
**MEETING OF THE WORKING GROUP ON
TROPICAL METEOROLOGY RESEARCH**

NANJING, CHINA

27-28 October 2015

Original: ENGLISH

DRAFT MINUTES

Present: Yihong DUAN (Chair), CP CHANG (Chair, Monsoon Panel), Johnny CHAN (Chair, Tropical Cyclone Panel), Phil KLOTZBACH, Richard JOHNSON, Robert ROGERS, Ajit TYAGI, Nanette LOMARDA (WMO),

Apologies: Tom KNUTSON, Gabriel LAU, John McBRIDE

Minutes and actions

The Chair welcomed the WGTMR members to the meeting.

The minutes of the previous meeting were accepted, and action items from the 1 July 2015 conference call and 2014 annual meeting of the working group (Montreal, aug2014) were reviewed.

The updated 2014 action sheet and an action sheet for this meeting are given as annexes.

Action #1: Chair to remind people to address the actions against their names.

Briefing on relevant WMO/WWRP documents

Nanette presented to the group the outcome of the following: WWRP SSC-7 (18-20 November 2014), IWTC-8 and IWTC-3 (2-10 December 2014), CAS Management Group-9 (22-23 April 2015), and Cg-17 (25 May-12 June 2015)

Below are the actions related to WGTMR from the above meetings:

WWRP SSC-7

1. WGTMR to consider all phenomena affecting the weather variability in the tropical belt

Action #2: WGTMR to consider including this in current or future projects of the working group

IWTC-8 and IWTC-3 Recommendations addressed to WMO

1. That WMO facilitate the transition of new, successfully – tested Tropical Cyclone (TC) techniques and algorithms from researchers/developers to operational environments (especially developing countries).
For example, innovative satellite – based methods that are showing Promise for TC analysis need to be integrated into local TC analysis/

Forecast offices for optimal employment as guidance in the TC forecast process.
WMO to assist identify resources for providing this transition and subsequent training.

Action #3: WGTMR to consult with TCP on this recommendation

2. That WMO encourages its Members to work together to realize the goal of regular and coordinated aircraft reconnaissance in the western North Pacific and other TC basins geared toward enhanced TC monitoring and resultant multi-day forecasts.
3. That WMO consider new topics for future TC - related workshops. Such topics could include societal impacts for the purpose of advancing the Total Warning System concept and for the sharing of relevant experiences. In addition, and in view of the continuing need, previous successful workshops such as TC Satellite Analysis and Extratropical Transition should also be taken into account.

Action #4: WGTMR to organize a scientific meeting with WGSERA

4. Recognizing the value and importance of the NRL Tropical Cyclone Site [<http://www.nrlmry.navy.mil/TC.html>] for both real-time operational use and as a resource for researchers, the IWTC expresses concern that continuing development and availability of this resource may cease. Reflecting on the exceptional value that operational centers in particular place on this web site as a unique and effective means of providing global access to the full suite of microwave imagery, the IWTC community recommends that WMO send a letter of commendation to the development team at NRL-MRY in recognition of the significant contribution they make to global disaster risk reduction.
5. That WMO encourages continued efforts by the Working Group on Forecast Verification to specify a basic set of TC verification metrics, such as time of landfall, for use by National Meteorological and Hydrological Services (NMHSs) and partner agencies based on the "Verification methods for tropical cyclone forecasts" document, with a view to delivering the basic set at the next IWTC.

Action #5: WGTMR to provide advice and assistance to JWGFVR on identifying the required verification metrics.

6. That WMO facilitate the standardization of the TC wind radii format so that RSMCs can create best track records including metadata that will be used to verify statistical and NWP guidance products.
7. That WMO encourage the TC research community to focus on dynamical extended-range and sub-seasonal forecasts of tropical cyclone activity, making use of forecast model output databases from the WWRP S2S project to systematically evaluate the skill of these forecasts. IWTC also recommends accelerated research into the best ways to communicate the value, uncertainties, and limitations of these forecasts to users.

