

North East England: climate

This describes the main features of the climate of NE England, the area east of the Pennine watershed from the Scottish border southwards to South Yorkshire. It comprises the counties of Northumberland, Tyne and Wear, Durham, North, West and South Yorkshire and the unitary authorities in the former county of Cleveland.



The topography of the northern half of the area is characterised by generally west to east sloping land, crossed by a number of eastwards-draining rivers including the Tyne, Wear and Tees. Further south, the River Ouse crosses the Vale of York, with tributaries such as the Wharfe, Aire, Nidd and Don. These all have their sources in the Pennines, a chain of rolling gritstone moors rising to well over 600 metres and reaching their highest point at Cross Fell (893 metres). The Pennines form a natural barrier to east-west communications, but there are the Tyne gap linking Carlisle and Newcastle and the Aire gap linking Lancashire and Yorkshire. The other significant area of high ground is the North York Moors, rising to over 400 metres.

The major population and industrial centres tend to be associated with the rivers and include Sheffield and Leeds in industrial South and West Yorkshire, Middlesbrough on Tees-side, Sunderland at the mouth of the Wear and Newcastle-upon-Tyne.

In contrast, the Vale of York is a farming area with cereals and the Yorkshire Dales are important for sheep farming. The Dales, North York Moors and cities such as York and Durham are also important for tourism.

The area's western and eastern boundaries are the main influence on its climate. The high altitude of the Pennines creates an environment that is frequently cool, dull and wet, but the Pennines also cast a 'rain shadow' across the area through the shelter they afford from the prevailing westerly winds. The North Sea exerts a moderating control on coastal districts where, especially, it can keep summer conditions relatively cool.

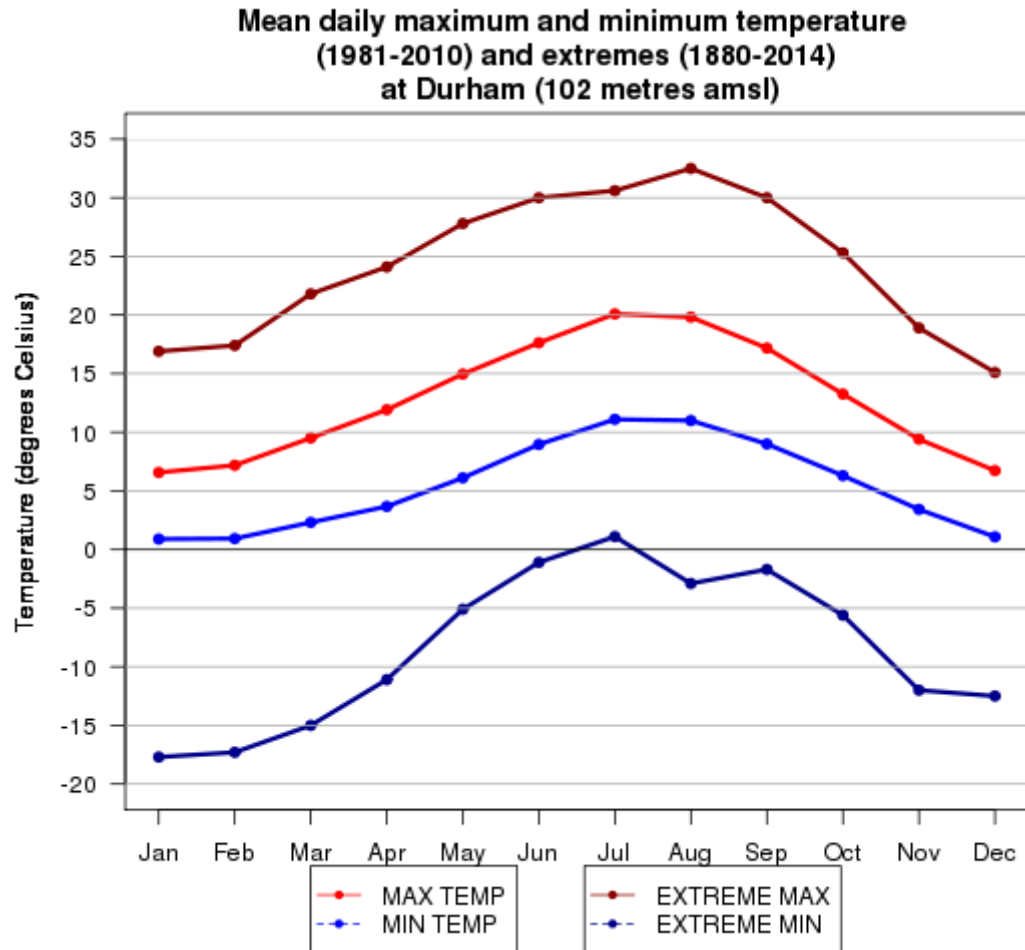
Temperature

Mean annual temperatures depend strongly on altitude, with a decrease of about 0.5 °C for each 100 metres increase in altitude, and, to some extent, proximity to the coast. The coldest waters around the UK are found off NE England with sea surface temperatures varying from about 5 °C in winter to 13 °C in summer (compared to a range of 8 °C to 18 °C off SW England). This, coupled with extensive areas of upland, means that temperatures, relative to elsewhere in England, are generally cool throughout the year. In the low-lying areas, mean annual temperatures over the region range from around 8.5 °C to around 10 °C. Over the UK, mean annual temperatures range from about 7 °C in the Shetlands to over 11 °C in Cornwall and the Channel Islands.

