

Making weather observations



Observing – whatever the weather

Introduction

The Met Office is a global leader in the provision of environmental and weather-related services. As the United Kingdom's national meteorological service, it also maintains meteorological observing networks. The observations collected have many immediate uses but are also quality controlled and archived to provide long-term records of weather and climate; those observations recorded in 'hard copy' format are available for inspection by the public.

While the Met Office receives many observations from stations manned by its own staff, for example on airfields, there also exists an invaluable network of various types of meteorological stations run voluntarily by private individuals, local authorities, water companies, agricultural bodies, industrial concerns, universities and other educational or research establishments.

Weather, apart from being interesting in itself, has an important bearing on everyday life. Records collected over the years provide the basis for the study of climate. The records have an increasing number of varied uses in agriculture, building design, transport, water supply, town planning and industrial research, in addition to their use in answering enquiries from members of the general public.

Weather observations are of the greatest use when they are made regularly at fixed times each day, throughout the year, by a trained observer and when accurate instruments of standard design, exposed under standard conditions, are used. When these conditions are fulfilled it is possible to compare reports from various stations in the United Kingdom and from stations in other parts of the world where similar standardisation has been adopted. This standardisation is encouraged by the World Meteorological Organization.

It is therefore necessary for the Met Office to lay down certain conditions before weather observations can be accepted into the National Climatological Archive. These conditions will be dealt with in the following pages.

This leaflet is primarily designed to give anyone who is contemplating setting up a climatological station a brief account of the requirements for recognition as a voluntary station co-operating with the Met Office. However, it will also be of help to others who wish to record the weather under standard conditions for their own purposes.

Voluntary co-operating schemes

Apart from a special network of auxiliary stations sending in frequent weather observations for use in the day-to-day forecasting work of the Met Office, there are four main types of meteorological station which function on a voluntary basis.

Rainfall stations

Rainfall measurements are taken at about 5,000 stations in the United Kingdom. At the end of each month, the observers send in their forms giving the daily totals. Full details are set out in Met Office leaflet, *Rules for rainfall observers*.

Climatological stations

A network of approximately 500 stations in the United Kingdom make more-detailed observations each day. Elements measured include temperature, humidity, wind speed and direction, cloud amount, visibility and state of ground, in addition to rainfall measurements. Some stations measure sunshine duration and other elements as well. These figures are sent in on forms, or on disk, at the end of each month.



A voluntarily operated climatological station at Lambourn, Berkshire

Health resort stations

A number of coastal and inland resorts maintain climatological stations in the normal manner but, in addition, take part in the Health Resort Scheme. Under this scheme, a limited amount of data are telephoned to an automatic receiving centre for onward transmission to the Met Office in London. These reports are then included in official releases each day to the national press. The scheme operates throughout the year, although some stations do not make reports during the winter months. Full details of this scheme are set out in Met Office leaflet, *The Health Resort Scheme*.

Agricultural meteorological (Agromet) stations

These are climatological stations maintained by people or organisations interested in the effects of weather on horticulture, forestry and agriculture. They include stations maintained by the Department for Environment, Food and Rural Affairs (DEFRA) at their husbandry or horticultural establishments and also some private farmers, agricultural colleges or other, similar bodies, set up as Agromet stations. Such stations record additional data such as soil temperatures, solar radiation and run-of-wind.

General requirements

The most important requirements for stations to be accepted into the Met Office's co-operating observing network are as follows.

- Observations are to be made each day of the year by a competent observer at the fixed time of 0900 Universal Time Co-ordinated (UTC) — 9 a.m. clock time in the winter, 10 a.m. clock time during British Summer Time.
- The instruments should be of a standard design and, where possible, must be certified by an appropriate body.
- The instruments should be correctly set up on generally level ground, away from the immediate influence of close obstructions such as fences, plants, trees or buildings.
- The proposed site should be representative of its general location and should not duplicate data from existing sites in the network.
- The site should have a planned lifespan of more than five years.

The minimum weather elements measured at a climatological station in the United Kingdom are daily maximum air temperature, daily minimum air temperature and daily rainfall amount, recorded over the period 09–09 UTC.

