

LONG TERM TRENDS IN AIR TEMPERATURE AT NETTLECOMBE COURT, SOMERSET, AND THE REGIONAL CONTEXT

SIMON RATSEY

Formerly of the Leonard Wills Field Centre, Nettlecombe Court, Somerset

Long term weather station monitoring of the climate at Nettlecombe Court provided a very detailed daily record of temperatures, rainfall and other weather phenomena extending back to 1968. Observations over the years indicated that Nettlecombe Court is both a sun-trap as well as a frost pocket, with unusual extremes of temperature recorded. The data series for Nettlecombe Court shows a 1°C rise in mean annual temperature during the past half-century, with a distinct period of acceleration in the rate of increase in the last two decades of the 20th century.

INTRODUCTION

In 1968, the FSC commenced observing the weather at Nettlecombe Court, the site being the only low-altitude non-coastal UK Meteorological Office (UKMO) climate station in the western half of Somerset. With few interruptions, mostly involving the breakage of thermometers, observations at 0900 GMT provided a very detailed daily record of temperatures, rainfall and other weather phenomena for nearly half a century. In the second decade of the present century, changing circumstances dictated that few if any Field Centre staff were living on site and daily observations at 0900 GMT consequently became increasingly irregular. This situation was exacerbated in 2020 by the effects of Covid-19, with the Field Centre closed and just a skeleton staff carrying out essential maintenance.

UKMO updates its climate reference period at the end of each decade. In line with this practice, at the end of 2020 it was considered desirable that an updated temperature time series for Nettlecombe Court should be created. Such a data base would allow comparisons to be made between mean temperatures for the period 1991 – 2020 with those for the period 1971 – 2000, the first three complete decades of daily weather observations at the site. In that context, this paper serves as a supplement to the detailed study of local weather and climate in the area previously published in this journal (Ratsey, 2018).

Previous data analysis demonstrated that at Nettlecombe the fairly strong maritime influence results in a seasonal temperature regime similar to that of the UKMO England South-West/Wales South region, although the mean annual temperature is close to that of the UKMO England South region. The author's own observation site in Wellington, in a more inland situation some 20 km south-east of Nettlecombe, has a temperature regime that is very representative of Southern England, with a significantly greater annual range of temperature than at Nettlecombe. (See Appendix 1.)

SOURCING THE DATA

The lack of observed data in recent years presented a serious challenge to creating an internally consistent data base, but the operation of an automatic weather station (AWS) at Nettlecombe for most of the period affected meant that some temperature and rainfall data had been collected. It had previously been noted that diurnal mean temperatures recorded by the AWS were broadly similar to those observed in the Stevenson Screen at the site, but with the suggestion of a reduced mean diurnal range. In order to create a complete temperature series up to the end of 2020, the daily readings of maximum and minimum temperatures (in Fahrenheit) for about three-and-a-half years were extracted from the AWS archive.

There remained the problem of missing data from before the AWS was installed, as well as for those periods when it ceased to function, which was sometimes for months. The only possible option was to refer to the complete daily data sets from the author's own non-standard climate station. Many comparisons had already been made between the patterns of temperature and rainfall at the two sites, in the production of the earlier paper referred to above. The large quantity of daily data collected at each site during the same thirty-year period demonstrated the ways in which diurnal temperatures correspond or diverge at the two sites, depending on the season and the prevailing pattern of weather.

To provide probable values of maximum and minimum temperatures where actual measurements were missing from the Nettlecombe time series, readings taken at the Wellington site were weighted appropriately and added to the data sets. A Nettlecombe time series of daily maximum and minimum temperatures for the period 1991 – 2020 was thus achieved, about 6% (some 1300 out of almost 22,000) of the values having been estimated in the way described.

PROCESSING THE DATA

Recognising the need for statistical integrity, it was decided to carry out detailed analysis of monthly mean maxima and minima as recorded by the AWS. For the period January 2018 – December 2020, the deviations of individual monthly values from the 1981 – 2010 mean were calculated. Similar calculations were carried out for the comparable period using data from the UKMO time series for the England South climate region, and from the Wellington observation site. Unsurprisingly, correlation coefficients between the equivalent sets of data were high (generally >0.94), with the mean minimum temperature during that three-year period being close to 0.6°C above the 1981 – 2010 average in all three data sets.

However, a problem was identified with the maximum temperatures, which prompted further close scrutiny. At Nettlecombe Court, according to the AWS data, the mean deviation of maximum temperatures for 2018 – 2020 was



0.46°C above the long-term average, significantly lower than the calculated values of +0.81°C for the UKMO England South-West/Wales South region, and +0.96°C for the England South region. The processing of equivalent data from the author’s Wellington site and the inland UKMO climate station at RNAS Yeovilton resulted in values of +1.03°C and +1.09°C, respectively.

In the quest to establish whether the Nettlecombe discrepancy was real, data were extracted from a sample of earlier years when observations were still made, and tested against data from the other sites. Monthly mean deviations of both minimum and maximum temperatures over the long term were found to be remarkably consistent across the data sets. The conclusion drawn from this analysis was that the AWS at Nettlecombe under-recorded daily maximum temperatures by, on average, about 0.5°C. This gave an actual value to something that had long been suspected, but also constituted a slight impediment in the process of calculating accurate mean temperature values for the period 1991 – 2020. Would the upward adjustment of maximum temperatures for the last forty-plus months of the Nettlecombe series correct or distort the final 30-year mean value?

Recognising the potential for inaccuracies within the estimated data sets, it was felt that tests should be devised to indicate the reliability of the results of this exercise. It was decided to compare monthly mean temperatures for the entire 1991 – 2020 series with those for the period 1991 – 2015, before the start of significant interruptions to daily observations at Nettlecombe. Comparisons were also made for the same periods using data from Wellington, site data from RNAS Yeovilton, and regional data for England South, and England South-West/Wales South. The results are summarised in Table 1, which incidentally highlights the overall relative warmth of the most recent five-year period. It is apparent that the changes in mean values have been fairly consistent across the five data sets, Wellington showing the greatest difference and the UKMO England South-West/Wales South region the smallest. (An apparently accelerating rate of warming in Wellington remains unexplained. The observation site has not changed, but the built-up area of the town has increased significantly in the past decade. One possibility is, therefore, an enhanced “heat-island” effect during the summer half of the year.)

Prior to the adjustment to Nettlecombe’s mean maxima, the difference between the annual mean temperature for the thirty-year period and that for the twenty-five year period was just under +0.06°C. March, April, October and November all showed a negative divergence. The upward adjustment of mean maxima would appear to have brought the figures more in line with those for the region as a whole, only November now showing a slight overall reduction in mean temperature, in common with the other data sets. It was therefore concluded that the 1991 – 2020 Nettlecombe data series thus created was accurate enough to be regarded as representative of reality.

TABLE 1. Difference between 1991 - 2020 monthly mean temperatures and 1991 - 2015 mean temperatures: comparisons between selected sites and regions. (°C).

| Site | Year | J | F | M | A | M | J | J | A | S | O | N | D | Yr |
|--|-----------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| Nettlecombe Court | 1991/2020 | 5.48 | 5.50 | 6.90 | 8.83 | 11.63 | 14.32 | 16.17 | 16.07 | 14.05 | 11.20 | 8.11 | 5.91 | 10.34 |
| | 1991/2015 | 5.37 | 5.36 | 6.87 | 8.81 | 11.52 | 14.14 | 16.04 | 16.01 | 13.93 | 11.15 | 8.19 | 5.67 | 10.25 |
| | Diff | 0.11 | 0.14 | 0.03 | 0.02 | 0.09 | 0.18 | 0.13 | 0.06 | 0.12 | 0.05 | -0.08 | 0.24 | 0.09 |
| UKMO England South-West & Wales South region | 1991/2020 | 5.03 | 5.10 | 6.63 | 8.63 | 11.43 | 14.10 | 15.93 | 15.80 | 13.83 | 10.84 | 7.70 | 5.53 | 10.04 |
| | 1991/2015 | 4.96 | 5.00 | 6.60 | 8.55 | 11.32 | 13.92 | 15.84 | 15.76 | 13.80 | 10.84 | 7.76 | 5.36 | 9.97 |
| | Diff | 0.07 | 0.10 | 0.03 | 0.08 | 0.11 | 0.18 | 0.09 | 0.04 | 0.03 | 0.00 | -0.06 | 0.17 | 0.07 |
| UKMO England South region | 1991/2020 | 4.75 | 4.97 | 6.79 | 9.06 | 12.00 | 14.86 | 16.98 | 16.81 | 14.40 | 11.07 | 7.53 | 5.13 | 10.36 |
| | 1991/2015 | 4.67 | 4.84 | 6.76 | 8.98 | 11.88 | 14.70 | 16.85 | 16.73 | 14.35 | 11.05 | 7.55 | 4.97 | 10.28 |
| | Diff | 0.08 | 0.13 | 0.03 | 0.08 | 0.12 | 0.16 | 0.13 | 0.08 | 0.05 | 0.02 | -0.02 | 0.16 | 0.08 |
| Wellington | 1991/2020 | 4.86 | 5.10 | 7.03 | 9.24 | 12.37 | 15.34 | 17.13 | 16.67 | 14.13 | 10.76 | 7.42 | 5.08 | 10.43 |
| | 1991/2015 | 4.76 | 4.97 | 6.98 | 9.08 | 12.17 | 15.14 | 16.94 | 16.55 | 14.00 | 10.69 | 7.44 | 4.84 | 10.30 |
| | Diff | 0.10 | 0.13 | 0.05 | 0.16 | 0.20 | 0.20 | 0.19 | 0.12 | 0.13 | 0.07 | -0.02 | 0.24 | 0.13 |
| Yeovilton | 1991/2020 | 5.29 | 5.38 | 7.10 | 9.19 | 12.25 | 15.12 | 17.09 | 16.92 | 14.62 | 11.43 | 7.95 | 5.65 | 10.67 |
| | 1991/2015 | 5.20 | 5.24 | 7.05 | 9.06 | 12.10 | 14.95 | 16.93 | 16.81 | 14.53 | 11.43 | 7.98 | 5.45 | 10.56 |
| | Diff | 0.09 | 0.14 | 0.05 | 0.13 | 0.15 | 0.17 | 0.16 | 0.11 | 0.09 | 0.00 | -0.03 | 0.20 | 0.12 |

