

State of the UK Climate 2017: Supplementary report on Climate Extremes

Met Office, National Climate Information Centre

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Introduction

This supplement to the State of UK Climate 2017 report presents a collection of standardised indices relating to climate extremes derived from observations of UK temperature and rainfall. Monthly and annual statistics are essential for monitoring climate change over decades and centuries. However, the impacts of climate variability and change are often felt through extreme weather and climate events that will be masked by these monthly to annual statistics.

In this report, we provide climatological maps of a set of climate extreme indices for the UK derived from gridded datasets of daily temperature and precipitation for the period 1961-2017. The information is presented to compare the most recent year (2017) to the most recent decade (2008-2017) and the standard reference climatology periods of 1981-2010 and 1961-1990.

Executive Summary

High temperature indices

- 2017 was the fifth warmest year for the UK in a series from 1910, but the summer was closer to average so that the year overall was not a notable year for high temperature indices.
- The hottest day of the year for the most recent decade (2008-2017) has been on average 0.1 °C above the 1981-2010 average and 0.8 °C above the 1961-1990 reference.
- The warm spell duration index in the most recent decade (2008-2017, 13.2 days) is more than double that of the 1961-1990 reference (5.3 days).

Low temperature indices

- Low temperature indices in 2017 were consistent with it having been a warm year overall. The year saw an above average lowest temperature and below average number of icing days. Parts of East Anglia and south east England were the only regions to record a 'cold spell' in the year with at least 6 consecutive days of temperatures significantly below climatological averages for the time of year.
- The lowest temperature of the year has increased by 1.7 °C when comparing the most recent decade (2008-2017) with the 1961-1990 average. A much larger increase than the equivalent change in the mean temperature of the UK of 0.8 °C

Rainfall indices

- Many parts of the UK in 2017 did not experience any extremely wet days, and heavy rain indices were generally below average.
- The highest rainfall accumulation over five days during the most recent decade (2008-2017) is 4 % higher than 1961-1990. The amount of rain from extremely wet days has increased by 17% when comparing the same periods. Changes are largest for Scotland and not significant for most of southern and eastern areas of England.
- There is a slight increase in the longest sequence of consecutive wet days for the UK. There has been a general decline in the longest sequence of consecutive dry days.

Climate extreme indices

There is no single definition of what constitutes a weather or climate extreme. We can broadly describe weather hazards as those relating to synoptic scale weather systems, which implies a duration of at most a few days for any given location. These could include, but are not limited to rain or wind associated with an intense storm system passing over the UK, or a notably hot or cold day. Climate hazards relate to exceptional conditions over periods of months to seasons such as the exceptional wet winter of 2013/14, or summer droughts and heatwaves spanning several weeks or even months. In the monitoring of climate change, extreme weather events and climate events are often referred to collectively as climate extremes.

The World Climate Research Programme (WCRP) and World Meteorological Organization (WMO) expert team on climate change detection and indices (ETCCDI¹) coordinate, organise and collaborate on climate extremes, indices and climate change detection. This team have defined a set of 27 core indices (the 'ETCCDI' indices²) which can be derived from land surface observations of daily temperature and precipitation (see also Frich et al. 2002 and Zhang et al. 2011). These indices have been used to produce suites of station based and gridded global datasets of the more extreme aspects of climate (e.g. Dunn et al. 2014). These are managed in a consistent manner and are reported on by the Intergovernmental Panel on Climate change (IPCC, Hartman et al. 2013) and the annual State of the Climate report (Blunden and Arndt, 2017).

Table 2 summarises the complete set of ETCCDI climate indices. In this summary report we present a selection of these indices that encompass a collection of high and low, temperature and rainfall metrics. The highlighted indices are identified in bold in Table 2. A number of climate indices are already routinely presented in the State of UK Climate reports (Kendon et al. 2018) including air and ground frost, heating, cooling and growing degree days, days of rain metrics and indices relating to extreme daily rainfall and high wind. The ETCCDI indices already available in the State of UK Climate reports are identified with an asterisk.

¹ <https://www.wcrp-climate.org/unifying-themes/unifying-themes-observations/data-etccdi>

² <https://www.climdex.org/indices.html>

Table 2: Description of climate Indices. See also: <https://www.climdex.org/indices.html>.

Index	Derived from	Resolution	Description
High temperature indices			
Number of summer days	Daily Maximum Temperature	Monthly	Number of days when the daily maximum temperature is above 25 °C
Number of tropical nights	Daily Minimum Temperature	Monthly	Number of days when the daily minimum temperature is above 20 °C
Highest maximum temperature	Daily Maximum Temperature	Monthly	Highest daily maximum temperature recorded during the month
Highest minimum temperature	Daily Minimum Temperature	Monthly	Highest daily minimum temperature recorded during the month
Percentage of warm nights	Daily Minimum Temperature	Monthly	Percentage of days when the daily minimum temperature is above the 90 th percentile centred on a 5-day window for the base period of 1961-1990. See Zhang et al. (2005)
Percentage of warm days	Daily Maximum Temperature	Monthly	Percentage of days when the daily maximum temperature is above the 90 th percentile centred on a 5-day window for the base period of 1961-1990. See Zhang et al. (2005)
Warm spell duration index	Daily Maximum Temperature	Annual	Count of days with at least 6 consecutive days when daily maximum temperature is above the 90 th percentile as defined above.
Low temperature indices			
Number of icing days	Daily Maximum Temperature	Monthly	Number of days when the daily minimum temperature is below 0 °C
Number of frost days*	Daily Minimum Temperature	Monthly	Number of days when the daily minimum temperature is below 0 °C
Lowest maximum temperature	Daily Maximum Temperature	Monthly	Lowest daily maximum temperature recorded during the month
Lowest minimum temperature	Daily Minimum Temperature	Monthly	Lowest daily minimum temperature recorded during the month
Percentage of cool nights	Daily Minimum Temperature	Monthly	Percentage of days when the daily minimum temperature is below the 10 th percentile centred on a 5-day window for the base period of 1961-1990. See Zhang et al. (2005)

Percentage of cool days	Daily Maximum Temperature	Monthly	Percentage of days when the daily maximum temperature is below the 10 th percentile centred on a 5-day window for the base period of 1961-1990. See Zhang et al. (2005)
Cold spell duration index	Daily Minimum Temperature	Annual	Count of days with at least 6 consecutive days when daily minimum temperature is below the 10th percentile as defined above.
Other temperature indices			
Growing Season Length	Daily Mean Temperature	Annual	Count between first span of at least 6 days with mean temperature above 5 °C and the first span after July 1 st of 6 days with mean temperature below 5 °C
Daily Temperature Range*	Daily Maximum Temperature and Daily Minimum Temperature	Monthly	Average difference between the daily maximum and daily minimum temperature.
Rainfall Indices			
Maximum 1-day precipitation	Daily Precipitation	Monthly	Highest value of daily rainfall
Maximum 5-day precipitation	Daily Precipitation	Monthly	Highest value of rainfall accumulated over 5 days
Simple precipitation intensity index*	Daily Precipitation	Monthly	Total precipitation falling on wet days (≥ 1 mm) divided by the number of wet days
Days of Rain 1 mm*	Daily Precipitation	Monthly	Number of days with ≥ 1 mm rainfall
Days of Rain 10 mm*	Daily Precipitation	Monthly	Number of days with ≥ 10 mm rainfall
Days of Rain 20 mm	Daily Precipitation	Monthly	Number of days with ≥ 20 mm rainfall
Longest dry spell	Daily Precipitation	Annual	Largest number of consecutive days with < 1 mm rainfall
Longest wet spell	Daily Precipitation	Annual	Largest number of consecutive days with ≥ 1 mm rainfall
Rainfall from very wet days	Daily Precipitation	Annual	Total rainfall falling on days with daily rainfall total in excess of the 95 th percentile of daily rainfall
Rainfall from extremely wet days	Daily Precipitation	Annual	Total rainfall falling on days with daily rainfall total in excess of the 99th percentile of daily rainfall
Total rainfall*	Daily precipitation	Annual	Annual total rainfall during the year.

*metrics provided in the State of UK Climate report (Kendon et al. 2018)

Climate Data and methods

The National Climate information Centre (NCIC) at the Met Office, with support from the Public Weather Service Customer Group and the Hadley Centre Climate Programme produce a suite of climate monitoring products and datasets. The availability of station data records across the UK has changed considerably over time. In order to produce spatially complete and homogenous national climate monitoring the station climate records are interpolated onto a uniform grid to produce gridded daily and monthly climate datasets along with reference to baseline climatologies for the standard reference periods 1961-1990 and 1981-2010.

The gridded datasets are derived from the station series by using the geo-spatial methods described in Perry and Hollis (2005a) for long term averages, Perry and Hollis (2005b) for monthly series, and Perry et al. (2009) for daily series. The gridding method used to create these datasets utilises regression analysis to model the relationship between temperature and topography and inverse-distance-weighted averaging to interpolate the regression residuals to a uniformly distributed set of points.

The climate indices presented in this report are derived for each location in the 5km by 5km grid of points using the gridded daily temperature or rainfall. The spatially complete gridded fields of indices can then be summarised over geographical regions to produce summary series. This is referred to as a grid-then-index approach. The statistics will differ in the detail if an alternative approach is adopted, such as determining the extremes index from the station observation and then interpolating that to a uniform grid. The grid-then-index approach has been adopted in this study because the interpolation process is well tested against daily temperature and precipitation, but is untested in relation to the statistical properties of the extreme indices.

More information about the observational data and associated methods are available in the appendices of the full State of UK Climate report (Kendon et al. 2018).

Climate indices and averaging

An important consideration for the interpretation of the statistics presented in this report relates to averaging. The indices are derived from daily temperature or rainfall for each location on a 5km by 5km grid of points. For summary purposes these data are then averaged over time, for example to produce a 1961-1990 climatology, or space, for example to produce a UK average, or both, to produce a 1961-1990 UK average. This averaging

affects the interpretation of some of these indices. For example if a climatological average for tropical nights index was 0.1 days, that equates to a single tropical night occurring at that location once every 10 years on average.

The impact of averaging is particularly apparent for indices relating to spells. For example the warm or cold spell indices are based on 6 consecutive days. If a 6 day warm spell were to affect exactly half of the country, then the UK average warm spell day count would be 3 days. The climatological averages and national statistics presented in this report are for monitoring indices of change but additional analysis of the underlying data would be required to determine whether that change is reflecting a change in extent, frequency, or severity of the given indices. Interpretation notes are provided in the relevant section to help with the understanding of the summary statistics for each index.

Climate extreme maps and charts

In the remainder of this report the indices highlighted in bold in Table 2 are presented. The main form of this presentation is a set of summary sheets on each index. Each summary sheet provides four maps showing (clockwise from top left) the climate index for: (i) the 1961-1990 reference period; (ii) the 1981-2010 reference period; (iii) the most recent decade (2008-2017); and (iv) the most recent year (2017).

The second page of the summary presents a timeseries of the UK average value of the index along with series for the northern Scotland region and the south east and central southern England region. Northern Scotland and south east England regions are presented to contrast the two geographical extremes of UK climate regions and provide some context for the variations around the UK average. Statistics for each index for the reference periods, most recent decade and most recent year are then provided in tabular form. These statistics are provided for UK, constituent countries and climatological regions the boundaries of which are drawn on each map, and are available from the Met Office UK climate pages³

High temperature indices

The **highest maximum temperature index**, can be considered as an index of the hottest day of the year. The climatology maps for this index represent the mean of the annual maxima, so individual years will be higher or lower than this value. The 2017 map shows the highest temperature at each location for a single year, but these will not necessarily have occurred on the same day everywhere. The national and regional values presented in the

³ <https://www.metoffice.gov.uk/climate/uk/about/districts-map>

time series and table of statistics are the mean of the annual maxima for all locations within that region in °C.

The highest maximum temperature index exhibits a positive trend through the period from 1961 to present. For the 1961 – 1990 reference climatology period, the average hottest day of the year was below 30 °C across the entire UK, with only some parts of East Anglia and the Thames basin exceeding 29 °C. However, as noted above this represents the mean of the annual maxima, and some individual years did exceed 30 °C. For the 1981-2010 reference period, much of the inland part of East Anglia was above 30 °C, with a regional average of 29.9 °C.

The notable heatwaves in 1976, 1990, 1995, 2003, and 2006 are apparent in the time series of highest maximum temperature. August 2003 saw the highest temperature on record for the UK (38.5 °C at Faversham, Kent). The heatwave that year was locally very intense, but it was not as widespread as some other historical events such as 1976 and 1990 which therefore rank higher by this metric for the UK as a whole.

The hottest day of the year for the most recent decade is on average 0.8 °C above the 1961-1990 reference. Increases have been larger for south east England (1.5 °C) than northern Scotland (0.3 °C). In 2017 the highest recorded temperature was 34.5 °C at Heathrow, London on 21st June. This was the most notable June heatwave since 1976 and the map on page 18 shows widespread maxima above 30 °C across central and southern England in 2017.

The **summer days index** is a count of days where the maximum temperature exceeds 25 °C. It is a count of discrete whole days, but when producing climatological averages the value may be less than 1. In such circumstances the index reflects that climatologically the event is not an annually occurring event at that location, but equally does not mean it never occurs there. A value of 0.5 for example can be interpreted as one summer day occurring every other year on average.

The summer day index ranges from values in excess of 20 days per year for London and parts of south east England and East Anglia, to no occurrences for the Shetland Isles. The index increased from the period from the 1960s to late 1990s, but a run of generally unsettled and wet summers for the UK since 2007, with the exception of 2013, means that the most recent decade (2008-2017) with an average of 5.3 days has seen on average slightly lower summer days index than the 1981-2010 climatology at 6.4 days. 2017

recorded 6.1 summer days index for the UK, marginally below the 1981-2010 average, but above the 1961-1990 average of 4.5 days.

The **tropical nights index** is also a count of days, in this case where the minimum temperature exceeds 20 °C. The caveats related to averaging are therefore similar to those for summer days described above. The summary statistics show that extended periods with nights remaining above 20 °C are quite rare for the current UK Climate, and are largely confined to southern England. In this index the rarity of events is reflected in the low values in the averages, with the highest number of occurrences in London, parts of Kent and the Isle of Wight.

