The Dynamic Earth

UC Irvine Department of Earth System Science

Volume 1 Issue 1 Spring 2011

Globe Image courtesy of NASA/Goddard Space Flight Center Scientific Visualization Studio

Welcome to the inaugural newsletter of the UC Irvine Department of Earth System Science (ESS)!

The title of this publication, *The Dynamic Earth*, illustrates both the quality of the science and the personality of the department. Research conducted in ESS at UC Irvine covers the broad range of environmental science. Whether we are flying over the top of the globe, trekking through tropical regions, spelunking in remote areas, sailing over the seas, boring into the ice of Antarctica, or creating computer simulations, ESS seeks to understand how the Earth's systems work. This understanding is translated into teaching undergraduate students, graduate students, and the general public. The Department includes chemists, biologists, ecologists, physicists, hydrologists, geologists, meteorologists, engineers, applied mathematicians, and oceanographers. In the pages that follow, you will see highlights from our research and teaching. We encourage you to visit our newly redesigned website at http://ess.uci.edu to learn more about our work.

We hope you enjoy this glimpse into *The Dynamic Earth*,

Michael Goulden

Chair and Professor of Earth System Science

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Design

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ESS on the Web

In January, 2011, ESS launched a new website! We have new graphics, updated content, and a more dynamic technical infrastructure. Our new site is averaging more than 4,000 visitors per month. The new website includes information about our academic programs, research projects and more. We also added a variety of dynamic new content. Publications are periodically added to the research section. Graduate Student awards are now listed within the Graduate section. The online directory is now searchable. The new site is a more vibrant representation of the research and teaching underway in ESS. Please take a minute to visit us online at http://ess.uci.edu You can also find us on Facebook (http://facebook.com/UCI.ESS) and Twitter (http://twitter.com/uciess).

Back to the Books and the Field

On an average day in the Spring, 2011 quarter, ESS Faculty presented more than forty student-hours of undergraduate instruction in Earth System Science. Course materials included atmospheric dynamics, climate change, global environmental issues, weather analysis, remote sensing, ecosystems, sustainability, and ESS field methods. UC Irvine students are presented with a variety of degree options in Earth System Science (see below for descriptions and more information). The wide-ranging expertise of ESS faculty and teaching assistants allow students to learn valuable scientific skills in the classroom, laboratory, and field experiences.

Earth & Environmental Studies (Bachelor of Arts)

The Gulf Oil Spill. Global Climate Change. Drought and Water Supply. Each of these topics illustrates the need for students to understand many dimensions of earth and environmental issues, including natural science, policy, and social science. In the Fall, 2011 quarter, ESS welcomed the first incoming freshman in this program. The Bachelor of Arts program provides students with a foundation in earth system science, along with other disciplines in the natural and social sciences to make a real difference in society.

Highlights of the Bachelor of Arts (B.A.) Program

- Scientific, socioeconomic, and policy aspects of environmental problems
- Graduates are prepared for careers in government, non-profit, and private industry that involve both science and policy
- Classes in local and global environmental issues, sustainability, and climate change
- Senior project in sustainability

Earth & Environmental Science (Bachelor of Science)

Influence of atmospheric chemistry on climate and air quality. Role of microbial diversity of ocean biogeochemistry. Energy transport across the Earth's oceans, atmosphere, and cryosphere. These are just a few of questions being answered by researchers who study the science of the Earth as a system. The Bachelor of Science program provides students with a solid scientific understanding of Earth system science, which can lead to careers in science, research, or technical fields.

Highlights of the Bachelor of Science (B.S.) Program

- Scientific aspects of environmental problems
- Prepares students for graduate studies or careers in science, research, or technical fields
- Classes in earth system science, weather and climate, oceanography, hydrology, and ecology
- Research opportunities available

Earth System Science (Doctor of Philosophy)

The graduate programs are aimed at training new research scientists in the field of Earth system science. Our goal in graduate education is to develop a comprehensive curriculum and conduct outstanding research involving graduate students. Our doctoral-level students become researchers with global perspectives and broad research skills as well as a high level of expertise in specific areas.

