



**Stakeholders Workshop to initiate the implementation of
impact-based forecasting and risk-based warnings**

Forecasting & Warning Services

26 September 2016
Maldives Meteorological Service

Hussain Waheed
Assistant Meteorologist

Outline

- Introduction
- MMS Capacity
- Forecasting Tools
- Weather warning procedure (SOP)
- Challenges

Vision

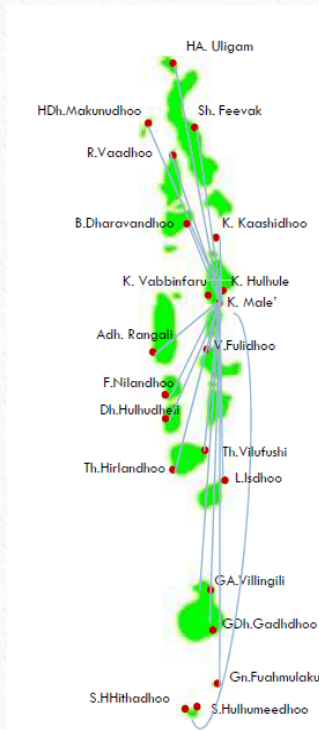
Provide accurate, timely and reliable meteorological information to minimize the impact on life and property while supporting sustainable socio-economic development of the Maldives.

Mission

- Timely dissemination of alerts and advisories on all natural disasters.
- Expansion and maintenance of weather observation net-work in accordance with international standards.
- Enable easy access of high quality historical meteorological data to the user community for Sustainable National Socio-Economic Development.
- Develop meteorological services and capacity building for the national requirement, and contribute to regional and international community.

Capacity of MMS

- Observing station: 5 manned, 20 automatic & 8 rainfall



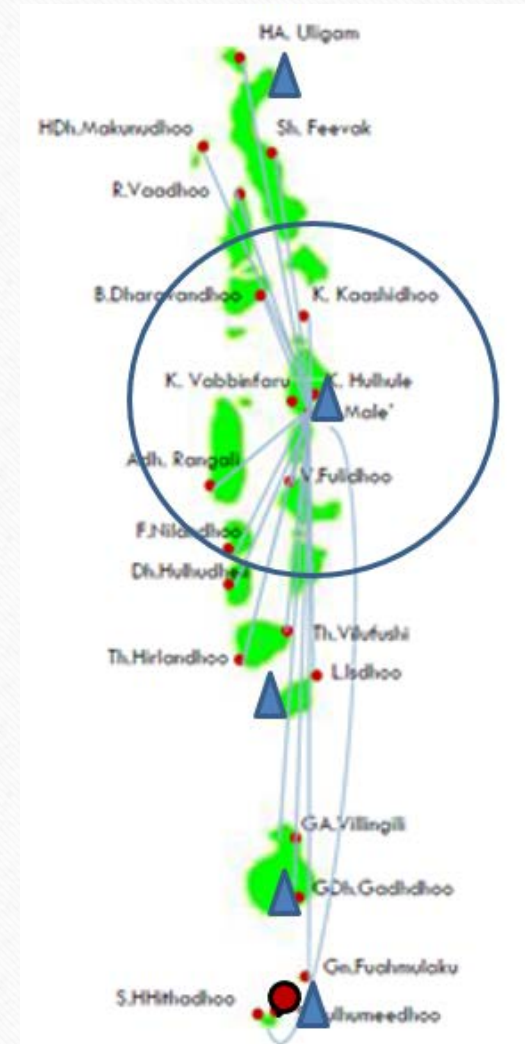
- The stations use vaisala weather transmitter WXT520. It is a small and lightweight transmitter that offers six weather perimeters in one compact package.
- WXT520 measures windspeed and direction, precipitation, atmospheric pressure, temperature and relative humidity.



Station: Select station From: 2009-11-10 00:00:00 To: 2009-11-10 23:59:59 Display: AWS Viewer 1.1.1 beta

AWS data for :male:

Time	Wind Dir Min (Deg)	Wind Dir Avg (Deg)	Wind Dir Max (Deg)	Wind Speed Min (Kt)	Wind Speed Avg (Kt)	Wind Speed Max (Kt)	Temp (°C)	RH (%)	Pressure (hPa)	Total Rain (Mm)	Rain Rate (Mm/hr)	Battery Voltage (V)	Logge Temp C
2009-11-09 13:15:51	282	96	192	2.527	13.0238	26.0475	25.2	90.3	1003.6	0.017	1		
2009-11-09 13:14:51	282	96	192	2.527	13.9957	32.851	25.2	90.1	1003.6	0.177	10.6		
2009-11-09 13:13:51	282	95	192	2.527	13.4125	32.851	25.2	90.3	1003.6	0.195	11.7		
2009-11-09 13:12:51	282	96	192	2.527	13.2181	32.851	25.1	90.2	1003.6	0.153	9.2	12.745	26.21
2009-11-09 13:10:51	282	97	229	2.527	12.8294	32.851	25.1	89.4	1003.6	0.095	5.7	12.801	25.61
2009-11-09 13:09:51	282	97	229	2.527	12.8294	32.851	25.1	89.1	1003.6	0.070	4.2		
2009-11-09 13:08:51	282	97	229	2.527	12.8294	32.851	25.2	89	1003.1	0.145	8.7	12.801	25.78
2009-11-09 13:07:51	282	97	229	2.527	12.635	32.851	25.3	89	1003	0.072	4.9		
2009-11-09 13:06:51	23	97	229	3.30454	13.4125	32.851	25.3	89.2	1003.3	0.035	2.1		
2009-11-09 13:05:51	23	96	229	3.30454	13.6059	32.851	25.4	88.7	1003.3	0.067	4		
2009-11-09 13:04:51	7	96	229	3.30454	13.2181	28.7689	25.5	89.5	1003.3	0.110	5.6		



