Radcliffe Meteorological Station

School of Geography and the Environment, University of Oxford

Annual Report 2021

1) Overview

The annual statistics for 2021 at the Radcliffe Meteorological Station are summarised in the table below. Whilst not as extreme as the warmth experienced in 2020, all temperature metrics for 2021 are above the long-term average, and with a mean air temperature of 10.8°C, the year registers as the 21st mildest in the Oxford record. Metrics for rainfall, sunshine and wind speed all fall within one standard deviation of the long-term mean, whilst the occurrence of air and ground frost, fog and lying snow were all around average.

Metric	2021 value	Date of reading	Anomaly	Rank (No. of years in record)
Mean air temperature (°C)	10.8		1.1	21st (207)
Absolute maximum air temperature (°C)	31.3	18/07	1.5	41st (207)
Lowest maximum air temperature (°C)	0.2	08/02		
Mean maximum air temperature (°C)	15.0		1.0	25th (207)
Absolute minimum air temperature (°C)	-4.5	11/02	3.0	12th (141)
Mean minimum air temperature (°C)	7.3		1.1	14th (141)
Absolute minimum grass temperature (°C)	-9.1	11/02	2.2	31st (141)
Mean minimum grass temperature (°C)	4.6		1.0	7th (141)
Absolute minimum concrete temperature (°C)	-6.0	11/02	1.0	9th (35)
Mean minimum concrete temperature (°C)	6.6		0.7	4th (35)
Mean soil temperature at 30cm (°C)	12.1		1.2	6th (97)
Mean soil temperature at 100cm (°C)	12.2			
Highest daily rainfall (mm)	22.4	19/10		
Total rainfall (mm)	718.4		72.1	63rd (255)
Total bright sunshine (hours)	1477.2		-38.2	82nd (141)
Mean daily bright sunshine (hours)	4.0			
Mean wind speed (knots)	8.8		0.0	64th (141)
No. of rain days (0.2 mm or more rainfall)	168		-2.1	81st (141)
No. of wet days (1.0 mm or more rainfall)	115			
No. of days with minimum temperature <0°C	38		-7.0	87th (141)
No. of days with ground temperature <0°C	104		2.8	60th (141)
No. of days with fog at 0900 GMT	11		-8.6	68th (141)
No. of days with snow lying at 0900 GMT	10		0.7	32nd (141)

Anomaly is calculated with respect to the long-term mean. Blue denotes anomalies that are more than one standard deviation away from the long-term mean.

Section 2 details the RMS records that were broken during 2021, with an overview of the weather for each month given in Section 3. An update on RMS instruments 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) Oxford Records

2.1) New Records

Warmest March day on record (22.6°C, 30th March)

Joint coldest April mean minimum air temperature on record (1.6°C)

Coldest April mean minimum grass temperature on record (-2.9°C)

Coldest April mean minimum concrete temperature on record (1.2°C)

Warmest June mean minimum concrete temperature on record (12.9°C)

2.2) Near-Records

4th warmest annual mean minimum concrete temperature on record (6.6°C)

5th wettest January on record (115.3 mm) – wettest January since 2014

2nd highest number of ground frosts for month of April (22)

3rd highest number of air frosts for month of April (10)

Joint 5th highest number of rain days for month of May (22)

4th warmest June mean minimum air temperature on record (12.3°C)

4th warmest June mean minimum grass temperature on record (10.4°C)

5th warmest September mean air temperature on record (16.4°C)

3rd warmest September mean 30cm soil temperature on record (17.8°C)

4th warmest December day on record (15.3°C, 30th Dec)

Mercury thermometer reading of the maximum temperature (22.6°C) recorded on the 30th March, the warmest March day in the RMS record. Photo Credit: David Crowhurst.

3) Monthly Summaries

2021 began with the 5th wettest **January** in the Oxford record (115.3 mm), with high rainfall and the antecedent ground conditions leading to a number of flooding impacts across the county. Indeed, there were 24 rain days during the month, resulting in a sunshine total (41.8 hours) well below the long-term mean. Whilst temperatures were around average (3.7°C), the month was actually the coldest January since 2010, with 7.5cm of snow lying on the 24th, the most recorded since the Beast from the East in March 2018.

