## The IPRC 10th Anniversary

The IPRC marked the completion of 10 years of scientific achievements with a series of events in May 2008. The previous issue of the *IPRC Climate* described the special IPRC Annual Symposium held on May 5 and 6 at the East-West Center. In their invited symposium talks, University of Tokyo Professor **Toshio Yamagata** remembered the history and evolution of the IPRC, and University of Maryland Professor **Antonio Busalacchi** described the scientific accomplishments of the IPRC over the last 10 years and speculated about IPRC's future in the international climate research community. In the evening of May 5, the IPRC staff held a reception and dinner to honor **Jay McCreary**'s service as IPRC Director and to mark Professor Yamagata's 60th birthday.

On May 9 the IPRC held an Open House for local school children and their parents. About 40 homeschooled students and their parents came to watch animations with the Magic Planet, a smaller version of the NOAA Science On a Sphere. The Magic Planet demonstrations were conducted by **Leon Geschwind**, who gives the NOAA Science On a Sphere demonstrations at Honolulu's Bishop Museum. In addition to the solar system, featuring spacecraft images of the planets and their moons, Geschwind showed animations from models of climate-change projections, including one that predicts how much of Waikiki would be under water with a 3-foot sea-level rise. In age, the students ranged from kindergarten to high school. They were fascinated by the images displayed on the Magic Planet, as were their parents, and asked many questions about the animations displayed on this truly magical sphere.

From left, Grant Mason, Josiah Gill, and Mary Mason are gazing at the Magic Planet.

A final event in our celebration was an informal review workshop on May 16, in which younger IPRC scientists showcased their research.

## Bin Wang Elected AMS Fellow!

AMS Fellow Bin Wang

IPRC Team Leader and Professor of Meteorology **Bin Wang** has been elected Fellow of the American Meteorological Society (AMS) for his "outstanding contributions to the atmospheric and related oceanic and hydrologic sciences during a substantial period of years." The AMS bestows this prestigious, lifelong title each year on no more than 0.2% of the Society's world-wide membership. The ceremony will take place at the AMS Annual Meeting to be held from January 11 to 15, 2009, in Phoenix, Arizona.

## IPRC Interim Director Visits JAMSTEC

In his new role as IPRC Interim Director, **Kevin Hamilton** travelled to Japan this summer to meet with several top-level administrators of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). At Yokosuka Headquarters, he visited with JAMSTEC Executive Director **Kiyoshi Suyehiro** and Operating Executive Director **Shiro Imawaki**. In Yokohama, he enjoyed the opportunity to talk with Frontier Research Center for Global Change (FRCGC) Director-General **Tatsushi Tokioka** and the FRCGC Program Directors **Hajime Akimoto, Toshio Yamagata,** and **Akira Noda** about the overall progress of IPRC–JAMSTEC collaborations. Hamilton was also able to discuss JAMSTEC–IPRC relations with key personnel of the JAMSTEC International Affairs Division including Manager **Masakuni Hanada**, Deputy Manager **Takero Kasaya**, and **Shiro Matsugaura**. Hamilton

Kevin Hamilton with Wataru Ohfuchi (left) and Takeshi Enomoto (right) at the Earth Simulator Center.

also enjoyed a discussion of science issues with **Taroh Matsuno**, formerly Director-General and currently Senior Scientist at FRCGC.

While in Japan, Hamilton paid an extended visit to the Earth Simulator Center, where he was hosted by Senior Scientist **Wataru Ohfuchi** and Scientist **Takeshi Enomoto** of the Atmospheric and Oceanic Simulation Group with whom he is collaborating on the analysis of high-resolution AFES global atmospheric model results. This work is part of the JAMSTEC–IPRC Initiative on Model Development, Diagnosis, and Application Research. He also got a chance to talk with several members of **Masaki Satoh**'s NICAM (Nonhydrostatic ICosahedral Atmospheric Model) group about other work underway at the IPRC on this research theme, including the analysis of NICAM global atmospheric model results.

