

Keeping Up-To-Date on Decadal Climate Variability

Are you keen to be up-to-date on decadal climate variability but tired of attending far away workshops? A solution is on the way. Soon you will be able to attend such workshops at HOME! And whenever you feel overloaded listening to the many speakers, you can leave the “conference room”, get that coffee and ice cream, or take a snooze, and come back refreshed when ready to hear more. All you will need to do is go on your computer to the **Virtual Center for Decadal Climate Variability** at <http://www.decvar.org>.

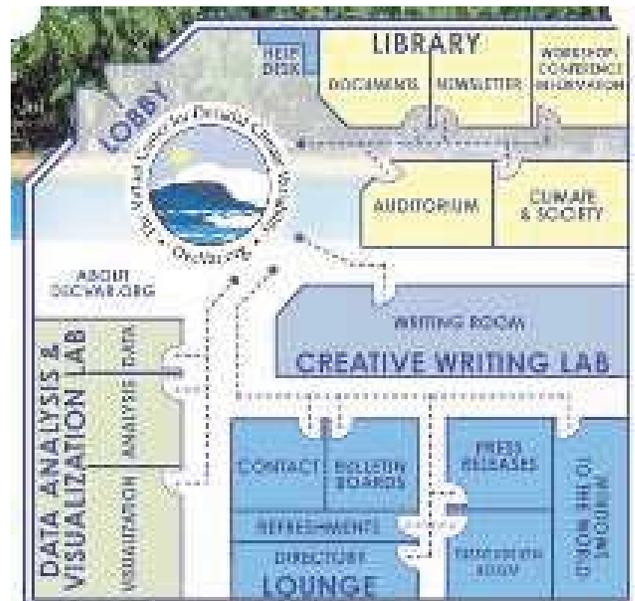
Much of this virtual center has already been built, so let us take a tour through it. After entering the *Lobby*, we see straight ahead of us the *Auditorium*. Soon you will be able to hear and see virtual poster sessions, seminars and workshops and you will be able to interact with “speakers” in real time or off-line.

In the room *Climate and Society*, you find articles on such topics as how global warming will affect health and agriculture. For example, in “Is Global Warming Harmful to Health?” Paul Epstein concludes that many diseases will surge as the earth heats up, and that mosquitoes, carrying dangerous diseases, are already on the march. Next door, you can read *Subtle Signals*, the Dec Center’s newsletter, which features opinion pieces, articles not intended for publication (or that cannot be published), program news, meeting summaries, or call-for-papers pertaining to decadal climate variability and its societal impacts. Published and in-press articles on decadal climate variability are in the *Document* room. You, yourself, may wish to write an opinion piece for *Subtle Signals* or contribute articles.

In the *Discussion* room, still under construction, you will be able talk with colleagues. The *Writing* room next door is ideal for working on joint papers. It holds software that automatically collects and organizes coauthors’ comments to make the final editing much easier. No need to worry about eavesdroppers—the manuscripts are password protected. Why don’t you practice on a sample document?

If you’re organizing a conference, just go to *Bulletin Boards* to advertise it there. Here you also check for those conferences you actually may wish to take the trouble to travel to.

Very exciting is the *Data Analysis and Visualization Lab*. It could make your research so much easier. Already the Data room has a description of and links to over 50 data sets covering 40 years or more and useful for decadal climate variability research and applications. For instance, the U.S.S.R. Northern Hemisphere surface pressure and



precipitation anomalies: January and July, 1873–1979; or Malaysia, Thailand and Indonesia surface observations: daily and monthly, 1951–1985; Brazil precipitation: daily, 1910–1974.

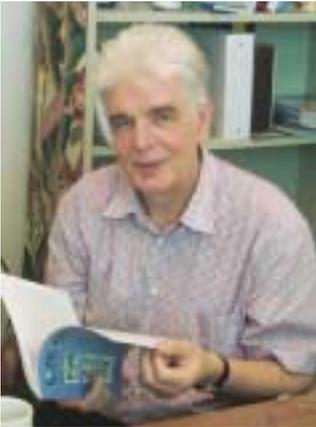
These data sets are to be linked to analysis systems and data visualizations. You will be able to carry out your analyses at the center and all you need to download are the figures of the outcomes of your analyses. This frees you to spend your time working on the scientific questions you are interested in rather than on time-consuming manipulation of data to adjust them for your research, or on development and adjustment of model codes.

