Atmospheric Pressure and a Simplified Approach to Determine Worst-Case Conditions for Ground Gas Monitoring in the UK

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October 2024

Introduction

This technical note provides guidance on the role of atmospheric pressure when assessing the risks posed from hazardous ground gas in the UK and provides an approach that can be adopted for other geographical locations. Whilst an understanding of the relationship between atmospheric pressure and ground gas can form a critical part of a source-pathway-receptor contaminant linkage model, it is important to note that additional consideration should be made to all lines of evidence when establishing a robust gas Conceptual Site Model (gCSM). A clear understanding of the source of ground gas, geological setting, groundwater behaviour and chemistry, hysteresis, and seasonal environmental variance are often key in accurately understanding the risk from ground gas at the surface [1,2]. Additionally, a clear understanding of the design, construction and ventilation performance of a building is essential when assessing the ground gas risk in the built environment. There are numerous guidance documents available to support the development of a gCSM in risk assessment. The aim of this technical note is to provide a guide for when the assessment of atmospheric pressure is considered necessary as part of this process.

While not all sites will require ground gas monitoring or an assessment of atmospheric pressure, it can be a dominant ground gas driver on many sites. Where a ground gas risk exists, the dominance of a pressure driven flow in medium to high permeability soils was demonstrated by Ettinger and Kerfoot in 2012 [3]. In their paper, diffusive flow was shown to be only dominant in low permeability soils.

Since the Loscoe incident in 1986, the relationship between ground gas and atmospheric pressure has been recognised and discussed in several guidance documents. These state that a ground gas monitoring programme should capture time periods when pressure is falling and low, as this will usually coincide when ground gas emission rates are at their highest [4,5]. A good understanding of the relationship between ground gas and low and falling pressure will reduce uncertainty for 'worst case' prediction used in risk assessment [6]. However, capturing worst-case conditions related to falling atmospheric pressure may not always be applicable or necessary, as this is dependent on the gCSM. In cases where other environmental factors have a more significant influence on gas behaviour and emission rates, or when the gas regime is well understood, further assessments of worst-case pressure conditions may not alter the conclusions of the risk assessment [7]. The data review process and an understanding to whether worst case pressure conditions are applicable to the risk assessment should be informed by professional judgement.

Current available guidance on potential worst-case atmospheric pressure conditions is not overly clear or defined. For example, no existing guidance on ground gas specifies a clear quantitative atmospheric pressure fall threshold, nor do they address how potential worst-case conditions vary based on specific geographical areas or seasonality. Boltze and de Freitas in 1996 [8] proposed the concept of a worse-case pressure zone. This was updated in CL:AIRE Technical Bulletin 17 (TB17) which discussed the atmospheric pressure conditions most likely to affect ground gas monitoring results [9]. Additionally, the State of New South Wales EPA suggest the use of two-year dataset and 95th percentile of 3-hour pressure falls to estimate worse-case meteorological conditions in Australia [10]. Whilst UK guidance documents recognise that in most cases the two most important factors to consider for assessing the risks posed by hazardous ground gas are the rate of fall and the duration of fall, none provide a measured threshold to what can be considered a worst-case pressure fall.

Defining low and falling atmospheric pressure

For a long time, relevant UK guidance for ground gas monitoring recommended that measurements should include a period when atmospheric pressure is below 1000 millibars and falling (e.g., [11,12]). This was amended in BS 8576 [7] which suggested monitoring should include periods of low and falling atmospheric pressure. However, what constitutes low atmospheric pressure will be directly affected by a site’s geographical and topographical location, and the season the measurement was taken; an atmospheric pressure regime below 1000 millibars is not always an ideal indicator of low pressure. To clearly define when atmospheric pressure is low or high, it is first important to standardise the measurement.

In a UK perspective, the MET office defines the standard Mean Sea Level Pressure (MSLP) as 1013.25 millibars [13], which provides a common value to compare atmospheric pressure across different locations and elevations (refer to additional notes provided in Annex K.1). Also, it is rare for sea level pressure in the UK to rise above 1050 millibars or fall below 950 millibars [13]. For a surface, or absolute pressure measurement to be useful in this context, it should be standardised to sea level pressure, allowing for an accurate description of the pressure regime at that time point. When atmospheric pressure is above or below the MSLP it can indicate either a high- or low-pressure system, and therefore defined as being either higher or lower than the average pressure specific to that geographical location (altitude and latitude). As sea level pressure will vary each month and by season, it is useful to categorize sea level pressure to provide a descriptive framework for reference to low and high pressure in the UK. The methodology used to derive low- and high-pressure criteria is set out in Annex K.2. The five simplified banded categories are below:

- Very high >1029 millibars
- High >1022 <1029 millibars
- Normal >1008 <1022 millibars
- Low >997 <1008 millibars
- Very low <997 millibars

For weather forecasting in the UK, The Meteorological Office [14] records falling pressure tendency over a 3-hour period, whereby every hour the change in atmospheric pressure over the proceeding 3 hours is noted as being:

- Stable <0.1 millibars
- Falling (or rising) slowly >0.1 millibars
- Falling (or rising) >1.6 millibars
- Falling (or rising) rapidly >3.6 millibars
- Falling (or rising) very rapidly >6 millibars

With reference to ground gas monitoring results, recording the 3-hour pressure tendency and sea level pressure provides a clear distinction to the pressure trending and occurrences of falling, rapidly falling and very rapidly falling pressure, and in combination with banded categories, whether atmospheric pressure is low or very low and falling. It is important to note that, in many cases, the atmospheric pressure over the preceding days will influence ground gas concentrations and gas flow at the point of measurement. By applying historical time series data for weather and atmospheric pressure (e.g., [15, 16]), a sequence of periodic monitoring visits can be further understood in the context of capturing low and falling pressure (refer to additional notes in Annex K.3).

*Note: all reference to atmospheric pressure in this technical note is standardised to sea level.

A very brief meteorological perspective

The UK's temperate maritime climate is influenced by westerly winds, with anticyclones and depressions often blowing in from the Atlantic. The transit and intensity of high- and low-pressure systems across the UK are driven by the position of the Jet Stream, which in turn is influenced by the North Atlantic Oscillation (NAO). Strong winds and warm air from the west will be a dominant feature of a positive NAO phase, whilst a negative phase will often lead to a weakened Jet Stream and more frequent, but lighter, winds from the east and north-east. The NAO has a strong influence on UK winter weather and meteorological patterns in general, affecting both short- and long-term trends and regional or local pressure variations [16,17] (refer to additional notes on the NAO presented in Annex K.4).

The scientific consensus on climate change is clear, with a body of evidence affirming that the current warming is primarily due to increased greenhouse gas emissions, leading to an anticipated rise in the frequency, intensity, and duration of extreme weather events. It is unclear whether the occurrence of more extreme falling pressure events are becoming more frequent, or if generalised patterns of seasonal high and low pressures are changing overtime. Longer term variance in atmospheric pressure trends are explored in Annex H.

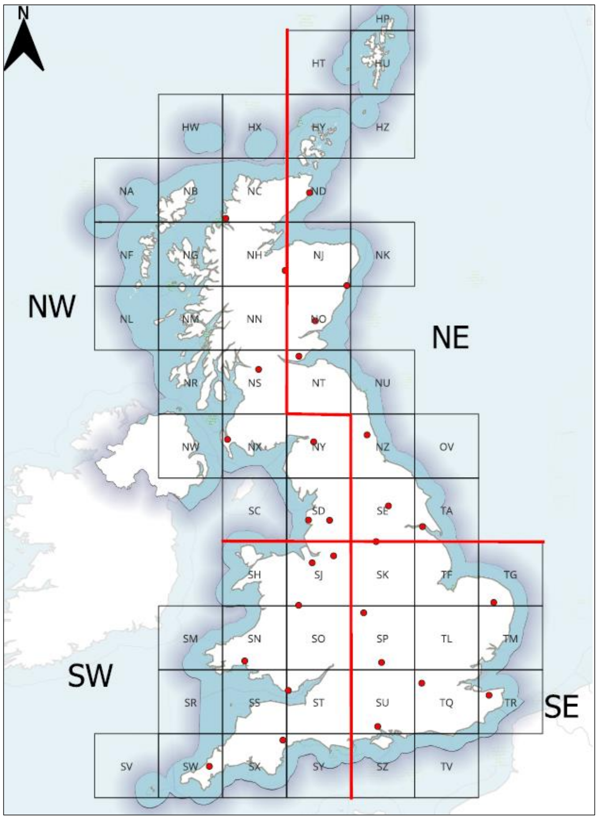
The proposed simplified approach

This technical note aims to establish worst-case thresholds for the rate of falling atmospheric pressure that are most likely to influence ground gas behaviour and migration. With the analysis of historical time series data, the objective is to also provide time reference to meteorological variance and allow for normal and extreme conditions to be understood. Consequently, the extent and significance of past occurrences of falling atmospheric pressure can provide a quantitative threshold to predict worst-case conditions. This is calculated by using the 95th and 90th percentiles of the rate of falling pressure, measured in millibars per hour, from historical time series data across multiple regional locations in the UK. The integration of these thresholds into ground gas risk assessments must align with a clear understanding of all lines of evidence and the gas conceptual site model. The methodology for the simplified approach is set out in the following section.

Methods

For this analysis, the UK was split into four regional zones – north-west, north-east, south-east and south-west. Whilst it may be applicable to include more zones, especially in reference to meteorological trends in temperature, rainfall, and phenology, the four zones were considered appropriate to perform analysis on regional and seasonal variance in atmospheric pressure.

Each zone was configured using Ordnance Survey UK national grid squares with seven locations selected in each zone based on their geography and topography, and with the simple aim to ensure a representative sample in each zone. Figure 1a below provides a geographic reference to each region and 28 locations used for the analysis.



Grid ref:	latitude	longitude	elevation	location
ND 36337 51027	58.4	-3.1	16	Wick
NH 12758 94311	58.0	-5.3	15	Ullapool
NH 89772 13385	57.3	-3.7	215	Aviemore
NJ 93622 06410	57.1	-2.1	10	Aberdeen
NO 45758 50631	56.6	-2.9	61	Forfar
NT 24866 73905	56.1	-3.3	74	Edinburgh
NS 56878 65285	55.9	-4.3	38	Glasgow
NZ 25509 64192	55.0	-1.6	53	Newcastle
NY 39976 55659	54.9	-2.9	24	Carlisle
NX 05871 60409	54.9	-5.0	13	Stranraer
SE 60254 51499	54.0	-1.1	13	York
SD 68404 27919	53.8	-2.5	120	Blackburn
SD 30901 36828	53.8	-3.0	23	Blackpool
TA 09892 29866	53.7	-0.3	9	Hull
SK 35501 87209	53.5	-1.4	75	Sheffield
SJ 74441 83471	53.3	-2.4	51	Rostherne
SJ 40018 65947	53.2	-2.9	32	Chester
SO 10388 91074	52.6	-3.2	110	Newtown
TG 22580 08812	52.6	1.3	25	Norwich
SP 19983 88782	52.5	-1.7	86	Coleshill
SN 41204 19551	51.8	-4.4	24	Carmarthan
SP 51174 06206	51.8	-1.3	71	Oxford
TQ 09998 85130	51.5	-0.4	44	Northolt
ST 01602 67983	51.4	-3.4	35	St Athan
TR 14888 57714	51.3	1.1	14	Canterbury
SU 42297 11317	50.9	-1.4	22	Southampton
SX 92244 92163	50.7	-3.5	54	Exeter
SW 82607 44793	50.3	-5.1	22	Truro

Figure 1a UK locations and regional zones, with National Grid References and elevations (m asl) of each site.

Hourly sea level pressure data was used from Open-Meteo [15] for all locations for a 6-year period (from 1st January 2017 to 31st December 2022) – additional notes on Open Meteo are provided in Annex K.5. The period was considered appropriate to capture both monthly and seasonal atmospheric pressure variance, and thus provide an appropriate representation to 'normal' weather conditions whilst ensuring that extreme events driven by regional climate were present in each dataset (e.g., extended positive and/or negative NAO, natural summer/winter variation). Each time series data set was analysed using a coded software program, which was written to select all falling pressure events of 8 hours or more with a minimum fall of at least 8 millibars. A falling pressure event is defined as a continuous fall at a rate above 0.1 millibars per hour. For example, the duration of a falling pressure event is stopped with the occurrence of either two hours of stable pressure (<0.1 millibar per hour) or one hour of rising pressure (>0.1 millibar per hour). The outputs from the analysis included:

- Duration of fall (hours)
- Total fall (millibars)
- Maximum 3 hr tendency in each fall (millibars)
- Average rate of fall for each falling pressure event (millibars per hour)

Statistical tools were used to present the monthly and annual data outputs for each site and region. The regional worst case pressure falls are presented in the following section, whilst the full results for each location are provided in Annex A.

The results section also includes the frequency of falling pressure events of 8 millibars lasting 8 hours or more that can be anticipated within each calendar month in each region.

To determine whether the rate of falling atmospheric pressure exceeds worst-case thresholds, the assessment requires a calculation of average rate of fall over an 8-hour reference period, simplified as:

Rate of fall in millibars per hour = $\frac{(pressure\ at\ 08{:}00 - pressure\ at\ 00{:}00)}{8}$

Results

North-west

The average total number of falls at least 8 millibars and lasting 8 hours or more for the north-west region was 403 (± 29). This would equate to an average frequency of approximately 67 falling pressure events over a calendar year at each location. The most significant fall during this period (2017-2022) was 71.4 millibars over 69 hours (Stranraer). The maximum duration of fall over this period was 88 hours (also, Stranraer), which coincided with a fall in pressure of 57.8 millibars. With consideration to all 7 locations in the north-west region, the average fall over this period was 16.2 millibars (± 0.4), whilst the average duration of fall was 24.1 (± 0.2) hours[1].

The annual average rate of pressure falls and 95th and 90th percentiles for the north-west region are 1.17 millibars per hour and 1.02 millibars per hour, respectively.

The worst-case rate of falls exhibits monthly variance with an expected rate of fall being at its highest during February and lowest in April. The expected frequency of a falling atmospheric pressure event (over 8 millibars lasting at least 8 hours) is at its highest during February and October and lowest during June and July. The full results are presented in Tables and Figures 1, 2 and 3 on the following pages.

North-east

The average total number of falls at least 8 millibars and lasting 8 hours or more for the north-east region was 400 (± 27). This would equate to an average frequency of approximately 67 falling pressure events over a calendar year for each location. The most significant fall during this period was 72.1 millibars over 60 hours (Wick). The maximum duration of fall over this period was for 104 hours (Aberdeen), which coincided with a fall in pressure of 39.8 millibars. The average fall over this period for the north-east was 16.3 millibars (± 0.4), whilst the average duration of fall was 24.5 (± 0.4) hours.

The annual average rate of pressure falls and 95th and 90th percentiles for the north-east region are 1.14 millibars per hour and 1.01 millibars per hour, respectively.

The worst-case rate of falls exhibits monthly variance with an expected rate of fall being at its highest during February and lowest in June. The expected frequency of a falling atmospheric pressure event

[1] Note: ± denotes standard deviation in all cases

is at its highest during January and October and lowest during June and July. The full results are presented in Tables and Figures 1, 2 and 3 on the following pages.

South-east

The average total number of falls at least 8 millibars and lasting 8 hours or more for the south-east region was 332 (± 16). This would equate to an average frequency of approximately 55 falling pressure events over a calendar year for each location. The most significant fall during this period was 60.2 millibars over 43 hours (Sheffield). The maximum duration of fall over this period was 79 hours (Norwich), which coincided with a fall in pressure of 36.4 millibars. The average fall over this period was 15.4 millibars (± 0.3), whilst the average duration of fall was 23.9 (± 0.6) hours.

The annual average rate of pressure falls and 95th and 90th percentiles for the south-east region are 1.05 millibars per hour and 0.94 millibars per hour, respectively.

The worst-case rate of falls shows monthly variance with an expected rate of fall being at its highest during December and lowest in April. The expected frequency of a falling atmospheric pressure event is at its highest during January and December and lowest during June and July. The full results are presented in Tables and Figures 1, 2 and 3 on the following pages.

South-west

The average total number of falls at least 8 millibars and lasting 8 hours or more for the south-west region was 350 (± 19). This would equate to an average frequency of approximately 58 falling pressure events over a calendar year for each location. The most significant fall during this period was 60.4 millibars over 47 hours (Chester). The maximum duration of fall over this period was 76 hours (Chester), which coincided with a fall in pressure of 51 millibars. The average fall over this period was 15.3 millibars (± 0.3), whilst the average duration of fall was 23.3 (± 0.5) hours.

The annual average rate of pressure falls and 95th and 90th percentiles for the south-west region are 1.09 millibars per hour and 0.98 millibars per hour, respectively.

The worst-case rate of falls exhibits monthly variance with an expected rate of fall being at its highest during December and lowest in April. The expected frequency of a falling atmospheric pressure event is at its highest during November and December and lowest during May and July. The full results are presented in Tables and Figures 1, 2 and 3 on the following pages.

All regions

The overall trend of worst-case falls (95th and 90th percentiles) are similar in each region, with a clear seasonal trend of a higher expected rate of fall during winter months (December, January, and February) and a lower expected rate of fall during the summer months (June, July, and August). The annual average rate of pressure falls and 95th and 90th percentiles for all regions combined is 1.11 millibars per hour and 0.99 millibars per hour, respectively.

With comparison to annual and seasonal trending in all regions, it is evident that the rate of falling pressure is lower in April than expected. The atmospheric pressure regime in April may be anomalous when compared to longer term trends, with the results a measure of the atmospheric pressure regimes occurring between 2017 – 2022. Also, when compared to other regions, the north-west exhibits a sharp increase in worst-case falls occurring in September. Whilst it may be evident that extreme events tend to influence this region more in early autumn, it could also be variance within the data used with longer term trending more aligned to other regions. However, monthly variance is evident between regions with the frequency of a falling pressure events shown to be higher in the north along with a strong seasonal signature.

Summary of Worst-Case Conditions

Firstly, it is important to understand whether ground gas monitoring has captured time periods to when pressure is low, or very low, and if monitoring evidence coincides with falling or rapidly falling atmospheric pressure. Understanding ground gas behaviour and concentrations measured in this context is key. The worst-case rate of falling pressure thresholds are presented on the following pages, both regionally and by location. While monthly and seasonal variance to the rate of falling pressure is expected, using the annual average threshold for the UK would provide a sufficient confidence level to worst case conditions to use in ground gas risk assessment. When a higher confidence level is required, or when an understanding of the gas conceptual site model confirms atmospheric pressure to be the dominant driving mechanism in lateral and vertical ground gas migration, the monthly worst-case falling pressure thresholds and meteorological summaries provided in the annexes may be applicable to use and support a ground gas risk assessment.

In most cases, the annual averaged worst-case rate of fall threshold for the UK can be used, which is set at 1.11 ± 0.05 millibars per hour. The worst-case threshold is measured by averaging the atmospheric pressure fall over an 8-hour reference period, and in time reference to either periodic monitoring or continuous monitoring completed at a site.

Table and Figure 1. Monthly Rate of falls and 95th percentile (millibars per hour)

	North-west	North-east	South-east	South-west	UK (Average)
January	1.55 ± 0.11	1.52 ± 0.10	1.36 ± 0.08	1.30 ± 0.08	1.43 ± 0.12
February	1.60 ± 0.14	1.67 ± 0.09	1.40 ± 0.09	1.36 ± 0.06	1.51 ± 0.15
March	1.30 ± 0.08	1.32 ± 0.08	1.25 ± 0.06	1.21 ± 0.11	1.27 ± 0.05
April	0.75 ± 0.07	0.79 ± 0.06	0.70 ± 0.08	0.73 ± 0.08	0.74 ± 0.04
May	1.09 ± 0.17	0.95 ± 0.12	0.96 ± 0.09	1.00 ± 0.10	1.00 ± 0.06
June	0.78 ± 0.05	0.75 ± 0.09	0.74 ± 0.06	0.78 ± 0.12	0.76 ± 0.02
July	0.81 ± 0.11	0.81 ± 0.12	0.75 ± 0.14	0.88 ± 0.12	0.81 ± 0.05
August	0.86 ± 0.03	0.82 ± 0.04	0.84 ± 0.08	0.86 ± 0.05	0.85 ± 0.02
September	1.34 ± 0.06	1.13 ± 0.13	1.04 ± 0.20	1.12 ± 0.18	1.16 ± 0.13
October	1.20 ± 0.21	1.20 ± 0.09	1.08 ± 0.07	1.14 ± 0.03	1.15 ± 0.06
November	1.27 ± 0.08	1.30 ± 0.15	1.12 ± 0.07	1.22 ± 0.07	1.23 ± 0.08
December	1.46 ± 0.08	1.43 ± 0.04	1.42 ± 0.06	1.50 ± 0.06	1.45 ± 0.04
Average	**1.17 ± 0.04**	**1.14 ± 0.01**	**1.05 ± 0.05**	**1.09 ± 0.03**	**1.11 ± 0.05**

± denotes standard deviation.

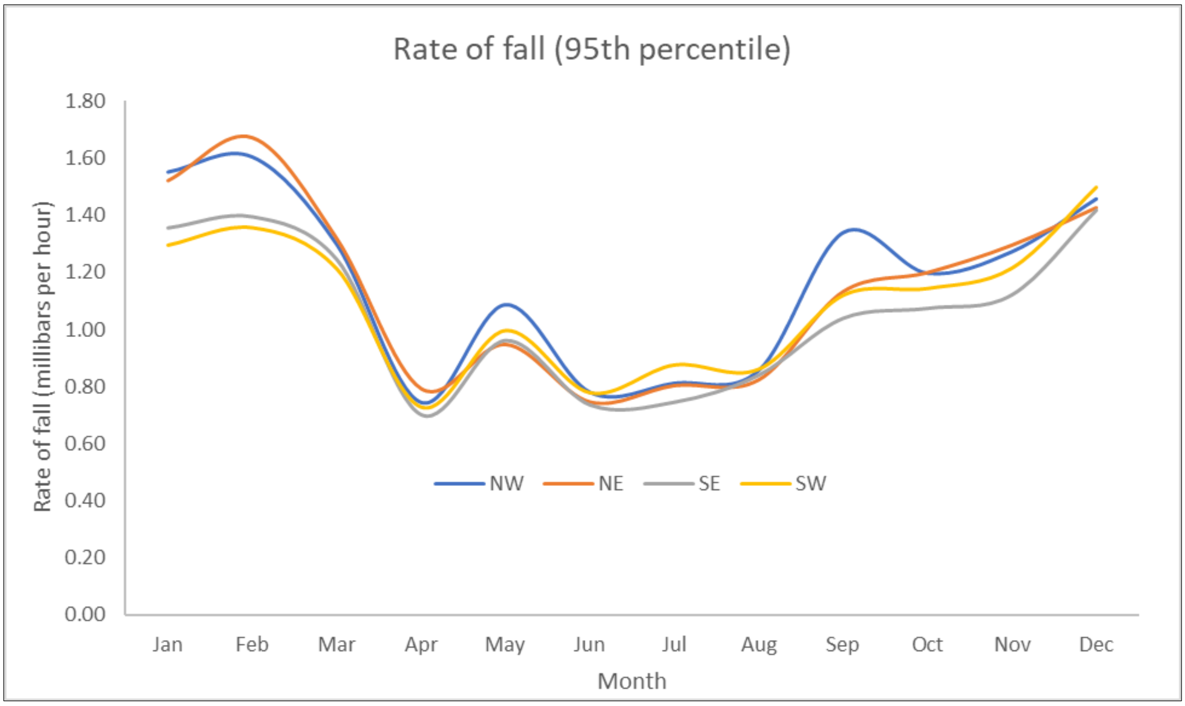


Table and Figure 2. Monthly Rate of falls and 90th percentile (millibars per hour)

	North-west	North-east	South-east	South-west	UK (Average)
January	1.31 ± 0.04	1.31 ± 0.05	1.18 ± 0.09	1.20 ± 0.10	1.25 ± 0.07
February	1.42 ± 0.09	1.46 ± 0.06	1.27 ± 0.10	1.25 ± 0.10	1.35 ± 0.11
March	1.14 ± 0.06	1.16 ± 0.13	1.07 ± 0.10	1.04 ± 0.06	1.10 ± 0.06
April	0.70 ± 0.06	0.75 ± 0.06	0.65 ± 0.06	0.67 ± 0.07	0.69 ± 0.04
May	0.95 ± 0.13	0.83 ± 0.10	0.89 ± 0.09	0.93 ± 0.08	0.90 ± 0.05
June	0.68 ± 0.04	0.68 ± 0.06	0.64 ± 0.03	0.70 ± 0.15	0.67 ± 0.02
July	0.73 ± 0.08	0.73 ± 0.09	0.70 ± 0.12	0.84 ± 0.12	0.75 ± 0.06
August	0.80 ± 0.03	0.76 ± 0.05	0.72 ± 0.06	0.81 ± 0.05	0.77 ± 0.04
September	1.06 ± 0.08	0.98 ± 0.08	0.94 ± 0.12	0.97 ± 0.06	0.99 ± 0.05
October	1.03 ± 0.18	1.03 ± 0.10	0.91 ± 0.07	0.95 ± 0.08	0.98 ± 0.06
November	1.09 ± 0.10	1.06 ± 0.10	1.01 ± 0.08	1.08 ± 0.08	1.06 ± 0.04
December	1.33 ± 0.03	1.33 ± 0.06	1.31 ± 0.05	1.35 ± 0.05	1.33 ± 0.02
Average	**1.02 ± 0.02**	**1.01 ± 0.02**	**0.94 ± 0.04**	**0.98 ± 0.02**	**0.99 ± 0.03**

± denotes standard deviation.

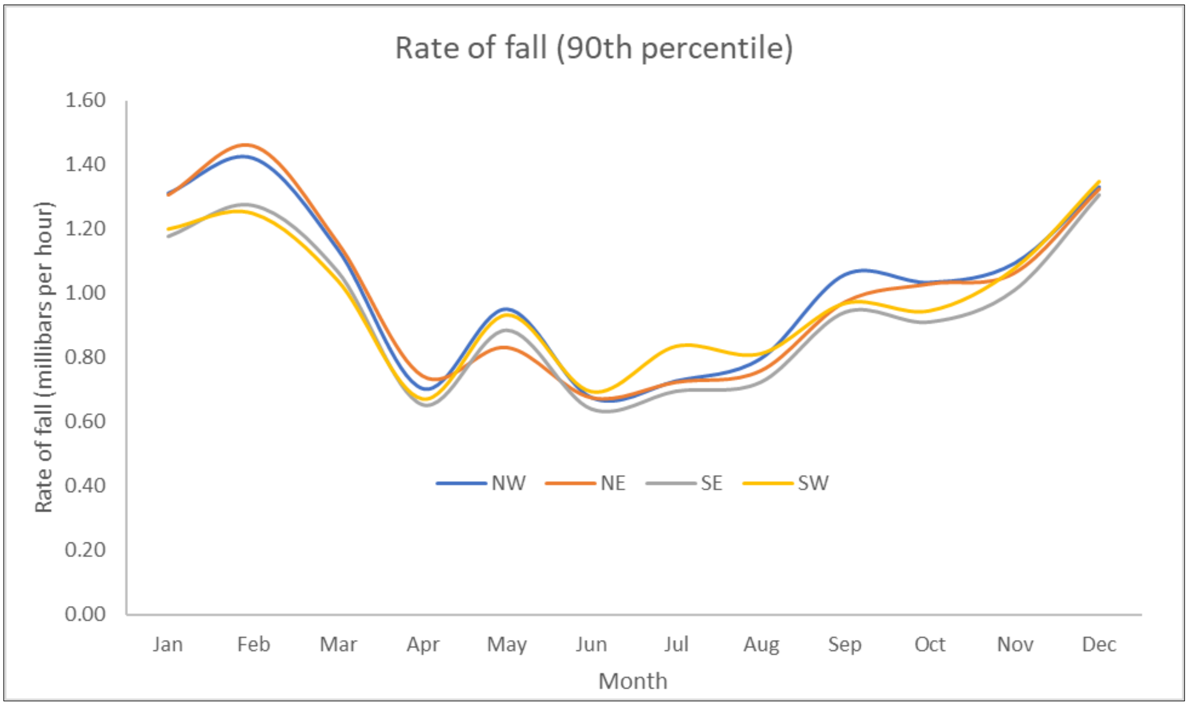


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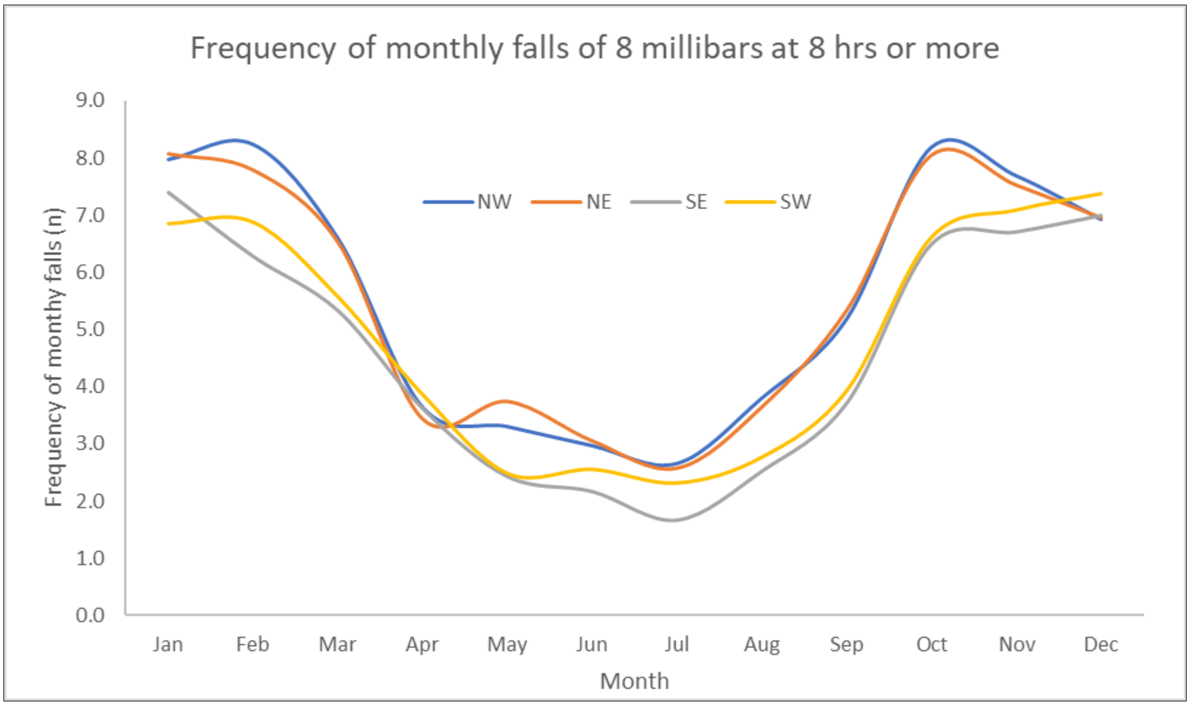
Table and Figure 3. Average frequency of monthly falls of at least 8 millibars lasting 8 hours or more

	North-west	North-east	South-east	South-west	UK (Average)
January	7.98 ± 0.71	8.07 ± 0.54	7.40 ± 0.21	6.86 ± 0.39	7.58 ± 0.56
February	8.24 ± 0.80	7.79 ± 0.77	6.29 ± 0.58	6.88 ± 0.59	7.30 ± 0.88
March	6.60 ± 0.70	6.52 ± 0.33	5.33 ± 0.48	5.57 ± 0.23	6.01 ± 0.65
April	3.64 ± 0.28	3.43 ± 0.45	3.62 ± 0.28	3.86 ± 0.22	3.64 ± 0.18
May	3.31 ± 0.75	3.74 ± 0.54	2.43 ± 0.21	2.48 ± 0.18	2.99 ± 0.64
June	2.98 ± 0.31	3.05 ± 0.44	2.17 ± 0.36	2.55 ± 0.43	2.68 ± 0.41
July	2.67 ± 0.53	2.57 ± 0.89	1.67 ± 0.14	2.31 ± 0.31	2.30 ± 0.45
August	3.81 ± 0.42	3.64 ± 0.48	2.52 ± 0.45	2.76 ±0.55	3.18 ± 0.64
September	5.19 ± 0.49	5.33 ± 0.71	3.71 ± 0.39	3.93 ± 0.74	4.54 ± 0.84
October	8.19 ± 0.35	8.05 ± 0.57	6.50 ± 0.55	6.62 ± 0.56	7.34 ± 0.90
November	7.69 ± 0.42	7.52 ± 0.30	6.71 ± 0.43	7.10 ± 0.38	7.26 ± 0.44
December	6.93 ± 0.68	6.95 ± 0.37	7.00 ± 0.43	7.38 ± 0.28	7.07 ± 0.21

± denotes standard deviation.



Summary

This technical note provides worst-case thresholds for the rate of falling atmospheric pressure to use in ground gas risk assessment. The thresholds are based on a six-year historical time series data set (from 1st January 2017 to 31st December 2022) from multiple sites across the UK.

The worst-case thresholds, derived from using the monthly 95th and 90th percentiles of pressure falls that last 8 hours or more with a minimum fall of 8 millibars, are considered most relevant to influence ground gas behaviour and migration.

While the worst-case rate of fall thresholds are available for each location and region, the annual 95th and 90th percentiles for the UK are 1.11 millibars per hour and 0.99 millibars per hour, respectively. A worst-case threshold is measured using the average rate of fall over an 8-hour period.

Additional annexes are for reference and interest and include detailed analysis on longer terms trends and case studies.

Annexes for additional information:

The worst-case monthly thresholds for each location are presented in Annex A. A climatological summary of atmospheric pressure in each region is presented in Annex B through to Annex E, with all regional graphical summaries presented together in Annex F. Analysis of the relationship between atmospheric pressure and latitude is presented in Annex G.

