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CAS/WWRP/TROPICAL METEOROLOGY RESEARCH REPORT

(Item 7 – Coordination with other activities of the WMO TCP)

(Submitted by Professor Russell Elsberry)

Summary and Purpose of Document:

This document summarizes the seventh WMO International Workshop on Tropical Cyclones (IWTC-VII) held at La Reunion, France during 15-20 November 2010.

Action Proposed

The Committee is invited to:

Note the forecaster-related recommendations from the seventh WMO International Workshop on Tropical Cyclones as summarized in the APPENDIX.

7.2 IWTC-VII Summary for ESCAP/WMO Typhoon Committee

7.2.1 Overview of IWTC-VII

The seventh International Workshop on Tropical Cyclones (IWTC-VII) occurred during 15-20 November 2010, which is 25 years after the first workshop in Bangkok, Thailand. The workshop was shortened from eight working days to six days, in part for economic reasons but also to facilitate participation throughout the workshop since a sizeable number of participants at previous workshops were only able to stay for one week. This is the first time an IWTC has been held in the southwest Indian Ocean, and was held in La Reunion, France and hosted by Meteo France. In addition to the World Weather Research Program (WWRP) funding, generous support by the World Weather Watch Tropical Cyclone Program and Meteo France allowed one of the best attendances by forecasters as at any of the previous IWTCs. The multiple opportunities for interaction between the forecasters and the researchers is one of the unique benefits of the IWTCs.

Since IWTC-VI, a book “Global Perspectives on Tropical Cyclones: From Science to Mitigation” has been published. A web version of “A Global Tropical Cyclone Forecast Guide II” is in preparation. An assessment of recent developments in the topic of tropical cyclones and climate change has been published in *Nature Geoscience*, and a panel discussion was held at IWTC-VII that presented various viewpoints on how the tropical cyclone community can better resolve and address the remaining questions in this highly debated topic. A second International Workshop on Tropical Cyclone Landfall Processes that was held in Shanghai during October 2009 helped focus the direction of IWTC-VII. The WWRP-sponsored Third International Workshop on Quantitative Precipitation Estimation/Quantitative Precipitation Forecasting included sessions on tropical cyclone precipitation and flooding.

The pre-workshop reports and other IWTC-VII documents are available at <http://www.wmo.int/pages/prog/arep/wwrp/tmr/IWTC-VII.html>. The Topic and Rapporteur reports provide an excellent summary of progress in research and forecasting over the past four years.

7.2.1 Recommendations from IWTC-VII

A primary objective of the IWTC-VII was the formulation of recommendations for future activities during the next four years. These recommendations are organized in three categories: (i) Recommendations directed to the WMO World Weather Watch Tropical Cyclone Program and WMO World Weather Research Program (WWRP); (ii) Recommendations to the forecaster community; and (iii) Recommendations to the researcher community. At IWTC-VII, these recommendations were also grouped by the four major topics (Structure and Intensity Changes; Formation and Extratropical Transition; Intraseasonal, Seasonal, and Climate; and Disaster Risks, Mitigation, Warning Systems, and Social-economic Impacts) plus the keynote topics (Surface Wind and Pressure Relationships; Precipitation and Flooding; and Probabilistic Forecasting). The Recommendations Committee received about 300 prospective recommendations and these were condensed into 59 recommendations. Twelve of these recommendations were labeled as

high priority with three aimed at WMO, four to the forecaster community, and five primarily to the researcher community.

For the purposes of the ESCAP/WMO Typhoon Committee, specific IWTC-VII recommendations will be summarized that may be of particular interest to the forecasters in this Region. In the first category will be recommendations in which the Typhoon Committee is already actively contributing. The purposes of listing these recommendations are to commend the Typhoon Committee, encourage your continued efforts, and recommend that you share your advances in forecasting techniques with other WMO Region Tropical Cyclone committees. In the second category are a few recommendations for future activities that the Typhoon Committee may want to take a leadership role. Although not covered here, Members of the Typhoon Committee who have good collaborations with research or academic institutions in their country may want to endorse and communicate certain research-related recommendations that would most likely provide improved tropical cyclone guidance product for your forecasters. The full IWTC-VII report should be available in February 2011 on the WMO website.

7.2.2 Recommendations in which Typhoon Committee is already active

WMO-1. (High Priority) The IWTC-VII strongly recommends that WMO encourages the maintenance of existing observing systems that pertain to the tropical cyclone and its environment, the development and transition of new observing systems to operations, and the expansion of surface observing systems along coastal areas worldwide by respective partner nations. These observing systems include: 1) Remote sensing, including scatterometer, geostationary microwave sounder, geostationary Doppler radar, scanning radar altimeter, lidar; and 2) *in situ*, including unmanned aerial systems, and expansion of aircraft reconnaissance. IWTC-VII notes the importance of documenting uncertainties related to these systems.

Although the need for more observations to improve tropical cyclone forecasts may be more evident in other WMO Regions, the Typhoon Committee is being requested to continue their efforts to facilitate new and additional observations as a high priority.

