# New Surface Mooring at Station Papa Monitors Climate

*by Robert Kamphaus, Meghan Cronin, Christopher Sabine, Steven Emerson, CHristian Meinig and Marie Robert*

*OCS Papa mooring in 4-m seas during February 2008 Line-P cruise.*

Canadian weatherships endured winter storms in the Gulf of Alaska for 30 years (1951 to 1981) to monitor and report continuous meteorological and oceanographic observations from Ocean Weather Station Papa (50°N, 145°W). Since then, research vessels from various nations have visited the site at regular intervals from three to six times per year. A mooring was maintained there for two years (NOPP 1997–1999) and beginning last winter, a new mooring is continuing the legacy by re-occupying the station.

As one of the oldest oceanic stations, Station Papa is a critical component in the global network of OceanSITES reference stations. The University of Washington (UW), NOAA's Pacific Marine Environmental Laboratory (PMEL), and the Canadian Department of Fisheries and Oceans (DFO), with financial support from the U.S. National Science Foundation and NOAA's Office of Oceanic and Atmospheric Research have partnered to design, instrument, and maintain a new Ocean Climate Station (OCS) mooring for Station Papa (see photo). The OCS Papa surface mooring and a sub-surface acoustic Doppler current profiler (ADCP) mooring were deployed in June 2007 from the Canadian Coast Guard Ship *John P. Tully*. Anchored in 4200 meters of water, the 3-m diameter buoy design is based largely on NOAA's tsunami moorings that have survived in high-latitude conditions.

A suite of instruments provide near real-time access to key climate variables, including meteorological measurements, near-surface physical oceanographic properties, and air–sea $CO_2$ concentrations. Recovery of the deployed sensors, including several that do not transmit their data in real-time, will allow high-resolution quantification of ocean–atmosphere interactions, $CO_2$ and $O_2$ fluxes, currents, productivity, and the pH of oceanic waters. The mooring will be serviced in collaboration with scientists from DFO, Pacific Region, who visit OCS Papa as a component of their Line-P observations program.

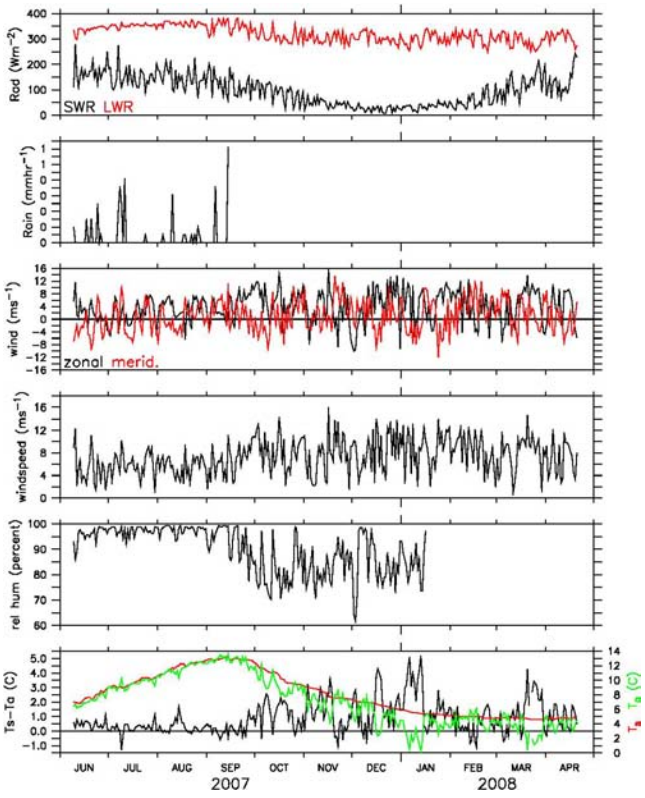


*Fig. 1 OCS Papa time series. From top to bottom: short- and long-wave radiation, rain rate, U/V wind components, wind speed, relative humidity, and sea, air, and Δ temperatures.*

The surface mooring has proved to be robust and reliable, providing near real-time hourly values from a suite of meteorological instruments and daily averages from both surface and subsurface instruments through the 2007–2008 winter season (**Fig. 1**). Data are transmitted to PMEL *via* Service Argos or Iridium and made available through the web (see: http://www.pmel.noaa.gov/stnP/). A subset of the meteorological data is also distributed *via* the Global Telecommunications System.

This is the first open-ocean mooring specifically designed to monitor ocean acidification. The OCS Papa mooring has been outfitted with a SAMI-pH sensor to directly measure acidity levels in the surface ocean. Monitoring $pCO_2$, $O_2$ and pH (**Fig. 2**) will allow a full description of the complex carbon chemistry at Station Papa and provide a better understanding of the processes controlling $CO_2$ variability at this site.