When your head steams from looking at the thousands of numbers on the screen, take refreshment in the refreshment room. And what is a virtual refreshment? Why not try one at <http://www.decvar.org/refreshments.php>.

The architect of this virtual center is **Vikram Mehta**, a research scientist at the Earth System Science Interdisciplinary Center, University of Maryland, and at the Climate and Radiation Branch, NASA–Goddard Space Flight Center. While a visiting scholar at the IPRC during Summer 2001, Mehta worked on developing the center. His dream, he says, has been to develop a facility that fosters speedier communication within the global, decadal climate variability and applications communities; provides access to a variety of long-term data sets that are integrated with analysis and visualization software; and allows community-wide planning and execution of data set inter-comparisons, multi-model experiments, and observing-system studies.

Improving Climate Models

Erich Roeckner's Experience with the ECHAM Model



Erich Roeckner of the Max Planck Institute for Meteorology (MPI), Hamburg, Germany, is the “father” of the widely used ECHAM general circulation model (GCM); he has been guiding its evolution from its beginnings to version 5, soon-to-be released. When Roeckner visited the IPRC in Summer 2001 as a consultant,

we thought that our readers might be interested in hearing from him about the challenges of model development.

Roeckner began his work with atmospheric general circulation modeling in the early 1970s for his doctoral dissertation: “The first satellite images of Venus were showing that Venus was very hot. Some strange theories were put forth to account for this, for example, the strong winds on Venus were stirring up sand, creating friction, which heated the atmosphere.” He developed a model of Venus’ atmosphere and showed that the chemical composition of the atmosphere, the high CO₂ content in particular, was responsible for the high temperature.

About the beginnings of the ECHAM model, Roeckner recalls, “The Max Planck Institute in the early 1980s had an atmospheric GCM for the Northern Hemisphere only. We wanted our own climate model in order to teach students and do research on climate change. But Germany did not have the critical mass of climate researchers for such a huge project, and so we turned to the European Centre for Medium-Range Weather Forecasts (ECMWF) model—the best available then.”

“To change this weather forecasting model into a climate model was a lot of work. The purpose of a climate GCM is to understand natural variability on various timescales from seasonal and storm-track variability, to interannual, decadal and longer,” explains Roeckner. “Energy, water, and mass in the climate system need to be conserved not over a few weeks but over 100 or more years. A new land-surface scheme was needed and the radiation scheme was not in good shape, so that a new radiation and cloud scheme were also incorporated.”

“From the beginning, computing power has constrained model development,” says Roeckner. “Physical

processes have often been quite well understood and the physical equations representing the processes have been available, but the equations have been only partially usable in the models because the grid size is too large. Larger mesh size means solving the equations only at certain points, and the climate processes have to be simplified and parameterized, resulting in an only partly realistic representation. It’s like Seurat’s Pointillism, where distinct points represent the continuity of colors in the real world. The closer the points are together, the more closely they will represent reality.” How small does the grid size need to be in order to capture reality? “That depends on the process in question.”

ECHAM’s first version, recalls Roeckner, had a grid of 600 km and no stratosphere, whereas the soon-to-be released ECHAM5 has a flexible grid size ranging from 50 km to 500 km and flexible atmospheric layers that extend into the mesosphere. How one uses ECHAM5 depends upon the process being studied and the computing power available. The model has a new radiation scheme, this time taken from the latest ECWMF version and a new cloud scheme. Deep convection and stratified clouds are still parameterized.

“Model development and validation—comparing the results of model runs with observations—go hand in hand. When a new process or a better way of representing the process is incorporated into a model, results often deteriorate. The challenge,” says Roeckner, “is to find the reason for the poorer performance: Is it due to errors in the codes for the scheme? Is the process not represented correctly? Is the problem the result of how the process interacts with other processes? For example, the interaction between radiation and cumulus convection may have changed. At times, problems arise from errors in two processes that cancelled each other in the previous version. With the introduction of a new scheme for one of the processes, the error in the second process now shows up, deteriorating model performance.”

“Understanding the model is sometimes just as difficult as understanding the real world. Figuring out why the model has deteriorated means tinkering until you get better performance. It requires much intuition and creativity in knowing how the many processes may be affecting each other.” Are there any specific steps for sniffing out the problems? Roeckner has two suggestions to make debug-

ging easier: "One way is to simplify the model, for example, to take out the mountains. Another way is to run the model in the column mode, with a single grid point, and use the results of the GCM as boundary conditions."

