Radcliffe Meteorological Station

School of Geography and the Environment, University of Oxford

Annual Report 2023

1. Summary

The annual statistics for 2023 at the Radcliffe Meteorological Station are summarised in the table below. The 2023 annual mean temperature was 11.85°C, the 2nd warmest year on record at the Radcliffe Meteorological Station after the record breaking year of 2022. In terms of anomalies, this was 0.78 K greater than the 1991-2020 mean and 2.17 K greater than the 1851-1900 mean.

2023 was also the fourth wettest year since reliable daily rainfall records began in 1827, with 929 mm of rainfall (137% of expected). The wettest year on record in Oxford was 2012, with a total of 979 mm of rainfall across the year.

The report progresses as follows: Section 2 details 2023 annual statistics, with an overview of the weather for each month given in Section 3. An update on RMS news and observer changes is given in Section 4, and acknowledgements are made in Section 5 to those who have helped support the work at the RMS throughout the year.

2. Annual statistics

	2023 values	RMS long term mean	RMS long term standard deviation	Difference from long period mean
Mean air temperature (°C)	11.85	9.7	0.7	**2.2**
Absolute maximum air temperature (°C)	31.4	29.9	2.4	**1.5**
Lowest maximum air temperature (°C)	-0.4	---	---	---
Mean maximum air temperature (°C)	15.8	14.0	0.9	**1.8**
Absolute minimum air temperature (°C)	-6.2	-7.5	2.7	**1.3**
Mean minimum air temperature (°C)	7.9	6.3	0.7	**1.6**
Absolute minimum grass temperature (°C)	-8.6	-7.5	2.7	**-1.1**
Mean minimum grass temperature (°C)	5.8	6.3	0.7	**-0.5**
Absolute minimum concrete temperature (°C)	-5.6	-7.0	1.7	**1.4**
Mean minimum concrete temperature (°C)	7.1	5.9	0.7	**1.2**
Mean soil temperature at 30 cm (°C)	12.5	10.9	0.7	**1.6**
Mean soil temperature at 100 cm (°C)	12.5	---	---	---
Highest daily rainfall (mm)	33.9	---	---	---
Total rainfall (mm)	929.5	646.6	113.5	**282.9**
Total bright sunshine (hours)	1657.7	1515.1	149.3	**142.6**
Mean daily bright sunshine (hours)	4.6	---	---	---
Mean wind speed (knots)	9.6	8.8	0.7	**0.8**
No. of rain days (0.2 mm or more rainfall)	186.0	170.1	18.0	**15.9**
No. of wet days (1.0 mm or more rainfall)	125.0	---	---	---

No. of days with minimum temperature less than 0°C	29.0	44.9	16.2	**-15.9**
No. of days with ground temperature less than 0°C	57.0	101.2	17.8	**-44.2**
No. of days with fog at 0900 GMT	4.0	19.5	10.2	**-15.5**
No. of days with snow lying at 0900 GMT	0.0	9.3	10.4	**-9.3**

Anomaly is calculated with respect to the long-term mean. Yellow denotes anomalies more than 1 standard deviation away from the long term mean. Orange denotes anomalies more than 2 standard deviations away from the long term mean, while red denotes anomalies more than 3 standard deviations away from the long term mean.

3. Monthly statistics

January. The majority of RMS Oxford's measurement statistics for January 2023 were within one standard deviation of the January long-term means, meaning weather conditions were largely typical for this time of year. However, more sunshine hours were recorded in January than would be expected, with several days recording among the highest number of sunshine hours in the UK. There were periods of particularly warm and cold temperatures during January, the former resulting in the unusually high maximum air temperature (13.7°C) towards the start of the month. A cold snap occurred between 21-24th January, setting minimum temperatures for the month.

February was an exceptionally dry month with total rainfall 34.0 mm below long-term mean, in excess of one standard deviation (SD). It was the driest February at the RMS since 1993 and the joint 13th driest February in RMS's 254 years of rainfall record. With only 5 days of rain days, it was also the February with the fewest rain days since 1993 and the joint-3rd February with the fewest rain days. The month was warmer than usual, ranking as the joint-11th warmest February for mean maximum temperature, with mean air temperature also exceeding 1 SD of long-term mean. Sunshine hour was close to exceeding one SD above long-term mean (SD 20.7 hours) and the mean windspeed was 1 SD below long-term mean. Overall, February 2023 was a sunny, mild, and dry month, registering the lowest February rainfall in 30 years at the RMS.

