Training Workshop on The First Steering Committee Meeting (SCM1) on Mekong River Commission Flash Flood Guidance(MRCFFG) System
Phnom Penh, Cambodia
29 November to 1 December

FORECASTING SYSTEM FOR EARLY WARNING IN DMH, MYANMAR

29.November.2016

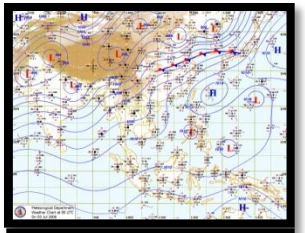
Cambodia

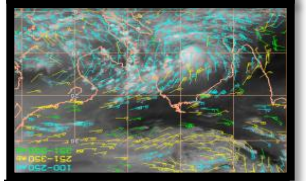
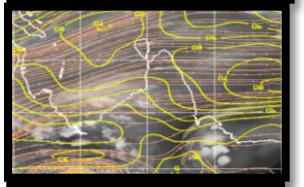
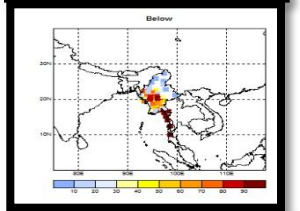
Topic of Presentation

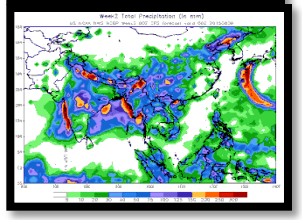
- Responsibility of Department of Meteorology and Hydrology-DMH
- Current Status and Existing Capacity
- DMH Hydrometeorological Network
- Organization Structure and Human Resources
- DMH Products
- Flash Flood Experience in Myanmar
- Early Warning Dissemination System
- Conclusion

History of Hydrometeorological Services
Established Meteorological Services
Member of IMO since January 1938
Aviation Meteorological Office 1946
Hydrological Services January 1964
Agro Meteorological Services 1982
Seismological and earthquake activities in July 1986
DMH's main responsibility is to provide Early Warning Information for Disaster Risk Reduction

Current Status and Existing Capacity



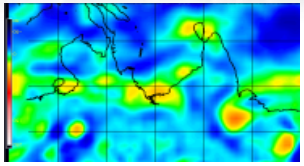


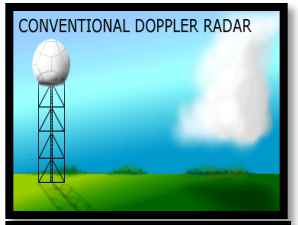
Daily Weather Forecast

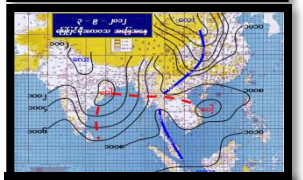
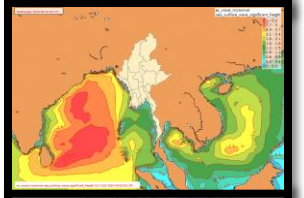
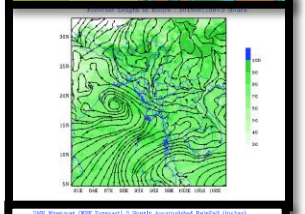
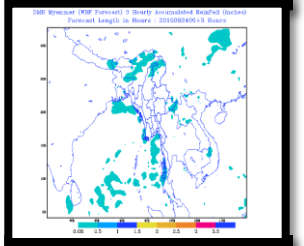
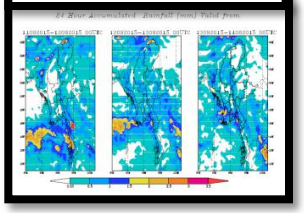
Issuing Step

- Synoptic Data (Myanmar/Other Country) → Synoptic Chart
- Upper Air Data (Myanmar/Other → Upper Air Chart
- Satellite Data (Grid point Data and Satellite Picture) → Satellite Picture (Past 24 hours & Present)
- Various Satellite Picture and Chart from other international Met. Dep → Synoptic Chart / Upper Air Chart / Satellite Picture
- Rader Data ↔ Compare with Present chart and Monthly Mean Chart ↔ Other NWP Model Output
- Result from JMA Model ↔ Results from PC Version Model
- RIME WRF Model output
- Compare and Analysis by using this Chart/ Draft Forecast
- Discuss with DG and Other Meteorologist
- Final Forecast