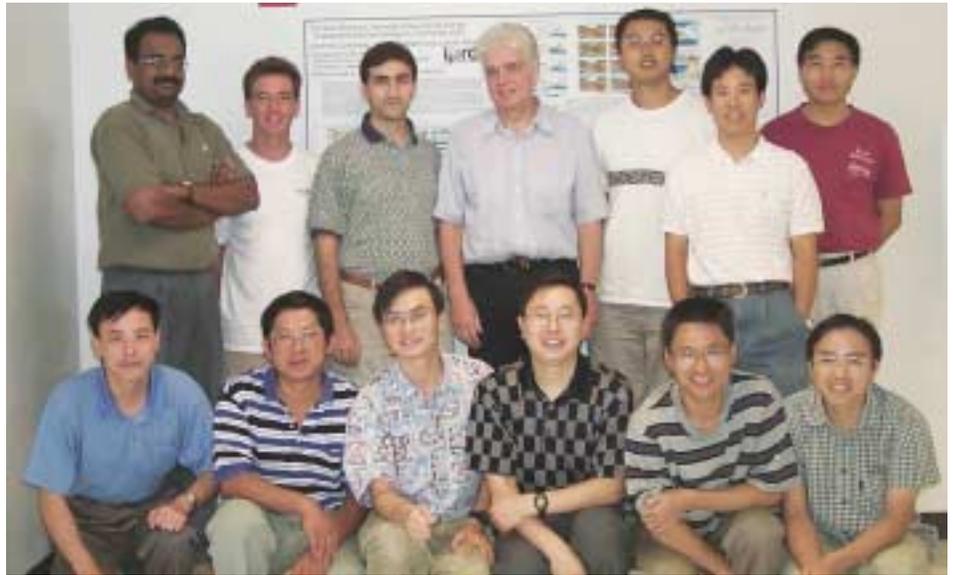
To study the sensitivity of Earth's climate to changes in the chemistry of the atmosphere, the ECHAM model has been coupled to different ocean models developed at MPI. Results of two possible future scenarios using ECHAM4 are included in the recent Intergovernmental Panel on Climate Change Report. Projected increases in global-mean surface temperature simulated by the ECHAM model fall into the middle range of outputs from simulations by other models in the report. Increase in global-mean precipitation, however, is substantially lower in the ECHAM model. Roeckner thinks this results from the fact that cloud-water content in the model is higher in the warmer atmosphere; this has a strong effect on albedo, decreasing solar radiation, and therefore decreasing evaporation. Furthermore, in ECHAM4, the thermohaline circulation (THC) does not decay with increased warming as it does in most other models. The ECHAM results suggest the following scenario: An El Niño-like mean state develops in the eastern Pacific (which other climate models also find). This results in subsidence and drought in the Amazon region and more evaporation in the subtropical Atlantic, increasing the salinity there and in the Gulf Stream, maintaining a North Atlantic sufficiently salty to drive the THC. Roeckner is looking forward to study this possible sequence using the ECHAM5 with its greater horizontal

and vertical resolutions and better radiation and cloud schemes. The model will be coupled to an MPI ocean model in such a way that the fluxes between atmosphere and ocean are represented directly without the necessity of arbitrary flux corrections.

"Collaboration with other scientists, building upon each others schemes for the many physical processes, is essential to progress in climate modeling and research," says Roeckner. At the IPRC, development and application of the ECHAM model has been truly a team effort. In January 1999, **Bin Wang** discussed with visiting MPI

director, **Lennart Bengtsson**, using ECHAM at the IPRC, and in the following summer a contract was signed to transfer the ECHAM 4.3 version to the IPRC.

