

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

Tokyo, Japan
11-14 March 2014

COUNTRY REPORT ON
TROPICAL CYCLONE MONITORING
In Lao PDR

Department of Meteorology and Hydrology (DMH)

1. Tropical Cyclone Monitoring, Analysis and Forecasting

1.1 Tropical Cyclone Monitoring

1.1.1 Tropical Cyclone genesis Monitoring

Department of Meteorology and Hydrology (DMH) Lao PDR, which is Weather Forecasting and Aeronautical Division monitors tropical cyclone genesis to identify tropical disturbances with potential to develop into TD by using SATAID and also products of the Joint Typhoon Warning Center issues probabilistic information on TC formation at its website such as from RSMC JMA, Hong Kong, Korea and other sources.

1.1.2 Tropical Depression (TD) Warnings

For tropical depression warning issuing to users we utilized meteorological observation data, weather map, satellite imageries, Doppler radar and necessary utilized the typhoon forecast and NWP products from JMA, Hong Kong, Korea and other center through GTS and internet. If tropical cyclone is located at longitude 120 degree east and Typhoon track forecast is expected the tropical depression land fall to Vietnam, in this case DMH must be issued early warning and sent to NDMC, MONRE, NDMO, Ministry concerning, Meteorological and Hydrological provinces and mass media by fax and broadcast real voice on radio by weather forecaster staffs.

1.1.3 Challenges, Needs and Improvement Plans

Regarding monitoring of tropical cyclogenesis and issuance of TD warnings the challenges of DMH is still lack of methodology and practical skill therefore need expert mission to assist operation task of Typhoon forecasting.

1.2 Tropical Cyclone Analysis

1.2.1 Parameters and Methods

Parameter	Time (UTC)	Methods	Other sources
DMH didn't analyzed any TC parameters such as position, speed, central pressure, maximum sustainable wind	no analysis time	On both satellite-based and non satellite-based methods used for analysis of respective parameters DMH lack of practical skill on Dvorak TC intensity estimation technique.	DMH refers to RSMCs Tokyo, Hong Kong, KMA and other sources

1.2.2 Challenges, Needs and Improvement Plans

The challenges after TC landfall to Vietnam becoming TD or TS it is difficult analyze uncertainty or issue forecast to public, and need expert mission to assist operation task of Typhoon analyzing.

1.3 Tropical Cyclone Forecasting

1.3.1 Parameter and Method

Tropical Cyclone forecasting technique we are lack of practical experience in forecasting and monitoring of TD, TS after landfall.

Parameter	Issuance Time (UTC)	Lead time (hours)	Methods
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Forecast TC parameters track, central pressure, maximum sustainable wind, strong wind areas refer to foreign centers especially RSMCs Tokyo center			For operational TC track forecasts such as TC intensity forecast DMH refer to the web site of JMA, KMA, Hong Kong and other sources.

1.3.2 Challenges, Needs and Improvement Plans

In Lao PDR the average 1 to 3 per year of tropical cyclone passed and up to now in some year more than three tropical cyclone over Laos, due to climate change and we needs training and assistance of expert mission to improvement plans for early warning system .

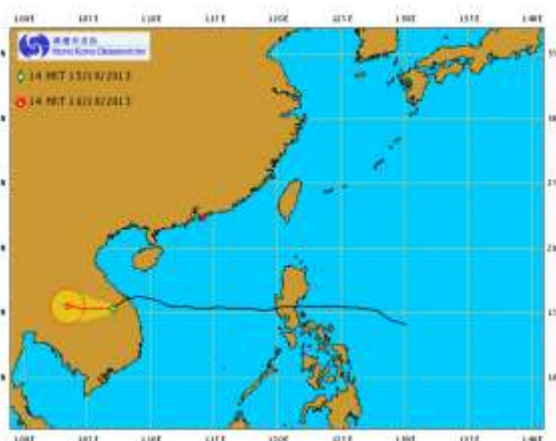
1.4 Tropical Cyclone Products

1.4.1 TC Products

TC products RSMCs we issued to the public which is Ty track forecast that received from severe weather demonstration WMO web site

RSMCS Tokyo

Hong Kong



KMA



1.4.2 Challenges, Needs and Improvement Plans

The challenges of TC product issued to the public must be trained to local authorities to understand the TC product and need to assist expert mission.

