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SURFACE WATER VAPOUR DENSITY DISTRIBUTION OVER NIGERIA

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Abstract: The spatial distributions of surface water vapour density (SWVD) over Nigeria during the decadal period 1987–1996 were investigated using daily mean temperature and relative humidity data for seven stations grouped into three areas arranged in a south-north transect; the Southern, the Midland and the Sahelian (Northern) Zones. Results show that the variations in each zone are influenced by the prevailing atmospheric conditions which are largely dependent on the seasonal north-south movement of the Inter-Tropical Discontinuity (ITD) and to some extent, by the topographical features. Values of daily mean of SWVD were found to be higher at midnight than at midday at both the Southern and the Northern Zones whereas at the Midland zone, the reverse was the case. The time series of SWVD showed evidence of quasi biannual oscillations at the Southern zone while at the Midland and the Northern zones, quasi-1-year oscillations persisits. The inter-stations and inter-zonal correlations have shown that there is spatial coherence in variation of SWVD over the whole country during the dry season period while during the rainy season, the Northern Nigeria (Midland and Northern Zones) and the Southern Nigeria emerge as two distinct areas in terms of spatial coherence in the variation of SWVD.

Keywords: Inter-Tropical Discontinuity, quasi-biannual, oscillations, density, topographical, Nigeria, surface water vapour density.

INTRODUCTION

Water vapour is the link between the surface and the atmosphere in the hydrological cycle. Almost all water vapour in the atmosphere originates at the surface of the Earth where water evaporates from the ocean and the continents owing to the sun’s radiation, and is transpired by plants and respired by animals into the atmosphere (AGU, 1995). Once in the atmosphere, water vapour can be transported horizontally and vertically by the three-dimensional circulation of the atmosphere and may condense to form liquid water or ice crystals in clouds. The cycle is completed when water returns to the Earth’s surface in various forms of precipitation such as rain or snow. This cycle is closely tied to atmospheric circulation and temperature patterns.

Water vapour causes about two thirds of the natural greenhouse effect of the Earth’s atmosphere and is for this reason, the most important greenhouse gas (Gerdig et al., 2002). Several climate models show that an increase in atmospheric humidity by 12-25% will have the same global mean radiative effect than doubling the CO₂ concentration (Hames, 1997). But in contrast to the homogenous distribution of long-lived CO₂, water vapour distribution is highly variable in space and time. Apart from its direct radiative effect, water vapour acts indirectly by interacting with aerosols, clouds, and precipitation (Hegg et al., 1996; Ramanathan et al., 2001). This indirect effect of surface cooling provides one of the largest uncertainties in the understanding of the radiative balance of the Earth’s atmosphere (IPCC, 2001).

The amount of water vapour in the air is an important factor influencing the rate of evaporation and evaportranspiration (Ayoade, 1993). These and other atmospheric circulations observed over the equatorial and most parts of the tropical continental regions are controlled by the migratory Inter Tropical Discontinuity (ITD) (Adeyemi and Aro, 2004).
Adeniyi (1966), Oguntuyinbo and Richards (1977), have found that the
ITD migrates over Nigeria in a highly irregular manner, in a series of surges, stagnations
and retreats. This differential pattern of advance and retreat of the ITD, and possibly the
enhancement of rainfall-producing processes by highlands, for example in the midland
area, have combined to determine the pattern of variations in water vapour parameters at
the individual stations. The fact that water vapour possesses permanent dipole moment
means it has a serious influence on radio wave propagation. It exhibits resonance
absorption effects at millimetric frequencies (Watson, 1951; Viewwanan et al., 1980), while
considering the importance of water vapour to radio propagation, it can be observed that
water vapour is a major contributor to the attenuation of microwaves. This behaviour has
a greater effect on satellite communication, remote sensing and radio astronomy (Hogg
and Girardet, 1979; Adedokun, 1983). Water vapour is also an important parameter in the
objective prediction of cloud and precipitation. This paper describes the analysis of SWVD
over seven meteorological stations in Nigeria. These are Ikeja and Ibadan in the Southern
zone, Ikor and Minna, in the Midland zone, Kaduna, Zaria and Kano in the Northern zone
of Nigeria. The aim is to find out for each zone, the diurnal and the interannual variations
of SWVD.

DATA AND DATA PROCESSING

Daily temperature and relative humidity data for the period 1987-1996 were obtained
for the seven stations shown in Table 1. The data were obtained from the Department
of Meteorological Services, Oshodi in Nigeria. These stations possess a long record of
daily data, and are evenly arranged in a south-north transect. These stations were grouped
into Southern, Midland and Northern zones to reflect areas of differing physical control
and Babalola (1999). These zones have the following characteristics:

(i) The Southern zone consisting of Lagos/Ikeja (06°33 thrilled) and Ibadan
(07°28N, 03°54'E) is dominated by humid air (M) for about three to
nine months of the year.

(ii) The midland zone, consisting of Ilorin (08°33N, 04°35'E) and Minna
(09°37N, 06°32’E) which is predominantly highland (Olaniran 1983),
where the CT air mass dominates, and the topography extends the length
of the rainy season due to localized convection and orographic effects.

(iii) The Northern zone, consisting of Kaduna (10°36N, 07°27E), Kano (12°03N,
08°32'E) and Zaria (11°08N, 07°41'E) where the CT air mass predominates
and the Mt air mass invades for only between three to five months.

The SWVD is calculated using the formula:

\[
\text{SWVD} = \frac{216.7e}{T_d}
\]

where e is the vapour pressure and Td is the temperature in Kelvin (Ajayi, 1989).

RESULTS AND DISCUSSION

Diurnal variation

The diurnal variations of SWVD over all the stations were observed (Figure 1). The
contrast in the distribution of SWVD over the stations is more evident during the dry season.
This diurnal distribution shows a decrease from the coast inland which is particularly marked
during this period.

During the dry season period of November-March (represented here by December, January
and March graphs; see Figure 1a-c) the Southern and the Northern zones experience a
gentle decrease in SWVD from midnight to about midday. The Midland zone on the other
hand, experiences an increase from midnight to around 0900 (local time) before dropping
to the lowest values during the day. Minimum values are observed around 1500 in the
Southern zone, while in the Midland and the Northern zones, the minimum occurred around
1000. These observed differences in the features between the northern and the southern
parts of Nigeria are in general agreement with the findings of Hamilton and Archbold (1945),
and Adedokun (1986) which show that the precipitation climates of the southern and northern
parts of Nigeria differ appreciably.

During the rainy season period, from April-September, (represented here by June
and September graphs; see Figure 2a and b), SWVD rises sharply around sunrise to the
highest value during the day. This is uniformly maintained until night time when the values
drop to their low night values at all the zones. The SWVD pattern during the dry season at
the southern zone where the minimum occurs around 1500 may be explained using the
austausch phenomenon (Aro, 1975; Adeyemi, 2004). During this time, the late morning
local surface heating of the atmosphere causes the environmental lapse rate near the surface
to exceed the dry adiabatic lapse rate causing conditional instability. Air then rises. The
adiabatic cooling of the convective rising air allows it to remain warmer and less dense
than the surrounding air so that it continues to rise through buoyancy. Water vapour is
then transported upwards resulting in its depletion at the bottom level of the atmosphere.
At both the Midland and Northern zones, the gentle increase observed during the day may
be explained using the atmospheric thermodynamics of these two regions. During this
period, the air that is prevalent in these regions is the tropical continental (CT) air. The CT air
Conference July 2007}
The high values in SWVD observed during this period at all the stations (ranging between 21.72 ± 1.22 at the coast and 16.05 ± 2.23 in the sahel) are due to the fact that during this period, the ITD is farthest North and all parts of Nigeria are under the influence of the moist mT air. A gentle increase in SWVD values are observed between sunrise and sunset at all the stations during this period. This behaviour could be associated with the occurrence of adequate vapourisation during the day to replace the uplifted water vapour by auschau most especially in the southern zone.

Midnight and Midday Variations

As humidity measurements near surface at all the stations were made at every hour of the day, it has been possible to compare the midday and midnight values of the monthly means as shown in Figure 3. For the southern zone, the annual trend of variation during the two periods is characterised by the curves with two maxima, whereas at the midland and the Northern zones, the trend is characterised by a curve with only one maximum. Between the two maxima observed for the Southern zone is a depression noticeable in July and August at these periods.

The two maxima observed at the Southern zone have the following characteristics; the first maximum corresponds to the beginning of the rainy season while the second symbolises the end of it. The first maximum occurs due to the northward advance of the Inter Tropical Discontinuity (ITD) and the deepening of the monsoonal flow while the second peak corresponds to the time of its southward recession.

The intervening August dip (known as the Intramonsoonal period) is believed to be a consequence of several factors such as coastal upwelling and the northern advance of the subtropical high pressure systems of the Southern Atlantic Ocean or because of the circulation aloft which becomes divergent and subsident due to the frequent occurrence of inversions and isothermals in the upper atmosphere along the coast when the weather zone E makes its appearance a short way inland from the coast (Adedokun, 1978; Balogun, 1981; Olaniran and Summer 1989; Trewartha, 1970).

The single peak observed in the midland zone lasts between May and September (see Figure 3). The Northern zone’s feature displayed a single peak in September.
This case in the Northern zone can be explained from the fact that the region is at the Southern brink of the Sahara which is the Northern limit of the ITD. During this period, the ITD is located in that region making humidity there to be very high due to the dominance of the moist mT air.

In the case of the midland zone, only a single maximum lasting between May and September is observed because they experience the passage of ITD once annually.

The Southern zone present higher midnight values than noon values during the dry season. This is also the case in the Northern zone. The midland zone on the other hand, has higher midday values than midnight values.