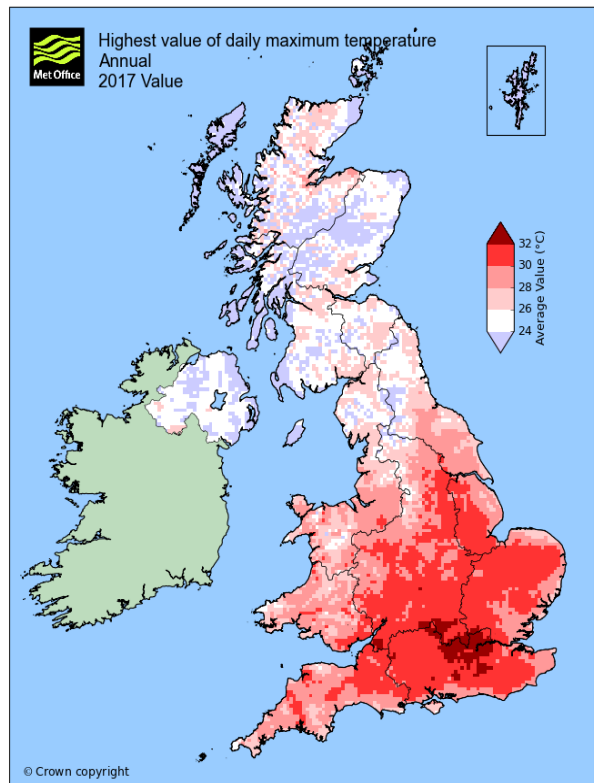
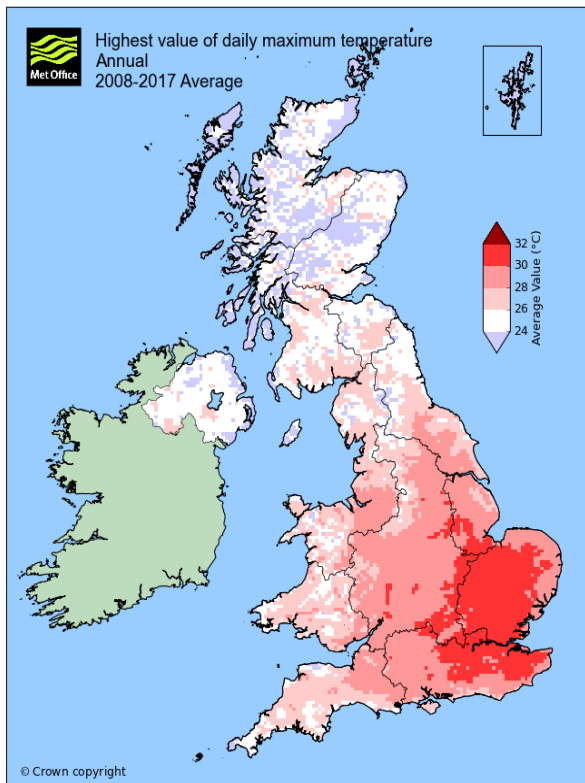
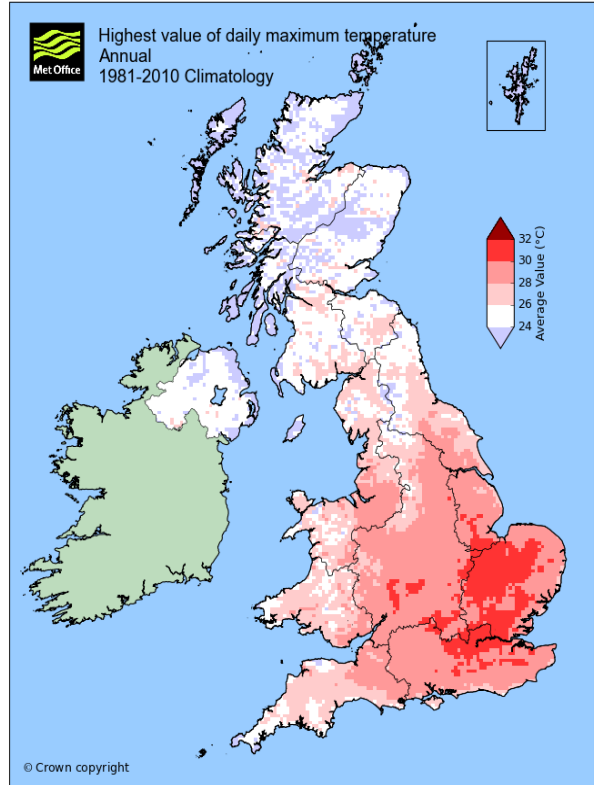
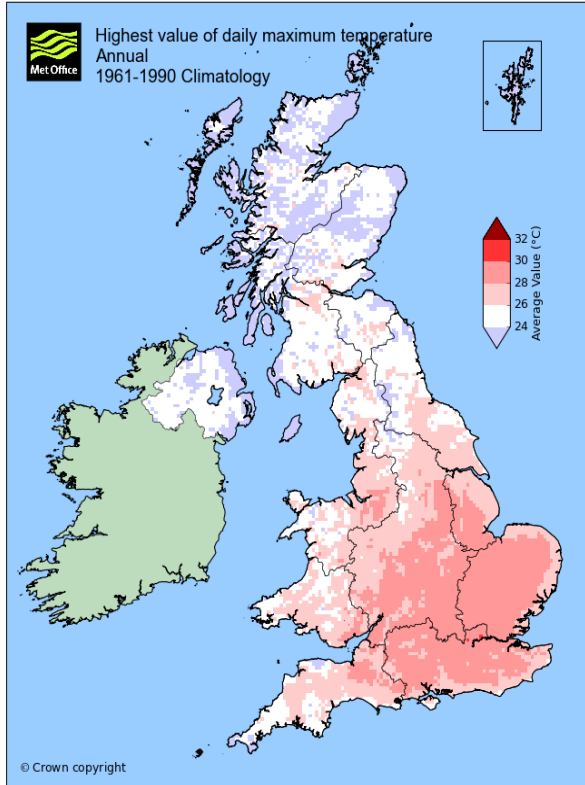
The ETCCDI are designed for application globally, but night minima above this threshold are relatively localised in the current UK climate. However it is informative to review this particular index because such elevated night time temperatures can be a particular human health hazard during heatwaves, depriving the body of respite from the heat. The heatwaves of 1995 and 2003 are apparent in the south east England tropical nights series for this index. By most standard heatwave metrics 1976 is one of the most significant heatwaves for the UK in the observational record. It is interesting to note that for the tropical nights index only events since 1995 stand out. The values are still low because even during those events the regions that experienced such high minima were not that extensive across the UK. The peak in tropical nights in 2016 resulted from a notable widespread hot night over 19th and 20th July of that year. The heat during the 20th July broke down into thunderstorms and it was not otherwise a protracted heatwave event. The highest temperatures of 2016 were actually recorded in September of that year, however the 20th July 2016 is the highest daily minimum temperature for any day in the daily Central England Temperature series from 1878. In contrast there were no tropical nights recorded for the UK during 2017.

The **warm spell duration index** counts the total number of days that are associated with spells of at least six days in duration for which the daily maximum temperature exceeds the 90th percentile of a daily climatology. This means that warm spells can occur at any time of year if they are sufficiently above the average temperature for the time of year. The cumulative total can also include multiple distinct warm spells that occurred at different times. It also means that for any individual year and specific location non-zero values must be six or above. When averaging over space and time however values lower than six indicate that either warm spells that meet the criteria have not occurred in each year of the averaging period, or that warm spells meeting the criteria have not occurred at all locations within the region.

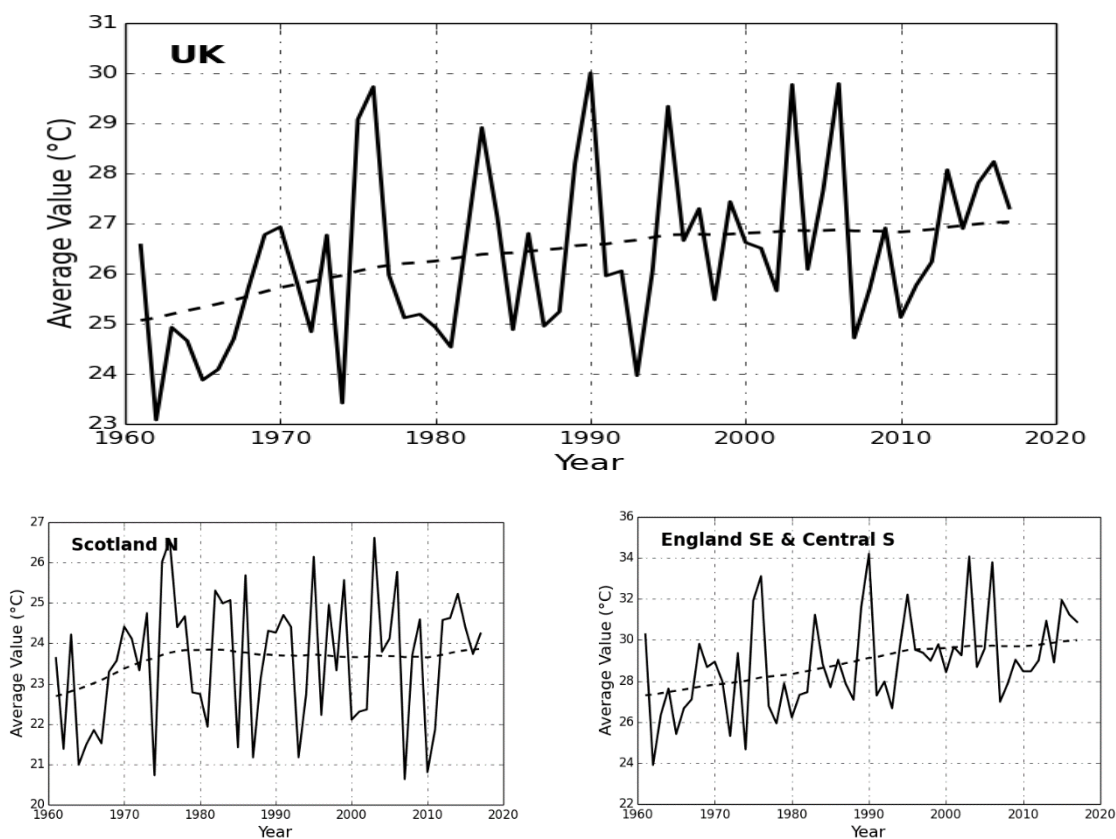
The warm spell duration index shows an increase through time, consistent with the observed warming of the UK. Warm spell duration is based on exceedances relative to temperatures for the time of year, so as noted above it is not confined to summer, but the years 1995 and 1976 both contained significant summer heatwave events and have the highest value for the UK by this metric. On average the most recent decade has had more than double the warm spell duration index of the 1961-1990 baseline across many regions, with the UK average increasing from 5.3 to 13.2 days. South east England has seen some of the most significant changes, with warm spell duration increasing from 6.1 days in the 1961-1990 average to 18.3 days per year on average for the most recent decade.

In 2017 the warm spell duration index for the UK overall was above the 1981-2010 average. However the map on page 18 shows that this masks considerable regional detail. Warm spells were most prevalent for the far south east coastal areas, Northern Ireland, coastal areas of west Scotland and a band from Dorset to the north east coast. The warmest months relative to average in 2017 were March, May and October, with a spell in late June being the only notable summer warm spell of the year.

Highest value of daily maximum temperature



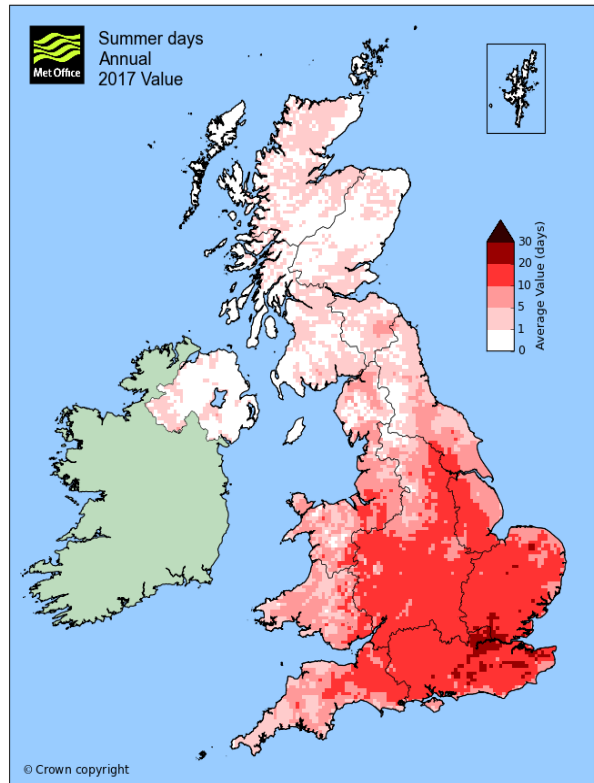
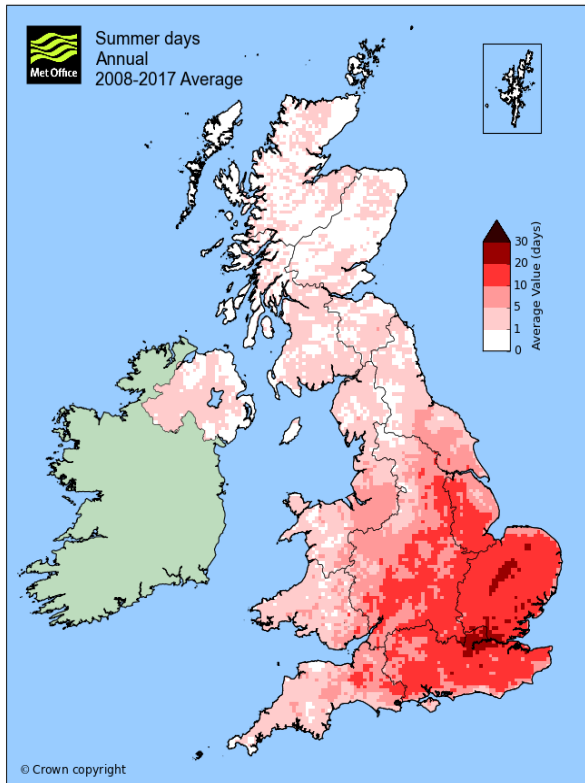
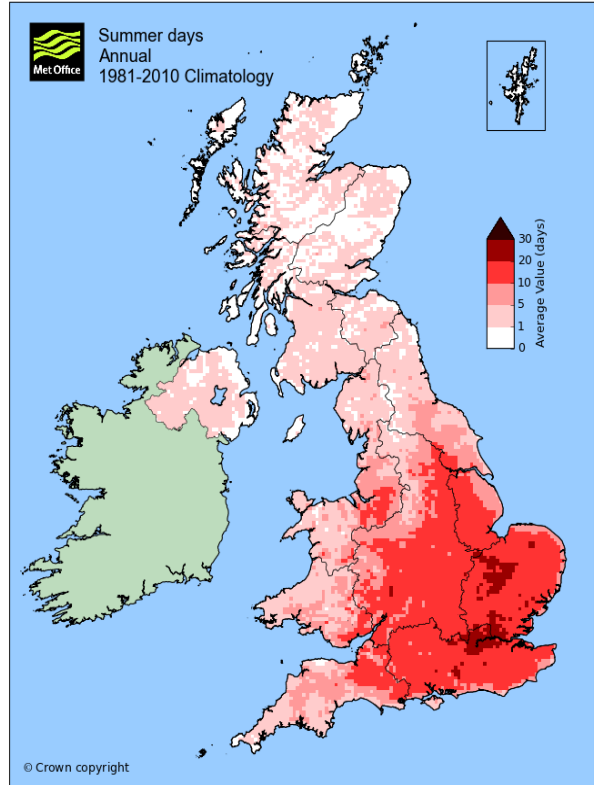
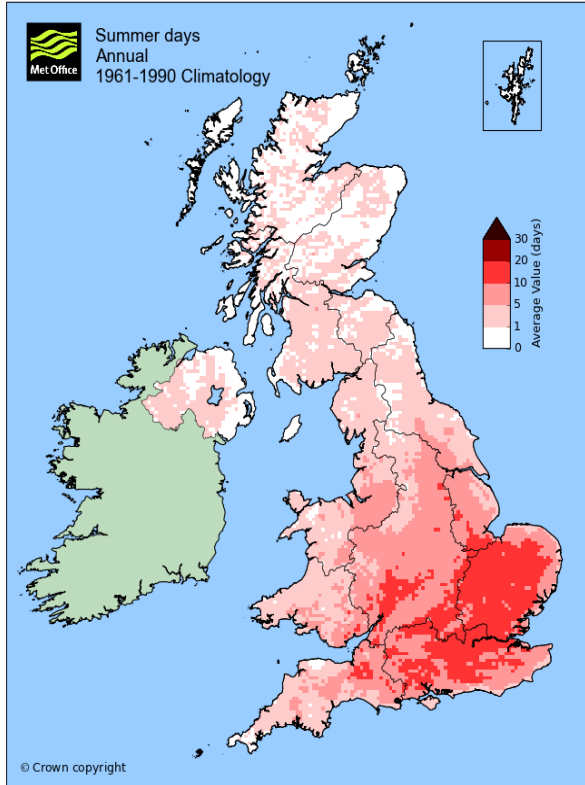
Highest value of daily maximum temperature