OBSERVED CHANGES IN MEAN TEMPERATURES

Figures 1A and 1B together depict in graphical form the diurnal mean temperatures at Nettlecombe Court for the whole year, comparing the new reference period 1991 – 2020 with 1971 – 2000. Changes through the seasons have clearly always been erratic, especially in the first half of the year. The immediate impression is one of overall warming, the difference being very marked at certain times in the year. Figure 1A shows that, on average, mid-January and mid-February are well over a degree warmer in the more recent period, the coldest week of the winter now occurring in late January rather than mid-February. The first week of March is one of the few spells that is shown to be cooler now, followed by a surge in diurnal mean temperatures of almost 3°C in the next twelve days. The negative anomaly at the beginning of March can be perhaps be attributed to this often being a period of weak upper atmospheric circulation, allowing a southward invasion by Polar or Arctic air. The daily temperature records indicate that in ten of the last twenty years there was a distinctly cold snap at this time.

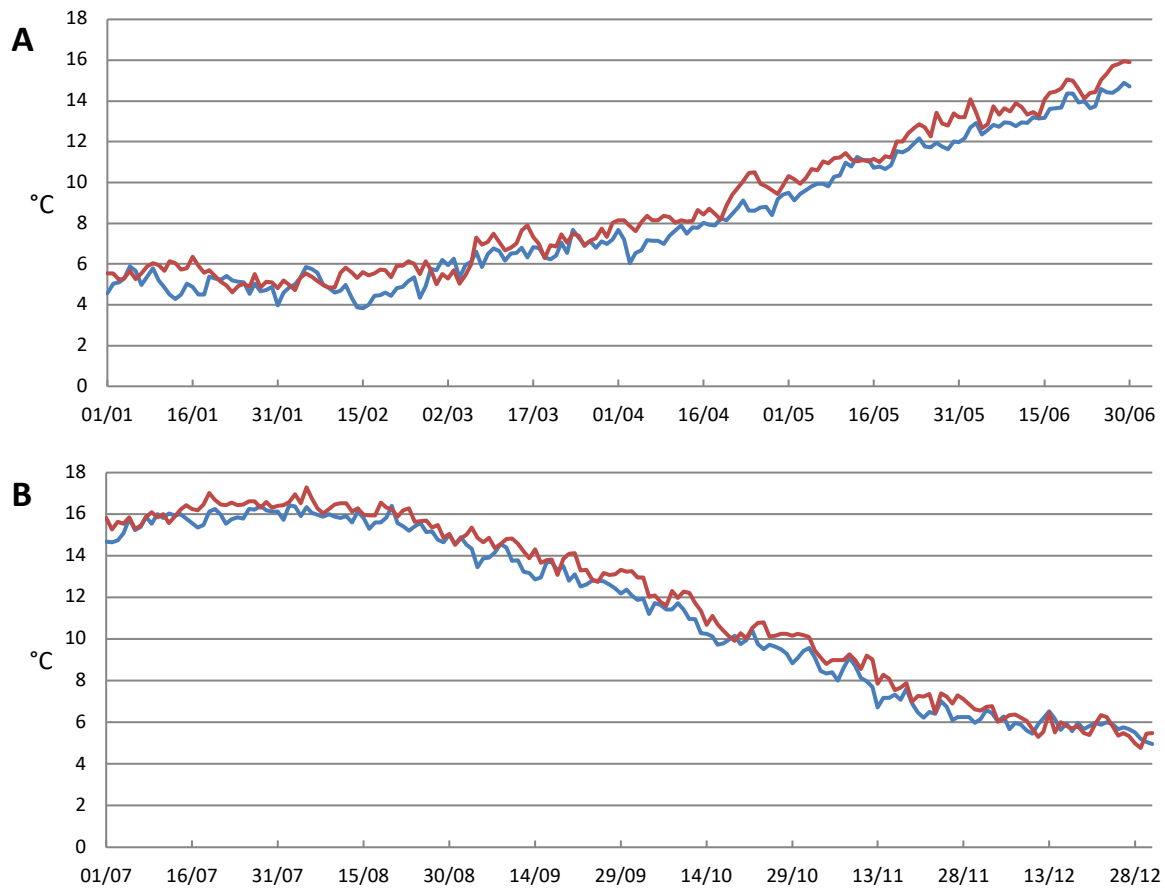


FIGURE 1. Nettlecombe Court Daily Mean Temperatures 1971 - 2000 (blue) and 1991 - 2020 (red).
A: January 1st - June 30th. B: July 1st - December 31st.

From mid-March, the advance of spring appears to be gradual until the third week of April when diurnal mean temperatures increase by more than 2°C in five days, before relapsing slightly. There remains a significant pause in the warming process in mid-May, followed by a strong but erratic warming signal towards midsummer. The slightly counter-intuitive cooler spell at the time of the summer solstice, noted in the earlier paper, would seem to persist through time. (Output from the author's domestic solar PV installation indicates this has on average been a noticeably dull week during the past decade, at least. The reasons for this are unclear.) Figure 1B suggests a rather slight increase in temperatures through July and August, but there appears to be a more marked increase in autumnal warming.

Looking at the data in more detail, it is evident that the changes in daily mean maxima and minima (depicted in Figures 2A and 2B, 3A and 3B) show slightly different patterns. Mean maxima are almost always higher in the later reference period, notably so in several spells during the first half of the year (Figure 2A). In contrast, diurnal mean minima appear to show little overall change until late spring, after which there seems to be a clearer warming trend, it being most marked in autumn (figure 3B). It has previously been noted that the average date of the first air frost in autumn is now about two weeks later than was the case in the early years of the Nettlecombe series.

