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The Great Heatwaves of 1975 and 1976, UK
Hurricane, Tropical Cyclone and Typhoon
Review, 2010
TORRO Whirlwind and Thunderstorm Reports



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The International Journal of Meteorology

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THE GREAT SUMMER HEATWAVES OF 1975 AND 1976 IN THE UK, AND SOME VIOLENT STORMS

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Abstract: 35 years ago, the summers of 1975 and 1976 were outstanding for the number of very hot days (maxima 32 °C or more) in the UK; in both years the heat was focussed in a well defined hot spell of exceptional length and intensity. The former year also featured a series of violent thunderstorm episodes during the high summer period.

Keywords: *heatwave, 1975, 1976, UK, storm.*

INTRODUCTION

There was a conspicuous shortage of very hot days (maximum temperatures over 32 °C) in the UK during the 1960s and early 1970s, and the few such events in that era were confined to southeast England or East Anglia. This background gave added impact to the two hot summers (with outstanding heatwave events) in 1975 and 1976. Several classic thunderstorm events also occurred, especially in 1975. Moreover, it is useful to review these historic hot spells from the perspective of subsequent, as well as preceding, summers; especially with the increased awareness and concern about climate change in more recent years. Both heatwaves are featured in early issues of this journal (*J. of Meteorology, UK 1, 2-5; J. of Meteorology, UK 1, 305-306; J. of Meteorology, UK 1, 355-357*).

THE HEATWAVE OF 26 JULY TO 14 AUGUST 1975

The summer of 1975 had begun with unseasonable snow on the 2nd June (see *J. Meteorology, UK 1, 33-34*)*. However, by late July it had already provided much brilliant summer weather, to the delight of organisers of the first cricket world cup! Oxford recorded its sunniest June since records began in 1881 with 301 hours, surpassing the previous record of 297 hours in 1957.

July followed with consistent warmth, albeit without any notable heat until the last few days. In fact, up to 25 July, the summer had been conspicuous for the absence of really hot days; 30 °C had been reached just once, at Southampton on the 12th June. All that was to change as the Azores high ridged strongly northeastwards across Britain from the 25th July onwards. From 27 July there was a run of 19 consecutive days when maximum temperatures exceeded 29 °C somewhere in the UK; 32 °C was reached on seven days (Table 1). At RAF Finningley, near Doncaster, 27 °C was surpassed each day from the 2nd to 14th August inclusive. On 4th August, 31.4°C and 31.2°C were recorded at Edinburgh and Glasgow airports respectively. On the 8th August, 128 climatological stations in England and Wales (28 % of the total) reached at least 32 °C.

SEVERE THUNDERSTORM EPISODES, JULY-AUGUST 1975

The 'high summer' period was also noteworthy for several outstanding thunderstorm events:

7-8 July. Violent thunderstorms broke out across southwest England in the evening, moving northeast in the early hours of the 8th. Numerous buildings were damaged by lightning and tens of thousands of homes lost power.

Pedestrians ran for cover when lightning scattered masonry across a main street in Torquay, Devon. More than 1200 lightning discharges were observed at Corsham, Wiltshire. Canning (1976) presented a first hand account of two alarming lightning strikes witnessed at a remote railway signal box at Hamstead Crossing, Wiltshire, just after the level crossing gates were opened for a train at 0220 GMT (almost certainly on this night):

“As I entered the door there was a blinding flash, and crack, followed instantly by an almighty crash as a fork shot from the sky into a clump of trees no more than twenty yards from where I stood... The lights went out, bells rung”. Then, after two more close discharges, “a fork seemed to come straight at the box. There was the familiar crack and crash, but this time the structure shook, sparks came through the wall and everything in the box glowed, every bell and phone rang together”.

Table 1. Highest recorded temperatures in the UK for each day, 27 July to 14 August 1975 °C (all Met Office synoptic or co-operating climatological stations).

July 27	29.3 Benson, 29.2 Wallingford, 28.7 Shirburn (all Oxfordshire)
July 28	30.2 East Dereham (Norfolk), 29.6 Aldenham (Hertfordshire)
July 29	31.0 Bromley (London), 30.9 East Dereham, Aldenham, 30.6 Abingdon (Oxfordshire)
July 30	32.0 Bromley (London), 31.3 Aldenham
July 31	31.1 Southampton Mayflowe Park (Hampshire), 30.0 Bromley
August 1	29.8 Southampton Mayflower Park
August 2	32.3 Trowbridge (Wiltshire), 31.2 Gloucester (Gloucester)
August 3	33.2 Trowbridge, 32.5 Hereford, 32.4 Usk (Monmouthshire), 32.3 Gloucester
August 4	34.1 Shinfield (Berkshire), 34.0 North Heath (W Sussex), 33.9 Gloucester, 33.8 South Farnborough (Hampshire)
August 5	31.4 Kensington Palace (London), 31.3 Santon Downham, 31.2 Marham (both Norfolk)
August 6	32.3 Costessey, 31.8 Marham (both Norfolk)
August 7	34.0 Bromley (London), 33.5 Cardington (Bedfordshire)
August 8	34.2 Heathrow (London), Stansted Abbots (Hertfordshire)
August 9	30.0 Finningley (South Yorkshire), 29.8 Haydon Bridge (Northumberland)
August 10	29.5 Onich, Lagganlia (Highland)
August 11	30.7 Lagganlia, Dinnet, 30.6 Strathy 1 (all Highland)
August 12	30.4 Costessey, 30.3 Scole, 30.2 East Dereham (all Norfolk)
August 13	31.4 March (Cambridgeshire), 31.3 Costessey, Scole (Norfolk), Mepal (Cambridgeshire)
August 14	31.3 Caistor (Lincolnshire), 31.0 Bromley (London), 30.7 Marholm (Cambridgeshire)

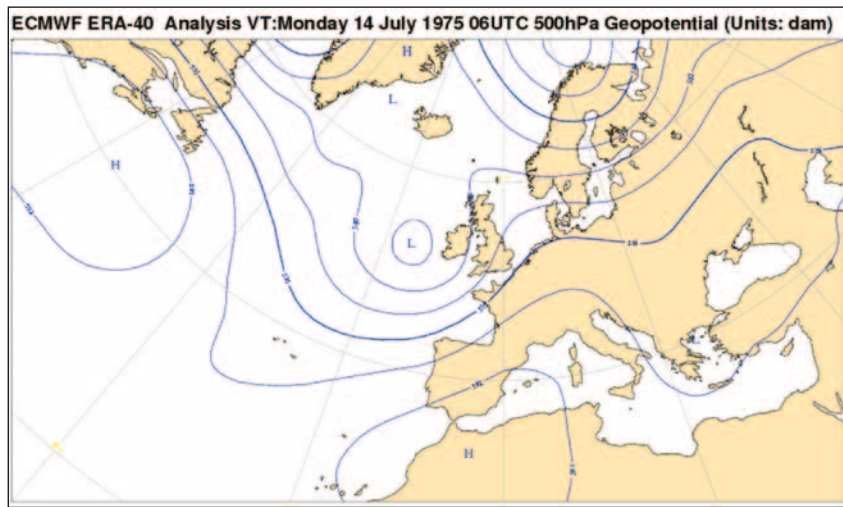


Figure 1. 500 mb analysis chart for 14 July 1975, 0600 UTC, courtesy ECMWF-ERA Interim Analysis (<http://data.ecmwf.int/data/> (accessed June 2011)).

13-14 July. A brief incursion of very warm, humid air was associated with widespread overnight thunderstorms and a destructive hailstorm across the north Midlands, the most severe of the 1970s in the UK in respect of both path length and hail size. A surface trough developed over Biscay and moved northeastwards, ahead of an Atlantic cold front. An upper trough was situated west of British Isles with a vortex just west of Ireland at 500 mb (Figure 1). The Aughton ascent (Figure 2) shows a south-southwesterly airflow of 37 kn at 500 mb, while surface winds backed southeasterly ahead of the trough enhancing the low level shear. The ascent shows latent instability between 750 mb and 450 mb, a classic ‘warm nose’ around 800 mb and a sharp fall in wet bulb potential temperature at mid levels (650 to 450 mb) indicating significant potential instability to be released in the general ascent triggered by the trough. Hail over 20 mm diameter fell along a 105 km long hail swath across the Midlands between 0300 and 0700 GMT with extensive damage to greenhouses, house windows, vehicles and also roof tiles in south Staffordshire, south Derbyshire and (especially) the Mansfield area of north Nottinghamshire (Stanier, 1976; and, 1996, Fellowes, 1976). Some hail in the Burton-on-Trent area measured 50-65 mm diameter. At Gleadthorpe experimental farm in Meden Vale, Nottinghamshire, vehicles were dented and a large greenhouse was demolished (Kirk, L, *Pers. Comm.*). A nearby colliery, at Welbeck, had its annual holiday at the time and contractors had to board up many broken windows in the colliery village while the residents were away. Severe hail also affected the Birmingham area (28 mm diameter hailstones at Edgbaston Observatory) with damage to greenhouses and vehicles in the Sutton Coldfield area.

17 July. Slow moving thunderstorms “(within a shallow depression under a marked upper trough) gave exceptional localised downpours with 120.7 mm in two hours at Aylsham, Norfolk (Briscoe, 1975).

Table 2. Highest recorded temperatures in the UK for each day, 23 June to 8 July 1976, °C (all Met Office synoptic or co-operating climatological stations).

June 23	32.2 Maldon (Essex); 32.0 Greenwich (London)
June 24	32.4 Gillingham (Kent); 32.0 Maldon
June 25	33.5 East Bergholt (Suffolk); 33.4 Wisley (Surrey)
June 26	35.4 North Heath (W Sussex) and East Dereham (Norfolk); 35.0 Waddon (London)
June 27	35.5 Southampton Mayflower Park (Hampshire); 35.1 East Dereham
June 28	35.6 Southampton Mayflower Park (Hants)
June 29*	32.8 Carmarthen (Dyfed), 32.6 Eilbridge (Cornwall), 32.5 Trowbridge (Wiltshire)
June 30	32.4 Trowbridge (Wiltshire); 32.1 Southampton Mayflower Park
July 1	33.5 Yeovilton, Cannington (both Somerset); 33.2 Trowbridge
July 2	35.7 Cheltenham (Gloucestershire), 35.6 Trowbridge; 35.0 North Heath
July 3	35.9 Cheltenham; 34.8 Wisley; 34.6 Malvern (Worcs)
July 4	34.1 North Heath, Cheltenham; 33.9 Wisley (Surrey)
July 5	33.1 Southampton Mayflower Park (Hants) and Benson (Oxon)
July 6	34.3 Cheltenham; 34.0 Benson, Maldon
July 7	32.7 Cheltenham; 32.3 Letcombe Regis (Oxon)
July 8	31.1 Benson (Oxfordshire)

*Note: a reading of 33.6C at Totnes, Devon, on the 29th (Shaw 1977) was subsequently revised down.

5 August. Burt (1976) described a storm which developed explosively in the Midlands and produced a tornado and damaging hail swath in the Coventry area.

The most widespread thunderstorm episode occurred on the 8th August, the hottest day for many (Figure 3), and a full account of developments on this dramatic day has been given by Prichard (1976).

Also, Grant (1995) noted that this was the day with the most extensive UK thunderstorm activity during the whole period 1972 to 1994 inclusive.

Finally, but not least, the more isolated historic Hampstead storm on the 14th August deposited 169 mm of rain in 2.5 hours with hailstones 20 mm diameter (Keers and Westcott, 1976). The daily total of 170.8 mm is a record for the Greater London area (see also *J. of Meteorology UK*, 1, 6-9 and 68).

