

MEETING SUMMARIES

ASIA–PACIFIC NATURAL HAZARD CONFERENCE

Disastrous Weather in a Changing Climate

BY YI-LENG CHEN, PAY-LIAM LIN, FENG HSIAO, PAO-SHIN CHU, AND MEI-HUEI SU

The main objective of the conference was to promote closer ties and foster future collaborations between Taiwan and Hawaii concerning disastrous weather in a changing climate. This was an end-to-end (from basic research to dissemination to the users' community) conference including: 1) basic research, 2) test bed development, 3) operational forecasting, and 4) warning, mitigation, management, adaptation, and reduction of natural disasters in the Asia–Pacific region (www.soest.hawaii.edu/MET/NatDisConf12/).

After the opening ceremony in the morning of 27 June, there were two keynote addresses. Richard E. Carbone, National Center for Atmospheric Research (NCAR), delivered the first keynote address on water worries in an evolving climate system. He discussed the potential impact and uncertainties of climate change on the precipitation process. Yuichiro Tanioka, Institute of Seismology and Volcanology, Hokkaido University, delivered the second keynote

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WHAT: To promote closer ties and foster future collaborations between Taiwan and Hawaii, more than 70 scientists, graduate students, operational forecasters, and disaster managers met to exchange research results, ideas, and visions concerning disastrous weather as well as the warning, reduction, and mitigation of natural disasters in the changing climate in the Asia–Pacific region.

WHEN: 27–29 June 2012

WHERE: Honolulu, Hawaii

address on the 2011 Great Tohoku-Oki earthquake and tsunami. Following the keynote addresses there were three presentations on the morning of 27 June. The first paper by Liang-Chun Chen et al. was presented by Yi-Chao Wu of the National Science and Technology Center for Disaster Reduction (NCDR), Taipei, Taiwan, on the projected changes in the natural and social environment, weather and climate extremes, and risk assessment and adaption in a warming climate. Chris Ostrander presented an overview of Pacific Islands Ocean Observing System (PacIOOS), which is a partnership of federal, state, and local governments; nonprofit organizations; academia; and industry based at the School of Ocean and Earth Science and Technology, University of Hawai'i at Mānoa (UHM). It provides all the current ocean information in the region based on users' needs. The third presentation by Kwok-Fai Cheung (UHM) was on the simulation of storm surges and inundation associated with landfalling tropical cyclones over

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the south shore of Oahu for coastal hazard warning, mitigation, and planning by emergency managers and local government agencies.

There were two sessions that afternoon: 1) monsoon over the western North Pacific (WNP) and 2) flooding, global monsoon, and downscaling. Chung-Hsiung Sui of the Department of Atmospheric Sciences, National Taiwan University (NTU-ATM) presented the contrast in water cycles during the summer months over the WNP between an El Niño and a La Niña year. Bin Wang and B. Xiang from the Department of Meteorology, University of Hawai'i at Mānoa (UHM-MET) presented profound ramifications for understanding atmospheric dynamics in the subtropics and predictability of the East Asian summer monsoon rainfall and tropical storm activity over the WNP. Pao-Shin Chu et al. (UHM-MET) analyzed the long-term (50 years) trend of the steering flow over the WNP and South China Sea during the peak typhoon season, suggesting a longer life span for typhoons and a tendency for more typhoons to recurve over the WNP in a warming climate. Ming-Chang Hsu et al. from the National Central University (NCU) discussed a newly developed method for the early detection of typhoons over the WNP using the vorticity field from the European Centre for Medium-Range Weather Forecasts and microwave satellite data. Pei-Hsuan Chung, Taipei Municipal University of Education, and Tim Li (UHM-MET) showed that during the last 30 years there has been a flow regime change over the WNP in 1998/99 that resulted in more frequent central Pacific El Niños the following years. These changes also impact the genesis of typhoons over the WNP.

The focus of the second session was on the impact of climate on precipitation, water resources, and winds over land and coastal waters including flooding and water resources (Yih-Chi Tan et al. of the Center for Weather Climate and Disaster Research, NTU; Clark Liu, Civil Engineering, UHM) and local wind systems (D. Hitzl and Yi-Leng Chen, UHM-MET) and the impact of global warming on precipitation (C. Norton and Pao-Shin Chu; Pan-Chi Hsu et al., UHM-MET). The only exception was the last paper which was on the dynamics of El Niño presented by Fei-Fei Jin (UHM-MET).