Since then, **Bin Wang**, **Tim Li**, **Xiouhua Fu**, **H. Annamalai**, **Renguang Wu**, and **Ping Liu** and others have been working intensely with the stand-alone ECHAM to study various atmospheric responses to SST forcing. Moreover, two coupled models have been developed with ECHAM 4.3 as the atmospheric component. Tim Li has coupled it to the GFDL Modular Ocean Model, and has studied the relationship among the El Niño-Southern Oscillation, the Indian Ocean Dipole, and the Indian monsoon. Xiouhua Fu coupled ECHAM4.3 to the intermediate ocean model developed by Wang, Li, and Chang (*JPO*, 1995); this hybrid-coupled model has been used to study how air-sea coupling affects the annual cycle of the Asian-Australian monsoon, the mean Asian summer monsoon (Fu, Wang, and Li, *J.Climate*, in press), and the intraseason-



Erich Roeckner with IPRC scientists.

al oscillations (**Kemball-Cook**, Wang, and Fu, *J.Atmos. Sci.*, in press). Wang, Fu, and Li are currently studying the effect of air-sea interaction on Indian Ocean SST and the Asian-Australian monsoon.

On his visit, Erich Roeckner brought the updated ECHAM4.6 to the IPRC. Wang, Liu, and Li have evaluated this new version, and recognizing ECHAM's weakness in land-surface processes, decided to incorporate the BATS land-surface scheme into ECHAM4.6. **Omer Sen** and Ping Liu are now undertaking this task in order to improve its simulation of the East Asia and Western Pacific monsoons.

News of IPRC Researchers



Kevin Hamilton, IPRC's Theme-4 leader, served as *Director* of the *School on the Physics of the Equatorial Atmosphere*, held September 24–October 5, 2001, at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. The ICTP is sponsored by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and is devoted to facilitating graduate level education and research opportunities for scientists from developing countries.

The School focused on the current state of research on the low-latitude atmosphere and included meteorological phenomena as well as phenomena related to stratospheric ozone chemistry and ionospheric effects on radio propagation. Designed for graduate students and young postdoctoral scientists with some background in atmospheric science, the School attracted 42 students from 27 countries. Hamilton returned from Trieste invigorated, saying that it had been a most rewarding scientific trip. "The School provided a wonderful opportunity to meet graduate students and other young scientists from an amazing array of countries. Hopefully many of the contacts made at the School will evolve into international scientific collaborations. Our colleagues from low-latitude countries are important partners in the global research efforts to study the near-equatorial atmosphere, and settings such as this international school are ways to ensure their full participation."



Selected as the 2001 *Henry G. Houghton Lecturer* at the Massachusetts Institute of Technology, **Julian P. McCreary**, IPRC Director, gave a series of seven lectures in Spring 2001 on the

dynamics of intergyre exchange circulations in the Pacific Ocean. The lecture series was established by the Henry G. Houghton Fund, with the idea that students at MIT's Center for Meteorology and Physical Oceanography invite distinguished scholars from the outside to conduct two-to-four weeklong mini-courses on topics not covered in the Center's curriculum.



Lorenz Maggaard, IPRC Executive Associate Director, was awarded the title of *Marine Technology Society Fellow* for his valuable contributions to the study of global climate change

and for his excellence in promoting marine science and technology at the university level. He received the award, November 5, 2001, during the OCEANS 2001 Conference at the Hilton Hawaiian Village in Honolulu.



Shang-Ping Xie, co-leader of IPRC Theme 1, was awarded the *Outstanding Collaborative Research Prize* by the Ocean University of Qingdao, China, for his research on the "Far-

Reaching Effects of the Hawaiian Islands on the Pacific Ocean-Atmosphere System," published in the June 15, 2001, issue of *Science*. The award, which was presented by Huashi Guan, the President of Qingdao University, consisted of a certificate and cash award and was reported in Chinese newspapers.

New Scientific Staff



Takahiro Endoh joined the IPRC in July 2001 as a research scientist from the Frontier Research System for Global Change. He received his Ph.D. in Science from the University of Tokyo, Japan, in March 2001. Endoh's research has focused on the bimodality of the Kuroshio path south of Japan, particularly on simulating observations showing

that the transition from the non-large meander path to large meander path is caused by the generation of a "trigger meander" off the southeastern coast of Kyushu and the subsequent amplification of this meander as it propagates eastward off Cape Shiono-misaki. Using an inflow-outflow regional numerical model with realistic topography, Endoh has successfully reproduced this observed transition in the Kuroshio paths. Based on his analysis of the simulation results, he has proposed the following explanation: the trigger meander is generated by the interaction between the Kuroshio and a strong anticyclonic mesoscale eddy approaching the Tokara Strait. When the Kuroshio volume transport is large and vertical current shear strong, the trigger meander propagates eastward up to Cape Shiono-misaki; there it slows down and is significantly amplified through baroclinic instability, which is particularly large in this region due to the local topographic feature, Kosu Seamount, about 200 km south of Cape Shiono-misaki.

