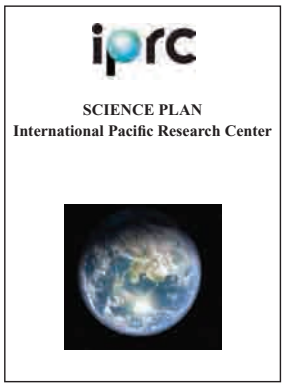
IPRC NEWS

A New Science Plan for the IPRC

The IPRC has a new Science Plan to guide its research. This new plan has been under development for two years and replaces the original plan written in 1999. The IPRC Science Plan presents key scientific questions for the IPRC and describes activities our researchers will conduct to address these questions. The focus is on issues for which substantial effort and progress are anticipated in the next five years, although activities in many areas described in the plan can be expected to continue beyond that time. The Science Plan can be downloaded from the "Research" page of the IPRC website http://iprc.soest.hawaii.edu/research/research.php.



IPRC Scientists Head Meteorology and Oceanography Departments at UH Mānoa

IPRC's **Kelvin Richards** was elected Chair of Oceanography and **Bin Wang** Chair of Meteorology at the University of Hawai'i. They began their 3-year terms on July 1, 2010.

Wang is well known in the monsoon research community through his numerous publications and for his service on international climate research boards and committees, and as editor on climate-related scientific journals. He is currently co-principal investigator of the international project "Climate Prediction and its Societal Application" to improve climate prediction for Asia. As Chair, Wang will work toward integrating climate-science research within the department and facilitating international collaboration to improve scientific understanding and prediction of changing climate in Hawai'i, the Pacific, and the global tropics.

Richards, who joined the IPRC and Department of Oceanography in 2002, is looking forward to the challenge of ensuring the smooth running of this very large department, with a faculty of over 40 and a further staff of over 40 researchers and others. He will also be busy in the next couple years with his growing observational program, participating in research cruises of JAMSTEC and KORDI and leading the new international research program "Mixing in the Equatorial Thermocline" and its partnerships with Woods Hole Oceanographic Institution, JAMSTEC, Korea Ocean Research and Development Institute, Seoul National University, and the University of Tokyo.

IPRC Postdoctoral Fellow Yu Kosaka Awarded Prestigious Prize by the MSJ

IPRC Postdoctoral Fellow **Yu Kosaka** has been awarded the Yamamoto–Shyono Medal by the Meteorological Society of Japan (MSJ) for her work on wave-like teleconnection patterns along the summertime Asian Jet. Each year the society selects two top papers written by young scientists for the award. Kosaka received the medal at the October fall meeting of the MSJ in Kyoto.

Yu Kosaka at the MSJ meeting with the Yamamoto–Shyono Diploma. Photo courtesy MSJ.

IPRC Participates in Annual Symposium of the Research Institute for Global Change

JAMSTEC's Research Institute for Global Change (RIGC) held its first Annual Symposium at Yokosuka Headquarters on April 20, 2010. In recognition of the close partnership between IPRC and RIGC scientists, JAMSTEC invited IPRC to participate in the symposium. IPRC Director **Kevin Hamilton** presented the talk "IPRC Science Highlights" and IPRC Assistant Researcher **Kazuyoshi Kikuchi** presented a poster on his research on tropical cyclone formation.

Kazuyoshi Kikuchi explains his research results to an attentive audience. Image courtesy JAMSTEC.

IPRC Director Visits JAMSTEC Headquarters

IPRC Director **Kevin Hamilton** visited JAMSTEC headquarters in Yokosuka on July 23 to meet with Executive Director **Shiro Imawaki** and **Shiro Matsugaura** of the JAMSTEC International Affairs Division. They discussed such issues as long-term JAMSTEC visitors to the IPRC, IPRC's reports to JAMSTEC, the composition of the IPRC Science Advisory Committee, and future joint JAMSTEC– IPRC science meetings.

NICAM Researchers Discuss New Simulations of Tropical Cyclones

Several participants in the JAMSTEC–IPRC collaborative analysis of results from the cutting-edge Nonhydrostatic ICosahedral Atmospheric Model (NICAM: http://www.ccsr.u-tokyo.ac.jp/~satoh/nicam/index.html) held an informal meeting on April 9, 2010, at the Atmospheric and Oceanic Research Institute (AORI) on the University of Tokyo Kashiwa Campus. Hosted by AORI faculty member **Masaki Satoh**, the meeting included IPRC's **Yuqing Wang**, who was in the middle of his sabbatical visit to AORI, JAMSTEC researchers **Kazuyoshi Oouchi** and **Yohei Yamada**, Yokohama National University faculty member (and recent IPRC postdoctoral fellow) **Hironori Fudeyasu**, and IPRC Director **Kevin Hamilton**.

The group discussed newly available NICAM integrations, including simulations by Yamada designed to study the global warming effects on tropical cyclone climatology. The discussion emphasized the need to optimize the model performance in simulating present-day mean tropical climate and variability.

