

Satellite Technology based Weather and Climate Forecasting Services in Bangladesh

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Dhaka, Bangladesh

Location of Bangladesh



Country Profile - Bangladesh

Area	: 147,570 sq. km
Population	: 164.7 million (2017)
Population Density	: 1,000 persons per sq. km
Location	: In the West, North & North-East: India In the South East: Myanmar In the South: Bay of Bengal
Average Height	: 10m above sea level.
Capital City	: Dhaka
Language	: Bengali
Currency	: Taka (1 US\$ = 84 Taka)
Government	: Parliamentary Form
Main River	: The Padma, the Jamuna & the Meghna
Climate	: Sub-tropical
Temperature summer	: 7.22 - 22.77 °C in winter & 23.88 - 38.5 °C in
Average Rainfall	: Annually 1429 to 4338 mm
Main Export	: Jute, Tea, Garments, Frozen Fish etc.



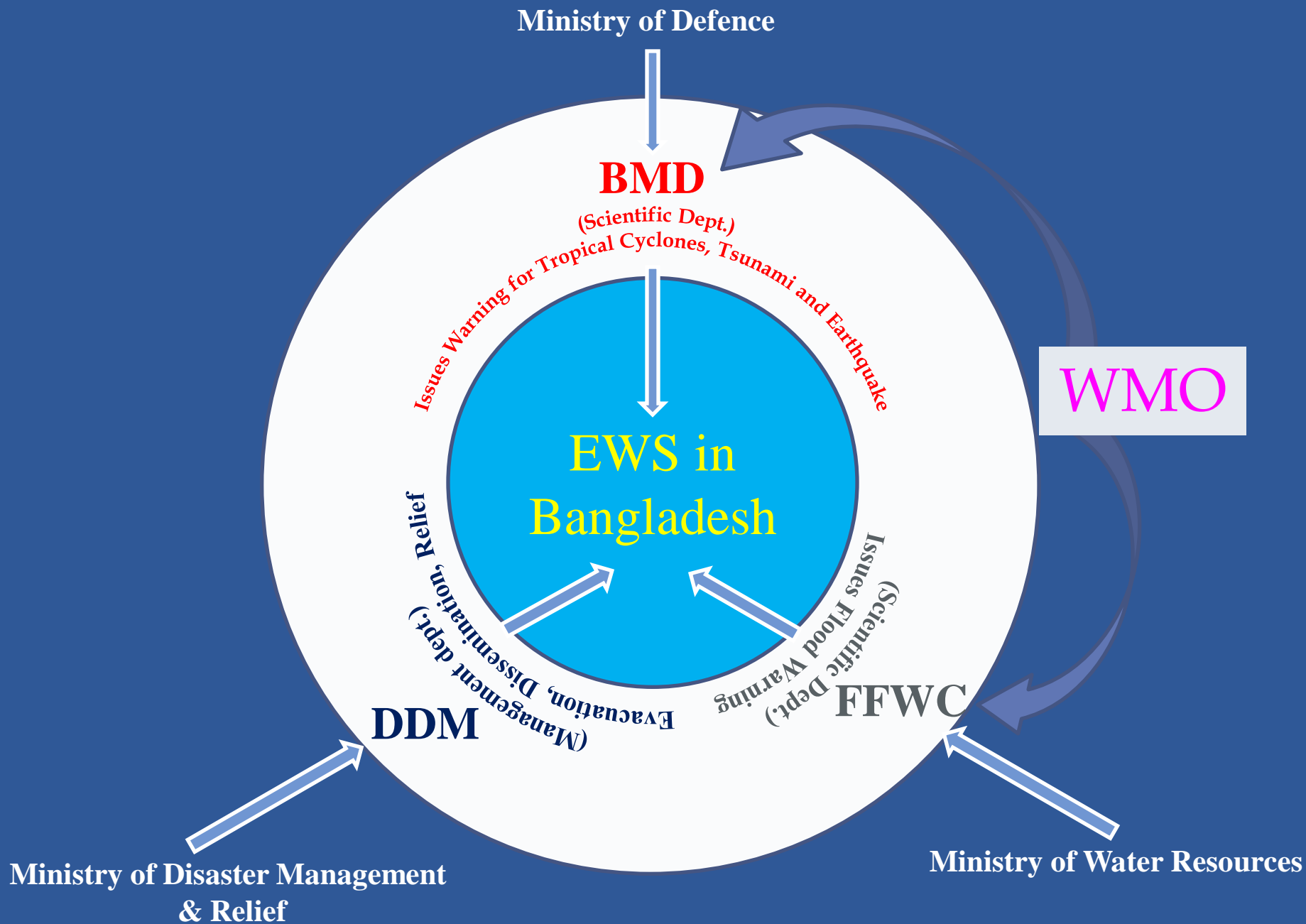
Major Disasters in Bangladesh

- **Tropical cyclone**
- **Storm surge**
- **Tidal bores**
- **Floods**
- **Flash flood**
- **Nor'westers**
- **Tornadoes**
- **Droughts**
- **Heat waves**
- **Cold waves**
- **Heavy rainfall**
- **River erosion**
- **Earth quakes**
- **Landslides**

Responsibilities of BMD

- **Bangladesh Meteorological Department is mandated by the Government to monitor asses and issue all kinds of forecasts and warnings for all extreme events including provision of earthquake information to Government and public.**
- National forecasting on all time scales including the issuance of tropical cyclone forecast and warnings.
- **Provide seismological information in and around the country along with Tsunami Advisories and warnings to the government and public.**
- Cater to all international and domestic air lines, VVIP and VIP Flights.
- **Providing agro-meteorological Advisories and long-range forecast for the agricultural sectors.**
- Supply and facilitate the applications of climate data and information to the government and private agencies for planning and performance of socio-economic activities.

Apex Ministry and Executive Agency involved in EWS in Bangladesh



Increment of Observational Facilities

a. Synoptic observatories:

➤ 2010: 35

➤ 2019: 60

b. Pilot Observatories : 10

c. Rawinsonde Observatories :

➤ 2010: 3

➤ 2017: 4

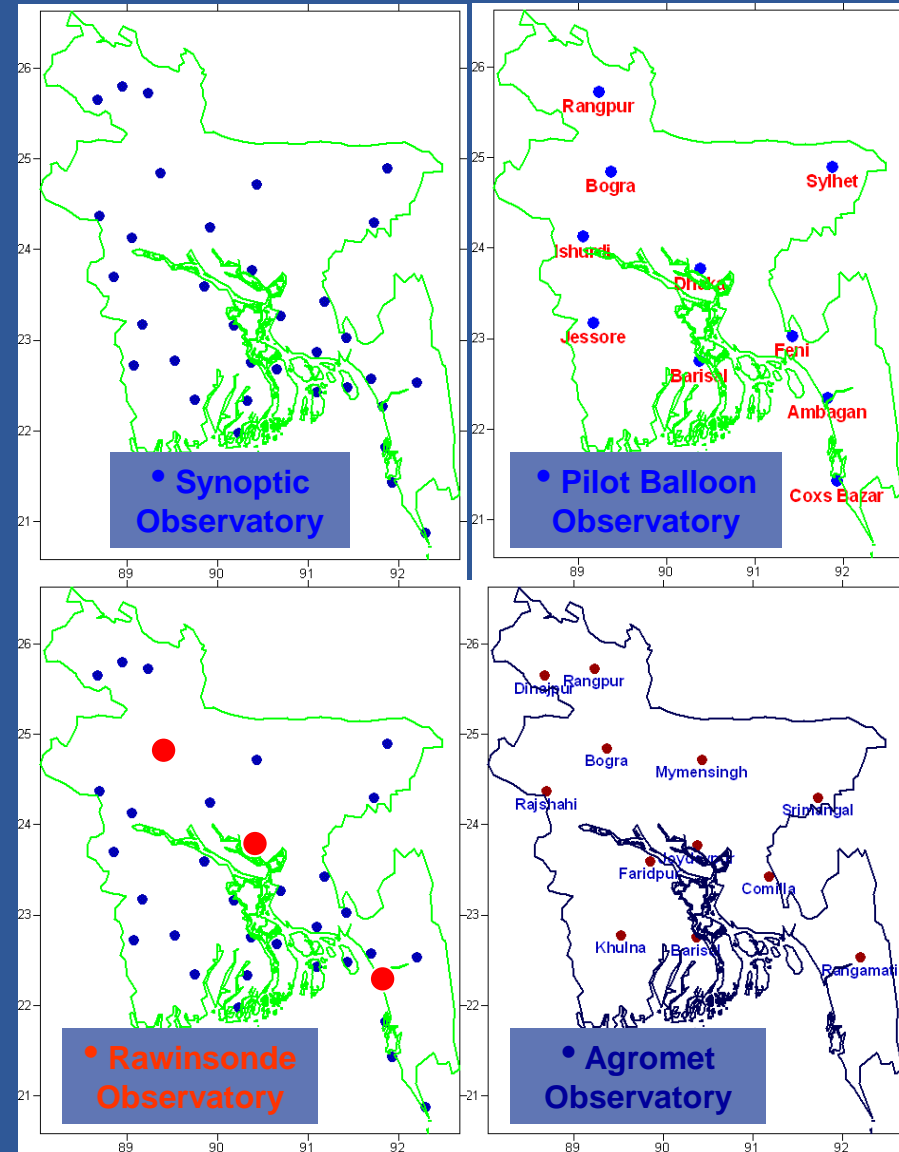
d. Agromet observatories : 12

e. RADAR Stations : 5 (3 are in Doppler mode)

f. Earthquake Monitoring Stations:

