

THIRTY YEARS OF WEATHER OBSERVATION AT PARKHEAD

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Introduction

Weather observation on the campus of the University of Stirling began in 1969 and has since provided a vital supply of information for a variety of research projects in the natural sciences. The observations were first published in the Monthly Weather Report of the Meteorological Office in January 1971 and so, by the end of 2000, the continuous record had reached the benchmark of thirty years, which is the standard averaging period for climatological normals. To mark the occasion, the following report places on record a short history of observation at the station and describes some of the principal features of the local climate that the records have revealed.

History

When the University of Stirling was founded in 1967 there were almost no suitable climate stations capable of providing a reliable flow of climatic information to support ongoing research in the biological sciences. The nearest station, at Stirling (Batterflats) (NS 786 925), had been established at the beginning of the 20th Century but the site had been encroached upon by urban development around Stirling, and observation eventually ceased during 1982. Falkirk and Grangemouth stations were distant from the University and experienced a much stronger climatic influence from the Forth Estuary than would be the case in Stirling. The other station, which also closed in the early 1980's, was at Earl's Hill (NS 725 882), to the south-west of Stirling, but this was at an elevation of 335 m (1100 ft). Support for the establishment of a new climate station was received from the Meteorological Office in 1969 and the site was officially named "Parkhead" in a letter dated 21st May 1969 to Dr S. Matthews of Biological Sciences. The name, which has not proved to be either helpful or appropriate, came from Parkhead Farm which, although less than 1km away from the station, is 100 m higher above sea-level. In retrospect 'Airthrey' or 'Logie' would have been more appropriate. As it is, the station has shared its name with a famous football ground, which has at least provided some amusement for the many school groups who have visited over the years.

The first official return of observations to the Meteorological Office, on METFORM 3208A, was made in 1970. The Office commented on the exceptionally high standard of the return. Publication of the observations from Parkhead in the Monthly Weather Report of the Meteorological Office began from January 1971, the year temperatures changed from Fahrenheit to Celsius.

In 1993 the University of Stirling produced draft plans for new residences in the immediate proximity of the Parkhead station, as a result of which it was moved to a new location a little over 100 m away (Figure 1). In 1994 the

University agreed that the new station should be located in the Memorial Garden between the existing site and Alexander Court, a group of student residences. Equipment for the new station was purchased by the University, which also provided the enclosure. The new station would continue the name and be referred to as Parkhead II. The new station became fully operational from January 1995. As there were slight differences in siting characteristics, particularly with regard to shelter, both old and new stations were operated between January and September 1995 in order to ensure homogeneity in the climatic record.

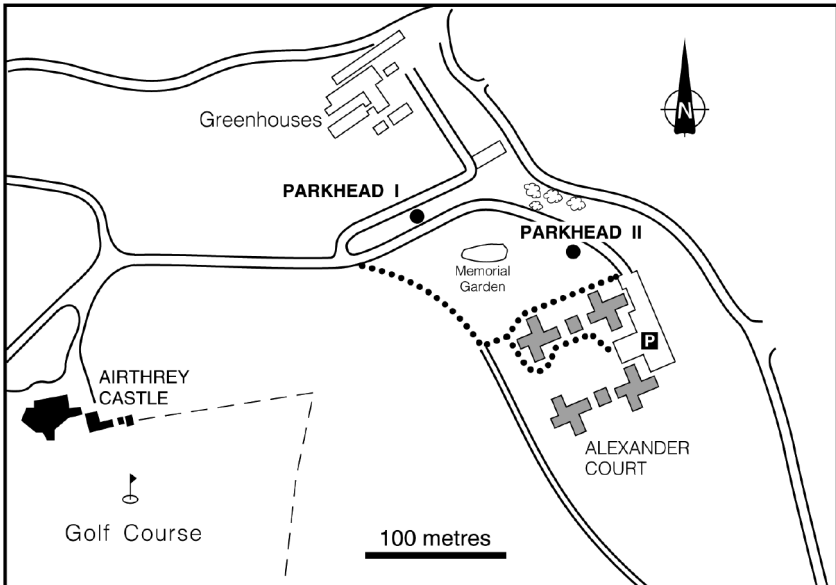


Figure 1. Location of Parkhead I and Parkhead II Climatological Stations

Site Characteristics

Parkhead I (1970–1995)

Grid reference	NS 815 969
Height above sea-level	35 m
Aspect	South-east
Shelter index	33.2 Slightly sheltered

The station was located in the University gardens in the north-east corner of the campus. Small bushes and a tall hedge lay within 10 m of the site to east, west and south. Open beds lay to the north with a steep rise to the Ochil Hills at 400 m distance. The site was, therefore, heavily sheltered from the north. The enclosure was generally maintained to a high standard and usually passed Meteorological Office inspection with only minor remedial action required.

