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

Tokyo, Japan
11-14 March 2014

COUNTRY REPORT

Cyclone Warning Services in Myanmar

May Khin Chaw, Kyaw Lwin Oo

Department of Meteorology and Hydrology

Summary

Department of Meteorology and Hydrology (DMH) is a nodal agency for the issuance of Cyclone News and Warning. DMH's cyclone forecast product is only text format and update (3) times a day. If the cyclone approaching Myanmar Coasts with emergency color, Cyclone Warning are updated (4) to (6) times a day. Meteorological warning are disseminated to the Higher authorities ,Minister and Deputy Ministers of Transport, Relief and Resettlement, General Administration, Broadcasting TV, FM radio, Newspapers, Journals, DMH's Hotline Phone and Website.

Tropical Cyclone Monitoring, Analysis and Forecasting

1.1 Tropical Cyclone Monitoring

1.1.1 Tropical Cyclogenesis Monitoring

Department of Meteorology and Hydrology (DMH) is a nodal agency for the issuance of Cyclone News and Warning. Meteorological division of DMH closely watch the development of severe weather system over Bay of Bengal by satellite images from MTSAT from Japan, INSAT from India and FY images from China. And various NWP outputs from WMO's RSMC New Delhi Tropical Weather Outlook, JTWC's daily outlook, GFS/WRF products and daily surface weather map and upper air charts.

1.1.2 Tropical Depression (TD) Warnings

DMH is a member of WMO's Panel on Tropical Cyclone. DMH follow the nomenclature of cyclone as by RSMC New Delhi. Color coded cyclone news and warning were used since 2009 Cyclone Season as per National Standing Order of Disaster Prevention and Management Committee.

1.1.3 Challenges, Needs and Improvement Plans

Currently, DMH issue low pressure area information after receiving the RSMC's issue. But, information was delay for the system like monsoon depression which developed very near to Myanmar Coasts. Myanmar DMH will set up (3) Radars under the JICA Project 2014-2017. Timely issuance of bulletin, advisory and warning is necessary. Close cooperation among RSMC and PTC member states is essential. PTC members reviewed to strengthen the activities of cyclone forecasting during the PTC's Integrated Workshop at Bangkok, Thailand (27-29 Nov 2013).

1.2 Tropical Cyclone Analysis

1.2.1 Parameters and Methods

Parameter	Time (UTC)	Methods	Other sources
Likelihood of development of TC	00,12,	Conventional methods of Synoptic Maps, Upper Air Charts, Pressure Tendency, MTSAT images, SATAID software are using to analyze Tropical Cyclone.	Deterministic NWP models of major centers (e.g. ECM WF, NCEP, JMA GSM, SWFDP, UK, JTWC,IMD, CIMSS, RIMES.
Dvorak Intensity (CI, T, DT, PT, MET number)	(3)Hourly	Cyclone Intensity based on Dvorak method from RSMC, CIMSS and JTWC are used.	
Center Position, Accuracy of center position, Direction & speed of movement	(3)Hourly	Center positions are estimated by using MTSAT satellite images. Information RSMC, CIMSS and JTWC are main sources to issue News and Warning.	
Central pressure, Maximum sustained wind speed, maximum gust wind speed,	(3)Hourly	CP and MSW estimated by using Dvorak method and products from RSMC, CIMSS and JTWC are main sources to issue News and Warning.	

1.2.2 Challenges, Needs and Improvement Plans

Computing facility, advanced weather observation networks, method of analysis (i.e Dvorak

method, Radar), well trained man power are the major needs to support the issuance on timely and accurate warning and information. WMO, RSMC and Regional NMHSs and INGOs provided technical training. Coordination with regional NMHSs for tools and technology transfer among Panel member countries and to improve the tropical cyclone monitoring and prediction technique.

1.3 Tropical Cyclone Forecasting

1.3.1 Parameter and Method

Parameter	Issu-ance Time (UTC)	Lead time (hours)	Methods
Track	23:30 06:30 11:30	(24) hour	Track forecasts are mainly based on products from RSMC, CIMSS and JTWC are main sources to issue News and Warning. Hourly weather observations, especially surface wind and pressure tendency, from coastal stations are used as lowest pressure fall and wind direction.
Central pressure, Maximum sustained wind,	23:30 06:30 11:30	(24) hour	Track forecasts are mainly based on products from RSMC, CIMSS and JTWC are main sources to issue News and Warning.

