SWFDP in South-east Asia: SWFDP-SeA

Regional Subproject Implementation Plan (Draft ver.5)

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# Introduction

This section outlines the concept of the Severe Weather Forecasting Demonstration Project (SWFDP) and the foundation laid for formulation of the Regional Subproject for Southeast Asia in RA II.

## Concept of SWFDP

## Principles of SWFDP

Numerical Weather Prediction (NWP) systems have become increasingly relevant and indeed essential to the severe weather forecasting process, with a growing number and variety of sophisticated outputs, currently available from NWP producing centres, which could be beneficial to severe weather forecasting for many National Meteorological and Hydrological Services (NMHSs). The Severe Weather Forecasting Demonstration Project (SWFDP) is designed as a series of regional subprojects whose scope is to test the usefulness of NWP products produced by global and regional meteorological centres, with the goal of improving severe weather forecasting services in countries where sophisticated model outputs are currently not used.

The original focus of the project was on the phenomena of strong destructive winds and heavy precipitation that could cause serious flooding, either associated with tropical cyclones or other weather systems. Such a demonstration project would use a cascading (forecasting) approach to provide greater lead-time for severe weather and would at the same time contribute to capacity building and improving links with National Disaster Management and Civil Protection Authorities (DMCPA).

According to the recommendations of the CBS-XIII (2005), the goals of the SWFDP are defined as follows:

* to improve the ability of NMHSs to forecast severe weather events;
* to improve the lead time of alerting these events;
* to improve the interaction of NMHSs with DMCPA before and during events;
* to identify gaps and areas for improvements;
* to improve the skill of products from Global Data-Processing and Forecasting System (GDPFS) centres through feedback from NMHSs.

The CBS-Ext.(2006) stressed the need to work with civil protection authorities and media organizations to improve delivery of severe weather warning services to end users. Subsequently, the Public Weather Services (PWS) and disaster risk reduction aspects have been integrated into the SWFDP.

## The cascading process

In the framework of the general organization of the Global Data-Processing and Forecasting System (GDPFS), the SWFDP implies a coordinated functioning among three types of GDPFS centres. Conceptually, it should involve one (or more) global centre(s), one (or more) regional centre(s) and a small number of NMHSs located within the area of responsibility of the regional centre.

According to the conclusions of CBS-XIII, the proposed SWFDP is an excellent way to apply the cascading approach for forecasting severe weather in three levels, as follows:

* global NWP centres to provide available NWP products, including in the form of probabilities;
* regional centres to interpret information received from global NWP centres, run limited-area models to refine products, liaise with the participating NMCs;
* NMCs to issue alerts, advisories, severe weather warnings; to liaise and collaborate with Media, and disaster management and civil protection authorities; and to contribute to the evaluation of the project.

The SWFDP will implement a cascading forecasting process implying the participation of selected centres chosen within a geographical area affected by an agreed type of severe weather event. The cascading process aims to ensure the real-time distribution of the relevant available information produced by both a Global Centre(s) and a Regional Centre(s) to selected NMHSs. Moreover it is necessary to continue the cascade by making the final authoritative products of hazardous conditions (advisories or warnings) produced by the NMHSs available to users such as media and local Services in charge of hydrology and/or DMCPAs.

The cascading process concerns both short-range and medium-range products. In the framework of the Regional Subproject described hereafter, short-range is defined as up to and including day-3 while medium-range is defined as day-4 to day-5 inclusive. Each centre will be required to adjust and tailor the list of products to the requirements of the particular regional subproject.

A near real-time evaluation will be conducted, based on observations of the meteorological parameters collected at local meteorological stations as well as information gathered on the impacts of the severe weather phenomena as reported by DMCPA Services. This evaluation of the performance of the cascading process will then be provided as feedback to the participating centres to further fine tune the process itself.

## Expected Benefits

The SWFDP aims to demonstrate the benefits of applying the cascading process for severe weather forecasting in the NMHSs, with the intention of not incurring research and development costs. It is viewed as way to explore how the concept could benefit several NMHSs in the same geographical region while facilitating a certain level of harmonization of forecasts and warnings to render them consistent across the region.

The SWFDP will help strengthen the links between the NMHS, the DMCPA and the media. This in turn will increase the efficiency and effectiveness of the public warning services in case of severe weather events

The SWFDP will provide the opportunity to encourage forecasters to use, and experiment with standard products and recommended procedures, which have already been introduced in GDPFS centres and which could be relevant to a number of NMHSs that have not yet used them.

The SWFDP will provide an opportunity to demonstrate and realise the benefits of new forecasting research through collaboration with the THORPEX TIGGE-GIFS project. THORPEX (The Observing System Research and Predictability Experiment) is a 10-year programme to accelerate improvements in the accuracy of 1-day to 2-week high-impact weather forecasts for the benefit of humanity. TIGGE-GIFS is developing new products, particularly from multi-model ensembles, and aims to develop the new GIFS (Global Interactive Forecast System) by developing cascading products in support of the SWFDP and involving the SERA (Societal and Economic Research & Applications) project to support effective propagation of benefits to society.

Besides, the collaboration with regional activities of other WMO programmes (i.e. research project and/or demonstration project) will produce the synergetic effect on the regional subproject of SWFDP.

## The four phases of the SWFDP

The SWFDP can be divided into four phases as follows:

* Phase I: Overall Project Planning. This phase includes the preparatory work necessary to prepare the project specifications, the list of types of products to be exchanged and the work of the Project Steering Group (PSG) of SWFDP to identify the possible participating centres and to select suitable regional subprojects according to the geographical area, the type of severe weather and the chosen period for the experimentation.
* Phase II: Regional Subproject Implementation Planning and Execution. This phase begins with the preparation of the detailed specifications (data and products to be exchanged, performance measurements, reviewing and reporting) allowing the participants (representatives of the participating GDPFS and national centres) to develop the specific subproject implementation plan, including a training programme, and to manage its implementation and then to carry out the experimentation itself which is likely to last about one year.
* Phase III: Regional Subproject Evaluation. This phase includes the analysis and the evaluation of the entire subproject as well as contributing to the evaluation of the overall SWFDP with respect to the goals proposed initially. This phase gives the opportunity to identify gaps and deficiencies, and areas for improvement in order to ensure a sustainability of the organization tested during the regional subproject and to provide improved specifications for other similar regional subprojects.
* Phase IV: Regional Subproject Long-term Sustainability and Future Developments. This phase includes long-term sustainability of the benefits gained and a process of continual improvement. This phase gives the opportunity to continuously take advantage of future capability and technology developments, and to foster broadening of activities in synergy with other WMO programmes. In this phase, the responsibility for management, including seeking funding, lies with the Regional Association, while the PSG continues to be informed of developments and to provide advice as appropriate.

It has to be noted that the Phase II, III and IV are specific to each regional subproject and will be repeated for each of the selected subproject. From the point of view of the project management, it is clear that the overall SWFDP project begins with the first step of the Phase I and after completion of the Phase III of the selected regional subprojects, the responsibility becomes that of the Regional Associations. It is clear also that each selected regional subproject of the SWFDP will have its own date of beginning and date of completion of Phase III and transitioning to Phase IV.

## Foundation laid for formulation of the SWFDP Regional Subproject for Southeast Asia

## Hydrometeorological disasters in Southeast Asia

The region in Southeast Asia is exposed to the hazardous weather phenomena such as tropical cyclones and heavy rains that may cause the loss of human lives and properties.

In 2009, the typhoon Ketsana caused the worst damage in Southeast Asia. It was formed on 23 September as tropical depression and was upgraded to typhoon early next day. After passing over Philippines, it made the landfall in Viet Nam on 29 September 2009 and hit Laos, Cambodia and Thailand. The total loss of lives is about 700 and the estimated damage reaches over $700 million to $1.0 billion USD.

In 2011, Thailand suffered the worst floods in more than a half century. Caused by excessive and continuous rainfall from successive, powerful monsoons and subsequent, numerous dam breaches, floods inundated 90 billion square kilometers of land, more than two-thirds of the country, and affected more than 13 million people from July through December.

## Subproject approval

The 14th Session of RA II (2008) recognized that the SWFDP has achieved significant results and benefits relative to the GDPFS and PWS programmes in its first regional project in Africa, and requested the Working Group on Disaster Risk Reduction and Service Delivery (WGDRS) to consider developing a SWFDP RA II project as a method for enhancing the GDPFS and PWS and contributing to disaster risk reduction goals in developing countries, for example, those in Southeast Asia that have recently experienced disasters.

The Technical Planning Workshop on SWFDP Development for Southeast Asia took place on 2 to 5 February 2010, in Hanoi, Viet Nam. The workshop concluded that the implementation of a SWFDP in Southeast Asia would be technically feasible and would bring benefits in terms of enhancement of technical capacity in operational forecasting and advancement in weather service delivery to Member countries in the region.

The SWFDP Project Steering Group (PSG), at its third session (Geneva, Switzerland, 23-26 February 2010) decided to promote three SWFDP Regional Subprojects, including one in the Southeast Asia.

The Philippines was invited to the two-week preparatory training workshop (Hong Kong, China; 4-15 July, 2011) as observer. Recognizing the potential benefits to be obtained through SWFDP, the Philippines indicated its intention to participate in the subproject in Southeast Asia, through a formal letter sent to WMO by the Permanent Representative of the Philippines with WMO in May 2012. The RSMT agreed by correspondence, to the participation of the Philippines.

Hereafter, SWFDP in Southeast Asia is also described as SWFDP-SeA in this document. The key milestones in the development of SWFDP-Southeast Asia are given below:

|  |  |
| --- | --- |
| Jan-Feb 2010 | Preparatory Work including Technical Planning Workshop on SWFDP Development for Southeast Asia (Ha Noi, Viet Nam, 2-5 Feb, 2010) with participation of NMHSs from Cambodia, Lao PDR, Viet Nam and Thailand, and contributing Global and Regional Centres |
| Sep 2010 | A Meeting to develop a strategy for preparing an implementation plan (RSIP) for a SWFDP in Southeast Asia (Tokyo, Japan, 17-18 September, 2010) |
| July2011 | Two-week preparatory training workshop (GDPFS/PWS) (Hong Kong, China, 4-15 July, 2011) |
| Oct2011 | First meeting of RSMT of SWFDP-SeA to review the draft RSIP |
| Nov. 2011 | Launch of the project website (RFSC Ha Noi web portal) |
| May 2012 | Philippines also joined SWFDP-SeA as a participating country making the total number of participating countries five |
| April 2013 | Two-week training workshop (GDPFS/PWS), jointly organized forcountries in Southeast Asia and the Bay of Bengal regions (Macao, China, 8-19 April, 2013) |
| June 2014 | Two-week training workshop (GDPFS/PWS), organized in Quezon City, Metro Manila from 2-13 June, 2014 |
| August 2015 | Second meeting of RSMT of SWFDP-SeA to review the RSIP |

# Framework of the Regional Subproject in RA II – Southeast Asia

## Key objectives

The key objectives of SWFDP-SeA are to produce and to deliver improved severe weather forecasts and warnings services by the better use of NWP information from major NWP centres in countries where sophisticated model outputs are not currently used.

## Participating countries / organizations

The participating countries and organizations in three levels of GDPFS centres are listed as follows:

* NMCs
  + Cambodia, Lao PDR, Philippines, Thailand and Socialist Republic of Viet Nam
* Regional Centres
  + RFSC Hanoi (lead centre for the project)
  + RSMC Tokyo (for typhoon forecast support)
  + RSMC New Delhi (for tropical cyclone forecast support)
  + Hong Kong Observatory (for training and technical support)
* Global Centres
  + China Meteorological Administration (CMA)
  + Japan Meteorological Agency (JMA)
  + Korea Meteorological Administration (KMA)
  + Deutscher Wetterdienst (DWD)
  + European Centre for Medium-Range Weather Forecasts(ECMWF)

## Targeting severe weather events

Recognizing that the following hazardous weather conditions and associated impacts (such as flooding, landslides, high waves and swell) are the most relevant in the region:

1. tropical cyclone (from the Northwest Pacific, South China Sea and the Bay of Bengal) track, intensity, structure changes and landfall process (wind and gust, rainfall and storm surge);
2. heavy rain triggered by tropical cyclones, SW and NE monsoon, troughs and ITCZ migration, and orography;
3. thunderstorms and hail associated with severe convection;
4. cold conditions and frost; and
5. extreme hot and dry conditions associated with föhn effect.

The sub-project, in its pilot/demonstration phases, focuses on heavy rain and strong winds, and may consider other hazardous weather conditions and weather-related hazards in future phases.

## Target domain

The domain to be covered for monitoring, analysing and predicting the various severe weather events is proposed to be bounded by 10°S, 40°N, 80°E and 140°E (Fig. 1).

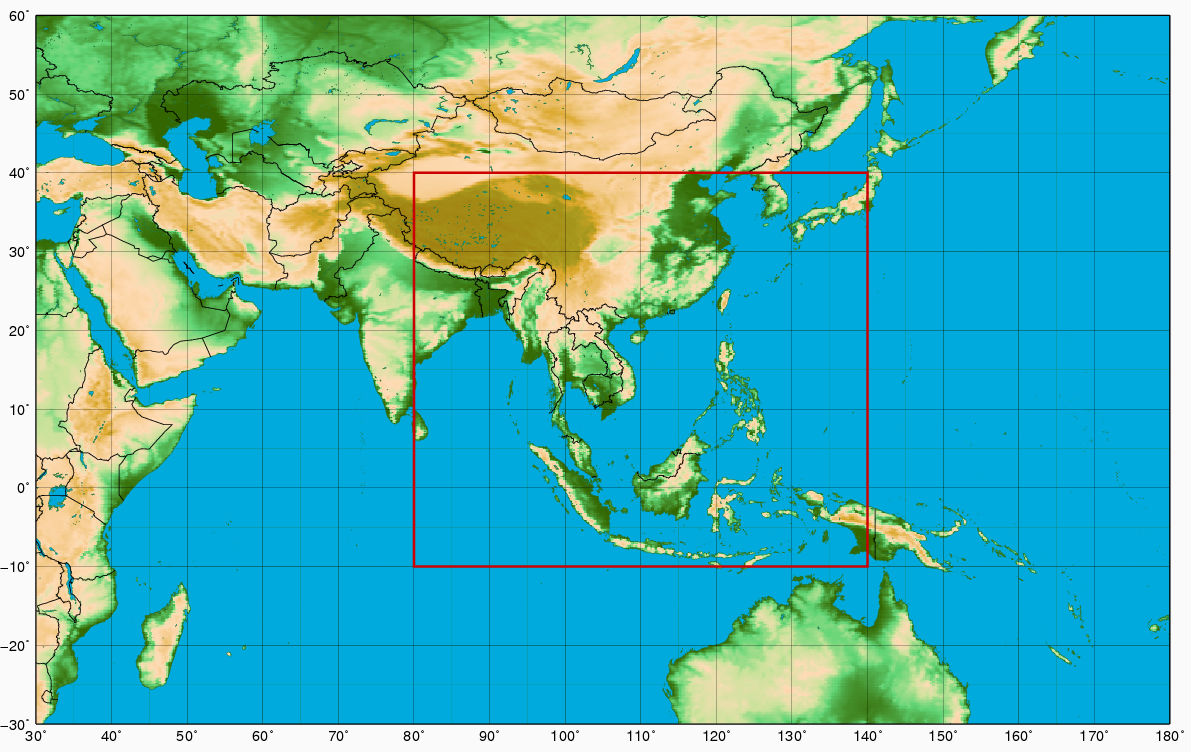


Figure 1: The red-coloured rectangle is the target domain for SWFDP-SeA.

## Demonstration phase period

The demonstration phase will be initiated in January 2016 at least for one year. Prior to this phase, the pilot phase has been implemented since November 2012. The pilot phase was the preparation period for Global and Regional Centres to provide products and for NMHSs to get use to the products and procedures. During the pilot phase, no formal evaluation report/feedback was requested. However, NMCs are requested to provide feedback on the RFSC Daily Severe Weather Forecasting Guidance (ref:Sec.5.2.2) to RFSC Hanoi from August to November 2015, aiming to improve the Guidance.

## Projects in synergy with SWFDP-SeA

Synergy with other regional projects that are on-going or will be implemented during the demonstration phase in the target domain may benefit SWFDP-SeA.

The participating members are aware of the products of the following regional projects that might be useful to improve severe weather forecasting and warning:

* SWFDP-Bay of Bengal
* Coastal Inundation Forecasting Demonstration Projects (CIFDP) in North Indian Ocean
* RA-II Project on the Provision of City-Specific NWP products
* JMA Pilot Project on EPS products
* GIFS-Forecast Demonstration Project (FDP) (THORPEX/TIGGE/GIFS)
  + North Western Pacific Tropical Cyclone (Track) Ensemble Forecast Research Project (WWRP Research Development Project)
* Landfall Typhoon Forecast Demonstration Project (WMO-Project, ESCAP/WMOTC)
* Flash Flood Guidance System (FFGS) in Mekong River Basin (WMO Regional Hydrology)
* NOAA/NCEP Indo-Asia Monsoon Desk.
* Mekong River Commission: rainfall estimation using satellite data.
* UNESCAP/WMO Typhoon Committee
  + Development of Regional Radar Network
* RAII WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training
* RA II and RA V cross-regional WIGOS project for Observing Systems Integration for Supporting Disaster Risk Reduction (subtitle: Capacity Building in Radar Techniques in the Southeast Asia)

## Planned progress in the development of theproject

The SWFDP-SeA will move into the demonstration phase from January 2016. This phase, as agreed by the RSMT will last until Dec 2016, at which time a full evaluation of this phase will be made. If the project has demonstrated its readiness to move into operational phase (phase IV), this will take place following the evaluation However, if this is not the case, the demonstration phase will continue until such time that the Members are ready to move into Phase IV. During the extended demonstration phase, severe weather events with lower priority (ref: Sec.2.3) could be paid more attention with additional products, some of which may be produced by new projects / initiatives in the region. Besides, more countries could also be accepted to participate in SWFDP-SeA.