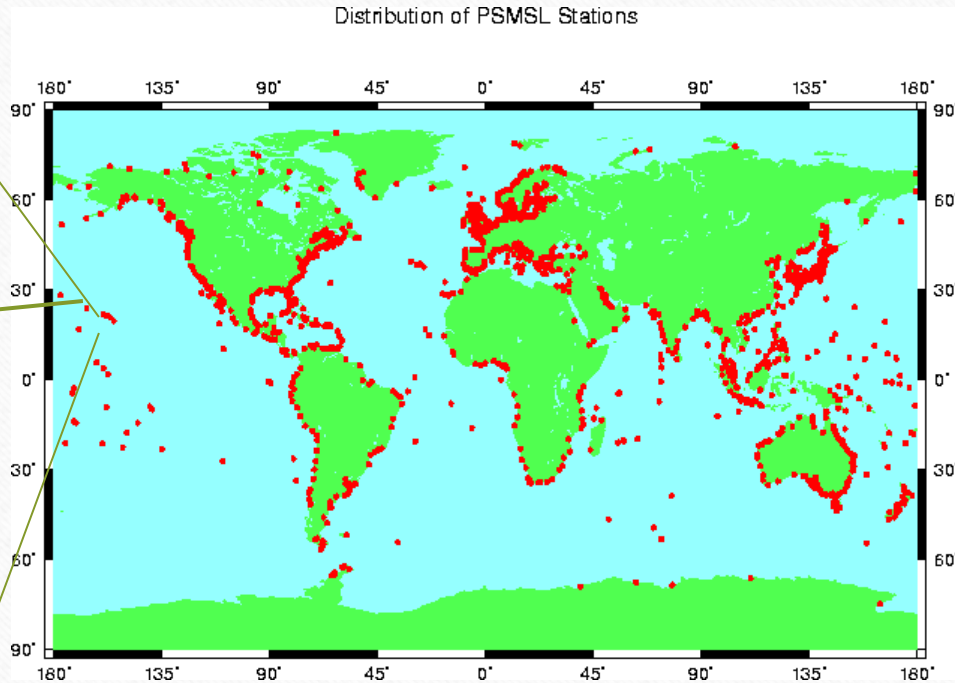
Capacity of MMS

- Tide gauges: 3

HD.Hanimaadhoo

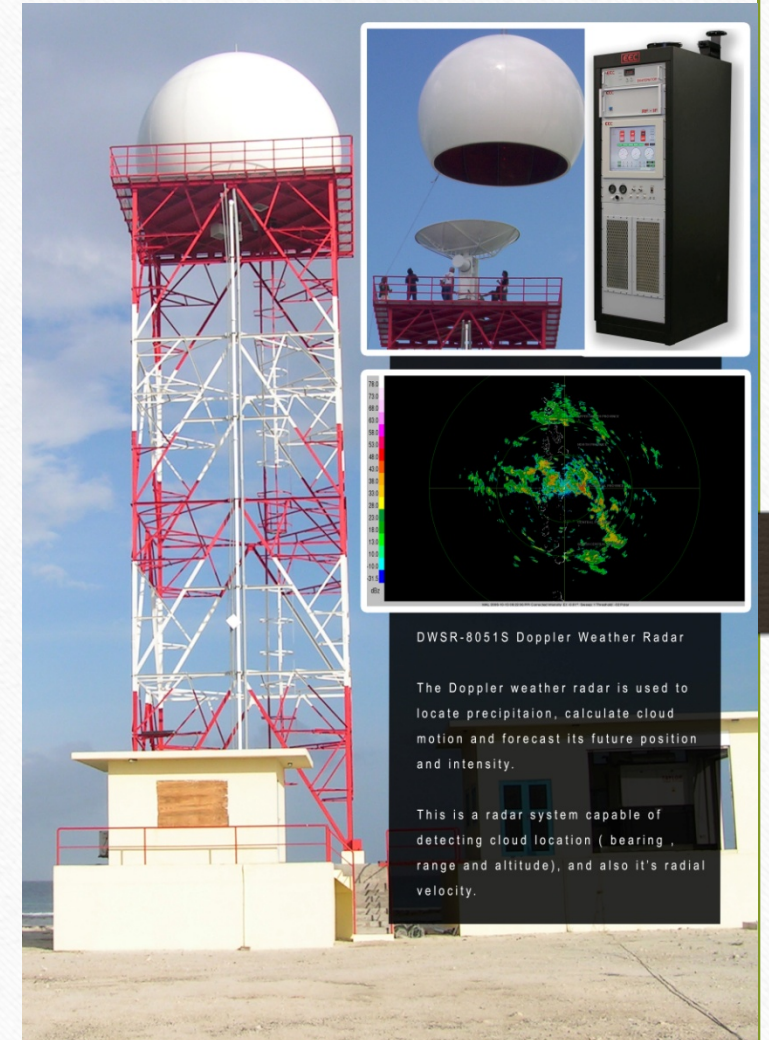
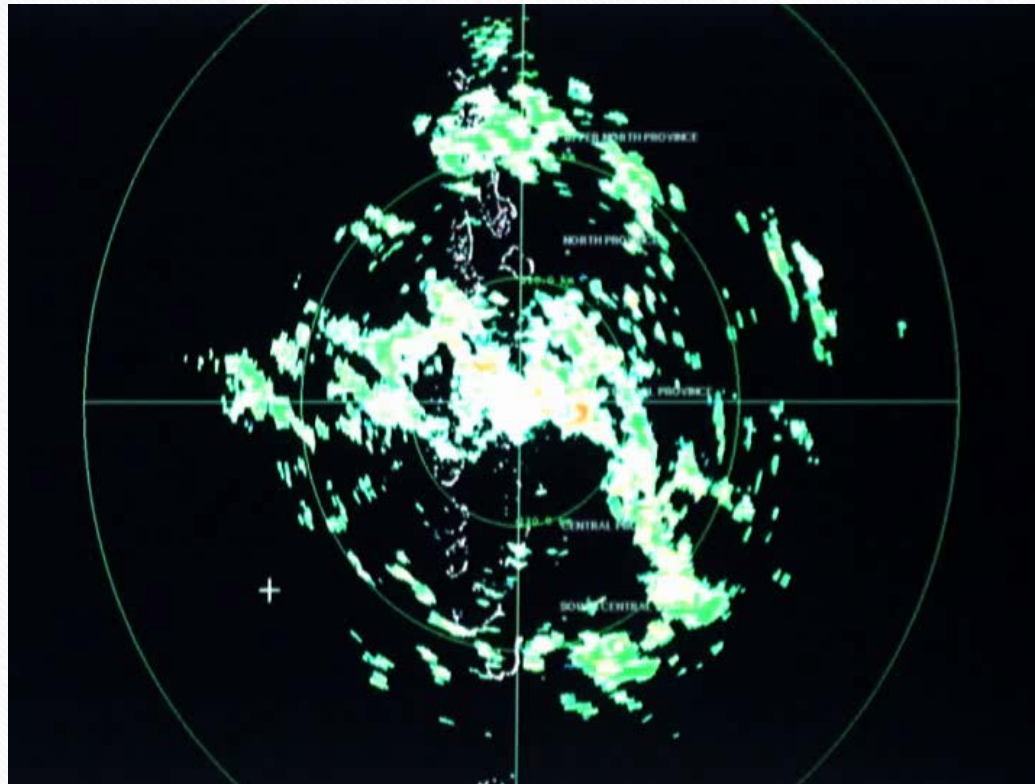
Hawaii

