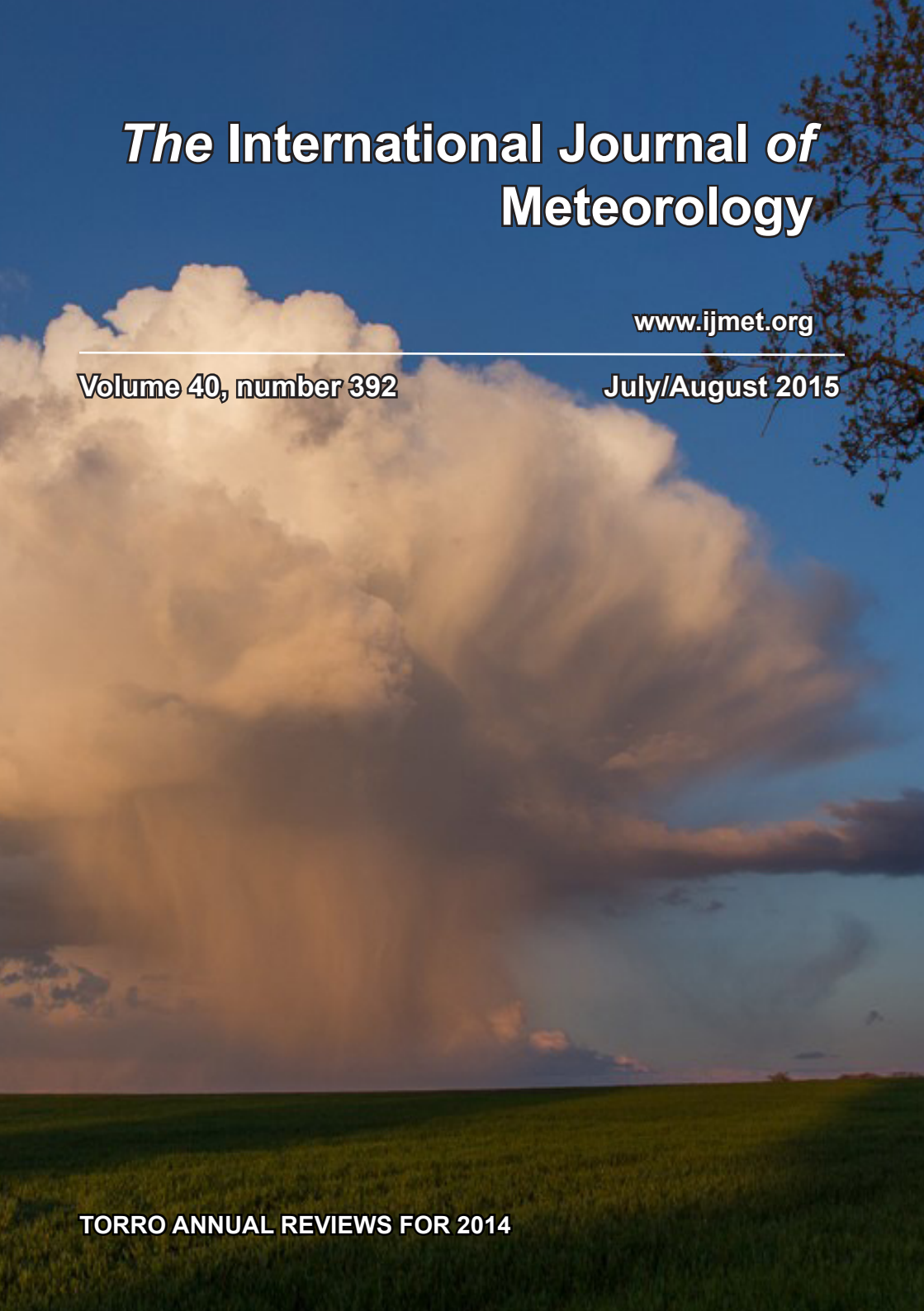

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Volume 40, number 392 July/August 2015

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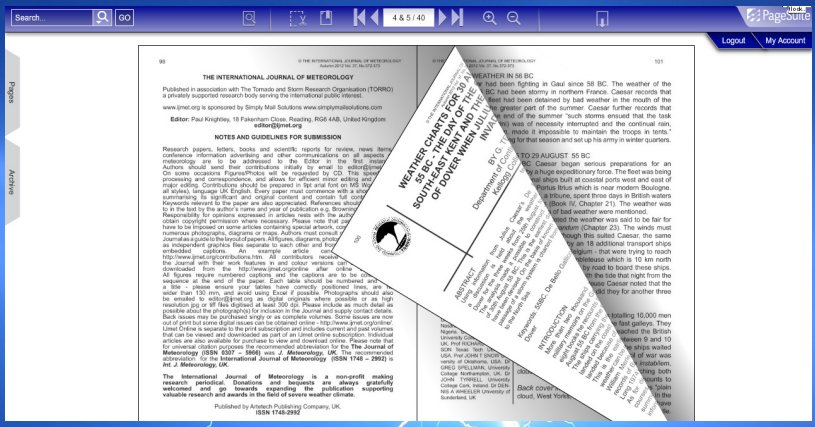

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Cover image: **© CHRIS BELL.** Shower near Themelthorpe, Norfolk, UK at around 1945 UTC on the 29 April 2015. Twitter @stormbell

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WEATHER ANNIVERSARIES: JULY/AUGUST

25 years ago, July and August 1990 were fine warm summer months over England and Wales (rather more changeable in Scotland and Ireland). August was among the warmest months in the Central England Temperature series, and in both months rainfall was well below average in most places away from the northwest. After an unsettled start to July high pressure dominated the rest of the month, allowing temperatures to reach 26°C or higher somewhere in the country every day from the 11th onwards (32°C in the south on the 21st). In early August the heat intensified as hot continental air was drawn round an anticyclone drifting east from the North Sea to the Baltic, culminating on the 3rd when temperatures exceeded 32°C widely over England and Wales, and reached 37.1°C at Cheltenham; this was at the time the highest official value ever recorded in this country (though later surpassed by 38.5°C at Faversham in 2003). The second half of August was less settled, and in parts of the southeast the 14th ended a spell of 38 days without measurable rain, the last of which had fallen on 6 July. Heavy thunderstorm rains in the east gave daily falls of over 70mm in Northumberland and Essex on the 24th and 25th respectively.

50 years ago, July and August 1965 were unsettled cyclonic months. July was particularly cool and cloudy, as an almost unbroken sequence of fronts and depressions crossed the country. Temperatures rarely reached 21°C and there were some unseasonably cold nights; on the 4th temperatures fell as low as +1°C in the English Midlands and there was widespread ground frost. At the end of the month fresh snow cover was reported on the tops of the Cairngorms. Despite the cyclonic weather, some areas (e.g. the far north of Scotland) had less rain than normal, but in others it reached more than twice the average. Rainfall was especially heavy from the 11th to 14th: daily falls of over 50mm were measured in various parts of England, and 139.4mm was reported to have fallen in less than four hours in a thunderstorm at Wadebridge, Cornwall, on the 14th. On the 20th 29.3mm fell in 18 minutes at Stansted (Essex). August saw a continuation of mainly cool weather, and 25-50mm of rain fell in southern England on the 2nd, but it was less cloudy and rainy than July, and a southerly spell in the second week gave a few days when temperatures reached 25-28°C.

75 years ago, July 1940 was cool and wet with frequent thunderstorms. Some stations in northern England reported thunder on up to 10 days in the month, and northeast England and eastern Scotland had two to three times the average monthly rainfall. On the 10th more than 75mm fell over parts of Lincolnshire and Yorkshire(106mm at Scarborough) on what was a very wet day generally in the east; large hailstones were also reported. Further heavy falls occurred in Yorkshire on the 17th. There were, however, a couple of fine days at the start of July (28°C in London on the 2nd), and the development of an anticyclone in the last few days heralded a complete change of type in August. Throughout this month pressure was high over or near southern Britain, while depressions passed close to northern parts; the enhanced west to northwesterly

gradient coupled with high pressure meant that much of England, Wales, and Ireland had less than 25% of normal rainfall, and many stations near the south coast of England and in the Home Counties had no measurable rain at all during the month in a drought that had begun on 28 July. (These were days of the renowned clear blue Battle of Britain skies.)

100 years ago, July 1915 was a cool cyclonic westerly month with frequent thunderstorms (as many as 10 or 11 thunder days in parts of eastern England). On the 4th a brief incursion of southerly air raised temperatures as high as 29°C ahead of a trough moving northeast from Biscay. Thunderstorms and large hail accompanied this trough as it travelled from the West Country to Buckinghamshire in the afternoon; some of the stones in Somerset were described as the size of hens' eggs and others measured 5½ inches (14cm) in circumference. There was much damage to roofs, windows, and vegetation, and many fowls (wild and domestic) were killed. During widespread heavy rain on the 16th more than 25mm fell quite widely over England and Wales and 75-100mm was recorded in the north Midlands as a depression moved from southern Ireland to The Wash. The month's total exceeded 200% of normal over much of the Midlands, and locally elsewhere. This cyclonic pattern of weather continued for the first half of August and there were further thunderstorms, but the second half of the month was much quieter (though still rather cool).

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TORNADOES AND OTHER WHIRLWINDS IN THE UNITED KINGDOM 2014

BY PAUL R. BROWN AND G. TERENCE MEADEN
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Abstract: Tornadoes, waterspouts, funnel clouds, and other whirlwinds are summarised for the United Kingdom for 2014, and the data compared with those for the preceding five years. All of the main types (tornadoes, waterspouts, and funnel clouds) were more frequent this year than for some time past: tornadoes returned to the long-term average after four years of relatively low counts, while waterspout and funnel cloud totals were both much higher than usual.

COMPARISON OF WHIRLWIND TOTALS FOR 2014 WITH THOSE FOR RECENT YEARS (TABLE 1)

After four years in which tornado reports were rather low 2014 saw a return to near the oft-quoted annual average of 33. Waterspout sightings (which are very dependent on the alertness of witnesses) were higher than usual, and the number of funnel cloud reports was extraordinarily high. Land devils were about normal. For the United Kingdom we know of 32 tornadoes over land, of which 17 have been classified as definite (15 probable); two of the tornadoes began over the sea as waterspouts, and there were another 17 reports of waterspouts that did not reach land. The total of all tornadoes, whether over land or sea, is therefore 49. Funnel clouds that did not reach the surface totalled 159 sightings (some of which were of more than one funnel). This gives a combined annual total for all tornado-related events (TN+WS+FC) of 208.

Table 1. UK whirlwinds: Annual totals 2009 to 2014.

	2009	**2010**	**2011**	**2012**	**2013**	**2014**
Tornado	36	22	22	23	24	32
Waterspout	5[2]	12	11[1]	13[2]	4[1]	19[1]
Funnel cloud	85	54	65	139	48	159
Total tornadic events	***125[3]***	***88***	***96[3]***	***174[3]***	***74[3]***	***208[3]***
Total No of days (UK) having TN, WS, or FC	***57***	***51***	***54***	***73***	***39***	***79***
Land and water devils	4	22	8	8	15	9
Eddy whirlwinds	1	1	1	1	0	0

[1] Two of these also included in tornado total
[2] One of these also included in tornado total
[3] Total excludes WSs that were also TNs

Tornadoes or waterspouts occurred on 30 different days during 2014, and there were an additional 49 days on which only funnel clouds were reported, making a total of 79 days with tornado-related events of some sort, one of the highest counts on record.

SUMMARY OF WHIRLWINDS FOR 2014 BY MONTH AND TYPE (TABLE 2)

Tornadoes in 2014 were concentrated in the three months of January, August, and October, which between them produced three-quarters of the year's total; dates with more than one tornado were January 25 (7), August 2 (2), August 10 (5), October 8 (5), October 16 (2). Waterspout sightings all occurred between June and November. Funnel clouds (as always) were predominantly a summer feature, more than three-quarters of the year's (very large) total occurring in the four months May to August. No tornadoes this year were rated as high as T3 on the International Tornado T-Scale: of the 32 in total, two were T2/3, eight were T2, four were T1/2, twelve were T1, one was T0/1, and four were T0; one tornado was not assigned a strength.

Table 2. UK whirlwinds: Monthly and annual totals 2014.

2014	TN	WS	FC[1]	TN+WS+FC	LD+WD	EW
Jan	8	0	2	10	0	0
Feb	1	0	3	4	0	0
Mar	0	0	2	2	0	0
Apr	0	0	8	8	0	0
May	3	0	30	33	2	0
Jun	2	4[2]	41	46[3]	3	0
Jul	1	2	24	27	4	0
Aug	8	4	33	45	0	0
Sep	0	0	2	2	0	0
Oct	8	5[2]	11	23[3]	0	0
Nov	1	4	2	7	0	0
Dec	0	0	1	1	0	0
Year	**32**	**19**	**159**	**208[3]**	**9**	**0**

[1] Excluding any that were seen together with tornadoes or waterspouts
[2] One of these also included in tornado totals
[3] Total excludes WSs that were also TNs

Table 3 lists the known tornadoes for 2014 together with their locations and strengths. Figure 1 shows the geographical distribution of tornadoes and waterspouts, annotated with the dates of occurrence and coloured by T-strength (note that waterspouts are usually plotted at the point from which they were observed, not necessarily where they were on the water; the waterspout in northeast Ireland was over Lough Neagh). The majority of tornadoes (as is usual) were in central England between the south coast and Yorkshire. Brief descriptions of all whirlwinds for 2014 can be found in the monthly summaries published in this journal (Brown and Meaden, 2014, 2015).

