**Weather report for 2023**

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**1 Introduction**

No natural system is so simple that it can be explained away easily and climate is certainly complex with many complicated inputs and feedbacks. Nevertheless, the vast majority of scientists are sure that global warming is being driven by human activity. There may be some minor and diminishing uncertainty around by how much our activities are creating the climate issues, but our sheer volume of energy use, agricultural practices and a whole host of human activity, especially in the west, are driving us to an uncertain and potentially very dangerous future. The changes we are witnessing tell us that the climate crisis is already upon us and we must all do what we can. There is still reluctance from those who have the power and are well briefed to take the difficult decisions and to start to put the situation right before it is beyond redemption. The time for prevarication is over. This year the global population has passed 8 billion people, with countless species of flora and fauna. In order to support that growing number we need to take our global and regional climate very seriously.

On the global scale The World Meteorological Office (WMO) reported that “The shift from cooling La Niña to warming El Niño by the middle of 2023 [was] clearly reflected in the rise in temperature from last year”.

The European Centre for Medium-Range Weather Forecasts (ECMWF) confirmed the same, that the ‘high temperatures from June onwards led to 2023 becoming the warmest year on record by a large margin. The temperature was close to 1.5°C above the pre-industrial level, according to the EU’s Copernicus Climate Change Service (C3S) implemented by ECMWF’.

WMO Secretary-General Prof. Celeste Saulo said we are clearly in new territory with regard to our climate, and whilst the introduction of the shift from cooling La Niña to warming El Niño by the middle of 2023 took place, there is little doubt that human activity is contributing to climate change and we have to make drastic reductions in greenhouse gas emissions and accelerate the transition to renewable energy sources as soon as possible.

The Bristol weather station that has been in the area for 30 years now and shows the city’s rising temperatures making the point that locally we are not shielded from larger scale and global trends.

There has been an amateur weather station in Totterdown, Bristol since 1993 and it is from here the weather data has been collated and analysed in this article. You can look at the data and follow the weather as it is updated via the internet at <http://www.bristolweather.org>. The weather station is situated in Bristol’s urban area and with that in mind, there are influences placed upon the data that would not be the case in a more rural setting. Since 2005 the weather station data has largely been collected automatically but the author still manually checks the daily rainfall amount collected even though rainfall is also measured automatically. The historical weather data used in this article comes from a variety of locally published historical sources. Some of the data is from as early as 1853 but there are time gaps and site differences which are too numerous to detail here. Broadly speaking the author has collated continuous records of rainfall and temperature for the Bristol area since 1882 and 1891 respectively; periods of 142 and 133 years.

To see further information on the different date periods and the sources used see <http://www.bristolweather.org/Historical.htm>. There are also several other good web sources of weather data in the Bristol region. The 30 year averages used in the text are a standard Meteorological Office device to easily denote the ‘longer term’ weather ‘normal’. This may not be a perfect method but it is well understood and widely used for comparison with the current data. The present 30 year period being used as the countrywide standard is 1991-2020 and is the one referred to unless otherwise stated.

One of the effects of urban sited weather station are the elevated temperatures especially at night and early morning when compared with a rural setting. Even though the site is not ideally situated, and is ‘amateur’. It is probably correct to say any long term data set is of value, if from one place, so time series comparisons can take place.

**2 Annual data**

2023 can be summed up as a warm and wet year.

**2.1 Temperature**

The annual average temperature for 2023 was 12.6°C. It was the second warmest since continuous records started in 1891 for the Bristol area. 2022, with an annual average temperature of 12.7°C, was the warmest. The 30 year average temperature for the city is 11.6°C. For a recent historical comparison the 30 year average for Bristol between 1961 and 1990 was 10.3°C. The current warming trend is obvious.

