JMA/WMO WORKSHOP ON EFFECTIVE TROPICAL CYCLONE WARNING IN SOUTHEAST ASIA

Tokyo, Japan
11-14 March 2014

COUNTRY REPORT

Thai Meteorological Department

by

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Summary

Typhoon is the most dangerous phenomena in this region, so we have to find the ways to reduce damage from it together. Thai Meteorological Department (TMD) is the designed organization to response the Tropical Cyclone warning for Thailand. During more than 70 years ago, Thailand had experience about three powerful Tropical Cyclones that hit directly to the South, they caused severe damage to the areas. Even it rare case to hit Thailand directly while its reach the powerful storm, TMD should prepare an appropriate effective early warning system to save people's live and their properties, so adopt technologies from leading countries such as Japan or USA to fulfill the gap is the best way to do for this moment.

Tropical Cyclone Monitoring, Analysis and Forecasting

1.1 Tropical Cyclone Monitoring

1.1.1 Tropical Cyclogenesis Monitoring

Thai Meteorological Department (TMD) closely watches all cloud clusters within its responsible area using MTSAT satellite images as well as deterministic NWP models of major centers available at the major Numerical Weather Prediction Website, such as ECMWF, NCEP, UKMO, NOGAPS, KMA and JMA. We try to use Early Dvorak Analysis technique, but unsuccessful due to limited knowledge or it may not practical for operational in a limited time, but we can used a guidance from NWP products for a roughly storm development estimation.

1.1.2 Tropical Depression (TD) Warnings

TMD will issue the warning of the tropical depression developing in the responsible area when identifies well organized convective cloud systems and high potential to further develop to major storm from NWP products guidance. The warning will send to the media such as, radio, television and internet.

1.1.3 Challenges, Needs and Improvement Plans

To further improve the accuracy of TC genesis information and length of its lead time, particularly in the South China Sea. TMD try to utilize all available NWP products both in deterministic and ensemble by using the manual multi models ensemble technique to increase the accuracy. The results show that this technique have a good predicted TC genesis tool with a lead time of at least five days, and more in some cases. TMD has a plan to replace the old NWP system by a new one, the new NWP system will include the typhoon model. Apart from the model, TMD also plan to use SATAID module for operational tool in the coming typhoon season.

1.2 Tropical Cyclone Analysis

1.2.1 Parameters and Methods

[Please describe analyzed Tropical Cyclone (TC) parameters and methods used for analysis by filling out the below table.]

Parameter	Time (UTC)	Methods	Other sources
Likelihood of development of OCCSs into TSs	00, 06, 12, 18	In operational TMD uses a semi Early Dvorak Analysis technique to determine likelihood of development of OCCSs into TSs. The cloud features are compared with T-number Pattern chart of Dvorak.	Deterministic NWP models of major centers (e.g. ECMWF, NCEP, NOGAPS, JMA, SWFDP), 850 hPa, 700 hPa, 500 hPa, and 200 hPa streamlines
Dvorak Intensity (CI, T, DT, PT, MET number)	-	- For operational, TMD do not use Dvorak intensity technique.	- guidance from JMA and JYWC
Center Position, Accuracy of center position, Direction & speed of movement	00, 06, 12, 18	Center positions estimated by using satellite images are adjusted, when other estimation methods which utilize surface observations are considered more reliable, also followed guidance from JMA and JTWC.	Deterministic NWP models of major centers (e.g. ECMWF, NCEP, NOGAPS, JMA), 850 hPa, 700 hPa, 500 hPa, and 200 hPa streamlines
Central pressure, Maximum sustained wind speed, maximum gust wind speed, R50 (50 kt radii), R30 (30 kt radii)	00, 06, 12, 18	For operational TMD follow guidance from JMA and JTWC	-

1.2.2 Challenges, Needs and Improvement Plans

Determination of TC center positions from cloud patterns are very difficult, especially in the night time or weaken stage or strong wind shear when visible data not available. To minimize the error, more objective analysis and reduces the burden of operational forecasters for daily operational, TMD needs a new appropriate TC forecasting technique and training to use for the operational.

