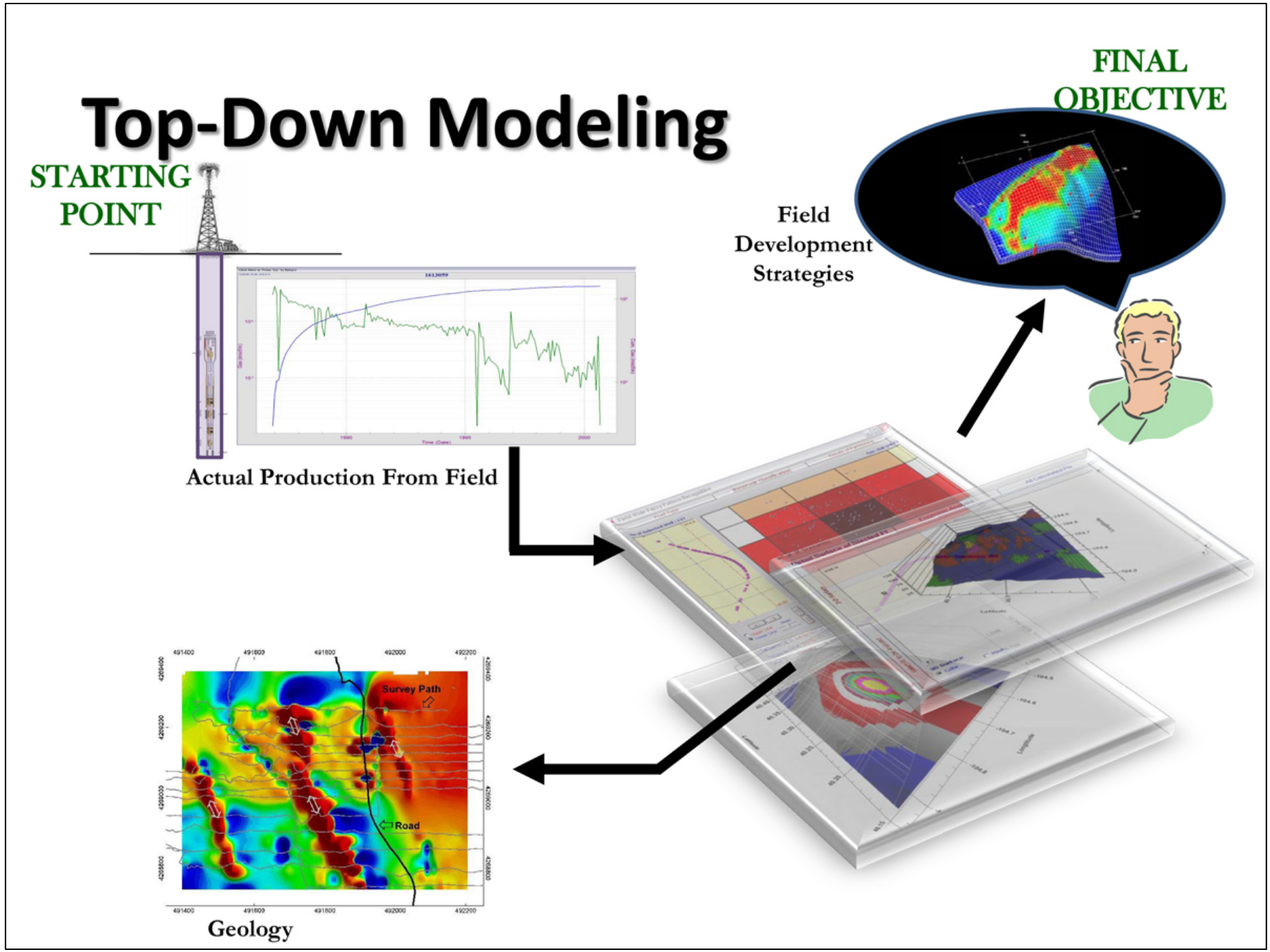
Although not intended as a substitute for the traditional reservoir simulation of large, complex fields, this innovative and novel approach can be used as an alternative (at a fraction of the cost) to traditional reservoir simulation in cases where performing traditional modeling is cost (and man-power) prohibitive. In cases where a conventional model of a reservoir already exists, Top-Down modeling should be considered as a complement to, rather than a competition for the traditional technique. It provides an independent look at the data coming from the reservoir/wells for optimum development strategy and recovery enhancement.

Top-Down Modeling is an elegant integration of state-of-the-art in Artificial Intelligence & Data Mining (AI&DM) with solid reservoir engineering techniques and principles. It provides a unique perspective of the field and the reservoir using actual measurements. It provides qualitatively accurate reservoir characteristics that can play a key role in making important and strategic field development decisions.