While the majority of climatological stations produce manual readings, the Met Office can accept observations from some automatic weather stations (AWSs), providing the instruments meet the specification required and that the station has been set up correctly. Both manual and automatic observing practices are discussed in the leaflets *Manual weather measurements* and *Automatic weather measurements*.

In certain parts of the United Kingdom there are already sufficient stations or co-operating stations to meet requirements. Anyone who is considering taking part in the scheme is advised, therefore, to enquire whether the records are required by the Met Office before making any investment.

Observations

The main climatological hour in the United Kingdom is 0900 UTC (GMT) and all stations make an observation at this time, each day of the year. Users of automatic equipment should note that data are preferred over the period 09–09 UTC rather than midnight to midnight.

At health resort stations only, the data reported to the press are based on an additional observation made at 1700 clock time, as this is the time required by the press in order to meet deadlines for the next day's newspapers.

All observations should be made by a competent observer and provision should be made for at least one deputy observer to ensure continuity for each day of the year.

Many schools maintain meteorological stations for the purpose of general education, but the difficulties of observing at the standard time and of keeping continuous records over the weekends and over school holidays often prevent them from becoming members of the co-operating scheme. Experience also shows that regular supervision by a teacher is necessary to achieve reliable observations.

Manual observations are usually recorded in the *Pocket register for climatological observers* (Metform 3100), which is accompanied by full instructions (Metform 3100A) for completing the monthly return form (other instructions are available for completion on disk). Records of any significant weather in the area may be made in the Weather Diary, which can be very useful when the data are being quality controlled. The observations and Weather Diary should be entered onto the form each day as this will reduce the task at the end of the month and help data returns to be sent in promptly.

Each co-operating station receives a free copy of the *Observer's handbook* and every possible assistance is given with any difficulties encountered.

Instrument specifications

The Table opposite shows the specification of measurements as defined in the CAWS (Climatological AWS) format for use with automatic measurements. However, the same specification applies to observations made manually.

Accuracy is defined as the root-mean-square difference from a standard measurement of the element under operational conditions over a period of 12 months.

Data returns

Co-operating observers are required to send in a return listing all the daily observations at the end of each month. The monthly return forms/disks are supplied free, together with prepaid, addressed envelopes. The extent to which a station is able to complete the various entries will depend primarily upon the degree of instrumentation, but each station is urged to complete as much of the return as possible. It is important to forward the monthly return as soon as possible after the end of the month to which it refers — it should reach the Met Office no later than the 6th, since the data are required for the preparation of climatological data sets and for answering climatological enquiries.

The monthly return form, Metform 3208B, is designed to facilitate the direct keying of weather information into computer data sets. The instructions issued for completion of the form (or disk) are comprehensive and, after a little practice, the observer should encounter little difficulty in completing the returns. All data received are subject to quality control comparison checks for



Measuring rainfall for the daily observation

Stationery, and other items used for making observations, are provided by the Met Office



Minimum requirements for a climatological station in the United Kingdom				
Element	Range	Resolution	Accuracy	Remarks
Maximum temp.	-30 °C to +40 °C	0.1 °C	0.5 °C	Daily
Minimum temp.	-30 °C to +40 °C	0.1 °C	0.5 °C	Daily
Rainfall amount	0 to 999 mm	0.2 mm	0.2 mm < 4 mm, 5% > 4 mm	Daily
Time		1 minute	1 minute	
Additional elements				
Element	Range	Resolution	Accuracy	Remarks
Air temperature	-30 °C to +40 °C	0.1 °C	0.3 °C	1 min mean
Concrete temp.	-40 °C to +30 °C	0.1 °C	0.5 °C	
Dew-point temp.	-50 °C to +40 °C	0.1 °C	0.4 °C	
Grass-min. temp.	-40 °C to +30 °C	0.1 °C	0.5 °C	
Soil temperature	-30 °C to +40 °C	0.1 °C	0.3 °C	
Wet-bulb temp.	-30 °C to +40 °C	0.1 °C	0.3 °C	
Global radiation	0 to 5 MJ m ⁻²		5% or 10 kJ m ⁻²	Hourly
	0 to 40 MJ m ⁻²	10 kJ m ⁻²	3% or 10 kJ m ⁻²	Daily
Net radiation	-1.5 to 5 MJ m ⁻²	10 kJ m ⁻²	10%	Hourly
Wind direction*	10 to 360°	10°	10°	Hourly modal
Wind speed	0 to 150 knots	1 knot	1 knot or 5%	Hourly mean
Gust direction*	10 to 360°	10°	10°	1 min mean
Gust speed	0 to 150 knots	1 knot	1 knot or 5%	3 seconds
Gust time	0 to 59 minutes	1 minute	1 minute	
Relative humidity	1% to 100%	0.1%	5% below 50%, 2% above 50%	
Sunshine duration	0 to 24 hours	0.1 hour	0.3 hour	Daily

