El Niño and La Niña change our weather.

Coastal erosion is changing our beaches.

Technology has changed, so we can monitor cryospheric dynamics.

We can measure changes in the air, land, ocean and ice.

You should also know that the Earth System Science undergraduate degrees are changing!

Beginning in the Spring, 2012 quarter, the degree requirements for the Bachelor of Arts degree will be streamlined.

Also, ESS originally had two degrees with very similar names. To better reflect the content of each degree, we’re updating the names. The Bachelor of Science (B.S.) Degree will be called Earth System Science. The Bachelor of Arts (B.A.) Degree will be called Environmental Science.

Wondering about the difference? Students in Earth System Science focus on the scientific aspects of environmental problems. Students in Environmental Science focus on the scientific, socioeconomic and policy aspects of environmental problems.

If you have questions about these changes please contact us at ugrads@ess.uci.edu or visit us online at http://ess.uci.edu/undergrad
Walk into a lab on any given day in ESS, and you will see people at varying levels in their career, doing science. In fact, one of the things that makes ESS dynamic is the combination of undergrads, grad students, researchers, postdocs, and faculty. This allows the department to train and inspire future generations, while infusing ESS with the energy of discovery. We strive to provide a quality educational experience for undergraduate students, which is infused with opportunities for research, intellectual growth, and scientific revelation. Our students attend classes in subjects like oceanography, the atmosphere, geology, local and regional environmental issues, global climate change and impacts, remote sensing, and sustainability. Beginning in the Spring, 2012 quarter, the Earth System Science undergraduate curriculum and degree requirements will be updated. This will facilitate the current, engaging, and rigorous Earth System Science (ESS) training program for undergraduate students. Years from now, these students will be making discoveries, creating new scientific understanding, and making policy.

The future begins today…
J. Keith Moore
Vice Chair of Undergraduate Studies, and Professor of Earth System Science

New this issue: Enhanced Content Online! 

There are so many interesting things happening in ESS that it’s sometimes difficult to fit it all into the pages of The Dynamic Earth. Starting this issue, we will be using the ESS website to publish enhanced newsletter content! To see the current issue, you can always visit http://ess.uci.edu/newsletter . Now, when you see a symbol like this in the print version:

That means you can read more online.

This funny looking image is called a QR Code. QR is abbreviated from Quick Response. It is, essentially, a barcode that can be read by mobile devices. To use a QR code, you’ll need a reader. Search for QR reader in your favorite app store.

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Featured Dynamics: Dynamical keys to climate variability

The oceans offer climate scientists something they always wished for: the ability to predict climate variations months, years, and even decades ahead of time. While the atmosphere is known to have a relatively short memory of several days to weeks, the oceans are believed to be capable of remembering what has happened in the atmosphere weeks, years, decades, and even centuries in the past. Fluctuations in the atmosphere leave footprints in the oceans through the exchanges of heat, momentum, and fresh water at the ocean surface. Over time these footprints expand to influence depths well below the surface and these footprints can emerge out of the ocean at later times to affect the atmosphere and lead to climate variations. If we understand the dynamical keys to how the atmosphere and oceans interact and where the ocean memory resides, we will be able to make successful long-term climate predictions.

Professor Jin-Yi Yu’s research group focuses on understanding and predicting climate variations on interannual to decadal time scales resulting from atmosphere-ocean interactions in the tropical Pacific and Indian Oceans, where two important climate phenomena reside: El Niño and the Asian-Australian monsoons. Together these two phenomena have the ability to substantially impact large portions of the population in Asia, Australia and North and South America. They use statistical analysis methods and numerical models of the climate system running on supercomputers to understand how the oceans control the intensity and frequency of occurrence of El Niño and abnormal monsoon activity. Their goal is to develop dynamical and statistical methods to predict these two influential climate phenomena seasons to decades ahead of the time.

