

Heatwave, September 2023

In early September the UK experienced a significant heatwave with daily maximum temperatures exceeding 30°C somewhere in the UK for seven consecutive days from 4th to 10th and reaching 31 to 32°C across south-east England. On 10th, Faversham (Kent) recorded 33.5°C, making this, unusually, the hottest day of the year. While the highest temperatures were mostly confined to southern England and Wales, temperatures also briefly reached the high 20s in both Northern Ireland and Scotland. Northern Ireland recorded a new September temperature record of 28.0°C at Castlederg (County Tyrone) on the 8th.

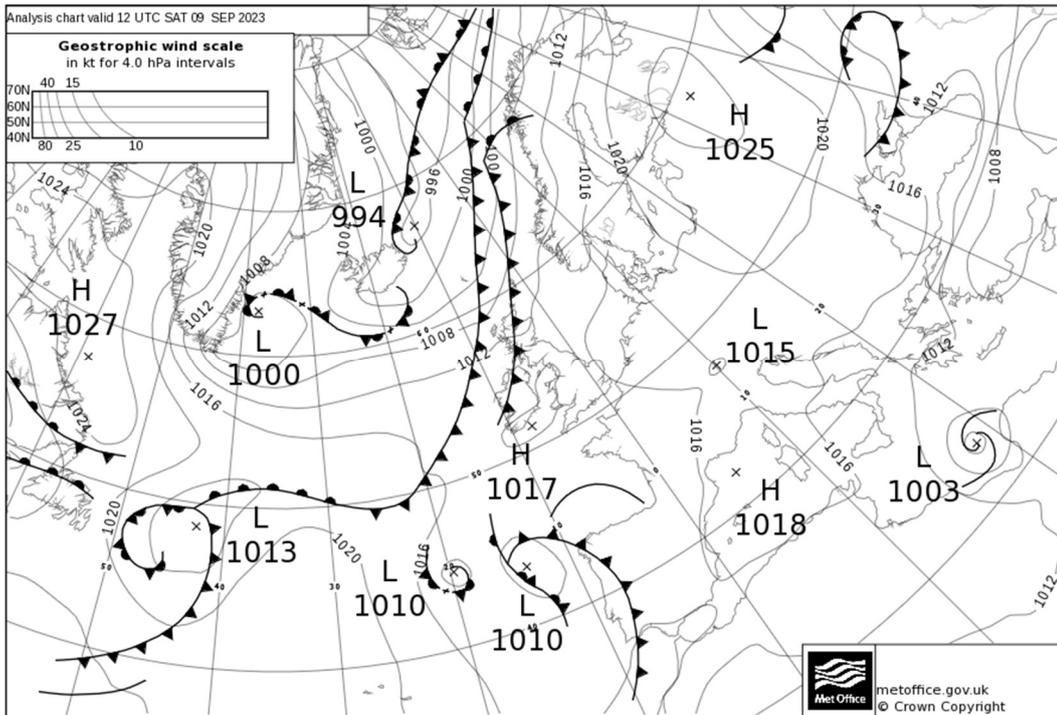
While this heatwave would not have been particularly unusual had it occurred during the high summer months (July or August), this was, for September, the longest run of days exceeding 30°C on record.

Impacts

The spell of fine weather was welcome for many after a prolonged period of unsettled weather lasting through much of July and August. For most of the UK, this was the most significant warm, dry and sunny spell of settled weather since June. However, the heat and humidity made uncomfortable conditions for the elderly and vulnerable, and difficult conditions for sleeping at night. Many escaped to cooler conditions at the coast with beaches packed over the weekend of 9 to 10 September. The DogFest show at Knebworth House in Hertfordshire was cancelled. The thundery breakdown caused various impacts with localized flash-flooding. Thousands of runners taking part in the Great North Run were stranded after the event due to major disruption to the transport network, with the South Shields Metro station closed while water was cleared from the tracks.