A longer-term analysis of atmospheric pressure variance has been completed at 7 sites from 1st January 1970 to 31st December 2023. The 7 sites are: Southampton, St Athan, Northolt, Coleshill, Rostherne, Newcastle and Glasgow. The analysis included the frequency of falling pressure events and time distribution of rapid falling pressure and low or high pressure. The analysis of longer-term trends across the 7 sites is presented in Annex H.

Analysis on the probabilities of exceeding 3-hr tendency thresholds of either falling, falling rapidly, or falling very rapidly is presented in Annex I. The probability of capturing very low pressure within a given month is also provided in Annex I. Annex J presents a selection of case studies for falling atmospheric pressure with relevance to worst-case conditions and extreme events. Annex K provides additional notes referred to throughout the text.

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[17] https://www.metoffice.gov.uk/weather/learn-about/weather/atmosphere/north-atlantic-oscillation

[18] https://www.climate.gov/news-features/understanding-climate/climate-variability-north-atlantic-oscillation

When referencing this white paper, please use the following citation:

Brunton A., Atmospheric Pressure and a Simplified Approach to Determine Worst-Case Conditions for Ground Gas Monitoring in the UK, 2024, Ground Gas Solutions Limited, https://ggs-uk.com/

I would like to thank Simon Talbot for his support, valuable feedback and suggestions during the review of this white paper. I would also like to thank the GGS team for their continued support and enthusiasm, and to Oliver Neilson for his work during the early stages of this project.

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Annexes for further information:

Annex A – Worst-case atmospheric pressure falls for each location.

Annex B – North-west summary.

Annex C – North-east summary.

Annex D – South-east summary.

Annex E – South-west summary.

Annex F – Regionalised summaries.

Annex G – Relationship of atmospheric pressure and latitude.

Annex H – Long term atmospheric pressure variance.

Annex I – Probabilities of rapid falling atmospheric pressure.

Annex J – Case studies.

Annex K – Additional notes and observations.

Annex A – Worst-case atmospheric pressure falls for all regional locations.

Table A.1. Worst-case monthly rate of fall for each location in millibars per hour (95th percentiles)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Aviemore	1.63	1.74	1.19	0.80	0.85	0.75	0.70	0.87	1.34	1.30	1.34	1.46	1.16
Blackburn	1.41	1.38	1.25	0.73	1.11	0.78	0.79	0.90	1.30	1.12	1.14	1.41	1.11
Blackpool	1.46	1.43	**1.41**	0.78	1.10	0.81	0.81	0.84	1.37	0.97	1.26	1.32	1.13
Carlisle	1.53	1.59	1.33	0.65	1.16	0.84	1.01	0.87	1.29	1.28	1.36	1.49	1.20
Glasgow	1.53	1.72	1.33	0.74	**1.34**	0.74	0.80	0.86	**1.45**	1.17	1.30	1.52	**1.21**
Stranraer	1.53	1.68	1.35	0.68	1.18	0.71	0.88	0.86	1.30	0.96	1.32	**1.57**	1.17
Ullapool	**1.76**	1.69	1.22	0.84	0.87	0.83	0.70	0.80	1.33	**1.58**	1.19	1.42	1.19
York	1.43	1.77	1.38	0.77	0.93	0.70	0.86	0.85	1.29	1.22	1.02	1.38	1.13
Edinburgh	1.50	1.58	1.38	0.75	1.14	0.70	0.88	0.82	1.03	1.17	1.35	1.46	1.15
Forfar	1.55	1.55	1.31	0.80	1.08	0.73	0.79	0.80	0.96	1.22	1.41	1.47	1.14
Hull	1.41	1.64	1.36	0.80	0.91	0.65	0.89	0.88	1.31	1.17	1.17	1.42	1.13
Newcastle	1.48	1.68	1.37	0.71	0.91	0.72	0.92	0.81	1.18	1.04	**1.43**	1.46	1.14
Aberdeen	1.58	1.68	1.22	**0.92**	0.81	0.82	0.65	0.86	1.14	1.28	1.38	1.37	1.14
Wick	1.70	**1.79**	1.19	0.81	0.85	0.91	0.64	0.76	1.04	1.31	1.31	1.43	1.14
Canterbury	1.39	1.35	1.27	0.63	0.88	0.64	0.55	0.79	0.83	1.11	1.07	1.36	0.99
Southampton	1.24	1.26	1.26	0.62	0.87	0.80	0.83	0.79	0.95	1.13	1.21	1.45	1.03
Sheffield	1.40	1.52	1.33	0.79	0.99	0.75	0.90	0.83	1.34	1.12	1.05	1.43	1.12
Northolt	1.32	1.38	1.26	0.64	0.93	0.73	0.79	0.87	0.87	0.99	1.06	1.52	1.03
Norwich	1.47	1.52	1.27	0.76	0.92	0.67	0.60	0.74	1.06	0.96	1.10	1.36	1.04
Oxford	1.31	1.36	1.13	0.67	1.06	0.79	0.86	0.91	0.94	1.10	1.18	1.44	1.06
Coleshill	1.37	1.38	1.21	0.82	1.09	0.78	0.70	**0.96**	1.29	1.12	1.19	1.38	1.11
Carmarthen	1.26	1.30	1.19	0.73	1.00	0.72	0.89	0.90	0.98	1.15	1.27	1.39	1.06
Chester	1.39	1.43	1.37	0.79	1.13	0.77	0.80	0.84	1.30	1.13	1.13	1.50	1.13
Exeter	1.21	1.30	1.13	0.61	0.89	**1.02**	0.96	0.86	0.95	1.16	1.23	1.56	1.07
St Athan	1.21	1.31	1.23	0.64	0.92	0.72	0.92	0.87	1.18	1.09	1.13	1.45	1.06
Rostherne	1.36	1.46	1.28	0.76	1.10	0.75	0.74	0.80	1.35	1.16	1.16	1.55	1.12
Newtown	1.38	1.37	1.25	0.83	1.06	0.67	0.76	0.83	1.18	1.18	1.27	1.50	1.11
Truro	1.26	1.32	1.03	0.75	0.89	0.81	**1.07**	0.94	0.90	1.14	1.32	1.55	1.08
Average	1.43	**1.51**	1.27	0.74	1.00	0.76	0.81	0.85	1.16	1.15	1.23	1.45	1.11

Table A.2. Worst-case monthly rate of fall for each location in millibars per hour (90th percentiles)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Aviemore	1.24	1.36	1.07	0.79	0.79	0.68	0.65	0.82	1.05	1.18	1.05	1.33	1.00
Blackburn	1.33	1.29	1.13	0.71	1.03	0.70	0.70	0.82	1.11	0.95	0.99	1.30	1.00
Blackpool	1.28	1.34	1.15	0.72	1.03	0.68	0.74	0.78	1.12	0.87	1.12	1.30	1.01
Carlisle	1.30	1.51	1.17	0.66	1.02	0.60	0.74	0.82	1.06	0.87	1.07	1.32	1.01
Glasgow	1.35	1.49	1.21	0.68	**1.06**	0.69	0.69	0.81	1.03	0.95	1.00	1.37	1.03
Stranraer	1.32	1.49	1.20	0.61	1.00	0.72	0.88	0.76	0.90	1.09	1.30	1.37	**1.05**
Ullapool	**1.37**	1.46	1.05	0.77	0.73	0.66	0.68	0.76	1.14	**1.34**	1.13	1.33	1.03
York	1.27	1.40	1.10	0.73	0.86	0.66	0.80	0.71	1.05	0.95	0.99	1.30	0.98
Edinburgh	1.30	1.51	1.17	0.70	0.97	0.62	0.78	0.80	0.86	1.02	0.95	1.29	1.00
Forfar	**1.37**	1.43	1.19	0.77	0.88	0.68	0.67	0.77	0.93	1.05	1.13	1.36	1.02
Hull	1.24	1.41	1.30	0.76	0.77	0.62	0.73	0.69	1.07	1.01	0.97	1.31	0.99
Newcastle	1.34	**1.55**	**1.32**	0.67	0.91	0.67	0.84	0.78	1.05	0.90	1.08	**1.43**	1.04
Aberdeen	1.30	1.41	0.99	**0.85**	0.75	0.72	0.62	0.84	0.89	1.19	**1.23**	1.33	1.01
Wick	1.34	1.51	1.05	0.73	0.70	0.78	0.63	0.73	0.98	1.10	1.10	1.25	0.99
Canterbury	1.10	1.26	1.08	0.59	0.80	0.63	0.52	0.69	0.82	0.97	0.94	1.30	0.89
Southampton	1.05	1.13	0.88	0.60	0.81	0.69	0.82	0.72	0.90	0.88	1.08	1.35	0.91
Sheffield	1.29	1.36	1.15	0.69	0.95	0.66	0.81	0.68	1.06	1.00	0.98	1.22	0.99
Northolt	1.14	1.24	1.11	0.62	0.83	0.61	0.71	0.78	0.86	0.82	0.97	1.31	0.92
Norwich	1.22	1.40	1.19	0.75	0.81	0.63	0.57	0.64	0.90	0.83	0.90	1.30	0.93
Oxford	1.19	1.18	0.97	0.64	0.97	0.60	0.80	0.80	0.91	0.90	1.12	1.38	0.96
Coleshill	1.25	1.35	1.10	0.69	1.02	0.66	0.66	0.75	**1.15**	0.97	1.09	1.29	1.00
Carmarthen	1.12	1.21	1.02	0.69	0.95	0.61	0.88	0.81	0.94	0.98	1.17	1.34	0.97
Chester	1.31	1.34	1.10	0.68	1.03	0.59	0.71	0.78	0.98	0.91	0.97	1.27	0.97
Exeter	1.16	1.16	0.96	0.59	0.83	**1.01**	0.93	0.83	0.94	0.99	1.12	1.38	0.99
St Athan	1.04	1.14	1.02	0.59	0.88	0.59	0.91	0.81	1.04	0.83	1.06	1.39	0.94
Rostherne	1.31	1.36	1.12	0.74	1.03	0.66	0.71	0.79	1.05	1.06	1.04	1.27	1.01
Newtown	1.23	1.34	1.08	0.77	0.96	0.67	0.72	0.77	0.97	0.88	1.01	1.40	0.98
Truro	1.21	1.18	0.99	0.66	0.86	0.74	**1.00**	**0.92**	0.87	0.98	1.18	1.38	1.00
Average	1.25	**1.35**	1.10	0.69	0.90	0.67	0.75	0.77	0.99	0.98	1.06	1.33	0.99

Annex B – North-West

The following tables and figures present a summary of atmospheric pressure in the north-west region.

The maximum atmospheric pressure recorded in the north-west region was in Ullapool on 29th March 2020 at 1050.4 millibars (this extreme event is discussed in the following paper[2]). The highest regional average pressure is also evident in March, with each location tending to record their maximum readings within this month, especially at locations with a higher latitude. In general, July is consistent in recording the lowest maximum pressure readings across each location. The minimum atmospheric pressure was also recorded in Ullapool at 949.0 millibars on 9th February 2020 (for low atmospheric pressure in the UK refer to an interesting and insightful reference guide[3]). Again, minimum pressures tend to be recorded in February and especially at locations at a higher latitude. December also tends to be when low atmospheric pressures are recorded across all locations.

The lowest average monthly atmospheric pressure occurs in Ullapool in December, with all other locations recording their lowest averages during this month. In general, all locations exhibit seasonal trending with other winter months recording low average atmospheric pressures - although January is higher than other winter months and that of autumn. All the highest average pressures have been recorded in April, with a general trend of higher average pressures during spring and summer.

[2] Burt S., 2020 New British and Irish Isles late-winter extreme barometric pressure, 29 March 2020. Royal Meteorological Society

[3] Burt s., 2007 The lowest of the Lows…Extremes of barometric pressure in the British Isles, Part 1 – the deepest depressions. Royal Meteorological Society

Table and Figure B.1 monthly maximum atmospheric pressures recorded at each regional location.

	Ullapool	Aviemore	Glasgow	Carlisle	Stranraer	Blackburn	Blackpool	Average
Jan	1045.1	1045.7	1046.3	1046.2	1045.8	1047.9	1048.0	1046.4
Feb	1039.9	1039.8	1040.5	1041.5	1041.0	1042.4	1042.5	1041.1
Mar	1050.4	1049.6	1049.6	1047.6	1049.6	1044.9	1045.2	1048.1
April	1038.5	1037.9	1037.0	1036.8	1036.8	1036.8	1036.6	1037.2
May	1038.3	1038.0	1038.8	1039.3	1039.0	1039.9	1040.0	1039.0
June	1034.5	1033.8	1032.5	1032.8	1033.6	1032.4	1032.6	1033.2
July	1030.7	1030.3	1032.6	1032.7	1033.9	1033.6	1034.0	1032.5
Aug	1038.4	1037.9	1036.3	1035.7	1036.0	1034.7	1034.5	1036.2
Sept	1038.2	1037.7	1036.5	1037.5	1038.0	1038.7	1038.8	1037.9
Oct	1034.1	1033.8	1036.2	1037.4	1038.7	1038.8	1039.3	1036.9
Nov	1032.5	1034.6	1036.7	1037.7	1037.9	1038.7	1039.1	1036.7
Dec	1041.3	1041.8	1042.6	1042.6	1042.3	1042.3	1042.2	1042.2

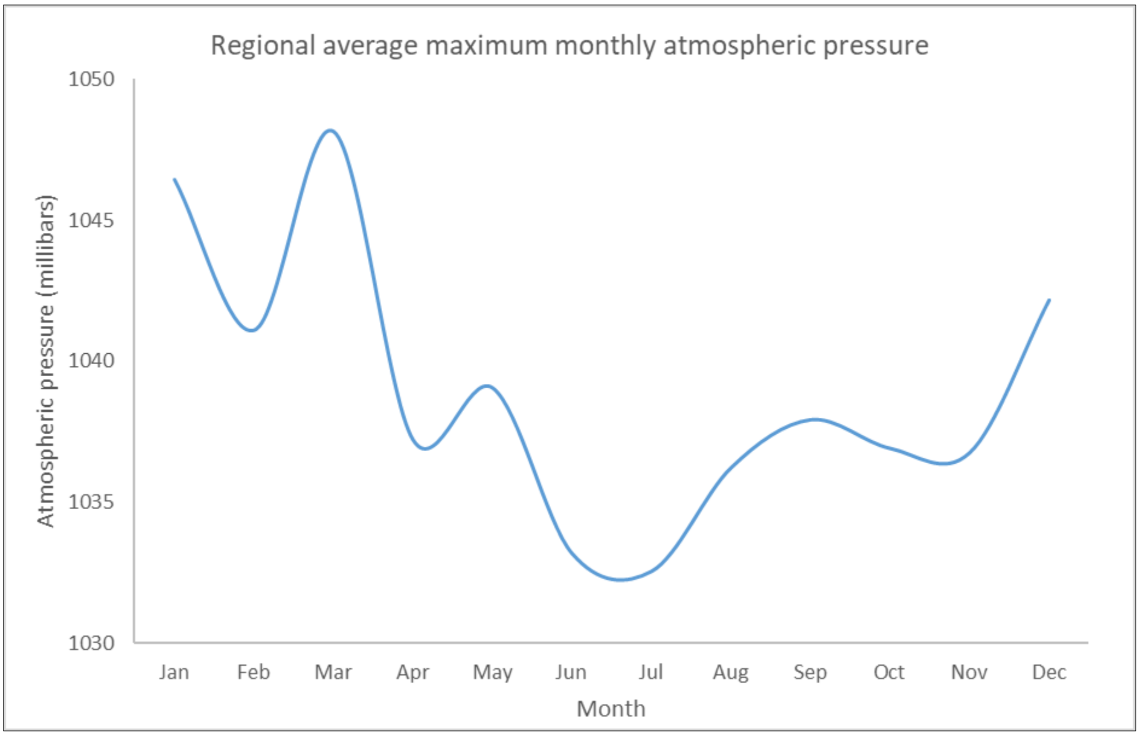

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Table and Figure B.2 monthly minimum atmospheric pressures recorded at each regional location.

	Ullapool	Aviemore	Glasgow	Carlisle	Stranraer	Blackburn	Blackpool	Average
Jan	962.5	967.2	971.1	971.4	971.9	972.7	973.8	970.1
Feb	949.0	950.9	960.7	965.3	962.3	972.4	972.7	961.9
Mar	957.6	957.4	963.5	969.7	967.6	975.7	976.1	966.8
April	974.6	973.0	971.1	971.6	971.8	975.5	976.9	973.5
May	988.0	988.5	988.1	985.6	985.2	984.6	984.4	986.3
June	978.8	980.5	988.8	985.6	990.0	986.0	986.4	985.2
July	988.3	990.5	991.9	993.2	991.3	992.6	992.7	991.5
Aug	984.4	984.6	983.9	982.8	982.8	983.8	983.9	983.7
Sept	974.8	975.6	977.7	978.8	978.4	981.8	982.5	978.5
Oct	971.2	971.4	974.8	975.4	974.9	977.4	977.2	974.6
Nov	971.0	970.5	973.2	973.3	972.6	972.8	972.9	972.3
Dec	956.5	959.8	963.2	965.9	963.6	968.1	967.2	963.5

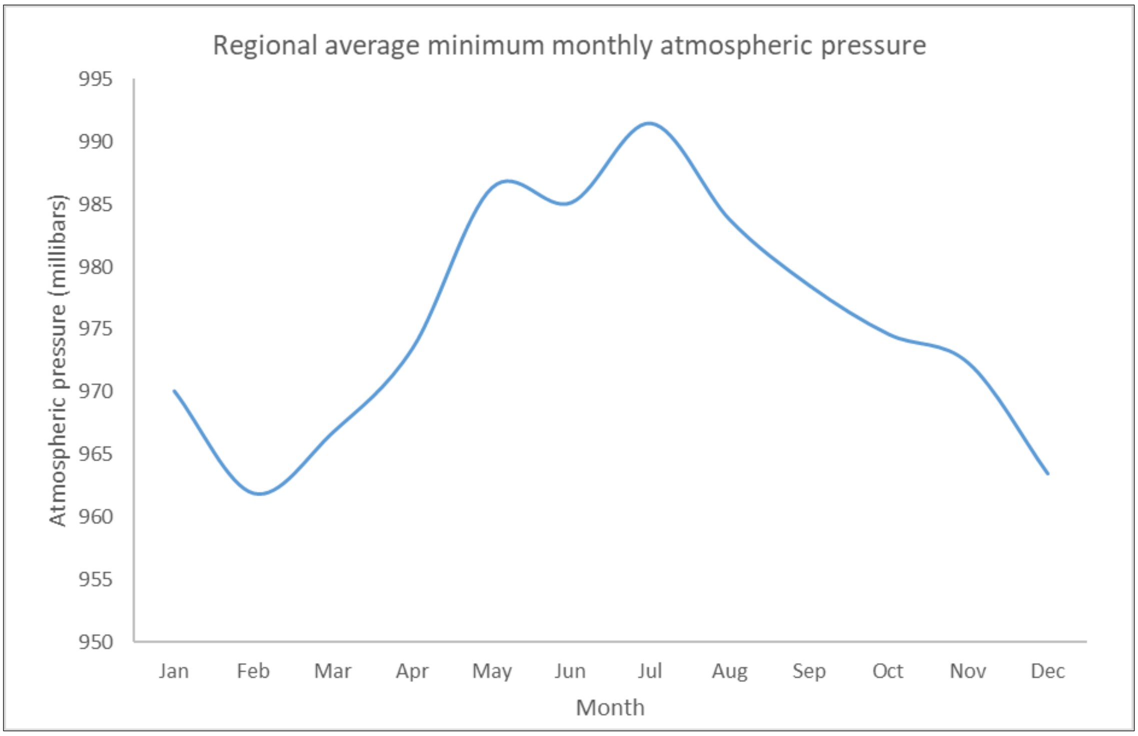

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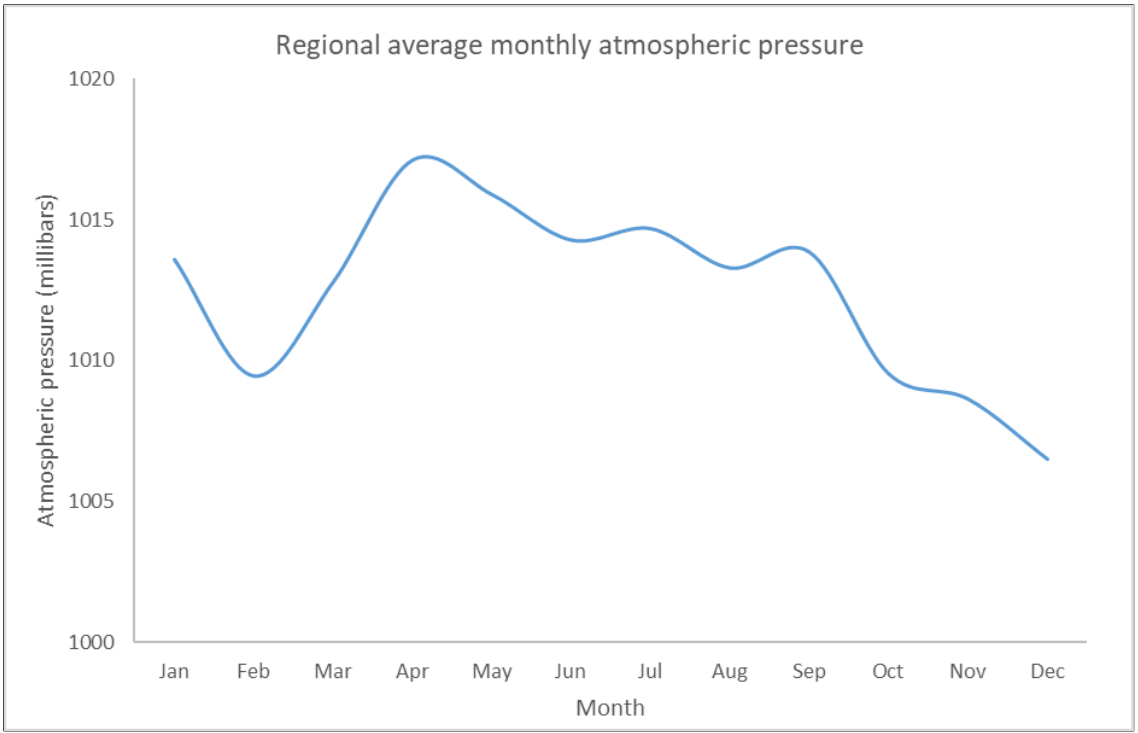
Table and Figure B.3 monthly average atmospheric pressures recorded at each regional location.

	Ullapool	Aviemore	Glasgow	Carlisle	Stranraer	Blackburn	Blackpool	Average
Jan	1010.1	1010.7	1013.5	1014.5	1014.3	1016.0	1016.1	1013.6
Feb	1005.6	1006.8	1009.1	1010.5	1009.6	1012.2	1012.2	1009.4
Mar	1010.5	1011.2	1012.7	1013.5	1013.0	1014.3	1014.3	1012.8
April	1016.6	1016.9	1017.2	1017.4	1017.1	1017.4	1017.3	1017.1
May	1015.1	1015.3	1015.8	1016.1	1015.9	1016.5	1016.5	1015.9
June	1013.3	1013.5	1014.1	1014.6	1014.4	1015.0	1015.0	1014.3
July	1013.5	1013.5	1014.5	1014.9	1015.1	1015.6	1015.7	1014.7
Aug	1011.8	1012.1	1013.1	1013.7	1013.4	1014.5	1014.5	1013.3
Sept	1011.7	1012.2	1013.8	1014.4	1014.3	1015.3	1015.3	1013.9
Oct	1006.7	1007.4	1009.3	1010.3	1009.8	1011.7	1011.7	1009.5
Nov	1006.5	1007.2	1008.5	1009.2	1008.7	1010.2	1010.2	1008.6
Dec	1003.8	1004.5	1006.2	1007.2	1006.6	1008.6	1008.5	1006.5



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Annex C – North-East

The following tables and figures present a summary of atmospheric pressure in the north-east region.

The maximum atmospheric pressure recorded in the north-east region was in Edinburgh on 29th March 2020 at 1049.1 millibars. The highest regional average pressure is also evident in March, with each location tending to record their maximum readings within this month, especially at locations with a higher latitude. In general, July is consistent in recording the lowest maximum pressure readings across each location. The minimum pressure reading was recorded in Wick at 948.7 millibars on 9th February 2020. Again, minimum pressures tend to be recorded in February and especially at locations at a higher latitude. December and January also tend to be when the low atmospheric pressures are recorded.

The lowest average monthly atmospheric pressure occurs at Wick in December, with all other locations recording their lowest averages during this month. In general, all locations exhibit seasonal trending with other winter months recording low average atmospheric pressures - although January is higher than other winter months and in autumn. All the highest average pressures have been recorded in April, with a general trend of higher average pressures during spring and summer.

Table and Figure C.1 monthly maximum atmospheric pressures recorded at each regional location.

	Wick	Aberdeen	Forfar	Edinburgh	Newcastle	York	Hull	Average
Jan	1044.7	1044.8	1045.6	1046.1	1045.2	1046.8	1047.3	1045.8
Feb	1040.6	1040.1	1039.6	1040.2	1040.8	1041.9	1042.1	1040.8
Mar	1049.0	1047.4	1048.4	1049.1	1046.5	1045.5	1045.7	1047.4
April	1037.1	1036.4	1036.8	1037.1	1036.3	1037.1	1037.7	1036.9
May	1037.7	1038.2	1038.6	1038.5	1039.1	1040.1	1040.6	1039.0
June	1033.5	1033.3	1033.2	1032.8	1033.3	1033.1	1033.0	1033.2
July	1029.5	1029.4	1030.2	1031.2	1031.1	1032.0	1031.9	1030.8
Aug	1037.0	1036.1	1036.1	1036.4	1034.8	1033.8	1033.0	1035.3
Sept	1036.8	1036.0	1035.9	1036.2	1037.0	1038.1	1038.1	1036.9
Oct	1034.4	1032.8	1033.4	1035.0	1036.4	1037.5	1037.2	1035.2
Nov	1034.9	1036.2	1035.7	1035.6	1036.3	1037.8	1038.0	1036.4
Dec	1041.1	1041.9	1042.2	1042.4	1042.4	1042.7	1042.6	1042.2

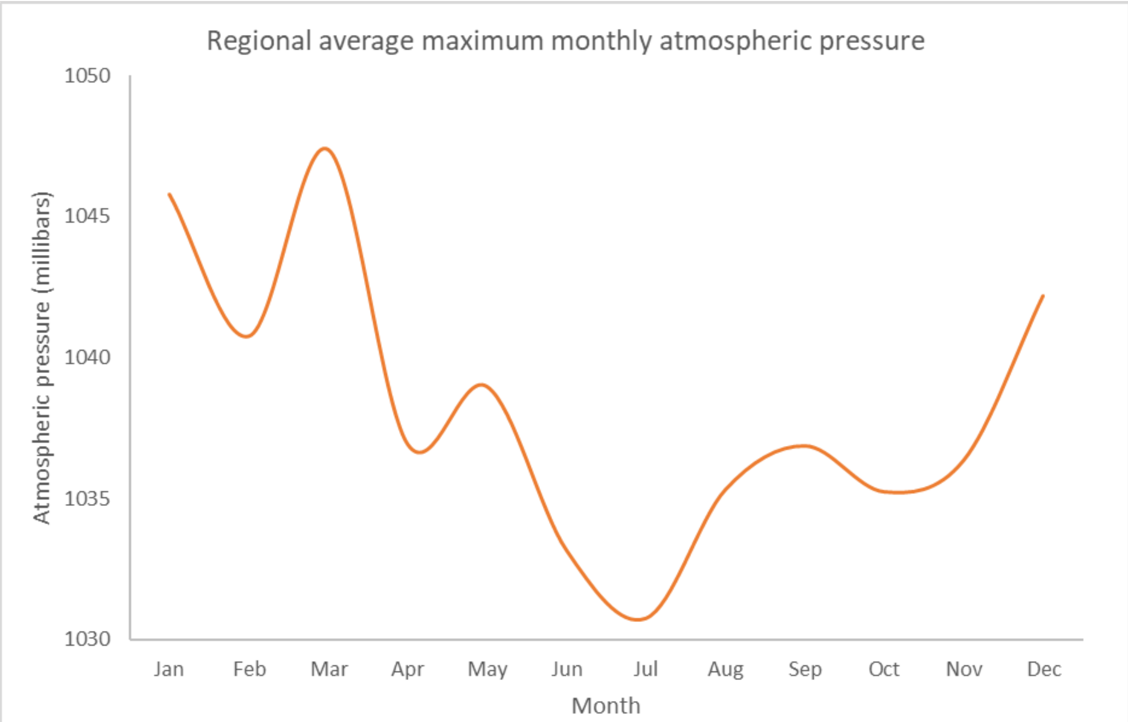

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Table and Figure C.2 monthly minimum atmospheric pressures recorded at each regional location.

	Wick	Aberdeen	Forfar	Edinburgh	Newcastle	York	Hull	Average
Jan	965.7	960.6	965.3	969.0	968.1	969.4	968.4	966.6
Feb	948.7	951.5	958.1	960.6	966.9	972.5	974.1	961.8
Mar	957.8	958.5	960.8	962.6	968.9	975.1	976.6	965.8
April	976.9	971.9	971.3	971.3	970.9	973.4	974.1	972.8
May	989.7	990.1	989.6	988.4	985.0	984.9	984.8	987.5
June	979.2	982.3	985.8	987.6	985.6	985.7	985.4	984.5
July	991.0	987.8	989.1	991.0	991.9	992.3	992.7	990.8
Aug	985.0	985.7	986.1	985.5	982.8	984.6	986.3	985.1
Sept	975.2	975.6	977.2	977.7	978.6	980.9	981.9	978.2
Oct	972.0	972.2	974.0	974.7	976.3	978.9	979.5	975.4
Nov	971.6	971.7	973.1	973.5	973.0	971.2	969.9	972.0
Dec	959.3	960.4	962.2	963.4	966.1	968.5	968.7	964.1

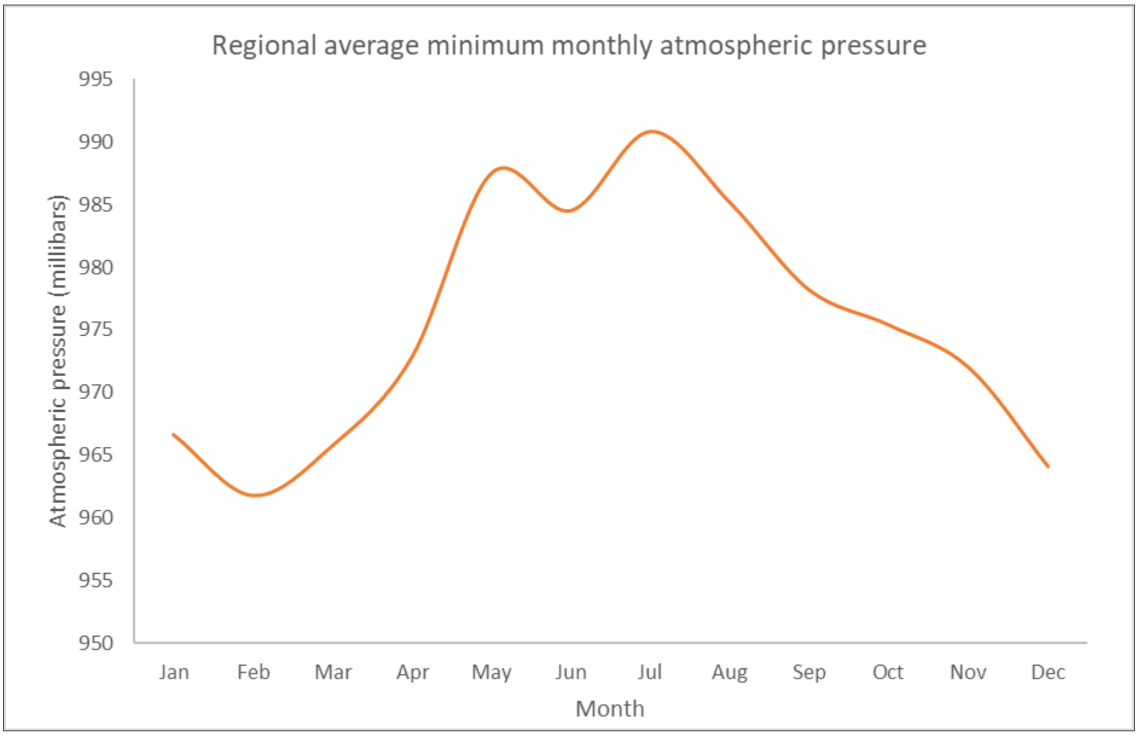

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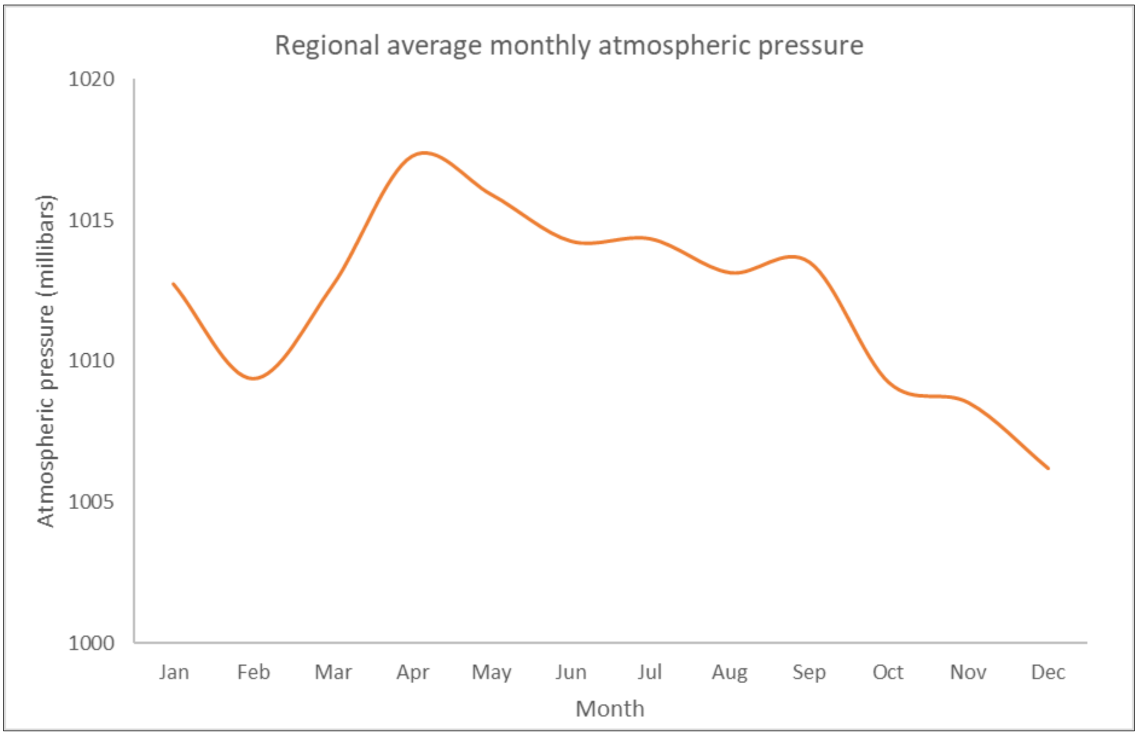
Table and Figure C.3 monthly average atmospheric pressures recorded at each regional location.