Hulhule



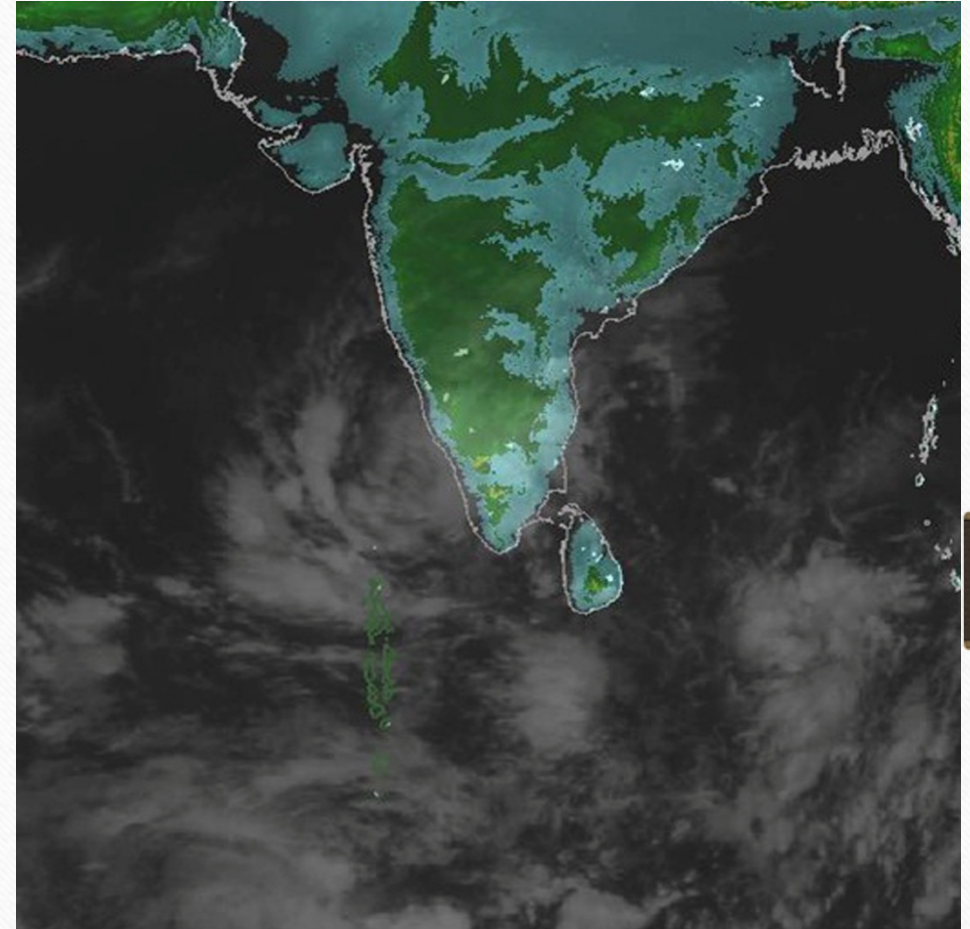
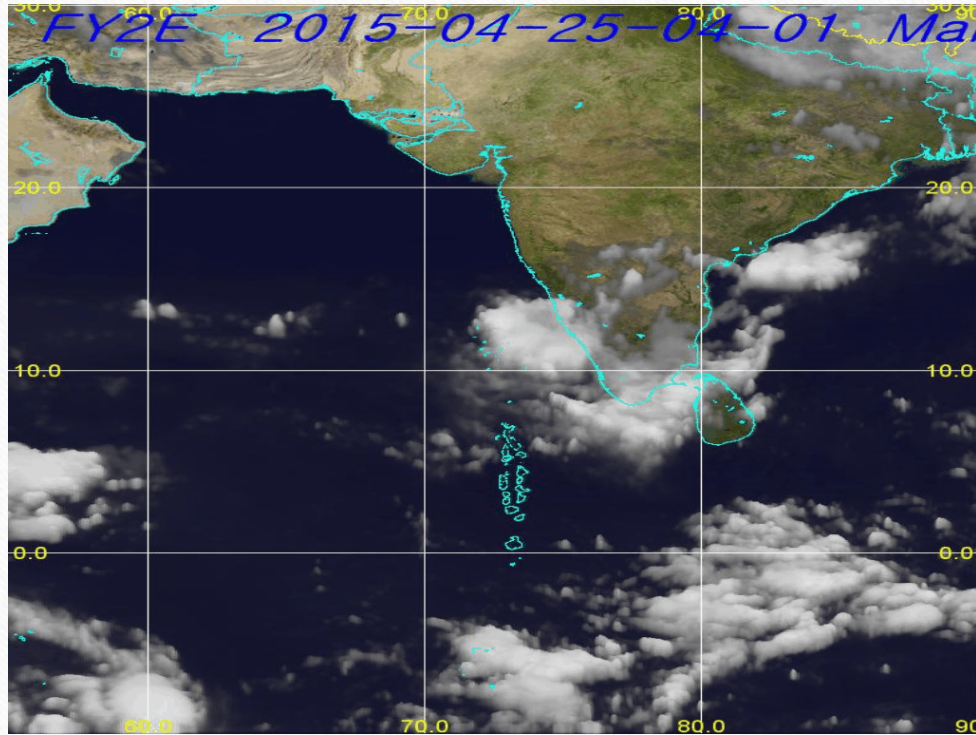
Capacity of MMS

- Doppler Weather Rader : 1 (Recently repaired)

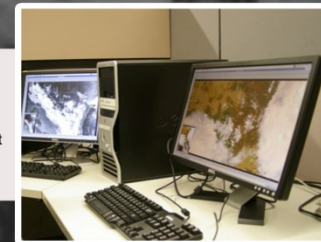


Capacity of MMS

- CMAcast

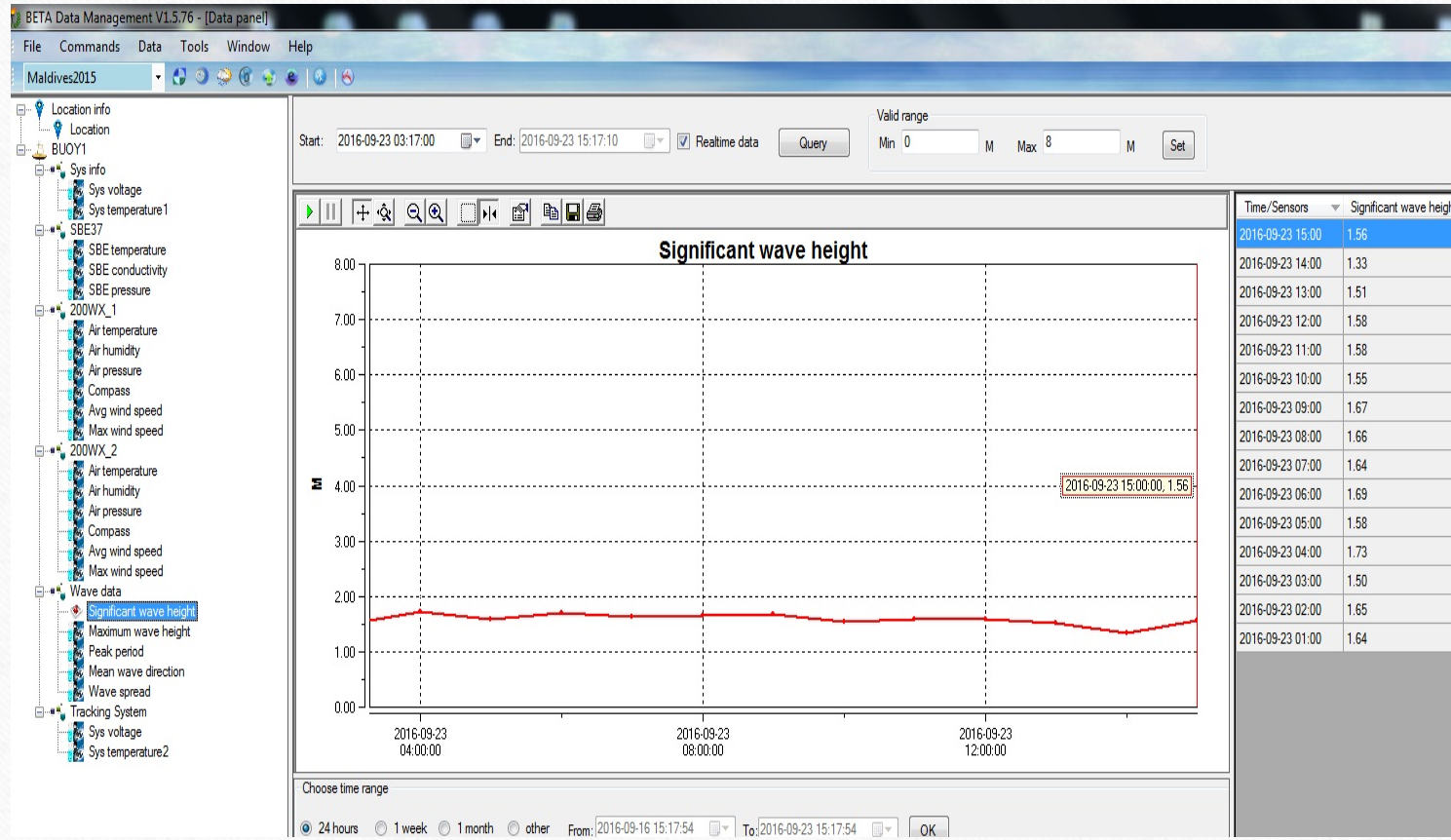


GEOSAT500 Satellite
Image Receiving System
fetches satellite images at
30 minute intervals.



