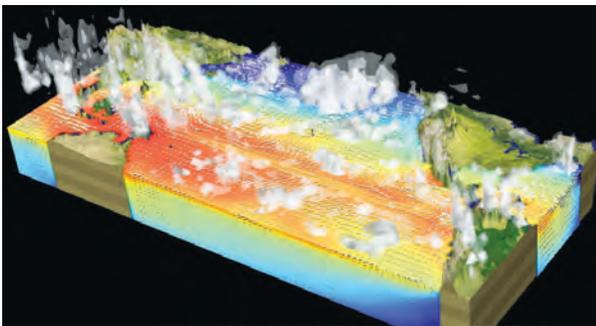


MEETINGS

Modeling the Atmosphere and Ocean

Fine-resolution modeling of the atmosphere and ocean is a major focus for collaboration between IPRC scientists and their JAMSTEC colleagues. With the advent of the Earth Simulator in 2002, JAMSTEC became a world leader in developing and applying very high-resolution models of the atmosphere and ocean. Notable among the global models developed at JAMSTEC are the Ocean General Circulation Model for the Earth Simulator (OFES), the Atmospheric General Circulation Model for the Earth Simulator (AFES), the Coupled General Circulation Model for the Earth Simulator (CFES) and the Multi-Scale Simulator for the Geoenvironment (MSSG) – all projects led by scientists at the Earth Simulator Center (ESC). In addition, University of Tokyo and JAMSTEC scientists have developed the Nonhydrostatic ICosahedral Atmospheric Model (NICAM) for cloud-system-resolving global simulations for application on the Earth Simulator.

For nearly a decade IPRC researchers have joined their Japanese colleagues in analysis of the very high-resolution model simulations conducted at JAMSTEC. The close cooperation in this area was recognized when JAMSTEC invited the IPRC to cosponsor the August 2008 “OFES International



Snapshot from a CFES simulation. Shown are ocean temperatures (colors), ocean currents (vectors) and cloud amounts. Figure courtesy of JAMSTEC ESC Geophysical Fluid Simulation Research Group.

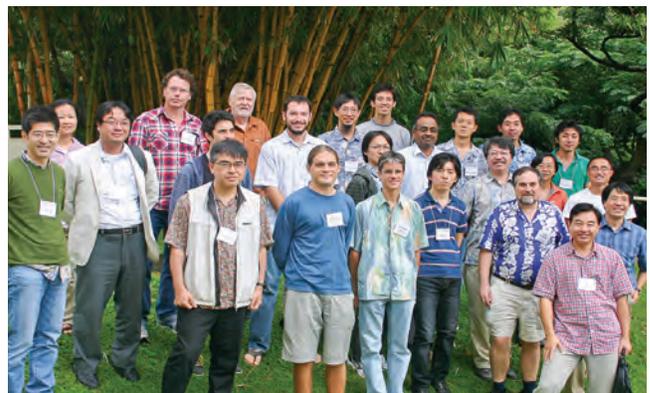
Workshop” in Yokohama (see *IPRC Climate* vol. 8, no. 2). This began a tradition of annual JAMSTEC-IPRC meetings, with the Second OFES International Workshop held in Honolulu in December 2009 (see *IPRC Climate* vol. 9, no. 2) and the Third OFES International Workshop held in Yokohama in November 2010 (see *IPRC Climate* vol. 10, no. 2). Given the breadth of the phenomena being modeled and analyzed by



Erik Lindborg presenting keynote lecture at the OFES workshop.

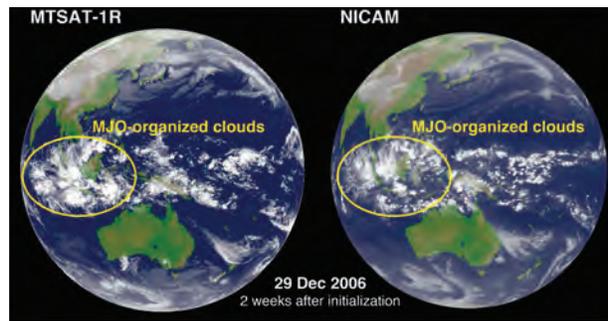
both JAMSTEC and IPRC scientists, the scope of the 2009 Honolulu meeting was expanded to include all areas of computationally intensive climate modeling.

Convened by ESC’s **Wataru Ohfuchi** and IPRC’s **Kevin Hamilton**, the *Fourth OFES International Workshop and Second ESC-IPRC Joint Workshop on Computationally-Intensive Modeling of the Climate System* was held December 1–2, 2011, in the Keoni Auditorium of the East-West Center. The meeting included presentations by 10 Japanese participants from JAMSTEC and the University of Tokyo. The meeting opened with a keynote address by **Erik Lindborg** of the KTH Royal Institute of Technology in Sweden, who discussed the dynamics controlling the mesoscale energy spectrum in the atmosphere. A total of 19 papers were presented that described results from a wide range of simulation and data assimilation models applied to understand phenomena in the ocean and atmosphere. One interesting development apparent in this year’s workshop was that over one-third of the talks referred to global coupled-model results obtained with CFES, an indication of the growing maturity of this important tool developed by ESC scientists. The meeting program and abstracts of the presentations are available at <http://www.jamstec.go.jp/esc/event/ofes-workshop4/>.