The second day of the conference focused on two of the most profound disastrous weather phenomena over Taiwan: typhoons and mei-yu, which is the regional frontal system in late spring that brings in frequent heavy rainfall. These two phenomena also act as major water resources for the island. These papers were presented by researchers with the aim

of transferring the research findings and technologies to operational forecasts. The day started with a keynote speech by George Tai-Jen Chen (NTU-ATM), who gave an overview of the Taiwan Area Mesoscale Experiment (TAMEX, 1987) research and recent work on mei-yu as well as the overall efforts of the National Science Council (NSC) and government agencies in Taiwan to enhance basic research, technologies transfer, operational forecasts, and disaster reduction, mitigation, and training. His presentation was followed by two invited presentations. One was a case study of a mei-yu heavy rainfall event during the Terrain-influenced Monsoon Rainfall Experiment, 2008 (TiMREX) by Shui-Shang Chi et al. of the Central Weather Bureau (CWB). The second was on the modeling of the precipitation process in high-resolution models by Wei-Kuo Tao of the National Aeronautics and Space Administration (NASA).

Presentations the next morning continued to focus on the study of heavy rainfall processes during the mei-yu season over Taiwan. Wei-Jiun Chen et al. from the Department of Atmospheric Sciences, National Central University (NCU-ATM) used the refractivity data from the NCAR S-band polarimetric Doppler radar (S-POL) deployed during TiMREX to retrieve moisture field data to study the interaction between moisture and precipitation. Ben Jong-Dao Jou et al. [NTU-ATM and Asia-Pacific Economic Cooperation Research Center for Typhoon and Society (ACTS)] (presented by Hsiao-Wei Lai) used the vertical profiles of reflectivity and surface Z-R relationship derived from ground-based disdrometers to estimate rainfall in the mountainous areas. Yu-Chen Chiang et al. (NCU-ATM) used five disdrometers deployed during the 2009 mei-yu season to study characteristics of raindrop size distributions over Taiwan. Yi-Leng Chen et al. (UHM-MET) compared two heavy rainfall events during TiMREX, focusing on the impact of local circulations and orographic effects on the timing and location of heavy rainfall occurrences. Szu-Han Chiu and Pay-Liam Lin (NCU-ATM) used the Weather Research and Forecasting Model (WRF) to study the orographic effects on heavy precipitation during the intensive observing period 3 of TiMREX. A discussion about the modeling aspects of the mei-yu heavy rainfall process began with the last paper in the morning session (Chiu and Lin) and continued into the next session in the afternoon (session 4). Chih-Ying Chen et al. (presented by Ching-Sen Chen of NCU-ATM) simulated an unusual heavy rainfall event in northern Taiwan during 2–3 June 1984. Yu-Ching Hsu et al. (NCU-ATM) studied the impact of land use change on local circulations

during the mei-yu season over Taiwan. Two papers in these sessions represent collaborative efforts between Taiwan and Hawaii (Chih-Ying Chen et al.; Yi-Leng Chen et al.).

The papers on typhoon studies began in the afternoon of the second day. The two papers on typhoons (Ben Jou et al., ACTS and NTU-ATM) presented by Yu-Cheng Kao and Po-Hsiung Lin et al. (NTU-ATM) discussed the observational aspects (precipitation and winds) of typhoons using Doppler radars and instrumented wind towers, respectively. Except for the last paper by Chih-Wen Hung, National Taiwan Normal University (NTNU), the presentations in the last session that day were on the analyses and modeling of Morakot (2009). After the Morakot disaster, considerable research and effort have been made to improve the basic understanding of typhoons and transfer research findings to forecasts of typhoons in operational settings. Yi-Chun Tsai et al. (NCU-ATM) used a new advanced radar analysis technique, which was developed at NCU and involves multiple Doppler radars, as a valuable tool for the analysis and monitoring of heavy precipitation over Taiwan. There were three papers on the high-resolution modeling of typhoon Morakot (2009). Chung-Chieh Wang et al. (NTNU) discussed the application of a cloud-resolving model in quantitative precipitation forecasts. Fang-Ching Chien (NTNU) and Hung-Chi Kuo (NTU-ATM) studied the impacts of slow translation speed and the southwesterly monsoon flow on extreme rainfall. Chih-Ying Chen et al. (NCU-ATM) (presented by Pay-Liam Lin) focused on orographic effects and moisture transport on localized heavy precipitation. Chih-Wen Hung provided the first direct evidence of the impact of the solar cycle on typhoon activities in Taiwan.