** Users are advised to check carefully any software used to average wind direction because of the discontinuity between 0 and 360 degrees. The simple arithmetic mean of 350° and 010° gives 180°, whereas the correct value is 360°.*

Completion of the Weather Diary on the reverse of the form assists staff performing these checks. For stations in England and Wales, a copy of the quality-controlled data is sent back to the station with any amended data indicated.

In general, most returns are submitted on Metform 3208B. However, it is now possible to submit monthly data on disk. The system is known as Data Input System for Climatological Stations (DISCS) and runs under Windows 3.1 on an IBM-compatible PC where it logs the daily readings and Weather Diary. It will automatically calculate monthly totals and means and also provides the facility to display a whole month of data and graphs of the observed values.

Where observations have been made by an AWS, it is no longer necessary to transfer the data to a handwritten form. Instead, data can be submitted using the Met Office CAWS format. This is designed to allow the transfer of a series of observations made over set time periods (usually a month). The data are transferred in comma-separated variable (CSV) spreadsheet format. The first two rows contain numbers that define the location, timing and content of the subsequent rows. A totals line terminates the data and missing data are denoted by a value of 88888. A full guide to the CAWS format is available in a Met Office leaflet.

Supply of publications and forms

A station co-operating with the Met Office is supplied with free monthly return forms, or disks, prepaid addressed envelopes for their dispatch, and pocket registers for recording the observations. In addition, the station is supplied with a free copy of the *Observer's handbook*. Free sunshine cards are supplied to those stations making sunshine records.

Once established, a station is given an annual automatic issue of forms (except for pocket registers, which, because of varying rates of use, are issued on request).

Courses

Observers are encouraged to attend the residential training courses at the Met Office College (near Reading), or in Edinburgh for observers in Scotland, for which no fee is charged. Travel expenses are refunded and accommodation is supplied free of charge. Details of such courses are sent to co-operating stations every year. It is not deemed essential that new observers undertake a course prior to commencing observations.

Bibliography

- *Rules for rainfall observers* (Met Office leaflet)
- *Manual weather measurements* (Met Office leaflet)
- *Automatic weather measurements* (Met Office leaflet)
- *The Health Resort Scheme* (Met Office leaflet)
- *An automatic weather station approved by the Met Office* (Met Office leaflet)
- *Aide-mémoire for climatological observers* (Met Office booklet)
- Metform 1091 — *Register of daily rainfall for a year (mm)*
- Metform 1122 — *Pocket register of rainfall*
- *Observer's handbook* (Met.O.1028)
- *Meteorological glossary* (Met.O.985)



Tutor group at the Met Office College

Site visit and inspections

When an enquirer undertakes to meet the requirements set out in this leaflet, the Met Office will ask for plans of the site (existing or proposed). These should be photocopied, where possible, from a large-scale Ordnance Survey map, showing the precise position of the site, its National Grid Reference and height above mean sea level. A detailed, large-scale plan is also required showing any neighbouring obstructions, their distances from the site, and their heights above ground. Once a requirement has been identified, a site visit will normally be made by a Met Office representative to confirm the suitability of both the site and the observer.

Soon after the establishment of a co-operating station, a further visit will be made to inspect the station and to discuss any difficulties that may have arisen. Inspection visits are made periodically thereafter, normally every three years. Inspections of health resort stations are also carried out every three years.



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