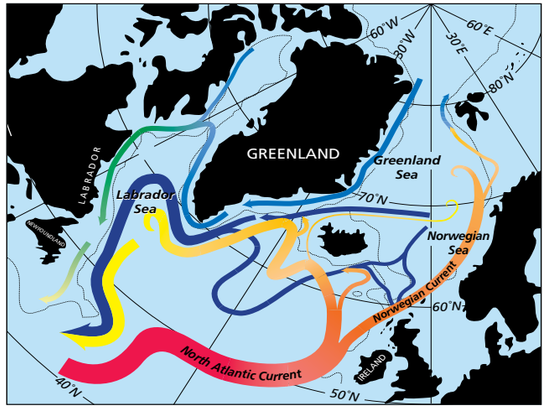


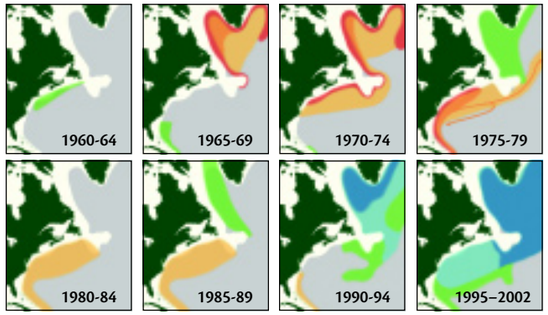
Jack Cook

Diagram of circulation patterns in the North Atlantic Ocean show warmer currents in red to yellow and colder, deeper currents in blue and green.

Ocean and Climate Change Institute

The oceans cover 71 percent of Earth's surface and contain over a thousand times more heat than the atmosphere. Slowly circulating, they redistribute huge amounts of heat around the planet and establish the underlying conditions that ultimately lead to storms, hurricanes, severe winters, monsoon seasons, El Ninõs, rainfall patterns, and other climate fluctuations.

The goal of the Ocean and Climate Change Institute (OCCI) is to evaluate and understand the role of the oceans in climate change and ultimately to improve long-term climate forecasts. To achieve this goal, OCCI sponsors observational, theoretical, and modeling studies on ocean-climate interactions, promotes development of new technology for monitoring and observing the oceans and atmosphere, and convenes interdisciplinary workshops and symposia to identify the key research issues for improving climate forecasts.



Data from Ruth Curry, Bob Dickson, and Igor Yashayaev

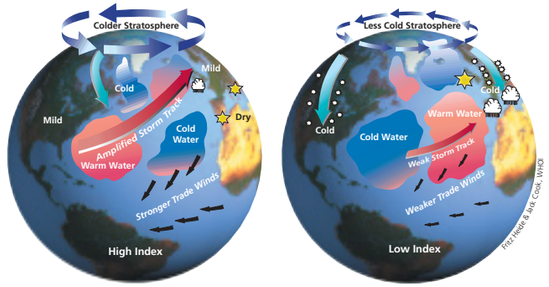
New data shows that North Atlantic waters at depths between 1,000 and 4,000 meters are becoming dramatically less salty, especially in the last decade. Red indicates saltier-than-normal waters. Blue indicates fresher waters. A large-scale freshening may cross a threshold that would disrupt global ocean circulation and cause abrupt climate changes.

Research Themes

Current research sponsored by the Ocean and Climate Change Institute focuses on the Atlantic Ocean's role in climate changes. OCCI studies encompass:

- Defining the role of the Atlantic Ocean in modes of climate variability such as the North Atlantic Oscillation, a regional, roughly decadal atmospheric circulation shift that specifically affects climate in Europe and North America and generally contributes to northern hemisphere temperature changes.
- Determining how ocean monitoring might improve longer-term climate forecasts.
- Identifying ocean processes that require better understanding to improve modeling of ocean/atmosphere interactions.
- Unraveling the history of thermohaline (heat- and salt-driven) circulation and studying its potential for causing abrupt climate changes in the future.

These themes are among many appropriate for study within the Institute. We expect that the themes will change every few years as progress is made on the current themes, and other, equally important topics are identified for future research.



