Schlumberger

ECLIPSE

Industry-reference reservoir simulator

BENEFITS AND FEATURES

- Unrivalled depth and breadth of functionality
- Robust, reliable reference simulator
- Blackoil, compositional, and thermal simulation
- Heavy oil recovery
- Chemical enhanced oil recovery
- CO_2 storage
- Coal and shale gas
- Faster runtimes with parallel processing
- Complex wells and completions
- Flexible reservoir control and field management
- Reserves estimation
- Production forecasting
- Design optimization
- History matching
- Uncertainty and sensitivity analyses
- Streamline-based screening and pattern flood management
- Fully integrated with the Petrel* E&P software platform

The ECLIPSE* industry-reference reservoir simulator offers the industry's most complete and comprehensive set of numerical solutions for fast and accurate prediction of dynamic behavior for all types of reservoirs, development planning, and operations. With over 30 years of continuous software development and innovation, the ECLIPSE simulator combines extensive capabilities, computational robustness, speed, and unmatched platform coverage.

Simulate any field type, any recovery method

The ECLIPSE simulator covers the entire spectrum of reservoir simulation, including black oil, compositional, thermal finite volume reservoir, and streamline simulation. This enables you to simulate any type of reservoir, with any recovery method—from waterflooding to heavy oil recovery and chemical enhanced oil recovery (EOR).

Blackoil simulation

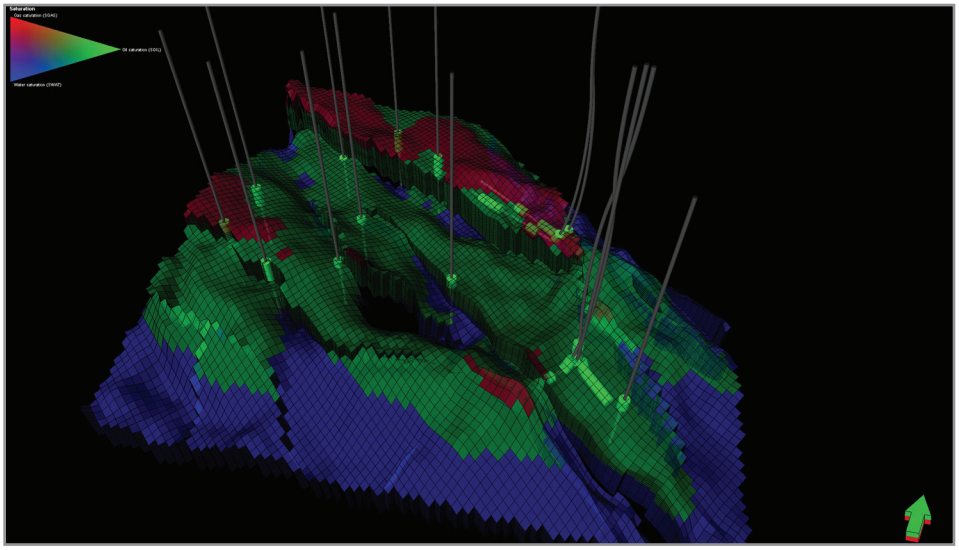
The ECLIPSE Blackoil simulator is the industry standard for reservoir modeling. It supports three-phase, 3D reservoir simulation with a huge range of capabilities, including extensive well controls, field operations planning, fault and fracture networks, aquifers, tracer tracking, advanced well and completion modeling, and EOR schemes.

Compositional simulation

The ECLIPSE Compositional simulator provides full equation of state modeling for multicomponent hydrocarbon flow in reservoirs in which there are compositional changes with depth, condensates or volatile crude oils, and gas injection programs. In addition to supporting the same unrivalled range of capabilities as the Blackoil simulator, the ECLIPSE Compositional simulator allows you to model chemical reactions, and CO_2 flooding and storage.

Thermal simulation for heavy oil recovery

Thermal recovery methods are required for heavy oil reservoirs in which oil viscosity changes as a function of temperature. The ECLIPSE Thermal simulator supports a wide range of thermal recovery process, including steam injection, steam flooding, steam assisted gravity drainage (SAGD), hot or cold fluid injection, wellbore heaters, in situ combustion, and cold heavy oil production with sand.



Fluid saturations from a full-field ECLIPSE simulation.