1.5 Computing Platform (including software)

DMH lack of operational platform (software) to make TC analysis, forecasts and products]

2 Numerical Weather Prediction Status for Effective Warning

We are using NWP status for effective warnings from UK ECMWF through GTS by using Synergie software visualization from Meteo-France, JMA, KMA and from other sources

2.1 NWP in Operational Use

DMH no have NWP models in operational use only by using models provided by foreign centers

Model	Domain (square degree)	Resolution (horizontal & vertical)	Initial Time	Forecast Range (hours)	Run by (own/foreign centers)
Synergie				24 hours	ECMWF

Fig.1. MSLP&Wind 850 hpa, for 3/2/14 ; 12 UTC

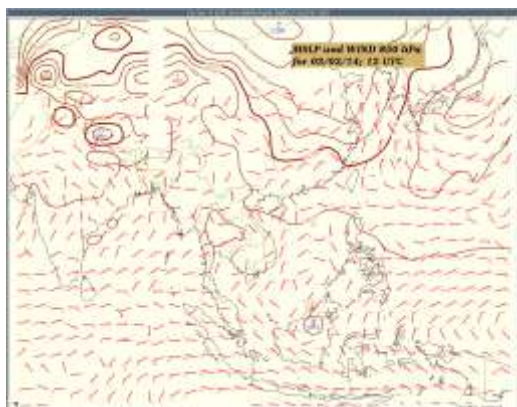
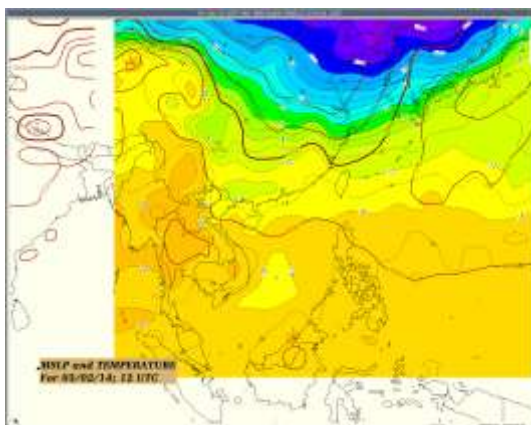


Fig.2. MSLP&Temperature, for 3/2/14 ; 12 UTC



2.2 Application Techniques of NWP Products for Operational Forecasts

Application techniques of NWP products for short-range (0-72 hrs) operational forecasts

2.3 Challenges, Needs and Improvement Plans

Challenge of DMH is lack of Upper air station and budget in operational of NWP and needs training, expert missions

3. Storm Surge

Lao PDR is land lock country there isn't using operational activity on storm surge information.

4. Effective Warnings

4.1 Emergency Response for TC Disasters

National level: (Decision making body) as National Disaster Management Committee (NDMC) consisting of 14 key government institutions:

1. Ministry of Defense: Vice Prime Minister Chairman
2. Minister of Natural Resources and Environment: Vice –Chair alive in service
3. Minister of Agriculture and Forestry: Vice-Chair
4. Minister of Public Works and Transport: Vice-Chair

5. Minister of Labour and Social Welfare: Vice-Chair
6. Minister of Public Health: member
7. Minister of Security: member
8. Chairman of Lao Red Cross: member
9. Vice Secretariat administrative Group Center Government of Lao Revolution Youth: member
10. Vice Director of General Staff Department, Ministry of Defense: member
11. Director of Cabinet Office, Ministry of planning and Budget : member Director of Cabinet Office, Ministry Foreign Affairs: member
12. Director of Cabinet Office, Ministry of Education and Sports: member
13. Direct of Cabinet Office, Ministry of Finance: member

4.1.1 Legal Framework for TC Disaster Management

The legal framework for the national disaster management for TC disasters in operational services and implement organization.