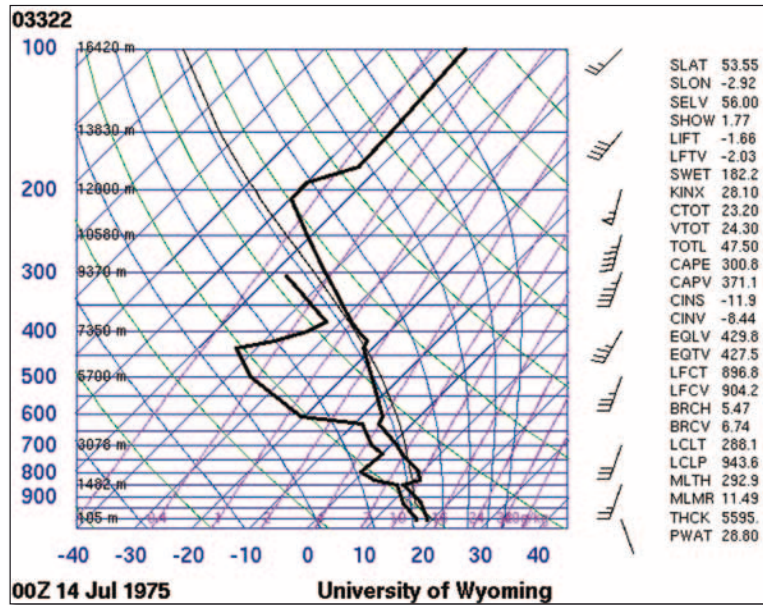


Figure 2. Upper air ascent for Aughton, Merseyside, 0000 UTC, 14 July 1975, courtesy of the University of Wyoming, USA.

THE HEATWAVE OF 23 JUNE TO 8 JULY 1976

The early months of 1976 saw increasing concern over water resources as a very dry winter had not replenished supplies. An early May heatwave saw temperatures climb to 29 °C in London (Waddon) on the 7th. A further portent of things to come occurred with another burst of very hot weather early in June, peaking with 31.7 °C at Kensington, London on the 9th.

The historic heatwave of late June to early July 1976 (Shaw, 1977) eclipsed even the previous summer's hot spell (Table 2). London, Heathrow airport recorded 16 successive days above 30.0 °C while 32.0 °C was surpassed on nine successive days at Trowbridge (Wiltshire) and seven consecutive days at Cheltenham (Gloucestershire) and Southampton. Although initially confined to southern Britain, Figure 5 confirms the northward spread of the very hot air by the 2nd July when 32.4 °C was reached at Wauchope (Scottish Borders).

About 27 % of stations in England and Wales recorded 32.0 °C or more on the 3rd July. Although 32 °C was only reached on one further day in 1976 (25th August) the drought situation intensified when large areas recorded 37-40 days without measurable rain in the weeks up to 27 August. At Oxford, the previous longest rainless spells (no falls of 0.2 mm) of 37 days in 1947 and 1959 were surpassed by a run of 40 successive days. The main summer period of 1976 was considerably less thundery than in 1975 (July was moderately thundery but there was little activity in June or August). However May and September redressed the balance. The early May hot spell brought some violent storms with 30 mm diameter hailstones in the Coventry and Nottingham areas on the 7th, and at Shooters Hill, London, on the 8th. September was exceptionally thundery, especially during the second half when a cyclonic southerly airstream and very high sea temperatures combined to generate frequent and widespread thunderstorm episodes. Guernsey airport recorded 10 thunder days this month. This was also the second wettest September (after 1918) in the entire England and Wales rainfall series, a relief to water authorities and a recently appointed 'drought minister'!

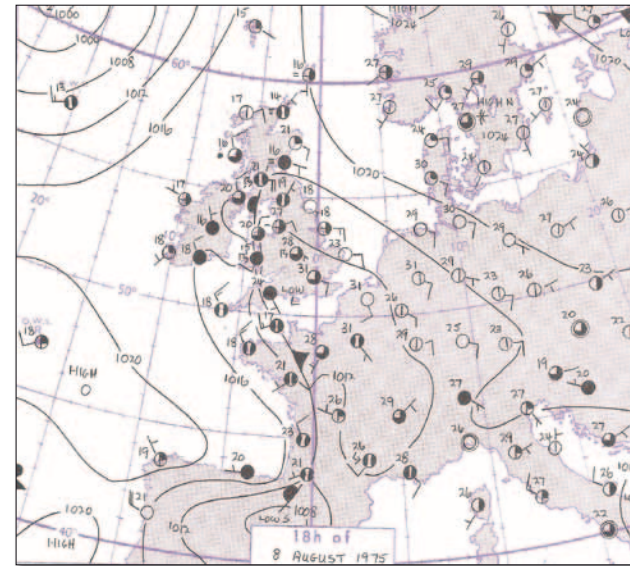


Figure 3. Surface analysis, 8 August 1975, 1800 UTC, from the Daily Weather Report of the UK Met Office, © Crown Copyright 1975-1976, the Met Office.

OTHER OUTSTANDING HOT SPELLS

Although 'hot' summers have been more frequent over the past three decades and new absolute UK maxima have been set twice (in 1990 and 2003), none of these subsequent seasons have produced heatwaves which quite match those of 1975 and (especially) 1976 for sustained intensity. The most notable have been:

July 1983. Until 2006, this was the hottest calendar month in the CET series. In the UK, temperatures reached 32 °C somewhere on each of the six successive days 11th to 16th July and Trowbridge (Wiltshire) reached 30 °C or more on 7 consecutive days from 10th to 16th inclusive.

August 1990. This heatwave was relatively brief but very intense (Burt, 1992). Several stations recorded maxima of 32 °C or more on four successive days (1st to 4th August) and at Cheltenham (Gloucester) a new UK record of 37.1 °C was recorded on the 3rd (this was surpassed in 2003).

July-August 1995. These were the hottest two consecutive calendar months in the CET series and between the 19th July and 22nd August there were only brief cooler intervals between a series of lengthy heatwaves. Boxworth (Cambridgeshire) and Cheltenham (Gloucester) both exceeded 32 °C on six successive days from the 29th July to 3rd August, a sequence only surpassed in 1976.

August 2003. A new national record 'high' of 38.1 °C was established at Kew Gardens (London) on 10 August while Wisley (Surrey) and Greenwich (London) registered ten successive maxima above 30 °C from the 3rd to 12th (Burt, 2004).

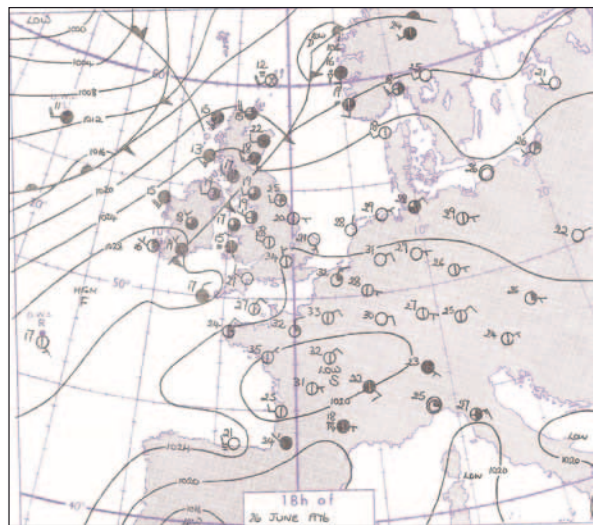


Figure 4. Surface analysis, 26 June 1976, 1800 UTC, from the Daily Weather Report of the UK Met Office, © Crown Copyright 1975-1976, the Met Office..

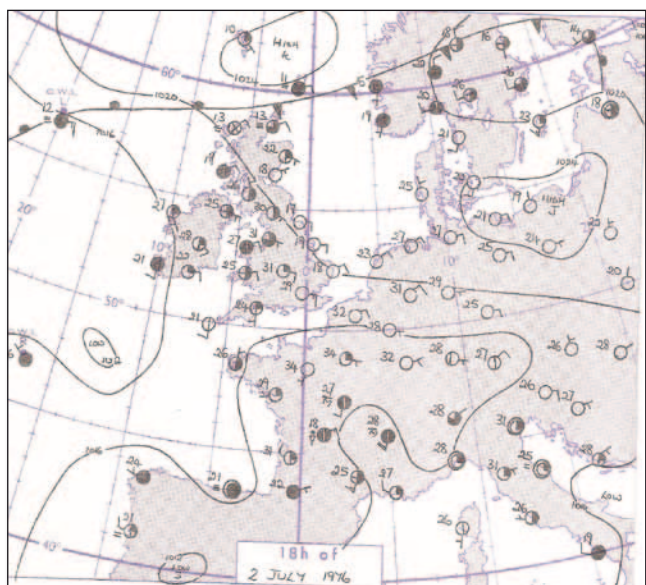


Figure 5 Surface analysis, 2 July 1976, 1800 UTC, from the Daily Weather Report of the UK Met Office, © Crown Copyright 1975-1976, the Met Office.

July 2006. This just pipped July 1983 as the hottest ever CET calendar month. UK maxima of 32 °C or more were recorded on each of the five days 17th to 21st and also on the 2nd and 25th-26th. Cambridge had 7 consecutive days of 30 °C or more (16th-22nd) while the 19th was one of the hottest days ever recorded across England and Wales as a whole, with a highest reading of 36.5 °C at Wisley. Prior to 1975, only two summer seasons were comparable in terms of the large number of very hot days: 1911 and 1947.

July-September 1911. Temperatures reached 32.0 °C or more somewhere in the UK on 14 days between 8 July and 8 September. The hottest day was the 9th August with 36.7

°C at Raunds, Northamptonshire, until 1990 the highest recorded UK reading. Equally remarkable was the 34.6 °C at Raunds on 8 September 1911.

May-August 1947. Two especially notable hot spells occurred. Between the 29th May and the 3rd June, some stations such as Waddington (Lincolnshire) recorded over 30 °C on six consecutive days, exceptional for so early in the season. On the 3rd June, 34.4 °C was recorded at Waddington and at Kensington Palace (London). Then in August, Bournemouth recorded 32 °C or more on four successive days from the 15th to 18th; several places reached 27 °C or more for 11 or 12 successive days commencing from the 12th. Before 1976, the longest sequence of maxima above 32 °C at any specific location was four days: in 1906, 1934 and (see above) 1947.

CONCLUDING REMARKS

The UK summers of 1975 and 1976 produced two outstanding hot spells within 12 months of each other, in sharp contrast to the scarcity of very hot days in the previous 15 years. In 1975, 32 °C was reached on seven days out of ten between the 30th July and 8th August. In 1976, 32 °C was exceeded on 15 successive days from the 23rd June to the 8th July with 14 to 16 consecutive maxima above 30 °C at numerous stations. However no absolute UK maxima were set.

ACKNOWLEDGEMENTS

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DECLINES IN RAINFALL IN THE WESTERN DEMOCRATIC REPUBLIC OF CONGO MAY CONVEY AN ALARMING SIGNAL FOR CLIMATE CHANGE EFFECTS IN THE CONGO BASIN

By BILA-ISIA INOGWABINI^{1,2}, BOIKA MOLA SANDOKAN³,
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Abstract: Rainfall time series data from three sites in the western Democratic Republic of Congo, Central Africa on rainfall were analyzed using regression analysis. This analysis indicated that in all three sites, rainfall intensities decreased, following the regression equations $y = -20.508x + 1723.5$ ($R^2 = 0.7011$) (for Mabali), $y = -13.643x + 1175.4$ ($R^2 = 0.5313$) (for Luki) and $y = -23.338x + 1426.6$ ($R^2 = 0.6709$) (for Kinshasa). The mean rainfalls for Luki and for Kinshasa in 2004 represented only 59 % and 61 % of its levels 33 years earlier while a more dramatic change was depicted for Mabali with the maximum rainfall in 2004 >25 % of its levels in 1970. These data indicated that the Congo Basin may be feeling effects of climate change and conforms to the conclusions of the Intergovernmental Commission on Climate Change.

