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Christopher J. White and Enric Aguilar

State of the UK Climate in 2025

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- Projections of the future state of the climate system
- Interplay between climate variability and change
- Implications of regional studies for the greater knowledge of the climate system
- Relationships from larger and longer climate scales to localised scales

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Cover Images:

Left: Sweet chestnuts collected in Devon during autumn 2025. 2025 was a 'mast' year with bumper crops of fruits or nuts for several species (see Section 8). Image: Mike Kendon, Met Office.

Right: Exceptionally low water levels for the time of year at Haweswater in the English Lake District on 16th May 2025. Parts of Mardale village, which was flooded when the reservoir was first constructed, can be seen re-emerging. Cumbria and Lancashire were among several areas declared in drought status by the Environment Agency in 2025. Image: David Spiby, Environment Agency.

COUNTRY REPORT OPEN ACCESS

State of the UK Climate in 2025

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The outstanding feature of the weather of June was its abnormal dryness. ... The fall for the month amounted to less than 6% of the average over the whole of England and Wales if parts of the extreme north and eastern counties from the Wash to Beachy Head were excepted. ... In many districts in the south and south-west of England and in the south of Wales the month was rainless.

An example of an exceptionally dry month 100 years ago: extract of text for June 1925 from the Met Office Monthly Weather report (Met Office 1926). In the current version of the HadUK-Grid dataset, England and Wales combined recorded 4.1 mm, 6% of the 1991–2020 June average, and this is the driest June for the UK in the series from 1836 to 2025.

Introduction

This report provides a summary of the state of the UK's climate in 2025. It is one of a series of annual reports published in the International Journal of Climatology (IJC) since 2018, with the series as a whole starting with a summary of 2014. It presents the latest assessment of UK climate trends, variations and extremes based on the most up to date observations. These observations represent 'ground truth', telling us what has already happened to our climate. As we enter the second quarter of the 21st Century, this report is an opportunity to take stock of the observational evidence of climate change in the UK.

The majority of observations presented are from the UK's network of weather stations, managed by both the Met Office and a number of key partners and cooperating volunteers. They conform to current best-practice observational standards as defined by the World Meteorological Organization (WMO). They also pass through a range of quality assurance procedures at the Met Office before application for climate monitoring.

The report also includes sections covering the following with further details given in Appendix A.1.

- Sea-surface temperatures around the UK in 2025 and warming trends;
- River flows across the UK in 2025 and trends in low and high flows;
- Trends in UK sea-level and storm surges in 2025;
- Yields of wild seeds as an example of Climate and Nature interactions.

This report and the UK's climate monitoring capability would not be possible without these observations, emphasizing the vital importance of maintaining observation networks, particularly the UK's land weather station network, into the future as our climate changes. This also applies to the other sections listed above. Observations cannot be made retrospectively. The UK's extensive observational records back to the 19th Century provide evidence that scientists from previous generations

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clearly recognized the importance of maintaining this capability. Of equal importance is the systematic quality control and storage of these observations in a database so these are available for both current and future scientists. No observational network or database can be perfect but taken collectively this dataset provides overwhelming evidence of our changing climate.

National, regional and county statistics are from the HadUK-Grid dataset of gridded climate data which is the principal data source (Hollis et al. 2019). Monthly temperature, rainfall and sunshine series from the HadUK-Grid dataset extend back to 1884, 1836, and 1910, with daily temperature and rainfall back to 1931 and 1961 respectively. The appendices provide details of the datasets used and how the series presented are calculated.

This report presents summary statistics for the most recent year (2025) and decade (2016–2025). The most recent decade represents a 10-year ‘snapshot’ of the UK’s current climate from a climate change perspective. This period’s relatively short length means that statistics for the latest decade may reflect shorter-term seasonal to decadal variations as well as longer term trends. Even so, our climate is changing sufficiently fast that the climate of 2025 may be considered different to that of 2016, and this 10-year snapshot is a compromise between these two competing factors. When considering the variability in the UK’s climate, it is perhaps helpful to consider the observational series presented in this report as one realization of an ensemble of possible outcomes which, taken together, represent the UK’s climate overall.

We compare the most recent year and decade against the 30-year standard climate averaging period 1991–2020 and the baseline period 1961–1990, following World Meteorological Organization climatological best practice (WMO 2017). 1961–1990 is widely used for historical comparison, climate change monitoring and climate modelling. We also include averages for 1931–1960 (for temperature, temperature indices, e.g., days of air frost and sunshine) and 1901–1930 and 1931–1960 (for rainfall), to better encompass the UK’s climate of the 20th Century. The full series provide longer-term context, while a comparison is also made to centennial averages for the Central England Temperature (CET) series from 1659.

Arguably, the way we experience the main effects of climate change in the UK is through the extremes; changes in averages alone (e.g., annual mean temperature or rainfall) fail to provide a sufficiently complete picture of the changing character of the UK’s climate. This report includes new analyses of trends in temperature and rainfall, providing a fresh perspective, particularly focussing on these extremes. For rainfall, any analysis is particularly challenging given the complexity of this variable due to large spatial and temporal variability.

Throughout the report’s text the term ‘above/below average’ refers to the 1991–2020 reference period unless otherwise stated. ‘Average’ can sometimes be used synonymously with ‘normal’, for example by the WMO—although for temperature and rainfall recent observations suggest this period can no longer be considered as ‘normal’ for the UK’s current climate, and the concept of ‘average’ or ‘normal’ is awkward in a

non-stationary climate. Indeed, in the last few decades, what has become ‘normal’ is the ongoing steady rise in temperatures in the observational record.

Maps of actual (i.e., absolute) values of climate variables (e.g., rainfall totals in mm) are often dominated by the underlying climatology, which is strongly influenced by elevation and distance from the coast. For this report, this is of lesser interest than the year-to-year variability. The majority of maps are therefore anomaly maps which show the spatial variation in difference from average.

To prevent the report becoming excessively long, several sections have been temporarily dropped this year, where the only addition from the 2024 report is an extra data point for the year 2025. For these, readers may refer back to State of the UK Climate in 2024 (Kendon et al. 2025).

Artificial Intelligence (AI) has not been used for any data analysis, interpretation or text within this report.

Notes and Definitions

Seasons and half-years: The four meteorological seasons are defined as DJF, MAM, JJA, SON. Winter and summer half-years are defined as ONDJFM and AMJJAS. Winter 2025 is defined as December 2024 to February 2025; the 2025 winter half-year is defined as October 2024 to March 2025 and so on.

Rounding: Values quoted in tables throughout this report are rounded, but any differences between two such values are calculated from the original unrounded values. The precision of values quoted (i.e., number of decimal places) depends on the variable and period.

Corrections to State of UK Climate in 2024

In Figure 19 showing UK near-coast sea-surface temperature the uncertainty range was stated incorrectly in the caption. This showed the 95% uncertainty range (i.e., 2.5% to 97.5%) accounting for bias correction uncertainty only. This error also applies to earlier reports, for 2022 onwards. The corresponding figure in this report has been updated to show the estimated 95% uncertainty range including all sources of uncertainty. The main message from the figure is unchanged.

Feedback

We welcome any suggestions for future publications of this report. Please send any feedback to the Met Office at ncic@metoffice.gov.uk.

Executive Summary

Observations continue to show unprecedented changes in the UK’s climate. Recent decades have been warmer, wetter and sunnier than the 20th Century.

Temperature

The UK's climate has warmed at approximately 0.25°C per decade since the 1980s. Changes can be seen on annual, seasonal, monthly and daily timescales, with extremes affected most.

- 2025 was the warmest year in the UK series from 1884, with the last 4 years in the top five warmest. This is the sixth time this century this record has been set.
- 2025 included the UK's warmest spring and summer, with the six months, March to August, all in the top ten warmest of their respective monthly series.
- The most recent decade, 2016–2025, has been 0.51°C warmer than 1991–2020, and 1.33°C warmer than 1961–1990, with warming extending northwards and uphill.
- The number of days over 30°C and nights over 18°C has more than quadrupled for Greater London for the most recent decade, 2016–2025, compared to 1961–1990.
- The average hottest day of the year has warmed by over 4.5°C in a swathe from Kent to Lincolnshire for the most recent decade, 2016–2025, compared to 1961–1990.
- The number of 'icing days' (maximum temperature below 0°C) has more than halved for the UK for the most recent decade, 2016–2025, compared to 1961–1990, and the number of hard frosts (minimum temperature below –8°C) has reduced by a factor of more than four.

Central England Temperature

The Central England Temperature (CET) findings support those for the UK with a multi-century perspective.

- The CET series shows that recent warmth has far exceeded any observed temperatures in at least 300 years.
- Recent changes in the frequency of UK daily maximum and minimum temperature extremes are supported by similar changes in the 250-year daily CET series.

Air and Ground Frost

Air and ground frosts have steadily declined from the 1980s onwards, reducing by around a quarter

- The most recent decade 2016–2025 has had almost a week fewer air frosts per year than the 1991–2020 average and over 2 weeks fewer than 1961–1990 and 1931–1960.
- The most recent decade 2016–2025 has had 1½ weeks fewer ground frosts per year than the 1991–2020 average and 4 weeks fewer than 1961–1990.
- Days of air and ground frost in 2025 were below the 1991–2020 average—although not exceptional.

Growing Degree Days

Growing degree days have steadily increased from the 1980s onwards. However, other factors such as rainfall and sunshine will also be important for plant growth.

- The most recent decade 2016–2025 has had 9% more growing degree days than 1991–2020 and 24% more than 1961–1990.
- Growing degree days in 2025 were the highest on record in the UK series from 1931. Six of the 10 highest GDD years have occurred in the most recent decade 2016–2025.

Near-Coast Sea-Surface Temperature (SST)

UK near coastal waters have warmed steadily since the 1980s onwards at a rate slightly lower than the warming rate over UK land. This trend has led to an increased risk of marine heatwaves.

- The most recent decade (2016–2025) has been on average 0.3°C warmer than the 1991–2020 average and 1.0°C warmer than 1961–1990 for UK near-coast SST.
- Five of the 10 warmest years for UK near-coast SST in a series from 1870 have occurred in the most recent decade 2016–2025. 2025 was the second warmest year, behind 2023.
- 2025 was the warmest year across a larger area of the Northwest European seas and the Northeast Atlantic in a series from 1982.
- There were 297 marine heatwave days for Northwest European seas and the Northeast Atlantic in 2025, more than any other year since 1982 and exceeding the previous record of 178 days in 2023 by a wide margin.

Rainfall

The UK's climate has become steadily wetter from the 1980s, due to an increase in winter half-year rainfall. There is some evidence for increases in the frequency of very wet months and days.

- 2025 was a relatively dry year overall but not exceptional. Rainfall deficits in spring and summer partially recovered in autumn.
- In spring 2025, most of England and Wales received less than half the 1991–2020 average rainfall, and in some places less than a third. England had its driest spring for over 100 years.
- Total annual rainfall in the most recent decade 2016–2025 has seen no change compared to 1991–2020 but has increased by 8% compared to 1961–1990.
- The winter half-year (October to March) for the most recent decade, 2016–2025, has been 3% wetter than 1991–2020, and 13% wetter than 1961–1990, with little change for the summer half-year.
- The spatial frequency of very wet months in the winter half-year (October to March) with twice the 1961–1990 average rainfall has approximately doubled from 1961–1990 to 2016–2025.

- There is no clear evidence of an increase in the frequency of very dry months in either the winter half-year or the summer half-year (April to September).
- Observations suggest an increase in very wet days across the UK in recent decades, but further digitization of daily rainfall before 1961 would provide greater confidence in this result.

Sunshine

The UK's climate has become sunnier from the 1980s, primarily driven by increases in winter and spring sunshine.

- 2025 was the sunniest year in the UK series from 1910, with 1645 sunshine hours, 117% of the 1991–2020 average.
- Spring 2025 was the sunniest spring in the UK series from 1910 and also sunnier than all but three summers: 1976, 1995 and 1911.
- The most recent decade 2016–2025 has been 4% sunnier than 1991–2020 and 10% sunnier than 1961–1990.
- For the most recent decade 2016–2025, springs for England have been 9% sunnier than 1991–2020 and 21% sunnier than 1961–1990, the latter equivalent to almost 1 h per day.

Extremes and Significant Weather Events

The large variability in the UK's weather on different timescales means that extreme weather events are an integral part of the UK's climate.

- Storm Éowyn was the UK's most powerful wind storm for over a decade, hitting the UK in late January 2025. A gust of 87 Kt (100 mph) was recorded in Scotland.
- Spring and summer 2025 combined saw a UK mean maximum temperature anomaly of +2.1°C and sunshine total 125% of the 1991–2020 average, by far the warmest and sunniest such period on record.
- Spring and summer 2025 combined saw less than 40% of 1991–2020 average rainfall in the driest areas, but for durations longer than 6 months the 1976 drought was far more severe.

Hydrology

River flow data from the 1960s do not show a clear overall trend in low flows, whereas there is some evidence for an increase in high flows.

- Mean March to August river flows were 'notably' to 'exceptionally' low, with many catchments in northern England and north-east Scotland setting new records, and others second or third lowest behind major summer droughts such as 1976, 1984 and 2022.

- March to August 2025 total flow of rivers for England was the second lowest in a record from 1961, lower even than several other major summer droughts except 1976.
- Any trends in low flows in the last six decades remain spatially uneven and rarely significant. In contrast, trends in high flows show a strong, coherent national increase, consistent with broader shifts towards higher winter half-year rainfall.

Sea-Level Rise

Sea level rise around the UK is accelerating, increasing the potential flood risk from storm surges.

- Since 1901, the sea level around the UK has risen by about 20.1 cm (likely range 16.6 to 23.6 cm), with two-thirds of this rise happening over the last three decades.
- Over the past 33 years (1993–2025) the UK sea level estimated from tide gauges has risen by 13.9 cm, although there are large uncertainties in estimates of sea level rise around the UK.
- The last 4 years were the highest on record for UK annual mean sea level from 1901, with the 21st Century so far (2001–2025) including the 18 highest years.
- Storm surges in the UK in 2025 mostly occurred on small or moderate tides, limiting their impact.
- The most severe surges were from storms Éowyn (January), Amy (October), and Bram (December). Had Éowyn arrived a week later, coinciding with a spring tide, the estimated total sea level at Heysham, Lancashire, would have made this a 1 in 300 year event.

Climate and Nature

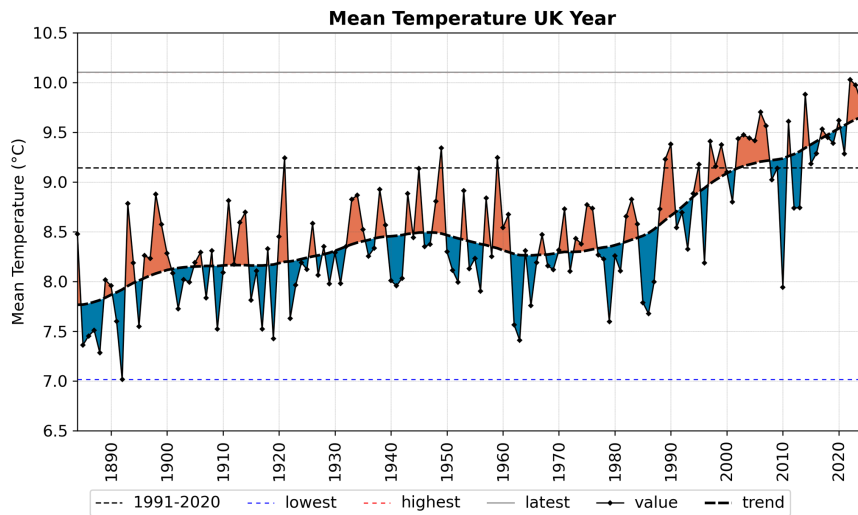
Many species and processes in nature are closely linked with climate. In 2025, high seed yields from common UK trees and shrubs were likely associated with the extreme warm, dry and sunny conditions experienced between April and September.

- In 2025, Nature's Calendar citizen science observations showed the highest seed yields on record (since 2001) for some common UK tree and shrub species.
- Seed yields of Blackthorn, Pedunculate oak and Sessile oak in 2025 were particularly high. For oak this phenomenon is often described as a 'mast' year

1 | Temperature

1.1 | Temperatures in 2025

The year 2025 was the warmest year on record for the UK in the series from 1884, with an annual mean temperature of 10.10°C, 0.96°C above the 1991–2020 average, and exceeding the previous record warmest year of 2022, 10.03°C (Figure 1). This was only the second year with a UK annual mean temperature exceeding 10°C. Anomalies in several areas exceeded



	1931-1960	1961-1990	1991-2020	2016-2025	2025
UK	8.48	8.31	9.14	9.65	10.10
England	9.17	9.04	9.96	10.53	10.95
Wales	8.80	8.60	9.41	9.93	10.31
Scotland	7.21	6.99	7.69	8.10	8.64
Northern Ireland	8.67	8.44	9.13	9.59	10.07

FIGURE 1 | Annual mean temperature for the UK, 1884 to 2025. The table shows actual values for the UK and countries (°C). While the series extends back to 1884, averages are shown back to 1931–1960 since network coverage before this reduces (see Figure A1). Charts for individual months and seasons are available at <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-temperature-rainfall-and-sunshine-time-series>.

1°C, and in particular in a swathe from the English Midlands to Northumberland (Figure 2a). Across the UK at a county level, the record warmest year is neatly divided between 2022 in the south-east, 2023 in the west and 2025 in the north and east—of which 2025 comprises the largest area (Figure 2b). 2025 was the warmest year on record for both England and Scotland, and second-warmest for both Wales and Northern Ireland, behind 2023. 2025 was also the UK's warmest year for average maximum temperatures (Tmax), exceeding 14°C for the first time, but not average minimum temperatures (Tmin) where 2023, 2024 and 2014 were all warmer.

All months except January and September were warmer than average, of which 7 months saw anomalies at least +1°C above the 1991–2020 average. The six consecutive months March to August were all within the top-ten warmest on record for the UK in respective monthly series: (March—tenth, April—third, May—equal-third, June—second, July—fifth, August—equal-eighth). While for Tmean, no month was record-breaking for the UK overall, England had its warmest June on record with an anomaly of 2.5°C relative to 1991–2020 (Table 1).

As a result of the persistent warmth from March to August, the UK had both its warmest spring and warmest summer on record (Figure 3). Spring 2025 was the UK's second consecutive

warmest spring, exceeding the previous record set in 2024, and it was the warmest spring across all four countries. These two consecutive springs 2024 and 2025 were very contrasting in character: the former unsettled, wet and dull with record average minimum temperatures; the latter settled, dry and sunny with record average maximum temperatures.

Summer 2025 was the warmest summer in series for England, Wales and Scotland and 2nd warmest for Northern Ireland, behind summer 1995. March to August were dominated by high pressure and prolonged settled weather; Section 5.3 describes the exceptional warmth, sunshine, and lack of rain through this period.

Figure 4 shows UK average daily Tmax and Tmin through 2025. A key feature was the persistent warmth through the year, with far more warm than cold days for the time of year—this is typical of recent years in the UK's climate record. Daily values approached the high temperature extremes (red line) on several occasions and, in particular, daily Tmax values were at least 5°C above the daily 1991–2020 average (one grid line spacing) for 29 days between March and August—representing almost an entire month's-worth—with very few days of below average Tmax throughout this period. Daily Tmin values were less persistently high, with notable cold spells in

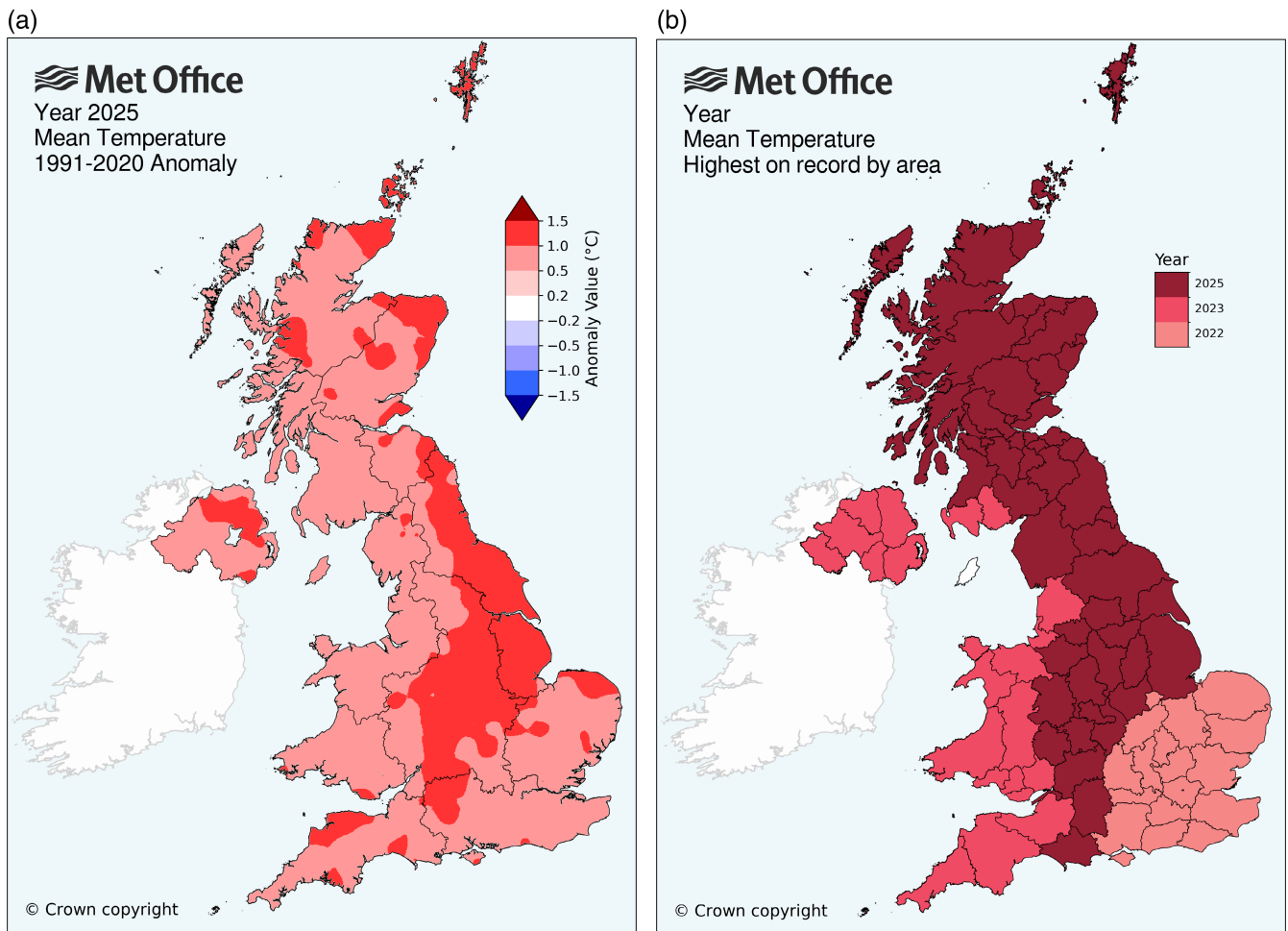


FIGURE 2 | (a) Mean temperature anomaly relative to 1991–2020 for year 2025. Maps for individual months and seasons are available at <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps> (b) the warmest year on record for mean temperature for county areas of the UK, based on county series from 1884 to 2025. Appendix A.1.7 describes these county areas. The Isle of Man is not included.

early January, mid-March, late September and late November, but Tmin also saw some unusual warmth in late February, June, early November and December. There were some particularly large temperature fluctuations in Tmin through the autumn due to abrupt changes in air mass over the UK; for example, UK average Tmin fell from 11.4°C on 4 November to −3.4°C on 21 November.

Further details for each month of the year and each day of the month are provided within the Met Office Monthly Climate Summaries and Daily Weather Summaries available from the Met Office Digital Library and Archive.

1.2 | Annual Trends

The UK's climate has warmed continuously from the 1980s onward at a rate of approximately 0.25°C per decade (1°C in 40 years), with the most recent decade 2016–2025 1.33°C warmer than 1961–1990. The last 4 years have all been within the top five warmest in the UK series—a statistic that would be virtually impossible without climate change, and all top 10 warmest years have occurred in the 21st Century so far (Figure 1). Human

influence, particularly from greenhouse gas emissions, has been the dominant driver of this warming (Amos et al. 2026).

Table 2 lists the 6 years of the 21st Century so far in which a new UK annual mean temperature record has been set. Back in 1949, the UK record was 9.34°C. This stood for 41 years until 1990, but since then and including 1990 and 1997 it has been broken in eight separate years, of which 2025 is the most recent. All but two of the last 10 years, 2016–2025, exceeded the previous 1949 record. These statistics illustrate starkly how human-induced climate change has influenced the evolution of this record through time; on the current trajectory the 2025 record will likely be exceeded again within a matter of years.

It can be challenging to put a warming of 0.25°C per decade in the UK's climate into perspective, given the very large variability in the UK's weather on a daily, or even hourly, basis, when temperatures may fluctuate by many degrees Celsius. Figure 5 shows UK annual mean temperature for the periods 1931–1990, 1961–1990, 1991–2020 and 2016–2025, dividing the UK into intervals of 0.5°C annual mean temperature. From this we see that virtually all of the UK lies within a temperature range of around 8°C—from central London to upland areas in northern Britain. The periods

TABLE 1 | Monthly, seasonal and annual mean temperature actual and anomaly values (°C) relative to 1991–2020 for the UK and countries for year 2025. Colour coding corresponds to the rank as given in the key below. The series lengths are 1884–2025 (142 years) except winter which is 1885 to 2025 (141 years).

	UK			England			Wales			Scotland			Northern Ireland		
	Actual	Anomaly		Actual	Anomaly		Actual	Anomaly		Actual	Anomaly		Actual	Anomaly	
January	3.0	−0.9		3.3	−1.1		3.5	−0.9		2.3	−0.6		4.0	−0.5	
February	4.6	0.5		5.0	0.4		4.8	0.4		3.8	0.7		5.6	0.9	
March	7.0	1.3		7.5	1.1		7.0	1.1		6.1	1.7		7.5	1.5	
April	9.6	1.7		10.3	1.6		10.0	1.9		8.3	1.8		9.8	1.8	
May	12.0	1.3		12.9	1.4		12.2	1.3		10.3	1.3		12.0	1.5	
June	15.2	1.9		16.9	2.5		15.3	1.8		12.7	1.1		14.1	1.1	
July	16.8	1.5		18.0	1.5		16.6	1.3		14.9	1.5		15.9	1.3	
August	16.3	1.2		17.4	1.1		16.3	1.3		14.6	1.3		15.9	1.4	
September	12.8	−0.1		13.8	−0.1		12.7	−0.3		11.3	0.0		12.2	−0.3	
October	10.4	0.7		11.2	0.6		10.6	0.5		9.0	0.9		10.5	0.8	
November	7.2	0.7		8.2	1.0		7.9	0.9		5.4	0.2		7.2	0.5	
December	5.8	1.6		6.5	1.8		6.3	1.5		4.6	1.6		5.9	1.2	
Winter	4.6	0.5		5.0	0.4		5.0	0.4		3.7	0.7		5.3	0.7	
Spring	9.5	1.5		10.2	1.4		9.7	1.4		8.3	1.6		9.7	1.6	
Summer	16.1	1.5		17.4	1.7		16.1	1.5		14.1	1.3		15.3	1.3	
Autumn	10.1	0.4		11.1	0.5		10.4	0.4		8.6	0.4		10.0	0.3	
Year	10.10	0.96		10.95	0.98		10.31	0.90		8.64	0.95		10.07	0.94	
Key	Coldest on record	Top ten cold	Cool: ranked in lower third of all years	Middle: ranked in middle third of all years	Warm: ranked in upper third of all years	Top ten warm	Warmest on record								

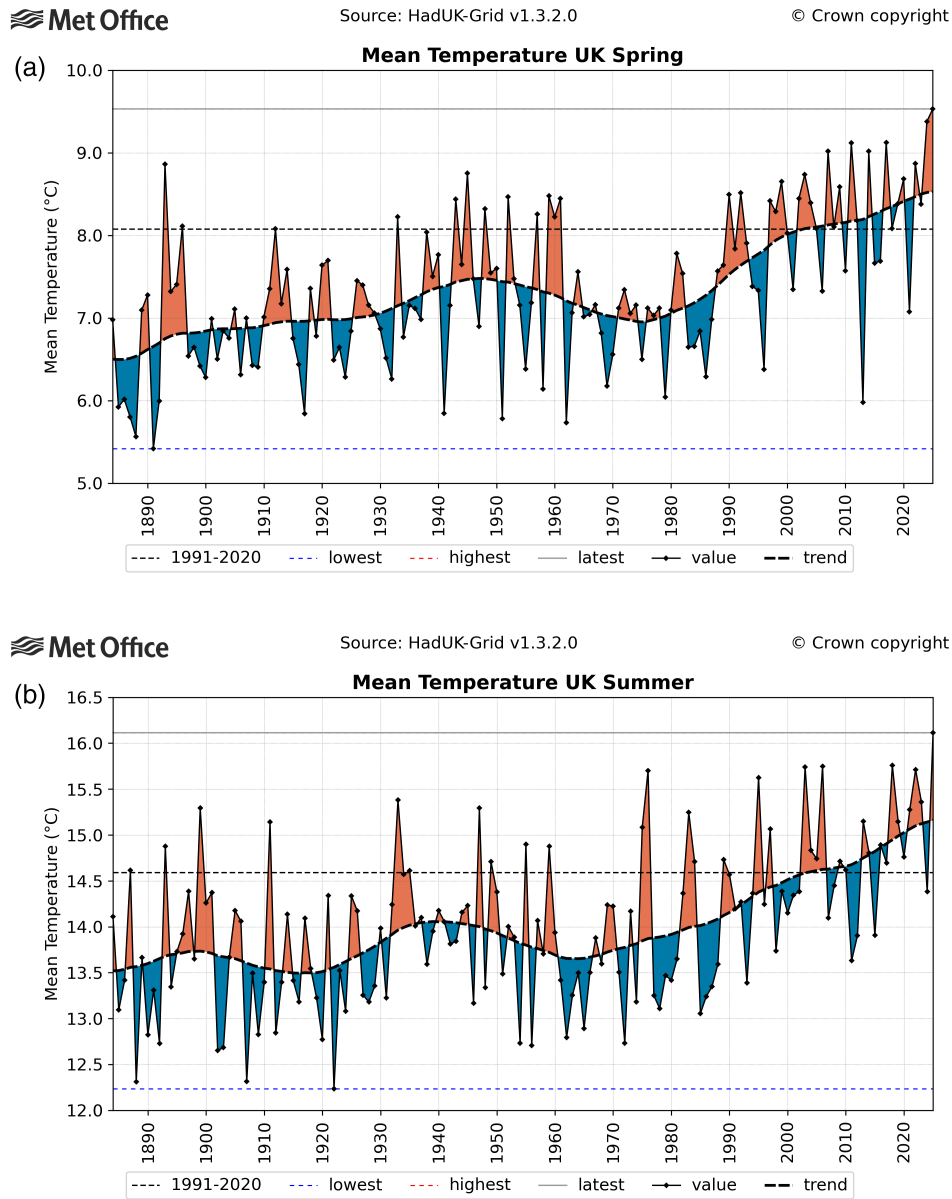


FIGURE 3 | Mean temperature for the UK (°C) from 1884 to 2025 for (a) spring and (b) summer.

1931–1960 and 1961–1990 were broadly similar but, by 1991–2020, the warmer areas have significantly expanded and the cooler areas contracted; this change is more pronounced again for 2016–2025.

If the percentage of land area of the UK within each 0.5°C interval is calculated using the gridded annual mean temperature data from 1884 to 2025, smoothed to remove the annual variability, we see the loss of the coolest areas of our climate and the emergence of new warmer areas (Figure 6). Since the 1980s, an area over 11°C has emerged, which by 2025 accounts for around 20% of the UK, while the land area below 7°C has decreased from over 15% to less than 10%. Intermediate 0.5°C intervals have moved geographically north, uphill and inland.

Figure 7 shows this effect for two thresholds exceeding 10°C (a) and 8°C (b)—chosen as illustrative examples. In the case of the 10°C threshold, the area has expanded very significantly across much of lowland England. Whereas in 1961–1990, this area was

largely confined to Greater London, coastal fringes of southern England and the flattest parts of Somerset; by 2016–2025 it has extended to parts of northern England either side of the Pennines—a northward displacement of approximately 250 km. In contrast, the 8°C area has mainly extended uphill in upland areas in the north. Thus a warming of 1.33°C from 1961–1990 to 2016–2025 is equivalent to approximately one sixth of the 8°C range of the UK’s annual mean temperature climate from Greater London to upland areas in northern Britain, shown in Figure 5. It is this climatological range that provides the appropriate context.

1.3 | Seasonal Trends

The seasonal warming in the UK’s climate is not uniform but depends on season, location and variable. Figure 8 shows warming for mean Tmax and Tmin across the UK for the most recent decade 2016–2025 relative to 1961–1990. Table 3 provides

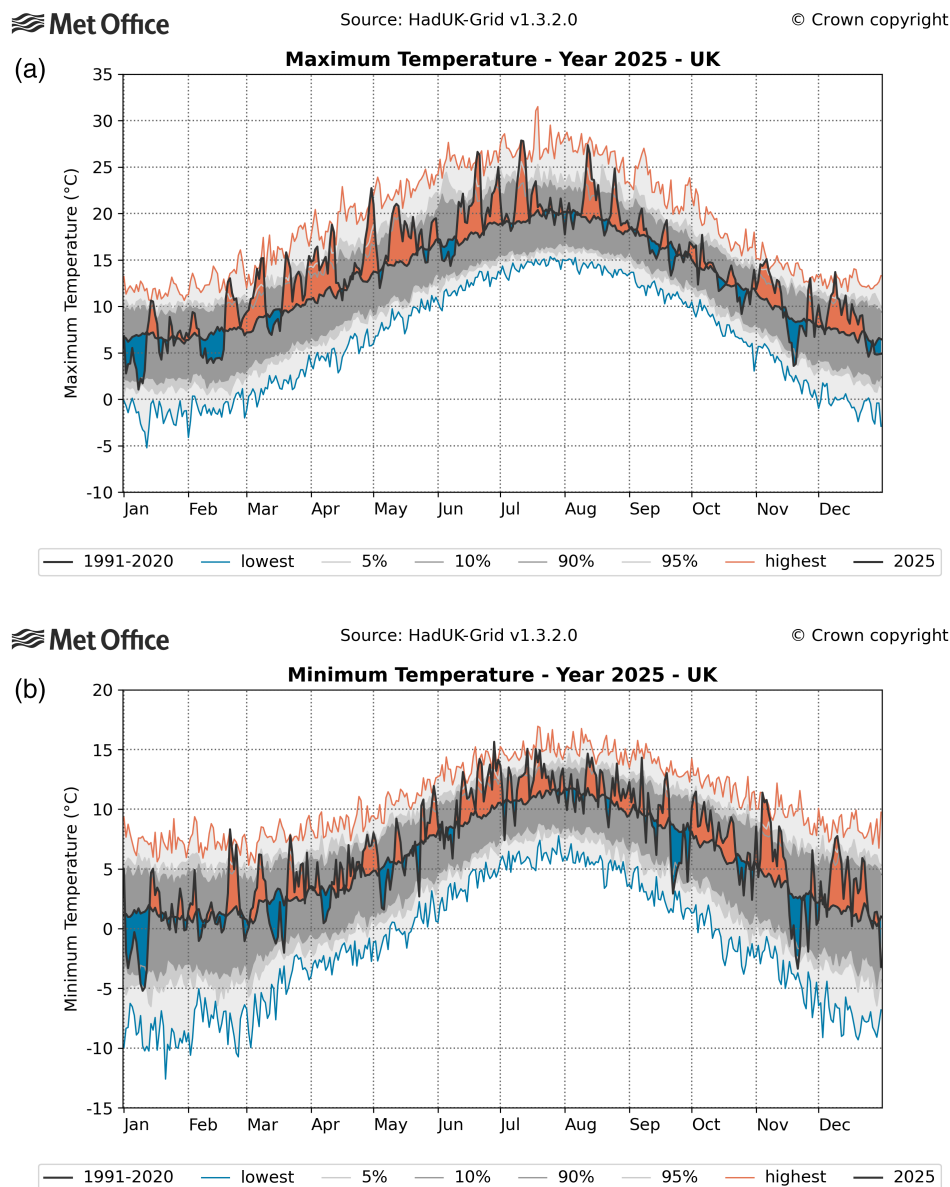


FIGURE 4 | Daily anomalies for (a) UK mean Tmax and (b) UK mean Tmin (°C) for each calendar day of the year 2025. The central black line shows the 1991–2020 average for each calendar day; the outermost red and blue lines the highest and lowest values and the grey shading the percentile values for each calendar day of the year based on the period 1931 to 2025 inclusive.

TABLE 2 | New records set for UK annual mean temperature since 2001 (The two previous record years since 1949 were 1990, at 9.38°C and 1997, at 9.41°C).

Year	Annual mean temperature (°C)	1991–2020 anomaly (°C)	Current rank in series 1884–2025
2025	10.10	+0.96	1
2022	10.03	+0.89	2
2014	9.88	+0.74	4
2006	9.70	+0.56	6
2003	9.47	+0.33	11
2002	9.44	+0.30	13

summary statistics for Tmax, Tmin and Tmean for each season and the calendar year. Overall, warming has been greater for Tmax than Tmin, greater across England and Wales than Scotland and Northern Ireland, and greater in winter, spring and summer than in autumn. Warming in some places has been significantly higher than the mean warming of 1.33°C for UK annual mean temperature overall. For example, Table 3a shows that mean Tmax for spring in England has warmed by 2.0°C from 1961–1990 to 2016–2025. These statistics will reflect some annual and decadal variability in the UK's climate in addition to the ongoing warming due to climate change.

1.4 | Monthly Trends

UK monthly mean temperature has a much larger variability relative to the underlying warming trend than annual mean

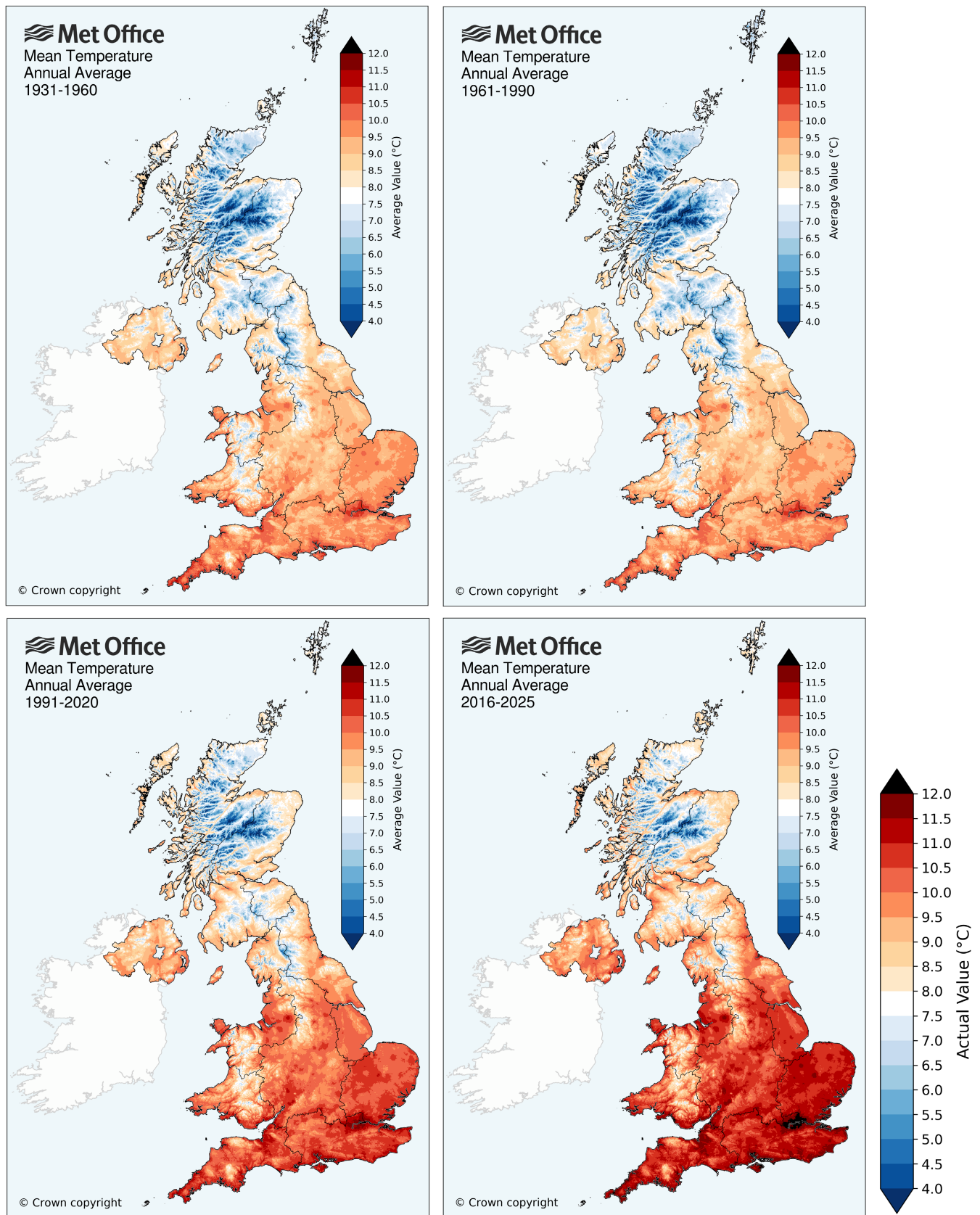


FIGURE 5 | UK annual mean temperature (°C) averaged over the periods 1931–1960, 1961–1990, 1991–2020 and 2016–2025.

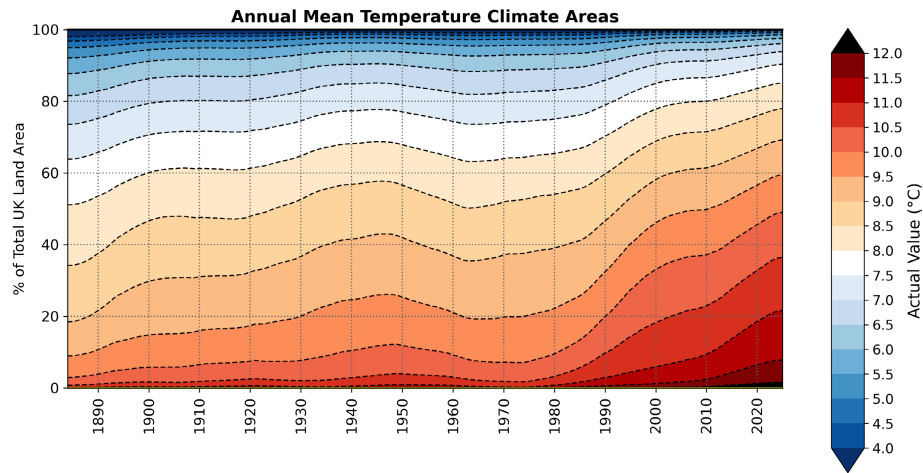


FIGURE 6 | The percentage of total UK land area within 0.5°C intervals of annual mean temperature across the UK from 1884 to 2025. The data have been smoothed to remove the annual variability using a weighted kernel filter described in Appendix A.2.1. The colour scheme is the same as Figure 5.

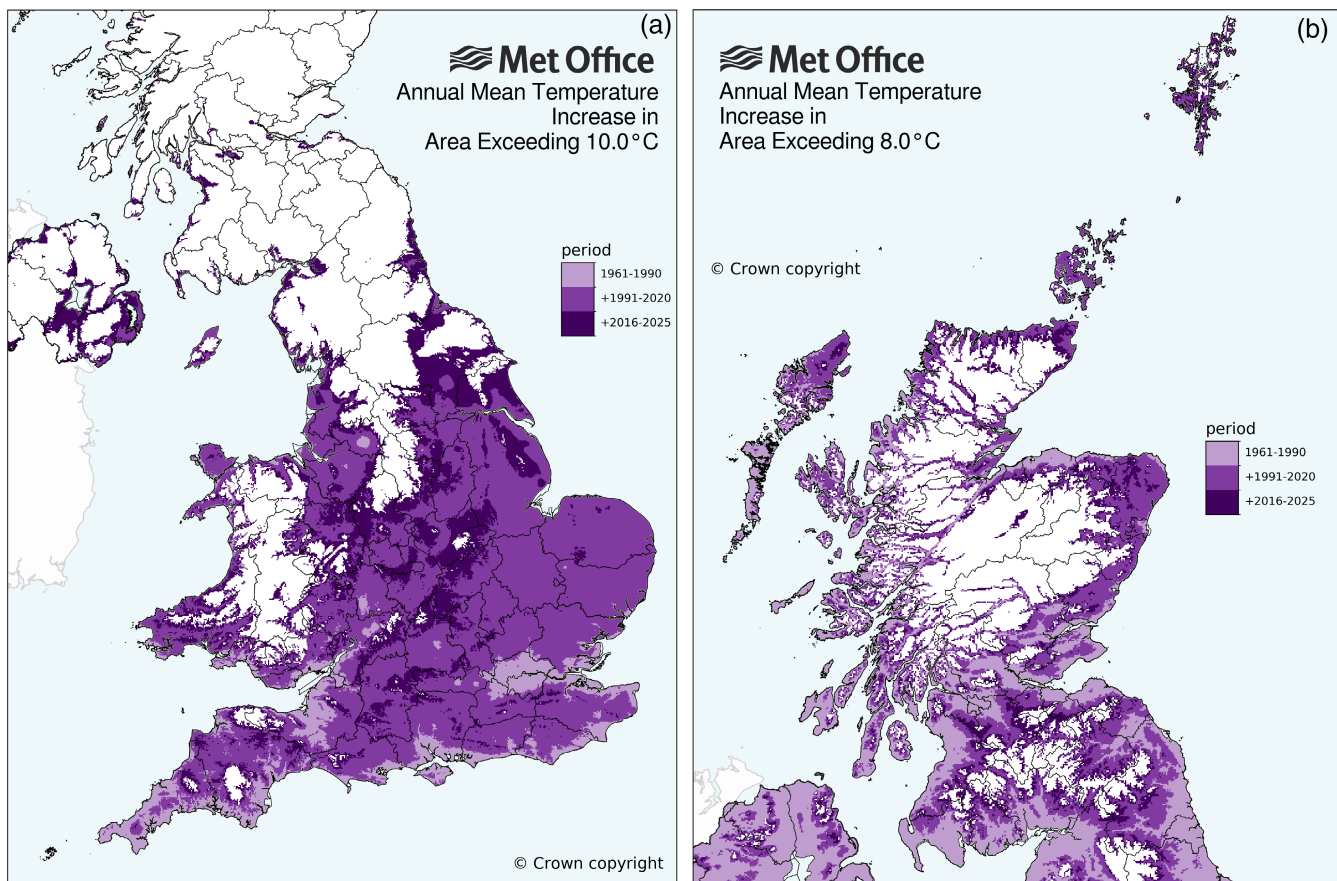


FIGURE 7 | The geographical increase in land areas of the UK with annual mean temperature exceeding (a) 10°C and (b) 8°C, from 1961–1990, to 1991–2020, to 2016–2025. The figure is cumulative so that the area for 1991–2020 also includes 1961–1990, while 2016–2025 also includes both 1991–2020 and 1961–1990. Across Scotland, the uphill progression of the +8°C climate area is most clearly seen across eastern and southern areas; for Highland Scotland the complex topography and limitations of gridding make the change in this area harder to distinguish.

temperature, and evidence of climate change can appear less immediately apparent. This is because annual mean temperature is the mean of the 12 constituent months so the monthly

variations are averaged out in the annual value, while the warming signal from climate change common to all months is retained.