**Table 1** below lists the 10 warmest years in Bristol. All ten have occurred in the last 35 years and so one has yet more evidence that the climate, not just globally, is warming compared to the recent past. In addition to the continuous data the author has found data from Dr Burder of Hotwells dating from 1853 when he recorded the annual average temperature of 8.2°C. Evidence suggests that the summer of 1853 was particularly cool and Hotwells might be generally cooler than Clifton, however, it does give a good indication of where we are heading, when in 2023 we had an average annual temperature 4.4°C above that figure.

|  |
| --- |
| **10 Warmest Bristol annual average temperatures 1891-2023** |
| **Year** | **Temperature °C** | **Rank (Hottest first)** |
| 2022 | 12.7 | 1 |
| **2023** | **12.6** | **2** |
| 2014 | 12.5 | 3 |
| 2020 | 12.4 | 4 |
| 2011 | 12.2 | 5 |
| 2018 | 12.1 | 6 |
| 2017 | 12.1 | 6 |
| 1997 | 12.1 | 6 |
| 1990 | 12.1 | 6 |
| 1989 | 12.1 | 6 |

**Table 1**: 10 highest annual mean temperatures, Bristol.

**Fig. 1**: Bristol Average temperatures 1891-2023

The graph (**Fig. 1**) puts a visual representation on these rising temperatures since 1891. It should be remembered that earlier records for the city are from different parts of the city, with different equipment and different recorders. One should therefore expect some minor differences and inconsistencies but I think the overall picture is clear. There seems to be a fairly consistent variation year on year for the average temperature up until the late 1960’s, early 1970’s. From then on there appears to be a rising variation. Fig. 1 is overlaid with a linear regression line running through the whole of the continuous average temperature series. One can see that the calculation starts at around 9.6°C and ends in 2023 at about 11.5°C. Not only is this rise significant in itself it also have implications for agriculture, vegetation, migration and all animals. Ironically it is we humans in wealthy parts of the world, in northern latitudes, that are probably the best placed to feel minimal consequences from the industrialisation and CO2 emissions that are one of the main drivers of these temperature rises.

|  |  |  |  |
| --- | --- | --- | --- |
| Month | Average monthly temperature (1991-2020) °C | Average temperature 2023 °C | Difference from average °C |
| JAN | 5.7 | 6.3 | 0.6 |
| FEB | 6.0 | 7.4 | 1.4 |
| MAR | 8.0 | 8.4 | 0.4 |
| APR | 10.6 | 10.0 | -0.6 |
| MAY | 13.7 | 14.9 | 1.2 |
| JUN | 16.6 | 19.3 | 2.7 |
| JUL | 18.5 | 17.2 | -1.3 |
| AUG | 18.1 | 17.8 | -0.3 |
| SEP | 15.5 | 18.4 | 2.9 |
| OCT | 12.0 | 13.9 | 1.9 |
| NOV | 8.1 | 9.0 | 0.9 |
| DEC | 6.1 | 8.6 | 2.5 |
| Average | 11.6 | 12.6 |  |
|  |  | accumulated monthly difference °C = | 12.3 |

**Table 2**: monthly temperature anomalies for 2023 compared with 30 year averages.

It is interesting to take all the anomalies from the monthly average temperatures for 2023 (**Table 2**) and compare them with the recent 30 year average for Bristol. Even with three months showing a lower than average temperature (April, July and August) the positive anomaly still adds up to a total of 12.3°C. June and September’s large positive temperature anomalies both wipe out all the three month’s small negative temperature anomalies.

**Fig. 2**: Bristol 2023 monthly average temperatures compares with 30 year average.

With regards to the average monthly temperature, compared with the 30 year average, one can see from **Fig. 2** (and Table 2) that it tended to be the autumn months that saw the largest positive anomalies. Particularly noteworthy were September (+2.9°C), June (+2.7°C) and December (+2.5°C).

**2.2 Annual Rainfall**

You may have noticed how wet it was and in fact the annual rainfall for Bristol in 2023 was 1247.6 mm making it the 2nd wettest year since the annual rainfall data started in 1853. The wettest year was 1315.4 mm in 2012. The 30 year average for the city is 913.8 mm so 2023 represents 137% of the average, 400 mm above the average.

The measurable rainfall duration for 2023 was 566 hours or 6.5% of the year. This measurement requires at least 0.2 mm to have been recorded. There were 224 days when the rainfall exceeded 0.2 mm. There were five 24 hour periods (09:00-09:00 GMT) when rainfall was greater than 25 mm. There were 104 days (excluding ‘trace’ which is less than 0.1 mm) without rainfall in 2023. The longest period without rainfall was for 21 days May 20th to June 9th.

