CO₂MOVE Project: testing CO₂ monitoring methods for onshore CCS

Clarissa Lovato Melo¹; Flávio Soares Goudinho¹; Lia Weigert Bressan¹; Marcelo Jardim Constant¹; Andresa Oliva²; Hung Kiang Chang²; Humberto Ribeiro da Rocha³; Walter Morinobu Nakaema⁴; Fátima do Rosário⁵; Ana Paula Santana Musse⁵

³ Universidade de São Paulo – USP - Instituto de Astronomia, Geofísica e Ciências Atmosféricas – IAG, Rua do Matão, 1226, - São Paulo, SP - 05508-090 - Brazil.  
⁴ Instituto de Pesquisas Energéticas e Nucleares- IPEN-CNEN-SP, Av. Prof Lineu Prestes, 2242-São Paulo, SP - 05508-000 - Brazil.  

Abstract

CO₂ injection into geological reservoirs has been conducted for many years in Brazil as a method of Enhanced Oil Recovery, without the intention of geological storage. Recently, with pre-salt discoveries in ultra-deep waters and driven by the need to contain climate change, CO₂ storage has become more relevant in the national energy production scenario. Therefore, one of the priorities in geological storage projects has been to demonstrate that CO₂ is safely stored, minimizing leakage risks, which contributes to a better public perception of Carbon Capture and Storage (CCS) as a technological solution to reduce greenhouse gas emissions in a short-term scenario. In Brazil, CO₂ monitoring techniques and methodologies for onshore CCS purposes have been tested for 6 years with the support of PETROBRAS in near-surface experiments with controlled CO₂ releases. The first initiative in this sense started in 2012 with the Ressacada Project, in Florianópolis (Santa Catarina state), and its activities are already closed. Since 2015 the CO₂MOVE Project is under development in an area inside PUCRS campus, in Viamão (Rio Grande do Sul state), involving more complex geological conditions and facing more challenges from the technological point of view. While in the Ressacada site prevailed quite sandy coastal marine sediments, the CO₂MOVE site has a predominantly siltic-argillaceous soil, as a result of weathered granites. In addition, local hydrogeology is characterized by a perched aquifer at about 1.5 meters depth, which its recharge depends on the local precipitation. The CO₂MOVE project is based on a system automation capable of adding up to 50Kg of CO₂ per day, which is 2 to 5 times more CO₂ than the manual system used in the Ressacada Project. The system has also a gaseous tracer injection module that allows incorporating tracers compounds to be tested as trackers of the injected CO₂. Monitoring tools were arranged in an area of approximately 3000m², occupying the entire region surrounding two vertical injection wells of 3 meters depth. Fieldwork involving injection and CO₂ monitoring has been developed on two occasions and the collected data was analysed in the university laboratories. The first campaign was conducted in 2016 during 60 days, in which 15 days were for preliminary surveys (pre-injection), 30 days for CO₂ injection and the last 15 days for post-injection measurements. A total of 326 Kg of CO₂ was injected in this period. At this time the research areas covered mainly geophysics (3D electrical imaging), CO₂ soil fluxes (dynamic flux chambers), subsurface gases (concentrations and isotopic analysis in soil and headspace gases), groundwater quality through four
multi-level monitoring wells, atmospheric analyses (Eddy Covariance Systems, Vaisala CarboCap sensors, Licor Closed-path Gas Analyser, Automatic Weather Station, Carbon Isotope Gas Analysers). The second campaign was conducted in 2017 during 15 days, aiming to obtain tracers response. A total of 140 Kg CO₂ and 10 mL of Perfluoro Methylcyclopentane (PMCP) were injected during 7 days. The methods used together were geophysics (3D electrical imaging), CO₂ soil fluxes, subsurface gases and groundwater quality. This paper will present an overview of the CO₂MOVE Project and the large experience acquired in these three years of research, approaching the behaviour of CO₂ and tracers observed through the multiple research methods covered.