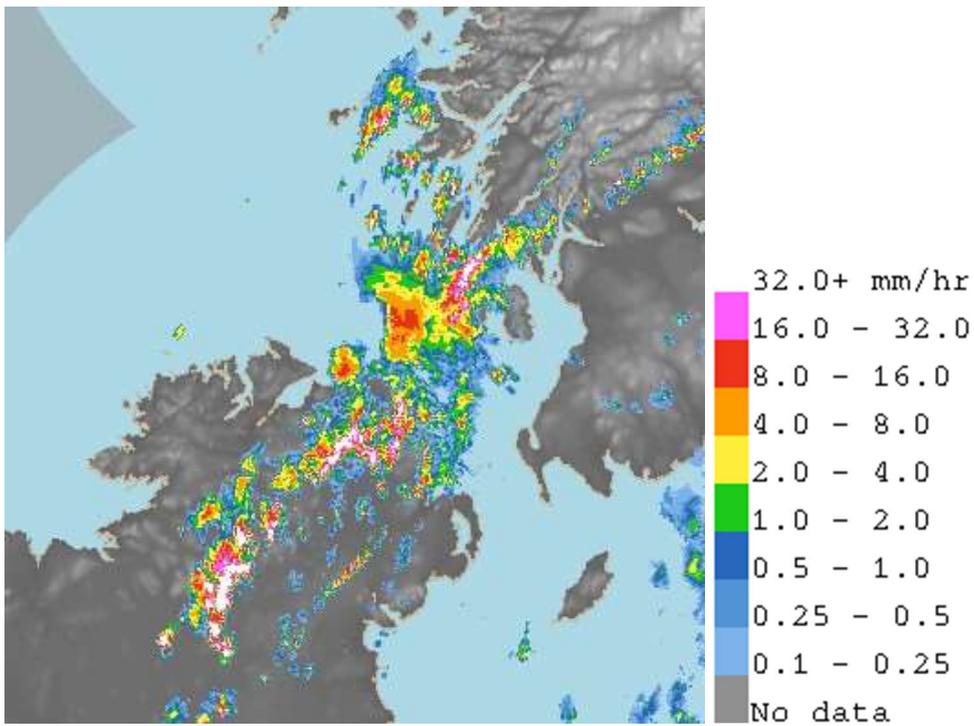
Weather data

The hot, sunny weather was due to the jet stream shifting to the north, allowing high pressure to build across the UK at the start of September. The influence of former tropical cyclone Franklin as it moved into the north Atlantic also amplified this build-up of high pressure. The analysis chart at 1200UTC 9 September 2023 shows high pressure across much of the UK with a light southerly flow drawing a hot Tropical Continental Air mass; this type of pressure pattern being typical of heatwave conditions across the UK. Temperatures on the 9th reached 31 to 32°C fairly widely across south-east England, and 33°C in London.

