WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

REGIONAL SUBPROJECT MANAGEMENT TEAM (RSMT) OF THE SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP) IN SOUTHEAST ASIA

Ha Noi, Viet Nam, 11-14 August 2015

FINAL REPORT

1. OPENING

The Meeting of the Regional Subproject Management Team (RSMT) of the Severe Weather Forecasting Demonstration Project (SWFDP) for Southeast Asia opened at 09:30 hours on Monday, 11 August 2015, at the National Hydro-Meteorological Service (NHMS) of Viet Nam, in Ha Noi, Viet Nam. Opening and welcome remarks were made by Mr. Tran Hong Thai, Deputy Director General of National Hydro-Meteorological Service (NHMS) of Viet Nam, and Mr Abdoulaye Harou, Chief of Data Processing and Forecasting System (DPFS) Division at World Meteorological Organization (WMO) Secretariat.

Mr. Tran Hong Thai highlighted the development activities carried at the Regional Forecast Support Centre (RFSC), Ha Noi for better limited area high-resolution numerical weather prediction (NWP) products and for the issuance of RFSC Daily Guidance for the NMHSs in Southeast Asia with the objective of improving the accuracy and lead-time of severe weather warnings, and to improve warning services to various users such as the media and the disaster management organizations at the national levels. He remarked that various kinds of hydrometeorological disasters affected several parts of the world in recent years like heavy rains, flash floods, floods, typhoons, storm surges, droughts, and heat waves which has reemphasized the need to have closer cooperation among the countries in the world to exchange observational data and forecast products and exchange expertise in climate variability and climate change including capacity building and technology transfer in concerned areas. For this reason, the SWFDP-Southeast Asia was developed with the aim to contribute to capacity-building of the NMHSs and to help developing countries in using the existing NWP products through a “Cascading Forecasting Process”. He acknowledged the steady progress of SWFDP in Southeast Asia since first meeting of RSMT in October 2011 and that Viet Nam was pleased to host the second meeting as another important step towards the project implementation plan. Mr Tran Hong Thai noted the importance of the WMO support to SWFDP which is helping the NMHSs in developing countries and least developed countries (LDCs) to improve their services in severe weather forecasting and delivery of warnings and alerts for hydrometeorological hazards. He acknowledged the support of contributing global, regional and national centres and wished for the success of the second meeting of RSMT in effectively updating the project implementation plan for the next years.

On behalf of the Secretary-General, Mr Abdoulaye Harou expressed sincere appreciations to the Government of the Socialist Republic of Viet Nam for hosting this event in Ha Noi and to the NHMS of Viet Nam for arranging for the meeting facilities. He mentioned the importance of improving severe weather forecasting in climate change scenario as climate change is manifested through extreme weather events in terms of frequency and/or intensity. He remarked that ever-increasing precision, reliability and lead-time provided by NWP systems have led to increasingly skillful weather forecasting over the last two decades and will become even more relevant in the future. It is in this context that the SWFDP is intended to enhance the use and application of outputs of latest state-of-the-art NWP systems, available through WMO, to improve severe weather forecasting in countries where such NWP outputs are poorly used and to deliver timely warning services to the users. He also extended WMO gratitude to Mr Tran Hong Thai, Deputy Director General of NHMS and his staff including the local organizing committee for their excellent work in making arrangements for the meeting.

Mr Harou also expressed his gratitude to the participating global and regional centres for their continuing support to the SWFDP-Southeast Asia. He also thanked Mr Yuki Honda, representative of WMO Regional Association II to the CBS Steering Group on SWFDP, for his hard work in leading the development of the SWFDP Southeast Asia project and for agreeing to act as the Chair for this meeting.

2. ORGANIZATION OF THE MEETING

2.1 Adoption of the agenda

The meeting adopted the provisional agenda, which is found in **Annex I** of this report.

2.2 Working arrangements

The meeting agreed on the organization of its working hours and session arrangements. All documents that were submitted for the consideration of the meeting have been placed on the WMO web site at:

http://www.wmo.int/pages/prog/www/BAS/CBS-meetings.html

2.3 The meeting was attended by all RSMT members (or their alternates) except from Hong Kong Observatory (HKO) and Deutscher Wetterdienst (DWD), Germany. The meeting welcome the joining of the Philippines as a participating country and ECMWF as a contributing global centre in the SWFDP-Southeast Asia. A list of the participants is found in **Annex II** of this report.

3. INTRODUCTION TO SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP)

3.1 Overall Framework

The Secretariat provided background information on the SWFDP framework, including guidance from the Commission for Basic Systems (CBS) provided through its Steering Group on the SWFDP, through its basic documents: *SWFDP Overall Project Plan* and *SWFDP Guidebook for Planning Regional Subprojects* and then described the progress made so far in the development and implementation of SWFDP regional subprojects in various regions including especially the SWFDP-Southeast Asia. The meeting was informed that the SWFDP has proven to follow a systematic and practical approach for developing capacity of the NMHSs on improving use of the NWP outputs and satellite information, and for transferring new knowledge and skills to the forecasters. The SWFDP which was started with involvement of just six countries in southeast Africa in 2006 has now been benefitting to 45 developing countries including LDCs and Small Island Developing States (SIDSs) in Southern Africa, Southwest Pacific, Eastern Africa, Southeast Asia, Bay of Bengal and Central Asia. The development of SWFDP regional subprojects in Western Africa, the Caribbean and Southeast Europe is also envisioned within next couple of years.

3.2 Summary of experience and progress of the SWFDP Development for Southeast Asia

3.2.1 The meeting reviewed the progress since the first meeting of RSMT held in Ha Noi, Viet Nam, in October 2011.

3.2.2 The meeting noted that the Philippines and ECMWF joined the subproject as a participating country and as a contributing global centre in May 2012 and in March 2015 respectively. Further, for the capacity development of the benefitting countries on making use of the NWP and satellite products in improving severe weather forecasting and warning services, two training workshops were held in Macao, China in April 2013 and in Quezon City, Philippines in June 2014. In the Philippines workshop, the participants also practiced on how to develop a RFSC Daily Guidance product with consensus. The RFSC Ha Noi started the issuance of Daily Guidance for both Short-range (1-2 days) and Medium-range (3-5 days) towards the NMHSs as per agreed format in 2015.

3.2.3 The meeting understood that the delay of the start of the project from its original estimate of April 2012 was due to a variety of reasons, however it allowed for a more reasonable development period for the project, including the project's Website, capacity development of the NMHSs, availability of more advanced NWP and satellite products by the global and regional centres, and RFSC Daily Guidance product. Considering the latest development, the meeting noted that it is high time to review and update the regional subproject implementation plan (RSIP) including defining time line to start the demonstration of the subproject as soon as possible.

3.3 Synergy with other projects in the region: GIFS-TIGGE products produced by MRI/JMA

3.3.1 On behalf of Dr Munehiko Yamaguchi (Meteorological Research Institute (MRI), JMA), Dr Mio Matsueda (University of Tsukuba), and Dr Richard Swinbank (Met Office in the UK), Mr Naohisa Koide presented the Global Interactive Forecast System (GIFS) - THORPEX Interactive

Grand Global Ensemble (TIGGE) products of tropical cyclone and severe weather events for SWFDP.

Tropical cyclone

3.3.2 The North Western Pacific Tropical Cyclone Ensemble Forecast Project (NWP-TCEFP), a joint project by the WMO Tropical Cyclone Programme (TCP) and the World Weather Research Programme (WWRP), was launched in 2009 with the aim to explore the utility of ensemble forecast products based on TIGGE Cyclone XML (CXML) data and to promote such products for operational TC forecasting. MRI/JMA has operated a password-protected website (http://tparc.mri-jma.go.jp/cyclone/login.php) to provide TC ensemble forecast products on a real-time basis in the western North Pacific for the ESCAP/WMO Typhoon Committee and the SWFDP in Southeast Asia (SeA) (http://www.wis-jma.go.jp/swfdp/ra2_swfdp_sea_tigge.html). It was confirmed through the two questionnaires by the Committee in 2011 and 2012, that the products have been utilized by the Members.

3.3.3 RSMT noted with appreciation that RSMC Tokyo - Typhoon Centre, following the said outcomes, plans to provide TC ensemble products in the western North Pacific of ECMWF, UKMO, NCEP and JMA in real time to the Numerical Typhoon Prediction website, if necessary data are provided from these Centres.

Ensemble products for severe weather events

3.3.4 MRI/JMA has operated a website (http://tparc.mri-jma.go.jp/TIGGE/tigge_SWFDP.html) which displays risks of severe weather events (e.g. heavy rainfall, extreme high/low temperature, and strong wind) using the TIGGE data from 4 NWP centres (ECMWF, JMA, NCEP and UKMO) approximately 2 days after the initial time of the forecasts, under a collaboration with University of Tsukuba. The forecast probability of the occurrence of severe weather events is defined based on each NWP model's climatological probabilistic density function (Matsueda and Nakazawa 2014). The website is automatically updated every day and includes forecasts up to 15 days ahead. A brief description of the products is also available on the website.

3.3.5 RSMT noted that JMA and the Met Office in the UK work together to make the products available in real-time for SWFDP, and, as a first step, currently being provided to the South Pacific (SWFDDP) region by the RSMC Wellington (www.swfddp.metservice.com), according to the needs identified by a questionnaire survey conducted by the THORPEX GIFS-TIGGE Working Group in 2012. It was proposed in accordance with discussion between RSMC Tokyo and RFSC Ha Noi that the products be preferably provided to the SWFDP-SeA through the RFSC website, similarly to SWFDDP if agreed by the four Centres (ECMWF, JMA, NCEP and UKMO). RSMT appreciated this initiative by JMA and UKMO and requested RSMC Tokyo to seek agreement for RFSC Ha Noi displaying the product.

3.3.6 The point of contact of the GIFS-TIGGE products is Dr Munehiko Yamaguchi (email: myamagu@mri-jma.go.jp) of the MRI-JMA.

4. SATELLITE DATA-PROCESSING SYSTEMS AND PRODUCTS FOR VERY SHORT-RANGE FORECASTING, INCLUDING NOWCASTING, IN RA II

HIMAWARI-8 and its Products to Support Severe Weather monitoring in Southeast Asia

4.1 The issuing of warnings of imminent threat (as part of forecasting in the first few hours of the forecasting range) requires specific tools, and therefore, in absence of adequate radar coverage, the useful products generated by satellite data-processing systems for very short-range forecasting is highly desired. In this context, the meeting was presented with a brief report on Himawari-8 and its products to support severe weather monitoring in Southeast Asia by Mr Yuki Honda from JMA.

