

(NOT SO) Glacial

THE FEROCIOUS SOUTHERN Ocean stirs violently as Madison Hall descends the metal staircase leading from the expedition vessel that has taken her from the tip of South America down here to the icy Antarctic continent. An inflated rubber boat is waiting on the windy sea to take her and a dozen other students ashore to the South Shetland Islands where the group will spend the morning studying the ecology and behavior of local penguin populations. Until now, the archipelago just off the northwestern coast of the Antarctic Peninsula has been a safe home for large penguin colonies. But Antarctica has begun to change, and how the birds will fare in a warming climate that thaws glaciers and sends sea levels on the rise is uncertain. That's what Hall came here to investigate.

The Michigan State University (MSU) graduate student is one of the participants in Studies in Antarctic System Science, one of a growing number of education abroad programs that look at the impact of a changing climate on environments and societies around the world. As global temperatures continue to climb, many scientists warn that a slow-motion catastrophe is unfolding on our planet. Because this crisis will likely affect the coming generation dramatically, international education is increasingly turning its attention to climate change.

A Perfect Fit for International Cooperation

Global warming ignores national borders and therefore lends itself to become the focus of education abroad programs. "In some sense it's the perfect international issue," said William Moomaw, professor of international environmental policy and director of the Center for International Environment

and Resource Policy at Tufts University. "With respect to resource and energy security, for example, we are all pretty much linked together. There are very few places in the world that can produce all of their own energy without engaging in international trade." And global collaboration will be essential to solve the problem, he added. "We really need concerted action because greenhouse gas emissions come from every country in the world, the richest and the poorest, and we need to figure out ways to work together to address this."

But it is also the consequences of climate change that are global. "Not only do people have to worry about whether they will harm themselves and their children, but they also have to think about what harm they are causing to people in other parts of the world," Moomaw said. The generous amounts of greenhouse gases that industrialized countries have been spewing into the atmosphere over the past decades have wrapped the entire globe in a thick, heat-trapping blanket that is transforming marine and terrestrial ecosystems everywhere. And those who will feel the impact of global climate change most are not the ones who are primarily responsible for it. "One thing that is really striking about climate change is that there is a huge equity issue; those who will suffer the most are contributing the least," Moomaw said. Many education abroad programs try to bring this message home by taking U.S. students to countries that will feel the impact far greater than people living in North America. University of Washington chemistry and oceanography professor Richard Gammon, for example, takes students to a small fishing village on the Brazilian coast. If sea levels rise as predicted they will completely inundate the town in coming decades. "When we go there our students see that these people already have very precarious living conditions and health, and they can directly see how much harder climate change will make their lives."

EDITOR'S NOTE: *The study of science is often underrepresented in discussions on education abroad and international exchange as traditionally these areas were established in humanities and social science disciplines. This article is the fourth in an occasional feature series on science in international higher education. Earlier articles have been on marine biology (March/April 2007), archaeology (July/August 2007), and engineering (November/December 2007).*

Changes

Global climate change is fast becoming an issue that involves all citizens in every nation. Because of its borderless nature, climate change presents the perfect opportunity for international education collaboration.

BY NICOLE BRANAN



Impact Not Just on Humans

But not only humans will suffer from the effects of rising global temperatures. Among those that are already feeling the heat are Arctic and Antarctic animals. So far, global warming has announced its presence nowhere more clearly than at the poles. In recent years the glacial regions have been changing at an unnerving pace, and these changes have left their mark on the regions' wildlife. For example, climate change has an already observable impact on penguin populations in Antarctica, said Pamela Rasmussen, assistant professor in MSU's Department of Zoology, assistant curator at the MSU museum, and research associate at the Smithsonian Institution. In 2006 Rasmussen accompanied MSU students to Antarctica where they conducted individual research projects, several of which looked at penguin populations. Glacial meltdown is one of the effects of global warming that threatens penguins, Rasmussen said. Calving glaciers, for example, cause water to pool in places that are penguin breeding grounds, drowning the birds' eggs. This could have dire consequences for the animals, which may not be able to adjust to the changing conditions quickly enough, Rasmussen said. "Penguins can't solve problems by thinking them through. That's why it usually takes a very long time before they adapt to severe perturbations of their environ-

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ment. This usually doesn't happen over a short time span like what we are seeing with global climate change."