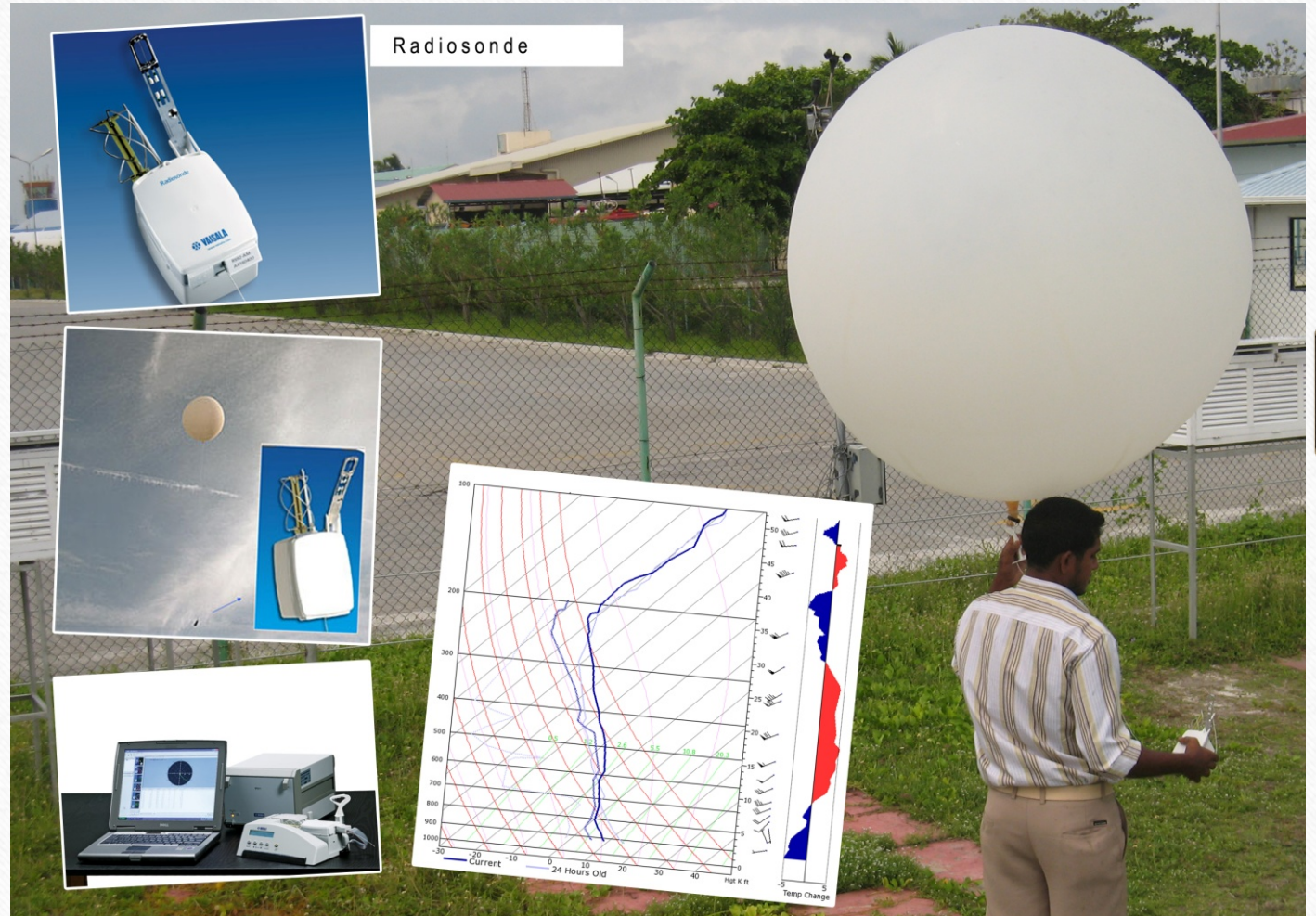
Ocean Observation

- The Ocean monitoring Buoy has been deployed near Addu City.



Capacity of MMS

Upper air station (RadioSonde)



Capacity of MMS

- Aviation weather workstation (COROBOR systems)

The screenshot displays the MESSIR-AERO software interface, which is a web-based aviation weather workstation. The interface is organized into several functional sections:

- Obs (Observations):** Includes buttons for TAF Long, TAF Short, METAR SPECI, and Bulletin.
- Forecast:** Includes buttons for SIGMET, AIRMET, and GAMET.
- Charts:** Includes buttons for SIGWX BUFR-coded, SIGWX PNG-coded, Wind/Temperature, Flight Documentation, Other PNG/T4 Chart, and Other model.
- MESSIR-AERO:** The central title of the application.
- COROBOR Systemes:** A logo and contact information for the system provider, including support@corobor.com, www.corobor.com, and V6.63.4.0 - 87V.
- Urgent:** A section for critical alerts, including Cyclon advisory, Volcanic ash advisory, Volcanic ash dispersion chart: 8, PNG chart amendment, Administrative message: 1, Special AIREP, Urgent SIGMET: 13, and Urgent SPECI: 74.
- Admin:** Includes buttons for Circuits monitoring, Rx monitoring, Circuits - Routing, and Setup.

A small bar chart is visible in the bottom right corner of the interface, and the system clock shows "Thu 25 18:41 UTC". The Windows taskbar at the bottom indicates the system is running on Windows XP with several open applications.

Capacity of MMS

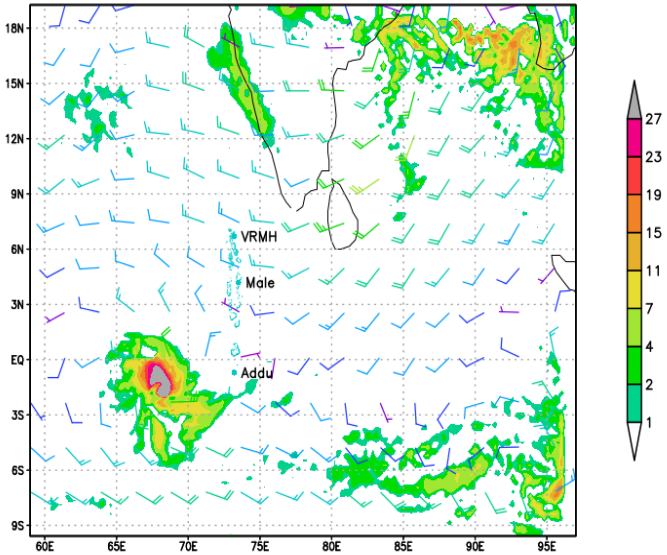
- Weather studio
- 2 Seismic Sensors
- GTS , AFTN
- NWP (WRF) model

Weather Forecasting Tools

NWP Model (WRF)

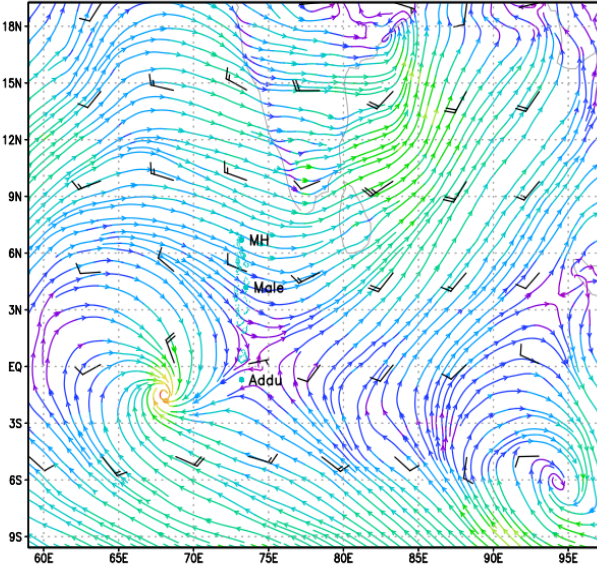
- Horizontal resolution 27 km

Forecasted Rainfall and winds(kt) on Mon 03Z26SEP2016



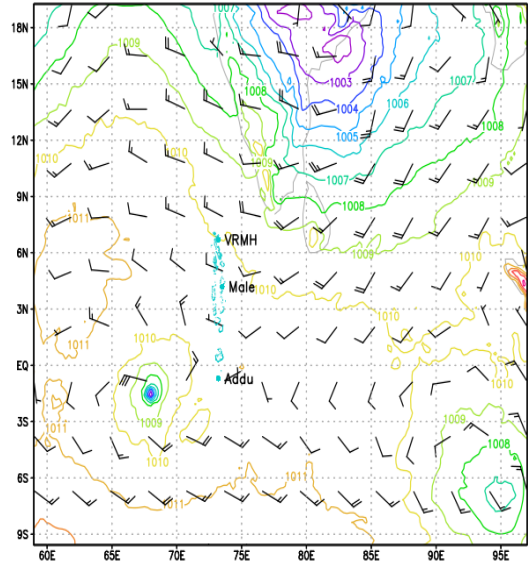
MMMS model run on MMS Climate Server on 22092016 12UTC

