

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

Tokyo, Japan
11-14 March 2014

**Country Report On
Tropical Cyclone Monitoring
In Cambodia**

Department of Meteorology

1. Tropical Cyclone Monitoring, Analysis and Forecasting

1.1 Tropical Cyclone Monitoring

1.2 Tropical Cyclogenesis Monitoring

The Department Of Meteorology DOM is under the Ministry of Water Resources and Meteorology MOWRAM the key activities of DOM are manage and monitor climate data information's network system and weather condition happening in the local and region; providing weather information necessary for preventing and mitigating natural disasters, which can cause negative impacts on human societies, communities and its socio-economic development activities. DOM generates many types of meteorological information, which can serve several purposes in different sector such as ministries and public via media. In dealing with hydro-meteorological hazards, DOM partners with the DHRW, which is responsible for flood forecasting and warning. As regards to its duties and responsibilities, it has special relationships and responsibilities with several ministries and state bodies such as Ministry of Environment, Ministry of Agriculture Forestry and Fishery, National Committee for Disaster Management, Ministry of Public Works and Transport (MPWT), Ministry of Labor and Social Welfare (MLSW), Ministry of Industry, Mines and Energy (MIME), and the Cambodian Red Cross (CRS) and also with the non-government organization. The DOM is headed by a Director who reports directly to the Minister. It is composed of six offices namely: Administrative Office, Observation Office, Equipment Office, Forecasts and Researches Office, and Climate Office and Hydro-meteorological Office and 24 provinces and municipalities, the Hydro-meteorological Offices are established under Department of Water Resource and Meteorology Provincial.

To monitoring weather forecasting and producing weather information's for short medium and long rang also for increasing the frequency and intensity of extreme weather events such as years of floods and drought have been affected on social economic. Forecasts of El Niño/La Niña, warnings for approaching tropical cyclone and heavy rains enable all sectors and the communities to plan their activities and the people to prepare to reduce or avoid damages from these natural hazards. Of all the sectors, the agriculture and transportation industries particularly shipping and aviation are the major beneficiaries of these weather services.

The mandated of DOM is to develop weather forecasts and provides warning on weather condition to relevant ministries. It provides short, medium and long range weather forecasts and issues Tropical Cyclone Warnings to inform the public of impending hazards. DOM conducts non-stop monitoring 24 hours a day during the severe weather as tropical cyclone Typhoon effected on region and locally the DOM forecasting is made through analysis of weather maps and weather reports of surrounding countries including weather forecasts for marine issued. DOM continuously analysis and monitors its meteorological observation network, satellite images, and weather charts for tracking of the cyclone based on different model and sources.

The Cambodia part we are using this entire product from different sources for comparing and analysis as tract, area of effected for the storm moving area we do not producing forecasting we using from the RSMC Tokyo - Typhoon Center (hereafter, "the Centre") closely watches all cloud clusters within its responsible area using MTSAT satellite images as well as deterministic by NWP models of major by using SATAIAD to run the model for checking a track and to looking the streamlines of 850 hPa and 200 hPa used for understand divergent/convergent atmospheric flows at lower and upper levels respectively of TS, TC and also when it can convert to TD also look a centers available and we using many products for rechecking and analysis as ECMWF, NCEP, UKMO and JMA when the weather or climate become unstable or unmorally.

1.2.1 Tropical Depression (TD) Warnings

The TD warning issuing we are basing on the data from the weather map , satellite imagery, Doppler Radar, NWP,SATAID, Typhoon forecasting, JMA, Hong Kong, Korea and through GTS system, if we see the tropical cyclone, TS it track forecast will be expected landing and converting to TD and also expected that the storm area or track impact the DOM will issued the warning and send to The Public by telephone, Facsimile and E-Mail are used for delivering the weather and flood forecasts and Tropical Cyclone Warnings to government and private sectors. DOM directly reports the message to MOWRAM and releases the message to public trough TV, radio and newspapers. In case of urgent warning, DOM provides an announcement to MOWRAM, and then MOWRAM reports to the Prime Minister. The Minister of MOWRAM and/or the Director of DOM makes live announcement of warnings on television and broadcasted over radio stations. At the same time DOM send the warning to NCDM and mass media. The dissemination of weather bulletins to public and private sectors

1.2.2 Challenges, Needs and Improvement Plans

For monitoring of TS, TC and TD warning or forecasting the challenges for DOM we are need to improve the capacities building for our staff and also needed the international expert mission to work or to assisting for operation and forecasting, therefore we using the product from the difference sources as JMA, ECMWF, NCEP, UKMO, RSMC and Hong Kong, Korea and other sources we are suggest that is they can provide us more informations as total ,accumulation of rainfall, flooded and area effected and can downscale to the region or the river basin.

