

WORKSHOP REPORT

SECOND WMO/WWRP MONSOON HEAVY RAINFALL WORKSHOP 10 – 12 December 2012, Petaling Jaya, Malaysia

The Malaysian Meteorological Department (MMD) hosted the **Second WMO/WWRP Monsoon Heavy Rainfall Workshop** at MMD Headquarters in Petaling Jaya, Malaysia from 10 to 12 December 2012. The workshop was organised by the Monsoon Panel of the WMO/CAS Working Group on Tropical Meteorology Research.

The aim of the Workshop is to present and discuss recent research results on the observation, modelling and prediction of heavy rainfall in the monsoon region and to provide training to National Meteorological and Hydrological Services (NMHS) forecasters in the monsoon region. The presentations session has included invited lectures and selected contributed papers.

The three-day workshop was attended by 45 researchers and forecasters from the countries namely Indonesia, Australia, P.R China, Hong Kong, India, Malaysia, Philippines, Thailand, Japan, Taiwan, Republic of Korea and U.S.A. A secretariat from the WMO was also present during the workshop.

A discussion on the proposed international field and modelling project, Southern China Monsoon Rainfall Experiment (SCMREX), was also held during the last session of the workshop.

1. Opening Ceremony

The workshop was officiated by Y.Bhg Dato' Dr. Sharifah Zarah Syed Ahmad, Deputy Secretary General (Policy), representing Y.Bhg Dato' Dr. Madinah Mohamad, Secretary General, Ministry of Science, Technology and Innovation, Malaysia (MOSTI).

Mr. Alui Bahari, Deputy Director General (Forecast) of MMD, representing Madam Che Gayah Ismail, Director General of MMD delivered the welcoming remarks to all participants of the workshop.

Madam Nanette Lomarda (WMO Representative), Professor Chih-Pei Chang (WWRP/WGTMR Monsoon Panel Chair) and Professor Zhiyong Meng (Workshop Chair) had expressed their sincere appreciation to the Government of Malaysia and MMD for hosting the workshop. They had also highlighted the importance of the workshop for a comprehensive review of the current status of knowledge, modeling capability, and future directions in research of monsoon systems around the world and hope that the workshop can serve as a basis to advance the application of monsoon research through exchange of new ideas and results among research scientists, forecasters, and end-users of monsoon predictions.

2. Workshop Sessions

Session 1 Observation of Monsoon Rainfall (Chair: Zhiyong Meng)

I) Characteristics of MJOs observed during DYNAMO

Keynote Speaker: **Richard Johnson**, Colorado State University, USA

The presentation was related to a major field campaign that was conducted during the period October 2011 – March 2012 to investigate one key aspect of this phenomenon – the MJO initiation over the Indian Ocean. A primary component of the observing system was an atmospheric sounding network comprised of two sounding quadrilaterals, one north and one south of the equator over the central Indian Ocean. Further work is underway to relate the evolution of the MJOs as determined by the sounding arrays to the properties of convection as observed by ship and island research radars.

Q & A session:

a. Prof. Ben Jong-Dao Jou :

Q: How is marine and mix /boundary layer development in your situation?

A: Rapid change in 700-800hPa. Upper ocean tends to warm up maybe by 1 degree.

b. Dr. John McBride

Q: How much gradient in southern array?

A: Very strong gradient in southern array with less distinct modulation of the moisture field by the MJOs and more persistent convection due to the presence of the southern ITCZ.

II) A possibility to monitor and predict localized heavy rainfalls by using new radar network in monsoon Asia

Keynote Speaker: **Hiroshi Uyeda**, Nagoya University, Japan

The presentation was related to the performance of the polarimetric radar system for operational use and Nagoya University polarimetric radar for research and also to identification of precipitation particle type by using the X-band polarimetric radar. Identification of graupel region in thunder cloud will be effective for short term forecasting of heavy rainfall. The speaker also shared about their mutual perspectives on radar network to monitor heavy rainfall and the high impact weather in monsoon Asia.

Q & A session:

a. Dr. Esperanza Cayan:

Q: What is the time lapse between observed rainfall and radar estimated?

A: 10 minutes for the radar data & hourly for observed rainfall data.