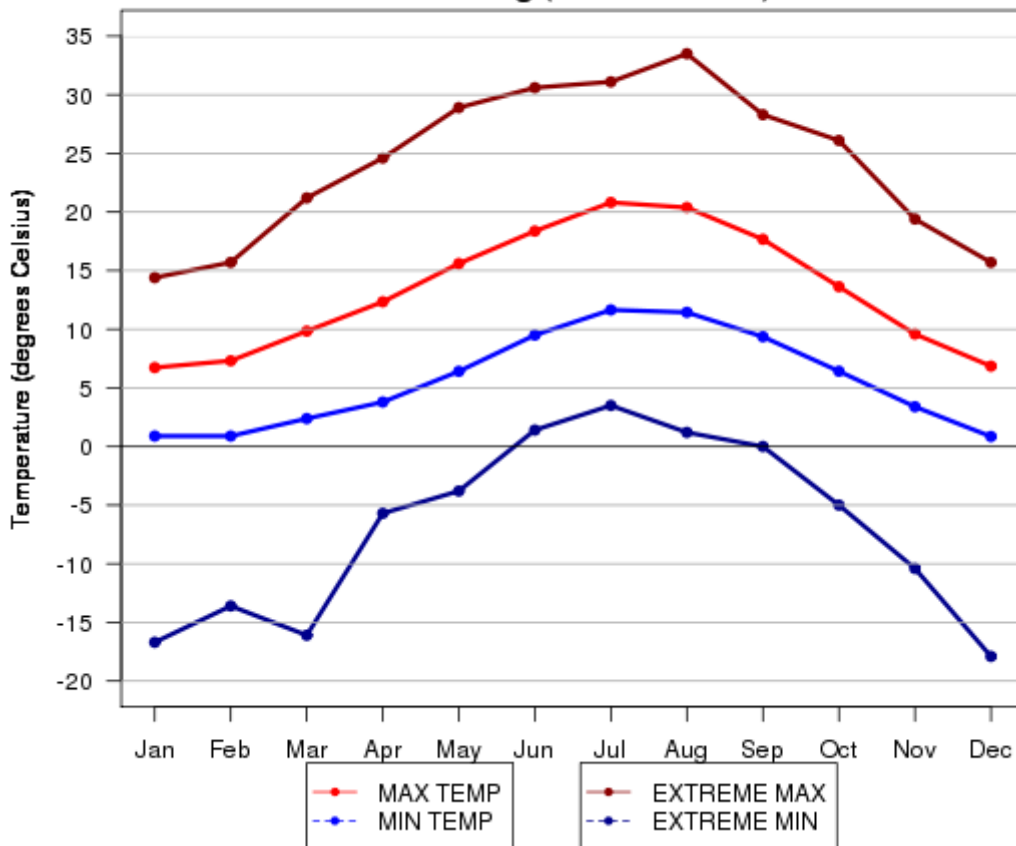
Temperature shows both a seasonal and a diurnal variation. January is usually the coldest month, with mean daily minimum temperatures varying from below -0.5 °C over the highest ground to about 2 °C along the coast and in South Yorkshire. Minimum temperatures usually occur around sunrise and extreme minima have been recorded in winter, most often in January or February. The lowest known temperature recorded in the region was -21.1 °C on 5 January 1941 at Houghall, a pronounced 'frost hollow' in the Wear valley near Durham.

July and August are the warmest months, with mean daily maximum temperatures ranging from about 21.5 °C in South Yorkshire to less than 17 °C in the higher Pennines. The highest July mean maxima occur in the London area (23.5 °C) whilst the lowest occur in the Shetlands (15 °C). Maximum temperatures are normally 2 or 3 hours after midday. Extreme maximum temperatures can occur in July or August, but are less common in NE England than areas further south. However, one example was the heat wave of 3 - 4 August 1990 when temperatures of 33 °C occurred widely.

The variation of mean daily maximum and minimum temperatures month by month, together with the highest and lowest temperatures recorded, is shown for Durham and Leeming.



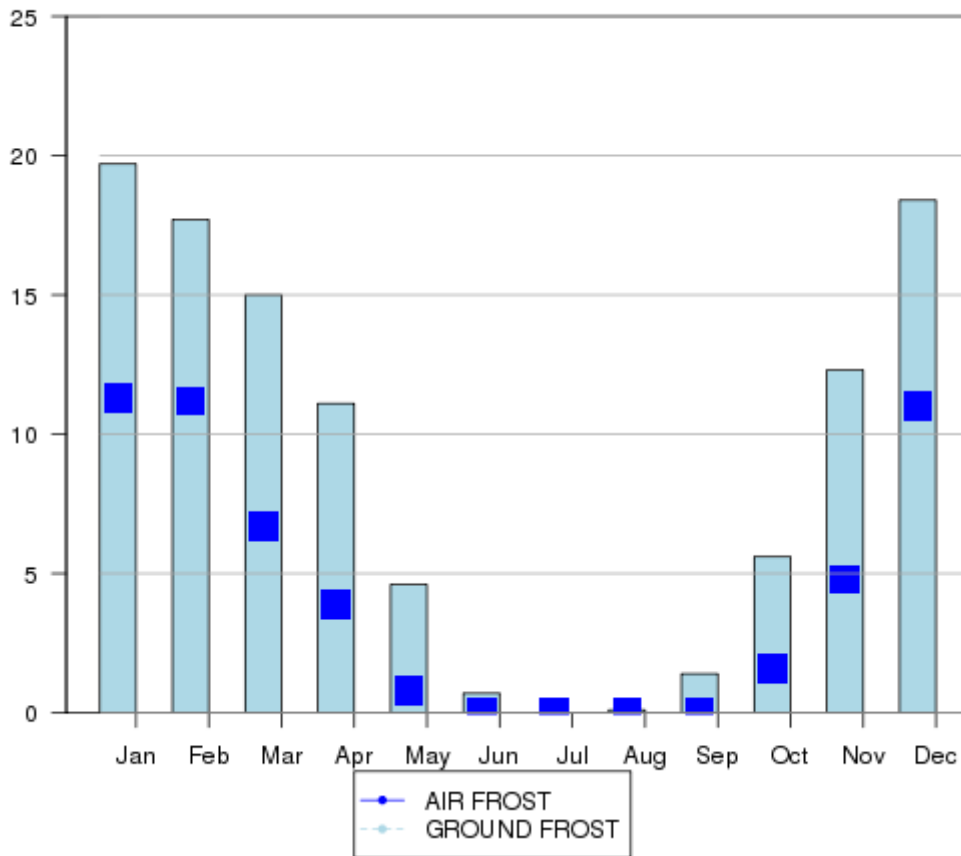
**Mean daily maximum and minimum temperature
(1981-2010) and extremes (1944-2014)
at Leeming (32 metres amsl)**