Seated from left, Masaki Satoh, Kazuyoshi Oouchi, Yuqing Wang, Kevin Hamilton, Hironori Fudeyasu. Standing Yohei Yamada.

Jay McCreary Continues the IPRC - Hokkaido University Partnership

Jay McCreary was invited by **Yasushi Fukamachi**, **Humio Mitsudera,** and **Youichi Tanimoto** to give a mini-course (6 lectures) to graduate students at Hokkaido University from October 20 to 22, 2010, thereby continuing the IPRC–Hokkaido partnership in educating climate scientists. Entitled "Large-scale Coastal Dynamics," the course provided an introduction into large-scale coastal dynamics, including the processes that drive and maintain coastal circulations and cause their variability. McCreary discussed such topics as the forcing mechanisms driving coastal currents, the type of waves generated at coasts, the key differences between two-dimensional and three-dimensional models of coastal circulation, the reason for the existence of eastern-boundary currents. The lectures provided the dynamical groundwork for a seminar given to a general audience on October 22, which summarized research carried out with UH colleagues **Fabian Schloesser**, **Ryo Furue**, and **Axel Timmermann** on the dynamics of the Atlantic meridional overturning circulation.

Jay McCreary during his lecture series at Hokkaido University. Image courtesy Yasushi Fukamachi, Hokkaido University

IPRC Scientists in the Media

For most of the news items in this section, there are links on the IPRC "News" page that lead to further information about the stories (http://iprc.soest.hawaii.edu/news/news.php).

Ocean Currents and Early Voyages to the Americas: IPRC Senior Researcher **Nikolai Maximenko** was featured in the History Channel program, "Who really discovered America?" The program explored several possible "discoveries" of the Americas before Christopher Columbus "staked his claim in 1492." Maximenko's work on ocean circulation provided information about ocean currents and whether they could have helped those early seafaring voyagers. The program aired several times internationally from June 2 –28.

Simulating the Spread of the Deepwater Horizon Oil Spill: IPRC's **Axel Timmermann** and **Oliver Elison Timm** together with oceanography Ph.D. student **Fabian Schloesser** studied the possible spread of oil from the Deepwater Horizon rig over the course of one year in a series of computer simulations that were based on typical ocean circulation fields obtained from a high-resolution ocean model hindcast. The scientists placed their findings on YouTube on July 8, while the oil was still flowing. In the simulation, the oil spreads initially in the Gulf of Mexico, then enters the Loop Current and the narrow Florida Current, and finally the Gulf Stream. After one year, about 20% of the particles initially released at the Deepwater Horizon site have been transported through the Straits of Florida and into the open Atlantic. The well was capped one week after the simulation was posted. Nevertheless, the site registered over 100,000 hits. You can watch the animation at http://www.youtube.com/user/SOESThawaii. Discrepancies between the projected and observed spreading of the oil spill were subsequently attributed to the fact that the ocean circulation field of summer 2010 was quite unusual. Furthermore, the posted simulations assumed a longer period of crude oil release. Neither the effects of dispersants on the surface oil concentrations nor the impact of biological weathering were included in the calculations.

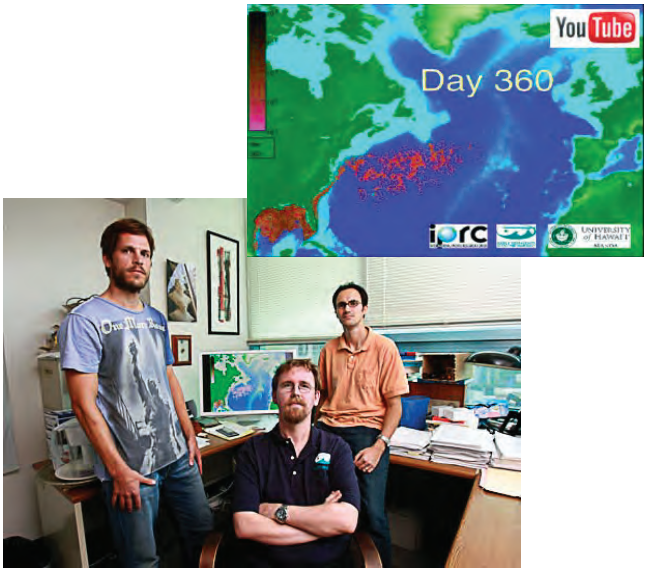


Photo of the team in the StarAdvertiser issue on July 8. From left, Schloesser, Timmermann, and Elison Timm.

Hottest Year Since Record-keeping: **H. Annamalai** was asked to comment for the July 22, 2010, issue of the Canadian *Globe and Mail* newspaper on the revelation by the U.S. National Oceanic and Atmospheric Administration that Earth was on course for the hottest year since record-keeping began in 1880.

