

HadCET v2.0.1.0

Release Notes, April 2023

Overview

This document summarises the most recent changes made to the CET series as part of the V2.0.1.0 release in April 2023.

These changes have been made to improve the accuracy and consistency of the series by correcting for errors in existing source data and adjustment calculations. Resulting changes in temperature in the series were within one tenth of a degree.

The corrections made to the series as part of the V2.0.1.0 series include:

- Fixing a bug in the use of certain backup station values
- Updating an erroneous maximum and subsequent mean temperature value for Ross on Wye
- Precision of station temperature values corrected from floats to decimals
- CET series values stored internally at 5dp precision and exported for public use at 1dp precision

1. Summary of changes

Applying these alterations and bug fixes as part of the V2.0.1.0. release caused relatively minor changes to the overall CET series.

The differences in the CET series temperature values up to the end of October 2022 can be summarised as follows:

- Mean CET: 133 (0.1%) changes to the series (out of 91,615 values)
 - 99% of temperature differences within 0.1C
 - Difference of +3.5C for 23rd December 1884 value
 - 90 (68%) of the changes to the mean CET series resulted in slight temperature increases and 43 (32%) in temperature decreases
- Min CET: 105 (0.2%) changes to the series (out of 52,899 values)
 - 93% of temperature differences within 0.1C
 - 7% of temperature differences within 0.2C
 - 69 (66%) of the changes to the min CET series resulted in temperature increases and 36 (34%) in temperature decreases
- Max CET: 123 (0.2%) changes to the series (out of 52,899 values)
 - 95% of temperature differences within 0.1C
 - 3% of temperature differences within 0.2C
 - Difference of -0.3C for 31st December 1969 value
 - Difference of +7C for 23rd December 1884 value
 - 66 (54%) of the changes to the max CET series resulted in temperature increases and 57 (46%) in temperature decreases

2. Backup calculation

A fix was added to the process which selects backup stations to use when one of the standard contributing stations has a missing value. It was found that temperature values from the same backup station could be used on the same date for two different stations with missing data. This has been corrected so that a backup station can only be used once for a given date in the V2.0.1.0 series.

This resulted in only one CET min value change on 31st December 1969 of 0.2C and 11 CET max value changes of -0.1C between December 1891 and December 1902 and one CET max value change of -0.3C on 31st December 1969.

3. Ross on Wye max/mean temperature

The recorded maximum temperature value for Ross on Wye on 23rd December 1884 was found to be erroneous in the source file that was used to generate the CET series. The value was corrected from -15.7C to +5.7C.

The resulting mean temperature for Ross on Wye, calculated as an average of minimum and maximum temperature, was also subsequently updated from -7.3C to +3.4C.

Applying this fix to Ross on Wye's maximum and mean temperatures for the above date resulted in 54 mean temperature values in the CET series being adjusted by at most 0.1C and the overall CET mean value for 23rd December 1884 increasing from -0.9C to +2.6C.

This fix resulted in 45 changes in CET minimum temperature between 1884-1921 of at most 0.2C due to slight changes in the bias adjustments during this period.

For CET maximum temperature, there were 42 changes of at most 0.2C between 1884-1921 due to slight changes in the bias adjustments and an increase of 7C in 23rd December 1884 value from -2.4C to 4.6C.

4. Converting station values to decimal

All station temperature values are recorded and stored to one decimal place and averaged to calculate the CET series values. During the calculations, it was found that these values were being treated as floating values. These values were converted to decimals to ensure consistency through the process.

In V2.0.1.0, the series was generated using station values as decimals as originally intended. Changes to the series were minor with all temperature differences within a tenth of a degree:

- 79 changes to the CET mean series
- 66 changes to the CET min series
- 64 changes to the CET max series

5. Internal CET Series rounding

As well as making the above corrections, the CET min/mean/max values are now only rounded to 1 decimal place at the end of the update process as opposed to during the generation of the series. This ensures consistency and avoids any unnecessary rounding of values through the series.

