48th ESCAP/WMO Typhoon Committee Session Report

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22-25 February 2016

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REPORT OF THE FORTY-EIGHTH SESSION
OF TYPHOON COMMITTEE

Honolulu, Hawaii
22– 25 February 2016

PART I – DECISIONS OF THE COMMITTEE

1. The Committee decided to:

   a. Approve the recommendations submitted by Credential Committee as provided in the **Appendix III.**

   b. Approve the Typhoon Committee Operational Manual (TOM) with the amendments provided in the **Appendix XIII**.

   c. Approve the recommendations submitted by Working Group on Meteorology (WGM) as expressed in **paragraph 55.**

   d. Approve the recommendations submitted by Working Group on Hydrology (WGH) as expressed in **paragraph 70**.

   e. Approve the recommendations submitted by Working Group on Disaster Risk Reduction (WGDRR) as expressed in **paragraph 80.**

   f. Approve the recommendations submitted by Training and Research Coordination Group (TRCG) as expressed in **paragraph 87**.

   g. Approve the recommendations submitted by Typhoon Committee Secretariat (TCS) as presented in **paragraph 96**.

   h. Approve the recommendation submitted by the AWG as expressed in **paragraph 102**, and request TCS, in consultation with AWG, to develop and send invitation letters to Members for nomination of AWG Chair and Vice-Chairs by 30 April, 2016 with nominations received by 31 July, 2016, and the list of candidates to be sent out by 31 October, 2016.

   i. Request AWG to consider the addition of AWG members and report back at the next Session.

   j. Request AWG and TCS to further consult Members on the Long Term Appointment Mechanism of TC Secretary and to develop a proposal to be presented for approval at the next Session.

   k. Approve the Terms of Reference (TOR) and composition of the Organizing Committee (OC) of EXOTICCA, as provided in **Appendix XXVI**.

   l. Request OC further develop terms and conditions and report back to the next Session.

   m. Request TCS to improve the TC website, including a portal website to share forecast products and information as proposed by AWG and to serve as a platform for the Members and provide better support.

   n. Request TCS to evaluate the effectiveness of the activities in the Committee, with the target to develop Members' capacity.

   o. Approve BUALOI as replacement names for RAMMASUN in the list of the names of tropical cyclones.

   p. Approve retirement of KOPPU, MELOR, SOUDELOR and MUJIGAE and request TCS to issue letters to relevant Members (Japan, Malaysia, USA and DPR Korea) requesting the

replacement names in accordance with the Committee's procedure.

q. Request TCS to send to Members a request to nominate a focal point for the development of Strategic Plan 2017-2021 and AWG to prepare a proposal for the new Strategic Plan to be presented to the next Session, for approval.

r. Approve the 2016 Budget as presented below (see **Appendix XXIV** for detail):

By Group	2016 Proposed
TCS	33,000.00
TRCG	23,000.00
WGM	27,000.00
WGH	24,000.00
WGDRR	20,000.00
AWG	3,000.00
TOTAL	130,000.00
Plus	
Special Request Budget for WGs	10,000.00
Total	**10,000.00**
Total Proposed Budget plus Special Request Budget	**140,000.00**

s. Request AWG to review the budgeting process including the transfer of funds between special budget and regular budget and the information to be included on the accounting report at the annual Session.

t. Request TCS, in consultation with TC Chair and AWG, to develop and send out letters to Members for proposals of hosting the next TCS.

u. Accept the kind offer of Philippines to host the 11th IWS tentatively on 24-28 October. Request TCS to confirm with Philippines the final dates and place, and circulate to Members. Request TCS to work with WG's Chairs on the theme for the 11th IWS.

v. Accept the kind offer of Republic of Korea to host the 12th IWS/3rd TRCG Forum.

w. Accept the kind offer of Japan to host the 49th Session of TC, tentatively on 20-23 February 2017. Request TCS to confirm the final dates and place, and circulate to Members.

x. Accept the kind offer of Viet Nam to host the 50th Session of TC and request AWG to consider the possibility of organizing some special events for the 50th Anniversary of TC.

y. Request TCS to solicit Members to provide a list of links to their information, data and forecast products to be shared.

PART II – PROCEEDINGS OF THE COMMITTEE

I. ORGANIZATION OF THE SESSION

2. The Forty-Eighth Session of the ESCAP/WMO Typhoon Committee (TC) was held at the Ala Moana Hotel, Honolulu, Hawaii, from 22 to 25 February 2016.

3. The Session was attended by **68** participants from 10 of 14 Members of the Typhoon Committee, namely: China; Hong Kong, China; Japan; Macao, China; Malaysia; Philippines; Republic of Korea; Thailand; the United States of America (USA); and the Socialist Republic of Viet Nam. Representatives of World Meteorological Organization (WMO) and Typhoon Committee Secretariat (TCS) also attended the Session. An address was given by United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) through video-recording.

4. The Session was attended by observers from Joint Typhoon Warning Center (JTWC), University of Hawaii, Sun Yat Sen University of China and Tohoku University of Japan. The list of participants is given in **Appendix I.**

Opening of the Session (agenda item 1)

5. The Session was declared open at 09:30 am on Monday, 22 February 2016 in Honolulu, Hawaii in the presence of the Members' representatives. Mr. Raymond TANABE, Pacific Region Director from National Weather Service (NWS) of National Oceanic and Atmospheric Administration (NOAA), in representation of Ms. Courtney DRAGGON, Director of the National Weather Service International Activities Office, NOAA, officiated the opening ceremony.

6. The following welcoming addresses were delivered at the opening ceremony by:

   a. Mr. Raymond TANABE, Pacific Region Director, NOAA.

   b. Mr. Peter HIRAI, Deputy Director of Department of Emergency Management of the City and County of Honolulu.

   c. Mr. YU Jixin, Secretary of the Typhoon Committee.

   d. Mr. Taoyong PENG, Representative of WMO.

   e. Mrs. Shamika SIRIMANNE, Representative of ESCAP.

   f. Mr. Raymond TANABE on behalf of Ms. Courtney DRAGGON, Director of the National Weather Service International Activities Office, NOAA.

7. The above-mentioned statements are provided in **Appendices II.a, II.b, II.c, II.d, II.e and II.f**, respectively.

8. Dr. Roman L. KINTANAR Award for Typhoon related Disaster Mitigation was to be presented by Mr. YU Jixin, Secretary of Typhoon Committee. The Committee was informed that the TCS received no nominations for this year's award.

II. REPORT ON CREDENTIAL COMMITTEE (agenda item 7)

9. Mr. LEI XiaoTu, Chair of Working Group of Meteorology (WGM), Mr. Yoshio TOKUNAGA, Chair of Working Group of Hydrology (WGH) and Dr. Jaehyun SHIM, Chair of Working Group of Disaster Risk Reduction (WGDRR) were appointed as members of the Credential Committee.

10. Dr. Jaehyun SHIM, Chair of WGDRR was appointed Chairperson of Credential Committee and presented the Summary Report of the Credential Committee, which can be consulted at **Appendix III.**

III. ELECTION OF OFFICERS (agenda item 2)

11. Mr. Raymond TANABE, Pacific Region Director, NOAA was elected Chairperson and Dr. Toshihiko HASHIDA, Director-General, Forecast Department of Japan Meteorological Agency (JMA) was elected Vice-Chairperson of the Committee. Mr. Kenneth KLEESCHULTE, Meteorologist/Hydrology Focal Point of NWS Guam (NOAA), was elected Chairperson of the Drafting Committee.

IV. ADOPTION OF THE AGENDA (agenda item 3)

12. The Committee adopted the agenda as shown in **Appendix IV.**

V. TECHNICAL PRESENTATIONS (agenda item 4)

4.1 Summary of the 2015 Typhoon Season

13. The Committee took note with appreciation of the review of the 2015 typhoon season provided by the RSMC Tokyo as provided in **Appendix V**.

14. The Committee noted that in the western North Pacific, 27 named tropical cyclones (TCs) formed in 2015, which is above the 30-year average of 25.6 for the period, 1981-2010. 18 reached typhoon (TY) intensity, and seven named TCs hit the continent.

15. The mean genesis point of the named TCs in 2015 was 13.0°N and 147.2°E, showing deviation to the southeast from the 30-year average (16.2°N and 137.4°E) possibly due to effects of a strong El Nino.

16. Four named TCs formed from January to March. Mekkhala (1501) formed over the sea east of the Yap Islands and damaged the Philippines. Maysak (1504) formed northwest of Pohnpei Island and damaged Micronesia and the Philippines.