Regarding the annual rainfall the graph below (**Fig. 3**) shows that there is in fact continuous annual data for the city of Bristol goes right back to 1853. Unfortunately some of the early monthly data is missing. 171 years is a good long period with which to be able to look back and analyse trends. It is worth noting that some UK sites go back into the 18th century and the Bristol record is from several different sites around the city so some care should be taken when drawing very specific conclusions about the rainfall and possible trends. From the graph (Fig. 3) below, despite the obvious inter annual variability of the annual rainfall; there is an almost horizontal dotted linear regression trend line. This demonstrates that overall there is little movement, of either an upward or downward trend, in the total annual rainfall record for Bristol. The ten year solid black line moving average shown on Fig. 3 shows some shorter term rises and falls of rainfall within the dataset. In more recent years, perhaps from the early 1990’s, there has been a short term trend of wetter years. Earlier in the 1890’s and again in 1960’s and 70’s there were drier periods. From the graph it is easy to see the wet outliers: 1882 with 1219.9 mm, 1903 with 1200.7 mm, 1924 with 1246.5 mm, 2000 with 1241.9 mm, 2012 with 1315.4 mm and 2023 with 1247.6 mm.

**Fig. 3**: Bristol annual rainfall 1853-2023 with 10 year moving average and linear regression line.

The graph below (**Fig. 4**), depicting the monthly rainfall for 2023 shows striking anomalies with some very wet months in excess of their 30 year averages. The 30 year average for Bristol broadly shows a wet autumn and winter and a drier spring and summer. April is usually the driest month whilst December is the wettest. Summer rainfall data can be misleading, for example in an essentially dry month, the monthly rainfall can be high if an intense thunderstorm occurs causing a heavy downpour and short term flooding, with several millimetres of rainfall falling in a short period of time. This tended not to happen in 2023, even though July was much wetter than usual there were no days of thunderstorms recorded. March 2023 was the wettest since records began in 1853 with precipitation being 305.9% the 30 year average for the month, though there are 13 early March’s with data missing. December 2023 was the wettest month in terms of quantity of rain with 199.7 mm which is 196.2% of its 30 year average.

**Fig. 4**: 2023 Bristol monthly rainfall compared with 30 year average.

**Fig. 5** shows, as expected, a rainfall duration with a similar pattern to the rainfall graph (Fig. 4). This shows March, July and December standing out, and to a lesser extent April, which usually has little rain in our area.

**Fig. 5**: Monthly rain duration Bristol compared with 2013-2023 average.

**2.3 Wind and Pressure**

2023 was a windier year than 2022 with an average wind speed of 4.6 mph but it was still below the average of 5.4 mph which is the average from when records began in 2005. There were more ‘calm’ days in 2023 at 4.9% than the average percentage (2005-2022) of 1.4%, but they were less than the 7.1% recorded in 2022. A calm day is when the average daily wind speed is less than 0.5 mph. There was no wind speed gust greater than 50 mph 2023. The highest gust was 44 mph on 10th April.

The daily wind direction in **Table 3** below is broken down into 8 main compass points by month. One fairly consistent weather statistic is the annual wind directions for Bristol. In 2023 this follows the typical pattern of the South Westerlies (SW & WSW) being the dominant wind direction in our region. South Westerlies accounted for 47.9% of the total days with North Easterlies accounting for 17.5% of the total wind directions. This data is calculated automatically by the weather station’s software. The annual average pressure of 1012 mb was the lowest since 2012.

**Table 3**: Daily and monthly wind direction by month 2022

As noted earlier to some small extent 2023 saw a slight increase in wind speeds but in the graph below, **Fig. 6**, 2023 still lags behind the longer term average with regard to monthly average wind speeds. Only July and December 2023 saw above average monthly wind speeds whilst February, April to June and August to October saw wind speeds below the longer term monthly averages.