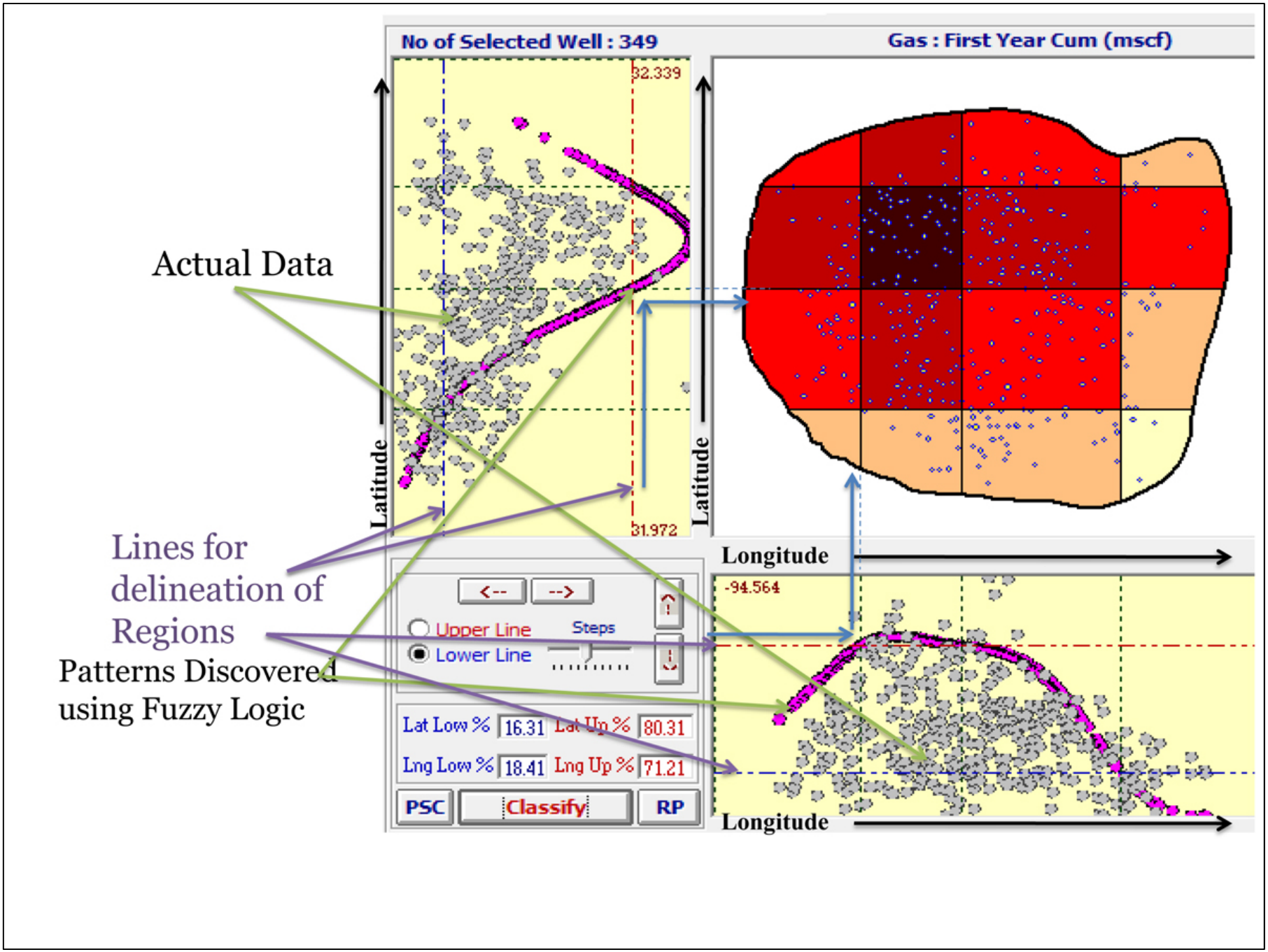
In this article, principles of Top-Down modeling are discussed along with an actual case study. Furthermore, validation of the top-down model using traditional simulation and modeling will also be presented and discussed.