The observations at the Southern and Northern zones where midnight values are higher than midday values during the dry season may be explained by the dynamic effect such as convection. At these stations, air temperatures near the surface during the dry season are, for most times, far above the dewpoint, so that temperature fall at night does not often reach the dewpoint, therefore, there would not be loss of water by condensation of any kind. At this time, continuous evaporation from the ground surface occurs both at night and during the day thereby increasing the water vapour passing into the lower layers of the atmosphere. Cloud formation and prevailing winds prevent the accumulation of water vapour in the higher layers (Aro, 1975).

Night time radiation losses from the ground makes static stability of the bottom layer of the atmosphere at night to be greater than at noon. Associating strong convection to low static stability at noon, and damped convection to high static stability at night, therefore at noon, the strong convection will transport the water vapour upwards rapidly, while at midnight, the damped convection will permit a layer of high water vapour near the ground resulting in higher surface water vapour at midnight than at noon.

On the other hand, the observations at the midland zone where midday values are higher than midnight values could simply be explained by the loss of water from the air by condensation as the midnight temperatures fall to or below the dewpoint. These midday peaks observed in this region, have also been identified by many studies based on diurnal rainfall variation in Northern Nigeria (Griffith, 1972; Ojo, 1977). These peaks have been associated with the strong influence of a diurnal solar cycle on squall lines and cloud cluster generation, characterising a period when maximum conditional instability of the boundary layer occurs due to surface heating (Shinoda et al., 1999).
Interannual Variations

Three distinctive features emerge in the interannual variations of SWVD for the Southern, midland and northern zones of Nigeria as shown in Figure 4. From these features, it is observed that the time series of SWVD gave good representation of the year to year regional characteristics of water vapour distribution in Nigeria. In approximate terms their means cover quasi-bi-annual oscillations (i.e., an annual double oscillation) at the Southern zone while at the midland and the northern zones, a quasi one-year oscillation persists. This is in sharp contrast to the findings of Olaniyan and Summer (1989), Ayode (1973) who in their study on climatic variability in Nigeria found out that a quasi-biannual oscillation (QBO) is a common feature in annual rainfall series in the coastal, Guinea Savannah and midland zones of the country. The first and second peaks observed at the southern zone are in consonance with the north-south movement of the Inter-tropical discontinuity (ITD).

In the Southern zone, the deviation from mean is low compared with those of the midland and Northern Zones. In the Southern Zone, the annual maximum deviation from the mean is 2.23 ± 0.11, in the midland zone 5.46 ± 0.21 and in the northern zone, it is 7.58 ± 0.61. In the southern zone, annual minimum are observed in the middle of the year while at the midland and northern zones, annual maxima are observed in the middle of the years. The annual minimum observed in the southern zone corresponds to the period of the little dry season (LDS), lasting three weeks, that commonly occur in West Africa in July/August.

The results of a simple linear correlation (r) between the data for all the stations (see Table 2a) show that, for adjacent stations, the greatest degree of interstation coherence for the distribution of SWVD occur in the Northern zones between Kaduna and Zaria (r = 0.98). The Northern stations are generally characterised by high correlation values (ranging between 0.78 and 0.98). Lower values apply elsewhere. Ikeja and the Northern stations presented negative values which decrease northward. The interzonal correlations (see Table 2b) shows that for adjacent zones, the greatest degree of interregional association in the distribution of SWVD occurs between the midland and the Northern zones, while lower values apply elsewhere.

<table>
<thead>
<tr>
<th></th>
<th>Ikeja</th>
<th>Ibadan</th>
<th>Ilorin</th>
<th>Minna</th>
<th>Kaduna</th>
<th>Zaria</th>
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<td>Midland Zone</td>
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Table 2. (a) Interstation and (b) Inter-zonal correlations in St characteristic in Nigeria. Annual values were taken into consideration here.

Dividing the data across the seasonal line (Tables 3 and 4) the linear correlations obtained between the adjacent stations are appreciable during the dry season. For instance, the correlation between Ikeja and Kano is 0.28 (see Table 2a). This shows that spatial coherence in SWVD distribution during the dry season period is discernible across Nigeria. This is not the case during the rainy season. During this period, the degree of association was poorer in the south than in the north. The inter-zonal correlations between adjacent areas during the dry season is high between Southern and midland zones (Table 3b) the highest being between midland and Northern zones. During the rainy season linear correlation is highest between midland and northern zones and poorest between Southern and midland zones. Therefore when comparing the two periods (rainy and dry season), a high degree of spatial coherence is observed across the country during the dry season while during the rainy season, spatial coherence is only discernible in the midland and northern zones. This compares well with the findings of other researchers (e.g., Hamilton and Archbold, 1945, Obasi, 1965 and Adefokun, 1986) which suggest that during the rainy season, in terms of spatial coherence, the country may be divided into two halves, southern and northern embracing on the one hand, the coastal and Guinea Savannah zone (i.e., Southern zone in this study) and on the other hand, the midland and the Sahelian zone (i.e., the midland and the northern zone in this study). This variation may be explained in terms of the mode of advance and retreat of the rain-producing zone (the ITD). The ITD invades from the South at the beginning of the rainy season in a highly irregular manner, in a series of surges, stagnation, and retreats. On the other hand, its net final retreat at the end of the rainy season is far more regular (Adefokun, 1965; Adefokun, 1978; Oguntuyono and Richards, 1977). This differential pattern of advance and retreat of the ITD, and possibly the enhancement of rainfall producing processes by the local relief, especially in the midland area, have combined to determine the pattern of distribution in SWVD in Nigeria.

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Table 3. (a) Interstation and (b) Inter-zonal correlations in St characteristic during the dry season in Nigeria.

CONCLUSION

The spatial distribution of SWVD over Nigeria has been investigated using daily mean surface data of temperature and relative humidity for 10 years. SWVD over the southern part of Nigeria has been found to be considerably different from those in the midland and northern zones. Strong diurnal variations have been observed over all the regions during the dry season period.
Water vapour in the atmosphere drops to the minimum value in the afternoon hours at the southern stations while a minimum value in the midland and northern zones are found in the late morning hours. This occurrence in the southern stations has been likened to austusch phenomenon, where water vapour is transported upwards during the day because of local surface heating of the atmosphere by ground.

<table>
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Table 4 (a) Interstation and (b) following page Interalzonal Interalzonal correlations in $S_{\text{a}}$ characteristics during the rainy season in Nigeria.

The southern and the northern zones present high midnight values than midday values whereas, in the midland zone, the midday values are higher than the midnight values. The inter-annual variability shows a quasi-annual oscillation at the Southern zone while at the midland and northern zones a quasi-1-year oscillation persists. The interstation and inter-zonal correlations show little evidence of spatial coherence during the rainy season across the country, with a notably persistent decay in the degree of association with increasing distance from the coast inland. During the dry season, a more consistent interstation and inter-zonal correlations exists over the country.

ACKNOWLEDGMENTS

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REFERENCES


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Abstract: Using the meteorological records taken by Thomas Barker at Lyndon in Rutland for the periods of 1748-1763 (Barker) and 1771-1784 (Manley, 1949 and Kington, 1988), a revised monthly temperature series has been derived which can now be compared to more recent series with standardised exposure and instrumentation. The indoor temperature data of Barker has been "reduced" to estimated outdoor temperatures, and corrections were made to this data to estimate the daily minimum and maximum temperatures. From these new values, mean monthly minimum and maximum temperatures are calculated. These monthly means were then tested statistically by a variety of comparative tests and also for the homogeneity of the means. With temperature changes credited to global warming, there has been an increasing interest by climatologists, meteorologists and the general public in the temperature records of the past. This led to frequent references to the Central England Temperature Series (Manley, 1974). This CET Series was probably the greatest achievement of the late Prof. Gordon Manley whose monumental work lead to a series of mean monthly temperatures for Central England from 1659 to 1973.

Keywords: mean temperatures, standardised statistical tests, 18th century weather, Central England Temperature series.

INTRODUCTION

The derived monthly mean temperatures were compared with the relevant Central England Temperature ("CET") values (Manley 1974) and were found to be within 1°C of the CET means. In addition to the monthly means, the highest and lowest temperatures for the month were so derived, as well as the temperatures for the coldest days and warmest nights, so providing an acceptable temperature summary for each of the months within the two specified periods above. A statistical approach was made in an attempt to solve the problem of the errors involved in estimating the outside (screen) temperatures from those observed indoors and a meteorological approach to estimate the likely minimum and maximum temperatures from the derived outdoor values with special attention to the date and time of these observations.

An expansion of the basic temperature data of Manley's CET series (1974) is produced with estimates of monthly mean maximum and mean minimum temperatures derived from estimated daily values. Consequently, the temperature records for the east Midlands now include detailed monthly summaries for the years 1748-1763, and 1771-1784, and also up to the present (Rothwell, 2006). The intervening years 1764-1770 are unfortunately missing from Barker's record, but these years are partially covered by using small regional adjustments to the CET values; so providing a temperature record going back some 250 years. The series for the north-east Midlands from 1785 to the present was determined by using a relative homogeneity test similar to that used by Craddock (1979) using a method of seasonal ratios of four principal locations with long and reliable records; and then comparing these ratios with the other shorter records within the east Midlands region (Rothwell, 2006).
Brief descriptions of some of the most significant months (towards the end of the article) are given, with 1783 being a particularly interesting year. The greater temperature variability experienced during these years, of the 18th century, is discussed, in which the greater frequency of cold winters did not significantly affect the level of summer heat. The series does, however, confirm the longer and more frequent cold winters, and the often subsequent cold springs. The estimated values for the coldest days shows a very significant difference to more recent years, but that the warmest nights, especially those experienced in hot spells do not seem to have changed. These details are of particular interest as they occurred during what had been described as the "Little Ice Age".

Thomas Barker (1722-1809)

These estimated temperatures are derived from the valuable records taken by Thomas Barker at Lyndon in Rutland from 1748 to 1798, whose records are some of the earliest instrumental observations known in England. Thomas Barker was a country squire who has been praised as "a pioneer and historian of the weather" (Kington, 1888). His records were widely recognised as a significant authoritative reference, and as such were published in the Philosophical Transactions of the Royal Society.

