Validating monitoring technologies for CCS in coastal waters

At CSIRO, we solve Australia's greatest challenges through innovative science and technology. Carbon capture storage (CCS) is an important part of global efforts to reduce carbon dioxide (CO_2) emissions to the atmosphere. CSIRO is leading research to develop methods for monitoring offshore CCS projects using fit-for-purpose technologies

Carbon capture storage – what's it all about?

Carbon capture and storage (CCS) involves capturing CO_2 emissions from industrial sources, compressing it, and then transporting it to a suitable site where it is injected deep underground for long-term storage. Implementing this technology will contribute to lowering atmospheric emissions of CO_2.

Careful selection and assessment of a potential storage site that has the right geological structures is critical to ensure long term storage.

Establishing a robust measurement and monitoring process for these CCS activities is also a key requirement to provide confidence and certainty to the community that the CO_2 has been stored effectively. It is also a legislative requirement of approvals for CCS activities in Australia that a robust measurement, monitoring and verification (MMV) program is implemented on CCS projects.

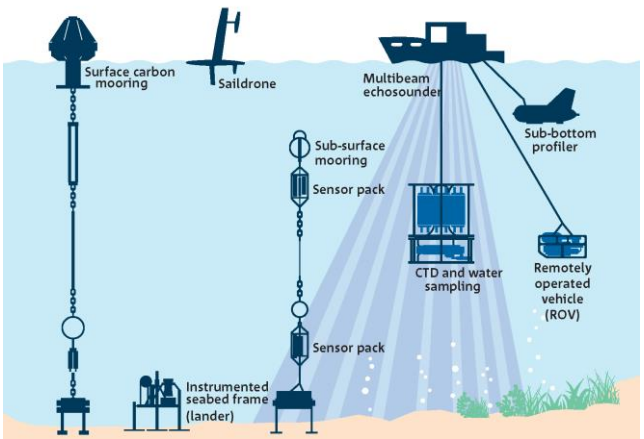

Illustration of the equipment to be tested for MMV of CCS.

Projects in Australia

Australia is home to a globally important projects demonstrating CCS feasibility and technologies that could be employed.

The first Australian research facility to demonstrate deep geological storage of CO_2 was established by the CO2CRC in the Otway Basin, western Victoria in 2009.

Chevron Australia's Gorgon Liquefied Natural Gas (LNG) Project, situated on Barrow Island, in the North West of Western Australia, is currently the largest onshore commercial CCS project in the world, having commenced operation in 2019.

Offshore Gippsland (Victoria, Australia) is widely recognised as one of the most attractive basins for CCS in Australia, with its proximity to large industrial sources of CO_2 emissions combined with promising geological storage potential.

Victorian Department of Jobs, Precincts and Regions (DJPR) though its CarbonNet Project is investigating the offshore Gippsland area for its potential for CO_2 storage. This commercial-scale carbon capture and storage (CCS) network could see the injection of up to 5 million tonnes of CO_2 per year over a 25-year period.

The CarbonNet Project offers a unique opportunity to test and validate a range of monitoring technologies and methods that could be applied to a commercial scale near-shore CCS project.

CSIRO and CCS

CSIRO and CCS

As part of a programme of research funded by the Australian National Low Emissions Coal Research and

Development, CSIRO is leading research which aims to demonstrate the methods that may be used for marine MMV in shallow coastal CCS projects.

CSIRO's scientists and technicians are conducting world-leading research to provide new knowledge to inform accurate and cost-efficient MMV. This will be used to correctly determine and attribute the causes of changes in shallow-coastal environments in the vicinity of CCS projects. The procurement of these technologies through investment by the Australian Government Education Investment Fund and their testing will enable the methods for MMV of subsea CO_2 storage to be validated and advice given on possible MMV frameworks for commercial CCS operations.

Understanding variability

As part of characterising an area in the vicinity of CO2 storage, it is important to understand the range in natural variability and predict how it may change over time. Knowledge of the natural variability and the processes in the subsea environment can then inform monitoring approaches selected. These need to be able to detect anomalies associated with the leakage of CO2 but also record other human induced or natural changes occurring in the environment.

Measurement, monitoring and verification

Taking measurements in the marine environment is a complex undertaking. Our research includes the development and demonstration of state-of-the-art marine measurement and monitoring tools tailored to offshore CCS monitoring activities.

This includes the testing/trialling of the suitability of:

- Fixed platforms: moorings and seabed frames (termed landers) equipped with a range of sensors to measure parameters such as CO2, pH, oxygen, methane, temperature and salinity.
- Mobile platforms: unmanned surface vehicles equipped with a range of physical and chemical sensors.
- Passive acoustic sensors and underwater sonar systems (echosounders) to provide information on bubbles and biological communities.
- Collection of infaunal samples for eDNA and taxonomic characterisation. Identification of major fish and invertebrate taxa through video surveys.

The final aspect of the research has included the development of numerical modelling tools that can be used for environmental prediction and that will inform monitoring framework designs.

The unmanned surface vehicle, saildrone, being trialled to collect environmental data in the Gippsland region.

Why is this research important?

CCS MMV research will help provide assurance to all stakeholders – community, industry and government – that shallow-coastal CCS operations are able to be effectively and accurately monitored. As a result of this work we will develop:

- Modelling tools for use in designing CCS-related marine environmental monitoring plans.
- A state-of-the-art networked technology toolkit that has been field tested and optimised for offshore CCS environmental monitoring.
- A database of environmental signals for reference use in future monitoring.
- Novel, rapid-assessment tools for biological indicators of environmental impact, based on (e)DNA approaches.

The outcomes will not only be relevant to Australia but also to the international community, informing best practice for monitoring CCS in shallow marine environments globally

Financial support

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