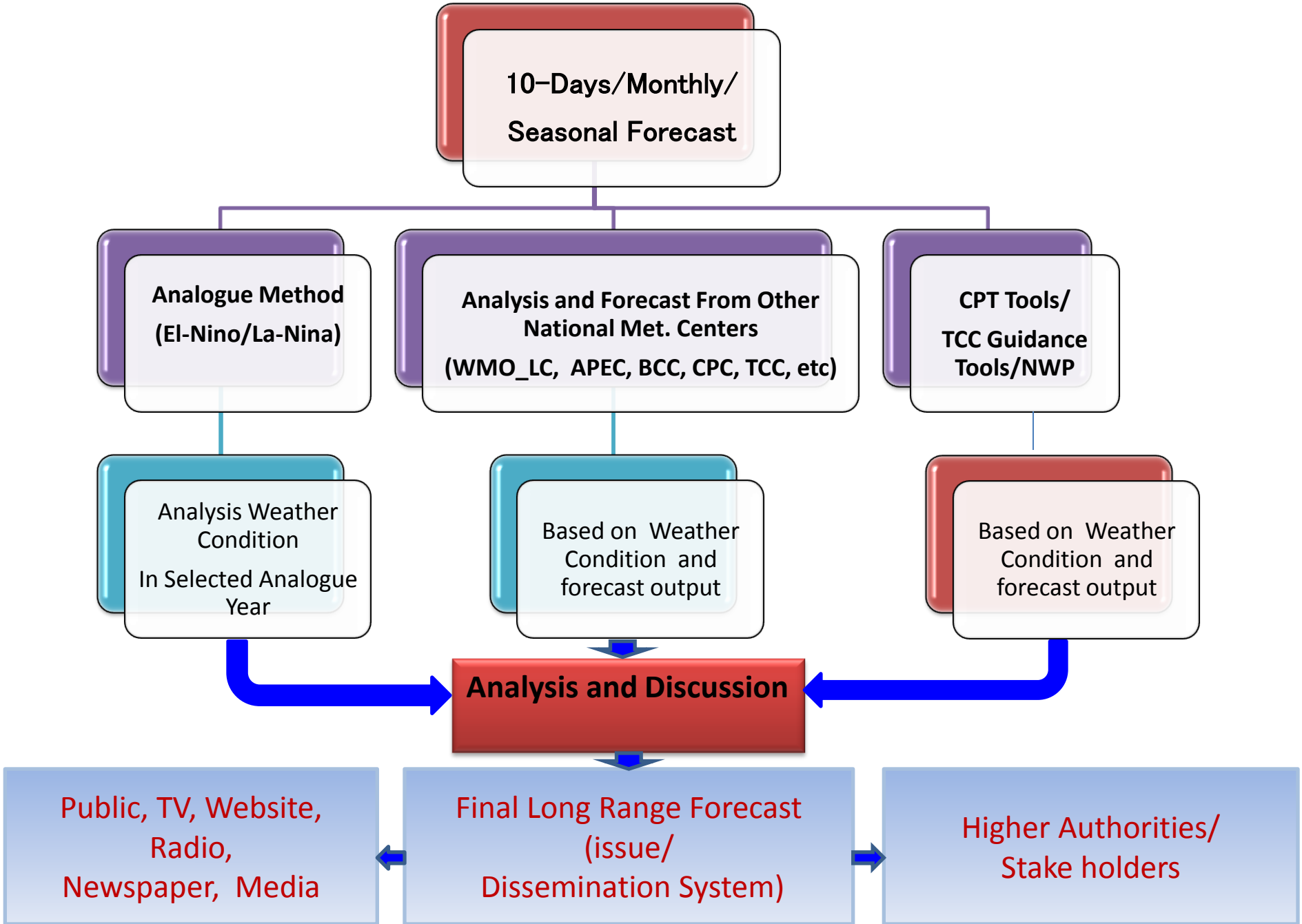




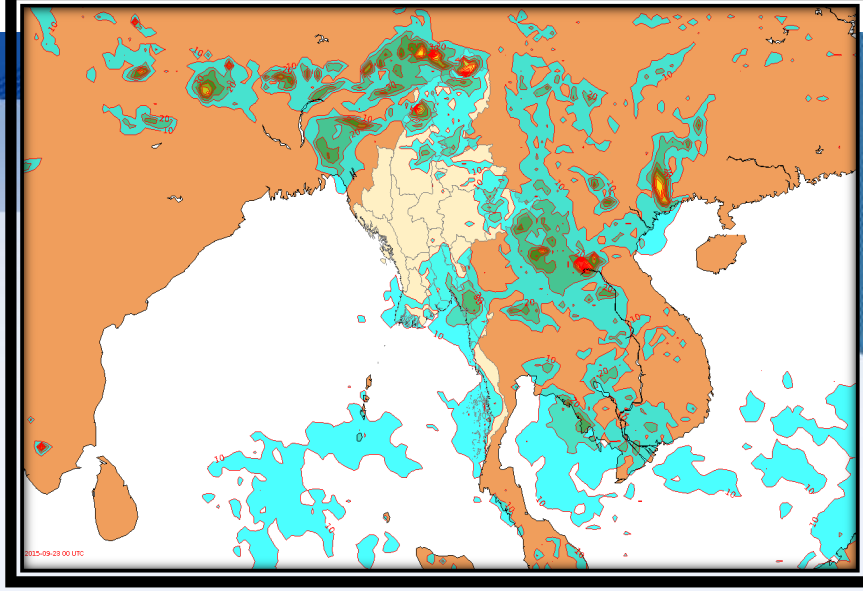


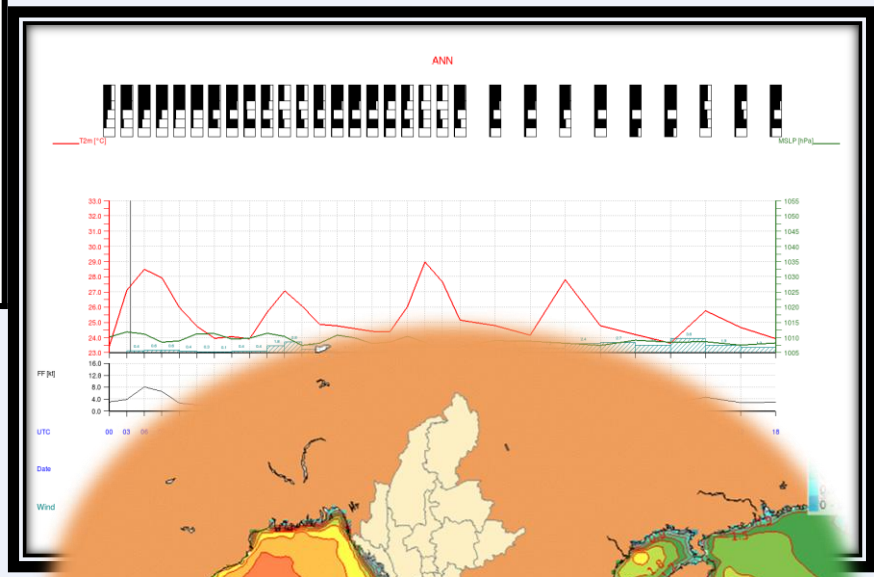






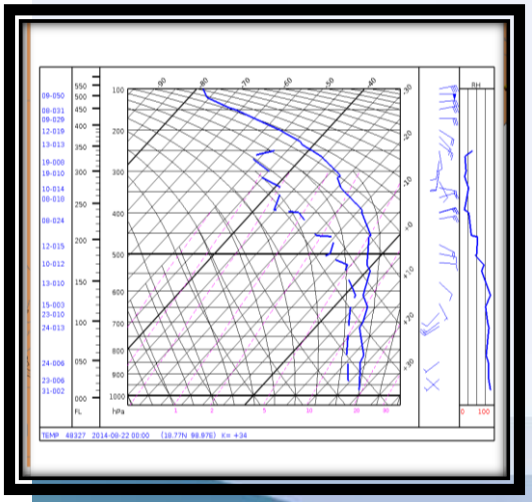
Current Prediction System



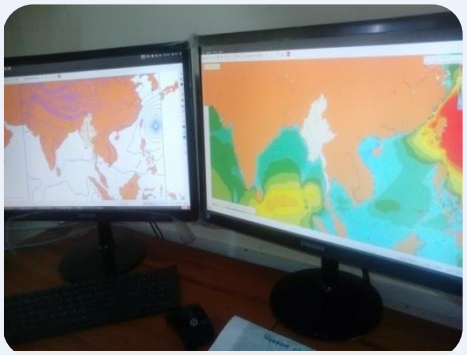
Data assimilation	Numerical model	Production data
• Input data : GFS model output (GRIB data) • ECMWF (Net CDF)	WRF regional model, DIANA tools(Norway, Met. N0.) Purchase high-performance PC	Forecast elements Max/Min. Temp. Humidity Sea level pressure Surface / Upper wind(speed, dir.) Precipitation & Meteorogram + Other parameters

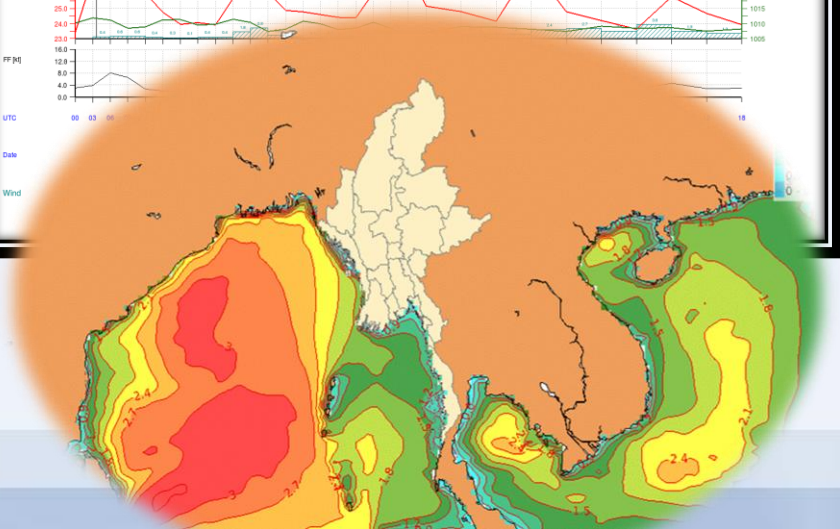




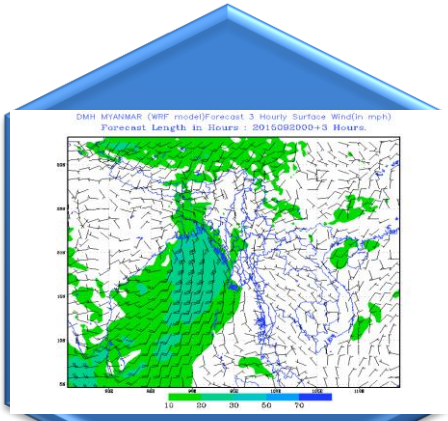


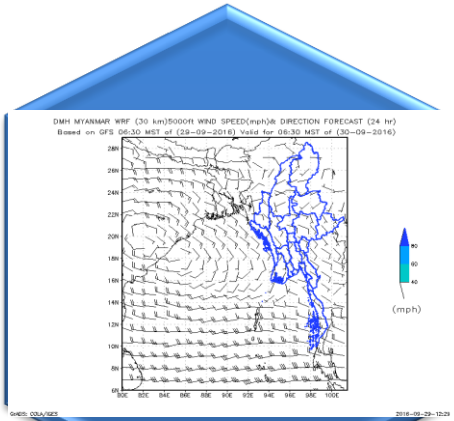
Met.no

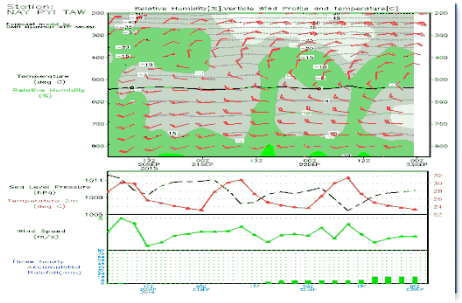


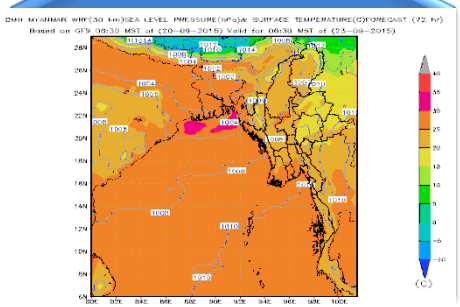


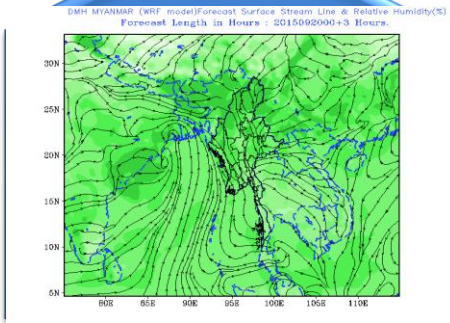
WRF Output

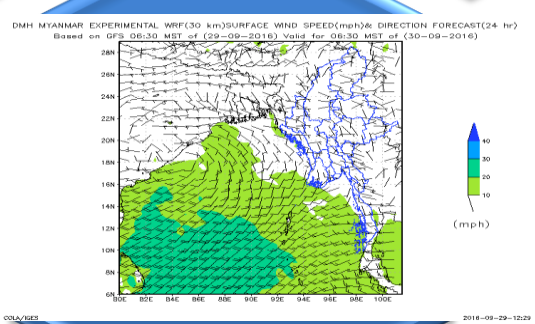

DMH MYANMAR (WRF model)Forecast 3 Hourly Surface Wind(in mph)
Forecast Length in Hours : 2015092000+3 Hours.


DMH MYANMAR WRF (30 km)5000ft WIND SPEED(mph)& DIRECTION FORECAST (24 hr)
Based on GFS 06:30 MST of (29-09-2015) Valid for 06:30 MST of (30-09-2015)
(mph)


Station:
NAY PYI TAW
Relative Humidity[%]Vertical Wind Profile and Temperature[C]


DMH MYANMAR WRF(30 km)SEA LEVEL PRESSURE(hPa)& SURFACE TEMPERATURE(C)FORECAST (72 hr)
Based on GFS 06:30 MST of (29-09-2015) Valid for 06:30 MST of (23-09-2015)
(C)

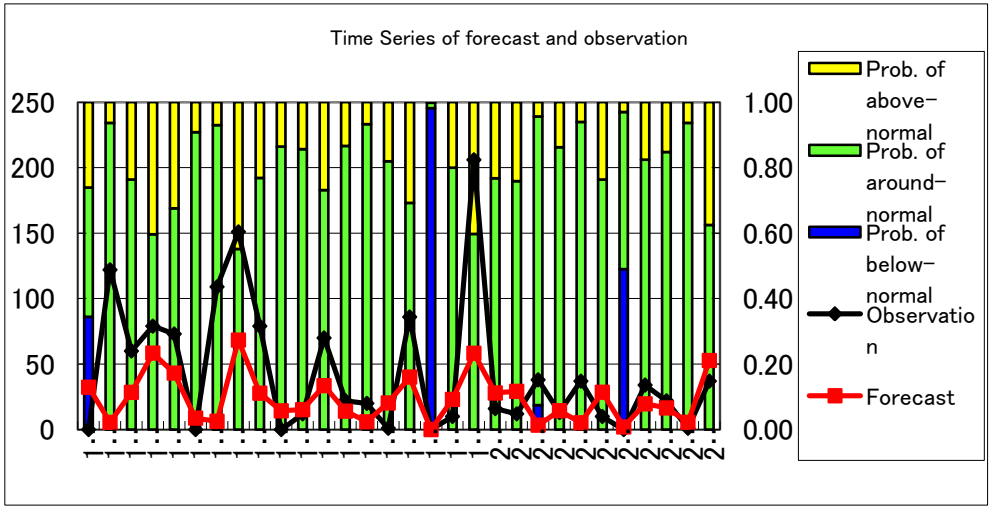

DMH MYANMAR (WRF model)Forecast Surface Stream Line & Relative Humidity(%)
Forecast Length in Hours : 2015092000+3 Hours.


