

Climate Change Monitoring

PML has developed the *Live pCO₂* autonomous underway CO₂ measurement system for remotely measuring the partial pressure of carbon dioxide (CO₂) in the ocean.



Global monitoring of ocean CO₂ is required for climate predictions and calculating global carbon budgets. The oceans play a key role in the global climate

system as the Earth's major reservoir and pathway for heat, freshwater and carbon and has a direct impact on coastal populations as a result of sea level change. Better knowledge of climate impacts on the marine environment is vital for improved forecasts of changes and for informing policy.

With over 30 years experience, PML scientists conduct research, develop novel technologies and provide policy advice to gain better understanding and improve the ability of sustainable management of the marine environment. PML is therefore uniquely qualified to research, apply its science and advise on many of the issues on global change and sustainability in marine systems.

Research services include:

- Predicting the effects of ocean acidification
- Marine carbon footprinting
- Valuation of environmental goods & services
- Autonomous underway measurement systems
- Carbon capture and storage (CCS)
- Marine renewable energy
- Blue biotechnology
- Pollution of the marine environment

Key capabilities include:

- Physical, chemical and biological processes and their interaction with climate change
- Technological solutions for monitoring the oceans and climate change
- Oceanographic data assimilation, earth observation, modelling and forecasting

Live pCO₂ System

PML has been involved in the development of underway pCO₂ measurement systems for over 20 years and has contributed to many international studies. To date, systems are in operation on five UK research vessels and can be installed for unsupervised operation on commercial ships, as part of their corporate responsibility monitoring. PML's *Live pCO₂* system was developed in collaboration with CASIX and Dartcom.

The latest *Live pCO₂* systems are designed for autonomous, ship-borne, underway operation at sea and does not need a scientist on board to operate.

The system samples seawater and atmospheric CO₂ concentrations with onboard instruments that combine robust, auto-calibrating, cost-effective technologies with a low maintenance, autonomous design. Satellite communication capabilities allow real-time data transmission and live system control to be carried out remotely.

Additional data from other instruments can also be included in the live data stream (e.g. sea surface temperature, conductivity, salinity, wind speed and direction, sea level pressure, fluorescence, dissolved oxygen, pH). These are especially useful for real-time data processing and calculation of air-sea CO₂ fluxes.



Research vessels with the system on board

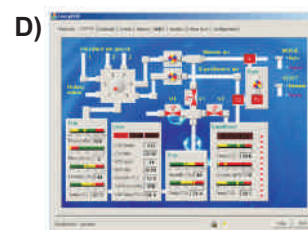
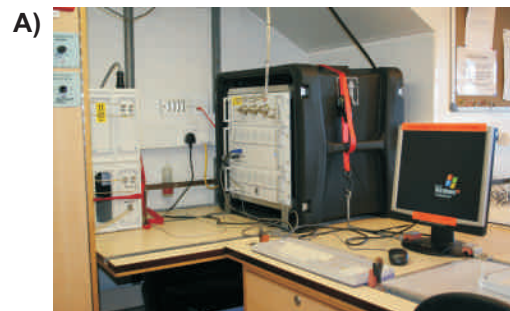
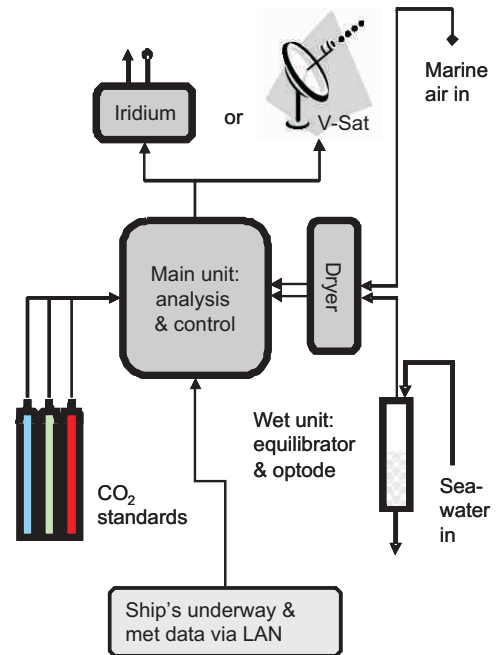
Live pCO₂ technical summary

The system comprises a main analyser unit with dryer unit, optional GPS/Iridium antennae unit and a wet unit consisting of equilibrator and O₂ sensor (see schematic).

The system is designed to run without interruption on a continuous basis, with two-way information flow with its home base. The system can run continuously for months at a time.

Specification:

- Autonomous operation
- High precision measurements of surface ocean and atmospheric pCO₂
- Integrated near-real time data supply with GPS
- Integrated meteorological sensors
- Remote system performance diagnostic checking and alarm system
- Auto-calibrating
- Simple plug-and-play installation and maintenance
- Fully networked for additional sensor integration
- High durability design
- Shock-resistant mounting for high vibration environments
- High-efficiency air dryer with water ingress protection system
- User-friendly control software
- 71cm (W), 73cm (D) and 64cm (H); weight 60kg



The system installed on a vessel, showing:
 A) Main unit and dryer
 B) Wet Unit
 C) Close up of the equilibrator (cover removed)
 D) Control software