**Fig. 6**: Monthly average wind speeds with longer term average 2005/2006.

**Fig. 7**: Average monthly wind speeds mph Bristol 2006-2022

**Fig. 7** shows all the average monthly wind speeds starting in May 2005. The added linear regression line on the graph shows a clear lowering of wind speeds as we come into to the current period. In the earlier part of the time series average monthly wind speeds were generally between 6 to 8 mph. Much more common in recent times, 2016 onwards, average monthly wind speeds have been 3 to 5 mph. This also explains the increase in ‘calm’ days as discussed earlier. The author has no evidence based explanation for this but it is possible that the equipment is under reporting. However this is thought to be unlikely as in early January 2024 a wind speed gust of 51 mph was recorded. This is often the upper limit for wind gusts in this relatively inland urban setting. Fig. 7 also shows the above average winds speeds well. In 2023 the highest average wind speed was in December with 6.6 mph. More notable in the past was February 2020 with 9.9 mph, and the windiest month in this relatively short time series. With regard to the average wind speed the windiest month was January 2007 with an average wind speed of 10.5 mph.

We can see from **Figures 8a and 8b** that the predominate wind direction for Bristol over 2023, and the 18 year longer term average, were from a South Westerly direction (202° to 247° - SSW-WSW) as seen in Table 3 earlier. There are however some subtle differences between the longer average and last year. There has been an increase in north easterlies, westerlies and ‘calm’ winds in 2023 and a corresponding decrease in south westerlies, southerlies and northerlies. There is some discussion with what is called ‘drift’ within the data when the equipment is moved. This last happened in 2010, but the writer thinks that the overall picture and longer term changes are broadly maintained. The increase in calm days has already been noted.

**Fig. 8a**: 2023 percentages of wind direction

**Fig: 8b:** 18 whole year (2006-2023) percentages of wind direction.

**Fig. 9**: Highest daily average wind speeds by month compared with the longer term average.

The above graph (**Fig. 9**) shows the highest average daily wind speed during each month and this is set against the longer term average. In 2023 it is seen that the highest daily wind speed occurred in the months of January, March, November and December, with October 2023 being the least windy of the year with regard to the daily average high wind speeds per month. Compared with the longer term average, from 2005/6, five of the 2023 months were significantly calmer.

There is some evidence that changes to the Jet Stream are weakening the wind speeds regionally. These wind speeds are, in turn, due to the asymmetric differences in the temperature changes between the Arctic and mid latitudes, differences which have been reduced by global warming. The Arctic is warming faster than scientists had predicted. This means the temperature gradient (and therefore pressure gradient) between the north and the mid latitudes are less great and so less windy with more high-pressure (or ‘blocking’) patterns over the north eastern Atlantic and Greenland. One must be careful in interpreting local phenomena and correlating it with global influences but it is very marked how average wind speeds have fallen in the last 17 years at the local site. One wonders if this trend will continue.

**2.4 Other parameters**

There were 19 days of air frost as seen in **Fig. 10** below. The graph has a linear regression line fitted and it can be seen that the number of frosts has been declining. The total time in 2023 that the temperature was below 0.0°C was 144 hours. There were 5 days of thunderstorms (11th January, 12th June, 26th August, 5th September and 2nd October) and 4 days of small hail (14th March, 12th April, 1st November and 30th December). There was only 1 day of snowfall which was lying for 1 day at 09:00 GMT on the 8th March.

**Fig. 10**: number of days with temperature less than 0.0°C

With regard to sunshine, measured as solar radiation, in 2023 it was very close to the yearly average for the percentage of maximum sunshine at 39.1%. The average (2006-2023) is 39.9%. The sunniest year in this relatively short time series was 42.5% in 2020. In 2023 the average megajoules per square metre (MJ m-2)was 9.48 MJ m-2. The average 2006-2-23 is 9.39 MJ m-2. From the graph (Fig. 11) below, it can be seen that May and June were the sunniest months whilst March was the standout dullest month with regard to the average maximum percentage sunshine. April’s deficit of sunshine is also seen. Most of the other months are close to their longer term average.