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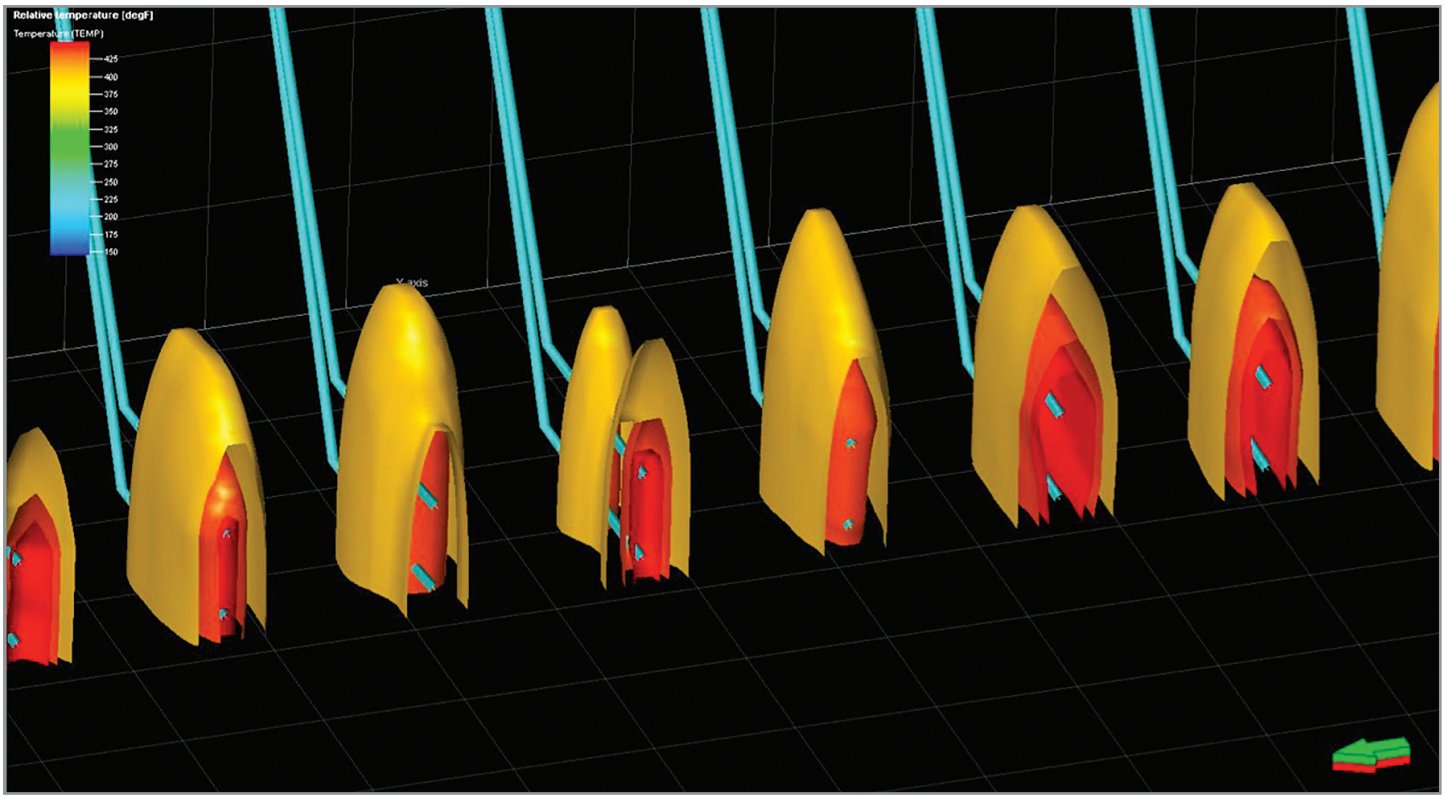

Steam chambers of a multipair SAGD model.

Chemical enhanced oil recovery

Tertiary recovery schemes involving injection of chemicals into the reservoir are becoming more common. The ECLIPSE simulator supports a wide range of EOR options.

Polymer added to injected water decreases its mobility and helps reduce viscous fingering and improve sweep efficiency. The ECLIPSE polymer model takes into account both increased viscosity of the polymer solution and reduction in reservoir permeability that results from polymer adsorption onto the rock.

Surfactant supports residual oil recovery by reducing surface tension between the oil and water phases. The ECLIPSE surfactant model handles all important features of a surfactant flood on a full-field basis, including surfactant effects on miscibility and wettability.

Foam reduces gas mobility and slows down breakthrough of injected gas. The ECLIPSE simulator expresses gas mobility reduction as a function of foam concentration and other relevant parameters. The progress of foam can be tracked as a tracer or as a water component.

Solvent modeling in the ECLIPSE simulator is handled by a four-component extension to the black oil model that models recovery mechanisms in which injected fluids are miscible with hydrocarbons in the reservoir.

Alkaline injection decreases the rate of adsorption of surfactants and polymers. The ECLIPSE simulator models alkaline as a tracer—the concentration of this is used to determine oil/water surface tension and adsorption of polymer and surfactant.

Frequently, chemical floods are done in combination—one of the most common being alkaline-surfactant-polymer flooding. These recovery processes can be simulated easily in the ECLIPSE simulator using chemical EOR models and sophisticated field management logic.