17. Five named TCs formed from April to June. Noul (1506) formed east of Yap Island and damaged the Philippines. Kujira (1508) formed west of Paracel Islands and damaged China and Viet Nam. Chan-hom (1509) formed around the Marshall Islands and caused severe damage to China.

18. Three named TCs formed in July. Linfa (1510) formed east of the Philippines and caused severe damage to the Philippines. Nangka (1511) formed over the sea around the Marshall Islands and damaged Japan. Halola (1512) entered the western North Pacific with STS intensity on 12 July and damaged Japan.

19. Four named TC formed in August. Soudelor (1513) formed around the sea east of the Mariana Islands and cause severe damage to China. Goni (1515) formed east of Guam Island and cause severe damage to the Philippines.

20. Five named TCs formed in September. Kilo (1517) entered the western North Pacific with TY intensity on 1 September. Etau (1518) formed west of the Ogasawara Islands and damaged Japan. Vamco (1519) formed over the sea east of Viet Nam and damaged Viet Nam and Cambodia. Dujuan (1521) formed south-southeast of Okinotorishima Island and damaged China.

21. Six named TCs formed from October to December. Mujigae (1522) formed off the eastern coast of Luzon Island and caused severe damage to the Philippines and China. Koppu (1524) formed west of the Northern Mariana Islands and caused severe damage to the Philippines. Melor (1527) formed south of Yap Island and caused severe damage to the Philippines.

4.2 Verification of tropical cyclone operational forecast in 2015 typhoon

22. The Committee took note with appreciation of the report on Verification of tropical cyclone operational forecast in 2015 typhoon provided by the Shanghai Typhoon Institute (STI) in **Appendix VI** and presented by Mr. LEI XiaoTu. Hong Kong, China provided comments and further information to update the verification statistics with respect to Hong Kong Observatory.

4.3 Cross cutting Projects

Synergized Standard Operating Procedures for Coastal Multi-hazards Early Warning System (SSOP)

23. The Session was informed of the activities and progress of the Project on SSOP. The details can be found in the **Appendix VII.**

24. The Session noted the remarkable achievement of SSOP-I and expressed its highest appreciation to ESCAP for great support to this project. The Session also recognized the importance to spread the achievement and results to the regions of TC and PTC, even outside of the region.

25. The Session reviewed the proposal of SSOP-II which was submitted to ESCAP by TCS after discussion at TC 10th IWS. The details can be found in the **Appendix VIII**.

26. The Session noted with pleasure that TCS made its efforts on the Proposal for SSOP-II. The Session also requested the Working Groups, in cooperation with TCS, to discuss and formulate plans for the implementation of SSOP-II should funds become available. The Session requested the implementation of SSOP-II to be fully integrated with Working Groups' AOPs.

Progress of the Experiment on Typhoon Intensity Change in Coastal Area (EXOTICCA)

27. The Committee took note with appreciation of the progress report EXOTICCA provided by the WGM Chair, Mr. LEI XiaoTu as provided in **Appendix IX**, and further implementation planning would be discussed under Agenda item 8.1.

28. The Committee discussed the TOR and composition of Organizing Committee (OC).

29. The Committee appreciates the presentation on Tentative Plan of Viet Nam participating in EXOTICCA.

4.4 Other Technical Presentations

30. The technical lectures were presented as shown in **Appendix IXa**. The Committee expressed its appreciation to all the lecturers and requested the TCS to post all the lecture papers/PowerPoint presentations on the TC website. The following technical lectures were presented as follows:

    a. Mr. Dan "Fig"LEAF, Director of Asia Pacific Center for Security Studies.
    b. Mr. Yuquing WANG, University of Hawaii.
    c. Mr. Tom BEDARD, National Disaster Preparedness Training Center, University of Hawaii.
    d. Mr. Yi-Leng CHEN, University of Hawaii.
    e. Mr. Michael M. BELL, University of Hawaii.
    f. Prof. CHEN Yangbo, Sun-Yat Sen University, China.
    g. Dr. QIAN Chuanhai from the National Meteorological Centre of China Meteorological Administration (CMA).
    h. Mr. Jack BEVIN, National Hurricane Center, NOAA.
    i. Dr. Nam-Young KANG, National Typhoon Center (NTC)/Korea Meteorological Administration (KMA).
    j. Ms. Seonghee WON, National Typhoon Center (NTC)/KMA.
    k. Prof, Dr. Tran Hong THAI, Deputy Director General, National Hydro-Meteorological Service of Viet Nam.

1. Dr. DUAN Yihong, Chair of Commission for Atmospheric Sciences (CAS) Working Group on Tropical Meteorology Research.

VI. REPORT ON TC'S KEY ACTIVITIES AND OVERVIEW SUMMARY OF MEMBERS' REPORTS (agenda item 5)

5.1 Report on TC's Key Activities and Main Events in the Region

31. The Committee took note of the report of the Typhoon Committee Chairperson on the TC's Key Activities and Main Events in the Region, 2015. (**Appendix X**)

32. The Committee expressed appreciation to the contributions of Mr. Alui BAHARI as the chairperson of the Committee.

33. The Committee dealt with related issues under the relevant agenda items.

5.2 Overview Summary of Members' Reports

34. The Committee took note of the major progress and issues in meteorology, hydrology, DRR, training and research aspects as reported by Members in 2015. (http://www.typhooncommittee.org/10IWS/Members10IWS.html) presented by AWG Chair, Mr. Edwin LAI.

35. The Committee reviewed the Overview Summary of Members Report in **Appendix XI**, reflecting Members experiences of Typhoon-related hazards in 2015 and reviewed the Members' efforts to study and mitigate the impact arising from such hazards. The Committee took note of the Session statement to be sent to Member's government based on the information as summarized by paragraph 2.1.1 and 2.1.2 in the **Appendix XI** of the Overview Summary.

VII. REVIEW OF THE ACTIVITIES OF RSMC TOKYO AND AMENDMENTS OF TOM (agenda item 6)

6.1 Review of the activities of the Regional Specialized Meteorological Center (RSMC) Tokyo 2015 (Appendix XII)

36. The Committee was pleased that RSMC Tokyo is ready for provision of multi-scenario storm surge predictions as well as ensemble wave forecasts based on the JMA's Typhoon Ensemble Prediction System (TEPS) to the Committee Members. Verification results using tidal data available are to be included into RSMC Tokyo Annual Activity Report. Members were encouraged to provide tidal data for RSMC Tokyo to verify the storm surge forecasts for calculating astronomical tides and the further improvement of its storm surge model. The Committee expressed its gratitude to RSMC Tokyo for provision of storm surge forecasts to the TC Members and sharing information on storm surges through the annual TC attachment training.

37. The Committee was informed that the effectiveness of Ensemble Prediction Systems (EPS) for TC genesis forecasts was found through the work done under the joint project of World Weather Research Program (WWRP) and Tropical Cyclone Program (TCP), North Western Pacific Tropical Cyclone Ensemble Forecast Project (NWP-TCEFP). The verification identified the Multi-center Grand Ensemble (MCGE) has better skills in TC genesis prediction than that of the best single ensemble, namely ECMWF ensemble. The Committee with appreciation noted the extension of NWP-TCEFP to 2016 for investigation of potential use of ensemble predictions for TC intensity forecasts and the planned provision of ensemble TC genesis prediction map in 2016 through the Numerical Typhoon Prediction (NTP) website if necessary data are provided.

38. The Committee reaffirmed that RSMC Tokyo participates in a sub-regional project in Southeast Asia (SWFDP-SeA) as the Regional Center for Tropical Cyclone/Typhoon Forecasting Support to provide typhoon related products, including NWP-TCEFP products at the NWP-TCEFP Home page. It noted that at the SWFDP-SeA regional Subproject Management Team Meeting, RSMC Tokyo and RFSC Hanoi agreed to work effectively, ensuring consistency of their products and avoiding duplication in accordance with the Regional Subproject Implementation Plan (RSIP).

39. The Committee was informed that RSMC Tokyo started tropical cyclone satellite re-analysis in 2012 for the period from 1981 to confirm and improve the quality of the Current Intensity (CI) number in the satellite TC analysis. Re-analysis over the period from 1987 to 1993 has been completed. RSMC Tokyo plans to complete re-analysis up to 1998 by the end of 2016.

40. The Committee was informed that RSMC Tokyo is continuing experimental provision of TC advisory in Common Alert Protocol (CAP) format at the JMA website (http://www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-eg/RSMC_HP.htm) since 12 November 2012.

41. The Committee was pleased that a technical meeting on radar composite techniques was held at Thai Meteorological Department (TMD) headquarters in December 2015 to discuss current issues on quality control of radar data, provide technical assistance for developments of QPE, and identify the way forward. Planned in 2016 are experimental test of radar data sharing among RSMC Tokyo, TMD and Malaysia Meteorological Department, technical assistance to TMD, and a technical meeting.