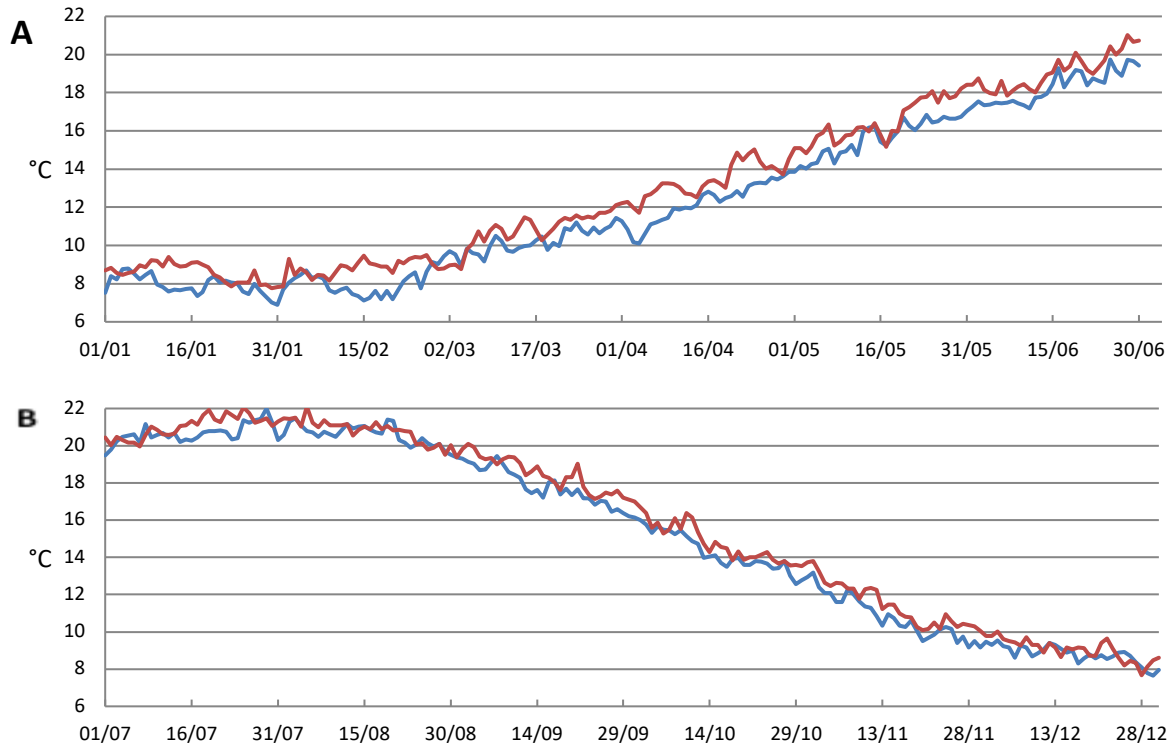


FIGURE 2. Nettlecombe Court: Daily Mean Maximum Temperatures 1971 - 2000 (blue) and 1991 - 2020 (red).
A: January 1st - June 30th. B: Daily July 1st - December 31st.

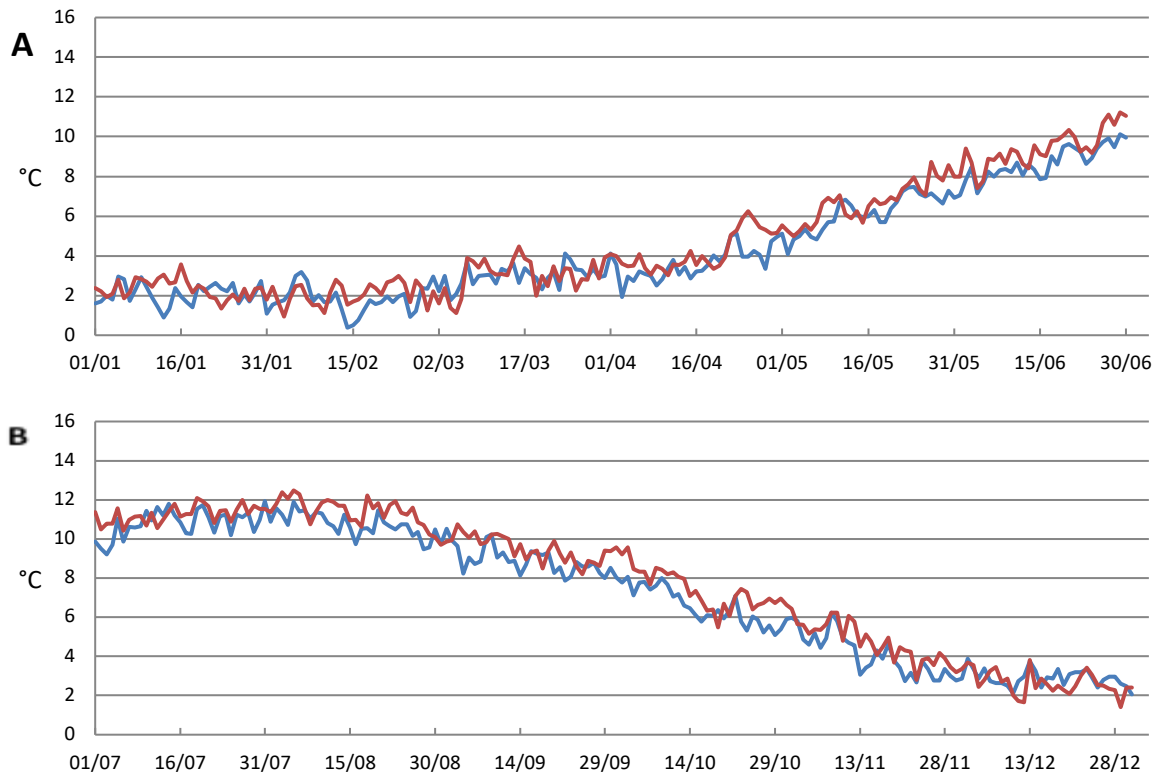


FIGURE 3. Nettlecombe Court: Daily Mean Minimum Temperatures 1971 - 2000 (blue) and 1991 - 2020 (red).
A: January 1st - June 30th. B: July 1st - December 31st.

Using the adjusted data, monthly mean temperatures for the period 1991 – 2020 were calculated, and compared with those for the periods 1971 - 2000 and 1981 – 2010, for Nettlecombe Court, for Wellington, and for the UKMO regions England South-West/Wales South, and England South. These are shown in Tables 2A – 2D. The author’s data collected



since 1960 had already indicated a temperature rise of almost 0.3°C in mean annual temperature for each successive update of the thirty-year reference period. This is seen to be broadly in line with the changes shown by the data for Nettlecombe Court, Yeovilton, and the two UKMO climate regions.

TABLE 2. Changes in mean temperatures (°C) over time: a comparison of sites and regions.

| A Nettlecombe Court | | | | | B England SW/Wales S | | | | |
|----------------------------|-------------|--------------|--------------|-------------|-----------------------------|-------------|-------------|--------------|-------------|
| | A | B | C | Diff. | | A | B | C | Diff. |
| | 1971/2000 | 1981/2010 | 1991/2020 | C - A | | 1971/2000 | 1981/2010 | 1991/2020 | C - A |
| Jan | 4.9 | 5.2 | 5.5 | 0.6 | Jan | 4.5 | 4.8 | 5.0 | 0.5 |
| Feb | 4.9 | 5.0 | 5.5 | 0.6 | Feb | 4.5 | 4.6 | 5.1 | 0.6 |
| Mar | 6.6 | 6.9 | 6.9 | 0.3 | Mar | 6.1 | 6.5 | 6.6 | 0.5 |
| Apr | 8.0 | 8.4 | 8.8 | 0.8 | Apr | 7.7 | 8.2 | 8.6 | 0.9 |
| May | 10.9 | 11.3 | 11.6 | 0.7 | May | 10.8 | 11.2 | 11.4 | 0.6 |
| Jun | 13.5 | 14.1 | 14.3 | 0.8 | Jun | 13.3 | 13.8 | 14.1 | 0.8 |
| Jul | 15.8 | 16.1 | 16.2 | 0.4 | Jul | 15.6 | 15.8 | 15.9 | 0.3 |
| Aug | 15.7 | 16.0 | 16.1 | 0.4 | Aug | 15.5 | 15.7 | 15.8 | 0.3 |
| Sep | 13.4 | 13.8 | 14.1 | 0.7 | Sep | 13.2 | 13.6 | 13.8 | 0.6 |
| Oct | 10.5 | 10.8 | 11.2 | 0.7 | Oct | 10.3 | 10.6 | 10.8 | 0.5 |
| Nov | 7.5 | 7.7 | 8.1 | 0.6 | Nov | 7.1 | 7.4 | 7.7 | 0.6 |
| Dec | 5.8 | 5.4 | 5.9 | 0.1 | Dec | 5.5 | 5.2 | 5.5 | 0.0 |
| Year | 9.76 | 10.06 | 10.34 | 0.58 | Year | 9.50 | 9.78 | 10.02 | 0.52 |

| C England S | | | | | D Wellington | | | | |
|--------------------|-------------|--------------|--------------|-------------|---------------------|-------------|--------------|--------------|-------------|
| | A | B | C | Diff. | | A | B | C | Diff. |
| | 1971/2000 | 1981/2010 | 1991/2020 | C - A | | 1971/2000 | 1981/2010 | 1991/2020 | C - A |
| Jan | 4.2 | 4.4 | 4.8 | 0.6 | Jan | 4.2 | 4.6 | 4.8 | 0.6 |
| Feb | 4.2 | 4.4 | 5.0 | 0.8 | Feb | 4.4 | 4.7 | 5.1 | 0.7 |
| Mar | 6.2 | 6.6 | 6.8 | 0.6 | Mar | 6.5 | 6.9 | 7.0 | 0.5 |
| Apr | 8.0 | 8.5 | 9.1 | 1.1 | Apr | 8.2 | 8.7 | 9.2 | 1.0 |
| May | 11.2 | 11.7 | 12.0 | 0.8 | May | 11.6 | 12.0 | 12.4 | 0.8 |
| Jun | 14.0 | 14.5 | 14.9 | 0.9 | Jun | 14.6 | 15.0 | 15.3 | 0.7 |
| Jul | 16.4 | 16.8 | 17.0 | 0.6 | Jul | 16.6 | 16.9 | 17.1 | 0.5 |
| Aug | 16.3 | 16.6 | 16.8 | 0.5 | Aug | 16.2 | 16.5 | 16.7 | 0.5 |
| Sep | 13.8 | 14.2 | 14.4 | 0.6 | Sep | 13.4 | 13.9 | 14.1 | 0.7 |
| Oct | 10.5 | 10.8 | 11.1 | 0.6 | Oct | 10.1 | 10.4 | 10.8 | 0.7 |
| Nov | 6.8 | 7.2 | 7.5 | 0.7 | Nov | 6.7 | 7.1 | 7.4 | 0.7 |
| Dec | 5.1 | 4.8 | 5.1 | 0.0 | Dec | 5.0 | 4.7 | 5.1 | 0.1 |
| Year | 9.73 | 10.04 | 10.37 | 0.64 | Year | 9.79 | 10.11 | 10.41 | 0.62 |