Streamline Winds(knots) Forecast on Mon 03Z26SEP2016



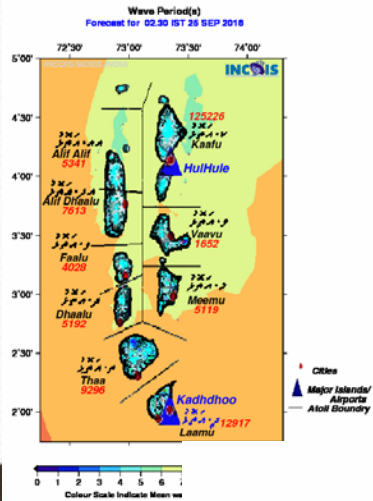
MMMS model run on MMS Climate Server on 22092016 12UTC

Surface Winds(kts) and MSLP (hPa) Forecast on Mon 03Z26SEP2016



MMMS model run on MMS Climate Server on 22092016 12UTC

RIMES & INCOIS Products for Maldives



INCOIS
Integrated Ocean Information and Forecast System
Maldives

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Home | Logout

Forecast Products

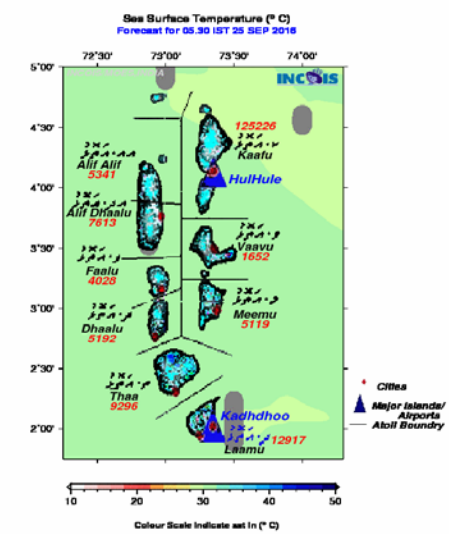
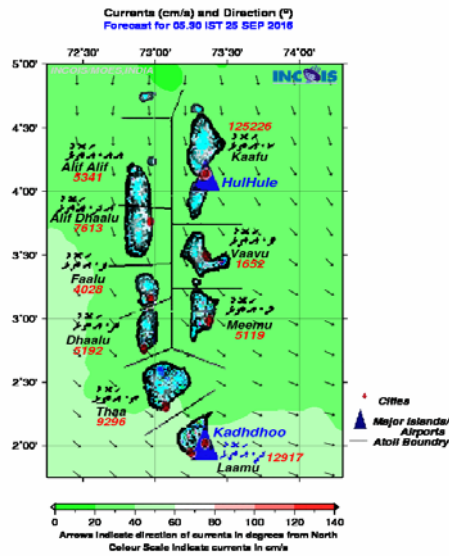
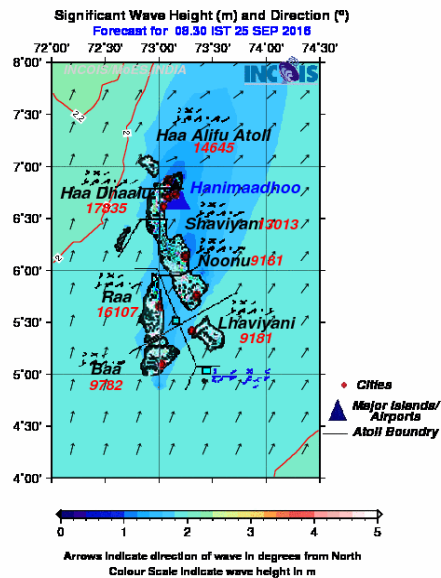
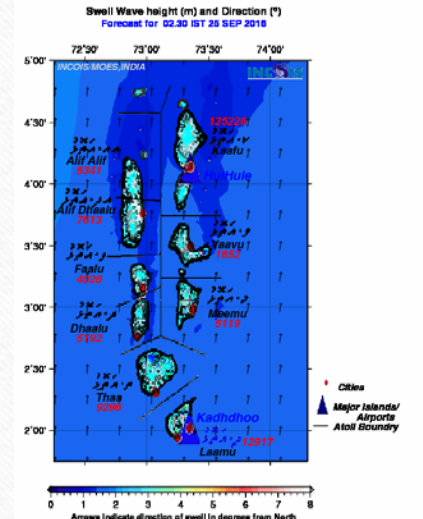
- Water
- Wave period
- Swell
- Swell period
- Wind
- Sea Surface Temperature
- Mixed Layer Depth
- Surface Currents
- Location Specific

Indian Ocean Forecast System (INDOFOS)

The Maldives, having a coastline of 0.44 km, is a tropical nation in the Indian Ocean comprising 26 coral atolls, which are made up of hundreds of islands. It is known for its beaches, blue lagoons and extensive reefs. The water depths just beyond the reefs can drop even upto 2000 m. Maldives being a low lying nation, is under the constant threat of coastal inundation by distant generated swell waves. There is also a risk of sea water inundation during extreme high e.g. perigean spring tides. Even though cyclone risk is minimal, the sea conditions are rough during the southwest monsoon season. The island communities (particularly fishermen, ports and harbours, tourism departments, defence, coast guard and shipping), require timely and accurate forecast information on ocean state and marine meteorological parameters.

To cater to these needs, Ministry of Earth Sciences, Government of India developed an integrated high resolution ocean forecasting system for Maldives. The forecast is available to the users three days in advance at 3-6 hour temporal resolution for wind, waves, currents, temperature in map form for the region. These forecasts are updated daily on operational basis. Since the latitudinal extent of these islands is high, these forecasts are again span sub-divided conveniently for the user for the Northern, Central and Southern Maldives. In addition, location specific forecast products are available for the following locations

