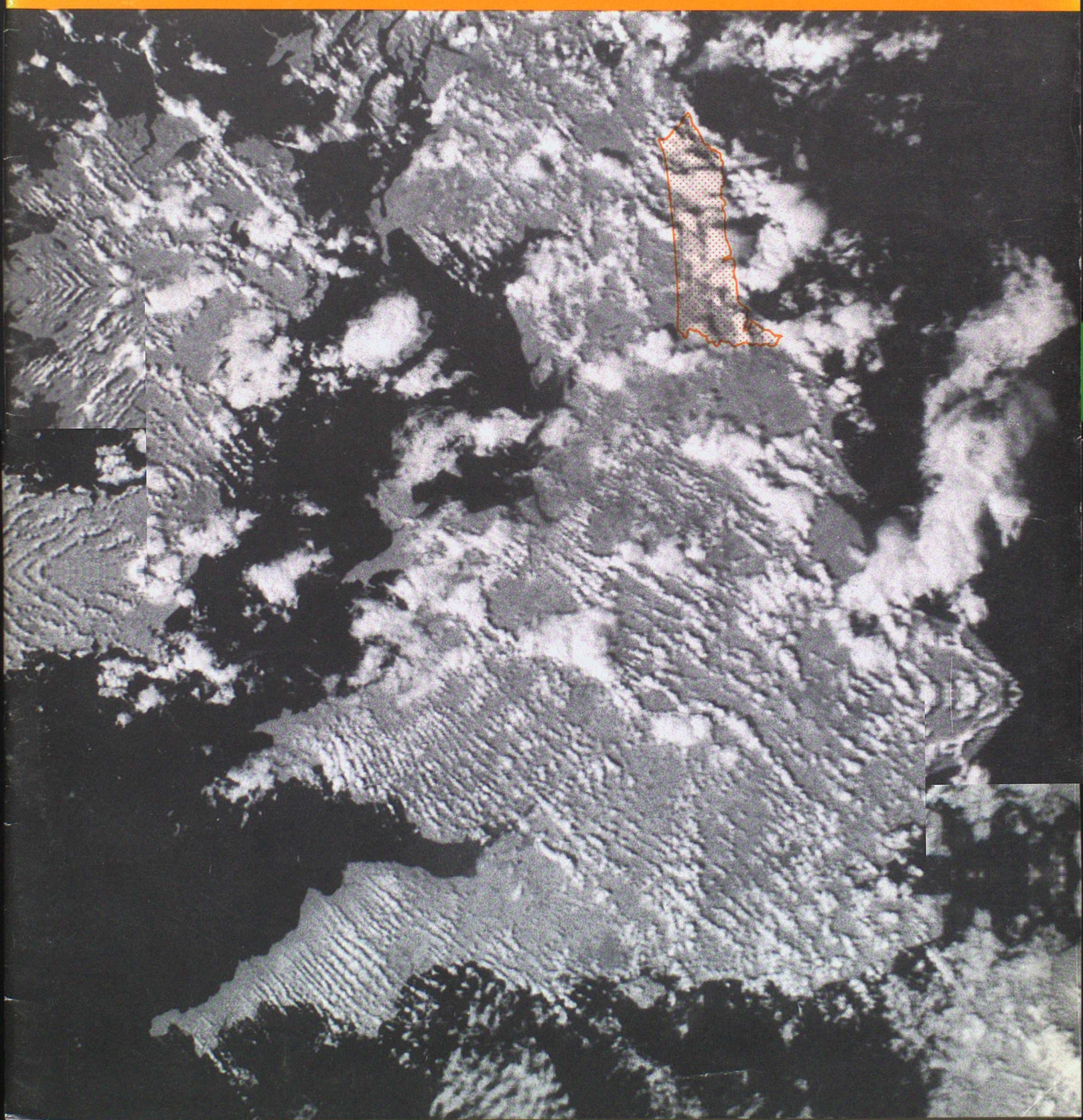
THE CLIMATE OF GREAT BRITAIN

NORTH-EAST ENGLAND

Climatological Memorandum 127



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The front cover shows a view of England and Wales from satellite Tiros N taken at 1518 GMT on Wednesday 2 April 1980 – photograph by courtesy of the Department of Electrical Engineering and Electronics, University of Dundee.

An anticyclone was positioned to the south-west of the British Isles and a showery north-westerly airstream covered Britain. The cloud 'streets' of cumulus cloud are clearly seen, with larger cumulonimbus in places. North-east England had about 8 hours of sunshine with maximum afternoon temperatures around 12 ^{o}C. Scattered showers with isolated hail and thunder occurred during the afternoon and early evening.

THE CLIMATE OF GREAT BRITAIN

Climatological Memorandum 127

North-east England

INTRODUCTION

This memorandum is one of a series which will cover the whole of Great Britain and seeks to present the main features of the climate of the area in a form suitable for use in schools and by members of the general public.

There is an Introduction to the series (Climatological Memorandum 113) which explains how the various weather elements are measured and defines some of the more common terms.

Industrial and commercial interests who are concerned with meteorological information for planning and design will probably require more complex analyses of the available data, and details of the services offered by the Meteorological Office to meet those needs are given on page 18.

CONTENTS

Advisory Services
February 1990

THE AREA

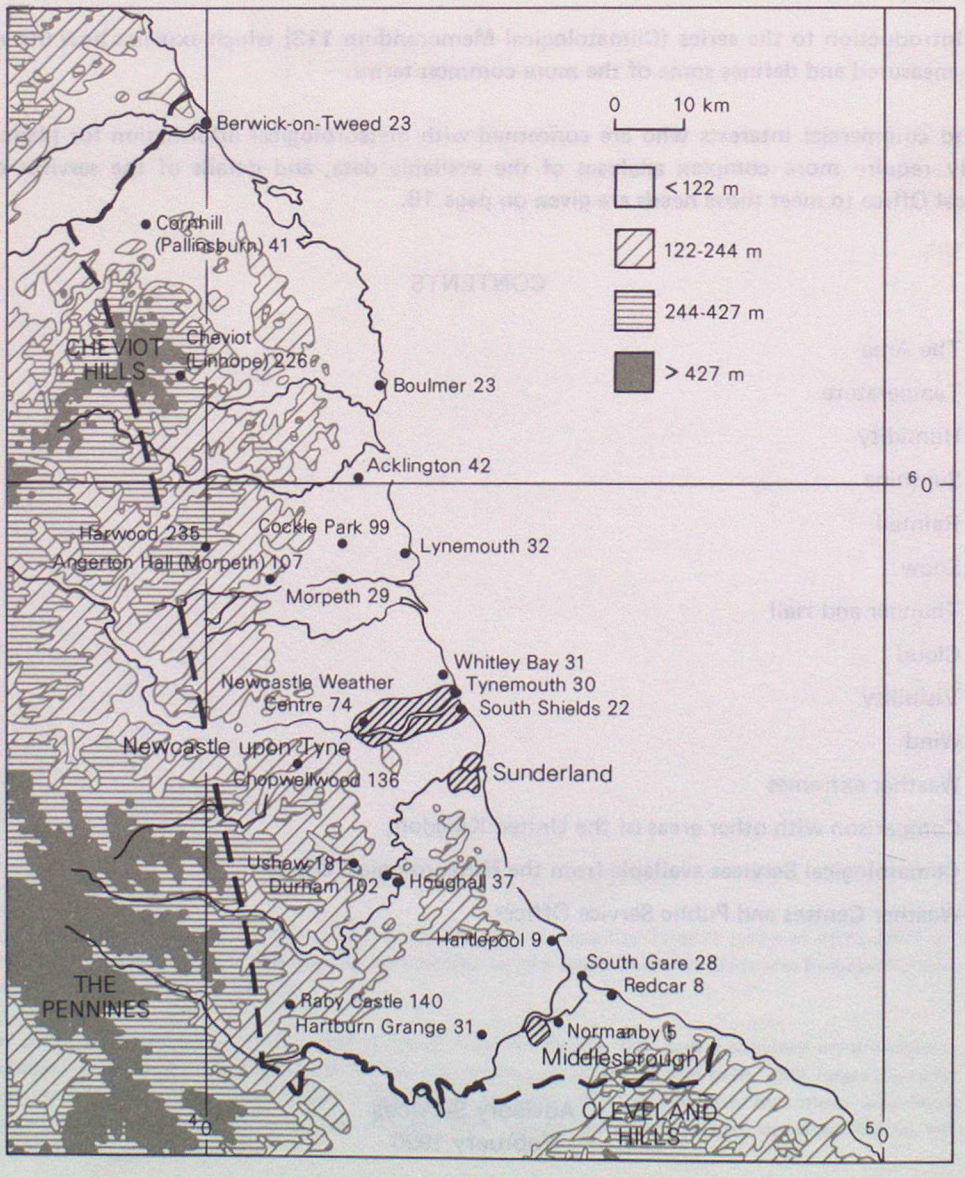
This memorandum describes the main features of the climate of north-east England. The area consists of Tyne and Wear, Cleveland and those parts of Northumberland and Durham to the east of the Pennines. It extends from the Scottish border to Teesside and is bounded in the west by the high ground of the Cheviots and the Pennines, and by the North Sea in the east. The highest point is The Cheviot at 816 metres.

The industrial development of the area was based on the Northumberland and Durham coalfield, which is the second most productive coalfield in Britain. The shipbuilding industry developed because of the need to transport coal, and the presence of local ores, since worked out, led to the development of the iron and steel industry. The shipbuilding industry produces around 40 per cent of the total United Kingdom tonnage though like the coal industry it has declined in recent years. The Stockton to Darlington railway, opened in 1825, was to link part of the coalfield with the port of Middlesborough.

Most farms and settlements are located in river valleys with dairy farming near the cities and sheep farming on the higher ground to the west. Newcastle-upon-Tyne at the lowest bridging point is the major regional centre. It is a commercial and industrial centre with coal mining, shipbuilding, marine engineering and chemicals among its industries. Sunderland at the mouth of the River Wear is an industrial town and seaport with coal mining, shipbuilding, engineering, glass and paper manufacturing industries.

The map below shows the topography of the area and the locations of the climatological and rainfall stations for which data are given in this memorandum. Data for Acklington and Boulmer are sequential and have been merged at times to give one set of data.

Topography of north-east England and locations and altitudes (in metres) of the stations. Coordinates are National Grid references.