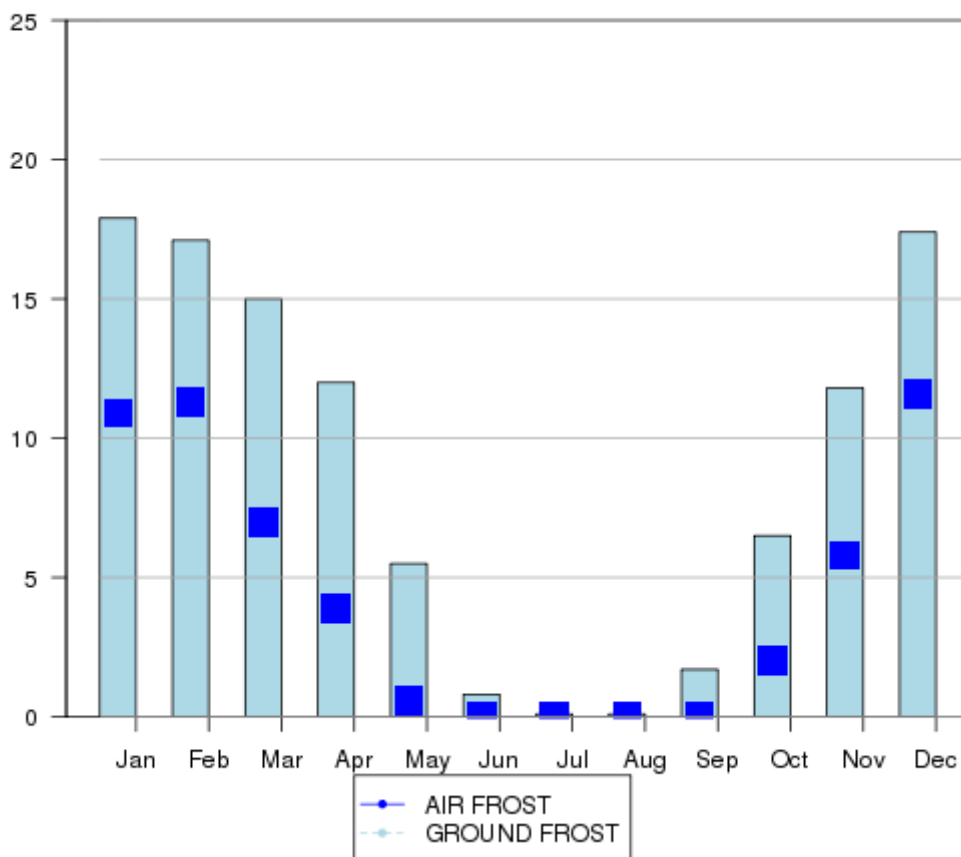
An 'air frost' occurs when the temperature at 1.25 metres above the ground falls below 0 °C, whereas incidence of a 'ground frost' refers to a temperature below 0 °C measured on a grass surface. In NE England, the average number of days with air frost varies from about 30 a year on the coast to about 55 inland and over 80 in the higher Pennines. Ground frost occurs on average on about 80 days per year on the coast and over 135 days on high ground, with a similar distribution to air frost.

The graphs show the average frequency of air and ground frost at Durham and Leeming. Although the summer months are usually free of air frost, ground frost may occur at any time of the year, especially at sites in inland valleys.

Average annual number of days of air and ground frost (1981-2010) at Durham (102 metres amsl)



Average annual number of days of air and ground frost (1981-2010) at Leeming (32 metres amsl)



Sunshine

The number of hours of bright sunshine is controlled by the length of day and by cloudiness. The day is shortest in December and longest in June and so in general December is the dulllest month and May, June or July the sunniest.

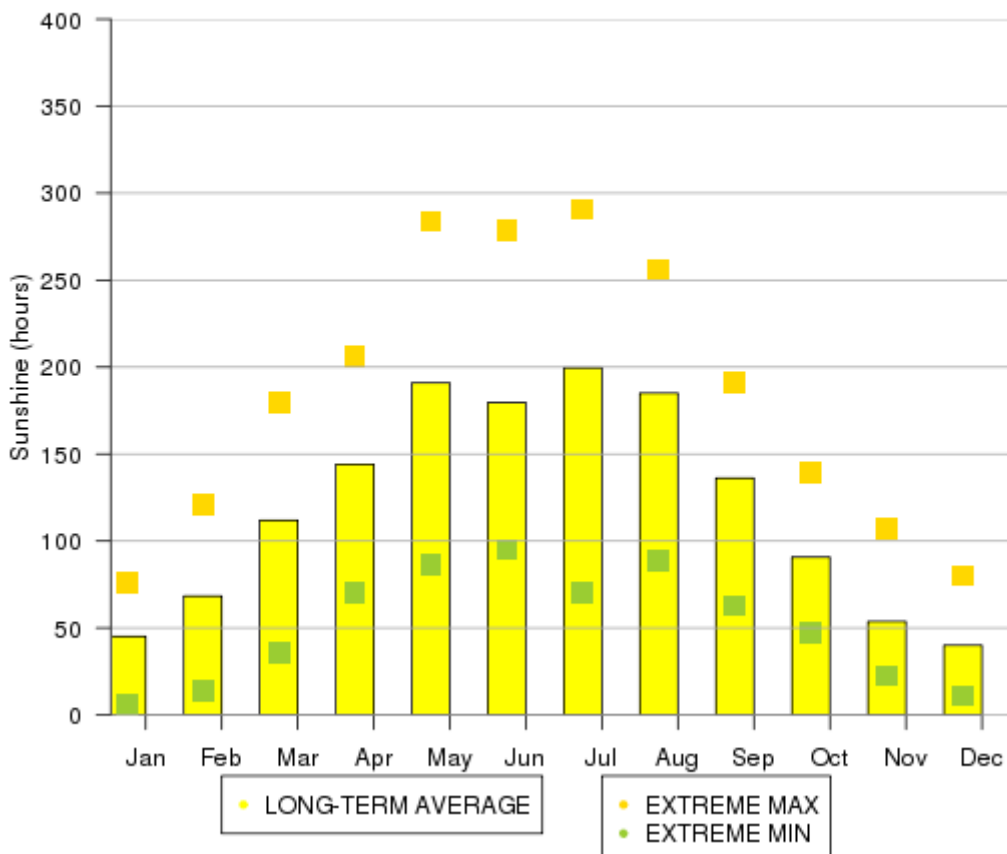
Sunshine duration decreases with increasing altitude, increasing latitude and distance from the coast. Industrial pollution and smoke haze can also reduce sunshine amounts but, because of the Clean Air Act of 1956 and a decline in heavy industry, there has been an increase in sunshine duration over the industrial areas of the north-east.