## Wang and Hamilton Hosted by Japan's Meteorological Research Institute

Japan's Meteorological Research Institute (MRI) in Tsukuba hosted consecutive seminars by IPRC's **Bin Wang** and **Kevin Hamilton** on July 9 for scientists from the MRI and the University of Tsukuba. Wang spoke about his recent work on Tibetan Plateau warming and its effect on rainfall in East Asia.

Wang's seminar came in the middle of his month-long visit to the MRI, where he worked with **Akio Kitoh** and his group in the Climate Research Department analyzing outputs from the very high-resolution (20 km) MRI global model outputs to see what future changes may occur in the diurnal cycle and in tropical cyclone activity in the western North Pacific.

In his MRI seminar, "Late 21st Century Climate Change in Hawai'i Simulated with a Fine Resolution Global Model," Hamilton discussed the results for the Hawaiian region from the pioneering simulations performed at MRI with its TL959 atmospheric model (see also Hamilton's article in *IPRC Climate* vol. 7, no. 2).

Front from left, Hiroaki Ueda (University of Tsukuba), Shoji Kusunoki (MRI), Masamichi Ohba (University of Tsukuba), Tomoshige Inoue (University of Tsukuba); back from left, Bin Wang, Kevin Hamilton, Akio Kitoh (MRI), Ryo Mizuta (AESTO).

## IPRC Scientists Active in the Climate Research Community

Interim IPRC Director **Kevin Hamilton** has been appointed to the External Advisory Panel of the National Center for Atmospheric Research (NCAR) Earth and Sun Systems Laboratory (ESSL). ESSL includes the main scientific divisions at NCAR. He has also been appointed to the inaugural Editorial Advisory Board of the *Journal of Advances in Modeling Earth Systems* (JAMES), a new international, electronic, open-access scientific journal on environmental modeling. For further information, please visit **adv-model-earth-syst.org**.

**Yuqing Wang** has been appointed to the Scientific Working Group of the VAMOS Ocean-Cloud-Atmosphere-Land Study (VOCALS), a program of the CLIVAR World Climate Research Programme. The goal of VOCALS is to develop and promote scientific activities that lead to a better understanding of the coupled ocean-atmosphere-land system in the Southeastern Pacific. For further information on VOCALS, please visit **www.eol.ucar.edu/projects/vocals/**.

## Research Team Investigates Arabian Sea Oxygen Minimum Zone

The Arabian Sea oxygen minimum zone (ASOMZ) lies at a depth of 200–1000 m in the central and eastern Arabian Sea. As all OMZs, the ASOMZ is caused by the sinking of surface-produced detritus and its consumption at depth by bacteria. An unusual feature of the ASOMZ is that it is not located in the western Arabian Sea, where surface production is largest, but in the central and eastern basin. A possible physical cause for its eastward shift is the presence of oxygenated Red Sea water (RSW) in the western Arabian Sea. A group of scientists consisting of **Jay McCreary, Zuojun Yu,** and **Kelvin Richards** at IPRC; **Akio Ishida** at JAMSTEC; **Raleigh Hood** at Horn Point Environmental Laboratory; and **P. N. Vinayachandran** at the Indian Institute of Science, Bangalore, have formed a research team to investigate this idea.

From July 22 to August 3, Raleigh Hood and P. N. Vinayachandran visited the IPRC to work with McCreary and Yu on including an oxygen compartment in the biological component of their 6½-layer, biophysical Indian-Ocean model (LOM). Preliminary solutions to the updated model showed that (1) subsurface oxygen concentrations are largely controlled by local processes, namely, the sinking rate of detritus and vertical mixing of oxygen; and (2) the oxygen flux due to the transport of RSW by mean currents may not be sufficient to shift the ASOMZ to the eastern basin. Earlier this year, Akio Ishida had studied the transport of a tracer from the Gulf of Aden to the Arabian Sea using OFES and found that the transport by eddies was much stronger than that by the mean currents. Based on this finding, the next step in the project is to run an eddy-resolving version of LOM for the region.