Highlights of the Doctor of Philosophy (Ph.D.) Program

- Interdisciplinary curriculum covering land, ocean and atmosphere, providing an integrated approach
- Study in California, research opportunities worldwide in mountains, forests, oceans, caves, glaciers, laboratories, and climate simulation centers
- Student research focused on global issues involving biogeochemistry, climate, and atmospheric chemistry
- Interactions with distinguished faculty and students

Alumni Perspective

"The heart and soul of the Earth System Science department at UC Irvine is scientific discovery to elucidate how the various Earth systems interact in a multi-disciplinary climate system. Assembled in this revolutionary department is a team of world-renowned faculty energized by this central goal. No doubt, this is a unique department that prepared me and the rest of my graduate student peers with the knowledge, ability, and scientific excitement needed to propel us as we began our scientific careers."

- Dr. John Kessler, Ph.D. in Earth System Science (2005)
Currently an Assistant Professor in the
Department of Oceanography at Texas A&M University

Air of Menace

Americans have learned by now that we live downwind from the crippled nuclear reactors in Fukushima, Japan. Suddenly Japan, 5000 miles from the west coast, seems too close for comfort. There plant workers wear protective "moonsuits", evacuées submit to geiger counters, and contaminated smoke, steam, and water continue to flow from the damaged reactor buildings. Radioactive material released since the earthquake and tsunami poses a real and lasting public health threat to that area. Meanwhile, the global wind belt called the prevailing westerlies carries the airborne emissions our direction. Understandably, Americans worry that this plume crossing the Pacific may endanger our health. Our health is compromised by a pollution plume, but not the radioactive one from Japan. First, let's see why Japan's nuclear accident poses us no immediate threat.

Air pollution from Mexico City creates a hazy sunset.

Image courtesy of University Corporation for Atmospheric Research

To be sure, the Fukushima reactors have emitted lethal doses of radiation. The International Atomic Energy Agency reported on March 15 that radioactive doses high enough to guarantee incapacitation and death after one day, were measured between two reactors. Fortunately, especially for the brave crew struggling at the site, most subsequent measurements fluctuate around much lower values. The dangerous readings in Japan unnerve residents downwind where radioactive material eventually falls or rains out. Wind and rain make any radioactive release a legitimate international concern.

Instruments designed to enforce the Comprehensive Test Ban Treaty have already measured traces of radioactivity in California, Massachusetts, and as far downwind as Germany. What does this mean for public health? These measurements are millions of times lower than necessary to cause any measureable health effects. The detection of such minute traces of radiation keeps nuclear weapons tests difficult to conceal (supporting our nuclear non-proliferation efforts), and fans the anxiety of a public who associates radioactivity, at any level, with mushroom clouds and mortal illness.

Nuclear safety and weather experts quickly reassured US residents that the radioactive fallout from Fukushima poses us no threat. Weather disperses the dangerous particles during their trans-Pacific journey, diluting the fearsome plume to safe levels far before landfall. Most of us consider acceptable the much higher doses we receive as "background radiation" from natural and benign man-made sources. These pervasive sources include cosmic rays, radon seepage from uranium decay in Earth's interior, and uranium and thorium from coal combustion. Watt-for-watt, a coal-fired electricity plant emits into the environment fly ash particles that carry about one hundred times more radioactivity than emitted by a nuclear plant. A non-malfunctioning nuclear plant, that is.

Of course people are not reassured to learn that background radiation exists, is unavoidable, and causes more cancer than nuclear power. Risk-averse people naturally want to minimize their exposure. Since background radiation comes from all directions in amounts much greater than the Fukushima plume, it makes no sense to flee eastward, seal our windows, or ingest (non-radioactive) iodine pills. Indeed the greater sources of our annual radiation exposure are the granite beneath and concrete around us, jet travel, and diagnostic medical X-rays. While we cannot reduce our exposure beneath background levels, we can reduce our health risks from more menacing pollution than the Fukushima plume.

