Services of

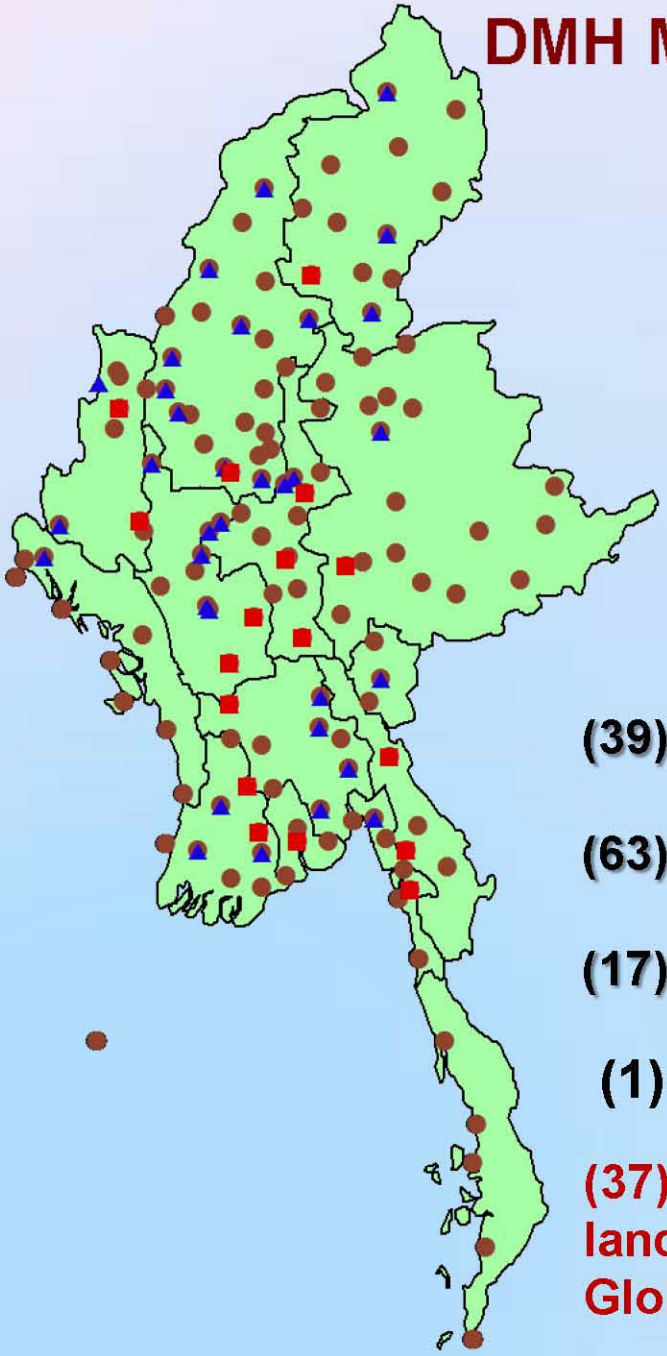
Department of Meteorology & Hydrology

DR LAI LAI AUNG

ASSISTANT Director

Department of Meteorology and Hydrology
Myanmar

DMH Meteorological Observation Networks



(39) ▲ Hydro/Meteorological Observatory

(63) ● Meteorological Observatory

(17) ■ Agrometeorological Observatory

(1) Upper Air Observatory

(37) Stations routinely disseminate every (3) hourly land observations and (1) Upper Air Obsevation to Global Meteorological Observing System.

Current Capacity- Community Awareness …

FM Bagan

City FM

Mandalay FM

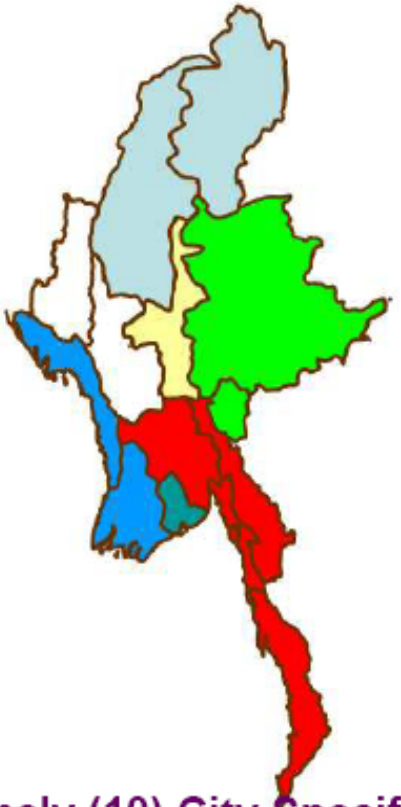
Pyinsawadi FM

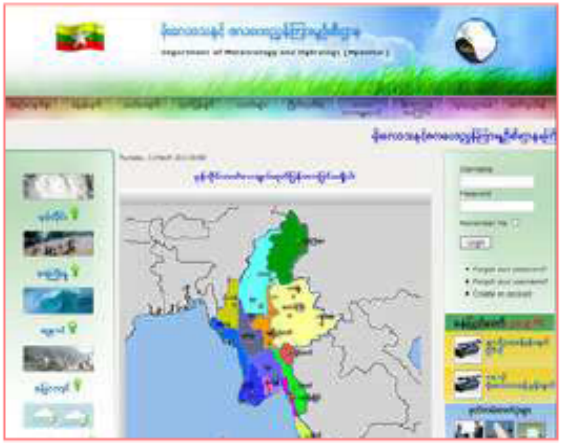
Thazin FM

Cherry FM

Padamya FM

Shwe FM





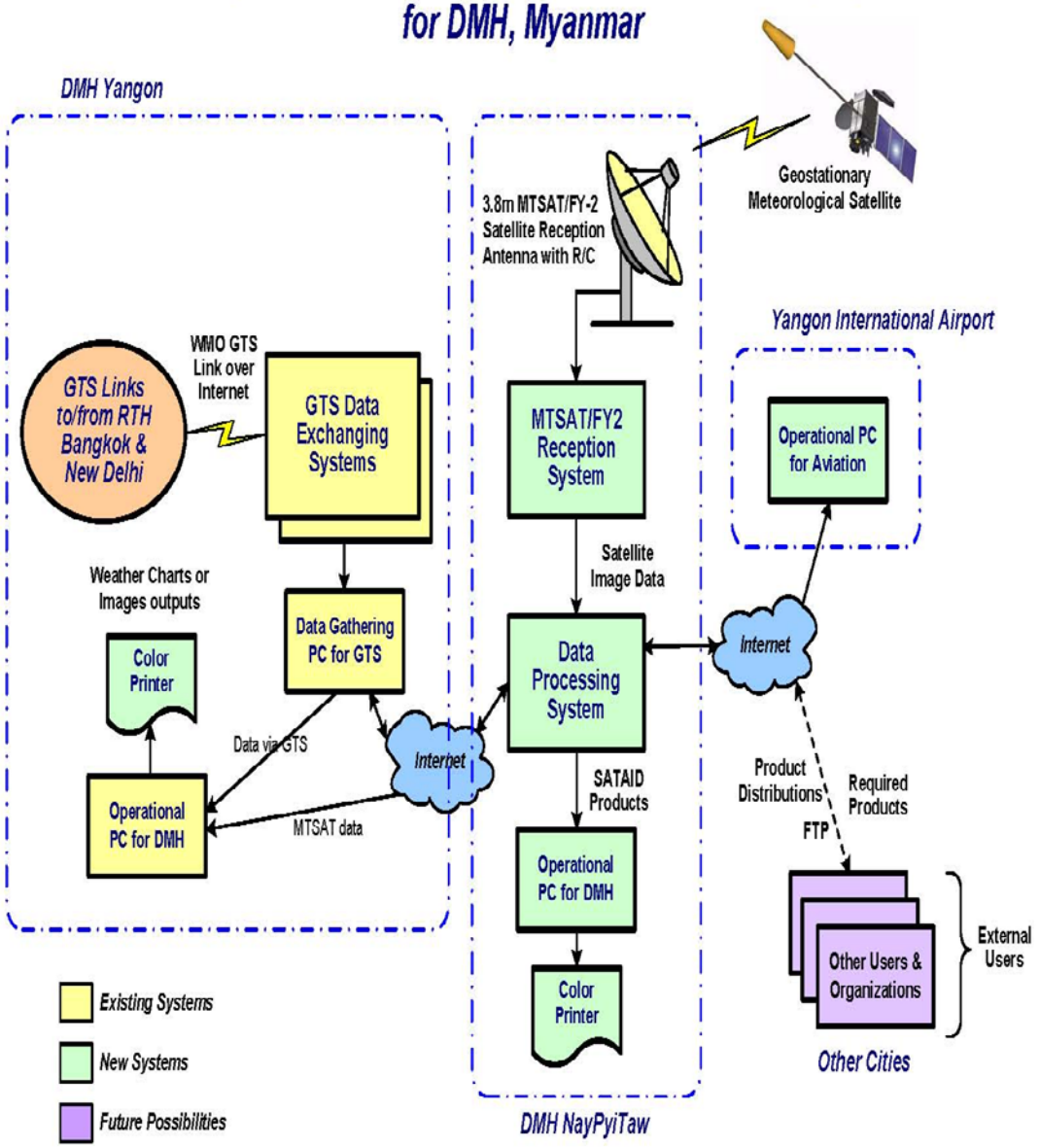
Real time updated Information on Web for users.

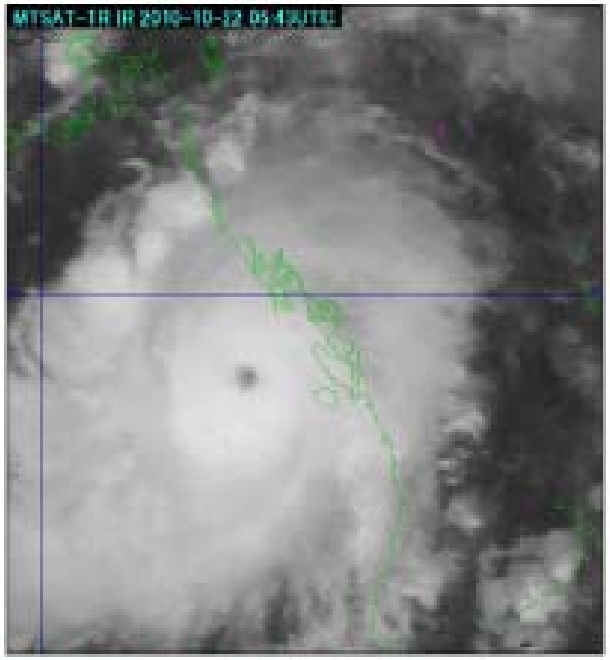
- Higher Authorities take care EW well.
- Local Authority and People are high Awareness for Hazards after 2008.
- Supportive Role of INGOs and MNGOs.

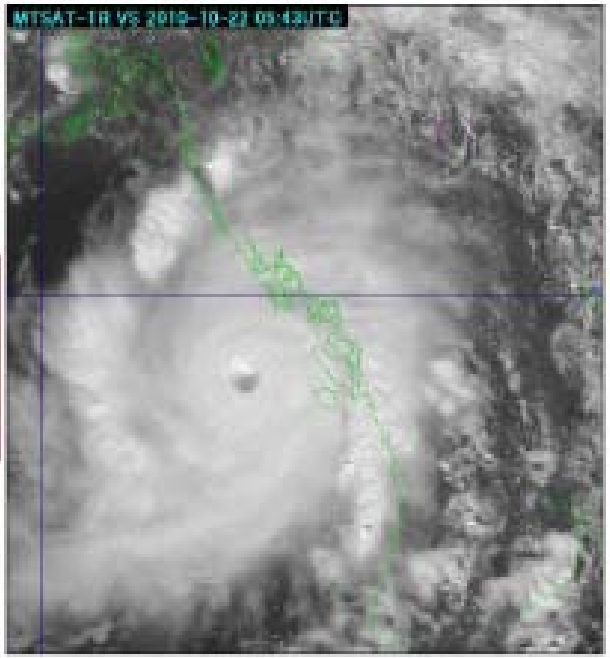
- We provide routinely (10) City Specific Forecast to Local FM Radio stations.
- If Emergency color, update every (4) to (6) Hours to these Stations.
- Some FM Station broadcast Weather News with Local Ethnic Language.

Role of State Media is Very Important.