TEMPERATURE

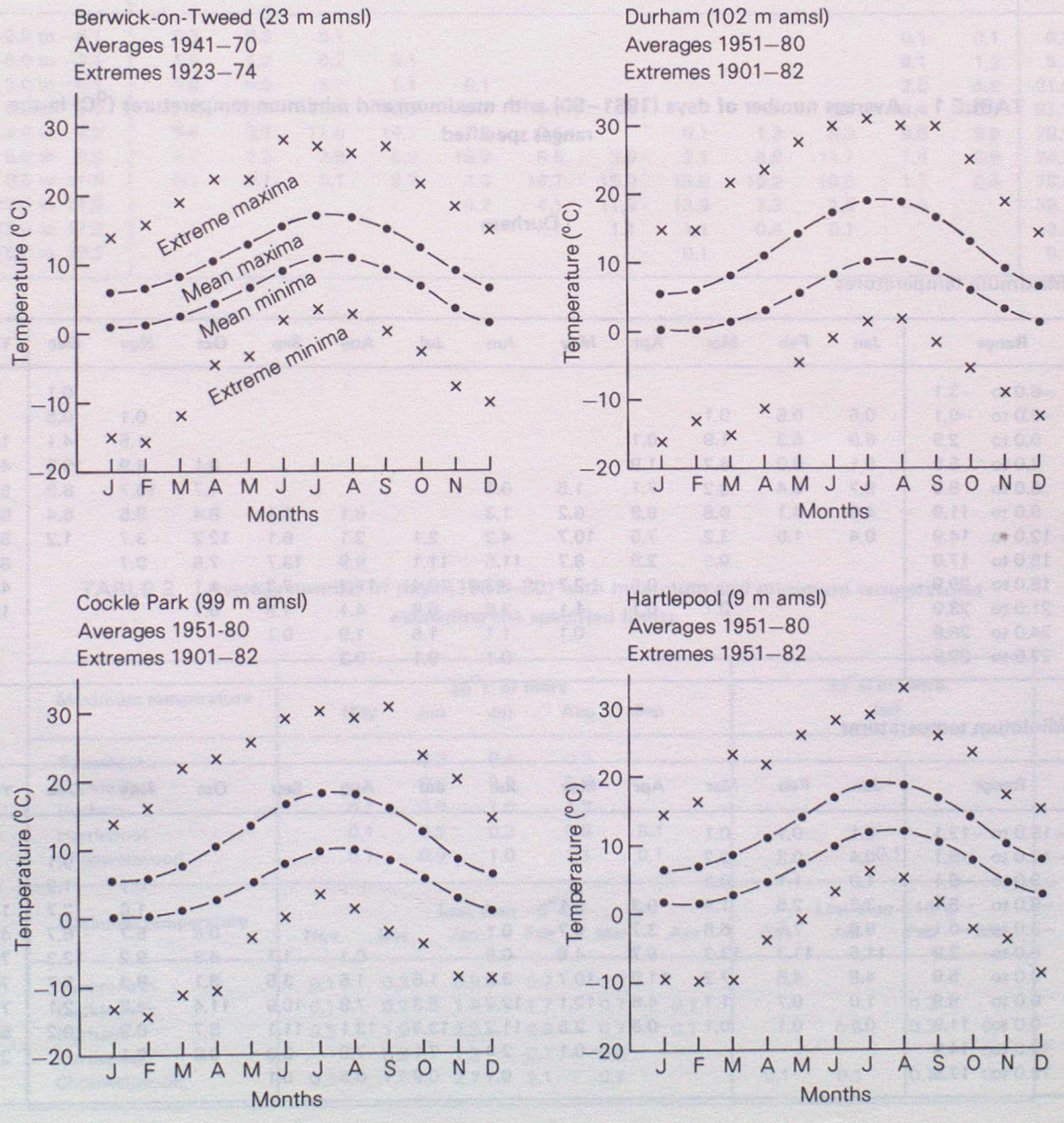
The mean annual temperature over the area varies from around 8.5 °C to 9.5 °C, values tending to be higher in the south of the area. These are the lowest values which occur in low lying areas of England. Over the British Isles the mean annual temperature ranges from about 7 °C in the Shetland Isles to over 11 °C in the extreme south-west of England and the Channel Islands.

Temperature shows both seasonal and diurnal variations. January is on average the coldest month with mean daily minimum temperatures varying from over 1.5 °C along the coast to −0.5 °C at some inland locations. This compares with −1.0 °C in parts of Tayside and Grampian to over 5.5 °C in the Isles of Scilly.

Minimum temperatures normally occur around sunrise and extreme minimum temperatures usually occur in January or February, though some locations in north-east England have recorded extreme minimum temperatures in December or March. The lowest known temperature recorded in the area was −21.1 °C at Houghall on 5 January 1941.

Mean daily maximum temperatures are highest in July and range from 17 °C in the Berwick-on-Tweed area to around 19.5 °C at some inland locations in the south of the area. The modifying effect of the sea which keeps the coastal locations relatively warm in the winter has the reverse effect in the summer. The highest mean daily temperatures in the British Isles of 22.5 °C occur in the London area and the lowest of 15 °C in the Shetland Isles.

FIGURE 1 Annual variation of maximum and minimum temperature and extreme temperatures for the periods stated.



Maximum temperatures normally occur 2 to 3 hours after midday and extreme maximum temperatures usually occur in July or August but occasionally in June or September. The highest known temperature recorded in the area was 33.9 °C at Ushaw on 1 September 1906. The highest September temperature recorded in the British Isles was also in 1906 when 35.6 °C was recorded at Bawtry near Doncaster on the 2nd.

The variation of mean maximum and mean minimum temperatures together with extreme temperatures recorded at four locations in the area are shown in Figure 1. There is a marked similarity between the curves of the mean values though the range of temperatures is less at the two coastal sites. The extreme values show more variation and reflect the differing topographical features of the locations as well as the period over which the data were recorded.

Table 1 gives the average number of days during the period 1961–80 that maximum and minimum temperatures at Durham and Tynemouth occurred in the ranges specified. The most striking feature of the table is the wide range of maximum and minimum temperatures which can occur at any time of the year. The modifying influence of the sea means that the range of temperatures is less at Tynemouth than Durham which has more occasions of both high and low temperatures. The high value in March at both locations occurred on the 29th during a warm spell in 1965.

The average number of days a year of air frost in north-east England varies from about 25 on the coast, increasing inland to 60 or more and reaching 100 on some high ground areas. For ground frosts the values vary from 65 to over 130 at some inland locations. Although the summer months are usually free from air frosts, at some inland sites a ground frost may occur at any time of the year. Figure 2 gives the average number of days of air and ground frost at four locations in north-east England over the period 1961–80. See also the Introduction to the series.

Table 2 lists the average number of days when temperatures exceeded certain limits at five locations in the area in the period 1961–80. The frequency of occurrence of temperatures above 25 °C is less than most other parts of England which have on average between 5 and 12 days a year with temperatures above 25 °C.

TABLE 1 Average number of days (1961–80) with maximum and minimum temperatures (°C) in the ranges specified

Durham

Maximum temperatures

Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
−6.0 to −3.1												0.1	0.1
−3.0 to −0.1	0.5	0.5	0.1								0.1	0.5	1.5
0.0 to 2.9	6.9	5.3	1.9	0.1							1.5	4.1	19.9
3.0 to 5.9	9.1	8.0	6.2	1.9						0.1	4.9	10.5	40.7
6.0 to 8.9	9.7	9.4	9.2	7.1	1.5	0.1				1.7	10.7	8.3	57.7
9.0 to 11.9	4.5	4.1	9.8	9.9	6.2	1.3		0.1	1.1	8.4	8.5	6.4	60.1
12.0 to 14.9	0.4	1.0	3.2	7.5	10.7	4.2	2.1	2.1	6.1	12.2	3.7	1.2	54.3
15.0 to 17.9			0.5	2.9	8.7	11.5	11.1	9.9	13.7	7.5	0.7		66.5
18.0 to 20.9				0.5	2.7	8.3	10.4	12.7	7.3	1.1			42.9
21.0 to 23.9			0.1	0.1	1.1	3.5	5.9	4.1	1.8	0.1			16.7
24.0 to 26.9					0.1	1.1	1.5	1.9	0.1				4.5
27.0 to 29.9						0.1	0.1	0.3					0.5

Minimum temperatures

Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
−15.0 to −12.1	0.1	0.1	0.1										0.1
−12.0 to −9.1	0.4	0.3	0.2									0.1	1.0
−9.0 to −6.1	1.0	1.1	0.3								0.1	1.2	3.7
−6.0 to −3.1	3.3	2.5	1.4	0.3	0.1						1.6	2.7	11.9
−3.0 to −0.1	9.0	7.5	6.8	3.7	0.7	0.1				0.8	5.7	6.7	40.9
0.0 to 2.9	11.5	11.3	13.3	9.7	4.8	0.8		0.1	1.1	4.3	9.2	12.3	78.1
3.0 to 5.9	4.8	4.8	7.2	11.0	10.7	3.2	1.5	1.5	3.5	8.1	8.3	5.7	70.2
6.0 to 8.9	1.0	0.7	1.7	4.8	12.1	12.2	8.3	7.9	10.9	11.4	4.2	2.1	77.1
9.0 to 11.9	0.1	0.1	0.1	0.5	2.5	11.2	13.3	13.1	11.1	5.7	0.9	0.2	58.7
12.0 to 14.9					0.1	2.4	7.1	7.9	3.3	0.9	0.1		21.9
15.0 to 17.9						0.1	0.9	0.5	0.1				1.7

TABLE 1 continued

Tynemouth

Maximum temperatures

Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
−3.0 to −0.1	0.2	0.1	0.1									0.3	0.6
0.0 to 2.9	3.6	3.9	1.3	0.1							0.8	2.5	12.1
3.0 to 5.9	10.7	10.5	9.1	4.1	0.2					0.1	3.9	8.8	47.2
6.0 to 8.9	10.8	8.3	8.7	10.9	5.4	0.1				1.1	10.9	11.3	67.5
9.0 to 11.9	4.9	4.5	8.9	7.9	9.9	3.8	0.5	0.1	1.8	9.9	9.5	6.0	67.9
12.0 to 14.9	0.7	1.1	2.4	5.5	9.1	8.7	7.5	6.1	10.2	12.9	3.9	2.1	70.3
15.0 to 17.9			0.4	1.5	5.5	9.7	10.9	14.2	11.5	5.9	0.8	0.1	60.5
18.0 to 20.9				0.2	0.7	6.1	9.1	8.0	5.5	1.0	0.1		30.7
21.0 to 23.9			0.1		0.2	1.3	2.5	2.0	0.9	0.1			7.1
24.0 to 26.9						0.3	0.3	0.6	0.1				1.2
27.0 to 29.9							0.1						0.1