1.2 Tropical Cyclone Analysis

1.2.1 Parameters and Methods

Parameter	Time (UTC)	Methods	Other sources
DOM not analysis any parameter for TC	Not time analysis	We using difference sources as satellite imagery ,MTSAT, SATAID, and model	Other sources website JMA, Hong Kong, Korea, RSMC NWP models by SATAID, ECMWF, USA, Arpage,NCEP, UK, mostly we are look at 850 hPa and 200 hPa streamlines

1.2.3 Challenges, Needs and Improvement Plans

The challenges during the TC, TS in the South China Sea and come to the landfall then converting to TD it difficulty analysis for forecasting.

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)			Operation and track forecasts are mainly we looking based on website of JMA , ECMWF, NCEP and UKMO, RSMC, Hong Kong, KMA

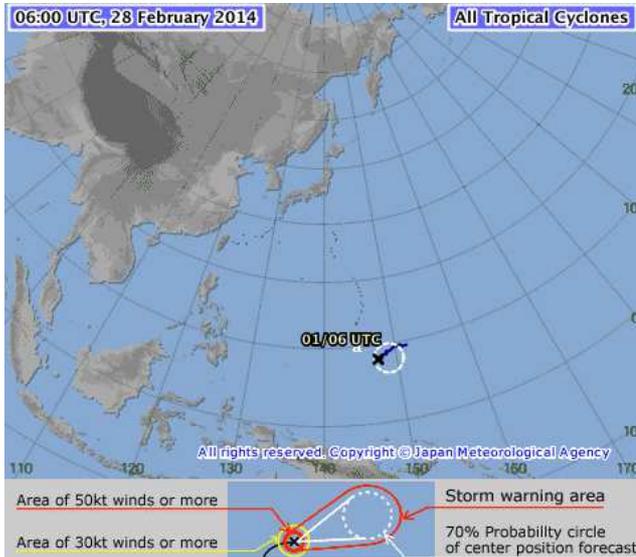
1.3.2 Challenges, Needs and Improvement Plans

The Cambodia not directed the tropical cyclone tropical storm, server tropical storm and typhoon or server typhoon pass affected from TC, TS

1.4 Tropical Cyclone Products

1.4.1 TC Products

We were using TC products of the RSMC Tokyo - Typhoon Center (<http://www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-eg/annualreport.html>) and Typhoon Committee Operational Manual (<http://www.wmo.int/pages/prog/www/tcp/operational-plans.html>).



Sources: JMA



Sources: Hong Kong Observatory

1.4.2 Challenges, Needs and Improvement Plans

The challenges TC product issued is needed to be advance training for DOM staff and assisting from expert

1.5 Computing Platform (including software)

For TC monitoring the DOM uses SATAID (Satellite Animation and Interactive Diagnosis) system. It

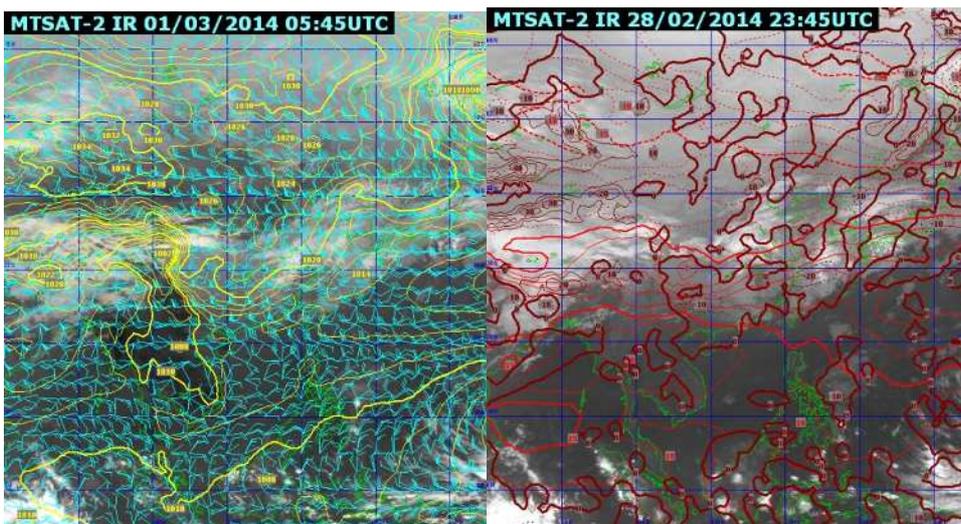
is equipped with multiple functions, not only for EDA and Dvorak analysis but also for daily weather analysis. The results of SATAID are provided to the DOM team weather analysis also provides idea for the weather forecast related products the computer equipment and software or model for operation as SATAID if developer can update or increasing more functionally included NWP and friendly using and analysis it may be comfortable for forecaster.