Closer scrutiny of the data for mean maxima and mean minima produced an interesting result. Table 3A shows that at Nettlecombe the mean maximum rose by almost 0.7°C between 1971 - 2000 and 1991 - 2020, and the mean minimum (Table 3B) by almost 0.5°C, both values found to be only marginally less than for the England South region. For England South-West/Wales South, both values are found to have increased by 0.5°C. In considering possible reasons for the lower rate of increase in maxima in the latter region, it has already been noted that data from certain inland sites appear to show an accelerating rise in mean maxima. In view of the fact that most of the climate stations in South-West England and South Wales are in coastal or upland locations, it is suggested here that maritime influences may be the factor responsible for slowing down the warming process in the region as a whole.

TABLE 3. Nettlecombe Court: Changes in mean (A) maximum and (B) minimum temperatures over time.

| A Mean monthly and annual maxima (°C) | | | | | B Mean monthly and annual minima (°C) | | | | |
|--|--------------|--------------|--------------|-------------|--|-------------|-------------|-------------|-------------|
| | A | B | C | Diff. | | A | B | C | Diff. |
| | 1971-2000 | 1981-2010 | 1991-2020 | C - A | | 1971-2000 | 1981-2010 | 1991-2020 | C - A |
| Jan | 7.9 | 8.2 | 8.6 | 0.7 | Jan | 1.9 | 2.1 | 2.3 | 0.4 |
| Feb | 8.0 | 8.2 | 8.8 | 0.8 | Feb | 1.7 | 1.8 | 2.1 | 0.4 |
| Mar | 10.2 | 10.6 | 10.8 | 0.6 | Mar | 3.0 | 3.2 | 3.0 | 0.0 |
| Apr | 12.3 | 12.9 | 13.4 | 1.1 | Apr | 3.6 | 3.9 | 4.2 | 0.6 |
| May | 15.6 | 16.1 | 16.5 | 0.9 | May | 6.1 | 6.5 | 6.7 | 0.6 |
| Jun | 18.3 | 18.9 | 19.2 | 0.9 | Jun | 8.8 | 9.2 | 9.5 | 0.7 |
| Jul | 20.6 | 20.9 | 21.1 | 0.5 | Jul | 10.9 | 11.2 | 11.3 | 0.4 |
| Aug | 20.5 | 20.7 | 20.7 | 0.2 | Aug | 10.8 | 11.2 | 11.5 | 0.7 |
| Sep | 17.8 | 18.3 | 18.5 | 0.7 | Sep | 9.0 | 9.3 | 9.6 | 0.6 |
| Oct | 14.2 | 14.5 | 14.9 | 0.7 | Oct | 6.7 | 7.1 | 7.5 | 0.8 |
| Nov | 10.8 | 11.1 | 11.4 | 0.6 | Nov | 4.1 | 4.4 | 4.8 | 0.7 |
| Dec | 8.8 | 8.6 | 9.1 | 0.3 | Dec | 2.8 | 2.2 | 2.7 | -0.1 |
| Year | 13.75 | 14.08 | 14.42 | 0.67 | Year | 5.78 | 6.01 | 6.27 | 0.49 |

The monthly data appear to show that there has been a slightly greater warming in the autumn at Nettlecombe than was shown by the UKMO regional data, and a reduced rate of warming in spring, especially in March, which shows no overall increase in mean minimum temperatures during the period of the records. There is some evidence from historic data that Nettlecombe Court has a most unusual microclimate, being positioned in a frost-pocket relatively near the coast. Spring-time warming can be a slow process, resulting from the combination of topography-induced late frosts,



and low sea surface temperatures in the Bristol Channel. In contrast, that same body of water in autumn remains a source of warmth, the effect in some years lasting through the winter into February.

Table 4 shows the Top Five warmest and coldest mean temperatures so far recorded for each month at Nettlecombe Court, and the year of occurrence. It is immediately obvious from Table 4A that the majority of particularly warm months have occurred in the 21st century, and five out six of them from 1990 onwards. All five of the warmest Septembers occurred in the space of just twelve years, with four out of five warmest Februarys, Aprils, Junes and Octobers in the past twenty years. In Table 4B, there are only six instances of 21st century months in the Top Five for coldness. These include March 2013 and December 2010, both of them being coldest in their series by a clear margin.

TABLE 4. Nettlecombe Court: Top Five (A) warmest and (B) coldest months.

| A | | | | | | | | | | | | | | | | | |
|---|-----|------|----------|-----|------|-------|-----|------|-------|-----|------|------|-----|------|------|-----|------|
| Mean temperature and deviation (dv) from 1981 - 2000 average (°C), and year of occurrence | | | | | | | | | | | | | | | | | |
| January | | | February | | | March | | | April | | | May | | | June | | |
| M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr |
| 7.6 | 2.4 | 1990 | 8.2 | 3.2 | 1990 | 8.7 | 1.8 | 1981 | 11.7 | 3.3 | 2011 | 13.1 | 1.8 | 2008 | 16.0 | 1.9 | 1976 |
| 7.4 | 2.2 | 1975 | 7.6 | 2.6 | 2002 | 8.4 | 1.5 | 2017 | 11.1 | 2.7 | 2007 | 12.9 | 1.6 | 1992 | 15.8 | 1.7 | 2018 |
| 7.4 | 2.2 | 2007 | 7.2 | 2.2 | 2020 | 8.3 | 1.4 | 1989 | 10.0 | 1.6 | 2020 | 12.7 | 1.4 | 2017 | 15.8 | 1.7 | 2004 |
| 7.3 | 2.1 | 2008 | 7.1 | 2.1 | 2011 | 8.0 | 1.1 | 2002 | 9.8 | 1.4 | 2003 | 12.6 | 1.3 | 1998 | 15.5 | 1.4 | 2005 |
| 6.9 | 1.7 | 2020 | 7.0 | 2.0 | 2019 | 8.0 | 1.1 | 2019 | 9.6 | 1.2 | 1987 | 12.5 | 1.2 | 1999 | 15.4 | 1.3 | 2006 |

| B | | | | | | | | | | | | | | | | | |
|---|-----|------|----------|-----|------|-------|-----|------|-------|-----|------|------|-----|------|------|-----|------|
| Mean temperature and deviation (dv) from 1981 - 2000 average (°C), and year of occurrence | | | | | | | | | | | | | | | | | |
| January | | | February | | | March | | | April | | | May | | | June | | |
| M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr |
| 18.7 | 2.6 | 1983 | 18.4 | 2.4 | 1995 | 16.3 | 2.5 | 2006 | 13.6 | 2.8 | 2001 | 10.9 | 3.2 | 2015 | 11.2 | 5.8 | 2015 |
| 18.2 | 2.1 | 2006 | 18.3 | 2.3 | 1997 | 15.8 | 2.0 | 2016 | 13.4 | 2.6 | 1995 | 10.8 | 3.1 | 1994 | 8.7 | 3.3 | 1974 |
| 17.9 | 1.8 | 2013 | 17.9 | 1.9 | 2003 | 15.1 | 1.3 | 2004 | 13.3 | 2.5 | 2005 | 9.9 | 2.2 | 2011 | 8.1 | 2.7 | 1988 |
| 17.6 | 1.5 | 1995 | 17.6 | 1.6 | 1975 | 15.1 | 1.3 | 2011 | 13.2 | 2.4 | 2006 | 9.5 | 1.8 | 2002 | 8.1 | 2.7 | 2018 |
| 17.6 | 1.5 | 2018 | 17.1 | 1.1 | 1990 | 15.0 | 1.2 | 2005 | 13.1 | 2.3 | 2017 | 9.3 | 1.6 | 1997 | 7.0 | 1.6 | 1977 |

