

# Autonomous pCO<sub>2</sub> Monitoring System

**Designed by MBARI – Enhanced by NOAA – Manufactured by Battelle**

Battelle, the world's largest non-profit research and development organization, has launched an innovative cooperative effort with the Monterey Bay Aquarium Research Institute (MBARI) and the National Oceanic and Atmospheric Association (NOAA) to manufacture and commercialize an analytical instrument that will help scientists understand and predict climate change – the Autonomous pCO<sub>2</sub> Monitoring System.

The self-contained, modular design has the ability to be deployed on a wide variety of platforms. It is designed to operate unattended for more than 12 months at a time. Currently, more than a dozen systems are placed on a variety of buoys around the world. NOAA is using this system to develop a global array of moored observation systems to determine air-sea flux in support of the Global Ocean Observing System (GOOS).

This new analytical instrument measures the partial pressure of carbon dioxide (pCO<sub>2</sub>) in the ocean and atmosphere, which is needed to understand the global ocean uptake of atmospheric CO<sub>2</sub>. The need for ocean carbon measurements is becoming increasingly important because high levels of carbon dioxide in the oceans have led to ocean acidification in surface waters, which could have significant effects on a variety of marine organisms and ecosystems.

The system has a measurement range of 100 to 600 parts per million, with an extended range available upon request. Incredibly, the system also has a precision accuracy to about one part per million. Self powered by batteries, the system contains compact flash memory storage and an Iridium satellite communications link.

In 1992, MBARI scientists Gernot Friederich and Francisco Chavez realized the importance of collecting precise and frequent data regarding CO<sub>2</sub> exchange between the ocean and the atmosphere in order to better understand climate change. They designed the pCO<sub>2</sub> monitoring system using known gas-equilibration chemistry and state-of-the-art non-dispersive infrared (NDIR) spectroscopy. Measuring the partial pressure of CO<sub>2</sub>

gives scientists an idea of whether the ocean is acting as a source or sink of CO<sub>2</sub> (relative to the atmosphere) at a given place and time. Such fluxes of CO<sub>2</sub> vary dramatically from place to place and over time.

In 2003, MBARI transferred the technology to NOAA, where scientists and engineers improved the design to make it more robust, more accurate, and easily manufactured.

A reference calibration gas and two-way satellite data transmission capabilities were added to control the system remotely and receive data in near real-time.

“Our system has sustained continuous measurements over extended periods of time,” said Dr. Christopher Sabine, Oceanographer, Ocean Climate Research Division, NOAA/PMEL.

The Autonomous pCO<sub>2</sub> Monitoring System will be manufactured at Battelle's specialized scientific instrument manufacturing facility in Columbus and will be commercially available summer 2009. “This is a wonderful cooperative effort between two non-profit organizations and a government agency to bring this important technology to the broader oceanographic and scientific community,” said Spencer Pugh, VP and Manager of Battelle's Industrial and International Market Sector.