➤ 2010: 4

➤ 2017: 10



Observational facilities of BMD



Conventional Observatory



An Observer is taking observation





VSAT Antenna



Moulvibazar
Doppler Radar



Khepupra Radar



Cox's Bazar Radar



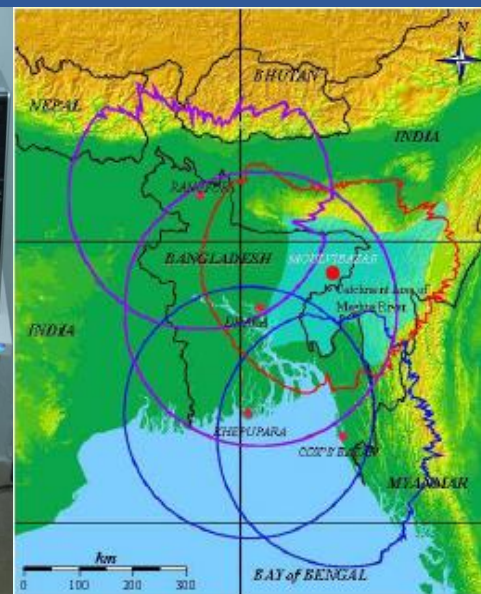
Dhaka Radar



Rangpur Radar



Composite Radar Picture



Radar Coverage

Types of weather forecasting

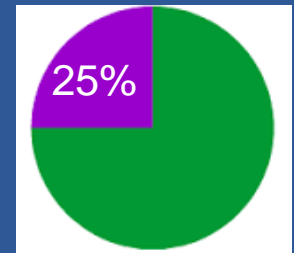
- Weather forecasts for can be grouped into:
 - **Very short-range forecast** **0 to 12 hours**
 - **Short range forecast** **12 to 72 hours**
 - **Medium-range forecasts** **3-7 / 3-10 days**
 - **Long range forecast** **30 days to the season**

Classification of rainfall used in Bangladesh

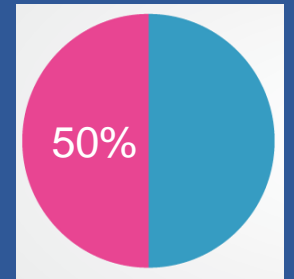
Sl	Intensity (mm/day)	Category of rainfall	Comments
1.	<0.5	Trace	Operationally used classification in Bangladesh
2.	1 - 10	Light	
3.	11 - 22	Moderate	
4.	23 - 43	Moderately heavy	
5.	44 - 88	Heavy	
6.	≥ 89	Very heavy	

Coverage area of rainfall forecast

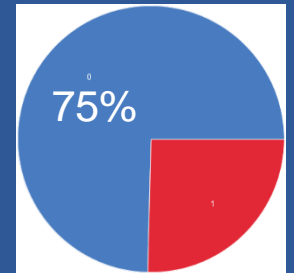
1. **At one or two places:** 01-25 % coverage area of forecasted division



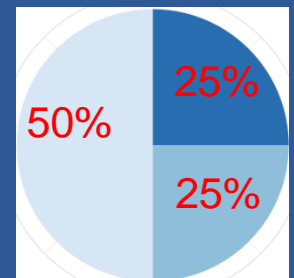
2. **At a few Places:** 26-50 % coverage area of forecasted division



3. **At many places:** 51-75 % coverage area of forecasted division



4. **At most places:** 76-100% coverage area of forecasted division



Regular Forecasts issued by BMD

a. Morning

1. Forecast for Hon'ble Prime Minister (Bengali & English) 10:00 BST
2. Weather Forecast For Dhaka And N/Hood 10:15 BST
3. Bangladesh Morning Inference 11:30 BST
4. Bangladesh Daily Weather Summery 14:00 BST
5. Weather Forecast for Farmers 14:00 BST

b. Evening

- Weather Forecast 15:30 BST
(For Chittagong & Chittagong Hill tracts)

c. Night

1. Bangladesh Evening Inference 22:00 BST
2. Weather Forecast For Dhaka And N/Hood 06:00 BST
3. Weather Forecast for Farmers 05:30 BST

List of Forecasts Daily Issued by BMD for River and Sea Navigation

Morning

- | | |
|-------------------------------------|-----------|
| 1. Inland Riverport Warning | 10:30 BST |
| 2. Sea Bulletin | 10:30 BST |
| 3. Weather F/C for Fishing Trawlers | 10:45 BST |

Evening

- | | |
|---|-----------|
| 1. Weather F/C For Bangladesh south of lat.24° N & North of 21° N | 15:00 BST |
| 1. Inland Riverport Warning | 16:00 BST |

Night

- | | |
|---|----------------|
| 1. Sea Bulletin | 22:00 BST |
| 2. Inland Riverport Warning (Two times) | 22:00,0530 BST |
| 3. Weather Forecast For Chittagong –Sandwip | 05:00 BST |

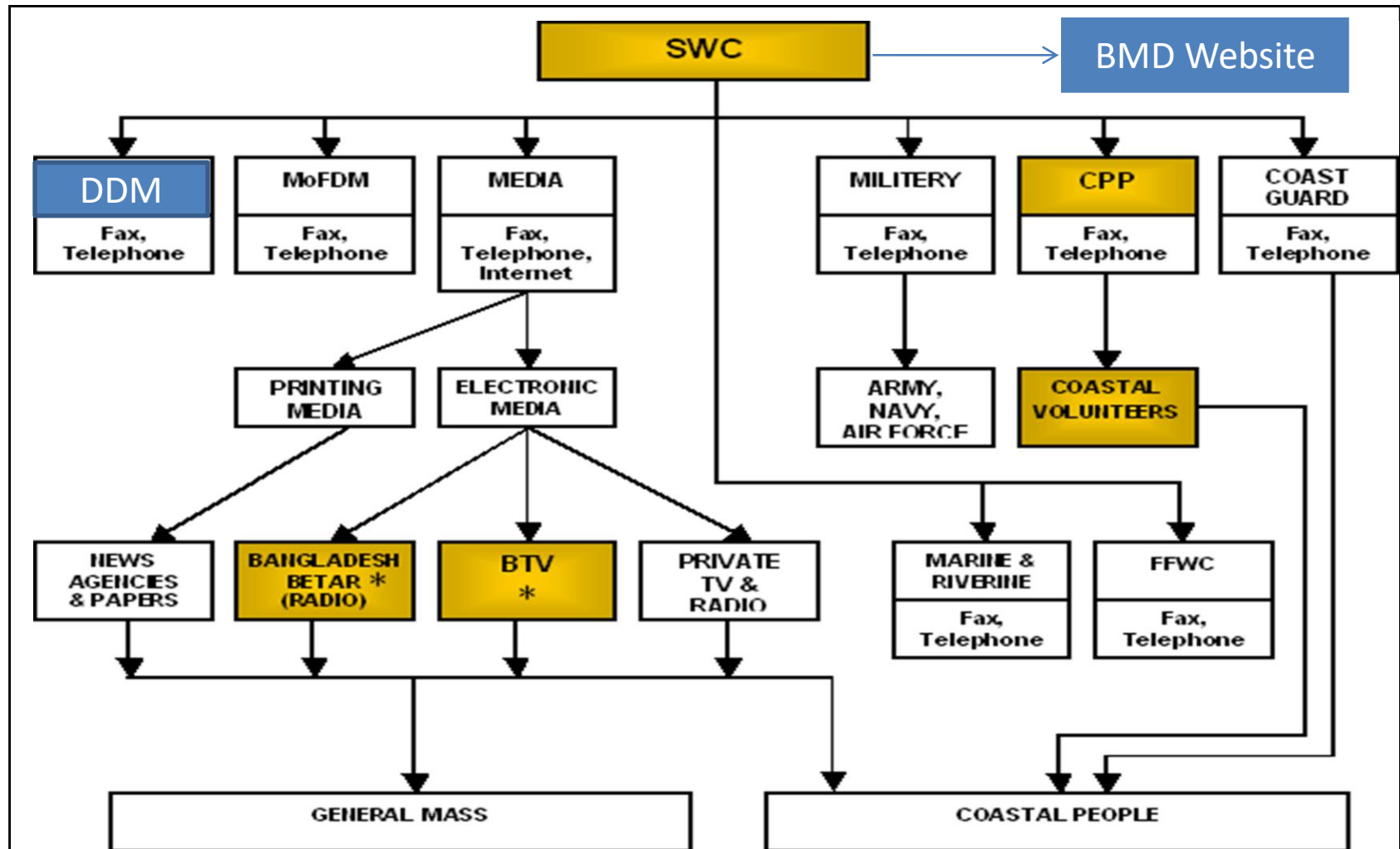
List of Severe/Special Forecasts Issued By BMD

- Tropical Cyclone Warning
- Kalbaishakhi/ Nor'wester Warning
- Heavy Rainfall Warning
- Warning for Squalls
- Heat Wave Warning
- Cold Wave Warning
- Fog Warning

The following forecast for Aviation are issued (Route forecast) for each flight from Airport Meteorological Office.

