CO_2 capture and storage in the UNFCCC

New instruments, the Clean Development Mechanism and views from geoscientists

Bonn, Germany - June 17th, 2011

Performance assessment: can we know what to expect?

Jean-Pierre DEFLANDRE

Professor at IFP School - Research project manager in CCS

Outlines

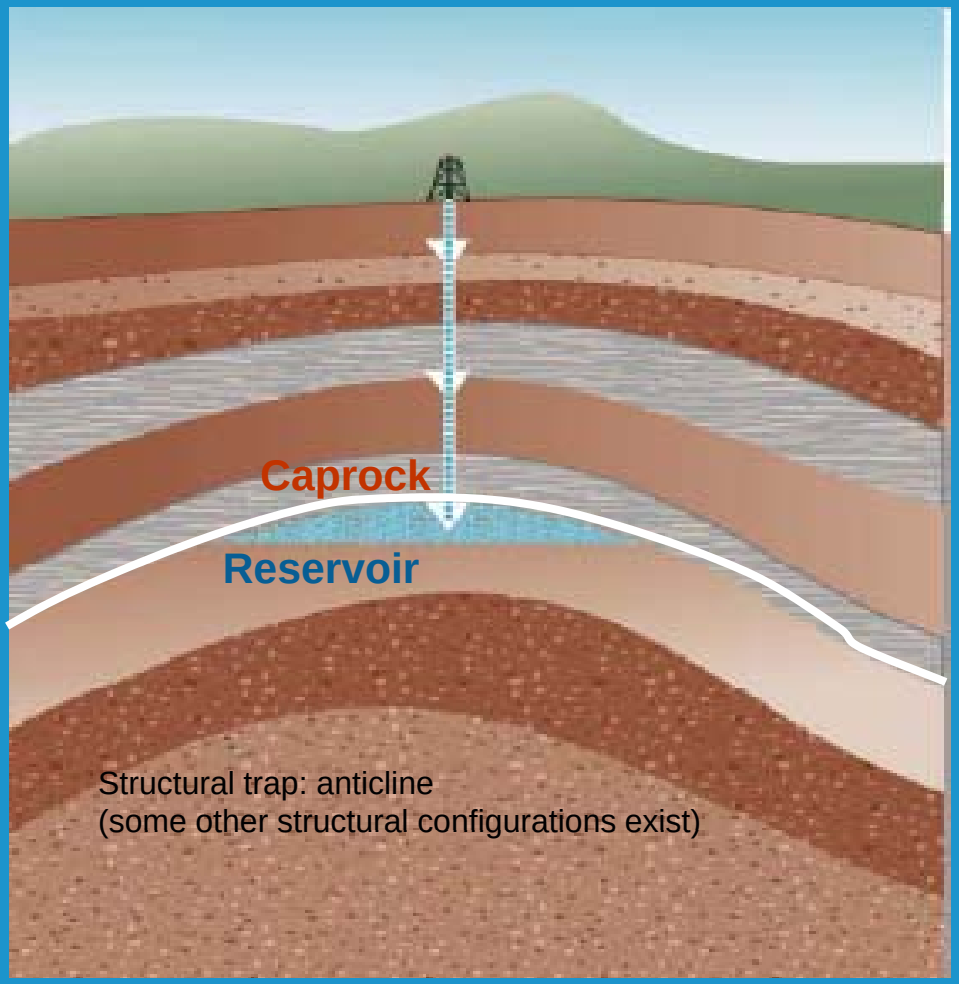
- CO_2 Geological storage: what do we need / what do we want?
- What is performance assessment of CO_2 geological storage?
- Illustration of reservoir pressure modelling and monitoring verification with the In Salah case (Algeria)
- Conclusions

CO_2 geological storage: what do we need?