4.1.2 Emergency Response Mechanism

The national emergency response mechanism when massive TC disasters are expected to occur as follow: Prime Ministry Office, National Disaster Management Committee (NDMC), Ministry Focal Point(MFP), Ministry Focal Point in Unit(MFPU), National Disaster Office(NDMO), Provincial Disaster Management Committee(PDMC), Provincial Focal Point in Unit(PFFPU), District Disaster Management Committee(DDMC), District Focal Point in Unit(DFFPU) and Village Protection Disaster Unit(VPDU).

4.1.3 Organs Responsible for Warnings and Evacuation Orders

Organs responsible for warnings and evacuation orders when TCs and associated severe weather phenomena, i.e., heavy rainfall, strong wind, flood, inundation and storm surge, are expected to occur as Provincial Disaster Management Committee(PDMC), Provincial Focal Point in Unit(PFFPU), District Disaster Management Committee(DDMC), District Focal Point in Unit(DFFPU) and Village Protection Disaster Unit(VPDU).

Severe Weather Phenomena	Organs responsible for Warnings	Organs responsible for Evacuation Orders
Tropical Cyclone	Organizations responsible for issuance of warnings for TCs	[Please specify organizations responsible for evacuation orders.]
Heavy Rain	DMH	NDMC, NDMO, PDMC,DDMC,VPDU
Strong Wind	DMH	NDMC, NDMO,

		<i>PDMC,DDMC,VPDU</i>
River Flood	<i>DMH</i>	<i>NDMC, NDMO, PDMC,DDMC,VPDU</i>
Storm Surge		

4.2 Warnings/Advisories for Severe Weather Phenomena

DMH On warnings/advisories for tropical cyclones as well as associated severe weather phenomena, i.e., heavy rainfall, strong wind, flood, inundation in the following formats respectively:

4.2.1 Tropical Cyclone

Warnings/Advisories and corresponding emergency responses	<i>warnings/advisories issued for tropical cyclones and corresponding emergency responses by relevant authorities and residents are listed: heavy rainfall, strong wind, flood or flash flood and inundation. After DMH prepared these information then sent to prime Minister Office, National Disaster Management Committee (NDMC), MONRE, NDMO, mass media and Meteorological and Hydrological at provinces.</i>
Potential Disaster Risks	<i>Potential disaster risks when the respective warnings/advisories listed above are issued mostly the protection infrastructure is not enough in remote areas, in low areas along the rivers doesn't dike protection and also in valley areas</i>
Target (warning areas)	<i>The targeted warning areas identified risk areas including citizen villages, crop plant areas and industry sectors.</i>
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	<i>Meteorological variables/indices used for criteria/thresholds for warnings/advisories are location of TC, when a TS located between 115 ° – 120 ° E, 110 ° – 115 ° E and nearest western of 110 ° E, for heavy rainfall is precipitation more than 100 mm in 12 hours, for strong wind 20-25 m/s and flood in different level at different areas along the rivers or its tributaries.</i>
Criteria/Thresholds	<p><i>Refer to the above criteria/thresholds for warnings/advisories are determined: these are issued three categories when a storm wind reaches 35 kts or greater as following.</i></p> <ol style="list-style-type: none"> Far warning: <i>This issued one time a day, valid for 24 or 48 hours when a TS is located between 115 ° – 120 ° E</i> Near warning: <i>This issued two time a day, valid for 24 hours when a TS is located between 110 ° – 115 ° E</i> Urgent warning: <i>This issued every 6 hours when a TS is located nearest western of 110 ° E</i>