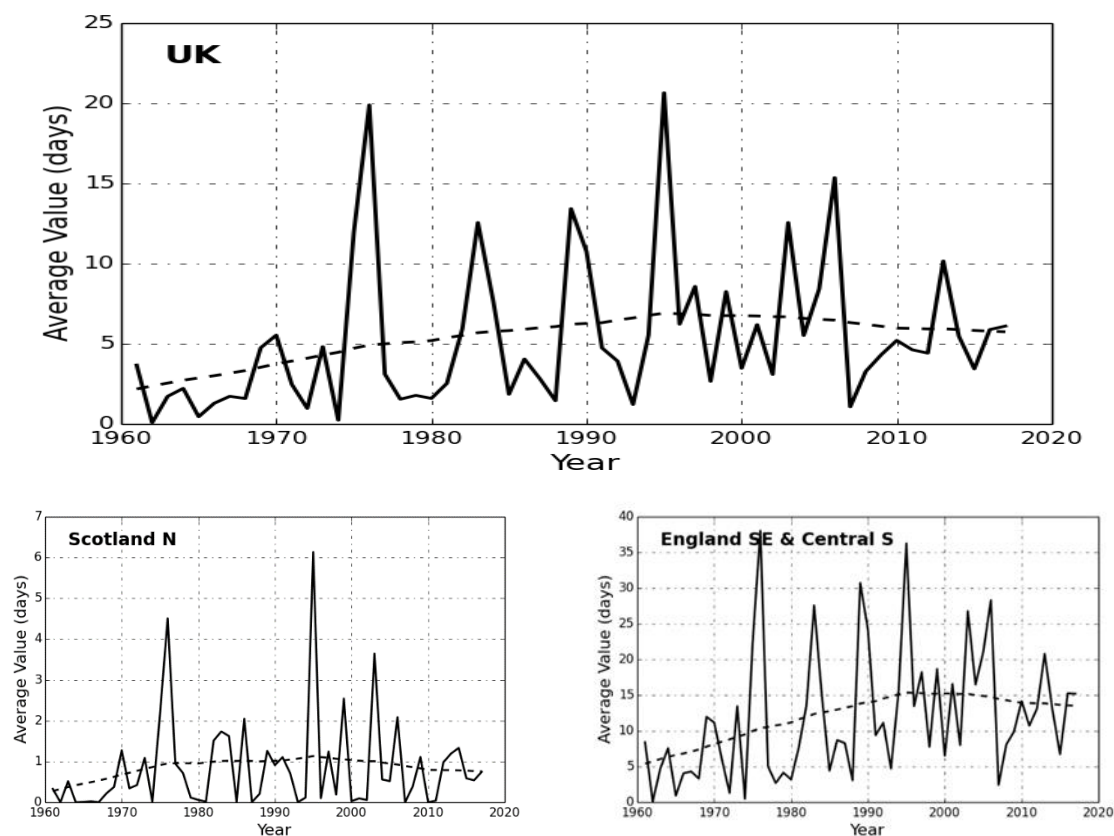
Climatological statistics for spatially averaged values across UK and regions (°C):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	26.0	26.7	26.8	27.3
England	27.3	28.3	28.5	29.3
Wales	26.2	26.8	26.8	28.2
Scotland	24.0	24.3	24.4	24.4
N Ireland	24.2	24.6	25.0	24.3
Scotland N	23.5	23.6	23.8	24.2
Scotland E	24.4	24.7	24.7	24.6
Scotland W	24.5	24.7	25.0	24.4
England E & NE	26.3	27.3	27.4	27.8
England NW & Wales N	26.2	26.9	26.8	27.2
Midlands	27.8	28.8	28.9	29.9
East Anglia	28.5	29.9	30.3	30.1
England SW & Wales S	26.4	26.9	26.9	28.9
England SE & Central S	28.2	29.3	29.7	30.9

Summer days



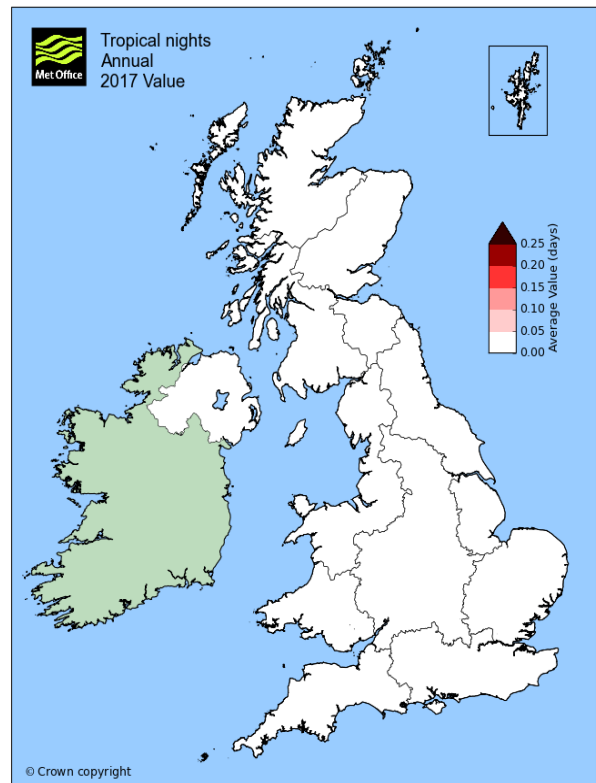
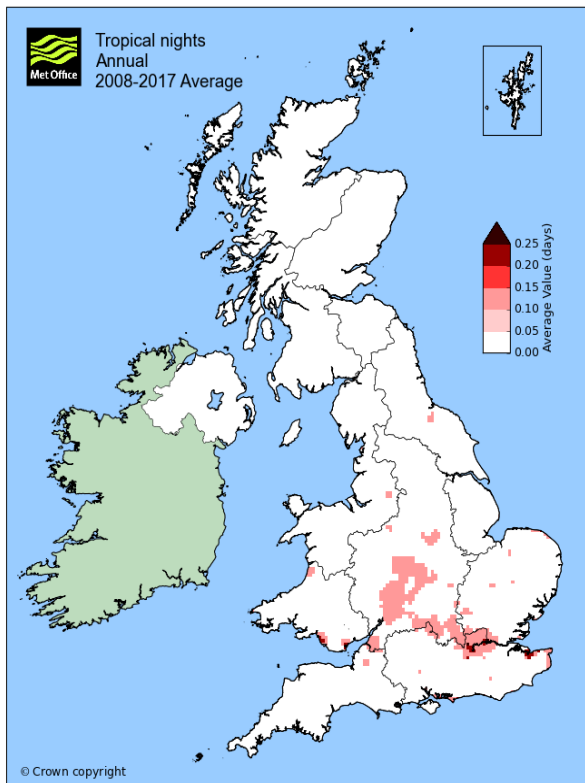
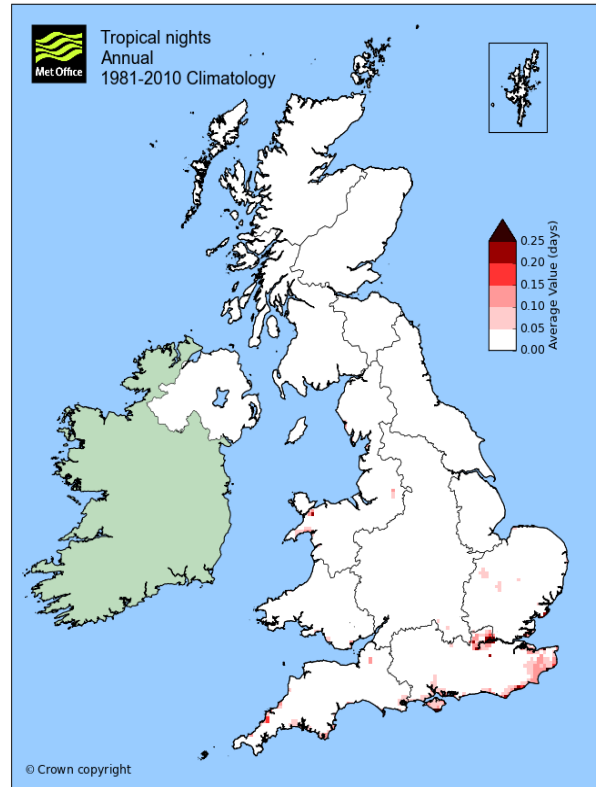
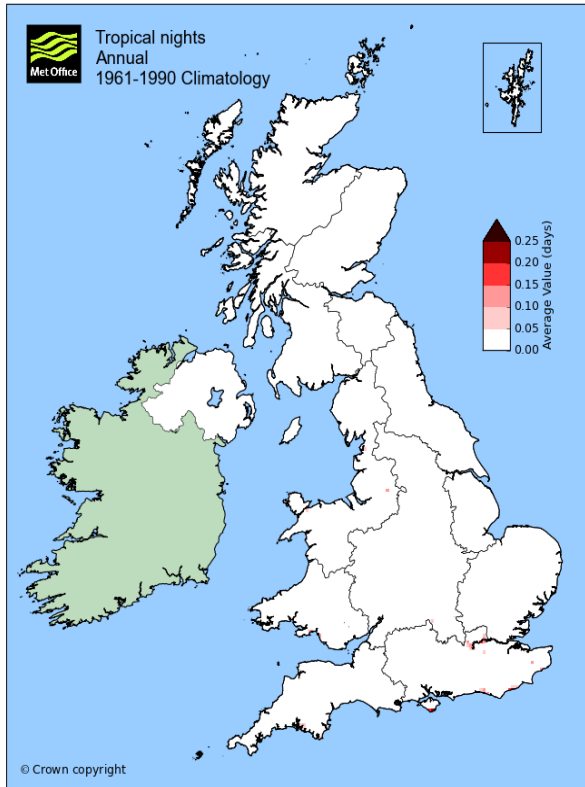
Summer days



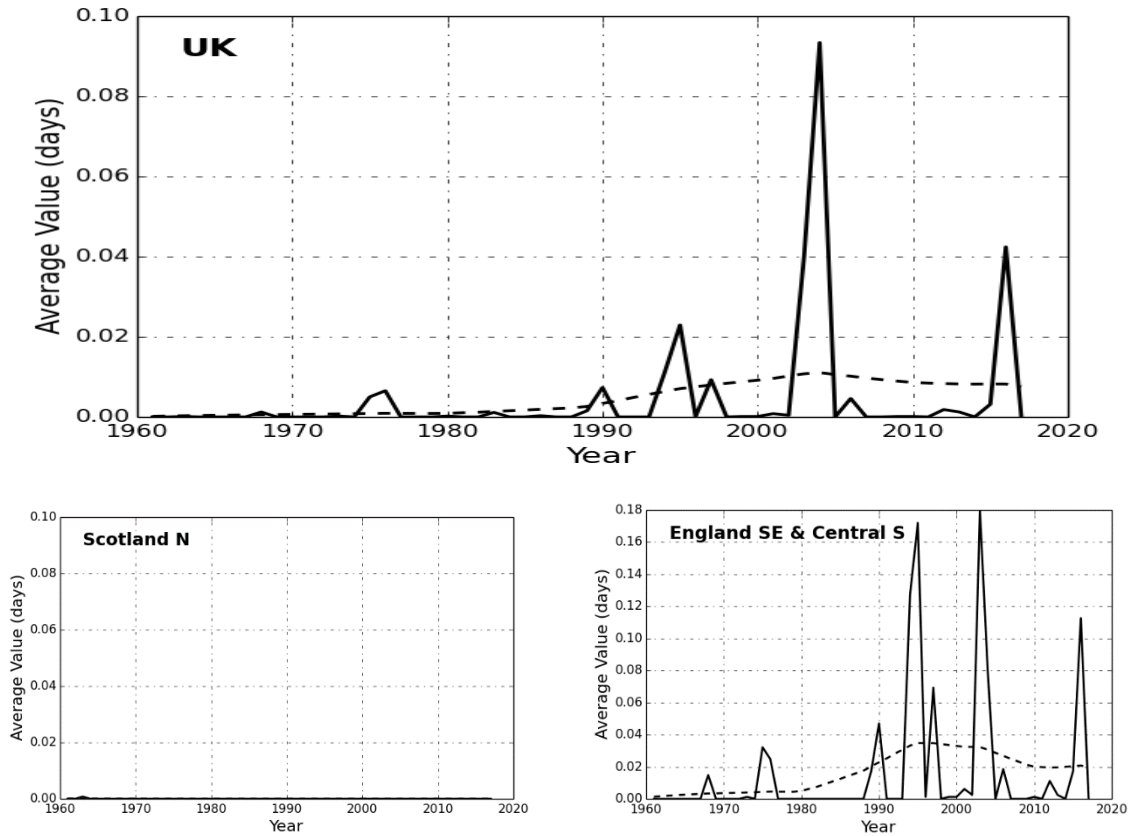
Climatological statistics for spatially averaged values across UK and regions (days):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	4.5	6.4	5.3	6.1
England	7.0	10.4	8.7	10.0
Wales	3.7	4.7	3.3	5.7
Scotland	1.1	1.3	0.9	0.8
N Ireland	1.2	1.5	1.2	0.5
Scotland N	0.7	1.0	0.7	0.7
Scotland E	1.2	1.4	0.9	0.8
Scotland W	1.5	1.8	1.2	0.8
England E & NE	4.1	6.4	5.4	5.7
England NW & Wales N	3.5	4.8	3.4	5.1
Midlands	7.6	11.2	8.7	11.2
East Anglia	10.8	16.4	15.7	13.2
England SW & Wales S	4.5	5.8	4.1	6.9
England SE & Central S	9.9	14.6	12.7	15.2

Tropical nights



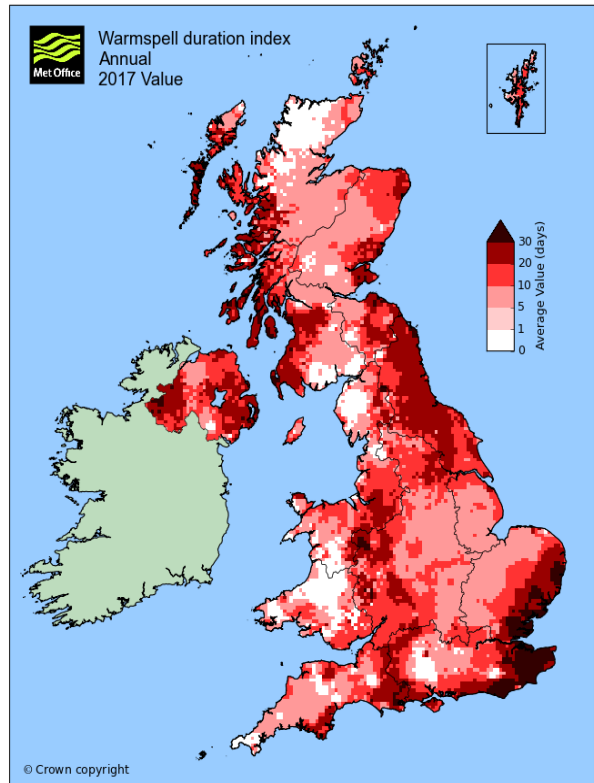
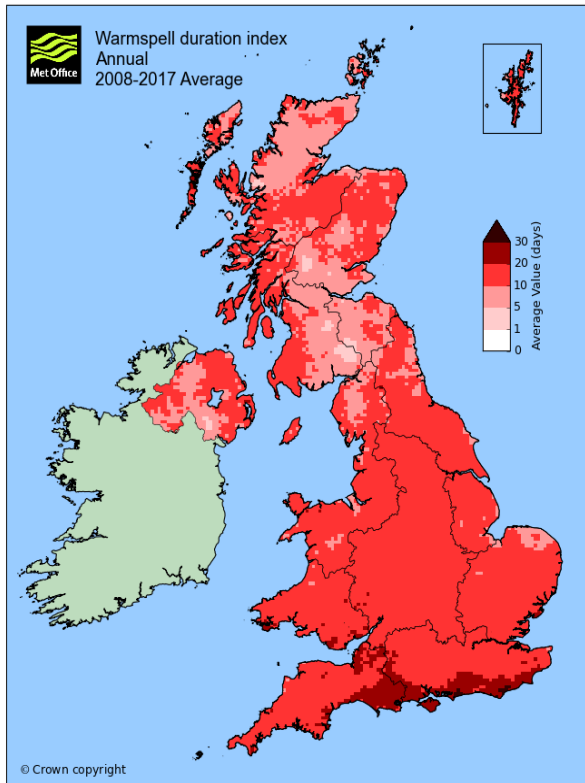
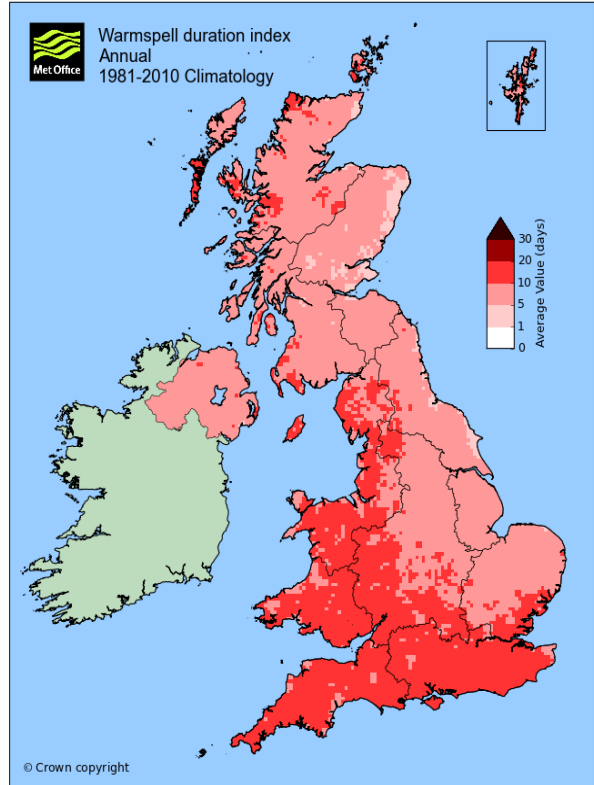
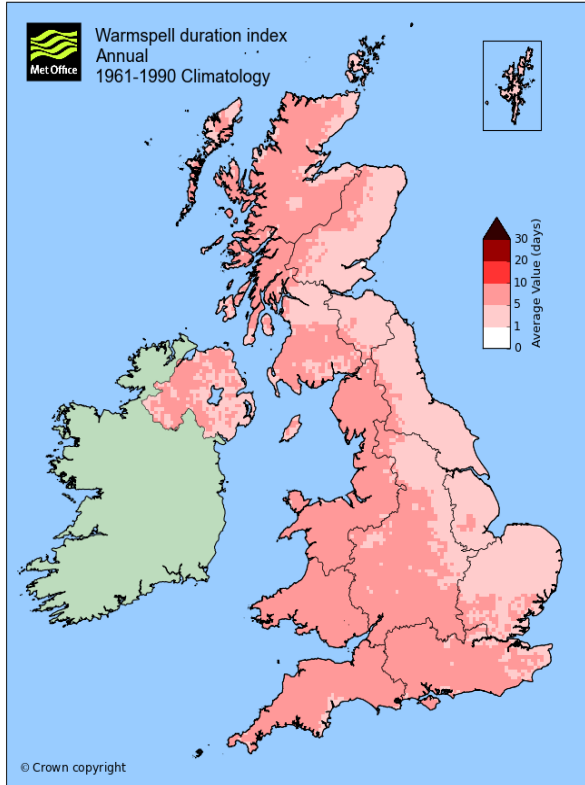
Tropical nights