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Figure 1. Geographical distribution of tornadoes and waterspouts in 2014 in the United Kingdom, coloured by type and annotated with dates of occurrence.

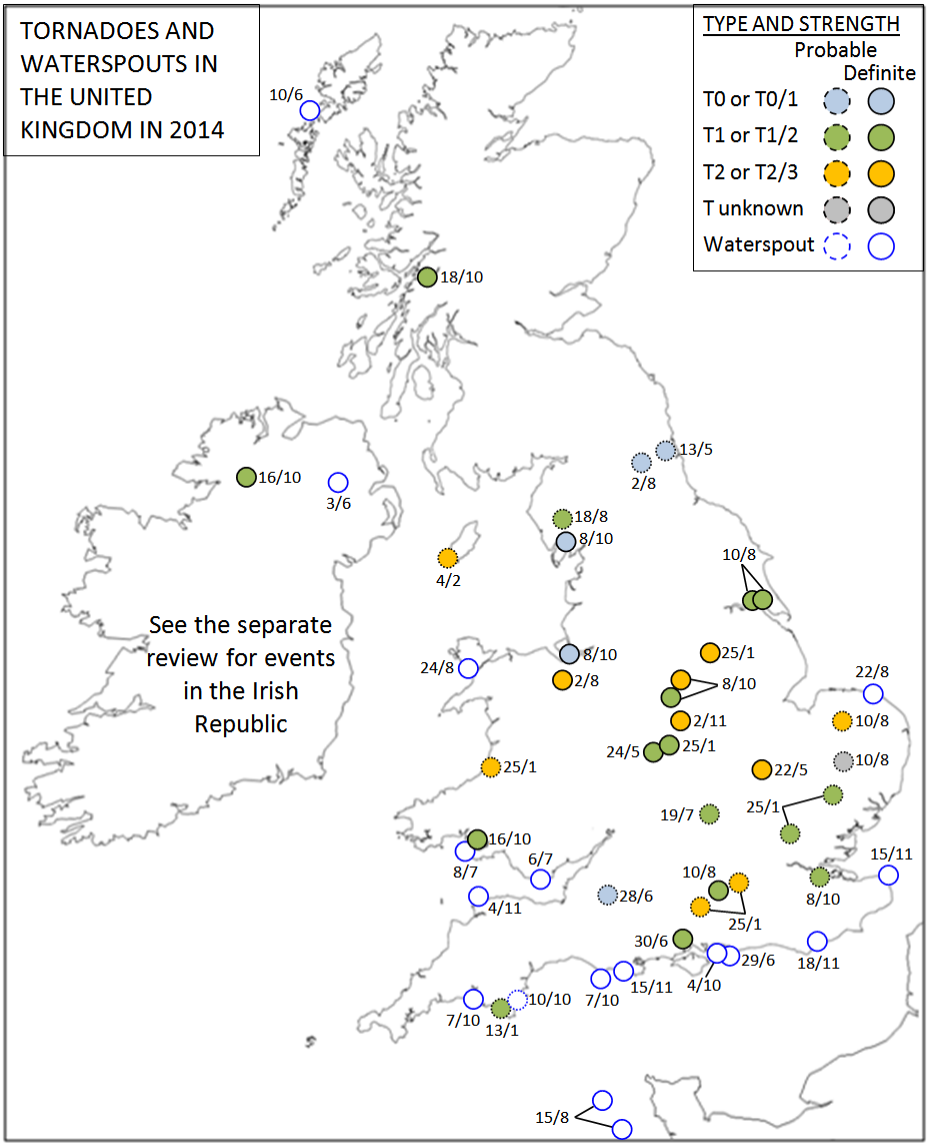

Table 3. Tornadoes in the United Kingdom in 2014.

TYPE/DATE	PLACE	COUNTY	NGR or IGR	STRENGTH
tn2014Jan13	Kingsbridge	Devon	SX734441	T1
tn2014Jan25	Llangwyryfon	Cardiganshire	SN623705	T2
TN2014Jan25	Nuneaton	Warwickshire	SP315920 to SP348910	T1+
tn2014Jan25	Upper Wield	Hampshire	SU619389	T2
TN2014Jan25	Retford	Nottinghamshire	SK698795 to SK712794	T2
tn2014Jan25	Chobham	Surrey	SU~976615	T2?
tn2014Jan25	Harlow	Essex	TL464082	T1+
tn2014Jan25	Acton	Suffolk	TL878445 to TL900446	T1/2
tn2014Feb04	Port Erin	Isle of Man	SC199686	T2/3
tn2014May13	Newcastle upon Tyne	Northumberland	NZ283696	T0
TN2014May22	Buckden	Cambridgeshire	TL190679	T2
TN2014May24	Birmingham, Tile Cross to Shard End	Warwickshire	SP1686 to SP158885	T1
tn2014Jun28	Buckland Dinham (near)	Somerset	ST~7351	T0
WS-TN-2014Jun30	Southampton Water to Park Gate	Hampshire	SU~4507 to SU517087	T1
tn2014Jul19	Steeple Claydon	Buckinghamshire	SP695268	T1
TN2014Aug02	Wrexham	Denbighshire	SJ301527	T2
tn2014Aug02	New Ridley, near Stocksfield	Northumberland	NZ0559	T0
TN2014Aug10	Fleet to Cove	Hampshire	SU780541 to SU839551	T1/2
TN2014Aug10	Kingston upon Hull, Victoria Docks to Thirtleby	Yorkshire, East Riding	TA111287 to TA173348	T1
TN2014Aug10	Preston	Yorkshire, East Riding	TA186304 to TA188311	T1/2

TYPE/DATE	PLACE	COUNTY	NGR or IGR	STRENGTH
tn2014Aug10	North Common, near Hepworth	Suffolk	TL977755	
tn2014Aug10	Gressenhall	Norfolk	TF9616	T2?
tn2014Aug18	Chapel Stile	Cumbria	NY313050	T1
TN2014Oct08	Haverthwaite, near Ulverston	Cumbria	SD340834 to SD346841	T0/1
TN2014Oct08	Hooton, near Bebington	Cheshire	SJ363780 to SJ365796	T0
tn2014Oct08	Rochester	Kent	TQ743654	T1/2
TN2014Oct08	Derby	Derbyshire	SK316366 to SK326375	T1
TN2014Oct08	Alfreton	Derbyshire	SK414550 to SK421561	T2/3
TN2014Oct16	Aghyaran, near Castlederg	County Tyrone	H1881	T1
TN2014Oct16	Llanelli	Carmarthenshire	SN491007	T1
WS-TN2014Oct18	North Connel, near Oban	Argyll	NM~908346	T1
TN2014Nov02	Coalville	Leicestershire	SK420136 to SK429145	T2

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REFERENCES

BROWN, P. R. and MEADEN, G. T. (2014) TORRO Tornado Division report: January to February 2014. *Int. J. Meteorology*, *UK,* 39, 91-98.

BROWN, P. R. and MEADEN, G. T. (2014) TORRO Tornado Division report: March to April 2014. *Int. J. Meteorology*, *UK*, 39, 164-166.

BROWN, P. R. and MEADEN, G. T. (2014) TORRO Tornado Division report: May 2014. *Int. J. Meteorology*, *UK,* 39, 187-195.

BROWN, P. R. and MEADEN, G. T. (2014) TORRO Tornado Division report: June 2014. *Int. J. Meteorology*, *UK,* 39, 230-240.

BROWN, P. R. and MEADEN, G. T. (2015) TORRO Tornado Division report: July 2014. *Int. J. Meteorology*, *UK,* 40, 12-16.

BROWN, P. R. and MEADEN, G. T. (2015) TORRO Tornado Division report: August 2014. *Int. J. Meteorology*, *UK,* 40, 57-66.

BROWN, P. R. and MEADEN, G. T. (2015) TORRO Tornado Division report: September to October 2014. *Int. J. Meteorology*, *UK,* 40, 92-100.

BROWN, P. R. and MEADEN, G. T. (2015) TORRO Tornado Division report: November to December 2014. *Int. J. Meteorology*, *UK,* 40, 155-157.

THUNDERSTORM DIVISION REVIEW FOR BRITAIN AND IRELAND 2014
(also incorporating the TCO annual survey)

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Abstract: Based on 'Thunder heard days', 2014 was the most thundery year since 2006 across much of Wales, central and southern England. This was also reflected in the highest number of significant lightning incidents reported since 2006. However, northern England and southeast Scotland had a relatively quiet year. Some very active thunderstorms occurred during the winter half year in 2014. Severe hail accompanied several events, again in both the summer and winter half years.

1. OVERVIEW

Thunder day totals for 2014 are mapped in Figure 1 (with a map of 1981-2010 means for comparison in Figure 2) and are also presented, for selected stations with long term averages (1981-2010 where available), in Table 1. The usual caveats apply with respect to the interpretation of maps of thunder frequencies such as the distribution of observers, the number of observations based on a 24 hour watch and the impact (arguably an increasing one) of background noise. Prichard (1985) and Webb (2014) discussed various issues associated with this statistic.

In southern England, thunder day frequencies were well above average, especially in a swath from east Devon to Surrey. Frequencies were also mostly above average across Wales, the Midlands and East Anglia, but much of northern England and south and east Scotland had fewer days than normal. Hours with thunder showed broadly similar spatial variations (Table 2). A feature of the stormy January was the remarkably high number of thunder days, locally, in southeast England (7 days at Claygate).

2. REPORTED INCIDENCE OF OVERHEAD STORMS, LIGHTNING DAMAGE AND OTHER SEVERE THUNDERSTORM EVENTS IN 2014

Overhead thunder is defined as electrical activity reported by an observer to be at a distance of 5km or less, or "close". Observations of overhead thunder and the duration of thunder are given for selected locations in Table 2. The reported significant lightning incidents (assumed to be only a proportion of the total and subject to future review) totalled 230. The seasonal distribution of reported lightning incidents and damage is shown in Table 3. The reported tally of incidents was the highest since 2006 and above the average for the previous 25 years (Figure 3). There were 20 incidents (reported so far) involving people being struck and these involved two fatalities (see Elsom and Webb, 2015). The incidents also included 163 which involved strikes on buildings (mostly residential) and 67 of these started fires. There was a surprisingly even seasonal distribution of lightning damage. While July had the most reported incidents, October and January ranked second and third. 25 January produced storms of unusual

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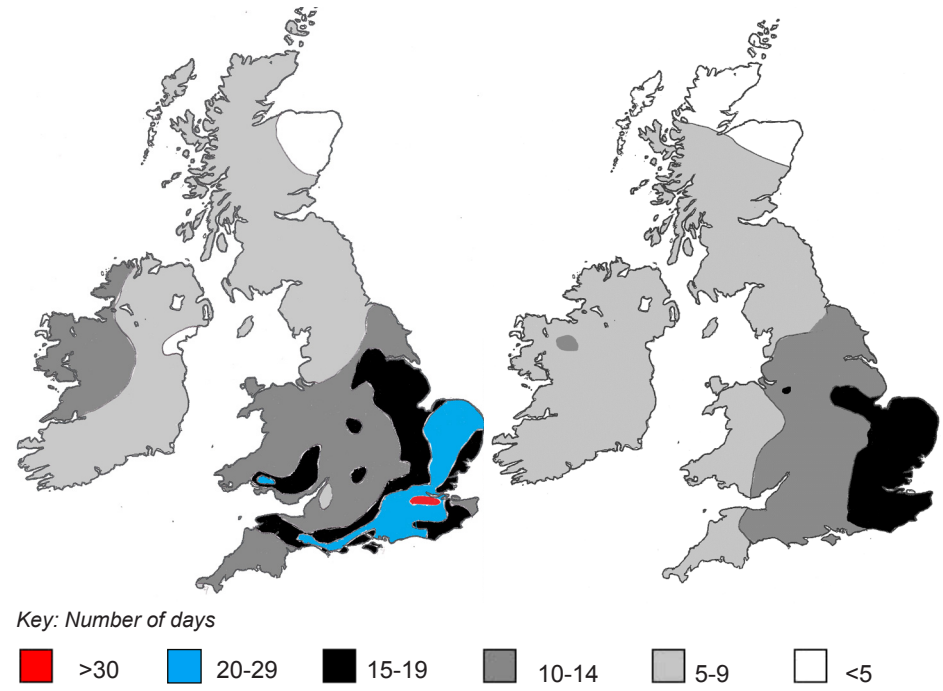
Figure 1. Thunder days in 2014. © TORRO.