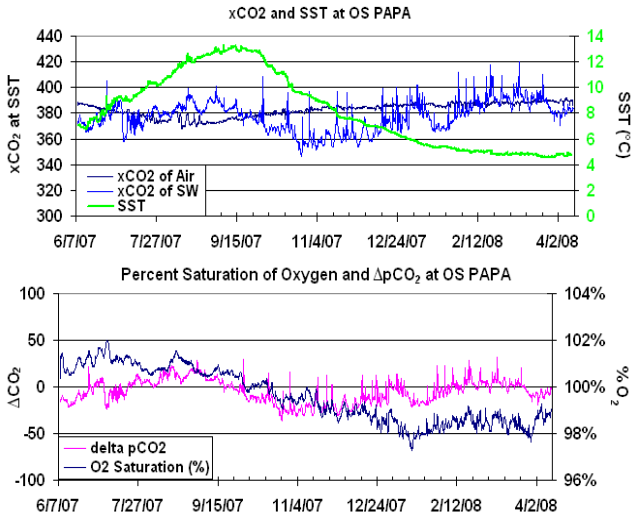


*Fig. 2 $CO_2$ and $O_2$ data from the OCS Papa mooring (available at www.pmel.noaa.gov/co2/moorings/papa/data_145w_all.htm).*

The valuable near real-time data will be augmented by high-resolution data after the sensors are recovered. Scientific analyses will produce improved understanding of surface heat fluxes, the mixed layer heat balance, mixed layer carbon dynamics, horizontal advection and entrainment velocities. In addition, episodic events such as freezing air temperatures and rapid carbon drawdown in surface waters will be investigated. Comparisons with similar data from the OceanSITES network could illustrate key differences in fluxes, cloud radiative forcing, carbon uptake, mixing, and eddies. The OCS Papa measurements also provide valuable data for assessing the accuracy of re-analyses of numerical weather predictions (NWP) and operational products.

Designed to be serviced every 6 months, the present mooring has been untended for over 9 months due to unfavorable weather conditions during the February 2008 servicing trip. A follow-on cruise is planned for June 2008. Upgrades will provide a significant increase in the near real-time transmission of subsurface data.

The OCS Papa surface mooring is funded until 2009 through a National Science Foundation Carbon and Water in the Earth System project "North Pacific Carbon Cycle" to Dr. Steven Emerson (UW). NOAA support is provided through the Office of Oceanic and Atmospheric Research. More information and data from the OCS Papa mooring can be found at http://www.pmel/noaa.gov/stnP/.


*Robert Kamphaus (top left, Robert.A.Kamphaus@noaa.gov) is an Operations Manager for the National Oceanic and Atmospheric Administration (NOAA) Commissioned Corps assigned to the Ocean Climate Research Division (OCRD) at NOAA's PMEL in Seattle.*

*Marie Robert (top right, Marie.Robert@dfo-mpo.gc.ca) is a Physical Oceanographer at the Institute for Ocean Sciences of Fisheries and Oceans Canada. She is the Coordinator of the Line P Program, managing research activities of this project, leading the cruises, and creating on-line products.*

*Christopher Sabine (bottom left, Chris.Sabine@noaa.gov) is an Oceanographer with OCRD at NOAA's PMEL. He is an affiliate faculty at the UW School of Oceanography and a Senior Fellow of the Joint Institute for the Study of the Atmosphere and Ocean (JISAO), UW. His research focuses on discrete and moored inorganic carbon measurements in the oceans, including air–sea exchange of $CO_2$.*

*Meghan Cronin (bottom, second from left, Meghan.F.Cronin@noaa.gov) is also an Oceanographer with OCRD at NOAA's PMEL, and an affiliate faculty at the UW School of Oceanography. She leads the Ocean Climate Stations program and her research interests include air–sea interaction and upper ocean dynamics. She is a Senior Fellow of JISAO.*

*Steven R. Emerson (bottom, second from right, emerson@u.washington.edu) is a Professor of chemical oceanography at the UW School of Oceanography. His research interests include cycling of metabolic gases and isotopes in surface waters, air–sea $CO_2$ exchange, and the effects of anoxic conditions on the solubility of metals in seawater. He is a Senior Fellow of JISAO and a member of the Board of Directors for the UW Program for Climate Change (PCC).*

*Christian Meinig (bottom, right, Christian.Meinig@noaa. gov) is an Engineer and the Leader of the Engineering Development Division at PMEL in Seattle.*