Soot particles, primarily emitted by diesel engines, open burning, and coal combustion, constitute a known, and increasingly preventable, public health threat. Plumes of soot (co-emitted with ozone, also harmful) flow downwind from shipping, transportation, and industrial centers such as freeways and ports. Our lungs trap some of the microscopic soot we inhale, much like cigarette smoke.

Over time, the accumulated soot in our bodies impairs cardiovascular, cognitive, and respiratory functioning. Living closer to freeways and ports increases our risk of heart attacks and heart disease. It reduces attention, memory, and ultimately lifespan. The Air Resources Board estimates that diesel soot alone is associated with about 18,000 premature deaths annually in California alone.

Our health risk from ongoing local soot emissions dwarfs our risk from radioactivity released in Japan. Fortunately, reducing exposure to soot is an effective means of protecting public health for both developed and developing nations. We can fit diesel exhausts with particulate traps, shift to cleaner burning fuels and battery-powered vehicles, and utilize shore-side electricity (rather than idling) for ships at port. Developing countries can transition to cleaner burning home cookstoves and heaters.

Recognizing the public health threat from soot, our national, state, and regional air resources agencies have been phasing-in policies to mitigate it. As a result, soot emissions in the US overall have leveled-off in recent decades. Strengthening restrictions on soot would accrue benefits to all, especially those who live or work in and downwind of the (often economically disadvantaged) neighborhoods near heavy shipping, traffic, and industry.

Citizens informed about the health hazards of soot are likely to support maintaining and extending policies that mitigate it, and to resist rolling them back even in a difficult budgetary climate. Despite its attention in the media, the trace amount of radioactivity wafting here from the Fukushima plant poses us no threat, in stark contrast to our chronic exposure to locally generated soot. Let's clear the air about that.

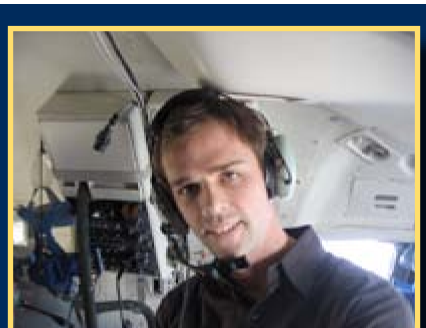
-Charlie Zender, Professor of Earth System Science
A version of this appeared in the OC Register on 4/18/11

Celebrating 20 Years of ESS at UC Irvine

Scientific advances have coincided with some of the greatest challenges to our society. It takes curiosity, training, and resources to move beyond the current boundaries of knowledge, which is essential to address these threats to civil society and our well-being. For the past two decades, the Department of Earth System Science (ESS) at UC Irvine has engaged the expertise and imagination of leading faculty, researchers and graduate students in groundbreaking research and teaching. As we reach the milestone of 20 years of science, we will explore grand challenges of the past and future, and the science that goes with them. ESS faculty, researchers, students and alumni look forward to discussing the future of the Earth.

Grand Challenges in Earth System Science for the 21st Century

September 15, 2011, 5:30 pm
Poster Session, Cocktail Hour,
Panel Presentation and Dinner
If you would like to attend, please RSVP to
(949) 824-1604 or celebrate20@ess.uci.edu



As a pollution forecaster and flight planning team member for the NASA ARCTAS field experiment, Christopher D. Holmes (Postdoctoral Scholar) lived in Fairbanks, Alaska during April 2008. He flew on the research aircraft directly over the North Pole, where he observed a polluted haze layer that originated in Asia, and also at 1000 ft over sea ice in the Arctic Ocean. Now a member of Michael Prather's research group, Chris aims to understand the forces controlling air quality and greenhouse gas changes in the 21st century. Through computer modeling of atmospheric circulation and chemistry, Chris is making projections of ozone and methane, two major anthropogenic greenhouse gases, and establishing confidence intervals for those projections. These results will help establish uncertainties for future climate change.