# Regional Subproject Management Team (RSMT)

A regional subproject management team (RSMT) is set up with the aim of preparing the implementation of the project and managing and controlling its execution. The management of the Regional Subproject is the responsibility of the RSMT and within the activities of CBS.

The RSMT will consult with regional groups and bodies such as the ESCAP/WMO Typhoon Committee, RA II and RA V Management Groups and relevant working groups,and ASEAN Sub-Committee on Meteorology and Geophysics (SCMG) during the planning and implementation of the SWFDP in Southeast Asia.

## Role and the responsibilities of the RSMT

The RSMT is responsible for the development and maintenance of the implementation plan for the Regional Subproject, for the promotion of the implementation of the Regional Subproject and for the monitoring and evaluation of the Regional Subproject.

## Members of RSMT

The members of the RSMT are appointed by the Permanent Representative (PR) of each participating NMHS and generally consist of the senior forecaster in charge of the forecasting team in the NMHS (able to direct and guide other forecasters). Each member is accountable to his/her respective PRs.

The chairperson of the RSMT is elected among members of RSMT by consensus.

The list of the members of the RSMT is as follows: (The family name is written in capital letter.)

* NMHSs:
  + Ms Bin Chann MONY, Department of Meteorology, Cambodia;
  + Mr Bounteum SYSOUPHANTHAVONG, Department of Meteorology and Hydrology, Lao PDR;
  + Ms Maria Cecilia A. MONTEVERDE, PAGASA, Philippines;
  + Mr Surapong SARAPA, Thai Meteorological Department (TMD), Thailand;
  + Mr DU Duc Tien, National Hydro-Meteorological Service (NHMS) of Viet Nam.
* Regional Centres:
  + Mr Dinh Thai HUNG and Mr DU Duc Tien, National Hydro-Meteorological Service (NHMS) of Viet Nam;
  + Mr CHAN Sai-Tick, Hong Kong Observatory (HKO);
  + Mr Tsukasa FUJITA, RSMC-Tokyo;
  + Dr M. Mohapatra, RSMC-New Delhi.
* Global Centres:
  + Ms Dongyan MAO, China Meteorological Administration (CMA), Beijing,
  + Mr Yuki HONDA, Japan Meteorological Agency (JMA), Tokyo,
  + Mr Hyun-Cheol SHIN, Korea Meteorological Administration (KMA), Seoul,
  + Mr David RICHARDSON, European Centre for Medium-Range Weather Forecasts (ECMWF), Reading, UK
  + Mr Detlev MAJEWSKI, Deutscher Wetterdienst (DWD), Offenbach, Germany

Mr Dinh Thai HUNG (NHMS of Viet Nam) is the chairperson of the RSMT.

Mr. Yuki HONDA (JMA), the Co-coordinator of Expert Group on Operational Forecasting in RA-II) is the RA II representative to the SWFDP Project Steering Group (PSG).

Mr CHAN Sai-Tick (HKO) is the regional PWS representative.

## Responsibilities of the members of RSMT

The tasks of the members of the management team, during the demonstration phase of the SWFDP are as follows:

* + 1. The chairperson will be responsible for:
* finalizing the RSIP and sharing between participating countries;
* ensuring the collaboration with other regional projects in synergy with SWFDP
* determining the requirements for and co-ordinating training activities that support the demonstration project and to provide information to WMO Secretariat;
* reporting on the project to the RA II Expert Group on Operational Forecasting , RA V Management Group and ESCAP/WMO Typhoon Committee.
  + 1. The lead person for each participating NMC will be responsible for:
* coordinating all aspects of project implementation and execution at their respective centres;
* evaluating possible data-processing developments (e.g. work required to adjust or tailor NWP products);
* arranging for forecasters in the centres to receive or have access to the agreed products;
* defining the information to be exchanged with their DMCPA and other users;
* defining the information to be transmitted to the media;
* identifying training requirements;
* preparing regular evaluation of the warnings during the field phase;
* reporting on a quarterly basis on the status of the activities in the respective centres.
  + 1. The lead person for each participating Regional Forecasting Support Centre and Regional Centre for training and technical support will be responsible for:
* coordinating all aspects of project implementation and execution at their respective centres;
* evaluating possible data-processing developments (e.g. work required to adjust or tailor NWP products);
* identifying training requirements;
* preparing regular evaluation of the Daily Regional Severe Weather Forecasting Guidance during the field phase;
* reporting on a quarterly basis on the status of the activities in the respective centres;
* providing a consolidated report to the global centres;
* arranging for verification of products from his/her global centre.
  + 1. The lead person for each participating Global Centre and RSMC will be responsible for:
* coordinating all aspects of project implementation and execution at their respective centres;
* evaluating possible data-processing developments (e.g. work required to adjust or tailor NWP products);
* arranging for verification of products from his/her global centre in collaboration with the regional centres of the SWFDP.
  + 1. The regional PWS representative will be responsible to:
* promote the awareness of the SWFDP-SeA to the main stakeholders (disaster management, media and the public), including through existing forums and organizations;
* enable and assist staff of participating NMHSs to build effective dialogue for service delivery with stakeholders;
* in liaison with stakeholders, identify improvements and changes to products, as necessary, for consideration of the NMHSs’ forecasting team;
* advise participating NMHSs on methods of evaluation of public forecasts and warnings and their use by stakeholders.

Each of the participating NMHSs are requested to involve their respective national PWS focal point nominated at the invitation of WMO (ref: WMO letter WDS/PWS/NFPS, Geneva, 15 December 2010) in the SWFDP-SeA to also act as the PWS focal point for the project. Where such a national focal point has not been nominated yet, the NMHSs concerned are invited to do so and inform the Secretariat.

* + 1. The representative of the subproject to the Project Steering Group (PSG) of SWFDP will be responsible for
* reporting to RA II Working Group on Weather Services and Management Group;
* reporting to RA V Management Group;
* liaising with the PSG on aspects of the regional subproject.

# Responsibilities of Participating Centres in Subproject Implementation

Specific tasks are attributed to the three types of centres participating to the SWFDP in the cascading process.

## The Global Centres

* + 1. The responsibilities of the Global Centres (except DWD) are:
* to provide the other centres with medium-range NWP guidance and EPS output including probabilistic products specially adapted to the concerned severe weather events;
* to tailor products to the requirements of the Regional Centres including the provision of sub-domain and probabilistic products according to the lists given in **Annex A** and **Annex B**;
* to suggest suitable existing satellite imagery and satellite based products that are helpful in assessing the current meteorological situation, and therefore also assess the quality of global NWP/EPS products;
* to maintain a dedicated Web site to provide NWP guidance and EPS products;
* to evaluate the efficiency of products dedicated to medium-range severe weather forecasting through the feedback provided by the other centres.
  + 1. The responsibilities of DWD are:
  + to provide the necessary global deterministic model data for running the higher-resolution limited-area model to RFSC Ha Noi;
  + (?) to provide the global ensemble products in pictorial form; (needs to be further discussed with Detlev);
  + to collaborate with RFSC Hanoi in studying severe weather phenomena (ie. Heavy rain and tropical cyclones); and
  + to assist RFSC Ha Noi in verification of DWD products (models and ICON data).

## The Regional Centres

There are three types of Regional Centres adopted in SWFDP-SeA. The mission of each type of Regional Centres is regional forecast support, training and technical support and tropical cyclone / typhoon forecasting support.

## The Regional Forecasting Support Centre (RFSC)

The responsibilities of the RFSC Ha Noi are:

* to redirect toward the NMHSs relevant products issued from the Global Centres (if necessary);
* to provide NMHSs with its own interpretation of the medium-range guidance, including EPS products;
* to provide the NMHSs with the short-range NWP guidance (including products adapted to severe weather events), as frequently as possible;
* to indicate existing satellite/radar imagery and satellite/radar based products that could be used for nowcasting purposes;
* to issue Daily Severe Weather Forecasting Guidance products summarizing interpretation of NWP products with respect to severe weather over the responsibility area of the NMHSs;
* to provide the other centres with short-range NWP guidance and EPS output including probabilistic products specially adapted to the concerned severe weather events;
* to tailor products to the requirements of the National Centres including the provision of sub-domain and probabilistic products according to the lists given in **Annex C**;
* to evaluate its own interpretation of EPS products as well as its NWP guidance;
* to provide global centres with a feedback about the usefulness and efficiency of global products;
* to facilitate the flow of all forecasting guidance information to all participating Centres in the SWFDP through a dedicated password protected Web site and portal. Ideally this Web site would be maintained on a 24/7 basis and dedicated for the Regional Subproject;
* to coordinate real-time communications among the participating centres in the region of the project (to maintain a list of contact information; e-mail , telephone, fax).

## The Regional Centre for Training and Technical Support

The responsibilities of the Hong Kong Observatory are to:

* help the RSMT to organize training workshops;
* provide the NMHSs with the technical support in response to their requests;
* provide guidance and advice in the use of multi-media facilities at training workshops.

## The Regional Centres for Tropical Cyclone / Typhoon Forecast Support

The responsibilities of the RSMC Tokyo and RSMC New Delhi are:

* to provide the other centres with NWP guidance and EPS output, including probabilistic products specially adapted to tropical cyclone / typhoon;
* to provide NMHSs with its own interpretation of the NWP guidance and EPS products adapted to tropical cyclone / typhoon;
* to evaluate its own interpretation of EPS products as well as its NWP guidance;
* to facilitate the flow of all forecasting guidance information to all participating Centres in the SWFDP through a dedicated password protected Web site and portal. Ideally this Web site would be maintained on a 24/7 basis and dedicated for the Regional Subproject;

## The National Meteorological Centres of the NMHSs

The responsibilities of the National Meteorological Centres are:

* to interpret the guidance provided by the global centre and the regional centre;
* to issue special bulletins and warnings as required by the users (hydrological services, Disaster Management Civil Protection Authorities (DMCPA) services, media, agriculture etc.) for dissemination to the end users when severe weather is expected;
* to use available nowcasting tools (satellite imagery or satellite based products, radar products) to update warnings;
* to exchange information on warnings between participating NMHS, and between NMHSs and RFSC;
* to provide regional and global centres with a feedback on the efficiency of the global and regional products;
* to develop a communication strategy and plan with the media and end users to ensure effective response when warnings are issued;
* to establish contacts with DMCPA services and end users prior and during severe weather events;
* to obtain feedback from media, the public and other users as appropriate after the event (opportunity of warning, usefulness of warnings, lead time, degree of impacts)
* to obtain feedback from the disaster risk management agencies on utilization/benefits of warnings issued by NMHSs (under the SWFDP);
* to prepare a compiled report on the severe weather events that contains all the data needed to perform the evaluation of both RFSC Daily Severe Weather Forecasting Guidance relevant to the country, and actual warnings issued by NMHSs;
* to evaluate the warnings;
* to develop training to facilitate improved communication with the users;
* to develop a generic basic set of standard operational procedures between a NMHS and disaster risk management agencies to ensure effective use of the SWFDP products.

# Data and Products to be issued from participating Centres

## Data and Products to be issued from Global Centres

Global NWP graphical products which can be made available by the global centres CMA, JMA, KMA and ECMWF should be cut and formatted to fit the project area (10°S, 40°N, 80°E and 140°E).

NWP forecasts should be updated every 12 hours, or every 6 hours if available. In addition to the daily production all the forecasts should be archived for a minimum of 7 days.

The table in **Annex A** gives a comprehensive list of products and indicates which centre(s) will provide them. The list in **Annex B** shows the selected locations where the EPS meteograms (EPSgrams) are available.

Products which are not routinely transmitted through the GTS should be provided in graphical form (Web pages) via Internet for rapid display and dissemination. Provision of data in digital format may assist regional centres in producing charts of derived parameter.

## Current Deterministic NWP Fields up to 5 days

The products are provided at 6-h Intervals up to 2 days and 12-h intervals after 2 days. The recommended products include:

* charts to depict the large-scale flow (e.g. 500 hPa , 700 hPa, 850 hPa geopotential height, 850 hPa temperature, upper air winds, MSLP);
* surface weather elements (e.g. 6-hour accumulated precipitation, surface (10m) wind-speed).

In tropical regions other relevant products could also include:

* charts to depict the large-scale flow (e.g. surface streamlines, 850 hPa, 700 hPa, 500 hPa, 200 hPa wind flow and relative humidity, surface streamlines);
* charts to assist with forecasts of tropical cyclone formation, movement and intensification (e.g. 850 hPa, 200hPa relative vorticity and convergence, 850-400 hPa deep layer mean flow, 850-200  hPa vertical wind shear, vertical motion);

## Probabilistic Forecast Products based on EPS

The recommended products include:

* probability of severe weather events such as precipitation and wind higher than given thresholds;
* “spaghetti” plots (e.g. 500 hPa geopotential height in extra-tropics, precipitation and wind higher than given thresholds);
* stamp maps (e.g. streamlines in the tropics, wind speed, accumulated precipitation);
* dispersion diagrams (plumes and EPSgrams) for weather elements at specific locations;
* representative members of a classification of weather pattern such as clustering or tubing (optional product depending on possibilities of Global Centre);
* severe weather risk index such as Extreme Forecast Index (where available).

If severe weather is associated with a Tropical Cyclone other relevant products could include:

* surface or 850hPa vortex track charts;
* tropical cyclone position fix and track forecast spread (strike probability);
* tropical cyclone formation probability.

## Satellite Imagery and Satellite based Products

The available satellite imagery and satellite based products that Global Centres suggest are:

* Satellite Images of VIS, IR and WV Channels of FY-/2G(operated by CMA), and the intensified monitoring products when the tropical cyclone influence South China Sea;
  + (images of rapid scan of typhoons in the coverage area of FY-2E/G)
* Satellite Images of VIS, IR and WV Channels of Himawari-8 (operated by JMA);
* Diagnostic products, e.g.
  + Imagery with Heavy Rainfall Potential Areas produced by Meteorological Satellite Center of JMA
  + Himawari-8 RGB Composite Imagery produced by Meteorological Satellite Center of JMA

## Data and Products to be issued from Regional Centres

Regional Forecasting Support Centre and RSMC Typhoon / Tropical Cyclone provide the different set of data and products. The **Annex C** gives a comprehensive list of products which Regional Centres provide.

Products which are not routinely transmitted through the GTS should be provided in graphical form (Web page) via Internet for rapid display and dissemination.

## Current deterministic Limited Area Model fields up to 2 days

Products are provided at 6-hour intervals.

Products could include:

* Upper air charts to depict the large-scale flow (e.g. 200hPa, 300hPa, 500 hPa, 700 hPa, 850 hPa geopotential height, temperature and wind, and tropopause height,);
* surface charts to depict large-scale flow (e.g. MSLP, surface stream lines, surface (10) wind direction, wind speed and gust (if available))
* surface weather parameters (e.g. 6-hour accumulated precipitation, 2m temperature,
* upper air parameters (e.g. 850 hPa temperature and specific humidity);
* maps of vertical motion, potential vorticity or height of specified PV surface;
* maps of convective indices such as CAPE, Lifting Index, helicity…,
* relevant satellite images (where NMHSs do not have satellite receiving capability);
* special products derived from satellite images (e.g. derived precipitation or images annotated with guidance notes).

In tropical regions other relevant products could also include:

* charts to depict the large-scale flow (e.g. upper airwind flow and relative humidity);
* charts to assist with forecasts of tropical cyclone formation, movement and intensification (e.g. 850 hPa, 200hPa relative vorticity and convergence, 850-400 hPa deep layer mean flow, 850-200  hPa vertical wind shear, vertical motion);

## RFSC Daily Severe Weather Forecasting Guidance

Daily Severe Weather Forecasting Guidance should be issued by Regional Forecasting Support Centre (RFSC) Hanoi once per day at 0800UTC to indicate the likelihood of severe weather occurrence:

* a short range (up to 2 days) guidance, including the risk-table, and a medium range (up to 5 days) guidance.

This guidance contains:

* Synopsis of weather (analysis and forecast);
* the interpretation of deterministic and ensemble NWP products from the Global and Regional Centres;
* severe weather predictions (risk or probability estimates) combining with tropical cyclone information of the RSMCs Tropical Cyclone Tokyo and New Delhi.

The threshold values used in RFSC Daily Severe Weather Forecasting Guidance are determined as follows:

* heavy rain: 50 and 100mm (the risk over 200mm/24h should be described in discussion)
* wind speed: 30knot over the land and 30 and 50knot over the sea.

An exampleof RFSC Daily Severe Weather Forecasting Guidance is given in **Annex D.**

## RSMC Tropical Cyclone Information/Advisory

RSMC Tropical Cyclone Information and Advisory are official information on typhoon or tropical cyclones. AnnexC.2 and C.3 give the information of all products and services provided by RSMC Tokyo – Typhoon Centre and RSMC New Delhi – Tropical Cyclone Centre, respectively.

## 5.2.4 Effective Collaboration between RSMC Tropical Cyclones and RFSC Hanoi

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

Consistency between RSMC TC advisories and RFSC Hanoi

To ensure consistency between RSMC TC advisories and RFSC Hanoi guidance, RFSC Hanoi 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 Hanoi understand RSMC TC advisories.

Coordination of products of RSMC Tokyo and RFSC Hanoi

Noting that RSMC Tokyo and RFSC Hanoi operates password-protected websites, 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 Hanoi. RFSC Hanoi 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 Hanoi to provide through its SWFDP-SeA website, RSMC Tokyo makes coordination for RFSC Hanoi to provide them through it. If RFSC Hanoi has their own TC related products which are considered useful, RFSC Hanoi shares them with and requests RSMC Tokyo to provide them through the NTP website.

## Data and Products to be delivered from other on-going projects or activities

The SWFDP-SeA expects the additional data and products from other on-going projects or activities in the target domain. These data and products are provided voluntarily by courtesy of these projects or activities so that these are additional materials.

The available data and products are listed in **Annex E** with the contact point of respective projects or activities. When the data and products become unavailable during the field phase, RSMT should contact a contact person of relevant projects or activities.