42. The Committee was informed that RSMC Tokyo, in cooperation with RSMC Honolulu, started drafting a Tropical Cyclone Forecaster Competency document, responding to the discussion at the 66th WMO Executive Council. It noted that, in 2016, the draft is to be updated in accordance with feedback to be received from the Members.

43. The Committee was informed that based on the techniques utilizing the cloud grid information for the analysis of existing CB areas, RSMC Tokyo, as the TCAC Tokyo, started providing graphical Tropical Cyclone Advisories (TCAs) according to MODEL TCG in the Appendix 1 of International Civil Aviation Organization (ICAO) Annex 3 in August 2015.

44. The Committee was informed that Himawari-8 geostationary meteorological satellite began operation on 7 July 2015, replacing the previous MTSAT-2 operational satellite. Two new services, HimawariCast and HimawariCloud, have been established for provision of Himawari-8 data. JMA conducts training for NMHSs to enhance capacity for satellite data usage. In November 2015, a training course was held in conjunction with the 6th Asia/Oceania Meteorological Satellite Users' Conference in Tokyo, Japan.

45. The Committee was pleased that RSMC Tokyo conducted the 14th Attachment Training from 22 to 31 July 2015 inviting three forecasters from Cambodia, Thailand, and Viet Nam. In accordance with the decision of the third joint session of the Panel on Tropical Cyclones (PTC) and the Typhoon Committee, RSMC Tokyo, ESCAP, WMO, and PTC secretariats agreed to invite three forecasters from PTC Members, i.e., Bangladesh, Maldives and Myanmar in 2015, Oman, Pakistan and Sri Lanka in 2016 on a trial basis with Japan Trust Fund. The Committee with pleasure noted that RSMC Tokyo plans to extend the training course by 2 days to provide lectures on TC warning developments with the financial supports of the WMO Secretariat.

6.2 Typhoon Committee Operational Manual (TOM)

46. The Session noted that the Typhoon Committee Operational Manual (TOM) rapporteur requests WMO to publish and upload the 2016 edition of TOM on the Tropical Cyclone Programme (TCP) Website as submitted by the Rapporteur, with the amendments given in **Appendix XIII**.

47. The Committee expressed its appreciation to the rapporteur for update of TOM.

VIII. REPORTS OF TC WORKING GROUPS AND TRCG (agenda item 8)

48. Parallel sessions of the Working Groups on Meteorology, Hydrology and Disaster Risk Reduction were convened during the 10th IWS to review progress of work during the past year, identify priorities for cooperation and make recommendations to the Committee.

49. The outcomes of the parallel sessions of the three Working Groups were reported to the plenary session as given in the following sections.

7.1. Meteorological Component

50. The Committee took note of the Members activities and major progress and issues in meteorological component in 2015 as reported by Members at the 10th IWS.

51. The Committee reviewed the activities of Members in implementing the TC Strategic Plan and its annual operating plan in relation to Meteorological Component during the past year, details of which are presented in **Appendix XIV**.

52. The Committee took note of the outcomes of the parallel session of the WGM on 27-28 October 2015 (**Appendix XIV**). With the help of WMO/TCP and TCS, and the sincere cooperation of all Members, WGM has successfully completed the tasks in 2015 with the significant outcomes as follows:

    a. WGM has completed all the action plans (include 4 POPs, 9 AOPs and 3 PPs), which were endorsed at the 47th session.

    b. The expert team (include 6 experts from TC Members) for the 3rd Assessment Report on the impact of climate change on tropical cyclone in TC region was established in 2014 and a provisional outline of the 3rd Assessment Report was drafted. The 3rd Assessment Report is planned to be published in 2017 or 2018.

    c. CMA has conducted a rocket dropsonde mission for Typhoon Mujigae in October 2015. The rocket travelled 200 km towards the centre of the typhoon and 4 dropsondes were deployed. Data were received and analyzed.

    d. The digitization of CI numbers for the period of 2004-2013 was completed and the best-track datasets including CI numbers of CMA, HKO, JTWC, and RSMC Tokyo were exchanged in June 2014. Most of the Dvorak Analysis of these four Centres were reasonably consistent, proving the credibility of the technique, but there were discrepancies in some of the cases.

53. The Committee further noted the following WGM activities in 2015:

    a. The first Organization Committee (OC) meeting for EXOTICCA (previously as EXOTICA) was held in Shanghai on 9 October 2015. Establishment of various committees and the corresponding terms of reference were discussed, with summaries on the progress by CMA, HKO and JMA. A technical lecture by USA on the current progress of the field campaign on hurricane intensity change in USA was also delivered.

    b. The technology transfer of Typhoon Analysis and Prediction System (TAPS) was conducted for two Members in 2015:
    - Lao PDR, 12-13 October 2015 and
    - Thailand, 14-16 October 2015
    Two experts from KMA met the Members to train the typhoon forecasters on the use of TAPS and provided follow-on technical assistance to the Members on the implementation of TAPS. The mission was completed successfully and reported in the 10th Integrated Workshop in Kuala Lumpur.

c. A research fellowship scheme was offered by Shanghai Typhoon Institute (STI) on tropical cyclone genesis forecast technique. The objectives of the research were to develop techniques for tropical cyclone genesis forecast and implement them in STI's objective typhoon forecast system, and provide the forecast products to Members through WMO-TLFDP's web site. The fellowship was offered to DPRK between 26 October and 25 November 2015.

d. The technical meeting on radar composite map project was held in Thailand between 30 November and 4 December 2015. The project applied JMA's quality management technique using statistical method to each of TMD's radar to develop source codes of radar data calibration for QPE by TMD with the assistance of JMA. The technical meeting was held to follow up on its progress and to identify a way forward.

e. Experts from USA and Viet Nam were invited by Shanghai Typhoon Institute (STI) on 6-11 December 2015 and 21-25 December 2015, respectively to improve the visibility of the Tropical Cyclone Research and Review (TCRR) journal by providing guidance on editorial procedures, seeking and encouraging submission of articles from Members as well as international institutions, and accelerating publicity and promotional activities about the Journal.

f. The WMO International Training Workshop for Tropical Cyclone Forecasting and Warning was held in the WMO RTC Training Center in Nanjing on 7-11 December 2015 for TC Members. 34 participants from China, DPRK, Republic of Korea, Lao PDR, Malaysia, Philippines, Thailand and Viet Nam attended the workshop. The workshop was to assist Members in their efforts to improve operational tropical cyclone forecast and warning through providing training and knowledge updates to its forecasters.

CONCLUSIONS of WGM:

54. On the basis of the information provided by Members and the respective coordinator of the AOPs (refer to **Annex I of Appendix XIV**) and on the discussion during the session, the following conclusions were reached:
    a. WGM action plans in 2015 were successfully completed.
    b. Members made important progress on the implementation of the TC Strategic Plan during the year 2015.
    c. Members made significant progress during 2015 in tropical cyclone monitoring and communication systems, data assimilation and numerical weather prediction systems, tropical cyclone forecast-aiding systems, and scientific understanding of tropical cyclone activities.
    d. Seasonal outlook information for typhoon genesis and track patterns issued by the KMA continued to be useful to TC Members.
    e. The web-based typhoon forum maintained by Shanghai Typhoon Institute of CMA acted as a convenient platform for forecasters and scientists to discuss typhoon-related topics online.
    f. 12 issues of the Tropical Cyclone Research and Review (TCRR) journal have been published since 2012 with more than 50,000 downloads from the website. Two visiting editors from USA and Viet Nam, respectively were invited to the editorial office in November 2015 to provide guidance for improving the editorial procedures, reviewing and inviting articles.
    g. The National Typhoon Center (NTC) of KMA was invited to conduct a follow-on technical assistance to the Department of Meteorology and Hydrology (DMH) of Lao, PDR on the Typhoon Analysis and Prediction System (TAPS) in October 2015. At the same time a training to Thai Meteorology Department (TMD) of Thailand on the use of TAPS was conducted.
    h. RSMC Tokyo relaunched the Numerical Typhoon Prediction (NTP) website in May 2015 to provide a variety of TC products including ensemble TC track guidance of ECMWF, NCEP and JMA.
    i. Forecasts of tropical cyclone track and intensity from operational forecast agencies and deterministic NWP models in 2014 were evaluated. Remarkable progress has been made for track forecast but it remained a challenge for intensity forecast. A one-month fellowship

scheme was offered to Mr. SONG Yong Choi and Mr. PAK Sang Il from DRPK to implement the tropical cyclone genesis products in real-time based on ECMWF-IFS gridded output in Typhoon Forecast Evaluation and Assessment System (TFEAS).