III) Climatological bypass flows around the Tibetan Plateau and their relation to the rainfall in Eastern China

Invited Speaker: **Renhe Zhang**, Chinese Academy of Meteorological

Sciences, China

The presentation was based on the reanalysis data from National Center for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR), therefore the seasonal variation of the bypassing flows caused by the splitting effect of the Tibetan Plateau (TP) is investigated. The relation of the splitting bypassing flows around the TP to the westerly jet stream, the thermal status over the TP, and the precipitation in China is also revealed.

Q & A session:

a. Prof. Richard Johnson:

Q: How the interannual variability for this experiment?

A: The presentation only shows climatology variation and the research is still on going.

IV) **Cloud properties in a monsoon environment: Darwin Australia**

Invited Speaker: **Peter May**, Centre for Australian Weather and Climate Research, Australia

The presentation provide a brief overview of the facilities, noting the data are freely available, a brief summary of some of the recent research areas and more detailed discussion of heavy rain events including a significant MCS that developed into an intense low and the variability of the cloud macro and microphysical properties as a function of the large scale regime. This latter work is linked with the development of new approaches to convection and cloud parameterization.

Session 2 Features of Monsoon Convection (Chair: Richard Johnson)

I) **Convection initiation and microphysical characteristics of Meiyu precipitation systems over South Taiwan**

Invited Speaker: **Ben Jong-Dao Jou**, Pacific Science Association

The presentation was based on radar and disdrometer data that are used to investigate the initiation processes of convective precipitation systems in southern Taiwan during the SoWMEX/TiMREX (May-June 2008). SPOL radar data are also examined and the mesoscale boundaries (MBs) are identified and the characteristics of these MBs are analyzed with the help of visible satellite images and also automatic surface data.

Q & A session:

a. Dr. Peter May:

Q: How small the stratiform?

A: For land type, 2/3 is convective and 1/3 is stratiform. Stratiform is observed much smaller in mid latitude.

b. Dr. John McBride:

Q: Do you have any soundings in mountain like what happened in mixed layer as well as convective CCL inversion as going up the mountain?

A: We have one sounding not on the top of the mountain but in the valley. The study on this project is still ongoing.

II) **Structure and evolution of line-shaped convective systems associated with Changma front during GRL PHONE-09: 6 July 2009 case**

Invited Speaker: **Dong-In Lee**, Pukyong National University, Republic of Korea

The presentation was related to the structure and evolution of line-shaped convective systems (LCSs) associated with Changma front observed in southwestern Korean Peninsula by using intensive observational data from upper-air sounding (Chujado), Doppler radars and MTSAT IR during the field campaign of Global Research Laboratory (Pukyong National Univ.-HyARC, Nagoya Univ. Observation Network in the East China Sea, GRL PHONE).

Q & A session:

a. Prof. Zhiyong Meng:

Q: What is the effect of Changma Front.

A: Better understanding regarding Changma Front is still on going using more observation data.

b. Prof. Richard Johnson

Q: Is there stratiform precipitation in advance. All the flow from behind the system not like the traditional trailing stratiform/pattern?

A: Complicated structure. More models need to be apply to get better result.

III) **The predictability of a squall line in South China on 23 April 2007**

Invited Speaker: **Zhiyong Meng**, Peking University, China

The presentation was based on the predictability of a squall line associated with a quasi-stationary front on 23 April 2007 in South China through deterministic and probabilistic forecasts. Result shows that the performance of squall line simulation is very sensitive to model error associated with resolution and uncertainties in the physical parameterization schemes.

Q & A session:

a. Dr. John McBride:

Q: Do you have any comments on squall line predictability?

A: For this simulation, the ensemble forecast gave simulation of squall line shorter/earlier than actual formation.

b. Prof. Johnny Chan:

Q1: Timing and migration of squall line

A1: parameterization problem arise because it is the mixture of different kind of element.

Q2: Have you tested the amount of data that you put in initial condition?
A2: The whole simulation only from NCEP analysis data and a lot of improvements still need to be done.

IV) **Continental Tropical Convergence Zone (CTCZ) Field Experiment**

Speaker: **Ajit Tyagi**, Ministry of Earth Sciences, India

The presentation was related to the large-scale rainfall over the Indian region during the summer monsoon is associated with a continental tropical convergence zone (CTCZ), which appears as a prominent zonal cloud band in satellite imagery. The CTCZ programme offers a unique opportunity to address several challenging scientific issues related to the interactions of the monsoon with the ABL, ocean-atmosphere coupling and land-surface/cloud/aerosol processes.