This change resulted in a further small number of discrepancies, all of which were within a tenth of a degree when rounded to 1dp:

- 67 changes to the CET mean series
- 57 changes to the CET min series
- 64 changes to the CET max series

6. Appendix

6.1 LTA changes – CET Mean

All changes to mean temperature LTA values within range of uncertainty due to precision, with only the following LTA values changing by one hundredth of a degree when rounded to 1dp:

- Feb 1991-2020 +0.01C
- Apr 1981-2010 +0.01C
- Apr 1991-2020 +0.01C
- May 1961-1990 -0.01C
- May 1971-2000 -0.01C
- Nov 1991-2020 +0.01C
- Dec 1981-2010 +0.01C
- Annual 1971-2000 +0.01C

Month	Current series				Refactored series				Difference			
	1961-1990	1971-2000	1981-2010	1991-2020	1961-1990	1971-2000	1981-2010	1991-2020	1961-1990	1971-2000	1981-2010	1991-2020
Jan	3.81	4.18	4.42	4.66	3.81	4.18	4.42	4.66	0.001	0.001	0.004	0.007
Feb	3.80	4.27	4.43	4.96	3.80	4.27	4.43	4.97	0.002	0.004	0.005	0.006
Mar	5.67	6.24	6.57	6.76	5.67	6.24	6.57	6.76	0.001	0.000	0.001	0.005
Apr	7.88	8.06	8.52	8.98	7.88	8.06	8.53	8.99	-0.002	-0.002	0.003	0.009
May	11.16	11.31	11.66	11.92	11.15	11.30	11.66	11.92	-0.001	-0.003	-0.003	-0.002
Jun	14.09	13.96	14.39	14.63	14.09	13.96	14.39	14.63	0.001	0.000	0.001	0.002
Jul	15.98	16.37	16.63	16.79	15.98	16.37	16.63	16.79	0.000	0.001	-0.003	-0.008
Aug	15.77	16.23	16.44	16.58	15.77	16.23	16.44	16.58	0.000	0.001	0.002	0.002
Sep	13.56	13.65	14.01	14.18	13.56	13.65	14.01	14.18	0.000	0.001	0.002	0.002
Oct	10.51	10.25	10.55	10.78	10.51	10.25	10.55	10.78	0.001	0.001	-0.001	-0.005
Nov	6.43	6.69	6.99	7.30	6.43	6.69	6.99	7.31	0.000	0.000	0.001	0.001
Dec	4.54	4.88	4.47	4.85	4.54	4.88	4.48	4.85	0.002	0.001	0.001	0.000
Year	9.46	9.70	9.95	10.23	9.46	9.71	9.95	10.23	0.000	0.001	0.001	0.002

6.2 LTA changes – CET Min

All changes to minimum temperature LTA values within range of uncertainty due to precision, with only the following LTA values changing by one hundredth of a degree when rounded to 1dp:

- Feb 1971-2000 +0.01C
- Apr 1961-1990 -0.01C
- Apr 1991-2020 -0.01C
- May 1971-2000 -0.01C
- June 1981-2010 +0.01C
- July 1991-2020 -0.01C
- Aug 1971-2000 +0.01C