j. The performance of the high-resolution version of South China Sea Typhoon Model (TRAMS-9km) for Typhoon Soudelor in 2015 was impressive, with 24- and 48-hour average forecast errors of 56km and 70km, respectively which were smaller than JMA, ECMWF and T639.

k. The website of RFSC-Ha Noi of SWFDP for Southeast Asia continued to improve and provide global and regional (ensemble) NWP forecast products as well as guidance products.

l. A technical meeting was held in December 2015 between TMD and JMA experts in Thailand for discussing technical support for applying the QC and QPE techniques in the regional radar network, as well as training for TMD radar experts.

m. The expert team for the 3rd Assessment Report on the impact of climate change on tropical cyclones in TC region has drafted a provisional outline of the Report. The Report was planned to be published in 2017 or 2018.

n. The storm surge prediction system developed by JMA continued to run and a request from Malaysia was received. Storm surge prediction time series at several stations in Malaysia was provided in January 2016.

o. The first Organization Committee (OC) meeting for EXOTICCA (previously as EXOTICA) was held in October 2015. Two aircraft observations for Typhoon Linfa in July 2015 were conducted by HKO, and a rocket dropsonde mission for Typhoon Mujigae in October 2015 was conducted by CMA in which 4 dropsondes were deployed.

p. RSMC Tokyo developed a zero draft of the tropical cyclone forecasting competency based on the version developed by BoM.

q. The high-resolution tropical cyclone model based on Global/Regional Assimilation and Prediction System (GRAPES-TCM) could be further improved. The project will be merged with EXOTICCA in 2016.

r. Digitization of CI numbers for the harmonization of tropical cyclone intensity analysis has been completed and best-track datasets between CMA, HKO, JTWC and RSMC Tokyo were exchanged. The overall CI numbers analyzed by the four Centres using the Dvorak Analysis were reasonably consistent (within 0.5 or less), proving the creditability of the technique.

s. Observation Areas in the South China Sea including Nansha Observation Area, Xisha Observation Area and Hainan Observation Area were set up to estimate tropical cyclone intensity using various Wind-Pressure Relationship (WPR). The average estimation error for the MSLP was 6.4hPa.

t. Based on the discussion on the action plans for 2016 and according to the new structure of the action plans, it was also concluded that:

    i. POP1-4 will continue in 2016.
    ii. AOP1, 3-9 will continue in 2016.
    iii. AOP2, Verification of Tropical Cyclone Operational Forecast, will be moved to POP5.
    iv. PP1, High Resolution Tropical Cyclone Model Based on GRAPES, will be merged with AOP8 (EXOTICCA).
    v. PP2 will continue in 2016.
    vi. The budget proposed by WGM, which was also concurred at the AWG meeting after the 10th IWS, for undertaking the action plans (POPs, AOPs and PPs) in 2016 was US$17,000. Another budget of US$10,000 was allocated for the support of WGM attendance at the next Integrated Workshop, thus the total budget for WGM in 2016 would be US$27,000. In addition, a budget of US$10,000 was proposed through the "Special Funding Request" for financial support on AOP8 EXOTICCA workshop (US$5,000) and POP3 TCRR editorial board meeting (US$5,000).

RECOMMENDATIONS of WGM

55. On the basis of the outcomes of the WGM parallel session at the 10th IWS in Kuala Lumpur, Malaysia and subsequent discussion, the WGM made the following recommendations:

a. To request KMA to further develop the techniques of typhoon seasonal prediction, and to provide the products of typhoon seasonal prediction for TC Members.
b. To request STI/CMA to attract more users from wider fields into the forum, to open new topic sessions which users are interested in, to encourage forecasters and scientists to participate in the discussion, to make the forum serve as an exchange platform of real-time observations and link the forum to TC website and tropical-storms email group.
c. To request CMA to attract more contributions from TC Members and WMO Members, to improve the editorial procedure, apply for online ISSN and to host an editorial board meeting in Shanghai in 2016 for TCRR.
d. To request KMA to train the typhoon forecasters of TC Members on the use of TAPS upon request, and provide follow-on technical assistance on the implementation of TAPS.
e. To request JMA to provide ensemble TC genesis guidance if necessary NWP data are available, and to examine the potential of global ensemble models for TC intensity forecast guidance using TIGGE datasets.
f. To request CMA to host a workshop to prepare the WMO-TLFDP (III, 2016-2018) in conjunction with WMO/WWRP, WMO/TCP, to continue post-season verification and reliability analysis on the operational forecasts of tropical cyclones and report to Committee Session, to provide real-time verification on tropical cyclone track and intensity through WMO-TLFDP website, and to further improve the evaluation system for tropical cyclone forecast, with special attention on genesis and ensemble forecast in conjunction with WMO-TLFDP (to be included in the TC Fellowship Scheme).
g. To request CMA to further improve the TRAMS-9km model, to provide new products through website, and to further improve the real-time verification system for TRAMS.
h. To request NHMS of Viet Nam to collaborate with RSMC Tokyo to release tropical cyclone guidance products over Southeast Asia, to update Himawari-8 images and storm-tracking products on SWFDP webpage, and to extend forecasting domain of regional NWP model to cover the east sea of the Philippines.
i. To request TMD and MMD to increase the number of radars used for the operational radar composite map, to apply radar calibration techniques for QPE with technical assistance from JMA, to experiment test of radar data sharing between JMA, TMD and MMD, and to submit a progress report by TMD. Upon the submission of the report, to hold a follow-up technical meeting at JMA or TMD to identify a way forward.
j. To request SMG to collaborate with the expert team for further literature review and discussion, especially for non-English papers, and to write the first draft of the 3rd Assessment Report on the Influence of Climate Change on Tropical Cyclone in Typhoon Committee Region in Oct-Dec 2016/2017.
k. To request JMA to provide multiple scenarios of storm surge predictions and ensemble one-week ocean wave predictions to TC Members for the 2016 typhoon season, to add storm surge time series prediction points if so requested by Members, and to verify storm surge predictions if tidal data during storm surge events are available.
l. To request CMA to hold an OC and SSC meeting of EXOTICCA among participating Members, to implement the field campaign collaboration among participating Members, and to demonstrate research on tropical cyclone intensity change in conjunction with WMO-TLFDP by using target typhoon data from field campaign (to be included in the TC Fellowship Scheme).
m. To request JMA to circulate and update the zero draft of tropical cyclone forecasting competency based on input/feedbacks from WGM Members and discussion at the 8th Tropical Cyclone RSMCs/TCWCs technical coordination meeting, and to finalize the draft if so agreed by WGM Members.
n. To request JMA to circulate summary of the tropical cyclone CI-number comparison study to CMA, HKO and JTWC for their feedback, and to finalize and report the summary.
o. To request CMA to continue to develop the tropical cyclone intensity estimate method with better use of surface observations, and improve the 2 minute average Wind-Pressure-Relationship.
p. To endorse the action plans in 2016 (including 5 POPs, 8 AOPs and 2 PPs) as listed in **Annex II of Appendix XIV** – Summary Report for the WGM Parallel Meeting at the 10th IWS which summarizes the above recommendations with additional action items.
q. To endorse the WGM budget request which is included in the budget proposal to be submitted by AWG.

r. To reappoint Mr. Tsukasa FUJITA as the rapporteur of TOM.

7.2. Hydrological Component

56. The Committee reviewed the activities of the Members related to the implementation of the TC Strategic Plan and its annual operating plan (AOP) for the hydrological component during the past year. Details can be found in the **Appendix XV.**

57. The Session noted that the Members conducted a series of activities in 2015 on hydrological component and achieved remarkable progresses; the serious flood disaster events, including river flood, urban flood, flash flood and debris flow occurred in Members such as China, Lao PDR, Japan, Malaysia, Philippines, Viet Nam, etc. The hydrological departments of the Members provided valuable service of flood forecasting and warning to the decision-making departments of the Governments.

58. The Session noted with pleasure that, the 4th WGH working meeting was held successfully from 15 to 17 April 2015 in Daegu, the Republic of Korea in conjunction with the 7th World Water Forum (WWF) with over 46000 participants from the governments and other sectors of 168 countries and other governmental agencies, universities, private corporations and NGOs. WGH took the good opportunities to have shared the experience and strategies for flood damage prevention in the Committee at WWF, one of the largest international events, and consequently enhanced the visibility of the Committee in certain ways. The Session expressed its appreciation to MOLIT of the Republic of Korea (ROK), through HRFCO with cooperation of KICT, for kindly hosting the meeting.