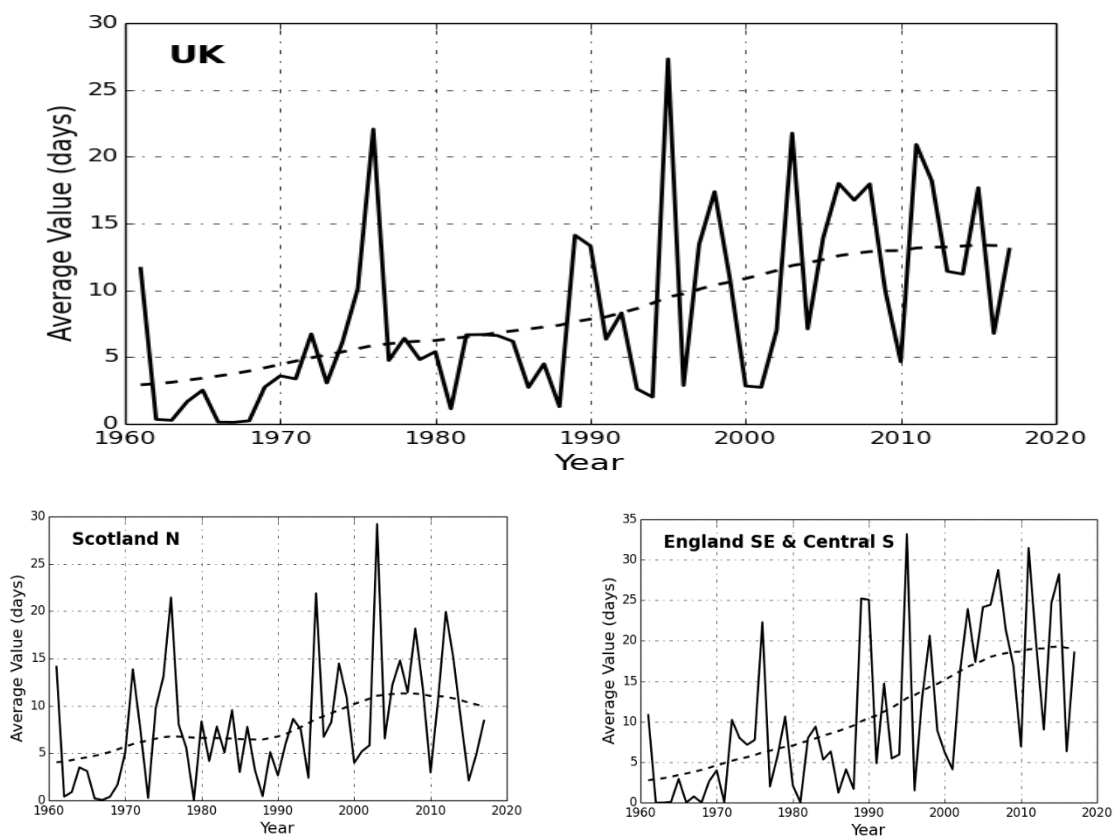
Climatological statistics for spatially averaged values across UK and regions (days):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	0.0	0.0	0.0	0.0
England	0.0	0.0	0.0	0.0
Wales	0.0	0.0	0.0	0.0
Scotland	0.0	0.0	0.0	0.0
N Ireland	0.0	0.0	0.0	0.0
Scotland N	0.0	0.0	0.0	0.0
Scotland E	0.0	0.0	0.0	0.0
Scotland W	0.0	0.0	0.0	0.0
England E & NE	0.0	0.0	0.0	0.0
England NW & Wales N	0.0	0.0	0.0	0.0
Midlands	0.0	0.0	0.0	0.0
East Anglia	0.0	0.0	0.0	0.0
England SW & Wales S	0.0	0.0	0.0	0.0
England SE & Central S	0.0	0.0	0.0	0.0

Warmspell duration index



Warmspell duration index



Climatological statistics for spatially averaged values across UK and regions (days):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	5.3	9.2	13.2	13.1
England	5.3	10.0	15.0	14.5
Wales	7.1	11.1	15.1	7.5
Scotland	4.9	7.7	10.1	11.4
N Ireland	4.9	7.9	10.7	18.0
Scotland N	5.5	8.6	10.2	8.4
Scotland E	3.9	6.3	9.5	12.2
Scotland W	5.2	8.0	10.4	14.5
England E & NE	3.5	7.1	12.7	16.9
England NW & Wales N	6.5	10.4	12.7	10.3
Midlands	5.4	9.8	15.5	12.2
East Anglia	4.2	8.8	13.2	16.3
England SW & Wales S	7.1	11.7	17.0	9.6
England SE & Central S	6.1	12.8	18.3	18.6

Low temperature indices

The **lowest minimum temperature** recorded across the UK can be considered as an index of the coldest day of the year. The interpretation of the averages for this statistic are the same as for the highest maximum temperature.

The lowest minimum temperature has increased significantly, rising from a 1961-1990 average of -8.5°C to -7.6°C for 1981-2010 and -6.8°C for the most recent decade, an increase of 1.7°C . The increase in the lowest minimum temperature is for all regions much larger than the rise in average winter temperature, which is approximately 0.7°C . There is considerable inter-annual variability with 2010 ranking as 3rd lowest for the UK in the series since 1961, and 2014 as the highest (Kendon, 2015). In 2017 the lowest temperature recorded at any individual location was -13.0°C at Dalwhinnie, Invernessshire on 11th and Shawbury, Shropshire on 12th December. The average value for the UK was -6.4°C , which is 1.2°C above the 1981-2010 average.

The **icing days** index is a count of days for which the daily maximum temperature is below 0°C , rather than air frost days that are days with a daily minimum temperature below 0°C . Like summer days and tropical nights this index is also a count of days.

For much of the country, except for upland areas, the expectation would generally be for fewer than five icing days in a typical winter. For the most recent decade (2008-2017) a significant area extending inland from the UK coastline has had less than 1 icing day per year on average, reflecting a general decline in icing days since the 1960s. The 2017 value for the UK of 1.8 is below the climatological average, and no icing days were recorded for south east England.

2010 recorded the most icing days in recent years, as shown by the series on page 25. Although regional variations are also apparent, with 2010 containing the most icing days on record for north Scotland. The winter of 1963 was much more significant for south east England by this metric.

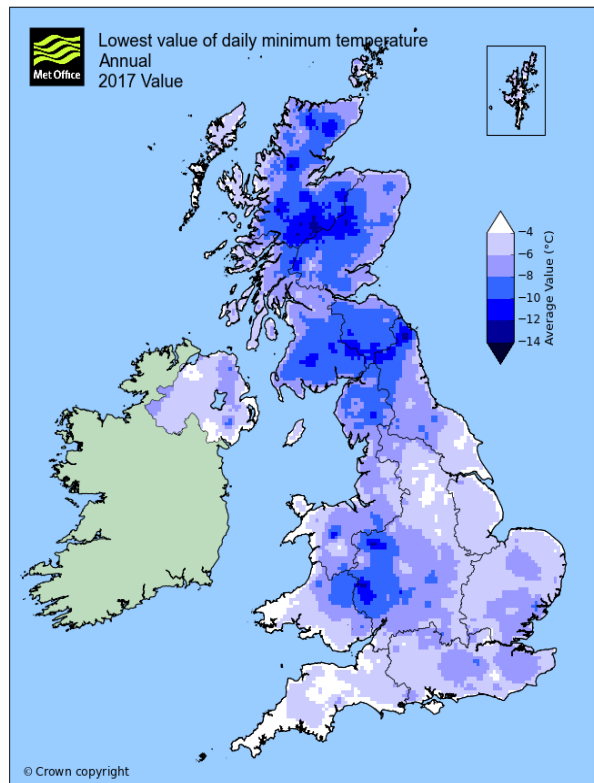
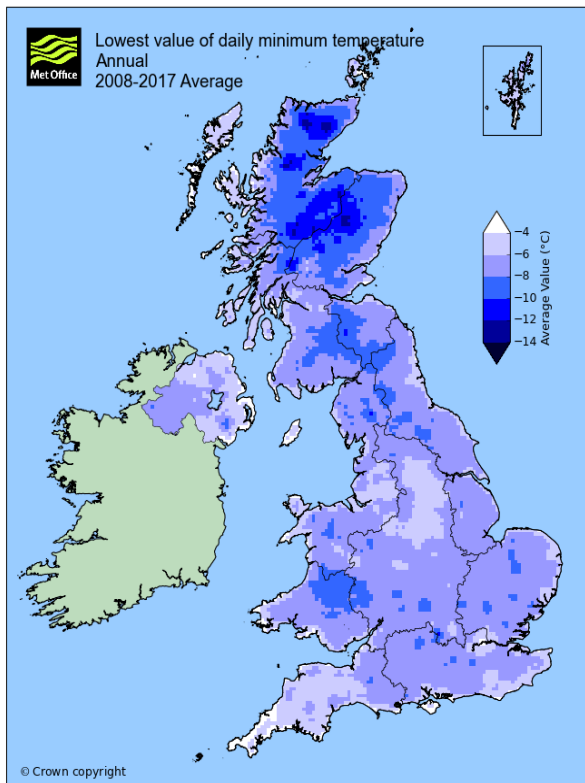
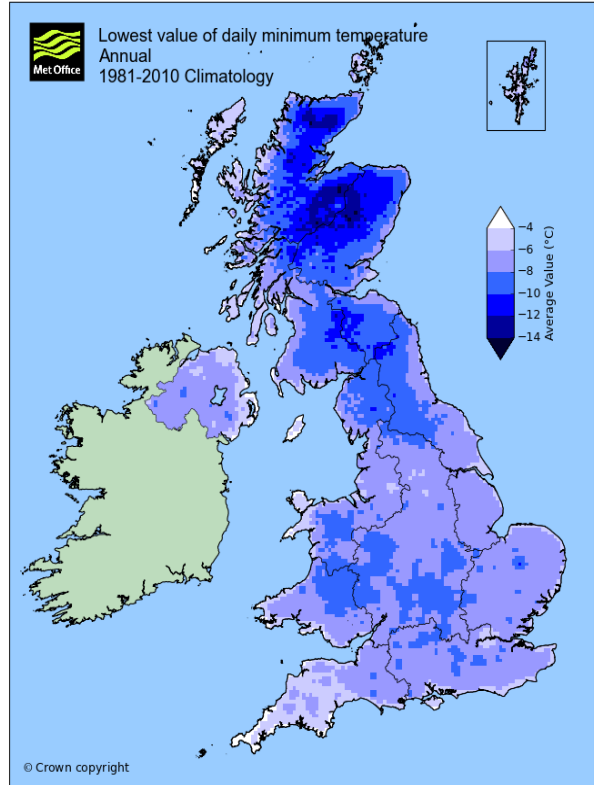
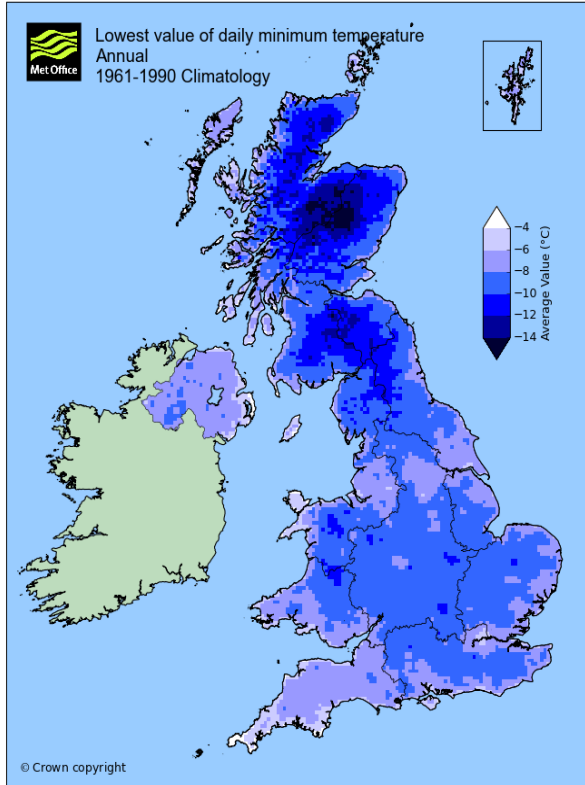
The **cold spell duration index** is the low temperature equivalent of the warm spell duration index described above, and the same caveats relating to the interpretation of the average statistics apply.

The cold spell duration index is relatively low for the UK, and lower than the warm spell duration index. Warm and cold spell indices are based on 90th and 10th percentiles of local temperatures respectively, so the total number of days above/below those thresholds during

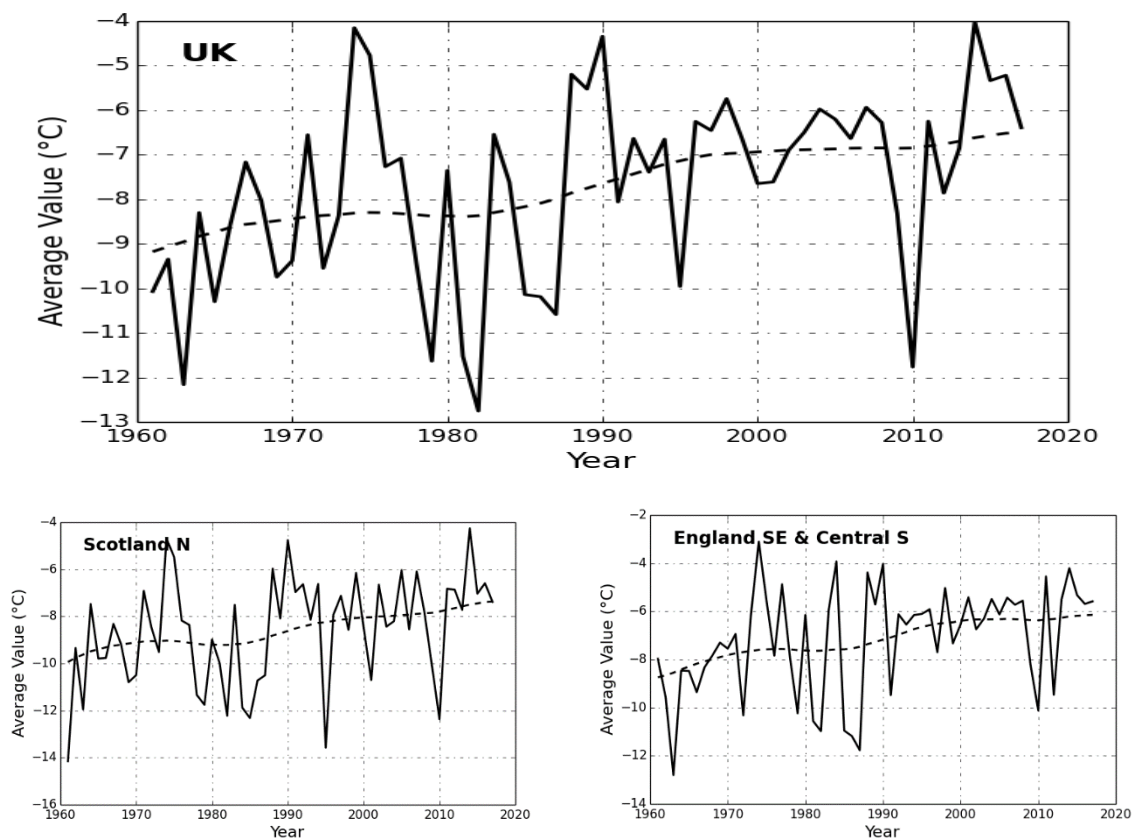
the baseline period will be similar. The difference in the magnitude of the metrics therefore reflect differences in the relative persistence of multi-day spells of warm or cold. The climatological averages are below the six day threshold across the UK, indicating that six day cold spells by this definition are not an annual occurrence.