Keywords: Climate change, rainfall, Western Democratic Republic of Congo.

INTRODUCTION

Climate change is a scientifically established fact now (Walther *et al.*, 2005), even though the magnitude of its multiple, diversified and multidimensional effects remain mostly of the domain of mathematical modeling. However, discussions on the mitigation of climate change and adaptation processes (social, cultural and biological) remain at the core of scientific and political debates (Hughes, 1986; Aiken *et al.*, 1992; Fletcher, 1997; Fletcher, 2000; Hobbs and Knäusenberger, 2003; Inogwabini *et al.*, 2006) because, as diversified and multidimensional as they stand, it has become common knowledge that impacts of climate changes will vary throughout the world. The nature and the magnitude of these impacts have, however, yet to be described for different geographic environments and locations. This even more important for the tropical region of Central Africa where documented evidence is scanty (Halpin, 1998; Inogwabini *et al.*, 2006). Informed guesses and mathematical projections convey the message that climate change's effects in Central Africa may range from drier conditions in areas similar to deserts (e.g. Sahara and Kalahari) where water shortages occur compared to high floods in coastal habitats directly adjacent to oceans which, due to increased water levels, are consequential to the melting of the ice in the poles (Halpin, 1998).

Unfortunately, however, long-term field data are difficult to find for Central Africa (Edwards and White, 2000; Pimm, 2007), thus documenting changes over the past years that can highlight the effects of climate change is difficult. Therefore surrogates that can unmistakably picture such effects of climate variations in Central Africa are used. One surrogate has been linking phenological data to weather patterns (Tutin and White, 1998) and direct measurements of water levels (Colombant, 2005).

This has been done using direct meteorology and looking at their trends (Inogwabini *et al.*, 2006). The use of long time series meteorological data as a proper detector of the effects of climate change is fully justified by the fact that if climate change will affect water level, then drier conditions in the terrestrial Central Africa region are, logically, linked to water cycles, principally rainfall regimes over the continent. However, continuous time series data on rainfalls are difficult to find in Central Africa to document the trends and extents of felt changes (Halpin, 1998). Furthermore, where there are continuous long time series data, the analytical capabilities has made it difficult to provide understandable trends that crude data convey.

This paper presents three long term data from three different localities in the western Democratic Republic of Congo (Figure 1): (1) Mabali, (2) Kinshasa and, (3) Luki. The objective of the paper is to present these long time series data in a single analytical framework and discuss patterns that emerge from that analysis in the context of global climate change.

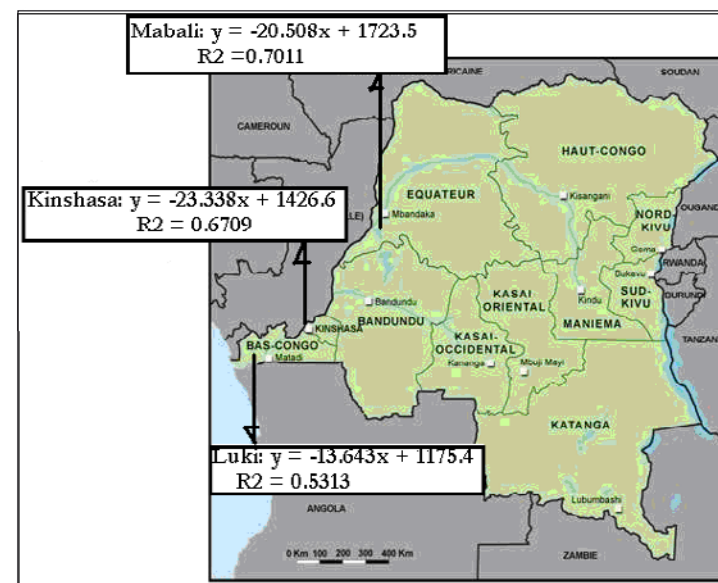


Figure 1. Locations from which weather data were collected.

Study sites, material and methods

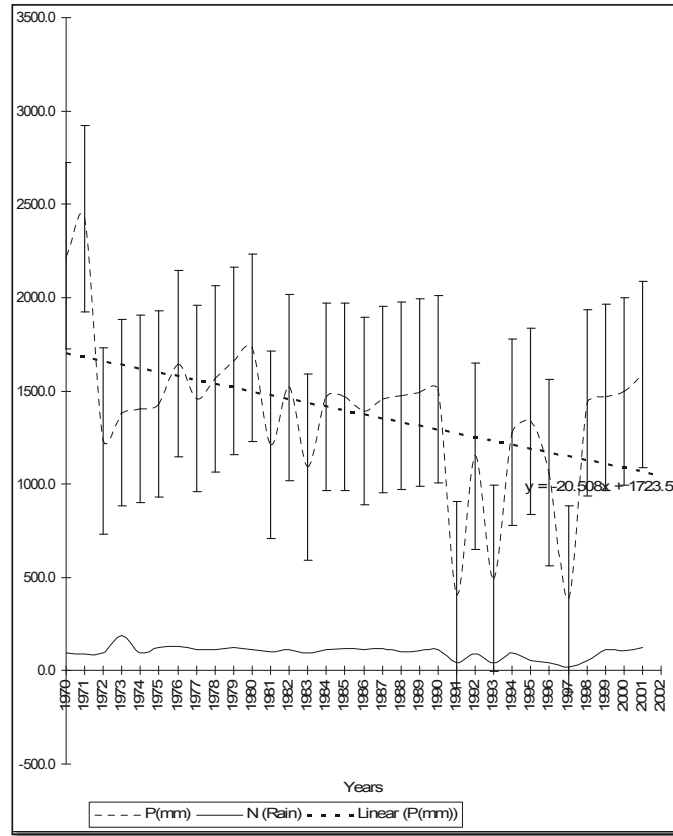
Mabali is located near the equatorial line, where weather patterns are believed to be stable. Kinshasa and Luki are located further south and closer to the Ocean in a way that they may be potentially influenced by climatic events affecting the Atlantic Ocean. Data from Mabali have been collected continuously since 1970 to 2004 (Inogwabini *et al.*, 2006) while those from Luki were collected between 1958 and 2004. The dataset from Kinshasa covers the period between 1971 and 2004. Total annual rainfall intensities (mm) were plotted over time, i.e. 34 years for the Mabali dataset, 46 years for Luki and 33 years for Kinshasa (Figure 1). To detect the trends in these datasets the authors used simple linear regression on annual rainfall intensities (mm) (2).

RESULTS

The rainfall intensities decreased in all three sites over time for each sites following the regression equation:

$y = -20.508x + 1723.5$ ($R^2 = 0.7011$), $y = -13.643x + 1175.4$ ($R^2 = 0.5313$) and $y = -23.338x + 1426.6$ ($R^2 = 0.6709$) respectively for Mabali (Figures 1 and 2), Luki (Figures 1 and 3) and Kinshasa (Figures 1 and 4). The rainfall for Luki and mean rainfall for Kinshasa in 2004 represented only 59 % and 61 % of its levels 33 years earlier, in 1971 following the drought of 1970 when Luki received only 327.8 mm of rain. The situation has been even more dramatic for Mabali where the maximum rainfall represents >25 % of its levels in 1970 or 34 years earlier (2).

Figure 2. Rainfall trends in the Mabali Region between 1970 and 2004.



DISCUSSION

These three data sets on rain intensities (Figures 1, 2 and 3) clearly indicate that there has been 'continuous' drying up of the zone over these last decades. The mean rainfalls for Luki and for Kinshasa in 2004 represented only 59 % and 61 % of its levels 33 years earlier while a more dramatic change was depicted for Mabali with the maximum rainfall in 2004 representing only ≥ 25 % of its levels in 1970. These inter-site variations would be logically expected, given the fact that weather patterns are functions of multiple parameters, including micro-climates, which are ecosystem-dependent themselves (Salati, 1987). Conditions, ecological and climate, in those three sites are widely different and, therefore account for those differences. In-site changes are rather difficult to explain, even though they may be linked to major human activities in some cases.

Luki is an island of forest within the Bakongo Region, which the most logged region of the Congo (Ilwoka, 2004). With a population of 1,504,361 at an estimated 237 people per km^2 (Ilwoka, 2004), the population struggle to make a living through agriculture and wood-cutting, which are reinforced by the response to high demands for foodstuffs and the high consumption of wood (for energy, construction, etc) in Kinshasa and the expanding towns of Matadi and Boma, mostly covered by products coming directly from the adjacent Province of Bas-Congo. All these activities increased the deforestation rate and unbalancing forest ecosystems, which may be feeding changes in climate. Even though there is a need to deepen knowledge on the correlation between forest cover and rainfall regime in this region, it is fairly logical to infer, based on studies undertaken in other regions of the world (Lettau *et al.*, 1979; Eltahir and Bras, 1993; and, Gash and Nobre, 1996), that changes in the rainfall in this region may be a consequence of deforestation, which is feeding global climate change's effects.

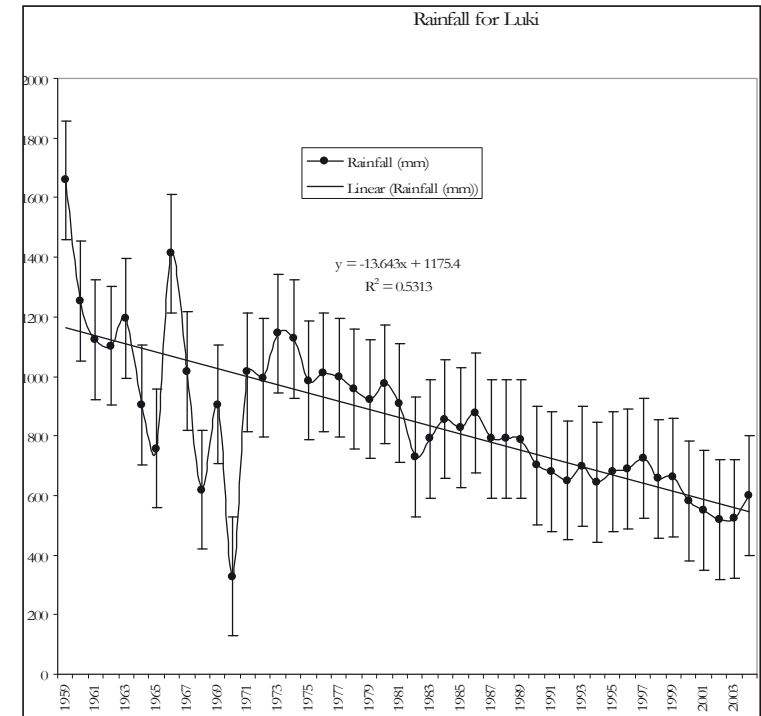


Figure 3. Rainfall trends in the Luki Region between 1958 and 2004.

There seem to be similarities between Luki and the case of Kinshasa. Kinshasa, with currently an estimated population of >8 million people, had seen its immediate environment washed of all natural forests and bushes due to demands in lands to accommodate a rapidly increasing population. Areas that were left to maintain a healthy urban environment have been either invaded by houses or had seen their trees cut down to provide charcoal for energy. As is the case for Luki and even though this question appeals for more detailed information to establish clear links in cause, it remains sensible, based on studies done elsewhere (Lettau *et al.*, 1979; Eltahir and Bras, 1993; and, Gash and Nobre, 1996), to hypothesize that changes observed in rainfall regime in Kinshasa may be subsequent to decreasing vegetation cover, both within the town itself and its immediately adjacent areas.