Barker started his weather observations with those of rainfall in June 1733 at the age of 11. Later, continuous records of temperature were made from March 1748 until the end of 1798. His first thermometer was a spirit in glass instrument just over two feet long, graduated from 0 to 95 as an inverted scale, with low values indicating high temperatures and high values low temperatures. The thermometer was made by John Parkin, and was similar to the one used by the Royal Society. Later Barker used thermometers graduated in degrees Fahrenheit, which were of an unspecified type. One of these thermometers was located in a "cool room" of the house, and another was located "outdoors in the shade". This enabled Barker himself to make numerous temperature comparisons in a variety of weather conditions.

In 1850, Glaisher (another pioneer of 19th century meteorology) reduced Barker's records into a monthly series for London due to gaps in the record of the Royal Society. Barker's data is reduced herein into a temperature series for the east Midlands which is compared with the regional monthly summaries available today. A daily analysis of the Lyndon data was made in the Climate Research Centre Tech. Note Number 11. Parker, Legg and Folland,1992), covering the period from 1772-1991 in which daily averages were constructed so as to be equal to the monthly CET values. However, such daily averages of the minimum and maximum temperatures do not reflect the diurnal variation of temperature, which for any given mean temperature may be very small, or on a hot sunny day during the summer may be considerable. The approach made here takes account of the diurnal variations of temperature, as well as covering an earlier period from 1748.

There are obviously several sources of differences with what we would now call the outside "screen" temperatures. However, corrections were made to Barker's original readings and so new estimated monthly minimum and maximum temperatures are derived from the "corrected" daily readings. The monthly mean temperatures derived from this new data are then compared with the relevant CET values.

To apply corrections to the original data taken at Lyndon, Barker's indoor readings are adjusted to become estimates of the outdoor (screen) temperatures. Temperatures are given in their original Patrick readings (for historical continuity and the scale has the advantage of acceptable accuracy without resorting to the use of decimal places, so suggesting a degree of accuracy which is unrealistic), together with Celsius and Fahrenheit.

To derive this temperature series, it was necessary to estimate the daily values of the minimum and maximum temperatures as screen temperatures, and so evaluate the mean maximum and mean minimum temperatures, and so calculate the mean monthly temperatures.

In using daily values, the use of the usual statistical methods is limited, and a strictly climatologically approach is not possible. A mainly meteorological approach is used, using the author's professional experience and local personal knowledge of this region. The accuracy of the derived data is not meant to be sufficient to necessarily represent Lyndon, but the accuracy obtained is considered sufficient to be representative of the east Midlands, and so can be compared with the relevant CET values. Additionally, the data can be used to extend the later north-east Midlands series (1785 to the present) back in time to the start of the Lyndon data in 1748.

The homogeneity of the Lyndon derived data was tested against the longer north-east Midlands series and was found to be homogeneous at the 5% level. This series was itself tested for homogeneity for four principal locations during the 19th, 19th and 20th centuries, giving an acceptable level of homogeneity throughout the series, as well a prolonged continuity.

METHODOLOGY

The Patrick scale was in use during the early years of these records, and readings were only taken to the nearest whole degree Patrick. Which for conversion into degree C involved what was an approximately linear scale. The exact conversions can be obtained from the equation:

$$C = 0.42033334 \times (\text{Patrick} \times 31.97888889)$$

<table>
<thead>
<tr>
<th>°Patrick</th>
<th>°Fahrenheit</th>
<th>°Celsius</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>90+</td>
<td>32</td>
</tr>
<tr>
<td>12</td>
<td>60</td>
<td>27</td>
</tr>
<tr>
<td>76</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>14</td>
<td>-10</td>
</tr>
</tbody>
</table>

Table 1. Temperatures conversions.

Next it was necessary to estimate the outdoor screen temperatures from the observed indoor temperatures. The differences between outdoor and indoor temperatures are shown in Table 3 and are based on the 20 year period from January 1771 to December 1790 during which daily comparisons were available.

The values given are for the mean daily temperature differences for each month, and the mean monthly maximum differences. For the maximum, these larger differences would have been on hot sunny days in the summer, and the large negative differences especially in the winter indicate the relative coldness outside on a clear calm night, compared to indoors. The range of such differences is up to 7.5 °C, with the first early frosts in October, when it becomes cold outside but the house is still quite warm. It should be noted from the table that the cool room was in fact cooler by several degrees from May to August, and warmer on average from November to February. The observed temperature differences therefore followed a fairly consistent pattern. The retention of day-time heating is clearly shown by the temperature differences of about 4.0 °C from July to September.

The daily diaries were analysed with regard to the rate of a temperature rise and the time it occurred with regard to the actual temperature readings.
It was also necessary to determine the actual dates of the actual monthly temperature extremes, and also for the dates and details of the warmest nights and coldest days of each month. To attempt this it was necessary to very carefully study the details of the daily diaries, especially regarding the timing and amount of temperatures changes. Indoors these were taken in the "Cool Room", and these readings were then compared with those taken outside. This was especially important when sudden temperature changes such as a sudden thaw after a cold spell occurred, and also vice-versa. Barker himself was aware of this problem and went to the trouble of taking additional temperature observations when he was able to.

Minimum and maximum temperatures

There were no minimum and maximum thermometers at this time. Consequently, the temperatures taken at the time of the morning observation, and in particular during the summer months, did not give a correct reading for the lowest overnight temperatures, so an allowance had to be made for this source of "error". The temperatures taken in the mid-late afternoon during the summer months were generally close to the estimated daily maximum temperatures, but detailed use of the daily register helped to consider how accurate the observed afternoon temperature may have been. In the winter months, the times of reading the thermometers were closer to the likely minimum and maximum temperatures, but again, careful use had to be made of the detailed weather diary.

The estimated deduction of temperature from that which was observed was derived from the use of a diurnal heating curve, as used by the Met Office for many years. This could not be made for Lyndon, but an appropriate curve for a location in the region (Thurgarton, Nottinghamshire, England) was used. This is located in a generally similar rural setting, and as such it is considered it would give results that are not significantly different from what may be appropriate for Lyndon.

The topography around Lyndon Hall is similar to that of the author's climatological station at Thurgarton, Nottinghamshire. Both are rural sites on a slightly sloping ground, facing approximately south. To the north of the Thurgarton site are undulating hills of about 30 m higher, with fields and mixed woodland. Both are fairly open sites, and partly sheltered to the north. The elevation of Lyndon is some 40 m higher, but there seems to be sufficient geographical similarity otherwise to be able to usefully apply the details given by the Thurgarton curve to the "Lyndon" data, and so derive estimated minimum temperatures for the Lyndon site area.

The graph used axes of (a) the hours after sunrise (0-4 hours) against (b) temperature rise. A series of sine-type curves then gave the value to be deducted from the morning observation. The largest correction was obtained from the curve for "clear skies with little or no wind" (with values up to 3.5 °C for a reading 4 hours after sunrise). Other curves gave lesser corrections for curves such as (mainly clear skies and mostly light winds), also for cloudy, or partly cloudy with moderate winds, and for cloudy and/or windy conditions (wind force five or greater). With the relevant corrections from this and Table 3, it was then possible to make estimates of the daily minimum temperatures. The graph and its associated factors are based on the Forecasters Reference Book (Met. Office, 1977).

ESTIMATED DAILY VALUES OF MINIMUM AND MAXIMUM TEMPERATURES

The estimated daily values of maximum and minimum temperatures are derived from the following equations. $E = (I + m) - c + h$ for readings taken indoors, and $E = O - c + h$, for those taken outdoors. Where I is the observed indoor temperature and O is the observed outdoor temperature.
The Dance of the "Water Devils" © Dr. Jonathan Duffy

This stunning capture was taken on 3 January 2007 at approximately 11:30 am from the Eastern shore of Buttermere in the Lake District (Cumbria, UK). Looking South along the lake, the "water devils" lasted approximately 40 seconds.
\( C \) is the correction to \( I \) and \( O \) to allow for the temperature rise between the assumed minimum temperature at about dawn, and the time of the morning observation; \( E \) is the estimated outdoor screen temperature; \( H \) is a further correction applied to the calculated monthly mean maximum and mean minimum temperatures, these were determined from the application of homogeneity to the two 14 year periods, 1748-1763 and 1771 to 1784, with three similar 14 year periods in the long homogenised temperature series for the adjacent north-east midlands from 1785 to 2005; \( I \) the observed indoor (Within) temperature; and \( m \) is the correction to \( I \) (using Table 2) for the period 1748 to 1763 only.

The test used on the data was the Standard Normal Homogeneity Test (Alexandersson, 1986), which tested the ratios of both the mean monthly minimum and maximum temperatures for the periods 1748-1763, 1771-1784, etc. These corrections were made for three seasons, namely Winter (November-February), Spring together with Autumn (i.e. March-April and September-October respectively) and Summer (May-August). This was done in an attempt to correct the previously derived monthly mean minimum and maximum temperatures for the effects of the open exposure of the Lyndon thermometers. The variation of these values was compared with those in a later and much longer period (1900-1989), which were taken under "standard" screen conditions with standardized and more accurate thermometers.

The homogeneity test is an attempt to correct the effects of both the non-standard exposure of the Lyndon thermometers and also of any inherent instrumental inaccuracies. The application of the adjustments from this test will hopefully bring the new monthly means close to the true values. Finally these monthly mean temperatures in are compared with the relevant CET (Table 4). The results of the homogeneity test gave the following corrections:

<table>
<thead>
<tr>
<th>Mean Monthly Maximum Temperature</th>
<th>Mean Monthly Minimum Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov-Feb</td>
<td>-0.3 °C</td>
</tr>
<tr>
<td>Mar-Apr &amp; Sep-Oct</td>
<td>-0.8 °C</td>
</tr>
<tr>
<td>May-Aug</td>
<td>-1.2 °C</td>
</tr>
<tr>
<td>Average correction</td>
<td>-0.8 °C</td>
</tr>
</tbody>
</table>

*Table 2. Mean monthly temperature corrections by season.*

The above corrections, in Table 2, were applied to the estimated monthly mean minimum and maximum temperatures for the period from 1748 to 1784. The mean monthly temperatures were then calculated from these values, which were then compared with the relevant CET and found to be generally within a degree Celsius, and so have been "adopted" for this series. These values confirm that homogeneity in temperatures is often of the opposite sign in summer when compared to that for winter (Taboney, 1988).