At the IPRC, Endoh is working with **Humio Mitsudera**, co-leader of Theme 2, on the three-dimensional structure of the North Pacific subtropical and subpolar gyres, particularly on the influence of outcropping isopycnal layers, mesoscale oceanic features, and bottom topography on the separation of the Kuroshio and the Oyashio from the western coast of Japan. They are planning an eddy-resolving numerical simulation of the North Pacific using a newly developed hybrid-coordinate ocean model (HYCOM) in which coordinate surfaces adhere to isopycnals in the interior ocean, and are geometrically constrained in shallow coastal regions and the mixed layer.



Hyoun-Woo Kang joined the IPRC as a postdoctoral fellow in September 2001. In 1993, he received his M.S. in oceanography from Seoul National University (SNU). As part of his master's degree work, he studied remote ocean sensing technology and its products. Kang continued his doctoral studies at SNU while working as a researcher at the

SNU graduate school (in fulfillment of compulsory military service). During this period he participated in projects on coastal processes and marine environment. After receiving his Ph.D. in oceanography from SNU in 2001, he joined the Korea Ocean Research and Development Institute as a part-time research assistant, studying coastal processes and the marginal sea circulation.

For his dissertation, "A Numerical Model Study on the Oceanic Circulation in the Yellow Sea and the East China Sea under Tidal and Wind Forcings," Kang developed a regional model and used this model to study the complicated shelf area of the region, where fast tidal variations and slow ocean-current variations have equally important effects on ocean conditions.

Kang's current research interests include the study of ocean-circulation dynamics and coastal processes using numerical modeling and satellite remote-sensing data. At the IPRC, he is working with **Tangdong Qu**, associate researcher in Theme 2, on low-latitude western-boundary currents in the Pacific. These currents have been shown to play an important role in ENSO and may be a key component of the global thermohaline circulation through their contribution to the Indonesian Throughflow. The project is based on an analysis of a combination of hydrographic data and data from a set of numerical modeling experiments. Since they will be using the IPRC version of the Princeton Ocean Model for process-related experiments, Kang is now investigating the sensitivity of this model to geographic features and wind forcings.

New Scientific Staff



Yoo Yin Kim received his Ph.D. in physical oceanography in June 1999 from Florida State University, where he continued as a postdoctoral research scientist in the Department of Meteorology until joining the IPRC as postdoctoral fellow in October 2001.

While working on his dissertation, Kim participated in two field experiments that gave him experience managing and analyzing moored data: As part of the World Ocean Circulation Experiment–Deep Basin Experiment, he dealt with current-meter observations and hydrographic data in the Mid-Brazil Basin; for the Ocean Margins Program, he analyzed the complete current, salinity, and temperature time-series data collected with ADCP, SEACATs, and about 80 current meters from 25 moorings in the southern part of the Mid-Atlantic Bight shelf.

His research has focused on describing and understanding oceanic and climatic variability on seasonal-to-interdecadal time scales. He has found that sea surface temperature (SST) changes during ENSO are represented as an irregular interplay between two dominant modes, a low-frequency mode and a biennial mode. Studying the response of the tropical subsurface current, temperature structure, heat content, and sea-level height to sea-surface conditions (temperature and wind), he has shown that their variability is connected with the two dominant modes of SST and the propagation of equatorial long-waves associated with ENSO in the tropical Pacific Ocean.

Working in Theme 2 with **Humio Mitsudera** and **Tangdong Qu** at the IPRC, Kim is now investigating the Pacific low-latitude western boundary currents (LLWBCs). He will be analyzing historical and recent hydrographic data, JAMSTEC high-resolution model data, the IPRC GCM data, and Simple Ocean Data Assimilation data to (1) complete a description of the time-averaged structure of the LLWBCs, (2) examine the variability of the LLWBCs from seasonal-to-decadal time scales, and (3) diagnose the ocean processes that maintain the LLWBCs and account for their variability.