	Wick	Aberdeen	Forfar	Edinburgh	Newcastle	York	Hull	Average
Jan	1009.1	1010.5	1012.0	1012.9	1013.9	1015.3	1015.5	1012.7
Feb	1005.8	1007.4	1008.5	1008.9	1010.5	1012.1	1012.5	1009.4
Mar	1010.4	1011.5	1012.2	1012.5	1013.4	1014.2	1014.4	1012.7
April	1016.8	1017.1	1017.3	1017.3	1017.5	1017.5	1017.5	1017.3
May	1015.2	1015.5	1015.7	1015.8	1016.2	1016.4	1016.5	1015.9
June	1013.4	1013.7	1014.0	1014.1	1014.6	1014.9	1015.1	1014.3
July	1013.3	1013.6	1013.9	1014.3	1014.7	1015.2	1015.3	1014.3
Aug	1011.8	1012.3	1012.7	1013.0	1013.6	1014.2	1014.4	1013.1
Sept	1011.4	1012.3	1013.0	1013.5	1014.2	1015.0	1015.1	1013.5
Oct	1006.5	1007.5	1008.4	1009.0	1010.1	1011.4	1011.7	1009.2
Nov	1006.5	1007.3	1008.0	1008.3	1009.2	1010.1	1010.3	1008.5
Dec	1003.5	1004.5	1005.5	1006.0	1007.1	1008.3	1008.6	1006.2



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Annex D – South-east

The following tables and figures present a summary of atmospheric pressure in the south-east region.

The maximum atmospheric pressure recorded in the south-east region was in Southampton on 19th January 2020 at 1049.5 millibars. The highest regional average pressure is also evident in January, with all locations recording their maximum readings within this month. June, July, and August record the lowest maximum pressure readings across each location. The minimum pressure reading was recorded in Norwich at 968.6 millibars on 4th December 2020. All minimum atmospheric pressures at each location are recorded in December. January also tends to be when low atmospheric pressures are recorded.

The lowest average monthly atmospheric pressure occurs at Sheffield in December, with all other locations recording their lowest averages during this month. In general, all locations exhibit seasonal trending with other winter months recording low average atmospheric pressures - although January is higher than other winter months and autumn. All the highest average pressures have been recorded in either January or April, with a general trend of higher average pressures during spring and summer.

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Table and Figure D.1 monthly maximum atmospheric pressures recorded at each regional location.

	Sheffield	Norwich	Coleshill	Oxford	Northolt	Canterbury	So/ton	Average
Jan	1047.6	1048.2	1048.9	1049.2	1049.3	1049.1	1049.5	1048.8
Feb	1042.4	1042.2	1042.9	1042.5	1042.2	1041.9	1042.1	1042.3
Mar	1045.0	1045.3	1043.7	1043.2	1042.9	1043.1	1042.4	1043.7
April	1037.2	1038.1	1037.7	1037.6	1037.6	1037.7	1037.5	1037.6
May	1040.1	1041.6	1040.7	1040.7	1040.7	1040.8	1040.1	1040.7
June	1033.0	1032.2	1031.7	1031.4	1030.8	1030.9	1031.4	1031.6
July	1032.7	1032.0	1033.5	1033.4	1032.9	1032.6	1033.4	1032.9
Aug	1034.1	1031.6	1033.1	1032.0	1031.3	1030.3	1031.0	1031.9
Sept	1038.6	1039.0	1039.4	1039.3	1039.2	1039.4	1039.1	1039.1
Oct	1038.2	1036.8	1038.9	1038.3	1037.8	1037.1	1038.5	1037.9
Nov	1038.5	1039.1	1039.7	1040.2	1040.3	1040.3	1040.1	1039.7
Dec	1042.5	1042.0	1042.1	1041.5	1041.3	1040.9	1040.7	1041.6

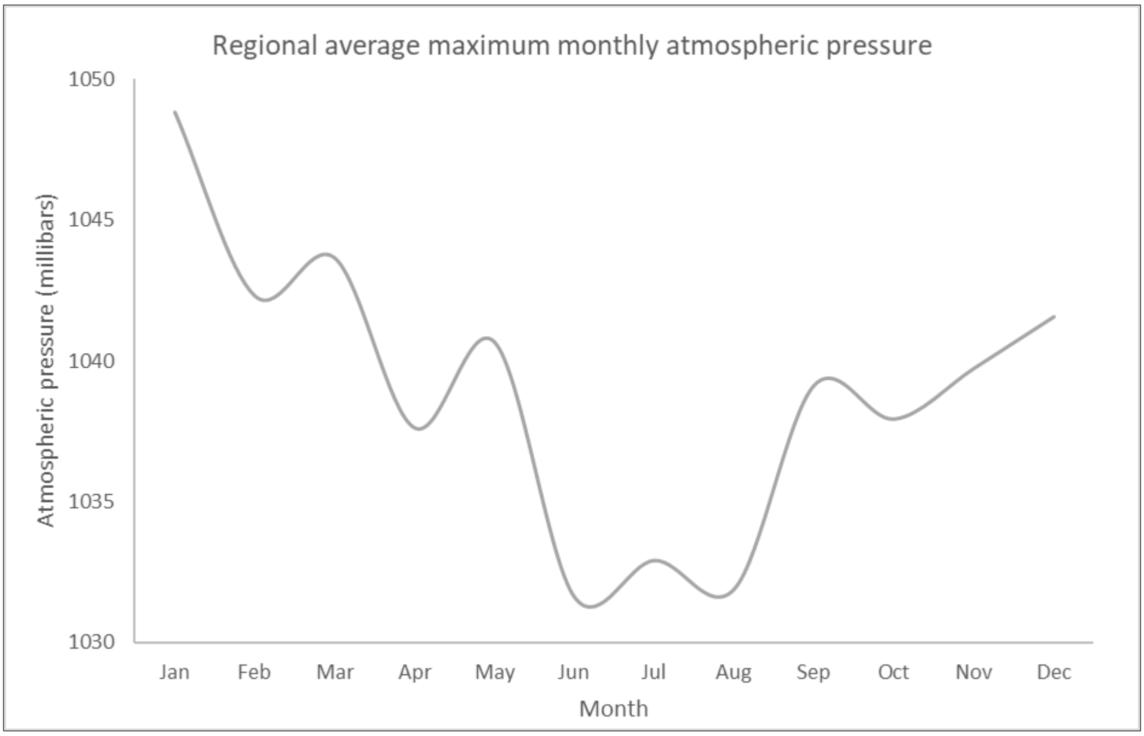

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Table and Figure D.2 monthly minimum atmospheric pressures recorded at each regional location.

	Sheffield	Norwich	Coleshill	Oxford	Northolt	Canterbury	So/ton	Average
Jan	971.0	970.9	971.9	973.2	974.6	976.4	975.6	973.4
Feb	974.4	978.5	978.5	981.4	981.3	981.5	981.9	979.6
Mar	976.8	983.3	981.9	983.9	984.2	984.5	982.9	982.5
April	975.7	978.3	980.6	983.7	984.4	984.3	986.4	981.9
May	985.6	988.4	989.3	990.0	991.2	992.6	990.8	989.7
June	985.9	985.2	985.9	986.3	987.1	989.5	988.8	987.0
July	992.6	994.5	992.5	993.4	993.6	995.5	992.7	993.5
Aug	985.8	992.0	991.2	994.4	995.3	996.6	995.4	993.0
Sept	982.2	986.4	986.1	989.0	990.6	991.9	992.1	988.3
Oct	977.8	979.8	977.1	979.3	980.2	980.9	981.2	979.5
Nov	971.6	973.6	970.6	973.4	974.8	974.0	974.6	973.2
Dec	969.2	968.6	969.5	970.3	970.9	970.0	969.8	969.8

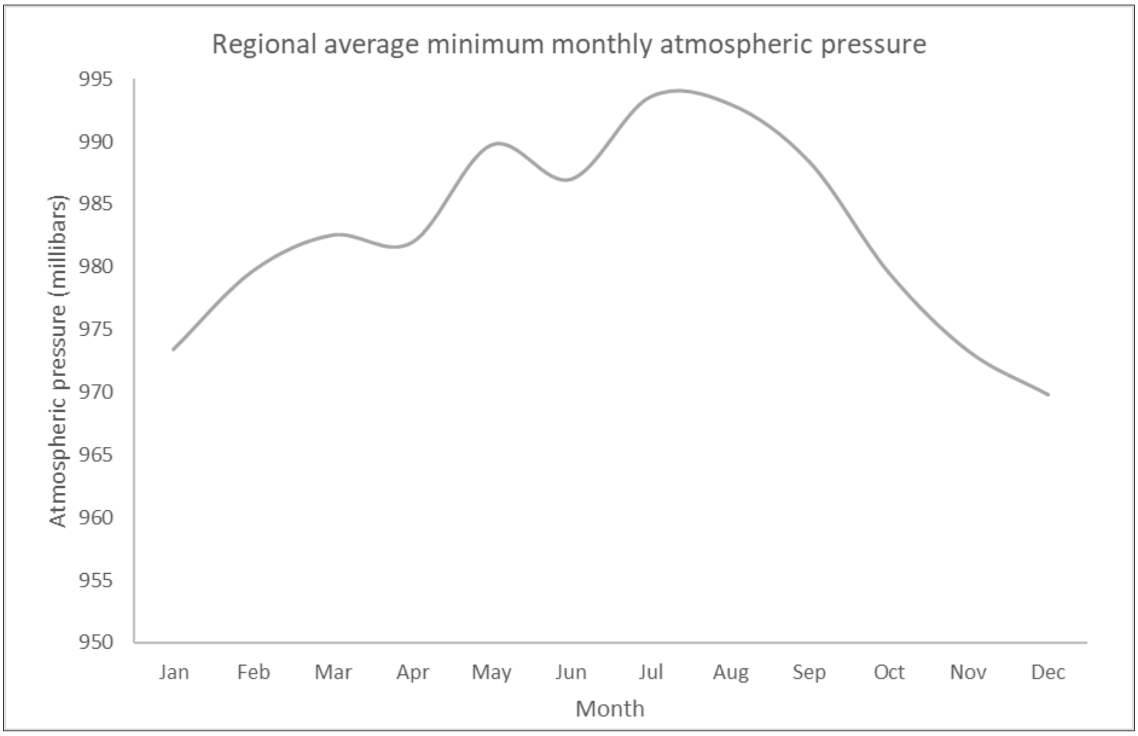

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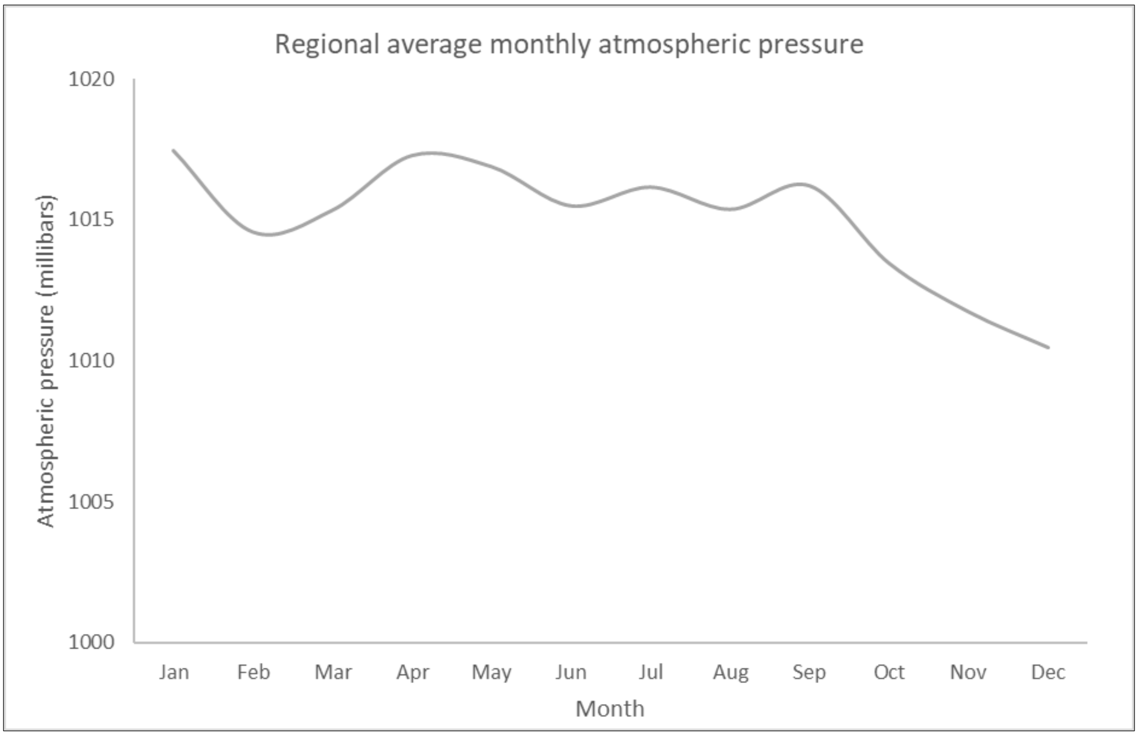
Table and Figure D.3 monthly average atmospheric pressures recorded at each regional location.

	Sheffield	Norwich	Coleshill	Oxford	Northolt	Canterbury	So/ton	Average
Jan	1015.9	1016.5	1017.2	1017.9	1018.0	1018.1	1018.6	1017.5
Feb	1012.5	1014.0	1013.8	1014.8	1015.3	1015.7	1015.7	1014.6
Mar	1014.5	1015.2	1015.0	1015.4	1015.6	1015.9	1015.7	1015.3
April	1017.5	1017.4	1017.4	1017.3	1017.2	1017.2	1017.1	1017.3
May	1016.6	1016.8	1016.8	1016.9	1017.0	1017.1	1017.1	1016.9
June	1015.1	1015.4	1015.3	1015.5	1015.6	1015.8	1015.7	1015.5
July	1015.5	1015.9	1016.0	1016.2	1016.3	1016.5	1016.6	1016.2
Aug	1014.6	1015.0	1015.1	1015.5	1015.7	1015.8	1016.0	1015.4
Sept	1015.3	1015.8	1016.0	1016.4	1016.5	1016.6	1016.8	1016.2
Oct	1011.8	1013.0	1012.9	1013.7	1014.1	1014.4	1014.3	1013.5
Nov	1010.4	1011.3	1011.3	1011.9	1012.2	1012.6	1012.4	1011.7
Dec	1008.8	1009.8	1009.9	1010.7	1011.1	1011.5	1011.4	1010.5



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Annex E

The following tables and figures present a summary of atmospheric pressure in the south-west region.

The maximum atmospheric pressure recorded in the south-west region was in Truro on 20th January 2020 at 1049.8 millibars. The highest regional average pressure is also evident in January, with all locations recording their maximum readings within this month. June, July, and August record the lowest maximum pressure readings across each location. The minimum pressure reading was also recorded in Truro at 966.3 millibars on 12th December 2019. All minimum atmospheric pressures at each location are recorded in December. January and November are also months when low atmospheric pressures are recorded.

The lowest average monthly atmospheric pressure occurs at Chester in December, with all other locations recording their lowest averages during this month. In general, all locations exhibit seasonal trending with other winter months recording low average atmospheric pressures - although January is higher than other winter months and autumn. All the highest average pressures have been recorded in either January or April, with a general trend of higher average pressures throughout spring and summer.

Table and Figure E.1 monthly maximum atmospheric pressures recorded at each regional location.

	Rostherne	Chester	Newtown	Carmarthen	St Athan	Exeter	Truro	Average
Jan	1048.4	1048.3	1048.9	1049.7	1049.6	1049.7	1049.8	1049.2
Feb	1042.7	1042.6	1042.9	1042.8	1042.8	1042.4	1042.1	1042.6
Mar	1044.3	1044.9	1044.0	1042.8	1042.7	1042.0	1040.7	1043.1
April	1037.0	1036.6	1036.9	1037.1	1037.1	1037.4	1037.7	1037.1
May	1040.0	1039.8	1040.0	1039.4	1039.7	1039.2	1037.7	1039.4
June	1032.1	1032.6	1032.6	1033.1	1032.5	1032.5	1033.0	1032.6
July	1033.8	1034.0	1034.0	1034.6	1034.3	1034.4	1034.6	1034.2
Aug	1034.2	1034.4	1033.9	1032.5	1032.1	1031.0	1030.3	1032.6
Sept	1039.0	1039.0	1039.4	1040.0	1039.7	1039.7	1039.9	1039.5
Oct	1039.1	1039.5	1039.6	1040.3	1039.7	1039.6	1040.3	1039.7
Nov	1039.3	1039.4	1039.9	1040.6	1040.3	1040.2	1040.2	1040.0
Dec	1042.2	1042.2	1042.3	1041.0	1041.0	1040.1	1039.2	1041.1

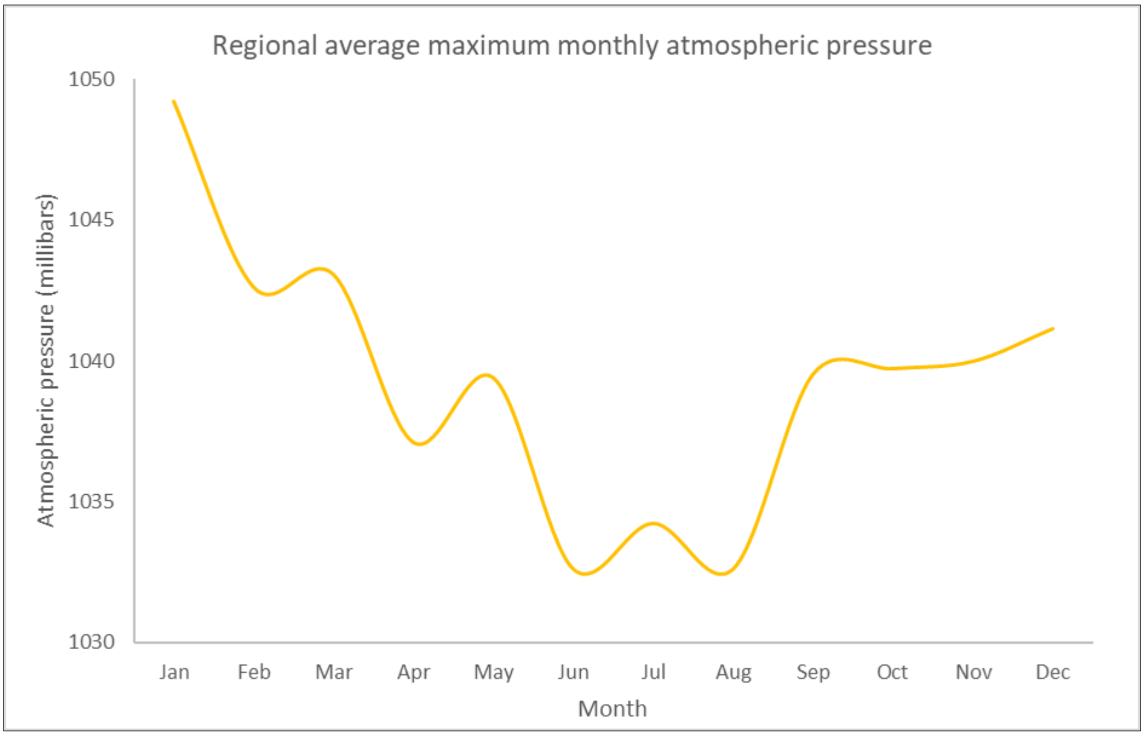

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Table and Figure E.2 monthly minimum atmospheric pressures recorded at each regional location.

	Rostherne	Chester	Newtown	Carmarthen	St Athan	Exeter	Truro	Average
Jan	973.4	974.3	973.5	975	974.7	976.1	977.4	974.9
Feb	975.2	973.9	977	981.1	982.4	983.1	981.8	979.2
Mar	977.8	977.1	979.6	981.5	982.3	982.8	980.7	980.3
April	977.8	977.9	980.1	986.1	986.1	986.8	984.1	982.7
May	985.8	985.1	986.9	988.5	989.5	990.1	989.4	987.9
June	986.5	986.5	986.8	988.6	988.4	990.3	991.7	988.4
July	992.4	992.6	992.8	993.1	992.4	991.6	991.4	992.3
Aug	986.1	984.8	987.3	991.1	992.8	994.3	992.1	989.8
Sept	983.4	983.2	984.7	989.2	989.6	990.5	990.4	987.3
Oct	977.2	977.3	977.3	981.4	981.1	980.3	982.5	979.6
Nov	972.7	972.9	972.6	971.2	971.5	975.7	977.7	973.5
Dec	968.1	967.2	967.3	967.8	967.8	967.8	966.3	967.5

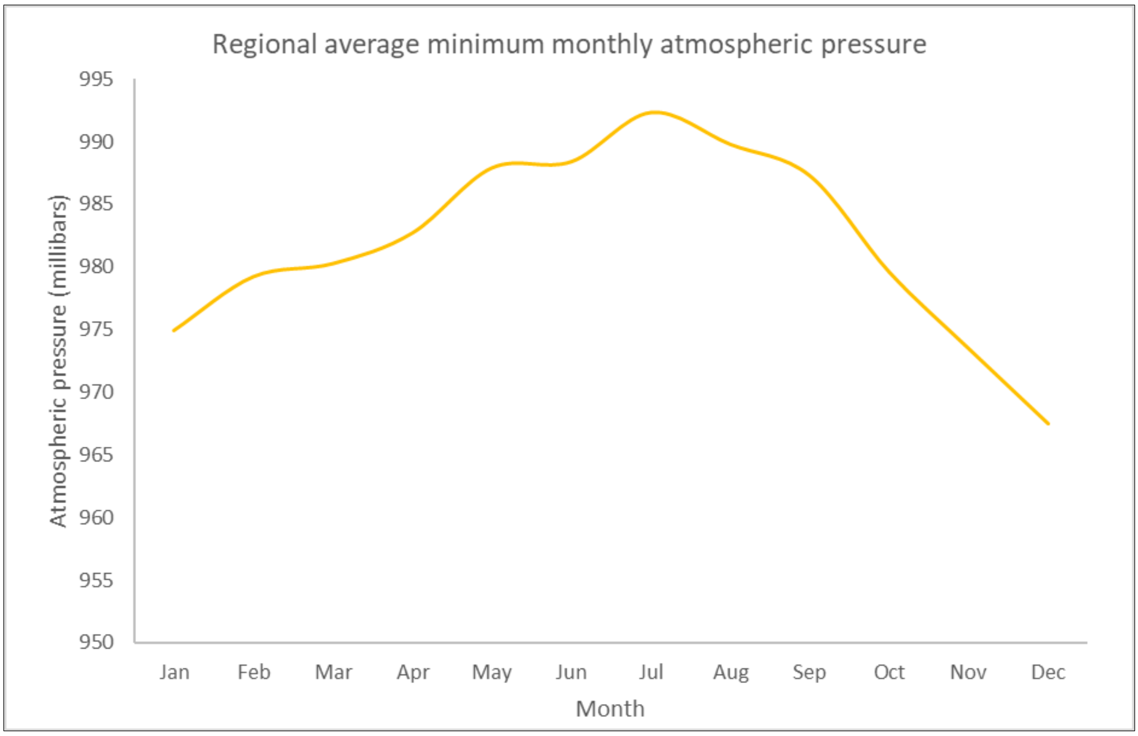
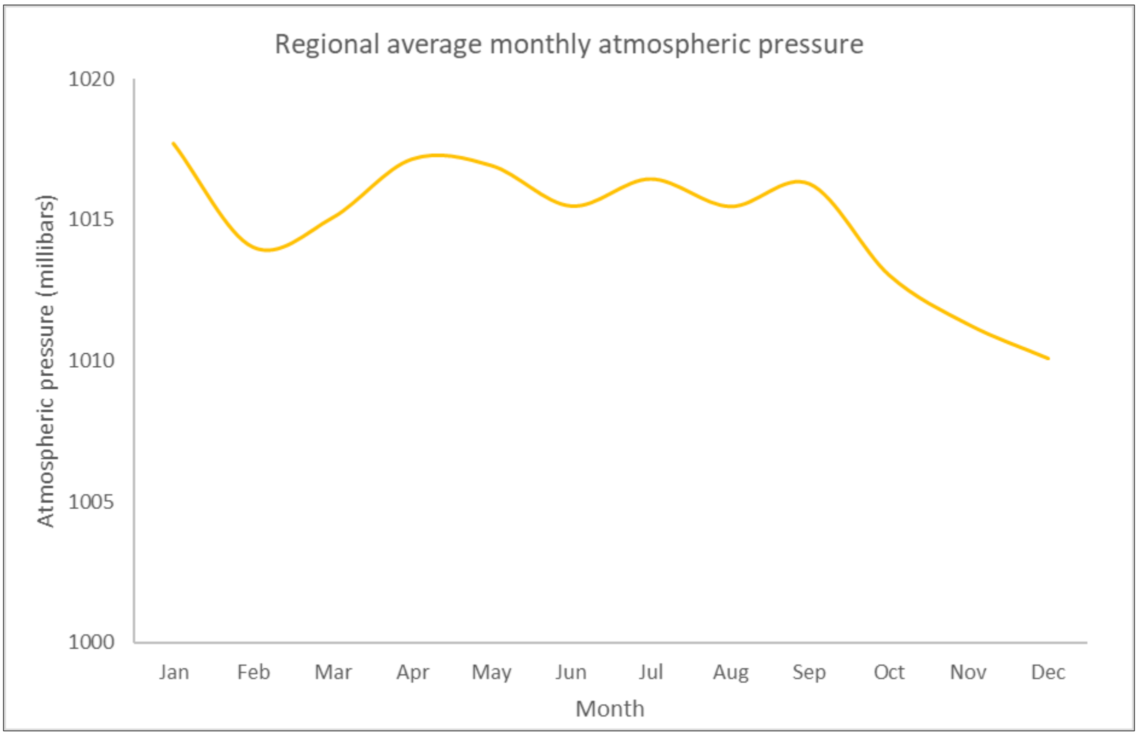


Table and Figure E.3 monthly average atmospheric pressures recorded at each regional location.

	Rostherne	Chester	Newtown	Carmarthen	St Athan	Exeter	Truro	Average
Jan	1016.5	1016.4	1016.9	1018.0	1018.2	1018.8	1019.2	1017.7
Feb	1012.7	1012.5	1013.1	1014.2	1014.7	1015.5	1015.6	1014.0
Mar	1014.6	1014.4	1014.8	1015.1	1015.3	1015.7	1015.7	1015.1
April	1017.4	1017.3	1017.4	1017.0	1017.1	1017.0	1016.8	1017.2
May	1016.6	1016.6	1016.7	1017.0	1017.0	1017.2	1017.4	1016.9
June	1015.1	1015.1	1015.3	1015.6	1015.6	1015.8	1016.0	1015.5
July	1015.8	1015.8	1016.0	1016.6	1016.6	1017.0	1017.4	1016.5
Aug	1014.7	1014.6	1015.0	1015.6	1015.8	1016.2	1016.5	1015.5
Sept	1015.5	1015.5	1015.8	1016.4	1016.5	1017.0	1017.2	1016.3
Oct	1012.1	1011.9	1012.4	1013.2	1013.5	1014.1	1014.2	1013.1
Nov	1010.6	1010.4	1010.8	1011.3	1011.7	1012.2	1012.2	1011.3
Dec	1009.0	1008.8	1009.3	1010.2	1010.6	1011.3	1011.5	1010.1



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Annex F

The highest average maximum atmospheric pressures tend to occur in the southern regions in January. The highest maximum pressures in the northern regions occur in March, but high pressures are evident in January, too. Although regional monthly variance is evident the highest average maximum pressures occur during winter and spring, with the lowest maximum pressures recorded during June, July, and August.

The lowest average minimum monthly pressures tend to occur in December, January, February, and March in the northern regions. In the southern regions, the lowest average minimum pressures tend to occur in November, December, and January. There are similar annual trends across each northern regions and are generally lower than in each southern region, especially during winter, spring, and early autumn. In contrast, all regions exhibit a similar trend in average minimum monthly pressures during the summer months of June, July, and August.

Both northern regions show a similar annual average monthly atmospheric pressure trend, which are lower each month than the southern regions, except for April. The southern regions also trend the same throughout the year and average higher in January and April. The lowest monthly averages are shown to occur during October, November, and December in all regions. The average monthly pressure is also low in February in both the northern regions, with an approximate 5 millibar difference between the southern regions.

Table and Figure F.1 Average regional maximum atmospheric pressure over the six-year period.

	North-west	North-east	South-east	South-west
January	1046.4	1045.8	1048.8	1049.2
February	1041.1	1040.8	1042.3	1042.6
March	1048.1	1047.4	1043.7	1043.1
April	1037.2	1036.9	1037.6	1037.1
May	1039.0	1039.0	1040.7	1039.4
June	1033.2	1033.2	1031.6	1032.6
July	1032.5	1030.8	1032.9	1034.2
August	1036.2	1035.3	1031.9	1032.6
September	1037.9	1036.9	1039.1	1039.5
October	1036.9	1035.2	1037.9	1039.7
November	1036.7	1036.4	1039.7	1040.0
December	1042.2	1042.2	1041.6	1041.1

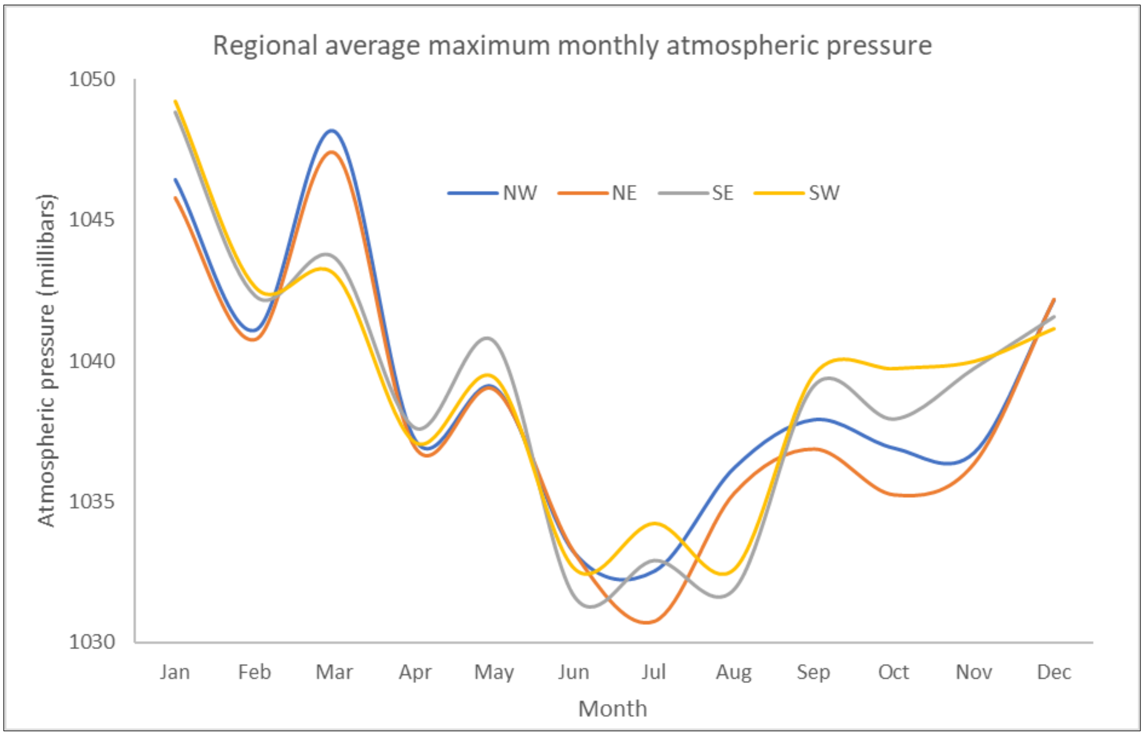

Table and Figure F.2 Average regional minimum atmospheric pressure over the six-year period.