A snowy Oxford landscape during January, observed from the roof of the engineering building. Photo Credit: David Crowhurst.

The weather in **February** was average for the time of year, with all but one metric falling within one standard deviation of the long-term mean. This was the absolute maximum air temperature; a reading of 16.0°C on the 24th making it the 6th warmest February day in Oxford in the 21st century. The mean value for the month (5.5°C) disguised a wide range in air temperatures, with easterly winds from Siberia producing a cold spell from the 6th – 14th. These were replaced by south-westerlies to give a relatively mild second half of the month. Rainfall (55.2 mm) was a little higher than usual, whilst sunshine (73.7 hours) and wind speed (9.0 knots) metrics were standard for the time of year.

March was a warmer month than average, with all temperature metrics above the long-term mean. Indeed, an extremely mild end to the month saw the 30th become the warmest March day in the Oxford record; a maximum air temperature of 22.6°C surpassing the 22.1°C set in 1965. There was also only one occurrence of air frost during the month, with the mean minimum air temperature (4.1°C) over one standard deviation above the long-term mean.

Rainfall (29.5 mm) and sunshine (105.0 hours) totals were a little lower than normal, whilst the mean wind speed (11.6 knots) was well above average.

With a mean air temperature of 6.7°C, **April** 2021 was the coldest April in the Oxford record since 1986, whilst the mean values for minimum grass (-2.9°C) and concrete (1.2°C) temperature were both record-breaking lows for the month. As well as this, the number of ground (22) and air (10) frosts recorded were both over two standard deviations above the long-term mean, and were the 2nd and 3rd highest values for the month of April respectively. These statistics were the product of high pressure and clear skies, conditions which also afforded 213.3 hours of total sunshine, making the month the 10th brightest April in Oxford since 1881. 1.2cm of snow was recorded on the 12th; the first incidence of snow in April since 2008.

May was a particularly unsettled month; 94.5 mm of rainfall was recorded, making it the wettest May in Oxford since 2008, whilst mean wind speeds (10.2 knots) were over one standard deviation above the long-term mean. There were 22 rain days during the month, the joint 5th most recorded for May, and consequently the total sunshine recorded (159.4 hours) was well below average. The month was cold for the time of year, with all temperature metrics below the long-term mean, including a mean air temperature of 10.8°C, making it the coolest May in Oxford since 2008.

In contrast to April and May, **June** was relatively warm, with a mean air temperature of 16.6°C the 16th highest value recorded for the month in the Oxford record. Of particular note were the mean minimum temperature metrics; the values for air (12.3°C) and grass (10.4°C) were both the 4th warmest in their respective June records, whilst the value for concrete (12.9°C) was the highest ever recorded for the month. Total rainfall (68.9 mm) was slightly above average for June, despite the month beginning with a 15-day dry spell; this was largely due to the period from the 17th – 21st, when 55.8 mm were recorded, with the 17th (20.0 mm) the wettest day in Oxford since late January.

David Crowhurst takes the daily observations at the RMS site, situated in the grounds of Green Templeton College. Photo Credit: David Crowhurst.

July was also considerably warmer than average, with most temperature metrics at least one standard deviation above the long-term mean. A spell of unseasonably high temperatures were recorded during the middle of the month, when maximum temperatures exceeded 25°C for eight consecutive days from the 16th – 23rd. Rainfall (67.7 mm) was normal for the time of year, although was concentrated at the beginning and end of the month, with no precipitation recorded in a ten-day period from the 13th – 22nd. It was also calmer than normal, with average wind speeds (5.6 knots) one standard deviation below the long-term mean for July.

The Radcliffe Observatory, situated in the grounds of Green Templeton College, houses the Newman barometer, an instrument which has provided readings of atmospheric pressure since it was installed in 1838! Photo Credit: Anlin Chen.

August was reasonably close to the seasonal average with regards to temperature, although the absolute maximum value recorded on the 14th of the month (23.7°C) was considerably lower than the long-term mean. Total rainfall (34.7 mm) was below average for August, culminating in a prolonged dry spell (26th – 7th Sep) that extended into September. The month was duller than average, with total sunshine (138.9 hours) one standard deviation below the long-term mean, however it was unseasonably windy, with speeds in excess of ten knots recorded on 18 individual days.