The products from Meteorological Satellite Centre (JMA) (ANNEX E.1) and GIFS products (ANNEX E.2) are evaluated through the demonstration phase in a way described in section 9. Other products are not necessary to be evaluated in SWFDP-SeA.

# Verification of Technical Capability of participating NMCs/NMHSs

## Technical feasibility

The SWFDP-SeA requests the Global and Regional Centres to provide their products on GTS or/and Internet. Therefore, the participating NMCs/NMHSs need to be equipped with the internet infrastructure enough to accommodate the high-speed access to NWP products of foreign countries.

Regarding the PWS, the NMCs/NMHSs are requested to have the infrastructure to be developed to be able to obtain feedback from users, including media, disaster risk management agencies and pubic.

## Current status of internet infrastructure and requests

## Cambodia

The bandwidth of internet line at the DoM in Cambodia is the order of 256 Mega bps. The NMHS in Cambodia relies on the internet as essential for severe weather forecasting. The internet connection at the DoM is sometimes shutdown especially when dry season is coming up. Electricity supply is limited for some area.

## Lao P.D.R.

The internet access of the NMC consists of 2 lines: (1) Asymmetric Digital Sub – Criber Line (ADSL) system whose speed normally has 128 / 256 Kbps serves for DMH’s website, and (2) MPLS system whose speed has 2 Mbps serves for common use in DMH headquarter and for data link between DMH and GISC - Tokyo. At the NMC the forecasters consider their internet access is not stable. The forecasters rely on the Internet as essential for severe weather forecasting at the NMC such as Global NWP products, EPSgram and Tropical Cyclone Advisory (RSMC products).

There are some Provincial Hydro-meteorological Offices where the Internet are available and the speed still slow.

The Aviation Meteorological Service Office located at the airports is served with ADSL internet access, but belonging to Air Traffic Control Department. This service is used by forecasters to download satellite data through SATAID system, and SWFDP-SeA web portal.

## Philippines

The PAGASA maintains a website which is hosted outside on which are posted its products and information on its various activities. At present, PAGASA Operations Centre is being served by three (3) different internet service providers with nominal speeds of 40Mbps, 40Mbps and 1Gbps (shared government services) and a backup of 8Mbps. The three Internet Access Service (IAS) go through a load-balancer which caters to various internet accesses as well as downloading of models from NCEP, JMA, etc. and data/products from other sources or NMHS. The IAS also caters to clients accessing PAGASA data through File-Transfer-Protocol (FTP).

Connectivity with RA II Tokyo Regional Specialized Meteorological Centre (RSMC) GTS is through a 64kbps IP-VPN MPLS lease line link and another 64kbps IP-VPN MPLS link with Singapore Meteorological Centre.

Lease-lines services also caters to connectivity requirements of the four (4) PAGASA Regional Services Division for the Forecaster's Workstation through a virtual private network Wide Area Network (WAN) setup which consumes a significant amount of bandwidth. There are times wherein internet access slows down especially during typhoon and monsoon season. We will be upgrading the bandwidth requirements of the regional office to accommodate large volume traffic.

The Aviation Meteorological Services Office located at the airport is served with a 10Mbps IP-VPN Transport Service. This service is used by forecasters to access web-based Forecasters Tools and downloading of data and products from sources. The internet access is being provided by the Operations Center in Quezon City.

## Thailand

The TMD has the internet line whose speed has 50(domestic)/10(international) Mbps. The TMD recognized that the internet access is slow. The forecasters rely on the Internet as essential for severe weather forecasting at the TMD.

## Viet Nam

NHMS has 3 international lines, including: High-speed line with 622 Mbps, normal-speed line with 12Mbps and 2Mbps. The high-speed line belongs to the Trans-Eurasia Information Network (TEIN4) and is used for accessing numeric data (ECMWF and NCEP). The normal-speed lines are rent of ISP VDC, IDC Viettel and CMC of Viet Nam. The normal-speed line is used by forecasters for accessing graphical products from other centres.

# PWS Aspects related to delivery of severe weather warnings

## PWS Guidance on Developing Service Delivery Mechanisms in NMHSs

Effective service delivery is a fundamental requirement for NMHSs if they are to meet national needs. There are many different interpretations of the concept of service delivery as it relates to the provision of weather-, climate- and water-related services. The WMO Strategy for Service Delivery and its Implementation Plan (WMO No. 1129) were developed and approved by Congress and the Executive Council respectively to guide Members in their service delivery activities. The publication is freely accessible through the following link:

<http://www.wmo.int/pages/prog/amp/pwsp/documents/WMO-SSD-1129_en.pdf>

The Implementation Plan reflects the fundamental role of Service Delivery in all WMO programmes and initiatives, particularly in PWS and DRR; Describes practices for strengthening service delivery by Members using a flexible methodology, and Provides NMHSs’ management with tools to understand use of NMHSs services in decision-making processes by users. All participating NMHSs in the SWFDP-SeA are strongly encouraged to use the Strategy and its Implementation Plan to assist them with the improvement of their PWS delivery under the project.

Many of the attributes of service delivery contained in the Strategy have been incorporated into the PWS Guidance on Developing Service Delivery Mechanisms in NMHSs for the purpose of their inclusion in the development of the SWFDP-SeA. (See **Annex F**). The PWS Guidance provides step by step advice on how to deliver effective services to users as indicated below:

Step 1: Focus on the user

Step 2: Focus on internal organization of your NMHS

Step 3: Improve communication skills of NMHS Staff

Step 4: Engage users

Step 5: Conduct Service Evaluation for Improvement

All steps are described in detail in the Guide. They specifically emphasize the importance of user focus and user feedback and evaluation as two elements that contribute to the success of SWFDP in meeting its objectives

## Implementation Plan to improve the warnings and forecasts services in NMHSs

Participating NMHSs are expected to develop implementation plans based on the Guide for achieving the improvement in delivering warnings and forecasts services to stakeholders. The plan will be tested during the demonstration phase and be evaluated to verify its usefulness and identify the area of improvement after this phase. This RSIP contains the steps to take actions as agreed to by each of the participating NMHSs as a starting point for implementing the PWS component of SWFDP-SeA as attached in **Annex G**.

# Training

## Overview

Training is necessary to ensure that forecasters from Regional Centres and NMHSs are able to correctly interpret the various NWP/EPS and guidance products made available for the SWFDP regional subproject and to prepare user-focused information. Also, the training will inform forecasters of all responsibilities as outlined in the RSIP.

Two-weeks training workshops combining DPFS and PWS requirements are held once per year. The venue of a training workshop should be selected among countries of participating NMCs.

The training should include specific topics on coordination and collaboration between NMHSs,DMCPAs, media, governmental and non-governmental organizations and any other relevant agencies as part of the PWS component of the SWFDP. Such training should take place with reference to any documented guidelines about service delivery principles and practices.

It is important to note that any special training session devoted to a regional subproject could be planned in conjunction with existing training programmes organized by the WMO Secretariat or WMO Members. In this context, aiming to enhance the regional and national forecasting process/capacity, it is planned to establish the RFSC Training Desk at RFSC Hanoi for a specific period during which forecasters from each participating NMC will be invited to participate on rotational basis for a period of two weeks. A detailed plan, including inviting an expert/lecturer from Global or Regional Centres for at least at the inception of the Training Desk, will be developed.

## Training topics for the course

Possible contents of training workshop are listed as follows:

* Interpretation and best practice use of deterministic and probabilistic NWP products for the forecasting of severe weather;
* Understanding and interpretation of specialized deterministic and probabilistic NWP products for forecasting severe weather associated with tropical cyclones;
* Feedback mechanisms and contingency plans;
* Use of probabilities in the preparation of weather forecasts;
* Model verification as part of the forecast process;
* Interpretation of Daily Severe Weather Forecasting Guidance produced by RFSC Hanoi and TC guidance products produced by RSMC Tokyo and RSMC New Delhi;
* Use and applications of the SWFDP-SeA project website;
* Guidance on the completion of the SWFDP-SeA evaluation form(s);
* Coordination activities with DMCPAs
* Constructing a case-study.

The PWS-related topics should typically include the following:

* Issues related to service delivery
* Coordination with Disaster Management and Civil Protection Agencies (DMCPA)
* Improvements in working relationships between NMHSs and DMCPA
* Communication and media skills
* Impact-based forecast and warning services delivery
* Public Education and Outreach
* Communicating Uncertainty in Forecasts
* Service Evaluation

The detailed information about training programme will be made available before the training workshop.

## RFSC Training Desk

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 RFSC Daily Severe Weather Forecasting Guidance issued by RFSC Hanoi 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 Hanoi 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.

# Evaluation

## Overview

Every SWFDP Regional Subproject is required to be evaluated against the SWFDP goalsas mentioned in Para 1.1.1 above. The aims of the SWFDP evaluation are:

* to assess the performances of the Daily Regional Severe Weather Forecasting Guidance;
* to assess the performances of the NMHS warning system,
* to inform about the efficiency of the SWFDP system and the level of satisfaction of the users.

During the demonstration phase, a continuous evaluation procedure using regular progress report must be implemented to check if the cascading process works efficiently.

At the end of the demonstration phase, a final evaluation of the regional subproject needs to be carried out by the RSMT to identify gaps and areas for improvement to ensure future sustainability of the demonstrated procedures and for other similar subprojects. In this evaluation, a qualitative assessment will be made of the success of the SWFDP related to the specific benefits of the Project and in particular the measurable improvements that have been noted in the warning services that are provided to the National Disaster Management Offices (NDMOs) and the media.

## Submission of Quarterly Progress Reports through SWFDP Database

To keep regularly informed the RSMT and WMO about the progress of the implementation of SWFDP-SeA and the project evaluation against SWFDP goals, each participating NMHS shall prepare quarterly progress reports including case studies and submit to WMO Secretariat online through SWFDP database after the end of each quarter. The SWFDP database has been developed using WMO’s Country Profile Database (CPDB) web portal. Each of the NMHSs involved in SWFDP-SeA shall have specific user ID and password to have access to the SWFDP database for submission of its progress reports. The national focal points for SWFDP-SeA (RSMT members) shall be responsible for implementation of the tasks related to the project at national levels including submission of SWFDP quarterly progress reports.

A progress report should contain information about the way the SWFDP is being implemented, such as the NWP/EPS 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 etc. The quarterly progress reports shall be prepared according to the schedule given in Section 10. The list of key elements and information that need to be reported in progress reports is given in **Annex H.**

To ensure that the needed information is reliably completed it is proposed that the information for the evaluation severe weather events be collected by using an “evaluation form”. A template of evaluation form is shown in **Annex I.** 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 (Excel file) 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.

## Feedback from users from the viewpoint of PWS

During the demonstration phase it will be particularly important for participating NMHSs 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 information in this continuous evaluation should be consolidated into regular quarterly progress reports. The feedbacks from users are quite useful to improve the severe weather forecasting services. The NMCs/NMHSs regularly obtain these feedbacks using the user assessment questionnaire for the public, NDMOs and the media in **Annex J**. This should be included in regular progress report.

# Timetable of implementation of the demonstration phase

|  |  |  |
| --- | --- | --- |
| **When** | **What**  **Task** | **Who**  **RSMT Member** |
| August2015 | Second meeting of RSMT to update the RSIP | All |
| January 2016 | Start a demonstration phase | All |
| April 2016 | 1st Quarterly Progress Report | NMHSs of participating countries |
| July 2016 | 2ndQuarterly Progress Report | NMHSs of participating countries |
| October 2016 | 3rdQuarterly Progress Report | NMHSs of participating countries |
| January 2017 | 4th Quarterly Progress Report | NMHSs of participating countries |
| Q1 of 2017 | Third RSMT meeting to review the demonstration phase | All |

# Costs

For the purpose of evaluating the total cost of the regional subproject, participating centres are required to estimate all additional costs associated with the SWFDP. This should include human costs (equivalent person-months) as well as expenditures of funds if any directly related to the project.

Financial assistance from a variety of sources will be needed to complete the project. There is potential for additional assistance as part of ongoing projects and activities in the region. The potential impact of demonstration phase project-related activities on operational staffing should be considered by all participating centres.

The WMO DPFS, PWS, DRR, Regional and ETR (Education and Training), TCP programmes and RMO may be able to source funding to assist with conducting RSMT meetings and training. CBS-XIV commended the efforts of the Secretariat in supporting the SWFDP through optimising activities across WMO programmes and in seeking support from aid donors. Following the recommendations of CBS, Members are urged to seek funds from potential development partners and other agencies who stand to benefit from the important results of the SWFDP.

# Communication and publicity of the project (Stakeholder engagement)

Informing stakeholders about the Project is an important on-going task. There should be publicity about the initiation of the Project as well regular progress reports.

Stakeholders include:

* NMHSs in the region, including spreading information within the NMHS of theparticipants;
* RA II / RA V Presidents and Management Groups;
* Relevant RA II / RA V Working Groups;
* Executive Council;
* Aid agencies and development partners : Asian Development Bank, World Bank;
* ASEAN Sub-committee on meteorology and geophysics
* UNESCAP/WMO Typhoon Committee
* Mekong River Commission
* WMO Secretariat

Communication could be through newsletters, information pamphlets, presentations (e.g., at the TC sessions, regular session of RA II, RA V and other regional meetings)

This Regional Subproject Implementation Plan should be passed to stakeholders for information and feedback. Responsibility for communicating the Project and publicity is a task for all participants, but with overall coordination by the chairperson.

# List of the Annexes

* ANNEX A: Availability of Minimum Required NWP Products from Global Centres
* ANNEX B: List of the Stations of EPSgrams (ECMWF ENS Meteograms) provided by Global Centres
* ANNEX C: Data and Products List issued from Regional Centres
* ANNEX D: Example of RFSC Daily Severe Weather Forecasting Guidance
* ANNEX E: Data and Products delivered from other Projects / Activities
* ANNEX F: PWS Guidance on Developing Service Delivery Mechanisms in NMHSs
* ANNEX G: Action Plan for Improvement of PWS element in NMHSs
* ANNEX H: SWFDP Quarterly Progress Report key elements and information
* ANNEX I: Template of Severe Weather Event Evaluation Form
* ANNEX J: User Assessment Questionnaire

# References

* Final Report of the 13th session of CBS (St. Petersburg, 23 February - 3 March 2005)
* Final Report of the Extra-ordinary session of CBS in 2006 (Seoul, Republic of Korea, 9-16 November 2006)(CBS-Ext.(2006))
* Final Report of the 14th session of Regional Association II (Asia) (Tashkent, Uzbekistan, 5–11 December2008), WMO-No.1037(2009).
* Final Report of the 14th session of CBS (Dubrovnik, Croatia , 25 March - 2 April, 2009)
* Final Report of the Workshop on SWFDP Development for Southeast Asia (Hanoi, Vietnam, 1-4 February 2010).
* Final Report of the 3rd meeting of CBS Steering Group for the Severe Weather Forecasting Demonstration Project (Geneva, Switzerland, 22-26 February, 2010).
* Final Report of the Technical Planning Workshop on SWFDP Development for Bay of Bengal (South Asia) (New Delhi, 23-27 January 2012).
* Final Report of the 4th meeting of CBS Steering Group for the SWFDP, Geneva, Switzerland, 28February to 2 March 2012).
* Final Report of the 15th session of CBS (Jakarta, Indonesia, 10-15 September, 2012)
* Final Report of the Extra-ordinary meeting of CBS Steering Group for the SWFDP, Geneva, Switzerland, 3 – 5 December, 2013).
* Final Report of the Extra-ordinary session of CBS (Asunción, Paraguay, 8–12 September 2014) (CBS-Ext.(2014))

# ANNEX A: Availability of Minimum Required NWP Products from Global Centres

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Deterministic Forecasts: | Availability | | | |
| 6-hourly out to 72 hours, then 12-hourly up to 144 hours | CMA | JMA | KMA | ECMWF |
| Parameters: wind (streamlines and speed/direction), temperature, geopotential height, humidity  Levels: sfc, 925hPa, 850hPa, 700hPa, 500hPa, 300hPa, 200hPa  Purpose: General forecasting parameters to gain a perspective on the overall atmosphere. For determination of frontal system and pressure maxima locations. | YES | YES | YES | YES |
| Parameter: vorticity  Level: 500hPa, 300hPa  Purpose: Determination of frontal and low pressure system locations. Crucial in locating potential severe weather outbreak locations. Can be used in determination of severe weather type | YES | YES | YES | YES |
| Parameter: vertical velocity  Level: 850hPa, 700hPa, 300hPa  Purpose: Determination of mesoscale patterns of rising and sinking air masses (convective updrafts) | YES | YES | YES | YES |
| Parameter: 850hPa wet bulb potential temperature  Level: 850hPa  Purpose: Frontal position diagnosis and change in airmass | 850hPa equivalent potential temperature (replacing  wet-bulb potential temperature) | 850hPa equivalent potential temperature (replacing wet-bulb potential temperature) | NO | 850hPa equivalent potential temperature(replacing wet-bulb potential temperature) |
| Parameters: instantaneous and accumulated precipitation, minimum temperature, maximum temperature, sea level pressure, relative humidity  Level: sfc  Purpose: General forecasting parameters | YES, except instantaneous precipitation | YES except instantaneous precipitation | Accumulated precipitation and sea level pressureare only available | YES  Except instantaneous precipitation and relative humidity |
| Parameter: 1000-500hPa thickness  Level: partial atmospheric column  Purpose: Freezing level determination and air mass distinguishing | NO | YES | YES | YES |
| Parameter: precipitable water  Level: atmospheric column  Purpose: Determination of total liquid water in the atmosphere and thus potential rainfall | NO | YES | YES | YES |
| Parameter: convective available potential energy (CAPE), Theta-E  Level: atmospheric column  Purpose: Amount of energy available in the atmosphere for storm production | Theta-SE replacing Theta-E. | CAPE only | NO | CAPE only |
| Parameter: lifted index, K index, total totals index  Level: stability index Purpose:  Pre-calculated indices to generalize severe weather potential | K index is only available | K index is only available | YES | NO |
| Parameter: convective inhibition (CIN)  Level: stability index  Purpose: Strength of force preventing convective initiation. The amount of energy (frontal forcing or daytime heating) that is needed to begin convection. | NO | YES | NO | NO |
|  | | | | |
| Ensemble Forecasts: | Availability | | | |
| 12-hourly out to 144 hours | CMA | JMA | KMA | ECMWF |
| Probability of 6-hour accumulated precipitation exceeding 50mm and 100mm threshold value | YES | YES | YES | 50mm threshold only |
| Probability of 24-hour accumulated precipitation exceeding 100mm threshold value | YES | YES | YES | YES |
| Probability of 10-meter wind speed exceeding 20kt and 30kt threshold value | YES | YES | YES | YES |
| Probability of significant wave height exceeding 2 m, 4 m and 6 m threshold value | NO | NO | NO | YES |
| Probability of mean wave period exceeding 10 s and 15 s threshold value | NO | NO | NO | YES |
| Ensemble Prediction System meteograms for specified locations (10-day / 15-day) | YES | YES  (10-day) | YES  (10-day) | YES |
| Spaghetti diagrams for 500hPa geopotential height | YES | YES | YES | NO |
| Thumbnails of probability of precipitation in excess of threshold of 50mm/6h at 6 hours intervals | NO | YES | NO | NO |
| Extreme Forecast Index and Shift of Tails, and M-Climate for TMean, Tmax, Tmin, wind gust, wind speed, total precipitation, Max significant wave height, total snowfall | NO | NO | NO | YES |
| ENS Cumulative Distribution Functions (Forecast and M-Climate) and EFI values (for precipitation, temperature and wind gust) | NO | NO | NO | YES |
| MJO Index - Extended range forecast | NO | NO | NO | YES |
| Tropical cyclone occurrence and genesis probability maps – including extended range forecast | NO | NO | NO | YES |
| Tropical cyclone strike probability maps | YES | NO | NO | YES |
| Tropical cyclone forecast tracks from ensemble members, including ensemble mean, deterministic and control tracks | YES | NO | NO | YES |
| Tropical Cyclone Lagrangian meteograms | NO | NO | NO | YES |
|  | | | | |
| Other REQUESTED Products: | Availability | | | |
|  | CMA | JMA | KMA | ECMWF |
| SKEW-T logarithmic forecast plots for selected grid points based on NWP output (out to 144 hours, 12-hourly) | NO | NO | YES | NO |