- Caprock

→contains fluids in the reservoir

- Reservoir
  - Large Volume for storage capacity
  - High Injectivity for efficiency and integrity
  - Low resulting reservoir Pressure



Caprock + Reservoir = Geological Trap

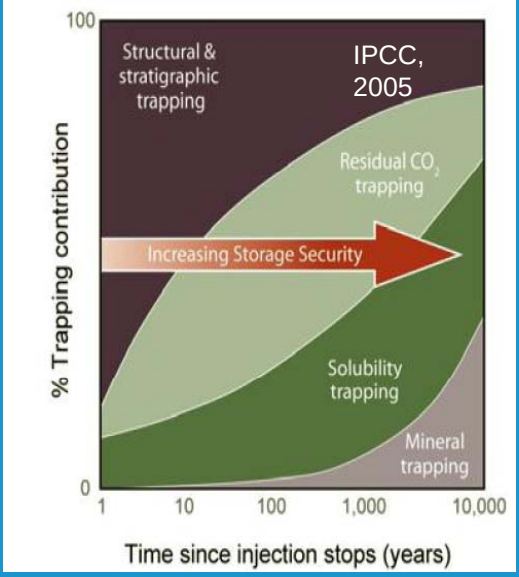
CO_2 geological storage: what do we want?

- CO_2 remains safely stored at long term
  - Where does CO_2 go?
  - What does it become?
  - Is that safe and reliable?
  - Is that efficient?

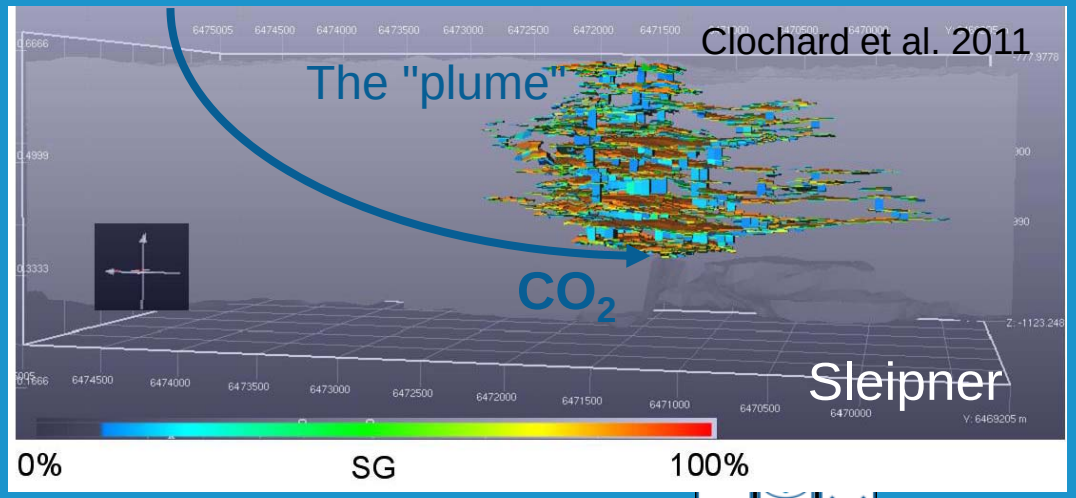
3D fluid flow

Reactive transport (Geochemistry)

Geomechanics



Quantification of stored CO_2 mass



Predict/mimic the CO_2 plume
Predict/mimic the Pressure field

Performance assessment of CO_2 storage

- Definition as considered in CO2ReMoVe:

"an analysis of the degree of containment of CO_2 in an anticipated CO_2 storage reservoir over appropriate time scales"

- Actions do deal with:
  - prediction of CO_2 migration and risk of leakage at short and long terms
  - understand CO_2 injection induced effects and storage (in situ modification of pressure, effective stresses, fluid composition, fluid-rock interactions...)
  - mapping of the CO_2 plume and monitoring of induced phenomena to verify assumptions and to detect any leakage through wells, caprock, geological structure heterogeneities (fracture, fault...)