2 Numerical Weather Prediction Status for Effective Warning

DOM using NWP model from SATAID interface for operation and analysis that provide by WIS system port from JMA

2.1 NWP in Operational Use (SATAID interface)

Model	Domain (square degree)	Resolution (horizontal & vertical)	Initial Time (UTC)	Forecast Range (hours)	Run by (own/ foreign centers)
Global Spectral Model				24	by SATAID interface



NWP

2.2 Application Techniques of NWP Products for Operational Forecasts

The following on DOM's application techniques for very short range and short range forecasts for precipitation. Details are described in (<http://www.cambodiameteo.com>)

2.3 Challenges, Needs and Improvement Plans

The NWP running in part of Cambodia may be big error, because we need the upper air station installations for data collection and budget for operation and also capacity building as training is also very important

3. Storm Surge

1) Storm Surge Information

not issuing

2) What is the reason?

b. No forecast are available

4. Effective Warnings

4.1 Emergency Response for TC Disasters

4.1.1 Legal Framework for TC Disaster Management

The disaster management in Cambodia we have institutional for responsible we call the National Committee for Disaster Management (NCDM) was established by the Royal Government of Cambodia in 1995 not only to provide timely and effective emergency relief to victims of disasters but also to develop preventive measures to reduce loss of lives and property.

NCDM is a Ministerial level Agency, chaired by the Prime Minister that formed to assist the Royal Government in its Mission to lead the Disaster Management in the Kingdom of Cambodia. Its functions and responsibilities are as follows:

- Manage data of disaster risk and develop report on the disaster situation;
- Proposal on reserves of resources for Disaster intervention in Emergency Response;
- Capacity Building and human resource development on disaster management;
- Coordination in implementation of disaster management policies;
- Exchange and sharing information;
- Coordination and mobilization of resources for disaster response;



4.1.2 Emergency Response Mechanism

The Public telephone, Facsimile and E-Mail are used for delivering the weather and flood forecasts and Tropical Cyclone Warnings to government and private sectors. DOM directly reports the message to MOWRAM and releases the message to public through TV, radio and newspapers. In case of urgent warning, DOM provides an announcement to MOWRAM, and then MOWRAM reports to the Prime Minister. The Minister of MOWRAM and/or the Director of DOM makes live announcement of warnings on television and broadcasted over radio stations. At the same time DOM send the warning to NCDM and mass media. The dissemination of weather bulletins to public and private sectors is shown in Figure