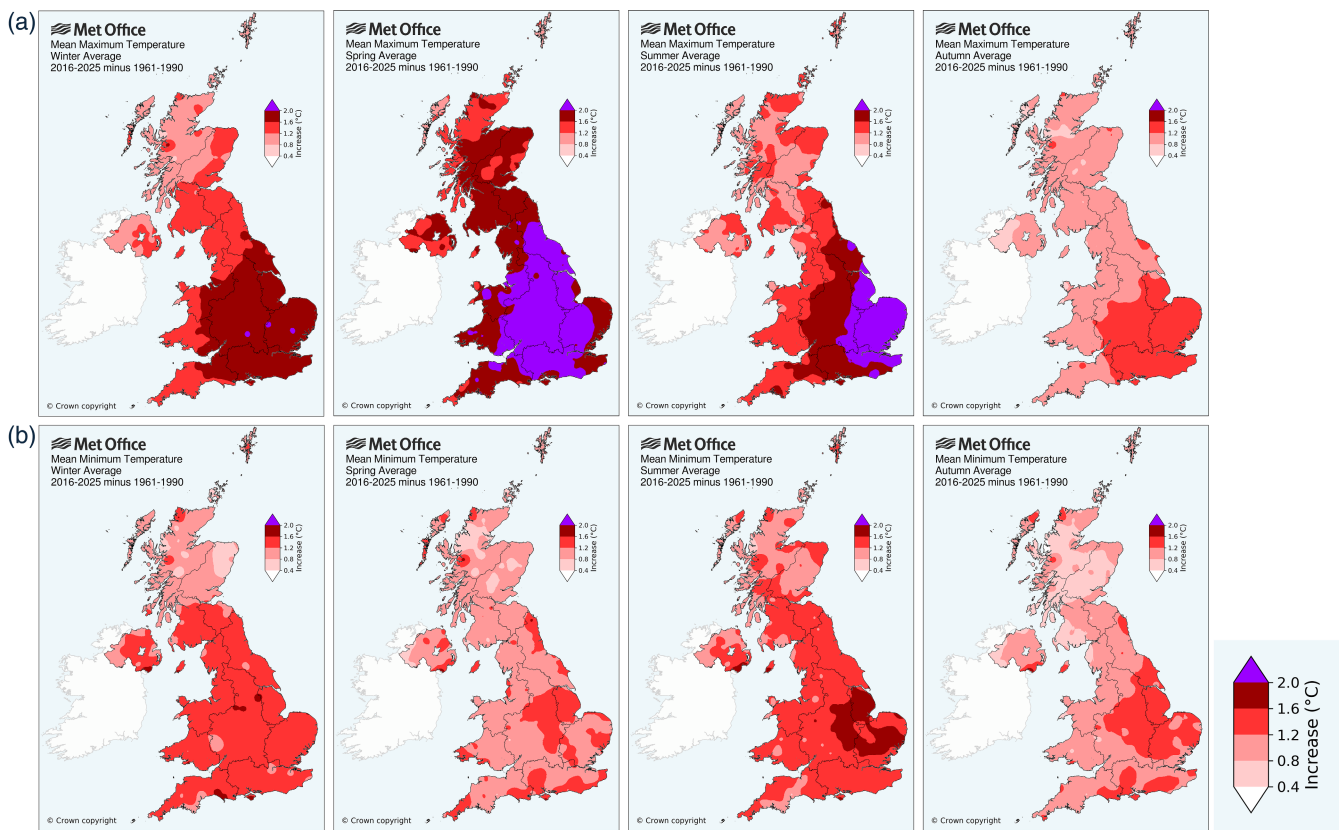


FIGURE 8 | Mean (a) Tmax and (b) Tmin anomalies for 2016–2025 for each season relative to 1961–1990.

Figure 9 shows Tmax and Tmin monthly anomalies relative to 1961–1990 for all 1704 constituent months of the UK series from 1884 to 2025. The most recent year is highlighted in black and other years in the most recent decade 2016–2025 in red. This figure emphasizes the large variability in monthly temperature. Most months typically lie within $\pm 3^{\circ}\text{C}$ of the 1961–1990 average, but extreme warm or cold months can fall outside this. Importantly, these temperature distributions are not even across all months of the year. The winter months in particular have seen some extreme cold months historically, with anomalies of -4°C or even -5°C , much further from the average than extreme cold summer months. The most recent example was December 2010 (anomalies -4.1°C for Tmax and -5.3°C for Tmin relative to 1961–1990), with other well-known months including January 1963 and February 1947. These exceptionally cold months were due to a bitterly cold polar continental airmass, with weather patterns ‘blocking’ the normal mild Atlantic influence on the UK. In contrast, monthly temperatures are constrained within a narrower range in the summer months, particularly for Tmin, due to the mild temperate influence of seas around the UK.

Although individual months within the most recent decade show large variability, taken collectively the pattern of higher temperatures in the most recent decade 2016–2025 can be seen. From the 120 constituent months of 2016–2025, only 11 have fallen below the 1961–1990 monthly average for Tmax and 11 also for Tmin. No months have approached the lowest monthly records for Tmax and only 1 month has for Tmin (April 2021, ranked third coldest April); extreme cold months

are in effect being lost from the UK’s climate. In contrast, monthly mean Tmax and Tmin have frequently approached or set record high values with records in the most recent decade including February 2019, May 2025, June 2023 and September 2023 (for Tmax) and May 2024 and June 2025 for Tmin. Overall, for both Tmax and Tmin, approximately 1 in 4 months in the most recent decade 2016–2025 have fallen within the top-10 warmest of their respective monthly series. For Tmax, the run of six warm months from March to August 2025 is particularly prominent (including the May 2025 record). While Tmin anomalies in 2025 were mostly more modest, they were also consistently above average and very high in June and July.

Figure 10 shows the trend in percentage of UK land area exhibiting UK monthly Tmax and Tmin anomalies relative to the 1961–1990 monthly average within 0.5°C anomaly intervals; the data have been smoothed to remove the month-to-month variability apparent in Figure 9. This is a very similar approach to Figure 6, and illustrates the change in the spatial frequency distribution of monthly temperature anomalies across the UK for all 12 months of the year through time.

As would be expected, in the period 1961–1990, UK’s land area was divided roughly evenly above or below the 1961–1990 average. While the early part of the series contained some decadal fluctuations in spatial distribution, these are small compared to the change seen from the 1980s onwards. By the 2020s, for both Tmax and Tmin, over 80% of UK land area contained monthly anomalies above the 1961–1990 average. The greatest changes

TABLE 3 | Seasonal and annual temperature anomaly values (°C) relative to 1961–1990 and 1991–2020 for the UK and countries for the decade 2016–2025 for (a) mean Tmax (b) mean Tmin and (c) Tmean. Colour coding corresponds to the anomaly values as given in the key below and is the same as for Figure 8. (Note: For the purpose of this table winter statistics for 2016–2025 are based on the constituent winters of the period, that is, they include December 2015 as this falls within winter 2016, but not December 2025 as this falls within winter 2026. This differs to Figure 8 where the constituent months of all seasons are within 2016–2025. Since the winter stats are based on 30 months for this 10 year period, any difference will be small. The period 1961–1990 is always based on months within the period from January 1961 to December 1990; similarly for 1991–2020.)

(a)	1961–1990					1991–2020				
	UK	England	Wales	Scotland	N Ireland	UK	England	Wales	Scotland	N Ireland
Winter	1.6	1.8	1.7	1.2	1.2	0.6	0.8	0.7	0.4	0.4
Spring	1.9	2.0	1.9	1.6	1.6	0.7	0.7	0.7	0.6	0.6
Summer	1.5	1.8	1.4	1.2	1.2	0.7	0.8	0.6	0.6	0.5
Autumn	1.1	1.2	1.0	0.9	0.8	0.4	0.5	0.3	0.3	0.2
Year	1.49	1.68	1.48	1.23	1.19	0.57	0.65	0.57	0.46	0.43

(b)	1961–1990					1991–2020				
	UK	England	Wales	Scotland	N Ireland	UK	England	Wales	Scotland	N Ireland
Winter	1.3	1.5	1.5	1.0	1.2	0.6	0.7	0.8	0.4	0.7
Spring	1.1	1.2	1.0	0.9	1.1	0.2	0.2	0.2	0.2	0.3
Summer	1.3	1.4	1.3	1.2	1.2	0.5	0.6	0.5	0.5	0.5
Autumn	1.0	1.2	1.0	0.8	1.0	0.4	0.5	0.4	0.3	0.4
Year	1.17	1.29	1.19	0.99	1.12	0.44	0.48	0.47	0.35	0.47

(c)	1961–1990					1991–2020				
	UK	England	Wales	Scotland	N Ireland	UK	England	Wales	Scotland	N Ireland
Winter	1.4	1.6	1.6	1.1	1.2	0.6	0.7	0.7	0.4	0.6
Spring	1.5	1.6	1.5	1.3	1.3	0.4	0.4	0.4	0.4	0.5
Summer	1.4	1.6	1.3	1.2	1.2	0.6	0.7	0.6	0.5	0.5
Autumn	1.1	1.2	1.0	0.9	0.9	0.4	0.5	0.4	0.3	0.3
Year	1.33	1.49	1.33	1.11	1.15	0.51	0.57	0.52	0.41	0.45

Key	< 0.4°C	0.4°C to 0.8°C	0.8°C to 1.2°C	1.2°C to 1.6°C	1.6°C to 2.0°C	>2.0°C
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Note: Shading is applied before values are rounded, so occasionally the same rounded values may have different shades.

in areal extents have been in the extremes of these distributions, particularly for Tmax, with large increases in very warm months (e.g., for Tmax, +2°C increasing from <10% to >30% of UK land area), and decreases in cold months (e.g., for Tmax, −1°C decreasing from >20% to <5%). In summary: very warm or extremely warm months are becoming increasingly spatially common and very cold or extremely cold months confined to smaller areas of the country as the UK's climate continues to warm.

1.5 | Daily Trends

This section first considers frequency then intensity of daily temperature extremes.

Figure 11 compares the average number of days of daily Tmax ≥ 30°C and daily Tmin ≥ 18°C across the UK per year for the periods 1931–1960, 1961–1990, 1991–2020 and 2016–2025. Hot days (≥ 30°C) are most focussed on England and Wales, particularly central southern and south-east England, including Greater London. They are typically associated with a southerly airflow drawing a hot airmass from the near-continent, and in these areas the sea-track of this airflow over the moderating influence of the sea tends to be shortest. Warm nights (≥ 18°C) are also largely focussed on England and Wales, but with greater spatial variability and a significant influence from both the urban heat island due to the built environment—particularly in London—and a coastal effect due to warm sea surface temperatures in late summer and early autumn, with the associated increased humidity preventing temperatures falling away at night.

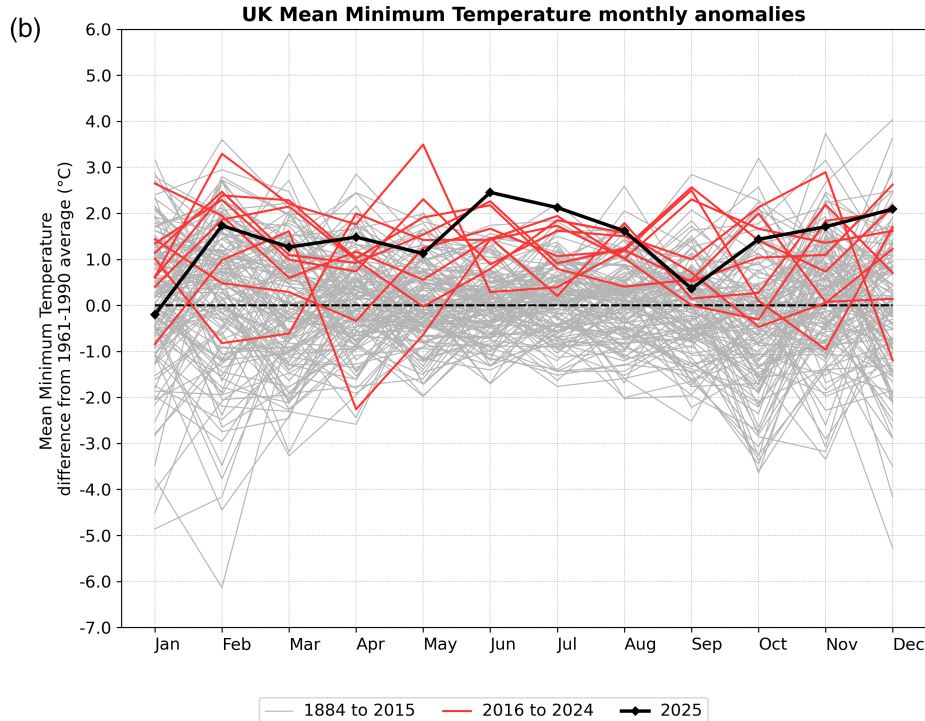
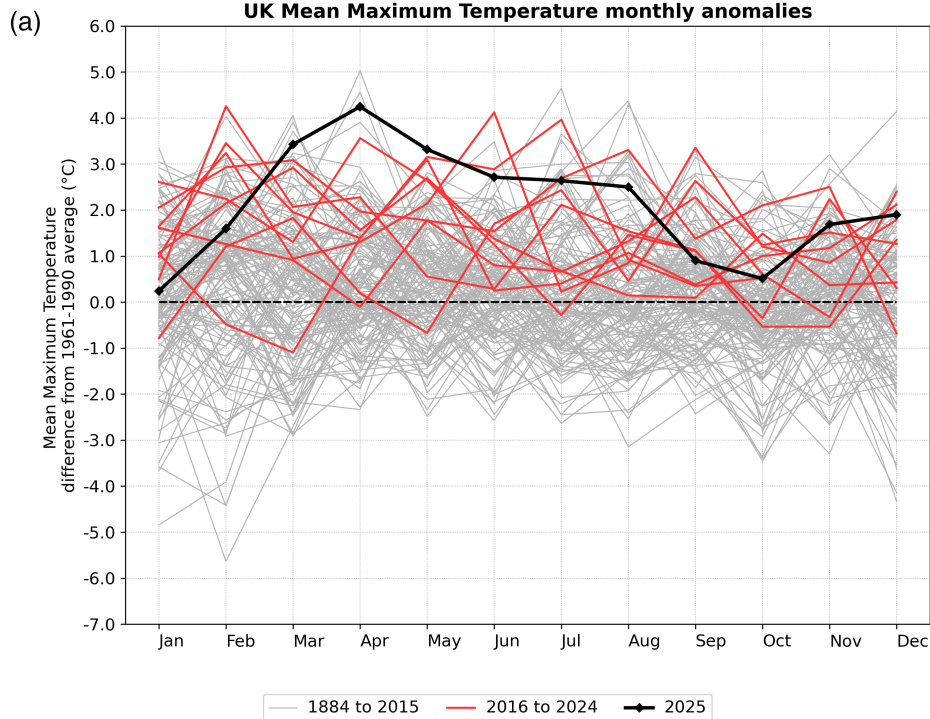


FIGURE 9 | Monthly mean (a) Tmax and (b) Tmin anomalies (°C) for the UK relative to 1961–1990 for the 12 calendar months for year 2025 (in black), other years of the most recent decade 2016–2025 (in red) and all other years from 1884 (in grey). The scale is identical for both figures.

There are large increases in the frequency and spatial extent of both hot days $\geq 30^{\circ}\text{C}$ and warm nights $\geq 18^{\circ}\text{C}$ for the most recent decade 2016–2025. For example, parts of south-east England have seen on average over five days per year $\geq 30^{\circ}\text{C}$ by 2016–2025 compared to between one and two days for 1931–1960 and 1961–1990.

Reaching this threshold is much rarer across Scotland and Northern Ireland, but by 2016–2025 the spatial extent of hot days $\geq 30^{\circ}\text{C}$ has expanded into parts of southern and eastern Scotland. Warm nights $\geq 18^{\circ}\text{C}$ have also significantly increased in frequency across England and Wales, especially Greater London.

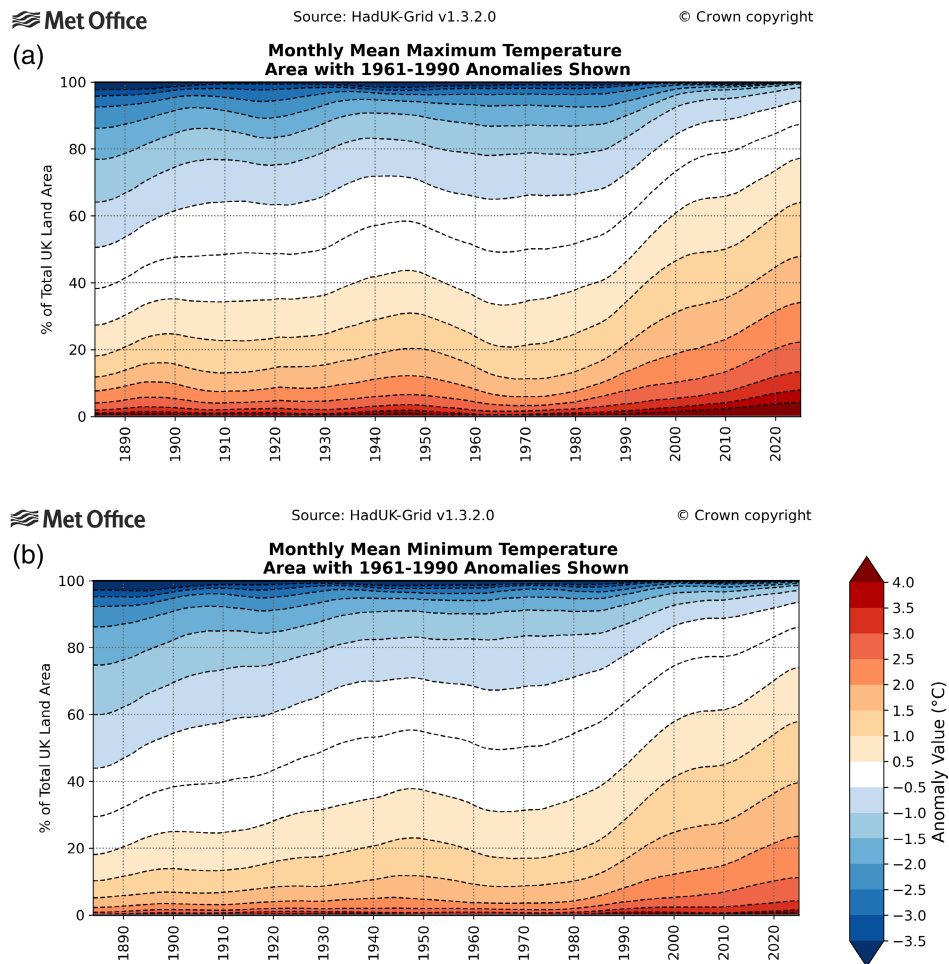


FIGURE 10 | The percentage of total UK land area each year with monthly (a) Tmax and (b) Tmin anomalies relative to the monthly 1961–1990 average within 0.5°C intervals as shown. The data have been smoothed to remove the annual variability using a weighted kernel filter described in Appendix A.2.1.

These indices have large annual variability—for example, some years may have a large number of days $\geq 30^{\circ}\text{C}$, while others have none. Figure 12 shows the number of days per year from 1931 to 2025 for both hot days and warm nights for Greater London. (Greater London is chosen because it is the area of the UK where these indices occur most frequently; the HadUK-Grid dataset includes several stations within this area, both in central London and Greater London more widely). For hot days, 1976 is the year with the highest count in this series (14 days of which 12 were in late June and early July). However, while this year was exceptional at the time, this is now much less so. In the last three decades, a handful of days are to be expected in Greater London, each year, exceeding 30°C on a consistent basis; the last year when 30°C was *not* reached was 2008. Warm nights have also increased markedly; prior to the 1980s only a few years saw Tmin $\geq 18^{\circ}\text{C}$ but since the 1990s there has been an abrupt increase so that these occur too on a consistent basis. Overall therefore, these temperatures that used to be relatively unusual have, in the most recent decade, come to be expected every year at some point during a hot spell, most likely in the summer months.

Of key importance is the distinction between the *absolute* and *proportional* change in the number of days per year exceeding the temperature threshold, and how this is affected by the

value of that threshold. Figure 13a shows *absolute* change; that is, the actual number of days each year between 1931 and 2025 for Greater London for daily Tmax above threshold values from 20°C to 30°C . The absolute change (in days) is more for lower thresholds and less for higher thresholds—for example, Tmax $\geq 20^{\circ}\text{C}$ has changed from around 80 days per year, to around 100 days per year; much more than Tmax $\geq 30^{\circ}\text{C}$ from fewer than 2 days per year to four or 5 days (the latter series is the same as in Figure 12a). However, the reverse is true when considering *proportional* change. Figure 13b shows the ‘change ratio’—that is, the ratio of the smoothed (trend) value each year to the 1961–1990 average for each temperature threshold. Here, the higher temperature thresholds have seen the greatest proportional change, so that by the 2020s, whereas days of Tmax $\geq 20^{\circ}\text{C}$ have increased by around 50% compared to 1961–1990 (a change ratio of 1.5), days of Tmax $\geq 26^{\circ}\text{C}$ have more than doubled and days of Tmax $\geq 30^{\circ}\text{C}$ have quadrupled for Greater London.

Annual variability for the higher thresholds (when scaled by the long-term mean) is larger, and the sample size (i.e., the number of days per year) is lower. Whereas Tmax $\geq 20^{\circ}\text{C}$ varies from 42 to 126 days between the lowest and highest years, Tmax $\geq 30^{\circ}\text{C}$ varies between 0 and 14 days and so corresponding uncertainty in the ‘change ratio’ increases due the reduced number of events.

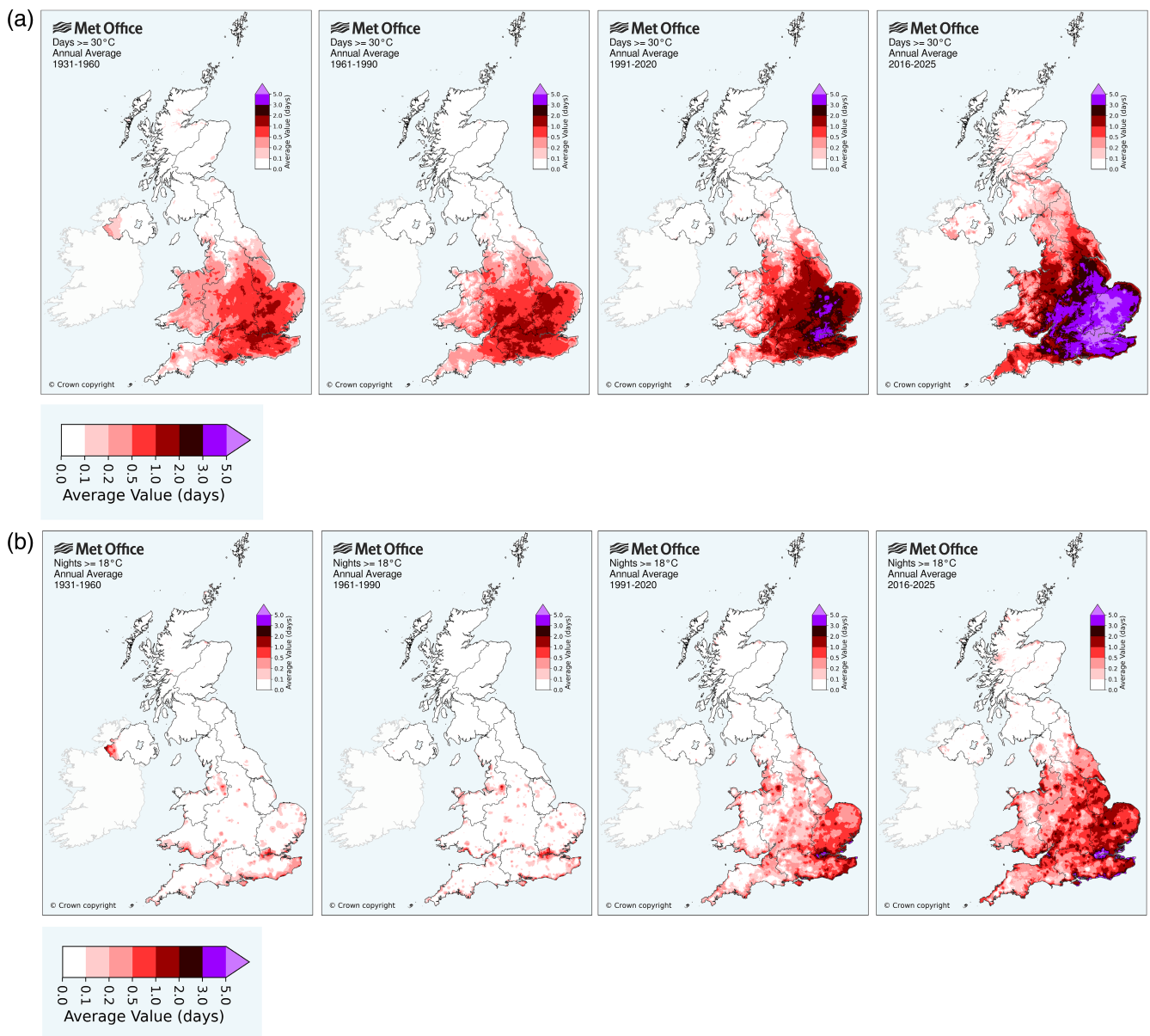
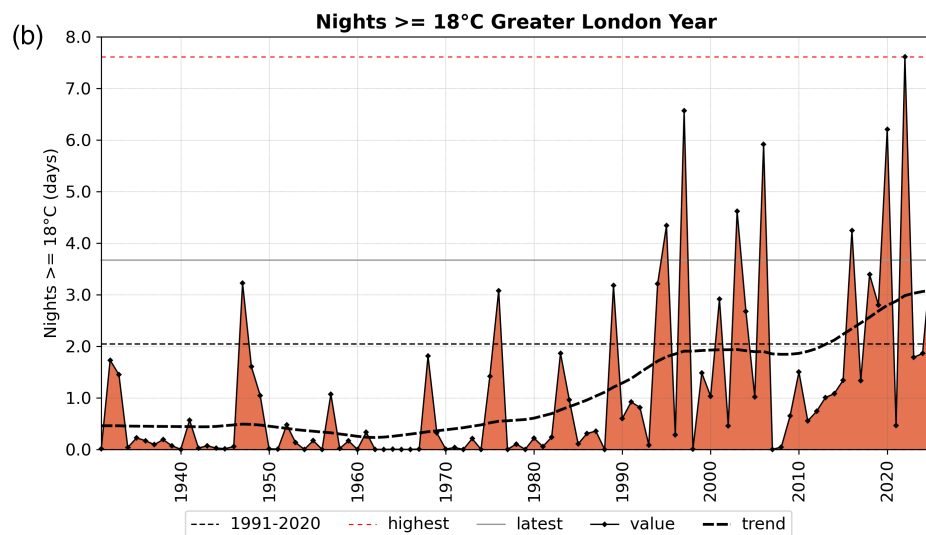
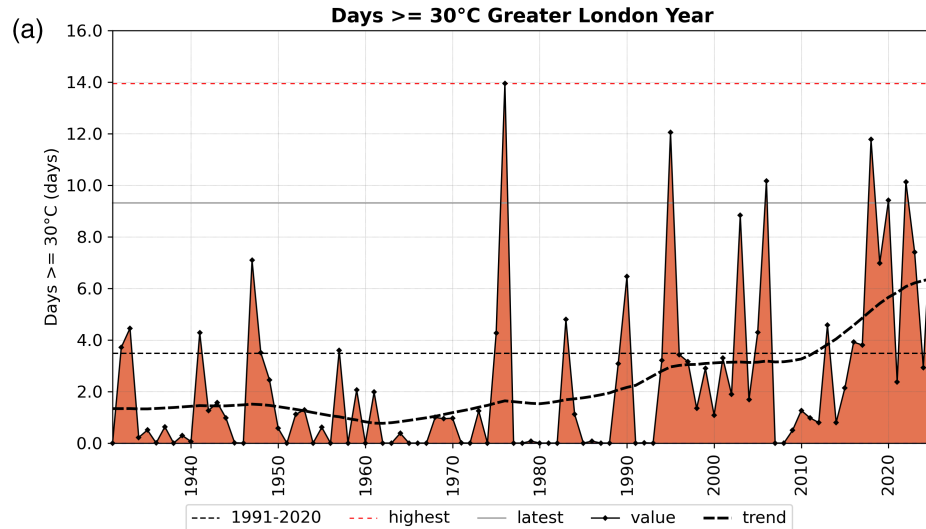


FIGURE 11 | Average number of days per year with (a) daily $T_{max} \geq 30^{\circ}\text{C}$, (b) daily $T_{min} \geq 18^{\circ}\text{C}$ for the periods 1931–1960, 1961–1990, 1991–2020 and 2016–2025. The features on these maps in the west of Northern Ireland relate to a problem with the dataset in this area and should be discounted.

This effect increases rapidly still further as thresholds become more extreme (e.g., $T_{max} \geq 34^{\circ}\text{C}$ or $T_{min} \geq 20^{\circ}\text{C}$ —so called ‘Tropical Nights’) and eventually if the threshold is sufficiently high (e.g., $T_{max} \geq 38^{\circ}\text{C}$), there will be no historical occurrences before a certain year—that is, the event is unprecedented up to that point.

Overall, when considering extremes it may be this **proportional** change that is most relevant, with Figure 13b demonstrating that the highest thresholds see the largest changes. This is particularly important because the extremes often have the greatest impacts (e.g., heatwaves affecting the elderly or vulnerable, or infrastructure in the built environment), and where a key requirement is to know *how many times more often* an event occurs in the current climate—and is likely in a future climate, compared to the past.

In a similar way, Figure 14 compares the average number of ‘icing days’ ($T_{max} < 0^{\circ}\text{C}$), and hard frosts ($T_{min} < -8^{\circ}\text{C}$) across the UK per year for the periods 1931–1960, 1961–1990, 1991–2020 and 2016–2025. During an icing day, any lying snow or ice would likely remain frozen all day. Icing days occur most frequently in upland areas of northern England and Scotland. They have a particularly strong relationship with elevation due to the temperature lapse rate (approximately 100 m elevation per 1°C). Freezing fog that is slow to disperse may also cause an icing day. Hard frosts similarly occur most frequently across these upland areas. However, the relationship with elevation is less clearly defined because the lowest temperatures may often occur in valleys due to cold air sinking at night. In lowland areas spatial variability of hard frosts can also be large, due to local topography and soil type (e.g., frost hollows or areas of sandy soil may make hard frosts



	1931-1960	1961-1990	1991-2020	2016-2025	2025
Tmax $\geq 30^{\circ}\text{C}$	1.3	1.3	3.5	6.8	9.3
Tmin $\geq 18^{\circ}\text{C}$	0.4	0.5	2.0	3.3	3.7

FIGURE 12 | Number of days with (a) daily Tmax $\geq 30^{\circ}\text{C}$ and (b) daily Tmin $\geq 18^{\circ}\text{C}$ for Greater London, 1931–2025. The statistic is an area-average across Greater London, so a value of 0.5 would indicate the threshold has been exceeded across half of the area. The table shows actual values for Greater London (days).

more likely). Inevitably the spatial pattern on these maps across lowland areas will also be influenced by the distribution of the station network—some stations, for example, are in locations that are particularly prone to low temperatures.

Both of these sets of maps show large decreases in frequency and spatial extent of icing days and hard frosts for the most recent decade, 2016–2025. For example, from 1931 to 1990, an average of between two and five icing days occurred across central England but by 2016–2025 they have largely become confined to higher ground. Similarly, nights with hard frosts have been

mostly lost from substantial parts of southern, central and eastern England.

Figure 15 shows counts of both icing days and hard frost nights as an average across the UK (the counts are by calendar year, i.e., with each winter split across 2 years). Similar to the high temperature thresholds, they show large annual variability but instead show substantial decreases since the 1980s. The most prominent years are 1963 and 1947 (the UK's coldest two winters since the start of the 20th Century) and, for hard frosts, 2010 (the latter as a result of extreme cold in both January and

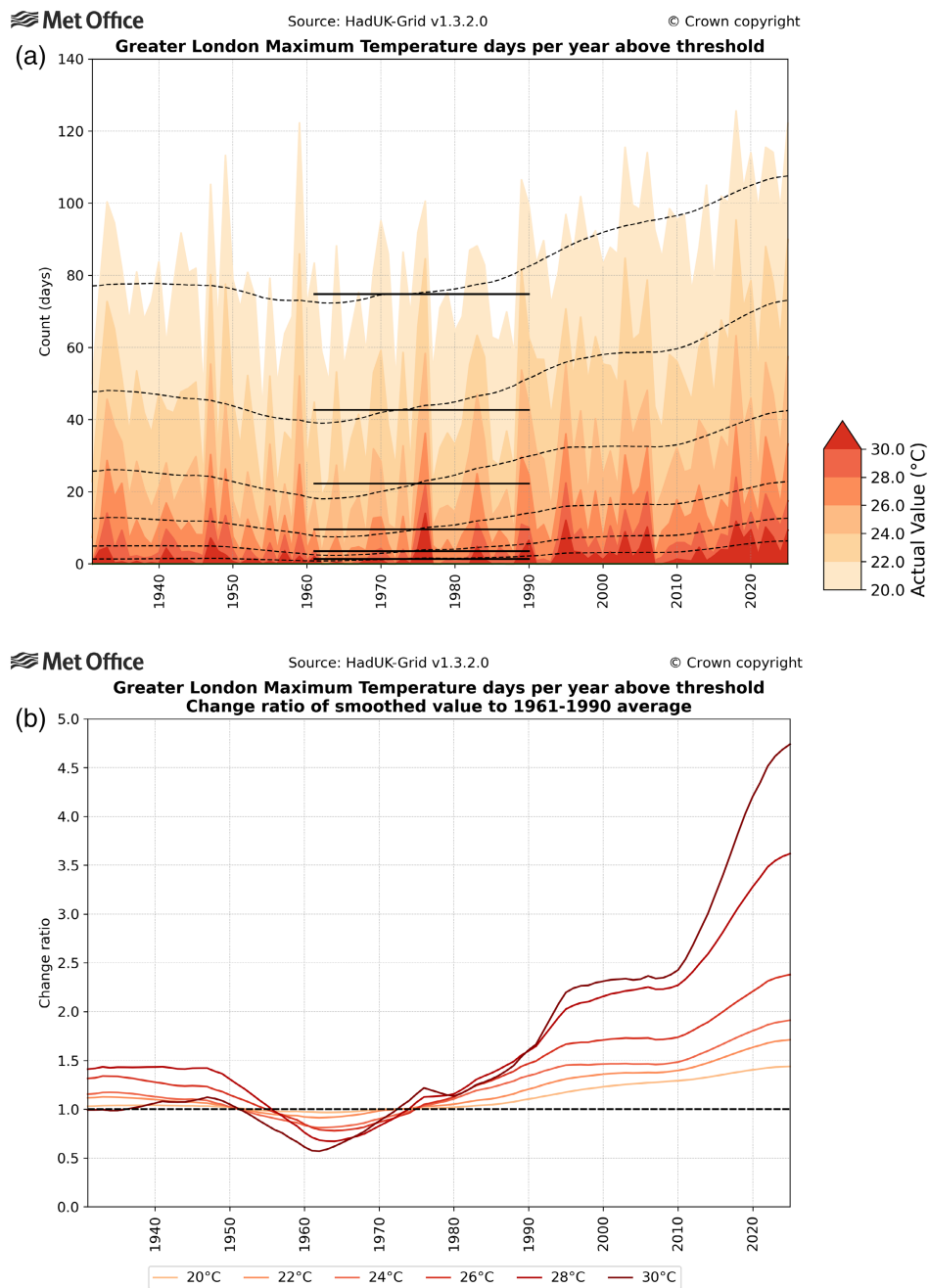


FIGURE 13 | (a) The number of days per year for Greater London from 1931 to 2025 with daily Tmax above thresholds from 20°C to 30°C. The hatched lines show the trend (i.e., smoothed) values. The solid black line shows the 1961–1990 average for each series. (b) The ‘change ratio’—that is, the ratio of the trend value for each individual year to the 1961–1990 average, for each threshold.

December of that year). Year 2010 demonstrates extreme cold spells in the UK have still been possible in recent decades, and this year may be contrasted to 1976: the persistent warmth of summer 1976 was exceptional at the time but now less so; the cold spells in 2010 (both January and December) now appear all the more exceptional given the recent warming in the climate.

The absolute and proportional changes are shown in Figure 16 for daily Tmin below threshold values from +2°C to –8°C. Here, the ‘change ratio’ has been reversed to show the ratio of the 1961–1990 average to the smoothed (trend) value each year. Again, the more

extreme thresholds have seen the greatest proportional change so that, by the 2020s, days of Tmin < –8°C now occur three to four times less often for the UK than they did in 1961–1990.

These large changes in the frequency of cold extremes may result in both positive and negative impacts. The UK will experience a corresponding reduced frequency of impacts from spells of severe winter weather. In addition, such cold extremes may be a factor limiting the geographical range of animal or plant species, potentially more critical than annual mean temperature. So, a change may provide an opportunity for this range to extend within the UK—although unfortunately this may include

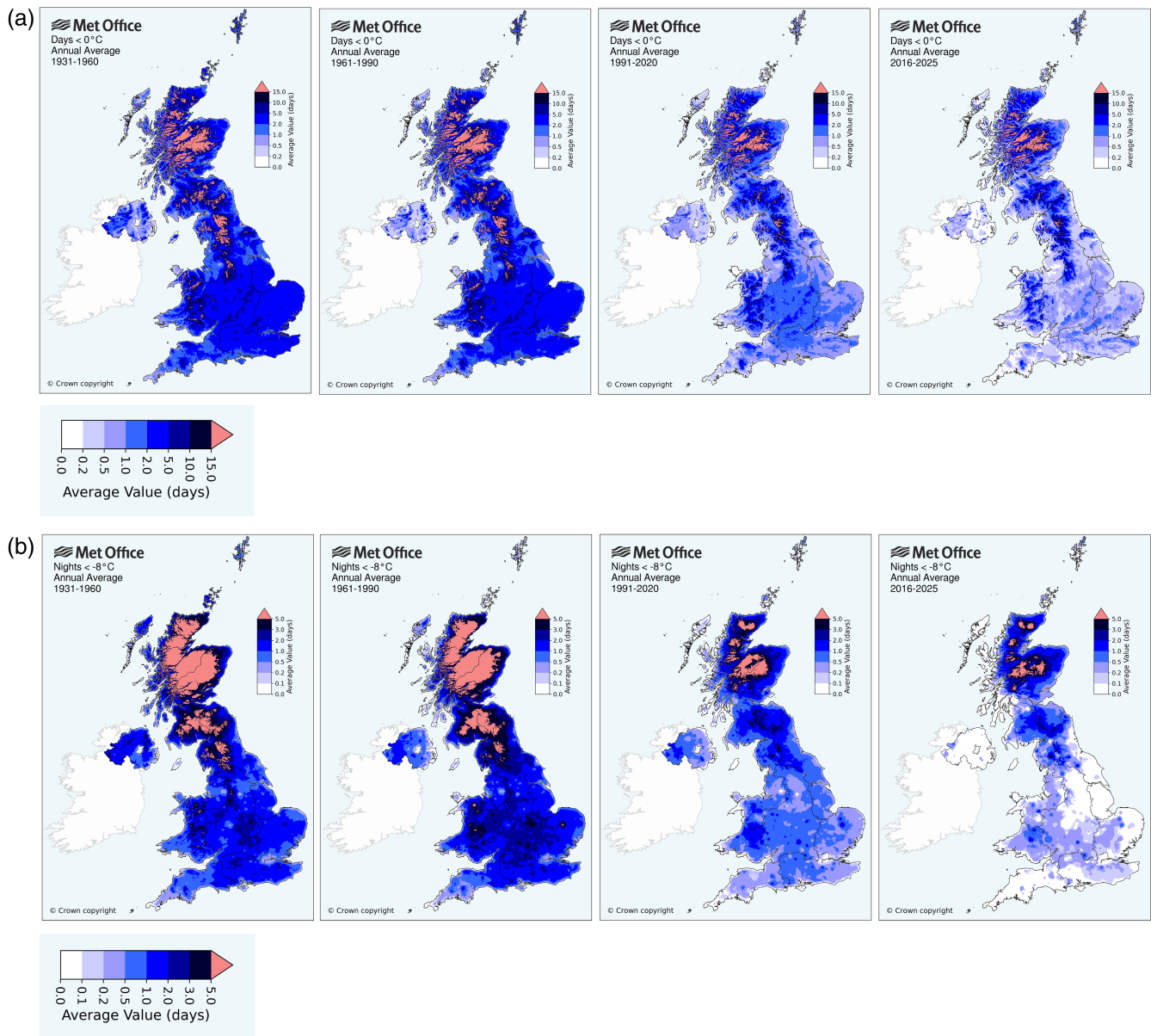


FIGURE 14 | Average number of days per year with (a) daily T_{max} < 0°C, (b) daily T_{min} < -8°C for the periods 1931–1960, 1961–1990, 1991–2020 and 2016–2025.

unwanted pests and diseases that would otherwise have been killed by low temperature extremes.

Figure 17 shows the temperature of the average hottest day of the year for the periods 1931–1960, 1961–1990, 1991–2020 and 2016–2025. This map is focussed mainly on England and Wales and shows county areas (see Appendix A.1.7 for details of these areas). Changes in Highland Scotland are harder to infer due to the sensitivity of this variable to the distribution of the station network through time; also, in this context, this area is perhaps of lesser significance because it is climatologically cooler and less densely populated.

The average highest T_{max} of the year was 28°C to 30°C across most of England and parts of eastern Wales for the periods 1931–1960 and 1961–1990, with only Greater London and

parts of the Home Counties and Cambridgeshire seeing 30°C to 32°C in 1931–1960 and nowhere averaging greater than 30°C in 1961–1990. In contrast, by 1991–2020 the spatial extent of 30°C to 32°C had greatly increased to most of central and south-east England and East Anglia, while by 2016–2025 the average highest T_{max} for Greater London exceeded 34°C, with areas over 32°C extending as far as the West Midlands and Lincolnshire, and 30°C out to Somerset, Cheshire, and parts of Yorkshire. These very large changes in highest T_{max} are emphasized by Figure 18, which shows how much the average highest T_{max} has increased from 1961–1990 to 2016–2025. Across almost all of England except the south-west, Cumbria and Northumberland, the increase has been by at least 3°C, and in a swathe from Kent to Lincolnshire over 4.5°C; this is over 3 times the 1.33°C increase in UK annual mean temperature for the same period (Table 3).

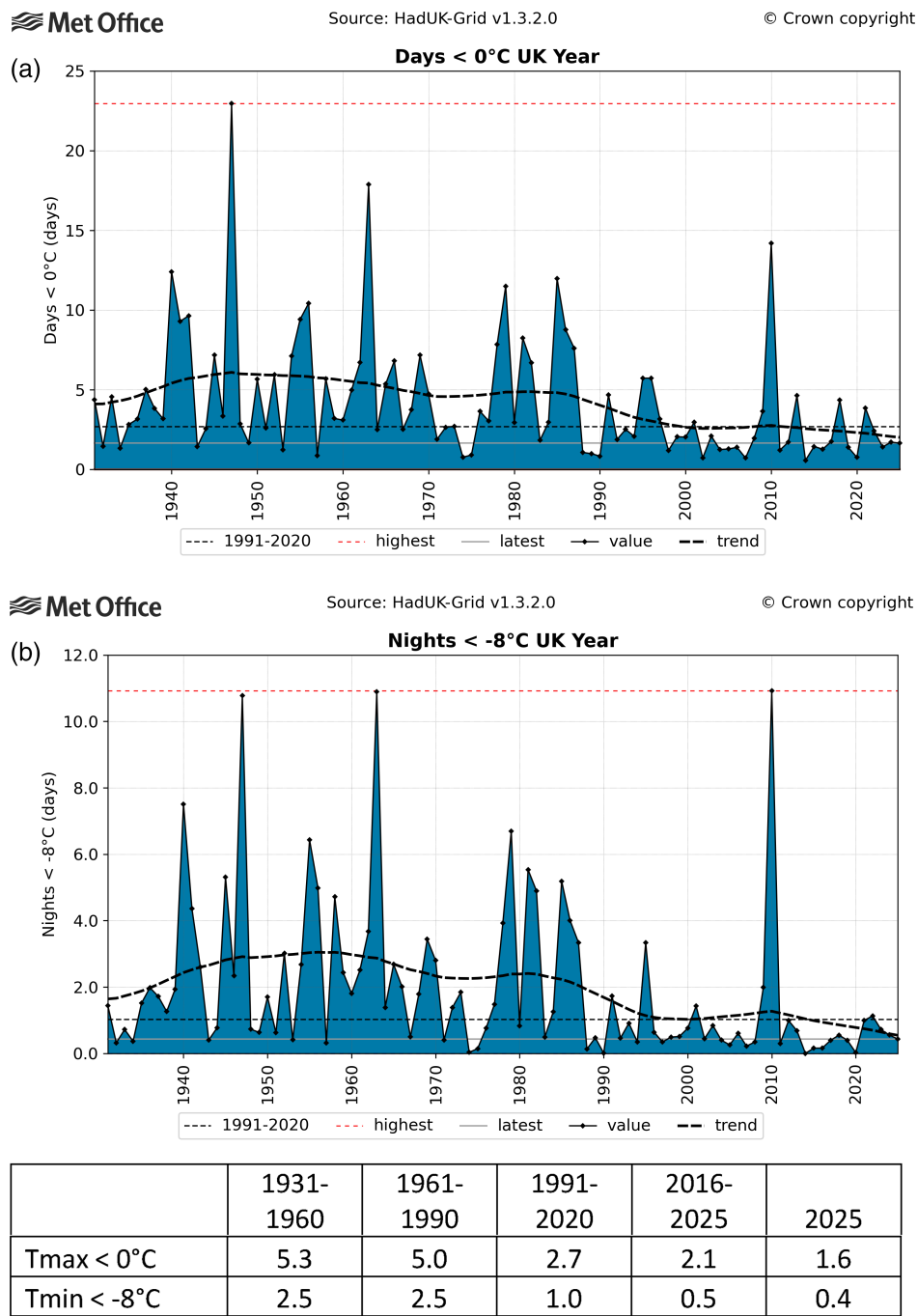


FIGURE 15 | Number of days with (a) daily Tmax < 0°C and (b) daily Tmin < -8°C for the UK, 1931–2025. The table shows actual values for the UK (days).

Although there will be large variability in annual highest Tmax, importantly, the increase is not skewed by a single extreme event in 1 year. While 40°C has been reached in the UK in only 2022, 38°C was recorded in 2022, 2019 and 2003, and 35°C reached or exceeded in 5 years during 2016–2025. Figure 19 compares average summer Tmax from 1884 to 2025 (bottom) against highest annual Tmax (top) from 1931 to 2025 for Bedfordshire—selected as being one of the counties in the area of greatest warming in Figure 18 (see county map Figure A9). These time-series emphasize just how much more warming there has been in annual highest Tmax, compared to average summer Tmax. Annual highest Tmax also has much greater variability as this statistic is based on the single

hottest day of a year rather than the mean of the 92 days of summer. For every year in the most recent decade, 2016–2025, the annual highest Tmax in Bedfordshire has exceeded 30°C; even the cooler years. In contrast, prior to 1990 there are a large number of years with the annual highest Tmax below 28°C, including four below 26°C, while in 1931 the annual highest Tmax for Bedfordshire (as an average across the county), failed to reach even 24°C. For example, Woburn, Bedfordshire only reached 23.3°C on 27 May, 12 July and 4 August, while Rothamsted, Hertfordshire and Oxford only reached 23.9°C all year. Even at the time, these are extremely low values, but by the 2020s, a year in which the highest Tmax all year failed to reach 24°C would be absolutely extraordinary.

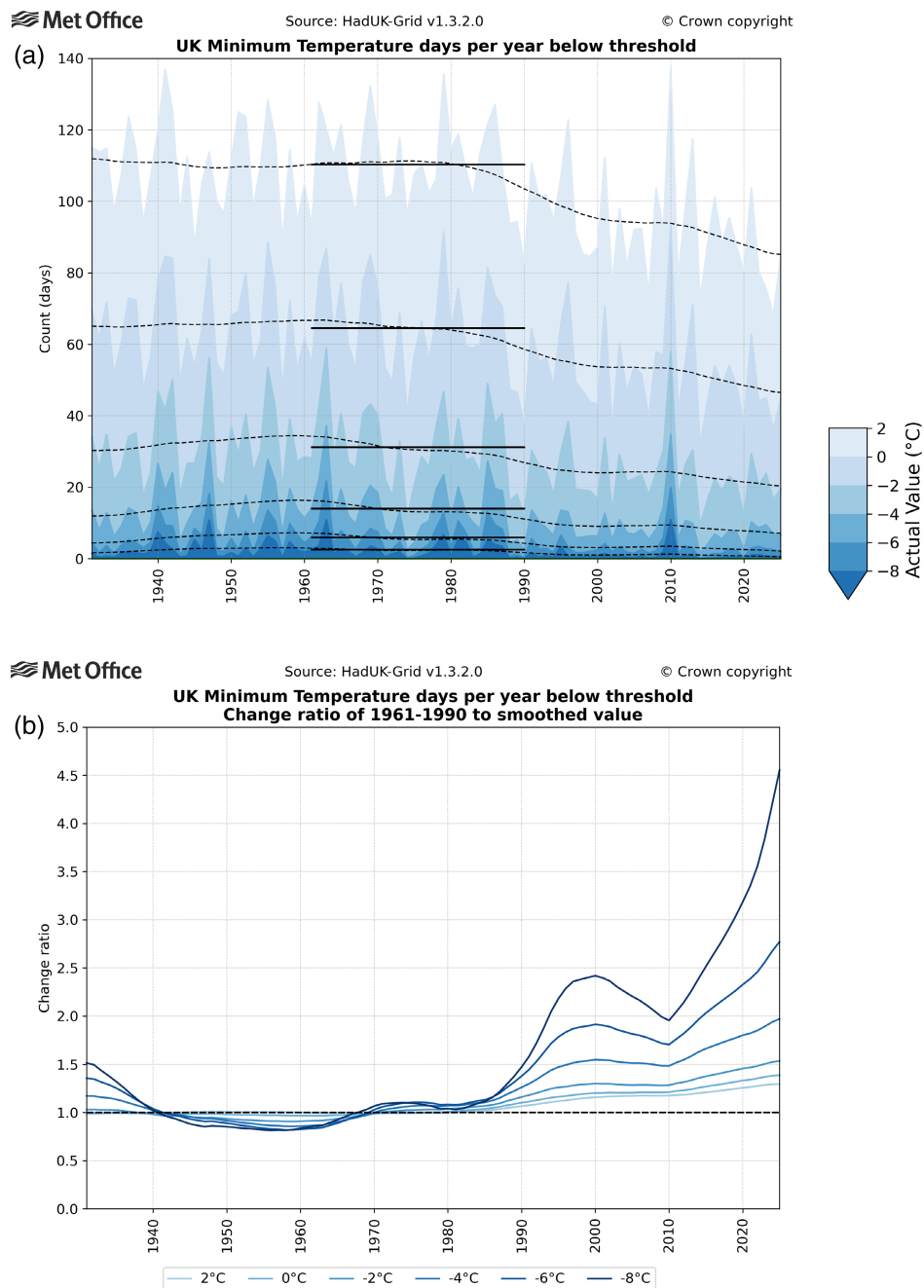


FIGURE 16 | (a) The number of days per year for the UK from 1931 to 2025 with daily Tmin below thresholds from +2°C to −8°C. The hatched lines show the trend (i.e., smoothed) values. The solid black line shows the 1961–1990 average for each series. (b) The 'change ratio'—that is, the ratio of the 1961–1990 average to the trend value for each individual year, for each threshold. Note, the change ratio here is reversed to that in Figure 13 for clarity. The 0°C series is the number of air frosts per year—that is, it is identical to Figure 15a.

