DEPARTMENT OF METEOROLOGY

The vision

To be a centre of excellence in weather and climate related services

The mission

To provide services pertaining to Meteorology, Aeronautical Meteorology, Marine Meteorology, Hydro Meteorology, Agrometeorology, Climatology and Astronomy to government agencies, private sector and the general public in keeping with national interests and international standards.

Significant Historical Milestones in Meteorological Activities in Sri Lanka

Started in 1867 with the establishment of a few Meteorological observation network and a network of rain gauges

- Establishment of Colombo observatory in 1907
- Aviation Meteorological Activities started in 1946
- Establishment of the Department of Meteorology in 1948
- Became a member state of the WMO in 1951
- Establishment of an Agro-meteorology Division in 1973
- Became a gradea department in 2003

Major services provided by the Department of Meteorology

a) Provision of meteorological and climatological services to general public and to agriculture, energy, fishery, shipping, insurance and other interested sectors;

b) Provision of warnings and advisories on weather hazards;

c) Provision of aviation and marine meteorological services;

d) Maintenance of climatological databases;

e) Provision of meteorological and climatological services and data for national development and research purposes;

f) Encourage study and research in meteorology and allied subjects;

j) Provision of specialized meteorological and climatological services on request.

k) Provision of awareness and trainings in Meteorology for interested parties such as school children, forces,police,agriculture sectors, Aviation sector

DATA COLLECTIONS ,ANALYSIS& FORECASTING

The collection of weather data

Observation and collection of meteorological data are done by the National Meteorological Centers. Meteorological elements that are expected to observe, instrument used for and the units of the parameters are as follows.

Instrument sqared maintained according to the World Meteorological Oragnization's (WMO) standards

Element	Unit	Measuring Instrument
Temperature	Celsius	thermometer
Relative humidity	%	,,
Atmospheric pressure	hectopascal (hPa)	Barometer
Clouds	oktas	
Height of cloud base	metres	Ceilometer
Wind speed	m/s, knots	Anemometer
Wind direction	deg. clockwise from North	Wind Vane
Precipitation	mm	Rain Gauge
Sunshine duration	hours	Sun Shine recorder
Irradiance	W/m2	Pyronometer
Radiance exposure (daily global)	J/m2	
Visibility	m, Km	Transmissometer
Evaporation	mm	Evaporation Tank

These parameters are measured at "standard time of observation" which is the internationally agreed time as contained in WMO (World Meteorological Organization) regulations.

Standard times for surface observations are 0000 , 0600 , 1200 and 1800 UTC (ie. In Universal Coordinated Time) with intermediate observations at 0300, 0900,1500 and 2100 UTC .

Thus the atmospheric pressure observations should therefore be made exactly at these times. Elements other than pressure should be observed within ten minute preceding this time.

Some of the important parameters needed for aeronautical industry are measured every half hourly at the international airports.

Readings of the instrument should be manually done by trained officer at the particular time and the required corrections should be done to get the correct value. Some of the mechanical instruments were deployed to get continuous recordings.

AWS & AWOS:-

At present electronic instruments are being deployed to get very frequent readings and these measurements are fed to computers.

Automated Weather Observing Systems have been installed at the Bandaranaike International Airport,Katunayake and Rajapaksa International airport,Mattala. Two sets of instruments are being installed at the both runway ends. These instruments give Temperature, Pressure, Humidity, .Height to the clouds & amount of the clouds. As the cloud detectors (Ceilometers) are point targeted, obviously they don't give accurate data in the tropical countries like Sri-Lanka. However this instrument is important to get the vertical visibility when the horizontal visibility is very poor.

In addition 37 automatic Weather systems are deployed at regional Meteorological Stations and collaborative stations. Parameters are measured at every minute and data is sent to head office at Colombo at every 10 minutes via INSAT 3-E satellite.
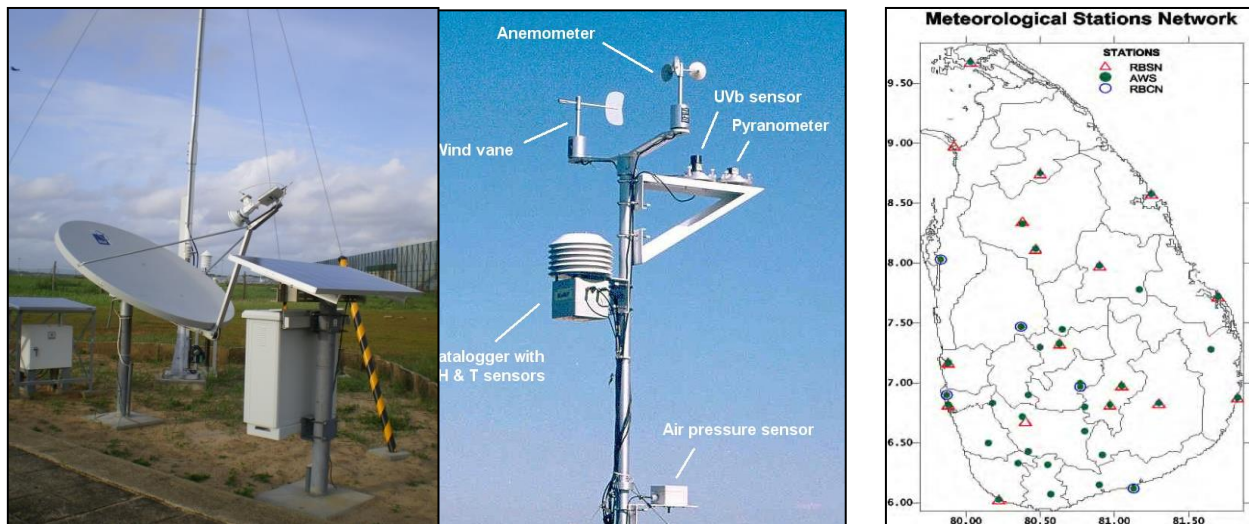
An automatic Weather system and network

Measuring of upper air data

| Hydrogen filled baloon | Radiosond instrument attaced to a baloon |

Upper air observations consists of pressure, temperature, humidity and direction and speed of the wind. A balloon is released to the atmosphere with a electronic device called radiosonde. The speed and direction can be calculated using the movement of the balloon. Radiosonde measures the Temperature, Humidity and Pressure.