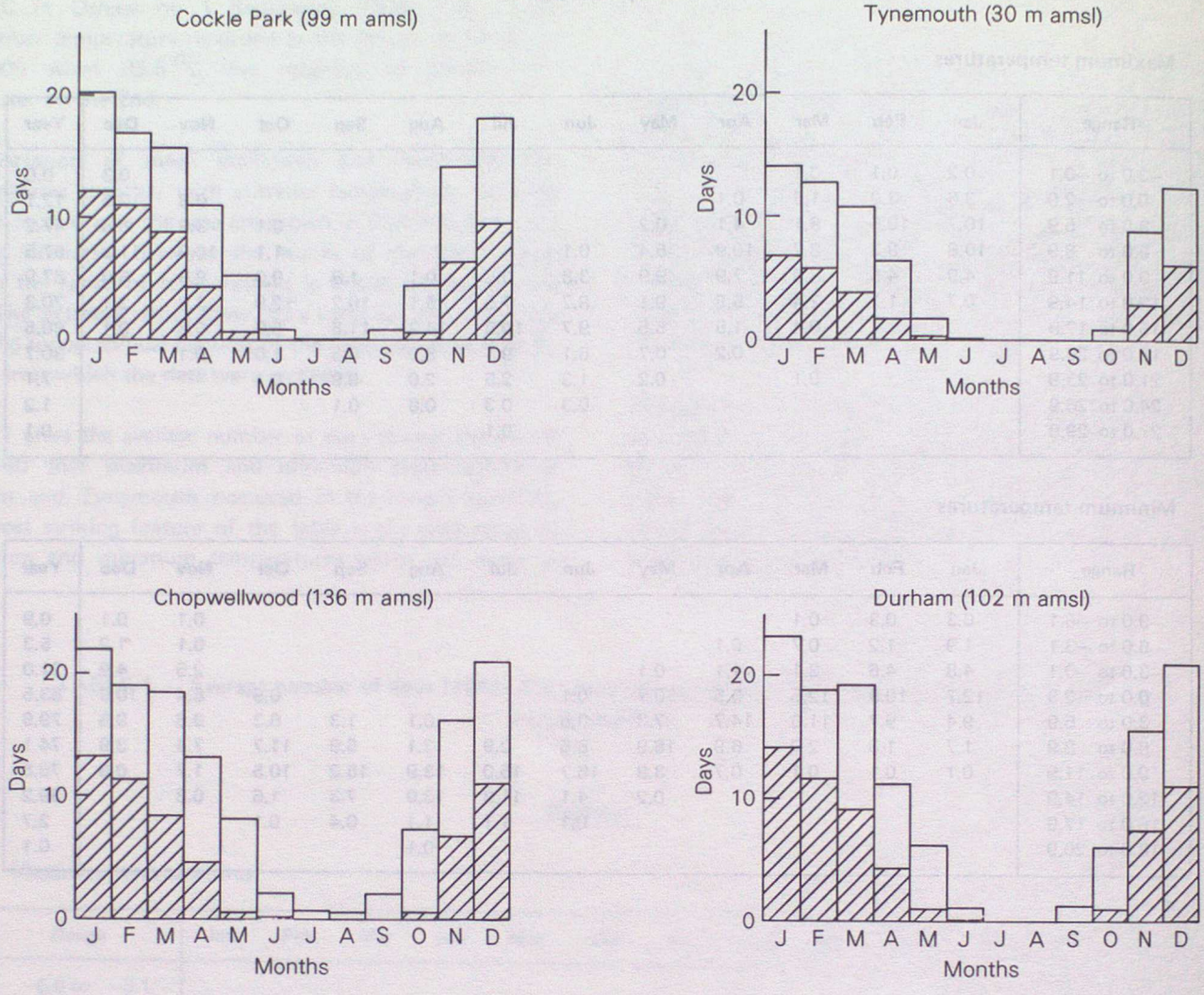
Minimum temperatures

Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
−9.0 to −6.1	0.3	0.3	0.1								0.1	0.1	0.9
−6.0 to −3.1	1.9	1.2	0.7	0.1							0.1	1.2	5.3
−3.0 to −0.1	4.8	4.6	3.1	1.1	0.1						2.5	4.9	21.0
0.0 to 2.9	12.7	10.9	12.5	6.5	0.7	0.1				0.9	8.4	10.9	63.5
3.0 to 5.9	9.4	9.7	11.6	14.7	7.3	0.5		0.1	1.3	6.3	9.6	9.5	79.9
6.0 to 8.9	1.7	1.3	2.9	6.9	18.9	8.5	2.9	2.1	5.9	11.7	7.4	3.9	74.1
9.0 to 11.9	0.1	0.1	0.1	0.7	3.8	16.7	15.0	13.9	15.2	10.5	1.7	0.5	78.5
12.0 to 14.9					0.2	4.1	11.9	13.9	7.3	1.6	0.3		39.2
15.0 to 17.9						0.1	1.1	1.1	0.4	0.1			2.7
18.0 to 20.9								0.1					0.1

TABLE 2 Average number of days (1961–80) with maximum and minimum temperatures exceeding the specified limits

Maximum temperature	25°C or more					30°C or more			
	May	Jun	Jul	Aug	Sep	Jun			
Tynemouth		0.2	0.1	0.3					
Cockle Park		0.4	0.5	0.7					
Durham	0.1	0.9	1.0	1.3					
Hartlepool	0.1	0.6	0.3	0.9	0.1				
Chopwellwood	0.1	0.9	1.0	1.1	0.1	0.1			
Minimum temperature	**Less than −5°C**					**Less than −10°C**			
	Nov	Dec	Jan	Feb	Mar	Apr	Dec	Jan	Feb	Mar
Tynemouth	0.1	0.3	0.9	0.7	0.2					
Cockle Park	0.1	0.7	1.5	1.7	0.7	0.1			0.2	
Durham	0.3	1.9	2.3	2.0	0.7	0.1		0.3	0.2	0.1
Hartlepool		0.9	1.2	0.7	0.5					0.1
Chopwellwood	0.3	1.5	2.7	2.1	0.7		0.1	0.1	0.1	0.1

FIGURE 2 Average number of days with air frost (hatched areas) and ground frost (whole columns) over the period 1961–80.



HUMIDITY

Relative humidity is a measure of the amount of water vapour in the air compared with the maximum amount which could be contained by the air at the same temperature, expressed as a percentage. If the amount of water vapour in the air remains constant then as the temperature rises (or falls) the relative humidity decreases (or increases).

The relative humidity in north-east England averages about 85 per cent over the year with higher values occurring in the winter and at night. This is primarily a reflection of the seasonal, and diurnal temperature changes. Relative humidity equals or exceeds 95 per cent for some 15 to 20 per cent of the time in the area, and 100 per cent can be reached in fog and persistent rain, snow or drizzle. Low relative humidities are less common as Figure 3 shows. This gives the percentage of time in the period 1971–80 that relative humidities in the stated 5 per cent ranges occurred at Acklington/Boulmer. The 26 to 30 per cent range represents just one hour during the ten-year period.

Figure 4 shows the average diurnal variation of relative humidity and temperature at Boulmer for the months of January and July; this illustrates a number of the points made in the text.

FIGURE 3 **Percentage of time relative humidity occurred in the ranges specified at Acklington/Boulmer over the period 1971–80.**

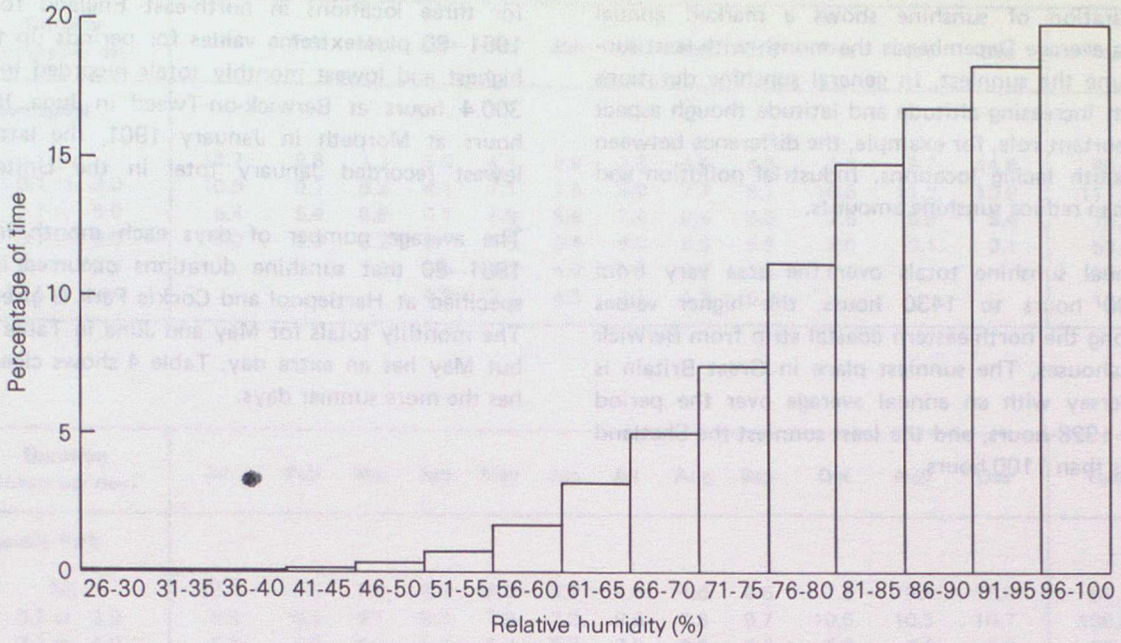
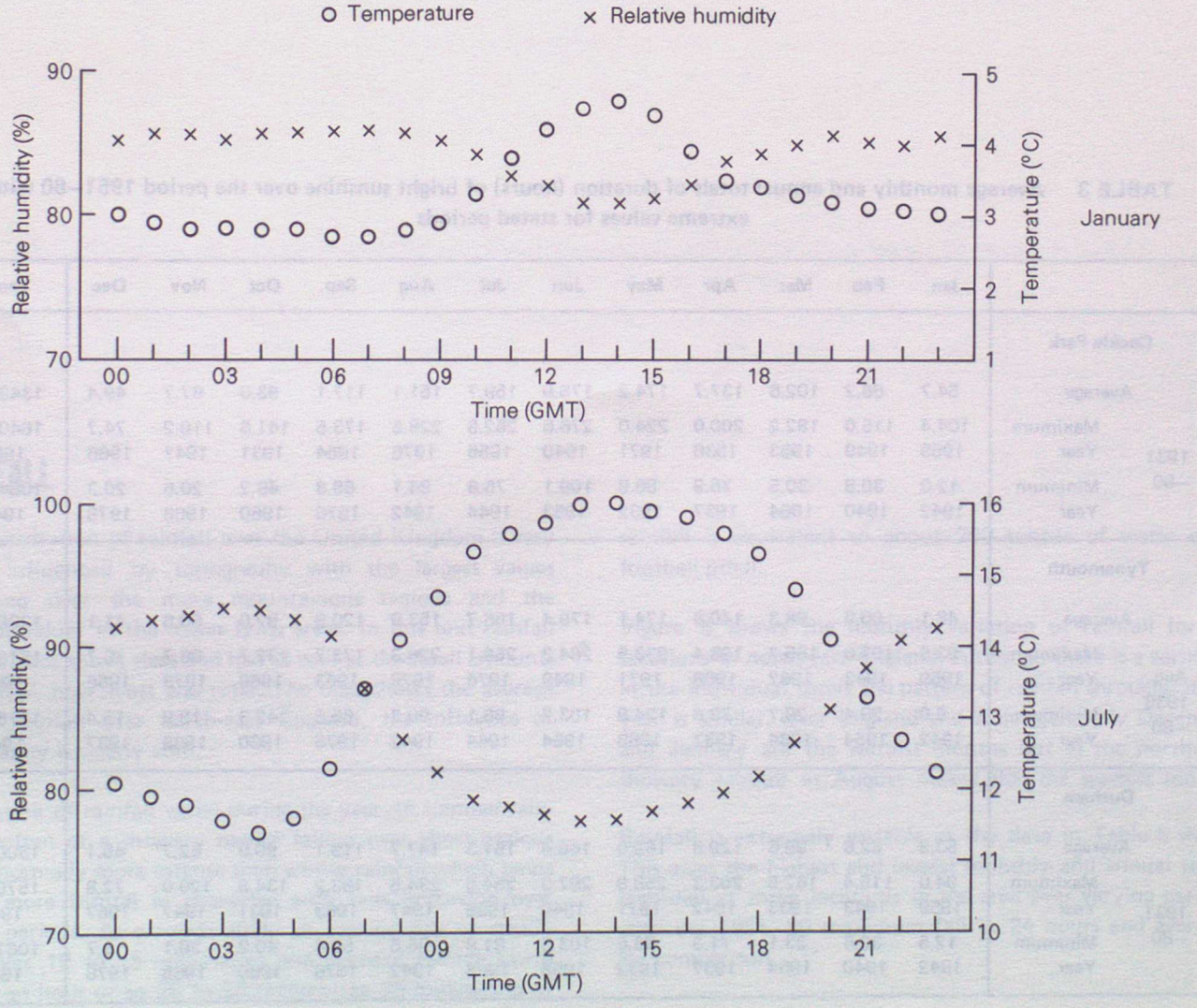