Month	Current series				Refactored series				Difference			
	1961-1990	1971-2000	1981-2010	1991-2020	1961-1990	1971-2000	1981-2010	1991-2020	1961-1990	1971-2000	1981-2010	1991-2020
Jan	1.16	1.47	1.65	1.87	1.16	1.47	1.65	1.87	0.000	-0.001	0.000	0.003
Feb	0.97	1.31	1.38	1.87	0.97	1.32	1.38	1.87	0.001	0.000	0.000	0.000
Mar	2.24	2.84	3.05	3.08	2.24	2.84	3.05	3.08	-0.001	0.000	-0.001	-0.003
Apr	3.92	4.03	4.28	4.62	3.91	4.03	4.28	4.61	-0.002	-0.002	-0.001	-0.002
May	6.72	6.74	7.10	7.35	6.72	6.73	7.10	7.35	-0.002	-0.001	0.001	0.002
Jun	9.64	9.54	9.89	10.08	9.64	9.54	9.90	10.08	0.002	0.001	0.002	0.005
Jul	11.59	11.80	12.05	12.16	11.59	11.80	12.05	12.15	0.000	0.000	-0.001	-0.002
Aug	11.45	11.70	12.00	12.23	11.45	11.71	12.00	12.23	0.001	0.001	0.001	0.000
Sep	9.59	9.68	10.01	10.12	9.59	9.68	10.01	10.12	-0.003	-0.002	0.000	0.002
Oct	7.10	6.85	7.16	7.39	7.10	6.85	7.16	7.39	-0.001	-0.001	-0.002	0.001
Nov	3.52	3.75	4.06	4.36	3.52	3.75	4.06	4.36	-0.001	-0.001	-0.002	-0.003
Dec	1.89	2.23	1.75	2.07	1.89	2.23	1.75	2.07	0.000	-0.001	0.001	0.003
Year	5.84	6.02	6.23	6.46	5.84	6.02	6.23	6.46	0.000	-0.001	0.000	0.000

6.3 LTA changes – CET Max

All changes to maximum temperature LTA values within range of uncertainty due to precision, with only the following LTA values changing by one hundredth of a degree when rounded to 1dp:

- Jan 1961-1990 -0.01C
- Feb 1991-2020 -0.01C
- Mar 1991-2020 -0.01C
- Sep 1991-2020 -0.01C
- Nov 1961-1990 +0.01C
- Dec 1991-2020 -0.01C

Month	Current series				Refactored series				Difference			
	1961-1990	1971-2000	1981-2010	1991-2020	1961-1990	1971-2000	1981-2010	1991-2020	1961-1990	1971-2000	1981-2010	1991-2020
Jan	6.47	6.89	7.20	7.45	6.46	6.89	7.20	7.45	-0.002	0.000	0.001	0.000
Feb	6.63	7.23	7.49	8.07	6.63	7.23	7.49	8.06	0.001	0.001	0.000	-0.002
Mar	9.10	9.64	10.10	10.45	9.10	9.64	10.10	10.44	0.000	0.001	-0.001	-0.003
Apr	11.85	12.09	12.77	13.37	11.85	12.09	12.77	13.37	0.000	0.000	0.001	0.003
May	15.59	15.87	16.21	16.49	15.59	15.87	16.21	16.49	-0.002	-0.002	-0.003	-0.003
Jun	18.54	18.38	18.88	19.17	18.54	18.38	18.88	19.17	0.000	0.000	0.001	0.000
Jul	20.37	20.94	21.21	21.42	20.37	20.94	21.21	21.42	0.000	-0.001	-0.001	0.001
Aug	20.10	20.75	20.89	20.93	20.10	20.75	20.89	20.93	0.000	0.000	0.000	-0.001
Sep	17.52	17.62	18.01	18.24	17.52	17.62	18.01	18.23	0.000	0.000	0.000	-0.001
Oct	13.92	13.65	13.94	14.17	13.92	13.65	13.94	14.17	0.000	0.002	-0.001	-0.001
Nov	9.34	9.64	9.92	10.25	9.35	9.64	9.92	10.25	0.002	0.001	0.002	0.003
Dec	7.19	7.53	7.20	7.64	7.19	7.53	7.20	7.63	0.001	0.001	-0.001	-0.005
Year	13.09	13.39	13.68	14.00	13.09	13.39	13.68	14.00	0.000	0.000	0.000	-0.001

References

Parker, D. E., Legg, T. P., & Folland, C. K. (1992). A new daily central England temperature series, 1772–1991. *International Journal of Climatology*, 12(4), 317–342. <https://doi.org/10.1002/joc.3370120402>

Parker, D., & Horton, B. (2005). Uncertainties in central England temperature 1878-2003 and some improvements to the maximum and minimum series. *International Journal of Climatology*, 25(9), 1173–1188. <https://doi.org/10.1002/joc.1190>