With a mean air temperature of 16.4°C, **September** was the 5th warmest in the Oxford record, and also featured the hottest September days (maximum temperatures of 29.0°C on the 7th and 8th) since 2016. Indeed, all temperature metrics were at least one standard deviation above the long-term average, with the value for mean 30cm soil temperature (17.8°C) the 3rd highest recorded for the month. Although not unusually dry, almost three quarters of the total monthly rainfall (43.7 mm) was received across two days (13th, 28th) in September, with the 28th (18.9mm) being the wettest day in Oxford since mid-June. It was not unseasonably bright or windy for the time of year, and no instances of ground frost were recorded during the month.

October was an unseasonably warm month, with a mean air temperature of 12.7°C making it the 10th warmest October in the Oxford record. With the exception of absolute maximum air temperature, all temperature metrics were at least one standard deviation above the long-term mean, and there was only one instance of ground frost during the month, following in a similar vein to preceding Octobers (0 in 2020, 1 in 2019). Despite the number of rain days (12) being below the long-term mean, total rainfall (92.2 mm) was above average, with the 19th (22.4 mm) being the wettest day in Oxford in 2021 and the highest daily total since December 2020.

Matt Clements takes a reading for soil temperature as part of the daily observations at the RMS. Photo Credit: Matt Clements.

18.2 mm of total rainfall made **November** the driest in Oxford since 1945, with the number of rain days (10) over one standard deviation below the long-term mean. Indeed, up until the 24th, only 3.8 mm of rainfall had been recorded during the month; ≈80% of the overall total falling in the final week of November. Other than that, the weather was fairly average for the time of year; all of the air temperature metrics fell within one standard deviation of the long-term mean, as did the values for total sunshine hours (73.1) and mean wind speed (8.0 knots). There were however no instances of fog recorded during the month.

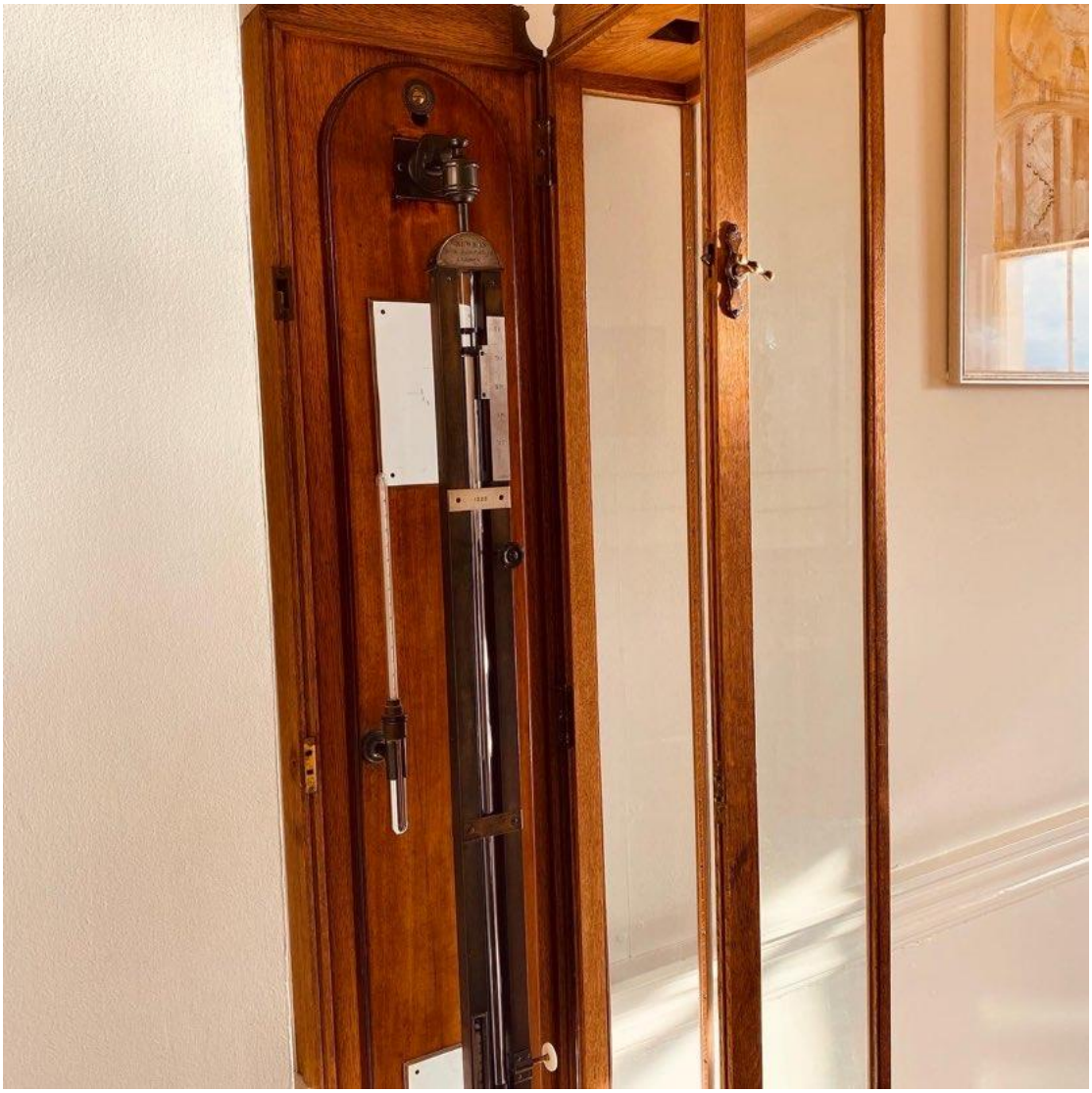
December was an unseasonably warm month, with a number of the temperature metrics one standard deviation above the long-term average. A mean air temperature of 7.3°C made it the 12th warmest December in the Oxford record, however an exceptionally mild end to the month saw the last 3 days of 2021 all break date records for maximum temperature (14.8°C on the 29th, 15.3°C on the 30th, 15.1°C on the 31st), with the 30th the 4th warmest December day on record. Total rainfall (71.4 mm) was average for the time of year, although the 17.7 mm recorded on the 24th made it the wettest Christmas Eve in Oxford since 1924. Total sunshine hours (33.4) were one standard deviation below the long-term mean, making it the dullest December month since 2010.