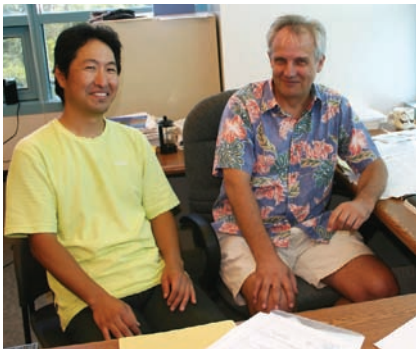
From left: Raleigh Hood, Jay McCreary, and P. N. Vinayachandran.

## IPRC–Hokkaido University Partnership Continues

The IPRC–Hokkaido University partnership in educating climate scientists continues (see last *IPRC Climate* issue). IPRC's **Kelvin Richards** visited Hokkaido University at the invitation of Professor **Youichi Tanimoto**. Richards gave a series of five lectures over two days, as part of the on-going lecture series given in English by IPRC scientists to graduate students of the Division of Earth System Science, Hokkaido University. The well-attended lectures focused on the transport, dispersion, and reaction of tracers in the ocean and atmosphere.

## An Ecosystem Model for OFES

**Yoshikazu Sasai**, research scientist at the Frontier Research Center for Global Change, visited the IPRC in Spring 2008 for three months. Sasai has implemented and run an ecosystem model embedded in OFES. At the IPRC, Sasai worked with IPRC's **Kelvin Richards** on output from the model and in particular, on the impact of the eddying Kuroshio on the primary production in the area.



Yoshikazu Sasai and Kelvin Richards discussing the link between the eddying flow around the Hawaiian Islands and the patterns of phytoplankton.

## IPRC Climate Research to Help Sustainable Rice Production

IPRC's **H. Annamalai** is participating in ClimaRice, a project that is to contribute to the development of regional and national adaptation strategies to sustain rice production and ensure food security in a changing climate. The project is supported by the Norwegian Ministry of Foreign Affairs and aims to assess the climate variability and its impacts on the water availabil-

Cauvery River, courtesy of Wikipedia, the free encyclopedia.

ity and rice production in the Cauvery River Basin of Tamil Nadu in India. In addition to the IPRC, the Tamil Nadu Agricultural University (TNAU) in Coimbatore, India, and the Norwegian Institute for Agricultural and Environmental Research (Bioforsk) are participating. The role of the IPRC in this project is to assess the value of high-resolution regional model simulations for describing the future impacts of climate change on the Indian monsoon and the frequency and intensity of drought in the region. The results from this assessment will provide input to the hydrological and crop-weather modeling, which will be conducted by Bioforsk and TNAU. For more information see **www.tnau.ac.in/climarice/index.html**.

## IPRC Hosts Alan Plumb

Professor **R. Alan Plumb**, FRS, former Director of the Program in Atmospheres, Oceans, and Climate at the Massachusetts Institute of Technology, visited the IPRC from November 5 to 14, 2008. Plumb is a leading authority in the field of geophysical fluid dynamics and is well-known for his contributions to the science of the stratosphere and atmospheric transports. He is also a leading scientist in the field of eddy-mean flow interaction, a field that has become very relevant to oceanographers in recent years. While at the IPRC, Plumb gave two seminars, one on the role of the stratosphere in climate and the other on the effects of eddy transports in the atmosphere and oceans. IPRC scientists took the opportunity to discuss their research with Plumb and to tap into his broad knowledge of large-scale fluid dynamics. Visiting Associate Researcher **Mototaka Nakamura**, a former student of Professor Plumb, was his host at the IPRC.

From left, Alan Plumb with Takeaki Sampe and his IPRC host Mototaka Nakamura.

## Published!

The article "Trends in Hail in China during 1960–2005," which IPRC's **Yuqing Wang** co-authored with colleagues **Baoguo Xie** and **Qinghong Zhang** of Beijing University was chosen as a highlight of the July 2008 issue of *Geophysical Research Letters* by the journal's editor and subsequently by the editor of *Nature China*. The study showed that the mean number of annual hail days in northern China decreased significantly from the early 1980s to 2005. The decrease was thought to stem from the fact that the freezing-level height has risen.