59. The Committee was informed on the implementation status in 2015 and future activities of on-going projects (AOPs):

    a) Project of Synergized Standard Operating Procedures for Coastal Multi-hazards Early Warning System (SSOP).

    b) Extreme Flood Forecasting System (EFFS).

    c) Estimation for Socio-economic Impact of Sediment-related Disaster.

    d) Development and Application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for TC Members.

    e) Extension of Xin'anjiang Model Application in Selected River Basins in TC Members.

    f) Guidelines for extreme flood risk management in TC region.

    g) Study on Prediction of Debris flow and Shallow landslide by the Satellite Rainfall Data.

60. The Session noted that, WGH participated very actively in and contributed to the Project of Synergized Standard Operating Procedures (SSOP) for Coastal Multi-hazards Early Warning System. The Session also noted the WGH is willing to cooperate with and integrate its activities into the proposed SSOP-II as:

    — Workshop on Innovative Technology for Urban Flood Risk Early Warning to be held in Bangkok, Thailand (tentative); and

    — Training Course on Real-time Operational System for Urban Flood Forecasting and inundation Mapping (OSUFFIM) to be held in SYS University, Guangzhou, China (tentative).

61. The Session was informed that, HRFCO of MOLIT of the ROK, in cooperation with KICT, successfully conducted the wrap-up meeting from 6 to 8 October 2015 for the three-time field surveys attended by participating Members (Republic of Korea, Lao PDR, Thailand, and Philippines) of the project of Extreme Flood Forecasting System.

62. The Session was informed that Japan, the leading Member of the Project on Estimation for Socio-economic impact of Sediment-related Disaster, distributed the draft format to the Members for collecting the record of sediment-related disasters.

63. The Session was informed that the project on Development Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) for TC Members, led by China, made remarkable progresses and achievement in 2015, including:

— China through Guangdong Provincial Government provided funding of around US$84,000 to support the pilot study of OSUFFIM in China and Thailand.

— The field survey was conducted in pilot cities of Thailand in early September 2015 participated by the Chief Scientist of OSUFFIM Prof. CHEN Yangbo from Sun Yat-Sen (SYS) University of China and the OSUFFIM Team of Thailand led by Mr. Thada SUKHAPUNNAPHAN from RID, Thailand.

— A kick-off meeting of China-Thailand Cooperation Project on OSUFFIM was held in SYS University, Guangzhou, China on 23 September, 2015, organized by SYS University with participants from SYS University, local government, pilot city of China and Royal Irrigation Department (RID) of Thailand.

— the field survey was conducted in Dongguan city, Guangdong, China in the middle of September 2015, participated by OSUFFIM team of China and Thailand, led by Prof. Yangbo Chen of SYS University and Mr. Thada SUKHAPUNNAPHAN of RID, Thailand, respectively.

— One-month attachment training was conducted in SYS University from 15 November to 14 December 2015. Four trainees from RID, Thailand and DID Malaysia joined the training. Prof. Chen and his team provided the courses. The software of Liuxihe river basin model and OSUFFIM were initially installed for both Thailand and Malaysia with proper running.

64. The Session noted SYS University was requested from Members to provide expertise and guidance on urban flood forecasting and inundation mapping. The Session also noted with appreciation that Prof. CHEN Yangbo from SYS University, as chief scientist of OSUFFIM, is willing to contribute his knowledge to the Members and would like to establish a linkage between OSUFFIM and proposed SSOP-II.

65. The Session was informed that BOH, China held a job training for DID Malaysia in Beijing from 15 to 18 December 2015 for solving the problems that happened in Xin'anjiang model application on trial basis in Malaysia. The Session noted with appreciation that BOH of China is willing to continue providing technical support to Members if needed.

66. The Session noted the progress achieved on the project of Guidelines for Extreme Flood Risk Management in 2015 with support of HRFCO of ROK, in cooperation with KICT. The Session was informed that the project would be extended one more year to 2017.

67. The Session was informed that, the project on Study on Prediction of Debris flow and Shallow landslide by the Satellite to Rainfall Data led by the ICHARM of Japan, will be cancelled and Japan-side will consider submitting a new proposal.

68. The Session noted with pleasure that hydrologists were invited as representatives from the Committee to participate in regional activities, such as the 7th WWF, the 5th Guangxi Forum on Disaster Risk Reduction and Sustainable Development with the objective of exchanging information on hydro-meteorological DRR between China and Association of Southeast Asian Nations (ASEAN), and the Regional Workshop on Flood Management organized by Global Water Partnership (GWP). The exchange would benefit the Committee on the enhancement of the visibility in the region.

CONCLUSIONS of WGH

69. On the basis of the outcome of the 4th WGH working meeting and the discussion of the WGH Parallel Session at 10th IWS, the following conclusions were reached:

- The working meeting of WGH is very important to review hydrological activities and implementation status of WGH AOPs and to prepare IWS and annual sessions. The meeting should be continued.
- The Project of Synergized Standard Operating Procedures for Coastal Multi-hazards Early Warning System (SSOP), under the ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness in Indian Ocean and Southeast Asian Countries, is a very successful example to closely link the two regional bodies together. The outcome and achievement of this project, which could benefit TC and PTC regions as well as other regions, should be transferred into application in practice of disaster risk reduction for promoting the capacity building in Members. As a continual project, SSOP-II, which was submitted by TCS and proposed to conduct a series of training courses and workshops on the "mechanics" of preparing and implementing SSOPs for coastal multi-hazards early warning system, will benefit the Committee in various aspects. As one part of support for decision-making of disaster risk management, technical training on hydro-meteorological forecasting and warning it is also very important to promote the capacity of coastal multi-hazards early warning.
- To promote the capacity of forecasting, early warning and risk management for urban flood is an urgent need among TC Members, especially urban flood forecasting and inundation mapping. The subsequent activity of TC first Cross-cutting project of Urban Flood Risk Management (UFRM), the on-going project of WGH on Development and Application of Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM) is a tangible measure on this aspect and it will play a very meaningful and important role for TC Members to promote the capacity on the technique of urban flood forecasting and warning. This activity may establish a linkage with SSOP-II proposed by TCS.
- The development of the Extreme Flood Forecasting System and the Guidelines for Extreme Flood Risk Management will definitely benefit the TC Members to strengthen their capacity on extreme flood risk reduction, especially under climate change. To enhance the achievement of development, the situation and needs on flood risk management in the Members should be considered and integrated into the System and Guidelines.

RECOMMENDATIONS of WGH

70. On the basis of the outcomes of 4th WGH working meeting and the discussion at the Parallel Session of 10th IWS and subsequent discussion, the WGH made the following recommendations:
    a. To allocate US$24,000 from TCTF in total for supporting overall WGH activities for 2016 calendar year.
    b. To approve extending one more year for WGH AOP6 to 2017.
    c. To request HRFCO, MOLIT of the Republic of Korea to host WGH 5th working meeting with funding support in 2016.
    d. To request SYS University, China to provide technical support on urban flood forecasting and inundation mapping to the Members of the Committee if needed.
    e. To request ESCAP and WMO to continue the support to implement further the on-going project of real-time Operational System for Urban Flood Forecasting and Inundation Mapping (OSUFFIM), which can be used in PTC and TC region.
    f. To request the Working Groups to proceed with the project of SSOP-II should funds become available, and to request China, the leading Member of on-going project of OSUFFIM, to establish a linkage with SSOP-II and to play the coordination role for the activities related to WGH in SSOP-II.

7.3. Disaster Risk Reduction Component

71. The Committee took note of the Members' activities and major progress and issues in DRR Component in 2015 as reported by members at the 10th IWS.

72. The Committee reviewed the Members' activities related to the implementation of the TC Strategic Plan and its AOPs of WGDRR during the past year, details of which are presented in **Appendix XVI**.

73. The Committee noted that the 10th WGDRR annual workshop was successfully held from 19-20 May in Seoul, Republic of Korea with good result. Oman, the PTC Member was invited to take part in the workshop to exchange the experience and information related the field of DRR between TC and PTC, as well as enhance the Mechanism between two regions.

74. Committee was informed that Dr. SHIM, Jaehyun has been selected as the director general of NDMI and he was appointed as the Chair of WGDRR by the DRR members at 10th DRR annual workshop that was held in Seoul, Republic of Korea in May and Mr. OH, Keumho will serve as Vice Chair of WGDRR for replacing of the vacancy from Dr. SHIM, Jaehyun.

75. The Committee noted that the seminar was successfully conducted by WGDRR on behalf of TC in the Third UN World Conference on DRR that was held in Sendai, Japan in March 2015.

