Efficiency assessment and dynamic interactions in hydrogen geological storage in saline aquifers

within the scope of the project H2GeoStore – Hydrogen geological storage and interactions in porous media of subsurface geology at ICT (Instituto de Ciências da Terra) - University of Evora

Author: Melito Espirito Santo do Rosario Soares

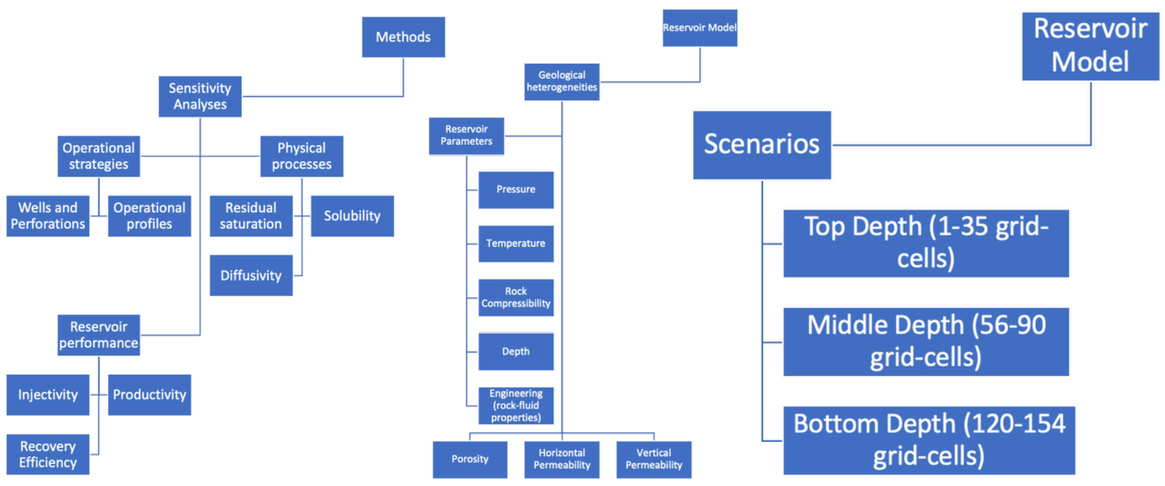
Supervisors: Prof. Dr. Leonardo Azevedo Guerra Raposo Pereira (CERENA) & Dr. Pedro Pereira (ICT)

INTRODUCTION

The search for sustainable energy alternatives has brought attention to hydrogen as a multifaceted and environmentally friendly energy carrier. The storage of hydrogen in underground saline aquifers is seen as a very promising alternative owing to its capacity for extensive storage and extended confinement.

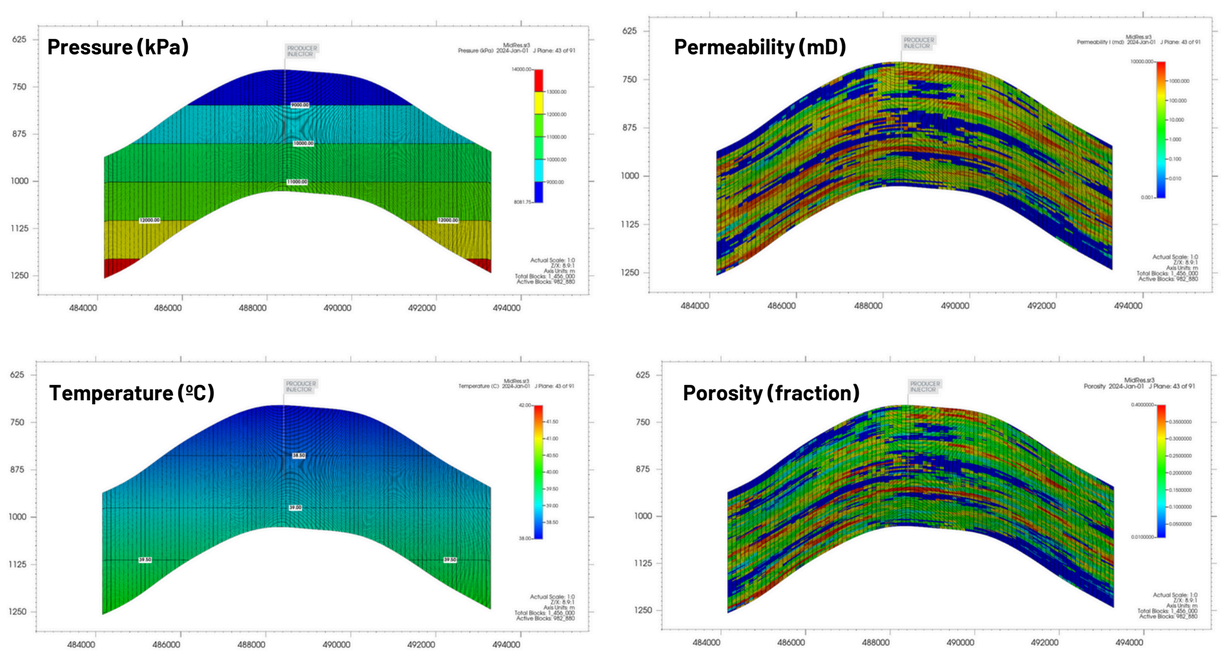
This work aims to evaluate the efficiency of saline reservoirs through a conceptual model, and different cyclical hydrogen loading and unloading strategies and well scenarios. In addition, it is also proposed the space-time characterization of relevant physical phenomena that may occur during the storage lifecycle of hydrogen in porous media.