Overall, coastal sites are the sunniest because of the tendency for convective cloud to develop over inland areas in summer. However, day to day, changes can occur with wind direction and easterly winds often bring dull conditions to coastal districts, especially in spring and early summer when sea fog (known locally as 'fret') occurs.

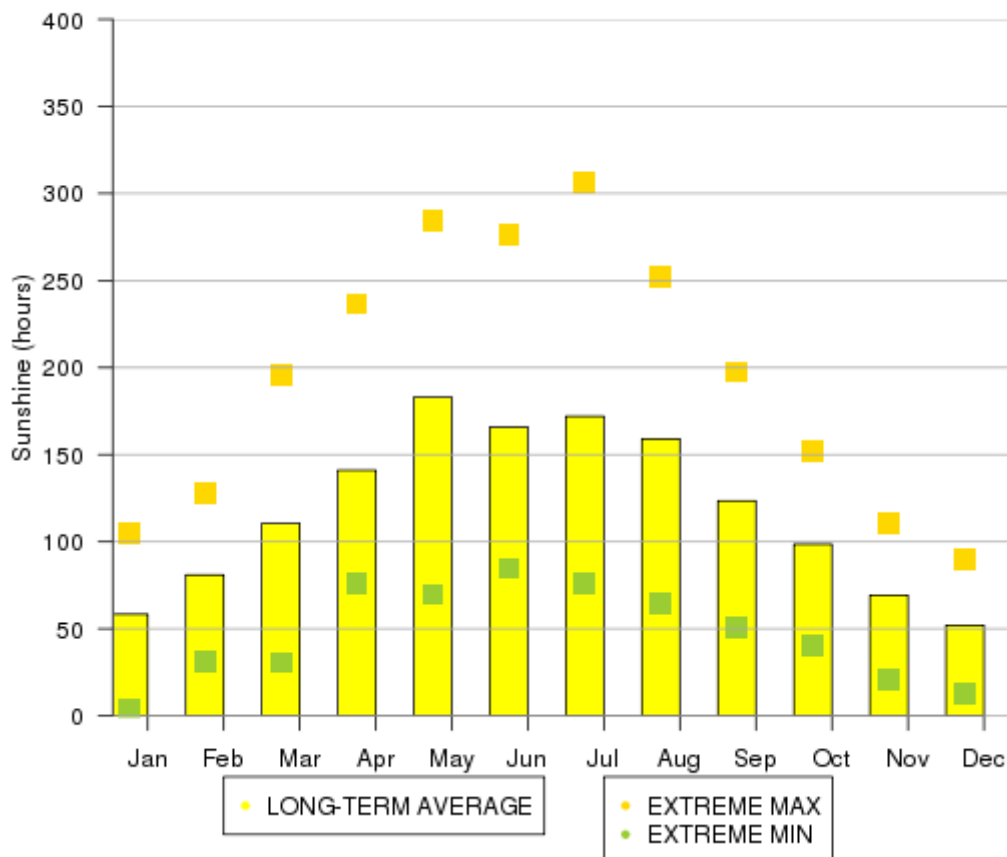
Average annual sunshine durations over NE England range from over 1500 hours on the coast to less than 1250 hours in the higher Pennines. These figures compare with values of less than 1100 hours a year in the Shetland Islands to over 1750 hours along the south coast of England and over 1900 hours in the Channel Islands.

The graphs show the average monthly sunshine totals for Sheffield and Morpeth Cockle Park, together with the highest and lowest totals recorded in the stated periods.

Mean monthly sunshine (1981-2010) and extremes (1929-2014) at Sheffield (131 metres asl)



Mean monthly sunshine (1981-2010) and extremes (1898-2014) at Morpeth Cockle Park (95 metres asl)



The highest known monthly sunshine totals in the region are 313.9 hours at High Mowthorpe in July 2006 and 308.3 hours at Catterick, N Yorkshire in June 1940. The highest UK monthly total is 383.9 hours at Eastbourne in July 1911. In the dullest winter months, less than 20 hours have been recorded - with only 3.6 hours at Morpeth in January 1901 and 5.3 hours at Tynemouth in January 1996.

Rainfall

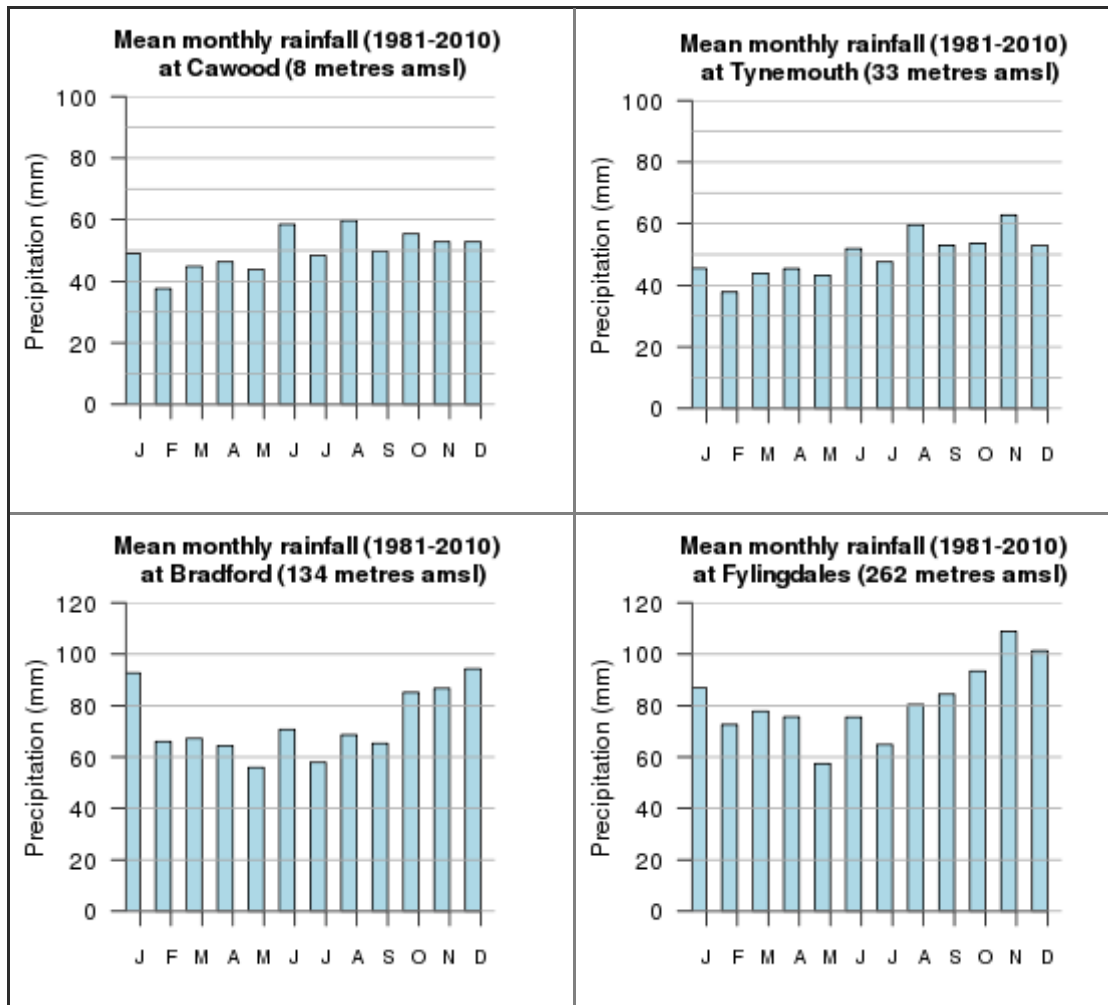
Rainfall is caused by the condensation of the water in air that is being lifted and cooled to its dew point. Rainfall tends to be associated with Atlantic depressions or with convection. The Atlantic lows are more vigorous in autumn and winter and bring most of the rain that falls in these seasons. In summer, convection caused by solar surface heating sometimes forms shower clouds and a large proportion of rain falls from showers and thunderstorms then.