Tropical Dynamics and the Madden-Julian Oscillation

The tropical atmosphere is notable for the frequent presence of organized large-scale patterns of intraseasonal variability (ISV) in the circulation. Organized eastward propagating disturbances of 30-60 day period are often referred to as Madden-Julian Oscillation (MJO) events and these are particularly prominent in the Indian Ocean and western Pacific regions. The MJO phenomenon has long been a major field of study for tropical meteorologists. In recent years the possible role of MJO dynamics in extended range weather prediction has attracted increased attention from IPRC researchers (see “NICAM Captures the Leading Weather Disturbance of the Tropics” and “Birth, Growth, & Decay of Tropical Cyclones Simulated by NICAM” in *IPRC Climate* vol. 9, no. 1) as well as from the broader climate research community.



Active phase of MJO as seen in MTSAT IR image (left) and in outgoing IR radiation from a NICAM model simulation (right). Figure adapted from Miura et al., 2007, *Science*, **318**, 1763-1765.

In order to review recent developments in observations and theory of the MJO, IPRC hosted the *Workshop on Tropical Dynamics and the MJO* January 15-17, 2012, at the East-West Center in Honolulu. The workshop was notable as the first major meeting on the subject of tropical ISV to be held since the October 2011 commencement of the joint Japan-US CINDY/DYNAMO field experiment in the tropical Indian Ocean. At the workshop the JAMSTEC leader for CINDY (Cooperative Indian Ocean Experiment on ISV in the Year 2011), **Kunio Yoneyama**, excited the audience with his report of initial results from this major campaign. Other talks covered

a wide range of topics from simulation of MJO-like variability in idealized models to evaluation of extended-range weather hindcasts made with sophisticated numerical prediction systems. The IPRC contribution to the workshop was quite prominent as 9 of the oral presentations and 4 of the posters were by IPRC scientists. The organizing committee was led by Colorado State University professor **Eric Maloney**. The workshop was held at the East-West Center in Honolulu and IPRC Director **Kevin Hamilton** acted as local organizer. The meeting was sponsored by the National Science Foundation. The detailed program is available at tinyurl.com/IPRCmjo.



Participants at the Tropical Dynamics Workshop. Organizers David Randall (left) and Eric Maloney (right) with leis.

CMIP5 Climate Model Analysis

Since its inception in 1995, the Coupled Model Intercomparison Project (CMIP) initiative of the World Climate Research Programme (WCRP) has coordinated international research in numerical modeling of the coupled global climate system. The CMIP Phase 5 (CMIP5) is a current project to distribute and analyze results from a large set of standardized model integrations conducted at many individual centers. The CMIP5 model runs became available starting in Fall 2011 and will provide an important input to the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report to be published in 2013.

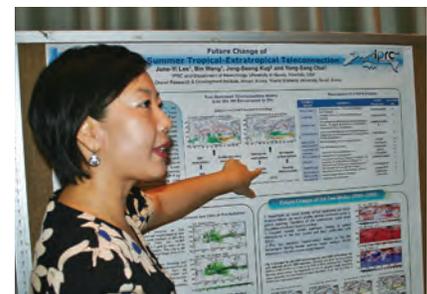
Thus it was very timely that the IPRC hosted the first meeting devoted to analysis of the WCRP-CMIP5 coupled global climate model simulations. The workshop was held March 5–9 at the East-West Center and attracted very wide international interest. The meeting program was devoted almost exclusively to poster presentations and 231 authors submitted poster abstracts, of which 170 were selected for presentation. With the poster present-



ers, sponsor representatives and local University of Hawai'i attendees, the workshop had more than 200 participants, making it the largest meeting ever hosted by the IPRC.

IPRC scientists were well represented in the program with poster presentations by IPRC Senior Researcher **H. Annamalai**, Assistant Researchers **June-Yi Lee**, **Axel Lauer** and **Pedro DiNezio**, and by Postdoctoral Fellows **Pang-Chi Hsu** and **Matthew Widlansky**. In addition, the program was replete with presentations by IPRC alumni and close collaborators, testament to IPRC's considerable influence in the field of climate modeling.

The workshop program committee was chaired by NCAR Senior Scientist **Jerry Meehl** and included **Sandrine Bony** (Laboratoire de Météorologie Dynamique), **Karl Taylor** (Lawrence Livermore National Laboratory) and **Ron Stouffer** (NOAA Geophysical Fluid Dynamics Laboratory). The detailed agenda is available at tinyurl.com/IPRCcmip.