- Terminal Aerodrome forecast (TAF)
- Route forecast (ROFOR)
- SIGMET
- METAR containing landing and take off Weather information
- SPECIS whenever condition exists

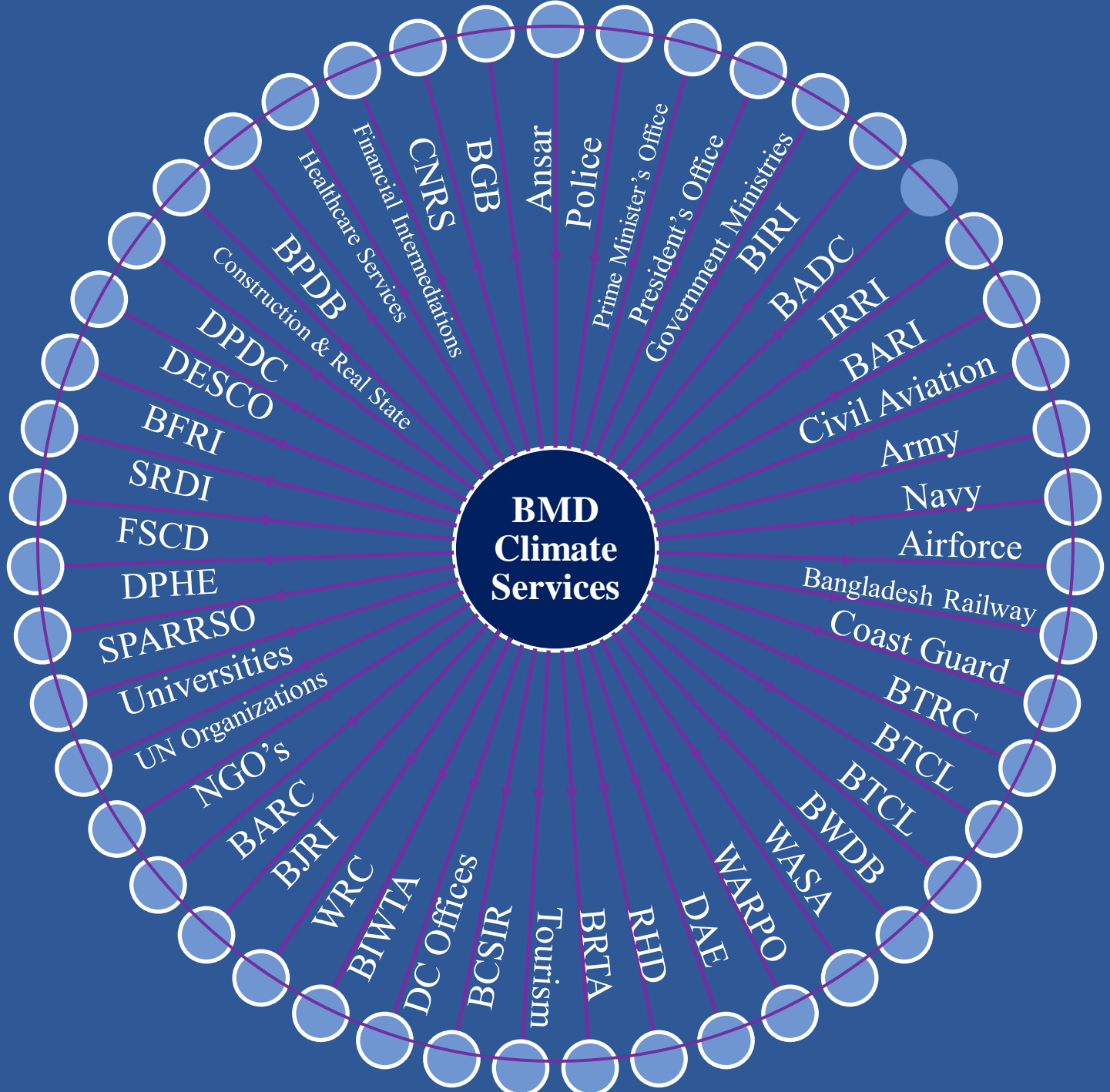
Warning dissemination system of BMD



* Mandated to continuous broadcasting of Special Weather Bulletins containing Warning round the clock in case of Cyclones

List of Short range, medium range and long range forecasts issued by BMD

Users	Forecast	Lead time
Public and Farmers,	Bangladesh Daily Weather summary	24 hrs, 3 days and 5 days
River voyagers	Inland Riverport Warning	06 hrs
Shipping	Sea bulletin	12 hrs
Public and Farmers	Regional forecast	12, 24 hrs
Aviators	Aviation Forecast	6, 12 hrs
Public and Farmers	Special Forecast	12, 24 hrs
Farmers and agricultural planners, Agricultural Extension	Decadal forecast	10 days
Farmers and agricultural planners, Agricultural Extension	Monthly forecast	30 days
Public , Farmers and agricultural planners, Agricultural Extension	Long range forecast	30 days
Public, agricultural planners, Agricultural Extension	Long range forecast	3 months



Recent Development on Weather and Climate Services of BMD

- ❑ **Expansion of NWP forecasts from 3 to 7 days.**
- ❑ Preparation of Meteogram for location specific forecast with 10 days lead time.
- ❑ **Drought Monitoring.**
- ❑ Introduction Meteosat -7 Satellite image receiving facility through Metno collaboration.
- ❑ **Improve T-series and Diana System through Metno Collaboration**
- ❑ Preparation of Meteogram upto Upzilla Level for better location specific weather forecasting with 10 days lead time.
- ❑ **Publication of the BMD journal 'Dew Drop' routinely.**
- ❑ Further expansion of observational network by the augmentation of more AWSs.
- ❑ **Development Website in 'Bangla' in parallel to 'English' format.**
- ❑ Introduction of Toll Free IVR for dissemination of forecasts or Warnings.

Introduction of Climate Data Portal

The screenshot displays the Bangladesh Climate Data Portal interface. At the top, the browser address bar shows the URL `bmd.wospace.org/team/homex.php`. The navigation bar includes a home icon, a menu icon, and links for **User Guide**, **Purchase Data**, and **Language**. A **Login** button is located in the top right corner.

The **Map Layers** panel on the left contains the following sections:

- Base Layer:** Includes **Streets** (selected) and **Landscape**.
- Overlays:** Includes **Districts**, **District Names**, **Station List**, **Grid**, and **Query Result**. Below these are radio buttons for **A**, **B**, and **A-B**.

A pink circle highlights a dropdown menu with the following options:

- Data Availability
- Current Purchase
- Purchase History
- Data Fee Calculation

The main search and filter area includes:

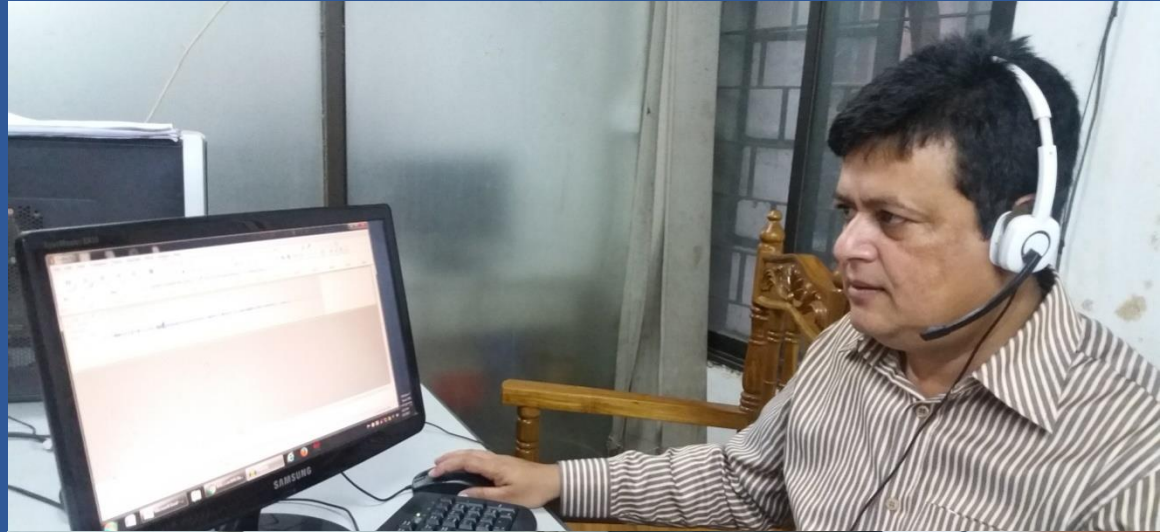
- Variable:** A dropdown menu.
- Resolution:** A dropdown menu set to **25 KM**.
- Models (for Projected Data Only):** Includes **Scenario** and **GCM** dropdowns.
- Statistics:** A dropdown menu.
- Scope:** A dropdown menu.
- Period:** Includes **From** and **To** date pickers.
- All Months:** A row of checkboxes for months J, F, M, A, M, J, J, A, S, O, N, D, with **All Months** checked.
- View:** A button.

The **Data (B)** panel at the bottom left mirrors the search and filter options above.

The right side of the interface features a map of Bangladesh with various cities labeled, including Dhaka, Rajshahi, Mymensingh, and Chittagong. A scale bar at the bottom of the map shows a range from 0 to 50 units. The map also includes a coordinate display at the top right showing `20.94092 : 90.00154`.

Forecast and Warning distribution: Interactive Voice Recorder (IVR): 1090, 10941

- i. Forecast/ Warning for sea going vessel: 1090-1
- ii. Inland River Port Warning: 1090-2
- iii. Daily Weather forecast/ Warnings: 1090-3
- iv. Cyclone Forecast /Warning: 1090-4
- v. Flood Forecast/ Warning: 1090-5.



Development of 'BMD Weather App':

❑ BMD Weather App was launched by Hon'ble Prime Minister Sheikh Hasina at a ceremony at her office in Dhaka on 27 December 2016.

❑ The following information could be displayed through this mobile app:

- Location specific current weather information;
- Weather forecast and warnings
- Latest available radar and satellite imageries;
- Recorded rainfall and temperature in the recent past etc.



Development of Application Oriented Software

❑ BMD has developed 'BMD Weather App' for distribution of weather and climate information, forecasts and hazardous weather warnings.

❑ 'BMD Weather App' has the flexibility for working in Android and iPhone flat forms.

❑ Relevant and updated information relevant to this app is kept available in BMD Web site (<http://bmd.gov.bd/apk/>).

❑ BMD also developed 'BMD Aquaculture App'. With this app BMD has been offering weather and climate information, forecasts and advisory for safe fresh water fishing activity to stakeholders and users.