	North-west	North-east	South-east	South-west
January	970.1	966.6	973.4	974.9
February	961.9	961.8	979.6	979.2
March	966.8	965.8	982.5	980.3
April	973.5	972.8	981.9	982.7
May	986.3	987.5	989.7	987.9
June	985.2	984.5	987.0	988.4
July	991.5	990.8	993.5	992.3
August	983.7	985.1	993.0	989.8
September	978.5	978.2	988.3	987.3
October	974.6	975.4	979.5	979.6
November	972.3	972.0	973.2	973.5
December	963.5	964.1	969.8	967.5

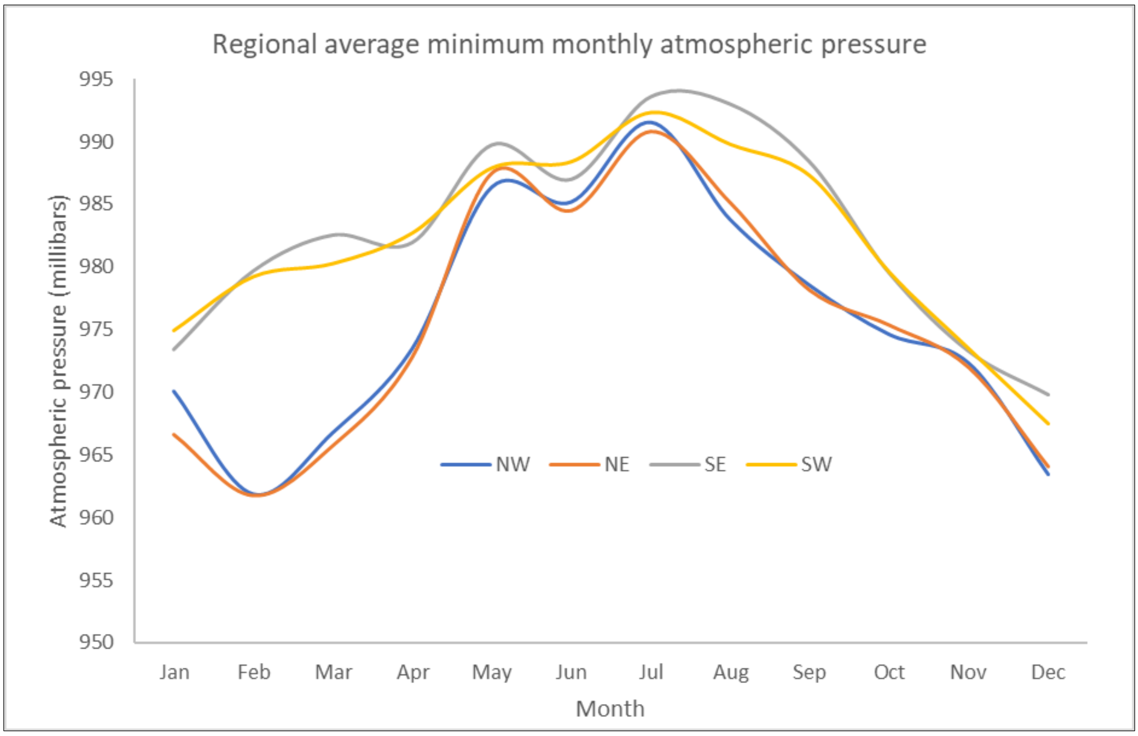

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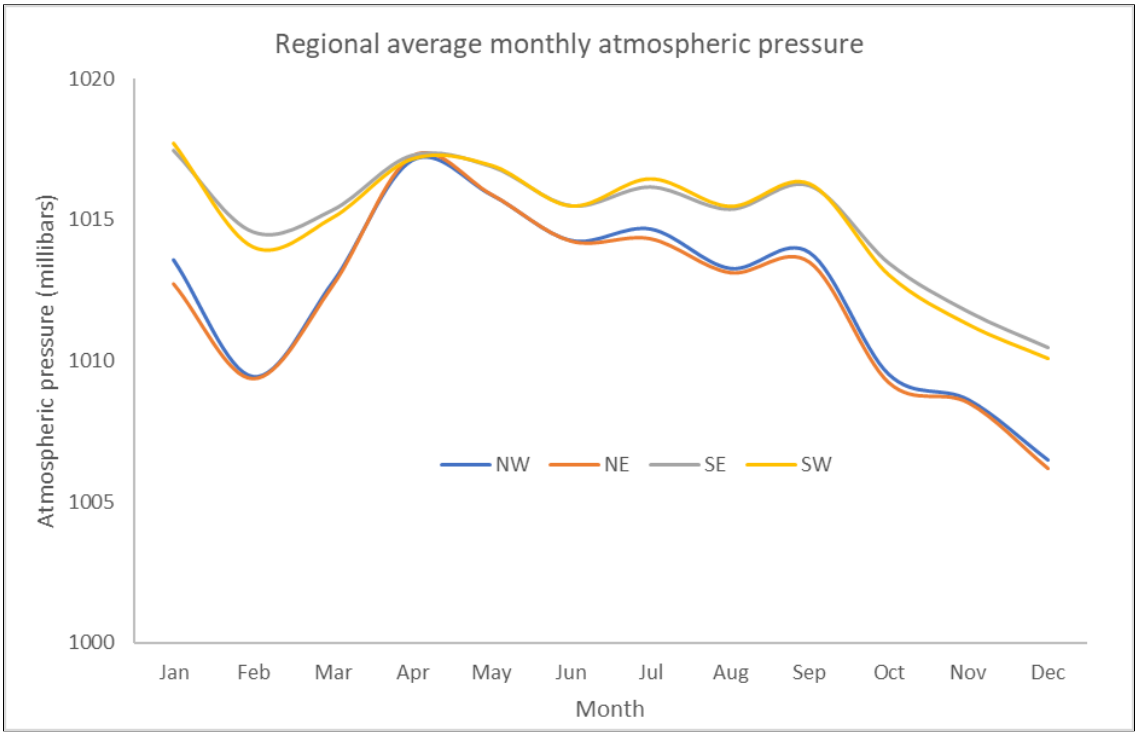
Table and Figure F.3 Regional average atmospheric pressure over the six-year period.

	North-west	North-east	South-east	South-west
January	1013.6	1012.7	1017.5	1017.7
February	1009.4	1009.4	1014.6	1014.0
March	1012.8	1012.7	1015.3	1015.1
April	1017.1	1017.3	1017.3	1017.2
May	1015.9	1015.9	1016.9	1016.9
June	1014.3	1014.3	1015.5	1015.5
July	1014.7	1014.3	1016.2	1016.5
August	1013.3	1013.1	1015.4	1015.5
September	1013.9	1013.5	1016.2	1016.3
October	1009.5	1009.2	1013.5	1013.1
November	1008.6	1008.5	1011.7	1011.3
December	1006.5	1006.2	1010.5	1010.1



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Annex G – The relationship between atmospheric pressure and latitude.

Atmospheric pressure trends in the UK are influenced by several factors. Whilst there are likely to be local variance, atmospheric pressure in the north will tend to experience lower average pressures as locations are closer to the polar front and Icelandic lows, especially in winter. Southern areas, being in closer influence of subtropical higher pressures, tend to have slightly higher averages. However, seasonal average atmospheric pressures will tend to be variable and influenced by the natural cycles of the NAO and position of the jet stream. The formation of low and high pressures is also directly related to air temperature and humidity, with warm humid air being less dense it will lead to lower pressure, while cold, dry air will increase air pressure due to its higher density. This is why the maximum atmospheric pressures will be lower in the summer and higher in the winter. Figure G.1 shows the linear relationship between annual average sea level pressure and latitude across the 28 sites used in this technical note.

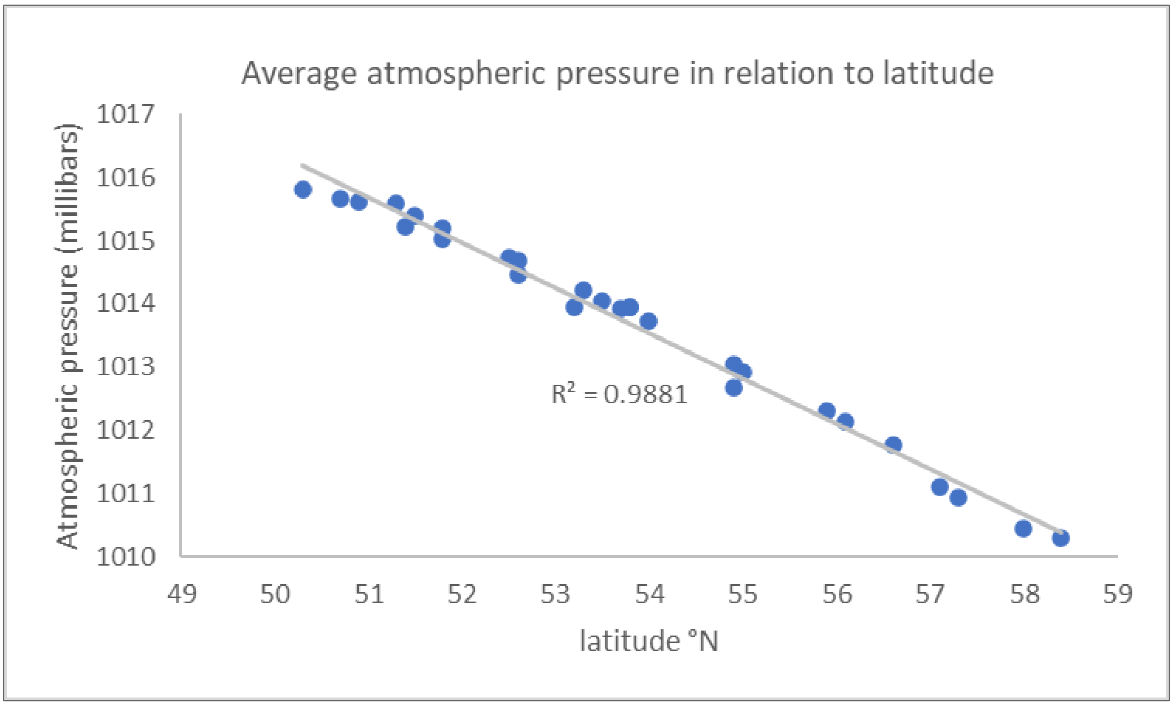

Figure G.1 The linear relationship between average annual atmospheric pressure and latitude.

The frequency of falling pressure events can also be attributed to latitude, with a higher annual average frequency of falls in the north, related to the position of the jet stream. The annual frequency of falls averaged over the six-year period have been averaged and plotted with latitude in Figure G.2. on the following page. The worst-case rate of falls (95th percentiles) are also plotted with latitude in Figure G.3. Whilst there is a similar trend, the linear relationship is not strong between latitude and the rate of fall, which is attributed to each sites longitudinal position and the dominant track of extreme low-pressure systems occurring across the UK (i.e., progressing in an easterly or north-easterly direction).

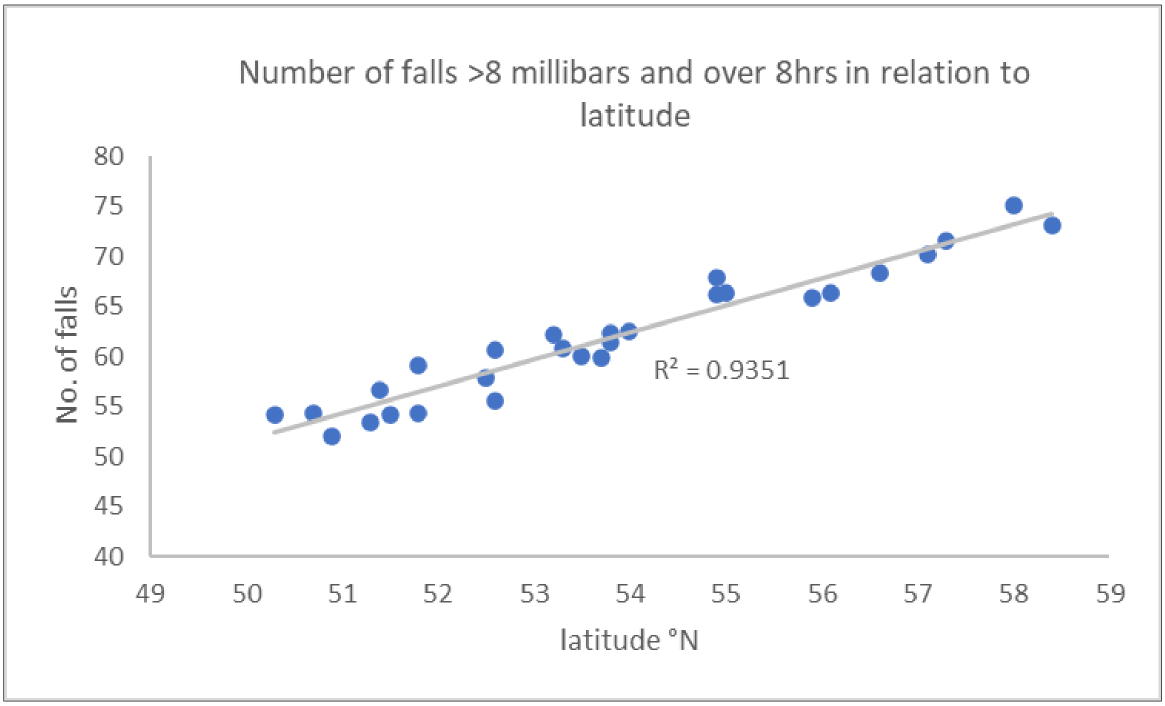

Figure G.2 Annual averaged frequency of falls in relation to latitude.

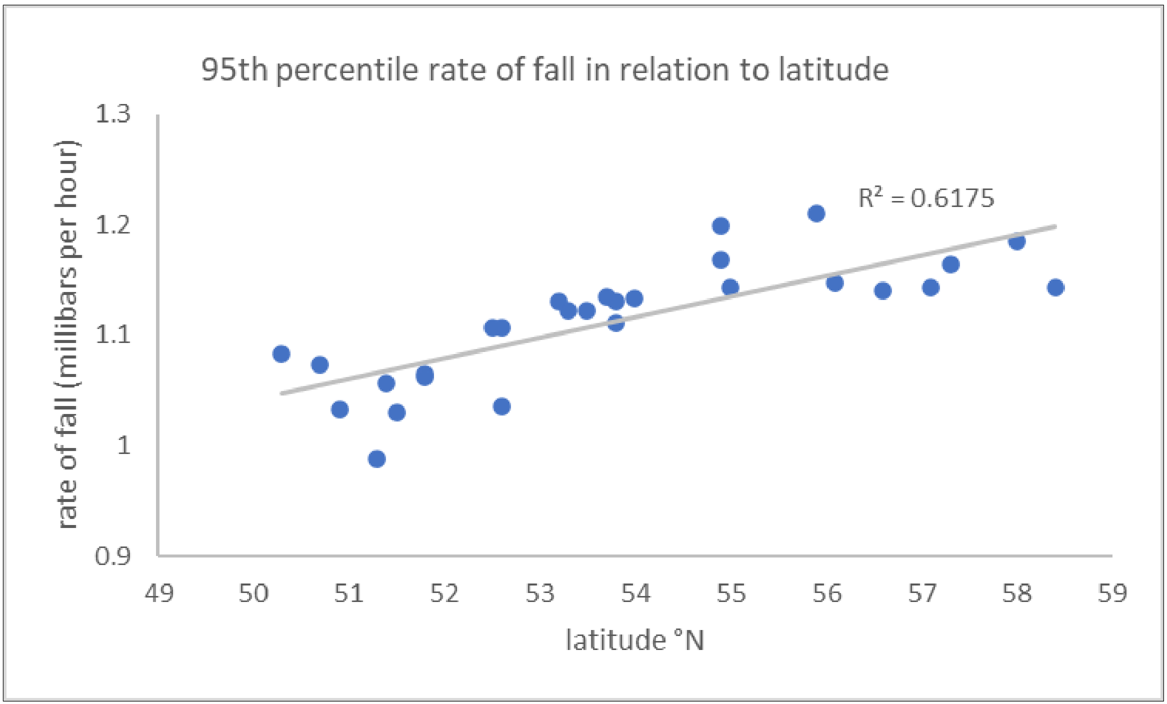

Figure G.3 Relationship between latitude and worst-case pressure falls (95th percentiles).

In summary, the frequency of falling pressure and the rate of fall will tend to increase from south to north, but trends are further influenced by regional meteorological variance and longitude.

Annex H – Long term atmospheric pressure variance.

The scientific consensus on climate change is clear, with a body of evidence affirming that the current warming is primarily the result of increased greenhouse gas emissions, leading to an anticipated rise in the frequency, intensity, and duration of extreme weather events. While extremes in temperature and precipitation are often reported, predicted trends in atmospheric pressure remain less understood. It is unclear whether the occurrence of more extreme falling pressure events are becoming more frequent, or if generalised patterns of seasonal high and low pressures are changing overtime.

As a general measure of storminess or a proxy to an increase or decrease in frequency of extreme events, analysis has been completed at seven sites from 1st January 1970 to 31st December 2023. The seven sites are: Southampton, St Athan, Northolt, Coleshill, Rostherne, Newcastle, and Glasgow, with analyses including the monthly hourly frequency of rapid falling pressure (e.g., >3.6 millibars change over a 3-hour period), monthly hourly frequency of very low atmospheric pressure (<997 millibars), and monthly hourly frequency of very high atmospheric pressure (>1029 millibars). The time frequency to the occurrence of very low or very high atmospheric pressure provides an indication to seasonal trends changing overtime and extreme conditions becoming more common, or less common. The monthly average atmospheric pressure is also calculated for each location as part of this analysis.

In tables H1 – H4, monthly analysis has been completed at all seven locations from 1970 to 2023. To determine longer term trends a rolling average has been calculated for the full data set, with a Pearson Correlation Coefficient calculated of the rolling average between 1980 to 2023. A positive correlation denotes an increasing trend, whilst a negative correlation denotes a decreasing trend over that period. Only a linear relationship above 0.5 is considered. A Pearson Correlation Coefficient between 0.5 and 0.75 indicates a moderate to good linear relationship, either negative or positive. Above 0.75 would indicate a very good to excellent linear relationship and are highlighted for reference in each table. A seasonal assessment has also been completed and months are grouped as follows:

Winter – December, January, and February.

Spring – March, April, and May.

Summer – June, July, and August.

Autumn – September, October, and November.

Tables H13. – H33 provide monthly hourly frequency of rapid falling atmospheric pressure, very low atmospheric pressure, and very high atmospheric pressure at each location between 1970 and 2023.

Table H.1 Pearson correlation coefficients of monthly hours of rapid falling atmospheric pressure between 1980 - 2023 (calculated as monthly hours of falling pressure at or above 3.6 millibars – 3-hr tendency). A negative correlation denotes that the number of hours of rapid falling pressure is decreasing overtime. Whereas a positive correlation denotes the hours of rapid falling pressure is increasing.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan		-0.72		-0.51			
Feb					0.60	0.72	0.74
March	-0.84	-0.85		-0.58			
April							
May							
June			-0.84	-0.88	-0.82	-0.87	-0.58
July	0.94	0.67	0.72	0.71			0.83
August		-0.72		-0.77	-0.76	-0.56	-0.60
Sept	-0.94	-0.96	-0.95	-0.95	-0.93	-0.95	-0.93
Oct	0.53	0.70	0.58	0.55	0.54		
Nov	-0.82	-0.83	-0.88	-0.92	-0.84	-0.78	-0.70
Dec	0.79	0.89	0.82	0.83	0.91	0.91	0.91
Winter			0.57		0.69	0.83	0.81
Spring	-0.79	-0.77		-0.49			
Summer		-0.56	-0.58	-0.87	-0.90	-0.56	
Autumn	-0.94	-0.89	-0.93	-0.94	-0.91	-0.94	-0.91
Annual	-0.81	-0.66	-0.59	-0.71			

Table H.2 Pearson correlation coefficients of monthly hours of very low atmospheric pressure from 1970 -2023 (calculated as monthly/annual hours <997 millibars). A negative correlation denotes that the total monthly hours below 997 millibars is decreasing overtime. Whereas a positive correlation denotes hours below 997 is increasing.

	Southampton	**St Athan**	**Northolt**	**Coleshill**	**Rostherne**	**Newcastle**	**Glasgow**
Jan	-0.66	-0.69	-0.68	-0.53	-0.65		
Feb							
March	-0.84	-0.85	-0.86	-0.85	-0.85	-0.82	-0.87
April	0.73	0.70	0.70	0.57	0.55	0.55	0.61
May	0.65		0.62	0.51	0.61	0.69	0.74
June	0.75	0.69	0.62				
July	0.62	0.56	0.68	0.72	0.79	0.76	0.78
August	0.87	0.84	0.86	0.71	0.55	0.53	
Sept	-0.52	-0.58	-0.69	-0.73	-0.65	-0.80	-0.74
Oct	0.54	0.69	0.57	0.68	0.73	0.73	0.79
Nov	0.94	0.96	0.92	0.92	0.89		
Dec	-0.81	-0.75	-0.74	-0.60		0.65	0.71
Winter	-0.78	-0.77	-0.78	-0.68	-0.60	-0.62	0.66
Spring		-0.60		-0.60	-0.62		-0.56
Summer	0.87	0.82	0.89	0.83	0.78	0.65	0.62
Autumn	0.84	0.87	0.82	0.85	0.86	0.65	0.68
Annual	-0.55		0.54			0.71	0.77

Table H.3 Pearson correlation coefficients of monthly hours of very high atmospheric pressure from 1970 -2023 (calculated as monthly/annual hours >1029 millibars). A negative correlation denotes that the number of hours above 1029 millibars is decreasing overtime. Whereas a positive correlation denotes hours above 1029 is increasing.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	0.72	0.75	0.70	0.76	0.80	0.78	0.84
Feb	0.72	0.82	0.60	0.60	0.53		0.68
March	0.97	0.98	0.98	0.98	0.96	0.94	0.94
April			0.73			-0.78	-0.85
May			0.52				
June							
July	0.67					-0.71	-0.59
August	-0.78	-0.78	-0.84	-0.86	-0.90	-0.93	-0.92
Sept			0.53	0.51	0.65	0.86	0.82
Oct	-0.74	-0.54	-0.65				
Nov							
Dec			0.54	0.59	0.55	0.77	0.79
Winter	0.70	0.75	0.68	0.72	0.73	0.79	0.86
Spring	0.95	0.95	0.96	0.96	0.95	0.75	0.77
Summer				-0.52	-0.65	-0.78	-0.61
Autumn						0.54	
Annual	0.81	0.83	0.81	0.80	0.80	0.79	0.83

Table H.4 Pearson correlation coefficients of monthly average atmospheric pressure from 1970 -2023 (calculated as monthly/annual averages). A negative correlation denotes that average pressure is decreasing overtime. Whereas a positive correlation denotes average pressure is increasing.

	Southampton	**St Athan**	**Northolt**	**Coleshill**	**Rostherne**	**Newcastle**	**Glasgow**
Jan	0.81	0.81	0.80	0.80	0.80	0.76	0.76
Feb	0.76	0.76	0.71	0.62	0.53		
March	0.92	0.93	0.93	0.94	0.94	0.92	0.90
April	-0.73	-0.78	-0.70	-0.74	-0.77	-0.75	-0.80
May	0.79	0.76	0.77	0.72	0.68	0.56	0.58
June							
July	-0.86	-0.89	-0.84	-0.86	-0.87	-0.82	-0.86
August	-0.91	-0.92	-0.92	-0.92	-0.91	-0.90	-0.89
Sept						0.57	0.67
Oct	-0.81	-0.83	-0.81	-0.82	-0.83	-0.79	-0.79
Nov	-0.91	-0.91	-0.88	-0.85	-0.82		-0.53
Dec							
Winter	0.81	0.82	0.79	0.77	0.74	0.57	0.55
Spring	0.90	0.86	0.90	0.87	0.83	0.69	0.51
Summer	-0.89	-0.92	-0.89	-0.92	-0.93	-0.92	-0.93
Autumn	-0.87	-0.87	-0.86	-0.84	-0.83	-0.64	-0.65
Annual	0.60	0.50	0.58				-0.63

Below are general comments on Tables H1-H4.

Table H1. Monthly hours of raid falling pressure (>3.6 millibars – 3-hour tendency).

There is a strong indication that trends in rapid falling pressure are decreasing in Autumn in all locations, and especially in September, whilst rapid falling pressure is shown to be increasing in all locations during December, and possibly in the north during all winter months. There is no significant change during January at any location. Overall, there is evidence to regional variance during the summer months, with an increasing trend of rapid falling pressure for July at Southampton.

Table H2. Monthly hours of very low pressure (<997 millibars).

There are regional and seasonal differences and evidence that the occurrence of very low pressure is increasing during Summer and Autumn, and especially in locations at lower latitudes. The trend is especially strong in August and November. Overall, very low pressure appears to be decreasing during winter months with trending most significant in locations at lower latitudes. Conversely, at higher latitudes (e.g., Glasgow) very low pressure shows an increasing trend both during Winter and annually. However, the trend is not overly clear.

Table H3. Monthly hours of very high pressure (>1029 millibars).

The frequency of very high pressure has a strong increasing trend at all locations during March. Conversely, there is a strong decreasing trend at all locations during August. Winter and Spring show a marked increasing trend; however, this increasing trend is less significant in southeast England during Winter months. There is evidence to suggest the occurrence of very high pressure during the summer months is decreasing at northern latitudes, but this trend is not overly clear. When analysed across the year the hourly frequency of very high pressure is shown to be increasing overtime.

Table H4. Monthly average atmospheric pressure.

The overall trend in average atmospheric pressure is complex with both regional differences and monthly changes evident. Average pressure is shown to be increasing in all locations during January and March, but decreasing in April, July, August, and October. Seasonal trends are more significant at locations in the south of England, with only average pressure shown to have a decreasing trend at locations in the north. However, there is no clear change in average atmospheric pressure when assessed annually.

Table H.5 monthly maximum atmospheric pressures recorded at each location between 1970-2023.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	1049.8	1049.7	1049.7	1049.1	1048.8	1047.4	1047.8
Feb	1046.4	1047.6	1046.1	1047.7	1047.6	1046.2	1045.3
Mar	1045.8	1045.2	1044.7	1043.9	1044.3	1046.1	1049.6
April	1038.8	1039.4	1038.8	1039.5	1039.3	1038.8	1040.0
May	1039.7	1040.3	1040.4	1040.6	1039.9	1040.0	1039.8
June	1037.6	1037.4	1038.0	1037.5	1037.1	1037.5	1037.5
July	1033.2	1034.3	1033.9	1035.3	1035.7	1037.4	1036.9
Aug	1031.2	1031.8	1031.4	1032.8	1033.8	1034.6	1036.0
Sept	1039.1	1039.7	1039.5	1040.4	1040.4	1040.0	1041.0
Oct	1039.2	1039.7	1040.1	1040.5	1040.4	1040.3	1040.0
Nov	1043.8	1045.5	1044.1	1046.1	1046.3	1045.4	1046.1
Dec	1045.2	1045.1	1045.0	1045.2	1044.9	1044.3	1045.3

Table H.6 monthly minimum atmospheric pressures recorded at each location between 1970-2023.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	967.3	964.4	967.7	959.3	956.8	952.3	953.0
Feb	951.1	952.5	952.7	955.3	956.7	953.5	953.6
Mar	962.5	957.8	962.2	958.1	958.8	959.0	957.2
April	974.2	969.5	972.1	965.3	964.1	966.4	965.5
May	977.6	976.1	977.2	974.4	972.8	972.8	972.1
June	989.2	985.5	987.3	985.2	982.1	985.6	984.2
July	985.5	984.8	986.5	987.4	987.0	983.9	984.9
Aug	984.1	979.6	984.1	979.6	977.0	975.8	974.5
Sept	979.0	979.3	981.5	977.6	972.9	967.8	971.3
Oct	958.8	959.4	961.1	957.8	959.1	961.3	963.3
Nov	953.1	958.2	954.1	959.8	962.6	965.1	959.6
Dec	963.1	957.0	964.2	957.1	952.9	951.1	950.6

Table H.7 monthly average atmospheric pressures recorded at each location between 1970-2023.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	1015.5	1014.7	1015.1	1014.0	1013.0	1010.9	1009.8
Feb	1015.9	1015.4	1015.7	1014.9	1014.2	1012.5	1011.7
Mar	1015.4	1015.0	1015.1	1014.5	1013.9	1012.5	1011.9
April	1015.0	1015.0	1014.9	1014.8	1014.7	1014.3	1014.1
May	1015.6	1015.5	1015.6	1015.4	1015.3	1015.1	1014.7
June	1016.5	1016.4	1016.3	1016.0	1015.8	1015.1	1014.8
July	1016.2	1016.2	1015.9	1015.4	1015.2	1014.1	1013.9
Aug	1015.9	1015.7	1015.6	1015.1	1014.8	1013.7	1013.4
Sept	1016.4	1016.1	1016.1	1015.6	1015.1	1013.9	1013.3
Oct	1014.2	1013.6	1014.1	1013.3	1012.6	1011.3	1010.5
Nov	1013.8	1013.2	1013.5	1012.6	1011.8	1010.0	1009.4
Dec	1015.2	1014.4	1014.8	1013.7	1012.9	1010.8	1010.0

Table H.8 averaged monthly maximum atmospheric pressures recorded at each location between 1970-2023.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	1036.5	1036.4	1036.3	1036.3	1036.1	1034.9	1035.1
Feb	1035.8	1035.9	1035.9	1036.1	1035.9	1035.4	1035.1
Mar	1034.8	1035.0	1034.8	1035.0	1035.0	1034.7	1034.7
April	1031.0	1031.3	1031.1	1031.6	1031.7	1031.9	1032.1
May	1029.6	1030.0	1029.7	1030.3	1030.4	1030.6	1030.5
June	1028.6	1029.0	1028.6	1029.0	1029.3	1029.4	1029.3
July	1027.6	1028.1	1027.5	1027.9	1028.0	1027.5	1027.5
Aug	1026.9	1027.1	1026.7	1026.9	1026.9	1026.6	1026.7
Sept	1030.5	1030.9	1030.6	1031.0	1031.1	1030.8	1030.6
Oct	1031.2	1031.3	1031.1	1031.4	1031.5	1031.2	1031.1
Nov	1032.8	1032.8	1032.9	1032.9	1032.7	1032.1	1031.9
Dec	1036.5	1036.5	1036.5	1036.5	1036.3	1035.5	1035.5

Table H.9 average monthly minimum atmospheric pressures recorded at each location between 1970-2023.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	985.2	983.8	984.6	982.5	980.7	977.1	975.6
Feb	987.9	986.7	987.8	986.0	984.7	981.4	980.3
Mar	988.0	986.3	987.6	985.5	984.5	982.8	981.6
April	993.5	992.0	993.2	991.6	990.7	990.0	989.2
May	997.4	996.3	997.2	996.0	995.4	994.6	993.6
June	1000.6	999.7	1000.3	998.8	997.9	996.2	995.5
July	1000.6	999.7	1000.2	998.9	998.1	996.3	996.1
Aug	999.7	998.5	999.4	997.7	996.4	994.7	994.4
Sept	996.5	994.8	996.3	994.3	993.0	990.7	989.7
Oct	988.1	986.4	988.1	986.3	984.9	983.2	981.9
Nov	984.9	984.5	984.5	983.6	983.0	980.9	979.6
Dec	985.0	983.3	984.6	982.2	980.6	977.1	975.3

The following tables refer to the "climate normal period" which is a standardized 30-year period used to calculate average meteorological conditions, providing a baseline for comparing current weather data. These averages serve as reference points for identifying anomalies of atmospheric pressure that deviate from typical conditions. The World Meteorological Organization (WMO) defines these periods to help ensure consistency in climate comparisons.

The current official climate normal period is 1991–2020, but earlier ones, such as 1961–1990 and 1981–2010, are also widely used. Every 10 years, the climate normal period is updated to reflect more recent conditions, providing researchers and meteorologists with a baseline to track long-term climate changes and trends.

Table H.10 average monthly maximum atmospheric pressures recorded at each location between 1991-2020 (climate normal period).

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	1037.5	1037.6	1037.4	1037.6	1037.5	1036.5	1036.7
Feb	1035.8	1036.0	1035.8	1036.2	1036.1	1035.6	1035.4
Mar	1035.6	1035.7	1035.7	1035.9	1036.0	1035.9	1036.1
April	1031.0	1031.3	1031.1	1031.6	1031.7	1031.6	1031.8
May	1030.2	1030.7	1030.3	1030.8	1030.9	1031.0	1031.0
June	1029.0	1029.4	1029.0	1029.6	1029.9	1029.9	1030.0
July	1027.5	1027.9	1027.4	1027.7	1027.8	1027.4	1027.3
Aug	1026.5	1026.8	1026.3	1026.5	1026.5	1025.9	1026.1
Sept	1030.3	1030.6	1030.4	1030.8	1030.8	1030.7	1030.5
Oct	1031.3	1031.6	1031.2	1031.7	1031.8	1031.7	1031.7
Nov	1031.8	1031.6	1031.8	1031.8	1031.5	1030.8	1030.8
Dec	1036.3	1036.2	1036.3	1036.5	1036.3	1035.9	1035.9

When compared to the overall average (1970-23), the averages for maximum atmospheric pressure for the climate normal period (1991-20) are shown to be increasing at all locations in January, March, May, and June. However, there is a decreasing trend evident in all locations in the months of July, August, and September.

Table H.11 averaged monthly minimum atmospheric pressures recorded at each location between 1991-2020 (climate normal period).

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	986.1	984.9	985.6	983.5	981.4	977.7	975.5
Feb	989.7	988.4	989.3	987.5	985.9	982.1	980.9
Mar	989.8	988.2	989.5	987.4	986.4	984.6	983.1
April	992.7	991.0	992.6	990.9	990.0	989.0	988.2
May	996.5	995.4	996.4	995.2	994.9	994.7	993.6
June	1000.1	999.2	999.8	998.2	997.1	995.8	995.2
July	1000.6	999.7	1000.2	998.9	998.0	996.0	995.8
Aug	999.7	998.6	999.4	998.0	996.6	994.9	994.5
Sept	996.0	994.6	995.8	994.3	993.3	991.7	990.9
Oct	987.8	985.8	987.9	985.9	984.6	983.7	982.8
Nov	985.0	984.2	984.8	984.2	983.7	981.9	980.3
Dec	985.5	984.1	985.2	982.7	981.0	977.0	975.3

When compared to the overall average (1970-23) the averages for minimum atmospheric pressure for the climate normal period (1991-20) are shown to be increasing each month in nearly all locations from November through to March. In contrast, the average minimum pressures are shown to decreasing from April to June.

Table H.12 averaged monthly atmospheric pressures recorded at each location between 1991-2020 (climate normal period).