**Fig.11**: Maximum monthly % of solar radiation for 2023 compared with longer term average.

**3 Seasonal data**

**3.1 Winter 2022/23** (December – February)

With an average winter temperature of 6.2°C it was 26th warmest in Bristol in 133 years of data. It was 0.3°C above the 30 year average for the city. The total rainfall for the 3 winter months was 462.4 mm. The 30 year average for the city is 260.7mm, 173% above the average. This total makes 2022/23 the 3rd wettest winter in 142 years in the city after 2013/4 493.4 mm, and 1994/5 463.8 mm. There were 26 days of frosts for a total of 243 hours. This was the equal highest, with 2013/4 with regard to days of frost since the data started 10 years ago. There was only one day of snowfall for the winter of 2022/23. Note the winter seasonal figures span more than one calendar year whereas the annual data does not.

**3.2 Spring 2023** (March – May)

The spring of 2023 was the 13th warmest with respect to the average temperatures, with a mean temperature of 11.1°C. Continuous data for the city started in 1891. The spring rainfall of 2023 was the 5th wettest out of 142 years of data with 304.5mm. The 30 year average is 179.5mm so 2023 represents 170% of the average.

**3.3 Summer 2023** (June – August)

The summer of 2023 was the joint 18th warmest, with 2021, in 133 years. With an average temperature of 18.1°C it was 0.4°C above the 30 year average. The warmest summer was 1995 with an average temperature of 19.4°C. The coolest summer was in 1954 when the average temperature only reached 14.4°C. The summer rainfall total was 250.6 mm which was 118% of the 30 year average of 212.7 mm. It was the 40th wettest summer in 142 years of data for Bristol.

**3.4 Autumn 2023** (September – November)

It was the warmest autumn on record in 133 years of data for Bristol. The mean temperature was 13.8°C which was +1.8°C above the 30 year average of 12.0°C. It was the 24th wettest autumn on record in 142 years of data. With a total rainfall of 329.8 mm in the autumn it was 127% above the 30 year average of 258.8 mm.

**4 Monthly data**

**January** 2023 was very clearly split into two halves. From the 1st to the 15th the weather was very wet and mild. In the second half it was much dryer and colder until the last week when temperatures recovered. The consequence of this was for the monthly average temperature of 6.3°C to come out at a very modest 0.6°C above the average for the month. Rainfall for the month, despite the dry last two weeks, on the other hand was still high at 146.3 mm (154.5% of the 30 year average). It was the wettest January since 2014 and continues a slightly rising January rainfall over the historical period starting in 1853. There was no snowfall but there were 9 consecutive days when frost was recorded. There were 71 hours when the temperature was below 0.0°C in the month and this is the highest in January since this data started in 2016. It was the sunniest January since records began in 2006 with 24.8% of the maximum. The average for January is 20.2%. Nearly 60% of the wind direction was from a south west (SW) or west south westerly (WSW) direction despite the cold snap in the month which mainly saw calm days.

**February** With high pressure dominant for much of the month, it was dryer and warmer than average although high pressure at this time of year doesn’t always mean warm days. It is often down the source of the winds and this can be from a cold continental Europe in the East. Wind speeds were abnormally light for the time of the year. Rainfall was well below average for the month and there were 11 consecutive days without any measurable rainfall. The total rainfall was 16.7 mm, only 25.2% of the 30 year average. It was the driest February since 1993 and followed four months of above average rainfall. The average temperature for the month was 7.4°C which is 1.4°C above the 30 year average. The lowest daily maximum temperature for February of 7.4°C on the 25th was the highest since 8.0°C was recorded in 1960 and is the 2nd highest since this data started in 1960 in Bristol. Pressure was high and the average of 1028 mb for the month was the 2nd highest since records began in 1994. The highest was 1031 mb in 2012 which was the highest for all months at the current site. It was the sunniest February since 2019 with regard to the actual percentage of maximum sunshine, but the 09:00 hours measurement of the overcast nature of the sky was 75% which is a duller than average start to the day. On average the days of February 2023 brightened up as the day progressed.