76. The Committee noted with pleasure that the video for raising the public awareness associated with typhoon danger, which was one of the fruitful projects of WGDRR was presented in the Third UN World Conference on DRR.

77. The Committee requested that the WGDRR take note of the WMO DRR Roadmap, Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals (SDGs) and Climate Change Agenda as references for future activities. It requested the WGDRR to share Expert Mission Reports.

78. The Committee was informed on the progress of AOPs 2015:

    a. Extend the WEB GIS based Typhoon Committee Disaster Information System (WGTCDIS) for upgrading the search option for finding similar Typhoon and collecting disaster information from TC Members.
    b. Provide the training program for disaster prevention policies including WGTCDIS.
    c. Promote the international cooperation research by dispatching the experts of NDMI and TCS to Philippines for installing the Flash Flood Alert System (FFAS) and Automated Rainfall Alert System.
    d. Promote and extend the dissemination of warnings and alerts by Members through SWIC (Severe Weather Information Center).
    e. Set up community weather stations for raising public awareness on climate change and extreme weather.
    f. Benefit Evaluation of Typhoon Disaster Prevention and Preparedness.
    g. The SSOP project related to disaster risk management.
    h. Participation in 3rd UNCDRR by hosting a public forum.

CONCLUSIONS of WGDRR

79. On the basis of the information provided by the Members and the respective coordinator of the action plans and based on the discussion during the meeting, the following conclusions were reached:

    a. In 2015, the NDMI expanded TCDIS to Lao PDR, Philippines, and Viet Nam. If there are no good responses about disaster damage data collection from Members, NDMI suggests to discontinue the work related to TCDIS. However, WGDRR recognized the necessity of continuous collection of disaster information from the Members for the TCDIS. Encouragement to the members to collect and share disaster information will be continued in 2016 and NDMI will find the way to submit disaster damage data through TCDIS website.

b. The expert mission was successfully conducted in Lao PDR and Viet Nam in 2015 to provide updated information on the operation of TCDIS and exchange information regarding new technology and policy related to field of DRR by NDMI. In November, NDMI will dispatch the experts to Oman in PTC for the cooperation between TC and PTC. The expert mission will be conducted upon requests of the Member in 2016. WGDRR agreed to collect the demands from the members on the expert mission.

c. The project to promote the international cooperation for disaster risk management, which is led by NDMI, will be continued in 2016 for Lao PDR and Viet Nam. In 2015, the NDMI dispatched the experts of Republic of Korea to the Philippines for installing the Automated Weather Station (AWS) and Flash Flood Alert System (FFAS) in Cagayan de Oro, Mindanao Island in Philippine. The Northern Mindanao Project, which is a joint effort between NDMI and PAGASA, has been completed in 2015. Similar projects will be conducted in Lao PDR and Viet Nam in 2016.

d. SWidget & ICOWIN project & Video

SWIdget (AOP4)

Hong Kong, China, leads the project "SWIdget" which allows users anywhere on the globe to obtain local severe weather warnings issued by official weather services in real time. Weather warnings from seven meteorological services, namely Hong Kong, China; Macao, China; USA (Guam); Republic of Korea; Singapore; Malaysia; and China in a near real-time manner.

iCowin (AOP6)

The "Community Weather Information Network (Co-WIN)" in Hong Kong, China, was further expanded as more community weather stations were installed in schools and community organizations. The number of Co-WIN members has reached around 150.

Under a Typhoon Committee WGDRR initiative, Hong Kong, China, led a project to promote the setting up of community weather stations among Typhoon Committee Members for raising public awareness on climate change and extreme weather. Viet Nam and Lao PDR attended the training workshop organized at HKO during 5-7 November 2014. Viet Nam has installed iCo-WIN weather station at An Hai Secondary School at Ly Son Island in 2015. Testing of data dissemination is on-going. Another training workshop was held in Hong Kong during 2-4 November 2015. DPR Korea and Thailand representatives attended the workshop.

Production of videos to enhance public awareness on tropical cyclone-related hazards (AOP9)- Project 2014

Under a project of Typhoon Committee WGDRR and led by HKO, a short educational video on hazards from tropical cyclones was produced to raise the public awareness of the threats from tropical cyclones. Through real-life visual images from typhoons in recent years, including Morakot, Utor and Haiyan, the video introduces four major threats caused by tropical cyclones, namely, strong winds, rainstorms, huge waves and storm surge.

The videos received worldwide support and were publicized in the international arena. They were premiered at the Third UN World Conference on Disaster Risk Reduction held in Sendai, Japan in March 2015, and have since been uploaded to the World Meteorological Organization (WMO) and Typhoon Committee websites.

Typhoon Committee website:

http://www.typhooncommittee.org/2015/03/19/tc-hazard-video/

WMO website:

https://www.youtube.com/watch?v=PV6cy1MXWxY

e. Benefit evaluation of Typhoon Disaster Prevention and Preparedness

The project aims to evaluate benefits of typhoon disaster prevention and preparedness by analysis of the difference between potential damage and real damage in detail. The potential damage assessment based on daily rain and maximum gust data in 2015. The benefit from

improving skill of typhoon track and intensity forecast will be evaluated in 2016. The project welcomes any members who are interested in joining the project or providing the data.

f. SSOP project

The SSOP Project Phase I was completed and the final report was submitted to ESCAP with the audit assessment in May 2015 by TCS. The main outcome of this project is to have successfully elaborated on updating the Manual on SSOP for coastal multi-hazards early warning system and TCS has distributed the said manual to TC members during this IWS. For extending the outcome of the project according to the decision from 3rd TC and PTC Joint Session that was held in Bangkok, Thailand in February 2015. At the IWS, TCS introduced the content of this proposal. WGDRR fully supported this proposal.

g. Regarding AOP 8, WGDRR held a seminar in the 3rd World Conference on Disaster Risk Reduction in Sendai, Japan in March 2015. In the seminar, typhoon disaster preventions on TC's visions and objectives were discussed. Also, the video for making the information of Typhoon more understandable to the public produced by HKO was presented in the seminar.

h. Regarding 2016 WGDRR AOPs, sharing information (e.g. legal framework, policy framework through member countries) was suggested by NDMI. Member countries agreed to include this item as a 2016 new AOP and NDMI will provide the guidelines or a list of questions for members to submit the information. NDMI will collect and compile the information.

i. It was suggested that WGDRR members should share the information of outcome examples, difficulties on response to disasters and lessons learned from past disasters through presentation in the annual WGDRR Meeting.

j. It was suggested to set up an exhibition booth in TC sessions. Each member can bring the materials related to DRR including manuals, advocate materials, etc. and those materials will be exhibited.

k. Regarding TCDIS and the research of benefit evaluation of Typhoon Disaster Prevention and Preparedness, it was agreed to exchange the data of the two projects.

l. WGDRR recognized the needs of sharing information on the existing bilateral cooperation projects such as between Republic of Korea, Philippines, China and Malaysia.

m. It was suggested that TCS coordinate and provide information on the schedules for events within member countries such as international seminars or conferences, training programs etc. through TC website.

RECOMMENDATIONS of WGDRR

80. On the basis of the information provided by the Members and their deliberations, the WGDRR made the following recommendations:

a. To allocate US$20,000 budget of TCTF in 2016 for i) supporting the participation in the next TC Integrated Workshop; ii) supporting the community based weather station pilot project and to provide a training workshop in Hong Kong, China; iii) supporting TCS participating in WGDRR expert mission.

b. To encourage the TC Members to collect and share the disaster information for extending TCDIS.

c. To request NDMI to conduct the expert mission in interested Members in TC and PTC.

d. To continue promotion of the international cooperation for Lao PDR and Viet Nam such as the Northern Mindanao Project by NDMI and PAGASA.

e. To continue the research of benefit evaluation of Typhoon Disaster Prevention and Preparedness and encourage the participation of Member in the project.

f. To set up automatic weather stations for community based weather station project or to provide relevant training in 2016.

g. To encourage the TC Members to share the information of legal framework or policy framework and compile the information into a book.

h. To evaluate KRA 1&2 of TC strategic Plan based on current data and proposes to remove the numerical targets.

i. To encourage the TC Members to share the information on the existing bilateral cooperation projects such as project between Republic of Korea and Philippines, China and Malaysia.

j. To encourage TCS to coordinate and provide information on the schedules for events within member countries such as international seminar or conference, training programs, etc. through TC website.

k. For the AOPs 2016, WGDRR suggested AOP 2015 item 1- 7 will be continued in 2016 and AOP3, 4 and 6 are combined into the AOP3- the project to promote the international cooperation. In the meantime, there is a suggestion to establish the new AOP in item 6 of "Sharing information with members e.g. legal and policy framework ". So there are six suggested AOPs of WGDRR in 2016.

l. To appoint Mr. OH, Keumho (ROK) as Vice Chair of WGDRR, to replace the vacancy of Dr. SHIM, Jaehyun, now the Director General of NDMI of Republic of Korea that had been recommended as Chair from Vice Chair of WGDRR in May at WGDRR annual meeting.