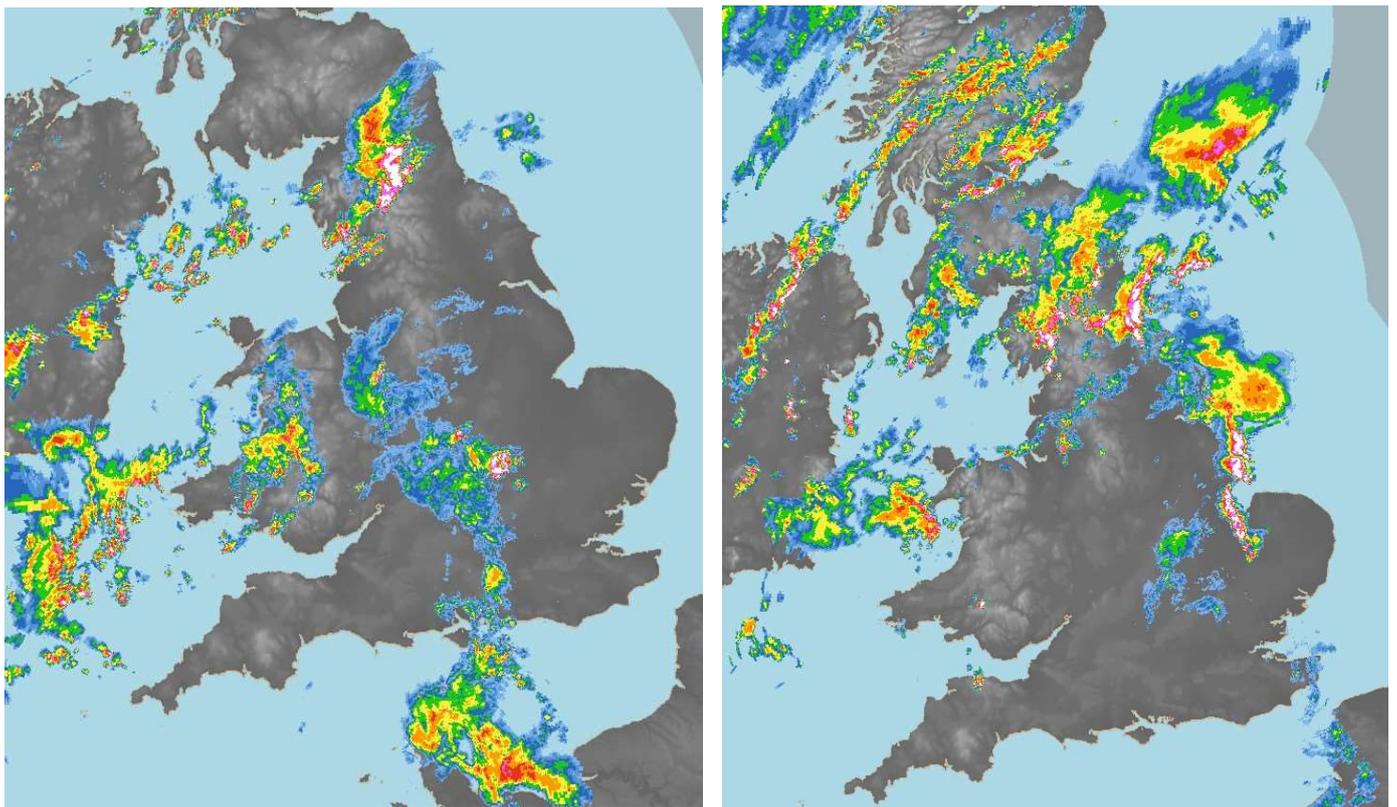


As often happens in the UK, the heat and humidity lead to some intense thunderstorms with lightning and torrential downpours. The rain-radar images below show some of the more intense storms across Northern Ireland on 7 September, and across northern and eastern England on 10 September. The most intense rainfall (areas in white) correspond to rainfall rates exceeding 32mm per hour. Several rain-gauges across Cumbria, County Durham, Tyne & Wear and Northumberland recorded hourly rainfall totals of between 20 and 30mm per hour including, for example, 29.4mm at Harpington Hall Farm and 26.4mm at Darlington, both County Durham.

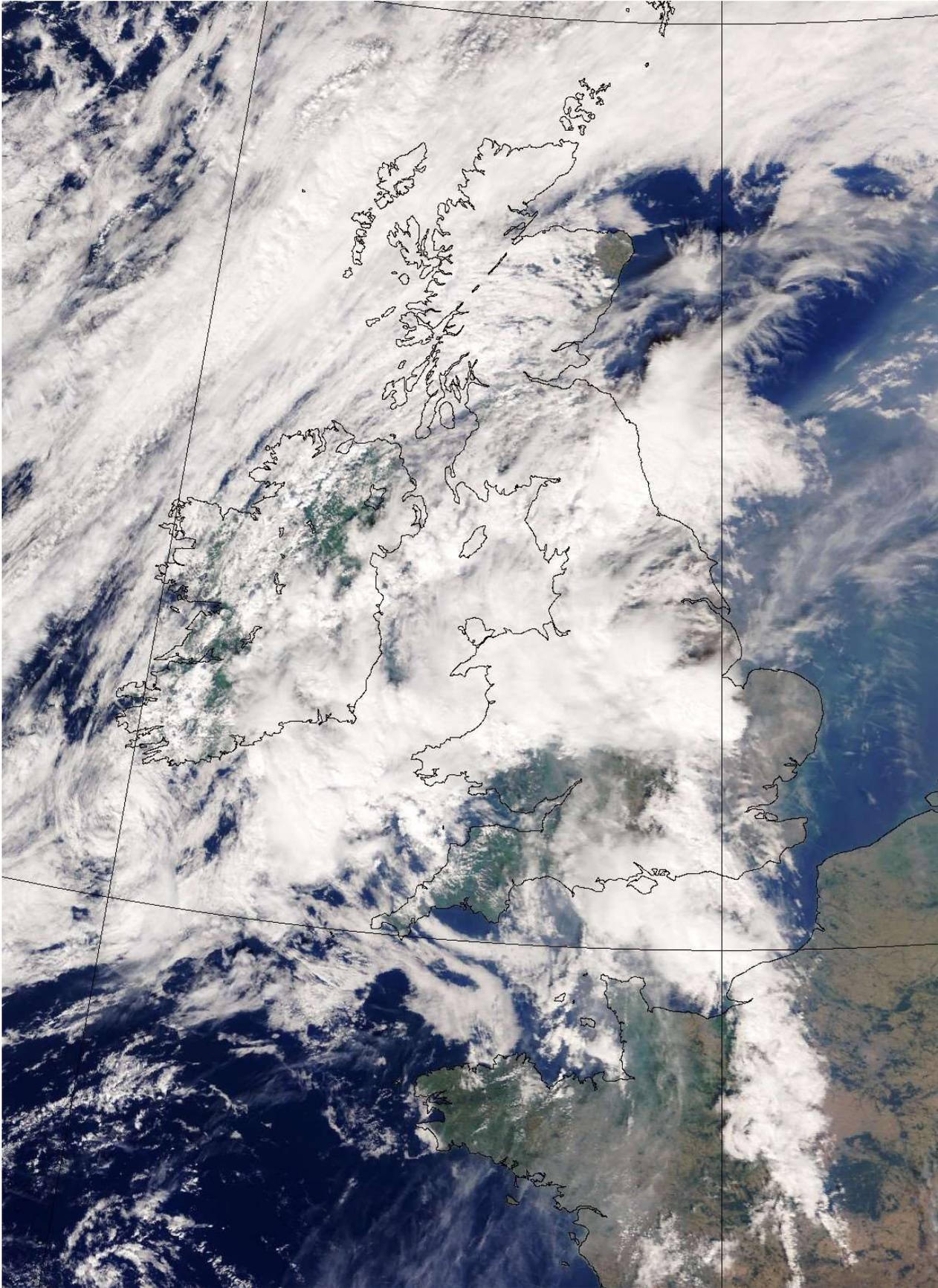
Rain-radar image at 1600UTC 7 September 2023