Action #6: WGTMR's Expert Team on Seasonal TC Forecasts to work with S2S Project

CAS MG-9

1. WGTMR to incorporate rainfall extreme issue in their activity/projects (AI #1)

Action #7: WGTMR to incorporate rainfall extreme issue in their activity/projects

2. CAS MG-9 recommended that the WGTMR encourage the development of similar projects currently undertaken by WG in other tropical cyclone/monsoon affected regions.

Action #8: WGTMR to encourage the development of similar projects currently undertaken by WG in other tropical cyclone/monsoon affected regions.

3. WGTMR to propose challenges, key tasks and expected result for WWRP Implementation Plan (2016-2023)

Action #9: See item: Discussion on WWRP Implementation Plan (2016-2023)

Cg-17

1. 4.3(3).11 Congress noted the role of the Tropical Meteorology Research Working Group (WGTMR) in improving the understanding of high-impact tropical weather events, such as tropical cyclones, and in the bridging of knowledge between researchers and forecasters. Congress requested CBS and CAS to prioritize the recommendations made by the WGTMR, on warning and advisory communication, and on improving the prediction of tropical cyclones through coupled modelling with a special focus on sub-seasonal to seasonal time-scale. Congress recommended Members to incorporate these improvements into operations at the six Tropical Cyclone Regional Specialized Meteorological Centres (RSMCs) and the six Tropical Cyclone Warning Centres (TCWCs) when ready. Congress also noted that the project "Experiment on Typhoon Intensity Change in the Coastal area (EXOTICA)" was being taken forward by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) / WMO Typhoon Committee with a view to improving the operational analysis and forecasting techniques of tropical cyclone (TC) intensity, understanding of the mechanisms of TC intensity and structural changes, and identifying key scientific issues of TC related disaster prevention and mitigation, and further coordination with the WGTMR would be expected.

Action #10: Organize a TLFDP progress meeting and workshop in December 2015 with EXOTICA group.

2. 4.3(3).12 Congress noted the recommendation from the Eighth International Workshop on Tropical Cyclones (IWTC-VIII) that consideration be given by WMO for new topics for future workshops. Such topics could include societal impacts for the advancement of the Total Warning System concept and for the sharing of relevant experiences. In addition, in view of the continuing need, previous topics such as Satellite Analysis of Tropical Cyclones, Extratropical Transition of Tropical Cyclones, should also be taken into account. Congress requested the Executive Council and the Secretary-General to support future workshops along these lines.
3. 3.1(4).8 Congress noted that the TCP and the World Weather Research Programme (WWRP) jointly organized various forums where operational forecasters and researchers exchanged their views and shared knowledge and identified the direction of their collaborations for the future. Those included the Eighth International Workshop on Tropical Cyclones (IWTC-VIII)/3rd International Workshop on Tropical Cyclone Landfall Processes (IWTCLP-III) that had been organized in Jeju, Republic of Korea, December 2014, and the Workshop on High Impact Weather in Ningbo, China, January 2015. Workshops and projects organized jointly by the TCP and WWRP provided excellent opportunities for active interaction between operational

forecasters and researchers focused on facilitating the transfer of research and technology developments to operations.

Action #11: WGTMR to organize a training course for TC forecasters in 2016

4. 3.1(4).9 Congress further noted that as part of the collaborative actions taken by the TCP and WWRP for promoting application of research outcomes to operational forecasting, two projects have been implemented within the framework of the Typhoon Committee, Tropical Cyclone Ensemble Forecast Project (TCEFP) which aims to explore the utility of ensemble forecast products through THORPEX interactive Grand Global Ensemble (TIGGE) and thus to extend the use of ensemble products in TC operational forecasting, and the Typhoon Landfall Forecast Demonstration Project (TLFDP) which is aimed at enhancement of the timeliness and accuracy of typhoon forecasts particularly during the landfall process, with particular focus on the verification of TC forecast guidance produced in the Typhoon Committee region to assess the currently available forecast techniques. Congress requested the WMO Secretariat to take necessary actions for sharing the outcomes of TCEFP and TLFDP between the regional TC bodies, and endorsed extension of the TLFDP until 2018 as the result of incorporating new forecasting verification techniques into new TC forecasting products.