Q & A session:

a. Prof. Chih-Pei Chang:

A: WMO/WWRP will consider India as the host of the third workshop

b. Prof. Richard Johnson:

Q: What you really need to look or expect when this large scale phenomena extending well beyond India?

A: During the weak phase, no cloud seen. Next the cloud development and precipitations could last for 10-15 days. The shortest phase is one week.

Session 3 Features of Monsoon Rainfall (Chair: Peter May)

I) **Numerical study of a westward-propagating rainfall episode near Taiwan during IOP-8 of SoWMEX 2008**

Speaker: **Chung-Chieh Wang**, Pacific Science Association

The presentation was based on the control experiment to reproduces the event realistically, with the organization and propagation of convection near Taiwan in close agreement with the observations. Both the gridded analyses and model results are used to study the mechanism of westward propagation, the role of LLJ in its organization and propagation, as well as the details of convection embedded within this westward-propagating rainfall episode during 16-18 June 2008.

II) **Case study of heavy rainfall events over Peninsular Malaysia during northeast monsoon season**

Speaker: **Mohan Kumar Sammathuria**, Malaysian Meteorological Department, Malaysia

The presentation was related to an extreme precipitation event that occurred during the period of Northeast Monsoon 2010. The Advanced Research

Weather Research and Forecasting (WRF - ARW) model was used to simulate the event. The simulated precipitation was compared with the precipitation values obtained from both the surface meteorological observation stations and the Tropical Rainfall Measuring Mission (TRMM) data. Verification of large-scale circulation pattern, moisture content and humidity fields were verified using NCEP Reanalyses Data.

III) **Anomaly heavy rainfall over the east coast of southern Thailand in 2011 transitional monsoon season**

Speaker: **Sukrit Kiritsaeng**, Thai Meteorological Department, Thailand

The presentation was based on the anomaly heavy rainfall resulted in inundation over the south in seasonal monsoon. The reinforcement of several factors, especially of typical cold surge during November to December, encouraged continuous rain. Further study still need to be done to analyze causes of the transient cold surge.

Q & A session:

a. Dr. Peter May:

Q: What is forecast model guidance used?

A: We use WRF model, Kain-Fritsch. In our next step is to do parameterization to know the performance of the model.

b. Prof. Ben Jong-Dao Jou:

Q: What is the effect of tropical cyclone on this area (flood in southern Thailand)?

A: It is due to cold surge.

IV) **Evaluation of a mesoscale Short Range Ensemble Forecast System for Peninsular Malaysia during northeast monsoon season**

Speaker: **Kumarethiran Subramaniam**, Malaysian Meteorological Department, Malaysia)

The presentation was related to a short-range ensemble prediction system (SREPS) consisting of ten members from the Weather Research and Forecasting Model (WRF) developed by the National Center for Atmospheric Research (NCAR) was constructed to run over the Malaysian region with 12-km horizontal resolution. The period of study was the 2010/2011 Northeast Monsoon season. The results show that ALL ensemble members was more skillful compared to POS, NEG and PY ensemble members respectively, indicating that the bred members introduced errors into the SREPS. The SREPS has indicated that it was capable of distinguishing low probability events from high probability events during the 2010/2011 Northeast Monsoon season.

Tuesday, 11 December 2012

Session 4 Tropical Cyclones (Chair: Hiroshi Uyeda)

- I) **Convective asymmetries associated with tropical cyclones near landfall**
Invited Speaker: **Johnny Chan**, City University of Hong Kong, Hong Kong China

The presentation was based on some recent observational and numerical studies on convective asymmetries associated with tropical cyclones as they are about to make landfall. It is shown that such asymmetries are prevalent but have large variations depending on the moisture availability, roughness of the land surface, topography and vertical wind shear. Observational studies from various locations will be presented to illustrate the diversity. Results from numerical experiments will also be used to describe the possible physical processes that would likely lead to the different observed asymmetries.

Q & A session:

- a. Prof. Hiroshi Ueda:

Q: Is the wind shear caused by tropical cyclone?