Meteorological Satellite Reception and Data Processing Systems for DMH, Myanmar





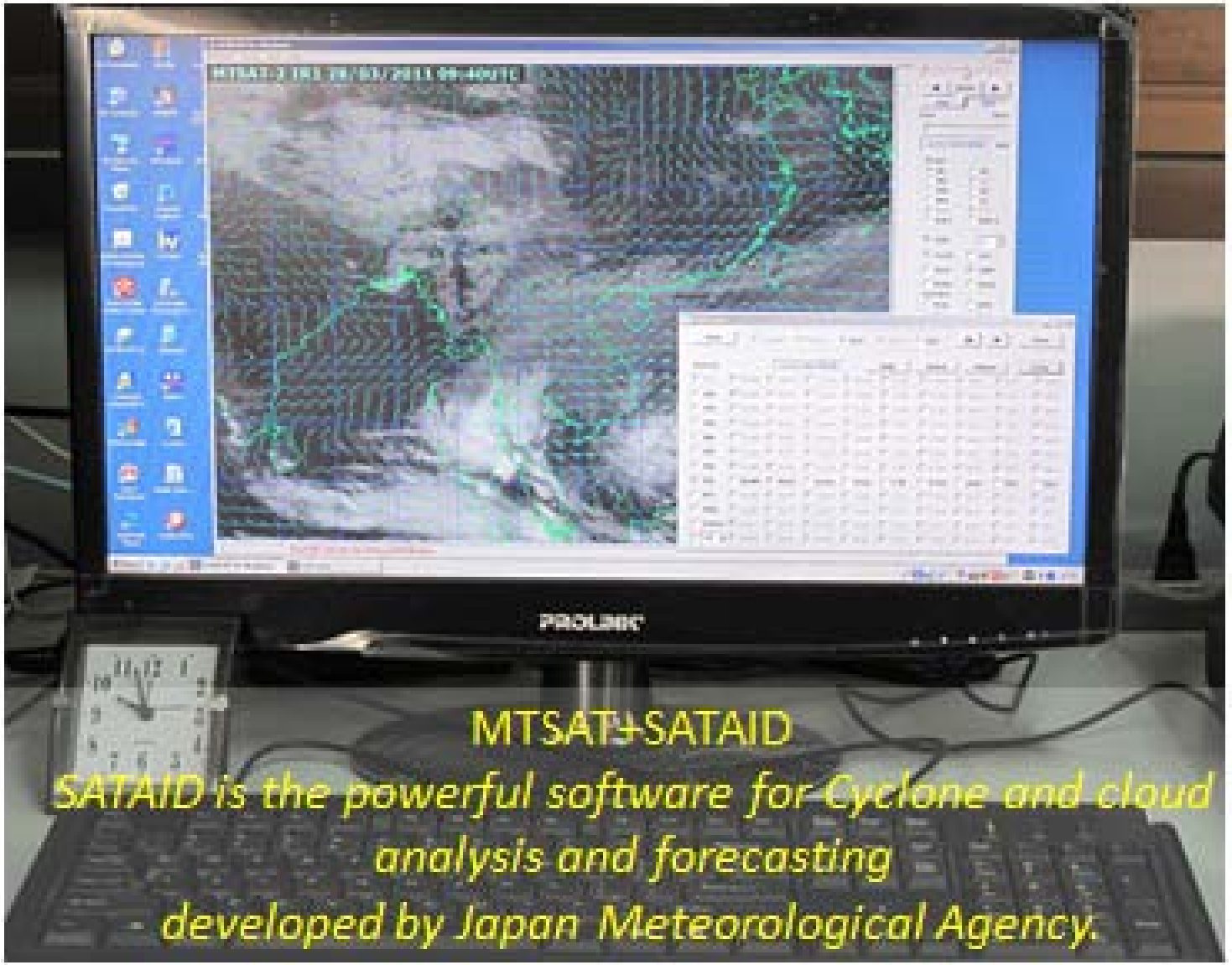


Installation of MTSAT and SATAID

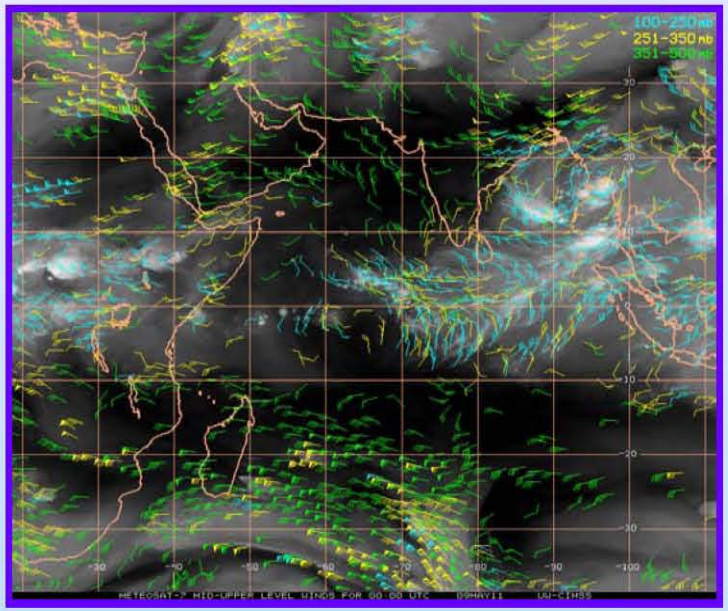
MTSAT direct Receiving Antenna

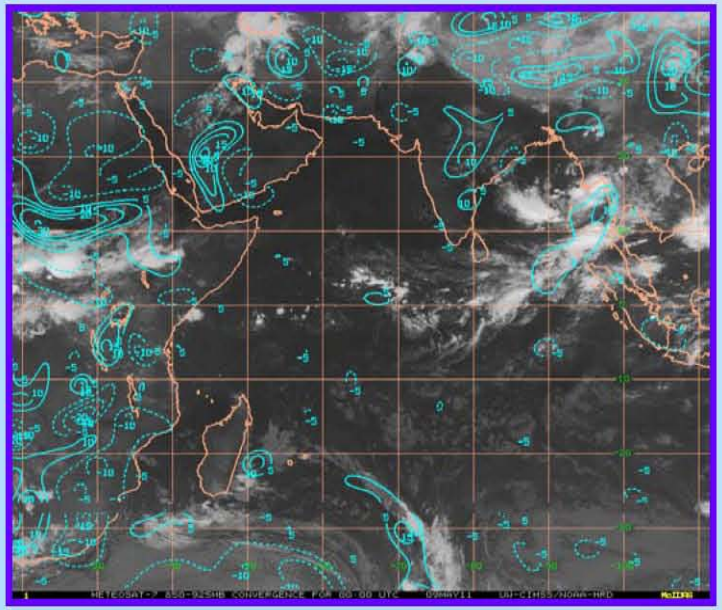
MTSAT Data Processing System in DMH, Nay Pyi Taw

MTSAT and SATAID System



Satellite based observation

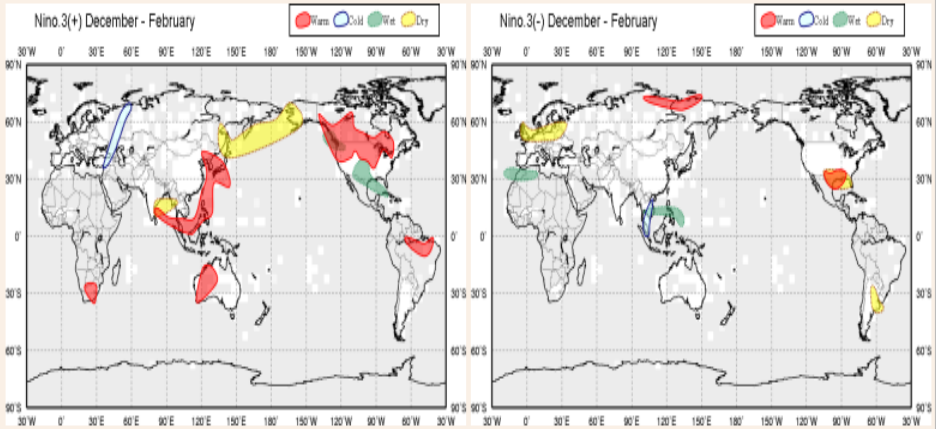




World Climate associated with El Niño / La Niña events

ematic View

El Niño Phase / La Niña Phase

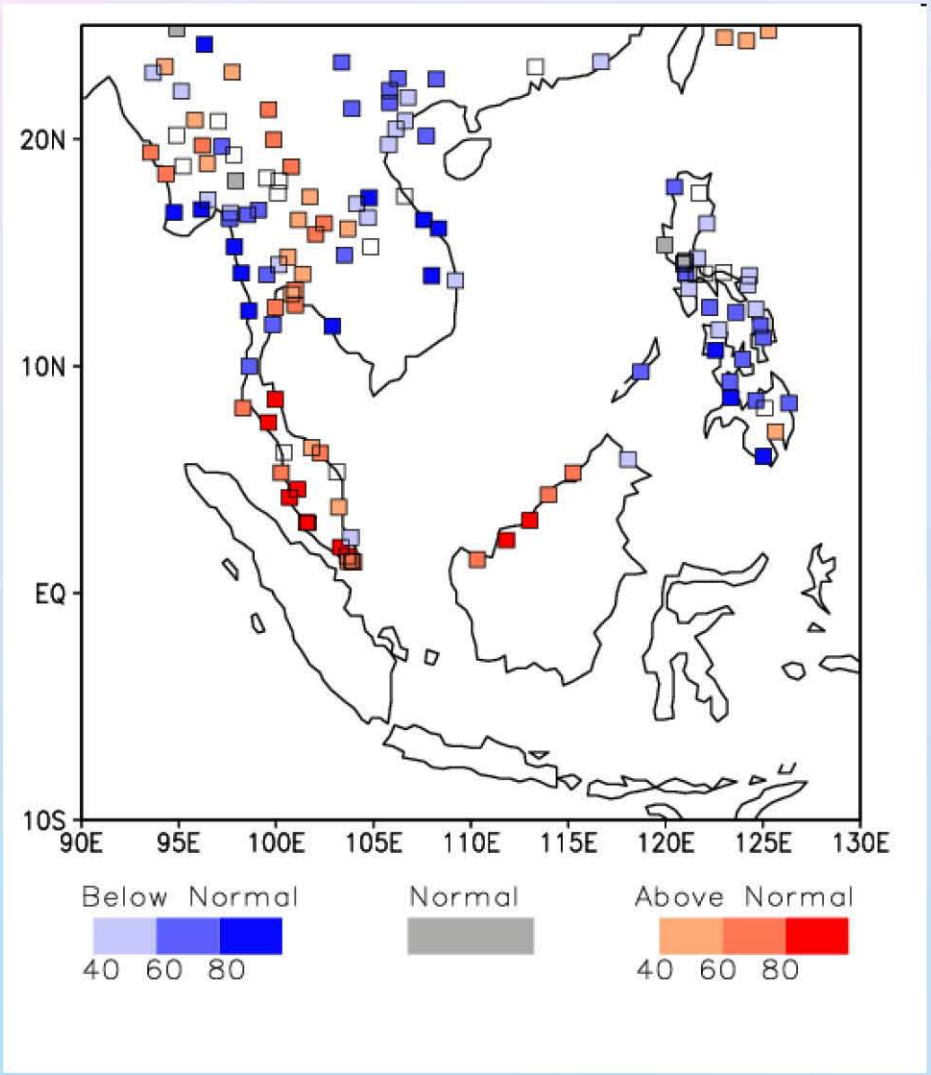


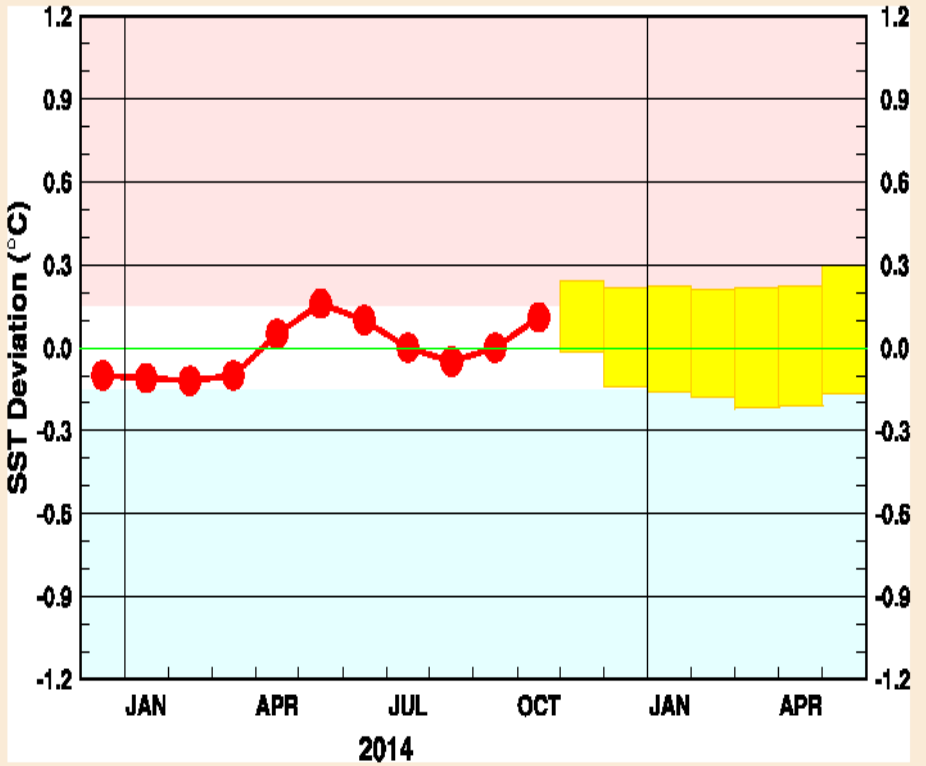
El Niño events in December to February

La Niña events in December to February

Schematic views show the areas to some degree in width with any consistent tendency for four seasons (DJF, MAM, JJA and SON) in El Niño/La Niña events.