The changes that are occurring in the Antarctic Peninsula are also causing more snowfall than usual, said John Hesse, adjunct faculty member in the Department of Fisheries and Wildlife at MSU. That means that each year bare areas where penguins can nest appear later and later in the spring. "That's compressing their nesting period because they have to wait for the snow to melt," he said. "This is direct evidence of some of the impacts of climate change that our students were able to observe."

But the effects of changes in precipitation, retreating glaciers and fracturing ice shelves reach far beyond local wildlife. Polar ice sheets, for example, impact Earth's reflectivity, or albedo. Light-colored ice reflects as much as 90 percent of incoming solar radiation while dark land surfaces soak most of it up. The ratio of light and dark surfaces influences global climate and inspired one MSU student to study the various

types of ice in Antarctica and the reflectivity of the different surfaces they form. "As you get more melting water you get less reflection," Hesse said. "That's a feedback mechanism that causes even faster melting."

Seeing effects such as these on Antarctica's wildlife and environment had a profound impact on some students. "It helped me gain a really important sense of the fragility of these natural places," said Hall, who just completed a master's degree in environmental journalism and who, after the trip, decided to pursue a Ph.D. degree in forestry. "It was a big paradigm shift for me, but I decided that rather than just quoting the experts I wanted to be one of the experts."

New Programs Aim to Spark Interest in Climate Change

Hesse hopes that a new study abroad program that will take students to the Arctic later this year will spark a similar interest in the sciences and climate change issues in students. The education abroad program Arctic Studies during the International Polar Year (IPY) will allow students to follow and get involved in the cutting-edge science that thousands of scientists are conducting as part of the IPY. The IPY, a large scientific program organized through the International Council for Science and the World Meteorological Organization, is currently examining a range of physical, biological, and social research topics on the Arctic and the Antarctic. "The timing of our program couldn't be better with thousands of scientists from over 60 nations being involved in the IPY," Hesse said. Students will travel to Svalbard, a Norwegian island in the high Arctic, and will explore the environment aboard a Russian icebreaker. Visits to research bases and meetings with IPY scientists are on the schedule. "Students will have ample opportunities to interact and work with the scientists," Hesse said. The expedition will allow students to gain insight into what's currently known about climate change and contaminant problems in the Arctic, he added. Each year the ice cap is getting smaller because of early melting and with that seals—the polar bears' main food source—are disappearing. "That's why a lot of the animals are starving," Hesse said. And because polar bears are at the top of the food chain they are accumulating high levels of organic pesticides and chemicals that are migrating up from industrialized countries and are concentrating in the Arctic region. Students will be looking at all of these topics in individual research projects, and polar bears are going to be a focus because "they are impacted by both issues," Hesse said. "I hope that this expedition will inspire students to focus their career and their citizenship goals onto filling gaps in scientific knowledge as researchers or becoming strong advocates for changes in public policy or personal behavior towards sustainability."



Michigan State University students soak in the sheer beauty of the Antarctic Peninsula while observing penguin behavior on Petermann Island. At 11:00 pm, the sun remains high in the southern skies in late December.

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rainforest is crammed with vegetation, as many as 1,500 plants and 750 species of trees cover a typical four-square-mile patch. To repel the ubiquitous insects many of these indigenous plants have developed complex chemical substances that are toxic to predators but can be highly effective for medicinal purposes. For example, seventy percent of those plants that have the potential to combat cancer live only in rainforests, according to the U.S. National Cancer Institute. As a result, pharmaceutical companies are exploring these areas intensively. "One option for our students is to look at this industry and study how it affects the environment and how the environment's degradation in turn affects poverty in the region," Horn said. Another industry that has a detrimental impact on the rainforest is charcoal production, which has contributed to large-scale deforestation. "Industries such as these are encroaching on the Amazon and are affecting the climate."