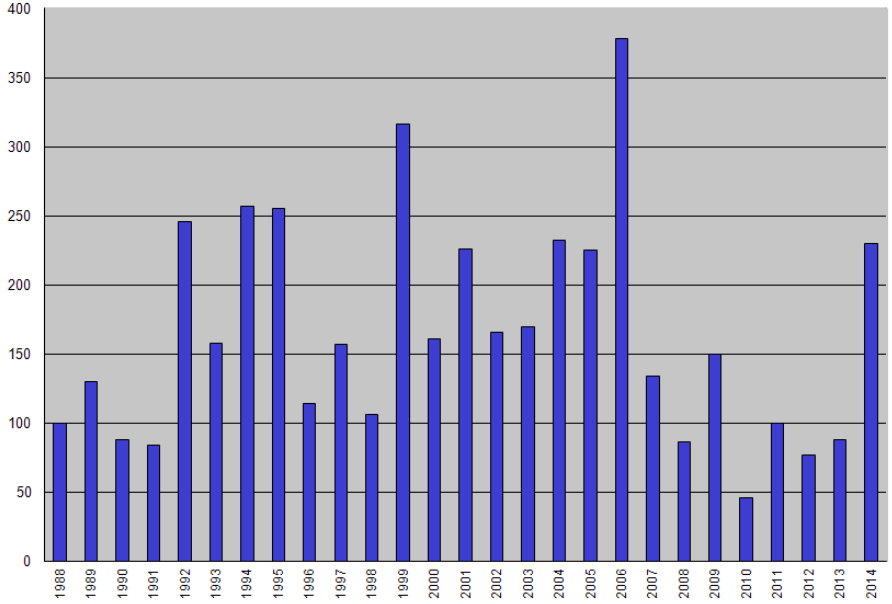
Figure 2. Mean number of thunder days 1981-2010. © TORRO.



severity for the time of year. The counties which reported the highest number of lightning incidents were Essex, Kent, Sussex and Wiltshire, each with 15 incidents.

An area of unexpectedly violent thunderstorms affected central southern England and the adjoining south Midland counties overnight 13-14 June 2014, despite high surface pressure of around 1024hPa. This large storm system, unusually, developed in situ (Figure 4) and then moved southeastwards (see Pike and Webb, 2015, Grahame et al, 2015). The most thundery spell of the year was 17-20 July, although the activity mostly affected central and southern Britain (Figure 5). This was a trademark 'Spanish Plume' scenario with a deep upper trough extending south to Iberia (Figure 8). The very fine September was interrupted by a conspicuous thundery spell across southern England and East Anglia from the 18th to 20th; however northern Britain was not affected at all. Surface charts show a very slack, cyclonic easterly airflow around a low over Biscay. A slow moving thunderstorm on the night of the 18th caused serious local flash flooding in north Wiltshire where Lacock recorded 115mm of rain. The 7-9 October, with deep polar air arriving with a long fetch across the warm Atlantic, was an especially thundery period over Ireland, Wales and some southern coastal counties of England. Observers in southwest Wales reported an unusual number of hours with thunder between 0900 UTC on 8th and 0900 UTC on 9th (Figure 7); at least 10 separate thunderstorms affected Llanwnnen, Ceredigion, while at Llangyndeyrn near Carmarthen electrical activity occurred throughout a 12 hour period from 1700 UTC on 8th to 0500 UTC on 9th (Smith, C – *Pers. Comm.*). December was a stormy and unusually thundery month in north and west Scotland. Seven days with thunder were recorded at Stornoway, Isle of

Figure 3. Significant lightning incidents by year, 1988-2014. Significant lightning incidents refer to people or animals directly or indirectly struck, houses and other buildings struck, trees struck and damaged, strikes causing an electricity supply cut over a large area.



Lewis (Graham, E. - *Pers. Comm.*); this was the highest monthly incidence in over 110 years of local records.

3. DAMAGING HAIL IN 2014

Severe hail (size 20mm diameter or more) was reported on eight days in 2014, while there were at least three other days when hail was intense enough to cause noticeable plant damage.

January 3. A very deep depression (949hPa) was situated close to northwest Ireland with a very strong south westerly airstream (of distant polar origin) across England and Wales. An unusually severe winter thunderstorm tracked across southern England from Devon to Suffolk with hail up to around 20mm diameter at several locations along the track (Figure 6). See also hail photos from Somerset on p37 (Weather Images) of IJMet V39.

May 22. Low pressure was slow moving close to southwest England. During widespread thunderstorms which developed and drifted northwards over eastern England, hail up to 20mm diameter was measured at Claygate (Surrey) and hail 20 to 24mm across was reported from Holt (Norfolk).

June 27. A shallow depression drifted slowly eastwards across southern Britain accompanied by heavy and slow moving showers, some with thunder. Hail damaged growing fruit and vegetables at Tenbury Wells (Worcestershire).

July 19. The general synoptic situation (see also section 2) is shown in Figure 8. A thunderstorm which developed over the Salisbury Plain area in mid afternoon

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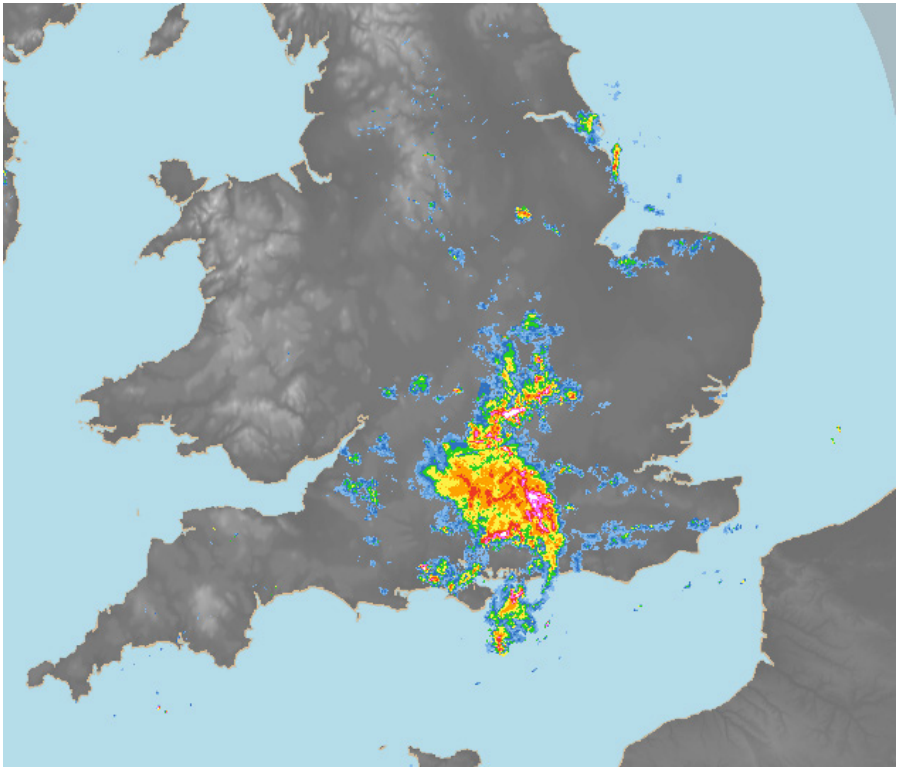
Figure 4. Southern UK radar composite for 0100 UTC, 14 June 2014 © Crown Copyright 2014 Met Office.



developed supercell characteristics across Oxfordshire and Buckinghamshire. Hail 10-15mm diameter occurred at various locations between Lambourn, Wantage and Oxford, while severe hail 20 to 30mm diameter fell from just northeast of Bicester to the Towcester area of Northamptonshire.

July 28. A band of intense early morning thunderstorms, closely associated with a southward moving cold pool aloft, affected eastern England from west Norfolk to west London, and down to the Sussex coast. Very heavy hail, up to small walnut size, fell in the Brighton/Hove area and plastic roofs were holed.

August 2. There was a rather warm, humid south-southwesterly airflow (with cyclonic curvature), while at 500hPa a cold pool was evident over the Irish Sea. A ferocious hailstorm (with almost continuous intra-cloud electrical activity) swept across the Vale of Evesham, Worcestershire, and caused extensive damage to the apple and plum crops which were yet to be harvested. Plastic roofing and paintwork were also damaged.

August 11. A deep depression (ex-hurricane Bertha) was situated close to north-east Scotland (where many hours of heavy rain caused flooding); further south, an unstable 'returning polar maritime' westerly airstream produced frequent showers, some thundery. There were reports of hail at least 25mm diameter in the Thorpe area of Norwich.

Figure 5. Lightning near Roche, Cornwall, looking east or east-northeast at about 2115 UTC on 17 July 2014. The thunderstorm cell was moving NNW. Photo © Matthew Clark 2014.

Figure 6. Hailstones at Woodlands St Mary, West Berkshire, on 3 January 2014 The hailstones were spheroidal and measured up to 17mm diameter (time of hail fall 1041-1042 UTC) © Bill Pike 2014.

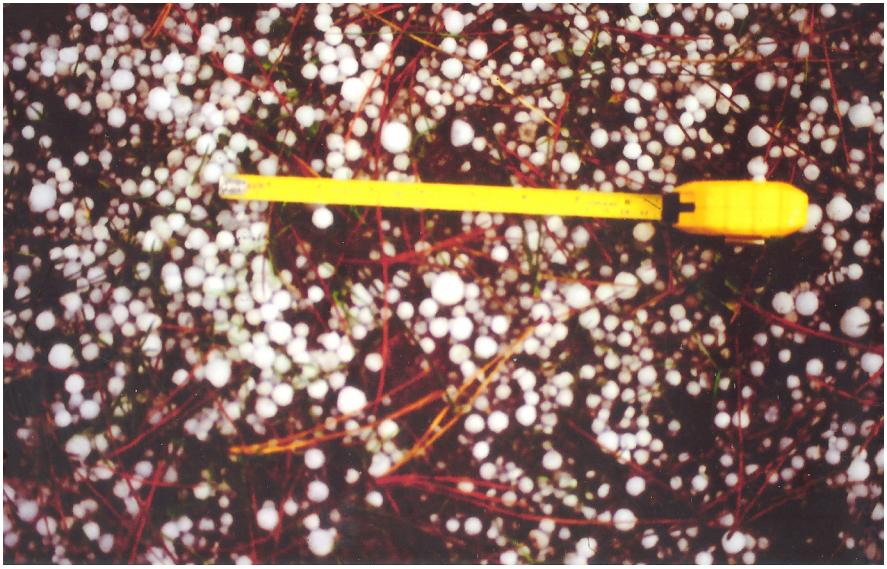


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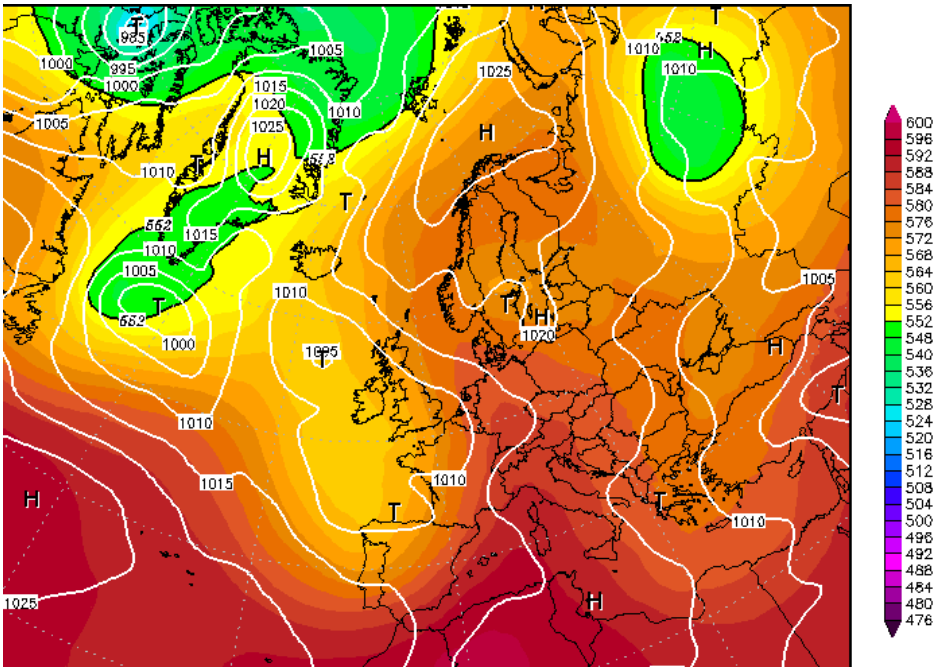
Figure 7. s-UK Lightning Detection Overlay showing locations of discharges detected between 2230 Z and 2300 Z on 8 October 2014. Crown Copyright 2014.

Figure 8. NCEP/CFS Reanalysis chart for 19 July 2014, 1200 UTC, showing surface isobars and (shading) 500hPa geopotential; courtesy of Wetterzentrale.



September 19. During this thundery spell in the south (see section 2), a sudden afternoon storm in east London deposited marble sized hailstones in the Tower Hamlets area.

October 11. There was a slack southwesterly airflow over England, associated with a filling depression over Scotland. A thunderstorm in the Norwich area dumped huge accumulations of hail which was also large enough to shred plants.

December 10. Hailstones up to five pence piece size (18mm diameter) fell at Lamlash, Isle of Arran.

December 18. During the very thundery period which affected northwest Scotland in December, a fierce hailstorm struck Ness, in the far north of the Isle of Lewis. PVC roofing and car windscreen glass were broken. Photographs confirmed hailstones the size of pound coins - about 23mm diameter (BBC 2014).

Table 1. Thunder days in 2014 at selected locations.