Remark: ECMWF will provide the indicated products as soon as possible; however, some products (e.g. Shift-of-tails, M-climate, CDF, extended-range) may not be available initially

# ANNEX B: List of the Stations of EPSgrams provided by Global Centres

**Remark:** ECMWF provides EPSgrams (known at ECMWF as "ENS meteograms") at stations in the form of italic style.

## B.1 Cambodia

B.1.1 List of stations for EPSgrams

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WMO ID** | **Station Name** | **Latitude**  **North** | **Longitude**  **East** | **Altitude**  **[m]** | **CMA** | **JMA** | **KMA** | **ECMWF** |
| 48969 | *Bantey Meanchey* | 13º37' | 102º58' | 31 | ○ | ○ | ○ | ○ |
| 48962 | Battambang | 13º06' | 103º12' | 13 | ○ | ○ | ○ |  |
| 48990 | *Kandal* | 11º26' | 104º49' | 8 | ○ | ○ | ○ | ○ |
| 48986 | *Koh Kong* | 11º38' | 102 59' | 13 | ○ | ○ | ○ | ○ |
| 48995 | *Kompomg Cham* | 12º | 105º27' | 14 | ○ | ○ | ○ | ○ |
| 48967 | Kompong Chhnang | 12º13' | 104º40' | 15 | ○ | ○ | ○ |  |
| 48992 | *Kompong Speu* | 11º28' | 104º34 | 27 | ○ | ○ | ○ |  |
| 48965 | *Kompong Thom* | 12º41' | 104º54' | 13 | ○ | ○ | ○ | ○ |
| 48985 | *Kompot* | 10º36' | 104º11' | 4 | ○ | ○ | ○ | ○ |
| 48970 | Krotie | 12º29' | 106º10' | 23 | ○ | ○ | ○ | ○ |
| 48991 | *Pochentong* | 11º33' | 104º50' | 11 | ○ | ○ | ○ |  |
| 48964 | *Preh Vihear* | 14º06' | 105º 09' | 62 | ○ | ○ | ○ | ○ |
| 48997 | *Prey Veng* | 11º29' | 105º19' | 13 | ○ | ○ | ○ | ○ |
| 48968 | Pursat | 12º33' | 103º51' | 18 | ○ | ○ | ○ |  |
| 48973 | Rattanakiri | 13º44' | 106º59' | 330 | ○ | ○ | ○ |  |
| 48966 | Siemreap | 13º22' | 103º51' | 15 | ○ | ○ | ○ |  |
| 48983 | *Sihanouk Ville* | 10º37' | 103º29' | 13 | ○ | ○ | ○ | ○ |
| 48972 | Stung Treng | 13º31' | 105º58' | 54 | ○ | ○ | ○ |  |
| 48998 | Svay Reing | 11º50' | 105º48' | 6 | ○ | ○ | ○ |  |
| 48993 | Takeo | 10º59' | 104º48' | 6 | ○ | ○ | ○ |  |
| 48971 | Mondul Kiri | 12º27' | 107º11' | 690 | ○ | ○ | ○ |  |
| 48963 | Pailin | 12º48' | 102º36' | 170 | ○ | ○ | ○ |  |

## B.2 Lao PDR

B.2.1 List of stations for EPSgrams

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WMO ID** | **Station Name** | **Latitude**  **North** | **Longitude**  **East** | **Altitude**  **[m]** | **CMA** | **JMA** | **KMA** | **ECMWF** |
| 48921 | Phongxali | 21.6763 | 102.0921 | 1300 | ○ | ○ | ○ |  |
| 48924 | *Louangnamtha* | 20.9310 | 101.4165 | 600 | ○ | ○ | ○ | ○ |
| 48925 | Oudomxai | 20.6967 | 101.9915 | 636 | ○ | ○ | ○ |  |
| 48926 | Houayxay | 20.2619 | 100.4372 | 401 | ○ | ○ | ○ |  |
| 48930 | *Louangphbang* | 19.8984 | 102.1652 | 305 | ○ | ○ | ○ | ○ |
| 48938 | Xaignabouli | 19.2438 | 101.7103 | 326 | ○ | ○ | ○ |  |
| 48927 | Viangxai | 20.4174 | 104.2309 | 913 | ○ | ○ | ○ |  |
| 48935 | Phonsavan | 19.4438 | 103.1711 | 1094 | ○ | ○ | ○ |  |
| 48941 | Phonhong | 18.4930 | 102.4488 | 179 | ○ | ○ | ○ |  |
| 48940 | *Vientiane* | 17.9700 | 102.5704 | 171 | ○ | ○ | ○ | ○ |
| 48945 | *Pakxan* | 18.3911 | 103.6657 | 157 | ○ | ○ | ○ | ○ |
| 48946 | *Thakhek* | 17.4048 | 104.8084 | 151 | ○ | ○ | ○ | ○ |
| 48947 | *Savannakhet* | 16.5523 | 104.7545 | 144 | ○ | ○ | ○ | ○ |
| 48952 | Salavan | 15.7119 | 106.4127 | 168 | ○ | ○ | ○ |  |
| 48953 | *Xekong* | 15.3424 | 106.7199 | 143 | ○ | ○ | ○ | ○ |
| 48955 | *Pakxe* | 15.1201 | 105.8561 | 104 | ○ | ○ | ○ | ○ |
| 48957 | Attapu | 14.8111 | 106.8302 | 105 | ○ | ○ | ○ |  |

## B.3 Philippines

B.3.1List of stations for EPSgrams

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WMO ID** | **Station Name** | **Latitude**  **North** | **Longitude**  **East** | **Altitude**  **[m]** | **CMA** | **JMA** | **KMA** | **ECMWF** |
| 98434 | INFANTA | 14.7464 | 121.6489 | 7 | ○ | ○ |  |  |
| 98223 | *LAOAG* | 18.1828 | 120.5342 | 5 | ○ | ○ |  | ○ |
| 98233 | *TUGUEGARAO* | 17.6375 | 121.7525 | 62 | ○ | ○ |  | ○ |
| 98325 | DAGUPAN | 16.0867 | 120.3522 | 2 | ○ | ○ |  |  |
| 98327 | CLARK AB | 15.1853 | 120.5489 | 155 | ○ | ○ |  |  |
| 98328 | *BAGUIO* | 16.4039 | 120.6014 | 1510.08 | ○ | ○ |  | ○ |
| 98334 | BALER RADAR | 15.7492 | 121.6319 | 2256 | ○ | ○ |  |  |
| 98425 | *MANILA* | 14.5869 | 120.9786 | 13 | ○ | ○ |  | ○ |
| 98531 | SAN JOSE | 12.3608 | 121.0475 | 3.314 | ○ | ○ |  |  |
| 98430 | SCIENCE GARDEN | 14.6447 | 121.0444 | 43 | ○ | ○ |  |  |
| 98431 | CALAPAN | 13.4097 | 121.1894 | 41 | ○ | ○ |  |  |
| 98432 | AMBULONG | 14.0900 | 121.0550 | 11 | ○ | ○ |  |  |
| 98444 | *LEGASPI* | 13.1506 | 123.7283 | 17 | ○ | ○ |  | ○ |
| 98440 | DAET | 14.1286 | 122.9825 | 4 | ○ | ○ |  |  |
| 98546 | CATARMAN | 12.5053 | 124.6283 | 7 | ○ | ○ |  |  |
| 98550 | TACLOBAN | 11.2256 | 125.0247 | 3 | ○ | ○ |  |  |
| 98618 | PUERTO PRINCESA | 9.7403 | 118.7586 | 15 | ○ | ○ |  |  |
| 98637 | *ILOILO* | 10.7131 | 122.5431 | 6 | ○ | ○ |  | ○ |
| 98642 | DUMAGUETE | 9.3331 | 123.2992 | 7 | ○ | ○ |  |  |
| 98644 | TAGBILARAN | 9.6669 | 123.8558 | 8 | ○ | ○ |  |  |
| 98558 | GUIUAN | 11.0453 | 125.7556 | 60 | ○ | ○ |  |  |
| 98646 | *MACTAN* | 10.3222 | 123.9800 | 24 | ○ | ○ |  | ○ |
| 98748 | *CAGAYAN DE ORO* | 8.4839 | 124.6475 | 6 | ○ | ○ |  | ○ |
| 98751 | MALAYBALAY | 8.1511 | 125.1339 | 609 | ○ | ○ |  |  |
| 98753 | *DAVAO AIRPORT* | 7.1278 | 125.6547 | 18 | ○ | ○ |  | ○ |
| 98755 | HINATUAN | 8.3664 | 126.3378 | 3 | ○ | ○ |  |  |
| 98836 | *ZAMBOANGA* | 6.9194 | 122.0631 | 6 | ○ | ○ |  | ○ |

## B.4 Thailand

B.4.1 List of stations for EPSgrams

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WMO ID** | **Station Name** | **Latitude**  **North** | **Longitude**  **East** | | **Altitude**  **[m]** | **CMA** | **JMA** | **KMA** | **ECMWF** |
| 48327 | *Chiang Mai* | 18.8 | | 99 | 314 | ○ | ○ | ○ | ○ |
| 48378 | *Phitsanulok* | 16.8 | | 100.3 | 46 |  | ○ | ○ | ○ |
| 48354 | *Udon Thani* | 17.4 | | 102.8 | 178 | ○ | ○ | ○ | ○ |
| 48407 | *Ubon Ratchathani* | 15.2 | | 104.9 | 124 | ○ | ○ | ○ | ○ |
| 48400 | *Nakhon Sawan* | 15.8 | | 100.2 | 35 |  | ○ | ○ | ○ |
| 48455 | *Bangkok* | 13.7 | | 100.6 | 4 | ○ | ○ | ○ | ○ |
| 48462 | *Aranyaprathet* | 13.7 | | 102.6 | 49 |  | ○ | ○ | ○ |
| 48500 | *Prachuap Khirikhan* | 11.8 | | 99.8 | 5 |  | ○ | ○ | ○ |
| 48568 | *Songkhla* | 7.2 | | 100.6 | 7 |  | ○ | ○ | ○ |
| 48565 | *Phuket Airport* | 8.2 | | 98.3 | 9 | ○ | ○ | ○ | ○ |
| 48331 | Nan | 18.78 | | 100.78 | 200 |  | ○ | ○ |  |
| 48421 | Thong Phaphum | 14.74 | | 98.64 | 97.36 |  | ○ | ○ |  |
| 48357 | Nakhon Phanom | 17.42 | | 104.78 | 145 |  | ○ | ○ |  |
| 48431 | Nakhon Ratchasima | 14.96 | | 102.07 | 186 |  | ○ | ○ |  |
| 48501 | Trad | 11.77 | | 102.88 | 2 |  | ○ | ○ |  |
| 48551 | Surat Thani | 9.14 | | 99.15 | 5 |  | ○ | ○ |  |

## B.5Viet Nam

B.5.1 List of stations for EPSgrams

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WMO ID** | **Station Name** | **Latitude**  **North** | **Longitude**  **East** | **Altitude**  **[m]** | **CMA** | **JMA** | **KMA** | **ECMWF** |
| 48808 | Cao Bang | 22.67 | 106.25 | 243 |  | ○ | ○ |  |
| 48803 | Lao Cai | 22.5 | 103.97 | 97 |  | ○ | ○ |  |
| 48830 | Lang Son | 21.83 | 106.77 | 263 | ○ | ○ | ○ |  |
| 48806 | *Son La* | 21.33 | 103.9 | 676 |  | ○ | ○ | ○ |
| 48820 | *Ha Noi* | 21 | 105.88 | 7 | ○ | ○ | ○ | ○ |
| 48826 | *Phu Lien* | 20.8 | 106.63 | 116 |  | ○ | ○ | ○ |
| 48823 | Nam Đinh | 20.43 | 106.15 | 3 |  | ○ | ○ |  |
| 48839 | Bach Long Vi | 20.13 | 107.72 | 56 |  | ○ |  |  |
| 48840 | *Thanh Hoa* | 19.75 | 105.78 | 5 |  | ○ | ○ | ○ |
| 48845 | *Vinh* | 18.67 | 105.68 | 6 |  | ○ | ○ | ○ |
| 48848 | Đong Hoi | 17.48 | 106.6 | 8 |  | ○ | ○ |  |
| 48852 | *Hue* | 16.43 | 107.58 | 9 | ○ | ○ | ○ | ○ |
| 48855 | *Đa Nang* | 16.03 | 108.2 | 7 |  | ○ | ○ | ○ |
| 48866 | *Pleiku* | 13.98 | 108 | 779 |  | ○ | ○ | ○ |
| 48870 | Quy Nhon | 13.77 | 109.22 | 6 |  | ○ | ○ |  |
| 48877 | Nha Trang | 12.22 | 109.22 | 4 |  | ○ | ○ |  |
| 48892 | Song Tu Tay | 11.42 | 114.33 | 5 |  | ○ | ○ |  |
| 48887 | Phan Thiet | 10.93 | 108.1 | 5 |  | ○ | ○ |  |
| 48900 | *Ho Chi Minh* | 10.82 | 106.67 | 10 | ○ | ○ | ○ | ○ |
| 48917 | Phu Quoc | 10.22 | 103.97 | 4 |  | ○ | ○ |  |
| 48916 | Tho Chu | 9.28 | 103.47 | 0 |  | ○ |  |  |
| 48914 | Ca Mau | 9.18 | 105.15 | 3 | ○ | ○ | ○ |  |
| 48918 | Con son | 8.68 | 106.6 | 9 |  | ○ |  |  |
| 48920 | Truong Sa | 8.65 | 111.92 | 3 |  | ○ |  |  |
| 48919 | Huyen Tran | 8.02 | 110.62 | 19 |  | ○ |  |  |