1.3.2 Challenges, Needs and Improvement Plans

The Centre mainly uses the RSMC New Delhi, CIMSS, JTWC, JMA Global NWP model and DMH WRF Model with reference to those of other major centers, to make official tropical cyclone forecasts. However, the accuracy of TC intensity forecasts by the DMH's WRF model is not enough in the direction and speed of TC track forecasts by the model. These weak points sometimes degrade the official forecasts of the Centre. To improve TC track forecasts, high computing facility and Numerical Prediction Technique for Cyclone Forecast Model.

1.4 Tropical Cyclone Products

1.4.1 TC Products

DMH's cyclone forecast product is only text format and update (3) times a day. If the cyclone approaching Myanmar Coasts with emergency color, Cyclone Warning are updated (4) to (6) times a day. WRF products of 24H, 48H and 72H time steps are upload in DMH website with MSLP, 850hPa, 700hPa, 500hPa,400hPA, 300hPa,250hPa Wind field images. http://www.moezala. gov. mm/index.php?option=com_content&view=article&id=107&Itemid=92&lang=en .

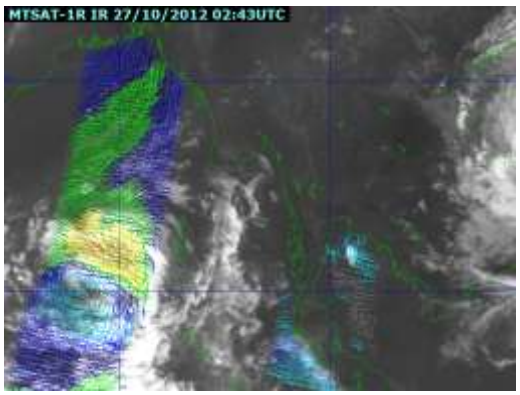
1.4.2 Challenges, Needs and Improvement Plans

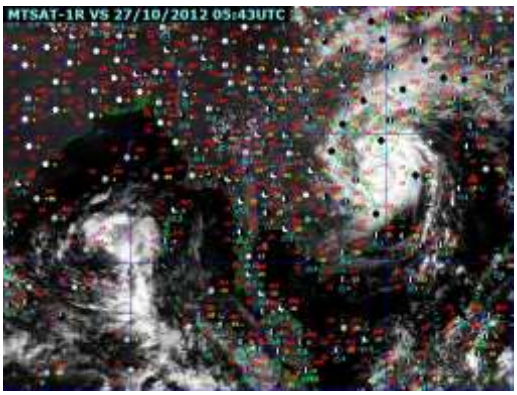
1. Technical transfer program are essential in forecast generation. Innovation on Graphical cyclone forecast products including cyclone forecast with uncertainty cone will be carried out. Training for cyclone forecasters should receive Dvorak's technique and application of various tools including Ensemble Prediction System (EPS) for tropical cyclone monitoring and prediction by PTC panel member with support from WMO and RSMC.DMH will cooperate with regional activities in cyclone forecasting to share the update and experiences of other NMHSs.

1.5 Computing Platform (including software)

For TC monitoring and satellite-based analysis, DMH uses SATAID (Satellite Animation and

Interactive Diagnosis) system developed by JMA. It is equipped with multiple functions, not only for Dvorak analysis but also for GSM daily weather analysis, including overlay of a variety of data such as SYNOP, SHIP, TEMP, METAR, AWS, Radar, NWP outputs, etc.





Myanmar DMH's SATAID Product

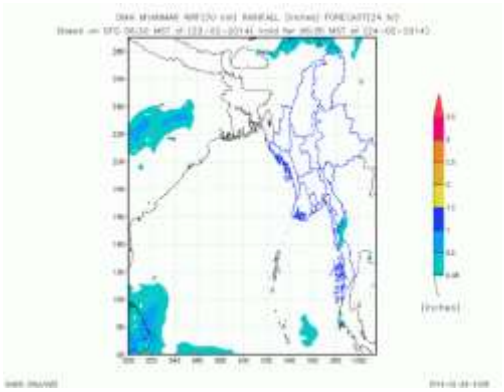
2 Numerical Weather Prediction Status for Effective Warning