Collaboration with National Aeronautics and Space Administration (NASA) and International Centre for Integrated Mountain Development (ICIMOD)

Lightning activity has become a crucial weather event in the recent times. It has been a cause for significant casualties in the recent years. BMD shows high importance on it and accordingly BMD has been trying to provide time and location specific forecasts. With this interest BMD has been collaborating with NASA to generate lightning climatology, lightning risk zone as well as underlying behaviour of lightning in Bangladesh. ICIMOD has involved with this activity.

Development of Academy for Climate Services (BACS)

In collaboration with CIMMYT, International Research Institute for Climate and Society (IRI), Columbia University, USA, CIMMYT and Independent University of Bangladesh (IUB) BACS has been development. Through BACS, BMD has been providing training on weather and Climate in addition to progression and availability of climate services to the participants from Government and Non-Government Organizations (<http://gobeshona.net/bacs/#sthash.d1ut6qdw.dpbs>). The first BACS training has been conducted on 21-25 October 2018 at BMD premises.

Installation of High Performance Computing (HPC) System

- ❑ High Performance Computing (HPC) System which is having 224 core processors and 8 nodes.
- ❑ WRF Model: 9 km, 3 km and 1 km resolutions.
- ❑ Update: 4-times in a day by means of updating the initial conditions;
- ❑ An Alert System has also been integrated with this system.
- ❑ User name 'test' & password 'test'
- ❑ Products and alert information are available for all.



www.bmd.gov.bd

বাংলাদেশ আবহাওয়া অধিদপ্তর
Bangladesh Meteorological Department

Dhaka MAX 32.2 °C | MIN 22.3 °C
Partly Cloudy
Sunrise : 6:12 AM
Sunset : 6:06 PM

Rainfall : 0 mm; Wind : 8 kph; Morning Humidity : 94%; Evening Humidity : 46%; Surface Pressure : 1014.5 hPa

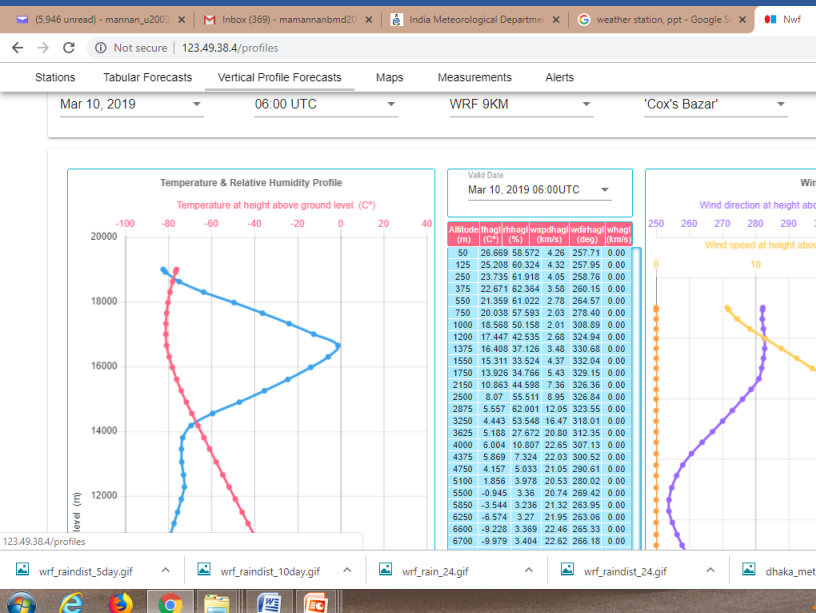
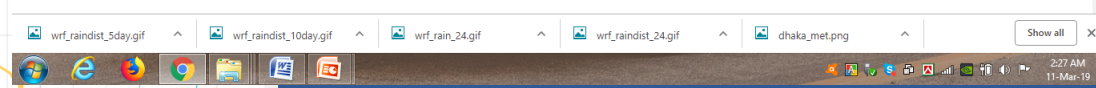
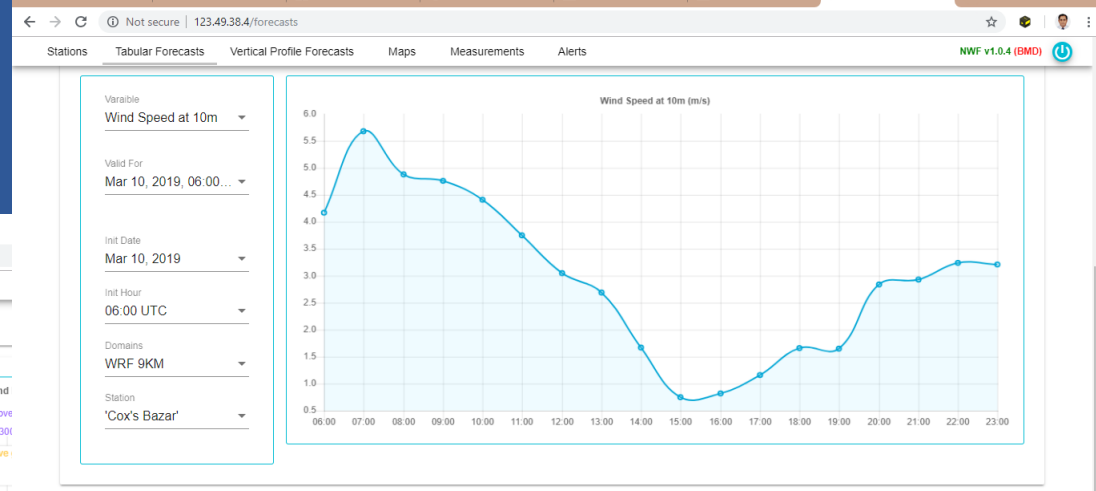
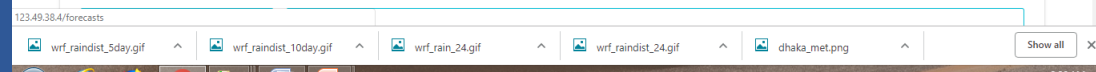
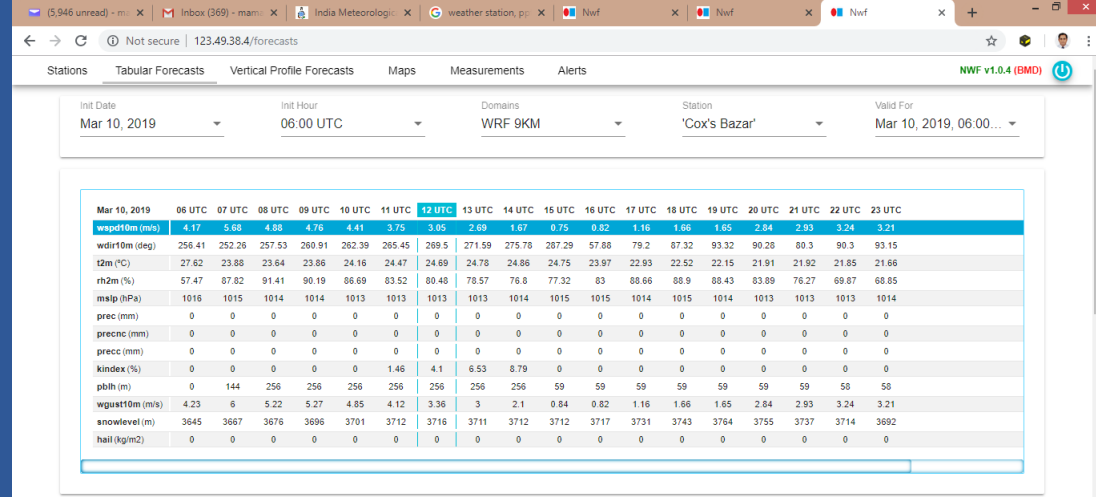
Director

wrf_raindist_5day.gif | wrf_raindist_10day.gif | wrf_rain_24.gif | wrf_raindist_24.gif | dhaka_mnt.png

BMD High Performance Computing (HPC) System

Products:

- Tabular Forecast;
- Vertical Profile Forecast;
- Maps;
- Measurements and
- Alert



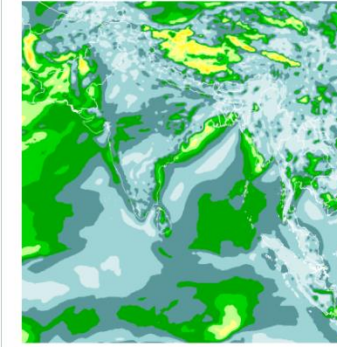
BMD High Performance Computing (HPC) System

Stations Tabular Forecasts Vertical Profile Forecasts Maps Measurements Alerts

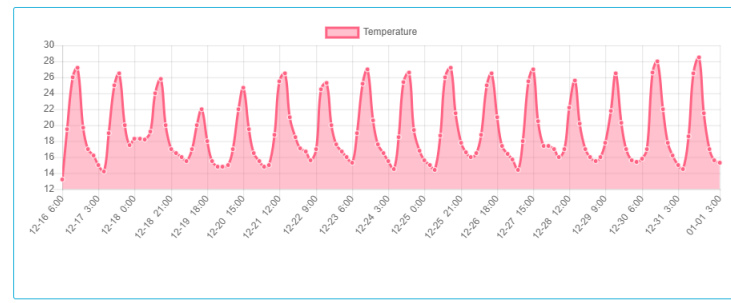
Barisal Temperature 12/16/2017 12/31/2017

Mar 10, 2019, 06.00 UTC
Domain: GFS 0 25°

Variables
Primary: Variable: Wind Gust, Vertical Level: 10M
Secondary: Variable: Sea Level Pressure