A further factor that greatly affects the rainfall distribution is altitude. Moist air that is forced to ascend hills may be cooled to the dew point to produce cloud and rain. A map of average annual rainfall therefore looks similar to a topographic map.

The average annual rainfall exceeds 1500 mm in the higher parts of the Pennines. There is a decrease as the land falls eastwards, such that the east coast is one of the driest parts of the UK with less than 600 mm in places such as Tees-side and the Northumbrian coast. Relatively low averages are also found in the Vale of York. In contrast, the higher ground of the North York Moors results in averages of over 1000 mm in places. These values can be compared with annual totals around 500 mm in parts of eastern England and over 4000 mm in the western Scottish Highlands.

The course of mean monthly rainfall for 1981 - 2010 for 4 sites is shown below. Whilst rainfall is generally well-distributed through the year, there is a seasonal pattern. The driest season is spring whilst in the wetter upland areas there is an autumn/winter maximum, when the Atlantic depressions are at their most vigorous. At the

lower sites and towards the coast the distribution is more even, with showery rainfall in summer contributing as much as the autumn/winter depressions.



Over much of the region, the number of days with rainfall totals of 1mm or more ('wet days') tends to follow a pattern similar to the monthly rainfall totals. In the higher parts in winter (December-February), 45-50 days is the norm but this decreases to about 35 days in summer (June-August). In the drier areas closer to the coast, about 30 days in winter and about 25 days in summer are typical.

Periods of prolonged rainfall are often associated with east or NE winds on the northern flank of depressions passing to the south of the area. Examples of such periods include 15-16 July 1973 when Sheffield and surrounding areas received over 100 mm.

Thunderstorms are most likely to occur from May to September, reaching their peak in July and August, but are less frequent than in areas further south, and the north of the region can expect only 5 to 8 days with thunder each year. The heaviest falls of rain in the UK are often associated with these summer thunderstorms. An example was a storm on 10 August 2003 at Carlton-in-Cleveland, N Yorkshire when 47 mm fell in just 12 minutes, with the highest rainfall rates over 5-10 minutes ever recorded in the UK. Another was the storm that struck the western edge of the North York Moors on 19 June 2005, when almost 60 mm fell in 1 hour at Hawnbly and there was considerable flooding in Ryedale. On 28 June 2012, severe thunderstorms caused considerable flooding in the Newcastle area.

Snowfall

The occurrence of snow is linked closely with temperature, with falls rarely occurring if the temperature is higher than 4 °C. For snow to lie for any length of time, the temperature normally has to be lower than this. Over most of the area, snowfall is normally confined to the months from November to April, but upland areas

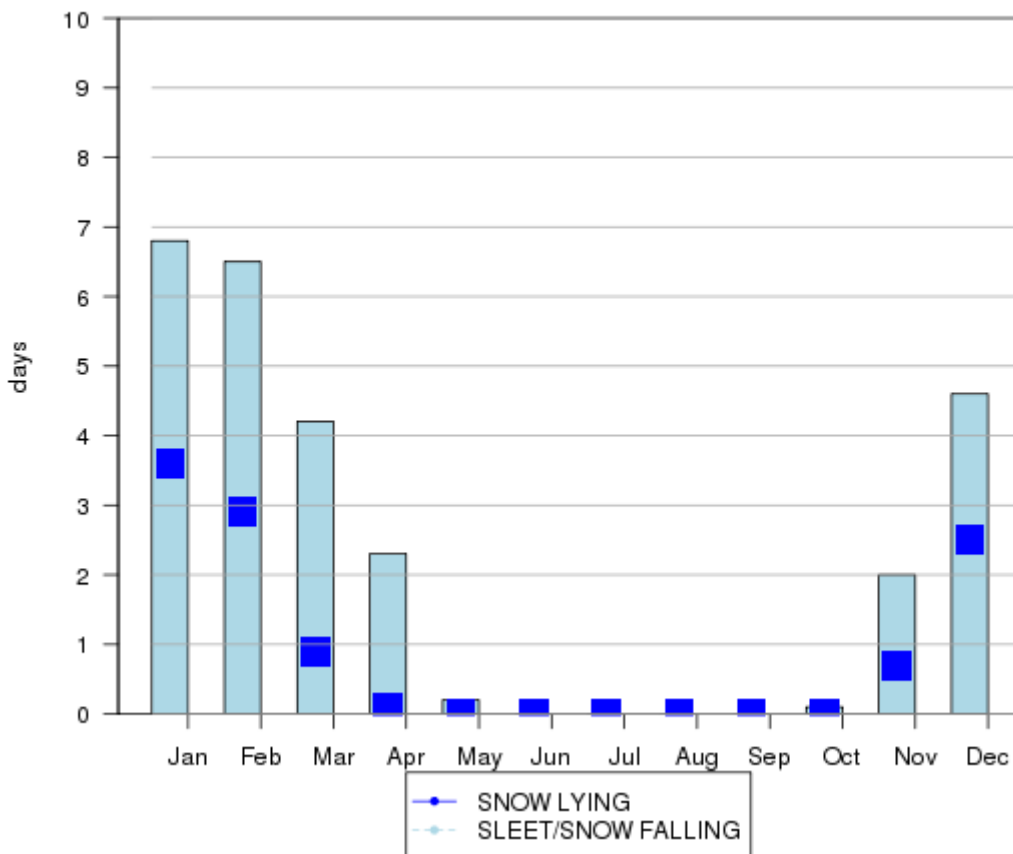
may have falls in October and May. Snow rarely lies on low ground outside the period from November to March but over higher ground lying snow can also occur in October and as late as May.