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow	Average
Jan	1016.2	1015.4	1015.8	1014.6	1013.7	1011.4	1010.3	1013.9
Feb	1016.5	1015.9	1016.1	1015.2	1014.4	1012.3	1011.6	1014.6
Mar	1016.1	1015.8	1015.8	1015.3	1014.8	1013.4	1012.8	1014.9
April	1014.5	1014.3	1014.4	1014.2	1013.9	1013.5	1013.1	1014.0
May	1016.1	1016.0	1016.0	1015.9	1015.7	1015.5	1015.1	1015.7
June	1016.5	1016.3	1016.2	1015.8	1015.6	1014.9	1014.6	1015.7
July	1015.7	1015.6	1015.3	1014.9	1014.6	1013.6	1013.3	1014.7
Aug	1015.5	1015.3	1015.1	1014.6	1014.3	1013.2	1012.8	1014.4
Sept	1016.1	1015.9	1015.9	1015.5	1015.1	1014.0	1013.6	1015.2
Oct	1013.9	1013.3	1013.8	1013.1	1012.4	1011.2	1010.5	1012.6
Nov	1013.1	1012.4	1012.9	1011.9	1011.2	1009.6	1008.8	1011.4
Dec	1015.3	1014.6	1015.0	1014.0	1013.1	1011.0	1010.1	1013.3

Monthly average atmospheric pressures from 1970 to 2023 are shown to be decreasing in April, July and August when compared to average pressure from the climate normal period (1991-20). In contrast, an increasing trend is evident in January and March across all locations.

Table H.13 Number of monthly hours of rapid falling atmospheric pressure in Southampton between 1970 – 2023 (3-hour tendency >3.6 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	14	36	15	9	0	2	2	7	7	2	32	8
1971	22	9	10	0	0	8	0	1	0	1	42	5
1972	18	18	13	36	8	0	0	0	4	0	46	6
1973	10	16	0	9	0	0	0	0	19	0	13	14
1974	31	33	13	0	0	0	1	1	36	23	14	22
1975	34	0	7	3	0	0	0	0	23	1	24	12
1976	15	8	12	0	0	0	0	0	7	20	18	25
1977	27	25	13	0	1	0	0	2	0	8	27	12
1978	65	9	28	3	0	0	0	0	0	0	4	21
1979	15	34	31	3	11	0	0	9	0	0	15	37
1980	23	21	13	1	0	6	0	3	0	26	3	38
1981	28	11	9	0	11	0	0	0	13	12	7	27
1982	10	0	26	0	5	0	0	0	1	9	19	45
1983	29	16	32	19	0	0	0	0	7	7	13	26
1984	74	16	4	0	0	0	0	0	5	9	16	5
1985	10	0	7	19	0	4	0	16	3	0	9	3
1986	36	0	23	9	0	0	0	11	0	22	19	43
1987	7	6	16	4	4	6	0	0	0	31	11	7
1988	52	21	15	0	0	0	4	0	13	5	7	2
1989	9	41	28	6	0	0	0	0	1	14	13	25
1990	35	62	0	6	0	5	4	0	4	16	21	41
1991	27	13	1	13	0	2	0	0	5	0	17	3
1992	0	6	19	9	4	0	0	13	1	11	47	27
1993	38	1	3	7	0	0	0	0	7	7	7	56
1994	32	14	20	19	0	2	0	0	4	4	0	25
1995	43	24	44	0	0	0	0	0	3	3	2	7
1996	7	36	0	0	0	0	0	0	0	10	50	10
1997	2	29	3	0	0	4	0	2	0	11	8	14
1998	49	0	13	5	0	0	1	4	1	24	17	10
1999	32	10	14	13	0	0	0	0	0	9	22	63
2000	9	36	0	14	11	0	6	0	1	33	30	30
2001	25	12	8	11	0	0	3	0	0	5	3	8
2002	15	29	5	19	4	0	3	0	0	27	28	17
2003	27	9	1	3	5	0	0	0	0	18	11	20
2004	45	4	4	10	9	6	2	0	2	15	7	27
2005	18	3	4	0	0	0	0	0	0	6	16	22
2006	0	13	16	1	12	0	0	0	0	5	11	24
2007	30	24	25	0	5	0	5	0	2	0	12	23
2008	28	15	37	0	0	0	0	5	0	7	19	20
2009	37	10	21	0	0	0	0	0	6	0	23	3
2010	23	6	1	0	0	0	0	7	0	11	25	16
2011	6	3	0	0	0	4	3	0	0	0	3	35
2012	11	8	0	35	0	5	0	0	9	11	17	35
2013	28	23	0	1	10	0	0	0	8	11	15	39
2014	37	59	7	0	3	0	0	8	0	10	6	26
2015	47	14	5	0	14	0	7	0	4	0	12	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	30	18	33	0	0	2	0	0	0	0	23	2
2017	14	12	9	0	0	10	0	0	8	0	6	48
2018	37	12	9	0	0	0	0	2	6	0	9	23
2019	26	11	34	0	7	0	0	0	9	8	26	51
2020	20	59	6	0	0	0	0	10	0	13	9	45
2021	21	4	8	0	22	0	3	1	0	25	19	24
2022	12	27	0	2	0	0	0	0	7	7	24	13
2023	20	0	16	5	0	0	2	11	0	14	34	24
Ave 1970-2023	25.2	17.1	12.6	5.4	2.7	1.2	0.9	2.1	4.2	9.5	17.2	22.5
Ave 1991-2020	24.8	17.1	11.4	5.3	2.8	1.2	1.0	1.7	2.5	8.6	16.0	24.3

Table H.14 Number of monthly hours of very low atmospheric pressure in Southampton between 1970 – 2023 (<997 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	177	39	33	16	0	0	0	0	31	0	127	0
1971	226	70	100	37	13	0	0	0	0	0	23	0
1972	56	158	114	124	0	0	0	0	0	11	75	47
1973	30	79	0	13	0	0	13	0	9	62	4	127
1974	21	189	39	7	20	0	0	0	122	16	78	0
1975	94	0	81	8	0	0	0	0	55	0	50	23
1976	0	18	32	0	0	0	0	0	26	141	37	214
1977	205	161	0	8	17	20	0	0	0	88	84	86
1978	141	156	77	27	0	26	0	0	0	0	0	292
1979	127	175	193	53	13	0	0	0	0	71	54	108
1980	94	15	102	0	0	0	0	0	0	96	15	43
1981	14	20	74	0	18	0	0	0	64	68	0	315
1982	8	0	25	0	0	0	0	0	15	104	82	176
1983	11	23	47	39	88	0	0	0	80	30	32	185
1984	116	24	104	0	17	0	0	0	11	100	119	15
1985	75	0	92	91	3	0	9	17	0	0	70	61
1986	137	0	57	99	0	0	0	24	0	54	38	11
1987	0	30	39	63	0	6	13	0	0	124	52	0
1988	231	142	35	0	32	0	62	0	41	51	22	15
1989	0	122	62	64	0	0	0	0	0	33	34	191
1990	130	180	0	0	0	19	9	0	0	143	75	67
1991	57	3	86	39	0	0	0	0	37	0	114	0
1992	12	3	80	83	0	0	0	27	0	59	36	111
1993	36	0	0	7	11	0	0	0	114	158	3	114
1994	155	44	23	59	12	0	0	0	25	64	7	99
1995	175	79	87	4	5	0	0	0	45	5	32	90
1996	131	97	0	0	30	0	0	0	0	13	66	21
1997	0	55	0	0	57	73	0	16	0	36	211	59
1998	118	0	10	194	0	0	0	0	51	34	35	10
1999	39	0	80	58	0	0	0	32	103	129	10	157
2000	0	6	0	160	4	0	29	0	31	135	276	105
2001	208	145	124	0	0	0	27	0	2	33	0	0
2002	30	71	15	39	32	0	12	0	0	94	143	63
2003	116	23	0	16	2	0	0	0	0	65	71	42
2004	103	0	0	52	62	17	0	16	0	149	0	27
2005	4	0	0	15	0	0	0	0	0	20	36	127
2006	6	111	56	0	48	0	0	0	0	143	101	95
2007	12	159	39	0	33	8	7	26	0	0	24	57
2008	93	22	114	69	0	0	4	26	40	24	75	74
2009	166	131	64	12	0	0	0	0	6	53	179	182
2010	20	263	53	0	0	0	0	3	0	50	137	47
2011	47	45	2	0	0	3	28	0	0	38	45	75
2012	0	0	0	194	0	24	0	0	72	32	101	72
2013	67	27	107	40	21	0	0	0	8	51	36	117
2014	288	269	37	0	0	0	0	7	0	38	104	11
2015	92	52	0	0	25	0	0	4	69	15	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	201	152	71	0	0	26	0	0	0	0	93	0
2017	5	104	58	5	33	38	0	0	34	0	19	153
2018	78	3	321	55	0	0	0	0	0	8	57	7
2019	79	48	64	82	30	2	0	0	12	0	246	170
2020	33	78	60	20	0	0	0	0	22	151	13	173
2021	131	49	22	0	24	0	8	13	0	72	46	82
2022	7	27	0	28	0	0	0	0	0	12	138	20
2023	96	0	117	16	0	0	0	26	35	229	156	72
Ave 1970-2023	83.3	67.9	55.5	35.1	12.0	4.9	4.1	4.4	21.5	57.4	68.2	81.6
Ave 1991-2020	79.0	66.3	51.7	40.1	13.5	6.4	3.6	5.2	22.4	53.2	75.7	75.3

Table H.15 Number of monthly hours of very high atmospheric pressure in Southampton between 1970 – 2023 (>1029 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	0	28	31	0	45	12	0	0	0	42	0	228
1971	0	254	118	23	0	0	56	0	53	131	104	225
1972	0	0	1	0	0	0	8	1	16	83	76	117
1973	229	129	268	65	0	76	0	0	0	146	154	59
1974	81	86	2	0	0	0	0	16	0	0	17	74
1975	98	194	0	62	56	26	14	21	24	102	67	264
1976	126	124	120	6	0	0	0	0	13	0	165	20
1977	145	24	43	28	0	25	0	0	64	19	0	109
1978	101	0	9	0	40	9	0	19	59	86	86	0
1979	41	128	17	57	56	35	33	0	52	9	51	0
1980	113	95	1	122	0	0	0	0	16	13	83	167
1981	300	94	0	27	0	30	0	67	30	0	239	56
1982	54	12	132	110	17	0	0	0	15	27	42	140
1983	227	153	115	63	0	106	0	0	40	166	11	231
1984	0	226	129	38	0	0	1	0	0	22	0	173
1985	53	164	145	42	0	0	14	0	9	220	43	42
1986	13	67	0	11	8	34	10	0	150	30	167	67
1987	265	0	74	57	120	0	0	0	16	0	152	84
1988	0	150	28	2	12	0	0	0	135	62	180	349
1989	353	175	0	0	75	0	0	0	68	38	36	124
1990	55	47	277	20	80	0	15	0	28	1	52	221
1991	279	96	77	48	178	0	0	0	34	74	3	499
1992	518	249	97	15	103	11	17	0	0	0	38	205
1993	102	482	120	0	40	0	32	19	15	193	127	0
1994	44	0	20	33	7	89	0	0	0	86	125	94
1995	140	22	104	132	17	31	0	0	0	49	91	133
1996	0	84	57	31	0	76	49	2	10	0	0	38
1997	185	64	184	149	42	0	25	0	0	116	4	76
1998	161	219	295	0	3	0	0	30	62	0	91	74
1999	63	127	75	0	0	0	30	0	0	71	136	9
2000	283	112	195	43	0	0	0	0	0	0	0	0
2001	42	231	0	71	15	5	4	0	0	7	252	364
2002	199	56	119	100	0	4	0	3	29	25	0	54
2003	190	95	195	78	0	0	0	0	119	0	0	98
2004	9	203	119	0	64	55	0	0	50	0	124	109
2005	204	117	117	20	0	69	48	0	0	52	171	226
2006	148	65	18	0	0	62	38	0	14	24	174	213
2007	85	81	116	3	0	0	0	16	99	122	228	267
2008	129	300	37	33	0	0	0	0	96	51	50	239
2009	102	112	163	0	62	8	0	0	79	133	0	73
2010	55	0	151	80	98	0	0	0	0	17	0	127
2011	165	20	301	31	7	62	0	0	6	24	24	80
2012	163	378	344	0	44	0	0	21	16	0	0	18
2013	97	58	17	31	0	92	85	3	21	0	211	142
2014	0	0	87	14	71	1	0	0	0	3	0	149
2015	114	160	165	148	1	82	0	0	140	16	0	28

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	25	36	112	14	2	0	0	0	0	95	85	227
2017	240	46	82	161	0	0	0	0	0	60	16	206
2018	46	20	33	0	0	38	0	0	109	97	0	147
2019	260	208	219	18	74	0	0	0	86	0	0	143
2020	197	49	79	17	124	0	0	0	0	0	92	29
2021	20	117	176	170	1	0	1	30	59	69	103	122
2022	404	51	175	75	5	0	60	11	0	5	1	7
2023	197	349	42	23	50	0	0	0	0	0	31	86
Ave 1970-2023	131.9	117.7	103.7	42.1	28.1	19.2	10.0	4.8	33.9	47.9	72.3	130.2
Ave 1991-2020	141.5	123.0	123.3	42.3	31.7	22.8	10.9	3.1	32.8	43.8	68.1	135.6

Table H.16 Number of monthly hours of rapid falling atmospheric pressure in St Athan between 1970 – 2023 (3-hour tendency >3.6 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	16	38	11	11	0	3	4	7	11	4	43	5
1971	27	10	12	0	0	8	0	4	0	1	34	6
1972	21	26	14	35	13	0	0	3	4	2	48	11
1973	16	15	0	13	0	0	0	3	16	2	9	12
1974	46	46	7	0	3	0	1	2	38	18	21	21
1975	40	0	3	5	0	4	0	0	16	5	19	14
1976	14	11	13	0	0	0	0	0	7	27	23	19
1977	35	29	21	1	2	0	0	3	0	9	26	9
1978	66	6	31	0	0	0	5	0	0	0	4	22
1979	17	31	32	4	4	0	0	15	0	0	12	38
1980	27	18	26	0	0	6	1	4	0	20	4	35
1981	25	16	14	3	10	0	0	0	10	9	13	27
1982	7	1	23	0	10	0	0	0	9	11	27	46
1983	32	13	34	16	0	0	0	0	12	9	13	24
1984	67	21	12	0	0	0	0	0	11	17	15	8
1985	24	0	12	21	1	4	0	19	3	3	9	5
1986	49	0	28	12	0	0	0	17	0	20	29	42
1987	7	10	13	1	4	9	0	0	5	30	15	10
1988	48	18	16	0	0	0	4	3	12	7	9	4
1989	8	47	26	9	0	0	0	1	4	21	13	38
1990	40	60	0	4	0	6	7	3	8	19	19	37
1991	27	14	6	13	0	0	0	0	8	1	27	1
1992	3	2	14	14	4	0	0	16	4	11	40	26
1993	41	1	3	7	2	0	0	3	6	4	9	63
1994	39	22	23	13	2	0	0	0	2	8	1	27
1995	45	29	39	1	0	0	0	0	8	4	6	7
1996	16	41	0	0	6	0	0	0	0	16	45	11
1997	2	39	0	0	4	11	0	0	0	8	11	20
1998	48	0	12	8	0	3	2	4	1	37	22	15
1999	37	11	11	18	0	2	0	0	1	6	21	57
2000	4	33	1	12	0	0	6	2	3	40	27	42
2001	22	22	7	14	0	0	1	0	2	7	1	13
2002	29	33	9	23	4	0	0	0	0	33	24	18
2003	30	7	1	7	6	0	0	0	1	14	19	21
2004	37	3	7	11	9	9	0	1	4	19	6	23
2005	18	4	0	4	0	1	0	1	1	7	20	20
2006	0	11	17	0	16	0	0	0	0	9	16	27
2007	32	27	32	0	5	0	3	0	4	0	18	23
2008	30	19	39	0	0	0	0	4	3	15	18	19
2009	35	7	20	7	0	0	0	0	6	1	30	5
2010	24	0	5	0	0	0	2	5	0	18	27	14
2011	8	7	0	0	2	0	5	0	2	0	6	33
2012	8	8	2	37	0	6	2	0	7	15	14	41
2013	27	16	0	0	9	0	0	0	9	13	16	47
2014	47	63	5	3	4	0	0	8	0	12	8	24
2015	46	20	13	0	18	4	6	1	2	4	14	6

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	34	31	38	0	0	4	0	2	0	0	23	3
2017	15	16	11	0	0	9	0	0	8	4	12	52
2018	40	12	10	3	0	0	2	3	5	0	17	25
2019	21	20	36	0	7	1	0	0	10	6	35	53
2020	28	65	6	0	0	0	0	8	2	10	19	44
2021	20	5	6	0	24	0	9	0	3	24	15	18
2022	16	35	4	1	0	0	0	0	10	10	23	23
2023	25	0	17	8	0	0	6	14	3	16	39	31
Ave 1970-2023	27.5	19.2	13.7	6.3	3.1	1.7	1.2	2.9	5.2	11.2	19.1	23.8
Ave 1991-2020	26.4	19.4	12.2	6.5	3.3	1.7	1.0	1.9	3.3	10.7	18.4	26.0

Table H.17 Number of monthly hours of very low atmospheric pressure in St Athan between 1970 – 2023 (<997 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	196	45	32	16	0	0	0	7	53	0	143	0
1971	220	74	113	34	15	0	0	0	0	0	26	0
1972	71	196	116	149	7	0	0	11	1	16	92	90
1973	41	80	0	15	12	0	14	6	10	57	5	131
1974	106	214	52	20	60	0	0	0	156	10	79	0
1975	119	0	67	9	0	0	0	0	53	0	49	24
1976	28	15	32	0	0	0	0	0	27	164	48	222
1977	240	190	25	14	19	21	0	26	0	101	64	101
1978	148	164	139	25	0	29	0	0	0	0	0	309
1979	128	172	181	82	5	0	0	10	0	79	47	114
1980	103	25	111	0	0	0	0	0	0	93	25	46
1981	14	33	141	0	16	0	0	0	90	76	0	327
1982	9	5	41	0	0	0	0	0	50	103	94	197
1983	13	17	50	77	123	0	0	0	93	36	35	203
1984	134	35	124	0	14	0	0	0	8	136	144	18
1985	89	0	101	105	22	15	12	24	0	0	82	68
1986	144	0	73	108	3	0	0	24	0	64	52	24
1987	0	39	43	65	0	5	19	0	0	142	55	23
1988	261	149	39	0	100	0	79	0	46	55	24	16
1989	0	126	63	71	0	0	0	0	0	59	32	224
1990	157	202	0	0	0	20	9	0	0	160	77	68
1991	106	8	108	51	0	0	0	0	34	1	120	0
1992	17	7	73	102	0	0	0	43	0	61	46	123
1993	49	0	0	26	36	0	0	0	118	180	4	115
1994	182	81	33	66	0	0	0	0	34	150	19	123
1995	200	111	94	2	0	0	0	0	45	11	84	96
1996	174	114	0	0	37	0	0	0	0	21	53	25
1997	0	63	0	0	70	64	0	35	0	54	253	111
1998	132	0	19	188	0	0	0	0	65	34	34	57
1999	64	0	72	67	0	2	0	35	155	134	13	168
2000	0	6	0	173	0	0	25	0	59	150	320	169
2001	234	144	145	28	5	0	24	0	6	59	0	0
2002	38	89	17	50	51	0	12	0	0	97	172	80
2003	129	21	0	20	4	0	0	0	0	66	83	42
2004	115	0	0	57	62	19	0	34	4	158	0	28
2005	3	0	0	22	0	0	0	0	0	27	43	135
2006	4	106	98	0	53	0	0	0	7	154	120	120
2007	22	177	50	0	27	0	0	31	0	0	44	57
2008	121	36	117	83	0	0	9	39	41	27	59	78
2009	181	125	64	17	0	0	0	0	10	63	220	214
2010	12	279	61	2	0	0	9	0	0	80	140	47
2011	54	62	11	0	0	0	29	0	0	49	52	84
2012	5	0	0	200	0	32	0	0	70	66	114	102
2013	82	24	126	46	21	0	0	0	7	73	51	132
2014	333	319	39	6	0	0	0	8	0	53	154	11
2015	94	54	0	0	44	0	9	0	78	21	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	220	156	84	0	0	37	0	0	0	0	101	0
2017	0	123	61	11	43	26	0	0	33	11	26	163
2018	90	12	350	64	0	0	0	0	3	0	93	24
2019	75	51	75	94	30	0	0	19	20	12	248	206
2020	56	100	56	31	5	0	0	30	22	175	27	207
2021	136	60	30	0	76	0	16	29	0	96	40	87
2022	7	43	3	30	0	0	0	0	0	31	176	50
2023	118	0	158	24	0	0	8	26	42	235	166	85
Ave 1970-2023	97.7	76.9	64.6	41.7	17.8	5.0	5.1	8.1	26.7	68.5	78.7	95.3
Ave 1991-2020	93.1	75.6	58.4	46.9	16.3	6.0	3.9	9.1	27.0	66.2	89.8	90.6

Table H.18 Number of monthly hours of very high atmospheric pressure in St Athan between 1970 – 2023 (>1029 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	0	31	49	0	66	13	0	0	0	45	0	228
1971	0	258	141	28	0	0	70	0	41	116	100	227
1972	0	0	1	0	0	0	20	13	26	92	81	110
1973	210	113	315	92	0	81	0	0	1	151	156	66
1974	73	91	0	9	0	0	0	27	4	0	14	73
1975	90	190	0	68	67	47	15	26	15	73	80	270
1976	134	108	113	27	0	0	0	0	18	0	154	36
1977	142	20	34	13	29	53	0	0	112	15	9	85
1978	107	0	6	1	41	14	0	40	72	90	52	0
1979	31	113	9	82	56	47	46	0	55	3	46	1
1980	109	102	7	131	1	0	0	0	17	18	92	163
1981	311	89	0	48	0	45	0	62	32	0	234	59
1982	57	2	124	115	18	0	10	0	22	4	44	119
1983	198	135	103	72	0	110	0	0	38	161	7	225
1984	0	227	137	30	23	0	8	0	0	17	0	158
1985	76	161	132	41	0	0	17	0	19	244	53	25
1986	11	59	0	19	17	38	28	0	155	34	154	62
1987	277	2	82	59	127	0	0	0	16	0	150	81
1988	0	188	32	0	3	6	0	0	153	59	180	346
1989	297	142	0	0	77	0	0	0	75	38	36	125
1990	46	29	278	18	80	0	19	0	44	0	55	238
1991	276	98	80	83	240	0	0	0	43	78	12	498
1992	519	216	65	17	111	28	18	0	0	16	36	207
1993	89	478	126	0	41	0	43	29	16	224	94	0
1994	44	0	18	27	2	109	0	0	0	86	122	96
1995	139	7	107	140	16	40	0	0	0	46	106	153
1996	0	119	71	30	0	92	61	18	28	0	0	40
1997	189	46	204	164	42	0	38	0	7	114	5	79
1998	154	200	300	0	7	0	0	36	64	19	83	59
1999	63	124	96	1	0	0	27	0	0	67	131	10
2000	282	86	203	42	0	0	0	0	0	0	0	0
2001	43	235	0	74	40	0	8	0	0	8	254	372
2002	171	65	118	95	0	8	0	5	29	25	0	62
2003	197	106	200	88	0	0	0	0	110	0	0	121
2004	10	234	118	0	79	67	0	0	48	0	126	82
2005	201	132	114	31	0	72	59	0	0	65	148	223
2006	158	76	0	1	1	91	44	0	14	10	161	209
2007	101	82	120	7	0	0	0	33	108	121	238	250
2008	124	279	40	41	0	0	0	0	104	29	53	232
2009	103	160	166	15	76	2	0	0	131	135	0	79
2010	56	0	185	104	117	11	0	0	0	11	0	141
2011	173	23	301	51	10	64	0	0	0	21	0	62
2012	168	399	345	0	46	0	0	24	18	0	0	22
2013	90	83	34	31	0	104	94	6	30	0	230	112
2014	0	0	119	9	76	25	0	0	0	12	0	141
2015	103	167	185	145	4	87	0	0	149	28	0	20

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	17	35	134	12	0	0	0	0	0	113	91	221
2017	241	28	90	181	0	0	0	0	0	63	22	208
2018	44	46	38	0	0	44	0	0	110	102	0	150
2019	267	190	211	22	72	0	0	0	90	0	0	135
2020	183	47	89	21	118	0	5	0	1	0	90	33
2021	16	89	209	176	0	0	13	51	71	67	95	120
2022	416	40	182	73	4	0	82	23	0	0	1	9
2023	196	350	56	25	79	0	0	0	0	0	37	80
Ave 1970-2023	129.7	116.7	109.0	47.4	33.1	24.0	13.4	7.3	38.6	48.5	71.0	128.2
Ave 1991-2020	140.2	125.4	129.2	47.7	36.6	28.1	13.2	5.0	36.7	46.4	66.7	133.9

Table H.19 Number of monthly hours of rapid falling atmospheric pressure in Northolt between 1970 – 2023 (3-hour tendency >3.6 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	9	40	14	9	1	1	6	7	7	6	32	9
1971	21	10	6	0	0	8	0	1	0	3	48	7
1972	16	18	10	38	9	0	0	0	4	0	42	5
1973	9	15	0	9	0	0	0	0	18	4	17	22
1974	35	32	9	0	0	0	2	2	34	14	13	27
1975	36	0	6	4	0	0	0	0	19	1	23	13
1976	20	11	10	0	0	0	0	0	7	19	21	25
1977	28	23	11	0	0	2	0	4	0	7	29	12
1978	65	9	27	5	0	0	1	0	0	0	5	19
1979	12	31	33	6	11	0	0	6	0	0	16	38
1980	22	17	10	0	0	10	0	4	0	19	5	41
1981	29	10	10	0	9	0	0	0	14	11	14	24
1982	10	0	26	0	6	2	0	0	1	10	17	45
1983	35	19	30	10	0	0	0	0	10	6	14	18
1984	80	20	8	0	2	0	0	0	6	11	17	6
1985	13	0	3	19	0	4	0	14	1	1	15	3
1986	41	0	22	9	0	0	0	14	0	22	20	44
1987	8	5	17	3	4	4	0	0	3	30	13	5
1988	47	20	14	0	0	0	2	0	14	5	9	3
1989	10	39	29	9	0	0	0	0	3	11	12	27
1990	35	68	0	6	0	5	3	0	7	19	16	42
1991	27	14	4	13	0	5	0	0	1	0	20	8
1992	1	5	25	8	4	0	0	11	2	13	53	28
1993	46	1	4	7	0	0	1	0	1	4	14	62
1994	31	19	20	20	0	0	0	0	4	6	0	32
1995	45	26	49	0	0	0	0	0	5	3	1	8
1996	4	26	0	0	0	0	0	0	0	10	49	11
1997	0	31	4	0	0	3	0	2	0	13	7	13
1998	50	0	18	4	0	0	0	7	1	31	15	11
1999	33	4	14	14	0	2	0	0	2	12	18	62
2000	10	39	2	15	11	0	6	0	0	39	32	32
2001	21	12	4	13	0	0	2	0	2	7	7	11
2002	15	31	6	19	0	0	4	0	2	29	24	20
2003	27	7	3	6	3	0	0	0	0	13	12	21
2004	47	4	6	13	10	4	2	0	0	11	8	31
2005	20	5	3	2	0	0	0	0	0	7	19	14
2006	0	14	11	0	11	0	0	0	0	4	11	25
2007	36	19	27	0	4	0	2	0	4	0	13	22
2008	36	26	37	0	0	0	0	5	0	4	26	19
2009	36	11	25	0	0	0	0	0	7	0	24	3
2010	22	6	1	0	0	0	0	6	0	11	28	16
2011	5	4	0	0	1	4	4	0	0	0	3	37
2012	15	6	0	23	0	4	0	0	11	10	18	42
2013	29	14	0	0	8	0	0	0	8	11	18	48
2014	39	55	10	0	3	0	0	8	0	9	8	27
2015	43	16	13	1	18	1	7	0	0	0	16	1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	28	14	39	0	0	0	0	0	0	0	17	4
2017	15	13	7	0	0	11	0	0	8	0	8	51
2018	44	12	10	3	0	0	0	4	3	0	5	29
2019	20	12	32	0	8	0	0	0	12	8	16	53
2020	20	62	6	0	0	0	0	9	1	7	8	47
2021	21	3	12	1	21	0	1	2	0	21	20	24
2022	16	33	0	2	0	1	0	0	7	7	21	13
2023	21	0	13	6	0	0	5	11	1	19	31	24
Ave 1970-2023	26.0	17.2	13.0	5.5	2.7	1.3	0.9	2.2	4.3	9.4	17.9	23.8
Ave 1991-2020	25.5	16.9	12.7	5.4	2.7	1.1	0.9	1.7	2.5	8.7	16.6	26.3

Table H.20 Number of monthly hours of very low atmospheric pressure in Northolt between 1970 – 2023 (<997 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	154	75	41	22	0	0	0	0	44	0	130	0
1971	234	70	101	27	14	0	0	0	0	0	22	0
1972	63	148	132	133	7	0	0	0	0	8	84	44
1973	30	80	0	15	0	0	10	0	10	61	4	125
1974	20	187	51	5	7	0	0	0	133	21	96	0
1975	100	0	79	9	0	0	0	0	55	0	57	23
1976	1	20	31	0	0	0	0	0	26	135	33	215
1977	206	167	0	13	19	23	0	0	0	81	104	77
1978	145	145	100	19	0	46	0	0	0	0	0	277
1979	127	155	201	41	13	0	0	5	0	61	64	116
1980	94	29	107	0	0	0	1	0	0	101	21	49
1981	41	13	71	0	21	0	0	0	64	66	0	300
1982	12	0	36	0	0	0	0	0	15	103	82	198
1983	11	32	48	44	96	0	0	0	89	31	39	184
1984	137	37	100	0	17	0	0	0	21	97	98	10
1985	75	0	87	106	0	0	10	18	0	0	76	67
1986	143	0	74	99	0	0	0	24	0	71	40	15
1987	0	38	47	66	0	6	13	0	0	129	54	0
1988	247	163	39	0	13	0	72	0	45	61	23	19
1989	0	122	66	71	4	0	0	0	0	39	39	196
1990	136	200	0	1	0	20	11	0	0	143	81	76
1991	79	4	81	43	0	0	0	0	38	0	121	0
1992	11	3	81	80	3	0	0	28	0	61	42	108
1993	42	0	0	10	11	0	0	0	95	157	6	127
1994	159	35	30	67	9	0	0	0	30	89	0	110
1995	186	91	98	9	5	0	0	0	45	3	29	84
1996	119	102	0	0	11	0	0	0	0	16	73	30
1997	0	67	0	0	71	75	0	16	0	35	206	78
1998	122	0	11	195	0	0	0	0	62	42	37	12
1999	41	0	90	64	0	0	0	20	105	130	13	177
2000	0	8	0	162	6	0	32	0	19	138	293	106
2001	212	150	106	5	0	0	26	0	1	36	6	0
2002	32	90	15	43	31	15	13	0	0	104	136	74
2003	120	30	0	16	2	0	0	0	0	65	73	43
2004	112	0	0	51	64	18	0	11	0	145	0	32
2005	5	0	0	14	0	0	0	0	0	24	44	128
2006	8	102	66	0	49	0	0	0	0	141	106	111
2007	18	155	44	0	29	11	4	28	0	0	16	72
2008	98	27	133	57	0	0	7	30	39	20	77	73
2009	168	125	66	12	0	0	0	0	10	44	199	183
2010	26	269	53	0	0	0	0	4	0	37	140	49
2011	41	42	1	0	0	3	43	0	0	30	40	83
2012	3	0	0	200	0	23	0	0	71	33	104	75
2013	56	31	97	35	20	0	0	0	11	57	59	117
2014	284	268	38	0	0	0	0	8	0	45	91	13
2015	96	51	11	0	27	0	11	4	71	14	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	205	151	78	2	0	34	0	0	0	0	94	0
2017	7	94	61	0	30	43	0	0	53	0	20	170
2018	103	1	307	55	0	0	0	0	0	15	52	15
2019	85	54	71	56	32	0	0	0	13	0	242	174
2020	42	95	64	25	6	13	0	0	24	167	15	173
2021	138	48	33	0	55	0	10	16	0	72	50	96
2022	11	47	0	32	0	0	0	0	0	10	133	27
2023	108	0	123	23	0	0	0	26	36	223	164	76
Ave 1970-2023	87.3	70.8	58.7	35.7	12.4	6.1	4.9	4.4	22.7	58.5	70.9	85.3
Ave 1991-2020	82.7	68.2	53.4	40.0	13.5	7.8	4.5	5.0	22.9	54.9	77.8	80.6

Table H.21 Number of monthly hours of very high atmospheric pressure in Northolt between 1970 – 2023 (>1029 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	0	29	26	0	30	20	0	0	0	33	0	225
1971	0	246	104	28	0	0	69	0	68	132	96	186
1972	0	0	6	0	0	0	17	0	18	92	70	119
1973	253	114	260	49	0	78	0	0	2	145	136	55
1974	59	85	8	1	0	0	0	19	0	0	14	65
1975	80	213	0	66	55	27	14	21	17	107	63	242
1976	92	124	121	6	0	0	0	4	9	0	147	24
1977	140	26	43	26	8	39	0	0	56	17	0	118
1978	102	0	3	0	39	7	0	18	52	71	73	0
1979	35	131	8	49	55	37	31	0	53	6	51	0
1980	118	102	0	112	11	0	0	0	15	9	82	161
1981	282	112	0	32	0	32	0	59	35	0	225	52
1982	46	12	130	103	19	0	2	0	16	35	41	142
1983	206	179	115	42	0	103	0	0	40	150	25	220
1984	0	230	127	37	0	0	0	0	0	17	0	157
1985	51	189	143	41	0	0	13	0	2	226	45	31
1986	13	84	0	11	0	34	0	0	142	32	162	57
1987	263	0	65	55	117	0	0	0	17	0	154	86
1988	0	116	16	8	9	0	0	0	124	79	197	336
1989	342	143	0	0	77	1	0	0	68	38	62	126
1990	47	45	253	26	82	0	4	0	27	0	60	208
1991	282	104	74	65	178	0	0	5	44	73	0	499
1992	509	233	66	6	92	17	16	0	0	3	35	208
1993	91	471	106	0	40	0	18	29	14	198	146	0
1994	35	0	18	28	11	78	0	0	0	84	127	95
1995	128	20	96	133	15	31	0	0	0	45	83	148
1996	0	78	56	32	0	77	56	1	5	0	0	37
1997	190	59	175	158	72	0	11	0	3	121	4	75
1998	160	202	291	0	8	0	0	19	67	0	100	72
1999	63	122	64	0	0	0	31	0	0	71	133	5
2000	275	105	180	44	0	0	0	0	0	0	0	0
2001	50	225	0	68	16	0	0	0	0	6	238	357
2002	204	57	117	99	0	0	0	3	34	17	0	60
2003	146	99	184	99	0	0	0	0	119	15	3	112
2004	0	190	121	0	68	53	0	0	55	0	111	110
2005	184	110	96	18	0	69	49	0	0	53	152	220
2006	160	61	30	0	0	64	50	0	18	30	172	214
2007	57	79	106	12	0	0	0	13	91	113	212	265
2008	115	300	32	28	0	0	0	0	100	47	30	250
2009	118	93	175	0	54	14	0	0	79	128	0	72
2010	54	0	130	80	95	2	0	0	0	18	0	113
2011	156	15	302	23	1	63	0	0	11	34	17	60
2012	151	342	358	0	42	0	0	11	15	0	0	17
2013	93	65	23	30	0	75	86	3	15	0	203	126
2014	0	0	86	30	72	0	0	0	0	5	0	127
2015	90	168	174	156	0	85	0	0	142	24	4	26