Time	Variable	Value
Dec 16, 2017, 03:00	Temperature	27.2
Dec 16, 2017, 06:00	Temperature	19.7
Dec 16, 2017, 09:00	Temperature	17
Dec 17, 2017, 12:00	Temperature	16.2
Dec 17, 2017, 03:00	Temperature	15
Dec 17, 2017, 06:00	Temperature	14.2
Dec 17, 2017, 09:00	Temperature	19
Dec 17, 2017, 12:00	Temperature	25
Dec 17, 2017, 03:00	Temperature	26.5
Dec 17, 2017, 06:00	Temperature	20
Dec 17, 2017, 09:00	Temperature	17.5
Dec 18, 2017, 12:00	Temperature	18.3
Dec 18, 2017, 03:00	Temperature	18.3
Dec 18, 2017, 06:00	Temperature	18.2

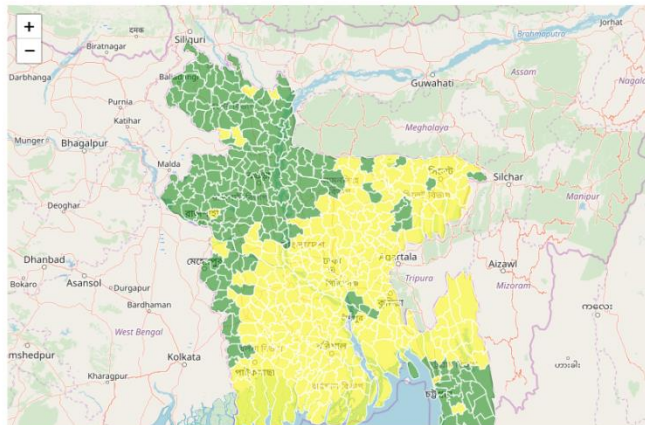



Stations Tabular Forecasts Vertical Profile Forecasts Maps Measurements Alerts

Mar 11, 2019


Admin Area: Level 1, Level 2, Level 3

Meteo Alert: Wind, Rain, Thunderstorm, Heat Wave, Cold Snap, All



Provision of online data purchase

www.bmddatportal.com/#/



Climate Data Portal Login

Climate and Weather Data Purchase Visitor: 9205

GoB Approved Rate of Climate and Weather Data Pay Now

Data Type* **Time Period***

Select Data Type Select Period

Variable/ Data*

Select Variable/ Data

Station*

Select Station

Basis of Data* **Scenario**

Select Basis of Data Select Scenario

Resolution

Select Resolution

Statistics

Select Statistics

Customer Name* **Office/ Organization**

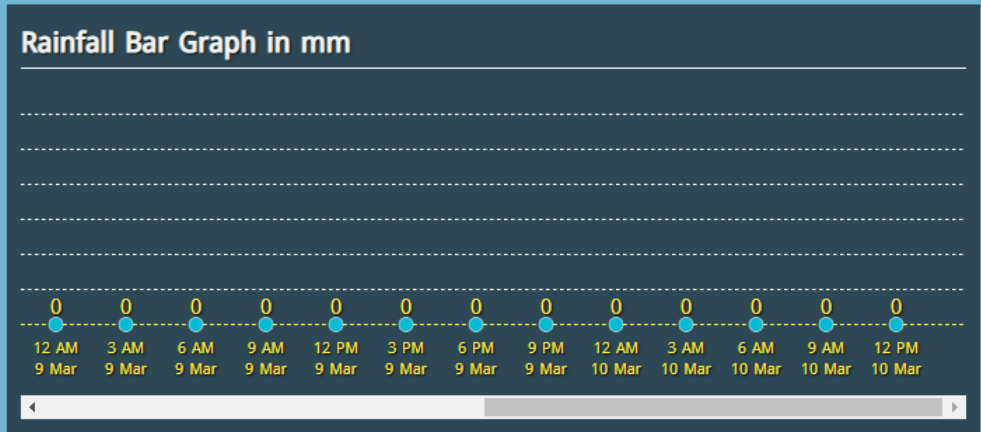
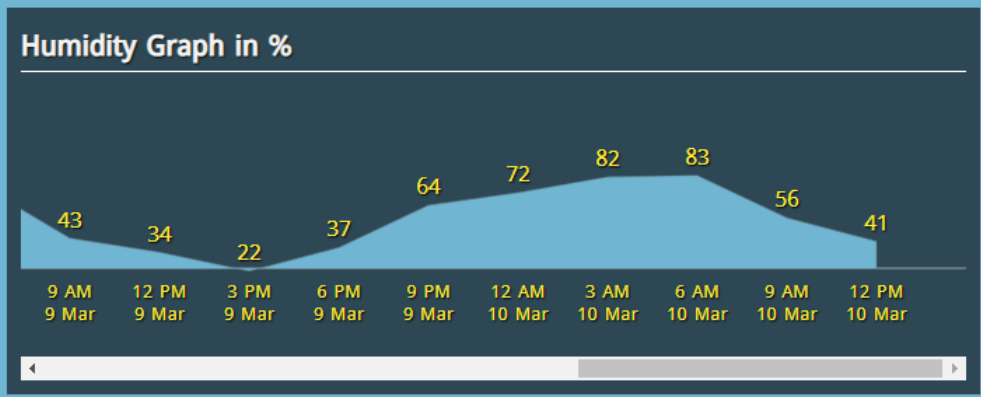
Select Office/ Organization

S.N.	Item	Number	Basis of Data		
			3-Hour Data	Daily	Monthly
1	Any Item	1	Tk. 1000.00/=	Tk. 800.00/=	Tk. 500.00/=
2	Number of Stations	1	Tk. 200.00/=	Tk. 100.00/=	Tk. 100.00/=
3	Time	Every 5 Years	Tk. 200.00/=	Tk. 100.00/=	Tk. 100.00/=

Note: 15% VAT/Tax and charge for payment gateway will also be payable

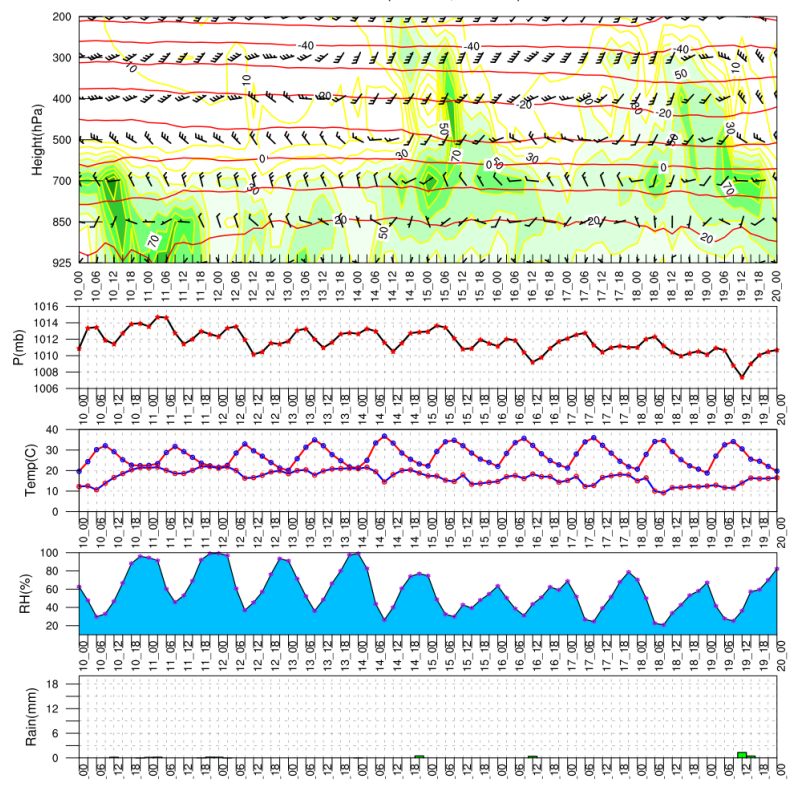
Transaction Charges

Method	Charge	Method	Charge	Method	Charge
VISA	2.50%	MasterCard	2.50%	AMERICAN EXPRESS	3.50%
ROCKET	2.50%	bKash	2.50%	১০৬	2.50%

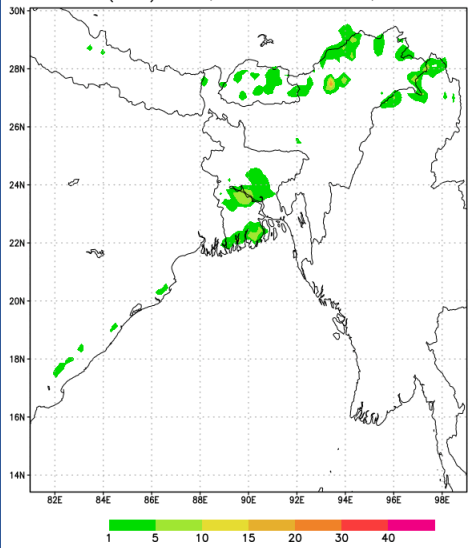


Enhancement of NWP Activity

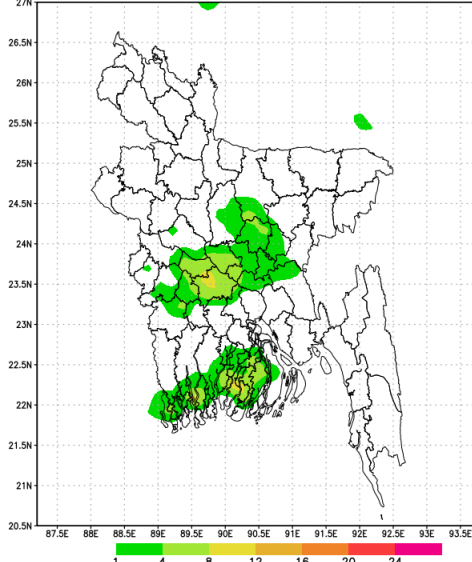
- ❑ Latest version of WRF Model;
- ❑ Horizontal Resolution 12 km;
- ❑ Update: 2-times in a day;
- ❑ Products: Maps (Bangladesh and adjoining countries, Bangladesh-districts;)
- ❑ Meteogram-district wise.