WMO-2. (High Priority) Recognizing the importance of the concept of an end to end warning system, the IWTC-VII recommends that the WMO encourage nations to upgrade communication systems in more isolated communities, which is essential to the timely communication of tropical cyclone warnings. This includes:

- **providing guidelines for effective communication between tropical cyclone forecasters and disaster managers, government entities, the public, and media; and**
- **communicating the differences between tropical cyclones and midlatitude cyclones and their associated impacts for better public preparedness.**

Again, the Typhoon Committee is to be commended for their efforts in improving communication systems from RSMC-Tokyo Typhoon Center and other Member warning centers, and is encouraged to share with other WMO Regions their effective practices in communicating

the warnings to all those being affected by tropical cyclones (e.g., presentation by S. T. Chan of Hong Kong Observatory at IWTC-VII).

WMO-6. The WMO should continue to support the regional tropical cyclone-related work of THORPEX to assist in the further development of a comprehensive suite of probabilistic forecast products targeting tropical cyclone track, intensity, genesis, and impacts on land and at sea.

The THORPEX Northwestern Pacific Forecast Demonstration Project and the WMO/ WWRP/PWS project to provide probabilistic forecast products in support of the Shanghai World Expo are examples of innovative programs, and these efforts in this Region should be shared with other WMO Regions.

WMO-10. The IWTC-VII encourages the WMO to continue support of training programs for forecaster development, which should include researcher participation and collaboration. Training should include new research developments, updates to current processes and products, and interaction between forecasters and researchers via visiting scientist programs and exchanges among RSMCs.

The Typhoon Committee is commended for its efforts in supporting forecaster training programs, and is encouraged to consider exchanges among RSMCs.

WMO-13. The IWTC-VII recognizes the value of tropical cyclone disaster mitigation. Because of this, the WMO should encourage communication and education between forecasting and disaster management communities globally. In addition, the WMO should assist developing countries to engage in hazard assessment, risk mapping, and tropical cyclone simulation exercises, especially in highly vulnerable coastal and island areas.

The Typhoon Committee has been a leader in tropical cyclone disaster mitigation efforts including hazard assessment and risk mapping including flooding, and is encouraged to share these successful programs with other WMO Regions.

WMO-14. The IWTC-VII recommends that the WMO encourage existing efforts within the UN to systematically track the loss of human life, socio-economic impacts, and direct and indirect costs associated with TC warning and other disaster mitigation initiatives globally.

Again, the Typhoon Committee has made considerable efforts to annually track the impacts of tropical cyclones, and is encouraged to digitize these records to facilitate quantitative studies of the social-economic impacts in terms of direct and indirect costs.

FCST-1. (High Priority) The IWTC-VII encourages the expansion of, and training in, forecast aids from the Atlantic basin (e.g., SHIPS, secondary eyewall formation index) to the remainder of the global tropical cyclone warning centers and the provision of these forecast aids in standard formats.

Whereas RSMC-Tokyo Center and other member warning centers have developed structure and intensity change forecast products, this recommendation may indicate other opportunities.

FCST-2. (High Priority) IWTC-VII encourages the continued development of probabilistic guidance, and consensus guidance for formation, intensity, and track forecasting of tropical cyclones.

As indicated in WMO-6 above, the efforts in the Typhoon Committee region to develop probabilistic products makes then a global leader in this task.

FCST-4. The IWTC-VII encourages an examination of differences in intensity forecasts among forecast agencies.

Although this is a long-standing issue in the Typhoon Committee, this recommendation is specifically directed at other basins where substantially different estimates of intensity exist.

FCST-7. (High Priority) The IWTC-VII recommends that the operational community examine the manner in which the high-impact weather that occurs during extratropical transition process can be effectively communicated. Examples include maintenance of the tropical cyclone name, forecast graphics that are consistent with those produced for the tropical cyclone phase, use of probabilistic products, and public perception of the post-tropical impacts. This should be accompanied by augmenting existing tropical cyclone training to include topics related to extratropical transition.

It is well-known that extratropical transition is a common occurrence in the Typhoon Committee region, and this recommendation is for the forecaster community to examine recent research results that might lead to improved and consistent warnings.

FCST-9. The IWTC-VII recommends that RSMCs contribute to the establishment of an extratropical transition best-track database to facilitate examination of the post-extratropical transition evolution and downstream development.

Although the recommendation only mentions contributions by the RSMCs, the Typhoon Committee Members affected by extratropical events are requested to also contribute to such a data base when it is established.

FCST-12. The IWTC-VII recommends that there be continued effort placed into reducing the uncertainty in climate change projections of tropical cyclones. A continued effort to improve the models and reduce uncertainty in projections of the spatial distributions of SST, upper tropospheric structures and mid-tropospheric humidity from global climate models is needed. There is also a need for very long control runs of TC activity to monitor and understand internal variability in various basins.

The Typhoon Committee has its own working group on tropical cyclones and climate. Member agencies working on climate change projections are encouraged to contribute to this effort to reduce the present uncertainty as to the impacts.