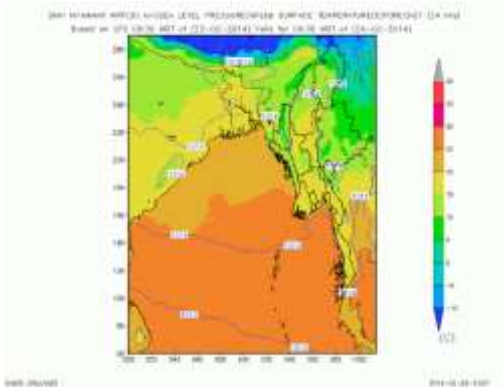
2.1 NWP in Operational Use

Model	Domain (square degree)	Resolution (horizontal & vertical)	Initial Time (UTC)	Forecast Range (hours)	Run by (own/ foreign centers)
WRF Model	80°E-101°E 6°N-29°N	(30)Km	00	24H,48H,72H	Own
JMA Storm surge Model	80°E-101°E 6°N-29°N	(30)Km	open	24H,48H,72H	Own
Diana Model Met.no	Station Time series	(16)Km	00	72H	Met.no

2.2 Application Techniques of NWP Products for Operational Forecasts

DMH responsible to issue timely information on Weather News and Warning. WRF Model products are generated once per day from GFS Data. Products are uploaded in DMH website.





Myanmar DMH's WRF Products

1) Short Range Forecast

Myanmar Daily Weather Reports is the main product of short range weather forecast. It comprise State and Region-wise precipitation and temperature forecast, next (48) hr outlook and (3) local area forecast. Comprehensive web based information from various center are utilized to prepare short range weather forecast with conventional Synoptic weather maps.

2.3 Challenges, Needs and Improvement Plans

Shortage of skilled man power and advanced computing facilities caused in accurate warning and information. Skills of Forecasters and observers are essential during the warning generation process. Utilization of Useful Software to support the weather forecast and seasonal weather forecast is still not yet developed. Technical Cooperation program with international institutes, some NMHSs, INGOs is ongoing for the strengthening of capacity.

3. Storm Surge

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))

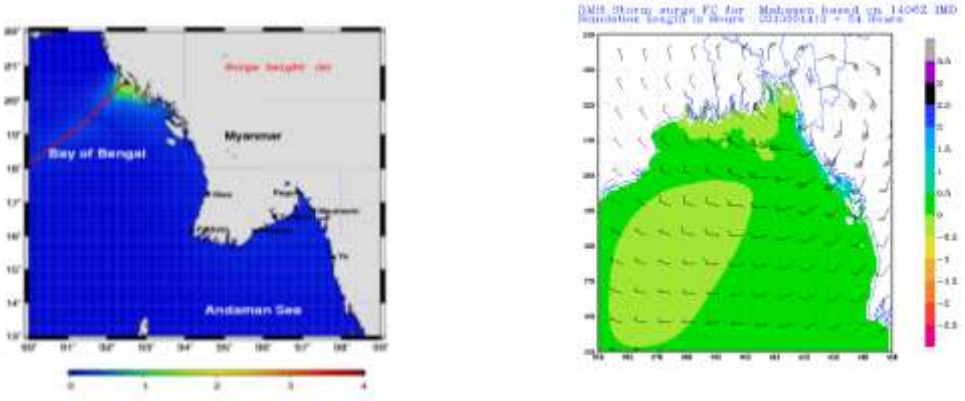
3) How the information is issued?

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

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

Storm surge forecast are issued before (36) hr or (48) hr before cyclone landfall to Myanmar Coasts. DMH used storm surge advisory from RSMC New Delhi, products of Indian Institute of Technology(IIT) Storm surge model and JMA Storm surge model. Sometime empirical method and analytical method on storm surge forecast are used.

Examples are shown below:



DMH Storm surge forecast products by JMA and IIT Model

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.)
Myanmar Area	15.0N-22.0N 90.0E-100.0E 30 km	Up to 48 hours	4 times/day (6 hourly)	Tides: not consider Inundation: not predicted

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

DMH used storm surge advisory from RSMC New Delhi, which issued (24) hour in advance of landfall.

4. Effective Warnings

4.1 Emergency Response for TC Disasters

4.1.1 Legal Framework for TC Disaster Management

DMH is responsible to issue timely information and warning on severe weather phenomenon including cyclone.

4.1.2 Emergency Response Mechanism

Myanmar Disaster Preparedness Agency is the supreme agency for guidance, decision making, plan formulation oversees monitoring and supervision of disaster risk management in Myanmar. For the effective disaster management mechanism, Management Working Committee and (13) sub-committee have been organized.