These upper air observations are done in **every six hours at 0000 , 0600 , 1200 and 1800 UTC in the world** but in **Sri-lanka 1800UTC time observation is not done**.
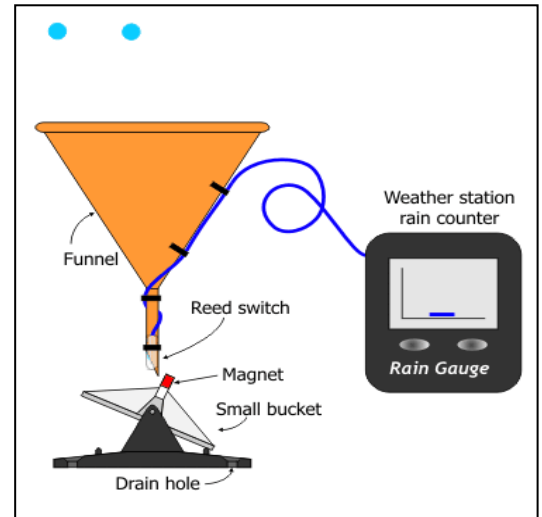
There are only **4 upper air observation centers(Colombo, Mannar,Trincomalee and Hambantota at present** i.e. in November 2015) in Sri-Lanka.

> ***If the upper air data is needed for any other place and at any other time, interpolated and forecast values will be given by the Duty Meteorologist***

Rainfall measuring net work
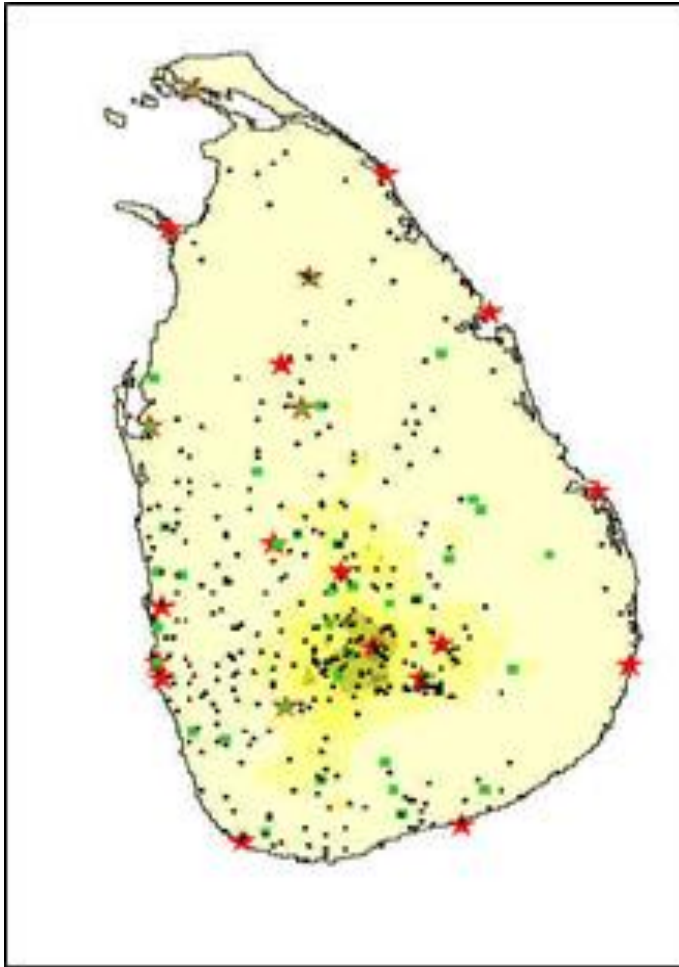
Rainfall collecting centres


Automated rain gauge

The network of rain gauge stations established throughout the island for the purpose of collecting rainfall data comprises of 487 rain gauge stations. Out of that, data are regularly obtained from 410 stations throughout the year .These stations are maintained in collaboration with government and non-governmental institutions and many voluntary observers. Rainfall is measured daily at 08.30 hours at these stations and the daily rainfall report is obtained by the Department at the end of the month for processing. Data from 210 stations selected island wide are obtained daily by telephone to be used for weather forecasting 20 telemeter rain gauges are deployed at rural and rainy areas. Half hourly data are received via SMS.

Agro Meteorological Data

40 agrometeorological centres to which a limited number of equipment and other technical information and advice are provided by the Department, have been established island wide and each day readings are obtained at 8.30 and 5.30 by the institutions that maintain these stations and these data are sent to the Meteorological department for the purpose of maintaining data systems.In addition to the weather parameters (such as wind speed and direction ,Temperature, humidity and rainfall ,temperature) measurements are obtained from depths below the surface at 5, 10, 20 30, 60 90 and 120cm depths. Grass minimum temperature and the amount of evaporations are also measured . These data are not utilized for weather forecasting and they are utilized for agro meteorological purposes.

Satellite & RADAR data:-

Meteorological data can repeatedly collected by weather Satellites and any changes on the atmosphere can be monitored in a global range in detail and over a long period of time. Polar orbiting satellites (850kms above the earth surface) and Geosynchronous satellites (36000 kms above the Earth surface) are deployed for cloud detection. These observed data are received on the ground and analyzed by computers.
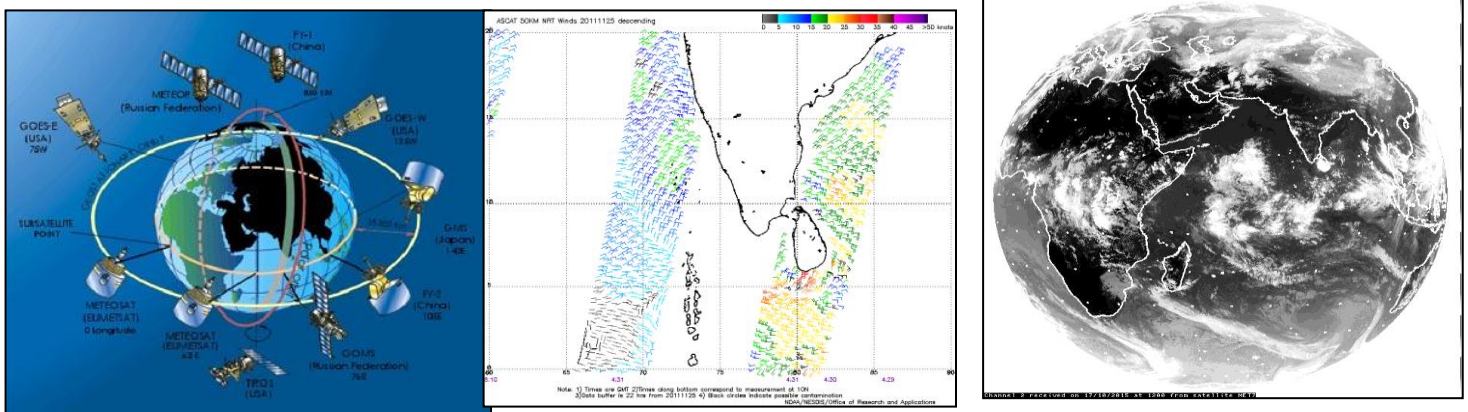
| Moving sattelites | Geostationary sattelite image | Polar orbiting sattelite image |

Images are from the internet

Governments of China and Korea have donated receiving systems to receive the data from their satellites. Satellite imageries from other satellites are received through internet.