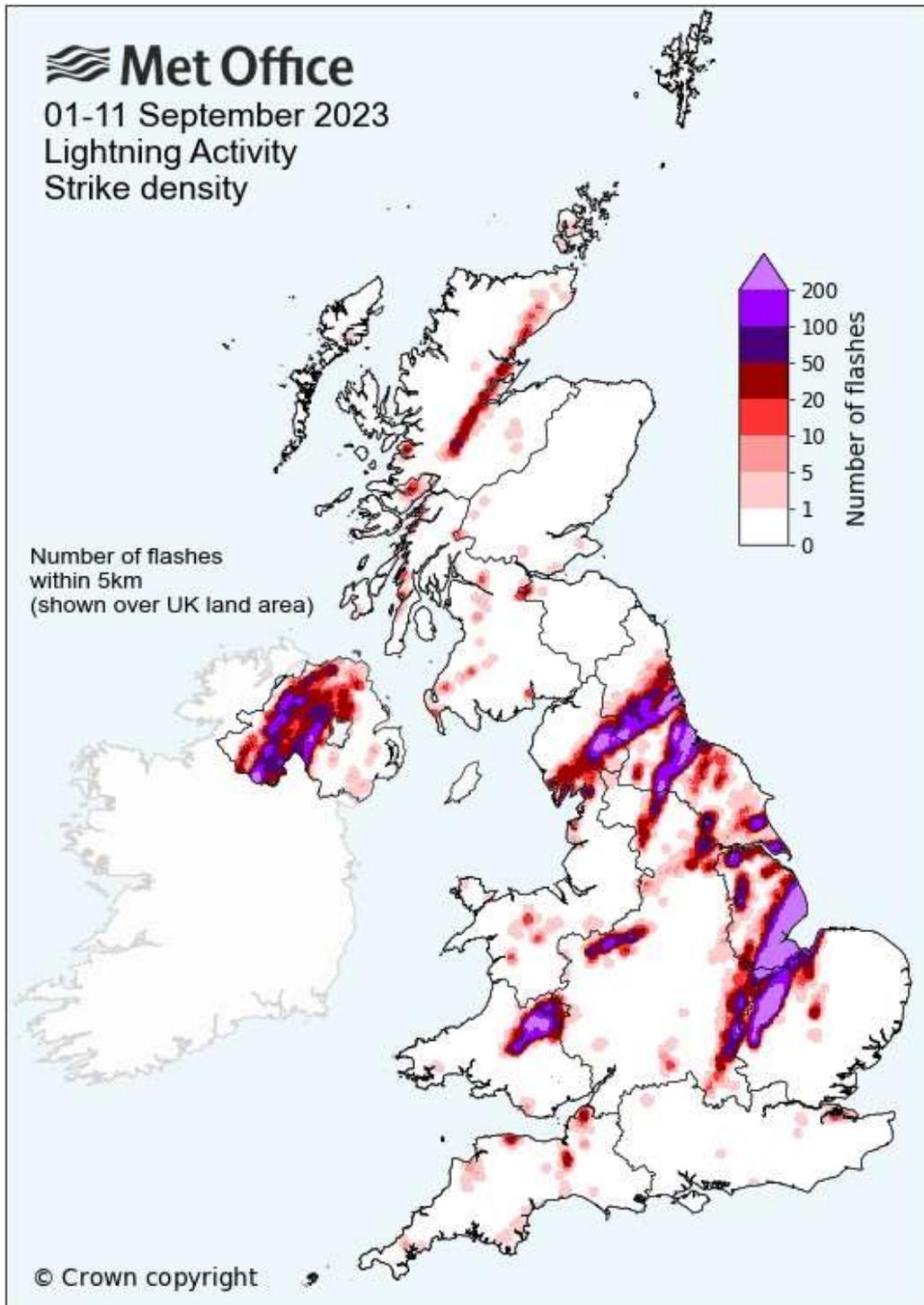
Rain-radar images at (left) 1300UTC and (right) 1700UTC 10 September 2023



The satellite image on the afternoon of 10 September 2023 shows areas of thunderstorms moving north-east across northern and eastern England, with large cumulonimbus clouds reaching the top of the troposphere and spreading outwards to form characteristic 'anvil' shapes. Image copyright Met Office / NOAA / NASA.