A: Referring to the presentation, additional shear generated by friction between land and ocean.

- b. Prof. Renhe Zhang:

Q: Do vertical wind shear cause rainfall

A: There is interaction between vertical wind shear and convection. In equilibrium stage, these two effects will balance.

- c. Prof. Zhiyong Meng:

Q: Is environment of tropical cyclone gives much impact on wind shear?

A: No. If don't have any environment then there will be vertical wind shear and it will link to convective system.

- II) **Predictability of Typhoon rainfall based on ensemble simulations**

Invited Speaker: **Chun-Chieh Wu**, Pacific Science Association

In the presentation, the influence of the translation speed is emphasized. Based on the EnKF data assimilation, an innovative method is applied to perform ensemble simulations with several designated translation speeds of Morakot using the WRF model. Thus the influence of the translation speed on the amount of accumulated rainfall over Taiwan can be quantitatively evaluated. The results from ensemble members reveal the usefulness of the ensemble simulations for examining the predictability of rainfall associated with tropical cyclones.

Q & A session:

- a. Dr. Peter May:

Q: What is imbalanced of translation speed on the data?

A: Simulation allows the model to look for new position at each time step. No perfect way to change flow/trend unless one can control the motion and give reasonable adjustment in model to see impact of hurricane to rainfall.

III) **On the geographic asymmetry of typhoon translation speed across the mountainous island of Taiwan**

Invited Speaker: **Hung-Chi Kuo**, Pacific Science Association

The presentation was based on the study which examines the effect of topographically phase-locked convection on the motion of typhoons across the island of Taiwan. Data for 84 typhoons that reached Taiwan's east coast from 1960 to 2010 are analyzed, with motions compared to the long-term average overland translation speed. Weather Research and Forecasting Model experiments are used to study the effect of convection on storm motion over a mountainous island resembling Taiwan which resulting that the topographically phase-locked convection acts to slow down (speed up) the northern (southern) landfalling typhoons.

Q & A session:

a. Renhe Zhang:

Q: Faster or slow the typhoon is to the region of typhoon or only the region close to Taiwan Island

A: Duration of the translation speed purely dependent on landfall from the point and departure point.

IV) **The effect of tropical cyclones on southwest monsoon rainfall in the Philippines**

Speaker: **Esperanza Cayan**, Philippine Atmospheric, Geophysical & Astronomical Services Administration, Philippines

In the presentation, the intense southwest monsoon (SWM) rainfall events causing massive landslides and flash floods along the western sections of the Philippines were studied. These rainfall events, are not directly coming from the tropical cyclones (TCs) for they are situated far north to northeast of Luzon Island. The heavy rainfall is hypothesized as caused by the interaction of strong westerly with the mountain ranges along the west coast of Luzon which produces strong vertical motion and consequently generates heavy rainfall. Four of heavy SWM rainfall cases was examined to determine how the presence and position of tropical cyclones in the Philippine vicinity affect these SWM rainfall events; three cases with TC of varying positions within the Philippine area of responsibility (PAR) and the fourth case without TC.

V) **Analysis of the 2012 typhoon TALIM**

Speaker: **Ching-Hwang Liu**, Pacific Science Association

In the presentation, the analysis has shown that several mesoscale circulation have formed within the frontal zone at the same time. One circulation near the Hainan island intensified and developed became typhoon TALIM. Subsequently, TALIM moved northeastward passing Taiwan and produced severe rainfall in the southern Taiwan area. In addition, it also brought the forecasters into jeopardy in forecasting the rainfall. Finally, typhoon TALIM transformed into an extratropical cyclone and continuously survived for more than a week. Its formation process is different from most of those tropical cyclones. In this presentation, the life cycle of typhoon TALIM developed from a circulation embedded within the frontal zone to a typhoon, and then transformed back to extratropical cyclone.

Session 5 Monsoon Rainfall and Flood (Chair: Johnny Chan)

I) The meteorology of the Australian monsoon floods of 2010-2011

Invited Speaker: **John McBride**, Centre for Australian Weather and Climate Research, Australia

In the presentation, major rainfall events in the monsoon tropics are rarely documented in the literature. It is important that such a knowledge base is built up as a step towards advancing our knowledge and understanding of the global and regional monsoon systems. The presentation will synthesize the major components of this two-month long flooding events into a schematic picture of different types of flooding event and into different types of metrological system.