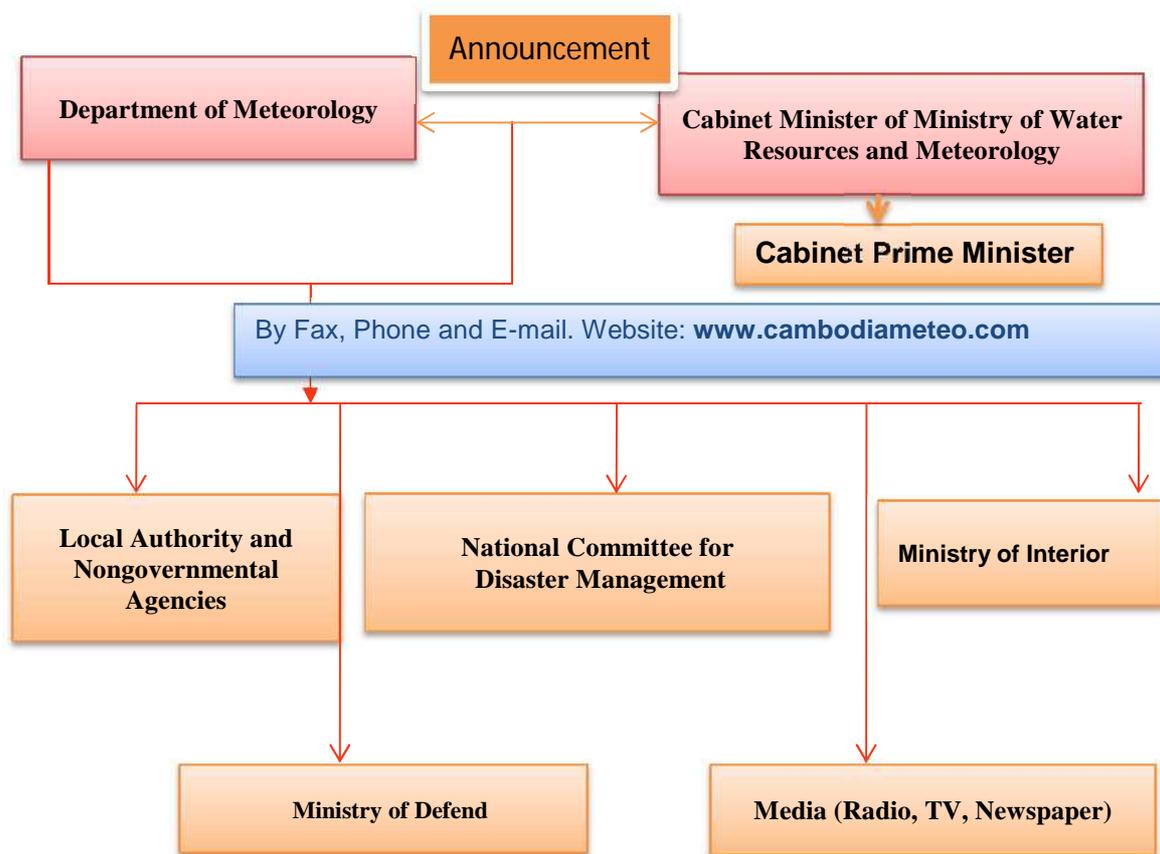


Figure4.1.2: Warning Dissemination Chart

4.1.3 Organs Responsible for Warnings and Evacuation Orders

Severe Weather Phenomena	Organs responsible for Warnings	Organs responsible for Evacuation Orders
Tropical Cyclone	MOWRAM/DOM	NCDM/ Royal Government Cambodia bodies
Heavy Rain (Sediment Disaster)	MOWRAM/DOM	NCDM/ Royal Government Cambodia bodies
Heavy Rain (Inundation)	MOWRAM/DOM	
Strong Wind		
Storm Surge		
River Flood	Department of Hydrology and River Works	

4.2 Warnings/Advisories for Severe Weather Phenomena

4.2.1 Tropical Cyclone

Warnings/Advisories and corresponding emergency responses	DOM issues warnings for disasters/phenomena associated with TCs, affected such as heavy rain, strong winds and storm surge,
Potential Disaster Risks	Null

Target (warning areas)	warning within area will effected from heavy, sunderstorm, continuously rain and strong wind so on
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	amount of rainfall in mm, wind speed in m/s or km/h more in www.cambodiameteo.com
Criteria/Thresholds	www.cambodiameteo.com
Contents of Warning/Advisory Message	Null
Sample Warning/Advisory Message	www.cambodiameteo.com

4.2.2 Heavy Rain

DOM issues two kinds of heavy rain warnings depending on risks of subsequent disasters, i.e., heavy raining will continuously more a few days and the weather unstable effected by TC, TS TD the some area will be disaster and inundation. we not warning for (Land slide)

Heavy Rain Warnings/Advisories (flood/inundation)

Meteorological variables/index used for criteria/threshold for warnings/advisories		
	Type	Meteorological variables/indices
	Emergency Warning	<ul style="list-style-type: none"> • 72-hour precipitation amount • daily- precipitation amount
Criteria/Thresholds		
	Type	Criteria
	Emergency warning	Please see the following DOM website (http://www.cambodiameteo.com)