1.3 Tropical Cyclone Forecasting

1.3.1 Parameter and Method

Parameter	Issu-ance Time (UTC)	Lead time (hours)	Methods
Track (center position, radius of probability circle, direction and speed of movement)	00, 06, 12, 18	24, 48, 72	Track forecasts are mainly based on deterministic and ensemble NWP models of major centers such as ECMWF, NCEP, JMA , KMA, NOGAPS, UKMO and SWFDP. Radius of probability circles are 100, 150 and 200 Km. for 24, 48 and 72 hr respective.
Central pressure, Maximum sustained wind, R50 (50 kt radii), R30 (30 kt radii), Maximum gust wind speed	00, 06, 12, 18	24, 48, 72	TC intensity forecasts are made by forecaster's comprehensive analysis mainly based on JMA and JTWC guidance. .

1.3.2 Challenges, Needs and Improvement Plans

TMD mainly uses the NWP products from the major centers to compare with TMD's model to make official cyclone forecasts. The accuracy of TC intensity depends on the accuracy of those available models and the collecting time. The NWP's products that TMD receives through internet and GTS mostly too late not a real time, forecaster have to adjust the products to fit the actual data by themselves. To improve TC track forecasts, TMD needs to get the products from major centers by real time or near real time for warning issue, JMA is the one center that we need for helping. Now a day TMD's staff try to run WRF, but it takes more time to waiting an initial data. Furthermore, to enhance the confidence of forecasters, TMD tries to utilize the guidance from SWFDP (Severe Weather Forecasting Demonstration Project) the project of WMO.

1.4 Tropical Cyclone Products

1.4.1 TC Products

Product Name	Issuance Time	Contents
Information on Developing Tropical Cyclone	00, 06, 12, 18	TMD will issue when TC is expected to develop and will affect Thailand in the next 2-3 days.
Typhoon Information (Tropical Cyclone Genesis)	00, 06, 12, 18	Inform the genesis of a TC and its developing condition. It includes the position, intensity and the time of the TC genesis
Typhoon Information	00, 03, 06, 09, 12, 15, 18, 21 (When a TC is expected to affect Thailand)	Detailed information on analysis and forecasts of a TC in a text graphical format are issued. 
Typhoon Information (General Information)	4 times per day (When a TC is expected to affect Thailand)	Inform current status and outlook of a TC, as well as precaution statements in terms of disaster mitigation. It consists of the following components. 1) Headline Points to be noted particularly by disaster management authorities and mass media 2) Current status and forecasts of a TC 3) Warning statements on potential severe phenomena such as heavy rain, strong wind, high wave and storm surge
Typhoon Information (landfall)	When a TC makes landfall	Issued to inform the position and the time of a TC landfall.
50 kt wind probability	none	- none
WTAS	none	Issued only in text format for fishery every 3 hr.

1.4.2 Challenges, Needs and Improvement Plans

TMD provide a fix radius of uncertainties of TC track forecast such as 100, 150 and 200 km for 24, 48 and 72 hr respectively. TMD needs a new technique from any centers for further improve the forecasting track.

1.5 Computing Platform (including software)

TMD is setting team to use SATAID for TC in operational in the coming TC season.

2 Numerical Weather Prediction Status for Effective Warning

[In this section, you are invited to provide summaries on your NWP status for effective warnings.]

2.1 NWP in Operational Use

Model	Domain (square degree)	Resolution (horizontal & vertical)	Initial Time (UTC)	Forecast Range (hours)	Run by (own/ foreign centers)
Global Spectral Model	Global	100 km VL: 19	00, 12	168 (6 hr)	Own
One-week Ensemble Prediction System (51 members)	-	-	-	-	-
Typhoon Ensemble Prediction System (11 members)	-	-	-	-	-
Meso-scale Model	126x126	48 km VL: 19	00,12	72 (3 hr)	Own
Local Forecast Model	123x123	17 km VL: 31	00,12	72(3 hr)	Own

2.2 Application Techniques of NWP Products for Operational Forecasts

1) Very Short Range Forecast

TMD plans to operate a very short range forecast when the new HPC is complete installation, but now a day it's still waiting for the new cabinet to approve the proposal. TMD uses radar observation and automatic observation station and satellite data to make a very short range forecast just for Bangkok metropolitan area.