Japan Meteorological Agency Tokyo Climate Center product for Myanmar

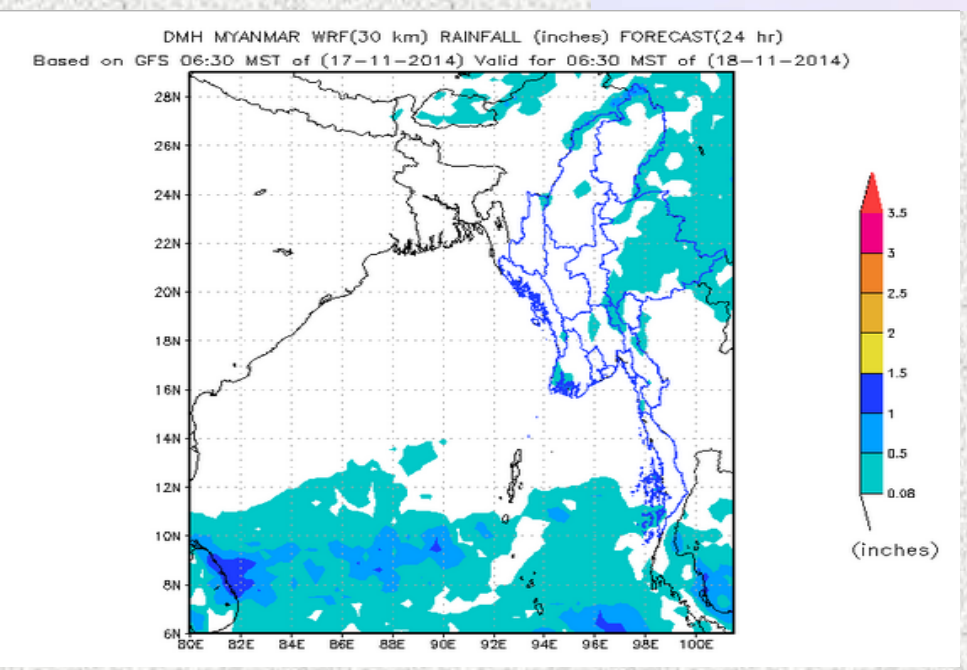


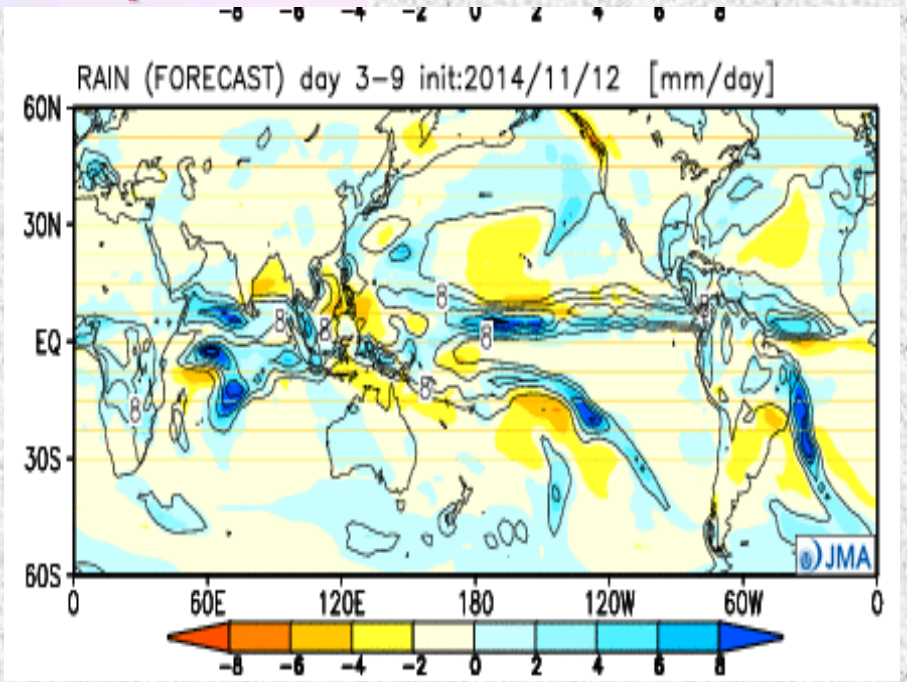


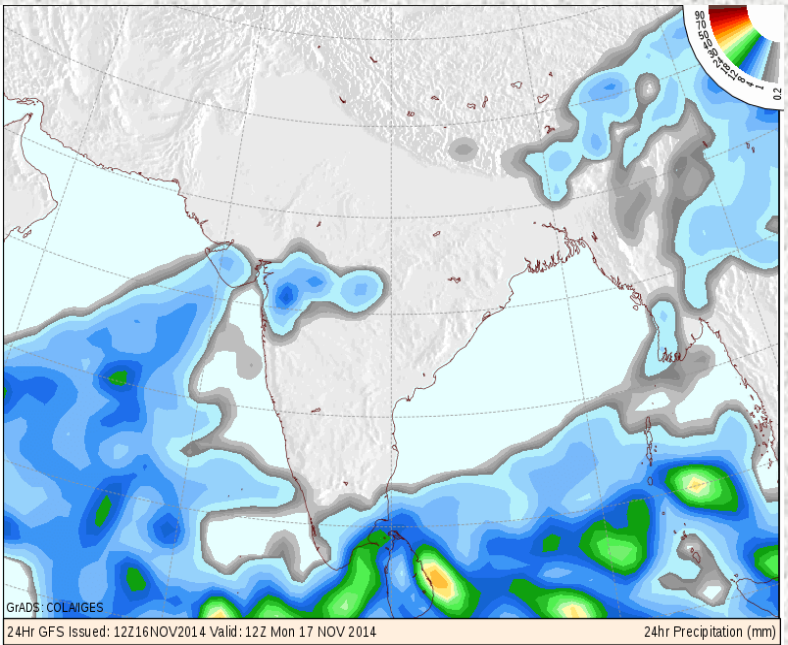
g.11 Outlook of the SST deviation for IOBW by the El Niño prediction model.

International Research Institute For Climate Prediction

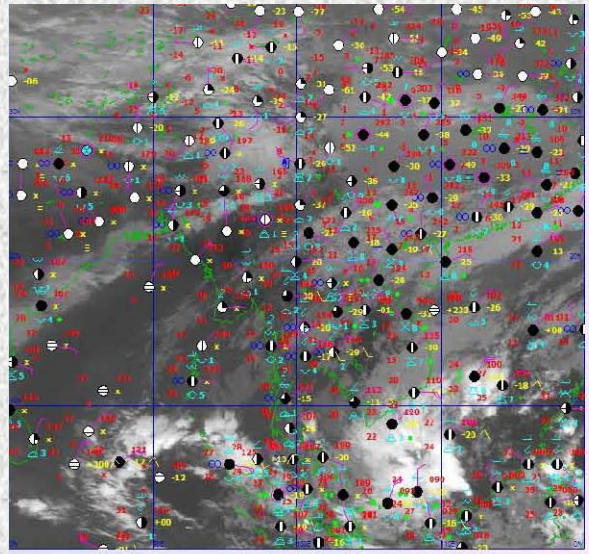
Forecast for Precipitation

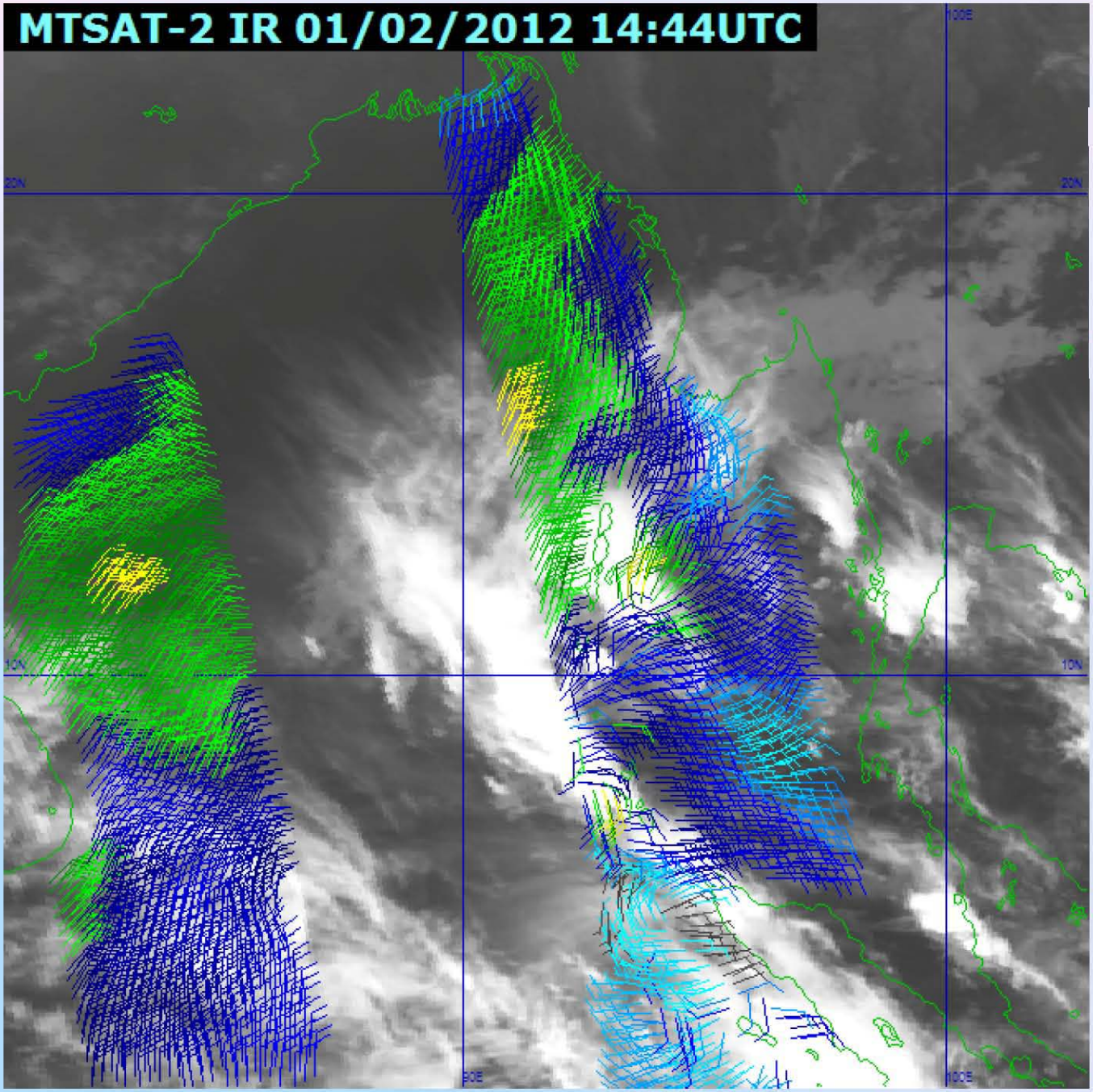






DMH use NWP products and cyclone forecast from RSMC/NOAA/JMA JTWC/BMD/ECMWF/TMD/RIMES