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	17	30	138	19	0	0	0	0	0	146	84	218
2017	241	31	87	145	0	0	0	0	0	54	12	200
2018	38	29	28	0	0	35	0	0	108	91	0	148
2019	229	209	206	20	77	14	0	0	84	0	0	137
2020	192	49	91	21	124	0	5	0	11	0	91	24
2021	17	124	193	187	11	0	3	36	62	66	80	126
2022	378	44	213	88	10	0	58	13	0	0	2	11
2023	187	330	41	41	73	0	0	0	0	0	18	84
Ave 1970-2023	124.8	115.3	101.6	43.0	28.9	19.5	9.9	4.7	34.0	48.7	69.6	126.4
Ave 1991-2020	134.3	118.2	120.3	43.8	32.2	22.6	10.7	2.8	33.8	45.9	65.2	133.2

Table H.22 Number of monthly hours of rapid falling atmospheric pressure in Coleshill between 1970 – 2023 (3-hour tendency >3.6 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	10	40	13	17	0	2	1	8	18	6	41	8
1971	22	9	6	0	0	9	1	2	0	5	50	6
1972	23	24	15	35	7	0	0	3	7	0	39	17
1973	12	16	0	14	0	0	0	5	17	8	21	21
1974	47	41	8	0	0	0	4	1	28	24	25	31
1975	44	0	5	7	0	5	0	0	18	5	20	13
1976	26	11	11	0	0	0	0	0	6	27	23	20
1977	32	29	26	0	3	8	1	5	0	9	35	11
1978	70	9	32	3	0	0	1	0	0	0	6	22
1979	11	24	35	5	7	0	0	14	0	0	13	47
1980	27	16	14	0	0	9	0	4	0	13	12	41
1981	33	13	17	1	12	2	0	0	15	7	15	23
1982	8	3	22	0	13	1	0	3	8	12	28	41
1983	38	15	33	12	0	0	0	0	12	11	14	17
1984	69	24	7	0	1	0	0	0	9	18	19	7
1985	23	0	4	24	0	3	0	20	3	2	15	4
1986	46	0	27	8	0	0	0	16	0	23	25	47
1987	13	15	17	0	5	5	0	0	12	26	11	12
1988	48	19	12	0	0	0	6	2	17	7	10	6
1989	8	37	33	14	0	0	0	1	1	23	13	39
1990	42	67	0	6	0	5	6	2	10	20	18	38
1991	31	16	13	14	0	0	0	0	2	2	29	9
1992	3	6	28	9	5	0	0	13	7	16	46	29
1993	68	1	3	7	0	0	0	5	1	1	11	79
1994	38	22	30	22	4	0	0	0	2	9	0	33
1995	49	26	46	2	0	0	0	0	8	5	5	9
1996	5	27	0	0	1	0	0	0	0	18	45	11
1997	0	39	7	0	3	4	0	0	0	8	7	21
1998	49	0	16	9	0	1	0	7	0	53	22	13
1999	43	3	19	20	0	0	0	0	4	9	21	58
2000	10	42	4	11	0	0	6	1	2	46	31	39
2001	12	13	8	15	0	0	0	2	5	8	5	16
2002	26	45	13	20	2	0	0	0	2	29	26	21
2003	24	8	3	8	0	0	0	0	0	16	19	26
2004	41	1	13	10	9	5	0	0	5	9	5	27
2005	23	10	5	7	1	0	0	1	1	8	23	10
2006	0	15	10	0	13	0	0	0	4	7	18	27
2007	37	21	22	0	2	0	4	2	4	0	8	23
2008	39	28	42	0	0	0	0	4	0	9	23	21
2009	38	7	22	4	0	0	0	0	8	0	28	4
2010	20	0	0	0	0	0	0	4	0	7	26	15
2011	4	9	0	1	4	2	7	0	4	2	7	47
2012	17	7	4	20	0	8	0	0	10	9	13	36
2013	28	12	0	0	6	0	0	0	9	13	17	52
2014	52	57	10	0	4	0	0	7	0	14	7	26
2015	50	21	18	0	21	5	7	0	0	1	23	18

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	32	21	36	0	0	1	1	0	1	0	16	5
2017	11	18	9	0	0	6	0	0	11	3	11	49
2018	49	14	10	7	0	0	0	5	6	1	15	24
2019	18	18	44	2	9	1	0	2	12	10	20	43
2020	27	76	5	0	1	0	0	10	1	14	12	47
2021	26	5	14	0	31	0	3	0	4	21	21	20
2022	20	36	0	3	0	0	0	0	10	9	19	23
2023	20	0	17	9	0	0	7	11	3	24	36	34
Ave 1970-2023	28.9	19.2	15.0	6.4	3.0	1.5	1.0	3.0	5.7	11.6	19.8	25.7
Ave 1991-2020	28.1	19.4	14.7	6.3	2.8	1.1	0.8	2.1	3.6	10.9	18.0	27.9

Table H.23 Number of monthly hours of very low atmospheric pressure in Coleshill between 1970 – 2023 (<997 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	173	112	43	24	0	0	0	12	67	3	142	0
1971	224	76	132	24	14	0	0	0	0	0	21	0
1972	74	188	142	173	16	0	0	12	2	13	99	92
1973	39	82	0	20	0	0	10	10	10	52	6	129
1974	96	235	78	10	34	0	0	0	174	19	110	9
1975	143	0	55	11	0	0	0	0	64	0	68	27
1976	5	19	31	0	0	0	0	0	30	147	48	222
1977	214	200	28	21	22	28	0	25	0	102	123	100
1978	155	161	168	22	0	60	0	0	0	0	0	281
1979	136	125	204	68	18	0	0	19	0	65	69	130
1980	98	41	113	0	0	0	0	0	0	126	36	60
1981	48	25	109	0	21	0	0	0	101	87	0	292
1982	25	0	96	0	0	0	0	0	43	115	104	237
1983	17	32	55	98	123	0	0	0	109	40	51	197
1984	188	49	121	0	15	0	0	0	36	124	111	9
1985	92	0	123	137	10	13	15	32	0	0	85	76
1986	155	0	111	117	0	0	0	24	0	97	50	57
1987	0	59	49	66	0	11	12	0	0	166	58	19
1988	270	183	42	0	94	0	92	0	57	70	24	30
1989	0	128	73	72	23	0	0	0	0	62	42	232
1990	159	245	0	5	0	21	19	0	1	150	80	104
1991	130	9	99	58	0	0	0	0	31	10	137	9
1992	14	8	95	97	2	0	0	56	0	65	59	126
1993	56	0	0	27	34	0	0	0	117	182	7	165
1994	190	57	32	74	0	0	0	0	38	131	0	137
1995	209	150	128	11	0	0	0	0	49	10	58	75
1996	147	127	0	0	17	0	4	0	0	23	86	30
1997	0	94	0	0	84	63	0	31	0	54	240	131
1998	143	0	35	188	0	0	7	0	73	62	33	37
1999	78	0	85	73	0	0	0	23	143	145	17	205
2000	14	12	0	161	0	0	31	0	51	156	351	156
2001	241	140	117	36	16	0	19	0	8	64	7	2
2002	59	136	18	55	61	0	31	0	0	102	170	94
2003	137	35	0	21	0	0	0	0	0	68	92	54
2004	160	0	6	57	66	22	0	33	10	162	0	35
2005	19	0	0	30	0	0	0	0	0	39	53	138
2006	7	95	137	0	65	0	0	0	0	161	144	129
2007	45	181	76	0	16	8	0	32	0	0	29	87
2008	142	55	149	68	0	0	15	44	59	24	51	79
2009	188	135	74	19	0	0	0	0	15	51	294	231
2010	24	295	65	0	0	0	8	0	0	73	142	45
2011	59	54	7	0	0	0	56	0	6	42	45	89
2012	14	0	0	213	0	30	0	0	67	69	111	136
2013	65	31	101	22	23	0	0	0	10	82	76	140
2014	333	330	64	0	8	0	0	10	0	56	131	16
2015	107	64	30	0	50	4	15	0	78	18	8	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	226	153	109	0	0	40	0	0	0	0	100	0
2017	0	116	75	0	32	40	0	0	71	23	32	195
2018	133	16	326	60	0	0	0	0	6	4	86	74
2019	89	67	94	78	29	0	0	20	23	31	253	215
2020	65	135	64	33	9	22	0	33	25	206	40	197
2021	137	56	48	0	93	0	11	44	0	110	57	123
2022	16	72	0	36	0	0	0	0	5	15	179	58
2023	150	0	180	34	0	0	17	27	46	222	179	102
Ave 1970-2023	105.7	84.9	73.8	42.9	18.4	6.7	6.7	9.0	30.1	72.2	85.1	103.9
Ave 1991-2020	103.1	83.2	66.2	46.0	17.1	7.6	6.2	9.4	29.3	70.4	95.1	100.9

Table H.24 Number of monthly hours of very high atmospheric pressure in Coleshill between 1970 – 2023 (>1029 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	0	38	30	0	30	11	0	0	0	27	0	226
1971	0	251	114	32	0	0	78	0	79	132	71	207
1972	0	0	29	8	0	0	47	3	45	101	69	117
1973	223	69	305	57	0	88	0	0	5	167	112	55
1974	49	97	9	36	0	0	0	28	0	0	14	50
1975	47	214	1	69	81	80	15	22	7	78	72	222
1976	77	115	109	17	0	0	0	13	17	0	129	30
1977	127	26	37	18	75	56	0	0	111	5	21	104
1978	107	0	0	22	43	9	0	42	51	68	32	0
1979	29	122	1	65	47	55	29	0	60	7	42	0
1980	120	109	0	122	14	0	0	0	16	5	96	144
1981	273	125	0	121	0	31	0	61	37	0	207	53
1982	44	0	123	111	14	0	29	0	11	20	41	116
1983	167	197	101	35	0	106	0	1	34	141	39	179
1984	0	232	128	43	56	0	0	0	0	4	0	142
1985	83	178	132	40	24	11	13	0	3	307	54	3
1986	11	113	0	19	2	26	7	0	137	37	141	58
1987	291	8	80	59	121	0	0	0	20	0	147	86
1988	0	133	12	21	11	0	0	0	150	79	200	320
1989	272	126	0	0	90	24	4	0	74	38	78	132
1990	42	27	232	22	85	0	0	0	50	0	69	223
1991	285	111	95	87	219	0	0	14	83	77	4	504
1992	487	160	37	6	93	36	15	0	0	17	25	208
1993	81	471	107	0	84	0	30	36	14	247	151	0
1994	23	0	12	11	11	80	0	0	0	83	123	92
1995	114	0	84	133	14	63	0	0	0	26	83	167
1996	0	112	66	34	5	87	64	4	35	0	0	39
1997	193	35	150	173	86	0	20	0	27	127	5	76
1998	164	185	281	0	19	0	0	11	74	14	98	59
1999	63	110	52	16	0	0	34	0	0	73	123	6
2000	269	57	172	43	0	0	0	0	0	0	0	0
2001	64	225	0	69	41	0	0	0	0	6	220	361
2002	176	67	125	81	0	0	0	5	46	5	0	83
2003	126	126	196	108	0	0	0	0	114	38	4	136
2004	0	226	120	0	73	55	0	0	70	0	100	85
2005	177	125	104	18	0	74	59	0	7	65	141	189
2006	211	70	24	0	0	69	63	0	19	35	149	213
2007	50	79	102	52	0	0	0	24	99	108	200	247
2008	106	283	34	31	0	0	0	0	107	24	28	247
2009	124	74	180	3	43	9	0	0	124	135	0	77
2010	55	0	175	117	98	25	0	0	0	10	0	123
2011	172	20	304	30	0	68	0	0	0	32	1	42
2012	148	319	358	0	41	0	0	16	12	0	0	22
2013	84	88	34	26	0	95	86	4	12	0	212	101
2014	0	0	92	28	73	35	0	0	0	13	0	116
2015	68	168	192	167	0	86	0	0	151	28	3	13

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	11	27	148	24	0	0	0	0	0	185	80	204
2017	235	19	89	164	4	0	0	0	0	55	14	192
2018	31	68	31	0	14	41	0	0	108	90	15	136
2019	240	200	198	40	81	31	0	0	94	0	0	122
2020	183	49	131	34	121	0	9	0	20	0	84	27
2021	17	118	220	217	15	0	15	68	66	74	71	124
2022	368	36	231	87	17	0	67	24	0	2	3	25
2023	195	327	60	58	133	0	0	0	0	0	19	69
Ave 1970-2023	120.0	113.6	104.6	51.4	36.6	25.0	12.7	7.0	40.5	51.6	66.5	121.7
Ave 1991-2020	131.3	115.8	123.1	49.8	37.3	28.5	12.7	3.8	40.5	49.8	62.1	129.6

Table H.25 Number of monthly hours of rapid falling atmospheric pressure in Rostherne between 1970 – 2023 (3-hour tendency >3.6 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	9	37	13	15	0	1	0	9	22	8	36	8
1971	24	10	6	0	0	8	1	2	0	3	50	5
1972	25	25	16	39	8	2	0	4	4	0	45	26
1973	11	20	2	17	0	0	0	9	11	9	18	20
1974	56	40	9	0	1	0	7	1	30	22	30	30
1975	48	1	3	9	0	5	0	0	18	5	18	9
1976	26	14	8	1	0	0	0	0	9	29	19	18
1977	34	18	26	0	0	12	1	5	2	11	30	10
1978	70	8	34	1	0	0	1	0	0	0	7	19
1979	8	12	39	3	5	0	0	14	0	0	14	43
1980	26	13	12	0	0	9	2	0	0	14	12	41
1981	37	14	16	2	12	5	0	1	12	15	19	21
1982	8	7	25	0	12	0	0	6	5	14	27	43
1983	39	15	33	11	0	0	0	0	19	13	14	20
1984	76	30	9	0	0	0	1	0	11	21	13	9
1985	23	0	8	22	0	2	0	20	4	0	16	7
1986	54	0	34	8	4	0	0	18	0	27	35	48
1987	12	16	18	2	6	5	0	0	13	20	12	13
1988	51	22	17	0	0	0	10	3	18	14	12	6
1989	12	41	31	13	0	0	0	4	0	23	10	38
1990	43	73	0	8	0	3	7	4	12	21	10	44
1991	33	19	17	17	0	1	0	0	3	7	31	12
1992	2	10	26	9	0	0	0	15	10	13	46	26
1993	76	1	2	7	0	1	0	6	0	0	13	79
1994	42	26	37	21	4	0	0	0	0	7	0	30
1995	53	31	36	3	0	0	0	0	7	4	4	8
1996	7	25	0	0	4	0	0	0	6	22	43	11
1997	0	57	8	0	4	6	0	1	0	7	5	32
1998	44	4	23	11	0	5	0	5	0	60	25	18
1999	46	3	23	22	0	2	0	0	1	8	14	50
2000	11	48	5	10	0	0	5	0	6	46	34	42
2001	14	15	8	14	0	1	0	2	4	7	9	17
2002	35	48	15	21	3	0	0	0	3	28	30	24
2003	24	4	3	10	0	0	0	0	0	11	26	30
2004	39	0	17	10	9	5	0	0	3	16	2	32
2005	27	14	5	10	0	0	0	4	3	10	25	11
2006	3	15	8	6	15	0	0	0	5	10	24	34
2007	43	22	26	0	2	0	4	1	4	0	12	19
2008	46	24	39	0	0	5	0	0	0	9	22	25
2009	35	0	30	8	0	0	0	0	8	0	31	9
2010	18	0	3	0	0	0	2	4	0	10	28	14
2011	4	18	2	0	4	5	6	0	8	6	11	41
2012	20	7	5	17	0	4	0	0	7	7	15	35
2013	26	8	0	1	0	0	0	0	12	16	20	56
2014	49	58	10	0	5	0	0	3	0	15	5	29
2015	51	21	26	0	24	6	6	2	0	4	35	29

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	36	23	38	0	0	2	1	0	4	0	14	7
2017	7	16	11	0	0	4	0	0	13	6	11	43
2018	55	14	13	8	0	1	0	4	14	0	18	22
2019	22	18	44	4	6	2	0	2	10	9	18	45
2020	34	75	5	0	3	0	3	9	0	19	22	46
2021	25	0	17	0	33	0	2	0	6	22	21	28
2022	21	48	0	3	0	0	0	0	12	5	24	28
2023	22	0	18	13	0	0	7	8	8	18	30	35
Ave 1970-2023	30.8	20.1	16.3	7.0	3.0	1.9	1.2	3.1	6.4	12.4	20.6	26.8
Ave 1991-2020	30.1	20.8	16.2	7.0	2.8	1.7	0.9	1.9	4.4	11.9	19.8	29.2

Table H.26 Number of monthly hours of very low atmospheric pressure in Rostherne between 1970 – 2023 (<997 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	186	129	43	22	0	0	6	15	77	26	152	0
1971	233	93	138	18	13	7	0	2	0	3	24	7
1972	86	198	145	185	37	0	0	15	0	15	112	137
1973	49	87	0	20	2	0	10	20	6	46	9	131
1974	167	255	96	10	34	0	0	3	199	17	148	23
1975	186	0	56	17	0	0	1	0	73	0	71	28
1976	7	19	31	0	0	0	0	0	30	164	90	227
1977	231	222	45	26	24	30	0	31	0	117	157	111
1978	161	166	193	23	0	66	0	0	0	0	0	275
1979	160	106	199	77	29	0	2	37	0	72	71	143
1980	101	44	123	0	0	0	0	0	0	105	61	72
1981	51	32	184	0	21	3	0	0	117	91	1	291
1982	36	4	127	0	11	0	0	0	53	120	130	256
1983	25	33	62	102	124	0	0	0	131	44	55	201
1984	222	72	123	0	6	0	0	0	49	140	133	8
1985	108	0	139	152	21	29	25	41	0	3	98	83
1986	169	0	157	116	3	0	0	22	0	113	68	74
1987	0	60	58	68	0	27	21	0	5	211	75	38
1988	290	202	45	0	109	0	100	21	74	82	25	31
1989	0	135	77	79	27	0	0	9	0	76	43	242
1990	175	276	0	8	0	23	23	0	3	172	83	108
1991	177	16	106	69	0	18	0	0	24	24	156	24
1992	12	11	98	104	0	0	0	71	0	69	77	133
1993	60	0	0	35	59	0	0	0	99	183	5	194
1994	218	74	39	80	0	14	0	0	43	163	0	140
1995	221	174	147	13	0	0	0	0	48	23	82	84
1996	167	151	0	0	19	0	22	0	0	24	97	32
1997	0	121	0	0	108	48	0	45	0	65	271	161
1998	155	0	46	163	0	16	11	0	112	90	33	64
1999	104	0	81	75	0	6	0	27	169	154	19	219
2000	19	18	0	151	0	0	31	0	62	186	399	215
2001	257	132	128	45	25	0	6	9	13	106	7	1
2002	76	174	21	58	80	0	48	0	0	101	184	107
2003	137	41	0	26	0	0	0	0	0	70	110	61
2004	180	0	16	61	67	24	0	39	32	197	0	39
2005	27	0	0	38	0	0	0	0	0	46	61	146
2006	6	96	163	0	75	0	0	0	13	176	174	143
2007	59	193	88	0	20	0	28	30	0	0	31	108
2008	184	74	158	79	4	0	28	59	80	31	72	83
2009	197	132	82	26	0	0	0	0	18	58	367	274
2010	21	310	76	2	0	0	20	0	0	96	144	42
2011	67	64	13	0	0	6	62	0	12	46	52	99
2012	24	0	0	220	0	39	0	0	65	74	127	184
2013	91	32	100	22	30	0	0	0	10	95	99	167
2014	357	368	74	0	21	0	1	13	0	72	161	18
2015	112	65	46	0	64	18	18	2	78	20	10	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	236	155	118	0	0	38	0	1	0	0	112	0
2017	0	147	88	0	35	44	0	0	79	35	36	206
2018	164	31	327	60	4	0	8	0	14	0	113	97
2019	91	77	131	86	27	0	0	33	47	36	250	240
2020	79	168	63	34	10	37	0	44	26	252	61	214
2021	139	73	64	0	120	0	13	62	0	133	61	142
2022	20	90	4	41	0	0	0	0	10	28	218	77
2023	194	0	197	39	0	0	33	27	67	222	190	118
Ave 1970-2023	120.3	94.8	83.6	45.4	22.8	9.1	9.6	12.6	35.9	83.2	99.7	117.0
Ave 1991-2020	116.6	94.1	73.6	48.2	21.6	10.3	9.4	12.4	34.8	83.1	110.3	116.5

Table H.27 Number of monthly hours of very high atmospheric pressure in Rostherne between 1970 – 2023 (>1029 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	0	40	48	0	29	16	0	0	0	18	0	241
1971	0	250	131	36	0	0	83	0	68	124	37	204
1972	1	0	43	17	0	0	59	13	59	105	68	110
1973	208	55	306	66	0	96	0	0	6	164	98	54
1974	37	98	6	66	0	0	0	27	1	0	15	42
1975	38	212	2	71	102	97	19	28	3	84	64	203
1976	75	114	90	46	0	0	0	23	9	0	121	24
1977	122	27	34	0	106	56	0	0	143	3	23	93
1978	94	0	0	32	41	12	0	48	49	61	0	0
1979	23	107	0	84	31	63	32	0	56	12	39	4
1980	117	109	0	124	18	0	0	0	15	2	102	135
1981	255	120	0	161	0	29	0	63	30	0	186	53
1982	45	0	119	113	8	0	45	0	6	7	41	104
1983	121	199	100	27	0	113	0	7	32	132	43	150
1984	0	238	133	33	62	2	0	4	0	3	0	132
1985	103	175	123	48	30	12	11	0	0	328	62	0
1986	9	126	0	29	2	15	16	0	130	36	125	55
1987	304	10	76	60	125	0	0	0	23	0	133	88
1988	0	135	9	20	13	7	0	0	158	70	195	278
1989	230	105	0	0	98	26	13	0	76	38	82	133
1990	31	8	188	29	83	0	0	0	63	0	73	223
1991	269	112	104	96	234	0	0	17	91	79	5	489
1992	496	139	33	7	81	51	14	0	0	19	8	206
1993	73	467	99	0	100	0	35	36	17	263	145	0
1994	13	0	4	16	11	82	0	0	0	83	115	84
1995	106	0	68	123	13	91	0	0	0	18	75	180
1996	0	121	71	32	16	99	68	9	53	0	0	50
1997	191	26	137	179	89	0	32	0	52	130	4	73
1998	161	143	252	0	21	0	0	10	74	22	72	47
1999	62	103	35	22	0	0	35	0	0	68	127	0
2000	242	28	167	43	0	0	0	0	0	0	0	0
2001	73	224	0	69	57	0	2	0	0	5	209	362
2002	162	69	113	54	0	0	0	5	72	4	0	89
2003	122	128	202	122	0	0	0	0	94	49	5	133
2004	0	240	119	0	77	56	0	0	77	0	93	51
2005	173	125	105	6	0	78	61	0	1	66	140	159
2006	240	91	42	3	0	62	72	0	19	36	141	211
2007	50	80	90	75	0	0	0	23	108	118	178	241
2008	98	246	32	31	0	0	0	0	113	5	26	241
2009	95	66	181	6	50	24	0	0	139	134	0	84
2010	79	0	189	131	92	29	0	0	0	6	0	123
2011	177	23	305	50	0	60	0	0	0	30	3	13
2012	145	307	355	0	41	0	0	15	13	0	0	23
2013	77	100	34	26	0	98	81	4	12	0	214	71
2014	0	0	93	16	72	49	0	0	0	14	0	93
2015	55	164	197	174	0	85	0	0	161	29	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	11	26	155	30	0	0	0	0	0	161	83	193
2017	238	22	92	176	17	0	0	0	0	50	4	182
2018	30	77	33	0	25	43	0	0	108	91	28	121
2019	240	172	186	49	78	34	0	0	90	0	0	107
2020	170	47	145	39	120	0	8	0	24	0	80	26
2021	14	109	232	219	15	0	17	75	65	56	58	123
2022	356	18	235	83	16	0	70	31	0	2	1	11
2023	193	316	71	82	154	0	0	0	0	0	13	54
Ave 1970-2023	115.3	109.6	103.4	55.9	39.4	27.5	14.3	8.1	42.8	50.5	61.7	114.2
Ave 1991-2020	128.3	111.5	121.3	52.5	39.8	31.4	13.6	4.0	43.9	49.3	58.5	121.7

Table H.28 Number of monthly hours of rapid falling atmospheric pressure in Newcastle between 1970 – 2023 (3-hour tendency >3.6 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	1	36	15	7	0	1	0	10	18	28	41	8
1971	20	16	1	3	1	0	0	2	0	10	43	10
1972	23	18	20	44	6	5	0	3	3	0	43	27
1973	18	24	3	19	0	0	0	11	10	8	29	30
1974	54	41	12	0	0	0	1	0	27	17	38	45
1975	65	6	7	14	0	5	1	0	18	4	23	10
1976	40	20	1	0	0	0	0	0	5	15	15	22
1977	16	20	29	0	3	14	3	1	22	9	31	19
1978	56	5	32	0	0	0	0	0	7	0	23	9
1979	15	0	34	7	5	0	0	9	4	3	27	43
1980	17	13	3	0	0	6	4	0	9	10	15	51
1981	51	9	38	0	13	2	0	4	19	15	28	16
1982	14	8	32	0	12	0	0	11	5	22	35	46
1983	56	19	31	6	0	4	0	0	22	23	12	27
1984	72	23	10	0	0	3	0	0	11	25	15	8
1985	19	0	5	16	0	2	3	25	11	0	21	13
1986	49	3	41	5	15	4	0	15	3	35	35	55
1987	14	25	22	3	7	5	3	0	13	24	9	18
1988	44	32	16	0	0	0	14	1	27	22	14	15
1989	15	49	32	11	0	3	0	6	2	17	9	29
1990	48	71	3	12	0	3	7	6	15	28	7	45
1991	43	19	27	26	0	5	0	0	9	13	37	21
1992	4	19	23	7	0	0	0	24	15	10	55	28
1993	79	7	0	9	0	0	0	4	0	0	10	74
1994	43	22	43	23	6	0	0	0	0	1	0	38
1995	63	30	30	0	0	0	0	0	12	7	0	9
1996	1	25	5	0	6	0	0	0	13	22	37	14
1997	0	61	18	5	9	0	0	0	0	5	1	27
1998	39	15	29	9	2	4	5	3	0	63	21	13
1999	47	16	28	23	0	0	0	0	0	16	20	56
2000	34	51	13	11	0	0	5	1	9	40	17	32
2001	14	9	4	8	0	1	0	0	9	7	17	40
2002	39	69	13	22	0	1	0	0	0	27	18	20
2003	28	1	5	11	2	0	0	0	4	5	27	45
2004	35	4	23	5	10	8	0	4	4	17	1	40
2005	44	19	11	9	0	0	0	5	5	8	36	24
2006	6	16	7	9	5	0	0	0	5	14	39	40
2007	74	21	25	0	4	2	0	4	5	2	23	18
2008	53	24	47	5	0	7	3	0	3	18	27	30
2009	31	0	39	6	0	0	0	0	6	11	40	4
2010	20	0	4	0	0	0	2	0	5	8	33	11
2011	2	19	6	0	7	0	3	3	12	5	15	45
2012	34	11	8	12	6	1	2	0	1	6	16	35
2013	30	11	0	6	0	2	4	0	12	16	32	72
2014	54	54	13	2	5	0	0	7	0	13	4	24
2015	50	18	28	1	28	6	0	0	0	6	42	32

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	30	22	19	1	0	3	0	0	0	0	11	9
2017	13	22	10	0	3	3	3	0	13	13	19	42
2018	63	15	12	1	0	7	0	4	18	10	24	26
2019	23	22	55	3	0	1	0	5	2	8	27	49
2020	41	77	12	1	5	0	7	13	0	21	22	37
2021	23	6	22	1	25	0	0	0	6	18	33	25
2022	30	60	0	11	0	0	0	0	15	7	16	23
2023	24	4	19	9	0	0	3	2	13	19	35	42
Ave 1970-2023	33.7	22.4	18.2	7.1	3.4	2.0	1.4	3.4	8.3	13.9	23.5	29.5
Ave 1991-2020	34.6	23.3	18.6	7.2	3.3	1.7	1.1	2.6	5.4	13.1	22.4	31.8

Table H.29 Number of monthly hours of very low atmospheric pressure in Newcastle between 1970 – 2023 (<997 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	174	214	80	23	0	1	49	29	94	66	241	2
1971	228	143	140	0	0	20	0	4	0	33	55	16
1972	77	154	175	201	46	15	0	18	0	13	179	150
1973	62	103	11	18	9	0	0	32	44	24	20	140
1974	232	272	105	0	27	0	21	9	241	43	209	97
1975	248	11	65	68	0	6	21	0	86	0	89	28
1976	35	19	25	0	22	0	0	0	26	164	157	229
1977	191	245	54	68	35	43	23	31	0	120	256	94
1978	183	164	256	0	0	81	0	0	27	0	7	239
1979	175	71	236	55	53	15	21	53	0	47	128	210
1980	148	32	107	0	0	6	15	7	19	119	92	97
1981	78	23	285	0	23	24	0	0	150	151	17	231
1982	41	16	189	8	42	0	0	11	83	114	190	282
1983	57	44	122	109	114	0	0	0	183	81	68	215
1984	261	113	132	0	0	0	0	0	99	173	124	11
1985	111	0	176	182	14	37	8	76	9	28	120	137
1986	238	0	268	127	23	0	0	19	0	142	114	110
1987	7	62	98	46	8	38	32	0	16	231	97	46
1988	331	238	97	0	65	0	105	51	113	111	19	47
1989	0	167	111	69	34	0	0	35	6	91	81	243
1990	213	341	11	43	0	39	39	26	38	192	88	115
1991	226	34	119	113	0	66	0	0	42	67	178	75
1992	14	23	127	101	0	0	0	95	6	99	157	166
1993	117	0	0	45	62	0	0	3	37	158	0	291
1994	282	70	64	120	0	21	0	0	72	196	24	176
1995	258	250	233	19	0	0	0	0	72	33	58	72
1996	161	169	0	1	15	0	35	0	9	63	152	35
1997	0	177	6	15	146	49	3	44	0	98	261	195
1998	194	0	71	139	18	33	21	0	112	136	62	66
1999	210	27	112	98	0	26	0	33	124	174	38	267
2000	47	103	20	98	10	0	36	0	57	194	437	273
2001	280	112	149	56	22	0	27	13	19	133	17	59
2002	149	309	59	77	93	0	56	0	0	107	200	118
2003	130	56	0	45	11	0	0	0	0	75	139	82
2004	212	6	48	64	70	34	0	43	65	211	0	106
2005	67	8	0	55	0	0	0	2	0	63	80	149
2006	7	97	198	8	109	1	0	0	6	225	220	172
2007	154	188	124	0	30	0	85	33	12	0	25	161
2008	251	117	209	98	8	8	29	101	96	69	111	85
2009	204	112	150	35	1	0	29	0	37	57	437	274
2010	30	304	90	7	0	0	26	13	0	110	158	42
2011	87	84	21	0	0	12	66	17	82	24	54	223
2012	72	0	0	218	0	63	0	0	55	102	139	252
2013	113	41	88	24	45	20	4	0	66	134	126	202
2014	367	426	109	0	30	0	8	36	0	83	142	63
2015	193	76	101	0	88	25	13	12	80	13	69	41

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	245	148	129	15	0	28	8	24	0	0	111	0
2017	11	148	117	0	5	57	0	9	116	41	49	246
2018	222	61	236	53	10	6	9	4	28	16	131	127
2019	127	91	211	54	17	0	0	61	77	86	221	312
2020	139	246	139	30	15	71	15	52	27	285	74	266
2021	142	89	83	0	118	0	15	65	3	150	75	168
2022	38	148	0	53	0	0	0	0	16	55	264	115
2023	248	0	202	47	0	0	47	35	98	225	239	188
Ave 1970-2023	149.8	113.9	110.3	50.1	26.6	15.6	16.0	20.3	49.0	100.5	125.9	144.6
Ave 1991-2020	152.3	116.1	97.7	52.9	26.8	17.3	15.7	19.8	43.2	101.7	129.0	153.2