DMH MYANMAR EXPERIMENTAL WRF(30 km)SURFACE WIND SPEED(mph)& DIRECTION FORECAST(24 hr)
Based on GFS 06:30 MST of (29-09-2016) Valid for 06:30 MST of (30-09-2016)
(mph)

Model output for Forecasting tools and other facilities :

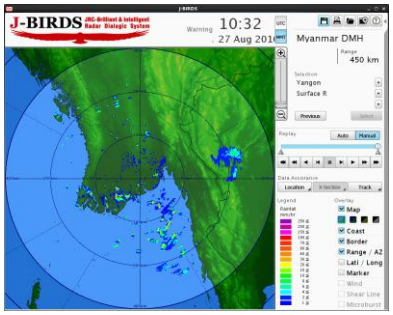
Based on IIT Storm Surge Model

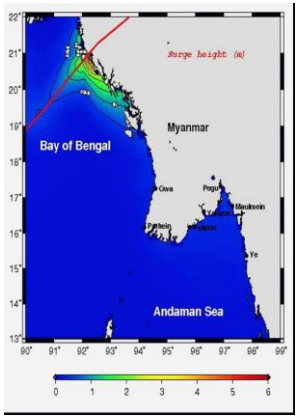
TCC Guidance

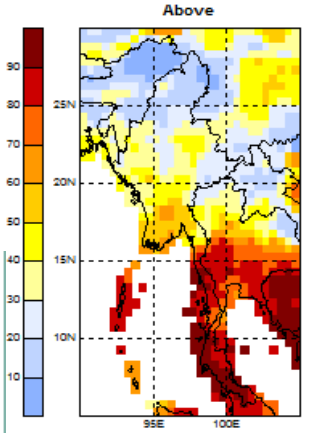


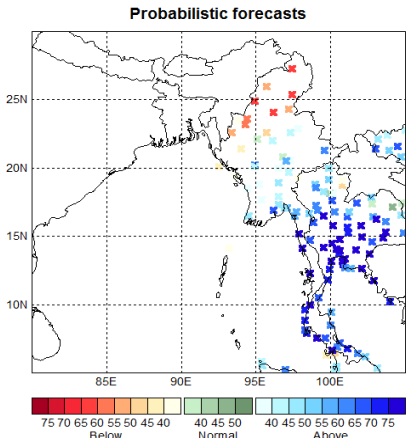
IIT and JMA Storm Surge Model

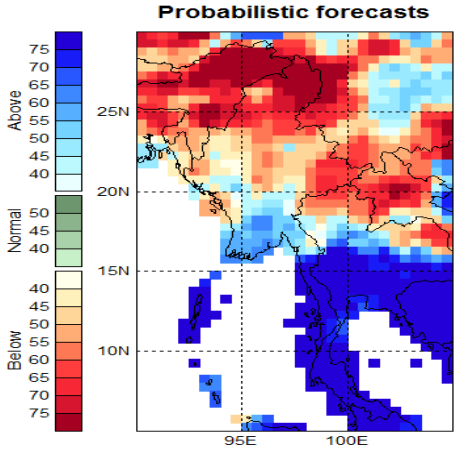
JMA Storm Surge Model

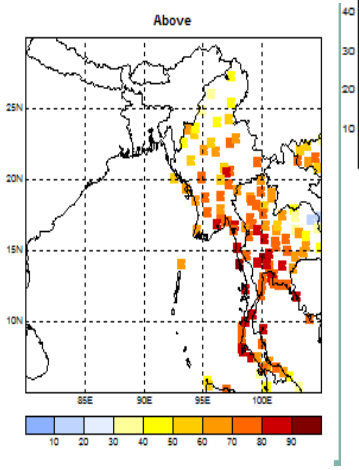












Flood Forecasting Methods

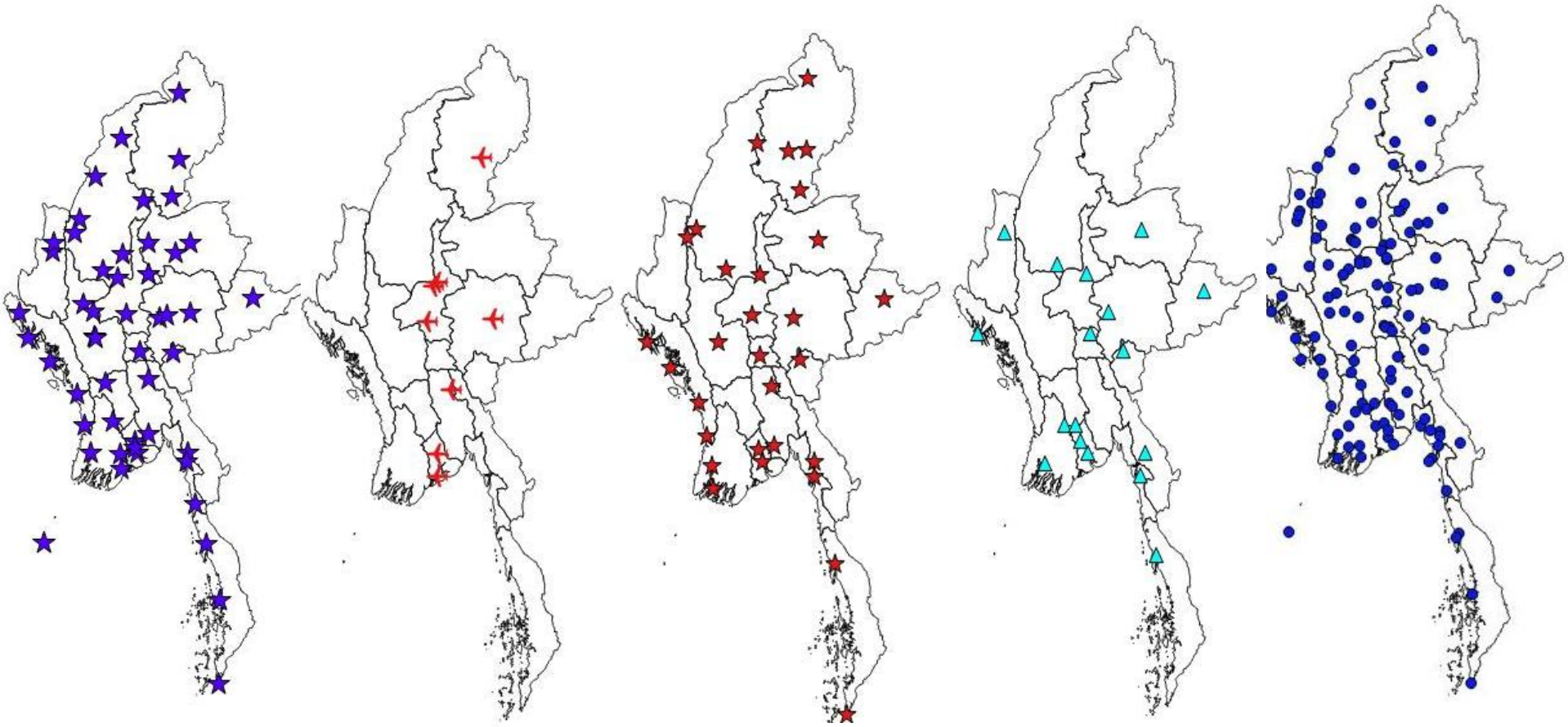
Daily water level forecast

- River Stage Correlation Method
- Multiple Linear Regression Method
- Integrated Flood Analysis System-IFAS (for research only)
- HBV model based on excel (for future)
- HEC-HMS Model for Ayeyarwady, Chindwin and Sittoung River

Seasonal water level forecast

- Based on flood characteristic occurred in Analogue years
- Based on seasonal weather forecast
- Based on comparison of current flow with the individual hydrograph for the last (10) years
- Based on the average flow of the last (10) years
- Based on Flood frequency analysis
- Based on ENSO forecast