4.2 JMA launched its geostationary meteorological satellite, Himawari-8, on 7 October 2014 and started Himawari-8 operation at 02:00 UTC on 7 July 2015, replacing the previous operational satellite, MTSAT-2. Himawari-9 will also be launched in 2016 as a backup and successor satellite.

Both satellites are located around 140.7 degrees east, and observe the East Asia and Western Pacific regions for a period of 15 years.

4.3 Himawari-8 and -9 have 16 bands. Full-disk imagery is obtained every 10 minutes, and the target area observation at 2.5-minute intervals is conducted.

4.4 JMA provides the products derived from Himawari-8 on JMA's SWFDP website at http://www.wis-jma.go.jp/swfdp/ra2_swfdp_sea_sat.html. The following products are provided and updated every 10 minutes in a pictorial form with the rectangular domain of (30°N, 90°E) and (15°S, 165°E).

I. Traditional-band imagery of visible imagery (B03), infrared imagery (B13), water vapor imagery (B08) and short-wave infrared imagery (B07)
II. True-color composite imagery: This is created with three visible bands corresponding to red, green and blue. This imagery looks as if human sees the earth from the space. This imagery is only available in the daytime.
III. Imagery with heavy rainfall potential areas: This provides information about the possibility of rainfall associated with deep convective clouds. Convective clouds detected from Himawari-8 data are colored in magenta and superimposed on infrared imagery. The Himawari-8 based product has the approximately-same property as the MTSAT-2 based product because the Himawari-8 observation bands used to detect convective clouds are similar to the MTSAT-2 bands.
IV. RGB composite products: Various RGB composite products are produced in accordance with WMO standard procedure. The website provides 7 RGB composite products: Air mass, Day natural color, Day microphysics, Convective storms, Night microphysics, Desert dust and Day solar. User's guide is available from:

http://www.data.jma.go.jp/mscweb/en/VRL/VLab_RGB/RGBimage.html

4.5 The products for the latest one day are available on the said JMA's SWFDP website. JMA may provide the past products on request since JMA stores them for the last one and half months.

4.6 The RSMT was informed of the 6th Asia/Oceania Meteorological Satellite Users' Conference to be held from 9 to 13 November this year in Tokyo, Japan. In conjunction with the Conference, JMA plans to organize two training events for capacity development of NMHSs in the Asia and Pacific regions. This Conference and two training events will be very useful for the development and improvement of satellite data utilization at national levels. JMA welcomes a lot of participants to the conference.

SCOPE-NWC Products for Nowcasting

4.7 The Secretariat informed the meeting that through WMO Space Programme, satellite-based new precipitation products have been developed and made available to SWFDP regional projects including in Southeast Asia, under the framework of the Sustained, Co-Ordinated Processing of Environmental Satellite Data for Nowcasting (SCOPE-NWC). The NMHSs will be able to select their SWFDP geographical region, as appropriate. These products are available at: http://sigma.cptec.inpe.br/scope/.

4.8 The SCOPE-NWC Products include:

- The TRMM multi-satellite precipitation analysis (TMPA) -real time version- product: Cumulated Precipitation in the last 24, 48 and 72 hours.
- Global Hydro-Estimator (GHE) Product : Real Time Precipitation Intensity (2 hours latency)
- Forecasting and Tracking Active Cloud Clusters (ForTrACC): Nowcasting of precipitation intensity (3 hours in Advance)
- The TRMM multi-satellite precipitation analysis (TMPA) -real time version- dataset: This dataset is provided by NASA GEO DIS. The TMPA-RT 3-hourly binary data files can be uploaded at the following webpage:

ftp://disc2.nascom.nasa.gov/data/TRMM/Gridded/3B42RT/

4.9 The reference material on the SCOPE-NWC products have already been sent to the NMHSs through respective RSMT Members via emails and the web link to access to these products has also been made available on RFSC Ha Noi web portal.

4.10 Further information and/or explanation can be obtained from Mr Stephan Bojinski (from the WMO Space Programme) at the WMO Secretariat.

5. CASCADING FORECASTING PROCESS: ROLES OF PARTICIPATING CENTRES IN SWFDP-SeA

5.1 Global Centres: CMA, JMA, KMA, ECMWF and DWD

5.1.1 The representatives of these centres informed the meeting of the general features of their respective global and regional NWP production systems and products that contribute to the SWFDP-SeA. The main points are summarized as follows:

China Meteorological Administration (CMA)

5.1.2 Ms. Mao Dongyan, the representative of CMA presented the CMA's contributions to SWFDP-SeA as a global products centre. CMA joined the work at the beginning of SWFDP-SeA in 2010. As one of the global centres for SWFDP-SeA, CMA did its best to support the project. CMA has set up a special website for SWFDP-SeA (http://eng.weather.gov.cn/swfdp/) and developed three kinds of guidance products to display though this website. The deterministic numerical weather prediction (NWP) products, with 6-hourly out to 72 hours and 12-hourly up to 144 hours, are mainly the synoptic weather analysis for different elements. The ensemble prediction system (EPS) products, with 12-hourly out to 144 hours are the station forecast of different meteorological elements, including total cloud cover, total precipitation, 10m wind speed and 2m temperature for the five countries in Southeast Asia. Moreover, the tropical cyclone strike probability and EPS tracks are also included in this kind of product. FY-Satellite images are displayed with 15 minutes interval in flood season.

5.1.3 Regarding NWP activities, CMA has been focusing on the development of the new-generation global-regional unified numerical prediction system Global/Regional Assimilation and PrEdiction System (GRAPES) since 2001. Global scale GRAPES_GFS has been applied for medium-range quasi-operational forecast since 2009, with the resolution around 50km. CMA scientists have gained valuable knowledge and experiences in core technologies for NWP, including numerical model development, optimization of physical processes, four-dimension variational data assimilation, and satellite remote sensing assimilation, etc. Details are:

a) Discretization scheme and solution to non-hydrostatic compressible equations have been developed, which further advance the study of new techniques for numerical calculation, such as conservative semi-Lagrangian advection scheme and matrix method for solving equations governing atmospheric motion;
b) Breakthroughs have been achieved in the development of precipitation parameterization scheme and double-parameter cloud physics parameterization specifically designed for East Asia monsoon zone;
c) Three- and four- dimensional variational data assimilation technology has been grasped and further developed in radar and satellite remote sensing assimilation, representing an important breakthrough in numerical prediction study in China.

5.1.4 In 2015, the construction of CMA operational system with a focus on GRAPES_GFS is as follows:

i. GRAPES_GFS (25km resolution, 60 levels in the vertical) will be applied for operational forecast;
ii. Development of SPPT scheme for GRAPES global ensemble forecast will be finished and verified; testing system for initial perturbation and SPPT scheme will be set up;

iii. New techniques related to GRAPES_GFS typhoon prediction will be developed, including BDA vortex initialization scheme and optimization of physical schemes;
iv. Effects of mixing perturbations and SPPT perturbation schemes in generating initial conditions for GRAPES ensemble forecast system will be evaluated; mixing scale initial perturbation scheme and SPPT random physics perturbation scheme will be upgraded;
v. The dynamic framework of GRAPES will be further improved. Development of hybrid vertical coordinate system will be finished and tested; development and test of stable extrapolation semi-Lagrangian scheme will be finished; codes for unequal spacing, second-order accuracy finite difference scheme in the vertical direction will be rewritten;
vi. Interaction between resolving-scale cloud physics and sub-grid scale convective process will be investigated with a focus on optimization of cloud-precipitation process; prediction of low clouds and tropical clouds will be improved and optimized; errors in GRAPES forecast of tropical circulation will be reduced.

5.1.5 Regarding capacity development, CMA actively supported the training work for SWFDP-SeA. In 2010, two experts participated and gave lectures on NWP technology and severe weather forecasting technology in the SWFDP-SeA meeting in Ha Noi. In 2011, CMA dispatched one expert to the SWFDP-SeA regional training workshop on severe weather forecasting in Hong Kong, China. In the future, CMA will continue to actively support the work of SWFDP-SeA. For the SWFDP training which will be held in Bangkok in September 2015, three Chinese experts will give lectures in the fields of Nowcasting, NWP and Meteorological Information Comprehensive Analysis and Processing System (MICAPS). In addition, according to the requirements and needs from the users, CMA will develop its technical supports and enrich the guidance products. Two points will be emphasized, the application of NWP and nowcasting techniques in the weather operation, and the continuous support of MICAPS.

Japan Meteorological Agency (JMA)

5.1.6 Mr. Yuki Honda presented JMA contributions to SWFDP-SeA. JMA has supported SWFDP-SeA since the first kick-off workshop (Ha Noi, February 2010) and participates as a global centre, as a regional centre (RSMC-Tokyo) and as a satellite centre (Meteorological Satellite Centre). JMA also provides additional products available from its other international services (see below).

5.1.7 JMA dispatched two lecturers to the SWFDP-SeA and SWFDP-BoB joint training workshop on severe weather forecasting and warning services (Macao, China, 8-19 April 2013) and two lecturers, to the SWFDP-SeA training workshop (Quezon City, the Philippines, 2-7 June 2014).

5.1.8 JMA operates a deterministic global model, the Global Spectral Model (GSM; TL959L100), four times a day (at 00, 06, and 18UTC with a forecast range of 84 hours and at 12UTC with a forecast range of 264 hours). JMA also operates the global ensemble prediction system for one-week forecast (WEPS). It runs twice a day at 00UTC and 12UTC and the forecast range is 11 days. The WEPS was upgraded in March 2014 for enhancing its operation frequency from once a day to twice a day. More detailed information on the JMA NWP systems are available on the following website: http://www.jma.go.jp/jma/en/Activities/nwp.htm

5.1.9 The complete list of the available products of GSM and WEPS for SWFDP-SeA is found in Annex A of the Regional Subproject Implementation Plan (RSIP). The products of forecasts from 00UTC and 12UTC initials are available. It is noted that the GSM products of 00UTC runs are limited to 84 hour forecasts while the GSM products of 12UTC runs fully cover 5 day forecast range essential for the operation of SWFDP-SeA. The products of the ensemble prediction system (EPS) are provided from 00 UTC and 12UTC runs. Although JMA provided WEPS's products once a day in the past, it started to update the products twice a day on 9 July 2014. With the request from PAGASA, JMA started producing EPSgrams for 27 Philippines cities on 13 August 2014 in addition to the cities in the other participating countries.