Global Passages of Scientists (GPS)

Whether he finds himself in California, Massachusetts, Alaska, or England, Chris enjoys hiking and stargazing.

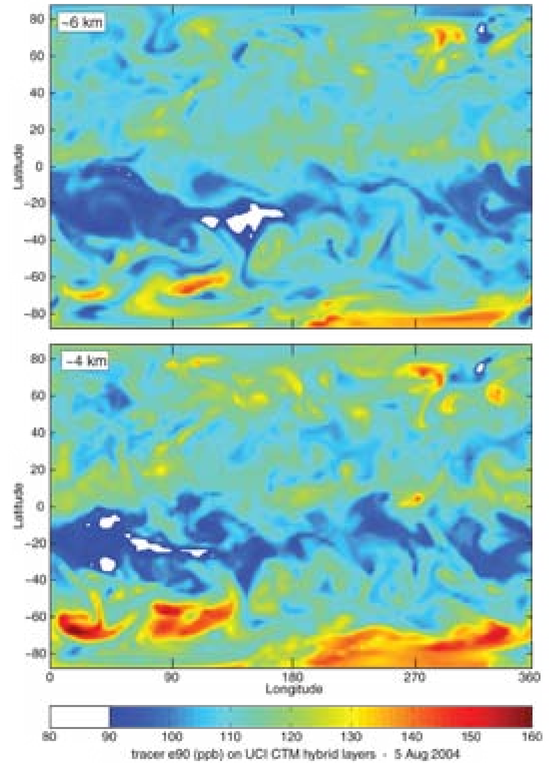
At the core... Publication Highlight

An atmospheric chemist in search of the tropopause.

Prather, M.J., X. Zhu, Q. Tang, J. Hsu and J.L. Neu (2011), An atmospheric chemist in search of the tropopause, J. Geophys. Res., 116, D04306, doi: 10.1029/2010JD014939

To those interested in atmospheric composition and chemistry, the tropopause is a somewhat fuzzy, porous boundary between two chemically distinct regions: the stratosphere and the troposphere. The stratosphere has high ozone levels and short-wave ultraviolet photochemistry that destroys refractory greenhouse gases like nitrous oxide and chlorofluorocarbons; whereas the troposphere has precipitation and hydroxyl chemistry that rids the atmosphere of pollution and gases like methane. By introducing a tracer into a well formed computer model of the atmosphere, a group of ESS scientists provides insight into the chemistry, physics, and location of the tropopause. A tracer that decays in 90 days was chosen to measure the age of air since last contact with the surface. The atmospheric model simulations monitor the chemical aging and circulation patterns of the tracer as shown in the figure. Analysis of this data indicates that the elusive tropopause is subject to seasonal and geographic variability, but can be accurately identified with this tracer. By focusing on time scales that separate stratosphere from troposphere, Dr. Prather's research group identified the oldest air in the troposphere, the cause of ozone seasonality at the midlatitude tropopause, and a previously unidentified north-south difference in the age of air of the lowermost stratosphere.