5. 3.1(4).10 (f) The TC operational community to engage with social scientists to develop tools and provide education and training for meaningful communication of risk to end users based on: (1) warnings; and (2) the forecast uncertainty associated with those warnings. This will help ensure that appropriate community actions are taken in response to those TC warnings.

See **Action Item #4:** WGTMR to organize a scientific meeting with WGSERA

Action #12: Include relevant action items above in the action sheet for this meeting

WGTMR activities and update on on-going projects

Typhoon Landfall Forecast Demonstration Project (TLFDP)

Dr Hui Yu, one of the Lead Scientists of the Project provided an update of the TLFDP:

Since May 2010 all the related data and products of named tropical cyclones in the Western North Pacific have been archived by the Shanghai Meteorological Service and are available for research, training and capacity-building activities. A variety of TC forecast and real-time verification products are also disseminated through the WMO-TLFDP website (<http://tlfdp.typhoon.gov.cn>). Real-time TC forecast products are collected through various ways from a total of 15 agencies, including the TIGGE TC EPS products from 7 NWP centres. The operational status of tropical cyclone forecast verification is analyzed on the basis of an e-mail survey covering the Members of Typhoon Committee. Post-season verification and reliability analyses have been carried out on the track, intensity and precipitation forecast of tropical cyclones since the project started in 2010. Two training workshops on tropical cyclone forecasting were held successfully in Shanghai, China in May 2010 and June 2012, respectively. More than 50 forecasters from China and Members of the Typhoon Committee attended the said workshops. An TLFDP related article “A New Verification Measure for TC Track Forecasts and its Experimental Application” was published in December 2013.

See Action #10: With the endorsed extension of TLFDP to 2018 by Cg-17, WGTMR to work with TLFDP in organizing a workshop in December with the EXOTICA project of the Typhoon Committee. WWRP and TCP were requested to support this activity.

South China Monsoon Rainfall Experiment (SCMREX)

Professor Yali Luo, Lead investigator of SCMREX provided an update on the project:

Field Campaigns conducted:

2013 (Intensive Observing Periods) 8-17 May and 24-28 May
2014 (Continuous IOP) 1 May to 15 June
2015 (Continuous IOP) 1 May to 15 June

SCMREX website: <http://scmrex.cma.gov.cn>

To date 5 scientific articles on SCMREX had been prepared 3 of which had been published in scientific journals.

Current research activities: QPE, DSD retrieval, dual-Doppler wind retrieval High-resolution analysis production; LAPS & WRF-EnKF & SGI; Physical mechanism study (multi-scale analyses); Climatology & case study; Data assimilation impact study; Wind-profiling radar; Weather radar; Ensemble-based predictability study; Noah-MP LSM: land surface states & subphysics; 2 versions of NCEP GEFS: IC & LBC; model physics schemes

Action #13: Endorse the extension of SCMREX to 2018 to focus on the physical mechanisms for multi-scale interactions in high-impact weather in monsoons, using ensembles, data assimilation and model physics studies.

Understanding and Prediction of Rainfall Associated with landfalling Tropical cyclones (UPDRAFT)

Professor Yuan Wang, Lead Investigator of the Project provided the meeting an update of UPDRAFT:

The composition of the International Scientific Steering Committee for the project was finalized in June 2015. Led by Professor Yuan Wang of the Nanjing University the ISSC organized the first International Workshop on Understanding and Prediction of Rainfall Associated with Landfalling Tropical cyclones (UPDRAFT) on 28-30 October 2015. A concept plan for the field campaigns are being drawn up for finalization by spring 2016. The project website will soon be online.

Action #14: UPDRAFT proponents to circulate concept plan to all WGTMR members by March 2016

High Impact Weather (HIWeather)

Professor Ajit Tyagi attended the High Impact Weather Workshop held in Ningbo, China in January 2015. He is coordinating with Dr Brian Golding possible collaboration of the WGTMR with HIWeather especially on High Impact Weather events in South Asia.