Unconventionals

Unconventional reservoirs typically have nano-darcy permeabilities, complex fracture networks from natural and induced fractures, and adsorbed gas in organic materials in the rock matrix. The ECLIPSE simulator includes advanced modeling options to model and understand the complex physics associated with these phenomena. Capabilities include dual porosity modeling of two interconnected systems representing the rock matrix and permeable rock fractures, as well as multiporosity modeling supporting detailed study of transient behavior in the matrix, including rock compaction effects.

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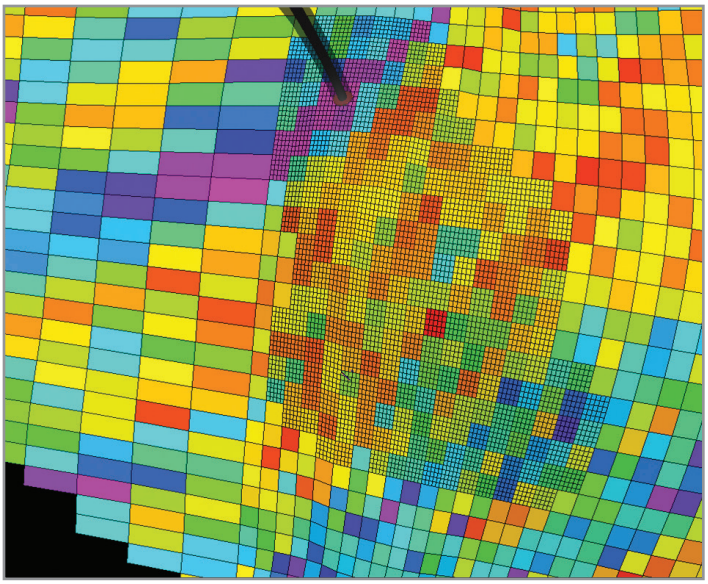


Local grid refinement around a multilateral well.

Streamline simulation

Streamline simulation uses different computational methods from standard finite-difference reservoir simulators, generating a series of streamlines that represent the fluid flow pattern. This is faster than the traditional approach and, consequently, invaluable for simulation-intensive workflows such geological model screening. Streamline simulation is also used extensively for waterflood optimization, as generated streamlines make it easy to understand injector–producer relationships.

The ECLIPSE FrontSim streamline simulator is a three-phase, 3D black oil and compositional simulator. It supports a wide range of features, including dual porosity and permeability, compressible and incompressible fluids, advanced field management controls, and chemical EOR. It also includes a dedicated workflow for pattern flood management that automatically adjusts production and injection rates to maximize a given criterion, such as sweep, voidage replacement, or minimizing water cut.

Understand complex reservoirs and wells

The ECLIPSE simulator includes some of the industry's most advanced modeling and simulation capabilities, enabling you to understand even the most challenging reservoirs.

Local grid refinement and coarsening

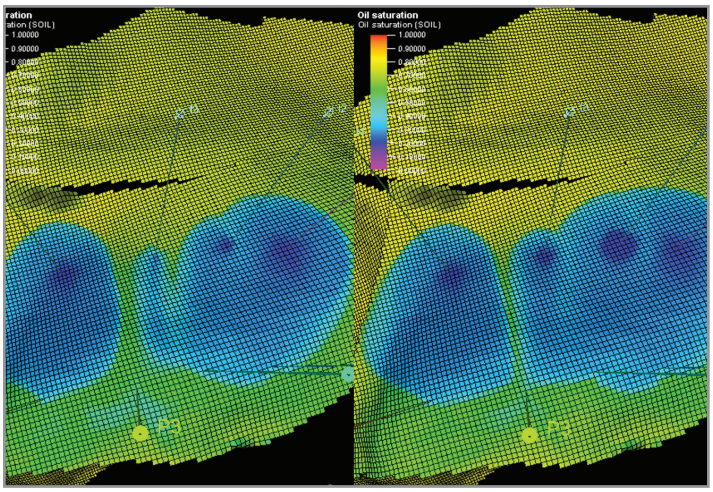
Local grid refinements (LGRs) allow enhanced grid definition in areas requiring a higher level of simulation accuracy, such as near wells or in areas of complex geology. The ECLIPSE simulator supports 2D radial, 3D radial, or 3D Cartesian LGRs. Properties of cells in the local grid are inherited from the global grid or can be specified explicitly. To speed up run times, grid coarsening is also available to amalgamate cells in regions of the reservoir that are less important.