2) Short Range Forecast

For operational weather forecasting, TMD uses a guidance from our NWP products (UM, WRF) and from major centers, such JMA, KMA, NOGAPS, IMD, UKMO and ECMWF, also from SWFDP guide line too. Various kinds of parameters, such as precipitation, wind patterns, probability of precipitation, are used in forecasting up to 72 hours.

2.3 Challenges, Needs and Improvement Plans

TMD have a very old version of UM (4.3) to run on IBMs (RISC, HP2), it has been installed more than 15 years ago and also very slow running. We are trying to replace by a new powerful HPC (500 TFLOP), but still waiting for approval from the concerned organization. At present, TMD has used initial data from NCEP, GFS to run WRF too.

3. Storm Surge

[You are invited to describe your operational activity on storm surge information.]

1) Storm Surge Information

a. (Issuing) b. not issuing

(For those who answered "b." in 1))

2) What is the reason?

a. No use (inland / no storm surge) b. No forecast are available

c. Other ( )

(For those who answered "a." in 1))

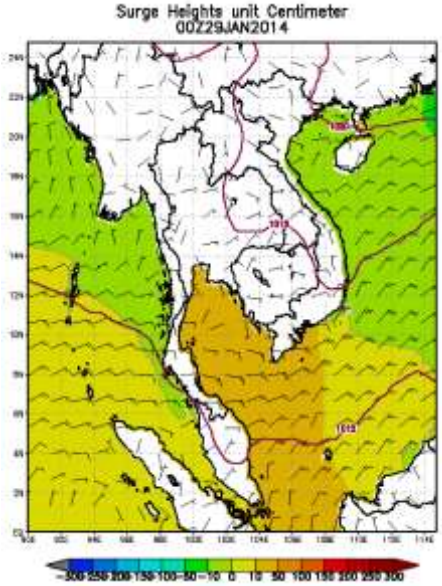
3) How the information is issued?

a. Independent storm surge information b. (Included in TC information)

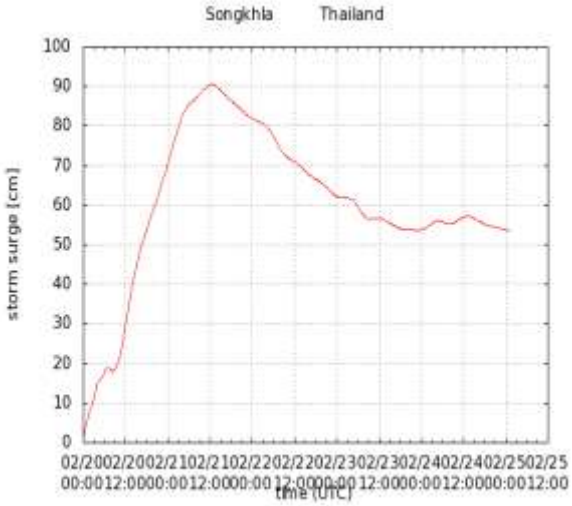
c. Other ( )

4) What products (observations /forecasts) are referred to?

TMD by Marine center has run the storm surge model, using initial data from JMA. Model results are provided to forecasters as horizontal maps and water level in some point.
Examples are shown below:



Storm surge forecast



Water level at a tidal station

5) If your Service runs a storm surge model by yourself, please describe the way in detail.

Model	Domain and resolution	Forecast Range (hours)	Frequency	Considered factors (Tide/ensemble/ inundation, etc.)
Thailand Area	lon 90-114 E lat 0-24 N (0.25 degree)	up to 96 hours	1 time /day	Tides: linearly added Inundation: not predicted

6) In case your Service issue storm surge forecast without your own model, please briefly explain the operational procedure.

4. Effective Warnings

4.1 Emergency Response for TC Disasters

4.1.1 Legal Framework for TC Disaster Management

TMD is Designated Government Organizations to make and provide a warning to the concerned governments organization, such as National Disaster Warning Center (NDWC), Department of Disaster Prevention and Mitigation (DDPM), the government steering committee, and mass media.