RES-20. The IWTC-VII recommends that there be continued effort placed into reducing the uncertainty in climate change projections of tropical cyclones. This includes:

- **Theory: A greater emphasis on theoretical understanding of TC formation and the relationship of tropical cyclones to climate**
- **Observations: Homogeneous TC data sets, construction and interpretation of historic TC data sets compiled from numerous sources and further research into the nature, causes and impact of inhomogeneities in historic tropical cyclone data sets from all cyclone basins**

This recommendation is similar to FCST-12 above, but also emphasizes the need for development of homogeneous data sets, and since the Typhoon Committee region experiences the largest number of tropical cyclones, Members are strongly recommended to contribute their historical observations.

RES-24. (High Priority) The global best track database of tropical cyclone position, intensity, size, and other metrics, is an extremely valuable and important resource for all aspects of tropical cyclone research from daily to seasonal and climate time scales. The IWTC-VII encourages the continued reanalysis and improvement of the quality of the global tropical cyclone best track database in the following ways:

- **A survey of users should be conducted to determine which metrics or parameters are needed from the global tropical cyclone best track dataset including documentation of the uncertainties in the historical tropical cyclone databases along with quality control flags for all derived quantities and a record of how they were derived.**
- **A working group of experts who will oversee the database should be established. This working group should ensure the homogeneity and long-term reliability of the database examining such issues as 10-min versus 1-min mean wind; consistency across regional borders; and consistency among datasets within the same region**
- **An online clearinghouse for the global tropical cyclone best track database should be hosted in a central location to facilitate access.**

This recommendation is similar to RES-20 in emphasizing the importance of historical tropical cyclone observations and specific tasks are laid out to develop a global best-track data base (a presentation on the IbTRACs program was given at IWTC-VII).

FCST-13. (High Priority) The IWTC-VII recommends that nations share real-time observed data across operational centers to enable flood forecasts in cross-country basins.

Perhaps this issue of adjacent countries not sharing meteorological observations necessary for flood forecasting does not apply to the Typhoon Committee, but it is a high priority of some IWTC-VII participants.

7.2.4 Recommendations where Typhoon Committee may lead

WMO-3. (High Priority) As a major initiative in the tropical cyclone landfall emphasis of the WWRP/Working Group on Tropical Meteorology Research Tropical Cyclone Panel, an expert team should be formed that will focus on the capability, gaps, and requirements needed to better understand, observe, forecast, and mitigate both the direct and remote rainfall associated with landfall events. An overall objective is to develop a multi-national Research Development Project or a Forecast Demonstration Project.

Direct and indirect (or remote) rainfall associated with tropical cyclones is one of the major impacts of landfalling typhoons in the Typhoon Committee region. China has a five-year national initiative on tropical cyclones, and other Members have observational networks and numerical modeling efforts that might contribute to a multi-national Research Development Project or a Forecast Demonstration in cooperation with the THORPEX Pacific Asia Regional Committee or the WWRP.

RES-25. (High Priority) High winds and heavy rainfall and flooding caused by landfalling tropical and extratropical cyclones are recognized as extreme weather events. However, the physical mechanisms associated with these processes are not currently well understood. Therefore, the IWTC-VII recommends that research efforts should be enhanced in this area. In addition, the research community should develop strategies to improve community preparation for such events via increased observations, improved forecast tools, adequate training, and threat communication.

This recommendation is closely related to recommendation WMO-3 above and encourages the research community (e.g., THORPEX and/or WWRP) to work with the forecast community such as the Typhoon Committee to develop strategies to improve community preparation for such landfalling tropical cyclone events.

RES-29. The IWTC VII encourages collaboration between hydrologists and precipitation researchers to develop and improve coupled hydrological–meteorological models that permit prediction of the temporal and spatial distribution of both the rainfall and the resultant flooding.

The Typhoon Committee Hydrology component should be considered as a model for the rest of the WMO Regions (Yihong Duan and Jinping Liu prepared a keynote session on tropical cyclone precipitation and flooding at IWTC-VII). The recommendation on hydrology should be integrated with recommendations WMO-3 and RES-25 above to improve warnings of typhoon precipitation and flooding.

RES-16. (High Priority) There is considerable value in prediction of tropical cyclone activity on intra-seasonal time scales. The IWTC-VII recommends continued research and development on dynamical extended-range forecasts of tropical cyclone activity that is also supported by standardized verification. The IWTC-VII also recommends that a website be created with the existing operational sub-seasonal tropical cyclone forecasts, following the same guidelines for the existing WMO-supported tropical cyclone seasonal forecast website.

This initiative to utilize dynamical models for intraseasonal (10-30 day) forecasts of tropical cyclone events is a personal interest of mine (see my scientific lecture). Typhoon Committee Members have (or will have) the capability to integrate dynamical models on this timeframe, and a multi-model consensus should provide a more useful product. An endorsement by the Typhoon Committee of the need or usefulness for such guidance may assist in promoting its development.