4.2 Warnings/Advisories for Severe Weather Phenomena

4.2.1 Tropical Cyclone

Warnings/Advisories and corresponding emergency responses	DMH issues warnings for disasters/phenomena associated with TCs, such as heavy rain, strong winds and storm surge.
Potential Disaster Risks	Landslide, flash flood advise
Target (warning areas)	Expected path of cyclone landfall and inland areas.
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	Pressure, wind, rainfall, cloud direction from hourly weather observations from coastal stations
Criteria/Thresholds	Nil
Contents of Warning/Advisory Message	Intensity, location, movement, estimated max wind, wind, rainfall, wave, advisory for fisherman and vessels.

Sample Warning/Advisory Message	

Cyclone Giri to make landfall this evening between Sittway and Kyaukpyu

NAY PYI TAW, 22 Oct—The Department of Meteorology and Hydrology today announced that according to the observations recorded at 1.00 hrs today, cyclone Giri over the mid-east of the Bay of Bengal has become stronger, moving northeastwards with its centre in the sea, about 50 miles southwest of Kyaukpyu.

The cyclone will make landfall this evening crossing between Sittway and Kyaukpyu.

The stronger cyclone Giri is now at red level and is moving towards Rakhine coast.

The maximum wind speed at its center is about 75 mph and may reach 85 mph. As the maximum tidal wave may rise up to 12 feet in Kyaukpyu, Yanbye, Manaung, An, Sittway, Pauktaw, Myebon Townships, the people from coastal areas of those regions where there is likelihood of tidal waves are to move to safety.

Alongside the cyclone, squalls are likely to be widespread. So, the people from highlands or slopes in Rakhine State are warned to avert possible dangers of landslides.

Under the influence of the cyclone, squalls are likely to be widespread along Rakhine Coast and the offshore with strong waves.

Surface wind speed in squalls may reach 70-75 mph along Rakhine coast and 50 mph in Delta region. Ships and trawlers are therefore warned to avert possible dangers of the natural disaster.

MNA

4.3 Supporting Meteorological Information for Warning/Advisory Messages

Name of Information	Potential Disaster Risks	Target (areas)	Issuance (update) Time	Contents
Bay Bulletin (Balloon/ Electron)	Cyclone, High wave, Strong wind	Navy, Port Authority, Fishery, Coastal Administration	Bulletins are issued to call public's attention to weather conditions prior to the issuance of Warnings/ Advisories and/or to supplement the Warnings.(2) to (3) times a day.	1. Issuance time 2. Name of Bulletin 3. Analysis 4. Current and expected weather condition 5. Surface wind 6. Sea condition 7. Visibility
Cyclone/ Storm surge	Inundation, sediment disaster, flood	Navy, Port Authority, Fishery Dept, Coastal Administration		1. Issuance time 2. Observation time and station 3. Hourly precipitation amount

4.4 Institutional Coordination

4.4.1 Coordination with Disaster Management Authorities

Warning Coordination	- Training, functional exercise, DRR day, conducted before disasters and emergency response activities during natural disasters. - Emergency cyclone color, **Orange** color :Cyclone is now heading towards Myanmar Coasts, **Red color** : Cyclone is expected to make landfall within next (12)hrs, **Brown color:** Cyclone is crossing, **Green color**: Clear the threatened by cyclone. - During the Cyclone, broadcasting media, printed media called for live interviewed with senior officials about latest information on cyclone and further advice.
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	Warning and Advisory are disseminated to State TVs and Radio, FM Radio, Newspapers, Mass Media Journal via Fax, mail, phone, website.
Needs from Media	Media ask for further improvements in forecasting accuracies and resolutions and warning messages for more easy-to-understand warning messages.

4.5 Challenges (and Future Plan)

Meteorological warning are disseminated to the Higher authorities ,Minister and Deputy Ministers of Transport, Relief and Resettlement, General Administration, Broadcasting TV, FM radio, Newspapers, Journals, DMH's Hotline Phone and Website. Warning should be received timely and effective manner from National level, regional level and grass root level by all possible ways. Radio is effective communication, but all the Radio broadcast 5 :00Am to 11 :00Pm. All possible communication channels, such as Radio Transceiver, Telephone, Fax, email and SMS systems should be maintained for the effective early warning. DMH need to establish a feedback receiving system from the users. i.e phone, email, social network, Facebook, website. Développent Project with RIMES, ADPC and Norwegian Meteorological Services has been carried out and link with the local people from selected pilot sites.