The 34-year data set from Mabali intrigues common wisdom and can be fully understood only in parallel with the overall climate change paradigm (Inogwabini *et al.*, 2006). Mabali (Figure 1) is located on a 75 km straight line distance south of the equator. Within this strip, climatic metrics are constant (Bultot and Griffiths, 1972): constant temperatures, stable rainfall regimes, and periodically constant seasonal cycles. A first look at the data from Mabali questions the rationality of the data because the site appears to be in an ideal environment for rainfall regime to remain constant over years. This remains the question even when one considers the fact that Mabali is also surrounded by active logging activities and a lot of forest clearings due to high human concentration around the Lake Tumba because the extend of vegetation clearing are far from a comparable magnitude to the situation in Luki and Kinshasa. Deconstructing the puzzle posed by the Mabali situation, Inogwabini *et al.* (2006), found that while the most acknowledged consequence of the climate change was global warming (Houghton *et al.*, 1990), the Mabali long-term data indicated a local cooling phenomenon, which they attributed to longer periods of dry seasons. Longer dry seasons means less precipitation; therefore it is understandable that rainfalls had decreased over the period covered by the study. Bultot and Griffiths (1972), Inogwabini *et al.* (2006), explained that in equatorial Africa, dry seasons are cooler than normal temperatures due to over-evaporation, meaning persistent clouds, but while tracking the explanations for longer dry seasons, they concluded that they could be logically explainable only by inserting the global climate into the equation. Overall, decreased rainfalls in the western Congo (in the three locations of Kinshasa, Luki and Mabali), regardless of reasons that may explain them, do however agree with patterns in the other regions of Africa and have been documented previously (Mahe *et al.*, 2001; IRD, 2002), even though at localized scales.

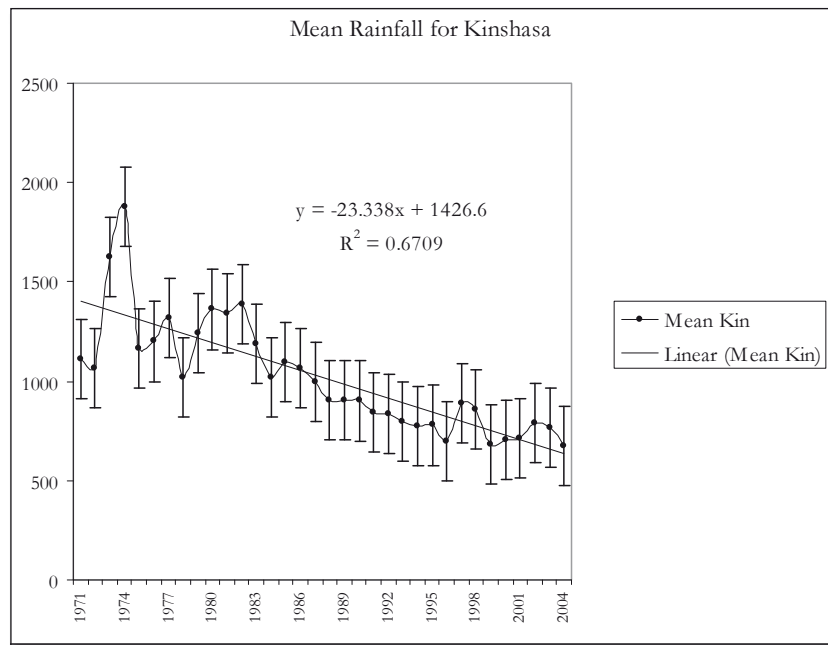


Figure 4. Rainfall trends in Kinshasa between 1971 and 2004.

CONCLUDING REMARKS

In conclusion, these trends are clear and should ignite the will to establish cause and links if they are to be managed appropriately. This is a call for appropriate experiment rather depending on opportunistic data. There is also one precaution in trying to use these datasets and/or extrapolating them: decreased annual rainfall intensities may depict a phenomenon of a long-term cyclical event whose frequencies may be difficult to decipher from such a short time-series of data. Nevertheless, given the fact that some may argue that human activities may have pushed natural environmental to the edges of irreversibility, the picture provided by these data series may convey an alarm signal given the fact that the authors may have gone beyond a certain resilience threshold. This is even more appealing when one considers that these climatic patterns agree with the overall picture of the Congo Basin and Africa, and may be attributable to the overall global climate change phenomenon (IRD, 2002, and Inogwabini *et al.*, 2006).

The authors argue that if weather change patterns described in this paper remain constant, in the mid or long-term future, there will be numerous ecological consequences to forests ecosystems of the western Congo Basin (IRD, 2002, and Inogwabini *et al.*, 2006). Evidence of such effects of climates on biodiversity have been described on several occasions (Fernández and Vrba, 2006; Lemoine and Böning-Gaese, 2003; Lemoine *et al.*, 2007a; and Lemoine *et al.*, 2007b) and will likely occur in this region whose biodiversity is one of the most important on earth. Beyond those consequences on biodiversity, effects of few rainfalls will most likely affect human economic activities such as agriculture and may lead to conflicts over water resources in the region. Lovett (2006) established that rainfall is one of the main determinants of ecological productivity, which in turn is the basis of agricultural economies. Shortages of rainfalls will, therefore, hammer the rich cultural diversity as well by pressing people to migrate to regions that would offer better agricultural production and sufficient water sources.

ACKNOWLEDGEMENTS

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A REVIEW OF THE 2010 HURRICANE, TROPICAL CYCLONE AND TYPHOON SEASON

By KIERAN R. HICKEY

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Abstract: 2010 was another exceptionally quiet year as regards hurricanes, tropical cyclones and typhoons and this continues the trend of the previous two years in terms of numbers of storms but there was an increase in the numbers of events that became full-blown hurricanes, tropical cyclones or typhoons. The ending of the El Niño and its replacement by La Niña is likely to lead to an end to this trend. Global fatality levels dropped significantly but damage was up, particularly in the Atlantic. Only the Atlantic Hurricane Season was above average and there were all time record lows for the North West Pacific Typhoon and East Pacific Hurricane Seasons. Once again there were four Category 5 events but not more than one in any region; of note was Typhoon Megi with a lowest central pressure of 885 hPa.

Keywords: Hurricane, Tropical Cyclone, Typhoon, 2010.

INTRODUCTION

There was once again a continuation of below average storms during the 2010 season (Hickey, 2009; Hickey, 2010). Only 73 storms were recorded: a drop of 13 from 2009, however the number of storms which developed into hurricanes, tropical cyclones and typhoons increased to 42 from 34 in the previous year (Table 1). Of these 42 hurricanes, tropical cyclones and typhoons only 23 were described as major events of category 3 or more. In terms of fatalities there were very few losses of life, with no event causing significant numbers of fatalities. The overall fatality level was 1,380 well down on last year and the previous year. However unlike fatalities there was an increase of damage caused with total damage of \$19.7 billion some \$6.6 billion larger than 2009. By far the most destructive event was Hurricane Karl in the North Atlantic which caused damage of \$5.6 billion with the worst affected countries included Mexico and Belize. Surprisingly, next most damaging was Tropical Storm Matthew which also occurred in the North Atlantic region and which generated \$2.6 billion in damages again affecting Mexico and a broad region from Venezuela to Costa Rica.

Region	No. of Storms	No. of Hurricanes	Overview
Global	73	32	below average
Atlantic (Hurricane)	19	12	above average
North Indian Ocean (Cyclone)	5	3	average
Southwest Indian Ocean (Cyclone)	10	5	average
Australian (Cyclone)	7.5	4.5	note 1 below average
South Pacific Tropical (Cyclone)	7.5	5.5	note 1 slightly below average
Northwest Pacific (Typhoon)	16	9	record low
East Pacific (Hurricane)	8	3	record low

Table 1 Global and Regional Overview of Hurricanes, Cyclones and Typhoons (HCT) Activity in 2009. Note 1 Cyclone Ului traversed both regions hence 0.5 score each.

The 2010 totals need to be put into the context of a moderate to strong El Niño which continued until May 2010, but by July this had transitioned to La Niña which intensified to become moderate to strong by the end of November. This change is likely to bring to an end the decline in hurricanes, tropical cyclones and typhoons if it continues throughout 2011.

Global average temperatures were the joint warmest on record since 1850 tied with 2005. Global average temperatures were 0.62 °C above the 20th century average of 13.9 °C according to NOAA (2011).

Name	Intensity	Month	Location	Max winds (km/h)	Min pressure (hPa)
H. Danielle		4 August	N. Atlantic	215	942
H. Earl		4 August	N. Atlantic	230	927
H. Igor		4 September	N. Atlantic	250	924
H. Julia		4 September	N. Atlantic	220	948
H. Karl		3 September	N. Atlantic	205	956
C. Phet		4 June	N. Indian	155	970
C. Giri		4 October	N. Indian	195	950
C. Anya		3 November	SW Indian	155	950
C. Cleo		4 December	SW Indian	195	930
C. Edzani		5 January	SW Indian	220	910
C. Gelane		4 February	SW Indian	205	930
C. Laurence		4 December	Australian	205	925
C. Ului		5 March	S. Pacific/Australian	215	915
C. Oli		4 February	S. Pacific	185	925
C. Pat		3 February	S. Pacific	140	965
C. Rene		3 February	S. Pacific	155	945
C. Tomas		4 March	S. Pacific	185	925
T. Kompasu		3 August	NW Pacific	150	960
T. Fanapi		3 September	NW Pacific	175	930
T. Megi		5 October	NW Pacific	230	885
T. Chaba		4 October	NW Pacific	175	935
H. Celia		5 June	E. Pacific	260	921
H. Darby		3 June	E. Pacific	195	959

Table 2 Most Intense Hurricanes (H), Cyclones (C) and Typhoons (T) in 2010.

REGIONAL OVERVIEW

The Atlantic Hurricane Season was above average as the switch to La Niña had occurred by July and which intensified as the rest of the year went on including the main part of the Atlantic hurricane season in August, September and October. In all, 19 storms were recorded of which 12 developed into hurricanes (Table 1). As a result of this very active hurricane season there was very significant damage recorded of the order of \$12.051 billion, nearly two-thirds of the overall global damage. However fatalities were few, with only 282 being recorded. No category 5 hurricanes occurred; there were four category 4 hurricanes and one category 3 hurricane (Table 2).

The North Indian Cyclone Season was average with 5 storms recorded of which 3 developed into cyclones. Two of the cyclones were category 4 – Phet which caused the most damage (which was in excess of \$780 million), and Giri which caused the most fatalities with 157 dead.



© Samantha Hall
USA stormchasing, May 2006



© **Keith Hall**
Lymm, Cheshire, UK 2011



© Philip Carden (top and bottom)
Winsford, Cheshire, UK Snow (2010)

The Southwest Indian Cyclone Season was also average with 10 storms of which 5 developed into cyclones and 4 of which were category 3 or above. Cyclone Edzani was the strongest at category 5 but did not make landfall which was typical of most of the storms and cyclones in this region. In all there was little damage recorded and just 40 fatalities.

The Australian Cyclone Season was below average with 7.5 storms and 4.5 actual cyclones of which only Ului was category 3 or greater. The reason for the 0.5 is that Cyclone Ului a category 5 event occurred in this region and also the South Pacific region but was strongest in the South Pacific region. Only three fatalities were recorded with damage of \$681 million spread out over a number of events.

The South Pacific Cyclone Season was slightly below average with 7.5 storms and 5.5 cyclones. Of these cyclones two were category 3 and two were category 4 and Ului was category 5. Damage and fatality numbers were very low as few of the storms and cyclones made landfall.

The Pacific Typhoon Season was a record low with only 16 storms and 9 typhoons. There were 398 fatalities and \$2.306 billion in damages of which Typhoon Fanapi generated the most fatalities with 136 and the greatest damage of at least \$735 million. Typhoon Megi which was a category 5 mostly occurred at sea but did make landfall in the Northern Philippines and China but no damage or fatalities were recorded.