For a more complete list of publications, see http://ess.uci.edu/biblio



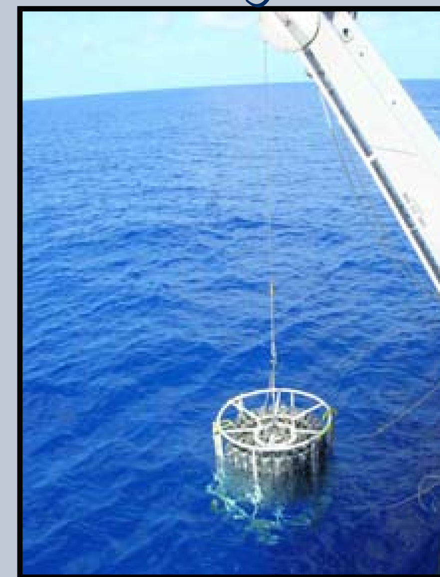
Instantaneous global distribution of the tracer simulated by the computer model for August 5, 2004 at altitudes of 6 and 4 km. White regions indicate very old air: at 75°N the small patch is a single stratospheric intrusion that contains high ozone levels; about 20°S there is a broad region of very old tropospheric air extending from the Greenwich Meridian (0° longitude) to the Date Line (180°).

Sheila Griffin (Research Specialist) spends her time exploring one of the most complex ocean ecosystems – coral reefs. Sheila is a member of Ellen Druffel's research group, which studies corals from sites around the world. Sheila sometimes goes to exotic locations to collect coral samples. Using 14C as a tracer, these corals are used to reconstruct seasonal-to-annual records of isotopes that reveal past temperature, salinity and upwelling strength in surface waters. In addition to her work studying corals, Sheila is a volunteer docent for the Newport Bay Conservancy. She really enjoys giving walking tours at Upper Newport Bay.

Global Passages of Scientists (GPS)

Sheila visited the Palmyra Atoll National Wildlife Refuge, home to a nature conservancy center for scientific study and a national wildlife refuge. She was searching for suitable coral heads to sample (pictured here).

Featured Dynamics



Biodiversity. This term is frequently used to describe the distribution and heterogeneity of species in a particular region or ecosystem. Biodiversity plays a significant role in biogeochemical cycles throughout the Earth's systems. In an undertaking beginning this year, Adam Martiny will lead a research project focusing on biological controls in the oceans. Awarded funding from the National Science Foundation's Dimensions of the Biodiversity program, this project represents a novel, integrated approach to understanding the significance of biodiversity in today's changing environment.

Martiny's project will focus on the Redfield Ratio, which is the ratio of nitrogen to phosphorus in seawater. Understanding how biodiversity regulates the Redfield ratio will provide important insights into the role of biodiversity in regulating global nutrient cycles. Ultimately, this understanding will lead to a model of biogeochemical cycles, which will allow scientists to investigate the consequences of global change on the ocean ecosystem.

This study will greatly expand knowledge of the genomic diversity among ocean microbes and how this diversity affects biogeochemistry. The stoichiometry (essentially the ratio) of the ocean's microbes is a parameter that nearly every chemical or biological oceanographer uses, from converting measurements made in one element to another, to estimating regional and global nitrogen budgets. The Martiny project will involve field observations of taxon-specific stoichiometry and growth rates, genomic analysis, and laboratory chemostat experiments to improve understanding of how ocean taxonomic, genetic, and functional biodiversity control the stoichiometry of the surface ocean plankton. Analyses of these data would lead to a mechanistic understanding of variations in the Redfield ratio, both spatially and temporally. The research also has important implications for the global carbon budget and any changes that might result from climate change

Moments of Merit

Faculty, Researchers and Graduate Students in Earth System Science are outstanding scholars, scientists and teachers who are frequently recognized for their achievements. Here are a few highlights from the Spring, 2011 Quarter

Jay Famiglietti (Professor) was named the Birdsall-Dreiss Distinguished Lecturer for 2012 by the Geological Society of Americas hydrogeology division.

Anne Kelly (Graduate Student) was awarded a 2011 NASA Earth and Space Science Fellowship. *"Climate Controls on Forest Biomass, Productivity, and Species Distribution Along the Western Sierra Nevada Gradient"*

Huidong Liu (Graduate Student) was awarded the Outstanding Student Paper Award from the 2010 American Geophysical Union Fall Meeting. *"Lake level simulations using a land surface model and satellite altimetry data"*

Alexandra Magana (Graduate Student) was admitted to the National Science Foundation East Asia and Pacific Summer Institute. Alexandra will be traveling to China.