Ping Liu joined the IPRC's Theme 3 researchers as a postdoctoral fellow in June 2001. He received his Ph.D. in climate dynamics from the Laboratory of Atmospheric Sciences and Geophysical Fluid Dynamics (LASG), Institute of Atmospheric Physics, Beijing, in May 1999. Working with Professors **Duzheng Ye** and **Guoxiong Wu**, he wrote his dis-

sertation on the dynamics of the interannual variation of the subtropical anticyclone over the western Pacific Ocean and the impacts of tropical SST anomalies on this anticyclone. Based on his dissertation research, he proposed that a two-stage thermal adaptation mechanism connects climate variability in the tropical ocean and subtropical monsoon circulation.

Upon graduation, Liu worked as an associate researcher at LASG, where he continued his research on monsoons and climate change using climate models. During November and December 2000, he visited the National Center for Atmospheric Research in Colorado to take part in the Sino-US joint research project on global warming and to research the historical and future climate change over the Sahara Desert. Analyzing their ensemble runs of the Department of Energy's Parallel Climate Model, he and his coauthors found that with increasing greenhouse gas concentrations, there is a shrinking, warming, and northward retreat of the Sahara during the twenty-first century.

At the IPRC, Liu is working with **Bin Wang** and **Tim Li** to study the ability of ECHAM—the atmospheric climate model from the Max Planck Institute for Meteorology in Hamburg—to simulate regional climate, particularly the Asian monsoon by carrying out a suite of model runs that vary in resolution and physical processes. He has nearly completed a comparison between ECHAM and CCM3.6. Moreover, as a subproject principal investigator of the Coupled Model Intercomparison Project, he is diagnosing the output from 29 models on climate change in the Sahara.

New Scientific Staff



Jim Potemra, after graduating with a Ph.D. in physical oceanography from the University of Hawaii in 1998 and a 7-month postdoctoral fellowship at the IPRC, spent two years as a postdoctoral fellow at the University of Washington's School of Oceanography. There he continued his work on Pacific-to-Indian Ocean water exchange

by analyzing observations of pressure, temperature and salinity collected in the Indonesian region. Potemra rejoined the IPRC this past August as an assistant researcher and plans to continue and expand on this work as part of IPRC's Theme-2 topic: Determining the influences of western-boundary currents and the Indonesian Throughflow on Asia-Pacific climate.

Upon earning a B.S. in physics from Stevens Institute of Technology in 1986, Potemra worked in the Washington D.C. area for the U.S. Navy in support of their submarine ship design and control systems. He then attended Florida State University for two years and in 1990 received his M.S. in oceanography. Returning again to the D.C. area, he worked at the NASA Goddard Space Flight Center, where his research involved numerical ocean modeling of equatorial Pacific processes. This work led to collaborations with various universities and was the impetus for Potemra to return to graduate school. The result was a five-year stay at the University of Hawaii.

At the IPRC, Potemra will be working on the effects of western boundary currents and the Indonesian Throughflow on climate, which will include further regional modeling and data assimilation and further analysis of data recently collected in the region.



Richard "Justin" Small joined the IPRC in August 2001 to work on analysis of satellite data that will help understand ocean-atmosphere interactions in the tropical Pacific. He comes from southern England and studied at the University of Reading, gaining a degree in Mathematics and a M.Sc. degree in meteorology. He then worked for ten years at

the United Kingdom Defence Research Agency, where he investigated underwater phenomena that could affect the propagation of sound from sonar systems. This research concentrated on oceanic internal waves, particularly the high-frequency solitary waves generated by tidal flow. During this time, Small completed his Ph.D. on the refraction and shoaling of internal solitary waves at the Southampton Oceanography Centre. His research has included numerical modeling and analysis of satellite and *in-situ* data. He took part in three sea experiments measuring internal tides and their effects. One of these is the ongoing Hawaiian Ocean Mixing Experiment, which is studying the generation of deep turbulence by internal tides generated at the Hawaiian Ridge.

As a postdoctoral fellow with **Shang-Ping Xie**, co-leader of Theme 1, Small is analyzing satellite data of surface winds and how they relate to SST and sea surface height fields. He is focusing initially on transient events such as Tropical Instability Waves, which are known to influence the atmosphere mainly through their modification of boundary layer stability. He is currently analyzing the relationship between the SST and wind fields and plans to simulate the interaction using the IPRC Regional Climate Model (p. 7). He is also investigating the question whether ocean currents are detectable by measuring the difference between scatterometer derived surface stress and *in-situ* measured wind stress.

