# Topic Page: meteorology

Definition: **meteorology** from *Philip's Encyclopedia*

Study of weather conditions, a branch of climatology. Meteorologists study and analyse data from a network of weather ships, aircraft and satellites in order to compile maps showing the state of the high- and low-pressure regions in the Earth's atmosphere. They also anticipate changes in the distribution of the regions and forecast the future weather.

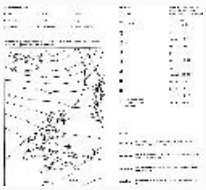

Image from: **meteorology** in *The Macmillan Encyclopedia*

Summary Article: **meteorology**
From *The Hutchinson Unabridged Encyclopedia with Atlas and Weather Guide*

Scientific observation and study of the atmosphere, so that weather can be accurately forecast.

Data from meteorological stations and weather satellites are collated by computers at central agencies, and forecast and weather maps based on current readings are issued at regular intervals. Modern analysis, employing some of the most powerful computers, can give useful forecasts for up to six days ahead.

At meteorological stations readings are taken of the factors determining weather conditions: atmospheric pressure, temperature, humidity, wind (using the Beaufort scale), cloud cover (measuring both type of cloud and coverage), and precipitation such as rain, snow, and hail (measured at 12-hour intervals). Satellites are used either to relay information transmitted from the Earth-based stations, or to send pictures of cloud development, indicating wind patterns, and snow and ice cover.

**History** Apart from some observations included by Aristotle in his book *Meteorologia*, meteorology did not become a precise science until the end of the 16th century, when Galileo and the Florentine academicians constructed the first thermometer of any importance, and when Evangelista Torricelli in 1643 discovered the principle of the barometer. Robert Boyle's work on gases, and that of his assistant, Robert Hooke, on barometers, advanced the physics necessary for the understanding of the weather. Gabriel Fahrenheit's invention of a superior mercury thermometer provided further means for temperature recording.

**Weather maps** In the early 19th century a chain of meteorological stations was established in France, and weather maps were constructed from the data collected. The first weather map in England, showing the trade winds and monsoons, was made in 1688, and the first telegraphic weather report appeared on 31 August 1848. The first daily telegraphic weather map was prepared at the Great Exhibition in 1851, but the Meteorological Office was not established in London until 1855. The first regular daily collections of weather observations by telegraph and the first British daily weather reports were made in 1860, and the first daily printed maps appeared in 1868.

**Collecting data** Observations can be collected not only from land stations, but also from weather ships, aircraft, and self-recording and automatic transmitting stations, such as the radiosonde. Radar may be used to map clouds and storms. Satellites have played an important role in televising pictures of global cloud distribution.

As well as supplying reports for the media, the Meteorological Office in Bracknell, near London, does specialist work for industry, agriculture, and transport. Kew is the main meteorological observatory in the British Isles, but there are other observatories, for example at Eskdalemuir in the southern uplands of Scotland, Lerwick in the Shetlands, and Valentia in southwestern Ireland. Climatic information from British climatological reporting stations is published in the *Monthly Weather Report*, and periodically in tables of averages and frequencies. The British Meteorological Office's *Daily Weather Report* contains a detailed map of the weather over the British Isles and a less detailed map of the weather over the northern hemisphere, and the *Daily Aerological Record* contains full reports of radiosonde ascents made over the British Isles and from some of the ocean weather ships, together with maps of the heights of the 700 mb, 500 mb, and 300 mb pressure surfaces, giving a picture of the winds at 3,048 m/10,000 ft, 5,182 m/18,000 ft, and 9,144 m/30,000 ft; there is also a map of the height of the tropopause. Ships' reports are plotted on the same charts using the same symbolic form. Data from radiosondes and aircraft are plotted on upper-air charts and on temperature–height diagrams, the diagram in use in Britain being the tephigram. With the help of this diagram it is possible to predict the formation or otherwise of clouds, showers, or thunderstorms, and sometimes to identify the source region of the air mass.

Observation stations may be classified as follows:

**Observatories** where reliable standard and absolute measurements are made as far as possible with autographic instruments, which are often duplicated for checking and research purposes. Elements such as atmospheric electricity and solar radiation are measured only at observatories and other research establishments.

**Climatological reporting stations** report the general daily weather conditions and make observations at standard hours during the day to provide cumulative data, such as average temperature, maximum and minimum temperatures, rainfall, sunshine, mean pressure, days of fog, frost, snowfall, and the extent and persistence of snow cover. After statistical analysis, climatic charts and tables are constructed showing the frequency of the different weather elements, such as gales and frost.