# ANNEX C: Data and Products List issued from Regional Centres

## **C.1 Regional Forecasting Support Centre Hanoi**

| **Deterministic Forecasts from global models that received at NCHMF**  **(present and near future)** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| All product is provided every 6-hourly out to 72 hours | Availability | | | | | |
| GSM (JMA) | GFS (NCEP) | NOGAPS (US Navy) | GME (DWD) | GEM  (CMC) | IFS (ECMWF) |
| **Surface parameters** | | | | | | |
| Every 6 hours and 24 hours total accumulated precipitation | x | x | x |  | x | x |
| 2 meters temperature and dewpoint temperature | x | x | x | x | x | x |
| 2 meters relative humidity or specific humidity | x | x | x | x | x | x |
| 10 meters wind (speed and direction) | x | x | x | x | x | x |
| Pressure of mean sea level | x | x | x | x | x | x |
| **Upper parameters** | | | | | | |
| Parameters: wind (streamlines and speed/direction), temperature, geopotential height, humidity  Levels: 1000hPa, 925hPa, 850hPa, 700hPa, 500hPa, 300hPa, 200hPa, 200hPa | x | x | x | x | x | x |
| Parameter: vorticity  Level: 850hPa, 700hPa, 500hPa, 300hPa | x | x | x | x | x | x |
| Parameter: divergence  Level: 500hPa, 300hPa, 200hPa | x | x | x | x | x | x |
| Parameter: vertical velocity  Level: 850hPa, 700hPa, 500hPa | x | x | x | x | x | x |
| Parameter: potential temperature and equivalent potential temperature  Level: 850hPa, 700hPa | x | x | x | x | x | x |
| **Atmospheric column or instable indices** | | | | | | |
| Parameter: lifted index, K index, total totals index, CAPE, CIN, Shalwater index, etc | x | x | x | x | x | x |
| Parameter: 1000-500hPa thickness | x | x | x | x | x | x |
| **SkewT and Meteogram at given locations** | | | | | | |
| List of location is requested by participating countries | x | x | x | x | x | x |

| **Deterministic Forecasts from high resolution regional models at NCHMF**  **(present and near future)** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| All product is provided every 6-hourly out to 72 hours | Availability | | | | | |
| COSMO | | WRF |  |  |  |
| **Surface parameters** | | | | | | |
| Every 6 hours and 24 hours total accumulated precipitation | x | x | |  |  |  |
| 2 meters temperature and dewpoint temperature | x | x | |  |  |  |
| 2 meters Max and Min temperature |  |  | |  |  |  |
| 2 meters relative humidity or specific humidity | x | x | |  |  |  |
| 10 meters wind (speed and direction) | x | x | |  |  |  |
| Pressure of mean sea level | x | x | |  |  |  |
| **Upper parameters** | | | | | | |
| Parameters: wind (streamlines and speed/direction), temperature, geopotential height, humidity  Levels: 1000hPa, 925hPa, 850hPa, 700hPa, 500hPa, 300hPa, 200hPa, 200hPa | x | x | |  |  |  |
| Parameter: vorticity  Level: 850hPa, 700hPa, 500hPa, 300hPa | x | x | |  |  |  |
| Parameter: divergence  Level: 500hPa, 300hPa, 200hPa | x | x | |  |  |  |
| Parameter: vertical velocity  Level: 850hPa, 700hPa, 500hPa | x | x | |  |  |  |
| Parameter: potential temperature and equivalent potential temperature  Level: 850hPa, 700hPa | x | x | |  |  |  |
| **Atmospheric column or instable indices** | | | | | | |
| Parameter: lifted index, K index, total totals index, CAPE, CIN, Shalwater index, etc | x | x | |  |  |  |
| Parameter: 1000-500hPa thickness | x | x | |  |  |  |
| **SkewT and Meteogram at given locations** | | | | | | |
| List of location is requested by participating countries | x | x | |  |  |  |

| **Ensemble Forecasts from EPS at NCHMF**  **(present and near future)** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Products | Availability | | | | | | |
| SREF  (6hrs out to 3 days) | LEPS  (6-12hrs out to 5 days) | NAEFS (12-24hrs out to 15 days) | EPS - ECMWF  (6-12hrs out to15days) | Wave EPS-ECMWF  (6hrs out to 15 days) | Monthly EPS- ECMWF  (4 periods of 7 days in a month) | Seasonal EPS- ECMWF  (out to  1-7 months) |
| Probability of 6-hour accumulated precipitation exceeding 50mm and 100mm threshold value | x | x | x | x |  |  |  |
| Probability of 24-hour accumulated precipitation exceeding 100mm threshold value | x | x | x | x |  |  |  |
| Probability of 10-meter wind speed exceeding 20kt and 30kt threshold value | x | x | x | x |  |  |  |
| Probability of significant wave height exceeding 2 m, 4 m and 6 m threshold value |  |  |  |  | x |  |  |
| Probability of significant wave period exceeding 10 s and 15 s threshold value |  |  |  |  | x |  |  |
| Ensemble Prediction System meteograms for specified locations | x | x | x | x |  |  |  |
| Spaghetti diagrams for 500hPa geopotential height | x | x | x | x |  | x | x |
| Thumbnails of probability of precipitation in excess of threshold of 50mm/6h at 6 hours intervals or more | x | x | x | x |  |  |  |
| ECMWF Extreme Forecast Index for precipitation and wind |  |  |  | x |  |  |  |
| Tropical cyclone occurrence and genesis probability maps | x | x | x | x |  |  |  |
| Tropical cyclone strike probability maps | x | x | x | x |  |  |  |
| Tropical cyclone forecast tracks from ensemble members, including ensemble mean, deterministic and control tracks | x | x | x | x |  |  |  |
| Tropical Cyclone Lagrangian meteograms (ECMWF) |  |  |  | x |  |  |  |
| **For monthly EPS: Weekly means of ensemble means, Weekly mean anomalies of ensemble means**  **For seasonal EPS: Monthly means of ensemble means, Monthly mean anomalies of ensemble means** | | | | | | | |
| 10 metre U-velocity anomaly |  |  |  |  |  | x | x |
| 10 metre V-velocity anomaly |  |  |  |  |  | x | x |
| 2 metre temperature anomaly |  |  |  |  |  | x | x |
| 2 metre dewpoint temperature anomaly |  |  |  |  |  | x | x |
| Maximum temperature at 2 metres since last 24 hours anomaly |  |  |  |  |  | x | x |
| Mean sea level pressure anomaly |  |  |  |  |  | x | x |
| Minimum temperature at 2 metres since last 24 hours anomaly |  |  |  |  |  | x | x |
| Sea surface temperature anomaly |  |  |  |  |  | x | x |
| Total precipitation anomalous rate of accumulation |  |  |  |  |  | x | x |
| Geopotential height anomaly, Temperature anomaly and U, V anomaly at 850hPa, 500hPa 300hPa and 200hPa |  |  |  |  |  | x | x |
| Forecast probabilities (weekly averaged): 2 metre temperature anomaly of at least +/-1K |  |  |  |  |  | x |  |
| Forecast probabilities (weekly averaged): 2 metre temperature anomaly of at least +/-2K |  |  |  |  |  | x |  |
| Forecast probabilities (weekly accumulated): Total precipitation anomaly of at least 10 and 20mm |  |  |  |  |  | x |  |
| Probability distributions of 2 metre temperature and total precipitation |  |  |  |  |  | x |  |

## **C.2 RSMC Tokyo – Typhoon Centre**

**Product List of RSMC Tokyo – Typhoon Centre**

**Products via GTS and AFTN**

1. RSMC Tokyo issues bulletins on TC satellite image analysis in satellite report (SAREP) shortly after observation times, as well as, on TC forecasts up to 72 hours ahead and TC track forecasts up to 120 hours ahead about 50 minutes and 90 minutes after observation times via GTS and AFTN. The code forms of the bulletins are written in Annual Report on the Activities of the RSMC Tokyo – Typhoon Center (<http://www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-eg/annualreport.html>).

**Table 1. Products of RSMC Tokyo via GTS and/or AFTN**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Products** | **via** | **WMO header** | **Frequency** | **Contents** |
| SAREP | GTS, NTP website | IUCC10RJTD | 8 times/day | Center position and its accuracy, Direction and speed of movement, Mean diameter of the overcast cloud, Apparent 24-hour change in intensity, Dvorak Intensity (CI, Final T, DT, MET, PT number), Cloud pattern type of DT number, Trend of past 24-hour change, Cloud picture type of PT number, Type of the final T-number |
| RSMC Tropical Cyclone Best Track | GTS, RSMC website | AXPQ20RJTD |  | Center position, Maximum sustained wind speed, Radii of wind areas over 50 and 30knots |
| RSMC Tropical Cyclone Advisory | GTS, RSMC website | WTPQ20-25RJTD | 8 times/day | Center position, Direction and speed of movement, Maximum sustained wind speed (10-minute average), Maximum gust wind speed (analysis and forecast), Accuracy of determination of the center position, Radii of wind areas over 50 and 30 knots (analysis) |
| RSMC Tropical Cyclone Advisory for Five-day Track Forecast | GTS, RSMC website | WTPQ50-55RJTD | 4 times/day | In addition to 72 hours forecast (same as WTPQ20-25), Center position, Direction and speed of movement for 96 and 120 hour forecasts |
| RSMC Guidance for Forecast | GTS | FXPQ20-25RJTD | 4 times/day | Center position, Central pressure, Maximum sustained wind speed (Central pressure and Maximum sustained wind speed are given as deviations from those at the initial time) |
| RSMC Prognostic Reasoning | GTS, NTP website | WTPQ30-35RJTD | 2 times/day | General comments on the forecasting method, the synoptic situation of the subtropical ridge, the movement and intensity of the TC as well as relevant remarks. |
| Tropical Cyclone Advisory for SIGMET | AFTN | FKPQ30-35 RJTD | 4 times/day | Center position, Maximum sustained wind speed (analysis and forecast), Direction and speed of movement, Central pressure (analysis) |

**Products via JMA radio facsimile broadcast**

1. Analysis and 24- and 48-hours Prognostic Charts of 850 hPa / 200 hPa Stream Line have been distributed via JMA radio facsimile broadcast (JMH) twice a day at 00 and 12 UTC since 1994.

**Products via Numerical Typhoon Prediction (NTP) website**

1. The Centre has been operating the NTP website since October 2004 as its contribution to the WMO/ESCAP Typhoon Committee. Products available at the website along with the planned product are listed in the below table.

**Table 2. Products of RSMC Tokyo via NTP website**

|  |  |  |
| --- | --- | --- |
| **Products** | **Frequency** | **Contents** |
| NWP Weather Map TC track guidance | Twice/day | Mean sea level pressure and 500 hPa Geopotential height (up to 72 hours at 00 TC, up to 168 hours at 12 UTC) of nine major NWP centers (BoM, MSC, CMA, DWD, KMA, UKMO, NCEP, ECMWF and JMA) |
| TC track guidance | Twice/day | TC track guidance of nine deterministic NWP models (BoM, MSC, CMA, DWD, KMA, UKMO, NCEP, ECMWF and JMA), ensemble TC track guidance of JMA’s TEPS |
| EDA Analysis | 4 times/day | Center position and its accuracy, T number |
| Sea Surface Temperature | once/day | Sea Surface Temperature in the area of responsibility |
| Tropical Cyclone Heat Potential | once/day | Tropical Cyclone Heat Potential in the area of responsibility |
| Vertical Wind Shear | 4 times/day | Vertical Wind Shear of initial fields of the JMA’s global model |
| Satellite Microwave Products |  | Microwave TC snapshot (37GHz(H,V,PCT), 89GHz(H,V,PCT), AMSU-based TC intensity(Central pressure, Maximum sustained wind) |
| Storm Surge Forecasts | 4 times/day | Storm surge distribution maps (up to 72 hours ahead), Time series storm surge forecasts (up to 72 hours ahead), |
| Stream line | 4 times/day | Stream line (850 hPa, 200 hPa) based on initial fields of the JMA’s global model |
| Graphical Tropical Cyclone Advisory for SIGMET  (planned) | 4 times/day | Center position, Maximum sustained wind speed, Direction and speed of movement, Central pressure, height and area of CB associated with a TC |
| Ensemble track guidance  (Planned) |  |  |
| Strike probability and/or 50 kt wind speed probability (Planned) |  |  |
| Ensemble TC genesis guidance  (Planned) |  |  |

## **C.3 RSMC New Delhi – Tropical Cyclone Centre**

**C.3.1. Bulletins and products available through GTS, AFTN and IMD website**

The information provided by RSMC, New Delhi includes the products and bulletins as mentioned in the following Table 1.

**Table 1. Tropical cyclone information, bulletin and product from IMD**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bulletins/**  **Products** | **Mode of dissemination** | **Frequency and time of issue** | **Content** |
| Tropical Weather Outlook | GTS, website | Once a day at 0600 UTC based on 0300 UTC | 1. Description of convection 2. Location of low pressure area (one closed isobar with maximum sustained wind (MSW) speed of less than 17 knots) 3. Large scale environmental features including location of upper tropospheric ridge etc. |
| Special Tropical Weather Outlook | GTS, Website | Twice a day at 0600 and 1500 UTC based on 0300 and 1200 UTC respectively when there is a depression/deep depression (17-33 knots)  It is issued more frequently as and when required. | 1. Current position and intensity, estimated central pressure and maximum sustained surface wind (MSW) 2. Past movement 3. Quantitative Forecast track and intensity upto 120 hrs from deep depression stage onwards (+6, +12, +18, +24, +30, +36, +42, +48, +54, +60, +66, +72, 78, +84, +90, +96, +102, +108, +114, +120 hrs). 4. Description of associated convection, T number based on INSAT-3D/Kalpana, Cloud top temperature, pattern of convection 5. Sea condition 6. Significant observational data, if any. 7. Prognostic and diagnostic features including SST, Ocean heat content, lower level convergence, lower level vorticity, upper level divergence, vertical wind shear, wind shear tendency, phase and amplitude of MJO index, any other synoptic features and NWP model guidance etc. |
| Tropical Cyclone Advisory bulletin | GTS, Website | 8 times a day based on 00, 03, 06, 09, 12, 15, 18 and 21 UTC observation | 1. Current position and intensity, estimated central pressure and maximum sustained surface wind (MSW) 2. Past movement 3. Quantitative Forecast track and intensity upto 120 hrs from deep depression stage onwards (+6, +12, +18, +24, +30, +36, +42, +48, +54, +60, +66, +72, 78, +84, +90, +96, +102, +108, +114, +120 hrs). 4. Description of associated convection, T number based on INSAT-3D/Kalpana, Cloud top temperature, pattern of convection. 5. Sea condition 6. Significant observational data, if any. 7. Storm surge guidance, as and when necessary 8. Prognostic and diagnostic features including SST, Ocean heat content, lower level convergence, lower level vorticity, upper level divergence, vertical wind shear, wind shear tendency, phase and amplitude of MJO index, any other synoptic features and NWP model guidance etc. |
| Cone of uncertainty | Web site | 4 times a day based on 00, 06, 12 and 18 UTC from deep depression stage onwards | 1. Given in graphical form along with track forecast |
| Quadrant wind forecast | GTS, Website | 4 times a day based on 00, 06, 12 and 18 UTC from deep depression stage onwards | 1. Radius of 28, 34, 50 and 64 knots forecast winds in four quadrants upto 120 hrs (+6, +12, +18, +24, +30, +36, +42, +48, +54, +60, +66, +72, 78, +84, +90, +96, +102, +108, +114, +120 hrs). 2. The product is available in both text and graphics form |
| Tropical cyclone advisory bulletin for SIGMET | GTS/AFTN | 4 times a day based on 00, 06, 12 and 18 UTC from cyclonic storm (MSW of 34 knots or more) stage onwards | 1. Current position and intensity, estimated central pressure and maximum sustained surface wind (MSW) 2. Past movement (direction and speed) 3. Forecast location and intensity upto 24 hrs (+6, +12, +18, +24 hrs). 4. In addition, there is advisory graphics in PNG format for transmission. 5. The TCAC bulletin is also sent to WMO’s, ADRR (Aviation-weather Disaster Risk Reduction)at Hong Kong through ftp. |
| Tropical cyclone warnings for the high seas | INMARSAT safety system,  Website | Twice daily, thrice during depression and six times during cyclone | (a) Type of warning and name of the centre  (b) Name of the system  (c) Date and time of reference in UTC  (d) Type of disturbance (depression, cyclonic storm, etc.);  (e) Location in terms of latitude and longitude or with reference to well-known landmarks  (f) Direction and speed of movement of the disturbance  (g) Extent of affected area  (h) Wind speed or force and direction in the affected areas  (i) Sea and swell condition in affected areas (in qualitative terms)  (j) Other important information such as future position of disturbances  Items (a), (b), (c), (d), (e), (f), (g) and (h) listed above are always included in the warning bulletins. |
| Satellite bulletin | GTS, Website | 8 times a day based on 00, 03, 06, 09, 12, 15, 18 and 21 UTC observation | 1. Centre position 2. Intensity (T /CI number) 3. Cloud description (area coverage and intensity of convection 4. Pattern based on Dvorak’s technique 5. Cloud top temperature 6. Characteristics of eye, if any 7. Environmental features based on satellite observation |
| Satellite imagery of cyclone | Website | Every half hourly | 1. VIS, IR, WV and colour composite imageries 2. Cyclone specific imageries |
| INSAT-3D Satellite derived products |  | Every three hourly | 1. Derived products including cloud top temperature, upper tropospheric humidity, sea surface temperature, quantitative precipitation estimate, Outgoing longwave radiation, Cloud motion vectors, water vapour wind vectors etc. 2. Special products : snow, fog, aerosol, smoke, cloud mask, fire |
| NOAA and MODIS satellite products | Website |  | 1. The satellite imageries and products based on NOAA and MODIS satellites are available |
| NWP products | Website | Twice dailly based on 00 and 12 UTC | 1. Model output of GFS(T574L64) (upto 7 days) and WRF model (upto 3 days) 2. Genesis potential based on IMD GFS Model 3. Multi-model ensemble (MME) product twice daily (00 UTC, 12 UTC) for prediction of track of cyclone upto 120 hrs 4. Intensity prediction by SCIP model upto 120 hrs 5. Probability of rapid intensification 6. Decay after landfall (+6, +12, +18, +24 hrs). 7. Track and intensity prediction by HWRF model upto 120 hrs 8. Track forecast by EPS 9. Cyclone Strike Probability, based on ensemble technique 10. INCOIS, Hyderabad storm surge and coastal inundation guidance. 11. IIT Delhi Storm Surge Model Guidance |
| Preliminary reports | Website | Within a week after the dissipation of the low pressure system | 1. Salient features, 2. Life history (genesis, intensification, movement), 3. Satellite and radar observed features, 4. Associated adverse weather, 5. Damage, if any, 6. Performance of RSMC (statistics of bulletin issued and verification of forecast and warning) |
| RSMC tropical cyclone best track | website | Once a year during March | 1. Date and time 2. Centre location 3. Intensity category 4. MSW 5. Estimated central pressure 6. Pressure drop at the centre 7. CI number |

**Explanatory notes:**

1. **Tropical weather outlook**

The tropical weather outlook is prepared once daily by RSMC tropical cyclones, New Delhi throughout the year. It is transmitted on the GTS at 06 UTC every day. The outlook covering the North Indian Ocean indicates possible development of tropical depressions over the sea.

1. **Special Tropical Weather Outlook**

Special Tropical Weather outlook is transmitted on the GTS at 0600 UTC and 1500 UTC when a depression is located over the north Indian Ocean region. The additional bulletin will be issued as and when felt necessary by RSMC, New Delhi.