Slight increases in the cold spell duration index are noted for western and northern areas of the UK and slight decreases across eastern, central and southern areas, but the low value and sensitivity to extreme years such as 1963 and 2010 make any trend evaluation not robust. The south of England was the only region to experience a cold spell meeting this definition during 2017. This was during mid to late January resulting from a high pressure system that brought cold conditions to the south and milder conditions to the north and west of Scotland.

Lowest value of daily minimum temperature



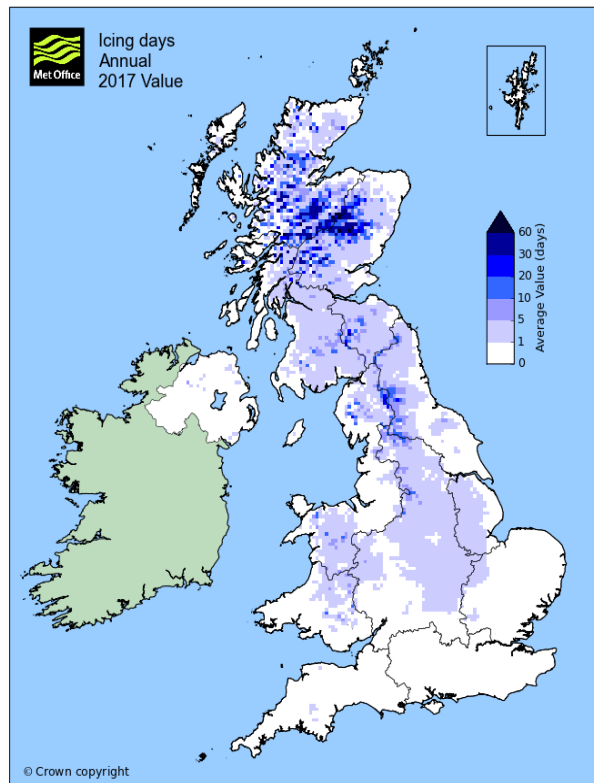
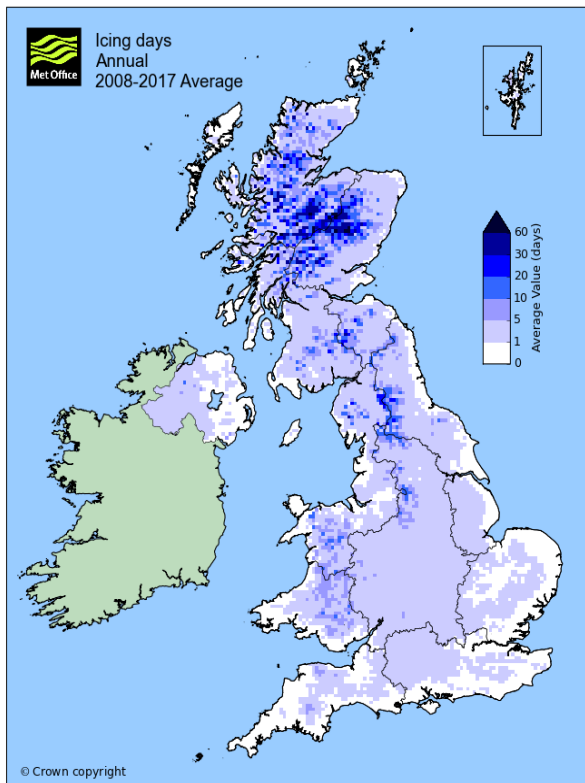
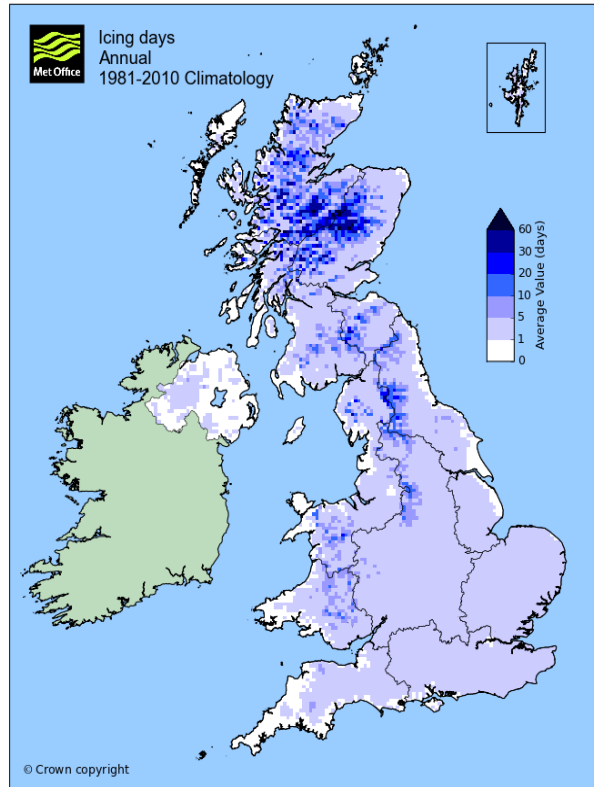
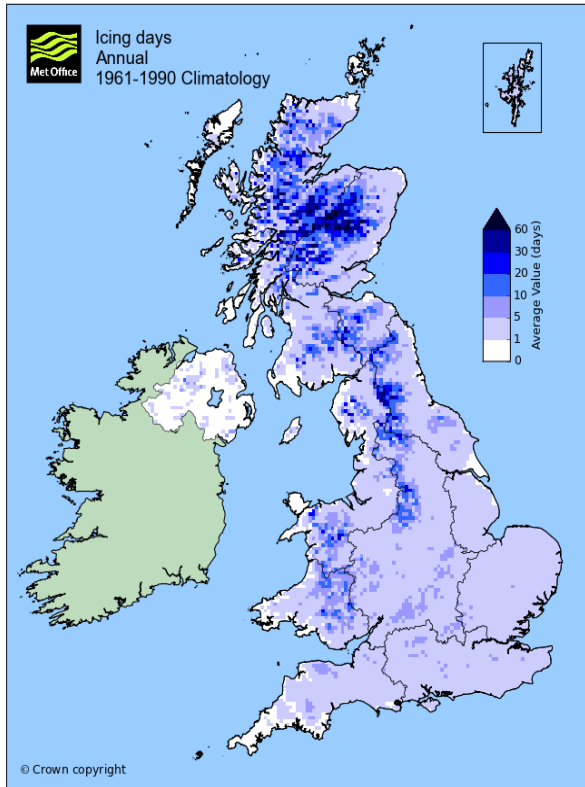
Lowest value of daily minimum temperature



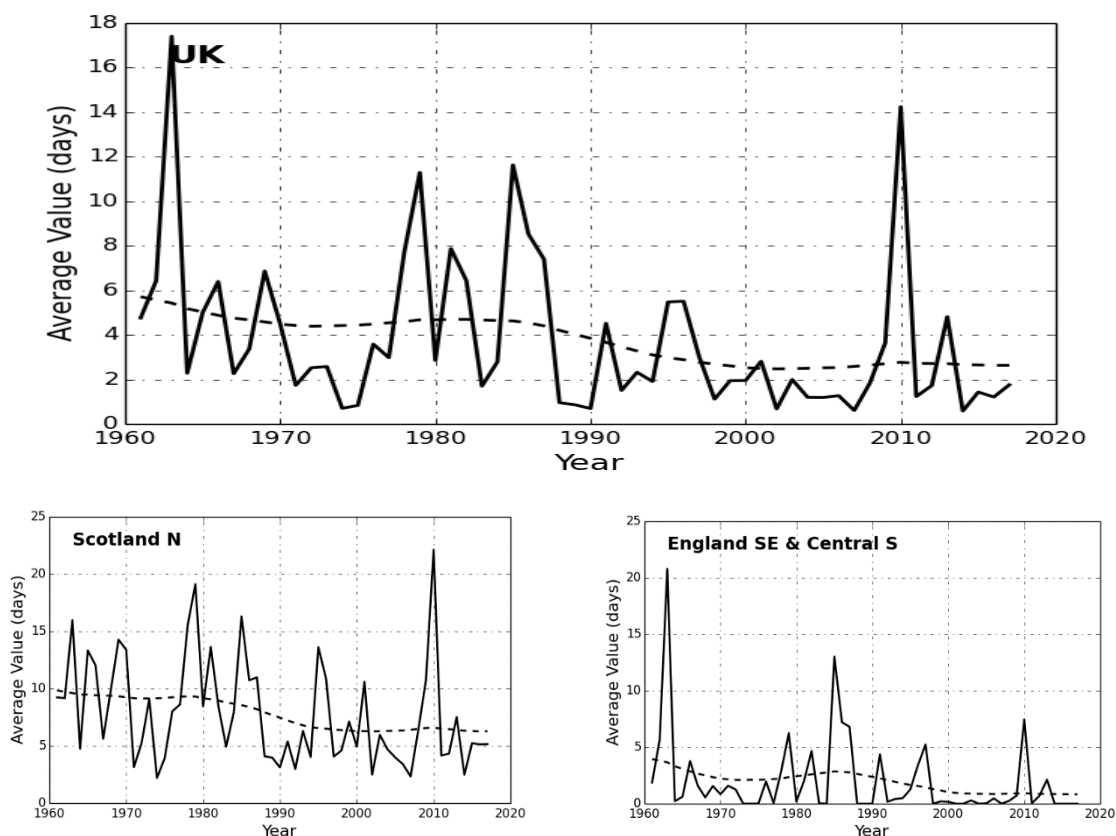
Climatological statistics for spatially averaged values across UK and regions (°C):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	-8.5	-7.6	-6.8	-6.4
England	-8.1	-7.2	-6.5	-5.9
Wales	-7.8	-7.1	-6.6	-5.6
Scotland	-9.5	-8.6	-7.6	-7.7
N Ireland	-7.0	-6.4	-5.9	-5.2
Scotland N	-9.3	-8.6	-7.7	-7.4
Scotland E	-10.6	-9.6	-8.3	-8.3
Scotland W	-8.5	-7.5	-6.6	-7.4
England E & NE	-8.4	-7.6	-6.9	-6.0
England NW & Wales N	-8.2	-7.3	-6.6	-6.6
Midlands	-8.7	-7.7	-6.7	-6.6
East Anglia	-8.1	-7.1	-6.9	-5.7
England SW & Wales S	-7.0	-6.4	-6.0	-4.5
England SE & Central S	-7.9	-7.1	-6.4	-5.6

Icing days



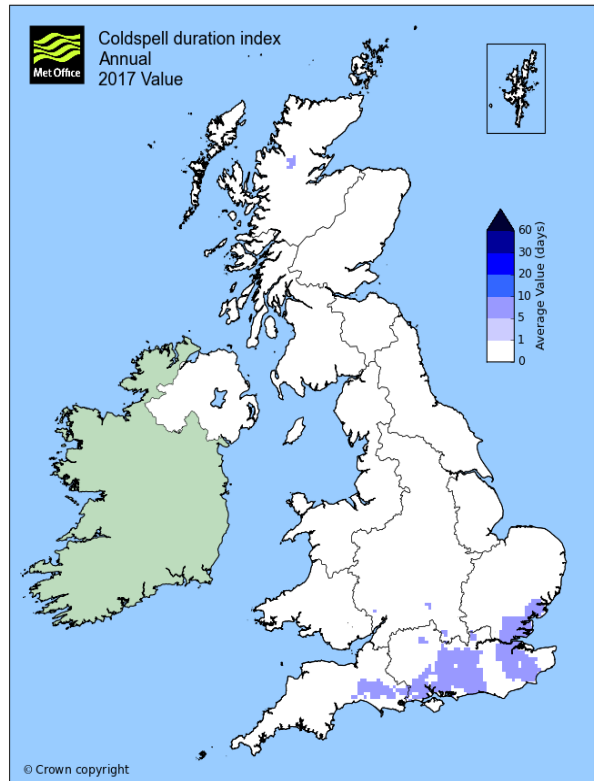
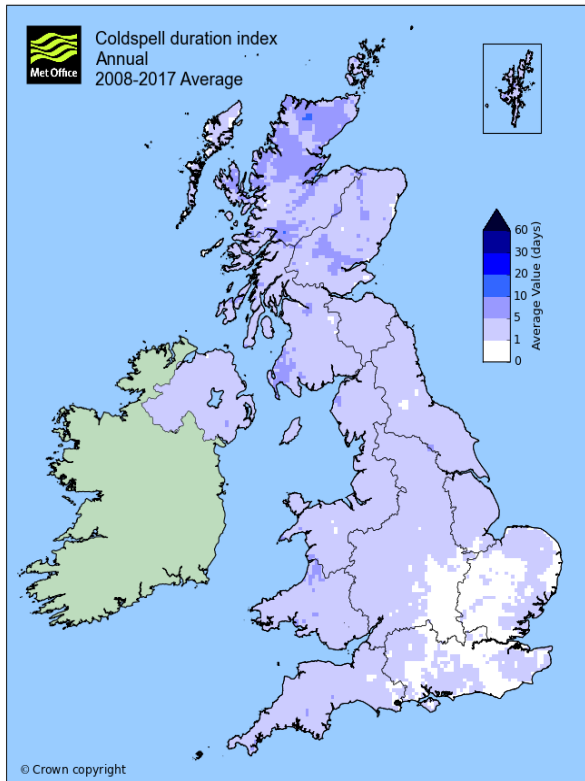
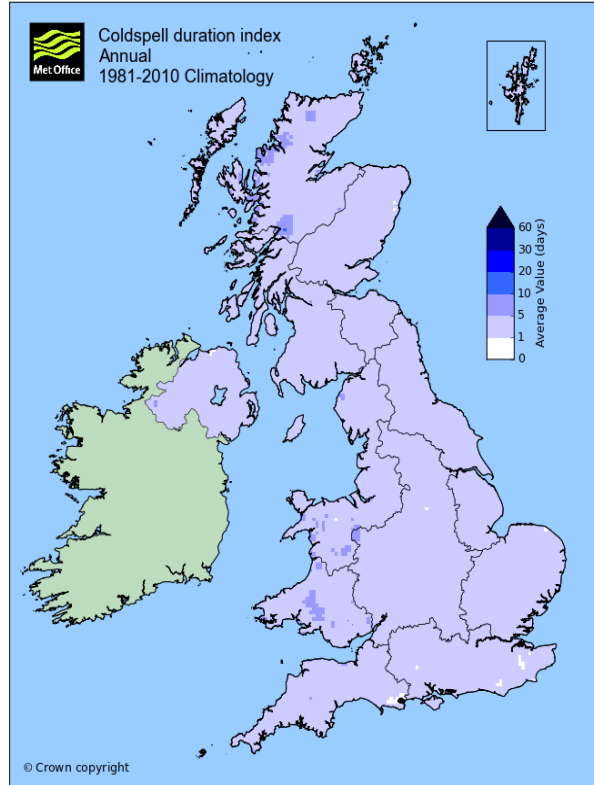
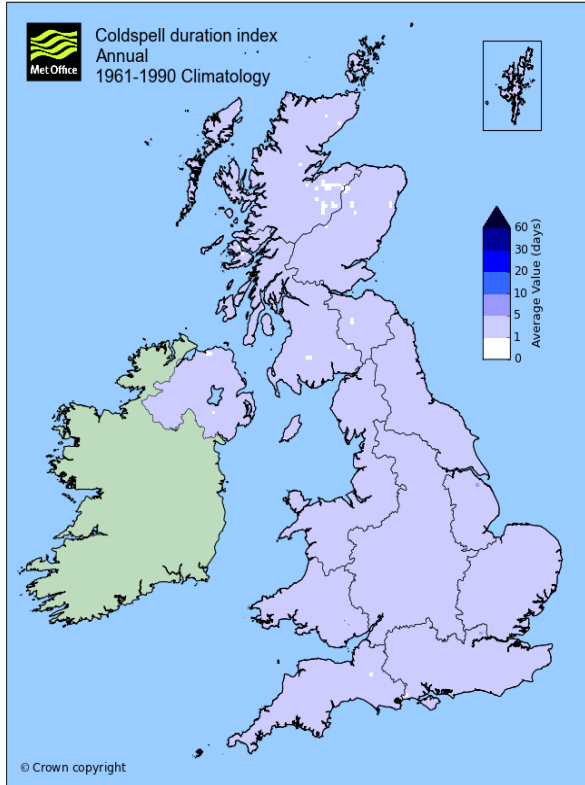
Icing days