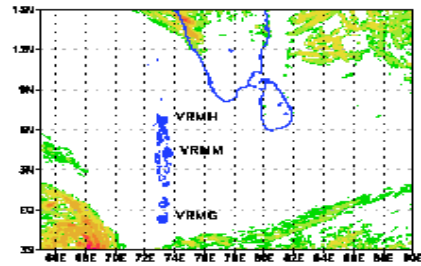
Northern Maldives



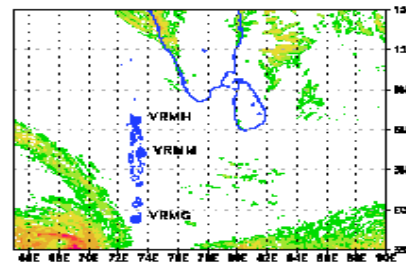
RIMES Products for Maldives

12 Hour Accumulated Rainfall (mm) simulation

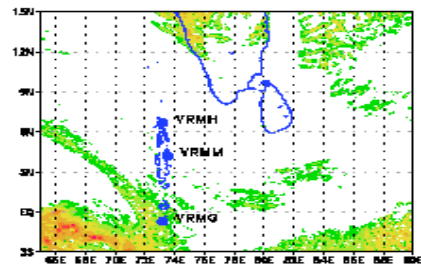
Valid from 00-12 UTC 24092016



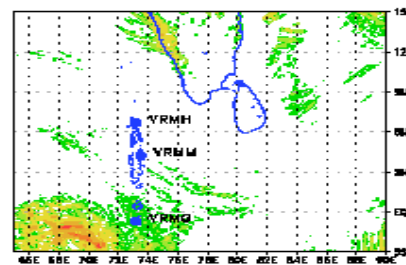
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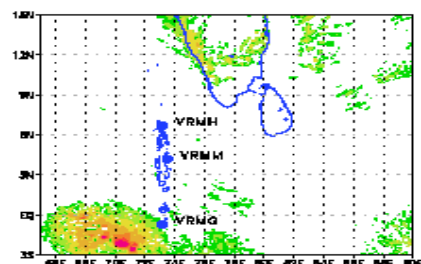
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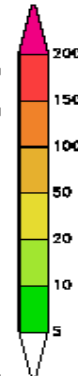
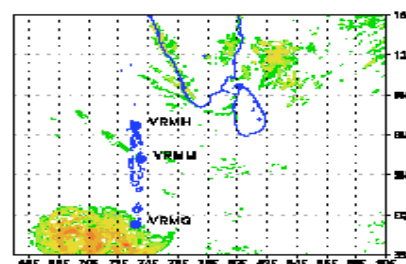
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Valid from 00-12 UTC 26092016

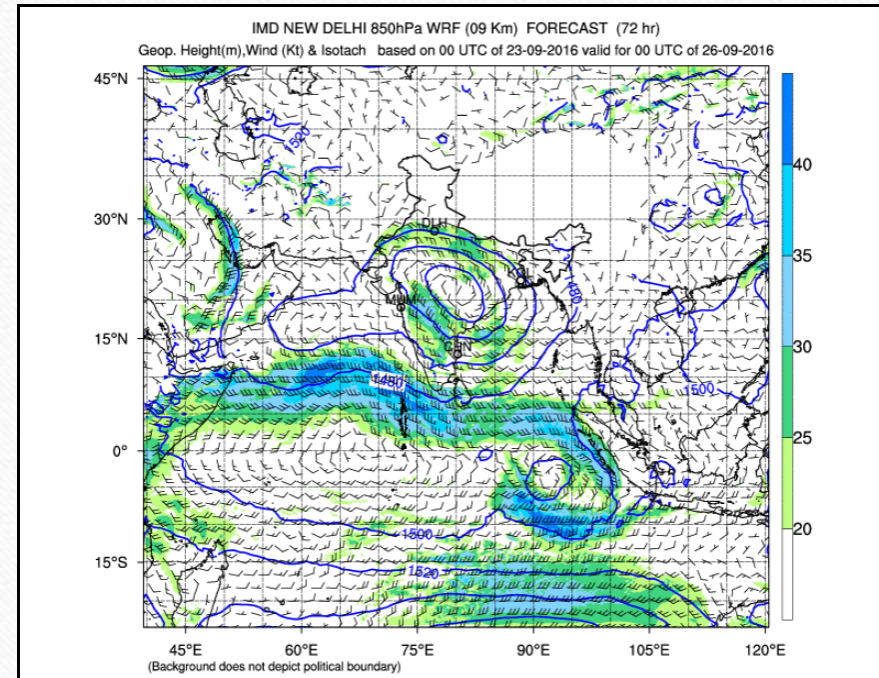
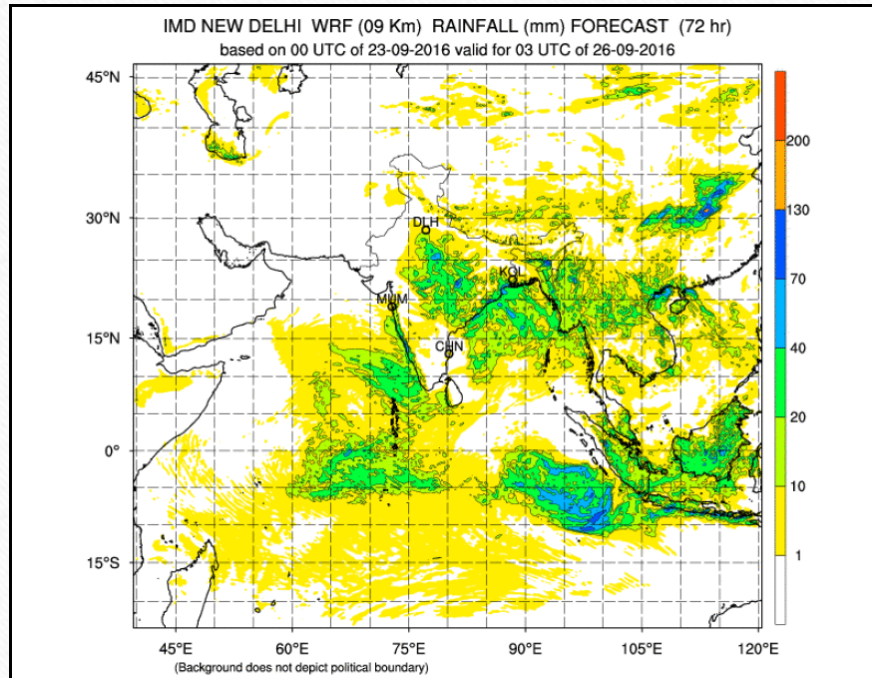