Fred Hoole & Jack Cook, WHOI

Wintertime wind, temperature, and precipitation patterns in Europe and North America are affected by high (left) and low (right) phases of the North Atlantic Oscillation.

Woods Hole Oceanographic Institution's four Ocean Institutes (Ocean Life Institute, Coastal Ocean Institute, Deep Ocean Exploration Institute, and Ocean and Climate Change Institute) were initiated in 2001 to focus on critical ocean-related issues that have substantial impact on society.

The Ocean Institutes' concurrent mission is to shorten the lag time between acquiring knowledge and making it accessible to decision makers who can use it to save lives, stimulate economic growth, and enhance our quality of life.

The Ocean Institutes identify and sustain interdisciplinary research initiatives to spur advances in ocean science and provide a rich, productive educational environment for future oceanographers. They convene meetings of key scientists and leaders from academia, government, and industry to delve into oceanographic research issues that are relevant to life on our planet.

Cover Photo: Hurricane Floyd off the Florida coast, September 1999. (NASA)

Ken Buesseler

Tom Kleindinst

Mary Cairns

Seafloor sediment cores like the one at upper left provide a long, continuous record of changes in both the environment and types of organisms and species living in the marine ecosystem. The sediments are collected with corers like the one in the large photo. The corer is dropped vertically from the ship with the weight (foreground) uppermost to drive the core barrel into the mud. In lower photo, OCCI Director Bill Curry, at left, explains the value of sediment cores in climate studies to a congressional staff member at the WHOI Seafloor Samples Laboratory.

Ocean and Climate Change Institute

William Curry, Director • wcurry@whoi.edu

Woods Hole Oceanographic Institution

Woods Hole, MA 02543 • www.whoi.edu/institutes/occi

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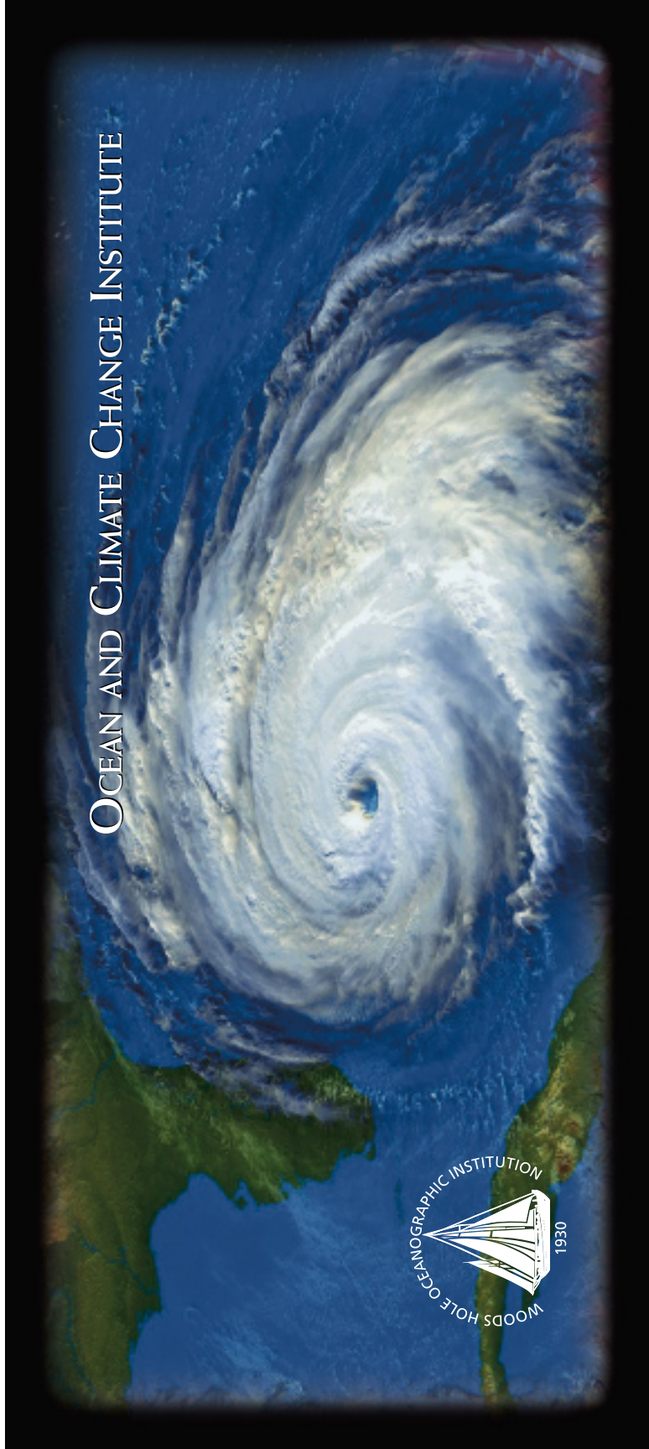
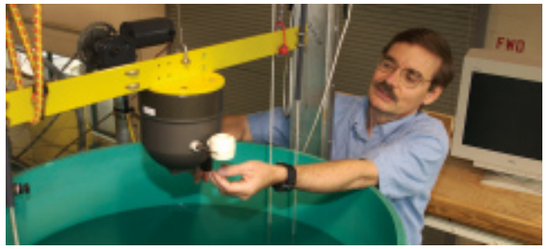