7.4. Training and Research Coordination Group

81. The Committee took note of the progress made in training and research activities as presented in the TRCG Report 2015. (**Appendix XVII**)

82. The Committee expressed its appreciation to the Department of Meteorology and Hydrology (DMH), Lao PDR for hosting the Roving Seminar in Lao PDR, the assistance of WGH for coordinating the speakers, and the support of resource persons by China, Japan and Republic of Korea.

    a. The Roving Seminar 2015 was held in Lao PDR on 4-6 November 2015 with the support of Department of Meteorology and Hydrology and the topic was "Flash Flood and Landslides". It was the first time that Members from Panel on Tropical Cyclones (PTC) were invited to the Seminar and there was a total of 22 participants from Bangladesh, Cambodia, China, Myanmar, Pakistan, Philippines, Lao PDR, Sri Lanka and Thailand. The lecturers came from China, Japan and Republic of Korea and the Seminar was warmly appreciated by the participants.

83. The Committee thanked China, Hong Kong, China and Republic of Korea for hosting research fellowship programs in 2015.

84. The Committee took note of the successful RSMC Tokyo training attachment of six forecasters from TC and PTC Members, including Cambodia, Thailand, Viet Nam, Bangladesh, the Maldives, and Myanmar, and thanked JMA and WMO TCP for continuously supporting this capacity-building initiative.

85. The Committee was informed of the plan to extend the RSMC Tokyo attachment training for TC Members by 2 days for Public Weather Service and to enhance the capacity building in warning development and coordination in the TC region with the financial support from WMO Secretariat.

86. The Committee appreciated TRCG's input in support of training and research activities in connection with TC's cross-cutting projects.

RECOMMENDATIONS of TRCG:

87. On the basis of the conclusions reached by the deliberation of Members, the TRCG made the following recommendations:

a. To request Members to confirm their respective focal points as members of TRCG and update the list of resource persons as appropriate.

b. To endorse the priority training and research areas as proposed in TRCG Report 2015.

c. To endorse the organization of Roving Seminar in Viet Nam in 2016 and consider participation of PTC Members in the Roving Seminar and Research Fellowship Scheme subject to availability of extra funding support and hosting venue capacity.

d. To request WMO to support the extension of the RSMC Tokyo attachment training for TC Members by 2 days for Public Weather Service delivery.

e. To endorse the TRCG AOP and budget request which are included in the budget proposal to be submitted by AWG.

IX. REPORTS OF THE TCS AND AWG (agenda item 9)

9.1 Activities of Typhoon Committee Secretariat (TCS)

88. The Committee took note of the report of the Typhoon Committee Secretariat (**Appendix XVIII**)

89. The Committee noted with appreciation the TCS's activities in 2015 in order to enhance support to Members, increase the role, contribution and visibility of Typhoon Committee, and to enhance transparency and improve efficiency as well as keeping Members informed on all matters of importance by using as many communications methods needed, including improvement of the TC Website. In this context, the Committee invited the TCS to take further measures and actions for transparency and for Members to be more involved.

90. The Session noted with high appreciation that Macao Government for the strong support to TCS in the past years, and for continuing hosting TCS for the 3rd term from 2015 to 2018, and for cooperating to renew and implement the Agreement between the Government of the Macao Special Administrative Region of the People's Republic of China and the ESCAP/WMO Typhoon Committee regarding Administrative, Financial and Related Arrangements for the Typhoon Committee Secretariat. During past year, Macao Government through SMG has supported the recurrent expenses of TCS about US$583,000 including operating costs for maintaining the physical premises occupied by TCS, the office expenses, the facilities provisions and the staff cost.

91. The Committee expressed appreciation to Members for their donation for the Typhoon Committee Trust Fund and in-kind contributions, and encourage Members to continue support activities of the Committee.

92. The Committee noted with appreciation the Members for their cooperation on SSOP project, and encourage continuing the support SSOP phase II to benefit all Members of the TC and PTC.

93. The Committee dealt with related issues under the relevant agenda items.

94. The TCS was requested to further improve the TC Website, to better share information and communication among Members.

95. The TCS was requested to evaluate the effectiveness of the activities in the Committee, with the target to develop Members' capacity.

RECOMMENDATIONS of TCS

96. Based on the experience of routine operation in 2015 and in the past years, and considering needs and possibility, TCS made the following recommendations to TC 48th Session for consideration:

a. To allocate US$28,000 from TCTF for supporting overall TCS activities; US$3,000 for supporting IWS hosting in 2016 and US$2000 for IWS related activities.

b. To express appreciations to Members for their donation for the Typhoon Committee Trust Fund and in-kind contributions, encourage Members to continue support activities of the Committee.

c. The Committee expressed high appreciation and recommends to express thanks to the Government of the Macao Special Administrative Region of the People's Republic of China, and the Macao Meteorological and Geophysical Bureau for the continued support that has been given to the ESCAP/WMO Typhoon Committee Secretariat, which ensured the operations of TCS successful.

d. To thank Members for their cooperation on SSOP project and encourage continuing the support SSOP phase II to benefit all Members of the TC and PTC.

9.2 Activities of Advisory Working Group (AWG)

97. The Committee was informed of the activities of the AWG as presented in the AWG Report 2015 (**Appendix XIX**).

98. The Committee was informed of the preparation of the budget for 2016, including the non-recurring items put up separately for special funding consideration.

99. The Committee was briefed on the major issues discussed at the AWG meeting in Kuala Lumpur, Malaysia on 28 October 2015.

100. The Committee was presented with proposals on the revised long-term mechanisms for appointing the TC Secretary.

101. The Committee expressed its sincere appreciation to AWG for offering advice and support to TC Chairperson and TCS in following up the key issues identified at the last Session and in coordinating key TC activities.

RECOMMENDATIONS of AWG

102. AWG recommended the Committee to:

a. Take note of the progress and recommendations made in the planning and implementation of TC activities, including the preparation of the budget for 2016.

b. Consider the proposed long-term appointment mechanisms of the TC Secretary (refer to Agenda item 10).

c. Take note of the terms of office of Chairperson and Vice Chairpersons of AWG, nominate appropriate candidates for consideration and approval by the Committee in a timely manner.

X. REVIEW OF THE LONG TERM MECHANISM FOR TC SECRETARY APPOINTMENT (agenda item 10)

103. The Committee took note the presentation made by AWG Chair, with the revised procedures on the Long Term Mechanism following the 10th IWS in Malaysia. (**Appendix XX**)

104. The Committee discussed the long term mechanism relating to the appointment of TC Secretary and agreed that the appointment process should also observe the TCS hosting terms and conditions approved at TC Sessions. However, consensus could not be reached on other aspects.

XI. PUBLICATIONS (agenda item 11)

105. The Committee took note of the publications of the Typhoon Committee in 2015.

106. The Committee noted with appreciation that the RSMC Tokyo - Typhoon Center published the "Technical Review No.17" in March 2015 and the "Annual Report on the Activities of the RSMC

Tokyo - Typhoon Center in 2015" in December 2015. These are available on the Web page of JMA/RSMC Tokyo at http://www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-eg/RSMC_HP.htm.

107. The Committee noted with appreciation the all Members' contributions to the publications of Typhoon Committee, which have promoted the visibilities, and transparencies of TC. The Committee further urged Members to take measures and actions for continuing support the TC publication, and making contributions to the TCRR Journal especially.

XII. PROGRAMME FOR 2017 AND BEYOND (agenda item 12)

Strategic Plan 2017-2021

108. The Committee took note of the presentation made by USA related to the new Strategic Plan 2017-2021.

109. The Committee noted the necessity to align with the WMO Strategic Plan and ESCAP targets, and reference the Sendai Framework and other related international processes.

110. The Committee requests TCS to send to Members a request to nominate a focal point and to collect inputs from Members for the new Strategic Plan 2017-2021 and together with USA to prepare the document to be presented to the next IWS, for approval at the next Session.

Retired and new tropical cyclone names

111. The Committee noted Thailand provided BUALOI, PHATTHAI and SOMTAM as replacement names for RAMMASUN.

112. The Committee noted the request from the Philippines to retire the names KOPPU and MELOR and request Japan and Malaysia to provide replacement names.

113. The Committee also noted the request from China to retire the names SOUDELOR and MUJIGAE and requested USA and DPR Korea to provide replacement names.