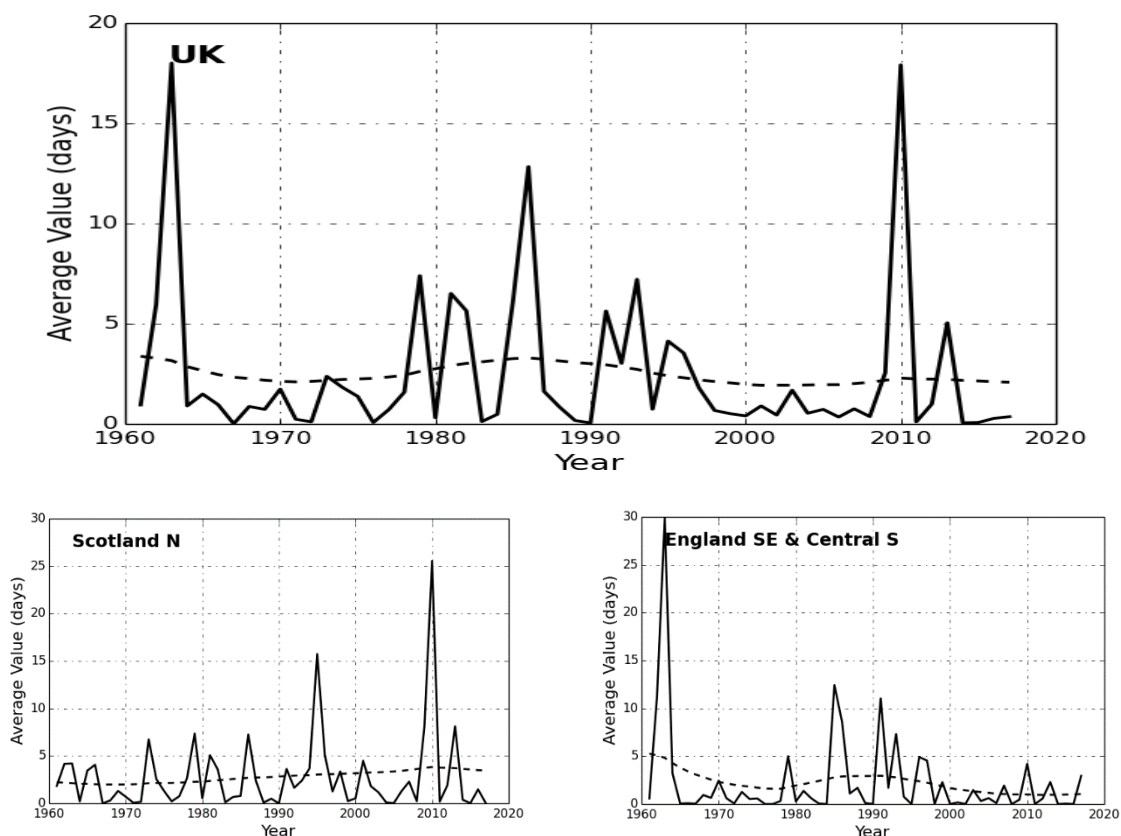
Climatological statistics for spatially averaged values across UK and regions (days):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	4.8	3.6	3.2	1.8
England	3.6	2.5	1.9	0.7
Wales	4.2	2.9	2.7	0.8
Scotland	7.8	6.1	6.0	4.1
N Ireland	0.8	0.9	1.2	0.1
Scotland N	9.2	7.4	7.3	5.2
Scotland E	9.8	7.5	7.2	5.2
Scotland W	3.9	3.0	3.0	1.6
England E & NE	4.0	2.7	2.3	1.2
England NW & Wales N	4.3	3.1	2.9	1.3
Midlands	4.4	3.1	2.5	1.0
East Anglia	2.9	2.0	1.0	0.1
England SW & Wales S	2.9	2.0	1.6	0.3
England SE & Central S	2.8	2.0	1.1	0.0

Coldspell duration index



Coldspell duration index



Climatological statistics for spatially averaged values across UK and regions (days):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	2.7	2.9	2.8	0.4
England	3.1	2.8	2.0	0.7
Wales	2.7	4.0	3.4	0.0
Scotland	2.1	3.0	3.9	0.0
N Ireland	2.3	2.4	2.8	0.0
Scotland N	2.1	3.4	4.6	0.0
Scotland E	2.2	2.6	3.5	0.0
Scotland W	2.1	2.9	3.4	0.0
England E & NE	3.3	2.6	2.3	0.0
England NW & Wales N	2.9	3.5	3.1	0.0
Midlands	3.4	2.9	1.9	0.0
East Anglia	3.7	2.8	1.0	0.9
England SW & Wales S	2.4	3.5	3.3	0.3
England SE & Central S	2.8	2.3	1.1	2.9

Rainfall indices

The **maximum 5-day precipitation amount** reflects the highest total rainfall accumulated over a five day period for each location, in mm. It has a similar spatial pattern to the climatology of total rainfall across the UK, with the wettest regions over the western uplands. This is due to the contribution from orographic enhancement. Some regions routinely record maxima well in excess of 100 or 200 mm, meaning that in most years that location will record at least one 5 day sequence at or above that amount of rain. The lowest values are across East Anglia with some areas below 50 mm. In the past few decades there has been a general increase in annual average rainfall across the UK with the most recent decade (2008-2017) being 8% wetter than 1961-1990. The maximum 5-day precipitation showed a general increase between the 1960s and 2000 of 4%, with larger increases across Scotland, but there is no compelling evidence of change across most of the eastern half of the country or central and southern England. 2017 was a notably low year for this metric across many regions with 70.7 mm for the UK compared to a 1981-2010 climatology of 83.2 mm.

The total **rainfall from extremely wet days** represents the total rainfall accumulated from rain days that exceed the 99th percentile of daily rainfall in mm. Increases in this metric can therefore reflect both increased number of extremely wet days or increased intensity of rain on extremely wet days. Typically these extremely wet days account for approximately 8 % of total annual rainfall. In extreme years, such as 2000 for south east England, the proportion of rain from extremely wet days was 14% of that years total rainfall.

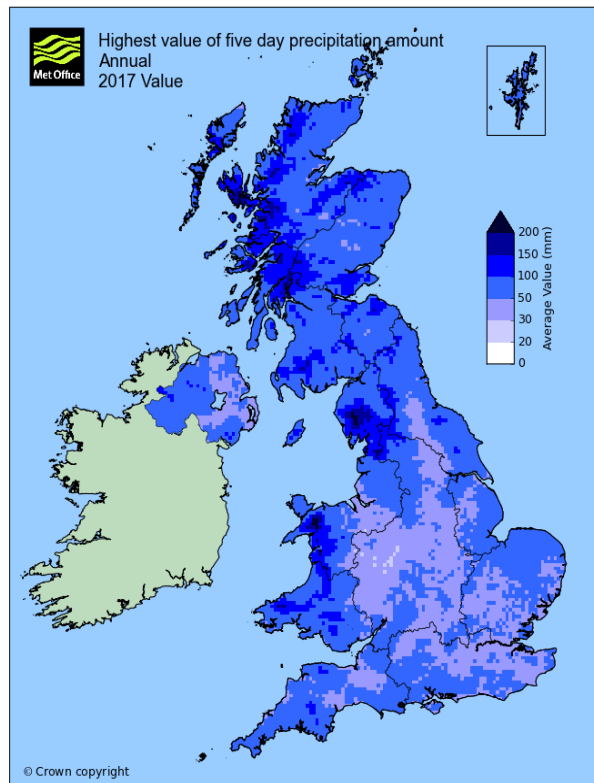
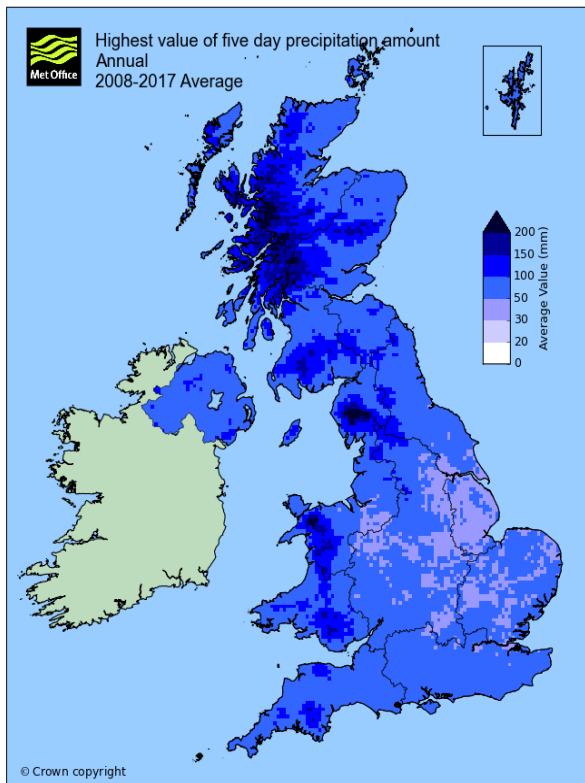
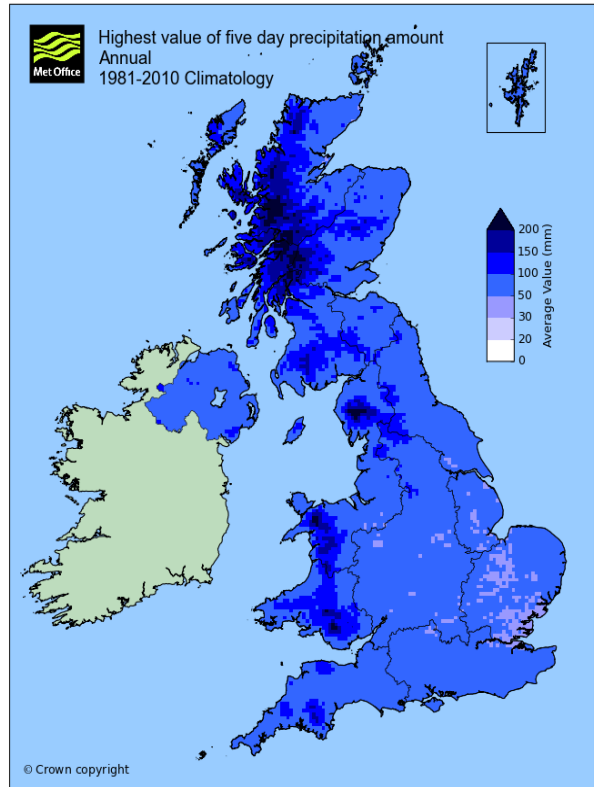
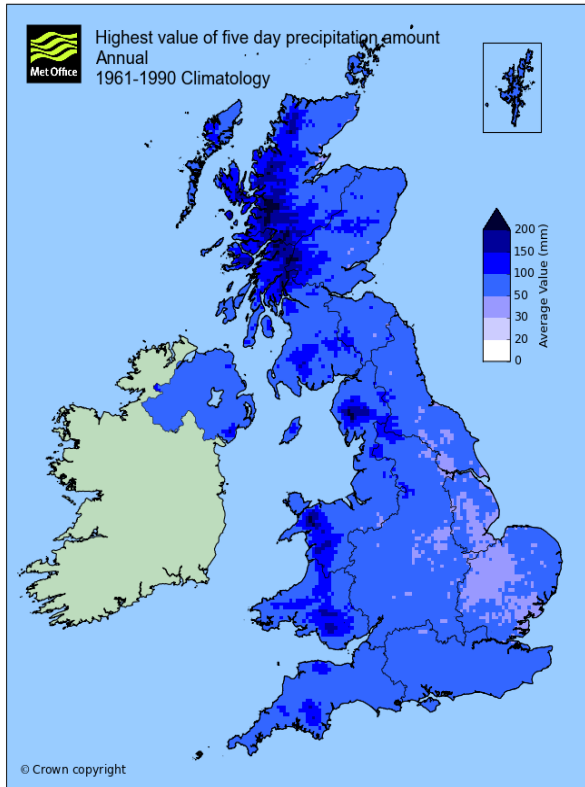
The extremely wet days index shows an increase of 17% when comparing the most recent decade (2008-2017) with the 1961-1990 climatology. The increases are larger for Scotland and some north and west parts of England and Wales, but less evidence of change across central southern regions. 2017 experienced a relatively dry winter, spring and autumn, and many places did not experience any extremely wet days in the year as shown by the white areas in the lower right hand map.

The **longest wet spell** and **longest dry spell** indices determine the longest period of consecutive days with or without rain during the year (where a rain day is defined to be one with at least 1 mm, thus ignoring very light rain days). This is calculated for each location in the gridded data, and therefore may not be coincident in time for different locations. Unlike the warm and cold spells duration these indices do not have a minimum threshold of consecutive days.

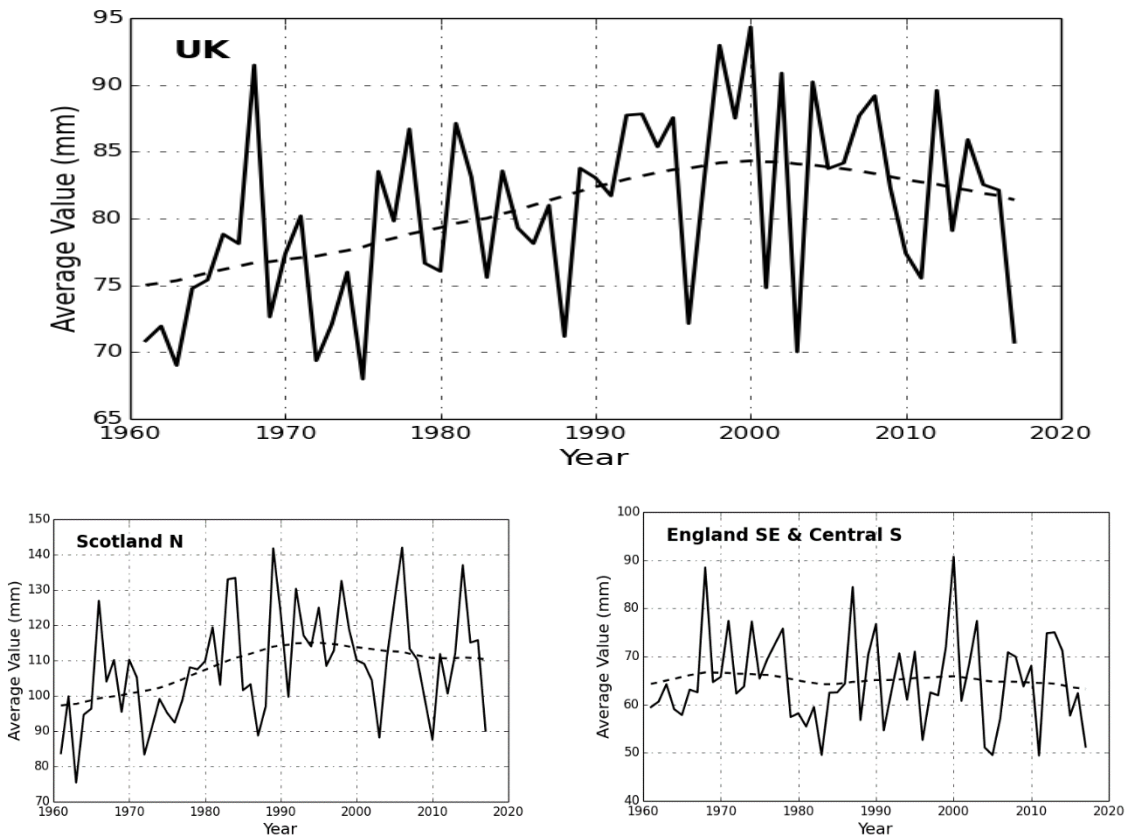
The average longest wet spell duration for the UK is 12 to 13 days, ranging from over 20 days in northern Scotland to less than 8 for East Anglia. Although the 1960s were somewhat low compared to other decades, for this metric there is no compelling trend in the duration of wet spells for the UK or regions. For most parts of the UK the longest wet spell in 2017 was close to or marginally below the 1981-2010 average.

