

MEETINGS

High-Resolution and Cloud Modeling: Tropical Cyclones

The *Third International Workshop on High-Resolution and Cloud Modeling: Tropical Cyclones and Climate* was held at the University of Hawai'i at Mānoa from December 2 to 4, 2008. The workshop assessed the current status of high-resolution atmospheric models, with a focus on the simulation of tropical cyclones and the connection of tropical cyclones to climate variability and change. Key issues considered were the scale interactions related to tropical cyclone genesis, intensification, structure and intensity changes; the large-scale control and large-scale impact of tropical cyclones; and the dynamical down-scaling of the impact of global warming on tropical cyclones. Other topics related to high-resolution modeling and satellite observations of cloud/mesoscale systems and cloud-aerosol interactions were also presented. The full agenda for the meeting can be found at iprc.soest.hawaii.edu/~kph/DEC_agenda.pdf.

The meeting attracted 45 researchers from Asia, North America, Europe and Australia, as well as about 20 scientists from the IPRC and the University of Hawai'i Meteorology department.

There was wide IPRC participation. Two IPRC scientists gave invited talks: **Yuqing Wang** presented "Formation and Quasi-periodic Behavior of Outer Spiral Rainbands in a Numerically Simulated Tropical Cyclone," and **Hironori Fudeyasu** presented "Multi-scale Interactions on the Life-cycle of Tropical Cyclones Simulated by Global Cloud-System-Resolving



Participants at the *Third International Workshop on High-Resolution and Cloud Modeling*. In the front row with leis are the Organizing Committee members, from left, Teruyuki Nakajima, Masaki Satoh, David Randall, Yuqing Wang, and Kevin Hamilton.

Model NICAM." Five IPRC posters were presented by Yuqing Wang, postdoctoral fellows **Lei Wang** and **Kazuyoshi Kikuchi**, and by long-term visitors to IPRC **Yongqing Wang** and **Qingqing Li**.

IPRC's JAMSTEC partners in analysis of high-resolution atmospheric model simulations contributed extensively. Notably, **Masaki Satoh** of JAMSTEC and the University of Tokyo opened the conference by presenting an overview of the scientific issues. JAMSTEC's **Tomoe Nasuno** and **Kazuyoshi Oouchi** also presented talks.

The meeting was hosted by the IPRC and co-organized with colleagues at JAMSTEC and other institutions. The organizing committee included

Yuqing Wang and **Kevin Hamilton** from the IPRC and **Masaki Satoh** from JAMSTEC, **Teruyuki Nakajima** from the University of Tokyo, and **David Randall** from Colorado State University. This high-resolution atmospheric modeling workshop was preceded by the successful *First International Workshop on High-Resolution and Cloud Modeling—Fusion of Satellite Observations and High-Resolution Modeling* in 2006 in Kusatsu, Japan, and the *Second International Workshop on High-Resolution and Cloud Modeling—Tropical Convection and the Madden-Julian Oscillation* in 2007 in Reading, UK.



Minisymposium on High-Resolution Atmospheric Modeling

The IPRC held the *Minisymposium on High-Resolution Atmospheric Modeling* on December 5, 2008. The meeting brought visiting colleagues from JAMSTEC together with IPRC and other UH scientists to review recent progress in analysis of high-resolution models and to consider future collaborations. IPRC's **Kevin Hamilton**, meeting organizer and chair, presented a historical overview of the field of high-resolution global atmospheric modeling, and IPRC's **Yuqing Wang** discussed highlights of recent work with high-resolution versions of the IPRC Regional Atmospheric Model. **Masaki Satoh** (University of Tokyo and JAMSTEC) described the current status and overall plans for development and application of the Nonhydrostatic ICosahedral Atmospheric Model (NICAM). Particularly intriguing was his description of the development of a stretched-coordinate version of NICAM, which will allow very high resolution for selected areas on the globe.

The remaining talks dealt with analyses of NICAM simulations: **Wataru Yanase** (University of Tokyo) discussed tropical cyclone formation; **Kazuyoshi Oouchi** (JAMSTEC) spoke on aspects of summer monsoon circulation; **Yohei Yamada** (University of Tokyo) described preliminary results of global warming experiments; **Ping Liu** (IPRC) described the analysis of the Madden-Julian Oscillation simulation; and **Xiouhua Fu** (IPRC) discussed application of high-resolution models to the study of monsoon variability. **Tomoe Nasuno** (JAMSTEC) also participated in the discussion. **Hironori Fudeyasu** (IPRC) ended the minisymposium with a discussion of plans for future analyses of NICAM data at the IPRC.

Participants at the *Minisymposium on High-Resolution Atmospheric Modeling*, from left, **Masaki Satoh**, **Yuqing Wang**, **Hironori Fudeyasu**, **Kevin Hamilton**, **Tomoe Nasuno**, **Kazuyoshi Kikuchi**, **Yohei Yamada**, **Wataru Yanase**, **Kazuyoshi Oouchi**.

First Steps Toward the Next IPCC Assessment Report

In early March, the IPRC hosted the workshop *New Science Directions and Activities Relevant to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. The Media Statement, which was released to over 150 newspapers and news stations worldwide at the end of the meeting by **Thomas Stocker** (IPCC), **Kathy Hibbard** (IGBP), and **Venkatachalam Ramaswamy** (WCRP), follows.