Small, furthermore, is continuing his work on internal waves as a side-project and plans to look at mooring data on internal tides in the tropical Pacific to try to determine the source and characteristics of these tides.



Weijun Zhu joined the IPRC as a postdoctoral fellow in July 2001. He obtained his B.Sc. and M.Sc. degrees in synoptic dynamic meteorology from the Department of Meteorology, Nanjing Institute of Meteorology (NIM), China, in 1991 and 1994, respectively. While an assistant professor in the Department of Atmospheric Sciences at NIM,

Zhu continued his studies there, and in 1999, he obtained his Ph.D. in meteorology. For his research on the effect of ENSO events on the Pacific storm track, he received, in January 1999, the prestigious Xue-Do-Feng-Zheng-Jiang award from the Institute of Atmospheric Physics, Chinese Academy of Science.

Shortly before coming to the IPRC, Zhu was associate professor and vice dean of the Department of Atmospheric

Sciences at NIM. He was also an instructor at NIM's Regional Meteorological Training Center of the World Meteorological Organization.

Zhu's research interest covers such topics as observations and modeling of the interaction between ocean and atmosphere, general atmospheric circulation and short-term climate prediction. At the IPRC, he is working with **Kevin Hamilton**, leader of Theme 4. He will conduct and analyze multi-decadal integrations with a coupled ocean-atmosphere model with different levels of solar forcing. These experiments will be analyzed to determine how well the global climate sensitivity to external forcing can be estimated on the basis of geographical and temporal variability in the model control run. Model integrations will also be examined to understand how the upper-tropospheric water vapor is maintained and how the water vapor and its sensitivity to climate perturbations may depend on the cumulus parameterization.

Visit by JAMSTEC Chairman

Dr. **Hiroshi Ohba**, Chairman of the Japan Marine Science and Technology Center JAMSTEC, Mr. **Masato Chijiya**, Executive Director of JAMSTEC, Mr. **Seiichi Nishimura**, Staff Supervisor at JAMSTEC, and Mr. **Hisayuki Tanami**, Associate Director, Kawasaki Heavy Industries, Ltd., met with IPRC Frontier researchers and Dr. Shang-Ping Xie on November 6, 2001, to discuss research at the IPRC. Dr. Ohba was in Honolulu to attend the OCEANS 2001 Conference and to receive the prestigious *Compass International Award* of the Marine Technology Society at the award luncheon held on November 7, 2001, at the Hilton Hawaiian Village.



Visiting Scholars

The IPRC has an active visitor program. Our visiting scholars give seminars and work with IPRC research staff. From April 2000 to October 2000, the IPRC sponsored the scientists named below for visits of one week or longer.

Tomoo Watanabe

Tohoku University, Sendai, Japan

Masaru Inatsu

Hokkaido University, Sapporo, Japan

Hiroshi Hashizume

Hokkaido University, Sapporo, Japan

Kwang-Yul Kim

Florida State University, Tallahassee, Florida

Vikram Mehta

NASA-Goddard Space Flight Center, Greenbelt, Maryland

Amita Mehta

NASA-Joint Center for Earth Systems Technology, University of Maryland, Baltimore, Maryland

Leland Jameson

Lawrence Livermore National Laboratory, Livermore, California

Erich Roeckner

Max Plank Institute for Meteorology, Hamburg, Germany

Mezak A. Ratag

Indonesian National Institute of Aeronautics and Space (LAPAN), Bandung, Indonesia

William Lau

NASA-Goddard Space Flight Center, Greenbelt, Maryland

Jong-Ghap Jhun

Seoul National University, Seoul, Korea

Friedrich Schott

Institute for Marine Research, University of Kiel, Kiel, Germany

Gabriel Vecchi

NOAA-Pacific Marine Environmental Laboratory, Seattle, Washington

Willa Zhu

NOAA-Pacific Marine Environmental Laboratory, Seattle, Washington



Jong-Ghap Jhun and Bin Wang join forces in looking for teleconnection patterns of the East Asian monsoon.

Amita Mehta and Zuojun Yu contemplate "rainy" data.



Gabriel Vecchi: "Just because data points are extreme, doesn't mean they're outliers."



Mezak Ratag and Lorenz Maggaard savor the prospects of cooperation in regional climate modeling between Indonesian institutes and IPRC.