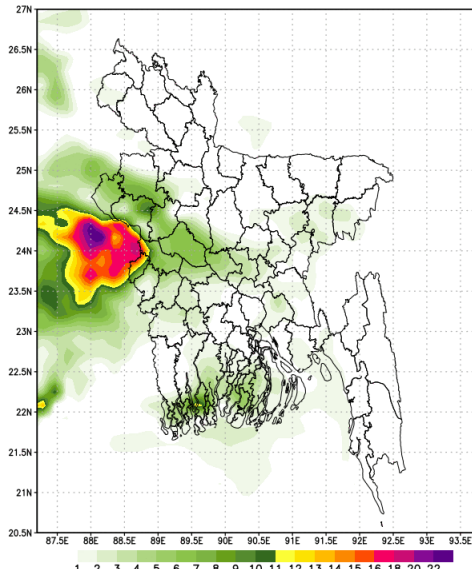
Rainfall(mm): 12Z,10.03.19 to 12Z,11.03.19



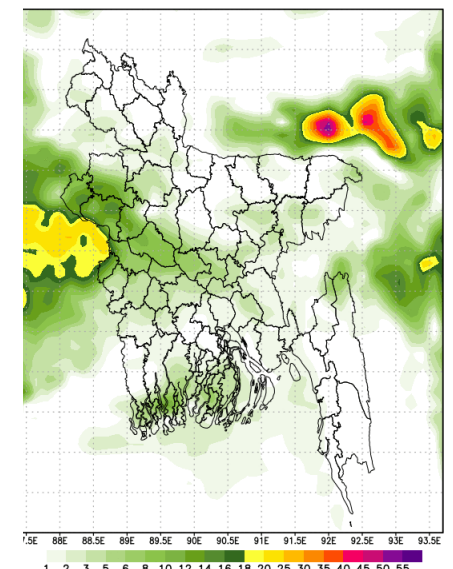
Rainfall(mm): 12Z,10.03.19 to 12Z,11.03.19



5 Day Accumulated Rainfall(mm): 00Z,10.03.19 to 00Z,15.03.19



7 Day Accumulated Rainfall(mm): 00Z,10.03.19 to 00Z,20.03.19

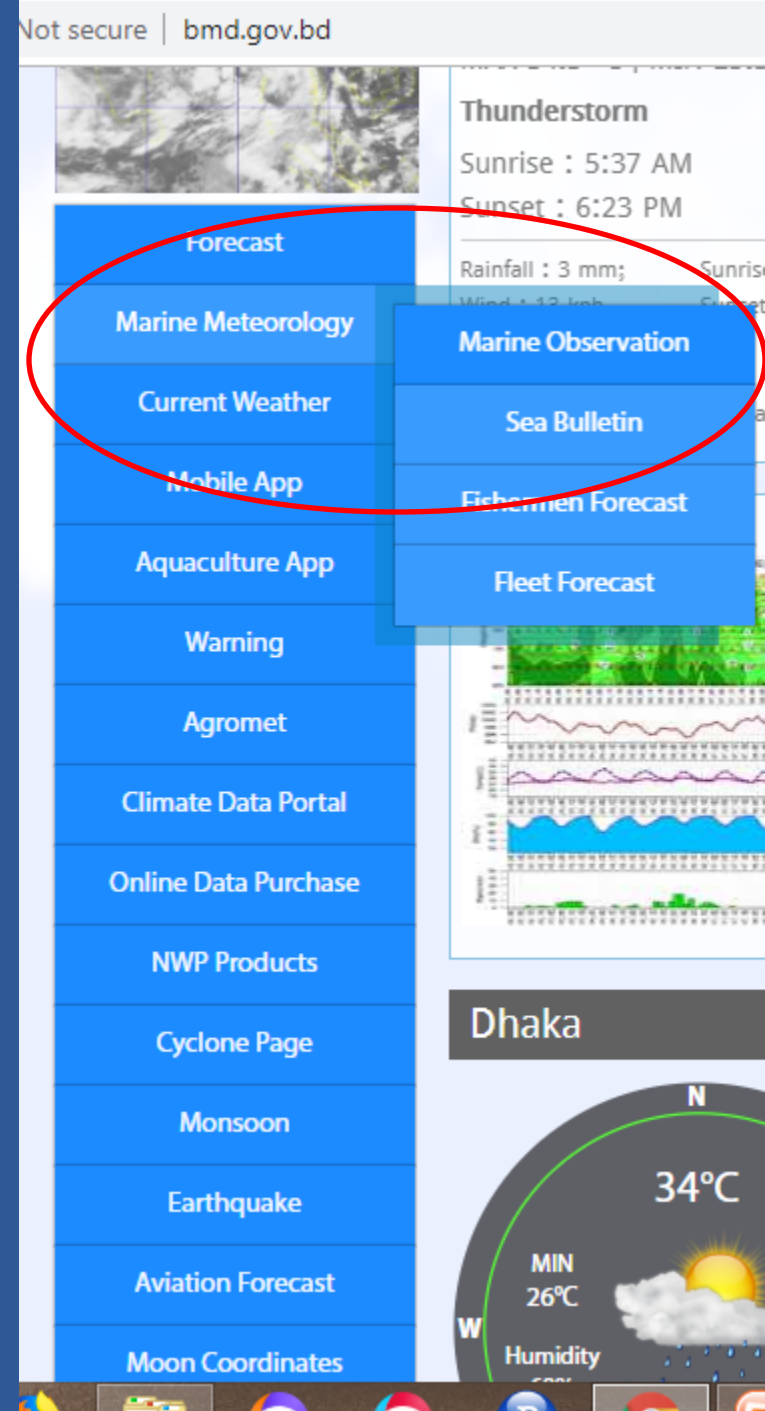


Recent Observational Network of BMD

❑ Marine Observational Network

❑ Soil Moisture observational Network

❑ Real time Rainfall Network

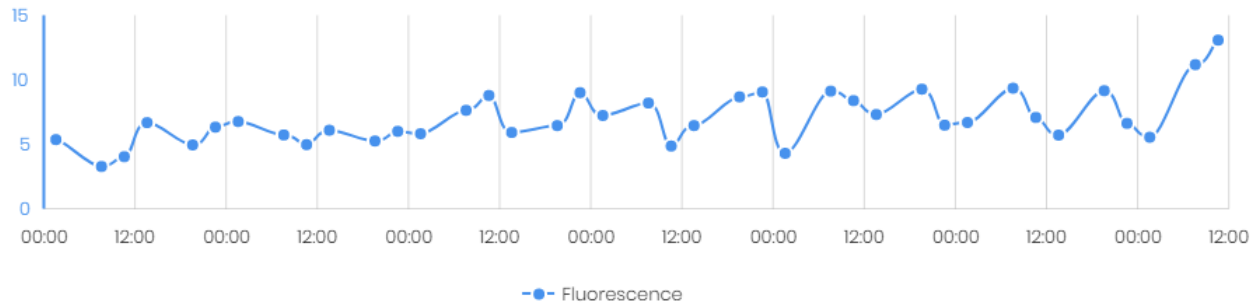


Sign in Required

Username: public@bmd.gov.bd

Pressure as of 2019-08-18 10:11:35 0.53 dba	Temperature as of 2019-08-18 10:11:35 28.599 °C	Salinity as of 2019-08-18 10:11:35 5.556 g/l	Turbidity as of 2019-08-18 10:11:35 357.115 ntu	Oxygen as of 2019-08-18 10:11:35 6.846 mg/l	Fluorescence as of 2019-08-18 10:11:35 13.127 µl
Battery as of 2019-08-18 10:11:35 10.743 volt					

Last 7 Days Graph For "Fluorescence"



Last 7 Days Graph with All Parameters

Recent Observational Network of BMD

❑ Marine Observational Network

❑ Soil Moisture observational Network

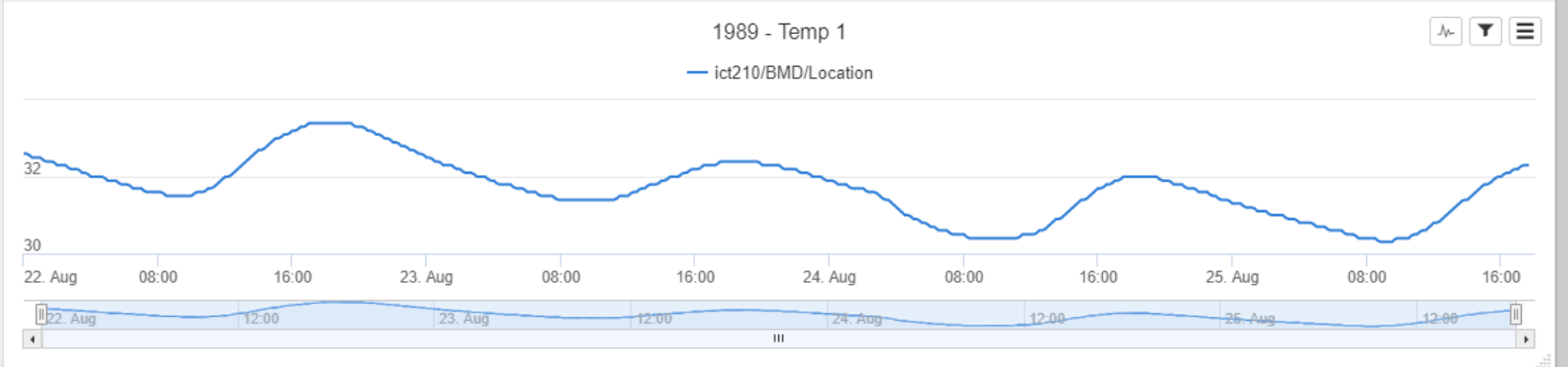
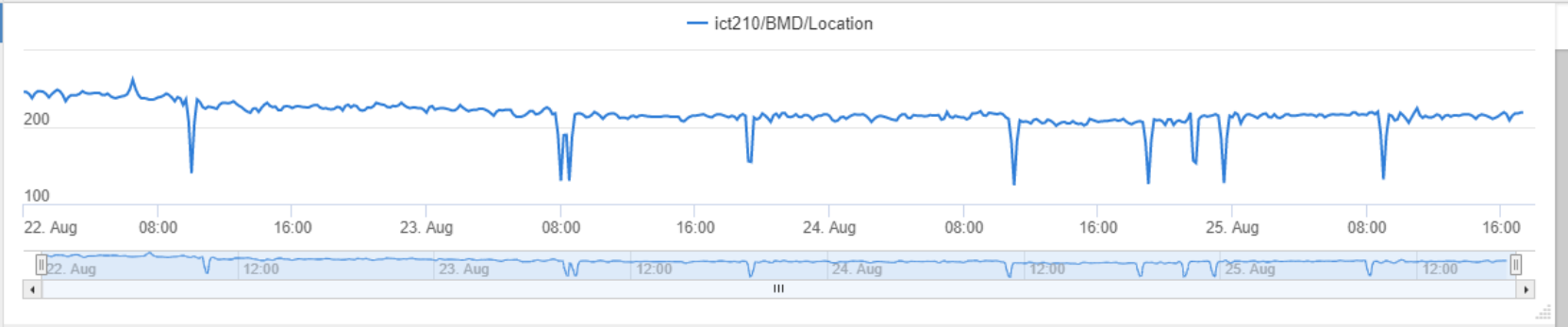
❑ Real time Rainfall Network