Action #15: Professor Tyagi to continue effort for WGTMR to collaborate with HIWeather

Subseasonal to Seasonal Project (S2S)

Professors BN Goswami and Bin Wang, co-chairs of the Monsoon Panels Expert Team on Climate Impacts on Monsoon Weather and some of their expert team members are actively involved in the monsoon component of the S2S project. Dr Phil Klotzbach is exploring possible collaboration with S2S on the seasonal prediction of tropical cyclone occurrence.

Action #16: Request Professors Goswami and Wang for update on their work with the S2S project

Global Framework for Climate Services (GFCS)

Professor Ajit Tyagi had made contact with the GFCS Director, Mr Filipe Lucio on planned involvement of WGTMR especially along the following areas: seasonal prediction of tropical cyclones, extended range prediction of monsoon especially related to agriculture, role of the MJO in modulating regional and tropical weather and prediction of heavy rainfall events.

Action #17: Professor Tyagi to provide WGTMR with firm plans of collaboration with GFCS

Joint activities with other working groups and WMO activities

Joint Working Group on Forecast Verification Research (JWGFVR)

WGTMR is working with the JWGFVR to continue the latter's efforts to specify a basic set of tropical cyclone verification metrics based on the 2013 JWGFVR publication "Verification methods for tropical cyclone forecasts".

Members of JWGFVR are also working on all the on-going WGTMR projects namely: TLFDP, SCMREX and UPDRAFT.

Action #18: WGTMR members to provide inputs to assist JWGFVR in identifying the tropical cyclone verification metrics and provide advice on verification methodologies for specific projects

Nowcasting and Mesoscale Working Group

Members of the Nowcasting and Mesoscale Working Group are actively involved in on-going projects of WGTMR.

Outreach Activities

WGTMR web page

Nanette outlined recent updates in the web page.

Action #19: WGTMR members continue to provide updates and news items for the web page.

World Monsoon Website

The Monsoon Panel announce to the meeting that the Yale University's World Monsoons Website is now online at: <http://monsoon.yale.edu/> The website was created by **Dr William Boos**, member of the Panel's Expert Team on Severe Monsoon Weather with financial

support from the US National Science Foundation CAREER award AGS-1253222. The website provides observations of current weather in the world's various monsoon regions, together with rainfall totals for the current seasons. The website also provides forecasts of monsoon activity over the next few days. Targeted for the layperson, there is also a blog, which every week or two features a current general-interest story; recent articles have focused on flooding in Jakarta, drought in Brazil, etc.

Publications

Proceedings of the 8th International Workshop on Tropical Cyclones and 3rd International Workshop on Tropical Cyclone Landfall Processes (Jeju, Republic of Korea, 2-10 December 2014)

Proceedings of the 3rd Monsoon Heavy Rainfall Workshop (New Delhi, 22-24 September 2015)

Seasonal Tropical Cyclone Forecasts

Dr Phil Klotzbach reported on the addition of two new forecast providers (Bureau of Meteorology and Tropical Storm Risk) to the website and plans to improve its visibility especially to NMHSs.

Action #20: Expert Team to provide detailed plans to increase visibility of the web site

Monsoon Data Archive Centers

The Monsoon Panel reported that aside from archiving monsoon data, the East Asian Monsoon Activity Center (Beijing, China) and the Center for Monsoon Field Campaign Legacy Data Sets (Colorado, USA) had expanded its activity to also include provision of training related to the monsoon and improving operational capabilities on monsoon monitoring, prediction and service.

WGTMR membership

Members whose terms are ending in April 2015 have agreed to continue for a second term to end in 2019. As Professor CP Chang's term was supposed to end in March this year, members of the working group unanimously requested that he continue on until after IWM-6 scheduled in 2017. This will also ensure the completion of the book "Global Monsoon System III where Professor Chang is the lead editor and is largely based on papers presented during IWM-V in 2013. Professor Chang agreed to stay on subject to the approval of SSC leadership to the Working Groups proposal.