STATION	COUNTY	2014 total	Average 1981-2010 (unless otherwise stated)	Diff +/-
Claygate	Surrey	32	18 (2005-2014)	+14
Calthorpe	Norfolk	26	18 (1987-2013)	+8
Epsom Downs	Surrey	24	17	+7
Bury St Edmunds	Suffolk	23	19 (2001-2010)	+4
Wokingham	Berkshire	23	16	+7
Llangyndeyrn, Carmarthen	Dyfed	23	12 (2001-2010)	+11
Ebbw Vale	Gwent	19	8 (1988-2010)	+11
Waddington	Lincs	18	15	+3
Lymington	Hampshire	18	9 (1986-2013)	+9
Guernsey Airport	Channel Isles	16	12	+4
Velindre	Powys	16	10	+6
Brize Norton	Oxfordshire	16	10 (1971-2000)	+6
Barnstaple	Devon	17	9 Chivenor (1957-1973)	+8
Straide, Co Mayo	Ireland	14	9 (2001-2010)	+5
Stony Stratford	N Bucks	14	14 (1986-2010)	0
Bulford	Wiltshire	14	11 Boscombe Down (1957-85)	+3
Llansadwrn	Anglesey	14	7	+7
Gloucester	Glos	13	10 Innsworth (1961-1981)	+3
Oxford	Oxon	12	12	0
Camborne	Cornwall	12	8 (St Mawgan)	+4

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STATION	COUNTY	2014 total	Average 1981-2010 (unless otherwise stated)	Diff +/-
Great Malvern	Worcs	12	10	+2
Cosby	Leics	11	13	-2
Woodlands St Mary	Berkshire	11	12 (1990-2009)	-1
Ardpatrick, Co Limerick	Ireland	9	11 (1991-2005)	-2
Carlton-in-Cleveland	N Yorkshire	9	13	-4
Ronaldsway	Isle of Man	9	4	+5
Eskdalemuir	Dumfries	9	7	+2
Fishponds	Bristol	8	10 (1950-2010)	-2
Drumburgh	Cumbria	8	8 (2001-2010)	0
Bramley	West Yorkshire	8	12 (1963-2012)	-4
Cork	Ireland	7	3	+4
Knockroe, Co Monaghan	Ireland	6	5 (Clones)	+1
Leuchars	Fife	6	5	+1
Fair Isle	N Isles	6	6 (1975-2000)	0
Newtownards, Co Down	Ireland	5	6	-1
Elderslie	Renfrew	5	6	-1
Dun Laoghaire, Dublin	Ireland	3	8 (2001-2010)	-5
Casement airport	Ireland	3	6	-3

Table 2. Duration of thunder in 2014.

Station (County)	Thunder days (Overhead thunder days)	Storm hours 2014	Comparative notes ref thunder duration
Fishponds (Bristol)	8 (6)	17	Mean hours 2002-2011 were 14 (mean t hours at Filton 1971-1980 were 23)
Oxford (Oxon)	12 (7)	25	Mean 2002-2011 was 21 hours (mean t hours at Brize Norton 1971-1983 were 24)
Calthorpe (Norfolk)	26 (9)	53	Mean t hours 2002-2013 were 44
Bury St Edmunds (Suffolk)	23 (13)	41	Mean t hours 2002-2011 were 31 (Wattisham 1971-1983 mean was 34)
Llangyndeyrn (Carmarthen)	23 (13)	64	
Knockroe, Monaghan (Ireland)	6 (5)	10	
Bulford (Wiltshire)	14 (7)	25	Mean t hours at Boscombe Down 1961-1980 were 24

Station (County)	Thunder days (Overhead thunder days)	Storm hours 2014	Comparative notes ref thunder duration
Carlton-in-Cleveland (N Yorks)	9 (5)	10	Mean hours 2002-2011 were 25 (mean t hours at Leeming 1971-1983 were 22)
Elderslie (Renfrew)	5 (5)	8	Mean t hours at Abbotsinch 1966-1980 were 16

Table 3. Reported lightning incidents by month, 2014.

January	27
February	7
March	18
April	5
May	20
June	22
July	50
August	8
September	21
October	32
November	6
December	14
Total	**230**

ACKNOWLEDGEMENTS

Sincere thanks are again due to all TORRO and other (e.g. COL, WON, also UKWW internet forum) observers who have contributed information on thunderstorms and associated severe weather in 2013. Special thanks are due to Matt Clark for radar data and Figure 5, Bill Pike for Figure 6 and Paul Brown for the lightning data for Figure 7. New thunderstorm observers are always welcome. Further details of reporting are available from Jonathan Webb.

REFERENCES

BBC (2014) Pickled onion-size hailstones fall in storm over Lewis http://www.bbc.co.uk/news/uk-scotland-highlands-islands-30552123 [Accessed 30 August 2015]

Elsom, D. M. and Webb, J. D. C. (2015) Lightning injuries and fatalities in the United Kingdom 2014 and a summary of personal-injury lightning incidents from 1988 to 2014. *Int. J. Meteorology, UK,* 40, 84-91.

Grahame, N; Page, A; Hickman, A; Pearson, C. (2015) An unusual thunderstorm event overnight 13-14 June 2014. *Weather* 70, 167-172.

Pike, W. S. and Webb, J. D. C. (2015) A note on the vivid overnight thunderstorms of 13-14 June 2014 associated with a travelling 1000-500 hPa cold pool. *Int. J. Meteorology, UK,* 40, 17-34.

Prichard, R. J. (1985) The spatial and temporal distribution of British Thunderstorms. *J. Meteorology UK,* 10, 227-230.

Webb, J. D. C. (2014) Thunderstorm Division review for Britain and Ireland 2013. *Int. J. Meteorology, UK*, 39, 135-140 (section 5).

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SITE INVESTIGATIONS AND EYE WITNESS REPORTS OF TORNADOES, WATERSPOUTS AND FUNNEL CLOUD EVENTS IN IRELAND, 2014

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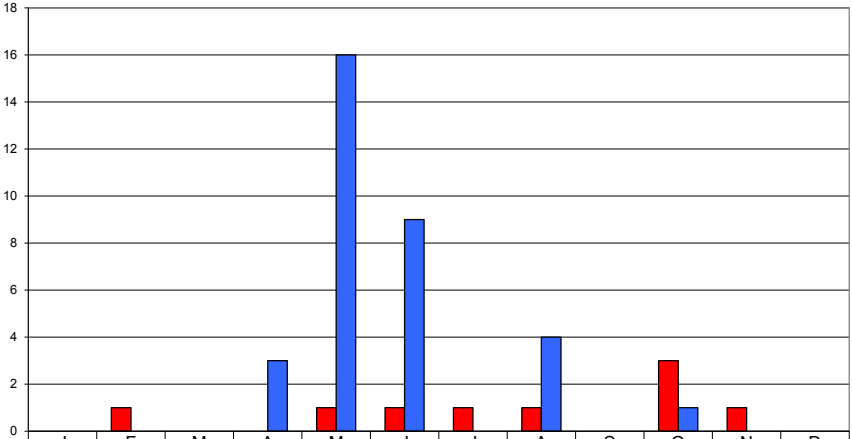
Abstract: Investigations were carried out for all reports of tornadoes or localised severe storm damage initially reported as tornado damage, during 2014. Nine of these were confirmed as tornadoes or waterspouts. Their intensity ranged up to T3. The damage track for each tornado is assessed from site investigation data. In addition, the distribution of 33 funnel cloud events are reported and discussed.

Keywords. Tornado, waterspout, funnel cloud, site investigation, Ireland.

INTRODUCTION

Tornado activity in Ireland during 2014 was consistent with that of recent years. Detailed on-site investigations were carried out for all reports of possible tornadoes. Five of these were confirmed as tornadoes and the other four were confirmed as waterspouts. In contrast to these nine events, funnel clouds were much more numerous. Of the 33 recorded, 25 of these were clustered between May and June (Figure 1).

Figure 1. The monthly frequency of tornadoes and waterspouts in Ireland during 2014.

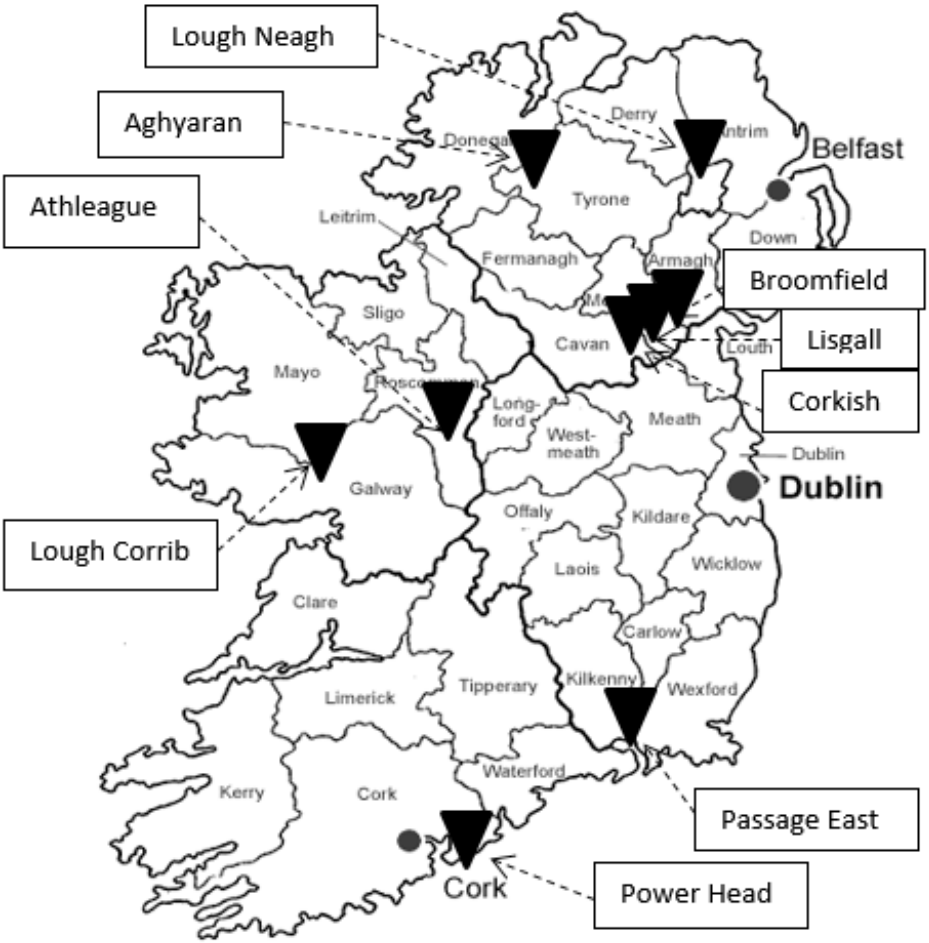


	J	F	M	A	M	J	J	A	S	O	N	D
TN+WS		1			1	1	1	1		3	1	0
FC				3	16	9	0	4		1		

TORNADOES AND WATERSPOUTS

The first tornado of the year was the Athleague tornado on February 12th, in County Roscommon (Figure 2). This was a mid-morning event, occurring a little before 1000 UTC. The village of Athleague itself was not affected, but the site investigation mapped the damage track which commenced approximately 2km east of the village (from where "funnel shaped clouds" had been seen). The track then followed an alignment towards the NNE for 8.5km, ending near the N63 road to the northeast of Roscommon town.

Figure 2. The distribution of tornadoes and waterspouts in Ireland during 2014.



Most of the track was across agricultural land where few people lived. However, the damage to large trees was significant and branches were carried up to several hundred metres and lodged 4-5 metres up in other nearby trees. One farmstead it did cross had a family in it at the time. They did not see the vortex because it was immediately preceded by very intense rain which drove everyone to shelter. Then, inside the farmhouse the peat fire suddenly blazed furiously, window shutters flapped frantically and it was impossible to see outside. In the yard a large oil tank was dislodged and the roof of the barn was ripped off, most of it then being carried some 4-500 metres across the adjacent farmland. Damage to the 15-20 metre high trees bordering the yard produced debris that was scattered across the yard and fields for some distance beyond. At various other points along the track further roof damage occurred, a construction yard was damaged and numerous trees were damaged, including some being snapped and uprooted. On the outskirts of Roscommon town, flying debris was a particular hazard, from roof tiles and flying shards of glass to small pieces of timber – one small piece of timber moved so powerfully that it penetrated a door.

The maximum intensity of the tornado was assessed at T2 for most of the track length, although it probably reached T3 (42-51m/s, or 93-114mph) where the "bigger trees were snapped and uprooted" (Meaden, 1985). The tornado was a by-product of a small, intense low pressure system that moved very rapidly. In 18 hours from 0000 to 1800 UTC, it travelled 1400km from the eastern Atlantic to Scotland, a mean forward speed of a little under 80km/hr (50mph) off the western and northern coast of Ireland. A further distinction was the relatively small diameter of its core area and a very sharp pressure gradient within its closed isobars. As a result, the severest surface winds varied between westerly and southerly across the counties from Galway to Donegal, producing some low level shear due to vertical differences in wind direction and speed. Upper winds played a further significant role in that the forward left exit region of the upper jet at 300hPa was divergent and would have encouraged the vertical stretching process from below.

On May 26th a second tornado occurred at Corkish, near Bailieborough in County Cavan. A funnel cloud was observed in the same local area around 1245 UTC, but it was not until 1615 UTC that the tornado occurred. It passed through the townland of Corkish, damaging a mixture of gardens and fields for a distance of less than 1km. The site investigation established that it created a damage swathe up to 25 metres wide. It occurred in drumlin country and it was on the steep drumlin slope that the vortex broke up.