| B | | | | | | | | | | | | | | | | | |
|---|------|------|----------|------|------|-------|------|------|-------|------|------|------|------|------|------|------|------|
| Mean temperature and deviation (dv) from 1981 - 2000 average (°C), and year of occurrence | | | | | | | | | | | | | | | | | |
| January | | | February | | | March | | | April | | | May | | | June | | |
| M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr |
| 0.9 | -4.3 | 1987 | -1.1 | -6.1 | 1986 | 3.1 | -3.8 | 2013 | 5.6 | -2.8 | 1986 | 9.0 | -2.3 | 1996 | 11.1 | -3.0 | 1972 |
| 1.0 | -4.2 | 1979 | 1.5 | -3.5 | 1991 | 4.3 | -2.6 | 1969 | 6.5 | -1.9 | 1978 | 9.1 | -2.2 | 1979 | 11.8 | -2.3 | 1977 |
| 1.8 | -3.4 | 1985 | 1.6 | -3.4 | 1979 | 4.3 | -2.6 | 2018 | 6.6 | -1.8 | 1983 | 9.6 | -1.7 | 1983 | 12.0 | -2.1 | 1991 |
| 2.0 | -3.2 | 2010 | 1.9 | -3.1 | 1969 | 4.6 | -2.3 | 1970 | 7.1 | -1.3 | 1989 | 9.7 | -1.6 | 1984 | 12.4 | -1.7 | 1971 |
| 2.2 | -3.0 | 1980 | 2.3 | -1.7 | 1983 | 4.7 | -2.2 | 1984 | 7.2 | -1.2 | 2013 | 10.0 | -1.3 | 1972 | 12.6 | -1.5 | 1979 |

| B | | | | | | | | | | | | | | | | | |
|---|------|------|--------|------|------|-----------|------|------|---------|------|------|----------|------|------|----------|------|------|
| Mean temperature and deviation (dv) from 1981 - 2000 average (°C), and year of occurrence | | | | | | | | | | | | | | | | | |
| July | | | August | | | September | | | October | | | November | | | December | | |
| M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr | M | dv | Yr |
| 13.8 | -2.3 | 1980 | 13.4 | -2.6 | 1986 | 10.2 | -3.6 | 1986 | 7.6 | -3.2 | 1993 | 4.6 | -3.1 | 1985 | 1.0 | -4.4 | 2010 |
| 14.4 | -1.7 | 1978 | 13.5 | -2.5 | 1979 | 10.9 | -2.9 | 1972 | 7.9 | -2.9 | 1992 | 5.2 | -2.5 | 1993 | 1.7 | -3.7 | 1981 |
| 14.6 | -1.5 | 1988 | 14.1 | -1.9 | 1993 | 11.8 | -2.0 | 1993 | 8.4 | -2.4 | 1974 | 6.0 | -1.7 | 1988 | 2.9 | -2.5 | 1995 |
| 14.8 | -1.3 | 1979 | 14.3 | -1.7 | 1978 | 11.9 | -1.9 | 1974 | 8.7 | -2.1 | 1981 | 6.0 | -1.7 | 2010 | 3.0 | -2.4 | 1976 |
| 14.8 | -1.3 | 1973 | 14.5 | -1.5 | 1974 | 12.4 | -1.4 | 2015 | 9.1 | -1.7 | 1980 | 6.3 | -1.4 | 1969 | 3.1 | -2.3 | 1996 |

Also worthy of note is the difference between the coldest and warmest Decembers, occurring within the space of six years. These data tend to confirm the belief among many climate scientists that, despite a generally strong warming trend, the increasingly erratic behaviour of the atmosphere will occasionally result in unusually cold conditions affecting certain parts of the globe. (At the time of writing in the spring of 2021, a weak North Atlantic jet stream has resulted in prevailing anticyclonic conditions, with air of polar origin persisting over the British Isles. At both Nettlecombe Court and at the author’s site in Wellington there were fourteen air frosts in April, compared with the long-term average of just four. The month’s mean minimum temperature of 0.8°C in Wellington was 3.3°C below the 1991 – 2020 average, and by far the lowest on record.)

Table 5 compares mean temperatures for each season by decades since 1970. Decadal mean temperatures are shown to have increased by 1°C between the 1970s and 2010s, the most significant period of change appearing to be the 1990s. Looking at the patterns of change for the different seasons, winter was almost a degree warmer in the 2010s than in the 2000s, but the latter decade includes December 2010, on its own cold enough to skew that mean. There have been fluctuations between decades for most seasons, mean maxima in spring and mean minima in autumn being the only sets to show a positive difference for each successive decade. With circumstantial evidence that sea surface temperatures in the Bristol Channel have exceeded 18°C in some recent summers, it is unsurprising that mean minimum temperatures in autumn have shown such a marked increase (Table 5C). Mean maxima in spring were a remarkable 1.6°C warmer in the most recent decade than in the 1970s (Table 5B), in contrast to spring mean minima which have changed erratically, with an apparently significant cooling in the 2010s. This can be attributed in part to the spring of 2013, more than 2°C cooler than the 1981 – 2010 average.

In view of the signs of warming noted above, it is no surprise that there has also been a trend towards higher annual mean temperatures at Nettlecombe in recent years. The “Warmest Year” title has changed hands seven times since the annual mean exceeded 10°C for the first time, in 1983. The current record of 11.0°C is held by 2014, with nine years in the 21st century to date occupying positions in the Top Ten. (See Appendix 2).



TABLE 5. Nettlecombe Court: Seasonal mean temperatures by decade.

| A | | | | | |
|-------------------------------|------------|------------|-------------|-------------|-------------|
| Mean diurnal temperature (°C) | | | | | |
| Decade | Winter | Spring | Summer | Autumn | Year |
| 1970s | 5.2 | 8.0 | 14.6 | 10.3 | 9.5 |
| 1980s | 5.0 | 8.4 | 15.1 | 10.4 | 9.7 |
| 1990s | 5.4 | 9.1 | 15.3 | 10.6 | 10.1 |
| 2000s | 5.2 | 9.2 | 15.6 | 11.3 | 10.3 |
| 2010s | 6.1 | 9.0 | 15.5 | 11.3 | 10.5 |
| Mean | 5.4 | 8.7 | 15.2 | 10.8 | 10.0 |

| B | | | | | |
|-------------------------------|------------|-------------|-------------|-------------|-------------|
| Mean maximum temperature (°C) | | | | | |
| Decade | Winter | Spring | Summer | Autumn | Year |
| 1970s | 8.1 | 12.1 | 19.4 | 14.1 | 13.4 |
| 1980s | 8.0 | 12.7 | 19.9 | 14.2 | 13.7 |
| 1990s | 8.6 | 13.2 | 20.2 | 14.4 | 14.1 |
| 2000s | 8.5 | 13.6 | 20.4 | 15.3 | 14.5 |
| 2010s | 9.4 | 13.7 | 20.3 | 15.0 | 14.6 |
| Mean | 8.5 | 13.1 | 20.0 | 14.6 | 14.1 |

| C | | | | | |
|-------------------------------|------------|------------|-------------|------------|------------|
| Mean minimum temperature (°C) | | | | | |
| Decade | Winter | Spring | Summer | Autumn | Year |
| 1970s | 2.3 | 3.8 | 9.9 | 6.4 | 5.6 |
| 1980s | 2.0 | 4.1 | 10.3 | 6.7 | 5.8 |
| 1990s | 2.2 | 4.9 | 10.3 | 6.9 | 6.1 |
| 2000s | 1.9 | 4.7 | 11.0 | 7.3 | 6.2 |
| 2010s | 2.9 | 4.4 | 10.8 | 7.6 | 6.4 |
| Mean | 2.3 | 4.4 | 10.5 | 7.0 | 6.0 |

FREQUENCY OF 'NOTEWORTHY' MAXIMUM TEMPERATURES

Previous analysis by the author of data from his personal recording sites had revealed significant changes in the frequency of what might be described as “noteworthy” daily maximum temperatures since 1960. Particularly noticeable was their increased frequency in the 21st century, in the majority of months of the year. This prompted a similar analysis of the Nettlecombe data from 1971 – 2020, in which the Top 100 daily maxima for each month were identified and grouped according to the decades in which they occurred. The results are shown in Table 6, and graphically in Figure 4. Immediately evident is the fact that notably high maxima were overall almost as twice as common in the last complete decade as in the 1970s. (The author’s data from the 1960s indicate that that decade had an even lower frequency of notably high maxima, at a time when some science writers were of the opinion that the signs of global cooling then being observed represented the start of a downward trend in temperatures towards the next glacial period.)