Satellite derived products like Atmospheric Motion Vectors, Vorticity, Convergence/Divergence, Sea Surface Temperatures, Total Precipetable Water are also used extensively in weather forecasting.

In addition weather RADAR(**Ra**dio **D**etection **A**nd **R**anging.) can be successfully used for detection of precipitation echoes. Meteorologists use these precipitation echoes effectively and also to study the different characteristics of precipitation in detail. Doppler weather Radar system is supposed to be installed at Gongala, (Deniyaya) and at Puttalam and it will give opportunity to improve the forecasting of heavy rain and strong winds for few hours period.
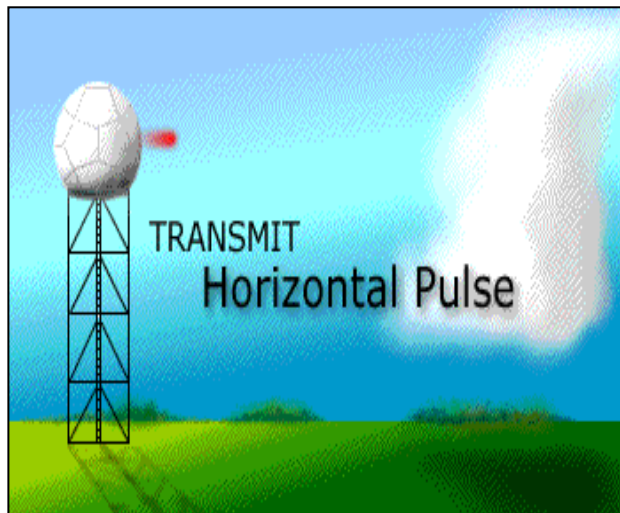

Image from the internet

The transmission of data

Transmission / communication of data on real time basis from the meteorological sites to the data analyzing centres is a very vital factor in weather forecasting. Transmission / communication of data should be as quick as possible in order to issue a forecast in advance to the stake holder organizations.

Telephones are used at the communication branch of DOM to get 3 hourly manual observations from 22 Meteorological stations. The steps are taken to receive these data through interne.
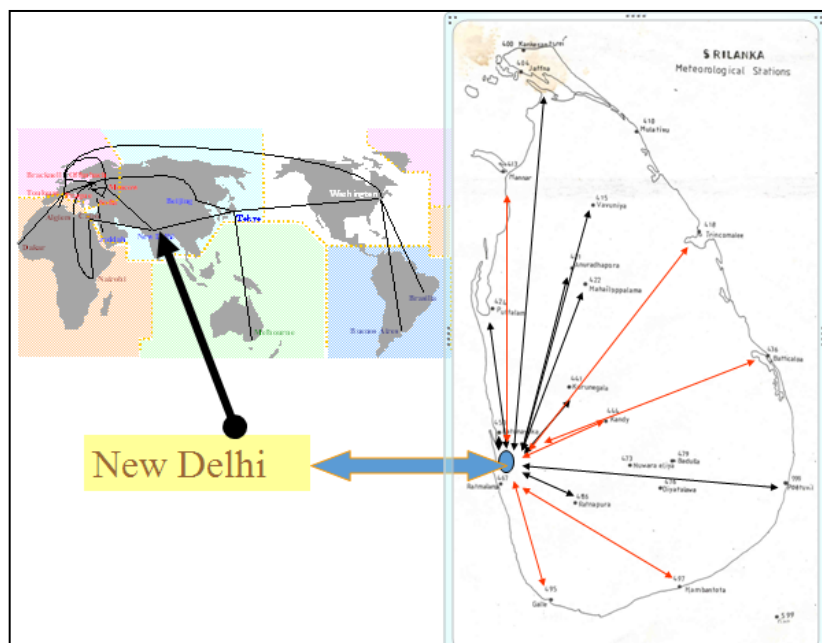
The Global Telecommunication System (GTS) of the World Weather Watch (WWW) of World Meteorological Organization (WMO) is responsible for accurate, timely, effective and easy exchange of all meteorological data and information. These data are disseminated and transmitted across the world in coded form and respective National Meteorological Centres receive them for their analysis.

Meteorological Data Analysis& interpretation
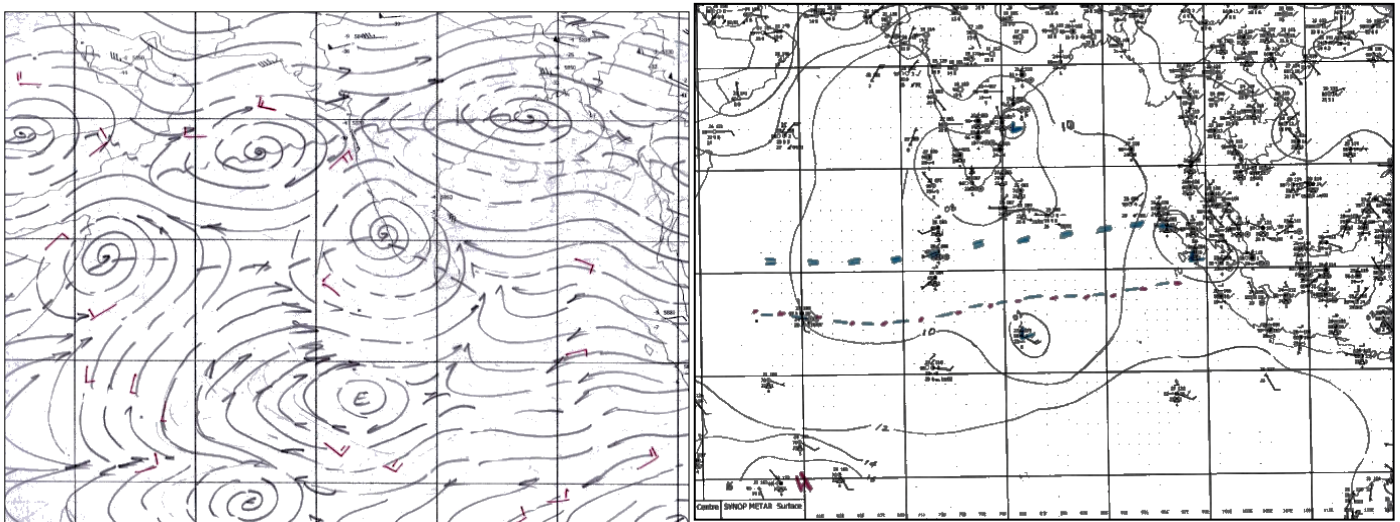
| Stream Lines | Isobars |

Working to uncover **patterns** and **trends** in data sets is called as data analysis. Explaining those patterns and trends is called "Data Interpretation". Scientists interpret data based on their background knowledge and experience as such different scientists can interpret the same data in different ways. **Visual representations** of data are essential for both data analysis and interpretation. Visualization highlights trends and patterns in numeric datasets that might not otherwise be apparent.

Understanding and interpreting graphs and other visual forms of data is a critical skill for scientists and students of science.