Again, eyewitness accounts noted that it was preceded by intense rain ("a terrible downpour"). But the vortex that followed was clearly observed as it drove through the gardens. As it did so, it lifted, span around and relocated upwind a cast iron garden bench that normally took two adults to move, snapped trees and dropped other debris on the rear side of the vortex. The tornado maximum intensity was assessed as T1 (32m/s, or 72mph). The profound effect of seeing this on two eyewitnesses who were very close by has resulted in them now being afraid of darkening clouds and skies with rain potential. Such stress related responses to experiencing tornadoes at first hand has become increasingly documented and studied in other tornado prone countries (Godleski, 1997) and growing evidence in Ireland suggests that greater attention to these needs to be given.

The synoptic set-up on 26th May was very different from the February event. A north-south convergence line had crossed Ireland slowly during the day from west to

east. Throughout this time there was a very slack pressure gradient across the country and only slight wind speed contrasts through the troposphere above. However, in the lighter winds throughout the vertical profile, there was very strong directional shear at a number of levels below 500hPa (5600m).Thus, despite the lack of any significant CAPE, the convergence and shear characteristics were sufficient to produce a short-lived tornado, as well as other vortices elsewhere in Ireland (see later).

The next three tornadoes were entirely over water. The first of these was on 3rd June at 1845 UTC on the northern part of Lough Neagh, near Toome (Figure 2). It was widely photographed from the shore, from where it was established that it did not come ashore. It occurred on the rear right flank of a parent thunderstorm that developed along the northern shoreline during the late afternoon. This appears to have been triggered again by a N-S convergence zone that moved over the lough from the west. It was topped by the forward diverging edge of an upper jet stream at 300hPa, facilitating vertical stretching. But before that, local thunderstorms (mostly over County Antrim), marked the convergence line. Earlier in the day there was little to suggest what lay ahead. Again, the pressure gradient at the surface was weak, although before 1700 UTC some convergence was noted between southwesterly and northwesterly flows. Continuing and strengthening convergence and uplift broke through a cap that had been limiting cloud growth, resulting in new, explosive growth.

On 24th July a further waterspout occurred, also during a thunderstorm. This was at the northern end of Lough Corrib in County Galway (Figure 2). It was much less visible to eyewitnesses and was in a much more remote area than the Lough Neagh event. It came close to the northern shore of Inchagoill Island, but did not land. In fact, investigations along the shore of the main lough established that it did not reach the main shoreline, either. Both eyewitness accounts and photographic evidence established that the funnel reached and created a strong disturbance on the surface of the lough.

Again, a relatively slack surface pressure gradient was involved. This produced a broad, weak easterly flow across Ireland that had marked shear characteristics in both wind speed and wind direction with altitude, at 4 or 5 different levels, but mostly below 450hPa. Above that, wind speeds rapidly increased significantly to between 20-45kts (23-52mph). Although at Valentia CAPE values were small, it was spread relatively deeply between 800 and 450hPa (2000m - 6500m). Within that layer strong directional wind shear occurred, while above it the wind shear was largely a marked wind speed feature.

A third waterspout occurred on 8th August near Passage East (County Waterford) at approximately 0930 UTC. During the day, a slow moving low pressure system had been moving closer towards the northwest coast of Ireland from the Atlantic. An occluded front moving ahead of it crossed Ireland from west to east. By noon there was a strong southerly jet at high levels. The vertical profile shows a consistent wind speed increase with height to 45kts (52mph) at 350hPa (8000m). There was only a very small CAPE value, mostly concentrated around 800hPa (approximately at 1500m). But in the Waterford region there were local thunderstorms and it was from one of these storm cells that the waterspout developed.

Passage East is located on the estuary of the River Suir, downstream of Waterford city. A number of eyewitnesses were able to confirm that the waterspout

tracked towards the NNW upstream, more or less following the alignment of the river valley, which is relatively steep sided. This continued for approximately 2km (1.2 miles), to a point where the river makes a sharp bend. But it did not cross the shoreline. Both eyewitness accounts and photographs taken record that the vortex was initially surrounded by very localised heavy rain, although this became less intense towards the northern limit of the waterspout's progress. There it was observed and photographed clearly from a distance of 8km, not shrouded in rain. Most of its track was actually in County Wexford rather than County Waterford, because the boundary bisects the river. However, since it was first reported from Passage East, a village on the Waterford shore and initially developed on the Waterford side of the boundary, that is how it continues to be designated.

October 16th was the most significant day of the year for tornadoes, since three occurred; two in County Monaghan and one in County Tyrone. A strong southerly flow due to a wide, strong and relatively stationary depression in mid Atlantic persisted throughout the day. However, embedded in this was an occluded front that crossed Ireland northwards, along which the tornadoes developed. At 300hPa (8000m) a S-N jet streak was positioned over the Celtic Sea off SE Ireland, which edged further eastwards later in the day. Over Ireland, there was some divergence at that level.

The first of these tornadoes occurred near the village of Aghyaran, County Tyrone, at approximately 1500 UTC, as the front crossed northwest Ireland from the south. This is a relatively remote area with a small population. Nevertheless the funnel was clearly visible to a number of people and considerable damage occurred. The intensity of the tornado was assessed as T1. On-site evidence shows that the tornado tracked at least 3.5km (2.2 miles) across the countryside. One eyewitness who observed it as it developed reported: "I saw the funnel grow about ten times in size in about a minute." "The wind seemed to just break the branches of the trees and carry them along as if they were leaves." Another householder said, "I heard the roar of the wind and looked up to see this tornado and branches of trees five inches thick being carried along". Another said, "I looked up and saw this massive tornado coming towards the house. It was very frightening, I was scared stiff and could see flower pots and branches of trees being sucked up by the wind. It was coming towards the house and I just ran inside to try and shelter. The tornado luckily passed by the house and I could see the flowers being sucked into it and the pots on the ground. We lost three slates from the roof of the house as well."

The two County Monaghan tornadoes of 16th October also occurred in the late afternoon just north of Carrickmacross. Although the distance between the two of them was not great and they occurred at a similar time, site investigations involving damage mapping established clearly that they were distinct. Site investigations revealed that the damage caused by the Lisgall tornado covered 2.3km (1.5 miles), while the Broomfield tornado created a damage track of 1.6km (1 mile).

The Lisgall tornado was observed as it was forming by two eyewitnesses, one of whom had been in the coastguard for 25 years in Wales, but had never experienced a wind like this before. At its maximum he had estimated that its speed reached 150mph (240kph), although the damage assessment carried out during the site investigation categorised the tornado as T2 - up to 41m/s (92mph). As the wind picked up he looked out of his house and saw "a thick black conical shaped cloud coming down from the stormy sky

over the fields to the rear of my house, then heading straight for us." He was aware of the wind rising and this quickly became an overwhelming crescendo of noise. As the swirling vortex arrived "we had to push against the patio doors to stop them from opening." The sky became nearly black with branches and leaves. "Everything was spinning around." In the garden some 25 year old pine trees snapped in half, half-way up their trunks. In all 12 trees were destroyed. Heavy garden furniture was carried across the garden and full bins were hurled its full length. "It just devastated everything in a really small path. It was so localised – nothing happened to my neighbours on either side." Thunder and lightning at the same time added to the experience. It was a terrifying experience to both, "I was terrified. I don't think I was ever so afraid in all my life…the experience scared me so much that I couldn't get to sleep thinking about it."

The tornado continued northwards, damaging many trees as well as a stone farm building and lime kiln that had withstood many severe storms in the past. The severity of the damage was less than the T2 intensity of the earlier part of the track. Damage details revealed by the site investigation suggested T0 and T1 intensities. Its track crossed a terrain of steeply sloping drumlin hills and valleys, which may have helped to fragment the lowest layers of the vortex, until it reached the townland of Rathmore where the funnel lost contact with the ground.

The Broomfield tornado was also in drumlin terrain, this time to the north east of Carrickmacross, some 8km beyond the Lisgall tornado event. A detailed inspection of the damage track also resulted in this being categorised as a T2 event. During a period of thunder and lightning a tornado developed on farmland and passed through a farmyard, causing extensive structural damage. Wall cappings were carried 100 metres away, some being deposited upwind of the wall, flung from the rear of the slow moving tornado. Corrugated sheeting from tall barns were 250 metres away at the time of the site investigation. The tornado then proceeded across the countryside scattering debris, snapping many large tree branches, then hit a bungalow, terrifying its occupants. The damage to the roof and garden structures included hundreds of tiles stripped from the roof, damaging the surrounds and being carried across adjacent fields as well as the main A37 road. The tornado crossed the A37 and ascended the side of a steep drumlin, where its contact with the ground ended.

The final confirmed event of 2014 was off the south coast of County Cork on 14th November. There are many long sections of the Irish coastline and inshore waters that are infrequently observed and this section is one such. A fully developed waterspout was observed and photographed from the coastal path between Ballycotton and Roches Point, when it was approaching the shoreline off Power Head. In poor visibility and very stormy conditions it was clearly extended fully between the sea surface and the cloud base. Subsequent local investigation found no evidence of the vortex coming ashore.

During the day a very small, but distinctive, low pressure was located off the Cork coast and moved away to the ESE, giving SSE surface winds beneath a SW jet at 300hPa (8480m). Such a set up would produce a sheared wind profile in both wind direction and wind speed. A small amount of CAPE was concentrated near the surface, particularly between 300m-1500m, providing a necessary aid to stretching. Thus, an environment conducive to vortex formation was present. Storm cells with locally torrential rain and some thunder made visibility particularly poor.

FUNNEL CLOUDS

Many of the funnel clouds that occurred were very substantial, extending close to 50% towards the ground surface. But it was established that none of them developed into tornadoes, even though a number of them were originally reported as 'mini-tornadoes'. The total of all events was 33, which is in the middle of the range of annual frequencies experienced in Ireland and a few more than in 2013 (Tyrrell, 2013). They occurred between April and October, a narrower monthly spread than tornadoes (Figure 1). The marked concentration in May and June was notable, when 25 of this total occurred.

Multiple occurrences on individual days has happened a number of times. The most striking of these was May 26th with at least eight, as well as a tornado in County Cavan (see above). These eight could not have been more widespread, occurring over 7 different counties, from Cork to Cavan and from Wexford to Donegal. They occurred in an extremely slack pressure system broadly centred over Ireland that was relatively slow moving. It had variable wind directions with height but very little variation in wind speed and low CAPE values. So shear features and stretching were very local, but significant, phenomena. Indeed, two funnel cloud events in Counties Antrim and Wexford during the previous day, May 25th, were a product of this same environment. In all some 7 days had more than a single, confirmed, funnel cloud. But only on this one date, 26th May, did funnel clouds and a tornado coincide.

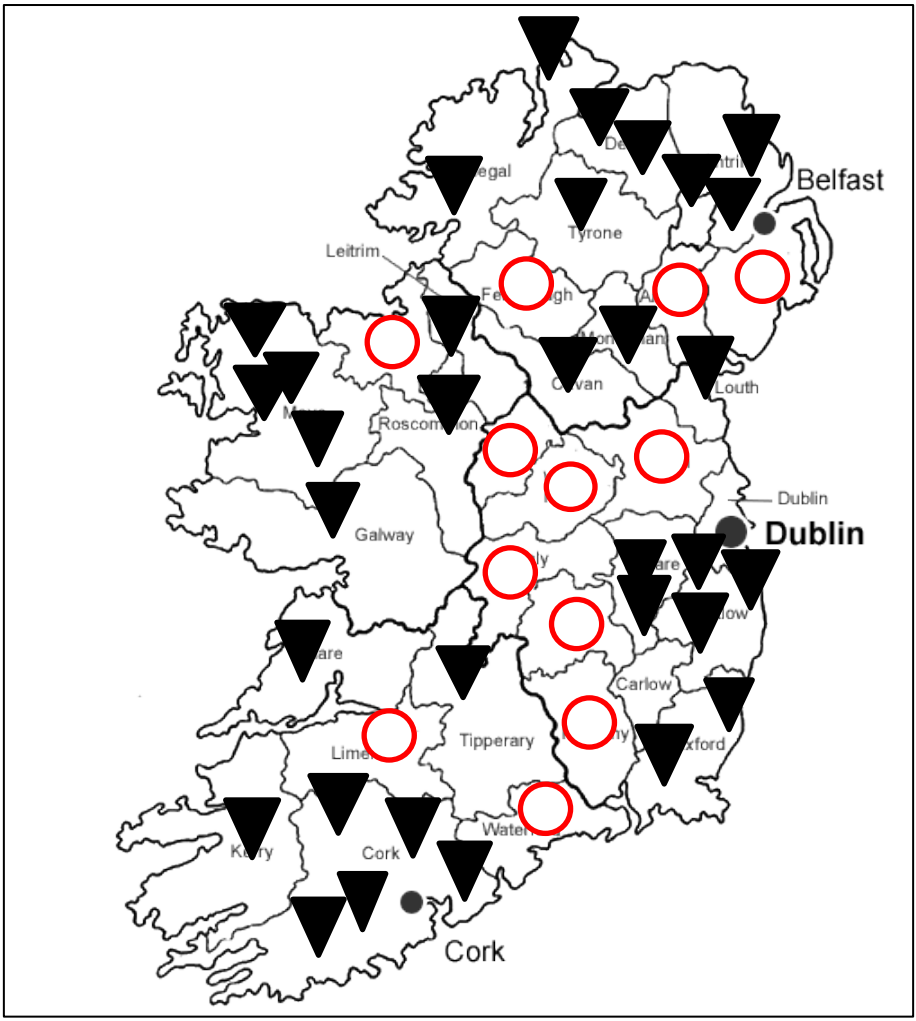
The distribution of funnel clouds across Ireland during the year has a suggestive pattern. Geographically, they were well spread, especially in the coastal counties (Figure 3). However, some 12 counties had none at all. This was not due to lack of potential observers since most, but not all, of the areas lacking funnel events were located in the more populated east of Ireland. These regions are also flatter, which may suggest that relief-induced turbulence in the overlying airflow of the other counties contributes to funnel development. Such links have long been documented (Price and Sasaki, 1963, Bluestein, 2005).