FIGURE 4 **Average diurnal variation of temperature and relative humidity at Boulmer for January and July over the period 1976–83.**



SUNSHINE

The variation in length of day throughout the year means that the duration of sunshine shows a marked annual variation. On average December is the month with least sunshine and June the sunniest. In general sunshine durations decrease with increasing altitude and latitude though aspect plays an important role, for example, the difference between north and south facing locations. Industrial pollution and smoke haze can reduce sunshine amounts.

Average annual sunshine totals over the area vary from around 1300 hours to 1430 hours, the higher values occurring along the north-eastern coastal strip from Berwick to about Seahouses. The sunniest place in Great Britain is St Helier, Jersey with an annual average over the period 1951–80 of 1928 hours, and the least sunniest the Shetland Isles with less than 1100 hours.

Table 3 lists the average monthly and annual sunshine totals for three locations in north-east England for the period 1951–80 plus extreme values for periods up to 1980. The highest and lowest monthly totals recorded in the area are 300.4 hours at Berwick-on-Tweed in June 1940 and 3.6 hours at Morpeth in January 1901, the latter being the lowest recorded January total in the United Kingdom.

The average number of days each month in the period 1961–80 that sunshine durations occurred in the ranges specified at Hartlepool and Cockle Park is given in Table 4. The monthly totals for May and June in Table 3 are similar, but May has an extra day. Table 4 shows clearly that June has the more sunnier days.

TABLE 3 Average monthly and annual totals of duration (hours) of bright sunshine over the period 1951–80 with extreme values for stated periods

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cockle Park														
	Average	54.7	66.2	102.6	137.7	174.2	175.9	159.7	151.1	117.1	93.0	67.7	49.4	1349.4
	Maximum	104.4	115.0	182.2	200.0	224.0	276.6	252.5	228.5	173.5	141.6	110.2	74.7	1640.8
1931	Year	1959	1949	1953	1936	1971	1940	1955	1976	1954	1931	1947	1966	1955
–80	Minimum	12.0	30.8	30.5	75.9	86.8	109.1	75.6	84.1	68.8	48.2	20.6	20.3	1084.5
	Year	1942	1940	1964	1937	1932	1953	1944	1942	1976	1960	1968	1978	1941
Tynemouth														
	Average	48.1	60.9	98.3	140.6	174.1	179.4	166.7	153.9	120.9	92.0	60.6	41.1	1336.6
	Maximum	93.5	107.6	165.7	198.4	233.5	264.3	256.1	226.3	173.7	132.7	96.7	70.7	1518.6
Aug	Year	1959	1943	1967	1968	1971	1949	1976	1976	1963	1968	1973	1966	1955
1936	Minimum	6.0	29.4	29.7	73.6	124.8	103.7	86.1	90.3	65.5	42.3	18.9	15.4	1115.9
–80	Year	1942	1954	1964	1937	1968	1954	1944	1942	1976	1960	1968	1937	1941
Durham														
	Average	53.9	62.6	99.6	129.8	169.0	168.6	151.3	147.7	119.1	90.9	62.7	45.1	1300.2
	Maximum	94.0	115.4	162.5	203.3	258.8	297.0	254.5	234.5	183.2	134.9	120.0	72.8	1576.8
1931	Year	1959	1943	1933	1942	1971	1940	1955	1947	1963	1931	1947	1967	1949
–80	Minimum	12.5	30.6	33.1	71.3	86.6	103.5	81.9	95.6	59.4	40.9	30.1	9.7	1067.6
	Year	1942	1940	1964	1937	1932	1958	1968	1942	1976	1960	1968	1978	1937

TABLE 4 Average number of days (1961–80) of sunshine duration in the ranges specified

Duration (Hours per day)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Hartlepool													
Nil	13.7	9.8	7.3	5.5	4.1	2.9	2.8	4.0	4.3	7.3	9.7	14.6	86.0
0.1 to 3.0	10.9	9.7	9.3	8.1	7.1	7.5	8.9	7.7	9.7	10.6	11.2	10.9	111.6
3.1 to 6.0	5.4	5.4	6.5	6.1	6.8	5.8	7.4	6.5	6.5	7.5	5.9	5.4	75.3
6.1 to 9.0	1.0	3.3	6.2	6.1	5.3	5.4	5.3	6.8	5.9	5.0	3.1	0.1	53.5
9.1 to 12.0			1.6	3.5	4.7	4.0	3.5	4.7	3.3	0.6			25.9
12.1 or more				0.9	3.1	4.3	3.1	1.3	0.2				12.9

Duration (Hours per day)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cockle Park													
Nil	13.5	10.5	7.2	5.2	3.5	3.1	4.0	4.6	5.5	7.8	9.1	12.9	87.2
0.1 to 3.0	9.9	8.5	9.1	8.3	7.8	7.3	8.5	7.3	9.7	10.5	10.3	10.7	108.0
3.1 to 6.0	5.9	5.5	6.8	6.4	6.7	5.7	7.0	6.8	6.7	7.3	7.2	6.5	78.5
6.1 to 9.0	1.7	3.9	6.1	6.4	5.4	5.3	4.9	6.6	5.2	4.9	3.4	0.9	54.6
9.1 to 12.0			1.7	3.3	4.7	4.7	4.3	4.6	2.7	0.4			26.3
12.1 or more				0.4	2.9	3.8	2.3	1.1	0.1				10.6

RAINFALL

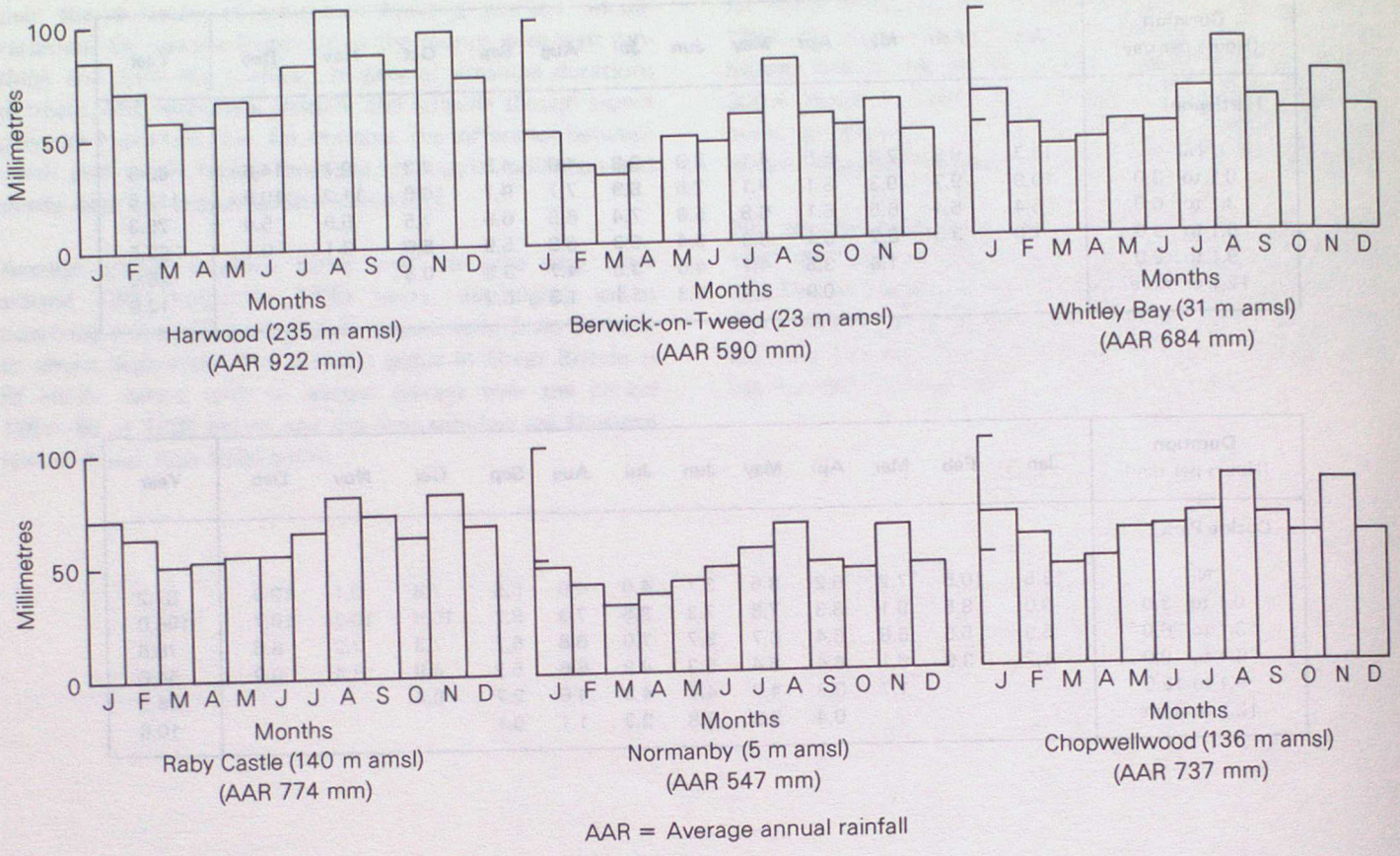
The distribution of rainfall over the United Kingdom is very much influenced by topography with the largest values occurring over the more mountainous regions and the smallest values in the lower lying areas. In this text rainfall also includes snow, sleet and hail as well as the small amounts from dew, hoar frost and rime. The map shows the average annual rainfall over north-east England; the influence of topography is clearly seen.