The 2016–2025 annual average number of days of $T_{\max} \geq 24^{\circ}\text{C}$ for Bedfordshire is 35 days—that is, the equivalent of more than 1 month in total.

Of note is the comparison between 1976 in these two series: summer $T_{\max}$ remains the warmest in the Bedfordshire summer $T_{\max}$ series (bottom), and, remarkably, the average summer $T_{\max}$ in 1976 was comparable to, or higher, than the highest daily $T_{\max}$ of the year in 1931, 1962, and 1974. Summer 1976 was exceptional for the persistence of warmth, but much

less so for the highest temperature extremes. The UK annual highest $T_{\max}$ in 1976 at any station was 35.9°C ; comparatively modest considering 36°C has been reached in the UK in seven separate years from 1990 to 2022. Similarly, 1976 appears less extreme when considering a higher threshold (days $\geq 32^{\circ}\text{C}$) for Bedfordshire, with broadly similar, or higher, day counts for 32°C in 2019, 2020 and 2022 (Figure 20).

Also of note in Figure 19 is the run of relatively 'poor' UK summers from 2007 to 2012—the highest annual $T_{\max}$ for these

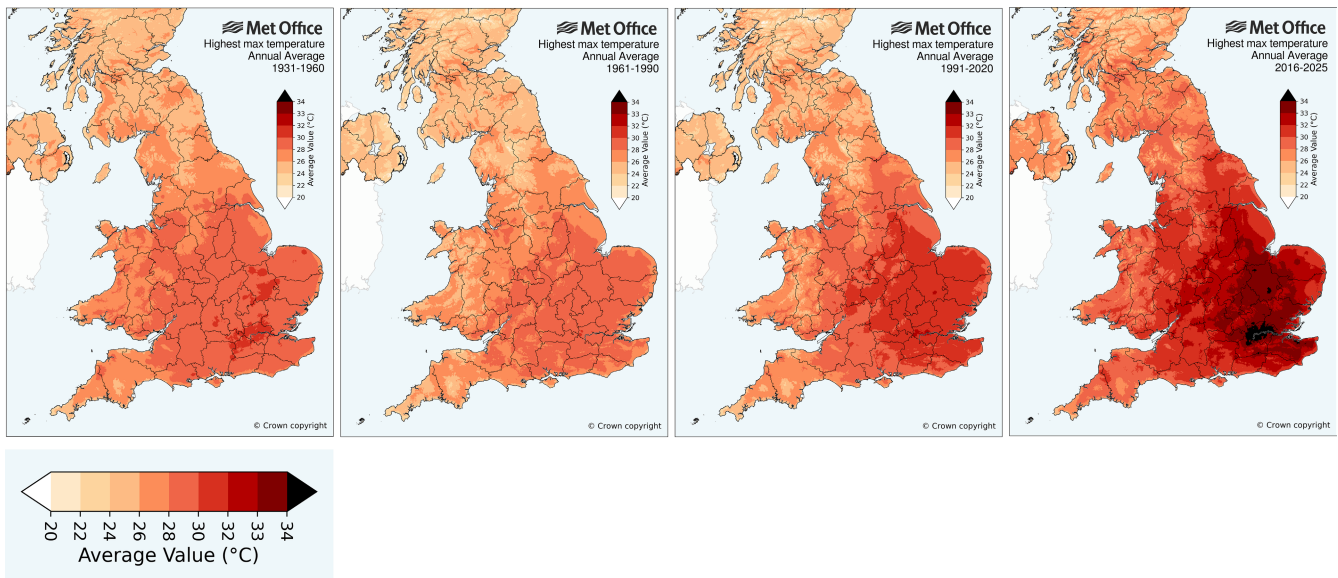


FIGURE 17 | Average highest Tmax of the year (°C) for the periods 1931–1960, 1961–1990, 1991–2020 and 2016–2025.

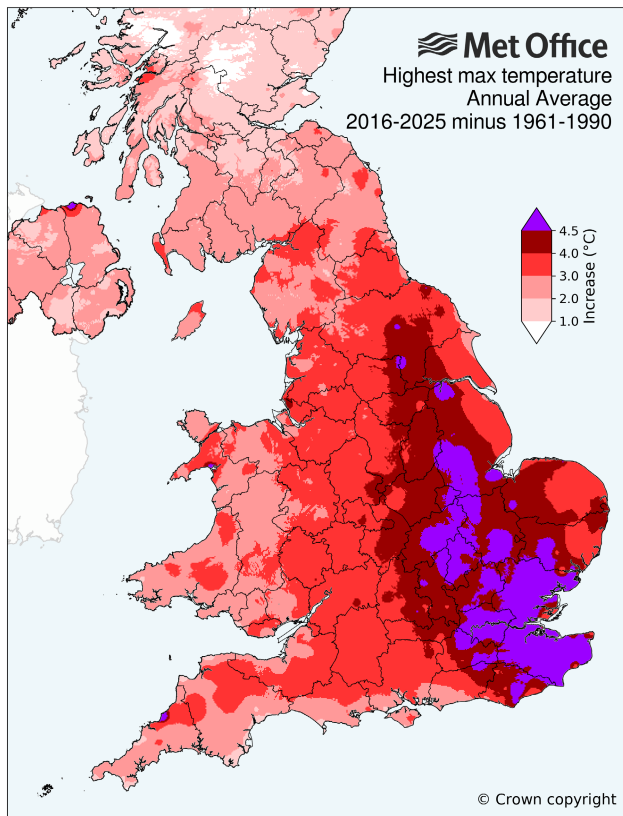


FIGURE 18 | Increase in average highest Tmax of the year (°C) for the period 2016–2025 compared to 1961–1990.

years is low in the context of recent decades but not so compared to the series in the 20th Century.

Taken collectively, these analyses therefore demonstrate some very large changes in the frequency of both high and low temperature extremes, and that the hottest day of the year has

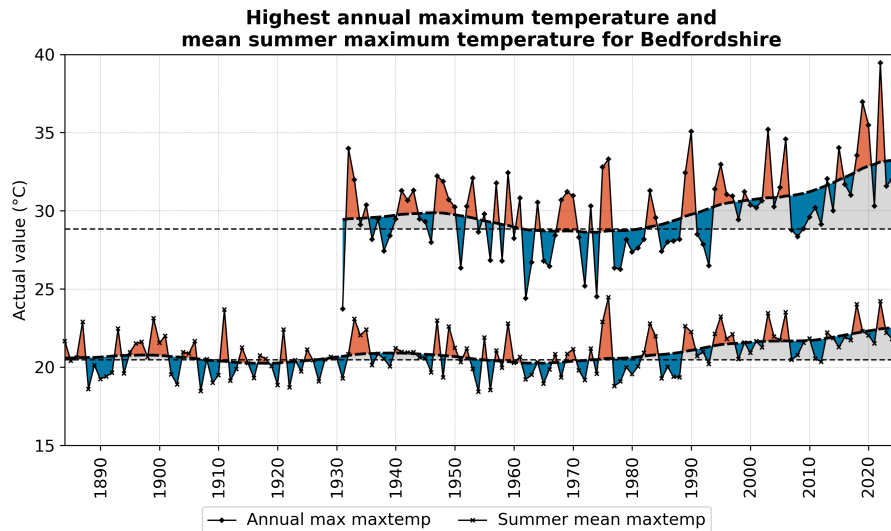
warmed by far more than average temperatures for large parts of the UK, including the south-east and Greater London. The observational evidence demonstrates that what we regard as our ‘normal’ climate in terms of the hottest and coldest spells of weather we would typically expect in any given year has very significantly changed from what it was through most of the 20th Century. It is vital that these changes are communicated clearly, and that it is understood that the UK’s warming climate is far more than simply an increase in annual mean temperature (Hawkins et al. 2026).

1.6 | Central England Temperature

The monthly Central England Temperature (CET) series is the world’s longest continuous instrumental temperature record, providing supporting long-term context for recent changes in the UK’s climate based on over 350 years of observations. Figure 21 shows the annual Tmean CET series from 1659 to 2025. 2025 was the warmest year in the CET series with the last 4 years all within the top five warmest. These statistics are the same as for the UK series in Figure 1. 2025 was also the warmest year in the CET Tmax series from 1878 and fifth warmest in the CET Tmin series.

The CET series provides evidence that the 21st Century so far has overall been warmer than any period of equivalent length within the previous three centuries; 2001 to 2025 was 1.0°C warmer than 1901–2000, 1.4°C warmer than 1801–1900 and 1.3°C warmer than 1701–1800. All seasons of the 21st Century so far have also been warmer than the same seasonal average in each of the previous three centuries (Table 4).

The daily CET series from 1772 provides long term context for recent changes at a daily timescale. Figure 22a shows the actual number of days each year between 1772 and 2025 for daily Tmean above threshold values from 10°C to 20°C; similarly, Figure 23a shows the number of days below threshold values from 10°C to 0°C. These figures emphasize the warming in the



	1931-1960	1961-1990	1991-2020	2016-2025	2025
Annual highest Tmax	29.7	28.8	31.1	33.4	32.1
Summer mean Tmax	20.8	20.5	21.7	22.6	24.2

FIGURE 19 | Average summer Tmax (bottom series) 1884–2025 and highest annual Tmax (top series) 1931–2020 for the county of Bedfordshire. The light grey shading shows the difference between the trend line and the 1961–1990 average. The table shows actual values (°C).

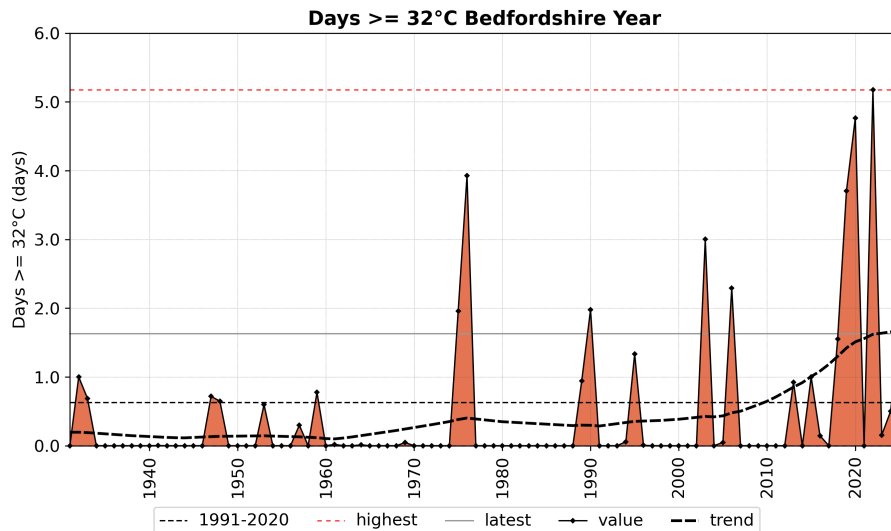
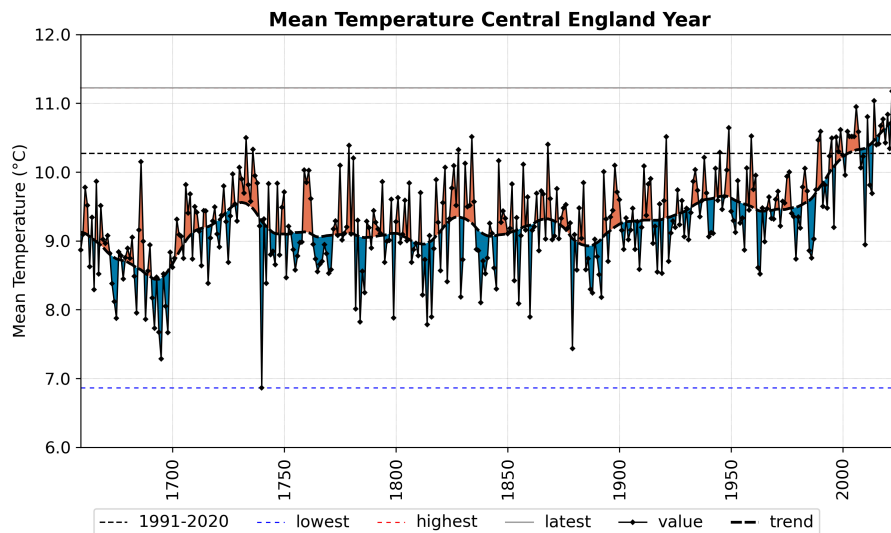


FIGURE 20 | Number of days with daily Tmax $\geq 32^{\circ}\text{C}$ for Bedfordshire, 1931–2025.

daily CET series: the changes in the daily temperature frequency distribution since the 1980s have exceeded any fluctuations in the previous 200 years. Figure 22b shows the ‘change ratio’, that is, the ratio of the smoothed (trend) value each year to the 1961–1990 average for each temperature threshold. The higher temperature thresholds have seen the greater proportional changes, so that by the 2020s the number of days per year with daily CET Tmean above 20°C has more than trebled compared

to 1961–1990. Figure 23b is very similar (here the ‘change ratio’ has been reversed)—such that by the 2020s the number of days per year with daily CET Tmean below 0°C has reduced by a factor of over 2.5.

Unsmoothed values for the most recent decade support this: for CET Tmean $\geq 20^{\circ}\text{C}$, there were 10.8 days on average for 2016–2025 compared to 3.2 days for 1961–1990; for CET Tmean



	1931-1960	1961-1990	1991-2020	2016-2025	2025
Central England	9.63	9.46	10.27	10.80	11.23

FIGURE 21 | Annual mean temperature for Central England (CET), 1659 to 2025. The table shows actual values (°C).

TABLE 4 | Averages for each century of the CET series (°C) 1659 to 2025 (winter from 1660 to 2025).

	1659–1700	1701–1800	1801–1900	1901–2000	2001–2025
Season	(42 years)	(100 years)	(100 years)	(100 years)	(25 years)
Year	8.7	9.2	9.1	9.5	10.5
Winter	3.0	3.5	3.7	4.2	5.1
Spring	7.5	8.1	8.1	8.4	9.4
Summer	14.9	15.5	15.2	15.3	16.3
Autumn	9.1	9.6	9.5	10.0	11.1

$\leq 0^{\circ}\text{C}$, there were 3.9 days for 2016–2025 compared to 12.1 days for 1961–1990. (The method for calculating the smoothed trend line, from which the ‘change ratio’ is calculated, is given in Appendix A.2.1. It is not a straight average of the last 10 years so the ratio values differ slightly). While the fluctuations in the CET series prior to 1961–1990 provide evidence of interdecadal variability, they are relatively small compared to the recent warming trend.

1.7 | Days of Air and Ground Frost

Air frost statistics are derived from daily Tmin grids extending back to 1931, whereas ground frost statistics are from gridded monthly days of ground frost from 1961. Both variables have a very large spatial variation in climatology across the UK. For example, the 1991–2020 annual average days of air frost range from more than 100 days across much of the high ground of Scotland to fewer than 10 days across parts of western

Cornwall. Appendix A.1.7 explains how these areal-series are calculated.

Figure 24 shows annual average days of air frost per year for 1931–1960, 1961–1990, 1991–2020 and 2016–2025, and days of ground frost for 1961–1990, 1991–2020 and 2016–2025. Figure 25 shows the time-series for the UK. The annual average days of air frost trend has been stable at around 65 days from the 1930s to the 1970s, followed by a steady decline from the 1980s. The most recent decade, 2016–2025, has had an average of six fewer air frosts compared to 1991–2020 and over 2 weeks fewer compared to 1961–1990 and 1931–1960.

The UK typically has around twice as many days of ground frost as air frost, reflecting the large number of marginal days in the UK's climate where the surface temperatures over grass are below freezing but air temperatures recorded within the Stevenson screen, typically around 1 to 3°C higher, are not. The shorter ground frost series shows a similar trend with larger

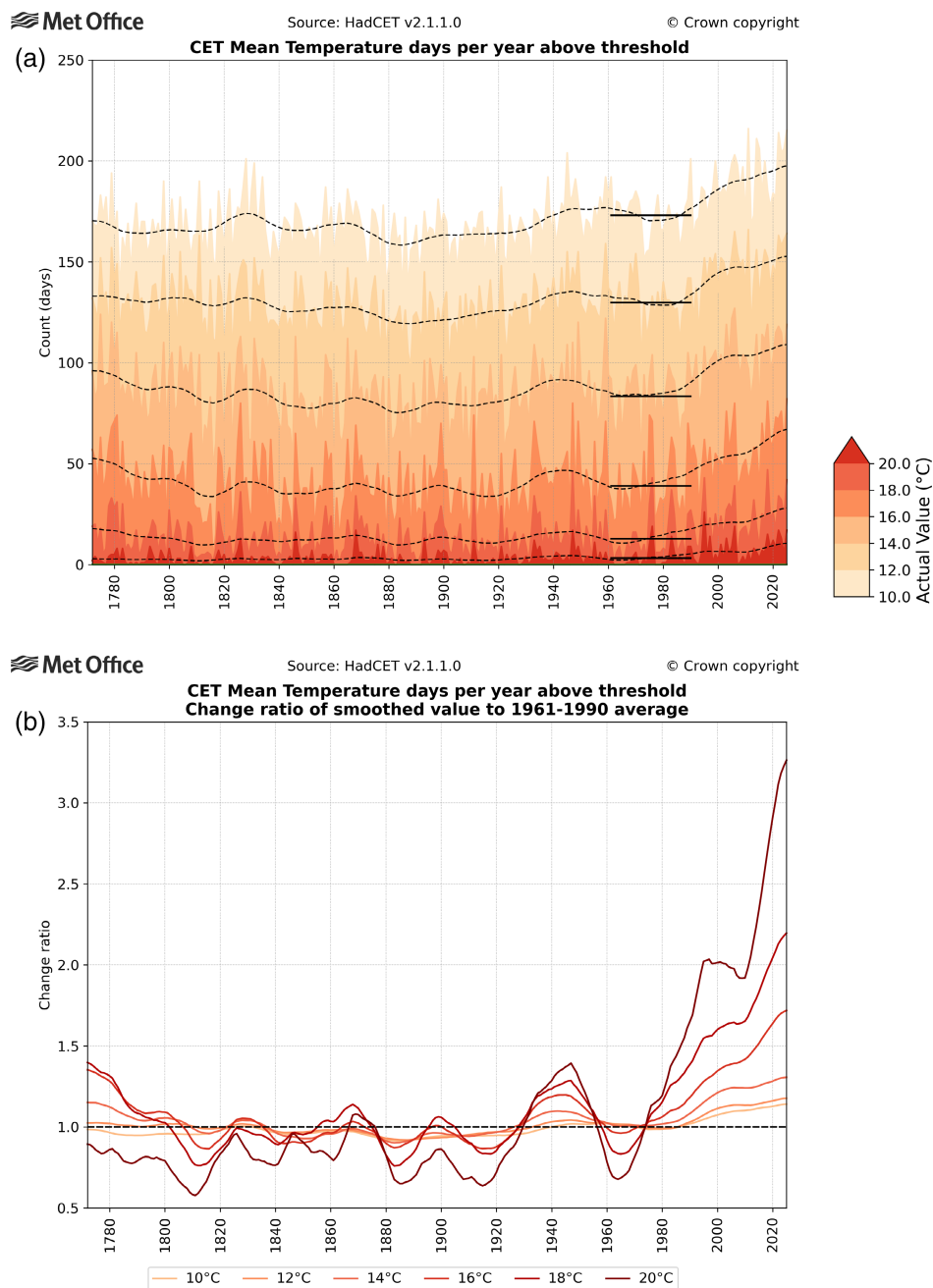


FIGURE 22 | (a) The number of days per year in the daily CET series from 1772 to 2025 with daily Tmean $\geq 10^{\circ}\text{C}$ to 20°C . The hatched lines show the trend (i.e., smoothed) values. The solid black line shows the 1961–1990 average for each series (b) The ‘change ratio’—that is, the ratio of the trend value for each individual year to the 1961–1990 average, for each threshold.

absolute reductions; the most recent decade 2016–2025 having 1½ weeks fewer ground frosts compared to 1991–2020 and 4 weeks fewer compared to 1961–1990.

For 2025, both days of air frost and days of ground frost were below the 1991–2020 long-term average—although not exceptional. An important point is that while the number of days of air and ground frosts has reduced by around a quarter from 1961–1990 to 2016–2025, this is much smaller than the ‘change’ ratio seen for more extreme temperatures (e.g., Tmin $< -8^{\circ}\text{C}$, Figure 15b). 2010 had the highest number of air frosts and the second highest number of ground frosts in the respective UK

series, despite this being a comparatively recent year, and in both series, this is an extreme outlier from the overall warming trend.

1.8 | Growing Degree Days

Growing degree days (GDD) are an integration of warmth over time above a base temperature (Tbase) which is dependent on the plant type/species. It relates temperature over time to the accumulated thermal conditions suitable for plant growth. The threshold for Tbase used in this and previous reports is 5.5°C , see Appendix A.1.4 for details. Other meteorological factors

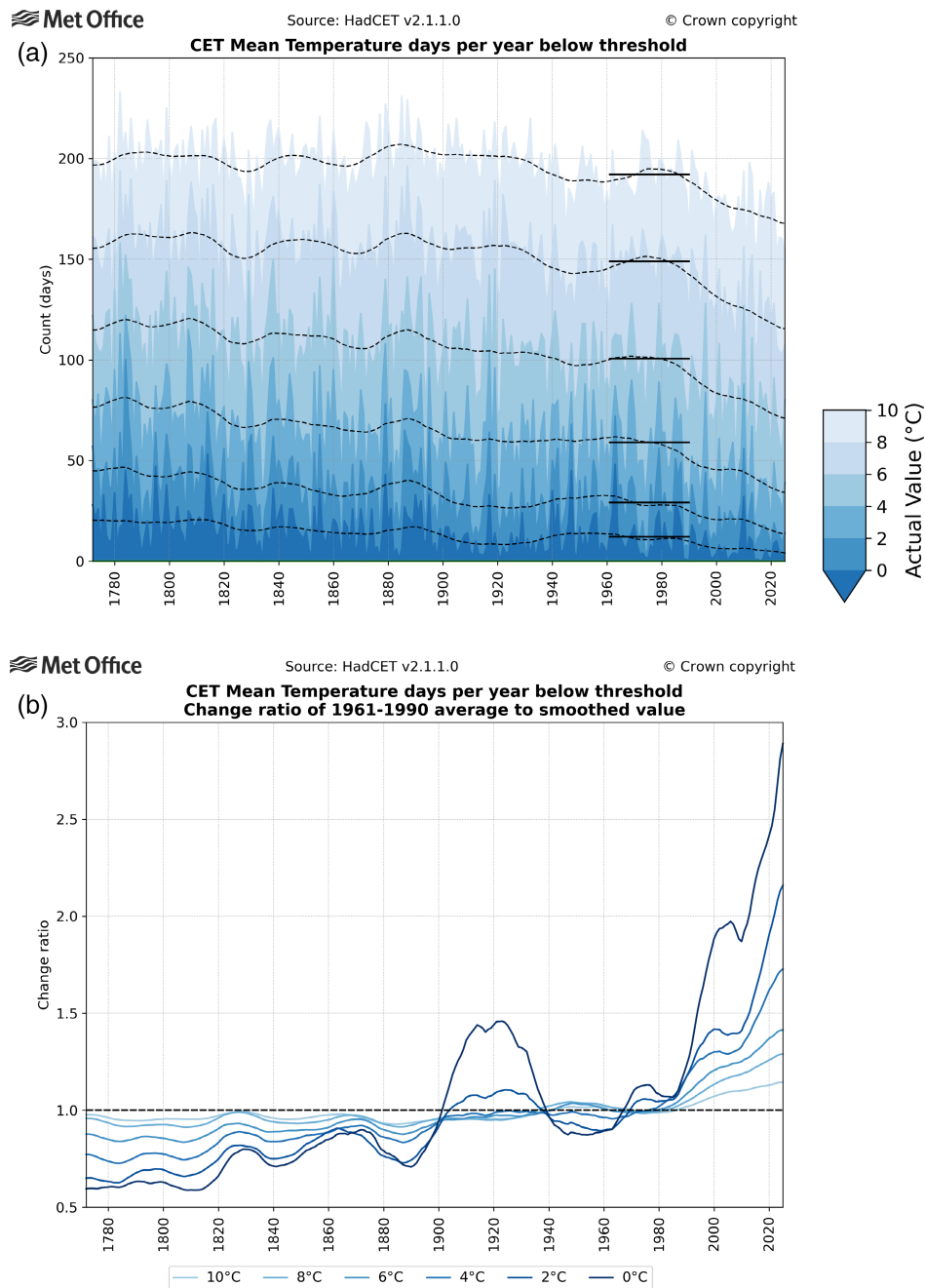


FIGURE 23 | (a) the number of days per year in the daily CET series from 1772 to 2025 with daily Tmean $\leq 10^{\circ}\text{C}$ to 0°C . The hatched lines show the trend (i.e., smoothed) values. The solid black line shows the 1961–1990 average for each series, (b) the ‘change ratio’—that is, the ratio of the 1961–1990 average to the trend value for each individual year, for each threshold. Note, the change ratio here is reversed to that in Figure 22 for clarity.

such as rain, wind and sun, as well as biotic interactions and management practices, will also influence the growth of plants.

The trend in UK GDD (with Tbase = 5.5°C) has been largely stable at around 1500 GDD from the 1930s to the 1970s, followed by a steady and continuing increase from the 1980s (Figure 26). The most recent decade 2016–2025 has had 9% more GDD than 1991–2020 and 24% more than 1961–1990—that is, an increase of almost a quarter. 2025 had the highest value of GDD on record with 118% of the 1991–2020 average, exceeding the previous record value in 2022. Six of the 10

highest GDD years have occurred in the most recent decade 2016–2025. Overall, this series is well correlated with UK annual mean temperature (R^2 0.88 for the years from 1931 to 2025).

Figure 27 shows the annual accumulated GDD values (Tbase = 5.5°C) for each calendar year from 1931 to 2025. By the end of February in 2025, UK GDD were running at close to the 1991–2020 average but increased rapidly through the spring months, and by mid-June exceeded the previous record up to that point in the year. The record margin increased until the end of July

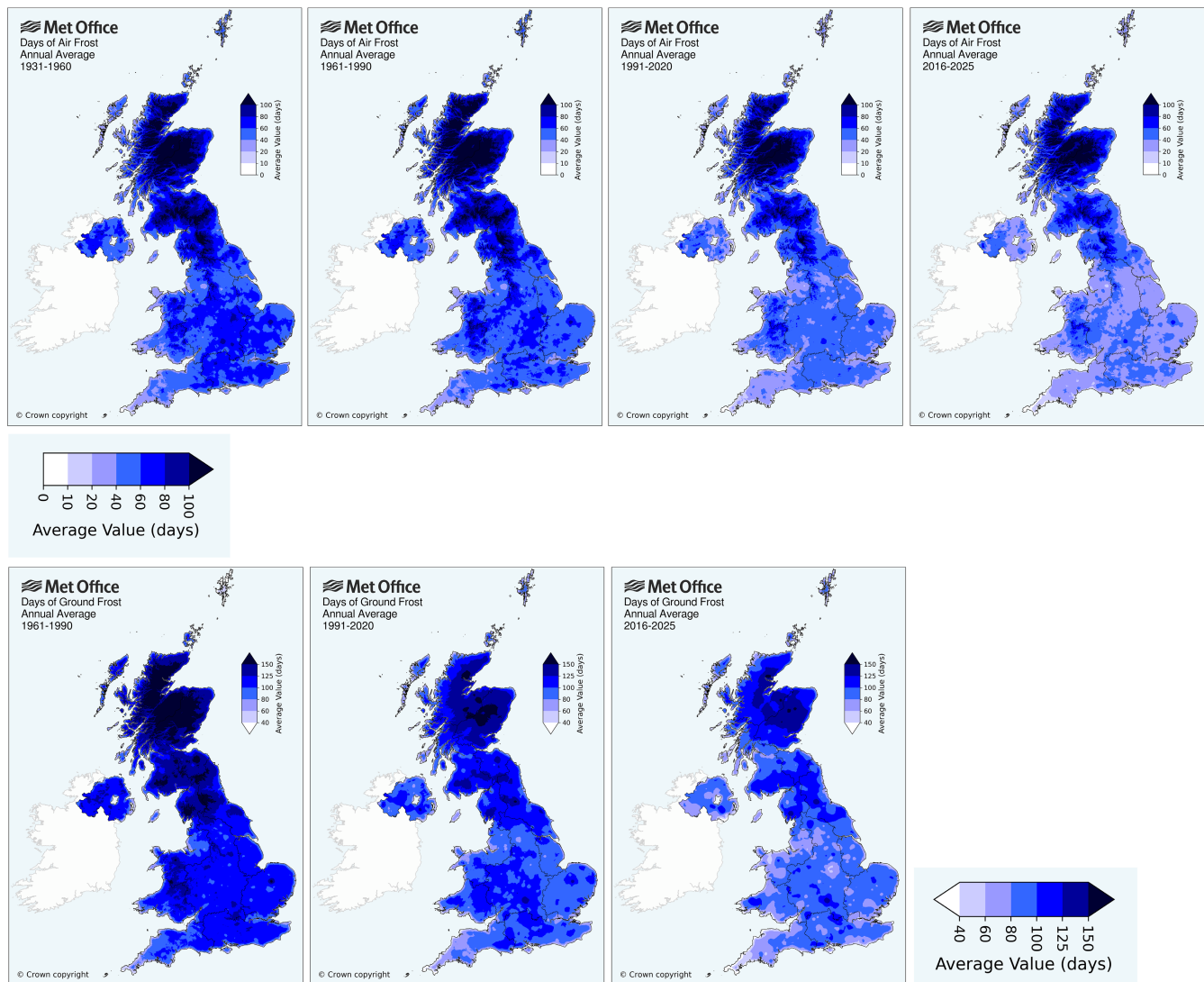


FIGURE 24 | UK annual average number of days of (a) air frost and (b) ground frost for 1931–1960, 1961–1990, 1991–2020 and 2016–2025 (1931–1960 is not available for ground frost).

and was sustained through the remainder of the year, narrowing slightly in late November due to a short cold spell (Figure 4).

1.9 | Near-Coast Sea Surface Temperature

The year 2025 was the second warmest year for UK near-coast sea surface temperature (SST) in a series from 1870; only 2023 was warmer (Figure 28). (See Appendix A.1.9 for details of this series, based on the HadSST4 dataset). The most recent decade 2016–2025 has been 0.3°C warmer than the 1991–2020 long term average and 1.0°C warmer than 1961–1990, which is less than the Tmean anomaly over UK land (0.51°C and 1.33°C relative to 1991–2020 and 1961–1990, respectively). This is consistent with global observations which also show greater warming over land than sea (IPCC 2021). Five of the 10 warmest years for UK near-coast SST from 1870 have occurred in the most recent decade 2016–2025. Although estimated total uncertainties in this UK near-coast series are large, particularly for earlier years in the series, the trend of rising temperatures is very clear. It is well correlated with the HadUK-Grid series of UK annual mean air

temperature land shown in Figure 1 (R^2 0.86 from 1884 to 2025, when de-trended R^2 is 0.75).

The year 2025 was the warmest year on record for mean SST across the Northwest European seas and Northeast Atlantic based on the OSTIA dataset from 1982 to 2025, with an average value of 12.37°C (only 2014, 2022, 2023 and 2025 reached values above 12°C). OSTIA is an in situ and satellite global dataset; compared to HadSST4 it is shorter but higher resolution. This series is well correlated with the UK near-coast HadSST4 series (R^2 0.95 for 1982–2025), but the Northwest European seas and Northeast Atlantic region covers a larger area—for example, a much greater spatial extent of the North and Celtic seas, and this explains the different rank of year 2025 (see Appendix A.1.9).

Figure 29 shows daily mean SST values during 2025, with key weather events noted. There were 297 marine heatwave (MHW) days in 2025 for Northwest European seas and the Northeast Atlantic (referenced to the 1991–2020 period), more than any other year since 1982 and exceeding the previous record of 178 days in 2023 by a wide margin (the 2025 value was

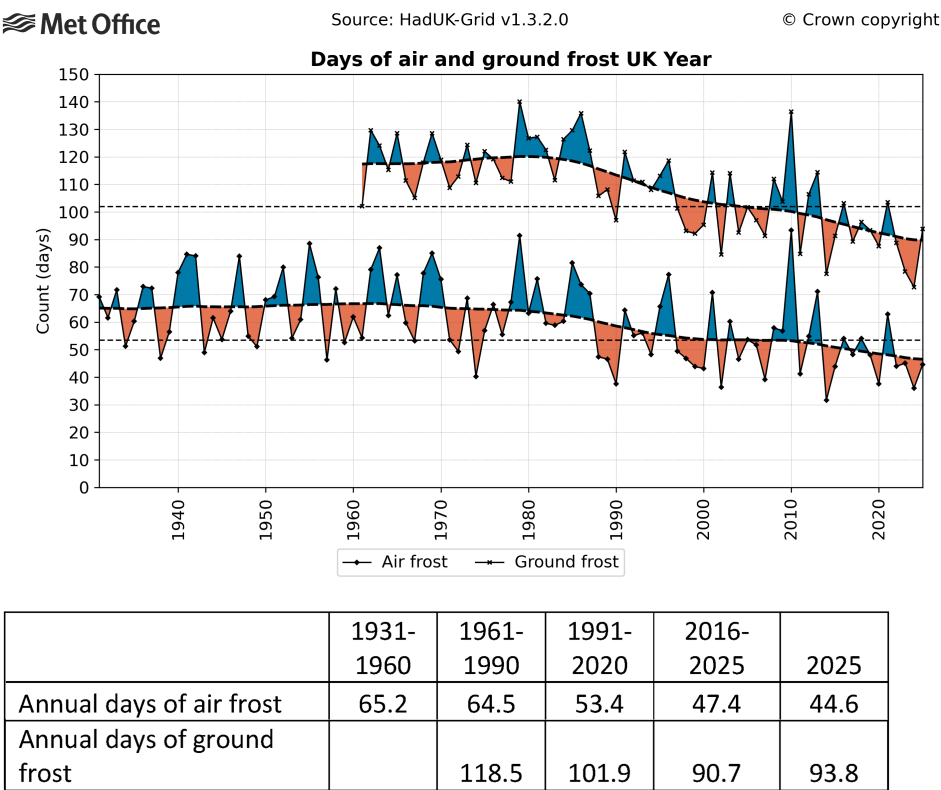


FIGURE 25 | Annual days of air and ground frosts for the UK, 1931 to 2025 and 1961 to 2025 respectively. The hatched line shows the 1991–2020 averages. The tables show actual values for the UK (days).

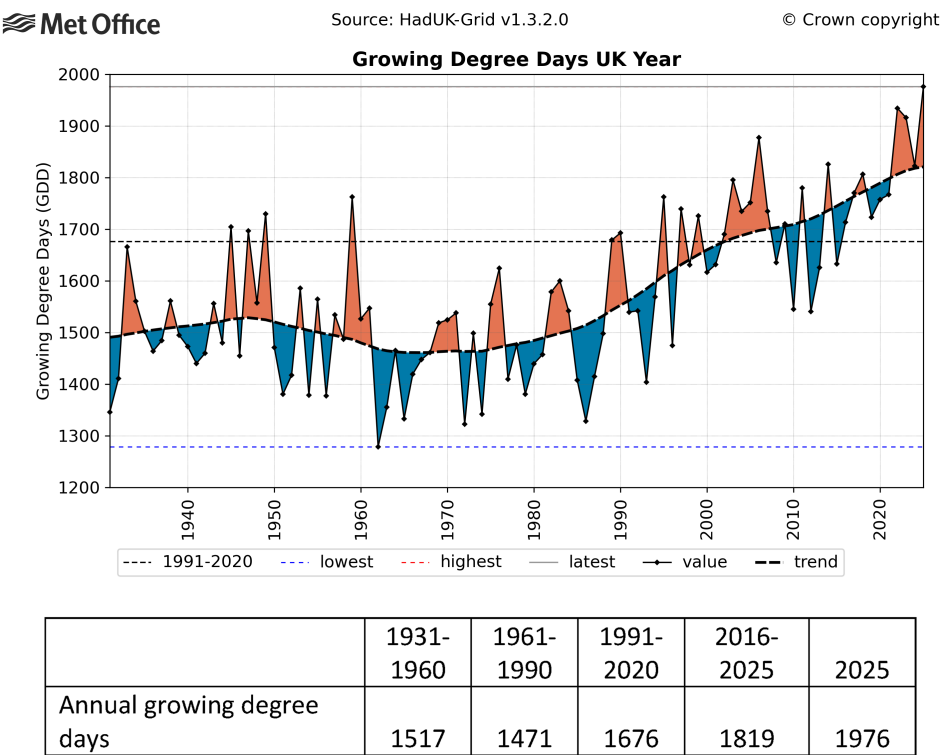


FIGURE 26 | Annual growing degree days for the UK, 1931 to 2025. The table shows actual values for the UK (GDD).

323 days if using 1982–2011 as the reference, commonly used as a baseline reference period for the satellite era). Marine heatwaves are prolonged spells of at least 5 days with the SST

anomaly exceeding the 90th percentile of the daily climatology. Category II, III, and IV heatwaves have SSTs 2×, 3× and 4× this anomaly, respectively (Hobday et al. 2018). The

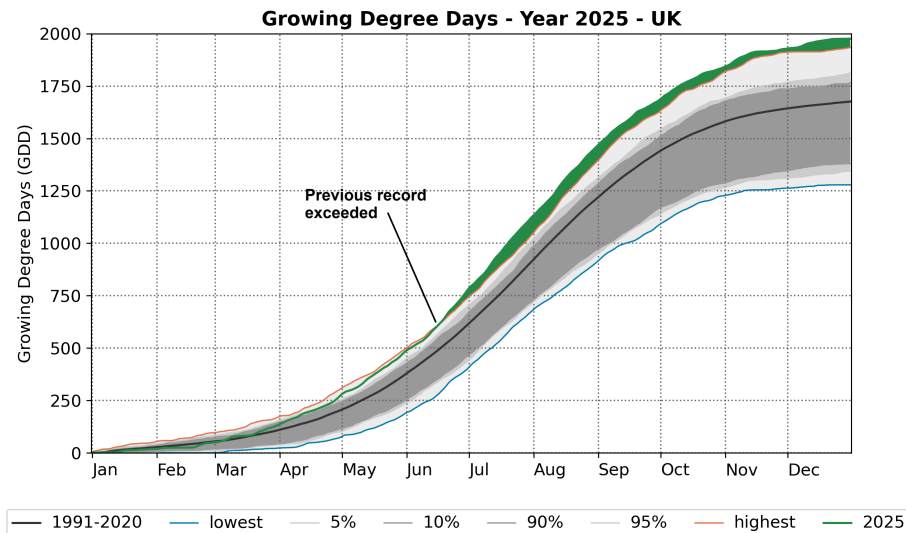


FIGURE 27 | Accumulated daily growing degree days (GDD) for the UK in 2025 compared to 1931 to 2024. The black line shows the 1991–2020 average for each calendar day as an accumulation for the year so far up to that point. The red and blue lines show the highest and lowest values and the grey shading the percentile values based on the period 1931 to 2024, with the green shading indicating the point in the year in which 2025 growing degree days exceeded the previous record.

number of days in the year is the total number of days across all such spells of at least 5 days.

2025 saw the warmest start to the year in the series (0.7°C above average), and followed a six-year period with no marine cold spells (the last cold spell was in March to April 2018). Ocean warming began around mid-February, a month earlier than usual. The anticyclonic conditions of the UK's record warm and sunny spring (Section 5.3) were associated with exceptional temperatures in the nearby ocean (0.7°C – 1.8°C above average) and marine heatwave conditions which peaked at 1.8°C in May and lasted until 3 June. High levels of sunshine, light winds and reduced wave activity are likely to have favoured the formation of a warm layer at the surface of the ocean earlier than usual. This was found to be a factor in the previous unprecedented June 2023 marine heatwave (Berthou et al. 2024). The MHW locally reached Category III in the Northeast Atlantic on 10 April and 22 May (Figure 30).

A second marine heatwave lasted from 15 June to 4 August, affecting all seas around the UK and peaking on 20 July at 1.3°C (Figure 29), with widespread Category I and II around the UK (Figure 30). This coincided with two widespread heatwaves on land across England and Wales. Storm *Floris* in early August caused a dip in SSTs as warmer surface layers were mixed with cooler water at depth. However, marine heatwave conditions resumed around the UK shortly after the storm. Marine heatwave conditions moved to the North Sea in September and through the autumn were sustained by long periods of 'anticyclonic gloom' (widespread stratocumulus clouds, dampening ocean cooling), before spreading again to all seas in December (Figure 30); the domain average oscillating between 0.5°C and 1°C anomalies in this cooling period.

Over 1982–2024, the strongest warming trend across this domain occurred in the southern North Sea where values

of greater than 0.4°C per decade were experienced (Cornes et al. 2025). Trends were lower to the west of the UK with values of 0.1°C – 0.2°C per decade. This long-term trend will naturally lead to an increase in the frequency and intensity of marine heatwaves, as illustrated by the difference in MHW days for 2025 using 1991–2020 as a reference (297 days) compared to using 1982–2011 (323 days).

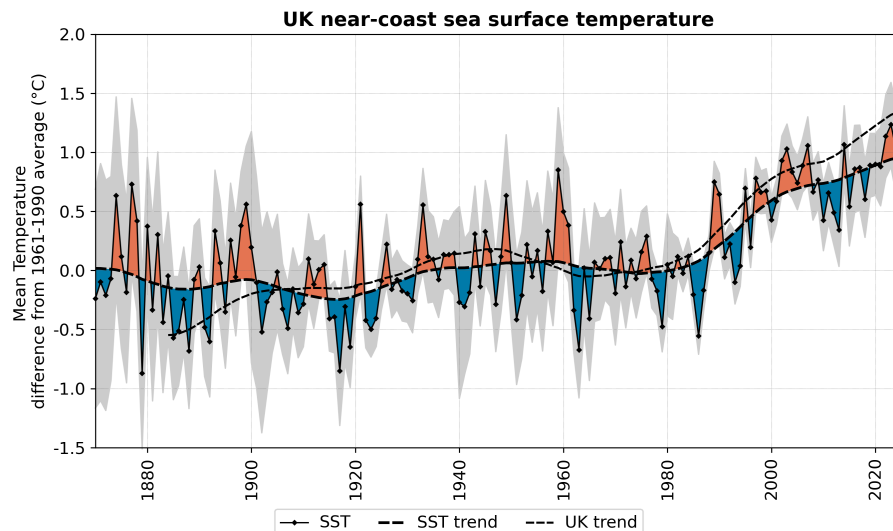
One potential consequence of the high SSTs and lack of cold spells for six consecutive years was a reported bloom in common octopus (*Octopus vulgaris*) numbers along the south-west coast of Devon and Cornwall, affecting the local fishing industry (Stewart et al. 2026).

2 | Precipitation

2.1 | Rainfall in 2025

The year 2025 was a relatively dry year across most of the UK with 91% of the 1991–2020 average rainfall. The driest areas were across East Anglia and north-east Scotland, with less than 75% of the 1991–2020 average in some locations—although nowhere was exceptional (Figure 31, Table 5).

Figures 32 and 33 show seasonal and monthly rainfall patterns during 2025, with the large spatial variations over the course of the year typical of the UK's climate. The first half was much drier than the second half, with a UK total of 381 mm from January to June compared to 681 mm from July to December. March was very dry across the southern half of England and Wales, for April it was the turn of north-east England and parts of north-east Scotland. May to August were less extreme but the dry theme nevertheless continued, with some exceptions (e.g., Cumbria in June, Kent, in July). The UK recorded its driest spring since 1974, sixth driest in the UK series from 1836.



Area	1991-2020	2016-2025	2025
SST	0.6	1.0	1.2
UK	0.83	1.33	1.79

FIGURE 28 | Annual mean sea surface temperature for near-coastal waters around the UK 1870 to 2025 as anomalies relative to 1961–1990 from HadSST v4.2.0.0. The trend in UK annual mean temperature over land from HadUK-Grid from 1884 to 2025 is also shown for comparison. The table shows anomaly values relative to 1961–1990 (°C). The SST series shows the best estimate 95% uncertainty range for each year accounting for all sources of uncertainty including measurement error, sampling error, spatial coverage and bias correction uncertainty.

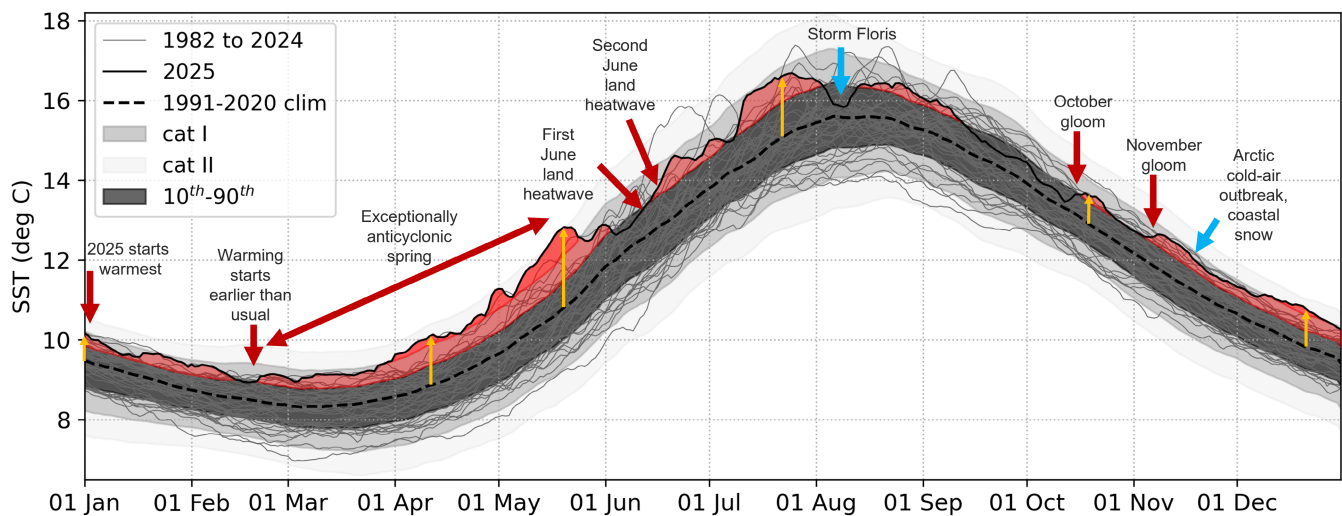


FIGURE 29 | OSTIA (Operational Sea Surface Temperature and Ice Analysis) daily mean SSTs for 2025 compared to previous years from 1982 to 2024 (thin grey lines), the 1991–2020 average (dashed black line) and the 10th to 90th percentiles smoothed with a 31-day moving average (dark grey shaded band). The mean is the daily average SST over the domain shown in Figure 30. The lighter shading shows Category I and II marine heatwaves (above 90th percentile) or cold spells (below 10th percentile) based on a 1991–2020 climatology, with the pale and dark red shading showing the periods of Category I and II marine heatwaves in 2025. The vertical yellow bars represent the dates for the maps in Figure 30. (This figure may be compared and contrasted with the daily UK land air temperature Tmax and Tmin series in Figure 4 where daily variability is very much greater and UK anomalies may reach $\pm 5^\circ\text{C}$ or more).

For England this was the driest spring since 1893. While the UK's summer was not unusually dry, rainfall was still well below average, just at the time when it was most needed for

farmers and growers. (Section 5.3 covers spring in more detail, Section 5.4 spring and summer combined including a comparison with 1976).