Meteorological data are plotted in charts for the Forecaster to process and analyze with other supplementary information. Satellite cloud imageries, oceanic data and other derived parameters are among them. Observed data at surface level are plotted on the surface map and upper air data at certain levels are plotted on the upper air charts.

Surface Chart Analysis and Pressure Patterns:-

Surface pressure pattern in the region is depicted in isobaric charts, plotted every 6-hourly, 0000, 0600, 1200 and 1800 UTC. Pressures at different locations are reduced to mean sea level, in order to facilitate comparison. Pressure pattern is essential to detect weather systems in advance. Change of state and position of cyclonic, anti-cyclonic and frontal systems can be observed in comparison with previous charts. Both manual and computer methods are employed for this.

Upper-air Chart Analysis and wind patterns

This is very important in weather forecasting. These charts are plotted twice daily 0000 and 1200 UTC at both meteorological offices at Colombo and Katunayake . Weather systems are easily identifiable with this upper level information. Again both manual and computer methods are employed for chart analysis.

Weather Forecasting Techniques

In general, methods of forecasting are (a) Subjective methodology and (b) Objective approach. In the former, more experienced meteorologist will come out with a more accurate forecast while in the other, the method is independent of the person who processes and analyses.

Subjective approach

By analyzing surface and upper-air information, a 3D picture of the atmosphere is created along with other supplementary information such as, cloud imageries, tephigram etc. Making use of Climatology and persistence of weather systems, a meteorologist can subjectively forecast expected weather.

It is not difficult to predict reasonably the weather due to well defined weather systems in the tropics; among them are, Cyclones, Inter Tropical Convergence Zone and Easterly waves dominant. Climatology is widely used to forecast the track of a cyclone. Nevertheless, the present status of the system is fully reviewed.

When there is no well-defined systems are around, wind flow dominate. Depending on the characteristics of these winds, dry, fair or wet weather will prevails over the island. Thus convection is common with weak pressure gradients and loose isobaric pattern. These are somewhat difficult to predict well in advance due to the scale of these systems. Tephigram, a thermodynamic diagram of an upper air sounding using temperature and entropy coordinates, gives information on the state of the atmosphere- whether it is stable or unstable.

Satellite cloud imagery gives the present state of the cloud cover. With the animation of both these sets of pictures and total precipitable water and along with the other surface and upper air observations, potential areas of development of weather and their progress could be recognized.
Sea surface winds given by satellites are also considered for the forecasting.

Using of Numerical Weather Predictions Products

Numerical weather prediction is the science of predicting the weather using "models" of the atmosphere and computational techniques.
Present situation in the form of grid point data are prepared first. Then in the Model correct equations and assumptions are made. Then the time integration for a very short period of may be after 45 seconds is

performed. Output products will be given in every three hours up to 168 hours at present. The product is again grid point values for meteorological parameters but for a future time.

Manipulating the huge datasets and performing the complex calculations necessary to do this on a resolution small enough to make it accurate requires some of the most powerful supercomputers in the world. Countries those who have a high annual budget run global numerical models using super computers and the made available for the other meteorological agencies. DOM uses these outputs for day to day forecast and the models called Weather Research and Forecasting (WRF) are run for Sri-Lanka area.
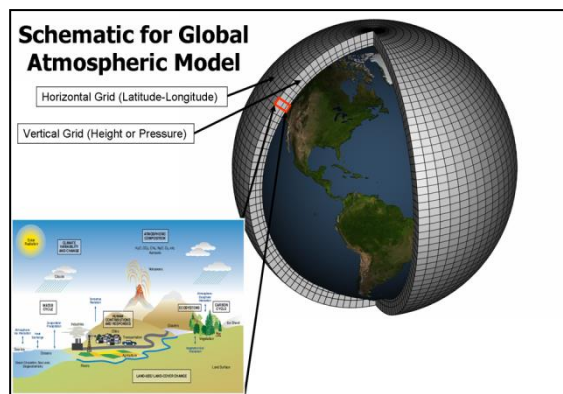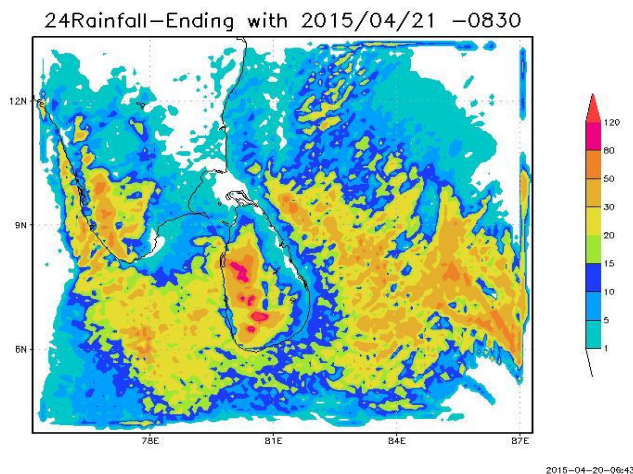
WRF model output-Rainfall forecast

Understanding the Weather Forecast

Several wordings are used in the weather forecast according to the probability of weather occurrence spatially and temporally. "Isolated" ,"at a few places" or "few showers" are the indication of less probabilities . "Scattered showers" , "At Several places" are used for moderate probabilities and there is no possibility for floods. But the wordings "Occasional " ,"Intermittent", "Widespread" , "at most places" are used for high probabilities and the possibility for flooding is also high.

- Isolated   : less than 25% of places in the mentioned region
- Scattered or at several place   : in between 25% and 50%
- Fairly widespread :in between :   50% and 75% of places
- Wide spread-   :   for more than 75%
- Light showers-   Rainfall is less than 12.5mm   during 24 hours of period
- Light to Moderate - Rainfall is in between 12.5mm and 25 mm during 24 hours of period
- Moderate-   Rainfall is in between 25mm and 50 mm   during 24 hours of period
- Fairly heavy-   Rainfall is in between 50mm and 100 mm   during 24 hours of period
- Heavy-   Rainfall is in between 100mm and 150 mm   during 24 hours of period
- Very Heavy-   Rainfall is more than 150mm   during 24 hours of period

Thunder showers indicates -Thunder and lightning activities

The dissemination of forecast

After the preparation of the forecast it must be disseminated among the concerned stake holders and the public at the fastest speed possible. This can be achieved by the use of radio, fax telephones, internet etc. Due to the high demand for voice cuts DOM introduced voice recording system. Examples of some issued weather forecasts are shown below.

WEATHER FORECAST FOR NEXT 36 HOURS
(ISSUED AT 1600 HOURS ON 07th JUNE 2013)

Gradually increasing of rain in the South-western parts and windy condition over Sri Lanka and neighbouring sea areas are expected.

Showers will occur at times in the Western, Sabaragamuwa, Central and Southern provinces. Showers may extend to Puttalam and Kurunegala districts too.