The degree of exposure to northerly winds is critical, and the North York Moors can receive nearly as much snow as the higher ground of the Pennines. Often this is of a showery nature, triggered by the passage of a cold airstream over the North Sea. On average, the number of days with snow falling is about 20 per year near the coast and in low lying areas of south Yorkshire and as much as 50 days over the higher Pennines. An average increase of about 5 days of snow falling per year for every 100 metres increase in altitude has been found to be typical.

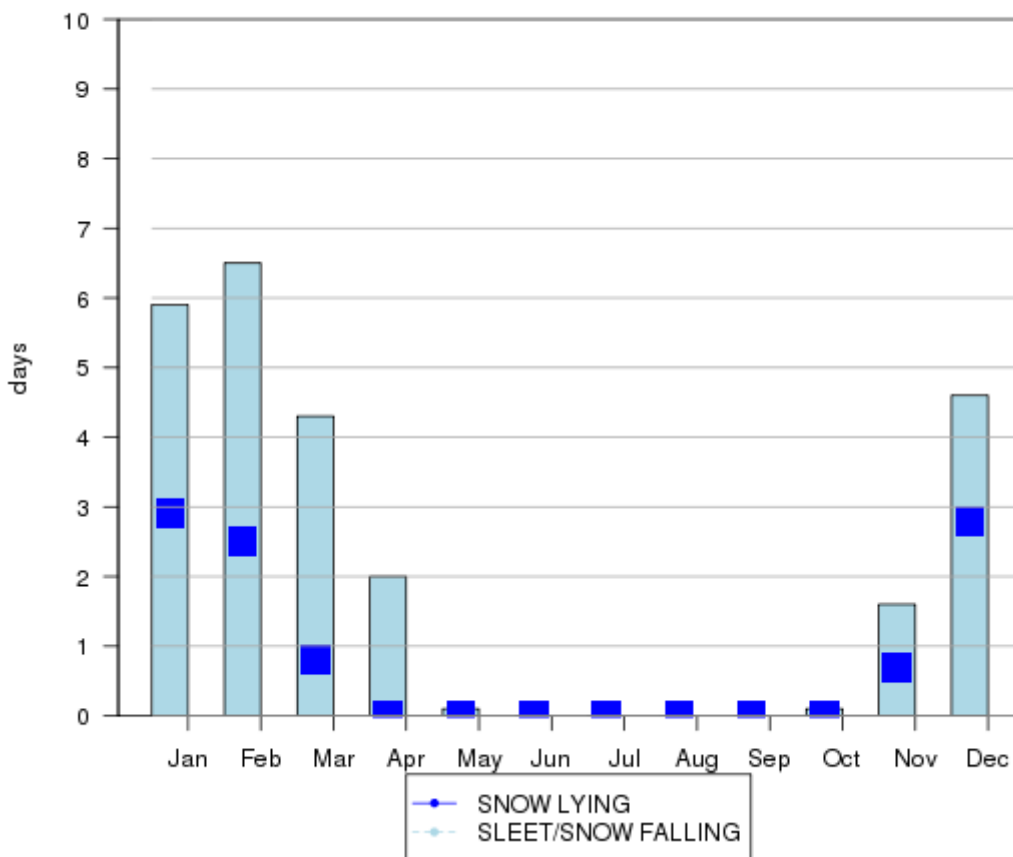
The number of days with snow lying is also mainly dependent upon altitude but partly upon proximity to the sea. The number therefore varies from about 10 days per year near the east coast and in low lying areas of south Yorkshire to over 40 days in the higher Pennines. These averages can be compared with parts of the Scottish Highlands, which have about 60 days with snow lying on average and with the coasts of SW England, with less than 3 days per year. In most places, January is the month with most days of both snow lying and snow falling.

The monthly averages of days with sleet/snow falling and lying at Leeming and Whitby are shown below (a day of lying snow is counted if the ground is more than 50 % covered at 0900).

Average number of days per year of sleet/snow falling and snow lying (1981-2010) at Leeming (32 metres amsl)



Average number of days per year of sleet/snow falling and snow lying (1981-2010) at Whitby (41 metres amsl)