The **longest dry spell** of the year for the UK is typically of order 20 days, ranging from approximately 17 in north Scotland to 24-25 in East Anglia and south east England. There is some evidence of a decline of 13% in dry spell duration since the 1980s. However it should be acknowledged that for all the precipitation indices the period 1961 to present is relatively short for diagnosing variability. Trends in UK precipitation are not well represented by a linear trend. The most recent decade has recorded an average longest dry spell for the UK of 18 days compared to a 1981-2010 average of 19.9 days and 20.5 days for 1961-1990. In 2017 western areas had shorter dry spells than average, for example 12.7 days for Wales compared to a 1981-2010 average of 19.3, in contrast some parts of the south English coast and central belt of Scotland were above average.

Highest value of five day precipitation amount



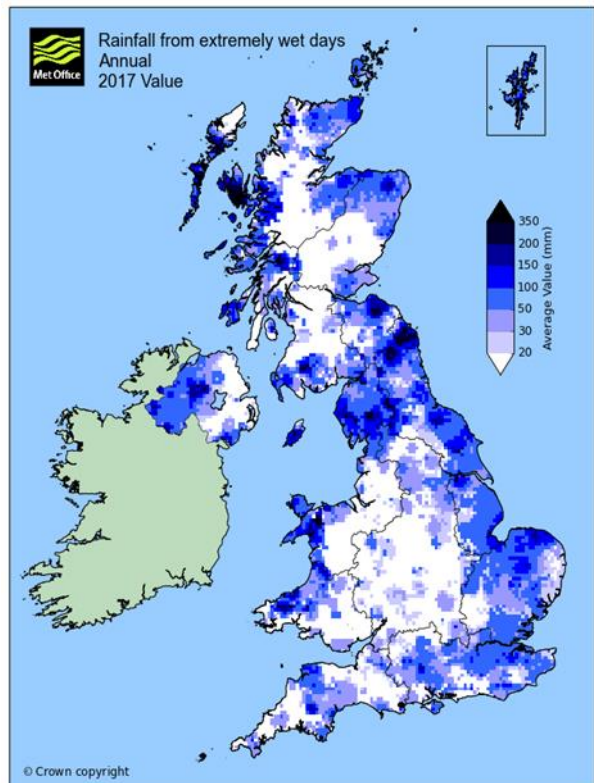
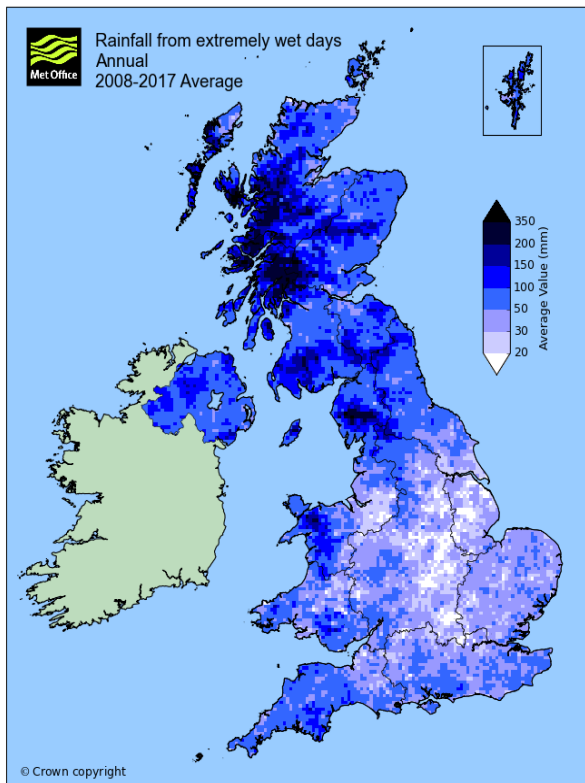
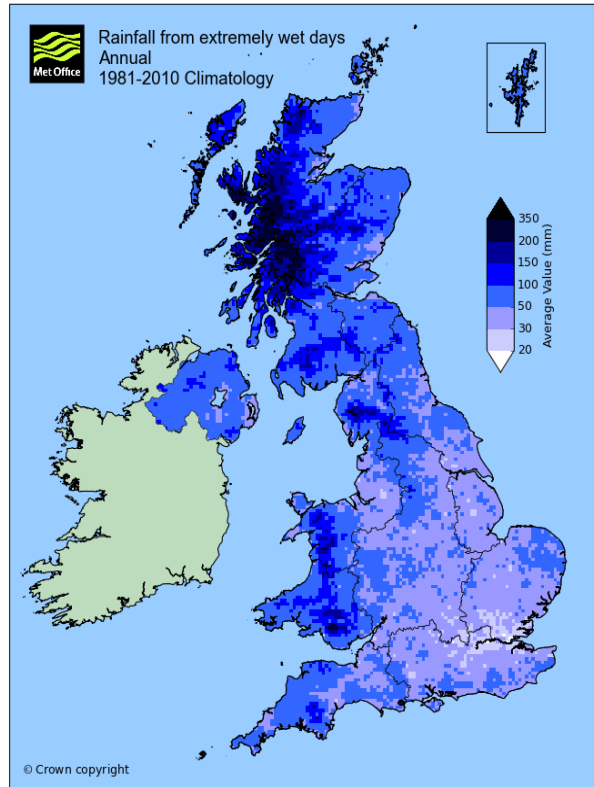
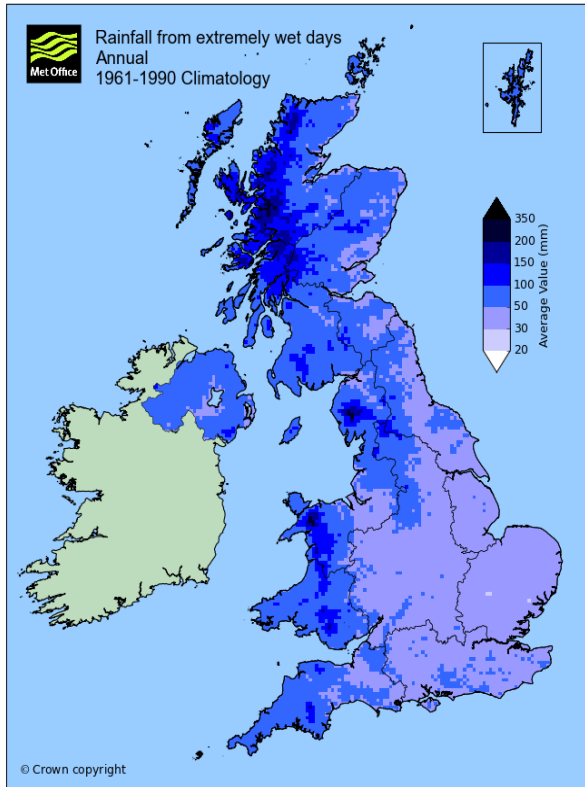
Highest value of five day precipitation amount



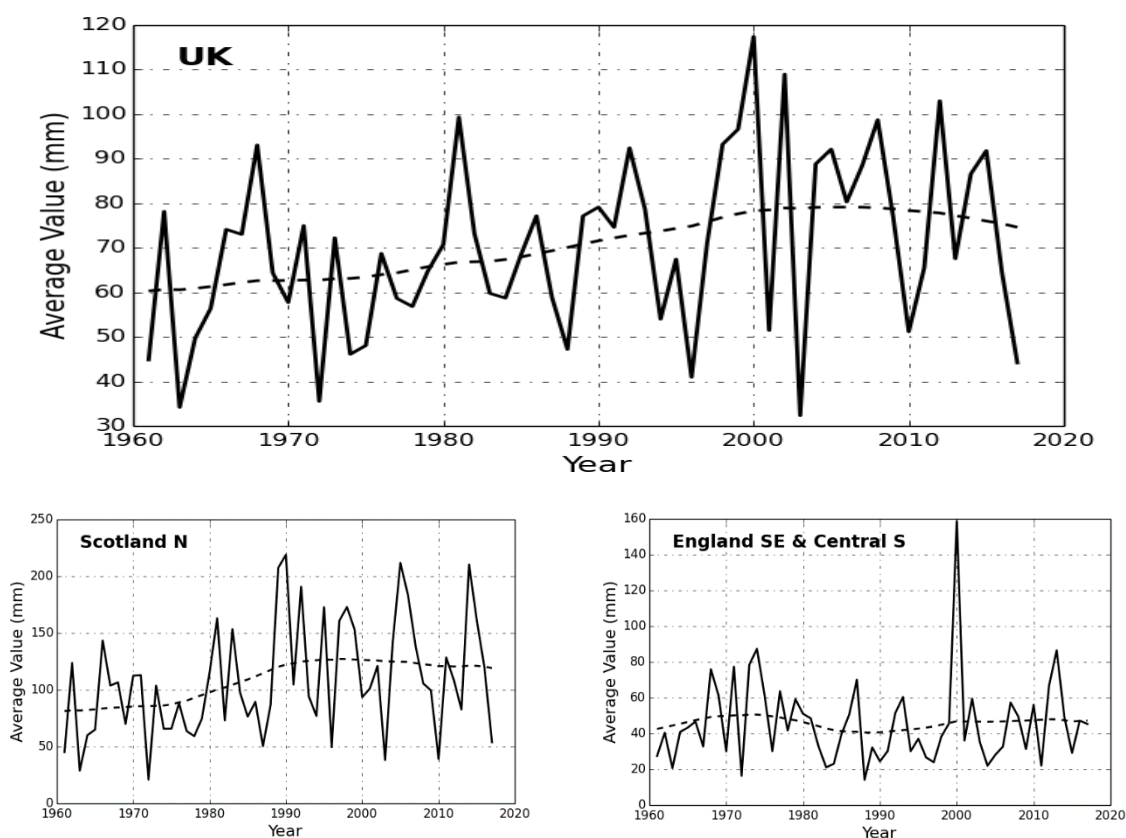
Climatological statistics for spatially averaged values across UK and regions (mm):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	77.8	83.2	81.4	70.7
England	64.7	67.3	65.7	59.1
Wales	96.9	102.1	94.7	84.0
Scotland	95.9	106.2	104.8	88.2
N Ireland	70.2	73.5	76.8	61.0
Scotland N	104.4	113.5	107.9	90.1
Scotland E	80.0	90.8	94.6	82.9
Scotland W	101.3	113.0	111.9	91.5
England E & NE	60.1	65.8	63.8	65.7
England NW & Wales N	88.0	91.3	93.0	85.9
Midlands	60.7	63.3	58.8	50.3
East Anglia	50.6	53.1	51.8	54.7
England SW & Wales S	87.1	91.3	85.7	70.5
England SE & Central S	65.6	64.6	64.4	51.3

Rainfall from extremely wet days



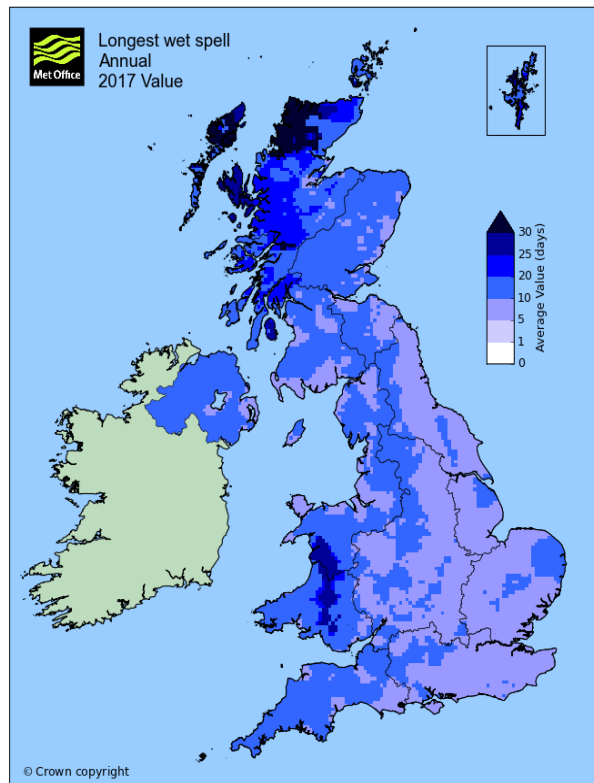
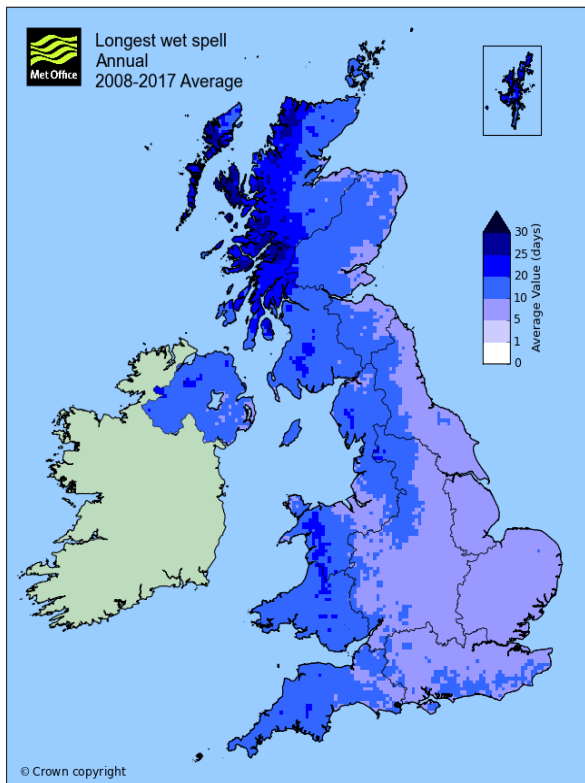
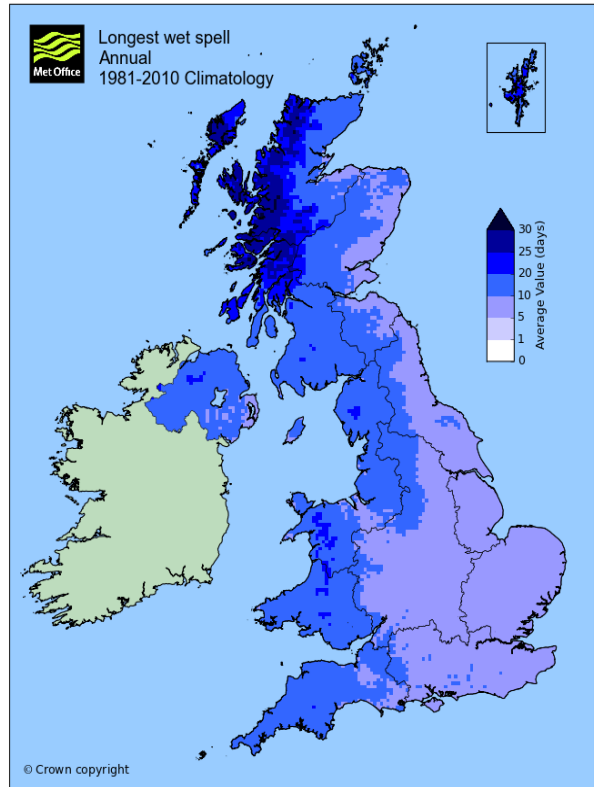
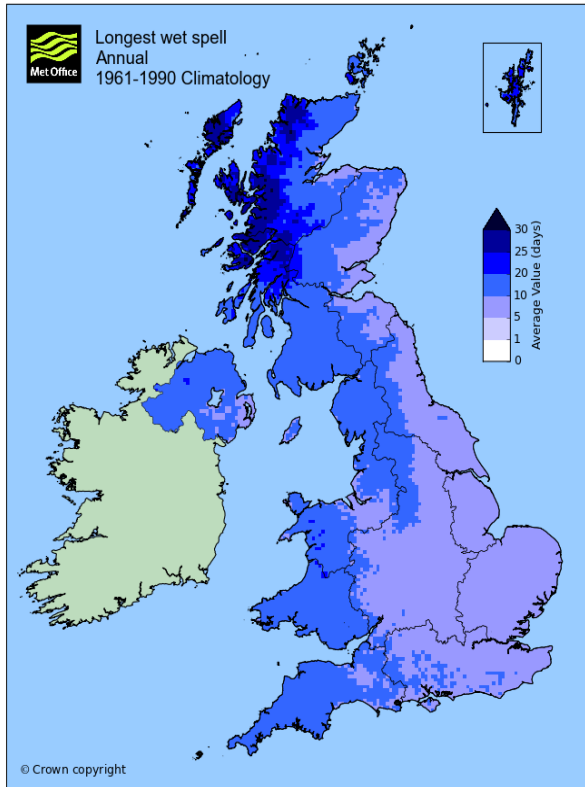
Rainfall from extremely wet days