**March** The monthly total rainfall of 185.4 mm was the highest recorded in March in Bristol since records began in 1853. The previous record was 165.1 mm in 1869. The rainfall of March 2023 was 306% of the 30 year average for the month of 60.6 mm. It was the 24th wettest of all 1,899 months with data. The record is held by September 1918 which recorded 258.3 mm. The average temperature for the month was close to the 30 year average at 8.4°C. This was 0.4°C above the average but it masks -0.3°C lower than average maximum temperature and 1.1°C higher than average minimum temperatures. The mean maximum temperature in March was only 0.5°C above that of February. It was the dullest March on record with only 28.9% of the maximum sunshine when the average is 41%. This data started in 2006. The average wind speed of 6.1 mph for the month made it the windiest month since February 2022 and the average monthly pressure of 1007mb was the lowest for the month since 1001 mb in March 2018.

**April** 2023 was a cooler than average month, with higher than average rainfall. The average temperature of 10.0°C was -0.6°C below the 30 year average. Maximum temperatures were -1.0°C on average. The minimum average temperature of 6.2°C was -0.3°C below the 30 year average. The rainfall for the month of 82.7 mm was 146.4 %, above the same 30 year average. April 2023 was the wettest since 2012 when 170.0 mm was recorded. The 30 year average for the month is 56.5 mm. The maximum percentage sunshine for April 2023 was below average at 44.1%. The average since the data started in 2006 is 51.6%.

**May** 2023 was warmer than average. The mean temperature of 14.9°C was 1.2°C degrees above the 30 year average. Rainfall was below average at 58.3% of the same 30 year average. All of the 36.4 mm of rain that did fall in the month was in the first 19 days. From the 20th May there were 12 consecutive days of no rain. Over the same period the predominate daily wind direction was unusually from a North Easterly direction. With 63.8% of the maximum sunshine recorded for May 2023 it was the 2nd sunniest since this data started in 2005. The average of all of May’s data starting in 2005 is 55.2%. The highest recorded for the month was in 2020 when 74.2% of the maximum sunshine was reached.

**June** It was the hottest June on record with regard to the average temperature in Bristol since 1891. With an average of 19.3°C it was 2.7°C above the 30 year average. The previous warmest June was in 2018 when the average was 18.4°C. The average maximum and average minimum temperatures for June were also records. The average maximum temperature at 24.4°C was 3.5°C above the 30 year average, and the average minimum temperature of 14.1°C was 1.7°C above the 30 year average.

**Fig. 12**: June average temperatures 1891 – 2023 Bristol

**Fig. 12** shows all the continuous records of average June temperatures since 1891. We can see the high temperature of 2023 and with the regression line we can calculate that in 133 year of data for the city the temperature for June has risen approximately 1.8°C. The total rainfall for the month was 33.2mm which is 54.3% of the 30 year average for the month. It was the driest June since 2018 which only had 4.0 mm.

**July** 2023 was a dull, wet and windy month with rainfall well above average. Temperatures were below average and sunshine levels low for this time of the year. It was also a windier month than average with low air pressure for this time of the year. Rainfall for July 2023 was over double the average for the month at 147.7 mm which is 214.2% of the 30 year average. It was the 6th equal wettest July, with 2009, since records began for Bristol. The wettest was 1888 with 161.8 mm. Measurable rain fell for 60.3 hours which represents 8% of the whole month. The average temperature for the month of 17.2°C was -1.3°C below the 30 year average and was the coolest July since 2012 which had an average temperature of 17.0°C. Notable was the low mean maximum temperature for the month of 20.5°C which was -2.2°C below the average, whilst the mean minimum temperature was only -0.3°C below the average. With an average air pressure of 1004 mb it was the lowest recorded for this site for a July from the data that started in 1995. Wind speeds were higher than the average with the highest daily gust average for the month of 25 mph This was the highest for any month since May 2021 which was also at 25 mph. Two thirds of all the predominate daily wind directions were from the SW or WSW. It was a dull month with only 48.4% of the maximum monthly sunshine when the average is 55.9%. This was a lower average percentage sunshine than the months April through to August. It was the dullest complete July month of data since records began in 2005.

**August** The August average temperature of 17.8°C was 0.3°C below the 30 year average for Bristol. It was a duller than average month with 47.8% of the maximum sunshine. The August rainfall of 70.0 mm was 84.4% of the 30 year average for the month. Notable for the second consecutive month was the low air pressure values. The average pressure in August of 1006 mb was the lowest for the month since this data started in 1995. Likewise the lowest pressure for the month of 979 mb was the lowest for August since this data started. The highest pressure of 1016 mb was the lowest for the month in the same period. The predominate westerly wind direction for August was the first time this has occurred in any month since March 2011.