*Discussion of Table 3*

This is the most important source of information, giving the temperature differences observed between indoors and outdoors. The data given covers the period from March 1748 to August 1763. Column 1, gives the mean maximum observed temperature difference between outdoors and indoors for each month. On an average day, it was colder outside from November to the middle of February up to \( 1.2 \) °C. Conversely, it was generally warmer outdoors from March to October by up to \( 3.3 \) °C in mid-summer. Column 2, gives the differences for the highest maximum temperatures for that particular month, varying from about \( 1.2 \) °C in the winter and up to \( 6 \) °C in the summer.
Column 3, gives the mean minimum temperature difference between indoors and outdoors for each month. The data given here show the same trend during the year as for the maximum temperatures, but the temperature range is more limited, and it is necessary to briefly discuss the apparent reasons for this muted trend.

It can be seen that the temperature differences are more limited through the year, in contrast to the monthly minimum and maximum temperatures. It should be remembered that in the 19th century the heating in even a gentleman’s house was limited to coal and wood fires in only the generally inhabited rooms of the house. It is, therefore, very unlikely that much heat would have been allowed to enter the “cool room”, with the door being kept closed at all times. Therefore, apart from a lag effect on the temperature changes, it is considered that it is possible to estimate the outdoor temperatures from those observed in such a “cool room”. In the summer residual heat at night was apparently reduced by ventilation, with the “cool room” windows almost certainly left open, once again minimising the temperature differences with outside. Barker’s own observations support this view, as published in (Kington, 1988).

Column 4, gives the differences between indoors and outdoors for the lowest minimum temperatures for that month. This shows that the greatest temperature differences occur in October (7.5 °C), often with the first really cool, clear nights of autumn. When the house was still relatively warm and there was subsequently limited cooling of the house, due mainly to the shorter summer nights. The differences are least in the summer with 3.8 °C in July, showing the effect of the short summer nights.

**ESTIMATION OF DAILY MINIMUM AND MAXIMUM TEMPERATURES**

**Methodology (Adjustments to the Observed Indoor Temperatures)**

1. Conversion of degrees Patrick to degrees Fahrenheit (1748-1763).
2. Adjustments for indoors to outdoors (1748-1763).
3. An adjustment to allow for the time of the morning observation in relation to sunrise times, 22 July 1759 (a hot and sunny day, with a high diurnal temperature range).

**Calculation of the Minimum Temperature**

The Patrick reading at 0645 GMT on 22 July 1759 was 30.0 °P. An approximately linear conversion from 30 °P gives a value of 19.4 °C. Using the July Minimum Temperature Correction (Table 3, column 4) gives a difference of -3.8 °C. Allowing for an estimated minimum temperature at about sunrise, a correction of 2.2 °C is then applied to the reading. The minimum temperature is then assessed at 19.4 °C - 3.8 °C - 2.2 °C = 13.4 °C (56 °F).

Comparison has shown that the temperature rises indoors are often about a third of those taken outside, based on the data given in Table 3.

**Calculation of the Maximum Temperature**

The Patrick reading at 1530 GMT was 23.5 °P. For July, the maximum temperature (Table 3, column 2) gives a correction of 5.6 °C. The “adopted” maximum temperature was therefore 22.2 °C + 5.6 °C = 27.8 °C. The final estimates for the 22 July 1759 were therefore, a minimum of 13.4 °C (56 °F) and an afternoon maximum temperature of 27.8 °C (82 °F).

The example above was for clear and settled conditions with light winds. For the majority of days which were more cloudy/windy, appropriate temperature corrections were applied to the observed readings using the Diurnal Heating/Cooling Curves which were used by the Met Office (referred to on page 306). Any corrections due for instrumental or exposure factors were applied later by a homogeneity test to the monthly means.

<table>
<thead>
<tr>
<th>Month</th>
<th>Monthly Av. Diff</th>
<th>Average Max</th>
<th>Monthly Av. Diff</th>
<th>Average Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0.3</td>
<td>2.3</td>
<td>11.1</td>
<td>-2.9</td>
</tr>
<tr>
<td>February</td>
<td>1.0</td>
<td>2.3</td>
<td>3.9</td>
<td>-3.7</td>
</tr>
<tr>
<td>March</td>
<td>0.2</td>
<td>3.0</td>
<td>2.3</td>
<td>-3.4</td>
</tr>
<tr>
<td>April</td>
<td>0.5</td>
<td>3.0</td>
<td>3.5</td>
<td>-5.6</td>
</tr>
<tr>
<td>May</td>
<td>1.2</td>
<td>3.5</td>
<td>3.1</td>
<td>-4.0</td>
</tr>
<tr>
<td>June</td>
<td>0.5</td>
<td>3.7</td>
<td>2.5</td>
<td>-4.2</td>
</tr>
<tr>
<td>July</td>
<td>2.0</td>
<td>2.5</td>
<td>2.0</td>
<td>-3.0</td>
</tr>
<tr>
<td>August</td>
<td>0.5</td>
<td>2.0</td>
<td>3.5</td>
<td>-4.5</td>
</tr>
<tr>
<td>September</td>
<td>0.2</td>
<td>3.5</td>
<td>2.5</td>
<td>-4.0</td>
</tr>
<tr>
<td>October</td>
<td>0.5</td>
<td>2.0</td>
<td>3.0</td>
<td>-4.0</td>
</tr>
<tr>
<td>November</td>
<td>0.2</td>
<td>3.0</td>
<td>3.5</td>
<td>-6.0</td>
</tr>
<tr>
<td>December</td>
<td>1.0</td>
<td>3.5</td>
<td>2.5</td>
<td>-5.0</td>
</tr>
</tbody>
</table>

| Mean     | 0.1              | 3.5         | 2.5              | -6.0        |

Table 3. Lyndon, Average temperature differences, Outdoors - indoors (1748 to 1763 only). Data derived from Barker’s own observations (Barker’s extant records, and Kington, 1988). January 1771-December 1790 (20 years, n = 220).

The derived monthly minima and maxima were then tested for serial homogeneity (Alexander, 1986). The corrections were small for the mean maxima, being generally less than 0.2 °C. The corrections for the mean minima required a value of -0.4 °C to be applied in the summer months and up to -0.6 °C in a few winter months. The daily values were not corrected, but these corrections were applied to the monthly means calculated from the daily values. Such values as the highest and lowest temperatures of the month, and the coldest days and warmest nights were therefore not affected.

**Table 4. Comparison of the mean monthly temperature range (averages for the year).**

<table>
<thead>
<tr>
<th>Period</th>
<th>Coeff. of Variation (%)</th>
<th>Period</th>
<th>Coeff. of Variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1748-1763</td>
<td>17.2</td>
<td>1748-1763</td>
<td>17.2</td>
</tr>
<tr>
<td>1771-1784</td>
<td>17.2</td>
<td>1771-1784</td>
<td>17.2</td>
</tr>
<tr>
<td>1785-1798</td>
<td>17.2</td>
<td>1785-1798</td>
<td>17.2</td>
</tr>
<tr>
<td>1800-1813</td>
<td>17.2</td>
<td>1800-1813</td>
<td>17.2</td>
</tr>
<tr>
<td>1817-1888</td>
<td>17.2</td>
<td>1817-1888</td>
<td>17.2</td>
</tr>
<tr>
<td>1930-1943</td>
<td>17.2</td>
<td>1930-1943</td>
<td>17.2</td>
</tr>
</tbody>
</table>

The monthly variation of mean maximum temperatures is shown above to be generally constant over the period from 1748 to 1943 in which these six 14 year periods occurred. The greatest variation is during the 1771-1784 period, when there were a series of cold or very cold winters. This is also shown for the mean minimum temperatures of that period. This analysis was carried out so as to confirm the level of continuity throughout the extended series and the addition of the Lyndon based data back to 1748.

The coefficient of variation of the monthly mean temperatures is a measure of the variation of these mean temperatures from the mean of that period. So that a period with large variations from the mean of say very cold winters and/or hot summers would be indicated by a larger coefficient of variation.
It is regarded as an excellent measure of the relative variation of such variables as the mean maximum and mean minimum temperatures (Craddock, 1979).

<table>
<thead>
<tr>
<th>Differences in the derived means from CET values</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months were 1.2 °C than CET</td>
</tr>
<tr>
<td>57 months were 0.6-1.1 °C warmer</td>
</tr>
<tr>
<td>142 months within 0.5 °C warmer than CET</td>
</tr>
<tr>
<td>96 months were 0.6-1.1 °C colder than CET</td>
</tr>
<tr>
<td>25 months were 1.2-1.5 °C colder than CET</td>
</tr>
</tbody>
</table>

Table 5. Differences in Lyndon derived data from CET (Manley, 1974) values.

The differences in mean monthly temperatures between the Lyndon derived values and those of the CET show a general pattern of lower mean temperatures in the eastmidlands in the winter months. For the mild Januarys of 1749, 1756, and 1759 the Lyndon means were less than 0.5 °C lower. In the cold Januarys of 1757, 1763, 1771, 1776 and 1784 the differences were greater, being between 0.5 °C and 1.0 °C. The differences for the summer months were usually less, and were reversed. In the hot July of 1793, the mean temperature of 19.4 °C at Lyndon was 0.6 °C higher than that given for the CET. For the cool Julys such as those of 1754, 1758 and 1784 the differences were small. In 15 of the 29 Januarys during this period, the differences were within 0.5 °C, with an average difference of all the Januarys of 0.5 °C. In 29 of the 30 Julys the differences were also within 0.5 °C, with an average difference of 0.2 °C.