A Shift in Pacific Tropical Cyclone Formation with Global Warming? IPRC's **Tim Li** was interviewed by *New Scientist* about his study "Global Warming Shifts Pacific Tropical Cyclone Location" published in *Geophysical Research Letters*. The study predicts that with global warming, the tropical cyclone genesis region will shift from the western towards the central Pacific. The modeling study suggests that more hurricanes could hit Hawai'i in the future. The write-up in *New Scientist* appeared in the October 1, 2010 issue.

Pacific Island Ocean Observing System: IPRC's **Jim Potemra**, acting manger of the APDRC, was a guest on the *Hawai'i Public Radio* technology show "Bytemarks Cafe" on September 8. Potemra was interviewed about his work with the Pacific Island Ocean Observing System (PacIOOS). With him on the show was **Chris Ostrander**, PacIOOS coordinator for the Hawaiian sub-region.

The North Pacific, a Global Backup Generator for Past Climate Change: **Yusuke Okazaki** from JAMSTEC, and **Axel Timmermann** from IPRC together with their international colleagues published "Deep Water Formation in the North Pacific During the Last Glacial Termination" in the July 9 issue of *Science*. The study found evidence that toward the end of the last ice age, a major reorganization took place in the current system of the North Pacific, which may have buffered the global impacts of the collapsed meridional overturning circulation in the Atlantic. The study received wide media attention. In a National Science Foundation interview, Timmermann describes in greater detail the findings (http://www.nsf.gov/news/news_summ.jsp?cntn_id=117283). **Thorsten Kiefer**, director of the international project office of Past Global Changes, wrote a detailed commentary "When Still Waters Ran Deep" on the paper in the July 27 issue of *Science*. Kiefer concludes that the paper clearly shows, "Climate scientists need to abandon their Atlantic centric view and adopt the Pacific Ocean as an active player."

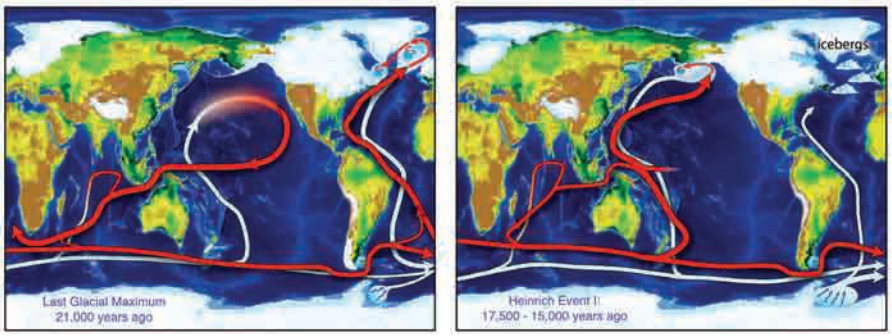
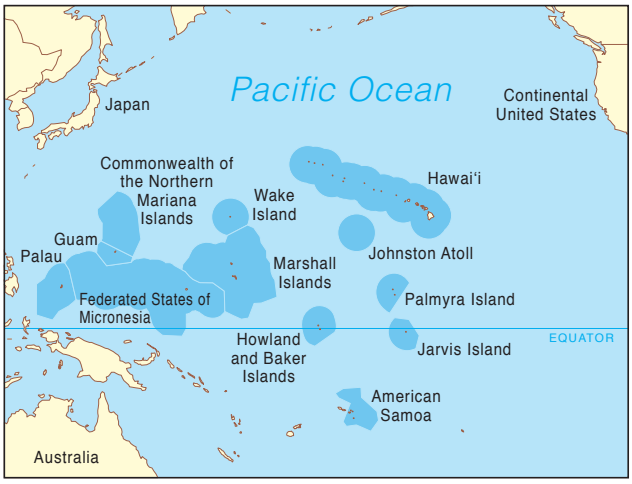


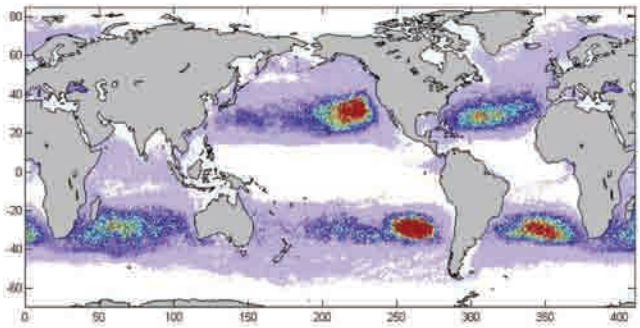
Figure of Back-up Generator. Courtesy Nancy Hulbirt.

Sea-Level Rise Will Be Worse for Some: **Axel Timmermann** was interviewed for a story on *Wired Science* that appeared in the July 16 issue about the impact of winds on sea-level rise, and which islands in the Indo-Pacific region are more threatened by sea-level rise and which less (see also *IPRC Climate*, vol. 10, no. 1). The research was published in the August issue of the *Journal of Climate*.



Map of PacIOOS region. Image courtesy PacIOOS.