Valid from 12-00 UTC 26092016



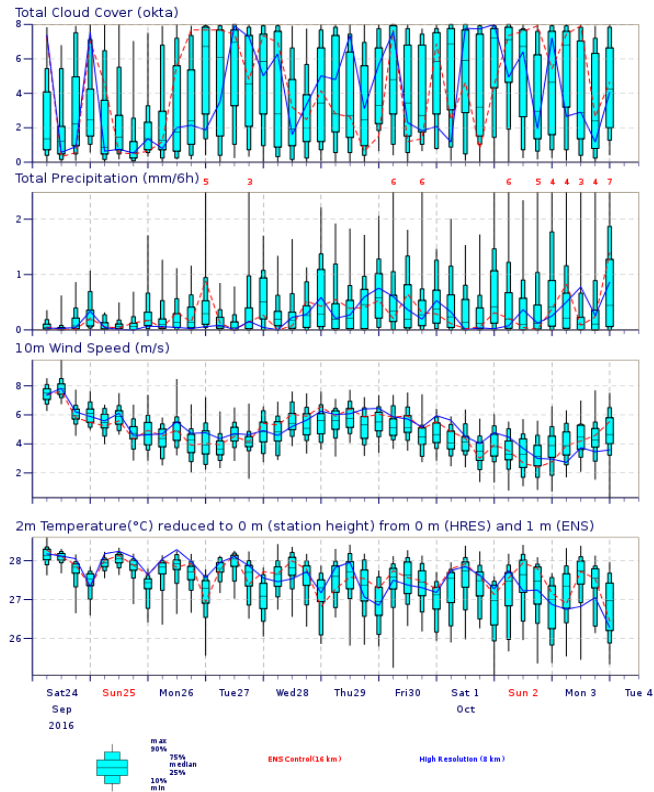
Product generated by NCEPWF and RIMES

Other online NWP Products

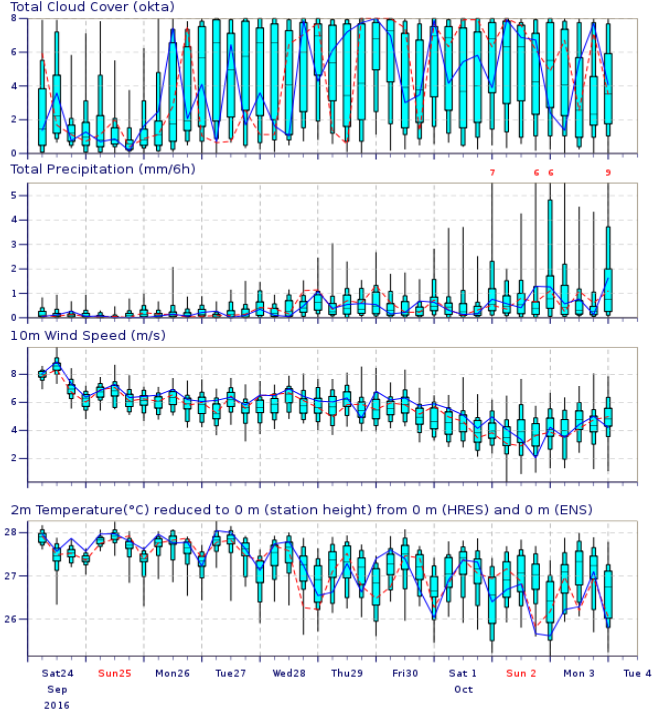


ECMWF NWP Products

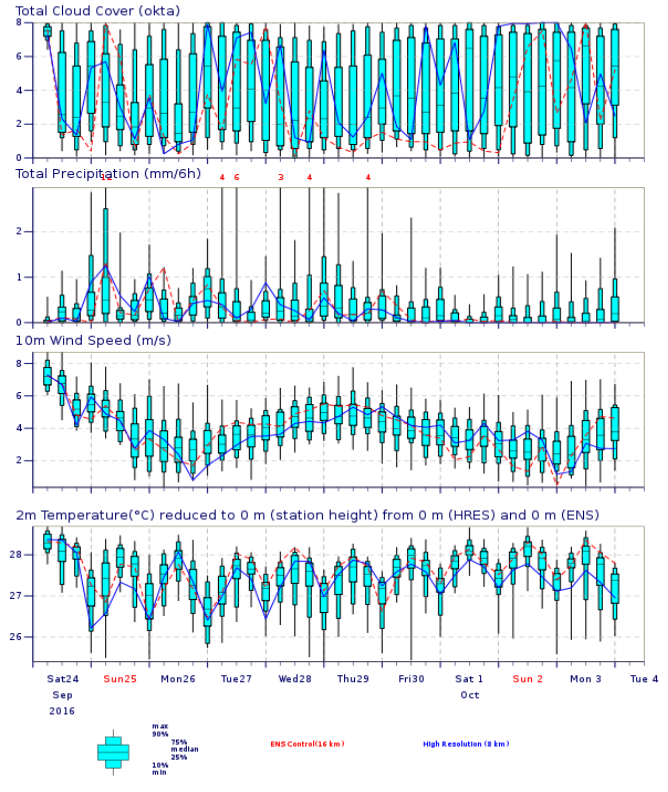
ENS Meteogram
 Male 4.15°N 73.46°E (ENS sea point) 0 m
 High Resolution Forecast and ENS Distribution Saturday 24 September 2016 00 UTC



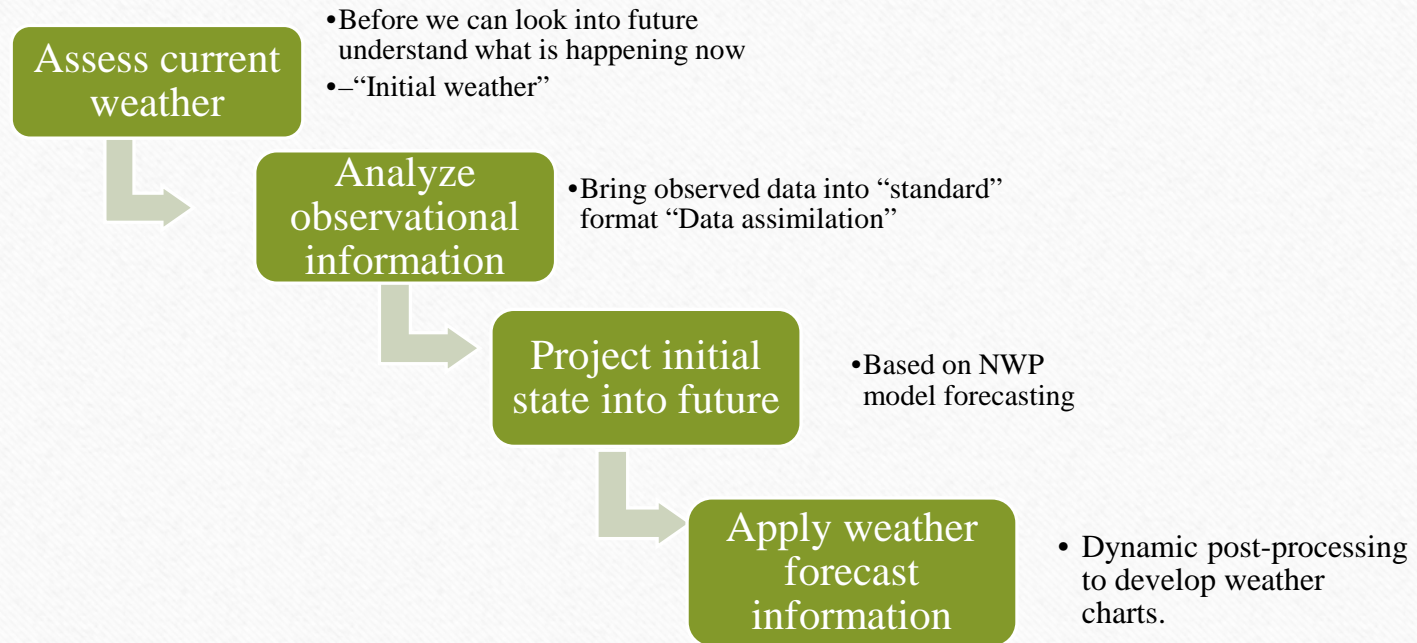
ENS Meteogram
 Hanimaadhoo 6.68°N 73.12°E (ENS sea point) 0 m
 High Resolution Forecast and ENS Distribution Saturday 24 September 2016 00 UTC



ENS Meteogram
 Gan 0.63°N 73.13°E (ENS sea point) 0 m
 High Resolution Forecast and ENS Distribution Saturday 24 September 2016 00 UTC



Weather forecasting process



WEATHER FORECASTING AND DISSEMINATION

Weather Forecast – Maldives

(Valid: 25 Oct / 10:00 am to 26 Oct / 10:00 am)

Scattered rain with a few heavy showers and thunderstorms will be experienced in central and northern atolls. Isolated showers are expected in southern atolls.

Surface winds will vary between south / south-west 13 – 23 miles per hour in central atolls and 7 – 17 miles per hour elsewhere. Winds may gust 40 miles per hour during showers.

Seas would be moderate becoming rough during showers.

Weather Forecast – Maldives

(Valid: 05 March/ 08:00 pm to 06 March / 08:00 pm)

Scattered showers with a few thunderstorms will be experienced in southern atolls. Generally fine weather is expected elsewhere.

Surface winds will vary between North-east / easterly at 8 – 18 miles per hour in southern atolls and 3 – 13 miles per hour elsewhere.

Seas are expected to be moderate in central atolls and slight elsewhere.