Contents of Warning/Advisory Message	<i>The contents of warning/advisory message for a tropical cyclone are consisted warning on strong wind, heavy rainfall, flood or flash flood and inundation</i>
Sample Warning/Advisory Message	<p style="text-align: center;">LAO PEOPLE'S DEMOCRATIC REPUBLIC Peace Independence Democracy Unity Prosperity</p> <p style="text-align: center;"><i>Ministry of Natural Resources and Environment</i> <i>Department of Meteorology and Hydrology</i></p> <p style="text-align: center;">WARNING No25...</p> <p style="text-align: center;"><u>Tropical Cyclone and flood Warnings</u> <i>Warning issued by DMH at: 10:00 am 12 October, 2013</i></p> <p><i>The strong SW monsoon from bay Bengal over Laos and is associated with Ty over south China sea(16.8 N/107.0 E) at 07:00 am 24 September is forecast to move northwest about 10 kt and estimated landfall to Vietnam this evening and will be moved over Central part of Laos at 16.5N/105.2E in mid-night. Heavy rain with speed wind 15-20mps will be expected at Bolikhamxay, Khammoune and Saravanne provinces. Light to moderate rain with thunders over Xekong, Champassack and Attapeu provinces. Therefore inhabitant within these above mentioned areas are advised to be aware of damages which may be caused by flash flood.</i></p> <p><i>For today water level at 07:00 am Thakhek station is 12.54 m(warning level is 13.00 m and danger level is 14.00 m), due to heavy rainfall the water level forecast must be exceeded warning level on tomorrow morning. The latest water level forecast for tomorrow morning at Thakhek station is 13.70 m and for day after tomorrow is 14.25 m therefore inhabitants who live at low – lying areas are advised to be aware of damages which may be caused by flood.</i></p> <p><i>Please follow next warning for the necessary action taking</i> Vientiane, 12 October,, 2013 Director General of DMH</p>

4.2.2 Heavy Rain

Warnings/Advisories and corresponding emergency responses	<i>Warnings/advisories issued for heavy rain and corresponding emergency responses by relevant authorities and residents: After DMH prepared these information then sent to prime Minister Office, National Disaster Management Committee (NDMC), MONRE, NDMO, mass media and Meteorological and Hydrological at provinces</i>
Potential Disaster Risks	<i>Potential disaster risks when the respective warnings/advisories listed above are issued mostly the protection infrastructure is not enough in remote areas, in low areas along the rivers doesn't dike protection and also in valley areas</i>

Target (warning areas)	<i>The targeted warning areas identified risk areas including citizen villages, crop plant areas and industry sectors.</i>
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	<i>Meteorological variables/indices used for criteria/thresholds for warnings/advisories value of intensity of heavy rain is more than 100 mm in 12 hours evacuated and more than 60-80 mm in 12 hours preparing for evacuation</i>
Criteria/Thresholds	<p><i>Refer to the above criteria/thresholds for warnings/advisories are determined as flood warning DMH also divided in to Two categories:</i></p> <ol style="list-style-type: none"> <i>Nearly warning:</i> <i>in case the water level forecast at that station will expect below 0.50 m to warning level. DMH have to provide the warning and timely delivering to users</i> <i>Urgent warning:</i> <i>in case the water level exceeds the warning level. DMH have to provide the urgent warning and rapidly sent to focus areas.</i>
Contents of Warning/Advisory Message	<i>Early warning/advisory message for heavy rain and Flood</i>
Sample Warning/Advisory Message	<p style="text-align: center;">LAO PEOPLE'S DEMOCRATIC REPUBLIC Peace Independence Democracy Unity Prosperity</p> <p style="text-align: center;"><i>Ministry of Natural Resources and Environment</i> <i>Department of Meteorology and Hydrology</i></p> <p style="text-align: center;">WARNING No05...</p> <p style="text-align: center;"><u>Heavy Rainfall Warnings</u> <i>Warning issued by DMH at: 10:00 am 15 August, 2013</i></p> <p><i>Due to heavy rainfall in some areas of Central part the water level forecast must be exceeded warning level on tomorrow morning. The latest water level forecast for tomorrow morning at Thakhek station is 13.70 m and for day after tomorrow is 14.25 m therefore inhabitants who live at low – lying areas are advised to be aware of damages which may be caused by flood.</i></p> <p style="text-align: right;"><i>Please follow next warning for the necessary action taking</i> Vientiane, 15 August, 2013 Director General of DMH</p>