Saving the Amazon

An important step toward saving the Amazon rainforest is gaining a better understanding of the atmospheric chemistry that goes on in the region, said Richard Gammon of the University of Washington. For example, "it's really important to

get the input conditions for the air that ends up in the Amazon," he said. That's why he started the Chemistry, Climate Change, Culture Exploration Seminar that takes students to Salvador, a large city on the Brazilian coast. Winds carry the air surrounding the densely populated city of nearly 3 million to the Amazon, which is why the area is an important place for air quality measurements. Gammon, who worked in Brazil for two years as a federal scientist, took his students to a global atmospheric watch station in Arembepe, a small fishing village just north of Salvador. The station is part of the United Nations' Global Atmosphere Watch, a network of weather stations that gather data on atmospheric composition and changes, but chemical measurements never got off the ground there, Gammon said. "My motivation was to take a group of students there and try to jumpstart the measurement program." He shipped carbon dioxide, ozone, and particulate-measuring instruments from the University of Washington to Arembepe where his students set them up to run continuously for the time they were there. Gammon hopes to eventually make the station a permanent contributor to the global network. "My goal is to find the resources to put instruments at that site so that there will be continuous measurements of carbon dioxide, methane, ozone, and other climate gases." Arembepe is a particularly important place to monitor greenhouse gas levels because it is one of only two Global Atmosphere Watch sites located in South America, Gammon said. And because the second station sits at the tip of Chile, pointing to Antarctica, Arembepe is the only network station that can monitor what's going into the Amazon.

Gaining Real-World Experience

Measuring the air quality in Brazil allowed students to gain hands-on experience and to use their knowledge in a real-world setting, said Mary Harty, chemistry academic adviser at the University of Washington and one of the program coordinators. "Just as important as having the textbook knowledge is knowing why it matters," she said. While in Brazil, students also looked at social and environmental justice aspects and worked with Bahia Street, a charity that provides high quality education for impoverished young women and girls in Brazil. Seeing the conditions in Salvador's shantytowns and Arembepé "put a face on climate change and what it means in human terms," Harty said. "The students actually saw the people who would be affected by it."

This year Gammon and Harty will add a visit to interior Brazil, where students will travel to the city of Teresina in the northeastern part of the country. Teresina suffers periodic droughts and is likely to get even drier in the future, Gammon said. "This is a place where major impacts of climate change are already apparent." Students will also spend ten days in the rainforest where they will go on a boat on the Amazon River and take water and air quality measurements.

Scientific Data Crucial

Gathering more scientific data is essential in addressing the challenges of global climate change but another critical part is effective communication, said Edward Maibach, professor and director of the Center of Excellence in Climate Change Communication Research (CECCCR) at George Mason University. "It's a massive challenge to try to change our behavior and to change the way we live." But in addition to individual behavior changes, we need a global carbon dioxide emissions framework, he said. "Communication is going to play an essential role in both of those parts of the challenge."

CECCCR conducts communication, marketing, and behavior change research to learn how to educate, motivate, and assist individuals and businesses in reducing their carbon footprint in an effective way. The center's international team includes Min Huang, associate professor and vice director of the news center at Beihang University in Beijing, China, who is currently a visiting scholar at the center. Huang investigates how news media in China and in other countries are covering the issue of global warming. "News media coverage of global climate change is playing a significant role in agenda setting and social consensus," she said, adding that Chinese media have begun to put more emphasis on the topic in recent years. For example, the number of articles on climate change in *People's Daily*, China's popular newspaper, rose from an average of only 24 per year between 1995 and 2000 to about 70 in 2006, and more than 270 last year, Huang said.

CECCCR is currently working actively to create a global network of sister climate change communication research centers in other countries, Maibach said and added that international exchange is essential when it comes to climate change. "For a long time the U.S. was the largest emitter and now that we are tied with China

it becomes just critical that the two of us work together and bring other countries to the table to solve this problem," he said. Global exchange of ideas both with regard to the nature of the problem and the extent of the problem, as well as ideas regarding solutions, is going to be absolutely essential, he said. "This is not a problem that can be solved without a global carbon emission framework and the question is 'How do we get there and how do we develop the kind of mutual trust, good will, and shared understanding that will allow us to get to a global framework?'"