5.1.10 All the products are provided in graphical format with both low and high resolutions on the dedicated website of JMA for SWFDP: http://www.wis-jma.go.jp/swfdp/index.html. Products of the latest 7 days are available on the website.

5.1.11 The RSMT was also informed of the various international services that JMA offers as a RSMC with geographical specialization: (1) JMA's website (http://www.wis-jma.go.jp/ddb/) under the WMO Information System (WIS) project where the data and products of GSM are provided in near real time in both binary and graphical formats as well as the monthly verification results of GSM using WMO standard methods; (2) JMA High-Resolution GSM Data Service (http://www.wis-jma.go.jp/cms/gsm/) where JMA provides the high-resolution grid-point value (GPV) data of GSM in GRIB format with the horizontal grid interval of 0.25 degree at the surface level and 0.5 degree at pressure levels; (3) RA-II Project on the Provision of City-Specific Numerical Weather Prediciton Products to Developing Countries, in which JMA provides meteograms at about 300 cities in 18 RA-II members twice daily via the Internet; and (4) JMA Pilot Project on EPS Products (http://eps.kishou.go.jp/EPSMRFA/), in which JMA provides the probability map of 24-hour accumulated precipitation, spaghetti diagrams for 500hPa geopotential height, and time-series point guidance (EPSgram) for major cities in Asia.

5.1.12 JMA is a Lead Centre on Verification of EPS and operates its website. The accuracy of the EPS products of worldwide NWP centers including JMA are reported on the website: http://epsv.kishou.go.jp/EPSv/.

Korea Meteorological Administration (KMA, Republic of Korea)

5.1.13 Mr Hyun-Cheol Shin briefed the meeting on KMA contributions to the SWFDP-SeA as a global centre. The performance of KMA's global NWP system has been gradually improved since the introduction of the Unified Model (UM) system from the UK Met Office in 2010. In 2011, the global model resolution was upgraded from 40km to 25km in the horizontal, and 50 to 70 levels in the vertical, providing more reliable NWP products to forecasters. In 2013, a global hybrid data assimilation system - combining 4DVAR with the ensemble forecast system - was launched operationally. The hybrid system makes use of ensemble forecast data to better represent the structure of "Errors of the Day", and gives improvements across a wide range of forecast scores, particularly over Asia.

5.1.14 In 2013, a dedicated web site was established to manage KMA's international NWP cooperation activities more effectively (http://www.kma.go.kr/ema/nema03). This site consists of 3 sections: 'SWFDP', 'RAII' and 'Africa'. 'SWFDP', which is KMA's contribution to the WMO SWFDP-SeA project, provides NWP output for 71 cities in 4 South East Asian countries. 'RAII', which is KMA's contribution to the WMO RAII Project on city-specific NWP forecasts, supports 20 Asian countries (287 cities) with a range of NWP forecast products. Positive comments on the usefulness of this site have been received from several Asian countries.

5.1.15 The Philippines became a member of SWFDP in May 2012, but EPSgrams for the Philippines are not yet available. Instead, KMA is providing NWP output for 27 cities in the Philippines through the RAII Project on City-specific NWP forecasts. KMA will complete the work to support the Philippines as a part of SWFDP shortly.

5.1.16 KMA's 4th supercomputer system (Cray), which has a total capacity of 5.8PF (Peta Flops), will be introduced in 2016. This will enable KMA to introduce a new global model with more stable dynamics, and upgrade the horizontal resolution from 25km to 17km. This improved global model, supported by a higher-performance computer, will help KMA play a better role as a global centre of SWFDP-SeA.

5.1.17 In 2011, KMA established KIAPS (Korea Institute of Atmospheric Prediction System) to develop KMA's next generation global model. KIAPS has a plan to finish its mission by 2019. After the KIAPS model has been developed, its performance will be compared with the current global model based on the UM, and its suitability for operational use will be evaluated.

The European Centre for Medium-range Weather Forecast (ECMWF)

5.1.18 Ms Anna Ghelli, representative of ECMWF informed the meeting on ECMWF contributions to the SWFDP-SeA as a global centre. The ECMWF specialises in global numerical weather

prediction for the medium range (up to two weeks ahead). ECMWF also produces extended-range forecasts for up to a year ahead, with varying degrees of detail.

5.1.19 The set of products agreed with WMO from the high resolution (HRES) deterministic forecast (16 Km) and the ensemble forecasting system (ENS, horizontal resolution: 32 Km) will be made available on ECMWF in early 2016, as soon as ECMWF finishes the migration from the old website to new website: www.ecmwf.int.The agreed products will be provided at the native model resolution, which it is expected to increase during the first half of 2016. The new resolutions will be 9 Km (approximately) for HRES and 16 Km (approximately) for ENS.

5.1.20 ECMWF will participate to WMO training events in order to provide basic training on the use of ECMWF data and products.

5.1.21 ECMWF has recently introduced a new licence (available to WMO NMHS) for graphical products and access to ECMWF visualization tool (ecCharts). This licence costs 3500 Euros per annum.

Deutscher Wetterdienst (DWD, Germany)

5.1.22 Dr Detlev Majewski, the representative of DWD could not attend the RSMT meeting, however he provided DWD contribution to the SWFDP-SeA by email.

5.1.23 DWD introduced its new non-hydrostatic global model ICON (ICOsahedral Nonhydrostatic) on 20 January 2015 with a horizontal grid spacing of 13 km (6.5 km over a European nest domain) and 90 layers. ICON replaced the former operational hydrostatic global model GME (20 km, 60 layers). ICON outperforms GME, especially for tropical regions, due to the higher horizontal and vertical resolution, more advanced numerical schemes and state-of-the-art physical parameterizations. In 2016 the operational introduction of a hybrid ensemble-based variational data assimilation (ICON-EDA) including a short-range ensemble prediction system (ICON-EPS) will lead to a significant further improvement of the quality and usefulness of ICON forecasts.

5.1.24 Via the internet DWD provides lateral boundary conditions based on ICON forecasts to more than 35 regional (hydro-) meteorological services worldwide which run the non-hydrostatic regional NWP system COSMO (Consortium for Small Scale Modelling), consisting of the weather services of Germany, Greece, Italy, Poland, Romania, Russia and Switzerland.

5.1.25 DWD collaborates with the National Hydro-Meteorological Service (NHMS) of Viet Nam in the field of regional NWP since October 2000 when NHMS, together with the National University of Viet Nam (VNU) introduced DWD's former regional NWP model HRM with a grid spacing of 28 km and 20 layers. In November 2008, NHMS hosted the 3rd International HRM Workshop, and in 2010 NHMS increased the resolution of its operational HRM to 14 km and began first tests of a 7-km high resolution version. Since 2012 NHMS runs the regional non-hydrostatic COSMO model operationally.

5.1.26 DWD approved that NHMS's National Center for Hydro-Meteorological Forecasting (NCHMF) can plot the ICON data and make available the ICON charts through SWFDP-SeA web portal.

5.1.27 DWD offers a free annual "Regional NWP, Environmental and Climate Modelling Training Course" to all regional (hydro-) meteorological services, the next training is from 15 to 23 February 2016.

Discussion, Remarks and Recommendations

5.1.28 The meeting extended its appreciation to all global centres for their continuing support and contributions to the SWFDP-SeA. The meeting also welcome the joining of ECMWF as a contributing global centre to the subproject.

5.1.29 The meeting requested the Secretariat to coordinate with DWD requesting for provision of ICON ensemble products for SWFDP-SeA and to seek more information about February training at DWD for potential participation of members.

5.2 Regional Centres: RFSC Ha Noi (Viet Nam), RSMC Tokyo (Japan), RSMC New Delhi (India), and Hong Kong Observatory (Hong Kong, China)

Regional Forecasting Support Centre (Ha Noi, Viet Nam)

5.2.1 Mr Du Duc Tien, the representative of RFSC Ha Noi briefed the meeting about the present activities and future plan of RFSC Ha Noi. Currently, all the SWFDP-SeA products are available through RFSC Ha Noi web portal (http://www.swfdp-sea.com.vn). The NWP products, satellite information and development of RFSC Daily Guidance are maintained by the Numerical Weather Prediction and Remote Sensing Division of NCHMF. The NWP products include both deterministic and ensemble forecasts from NCEP, JMA and DWD (horizontal resolutions ~ 14km to 50km) for global scales and SREPS, LEPS, WRF-ARW and COSMO for regional scales (horizontal resolutions ~ 7km to 22km). The satellite products include JMA's satellite images, satellite-based products from JAXA (GSMap), SCOPE-NWC project and storm tracking by NCHMF.

5.2.2 The RFSC Daily Guidance product for heavy rainfall and strong wind over Southeast Asia issued towards the participating NMHSs is generally based on weather analysis and NWP inference. The Guidance for short-range (1-2 days) was started in April of 2015 and the Guidance for medium-range (3-5 days) was started in August 2015. The NMHSs can make use of the Guidance product to enhance their forecasts. Main contents of the Guidance include: i) current synoptic situations (1-2 days, supplementing with current satellite images and surface analysis maps of NCHMF) and longer expectations (3-5 days, analyzing the large scale trends from global model systems (GFS, GSM and ECMWF)), ii) the risk situations for strong wind and heavy rainfall with above criteria for each day, iii) the comments about the degree of confidence for risk areas (high, medium and low) basing on agreements of the different models and agreements of the latest running cycles and other previous running cycles, and iv) the risk maps and risk table are created by forecaster for each day. The Guidance product is issued at 0800UTC every Monday to Friday. In case of extreme weather condition such as typhoon or depressions, NHMS will ensure the Guidance product is available during the weekend. However, NHMS is committed to find a solution to issue the Guidance product on all week days towards the end of 2015.