The third day of the conference focused on the test bed, operational forecasts, and warning and decision support to end users in the community with emphasis on threat and risk management related to typhoons. Director Robert Falvey of the Joint Typhoon Warning Center (JTWC) gave the keynote speech on the overview of JTWC operations. The responsibility area of the JTWC on typhoon warnings and forecasts also covers the Taiwan area and adjacent coastal waters. Two papers followed the keynote speech. One was presented by Michael Bell (UHM-MET) on recent international field experiments on tropical cyclogenesis, including The Observing System Research and Predictability Experiment (THORPEX) Pacific Asian Regional Campaign (TPARC) and the Tropical Cyclone Structure—2008 (TCS-08) field experiments that took place over the WNP during the Asian

Monsoon Year (AMY) in 2008. Hong-Chi Kuo et al. (presented by Lei Feng) discussed the mission and overall operations of the Taiwan Typhoon and Flood Research Institute (TTFRI), which seeks to link basic research with operational forecasts and bridge the gap between academia and various government agencies. Four papers in the following session were related to test bed research and development for typhoon forecasts. Chia-Lun Tsai and Cheng-Ku Yu of the Chinese Culture University studied the change in the structure of typhoon rainbands as storms made landfall over Taiwan, based on the analyses of dual-Doppler radar data. Pei-Yu Hung et al. (NCU-ATM) discussed the application of polarimetric/Doppler radars in monitoring the effects of Taiwan's topography on storm circulations and precipitation processes. Hiep Nguyen and Yi-Leng Chen (UHM-MET) focused on the application of a new numerical technique that could be used to improve model initialization conditions associated with typhoons in high-resolution numerical models and improve the track and intensity forecasts in operational settings. The last paper was on the development and testing of very short-range quantitative precipitation forecasts at the county level for typhoon cases by Lei Feng et al. (TTFRI).

The first afternoon session on the third day featured two invited papers on typhoon forecasts by operational centers in Hawaii (JTWC) and Taiwan (CWB), respectively. Mathew Kucas presented the development of guided methods for the prediction of tropical cyclogenesis and rapid intensification at JTWC. The second paper by Ming-Dean Cheng et al. (presented by Show-Wen Lin) was on the overview of the typhoon threat and forecast operations at CWB. A subsequent session featured three papers on the development of typhoon decision support tools for emergency managers and government agencies by disaster reduction centers in Taiwan (NCDR) (Liang-Chun Chen et al.) and Hawaii (Pacific Disaster Center) (Chris Chiesa) and JTWC (Allan Howard). The last session of the meeting covered dissemination and public outreach on the forecast products issued by JTWC (James Darlow) and the National Weather Service (NWS) forecast office in Honolulu (Victor DeJesus). As evidenced by the topics covered during the event, the conference is truly an end-to-end conference that goes from basic research to dissemination to the users' community.

CONCLUSIONS. This conference was a success in that it brought together researchers, operational forecasters, and disaster managers from all sectors in both Taiwan and Hawaii concerning the current status and

challenges related to disastrous weather in a changing climate in the Asia–Pacific region. Prior to the conference there were already strong links, interactions, and collaborations between Taiwan and Hawaii related to Asian–Pacific meteorology. Areas of focus include monsoons, typhoons, and the impact of terrain on rainfall distribution, disaster reduction, and society. This type of conference helps strengthen already existing ties. In addition, the conference also helped to bridge some gaps, including an office visit to the newly established Federal Emergency Management Agency (FEMA) National Disaster Preparedness Training Center at UHM after the conference by the delegates of NCDR, an unofficial meeting between the delegates of ACTS and scientists of the East-West

Center in Hawaii, and correspondence related to the exchange of ideas, vision, and possible future visits between the Marine Science Division of CWB and PacIOOS.

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