Ashley Payne (Graduate Student) was awarded a 2011 NSF Graduate Research Fellowship. Ashley will be looking at the dynamics of atmospheric river formation and intensity over the eastern Pacific basin.

The UC Irvine Environment Institute (Director Michael Prather, Professor) was awarded LEED Green Building Certification (Gold level)

Eric Saltzman (Professor) was elected to be a 2011 Fellow of the American Geophysical Union. *"For innovations in measuring the natural cycles of sulfur and halogen gases and insight in analyzing the interactions of air, ocean, and ice to discern the chemical history of the atmosphere."*

Desert Club to become UCI field research station thanks to generous gift

Climate change, water supply and visitor use of parkland will be studied

A stunning and historic clubhouse at the doorstep of California's largest state park will be turned into a long-sought UC Irvine field research center for biologists, astronomers, anthropologists and others, thanks to a generous gift from Audrey Steele Burnand, who has deep ties to the property and the small town in which it's located.

The Desert Club, a sleek, airy structure built into a broad Sonoran slope bordering Anza-Borrego Desert State Park, is expected to become part of the University of California's 135,000-acre Natural Reserve System. It will provide much-needed shelter and laboratory space in a remote area where temperatures can top 100 degrees.

"It feels great. This building is perfect; it will be our home base for research of all kinds," said biologist Diane Pataki, director of UCI's Center for Environmental Biology, who has tried for five years to set up a research station in Borrego Springs. "We're so lucky to be able to take advantage of the opportunity to get this property."

Burnand's father-in-law, Alphonse Burnand Jr., commissioned Streamline Moderne architect William Kesling to design the structure as the social hub of a planned new community in the 1940s.

"I made this gift to give new life to a beautiful, special place near the state park, one that has deep meaning for my family and will benefit generations of University of California researchers and others who share my love of the desert," said Steele Burnand in a statement.

The gift will fund the purchase, expansion and operation of the property, including dorm rooms for up to 24 visitors or graduate students and longer-term housing for professors conducting in-depth research. The building will be renamed the Steele Burnand Anza-Borrego Desert Research Center, in honor of her parents and her husband's family. Its unique architectural features will be preserved.

"Audrey Steele Burnand's gift enriches the interdisciplinary research opportunities for our faculty and students, and we're very grateful to her," said UCI Chancellor Michael Drake. "This kind of generous support is essential to continuing research and academic excellence."

UC faculty and students working in the area will have a welcome nearby perch, minimizing the need to drive long distances over twisting roads. Six schools at UCI alone have already expressed interest in conducting studies at Anza-Borrego on such topics as shifting rainfall due to climate change, the impact on native plant species of overpumping underground aquifers, and how recreational use affects natural landscapes. UCI researchers will work with the community and state parks staff on everything from public events to better open-space management.

"This is such a wonderful thing for UCI and Borrego Springs," said Albert Bennett, dean of the School of Biological Sciences. "It just makes you feel good to be out there. It was meant to be."

- Janet Wilson, University Communications
Photos courtesy of Daniel A. Anderson

When Kathe Todd-Brown (Graduate Student) sees dirt, she thinks about how it breathes and how she can simulate this on a global scale, using a computer model. According to Kathe, "Dirt is a world rich with complex interactions that plays a critical role in governing the future of our planet. We stand at a convergence of scientific understanding, modeling abilities and data availability which has the potential to shift our understanding of future climate." An outdoor adventurist, Kathe takes extended bike tours every year. Over the course of two years, she traveled from Oregon to Orange County, California.

Global Passages of Scientists (GPS)
Kathe lived in Japan for 4 months. She also lived under a couple of hay bales for 6 months in college as part of a wilderness semester program.

Research Facilities

Faculty, Research Staff and Students in ESS utilize state-of-the-art facilities, ranging from distributed computing to advanced mass spectrometers, to stable-isotope facilities. The wide range of research underway in the department involves virtually every scale, from the smallest microbe, to the largest ocean system.