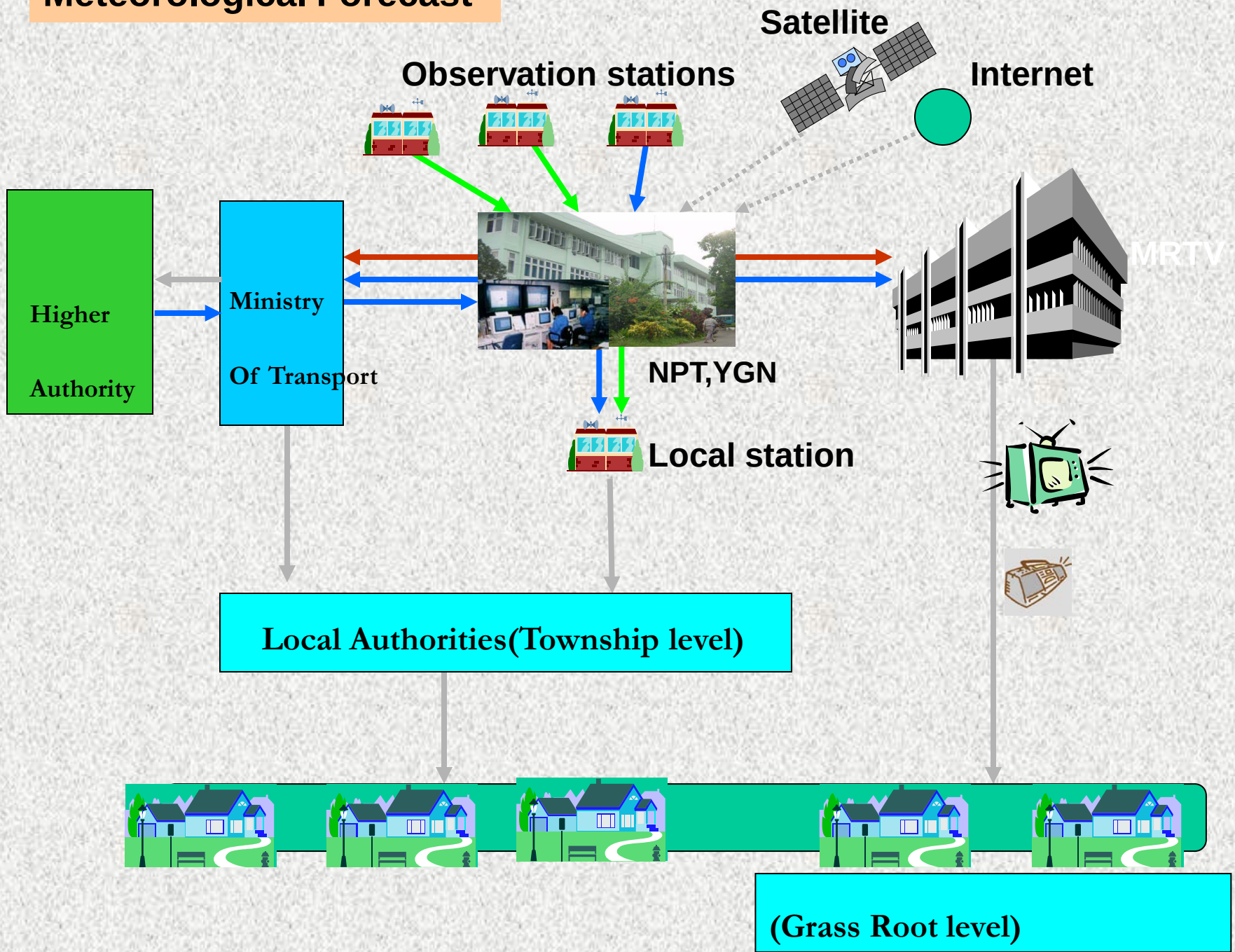
New Tools SATAID provide Forecasting of Severe Weather.

RSMC New Delhi NWP Products are very useful.

MSLP/ Vorticity / wind/ Rain/etc…

Upto 72 Hr Forecast

Meteorological Forecast

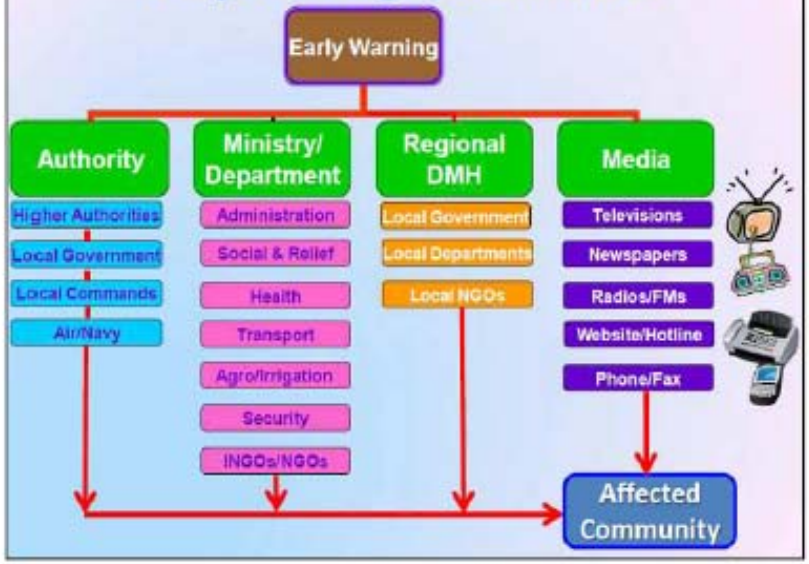


Warning, Forecast, Bulletin and News

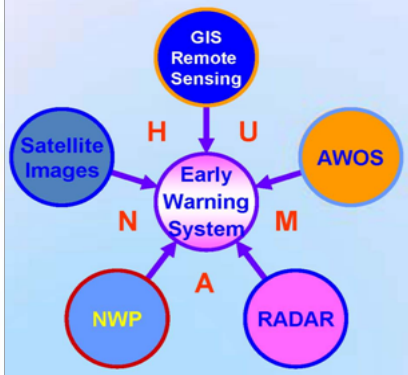
- Cyclone Warning
- Storm Surge Warning
- Flood Warning
- Untimely Rainfall Warning
- Fog Warning
- Heavy Rain Warning
- Aviation weather warning
- Low flow water level
- Tsunami
- Port Warning
- Agro-meteorological Bulletin
- Bay Bulletin
- Flood Bulletin
- Special Weather Bulletin
- Daily Weather/water level
- Monthly Weather/Flood
- Seasonal Weather/River Flood Forecast
- Aviation Weather Forecast
- Marine Weather Forecast
- Special Forecast
- Earthquake
- Earthquake News
- Rainfall/Temperature Records
- Cyclone News

We're trying quality products !

Early Warning Dissemination



Strategies to Enhance Early Warning

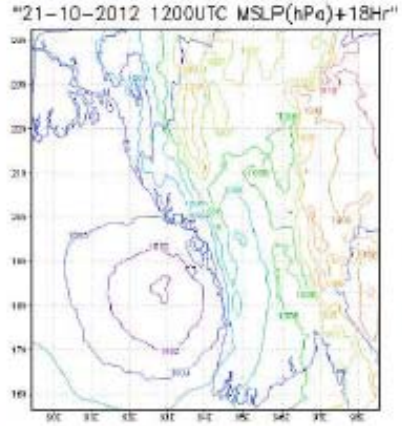


- Extend Regional Cooperation to receive real time and near real time Multi Hazard Early Warning: supportive to National EWS to reduce impacts of Natural Disasters.

. Upgrading Capacity Development in National Multi Hazard Early Warning Center with National Budget to reach effective EWS.

- Strive to succeed clear, under - standable and actionable warnings.

(3) Radars and (30)AWOS will be installed In Myanmar with Japan's Grant Aid Program.

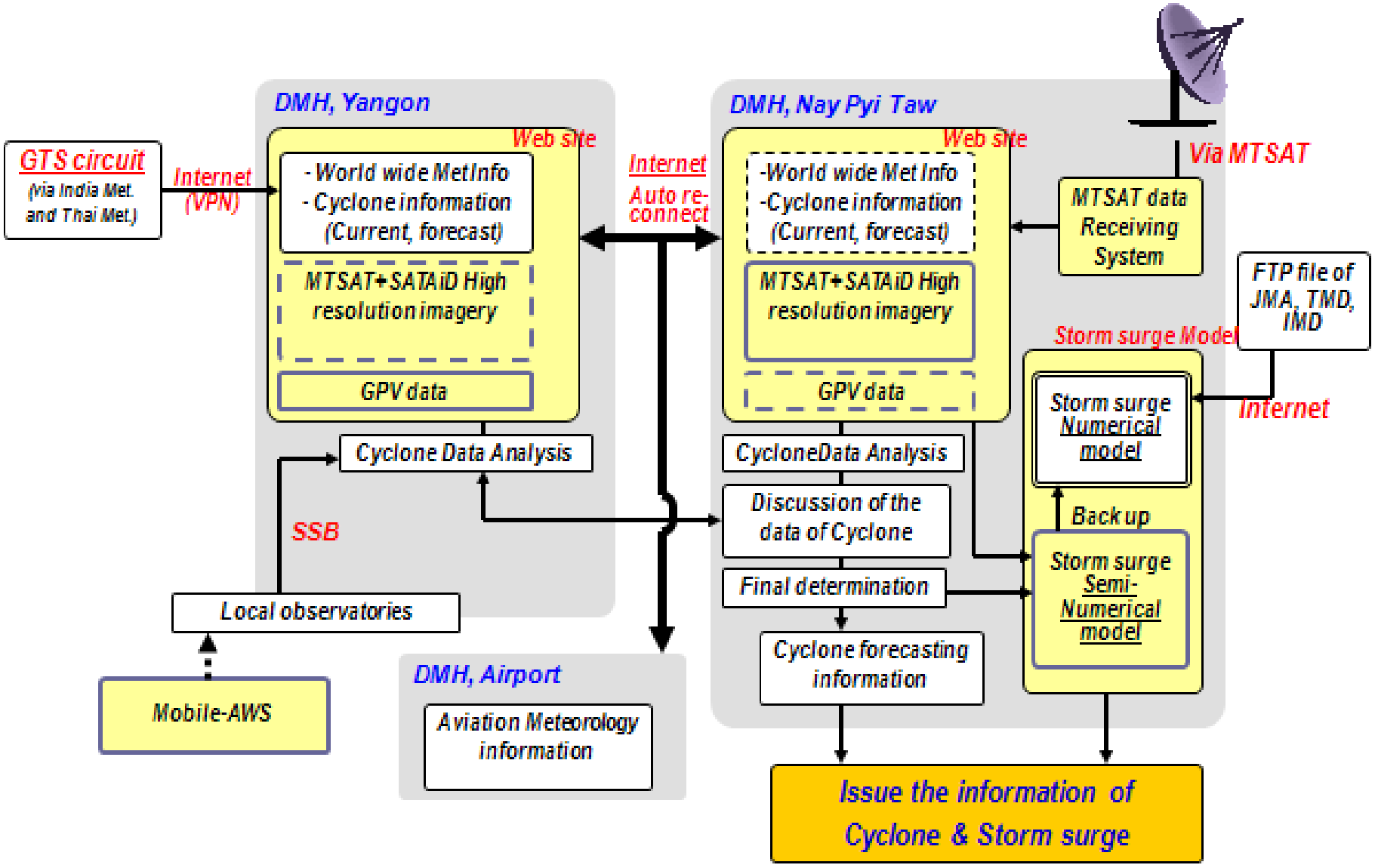


DMH set up WRF Model Since 2012 Nov . Now Updated in our website For our users.