Reservoir Simulation

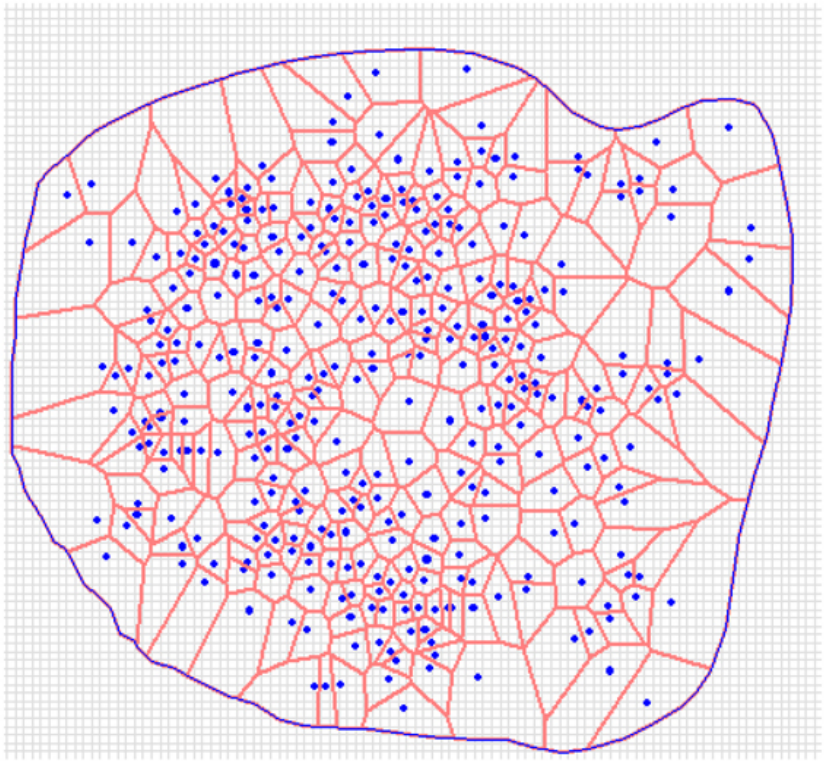


Top-Down Modeling



Lines for Delineation of Regions

Fuzzy Pattern Recognition



Field-Wide Fuzzy Pattern Recognition

Features for Analysis | Pattern Recognition

Current Zone : Entire Reservoir

Partition Type	RRQI	First Year Cum (mscf)-Gas		
		Avg. Value	# Wells	% Wells
High-High	1	583,954.556	45	12.89
High-Mid	2	375,704.359	142	40.69
High-Low & Mid-Mid	3	295,810.800	100	28.65
Mid-Low	4	211,609.288	59	16.91
Low-Low	5	122,354.000	3	0.86
Total Wells			349	100

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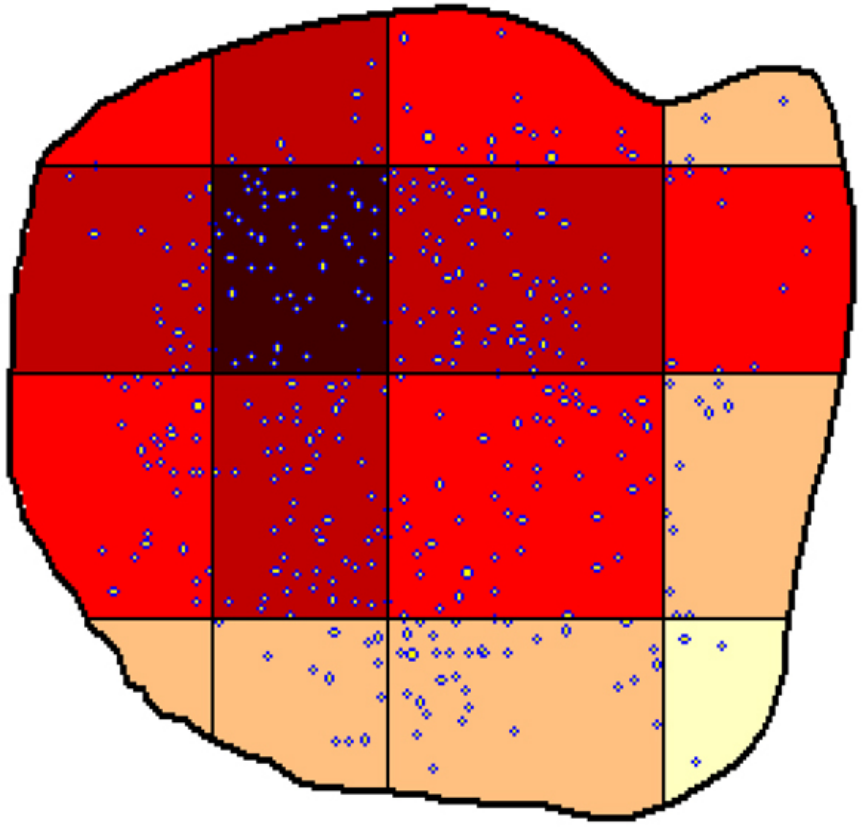