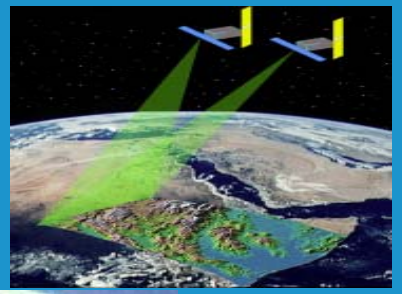
Site Characterization, Modelling (prediction), Monitoring, Simulation (must fit with observation)

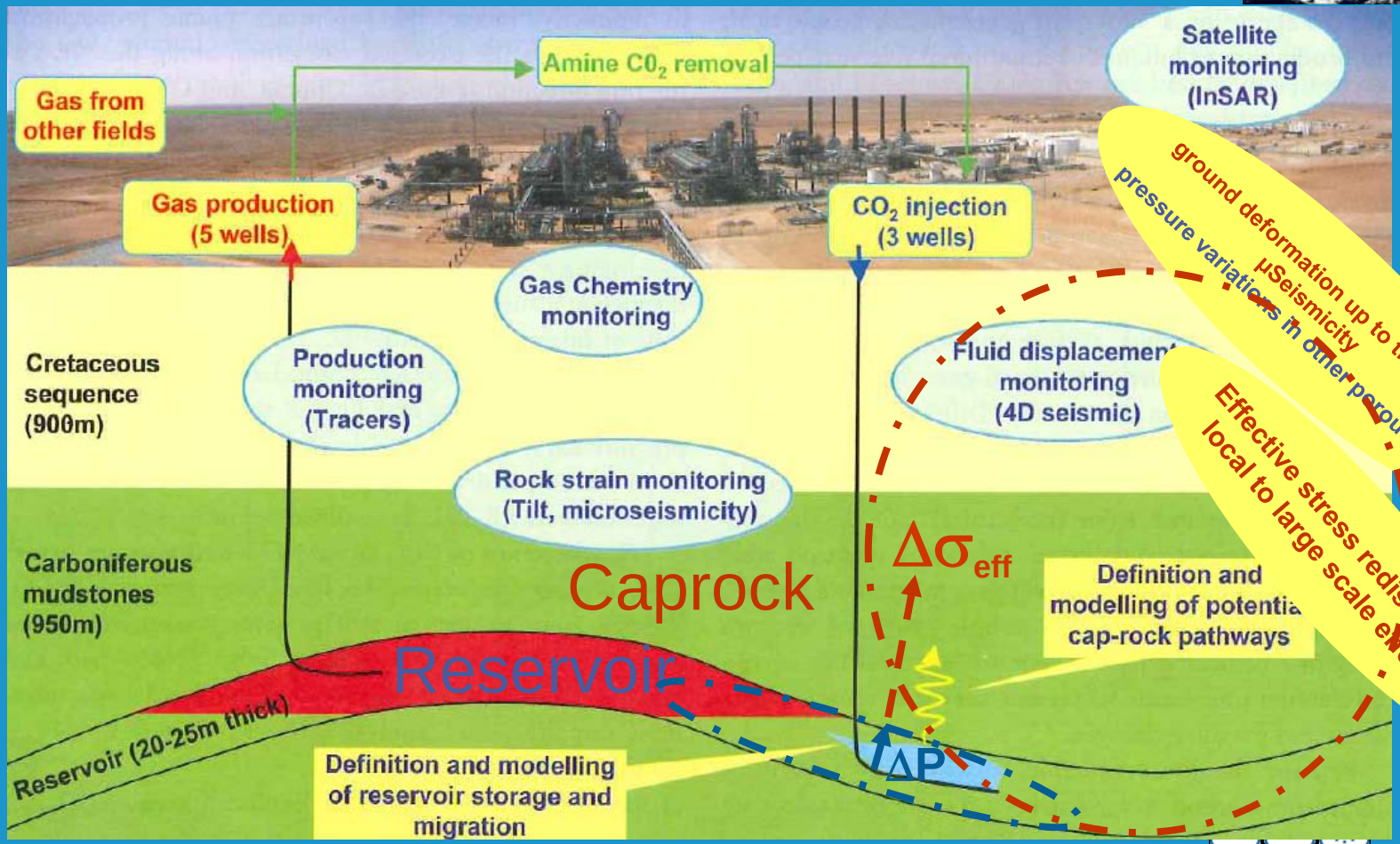
The geological storage workflow to be applied