Professor Yu’s recent efforts have concentrated on the changing behavior of El Niño, which has occurred more frequently since the beginning of the twenty-first century and whose central location has moved from the eastern Pacific to the central Pacific. He terms this new type of El Niño the Central-Pacific El Niño and differentiates it from the traditional El Niño the Central-Pacific El Niño. He believes this new type of El Niño has an underlying dynamic that is distinct from the traditional El Niño and that it affects global climate in new ways. By analyzing climate data and by conducting climate model experiments on supercomputers, Professor Yu’s research group is working to isolate the dynamical keys to explain and to predict this emerging change in the behavior of El Niño, which may be a consequence of global warming. A more complete understanding of these dynamical keys will lead to increases in the accuracy of predictions of El Niño behavior and its impacts.

The windward side of Kanton Island, American Samoa.
Copyright University Corporation for Atmospheric Research
Gretchen Keppel-Aleks (Postdoctoral Scholar) uses observations and models to understand carbon exchange between the atmosphere, land, biosphere, and oceans. A member of Jim Randerson’s Research Group, Gretchen works to improve flux estimates of CO$_2$ in two ways. First, by comparing observed to modeled CO$_2$ levels, she can determine how well the model captures reality. This information informs improved models of CO$_2$ patterns of variability. Second, Gretchen uses flux data and satellite observations to improve models of gross photosynthesis and respiration for global ecosystems. Prior to starting her postdoc, Gretchen spent five weeks biking and hiking through the Cascades and Rocky Mountains. She biked from Seattle up to Jasper before hopping on a Greyhound back to the LA area.

Global Passages of Scientists (GPS)

While completing her studies at Caltech, Gretchen visited Park Falls in northern Wisconsin. They used a Fourier transform spectrometer inside a converted shipping container (pictured right), sitting in the middle of a field, that made remote sensing observations of atmospheric CO$_2$. Generally, the measurements were automated, but sometimes things broke, and when they did it was usually during cold, icy winters. Gretchen would head out there in the snow to fix things – this was a pretty good reality check for a grad student living in southern California.

Climate research requires accurate data about the oceans

The U.S. Global Ocean Carbon and Repeat Hydrography program executes research cruises to collect water samples, which are then measured, analyzed and made available to the scientific community. By collecting data on these repeated cruise tracks around the world, CLIVAR aims to describe the physical processes responsible for climate variability, improve oceanic models with these measurements, and predict the response of the climate system by detecting the anthropogenic modification of the oceans. Alysha Coppola (Graduate Student, Druffel Group) had the opportunity to be apart of one of the cruises last fall to collect samples for her dissertation. The cruise track was from 30’S, leaving from Cape Town to Rio de Janerio.

The Druffel Group was specifically interested in dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), and black carbon (BC) in the ocean. They had the exciting opportunity to use these measurements to understand the complexities of DOC. Prior to this cruise, only 5 locations had been measured for DOC in the ocean – this cruise provided the first 3 profiles for the South Atlantic! Their mission was to collect samples that will help to explain why DOC in the ocean is cycled on multi-millennial time scales, surviving through several ocean circulation cycles.

Alysha arrived in Cape Town excited with the prospect of her first cruise. She spent the first few days setting up the supplies needed to collect seawater for Dissolved Organic Carbon (DOC) and Black Carbon (BC). After spending a few days in beautiful Cape Town they were off on an amazing voyage of discovery. Three days out of port they had to turn back without getting any samples yet. Alysha was so disappointed but it was better than nothing. Alysha was very anxious to get on with the voyage of discovery. Three days out of port they had to turn back without getting any samples yet. Alysha was so disappointed but it was better than nothing. Alysha was so disappointed but it was better than nothing.

KUCI. Student Government. Research in ESS. Leading the Earth System Science Club. Building Ecojars. Is there anything Jack Pan hasn’t done? Currently a senior in the Earth and Environmental Science (B.S.) program, Jack has loved all his Earth System Science courses. His favorite class would have to be EarthSS 134: GIS for Environmental Science (Winter, 2012). In this course, Jack is learning how to represent numerical data in a figure. “A picture is worth a thousand words.”