The nature of rainfall varies during the year. In summer rainfall is often of a showery nature falling over short periods and is normally more intense than winter rainfall which tends to be more frontal in character with falls occurring over longer periods. As a rough guide an average day of steady rain gives 10 to 15 millimetres and a heavy thunderstorm lasting an hour or so 25 to 50 millimetres. 25 millimetres of rainfall is equivalent to about 200 tonnes of water on a football pitch.

Figure 5 shows the monthly variation of rainfall for six locations in north-east England. Although there is a variation in the individual totals the pattern of rainfall throughout the year is similar. Over England and Wales generally December and January are the wettest months but in the north-east showery rainfall in August makes this the wettest month.

Rainfall is extremely variable as the data in Table 5 show. This gives the highest and lowest monthly and annual totals recorded at three locations in the area over varying periods with the 1951–80 maximum fall in 24 hours and averages for comparison.

FIGURE 5 Average monthly rainfall over the period 1941–70.

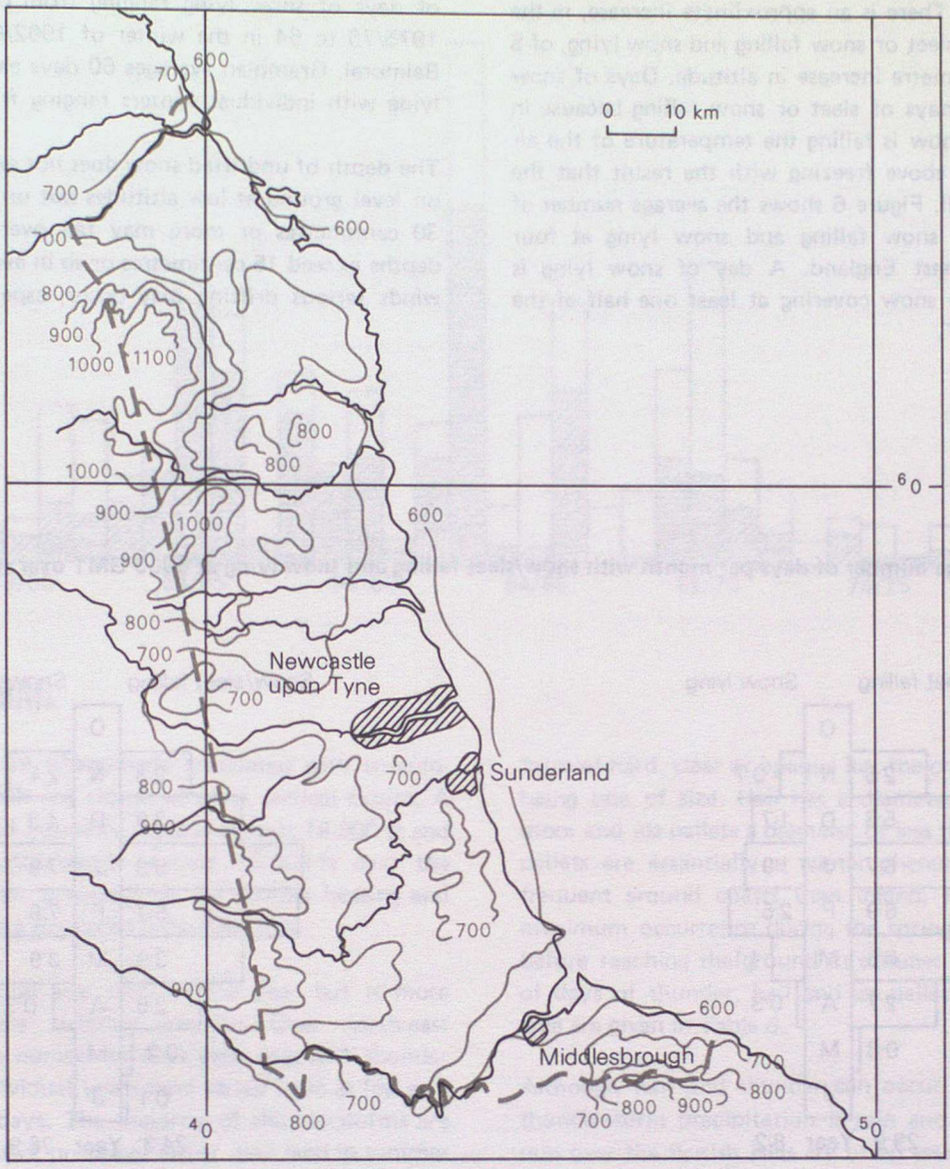


AAR = Average annual rainfall

TABLE 5 Average annual and monthly rainfall (mm) and maximum fall in 24 hours over the period 1951–80 with extreme values for stated periods

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Durham													
Average	58	47	45	39	54	51	54	72	54	52	62	57	645
Maximum fall in 24 hours	29.7	23.9	50.6	32.2	35.2	33.4	43.9	50.3	87.8	39.1	40.2	34.3	
1880 Wettest	188.0	152.5	166.0	101.6	154.0	191.4	209.7	175.7	193.2	201.8	186.0	195.5	885.7
–1980 Driest	9.1	2.1	1.3	2.2	8.1	1.7	7.7	6.4	6.3	9.6	12.1	13.1	439.8
Cockle Park													
Average	67	53	53	42	55	49	63	84	63	57	72	61	719
Maximum fall in 24 hours	30.5	31.5	37.3	42.2	36.0	44.6	53.8	96.0	58.5	40.6	46.2	41.5	
1931 Wettest	231.0	163.6	126.4	139.5	110.2	132.2	150.7	219.0	189.7	178.5	184.5	218.6	978.1
–82 Driest	18.5	7.9	5.6	2.6	9.2	3.3	12.8	4.0	13.1	7.7	14.1	11.0	497.4
Hartlepool													
Average	52	41	41	35	47	51	53	63	48	50	66	55	602
Maximum fall in 24 hours	29.6	22.1	47.3	21.1	36.3	26.4	41.7	51.8	60.4	47.0	37.1	33.8	
1951 Wettest	123.4	99.8	139.7	85.8	142.2	123.8	108.3	165.6	171.8	153.4	149.2	130.0	793.4
–82 Driest	12.1	8.6	3.3	5.3	6.1	7.5	10.1	5.4	8.8	7.8	17.2	9.9	424.8

Average annual rainfall (mm) over the period 1941–70. Coordinates are National Grid references.



SNOW

The occurrence of snow is linked closely with temperature with falls rarely occurring in association with temperatures higher than 4 °C. The number of falls increases with increasing altitude and latitude. Falls of sleet or snow over north-east England are normally confined to the months November to April but falls also occur in October and May. Snow also very rarely occurs in June and a fall over the area on 2 June 1975 was the first recorded in summer since 1888.

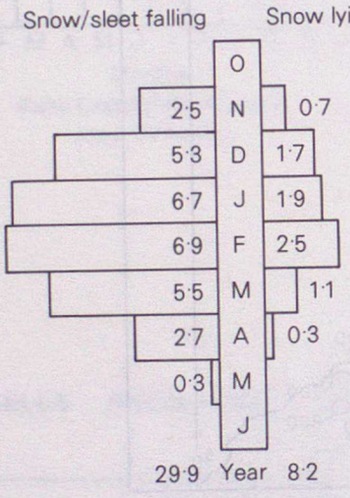
The average number of days each year when sleet or snow falls over the area ranges from around 20 along the coasts to over 40 in the Cheviots. Snowfall amounts are measured as the equivalent water content and included in the rainfall statistics. As a rough guide 10 centimetres of snow is equivalent to one centimetre of rainfall.

Snow rarely lies on low ground in north-east England before November or after April with the average number of days with snow lying varying from about 10 along coasts to 30 or so on the Cheviots. There is an approximate increase, in the number of days of sleet or snow falling and snow lying, of 5 days for each 100 metre increase in altitude. Days of snow lying are less than days of sleet or snow falling because in many cases when snow is falling the temperature of the air and ground remain above freezing with the result that the snow never lies at all. Figure 6 shows the average number of days with sleet or snow falling and snow lying at four locations in north-east England. A day of snow lying is defined as one with snow covering at least one half of the ground at 0900 GMT.

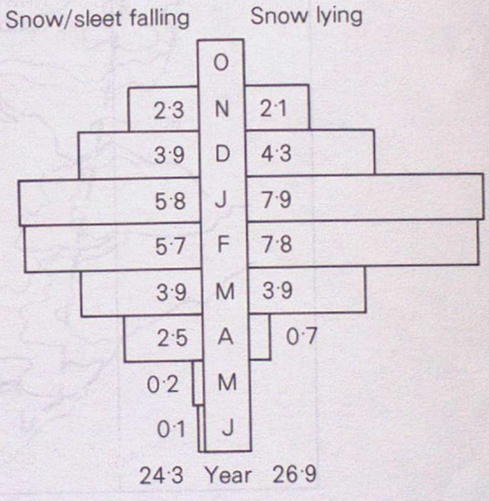
Figure 7 shows the number of days of snow in various depths at Acklington/Boulmer since the winter of 1946/47. This illustrates the great variability which occurs, with the number of days of snow lying ranging from one in the winter of 1975/76 to 64 in the winter of 1962/63. As a comparison Balmoral, Grampian averages 60 days each winter with snow lying with individual winters ranging from 14 to 102 days.

The depth of undrifted snow does not exceed 15 centimetres on level ground at low altitudes but on occasions depths of 30 centimetres or more may fall over a wide area. When depths exceed 15 centimetres or so in association with strong winds serious drifting may occur, especially in hilly areas.

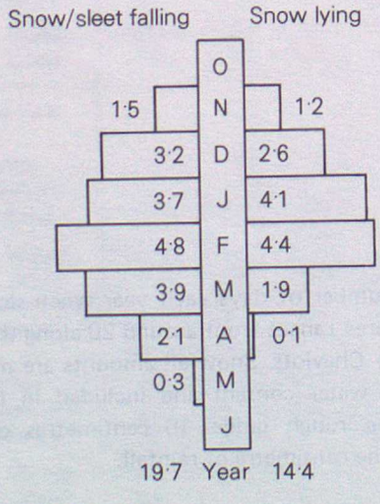
FIGURE 6 Average number of days per month with snow/sleet falling and snow lying at 0900 GMT over the period 1961–80.