IPRC's June-Yi Lee discussing her poster.



From left: **Jerry Meehl** (program committee chair), **Sandrine Bony** (program committee), **Kevin Hamilton** (local organizer), **Karl Taylor** (program committee), **Thomas Stocker** (IPCC Working Group 1 co-chair).

A brief summary of the results from the meeting has been published by WCRP and is available at www.wcrp-climate.org/documents/ezine/WCRPnews_14032012.pdf.

The workshop was sponsored by WCRP, the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), the US Climate Variability and Predictability (CLIVAR) program, the National Science Foundation, the Department of Energy, NASA and NOAA.

Past Climates Guide

Projections for a Warmer World

Can information about past climates help to constrain climate projections for a warming Earth? To provide answers, an international group of 50 climate modelers, dynamicists, and paleoclimatologists met at the Bishop Museum in Honolulu for a 3-day workshop at the beginning of March 2012.

A pivotal step missing in climate projections has been the quantitative link between information about past climates and simulations of future climate. The workshop highlighted some important findings contribut-

ing to this link. As part of the Paleo-Model Intercomparison Project Phase 3 (PMIP3), a number of climate models were run under Last Glacial Maximum conditions (LGM) 21,000 before present. Researchers found a strong relationship between the responses of these models to the LGM climate and their responses to anthropogenic greenhouse emissions. Thus, by constraining the former with existing paleoclimate reconstructions for surface temperatures obtained from numerous paleoclimate archives (pollen, marine sediment cores, ice-cores), one can derive upper bounds for the future climate sensitivity. Current estimates using this approach suggest that future climate sensitivities higher than 4°C per CO₂ doubling are unlikely to occur.

The workshop continued with discussions on the reliability of paleo-proxy reconstructions, reconstruction methods, the physical mechanisms for abrupt climate change, the behavior of El Niño in the past and the response of major ice-sheets and sea level to past and future climate forcings.

The workshop outcome will be a white paper that describes the importance of paleoclimate simulations as part of a suite of criteria that a climate model must meet before its projections are credible.

IPRC's **Axel Timmermann** co-organized the workshop with **Gavin Schmidt** from NASA Goddard Institute for Space Studies.



Paleoclimate workshop participants in front of the Hawaiian Hall Complex at the Bishop Museum.

The Uncertainty of Climate Projections

The Japan Uncertainty Modelling Project (JUMP) aims to increase the certainty of climate model projections. With funding from Japan's Ministry of the Environment (MOE) and Ministry of Education, Culture, Sports, Science and Technology (MEXT), and also from JAMSTEC, the project started five years ago. **Julia Hargreaves**, the JUMP coordinator, and **James Annan**, both at JAMSTEC, visited the IPRC in March and met with **Axel Timmermann's** paleoclimate research group to discuss collaborations between JUMP and the IPRC on evaluating the CMIP5 multi-model climate scenarios. For this purpose, IPRC Assistant Researcher **Oliver Elison Timm** organized the *Workshop on Integrating Multi-model Ensembles in Global and Regional Climate Change Studies: Estimating and Understanding Past, Present, and Future Climate Change*.

At the workshop, Hargreaves summarized JUMP's research activities and strategy. Most of the uncertainty in climate model projections is due to the lack of knowledge of the sensitivity of climate to man-made greenhouse-gas and aerosol emissions, and the current coupled general circulation models (GCMs) differ widely in their temperature projections under global warming. Since the abundant paleo-

climate records permit model evaluation outside the present-day range of climate variability, Hargreaves and Annan have analyzed how well GCMs capture climate changes in the past. Their comparisons of sea-surface and land-based temperature reconstructions of the Last Glacial Maximum (21,000 years ago) with the mid-Holocene (6,000 years ago) reconstructions in paleoclimate models show that the models capture past climate changes reasonably well. Based on several independent estimates, Hargreaves and Annan have succeeded in fixing the climate sensitivity during past climate changes between 2° to 4°C per CO₂ doubling.

Generalization of this sensitivity to the present situation has been hampered by the fact the coupled GCMs used for current global warming scenarios differ from the paleoclimate models. With the CMIP5 initiative (see page 16), however, Hargreaves and Annan have a new suite of climate simulations ranging from the Last Glacial Maximum to future scenarios based on the same models. The IPRC paleoclimate research group plans to work with Hargreaves and Annan in extending the climate sensitivity analysis, with IPRC research targeting the physical feedback mechanisms that have impacted Earth's climate sensitivity in the distant and recent past.



Discussing how paleoclimate studies can improve current climate models, from left, Oliver Timm, Samantha Stevenson, Matt Widlansky, Axel Timmermann, Yusuke Yokoyama, Malte Heinemann, Julia Hargreaves, and James Annan.