Validating monitoring technologies for CCS in coastal waters

Carbon capture storage (CCS) is an important part of global efforts to reduce carbon dioxide (CO_2) emissions to the atmosphere. CSIRO Oceans & Atmosphere is collaborating with other researchers 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 help to lower Australia's contribution to atmospheric emissions.

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

Establishing a robust measurement and monitoring process for future CCS activities is also a key requirement to provide confidence and certainty to the community. It is also a legislative requirement of approvals for CCS activities in Australia that a robust measurement, monitoring and verification (MMV) program is implemented.

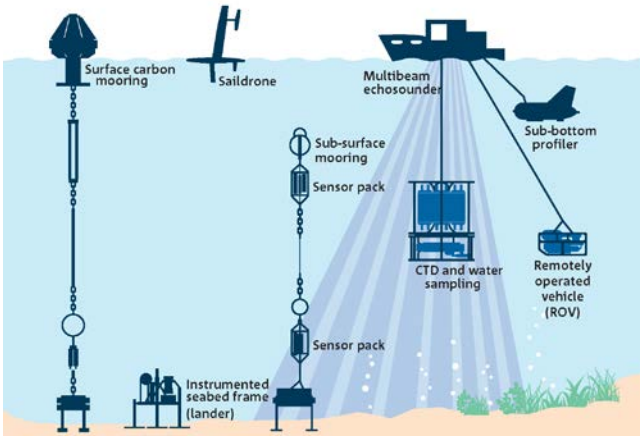

Illustration of the equipment to be used for the research.

Projects in Victoria, Australia

Australia is home to a globally important suite of active investigations into CCS technology, with the first Australian research facility established to demonstrate deep geological storage of CO_2 in the Otway Basin in western Victoria by the CO2CRC for more than a decade.

The CarbonNet Project is investigating the potential for establishing a commercial-scale CCS network in Gippsland (Victoria).

A number of research organisations are collaborating in the GipNet initiative which is focussed on the Gippsland region. The research program will test and validate a range of technologies and methods that CarbonNet and other CCS projects could adopt to monitor coastal environments where CO_2 storage sites may be located.

CSIRO and CCS

The CO2CRC manages GipNet which is a programme of research funded by the Australian National Low Emissions Coal Research and Development and the Australian Government Education Investment Fund.

CSIRO is leading the marine component which aims to improve methods for the environmental components of measurement, monitoring and verification (MMV) in marine coastal CCS projects.

CSIRO's scientists and technicians will be conducting world-leading research to provide new knowledge to inform cost-efficient MMV. The procurement of these technologies, and their testing in an Australian context, will enable the methods for MMV of subsea CO_2 storage in the marine environment to be advanced. All research will be carried out between 2017 and 2020 with field work centred on coastal waters of the Gippsland region.

Gippsland Basin
Located 220 km east of Melbourne in the State of Victoria (Australia), the Gippsland Basin is widely recognised as one of the most attractive basins for CCS in Australia due to its promising geological storage characteristics.

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Research objectives

Two key objectives of the research are:

- To gain knowledge about the Gippsland coastal subsea environment and its natural variability.
- To develop MMV methods which are cost-effective, accurate, and best-practice and can capture and correctly attribute small changes in dissolved CO_2 and gas bubbles in shallow-coastal ecosystems.

Seabed processes of Gippsland

As part of characterising an area for potential CO_2 storage, it is important to understand any unusual or unique features of the area. Knowledge of the natural variability in the subsea environment and its processes is needed to inform the scale of monitoring requirements.

During 2017/18 researchers will be undertaking targeted field surveys to gather acoustic, visual and geochemical data on several seabed sand-wave like features located offshore of Golden Beach in the Gippsland region. All field surveys are located in coastal waters (<30 m depth).

Investigation of these seabed features will provide insights into the dynamic processes shaping the nearshore Australian seabed and help characterise the sediment and biological communities present. Some of the data collected will also be used to develop novel approaches for rapid biological assessment using environmental (e)DNA.

Measurement, monitoring and verification

Data will be gathered to understand how and where dissolved CO_2 and gas bubbles occur naturally in the coastal waters surrounding CarbonNet's proposed CCS site.

Seawater naturally contains high levels of dissolved CO_2 and animals living on the seabed or in seabed sediments can produce bubbles of CO_2 when they breathe. By understanding the variability of such natural signals, we can improve confidence in the monitoring systems.

Taking measurements in the marine environment is a complex undertaking so part of the research will be developing state-of-the-art marine measurement and monitoring technologies tailored to offshore CCS activity.

These technologies include moorings and seabed frames (termed landers) which are equipped with a range of sensors to measure parameters such as CO_2, pH, oxygen, methane, temperature and salinity. Passive acoustic sensors and underwater sonar systems (echosounders) will provide information on bubbles.

An unmanned surface vehicle (saildrone) will also be equipped with a number of sensors and trialled to determine its suitability as a monitoring tool for CCS.

The final aspect of the research will develop numerical modelling tools that can be used for environmental prediction.

The unmanned surface vehicle, saildrone, to be used to collect environmental data in the Gippsland region.

Why is this research important?

This research will help provide assurances to all stakeholders – community, industry and government – that shallow-coastal CCS operations are able to be monitored effectively and accurately. 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.

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