Also evident is the erratic nature of the trend towards higher temperatures, but this can be accounted for by the skewing effect of particular spells of unusually warm or hot weather. For example, heatwaves in July 1983, 1989 and 1990 accounted for the majority of that month’s decadal total, while heatwaves in June 1982 and 1989 also had a disproportionate impact. December 2015 on its own contained more notably high maxima than the combined total for all the Decembers in the 1980s. 10% of February’s total occurred in 1990, the last year of the 1980s sampling period, with a similar but slightly smaller effect created by April 1987. For such reasons, one might argue that using the decade is a very coarse sampling method, but in the present context of assessing the overall trends found in the Nettlecombe temperature record, the conclusions are fairly obvious.

TABLE 6. Distribution by decade of Top 100 daily maxima for each month.

| | 1970s | 1980s | 1990s | 2000s | 2010s | Total |
|------------------|-----------|-----------|-----------|-----------|-----------|------------|
| Jan | 7 | 9 | 20 | 34 | 30 | 100 |
| Feb | 3 | 22 | 21 | 18 | 36 | 100 |
| Mar | 12 | 13 | 16 | 29 | 30 | 100 |
| Apr | 11 | 20 | 7 | 24 | 38 | 100 |
| May | 9 | 19 | 24 | 25 | 23 | 100 |
| Jun | 17 | 22 | 13 | 29 | 19 | 100 |
| Jul | 10 | 32 | 10 | 24 | 24 | 100 |
| Aug | 23 | 18 | 33 | 17 | 9 | 100 |
| Sep | 14 | 16 | 17 | 31 | 22 | 100 |
| Oct | 22 | 11 | 13 | 23 | 31 | 100 |
| Nov | 23 | 14 | 18 | 21 | 24 | 100 |
| Dec | 17 | 12 | 23 | 16 | 32 | 100 |
| Total (n) | 168 | 208 | 215 | 291 | 318 | 1200 |
| Total (%) | 14 | 17 | 18 | 24 | 27 | 100 |

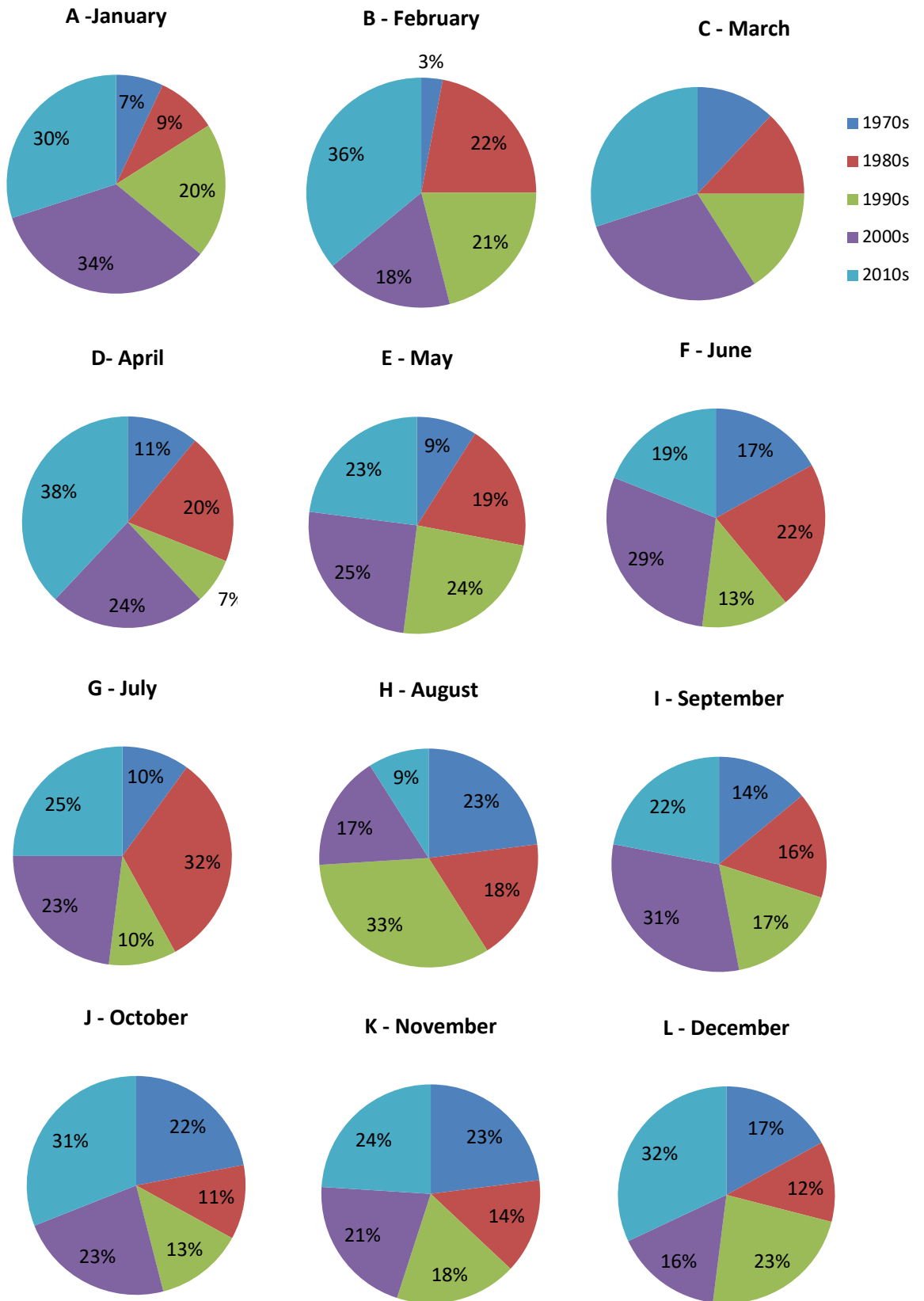


FIGURE 4. Distribution of Top 100 daily maximum

For most months of the year, what were formerly very unusual maxima have become more frequent. (Figure 4) The one exception is August, showing a significant reduction since the 1990s. Paradoxically, this does not correspond to an overall cooling of that month, ten of the last twenty Augusts being warmer than the 1981 – 2010 average. In detail, the fact that the August mean minimum at Nettlecombe in the 21st century to date is 1.4°C higher than that for 1971 – 2000 accounts for much of the observed warming. Data from other sites in the region suggest that August sunshine peaked in the 1990s, and increased cloudiness since then might account for both more high minima and fewer high maxima in the month, this subject possibly warranting further investigation. (It is worth noting here that on August 12th 2020, the AWS at Nettlecombe recorded a temperature of 92.7°F (33.7°C), which, even without an adjustment, was a new all-time record maximum at the site, surpassing the previous record of 33.3°C set on August 3rd 1990.) Looking at the other months, one sees that 30% or more of the noteworthy maxima in January, February, March, April, October and December have occurred in the last decade. This is unsurprising in view of the number of notably warm months that have occurred in the past ten years.

A different perspective on this topic can be gained by noting the frequency per decade of months with no maximum achieving a Top 100 position. This measure decreased from 64 (53% of all months) in the 1970s to 33 (28%) in the 2000s, with a slight increase in the last decade. Looking at ten-year running totals, the period 1997 – 2006 stands out, with just 24 months (or one in five) meeting the current criteria. This period included 2003, the only year in the entire series in which every month contained at least one temperature placed within the Top 100. Among other interesting individual years, 1986 included nine months with no noteworthy maximum, while seven of the ten years in the 1970s contained seven or eight such months. This is illustrated in Figure 5, showing a clear if erratic downward trend with the passage of time.