CONCLUSION

The year was outstanding in being very ordinary. All tornadoes were 'weak', ranging in intensity from T0 to T3. In some instances the terrain may have played a part in disrupting the flow, as occurs from time to time with weaker tornadoes. The annual total of nine events, which was one more than the total for 2013, was well within the typical range for Ireland. The role of vertically sheared wind conditions, both in wind direction and wind speed, together with convergence in the surface layers, appears to have been dominant in producing vortices of different intensities. The values for CAPE associated with these events were consistently low.

The impact upon eyewitnesses and local residents was noticeably significant in several cases. In four of the five land based tornado events site investigation work found that the experience itself was described by local residents as frightening and terrifying. In some cases this appears to be associated with longer-term trauma triggered by storm-like conditions. This is not a new phenomenon and may need further investigation so that appropriate support can be provided after events such as those reported here.

Figure 3. Confirmed funnel cloud events. Circles denote counties with no confirmed event during the year.



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REFERENCES
BLUESTEIN, H. B. (2005) More observations of small funnel clouds and other tubular clouds. *Mon. Wea. Rev.* 133, 3714-3720.
GODLESKI, L. S. (1997) Tornado disasters and stress responses. *J. Ky. Med. Assoc.* 95, 4, 145-148.
MEADEN, G. T. (1985) The classification of whirlwind types and a discussion of their physical origins. *J. Meteorology, UK,* 10, 194-202.
PRICE, S. and SASAKI, R. I. (1963) Some tornadoes, waterspouts and other funnel clouds of Hawaii. *Mon. Wea. Rev.* 91, 4, 174-190.
TYRRELL, J. G. (2014) Tornadoes, waterspouts and funnel clouds in Ireland, 2013. *Int. J. Meteorology, UK*, 39, 386, 141-150.

TORRO SEVERE WEATHER FORECAST SUMMARY FOR BRITAIN AND IRELAND 2014

BY PAUL KNIGHTLEY
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INTRODUCTION

2014 was somewhat more active as far as severe convection is concerned than the previous several years, including a higher number of severe weather reports than some recent years. Another warm summer occurred but several severe thunderstorm episodes occurred, which overall made it a busier year than 2013.

In 2014, TORRO issued 19 verifiable forecasts.

TORRO's FORECASTS

TORRO issued three types of verifiable forecast in 2014. These were:

Convective discussion (TCD)

Issued when conditions are favourable for either isolated severe weather events, or when marginally severe events are expected (e.g. T0-2 tornadoes; damaging hail, or heavy hail, but <20mm diameter).

Severe weather watches, which include:

Severe thunderstorm watch (SVR)

Issued when conditions are expected to be favourable for organised severe thunderstorms/convective storms.

Tornado watch (TOR)

Issued when either organised severe thunderstorms are expected, and they bring a risk of tornadoes, or when tornadoes are deemed possible, even though thunder may not occur (e.g. strong cold front, non-electrified showers).

In 2014, TORRO issued:

7 convective discussions

12 weather watches
- 9 tornado watches
- 3 severe thunderstorm watches

There is, as yet, no formal recording of severe convective winds within TORRO although some damaging wind events get assigned a 'squall' rating. However, verification of forecasts is not possible in regard to winds at this time.

HAIL

Severe hail was rather more prevalent in 2014 than in recent years, or at least the reports received suggest this (J. Webb, *pers. comm.*). Given that there were more thundery episodes in the summer this seems to be a real difference rather than just one or reporting. There were 10 days on which hail >= 20 mm was reported. On 4 of those days, TORRO convective discussions were in effect, and on one (August 10th), a tornado watch was in effect. Although hail was mentioned as a risk in each forecast, it wasn't the prime reason for the issuance of the forecast. This demonstrates that severe hail remains a challenging area for forecasters in the British Isles, especially where relatively isolated or marginal cases exist. It should be noted that, in general, the hail reports were not part of widespread outbreaks or long-track (i.e. supercell) thunderstorms, in most instances. One exception may have been on July 19, when one or more supercells occurred over central southern England/south Midlands.

TORNADOES

Provisionally, 33 verifiable tornadoes/probable tornadoes occurred in 2014 across the UK and Republic of Ireland (Brown/Meaden/Tyrrell, *pers. comm.*). This number does not include tornadoes over the sea which did not make landfall.

Tornadoes were reported in 3 tornado watches and not in 6 tornado watches. This gives a probability of detection (POD – the % number of watches containing at least one tornado) of 33%, and a false alarm rate of 67%. This compares to a POD of 100% in 2013, 75% in 2012, 37.5% in 2011, 11% in 2010, 19% in 2009, 24% in 2008, 27.5% in 2007, 29% in 2006, and 35% in 2005.

Within the successful watches, 10 tornadoes/probable tornadoes occurred. This means 30% of 2014's tornadoes occurred within watches. This compares with 37.5% in 2013, 43% in 2012, 35% in 2011, 4% in 2010, 13% in 2009, 38% in 2008, 31% in 2007, 32% in 2006, and 33% in 2005.

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Table 1 (below) shows the number of tornadoes within each type of TORRO forecast.

Table 1. Number of tornadoes by TORRO forecast type.

Forecast Type	Number of tornadoes	Percentage
TORNADO WATCH	10	30
SEVERE THUNDERSTORM WATCH	0	0
CONVECTIVE DISCUSSION	2	6
NOT FORECAST	21	64
TOTAL	**33**	**100**

In addition, 2 tornadoes occurred in convective discussion, with 0 occurring in severe thunderstorm watches. In total, 12 out of the 33 tornadoes occurred within a TORRO forecast, which means 36% of the tornadoes developed within a TORRO forecast.

Table 2 below shows tornado occurrence in 2004-2014 as a function of TORRO's forecasts.

Table 2. Tornadoes within TORRO forecasts.

Year	Tornadoes	No. of tornadoes within TORRO forecast	No. of tornadoes not forecast
2004	51*	26 (51%)	25 (49%)
2005	63*	41 (65%)	22 (35%)
2006	70^	39 (56%)	31 (44%)
2007	51*	32 (63%)	19 (37%)
2008	13*	7 (54%)	6 (46%)
2009	39	21 (54%)	18 (46%)
2010	25	9 (36%)	16 (64%)
2011	26	15 (58%)	11 (42%)
2012	28	15 (56%)	13 (44%)
2013	24	10 (42%)	14 (58%)
2014	**33**	**12 (36%)**	**21 (64%)**
2004, '05, '06, '07, '08, '09, '10, '11, '12, '13, '14	**423**	**227 (54%)**	**196 (46%)**

* - figures based on provisional figures for those years, at the time the reviews were written.
^ - 5 more occurred, but due to forecaster absence, are not included.
Note figures for 2004-06 are based on those used in these years' forecast reviews, and may not match the actual, final tornado numbers.

CONCLUSIONS

TORRO continues to try to reserve severe weather watches for the more 'dynamic' set-ups, especially tornado watches. The point of a tornado watch is to try to pick out situations where the overall risk is rather higher than a typical 'background' day, even those days where convection is possible which could be marginally severe. This should mean that stronger tornadoes (e.g. above T2-3), or multiple tornadoes should, ideally, occur on days when a tornado watch is deemed the most appropriate product, as opposed to convective discussions or severe thunderstorm watches. In 2014, two tornadoes were given a T2-3 rating – one occurred in a tornado watch, one did not (although this was classed as a 'probable' tornado as opposed to a confirmed one). There were 3 days when five or more tornadoes occurred (although, of course, one could pick any arbitrary number to define a multiple tornado day). On 2 of these days tornado watches were in effect, and on one no forecast was in effect. This latter event (Jan 25th) was dominated by a line of thunderstorms and many of the possible tornadoes may well have been straight-line winds. Of course, ideally a severe thunderstorm watch would have been in effect for this.

As in previous years, many of the events which were not forecast were weak, isolated events, many considered as probable tornadoes rather than definite. When considering the philosophy surrounding forecasting tornadoes one must consider what a forecast is attempting to convey. In the USA, for example, a tornado watch should be issued if the expectation is that 2 or more tornadoes (or at least one (E)F2 – (E)F5 tornado) are expected (Dean et al, 2006). Watches are thus verified on that basis. The notion is that severe weather warnings are issued for organised severe weather rather than isolated and/or marginal incidences. Given that many events in the British Isles could be described as the latter then it should follow that relatively few watches should be issued. Attempts have been made in the last several years to reserve tornado watches for the more 'dynamic' events, as mentioned above. However, clearly a fairly large proportion of tornadoes occur within any form of forecast (even a TCD). The issue is that most of these are isolated, weak events from 'normal' convective cells or poor organisation. Such tornadoes, although still presenting a hazard, in reality pose a small enough threat that issuing a forecast would appear to be over-zealous.

ACKNOWLEDGEMENTS

MeteoGroup UK, for allowing the author time on shift to construct and issue TORRO forecasts, and for the provision of the NWP model data; Paul Brown, Terence Meaden, Jonathan Webb, and John Tyrrell for providing the data sets for tornadoes and hail; TORRO and UKWW members for their observations of severe weather, and severe weather discussion/forecasts/comments.

REFERENCES

Dean, A. R., Schneider, R. S., and Schaefer, J. T. (2006) Development of a comprehensive severe weather forecast verification system at the Storm Prediction Center,
retrieved from http://www.spc.noaa.gov/publications/dean/spcverf.pdf [Accessed 30 August 2015]

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A REVIEW OF THE 2014 HURRICANE, TROPICAL CYCLONE AND TYPHOON SEASON

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Abstract: 2014 was the most active year of the last seven years for hurricanes, tropical cyclones and typhoons. There were decreases in the number of storms recorded but increases in the number of hurricanes, tropical cyclones and typhoons from 2013 and a further substantial increase in the number of category 5 events, seven of which occurred in the NW Pacific region. Despite this there were much fewer fatalities and damage globally. There were above-average Southwest Indian cyclone and East Pacific hurricane seasons and average or below average activity in the other regions. Typhoon Rammasun caused the greatest number of fatalities with 195 deaths mostly in the Philippines. This event also caused the greatest damage at $7.1 billion, more than half the global total for this year. Cyclone Pam had a very exceptional lowest recorded central pressure of 896hPa and devastated the islands of Vanuatu but with few fatalities and also got the most media coverage. Hurricane Marie generated the highest recorded wind speeds of 260km/h off the coast of Mexico and California, USA.

Keywords: Hurricane, Tropical Cyclone, Typhoon, 2014.

INTRODUCTION

Worldwide, the 2014 tropical storm season was near average with a drop in the number of tropical storms recorded, but a significant increase in the numbers of those that further developed into hurricanes, cyclones and typhoons. Of the 50 hurricanes, tropical cyclones and typhoons, 29 developed into category 3 or higher events; again a significant increase on the previous year. There was also a further increase in category 5 events. Despite this, fatalities were very low globally with only 878 deaths recorded, almost exactly 10% of the previous year number and the lowest since at least 2008 (Hickey 2013, 2014). Most fatalities were recorded in the NW Pacific region where Typhoon Rammasun a category 5 event, caused 195 fatalities mostly in the Philippines.

Damage globally was at just under $14.3 billion, again substantially down on the previous year. This was the second-lowest value over the last seven years after 2009 (Hickey 2013). As with last year the major damaging event occurred in the NW Pacific region with Typhoon Rammasun, a category 5 event, generating damage in excess of $7.1 billion, mostly in the Mariana Islands, the Philippines, Hong Kong, China and Vietnam. This event alone accounted for just under half the global value of damage this year. Next most damaging was Cyclone Hudhud, a category 4 event in the North Indian region, which generated losses of $3.4 billion in India and Nepal along with 147 fatalities. Also of note is the impact of category 5 event Cyclone Pam in the South Pacific, which devastated the island archipelago of Vanuatu killing 16 people and causing losses of $250 million, as well as damaging or destroying over 90% of all buildings. This event also received the most global media coverage because of the severity of the impact on this nation (NOAA, 2014).

Neutral ENSO conditions continued from the last months of 2012 throughout all of 2013 and 2014. The dominance of neutral ENSO conditions continued with a somewhat similar outcome as 2013 with a near average year globally, but with an above-average Southwest Indian cyclone, and East Pacific hurricane seasons respectively, and below-average North Atlantic hurricane, North Indian cyclone and South Pacific cyclone seasons. 2014 also saw near average precipitation conditions across the globe for the third year in a row, but with significant variations from region to region. This year was recorded as the warmest year since records began in 1880, and the 38th consecutive year of above average global temperatures over this time period. This record temperature occurred despite neutral ENSO conditions. 2014 was 0.69°C above the 20th century average of land and ocean temperatures of 13.9°C (NOAA, 2015).

REGIONAL OVERVIEW

The Atlantic Hurricane Season was below average with only 8 storms, far fewer than last year, but of these 6 developed into hurricanes, far more than last year (Table 1). Of these, one each were categories 2, 3 and 4, and three were category 1. As a result there was very little loss of life (21) but damage of $233 million did occur. $200 million of the damage was caused by Hurricane Gonzalo, a category 4 event, with impacts stretching from the Lesser Antilles all the way to Europe. This was one of three events which had a discernible effect on Western Europe and beyond (NOAA, 2014).