The East Pacific Hurricane Season was also a record low with just 8 storms, 3 actual hurricanes of which Celia was category 5 and Darby was category 3. Again neither of these caused any damage or fatalities as they remained offshore throughout almost all of their existence. However, most of the 243 fatalities and \$1.6 billion damage caused in this region was due to Tropical Storm Agatha which caused \$1.1 billion in damages and 190 fatalities in a number of countries in Central America.

INDIVIDUAL EVENTS

There were seven category 3 events, 12 category 4 events, both figures up from last year, and like 2009 four category 5 events. The most remarkable of all the hurricanes, tropical cyclones and typhoons was Typhoon Megi, a category 5 event. Typhoon Megi had a low central pressure of 885 hPa and this made it the strongest typhoon since Typhoon Yuri in 1991. It was also the first Pacific typhoon to reach lower than 900 hPa in the 21st century and the first to do so anywhere in the world since Hurricane Wilma in the Atlantic in 2005. Typhoon Megi had some remarkable wind speed measurements as it was also the first typhoon in the 21st century to have a one-minute sustained wind speed of 305 km/h and the first since Hurricane Allen in the Atlantic in 1980. The lowest pressure value ever recorded for a hurricane, tropical cyclone or typhoon was Typhoon Tip in 1979 at 870 hPa.

Other notable low pressure values in 2010 included Cyclone Edzani at 910 hPa and Cyclone Ului at 915 hPa, the remainder were 921 hPa or above (Table 2). Surprisingly Typhoon Megi did not have the highest wind speed however, this goes to Hurricane Celia which had a wind speed of 260 km/h, Hurricane Igor was next with 250 km/h followed by Typhoon Megi and Hurricane Earl both with 230 km/h. The remainder were 220 km/h or less.

IMPACT ON EUROPE

Although Europe is well outside the normal range of Atlantic hurricanes, occasionally the tale-end of hurricanes can have a significant impact on Europe stretching from Iceland, Scandinavia, Ireland, Britain, Portugal and even into the Mediterranean. A recent chapter by Hickey (2011) identified the tail-ends of 21 hurricanes and tropical storms which have affected Europe since 1960 generating 27 fatalities mostly in Ireland and Britain and which caused very significant damage running into the billions of euro.

However, figures for the damage have not been computed for most events, the only relatively good figure is that for Hurricane Lili in October 1986 for England where the estimated damage was of the order of \$300 million and which also caused two fatalities. The two events which generated the most fatalities were Hurricane Debbie in September 1961 which killed 11 people in County Mayo, Western Ireland and injured at least 50 others and Hurricane Charley in August 1986 which also killed 11 people, six in Ireland and five in England.

Three tail-ends of hurricanes had some impact on Europe in 2010 but in all cases the impacts were very small. The first of these was Hurricane Igor whose extra-tropical remnants combined with an extra-tropical storm in Baffin Bay on the 26th September and which then moved across Greenland and into Europe. Hurricane Otto's remnants drifted across the Atlantic Ocean and eventually dissipated near Portugal by the 16th October. Finally it is suggested that the remnants of Hurricane Tomas also made it to Britain and Ireland by the 14th November. However its route was very complicated as it was absorbed by one extra-tropical storm and then broke free of it off northeast USA before being absorbed by another extra-tropical storm in the Atlantic.

RECENT ADVANCES IN UNDERSTANDING HURRICANES, CYCLONES AND TYPHOONS

A major book on hurricane research was recently published (Lupo, 2011). The book contains 31 chapters written by different authors, was split into six sections including climatology and climatological factors, tropical cyclone dynamics and structure, forecasting of tropical cyclones, societal impacts: risk and damage assessment, societal risk: evacuation risk and hazards and ecological impacts and modelling. The book and individual chapters are available for free download at www.intecopen.com. Separately of note is Terry and Etienne (2010) study of recent increases of tropical cyclone activity in parts of the Pacific.

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TORRO TORNADO DIVISION REPORT: January-May 2011

By PAUL R. BROWN and G. TERENCE MEADEN

The first half of January 2011 was unsettled and often mild, the second half anticyclonic and rather cold: there was just one (rather questionable) report of funnel clouds this month. February was changeable with winds mainly from south or southwest, while March was often anticyclonic; no whirlwinds were reported in either of these months. April was a very warm, dry, month dominated by high pressure, and the only whirlwinds were a funnel cloud and a few land devils. May was more changeable, with winds from between east and south at first followed by westerlies from the 10th onwards. Several reports of whirlwinds were received, many of which unfortunately could not be verified, leaving us with just six funnel clouds (some of which are still uncertain).

FCs2011Jan02 *Coventry (Baginton) Airport, Warwickshire (c 52° 22' N 1° 29' W, SP 3574)*

Funnel clouds were reported in the vicinity in the 1420 and 1450 GMT METARs from Coventry Airport. At 1200 GMT a high, 1033 mb, was centred over northwest Ireland. Apart from a few coastal showers, the weather was quiet and cold with a good deal of stratocumulus. In the upper air there was a steep lapse rate from the surface, topped by a strong inversion at 5000 ft - a situation known to produce funnel clouds over the sea, but not inland; nevertheless, coming from a professional source, we have no choice but to accept the reports.

LD2011Apr08 *Earlswood Lakes, Redhill, Surrey (51° 13' N 0° 11' W, TQ 2748)*

The *Surrey Mirror* of the 15th April reported that two witnesses, Ms Helen Hughes and Ms Toni Twist, had seen a 'mini-tornado' throwing dust and debris in the air the previous Friday afternoon in this dog-walking area of Surrey. At 1200 GMT a large high, 1029 mb, was slow-moving over the Irish Sea. England and Wales were dry and warm with prolonged sunshine (coasts were cooler with sea breezes and local fog patches).

fc2011Apr23 *Welton, Lincolnshire (53° 18' N 0° 29' W, TF 0179)*

William Copeland of TORRO photographed a funnel cloud on the back edge of a storm that passed to the south. The picture does not make the funnel very clear but he assured us that it looked much better to the naked eye. See the following entry for the synoptic details.

2LD2011Apr23/I? *Grantham, Lincolnshire (52° 54' N 0° 39' W, SK 913347)*

LD2011Apr23/II? *Caythorpe area, Lincolnshire (c 53° 01' N 0° 37' W, SK 9348)*

The *Grantham Journal* of the 30th April published film of a well-formed dust devil taken by Mr Martin Clark near Springfield Road, Grantham, probably in the afternoon. Another one had formed in the same area a few minutes earlier; and it was also stated briefly that similar reports had been received from the Caythorpe area. The exact date was not given for either of these reports, but they were during the Easter weekend (22-25th April). Pressure was high to the northeast and southwest of the British Isles for most of this period; England and Wales were very warm (away from coasts), but a few heavy thunderstorms broke out on the 23rd.

LD2011Apr27 *Braehead, Renfrew, Renfrewshire (55° 52' N 4° 22' W, NS 525665)*

Scottish Television showed a picture of this dust devil taken by Mr Alastair Brown.

It was seen in the car park of a furniture shop at the Braehead Shopping Centre at about 1630 GMT. At 1200 GMT a high, 1030 mb, was centred off the east coast of Scotland, while a warm front was approaching the Hebrides. Much of Scotland was fine and sunny, but cloud and occasional rain moved in to the far west.

fc2011May07 *Withington/Didsbury, Manchester, Lancashire (53° 25' N 2° 14' W, SJ 8592)*

Mr Andrew Wright contacted us to report a funnel cloud beginning to form at 2010 GMT during a thunderstorm with hail, but the gathering darkness prevented further observation of it. At 1800 GMT a large low, 978 mb, was slow-moving to the southwest of Ireland, and shower troughs were affecting western and northern parts of Britain in a southeasterly airstream. Showers or longer spells of rain occurred in many areas, especially during the evening.

FC2011May09 *Antrim, County Antrim (54° 43' N 6° 14' W, J 1487)*

Mr David O'Reilly submitted a report of a funnel cloud seen during a thunderstorm with hail between 1730 and 1815 GMT. The duration of the funnel cloud was 15 minutes or longer. At 1800 GMT a large low, 990 mb, remained slow-moving to the west of Ireland, and shower troughs were moving northeast across the British Isles in a returning maritime Polar airmass. Showers or thunderstorms occurred in most areas (apart from southeast England).

fc?2011May09 *Neath, Glamorgan (c 51° 39' N 3° 49' W, SS 7597)*

Nicky Lambert of TORRO reported that her partner photographed a possible funnel cloud at 1445 GMT, but the picture was inconclusive.

FC/TN2010May10 *Bodmin Moor, Cornwall (c 50° 35' N 4° 35' W, SX 17)*

Mr Alex Horrocks saw a funnel cloud descend towards the ground at 1100 GMT about three miles from where he was working (exact position not known); it lasted 45 seconds. At 1200 GMT the low that had been to the west of Ireland for several days was now centred to the northwest, central pressure 998 mb. Shower troughs were again rotating round it over the British Isles, bringing further showers to the west and north.

tn?2011May13 *Willenhall, Warwickshire (52° 23' N 1° 28' W, SP 3676)*

A report was received from Mr Liam Alan Lindsay to the effect that a tornado caused slight damage to rooftops in Willenhall at 1900 GMT. It was said to have lasted 10 minutes, moving northeast for about 0.2 miles before dissipating over fields. While elements of this sound plausible, firmer evidence would be required before we can accept it for the records. At 1800 GMT a northwesterly airstream covered England and Wales between a low, 1003 mb, north of Scotland and a large high north of the Azores; weak fronts and shower troughs were moving southeast. Showers and isolated thunderstorms affected the north and west, but the southeast had a dry day.

FC2011May14/I *Seaton, County Durham (54° 50' N 1° 24' W, NZ 3949)*

FC2011May14/II *West of Peterlee, County Durham (c 54° 45' N 1° 21' W, NZ 4240)*

Ian Miller of TORRO saw these two short-lived funnel clouds from the same southeastward-moving storm cell, the first at 1200 GMT, the second 15 minutes later; pea-sized hail was also observed. At 1200 GMT a northwesterly airstream covered the British Isles between a complex low, 1005 mb, to the northeast and the Azores High, 1037 mb, to the southwest. Scattered showers affected much of Britain (the southwest was mainly dry).

fc?2011May16 *Between Wellington and Taunton, Somerset (c 51° 00' N 3° 15' W, ST 12)*

Mr Lee Gilham submitted a report of a funnel cloud, which he said was "very close to touching down", although it was a few miles away from him. The time was about 1920 GMT, and it lasted 10-15 minutes. He was on the road somewhere between Wellington and Taunton. At 1800 GMT a westerly airstream covered the British Isles between a complex area of low pressure over Scandinavia and a ridge from the Azores High to central Europe. A cold front was giving rain in the north, while the south was mainly dry with variable amounts of layered cloud. In the absence of any supporting evidence, we suspect the observer misinterpreted what he saw.

fc2011May23 *Broughty Ferry, Angus (c 56° 28' N 2° 53' W, NO 4630)*

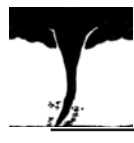
A report was received from Mr Matthew Porter who saw a small funnel cloud at 1405 GMT, lasting about two minutes. A severe gale was in progress at the time - not a situation conducive to funnel clouds. At 1200 GMT an intense depression of 976 mb was moving northeast near the Hebrides; its cold front was crossing England while the occlusion was returning into western Scotland. There was rain on the cold front and squally showers behind it (gales affected much of Scotland).