Current hydrometeorological networks



51 WMO GTS Stations

8 Aviation Stations

30 AWOS Stations

17 Agro_Met Stations

121Reporting Stations

Perspective View

Kyauk Phyu

Yangon

Yangon International Airport

Wireless LAN

Mandalay

Internet Link

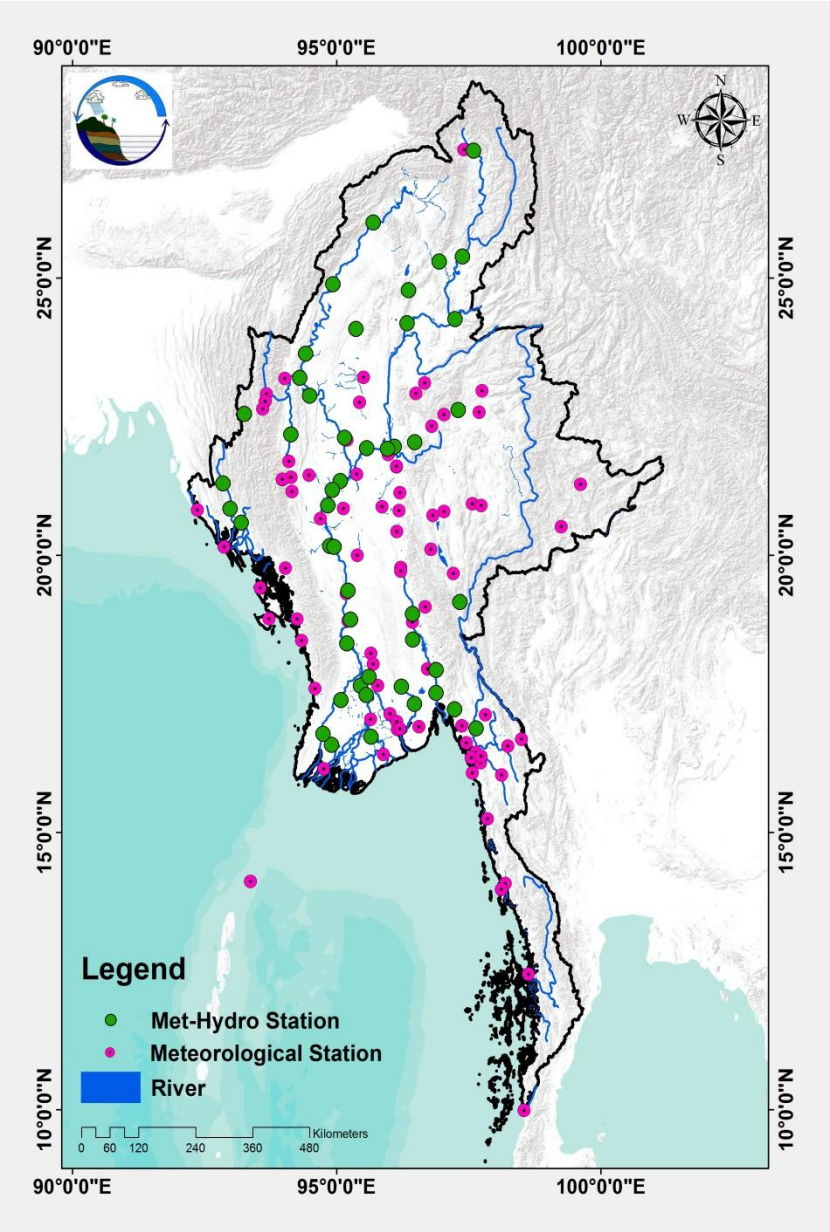
VSAT

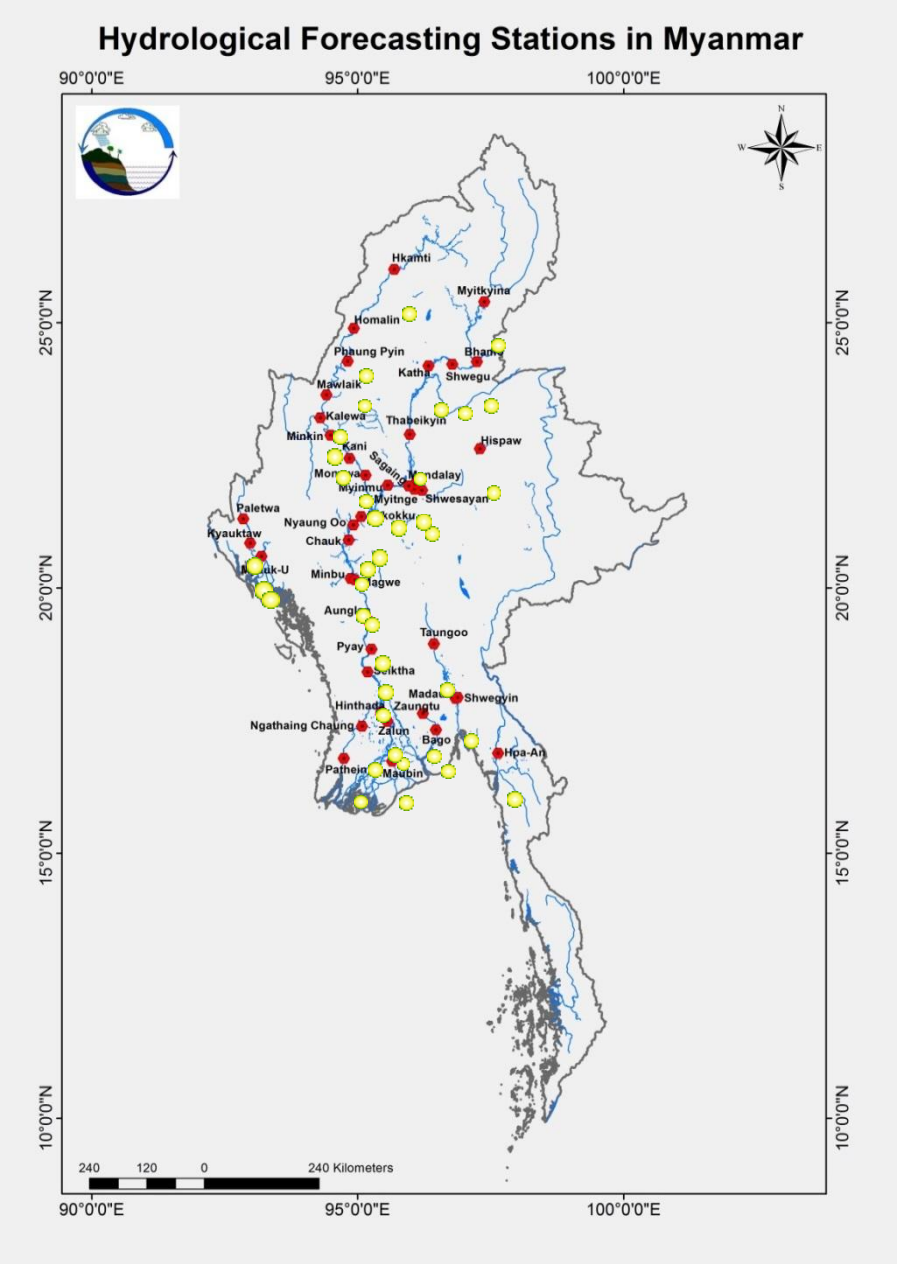
Internet Link

DMH Multi-Hazard Early Warning Center, Nay Pyi Taw

JRC Japan Radio Co., Ltd.

Hydrometeorological Network





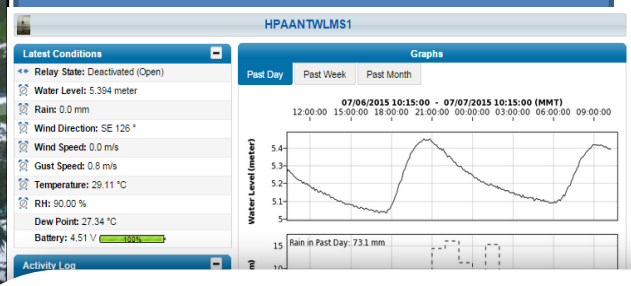
RIVER FLOW MEASUREMENT

Two different method have to used for river flow measurement with current meter and River Surveyor M9.

- **Moving Boat Method**
- **Conventional or Stationary**

Upgrading of Real Time Hydrological Data

Bago
(Bago River)



Toungoo
(Sittoung

Install the telemetry system with Funded by Norway Gov.

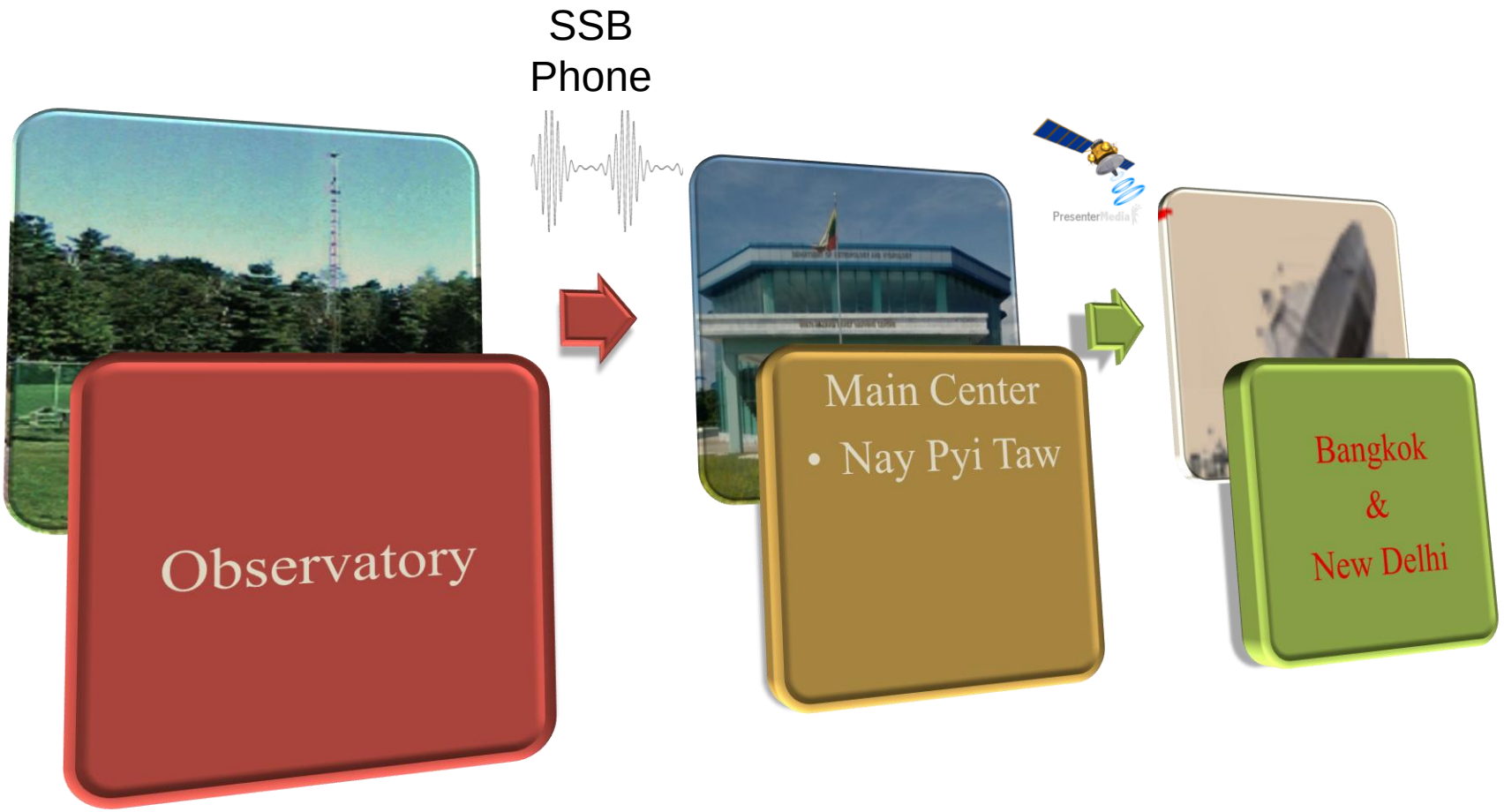
Hsipaw
(Dokehtawady
River)