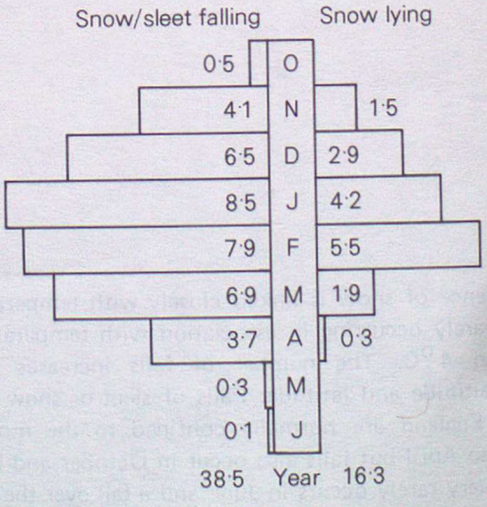
Tynemouth (30 m amsl)



Chopwellwood (136 m amsl)

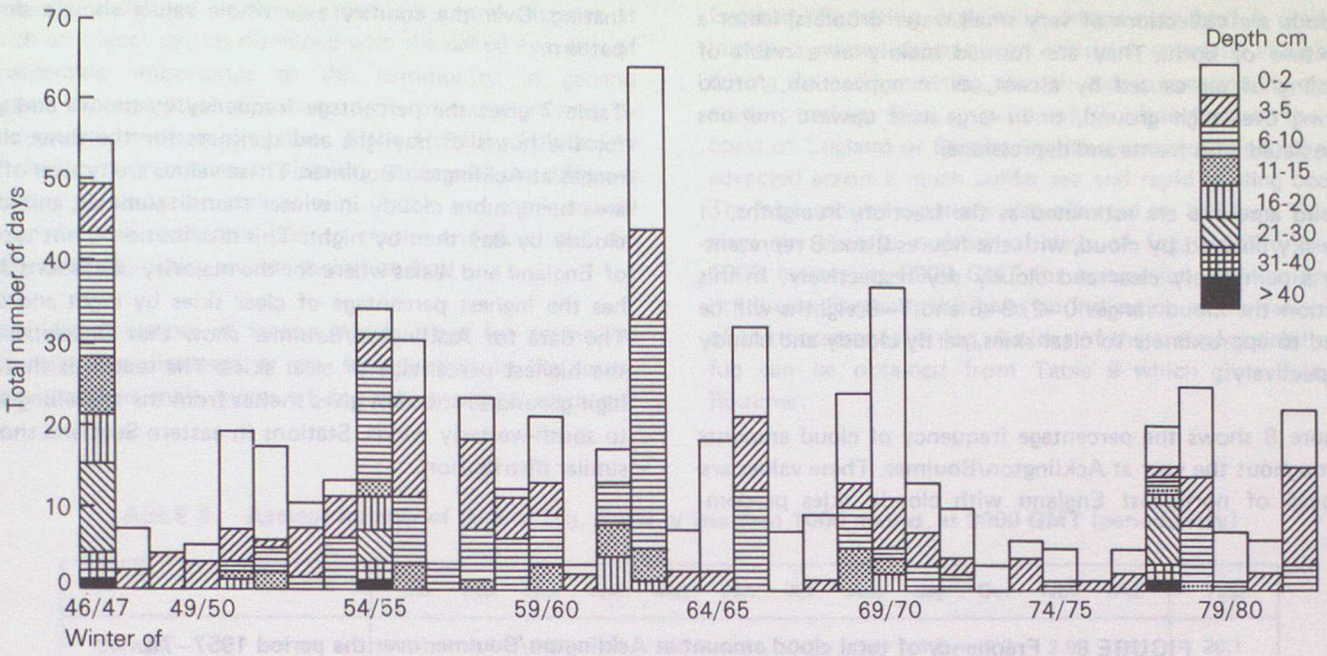


Hartlepool (9 m amsl)



Acklington/Boulmer (42 m/23 m amsl)

FIGURE 7 Number of days with total snow depth at 0900 GMT in stated ranges at Acklington/Boulmer.



THUNDER AND HAIL

Thunder and hail are phenomena associated with cumulonimbus clouds, which are clouds of great vertical extent. A typical thundercloud normally reaches at least 18 000 ft and in summer may occasionally exceed 40 000 ft over the British Isles. Thunder is caused by the sudden heating and expansion of air along the path of the lightning.

Thunder can occur at any time of the year but is more frequent during the summer months. Over north-east England the average number of days each year with thunder is around 8 but individual years have varied from as few as 3 to as many as 17 days. The majority of thunderstorms are triggered by convective processes either over land in summer or over a comparatively warm sea in winter.

In thunderstorms or heavy showers at any time of year the precipitation may be of hail or ice pellets. Both are in the form of hard, clear or opaque ice, the criterion between them being one of size. Hail has a diameter of 5 millimetres or more and ice pellets a diameter of less than 5 millimetres. Ice pellets are essentially a winter phenomenon and are more frequent around coasts than inland. Hail tends to have a maximum occurrence during the spring as it generally melts before reaching the ground in summer. The average number of days of thunder, hail and ice pellets for locations in the area are given in Table 6.

Although hail and thunder can occur simultaneously most thunderstorm precipitation is rain and the heaviest falls of rain over the British Isles are often associated with thundery situations. On 7 September 1898 at Angerton Hall a severe thunderstorm lasting about 3 hours gave 170 millimetres of rain resulting in "Much damage to highways in the district something like £500 being required to repair them".

TABLE 6 Average number of days of thunder, hail and ice pellets (periods vary)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Thunder													
Acklington/Boulmer	0.1	0.1	0.2	0.3	1.1	1.5	1.5	1.5	0.7	0.2	0.3	0.2	7.7
Hartburn Grange	0.2	0.0	0.2	0.0	2.4	2.8	1.9	1.5	0.9	0.1	0.5	0.3	10.7
Tynemouth	0.1	0.1	0.1	0.4	1.2	1.6	1.8	1.5	0.9	0.2	0.2	0.1	8.2
Newcastle Weather Centre	0.0	0.1	0.3	0.6	1.6	2.0	1.0	1.7	0.6	0.4	0.4	0.0	8.6
Hail													
Acklington/Boulmer	0.5	0.9	0.9	1.1	0.5	0.1	0.1	0.0	0.1	0.3	0.7	0.9	6.0
Newcastle Weather Centre	0.0	0.0	0.0	0.1	0.7	0.1	0.0	0.0	0.1	0.1	0.0	0.1	1.4
Ice Pellets													
Acklington/Boulmer	3.9	4.0	3.1	3.0	0.3	0.1	0.0	0.0	0.0	0.5	2.5	3.7	20.9
Newcastle Weather Centre	4.1	3.9	3.6	4.0	0.4	0.3	0.0	0.1	0.0	0.3	1.3	3.5	21.4

CLOUD

Clouds are collections of very small water droplets, ice or a mixture of both. They are formed mainly as a result of cooling of air caused by ascent, as in convection, forced lifting over high ground, or in large-scale upward motions associated with fronts and depressions.

Cloud amounts are estimated as the fraction, in eighths, of the sky covered by cloud, with the figures 0 and 8 representing a completely clear and cloudy sky respectively. In this section the cloud ranges 0–2, 3–6 and 7–8 eighths will be used to approximate to clear skies, partly cloudy and cloudy respectively.

Figure 8 shows the percentage frequency of cloud amounts throughout the year at Acklington/Boulmer. These values are typical of north-east England with cloudy skies predominating. Over the country as a whole values show a similar pattern.

Table 7 gives the percentage frequency by month and year for the hours of daylight and darkness for the three cloud ranges at Acklington/Boulmer. These values are typical of the area being more cloudy in winter than in summer, and more cloudy by day than by night. This distribution is not typical of England and Wales where for the majority of stations June has the highest percentage of clear skies by night and day. The data for Acklington/Boulmer show that December has the highest percentage of clear skies. The reason is that the high ground to the west gives shelter from the prevailing west to south-westerly winds. Stations in eastern Scotland show a similar distribution.

FIGURE 8 Frequency of total cloud amount at Acklington/Boulmer over the period 1957–76.

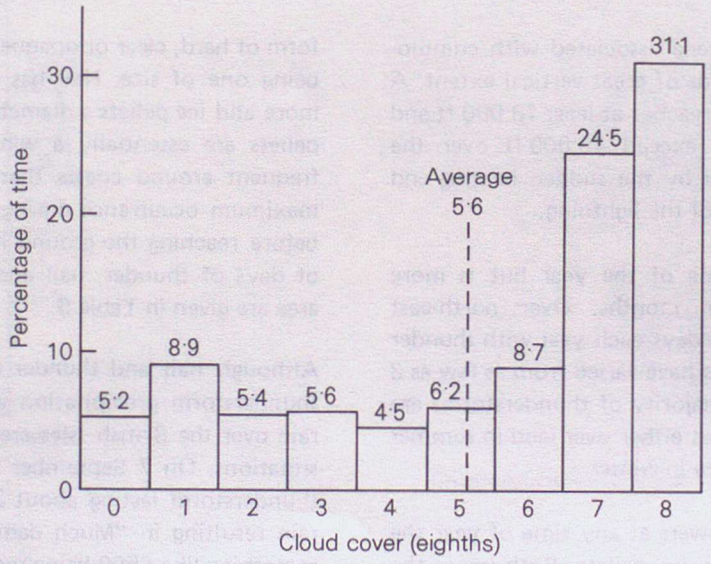


TABLE 7 Percentage frequency of hours with total cloud amount in selected ranges at Acklington/Boulmer over the period 1957–76

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Eighths	Daylight hours												
0–2	15.2	13.7	12.1	12.3	11.4	14.1	10.9	12.9	13.2	13.1	16.3	17.8	13.3
3–6	24.0	25.1	26.1	28.3	30.0	31.6	28.5	30.7	29.2	27.4	26.6	25.7	28.3
7–8	60.7	61.2	61.7	59.4	58.6	54.3	60.5	56.3	57.5	59.6	57.2	56.4	58.5
	Hours of darkness												
0–2	25.4	25.0	24.7	27.8	24.1	22.3	20.4	25.5	27.6	24.4	28.5	30.1	25.7
3–6	19.1	19.3	19.9	18.9	23.4	27.2	26.7	24.3	20.8	21.7	21.4	21.7	21.8
7–8	55.4	55.7	55.4	53.4	52.5	50.6	52.8	50.2	51.8	53.6	50.1	48.1	52.6

VISIBILITY

Visibility is defined as the greatest horizontal distance at which an object can be discerned with the naked eye. It is of considerable importance to the community in general because the operation of various types of transport may be disrupted or stopped altogether if the visibility falls below certain limits. Variations in visibility occur with the different types of precipitation such as rain, drizzle and snow, as well as atmospheric pollution due to smoke and dust, but the really poor visibilities are due mainly to fog.

There are a number of factors which affect fog formation and these are discussed in the Introduction to the series. There are two main types of fog which affect north-east England. Radiation fog which forms over land is predominantly a winter phenomenon occurring generally at night or during the early morning, though it does occasionally persist all day; and sea fogs, or haars, which often form on the east coast of England or Scotland when warmer continental air is advected across a much colder sea and rapid cooling occurs. The high ground areas are also affected by hill fogs. Table 8 gives the average number of days of fog, visibility below 1000 metres, at 0900 GMT for a selection of locations in north-east England; this gives an indication of the variability of the occurrence of fog. An idea of the annual variability of fog can be obtained from Table 9 which gives data for Boulmer.