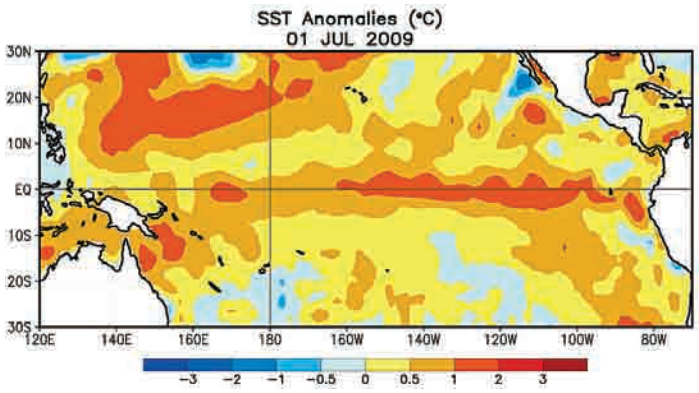
Predicting the North Atlantic Garbage Patch: **Nikolai Maximenko** co-authored the paper "Plastic Accumulation in the North Atlantic Subtropical Gyre," which appeared in the August 19 issue of *Science*. The study presented results from students, who had collected plastic pieces over 22 years at 6100 locations in the North Atlantic as part of their study in the SEA Program, which is associated with Woods Hole Oceanographic Institution. Maximenko contributed to the research through analyses with the drifter-based circulation model that he has developed. The highest concentration of plastic was found in the region predicted by the model, pointing out this model's usefulness in guiding ocean clean-ups. The research received wide media attention.



The garbage patches in Maximenko's model. Image courtesy Nikolai Maximenko.

IPRC Scientists Active in the Climate Research Community

How Will the El Niño-Southern Oscillation Respond to Global Warming?



Sea surface temperatures along the equatorial Eastern Pacific on July 1, 2009, are at least one degree above average — a sign of El Niño. Image courtesy NOAA.

IPRC's **Axel Timmermann** is a member of the Climate Variability and Predictability (CLIVAR) Pacific Panel, which published the review "The impact of global warming on tropical Pacific Climate and El Niño" in the June 2010 issue of *Nature Geoscience* (http://www.nature.com/ngeo/journal/v3/n6/full/ngeo868.html). Combining observations, theories and results from cutting-edge coupled general circulation models, the panel concluded that the tropical-subtropical Pacific climate is likely to change as follows: the easterly tradewinds to weaken further; surface ocean temperatures to warm faster near the equator than in the subtropics; the equatorial thermocline, which marks the transition between the wind-mixed upper ocean and deeper layers, to shoal; and both the north–south and east–west temperature gradients across the thermocline to become steeper. What these changes could mean for the Indo-Pacific region for rainfall patterns has been shown by IPRC's **Shang-Ping Xie** and colleagues (February 2010 issue of *Journal of Climate)*, and for sea-level rise by Axel Timmermann and colleagues (August 2010 issue of *Journal of Climate*).

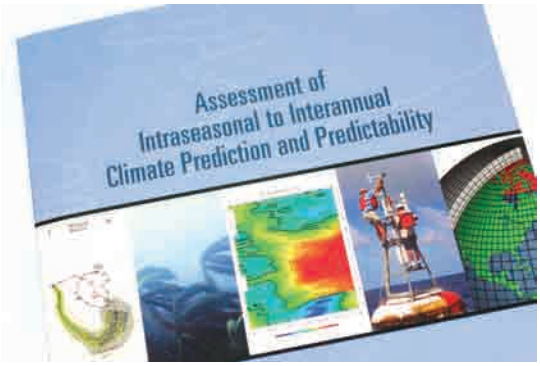
Although the review increases greatly understanding of the feedback processes contributing to the El Niño–Southern Oscillation (ENSO), the panel found no consistent response of ENSO to the projected wind and ocean-temperature changes. Projections based on past climate change are hampered by the fact that the current rapid greenhouse-gas-induced climate change has no past analogue. Ultimately ENSO may be unpredictable, concludes the panel, as these feedback processes are impacted by such (as yet) unpredictable natural events as volcanic eruptions and solar activity.

IPRC Scientists Take Part in IPCC Assessment

IPRC faculty members **Shang-Ping Xie** and **Axel Timmermann** have been appointed as lead authors on the *5th Assessment Report (AR5)* of the Intergovernmental Panel on Climate Change Working Group 1: Xie will be a lead author for the chapter "Climate Phenomena and the Relevance for Future Regional Climate Change" and Timmermann for the chapter "Information from Paleoclimate Archives." The report is scheduled to be completed in 2013.

