

Eni Deploys High-Resolution Reservoir Simulator Across Complex Global Assets

INTERSECT simulator powers detailed and complex model runs in economic timeframes

CHALLENGE

Improve reservoir modeling and simulation across complex assets worldwide, to optimize prediction reliability and accelerate corporate decision making.

SOLUTION

Introduce INTERSECT* high-resolution reservoir simulator to overcome existing simulation limitations, taking advantage of the computational power available at the Eni HPC2 computing center.

RESULTS

Decision making across key global assets now based on strategic input provided, in economic timeframes, through the computationally efficient simulation of large and complex reservoirs.

“Intersect allows us to run more simulations, more frequently, at the geological model scale and avoid upscaling and related approximations. In the future, we will build increasingly detailed models to compare the benefits of different complex recovery methods.”

Advanced Modeling Manager
Eni



Eni—the Italian oil and gas company—has implemented the INTERSECT high-resolution reservoir simulator across its most complex global assets to boost computational efficiencies and improve model accuracy. In many cases, the simulator has been introduced to overcome computational limitations imposed by existing simulation technologies, as the company seeks to understand increasingly complex reservoirs to support faster decision making.

Impressive results have been obtained thanks to the combination of high-resolution simulation technology delivered by the INTERSECT simulator, and the strong technical competencies of the Eni team.

Complexity captured

In the Baker field, offshore North Africa, Eni had used an existing simulator for history matching and depletion scenarios for the field's 117 wells. However, the simulator did not have the power to model the effects of downdip aquifer CO₂ injection. The conventional reservoir simulator formerly used was unable to undertake the required simulations, in a reasonable timeframe. The INTERSECT simulator allowed the asset team to model the CO₂ injection in a much shorter timeframe obtaining more viable results.

Eni introduced the technology to correctly model similar effects in the Cormorant field—a recently discovered West African, deepwater, turbidite-channelized reservoir. The INTERSECT simulator allowed the team to capture permeability contrasts associated with a large degree of heterogeneity, in the context of a water-alternating gas (WAG) injection strategy characterized by countercurrent flow—a result impossible to achieve with the former simulator.

This was also the case in the Norma field, West Africa—an offshore heterogeneous, tight oil reservoir featuring turbiditic currents. Eni's development plan required local grid refinements (LGR) for all development wells to optimally represent the hydraulic fracturing plans. Here, an impressive reduction in simulation runtimes was achieved—from the 20 hours required by the former reservoir simulator to only 26 minutes.

The company used the INTERSECT simulator for a number of development studies around the super-giant Tango field, a large heavy and high-viscosity oil reservoir in South America. The reference development strategy was primary depletion by means of a very large number of horizontal wells—approximately 1,600. The INTERSECT simulator emphasized the impact of improved grid resolution on simulation results. The team observed an enhanced description of the phases interplay, highlighting the detailed dynamical behaviour in interwell regions caused by the difference in mobility between oil and water, which has an important impact in production performance. The impact on the simulation results clearly indicated that detailed grids were needed to correctly manage future production activities.

Superior performance

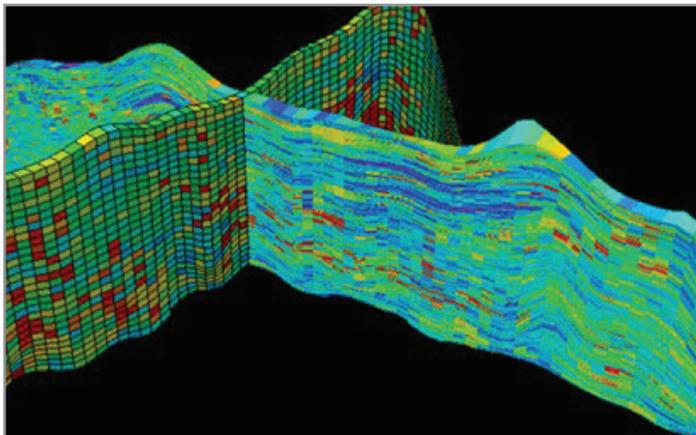
For the deepwater Mango field, offshore West Africa, Eni used the INTERSECT simulator on a simulation model covering 15 years of water flooding. The highly faulted, channelled, heterogeneous reservoir was characterized by a complex structural framework in a flower-fault setting. This model would not run in an economic timeframe using the reference simulator, so the INTERSECT simulator was introduced to achieve the finalization of the integrated reservoir study within project deadlines.