Southwestern monsoonal winds will be strengthen at times over the island and neighborhood.

Sea Conditions –

Naval and fishing communities are requested to be vigilant as deep and shallow sea areas off the coast extending from Mannar to Pottuvil via Colombo and Galle will be rough with strong southwesterly wind upto 80kmp/h.

දිවයිනේ නිරිත දිග කොටසේ ක්‍රමයෙන් වැසි වැඩි වීමක් සහ දිවයින සහ අවට මුහුදු ප්‍රදේශවල සුළං වැඩි වීමක් අපේක්ෂා කෙරේ

දිවයිනේ බස්නාහිර, සබරගමුව, මධ්‍යම සහ දකුණු පළාත් වල විටින් විට වැසි ඇති වේ. පුත්තලම සහ කුරුණෑගල දිස්ත්‍රික්ක වලට ද මෙම වැසි පැතිර යා හැක.

දිවයින තරහා සහ අවට ප්‍රදේශ වල විටින් විට නිරිත දිගින් හමන තරමක තද සුළං ඇති විය හැක.

මුහුදේ තත්ත්වය :-

මන්නාරම සිට කොළඹ සහ ගාල්ල හරහා පොතුවිල් දක්වා වෙරළට ඔබ්බෙන් වන ගැඹුරු සහ නොගැඹුරු මුහුදු ප්‍රදේශ රළු වන අතර පැ.කි. 80 පමණ දක්වා සුළං ඇති වන නිසා ඒ පිළිබඳව විමසිලිමත් වන ලෙස නාවික සහ ධීවර සහ නාවික ප්‍රජාවගෙන් ඉල්ලා සිටිනු ලැබේ.

Weather Forecast for Main Cities					Date: 08/06/2013
City	**Temperature (0C)**		**Relative Humidity**		**Weather**
	Max	**Min**	**Max**	**Min**	
Anuradhapura	32	25	85%	70%	Mainly fair.
Batticaloa	34	26	85%	70%	Mainly fair.
Colombo	29	25	95%	80%	Showers at times.
Galle	29	26	95%	80%	Showers at times.
Jaffna	32	28	85%	70%	Mainly fair.
Kandy	27	22	95%	85%	Showers at times.
Nuwara Eliya	17	13	95%	85%	Showers at times.
Ratnapura	29	23	95%	75%	Showers at times.
Trincomalee	33	26	85%	70%	Mainly fair.
Mannar	31	27	90%	70%	A few showers.

ප්‍රධාන නගර සඳහා කාලගුණ අනාවැකිය					දිනය : 08/06/2013
නගරය	**උෂ්ණත්වය (ඳස. අංශක)**		**සාපේක්ෂ ආර්ද්‍රතාවය**		**කාලගුණය**
	උපරිම	**අවම**	**උපරිම**	**අවම**	
අනුරාධපුරය	32	25	85%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
මඩකලපුව	34	26	85%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
කොළඹ	29	25	95%	80%	විටින් විට වැසි.
ගාල්ල	29	26	95%	80%	විටින් විට වැසි.
යාපනය	32	28	85%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
මහනුවර	27	22	95%	85%	විටින් විට වැසි.
නුවරඑළිය	17	13	95%	85%	විටින් විට වැසි.
රත්නපුරය	29	23	95%	75%	විටින් විට වැසි.
ත්‍රිකුණාමළය	33	26	85%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
මන්නාරම	31	27	90%	70%	වැසි ස්වල්පයක්.

කාලගුණ විද‍යාඥ (Duty Meteorologist),
කාලගුණ විද‍යා දෙපාර්තමේන්තුව (Department of Meteorology).

නිරිත දිග බෙංගාල බොක්ක ප්‍රදේශයේ පවතින සුළිකුණාටුව (තවමත් ප්‍රබල නොවන) 2013 මැයි මස 13 වන දින පෙ.ව. 05.30 වන විට (උතුරු අක්ෂාංශ 11.5 හා නැගෙනහිර දේශාංශ 87.0 පමණ) ත්‍රිකුණාමලය සිට ඊසාන දෙසින්කි.මී. 650 ක් පමණ දුරින් කේන්ද්‍රගතව පැවතුනි. මෙම පද්ධතිය බොහෝ දුරට එහි කේන්ද්‍රයේ සිට උතුරු දෙසට, දිවයිනෙන් ඉවතට ගමන්කරනු ඇත.

මෙම පද්ධතියේ බලපෑම මත මන්නාරම සිට ත්‍රිකුණාමලය සහ යාපනය හරහා මඩකලපුව දක්වා වෙරළට ඔබ්බෙන් වන මුහුදු ප්‍රදේශ රළ වන අතර, නිරන්තර වැසි සහ තද සුළං (පැ.කි. 70ට වැඩි) ඇතිවිය හැක.

නැගෙනහිර සහ උතුරු වෙරළට ඔබ්බෙන් වන මුහුදු ප්‍රදේශවල ධීවර හා නාවික කටයුතු වල යෙදීමෙන් වළකින ලෙස ධීවර හා නාවික ප්‍රජාවගෙන් කාරුණිකව ඉල්ලා සිටී.
දිවයින සහ අවට ප්‍රදේශ වල නිරිත දෙසින් හමන තරමක් තද සළං (පැ.කි. 60 පමණ) අපේක්ෂා කල හැක.

දිවයිනේ බොහෝ ප්‍රදේශ වල අහස වලාකුලින් බරව පවතී.
යාපනය, කිලිනොච්චි සහ මුලතිව් දිස්ත්‍රික්ක වල නිරන්තර වැසි ඇති වේ . ඇතැම් ස්ථාන වල මි.මී . 200 ට වඩා වැඩි තද වැසි ඇති වේ

මධ්‍යම, සබරගමුව, බස්නාහිර,නැගෙනහිර සහ දකුණු පළාත්වල විටින් විට වැසි ඇති විය හැක. ඇතැම් ස්ථාන වල මි.මී . 100 ට වඩා වැඩි තද වැසි ඇති වේ. අනෙකුත් ප්‍රදේශ වලද තැනින් තැන වැසි ඇති විය හැක.

කායර්යේ නියුතු කාලගුණ විද්‍යාඥ (Duty Meteorologist)
කාලගුණ විද්‍යා දෙපාතර්මේන්තුව (Department of Meteorology)

Why does the forecast go wrong?
Difficulties in weather prediction purely based on synoptic scale are largely due to local orography, diurnal and seasonal effects in tropics with the former dominating over our small island
Being a tropical island weather forecasting for the country is more challengeable due to high amount of energy and vast oceanic area.

Cloud Formation and Rainfall

The main way in which water vapour in the atmosphere can be converted to clouds, and hence potentially fall as rain, is for air temperature to be reduced.

When the cooling air saturated due to the low temperature, water vapor begins to condense as water droplets or ice crystals, becoming visible as clouds. The required low temperature is usually reached by lifting air into the colder, higher levels of the atmosphere.