Hpaan
(Thanlwin River)

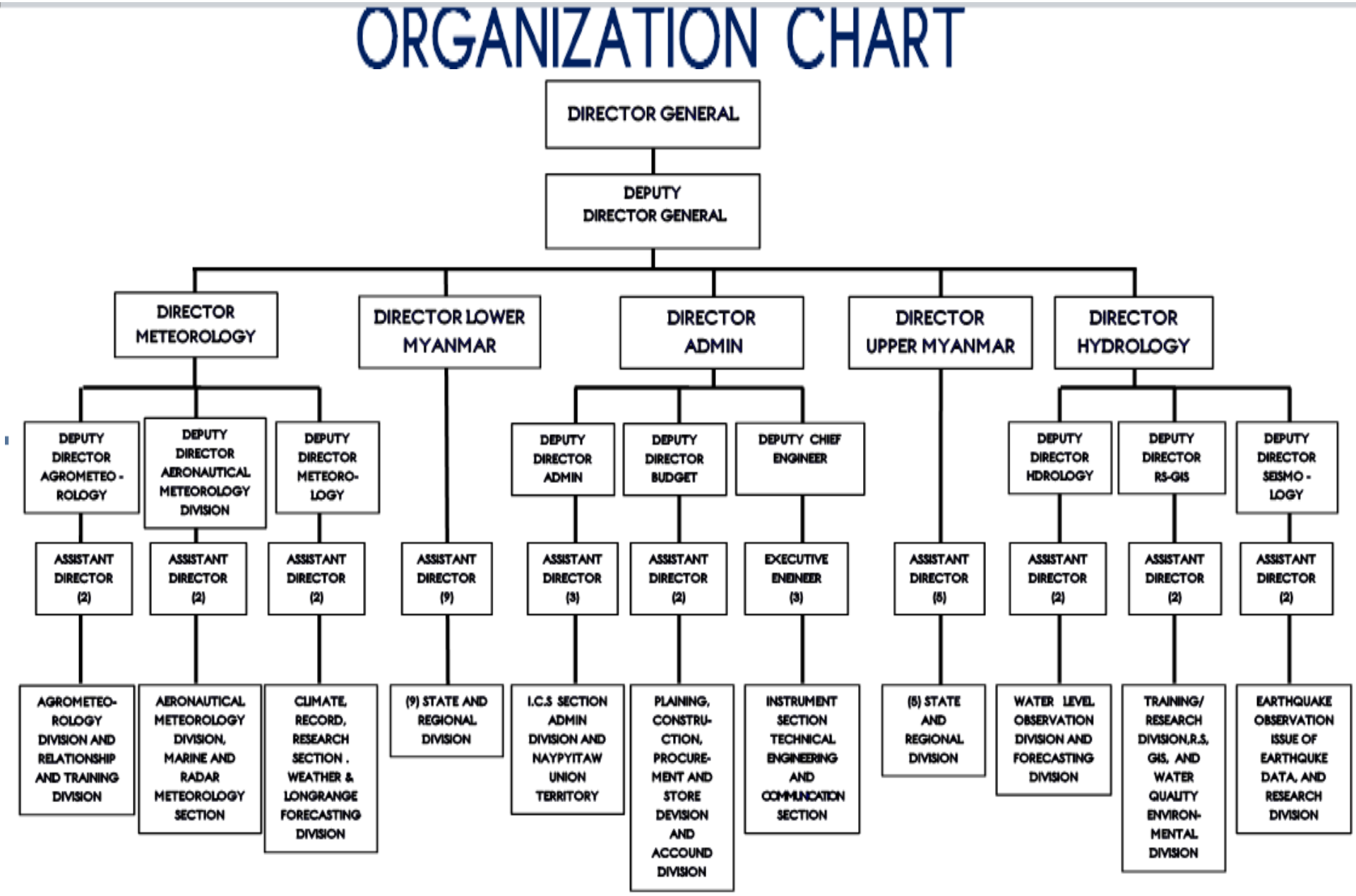
Hinthada
(Ayeyarwady
River)

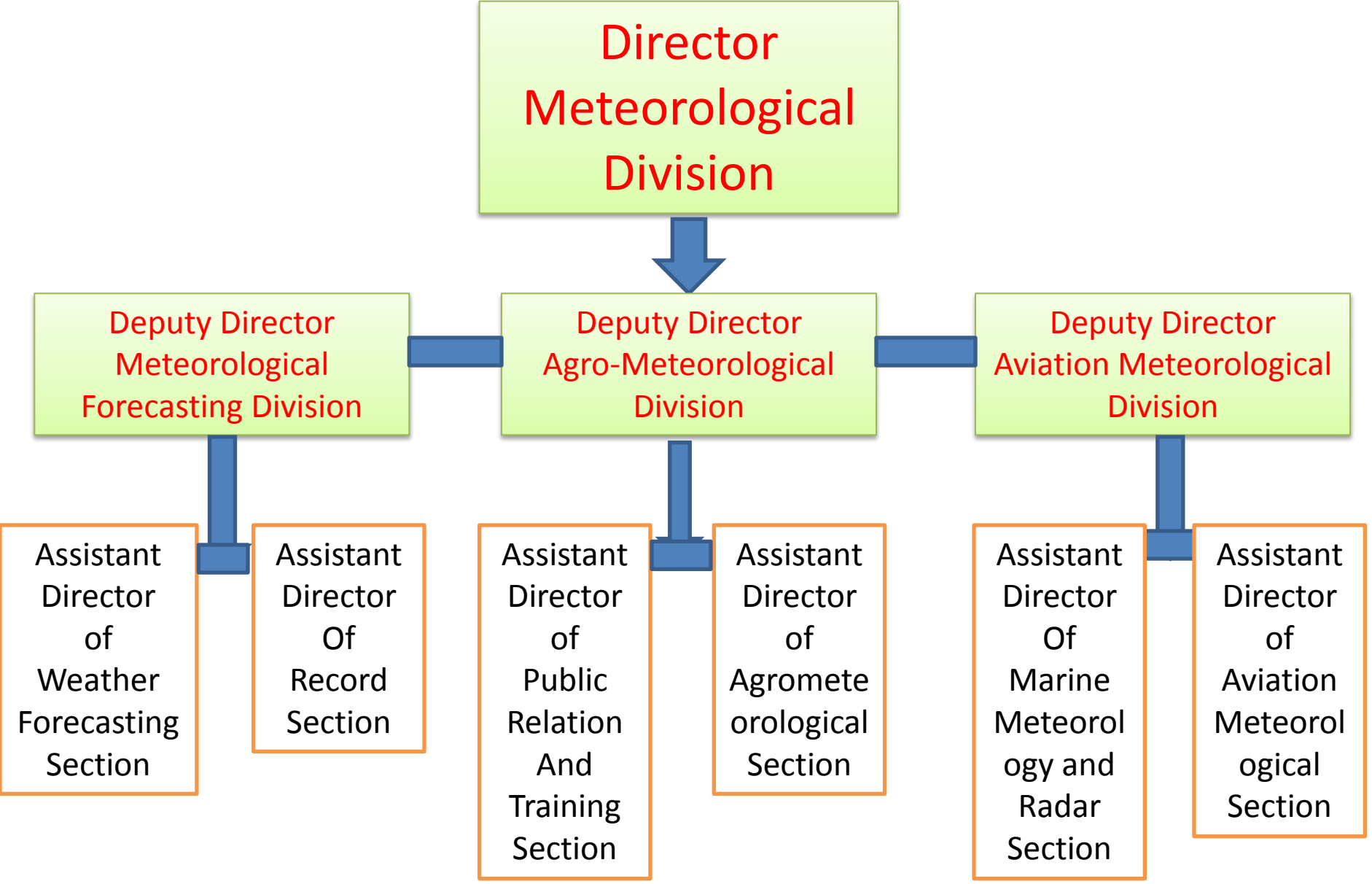
Shwegyin
(Shwegyin River)