Improving Climate Forecasts

IPRC's **Bin Wang** served on the National Academy of Sciences Committee on "Assessment of Intraseasonal to Interannual Climate Prediction and Predictability," which produced a report discussing ways to improve climate forecasts in three areas: (1) Make the forecasts more accessible to decision makers and researchers, for example, by greater exchange among operational centers and the research community and by establishing public archives. (2) Improve the tools of forecast systems by using a combination of statistical methods, dynamical models, multi-model ensemble modeling, and state-of-the art data assimilation systems. (3) Investigate further sources of predictability by conducting research on the climate impact of, for instance, the Madden–Julian Oscillation and El Niño, and their interaction; the interaction between the stratosphere and lower layers of the atmosphere; air–sea–land interactions, particularly heat and moisture exchanges; and volcanic eruptions and increasing greenhouse gases. The report was issued in September and can be downloaded from http://dels.nas.edu/Report/Assessment-Intraseasonal-Interannual-Climate/12878.



IPRC Scientists Appointed to Editorships

IPRC faculty member **Yuqing Wang** has been appointed as an editor for the *Journal of the Meteorological Society of Japan*. He will have special responsibility for papers dealing with tropical cyclones. Wang adds this new appointment to his continuing editorial duties as Associate Editor for the American Meteorological Society journal *Weather and Forecasting* and Associate Editor for *Advances in Atmospheric Science*.

IPRC Assistant Researcher **Axel Lauer** has been appointed as an editor for *Geoscientific Model Development* published by the European Geophysical Union. This journal is devoted to articles related to the development and evaluation of numerical models of the Earth System and its components.

IPRC Director **Kevin Hamilton** has been appointed as an associate editor of *Atmosphere–Ocean*, the scientific journal of the Canadian Meteorological and Oceanographic Society. Hamilton adds this appointment to his continuing service as Co-Chief Editor of the *Atmospheric and Oceanic Sciences Library* monograph series published by Springer, and service as a member of the Editorial Advisory Board of the *Journal of Advances in Modeling Earth Systems (JAMES)*. Originally published by the Institute of Global Environment and Society, starting in 2011 *JAMES* will be published by American Geophysical Union (AGU), the first outside journal to be "adopted" by the AGU.

The Future of Oceanography in Space

NASA Program Manager **Eric Lindstrom** and IPRC Senior Researcher **Nikolai Maximenko** are editors of the December 2010 issue of *Oceanography*. It is a special issue on "The Future of Oceanography from Space," which features an overview of developments in remote sensing over the last decades. The intent of this special issue is to articulate areas of scientific inquiry that are fueling the development of next generation satellite missions and to determine the upcoming challenges in oceanography using satellites.

Image courtesy Oceanography Society.

The 2010 IPRC Public Lecture in Climate Science

Every year, the IPRC invites a renowned climate scientist to the University of Hawai'i at Mānoa to give a public lecture. This year an audience of about 150 students, faculty, and members of the general public heard the engaging and informative lecture "Changing World, Changing Ocean" presented by Dr. **Susan Avery** on November 9. Dr. Avery has had a distinguished career in atmospheric research and in scientific and educational leadership. She is currently President and Director of the Woods Hole Oceanographic Institution (WHOI) in Massachusetts, the first woman and the first atmospheric scientist to hold this prominent position in the U.S. oceanographic community.

Avery began her lecture by reviewing some basic facts about the world ocean. From a cosmic perspective, the ocean appears as just a thin skin covering parts of the earth; in fact, all the ocean's water could be collected in a sphere smaller than the moon. However, an amazing range of phenomena occurs at and beneath the ocean surface. The ocean covers mountain ranges higher than Everest, canyons deeper and grander than the Grand Canyon. The vastness of the ocean and the difficulty in directly observing below the surface mean that a great deal remains unknown. Avery noted that only two people have reached the deepest part of the ocean at the bottom of the Marianas Trench, a more exclusive "club" than even the 12 men who have walked on the moon!

Civilization, indeed human life itself, depends on the ocean. A 1997 study estimated that the ocean and its ecosystems provide services that could conservatively be valued globally at over $20 trillion per year. Unfortunately humankind's exploitation of the ocean is becoming increasingly unsustainable. Energy companies are drilling for fossil fuels ever deeper and farther from the coast with consequent dangers of catastrophic leaks. The world's fishing fleets have expanded the geographical extent and intensity of their fishing even as there is less stock available to catch. Global stocks of high-value fish have dropped by 90 percent over the past 50 years. The ocean is also used as the final repository for much of the waste product of our civilization. A particularly serious problem is runoff of agricultural chemicals causing the formation of as many as 400 low-oxygen "dead zones" throughout the world ocean that may act to further curtail fish populations.

The enhanced greenhouse effect from accumulated air pollution is raising global air temperature. The effects are particularly apparent in the Arctic where the summer melt of sea ice has become more extensive in recent decades. The plight of large mammals such as the polar bears that depend on Arctic ice to survive has received a great deal of attention, but Avery noted that much needs to be learned about the effects on the bottom of the food chain, the algae and other microorganisms that feed the larger animals.

Shrinking sea ice is also a growing flash point for conflict among the countries claiming sovereignty over parts of the Arctic Ocean. At stake are massive reserves of oil, natural gas, and minerals, and access to vastly shortened trade routes. The melting may open a nearly pristine ecosystem to large-scale economic exploitation.