4.2.3 Strong Wind

Warnings/Advisories and corresponding emergency responses	<i>Warnings/advisories issued for heavy rain and corresponding emergency responses by relevant authorities and residents: After DMH prepared these information then sent to prime Minister Office, National Disaster Management Committee (NDMC), MONRE, NDMO, mass media and Meteorological and Hydrological at provinces</i>
Potential Disaster Risks	<i>Potential disaster risks when the respective warnings/advisories listed above are issued mostly house damages, utility pole for power line fall down destroyed power supply system and aircraft accident.</i>
Target (warning areas)	<i>The targeted warning areas identified where is covered areas by strong wind.</i>
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	<i>Meteorological variables/indices used for criteria/thresholds for warnings/advisories: speed wind more than 15-20 m/s too hard to walk against the wind small branches breaks, speed wind more than 20 -25 m/s too hard to stand against the wind slight structural damage occurs and speed wind greater than 25 m/s trees uprooted considerable structural damage occurs.</i>
Criteria/Thresholds	<i>Refer to the above criteria/thresholds for warnings/advisories are determined as strong wind warning DMH take three criteria are advised to be aware of damages which may be caused by trees fall down. also divided in to Two categories:</i>
Contents of Warning/Advisory Message	<i>Contents of warning/advisory message for strong winds: Strong wind warning</i>
Sample Warning/Advisory Message	<p style="text-align: center;">LAO PEOPLE'S DEMOCRATIC REPUBLIC Peace Independence Democracy Unity Prosperity</p> <p style="text-align: center;"><i>Ministry of Natural Resources and Environment</i> <i>Department of Meteorology and Hydrology</i></p> <p style="text-align: center;">WARNING No01...</p> <p style="text-align: center;"><u>Strong wind Warnings</u> <i>Warning issued by DMH at: 10:00 am 22 March , 2013</i></p> <p><i>A trough of low pressure with strong intensity lies over southern part of Lao PDR associated strong SW monsoon, there will be occasional strong wind with thunders occurred during after afternoon I Saravanne, Champassack and Xekong provinces. Therefore inhabitant within these above mentioned areas are advised to</i></p>

	<p><i>be aware of damages which may be caused by these situation.</i></p> <p><i>Please follow next warning for the necessary action taking</i></p> <p style="text-align: right;"><i>Vientiane, 22 Marcht, 2013</i> <i>Director General of DMH</i></p>
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4.2.4 River Flood

Warnings/Advisories and corresponding emergency responses	<i>Warnings/advisories issued for River flood and corresponding emergency responses by relevant authorities and residents: After DMH prepared this information then sent to prime Minister Office, National Disaster Management Committee (NDMC), MONRE, NDMO, mass media and Meteorological and Hydrological at provinces</i>
Potential Disaster Risks	<i>Potential disaster risks when the respective warnings/advisories listed above are issued mostly people who live in the bank of river, in low areas along the rivers doesn't dike protection especial Mekong River the protection infrastructure is not enough</i>
Target (warning areas)	<i>The targeted warning areas identified risk areas including citizen villages, crop plant areas and rice field.</i>
Meteorological variables/indices used for criteria/thresholds for warnings/advisories	<i>Meteorological variables/indices used for criteria/thresholds for warnings/advisories is water level in different stations.</i>
Criteria/Thresholds	<p><i>DMH divided the flood warning criteria, which consists as the following:</i></p> <ul style="list-style-type: none"> - Nearly warning: <i>In case the water level forecast at that station will expect below 0.50 m below to Warning level. DMH have to provide the warnings and timely delivering to users.</i> - Urgent warning: <i>In case the water level exceeds the warning level, DMH have to provide the urgent warning and rapidly sent to focus areas.</i>
Contents of Warning/Advisory Message	<i>Flood warning</i>