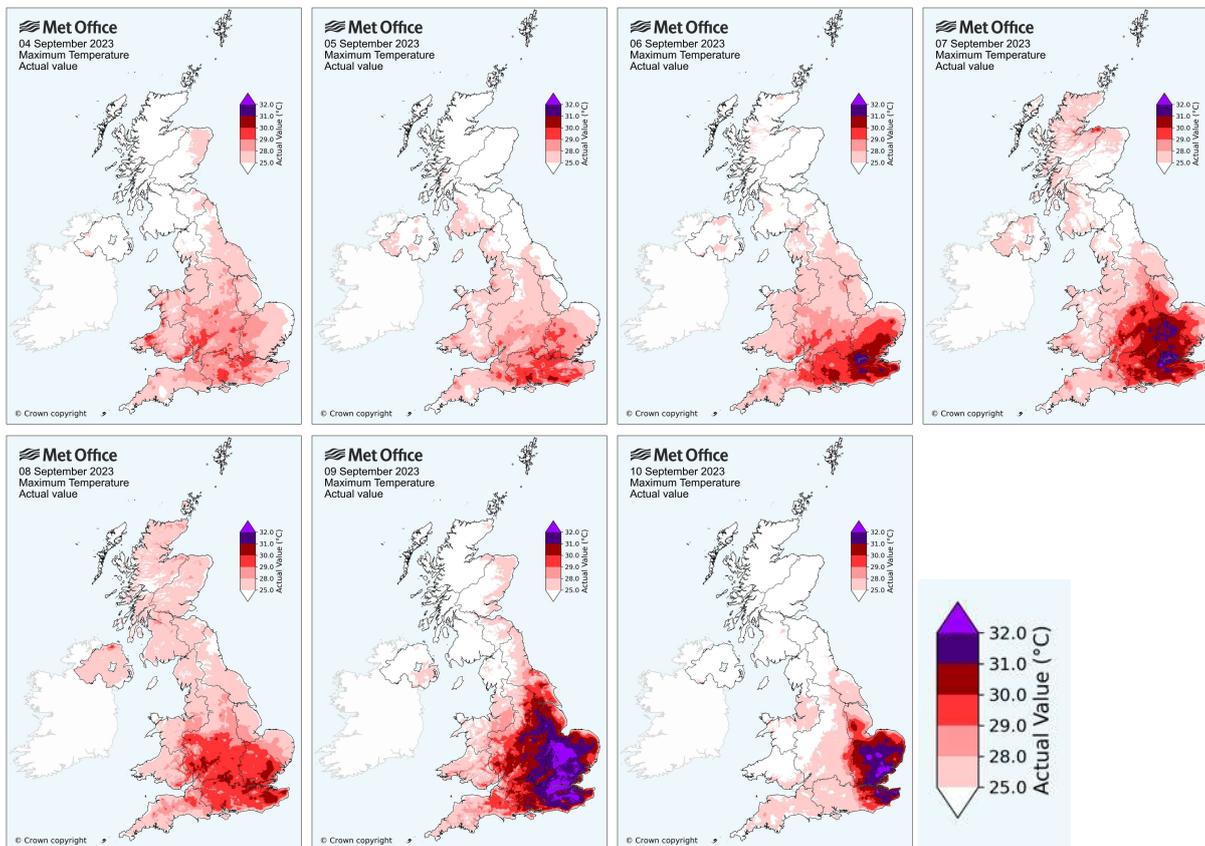


The map below shows lightning strikes recorded across the UK from 1 to 11 September 2023 inclusive, with the majority of these recorded across Northern Ireland on 7 September and northern and eastern England on 9 and 10 September. The map shows the north-easterly track of these thunderstorms as they developed. In total over 75,000 strikes were recorded by the lightning detection network across the UK and around UK near-coast areas over this period.

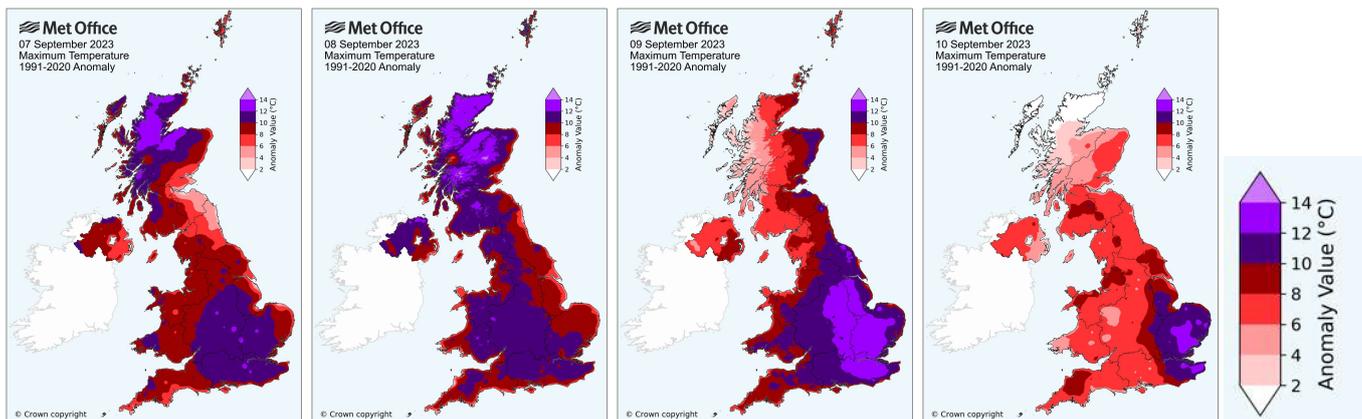


The panel of maps below shows daily maximum temperatures from 4 to 10 September 2023 (Monday to Sunday) indicating the spatial distribution of the hottest areas during the week. Temperatures exceeded 30°C in England on all these dates and briefly in west Wales on 4th, with the warmth also extending to Scotland and Northern Ireland on 7th and 8th. Temperatures in England reached 32°C on 6th, 7th, 9th and 10th.