Anthropogenic emissions of CO_2 not only affect Earth's climate (and hence ocean temperature and currents) but directly impact ocean chemistry. As it dissolves in seawater, CO_2 makes the ocean more acidic. If this trend continues, we can anticipate that coral reefs may die and begin to dissolve, shelled animals at the base of the marine food chain will suffer, and marine ecosystems may be wholly reshuffled.

Sea-level changes at any location can have multiple proximate causes, but the overall warming of the ocean water and melting of glaciers and ice sheets on land are producing a global rise in sea level that will significantly impact all coasts

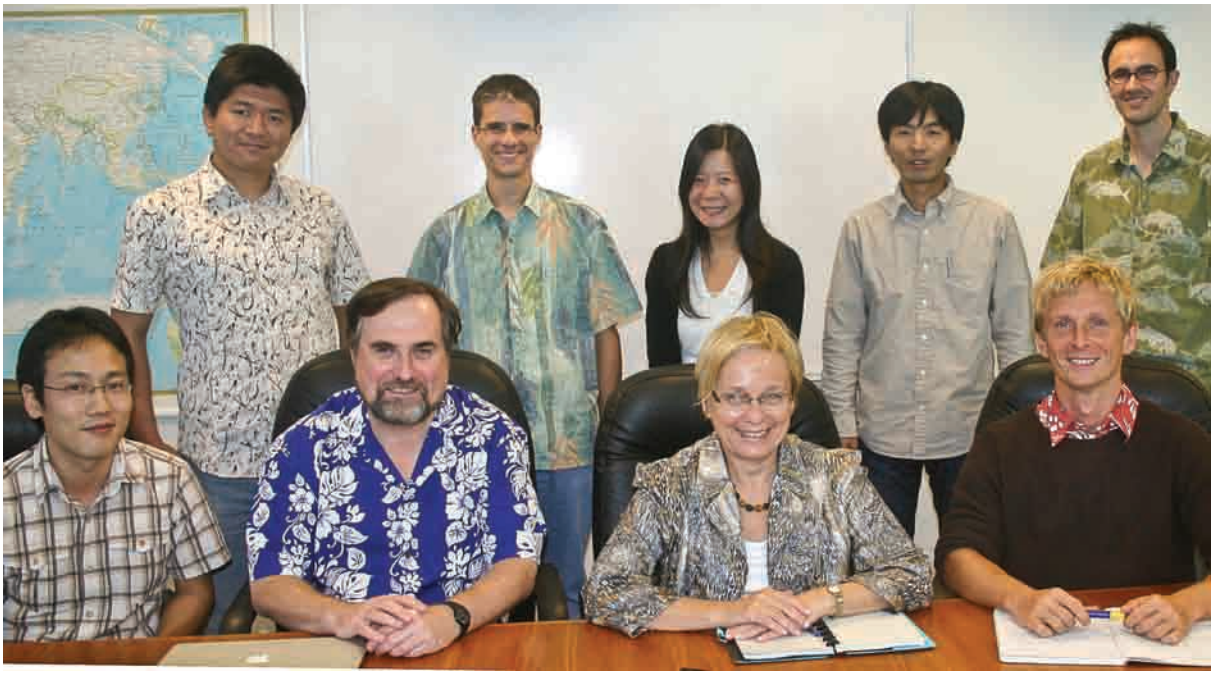
Susan Avery giving the "2010 IPRC Public Lecture." Photo courtesy Jian Ma.

over the next century. Of the world's 25 most populous cities, 22 are coastal. Wealthy countries are constructing, or at least considering, massive engineering projects to keep the waters at bay (such as the Thames Barrier built in 1982). But this is not an option for much of the world. A particularly serious case is presented by the nation of Bangladesh, which has half the population of the U.S. most of whom live near sea level. The US Department of Defense has identified climate change and sea level rise as crucial factors in the global security landscape. Avery noted, "We may be able to wall our cities from the water here in the West, but we can't separate ourselves from the rest of the world."

IPRC Director Kevin Hamilton with Susan Avery and University of Hawai'i at Mānoa Chancellor Virginia Hinshaw. Photo courtesy Jian Ma.

The last part of Avery's lecture focused on the critical role scientific research must play in meeting the many challenges posed by our interactions with the global ocean and the climate system in general. Concentrating on recent advances at WHOI, Avery showed that a new age of ocean exploration and monitoring has been opened by recent developments in autonomous vehicles with new sensors to measure physical, chemical, and biological properties. Avery concluded her lecture by showing how the WHOI expertise obtained in studying the environment around hydrothermal vents in the ocean floor was applied to support the response to last spring's Deepwater Horizon blowout and oil leak in the Gulf of Mexico.

The IPRC looks forward to continuing this high-profile contribution to public outreach efforts in Hawai'i by bringing a world-renowned scientist to the Mānoa campus each year to present the annual "IPRC Public Lecture in Climate Science."