Advanced wells

The ECLIPSE simulator features the industry-leading multisegment well model. This enables realistic modeling of highly deviated, horizontal, and multilateral wells with advanced completions and inflow control devices. One of its key advantages is its ability to accurately represent the well topology and include friction and pressure loss effects along the wellbore. The drift-flux model enables detailed tracking of fluid flow in the well accounting for different velocities of different phases. Additionally, individual segments can be configured to represent flow control devices in the well, such as chokes and valves. The ECLIPSE simulator contains several built-in devices, such as flow-limiting valves, labyrinth devices, and downhole separators. Additional devices can be modeled by specifying a table of their pressure loss characteristics.

Sophisticated field management

The ECLIPSE simulator contains numerous facilities that allow users to easily simulate any field development strategy. Every well, or group of wells, in the simulation can have production/injection targets and limits specified for oil rate, water rate, gas rate, liquid rate, bottom hole pressure, tubing head pressure, and voidage replacement. Reservoir engineers can set additional economic constraints on production wells, so wells are automatically shut in or recompleted if their oil, gas, or liquid rate falls below a lower limit, or if water-cut or gas/oil ratio exceeds a specified upper limit. It is also possible to specify advanced logic so that a series of actions are performed if certain criteria are met. In addition, dedicated models support gas field operations, gas lift optimization, surface networks, and reservoir coupling.



Reservoir oil saturation: Water injection only (left); with polymer injection, sweep efficiency improves (right).

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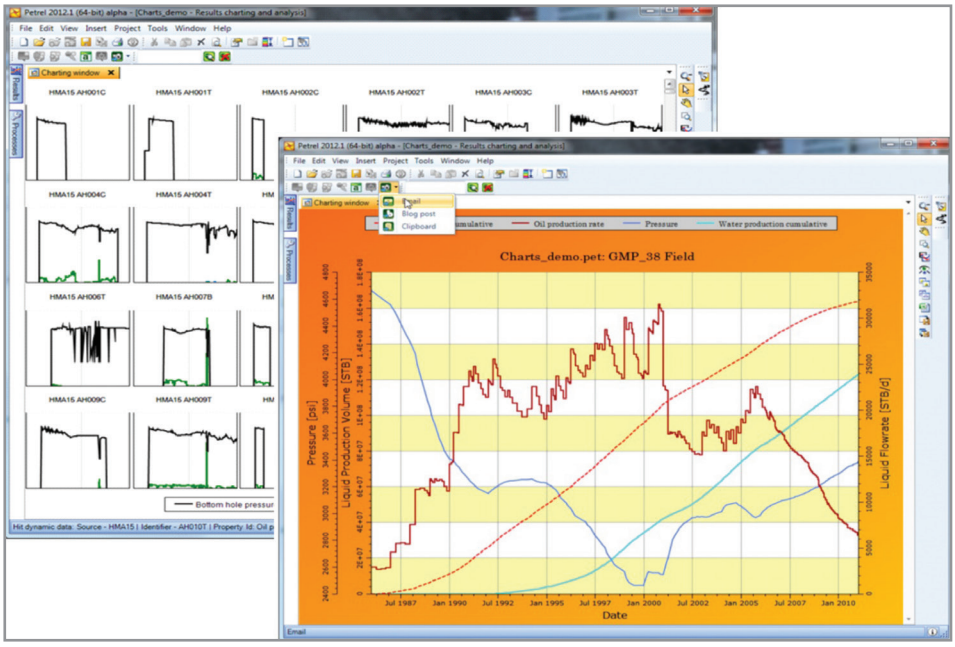

ECLIPSE simulation results visualized in the Petrel Results Charting and Analysis process.

Petrel reservoir engineering environment

The Petrel* E&P software platform integrates the multidisciplinary workflows surrounding the ECLIPSE simulator, providing transparent data flows and an intuitive graphical user interface for reservoir engineering. The Petrel platform provides the ideal environment for simulation pre- and postprocessing, with key supporting workflows including advanced gridding and upscaling, assisted history matching, uncertainty and sensitivity analysis, well path and completion design, and design optimization of well locations, completions, and reservoir recovery methods.

With seamless integration from the geophysicist and geologist to the reservoir and production engineer, the Petrel platform enables specialists from all disciplines to combine their domain information and knowledge into a single, model-centric subsurface representation. Changes in the seismic interpretation or the geological model easily cascade through to the reservoir simulation model and back, allowing fast and efficient evaluation of the impact of these changes on production rates and reserves.

MEPO multiple realization optimizer

The uncertainty and optimization capabilities of the Petrel platform can be extended with the MEPO* multiple realization optimizer, enabling advanced simulation-intensive workflows to be run in the ECLIPSE simulator. The MEPO optimizer, in combination with the ECLIPSE simulator, empowers reservoir engineers to examine and understand the full range of uncertainties in reservoir behavior as well as parameter dependencies and probabilities associated with delivering both greenfield and brownfield projects.

E-mail sisinfo@slb.com or contact your local Schlumberger representative to learn more.

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