5.2.3 In near future, besides updating the Himawari-8/9 satellite data from JMA and its related products, the RFSC has planned for the following:

I. To improve the Guidance products

+. Collaboration with RMSC Tokyo to release the guidance in case of having tropical storm (TS) or tropical cyclone (TC) over the Southeast Asia domain.
+.Collaboration with experts from NHMS in SeA to enhance the knowledge of forecast experiences over different countries
+. Verification for the guidance every day to enhance the skill of the forecasters in SWFPD-SeA RFSC Ha Noi team

II. To update the regional NWP:

+. Extending regional model running domain covering the east sea of the Philippines
+. Replacing the SREPS and LEPS systems by 1 system for 5 days ensemble regional forecast with data assimilation (WRF/COSMO/NHM-JMA with ensemble assimilation methods (Kalman Filter)).

The implementation of above activities is dependent on the availability of new computing system for NCHMF which is expected next year.

RSMC Tokyo – Typhoon forecast

a) Operational Services

5.2.4 The representative of RSMC Tokyo – Typhoon Centre, Mr Naohisa Koide reported the current and planned activities of the Centre. The operational products and services of RSMC Tokyo are listed in Annex C.2 of RSIP.

5.2.5 RSMC Tokyo re-launched,the Numerical Typhoon Prediction (NTP) website (https://tynwp-web.kishou.go.jp/NWP/NwpMap/nwp_map.html) on 26 May 2015 with a completely new design for enriched content and improved user friendliness. The new products available include Tropical Cyclone Heat Potential, satellite microwave-based TC intensity estimation, microwave TC snapshot and cross section. RSMC Tokyo plans to provide TC ensemble products such as ensemble track guidance, strike probability, and TC genesis prediction, and multi-scenario storm surge products, in the near future. The website is available only to registered organizations, including the Typhoon Committee Members and participating NWP centres.

5.2.6 The Centre publishes Annual Report on the Activities of the RSMC Tokyo – Typhoon Centre and RSMC Tokyo Technical Review every year for users to understand products and services of RSMC Tokyo. The former includes outlines of its operational products, verification statistics of operational forecasts and the NWP models of JMA, and best track data in table and chart forms, while the latter provide technical details on RSMC Tokyo operational services and research activities (http://www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-eg/techrev.htm).

b) Regional Initiative under the Typhoon Committee

5.2.7 RSMC Tokyo introduced its regional initiatives in the western North Pacific under the Typhoon Committee which are particularly considered beneficial for the SWFDP-SeA and thus should be implemented in a synergetic manner responding to needs/feedbacks from SWFDP-SeA.

Development of Regional Radar Network

5.2.8 Development of Regional Radar Network is a project of the Working Group of Meteorology of the Typhoon Committee to develop a regional radar network in Southeast Asia. As its first step, RSMC has been providing technical assistance to Thai Meteorological Department (TMD) for its development of the national radar network since 2011. With technical assistance by RSMC Tokyo, TMD has experimentally applied the JMA's radar composite techniques to its nationwide radar network, and preliminary study on quantitative precipitation estimation (QPE) technique of its own. RSMC Tokyo continues to provide technical assistance to TMD for further improvements of TMD's radar data quality and introduction of the QPE technique.

5.2.9 RSMC Tokyo also mentioned that currently most of the countries in the region operate weather radar system, but do not utilize well the data for their operational services due to lack of expertise particularly in maintenance, quality control and radar composite techniques. RSMT discussed and noted that quality assured regional radar composite products would enhance regional capacity for nowcasting and severe weather forecasting in order to save life and protect property and livelihood. RSMT agreed that radar data exchange, which is needed to build such composite maps, should be discussed at appropriate regional decision making bodies such as ASEAN SCMG, the ESCAP/WMO Typhoon Committee, and WMO Regional Association(s).

Storm Surge Watch Scheme in the western North Pacific

5.2.10 The development of the Storm Surge Watch Scheme was requested at the 60th Session of WMO Executive Council (Geneva, 2008) in response to the devastating storm surge disaster such as the one caused by Cyclone Nargis in 2008. According to the decision of 41st session of the Typhoon Committee (Chiang Mai, 2009), RSMC Tokyo established a regional Storm Surge Watch Scheme suitable for the western North Pacific.

5.2.11 RSMC Tokyo currently provides storm surge forecast distribution maps since June 2011 and time-series charts of storm surges since June 2012 through the NTP website (https://tynwp-web.kishou.go.jp/). The storm surge products have been enhanced according to Member's needs. As of August 2015, time-series storm surge forecasts are provided to 51 stations; USA (1), the

Philippines (10), Viet Nam (20), Hong Kong China (6), Macao China (1), Republic of Korea (11), and Thailand (2). In 2016, RSMC Tokyo plans to provide multi-scenario storm surge forecasts based on the JMA's Typhoon Ensemble System (TEPS).

5.2.12 While the above storm surge products are provided only within the western North Pacific, RSMC Tokyo could provide technical assistance for Members including those outside the region for them to operate JMA's storm surge models within resources available, according to their requests.

RSMC Tokyo Attachment Training

5.2.13 RSMC Tokyo has organized ESCAP/WMO Typhoon Committee Attachment Training courses every year since 2001 with the support of the WMO Tropical Cyclone Programme (TCP) and the Typhoon Committee to enhance the capacity of Committee members in typhoon analysis and forecasting. In accordance with the decision of the third joint session of Panel on Tropical Cyclone (PTC) and Typhoon Committee (Bangkok, 2015), three Members (i.e. Bangladesh, Maldives and Myanmar) were invited in 2015. The meeting noted with appreciation that RSMC Tokyo explore the further enhancement of the training to incorporate training materials on Public Weather Service, particularly focusing on warning development and coordination, into the training, considering the needs identified at the JMA/WMO Workshop on Effective Tropical Cyclone Warning in Southeast Asia from 11 to 14 March 2014 for capacity developments of risk-based warning developments in the region.

Contribution of RSMC New Delhi – Tropical Cyclone forecast

5.2.14 The representative of RSMC New Delhi, Dr S.D. Kotal presented the comprehensive report on contribution of RSMC New Delhi to the SWFDP-SeA. The list of products and services RSMC New Delhi provides is included in Annex C.3 of RSIP.

Hong Kong Observatory (HKO) –Training and Technical Support

5.2.15 The meeting reviewed the roles of Hong Kong Observatory (HKO), China as the regional centre for training and technical support in the SWFDP-SeA. Mr Sai-tick Chan, the designated representative of HKO could not attend the meeting. However, he provided HKO contribution through email.

5.2.16 The HKO is the national meteorological service in Hong Kong, China. It operates a suite of limited area models (LAM) known as the Atmospheric Integrated Rapid-cycle (AIR) forecast model system, in two forecast domains with horizontal resolution at 10 km and 2 km respectively. The outer 10-km resolution model, named as Meso-NHM, covers the Asian region and is run 8 times a day to generate 72-hour forecasts. The inner 2-km resolution model, known as RAPIDS-NHM, is run on an hourly basis covering an area 19.5 – 25.0 N, 111.2 – 117.1 E with a forecast range of 15 hours. The models were adapted from the Non-Hydrostatic Model (NHM) of the JMA. The responsibilities of HKO as the regional centre for training and technical support in SWFDP-SeA include: helping the RSMT to organize training workshops; providing the NMHSs with the technical support in response to their requests; providing guidance and advice in the use of multi-media facilities at training workshops; and offering advice to participating NMHSs of the SWFDP-SeA on the delivery of Public Weather Service (PWS).

5.2.17 Since the first RSMT Meeting of SWFDP-SeA (Hanoi, October 2011), the HKO has participated in various training activities under the subproject. Mr. Tai-wai David Hui, a PWS expert from HKO, gave lectures in the SWFDP Southeast Asia and Bay of Bengal Training Workshop held in Macau, China in April 2013. The topics covered by Mr. Hui included, among others, dissemination of forecasts and warnings, public education, and dealing with media. Mr. Wai-kin Wong and Mr. Chi-tai Shum of HKO delivered lectures at the SWFDP-SeA Training Workshop held in Manila, the Philippines in June 2014. Their lectures covered the application of NWP and radar-based nowcasting techniques, as well as effective communication skills with the media.

5.2.18 The HKO will also offer a resource person, Dr Kwok-chung Yeung, to give lectures during week-2 of the Training Workshop for SWFDP – Regional Subprojects for the Bay of Bengal and Southeast Asia to be held in Bangkok, Thailand during 14-25 September 2015. Dr. Yeung will cover topics including communication and media as well as working with disaster managers and responders. The HKO is committed to provide continuous support to SWFDP-SeA.

5.2.19 The HKO has also been actively taking part in a number of international services for the NMHSs in RA-II as well as other Regions. Those that are considered relevant to SWFDP-SeA are given below:

- HKO serves as the coordinator of the RA-II Project on the Provision of City-Specific NWP Products to Developing Countries. The key objective of the project is to enable the NMHSs of developing countries to improve their public weather services and to strengthen the public recognition of their services. Apart from HKO, JMA and KMA are currently the other product providers.

- A web portal named the Asian Consortium for NWP Forecast (ACNF) (http://acnf.weather.gov.hk) has been set up under the RA II Pilot Project to support NMHSs in NWP application and development. Two community models, namely CMA-GRAPES and JMA-NHM, and model output and post-processing products were made available to RA II members on the ACNF web portal, with a view to enhancing the capacity and mutual co-operation on NWP, in order to attain more effective disaster reduction and mitigation. The HKO and KMA have been serving as the joint coordinators of the Pilot Project.

- Selected prognostic charts from Meso-NHM are available on the ACNF web portal, along with model products from CMA, JMA and KMA. In 2012, the HKO organised a workshop on "Latest Development on the Use and Interpretation of NWP Models" under the WMO Voluntary Cooperation Programme (VCP) to provide training for users of the mesoscale community models available under the ACNF web portal.

- In May 2014, HKO started operation as a Data Collection or Production Centre (DCPC) for the World Weather Information Service (WWIS) under the framework of the WMO Information System (WIS). The DCPC aims to consolidate official weather forecasts and climatological information for worldwide cities supplied by the respective NMHSs and disseminate the information through the Discovery, Access and Retrieval (DAR) services under WIS. These weather forecasts and climatological information are provided by NMHSs under the WMO WWIS project (http://worldweather.wmo.int). As of May 2015, 166 Members were contributing weather forecasts and climate information for 1,719 cities to the project.