[Dhivehi Forecast](#)

[English Forecast](#)

[Marine Forecast](#)

[Daily Rainfall Report](#)

Aviation Products

- [SYNOP/PILOT-TEMP](#)
- [Flight Folder](#)
- [T4Charts](#)
- [METAR/SPECI](#)
- [SIGMET](#)
- [SIG WEATHER](#)
- [TAFS](#)

Forecast on Web

The screenshot displays the Maldives Meteorological Service website. The browser's address bar shows the URL www.meteorology.gov.mv/dhivehiweather. The website header includes the logo of the Maldives Meteorological Service, the text "Maldives Meteorological Service Republic of Maldives", and navigation links for "Public", "Aviation", "Climate", "Earthquakes", "Awareness", "Media", and "About us". A secondary set of links for "Links", "Contact Us", and a flag icon is also present. The main content area features a large background image of blue ferries on turquoise water. Below this image, the text "HOME / DHIVEHI WEATHER" is visible. The forecast is presented in Dhivehi script, starting with "ދިވެހިރާއްޖޭގެ ފަރާތްތަކަށް ބޭނުންކުރާ ފަރާތްތަކަށް" and "(08:00 ވަނަ ވަގުތުގެ ފަރާތްތަކަށް 08:00 ވަނަ)". It continues with "ދިވެހިރާއްޖޭގެ ބޭނުންކުރާ ފަރާތްތަކަށް ބޭނުންކުރާ ފަރާތްތަކަށް" and "ދިވެހިރާއްޖޭގެ ބޭނުންކުރާ ފަރާތްތަކަށް ބޭނުންކުރާ ފަރާތްތަކަށް". The forecast includes the date "22 ފެބްރުއަރީ 2016" and the time "14:36".

Public weather broadcasting

- TV (PSM) @ 8 pm & Radio stations 24/7



Standard Operating Procedure of MMS

- MMS uses 4 different colors of Alerts; White, Yellow, Red and Green.
- Stage 1 – Alert Level 1(Lookout-White), information bulletin
- Stage 2 – Alert Level 2 (Advisory - Yellow) Advisory bulletin
- Stage 3 – Alert Level 3 (Warning - Red) Warning bulletin
- Stage 4 – Step Down (Green) Downgraded or cancellation bulletin

Weather Alert condition

Alert Level		Description	Action
1	WHITE	<ul style="list-style-type: none"> -Mean wind speed is expected or prevailed between 23 – 29 mph. -Rainfall of more than 50 mm is expected to occur within 24 hours. -High tidal waves are expected. 	Weather Information, but no immediate threat.
2	YELLOW	<ul style="list-style-type: none"> -Mean wind speed is expected or prevailed between 30 – 40 mph. -Torrential rain is expected and if heavy rain occurred for more than 2 hours. -A severe thunderstorm is expected or experienced. -Tropical Cyclone is formed within effective areas of Maldives. -Significant tidal or swell waves expected or experienced. 	Concern authorities and people living in the area to be on alert & be ready to take action. Travel by sea not advisable.
3	RED	<ul style="list-style-type: none"> -Flash flood is expected. -A tropical Cyclone is tracked to move closer or cross Maldives islands. -Destructive tidal or swell waves or storm surge is expected or observed. 	Evacuation of population from threatened areas to safer places. Prohibition of sea transportation.
4	GREEN	The condition has improved.	Cancel warning

WEATHER ADVISORIES AND DISSEMINATION

- CURRENT medium
- Bulk sms, Twitter
- Telephone
- Fax
- Hot Line
- Media

ALERT YELLOW

Advisory:

Torrential rain expected.

Area: Southern atoll.

PERIOD:

03/0745 - 03/1145 hrs.

ISSUED:

0730 hrs 03 March 2016.

-MetService-

ALERT WHITE

INFORMATION:

Heavy rain with gust winds of 45 mph expected.

Area: Between Gaafu Alifu & Seenu atoll.

PERIOD:

05/1515 - 05/2100 hrs.

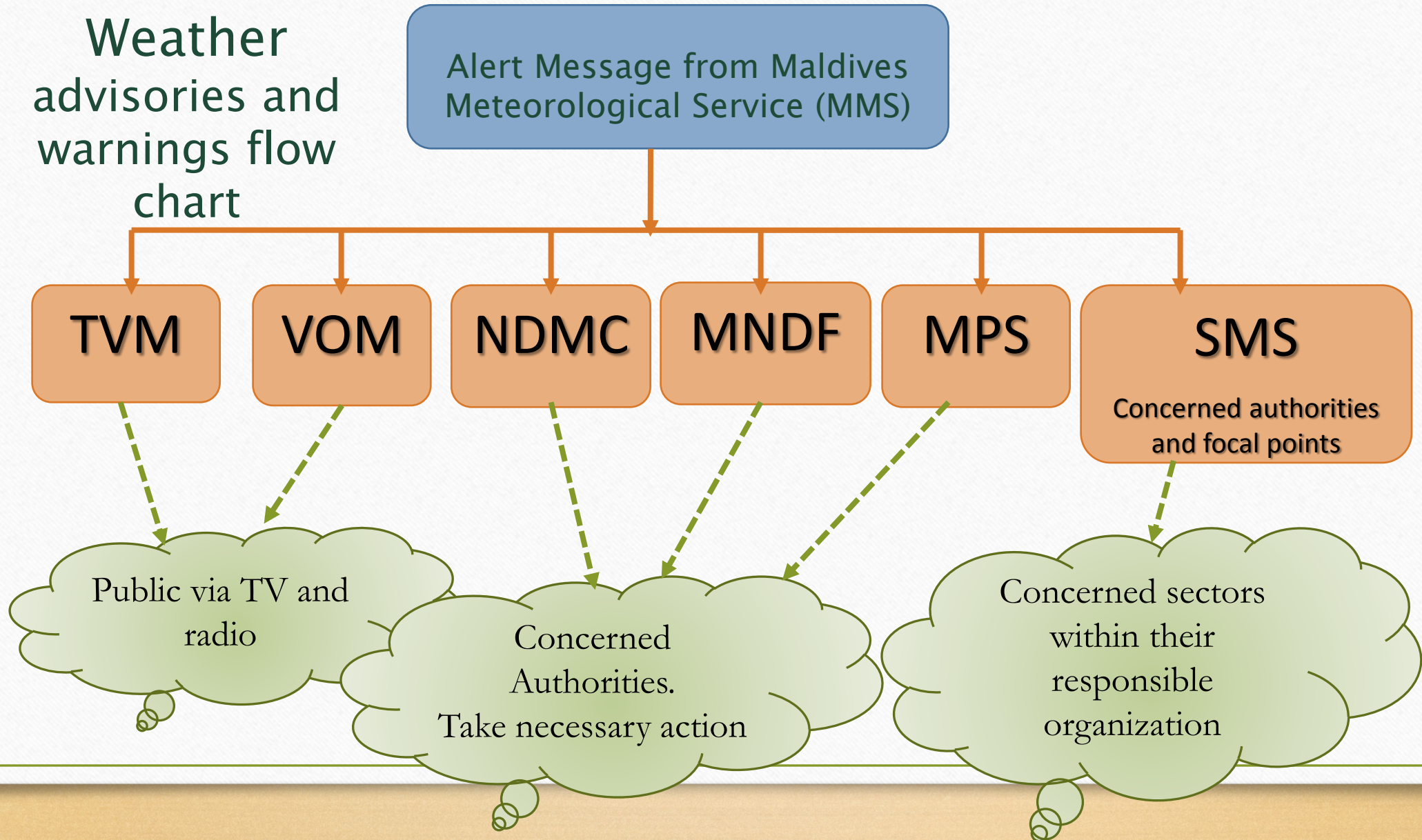
ISSUED:

1450 hrs 05 March 2016.

-MetService-

EARLY WARNING MECHANISM

Weather advisories and warnings flow chart



Challenges

- Lack of well trained staffs in weather forecasting and instrument maintenance.
- Topography (Disperse islands, Large area of Sea)
- Low Computing Capacity for Modeling
- Limitation of data availability



Thank you