The seven consecutive days with temperatures exceeding 30°C in the UK was the longest such spell on record with the previous longest runs five days in the Septembers of 1929 and 1911.

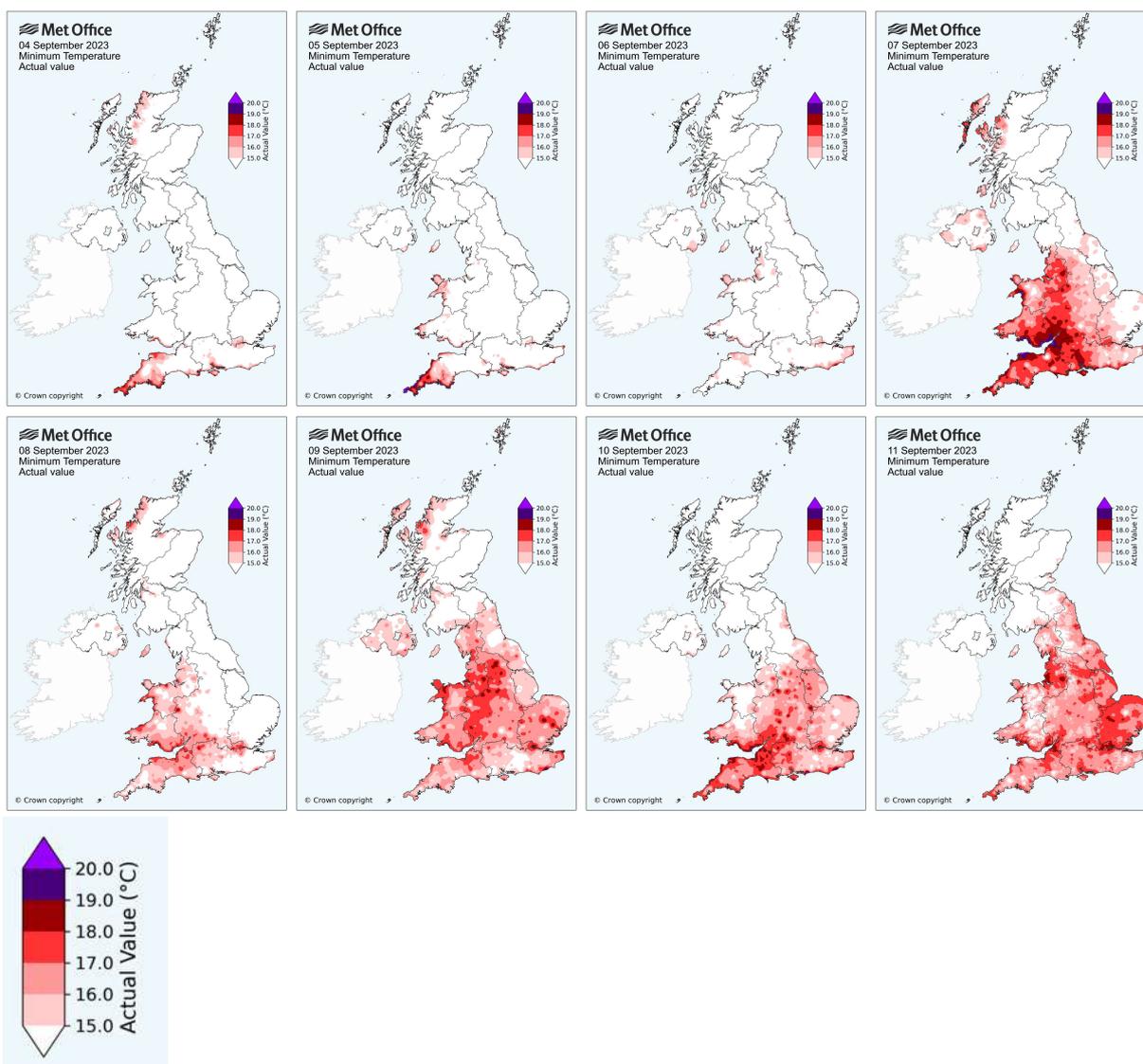


The panel of maps below shows daily maximum temperature anomalies relative to the 1991-2020 September average for the hottest days of the spell on 7 to 10 September 2023. On 7th and 8th, maximum temperatures across northern Scotland reached 27 to 29°C, around 12°C above the September 1991-2020 average in this area (15 to 17°C). On 8th, Castlederg (County Tyrone) recorded 28.0°C, setting a new September Northern Ireland record, exceeding the previous record of 27.6°C at Armagh on 1 September 1906. On 9th and 10th, maximum temperatures across south-east England reached 31 to 32°C, also more than 12°C above the September 1991-2020 average in this area (18 to 19°C).