Susan Avery with Kevin Hamilton meet with some of IPRC's younger scientists.

Expedition to Kamilo Beach, the "Dirtiest Beach on Earth"

Five large garbage patches in the world ocean are predicted by **Nikolai Maximenko's** surface current model (*IPRC Climate*, vol. 8, no. 2). The North Atlantic and North Pacific patches have already been found and are making news.

The debris from the North Pacific Patch occasionally escapes and the model shows it floats towards the Hawaiian Islands, making windward shores of the islands trashcans for marine debris. Kamilo Beach near South Point on the Big Island is arguably the most famous beach for the enormous amount of marine debris sweeping up on it. A BBC video labeled it as "The Dirtiest Beach in the World." The beach is unusual, however, in that it lies not on the windward side of the island, but at its southern tip.

Curious about why this beach is so favored by marine garbage and what currents take it to this unusual location, Maximenko put together a team to investigate: Assistant Visiting Researcher **Oleg Melnichenko** took the lead in deploying current meters in the surf to determine the impact of currents, Scientific Computer Progammer **Jan Hafner** took charge of documenting the garbage and collecting samples, and undergraduate marine biology student **Jeremy Soares** was the "above-and-below-water" movie camera man.

The expedition took place in early June 2010. "We had prepared well, but everything turned out differently from what we had pictured in the IPRC conference room," recollects Melnichenko. Already finding the way to Kamilo Beach was an adventure with so many unmarked rough little dirt roads.

"Without **Bill Gilmartin** as our guide, we might still be wandering around the lava," says Maximenko.

Gilmartin, Director of Research from the Hawai'i Wildlife Fund, has been leading clean ups of the beach since 2003, and over 100 tons of marine debris have been removed. Hafner was surprised by how clean the beach looked: "I was maybe a little disappointed, as our mission was to explore the garbage on Kamilo, though of course it is better this way."

The largest piece of debris they saw was a 4-foot long tree trunk. Objects that typically litter the windward Hawai'i beaches were there: Hagfish trap cones from the Pacific Northwest and oyster spacer tubes from East Asia. "The typical size of the debris, however, was 1 inch or smaller," said Hafner.

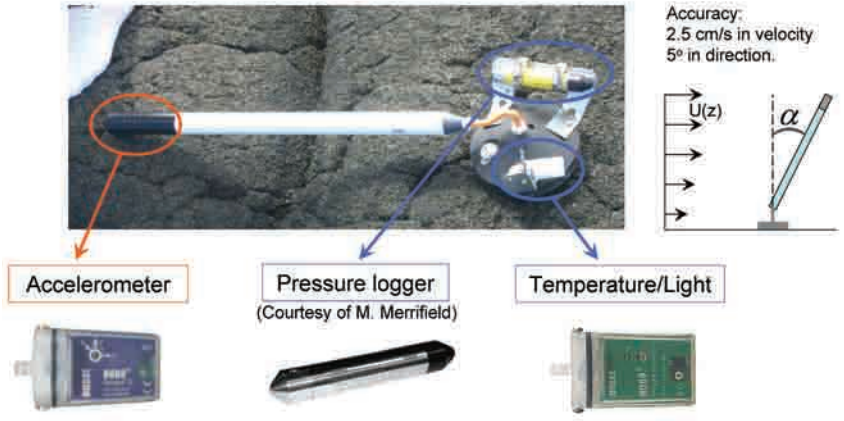
Setting the current meters was a challenge. The surf breaks far out, rolling in over a long rocky distance to shore. So the meters had to be put in place during fairly strong waves. "The meters were too heavy for us to swim with them; so we crawled, pushing them forward and coming up for deep breaths," said Melnichenko.

Kamilo Beach as it was several years ago, before the regular clean-up efforts. Image courtesy Mrs. Soares. Red dot in satellite-picture inset shows location of Kamilo Beach.

The pilot deployment showed the meters were feasible. Although "the environment is hostile" for the meters with waves pounding them ceaselessly, they held. Melnichenko: "Their design is simple and they are inexpensive. We were surprised how well they worked. With an accelerometer and with pressure, temperature and light sensors, they are flexible and can be deployed over uncharted ocean topography. You can move them readily if you want to redesign your experiment, for instance place, them in a line straight out from the beach, or along the beach. No drilling is needed so there is no harm to the environment. And they give instant data. The two days the meters stayed, we collected data that showed the daily cycle, the impact of waves and tides, and lower frequency variations of the currents."

"We are still unclear about the current pattern that brings marine trash to this unusual southwest location. the picture is very complex; the meters are responding to many different things," explained Melnichenko.

"Our exploration brought us no answers but inspired more questions and speculations," said Maximenko. "We confirmed that some debris on Kamilo Beach has travelled in the Pacific subtropical gyre from far away East Asia and from the North American West Coast. The current meters tell us that the waves and the tides provide the energy, pushing the debris to shore like a broom. The rather long shore break may contribute to debris accumulation. But, we still need to understand the interaction between large-scale currents collecting debris from the entire North Pacific and the coastal dynamics that move the debris over the reef."