Parkhead II (1995–date)

Grid reference NS 816 968
 Height above sea-level 35 m
 Aspect South-east
 Shelter index 26.5 Average shelter

The station is located in the eastern corner of the Memorial Garden between the Alexander Court student residences and the former site of Parkhead. There is relatively open ground to the west, and a low (1.5 m) hedge nearby to the east and north. There are mature trees (15-18 m high) at a distance of 50 m to the north. To the south there are University residences at a distance of less than 100 m.

Observations and Data Quality

Table 1 Principal observations at Parkhead climatological station

Element	Description
Air Temperature	At 1.2 m above ground level in a thermometer screen. Maximum and minimum over 24 h 0900-0900 GMT. Dry bulb and wet bulb temperature at 0900 GMT. Surface beneath screen is bare concrete.
Rainfall	Total accumulated in 24 h 0900-0900 GMT in a standard raingauge with 12.5 cm orifice set at 30 cm above a grass surface.
Cloud Cover	Estimated by the observer in oktas (eighths) at 0900 GMT.
Wind Direction	Estimated by the observer to the eight principal points of compass at 0900 GMT. No wind vane.
Wind Speed	Estimated by the observer using the Beaufort wind scale at 0900 GMT. Wind not metered. Converted to knots using mid-points on the scale.
Present Weather	Estimated by the observer at 0900 GMT using international reporting codes. Not included in 3208A report.
Visibility	Estimated by the observer at 0900 GMT using standard reporting codes.
Soil Temperature	Temperature at 30 cm depth at 0900 GMT using a mercury-in-glass thermometer suspended down a metal tube.
State of Ground	Reported by the observer using standard reporting codes. No bare soil plot at the station.
Snow	Whether snow lying (50 % or more of surface within the immediate vicinity of the station) plus depth of lying snow.

The climatic observations generated by Parkhead are specified in Table 1. Observations were made initially by Mr A Liddell of Biological Sciences at the University, but during the 1970s this responsibility was transferred to the University ground staff. Mr Liddell was responsible for completing the 3208A METFORM at the end of each month, a duty which he transferred to Mr L. Taylor on his retirement in 2000. Research staff in Biological Sciences acted as superintendent of the station until the establishment of the Department of Earth and Environmental Science in 1978 when responsibility passed to Dr S.J. Harrison.

Quality control of the observations was primarily left to the Meteorological Office until 1996 when a system of internal pre-checking was introduced. A photocopy is taken of the observers' register, which is then cross-checked against observations from Bridge of Allan, less than 2 km to the west of the station. Hard copies of monthly returns made prior to 1996 have been quality controlled retrospectively. On the whole, the quality of observing has been high. The most persistent problems have been occasional failure to re-set the maximum and/or minimum thermometers, failure to report broken thermometers, persistent use of 'TR' (trace) to register both negligible and zero daily rainfalls, and a failure to melt accumulated snow into the raingauge. Despite being next to a relatively busy thoroughfare the level of vandalism has been exceptionally low.

The daily data for the 30-year record have been quality controlled and are now available in monthly summary form as Minitab data files (Table 2) which are available as e-mail attachments or hard-copy from the author.

Table 2 Minitab data file specifications

Minitab File Label	Variable
maximum	means of daily maximum temperatures
minimum	means of daily minimum temperatures
frosts	number of air frosts in the month
rainfall	total rainfall for each month
rainmax	highest daily rainfall in each month
rain02	number of days with rainfall ≥ 0.2 mm
rain10	number of days with rainfall ≥ 1.0 mm
rain50	number of days with rainfall ≥ 5.0 mm

*** Monthly means, or absolute maxima (greatest falls) are included under the year code '999' and should be deleted before any analysis is undertaken of monthly data.

Monthly summaries of the observations from Parkhead were published in the Monthly Weather Report until publication of the report ceased in 1993. The data are now available via the Internet on the British Atmospheric Data Centre (BADC) web site (www.badc.rl.ac.uk). The University of Stirling's Annual Climatological Bulletin is based on observations from Parkhead and subsequently appears in summary form in the *Forth Naturalist and Historian*.

Analysis of Weather Data

Air Temperature

Due to thermal lag in the ground surface and in the lower atmosphere, the mean maximum temperatures tend to follow the solstices, the warmest month being July (19.8°C) and the coolest January (6.5°C). The daytime temperature in summer frequently exceeds 20.0°C while in December and January there are occasional days on which the air temperature does not rise above 0.0°C. Most of the hottest days have occurred during July, with some in August, and the highest air temperature ever reached at Parkhead was 29.8°C on July 12th 1983.