Oxford from the roof of the engineering building, where daily readings of wind speed, sunshine hours and visibility are made. Photo Credit: Anlin Chen.

4) RMS News

4.1) Instrument Updates

The Newman barometer, situated in the Radcliffe Observatory, was repaired and reinstalled in November 2021, and readings are again being taken from the instrument. Readings of atmospheric pressure were taken from two aneroid barometers whilst the Newman was out of service.



The Newman barometer, which provides readings of atmospheric pressure, was reinstalled in 2021 and once again makes up part of the daily weather observations. Photo Credit: Matt Clements.

During May, the thermometer used to measure 10cm temperature was broken and subsequently replaced in June. There is therefore a 23-day period where no 10cm soil readings were taken.

4.2) Observers

2021 saw several staff changes at the RMS. David Crowhurst left Oxford after completing his DPhil in June; we thank him for his 225 days of service as an observer, and the invaluable guidance and support he has passed on to the new staff members. Sophie Harbord and Matt Clements, both DPhil students in the School of Geography and the Environment, took up roles as observers in June, joining Anlin Chen, a Geography undergraduate who continues in her role as an observer.

We would like to thank Callum Munday, Marcus Buechel, Kate Washington, Zachary Spavins-Hicks, Ben Clarke and Joe Fishlock for their assistance in taking observations through 2021.

5) Acknowledgements

Everyone at the RMS would like to thank Stephen Burt and Roger Brugge at Reading for the time they have taken during 2021 to provide invaluable support and advice to the observing team. We would also like to thank everyone at Green Templeton College and in the Department of Engineering Science who has helped or supported the work of the RMS through the year. We thank Mike Stewart at the Met Office for his help and support during the year. And finally, we would also like to thank Richard Washington, Ian Curtis and Chris White at the School of Geography and the Environment for their help and advice throughout the year.

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The Radcliffe Met Station. Photo Credit: Anlin Chen.