

## Station ALOHA data reveal ocean acidification

The burning of fossil fuels has released tremendous amounts of the greenhouse gas carbon dioxide (CO<sub>2</sub>) into the atmosphere, significantly impacting global climate. Were it not for the absorption of CO<sub>2</sub> by the oceans, the alarming growth of atmospheric CO<sub>2</sub> concentration would be substantially greater than it is. However, this beneficial role of the oceans as a CO<sub>2</sub> "scrubber" does not come without undesired consequences. When dissolved, CO<sub>2</sub> acts as an acid, and lowers seawater pH. Since the beginning of the industrial age, CO<sub>2</sub>-driven acidification of the surface oceans has already caused a 0.1 unit lowering of pH, and models suggest that another 0.3 pH unit drop by the year 2050 is likely. Continued acidification of the sea may have a host of negative impacts on marine biota, and has the potential to alter the rates of ocean biogeochemical processes.



Hawaiian Ocean Time-series scientists recover their sediment traps at dawn. Image courtesy of HOT/SOEST

Despite the global environmental importance of ocean acidification, there are few studies of sufficient duration, accuracy and sampling intensity to document the rate of change of ocean pH and shed light on the factors controlling its variability. In 1988, Dave Karl and Roger Lukas of the School of Ocean, Earth Science and Technology (SOEST) at the University of Hawaii at Manoa founded the Hawaii Ocean Time-series (HOT) program, in part to establish a long-term record of the oceanic response to rising atmospheric CO<sub>2</sub>. Monthly research cruises to Station ALOHA, north of Oahu, have yielded after 20 years the most detailed record to date on ocean acidification in the Pacific. Reporting in this week's issue of Proceedings of the National Academy of Sciences, lead author and former SOEST researcher John Dore (now at Montana State University) presents an analysis of the changes of pH at Station ALOHA over time and depth. Dore, along with SOEST co-authors Karl, Lukas, Matt Church and Dan Sadler, found that over the two decades of observation, the surface ocean grew more acidic at exactly the rate expected from chemical equilibration with the atmosphere. However, that rate of change varied considerably on seasonal and inter-annual timescales, and even reversed for one period of nearly five years. The year-to-year changes appear to be driven by climate-induced changes in ocean mixing and attendant biological responses to mixing events. The authors also found distinct layers at depth in which pH declines were actually faster than at the surface. Dore and colleagues attribute these strata of elevated acidification rates to increases in biological activity and to the intrusion at Station ALOHA of remotely formed water masses with different chemical histories.

### Article Information: Physical and biogeochemical modulation of ocean acidification in the central North Pacific

John E. Dore, Roger Lukas, Daniel W. Sadler, Matthew J. Church and David M. Karl

PNAS July 28, 2009 vol. 106 no. 30 12235-12240

Open Access article available online at <http://www.pnas.org/content/106/30/12235>

### About the Hawaii Ocean Time-series Program

Scientists working within the Hawaiian Ocean Time-series (HOT) project have been making repeated observations of the hydrography, chemistry and biology at a station north of Hawaii since October 1988. The objective of this research is to provide a comprehensive description of the ocean at a site representative of the central North Pacific Ocean. Cruises are made approximately once a month to Station ALOHA, the HOT deep-water station (22°45'N, 158°W) located about 100 km north of Oahu, Hawaii. Measurements of the thermohaline structure, water column chemistry, currents, primary production and particle sedimentation rates are made over a 72-hour period on each cruise.

For more information about Hawaii Ocean Time-series Program please visit <http://hahana.soest.hawaii.edu/hot/hot.html>

### Contact information

David Karl, Professor, Department of Oceanography, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa, [dkarl@hawaii.edu](mailto:dkarl@hawaii.edu) (808) 956-8964

Roger Lukas, Professor, Department of Oceanography, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa, [rlukas@hawaii.edu](mailto:rlukas@hawaii.edu), (808) 956-7896

**SOEST Media Contact:** Tara Hicks Johnson, (808) 956-3151, [hickst@hawaii.edu](mailto:hickst@hawaii.edu)