Q & A session:

a. Prof. Johnny Chan:

Q: Can you draw similarity between what happened in Queensland flood versus Northern Hemisphere?

A: Yes, I think there would be similarity.

II) Indirect effects of tropical cyclones on heavy rainfall events in Kyushu, Japan during the Baiu Season

Invited Speaker: **Hisanori Itoh**, Kyushu University, Japan

This presentation shows the indirect effect of tropical cyclones (TCs) on cases of heavy rainfall during the Baiu season in Kyushu, Japan using data analyses and numerical experiments. A detailed analysis of the heavy rainfall event that occurred on 7 June 1999 (JST) is performed. This event was remotely affected by Typhoon Maggie (9903), which was located approximately 2000 km from Kyushu at the time.

Q & A session:

b. Prof. Richard Johnson:

Q: What determines sometimes you have it and sometimes you don't (typhoon flow to the east)?

A: Refer to the slide. In the study we get heavy rainfall data over Kyushu and verify the model result are the same as forecast.

III) **Verification and meteorological analysis of heavy rainfall over India during southwest monsoon**

Speaker: **B.P. Yadav**, India Meteorological Department, India

The detailed results of verification of operational heavy rainfall warnings of IMS are presented in the study. The numerical weather prediction (NWP) models are an important tool used by the forecasters for issuing heavy rainfall warnings. Performance of various NWP models which are used operationally (MM5, WRF, NCMRWF T-254/L64, UKMO, GFS T382 & T574 and ECMWF models) for heavy rainfall prediction is being done regularly by IMD.

IV) **The heavy rainfall in Indonesia at 2010 and factors affecting its variability**

Speaker: **Dodo Gunawan**, Agency for Meteorology, Climatology and Geophysics, Indonesia

This presentation shows the rainfall observed by TRMM satellite that has been used to analyze the heavy rainfall during the period of January – December 2010. In this period the rainfall over Indonesia region were above their average (positive anomaly). Several parameters of the ocean and atmosphere which determine the circulation and hence causing rainfall variability in Indonesia region have been analyzed to explain the anomaly.

Q & A session:

a. Prof. Johnny Chan:

Q: In your Regional Climate Model Simulation, what you use for your boundary condition?

A: Reanalysis from NCEP.

V) **Intraseasonal oscillation of heavy rainfall over Malaysia during the winter monsoon**

Speaker: **Subramaniam Moten**, Malaysian Meteorological Department, Malaysia

This presentation shows the gridded reanalysis data from the Japan Meteorological Agency (JRA25) is used to obtain the intensity of the cold surges and the propagation of convection from the OLR data to examine the relationship with the observed heavy rainfall. It was found that in some years there is strong intraseasonal oscillation in the heavy rainfall associated with the cold surges. Over Sabah the intraseasonal oscillation is prominent in some years when the easterly wave is strong but is absent in other years.

Session 6 SCMREX Plan (Chair: Chih-Pei Chang and Yali Luo)

Southern China Monsoon Rainfall Experiment (SCMREX)
(**SCMREX Team led by Yali Luo**, Chinese Academy of Meteorological Sciences, China)

A discussion on the proposed international field and modelling project, Southern China Monsoon Rainfall Experiment (SCMREX), has been held during the last session of the workshop. The 1st session of the discussion Prof. Yali Luo gave presentation on the Southern China Monsoon Rainfall Experiment (SCMREX). The discussion on SCMREX plan was continued on Wednesday morning, 12 December 2012.

3. Closing Ceremony

All participants had successfully completed the three-day workshop. At the closing remarks, Dr. Wan Azli Wan Hassan, Senior Director, Technical Development Division, on behalf of MMD congratulated and thanked the participants on their completion and active involvement.

4. Technical Tour

During the last day of the workshop, the participants had a facility tour at MMD. The participants visited the Central Forecast Office and were briefed on the forecast system and facilities, including their work flows. The participants also had a technical tour to the Stormwater Management and Road Tunnel (SMART), Kuala Lumpur. The participants were briefed on the function and operation of SMART in mitigating flash floods in Kuala Lumpur.