- The HKO also hosts the WMO Tropical Cyclone Forecaster Website (http://severe.worldweather.wmo.int/TCFW/) on behalf of WMO. The main purpose of the website is to assist weather forecasters around the world in gaining access to a comprehensive source of tropical cyclone information useful for operational forecasting. The website provides a portal of real-time information as well as forecast products concerning tropical cyclone development, movement, intensity and structure.

Discussions, Remarks and Recommendations

5.2.20 The meeting appreciated RFSC, Ha Noi, RSMC Tokyo, RSMC New Delhi and HKO for their continuing support and contributions to the SWFDP SeA. The RFSC Ha Noi was requested to improve the password management of SWFDP-SeA website.

Effective Collaboration between RSMC Tokyo and RFSC Hanoi

5.2.21 Mr Naohisa Koide (RSMC Tokyo) and Mr Du Duc Tien (RFSC Ha Noi) reported the outcomes of discussion made between RSMC Tokyo and RFSC Ha Noi during the preparatory meeting on 10 August 2015 on their effective collaboration.

5.2.22 RSMC Tokyo and RFSC Ha Noi agreed, in accordance with the roles and responsibilities of RSMC Tokyo and RFSC Ha Noi described in RSIP, 1) to ensure consistency between RSMC TC advisories and RFSC Hanoi guidance, and 2) to coordinate their products to avoid duplication.

Consistency between TC advisories (issued by RSMC Tokyo and RSMC New Delhi) and RFSC Ha Noi Guidance Product

5.2.23 To ensure consistency between RSMC TC advisories and RFSC Ha Noi Guidance product, RFSC Ha Noi makes its own interpreted regional severe weather forecasting scenario, based on RSMCs TC advisories, in consideration of their TC forecast uncertainties. Also, RSMCs Tropical Cyclones provide information on NWP TC guidance used for operational TC forecasts (incl. verification results) to help RFSC Ha Noi understand RSMC TC advisories.

Coordination of products of RSMC Tokyo and RFSC Ha Noi

5.2.24 Noting that RSMC Tokyo and RFSC Ha Noi operates password-protected websites, the meeting recommended that tropical cyclone related products be consolidated and provided through the NTP website operated by RSMC Tokyo, while severe weather related products, other than those of NTP website, be provided through the SWFDP-SeA website operated by RFSC Ha Noi. RFSC Ha Noi will display RSMC TC advisories on its warning area map at the SWFDP-Sea website. If RSMC Tokyo has severe weather related products which are considered appropriate for RFSC Ha Noi to provide through its SWFDP-SeA website, RSMC Tokyo makes coordination for RSFC Ha Noi to provide them through it. If RFSC Ha Noi has their own TC related products which are considered useful, RFSC Ha Noi share them with and request RSMC Tokyo to provide them through NTP website.

5.3 National Meteorological Centres: Cambodia, Lao PDR, Philippines, Thailand, Viet Nam and Myanmar

5.3.1 The representatives of Cambodia, Lao PDR, the Philippines, Thailand, Viet Nam and Myanmar provided updates on severe weather forecasting and warning services in their respective countries, including on use of the NWP and satellite products made available through SWFDP-SeA and on any changes to their forecasting and services programmes, and on follow up activities or impacts of the SWFDP training that they received in Macao, China in April 2013 and in Quezon City, Philippines in June 2014. The meeting was informed that though Myanmar is a participating country in SWFDP-Bay of Bengal, it was especially invited to the RSMT meeting of SWFDP-SeA as an observer for its early involvement in the process as per request of the Permanent Representative of Myanmar with WMO.

Cambodia

5.3.2 Ms Bin Chann Mony, representative of Cambodia informed the meeting that the Department of Meteorology in Cambodia is responsible for monitoring the weather condition and issuing the weather forecast to the relevant ministries and public. Severe weather affecting the country includes: heavy rain, thunderstorm, lightning, wind gust, flood, flash flood and tropical cyclone.

5.3.3 The Department of Meteorology has fully utilized the skills learned from the SWFDP training workshops on making use of the various NWP/EPS products from global and regional centres. The Forecaster Team had developed their capacity on applying those products including RFSC Guidance efficiently in issuing accurate weather information to the users. The lead time of warnings has improved especially, for heavy rainfall, strong winds, severe thunderstorm and tropical storm track events. Additional guidance products required from the Global and Regional Centres include: flood, flash flood guidance, very-short-range forecast (nowcasting), rainfall intensity when tropical cyclone landfall and lightning forecast guidance.

5.3.4 The meeting was informed that Department of Meteorology is facing problems due to lack of the real time ground observation stations (AWS) and rain gauge network for the data sharing. Therefore, the department could not provide the weather forecasting on precipitation amount for the specific area forecast. Future development plan of Department of Meteorology includes:

- improve the lead time on weather forecasting information and warning to the users
- conduct TV studio on weather forecasting information and warning
- collaborate with mass - media on how to broadcast on time of weather information and early warnings to public and users.
- upgrade synoptic observation stations manual and AWS for the whole 24 provinces station in the county.

Lao PDR

5.3.5 Mr Bounteum Sysouphanthavong, representative of Lao PDR informed the meeting that to meet the WMO and SWFDP requirements, Department Meteorology and Hydrology (DMH) of Lao PDR has upgraded the facilities such as: DMH has planned to migrate gradually to digitized sensing system or Automatic Weather Station (AWS); upgraded the GTS data link between DMH – Lao PDR and RTH Bangkok by using Lease Lines to 128 kbps, DMH has planned to upgrade the system to meet WMO's requirement during 2015-2016 under Japan Grant Assistance. In order to strengthen the cooperation in the field of meteorological science and technology between the Lao PDR and the People's Republic of China to enhance real-time meteorological data exchanges, DMH Lao PDR and CMA have agreed to establish Beijing – Vientiane Meteorological Data Exchange Circuit (GTS link on IP basis) by using MPLS VPN, line speed 128 kbps. DMH is a National Centre connected to RTH Bangkok, Thailand, as regard WIS operation, Lao National Center selected Tokyo-GISC as principle center, Beijing GISC as secondary, Lao National Center has planned to install WIS system including hardware and software during 2015-2016 under Japan Grant Assistance. DMH has already upgraded the internet speed by setting up Internet Lease Line MPLS, speed 2 Mbps.

5.3.6 DMH staff attended the RA II SWFDP SeA Regional Training Workshop on Severe Weather Forecasting (GDPFS) and Warning Services (PWS), and after coming to office, the trainees transferred their knowledge that they got from training workshops to their colleagues to enhance the utilization of SWFDP-SeA web portal. DMH found that the SWFDP products are more useful NWP guidance to improve the hydro-meteorological services in Lao PDR, especially for weather monitoring, analysis, forecast and early warning for severe weather events in Lao PDR.

5.3.7 Future Plans of DMH includes:

- Enhance the use of SWFDP-SeA web portal by conducting on-the-job training at headquarters office and at provincial hydro-meteorological offices;
- Carry on the upgrading of the facilities to meet the WMO's requirements;
- Strengthening the capacity building on hydro-meteorological services such as to attend the RA II SWFDP SeA- Regional Training Workshop on Severe Weather Forecasting (GDPFS) and Warning Services (PWS), and WMO training programmes;
- Promote NWP System and Install suitable Models for short range and meduim range forecasts;
- Increase lead times, frequency of issuing forecasts and warnings through media.
- Forecast evaluation and verification;
- Strengthening the cooperation with media as well as with line agencies to improve delivery of services;
- Conduct the training workshop on Media-Weather Presentation with media;
- Apply the SWFDP output for hydrological sector such as flash flood guidance, river forecasts, etc.

Philippines

5.3.8 Ms Maria Cecilia A. Monteverde, representative of the Philippines provided information related to her country. The meeting was informed on the usefulness of the NWP, EPS and satellite-based products which served as guide for forecasters in the issuance of forecast and warnings. She highlighted the need to enhance the capacity of forecasters in all stages of the forecasting system including the validation of the various NWP products. The meeting noted the status of implementation and the role of PAGASA in SWFDP-SeA in enhancing the weather monitoring and

forecasting processes in the country and the improvement in the provision of weather services to target users.

5.3.9 Status of Implementation:

- Attendance to the SWFDP-SeA and Bay of Bengal Regional Training Workshop on Severe Weather Forecasting and Warning Services held in Macao, China on 8–19 April 2013;
- Philippines hosted the SWFDP-SeA Training Workshop on Severe Weather Forecasting (GDPFS) and Warning Services (PWS) at Quezon City, Metro Manila, Philippines on 2-13 June 2014. It was attended by 42 participants from 5 countries of Southeast Asia including 34 participants (10 forecasters, 8 researchers, media and Disaster Management Agency) from the Philippines;
- The analysis of the different NWP models in the global scale are found to be useful in enhancing the weather monitoring and forecasting processes, and in the improvement of the provision of weather and warning services. Forecasters make use of the various NWP model products (e.g GSM (JMA), GFS (NCEP), NAVGEN, GEM (CMC), GME (DWD), JMA, KMA, CMA, and etc.), and these are enhanced through the use of in-situ, satellite and radar data;
- One of PAGASA's efforts relative to the operation of SWFDP-SeA is to conduct continuous assessment on the performance of various NWP and EPS products from different centres. PAGASA, through its R&D conducted a study entitled "Assessment of Global and Regional Scale Model during the passage of Tropical Cyclone Glenda (Rammasun) in the Philippines". NWP models already showed reliable forecast track information prior to the landfall. The analysis on synoptic and regional scale reveals good performance in predicting severe weather events. Also, with the use of other meteorological tools such as satellite, upper air analysis and surface observation, guidance products from the Regional Specialized Meteorological Center (RSMC) coupled with forecasters' thorough analysis, the warning and mitigation efforts of PAGASA relative to the passage of tropical cyclone had been achieved. Enough warnings and information had been provided to the people and disseminated to the National Disaster Risk Reduction and Management Council (NDRRMC). The public had been fed with enough information in Tri-Media including news program aired in various television channels;
- As an initial assessment, the issues relative to SWFDP operation: Some of the NWP models provide delayed information which may not serve as a good reference to operational weather forecasting; in terms of domain coverage, the area provided for in the GME (DWD) and WRF models does not cover the whole Philippines, it is suggested to extend the domain to about 140o-150o longitude to cover the entire country and to monitor incoming severe weather systems over the Pacific Ocean; and COSMO model provided for in the global NWP products cannot load model output in the SWFDP web and portal. Although the PAGASA has its own COSMO model and the products are posted in PAGASA website;
- On-going forecast verification/validation of NWP/EPS and Guidance products with observed data. More cases are required to validate the results;
- PAGASA has ground receiving system: Himawari, Fengyun-2E (FY-2E), NOAA, MODIS, and COMS satellites;
- Establishment of HimawariCloud Service and HimawariCast Service;
- COMS Training on Satellite Analysis System conducted in Korea (1-7 March and 1-12 June 2015) was participated by 7 and 10 PAGASA trainees respectively;
- Conducted trainings on COMS Data Analysis by Korean Expert to provide Technical advice to PAGASA for five months (20 March 20 to 19 August 2015);
- On-going Upgrade of GTS Message Switching System;
- PAGASA maintains a website where products and information on its various activities are posted. The website serves as medium to disseminate forecasts and warnings through e-mail and social networking (e.g. Facebook, Twitter) which played a powerful channel for dissemination of severe weather warnings and valuable source of feedback from users. The PAGASA website (www.pagasa.dost.gov.ph) contains information on the following: real-time weather, tropical cyclone warning, flood forecasts, climate information, astronomy

updates, Philippine Standard Time, hourly satellite imagery updates, radar images, COSMO, WRF products, etc. PAGASA uses Weather Research and Forecasting (WRF) model with a 3-km resolution;