Table H.30 Number of monthly hours of very high atmospheric pressure in Newcastle between 1970 – 2023 (>1029 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	0	42	24	0	7	10	0	0	15	4	8	222
1971	0	155	135	47	0	0	77	0	52	124	0	159
1972	40	18	68	27	0	0	85	5	78	109	49	112
1973	210	30	274	19	0	84	0	19	11	137	59	42
1974	0	99	54	182	0	0	0	27	0	0	7	24
1975	0	235	21	76	158	122	14	15	0	79	68	87
1976	35	68	53	123	0	11	1	51	0	0	93	14
1977	98	30	32	0	171	51	0	0	130	0	23	68
1978	67	0	0	58	38	0	4	25	6	21	0	0
1979	7	110	0	60	3	46	8	0	49	25	26	0
1980	111	105	0	111	50	0	0	0	0	0	136	44
1981	201	163	0	242	0	22	0	24	19	0	144	33
1982	39	29	101	99	57	0	77	0	8	2	39	88
1983	86	213	29	0	0	152	4	60	22	110	58	75
1984	0	239	165	90	96	0	0	19	0	0	0	66
1985	117	149	114	39	43	31	0	0	0	332	139	0
1986	1	151	0	53	0	13	0	0	106	23	18	40
1987	285	15	99	18	109	0	0	0	27	0	125	92
1988	0	95	0	49	20	0	0	0	101	70	148	156
1989	187	51	0	0	107	45	24	0	73	38	85	126
1990	4	0	158	32	105	0	44	0	44	0	85	190
1991	255	124	116	103	208	0	8	25	111	78	0	418
1992	464	89	21	0	71	67	0	0	0	25	0	187
1993	67	360	71	0	138	0	1	29	12	292	169	0
1994	4	34	0	41	15	75	0	0	0	94	95	71
1995	58	0	50	99	13	141	0	0	0	21	60	202
1996	31	109	80	43	35	85	63	0	55	0	0	61
1997	200	11	126	163	93	26	0	0	116	116	2	68
1998	137	81	184	0	23	0	0	0	77	23	60	47
1999	59	81	0	41	0	0	40	0	0	26	131	0
2000	204	5	145	33	25	0	0	0	0	0	0	0
2001	103	199	0	65	81	0	0	0	0	3	178	350
2002	177	66	91	0	0	0	0	2	126	0	0	180
2003	69	150	180	135	0	0	0	0	34	78	31	114
2004	0	228	119	0	56	18	0	0	87	0	49	15
2005	147	110	92	0	0	83	57	0	15	87	127	149
2006	249	122	72	8	0	33	69	0	27	64	102	212
2007	18	55	46	125	0	29	0	4	52	122	107	238
2008	18	231	20	7	8	0	0	0	142	0	22	233
2009	80	31	159	0	112	41	0	0	153	129	0	81
2010	88	8	127	136	80	27	0	0	0	0	0	61
2011	150	23	274	47	0	65	0	0	0	31	38	5
2012	107	260	307	0	66	0	0	0	0	0	0	19
2013	54	107	28	23	0	74	82	0	0	18	153	40
2014	0	0	90	17	72	68	0	0	18	12	0	77
2015	22	150	182	170	0	80	0	0	151	31	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	0	20	170	38	0	3	0	0	0	187	94	137
2017	200	117	80	126	80	0	0	0	0	37	0	124
2018	31	104	25	0	36	19	0	0	69	31	58	82
2019	205	107	141	98	77	52	0	0	72	29	0	52
2020	128	45	188	37	112	0	0	0	52	30	68	21
2021	15	135	220	240	20	0	5	102	49	24	46	121
2022	311	7	273	85	26	0	50	37	0	18	1	32
2023	176	272	85	116	174	27	0	0	0	0	7	24
Ave 1970-2023	98.4	100.7	94.2	61.5	47.9	29.6	13.2	8.2	40.0	49.6	53.9	93.7
Ave 1991-2020	110.8	100.9	106.1	51.8	46.7	32.9	10.7	2.0	45.6	52.1	51.5	108.1

Table H.31 Number of monthly hours of rapid falling atmospheric pressure in Glasgow between 1970 – 2023 (3-hour tendency >3.6 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	2	39	22	8	3	3	0	8	20	28	39	13
1971	20	17	5	6	1	0	0	0	0	14	42	10
1972	30	19	20	38	7	6	0	6	0	2	41	31
1973	19	22	9	11	0	0	0	14	9	7	28	27
1974	70	45	13	0	0	0	0	3	22	21	37	40
1975	68	6	6	17	0	10	3	0	23	1	23	9
1976	42	18	1	2	2	0	0	0	6	23	17	22
1977	18	16	32	1	2	9	5	3	19	10	35	18
1978	51	8	34	0	0	0	0	0	7	1	30	6
1979	16	8	42	13	1	0	0	10	6	5	28	48
1980	22	9	13	0	0	5	5	0	10	14	15	49
1981	51	18	37	1	15	1	0	3	23	16	27	17
1982	13	16	47	1	16	0	0	15	15	32	36	55
1983	78	14	26	2	2	5	0	0	25	21	3	25
1984	84	31	9	0	0	7	0	0	12	32	18	12
1985	20	0	10	8	0	0	4	27	14	3	14	19
1986	46	0	41	1	32	6	0	8	0	40	39	60
1987	11	18	18	2	13	6	0	0	10	17	20	19
1988	47	43	24	1	0	0	10	3	26	26	10	16
1989	24	54	35	11	1	4	0	13	8	26	13	32
1990	48	79	8	18	0	4	5	4	13	22	7	46
1991	39	12	18	32	0	12	2	4	20	16	29	27
1992	5	24	23	3	3	0	0	21	14	7	54	26
1993	84	2	0	8	1	0	3	3	0	0	12	84
1994	48	20	40	22	3	0	0	0	0	0	6	48
1995	66	40	34	1	0	3	0	0	14	20	3	4
1996	7	35	0	4	6	0	0	0	11	29	34	14
1997	0	73	18	3	7	0	0	0	7	6	0	30
1998	37	19	30	7	2	4	3	5	0	65	34	27
1999	53	10	29	23	6	3	0	0	2	13	23	59
2000	40	54	12	10	0	0	5	1	16	41	10	35
2001	13	13	12	2	0	1	0	0	14	7	19	25
2002	47	70	12	14	4	4	7	1	0	19	16	15
2003	33	1	4	5	9	0	0	0	1	7	28	43
2004	26	6	25	10	9	4	2	6	8	12	4	38
2005	43	21	9	9	0	0	0	4	10	9	31	22
2006	9	14	5	10	6	4	4	0	6	13	52	70
2007	84	19	27	0	6	1	0	0	1	3	18	25
2008	60	33	54	2	0	7	0	4	1	31	28	27
2009	29	0	40	9	3	1	0	9	4	16	54	11
2010	18	0	2	0	0	0	9	0	2	20	37	12
2011	6	19	7	0	8	0	4	7	13	5	23	48
2012	27	13	9	16	9	1	3	1	6	4	8	42
2013	33	14	1	18	2	4	0	5	12	20	33	77
2014	54	65	11	1	3	0	0	0	0	20	10	22
2015	53	18	38	1	20	7	0	1	0	10	45	35

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	36	26	14	1	0	4	0	2	4	0	10	15
2017	11	20	11	0	1	2	6	0	9	19	15	42
2018	59	16	23	0	0	13	0	1	11	12	30	20
2019	26	21	54	4	0	3	0	5	3	9	31	44
2020	39	89	12	0	7	0	6	16	4	20	14	39
2021	11	26	25	3	28	0	0	0	6	13	27	32
2022	36	59	2	11	2	0	0	0	19	15	10	24
2023	39	4	19	12	0	0	8	5	19	4	35	33
Ave 1970-2023	36.1	24.7	19.9	7.1	4.4	2.7	1.7	4.0	9.4	15.7	24.2	31.3
Ave 1991-2020	36.2	25.6	19.1	7.2	3.8	2.6	1.8	3.2	6.4	15.1	23.7	34.2

Table H.32 Number of monthly hours of very low atmospheric pressure in Glasgow between 1970 – 2023 (<997 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	177	219	68	21	0	2	48	23	104	73	259	2
1971	244	147	131	0	21	28	0	22	0	49	71	21
1972	140	178	175	207	73	21	6	30	0	32	186	195
1973	77	101	27	14	19	0	1	38	45	7	19	137
1974	342	284	123	0	35	0	25	7	267	23	220	121
1975	300	11	103	59	0	5	26	0	90	14	87	27
1976	59	19	25	0	30	0	0	0	5	209	252	239
1977	207	269	134	80	36	44	18	36	0	130	285	124
1978	186	172	295	17	0	76	0	12	28	0	14	265
1979	166	68	242	90	45	5	26	50	10	97	116	230
1980	171	35	139	0	0	28	9	2	21	125	118	93
1981	74	26	325	0	21	33	0	0	194	153	20	244
1982	40	68	202	7	42	0	0	11	124	130	269	274
1983	85	38	116	117	120	0	0	0	187	115	70	237
1984	272	137	126	0	0	0	0	0	95	182	185	33
1985	112	0	182	197	21	53	1	101	18	49	126	211
1986	258	0	286	124	79	7	7	11	0	162	179	133
1987	7	65	99	24	3	38	25	0	23	265	102	70
1988	369	240	99	20	83	0	125	104	133	110	19	48
1989	0	189	152	70	34	0	0	72	25	109	82	258
1990	216	432	9	46	0	59	36	26	29	206	83	126
1991	241	47	158	125	0	72	0	0	59	82	207	87
1992	16	41	116	124	0	0	0	140	25	97	187	199
1993	164	0	7	81	83	0	0	0	53	140	0	333
1994	298	91	91	142	8	23	0	0	84	207	41	206
1995	299	286	240	13	0	0	0	0	55	96	78	74
1996	188	203	0	6	27	0	41	2	21	118	141	37
1997	0	222	16	14	131	54	0	50	0	105	265	199
1998	206	8	81	140	36	37	17	0	117	155	51	101
1999	243	40	95	89	0	47	3	21	175	179	58	280
2000	72	124	18	123	0	2	28	0	82	209	492	309
2001	289	100	196	52	23	0	27	0	28	165	36	54
2002	188	330	79	81	149	28	57	0	0	105	272	136
2003	140	55	5	71	36	0	0	0	0	70	175	76
2004	248	13	57	90	72	21	0	41	78	260	0	104
2005	88	4	8	64	0	0	0	12	0	122	73	155
2006	18	98	205	39	133	16	0	0	52	225	248	209
2007	178	212	138	0	51	0	93	31	14	0	21	170
2008	276	129	218	99	9	22	18	114	95	77	145	89
2009	234	98	148	46	18	0	43	6	39	93	514	283
2010	17	318	88	4	0	0	38	15	2	163	163	28
2011	120	115	35	1	2	8	82	14	94	62	80	235
2012	88	0	0	210	0	87	0	0	46	115	176	284
2013	124	46	79	61	73	30	0	6	67	163	126	257
2014	391	501	139	0	33	0	9	51	0	116	224	81
2015	204	75	103	0	88	28	8	34	74	28	89	119

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	273	177	136	16	0	20	15	36	1	0	88	0
2017	6	175	131	0	23	38	11	14	111	84	51	231
2018	241	66	248	47	17	11	29	3	35	35	167	199
2019	121	82	216	62	5	7	0	90	85	121	206	346
2020	171	276	168	32	14	80	16	69	25	305	86	300
2021	146	125	94	0	121	0	15	70	0	164	77	174
2022	67	153	14	53	0	10	0	0	17	86	299	178
2023	261	0	229	50	0	0	55	33	112	216	258	221
Ave 1970-2023	168.9	127.9	122.5	56.1	33.6	19.3	17.7	25.9	56.4	118.6	145.5	163.7
Ave 1991-2020	171.4	131.1	107.3	61.1	34.4	21.0	17.8	25.0	50.6	123.2	148.7	172.7

Table H.33 Number of monthly hours of very high atmospheric pressure in Glasgow between 1970 – 2023 (>1029 millibars).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	0	48	58	0	13	0	0	0	0	0	0	225
1971	0	154	128	39	0	0	85	0	21	108	4	192
1972	54	15	61	48	0	0	79	30	86	113	51	76
1973	188	12	288	65	0	62	0	3	8	129	82	32
1974	0	98	1	149	0	0	0	18	0	0	0	25
1975	0	223	29	74	167	131	18	8	0	92	77	109
1976	44	58	30	132	0	5	0	62	0	0	122	40
1977	92	27	32	0	165	58	0	0	166	0	34	38
1978	64	0	0	67	35	0	0	30	15	27	0	0
1979	37	108	0	81	0	56	21	0	42	16	14	27
1980	110	106	7	127	26	0	0	0	0	0	140	34
1981	197	90	0	232	0	21	0	36	13	0	142	46
1982	32	9	91	107	15	0	68	0	0	0	29	43
1983	88	205	30	0	0	148	0	38	24	109	55	32
1984	0	235	178	53	92	0	0	17	0	0	0	59
1985	129	94	68	48	40	15	0	0	0	351	185	0
1986	0	127	2	145	0	3	0	0	97	19	19	49
1987	287	17	85	26	171	0	0	0	20	0	131	106
1988	0	111	0	21	4	3	0	0	138	60	183	144
1989	168	20	0	0	116	33	17	0	77	38	82	130
1990	0	0	146	27	93	0	20	0	66	0	92	199
1991	253	119	115	109	282	0	6	19	105	86	17	385
1992	421	73	20	0	60	88	0	0	0	61	0	133
1993	21	363	89	2	141	0	16	30	19	308	73	0
1994	3	10	0	88	6	79	0	0	0	82	92	69
1995	54	0	46	101	0	142	0	2	0	24	53	210
1996	39	120	85	9	40	83	68	0	55	0	0	102
1997	206	5	104	163	86	34	0	0	88	98	2	66
1998	117	78	187	0	22	0	0	0	66	27	48	46
1999	55	73	0	40	0	0	42	0	0	16	165	0
2000	232	0	163	31	24	0	0	0	0	0	0	0
2001	101	189	0	67	81	0	0	0	0	4	196	334
2002	145	65	54	0	20	0	0	8	116	0	0	186
2003	73	136	184	134	0	0	0	0	34	66	10	131
2004	0	243	129	0	60	29	0	0	90	0	44	0
2005	193	120	105	0	0	90	72	0	0	56	130	161
2006	260	170	72	14	0	54	69	0	20	49	105	209
2007	54	59	47	112	0	30	0	16	98	109	113	231
2008	7	222	22	15	0	0	0	0	132	0	21	234
2009	84	41	151	0	63	32	0	0	166	112	0	86
2010	112	27	164	147	78	25	0	0	0	0	0	76
2011	178	27	262	52	0	64	0	0	0	0	16	3
2012	97	271	296	0	50	0	0	0	5	12	0	28
2013	41	122	30	17	0	83	75	0	0	40	158	37
2014	0	0	89	6	59	57	0	0	2	0	0	73
2015	18	145	181	188	0	81	0	0	143	44	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	11	18	169	30	0	23	0	0	0	187	124	117
2017	206	116	71	143	91	0	0	0	0	45	0	109
2018	33	116	32	0	36	41	3	0	71	34	51	74
2019	223	71	124	53	77	47	11	0	75	46	0	51
2020	119	43	177	32	111	0	0	0	43	55	67	27
2021	54	107	263	236	13	0	23	115	48	41	48	117
2022	291	0	235	79	0	0	68	42	0	16	0	54
2023	142	261	92	100	172	30	0	0	0	0	5	0
Ave 1970-2023	98.8	95.7	92.4	63.1	46.5	30.5	14.1	8.8	39.8	49.6	55.2	91.8
Ave 1991-2020	111.9	101.4	105.6	51.8	46.2	36.1	12.1	2.5	44.3	52.0	49.5	105.9

The monthly frequency of falling atmospheric pressure events of at least 8 millibars lasting 8 hours or more has been analysed from the data between 1970 and 2023 in Glasgow. The monthly frequency of falls are presented in Table H34 on the following page. In Figure H1 below the monthly data are group into frequencies of seasonal average falling pressure events with the average from the climate normal period between 1991-2020. The frequency of falling events are potentially increasing in all seasons. There is a strong linear relationship showing an increasing trend in Winter and Summer, but only a moderate relationship in Spring and Autumn where the overall increase is slight. The linear relationship has been calculated using Pearson Correlation Coefficient of the rolling average between 1980 to 2023. The Pearson Correlation Coefficient for Winter, Spring, Summer, and Autumn are 0.91, 0.65, 0.89 and 0.69, respectively. The analysis indicates that frequency of falling pressure of at least 8 millibars lasting 8 hours is increasing through time. From the analysis completed with the Glasgow data set, the duration of falling atmospheric pressure events are potentially increasing, with strong linear relationships evident in April, May, June, July, August, September, October, and November. However, it is acknowledged further work is required to confirm the frequencies and duration of falling pressures events and to explore regional variance across the UK.

Figure H1. Average seasonal falling pressure events in Glasgow

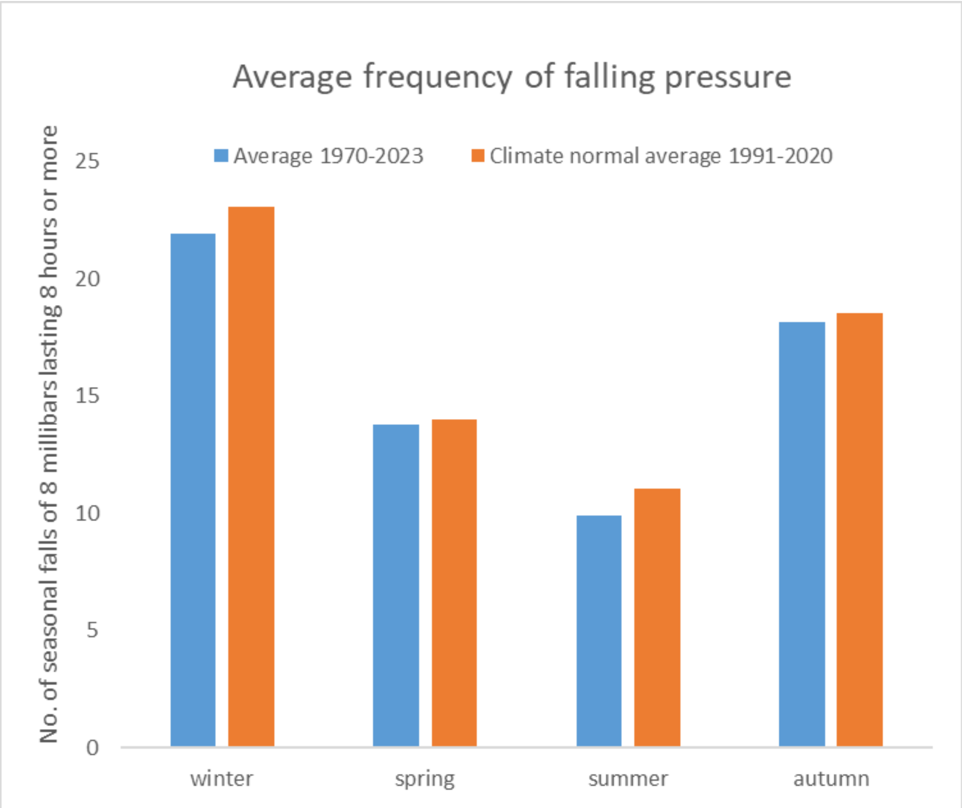

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Table H.34 Number of monthly falling pressure events in Glasgow between 1970 – 2023 of over 8 millibars and lasting 8 hours or longer.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	3	6	9	3	2	1	1	1	4	8	8	6
1971	5	2	3	3	2	2	0	2	0	5	7	2
1972	6	5	5	4	2	3	2	3	1	1	6	6
1973	5	3	5	5	4	1	2	4	1	4	6	7
1974	13	7	2	5	3	2	6	6	8	5	9	11
1975	13	1	3	5	4	2	2	0	7	4	6	7
1976	10	4	5	4	5	2	3	1	2	5	5	5
1977	6	5	7	7	2	2	1	3	7	4	9	8
1978	9	5	8	3	3	2	3	2	6	4	5	7
1979	7	3	6	5	5	3	3	3	8	5	9	11
1980	6	4	6	2	0	2	5	4	5	8	9	11
1981	8	6	8	4	1	5	4	2	10	8	9	5
1982	5	7	8	4	2	3	2	4	5	7	9	7
1983	12	5	9	2	3	3	2	2	6	11	5	8
1984	12	8	3	3	1	4	1	1	5	7	5	6
1985	5	3	8	8	4	6	4	10	8	3	6	7
1986	11	2	6	4	10	4	3	6	2	8	7	13
1987	5	6	7	4	4	3	3	3	6	6	6	5
1988	7	5	7	3	3	1	5	7	6	6	4	7
1989	8	10	11	3	3	4	0	6	3	6	6	7
1990	9	12	8	7	1	5	3	2	5	7	5	8
1991	8	7	6	6	1	5	5	4	6	7	9	6
1992	2	8	10	8	5	1	5	9	4	6	13	7
1993	14	4	4	4	4	2	4	4	1	3	4	11
1994	10	6	10	4	2	6	1	1	3	5	4	10
1995	11	10	9	6	2	2	2	1	4	6	5	4
1996	6	8	3	3	6	2	3	3	4	8	9	5
1997	4	13	8	6	2	5	2	1	6	4	6	8
1998	8	8	6	2	3	5	7	7	4	9	9	11
1999	8	8	5	5	3	5	2	2	7	3	7	10
2000	8	12	5	5	3	4	2	4	6	11	9	6
2001	4	8	5	7	3	4	3	4	6	7	11	6
2002	10	13	5	5	4	4	4	3	1	5	7	5
2003	9	7	2	4	4	3	3	2	5	4	8	7
2004	11	6	7	3	2	4	1	5	5	7	7	8
2005	8	5	4	4	4	6	4	4	8	4	8	6
2006	5	7	8	6	4	2	2	2	7	7	7	9
2007	16	7	6	2	6	1	5	5	7	6	10	8
2008	10	5	9	3	1	3	3	4	4	11	5	7
2009	7	2	6	4	7	2	3	8	3	6	11	7
2010	8	2	7	2	2	1	7	3	4	8	6	4
2011	6	5	5	2	5	5	4	5	6	8	6	12
2012	8	6	3	5	4	5	3	5	5	5	6	8
2013	8	5	3	7	3	5	2	2	3	8	6	11
2014	7	11	7	4	4	0	2	6	0	6	5	7
2015	12	7	9	3	8	4	7	4	4	4	11	11

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	9	6	5	6	3	4	4	4	6	1	6	3
2017	3	8	7	3	2	4	4	5	6	11	8	8
2018	9	6	5	4	2	2	1	5	6	10	7	5
2019	8	7	13	3	3	3	4	5	5	6	6	8
2020	12	12	5	3	2	5	6	5	5	6	8	6
2021	6	7	6	3	5	1	0	1	4	5	6	7
2022	8	11	5	3	4	2	1	3	5	11	9	5
2023	8	8	8	5	1	0	5	3	4	5	7	4
Ave 1970-2023	8.1	6.6	6.3	4.2	3.3	3.1	3.1	3.7	4.8	6.2	7.2	7.3
Ave 1991-2020	8.3	7.3	6.2	4.3	3.5	3.5	3.5	4.1	4.7	6.4	7.5	7.5

Annex I – Probability of rapid falling atmospheric pressure

The following tables provide % scores to the probability of capturing either falling pressure, rapid falling pressure, or very rapid falling pressure during each calendar month in each region. The time series data for all 28 locations between 1st Jan 2017 and 31st Dec 2022 has been used. Assessment criteria is defined from the 3-hr tendencies and a probability score of hourly frequencies equal to and above 1.6 millibars, 3.6 millibars and 6 millibars, respectively. Note that a % probability <0.1 does not mean it is not possible, just that an occurrence is rare based on the 6-year data sets used for each probability calculation.

All results are the probability of exceeding a given threshold and expressed as a percentage. This calculates the cumulative probability that a random value from the normal distribution using the mean and standard deviation being equal to or less than one.

Very rapid falling pressure is more frequent in winter months with occurrences above 6 millibars over the preceding 3 hours tending to be more frequent at higher latitudes. Whilst it is evident that winter storms can potentially extend into spring and autumn in the north, very rapid falling pressure is restricted to December, January, and February in the south. Occurrences of rapid falling pressure is more likely to occur in all seasons except the summer months, and there is a high probability that falling pressure will occur all year.

Table I.1. % Probability scores based on hourly frequencies of a 3hr tendency exceeding 6 millibars or capturing very rapid falling atmospheric pressure.

	North-west	North-east	South-east	South-west
January	89.7	95.8	67.2	64.7
February	99.9	99.9	72.9	56.8
March	35.3	15.9	0.5	0.4
April	<0.1	<0.1	<0.1	<0.1
May	<0.1	<0.1	<0.1	<0.1
June	<0.1	<0.1	<0.1	<0.1
July	<0.1	<0.1	<0.1	<0.1
August	<0.1	<0.1	<0.1	<0.1
September	<0.1	<0.1	<0.1	<0.1
October	4.2	3.9	<0.1	<0.1
November	26.0	27.9	0.1	1.6
December	100.0	95.5	99.1	98.0

Table I.2. % Probability scores based on hourly frequencies of a 3hr tendency exceeding 3.6 millibars or capturing rapid falling atmospheric pressure.

	North-west	**North-east**	**South-east**	**South-west**
January	100.0	100.0	100.0	100.0
February	99.9	100.0	100.0	100.0
March	100.0	100.0	100.0	100.0
April	39.1	55.0	1.7	3.3
May	46.4	39.9	4.4	7.2
June	<0.1	0.1	<0.1	<0.1
July	<0.1	<0.1	<0.1	0.5
August	33.8	20.3	<0.1	<0.1
September	92.9	88.0	72.1	99.9
October	100.0	100.0	99.2	100.0
November	100.0	100.0	99.3	100.0
December	100.0	100.0	100.0	100.0

Table I.3. % Probability scores based on hourly frequencies of a 3hr tendency exceeding 1.6 millibars or capturing falling atmospheric pressure .

	North-west	North-east	South-east	South-west
January	100.0	100.0	100.0	100.0
February	100.0	100.0	100.0	100.0
March	100.0	100.0	100.0	100.0
April	100.0	100.0	100.0	100.0
May	99.9	100.0	100.0	100.0
June	100.0	100.0	100.0	100.0
July	99.5	97.0	97.0	100.0
August	100.0	100.0	100.0	99.8
September	100.0	100.0	100.0	100.0
October	100.0	100.0	100.0	100.0
November	100.0	100.0	100.0	100.0
December	100.0	100.0	100.0	100.0

The following table shows the probability scores for the seven locations from longer term analysis of hourly frequencies of a 3-hour tendency exceeding 3.6 millibars or rapid falling pressure occurring each month (data used from 1st January 1970 to 31st December 2023).

Table I.4. % Probability scores based on hourly frequencies of a 3hr tendency exceeding 3.6 millibars or capturing rapid falling atmospheric pressure .

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	94.1	95.7	93.7	94.3	94.1	94.6	94.2
Feb	85.7	86.3	85.2	85.8	85.1	86.7	86.5
Mar	84.9	86.3	84.5	87.0	88.9	89.5	90.4
April	70.3	73.1	72.0	75.0	76.6	76.2	76.7
May	63.9	65.9	63.5	63.6	62.8	65.8	69.3
June	53.7	58.8	54.9	57.8	62.5	63.8	69.2
July	46.5	53.9	47.5	50.3	53.7	55.4	60.7
Aug	60.8	65.3	61.9	66.5	66.9	66.4	70.0
Sept	68.5	74.7	69.6	77.5	79.2	83.9	86.4
Oct	82.7	85.2	82.5	83.4	84.2	86.9	88.3
Nov	91.9	94.9	93.0	95.3	95.5	96.0	95.5
Dec	92.0	93.1	92.3	93.8	95.2	96.0	95.5

The following table shows the probability scores for the seven locations from longer term analysis of hourly frequencies of very low atmospheric pressure (<997 millibars) (data used from 1st January 1970 to 31st December 2023).

Table I.5. % Probability scores based on hourly frequencies of atmospheric pressure being below 997 millibars, or very low pressure.

	Southampton	St Athan	Northolt	Coleshill	Rostherne	Newcastle	Glasgow
Jan	86.6	88.3	87.6	90.2	91.3	94.4	95.0
Feb	82.5	83.4	83.7	84.8	85.5	86.7	86.7
Mar	83.0	84.3	84.6	87.3	88.6	91.8	92.9
April	76.3	78.9	76.3	78.6	79.8	81.8	83.5
May	72.0	72.5	71.1	72.7	74.1	76.2	78.8
June	61.9	62.7	63.8	64.9	69.7	74.8	77.6
July	61.4	62.7	62.1	64.1	67.8	74.3	74.0
Aug	64.6	70.3	65.0	70.7	73.0	77.5	76.8
Sept	74.1	74.5	74.8	76.1	77.2	81.9	82.7
Oct	85.0	87.2	85.4	88.2	89.1	92.2	94.9
Nov	85.8	86.2	86.3	86.7	87.5	90.4	90.5
Dec	85.9	87.9	87.1	90.4	91.8	95.0	95.9

Annex J – Case Studies

Storm Ciarán (November 2023)

Whilst the worst impacts of Storm Ciarán occurred across Northern France and the Channel Islands, it was an exceptionally severe storm affecting the Southern coast of England for the time of year. Figure J.1 below shows the track of falling pressure across the south coast from Falmouth to Eastbourne between 12:00 on 1st November to 23:00 on 2nd November 2023. A minimum atmospheric pressure was recorded in Weymouth at 952.8 millibars at 05:00 on 2nd November 2023 and a low pressure of 953.1 millibars was also recorded in Southampton at 06:00. This was the lowest recorded atmospheric pressure for November in Southampton from analysis of monthly minimum atmospheric pressures between 1970 and 2023. During the same period, only one lower monthly pressure in Southampton has been recorded, which was 951.1 millibars on 25th February 1989. The average minimum pressure for November at Southampton between 1970 and 2023 is 984.9 millibars. The atmospheric pressures associated with Storm Ciarán were exceptionally low for the south of England and time of year.

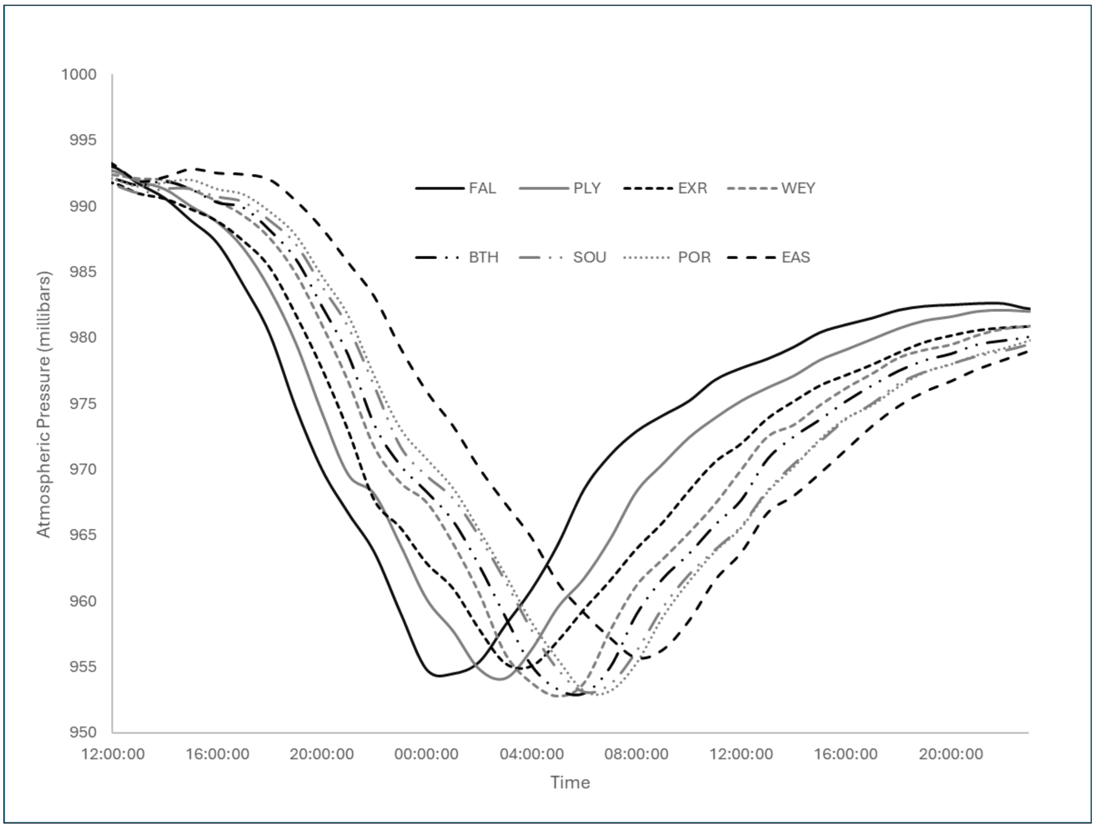

Figure J.1 Atmospheric pressure during Storm Ciarán across the Southern coast of England (West to east - Falmouth, Plymouth, Exeter, Weymouth, Bournemouth, Southampton, Portsmouth, and Eastbourne). The minimum atmospheric pressures recorded are plotted longitudinally in Figure J.2.