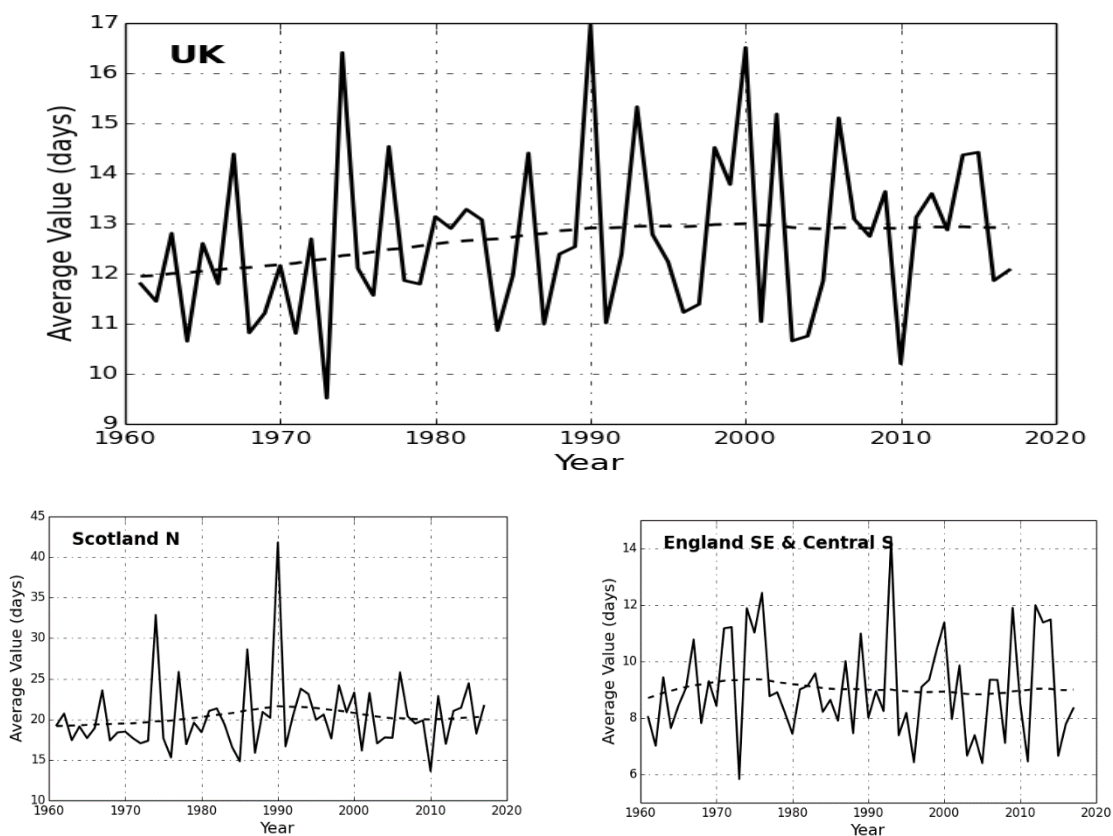
Climatological statistics for spatially averaged values across UK and regions (mm):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	80.6	91.2	94.6	68.6
England	64.8	69.3	72.0	64.0
Wales	99.8	106.8	93.8	78.2
Scotland	102.4	125.1	130.9	73.6
N Ireland	75.1	82.2	102.5	71.7
Scotland N	113.1	136.9	132.1	84.3
Scotland E	86.2	105.5	117.7	65.4
Scotland W	105.3	130.3	143.9	67.7
England E & NE	64.3	72.3	77.2	81.0
England NW & Wales N	92.9	93.1	104.2	89.9
Midlands	61.8	68.2	63.3	38.2
East Anglia	50.1	56.8	53.2	65.3
England SW & Wales S	85.0	91.3	88.7	58.7
England SE & Central S	60.7	60.0	62.3	57.2

Longest wet spell



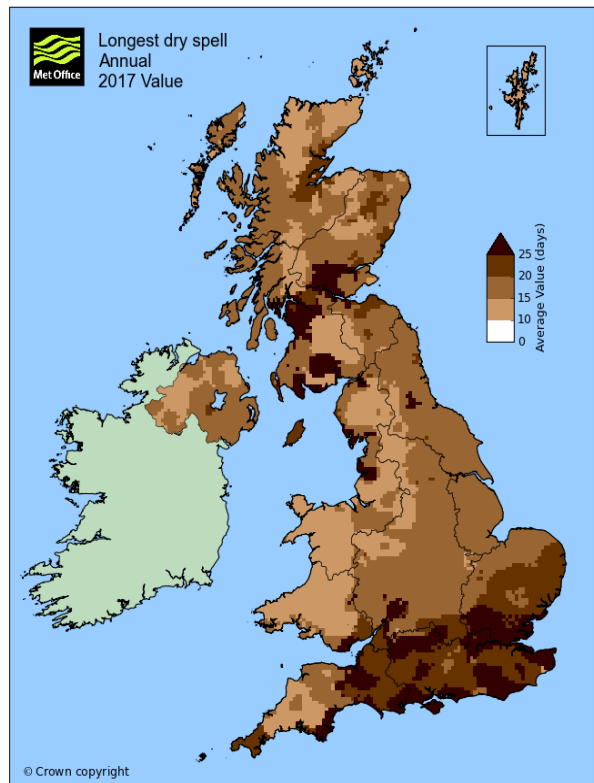
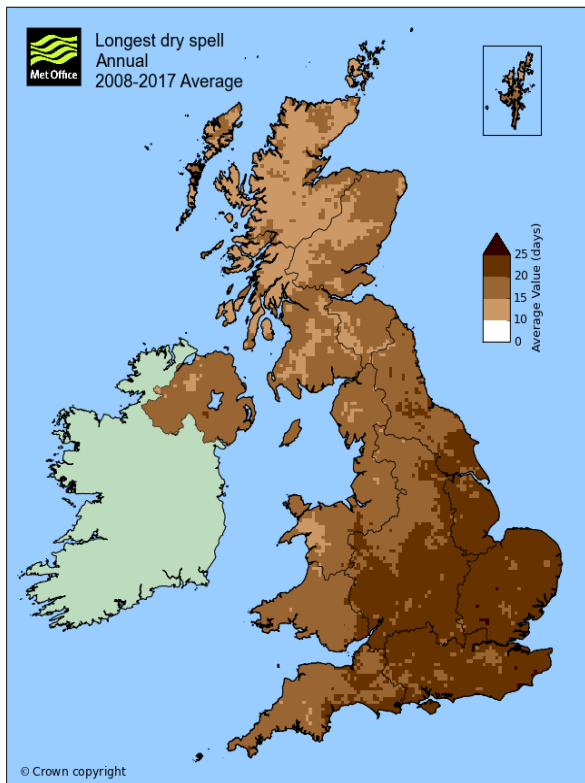
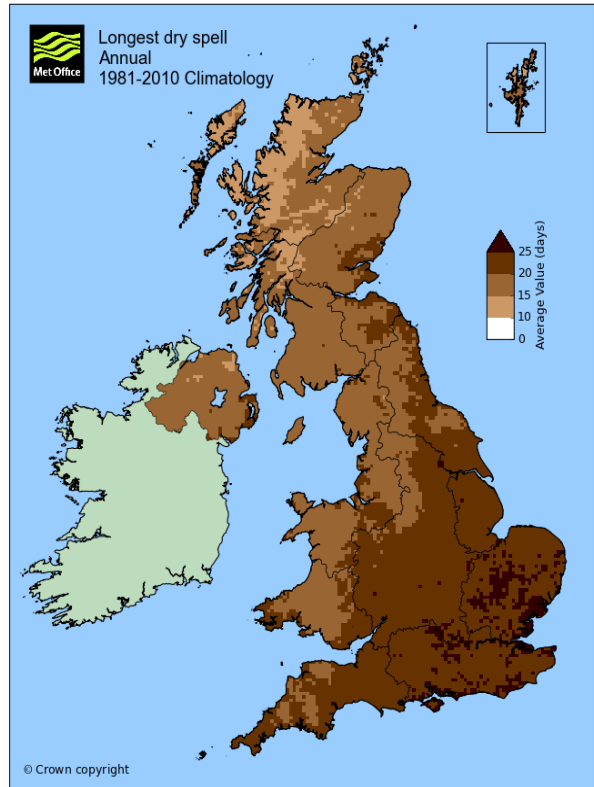
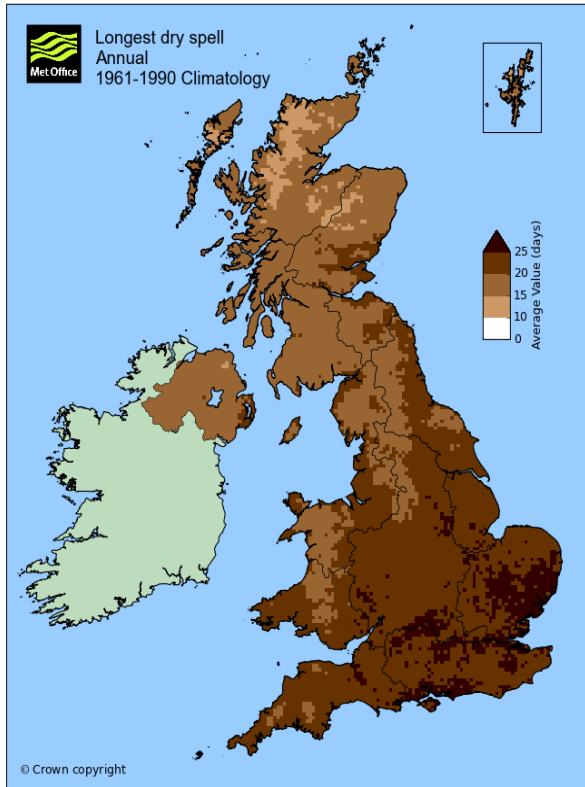
Longest wet spell



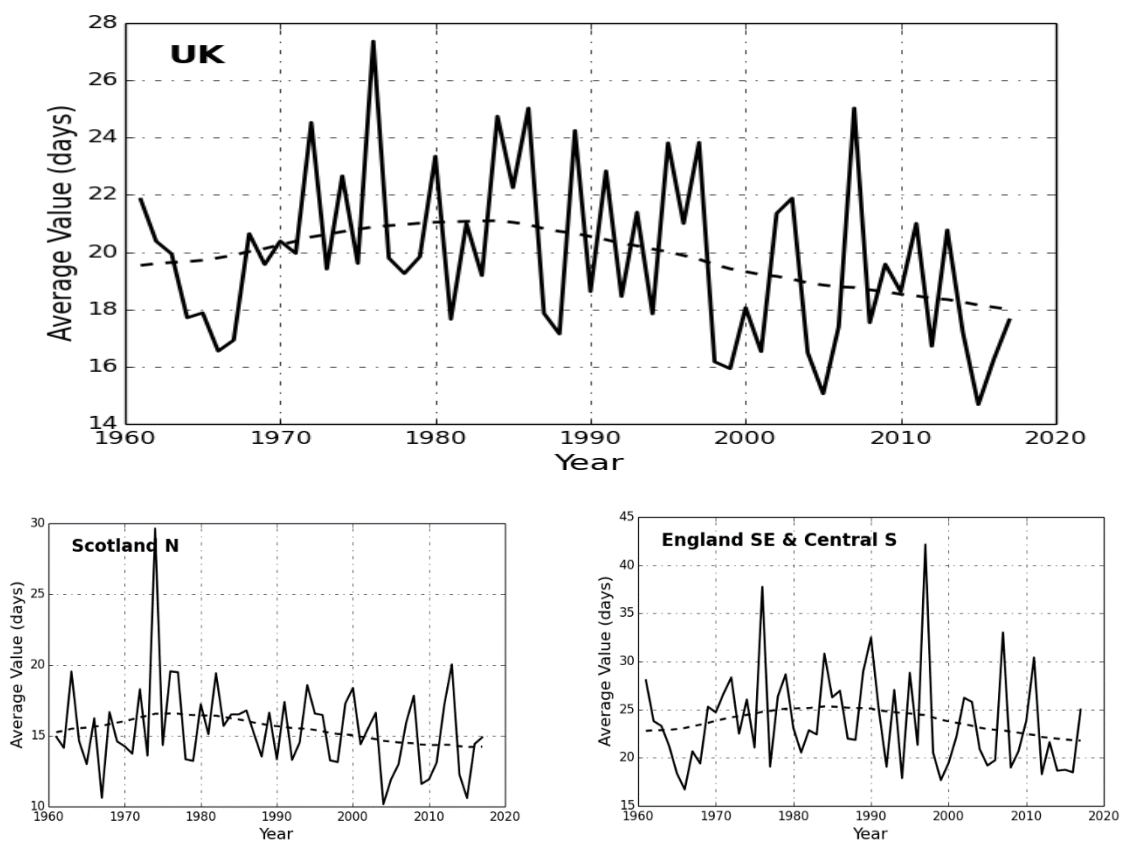
Climatological statistics for spatially averaged values across UK and regions (days):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	12.4	12.8	12.9	12.1
England	9.5	9.6	9.8	9.2
Wales	14.3	15.2	15.3	14.8
Scotland	16.7	17.3	17.1	16.0
N Ireland	13.6	14.2	14.2	12.7
Scotland N	20.3	20.7	20.0	21.7
Scotland E	11.4	11.8	12.2	11.1
Scotland W	17.3	18.3	18.4	13.7
England E & NE	8.5	8.6	8.7	8.3
England NW & Wales N	12.9	13.9	13.6	12.2
Midlands	8.9	9.1	9.4	9.1
East Anglia	7.5	7.4	7.8	8.4
England SW & Wales S	13.4	13.8	14.0	12.7
England SE & Central S	9.1	8.9	9.2	8.3

Longest dry spell



Longest dry spell



Climatological statistics for spatially averaged values across UK and regions (days):

Region	1961-1990 average	1981-2010 average	2008-2017 average	2017
UK	20.5	19.9	18.0	17.6
England	22.7	22.2	20.1	19.3
Wales	20.6	19.3	17.0	12.7
Scotland	17.3	16.6	15.0	16.6
N Ireland	18.0	17.8	16.9	15.4
Scotland N	16.0	15.2	14.4	14.9
Scotland E	18.3	18.2	15.7	17.4
Scotland W	17.9	16.8	15.2	18.2
England E & NE	21.2	21.3	19.7	16.6
England NW & Wales N	20.0	18.8	17.0	14.2
Midlands	22.8	22.0	20.3	17.1
East Anglia	24.7	24.5	22.2	23.3
England SW & Wales S	21.9	20.8	17.9	16.7
England SE & Central S	24.5	24.2	21.5	25.0

Summary

This supplement provides a summary of a range of standard climate extremes indices for the UK. Presenting climatological reference maps and statistics, along side the most recent data for the last year (2017) and decade (2008-2017). The results presented here are provided in support of the State of the UK Climate 2017 report (Kendon et al, 2018).

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