- Conducted an in-house Forecasters' Refresher Course at Baguio City Guest house in two (2) batches, April 9-11 & April 16-18 with a total number of forty (40) participants from Weather Division and Regional Services Division (PRSD). The purpose of the course is to update forecasters on forecasting techniques wherein the knowledge and technical skills gained by the experienced forecasters were handed down to the new generation forecasters;
- JMA provided PAGASA with the storm surge model for operational purposes. JMA also trained PAGASA technical staff on the use of the model and have been using the model since Typhoon Haiyan in November 2013;

5.3.10 Public Weather Services: Delivering Services to Target User Groups

- Video streaming of daily weather forecasts to be embedded in PAGASA Website;
- On-going enhancement of PAGASA Mobile App.,
- Currently, the NDRRMC institutionalized the Pre-Disaster Assessment (PDRA) and its action, protocols and programs to evaluate an impending hazard's level of risk given the degree of exposure and vulnerability in a specific area (NDRRMC, 2015). PAGASA regularly provides weather updates during severe weather events which serves as basis for PDRA;
- PAGASA is working with Google on publishing Common Alerting Protocol (CAP) compliant Typhoon alerts. CAP is recognized by WMO while Google is the authorized aggregator.
- Regular Climate Forum is also being conducted to various stakeholders (agriculture, energy, water, economic and other sectors);
- Annual Training conducted for media;
- An on-going Project with USAID assists PAGASA in the simplification of weather information for easy interpretation of the message by users and takes appropriate action. In the same project, human response survey of PAGASA's forecast products and services will also be conducted through funding from UNESCAP Trust Fund for Tsunami Disaster and Climate Preparedness;

5.3.11 Way Forward: PAGASA

- Undertake more case studies and research activities to validate the performance of various SWFDP products during inclement weather systems of both local and synoptic scales;
- Improve forecasting/warning services and improve lead time and cascade the forecast/warnings to various stakeholders including disaster management agency, the media and the general public in general;
- Develop partnership and cooperation among the member countries for the success of the project. The network that was created in the SWFDP project can reach a mile in saving life and properties through the sharing of technical knowledge/expertise and the NWP/EPS products to improve the forecasting services;
- Provision of feedback to fully assess/validate the performance of the forecast and warnings and correlate with the impact;
- Introduction of SWFDP to PAGASA Regional Services Centers for their local forecast analysis. This has been introduced to the Southern Luzon PRSD during Training/Workshop on Rainfall Warning System and Climate Change.

5.3.12 Training Requirements

- Enhancing capacity of forecasters and researchers on ensemble forecasting, interpretation and use of various NWP/EPS products, satellite interpretation, wave modelling and newly, added products and forecast validation;
- Forecasting tools for very-short-range forecasting for short duration rainfall (severe thunderstorms, lightning and tornado), this type of event is not captured by NWP models;
- Training needs on how to develop local/regional guidance based on the different NWPs used in this project and the guidance provided by RSMC-Ha Noi;

- Learn the methodology on how to develop ensemble prediction systems for local and/or regional scale analysis;
- Avail the DWD training on the COSMO model;
- Assist on how to provide “prognostic reasoning” in every severe weather event, based on various NWPs used in this project;

Thailand

5.4.13 Mr Surapong Sarapa informed the meeting about the Thailand Meteorological Department (TMD) activities related to the subproject.

5.3.14 Status of Implementation

- TMD obtains various NWP products from Global centers such as ECMWF, JMA, NCEP, NAVGEM, KMA, IMD and BOM, and all of products are good in forecasting and supporting the warning system;
- TMD found the SWFDP-SeA website from RSFC Ha Noi provides useful NWP products and Guidance product for forecasters to improve the severe weather forecast and issue warning information. Also TMD will further make use of the RFSC Ha Noi website and introduce it to forecasters working on regional and local stations;
- TMD has ground receiving satellite data: FY2, NOAA, MODIS and Himawari-8 (installation of satellite receiver on-going). In addition, TMD receives satellite data from the HimawariCloud service and apply data to estimate rainfall;
- TMD has also implemented WRF model-3DVAR and its overlay with satellite images to use for improving of the short-range weather forecast;
- TMD has good cooperation with the other government agencies and media to disseminate useful data and delivery services to various user groups;
- SWFDP Training Workshop on Severe Weather Forecasting (GDPFS) and Warning Services (PWS) for Southeast Asia and Bay of Bengal will be held in TMD Headquarters, Bangkok in September 2015.

5.3.15 Future Plan

- Plan to install the supercomputer to run the high resolution NWP model for nowcasting and short range forecast up to 3 days ahead;
- On-the-job training for weather forecasters to access & use NWP/EPS products for improving the severe weather forecast;
- To improve the feedback report on the usefulness of NWP and ensemble products to the Global centres and SWFDP-SeA;
- Ongoing to improve the meteoalarm system for warning and announcement of occurrence of special, dangerous and unfavorable meteorological events;
- Plan to broadcast weather forecasts and severe weather information by TMD forecasters on social media.

Viet Nam

5.3.16 Ms. Binh Nguyen Thi Thanh, the representative of Viet Nam informed that the NHMS of Vietnam administers offices including: i) National Centre of Hydro-Meteorological Forecasting (NCHMF), ii) 9 Regional Hydro-Meteorological Centres, 54 Provincial Hydro-Meteorological Forecasting Centres and observation station networks. The NCHMF has the following functions:

- Providing daily weather forecast of Vietnam (for some big cities and 9 regions related to regional centers) and Bien Dong Sea (the South China Sea or East Sea of Vietnam);
- Issuance of the Warnings of Nation-Wide High impact Weather (cold surge, extreme Heat, gale, tropical cyclones, etc.);
- Services to Central Government for Decision-making;
- Services to Regional Hydro-meteorological Centers;
- Services to Public and external User Community.

5.3.17 The NCHMF has role of providing the meteorological background forecast for whole Vietnam and Bien Dong Sea. After receiving the background forecasts, the regional centers or

lower levels (provincial centres) will add more detail forecast and warning for their responsibility areas.

5.3.18 In NCHMF, the operational NWP web portal system named MHDARS is used to provide the forecasters all NWP products. NHMS and NCHMF will host this system in few years; In some aspects, the SWFDP-SeA web portal (http://www.swfdp-sea.com.vn) has some features of the NCHMF web portal but focuses on the risks of heavy rainfall and strong wind and the confidence of the risk areas guiding from deterministic/ensemble global and regional NWP models. Therefore, the SWFDP-SeA web portal is like a 'lite' version of MHDARS for sub centres. The regional and provincial centres have been accessing the SWFDP-SeA web portal since 2011.

5.3.19 There are a number of NWP products from different international centres and at different scales, therefore the forecasters may not have enough time to look at all of the products. For that reason, the risk maps with confidence degree tables are quite useful for forecasters to know the uncertainties of the model forecasts or the high variable weather situations and reducing the circumstance of focusing too much on only one model.

5.3.20 Another usefulness of the SWFDP-SeA web portal both for NCHMF and for regional centres is to address the hydrological problems. All the warnings for precipitation over Lao PDR, Cambodia or Thailand were related to the lower Mekong river delta – the south part river system of Viet Nam. For the deltas over the north of Viet Nam, the short range heavy rainfall warnings from the north of Vietnam, from the border between China and Viet Nam and the north of Lao PDR are important.

5.3.21 The other activities related to functions of NCHMF/NHMS are marine forecasts for the Bien Dong Sea. With the strong wind risk maps, the forecaster of marine division in NCHMF can relate to their warning and forecast for wave characteristics over the Bien Dong Sea and off shore islands.

PWS activities

5.3.22 Implemented:

As a member of the Central Committee for Natural Disaster Prevention and Control, NHMS of Viet Nam has a good cooperation with Mass Media and Natural Disaster Agencies in delivering weather forecasting bulletins as well as natural disasters. In recent couple of years, NHMS in collaboration with mass media (the Voice of Viet Nam – VOV1, VOV Transportation, Viet Nam Television, Nhandan Newspaper) implemented many dissemination programs on hydro-meteorological knowledge. Beside, NHMS cooperated with some international partners and organized seasonal outlook forums with participation of many sectors. Some surveys were implemented in coastal areas to understand the need of users more.

5.3.23 Future Plan:

- Continue to sustain and promote relation with Mass Media and Natural Disaster Agencies;
- Implement some propagation programs on natural disasters for public focusing on the prone natural disaster areas;
- Implement survey in areas having flash flood;
- Develop software delivering weather for mobile phone.

