Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO_2-Enhanced Oil Recovery Pilot, Anadarko Basin, Texas

Award Number: DE-FE0012173

Prime Performer:
Oklahoma State University

Principal Investigator:
Peter Clark

Project Duration:
10/1/2013 – 3/31/2017

Performer Location:
Stillwater, Oklahoma

Field Sites:
Farnsworth Unit site, Texas

Program:
Carbon Storage

Project Summary:

Oklahoma State University (OSU) conducted a three-year research and development project that aimed to develop and demonstrate an integrated monitoring system that is capable of directly detecting and quantifying seepage of carbon dioxide (CO_2) and methane (CH_4); into the soil and atmosphere. The approach employed in-ground and surface sensors and unmanned aerial vehicles (UAV) to collect data. OSU proposed to develop the CO_2 and CH_4; sensors and the UAV platform at OSU facilities. The integrated system would then be installed, tested, and optimized at a field site, the Farnsworth Unit (FWU), site of the Southwest Regional Partnership on Carbon Sequestration (SWP) Phase III field site.

Figure 1: The Skywalker X8 platform will act as the UAV for sensor testing at the FWU site

Project Outcomes:

This project developed a ground-based system and an airborne system for directly detecting and quantifying seepage of CO_2 into the atmosphere. The ground-based sensor network consists of a three-tiered hierarchy. The lowest tier (tier 1) consists of solar-powered low-cost, low-power, and transportable sensor nodes with radios for wireless communication with other nodes. The second tier consists of communication nodes that receive data from the tier 1 sensors, store the data locally, and transmit the data via cell modem to the tier 3 node. The tier 3 node is a computational workstation housed at the base of operations, with the capability to process and analyze the data. The ground-based system was tested at the FWU project site. The sensors and associated electronics were stable and reliable; failure rates of the units were 1% or less. Several short-duration CO_2 releases, unrelated to subsurface geologic containment of the injected CO_2 were recorded during the study.

The airborne CO_2 monitoring system consisted of a UAV that was flight tested at various sites. While the system is able to detect increased CO_2 levels, further testing and improvements are required to be able to accurately quantify the CO_2 levels. Initial flight testing was also carried out on the Anaconda UAV, a larger aircraft capable of carrying more payload, flying for longer periods of time, and automated take-off and landing for use by a more general end user.

In addition to sensor development, theoretical studies showed the feasibility of using machine learning to model flight paths for detection of a CO_2 plume in the air. A model was developed to determine optimal paths in the presence of a non-stationary plume.

Presentations, Papers, and Publications

Final Report: ***Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO_2 Enhanced Oil Recovery Pilot, Anadarko Basin, Texas*** (June 2018) Peter Edward Clark, Jarney Jacob, Tyler M. Ley, Nicholas F. Materer, Jack Pashin