4.1.2 Emergency Response Mechanism

In the emergency case, the steering government committee will setup to respond the hazard by following the National Disaster Plan. This committee consist of TMD, NDWC, DDPM, Army, Police and other related organizations. The committee lead by minister of interior or prime minister, depends on the magnitude and scale of the hazard.

4.1.3 Organs Responsible for Warnings and Evacuation Orders

Severe Weather Phenomena	Organs responsible for Warnings	Organs responsible for Evacuation Orders
Tropical Cyclone	TMD	Provincial Governor And Provincial DPM
Heavy Rain (Sediment Disaster)	Department of Mineral Resources (DMR), Department of Water Resource (DWR) and NDWC	
Heavy Rain (Inundation)	TMD	
Strong Wind		
Storm Surge		
River Flood	Office of the National Water and Flood Management Policy (for single command).	

4.2 Warnings/Advisories for Severe Weather Phenomena

[You are invited to provide details on warnings/advisories for tropical cyclones as well as associated severe weather phenomena, i.e., heavy rainfall, strong wind, flood, inundation and storm surge, in the following formats respectively.]

4.2.1 Tropical Cyclone

Warnings/Advisories and corresponding emergency responses	TMD issues warnings for disasters/phenomena associated with TCs, such as heavy rain, strong winds and storm surge, depends on the TC track..
Potential Disaster Risks	Flooding, Strong wind, High wave, Storm surge
Target (warning areas)	Affecting areas, depends on TC tracks.
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	

Type	Meteorological variables/indices
Emergency Warning	- maximum wind - direction - rainfall amount
Warning	- maximum wind - direction - rainfall amount
Advisory	- TC status (movement, developing)

<table>
<tr><td>Criteria/Thresholds</td><td>
<table>
<tr><th>Type</th><th>Criteria</th></tr>
<tr><td>Emergency warning</td><td>- TC make landfall or on arrival with maximum wind more than 100 km/hr</td></tr>
<tr><td>Warning</td><td>-TC with maximum wind 50 - 100 km/hr will make landfall or arriving within 24 hr
- TC with maximum wind more than 100 km/hr will make landfall or arriving within 48 hr</td></tr>
<tr><td>Advisory</td><td>- the change of direction and its intensity and the location out of longitude 120 degree East</td></tr>
</table>
</td></tr>
<tr><td>Contents of Warning/Advisory Message</td><td>
<table>
<tr><th>Type</th><th>Content</th></tr>
<tr><td>Emergency warning</td><td>- Issuance time
- Warning statements on status of TC, potential disasters (strong wind disaster and/or Inundation) including warning areas and period of warning in effect.
- next issuance time</td></tr>
<tr><td>Warning</td><td>- Issuance time
- Warning statements on status of TC, potential disasters (strong wind disaster and/or Inundation) including warning areas and period of warning in effect.
- next issuance time</td></tr>
<tr><td>Advisory</td><td>- Issuance time
- Advisory statements on status of TC, potential disasters including affecting areas and period of advisory in effect
- next issuance time</td></tr>
</table>
</td></tr>
<tr><td>Sample Warning/Advisory Message</td><td>Strom Warning
Issuance No. xx
Warning statement
At 1000 AM today Tropical storm NARI was centered near the central Vietnam coast at 15.5 degree North 108.5 degree East or about 350 kilometers east of Ubon Ratchathani, maximum wind near the center about 90 km/hr . It is moving westward about 20 km/hr, and expected to arrive Ubon Ratchathani by midnight. Heavy to very heavy rain (maximum rainfall more than 100 mm.) and strong wind with gust more than 100 km/hr are expected in the southern area of the Northeast, particularly in Ubon Ratchathani, Sri Saket, Surin, Roi Et, Buri Ram and Nakhon Ratchasima provinces by this evening and will last until tomorrow night. People in these areas should prepare for self-protection from strong wind hazards and flooding condition during the mention time period.