Myanmar

5.3.24 Ms War War Thein, the representative of Myanmar informed the meeting on activities of Myanmar's Department of Meteorology and Hydrology (DMH) in monitoring and forecasting of severe weather in Myanmar. The severe weather events that impact in Myanmar are heavy rainfall (by active Monsoon, western disturbance, Easterly waves and remnants of typhoon from South China Sea), tropical cyclone, storm surge, strong wind, thunderstorm, drought, heat and cold waves. DMH collects and analyses different NWP model outputs from global and regional centres (NCEP, JMA, IMD, TMD, BMD, NOAA, RIMES, KMA, BoM, and ECMWF) for their use in enhancing the weather forecasting and monitoring system. Also very recently, SWFDP-SeA Ha Noi website is used for improving severe weather forecasts and warning system. DMH (Myanmar) also operationally runs the WRF model carried up to 72 hours forecast. DMH (Myanmar) needs to

improve data assimilation system for the WRF model and also plan to install Regional Climate Model (RegCM). DMH uses Diana Tool to display ECMWF model outputs overlaying them with satellite images (MTSAT) for improving short-range and medium range weather forecasts. DMH also has access to satellite-based products and using warnings and advisories from RSMC, New Delhi, JTWC and TMD.

5.3.25 Regarding service delivery in Myanmar, the meeting was informed that main works performed by DMH are: providing weather and climate information for the general public, providing warnings and advisories to the people in threatened area through governmental organizations and mass media i.e, Myanmar Radio, MRTV, FM radios, Newspapers, Ministry of Transport's Journal and other private Journals. This information is also provided to neighbouring countries through GTS link of WMO. DMH established a link with broadcasting for early warning. DMH owned weather studio for effective communication with clear, understandable weather information. DMH official website (www.dmh.gov.mm) is regularly updated. In addition, social media e.g. Facebook and automatic weather answering phones fulfil early warning system with updated warnings and news.

5.3.26 DMH would like to upgrade severe weather forecasting and implement nowcasting system. DMH has planned to install three modern radars to cover the coastal regions and central areas for heavy rainfall forecasting and tropical cyclone monitoring. DMH has conducted 'National Monsoon Forums' which are organized twice in a year with joint collaboration of RIMES, UNESCAP and stakeholders for seasonal Climate Outlook and intends to get feedback from users. DMH cooperated with WMO/UNESCAP/RIMES, project to establish Emergency Operational Centre (EOC). Also, WMO supported long-term trainings for Myanmar to upgrade capacity development.

Discussion, Remarks and Recommendation

5.3.27 The meeting noted that in some of the countries the synoptic observations are not maintained properly and also not made available through GTS due to various reasons including mainly lack of staff. The meeting requested the RSMT members (from the NMHSs) to make appropriate measures so that the observations could be available through GTS and it could be indigested to the NWP models to improve the products for the subproject.

5.3.28 The meeting also discussed the issue of data sharing among the countries of the project, and emphasized the importance of understanding the actual situation of real-time exchange of basic observational data from national observation networks of this region, which is critical for weather forecasting, especially in relation to monitoring severe weather events. In addition to basic synoptic and precipitation data, radar data exchange is also very important to monitoring the development of severe weather. All participants are encouraged to review the status of data exchange and explore the sharing of non GTS no-real time data among the subproject's countries for verification of forecasts by RFSC Ha Noi.

5.3.29 Noting the progress of TMD in initiating developing of a meteoalarm prototype system in Thailand, the meeting encouraged the RSMT members (from the NMHSs) to also explore possibility of developing such system in their countries.

5.3.30 The meeting was also pleased to note that Philippines and Myanmar have developed a colour coding system in their warnings especially related to tropical cyclones, and that coastal communities are finding it useful.

6. PUBLIC WEATHER SERVICES (PWS): DELIVERING SERVICES TO TARGET USER GROUPS

6.1 The purpose of this session was to provide information and guidance on the issues surrounding delivery of Public Weather Forecasts and Warning Services to the target user groups of the SWFDP in the framework of the Public Weather Services (PWS) Programme of WMO.

6.2 The opportunity of the Meeting was taken to inform the participants on the concept of the value chain of meteorological and hydrological services in the framework of social and economic

benefits of met/hydro services. This concept has been explained in the newly published WMO-World Bank book on valuing socio-economic benefits of met/hydro services. The value chain serves to put in context the social and economic value of the warnings and forecasts delivery beyond the production process of the warnings and forecasts, and highlights the role of NMHSs in the delivery of services and decision making process for the benefit of society as a whole.

6.3 The participants were informed that the WMO Strategic Plan for the period 2016-2019 has recognized "Improved service quality and service delivery" as an Expected Result for the Organization. This Expected Result is aimed at improving the operational, end-to-end framework for NMHSs to translate leading-edge science into information that is actionable and easy to interpret by different sectors of society. It is through effective and timely delivery of services that users derive a high level of return on NMHSs' investment in basic infrastructure (such as observing systems, modelling, communications and human resources) and that nations derive a high level of return on their investments in NMHSs. The WMO Congress has recognized Service Delivery as the core business of NMHSs, that is, providing essential meteorological, hydrological and related environmental services and information to communities, for the purpose of saving lives and livelihoods, and for improving the quality of life as well as enhancing national economies.

6.4 The issues regarding gaps such as warning criteria, dissemination, relations with users and in particular disaster management agencies and lack of coherent programs in warning services were discussed. Challenges in the PWS component of SWFDP include acquiring skills and knowledge beyond those of a forecaster, such as engagement with users, and communication skills. These challenges have often hampered the realization of the full benefits of the SWFDP for the user communities. A most important lesson learnt from SWFDP as far as service delivery is concerned has been the need to be proactive in getting feedback from users, since such feedback does not normally materialize in an automatic manner.

6.5 The importance of impact-based forecasting was highlighted for the participants. It was explained that improving the understanding of the potential impacts of severe hydrometeorological events poses a challenge for most NMHSs and their partner agencies, particularly disaster response agencies. Participants were informed on the work of WMO in this field and in particular the publication of a set of WMO Guidelines on Impact-based Forecast and Warning Services (WMO NO. 1150), which was published recently in all WMO languages. Examples of risk matrix and the use of colour codes were used to illustrate the importance of consideration of hazard impacts in decision- making. The Guidelines were distributed to the participants using the CD-ROMs produced by WMO for this purpose.

6.6 It was emphasized that in terms of PWS delivery, service evaluation involves ensuring that the warnings and forecasts are accurate and skilful from a technical point of view. However, determination of forecast skill, timeliness and product accuracy, is not in itself sufficient for a meaningful evaluation of usefulness of forecasts. Service evaluation in terms of PWS means whether PWS and other services are meeting user requirements and whether users understand the products and services provided and are making optimum use of them. A summary guide on preparation of surveys and examples of surveys from a number of NMSs are given on the PWS Programme Website: http://www.wmo.int/pages/prog/amp/pwsp/surveys.htm

7. VERIFICATION OF FORECASTS AND WARNINGS, AND THEIR EVALUATION, INCLUDING USEFULNESS AND USER RESPONSE

7.1 The Secretariat made a briefing to the meeting regarding the motivation behind and the importance of the verification activities that will be carried out as part of the SWFDP-SeA implementation. The meeting was informed about the contingency tables that were prepared using MS Excel sheets using forecast and observation data that could be used in calculating various verification scores. The template documents (MS Excel files) provide a very practical way to develop contingency tables and to calculate different scores that could be useful for the purpose of progress reporting by the NMHSs. The meeting was informed that the participants were already provided more specific trainings on how to use contingency tables for verifying warnings and severe weather events during SWFDP-SeA training workshops in 2013 and 2014.

7.2 The meeting was informed that the WMO Secretariat has published "Forecast Verification for the African Severe Weather Forecasting Demonstration Projects" (WMO No. 1132) in 2014 which describes about the principles and importance of forecast verification and verification procedures of severe weather forecasts. The meeting noted that this WMO publication, which is based on the demonstration experiments and case studies of severe weathers in African countries, can be a good reference for the participating NMHSs of SWFDP-SeA to initiate systematic forecast verification exercise as part of SWFDP-SeA implementation and to have similar publication using data of countries in Southeast Asia to be collected during demonstration phase.

7.3 The participants were provided with the relevant template documents (MS Excel files) for developing contingency tables and calculating various verification scores.

Discussion, Remarks and Recommendations

7.4 Taking note of the importance of verification of severe weather forecasts in improving the overall forecasting system, the meeting encouraged the participants (NMHSs/RFSC) to start gathering data on severe weather events and warnings for verification of forecasts and warnings (see information required in the implementation plan).

8. SWFDP DATABASE, FEEDBACK AND REPORTING

8.1 The Secretariat informed the meeting that WMO developed a SWFDP database during 2013-2014 using WMO's Country Profile Database (CPDB) platform (https://www.wmo.int/cpdb/). The main objective of the SWFDP database is to facilitate the SWFDP participating countries in each region to on-line submit their progress reports in an efficient and convenient (paper-free) way and to improve monitoring and tracking of the progress of each SWFDP regional subproject which may also be helpful in preparing feedback for the donors to secure necessary funds for the continuity and sustainability of each SWFDP regional subproject.

8.2 It was informed that the participants of 2014 SWFDP-SeA Training Workshop in Quezon City, Philippines were familiarized on this new reporting mechanism. The database was initially tested at the Secretariat and then by some of the participating countries of SWFDP-Eastern Africa during 2014-2015 in order to identify for any bug. The database has been fully functional for submission of progress reports on quarterly basis by the benefiting countries of SWFDP in each region. The participating countries of SWFDP-Eastern Africa have already started on-line submission of their Quarterly Progress Reports. The database is password protected and can be accessed by the designated focal points for SWFDP in each of the NMHSs (i.e. RSMT Members) by using their email addresses as usernames. However, first they have to reset their passwords.

8.3 The meeting was introduced on how to access to the SWFDP database by the NMHSs (RSMT Members) through internet and on how to provide information and feedback on-line on various elements of the progress report.

Discussion, Remarks and Recommendations

8.4 The meeting noted that progress reports should contain information about the way the SWFDP is being implemented in Southeast Asia in order to evaluate the regional subproject against SWFDP goals. It will contain information about NWP including EPS products, RFSC Daily Guidance, nowcasting products used in preparing severe weather forecasts and warnings, severe weather events observed, number of warnings issued during the reporting period, probability of detection and false alarms, dissemination channels, clients/users' feedback, outcomes of case studies etc. The quarterly progress reports shall be prepared and submitted immediately in the following month of each quarter as per schedule mentioned in the Regional Subproject Implementation Plan (RSIP).