**September** It was the warmest September on record since this data started in 1891. With an average temperature of 18.4°C it was +2.9°C above the 30 year average. The previous warmest was 2006 with an average temperature of 17.7°C. September was warmer than both July and August. The average minimum temperature of 14.3°C for the month was the highest since continuous data started in 1894. The average maximum temperature of 22.5°C was the second highest since 1895.

|  |  |  |
| --- | --- | --- |
| Year | Temperature °C | Rank (Hottest first) |
| **2023** | **18.4** | **1** |
| 2006 | 17.7 | 2 |
| 2014 | 17.5 | 3 |
| 2021 | 17.5 | 3 |
| 1895 | 17.1 | 5 |
| 2016 | 17.1 | 5 |
| 1999 | 16.9 | 7 |
| 2005 | 16.8 | 8 |
| 1949 | 16.6 | 9 |
| 1898 | 16.5 | 10 |

**Table 4**: Ten warmest Septembers in Bristol since 1891 ranked.

**Table 4** shows 2023’s number one position as the warmest September in 133 years of data. Unlike some of the other temperature data there are warm Septembers from earlier years in the time series. Particularly notable in the above table is 1895 which was the joint 5th warmest September in the time series. It must have felt particularly warm that year as the annual average temperature was only 9.9°C as opposed to 12.6°C in 2023. Rainfall was close to the 30 year average at 65.0 mm. The average pressure of 1012mb was the lowest since 2006 when the average pressure at 09:00 hours was 1011 mb. Wind speeds were very low in the first half of the month but picked up in the second half.

**October** was another warm month. It was the 6th warmest since continuous records began in 1891. With an average temperature of 13.9°C it was 1.9°C above the 30 year average. The average maximum temperature for October of 17.2°C had a larger anomaly of +2.1°C set against the 30 year average. Rainfall was 131.3% above the 30 year average at 124.5 mm.

**November** Despite a short cold period at the end of the month the average temperature of 9.0°C was still 0.6°C above the 30 year average. The monthly rainfall of 140.3 mm was 139.6% of the 30 year average. It was as usual a predominately SW/WSW wind direction month, only swinging more northerly in the last few days of the month.

**December** The average temperature of 8.6°C was 2.5°C above the 30 year average. It was the joint 4th warmest December with 2018. The total rainfall was 199.7 mm. This was the 3rd highest since continuous annual records for Bristol began in 1853. The wettest December was in 1929 with 205.2 mm, followed by 200.0 mm in 1965. Furthermore, it was the 11th wettest of all months in Bristol’s known data record. The 30 year average for Bristol's rainfall is 101.8 mm so 2023 was 196.2% of the average. It was a dull month with restricted sunshine only amounting to 16.4%. It was the 3rd dullest month on record which started in 2005. December 2023 was the windiest month since February 2022 and the windiest December since 2015.

**5 Some notable events in 2023**

**5.1 Temperature**

The lowest daily maximum temperature of 1.1°C on the 21st January was the lowest for the month since 0.2°C in January 2013. The lowest daily mean temperature of -0.7°C also on the 21st was the lowest for January since 2010.

The highest daily maximum temperature on the 29th April of 19.0°C was the lowest since 18.2°C was recorded in April 2016.

The lowest daily maximum temperature of 16.2°C on the 8th May was the highest recorded for Bristol since this data started in 1960.

The lowest daily maximum mean temperature of 16.4°C on the 4th of July was the lowest for July since 16.1°C in 2015. The highest daily mean of 21.4°C on the

7th was the lowest for July since 20.4°C was recorded in July 2011.

There were some notable daily maximum temperatures in September. From the 4th to the 9th consecutively the maximum daily temperature reached over 30.0°C.

On the 4th and 6th the maximum reached was 30.7°C and these were the highest temperatures of 2023. The maximum minimum temperatures of 20.8°C recorded on the 7th and 10th were the highest for September since the data started in 1960.

The daily maximum temperature of 24.5°C on the 8th October was the 3rd highest for the month since continuous data started for Bristol in 1891.