Issuance time at 10:30 LST on 5 Sep. 2013
Next issuance time at 16:30 LST on 5 Sep. 2013

Weather Forecast Bureau
Thai Meteorological Department</td></tr>
</table>

4.2.2 Heavy Rain

TMD issues only a status of weather phenomena that will cause heavy rain such as what, when, where and how. NDWC and Office of the National Water and Flood Management Policy (single command) will take responsibility on their designed plan.

Heavy Rain Warnings/Advisories (Inundation)

<table>
<tr><td>Warnings/Advisories and corresponding emergency responses</td><td>The following table summarizes recommended emergency responses by municipalities and residents when heavy rain warnings/advisories are issued

<table>
<tr><th>Type</th><th>Expected Phenomena</th><th>Emergency responses</th></tr>
<tr><td>Emergency Warning (Sediment Disaster)</td><td>one-two day accumulated rainfall excess 200 -300 mm. in wide area and heavy rain still continues.</td><td>Both municipal and resident in the risk areas taking immediate action for evacuation and follow the rule of emergency action plan.</td></tr>
<tr><td>Warning (Sediment Disaster)</td><td>one-two day accumulated rainfall excess 100-150 mm. in wide area and heavy rain still continue</td><td>Both municipal and resident in the risk areas should prepare for evacuation.</td></tr>
<tr><td>Advisory (Sediment Disaster)</td><td>Continuing rain and weather conditions are likely to still continue.</td><td>Both municipal and resident in the mention areas should prepare for self-protection to save their property and life and closely monitor the weather situation from media.</td></tr>
</table></td></tr>
<tr><td>Potential Disaster Risks</td><td>Landslides, debris flows</td></tr>
<tr><td>Target (warning areas)</td><td>Individual risky municipality</td></tr>
<tr><td>Meteorological variables/index used for criteria/threshold for warnings/advisories</td><td>
<table>
<tr><th>Type</th><th>Meteorological variables/indices</th></tr>
<tr><td>Emergency Warning</td><td>- coverage pattern and movement of precipitation
- 24- 48-hour rainfall amount</td></tr>
<tr><td>Warning</td><td>- coverage pattern and movement of precipitation
- 24-48-hour rainfall amount</td></tr>
<tr><td>Advisory</td><td>- coverage pattern and movement of precipitation
- 24 hr rainfall amount</td></tr>
<tr><td></td><td></td></tr>
</table></td></tr>
</table>

Criteria/Thresholds

Type	Criteria
Emergency warning	24-48 hr accumulated rainfall excess 200 -300 mm in wide area and heavy rain still continue.
Warning	24-48 hr accumulated rainfall excess 100-150 mm in wide area and heavy rain still continue.
Advisory	24 hr accumulated rainfall excess 50 mm in wide area and weather conditions are likely to cause continuing rain.

Contents of Warning/Advisory Message

Type	Content
Emergency warning	- Issuance time - Warning statements on the potential of flooding including warning areas and period of warning in effect. - next issue time
Warning	- Issuance time - Warning statements on potential of flooding including warning areas and period of warning in effect. - next issue time
Advisory	- Issuance time - Advisory statements on weather condition including affecting areas and period of advisory in effect. - next issue time
Sediment Disaster Alert	- siren sound in the individual area.

Sample Warning/Advisory Message

Strom Warning
Issued No. xx
Warning statement

At 1000 AM today Tropical storm NARI was centered near the central Vietnam coast at 15.5 degree North 112.0 degree East or about 300 kilometer east of Ubon Ratchathani, maximum wind about 90 km/hr . It is moving westward about 20 km/hr, and expected to arrive Ubon Ratchathani by tonight. **Heavy to very heavy rain (maximum rainfall more than 100 mm.)** and strong wind with gust more than 100 km/hr are expected in the southern area of the Northeast, particularly in **Ubon Ratchathani, Sri Saket, Surin, Roi Et, Buri Ram and Nakhon Ratchasima provinces** by this evening till the day after tomorrow night. People in these areas should prepare for self-protection from strong wind hazards and flooding condition during the mention time period.