The study "Rise in Tibetan Plateau Temperatures May Affect East Asian rainfall," spearheaded by IPRC's **Bin Wang** and also published in the July issue of the *Geophysical Research Letters* was highlighted in the September issue of the *Nature Geoscience*. The 1.8°C rise in temperatures on the Tibetan Plateau over the last 50 years may have had a notable effect on East Asian rainfall according to the experiments with atmospheric general circulation models. Projected increases in Tibetan Plateau temperatures may further enhance summer rainfall in East Asia. Co-authors of the study are **Qing Bao, Guoxiong Wu,** and **Yimin Liu** of the Chinese Academy of Sciences, and **Brian Hoskins** of the University of Reading.

The article "Topographic Effects on the Solar Semidiurnal Surface Tide Simulated in a Very Fine Resolution General Circulation Model" by IPRC's **Kevin Hamilton**, NOAA's **Steve Ryan** and JAMSTEC's **Wataru Ohfuchi**, published in September in the *Journal of Geophysical Research*, was selected as an *AGU Journal Highlight*. The study used both high-resolution global model simulations and observations from a network of surface pressure sensors on the island of Hawai'i to explore small-scale topographic modulation of the semidiurnal atmospheric tide (*IPRC Climate*, vol 8, no. 1).

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# NEW IPRC STAFF


Tobias Friedrich

**Tobias Friedrich** joined the IPRC as a postdoctoral fellow in June 2008, just after obtaining his PhD from the Leibniz Institute for Marine Sciences GEOMAR at the University of Kiel in Germany. His dissertation focused on quantifying North Atlantic carbon uptake from data taken on transects by volunteer-observing ships in the North Atlantic. Using a high-resolution model, he simulated the present-day monitoring of carbon dioxide partial pressure ($pCO_2$) at the ocean surface in the North Atlantic and then examined several methods for extrapolating the individual local observations to create a basinwide view of $pCO_2$. He found that he could create monthly mean maps of $pCO_2$ for the North Atlantic by using neural network techniques to combine remotely sensed data of sea surface temperature and chlorophyll as well as Argo float data with ongoing measurements of $pCO_2$ and related variables. The high spatial and temporal variability of ocean-surface $pCO_2$ and insufficient optical satellite and observational coverage of the ocean, however, he feels limit the accuracy of the mapping procedure he designed.

At the IPRC, Friedrich is working with **Axel Timmermann** and **Oliver Timm** on mechanisms that cause centennial-to-millennial scale variations of the Atlantic Meridional Overturning Circulation. "My studying physical oceanography in Kiel," he says, "was arranged by fate and gives me the opportunity to become a scientist with social responsibility, while at the same time I can enjoy the ocean."


Xuyang Ge

**Xuyang Ge** joined the IPRC as a postdoctoral fellow in June 2008. He became interested in meteorology, particularly in tropical cyclones, because typhoons threaten his hometown, Zhejiang, China, nearly every year and can cause severe damages. After obtaining a master's degree in meteorology at the Nanjing University of Information Science and Technology in 1997, he worked at the Shanghai Climate Center for several years. He then came to the University of Hawai'i and received his PhD in meteorology in 2008.

For his dissertation, Ge investigated the energy dispersion from a tropical cyclone in a three-dimensional baroclinic model and how this energy dispersion leads to the formation of a synoptic-scale Rossby wave train in its wake. This Rossby wave train can then trigger a new tropical cyclone. Analyzing the model results of such a sequence of events, he found that a concentrated vorticity band formed in the upper levels of the wave train, which then propagated downward. A possible explanation is that smaller inertial instability in the upper-level wave branch can lead to stronger vorticity there. Once an intense asymmetric outflow jet has been generated, it can propagate to the lower level of the Rossby wave train. The development of the outflow jet results in a more intense and larger tropical cyclone, affecting the strength of the Rossby wave train since the energy dispersion is sensitive to tropical cyclone intensity and size. The downward propagation of the Rossby wave energy strengthens the lower-level wave train branch.

At IPRC, Ge is further investigating tropical cyclogenesis with **Tim Li** and is studying the application of satellite data to tropical cyclone and hurricane prediction with numerical models.