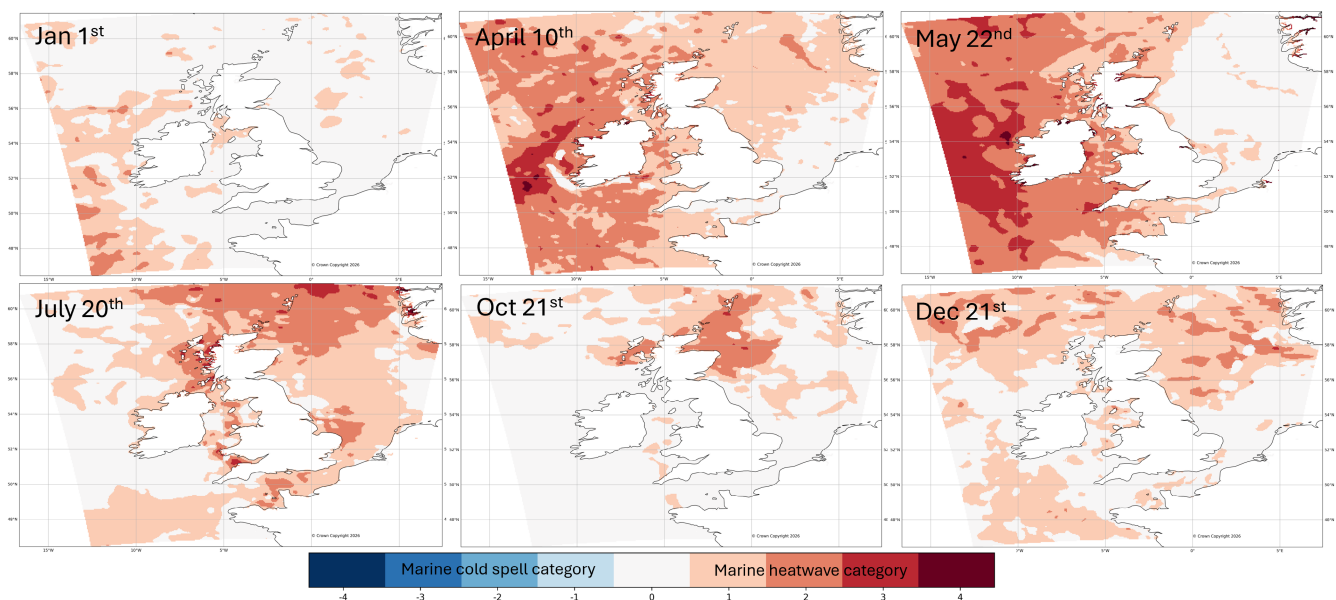


FIGURE 30 | Marine heatwave/cold spell category for six dates in 2025, using the 1991–2020 baseline. These dates are shown as vertical yellow bars in Figure 29. The maps show the domain of the Northwest European seas and the Northeast Atlantic.

The autumn was much wetter: September was a wet month fairly widely, while November saw twice the average rainfall in a swathe from the East Midlands to east Yorkshire. Storm *Claudia* from 13 to 14 November was part of a longer spell of unsettled and very wet weather in the first half of November, with 100 to 150% of the whole-month average rain falling in 6 days across an area from South Wales to Lincolnshire, causing some flooding problems. For Wales and Northern Ireland the autumn was ranked sixth/fourth wettest in the respective series. Colder and drier weather from Christmas to the New Year provided a brief respite before persistent wet weather and flooding concerns resumed in early 2026.

Figure 34 shows UK daily rainfall totals over the course of the year, with notable dry spells in March, April and May and a long unsettled period from mid-October to mid-December. For the UK overall, the wettest day of the year was 3rd October, coinciding with storm *Amy*. (October is the month that most frequently sees the UK's wettest day of the year overall, accounting for 17 out of 66 years from 1961 to 2025, approximately 1 in 4).

It is only possible to capture the patterns of observed rainfall across the UK as shown in Figures 31–33 if the rain gauge network across the UK is adequate. This report emphasizes the need to halt, and preferably reverse the ongoing steady decline in this network since the 1970s. This is especially important for daily rainfall extremes where spatial variation can be extremely large. If this decline continues, we will put at risk our ability to reliably monitor observed changes in rainfall in future years. More details are given in Appendix A.1.1.

2.2 | Annual, Seasonal and Monthly Trends

The UK annual precipitation time-series from 1836 to 2025 shows large annual variability but with an upward and ongoing

increase from the 1970s (Figure 35). The 21st Century so far has seen a cluster of wet years compared to the 19th and 20th Centuries, although there are wet years early in the series including 1903, 1877 and 1872 (the UK's wettest year on record in the series from 1836).

The most recent decade 2016–2025 has been 8% wetter than 1961–1990, with the largest seasonal changes at a national level around 20%. Most notably, while there has been little change in summer half-year rainfall (April to September), winter half-year rainfall (October to March) has increased for the UK by 13% from 1961 to 1990 to 2016–2025, and by 17% for England (Table 6). Figure 36a,b show the UK winter and summer half-year time-series, with the contrast between the trends in the two series shown in Figure 37. Until the 1970s, this difference was around 100 mm but from the 1980s it has approximately doubled to around 200 mm. There is no clear spatial pattern across the UK associated with this change (e.g., a north-west/south-east contrast); the winter half-year has broadly become wetter across most areas, especially England (Figure 38a). We note that while there has been no increase in summer half-year rainfall, there is no decrease either (Figure 38b). The impact of an increased contrast between winter and summer half-year rainfall shown in Figure 37 might be perceived as all-the-more pronounced because, in addition to this change in rainfall, the warming trend in the UK's climate is likely leading to an increase in evaporative demand in the summer half-year. The winter half-year increase represents 50 to 100 mm more of rain across much of the UK, and over 200 mm in some climatologically wetter upland areas in the west—approaching the whole-month average rainfall for March (Figure 38c).

Importantly, while the UK's climate is becoming wetter overall, the very large annual and decadal variability means caution is needed when interpreting these trends based on only a decade

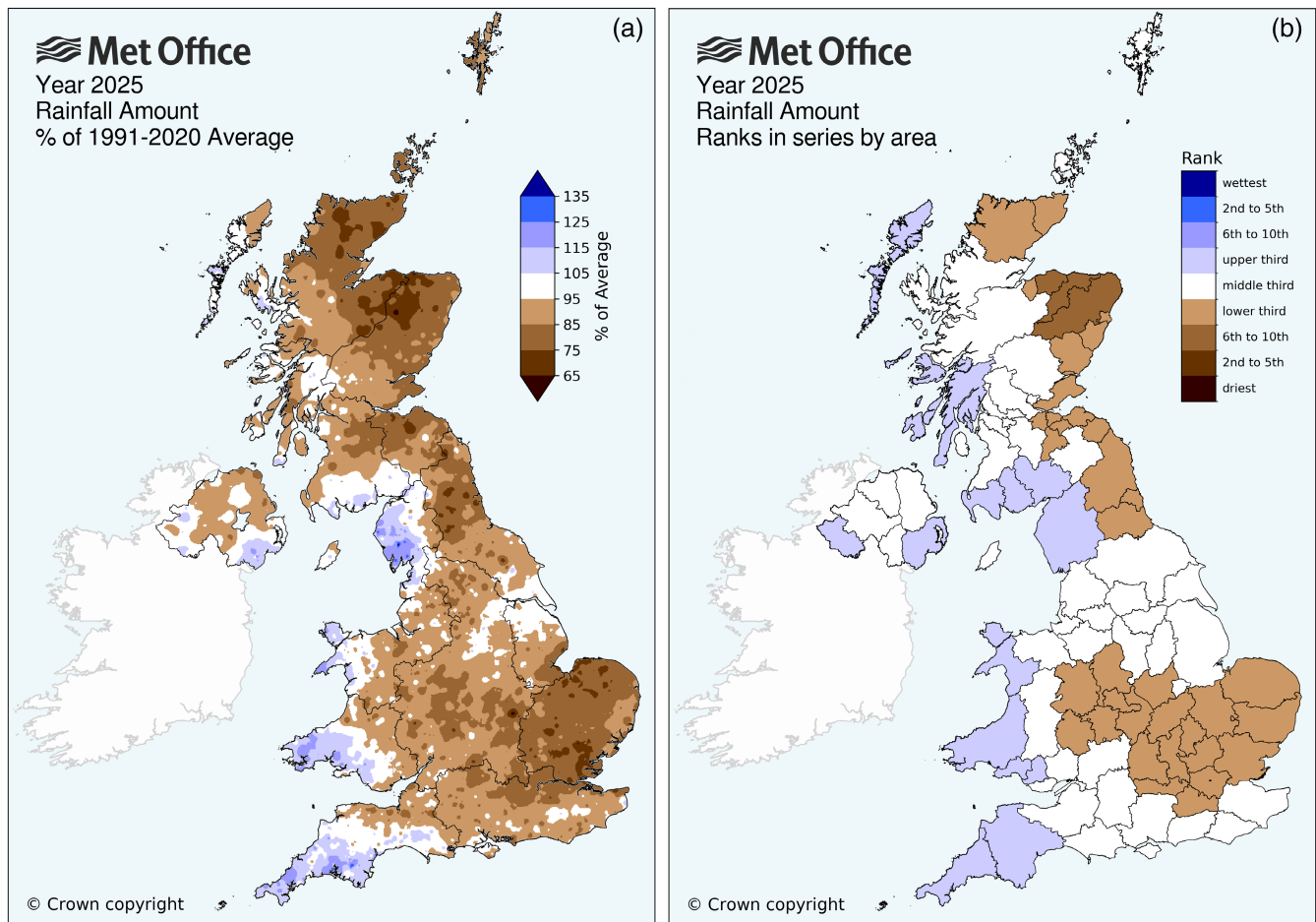


FIGURE 31 | (a) Rainfall anomalies (%) relative to 1991–2020 for year 2025 (b) The rank of 2025 annual rainfall for all counties of the UK based on county series from 1836 to 2025. Uncertainty in county statistics will increase in the 19th Century as the network size reduces (see Appendix A.1.1). The Isle of Man is not included.

of observations (2016–2025), since averages for this period may be strongly influenced by extreme months and years within this period. Changes for individual months show large variability—both from one month to the next, and from one part of the UK to another (Figure 39). While, taken collectively, the winter ‘half-year’ (top row) is broadly wetter, particularly October and February, the summer ‘half-year’ (bottom row) presents a mixed picture, and any detail will reflect this variability. Figure 40 emphasizes the very large variability in UK rainfall anomalies throughout the record from 1836 to 2025.

A separate limitation to note is the ability of the network to record precipitation falling as snow (see Appendix A.2.3). In recent decades, the number of snow events has reduced as the UK’s climate warms, so this may affect trends in the winter months.

2.3 | Monthly High and Low Extremes

Any changes in extreme monthly rainfall will have significant implications for flood risk, for example from fluvial flooding. Figure 41 shows the percentage of the UK’s land area each year recording monthly rainfall totals $\geq 200\%$ and $\leq 33\%$ of the

1961–1990 monthly average for that month, across all months of the year and all years in the UK series from 1836, separated into the winter and summer half-years. Summary statistics are presented below. As would be expected, these series show large annual variability, but the most pronounced feature is the increase in the spatial frequency of very wet months (expressed as an increase in area) in the winter half-year: in the most recent decade 2016–2025, around 8% of the UK’s land area has seen monthly rainfall twice the 1961–1990 average, approximately doubling the area since 1961–1990. In contrast, the summer half-year has seen no increase although the run of wet summers from 2007 to 2012 is prominent. There is no evidence in these series of an increase in spatial frequency of very dry months in either the winter or summer half years, although there is considerable variability in the earlier years of the dataset, which may in part be affected by station network density and data quality.

2.4 | Daily Trends and Extremes

In this section, we show some trends in daily rainfall for the UK based on series from 1961 to 2025. Any analysis of extreme daily rainfall is constrained by the limitations of digitized data available

TABLE 5 | Monthly, seasonal and annual rainfall actual values (mm) and percentage of average values relative to 1991–2020 for the UK and countries for year 2025. Colour coding corresponds to the rank as given in the key below. The series lengths are 1836–2025 (190 years) except winter which is 1837 to 2025 (189 years).

	UK		England		Wales		Scotland		Northern Ireland	
	Actual	%	Actual	%	Actual	%	Actual	%	Actual	%
January	99	81	95	115	150	97	94	53	76	66
February	72	75	52	79	92	77	102	73	69	75
March	37	43	15	25	24	23	78	63	26	31
April	40	56	28	51	72	82	45	48	82	111
May	51	71	33	57	51	59	79	89	58	78
June	82	106	52	81	115	125	118	127	104	128
July	74	90	59	88	60	61	103	99	77	86
August	59	63	31	42	70	63	101	84	66	67
September	121	133	103	150	198	177	126	102	147	168
October	124	101	82	91	146	92	182	108	157	137
November	165	133	140	152	261	161	184	111	143	117
December	138	109	108	117	207	118	178	102	101	83
Winter	317	92	230	95	434	96	445	90	235	72
Spring	128	56	76	44	148	53	202	66	166	71
Summer	215	85	142	69	244	81	323	102	247	91
Autumn	409	122	325	129	605	140	492	108	447	138
Year	1061	91	798	92	1446	99	1391	88	1106	96

Key	Driest on record	Top 10 driest	Dry: ranked in lower third of all years	Middle: ranked in middle third of all years	Wet: Ranked in upper third of all years	Top 10 wettest	Wettest on record

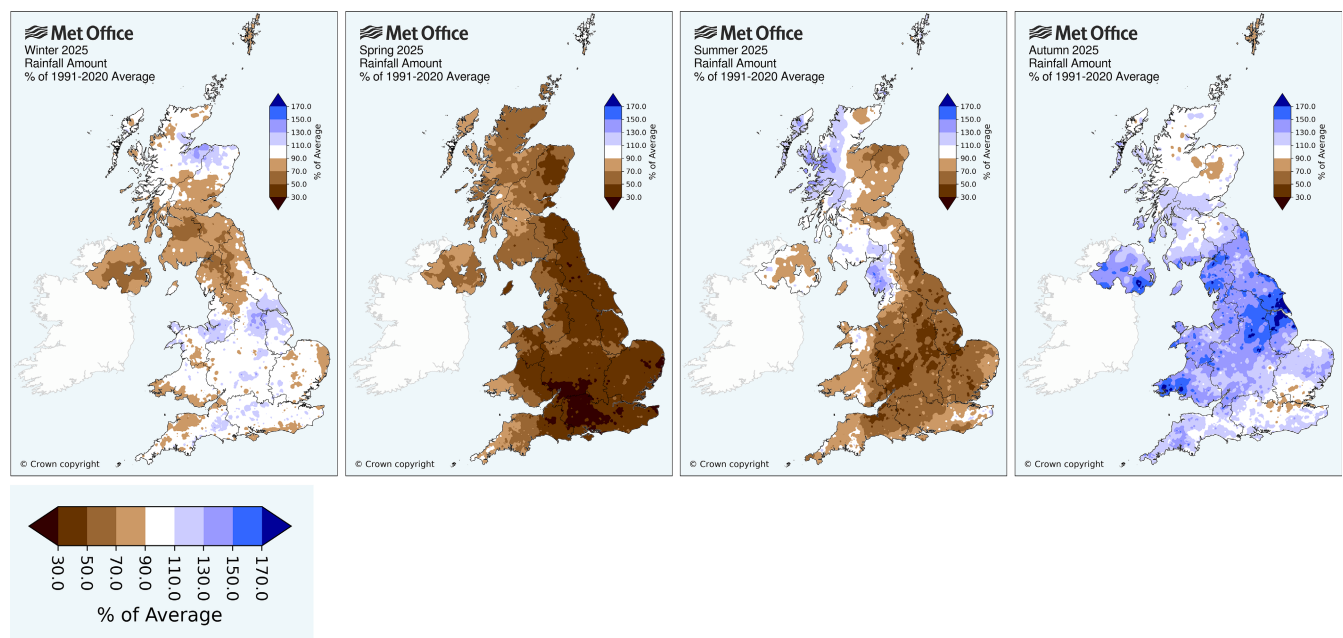


FIGURE 32 | 2025 seasonal rainfall anomalies (%) relative to 1991–2020. Winter refers to the period December 2024 to February 2025. The spring map is repeated in Figure 56b, together with spring rainfall totals in mm in Figure 56a.

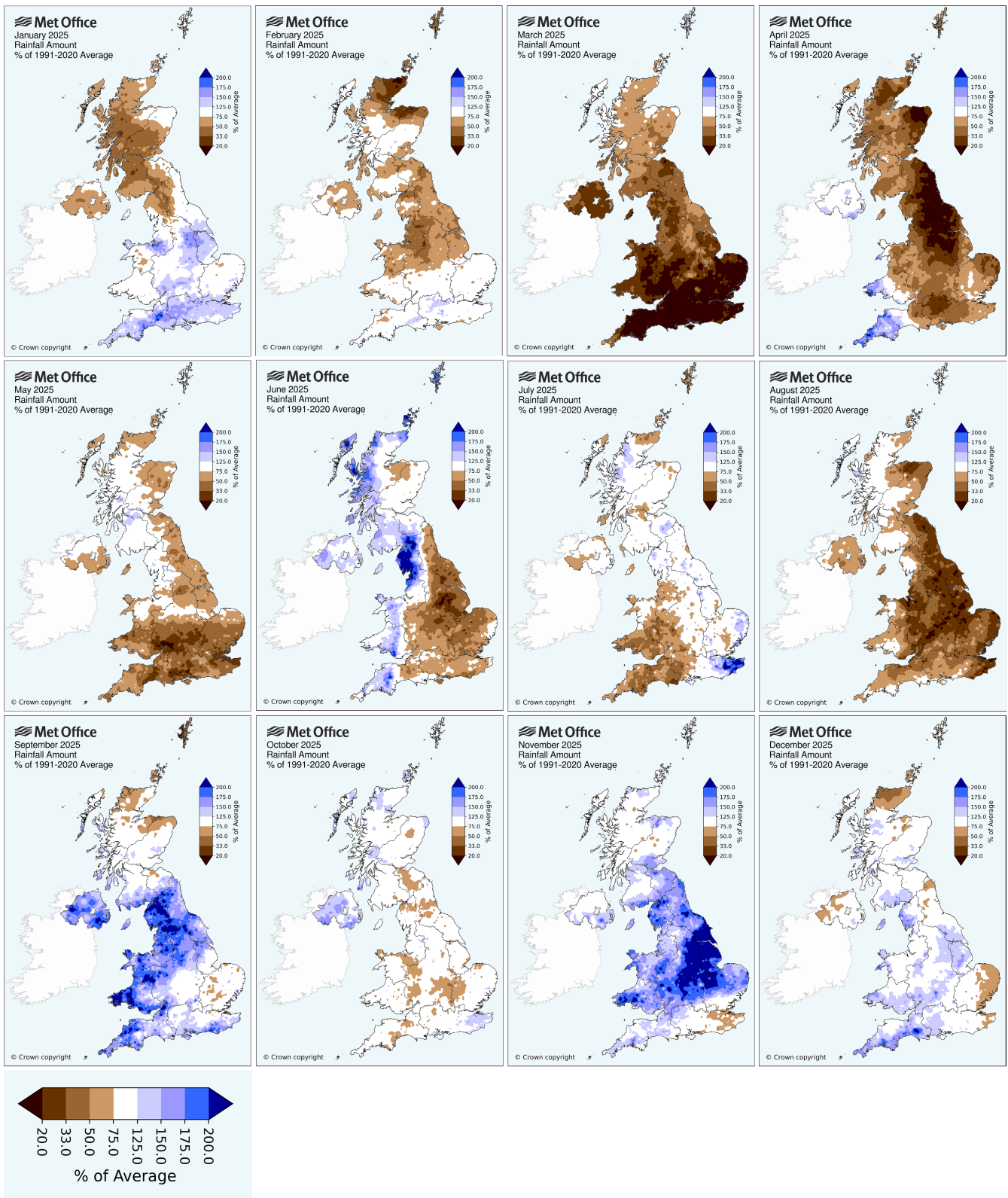


FIGURE 33 | 2025 monthly rainfall anomalies (%) relative to 1991–2020.

for analysis; prior to the 1960s there is a large drop in data currently available (Figure A3). Heavy rainfall can be highly localized, and a network of several thousand rain gauges is required across the UK to reasonably capture the spatial variation. Most rainfall events will be reasonably well captured, but inevitably some highly localized convective events may fall between gauges and be missed.

The limitation of the length of these series emphasizes the importance of future digitization work before 1961. Earlier years will include a number of extreme daily rainfall events (such as the Norfolk rain storm of August 1912) which have been captured by observations (British Rainfall Organization 1913), but where much daily data are yet to be digitized and fully included in the

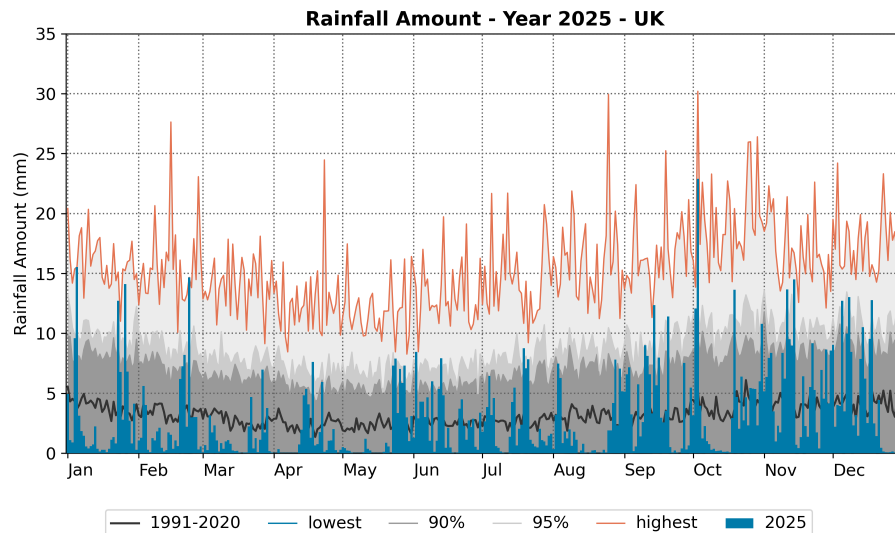
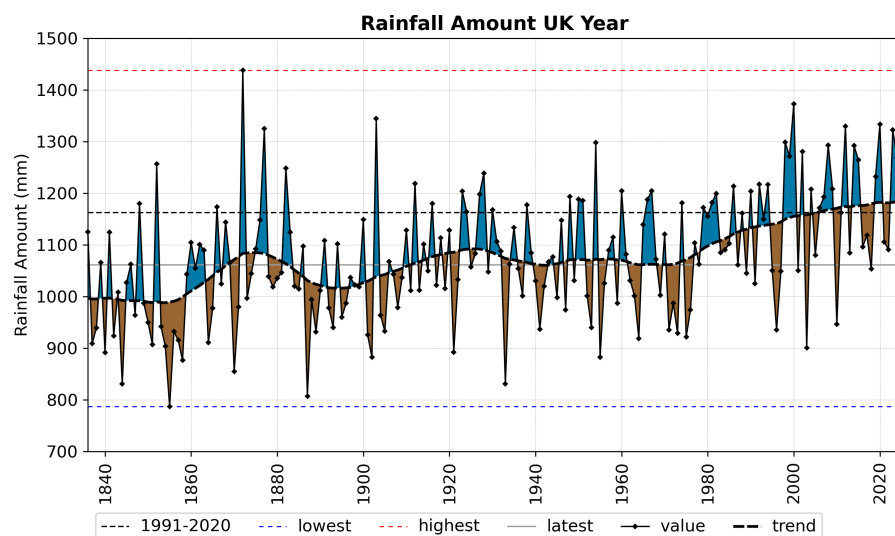


FIGURE 34 | UK daily rainfall totals for each calendar day of the year 2025. The black line shows the 1991–2020 average for each calendar day; the red line the highest value and the grey shading the percentile values for each calendar day of the year based on the period 1891 to 2025 inclusive.



	1901-1930	1931-1960	1961-1990	1991-2020	2016-2025	2025
UK	1075	1064	1084	1163	1168	1061
England	832	825	820	870	897	798
Wales	1380	1365	1380	1465	1511	1446
Scotland	1395	1380	1444	1573	1532	1391
Northern Ireland	1097	1084	1090	1156	1147	1106

FIGURE 35 | Annual rainfall (mm) for the UK, 1836 to 2025. The table shows actual values for the UK and countries. While the series extends back to 1836, averages are shown back to 1901–1930 since network coverage before this reduces (see Figure A3). Charts for individual months and seasons are available at <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-temperature-rainfall-and-sunshine-time-series>.

HadUK-Grid dataset (see Appendix A.1.1 and Figures A5 and A6). Events such as this from over a century ago are a reminder that extreme rainfall has occurred in the UK prior to any influence from

the warming climate. They demonstrate the importance of a long term perspective on variability of UK rainfall extremes in order to fully quantify the climate change signal.

TABLE 6 | Seasonal, annual, and winter and summer half-year rainfall percentage of average values relative to 1961–1990 and 1991–2020 for the UK and countries for the decade 2016–2025. Colour coding corresponds to the % of average values as given in the key below and is the same as Figure 38a. See also the note on Table 3 regarding winter which also applies in this table to the winter half-year. For 2016–2025 the first winter half-year is October 2015 to March 2016, the last October 2024 to March 2025.

	1961–1990					1991–2020				
	UK	England	Wales	Scotland	N Ireland	UK	England	Wales	Scotland	N Ireland
Winter	119	118	121	122	108	105	108	111	101	100
Spring	93	93	95	92	94	93	98	97	86	92
Summer	107	102	106	112	119	98	93	95	104	104
Autumn	110	122	113	100	104	105	111	108	99	103
Year	108	109	110	106	105	100	103	103	97	99
Oct-Mar	113	117	114	110	105	103	109	107	98	99
Apr-Sep	102	100	104	103	108	98	96	99	99	101

Key	< 85%	80% to 85%	85% to 90%	90% to 110%	110% to 115%	115% to 120%	> 120%

Note: Shading is applied before values are rounded, so occasionally the same rounded values may have different shades.

Figure 42 shows the UK area-average number of days of rain per year ≥ 1 , 10, 25 and 50 mm, with average values in the table. There are typically around 150 raindays ≥ 1 mm per year (1 in every 2 to 3 days), compared to 30 raindays ≥ 10 mm (1 in 10 days), five raindays ≥ 25 mm and less than one rain-day ≥ 50 mm—although clearly there will be large variations across the UK and by month of the year. The annual variability in these series (when scaled by the long-term mean) increases as the threshold increases and the corresponding number of events reduces. The raindays ≥ 1 mm series shows only a slight upward trend, but the relative change is greater for the higher thresholds, so the most recent decade 2016–2025 has seen increases in the number of raindays ≥ 10 , 25 and 50 mm of 12%, 18% and 29% respectively compared to 1961–1990. This analysis does therefore provide some supporting evidence of an increased frequency of wet or very wet days in the UK's climate in recent decades. A longer time-series with statistics for the period 1931–1960 would provide greater confidence in the extent to which 1961–1990 is representative of much of the 20th Century.

Figure 43a shows UK average rainfall intensity on wet days, (b) and (c) show the number of days each year from 1961 onwards where the rainfall total has exceeded the 95th and 99th percentiles for wet days (≥ 1 mm). The percentiles are calculated at each grid point based on rainfall totals over the period 1961–1990 on wet days—days exceeding 1 mm of rain; the UK value is the areal average of the number of days calculated at each grid point. The percentile series are well correlated with the rainday series: 95th percentile to raindays ≥ 10 mm; R^2 0.80, 99th percentile to raindays ≥ 50 mm R^2 0.77. Both percentile series show an upward increase of 20% or more for the most recent decade compared to 1961–1990. Rainfall intensity has also increased by 5% for the most recent decade 2016–2025 from 1961 to 1990; this compares to an increase of 8% in total annual rainfall for the same period (Table 6).

3 | Sunshine

The year 2025 was the UK's sunniest year on record in the series from 1910, with 1645 h, 117% of the 1991–2020 average, exceeding the previous sunniest year of 2003 by 57.7 h. This is a large margin given that the second sunniest year and tenth sunniest year in the UK series differ by less than 60 h. All parts of the UK were sunnier than average except for the Western Isles and a few coastal fringes (Figures 44 and 45). The year was ranked sunniest for England, fifth sunniest for Wales, second sunniest for Scotland and eighth sunniest for Northern Ireland. All countries recorded over 110% (Table 7).

The outstanding feature of the year was the exceptionally sunny spring. March, April and May were all much sunnier than average and all four nations recorded over 140% of average sunshine hours for spring overall. May and April were the sunniest 2 months of 2025 overall. As a result, this was, by far, the sunniest spring on record in the UK series from 1910, and, remarkably, it had more sunshine hours than all but three summers: 1976, 1995 and 1911 (spring 2025 is covered in more detail in Section 5.3).

Overall for the UK, the first half of the year (972 h) was far sunnier than the second half (672 h) and it included the UK's fifth sunniest January, fourth sunniest March, sunniest April and second sunniest May (marginally behind 2020). Only 2 months, February and October, were duller than average. The UK had its dullest October since 1968 and was an especially dull month in the west.

Northern Ireland recorded 284 h in May 2025, 155% of the 1991–2020 average, the sunniest calendar month on record for Northern Ireland as a whole in a series from 1910, while a weather station at Magilligan (County Londonderry) recorded 301.3 h, the highest monthly station total on record—also for any month—in Northern Ireland (when

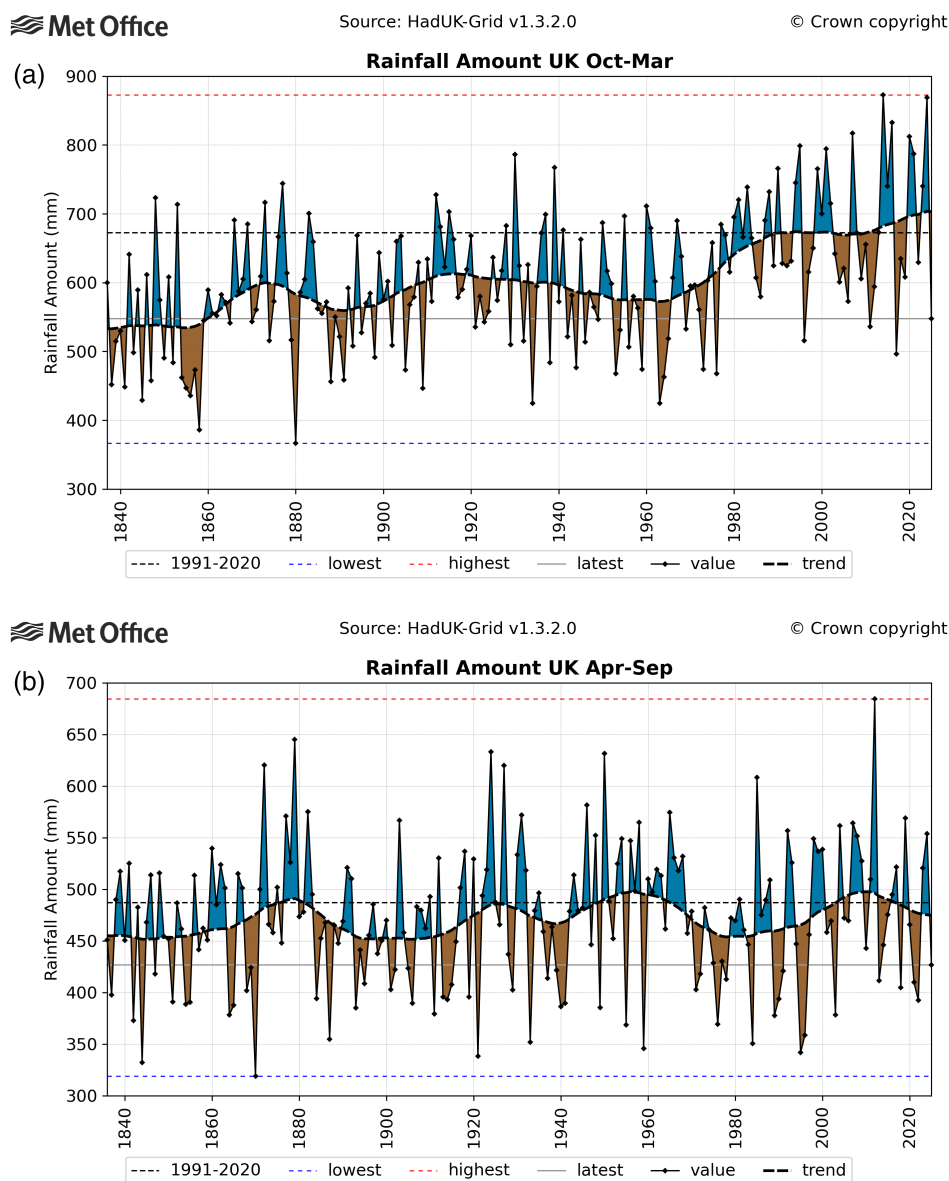


FIGURE 36 | UK half-year rainfall (mm) for (a) October to March 1837 to 2025, (b) April to September 1836 to 2025. The year refers to the month March falls in. The y-axis gridline spacing differs between these figures.

converted to Campbell-Stokes equivalent sunshine hours, see Appendix A.1.11). Spring 2025 was the sunniest overall season for Northern Ireland in a series from 1910, sunnier than any other spring or summer.

Annual sunshine totals for the UK have increased from the 1980s onward, with the most recent decade 2016–2025 4% sunnier than 1991–2020 and 10% sunnier than 1961–1990 (Figure 45). The annual trend is primarily due to increases in winter and spring (Figure 46, Table 8). For England, spring in the most recent decade 2016–2025 has been 21% sunnier than 1961–1990—representing a difference of almost 1 h per day. There has been no significant change in summer or autumn sunshine.

These decadal statistics reflect annual and decadal variability in the UK's climate in addition to the overall increasing sunshine trend. They are influenced by natural variability and circulation changes, as well as other regional and global drivers such as those contributing to global dimming and brightening trends including

direct and indirect response to aerosols (Wild 2009). Christidis et al. (2016) found evidence of human influence on winter sunshine extremes in the UK with the increase in winter sunshine most likely to be explained by reduced aerosol emissions.

The sunshine network is relatively sparse (Appendix A.1.2). Areas such as Highland Scotland and central Wales have relatively few observations, and sunshine stations may be affected by exposure issues, particularly in the winter months when the sun is at a low elevation and topographic shading may be important.

4 | Extremes

4.1 | Annual Extremes in 2025

Table 9 shows station extremes for year 2025. The UK lowest daily Tmin of -18.9°C was the lowest such value since February 2021 (when -23.0°C was recorded). The UK lowest daily Tmax

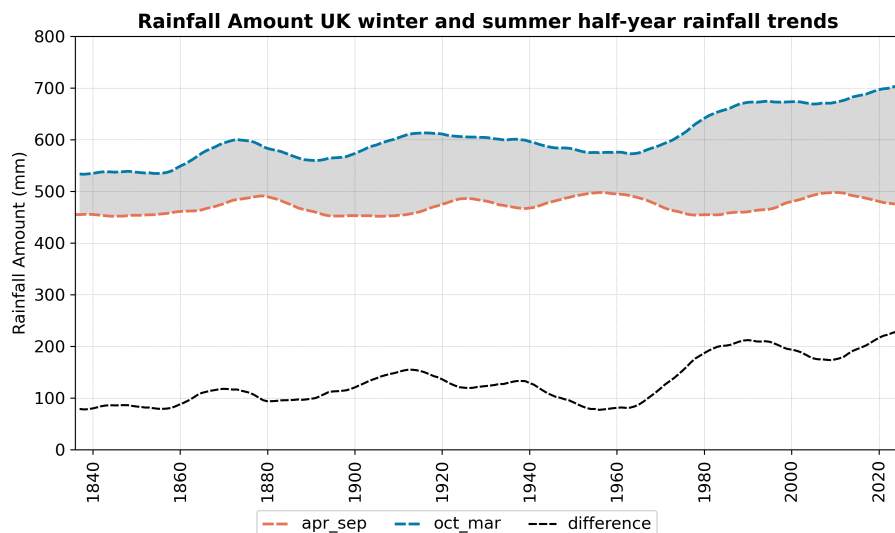


FIGURE 37 | A comparison of the trends in UK rainfall for October to March and September to April shown in Figure 36, with the difference between the trend lines (mm) shaded in grey. This difference is also plotted separately in black.

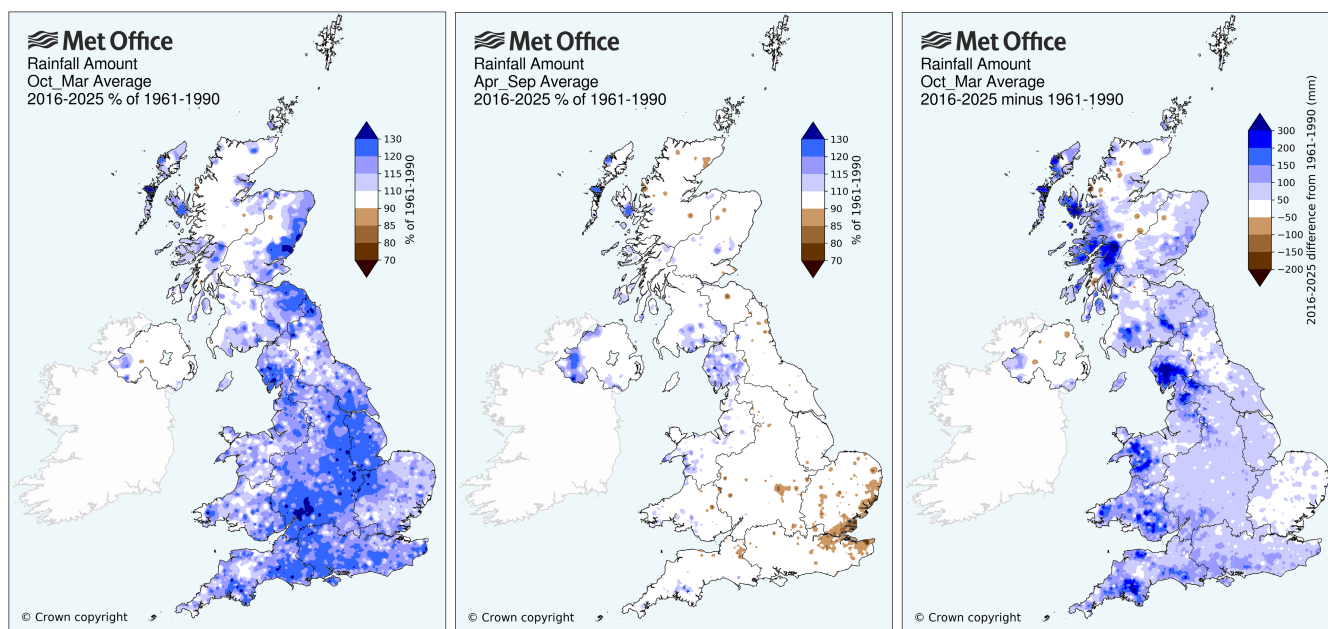


FIGURE 38 | Rainfall anomalies (%) for 2016–2025 for the winter half-year October to March and summer half-year April to September relative to 1961–1990, and the absolute difference in mm for the winter half-year from 1961–1990 to 2016–2025.

of -10.8°C was the lowest such value since the extreme cold of December 2010. The highest gust speed of 87 Kt (100 mph) occurred during storm *Éowyn* (described in Section 5.2), while the highest gust speed at Cairngorm Summit occurred during named storm *Amy*. The UK all-time gust record is 150 Kt (173 mph) at this station on 20 March 1986.

Figure 47a, b shows the UK's highest maximum and lowest minimum temperatures at any station, by year, from 1900. The UK's average highest Tmax for the most recent decade 2016–2025 was over 35°C , with 5 years over 35°C , three over 37°C , one over 40°C and only two below 34°C . The average highest Tmax for 2016–2025 was 4.4°C hotter than in 1961–1990, broadly consistent with

Figure 18 which shows the spatial variation of warming in the hottest day of the year across the UK (the statistic from Figure 47a is not identical because the particular station recording the UK's highest maximum temperature will vary on a year-to-year basis). 1993 was the last year where 30°C was *not* reached at any UK station, but in the historical record this was not especially unusual with a number of other years failing to reach 30°C , notably between the 1960s and 1980s.

The UK's average lowest minimum temperature over the most recent decade 2016–2025 was 3.4°C higher than 1961–1990. The period 1961–1990 included some particularly extreme cold spells with temperatures falling to -20°C or lower in over half of these

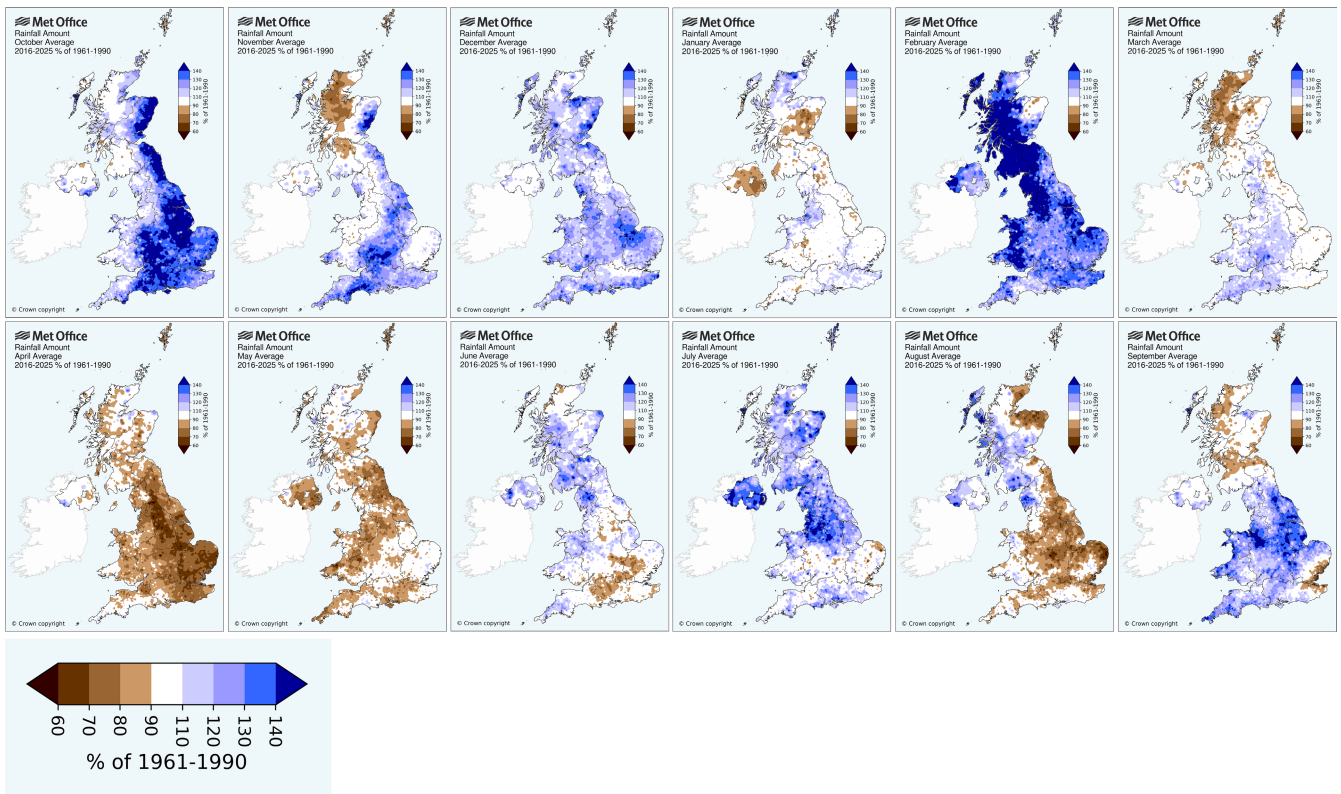


FIGURE 39 | Rainfall anomalies (%) for 2016–2025 for the 12 months of the year: October to March (top) and April to September (bottom) relative to 1961–1990.

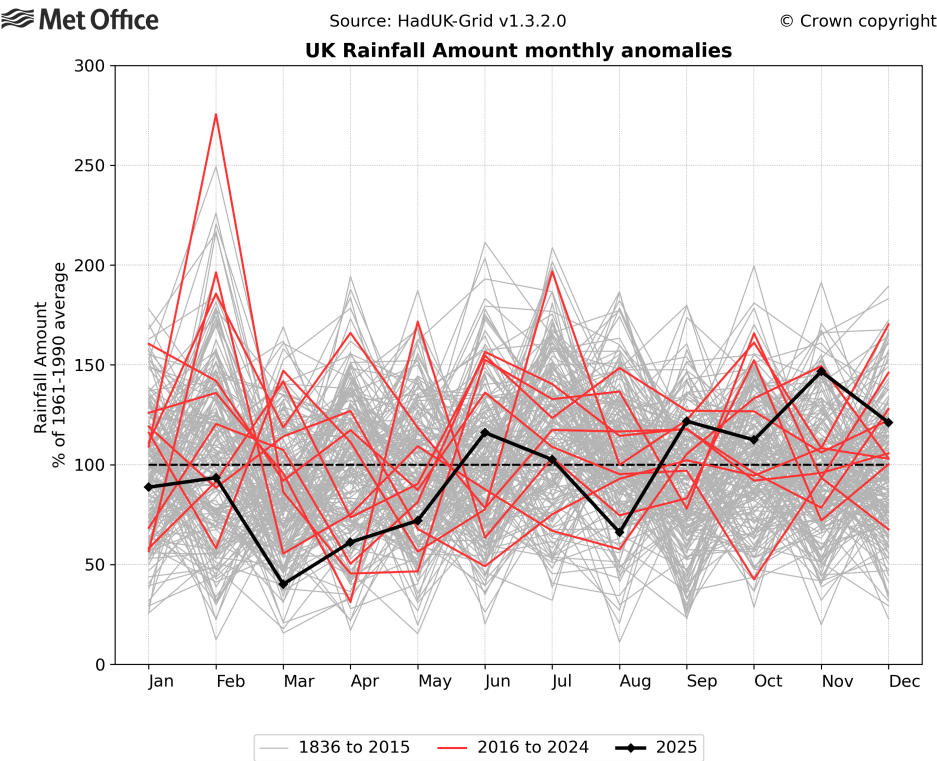
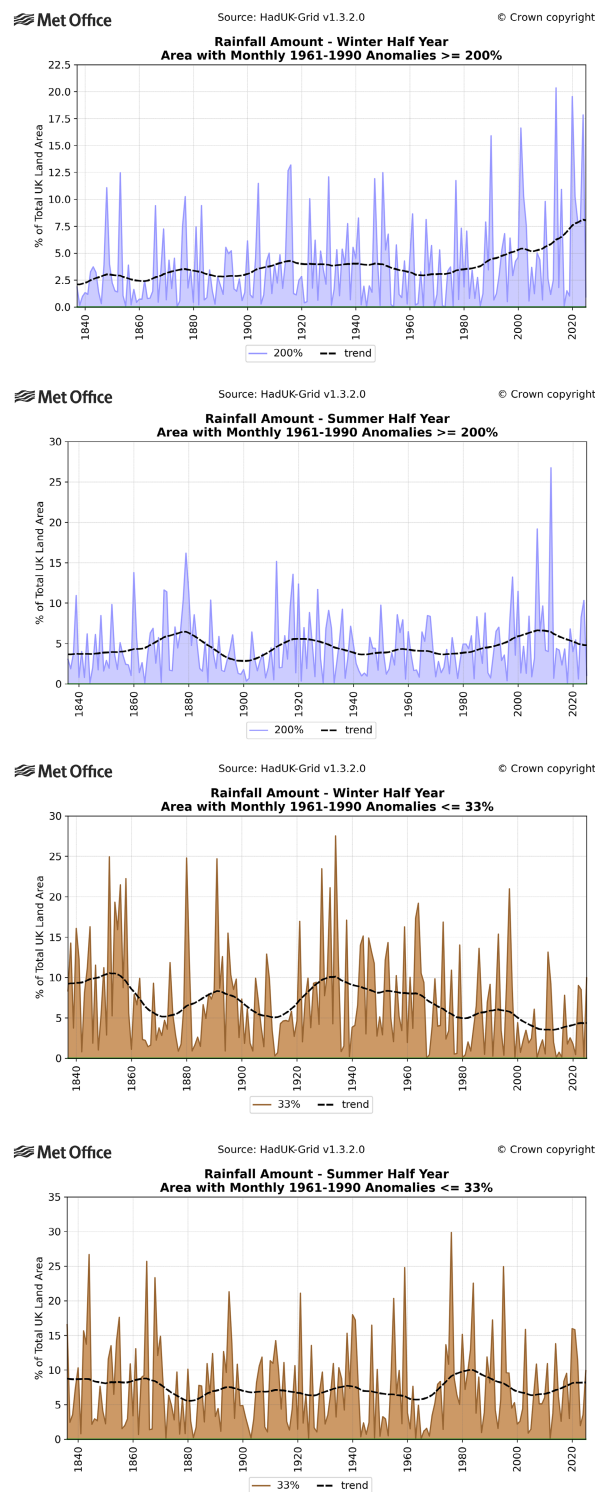
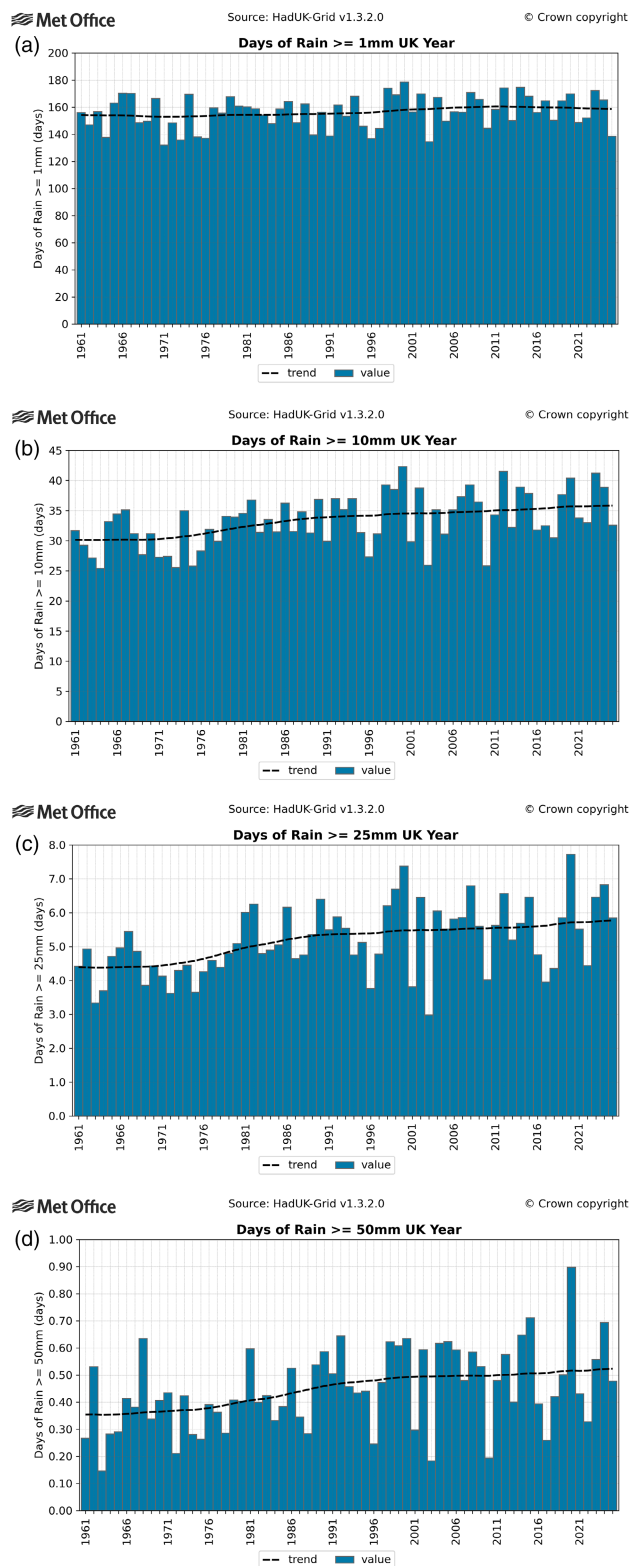


FIGURE 40 | Monthly rainfall anomalies (%) for the UK relative to 1961–1990 for the 12 calendar months for year 2025 (in black), other years of the most recent decade 2016–2025 (in red) and all other years from 1884 (in grey). Figure 9a,b show equivalent figures for monthly Tmax and Tmin.