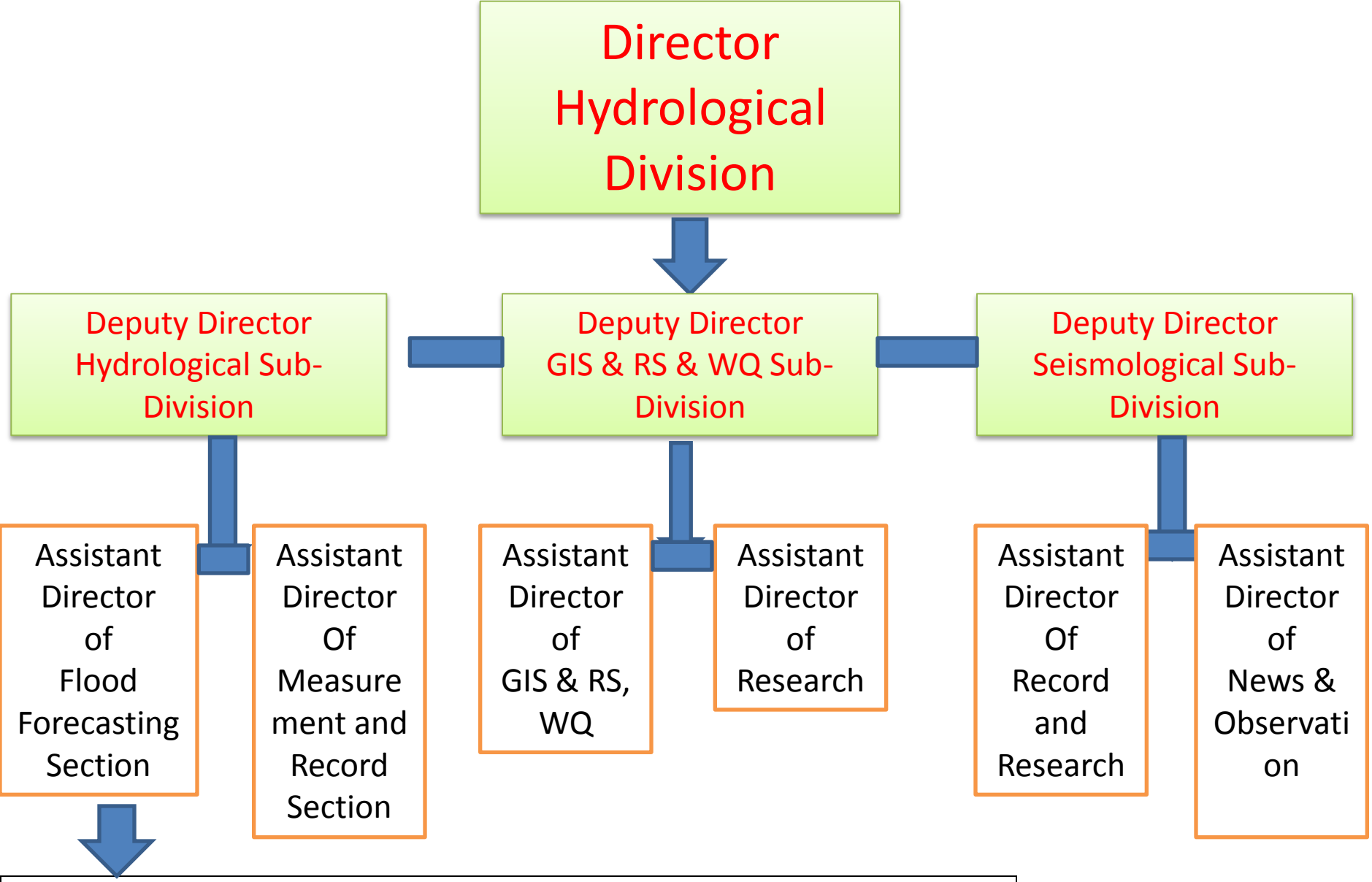
GTS Data Dissemination Method



Organizational structure and human resources

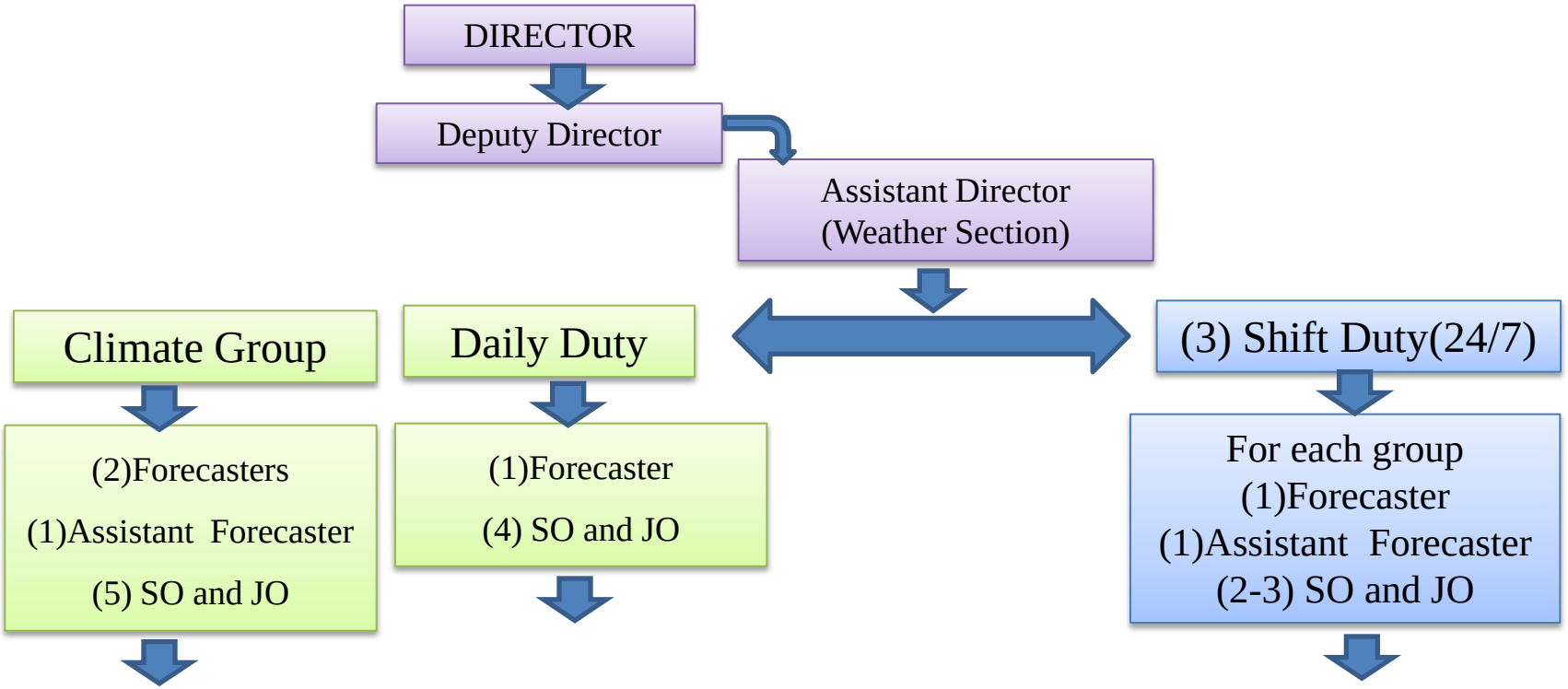



Director Meteorological Division
Deputy Director Meteorological Forecasting Division
Deputy Director Agro-Meteorological Division
Deputy Director Aviation Meteorological Division
Assistant Director of Weather Forecasting Section
Assistant Director Of Record Section
Assistant Director of Public Relation And Training Section
Assistant Director of Agrometeorological Section
Assistant Director Of Marine Meteorology and Radar Section
Assistant Director of Aviation Meteorological Section



- 3 Forecaster
- 3 Assistant Forecaster
- 9(Senior and Junior) Observer

Skill Manpower of Weather and Long Range forecasting Division (Nay Pyi Taw)



- Climate Modeling
- Seasonal Forecast
- Monthly Forecast
- 10 Days Forecast
- Research

- Management
- Meeting / Workshop Training
- Data collection
- Administration

- Plotting
- Analysis of Weather chart
- Weather forecasting
- Sending Fax (dissemination)
- To issue Warning/News

DMH Products

Climate Information Timeline

Type of Forecast	Time of Issuance	Forecast Validity
Daily Weather Forecast	7:00Am/12:00noom/2:00pm/ 4:00pm/7:00pm	24 hours
Sea Route Forecast	10:30 Am/1:30Pm	24 hours
Special weather forecast	As per request and weather conditions	Depend on duration
Cyclone/surge	24-36 Hr before	-
Untimely Rainfall	Weather disturbance....	-
Strong Wind Warning	March (15)(31)/April(1)	Pre Monsoon Period
significant day & night temperature	If necessary	-
Heavy Rainfall/ Scarcity Rainfall Warning	If necessary	-
New Records (Rainfall/Max/Min)	when new record occur..	-
(10)Day Weather Forecast	Every Month of 8/18/28	(10)Days
Monthly Weather Forecast	Every Month of 28	(1) Month
General Weather Outlook for (SW/NE)Monsoon Season	April 28/October 28	Monsoon Season
Seasonal Weather Forecast	April 28, June 28, August 28	Early, Peak, Late Monsoon

Types of Hydrology Forecast

Types of Forecast	Time of Issuance	Forecast Validity
General Long Range Water Level Forecast	April 28	Monsoon season
Seasonal Water Level Forecast	28th of April, June, August, Oct	Early, Mid, Late Monsoon Winter Monsoon
Monthly Water Level Forecast	28th of every month	1 month
10 Days Water Level Forecast	8th, 18th, 28th of every month	10 days
Daily Water Level Forecast	Daily	1 Day

Warning

- **Flood Warning**
- **Minimum Alert Water Level**

Bulletin

- **Flood Bulletin**
- **Significant Water Level Bulletin**
- **Low Flow Bulletin**

Forecast

- **10 Days Water Level**
- **Monthly Water Level (Flood FC for MS Season)**
- **Seasonal Water Level (Flood Forecast for MS season)**
- **Genera Long Range Water Level (for MS season)**

Significant Water Level Bulletin

(Issued at 11:00 hr M.S.T on 23-2-2016)

According to the (22:30) hrs M.S.T observations on 2016, February 22nd, the water levels of Ayeyarwady River at Myitkyina is (503) cm, and the rise of water level is about (12) feet within 16 hrs. It may rise about (7) to (8) feet above the present water level at Bhamo and Katha during the next (1) to (3) days and about (5) to (6) feet above the present water level at Mandalay, Sagaing, Myinmu, Pakokku and Nyaung Oo during the next (3) to (5) days and about (4) to (5) feet above the present water level at Chauk, Minbu, Magway, Aunglan, Pyay, Seikthar, Hinthada and Zalun during the nex

It is advised that the vessels plantations on sandbank durin low for the sharp rise of water level.