Types of Forecast/Warning	Responsible Section/Division	Time
Daily Weather	Forecast	7:00Am/12:00Am/2:00pm/ 4:00pm/7:00pm
10 day weather	LRF	Every month of 8/18/28
Monthly Weather	LRF	Every month of (28)
Seasonal Weather	LRF	April 28/June 28/August 28
Aviation Weather	Aviation Met	Every 6 Hourly
Special weather	Forecast	As per request and weather conditions
Coastal Weather	Forecast	10:30 Am/ 1:30pm
New Records	Forecast	If new record occur..
Agromet Bulletin	Agromet	Every 10 day
Cyclone/surge	Forecast	24-36 Hr before
Heavy rainfall	Forecast	Vigorous monsoon/cyclone/....
Untimely Rainfall	Forecast	Weather disturbance....
Fog Warning	Aviation Met	If necessary
Port Warning	Forecast	Squally wx is expected

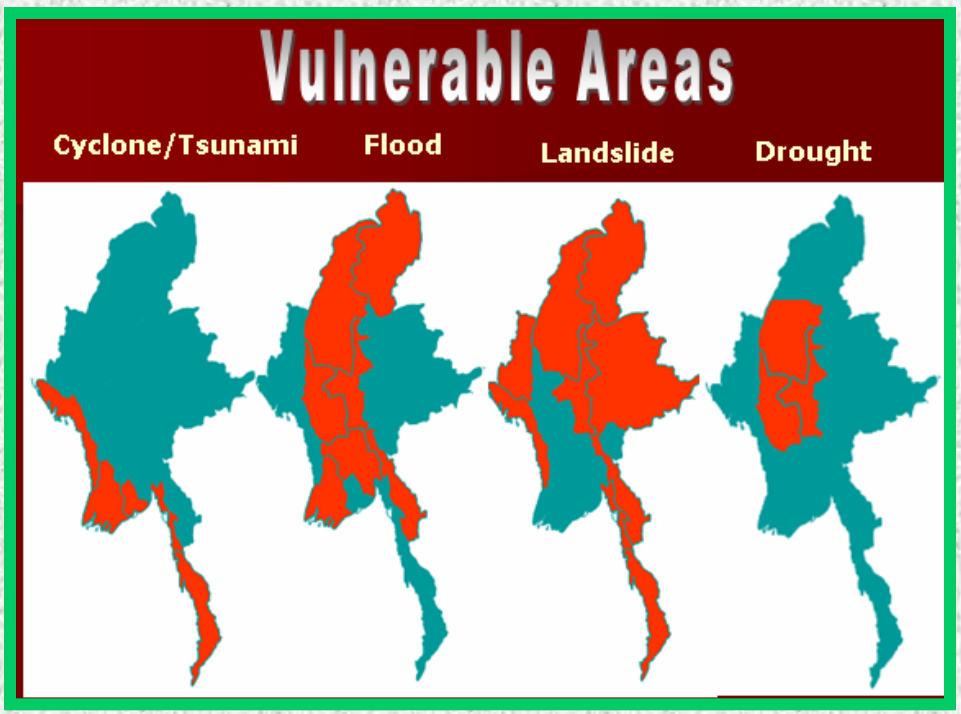
We're trying quality products !

Cyclone and Storm Warning

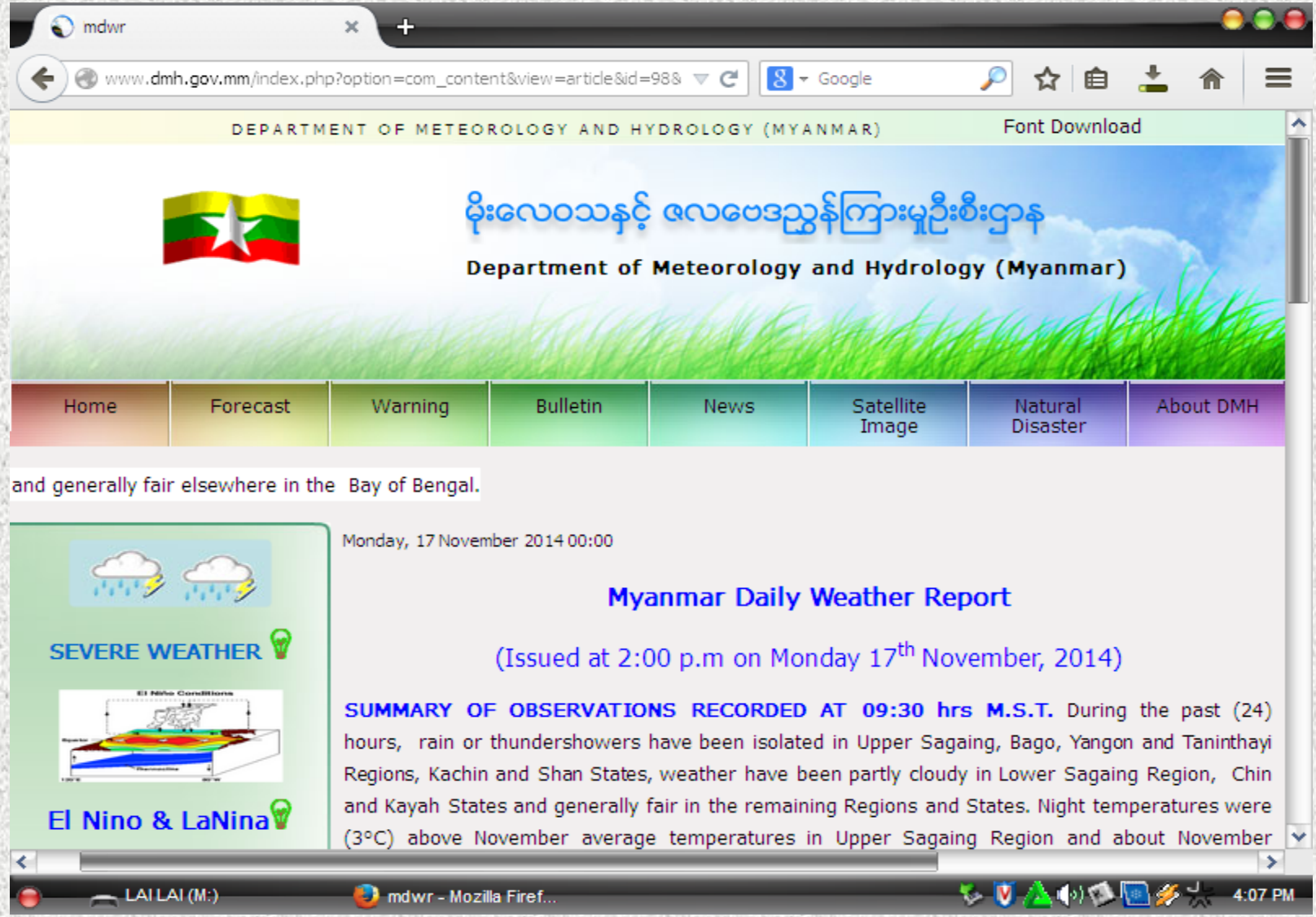


Myanmar frequently hit by ...

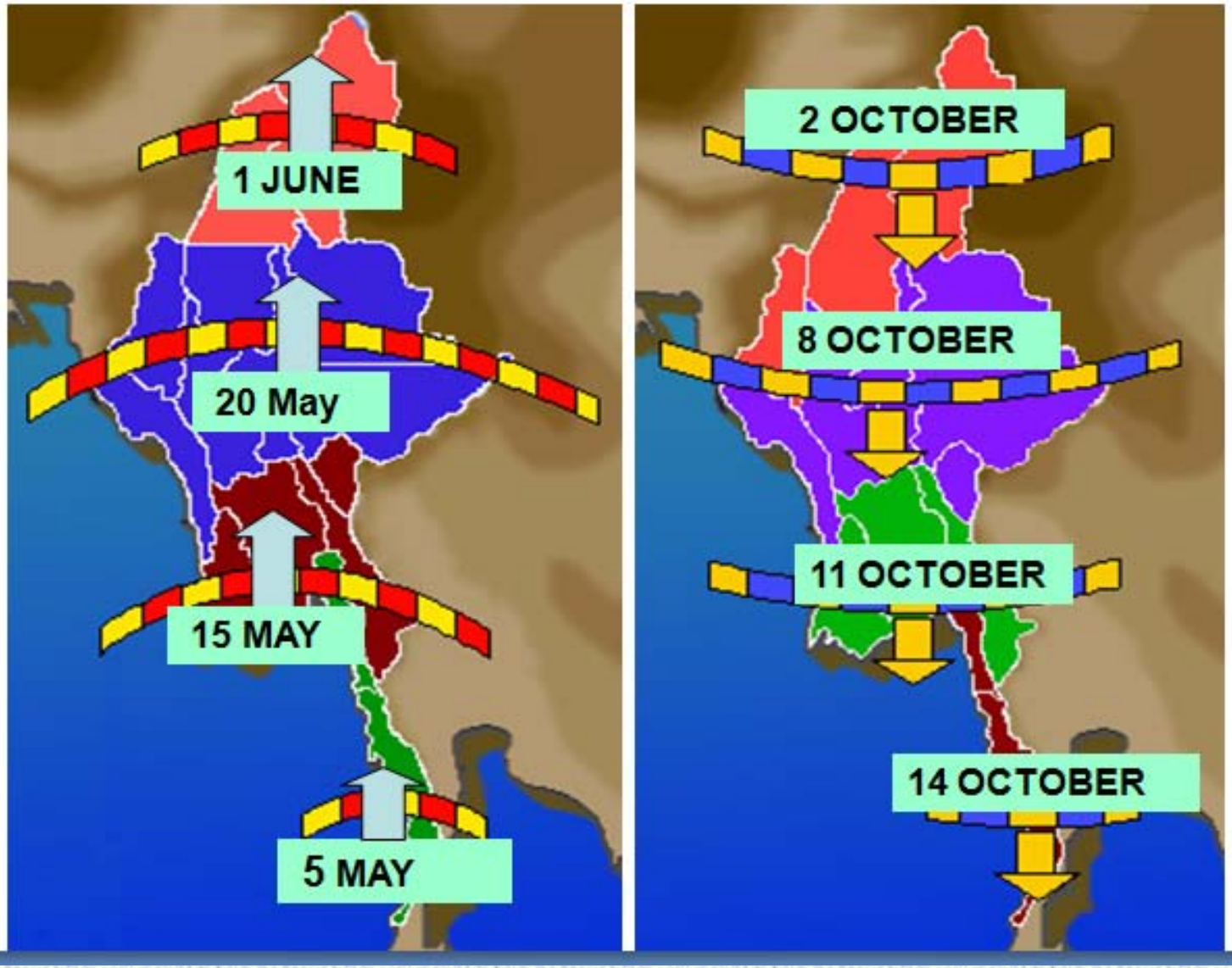
- Cyclone
- Storm surge
- Temperature.
- Drought
- Extremely rain.
- Strong wind.



www.dmh.gov.mm



Climatological (1960-1990) Mean Monsoon Onset & Withdrawal Date



Statistics of Historical Record of Bay Storms and Storms whi crossed Myanmar Coast for the period 1877 - 2009

Month	Storms formed in the Bay of Bengal	Storms which crossed Myanmar coast
JAN	16(1%)	2(2%)
FEB	3(0%)	1(1%)
MAR	8(1%)	---
APR	33(3%)	15(18%)
MAY	96(7%)	27(33%)
JUN	121(9%)	1(1%)
JUL	185(14%)	---
AUG	201(15%)	--
SEP	216(17%)	---
OCT	201(15%)	14(17%)
NOV	146(11%)	14(17%)
DEC	77(6%)	9(11%)
Total	1303(100%)	83(100%)
Total	9.76	0.62