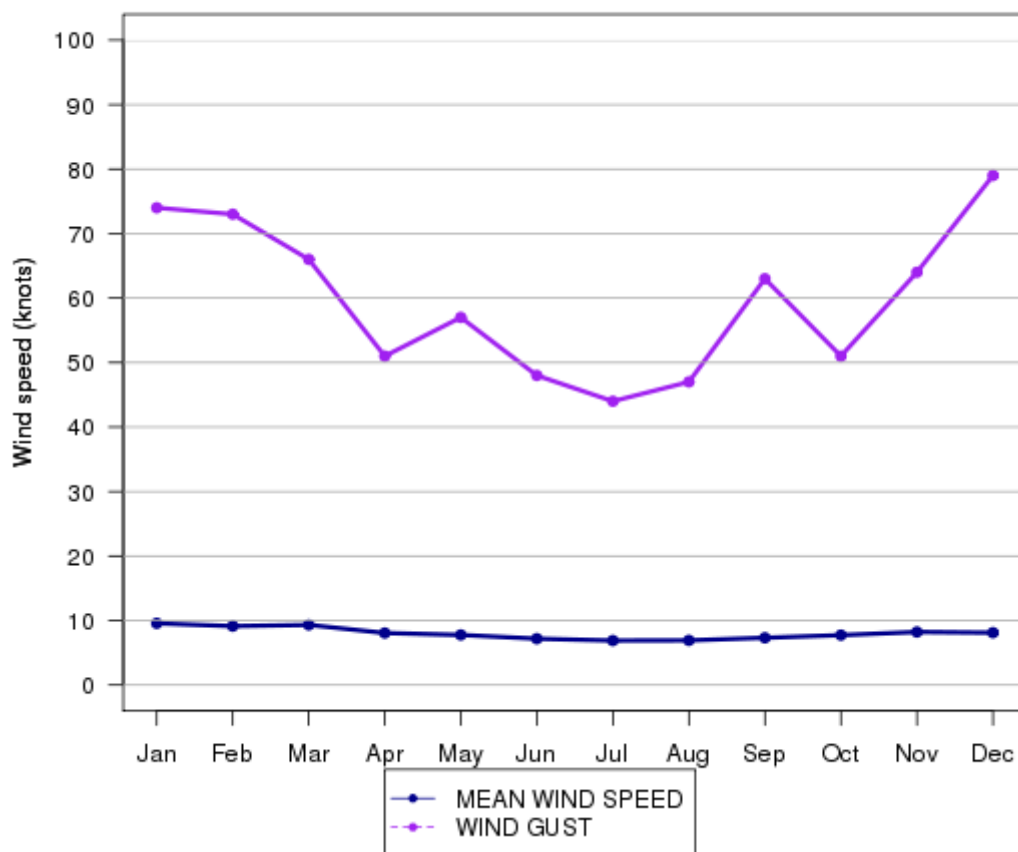
The depth of undrifted snow does not often exceed 15 cm at low altitudes but on occasions depths of 30 to 60 cm may occur over a wide area. When depths exceed 15 cm in association with strong winds, serious drifting may occur, especially in hilly areas, leading to widespread travel disruption. Notable examples affecting NE England include the heavy snowfalls of 11-13 February 1978 (53 cm at Morpeth on the 13th), 17-18 March 1979, and 25 November-2 December 2010.

Wind

The strongest winds are associated with the passage of depressions close to or across the UK. The frequency and depth of these areas of low pressure is greatest in the winter half of the year, especially from December to February, and this is when mean speeds and gusts (short duration peak values) are strongest. The graph shows a typical variation of the monthly mean speeds and highest gusts. The period November to March has the highest mean speeds and the peak gusts follow a similar pattern. Leeming is an open, but low and relatively sheltered, site in the Vale of York. Upland areas and coastal areas, particularly those exposed to the north, will experience stronger winds.

The variation in monthly mean speeds (average of a continuous record) and highest gusts ('instantaneous' speed averaged over about 3 seconds) at Leeming is shown below.

Monthly mean wind speed (1981-2010) and maximum gust (1965-2014) at Leeming (32 metres amsl)



Another measure of wind exposure is the number of days when gale force is reached. If the wind reaches a mean speed of 34 knots or more over any ten consecutive minutes, then that day is classed as having a gale. Over the highest Pennines there are about 15 gales per year while along the coast gales occur on 5-10 days and low-lying places inland experience less than 5 gales per year. Wind speed is sensitive to altitude and local topographic effects.

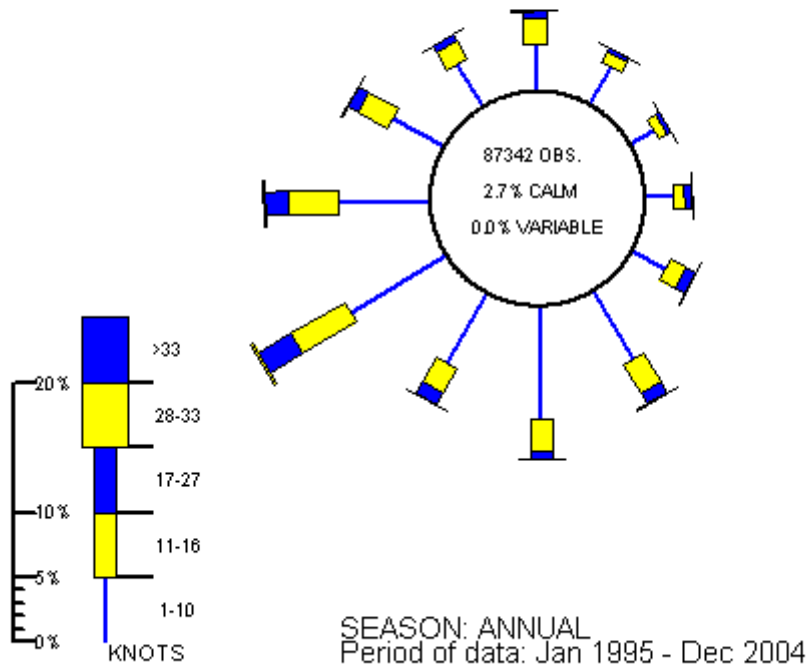
There have been several noteworthy gales affecting NE England, accompanied by property damage and disruption to travel and power supplies. Examples include 16 February 1962 when nearly 2/3 of all houses in Sheffield suffered some form of damage as a result of winds accelerating as they crossed the Pennines. On 2 January 1976 a depression moving eastwards across Scotland to the North Sea brought storm force winds with an hourly mean speed of 70 knots at South Gare (Cleveland). More recently, the storm of 28-29 January 2002 led to rail and road transport disruption (with lorries overturning), power cuts (20,000 homes affected in the Tyne valley) and building damage, and a severe gale on 7-8 January 2005 caused similar transport disruption and left 20,000 homes without electricity in Yorkshire and Humberside for most of the day on the 8th.

The direction of the wind is defined as the direction from which the wind is blowing. As Atlantic depressions pass the UK the wind typically starts to blow from the south or south west, but later comes from the west or north-west as the depression moves away. The range of directions between south and north-west accounts for the majority of occasions and the strongest winds nearly always blow from this range of directions. North-easterly winds are most common during spring time.

The annual wind rose for Boulmer is typical of open, level locations across the region, with a prevailing south-westerly wind direction through the year. However, there is a high frequency of north to north-east winds in spring. Topography can play a part in modifying the wind climate, as illustrated by the wind rose for Leeming. There is a tendency for the North York Moors to shelter this site from SE and easterly winds, with channelling through the Vale of York.