The minimum temperature of -1.4°C on the 25th November was the lowest for the month since -3.3°C was recorded in 2016.

**5.2 Rain**

January 11th 2023 saw a 24 hour rainfall of 43.2mm. This was the second highest for the month. The highest was 52.0mm in January 1926 with data starting in 1893. Between 11th and 13th of January 77.3 mm of rain was recorded.

The wettest 24 hour period in March 2023 was 23.2 mm on the 31st. This was the highest for the month since 27.2 mm in March 2016.

Almost half of May's monthly total rainfall fell in one 24 hour period on the 8th May.

Between 10th to the 15th July there was 88 mm of rain recorded. The 30 year average for the whole of July is 68.8 mm so in those 5 days there was 128% of the month’s rainfall.

The maximum 24 hour rainfall of 33.9 mm recorded on the 9th of November was the most for the month since 2012 when 39.8 mm was recorded.

The 35.0 mm 24 hour maximum rainfall on the 4th of December was the highest since 37.7 mm was recorded in 2013. In the last 7 days of December at the year end there was 77.3 mm of rain recorded.

**5.3 Hail**

Small hailstones (less than 5 mm) were recorded on 14th March, 12th April, 1st November and 30th December.

**5.4 Wind and pressure**

The 09:00 hour's pressure of 1046 mb on 5th of February 2023 was the highest of the month and 2nd highest of all months since 1994. With regard to the average wind speed it was the 2nd least windy February since records started in 2006. The maximum wind speed gust of 33 mph on 17th was the equal 2nd lowest maximum gust for the month since this data started in 2006.

The highest wind gust of the year of 44 mph was recorded on 10th April.

The maximum daily wind speed of 7.8 mph on the 29th May was the least windy day for the month since this data started in 2006. The maximum gust of 28 mph on the 10th was the equal lowest for the month, with 2012, since this data began in 1995.

The maximum daily pressure of 1011 mb recorded on three days in July were the lowest of any month since February 2014. The highest daily maximum pressure of 1013.8 mb recorded on the 17th July was the lowest for any July with data starting in 2005. The lowest daily maximum pressure of 989.4 on the 15th was the lowest for the month. Pressure this low is usually reserved for the late autumn and winter months.

The low pressure of 976mb at 09:00 GMT on October 20th was the lowest for the month since the data started in 1995. It was the 2nd least windy October with an average wind speed of 3.0 mph since data started in 2005. The lowest was 2.8 mph in 2016. The windiest day of October on the 13th of 7.0 mph average wind speed was the lowest for the month since the data began in 2004.

Pressure was generally low for the whole of November but the 957.2mb at 05:00 hours on the 2nd of the was the lowest recorded at this site since this data started in 2005. The 09:00 GMT hour’s pressure started in 1994 and the 962.0 mb recorded, also on the 2nd, was the lowest at this site. Pressure is usually measured at 09:00 GMT but the current software additionally allows anytime low and high pressures to be observed.

The maximum daily wind speed on December 24th of 15.2 mph was the highest of the year.

**5.5 Solar radiation**

The hourly sunshine record for April was broken on the 25th when 910.3 WM2 was recorded for the hour starting at 13:00 GMT.

**6 Conclusion**

I can do no better than report from the WMO (World Meteorological Office) that “2023 is the warmest year on record, by a huge margin. Six leading international datasets used for monitoring global temperatures… show that the annual average global temperature was 1.45 ± 0.12 °C above pre-industrial levels (1850-1900) in 2023. Global temperatures in every month between June and December set new monthly records. July and August were the two hottest months on record.”

Much of this, but not all, has been reflected in the local climate of Bristol and its immediate environs. It is getting warmer and recent winters wetter. Locally we are not exempt from the larger scale global trends and patterns.

The WMO go on to say “Climate change is the biggest challenge that humanity faces. It is affecting all of us, especially the most vulnerable. We cannot afford to wait any longer. We are already taking action but we have to do more and we have to do it quickly. We have to make drastic reductions in greenhouse gas emissions and accelerate the transition to renewable energy sources”. Let’s hope we all realise this and take the appropriate action.