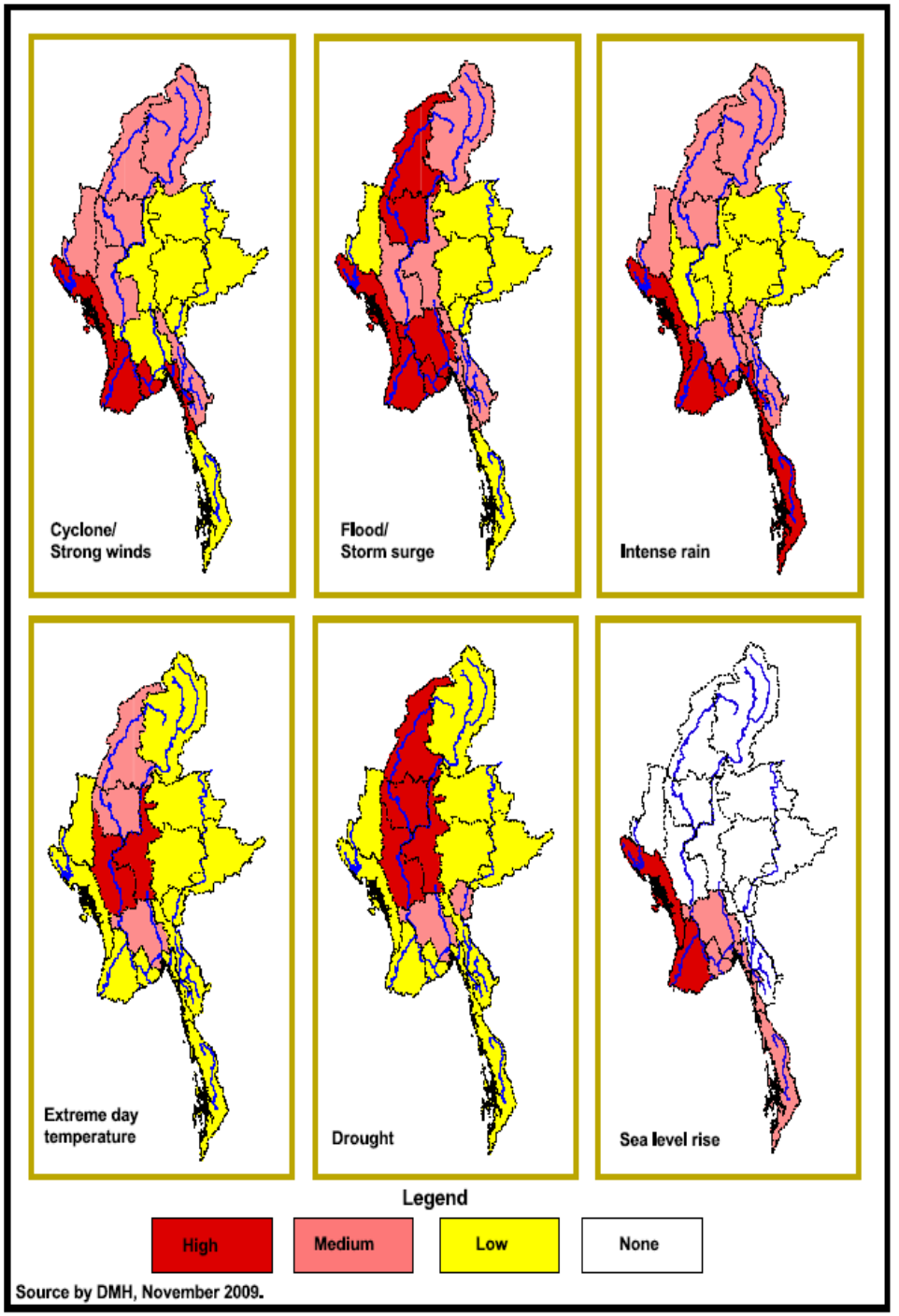
APRIL-MAY IS FIRST STORM SEASON OF MYANMAR
WITH POSSIBILITY OF 51% CHANCE OF LAND CROSSING.
44% of Pre-monsoon Bay storms crossed Myanmar coast.

OCT-NOV-DEC IS SECOND STORM SEASON OF MYANMAR
WITH POSSIBILITY OF 45% CHANCE OF LAND CROSSING.
Only 9% of post-monsoon Bay storms Crossed Myanmar coast.

Source: Dr. Tun Lwin, 2002

Major cyclone

1968 Sittwe cyclone 1037 lives
1982 Gwa Cyclone
1994 Maungdaw cyclone
2006 Mala cyclone in May
2008 Nagis cyclone in May 84537 deaths,
53836missing
2.4million people affected
11.7trillionkyats
2009 Bijli Cyclone in May
2010 Giri cyclone in October
2011 02 B in October
2012 Deep Depression in October
2013 Mahasen in May
2014 Hut Hut Cyclone in October



Cyclone landfall probability along Myanmar coast

Place	Probability %
Maungtaw	9.6
Sittwe	20.8
Kyaukpyu	11.2
Thandwe	8.7
Gwa	8.7
Haigyi	3.2
Yangon	3.2

Killer Cyclones & Associated storm surges

No	Name	Date	Peak Surge (m)	Landfall Point	Death toll	Damage (Kyats)
1.	Sittwe Cyclone	7.5.1968	4.25	Near Sittwe	1037	800 million
2.	Pathein Cyclone	7.5.1975	3.00	Near Pathein	304	776 million
3.	Gwa Cyclone	4.5.1982	3.70	Near Gwa	31	38 million
4.	Maungdaw Cyclone	2.5.1994	3.66	Near Maungdaw	10	78 million
5.	Mala Cyclone	29.4.2006	4.57	Near Gwa	1	
6.	“Nargis” (SCS)	2-3. 5.2008	5.61	Ayeyarwady, Yangon,Mon & Kayin	~85000 (nearly 53000 missing)	13 Trillions


Meeting Minutes Aggrement for Radar Installation on May 2013
Photo:THO


Climate Change Training at DMH
12-13 Nov 2013
Photo:THO

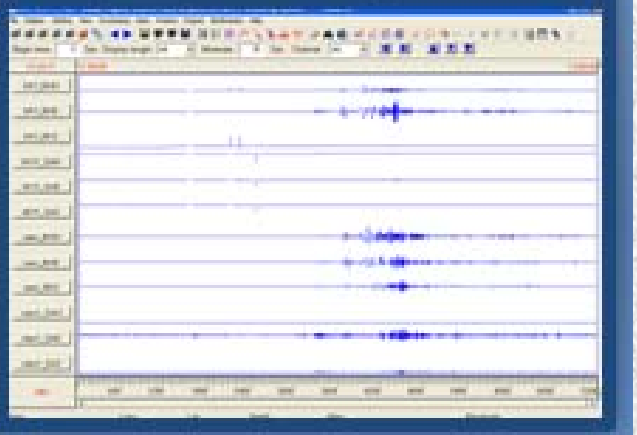

Installation of New Automatic Weather Station on May 2013
Photo:HL


(2) DMH Forecasters observed at Norway On Oct 2013
Photo:KLO

NATIONAL EARTHQUAKE DATA CENTER (NEDC)

NEDC started monitoring earthquakes and Tsunami in 2008.
As well as, National Tsunami Warning Center (NTWC).

- EARTHQUAKE NEWS
- EARTHQUAKE REPORT
- TSUNAMI WARNING



SEISMIC NETWORKS

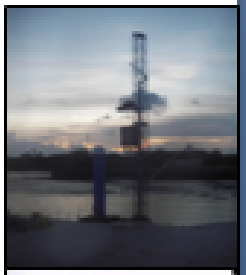
Earthquakes monitoring networks as part of Tsunami Warning System.

(4) Analog Seismographs

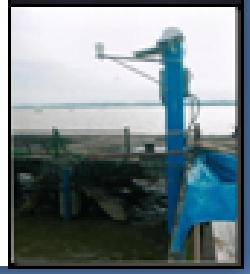
(11) Strong Motion Accelerographs

(8) Digital Broadband Seismometers

(2) Two sea level tide gauges

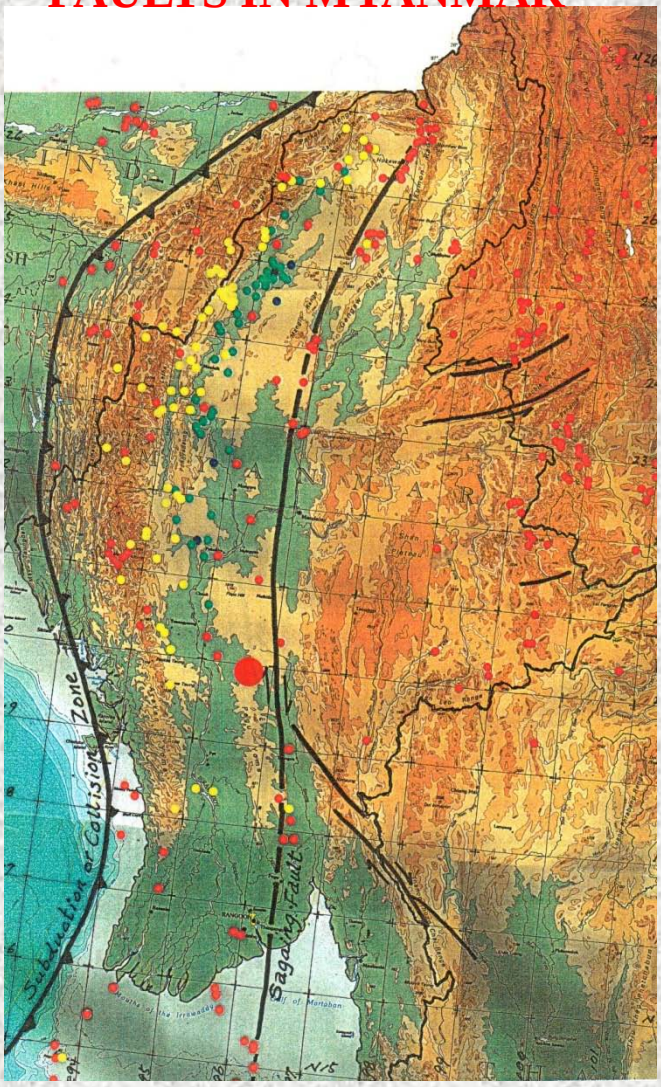


Sittwe
http//ilikai.soest.hawaii.edu/RSL/sitt1.html



Mawlamyine
http//ilikai.soest.hawaii.edu/RSL/moul3.html

FAULTS IN MYANMAR



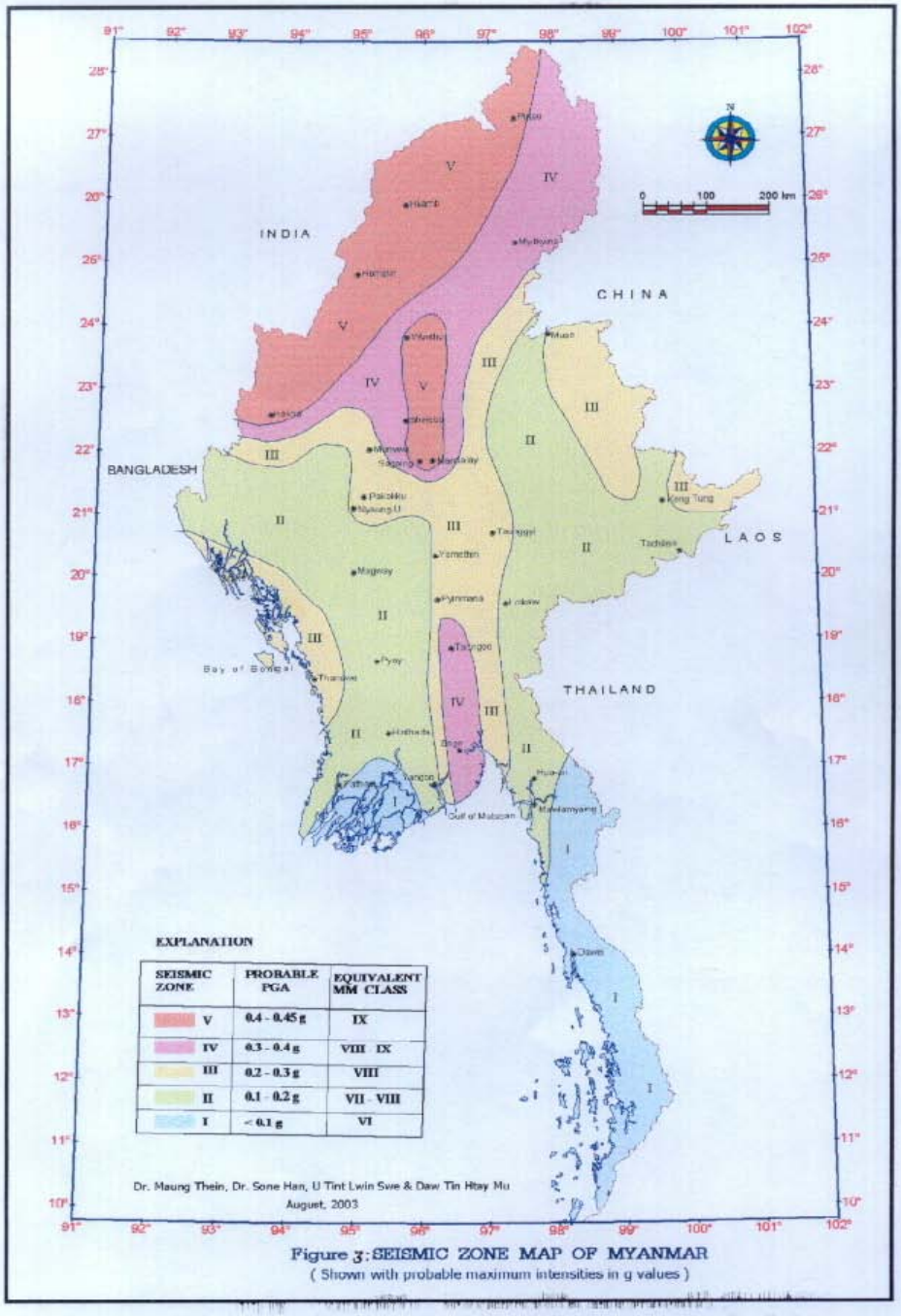
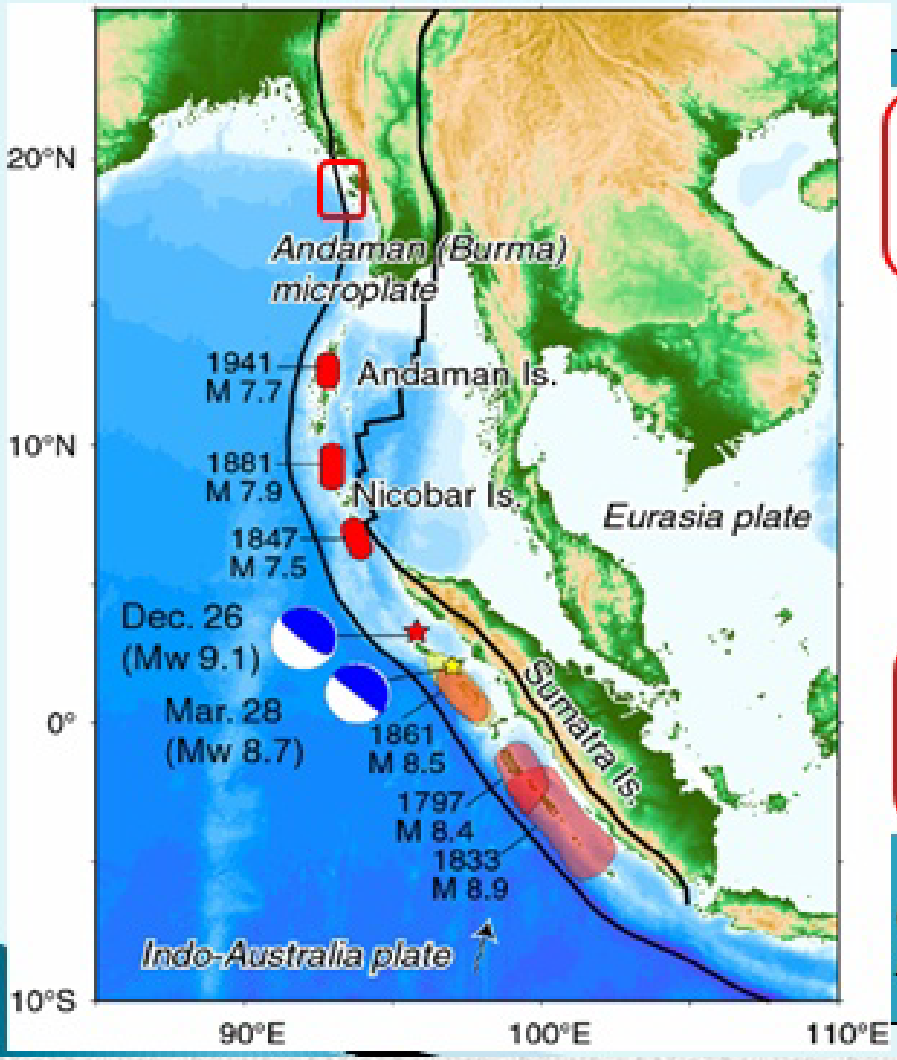