Issue time at 10:30 LST on 5 Sep. 2013
Next issue time at 16:30 LST on 5 Sep. 2013

Weather Forecast Bureau
Thai Meteorological Department

Heavy Rain Warnings/Advisories (Sediment Disaster)

<table>
<tr><td>Warnings/Advisories and corresponding emergency responses</td><td>The following table summarizes recommended emergency responses by municipalities and residents when heavy rain warnings/advisories are issued
<table>
<tr><th>Type</th><th>Expected Phenomena</th><th>Emergency responses</th></tr>
<tr><td>Emergency Warning (Sediment Disaster)</td><td>one-two day accumulated rainfall excess 200 -300 mm. in wide area and heavy rain still continue.</td><td>Both municipal and resident in the risk areas taking immediate action for evacuation and follow the rule of emergency action plan.</td></tr>
<tr><td>Warning (Sediment Disaster)</td><td>one-two day accumulated rainfall excess 100-150 mm. in wide area and heavy rain still continue</td><td>Both municipal and resident in the risk areas should prepare for evacuation.</td></tr>
<tr><td>Advisory (Sediment Disaster)</td><td>Continuing rain and weather conditions are likely to still continue.</td><td>Both municipal and resident in the mention areas should prepare for self-protection to save their property and life and closely monitor the weather situation from media.</td></tr>
</table>
Sediment Disaster
Sediment Disaster Alerts are issued jointly by MRD and local government, by using 24 hr accumulated rainfall from the risk area station sites.</td></tr>
<tr><td>Potential Disaster Risks</td><td>Destroying bridge, roads, plants and house, etc.</td></tr>
<tr><td>Target (warning areas)</td><td>Individual municipality</td></tr>
<tr><td>Meteorological variables/index used for criteria/threshold for warnings/advisories</td><td>
<table>
<tr><th>Type</th><th>Meteorological variables/indices</th></tr>
<tr><td>Emergency Warning</td><td>- rainfall amount.
- Flooding condition.</td></tr>
<tr><td>Warning</td><td>- rainfall amount.
- Flooding condition</td></tr>
<tr><td>Advisory</td><td>- 24-hour precipitation amount.</td></tr>
<tr><td>Sediment Disaster Alert</td><td>accumulated rainfall in the risk areas excess the criteria.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>Criteria/Thresholds</td><td>
<table>
<tr><th>Type</th><th>Criteria</th></tr>
<tr><td>Emergency warning</td><td>- Continuing heavy rain.
- Flooding in large area along the steep hill side.</td></tr>
<tr><td>Warning</td><td>- Continuing heavy rain.
- Flooding in large area along the hill side.</td></tr>
<tr><td>Advisory</td><td>- continuing rain.
- 24-hour precipitation amount.</td></tr>
<tr><td>Sediment Disaster Alert</td><td>24 hr accumulated rainfall in the risk areas excess 150 mm. and weather conditions are likely to cause continuing rain.</td></tr>
</table>
</td></tr>
<tr><td>Contents of Warning/Advisory Message</td><td>
<table>
<tr><th>Type</th><th>Content</th></tr>
<tr><td>Emergency warning</td><td>- siren sound with red light and gun shooting in the individual area</td></tr>
<tr><td>Warning</td><td>- siren sound with amber light and gun shooting in the individual area</td></tr>
<tr><td>Advisory</td><td>- siren sound with green light in the individual area</td></tr>
<tr><td>Sediment Disaster Alert</td><td>- siren sound in the individual area.</td></tr>
</table>
</td></tr>
<tr><td>Sample Warning/Advisory Message</td><td>siren sound with light and gun shooting in the individual area.</td></tr>
</table>