As a further measure of the close comparability of the Lyndon estimated mean monthly temperatures, correlation coefficients were calculated for the periods 1748 to 1763, and 1771 to 1784. These coefficients were 0.93 and 0.97 respectively. The derived monthly means are therefore similar to those of the CET.

It is not possible to show the complete monthly record for the years above, except for 1758 given as an example. Some months were missing in the earlier period when Barker was away, and unfortunately the records from 1764 to 1770 are missing, the later records are almost complete. It is possible, however, to give a mention to some of the more important climatological events that occurred in this period. The first month of the temperature record, April 1748, was a particularly cold month. The mean maximum was only 10.0 °C and the mean minimum 5.3 °C, giving a monthly mean of 6.1 °C.

The first time that 32.2 °C (90 °F) was recorded was on 13 August 1749, which was followed by a very warm night with a minimum temperature of 18.3 °C (these values compare very well with those recorded in the recent hot summer of 2003 in England).

The first complete year of record was 1752, except that this was the year when the calendar was changed to the present Gregorian system, so 11 days were “missing” in September of that year. However, all the dates here have been changed to the modern calendar. The year 1752 was a generally cool year with the warmest days being the 23rd and 28th June with a maxima of 25.5 °C. A cold January and February in 1753 was followed by an unusually warm spell in April 1755 when the temperature reached 24.0 °C on 20 April 1755. However, the mainly cold weather returned with a cold May 1755 in which the temperature failed to exceed 20.0 °C.

The first very cold month in this period was that of January 1757, when the temperature fell to -9.4 °C on the 8th, and two extremely cold days when the temperature failed to rise above -7.8 °C on both the 7 and 8 January 1757.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Lyndon °C</th>
<th>CET °C</th>
<th>Diff °C</th>
<th>YEAR</th>
<th>Lyndon °C</th>
<th>CET °C</th>
<th>Diff °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1748</td>
<td>n/a</td>
<td>2.5</td>
<td>-2.5</td>
<td>1771</td>
<td>-0.1</td>
<td>1.0</td>
<td>-1.1</td>
</tr>
<tr>
<td>1749</td>
<td>5.0</td>
<td>5.3</td>
<td>-0.3</td>
<td>1772</td>
<td>0.5</td>
<td>1.2</td>
<td>-0.7</td>
</tr>
<tr>
<td>1750</td>
<td>3.9</td>
<td>4.0</td>
<td>-0.1</td>
<td>1773</td>
<td>3.3</td>
<td>4.0</td>
<td>-0.7</td>
</tr>
<tr>
<td>1751</td>
<td>n/a</td>
<td>4.0</td>
<td>n/a</td>
<td>1774</td>
<td>0.3</td>
<td>0.6</td>
<td>-0.3</td>
</tr>
<tr>
<td>1752</td>
<td>2.8</td>
<td>3.2</td>
<td>-0.4</td>
<td>1775</td>
<td>3.9</td>
<td>4.7</td>
<td>-0.8</td>
</tr>
<tr>
<td>1753</td>
<td>1.7</td>
<td>2.2</td>
<td>-0.5</td>
<td>1776</td>
<td>2.2</td>
<td>1.8</td>
<td>0.4</td>
</tr>
<tr>
<td>1754</td>
<td>2.7</td>
<td>3.3</td>
<td>-0.6</td>
<td>1777</td>
<td>0.9</td>
<td>1.9</td>
<td>-1.0</td>
</tr>
<tr>
<td>1755</td>
<td>1.7</td>
<td>2.2</td>
<td>-0.5</td>
<td>1778</td>
<td>1.3</td>
<td>1.9</td>
<td>0.6</td>
</tr>
<tr>
<td>1756</td>
<td>4.5</td>
<td>4.4</td>
<td>+0.1</td>
<td>1779</td>
<td>2.2</td>
<td>2.9</td>
<td>-0.7</td>
</tr>
<tr>
<td>1757</td>
<td>-0.5</td>
<td>0.3</td>
<td>-0.8</td>
<td>1780</td>
<td>-1.1</td>
<td>-0.9</td>
<td>-0.2</td>
</tr>
<tr>
<td>1758</td>
<td>1.7</td>
<td>2.6</td>
<td>-0.9</td>
<td>1781</td>
<td>1.6</td>
<td>2.1</td>
<td>-0.5</td>
</tr>
<tr>
<td>1759</td>
<td>5.5</td>
<td>5.9</td>
<td>-0.4</td>
<td>1782</td>
<td>4.5</td>
<td>5.2</td>
<td>-0.7</td>
</tr>
<tr>
<td>1760</td>
<td>1.6</td>
<td>1.9</td>
<td>-0.3</td>
<td>1783</td>
<td>3.1</td>
<td>3.4</td>
<td>-0.3</td>
</tr>
<tr>
<td>1761</td>
<td>4.5</td>
<td>5.4</td>
<td>-0.9</td>
<td>1784</td>
<td>-1.1</td>
<td>-0.6</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

Table 6. Mean differences in mean monthly temperatures, significant temperature events (1748 to 1784) - Lyndon minus CET for Januaries 1748 to 1784.

In direct contrast, July 1757 was a very warm month, having a mean maximum temperature of 24.0 °C and a mean minimum of 12.2 °C and a monthly mean of 18.3 °C.

During a very hot spell the temperature rose to 32 °C on the 14th July 1757 followed by a very warm and humid night in which the temperature did not fall below 20.0 °C. This is equal to the warmest nights on record for this rural region, for the period from 1785 to 2004.

The year 1762 brought a very wintry March with a monthly mean temperature of only 3.3 °C, and in which the temperature fell to -6.7 °C and did not exceed 12.8 °C during the month. Wintry months were not unusual at this time. Another very cold and wintry month was that of January 1763 with a mean maximum temperature of 0.5 °C, and a minimum of -2.8 °C, giving a monthly mean temperature of only -1.1 °C.

A long cold winter occurred in 1771, followed by a cold spring. In early April 1771 a day with snow all day gave the lowest maximum temperature of the entire series, with a maximum of only 0.5 °C. A similar cold spell in April 1772 gave a maximum temperature of 1.7 °C, but in contrast April 1775 gave a very warm day with the temperature climbing up to 26.7 °C (80 °F) on 29 April 1775, equal to the highest recorded in the extended series to 2006, recorded in April 1949.

January 1776 produced some very severe conditions, with a mean maximum temperature of -1.1 °C and a minimum of -3.3 °C, giving a monthly mean of only -2.2 °C, making this one of the coldest months on record for this area. The temperature fell to -12.2 °C, and failed to rise above -8.9 °C on 27 January 1776. This was therefore one of the coldest days ever recorded, and probably equalled those experienced during the severe cold of the winter of 1740. The following winters of 1777 and 1778 followed a similar pattern, but were not quite as severe.

Despite the prevalence of cold winters at this time 1779 was very much in contrast a mild winter.
February 1779, in particular, was a very mild month with a monthly mean temperature of 6.7 °C. This is a rather lower figure than that quoted by Manley (1974). The high mean of 7.9 °C quoted by Manley (1974) has been queried by other researchers, and the estimated values derived herein from the Lyndon data supports this lower mean. The mild winter gave way to a mostly warm spring in which the temperature rose to 22.2 °C on 15 April 1779. Christmas of that mainly warm year was particularly cool, with the temperature falling to -9.4 °C, and failing to exceed -3.9 °C on Christmas Day. This cold weather continued on into January 1780, with a monthly mean temperature of 1.1 °C, and overnight temperatures falling as low as -9.4 °C.

The coldest year was 1782, and this had one of the coldest Aprils on record, with a monthly mean temperature of 5.3 °C and in which the temperature did not rise above 13.9 °C. Later in this generally cold year November had a monthly mean temperature of 1.9 °C. One of the most interesting years was 1783, this really was a year of temperature contrasts. The most significant factor was the very warm weather during July which was accompanied by a thick general haze, the result of a volcanic eruption in Iceland earlier in the year. The haze from this eruption seriously affected many parts of the world. Several researchers have commented on the heat and later the coldness during 1783, putting at least part of the blame on the effects of the volcanic haze (Lamb, 1972).

July 1785 was a particularly warm month, and was equal to the warmest months recorded in the extended series, and is probably equal in warmth to that of July 1983. The mean maximum temperature was 25.5 °C and the mean minimum 13.3 °C, giving a monthly mean of 19.4 °C. The temperatures rose to 22.2 °C on the 11 July 1783, and on that night the temperature did not fall below 10.0 °C. This was the only month on record when the temperature remained at or above 10.0 °C for the whole month. Some very warm nights occurred with night-time temperatures falling to below 20.0 °C from the 10 to the 12 July 1783. The thick haze may have been a factor in keeping minimum temperatures as high for so long in a rural area.

The upper temperature limit in this area was 20 °C and in July 1783 there were three such consecutive nights. The heat of July 1783 soon cooled to give a particularly cold spell in the following December 1783 when temperatures fell to -13.3 °C on the morning of 30 December 1783, with the temperature not rising above -6.7 °C that day.

This period of severe cold continued into January 1784, when the mean maximum temperature was 0.5 °C, and the minimum -2.8 °C, giving a mean for the month of -1.1 °C. The cold winter led into a predominately cold spring. On a snowy day on 2 April 1784 with temperature falling to higher than 1.7 °C, but a warm July followed. August 1784 was a particularly cool and rainy month with the temperature rising to only 22.2 °C on the warmest days, and not exceeding 11.1 °C on both the 29 and 30 August 1784 with two very cool and rainy days. These are the coolest August days on record in this region. This chilly year ended with a very cold December 1784 having a monthly mean temperature of -1.1 °C, and the temperature not rising above -6.7 °C (20 °F) on 10 December 1784, a very early date for such a cold day.

The overall temperature ranged from 32 °C to -13 °C, and the range of the monthly mean temperatures from 19.4 °C to -2.2 °C. These values compare favourably with more recent values of monthly mean temperatures during the last three decades. Also the warmest nights of 20 °C are about the same as is expected in recent hot spells.