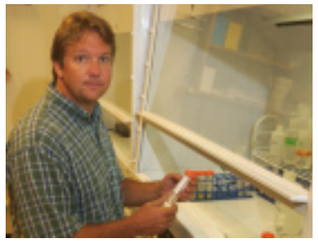
Institute Fellows

OCCI Fellows receive two to three months of salary support annually for a three-year period to pursue research interests related to the current themes of the Institute and to participate in Institute workshops, symposia, and outreach activities. Four Institute Fellows were named in 2001.



Ray Schmitt

Lloyd Keigwin



Konrad Hughen

John Toole

Photos by Tom Kleindinst

Ray Schmitt (Physical Oceanography) is studying the global water cycle and how changes in it may affect future ocean circulation and climate variability.

Lloyd Keigwin (Geology and Geophysics) is pursuing reconstruction of the recent geological history of ocean circulation and climate change.

Konrad Hughen (Marine Chemistry and Geochemistry) is assembling high-resolution records of past climate, ocean circulation, and atmospheric chemistry.

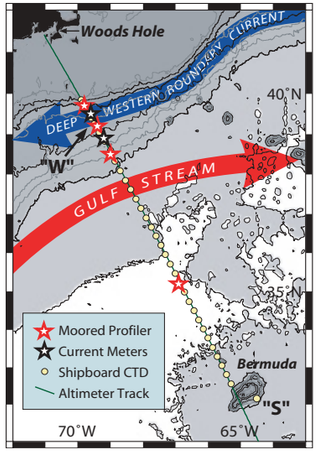
John Toole (Physical Oceanography) is leading the Institute's "Station W" program to establish a permanent observing system for the Gulf Stream and Deep Western Boundary Current region of the North Atlantic.

Jim Canavan

Scientists and Oceanus *crew launch floatation for a "Station W" mooring.*

"Station W" Observation System

OCCI embarked on a new era of ocean monitoring in 2001 by establishing a new, permanent observing system in the western North Atlantic. "Station W" was initiated with a generous gift from the Vetlesen Foundation. This first moored profiling system, deployed along the western boundary of the Gulf Stream, will provide continuous monitoring of water column heat and salt content from 50 meters depth to the 3,000-meter seafloor. A total of 6 moorings are proposed for "Station W" (red stars in the diagram below) to collect data that will be combined with satellite measurements (blue track line), salinity and temperature data from ship stations (yellow dots), and information from "Station S" near Bermuda. Using this database, scientists expect to be able to determine the strength of the northward-flowing Gulf Stream, its variations in heat and salt content, and changes in the intensity and composition of the southward-flowing, deep western boundary current made up of Labrador Sea Water and the deeper components of North Atlantic Deep Water. This observation system is located at the most important position for understanding how changes in ocean circulation affect such ocean-atmosphere systems as the North Atlantic Oscillation and the thermohaline circulation of the North Atlantic.