Establishing International Research Teams

With twenty-first century communication technologies this global exchange of ideas does not even need to involve greenhouse gas-emitting plane rides across the globe, as Montana State University's undergraduate research seminar Global Climate Change and Its Implications for Agriculture illustrates. The seminar's intent is to set up collaborative research teams with University of Western Australia students and faculty in Perth and let them connect electronically to explore the topic together. Individual teams work on sub-themes of global climate change, such agricultural impacts or agricultural modifications that can be adapted in response to global climate change. "We think that [global climate change] is a terribly



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important issue but it's also a global issue, and to explore it in a global way seemed to be an exciting approach," said Norman Peterson, vice provost for international education at Montana State University. And because Montana is a semi-arid wheat-producing state and Australia is a semi-arid wheat-producing country, "we thought that it would be interesting to do this program with the Australians."

The seminar tied together Montana State University's and the University of Western Australia's respective experience in the field, Peterson said. "We pulled in the University of Western Australia's expertise in climate modeling through lectures provided by their faculty, and Montana State University faculty provided lectures about the kinds of strategies that agriculture needs to follow to adapt to changes in climate." Each lecture was presented with interactive video technology so that students in Montana and in Perth could interact with the speaker and ask questions. "We believe that the future of international education lies in synthesizing and combining traditional international programs, such as study abroad and exchange experiences, with technologically based programs," Peterson said. Perth is one of two main cities in Australia whose water supplies are most vulnerable to climate change, and collaborating with students and faculty there emphasized the ubiquitous presence of the issue. "I think that students gained a tangible knowledge of the global dimensions of this subject and got a much more global, rather than just a Montana-rooted, perspective on the issue," Peterson said.

Campus Presidents Take Action on Global Climate Change

COLLEGE AND UNIVERSITY PRESIDENTS are paying attention to global climate change as a key issue facing today's society. More than 500 campus presidents have signed the American College & University Presidents Climate Commitment; the organization began in 2006 and the written commitment was signed by the first campus presidents in 2007. Signatories commit to reducing and eventually, eliminate their campuses greenhouse gases to become "climate neutral" to help prevent global warming and implement sustainability into the campus curriculum. For more information, visit www.presidentsclimatecommitment.org.



CRAIG TWEEDIE

Michigan State students dock on land in Antarctica.

Incorporating Climate Change into International Policy

Students can learn not only from participating in international collaboration at the research level but also from analyzing what happens at the international policy level, said Moomaw, who co-directs Harvard Summer School's course *Global Climate Change: The Science, Social Impact, and Diplomacy of a World Environmental Crisis*. International communication about global warming started decades ago when various nations started to come together to develop agreements such as the United Nations Framework Convention on Climate Change (FCCC) and the Kyoto Protocol, intended to confront the issue together. "One of the most important lessons we have learned about these diplomatic efforts is that they did not work the way we thought they would," Moomaw said. The expectation was that nations of the world would get together and agree to some treaties, then governments would do what the treaties said, and the problem would be solved, he added. "But it has not worked that way at all, mainly because governments have been very cautious about doing anything that would change the system that they are familiar with." Yet the opportunities for innovation are enormous and the relatively small number of nations that have taken advantage of them have done quite well, he said. One example is Denmark, which, after the government encouraged the development of wind power, became the dominant manufacturer of wind turbines in the world. "By hanging back the U.S. has discouraged renewable energy industries, and by doing that we have been handicapping ourselves and others are now rising up and are reaping the harvest of their engagements in these new technologies," he said. "That is a lesson that students need to understand and from which they can learn a lot." In the end, educating today's students about the various aspects of global climate is essential for their own good. "These students will see a dramatically altered climate if it plays out the way it might if we stay on the present trajectory," Moomaw said. "That's why they need to understand what the implications are for the things that we are doing today. It's really all about their own future." **IE**

NICOLE BRANAN is a freelance journalist based in Colorado Springs, Colorado. Her latest article in *IE* was "Uncovering Archaeological Treasures" in the July/August 2007 issue.