CASE STUDY: Eni Deploys High-Resolution Reservoir Simulator Across Complex Global Assets

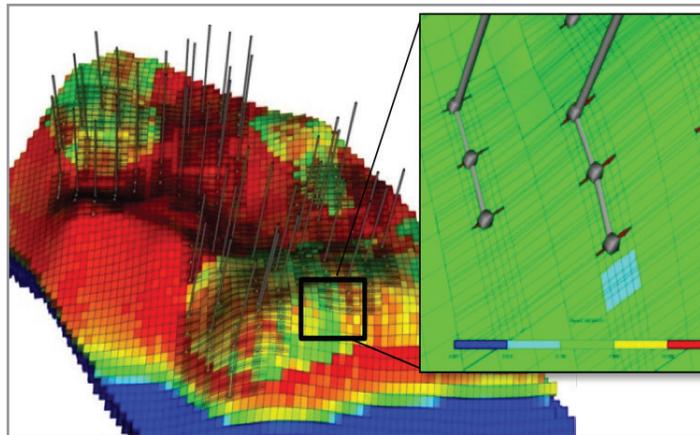
It also delivered performance improvements—the power of the INTERSECT simulator made upscaling unnecessary, saving further time and providing more accurate forecast results.

Long-term simulation excellence

Eni will continue using the INTERSECT simulator globally to overcome the technical challenges of running efficient and detailed simulations for large and complex fields, including the implementation of unstructured gridding and proprietary workflows. A strong focus will be placed on the simulation of enhanced oil recovery (EOR) techniques in order to increase field recovery factors. Advanced simulation process and workflows will leverage the outstanding computational performance of the Eni HPC2 High Performance Computing Cluster, featuring 30,000 computational cores and 3,000 tesla accelerators. Using HPC2, Eni is currently running INTERSECT models with hundreds of millions of active cells. This new reservoir modeling strategy will improve decision making through more detailed geological descriptions, and accelerated subsurface development plan screening.



Different resolution between coarse and fine grids for a super-giant carboniferous reservoir.



Systematic multistage hydraulic fracturing.

Field	Location	Details	Challenge	Results
Baker	North Africa	Carbonate reservoir characterized by gas condensate accumulations on top of a thin oil rim, surrounded by an active aquifer.	Study the effects of downdip aquifer CO ₂ injection using a compositional model with 1.2 million active cells.	The INTERSECT simulator allowed CO ₂ injection modeling in economic timeframes, while standard reservoir simulator was not able to converge.
Cormorant	West Africa	Deepwater, turbidite-channelized reservoir.	Capture permeability contrasts associated with a large degree of heterogeneity, in a WAG injection scheme. 600k active cells.	Thanks to a reduction of simulation time by a factor of 15, the INTERSECT simulator allowed the asset team to meet the schedule for field development concept selection.
Norma	West Africa	Heterogeneous, tight oil reservoir, characterized by turbiditic currents triggered by floods and tectonic activity.	Development plan required intense use of LGRs for all wells to explicitly represent the systematic multistage hydraulic fractures. 442k active cells, 162k non-neighbouring connections for 49 local grid refinements.	INTERSECT simulator allowed a huge number of LGRs to be included in the simulation, reducing simulation time from 20 hours to 26 minutes.
Tango	South America	Large heavy oil reservoir, 12 API, average viscosity 2000 cp.	Simulate primary depletion by 1,600 horizontal wells. 6.5 million active cells.	Improved grid resolution, enhanced description of the phases interplay, highlighting detailed dynamical behaviour in interwell regions caused by the difference in mobility between oil and water.
Mango	West Africa	Under-saturated, deepwater, reservoir, complex structural framework, flower-fault setting, embedded in heterogeneous channelized setting.	Simulation model covering 15 years of water flooding, plus 5 producers and 4 injectors, 2.4 million active cells.	Economic simulation times and detailed results obtained within project deadlines, using the geological model without any upscaling.

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