Figure 3: SEISMIC ZONE MAP OF MYANMAR
(Shown with probable maximum intensities in g values)

SEISMIC ZONE MAP

Map of Local Tsunami Sources

The past earthquake and tsunami events in and around the Sunda Trench



1750	Cheduba Island Myanmar
1762 April 12	Bay of Bengal
1797Feb 10	Sumatra
1833 Jan 29	Sumatra
1861 Feb 16	Sumatra (Mw 8.5)
1881 Dec 31	Bay of Bengal (Mw 7.9)
1883 Aug 27	Sunda Strait
1941 June 26	Andaman Island (Mw 8.1)
2004 Dec 26	Sumatra (Mw 9.1)

Chhibber 1934, Heck 1947, Berninghausen 1966, La Dean 1984

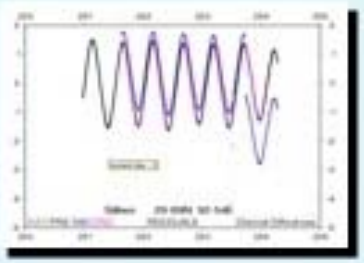
Tsunami Signboard

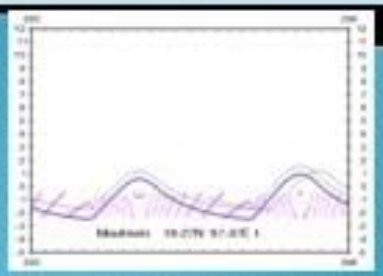
Ayeyarwady

Division

Sea Level Tide Gauges

Installation of 2 Tide Gauges (UNESCO/IOC)





TSUNAMI EXERCISE

Tabletop Exercise

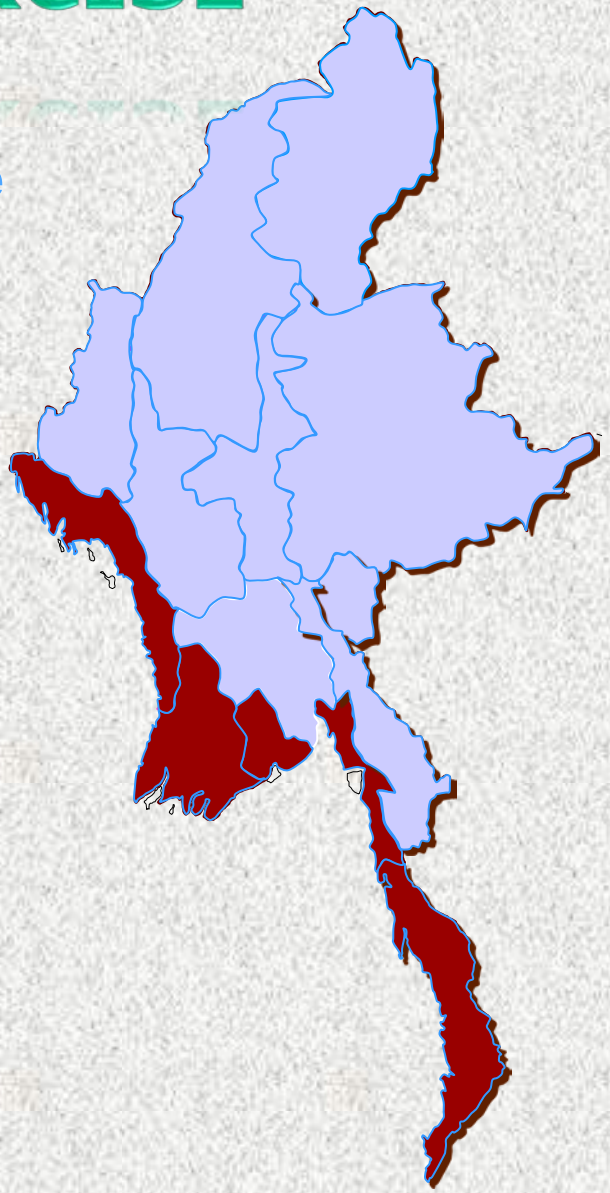
- Tabletop Exercise conducted on 14th September 2009 on Myanmar.
- In the tabletop exercise, the participants were divided into three groups and discussed on their respective SOPs of disaster management on tsunami.




TSUNAMI EXERCISE

Functional Exercise

- The IOWave09 Functional Exercise conducted on 14th October 2009 on Myanmar at five selected regions;
  - Rakhine
  - Ayeyarwady
  - Yangon
  - Mon
  - Tanintharyi



TSUNAMI EXERCISE

P H O T O N E W S

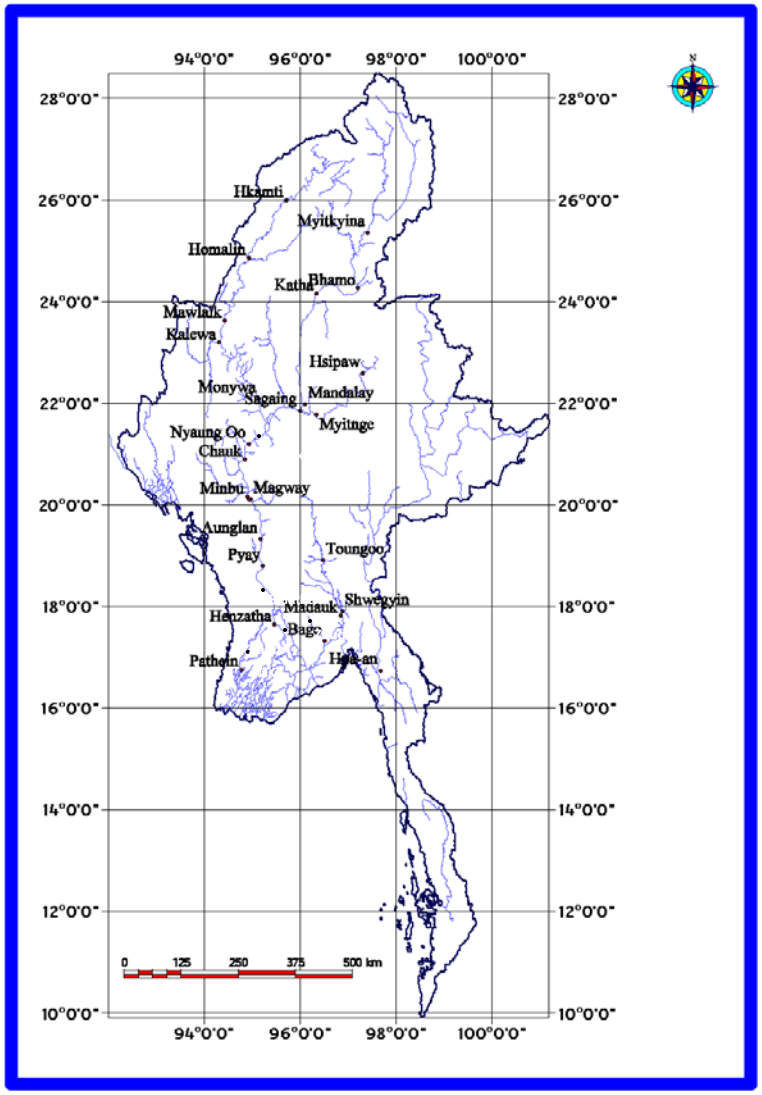
ဆုနာမီဘေးအန္တရာယ်ကျရောက်နိုင်ခဲ့တွင် ဘေးလွတ်ကင်းနေရာသို့ အပြန်အဆုံးပြောင်းရွေ့ရောက်ရှိနိုင်မည့် နည်းလမ်းများကို ဖော်ထုတ်ရရှိစေရန် လူရွေ့ပြောင်းမှုမပါဝင်ဘဲ ဆုနာမီကြိုတင်သတိပေးလေ့ကျင့်ခန်းကိုအောက်တိုဘာလ ၁၄ ရက်နေ့တွင် မွန်ပြည်နယ်အတွင်းလေ့ကျင့်ဆောင်ရွက်ခဲ့ကြောင်း သတင်းရရှိသည်။ အဆိုပါလေ့ကျင့်ဆောင်ရွက်မှုတွင် ပင်လယ်ကမ်းခြေရှိ မော်လမြိုင်မြို့နယ်ကျောက်တန်းရွာ၊ ပေါင်မြို့နယ်အလုပ်ရွာ၊ သံဖြူဇရပ်မြို့နယ်စက်စဲခမင်းဆိပ်ရွာ၊ ရေးမြို့နယ်ဒမင်းရွာတို့တွင် ဒေသခံပြည်သူများဌာနဆိုင်ရာအခွဲအဆင့်းတို့ဖြင့် သရုပ်ပြလေ့ကျင့်ခဲ့ကြပြီး ကျန်မြို့နယ်တို့တွင် ညွှန်ကြားသတင်းပေးမှု၊ ထပ်ဆင့်အသိပေးဆောင်ဖြေမှု၊ ပြန်လည်သတင်းပို့မှုတို့၏ အသွားအပြန်တို့ကို စံစီနှိမ့်တတ်မီးယူမှုများဆောင်ရွက်ခဲ့ကြောင်း သိရသည်။