Addition to report for June 2010 (published in Int. J. Meteorology, UK, vol. 36, pp102-105)
LD2010Jun02 *Kirkham, Lancashire (53° 47' N 2° 53' W, SD 415322)*

Ms Pamela Brindle witnessed a rotating vortex moving across freshly mown school playing fields and depositing grass on nearby gardens at about 1400 GMT (information from Mr David Brindle via Tim Sharp of TORRO, who supplied the grid reference). At 1200 GMT a high, 1024 mb, was centred over the Irish Sea. England and Wales were dry with sunny periods and coastal sea breezes.

TORRO TORNADO DIVISION REPORT: June 2011

By PAUL R. BROWN and G. TERENCE MEADEN



High pressure prevailed for the first few days of June 2011 but cyclonic or westerly types dominated the rest of the month, which was often very unsettled. We know of one confirmed tornado, plus an unconfirmed one in the Irish Republic; 14 funnel clouds, plus one in the Republic; one waterspout; and two land devils.

FCs/TN2011Jun07/I *Maghera area, County Derry (c 54° 50' N 6° 42' W, H 8499)*

Mr Martin McKenna of the UKWeatherworld internet forum saw at least three funnel clouds from midday onwards, the last of which, at 1400 GMT, reached a good two-thirds of the way to the ground and might have been a tornado; it was seen from the Glenshane Road outside Maghera. His photographs were reported on *BBC Northern Ireland*, and also in the *Belfast Telegraph* (9th June).

At 1200 GMT a low, 994 mb, was slow-moving over northern Ireland. Many places had showers, some of which were thundery, but southeast England remained dry.

FC2011Jun07/II *Ronaldsway, Isle of Man (c 54° 05' N 4° 38' W, SC 2868)*

A funnel cloud was reported in the vicinity from Ronaldsway Airport at 0650 GMT.

TN2011Jun08 *Craigbrack, near Eglinton, County Derry (55° 00' N 7° 09' W, C 5418)*

This was first reported by *BBC Northern Ireland* under the headline 'Eglinton farm workers escape tornado'. It removed the roof of a barn in which 10 labourers were working, and a motor car was damaged when a wall fell on it. The account was repeated in the *Irish Times* and the *Belfast Telegraph* (both 9th June), but none of the sources stated the time, other than 'afternoon'. An investigation was later conducted by Dr John Tyrrell of TORRO, who interviewed eye-witnesses and identified a track length of 2.25 km, commencing at Craigbrack; maximum intensity T3 (but lower than that along most of the track). There was a heavy rainstorm at the time.

At 1200 GMT the previous day's low, now 998 mb, was drifting very slowly northeast across Scotland. Showers, with local hail and thunder, occurred widely across the British Isles during the day.

FC2011Jun08/I *near Ben Barvas, Isle of Lewis, Ross and Cromarty (c 58° 19' N 6° 31' W, NB 3645)*

Mr Edward Graham photographed a funnel cloud from the road between Stornoway and Barvas (Barabhas on the O.S.). Time was 1635 GMT and the picture shows it reaching about a third of the way to the ground. Cumulus congestus had been in evidence since mid-morning, aided by the convergence of sea breezes from opposite sides of the island. This report also appeared in the *Stornoway Gazette* of the 13th June.

FC2011Jun08/II *Prestwick, Ayrshire (c 55° 29' N 4° 37' W, NS 3525)*

Scottish Television showed a picture of this funnel cloud taken by Mr Lee Young just after 1000 GMT. As far as can be judged it appears to reach a third of the way to the ground.

FC/WS2011Jun09 *Offshore Brighton, East Sussex (c 50° 49' N 0° 09' W, TQ 3103)*

The *Brighton Argus* of the 9th June published a photograph of a slender funnel cloud seen off the coast earlier that day at about 0900 GMT. The photographer was Mr Rafe Oxley, who said: "It was quite thin and narrow but it stretched all the way down to the sea"; the picture, however, does not confirm this. At 1200 GMT the previous day's low, still 998 mb, was centred off northwest Scotland, and a weakening westerly airstream covered the British Isles. Further showers occurred in many parts, although central England was mostly dry.

FC2011Jun10/I *Near Templepatrick, County Antrim (c 54° 42' N 6° 06' W, J 2385)*

FC2011Jun10/II *Near Carrickfergus, County Antrim (c 54° 43' N 5° 48' W, J 4288)*

Martin North of TORRO photographed these two funnel clouds, the first at about 1800 GMT, the second half an hour later; both extend nearly halfway to the ground in the pictures.

At 1200 GMT the depression that had been affecting Britain for several days was northwest of the Hebrides, 1003 mb, and a very slack pressure gradient covered the country. Showers, thundery in places, were again quite widespread, especially over England and Wales.

WW2011Jun10 *Curdworth, Warwickshire (52° 32' N 1° 43' W, SP 193937)*

Mr Martin Plunkett of Reindeer Park near Curdworth reported a whirlwind at 1415 GMT, which overturned a chicken coop (weight 250-300 lbs) and carried it seven metres. It only lasted 10-15 seconds, but seemed 'incredibly powerful for its size'. Whether this was a weak tornado or a strong land devil we cannot say from the brief description.

FC/TN2011Jun10/III *Donington, Lincolnshire (c 52° 54' N 0° 12' W, TF 2135)*

The *Lincolnshire Free Press* (13th June), while reporting a hailstorm at Quadring, added that a reader, Mr Andy Scott, photographed a funnel cloud from Donington. The picture shows it at least halfway to the ground, and Mr Scott suggested that it might have touched down somewhere over Quadring Fen (i.e. to the southwest). No time of day was given. A report was also received directly from Mr Derek Williams who observed 'spinning cloud formation' overhead Quadring at 1800 GMT followed by a thunderstorm with hail.

FC2011Jun10/IV *West of Basildon, Essex (c 51° 33' N 0° 25' E, TQ 6887)*

Ms Astrid Haeger submitted a report of a funnel cloud seen at about 1000 GMT looking west from Lee Chapel Lane, Basildon. There was a rain shower with a little hail at the time. A photograph reached us separately (source unknown, but credited to Mr Stephen Morton) showing a long snaking funnel, which tallies with Ms Haeger's description.

LD2011Jun11 *Greenholme, Cumbria (54° 27' N 2° 37' W, c NY 597057)*

The *Westmorland Gazette* of the 13th June reported that a 'mini-twister' lifted a small marquee and upset stalls at the Greenholme Gala and Agricultural Show at about 1130 GMT. A similar account appeared in the *News and Star* of the 17th June. At 1200 GMT there was a small low, 1010 mb, in the North Sea and a weak ridge extending north across Ireland from a high, 1022 mb, in the Bay of Biscay. There was rain, heavy at times, in eastern Scotland, which extended into the Lake District during the afternoon, although it appears to have been dry here up to the time of the whirlwind, making a land devil more likely than a tornado (elsewhere there were scattered showers, thundery in some eastern parts).

(Reports of a tornado at Brandon, County Durham, on the 12th June, and a funnel cloud at Stoke-on-Trent on the 16th, were considered too unreliable to document - the latter was a precipitation column, as was a reported 'waterspout' off the Durham coast at Seaton Carew on the 29th.)

fc2011Jun16/I *Nuneaton, Warwickshire (52° 31' N 1° 26' W, SP 3892)*

Mr Chris Roe at Langley Road, Nuneaton, reported a funnel cloud seen at 2024 GMT (which seems rather late for daytime convection, so we treat the report with caution).

At 1200 GMT a westerly airstream covered most of Britain, associated with a low, 985 mb, in mid-Atlantic and a trough extending east across north Scotland. Most areas had scattered showers, locally thundery in the east.

fc2011Jun16/II *Amble?, Northumberland (55° 20' N 1° 36' W, NU 2604?)*

Mr Tony Sales of the UKWeatherworld forum photographed what appears to have been a funnel cloud descending a third of the way from the ragged base of a shower cloud, but as it only lasted 30 seconds it could not be confirmed. The correspondent was from Amble but it is not clear if that is where the cloud was (and the time of day was not stated).

FC2011Jun18 *Carlisle (Airport), Cumbria (c 54° 56' N 2° 48' W, NY 4860)*

A funnel cloud was reported in the vicinity from Carlisle Airport at 0920 GMT. At 1200 GMT a low, 992 mb, was slow-moving in the North Sea and a broad trough extended west across the British Isles. Showers and thunderstorms were widespread over England, Wales, and Ireland, while Scotland (and northernmost England) had more persistent rain.

ws2011Jun18 *Pease Bay, Cockburnspath, Berwickshire (c 55° 51' N 2° 20' W, NT 7961)*

Hawick News (20th June) published a photograph taken by Mr Fran [Frank?] Barker at about 1400 GMT showing a well-developed funnel cloud just off the coast, which probably reached the sea, although the picture is not clear enough to confirm this (it was raining at the time). A report of 'a small waterspout' seen off Lowestoft this day was too vague to be counted.

(A possible tornado at Eppleby in North Yorkshire on the 22nd June, reported in the *Northern Echo* of the 23rd, was probably just a strong gust.)

LD2011Jun29 *Weston (near Crewe), Cheshire (53° 03' N 2° 24' W, SJ 7350)*

This land devil was reported by Mr Norman Lynagh (retired meteorologist), who observed it on a golf course at 0945 GMT. It was 10-15 yards in diameter, and lifted sand from the bunkers and ripped leaves from trees; he estimated the wind speed within it as 30-40 knots, and it was rotating anticyclonically. It died out after 20-30 seconds. Cumulus clouds were building at the time, and a few showers were starting in the area. At 1200 GMT a northwesterly airstream covered the British Isles within a ridge from the Azores High, 1034 mb, to the southwest; but an upper trough crossing the country allowed scattered showers to develop during the day, mainly in the north and west.

FC2011Jun30 *Little Bavington (near Great Bavington), Northumberland (55° 06' N 2° 02' W, NY 9878)*

An anonymous correspondent to the UKWeatherworld forum published photographs of a short thick funnel cloud seen between 1110 and 1120 GMT.

At 1200 GMT the synoptic pattern was very similar to the previous day's, with an anticyclonic northwesterly airflow round a high, 1034 mb, to the southwest; but there were still quite a few showers in the north and east (and even isolated reports of thunder).

FC2011Jun *Great Orme, Llandudno, Caernarvonshire (53° 20' N 3° 53' W, SH 7583)*

The *Liverpool Daily Post (North Wales Edition)* of the 30th June stated very briefly that a reader, Mr Andy Thomas, had sent in a picture of a 'mini-tornado' over the Great Orme at Llandudno. No date or time of day was given, and the picture seems only to have been published in the printed version of the newspaper, which we have not seen.

Whirlwinds in the Irish Republic

FC2011Jun18 *Between Ferns and Camolin, County Wexford (c 52° 36' N 6° 29' W, T 0350)*

Mr Sean Carley reported a funnel cloud between Ferns and Camolin at 1540 GMT; it lasted less than five minutes, and there was a thunderstorm at the time. See the *Carlisle* entry above for the synoptic situation.

tn2011Jun21 *Portlaoise, County Leix (53° 02' N 7° 19' W, S 4698)*

Mr Niall Dollard submitted a report of a tornado that damaged a roof and trees and lifted a trampoline. It happened at 1930 GMT and lasted four minutes. (At the time of writing we have not heard the result of the site investigation, so we enter this as a provisional tornado.) At 1800 GMT a low, 1001 mb, was moving slowly northeast across Ireland with several occluded fronts in its circulation - one over eastern Ireland, another approaching the west coast. There were showers over Ireland and longer periods of rain over Scotland.

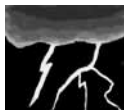
Reporting Severe Weather

TORRO rely on members and general public for reports on severe weather events to carry out this pioneering research into severe weather in Britain and Ireland. If you witness, hear of, see any articles anywhere (etc) about any event, please do get in touch with us and give us as much detail as you possibly can. If the event was recent, please try and report it to us as quickly as possible as often site investigations are required to establish what type of weather phenomena caused the damage and it is important if our volunteers who carry out site investigations arrive at the scene as soon as possible so that the bulk of the damage has not yet been cleared away, thus ensuring a more accurate account of what happened.