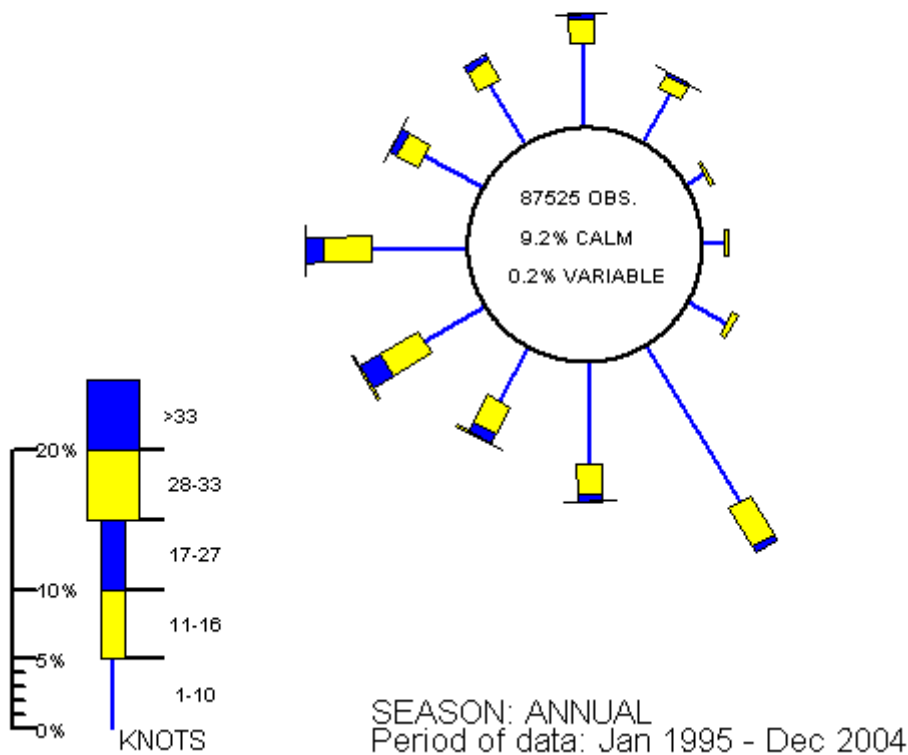
WIND ROSE FOR BOULMER
N.G.R: 4253E 6142N

ALTITUDE: 23 metres a.m.s.l.

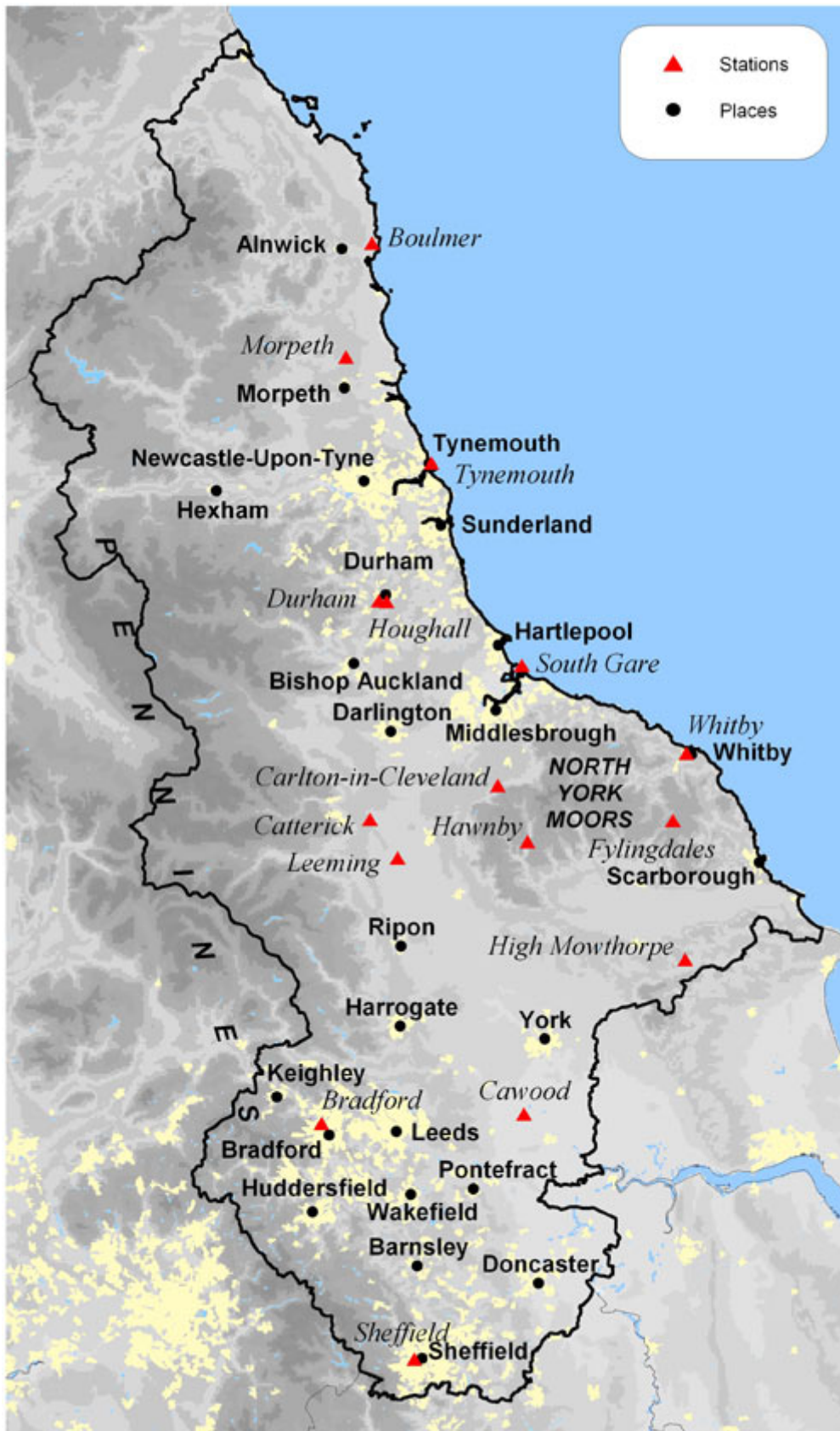


WIND ROSE FOR LEEMING
N.G.R: 4306E 4890N

ALTITUDE: 32 metres a.m.s.l.



Location map



Last updated: 10 October 2016