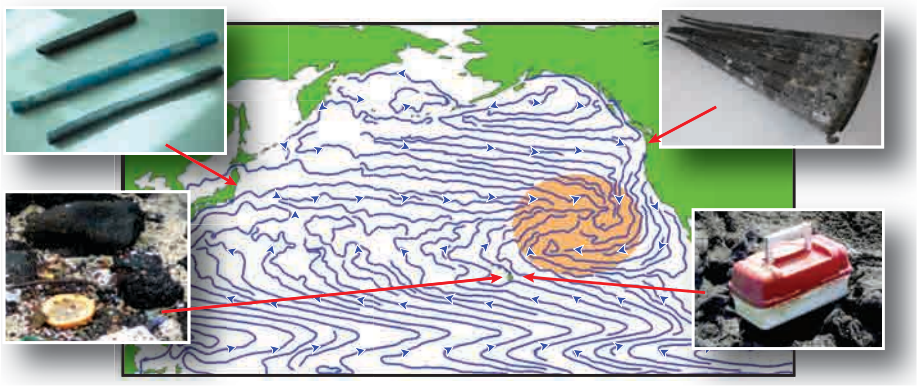


SeaHorse tilt current meter developed by Vitalii Sheremet from the University of Rhode Island. While in the water, a buoyant plastic pipe containing an accelerometer is anchored vertically to the sea floor. Currents cause the pipe to tilt. The angle of the tilt, measured by the accelerometer, is converted into velocity of the current. Additionally, temperature and pressure sensors are attached to the current meter's anchor.

"I'm particularly curious about what happens over time to the plastic, how the small pieces form. The fragments have no sharp edges. Does the plastic dissolve? This could account for the puzzling results of our recent *Science* study with **Kara Lavender Law** on the North Atlantic Patch, which found no increase in plastic density over the decades, even though plastic production increased a lot during that time. If plastic dissolves, does it release CO_2 and contribute to ocean acidity?"

"We need chemists and we need unified global observations to tackle this marine debris problem," Maximenko thinks. "Much is being done, but efforts are so varied that scientifically usable data has not yet been collected."

In conjunction with the "5th International Marine Debris Conference" to be held in Honolulu in March 2011, Maximenko is organizing the "Hydrodynamics of Marine Debris Workshop" to try to generate a more unified and scientific approach to this huge problem facing our oceans and the life in it.



Map showing the actual "mean trajectories of surface drifters" (blue lines with arrows) and the convergence associated with the garbage patch (in orange). The origins of objects found on Kamilo Beach are also shown: oyster spacer tubes from Asia, Hagfish trap cones from the US West Coast, and items from waters around the Big Island.

IPRC Helps Develop a Climate Forecast Tool for Rice Crop Yield

IPRC's Senior Researcher **H. Annamalai** continues to work with ClimaRice, the Indian – Norwegian – IPRC project that aims for sustainable rice production amidst changing climate in the Cauvery River basin of Tamil Nadu in India. Annamalai explains, "The project has the ambitious goal of forecasting the impacts of climate change on crop yield and on the economy in the rice bowl region of the Cauvery River Basin. A major stumbling block, however, is that there are no climate projections available yet for the region."

To develop such a forecasting system, the project is sponsoring **Senthilnathan Samiappan**, assistant professor of agricultural economics at Tamil Nadu Agricultural University (TNAU), for a year-long visit to the IPRC that began in August 2010. He is working with Annamalai on downscaling the outputs from the models used in the Fourth Report of the Intergovernmental Panel on Climate Change in order to drive the high-resolution IPRC Regional Atmospheric Model (iRAM), which first needs to be adapted to the Cauvery River Basin. The downscaled climate-warming data will then be fed to the crop model InfoCrop/DSSAT to see the effect of climate change on crop yield.

"Before I can use the models for forecasting, however, I need to validate both iRAM and the crop model for the region," says Samiappan. "I plan to use historical data over the last 40 years to see how well the temperature and rainfall changes in iRAM and the crop-model yields compare with actual climate indicators and crop yields during that time."

Rice spikelets. Image courtesy TNAU.

Once the 'hindcasts' capture past events, the iRAM and crop model can be run into the future with various IPCC climate-change scenarios to see how the projected climate changes could affect crop yield. "I am especially interested in seeing how years of droughts and floods impact crop yields," notes Samiappan. "The final step is to use the crop yield results from the forecasts to run an agro-economic model to see the socioeconomic impacts of climate change on agriculture. But that is still a long way off."

Samiappan is an excellent choice for this demanding work. His doctoral research dealt with the impact of climate change on crop yields and economics, and he comes from a farming family in Tamil Nadu. His father has noticed the changes in rainfall over the many years he has been farming. Rain comes later in the summer and there is less of it!

Rice transplanting. Image courtesy TNAU.