Action #21: Chair to request SSC to approve Professor CP Chang's extension on an exceptional basis.

Future work plans

Publications

Global Monsoon System III (this will be Vol. 9 of the World Scientific Series on Asia-Pacific Weather and Climate

World Scientific Series on Asia-Pacific Weather and Climate

Vol. 6: Climate Change: Multidecadal and Beyond (CP Chang, M Ghil, M Latif, JM Wallace) Sept 2015

Vol. 7: Indo-Pacific Climate Variability and Predictability (SK Behera & T Yamagata) Nov 2015

Preparation for the 3rd TLFDP Workshop (Shanghai, December 2015)

Preparation for the 2nd UPDRAFT Workshop and Training Course for TC Forecasters

Organize a Scientific Meeting between WGTMR and WGSERA in 2016

Possible Future RDPs/FDPs

India/US/China Tropical Cyclone Project (2017-2021)

KOUDVAN (2017-2022)

India Monsoon Heavy Rainfall Project (2017-2022)

Discussion on WWRP Implementation Plan (2016-2023)

The Working Group decided on the following points:

Research Priorities:

- Advance the understanding and capability to predict tropical cyclone landfall and its impacts
- Advance the understanding and capability to predict severe monsoon weather phenomena and their impacts

Research Strategy:

- Improved understanding of the dynamics and thermodynamics based on comprehensive observational and modeling approaches improves forecasting of unusual behavior of tropical cyclones.
- Improved understanding the fundamental physics governing tropical cyclone genesis and prediction
- Improved understanding and capability to predict severe convective events in monsoon regions (including monsoon onset, intraseasonal oscillations, active and break periods, and extreme rainfall incidents)

This will be accomplished through:

- RDPs and FDPs
- Use of new observational equipment/systems
- Inter-comparison and evaluation of different forecast techniques
- Workshops on tropical cyclones/monsoons/socio-economic impacts of tropical cyclones and monsoons
- Closer cooperation with other WWRP working groups/WMO programmes and projects

Long-range Plans

- Study of unusual behaviors of tropical cyclones (e.g., sudden intensity and track changes and extreme precipitation)
- Better utilization in the data assimilation system of newly developed observing equipment for both the environment and the inner-core of the tropical cyclone
- Targeted observation strategies for improved tropical cyclone structure prediction
Improve accuracy of forecasts and warnings focusing on impacts (high winds, heavy precipitation, high surface waves and storm surge)
- Closer collaboration with the societal and economic researchers

Discussion on WGTMR endorsement of Years of Maritime Continent (2017-2018)

Dr K Yoneyama presented to the group the objectives and plans for the “Year of the Maritime Continent (YMC)” (April 2017-October 2018):

The aim of YMC is to understand the role of the Maritime Continent in the global weather-climate continuum by providing a framework for the international collaboration on field observations and modeling based on the establishment of support from agencies of participating countries. To this end, the project will study key processes and then coordinate a number of intensive observations. This will be a 1.5 year campaign and will involve scientists from 17 WMO Members. The project will study key processes that characterize maritime continent weather and climate which includes: Diurnal Cycle (source of local circulation), large-scale disturbances (MJO, monsoon, local circulation) Sea Surface temperature (ENSO, IOC, ITF, SCSTF), Upwelling (relation to eddies and biogeochemical response), Aerosols (Biomass burning and aerosol-cloud interaction), TTL (interactions between the troposphere and the stratosphere). YMC is also expected to collaborate with existing projects such as: IIOE-2, S2s; MJO Task Force, SOWER, Strateole-2) and 7SEAS.

Based on the discussions, the WGTMR decided to endorse the proposed YMC project as it is very much in line with the primary objectives of the Working Groups Monsoon Panel and that of the Working Group itself. The general thrust of the proposal is also highly relevant to the research priorities and work programme as outlined in the WWRP Strategic Plan (2009-2017). The WGTMR further recommended that WWRP SSC also endorse the YMC.

Action #22: WGTMR to recommend that WWRP SSC endorse YMC.