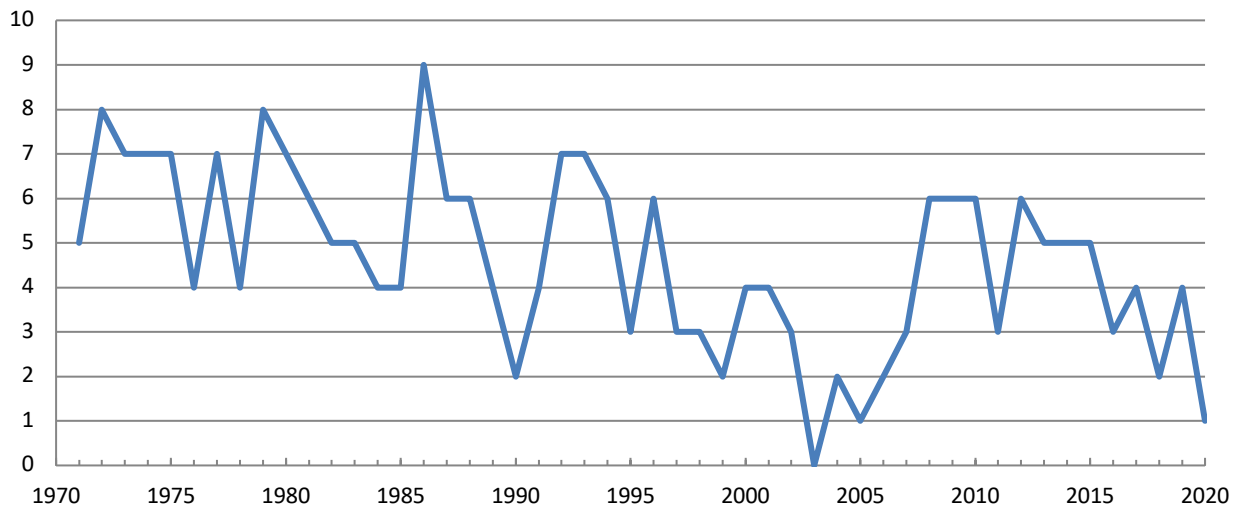


FIGURE 5. Number of months per year with no "noteworthy" maximum temperature

CONCLUSIONS

Tables 7A and 7B show the "headline" temperature statistics for the new reference period, and for comparative purposes those for the period up to 1990. Interestingly, the monthly frequency of days with maxima $\Rightarrow 21^{\circ}\text{C}$, and of nights with an air frost, does not appear to have changed greatly. Also, four of the highest monthly maxima were recorded in the earlier period, and six of the lowest monthly minima in the latter period, which might be construed as evidence that temperatures are not in fact rising overall. However, observations over the years indicate that with the site of Nettlecombe Court being a sun-trap as well as a frost pocket, highly unusual extremes of temperature have occurred throughout the period of observation. This is a phenomenon that is likely to persist irrespective of any overall changes in mean temperatures, which can be seen to have increased significantly since the start of the Nettlecombe series. As has been shown in Figure 4, noteworthy high maxima for the time of year have become more frequent in the 21st century. More than half the April days with maxima $\Rightarrow 21^{\circ}\text{C}$ have occurred just in the last decade, which also includes four of the top five warmest years on record at Nettlecombe.

It would seem that whichever measurement is employed, the data series for Nettlecombe Court shows a 1°C rise in temperature during the past half-century (see Table 5), with a distinct period of acceleration in the rate of increase in the last two decades of the 20th century. The rate of increase then slowed slightly, although the last five years have together been warm enough to positively affect the 30-year mean temperatures of eleven of the twelve months, as shown in Table 1.

Daily mean temperatures are higher than before on all but a handful of days in the year, and more than 2°C higher in mid-February. Despite that, the average date for the start of the growing season (using the generally-accepted threshold temperature of 6°C) does not appear to have changed from 6th March, but there is then a much more rapid warming-up in spring, with the growing season extending on average by ten days, well into December.

TABLE 7. "Headline" Statistics: Nettlecombe Court. Monthly ($^{\circ}\text{C}$) averages and extremes: (A) 1991 - 2020, (B) 1969 - 1990.



| A | Mean Max | Mean Min | MAT | Max 21°C or above | Min 0°C or below | Highest Max | Year | Lowest Min | Year |
|-------------|-------------|------------|-------------|-------------------|------------------|-------------|-------------|--------------|-------------|
| Jan | 8.6 | 2.3 | 5.5 | 0 | 8 | 14.8 | 1998 | -9.0 | 2009 |
| Feb | 8.8 | 2.1 | 5.5 | 0 | 8 | 18.0 | 1998 | -11.2 | 1991 |
| Mar | 10.8 | 3.0 | 6.9 | 0 | 6 | 20.0 | 2012 | -5.6 | 2018 |
| Apr | 13.4 | 4.2 | 8.8 | <1 | 3 | 23.8 | 2003 | -4.0 | 2013 |
| May | 16.5 | 6.7 | 11.6 | 3 | <1 | 27.2 | 2012 | -2.1 | 2020 |
| Jun | 19.2 | 9.5 | 14.3 | 7 | 0 | 30.3 | 2017 | 0.8 | 1991 |
| Jul | 21.1 | 11.3 | 16.2 | 14 | 0 | 30.7 | 2003 | 3.5 | 2008 |
| Aug | 20.7 | 11.5 | 16.1 | 13 | 0 | 33.7 | 2020 | 4.0 | 2014 |
| Sep | 18.5 | 9.6 | 14.1 | 5 | 0 | 25.5 | 2011 | 1.0 | 1993 |
| Oct | 14.9 | 7.5 | 11.2 | <1 | <1 | 26.6 | 2011 | -5.5 | 1993 |
| Nov | 11.4 | 4.8 | 8.1 | 0 | 4 | 17.2 | 2015 | -9.0 | 1993 |
| Dec | 9.1 | 2.7 | 5.9 | 0 | 9 | 15.0 | 2001 | -9.0 | 2010 |
| Year | 14.4 | 6.3 | 10.3 | 43 | 39 | 33.7 | 2020 | -11.2 | 1992 |

| B | Mean Max | Mean Min | MAT | Max 21°C or above | Min 0°C or below | Highest Max | Year | Lowest Min | Year |
|-------------|-------------|------------|------------|-------------------|------------------|-------------|-------------|--------------|-------------|
| Jan | 7.8 | 2.0 | 4.9 | 0 | 9 | 13.7 | 1983 | -14.0 | 1987 |
| Feb | 7.4 | 1.4 | 4.4 | 0 | 10 | 14.9 | 1990 | -9.1 | 1985 |
| Mar | 9.6 | 2.5 | 6.0 | 0 | 7 | 18.5 | 1990 | -8.8 | 1986 |
| Apr | 12.1 | 3.3 | 7.7 | <1 | 5 | 22.6 | 1990 | -4.4 | 1990 |
| May | 15.4 | 6.0 | 10.7 | 2 | <1 | 25.2 | 1989 | -2.2 | 1982 |
| Jun | 18.2 | 8.8 | 13.5 | 6 | 0 | 30.7 | 1976 | 1.3 | 1989 |
| Jul | 20.5 | 10.8 | 15.7 | 12 | 0 | 32.3 | 1976 | 3.9 | 1979 |
| Aug | 20.2 | 10.7 | 15.5 | 12 | 0 | 33.3 | 1990 | 2.9 | 1980 |
| Sep | 17.7 | 8.9 | 13.3 | 3 | 0 | 26.1 | 1982 | 0.1 | 1986 |
| Oct | 14.4 | 7.0 | 10.7 | <1 | <1 | 24.3 | 1978 | -2.2 | 1972 |
| Nov | 10.6 | 3.9 | 7.3 | 0 | 5 | 16.7 | 1978 | -5.8 | 1980 |
| Dec | 8.7 | 2.9 | 5.8 | 0 | 8 | 15.4 | 1977 | -7.8 | 1981 |
| Year | 13.6 | 5.7 | 9.6 | 36 | 44 | 33.3 | 1990 | -14.0 | 1987 |

The overall increase in temperature at Nettlecombe between 1971 - 2000 and 1991 – 2020 is less than that for the UKMO England South region, but greater than that for England South-West/Wales South. April and June show the biggest increase in mean temperature, with the last twenty years containing seven Junes and six Aprils that had a temperature more than 1°C above the 1981 – 2010 average.

If present trends were to continue, a 0.2°C rise for each successive decade would result in a mean annual temperature of 11.5°C at Nettlecombe in the 2060s, slightly lower than that projected for Southern England as a whole. However, if the recent acceleration in winter warming proves to be just a temporary phenomenon, a more modest rate of increase would be implied. Nevertheless, one can anticipate at the very least a lengthening of the growing season, with an associated further reduction in the frequency of frost. The factors that combine to produce Nettlecombe’s very distinctive microclimate may modify overall changes in temperature. However, judging by recent form, as suggested in Table 6, more frequent extremes of heat seem inevitable. (On March 30th 2021, the air temperature at the site exceeded 70°F (21°C) in March for the first time, according to the AWS.)