1. The special tropical weather outlook issued in association with the depression provides brief descriptions of tropical depressions affecting the area. It will give the location, intensity and movement of the system as well as a general statement of land areas coming under threat. It will also contain description of the convective clouds in satellite imageries and diagnostic & prognostic features of the system. When the depression intensifies into a deep depression, the special tropical weather outlook issued twice a day based on 0300 and 1200 UTC observation will in addition contain the 120 hrs forecast track and intensity of the system in a tabular form. These track and intensity forecasts are issued for (+6, +12, +18, +24, +36, +48, +60, +72, 78, +84, +90, +96, +102, +108, +114, +120 hrs.
2. **Tropical cyclone advisories**

When a tropical low pressure system reaches the cyclonic storm stage, or is shortly expected to reach that intensity, RSMC tropical cyclones, New Delhi will issue tropical cyclone advisories. Advisories are issued at 00, 03, 06, 09, 12, 15, 18 and 21 UTC. The area of responsibility for the issue of tropical cyclone advisories by RSMC Tropical Cyclones, New Delhi covers sea areas of north Indian Ocean between long. 45° E to 100° E. Supplementary advisories may be issued as necessitated by circumstances, e.g., change in intensity or movement.

Tropical cyclone advisories contain the information of tropical cyclone, name of the cyclone, the present location, intensity and movement (present and past twelve hours) of the storm, and its forecast position, movement, intensity, maximum average surface wind speed with highest gust wind speed and sea conditions (in qualitative terms). These track and intensity forecasts are issued for (+6, +12, +18, +24, +36, +48, +60, +72, 78, +84, +90, +96, +102, +108, +114, +120 hrs. It also contains description of the convection as seen in satellite imageries and brief description of the diagnosis and prognosis of the system. The bulletin contains the storm surge guidance based on IIT, Delhi Storm Surge prediction model in case of the cyclone land falling over any member countries. Important information obtained from radar, synoptic, ship observations from the affected areas will also be reported in the advisory bulletin.

Advisories are exchanged under appropriate headings for regional distribution by RTH, New Delhi on the GTS.

1. **Tropical cyclone warnings for the high seas**

The World Meteorological Organization (WMO) in its Manual on Marine Meteorological Services has recommended the issue of weather and sea bulletins for the high seas in six parts. The cyclone warning centres of India issuing forecasts and warnings for the benefit of the ships on the high seas, area covered by these stations in their bulletins, name of the coastal radio stations with their call signs from where the tropical cyclone warnings are broadcast, are given in **Table 2.**

**Table 2. Stations issuing cyclone warnings for ships on the high seas**

**Station Area covered**

**India,** Mumbai Arabian Sea north of Lat. 5oN and east of Long. 60oE excluding the area north of Lat. 20oN and west of Long. 68oE. The eastern boundary of the Arabian Sea for which these bulletins are issued by Mumbai is Long. 80oE meridian excluding the Gulf of Mannar.

**India,** Kolkata Bay of Bengal north of Lat. 5oN except the area between the coastline on the east and the line drawn through the points 18oN 94.5oE, 18oN 92oE, 13.5oN 92oE, 13.5oN 94oE, 10oN 94oE, 10oN 95oE and 5oN 95oE. The western boundary of the sea area for which bulletins are issued by Kolkata is up to and inclusive of the Gulf of Mannar (i.e., 77.5oE meridian).

**India,** Chennai Bay of Bengal bulletins issued by ACWC Kolkata are being broadcast through Navtex, Chennai by Narrow Band Direct Printing ( NBDP )

Under the new Marine Meteorological Broadcast system, GMDSS (Global Marine Distress Safety System) of IMO/WMO, India issues two bulletins at 0900 and 1800 UTC everyday for broadcast through INMARSAT SAFETY SYSTEM. Additional bulletins are broadcast during Cyclone period.

1. **Warnings and advisories for aviation**

In accordance with the International Civil Aviation Organization (ICAO) Annex 3 — *Meteorological Service for International Air Navigation*/ WMO Technical Regulations [C.3.1], tropical cyclone warnings, required for the international air navigation, are issued by designated meteorological watch offices (MWO) as SIGMET messages \* , including an outlook, giving information for up to 24 hours ahead concerning the expected positions and maximum surface wind of the centre of the tropical cyclone. Each MWO provides information for one or more specified Flight Information Regions (FIRs) or Upper Information Regions (UIRs). The boundaries of the FIRs/UIRs are defined in ICAO Air Navigation Plans (ANP) for the Asia (ASIA), Middle East (MID) and Pacific (PAC) Regions.

The content and order of elements in a SIGMET message for tropical cyclone are in accordance with WMO Technical Regulations [C.3.1]. The data type designator to be included in the WMO abbreviated header of such messages shall be T1T 2 = WC (WMO No. 386, Manual on GTS refers).

The designated Tropical Cyclone Advisory Centre (TCAC), New Delhi monitors the development of tropical cyclones in its area of responsibility, in accordance with the ASIA/PAC ANP and issue advisory information concerning the positions of the centre of the cyclone, its direction and speed of movement, central pressure and maximum surface wind near the centre. These advisories are disseminated to the MWOs in the TCAC New Delhi area of responsibility, to be used in the preparation of the OUTLOOK appended to SIGMETs for tropical cyclones. In addition, the tropical cyclone advisories are disseminated to the other TCACs, whose areas of responsibility may be affected, to the World Area Forecast Centers (WAFC) London and Washington and international OPMET data banks and centers operating the satellite distribution systems (SADIS and ISCS).

**C.3.2. Observational data provided through GTS**

(i)All the observational data including SYNOP, AWS, PILOT, TEMP, SHIP, BUOY data are made available through GTS.

(ii) Many of these including current weather observation and upper air data of Indian stations are also available in IMD website ([www.imd.gov.in](http://www.imd.gov.in))

**C.3.3. NWP products available in IMD website (twice daily based on 00 and 12 UTC)**

1. The IMD GFS model (T574L64, 23 km resolution) products (circulation fields and rainfall) for analysis and forecast upto 168 hrs at the interval of 6 hrs.
2. IMD GFS Model (T574L64, 23 km resolution) based derived dynamical and thermodynamical products like vorticity, divergence, wind shear, CAPE, CINE etc.
3. The WRF ARW models analysis and forecast (circulation fields and rainfall) upto 72 hrs with resolutions of both 27 km and 09 km.
4. WRF ARW Model (9 km resolution) based derived dynamical and thermodynamical products like vorticity, divergence, wind shear, CAPE, CINE etc.
5. Location specific forecast (Meteograms) for Airports and major cities.
6. Genesis potential based on IMD GFS Model
7. Multi-model ensemble (MME) product twice daily (00 UTC, 12 UTC) for prediction of track of cyclone upto 120 hrs
8. Intensity prediction by SCIP model upto 120 hrs
9. Probability of rapid intensification
10. Decay after landfall (+6, +12, +18, +24 hrs)
11. Track and intensity prediction by HWRF model upto 120 hrs
12. Cyclone Strike Probability, based on ensemble technique
13. IIT Delhi Storm Surge Model Guidance
14. INCOIS, Hyderabad storm surge and coastal inundation guidance

**C.3.4. Extended range forecast**

1. Extended range MME forecast upto four weeks of rainfall (mean and anomaly) based on NWP model (a) IITM-CFSv2, (b) IITM-GFSbc, (c) NCEP-CFSv2, (d) JMA-EPS once a week.

**C.3.5.** Wave model products from Indian National Centre for Ocean Information Services (INCOIS) are available in IMD website (cyclone page) through a link to INCOIS website (<http://www.incois.gov.in/portal/osf/osf.jsp>).

INCOIS provides forecasts of various products:

1. Height, direction and period (of both wind waves and swell waves).
2. Sea surface currents.
3. Sea surface temperature.
4. Mixed Layer Depth (the well mixed upper layer of the sea).
5. Depth of the 20 degree isotherm (a measure of the depth of the thermocline).
6. Astronomical tides.
7. Wind speed and direction.
8. Oil-spill trajectory

# ANNEX D: Example of RFSC Daily Severe Weather Forecasting Guidance

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| --- |
|  |

**RFSC Guidance Product for SWFDP-Southeast Asia**

**SHORT-RANGE (DAY 1 and DAY 2)**

|  |
| --- |
| ***Issue time: 0300Z Monday 29th Dec*, 2014** |
| ***Valid time: DAY1: 1200Z Mon 29th to 1200Z Tue 30th December 2014***  ***DAY2: 1200Z Tue 30th to 1200Z Wed 31th December 2014*** |

**Preamble**

RFSC Guidance Products are based on a skilful evaluation of both Global and Regional model outputs for the domain area, satellite imagery at the hour of issue and, expert interpretation that takes into consideration interactions with the local features**.** For generating the guidance products, the following criteria are used:

* Heavy precipitation: > 50mm/24h &> 100mm/24h(the risk over 200mm/24 shall be described in discussion text)
* Strong Winds: > 30 Knots (over land and Sea) > 50 Knots (over Sea)

**Assessment Scale for the Degree of Confidence of Forecast:**

Confidence Level >75% (High); Confidence Level50-75%(Medium); and Confidence Level <50%(Low)

**Synopsis Situation:**

+. The North of Vietnam is affected by weak south part of Siberian High (SH). This high system is expected to be enhanced in next 48 hours.

+. The tropical cyclone Jangmi (ID 1423) will effect to the Center and South of Philippine (see surface analysis map).

+. Over the south of Southeast Asia domain are a series of low systems at around 5N to 10N latitudes (see surface analysis map)

**Guidance from Global and Regional Models:**

By looking at the 18Z (deterministic) and 12Z (ensemble) data sets for the period 12-12Z data the available Global NWP products (GFS and GSM models), and the Global EPS products (NAEFS and ECMWF) show clear heavy rain and strong wind over the center of Philippine next 2 days due to tropical storm (00z 29-Dec-2014 position is 126E-8.9N).

**Degree of Confidence:**

A high united among the previous running (on 28/12/2014) of global models (GSM and GFS) and ensemble systems (both global NAEFS and regional systems LEPS) provides high confidence of severe weather over the center of Philippine (around latitude 10N to 12N) for next two days.

**Surface analysis maps:**

|  |
| --- |
| surface_analysis |

**Warning maps:**

|  |
| --- |
|  |
| Warning map for day 1 |

|  |
| --- |
|  |
| Warning map for day 2 |

**Risk Tables**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DAY 1: Risk Probability Table (period 1200-1200 UTC) Date 29th/30th Dec 2014:** | | | | | | | | | | | | | | | | |
| Country | Rain > 50mm/24h  Risk | | | | Rain > 100mm/24h  Risk | | | | Wind > 15m/s (30kts)  Risk | | | | Wind > 25m/s (50kts)  Risk | | | |
|  | No | Low | Med | High | No | Low | Med | High | No | Low | Med | High | No | Low | Med | High |
| Cambodia | X |  |  |  | X |  |  |  | X |  |  |  | X |  |  |  |
| PDR Laos | X |  |  |  | X |  |  |  | X |  |  |  | X |  |  |  |
| Philippines |  |  |  | C |  | C |  |  |  |  |  | C |  |  | C |  |
| Vietnam | X |  |  |  | X |  |  |  | X |  |  |  | X |  |  |  |
| Thailand | X |  |  |  | X |  |  |  | X |  |  |  | X |  |  |  |
|  | | | | | | | | | | | | | | | | |
| **DAY 2: Risk Probability Table (period 1200-1200 UTC) Date 30th/31st Dec 2014:** | | | | | | | | | | | | | | | | |
| Country | Rain > 50mm/24h  Risk | | | | Rain > 100mm/24h  Risk | | | | Wind > 15m/s (30kts)  Risk | | | | Wind > 25m/s (50kts)  Risk | | | |
|  | No | Low | Med | High | No | Low | Med | High | No | Low | Med | High | No | Low | Med | High |
| Cambodia | X |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |
| PDR Laos | X |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |
| Philippines |  |  |  | C |  |  | C |  |  |  |  | C |  |  | C |  |
| Vietnam | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Thailand | X |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |

**Key notes:**

S: South

N: North

C: Center

E: East

W: West

Med: medium

# ANNEX E: Data and Products delivered from other Projects / Activities

## **E.1 Special Products from Meteorological Satellite Center, JMA**

**E.1.1 Products**

The Meteorological Satellite Center (MSC) of JMA will provide Himawari geostationary satellite imagery with the information of potentially raining heavily associated with deep convective clouds over the South-East Asia region. The imagery will be available on the MSC Web page (http://www.data.jma.go.jp/mscweb/data/himawari/).

**E.1.2 Contact Point**

Mr. Toshiyuki Sakurai

Meteorological Satellite Center / Japan Meteorological Agency

Email: calmstr@dpc.kishou.go.jp

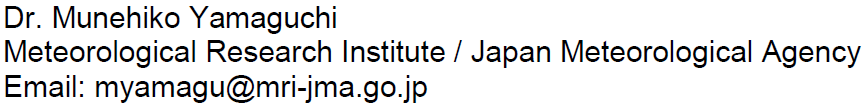
## **E.2 GIFS-Forecast Demonstration Project (FDP) (THORPEX/TIGGE/GIFS), including North Western Pacific Tropical Cyclone (Track) Ensemble Forecast Research Project (WWRP Research Development Project)**

**E.2.1 Products via website**

The MRI/JMA providesTC track forecast guidance through <http://tparc.mri-jma.go.jp/cyclone/login.php> and plots for severe weather events through <http://tparc.mri-jma.go.jp/TIGGE/tigge_SWFDP.html>.

|  |  |  |  |
| --- | --- | --- | --- |
| Products | Provided through | Frequency | Content |
| TC track forecast | Website | 4 times / day | Deterministic and ensemble TC track forecast by major NWP centres. |
| Ensemble products forsevere weather events | Website | 1 time / day | Forecast probability of the occurrence of severe weather events such as heavy rainfall, extremely high/low temperature, and strong wind based on the ECMWF, JMA, NCEP and UKMO EPSs |

**E.2.2 Contact Point**

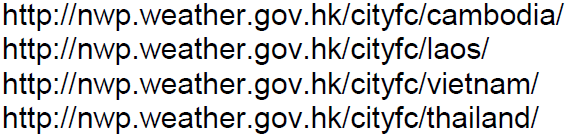


## **E.3 RA-II Project on the Provision of City-Specific NWP products**

**E.3.1 Products via website**

The products are available from the following websites:

Products provided by HKO



Products provided by JMA:

http://ra2-nwp.kishou.go.jp/cityfc/Cambodia/

http://ra2-nwp.kishou.go.jp/cityfc/Lao/

http://ra2-nwp.kishou.go.jp/cityfc/Philippines

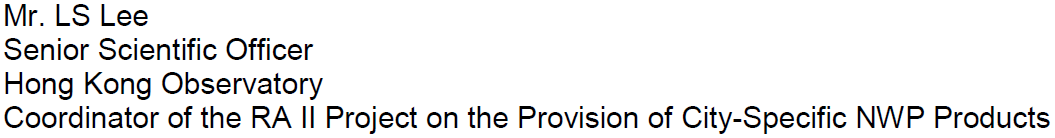
http://ra2-nwp.kishou.go.jp/cityfc/Thailand/

http://ra2-nwp.kishou.go.jp/cityfc/VietNam/

Products provided by KMA

http://www.kma.go.kr/ema/nema03/

**E.3.2 Contact Point**



## **E.4 JMA Pilot Project on EPS products**

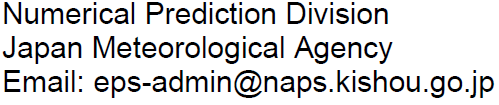
**E.4.1 Products**

The detail of products is shown in the following table. All products are provided on the website: epsweb .

|  |  |  |  |
| --- | --- | --- | --- |
| Daily EPS product | | Variable | Area or point |
| EPS charts | - Ensemble mean  - Normalized spread  - Spaghetti  - Stamp map | - Mean-Sea-Level Pressure (MSLP)  - 500hPa geopotential height | - Northwestern Pacific  - Asia |
| - MSLP  - Surface Wind | - South China Sea  (100°E -130°E,5°N -30°N) |
| Probabilistic maps |  | - 850 hPa temperature anomalies with thresholds ±2, ±4, ±8 K  - Precipitation with thresholds 24, 48, 72 mm/24hours | - Northwestern Pacific  - Asia  - Northern Hemisphere |
| Point forecast | EPSgram  (Box plot diagram) | - Surface, 925, 850, 700, 500, 300hPa temperature (°C)  - Precipitation rate (mm/6hr)  - MSLP (hPa) | - Major cities in Asia |
| Plume diagram | Accumulated precipitation (mm) |

**E.4.2 Contact Point**

Mr. Kenta Ochi



## **E.5 RAII WIGOSProject to Develop Support for NMHSs in Satellite Data, Products and Training**

**E.5.1 Products**

Products are provided on the website:

http://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro\_en\_jma.html

**E.5.2 Contact Point**

Mr. Takeshi Otomo

Senior Coordinator for Satellite Systems

Satellite Program Division, JMA

Email: [ootomo@met.kishou.go.jp](mailto:ootomo@met.kishou.go.jp)

Dr. Dohyeong Kim

Senior Researcher

National Meteorological Satellite Center, KMA

Email: dkim@kma.go.kr

## **E.6 Landfall Typhoon Forecast Demonstration Project (WMO-Project, ESCAP/WMO TC)**

**E.6.1 Products via website**

Products are provided on the website: tlfdpweb

**E.6.2 Contact Point**

Mr Taoyong PENG

Chief, Tropical Cyclone Programme Division, WMO

Email: tpeng@wmo.int

# ANNEX F: PWS Guidance on Developing Service Delivery Mechanisms in NMHSs

**1. Introduction**

Effective service delivery is a fundamental requirement for NMHSs if they are to meet national needs. There are many different interpretations of the concept of service delivery as it relates to the provision of weather-, climate- and water-related services. To this end, WMO has developed a “Strategy for Service Delivery” to guide NMHSs in the provision of weather, climate and water-related services that take into account user needs. This “Guidance on Developing Service Delivery Mechanisms in NMHSs” incorporates many of the elements of the “WMO Strategy for Service Delivery”.