TABLE 8 Average number of days of fog, visibility less than 1000 metres, at 0900 GMT (periods vary)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Durham	3.1	4.7	3.0	1.4	0.6	0.3	0.2	0.4	1.5	5.0	2.9	3.0	26.1
Hartburn Grange	2.3	1.9	1.2	1.3	0.7	0.4	0.3	0.8	1.0	2.6	1.8	2.7	17.0
Tynemouth	1.0	1.2	1.3	1.4	1.4	1.4	1.2	1.4	1.0	2.0	1.1	1.0	15.3
Chopwellwood	1.6	2.0	1.3	1.3	0.9	0.0	0.7	0.5	0.8	1.9	0.8	1.5	13.3
Acklington	1.1	1.1	1.5	1.4	0.6	0.5	0.5	0.8	0.7	2.2	1.0	0.9	12.2
Cockle Park	1.0	1.2	1.0	1.4	0.6	0.7	0.5	1.0	0.8	1.2	0.4	1.1	10.8
Newcastle Weather Centre	0.3	1.3	0.6	0.6	0.1	0.4	0.1	0.1	0.4	1.6	0.9	0.6	7.1
Hartlepool	1.1	0.7	0.7	0.7	0.3	0.3	0.3	0.3	0.5	1.0	0.5	0.8	6.9

TABLE 9 Annual totals (1976–82) of hours of fog, visibility less than 1000 metres, and thick fog, visibility less than 200 metres, at Boulmer

Year	1976	1977	1978	1979	1980	1981	1982
Fog	256	196	344	223	247	125	266
Thick Fog	94	44	103	65	76	18	48

WIND

The wind direction is that from which the wind blows recorded either as a compass point or degrees from true north. Wind speeds are measured in knots (1 knot = 1.15 mph; 1 metre per second = 1.94 knots) and are closely related to the pressure distribution. The strongest winds are associated with the passage of deep depressions across or close to the United Kingdom. The frequency of depressions is greatest during the winter months so this is when the strongest winds normally occur.

Wind seldom occurs as a smooth flowing airstream and eddies give variations both in direction and speed. Winds are usually stronger by day because temperature rise causes increased turbulence making average speeds higher and the wind more gusty.

A day of gale is defined as a day on which the wind speed attains a mean value of 34 knots or more over any period of ten consecutive minutes. The average number of days of gale a year over north-east England is about 10 to 15 along the coast decreasing away from the coast to 5 to 10 days, with the majority of the more sheltered inland locations having less than 5 days a year. As a comparison the Shetland Isles have on average 50 days of gale a year.

Table 10 gives the annual percentage frequency of hourly mean wind speeds and directions for South Gare for the period December 1974 to November 1981. These data are fairly typical of the area though away from the coast mean wind speeds will be lower but the percentages for the wind directions will be similar with the west to south-westerly

winds predominating. South Gare has recorded the highest hourly mean wind speed in any month for a low level site of 70 knots and also the highest June gust speed of 95 knots for any location in the United Kingdom.

The wind roses for Durham illustrate how the wind varies throughout the year. The high incidence of north-easterly winds in April is due to the weather patterns which predominate during this month.

TABLE 10 Annual percentage frequencies of hourly mean wind speed and direction for South Gare over the period December 1974 to November 1981

Knots	Beaufort force equivalent	30° sectors centred on 360°	030°	060°	090°	120°	150°	180°	210°	240°	270°	300°	330°	All directions
Calm	0													1.1
1–3	1	0.3	0.2	0.3	0.3	0.3	0.2	0.1	0.2	0.7	0.5	0.2	0.2	7.7
4–10	2–3	1.6	1.6	1.6	2.1	2.1	1.2	1.2	3.2	6.0	2.7	1.2	1.2	26.2
11–21	4–5	2.9	2.0	1.7	2.7	2.9	1.8	3.2	7.3	9.4	5.1	2.7	2.7	44.7
22–33	6–7	0.9	0.6	0.7	0.9	0.8	0.3	0.7	2.2	3.3	2.3	1.0	1.0	14.9
⩾34	⩾8	0.2	0.1	0.1	0.3	0.1	+	+	0.1	0.4	0.3	0.1	0.2	2.0
Total ⩾4	⩾2	5.5	4.4	4.0	6.0	5.9	3.4	5.2	12.8	19.1	10.4	5.0	5.0	87.8
												Missing data		3.3

+ = Observations recorded in these categories but for less than 0.05 per cent of the time

The totals for 1–3 and 4–10 knots include a percentage of variable winds

Wind roses for Durham over the period 1970–79.

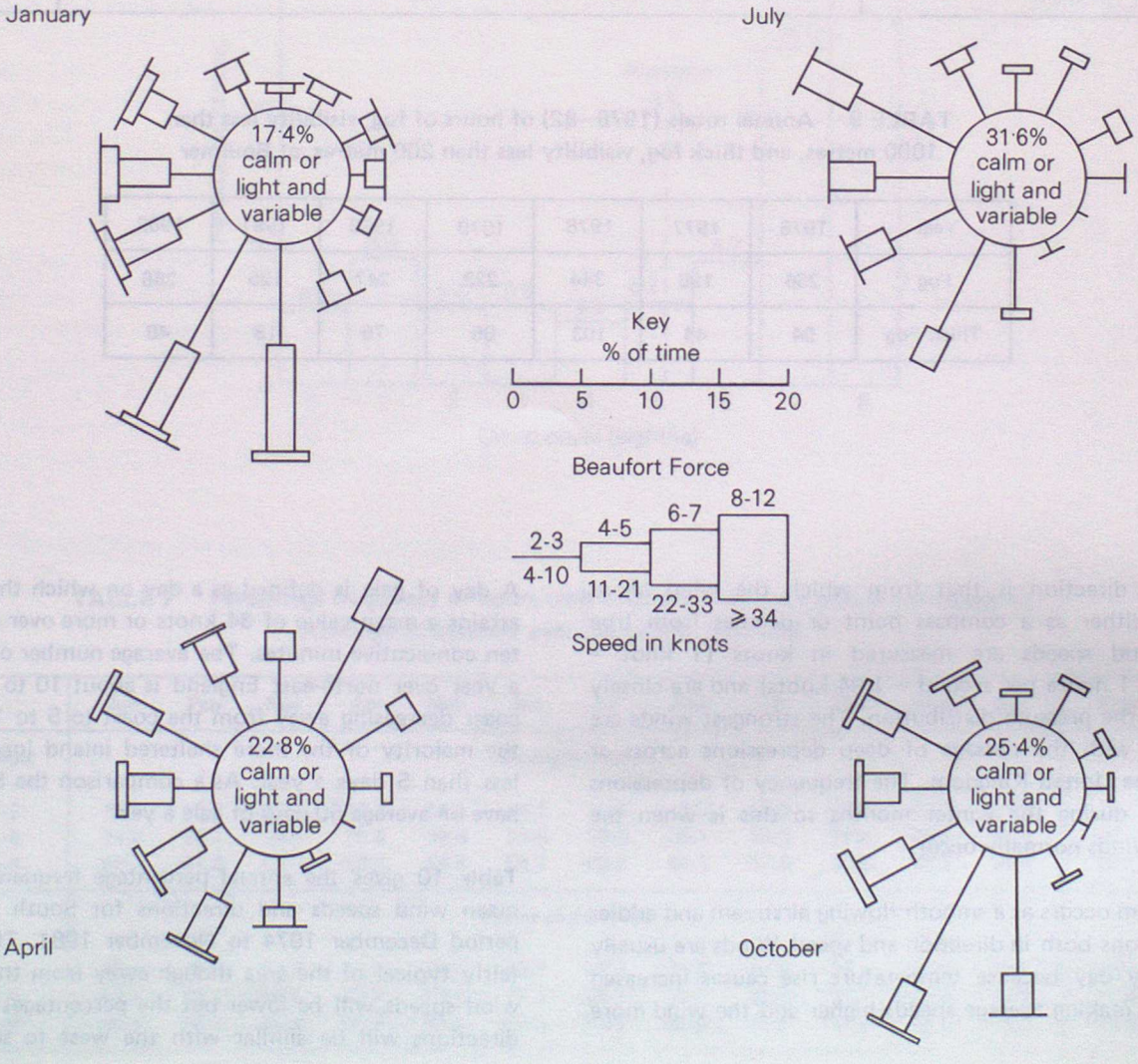


TABLE 11 Weather extremes

TEMPERATURE	Date records began and ceased where stated	Maximum daily temperature (°C)	Date	Minimum daily temperature (°C)	Date
North-east England					
Ushaw	1901[1]	33.9	1 September 1906	−12.8	6 February 1917
Redcar	1939[2]	32.8	12 August 1953	−15.0	24 January 1945
Hartlepool	1951	32.8	12 August 1953	−10.0	20 February1955 3 March 1965
Houghall	1925[3]	30.6	12 August 1953	−21.1	5 January 1941
Hartburn Grange	1962	30.0	3 June 1976	−17.1	18 December 1981
Durham	1901	30.6	10 July 1921 31 July 1943	−16.1	21 January 1940 11 January 1982
United Kingdom					
Raunds Epsom Canterbury	—	36.7	9 August 1911		
Braemar	—			−27.2	11 February 1895 10 January 1982

SUNSHINE	Date records began and ceased where stated	Maximum monthly duration (hours)	Date	Minimum monthly duration (hours)	Date
North-east England					
Berwick-on-Tweed	1924[4]	300.4	June 1940	12.5	December 1927
Durham	1931	297.0	June 1940	9.7	December 1978
Chopwellwood	1911[5]	284.0	June 1940	12.3	January 1942
Tynemouth	1936	264.5	June 1949	6.0	January 1942
Hartlepool	1956	280.8	June 1957	7.1	December 1968
Redcar	1938[6]	272.0	June 1940	8.9	January 1942
United Kingdom					
Eastbourne	—	383.9	July 1911		
London (Westminster)	—			0	December 1890

RAINFALL	Date records began and ceased where stated	Maximum daily fall (mm)	Date
North-east England			
Morpeth (Angerton Hall)	—	170	7 September 1898
Cheviot (Linhope)	1903	122	25 October 1949
Berwick-on-Tweed	1924	117	12 August 1948
Cornhill (Pallinsburn)	1947	114	12 August 1948
United Kingdom			
Martinstown (Dorset)	—	279	18 July 1955

WIND	Date records began and ceased where stated	Hourly mean wind speed (knots)	Date	Gust speed (knots)	Date
North-east England					
South Gare	1974[7]	70	2 January 1976	95	2 June 1975
Lynemouth	1972	63	17 December 1979	93	17 December 1979
South Shields	1912	56	18 January 1945	77	7 April 1943 18 January 1945
Durham	1938[3]	47	3 November 1970	90	15 January 1968
United Kingdom					
(Low-level sites)					
Shoreham-by-Sea (East Sussex)	—	72	16 October 1987		
Fraserburgh (Grampian Region)	—			123	13 February 1989

Records ceased: [1], 1972; [2], 1973; [3], 1978; [4], 1974; [5], 1960; [6], 1979; [7], 1984

TABLE 12 Climatological data for places in the United Kingdom based on the period 1941–70 except where indicated