Contents of Warning/Advisory Message	Type	Content
	Emergency warning	<ul style="list-style-type: none"> ➤ Issuance time ➤ Warning statements on potential disasters including warning areas and period of warning in effect ➤ Potential disasters (flooded/Inundation cooperation within Department Hydrology and River works) ➤ Quantitative forecasts (period of warning in effect)
	Warning	<ul style="list-style-type: none"> ➤ Issuance time ➤ Warning statements on potential disasters including warning areas and period of warning in effect ➤ Potential disasters (flooded/Inundation cooperation within Department Hydrology and River works) ➤ Quantitative forecasts (period of warning in effect)
	Advisory	<ul style="list-style-type: none"> ➤ Issuance time ➤ Warning statements on potential disasters including warning areas and period of warning in effect ➤ Potential disasters (flooded/Inundation cooperation within Department Hydrology and River works) ➤ Quantitative forecasts (period of warning in effect)
	flooded/ inundation(De partment of Hydrology and River Works	<ul style="list-style-type: none"> ➤ Issuance time ➤ Explanatory note on potential risks ➤ Targeted municipalities or provincial area ➤ Actions required
Sample Warning/Advisory Message	<p>Heavy Rain Warning issued by the DOM at 18:32 Cambodia time on date/Month /Year</p> <p>Warning statement</p> <ul style="list-style-type: none"> • Heavy rain warning (flood/flash flood disaster) for the northeast and south region in the Cambodia <p>Target area: five Provincial as.....</p> <p>Period of warning/advisory in effect</p> <p>Warning heavy raining: weather unstable from 9 pm of 15 Oct. to 9 am of 18 Oct.</p> <p>Advisory: until noon of 18 Oct.</p> <p>Maximum hourly precipitation: 80 mm</p>	

4.2.3 Strong Wind

Warnings/Advisories and corresponding emergency responses	Type	Expected Phenomena	Emergency responses
	Emergency warning	Storm in association with a typhoon expected to have a level of intensity observed only once every few decades the today is strong wind comparable with many year average wind speed.	Same as heavy rain warnings/advisories relevant to the flooded /height tidal for the sea (http://www.cambodiameteo.com)
	Warning	Same as heavy rain but warnings relevant to the height of tidal for the sea	
	Advisory	Same as heavy rain but warnings relevant to the height of tidal for the sea	
Potential Disaster Risks	effected to the houses, buildings, boat, fisherman maritime disaster		
Target (warning areas)	Individual Provincial, municipality, sea site		
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	daily average wind speed m/s or km/h		
Criteria/Thresholds	Type	Criteria	
	Emergency warning	Please see the following DOM website (http://www.cambodiameteo.com)	
	Warning	The procedure for determination of warning criteria is same as those for heavy rain warnings. One of the examples used as indicators for wind speed of storm disasters is the number of the effected. i.e 10 m/s in land, 25 m/s at sea	
	Advisory	10 m/s in land, 15 m/s at sea site	
Contents of Warning/Advisory Message	Same as heavy rain warnings.		
Sample Warning/Advisory Message	<p>Wind speed Warning issued by the DOM at 18:32 Cambodia time on 15/10/2013</p> <p>Warning statement</p> <ul style="list-style-type: none"> Strong wind speed warning (tidal height) for the lake, river and sea region in the Cambodia <p>Target area: Provincial region location on the sea site</p> <p>Period of warning/advisory in effect</p>		

	<p>Warning strong wind speed: weather unstable from 9 pm of 15 Oct. to 9 am of 18 Oct. Advisory: until noon of 18 Oct. Maximum averages wind speed 10 m/s at the sea, lake site, 9m/s in land</p>
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4.2.4 River Flood (Department of Hydrology and River Works DHRW)