4.2.3 Strong Wind

<table>
<tr><td>Warnings/Advisories and corresponding emergency responses</td><td>
<table>
<tr><th>Type</th><th>Expected Phenomena</th><th>Emergency responses</th></tr>
<tr><td>Emergency warning</td><td>TC with maximum wind over 100 km/hr will pass the area in the next 24-48 hr.</td><td rowspan="3">- Municipal and resident prepare for reduce the damage from strong wind
- Stay far away from the high bill board, high tree and unhealthy building.</td></tr>
<tr><td>Warning</td><td>TC with maximum wind 50 - 100 km/hr will pass the area in the next 24-48 hr.</td></tr>
<tr><td>Advisory</td><td>TC with maximum wind less than 50 km/hr will pass the area in the next 24-48 hr.</td></tr>
</table>
</td></tr>
<tr><td>Potential Disaster Risks</td><td>Damage to houses, buildings, agricultural crops and maritime disaster</td></tr>
<tr><td>Target (warning areas)</td><td>Along the forecasting track.</td></tr>
<tr><td>Meteorological variables/indices used for criteria/thresholds for warnings/advisories</td><td>10-minute average wind speed (m/s)</td></tr>
<tr><td>Criteria/Thresholds</td><td>
<table>
<tr><th>Type</th><th>Criteria</th></tr>
<tr><td>Emergency warning</td><td>Maximum wind over 100 km/hr</td></tr>
<tr><td>Warning</td><td>Maximum wind 50-100 km/hr</td></tr>
<tr><td>Advisory</td><td>Maximum wind less than 50 km/hr</td></tr>
</table>
</td></tr>
<tr><td>Contents of Warning/Advisory Message</td><td>Same as storm warning</td></tr>
<tr><td>Sample Warning/Advisory Message</td><td>Same as storm warning</td></tr>
</table>

4.2.4 River Flood

<table>
<tr><td>Warnings/Advisories and corresponding emergency responses</td><td>
<table>
<tr><th>Type</th><th>Expected Phenomena</th><th>Emergency responses</th></tr>
<tr><td>Warning</td><td>- Water revel rise very steep
- heavy rain in the upper reach still continue</td><td rowspan="2">Both municipal and resident in the risk areas taking immediate action for evacuation to the near highest area.</td></tr>
<tr><td>Advisory</td><td>- Water revel continue rising
- heavy rain in the upper reach still continue</td></tr>
<tr><td>River Flood Forecasts for Designated Rivers</td><td>Issued only for major rivers, jointly by either RID and EGAT</td><td>The forecast represents the water revel at critical point.</td></tr>
</table>
</td></tr>
<tr><td>Potential Disaster Risks</td><td>Flood, dike break, washout of bank, Inundation, etc.</td></tr>
<tr><td>Target (warning areas)</td><td>Individual Municipality along the main river</td></tr>
<tr><td>Meteorological variables/indices used for criteria/thresholds for warnings/advisories</td><td>・ Rainfall amount
・ Runoff Index
・ Water levels of rivers</td></tr>
<tr><td>Criteria/Thresholds</td><td>Warning levels based on water levels are determined depending on expected degree of flood risks in consideration with corresponding actions to be taken by river management authorities and residents. Those criteria are proposed by Office of the National Water and Flood Management Policy (single command) and determined through the coordination with relevant municipalities.</td></tr>
<tr><td>Contents of Warning/Advisory Message</td><td>River Flood Forecasts for Designated Rivers
- Issuance time
- Warning statements on observed and forecasted warning levels, and municipalities/areas with warnings in effect.
- Observations and forecasts of precipitation and water levels</td></tr>
<tr><td>Sample Warning/Advisory Message</td><td>-</td></tr>
</table>

4.2.5 Storm Surge

<table>
<tr><td>Warnings/Advisories and corresponding emergency responses</td><td>
<table>
<tr><th>Type</th><th>Expected Phenomena</th><th>Emergency responses</th></tr>
<tr><td>Emergency Warning</td><td>-Storm in association with a typhoon expected to have a level of very high intensity.
- TC with maximum wind over 100 km/hr will pass the area in the next 24-48 hr.</td><td rowspan="3">- All ships move to the save place
- All activity in the low land along the coastal line move to the high place.</td></tr>
<tr><td>Warning</td><td>TC with maximum wind 50 - 100 km/hr will pass the area in the next 24-48 hr.</td></tr>
<tr><td>Advisory</td><td>TC with maximum wind less than 50 km/hr will pass the area in the next 24-48 hr.</td></tr>
</table>
</td></tr>
<tr><td>Potential Disaster Risks</td><td>Inundation, damage of ships, shore facilities including ones for fishery, etc.</td></tr>
<tr><td>Target (warning areas)</td><td>Individual low land municipality</td></tr>
<tr><td>Meteorological variables/indices used for criteria/thresholds for warnings/advisories</td><td>Tidal level</td></tr>
<tr><td>Criteria/Thresholds</td><td>
<table>
<tr><th>Type</th><th>Criteria</th></tr>
<tr><td>Emergency warning</td><td>When typhoons are expected to hit southern Thailand</td></tr>
<tr><td>Warning</td><td>When tropical cyclone is moving in the South China Sea and will move into to the gulf of Thailand</td></tr>
<tr><td>Advisory</td><td>When tropical cyclone moving in the South China Sea and will not move into to the gulf of Thailand</td></tr>
</table>
</td></tr>
<tr><td>Contents of Warning/Advisory Message</td><td>Same as tropical cyclone warnings/advisories</td></tr>
<tr><td>Sample Warning/Advisory Message</td><td>Same as tropical cyclone warnings/advisories (include in the same warning)</td></tr>
</table>