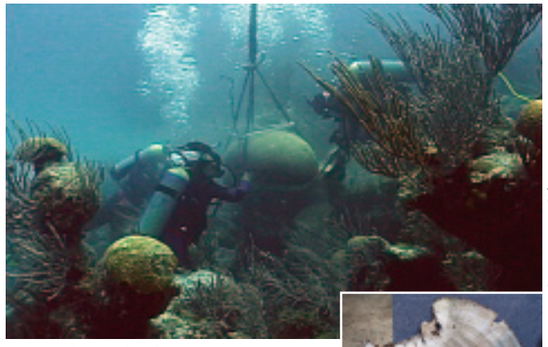


"Station W" encompasses several data-collection approaches.

Research Awards

The Ocean and Climate Change Institute supports interdisciplinary research projects related to current Institute themes. In 2001 and 2002, eleven awards went to investigators from the Geology and Geophysics, Physical Oceanography, and Marine Chemistry and Geochemistry Departments. They include:

- Examining 500 years of Atlantic sea-surface temperature in a brain coral skeleton (Anne Cohen and Mike McCartney)
- Modeling Hudson Bay freshwater discharge both today and 8,500 years ago (Dave Chapman, Lloyd Keigwin, and Steve Lentz)
- Observing an anomalous plume of Labrador Sea water within the North Atlantic's Deep Western Boundary Current (Ruth Curry, Mike McCartney, and John Toole)
- Tracking the variability of North Atlantic circulation between glacial periods using uranium decay products and sediment particle size distribution (Jerry McManus and Roger François)
- Examining the mixing characteristics of the Atlantic Ocean and its role in modulating Earth's climate (Rui Xin Huang and Kurt Polzin)
- Developing upper ocean instrumentation for the Northwest Tropical Atlantic Station (Al Plueddemann)
- Reconstructing global ocean "ventilation" (exchange of gases between ocean and atmosphere) and correlating this history with climate change records (Olivier Marchal)
- Developing paleoclimatic records from sediments beneath the Deep Western Boundary Current in the North Atlantic (Lloyd Keigwin and Liviu Giosan)
- Documenting changes in transport of heat and fresh water in the North Atlantic (Terry Joyce and Ruth Curry)
- Tracing the circulation patterns of water flowing south from the deep North Atlantic by examining Southern Hemisphere mixing rates (Bernadette Sloyan)
- Using molecular organic compounds to reconstruct North Atlantic climate variability (Tim Eglinton)



Courtesy Anne Cohen

Tom Kleindinst

Anne Cohen and colleagues raise a 350-year-old Bermuda brain coral. The five millimeter thick slab of coral at right was removed for x-ray and CT scanning.

Educational Activities

Graduate Students and Postdoctoral Fellows

A major objective of the Ocean and Climate Change Institute is to train the next generation of oceanographers by supporting well qualified postdoctoral fellows and advanced graduate students whose research interests fit within the Institute themes. In 2002 OCCI named two Postdoctoral Fellows. Peter Winsor will be studying Arctic Ocean circulation and climate and Mahdi Ben Jelloul will be studying modes of low frequency variability in the oceans. Joint Program student Rose Came is constructing the recent geological history of mid-depth water circulation.

Tom Kleindinst

Joint Program student Rose Came, left, works with fellow student Kristina Dahl to identify fossil forminifera.

Ocean Forums and Outreach Activities

The Ocean and Climate Change Institute conducts activities to broadly communicate scientific results in a timely, objective, and effective manner to all segments of society. This is an important part of a 2002 visiting summer scholar program on abrupt climate change. Experts from four other research institutions are presenting lectures and working with WHOI scientists to assemble a body of knowledge about the causes and consequences of abrupt climate change and to determine what areas require further concentrated research in order to improve our understanding of future abrupt climate changes.

Other ocean and climate change lectures and forums are being developed. Please watch the OCCI Web site (www.whoi.edu/institutes/occi) for updates.

Tom Kleindinst

Atmospheric scientist Dave Battisti (University of Washington) takes a question during a summer 2002 forum on abrupt climate change.