Warnings/Advisories and corresponding emergency responses	<table border="1"> <thead> <tr> <th>Type</th> <th>Expected Phenomena</th> <th>Emergency responses</th> </tr> </thead> <tbody> <tr> <td>Warning</td> <td>Same as heavy rain warnings relevant to flooded</td> <td rowspan="2">Please see the web site www.dhrw-cam.org</td> </tr> <tr> <td>Advisory</td> <td>Same as heavy rain advisories relevant to flooded</td> </tr> <tr> <td>River Flood Forecasts for Designated main rivers as Mekong, Tonle Sap Lake, Basac rivers</td> <td>Issued only for major rivers, by DHRW when there is a risk of river flooding due to heavy rains or effected by TC,TS, TD</td> <td>The forecast represents the degree of risk with the warning levels determined by water levels. Corresponding emergency responses required by provincial, municipal governments and residents area will cover by flooded or inundation</td> </tr> </tbody> </table>	Type	Expected Phenomena	Emergency responses	Warning	Same as heavy rain warnings relevant to flooded	Please see the web site www.dhrw-cam.org	Advisory	Same as heavy rain advisories relevant to flooded	River Flood Forecasts for Designated main rivers as Mekong, Tonle Sap Lake, Basac rivers	Issued only for major rivers, by DHRW when there is a risk of river flooding due to heavy rains or effected by TC,TS, TD	The forecast represents the degree of risk with the warning levels determined by water levels. Corresponding emergency responses required by provincial, municipal governments and residents area will cover by flooded or inundation
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Potential Disaster Risks	Flood, overbank flow, flooded effected in provincial area, Inundation, etc.											
Target (warning areas)	Individual Provincial, municipality, river basin											
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	<p>Warnings/Advisories</p> <ul style="list-style-type: none"> Daily observation precipitation amount in the hydrological station <p>River Flood Forecasts</p> <ul style="list-style-type: none"> Water levels of rivers will be reaching warning stages 											
Criteria/Thresholds												
Contents of Warning/Advisory Message	<p>River Flood Forecasts for Designated Rivers</p> <ul style="list-style-type: none"> Issuance time Warning statements on observed and forecasted warning levels, and municipalities/areas with warnings in effect. Observations of precipitation and and forecasts of water levels 											
Sample Warning/Advisory Message	<p>Warnings/Advisories</p> <p>Water Levels Warning issued by DHRW at 19.00 Cambodia time on 15 Oct. 2013</p> <ul style="list-style-type: none"> Be effected for water level rise on date 16-18 Oct 2013 of rivers for hydrological in the Mekong, Bassac and Tonle Sap river. <p>Target area: Provincial, municipality, Warning (flood): 7 am of 16 Oct. to 19 am of 18 Oct.2013 Advisory (flood): until of 18 Oct.2013</p>											

4.2.5 Storm Surge No issue

4.3 Supporting Meteorological Information for Warning/Advisory Messages

Name of Information	Potential Disaster Risks	Target (areas)	Issuance (update) Time	Contents
Bulletin	All kind of Meteorology disasters	affected area, Region,	Bulletins are issued to call public's attention to weather conditions prior to the issuance of Warnings/Advisories and/or to supplement the Warnings.	<ol style="list-style-type: none"> 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
Bulletins on Exceptionally Heavy raining	Inundation, flood	Provinces and municipal area.	Bulletins on Exceptionally Heavy raining are issued when happens only once in several years observed or analyzed in one daily.	<ol style="list-style-type: none"> 1. Issuance time 2. Observation time and station 3. Daily precipitation amount

4.4 Institutional Coordination

4.4.1 Coordination with Disaster Management Authorities

Warning Coordination	- MOWRAM meeting with line agencies involved for discussion one time per year
Needs from Disaster Management Authorities	Disaster management authorities often ask for further improvements in forecasting accuracies and resolutions, 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	Whenever new warnings/bulletins are developed or important updates of existing warnings/bulletins are made, we send the product through fax, email, TV, Radio for dissemination and in consideration with requests from mass media through interview meetings with mass media.
Needs from Media	DOM's bulletins/warnings are complexly systematized and not necessarily user-friendly, thus reduction of the complexity are sometimes requested from mass media for explanation.

4.5 Challenges (and Future Plan)

DOM has needed to improve its forecasting product result should be more accuracy and warning system through the technical developments and refinements of warning messages. For example, in 2012 we have been analysis, with the model, Doppler Radar, satellite, and other products sources as from the JMA, Hong Kong, ECMWF, NCEP, UKMO, RSMC then we expected that TC GAMY is will be heavy rain strong wind and flashed flood will effected on the

region north, northwest and northeast part until XXX then we started to warning all provincial located in the region as we mention should be preparing for the people, but for the observed is only shower rain, no any flashed flood coming and also capacity building, data analysis, network, equipment needed to improve system. In order to re-organize its warning in a more systematic and user-friendly manner