The North Indian Cyclone Season was below average with just 7 storms and 2 hurricanes. All of the damage and deaths recorded for this region were as a result of Cyclone Hudhud, a category 4 event, as already discussed above.

The Southwest Indian Cyclone Season was again above average with 12.5 storms, of which 5.5 made hurricane status. The half event is a result of Cyclone Kate having affected two regions. Most of the fatalities and damage for this region were as a result of the impact of Tropical Storm Chedza on Madagascar causing 80 of the 111 total fatalities and $40 million of the $46 million total damages.

The Australian Cyclone Season was considered near average and yielded 7.5 storms and 6.5 hurricanes, this being the location of half of Cyclone Kate. There were no fatalities recorded but damage of at least $732 million, both figures down on last year. Most of the damage was caused by Cyclone Marcia, a category 4 event, which caused extensive destruction across Queensland, Australia.

The South Pacific Cyclone Season again remained below average in 2014 with 5 storms, of which only 2 were of cyclone status. Cyclone Pam, a category 5 event, caused all the damage and fatalities on the islands of Vanuatu as mentioned above.

The Northwest Pacific Typhoon Season was considerably less active than 2013 and was considered near average with 20.5 storms and out of this total there were 11.5 hurricanes. Typhoon/Hurricane Genevieve affected two regions and hence the half event. 6.5 of these storms reached category 5 strength, a considerable increase on the previous year which had four. Both fatalities and damage were considerably down on the previous year but again most of the fatalities and damage for 2014 globally occurred in this region. The major storm in terms of fatalities and damage, as mentioned above,

was Typhoon Rammasun, a category 5 event, which killed 195 people and caused $7.13 billion in damage. The next most lethal event was Tropical Depression Lingling which caused 70 fatalities but only $12.5 million of damage in the Philippines. The second most damaging event was Typhoon Matmo, a category 2 event, which caused 62 fatalities and 567 million in damages across Palau, the Philippines, Taiwan, China and Korea.

The East Pacific Hurricane Season for 2014 was exceptionally active and well above average with 20.5 storms, of which 15.5 reached hurricane strength. Typhoon/ Hurricane Genevieve was the shared event between this and the previous region. Despite this increased level of activity, both fatalities, at 45, and damage, at just over $1.4 billion were well down on 2013. Hurricane Odile caused the largest number of fatalities with 15 deaths, and most of the damage, at $1.22 billion, affecting in particular western Mexico, the Baja California peninsula and SW United States of America. Tropical Storm Trudy was the next most lethal with 8 fatalities but no recorded damage. The next most damaging was Hurricane Iselle, a category 4 event, which caused 1 fatality and $79.2 million in damages across the Hawaiian Islands.

*Table 1. Global and Regional Overview of Hurricanes, Cyclones and Typhoon (HCT) Activity in 2014 after NOAA, 2015a (*Cyclone Kate affected two regions at the same maximum category strength **Typhoon/Hurricane Genevieve affected two regions, but at different maximum strengths) after NOAA (2014).*

Region	No. of Tropical Storms	No. of Hurricanes, Cyclones and Typhoons	Overview	Fatalities	Damage $ billions
Global	79	50	Near Average	878	14.291+
Atlantic (Hurricane)	8	6	Below Average	21	0.233+
North Indian Ocean (Cyclone)	5	2	Below Average	147	3.400
Southwest Indian Ocean (Cyclone)	12.5*	5.5*	Above Average	111	0.046
Australian (Cyclone)	7.5*	6.5*	Near Average	0	0.732+
South Pacific (Cyclone)	5	2	Below Average	0	0.732+
Northwest Pacific (Typhoon)	20.5**	11.5**	Near Average	7886	22.800
East Pacific (Hurricane)	20.5**	15.5**	Above Average	45	1.220

INDIVIDUAL EVENTS

The 2014 season consisted of 6 category 3 events, an increase on 2013, 11 category 4 events, also an increase, and 12 category 5 events, a more substantial increase, with 7 of these occurring in the NW Pacific region. There is a remarkable increase in the number of category 5 events being recorded in 2013 and 2014. From 2008 to 2012 between 1 and 4 category 5 events were recorded, this rose to 7 in 2013 and 12 in 2014. Almost two-thirds of all category 5 events are recorded for the NW Pacific region.

The strongest wind recorded was in Hurricane Marie in the East Pacific region. This was a category 5 event with maximum wind speeds of 260km/h. Two events had wind speeds of 250km/h and these were Cyclone Pam (category 5) in the South Pacific region and Hurricane Amanda (category 4) in the East Pacific region. Cyclone Pam also set a new record in the Southern Hemisphere for the highest 10-minute sustained wind speed, reaching 320km/h. In addition, two events had wind speeds of 240km/h and these were Cyclone Eunice (category 5) in the SW Indian region and Hurricane Cristina (category 4) in the East Pacific region (NOAA, 2014).

The lowest recorded barometric pressure of any event was within Cyclone Pam (category 5) in the South Pacific region, with a barometric pressure of only 896hPa, one of very few events to breach the 900 hPa threshold. Two additional events reached the 900hPa threshold. These were Cyclone Eunice, a category 5 event in the SW Indian region, and Typhoon Vongfong in the NW Pacific region, also a category 5 event. Typhoon Hagupit, a category 5 event in the NW pacific region, had a barometric pressure low of 905hPa, whereas Typhoon Nuri had the fifth lowest barometric pressure of 910hPa. This was also a category 5 event in the NW Pacific region.

*Table 2. Most Intense Hurricanes (H), Cyclones (C) and Typhoons (T) in 2014 (*Cyclone Kate affected two regions at the same maximum category strength **Typhoon/Hurricane Genevieve affected two regions but at different maximum strengths) after NOAA (2014).*

Name	Intensity	Month	Location	Max Winds (km/h)	Min Pressure (hPa)
H. Edouard	3	September	N. Atlantic	195	955
H. Gonzola	4	October	N. Atlantic	230	940
C. Hudhud	4	October	N. Indian	185	950
C. Nilofar	4	October	N. Indian	205	950
C. Kate*	3	December	SW. Indian	175	947
C. Bansi	5	January	SW. Indian	220	923
C. Eunice	5	January	SW. Indian	240	900
C. Kate*	3	December	Australian	175	947
C. Lam	3	February	Australian	185	943
C. Marcia	4	February	Australian	205	930
C. Ikola	3	April	Australian	175	951
C. Quang	4	April	Australian	195	945
C. Pam	5	March	S. Pacific	250	896

Name	Intensity	Month	Location	Max Winds (km/h)	Min Pressure (hPa)
T. Neoguri	5	July	NW. Pacific	185	930
T. Rammasun	5	July	NW. Pacific	165	935
T. Halong	5	August	NW. Pacific	195	920
T. Genevieve**	5	August	NW. Pacific	205	915
T. Phanfone	4	October	NW. Pacific	175	935
T. Vongfong	5	October	NW. Pacific	215	900
T. Nuri	5	November	NW. Pacific	205	910
T. Hagupit	5	December	NW. Pacific	215	905
H. Amanda	4	May	E. Pacific	250	932
H. Cristina	4	June	E. Pacific	240	935
H. Genevieve**	4	July	E. Pacific	215	960
H. Iselle	4	August	E. Pacific	220	947
H. Julio	3	August	E. Pacific	195	960
H. Marie	5	August	E. Pacific	260	918
H. Norbert	3	September	E. Pacific	205	950
H. Odile	4	September	E. Pacific	220	918
H. Simon	4	October	E. Pacific	215	946

IMPACT ON EUROPE

Despite the below-average Atlantic hurricane season three hurricanes had an impact on NW Europe and beyond. Hurricane Bertha, a category 1 event, was only a hurricane from the 4 to 6 August. However, its extratropical remnant, when combined with an approaching trough from the west, survived until 16th August and produced high winds particularly in Ireland, the United Kingdom and Germany, unseasonable rains and flooding in Ireland, England and Scotland, and a small tornado outbreak in England, Luxembourg, Belgium, France and Germany. This remnant also produced a band of severe weather stretching from Sweden to France. One person on a yacht was killed offshore of England and a further 97 people were treated for hypothermia after 20 sailboats capsized during a race in Strangford Lough, Northern Ireland. This included one person who was treated for injuries sustained as well. In Luxembourg a further four people were seriously hurt as a result of the touchdown of a tornado at an outdoor event. No figures are currently available for the damage caused by this event. Hurricane Cristobal, a category 1 event, made landfall on Iceland as an extratropical storm on 1st September and caused high winds and some flooding in Reykjavík.

Hurricane Gonzalo, a category 4 event, remained a hurricane from 12th October until the 18th, but then remained a powerful extratropical storm until 20th October. It generated very strong winds over Ireland, England, Wales and Scotland and most of western and

central Europe, especially Germany, Austria and Switzerland. The highest wind speed at low levels was recorded at Oban in Scotland with a gust of 142km/h, and in NW Ireland with gusts of 115km/h. At elevation in Switzerland gusts of up to 185km/h were recorded, whilst in Germany gusts peaked at 145km/h. These high winds generated lots of damage including trees down and damage to structures. There was significant disruption to transport links with over 100 flights cancelled at Heathrow Airport, London. There were also some power outages across Europe. In addition the storm generated a significant storm surge in the North Sea, a tornado in Austria, and a Mistral in southern France. Significant snowfalls occurred on the Alps as a result of an upper level low from the extratropical remnant, which also generated torrential rain causing serious flooding in parts of Bulgaria, and in Athens, Greece. Three people were killed directly: two in the UK and one in Bulgaria and two more were killed as a result of weather-related traffic accidents, one each in the UK and Germany. Falling trees in London also injured several other people. There is no overall figure for the losses generated by this event in Europe but German insured losses were estimated at between 60 and 100 million Euros.

Since 1960 only 5 hurricanes, tropical storms or their remnants have caused fatalities in Europe (Hickey, 2011). An additional two events have been added to this list in 2014, generating an additional 6 fatalities either directly or indirectly.

REFERENCES

HICKEY K. R. (2011) The Impact of Hurricanes on the Weather of Western Europe. In, Lupo A. (ed) *Recent Hurricane Research – Climate, Dynamics, and Societal Impacts,* InTech, Croatia, 77-84.

HICKEY K. R. (2013) A review of the 2012 Hurricane, Tropical Cyclone and Typhoon Season, *Int. J. Meteorology, UK,* 38, 176-181.

HICKEY K. R. (2014) A review of the 2013 Hurricane, Tropical Cyclone and Typhoon Season, *Int. J. Meteorology*, *UK,* 39, 154-159.

NOAA (2014) Significant Climate Anomalies and Events in 2014 @ www.nhc.noaa.gov [Accessed 30 August 2015].

NOAA (2015) State of the Climate Report Annual 2014 @ www.nhc.noaa.gov [Accessed 30 August 2015].

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BALL LIGHTNING IN THE BRITISH ISLES REVIEW 2014

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Abstract: Four ball lightning reports were received in 2014; 3 occurred in England and one in Guernsey, the Channel Islands. The English events occurred on 17-19 July and were very different in nature.

As always stated in these reviews, ball lightning is a largely unreported phenomenon and more events will probably come to light in due course.

Report 1: Night of 17th into the 18th July – Fleetwood Nautical College, Broadwater, Fleetwood, Lancashire.
The following message was sent to me by Cadet Peter Wilson:
"A colleague of mine at the Nautical College took a photograph of some strange-looking Lightning last night over Fleetwood. Do you think that it could be ball lightning?"

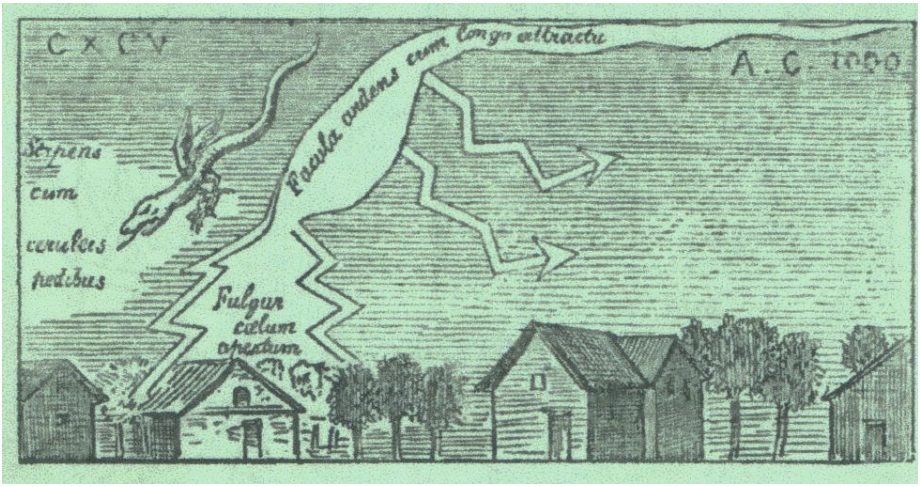
Written permission has been received to publish the photo below, Figure 1a.

Figure 1a. Phenomenon photographed from Fleetwood Nautical College, 17/18.07.2014 © Peter Wilson.

It appears to show a vast and complex light-emitting body: clearly not a globe of light and certainly not a commonly reported form of BL. What does the photo record? With an absence of more data, and rather than incur the wrath of an increasingly sceptical world, let us just say that it is a curiosity well worth recording.