	Altitude (metres)	Average annual rainfall (mm)	Average daily temperatures (°C) # Minimum Jan.	Minimum July	Maximum Jan.	Maximum July	Average annual duration of bright sunshine (hours)	Average annual no. of days with* Air frost	Snow lying
England									
Abingdon (Oxfordshire)	69	605	0.3	11.6	6.3	21.6	1544	57	13
Acklington (Northumberland)	42	644	0.0	10.3	5.5	17.9	1429	60	20
Birmingham Airport (W. Midlands)	96	679	0.1	11.2	5.7	20.5	1385	62	15
London (Kensington Palace)	25	640	1.7	13.3	6.6	22.2	1384[x]	35	7
Manchester Airport (Gr. Manchester)	75	819	0.5	11.7	5.8	19.6	1334	47	10
Plymouth/Mount Batten (Devon)	27	990	3.1	12.7	8.3	19.0	1678	25	3
Shawbury (Shropshire)	72	670	0.0	11.2	6.0	20.2	1368	63	17
Southsea (Hampshire)	2	702	2.4	13.9	7.1	20.7	1748	25	6
Waddington (Lincolnshire)	68	598	0.1	11.6	5.2	20.3	1503	54	18
Wales									
Cardiff/Wales Airport (S. Glamorgan)	67	947	1.3	11.9	6.6	19.3	1571	36	8
Valley (Gwynedd)	10	871	2.5	12.0	7.5	18.1	1612	27	3
Northern Ireland									
Belfast Airport (Antrim)	68	912	0.6	10.7	6.1	18.1	1281	53	9
Scotland									
Aberdeen Airport (Grampian)	58	872	−0.9	9.6	5.0	17.5	1341	75	30
Balmoral (Grampian)	283	834	−2.8	8.1	3.7	17.4	1120[†]	116	63
Edinburgh Airport (Lothian)	35	677	−0.6	10.3	5.7	18.5	1294	66	14
Lerwick (Shetland)	82	1172	0.6	9.3	5.0	14.0	1067	53	32
Stornoway (Western Isles)	3	1094	1.3	10.1	6.4	15.7	1244	49	11
Glasgow Airport (Strathclyde)	5	991	0.1	10.8	5.8	18.6	1266	58	6

* Based on 1956–70 only.

[x] For Regents Park.

[†] For Braemar.

Referring to 24-hour (09–09 GMT) extremes. Adjustments have been made to those stations normally recording night minimum (21–09 GMT) and day maximum (09–21 GMT). See Introduction to the series.

CLIMATOLOGICAL SERVICES AVAILABLE FROM THE METEOROLOGICAL OFFICE

The Meteorological Office collects and archives regular weather reports from a national network of observing stations, consisting of both Meteorological Offices manned by professional staff and co-operating stations operated by interested organizations or individuals. All these data are subjected to close scrutiny before being archived, to ensure consistency of standards, and are then available to meet the needs of the community.

Any undertaking which is at all weather-sensitive can benefit from a prior knowledge of the climate within which it is expected to operate. The building industry can use past weather statistics to estimate likely delays on contracts, architects and civil engineers need to know the likely extremes of weather which a design must withstand, and many industrial processes are dependent on atmospheric conditions for their success. The agricultural industry uses such information for a variety of purposes, many relating to the viability of new crops and the weather-related incidence and spread of pests and diseases.

In addition to special analyses of weather data for these purposes, the Meteorological Office can supply factual statements on weather conditions for legal or insurance purposes.

Enquiries related to aspects of past weather data should be directed to the appropriate address given on page 20 or, if more convenient, initially to your local weather centre (see page 19). Charges for the supply of information depend mainly on the staff time taken to meet the request.

Further information

Information leaflets and brochures describing in more detail the range of specialized services available from the Meteorological Office are available free from the same addresses. These leaflets and brochures also indicate the range of complex analyses that the Meteorological Office can undertake.

Forecasting services

For the day-to-day planning of outdoor work, special weather forecasts and warnings can be arranged to cover specific weather elements at agreed sites. Details may be obtained from:

The Chief Executive
Meteorological Office (Met O 7)
London Road
Bracknell
Berkshire RG12 2SZ

or from your local weather centre.

WEATHER CENTRES AND PUBLIC SERVICE OFFICES

Weather Centres

Aberdeen
Seaforth Centre
Ltime Street
Aberdeen AB2 1BJ

Aberdeen (0224) 210571

Bristol
The Gaunts House
Denmark Street
Bristol BS1 5DH

Bristol (0272) 279272

Cardiff
Southgate House
Wood Street
Cardiff CF1 1EW

Cardiff (0222) 390420

Glasgow
33 Bothwell Street
Glasgow G2 6TS

041—248 7272

Leeds
Oak House
Park Lane
Leeds LS3 1EL

Leeds (0532) 457753

London
284–286 High Holborn
London WC1V 7HX

071—430 5627

Manchester
Applicon House
Exchange Street
Stockport SK3 0ER

061—477 1017

Newcastle
7th Floor
Newgate House
Newgate Street
Newcastle-upon-Tyne NE1 5UQ

091—232 3808

Norwich
Rouen House
Rouen Road
Norwich NR1 1RB

Norwich (0603) 630164

Nottingham
Main Road
Watnall
Nottingham NG16 1HT

Nottingham (0602) 384094

Plymouth
Royal Air Force Mount Batten
Plymouth
Devon PL9 9SH

Plymouth (0752) 493377

Southampton
160 High Street-below-bar
Southampton SO1 0BT

Southampton (0703) 220646

Public Service Offices

Meteorological offices at:

Belfast International Airport
Belfast
Northern Ireland BT29 4AB

Crumlin (084 94) 22804

Birmingham Airport
Birmingham B26 3QN

021—782 6240

Kirkwall Airport
Kirkwall
Orkney KW15 1TH

Kirkwall (0856) 3802

Sella Ness
Port Admin Area
Craven, Mossbank
Shetland ZE2 9QR

Sullom Voe (0806) 242060

THE CLIMATE OF GREAT BRITAIN

This memorandum is one of a series which will cover the whole of Great Britain in due course, published in the Climatological Memoranda range. The Introduction (CM 113) to the series explains how various weather elements are measured. The areas to be covered are:

SCOTLAND

114 Borders Region
115 Edinburgh, Lothian Region and Stirling
116 Fife, Dundee and Perth
117 Aberdeen and Buchan
118 Moray Firth coastal Region
119 Northern Isles
120 Western Isles
121 Skye and the North-west
122 Argyll and the Inner Hebrides
123 The Grampians and Perthshire Highlands
124 Glasgow and the Clyde valley
125 Ayrshire and the Firth of Clyde
126 Dumfries and Galloway Region

ENGLAND

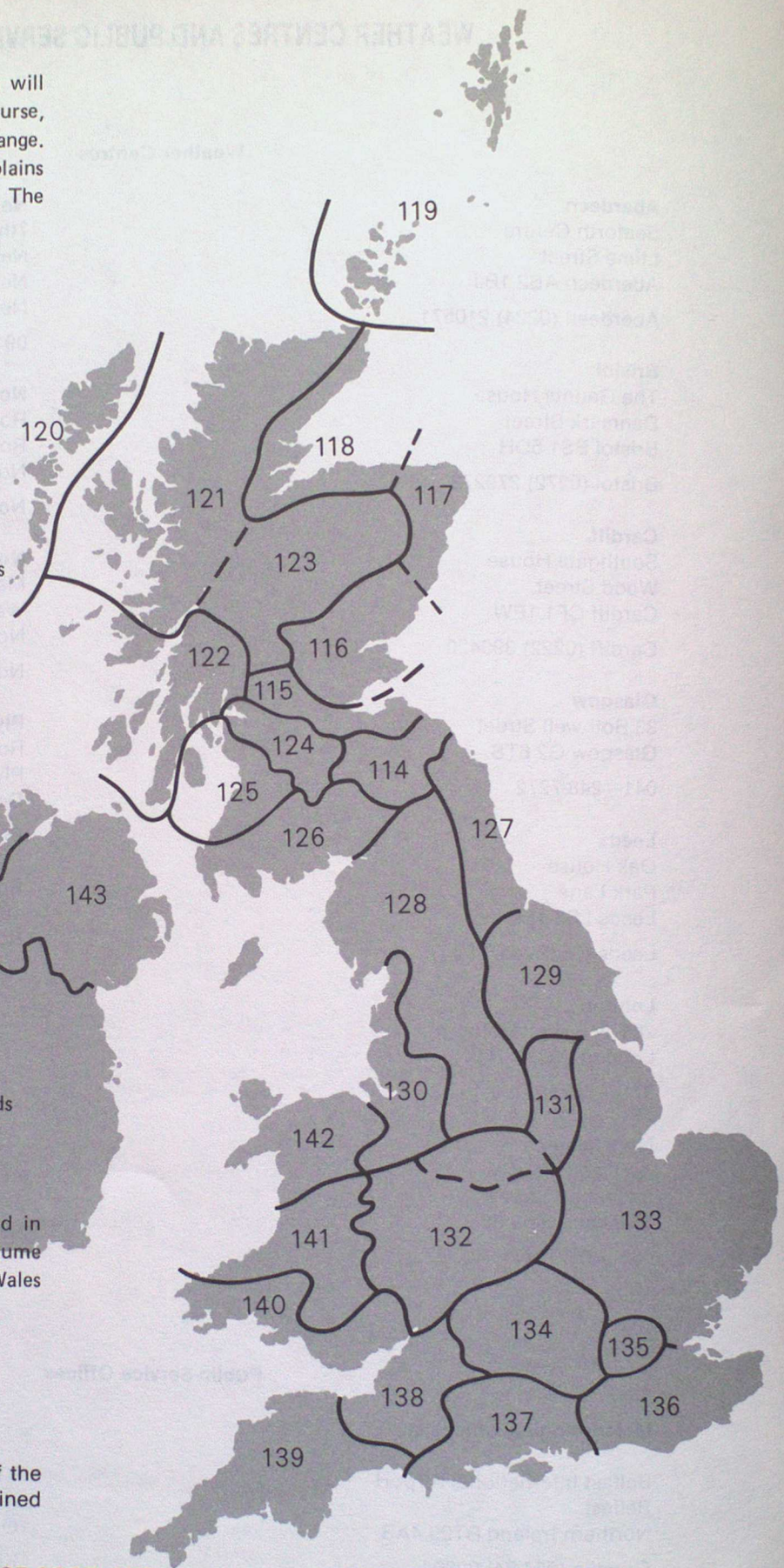
127 North-east England
128 Pennines and Lake District
129 East Yorkshire and North Humberside
130 Lancashire and Cheshire and Isle of Man
131 Trent Valley
132 Midlands
133 East Anglia and Lincolnshire
134 Thames Valley
135 London
136 South-east England
137 South England
138 Somerset and Avon
139 South-west Peninsula and Channel Islands

WALES

140 South Wales
141 Mid Wales
142 North Wales and Anglesey

} Now issued in one Volume No. 140 Wales

Also available
143 The Climate of Northern Ireland



Further details of these memoranda and of the services mentioned of page 18 can be obtained from:

FOR ENGLAND AND WALES

Advisory Services
Meteorological Office (Met O 3b)
London Road
Bracknell
Berkshire RG12 2SZ

FOR SCOTLAND

The Superintendent
Meteorological Office
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Edinburgh EH11 3XQ

FOR NORTHERN IRELAND

The Senior Meteorological Officer
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1 College Square East
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