Flood Warning

(Issued at 13:00 hr M.S.T on 17-7-2016)

According to the (12:30) hrs M.S.T observation today, the water level of Chindwin River at Hkamti is observed as about (1½)feet below its danger level. It may reach its danger level during the next (1) Day.

It is especially advised to the people who settle near the river bank and low

Flood Bulletin

(Issued at 13:00 hr M.S.T on 18-7-2016)

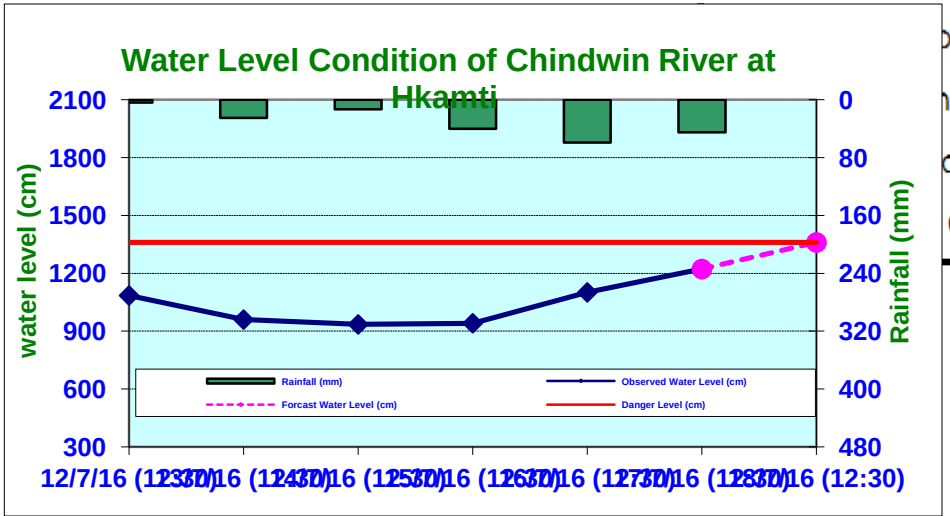
According to the (12:30) hr M.S.T observation today, the water level has

bout (2) feet above its danger level, its may continue to rise about (1½)

next (1)day and may remain above its danger level.

ally advised to the people who settle near the river bank and low lying

Chindwin River, to take precaution measure.



Cyclonic Storm Warning No.14, 2016
20th May, 2016 19:00 MST Today

Condition of Cyclonic Storm

According to the observations at (18:30)hrs M.S.T today, the Cyclonic Storm "ROANU" over West Central Bay of Bengal and adjoining Northwest Bay of Bengal moved to Northeast wards at a speed of (12) mph and lay centred at about (125) miles South- Southwest of Paradip (India), (440) miles Southwest of Chittagong (Bangladesh), (425) miles Southwest of Cox's Bazar, (455) miles West-Southwest of Sittwe (Myanmar), (485) miles West- Southwest of Kyaukphyu (Myanmar), (460) miles West- Southwest of Maungdaw (Myanmar). It is continuous moving to Northeast wards and may further intensify into a severe cyclonic storm.

Cyclonic Storm "ROANU" is moving towards Southern coast of Bangladesh but the effects of the cyclonic storm are likely to be in Chin and Rakhine States, Magway and Sagaing Regions (Myanmar) due to its banding features. The present stage of the cyclonic storm is coded orange stage on this condition.

Position of Cyclonic Storm, Center pressure and wind speed

The cyclonic storm is located at Latitude (18.8) degree North and Longitude (85.0) degree East, Centre pressure of the cyclonic storm is (992) hPa and maximum wind speed near the center is (50)miles per hour at (18:30) hrs MST today.

Forecast for next (24) hours

It is expected to cross Southern coast of Bangladesh near Cox's Bazar and Chittagong during next (24) hours commencing evening today.

In this condition, maximum wind speed will be (50-60) mph in Chin and Rakhine States, (35-40) mph in Magway, Lower Sagaing, Ayeyarwady and Mandalay Regions.

Frequent squalls with rough to very rough sea will be experienced off and along Myanmar Coasts. Surface wind speed in squalls may reach (50 - 60) m.p.h.

When Cyclonic Storm is crossing to Southern coast of Bangladesh, probable maximum storm surge is about (10-12) feet at Maungdaw and Sittwe districts, about (8-10) feet at Kyaukphyu district.

General caution

Under the influence of the cyclonic storm, rain or thundershowers will be fairly widespread to widespread in the whole country and regionally heavy falls in Sagaing, Magway and Ayeyarwady Regions, Chin and Rakhine States and isolated heavy falls in the remaining Regions and States during 20th May to 22nd May, 2016.

Advisory

Under the influence of the cyclonic storm, strong wind, heavy fall, flash flood and landslide may occur during this time. Advisory for people living near high land areas, small river and streams is to avoid landslide and suddenly rise the water levels. Domestic flight, trawlers, vessels and ships off and along Myanmar Coasts are advised to avert specially in condition of the cyclonic storm.

DMH couldn't issue for flash flood forecast but just only advisory information

Flash Floods Experience

The causes of flash floods

- Heavy rain
- Rainfall intensity and duration, topography, soil conditions, and land cover
- Over flow of dams and reservoirs
- Poor flowing rate of water in the stream

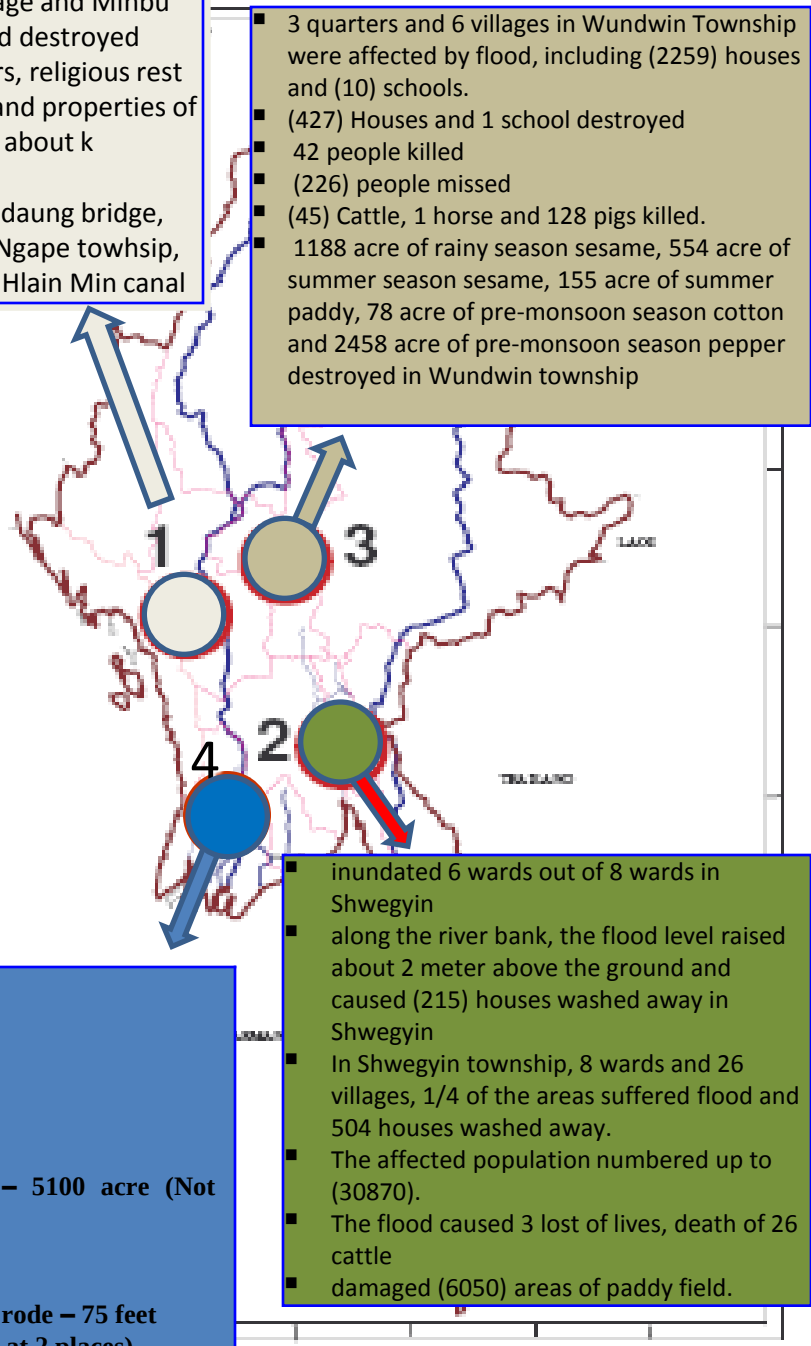
1.Manchaung Flash Flood in 1987
(at Shwe Settaw Pagoda)
2.Shwegin Flash Flood in 1997
3.Wundwin Flash Flood in 2001
3.Kyangin Flash Flood in 2006

Issuing the flash flood warning

It depends on availability of real time rainfall in the catchment area

- 104 houses in Latpandan village and Minbu township were inundated and destroyed
- it also caused damages to cars, religious rest houses, big and small shops and properties of religious elders amounted to about k 2503030.
- damaged Uyinywa bridge, Padaung bridge, Thitjpyauk Chaung bridge in Ngape towhsip, Padan Zekar Palta canal, Pan Hlain Min canal

- 3 quarters and 6 villages in Wundwin Township were affected by flood, including (2259) houses and (10) schools.
- (427) Houses and 1 school destroyed
- 42 people killed
- (226) people missed
- (45) Cattle, 1 horse and 128 pigs killed.
- 1188 acre of rainy season sesame, 554 acre of summer season sesame, 155 acre of summer paddy, 78 acre of pre-monsoon season cotton and 2458 acre of pre-monsoon season pepper destroyed in Wundwin township



- **Loss of human life – 18**
- **Lost Person – 14**
- **Injured – 1**
- **Affected person – 1992**
- **Damaged building – 417**
- **Damaged Schools – 5**
- **Inundated paddy field – 5100 acre (Not damage)**
- **Damaged Bridge – 4**
- **Damaged Railroad – 1**
- **Total length of damaged rode – 75 feet**
- **Broken Gas Pipeline (at 2 places)**

- inundated 6 wards out of 8 wards in Shwegyin
- along the river bank, the flood level raised about 2 meter above the ground and caused (215) houses washed away in Shwegyin
- In Shwegyin township, 8 wards and 26 villages, 1/4 of the areas suffered flood and 504 houses washed away.
- The affected population numbered up to (30870).
- The flood caused 3 lost of lives, death of 26 cattle
- damaged (6050) areas of paddy field.