METHODOLOGY



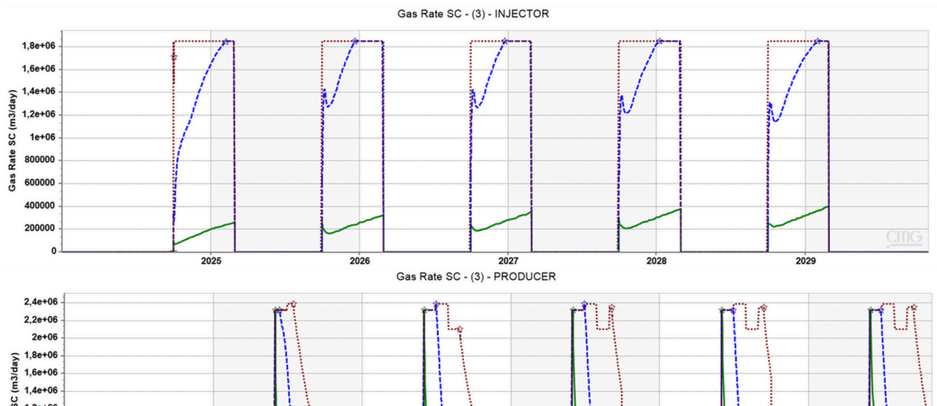
Operational strategy for the seasonal cycle of H2 storage

Cycle Parts	Event length (months)	Injection rate (10^6 m^3/day)	Production rate (10^6 m^3/day)
1 (Injection)	5	1,85	-
2 (Shut-in)	3	-	-
3 (Production)	4	-	2,32; 2,39; 2,10; 2,35