8.5 To ensure that the needed information is reliably completed it was proposed that the information for the evaluation of severe weather events be collected by using an "evaluation form" and contingency table (MS Excel files, please see also Para 7). A template of evaluation form is available in the RSIP. This evaluation form has to be completed by the NMHS when a severe

weather event has been observed or when a severe weather event has been forecast. The evaluation form needs to be formatted in a convenient form in order to simplify the processing and archiving of the data. The products that have been used in the production of severe weather forecasts must also be archived for use in future case studies. Further, it will be particularly important for participating NMCs/NMHSs especially during the demonstration phase to keep regular contacts with users i.e. public, national disaster management offices (NDMOs) and the media to ensure smooth flow of information with a view to measuring the level of user satisfaction. The feedbacks from users are quite useful to improve the severe weather forecasting services. The NMCs/NMHSs should regularly obtain these feedbacks using the user assessment questionnaire for the public, NDMOs and the media as available in the RSIP. The information in this continuous evaluation should also be consolidated into quarterly progress reports.

9. IMPLEMENTATION OF THE SWFDP IN SOUTHEAST ASIA

9.1 Regional Subproject Management Team (RSMT)

9.1.1 The meeting reviewed the management system of SWFDP-SeA including in particular the responsibilities of the members of the Regional Subproject Management Team (RSMT). .

9.1.2 The meeting also reviewed the composition of RSMT and welcome the representation of Philippines and ECMWF after their joining the subproject as national and global centres in May 2012 and March 2015 respectively. The meeting noted that Mr L.S. Lee (from HKO), the Regional PWS representative in the RSMT has been replaced by Mr Chan Sai Tick by the Hong Kong Observatory.

9.1.3 The RSMT selected Mr Dinh Thai Hung (from Viet Nam) as the new chairperson of the RSMT. However, the chairperson will only be confirmed through official correspondence between the Permanent Representative of Viet Nam with WMO and the Secretariat.

9.1.4 The list of RSMT Members has been updated in the regional subproject implementation plan (RSIP) and can also be found in **Annex III** of this report.

9.2 Training Aspects

9.2.1 The meeting noted that the capacity development activities for the NMHSs of SWFDP participating countries through specialized training programmes on NWP, EPS and satellite products and their interpretation and use in making forecasts of impending severe weather and issuance of warnings for associated hazardous hydrometeorological conditions is one of the key elements of SWFDP development and implementation in Southeast Asia.

9.2.2 The Secretariat informed the meeting that based on the regional and national needs, the following approach has been followed for planning and designing of the SWFDP training programmes in various regions: Two-week SWFDP training workshops; RSMC training desk; In-country training; and Global guidance service. In addition, a number of participants from SWFDP participating countries are also supported and sponsored for NWP and EPS products interpretation and high resolution limited-area NWP Modelling trainings offered by various global and regional NWP centres, e.g. ECMWF (annual training on interpretation of ECMWF products), DWD (annual training on COSMO aligned with SWFDP), WMO Regional Training Centres (training programmes on forecasting aligned with the SWFDP) and NOAA/NCEP Monsoon desks.

Training activities for SWFDP-Southeast Asia

9.2.3 The meeting was informed that since first meeting of the RSMT in 2011, two SWFDP training workshops have been conducted for the benefitting countries of the subproject including a two-week training workshop in Macao, China in April, 2013 (which was jointly organized for the NMHSs in Southeast Asia and the Bay of Bengal regions), and SWFDP-SeA Training Workshop in Quezon City, Philippines in June 2014. The Macao workshop was attended by 33 participants from 16 countries of Southeast Asia and Bay of Bengal regions, while 42 participants from 5 countries of Southeast Asia attended the Philippines workshop including 34 participants from the host country alone. Additionally, WMO sponsored two forecasters from RFSC Ha Noi for their participation in a

Training course on COSMO/CLM/ART in Langen, Germany held from 23 to 31 March 2015 in order to improve high-resolution limited-area NWP Modelling at RFSC Ha Noi.

9.2.4 The meeting was further informed that a two-week SWFDP training workshop has been planned in Bangkok, Thailand from 14 to 25 September 2015. The workshop will be held jointly for the NMHSs in Southeast Asia and Bay of Bengal regions. In addition to the 10 participating countries of SWFDP-SeA and SWFDP-Bay of Bengal, Bhutan, Nepal and Pakistan have also been invited. The meeting was pleased to note that PAGASA (Philippines) has nominated one additional forecaster for week-1 of this workshop with its own funding. The meeting also encouraged the host NMHS (i.e. TMD) to nominate its maximum operational staff for attending the training.

Discussions, Remarks and Recommendations

9.2.5 Noting the request of participating NMHSs on extensive training on radar products interpretation and Nowcasting trainings for the region, the meeting was informed that in the forthcoming SWFDP training workshop in Bangkok in September 2015, two of the three invited experts from CMA will cover the topics on nowcasting using radar and satellite products. In addition, there will be a Webinar on Himawari-8 products by a JMA expert. The meeting expressed its appreciation to the Secretariat for planning these lectures and requested to explore more opportunities for delivering trainings on radar products and nowcasting to as many forecasters as possible.

9.2.6 The meeting noted that the training needs of operational forecasters are quite diverse and it may include topics that are slightly outside the remit of the SWFDP-SeA. The meeting therefore explored various other options and opportunities for the training on diversified topics including through e-learning. It was clear that MetEd resources could be explored to satisfy some of the needs. The MetEd website provides education and training resources (online only) to benefit the operational forecaster community, university atmospheric scientists and students, and anyone interested in learning more about meteorology and weather forecasting. MetEd is populated and maintained by the COMET® Program, which is part of the University Corporation for Atmospheric Research's (UCAR's) Community Programs (UCP). Registration is needed, but resources are freely available. The various courses are self-paced and can be accessed through MetEd website (https://www.meted.ucar.edu/index.php). The meeting encouraged the forecasters to reap maximum benefits from such e-learning sources.

9.2.7 The meeting also requested the Secretariat to explore opportunities for blended courses (e-learning and face-to-face) to reach out efficiently to wider audiences.

9.2.8 Noting various types of trainings conducted for SWFDP regional subprojects, the RSMT recognized that the Training Desk approach tested for SWFDP-Southern Africa is very useful in enhancing the regional and national forecasting process and capacity. The RSMT further recognized that the Daily Severe Weather Forecasting Guidance issued by RFSC Ha Noi for the benefitting NMHSs could be also improved by including local-scale meteorological knowledge. By establishing a Training Desk at RFSC Ha Noi with attachment of forecasters from the participating NMHSs, it will not only facilitate improvement in the RFSC Guidance but it will also provide the forecasters of NMHSs with an opportunity to learn from the forecasters of RFSC Ha Noi on the rationale behind the RFSC Guidance and on its effective use for generating forecasts of severe weather at national and local levels. The RSMT therefore agreed that the Training Desk plan may be developed in consultation with WMO Secretariat to establish RFSC Training Desk for a specific period during which at most two forecasters from each participating NMHS will be invited to participate for a period of two weeks at a time depending upon the availability of resources. The representative of Viet Nam indicated its willingness to accommodate the Training Desk at RFSC Ha Noi and expressed the need of inviting expert(s)/lecturer(s) from Global and/or Regional Centre(s) who can provide appropriate guidance, at least at the inception of the Training Desk. The RSMT invited the Hong Kong Observatory, which is designated to support training activities, for its assistance and advice on this aspect.

9.3 Regional Subproject Implementation Plan (RSIP)

9.3.1 Based on discussions under previous agenda items and following guidelines provided in the “SWFDP Guidebook on Planning Regional Subprojects” the meeting reviewed and updated the Regional Subproject Implementation Plan (RSIP).

9.3.2 A new project schedule including timeline for the demonstration was developed. The meeting decided to start the demonstration phase of the subproject in January 2016 with submission of first Quarterly Progress Report, pertaining to January-March 2016 period, in April 2016. The NMHSs would be required to submit their quarterly progress reports on-line through SWFDP database by 20th day of the following month after the end of each quarterly period as specified in the RSIP.

10. Review and adaptation of the Meeting Report

After review, the meeting adopted the meeting report.

11. ANY OTHER BUSINESS (AOB)

There was no additional business arising.

12. CLOSING

The meeting of the Regional Subproject Management Team (RSMT) for the SWFDP-SeA closed at 19:00 hours on Friday, 14 August 2015.

Annex I – AGENDA

1. OPENING

2. ORGANIZATION OF THE MEETING

2.1 Adoption of the agenda
2.2 Working arrangements

3. INTRODUCTION TO SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP)

3.1 Overall Framework
3.2 Summary of experience and progress of the SWFDP Development for Southeast Asia (RA II)
3.3 Synergy with other projects in the region: GIFS-TIGGE products produced by MRI/JMA

4. SATELLITE DATA-PROCESSING SYSTEMS AND PRODUCTS FOR VERY SHORT-RANGE FORECASTING, INCLUDING NOWCASTING, IN RA II

5. CASCADING FORECASTING PROCESS: ROLES OF PARTICIPATING CENTRES IN SWFDP-SeA

5.1 Global centres: CMA, JMA, KMA, ECMWF, DWD (for LAM support to RFSC Ha Noi) and NOAA/NCEP
5.2 Regional centres: RFSC Ha Noi (Viet Nam), RSMC Tokyo (Japan), RSMC New Delhi (India), and Hong Kong Observatory (Hong Kong, China)
5.3 National Meteorological Centres: Cambodia, Lao PDR, Philippines, Viet Nam, Thailand, and Myanmar

6. PUBLIC WEATHER SERVICES: DELIVERING SERVICES TO TARGET USER GROUPS

7. VERIFICATION OF FORECASTS AND WARNINGS, AND THEIR EVALUATION, INCLUDING USEFULNESS AND USER RESPONSE

8. SWFDP DATABASE, FEEDBACK AND REPORTING

9. IMPLEMENTATION OF THE SWFDP IN SOUTHEAST ASIA

9.1 Regional Subproject Management Team (RSMT)
9.2 Training Aspects
9.3 Regional Subproject Implementation Plan (RSIP)

10. REVIEW OF THE RSIP AND REPORT

10.1 Review and updating of the RSIP
10.2 Review of the Report of Meeting

11. ANY OTHER BUSINESS (AOB)

12. CLOSING

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