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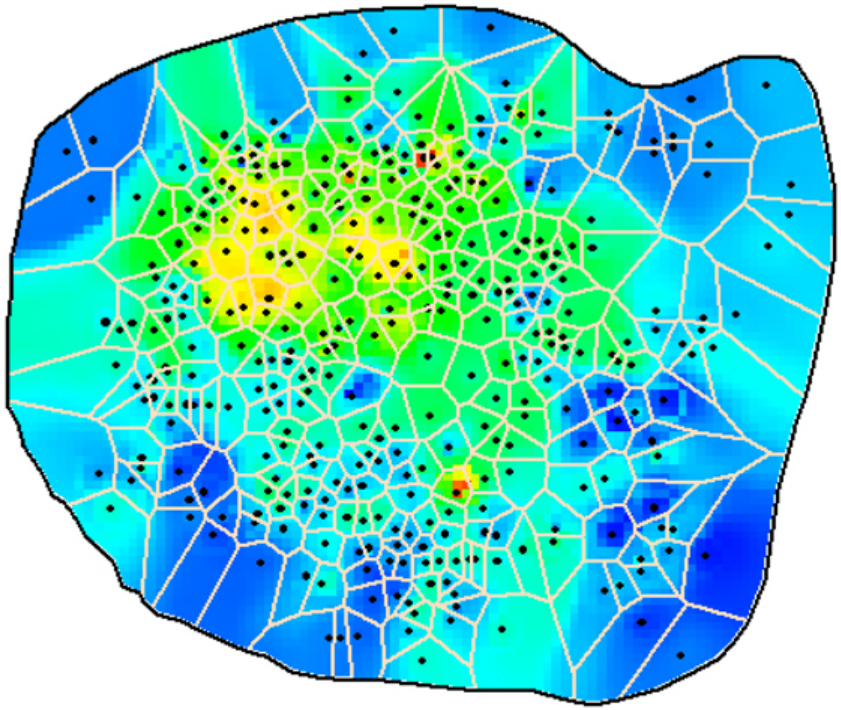

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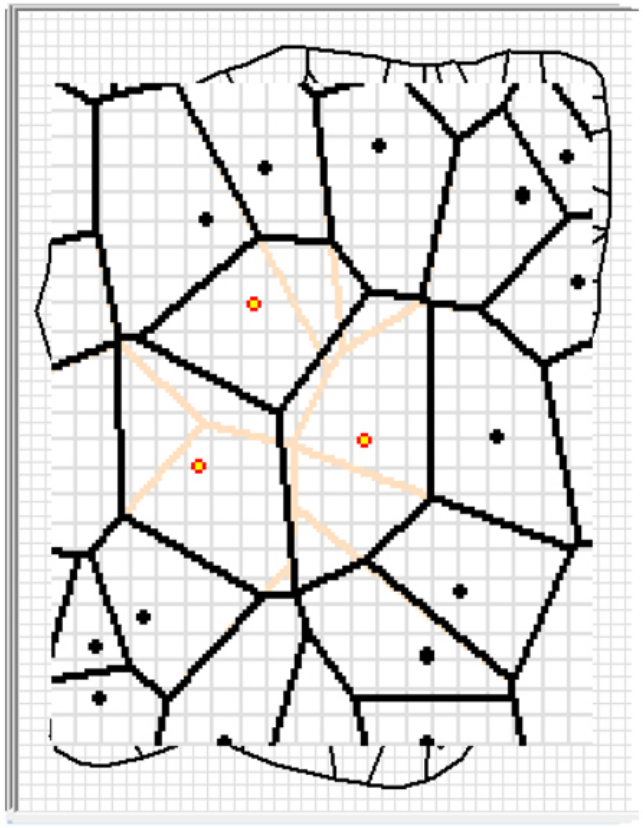
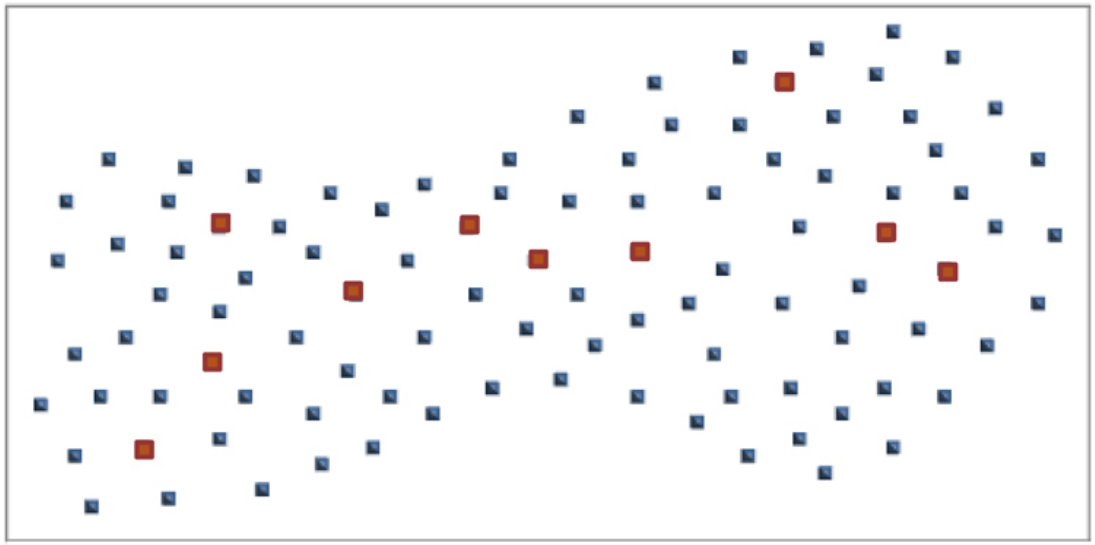
Field Development Strategies