“From March 3 to 6, over 150 leading climate scientists from around the world gathered at the International Pacific Research Center of the University of Hawai‘i to discuss the latest developments in Climate Change science. The hosting institute is internationally known for its research in climate variability and climate change and serves as a meeting place for scientists from all over the world. The workshop was jointly sponsored by the Intergovernmental Panel on Climate Change (IPCC), the World Climate Research Programme (WCRP) and the International Geosphere-Biosphere Programme (IGBP).

“The goal of this workshop was to identify the latest developments in Climate Change science and discuss their implications for our understanding of the Earth System and its response to ongoing accelerated emissions of greenhouse gases and pollution particulates (aerosols), and deforestation.



The findings of the scientists will be made available for the planning of the *Fifth Assessment Report of the IPCC* which is due in 2013.

“Increasing computational power, and advances in process understanding and observations, now permit global climate models to address regional climate change and extreme events in much greater detail. In an unprecedented effort involving all climate modelling centers around the world, including the participation of developing countries, the World Climate Research Programme (WCRP) is coordinating climate model experiments and their analyses which will be assessed for the next IPCC report. This will result in a better estimate of the uncertainty involved in climate change projections and accelerate the development of climate models.

“In the framework of the International Geosphere-Biosphere Programme (IGBP), these computer models are now evolving into “Earth System” models which are more inclusive of the roles of biology and chemistry, and the role of human activities, in the

climate system. These models will be the tools to understand how current and future changes in energy use and environmental management will affect our climate and ecosystems worldwide.

“Among the findings that were discussed by the scientists are interactions between the cycling of carbon and nitrogen in the climate system and new feedback processes involving the atmosphere, oceans, land and ice, details of which are yet to be fully understood and quantified. The fate of the large ice sheets of Greenland and Antarctica in a warmer world and the role of warming oceans in promoting ice-shelf melt, is a continuing concern that has direct implications for uncertainties in the projection of global sea level rise.

“The scientists, gathered from all over the world, who participated in the workshop have extensive experience in performing scientific assessments for policy makers worldwide. In seeking to advance knowledge about the vulnerability of this planet to human-induced climate change, scientific rigor must remain a hallmark of the information

Participants at the workshop *New Science Directions and Activities Relevant to the Fifth Assessment Report*.

that will be used for responsible decisions and wise stewardship.”

Climate Processes over the Asia-Pacific Region

The mini-symposium *Climate Processes over the Asia-Pacific Region* was held in conjunction with the visit of **Sir Brian Hoskins** on March 12 (see page 23). Organized and chaired by IPRC’s **H. Annamalai**, the symposium featured talks by several IPRC scientists. The presentations included results related to Indian Ocean climate, monsoon dynamics, equatorial oceanography, tropical-extratropical interactions, paleo-monsoon simulations and simulations of clouds and tropical cyclones in high-resolution models. For the complete agenda, visit iprc.soest.hawaii.edu/meetings/workshops.html.



Capturing the Impacts of Ocean Mixing on the Circulation

Ocean Mixing Mini-Workshop participants.

By Ryo Furue

Although ocean mixing significantly impacts the large-scale ocean circulation and surface fluxes, it is among the least well understood phenomenon in climate modeling. The processes directly responsible for mixing occur at such small spatial and temporal scales that they must be parameterized by representing small-scale effects on large scales in terms of large-scale variables.

When a team of ocean experts and data assimilation, led by **Detlef Stammer**, from Scripps Oceanographic Institution and the University of Hamburg visited the UH in March, IPRC's **Niklas Schneider** took the opportunity to organize the *Ocean Mixing Mini-Workshop*. The workshop brought together scientists who use a variety of approaches to work on the mixing issue: data assimilation, observations, theories, and large-scale ocean modeling. For the complete agenda visit iprc.soest.hawaii.edu/meetings/workshops.html.

Data assimilation has been suggested as a tool for gaining insights into the interaction between mixing and the large-scale circulation and for estimating mixing parameters.

The adjoint method of data assimilation minimizes differences between observations and model output (“cost function”) by adjusting model parameters (such as mixing parameters) and forcing fields (such as wind stress). The Scripps-University of Hamburg team demonstrated that by adjusting mixing parameters, adjoint data assimilation can indeed reduce the cost function, thereby giving better estimates of mixing parameters. But a similar improvement (i.e., reduction in cost function) can possibly be obtained by adjusting forcing fields. In-depth analyses of the estimated states and parameters will resolve this ambiguity.

Observational studies presented suggest that ENSO modulates the vertical heat transfer at the bottom of the equatorial Pacific mixed layer by a factor of about 10 and that variations in the Kuroshio Extension strength and position modulate the erosion of the Subtropical Mode Water.

Another approach presented to the mixing parameterization issue is the global mapping of vertical diffusivity constructed by combining observa-

tions and theories. Such mapping is beginning to show a consistent picture.

A reported modeling study suggests that vertical diffusivity changes the temperature of equatorial subthermocline currents, altering the heat balance of the remote mixed layer where currents upwell. Finally, velocity profiles taken at high-vertical resolution at the western equatorial Pacific reveal a new type of fine-scale disturbances. Theories and numerical simulations suggest that the disturbances are due to the instability of small-scale equatorial waves and that they significantly contribute to horizontal and vertical mixing. A new, simple parameterization to represent the phenomenon has improved representation of the Equatorial Undercurrent in a general circulation model.

The participants were hopeful that combining data assimilation and expanded observations of mixing with an understanding of physical processes and large-scale ocean dynamics will lead to improved modeling of the ocean circulation.

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