- Short term prediction of CO_2 migration based on site characterization and history matching
- Verification based on field monitoring feedbacks (time lapse monitoring campaigns in addition to permanent measurements)
- Analysis of discrepancies, updating models and physics to be considered, remediation when necessary
- Updating short term and long term site performance assessments
- Go/No Go decision (if applicable)

The In Salah CO_2 industrial pilot site (Algeria)

In Salah JV: BP, STATOIL and SONATRACH

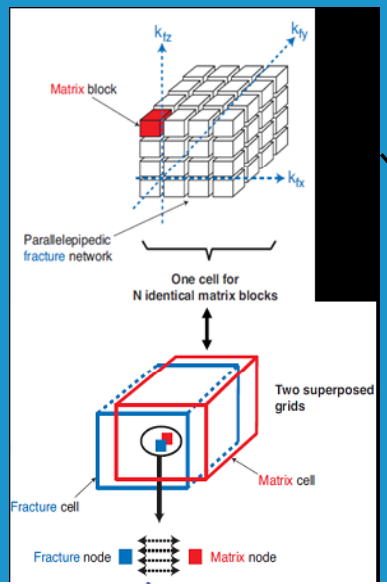




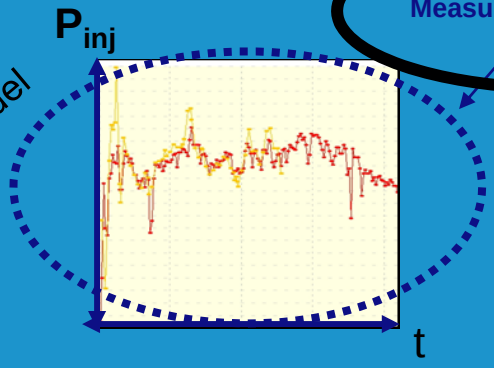
Ringrose et al. 2009

3D-reservoir pressure and geomechanical modelling

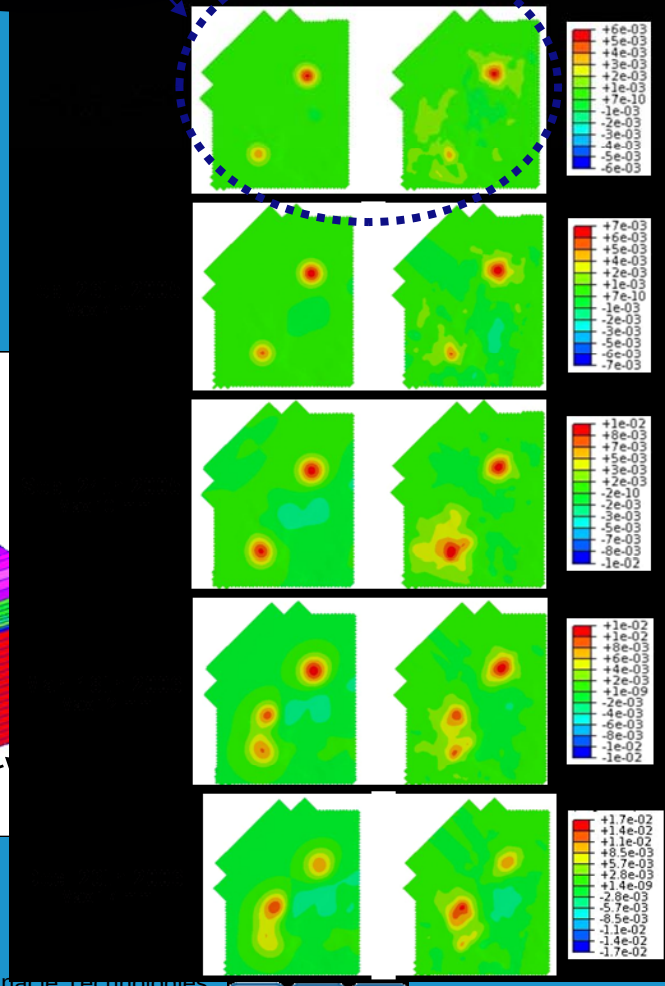
Dual reservoir model

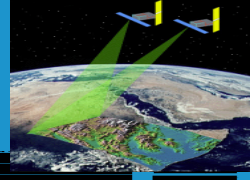


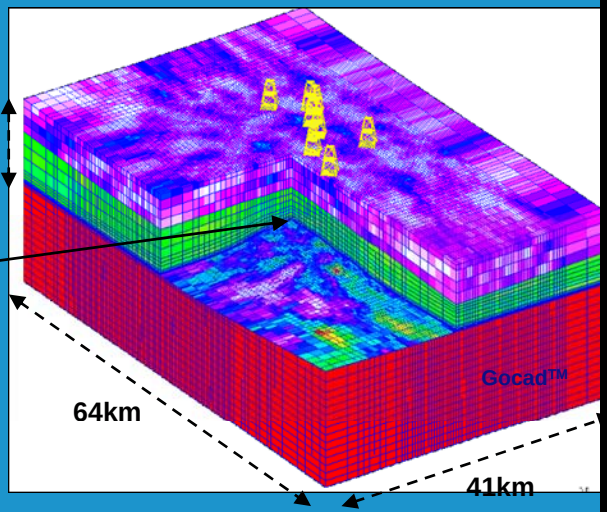
History matching
→Reservoir model

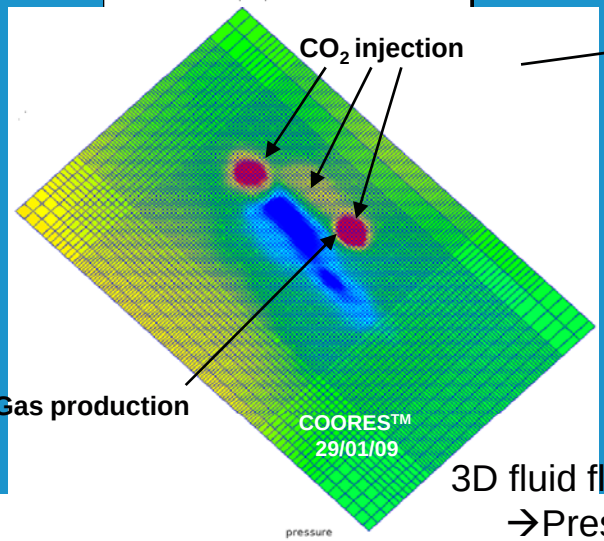


Measurements/simulatio









3D fluid flow modelling
→Pressure field

Baroni et al. 2011
and Courtesy of In Salah JIP and MDA/ Pinnacle Technologies
for InSAR satellite surface ground displacements

Pressure field well simulated

Conclusions

- Performance Assessment of CO_2 geological storage aims at applying a methodological workflow adapted to the site to be considered, using iterations between modelling tools and methods together with monitoring techniques.
- **Long term PA** aims at **predicting the long term fate of injected CO_2** within the storage complex. It is based on a **successful short term PA and would contribute to plan the long term monitoring programme.**
- Satisfactory/reliable **short term PA required appropriate monitoring** (site characterization, monitoring baseline and time-lapse adequate surveys) to reduce discrepancies between prediction and observation (including remediation actions if required).
- **Research in association with site storage pilots is necessary** to improve tools and methods especially for the long term prediction of geochemical interactions (reactive transport).

Acknowledgements

The results presented here are part of the CO_2ReMoVe European project (FP6 contract n°518350), which is directed to the development of technology and procedures for monitoring and verifying underground CO_2 storage locations. The financial support of the European Commission and the industrial consortium consisting of BP, Statoil, Wintershall, TOTAL, Schlumberger, DNV, ExxonMobil, ConocoPhillips, Vattenfall and Vector, is greatly appreciated. The success of the CO_2ReMoVe project depends to a large degree on the accessibility of the storage sites and the availability of site data, e.g. for In Salah, Sleipner, Snøhvit, Ketzin and K12-B.

Thank you for your attention

Contact:
jean-pierre.deflandre@ifpen.fr