Site Investigation Results

Anyone who kindly undertakes an investigation for TORRO please do write up your findings to enable us to disseminate this important research to thousands of readers worldwide through online libraries, other subscriptions, and so on.

For help in writing reports, email editorial@ijmet.org. Thank you.



TORRO THUNDERSTORM REPORT FOR THE BRITISH ISLES: SEPTEMBER AND OCTOBER 2010

By BOB PRICHARD

SEPTEMBER

It was another month of below normal activity. Many places throughout the British Isles heard no thunder all month, but there were quite a few reports of two days with thunder heard – mostly arising from the only two days of any note, the 7th and the 23rd. There were isolated reports of thunder on several other days in this month of changeable weather.

As an anticyclone slowly receded to the east and northeast during the opening days of the month, occluded fronts edged into Ireland from the 3rd to the 5th and there may have been a little thunder amongst the patchy rain associated with them. A much more active frontal system gave copious rainfall over Ireland on the 6th, and just behind it a few sharp thunderstorms developed over southwest Ireland in the afternoon. Meanwhile, a pre-frontal trough brought a narrow band of rain from medium-level cloud northwards into southeast England and East Anglia in the afternoon. There was isolated thunder on the northern side of London and it was reported that lightning damaged signalling on the London-Clacton rail line.

By the 7th, the fronts were moving north over Scotland, and an unstable south to southwesterly airflow followed across southern and central Britain. Thundery showers became fairly widespread. There was one in southwest Cornwall early in the day, then weak activity from West Sussex to The Wash during the late morning and early afternoon. However, the main zone was from the Bristol Channel across the west and north of the Midlands and into northern England in the afternoon, with a further area over southern and central Scotland into the evening. There were also a few thundery showers over Ireland in the afternoon and one just north of London in the early evening.

From the 8th to the 21st, there was isolated thunder (or sferics) on several days: on the 8th over Ireland and parts of southwest and southeast England, the 9th over southeastern England, the 11th mainly over Ireland, the 14th in parts of northwest Britain, the 15th near the coast of northeast England and the 16th near a few eastern coasts. All these minor incidents were, broadly, linked to showery westerly airflows.

Thundery activity perked up on the 22nd over Northern Ireland and Scotland in a showery southwesterly airflow between a depression just off northwest Ireland and an active cold front moving slowly southeastwards away from these areas. During the 23rd, the cold front cleared eastern England whilst the depression was drifting across Scotland. Heavy rain accompanied the front, and there was a sferic near Gatwick in the late morning, but it was in the showery airflow behind it that the most widespread and noteworthy activity of the month occurred: thunderstorms developed over many parts of England, away from the more southern and southeastern regions, during the afternoon. They were particularly lively over the north Midlands in the late afternoon (32.5 mm fell at Rosliston, Derbyshire), whilst in a storm that moved northeast across Berkshire, lightning put railway signalling out of action near Reading, leading to severe disruption to services over a wide area for several hours. At Willenhall, West Midlands, lightning hit a telegraph pole and knocked out telephone equipment to houses in the area. Intense rainfall in various districts caused localised flooding, notably in Newcastle-upon-Tyne. The storms rumbled well into the night in parts of northeast England, and the last of them affected Whitby in the early hours of the 24th to round off this month's thundery activity.

OCTOBER

It was another very quiet month, with only the 19th and 23rd showing more than isolated reports.

Towards midnight on the 1st thunder accompanied showers over parts of northwest Ireland, and it reappeared on the 2nd in one or two of the showers over Ireland and around the northern Irish Sea, mainly in the afternoon, in a strong south to southwesterly airflow. A similar weather pattern on the 5th saw bands of showers move northeast over the west and north of Ireland and western Scotland, with a little thunder. Lightning struck a house at Ballyholland, near Newry, (County Down): a hole was blown in the roof, and the flash traversed a metal downpipe which it shattered. Electrical sockets and light fittings were hurled off the wall and windows blown in.

A cold front swept across the country early on the 6th, and thunder was reported from south Cheshire. In the showery westerly behind it, a small shower coming off the north Wales hills turned thundery along a track from northwest Cheshire to north Derbyshire just after midday. Hail 10 mm in diameter was reported from Timperley and a close lightning strike knocked out some telephone circuits.

After the mild, unsettled start to the month, a quieter – and eventually much colder – interlude took over, and the next report of thunder is not until the 18th, when a blustery northwesterly airflow led to thunder in some of the showers in northwest Scotland through the middle of the day. This northwesterly brought an afternoon of numerous showers throughout the country on the 19th and there was some thunder over central and eastern England, especially in the more southeasterly areas.

Overnight on the 22nd/23rd, a depression moved east across central regions, and there was isolated thunder over southeast England as its cold front crossed shortly before daybreak. During the day, thundery showers transferred from southwestern coasts to southeastern coasts by the early afternoon. At Romansleigh, to the south-west of Exmoor, hail covered the ground in mid-morning, and hailstones measured 10 mm in diameter at Hurstpierpoint (West Sussex). There was isolated thunder further north over England, including Whitby shortly after midnight.

On the 27th, there was thunder in a few western areas, especially western Ireland, during the afternoon and evening near eastward-moving cold-frontal troughs, and isolated thunder reappeared in the Hebrides next morning. On the 30th, there were showers towards southern and western coasts, with a sferic over mid-Kent in mid-morning and sferics off the Lley peninsula in mid-afternoon. A depression moved east into Biscay during the 31st, and as the airflow over England backed from southeast to northerly, convergence set off a few heavy downpours over the east Midlands and Lincolnshire in mid-afternoon with a sferic in the Grantham area.

WEATHER STATION READINGS IN BERGENFIELD NEW JERSEY, NEW YORK, USA: JANUARY AND FEBRUARY 2011

By RUDY NICKMANN

JANUARY 2011

January (Figure 1) was cold with record-breaking snowfall. I measured 32.3" (82.0 cm) here in Bergenfield, the most since 1983. There were two major storms. The 11th and 12th saw 8.5" (21.6 cm) of snow while 12.0" (30.5 cm) fell on the 26th and 27th. There was a persistent snow cover ranging from 3" (7.6 cm) on the 6th to 19" (48.3 cm) on the 27th.

ENGLISH UNITS							METRIC UNITS						
DAY	TEMPERATURE		PRECIPITATION		WIND		TEMPERATURE		PRECIP				
	MAX	MIN	AVG	RAIN	SNOW	SC	GUST	DIR	MAX	MIN			AVG
1	52	29	41			5	11	S	11.1	-1.7	4.7		
2	49	34	42	0.03		5	27	N	9.4	1.1	5.3	0.762	
3	38	25	32			4	25	WNW	3.3	-3.9	-0.3		
4	42	23	33			4	16	S	5.6	-5.0	0.3		
5	42	21	32			4	20	WSW	5.6	-6.1	-0.3		
6	35	17	26			3	8	SW	1.7	-8.3	-3.3		
7	33	20	27	0.34	5.0	7	8	E	0.6	-6.7	-3.1	8.636	12.7
8	29	13	21	T	T	7	11	W	-1.7	-10.6	-6.1	T	T
9	33	24	29			6	29	W	0.6	-4.4	-1.9		
10	36	23	30			6	29	W	2.2	-5.0	-1.4		
11	30	16	23	0.17	2.8	6	17	NE	-1.1	-8.9	-5.0	4.318	7.1
12	32	22	27	0.34	5.7	14	28	W	0.0	-5.6	-2.8	8.636	14.5
13	31	15	23			12	25	WNW	-0.6	-9.4	-5.0		
14	32	9	21	T	T	11	12	W	0.0	-12.8	-6.4	T	T
15	35	12	24			10	17	SW	1.7	-11.1	-4.7		
16	37	21	29			9	24	W	2.8	-6.1	-1.7		
17	28	18	23			8	17	N	-2.2	-7.8	-5.0		
18	38	23	31	0.95	1.8	5	18	N	3.3	-5.0	-0.8	24.13	4.6
19	40	33	37	T		5	12	W	4.4	0.6	2.5	T	
20	34	28	31			5	17	N	1.1	-2.2	-0.6		
21	33	16	25	0.35	4.0	9	28	W	0.6	-8.9	-4.2	8.89	10.2
22	27	8	18			9	14	W	-2.8	-13.3	-8.1		
23	26	5	16			8	25	W	-3.3	-15.0	-9.2		
24	23	1	12			8	11	N	-5.0	-17.2	-11.1		
25	39	19	29	0.05	1.0	8	5	SSW	3.9	-7.2	-1.7	1.27	2.5
26	31	24	28	0.25	2.8	10	31	NNE	-0.6	-4.4	-2.5	6.35	7.1
27	36	21	29	0.84	9.2	19	22	W	2.2	-6.1	-1.9	21.336	23.4
28	36	20	28	T	T	16	8	SSW	2.2	-6.7	-2.2	T	T
29	38	21	30	T	T	15	13	SW	3.3	-6.1	-1.4	T	T
30	41	23	32			15	22	WSW	5.0	-5.0	0.0		
31	33	15	24			14	12	N	0.6	-9.4	-4.4		
AVG	35.1	19.3	27.2						1.7	-7.0	-2.7		
SUM				3.32	32.3							84.3	82.0
MAX	52	34	41.5	0.95	11.0	31	NNE	11.1	1.1	5.3	24.1	23.4	
MIN	23	1	12						-5.0	-17.2	-11.1		

*Weather station data for
Bergenfield, New Jersey,
USA in January 2011.
Note, peak gusts are
shown in mph.
SC = Snow Cover.

Total precipitation was close to normal. The month began with relatively mild temperatures. I recorded 52 °F (11.1 °C) on the 1st and 49 °F (9.4 °C) on the 2nd. Below normal temperatures soon arrived and remained for the next 4 weeks. A low of 1 °F (-17.2 °C) was reached on the 24th. A major blizzard struck the region on the 26th and 27th setting record depths and disrupting traffic. I measured a total of 12.0" (30.5 cm) but snowfall totals were greater to the east on central Long Island and western Connecticut.

FEBRUARY 2011

February (Figure 2) brought near-normal temperatures to Bergenfield, New Jersey. Snowfall was a bit below normal while precipitation totaled about 30 % above the long-term mean. The first half of February was relatively cold. A marked warm-up took place during the final two weeks. The temperature averaged 33.6 °F (0.9 °C) which is 0.4 °F (0.2 °C) below normal. A maximum of 68 °F (20.0 °C) was reached on the 18th. I measured a minimum of 10 °F (-12.2 °C) on the 10th.

The persistent snow cover and numerous cloud-free nights led to considerable radiational cooling. While the average high temperature was 1.2F (0.7C) above normal, the average low was 1.9 °F (1.1 °C) too cold.

Light snow and freezing rain fell on the first two days of the month resulting in dangerous walking and driving conditions. The only major snowfall occurred on the 21st when 5.7" (14.5 cm) fell.

Heavy rains hit the region on the 25th. The snow cover slowly wasted away as the month progressed. There was 14" (36 cm) on the ground as the month commenced. It was almost all gone by the 25th save for some isolated patches.