Jasti Sriranga Chowdary

**Jasti Sriranga Chowdary** joined the IPRC as a postdoctoral fellow in June 2008. He received his PhD in December 2007 from the Indian Institute of Tropical Meteorology at the University of Pune, where he continued to work as a research associate until coming to Hawai'i. Chowdary recalls, "I became fascinated with meteorology and oceanography while studying for my master's degree in atmospheric physics at the University of Pune. I was especially interested in learning about the El Niño-Southern Oscillation and its influence on the Indian Ocean. This led me to do my dissertation research on surface and subsurface variability of the tropical Indian Ocean."

Using various observational and modeling data sets, Chowdary studied several Indian Ocean climate-related

phenomena for his dissertation. He evaluated the Indian Ocean basin-wide warming due to El Niño during years with and without an Indian Ocean Dipole. He studied the effects of La Niña—before 1976, La Niña was associated with wintertime basin-wide tropical Indian Ocean cooling, but not after 1976. He also compared the atmospheric and oceanic conditions of the Arabian Sea during the contrasting southwest monsoon years of 2002 (drought year) and 2003 (normal year). He noted that during the 2002 monsoon season, early onset and weak winds stress curl cooled the Arabian Sea, whereas in 2003, late onset of the southwesterlies in June and downwelling Rossby wave propagation probably kept the Arabian Sea warm until late July.

At the IPRC, Chowdary is working with **Shang-Ping Xie** in the areas of ocean-atmosphere interaction, and climate variability and change in the Indo-western Pacific.

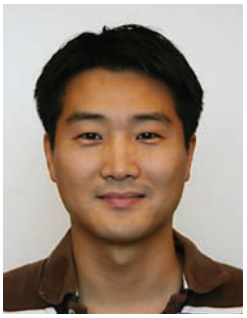

Minoru Kadota

**Minoru Kadota** joined the IPRC as a postdoctoral fellow in fall 2008 after receiving his PhD in applied mathematics from the Courant Institute of Mathematical Science at New York University.

After high school, Kadota worked as a commercial fisherman for four years. He ploughed through 30- to 40-foot waves, fought through fierce storms, even typhoons, and became awed by the power of nature. No wonder that, when he decided to go to university, he first went into oceanography before turning to mathematics.

For his dissertation, Kadota examined the ensemble predictability of mid-latitude weather associated with the Madden-Julian Oscillation (MJO), the dominant mode of intraseasonal variation in the tropical atmosphere. Observations indicate that rainfall patterns over North America and South America are associated with phases and the spatial range of the MJO. General circulation models, however, still have major problems with producing the MJO patterns and variance distribution, and therefore are poor in predicting these MJO-related weather disturbances. Kadota built a simple numerical model of the MJO, which he drove with the MJO latent-heat pattern, and inserted this MJO model into a GCM. Using information theory, he was able to show that with his more realistic simulation of the MJO, the relevant medium-to-long-range weather predictions will improve.

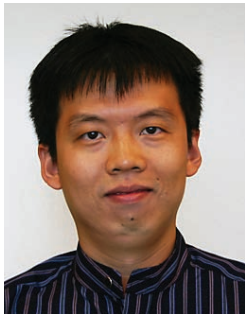
At the IPRC, Kadota is investigating with **Kevin Hamilton** the extent to which the stratosphere impacts weather in the Northern Hemisphere and whether winter-weather forecasts can be improved with knowledge of stratospheric activity.


Hyodae Seo

**Hyodae Seo** joined the IPRC in August 2008 as a NOAA Climate and Global Change Postdoctoral Fellow. After receiving his bachelor's degree in atmospheric sciences at Yonsei University in 2002, he switched to Scripps Institution of Oceanography, where he received his PhD in climate science in 2007.