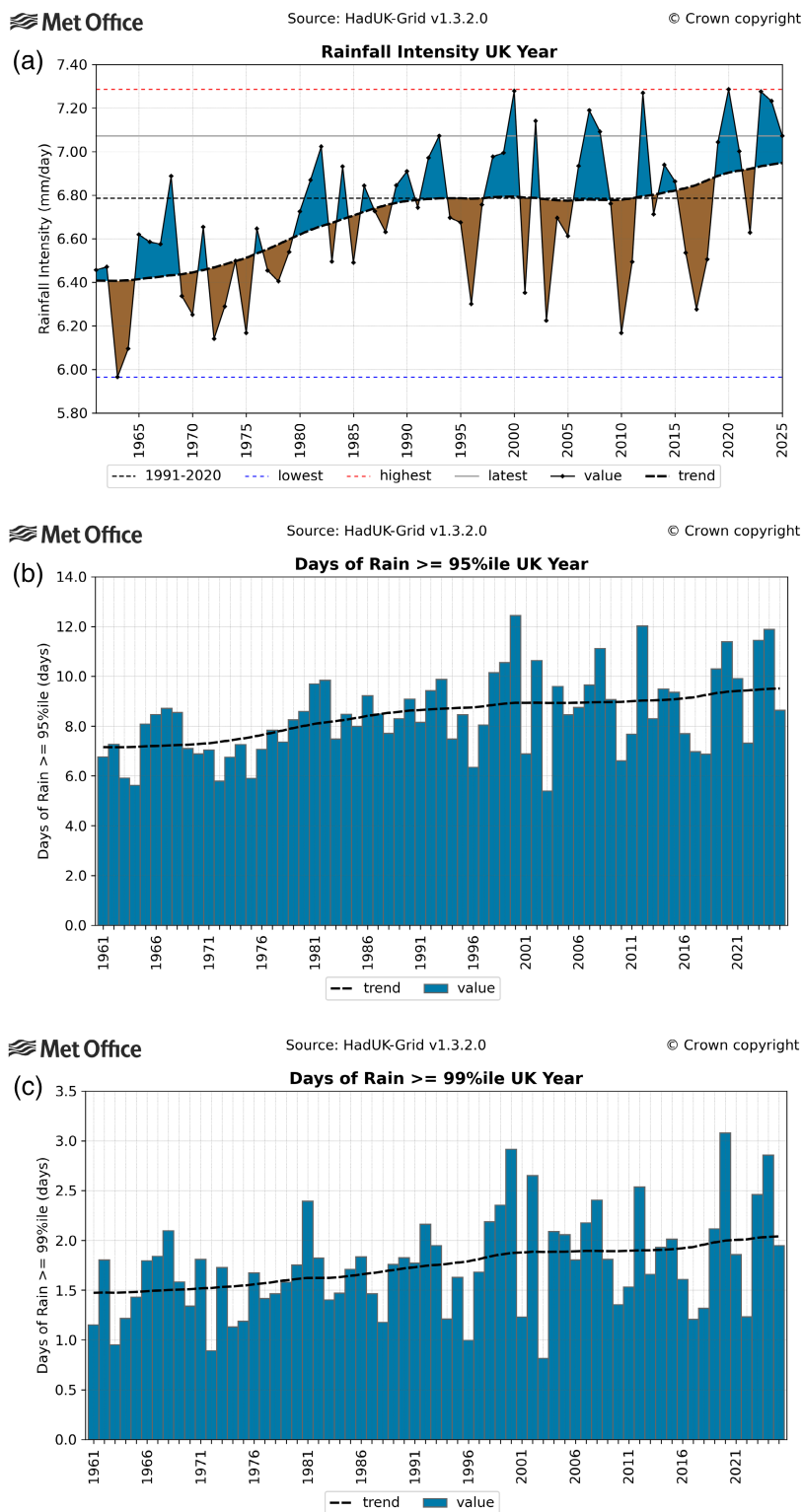
Period	Threshold	1931-1960	1961-1990	1991-2020	2016-2025
Oct-Mar	$\geq 200\%$	4	4	5	8
Apr-Sep	$\geq 200\%$	4	4	6	4
Oct-Mar	$\leq 33\%$	9	6	4	4
Apr-Sep	$\leq 33\%$	8	7	7	8

FIGURE 41 | Total percentage land area of the UK each year with monthly rainfall anomalies $\geq 200\%$ and $\leq 33\%$ of the monthly 1961-1990 average within the winter and summer half-years October to March and April to September. For 2016-2025 the first winter half-year is October 2015 to March 2016, the last October 2024 to March 2025; similarly for earlier periods. (Any given data point is the sum of areas exceeding the threshold across all winter or summer half-year months of that year, divided by $6 \times$ the total UK land area, which is approximately $245,000 \text{ km}^2$).



	1961-1990	1991-2020	2016-2025	2016-2025 % of 1961-1990
UK raindays ≥ 1 mm	154	159	158	103
UK raindays ≥ 10 mm	31	35	35	112
UK raindays ≥ 25 mm	4.7	5.5	5.6	118
UK raindays ≥ 50 mm	0.39	0.50	0.50	129

FIGURE 42 | Annual days of rain for the UK from 1961 to 2025 for (a) ≥ 1 mm (b) ≥ 10 mm (c) ≥ 25 mm (d) ≥ 50 mm. The table shows average values (days).



	1961-1990	1991-2020	2016-2025	2016-2025 % of 1961-1990
UK rainfall intensity (mm/day)	6.6	6.8	6.9	105
95 %ile (days)	7.7	8.9	9.2	120
99 %ile (days)	1.6	1.9	2.0	126

FIGURE 43 | (a) Rainfall intensity for the UK (mm/day) see Table A1 for definition, (b) UK mean number of days each year where rainfall totals have exceeded the 95th percentile, and (c) the 99th percentile. The table shows average values.

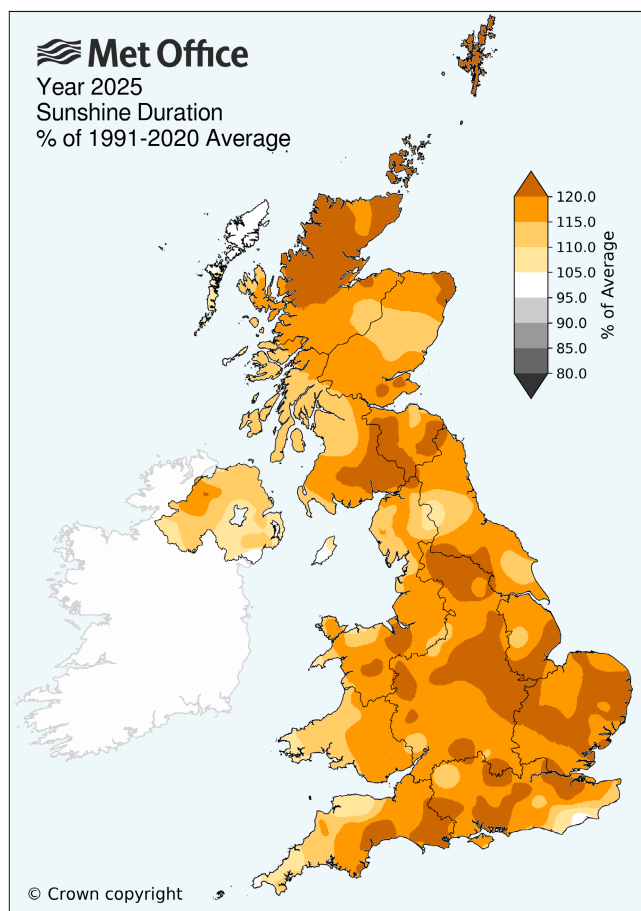


FIGURE 44 | Sunshine anomaly relative to 1991–2020 for year 2025. Maps for individual months and seasons are available at <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps>.

30 years. For comparison, in the 21st Century, temperatures lower than -20°C have been recorded in the UK in just 3 years: 2001, 2010 and 2021.

4.2 | Daily Temperature Extremes for Each Month of the Year

Despite 2025 being a record warm year, only one national monthly station temperature record was set. Aldergrove (County Antrim) recorded a daily minimum temperature of 18.2°C on 21 June 2025, the highest daily minimum temperature on record for June in Northern Ireland. The previous June record was 17.5°C , jointly held by Annaghmore (County Armagh) on 18th June 2005 and Portglenone (County Antrim) on 14th June 2023.

In the most recent decade (2016–2025), the UK has recorded both its all-time highest maximum temperature (i.e., at any station) and highest minimum temperature for four of the 12 calendar months of the year. One record has been set for lowest maximum and none for lowest minimum—see Table 10. The contrast in the number of high temperature records (eight) and low temperature records (one) is another clear indicator of how extremes are affected by the UK's warming climate, although importantly the occurrence of record values tends to be very

irregular with some years seeing multiple records set and others seeing none.

All official UK station records are available on the Met Office website at <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-extremes>. For more details of the verification process for these records, see Appendix A.1.6.

5 | Significant Weather Events

This section provides a summary of key weather events which occurred during 2025. The choice of event is determined by the National Climate Information Centre, taking into account a combination of spatial extent, severity and duration and any associated impacts. It does not represent a comprehensive list of all impactful weather affecting the UK during the year, although Section 5.5 mentions several other notable events. Summaries of notable weather events, including all named storms, are available at <https://weather.metoffice.gov.uk/learn-about/past-uk-weather-events>.

5.1 | Named Storms and Windiest Days of 2025

Major storms are to be expected as a normal part of the UK's climate due to the country's geographical position relative to the jet stream and associated Atlantic storm track—although every year is different. Named storms of 2025 are listed in Table 11a, with the windiest days of the year in Table 11b. Storms affecting the UK have been named since 2015 by the western European storm naming group comprising the Met Office, Met Éireann and KNMI. Storm naming improves the communication of severe weather warnings through the media and government agencies by using a single authoritative system. Storms are named when they are likely to cause disruption or damage significant enough to warrant an amber or red warning; this is based on a combination of both their potential impacts and the likelihood of those impacts occurring, taking into account wind, rain or snow. The number of named storms from year-to-year should not be used as a climate index because the system has been in place for a relatively short time, and the criteria for naming storms have changed since the scheme was first introduced.

Storm *Éowyn* in late January was the most significant named storm of 2025 in terms of impacts and is described in Section 5.2. Storm *Floris* in early August was one of the most severe wind storms to affect Scotland in the summer months in observational records. Northern Scotland saw the strongest winds with a gust of 71 Kt (82 mph) at Wick Airport, Caithness (equalling Scotland's August record). In Edinburgh the Royal Military Tattoo was cancelled. Storms *Amy* and *Bram* were major Atlantic storms—notable for impacts but not exceptional. *Amy* mainly affected north-western Scotland and Northern Ireland, with a gust of 80 Kt (92 mph) at Magilligan, County Londonderry (a new Northern Ireland October record), *Bram* mainly affected western areas with strong winds and up to 100 mm of rain in the wettest areas falling on saturated ground—for example parts of south Devon experienced flooding from the River Dart. Storm *Claudia* brought persistent wet weather with 75 to 100 mm locally across parts of

TABLE 7 | Monthly, seasonal and annual sunshine actual values (hours) and percentage of average values relative to 1991–2020 for the UK and countries for year 2025. Colour coding corresponds to the rank as given in the key below. The series lengths are 1910 to 2025 (116 years) except winter which is 1911 to 2025 (115 years).

	UK		England		Wales		Scotland		Northern Ireland	
	Actual	%	Actual	%	Actual	%	Actual	%	Actual	%
January	62	130	69	124	61	129	50	142	58	137
February	67	94	67	86	68	99	67	106	65	97
March	157	144	184	157	165	150	118	121	116	115
April	228	147	244	149	218	138	206	145	215	145
May	266	139	260	131	263	138	273	150	284	155
June	193	112	232	124	176	99	143	98	126	84
July	182	105	204	104	193	109	151	107	136	100
August	180	111	199	110	184	115	154	114	137	100
September	140	110	158	112	127	98	117	110	114	101
October	63	69	71	69	54	59	57	76	38	45
November	61	105	70	108	62	112	45	94	59	108
December	47	109	57	111	53	127	28	94	46	121
Winter	153	94	164	89	153	97	136	106	146	99
Spring	651	143	687	143	647	141	597	142	615	142
Summer	555	110	636	113	553	107	448	106	399	94
Autumn	264	95	299	97	244	88	219	96	211	83
Year	1645	117	1815	118	1626	116	1409	117	1394	111

Key							
	Dullest on record	Top 10 dullest	Dull: ranked in lower third of all years	Middle: ranked in middle third of all years	Sunny: Ranked in upper third of all years	Top 10 sunniest	Sunniest on record

eastern Wales and central England; Monmouth experienced flooding from the River Monnow due to rain falling in the catchment across the Black Mountains. See <https://weather.metoffice.gov.uk/learn-about/past-uk-weather-events> for more details.

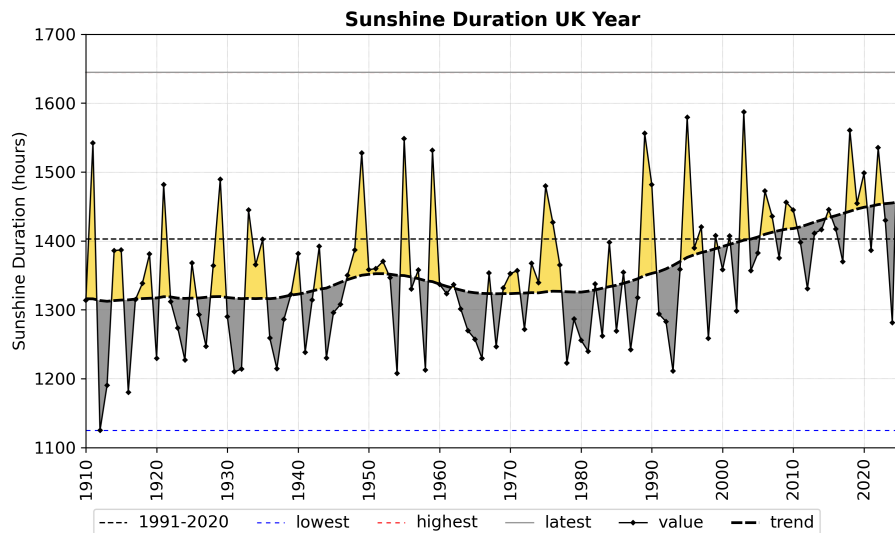
Any storm analysis is complex because it depends on severity, spatial extent and duration, and every storm is unique. However, most Atlantic storms are large-scale systems having widespread impacts. It is notable that five of the seven dates listed in Table 11b coincided with named storms, and of these *Éowyn*, the most severe of these storms, had the highest station gust counts, including all stations in Northern Ireland recording gusts greater than or equal to 50 Kt (58 mph), almost all in both Scotland and Wales and around half in England (see also Figure 50a). Of the named storms listed in Table 11a, only *Claudia* is omitted from Table 11b, just missing with an overall count of 19 stations. The other two dates in Table 11b, 21 and 23, were associated with deep Atlantic low-pressure systems, but failed to meet the criteria for storm naming.

5.2 | Storm *Éowyn* January 2025

Storm *Éowyn* hit the UK in late January 2025. Figure 48 shows the storm centred off the coast of County Donegal in

the Republic of Ireland at 0600 UTC 24 January 2025. This was a major Atlantic storm which interacted with a powerful jet stream, deepening explosively as it approached the UK with the central pressure falling by 50 hPa within 24 h. The jet stream was intensified by a large temperature contrast upstream across the North American continent, with a ‘cold plunge’ of air moving south bringing severe winter weather to the United States. In the UK, the lowest recorded pressure was 941.9 hPa on the Isle of Tíree, Inner Hebrides, the UK’s lowest pressure reading since 24 December 2013—before storm naming was introduced in autumn 2015.

The Met Office issued a red warning, meaning a risk to life, covering Northern Ireland, Scotland’s Central Belt and much of south-west Scotland (Figure 49). Areas experiencing the brunt of this storm recorded gusts widely in excess of 70 Kt (81 mph), and in places over 80 Kt (92 mph). The highest wind gust in the UK was 87 Kt (100 mph) at Drumalbin, Lanarkshire (Figure 50a). Winds gusted at well over 100 mph across mountain summits with 117 Kt (135 mph) recorded at the Cairnwell, Aberdeenshire (928 masl). It is probable gusts at Cairngorm Summit (1237 masl) were significantly higher than this but data are unfortunately not available. In the North Pennines, Great Dun Fell (847 masl) recorded an hourly mean speed of



	1931-1960	1961-1990	1991-2020	2016-2025	2025
UK	1337	1328	1403	1458	1645
England	1437	1430	1538	1604	1815
Wales	1388	1352	1407	1433	1626
Scotland	1169	1165	1200	1252	1409
Northern Ireland	1252	1233	1256	1268	1394

FIGURE 45 | Annual sunshine for the UK, 1910 to 2025. The table shows actual values for the UK and countries (hours). Charts for individual months and seasons are available at <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-temperature-rainfall-and-sunshine-time-series>.

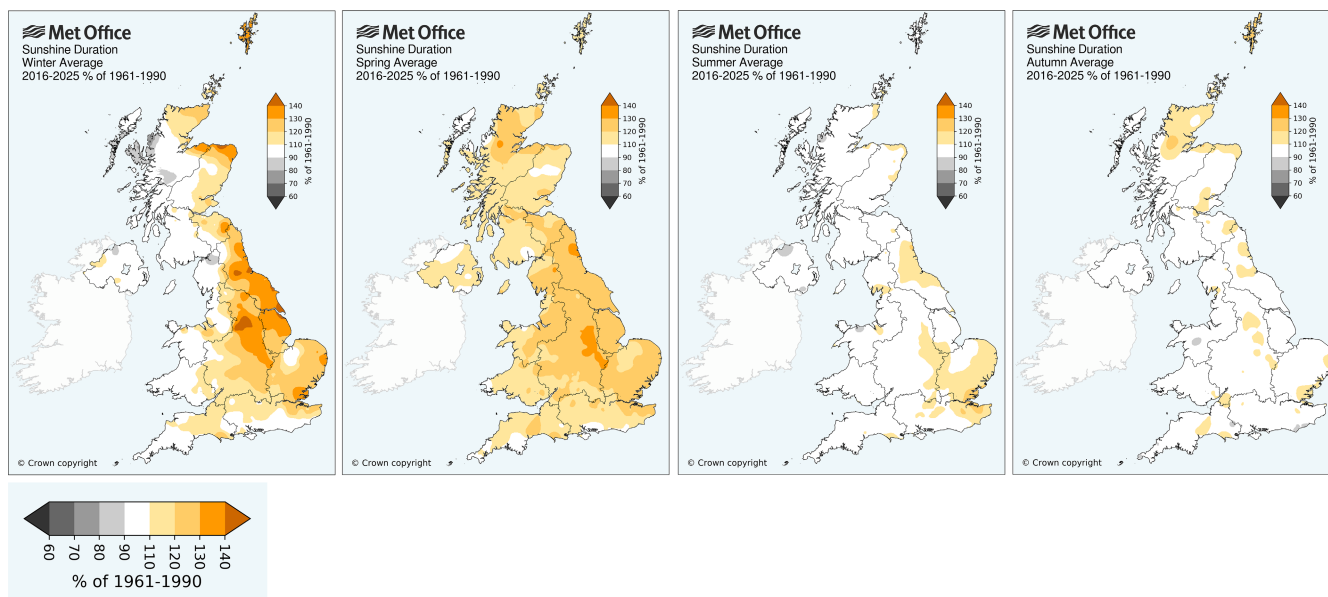


FIGURE 46 | Sunshine anomalies for 2016–2025 for each season relative to 1961–1990.

TABLE 8 | Seasonal and annual percentage of average values relative to 1961–1990 and 1991–2020 for the UK and countries for the decade 2016–2025. Colour coding corresponds to the % of average values as given in the key below and is the same as for Figure 46. See also the note on Table 3 regarding winter.

	1961–1990					1991–2020				
	UK	England	Wales	Scotland	N Ireland	UK	England	Wales	Scotland	N Ireland
Winter	112	117	102	106	102	101	101	95	104	99
Spring	119	121	117	117	112	109	109	109	109	107
Summer	104	107	101	100	95	103	103	100	103	97
Autumn	104	105	99	105	101	99	100	96	99	98
Year	110	112	106	107	103	104	104	102	104	101
Key	<70%	70% to 80%	80% to 90%	90% to 110%	110% to 120%	120% to 130%	>130%			

Note: Shading is applied before values are rounded, so occasionally the same rounded values may have different shades.

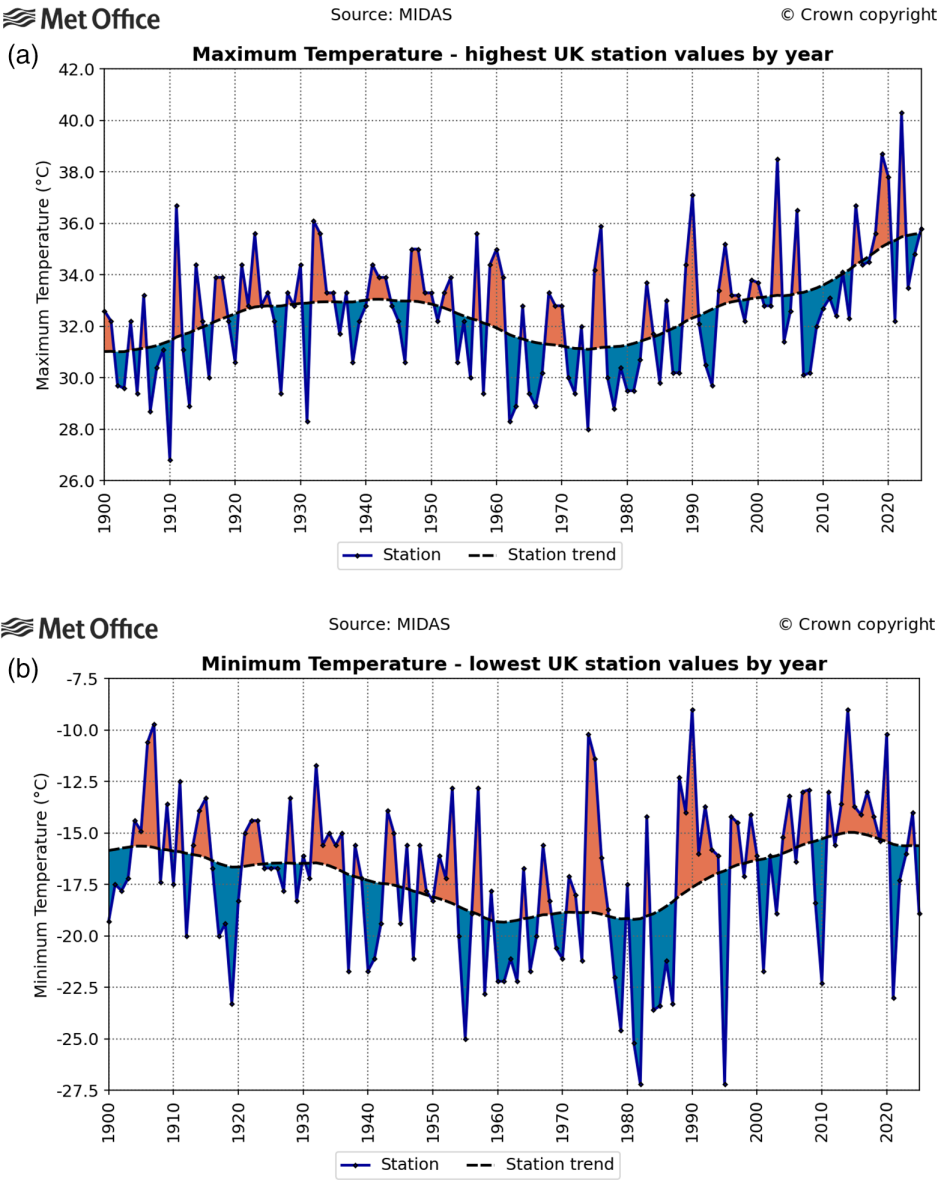
TABLE 9 | Annual extremes for the UK for year 2025. Stations above 500m above mean sea level (masl) are considered as mountain stations and therefore not representative of low-level areas. They are excluded from the table with the exception of the highest mountain gust. Channel Islands and Isle of Man stations are also excluded.

Extreme	Value	Date	Station
Highest daily maximum temperature	35.8°C	1 July	Faversham, Kent
Lowest daily minimum temperature	−18.9°C	11 January	Altnaharra, Sutherland
Lowest daily maximum temperature	−10.8°C	10 January	Altnaharra, Sutherland
Highest daily minimum temperature	22.2°C	1 July	Heathrow, Greater London
Lowest grass minimum temperature	−15.0°C	11 January	Oyne, Aberdeenshire
Highest daily rainfall (09–09 UTC)	188.4 mm	14 December	Honister Pass, Cumbria
Greatest snow depth (09 UTC)	26 cm	9 January	Loch Glascarnoch, Ross & Cromarty
Highest daily sunshine	16.4 h	12 July 13 July	Kirkwall, Orkney Lerwick, Shetland
Highest gust speed	87 Kt 100 mph	24 January	Drumalbin, Lanarkshire
Highest gust speed (mountain)	118 Kt 136 mph	3 October	Cairngorm Summit, Inverness-shire

84 Kt (97 mph) at the peak of the storm. Mace Head, County Galway, recorded a gust of 184 km/h (99 Kt, 114 mph), setting a new gust speed record for the Republic of Ireland (see <https://www.met.ie/climate/weather-extreme-records>).

Overall, 25 stations across the UK network recorded gusts of 70 Kt or higher during storm Éowyn. To put this into context, Figure 51 counts the number of stations recording gusts ≥ 70 Kt for major storms in the UK's observational records.

The counts are indicative because the station network changes over time, stations may be affected by data outages, particularly during periods of severe weather, and this UK-wide metric does not take into account regional detail. For example, 12th February 2014 was more severe across the southern half of the UK. Of the storms listed, the Great Storm of 16 October 1987 is the only one where trees would have been in leaf; a key reason for the severity of impacts experienced from this event.



	1931-1960	1961-1990	1991-2020	2016-2025
Tmax	32.9	31.3	33.5	35.8
Tmin	-17.6	-19.0	-15.5	-15.6

FIGURE 47 | (a) UK highest daily Tmax and (b) lowest daily Tmin at any station for each year 1900 to 2025. The table shows averages of these station values (°C). For highest Tmax, the figure shows the evolution of the UK national maximum temperature record through time—in 1911 (36.7°C), 1990 (37.1°C), 2003 (38.5°C), 2019 (38.7°C) then 2022 (40.3°C). For lowest Tmin, the figure shows the national record in 1982 and 1995 (−27.2°)—which also occurred in 1895. The trends shown in these station series may be affected by station data availability, particularly prior to the 1960s, since a lower station network density will be less able to capture extremes. Not all historical values have been manually checked and values may change as further data are digitized and additional quality control applied.

In addition to the numerous stations recording gusts ≥ 70 Kt during storm Éowyn, four stations recorded gusts ≥ 80 Kt (Figure 50a), compared to 6 on each of 9 January 2015, 12 February 2014 and 3 January 2012. While there is no single definitive measure for the overall severity of a UK storm, it is reasonable to consider Éowyn as the most severe windstorm for over a decade. For Northern Ireland, with widespread gusts of 70 to 80 Kt (81 to 92 mph), this was the most severe wind storm

since Boxing Day 26 December 1998, although overall for the UK the Boxing Day storm was much more severe (Figure 50b).

Members of the public were advised to stay at home and schools were closed in the red warning area. Over 100 flights were reported to be cancelled and around a million homes lost power at the peak of the storm as strong winds brought down trees and electricity lines; Scotrail reported extensive damage to overhead

TABLE 10 | UK monthly station records for highest and lowest Tmax and Tmin (°C) occurring within the last decade 2016–2025. Mountain stations above 500 masl are excluded from this analysis.

Month	Record type	Temperature (°C)	Date	Station
January	Highest Tmax	19.9	28 January 2024	Achfary, Sutherland
February	Highest Tmax	21.2	26 February 2019	Kew Gardens, London
July	Highest Tmax	40.3	19 July 2022	Coningsby, Lincolnshire
December	Highest Tmax	18.7	28 December 2019	Achfary, Sutherland
January	Highest Tmin	13.2	1 January 2022	Chivenor, Devon
February	Highest Tmin	13.9	23 February 2019	Achnagart, Highland
April	Highest Tmin	15.9	19 April 2018	Kenley Airfield, Greater London
July	Highest Tmin	26.8	19 July 2022	Shirburn Model Farm, Oxfordshire
March	Lowest Tmax	−4.7	1 March 2018	Tredegar, Blaenau Gwent

TABLE 11a | Named storms of 2025, (for storms in the 2024–2025 storm season ending August and 2025–2026 season starting September), as named by the western European storm naming group, except where otherwise stated.

Name	Date of impact on UK
<i>Éowyn</i>	24 January
<i>Floris</i>	4 to 5 August
<i>Amy</i>	3 to 4 October
<i>Claudia</i> ^a	14 November
<i>Bram</i>	8 to 10 December

^aStorm *Claudia* was named by AEMET, the Spanish State Meteorological Agency.

lines. One fatality was reported in Ayrshire from a falling tree while 15 trees were reported uprooted or broken and another 25 badly damaged at Scotland's national botanical collection at the Royal Botanic Garden in Edinburgh.

5.3 | Record Warm and Sunny Spring 2025

The UK experienced a record-breaking warm, dry and sunny spring in 2025. Weather patterns were dominated by high pressure building from the Azores or continental Europe. Figure 52 shows mean sea level pressure anomalies across the North Atlantic for spring 2025. This pattern tended to block Atlantic low-pressure systems with the UK in a relatively dry continental airmass. The result was reduced cloud cover, many days of largely unbroken sunshine, high daytime temperatures and low windspeeds. Average windspeeds for the season overall were particularly low, although comparable to the springs of 2010 and 1984 which were also characterized by high pressure frequently near or over the UK.

Figure 53 shows mean maximum temperatures and sunshine anomalies across the UK for spring 2025. Seasonal Tmax anomalies exceeded 2.5°C across many central and western areas,

and while most parts of the UK recorded over 135% of average sunshine hours, some locations exceeded 150%. Examples of individual stations included Eskdalemuir, Dumfriesshire (626.7 h, 161%), Bala, Gwynedd (629.3 h, 155%) and Wisley, Surrey (726.9 h, 152%); in total, 10 stations exceeded 150% of the spring 1991–2020 average.

This was the warmest spring for mean temperature for the second consecutive year in both the UK HadUK-Grid series from 1884 and the CET series from 1659. For mean Tmax it was warmest by a wide margin: 14.6°C in 2025 compared to 14.0°C in 1893 (Figure 54a). For the UK spring mean Tmax series, the latest decade 2016–2025 includes five of the top ten warmest springs: 2025, 2020, 2017, 2022 and 2024. Historical records such as spring 1893 have gradually been surpassed in recent decades; very few now remain from the 19th Century.

This was the UK's sunniest spring (Figure 54b), exceeding the previous record in 2020, which coincided with the first UK lockdown from the COVID-19 pandemic. Figure 55 illustrates the exceptional combination of high daytime temperatures and sunshine, with 2025 an extreme outlier (these variables are correlated with $R^2=0.38$). Remarkably, the UK spring 2025 sunshine total of 650.9 h (equivalent to an average of around 7 h per day) made this the UK's fourth sunniest season on record, behind the summers of 1976, 1995 and 1911, while spring 2020 is ranked sixth sunniest in this series (Table 12). The sunshine anomalies for spring 2025 (143%) and spring 2020 (137%) were the two highest anomalies for any season from 1910, the next highest being 133% in summer 1976. For Northern Ireland spring 2025 was the sunniest season on record, marginally ahead of summer 1995.

Most of England, Wales and eastern Scotland received less than half the normal rainfall amount for spring 2025, with counties in the driest areas receiving only around a third or less. A wide area of central, eastern and south-east England recorded less than 50 mm for the 3 months of spring combined (Figure 56a). The UK had its sixth driest spring on record, while for England this was the driest spring since 1893, with only 44% of the 1991–2020 average rainfall (Figures 54c, 56b, 56c). Nevertheless,

TABLE 11b | The windiest days of year 2025. The table lists dates where 20 or more stations across the UK recorded a maximum wind gust greater than or equal to 50 Knots (58 mph) on that day. The indicative number of wind observing sites in 2025 for each country (based on data availability) is also given in brackets.

Date	England (85)	Wales (14)	Scotland (34)	Northern Ireland (10)	Total (143)	Named Storm
24/01/2025	40	12	31	10	93	Éowyn
21/02/2025	8	3	8	3	22	
23/02/2025	7	4	12	3	26	
04/08/2025	5	3	27	1	36	Floris
03/10/2025	14	7	30	9	60	Amy
04/10/2025	12	5	21	2	40	Amy
09/12/2025	18	9	22	4	53	Bram

Key					
Stations	1-9	10-19	20-29	30-39	40+

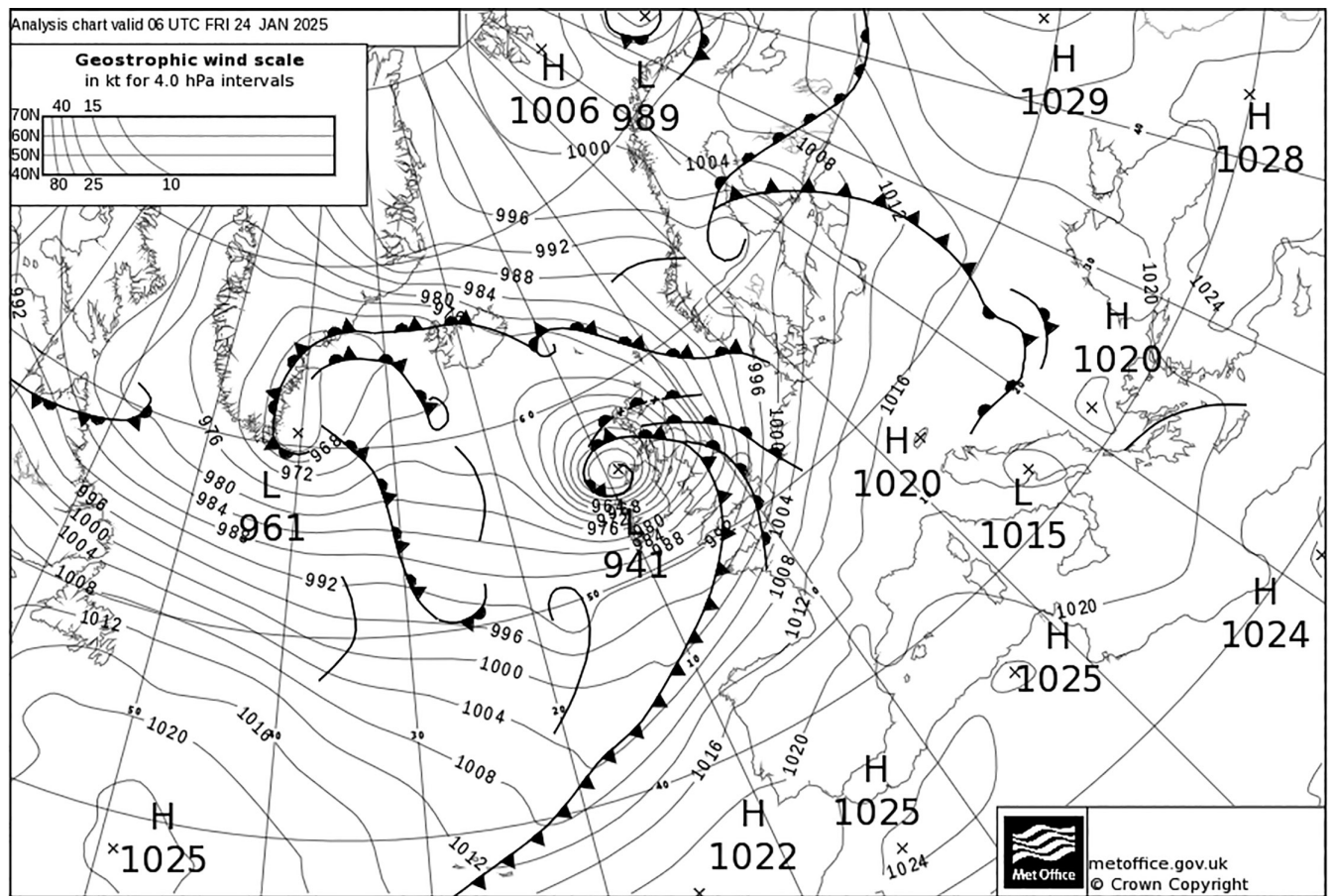


FIGURE 48 | Analysis chart at 0600UTC 24 January 2025.

the historical record does illustrate that dry springs are to be expected occasionally as part of the UK's highly variable climate—other examples including 1840 (53% of normal rainfall for the UK), 1852 (44%), 1893 (47%), 1929 (55%), 1974 (54%) and now 2025 (56%). In total nine springs out of 190 from 1836 to 2025 have seen less than 60% of average rain across the UK overall.

5.4 | Prolonged Warm Dry Spell March to August 2025 and Comparison With 1976

The exceptional spring of 2025 was part of a longer period of warm, dry, settled weather lasting through much of the summer, particularly across England. Table 13 shows monthly mean Tmax, Tmin and Tmean anomalies for the UK from

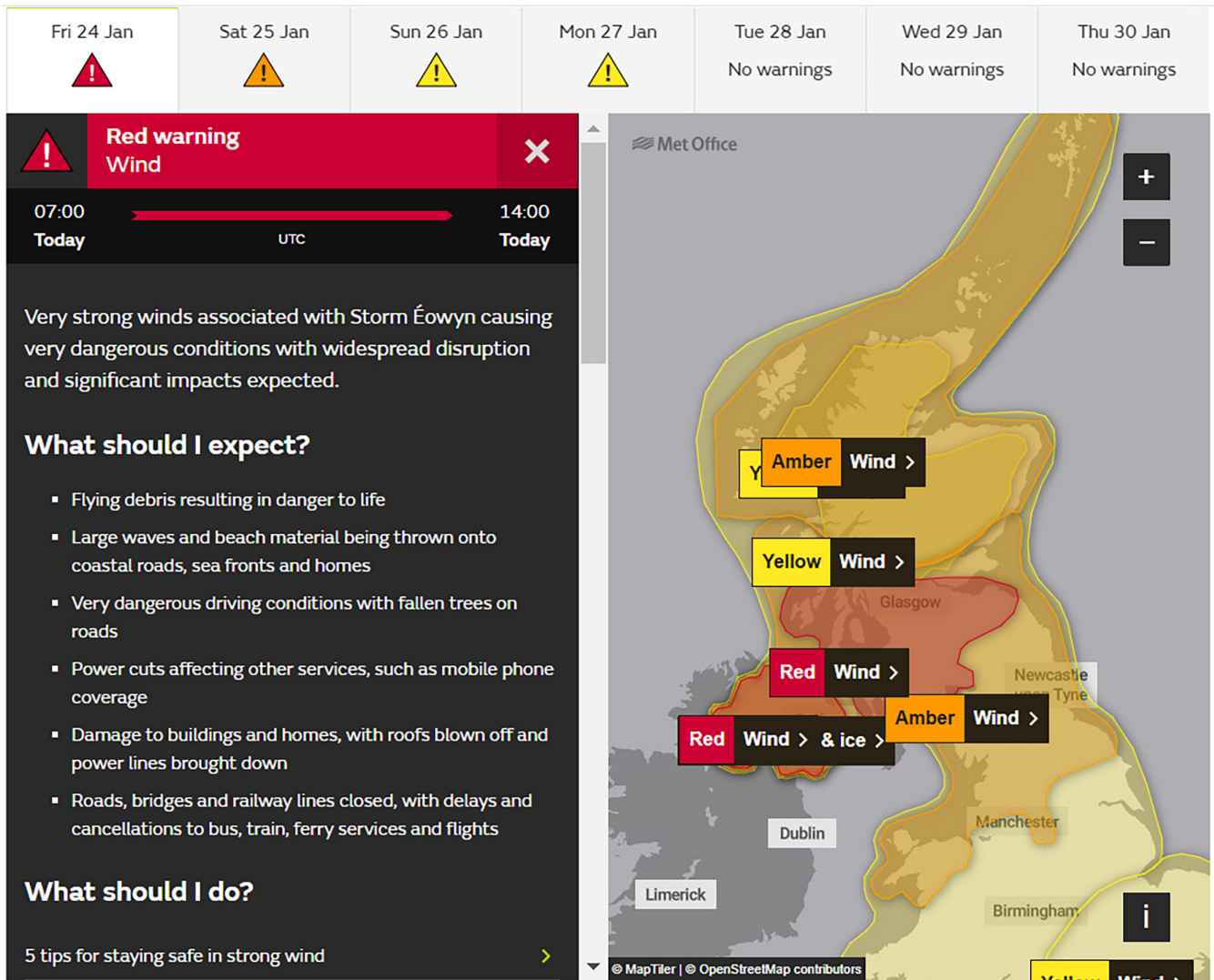


FIGURE 49 | A screen shot from the Met Office website showing warning areas issued for Storm Éowyn on 24 January 2025 from 0700 UTC to 1400 UTC. A red warning means dangerous weather is expected and there is very likely to be a risk to life.

March to August, spring, summer, and the six-month period overall. Mean temperature anomalies were typically around 1.5°C above the 1991–2020 average, but mean Tmax anomalies exceeded 2°C from March to June inclusive, were almost 3°C in April, while May was the warmest on record for mean Tmax. Monthly Tmin was unremarkable for the spring months, but the highest on record for June and second highest for July.

The UK spring anomaly of +2.5°C was the highest for mean Tmax for any UK season from 1884 (i.e., out of winter, spring, summer and autumn for all years of the respective series). The next highest seasonal anomaly values are summer 1976 (+2.1°C), spring 1893 (+1.9°C) and summer 2025 (+1.8°C).

The summer mean Tmax (20.7°C) was exceeded by only summer 1976 (21.0°C). Despite the UK's warming climate, this summer from 50 years ago is still the UK's hottest for mean Tmax in the series from 1884. Although summer 1976 was not as warm as 2025 for mean temperatures, there were many

more hot days with daily Tmax ≥ 28°C in summer 1976 compared to summer 2025 (Figure 57). Summer 2025 was the UK's warmest summer on record for both Tmean and mean Tmin. March to August 2025 (spring and summer combined) was the warmest such period for the UK for Tmax, Tmean, and Tmin, with a large margin of over 0.7°C for Tmax. It was also the sunniest such period on record for the UK (125% of 1991–2020 average sunshine hours).

The prolonged spell of warm, dry, sunny weather caused significant problems for agriculture and water resources and led to the Environment Agency declaring drought in several areas. For England, the March to August rainfall total was 217.9 mm, 58% of the 1991–2020 average, the third lowest value in the series from 1836 behind 1976 (193.3 mm) and 1995 (196.8 mm), although there are several other comparable values in the observational record including 1870, 1887, 1990 and, most recently, 2022. Figure 58 shows the relationship between England mean Tmax and rainfall for this six-month period (these variables are

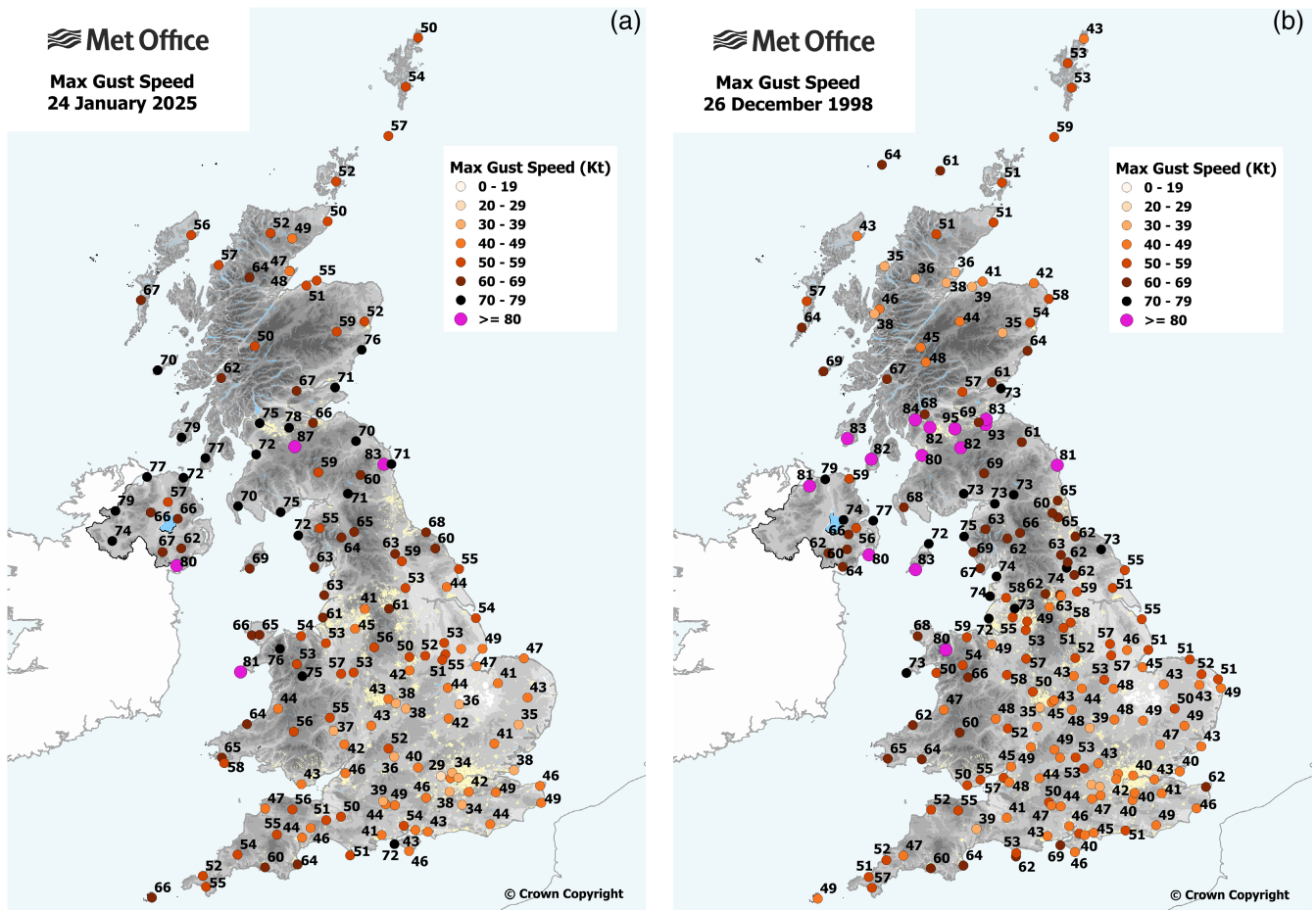


FIGURE 50 | Maximum gust speeds for (a) Storm Éowyn on 24 January 2025 compared to (b) the Boxing Day storm of 26 December 1998. High-level stations above 500 masl are excluded.

fairly weakly correlated with $R^2=0.23$). In 2025, while the lack of rain was very significant, it was the exceptionally high average maximum temperatures for the period March to August that were unprecedented.