The main difference is the frequency of cold or very cold winter months, and the associated cold springs, and the occurrence of a number of extremely cold winter days. These very cold spells seem to have occurred mostly in short spells of freezing fog which formed over a recent snowfall. A combination of which has been a rare event in recent years.

### Table 7: Lowest annual minimum temperatures.

<table>
<thead>
<tr>
<th>Year Range</th>
<th>The Mean Annual Lowest Temperature</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1748-1763</td>
<td>-7.8 °C</td>
<td>1.6 °C</td>
</tr>
<tr>
<td>1771-1784</td>
<td>-9.8 °C</td>
<td>2.8 °C</td>
</tr>
<tr>
<td>1950-2003</td>
<td>-6.8 °C</td>
<td>1.7 °C</td>
</tr>
</tbody>
</table>

### Table 8: Lowest annual maximum temperatures.

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Average Coldest Day</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1748-1763</td>
<td>-1.2 °C</td>
<td>2.5 °C</td>
</tr>
<tr>
<td>1771-1784</td>
<td>-4.1 °C</td>
<td>2.1 °C</td>
</tr>
<tr>
<td>1950-2003</td>
<td>-0.3 °C</td>
<td>1.7 °C</td>
</tr>
</tbody>
</table>

It is in analysing this parameter that we can see the most significant difference between these winters and more recent years. In the winter of 1757 the lowest maximum temperature experienced was that of -7.8 °C, and in the winter of 1776 it was -8.9 °C. In contrast, the lowest value for the latter period was -3.9 °C.

In the earliest period there were four winters out of the 14 in which the coldest day of the winter exceeded freezing point. There were none in the middle period, and in contrast there were seven out of the 14 in the recent period. The first period saw the greatest standard deviation, and it may have been these increasing variations that were the early years of the particularly cold decades of the 1770s and 1780s. The recent period is quite different in character, with less year to year variation, and a tendency for milder and shorter winters. In particular, the relative lack of very frosty and quite weather which could lead to the very cold winters followed by a spell of persistent freezing fog and associated very low daytime temperatures. It was not always cold, and it is interesting to look at the intensity and frequency of warm weather as well, see Table 9.

Hot months seem to have been as warm as those of more recent summers. In July 1783, the highest temperature recorded was 90 °F (32.2 °C), and it did not fall below 50 °F (10.0 °C), with a mean maximum temperature of 78.0 °F (25.5 °C), giving a monthly mean temperature of 67.0 °F (19.4 °C). Temperatures which were quite equal to those experienced in the recent hot summers of the 1990s in England.
A feature of the hot summers of the 1930s has been the warm and often humid nights, and it is interesting to see how much they were a feature of eighteenth century summers.

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Average Highest Max Temperature</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1748-1783</td>
<td>26.8 °C (70.6 °F)</td>
<td>2.2 °C (39.9 °F)</td>
</tr>
<tr>
<td>1771-1784</td>
<td>28.4 °C (83.1 °F)</td>
<td>2.1 °C (39.8 °F)</td>
</tr>
<tr>
<td>1900-2003</td>
<td>30.0 °C (86.0 °F)</td>
<td>2.1 °C (39.8 °F)</td>
</tr>
</tbody>
</table>

Table 9. Highest annual maximum temperatures.

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Average Highest Min Temperature</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1748-1783</td>
<td>63.1 °F (17.3 °C)</td>
<td>2.6 °F (1.4 °C)</td>
</tr>
<tr>
<td>1771-1784</td>
<td>63.5 °F (17.5 °C)</td>
<td>1.8 °F (1.0 °C)</td>
</tr>
<tr>
<td>1900-2003</td>
<td>63.5 °F (17.5 °C)</td>
<td>1.7 °F (0.9 °C)</td>
</tr>
</tbody>
</table>

Table 10. Highest annual minimum temperatures.

The range of the annual warmest night varied from about 15.6 °C (60 °F) in the cooler summers up to what may be an upper limit for rural areas of 20.0 °C (68 °F). This high value has been reached several times in the 1930s, but has not yet been exceeded. The higher temperatures have only been recorded in more urban areas, and so are not relevant here. The springs were mostly cold, dry and late, but a notable exception was that of April 1775 when a maximum temperature of 26.7 °C (80 °F) occurred on 29 April 1775, and only equalled in July of that year.

The above analyses seem to be consistent with the research of the late Prof. H. H. Lamb (Lamb, 1972). Lamb was particularly concerned with the increase of the north to the north of Ireland in the 1860s and its associated reduced sea surface temperatures, and the resultant effect on the climate of north-west Europe. The way in which the relatively severe winters of the 18th century seemed to come to a peak in the 1770s but with surprisingly warm summers, indicates that with a change of air mass from a northerly source to a southerly one significant temperature changes occurred in the east midlands, especially as the seas were then colder to the north of the British Isles.

The CET data has been studied by many researchers, but these more detailed monthly climatological summaries are derived so that greater detail of the variations of temperature within the east-midlands region can be similarly referred to. It has at least provided local daily temperature data from 1748 to 1784, and on to the present, a series extending some 250 years. Menley (1974) was able to derive his CET series back to 1659, but daily observations especially of an instrumental nature are not available in this region. Nevertheless this work is expected to extend this series farther back in time for central England and so provide an even longer temperature series.

As a further check on the variation of the monthly means of minimum and maximum temperatures, the standard deviations of the two 14 year periods from Lyndon are compared with a long period of a similar record for the adjacent north-east midlands from 1900 to 1989 (90 years). The two Lyndon periods are retained separately because the earlier period is estimated from indoor readings, and the later period is modified outdoor observations.

The standard deviations follow a similar trend for all periods, with the largest values for the mean maximum temperature in the winter months, with a secondary maximum in July to August. The largest values for the mean minimum temperatures are also to be found in the winter with a general minimum during the summer.

These findings reflect the effects of a large variability of the winter temperatures, and also of the occasional hot months usually in mid-summer. The night-time temperatures during the summer show less variability as would normally be expected. It is interesting to note that the lowest deviations are for autumn and for a lesser extent the spring, indicating the tendency for the maximum temperatures to remain generally either high for the season or low, reflecting the consequences of a cold spring or a warm autumn.

<table>
<thead>
<tr>
<th>Month</th>
<th>Min Temp. °C (Date)</th>
<th>Mean Temp. °C (Date)</th>
<th>Min °C Max</th>
<th>Mean °C Min</th>
<th>Mean °C</th>
<th>Coldest °C Day</th>
<th>Warmest °C Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>7.8 (7th)</td>
<td>-8.9 (29th)</td>
<td>4.4</td>
<td>-1.1</td>
<td>1.7</td>
<td>0.0 (2nd)</td>
<td>6.1 (3rd)</td>
</tr>
<tr>
<td>FEB</td>
<td>9.4 (27th)</td>
<td>-7.2 (17th)</td>
<td>5.5</td>
<td>0.0</td>
<td>2.7</td>
<td>2.2 (2nd)</td>
<td>5.5 (3rd)</td>
</tr>
<tr>
<td>MAR</td>
<td>14.4 (31st)</td>
<td>-8.1 (12th)</td>
<td>8.9</td>
<td>1.1</td>
<td>5.0</td>
<td>2.5 (11th)</td>
<td>10.0 (1st)</td>
</tr>
<tr>
<td>APR</td>
<td>16.7 (22nd)</td>
<td>-3.9 (6th)</td>
<td>11.7</td>
<td>2.8</td>
<td>7.2</td>
<td>5.0 (5th)</td>
<td>11.7 (26th)</td>
</tr>
<tr>
<td>MAY</td>
<td>26.7 (25th)</td>
<td>1.7 (17th)</td>
<td>20.0</td>
<td>7.8</td>
<td>13.9</td>
<td>10.0 (1st)</td>
<td>15.6 (26th)</td>
</tr>
<tr>
<td>JUN</td>
<td>28.3 (7th)</td>
<td>6.1 (32nd)</td>
<td>20.5</td>
<td>9.4</td>
<td>15.0</td>
<td>12.8 (1st)</td>
<td>17.2 (12th)</td>
</tr>
<tr>
<td>JUL</td>
<td>23.9 (12th)</td>
<td>7.2 (1st)</td>
<td>18.9</td>
<td>11.1</td>
<td>15.0</td>
<td>15.0 (1st)</td>
<td>15.6 (26th)</td>
</tr>
<tr>
<td>AUG</td>
<td>26.7 (5th, 22nd)</td>
<td>7.8 (30th)</td>
<td>21.7</td>
<td>11.7</td>
<td>16.7</td>
<td>15.6 (30th)</td>
<td>17.2 (5th, 22nd)</td>
</tr>
<tr>
<td>SEP</td>
<td>21.1 (3rd)</td>
<td>3.5 (25th)</td>
<td>16.7</td>
<td>7.8</td>
<td>12.2</td>
<td>10.5 (6th)</td>
<td>14.4 (4th)</td>
</tr>
<tr>
<td>OCT</td>
<td>18.3 (1st)</td>
<td>-7.1 (27th)</td>
<td>11.7</td>
<td>4.4</td>
<td>8.1</td>
<td>7.8 (26th)</td>
<td>12.2 (9th)</td>
</tr>
<tr>
<td>NOV</td>
<td>12.2 (2nd)</td>
<td>-3.3 (28th)</td>
<td>7.8</td>
<td>3.3</td>
<td>5.5</td>
<td>3.9 (28th)</td>
<td>8.9 (2,8th)</td>
</tr>
<tr>
<td>DEC</td>
<td>10.0 (18th)</td>
<td>-6.7 (8th)</td>
<td>6.1</td>
<td>0.5</td>
<td>3.3</td>
<td>1.7 (7th)</td>
<td>7.8 (19th)</td>
</tr>
</tbody>
</table>

Table 11. Standard deviation of the mean maximum and minimum temperatures.