The object in the photo bears a resemblance to a phenomenon reported to have been seen over Europe in 1000 AD - see figure 1b below.

Figure 1b. 'Draco Volans' 1000 AD from Amédée Guillemin, The World of Comets, p20, London, Sampson Low, Marston, Searle, & Elvington, 1877. Tinted version by Peter van Doorn.



Report 2: 18 July - Ball lightning damages house in London SW16
At close to 0230 BST on 18 July the roof of a house in Hoadly Road, Streatham, London SW16, was set on fire and destroyed after the explosion of a "big red ball of lightning." The chimney stack was also brought down. A neighbour described a "ball of fire" that caused an explosion "like a bomb going off."

Report 3: 19 July – Ball lightning manifested in two houses at Bradford-on-Avon, West Wiltshire 1010 BST (Saturday)
Reported by Dr. Terence Meaden, founder of TORRO:
At 1010 BST, Dr. Meaden, resident at Whitehill, was working on his computer when he heard a sudden crash of thunder overhead – he immediately made an entry in his diary, noting that "a tree or house nearby would have been hit."

At the same time a house was actually struck by lightning: number 22 Berryfield Road; his daughter, Isabella Meaden, lives at 33 Berryfield Road, about 500 metres distant from Terence's residence.

At 35 Berryfield Road, Isabella's neighbour John observed a ball of purple light. A lady in Bath Road also saw a ball of light - her house is about 250 metres from the lightning-damaged property.

Terence's notes (edited): "Isabella, looking west from her dining-room window felt herself tingling just before the overhead crash of thunder. Later, she found that her

telephone was down and Sky-box wrecked."

"John's house is semi-attached to Isabella's. He was in the kitchen, hands in water, facing west. He felt tingling, withdrew his hands, saw a purple ball of lightning in the kitchen to his left. Diameter about 100 mm. It immediately disappeared (vanished/ imploded?), and then came the peal of thunder almost at once. His wife, upstairs, had the same experience of tingling. No electrical damage at this house. John is aged 66."

"Next door, at number 37, Sharon Shepherd, phone lost and the BT Internet connection too. Number 39 lost phone too."

"No. 22 Berryfield Road was struck, and all electrical circuits wrecked. The owners are obliged to live in a hotel and will do so for weeks. The chimney of their bungalow was damaged. The TV aerial on it does not look bent."

"All the homes on that side of the street have lost telephones (i.e. at least ten houses). The primary school behind these houses has lost its telephones."

"My daughter spoke with Doreen who lives opposite [her house]. A passing couple had stopped, and the lady said that she saw ball lightning at her home too. Her address came to me as Bath Road."

"There were two entirely different sightings of ball lightning, both occurring something like milliseconds before the lightning strike." "Damage to the struck bungalow about £30,000."

A very interesting event that clearly demonstrates the complexity of the ball lightning phenomenon. Both anomalies appear to have been BL in its Static Apparition Mode.

Report 4: 18 September - Guernsey, Channel Islands

Paul Domaille, TORRO Regional Co-ordinator for the Channel Islands, posted the following:

"This morning between about 0445 and 0715 we had a pretty intense thunderstorm accompanied by heavy rain. This evening I had a call from a gentleman who was put on to me by Guernsey Met office to say his son-in-law had witnessed something. Looking out of the window at the storm at about 0715 he heard a bang and saw an orange light appear in the garden of the house opposite, an orange ball rose up and then 'shot off.' The gentleman who called me was also watching the storm at the same time, they live about 1/2 a mile apart. He said he heard a very loud bang, more like a gunshot than the noise normally associated with thunder, then he heard what he described as a 'screeching' wind coming towards him, about 3-4 seconds after the first bang a second occurred which he guessed was fairly low overhead and then about 3-4 seconds later a further loud bang."

A very weird event, but one has to accept that ball lightning is extremely strange in nature with often inexplicable concomitant phenomena.

REFERENCES

Report 2. ITV/London Fire Brigade http://www.itv.com/news/london/2014-07-18/family-flees-after-lightning-bolt-triggers-fire-in-their-home/ [Accessed 30 August 2015].

Report 3. TORRO Members Forum, 21 and 25 July 2014.

Report 4. TORRO Members Forum, 18 September 2014.

TORRO TORNADO DIVISION REPORT: November to December 2014

BY PAUL R. BROWN AND G.TERENCE MEADEN

The first half of November 2014 was cyclonic but high pressure was more prevalent in the second half of the month; one tornado, two funnel clouds, and four waterspouts were reported this month. December was dominated by mild westerly types apart from the last few days, which were anticyclonic; just one funnel cloud was reported.

FC2014Nov02 *St Mawgan, Cornwall (c 50° 26' N 5° 01' W, SW 8664)*

A distant funnel cloud was reported in the 0820 GMT METAR from St Mawgan Airfield.

At 0600 GMT a cold front was crossing central England followed by an unstable westerly airstream. Outbreaks of rain were followed by showers, mainly in the west, where a few turned thundery later in the day.

TN2014Nov02 *Coalville, Leicestershire (52° 43' N 1° 23' W to 52° 44' N 1° 22' W, SK 420136 to SK 429145)*

The *Leicester Mercury* of 2 November reported that a 'mini-tornado' had caused damage in Coalville town centre early that morning. Garden furniture and fences were blown away, roof tiles were removed (damaging parked motor cars), and full rubbish bins were seen flying through the air. A resident in Wentworth Road, Ms Katheryn Crick, said: "I woke up to this terrific rumbling and whirring sound. The windows were shaking violently ... I honestly thought it was an earthquake. But listening to this tremendous noise, you could hear it moving. It was like a giant vacuum cleaner passing over the top of the house ... I looked outside and you could see its path in the field behind the house. There were fence panels down and branches everywhere. My next door neighbour's roof tiles came crashing down into the gardens below and a trampoline was lifted up and thrown into a fence ...". Other streets affected were Gutteridge Street (SK 423138), Belvoir Road (SK 424139), London Road, High Street, and Hotel Street (all about SK 426142), together with neighbouring roads.

Sam Jowett (formerly of TORRO) visited the scene during the day and found a track approaching a mile in length (1.3 km by grid references) and up to 100 metres wide, southwest to northeast from Wentworth Road to Stenson Road. Time 0710 GMT. Force T2.

WS2014Nov04 *offshore Ilfracombe, Devon (c 51° 13' N 4° 08' W, SS 5148)*

Ms Charmain Lovett sent us a photograph taken by Mr Garry Edworthy showing a waterspout out at sea from Ilfracombe at 0705 GMT. At 0600 GMT a broad trough of low pressure covered the British Isles from a low, 984 mb, near south Norway. There were showers in many northern and western areas (as well as in the English Channel, where they became thundery later).

FC2014Nov09 *Poole Harbour, Dorset (c 50° 43' N 2° 02' W, SY 9890)*

Mr Ian Brown photographed a short funnel cloud (which had earlier been longer) from Lake Pier in Poole Harbour, looking towards Kingston (to south), timed at 1520 GMT. There was a thunderstorm a little later. At 1200 GMT a complex shallow depression covered the British Isles, having centres of 998mb over Ireland and 994-997mb north of Scotland. There were scattered showers, some thundery, mainly in the west and south.

WS2014Nov15/I *Kimmeridge Bay, Dorset (50° 36' N 2° 09' W, SY 9078)*

Dr Patricia Mathers sent us an account of this waterspout, which moved slowly west for 10 minutes across Kimmeridge Bay at about 1415 GMT. Her photograph shows a tenuous funnel reaching from cloud to sea; another picture, from Ms Hayley Watson, is similar.

At 1200 GMT a weak southeasterly airstream covered the British Isles associated with a complex depression, 983mb, west of Ireland. Most inland places were dry, but showers affected southern and eastern coasts (and were thundery locally in the west).

WS2014Nov15/II *Joss Bay, North Foreland, Kent (51° 23' N 1° 27' E, TR 4070)*

Several accounts were received of this waterspout, and it was reported in the *Isle of Thanet Gazette* (15 November). In the photographs we have seen the visible funnel cloud does not quite reach the sea but there is much disturbance of the water beneath it. The time was about 1430-1445 GMT. Mr Nick Parnell of TORRO sent us a detailed account as seen from a fishing boat about a mile off Margate; the waterspout was towards Ramsgate and apparently only a few hundred metres from the beach. It moved slowly north or northwest towards the land for 10 minutes before disappearing.

WS2014Nov18 *offshore Bexhill, East Sussex (c 50° 50' N 0° 27' E, TQ 7306)*

A waterspout was seen off the East Sussex coast at 1100 GMT. Ms Sharon Glamma Webster photographed it from Bexhill, and the *Eastbourne Herald* (19 November) published a picture taken by Mr Matt Neumann at Eastbourne: the former shows a long vertical funnel, not quite reaching the sea but disturbing the water beneath it; the latter shows a shorter thicker funnel (sea not visible in the photograph). At 1200 GMT an easterly airstream covered the British Isles between a shallow trough over France and a large high over Russia. Most places were dry but there were showers in southeast England and eastern Scotland.

FC2014Dec05 *Hoy, Orkney Islands (c 58° 54' N 3° 21' W, HY 2202)*

Photographs were received from Ms Kathie Touin showing a distant oblique funnel cloud about halfway to ground (it had been longer before) over the north of Hoy at about 1530 GMT. At 1200 GMT a cold front was crossing central England followed by a northwesterly airstream. There was a little rain on the front, then scattered showers (and isolated thunder) round northern and western coasts.

Annual totals for 2014

The total of tornadoes in the British Isles (including Ireland) for 2014 is 36, four of which were in the Irish Republic; January, August, and October were the most productive months, having three-quarters of the year's tornadoes between them. Two tornadoes began over the sea as waterspouts, and there were another 20 waterspouts

that did not reach land, three of these being in the Irish Republic. 186 reports of funnel clouds were received during the year, of which 27 were in the Irish Republic. There were also 10 land devils, one of which was in the Republic.

ACKNOWLEDGEMENTS
We are indebted to Peter Kirk of TORRO for discovering and making enquiries about several of the reports, and to Sam Jowett for investigating the Coalville tornado.

BOOK REVIEW:
TAMBORA: The Eruption That Changed the World

by Gillen D'Arcy Wood
Princeton University Press
US$29.95 Hardback (also available in paperback). 293pp.
ISBN: 978-0-691-15054-3 (2014)

This is the title of a detailed examination of the volcanic eruption of Mount Tambora in Indonesia in March 1815, and its effects on the weather and climate of much of North America and Europe over the following three years.

Written by Gillen D'Arcy Wood, Professor of English at University of Illinois, Urbana-Champaign, it is a vivid account not only of the immediate effects but what is generally accepted to have been the most destructive period of weather the world has witnessed in the last thousand years.

Many people have heard of 'The year without a summer' in 1816. This was the year in which Mary Shelley's "Frankenstein" and Byron's "Childe Harold's Pilgrimage" were written when the authors, on holiday in Switzerland, were more or less confined indoors by incessant rain. This book, however, while covering these events very fully, ranges much more widely and chronicles the effect on so many localities worldwide. Thus, we learn of the worldwide cholera pandemic, the expansion of the opium market in China and set the stage for Ireland's great famine and the United States great depression of the 1930s.

Being an American academic, the author goes into great detail on the political consequences of the eruption in the USA. The chapter headings of the nine chapters well illustrate this: "Frankenstein's Weather" and "This End of the World Weather" are two examples.

There are many illustrations ranging from an aerial view of the Tambora caldera to a map of the spread of the cholera epidemic which add considerably to the value of this book. Each chapter has detailed notes and the bibliography and index are comprehensive.

I found this book extremely interesting and instructive and can wholeheartedly recommend it to readers of this journal.

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BOOK REVIEW:
The Ice Age - A Very Short Introduction

by Jamie Woodward
Open University Press
£7.99 Paperback. 163pp.
ISBN: 978-0-19-958069-9 (2014)

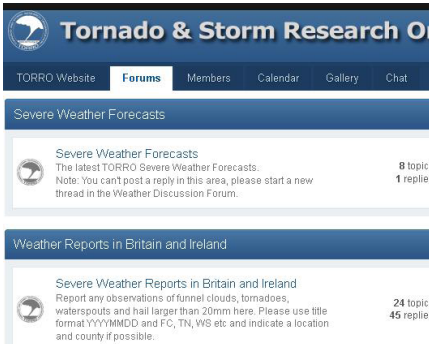
This is a recent addition to the very successful series produced by O.U.P. which include volumes on climate change and other subjects likely to be of interest to readers of this journal. The author is Professor of Physical Geography at the University of Manchester and a Fellow of the Royal Geographical Society.

All the volumes in this series are admirable summaries of the latest science of a particular subject covered and all are clearly written in non-technical language readily understandable by laymen.

This volume has nine chapters ranging from 'Quaternary ice age' to 'deep ocean sediments and dating the past'. It has no less than 33 black and white illustrations ranging from graphs to photographs and in the opinion of this reviewer gives an admirably succinct summary.

The price of this pocket-size paperback is extremely reasonable and the amount of solid reading makes it an ideal book for a long train journey.

TORRO FORUM



It is now over two years since the new style TORRO forum went online.

It is a private forum only available to TORRO members and individual IJMet subscribers. Here we discuss the forecasts, severe weather events and site investigations.

If you have not received a log on via email and wish to have access to our forum please contact:
membership@torro.org.uk

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