The highest daily maximum temperature recorded during this spell was 33.5°C at Faversham (Kent) on the 10th. While this is a notably high value it was not record-breaking, falling well short of the UK September record of 35.6°C set at Bawtry (South Yorkshire) on 2 September 1906. A higher value was also recorded only seven years previously (34.4°C at Gravesend (Kent) on 13 September 2016). The September maximum of 33.5°C exceeded those of June (32.2°C), July (30.2°C) and August (28.4°C) and was the UK’s highest temperature of 2023. This has only occurred in September on four previous occasions in 2016, 1954, 1949 and 1919.

The panel of maps below shows daily minimum temperatures from 4 to 11 September 2023. At first, the warmest nights occurred around coastal areas of southern England and Wales – with the sea typically at its warmest at this time of year and the increased levels of humidity due to the proximity of the coast helping to hold up night-time temperatures. However, later in the spell high daily minimum temperatures occurred more widely across England and Wales, with temperatures remaining above 17 or 18°C. A few locations recorded a ‘tropical night’ with the daily minimum temperature exceeding 20°C, for example 20.2°C at Mumbles Head (Swansea) on 7th and 20.3°C at Hastings (East Sussex) on 10th.



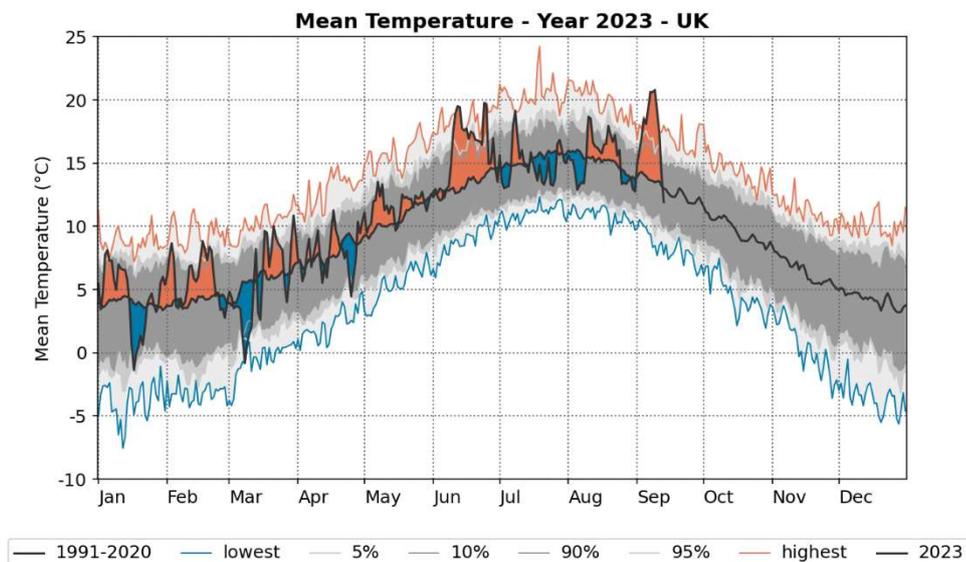
The chart below shows UK average daily mean temperature for 2023 compared to the daily 1991-2020 long term average. The natural variability in the UK’s weather means that every year temperatures fluctuate above and below average for different periods through the course of the annual cycle: every year is different. What makes 2023 unusual is that the two warmest spells of the year occurred in June and September – with four of the ten warmest days of the year in June and five in September, one in July and none in August. Unusually, June was also the warmest

month of the year, with the last time this occurring in 1966. So far there has been only one year in the UK series from 1884 in which the warmest month of the year has been September - 1890.