Not secure | bmd.gov.bd

The screenshot shows the BMD website interface. On the left is a vertical navigation menu with blue buttons. A red circle highlights the 'Soilmoisture Network' button, which has opened a sub-menu. The sub-menu contains the following options: 'SPI for One Month', 'SPI for Three Month', 'Max. Temp. Deviation', 'Mean Temp. Deviation', and 'Min. Temp. Deviation'. To the right of the menu is a weather widget for Dhaka, displaying a current temperature of 34°C, a minimum of 26°C, 60% humidity, and a partly cloudy sky with rain. The website footer shows a date and time grid for August 3rd, 4th, and 24th.

Time	3 AM	9 AM	12 PM
4 Aug		24 Aug	24 Aug

- BMD
- Site Pictures
- Location

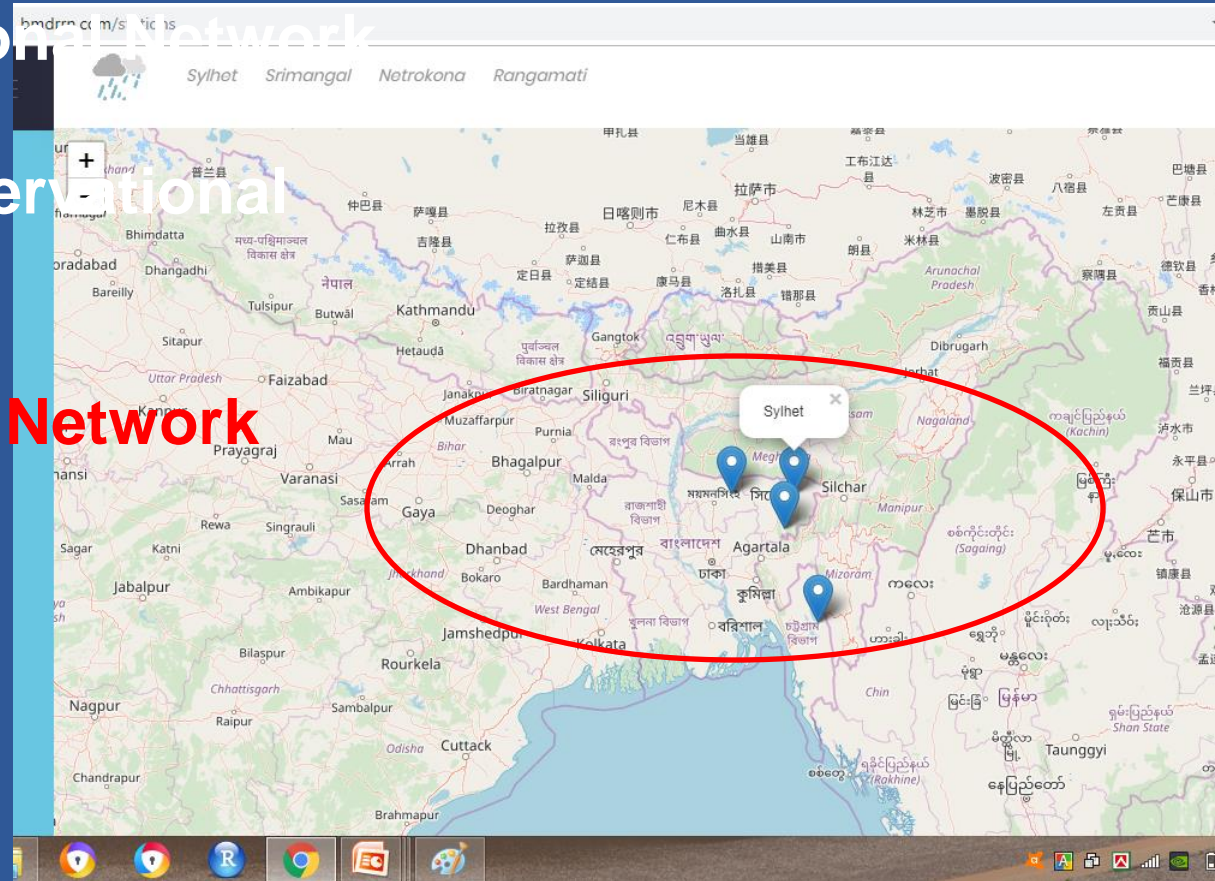


Recent Observational Network of BMD

☐ Marine Observational Network

☐ Soil Moisture observational Network

☐ Real time Rainfall Network



1. Features:

- Dashboard
- Real Time Data
- Live Graph
- Last 24 Hrs Data

2. Networks

- Network Coverage

3. Reporting

- Generate Report

4. Early Warning System

- Get Warning





5. Data Comparison

- Compare With Location

6. Sample Data Request

- Sample Data
- My Requested Data

FEATURES

-  Dashboard
-  Real Time Data
-  Live Graph
-  Last 24 Hrs Data

NETWORKS

-  Network Coverage

REPORTING

-  Generate Report

EARLY WARNING SYSTEM

-  Get Warning

DATA COMPARISON

-  Compare with Location

Real Time Rainfall SCADA Network

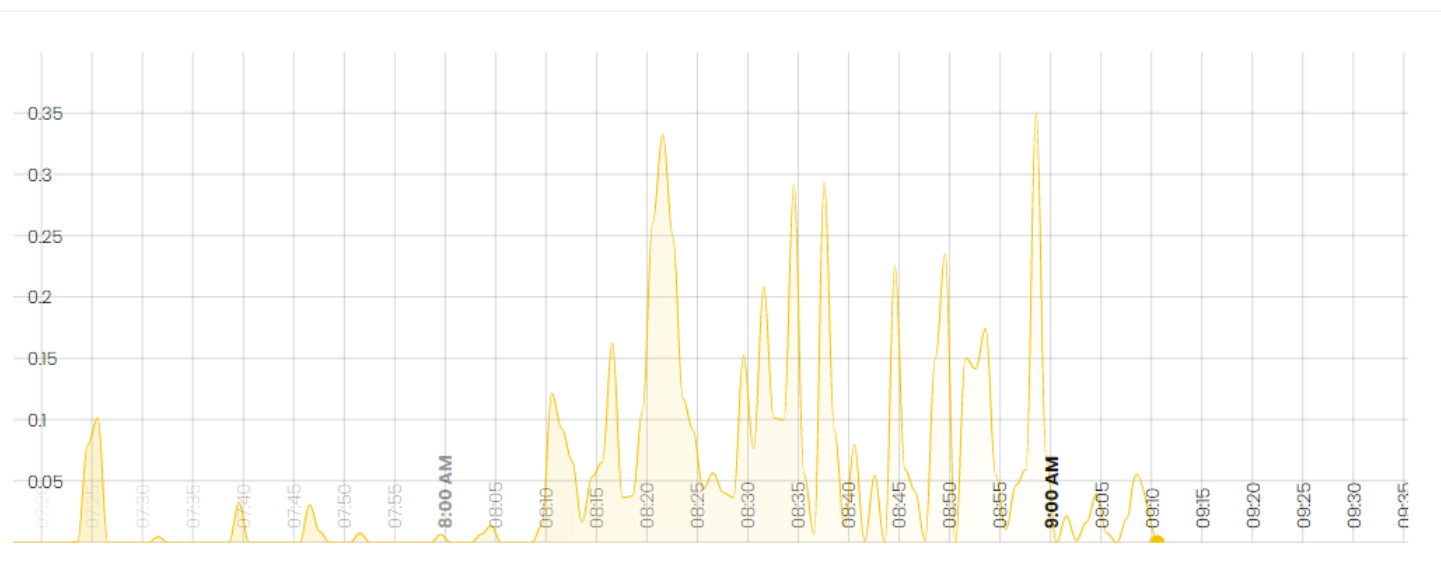
Netrokona Rangamati

Real Time Rainfall SCADA Network

Sylhet (RR@ 0.002) Srimangal Netrokona (RR@ 0.018) Rangamati

- FEATURES
 - Dashboard
 - Real Time Data
 - Live Graph
 - Last 24 Hrs Data
- NETWORKS
 - Network Coverage
- REPORTING
 - Generate Report
- EARLY WARNING SYSTEM
 - Get Warning
- DATA COMPARISON
 - Compare with Location
- SAMPLE DATA REQUEST
 - Sample Data