Select 10 wells in the reservoir and added positive skin (+4)

Model SLM 100 Under Performer Wells



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Model SLM 100

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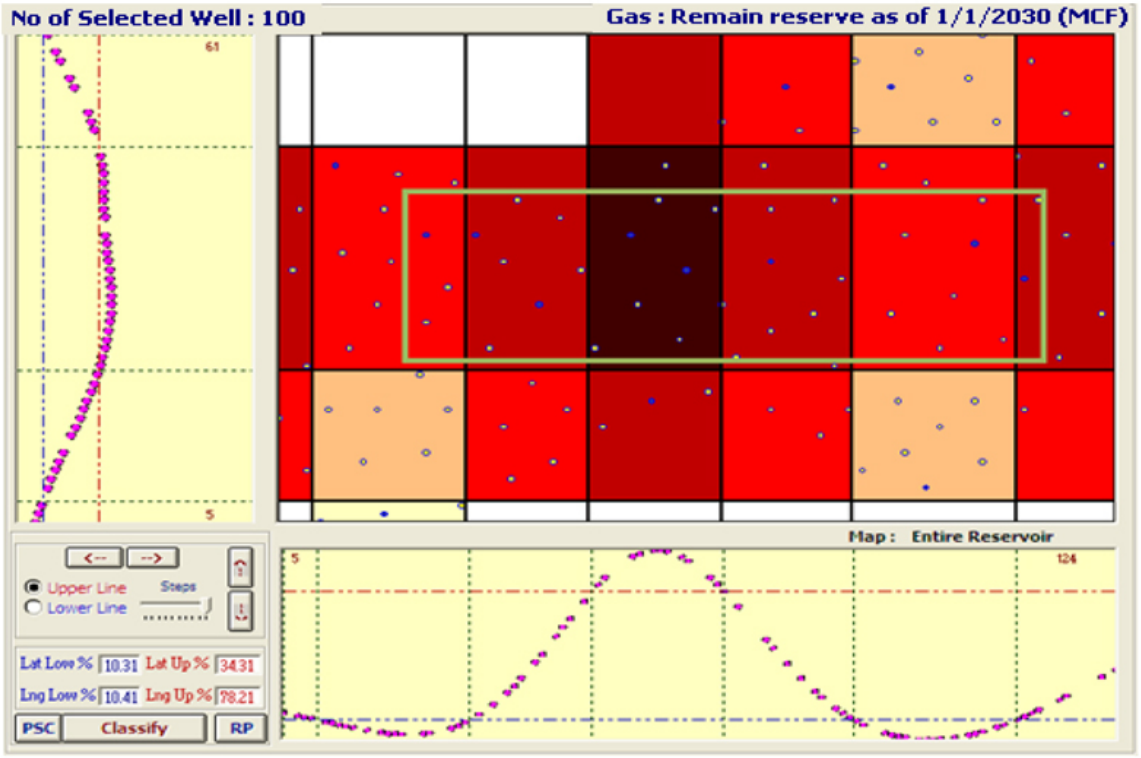

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Predicting Behavior of Future Wells

Model SLM 100

Verification Process