ENGLISH UNITS							METRIC UNITS						
DAY	TEMPERATURE		PRECIPITATION		WIND		TEMPERATURE		PRECIP				
	MAX	MIN	AVG	RAIN	SNOW	SC	GUST	DIR	MAX	MIN			AVG
1	26	22	24	0.21	1.0	14	11	N	-3.3	-5.6	-4.4	5.3	2.5
2	37	25	31	0.73	0.2	13	27	NE	2.8	-3.9	-0.6	18.5	0.5
3	34	19	27			12	24	NW	1.1	-7.2	-3.1		
4	36	14	25			12	20	SW	2.2	-10.0	-3.9		
5	39	20	30	0.23	T	11	27	NE	3.9	-6.7	-1.4	5.8	T
6	47	29	38			11	29	NW	8.3	-1.7	3.3		
7	46	26	36	0.12		10	10	SSW	7.8	-3.3	2.2	3.0	
8	38	17	28	0.11		9	31	W	3.3	-8.3	-2.5	2.8	
9	33	12	23			8	18	WSW	0.6	-11.1	-5.3		
10	30	17	24			7	20	WNW	-1.1	-8.3	-4.7		
11	39	10	25			6	19	SW	3.9	-12.2	-4.2		
12	42	17	30			6	29	W	5.6	-8.3	-1.4		
13	46	22	34			5	24	S	7.8	-5.6	1.1		
14	59	37	48			4	41	S	15.0	2.8	8.9		
15	37	22	30			3	36	NW	2.8	-5.6	-1.4		
16	50	20	35			2	20	SSW	10.0	-6.7	1.7		
17	65	38	52			2	11	S	18.3	3.3	10.8		
18	68	37	53			1	35	SW	20.0	2.8	11.4		
19	52	22	37	T	T	4	41	W	11.1	-5.6	2.8	T	T
20	42	20	31			T	29	WNW	5.6	-6.7	-0.6		
21	36	23	30	0.44	5.7	5	21	N	2.2	-5.0	-1.4	11.2	14.5
22	39	15	27			4	20	N	3.9	-9.4	-2.8		
23	47	12	30			3	10	N	8.3	-11.1	-1.4		
24	45	15	30	T		2	14	SSE	7.2	-9.4	-1.1	T	
25	45	32	39	1.57		T	36	WNW	7.2	0.0	3.6	39.9	
26	45	29	37			16	W	7.2	-1.7	2.8			
27	53	35	44			17	ESE	11.7	1.7	6.7			
28	58	40	49	0.46		25	E	14.4	4.4	9.4	11.7		
AVG	44.1	23.1	33.6						6.7	-4.9	0.9		
SUM				3.87	6.9							98.3	17.5
MAX	68	40	52.5	1.57	5.7	41	W	20.0	4.4	11.4	39.9	14.5	
MIN	26	10	23						-3.3	-12.2	-5.3		

*Weather station data for Bergenfield, New Jersey, USA in February 2011.
Note, peak gusts are shown in mph.
SC = Snow Cover.



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SHORT COMMUNICATION

NORTHEAST MONSOON RAINFALL OF KERALA IN 2010: NEAR RECORD AND RECORDS OF NORTHEAST MONSOON RAINFALL IN MOST SOUTHERN DISTRICTS OF KERALA.

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The period October to December is known as the northeast monsoon season of Kerala. Though the northeast monsoon starts in the middle of October but the rainfall for the season is accounted from first of October. During the months October, November and December Kerala gets a normal rainfall of 29.2 cm, 16.4 cm and 4.3 cm respectively, thus totaling a rainfall of 49.9 cm for the northeast monsoon which is about 16 % of the annual rainfall and about 24 % of the southwest monsoon rainfall.

The beneficiary of the northeast monsoon is mainly the southern peninsula comprising of Tamilnadu, Kerala, Coastal Andhra Pradesh and Karnataka. The normal rainfall for the northeast monsoon for Kerala is 49.9 cm, for Tamilnadu it is 43.2 cm and for Coastal Andhra Pradesh it is 32.6 cm. It may be noted that Kerala gets slightly higher northeast monsoon rainfall than Tamilnadu.

A look at the northeast monsoon rainfall of Kerala shows that during the period 1901-2009 the highest northeast monsoon rainfall of Kerala was received in the year 1932 with a rainfall amount of 83.5 cm while the lowest northeast monsoon rainfall was recorded in the year 1988 with rainfall amount of 18.0 cm. During the period 1901 -2009 the northeast monsoon rainfall of Kerala was normal in 58 years, excess in 21 years, deficient in 28 years and scanty in two years in 1974 and 1988. There were 6 years of deficient rainfall in the decade 1981-1990. A look at the decadal average of Northeast monsoon rainfall of Kerala during the period 1901 -2000 shows that the highest northeast monsoon rainfall of Kerala was received in the decade 1911 – 1920 with a rainfall of 59.6 cm and the lowest Northeast monsoon rainfall of 42.3 cm in the decade 1981 – 1990.

A frequency distribution of northeast monsoon season rainfall of Kerala during the period 1901-2009 is given below.

Rainfall in cm	Number of years.
0.1 – 10.0	0
10.1 – 20.0	1
20.1 – 30.0	4
30.1 - 40.0	20
40.1 - 50.0	25
50.1 – 60.0	25
60.0 - 70.0	24
70.1 - 80.0	8
80.1 – 90.0	2
Total	109



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The northeast monsoon in the year 2010, Kerala received a rainfall of 82.6 cm as against a normal of 49.9 cm and this is very close to the highest northeast monsoon rainfall ever, which was 83.5 cm in 1932 since 1901. Tamilnadu, Coastal Andhra Pradesh, Coastal Karnataka and South Interior Karnataka too received excellent rainfall in the northeast monsoon with 61.2, 57.4, 59.0 and 33.2 cm as against a normal of 43.1, 32.7, 25.8 and 20.1 cm respectively thus recording excess northeast monsoon rainfall. The excess rainfall of northeast monsoon in southern peninsula caused havoc for farmers in Tamilnadu. South Kerala was also badly affected agriculturally. Almost all the tanks and lakes in the southern peninsula seemed to have got filled up in this year's northeast monsoon rainfall.

District-wise weekly rainfall reports started from 1976 by India Meteorological Department and as per district-wise weekly rainfall reports of Kerala for the northeast monsoon showed the four districts Ernakulam, Kollam, Kottayam, and Pathanamthitta recorded more than 100 cm of rain, with: 120.4, 101.1, 111.3, and 107.0 cm as against the normal of 62.2, 56.2, 62.7, and 58.0 cm respectively. The northeast monsoon rainfall district-wise since 1976 shows that there have been hardly three occasions earlier when rainfall in northeast monsoon exceeded 100 cm in the recorded districts. The details are Kollam district received 106.9 cm in 1992 and 113.9 cm in 1987 while Trissur district received 128.3 cm the highest ever district-wise so far 128.3 cm in 1977. It may be mentioned that Kerala received a rainfall of 80.3 cm in the northeast monsoon 1977 and the amount of 128.3 cm received by Trissur district in 1977 is the highest northeast monsoon rainfall received by any district since 1976 to till date. It is interesting to note that 4 districts received more than 100 cm in this year northeast monsoon 2010. It may be mentioned that out of the eight districts in South Kerala, five districts Thiruvananthapuram, Pathanamthitta, Kottayam, Alleppey and Ernakulam reported the highest ever northeast monsoon rainfall in this year 2010 with rainfall amounts of 92.9, 107.0, 111.3, 96.1, and 120.4 cm respectively.

The highest northeast monsoon rainfall received in Kerala since 1901 is in the year 1932 with a rainfall amount of 83.5 cm. This year's rainfall (2010) of 82.6 cm is close to near record northeast monsoon rainfall thus becoming the second best. A look at the rainfall at the rainfall received by districts in South Kerala in 2010 shows that South Kerala received a northeast monsoon rainfall of 99.5 cm which is fairly average, while north Kerala districts received an average rainfall of 63.3 cm showing that South Kerala received more than one and half times rainfall than that of North Kerala.

The most interesting note about this year's northeast monsoon is that normally North Kerala does not get much rainfall compared to South Kerala while this year uniformly entire Kerala got excellent northeast monsoon rainfall. In fact stations like Punalur, Kochi, and Kottayam received a rainfall of 121.9cm, 112.1cm, and 107.9 cm respectively in the northeast monsoon season of 2010. The excess rainfall of northeast monsoon has indeed created misery in inundating hundreds of acres of paddy fields and damages to other agricultural crops in Tamilnadu, Coastal Andhra Pradesh and also in Kerala. The districts of Thiruvananthapuram and the adjoining Kanyakumari district of Tamilnadu were worsted affected by the very heavy rainfall that occurred in association with a depression which crossed south Andhra coast on 8th December 2010 morning causing land slip in the Trivandrum – Nagercoil railway line disrupting train services for about a week. Earlier a similar landslip occurred in Trivandrum – Nagercoil railway line on 4/5th November 1998 (during the first week of November 1998) when Trivandrum district and adjoining Kanyakumari district was lashed by very heavy rainfall and thunderstorm on 4th/5th November 1998 and the train services between Trivandrum – Nagercoil was disrupted for about a month or so.

There have been only two years when Kerala had more than 80 cm of rainfall in the northeast monsoon season: 1977 with 80.3 cm, and 1932 with 83.5 cm and thus this year's rainfall of 82.6 cm is the second highest and is very close to the record rainfall of 83.5 cm.

Studies have shown that Tamilnadu gets normal to above normal rainfall in northeast monsoon season during La Nino phase as in the present case like this year. However no such study is available for Kerala as this is not the principal rainy season compared to the copious rainfall Kerala gets in the southwest monsoon season June to September.

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BOOK REVIEWS

By PETER ROGERS

THE AMS WEATHER BOOK. THE ULTIMATE GUIDE TO AMERICA'S WEATHER edited by Jack Williams ISBN -13:978-0-226-89898-8 and -10:0-226-8989-9 (2009) *University of Chicago Press* in conjunction with the *American Meteorological Society* hb pp316 US \$35.00.

This large format hardback covers its subject well in 12 Chapters ranging from "Earth's Energy" to "Tropical Cyclones" and "Under The Radar". The print is easy to read, (and not too small) the photographs excellent, and the diagrams very clearly drawn. One feature, not usually present in similar books in Britain, is frequent profiles of personalities who present or research the particular topic being covered, invariably accompanied by a photograph of the person or persons concerned (there are some married couples).

I particularly liked the very informative diagrams. For instance, there is a two-page spread on "Winds with Names" which explains "Land and Sea Breezes", "Santa Ana Winds" and "Chinook Winds" very clearly.

The last chapter is entitled, "Weather and Climate Threats" which deals with the evidence of climate change, and the research into them in a measured way, without adopting any political attitude, which cannot be said about some American weather books published in the past, no doubt because the American Meteorological Society is a respected body in this field.

Obviously, this is an American book aimed for Americans, but we can surely learn from the American experience. The book can be obtained through Amazon (my copy cost £21 including postage), so it is well within the budget of many readers of this Journal. Recommended.

DESERTS: A VERY SHORT INTRODUCTION by Nick Middleton ISBN 978-0-19-956430-9 (2009) *OUP* pp 134 pb £7.99.

When first published, this was number 215 in an ever-expanding series which covers subjects as diverse as Global Warming, Schizophrenia and Presocratic Philosophy. The author covers an enormous amount of ground in the 134 pages of necessarily small print, supplemented by some very appropriate black and white illustrations. The chapter which will be of most interest to readers of this Journal, is the first and longest, on *Desert Climates*, which is extremely comprehensive, and contains some very interesting statistics. Thus, there is a table which, in the first column, gives the mean annual precipitation for eight of the driest locations ranging from Chicama in Peru to El Djem in Tunisia, and in the second the highest precipitation received in a single storm, the third column giving the date of that storm. Thus, for Chicama, the average annual precipitation is 4.00 mm but in a single storm in March 1925, the locality received 394 mm. By contrast, Ziyaratgah in Iran has a mean annual precipitation of 28 mm, but its heaviest single storm (in 1997) only produced 30 mm! This book illustrates that there is a lot more to deserts than meets the eye!

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