ACKNOWLEDGEMENTS
Mrs. J. Pennington (Archivist) Lancine College Sussex (for access to Barker's extant diaries from 1738 to 1783). The staff of the British Museum, London. The staff of the Meteorological Office Archives, Bracknell, Berkshire. The help and advice given by ex-colleague Jim Craddock, Met. Office (pre-retirement).
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REFERENCES


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TORRO TORNADO DIVISION REPORT: JANUARY TO APRIL 2007

By PAUL R. BROWN and G. TERENCE MEADEN

Strong westerly winds prevailed during much of January 2007, resulting in a very mild wet month over the British Isles. There were two definite tornadoes, four funnel clouds (one of which might have been a waterspout) and two reports of eddy whirlwinds. In addition, we received a number of reports of tornado damage for the 18th January, but this was a very windy day over England and Wales, with gusts widely in the range 60-70 knots, and it would be impossible to differentiate minor tornado damage from that due to the severe gusts.

The first week of February was anticyclonic and rather cold, but the rest of the month was unsettled and mild. It was devoid of whirlwinds apart from one unconfirmed funnel cloud. A vigorous westerly type dominated the first half of March, but the last two weeks were mainly anticyclonic with easterly winds: just one tornado and two funnel clouds were reported to TORRO for this month. April was very warm and dry (the warmest on record in the Central England series); and, not surprisingly, the only whirlwinds that have come to our attention were a couple of land devils.

FC2007Jan011 Dundee, Forfarshire (56° 28' N 3° 01' W, NO 3632)

Mr Matthew Porter sent in a photograph taken in the fading light of New Year's afternoon at 1545 GMT, showing a long thin diagonal strip across the sky, which might be taken for a condensation trail, but which Tony Gilbert, who contacted the witness on behalf of TORRO, confirmed to be a funnel cloud. At 1200 GMT a brisk westerly airstream covered the British Isles between deep complex lows, main centre 980 mb in the Norwegian Sea, and a large complex high, main centre 1041 mb off Portugal. Several shower troughs moved east during the day. Showers, some heavy and thundery, affected many districts during the afternoon, but eastern parts were mostly dry. (Another report from the same source of a funnel cloud over Edinburgh on the 5th January, was not considered substantial enough to be documented.)

fc2007Jan011 Ashill, Somerset (50° 57' N 2° 57' W, ST 3217)

Reported (anonymously) on the UKweatherworld on-line forum, with an inconclusive photograph, taken looking south. Time was 1440 GMT.

EW2007Jan03 Buttermere, Cumbria (54° 31' N 3° 15' W, NY 1815)

Several good photographs of eddy whirlwinds were submitted to the UKweatherworld forum (the photographer, unfortunately, did not give his full name, so cannot be credited). They lasted about 30-40 seconds at a time (time of day uncertain). At 1200 GMT a low, 988 mb, was centred south of Iceland; most of Britain was in the warm sector with strong southwesterly winds, but the cold front moved east across western districts during the afternoon.

TN2007Jan06 Farnborough, Hampshire (51° 16' N 0° 44' W, SU 8754)

This tornado was reported to us by Mr Malcolm Clarke, who witnessed the final moments of it in Aldington Place, Farnborough, at about 2.30-2.45 pm (1430-1445 GMT). His mother saw "a long dark funnel weaving in between the houses." Duration was less than two minutes. The most serious damage was to a garage, which was destroyed; and roofs, fences, and trees also suffered lesser damage.

A site investigation by TORRO's Tony Gilbert revealed a short-lived tornado with a track length of 320 m from 300° towards 120°, and track width of no more than 20 m.
It was only intermittently in touch with the ground, and may have been travelling as fast as 50 knots, which would explain why damage was only found on the right-hand side of the track (the reverse wind on the other side being negated by the forward movement of the system as a whole). There were several witnesses to the funnel. Force T2.

At 1200 GMT a westerly airstream covered the British Isles between a complex low, 966 mb, centred west of Iceland and a broad area of high pressure over southern Europe. A shallow wave depression of 1010 mb was moving east across southern England, and would have been close to Farnborough at the time of the tornado. There was heavy rain on the wave, and one of the Farnborough witnesses saw lightning, but there do not appear to have been any reports of thunder.

FCWS2007.Jan13/14 Guernsey, Channel Islands (c 49° 27'N 2° 43'W)
Paul Donnachie of PORRO received a report (about a month after the event) of a funnel cloud off the west coast of Guernsey, which probably reached the sea surface. There is uncertainty about the date. A westerly type covered the British Isles on both the 13th and 14th - the former date being in a warm sector, the latter being post-cold front with high pressure near the south.

EW2007.Jan18 Woking, Surrey (51° 19'N 0° 33'W, TQ 0058)
Reported to us by Mr Mike Cochrane as "Approximately 10 feet in diameter, lifting water and spray about 20-30 feet in the air. Disappeared and re-formed several times over an hour or so."

Time was about 1300 GMT. At 1200 GMT a low of 986 mb was moving quickly east across the North Sea after crossing southern Scotland. To its south, a very strong westerly airflow covered England and Wales; there were gusts over 60 knots in many places, especially just behind the cold front, which was crossing the Home Counties at this time.

FC/TP2007.Jan20 Exeter, Devon (50° 43'N 3° 31'W, SX 8292)
A brief report from Mr Sam Howe stated that a funnel cloud, possibly reaching the ground in the distance, was seen travelling from west to east. Time was given as 1300 GMT, and duration one to two minutes from first sighting. (He apparently took photographs of it, but we have not seen them.)

At 1200 GMT a strong westerly airstream covered the British Isles, between a vigorous low, 960 mb, east of Shetland and a high, 1034 mb, near the Azores. There were showers in many western areas, especially in the afternoon, when some of them were accompanied by thunder.

TN2007.Jan21 Darwen, Ayrshire (55° 36'N 4° 16'W, NS 5637)
The Kilmanock Standard of the 2nd February reported that at 5 am (0500 GMT) on the 21st January a tornado swept through Muir Drive and Linstill Road, Darwen. It is said to have lasted 60 seconds, and caused damage to roofs, trees, and garden furniture. It appears to have moved from northwest to southeast. Force probably about T2.

At 0600 GMT the British Isles were between a low, 977 mb, off southwest Sweden and a high, 1034 mb, mid-Atlantic. An occlusion, marking the boundary of an advancing northerly airstream, was over north Scotland, and a shower trough was moving east into southwest Scotland. Showers, locally heavy, were affecting many western areas at the time.

fc2007.Feb06 Nuneaton, Warwickshire (c 52° 31'N 1° 27'W, SP 3691)
Mr Carl Peak reported a possible funnel cloud seen in the early morning (c 0800 GMT?) to the west of Nuneaton.

It was unclear from the photograph whether it was a funnel or a precipitation shaft. At 0600 GMT a very weak northerly airflow covered England and Wales, between a low, 996 mb, in the North Sea, and a high, 1026 mb, north of Iceland. Most inland places were dry and frosty, but a few light snow showers were affecting the Midlands about this time.

TN2007.Mar04 Craydon, London (51° 22'N 0° 04'W, TQ 3365)
This was reported in the Craydon Advertiser of the 9th March as "Tornado blows the roof off" (press cutting forwarded by the Editor, Samantha Hall). It took the roof off the home of Mrs Nicky Peirce and deposited half of it more than 50 ft away. She said: "There was a whirring noise and I could feel the whole house shake - it was vibrating." Neighbouring houses also suffered damage, and Mr Tony Collins said: "It was nothing like a normal storm - our houses were vibrating and there was such a roar..." The tornado was reported as having occurred "on Monday night", and the fire brigade was said to have arrived at 11.50 pm, which we take to mean the late evening of Sunday the 4th.

At 0600 GMT on the 5th the British Isles were within the circulation of a deep low, 954 mb, centred to the northwest of Scotland. Its main frontal system had just cleared the east coast, but a secondary cold front, with a fragmented band of showers, was crossing eastern England, including the London area, and the tornado was probably associated with this feature.

FC/TP2007.Mar06 Tiverton, Devon (50° 54'N 3° 29'W, SS 9512)
PORRO's Nigel Bolton saw a short (and short-lived) funnel cloud to his east just before 1800 GMT, and Matt Clark of PORRO reported something similar in the same area at that time. At 1800 GMT a westerly airstream covered the British Isles associated with a complex low, 956 mb, near Iceland; a shower trough was moving east into western England and Wales. Showers, locally thundery, were affecting many western districts at this time.

fc2007.Mar19 Wolverhampton, West Midlands (52° 35'N 2° 07'W, SO 9198)
Two independent reports were received of a possible tornado or funnel cloud in the Wolverhampton area at about 1645 GMT. While neither report by itself would seem strong enough to be accepted, the two taken together are suggestive of some form of whirnwind activity. The first report came from a friend of PORRO's Nick Cole, showing pictures of what was said to be a funnel cloud (over Wolverhampton) but which might have been a precipitation shaft; the second came from Mr Darren Jaundrell, from Dudley, who described "rotation to the northwest of me [i.e. towards Wolverhampton] in a cloud formation. It seemed to rotate and lower slightly. It formed a nice conical shape as it approached some trees but then dissipated to nothing."

At 1200 GMT a strong cold northerly airstream covered the British Isles between a large low, 968 mb, over the Gulf of Bothnia and an intense high, 1047 mb, north of the Azores. Wintry showers were widespread over Britain in the afternoon, some of them thundery, especially over central England.

LD2007.Apr07 Telford, Shropshire (52° 40'N 2° 27'W, SJ 6909)
The Shropshire Star (10th April) printed a photograph of a well-formed dust devil taken by Mr Clive Bentley. He described it as: "... around 10 feet to 12 feet high and it ran along the length of the car park and passed through a mesh fence before collapsing to the ground..." (Time of day not stated.) At 1200 GMT the British Isles were within the circulation of a high, 1029 mb, centred in the Irish Sea. Except in the Northern Isles, the weather was generally fine and rather warm with light winds.
Thundery showers affected western and northwestern coasts on a few days, whilst a zone from Dorset through London to East Anglia had thunder on two or three days; activity was unusually marked for November in these areas on the 25th and 26th. Most of the rest of the country was thunder-free.