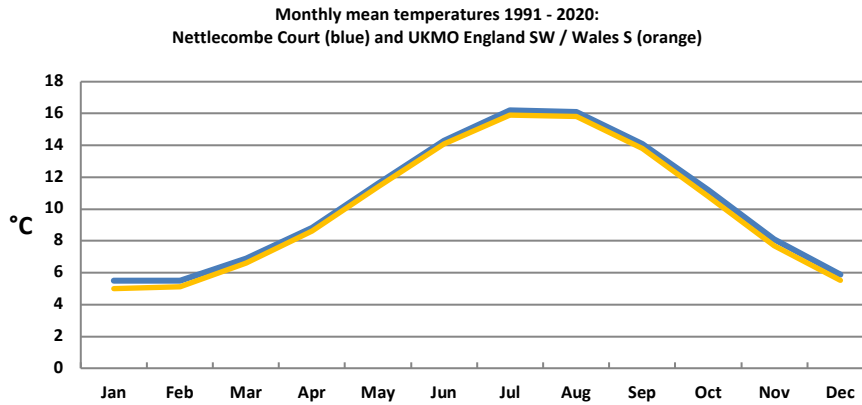
REFERENCE

Ratsey, S., (2018) Local climate and climate change in lowland West Somerset. *Field Studies* https://fsj.field-studies-council.org/media/5290217/fs2018_ratsey280119.pdf

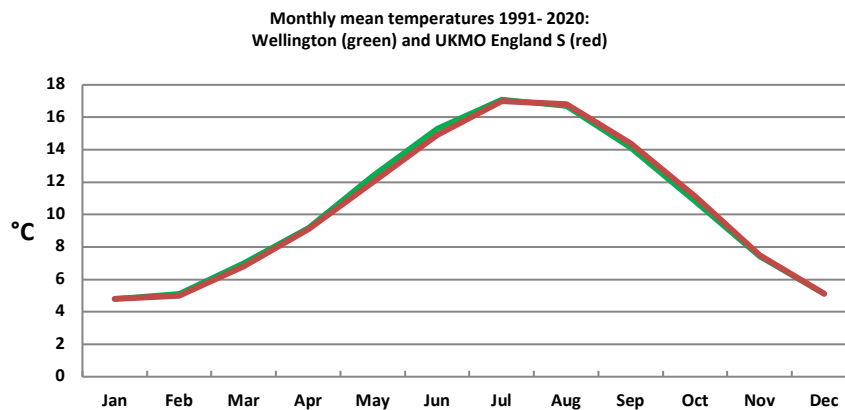


APPENDIX 1. MONTHLY MEAN TEMPERATURES (°C) 1991 - 2020

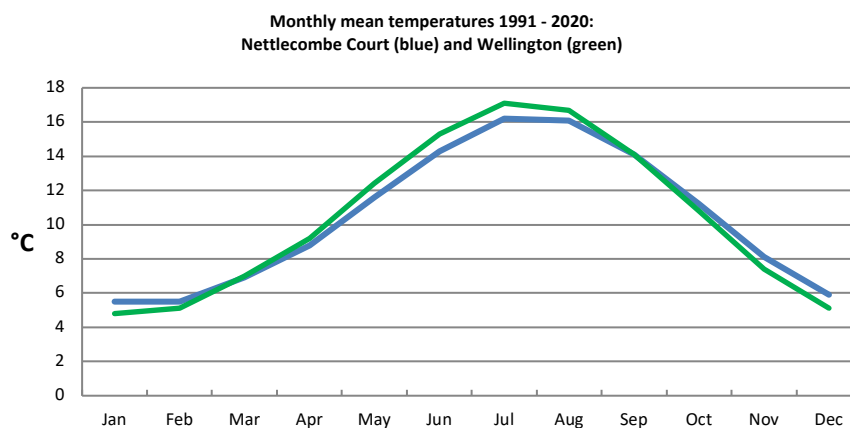
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | No v | Dec | Year |
|--------------------|-----|-----|-----|-----|------|------|------|------|------|------|---------|-----|-------------|
| Nettlecombe Court | 5.5 | 5.5 | 6.9 | 8.8 | 11.6 | 14.3 | 16.2 | 16.1 | 14.1 | 11.2 | 8.1 | 5.9 | 10.3 |
| England SW/Wales S | 5.0 | 5.1 | 6.6 | 8.6 | 11.4 | 14.1 | 15.9 | 15.8 | 13.8 | 10.8 | 7.7 | 5.5 | 10.0 |



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | No v | Dec | Year |
|------------|-----|-----|-----|-----|------|------|------|------|------|------|---------|-----|-------------|
| Wellington | 4.8 | 5.1 | 7.0 | 9.2 | 12.4 | 15.3 | 17.1 | 16.7 | 14.1 | 10.8 | 7.4 | 5.1 | 10.4 |
| England S | 4.8 | 5.0 | 6.8 | 9.1 | 12.0 | 14.9 | 17.0 | 16.8 | 14.4 | 11.1 | 7.5 | 5.1 | 10.4 |



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | No v | Dec | Year |
|-------------------|-----|-----|-----|-----|------|------|------|------|------|------|---------|-----|-------------|
| Nettlecombe Court | 5.5 | 5.5 | 6.9 | 8.8 | 11.6 | 14.3 | 16.2 | 16.1 | 14.1 | 11.2 | 8.1 | 5.9 | 10.3 |
| Wellington | 4.8 | 5.1 | 7.0 | 9.2 | 12.4 | 15.3 | 17.1 | 16.7 | 14.1 | 10.8 | 7.4 | 5.1 | 10.4 |



APPENDIX 2. ANNUAL MEAN TEMPERATURES AT NETTLECOMBE COURT

| 2A | | Annual mean and decadal mean temperatures (°C) | | | | | | | | | |
|---------------------|------|--|-------------|------|-------------|------|--------------|------|--------------|------|--------------|
| | | 1971 | 9.80 | 1981 | 9.50 | 1991 | 9.30 | 2001 | 9.90 | 2011 | 10.89 |
| | | 1972 | 9.11 | 1982 | 9.92 | 1992 | 9.94 | 2002 | 10.67 | 2012 | 9.93 |
| | | 1973 | 9.71 | 1983 | 10.04 | 1993 | 9.48 | 2003 | 10.55 | 2013 | 10.03 |
| | | 1974 | 9.63 | 1984 | 10.00 | 1994 | 10.25 | 2004 | 10.65 | 2014 | 11.00 |
| | | 1975 | 10.02 | 1985 | 9.00 | 1995 | 10.58 | 2005 | 10.73 | 2015 | 10.54 |
| | | 1976 | 9.78 | 1986 | 8.58 | 1996 | 9.17 | 2006 | 10.83 | 2016 | 10.42 |
| | | 1977 | 9.70 | 1987 | 9.17 | 1997 | 10.61 | 2007 | 10.70 | 2017 | 10.70 |
| | | 1978 | 9.46 | 1988 | 9.98 | 1998 | 10.58 | 2008 | 10.10 | 2018 | 10.87 |
| 1969 | 9.48 | 1979 | 8.61 | 1989 | 10.50 | 1999 | 10.63 | 2009 | 10.00 | 2019 | 10.61 |
| 1970 | 9.74 | 1980 | 9.27 | 1990 | 10.65 | 2000 | 10.31 | 2010 | 9.09 | 2020 | 10.95 |
| Decadal Mean | N/A | | 9.51 | | 9.73 | | 10.09 | | 10.32 | | 10.59 |

| 2B | | Annual mean temperatures ranked highest to lowest (°C) | | | | | | | | | |
|-----------|-------|--|-----------|-------|------|-----------|-------|------|-----------|------|------|
| 1 | 11.00 | 2014 | 14 | 10.61 | 2019 | 27 | 10.00 | 1984 | 40 | 9.50 | 1981 |
| 2 | 10.95 | 2020 | 15 | 10.58 | 1995 | 28 | 10.00 | 2009 | 41 | 9.48 | 1969 |
| 3 | 10.89 | 2011 | 16 | 10.58 | 1998 | 29 | 9.98 | 1988 | 42 | 9.48 | 1993 |
| 4 | 10.87 | 2018 | 17 | 10.55 | 2003 | 30 | 9.94 | 1992 | 43 | 9.46 | 1978 |
| 5 | 10.83 | 2006 | 18 | 10.54 | 2015 | 31 | 9.93 | 2012 | 44 | 9.30 | 1991 |
| 6 | 10.73 | 2005 | 19 | 10.50 | 1989 | 32 | 9.92 | 1982 | 45 | 9.27 | 1980 |
| 7 | 10.70 | 2007 | 20 | 10.42 | 2016 | 33 | 9.90 | 2001 | 46 | 9.17 | 1987 |
| 8 | 10.70 | 2017 | 21 | 10.31 | 2000 | 34 | 9.80 | 1971 | 47 | 9.17 | 1996 |
| 9 | 10.67 | 2002 | 22 | 10.25 | 1994 | 35 | 9.78 | 1976 | 48 | 9.11 | 1972 |
| 10 | 10.65 | 1990 | 23 | 10.10 | 2008 | 36 | 9.74 | 1970 | 49 | 9.09 | 2010 |
| 11 | 10.65 | 2004 | 24 | 10.04 | 1983 | 37 | 9.71 | 1973 | 50 | 9.00 | 1985 |
| 12 | 10.63 | 1999 | 25 | 10.03 | 2013 | 38 | 9.70 | 1977 | 51 | 8.61 | 1979 |
| 13 | 10.61 | 1997 | 26 | 10.02 | 1975 | 39 | 9.63 | 1974 | 52 | 8.58 | 1986 |