The mean minimum temperatures tend to follow a similar pattern to the maxima between July (10.6°C) and January (0.5°C). The winter air temperature frequently falls below freezing with the coldest days tending to occur in either December or January. The monthly mean minimum air temperature has been below 0.0°C in six times in December and ten times in January. The lowest air temperature ever reached at Parkhead was -17.2°C on the 11th January 1982 during a protracted spell of very cold weather. In the context of local climates in the Stirling area, Parkhead is relatively well protected from air frost when compared to the low lying carse lands of the Forth valley where there are relatively more frequent frosts and a shorter frost-free season. The season of greatest frequency of frost at Parkhead is from October through to April, with the highest average frequency being in January. Late spring frosts occur in May but usually in the first half of the month, and June air frosts are extremely rare. The first of the autumn air frosts usually arrives in October but in roughly one year in four, this occurs during September.

Rainfall

Most of the rainfall in Stirling is associated with low atmospheric pressure with only occasional convective storms, usually in late summer. The seasonal pattern of rainfall is typical of a mid-latitude climate in which rainfall is dominantly from depressions arriving from the Atlantic in that the wettest months are, on average, from September through to March. December and January have the highest average rainfalls. Although the summer months are relatively drier, a particular feature of the local climate is the abrupt shift from a generally wet March to a considerably drier April, this being the driest month, on average, during the year. Rainfall is extremely variable from year to year. The most variable month is March, with April being one of the most consistent.

Daily falls in excess of 25 mm are relatively frequent, particularly during the winter months. There have, however, been a number of remarkable falls during the 30 year period, most of which have resulted in local flooding (Table 3). The largest 24-hour total was recorded on November 3rd 1984, which resulted in a massive slope failure above Menstrie.

Table 3 Daily rainfalls of 40.0 mm or more. 1971-2000

Rank	Rainfall mm	Date
1	68.3	3rd November 1984
2	66.2	1st October 1981
3	65.6	26th July 1985
4	44.2	18th September 1985
5	44.0	25th March 1979
6	43.8	16th December 1989
7	40.5	30th November 1985
8	40.0	1st January 1991

The three standard thresholds of daily rainfall are 0.2 mm (rain day), 1.0 mm (wet day), and 5.0 mm (very wet day). On average 51 % of days are classified as rain-days although there is considerable year-to-year variation in this figure, ranging from 60 % in 1986 to only 43 % in 1997. Expressed in terms of percentage of days in each month, there is a well marked seasonal contrast between winter and summer months. On average 41 % can be classified as being wet, varying between winter (45-55 %) and summer (30-35 %) months. Only 18 % of days are, on average, very wet days. Only 10 % of April days are very wet, in contrast to January when the proportion is 26 %.

Other Weather Observations

Because of the sheltered nature of the site and the use of the Beaufort scale of wind force, a very high number of 'Calms' appears in the record. Otherwise, the most frequent wind directions are between South-West and West.

The record of soil temperature at a depth of 30 cm is discontinuous due to the change in location in 1995. At a depth of 30 cm the highest temperature has usually been reached in late July or early August and the lowest in early February.

Climatological Normals

The quality controlled and revised climatological normals for Parkhead are as follows in Tables 4 and 5.

Table 4 Climatological Normals for Parkhead 1971-2000 (Temperature)

Month	Maximum Temperature °C	Minimum Temperature °C	Number of Air Frosts
January	6.5	0.5	13
February	6.9	0.8	11
March	9.1	1.9	7
April	11.8	3.4	4
May	15.3	5.8	1
June	17.7	8.4	<1
July	19.8	10.6	0
August	19.4	10.2	0
September	16.3	8.3	<1
October	12.9	5.4	2
November	9.2	2.6	8
December	7.2	1.1	11
YEAR	12.7	4.9	57

Table 5 Climatological Normals for Parkhead 1971-2000 (Rainfall)

Month	Total Rainfall mm	Greatest Fall mm	Number of days ≥ 0.2 mm	Number of days ≥ 1.0 mm	Number of days ≥ 5.0 mm
January	110.7	40.0	19	16	8
February	73.2	31.8	16	12	5
March	81.4	44.0	17	14	5
April	47.5	35.3	13	10	3
May	56.9	28.3	14	11	4
June	57.1	35.8	13	10	4
July	62.9	65.5	13	10	5
August	68.1	30.0	14	11	5
September	87.7	44.2	15	12	6
October	97.9	66.2	17	14	6
November	98.9	68.3	17	14	7
December	101.0	43.8	18	15	7
YEAR	943.3	68.3	186	149	65

Bibliography

Data from the station have been used in a number of research publications but those specifically relating to the climate in Central Scotland include:-

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