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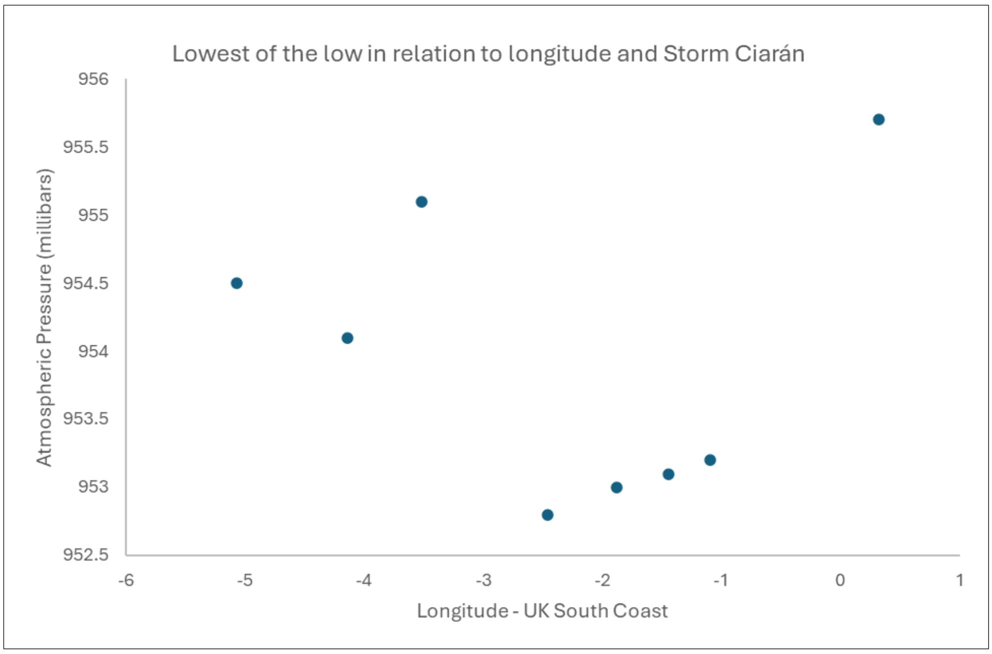


Figure J.2 Minimum low atmospheric pressure associated with Storm Ciarán in relation to longitude across the English south coast.

The rate of falling pressure was also significant with a maximum 3-hour tendency of 14.1 millibars recorded at Plymouth and Exeter at 21:00 and 22:00, respectively on 1st November 2023 as Storm Ciarán approached from the west. As Storm Ciarán passed over there were ten consecutive hours of very rapid falling pressure (a 3-hour tendency of >6 millibars), with the most significant fall of 38.5 millibars over 13 hours recorded at Falmouth – which included a fall of 25.5 millibars over 6 hours. Figure J.3 provides the maximum rates of fall (3-hour tendencies) at each location.

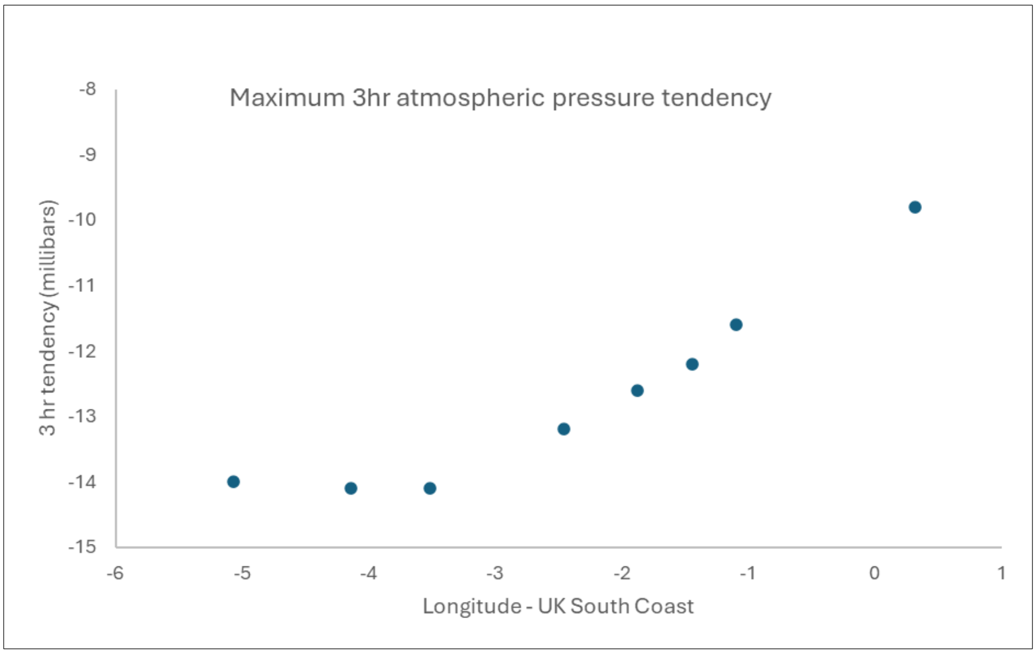


Figure J.3 Maximum rate of falls calculated as 3-hour tendency during Storm Ciarán.

The maximum rate of falls occurred in the west as Storm Ciarán approached the UK, with the lowest atmospheric pressures occurring where the centre of the depression began to track across land.

For a meteorological synopsis of Storm Ciarán refer to:

https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-storm-centre/index

Storm Lilian (August 2024)

It is meteorological convention to name storms, which run in alphabetical order from 1st September to the end of August. The 2023/24 season contributed twelve named storms, and this is the highest number of storms in a single season since naming storms started in 2015[4]. This case study summarises atmospheric pressures associated with the last-named storm of that season - Storm Lilian which occurred between 21st August and 23rd August 2024. Analysis has been completed of the atmospheric pressure regimes for all twenty-eight locations used in this technical note, including the minimum atmospheric pressures and rate of falls recorded over this period (expressed as 3-hour tendencies and average rate of fall calculated over an 8-hour refence period). Table J.4 on the following page provides a synopsis of minimum pressure and maximum rate of falls at each location. The key for Table J.4 is as follows:

- A- Location latitude °N.
- B- Minimum atmospheric pressure recorded.
- C- Maximum rate of fall (3-hour tendency).
- D- Maximum rate of fall (averaged rate of fall over an 8-hour reference period).
- E- 95th percentiles for August (from analysis completed in this technical note).
- F- The difference between D minus E.

Table J.4 Summary of minimum atmospheric pressures and maximum rate of falls associated with Storm Lilian.

	A	B	C	D	E	F
Wick	58.4	982.9	5.0	1.19	0.76	0.43
Ullapool	58.0	982.5	5.9	1.16	0.80	0.36
Aviemore	57.3	984.4	5.3	1.23	0.87	0.36
Aberdeen	57.1	986.1	5.1	1.25	0.86	0.39
Forfar	56.6	986.4	5.3	1.29	0.80	0.49
Edinburgh	56.1	987.3	5.8	1.36	0.82	0.54
Glasgow	55.9	987.9	6.0	1.41	0.86	0.55
Newcastle	55.0	981.7	8.7	1.82	0.81	1.01
Carlisle	54.9	982.3	8.2	1.80	0.87	0.93

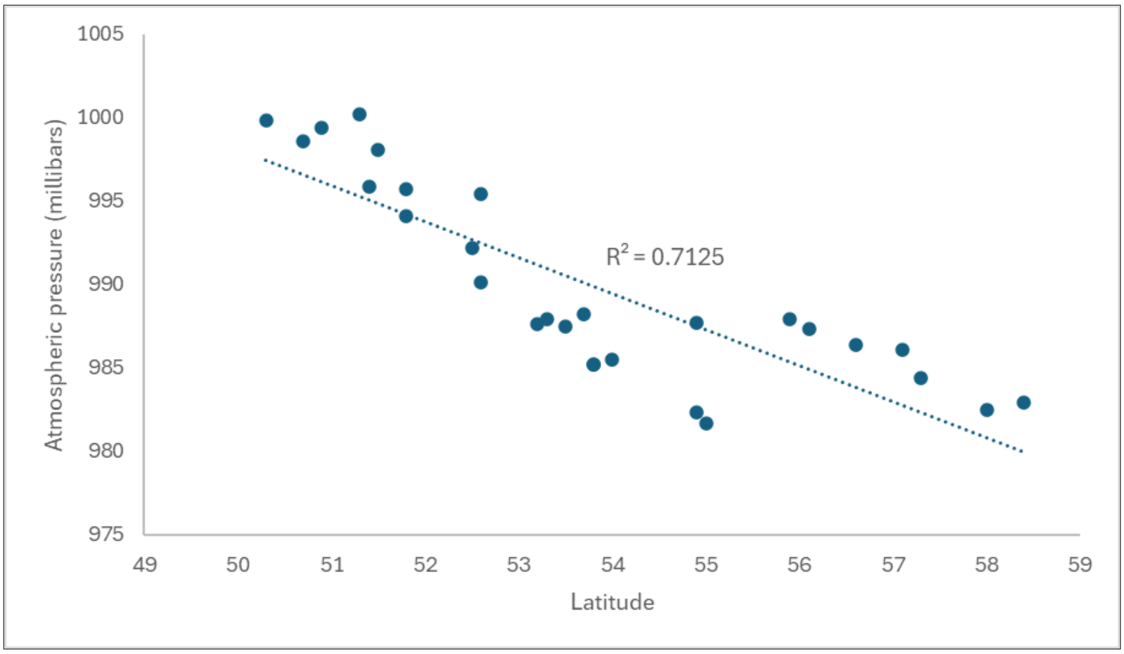
[4] https://www.bbc.co.uk/weather/articles/c1w7zl30dq5o

Stranraer	54.9	987.7	5.6	1.34	0.86	0.48
York	54.0	985.5	7.6	1.56	0.85	0.71
Blackburn	53.8	985.2	8.0	1.68	0.90	0.77
Blackpool	53.8	985.2	8.5	1.68	0.84	0.83
Hull	53.7	988.2	6.7	1.38	0.88	0.50
Sheffield	53.5	987.5	6.8	1.51	0.83	0.68
Rostherne	53.3	987.9	7.1	1.55	0.80	0.75
Chester	53.2	987.6	7.6	1.56	0.84	0.72
Newtown	52.6	990.1	6.4	1.43	0.83	0.60
Norwich	52.6	995.4	3.4	0.78	0.74	0.04
Coleshill	52.5	992.2	4.6	1.15	0.96	0.19
Carmarthen	51.8	994.1	5.0	1.14	0.90	0.24
Oxford	51.8	995.7	3.7	0.89	0.91	-0.02
Northolt	51.5	998.1	3.0	0.74	0.87	-0.13
St Athan	51.4	995.9	4.6	1.00	0.87	0.13
Canterbury	51.3	1000.2	2.7	0.70	0.79	-0.09
Southampton	50.9	999.4	2.9	0.73	0.79	-0.06
Exeter	50.7	998.6	3.7	0.81	0.86	-0.05
Truro	50.3	999.8	3.7	0.88	0.94	-0.06

Although there is a relationship between low pressure and latitude (refer to Figure J.5 below), the extent of low pressures and the rate of falls are further influenced by tracking position of the depression across the UK. The lowest atmospheric pressure and highest rate of fall were recorded at Carlisle and Newcastle. The lowest pressure of 981.7 millibars was recorded at Newcastle, which is considered very low, and especially for August. The average August minimum atmospheric pressures recorded at Newcastle between 1970 and 2023 is 994.7 millibars, with only one other reference to a lower pressure of 975.8 millibars recorded in August 1992.

Out of the 28 locations 22 exceeded the 95th percentile for August, confirming worst-case conditions occurring for the time of year. Moreover, and with consideration to the annual UK average 95th percentile set at 1.11 millibars per hour, 20 locations still exceeded this worst-case threshold, with only locations in the south and south-east not capturing worst-case conditions applicable to the average over the entire year.

Figure J.5. provides a reference to all minimum atmospheric pressures recorded in relation to latitude.



With reference to the probability scores presented in Annex I, it is unusual for rapid falling pressure to occur at this time of year, with minimal occurrence predicted only in the north. From the 28 locations used for the analysis only 4 did not experience a period of rapid falling pressure during Storm Lilian (falling pressure at 3.6 millibars or above over the preceding 3 hours – 3-hour tendency), and all these were in the south-east region. It is also evident that very rapid falling pressure (>6 millibars – 3-hour tendency) was recorded at 11 locations, including a maximum 3-hour tendency of 8.7 millibars recorded at Newcastle. In August between 1970 to 2023, very rapid falling pressure has only been recorded during six separate falling pressure events (in 1970, 1973, 1979, 1985, 1992 and 2020). A maximum 3-hour tendency recorded during all these events was 8.5 millibars in 1985, which makes the rate of falling pressure during Storm Lilian a new record for August (for Newcastle – analysis for other locations has not been completed).

Whilst significant falling pressure can occur during August, such a rate of fall and combined with very low pressure is not expected to occur at this time of year.

For a meteorological synopsis of Storm Lilian refer to:

https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-storm-centre/index

Storm Noa (April 2023)

Storm Noa occurred on 12th April 2023 and provides an example of an unusually severe storm for the time of year. With wind gusts over 58mph it brought down trees and power lines and caused widespread disruption to the road and rail network. It was the most notable April storm for wind since 17th April 2013. But how did atmospheric pressure compare for this time of year? With reference to the analysis completed between 2017 and 2022, the worst-case rate of falls in April during this period were potentially below average, and especially in relation to the low pressures and frequency of falls recorded. Table J.6 below provides a synopsis of minimum pressure and maximum rate of falls during Storm Noa at the seven locations used for the longer-term analysis in Annex H. The key for Table J.6 is as follows:

- A- Minimum atmospheric pressure recorded.
- B- Averaged of all minimum atmospheric pressures for April between 1970-2023.
- C- Maximum rate of fall (3-hour tendency).
- D- Maximum rate of fall (averaged rate of fall over an 8-hour reference period).
- E- 95th percentiles for April (from analysis completed in this technical note).
- F- Consecutive hours of rapid falling pressure (>3.6 millibars – 3-hour tendency).

Table J.6 Summary of minimum atmospheric pressures and maximum rate of falls associated with Storm Noa.

	Southampton	**St Athan**	**Northolt**	**Coleshill**	**Rostherne**	**Newcastle**	**Glasgow**
A	989.0	986.7	988.3	984.2	980.5	983.2	980.2
B	993.5	992.0	993.2	991.6	990.7	990.0	989.2
C	7.2	8.7	6.4	8.0	9.1	9.0	7.9
D	1.61	1.88	1.56	1.86	2.16	2.38	2.16
E	0.62	0.64	0.64	0.82	0.76	0.71	0.74
F	5	5	6	6	8	8	9

The analysis in Table J.6 has been focused from 09:00 on 11th April for a 24-hour period. The duration of each fall was variable and coincided with a relatively short period of falling pressure overall. A low pressure of 980.2 millibars was recorded in Glasgow but the rate of fall was more significant in Newcastle, with a similar fall in millibars over a shorter period. The minimum recorded pressures were all below the average calculated from all the minimum pressures recorded during April between 1970 and 2023 and the rate of falling pressure exceeded the 95th percentiles in all locations. However, the deepest low-pressure system recorded in April since 1970 was on 1st April 1994. Table J.7 below provides the same synopsis of the pressure regime associated with the storm. Whilst a similar analysis has been completed, the meteorological conditions over the preceding days were unsettled with rapid falling pressure noted in the timeline at the end of March, especially at locations in the North. A low pressure of 964.1 millibars was recorded at Rostherne, which is almost 27 millibars below the climatological average for minimum atmospheric pressure for that location in April. The rate of falling pressure was also significant with a 3-hour tendency of over 10 millibars. However, rapid falling pressure was not recorded during the same period in Glasgow and worst-case conditions were not exceeded (95th percentile).

Table J.7 Summary of minimum atmospheric pressures and maximum rate of falls associated with the deep depression on 1st April 1994.

	Southampton	**St Athan**	**Northolt**	**Coleshill**	**Rostherne**	**Newcastle**	**Glasgow**
A	974.2	969.5	972.1	965.3	964.1	966.4	970.2
B	993.5	992.0	993.2	991.6	990.7	990.0	989.2
C	9.8	10.4	9.8	10.5	10.3	7.0	2.7
D	2.46	2.69	2.56	2.73	2.58	1.73	0.66
E	0.62	0.64	0.64	0.82	0.76	0.71	0.74
F	8	8	8	9	8	6	0

The potential for worst-case conditions, in terms of low and rapid falling pressure, are likely to be regionally variable with extreme conditions possible in any month.

For a meteorological synopsis of Storm Noa refer to:

https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-storm-centre/index

The Loscoe event (March 1986)

The importance of atmospheric pressure in driving ground gas migration proceeded the Loscoe enquiry and has been reiterated in multiple guidance documents since. We know that falling atmospheric pressure was the key driver in landfill gas migration that led to accumulation of ground gas in the void space below 51 Clarke Avenue and subsequent explosion at approximately 06:30am on 24th March 1986. Although there were no fatalities, the three occupants inside were injured and the house was destroyed. We know from the public inquiry that the rate of falling pressure was significant and noted to be a 29 millibar fall over 7 hours, with an average fall of 4 millibars per hour leading up to the incident. The atmospheric pressure regime and the rate of fall (3-hour tendency) either side of 24th March is plotted in Figure J.8 below, with time reference to when the explosion occurred (dotted line). The rate of fall peaked at 06:00 just immediately before the explosion with a fall of 14.3 millibars over the preceding 3 hours recorded. Atmospheric pressure continued to fall after the incident occurred to a low of 958.4 millibars at 11:00. In total, 10 consecutive hours of very rapid falling pressure was recorded either side of the explosion.

Table J.9 provides a summary of the falling pressure from 22:00 on 23rd March (prior to pressure falling rapidly) to 12:00 on the 24th and when pressure began to rise.

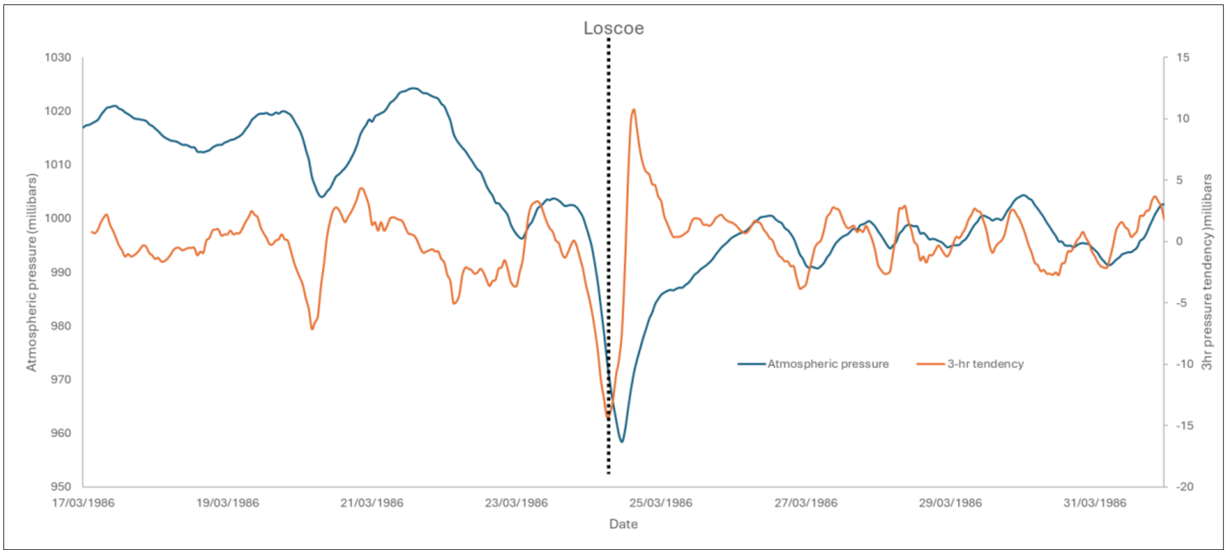


Figure J.8 Falling pressure regime associated with the Loscoe event. The dotted line denotes the time of the explosion..

Table J.9 summary of falling atmospheric pressure and 3-hour tendencies at Loscoe on 23rd and 24th March 1986

Time	Pressure	1 hour change	3-hour tendency	Average 8-hour rate of fall
22:00	1000.2	-1.0	-2.2	-0.39
23:00	998.5	-1.7	-3.5	-0.54
00:00	996.7	-1.8	-4.5	-0.70
01:00	994.5	-2.2	-5.7	-0.99
02:00	991.3	-3.2	-7.2	-1.40
03:00	987.7	-3.6	-9.0	-1.84
04:00	983.2	-4.5	-11.3	-2.35
05:00	978.5	-4.7	-12.8	-2.84
06:00	973.4	-5.1	-14.3	-3.35
07:00	969.2	-4.2	-14.0	-3.66
08:00	965.6	-3.6	-12.9	-3.89
09:00	962.5	-3.1	-10.9	-4.00
10:00	959.6	-2.9	-9.6	-3.96
11:00	958.4	-1.2	-7.2	-3.66
12:00	960.7	2.3	-1.8	-2.81

all data in millibars

Note: the data is just a segment from the time sequence of changing pressure which is calculated from data earlier in the timeline.

Annex K - Additional Notes:

K.1 – Atmospheric pressure and altitude

Atmospheric pressure will decrease with altitude at approximately 1.2 millibars per every 10 metres gained in height. A conversion of surface pressure to sea level pressure would require a barometric equation that considers the temperature lapse rate. Assuming a standard temperature and lapse rate, a simplified formula to use for a minor change in elevation is:

Sea level pressure = surface pressure + (altitude(m)/8.3)

An example being a surface pressure measurement of 980 millibars at 100m above sea level would calculate at 992.05 millibars when standardised to sea level pressure.

https://www.metoffice.gov.uk/weather/guides/observations/how-we-measure-atmospheric-pressure

ggs
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K.2 – Defining Low and high pressure

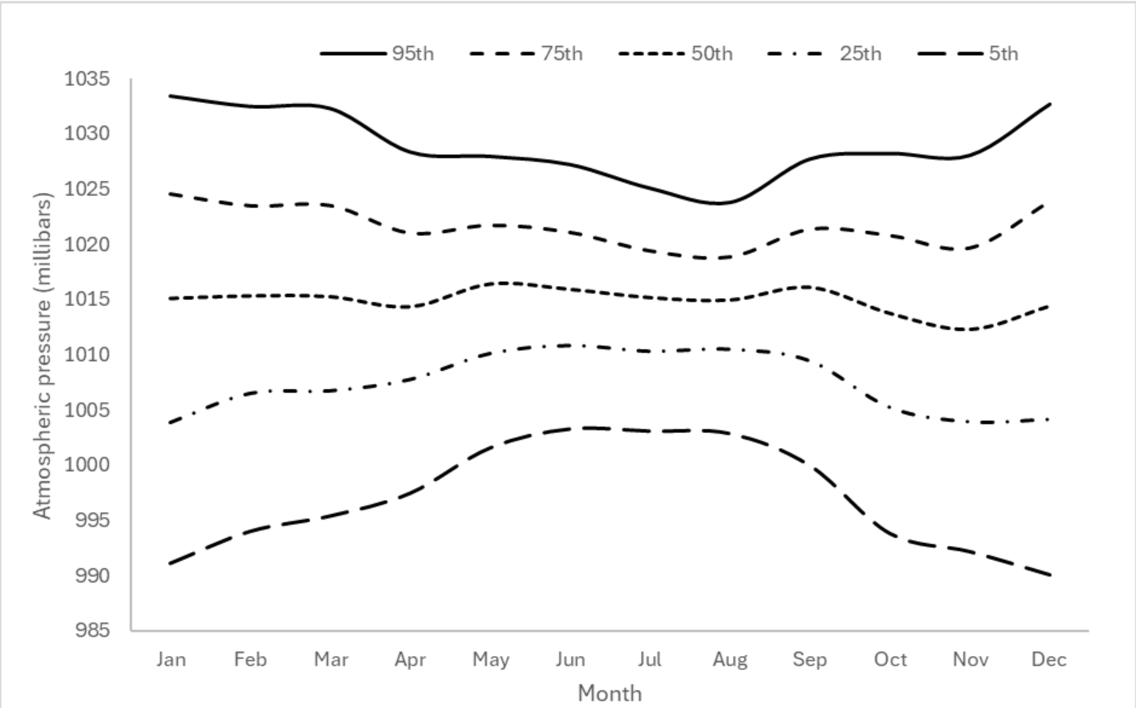
Atmospheric pressure was segmented into five distinct categories. Time series data of atmospheric pressure from the seven selected UK sites used for longer-term analysis presented in Annex I (between 1st January 1970 to 31st December 2023 at Southampton, St Athan, Northolt, Coleshill, Rostherne, Newcastle, and Glasgow), has been used to define each segment in millibars. This has been completed using monthly percentiles of each data set to provide an overall UK annual average from the climate normal period (1991 to 2020) and statistical banded categories of:

Very high pressure >95th percentile (>1029 millibars).
High pressure >75th percentile <95th percentile (>1022 and <1029 millibars).
Normal pressure >25th percentile < 75th percentile (interquartile range) (>1008 and <1022 millibars).
Low pressure >5th percentile <25th percentile (>997 and <1008 millibars).
Very low pressure <5th percentile (<997 millibars).

In all cases, and to simplify banded categories, averages have been rounded to the nearest millibar. This approach would be relevant to use in different geographical locations to define each banded category.
Table K.2 on the following page provides the averaged percentiles for each banded category used to define very high, high, normal, low, and very low atmospheric pressure in the UK. The median values are also presented.

Table and Figure K.2 Percentiles for defining banded categories for low, high, and normal atmospheric pressure.

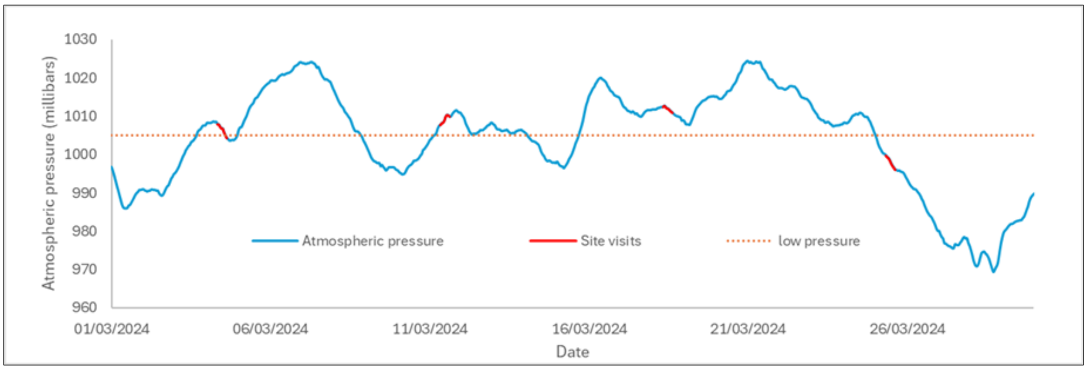
	95th percentile	75th percentile	Median	25th percentile	5th percentile
Jan	1033.4	1024.5	1015.1	1003.9	991.1
Feb	1032.5	1023.5	1015.3	1006.5	994.0
March	1032.3	1023.5	1015.2	1006.8	995.4
April	1028.4	1021.0	1014.3	1007.8	997.5
May	1028.0	1021.7	1016.4	1010.1	1001.6
June	1027.2	1021.1	1015.9	1010.8	1003.3
July	1025.1	1019.4	1015.2	1010.3	1003.1
August	1023.8	1018.8	1014.9	1010.5	1002.8
Sept	1027.7	1021.3	1016.1	1009.5	999.9
Oct	1028.2	1020.8	1013.7	1005.2	993.8
Nov	1028.1	1019.7	1012.3	1003.9	992.2
Dec	1032.7	1023.9	1014.4	1004.2	990.1
Ave	1028.94	1021.59	1014.89	1007.47	997.06



K.3 – Period Monitoring

For periodic monitoring assessments, this simple step will provide a level of confidence to whether sufficient data has been collected over a given monitoring period in terms of the atmospheric pressure regime. It is likely that there would be a requirement to undertake continuous ground gas monitoring to fully understand the gas regime on many sites, especially in the context of key environmental drivers, and thus supporting the development a robust gCSM. However, the sequence of periodic monitoring visits can be plotted in the context of the atmospheric pressure regime using historical and assimilated time series data from an online provider (e.g., Open Meteo[5]). The 3-hour tendency can also be plotted to provide an understanding to the rate of atmospheric pressure change during and preceding each site visit. The 3-hour tendency is the pressure change in millibars over the preceding three hours.

Figure K.2 below provides an example of targeted site visits for periodic ground gas monitoring in the context of the atmospheric pressure regime and the 3-hour tendency.



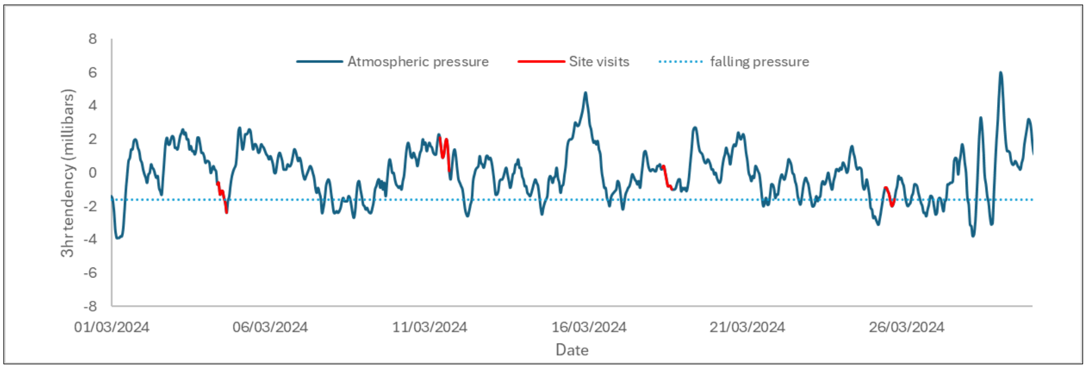


Figure K.2 Time series atmospheric pressure data and periodic monitoring visits. Each site visit was completed on a Monday throughout March 2024, providing evidence to both falling and low pressure during each visit. In this example, the sequence of visits would capture both low and falling pressure in reference to available guidance.

[5] https://open-meteo.com/

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Whilst there could be multiple scenarios for a periodic monitoring visit in relation to atmospheric pressure change, the example set out in Figure K.2. would capture rising and falling pressure and low pressure. The monitoring points would provide some understanding to ground gas behaviour and the gas conceptual site model but an understanding to whether worst-case pressure conditions are relevant is often needed to provide the level of confidence to the risk assessment. This is not always achievable with standalone periodic monitoring data. For example, capturing a period when atmospheric pressure is falling rapidly during a site visit is routinely difficult. It is also important to consider the atmospheric pressure regime over the preceding hours/days of a site visit, as this will often influence the gas regime at the point of measurement. Dependent on the potential gas source and geological pathway/s, the behaviour and concentrations of ground gas and flow are often reliant on hysteresis and the pressure trend prior to the monitoring visit. Occasionally, precipitation, temperature and wind can additionally influence the results from ground gas monitoring. All these environmental parameters are available from an online historical data provider, helping to build a robust gas conceptual site model using periodic data.

K.4 – The North Atlantic Oscillation

The common pressure features seen in the North Atlantic Ocean are for large regions of high pressure centred over the Azores (west of Portugal, known as the sub-tropical or Azores high) and low pressure centred over Iceland (the sub-polar or Icelandic low). The North Atlantic Oscillation (NAO), often referred to the Winter Atlantic Pressure Gradient, describes the relative changes in pressure between these two regions (Azores minus Iceland). This pressure gradient is responsible for much of the variability in weather experienced in the UK and Europe, with the strength of the gradient between these two regions influencing the position of the Jet Stream. When the pressure difference is large, unsettled conditions tend to be directed towards the UK. In contrast, stable conditions tend to be the dominant feature when the pressure difference is small, with unsettled conditions directed further south of the UK. The NAO will be a feature of UK weather throughout the year but tends to be dominant during the winter. The NAO index is calculated as a seasonal mean of the difference in sea-level pressure between Iceland and Gibraltar.

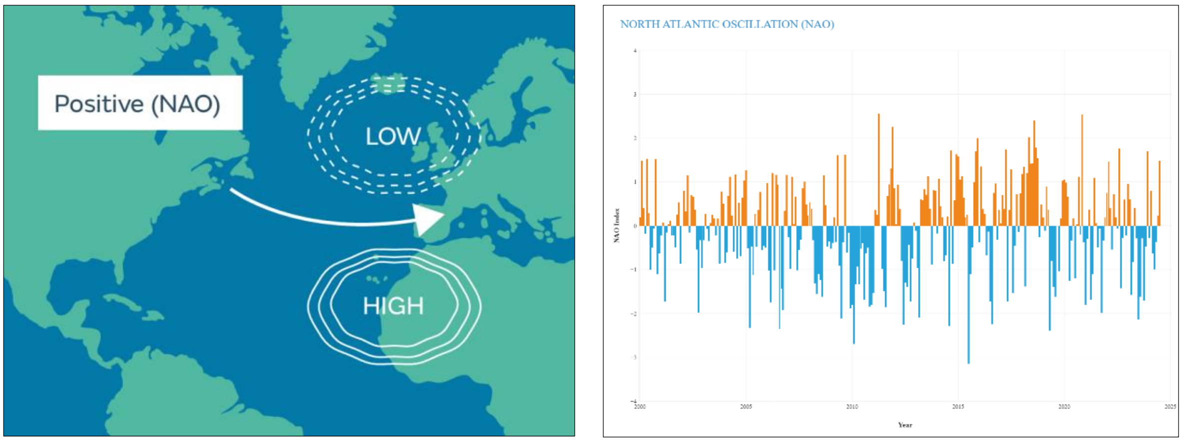

Figure K.3. Either a positive and negative NAO is recorded using the NAO index, with a positive recorded when there is a large pressure difference and negative when the pressure difference is low. The NAO is characterized by positive and negative events that can last for several months, separated by periods of near-neutral conditions. The strength and spatial shape of these events depend on the NAO index prior to the event. The NAO can influence meteorological conditions on a yearly basis, or fluctuations can take place decades apart. The right-hand graph plots the NAO index since year 2000, with clear variability between a positive or negative index.

https://ncas.ac.uk/how-do-the-north-atlantic-oscillation-and-east-atlantic-pattern-shape-our-weather/

Image left: https://www.metoffice.gov.uk/weather/learn-about/weather/atmosphere/north-atlantic-oscillation

Image right: https://www.climate.gov/news-features/understanding-climate/climate-variability-north-atlantic-oscillation

K.5 - Open Meteo:

Open-Meteo is a weather API that operates on an open-source basis and provides free access for non-commercial purposes. The Historical Weather API is based on reanalysis datasets and uses a combination of weather station, aircraft, buoy, radar, and satellite observations to create a comprehensive record of past weather conditions. The API allows users to retrieve historical weather data for a specific location and time in an 9km grid spatial resolution.

Zippenfenig, P. (2023). Open-Meteo Weather API https://open-meteo.com/en/docs/historical-weather-api