**2. Purpose of this Guide**

While there is no prescriptive way to provide services, this “Guidance on Developing Service Delivery Mechanisms in NMHSs” is a step-by-step guide on how an NMHS may develop and implement a mechanism that would enable it to better deliver services to users. Effective services, however have the certain attributes in common as outlined below.

**3. Attributes of effective services**

Effective services should be:

* Available: at time and space scales that the user needs;
* Dependable: delivered regularly and on time;
* Usable: presented in user specific formats so that the client can fully understand;
* Useful: to respond appropriately to user needs;
* Credible: for the user to confidently apply to decision-making;
* Authentic: entitled to be accepted by stakeholders in the given decision contexts;
* Responsive and flexible: to the evolving user needs,
* Sustainable: affordable and consistent over time, and,
* Expandable: to be applicable to different kinds of services.

**4. Step 1: Focus on the user**

1. **Identify the users**

The purpose of preparing and delivering services to users is to enable them to make better decisions by using weather and climate information. User engagement and feedback is essential in designing and delivering effective services. For the implementation of a successful service delivery mechanism, it is very important to identify specific users that your Service will be serving, and to engage with them appropriately. Generally, users may be divided into five main groups as follows:

* + The hazards community - The mission (shared with the NMHS) of these organisations is to ensure safety of life, livelihood and protection of property. The NMHS should consult and coordinate closely with them, know their specific requirements and give them high priority. The public safety, emergency and civil defence agencies constitute this important group. Their mandate and responsibilities make them major players in planning for and responding to most emergency situations. It is clearly in the interest of NMHSs to ensure that coordination with these important organizations be given a high priority.
  + Government authorities – Governments are the most important users of the services and information provided by NMHSs. The most important users are usually the host ministry where the NMHS is situated. It is important to ascertain the requirements of this group and to maintain formal communication with them.
  + Weather-sensitive economic sectors – Public Weather Services can be of significant value to weather-sensitive sectors of the economy such as agriculture, forestry, fishing, marine, air and land transport, energy production, construction, sport, tourism and outdoor entertainment. Many NMHSs also provide specialized meteorological, climatological and hydrological services The needs of this user group can be very specific, ranging from long-range forecasts and climate information for planning purposes to short range forecasts and warnings for daily operations.
  + Media (print, radio, TV and others) - The media is the most important user and partner of NMHSs products and services. Different media types and outlets have well defined expectations in regards to the final product they require from NMHSs. The final forecast product would need to be tailored to suit the media delivering the product.
  + The public – The general public is the largest user group of NMHSs. The most important need of the public concerns warnings of severe weather so as to take prompt action to preserve life and secure property. Their routine needs relate to travel, leisure and general convenience. The requirements of general public are not as precise and well-defined as those for other user sectors and have to be better ascertained through establishing feedback mechanisms including comprehensive, fact-finding surveys.

1. **Determine user needs**

Different users have different needs and the only way to determine their exact requirement is through consultation and gathering information. The starting point should be to ask very clearly how the currently available weather information is used in daily decision making by users, how they apply it and what would be the negative impact of lack of such information. The following lists a number of techniques that can be applied to gather such information:

* + Surveys, questionnaires, interviews and in-depth case studies to identify a broad overview of the users' needs and expectations. Expertise outside of NMHSs, such as professional survey designers may be required for this type of information gathering;
  + Fora and workshops with users' participation in order to learn their requirements and to explain to them of the capabilities of the NMHS;
  + Pilot projects in collaboration with users to develop products and services on a longer term to meet the stated requirements;
  + Monitoring feedback of user response through press clippings, letters, phone-calls, fax, suggestion boxes or the Internet;
  + Interaction with users during Open Days, World Meteorological Day and activities of the NMHS outreach programme;
  + Regular meetings with government agencies and emergency managers to ascertain their information needs.

1. **Ensure that users are aware of NMHS services**

It is important that users be made aware of the services that an NMHS can deliver as well as understand the limitations of forecast and warning products. Hosting discussion and short training events by NMHSs for different user groups helps to make them aware of how weather and climate products are prepared. Operational forecasters should be involved in such training for fruitful dialogue with users. **Table 1** below shows user groups and suggested approaches to educate or reach out to them.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***User Groups*** | ***Training Courses*** | ***Seminars*** | ***Informal*** | ***Leaflets / Pamphlets*** | ***Media*** | ***One-to-One*** |
| ***Politicians / Senior Public Servants*** |  |  | x |  | x | x |
| ***Emergency Managers*** |  | x | x |  |  | x |
| ***Water Managers*** |  | x |  |  |  | x |
| ***Transport Authorities*** |  | x |  |  |  | x |
| ***Power Supply Engineers*** |  | x |  |  |  | x |
| ***Media*** | x |  | x |  |  | x |
| ***Farmers*** |  | x |  | x | x |  |
| ***Fishermen*** |  | x |  | x | x |  |
| ***Schools*** | x |  |  | x | x |  |
| ***General Public*** |  |  |  | x | x |  |

***Table 1****: User groups and suggested approaches to educate or reach out to them*

**Step 2: Focus on internal organization of your NMHS**

1. **Get the NMHS ready to deliver service**

Delivery of effective public weather services needs an organisation-wide commitment involving the NMHS leadership, technical systems and those directly involved in service delivery. An enthusiastic and motivated focal point or team of officers trained in different aspects of service delivery such as consultation and communication with user groups and with skills in dissemination and presentation of NMHSs products would be a necessity for effective service delivery. Where possible, a Public Weather Services (PWS) office or unit should be established for this purpose.

1. **Ensure that NMHS staff are aware of the user needs**

This step requires that members of staff in charge of service delivery are informed in detail of the requirements of different users and the NMHS processes for preparing and delivering the required services. This may require training, to be conducted within the NMHS so that all staff would follow the same rules and regulations and ‘read from the same page’ as they serve users.

1. **Develop an effective warning programme**

Since preparing and issuing warnings of hazardous weather is one of the most essential activities of NMHSs, it is crucial to develop an effective warning programme. The NMHS staff in charge of forecasting and public weather service provision should be involved in the development of the programme as they are aware of the realities on the ground in terms of strengths and limitations of the NMHS. To be successful, a warning programme strives to ensure that everyone at risk must:

* + Receive the warning;
  + Understand the information presented;
  + Believe the information;
  + Personalize the information;
  + Make correct decisions; and,
  + Respond in a timely manner.

The ideal warning process has to take into account each of the above components to be successful. It takes training and planning as well as strong collaboration with other partner agencies such as the disaster management and media, to implement a warning programme.

**Step 3: Improve communication skills of NMHS Staff**

Communication is one of the most necessary skills for a forecaster, but it is a skill rarely taught during academic training in Meteorology. Communication, at its most fundamental, involves the transmission of thoughts, emotions and meaning from one person to another. While words (written or spoken) are usually thought of as the primary medium of communication, studies have shown that many other factors (tone of voice, inflection and body language) play a significant role in aiding   
(or impeding) communication. Effective two-way communication implies listening skills as well as speaking skills. Confidence is an important element in communication, and this cannot be taught directly, but must be developed within each person. Formal communication training courses for forecasters (in whatever medium they are required to operate – telephone, radio, television, etc.) are crucial in developing communication skills, but they should be augmented with mentoring and feedback schemes and with regular refresher training.

**Step 4: Engage users**

1. **Formalize NMHS working relationship**

Formalize the working relationship with the user and agree on the following:

* Detailed description of products and services needed by the users;
* Detailed description of products and services provided by the NMHS;
* Service delivery procedures including product formats and delivery times;
* Responsibilities of the NMHS – ensuring high quality products and timely delivery;
* Responsibilities of the user – providing regular feedback on the quality of the services. (This is important to the NMHSs for use in service improvement);
* Training that may be required for users, including schedules;
* Assigning NMHS and user focal points who would: be easily accessible; capable of responding to concerns that may arise and; oversee the success of the mutual engagement.

1. **Engage and educate the media**

Many NMHSs have difficulties in working successfully with media organizations. However, there is a substantial common interest between NMHSs and the media in providing a quality weather service to the public. Therefore, a dialogue needs to be established with media representatives through which NMHS personnel can gain a full understanding of the media concerns while the media representatives can gain an appreciation of the services that the NMHS can deliver. This is best achieved by a combination of formal (seminars, training courses) and informal contacts such as social events, familiarisation visits, etc. In order to kick off media engagement where it has not existed before, training by internationally-respected experts, organised through WMO is recommended. The NMHS may learn the following from the media:

* How to write appropriate press releases for use by the media;
* How to organize proper press conferences, press briefs etc;
* How to perform effectively during radio, television or newspaper interviews etc.

The media may learn the following from the NMHS:

* Understanding and interpreting basic weather terminologies;
* Understanding and interpreting forecasts, advisories and warnings correctly;
* The limitations associated with the accuracy of weather forecasts;
* Communicating forecast uncertainty and confidence etc.

**Step 5: Conduct Service Evaluation for Improvement**

1. **Verification**

This involves assessing the accuracy of forecasts and warnings from a technical point of view. It serves to inform the NMHS about the skills of its forecast procedures and the aspects of forecasting that need improvement. If no verification procedure exists in the NMHS, start with very simple steps to verify one or two elements (e.g., rainfall, temperature) in a few key locations, and use many available WMO resources to have staff trained on more advanced verification methodologies.

1. **Assessing user satisfaction and perception**

Service evaluation determines whether services are meeting user requirements and ascertains whether users understand the products and services provided and are making optimum use of them. Some of items to consider include the language used in communicating forecasts (non-technical and simple for non-meteorologists), the timeliness of forecasts, presentation formats, and communication and dissemination methods. Evaluation must include an assessment of what value the users gained from the NMHS products and services and how such services helped them with making informed decisions. The evaluation process should be kept simple with the aim of having some results available when talking to decision-makers and in response to media enquiries. Annexes to this document provide examples of service delivery evaluation surveys.

**Step 6: Make a PWS implementation / Improvement Plan**

1. **Timelines**

A Service Delivery Plan for the NMHS, should include an implementation programme in the form of a table of activities to be carried such as meetings with respective users or user groups, training seminars or workshops, the agreements to be entered into etc. The plan should take into account the realities of the situation on the ground, including budgetary and personnel matters. These considerations are essential in helping to fix realistic timelines for achievement of milestones of the implementation of the plan.

1. **Action persons**

A good plan is specific, not just on the actions to be taken, but also on the person to take the action. Contact details of the action persons should be included as appropriate. The action people should include focal points from the user organization(s) engaged in the project.

**A Simple User Assessment Questionnaire**

NMHS ------- (Country)

Q1. From where do you obtain weather information of your country?

1. Radio
2. Television
3. Newspaper
4. Directly from the Meteorological Service
5. Meteorological service Website
6. Other Websites
7. Mobile phones
8. Other sources (please specify)

Q2. Do you consider the warnings of severe weather of your country over the past several months accurate or inaccurate?

1. Very accurate
2. Somewhat accurate
3. Average
4. Somewhat inaccurate
5. Very inaccurate
6. Don’t know / no comment(s)

Q3. How easy is it for you to understand the format and the language used in the severe weather warnings?

1. Very easy
2. Easy
3. Neutral
4. Difficult
5. Very difficult
6. Don’t know / no comment(s)

Q4. Comparing to 2 years ago are forecasts and warnings of severe weather:

1. More accurate
2. About the same
3. Less accurate
4. Don’t know / no comment(s)

Q5. Are the forecasts and severe weather warnings useful in helping you decide on appropriate response action (e.g., stay at home, do not take the car out of the house, keep children indoors, etc.)?

1. yes
2. No

Q6. On the whole, how satisfied are you with the severe weather warnings provided by your country?

# ANNEX G: Action Plan for Improvement of PWS element in NMHSs

## **G.1 Cambodia**

**A: Disaster Management**

1. The Department of Meteorology works with the National Committee on Disaster Management (NCDM) through the Chief of Cabinet of the Ministry of Water Resources and Meteorology. The Focal Point for weather at NCDM is responsible to liaise with the officials who are in charge of taking actions in response to severe weather. Any feedback from the response action officials may get back to the Met Service via the Chief of Cabinet. As such there is no direct engagement between the Met Service and NCDM, since the two ministries responsible for weather and disaster management operate without close interaction. The Red Cross is active in responding to emergency situations.
2. An indirect way of engaging the NCDM is through the improvement of accuracy of forecasts and warnings which in turn will get the attention of the media and will be a good step towards increasing the visibility and credibility of the Met Service.

**B: Media**

1. Daily weather broadcasts are made on TV twice per day, and more frequently on radio, by broadcast companies own presenters, although the content is provided by the Met Service. In case of severe weather, live interviews are conducted with the Chief of Cabinet or with the head of forecasting at the Met Service. Radio broadcasts are not at fixed times or regular intervals, and depends on the media schedule.
2. The media relations could benefit from certain improvements. For example, there is no direct feedback from media, although the media reflects the opinion of the public on the performance of the forecasts or warnings, such as the requirements for more location or time specific forecasts and long-range forecasts.
3. It is hoped that SWFDP will help the Met Service achieve these improvements in its performance and consequently enjoy better relations with media, more appreciative feedback from the public, and closer collaboration with NCDM.

**Actions to take**

1. Establish the Met Service official website in 2012 and directly disseminate improved forecasts and warnings to the public and other users.
2. Establish own TV studio in 2012 with the help of Meteo France International and use this channel to disseminate improved forecasts and warnings.
3. Inform WMO and the training coordinator (HKO) of the progress in the establishment of the studio.
4. Discuss the objectives and benefits of SWFDP with the Met Service management, in terms of improved services to the users and improved relations with media and National Committee for Disaster Management.
5. Try to explain the SWFDP feedback mechanism to the management of the Met Service with a view to obtaining their support for providing input to the report of the project on the agreed schedule.

## **G.2 Department of Meteorology and Hydrology of Lao PDR**

1. **Disaster Management**

The National Disaster Management Committee (NDMC) is the highest inter-ministerial body for disaster management in Lao PDR, chaired by the Deputy Prime Minister/Minister of Defence. It is the overall coordination body for disaster management policies, mobilization of national and international assistance in times disasters, information management and public awareness. As secrateriat responsibilities are transferred to Ministry of Natural Resources and Environment (MONRE), the NDMC has been revised to reflect the change in structure. To date, the National Disaster Management Office (NDMO) has served as the secretariat of the NDMC, with the current restructuring, NDMO’s function has been moved to the Department of Disaster Management and Climate Change (DDMCC) under MONRE, DDMCC is served a a central focal point for all domestic and international networks on mitigation and recovery activities. As DMH Lao PDR is under MONRE to serve as National Meteorological and Hydrological Service and to be responsible for monitoring, collecting, analyzing of hydro-meteorological data and provision of water supply conditions, weather forecasts and issuing early warning. The NMHS of Lao PDR has a good working relation with the NDMC and DDMCC. As a dissemination protocol, DMH provides warning, alert, advisories and bulletins to NDMC and DDMCC, government sectors from national Level down to provincial, districts and risk areas by telefax, internet and website.

Steps to take to further improve the relationship

* 1. Restructure the role and responsibilities of Disaster Management Office from national to community’s levels.
  2. Ensure that a systematic of early warning system is clearly outlines for all major hazard in Lao PDR and early warning system SOP are integrated into the over all disaster risk management SOP.
  3. Conduct the Pre-Post Monsoon Forum for enhancing the utilities of hydro-meteorological information.
  4. Enhance the capacity of Disaster management, media and general public on DMH weather information and service.

1. **Media**

The Department of Meteorology and Hydrology Lao PDR and medias have been signed the agreement for broadcast the weather and warning information in timely, especially in the severe weather occurred, the medias can broadcast the events over various channels as frequent as necessary. The Agency’s activities are regularly consisted of Radio, Television and Newspaper.

Steps to take to further improve the relationship

1. Establish the weather mass-media studio for weather information at DMH headquarter;
2. Conduct the training workshop on media-weather presentation.
3. Establish the communication system between DMh headquarters and Lao National TV, Radios.
4. Ugrading the DMH’s Website in to two languages (Lao and English) .
5. Establish the weather and Warning information via DMH Mobile Apps, especially via SMS.
6. Request the assistance of media to get the feedback.
7. Improve the weather and warnings bulletins for easy understanding for the general people.

## **G.3 Philippines**

1. **Disaster Management**

The Philippine Atmospheric and Geophysical and Astronomical Services Administration (PAGASA), the NMHS of the Philippines has a good working relation with the National Disaster Risk Reduction and Management Council (NDRRMC). As a dissemination protocol, PAGASA provides warning, alert, advisories and bulletins to NDRRMC and they (NDRRMC) are responsible in disseminating the information to the Region down to the barangay, the smallest administrative unit. Various media have been used to disseminate warnings and advisory that includes internet, intranet, telefax, SMS, Infoboard, and social media (Twitter and Facebook).

**Necessary Steps and Actions to take**

* 1. 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 in determining the appropriate preparedness and response actions from the national down to the local government units (LGUs).
  2. PAGASA website migrated to i-Gov Webhosting in March 2015. PAGASA will continuously refine the website to make it more user-friendly. This will include various tools (e.g radars, ARG/AWS, satellite etc.) and products that will provide weather and hydrologic information to the emergency managers and the general public to warn them of the imminent threat of hydrometeorological hazards. It serves as the channel for dissemination of its products and services.
  3. Video streaming of daily weather forecasts to be embedded in PAGASA website.
  4. Enhance the capacity of NDRMMC, LGUs, media, and general public on PAGASA weather information and services.
  5. Establishment of advocacy program for executive, legislative branches and LGUs and a pro-active system to alert decision makers, media and the general public on impending extreme weather events by developing an effective pro-active alert system for government, DRRMC, Media (local and international ) LGUs and general public.
  6. Familiarize the disaster management agency with the benefits of the various products and services for improved services and to get feedback from them and request assistance for product validation.