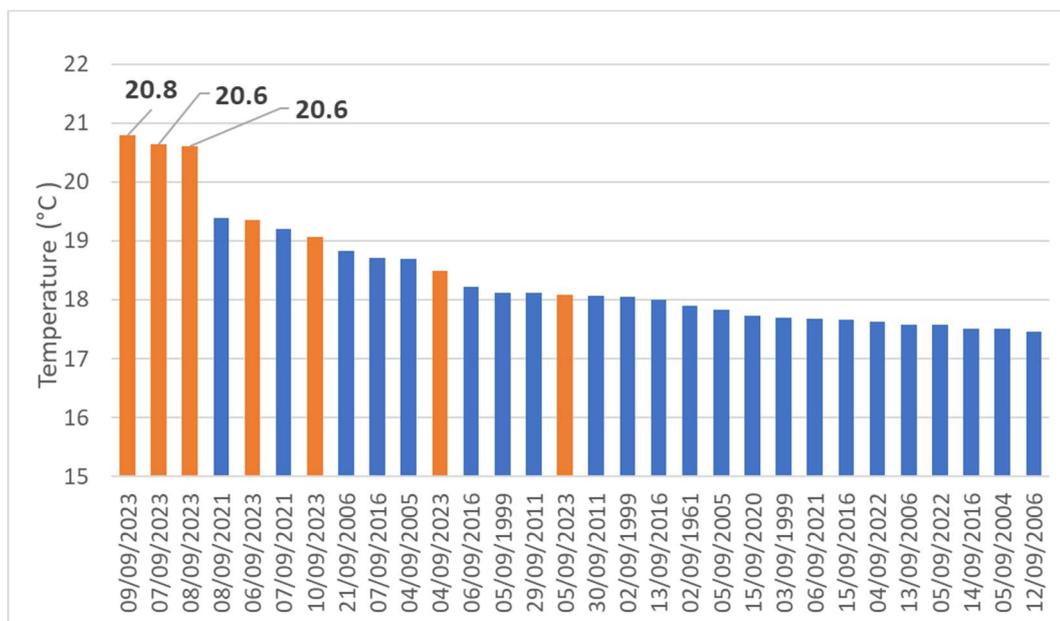


Source: HadUK-Grid 14/09/2023 12:05

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The September 2023 heatwave saw three consecutive days from 7th to 9th having a UK daily mean temperature exceeding 20°C. The following chart shows that these were the UK's three warmest September days on record, by a significant margin, based on a daily series from 1960. Note however this statistic must be interpreted cautiously because it is highly probable that one or more September days prior to 1960 may have been warmer. In particular, on 1 September 1906 the temperature exceeded 32°C as far as northern Scotland with (32.2°C at Gordon Castle, Moray) and 32 to 33°C widely across England. In contrast to September 2023, the Met Office Monthly Weather Report for September 1906 states *'It is not a little remarkable that the abrupt change from the very hot to much cooler conditions was not accompanied by a thunderstorm in any part of the country.'*



This heatwave set a significant number of new September daily maximum temperature station records, as listed in the table below for stations with 100+ year record lengths. In addition, Stornoway Airport, Western Isles and Durham each recorded their highest September temperature since 1 September 1906 (respectively 22.9°C on 7 September 2023 and 28.4°C on 9 September

2023), while Sheffield and Oxford each recorded their highest September temperature since 8 September 1911 (30.5°C on 9 September and 30.8°C on 7 September 2023). Bradford (27.6°C on 9 September), and Morpeth, Cockle Park, Northumberland (26.7°C on 9 September) also equalled their previous station records.

Several long running stations also set September daily minimum temperature records as listed in the table below. In addition, Sheffield recorded its highest daily minimum temperature since 8 September 1898 (18.1°C on 9 September 2023).

New September daily maximum temperature records for 100+ year stations

Station	Maxtemp (°C)	Date	Previous record (°C)	Previous date	Record length (years)
Armagh, County Armagh	27.9	8 Sep 2023	27.6	1 Sep 1906	157
Lerwick, Shetland	20.7	8 Sep 2023	19.4	7 Sep 1953	109
Wisley, Surrey	33.1	9 Sep 2023	31.1	4 Sep 1929	109
Balmoral, Aberdeenshire	27.4	8 Sep 2023	25.8	8 Sep 2021	109
Wick Airport, Caithness	25.2	8 Sep 2023	23.9	7 Sep 1953	109
Woburn, Bedfordshire	31.3	7 Sep 2023	30.7	13 Sep 2016	108
Cranwell, Lincolnshire	31.6	9 Sep 2023	30.0	5 Sep 1949	107
Leuchars, Fife	26.8	9 Sep 2023	26.6	5 Sep 1999	100

New September daily minimum temperature records for 100+ year stations

Station	Mintemp (°C)	Date	Previous record (°C)	Previous date	Record length (years)
Stornoway Airport, Western Isles	15.8	9 Sep 2023	15.0	26 Sep 1895	150
Bradford, West Yorkshire	18.3	9 Sep 2023	17.7	7 Sep 2016	114
Buxton, Derbyshire	16.8	9 Sep 2023	16.1	5 Sep 1949	102

Climate change has increased air and sea surface temperatures across the UK and Europe, meaning that while a climate attribution analysis has not yet been conducted for this specific event the existing scientific evidence would suggest that it is likely temperatures were higher than they might otherwise have been under the same weather pattern in a world without human-induced climate change. As our climate continues to change, it will tend to further increase the likelihood, duration and intensity of heatwave events experienced across the UK. [Met Office research](#)¹ has also shown that climate change is expected to increase the frequency of summer-type weather regimes during the Autumn in the UK.

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¹ [Future summers could last longer hints Met Office research | Official blog of the Met Office news team](#)