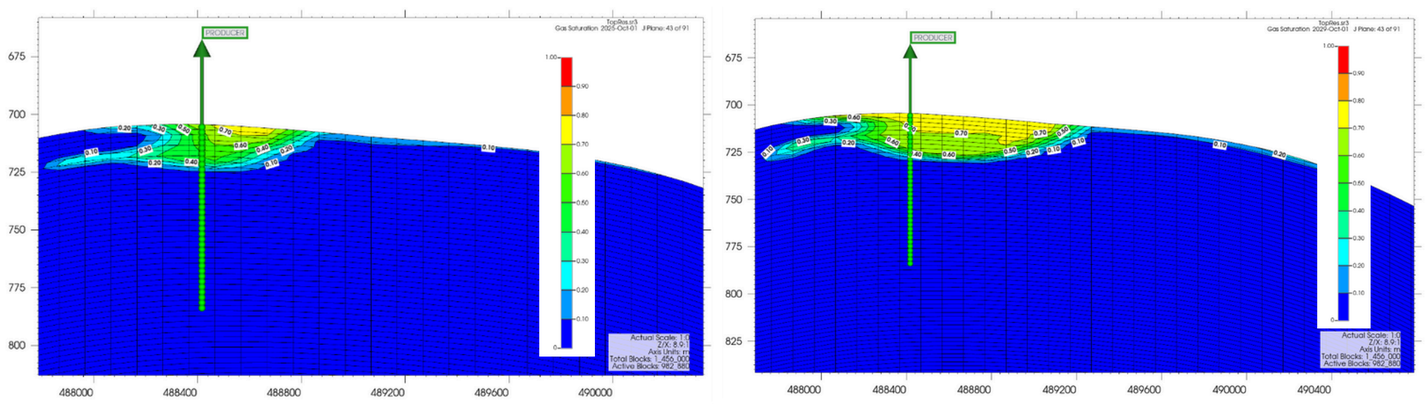


RESULTS

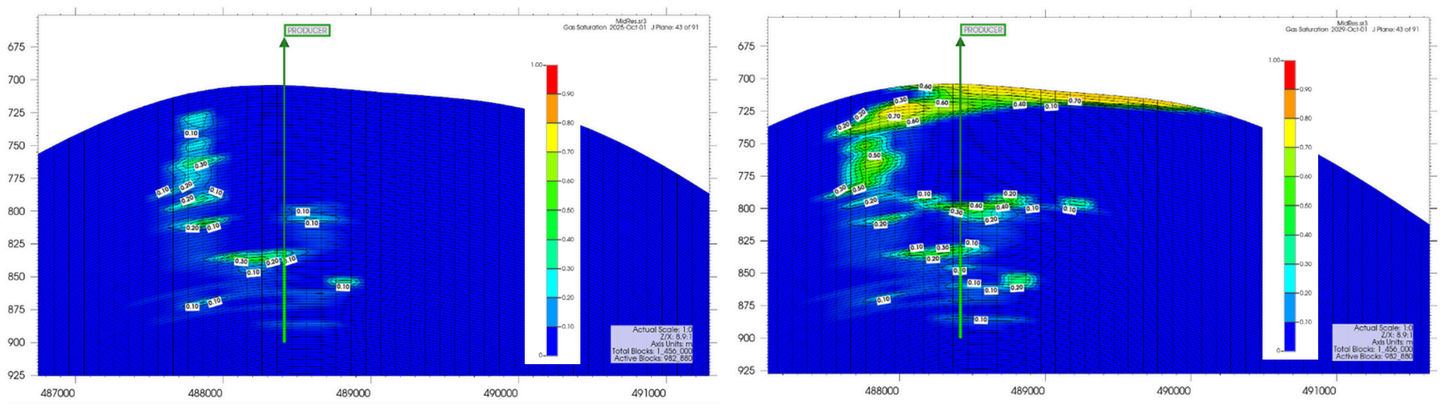
Impacts of the reservoir heterogeneity based on the operational strategy at the scales of 1 cycle (Oct'24 - Oct'25) and 5 cycles (Oct'24 - Oct'29)



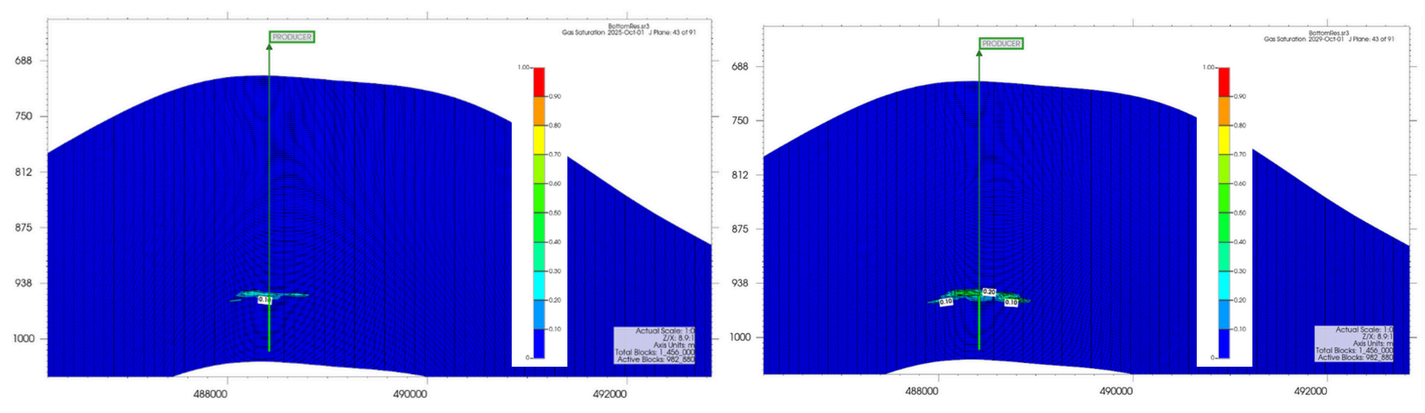
Top Reservoir (IK View): Final cycle of 1 year (Oct'25) & Final cycle of 5 years (Oct'29) - GAS SATURATION



Middle Reservoir (IK View): Final cycle of 1 year (Oct'25) & Final cycle of 5 years (Oct'29) - GAS SATURATION



Bottom Reservoir (IK View): Final cycle of 1 year (Oct'25) & Final cycle of 5 years (Oct'29) - GAS SATURATION



FINAL REMARKS & FUTURE WORK

The study of the impacts of reservoir model heterogeneities shows that the Top Depth scenario presents the best results among other models because it had the highest cumulative gas rate and it was also possible to see the gas saturation after one cycle and throughout the defined period (5 years). Adding to that, it will be conducting further studies on the phenomenon of cycles, the impacts of cushion gas, and the impacts of other operational scenarios (i.e., perforations & number of wells and their placements) which will ultimately be able to conclude regarding the reservoir performance on both injectivity and productivity.

Acknowledgements: I would like to thank CO2GeoNet for granting me a scholarship to attend the 17th Open Forum and the opportunity to showcase my ongoing master's thesis. My gratitude also goes to CERENA/IST for funding my trip and to ICT/UE for allowing me to conduct my master's thesis within the H2GeoStore project on Hydrogen Geological Storage.

DOI: https://doi.org/10.54499/2022.10650.PTDC