"My initial focus for my dissertation," Seo recalls, "was to investigate the mesoscale air-sea coupling of the California coastal oceans. So I helped construct a regional coupled ocean-atmosphere model that would capture such air-sea coupling. But coming across one of **Shang-Ping Xie**'s papers on tropical instability waves (TIWs) and the Central American gap winds, I applied the model to the eastern equatorial Pacific. The first model results revealed surprisingly realistic TIWs and the atmospheric responses that Xie and others reported from the satellite measurements. I turned, therefore, to study how, in the model, the observed mesoscale coupling feeds back to the tropical atmosphere and ocean. I also looked at whether resolving the Atlantic TIW mesoscale air-sea process in this coupled model improves simulation of mean climate in the tropical Atlantic Ocean. The coupled model showed that including representation of TIWs and other oceanic eddies improves the Atlantic meridional sea surface temperature gradients and meridional winds, and hence the location of the inter-tropical convergence zone (ITCZ). Moreover, including small-scale convergence and convective processes associated with the synoptic-scale African Easterly Waves (AEWs) in the atmospheric component of the coupled model substantially improves simulation of the amount of Atlantic ITCZ rainfall. The processes arising from TIWs and AEWs are poorly resolved in today's global coupled climate models, a fact that probably accounts for why those models show large climate biases in the Atlantic and the Pacific."

For his fellowship research, Seo has been focusing on coupled climate modeling of the tropical Atlantic, Indian, and North Pacific oceans. At IPRC he will continue to study various coupled climate processes of these oceans with Shang-Ping Xie and other scientists.


Lei Wang

**Lei Wang** joined the IPRC as a postdoctoral fellow in August 2008 after obtaining his PhD in atmospheric science from the Department of Mathematics at Hong Kong University of Science and Technology. His bachelor's and mater's degrees were actually in physical oceanography, a field he chose without knowing much about, but it sounded interesting. He recalls, "After taking part in several field ocean investigations, during which I could observe and get to know the ocean better, I began to understand what physical oceanography is about, and I enjoyed doing the research. The switch to atmospheric science for my PhD was a big change and challenge for me. I chose my topic—atmospheric vortices and tropical cyclones—because of my experiences with ocean eddies. In my dissertation, I tried to answer the question, How do tropical cyclones form? This is still one of the great mysteries of the tropical atmosphere. Based on results of my study, I proposed that the critical condition for tropical cyclogenesis is the persistent release of large amounts of latent heat induced by lower-upper tropospheric coupling. The reason that many tropical disturbances do not develop into tropical cyclones is that lower-upper tropospheric coupling, either dynamical or thermal, is not strong enough."

At the IPRC, Wang is working with **Yuqing Wang** on developing a new version of the IPRC regional coupled model (iROAM) with which he plans to study the air-sea interaction in the eastern Pacific. "It is a new research topic for me, and I hope my previous experiences in both oceanography and tropical cyclones will be helpful."

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## IPRC Bids Sayonara

Associate Researcher **Tommy Jensen**, who has been a part of the IPRC since 1998, took a position with the Navy Research Laboratory-Stennis Space Center in Mississippi this past summer. While at the IPRC, Jensen explored, among other topics, the upper-ocean water mass exchanges between the Arabian Sea and the Bay of Bengal using the numerical layer model he developed. He served, furthermore, as editor of the *Journal of Climate* from 2003 to 2007. At Stennis, he is with the Planning Systems Inc., part of QinetiQ, North-America. He is analyzing coupled atmosphere-ocean-wave models and has participated in a validation study of Hurricane Katrina for the Coupled Ocean Atmosphere Prediction System.

Associate Researcher **Maxim Yaremchuk** has also been with the IPRC since 1998. His research at IPRC focused on regional climate studies at seasonal time scales using different methods of variational data assimilation into numerical models. He also joined Stennis Space Center in Mississippi and is now doing research on the data assimilation methods themselves; specifically, he is trying to combine ensemble and variational approaches to interpolate oceanographic data in open-boundary domains.

Postdoctoral Fellow **Shinichiro Kida**, who joined the IPRC in 2006, returned to Japan in November to work as a researcher at the JAMSTEC Earth Simulator Center, where he joins another former IPRC colleague, Bunmei Taguchi. Kida continues to do climate variation research on the Indonesian Throughflow and marginal seas in the western Pacific.

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