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## Global Changes in Ocean Carbon: Variability and Vulnerability

Nicolas Metzl, Bronte Tilbrook, Dorothee C. E. Bakker, Corinne Le Quéré, Scott C. Doney, Richard A. Feely, Maria Hood, Roger Dargaville

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# AmeriFlux Network Aids Global Synthesis

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The AmeriFlux network of 15 sites across the United States and Mexico has provided a comprehensive record of carbon fluxes in a variety of ecosystems, including forests, wetlands, and tundra. This data is being used to improve global models of the carbon cycle and to understand the impact of climate change on these systems. The network also provides a platform for international collaboration and data sharing.

The AmeriFlux network is a key component of the Global Carbon Project (GCP), which aims to improve our understanding of the global carbon cycle. The network's data is being used to develop a global carbon budget and to identify areas where more research is needed.

The AmeriFlux network is also providing valuable information on the impact of land use change on the carbon cycle. For example, the network has shown that deforestation in the Amazon basin has led to a significant increase in carbon emissions. This information is being used to inform policy decisions on land use and forest management.

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# MEETINGS

## Global Changes in Ocean Carbon: Variability and Vulnerability

**Surface Ocean CO<sub>2</sub> Variability and Vulnerability Workshop, Paris, France, 11-14 April 2007**

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The oceans have taken up approximately half of the anthropogenic CO<sub>2</sub> emissions. This uptake reduces climate change but also lowers ocean pH, with the potential to disrupt ecosystems. Climate change affects ocean biology and physics and could lead to reduced efficiency of the carbon sinks, a process that atmospheric data and ocean models indicate is already occurring in the

Southern Ocean. Attempts to set a baseline stabilization target for the atmospheric CO<sub>2</sub> concentration will ultimately depend on our understanding and prediction of oceanic CO<sub>2</sub> sinks. While we are now close to monitoring oceanic CO<sub>2</sub> uptake on decadal and regional scales, meaningful predictions of its future behavior are difficult. There is a critical and urgent need to better understand the ocean processes regulating CO<sub>2</sub> uptake

and to identify research and observational priorities for the future.

On 11-14 April 2007, over 100 scientists from 20 countries gathered at the United Nations Educational, Scientific, and Cultural Organization (UNESCO), in Paris, to review current knowledge on the magnitude, variability, and processes governing ocean sources and sinks of carbon. The discussions covered observations, process-based models, and atmospheric and oceanic inversions. This workshop was cosponsored by the International Ocean Carbon Coordination Project (IOCCP), the Surface Ocean Lower Atmosphere Study (SOLAS), the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), and the Global Carbon Project (GCP) programs.

New results were presented for a global air-sea CO<sub>2</sub> flux climatology and detection of decadal variations in oceanic partial pressures of CO<sub>2</sub> (pCO<sub>2</sub>). Observations conducted over more than 20 years show the long-term pCO<sub>2</sub> increase of surface waters is

generally close to the atmospheric CO<sub>2</sub> increase, indicating relatively constant sinks. In recent years, significant decadal changes in  $\rho\text{CO}_2$  have been observed in some parts of the ocean, e.g., in the North Atlantic and the equatorial Pacific; however, for many regions there are still no routine observations. Quantification of the decadal changes of the air-sea CO<sub>2</sub> fluxes has been improved using atmospheric data, especially for the vulnerable Southern Ocean, where oceanic data are sparse. Presentations, posters, working group reports, and maps and tables of the ocean carbon observation network are

available on the meeting Web page: [http://www.ioc.unesco.org/ioccp/pCO2\\_2007.htm](http://www.ioc.unesco.org/ioccp/pCO2_2007.htm).

A major outcome of the workshop was the widespread recognition and strong support for sustained funding and further development of the global observing system for surface  $\rho\text{CO}_2$ . The workshop resulted in actions for developing joint synthesis papers, establishing a standard and well-documented global surface  $\rho\text{CO}_2$  data set, and producing a regular atlas of surface ocean  $\rho\text{CO}_2$ . Regional synthesis groups were formed to analyze the underlying causes for variability and vulnerability in the system

and to develop plans for a sustained observing system.

—NICOLAS METZL, Institute Pierre Simon Laplace, Paris; BRONTE TILBROOK, CSIRO Marine and Atmospheric Research, Hobart, Tasmania, Australia; DOROTHEE BAKKER, University of East Anglia (UEA), Norwich, UK; CORINNE LE QUÉRÉ, UEA and British Antarctic Survey, Cambridge, UK; SCOTT DONEY, Woods Hole Oceanographic Institute, Woods Hole, Mass.; RICHARD FEELY, NOAA Pacific Marine Environmental Laboratory, Seattle, Wash.; MARIA HOOD and ROGER DARGAVILLE, United Nations Educational, Scientific, and Cultural Organization (UNESCO), Paris.