XIII. COORDINATION WITH OTHER ACTIVITIES OF THE WMO TROPICAL CYCLONE PROGRAMME (agenda item 13)

114. WMO representative presented to the Committee activities under, and those requiring coordination through, TCP. The Committee appreciated the comprehensive presentation, and thanked WMO support to endeavours of the Committee.

115. The Committee was informed by the WMO Secretariat that the 17th Congress of WMO in May-June 2015 gave following guidance to the Tropical Cyclone Programme (TCP), among others:

- to expand and consolidate further the regionally coordinated systems to cover all Members prone to tropical cyclones;
- to enhance the capacities of Members to provide more accurate forecasting and warning services which are impact-based and in multi-hazard approach (which is also a decision of EC-66);
- to improve forecasting and warning capabilities of Members through advances in sciences and technologies, and capacity development; and
- to reduce damage and loss of life through the above institutionalized activities and arrangements, and in step with the developmental goals of the Sendai Framework.

116. The Committee was informed that collaborative actions were 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. They are: North Western Pacific – Tropical Cyclone Ensemble Forecast Project (NWP-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 focus on the verification of TC forecast guidance produced in the Typhoon Committee region to assess the currently available forecast techniques. It was further informed that the 17th WMO Congress requested the WMO Secretariat to take necessary actions for sharing the outcomes of NWP-TCEFP and TLFDP between the regional TC bodies, and endorsed extension of the NWP-TCEFP and TLFDP until 2018 to incorporate the outcomes into operational TC forecasting services.

117. The Committee was informed of WMO support for the project "Experiment on Typhoon Intensity Change in the Coastal area (EXOTICCA)" being taken forward by the 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, with expectation of further coordination through Working Group on Tropical Meteorological Research (WGTMR) and TCP.

118. The Committee was also briefed about the TCP activities during the inter-sessional period in the areas as follows:

- Training and Capacity Development

TCP/PWS joint training courses/workshops on TC Forecasting and Public Weather Service were held for RA I TCC (La Reunion, September 2015), RA IV Hurricane Committee (USA, March 2015) and RA V TCC (Melbourne, Australia, October 2015), and attachment training for both Panel on Tropical Cyclones and Typhoon Committee (RSMC Tokyo, July 2015), International Training Workshops on Tropical Cyclone Forecasting and Warnings (New Delhi, India, August 2015, Nanjing, China, December 2015) and the 2nd International Workshop on Satellite Analysis for Tropical Cyclones (February 2016).

- Support to Operational Forecasting

Global Guide to Tropical Cyclone Forecasting was announced available during the Cg-17 in May 2015. The new Guide is Web-based and can be accessed through the link (https://www.wmo.int/cycloneguide/). The Guide is expected to achieve synergetic effect with the TC Forecaster Website (http://severe.worldweather.wmo.int/TCFW/) hosted by Hong Kong, China.

- Global Coordination

The 8th TC RSMCs/TCWCs Technical Coordinating Meeting was held in Miami, Florida, USA, 2 – 6 November 2015, to discuss issues in relation to global coordination on tropical cyclones.

TC Regional Bodies

- Annual/biennial sessions of two of the other four regional TC committees were held as follows:

  I. The 37th session of the RA IV Hurricane Committee was held in San Jose, Costa Rica 13 to 17 April 2015.

  II. The 21st session of the RA I Tropical Cyclone Committee (TCC) was held in La Reunion, France, from 28 September to 2 October 2015.

119. The Committee was informed that the scope of activities of the regional TC Committees had been expanded through involvement with the WMO's cross-cutting projects such as the Severe Weather Forecasting Demonstration Project (SWFDP), Coastal Inundation Forecasting Demonstration Project (CIFDP) and Disaster Risk Reduction projects for Early Warning Systems in Regions I, II, IV and V. The Committees' annual/biennial sessions serve as venues for information sharing of the projects

and their technical plans have incorporated collaborative actions with those projects. Wider cross-cutting project coverage was further needed to reach all the Member countries of the regional TC committees. In addition, a synergistic relationship with other UN agencies and international/regional entities has been developed.

120. The Committee noted that among the priority actions of TCP for 2016 and beyond, such as organization of regional workshops and TC Committees' sessions, the Programme would lay special emphasis on i) promoting tropical cyclone forecasting and warnings services with impact-based and risk-mapped approaches; ii) effective organization of group training sessions in Regions I, IV and V, WMO/ESCAP Panel on Tropical Cyclones, and ESCAP/WMO Typhoon Committee; and iii) global coordination on tropical cyclones.

121. The Committee noted with pleasure WMO support for extending two days of the RSMC Tokyo attachment training to include Public Weather Services portion in the training programme, starting from the year 2016.

122. The Committee commented on linkage of TCP with other WMO Programmes like GDPFS, PWS, etc. It was informed that TCP had been in cross-cutting with major WMO Programmes and projects. The Committee expected that cooperation and collaboration between TCP and other WMO Programmes should be further strengthened.

123. The Committee was briefed of the outcomes and recommendations from the recent workshops on IBTrCAS and IWSATC-II. It recognized the importance of the outcomes from both workshops, and recommended to include the new technologies identified into training activities under TCP.

XIV. SUPPORT REQUIRED FOR THE COMMITTEE'S PROGRAMME (agenda item 14)

14.1. Technical Cooperation

124. The WMO report of technical cooperation activities was not available during the Session. Documentation will be posted on TC Website when available.

14.2. In-kind Contributions

125. The Committee expressed appreciation for the in-kind contributions from some Members, namely China; Hong Kong, China; Japan; Macao, China; The Philippines; Republic of Korea, and Thailand. The Committee also invited the other Members to report their in-kind contributions, quantifying the corresponding unit of Man-months that have consumed in actions related to TCTF projects. (**Appendix XXI**).

126. The Committee also expressed the importance of having in-kind contributions with correspondence values.

14.3. Typhoon Committee Trust Fund (TCTF)

127. The Committee reviewed the final statement of account of TCTF for the period of 1 January to 31 December 2014 and the interim statement for 1 January to 31 December 2015 submitted by the representative of the WMO Secretariat as shown in **Appendix XXII**.

128. The Committee was informed by TCS, the summary of income and expenditure from 1 January to 31 December 2013 and 2014 and the provisional summary of income and expenditure for 2015 related to the execution of the Work Plan 2015. (**Appendix XXIII**)

129. The Committee discussed about the special budget request mechanism and took note of the balance of TCTF. Thailand, in view of the current balance of the Trust Fund, proposed the possibility of decreasing Members' annual contributions to be considered at the next Session.

14.4. Approval of Typhoon Committee Trust Fund (TCTF) 2016

130. The Committee discussed the budget proposal for 2016. (**Appendix XXIV**)

XV. DATE AND PLACE OF THE 11th IWS (agenda 15)

131. The Committee was informed that the Philippines would host the 11th IWS. The proposed dates tentatively 24-28 October or 07-11 November 2016. The final date and place will be confirmed in due course by Philippines and later communicated to TCS.

XVI. HOSTING OF THE 12th IWS/3RD TRCG FORUM (agenda 16)

132. The Committee was informed that Republic of Korea will host the 12th IWS/3rd TRCG Forum. The final date and place will be confirmed in due course by Republic of Korea and later communicated to TCS.

XVII. DATE AND PLACE OF THE 49th TC SESSION (agenda 17)

133. The Committee was informed that Japan will host the 49th Session. The proposed date is 20-23 February 2017. The date and place of the Session will be confirmed in due course by Japan and later communicated to TCS.

XVIII. HOSTING OF THE 50th TC SESSION (agenda 18)

134. The Committee noted that Viet Nam has agreed to host the 50th Session of the Committee. Proposed dates and place will be confirmed in due course.

XIX. OTHER BUSINESS (agenda item 16)

135. The Committee noted the presentation on Sharing Information presented by RSMC Tokyo. (**Appendix XXV**).

136. The Committee noted the necessity on information data sharing and request TCS to solicit Members to provide a list of links to their information, data and forecast products to be share.

XX. ADOPTION OF THE REPORT (agenda item 17)

137. The Committee adopted the report of the session at 12:47 pm, 25 February 2016.

XXI. CLOSURE OF THE SESSION

138. The delegates from the Members of the Typhoon Committee, representatives of WMO and TCS expressed their thanks and appreciation to the NOAA, USA for the successful hosting for organizing the Forty-Eighth Session of the Typhoon Committee. They also expressed gratitude to Mr. Raymond TANABE, Pacific Region Director and his staff for the warm hospitality and excellent arrangements made.

139. The Session was closed by the Chairperson at 13:05 pm, 25 February 2016.