John V. Croul Hall

Croul Hall is a state-of-the-art research facility, which was built through a private-public partnership. Croul Hall houses Earth System Science, including faculty and staff offices, laboratories, and conference rooms.

Green Planet

Green Planet is a supercomputer devoted to modeling land, atmosphere and ocean interactions involved in the Earth's climate system. Researchers in the Department of Earth System Science use Greenplanet to analyze and make predictions based on massive amounts of data.

High Resolution Mass Spectrometer

This facility is a high resolution triple-sector mass spectrometer. It is used for the identification and quantification of hydrocarbons and halocarbon trace gases in atmospheric samples, and air extracted from polar firn and ice cores.

Instrumentation Development Facility

This facility provides electronic engineering and instrumentation support. The facility assists in the maintenance, development, and field deployment of analytical instrumentation.

Stable Isotope Ratio Mass Spectrometry

This facility makes high precision isotopic measurements on very small amounts of atmospheric trace gases (e.g. methane, nitrous oxide, carbon dioxide, and carbon monoxide).

W. M. Keck Carbon Cycle Mass Spectrometer

The W.M. Keck Carbon Cycle Accelerator Mass Spectrometer (Keck) uses radiocarbon as a tracer of the global carbon cycle. The facility analyzes 14C in carbon from natural waters, soils, sediments, the atmosphere, and biota.

Earth System Science Club forms for Undergraduate Students

Introducing the newly formed Earth System Science/Studies Club! Initiated by students, the ESS club includes a good mix of students taking lower and upper division Earth System Science courses. Members that are currently engaged in research have shared their experiences, and provided suggestions for students who are interested in participating in research projects. Also, students who presented at the Undergraduate Research Opportunities Program (UROP) symposium and at professional science conferences have encouraged younger members to get involved in research. In their first meeting of the Fall Quarter, ESS Club members took a tour of the Keck facility and Professor Saltzman's lab. Other meetings have included finals study/tutoring sessions, interactive activities, and a viewing of Dr. Seuss' "The Lorax." This dynamic group has great plans for fun, academic, and professional activities.

News Briefs

For a more complete listing of ESS news, see http://ess.uci.edu/news , or visit us on Facebook or Twitter

Ice Bridge: An Airborne Mission for Earth's Polar Ice

IceBridge is a mission directed project that will continue an important time series of observations of ice sheets started in the early 1990s. IceBridge is operating on airborne platforms in Greenland and Antarctica for the next five years with the main instrumental goal to bridge the gap between the ICESAT laser altimetry mission and the ICESAT-2 follow on. This instrumentation is used to measure volume changes of the ice sheet and deduce the contribution of ice sheet to sea level. The mission will however address broader science objectives, including measuring the discharge of ice into the oceans comprehensively, documenting the patterns of thinning and acceleration of key outlet glaciers to better characterize the dynamic response of ice sheets, and collect critical data on glacier thickness and depth of the sea floor in front of the glaciers or beneath their floating extension so that modelers can better represents ice sheet and better constrain their interactions with the surrounding oceans.

Eric Rignot, Professor of Earth System Science at UC Irvine, is involved in this project as a Science Team member. Professor Rignot is interested in using IceBridge data to measure ice sheet fluxes at the grounding line, provide guidance on areas of importance and of rapid change, and couple ice sheet models and ocean models to better represent ice-ocean interactions and their impact on ice sheet evolution. Rignot's research group at UC Irvine is completing the first comprehensive map of ice motion in the Antarctica for NASA (publication pending).

The IceBridge team is conducting a more extensive campaign: Spring in the Arctic, Winter in Antarctica. The folks collecting data accumulate an incredible amount of flight hours (each mission is 10-12 hours long - and you thought transAtlantic flights were long?); they work for 3-4 weeks straight, each day is called upon weather report; and they usually complete the entire mission plan and sometimes more.