2011 Flash Flood

Thandwe (18-6- 2011)

Rainfall 7.48 in (17-6-2011)

12.45 in (18-6-2011)

(Due to Depression at North Bay)

Gwa (19-20 June 2011)

Rainfall 3.86 in (19-7-2011)

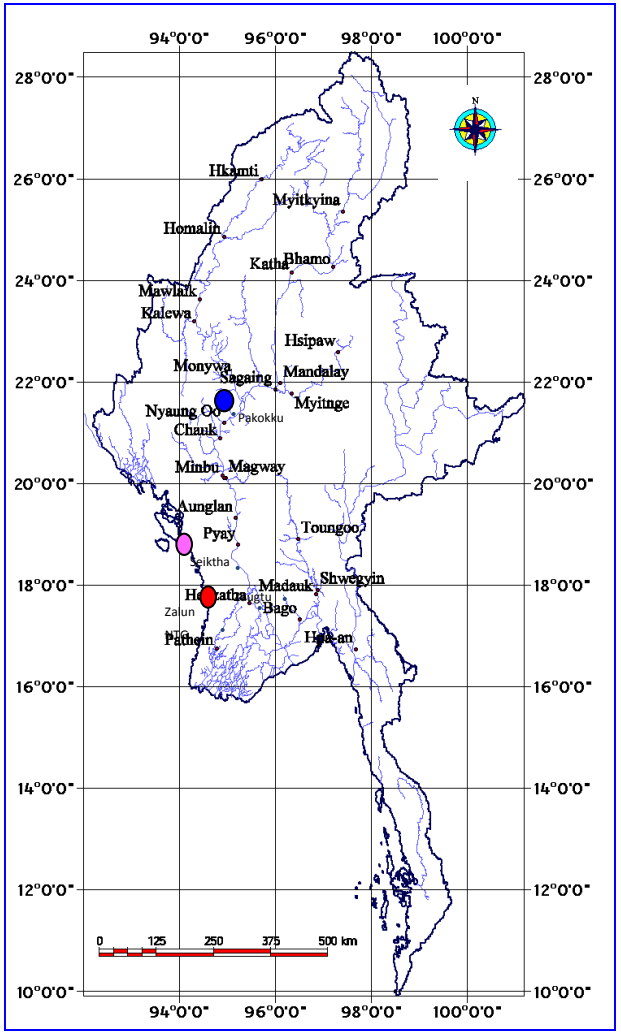
13.07 in (20-7-2011)

Affect houses 356

Affected Population 1691

Landslide 20 ft (Thandwe-Gwa Highway)

20 ft (Gwa-NTG Highway)



Pakokku District (19-20 Oct 2011)

- Rainfall (18-20 Oct 2011)
  - Pakokku 6.65 in
  - Gangaw 5.95 in
  - Nyaung Oo 9.34 in

Affect Villages/wards 102

Death toll 161

livestock losses 3384

Damaged Houses 2535

Damaged Gov. Buildings 15

Damaged religious Building 33

Damaged croplands (acres) 5378

Damaged Bridges 7

Affected Houses 9523

Affected Population 29751

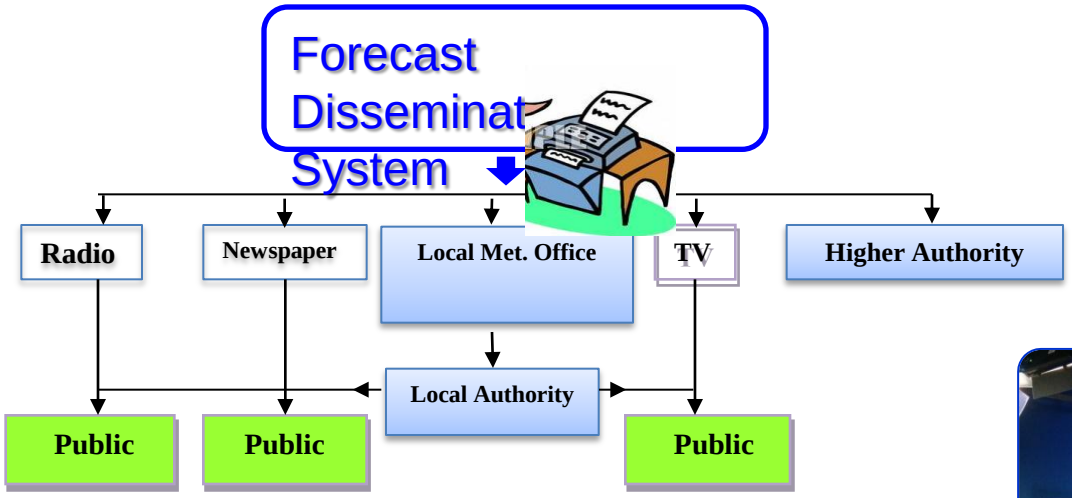
The loss in terms of cash 1544.59 (million kyats)

Bawlakhe (Nanpon Stream)

- Rainfall 1.54 in (3 Oct 2011)- - Some Streets were inundated

- Some houses were inundated

Forecast Dissemination System



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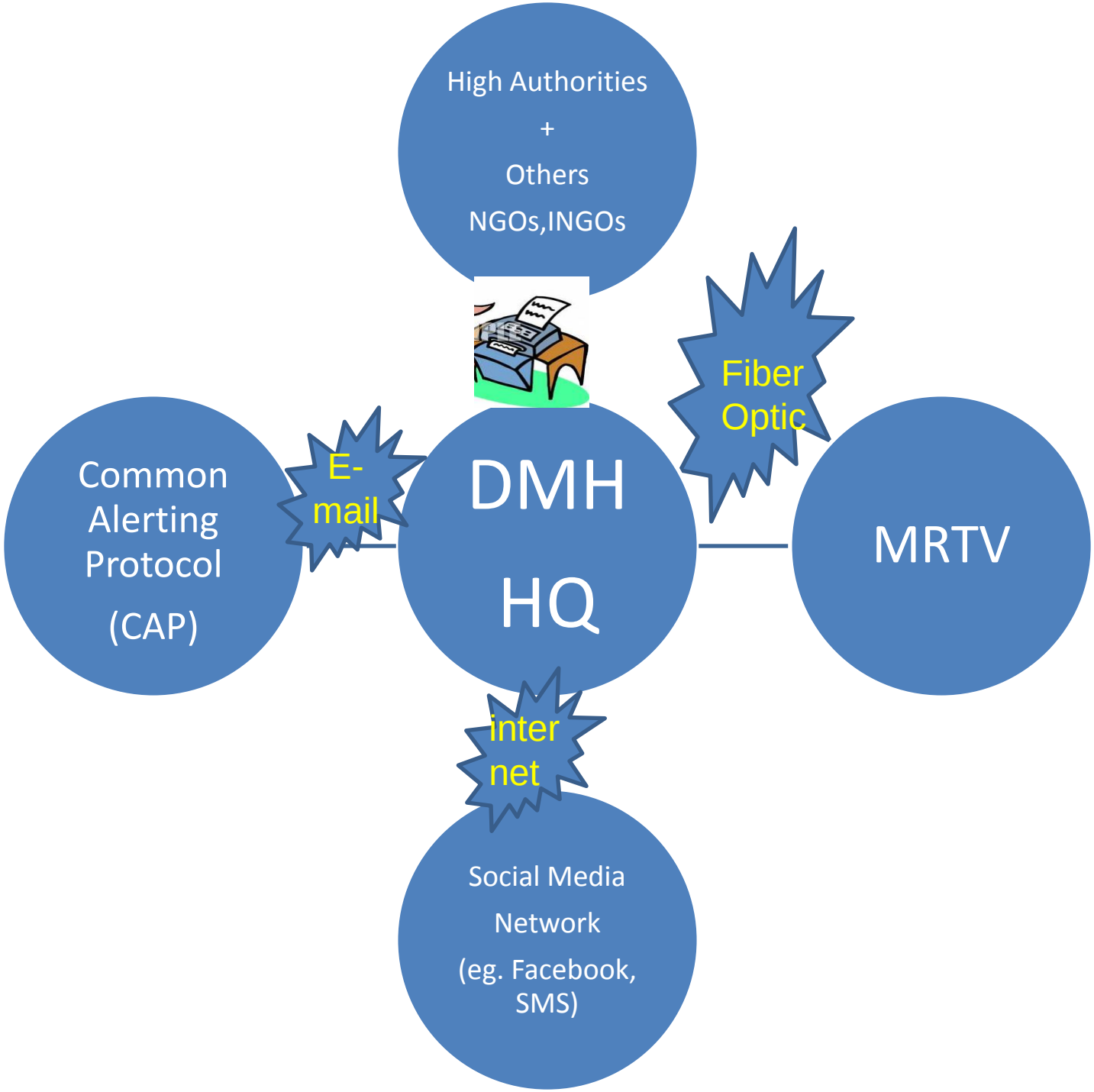
High Authorities
+
Others
NGOs,INGOs
Common Alerting Protocol (CAP)
E-mail
DMH HQ
Fiber Optic
MRTV
inter net
Social Media Network
(eg. Facebook, SMS)

CONCLUSION

DHM cooperation and collaborations with local and international organizations to organize the meeting & workshops and trainings for not only infrastructures but also modernize techniques to reduce of natural disaster in Myanmar .

THANK YOU FOR YOUR ATTENTION