

Monitoring system for a geological CO₂ storage in a saline aquifer

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Physical Twin description

A geological **CO₂ storage** in a saline aquifer.

Digital Twin usages

- To update physical parameters uncertainty through **real-time data assimilation**
- To predict the storage future dynamic behaviour considering **various sources of uncertainty** (physical characteristics, future operational constraints, etc.)
- To **quantify risks**
- To **detect and anticipate anomalies** (leaks, non conformance, etc.)

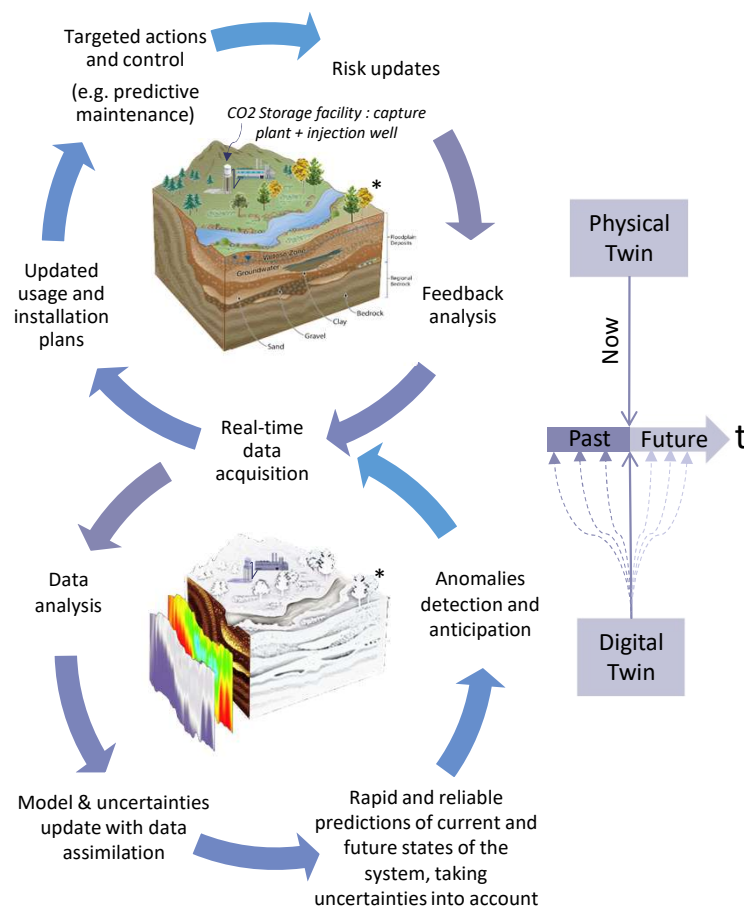
Digital Twin Description

At project start, the DT consists of an initial POC implementing a single functional brick with **fast surrogate models**, basic visualization, and near real-time data display in an external web app. FIWARE has been identified as a potential open-source backbone for the future architecture.

Engineering Digital Twin challenges

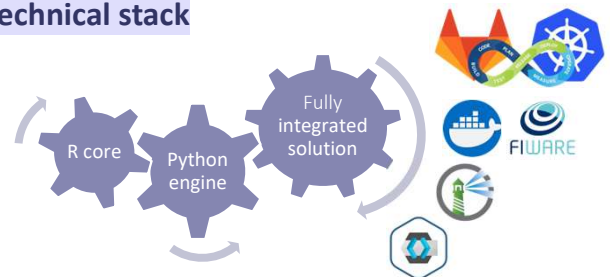
- To develop a **generic, interoperable subsurface DT**, initially applied to CO₂ storage, **reusable across scales*** and other subsurface applications (e.g., geothermal) through contextualized **ontologies**
- To **assimilate data in near real-time** into physical models for accurate system representation
- To build and **continuously update ML models** to optimize predictive accuracy
- To identify **optimal data acquisition strategies** (type, location, frequency) to improve monitoring and decision-making

* from a single well to the reservoir scale and surface installations.

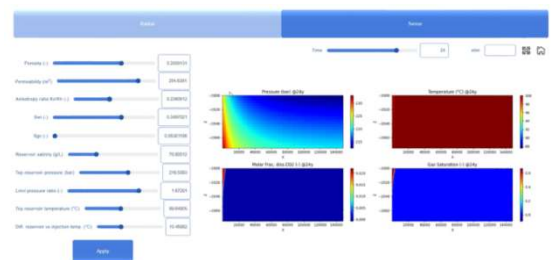


* Modified from Binley et al., 2015

Technical stack



Visualization



R models and simulators