Earth System Science Ph.D. Program is Ranked Highly by the National Research Council

In rankings released in September, 2010 from the National Research Council (NRC), the Earth System Science graduate program at the University of California, Irvine is consistently ranked among the top Earth Science Ph.D. Programs. Based on surveys submitted by 140 Earth Sciences graduate programs, the 2010 NRC rankings provide statistical evidence that the UCI Earth System Science program excels in research productivity. This measure is based on productivity in scientific research, including publications per faculty member, citations per publication, percent of faculty holding grants, and awards per faculty member.

Rankings are available online at http:/graduate-school.phds.org/rankings/earth-sciences . The ranking system allows users to weight criterion, and review the complete profile of a particular degree program.

Discussing Hydrology on the World's Stage

The 2011 Global Water Summit provided a unique opportunity for Jay Famiglietti to discuss water challenges with science and policy leaders from around the globe. In addition to presenting his research ("*The global water challenge as seen from space*"), Jay met with Kofi Annan, former U.N. secretary general and Nobel Peace Prize laureate.

"We shared our major concerns over the future of global water issues and the lack of international policy infrastructure to deal with their complexities," Famiglietti said. "We had a great conversation, and Mr. Annan encouraged us to keep working hard."

Global warming is bringing both devastating floods and searing droughts in its wake. It puts the performance of water utilities on the line as never before. Using satellite data from NASA, Jay has built up the most detailed picture to date of the evolving pattern of global water availability.

During most Fall Quarters, you will find Todd Dupont (Faculty) teaching one of our largest courses, Earth System Science 1: Physical Environment. Last Fall, Todd had over 300 students enrolled. When he's not teaching, Todd explores the cryosphere. He is interested in the dynamics of ice sheets and glaciers, in part because of their potential for changing sea level, but also more broadly in the context of the larger Earth system. Todd uses numerical models of the flow and evolution of these ice masses to explore their observed behavior, as well as to estimate how they may behave in the future. He likes to cook up more than great science. Todd enjoys baking. According to Todd, there's nothing more therapeutic than the sight, smell and taste of fresh baked bread.

Global Passage of Scientists (GPS)

Todd's visit to Siple Dome, West Antarctica provided an opportunity for fieldwork, and exploration of this very interesting region.

Preparing Future Generations of Geoscientists

Whether she is analyzing mollusk shells from the deep ocean, or collecting speleothems from caves in China, Sri Lanka, Laos, or Sequoia National Park, Kathleen Johnson uses geological techniques to reconstruct time-series of past environmental change. In the laboratory at UC Irvine, Kathleen uses advanced mass spectrometry and physical geology techniques to measure trace elements in samples collected from carefully selected locations. Kathleen's team of postdoctoral scholars and graduate students are involved in innovative research that has helped refine existing climate change models.

When not conducting her own research, Kathleen teaches one of our most popular undergraduate courses, Physical Geology. In this course, she takes students on a field trip to Crystal Cove State Park to experience, first hand, the process of sample/data collection and analysis. According to an article recently published in Nature (*Geoscience: Earth Works*, May 1, 2011, doi: 10.1038/nj7346-243a), Kathleen is preparing students to meet an increasing demand for geoscientists.

Demand for geoscientists is expected to rise worldwide, not just in the United States. …Someone entering an undergraduate geoscience program today and then pursuing a master's or PhD degree will enter a job market flush with opportunities — especially if they are willing to relocate.

Contributing to a fundamental scientific understanding of the Earth as a cupled system, through research and education

http://ess.uci.edu

What on earth?

Faculty, Researchers and Graduate Students in the UC Irvine Department of Earth System Science often find themselves in unique locations, undertaking extraordinary feats. In each issue of *The Dynamic Earth*, we will present you with an actual photo from the field or classroom. Can you guess what we're doing, or where we're doing it?