Thunder accompanied one of the many showers to affect northeast Norfolk in a strong northwesterly airflow on the 1st; otherwise, November began with rather more than a week of quiet, settled, chilly weather - easily overcast when the overall figures show a warm, wet month. The change was effected by the 11th as a deep depression drifted east near Ireland; northwestern regions were very showery and there was isolated thunder around the western and northern coasts of Scotland. It was a similar story on the 14th. On the 16th, it became increasingly showery in the south and west following the passage of a cold front from the west; thunder (and hail) was reported during the evening and night, especially in coastal regions from Cornwall to Hampshire - there were some lively storms, notably in east Devon around 3 am on the 17th. Later that day, another cold front crossed from the west and isolated thunder accompanied some intense bursts of rain and hail over central southern England and the east Midlands during the afternoon. Blustery showers gave a little more thunder, mainly near western coasts, during the next few days; a house was struck by lightning on Bodmin Moor on the 21st. Then came the unusually active storms of the weekend of the 25th/26th in the south.

The main outbreak on the 25th was over central southern England, the east Midlands and East Anglia during the morning; associated with a secondary cold front that was drifting east. There was frequent thunder and lightning; very heavy rain, hail, squally winds and a marked temperature drop, whilst a tornado caused some damage at Boarhunt, near Fareham; flooding was reported from some localities, especially in Bedfordshire. Behind the front, there was a scattering of thundery showers across southern counties during the afternoon and evening; at Tadworth (Surrey), lightning struck and killed four ponies in a field and electrical equipment in a nearby house was put out of action. On the 26th, there was thunder in a showery trough as it moved into southwest England and south Wales during the early hours. Lightning struck a house in Plymouth, damaging the roof and electrical equipment; smoke filled the house. The trough moved away quickly to the east, but left behind a band of persistent showers during the morning from Dorset through Hampshire, Berkshire, north Surrey, London and Hertfordshire to Essex and Suffolk. The band slowly twisted from a southwest to northeast track to become more aligned west to east by early afternoon, and weakened; at its most intense in mid-morning, it owed much to being fed by the very long sea track past northwest Brest as well as being intensified by the downs and ridges it crossed. The storms were particularly active over east Berkshire, London and Essex, with large hail and local flooding. Lightning struck and damaged houses at Bracknell and at Bourne End (Buckinghamshire). The month ended with a few more reports of thunder amongst showers near western and southern coasts in this closing days; there was a tornado near Aberystwyth early on the 28th.
TORRO THUNDERSTORM REPORT FOR THE UNITED KINGDOM: DECEMBER 2006

By BOB PRICHARD

The weather was very disturbed for two-thirds of this month, and thundery activity mirrored the broader pattern. Many places in the south and west had at least one day of thunder, and four days were reported from parts of northwest Wales. However, large areas of England escaped without any at all.

The first six days brought fairly isolated incidents of thunder amongst the interleaves of squally showers between rain-bands, mainly near western coasts. On the 7th, vigorous showers penetrated right across England and one of these developed into a notable thunderstorm (with hail) that started life around the Berkshire Downs around 10am and tracked across London, dying out over mid Essex shortly before midday. During its most active phase over west London, it briefly unleashed a violent tornado that wreaked devastation in part of Kensal Rise. Also on the 7th, there were two incidents of lightning damage. An 11,000 volt transformer was struck at Feryside (Dyfed) cutting power to local properties, with a resulting power surge down telephone cabling damaging a new computer and surge arrestor in one house; at West Hendon (London), roofing was damaged and a pipe burst when a block of flats was hit. Several more days of rather isolated storms amongst the showers followed until the weather quietened down in mid-month.

Thunder returned on the last three days. Merseyside and the surrounding area caught a short, sharp storm on a cold front on the evening of the 29th; houses were damaged by lightning at Bolton. The 30th was another day with a mix of thunder and tornadoes in southeastern counties near a small, deep secondary depression that tracked from Hampshire to Norfolk in the afternoon. A fair number of thundery showers, with hail, affected western regions on the 31st. Early in the day, a teenage girl had a lucky escape when lightning hit the metal frame of her bed at Alveston (south Gloucestershire); the house was badly damaged, with all the first-floor ceiling collapsing. At about the same time, another house was damaged in the same county, at Elberton, whilst in the late morning lightning started a fire when it hit a house at Maghera (Londonderry). An hour or two before the year ended, a thundery shower in east Devon brought reports of very loud thunder and strange ‘explosive’ effects – as well as giant hail.

TORRO’s excellent research relies on you, the public and members to tell us if you hear of or witness any severe weather events. Do not worry about whether we already know of the event, your statements could confirm a sighting or give us vital inomation to already investigated events. Your reports are vital for severe weather research, for the database, analysis and verification of forecasts. All important in helping to educate and keep mankind safe.

Thank you for taking the time to report events to us. If you’d like to know how to report an event to us, please contact us or visit the website: www.torro.org.uk.

INTERNATIONAL NEWS IN BRIEF

Burma tornado DOI: 3-5 July 2007
Two died and many others suffered injuries as storms spawned a strong tornado in Burma destroying 160 houses during the first few days of July 2007. Heavy rain also affected about 800 families after flash flooding inundated their homes. (BBC News)

Stormy weather in New York, USA DOI: 9 August 2007
A storm spawned a tornado in Brooklyn, whilst heavy rain and wind swept across the US State on the 8th. Meteorologists assessing damage to homes stated winds were probably in excess of 180-217 km/hr (111-136 mph). Meanwhile heavy rain flooded main streets and caused havoc on the city’s subway system. A meteorologist at Penn State University stated the tornado that hit Brooklyn was the first since 1950.

New Zealand struck by lightning DOI: 13 August 2007
Significant damage from a lightning strike to a number of homes including power failures occurred in South Auckland on the 13th. The bolt of lightning struck a tree and shattered windows, caused a power surge and resulted in at least one injury. Electricity and phone lines were damaged and several bits of tree debris were blown 100 metres away. Elsewhere in Canterbury 1,000 people were left without electricity as gales brought power lines down.

1,500 people stranded in China DOI: 14 August 2007
Strong winds caused transport authorities to take drastic action on the 15th August and close major routes in the country due to the hazards. 1,500 people were stranded on the highway in the Xinjiang Uygar Autonomous Region. Meanwhile the Xinjiang railway also had to be closed causing disruption to thousands of passengers. But disruption is better than what could have happened as the country’s transport networks were being lashed by hurricane force winds of up to 117 km/hr (73 mph).

Category 5 – Dean National Climatic Data Center (NCDC) DOI: August 2007
Hurricane Dean – the first hurricane of this year’s season and the first category 5 hurricane to make landfall in the Atlantic Basin since Andrew in 1992 (NCDC) had maximum sustained winds of 269 km/hr (167 mph) with gusts of up to 322 km/hr (200 mph) and a pressure core of 906 mb before making landfall in Mexico’s Yucatan Peninsula.

Dean downgraded to category 1 after travelling over land but soon picked up strength again as it crossed the Gulf of Mexico. Dean made landfall for the last time on 22 August near Tecoluta, Veracruz as category 2 and then lost strength and dissipated over central Mexico.

39 dead as Typhoon Sepat hits China DOI: 23 August 2007
Typhoon Sepat destroyed or damaged several crops and homes; also responsible for significant economic loss and tragically killing at least 39 people. The Met Office reports that most of the deaths were caused by landslides attributable to the typhoon and one area was also hit by a tornado derivative of the storm.

Livestock industry suffers from drought DOI: 1 September 2007
The worsening drought conditions in Virginia, USA are seriously affecting the local livestock industry with supplies of hay-feed diminishing forcing farmers to purchase feed from the shops which they say is not as good quality. This effect could domino causing higher beef prices. Many farmers have applied for drought relief to help reduce the impact of the weather.
TORRO in Association with The International Journal of Meteorology

Are proud to present the 2007 “Weather” photography exhibition and competition.

The exhibition of UK weather photographs will be held at the TORRO Autumn conference at Oxford Brookes University, Oxford, UK Saturday 20 October 2007.

Entry is free and open to all TORRO members and attendees at the conference. The subject is of course, weather. As this is the first exhibition held under the joint TORRO/IJMet banner, the photographs may be from any date. Entry criteria are that the photographs must have been taken in the British Isles, they may be black and white or colour and presented as a print in any format up to 8” by 10” (traditional prints or good quality computer prints are acceptable). Up to four different prints per entrant will be allowed. They must of course be the entrants own work and all prints will be judged under the single category of weather. Minor digital alterations to colours and contrast will be allowed, digital manipulation of subject matter will NOT be allowed.

We have some great prizes for the top three entrants:

1st Prize: A £100 voucher for Jessops photographic stores
2nd Prize: A copy of the book Storm Force featuring images from The IJMet and TORRO
3rd Prize: The first copy off the press of the IJMet 2008 calendar

Judging will be by participants of the conference and prizes awarded at the close.

Entrants are invited to e-mail Paul Domaille at paul.domaille@torro.org.uk in the first instance, giving the number of images entered and the size. A posting address for prints will be e-mailed by return. It is hoped that entrants will be able to forward their prints by post at least two weeks prior to the conference, this will enable the exhibition to be set up before the conference opens. We will be able to accept a small number of entries before 10 am on the day, however space cannot be guaranteed.

Please reserve your space early as display area will be limited.

TORRO and the International Journal of Meteorology reserve the right to use any entry for publicity purposes with due accreditation. Entries may not be removed from the display before 4.15pm on the 20th October. TORRO and the IJMet will not be responsible for returning prints to entrants. In the event of any dispute the IJMet Editor’s decision will be final.
“An international magazine for everyone interested in weather and climate, and in their influence on the human and physical environment.”

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