4.3 Supporting Meteorological Information for Warning/Advisory Messages

[Please describe supporting meteorological information which provides supplementary explanation on warning/advisory messages to support emergency responses of recipients, if any.]

Name of Information	Potential Disaster Risks	Target (areas)	Issuance (update) Time	Contents
Bulletin	All kind of disasters	Nationwide, Region, Province.	Bulletins are issued every 6 hr when the situation of the weather conditions expected to worsen.	1. Issuance time 2. Explanatory note 3. Current and expected condition of typhoons or lows 4. Quantitative forecasting e.g. for rainfall amounts and wind speeds in some case
Bulletins on Exceptionally Heavy Downpours	Inundation, sediment disaster, flood	Municipal or provincial area	Bulletins on Exceptionally Heavy Downpours are issued when the radius of the TC covered.	1. Issuance time 2. Explanatory note 3.Current and expected condition of typhoons or lows 4. Quantitative forecasting e.g. for rainfall amounts and wind speeds in some case

4.4 Institutional Coordination

4.4.1 Coordination with Disaster Management Authorities

Warning Coordination	TMD staff visits provinces and communities in risky areas with questionnaire about what media, time and how often they receive the warning/advisories massage, and how they understood the warning / advisory massage and what they need to improve..
Needs from Disaster Management Authorities	Disaster management authorities often ask for further improvements in forecasting accuracies and resolutions, and warning messages supporting their decision making, for the effectiveness and efficiency of their emergency operations, as well as more easy-to-understand warning messages.

4.4.2 Partnership and Coordination with Media

Warning Coordination	During normal weather conditions, TMD has a liaison with the media on a regular basis. And in some occasional seminar with media, TMD has to request them to fill the questionnaire about warnings message contents. They need a warning message that should be concisely, in layman's terms and without scientific jargon.
Needs from Media	TMD's bulletins/warnings are difficult to understand, thus sometimes they requested to clarify, and need to get information before others.

4.5 Challenges (and Future Plan)

Nowadays, an extreme decentralization of information and data through the World Wide Web makes it possible for millions of people worldwide to have easy, instantaneous access to a vast amount of diverse online information. This powerful communication medium has spread rapidly to interconnect our world, enabling near-real-time communications and data exchanges worldwide. That means media, people and also government agencies can access any warning information from centers very easy. We have to change a warning for more interesting and friendly to user, such as enough lead time and feel confident to take action and easy to understand. Warning contents in text format could be replaced by graphic presentation or graphic animation. That is a huge challenge for TMD to work hard to meet a need of user or can competitive with other warning centers.

TMD tries to develop color code for category the degree of hazards, such as Green, Yellow, Amber and Red for normal, little, medium and high respectively for all types of meteorological hazards for which TMD is responsible for issuance of warnings, but some media prefer to use number such as 1, 2, 3, 4. for more understanding. They can compare and easy to understand the severities of weather phenomena. To make criteria for each hazard is very difficult due to the different of geography in each areas. In the coming season TMD plans to include category color code or/and number into the warning messages, short statements in comparison with past major disasters that occur not only in Thailand but also from the neighbouring countries also will include, so that people intuitively understand expected severity of disasters from their experience.