**Crop weather stations** make observations for use in agricultural meteorology, or micrometeorology, where the elements of the weather need to be studied in detail. It is necessary to have detailed information on temperature, humidity, and wind at heights below the average crop height in order to study and control plant diseases spread by aphids or wind-borne viruses. Details of frost hollows, wind breaks, and the degree of frost that will damage plants must all be studied.

**Rainfall stations** measure the amount of rain that falls. Most stations measure the daily amount, while those in remote areas measure the monthly rainfall.

**Synoptic reporting stations**, where observations are made simultaneously throughout the world, report in a mutually agreed form so that data can be directly compared between them. Observations are restricted to the elements required for forecasting. Reports are received at a national centre and a selection is broadcast for use by other countries.

**Analysis** The huge mass of synoptic data collected and disseminated for forecasting purposes is plotted on synoptic weather charts. Modified copies of these charts using standard symbols are published daily by most meteorological services.

**Measuring and describing conditions** Meteorological observations, for whatever purpose, must be

clear, precise, and strictly comparable between stations. It is easy to decide whether it is fine or cloudy, or if there is a thunderstorm; the distinctions between rain, snow, and hail are obvious; sleet is wet snow, melting snow, or a mixture of rain and snow; soft hail is halfway between snow and hail; and drizzle, which consists of very small drops, is halfway between rain and cloud, the water drops being just large enough to fall to the ground. It is useful also to describe rain as showery, intermittent, or continuous, as light, moderate, or heavy. The rate of rainfall and the total rainfall during a given period can be measured with a rain gauge. Wind strength and direction can be measured accurately by anemometers and wind vanes. Clouds are observed carefully, since they are closely related to other weather conditions. Fog and other hindrances to visibility indicate approaching weather conditions as well as being of great practical importance.

**Air pressure** Although the condition of the air overhead can be partly deduced from cloud observations, measurements of the physical state of the atmosphere are made at as great a height as possible. The weight of the air above any point presses downwards (see atmospheric pressure) and the force this produces in all directions is called the air pressure; it is measured by barometers and barographs, the unit of measurement being the millibar (mb). With increase in height there is less air above and therefore pressure decreases with height by about a factor of 10 for every increase of height of 16 km/10 mi. If the temperature of the air is known the decrease in pressure can be calculated: near sea level it amounts to about 1 mb in every 10 m/33 ft. In order to compare pressures between many stations at a constant level, pressures are reduced to sea level – that is, barometer readings are adjusted to show what the pressure would be at sea level.

**Temperature** Measuring the temperature of the air can be difficult, because a thermometer measures its own temperature, not necessarily that of its surroundings. In addition, temperature varies irregularly with height, particularly in the first few metres. Thus the temperature at 1 m/3.3 ft above the ground may easily be 5°C/9°F lower than the temperature closer to the ground, whereas on a following clear night the reverse usually occurs. On the other hand the temperature of air which rises 100 m/330 ft only cools about 1°C/1.8°F by reason of its change of height and consequent expansion because of decrease in pressure. Temperatures are therefore read at a standard height (usually 1.2 m/3.9 ft) above the ground, and not reduced to sea level. A thermometer is kept at the same temperature as the surrounding air by sheltering it in a Stevenson screen.

**Humidity** The humidity of the air is found by comparing readings taken by an ordinary thermometer with readings from a thermometer whose bulb is covered with moist muslin (a hygrometer). Temperature and humidity in the upper air are measured by attaching instruments to an aircraft, to a small balloon, or even to a rocket. With aircraft, measurements have been made up to more than 15 km/9.3 mi above the Earth, with balloons to 30 km/18.5 mi, and with rockets to more than 150 km/93 mi. Initially, instruments carried by balloon had to be recovered before readings could be obtained; now, radiosonde balloons transmit observations back to Earth. Balloons can also be used to measure winds since they are carried by the wind, and direction-finding radio or radar enable their drift to be calculated, thus determining the speed and strength of winds at the different heights through which the balloon passes.

**Weather ships** Reports from ships follow the same patterns as those from land stations, but also include the state and temperature of the sea. Weather ships are equipped to cruise at fixed points making observations, including radiosonde ascents, at standard intervals. These ships are also used as navigational beacons for aircraft.

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