A cold clear February day in the gardens of Green Templeton College. Photo credit Kitty Attwood.

March was a record-breaking month at RMS Oxford, as we recorded the highest March monthly rainfall total (133.9mm) since records began in 1767. This replaces the previous record of 133.6mm from March 1862. The most rainfall recorded on a single day was 15.3mm (31st March), which isn't abnormally high for a winter storm, but there was a higher frequency of significant rainfall days across the month, with 6 days recording over 10mm of precipitation. Another record matched this month is the number of days on which rainfall occurred, with 27 of the 31 days this March receiving rainfall (over 0.2mm). This is joint with March 1917, which also had 27 rainfall days. The record-breaking rainfall this month is likely due to a sudden stratospheric warming (SSW) event in February that shifted the jet stream southwards and so brought more Atlantic low-pressure systems over the UK.

April was a fairly typical month, with only 2 variables exceeding one standard deviation of long-term mean. The mean air temperature of 9.0°C, mean maximum temperature of 13.8°C and mean minimum temperature of 5.0°C are all slightly higher than historical average, indicating a marginally warmer April compared to historical records at the RMS. Mean minimum grass temperature and mean 30cm soil temperature at 0900 were both higher than historical averages, exceeding 1 standard deviation. Total rainfall of the month was higher than normal, although just falling short of 1 standard deviation above long-term mean. Total sunshine hours were slightly higher than the long-term mean, while the mean windspeed was slightly lower.

The Radcliffe observatory at Green Templeton College. Photo credit Charlie Knight.

May was a particularly ordinary month, with no variables exceeding one standard deviation above or below the long-term mean. In general, the month was of average temperature and rather sunny; the mean maximum air temperature was 1.49°C colder than the long term mean while there were 30.9 more hours of sunshine. Notably, there were no frost days this month: on no day was the ground temperature less than 0°C and the lowest minimum temperature recorded by the grass minimum thermometer was 1.4°C on the 21st May 2023.

June was the hottest UK-wide June in the Met Office record. However, while temperatures were much higher than usual in Oxford, it was only the 4th warmest June recorded at RMS. Records were broken for the highest June average 30cm soil temperature (19.3°C) and the highest mean minimum concrete temperature (12.8°C), both surpassing records set in June 2017. The average maximum temperature was the second highest in RMS's 142-year record, only lower than the 'long hot summer' of 1976. Other notable statistics recorded include the 5th highest June mean minimum temperature, the 25th most sunshine hours in June, the 16th highest absolute maximum June temperature, and the 5th highest mean minimum June grass temperature. High pressure over the UK caused warmer temperature values early in the month. This was followed by warm humid air arriving from the Bay of Biscay and the Atlantic Ocean southwards of the UK's latitude, resulting in unusually warm temperatures across the month.

July was a particularly wet month at RMS Oxford, with 20 rainfall days and a total rainfall of 100.3 mm, exceeding the average total July rainfall by 40.9 mm. It was also a particularly windy month – the mean wind speed (11.6 kts) was two standard deviations above the mean, making it the windiest July on record at the RMS. Temperatures were close to average for the time of year, with the mean

air temperature (16.8ºC) only 0.1ºC higher than the long term mean and the absolute maximum air temperature (28.1ºC) just 0.2ºC below average. This strongly contrasts to July 2022 at the RMS when the maximum air temperature reached 38.1ºC and the total monthly rainfall was just 7.1 mm. The minimum grass temperature values for July 2023 were excessively high when compared to those at Reading and the minimum concrete temperatures from Oxford, which we believe to relate to bubbles in the thermometer. Please treat these with caution.

August was a month of mostly typical weather for the time of year. Temperatures and rainfall were as expected while sunshine was slightly above average (but not significantly so against the long term standard deviation). It was generally slightly windier than a typical August, with mean wind speeds 2.3 knots above the long term mean for the month. There was also a notable lack of cool nights; absolute minimum grass, concrete and air temperatures were all >1 standard deviation above the long term mean, with the absolute and mean minimum grass temperatures >3 and >2 standard deviations above the long term mean respectively. While the lack of cool nights is reflected in multiple minimum temperature statistics it may be overemphasised in the grass minimum temperature values as bubbles affected the thermometer on a number of days.