ဧကတင်ဘာလဝင်ရောက်ကလည်း အိန္ဒိယသမုဒ္ဒရာအတွင်းဆုနာမီကြိုတင်သတိပေးခြင်း TABLE-TOPလေ့ကျင့်ခန်းကို ပြန်မာနိုင်ငံဆုနာမီဘေးအန္တရာယ်ကျရောက်နိုင်မည့် တနင်္သာရီတိုင်း၊ မွန်ပြည်နယ်၊ ရန်ကုန်တိုင်း၊ ဧရာဝတီတိုင်းနှင့် ရခိုင်ပြည်နယ်တို့တွင် ဆောင်ရွက်ခဲ့သည်။ မောင်မောင်လွင်ဖြိုး

Training Workshop on the Development of End-to End Tsunami Standard Operating Procedures (SOPs)

19-21 January 2010, Nay Pyi Taw, Myanmar

Hydrological Forecasting Stations



Ayeyarwady - 15 Stations

Chindwin - 5 Stations

Sittaung - 2 Stations

Thanlwin - 1 Station

Dokehtawady - 2 Stations

Bago - 2 Station

Shwegyin - 1 Station

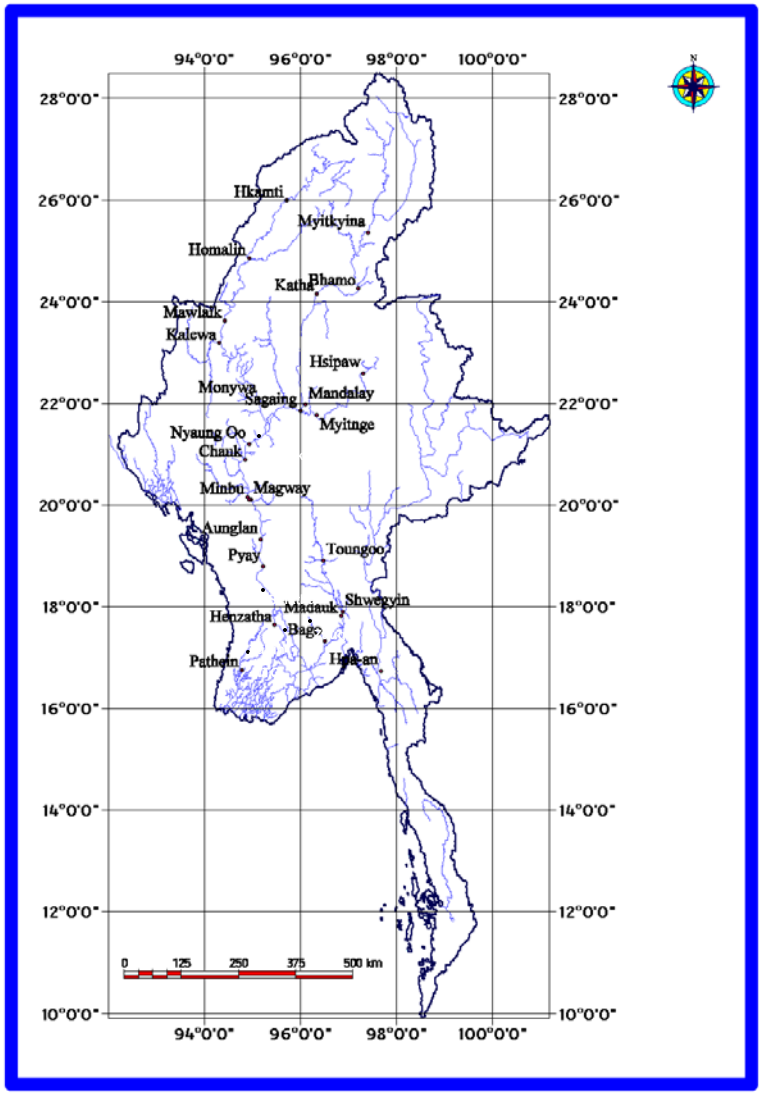
Ngawun - 2 Stations

Hydrological Observation Network and Types of Forecast and Warning

- Daily water level forecast
- Dekad Forecast
- Monthly Forecast
- Significant Water level Bulletin
- Flood warning and Bulletin
- Minimum Alert Water Level and Bulletin (for low flow)
- Seasonal water level forecast

- General Long Range flood Forecast
- Flood Forecast for early monsoon
- Flood Forecast for Peak-monsoon
- Flood Forecast for Late-monsoon

Hydrological Forecasting Stations

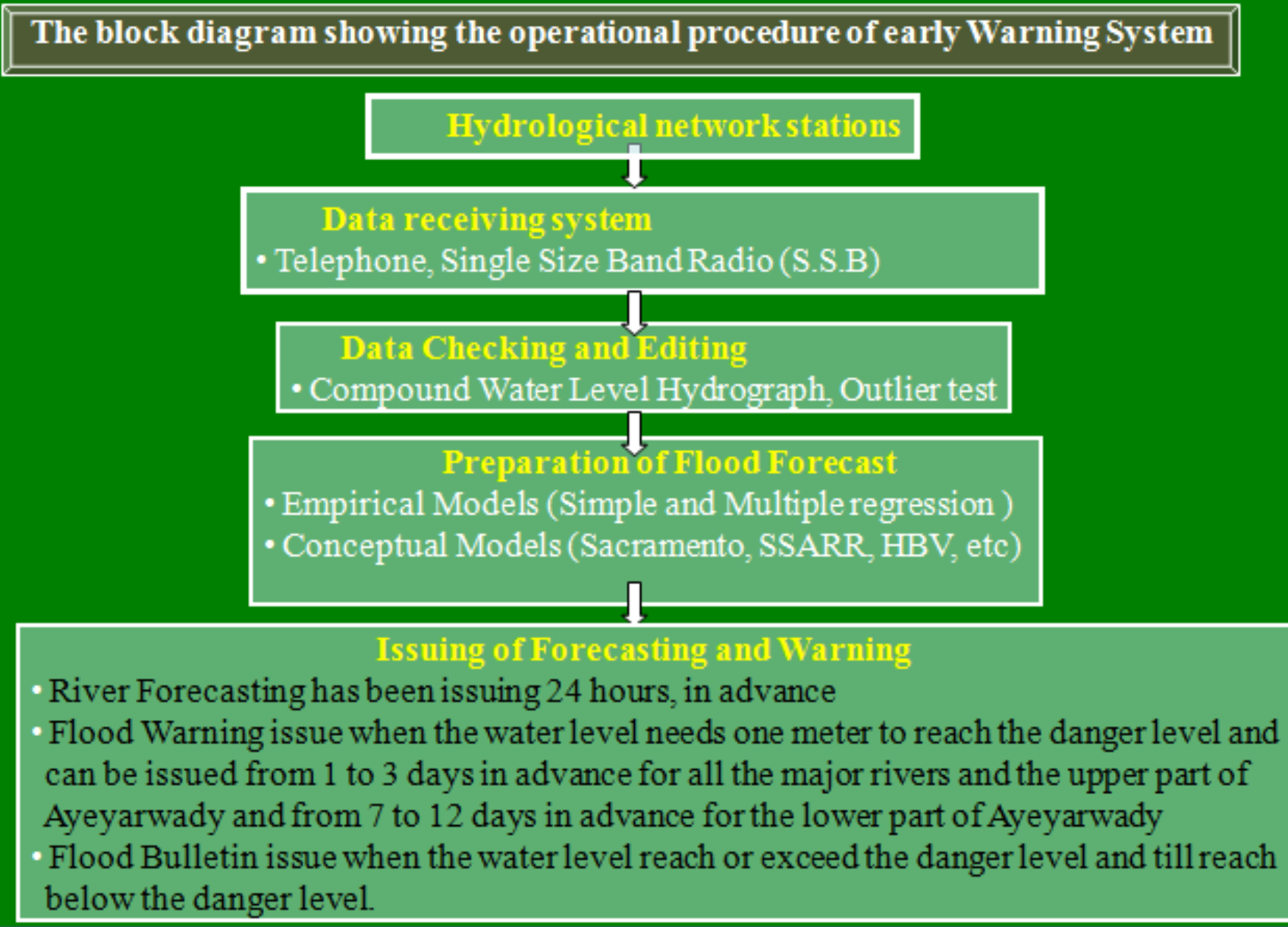


- DMH operated a manual controlled daily river forecasting and flood warning system since 1966
- DMH is issuing daily water level forecasting and flood warning for major river such as Ayeyarwady, Chindwin, Thanlwin, Sittoung, Bago, Shwegyin, Myitnge and Ngawun
- Issuing early flood warning is depending on availability of rainfall data from the reporting station in the catchments and lag time or forecast lead-time of the station from upstream station
- In case of lower part of Ayeyarwady, such as Pyay and Hinthada, the flood warning can be issued from 7 to 12 days in advance.

Widespread flood

Flash Flood

The block diagram showing the operational procedure of early Warning System



Dissemination of flood forecasts and warnings

Issuing flood warning and bulletin through following agencies;

- Radio and television
- Newspaper
- Sending warnings to local authorities
- Related ministries, departments and organizations

Flood Alert

- Sending Hydrologist to the effect area
- Taking hourly water level data
- Taking part in flood Committee of effected township

Flood Survey

- Sending forecast survey team to the effect township
- Collecting data of inundated area and flood marks
- Collecting data of damages caused by the flood
- Meeting with township authorities to get information
- Submitting Flood Survey report
- Flood Plain Mapping

Significant Water Level Bulletin

(Issued at 12:00 hr M.S.T on ***29.5.2006***)

According to the 06:30 hrs M.S.T observation today, the water level 646 cm of Ayeyarwady River at **Myitkyina** shows a rise of 291 cm (about **10 feet**) within 24 hrs. The **Ayeyarwady** water level may rise about 210 cm (about **7 feet**) at **Bhamo, Katha, Mandalay, Sagaing and NyaungOo** above the present water level during the **next 2 to 6 days** .

Flood Warning

(Issued at 12:00 hr M.S.T on ***15.7.2004***)

According to the 06:30 hrs M.S.T observation today, the water level may reach the respective danger levels of (**1260**) cm and (**1150**) cm **at Mandalay and Sagaing** during the **next (3) days** and the danger level of (**2120**) cm at **Nyaung Oo** during the **next (5) days**.

Flood Bulletin

(Issued at 12:00 hr M.S.T on 6***.7.2006***)

According to the (06:30) hr M.S.T observation today, the water level of Shwegyin River at Shwegyin is (**734**) cm. It may remain above the danger level (700) cm during the next (48) hour commencing noon today.

Achievement in DRM Policy and Practice

Institutional Framework

- National Disaster Preparedness Central Committee - formed in January 2005 with the chairmanship of Prime Minister.
- Myanmar Disaster Preparedness Agency, chaired by Union Minister for Social Welfare, Relief and Resettlement has been reformed on 20th April 2011.
  - Region/State Disaster Preparedness Committee
  - District Disaster Preparedness Committee
  - Township Disaster Preparedness Committee
  - Village Tract/Village Disaster Preparedness Committee
- Myanmar National Search and Rescue Committee has also been formed on 20th April 2011.

Myanmar Implementation in connection with Five Priorities Action

1. To ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation
   - Central Committee for National Disaster Prevention.
   - Management Working Committee.
   - 10 – Sub-committees.
   - Local Committees of Different Levels.

2. To identify assess and monitor disaster risk and enhance early warning
   - Daily Weather Report.
   - Monthly weather Forecasting Report.
   - Warning
   - Flood
   - Storm
   - Heavy Rain
   - Tidal Wave

Myanmar Implementation in connection with Five Priorities Action

3. To use knowledge, innovation and education to build a culture of safety and resilience at all levels
   - Disaster Management Courses.
   - School Curricula.
   - Public Education.
   - Lectures
   - Radio and T.V Talks.
   - Pamphlet.
   - Leaflet.
   - Bill Board.
   - Sign Board.

Myanmar Implementation inconnection with Five Priorities Action

4. To reduce underlying risk factor

- Town Plan.
- Cottage to Apartment.
- Post-disaster Reconstruction to Development.

5. To strengthen disaster preparedness for effective response for all levels

- Central Committee, Working Committee and Sub-committees.
- Local Committees at all levels.
- Government Officials.

Public Awareness Programs

- **● Workshop and Training Courses at DMH**
- **● Lectures to University/college/High School about weather and disaster mitigation and prevention**
- **● Radio Talks and Television News for Public Education**
- **● Distribution of pamphlets**
- **Articles in the Newspapers and Journals**

PUBLIC EDUCATION

CAPACITY BUILDING

PUBLIC EDUCATION

CAPACITY BUILDING

Monsoon Forum (Twice a year)

International and Local seminar, workshop and meeting for Disaster Reduction

International and Local seminar, workshop and meeting for Disaster Reduction

Disaster Management

Course

for

Managers

THANK YOU