A comparison with the 1976 drought provides helpful context—this was an exceptionally extreme landmark drought in the UK's long observational records. The key factors of any drought are spatial extent, intensity and duration. Figure 59a,b compares rainfall totals across the UK for the period March to August in 2025 and 1976. All droughts are different and 1976 was much more intense for this six-month period along the south coast and in Nottinghamshire and Lincolnshire, while 2025 was drier in parts of western and north-east England. However, the total size of the areas with less than 50% of the 1991–2020 average rainfall was fairly similar—that is, these maps are broadly comparable. Where 1976 and 2025 differ can be clearly seen by considering a longer duration including the preceding winter (the key period for recovery/recharge of water resources). Figure 59c,d shows rainfall totals for the 16-month period from May to August in 2024–2025 and 1975–1976. The contrast is stark, with May 1975 to August 1976 seeing less than two thirds of average rainfall across most of the UK south of the Humber, and as little as 50% in parts of Lincolnshire, central and south-west England. Any rainfall deficits from May 2024 to August 2025 by comparison were far more modest. It is the

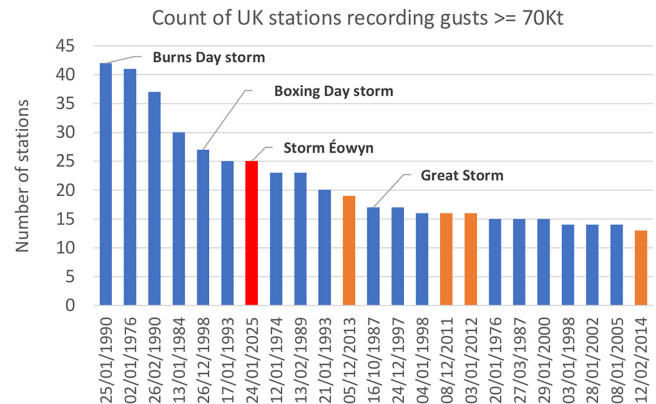


FIGURE 51 | Count of the number of stations recording maximum gust speeds ≥ 70 Kt (81 mph) for major UK wind storms in observational records back to 1973. Storm Éowyn is shown in red with other comparatively recent storms 2011, 2012, 2013 and 2014 in orange. Storm dates are listed on the x-axis.

sustained rainfall deficits over this duration that make the 1976 drought so exceptional.

A further impact from the prolonged warm, dry spell in 2025 was wildfires. The UK is not usually known for wildfires, being

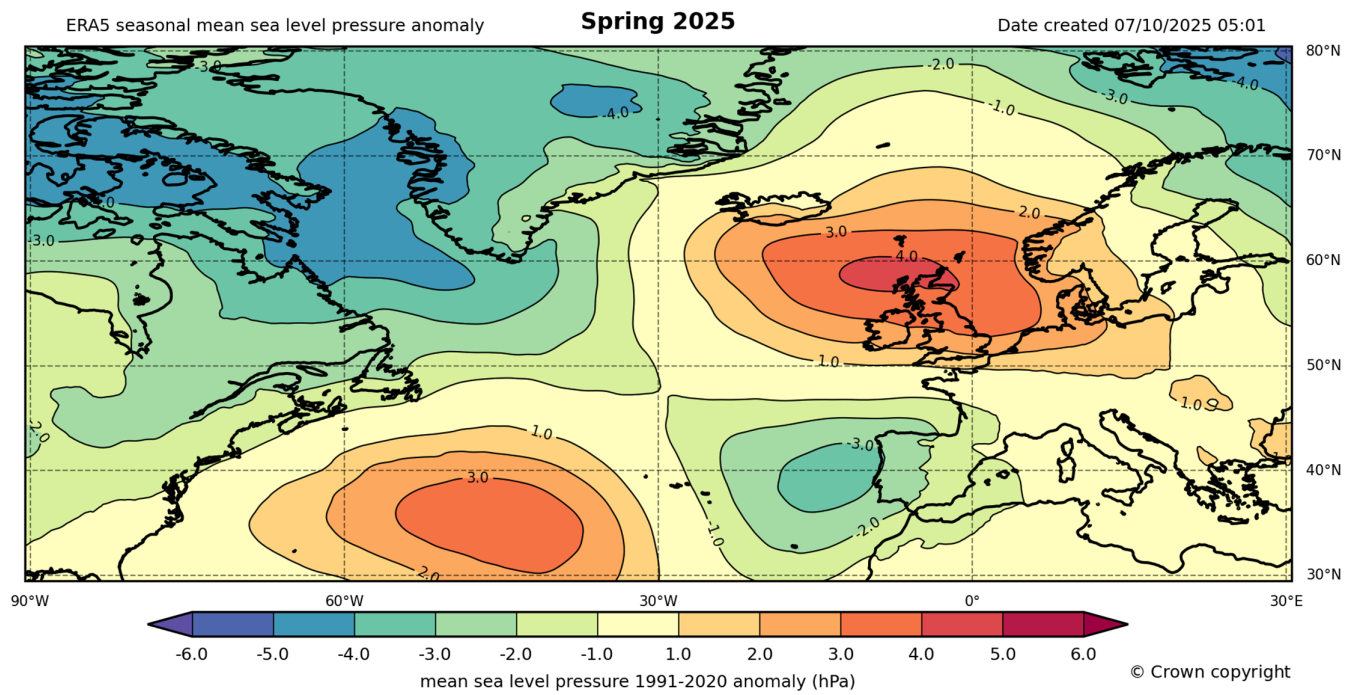


FIGURE 52 | Mean sea level pressure anomalies (hPa) relative to 1991–2020 for spring 2025 across the UK and North Atlantic from the ERA5 reanalysis dataset (Hersbach et al. 2020).

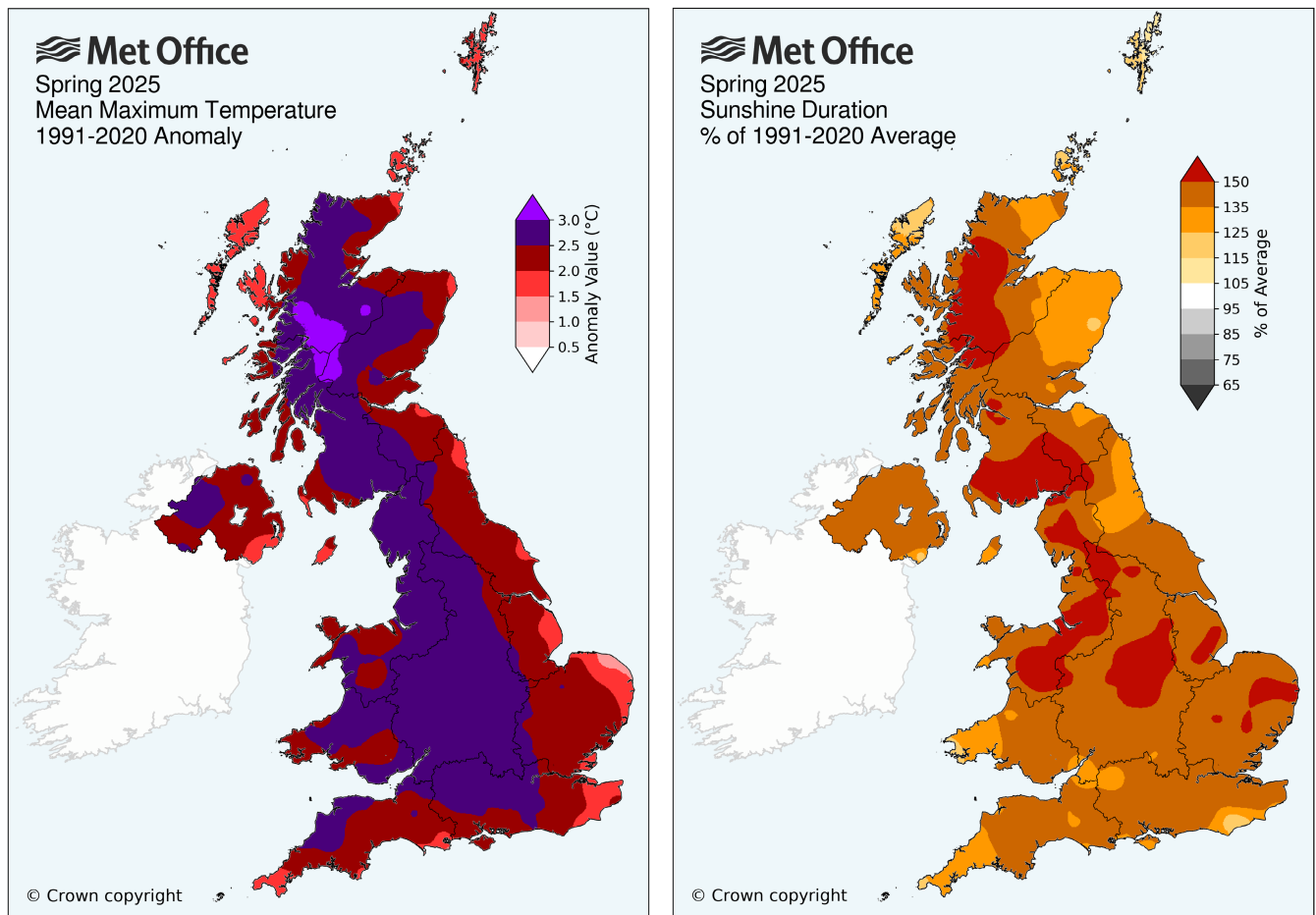


FIGURE 53 | Mean Tmax (°C) and sunshine anomalies (% of average) relative to 1991–2020 for spring 2025.

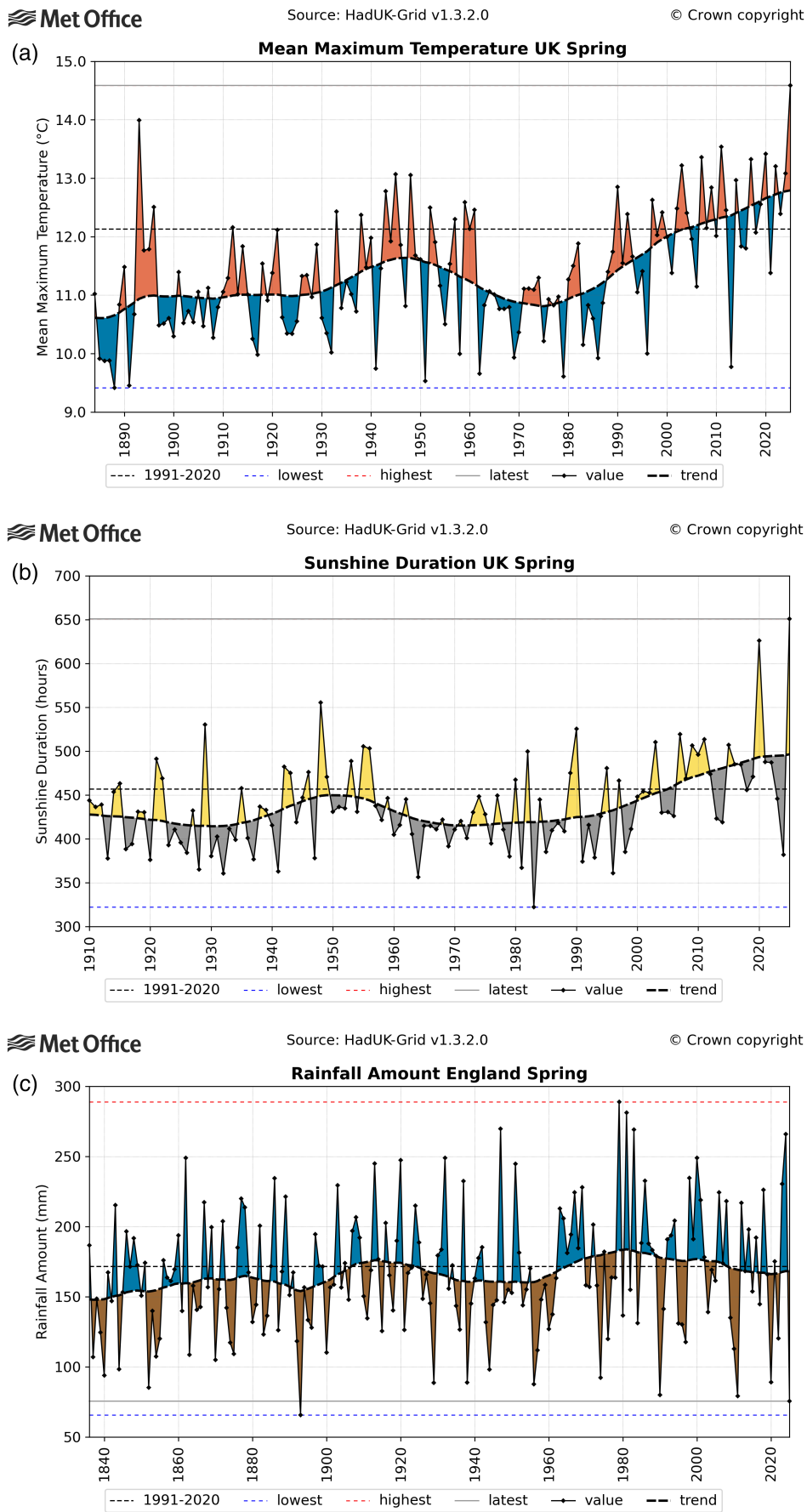


FIGURE 54 | (a) UK mean Tmax (°C) for spring 1884 to 2025, (b) UK sunshine duration (hours) for spring 1910 to 2025 (c) **England** rainfall (mm) for spring 1836 to 2025.

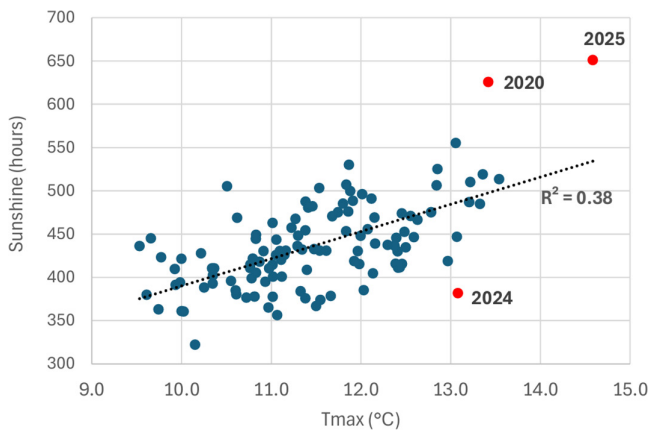


FIGURE 55 | Scatterplot of UK mean Tmax and sunshine for spring, 1910 to 2025.

TABLE 12 | The UK's top ten sunniest seasons, 1910 to 2025.

Season	Sunshine duration (hours)	% of 1991–2020 seasonal average
Summer 1976	672.2	133
Summer 1995	664.6	131
Summer 1911	656.5	130
Spring 2025	650.9	143
Summer 1989	645.8	127
Spring 2020	625.9	137
Summer 1975	623.1	123
Summer 2018	615.5	121
Summer 1949	605.1	119
Summer 1955	596.0	118

characterized by relatively cool year-round temperatures, frequent rainfall and fragmented landscapes. However, fire is becoming an emerging risk, driven by milder, wetter winters that build up fuel and the potential for hotter and drier summers that lead to fire-prone conditions.

In 2025, the UK experienced the highest burned area and number of fires on record in a series from 2006, and the most extensive fire ever seen in Scotland. Some unusual warmth in Scotland from late winter promoted early spring vegetation growth, followed by the warmest and sunniest spring on record for the UK. The spring fire season in the UK started earlier than normal, and saw unusually high numbers of fires (170 by the end of May compared to the 2006–2025 long-term average of 36; EFFIS (European Commission Joint Research Centre, 2026)), which was followed by larger, long-lasting fires in the summer. In the Scottish Highlands north of the Cairngorms, the Dava and Carrbridge fires burned 11,827 ha, the largest area ever recorded in Scotland and persisted over 3 days (28–30 June; State of Wildfires Project 2025), while in the North York Moors, the Langdale Moor wildfire burned for over 6 weeks. Deep peat burning led to high carbon emissions and potential for continued over-winter smouldering below ground. The UK's warming climate means that peatlands, such as those burned in the Dava and Carrbridge in 2025, are increasingly vulnerable to wildfires in prolonged spells of dry weather and low soil moisture (Schoenecker et al. 2026).

5.5 | Other Notable Events

From late December 2024 to early January 2025, the UK experienced a spell of very wet and windy weather with significant snowfalls in northern areas. The Hogmanay celebrations in Edinburgh were cancelled and on New Year's Day the Manchester area was badly affected by widespread flooding with a major incident declared. Northern Scotland and much of the Pennines experienced significant lying snow,

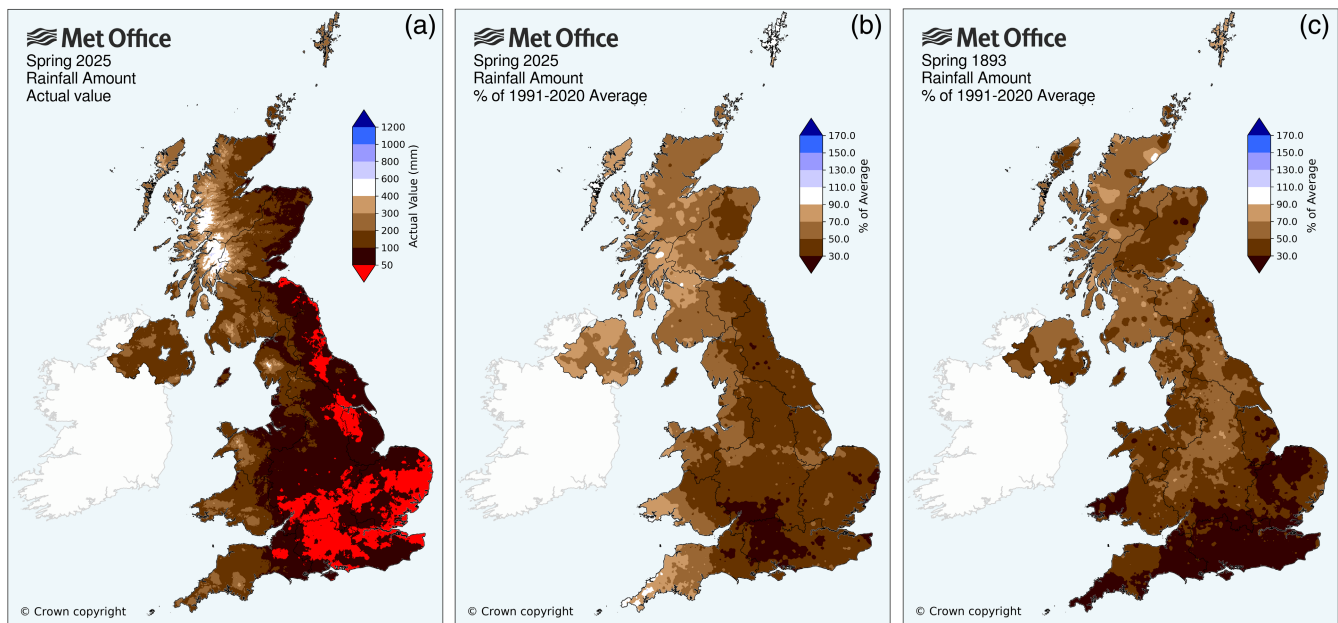


FIGURE 56 | Rainfall totals (mm) for (a) spring 2025, and anomalies relative to 1991–2020 for springs of (b) 2025 and (c) 1893.

TABLE 13 | UK mean Tmax, Tmin and Tmean anomalies relative to 1991–2020 and ranks for months from March to August, spring, summer and the 6-month period March to August for 2025. Record values are highlighted. See also Figure 9 which shows the UK mean monthly Tmax and Tmin anomalies for the full series relative to 1961–1990.

Period	UK Tmax anomaly (°C)	Rank in UK series from 1884 to 2025 (142 years)	UK Tmin anomaly (°C)	Rank in UK series from 1884 to 2025 (142 years)	UK Tmean anomaly (°C)	Rank in UK series from 1884 to 2025 (142 years)
March	2.2	4	0.4	> 20	1.3	10
April	2.9	3	0.5	16	1.7	3
May	2.3	1	0.4	> 20	1.3	=3
June	2.1	=5	1.7	1	1.9	2
July	1.6	=11	1.3	2	1.5	5
August	1.6	11	0.8	=7	1.2	=8
Spring	2.5	1	0.4	10	1.5	1
Summer	1.8	2	1.3	1	1.5	1
March to August	2.1	1	0.9	1	1.5	1

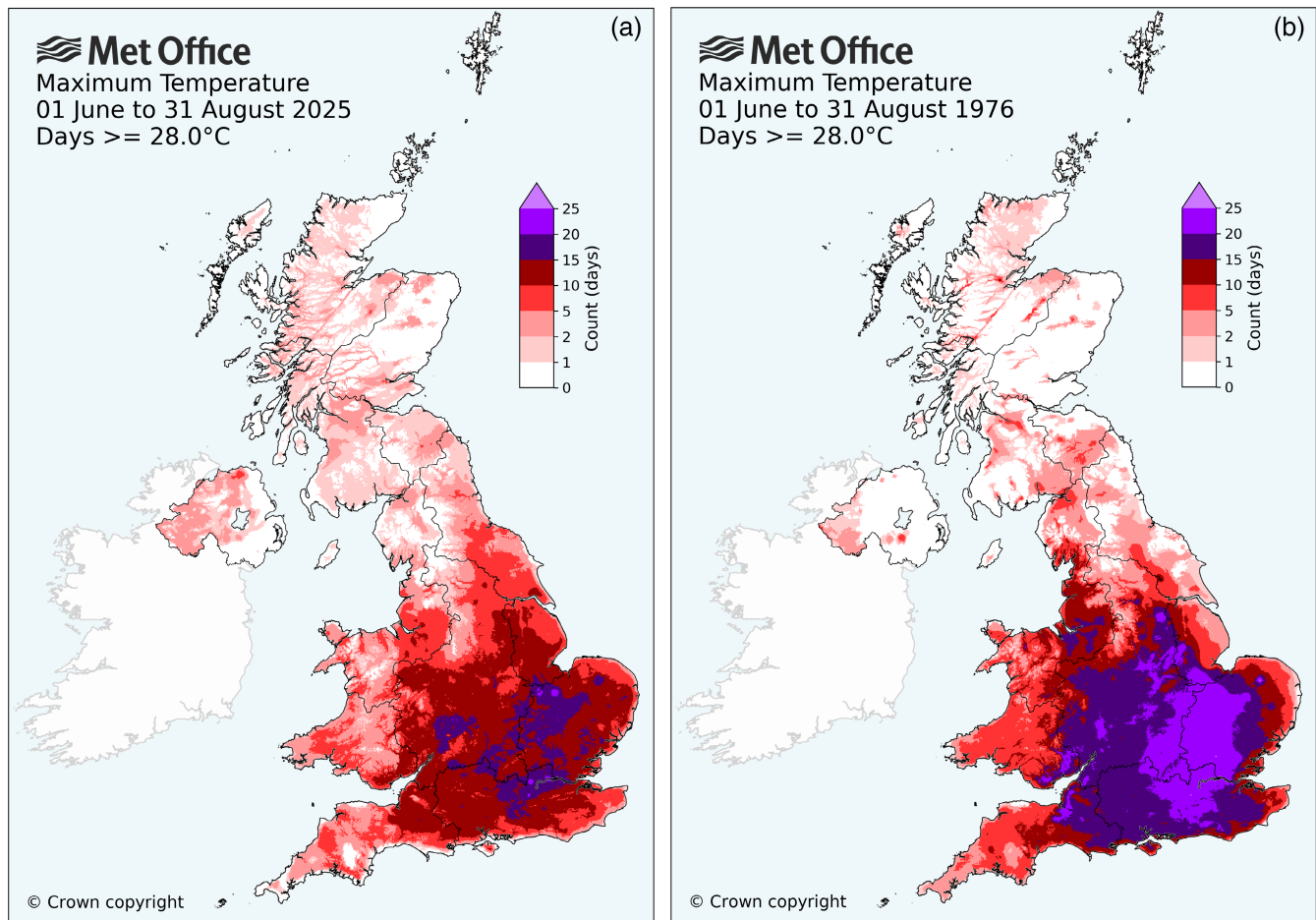


FIGURE 57 | The number of days with daily Tmax $\geq 28^{\circ}\text{C}$ in (a) summer 2025 and (b) summer 1976.

with depths of 10 to 20 cm lying unmelted for around a week in some areas. Flooding also affected parts of Leicestershire and Lincolnshire. See <https://weather.metoffice.gov.uk/learn-about/past-uk-weather-events> for more details. Flooding also affected parts of south-east England. Although this snow

event was not particularly unusual, observations clearly show a decline in the number and severity of snow events in the UK since the 1960s (Kendon et al. 2025). Long-term records from the Scottish mountains also provide evidence of declining snow cover, with no patches of lying snow from winter 2025

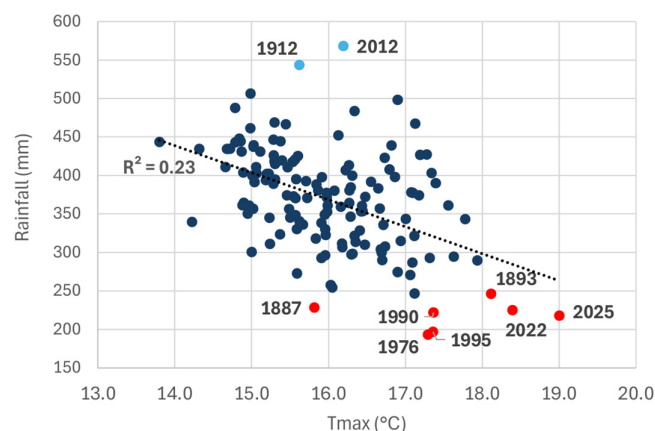


FIGURE 58 | Scatterplot of mean Tmax and rainfall for England for the period March to August from 1884 to 2025.

surviving unmelted through to winter 2026 for the fourth consecutive year. Since the 1840s this has occurred in 1933, 1959, 1996, 2003, 2006, 2017, 2022, 2023, 2024 and 2025 (Cameron and Kish 2026).

6 | Hydrology

6.1 | River Flows in 2025

Figure 60 shows the drought conditions characterized by the Standardized Precipitation Evapotranspiration Index (SPEI) for the six-month accumulation period March to August 2025. The SPEI is a commonly used drought index, based on the difference between precipitation and evapotranspiration. It therefore represents the climatic water balance, which will be influenced by the UK's warming climate (see Appendix A.1.13 for details). The spatial pattern of the SPEI across the UK reflects the rainfall anomaly pattern for this same period (Figure 59a). Over most hydrological units in England and Wales, conditions were extremely dry ($\text{SPEI} \leq -2$), with much of northeast Scotland also severely or extremely dry.

These rainfall deficits were reflected in mean river flows for the same period. Mean river flows for March to August 2025 were notably to exceptionally low for this 6-month period across most of the UK, with a number of catchments in northeast Scotland and northern England setting new minimum flows for this period (Figure 61). Where flows were not the lowest for this period, they often ranked second or third lowest behind other notable summer droughts (e.g., 1976, 1984, 2022), and many rivers recorded less than half the 1991–2020 long-term average flow for this period. While a number of catchments registered flows in the normal range, reflecting periods of wetter weather shown in the monthly rainfall anomaly maps for 2025 (Figure 33), most still remained below average. In south-east England, flows across catchments in the slow-responding chalk aquifer were bolstered by the previous wet winter of 2023 to 2024 and as a consequence were generally less extreme. These include the groundwater-fed River Itchen in Hampshire—the only UK catchment with flows above normal for this period.

The dominance of the low flows throughout 2025 is reflected in the national daily outflow series for England (Figure 62, see Appendix A.1.13 for details). Despite above average peaks in January and February, a recession—that is, a sustained fall in flow—dominated the first half of the year, with only minimal interruptions in March and April. Although there were several brief higher flow episodes in June and July, mean daily outflows from England generally remained below average. September saw a marked recovery in river flows, although they were generally more variable before the wetter November and first half of December, which saw flooding in some areas (e.g., from storm *Claudia* in south Wales in mid-November). For the six-month period March to August (spring and summer combined), mean outflows from England were the second lowest in a series from 1961, with only 1976 lower (Figure 63). 2025 was lower than other notable summer half year droughts such as 1995, 2003 and 2022. As with rainfall, this figure emphasizes the very large annual variability in river flows (here summarized using the outflow series for England), with mean outflows for the period March to August for the highest year (1979) more than three times that for the lowest year (1976).

6.2 | Trends in River Flows

Low flow indices (Q_{05}) offer insight into water-resource stress, ecological health and drought vulnerability. Across the 108 index stations (described in Appendix A.1.13), the UK-wide median trend magnitude in low flows is +4.5%. Just over half (56%) show increasing low flows, while 44% exhibit decreasing trends in low flows (Figure 64a). There is no single nationwide pattern emerging—despite these data including the severe drought in 2025. This has also been found in previous studies (e.g., Hannaford et al. 2025). Catchments with declining low flows are concentrated across England, Wales, eastern Scotland and eastern Northern Ireland. On face value, this suggests that these regions may see increased pressure on water resources, especially during prolonged dry periods. However, few catchments showed statistically significant trends at the 5% level (4% of catchments had statistically significant decreases and 8% had statistically significant increases). The limited proportion of significant results in this assessment reflects the high interannual variability of low flows and the influence of climatic fluctuations, groundwater characteristics, antecedent conditions and anthropogenic pressures such as abstraction and land use change.

High flow indices (Q_{05}) are important for potential flooding impacts, and here, trends are more consistent (Figure 64b). The UK-wide median trend magnitude is +16.8%, with 88% of stations exhibiting increasing high flows, with 14% of these increases statistically significant at the 5% level (i.e., this trend is unlikely to be due to chance alone). Only 12% of stations display negative Q_{05} trends, none being statistically significant. While the overall picture shows increasing high flow trends, some catchments in western Scotland and south-east England, show weaker or negative trends. Nevertheless, the overall pattern of increasing high flows aligns with broader evidence of increasing winter half-year rainfall (see Section 2) and fluvial flooding (Hannaford et al. 2021). Even where individual trends do not

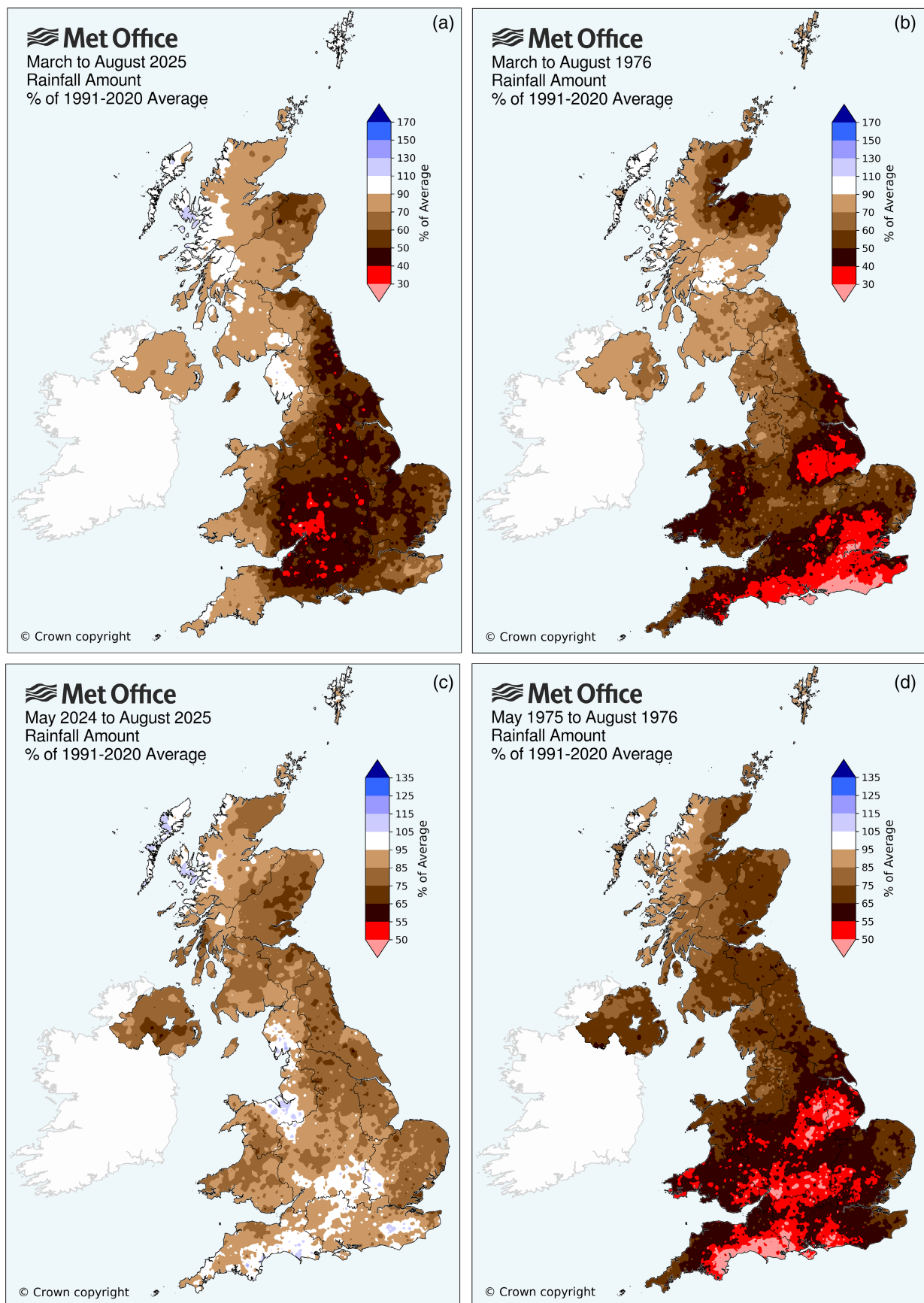


FIGURE 59 | (a and b) Rainfall anomalies relative to 1991–2020 for the six-month period March to August 2025, compared to March to August 1976 (c and d) the same for the 16-month period May 2024 to August 2025, compared to May 1975 to August 1976. Note the different legend scales for the six-month and 16-month durations.

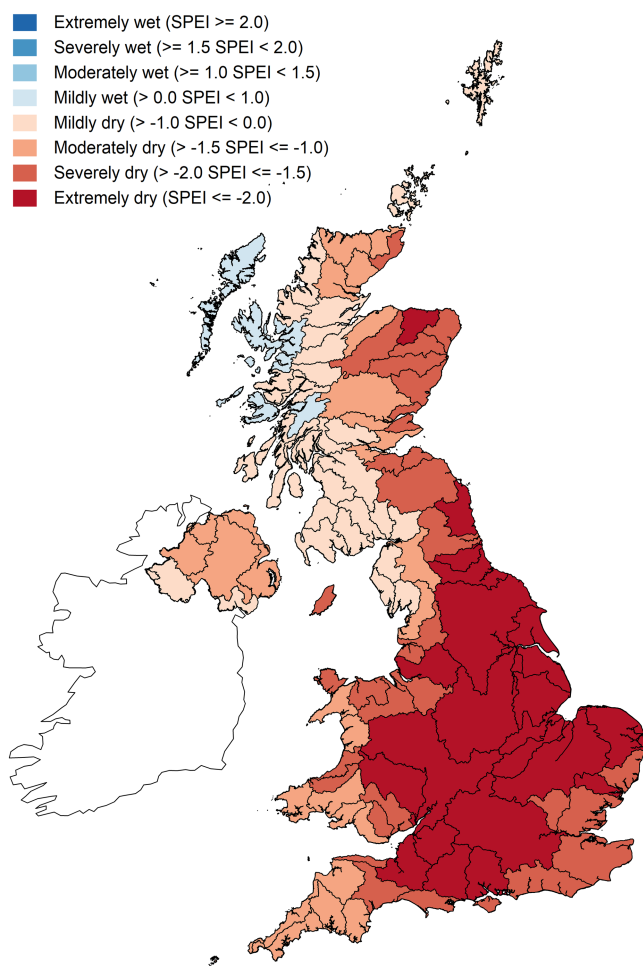


FIGURE 60 | Six-month accumulation period of the Standardized Precipitation Evapotranspiration Index (SPEI-6) for March to August 2025 for Integrated Hydrological Unit Areas covering the UK derived from HadUK-Grid.

reach statistical significance, the spatial coherence contributes to a growing body of evidence supporting this.

7 | Sea Level

7.1 | Mean Sea Level

Since the beginning of the 20th Century, sea level around the UK has risen by about 20.1cm, with a likely range (95% confidence interval) of 16.6 to 23.6cm (Figure 65). This has been calculated using five tide gauges from across the UK with long-term records, following the methods described in Woodworth, 2009. The large uncertainties in sea level rise estimates in recent years are the result of ongoing issues with the instrumental network (Kendon et al. 2025). The UK sea level rise of 20cm is comparable with global estimates of sea level rise of approximately 20cm over the period 1901–2018, with a range of 15 to 25cm in the IPCC 6th Assessment Report (Fox-Kemper et al. 2021).

Observational evidence from the UK tide gauges shows the rate of sea level rise has increased in recent decades (Kendon

et al. 2025; Kendon et al. 2022). Over the period 1993–2025, this UK index shows a rise of 13.9cm, with a wide likely range of 7.7 to 20cm, resulting in $4.2 \pm 1.0 \text{ mm} \cdot \text{year}^{-1}$ during the period 1993–2025 compared to $1.6 \pm 0.1 \text{ mm} \cdot \text{year}^{-1}$ since 1901. For comparison, the rate of global sea-level rise, calculated from satellite altimetry data, is $3.5 \pm 0.4 \text{ mm} \cdot \text{year}^{-1}$ during the period when satellite measurements have been available (1993 to 2025, Thompson et al. 2026).

Both the long term and recent trends are shown in Figure 65. However, sea level rise is not uniform around the coastline of the UK. As we have demonstrated previously (Kendon et al. 2022) over recent decades (1991–2020) the rates of sea level rise at individual locations in the UK vary from 3.0 to $5.2 \text{ mm} \cdot \text{year}^{-1}$, once tide gauge data have been corrected for vertical land movement in tide gauge locations associated with glacial isostatic adjustment (GIA) of the solid Earth.

According to the index, 2025 itself was the third highest year on record, slightly lower than 2023 and 2024. However, the large uncertainties mean direct comparison of individual years can be difficult. Nevertheless, 2022 to 2025 are the four highest years on record, and the highest 18 years in the record have all occurred since 2001.

7.2 | Extreme Sea Level

The largest surge events were associated with storms *Éowyn*, *Amy* and *Bram*. Section 5.2 provides more detail of storm *Éowyn*.

Storm *Éowyn* on 24 January was the largest surge event of the year. It primarily affected the west coast (Figure 66), with skew surges over 1m recorded almost everywhere between southwest Wales and northwest Scotland, over 1.5m at several sites. The highest skew surge recorded was 1.82m at Heysham, on the Morecambe Bay coast of Lancashire. (Skew surge is the difference between the peak total water level and the astronomical high tide, see Appendix A.1.14).

Fortunately, *Éowyn* occurred during neap tides, just after a new moon. This timing is entirely a matter of chance. Figure 67a illustrates how this timing mitigated any coastal impacts, at least in places with a large tidal range. Had such a large storm surge occurred a week later (1 February) on top of the next spring tide of the year, the total water level would have been much higher. In this scenario, total levels at Heysham would have been 3m more than the recorded level of 3.94m, reaching 6.93m above Ordnance Datum Newlyn (ODN). This extreme level is estimated to occur only around 1 in 300 years based on historic data (CFBC 2018). For other places with a much smaller tidal range, the timing has a lesser effect on the total level. For example, at Portrush, on the north coast of County Antrim, the total level (1.56m above Ordnance Datum Belfast, ODB) was within 6cm of the annual return level, although here too, had *Éowyn* arrived a week later the extreme level would have been 1 in 100 years (Figure 67b). *Éowyn* also caused negative surges on the east coast, with the impact here also moderated by neap tides (e.g., Unexpectedly low water levels at ports have the potential to disrupt shipping).

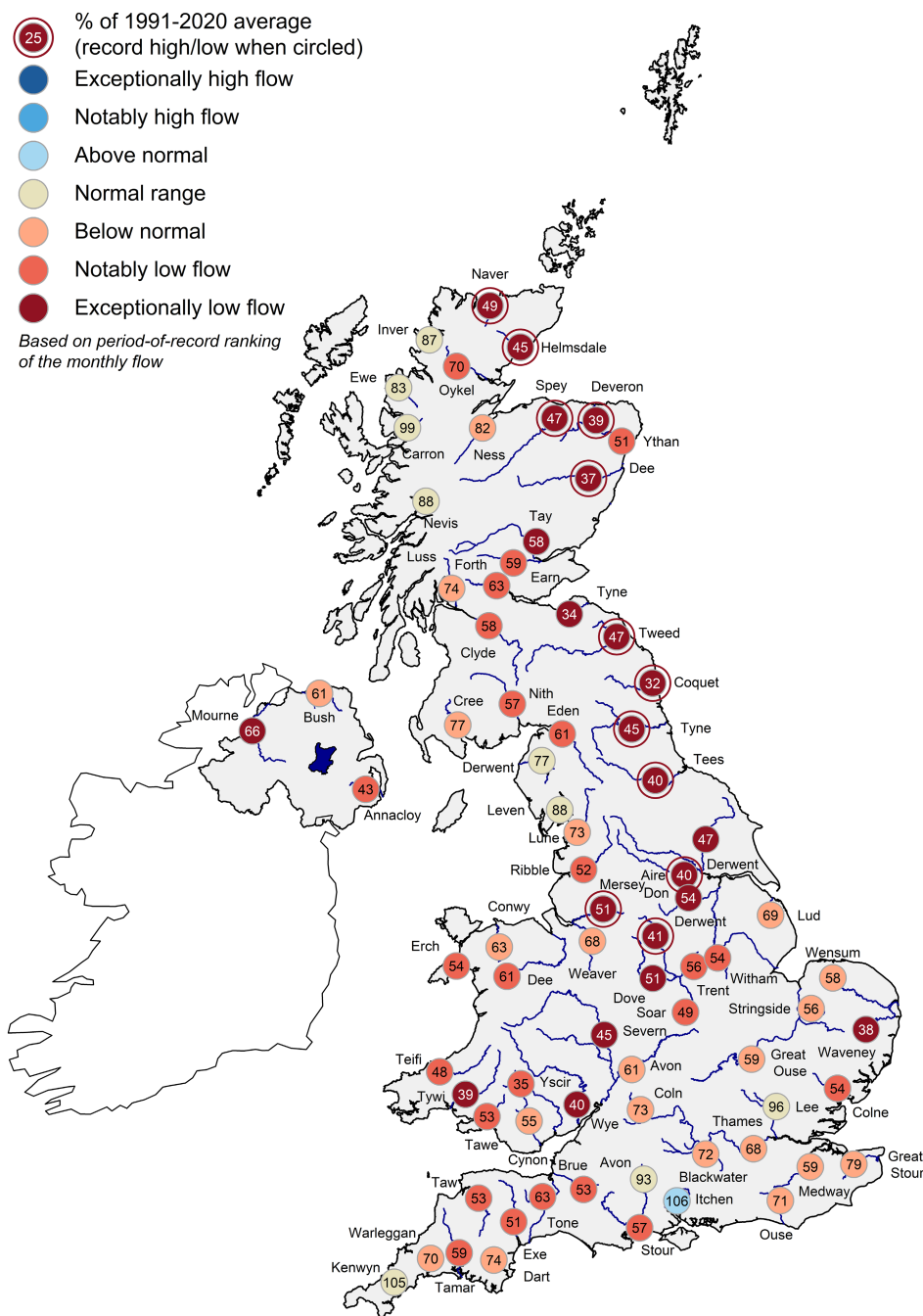


FIGURE 61 | Mean river flows across the UK for March to August 2025. Each point represents the location of a gauging station; the length of record, catchment area and catchment properties (including the level of human activities within a catchment) vary between catchments. Please refer to the on-line version to view the numbers. More information on each gauging station and associated data records can be found on the National River Flow Archive <https://nrfa.ceh.ac.uk/>.

Storm *Amy* on 3 to 4 October caused skew surges over 1 m in the northern Irish Sea and southwest Scotland. Again, the surge impact of *Amy* was moderated by the tides, but it did cause the highest water levels of the year at Portrush.

Storm *Bram* on 8 to 10 December was less extreme as a surge event but came on slightly higher tides. It resulted in the highest total water levels of the year at Port Erin (Isle of Man), Millport (North Ayrshire) and Portpatrick (Dumfries & Galloway), the latter being a 10–20 year return period event based on historical data (CFBC 2018).

As it happened, all UK storm surges of 2025 occurred on small or moderate tides. At around half of UK sites the highest total water level of the year fell on the spring tides close to the equinoxes (the highest tides of the year).

Long term nodal (18.6 year) and perigean (4.5 year) cycles associated with the moon's orbit around the Earth affect the maximum tide that occurs in any given year, with up to 75 cm variation in the Bristol Channel. 2025 was a year of medium tides, and the UK sites had predicted tides 5–36 cm short of the local maximum possible due to astronomical factors alone. Therefore,

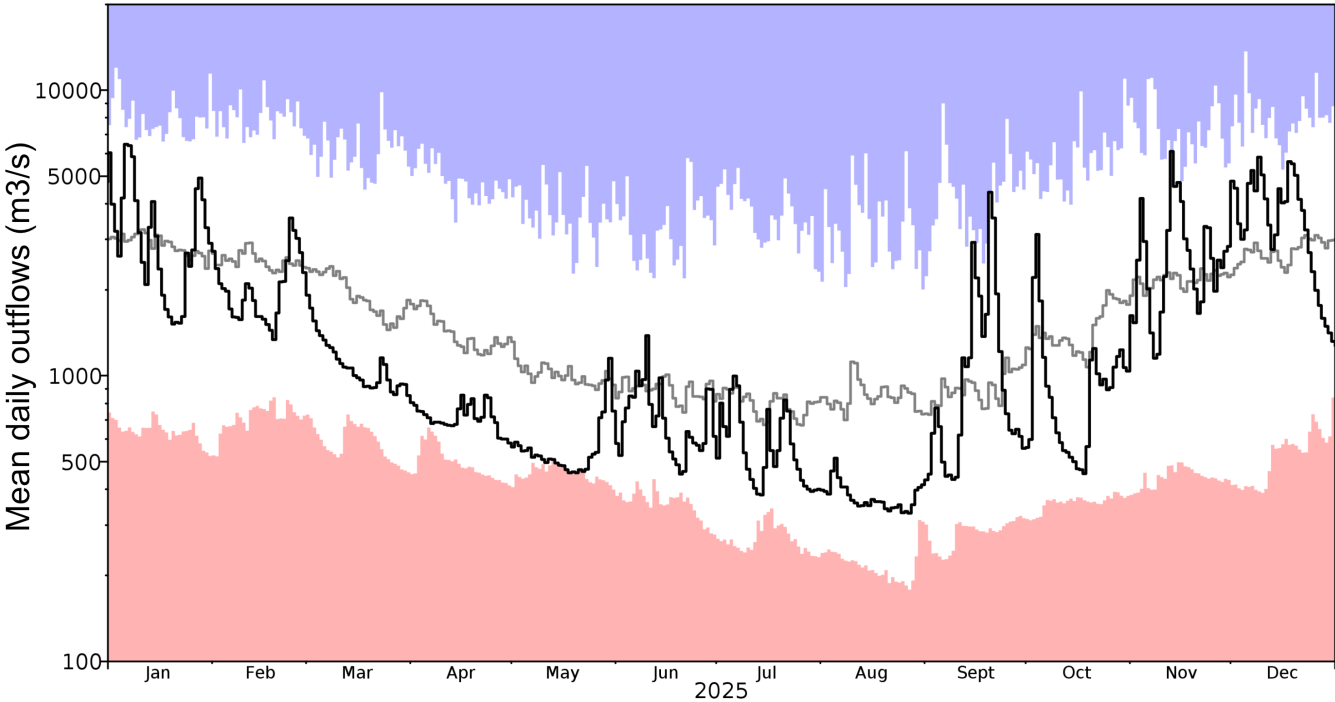


FIGURE 62 | Daily mean outflows from England in 2025 in m³/s (black line). The grey line shows daily long-term average outflows relative to the 1991–2020 standard period, with blue and red the highest and lowest daily outflows on record in the series from 1961. The y-axis is on a logarithmic scale to emphasize the lower outflows.