For the last two years, Jack worked on a project investigating the nitrogen cycle of Orange Pitcher Plants. These plants are carnivorous and they capture insects through the pitcher at the tip of each leaf. This causes their nutrient uptake pathway to be very different from normal plants. His lab work includes growing and feeding the plants in a greenhouse, and also processing and analyzing stable isotope samples.

If he could share one tip with his fellow UC Irvine undergrads, it would be to keep exploring Orange County (OC)! There are a lot of exciting places in OC. It’s very close to the beach, and yet OC is like having the metropolitan lifestyle without the busyness, distraction, and stress. Three of Jack’s favorite casual “foodie” places are Itiya Café (a very artistic spaghetti restaurant located in Diamond Jamboree Center), Native Foods Café located in The District of Tustin (very good vegan dishes), and Z-Pizza (with all their organic ingredients makes very special toppings).

When atmospheric circulation patterns collide, dynamic storms and weather emerge. In the open sea, these collisions exert a major influence on the ocean. Colene Haffke (Graduate Student) studies the short and long term variability of the South Pacific Convergence Zone to better understand how and why it forms. One of this year’s Graduate Student Representatives, Colene also enjoys playing volleyball (she has more than a decade of experience), gardening, and watching Antiques Roadshow on PBS.

Global Passages of Scientists (GPS)

Originally from Nebraska, Colene has traveled to Ireland, where she enjoyed the amazing Cliffs of Moher.
Numbers can be very dry and visually uninteresting – particularly when they are characterizing the El Niño / La Niña weather system. In her project with Professor Yu, Alice Kim makes these numbers come alive in a video simulation. It’s pretty amazing to see black and white numbers turn into a short movie, with colors representing temperatures on a global scale. Alice first became interested in atmospheric chemistry in one of her Earth System Science Courses (EarthSS 55, taught by Gudrun Magnusdottir). The circulation patterns and the Hadley Cell fascinated her. Now, she is involved in a research project that characterizes the La Niña phenomenon. One of the newest undergraduate researchers in ESS, Alice is learning much about weather, and MatLab!

When you walk into the room, you’re greeted with music playing in the background. Researchers, Graduate Students, and Undergrads are working through protocols, collecting data, and making discoveries. Some of the equipment has been custom-fabricated, while other pieces of equipment cost literally millions of dollars. Safety gloves and goggles are standard issue, and an engaged mind is essential. This is no run-of-the-mill time and place, this is a cutting-edge lab in the Department of Earth System Science, and these students are engaged in research.

The samples start as leaves, soil, or other organic samples that can easily be seen. By the time they reach Mariela Ruacho’s lab bench, the samples are tiny – refined powder. Mariela’s role in the lab is to prepare these organic samples for analysis of their radiocarbon (14C) content on UCI’s Accelerator Mass Spectrometer. 14C is a radioactive isotope of carbon that is mostly studied to determine the age of things. Mariela is involved in everything that goes on in the lab, including making glass tubing, weighing reagents and samples and managing and discussing data. Mariela doesn’t get lost in the details though. She understands the importance of carbon to the environment – she knows she has an important role to play in the cutting-edge research that will eventually make a difference, e.g. in predicting the effects of climate change in the Arctic.

I was pretty intimidated before I got into the lab, particularly if I had questions for professors or grad students. But now, this project is kind of an excuse – now I can ask another question, to get the conversation started.

-Alice Kim

I really feel like I have felt the most close to science by doing this. It’s been fun, I’ve been able to meet a Ph.D. student, and gotten closer to my professor. I have learned from them, and built relationships.

-Mariela Ruacho

While the actual tasks involved in research can vary from lab to lab, the idea remains the same. Research is the process of actively answering a question. It could involve power tools, fire, ice, water, computer programming, measurement, and more. Unlike course-work in the sciences, research can take you to new places, and present new discoveries.

One of the newest undergraduate researchers in ESS, Mariela is involved in a research project that characterizes the El Niño / La Niña weather system. In her project with Professor Yu, Alice Kim makes these numbers come alive in a video simulation. It’s pretty amazing to see black and white numbers turn into a short movie, with colors representing temperatures on a global scale. Alice first became interested in atmospheric chemistry in one of her Earth System Science Courses (EarthSS 55, taught by Gudrun Magnusdottir). The circulation patterns and the Hadley Cell fascinated her. Now, she is involved in a research project that characterizes the La Niña phenomenon.