<p style="text-align: center;">Sample Warning/Advisory Message</p>	<p style="text-align: center;">LAO PEOPLE'S DEMOCRATIC REPUBLIC Peace Independence Democracy Unity Prosperity</p> <p style="text-align: center;"><i>Ministry of Natural Resources and Environment</i> <i>Department of Meteorology and Hydrology</i></p> <p style="text-align: center;">WARNING No01...</p> <p style="text-align: center;"><u>Flood warnings</u> <i>Warning issued by DMH at: 10:00 am 15 September, 2013</i></p> <p>For today on 22/8/2013 water level at 07:00 am Thakhek station is 12.54 m(warning level is 13.00 m and danger level is 14.00 m), due to heavy rainfall the water level forecast must be exceeded warning level on tomorrow morning. The latest water level forecast for tomorrow morning at Thakhek station is 13.70 m and for day after tomorrow is 14.25 m therefore inhabitants who live at low – lying areas are advised to be aware of damages which may be caused by flood. Please follow next warning for the necessary action taking Vientiane, 15 Septembert, 2013 Director General of DMH</p>
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4.3 Supporting Meteorological Information for Warning/Advisory Messages

No any supporting meteorological information which provides supplementary explanation on warning/advisory messages to support emergency responses of recipients, DMH provided free all meteorological information.

Name of Information	Potential Disaster Risks	Target (areas)	Issuance (update) Time	Contents
[Please describe name of information.]	[Please describe potential disaster risks when the this information is issued.]	[Please specify unit of target areas (e.g. prefectural government).]	[Please describe timing of issuance of this information.]	[Please describe contents of this information.]

4.4 Institutional Coordination

4.4.1 Coordination with Disaster Management Authorities

In order for disaster management authorities to respond appropriately and timely to our warnings under emergency situations, contents of warnings should be well coordinated between our Service and those authorities. Also, dissemination of warning messages to them should be immediate and secure enough. Efforts for coordination of warning messages as well as establishment of secure dissemination of warning messages to the authorities that DMH set up the Forecast and Warning Dissemination frame work.

<p style="text-align: center;">Warning Coordination</p>	<p>DMH Service coordinates with disaster management authorities to improve our warnings and advisories which DMH organized the meeting on dissemination information of early warning system and invited NDMC, NDMO, MONRE, MAF and other line agency to be provided these information to the effective areas on time and explanation to the people could understand word of warning criteria.</p>
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Needs from Disaster Management Authorities	<i>Needs from disaster management authorities for improvement of Our warnings and advisories that the feedback from the people of effective areas, how Our information on early warning influence to them.</i>
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4.4.2 Partnership and Coordination with Media

The immediate and appropriate dissemination of our warnings/advisories to the public as an easy-to-understand message, close coordination with media on warnings/advisories is also vitally important. Our efforts regarding coordination with media on a routine basis and in the case of emergency

Warning Coordination	<i>Our Service coordinates with media to broadcast warnings and advisories promptly and accurately in these for radio, staffs of Weather Forecasting and Aeronautical Division by real voice broadcasted and for television sent by Fax and E-mail and upload to the internet DMH web site</i>
Needs from Media	<i>Needs from media for improvement of our warnings and advisories that broadcast on air should be frequently.</i>

4.5 Challenges (and Future Plan)

It is always a challenging task for NMHSs to make warnings lead to appropriate emergency responses by relevant authorities. Current challenges to establish effective warning systems in our country is lack of technical facilities, telecommunication system and practical experiences.

Summary :

Lao PDR is a country that is affected by extreme weather every year and one to three tropical cyclone per year across and it is bringing natural disaster to damages infrastructures , agricultural sectors, houses and e.g.....

The extreme weather monitoring and accurate of forecasts and warning at DMH Lao is a great importance to assist the Government and public users to take prevention activities

Tropical cyclone warning is very important in order to disaster prevention and reduction, therefore warning information issued must be urgently provided to the peoples that effective area and training is one way able to make local staffs understand and how to transfer to the people and know how to protect people life and properties of peoples from disaster on time.

The monitoring of tropical cyclogenesis and issuance of TD warnings the challenges of DMH is still lack of methodology and practical skill therefore need expert mission to assist operation task of Typhoon analyzing and forecasting.

Sharing of Meteorological and Hydrological information with mass-media and concerned line agencies.