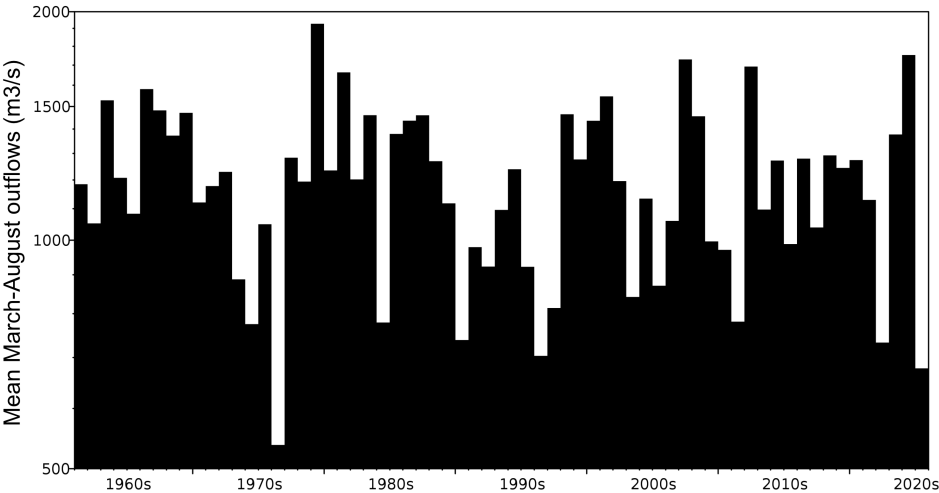


FIGURE 63 | Mean outflows from England for the six-month period March to August from 1961 to 2025 in m³/s. The y-axis is on a logarithmic scale to emphasize the lower outflows.

these events were generally only at around 1 to 2 year return period levels, based on CFBC 2018.

8 | Climate and Nature: Yields of Wild Seeds

In autumn 2025, several anecdotal comments were being made in social and traditional media on the abundance of shrub and tree seeds, notably acorns on oak trees. Such seeds, for some species often contained within a fleshy fruit, are of utmost importance as a food supply for wildlife and for regeneration of the parent plants. Nature's Calendar is a Citizen Science

project run by the Woodland Trust. Fortunately, Nature's Calendar recorders have been monitoring the yields of seeds of 16 species since 2001. As a departure from our usual reporting of phenology, we take this opportunity to examine the data on seed yields from 2001 to 2025 and the influence of the weather in 2025 on these yields. Seed yields will reflect an integration of all the weather and other environmental factors to which these species respond over the course of the year, and in some cases to preceding years.

Table 14 shows seed yields in 2025 in comparison with the mean of the preceding years 2001 to 2024. Yields were higher

Annual – Q95 (Low Flows)

Annual – Q05 (High Flows)

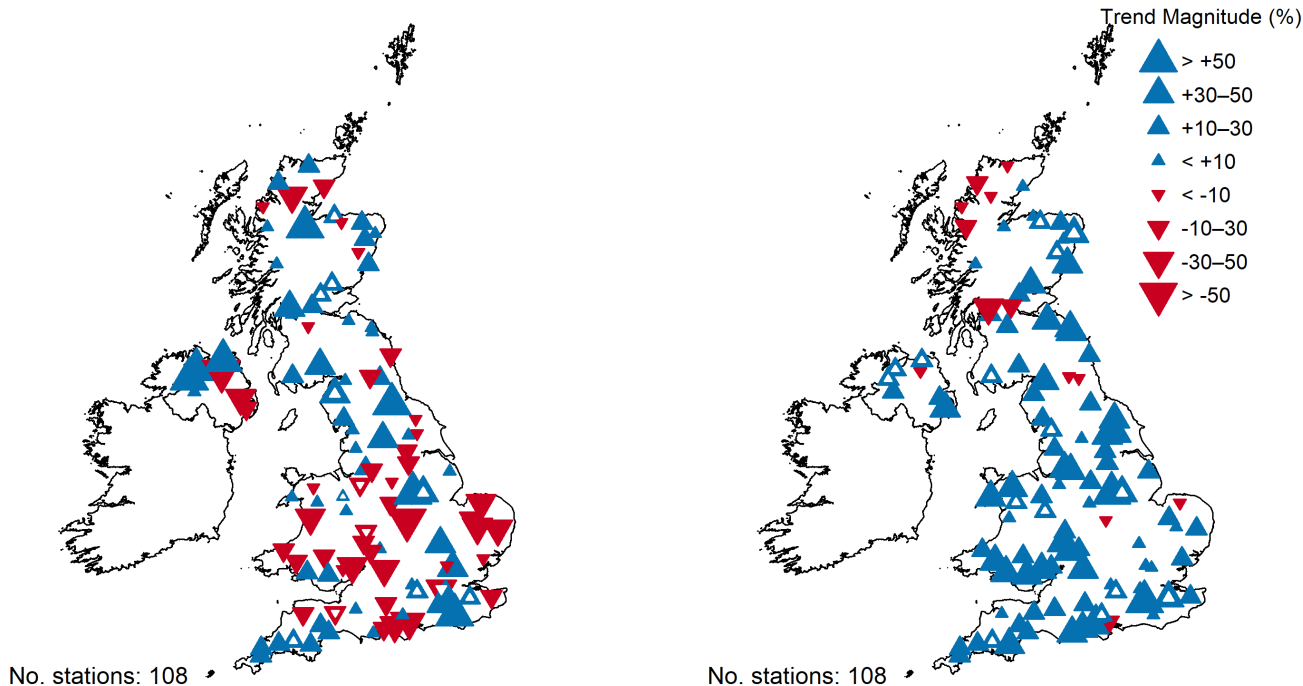


FIGURE 64 | Trend analysis of river flow indicators relevant to (a) water resources and potential drought conditions (Q_{95}) and (b) high flows and potential flooding (Q_{05}) for the period 1965–2025. The stations included represent those used in the National Hydrological Monitoring Programme monthly reporting, ensuring long, good-quality records and broad spatial coverage across the UK. Trend magnitude is expressed as percentage change over the period (1965–2025). White infill indicates stations with statistically significant trends at the 5% level based on the Mann-Kendall test, with adjustments applied where serial correlation is present.

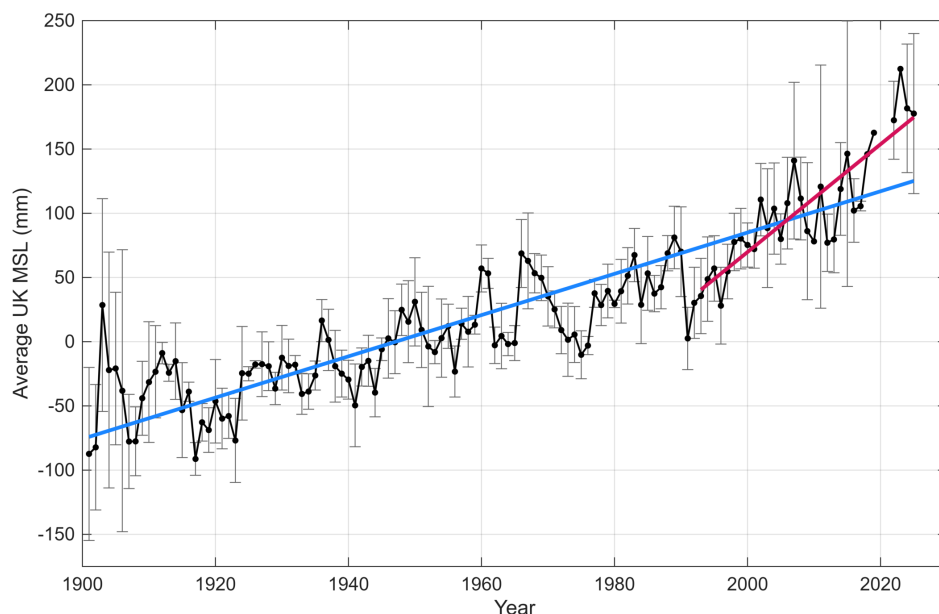


FIGURE 65 | UK sea level index, 1901–2025 based on tide gauge data. Heights are distances above the long term mean of this index for 1921–1990. The blue line represents the best-fit trend over the length of the whole index of 1.6 mm-year^{-1} , the red line represents the trend of 4.2 mm-year^{-1} over the period 1993–2025, this is the period of satellite altimetry.

than the mean in all monitored species except Rowan, and were notably higher for Blackthorn and the two oaks. Furthermore, seven of the 16 species (Blackthorn, Dog Rose, Hawthorn, Horse Chestnut, Ivy and both oak species) had their heaviest

crop in 2025. The average seed score across all 16 species confirms the high yields achieved in 2025 (Figure 68). The mean score has not increased significantly over the 25 years, which may be because this is a short series with large annual

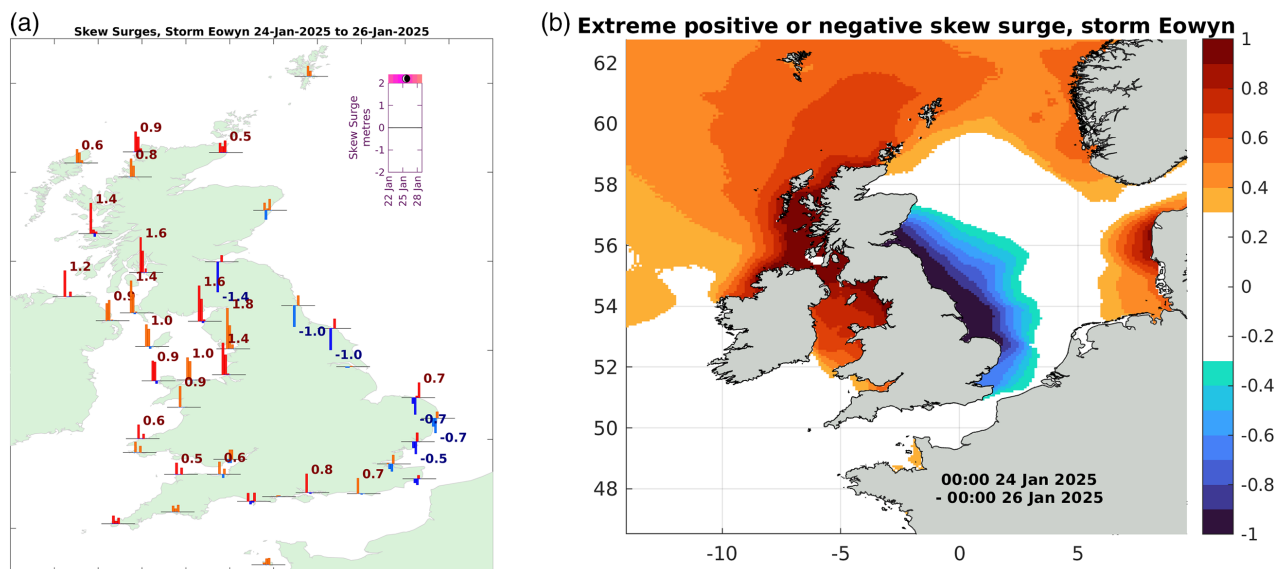


FIGURE 66 | Observations (a) and storm surge model (b) of storm *Eowyn*; units are metres for both. *Eowyn* caused high skew surges on the north-west coasts, but fortunately occurred during neap tides, limiting total water levels. It was also notable for negative surges on the east coast. The model map shows the most extreme positive skew or negative skew during each event (if there are both then positive only is plotted). (See Figure 48 for the analysis chart for storm *Eowyn*).

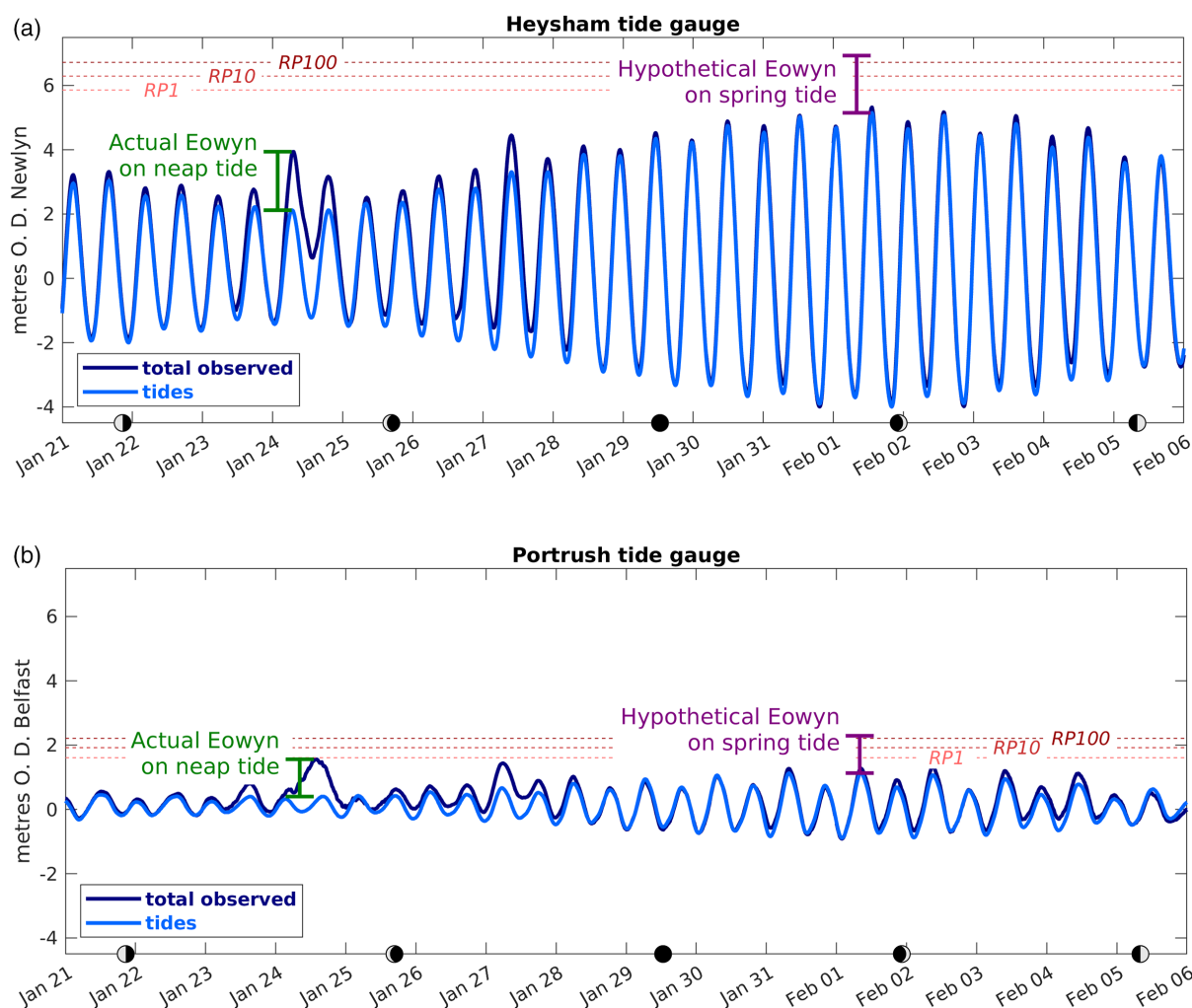


FIGURE 67 | The predicted astronomical tide and total water level observed at (a) Heysham (Lancashire) and (b) Portrush (County Antrim) around the time of Storm *Eowyn*, showing the potential impact of the storm had it coincided with a spring tide. RP1, RP10 and RP100 indicate median return periods of 1, 10 and 100 years (CFBC 2018).

TABLE 14 | Seed yields of the 16 monitored species in 2025 in relation to the mean over the 2001–2024 period. The yield is calculated as a mean across all the observations of a simple 5-point score as follows: 1 = no fruit, 2 = meagre, 3 = moderate, 4 = good, 5 = exceptional. Record high values are shown in bold red.

	No. of records for 2025	Mean yield 2025	Mean yield 2001–2024	Difference
Ash	116	3.8	3.5	+0.3
Beech	86	3.7	3.4	+0.3
Blackthorn	133	4.1	3.2	+0.9
Bramble	208	4.0	3.8	+0.2
Dog rose	140	3.9	3.7	+0.2
Elder	145	3.8	3.6	+0.2
Field maple	57	3.7	3.6	+0.1
Hawthorn	225	4.3	3.9	+0.4
Hazel	94	3.4	3.0	+0.4
Holly	139	3.8	3.6	+0.2
Horse chestnut	150	3.8	3.3	+0.5
Ivy	140	4.3	4.1	+0.2
Pedunculate oak	188	4.5	3.2	+1.3
Sessile oak	68	4.2	3.1	+1.1
Rowan	182	3.9	3.9	0
Sycamore	93	4.0	3.7	+0.3

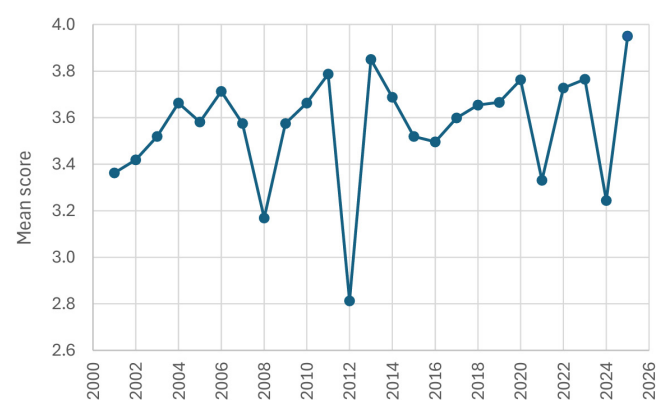


FIGURE 68 | Seed yields averaged across the 16 monitored species 2001–2025.

variability. Our broad-brush approach of averaging across all species does not consider the varying levels of correlation in yields (i.e., synchronized low and high yield years) between species, for example correlation was very good between seed yields of the two oaks ($R^2=0.94$) but almost non-existent between Ash and Field Maple.

The mean score across all species was positively correlated with both April–September mean CET ($R^2=0.34$) and April–September England sunshine ($R^2=0.63$, with some evidence of curvature) and negatively correlated with England and Wales Precipitation (EWP) for the same months ($R^2=0.50$) (Figure 69). Each of these variables may therefore explain between one third and two-thirds of the variability in seed yields

from 2001 to 2025 across all species, with sunshine having the strongest relationship. April–September CET in 2025 was the highest on record in the series from 1659, April–September sunshine was also the highest on record for England in the series from 1910, and April–September EWP was well below average.

Despite these significant results it should be borne in mind that the influence of weather on seed yields is highly complex. For example, some species have noticeable mast years producing a heavy crop. Others have boom and bust years focussing on flower bud production in 1 year and on subsequent seed production in the following year, and thus weather in more than 1 year may be influential. Such masting and boom and bust strategies may operate at the level of an individual tree, or may be synchronized over large areas (Zamorano et al. 2018). The species considered here are either wind pollinated or insect pollinated. Both forms of pollination benefit from ideal weather conditions and flowering synchrony, the latter also from an abundance and high activity rate of insect pollinators.

In terms of spring weather, 12 of the 16 species had significant positive correlations with mean April CET (nine species) and/or significant negative correlations with March to May EWP totals (seven species). These imply that years of heavy yields tended to be associated with warm Aprils and drier springs, both features likely to encourage wind and insect pollination. These two variables will be negatively correlated, so disentanglement of the key factors is difficult, but both are likely important.

Warm, dry springs without damaging frosts will be favourable to flower survival and both forms of pollination and hence

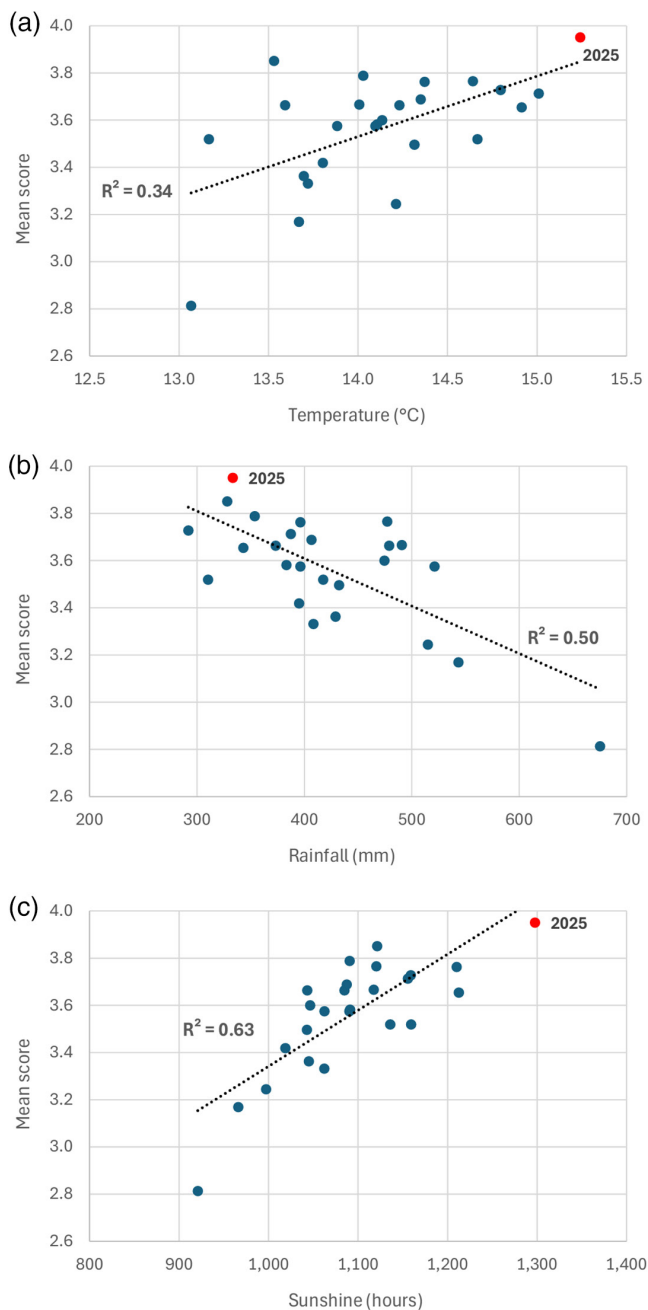


FIGURE 69 | Seed yields averaged across the 16 monitored species from 2001–2025 in relation to (a) April–September mean CET ($R^2=0.34$), (b) total April–September England and Wales Precipitation (EWP, $R^2=0.50$) and (c) total April–September sunshine for England ($R^2=0.63$). Regression lines are superimposed.

subsequent seed production (e.g., Caignard et al. 2017; Journé et al. 2025). Sunny warm temperatures during the summer will encourage seed production and ripening. Extreme weather (e.g., late frosts, heatwaves and drought) may cause flower death and seed abortion but in relatively short series, as considered here, these are unlikely to be easily detected.

The low yield in 2012 (Figure 68) was associated with the wettest April–September period in the EWP series for over 200 years,

the coolest April–September in the CET series since 1993, and the lowest April–September sunshine for England since 1981.

Further work is necessary to investigate the influence of weather on the seed yields of the individual monitored species, including the influence of the past year's weather and past year's yields. The potential complexity is very large given the dependence on multiple variables (temperature, rainfall and sunshine) and different ways in which the different species may respond.

Author Contributions

Mike Kendon: writing – review and editing. **Amy Doherty:** writing – review and editing. **Dan Hollis:** writing – review and editing. **Emily Carlisle:** writing – review and editing. **Stephen Packman:** writing – review and editing. **Nick Rayner:** writing – review and editing. **Ségolène Berthou:** writing – review and editing. **Lucy Barker:** writing – review and editing. **Steve Turner:** writing – review and editing. **Jamie Hannaford:** writing – review and editing. **Svetlana Jevrejeva:** writing – review and editing. **Andrew Matthews:** writing – review and editing. **Joanne Williams:** writing – review and editing. **Alex Marshall:** writing – review and editing. **Tim Sparks:** writing – review and editing.

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Conflicts of Interest

The authors have no conflicts of interest to declare.

Data Availability Statement

The data that support the findings of this study are openly available in the Centre for Environmental Data Analysis at: <https://catalogue.ceda.ac.uk/uuid/4dc8450d889a491ebb20e724debe2dfb/>.

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State of the UK Climate in 2025—Appendices

These appendices provide information about the underlying datasets used in this report. Much of the content is repeated from previous reports, with only minor updates, but they are included here in full for reference.

A.1 | Datasets

A1.1 | HadUK-Grid Dataset

The principal source of data in this report is the HadUK-Grid dataset, comprising monthly and daily gridded data covering the UK (Hollis et al. 2019). The primary purpose of these data is to facilitate monitoring of UK climate and research into climate change, impacts and adaptation. All gridded data are at 1 km resolution. The grids are based on the GB national grid, extended to cover Northern Ireland and the Isle of Man, but excluding the Channel Islands.

This dataset is updated annually. This report uses version 1.3.2.0, ending 2025. The previous version 1.3.1.0 ending in 2024 was used for the State of the UK Climate 2024 report (Kendon et al. 2025). In addition to the extra year, 2025, the main change from v1.3.1.0 has been the addition of a new automated quality control test applied to daily rainfall, briefly described in Section A1.5. Evaluating and improving the HadUK-Grid dataset and associated underlying station data for UK climate monitoring is an active and ongoing task.

The underlying source of UK station data used to produce the gridded dataset is the Met Office Integrated Data Archive System (MIDAS) Land and Marine Surface Stations Database. This has been supplemented by further digitized historical data from multiple sources including Met Office Monthly and Daily Weather Reports and monthly rainfall totals from both British Rainfall and the ‘Rainfall Rescue’ project, comprising digitized data contained within the ‘Ten year rainfall’ collection (Met Office Digital Library and Archive 2020). This collection of transcribed data went through an extensive process of consolidation, quality control and verification of metadata, described in detail by Hawkins et al. (2023). This version of HadUK-Grid uses the second version of this rainfall rescue collection (v2.0.0, Hawkins 2023), used in HadUK-Grid since v1.2.0.0, ending 2022.

The HadUK-Grid dataset uses open-source ancillary files for terrain elevation, proximity to coast and urban land use within the interpolation scheme, which provides traceability. The gridding method used within HadUK-Grid involves interpolation of the station data to a regular grid of point locations using inverse-distance weighted (IDW) averaging. Hollis et al. (2019) provide further details.

A point of note is that the Met Office routinely disseminates provisional UK climate statistics which are widely reported in national media. These provisional statistics are released each month, season and year end, with the latest published version of the dataset used to provide context historical context. The provisional data are primarily from the Met Office real time network of weather stations only, but also include some additional rain gauge data from registered gauges, where these have been automated (Appendix A.1.10). Any manually read climate stations or rain gauges reporting in slower time will be excluded, and all provisional data have yet to pass through the full Quality Control process (Appendix A.1.5)—although some preliminary checks will have been applied. The number of stations comprising the provisional network is generally smaller than the complete network (e.g., shown in Figure A7) although this depends on variable and geographical location. Provisional statistics are therefore subject to change, however, any difference between them and the versioned statistics presented in this report are typically small—although they will depend on variable and geographical extent. Further details are beyond the scope of this report.

Table A1 shows the daily, monthly, seasonal and annual grids from HadUK-Grid used for this report, including the year from which variables are available. A distinction is made between daily and monthly grids which are gridded directly from station data and other ‘indices’

grids that are calculated from these grids as a second step. For example, monthly days of air frost and days of rain are calculated from daily Tmin and rainfall grids respectively, rather than being gridded directly from the monthly station values. A key advantage is that they are therefore consistent with these daily grids which would not be the case if they were gridded from station data. Because the gridding is at a daily timescale, we also anticipate that there will be a better overall representation of spatial variation in these monthly variables. Seasonal and annual grids are calculated from either the daily or monthly grids.

Monthly temperature and rainfall grids are gridded from monthly station data, rather than being derived from daily temperature and rainfall grids. They also extend further back in time. This means that they are not exactly consistent (indeed observations from monthly rain-gauges, or digitized monthly rainfall data from Rainfall Rescue, can only be used for the monthly rainfall grids)—but in general differences are small.

The approximate total number of station values used to generate the grids for each variable is given in Table A2. In total, well over 100 million station values have been used to generate the HadUK-Grid dataset, daily rainfall accounting for the most by far. Figures A1–A4 show the number of stations used for creating the daily and monthly grids gridded directly from station data.

For monthly temperature, the number of stations starts at fewer than 100 for the period 1884 to 1900, increasing steadily to a peak of over 600 stations in the 1990s, followed by a subsequent decline to just over 300 in 2025. The number of stations recording monthly days of ground frost (i.e., with a grass minimum thermometer) is typically around 100 fewer than air temperature from the 1960s onwards. Daily temperature has been gridded back to 1931, with around 100 stations through the 1930s, 1940s and 1950s. Temperature has relatively smooth spatial variability so the reduced network size in these earlier decades is a much less critical factor than for rainfall—the benefit of these additional years in providing climate context outweighs any limitations of the sparser network.

The number of stations used for monthly rainfall has increased from fewer than 100 stations in 1840 to 4000 or more stations from around 1900 to 2000, followed by a subsequent decline to fewer than 2500 in the 2020s. The approximate halving of station numbers in the last 40 years is a cause for concern. The inclusion of digitized monthly rainfall data sources prior to 1961, in particular Rainfall Rescue data, has eliminated a previous step change in station numbers before 1960 and transformed the quality of this dataset. The number of stations in the dataset in the 2020s is now approximately equivalent to that in the 1880s, although network coverage in the 1880s is more uneven with some spatial clustering.

The number of monthly sunshine stations rises from around 150 in the 1910s to over 300 from the 1950s to 1980s, followed by a steady decline to around 100 stations in 2010, thereafter remaining stable.

For rainfall, the step change in station numbers prior to 1961 is still present at a daily resolution. Metrics in this report based on the daily rainfall grids are therefore mostly presented from 1961, even though these grids extend back to 1891. Further work is needed to determine the extent to which any trends in metrics in earlier years are influenced by the relatively low station network density. The gap between daily and monthly rainfall prior to 1961 shown in Figure A3 emphasizes the potential volume of historical daily rainfall station data to go into future versions of HadUK-Grid and be made available more generally—for example, for flood risk applications where long time-series are important. Any analysis of extreme rainfall in the UK must therefore await further digitization work if the observations are to be fully exploited. An average of 3000 stations each day for 100 years would be equivalent to over 100 million observations; a considerable challenge. This is a current active area of work in the Met Office using ‘artificial intelligence’/‘machine learning’ (AI/ML) techniques to recover the data from scanned images.

Daily rainfall data yet to be rescued will include a significant number of major extreme rainfall events. One such example is the Norfolk rain

TABLE A1 | Variables presented in this report, gridded over the UK at 1 km resolution. Bold indicates gridding from station data.

Climate variable	Statistic	First year	Temporal resolution	Comment
Max air temperature	Daily Tmax °C	1931	Daily	Gridded from station data
Min air temperature	Daily Tmin °C			
Mean air temperature	Daily Tmean °C	1931	Daily	Calculated from daily Tmax, Tmin grids
Precipitation	Daily precipitation amount (mm)	1891	Daily	Gridded from station data
Max air temperature	Monthly average of daily Tmax °C	1884	Monthly	Monthly grids are gridded from station data. Seasonal and annual grids are calculated from monthly grids.
Min air temperature	Monthly average of daily Tmin °C		Seasonal	
Mean air temperature	Monthly average of daily Tmean °C		Annual	
Precipitation	Total monthly precipitation amount (mm)	1836		
Sunshine	Total hours of bright sunshine during the month consistent with the Campbell-Stokes recorder	1910		
Days of ground frost	Count of days with grass min temperature <0°C	1961		
Days of air frost	Count of days with Tmin <0°C	1931	Monthly Seasonal Annual	Calculated from daily Tmin grids
Growing degree days	Day-by-day sum of number of degrees by which the mean temperature is more than 5.5°C	1931	Daily Annual	Calculated from daily Tmax, Tmin and Tmean grids (see Table A3)
Max air temperature	Highest daily Tmax °C	1931	Annual	Calculated from daily Tmax grids
Days ≥ 30°C Similarly applied for other thresholds	Count of days with Tmax ≥ 30°C etc.	1931	Annual	Calculated from daily Tmax or Tmin grids
Days of rain ≥ 1, 10, 25, 50 mm	Number of days with ≥ 1, 10, 25, 50 mm precipitation	1891 ^a	Monthly Seasonal Annual	Calculated from daily rainfall grids
Rainfall intensity	Total precipitation on days with ≥ 1 mm divided by the count of days with ≥ 1 mm during the year	1891 ^a	Annual	Calculated from daily rainfall grids
Raindays ≥ 95, 99 percentile	Number of days with daily rainfall exceeding 95, 99%ile on wet days ≥ 1 mm based on 1961–1990			

^aClimate series are presented from 1961 due to the reduction in station numbers before this year.

storm of August 1912 mentioned in Section 2.4. Figure A5 shows how exceptional the August 1912 monthly total for Norfolk was: this exceptional monthly total was largely due to the rainfall totals from the 26th—that is, from just 1 day. There are very few spikes in the observational records as extreme as this and an important message is that such spikes are not just to be found in the most recent decades. Figure A6 shows the contrast between the daily and monthly station data availability for 26th August 1912 and August 1912 overall in v1.3.2.0. Coverage is excellent at monthly resolution but unfortunately not yet at daily resolution.

A1.2 | The Observing Network in 2025

Figure A7 shows the state of the UK's observing network in 2025 based on data availability from stations that have actively returned data during the year. The networks are designed and maintained to achieve good spatial coverage with stations representative of all areas of the UK.

The rainfall network is much denser compared to other variables, due to its very high spatial variability. Unfortunately this network has been steadily declining. At present, most rainfall events will be reasonably

well captured although inevitably highly localized convective events may still be missed. Overall however, even though the current number of stations may be fewer than in earlier decades (e.g., the 1970s), the spatial distribution of stations is more even, and so there is an improvement in the overall network's ability to capture the spatial characteristics of the weather on any day. At a monthly resolution, a comparison of the rainfall network maps for August 1912 and June 2025 (Figures A6 and A7) shows different degrees of spatial clustering on these dates.

While the majority of the UK is reasonably well covered for the variables shown, some areas are more data-sparse than others, although these often tend to have a lower population. The sunshine network is sparse and coverage may considerably reduce if data for an individual station is missing, and where surrounding stations struggle to cover the gap—that is, there is limited redundancy in the network.

A1.3 | Long Term Average Grids

The long term averages for the WMO standard 30-year climatological reference periods 1961–1990 and 1991–2020 and other periods 1901–1930 and 1931–1960 presented in this report have been calculated from

TABLE A2 | Approximate total number of station observations used for each variable in v1.3.2.0 presented in this report.

Climate variable	Number of years	Number of grids	Average number of stations values	
			per grid	Total number of station values
Monthly Tmax	142	1704	355	600,000
Monthly Tmin	142	1704	357	610,000
Monthly Tmean	142	1704	353	600,000
Monthly rainfall	190	2280	3437	7,800,000
Monthly sunshine	116	1392	233	320,000
Monthly groundfrost	65	780	331	260,000
Daily Tmax	95	34,699	389	13,000,000
Daily rainfall	135	49,308	1933	95,000,000

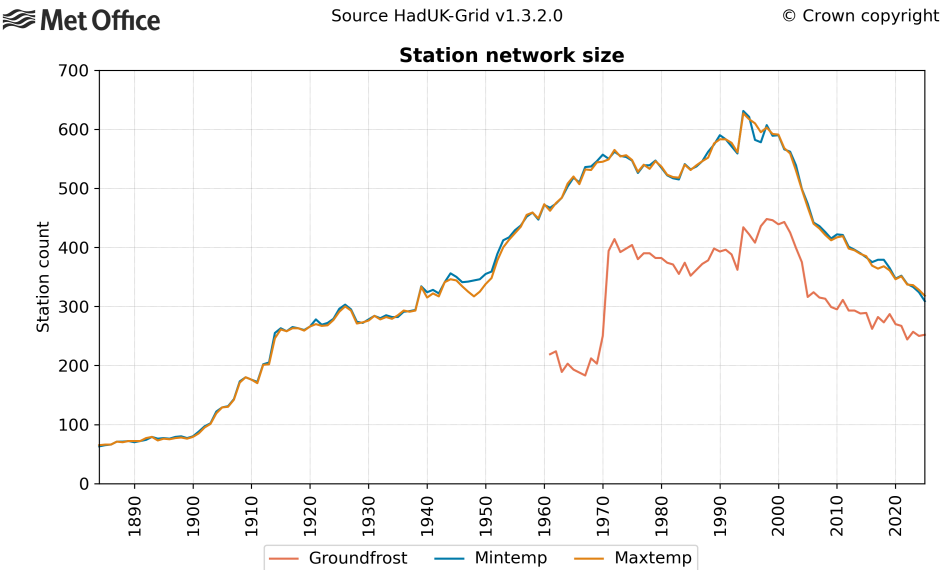


FIGURE A1 | Indicative numbers of stations used for gridding in this report—monthly Tmax and Tmin (1884 to 2025), monthly days of ground frost (1961 to 2025) based on the actual numbers of stations used in June for each year. Monthly Tmean closely follows monthly Tmax and Tmin but is omitted for clarity.

long term average monthly or annual gridded datasets at 1 km. They are simply averages of the 30 monthly or annual grids spanning each period. We refer to this as ‘grid-then-average’. Long term averages for countries and regions quoted in this report are therefore self-consistent with the long term averages calculated from monthly, seasonal and annual series in the report, although this is not exactly true for winter, or the winter ‘half-year’ October to March, since, for example, 30 individual winters in the period will include the previous December (e.g., December 1990 for the period 1991–2020) and omit the last December (December 2020). The introduction section explains of the choice of average periods used in this report. Hulme (2021) provides more background and discussion regarding averaging periods.

A1.4 | Growing Degree Days

A degree day is an integration of temperature over time and is commonly used to relate temperature to particular impacts. It is typically estimated as the sum of degrees above or below a defined threshold each day over a fixed period of time. The threshold used for growing degree days (GDD) in this report is 5.5°C and the formulae used are described in Table A3. The daily Tmean is calculated as the mean of the daily Tmax and Tmin. The degree-day value is calculated differently depending on which of Tmax, Tmean or Tmin is the defined threshold.

A1.5 | Quality Control

Quality Control (QC) is critically important for UK climate monitoring: the quality of this report can only be as good as the quality of the observations on which it is based. At the same time, no real world climate observing network can be perfect, or database of historical observations completely free from errors.

The HadUK-Grid dataset is mainly based on observations from the Met Office’s national network of climate stations, and rain-gauges registered with the Met Office. These observational data are held within the MIDAS database which is the formal national archive. They undergo a range of Quality Control Processes as outlined in World Meteorological Organization guidelines WMO-No. 1269 (WMO 2021). Other data sources which HadUK-Grid uses, such as data rescued from historical archives, have also had their quality checked. For example, tables of monthly rainfall published in British Rainfall also include annual totals, enabling a closure check on the monthly totals.

The gridding of station data as processed in HadUK-Grid includes automated and manual QC steps depending on the variable and period. Automated QC is much easier for some variables than others. For example, the relatively smooth spatial variation of the anomaly field for daily or monthly Tmax makes automated QC comparatively straightforward.

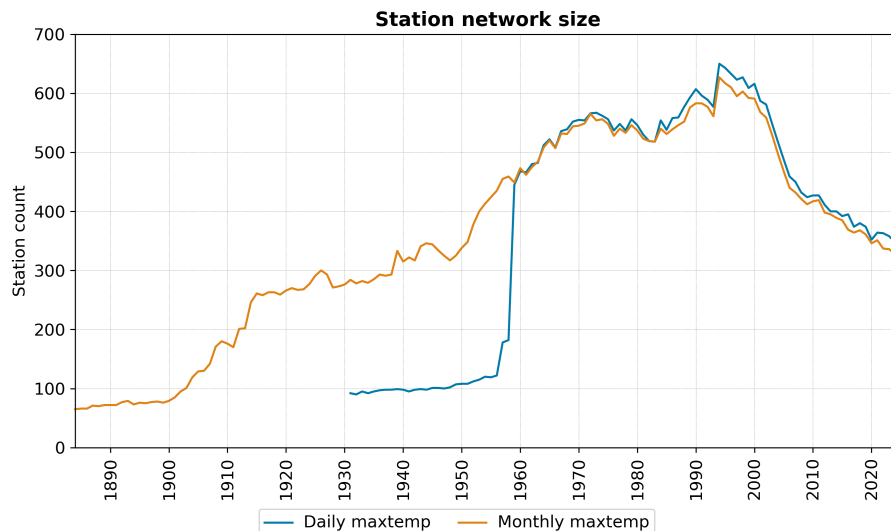


FIGURE A2 | Indicative numbers of stations used for gridding in this report—monthly Tmax (1884 to 2025), daily Tmax (1931–2025) based on the actual numbers of stations used in June/1 June of each year. Tmin closely follows Tmax but is omitted for clarity.

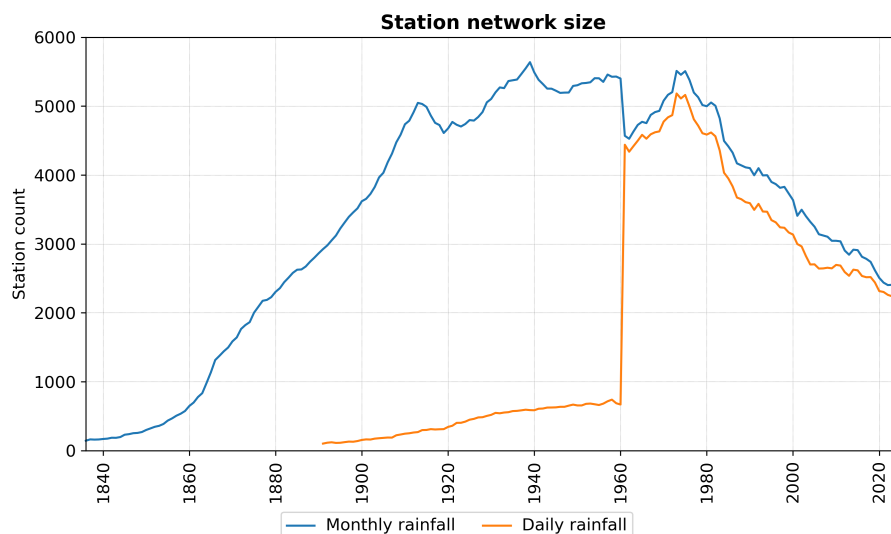


FIGURE A3 | Indicative numbers of stations used for gridding in this report—monthly rainfall (1836 to 2025), daily rainfall (1891–2025) based on the actual numbers of stations used in June/1 June of each year.

In contrast, the large spatial variability of daily rainfall makes this extremely difficult.

An additional test that has been introduced to v1.3.2.0 is intended to remove ‘false zeros’ in the daily rainfall station dataset used for gridding, by comparing all instances of zero values against near-neighbours. Importantly, the aim of automated QC tests such as this is to remove as much bad data as possible (‘hits’), minimize data errors (‘misses’) and avoid removing good data (‘false alarms’) which can cause over-smoothing, and it is the latter that makes daily rainfall so challenging. For example, ensuring the removal of all instances of ‘false zeros’ in this automated test is virtually impossible because it would inevitably result in the removal of some ‘true zeros’ too, so a compromise threshold is designed to remove worst offenders only.

More generally, this same type of approach would be common to any type of automated test designed to capture other types of error. Details

of the automated QC tests applied to the HadUK-Grid data are beyond the scope of this report, but this is an ongoing active area of research and development likely to feed into future versions. It is also an area of potential future application of ‘artificial intelligence’/‘machine learning’ (AI/ML) techniques—that is, replicating the QC decisions a human would make based on judgement and experience, although clearly such techniques can only be as good as the data on which they are trained and must be applied very carefully (Figure A8).

A1.6 | Quality Control of Record Values

Quality control of station observations is particularly important for potential new record values. All possible records must be carefully checked, and this is especially the case for high profile records such as the UK highest Tmax and highest Tmin temperature records, both set on 19 July 2022; 40.3°C at Coningsby (Lincolnshire) and 26.8°C at Shirburn

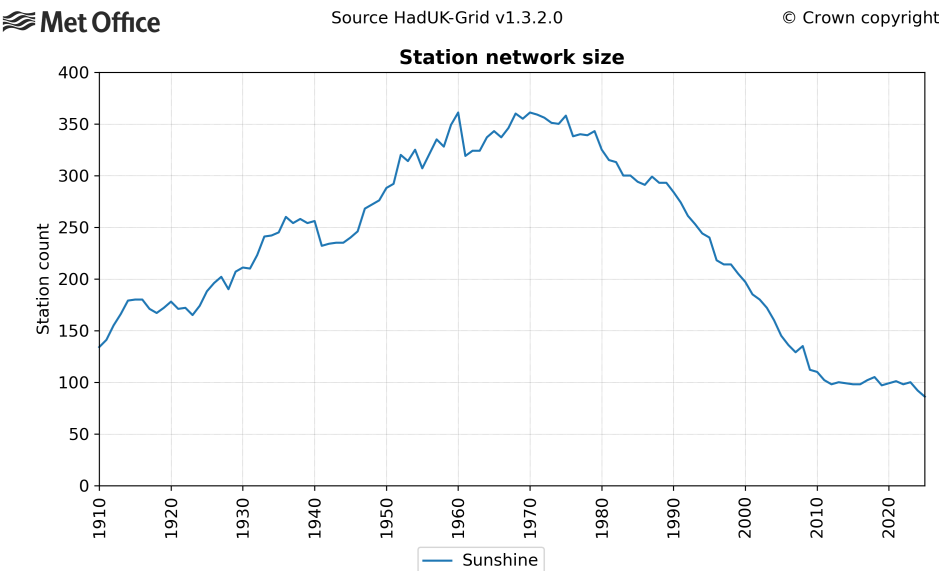


FIGURE A4 | Indicative numbers of stations used for gridding in this report—monthly sunshine (1910 to 2025) based on the actual numbers of stations used in June of each year.

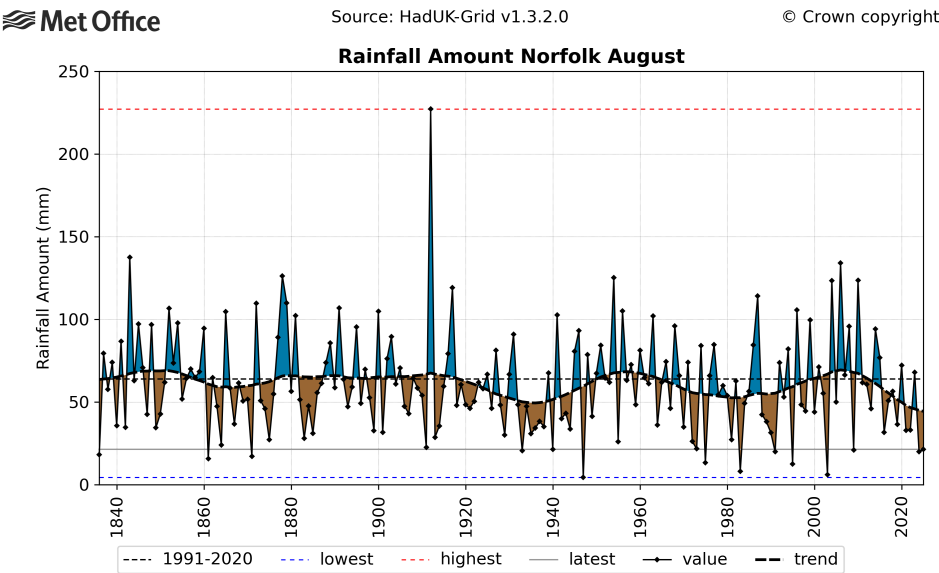


FIGURE A5 | Norfolk rainfall 1836 to 2025 (mm). The 1912 value includes the Norfolk rainstorm of 26 August 1912 (British Rainfall Organization 1913).

Model Farm (Oxfordshire) (Burt 2025a, 2025b). The monthly temperature records in Section 4.2 are examples of record values; ‘official’ records are published on the Met Office website at <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-extremes>.