This lifting can happen in several ways:
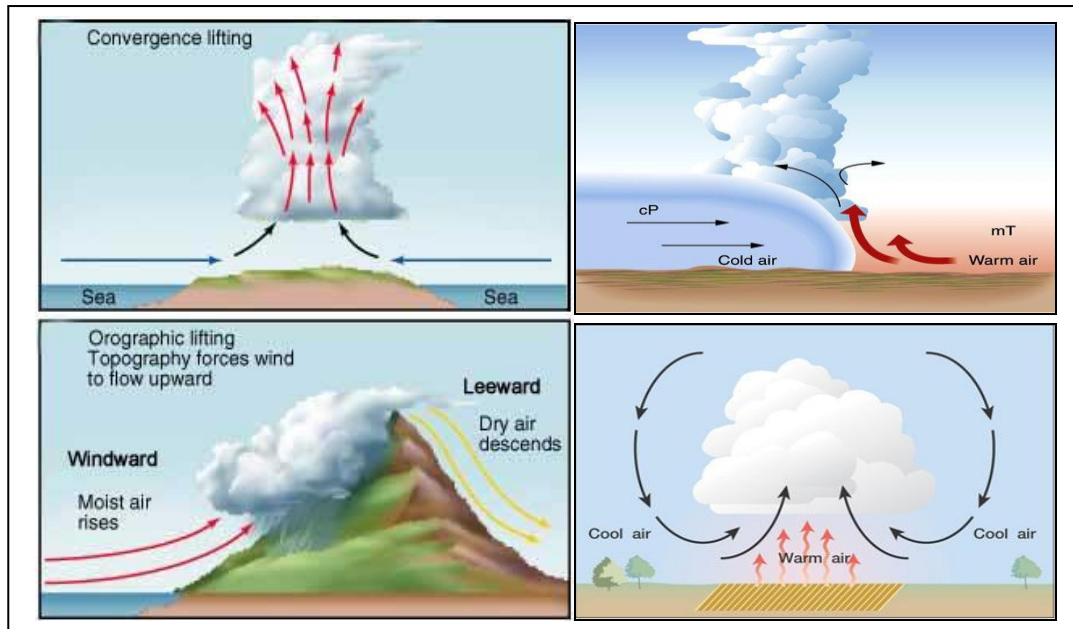
Cloud formation methods

Convective rainfall:

When the earth's surface is heated, air near the ground expands and rises by buoyancy above the cooler and therefore heavier air around it. As it rises it cools; if the dew-point temperature is reached, condensation of water vapor releases heat, which causes the air to rise further.

So on a hot afternoon, especially in the tropical country like Sri Lanka where the air is moist, surface heating is intense and condensation is abundant. You may see towering anvil-topped clouds. Often 10 or more kilometers high, **these thunderstorms may generate intense rainfall causing flash flood.**

Orographic rainfall:

Air may be forced to rise when land barriers such as mountain ranges lie in the path of extensive air masses.

The ideal conditions are when winds off a warm ocean meet a relatively continuous mountain range close to the coast, at right angles. Prime examples are parts of the west or southwest coasts of the island. On the leeward side of mountains, descending air depleted of its moisture is characteristically dry while rain or showers occur on the windward side. **These rain water feeds the rivers and threats the coastal flood prone areas in the both sides of the rivers.**

weather systems affecting Sri-Lanka

The weather that Sri Lanka experiences could be broadly divided into monsoonal and inter monsoonal. The summer monsoon or southwest monsoon is from May to September and winter or northeast monsoon is from December to February. The inter monsoon periods are considered to be the periods of transition from one monsoon to the other. The first inter monsoon is from March to April whereas the second inter monsoon is from October to November. During the southwest monsoon weather is confined mainly to the southwest quarter and hill country. Eastern and Northern regions receive rainfall during the northeast monsoon.

| South-West monsoon | North-East monsoon | 1st inter monsoon | 2nd inter monsoon |
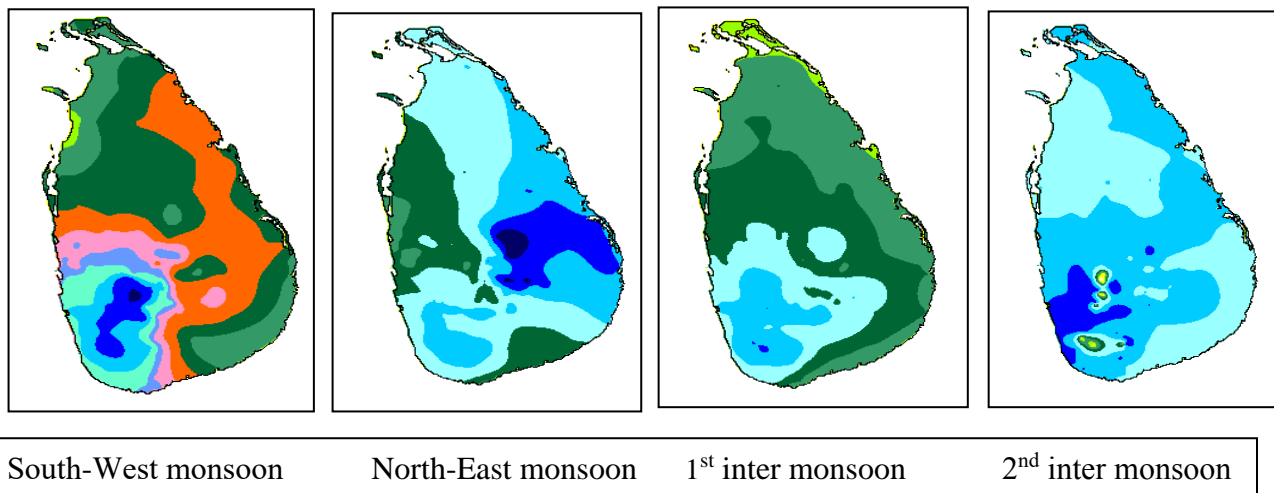
However, out of these two monsoons, southwest monsoon is more effective in Sri Lanka since it gives more rain over large parts of the Island and is experienced nearly a half of the year. The farmers in the western and southern parts in the country, mostly depend on southwest monsoon rainfall for their agriculture. Also the amount of rainfall which Sri Lanka receives during the southwest monsoon period, contribute much to the generation of hydro power electricity in the country.

The annual average rainfall varies from below 1000mm in the driest zones in the northwest and southeast of the island to over 5000mm in some areas on the western slopes of the central highlands.

At the beginning of the monsoon, rain can be expected particular along the coastal areas. Then these showers will penetrate inland areas .with the strong wind flow the facing side of the central hills experiences occasional showers. If the two wind flows meet each other (Confluence) heavy showers can be expected causing floods.

Out of these flood situations due to monsoonal rain, there was an exceptionally heavy rainfall in Colombo on 4th June 1992 and hence most parts of the Colombo city was flooded. The 24-hour rainfall of this event was 493.7 mm and it was the highest rainfall recorded at Colombo since observations commenced in 1869.

The heavy rains occurred on 17th May 2003 over Ratnapura and Deniyaya areas and on the 17th May 2010 over Colombo area were due to the confluence of wind flow.
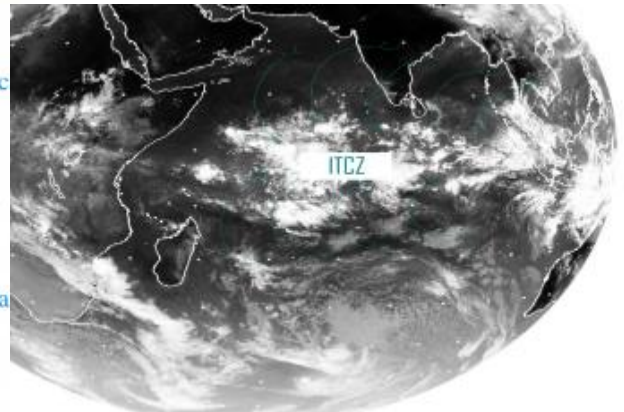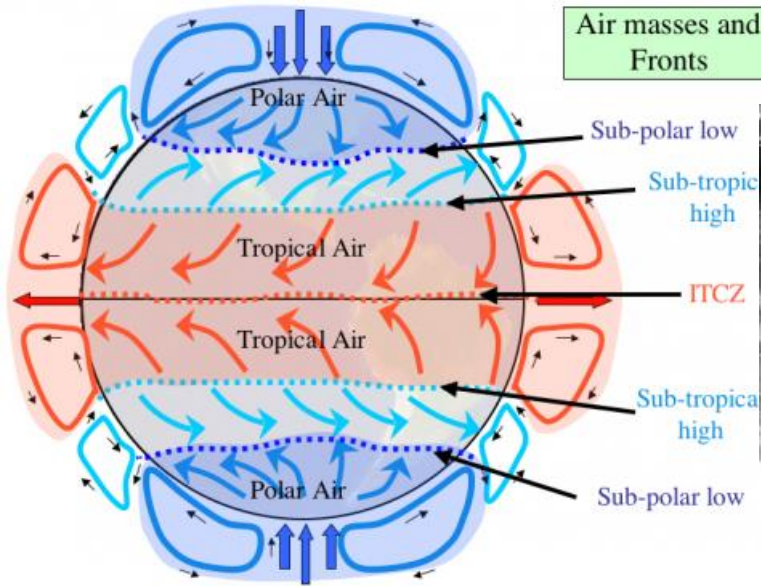
ITCZ   (Inter Tropical Convergence Zone)

The area at where the air from northern hemisphere and southern hemisphere meet. ITCZ is a narrow zonal band of intense deep convection. **As a result it gives torrential rain causing flood.** This zonal band moves North and Southwards according to the Sun's apparent movement. During the third week of April and the Month of October UTCZ comes over Sri Lanka enhancing the afternoon thunder activity.

Easterly waves

In the tropical zone, there are various types of perturbation, which occur almost exclusively in the lower layers of the atmosphere. Only a few of these develop into vortices, and appear on surface weather maps as cyclones. Most of them are shallow waves traveling from east to west within the tropical easterly current appearing fairly regularly but especially in undisturbed regions above the sea; these are called "**Easterly waves**" in many tropical regions. It has been noticed that significant rain or thunder showers are experienced at many places over countries like Sri Lanka for consecutive 3-4 days due to the waves in the easterlies.

Tropical Revolving Storms (TRS)

TRS are the revolving weather systems which give intense rain. Winds are rotating around a center and air moves up. TRS are classified according to their intensity which is measured using the speed of rotating wind and the pressure at the center.

| Satellite image of a Cyclone | Moving direction | Wnd speed revolving around the center |

Classification of TRS

System	Wind speed (ms^{-1})	Wind speed (km/hr)
Low pressure area	< 8.5	<31
Depression	8.5 – 13.5	31
Deep depression	14.0 – 16.5	52-61
Cyclonic storm	17.0 – 23.5	62-88
Severe cyclonic storm	24.0 – 31.5	89-118
Very severe Cyclonic Storm	32.0- 59.5	119-221
Super Cyclone	>60	>221

According to the above classifications well developed TRS are called as Cyclones. Cyclones are generally considered as one of the most dangerous natural disasters of meteorological origin in the tropical region. They are called Hurricanes' in the Atlantic and eastern Pacific, Typhoons in the Western Pacific and far eastern waters, 'cyclones' in the Bay of Bengal and Arabian seas whereas in the Australian region and the South-West Indian ocean region they are more specifically termed tropical cyclones (TC)'

Tropical cyclones are responsible for significant damage to infrastructure, utilities and agriculture, as well as loss of lives. They are the cause of major set-backs in the economic and social progress of countries in cyclones prone areas. The cyclone season for Sri Lanka extends from November to January with a peak of cyclone activity during November-December.
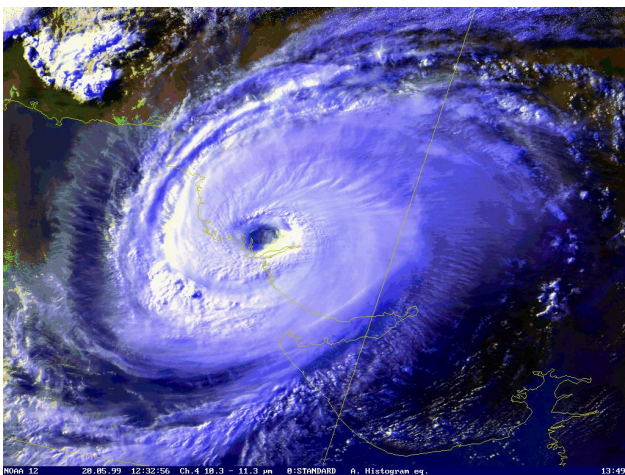
TC are low pressure systems in the tropical region which in the northern hemisphere, have well defined anti-clockwise wind circulation spiraling toward the centre with great violence. The surface atmospheric pressure is below 1000 hPa and may fall as low as 930 hPa. **Torrential rains are observed around the region close to the centre, where maximum uplift occurs.** Spiral rain-bands. Spiral bands also known as 'feeder bands' are another typical feature of tropical cyclones. These feeder bands, in which rain activity and strong squally weather is most pronounced, may be located as far as 500 km or more from the centre, gradually spiraling up to the eye wall.

Tropical cyclones derives their energy from the warm tropical oceans decay and die if the supply of water vapor is cut off, so they quickly lose intensity when they move over land or colder waters. They don't develop at the equator because the Coriolis force is zero there. it is not strong enough to sustain the rotation of a cyclone until five or more degrees of latitude from the equator.

Summary of Data Collection, and Forecasting Analysis

Meteorological parameters:

Wind speed and direction ,

- Temperature, Pressure
- Cloud type, Amount and height,
- Rainfall , amount of
- water vapour,
- Visibility,
- present and past weather

Agrometeorological Parameters:

- Evaporation
- Radiation
- Soil Temperatures

Surface observations : Taken every three hours from 23 stations

Upper air observations : Taken every six hours from 4 stations– Only wind speed and direction

Radiosonde : Taken three times per week- Amount of Water Vapour ,Temperature and Pressure, GPS based tracking of the balloon gives Wind speed and direction

surface and Upper air data are coded and sent to Head office .

All surface, Upper air and Radiosonde data : Fed into GTS for global communication.

Received by National Meteorological centers all over the world

Rainfall measuring stations: More than 400 stations

Measured once a day

About 197 stations send daily through regional met offices

Rest are sent monthly by post

Telemeter rain gauges: Fully automatic

Half hourly data sent through SMS

Agrometeorological stations: 35 stations , Data sent monthly

Automated Weather Stations: 37, all the surface parameters are measured , One minute data stored at the station. Ten minute data sent to Colombo via satellite INSAT 3-E

Satellite data: Two type of satellites

1.Geostationary- 36000kms above the Earth. half hourly data available

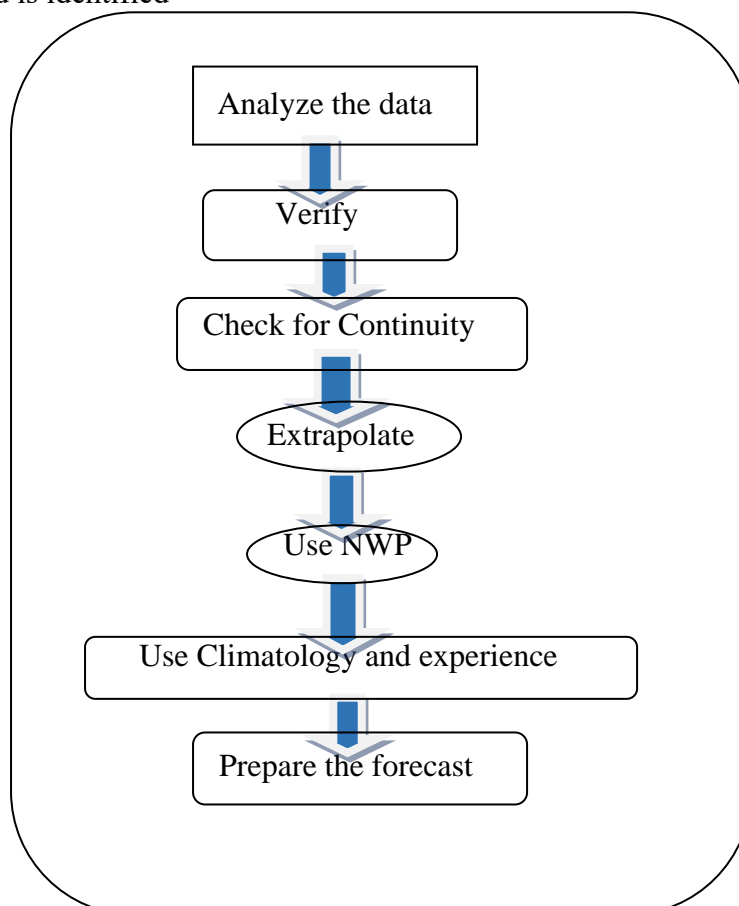2.Polar orbiting- 850-900kms above the Earth ,

Satellite imageries of clouds are taken using visible (reflected) and infrared (emitted) energy. Water vapor and Ozone amount are measured using the absorption of energy by atoms.

Winds over the sea is measured by the energy scattered back to the satellite due to the roughness of the sea

Forecasting Process:

Coded data are decoded and plotted on the maps. Equal pressure lines and wind flow are drawn Pattern of data and it's trend is identified

Steps:

```
Analyze the data
      ↓
    Verify
      ↓
Check for Continuity
      ↓
  Extrapolate
      ↓
   Use NWP
      ↓
Use Climatology and experience
      ↓
Prepare the forecast
```

Two types of Forecasting methods : Subjective and Objective

Subjective forecasting: After analyzing the data pattern and trends are identified by a experienced Meteorologists and forecast is prepared by a Meteorologist or group of Meteorologists

Objective Forecasting: Mathematical equations are solved by computers and forecast is made.

Type of Forecasts.

General weather forecast: For public and fisher Falk

Three times a day (0530,1200,1600)

Issued at any time if there is a significant change

FAX, email, voice recording, web

Severe weather warnings: Issued at any time for severe weather, Cyclones, heavy rain, strong winds.

Marine forecasting

Shipping reports : Issued twice a day (at 10.00am and 04.00pm). Use for marine activities around the island and transmit through Navy and Colombo Radio Flag Staff.

Fleet forecast : Issued twice a day (At 07.00am and 05.00pm). Use for the responsible international sea area and transmit   through Navy and Colombo radio

Aviation Forecasting

Route forecast and area forecast: Issued twice a day for domestic aviation.

1. 8 Route Forecasts (RF) and 8 Area Forecasts(AF) issue in the morning

2. 2 Route Forecasts (RF) and 8 Area Forecasts(AF) in 12 noon

Additionally, it can be issued at any time on request, especially for VIP movements and includes winds, temperature up to 12 km, Clouds, weather and visibility .

Terminal Aerodrome Forecast (TAF): Issued 4 times per day (at 0310 am, 0910 am. , 0310pm, 0910pm) and issue for international aviation activities and forecast winds ,visibility, weather, clouds, moisture are given.

Take off data : Issued   3 hours prior to the departure and winds, Pressure and Temperature are given.

Warnings : Issued when the criteria are fulfilled.

For strong winds ,poor visibility, turbulences, icing, Cyclone,

Understanding the forecast

Isolated   : less than 25% of places in the mentioned region

Scattered or at several place: in between 25% and 50%

Fairly widespread   : in between 50% and 75% of places

Wide spread-   : for more than 75%

Light showers-   Rainfall is less than 12.5mm   during 24 hours of period

Light to Moderate -   Rainfall is in between 12.5mm and 25 mm   during 24 hours of period

Moderate-   Rainfall is in between 25mm and 50 mm   during 24 hours of period

Fairly heavy-   Rainfall is in between 50mm and 100 mm   during 24 hours of period

Heavy-   Rainfall is in between 100mm and 150 mm   during 24 hours of period

Very Heavy-   Rainfall is more than 150mm   during 24 hours of period

Thunder showers indicates -Thunder and lightning activities

                             Strong localized winds during showers

                             Intense rain

Colour code :-

White	Information
Amber	Alert/Advisory
Red	Warning
Brown	Severe warning
green	Threat is over