September was an exceptionally warm month in Oxford by every temperature statistic we record. A mean air temperature of 17.4°C was 3.7°C and 3 standard deviations greater than the long term mean for the month, matching 2006 as the joint-warmest September in our records by mean air temperature. The start of the month was characterised by a prolonged heatwave across the country, and in this period we recorded a maximum temperature of 31.4°C on the 9th September 2023. This was the hottest September day in Oxford since 1911. Minimum temperatures were also well above average, with mean minimum grass temperatures 3 standard deviations above the long term mean and mean minimum air temperatures 2 standard deviations greater. Unsurprisingly given the abnormal temperatures, sunshine hours were 39.5 hours greater than expected for September and rainfall slightly less.
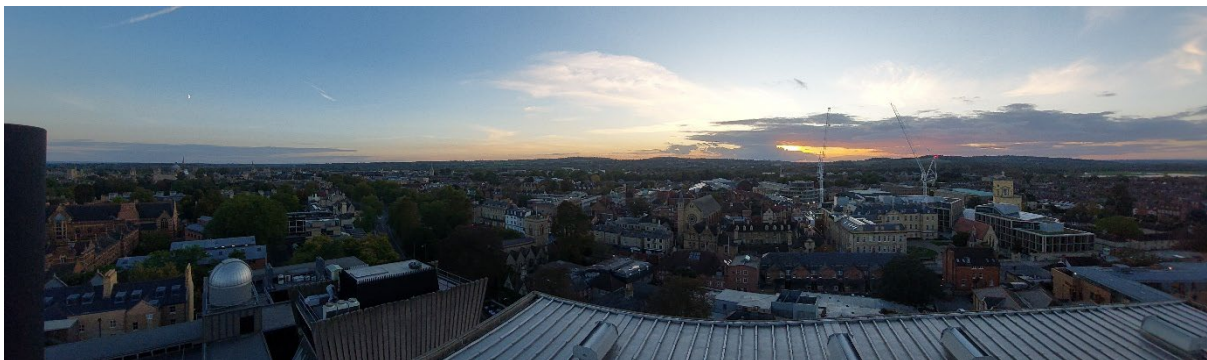
A sunset panoramic photo from the top of the Thom Engineering building, where the Campbell-Stokes sunshine recorder is located. Photo credit Charlie Knight.

October was a warm and rather wet month in Oxford. A number of temperature statistics were greater than 1 standard deviation above the long term mean, including mean air temperature, absolute maximum air temperature, and mean minimum air grass and concrete temperatures. The station received double the typical rainfall for the month with 137.8mm of rain. This is unusually wet, although October is the month we see the largest inter-annual variability in rainfall (the standard deviation of the long term record for October is the highest of any month of the year at 36.7mm).

November was a month of typical weather for the time of year in Oxford, with a distinct cold snap towards the end of the month. The only two records varying significantly above or below their

respective long term means were total bright sunshine hours (above by 19.7) and the number of days with ground temperature less than 0°C (below by -5). Temperature metrics, rainfall and wind were all otherwise close to expected.

Two friendly visitors to the station compound in Green Templeton College gardens. Photo credit Kitty Attwood.

December was a dull and wet month in Oxford. Bright sunshine across the month was just 29.7 hours, less than an hour for each day of the month and the dullest December since 2010 (which had shockingly low 14 bright sunshine hours for the month). Rainfall was significantly above expected, with 117.2mm of rainfall for the month making December 2023 the wettest December since 1989. This was very clear in the local flooding of the Thames into early January. As is typical of the winter weather patterns that bring wet weather to the UK, average temperatures were comfortably above average and the number of frost days well below what would be expected for the month.

4. RMS News

In 2023, a team of 14 covered the 365 days of weather readings. Our regular observers were supported by a few extra hands, and we thank them for their assistance. Particular thanks to Clifford Coiffe for his cover of both the Christmas and New Years Day shifts.

In June 2023 we said goodbye to Anlin Chen, a stalwart observer at RMS. Anlin began taking observation during the depths of lockdown in December 2020, and has since completed 250 days of readings as well as numerous media appearances. We thank Anlin for her service - she will be missed in 2024.

In October, Sophie Harbod passed the lead observer role to Charlie Knight, a DPhil student in the Climate Lab in the School of Geography and the Environment. Charlie joined the RMS team in

January 2023. We would thank Sophie for her hard work as lead observer from August 2022 – October 2023. She remains an integral part of the observing team.

5. Acknowledgements

Charlie Knight

On behalf of the RMS observer team

University of Oxford