1. **Media**

The Philippine media have been an active partner of PAGASA in broadcasting severe weather events in a timely manner and in the promotion of important issues like climate change and disaster risk reduction and management and other weather- climate and water-related information. Whenever there is threatening weather events and rapidly changing weather conditions, media covers press briefing and conferences and broadcast the events over various channel as frequent as necessary. The Agency’s activities are regularly covered by tri-media (press, TV, and radio).

**Necessary Steps and Actions to take**

Recognizing the importance of media in information dissemination, PAGASA continues the conduct of series of in-house media seminars and workshops. This has been conducted since 2003 up to the present to educate and familiarize the media with the various products and services and have better understanding on the proper dissemination of PAGASA’s products and information services to the public.

1. Video streaming of daily weather forecasts to be embedded in PAGASA Website .
2. On-going Enhancement of PAGASA Mobile App.
3. PAGASA worked with Google on publishing Common Alerting Protocol (CAP) compliant Typhoon alerts. CAP is recognized by WMO while Google is the authorized aggregator. The general public can view detailed information about storm such as the location, strength, movement and impact, as well as recommended actions and precautionary measures.
4. Simplification of forecast products and brochure/flyers for easy interpretation of the message by users in order to take appropriate action.
5. Continue the conduct of Broadcasters’ training to enhance the delivery of forecast and warning information of forecasters to users
6. Conduct Human Response Survey to get feedback from users. Social networks (e.g. Twitter and Facebook) are good source of feedbacks.
7. Request the assistance of media in getting feedbacks.

## **G.4 Thai Meteorological Department**

1. **Disaster Management**
2. The working arrangements between Thai Met Department (TMD) and the disaster management is relatively well-established and a structure is in place whereby the warnings from TMD are disseminated through multiple channels including the Internet, Intranet, telephone, fax, and own radio studio. The contact lists of disaster management officials are available at TMD and feedbacks from disaster management are obtained during weekly meetings.

**Steps to take to further improve the relationship**

1. Prepare in writing the exact instructions to follow for contact for severe weather events (before, during, after)
2. Improve and simplify the language of warnings sent to the disaster management or at least provide them with a list of technical terminology to assist in the interpretation of the message
3. Organize a short (perhaps only one day) workshop for the disaster management to provide some familiarization or training in meteorological terms
4. Make sure all dissemination channels are in good working order through regular testing
5. Obtain and provide feedback from disaster management using the questionnaire provided.

**B .Media**

1. On the whole relationships with the media are satisfactory. Some problems related to the media getting its information from sources other than TMD.
2. Currently the forecasts are presented on TV and radio by presenters, using the TV produced graphics. Plans are in place for TMD to have its own TV studio with own forecasters trained as broadcasters

**Steps to take**

1. Prepare a list of contact for media organizations and keep it up to date
2. Obtain and provide feedback from various media using the evaluation questionnaire provided.

## **G.5Vietnam Hydro and Meteorological Service**

1. **Disaster Management**
2. As a member of the Central Committee for Natural Disaster Prevention and Control (CCDC), NHMS always implements its responsibility and has a good relation with CCDC.
3. Conducting the Meetings to discuss about the risk level of natural disaster to give the suitable method for prevention and preparedness
4. Climate outlook forums were organized with the participation of CCDC
5. A contact list for Met Service and CCDC exists as well as a group email listing.
6. Dissemination of warnings is done directly through FTP server to DPM at the national level and the warnings then follow through to the provincial level.
7. Pre-warnings are sent to DPM by fax and email.
8. NHMS in collaboration with CCDC implements some projects focusing on strengthening capacity of forecasting in order to serve natural disaster prevention and preparedness including raise awareness of public and evacuation drill. However, due to limited fund,

**Steps to take to further improve the relationship**

1. The Law No 33/2013/QH13 on Natural Disaster Prevention and Control in 2013 was promulgated and taking effect on May 1, 2014 by Parliament of Viet Nam; Decision No 44/2014/QD-TTg on Regulating Detail of Level of Natural Disaster Risks dated 15 August 2015 by the Prime Minister; Decision No 46/2014/QD-TTg on Regulating Forecasting, Warning and Communication dated 15 August 2015 by the Prime Minister.

To implement these documents, NHMS is researching and developing implementation plan, including:

* Cooperate with other related sectors to give the guidance documents: affected areas by typhoon with high certainty, storm surge.
* updated method to respond proactively to large and super typhoon
* Developing technical norms, regulation, procedure on forecasting, warning, operating and maintaning equipment, ..

1. Improving cooperation between two sides in providing information timely and raising awareness of public.
2. **Media**
3. As a member of the Central Committee for Natural Disaster Prevention and Control (CCDC), NHMS always implements its responsibility and has a good relation with mass media.
4. Organizing many meetings to provide information on the forecast of typhoons with particpation of over 30 press agencies in each meeting
5. Cooperating with Newspaper Association held the Trainning on "Improving on Skills of speaking and providing information to the mass media“ and Workshop on "Cooperating with the mass media providing people with hydro-meteorological forecasts“.
6. Organizing annual press conference
7. In cooperation with the Voice of Viet Nam to implement many dissemination programs on severe hydro-meteorological phenomena especially typhoon, tropical cyclone, flood in VOV1 in every Sunday and medium long term forecasting in the Transportation Channel

**Steps to take to further improve the relationship**

1. Researching the WMO Strategy for Service Delivery and Its implementation Plan.
2. Improving cooperation between two sides in providing information timely and raising awareness of public; Cooperating with VTV 2 implementing programs on dissemination of hydro-meteorology on VTV2 such as typhoon, super typhoon, flash flood, landslide in the form of scientific guidance combined with technical graphics (05 clips with duration 3 to 5 minutes).
3. Publishing brochure on:
   1. + Introduction on NHMS of Viet Nam;
   2. + Severe hydro-meteorological phenomena;
   3. + Method of receiving hydro-meteorological information as well as preparation and preparedness;
   4. Developing a plan and implementing a survey on flood and landslide and Developing thematic report on the survey results and recommend appropriate communication plan for floods, flash floods, landslides to residents (Developing 02 samples of questionnaire survey (1) on the need of receiving information; (2) on the need of the local authorities and other related sectors).

# ANNEX H:SWFDP Quarterly Progress Reportkey elements and information

*Important elements & information to be reported in the Quarterly Progress Report (to be submitted on-line through SWFDP database)*

1. **Reporting Period** (Start date to end date)
2. **Severe events** (e.g. heavy rainfall, strong winds, high waves, flooding etc.)
3. **Reporting period highlights** (e.g. duration and amount of rainfall, impact of rainfall and/or strong wind and high waves, affected areas, damages (if any), coordination with disaster management offices etc.)
4. **Clients** (e.g. Disaster Management Offices, media, humanitarian organizations etc. New clients can also be added)
5. **Client feedback** (e.g. adequacy and effectiveness of the warning and how it was used etc.)
6. **Desired products** (e.g. NMHS may propose a demand for additional product(s) from global and/or regional centres if already not available etc.)
7. **Forecast Period and Area** (to provide information about area of responsibility of an NMHS and the period for which NMHS issues forecast etc.)
8. **Disseminationchannels**(e.g.TV, radio, mobile SMS etc. New channel can be added)
9. **Observing Systems** (e.g. basic synoptic network, AWS network, radar and satellite information receiving stations etc.)
10. **Workshop** (to provide title, duration and summary outcome of the training workshops arranged for the forecasters, emergency managers, media, school officials, general public etc. during the reporting period)
11. **Product usage** (to select various products which are available from participating global and regional centres and are used in making forecasts at national level etc.)
12. **Local forecasting tools** (to provide information about the existing forecasting tools used at the NMHS and any new forecasting tool implemented at the NMHS etc.)
13. **Resources**(to provide information about the budget of NMHS and the number of forecasters and observers working in NMHS etc.)
14. **Case Studies** (to provide title and description of case studies related to the severe event(s) observed during the reporting period, key findings of the study etc.)
15. **Related projects** (to provide information about the on-going and new related projects etc.)
16. **PROJECT EVALUATION AGAINST SWFDP GOALS**

|  |  |  |
| --- | --- | --- |
| **SWFDP GOAL** | **COMMENTS ON PROGRESS TOWARDS EACH GOAL** | **Questions to help you with an answer for each box** |
| To improve the ability of NMHSs to forecast severe weather events |  | How did the products on the RSMC New Delhi help you make better severe weather forecasts and warnings? |
| To improve the lead time of alerting these events |  | How much earlier do you issue severe weather forecasts & warnings now compared to before? |
| To improve the interaction of NMHSs with Disaster Management and Civil Protection authorities (DMCPAs), the media, and the public, before, during and after severe weather events |  | Comment on any interactions with your disaster agency, media agencies and the public. Please indicate if there hasn't been any interaction since the last repor,. |
| To identify gaps and areas for improvements |  | What are the weaknesses in your forecast system? |
| To improve the skill of products from Global Centres through feedback from NMHSs |  | What weaknesses have you found in the products from RSMC, New Delhi, JMA,NCEP, UKMO, ECMWFetc.? |

1. **EVALUATION OF PWS COMPONENT**

|  |  |  |  |
| --- | --- | --- | --- |
| **Users** | **Question** | **Answer** | **Comments** |
| **Public** | Any feedback from the public? | Yes or No | If Yes, please give details. |
| Any public reaction when the warnings were heard or received? | Yes or No | If Yes, please give details. |
| Were there any difficulties in obtaining feedback? | Yes or No | If Yes, please give details. |
| **Disaster Management** | Any feedback from disaster management authorities about the timeliness and/or usefulness of the warnings | Yes or No | If Yes, please give details. |
| Were safety messages and/or call to action statements issued by the disaster management authority in agreement with your forecasts & warnings? | Yes or No | If Yes, please give details. |
| **Media** | Any feedback from the Media? | Yes or No | If Yes, please give details. |
| How did your relationship with the Media work in getting warnings delivered? | Yes or No | If Yes, please give details. |
| Were their difficulties in working with the Media? | Yes or No | If Yes, please give details. |

1. **SUMMARY (general comments, challenges, etc)**
2. **CASE STUDY** (PowerPoint presentation to include guidance products (RSMC and NWP), satellite imagery, warnings issued, impact evidence etc.)

Case studies for each severe weather event ***DON'T*** need to be completed at the same time as the rest of this report.

***Comment:*** *Case studies don't need to be long. What's important is the learning experience that you gain from actually doing the case study.*

1. **Severe Event Evaluation**(Attach all Severe Weather Event Evaluation Form)

# ANNEX I: Template of Severe Weather Event Evaluation Form

The proposed evaluation form should allow to evaluate the performance of the RSMC Severe Weather Forecasting Guidance and as well as the efficiency of the NMHS warning system. It must be completed by the NMHS in both of the following cases:

* a severe weather event has been observed; and
* a severe weather event has been forecast.

The evaluation form should document the characteristics of the severe weather event (whether observed or forecast) and allow evaluating the efficiency of the forecasts given by the RSMC Daily Severe Weather Forecasting Guidance as well as the performance of the warnings issued by the NMHS. Therefore it should include the three following sections.

***Section A – Identification of the severe weather event:***

* NMHS concerned;
* number of the event;
* type of event;
* region affected.

***Section B – Information about the observed weather event:***

* start and end times of the severe weather event;
* maximum observed value of the characteristic parameter;
* assessment about the efficiency of the warning given to the DMCPA;
* information from the end-users (number of interventions, casualties, damages, usefulness of the warning).

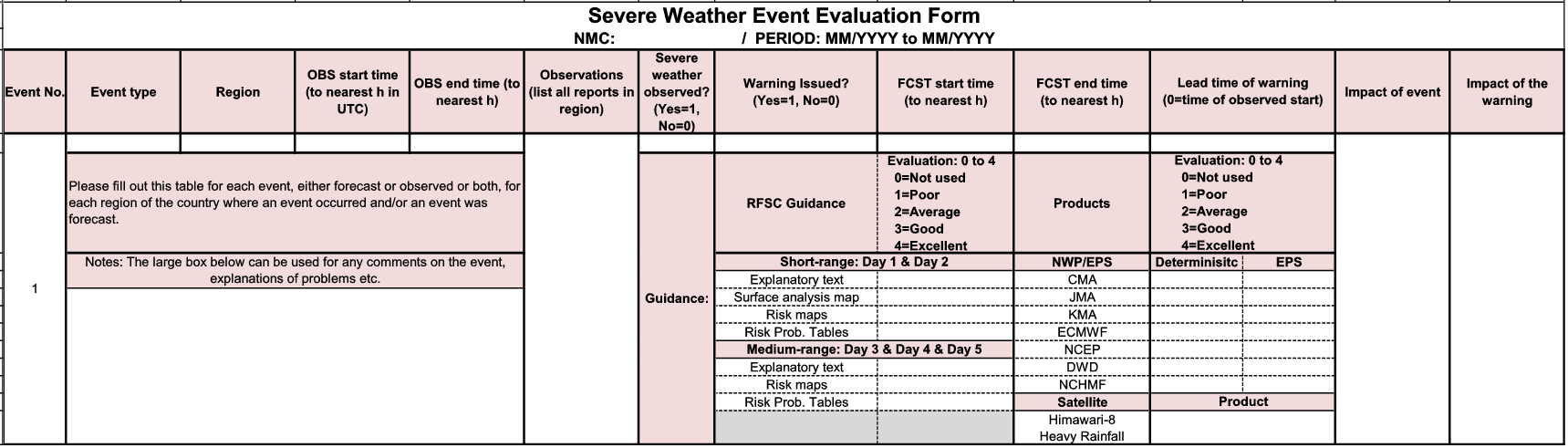
***Section C – Information about the forecast and warning issued from the NMHS:***

* lead-time of the warning;
* start and end time of the severe weather event according to the forecaster’s assessment;
* level of risk as indicated in the RSMC Severe Weather Forecasting Daily Guidance;
* probabilities of medium-range in the RSMC Severe Weather Forecasting Daily Guidance;
* usefulness of the various products (RSMC Guidance, various models);
* comments including information on usefulness and applicability of used tools.

**How to use this evaluation form to evaluate the performance of warnings?**

The common way to evaluate the performance of a warning system is based on the 2 x 2 contingency table matrix including the number of justified warnings (“hits”) “a”, the number of missed severe events “b” and the number of false alarms “c”. The POD index (Probability of Detection) is defined as the ratio of the number of hits by the total number of severe events, i.e., a/(a+b) ; the FAR (False Alarm Ratio) is defined as the ratio of the number of false alarms by the number warnings issued, i.e., c/(a+c).The information contained in the proposed evaluation form enables to computes the performance indicators of the warning issued by the NMHS as long as the assessment of the DMCPA (in section C) is correctly taken into consideration.

A template of an evaluation form is provided in the following pages. The evaluation form is to be filled by the NMHSs (preferably by a forecaster or manager of the forecasting unit) participating to the SWFDP regional subproject. This template can be modified with respect to the products selected for preparing the severe weather forecasts and warnings. It is important that the design of the evaluation form be adapted to allow the data and information to be easily gathered and transformed into a tabular form. Avoid unnecessary and repetitive typing, and as much as possible to encourage and allow reliable creation and maintenance of the dataset that is needed to analyze and evaluate the performance indicators.



# ANNEX J: USER ASSESSMENT QUESTIONNAIRE

## **J.1 Evaluation Questionnaire for the Public**

Q1. Do you get the warnings and forecasts issued by the National Meteorological Service?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q2. Do the warnings and forecasts arrive early enough for you to take any actions?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q3. How Do you get the forecasts and warnings? (Can choose more than one)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Radio | TV |  | Internet | Telephone | Local radio  network | Other(s) |
| □ | □ |  | □ | □ | □ | □ |

If other(s), please specify:

Q4. Do you understand the warnings and forecasts?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q5. Do you take any action in response to the warnings and forecasts?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

If yes, what did you do?

Q6. The warning was useful to protect your (Can choose more than one)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| family | home | boat | farm | animals | other(s) |
| □ | □ | □ | □ | □ | □ |

If other(s), please specify:

Q7. Are warnings issued by the National Meteorological Service correct?

|  |  |  |
| --- | --- | --- |
| Yes | No | More or less |
| □ | □ | □ |

Q8. Are forecasts issued by the National Meteorological Service correct?

|  |  |  |
| --- | --- | --- |
| Yes | No | More or less |
| □ | □ | □ |

Name: Date:

## **J.2 Evaluation Questionnaire for Disaster Management**

Q1. Did you get the warnings for the severe weather events in the period…to….? (Specify)

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q2. Did the warnings arrive early enough for you to take the necessary actions according to your specified responsibilities?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q3. How did you get the warnings? (Can choose more than one)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Radio | TV | Fax | Internet | Telephone | Local radio  network | Other(s) |
| □ | □ | □ | □ | □ | □ | □ |

If other(s), please specify:

Q4. Did you understand the warnings?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q5. Did you take any action in response to the warnings?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

If yes, what did you do?

Q6. In your opinion were the warnings correct?

|  |  |  |
| --- | --- | --- |
| Yes | No | More or less |
| □ | □ | □ |

Q7. Do you have any suggestions on how to improve the warning process, including dissemination methods, format, language etc.

Post and name: Date:

## **J.3 Evaluation Questionnaire for Media**

Q1. Do you get the warnings for the severe weather events and forecasts from the National Meteorological Service?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q2. Do the warnings and forecasts arrive early enough for you to take the necessary actions according to your specified responsibilities?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q3. How do you get the warnings and forecasts? (Can choose more than one)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Radio | TV | Fax | Internet | Telephone | Local radio  network | Other(s) |
| □ | □ | □ | □ | □ | □ | □ |

If other(s), please specify:

Q4. Do you understand the warnings and forecasts?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q5. Are the language and format clear enough for you?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

Q6. Do you take any action in response to the warnings and forecast you receive?

|  |  |
| --- | --- |
| Yes | No |
| □ | □ |

If yes, what do you do?

Q7. In your opinion are the warnings and forecasts accurate?

|  |  |  |
| --- | --- | --- |
| Yes | No | More or less |
| □ | □ | □ |

Q8. Do you have any suggestions on how to improve the warning and forecast process, including dissemination methods, format, language etc.

Post and name: Date: