Weather Forecasting

Weather plays a great role in growth and development of plants. Management operations such as irrigations schedulling, fertilizers applications, sowing and harvesting, all are dependent on weather conditions. To make the maximum advantage from agriculture it is neccessary to take all the decisions based on the weather conditions. For planning all the operations well in advance, weather forecasting is required.

Weather Forecasting is the act of foretelling about the happening and quantification of the different weather elements (parameters).

It is estimated that about 8 per cent of the total crop losses can be avoided through improved weather forecasts.

The weather forecasts also provides guidelines for long range seasonal planning and selection of crops most suited to anticipated climatic condition.

Type of Weather Forecast

S	Types	Ephasis on	Applicability
1	Short range (12-48 hours with 70 – 80% accuracy)	Temperature, wind velocity and direction, sunshine duration, time and amount of precipitation, relative humidity	a) Adjustment in irrigation b) Adjusting time of agricultural operations c) Protection of plants from frost, pest and diseases d) Spray applications e) Adjusting the usage of labour f) Drying of produce
2	Medium Range (3-10 days 60–70% accuracy)	Type of weather, sequence of rainy days, normal weather hazards in farming such as strong winds, extended dry or wet spells	a) Determine the sowing time b) Depth of sowing c) Planning of irrigation d) Decision on harvesting e) Decision of time of spraying efficiency f) Management of labour and equipment
3	Extended forecast /Long range fore cast (30 days to seasonal outlook; 60% accuracy)	Abnormality of temperature and precipitation	a) To decide on soil moisture management b) Decision on irrigation scheduling c) Decision on selection of crop d) To decide how can manage with limited water supply e) Decide suitable cropping pattern f) Determine the crop yield

Tools of Weather Forecasting

Weather forecasting is done on the basis of present weather conditions and the changing sequences of weather. The upper air climatic conditions also play great role in controlling weather conditions on ground surface.

1) Pilot Ballons: A small balloon is inflated with a gas (hydrogen/helium) lighter than air and released for measurement of wind direction and speed at different heights in the atmosphere using theodolite. The theodolite is an optical telescope, which measures horizontal and vertical angles of the ascending balloon at known intervals of time. Sometime Meteorograph (conbination of barograph, thermograph, and hygrograph) is also attached with ascending balloons. The observations are made once balloons returned to ground.

Pilot Ballon

A small meteorological balloon used to track air currents.
A method of winds-aloft observation, temperature, and relative humidity of the upper that is, the determination of wind speeds and air and to automatically transmit that directions in the atmosphere above a station. This is done by reading the elevation and azimuth angles of a theodolite (instrument) observation while visually tracking a pilot balloon. The ascension rate of the balloon is approximately determined by careful inflation to a given total lift. After release from the ground, periodic readings (usually at one-minute intervals) of elevation and azimuth angles of the balloon are recorded. These data are transferred to a winds-aloft plotting board, and wind speed and direction at selected levels are calculated by trigonometric methods


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Tools of Weather Forecasting

2) Radiosonde: The radiosonde (Sonde (french) = probe) is a device with sensitive sensors, which transmit observations by radio signals to a ground receiver as the balloon ascends. The instruments measures temperature, humidity and pressure at various levels of the atmosphere through which it passes.

3) Radar and Satellite: The Active Remote Sensing is used for drawing information about the atmospheric conditions. This technique is used by RADAR (RAdio Detection And Ranging) which transmit electromagnetic pulses of a given characterstics an also receive them back. The modification of the transmitted pulses can be interpreted based on characterstics of the reflected surface. RADAR technique is used to detect the cyclone and cloud condition. The amount of precipitable water can also be detected by this technique. RADAR are mounted on the ground surface while similar kind of instruments can also be used on sattelite system.

Radiosonde and Receiver

A **radiosonde** is a battery-powered telemetry instrument package carried into the atmosphere usually by a weather balloon that measures various atmospheric parameters and transmits them by radio to a ground **receiver**
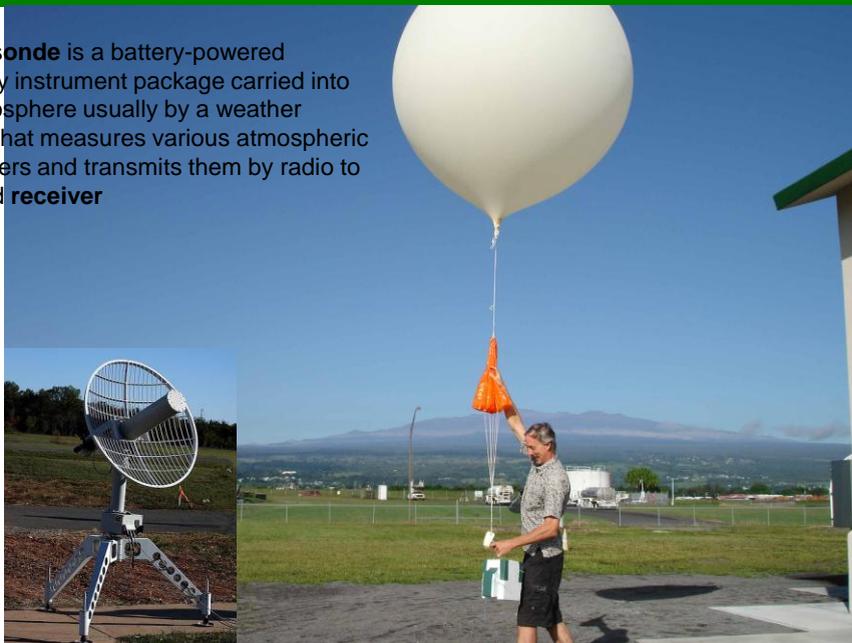
# Doppler Radar & Satellite

Tools of Weather Forecasting

The advantage of satellite technology is that it can give information on cloud spread and amount and the information on temperature of the eath surface and cloud tops.

4) Synoptic Chart: An enormous volume of meteorological data is being collected from all over the world, continously round the clock through various telecommunication channels. To assess, assimilate and analyse the above vast data, they have to be suitabely presented. For this purpose, the observations are plotted on maps in standard weather codes. Synoptic chart is a chart or map on which distribution of selected meteorological elements, over a large area, at a specified instant of time is represented. The surface and upper air charts are the two type of synoptic charts currently in use. The surface synoptic charts plotted for different synoptic hours (00, 03, 06, 09, 12, 15, 18, 21 UTC) depict the distribution of pressure, temperature, dew point, clouds, winds, present and past weather.

Synoptic Charts

Forecast chart (T+36)
Valid 1200 UTC Tue 25 Sep 2012
Met Office
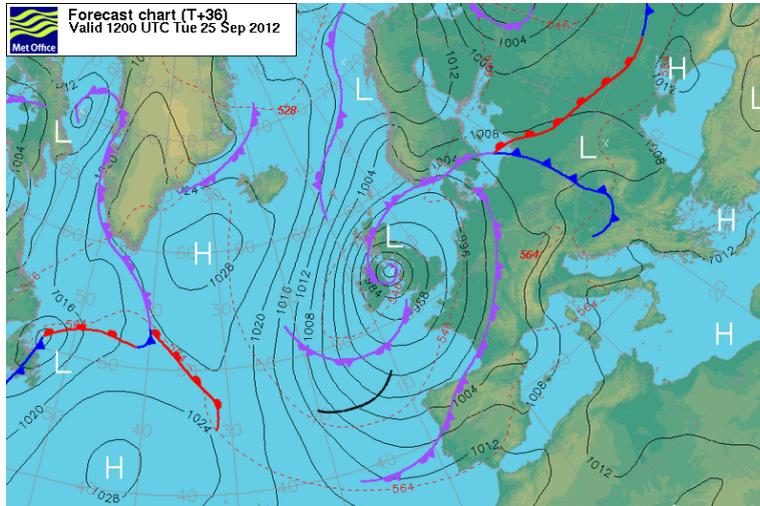
A **synoptic chart** is the scientific term for a weather map. **Synoptic charts** provide information on the distribution, movement and patterns of air pressure, rainfall, wind and temperature. This information is conveyed using symbols, which are explained in a legend.

Tools of Weather Forecasting

Tephigram

A tephigram is a graphical representation of observations of pressure, temperature and humidity made in a vertical sounding of the atmosphere. Vertical soundings are made using an instrument called a radiosonde, which contains pressure, temperature and humidity sensors and which is launched into the atmosphere attached to a balloon.

The tephigram contains a set of fundamental lines which are used to describe various processes in the atmosphere. These lines include:

Isobars - lines of constant pressure
Isotherms - lines of constant temperature
Dry adiabats - related to dry adiabatic processes (potential temperature constant)
Saturated adiabats - which are related to saturated adiabatic processes (wet bulb potential temperature constant).

On the tephigram there are two kinds of information represented
- The environment curves (red) which describes the structure of the atmosphere
- The process curves (green) which describes what happens to a parcel of air undergoing a particular type of process. (eg Adiabatic process).

In addition, the right hand panel display height, wind direction and speed and a selection of pressure levels.

Tephigrams can be used by the forecaster for the following purposes
- to determine moisture levels in the atmosphere
- cloud heights
- to predict levels of convective activity in the atmosphere
- forecast maximum and minimum temperatures
- forecast fog formation and fog clearance
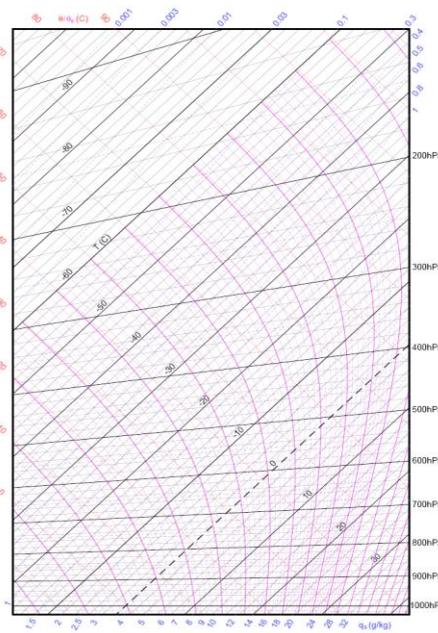
Tephigram: Interpretation

Potential temperature is obtained by following the dry adiabat to 1000 mb and reading the temperature there or more easily by noting the values of potential temperature printed on the dry adiabatic lines.

Saturation mixing ratio is read immediately at any point on the temperature pressure plot by intepolation from the mixing-ratio lines.

Mixing ratio is obtained by multiplying the saturation mixing ratio by the measured relative humidity.

Dew point temperature is obtained a the temperature at the point where the actual mixing-ratio line or interpolated line inersects the observed pressure line.

Condensation pressure, temperature is found at the intersection of the potential temperature line and the mixing-ratio line which corresponds to the value at the starting point.

Wet-bulb temperature, wet bulb potential temperature are obtained by following the pseudoadiabatic line from the condensation point to the original pressure and to 1000 mb, respectively.

Equivalent temperature, equivalent-potential temperature are found by determining the potential-temperature line which is approached asymptoticall by the pseudoadiabat that passes through the condensation point. This potential temperature line has the value of the equivalent-potential temperature. By following it back to the original pressure, the equivalent temperature is read on the temperature scale.
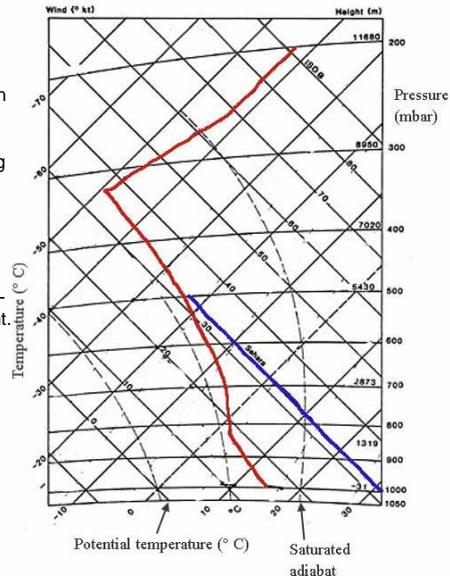
Weather Forecasting Methods

Weather forecasting methods can be categorised into three broad categories:

1) Synoptic Methods: The state of atmosphere over an area is known at an instant through a set of meteorological variables, viz rainfall, maximum and minimum temperatures, wind and pressure systems measured simultaneously at various locations. Using the observations recoreded simultaneously, surface and upper air charts are prepared which give the present state of atmosphere. The inferences on expected movement of weather system are drawn using the previous and present charts. In addition to the synoptic charts, satellite pictures also supply considerable information evolved on the lines of the past analogous one. In this method, previously occured analogous events are selected and is assumed the weather sequences will follow the same pattern. This technique is generally used to forecast weather up to 2 days.

Weather Forecasting Methods

2) Statistical methods: The statistical methods are used mostly in long range and climatic forecasts. Techniques based on Multiple regressions and Auto Regressive Integrated Moving Average (ARIMA) models are used for longe range weather prediction Rainfall during monsoon in India is also forecaseted with this technique using 16 different Land-Ocean-Atmospheric parameters.
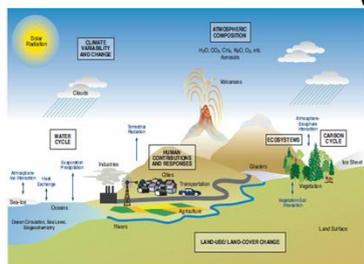
3) Numerical Weather Prediction: The motion of atmosphere is primarily governed by distribution of radirion, which is uneven across land and ocean surfaces. Air motions are driven by several other forces such as pressure gradient, coriolis force, gravitational force and frictional force. All the other forces can be expressed in terms of differential equations based on certain laws of physics and in an integrated form of these equations is known is atmospheric model, which explains the evolution of atmosphere from a given state to some future state.
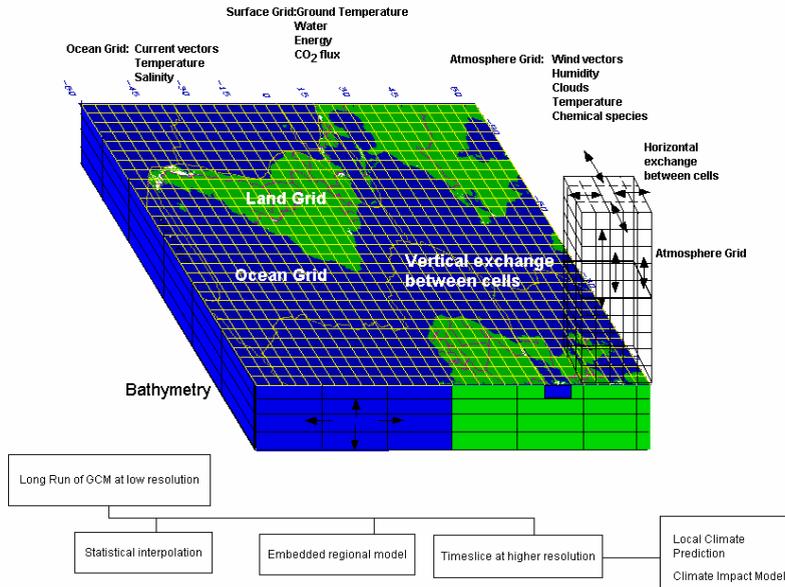
Numerical Weather Prediction

Numerical Weather Prediction

Numerical Weather Prediction
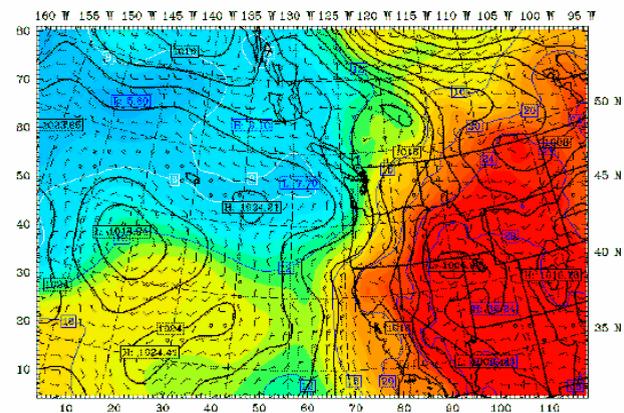
Challenges in Weather Forecast

1. Partial understanding of atmosphere
2. Higly variable nature of atmosphere
3. Occurence of extreme events
4. Laking of in house built Numerical Weather Prediction (NWP) Model
5. Use of not routinely measured parameters by NWP model
6. Data quality
7. Unstandardised data
8. Data Transmission
9. Lack of historical weather series
10. Different Units of weather parameters
11. Sparsed weather observatories

Weather Forecasting Service in India

Weather Forecasting In India

In India, medium range weather forecasting is done by National Centre for Medium Range Weather Forecasting (NCMRWF, Noida). NCMRWF is a center of India Meteorological Department (IMD). IMD also issues long range weather forecast especially monsoon.

Weather Forecasting Service

IMD started issuing Farmers *Weather Bulletin* since 1945. Later on this work was entrusted to Regional Meteorological Centres (New Delhi, Mumbai, Kolcatta, Chennai and Nagpur). The weather forecast is broadcasted by All India Radio and National TV channel in regional languages by its regional centres spread across the country.

Weather Forecasting Service in India

NCMRWF was established in 1988 for implimentation of Agrometeorological Advisory Service (AAS). The development work could be initated in 1989 after setting super computer (CRAY-XMP/216) in centre. NCMRWF has established over 100 Agro Meteorological Field Units (AMFU) in different agroclimatic regions of country. The weather forecast is sent to AMFUs and the scientist issues local need based Agrometeorological Advisory Service in regional language to the farmers of the region. The five days weather forecast is done twice (Tuesday and Friday) in week with one day overlaping. NCMRF has mandate to establish AMFU in all the 127 Agroclimatic Zones proposed by National Agricultural Research Project (NARP) funded by ICAR.
IMD has also established Agromet Advisory Service Units (AASU) at the state Meteorological Centres.