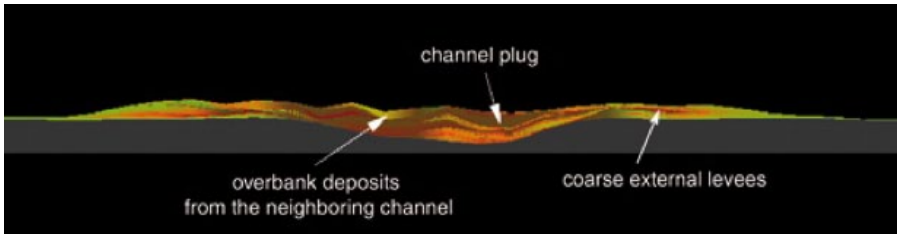
# CATS

## A Joint Industry Project

## Cellular Automata for Turbidite Systems

### Objectives

- characterize the 3D sedimentary architecture of turbidite reservoirs using a process-based modeling approach and predict distribution of reservoir heterogeneities;
- identify and rank the main physical parameters controlling the evolution of the turbidite system and test various geological scenarios;
- reduce uncertainties in static and dynamic reservoir models using the geological information embedded in the process-based simulation results.




*Simulation from CATS:*
*cross section in a channel complex showing the sand/shale distribution.*

### Background

The CATS JIP will provide reservoir geologists with executable prototype software producing realistic numerical simulations of turbidite systems validated on real field cases.

The prototype will comprise a set of tools and interfaces dedicated to petroleum applications, derived from IFP Energies nouvelles research algorithms. It will use physically-based cellular automata to model turbidite systems.

The CATS algorithms produce a realistic full 3D description of the sedimentary architecture and heterogeneities at reservoir scale. The sedimentary processes are simulated with a limited set of physical parameters. The model takes local changes in these processes into account and simulates the associated deposits. The integration of physical processes and their simulation over time also yields a better understanding of the construction of the system.

For example, the geometry and sand/shale ratios of levees can be simulated in detail. The model reproduces the chronology of incision, channel-fill, and levee construction in a channel complex. The results are geologically consistent.

Moreover, the methodological work is designed to help the user to calibrate his model and adjust the simulation parameters. It will include sensitivity analysis, and synthetic seismic images and logs which will be compared to subsurface/outcrop data.

### Technical program

Develop operational prototype software with pre- and post-processing user interface capabilities:

- develop methodologies and algorithms to model turbiditic reservoir architecture with a process-based approach;

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in the fields of energy, transport and the environment.

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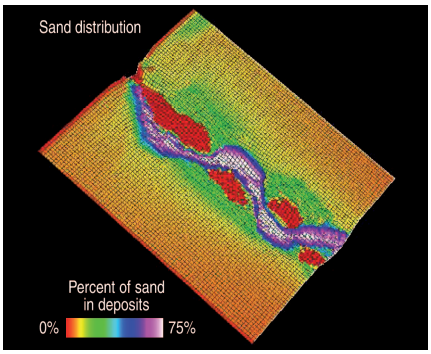



*Simulated 3D block showing sand deposition in the outer bends of meandering channel.*

- validate the prototype software and the methodology on actual data sets (flume experiments, outcrop observations, subsurface data, etc.).

The main steps of the CATS technical program are the following:

### Phase 1 – First year

Development of prototype interface in IFP Energies nouvelles' OpenFlow software platform with proper import/export capabilities.

### Phase 2 – Second year

- improvement of the model with enhanced description of deposits and integration of channel evolution;
- prototype quantification and visualization tools for sediment volumes, facies distribution, and physical parameters such as connectivity of geological reservoir bodies;
- sensitivity analysis to assess the effects of each physical parameter on the sedimentary architectures.

### Phase 3 – Third year

- methodological work on synthetic seismic images and associated logs;
- comparative study of existing conditioning methods;
- improvement of the model towards the simulation of granular flow.

## Deliverables

### Phase 1

- prototype software - version 1 embedded in IFP Energies nouvelles' OpenFlow software platform including a simple OpenFlow graphical user interface dedicated to petroleum applications;
- modeling of turbiditic systems with turbulent flow.

### Phase 2

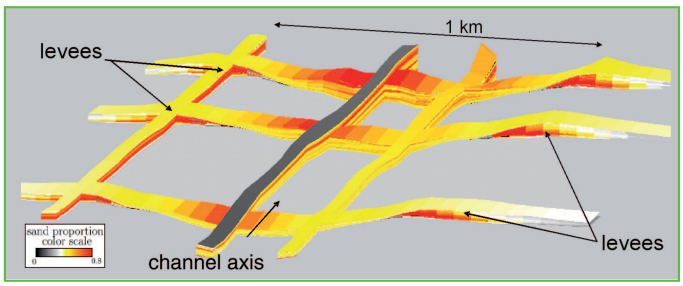
- prototype software - version 2 including modeling of channel migration and deposit description;
- code that can run on parallelized clusters to enhance code efficiency and deal with complex geological architectures;
- a comprehensive user's guide that will also include a sensitivity analysis.

### Phase 3

- prototype software - version 3 including vertical description of the current and a bedload component;
- methodological report on model calibration with synthetic seismic and logs and on conditioning methods.

## Project organization

The program is planned to last 3 years. Two workshops per year will be held to present on-going progress reports and trigger discussion of future strategy with partners. Users' meetings will also be organized, for both technical discussion and the collection of feedback. A secure website will be opened for file/data exchange and the storage of documentation and deliverables.




*Simulated 3D block showing the sand/shale distribution in a channel complex.*

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