Live Graph For "Srimangal"



Live Graph For "Netrokona"

Future Plan: Implementation of Bangladesh Weather and Climate Services Regional Project (BWCSR): Component A

- ❑ Installation of 200 AWSs**
- ❑ Installation Automatic Rain Gauge Stations over Megha City area- Dhaka, Chattogram, Khulna and Rajshahi;**
- ❑ Installation of Ag-AWSs;**
- ❑ Installation of 3-moored Buoy over Bangladesh part of the Bay of Bengal;**
- ❑ Increase computational facility;**
- ❑ Capacity building by providing training in home and abroad;**
- ❑ Introduction of Ocean Modelling- Wave Watch Model, Hurricane- WRF Model;**
- ❑ Enhancement of Ensemble Forecasting;**
- ❑ Improvement of Seasonal Weather Forecasting**

Nowcasting Operation in BMD

❑ **Monitoring short lived weather phenomena:**

- Severe thunderstorm,
- Lightning,
- Hail,
- Tornado,
- Low visibility,
- Fog
- Heavy rainfall
- High wind

❑ **Nowcasting Technology**

- Real time observation
- Numerical Weather Prediction Model
- Radar image and information
- Satellite image and information
- Synoptic Analysis field of meteorological parameters

□ **Difficulties in Nowcasting Operation in BMD**

- **Regular operation of BMD Radars**
- **Less Human Capacity**
- **Irregular and changing behaviour of Weather and Climate**
- **Non-familiarity of updated Technology**
- **Adoption of new technology**

□ **Requirement to improve Nowcasting operation in BMD**

- **Human Capacity Building relevant to Nowcasting;**
- **Organization of Training and Workshop in Bangladesh**
- **Implementation WMO adopted technology;**
- **More practice on NWP modelling;**
- **Implementation of Decision Support System through integration of available data and information.**
- **Exchanging idea and views among operational forecasters, scientists, managers and users.**

Satellite Receiving System in BMD

☐ Himawari Satellite Receiving System:

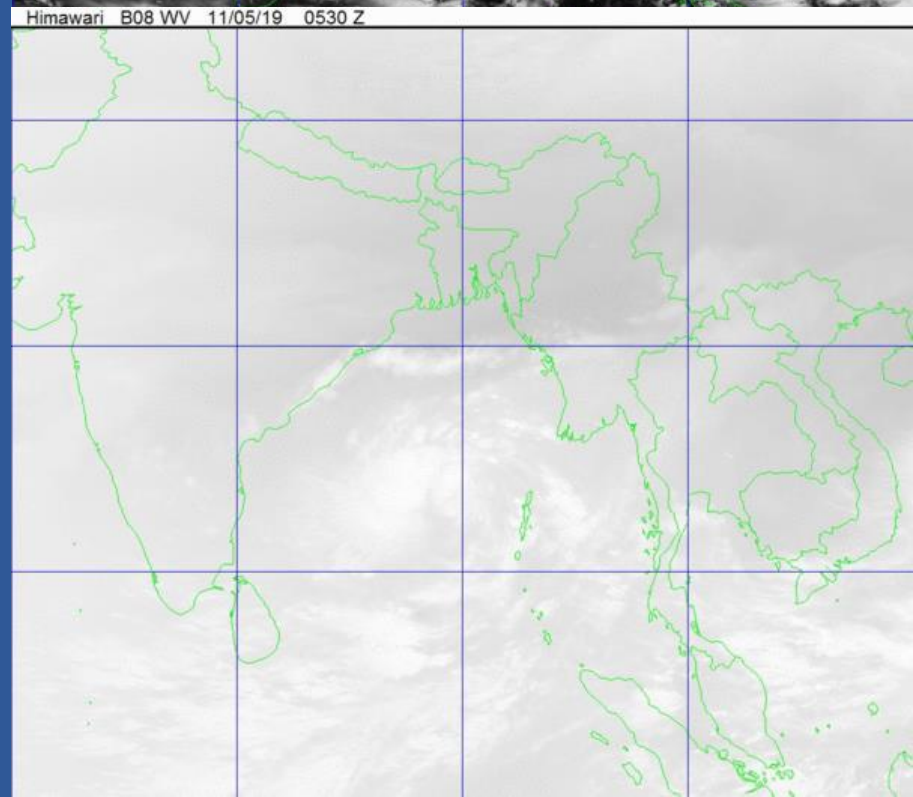
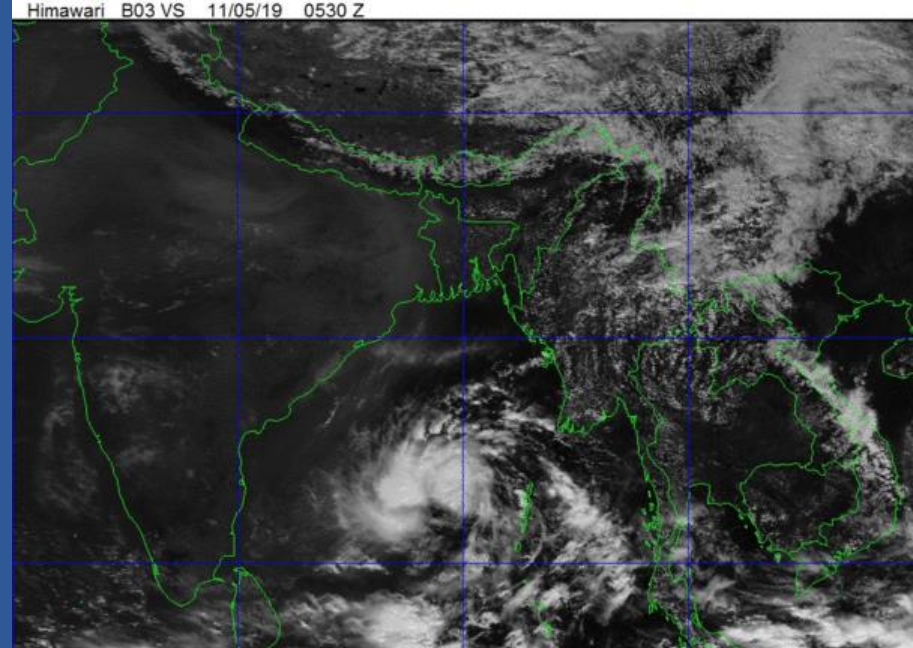
- Infrared channel
- Visible channel
- Water vapour channel

☐ Feng Yung Satellite Receiving System through CMACast System

- FY-2G, FY-2D and FY-2E images;
- Infrared Channels

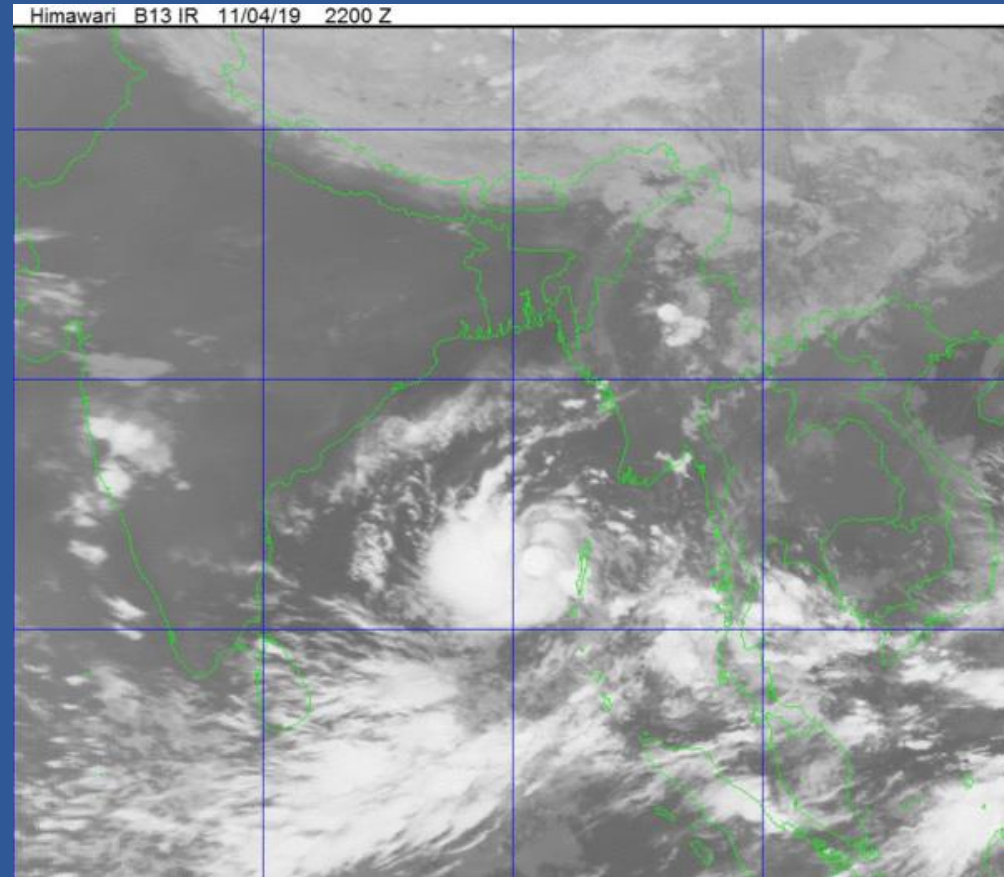
☐ MeteoSat Satellite image reception facility

- Visible & Infrared Channels



Utilization of Satellite information in BMD

- ❑ Data collection from the remote sites and Oceanic areas like Bay of Bengal area;
- ❑ Analyzing the features of weather systems;
- ❑ Determining the location of weather system;
- ❑ Following the movement of weather systems;
- ❑ Monitoring the life cycle of the weather system;
- ❑ Assessing the impact of weather system;
- ❑ Cyclone monitoring



THANK YOU