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The ocean ecosystem is home to a wide variety of organisms. Some of these can be seen un-aided (i.e. dolphins), but most are invisible to the naked eye (i.e. microbes). The "invisible" organisms exert significant influence over global biogeochemical cycles. Researchers are working to understand more fully what organisms exist in the ocean, and where they apply the greatest influence.

In an article published in the ISME Journal, the Martiny Research Group characterized the global distribution and diversity of a specific group of microbes (Verrucomicrobia). The group based their study on samples collected off the Newport Beach Pier, alongside more than 500 globally distributed samples from the International Census of Marine Microbes (iCoMM). Based on these samples, they identified where the microbes exist geographically, their typical location in the ocean (i.e. near the surface, in the deep ocean, or in sediments), and how ocean conditions (i.e. temperature, salinity, circulation, depth) affect the proliferation of this lineage. To identify the specific microbes, the group used a process called Polymerase Chain Reaction (PCR) followed by DNA sequencing and a detailed computational analysis.

In the paper's discussion, Sara Freitas (ESS Undergraduate Student, and lead author on the paper) concludes:

"In this global study, we have shown that Verrucomicrobia is one of the more common phyla in the ocean. The phylum is nearly ubiquitous in the marine environment and is found in almost all marine environments across a range of environmental conditions. Further, we show that the phylum appears to consist of several ecologically distinct lineages that occupy unique environmental niches. We hope that this can form the basis of more detailed studies in order to further define the biogeochemical role of Verrucomicrobia ecotypes."
Graduate Students Unplugged

The Department of Earth System Science at UC Irvine offers graduate students a unique opportunity to study the Earth as a system, which encompasses the transfers of energy, water and elements among the atmosphere, land, ocean, and cryosphere, with emphasis on the recent impacts of human activity. Doctoral students engage in a variety of activities, including field research in diverse global locations, advanced computer modeling, cutting-edge techniques in modern laboratory environments, and interactions with recognized experts in atmospheric chemistry, biogeochemical cycles and physical climate.

Of course, when they’re not in the lab, or the classroom, ESS Grad Students enjoy all the best of Orange County. Here are a few highlights from their adventures!

Best place to go cycling in Orange County is around the Newport Back Bay. You can hook up with the bike path as it passes campus and then ride down to you hit the bay in the right season the estuary is just covered in birds wintering over in sunny SoCal. When you get tired of birding there is a small local natural history museum (Muth Interpretive Center) tucked just off the bike path or you can take a guided nature walk or kayak tour of the area, also located right next to the bike path.

Great place to surf? San Onofre

Great place to kayak? Channel Islands

Great places to hike? Crystal Cove State Park, “Holy Jim Trail” near Trabucco Creek, San Jacinto

Great places to mountain bike? Aliso Woods, Crystal Cove State Park, Newport Back Bay, Santiago Oaks, Whiting Ranch

Great place to enjoy the art scene? Downtown Santa Ana, The Lab / The Camp in Costa Mesa

Cool thing to do on campus? Frisbee in Aldrich Park!

What on Earth?

This photo from the last issue of The Dynamic Earth is a fossil gastropod shell (~1 mm diameter) that was incorporated in a stalagmite (cave calcite deposit) from Laos. Special thanks to Kathleen Johnson (Faculty, http://ess.uci.edu/~kathleej) for submitting this photo.
What on Earth?

Faculty, Researchers and Graduate Students in the Department of Earth System Science at UC Irvine often find themselves in unique locations, undertaking extraordinary feats. In our last issue, we showed you a picture from Dr. Kathleen Johnson. Do you have any idea what this picture captures?

Hint: This picture was submitted by the W.M. Keck Carbon Cycle Accelerator Mass Spectrometry Laboratory (http://ess.uci.edu/ams).