The Met Office has an established process for verifying potential new records, managed by the Site Weather Assessment Team (SWAT). Whenever a potential new record occurs, this team undertakes a detailed manual assessment prior to the new record’s acceptance. This assessment includes: a site assessment to take into account any potential issues affecting exposure; checking instrument calibration dates; and a detailed check of the observations (at an automated site this would typically comprise minute-resolution data), including checks with neighbouring stations. At a manual station, verification may also involve a discussion with the observer. Supplementary evidence or observations would be used where possible (e.g., rain-radar).

The SWAT team makes a final decision based on collective expert judgement using all available evidence, based on the general premise that an

observation should be assumed valid unless there is clear supporting evidence to the contrary. The record’s acceptance or rejection is confirmed in as timely a manner as possible, typically within a week.

While SWAT reports are official Met Office documents primarily for internal use, publicly available versions of these documents are available as Weather Event Verification Reports from the Met Office digital library and archive at https://digital.nmla.metoffice.gov.uk/SO_cb95d84f-d807-4818-897c-687c2cdfc80b/.

A1.7 | Area Average Statistics

The climate series and averages for the UK and countries are calculated as area averages derived from the 1 km gridded datasets. Each value is an average of all the individual 1 km grid point values which fall within the UK or country. This approach enables a single statistic to be produced for each area (UK or country) from each grid, despite the fact that the UK’s climate has a very high degree of spatial variation. These

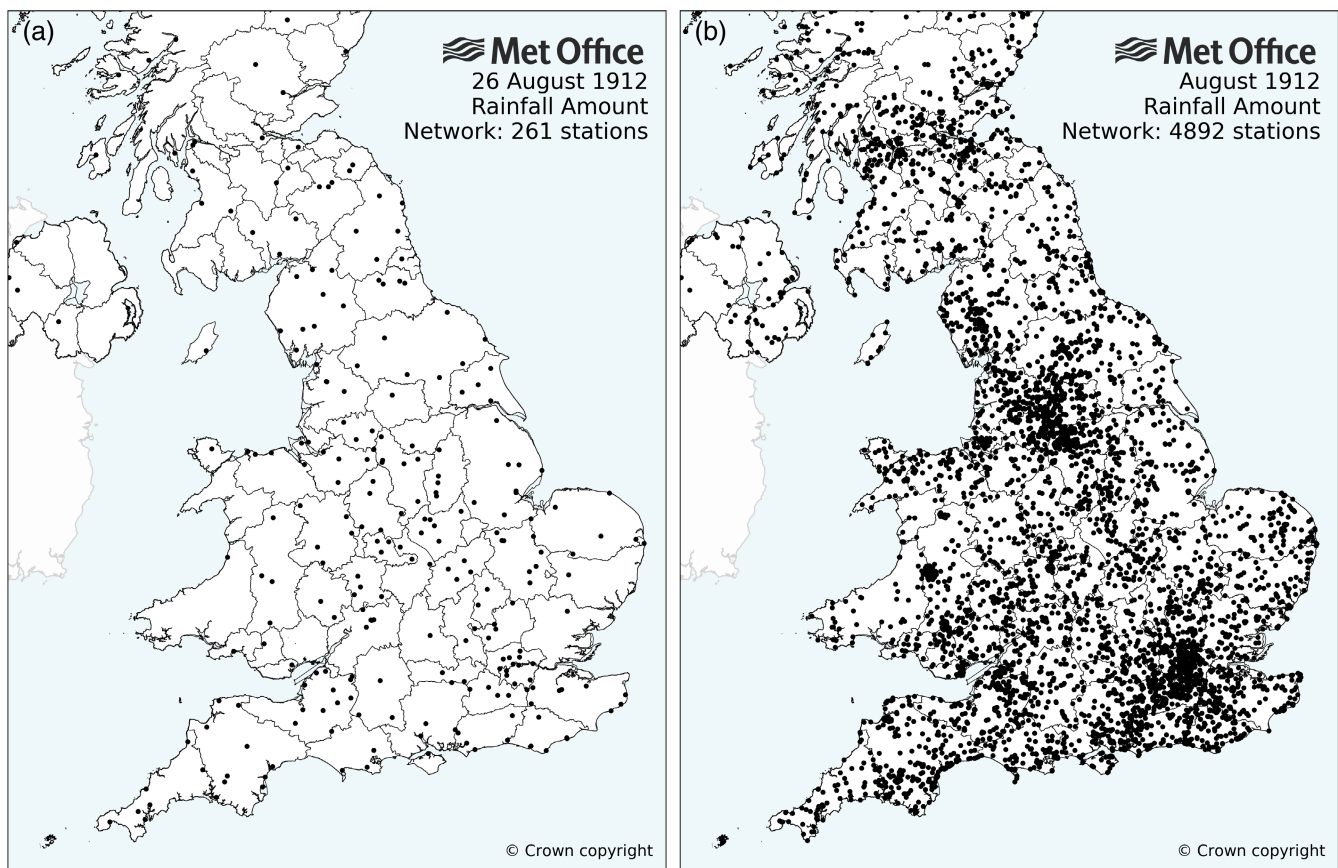


FIGURE A6 | The contrast between the number of stations used in (a) the daily rainfall grid for 26 August 1912 (261 stations) and (b) the monthly grid for August 1912 overall (4892 stations).

statistics are self-consistent through time, without any gaps. These area average statistics are useful for monitoring annual variability, trends and extremes but inevitably may mask considerable spatial variation across the area as illustrated by the anomaly maps.

Some of the analyses and maps within this report are based on a set of county areas for the UK. These comprise ceremonial counties in England, Scottish lieutenancy areas in Scotland, and preserved counties in Wales, defined in 1997. Northern Ireland is divided into six counties. These county areas provide a pragmatic and stable set of areas for long term monitoring, avoiding potential problems with boundary changes for other possible choices of areas which might be routinely updated (e.g., as a result of administrative changes). Area average statistics would otherwise need continual updating to keep in step.

There are 97 county areas in total (Figure A9). These are particularly useful for climate monitoring because they are generally similar in size, although inevitably some areas are much smaller than others. At this size these counties provide area average statistics which usually cover much of the spatial variation across the UK. Rainfall has such a large spatial variability that even at this scale the county areas may struggle to capture the detail. Statistics for county areas will also be much more sensitive to station network density (see Figures A1–A4). More work is required to evaluate the relationship between area size and uncertainty in the area average statistics. Appendix A.2 discusses uncertainties further.

A1.8 | CET

The CET monthly series, beginning in 1659, is the longest continuous instrumental temperature record in the world (Manley 1974). It comprises the mean of three observing stations covering a roughly triangular area of England from Bristol to London to Lancashire; the current stations used for this series are Pershore College (Worcestershire),

Rothamsted (Hertfordshire) and Stonyhurst (Lancashire), although the stations used in this series have changed in the past. A CET daily series is also available from 1772 (Parker et al. 1992).

Following each station change the data are adjusted to ensure consistency with the historical series by analysing periods of overlap between stations, and since 1974 the data have been adjusted to allow for any artificial warming effects due to the expansion of local built-up areas. Parker and Horton (2005) and Parker (2010) have investigated uncertainties in the CET series.

The CET and HadUK-Grid England series are very highly correlated, so the CET series could effectively be considered a proxy for an England series from 1659, although because these are different datasets produced in different ways, some differences are inevitable.

CET is updated annually in the same way as the HadUK-Grid dataset. Detailed release notes are at https://www.metoffice.gov.uk/hadobs/hadcet/releases/cet_releases.html. This report uses v2.1.1.0. Previous updates have included substantial structural improvements to the underlying software and addressing some historical issues. The major update to version 2 of this dataset is described in Legg et al. (2025). Overall, these changes have had negligible impact on the CET series overall (e.g., the rank of individual years).

A1.9 | Sea-Surface Temperature Data

The Met Office Hadley Centre's sea surface temperature (SST) data set, HadSST.4.2.0.0, is a monthly global field of SST on a 5° latitude by 5° longitude grid from 1850 to date. This is derived from a combination of fixed and drifting buoys, ship bucket and engine room intake thermometers and hull sensors. The data have been adjusted to minimize the effects of changes in instrumentation throughout the record. The

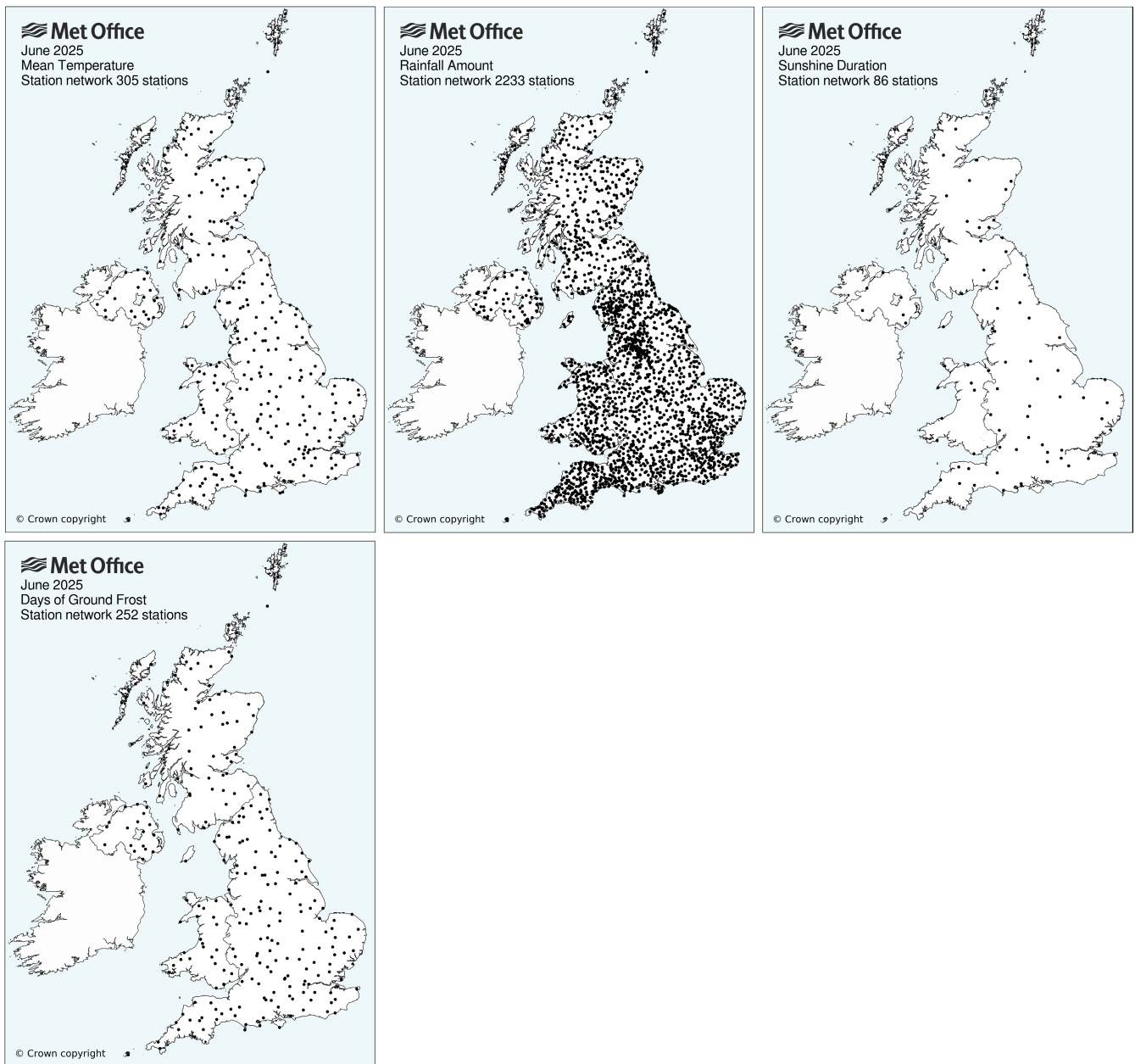


FIGURE A7 | State of the UK observing network in 2025. The maps show the actual number of stations used for the monthly grids for each variable for June 2025. The precise number of stations each day and month will vary depending on data availability, data completeness (for the month), and the amount of suspect data removed.

data set is presented as a set of interchangeable realizations that capture the temporal and spatial characteristics of the estimated uncertainties in the biases (Kennedy et al. 2019; Sandford and Rayner 2026).

The UK near-coast sea-surface temperature series in this report comprises the average of the 5° latitude-longitude grid-cells adjacent to the coast of Great Britain, which at this spatial resolution comprises four grid-cells. Please also refer to the correction note at the start of this report.

The UK near-coast sea-surface temperature series is entirely independent from observations from the UK land network. Some differences between historical trends in these series are apparent, notably in the period pre-1900. However, these differences are also apparent in the CET series which closely follows the UK series (Figure 21). Uncertainties in the SST dataset are larger at smaller spatial scales, for example, UK near-coast. In this report the series is presented back to 1870.

The OSTIA (Operational Sea Surface Temperature and Ice Analysis) dataset uses in situ and satellite data from both infra-red and microwave

radiometers to provide foundation sea surface temperature on a 0.05° horizontal resolution grid (Good et al. 2020). It is a much shorter dataset than HadSST4, so it is less able to identify long-term trends. However, it is gridded at a daily temporal resolution and a much higher spatial resolution.

A1.10 | Rain Gauge Data

Daily rainfall data presented in this report are 0900–0900 UTC totals from either daily or tipping-bucket rain-gauges registered with the Met Office. The majority of these gauges are owned and maintained by the Met Office, the Environment Agency, Natural Resources Wales, SEPA and Northern Ireland Water.

A1.11 | Sunshine Data

The UK's sunshine network comprises two instrument types. The majority are Kipp & Zonen CSD-1 (KZ) automatic sunshine recorders from

automated stations, with the remainder Campbell-Stokes (CS) sunshine recorders at manual stations. An upward adjustment of KZ totals is made to give a monthly 'CS equivalent sunshine'. This ensures that the full sunshine network (automatic and manual) is used while maintaining consistency between the two instrument types. The adjustment is made KZ to CS, not the other way round, because although KZ outnumber CS for the current network, the majority of total historical sunshine observations, by far, are CS. Legg (2014) and references therein provide further details.

A1.12 | Wind Data

Wind speeds are measured by cup anemometers located on a standard 10m height mast. The rate of rotation is proportional to the speed of the

wind. These were introduced by the Met Office for wind measurement at surface stations during the 1950s (Sloan and Clark 2012). At mountain stations, wind speeds are measured by heated sonic anemometers which have no moving parts and reduce potential problems with icing.

A1.13 | Hydrology Data

Standardized Precipitation Evapotranspiration Index (SPEI). The Standardized Precipitation Evapotranspiration Index (SPEI) is a commonly used drought index developed by Vicente-Serrano et al. (2010) and recommended by the World Meteorological Organization for monitoring meteorological droughts (WMO 2024). It provides an indication of the severity and the likelihood of precipitation deficits, or excesses, over given accumulation periods (e.g., 1, 3, 6, 12 or 18-months) and represents the climatic water balance based on the difference between precipitation and evapotranspiration.

Here we use the six-month accumulation period (SPEI-6), calculated using a reference period of 1961–2010 (selected to provide a sufficiently long period to capture the full range of climate variability) to characterize drought conditions over the UK for the six-month period March to August 2025. Potential evapotranspiration is derived from HadUK-Grid temperature using the McGuinness and Bordne approach (Tanguy et al. 2018). The SPEI-6 is calculated for Integrated Hydrological Units (IHUs) areas (National River Flow Archive 2014). IHU areas are main river basins which have one or more outlets to the sea or tidal estuary, or several contiguous river basins with similar topography but separate tidal outlets. They can be used to represent meteorological data such as precipitation at a hydrologically relevant spatial scale.

TABLE A3 | Formulae used for calculating growing degree days above a threshold of 5.5°C.

Condition: daily $T_{\max}$, $T_{\min}$ and T_{mean} above or below $T_{\text{threshold}}$	Degree-day value
$T_{\max} \leq T_{\text{threshold}}$	0
$T_{\min} \geq T_{\text{threshold}}$	$T_{\text{mean}} - T_{\text{threshold}}$
$T_{\text{mean}} \geq T_{\text{threshold}}$ and $T_{\min} < T_{\text{threshold}}$	0.5 $(T_{\max} - T_{\text{threshold}}) - 0.25$ $(T_{\text{threshold}} - T_{\min})$
$T_{\text{mean}} < T_{\text{threshold}}$ and $T_{\max} > T_{\text{threshold}}$	$0.25 (T_{\max} - T_{\text{threshold}})$

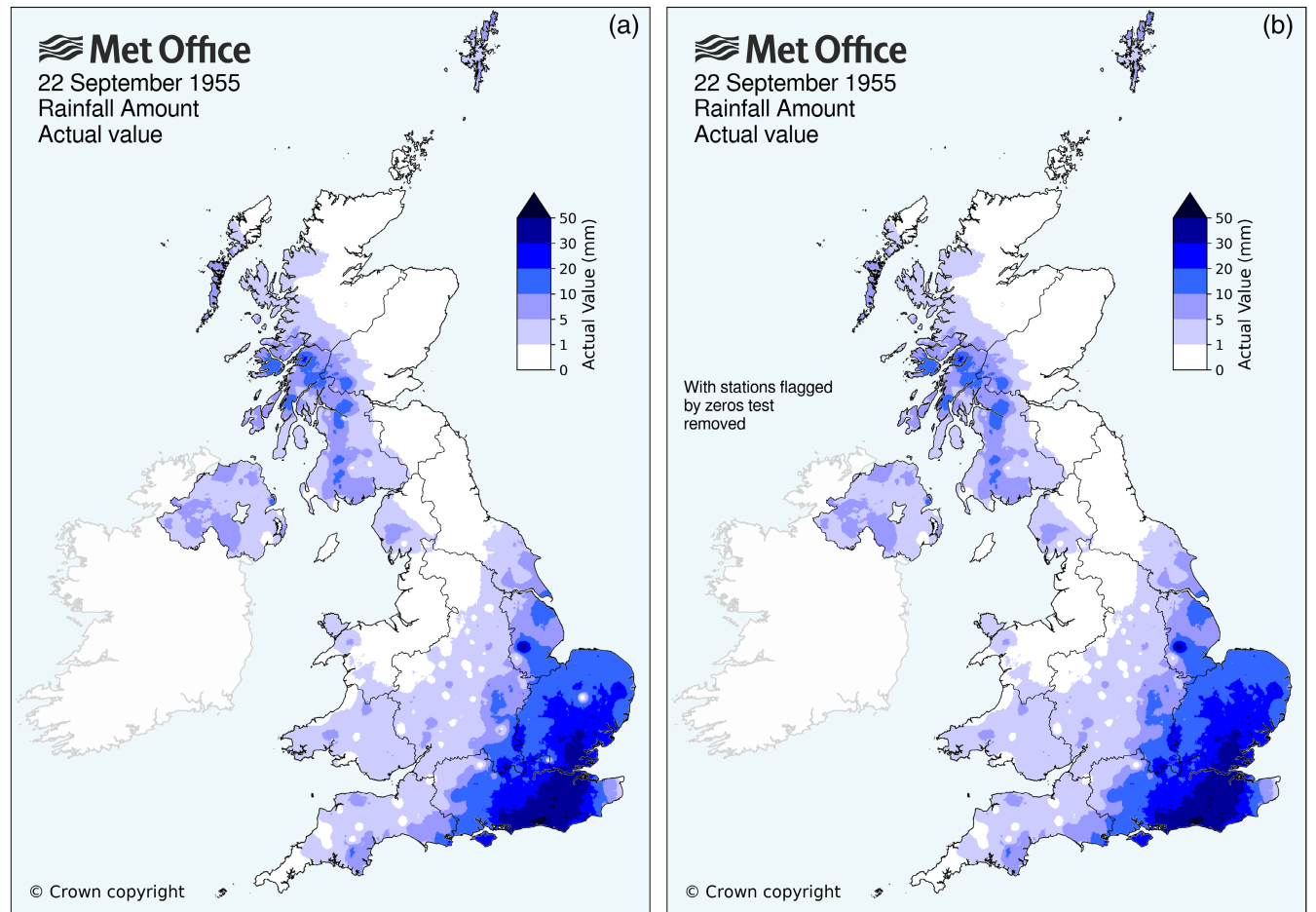


FIGURE A8 | UK daily rainfall on 22nd September 1955 comparing (a) v1.3.1.0 of the HadUK-Grid dataset, ending 2024, and the current version (b) v1.3.2.0, ending 2025, showing 'false zero' values removed from East Anglia and north London.

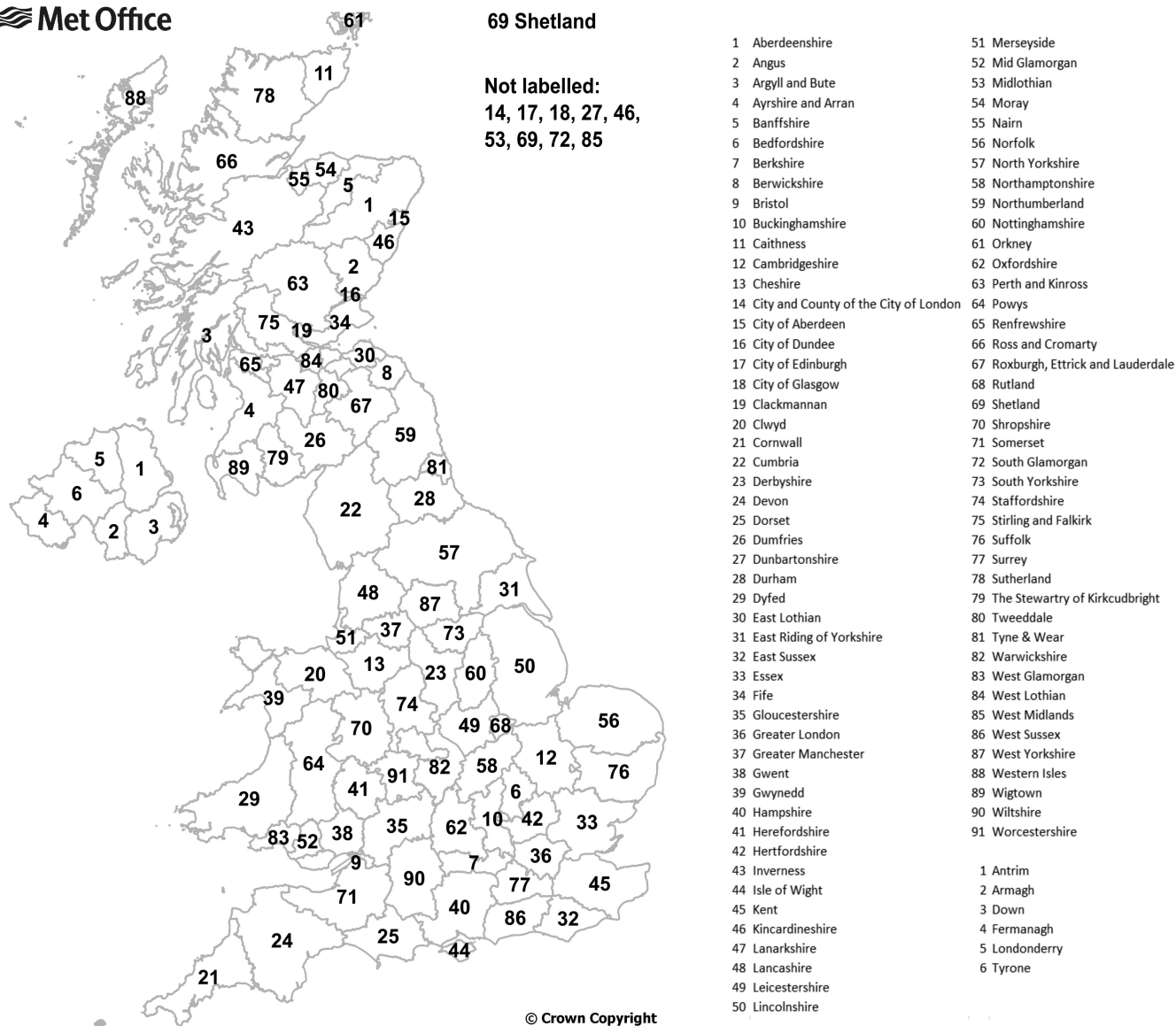


FIGURE A9 | County areas for the UK used in this report. The Isle of Man is excluded.

The monthly climatic water balance, calculated as the difference between HadUK-grid precipitation and temperature-based potential evapotranspiration, is aggregated for each IHU area for each calendar end-month of the six-month accumulation period and fitted to the Generalised Logistic distribution (a three-parameter distribution). It is then transformed to the standard normal distribution with a mean 0 and standard deviation 1. It is this standardization which makes the SPEI comparable across both time and space. Methods are further described in WMO and GWP (2016). SPEI is commonly categorized according to drought severity as shown in Table A4.

Measuring River Flows. Flows are normally measured indirectly from recorded water level (or 'stage'), which is then converted to flow using a stage-discharge relationship, commonly referred to as the rating.

Gauging stations are typically located at sites where a stable hydraulic relationship between stage and flow can be maintained, such as purpose-built weirs or flumes or suitably stable natural channels. In open-channel sites, changes to channel form—such as bed movement following high flows or seasonal weed growth—can alter the hydraulic characteristics and require regular review and revision of the rating (Dixon et al. 2013).

Nationally, there are a wide variety of measurement techniques, and to ensure consistency operational procedures are developing in line with appropriate national and international standards (e.g., British

Standard Institution, BSI). The most common approach at primary gauging stations is continuous water level measurement, historically using float-operated stilling wells, but increasingly using solid-state pressure, index-velocity or ultrasonic sensors. Almost all UK stations now provide routine telemetry, most commonly via the mobile network, enabling real-time transmission of river level data.

Widespread installation of river gauging stations in the UK generally occurred in the 1960s and 1970s, although some stations have much longer records, with operational flow measurements undertaken by the UK environmental regulators (the Environment Agency in England, the Scottish Environmental Protection Agency, Natural Resources Wales and the Department for Infrastructure—Rivers in Northern Ireland). They are archived, collated, quality controlled and published by the National River Flow Archive (NRFA), hosted by the UK Centre for Ecology & Hydrology (Dixon et al. 2013; <https://nrfa.ceh.ac.uk/>).

Flow Analysis. The National Hydrological Monitoring Programme (NHMP) uses a selected subset of 108 NRFA gauging stations (index stations) chosen to provide good spatial coverage across the UK that are updated each month by UK environmental regulators. Data for these stations are checked for significant errors but are deemed provisional until they have passed through the NRFA annual validation process (Dixon et al. 2013). The network focuses on downstream reaches of

TABLE A4 | SPEI severity categories (after McKee et al. 1993).

Category	SPEI range
Extremely wet	$\text{SPEI} \geq 2.0$
Severely wet	$\geq 1.5 \text{ SPEI} < 2.0$
Moderately wet	$\geq 1.0 \text{ SPEI} < 1.5$
Mildly wet	$> 0.0 \text{ SPEI} < 1.0$
Mildly dry	$> -1.0 \text{ SPEI} < 0.0$
Moderately dry	$\geq -1.5 \text{ SPEI} < -1.0$
Severely dry	$> -2.0 \text{ SPEI} < -1.5$
Extremely dry	$\text{SPEI} \leq -2.0$

major rivers, ensuring that the stations are representative of broader river conditions. Sites are selected for their long records (typically over 40 years, with a mean record length = 65 years) and for consistently high-quality data at both high and low flows; they include both near-natural catchments and those impacted by human activities.

For each gauging station, mean flows were derived for the March to August period from daily mean flow records. The mean flows for this period were then transformed to a percentage of average using the standard period 1991–2020 (shown in Figure 61). At each station, the March to August mean flows were then converted to ranked percentiles to compare the position of March to August 2025 against all other years (Equation A1). These were then categorized into seven classes (Table A5), with category thresholds derived from the normal distribution to ensure the majority of flows in each station's record were within the normal range.

$$Q_{\text{Mar-Aug}} = \frac{i}{N+1} \quad (\text{A1})$$

where $Q_{\text{Mar-Aug}}$ is the ranked percentile of mean March to August river flows, i is the rank of the 2025 March to August mean flows, and N is the number of historic complete March–August periods in the period of record.

National Outflow Series. The national outflow series are derived each month from the network of 108 NHMP index stations, representing a broad range of climates and catchments. At the catchment scale, river flows represent the balance between precipitation and evapotranspiration, while also integrating the impact of catchment properties and human activities. Aggregating river flows to the country and national scale enables a wider assessment of water resources and the hydrological impacts of extreme events, such as floods and droughts. Flows from ungauged catchments were assessed using G2G—a spatially distributed hydrological model (Bell et al. 2009). Details of how the gauged flows and ungauged estimates are brought together to derive the national outflow series can be found in Marsh et al. (2015). This report uses the daily outflow series for England from 1961.

Trend Analysis. This assessment examines trends in low flows (Q_{95}) and high flows (Q_{05}) across the 108 NHMP index stations for 1965–2025. The low flow (Q_{95}) is the flow exceeded 95% of the time; the high flow (Q_{05}) is exceeded 5% of the time. Temporal trends in annual indicators (Q_{95} and Q_{05}) were assessed using standard statistical techniques. Annual Q_{95} and Q_{05} flows were derived from daily mean flows, and any year with > 10% missing data was excluded. No gap-filling was applied.

The statistical methods used for the trend analysis are described in more detail in Hannaford et al. (2021) and Murphy et al. (2013). A brief summary is provided below.

The presence and direction of long-term, consistent trends (i.e., ‘monotonic trends’) were evaluated using the Mann–Kendall (MK) test. Trend magnitude was estimated using the Theil–Sen slope estimator

TABLE A5 | Ranked percentile thresholds for assigning flow categories.

Category	Ranked percentile range
Exceptionally high	$Q_{\text{Mar-Aug}} \geq 0.95$
Notably high	$\geq 0.87 \text{ } Q_{\text{Mar-Aug}} < 0.95$
Above normal	$\geq 0.72 \text{ } Q_{\text{Mar-Aug}} < 0.87$
Normal range	$\geq 0.28 \text{ } Q_{\text{Mar-Aug}} < 0.72$
Below normal	$\geq 0.13 \text{ } Q_{\text{Mar-Aug}} < 0.28$
Notably low	$> 0.05 \text{ } Q_{\text{Mar-Aug}} < 0.13$
Exceptionally low	$Q_{\text{Mar-Aug}} \leq 0.05$

(Theil 1950; Sen 1968) and expressed as a relative percentage change over the full record, scaled by the long-term mean (relative to 1965–2025). Because hydrological data is influenced by previous values (e.g., if a river is high today, it is likely to be high tomorrow), we check whether this ‘memory’ affects the trend results. If it does, we use a more robust statistical test which accounts for this memory before deciding whether a trend is significant.

Annual indicators can mask strong seasonal patterns, for example, winter flooding or summer drought signals, and trends can also be sensitive to the start and end years. The 1965–2025 window includes several major droughts (e.g., 1975/76, 1995, 2010–2012, 2018, 2022, 2025) and notable flood periods (e.g., 2007, 2013/14, 2015/16, 2019–21, 2023/24), all of which influence long-term behaviour. Catchment characteristics, land-use change, abstraction and regulation further modulate observed trends alongside climatic drivers.

A1.14 | Sea Level Data

Sea-level changes around the British Isles are monitored by the UK national network of 42 tide gauges, which falls under the authority of the Environment Agency. For more than 100 years, tide gauges have provided measurements of sea-level change relative to the Earth's crust. However, tide gauges are attached to the land, which can move vertically, thus creating an apparent sea level change.

In recent years, the State of the UK Climate report has included a UK sea level index for the period since 1901 computed from sea level data from five of the longest operating stations (Aberdeen, North Shields, Sheerness, Newlyn and Liverpool), which provides a reliable estimate for UK sea level rise, excluding the effect of this vertical land movement. The records from each station are combined after removing the long-term trend from each over a reference period of 1921 to 1990, to account for varying vertical land movement rates across the country. After aggregating the records, the calculated country-wide average rate of 1.4 mm yr^{−1} over the reference period is reintroduced (Woodworth et al. 2009; Bradley et al. 2011).

Creating this index relies on tide gauges following international best practice on operation and quality control to ensure reliability of the data, and long-term stability of the vertical reference frame (UNESCO/IOC 2020). Unfortunately, from 2007 onward, there have been more gaps in observations throughout the network, including for the five long-running stations. The 2025 value is again only based on two sites, as only Newlyn and North Shields provided enough data to generate an annual mean—as was the case for 2024. A UK national report in 2025 for the Global Sea Level Observing System (GLOSS, <https://gloss-sealevel.org/>) provides more information about issues with the network, available at <https://goosocean.org/document/35771>.

The tide gauge data used in this study are distributed by the British Oceanographic Data Centre (BODC, <https://www.bodc.ac.uk>). They are funded by the Environment Agency and have undergone full quality control. Trends in the index have been calculated by fitting linear trends

using the CATS (Create and Analyse Time Series) package described in Williams (2008) which produces realistic estimates of uncertainty by accounting for autocorrelation in the series. Quoted ranges of sea level rise are based on a 95% confidence interval around a best-fit linear trend.

The data for the storm surge analysis are also supplied by BODC and processed for the National Tidal and Sea Level Facility (<https://ntslf.org>) specifically for short-term surge analysis. For surge quality control, sites with possible datum shifts and levelling uncertainties not suitable for long-term trend analyses are included. This provides a larger dataset to analyse the storm surge, but as a result, levels may not be comparable between sites or year-to-year.

Skew surge is the difference between the peak observed tide and peak astronomical tide, which is the part that can be predicted months in advance (Figure A10). It is usually slightly smaller than the 'non-tidal residual' that is sometimes reported, but is a more robust measure of peak impact, being independent of timing (Williams et al. 2016).

Spring tides occur twice each lunar month (29.5 days), in the days following a full or new moon. Neap tides occur 7 days after a spring tide following the first and third quarter moon. However, locally the timing of the spring or neap tide may differ significantly from this due to the local coastal geography and bathymetry.

Modelled skew surges in Figure 66b are based on the NEMO tide and surge forecasting model over the AMM7 domain run operationally by the Met Office. Further technical details are beyond the scope of this report. The skew surge shown is the biggest excess over High Water, or lowest fall below Low Water in the forecast between the dates indicated.

A1.15 | Wild Seed Data From Nature's Calendar

The Woodland Trust's Nature's Calendar has been collating citizen science observations across the UK since 2001 on seed yields for the following 16 species.

Ash <i>Fraxinus excelsior</i>	Beech <i>Fagus sylvatica</i>
Blackthorn <i>Prunus spinosa</i>	Bramble <i>Rubus fruticosus</i>
Dog Rose <i>Rosa canina</i>	Elder <i>Sambucus nigra</i>
Field Maple <i>Acer campestre</i>	Hawthorn <i>Crataegus monogyna</i>
Hazel <i>Corylus avellana</i>	Holly <i>Ilex aquifolium</i>

Horse Chestnut <i>Aesculus hippocastanum</i>	Ivy <i>Hedera helix</i>
Pedunculate Oak <i>Quercus robur</i>	Sessile Oak <i>Quercus petraea</i>
Rowan <i>Sorbus aucuparia</i>	Sycamore <i>Acer pseudoplatanus</i>

A simple 5-point score is used for yields as follows: 1 = no fruit, 2 = meagre, 3 = moderate, 4 = good, 5 = exceptional. Annual mean scores were calculated for each species as a simple average of all submitted observations without any geographical correction. We have regressed the average across the means for all 16 species from 2001 to 2025 against mean April–September CET, England and Wales Precipitation sum (Wigley et al. 1984), and total sunshine hours for England based on the HadUK-Grid dataset for the same period. We have also regressed the annual series for individual species against some other temperature and rainfall series. For a series of 25 years, $R^2 > 0.16$ will be statistically significant.

A.2 | Time-Series, Trends and Uncertainty

A2.1 | Time-Series and Trends

The time-series in this report are plotted on either actual or anomaly scales and include a smooth trend. This means that both annual variability and the longer-term trend (removing short-term variability) can be viewed simultaneously. For some series, there may be few individual years that fall close to this long-term trend and many or even most years may fall well above or well below.

The smooth trend-lines are constructed using a weighted kernel filter of triangular shape, with 14 terms either side of each target point. The kernel defines how much weighting the terms either side of a point in the series have in estimating the smoothed average at that point; in this case the triangular shape using 14 data points either side means that data points further away have less influence. The effect is to smooth out the year-to-year variations and estimate any longer-term variations in the data. The kernel is reflected at the ends of the time series to enable the trend lines to cover the full length of the series. However, this process of reflection will tend to damp any trends at the ends of the time series, so the trend line for the first and last decade of each series should be interpreted cautiously. The method of creating smoothed trend-lines using a 'non-parametric regression' is described in Mudelsee (2019), who describes the advantages and disadvantages of various possible statistical approaches in trend analysis of climate time-series. Further discussion is provided in de Valk (2020).

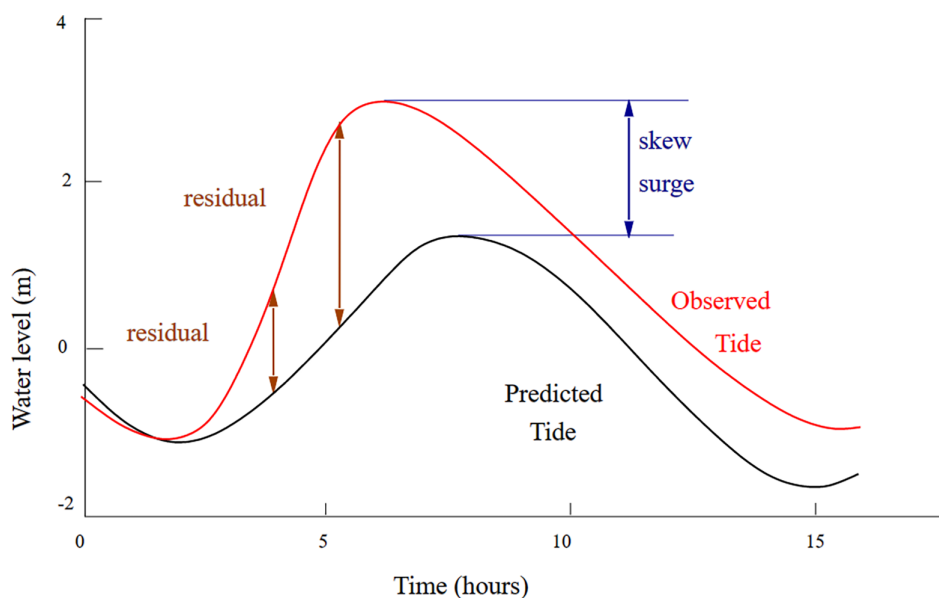


FIGURE A10 | Diagram of skew surge showing the difference between predicted tide and observed tide.

Climate records at individual stations may be influenced by a variety of non-climatic factors such as changes in station exposure, instrumentation and observing practices. Issues of changing instrumentation and observing practices will tend to be of greater importance early in the series, particularly before the 20th Century. In contrast, station exposure issues related to urbanization, which may for example affect temperature-related variables, may be of greater importance in the late part of the series from the mid-20th Century, although this is likely to vary on a station-by-station basis—for example whether a station is located in the centre of a large city or nearer the periphery, the latter being more likely to have changed over time. Identifying and correcting for such factors in climate monitoring is referred to as homogenization. This aims to ensure any biases introduced into the observations caused by these non-climatic factors are removed and the climate series are self-consistent through time. Homogenization may be considered as distinct from quality control—which is the identification and removal of errors in the observations (described in Appendix A.1.5). Some homogenization has been undertaken for some series presented in this report, such as the CET record, and the adjustment of sunshine records described in Appendix A.1.11. For most variables however, the individual station data in this report have not been explicitly homogenized to account for these non-climatic factors.

A2.2 | Uncertainty Estimates

Earlier studies have considered uncertainties in the gridded data and areal-averages based on a 5 km ‘legacy’ gridded dataset previously used for UK climate monitoring (Legg 2011; Legg 2015). Although the HadUK-Grid dataset is at a different resolution, it uses the same method of interpolation. The earlier uncertainty estimates will therefore still be broadly representative, although they will not reflect recent additions to the dataset (particularly the recent addition of Rainfall Rescue data).

The most important source of uncertainty in the dataset is spatial sampling—that is, how the number and distribution of stations in the observing network changes over time. Table A6 lists 1σ uncertainty (standard error) ranges for annual mean temperature, rainfall and sunshine for different periods in the legacy 5 km gridded dataset for the UK and countries. These correspond to: the earliest years in the 5 km dataset where the availability of station data was generally lowest and uncertainty highest; a period in the dataset around the 1960s which for rainfall corresponded to a step increase in availability of station data and decrease in uncertainty (for monthly rainfall this step has been

eliminated) and a comparatively recent period in the dataset. More comprehensive tables covering the full date range can be found in Legg (2015). We have applied a conservative reduction factor of $\sqrt{2}$ to convert monthly uncertainty ranges to annual. Uncertainty associated with individual months of the year cannot be considered independent but it is reasonable to assume that winter half-year biases are likely to be different in nature from summer half-year biases (Parker 2010). Seasonal uncertainty ranges are likely to be similar to monthly uncertainty ranges presented in Legg (2015). The uncertainty estimates in these earlier studies have been adjusted upward to acknowledge other sources of error, for example, observational errors such as random errors in instrument readings, calibration errors or structural uncertainty (the latter implying that alternative methods of analysis may produce slightly different results).

In general, uncertainty ranges for areal averages of monthly mean temperature, rainfall, and sunshine increase in the past as the network density reduces. For monthly, seasonal and annual temperature for the UK and countries, the standard error is less than 0.1°C and consequently the uncertainty is much smaller than the year-to-year variability. For rainfall, the standard error is around 1% or less when the network comprises several thousand rain gauges but approaches 4% in early decades where this number reduces. For sunshine, the standard error can approach 2% (equivalent to approximately 5 min per day, on average).

Uncertainties will be larger for small (county-sized) areas earlier in the series as the number of stations reduces, depending on the spatial distribution, with rainfall affected to a much greater extent than temperature due to the much greater spatial variability. As noted in Appendix A.1.1, the addition of monthly Rainfall Rescue data has transformed the quality of the monthly dataset, and a systematic reappraisal of uncertainty estimates in the 1 km HadUK-Grid dataset, taking into account both this and other recent additions of historical data, is required.

A2.3 | Other Sources of Uncertainty

The summary rainfall statistics for the UK and countries presented in this report are based on an areal average of the rainfall total in mm, rather than an areal average of the rainfall anomaly field as a percentage. This is judged to be the simpler and more readily comprehensible statistic for the majority of users and is directly proportional to the total volume of rainfall across the country. However, it means that climatologically wetter areas of the UK have a greater influence on the overall

TABLE A6 | 1σ Uncertainty (standard error) ranges for annual Tmean, rainfall and sunshine for 5 km resolution ‘legacy’ gridded dataset.

(a) Temperature (°C)					
Year range	UK	England	Wales	Scotland	Northern Ireland
1910–1919	0.04	0.04	0.06	0.06	0.08
1961–1965	0.03	0.03	0.04	0.03	0.04
2006–2012	0.03	0.03	0.04	0.04	0.04
(b) Rainfall (%)					
Year range	UK	England	Wales	Scotland	Northern Ireland
1910–1919	1.2	1.2	3.0	2.8	3.7
1961–1965	0.3	0.3	0.6	0.5	0.8
2006–2012	0.4	0.4	0.9	0.7	1.6
(c) Sunshine (%)					
Year range	UK	England	Wales	Scotland	Northern Ireland
1929–1935	0.7	0.8	1.0	1.0	1.6
1959–1964	0.6	0.8	0.9	0.8	1.4
2005–2012	0.7	0.9	1.1	1.1	1.8

UK summary statistic than the drier areas, rather than all equal-sized areas having equal influence (as would be the case using an areal average of the rainfall anomaly field). This introduces uncertainty because the rank of each year relative to the others may vary depending on which of these two metrics is chosen (Kendon and Hollis 2014). It may also influence any trend in overall UK rainfall if this varies spatially between climatologically wetter and drier parts of the UK.

A further source of uncertainty in the rainfall data is introduced by measurement of precipitation which has fallen as snow. At manually-read rain gauges the observer will measure precipitation equivalent of fresh snow fallen at 0900 UTC, whereas at automatic rain gauges any snow collected will be recorded when it subsequently melts; quality control of these data may then re-apportion this precipitation to previous days. However, inevitably snow measurement can be problematic, for example if wind eddies may carry snow over or blow it into or out of the gauge, in many situations estimation of precipitation from snow may be either underestimated or overestimated. This now tends to be usually less of a problem than during colder, snowier years of earlier decades.

A2.4 | Coefficient of Determination

The coefficient of determination, R^2 , as presented in this report is a measure of the strength of the linear relationship between a predictor variable and a dependent variable, where R is the correlation coefficient, based on a linear least-squares regression. The R^2 value is a statistical measure of how closely the dependent variable can be predicted from the predictor variable. An R^2 value of 1 would indicate a perfect correlation, in which the dependent variable can be predicted without error from the predictor variable. An R^2 value of 0 would mean the predictor variable has no predictive value for the dependent variable. An R^2 value of 0.5 would mean that half of the variance in the dependent variable can be explained by variations in the predictor variable. R^2 values exceeding 0.9 for time-series in this report would indicate that they are very highly correlated. R^2 may also be expressed as a percentage.

A2.5 | Rounding

Values quoted throughout this report are rounded, but where the difference between two such values is quoted (for example comparing the most recent decade with 1991–2020), this difference is calculated from the original unrounded values. For internal processing purposes, unrounded values of area average statistics generated from the HadUK-Grid dataset are stored with a five decimal place precision for all variables and areas.

A3 | Useful Resources

Met Office

This list is not exhaustive.

Annual State of the UK climate publications from 2014, published in the International Journal of Climatology from 2017 <https://www.metoffice.gov.uk/research/climate/maps-and-data/about/state-of-climate>.

UK climate information <https://www.metoffice.gov.uk/research/climate/maps-and-data>.

HadUK-Grid information: <https://www.metoffice.gov.uk/research/climate/maps-and-data/data/haduk-grid/haduk-grid>.

The CET dataset is maintained by the Met Office Hadley Centre and can be downloaded at <https://www.metoffice.gov.uk/hadobs/hadcet/>.

The HadSST4 dataset is maintained by the Met Office Hadley Centre and can be downloaded at <https://www.metoffice.gov.uk/hadobs/hadsst4/>.

Met Office UK Storm Centre for named storms <https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-storm-centre/index>.

Met Office digital library and archive (for scanned copies of Daily Weather Summaries, Monthly Weather Reports, British Rainfall, etc.) <https://digital.nmla.metoffice.gov.uk/>.

Further information on data products available from the Met Office may be obtained by contacting the Customer Centre <https://www.metoffice.gov.uk/about-us/contact>.

External Links

This list is not exhaustive. The Met Office is not responsible for the content of external internet sites.

Access to HadUK-Grid dataset (open access) <https://catalogue.ceda.ac.uk/uuid/789b3065d74a4c948ab05d33556c86d0/>.

Access to HadCET dataset (open access) <https://catalogue.ceda.ac.uk/uuid/f1e8696c6d5746e694fde4d6022e5a36/>.

Access to a copy of the Met Office Midas database is available to researchers on registration at <https://catalogue.ceda.ac.uk/uuid/220af5615218d5c9cc9e4785a3234bd0>.

An open access version of the Met Office Midas database (Midas Open) is available at <https://catalogue.ceda.ac.uk/uuid/dbd451271eb04662beade68da43546e1>.

Centre for Ecology and Hydrology, National Hydrological Monitoring Programme, Monthly Hydrological Summaries for the UK <https://nrfa.ceh.ac.uk/nhmp/monthly-hydrological-summary-uk>.

Centre for Ecology and Hydrology reports for major hydrological events <https://nrfa.ceh.ac.uk/nhmp/occasional-reports>.

Centre for Ecology and Hydrology UK Water Resources Portal for monitoring rainfall, river flows, soil moisture and groundwater <https://ukwrp.ceh.ac.uk/>.

ECMWF Copernicus Climate Data Store <https://cds.climate.copernicus.eu/>.

Environment Agency Water Situation Reports for England <https://www.gov.uk/government/collections/water-situation-reports-for-england>.

European Forest Fire Information System <https://forest-fire.emergency.copernicus.eu/>.

Lamb weather types and UK Jenkinson Gale Index maintained by the University of East Anglia Climatic Research Unit: <https://crudata.uea.ac.uk/cru/data/lwt/>.

North Atlantic Oscillation (NAO) data maintained by the University of East Anglia Climatic Research Unit: <https://crudata.uea.ac.uk/cru/data/nao/>.

National Tidal and Sea Level Facility UK National Tide Gauge Network (owned and operated by the Environment Agency) <https://ntslf.org/data/uk-network-real-time>.

Scottish Avalanche Information Service annual reports of the winter season <https://www.sais.gov.uk/sais-annual-reports/>.

SEPA Portal for real-time rainfall data for Scotland <https://www2.sepa.org.uk/rainfall/>.

UK Health Security Agency heat mortality monitoring reports <https://www.gov.uk/government/publications/heat-mortality-monitoring-reports>.

WMO guide to climatological practices https://library.wmo.int/index.php?lvl=notice_display&id=5668.