TORRO site investigations

Documenting storm damage in the UK and Ireland

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Talk outline

- Purpose of site investigations
- A brief history of site investigations in the UK
- Arranging and conducting investigations
- Some recent examples:
  - Flash flood
  - Microburst
  - Tornadoes

Near Dunnington, Yorkshire, 3 August 2012 ((c)Tim Prosser)
Purpose of site investigations

- To document the damage, its severity and extent (field notes, annotated maps and photographs)
- To obtain accounts and information from eyewitnesses
- To establish the most likely cause of the damage (i.e. tornado, downburst, other thunderstorm-related winds, flooding etc.)
- To assist with media enquiries at the scene (usually only applies to the larger events)
- To record findings for future reference (TORRO tornado database entry; more detailed write-up e.g. in *Int. J. Meteorology* or *Weather* where possible)
A (very) brief history of site investigations in the UK

- Interest in tornadoes and other storm damage increased markedly during the 19th Century.

- Some early examples of site investigations appear in the *Quarterly Journal of the Royal Meteorological Society*.

- E.g. G. J. Symons, 1900 (QJRMS Vol. 26 No. 116).

- Notable investigations in the early-mid 20th Century include:

- In recent decades large majority of investigations have been undertaken by TORRO members.

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**THE WILTSHIRE WHIRLWIND OF OCTOBER 1, 1899.**

**BY THE LATE G. J. SYMONS, F.R.S.**

(Plate XIII.)

[Read May 16, 1900.]

It has been the author's privilege to visit the sites of many of these disturbances during more than thirty years, and also during that period to receive particulars of the paths of many others, with maps, photographs, and other illustrations. He is not now submitting a paper upon whirlwinds in general, but upon that of October 1, 1899, and he refers to previous ones merely to say that, as regards force, he has seen more remarkable manifestations at Baldock, Hertfordshire, in 1875, and Walmer in 1878. With regard to direction there is a curious parallelism between the track herein to be described and that of the Cowes whirlwind of September 28, 1876. The fact of the one occurring within three days of the anniversary of the other may be a mere coincidence. But as regards direction there are some facts still more curious, but which cannot be considered now. It is hoped that some one will take them up on another occasion. The author now gives merely the dates and the angles with the meridian of all the whirlwinds in the south-east of England which he can find or has himself determined:

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1729. May 20.</td>
<td>Pevensey Bay to Newingden Level</td>
<td>N. 24° E.</td>
</tr>
<tr>
<td>1727. July 25.</td>
<td>Wantage</td>
<td>N. 22° E.</td>
</tr>
<tr>
<td>1727. Nov. 30.</td>
<td>Banbury (a curved track but about)</td>
<td>N. 10° E.</td>
</tr>
<tr>
<td>1786. Sept. 28.</td>
<td>Cowes</td>
<td>N. 30° E.</td>
</tr>
</tbody>
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G. J. Symons, QJRMS 26 No. 116
Sources of damage reports

“Tornadoes at breakfast leave a trial of destruction”
The Guardian, 24 Sep 2007

“25 people rescued after giant hailstone hits Devon village”
The Mirror, 30 Oct 2008

“Freak ‘mini tornado’ rips through city allotments”
Peterborough Today, 4 April 2013

“‘Mini hurricane’ devastates garden”
The Telegraph, 22 Jan 2009

“Freak twister hits streets in Bognor Regis AGAIN”
Mail Online, 8 Jul 2011

Initial reports of damage reach TORRO via:

Articles in the media
Sources of damage reports

Initial reports of damage reach TORRO via:

- Articles in the media
- Other online forums e.g. UK Weather World
- Eyewitness reports to the Met Office, which are forwarded to TORRO
Before the site investigation

- Damage/eyewitness reports routinely published on the TORRO members’ forum
- Members may then volunteer to undertake an investigation
- TORRO has a network of volunteers across the UK and Ireland – good chance that at least one member will live close to the location of the reported damage and be able to take a look
- Storm track (and therefore likely damage track) can often be inferred from supplementary data such as radar imagery
- Multiple investigators and/or several separate trips are sometimes required

3 Nov 2009: initial damage reports (red dots)

3 Nov 2009: tornado tracks confirmed following site investigations (bold red lines)
**How to conduct a site investigation**

- No particular expertise required – just an ability to carefully observe and document the damage.

- **Safety is paramount** – be aware of hazards such as fallen power lines; surveys should be undertaken on foot; seek prior permission from the landowner before accessing private land.

- Good technique is to start at initial damage report location(s) and then traverse the projected track (e.g. as suggested by radar data) wherever possible.

- Note the damage (or absence of damage) at each location, to gradually build up a picture of extent and severity of damage.

*Sancreed tornado: 16 Dec 2012*
Some specific details to record

- Width and length of damage track(s)
- Throw direction of debris e.g. direction in which trees are felled

- **Indicators of severity** (see T Scale descriptors at [www.torro.org.uk/site/tscale.php](http://www.torro.org.uk/site/tscale.php)):
  - Extent of roof/wall damage to buildings
  - Size, weight, distance of throw and resting positions of various debris
  - Approx. numbers, diameters of felled/snapped trees
  - Any other unusual or exceptional instances of damage e.g. shearing effects or sharp gradients in damage intensity

- **Photographs are extremely useful**
  - Note date, time, location and viewing direction for each photo

- **Eyewitness accounts**
  - Estimated time and duration of event
  - Visual and audio description e.g. sequence of events, estimated direction of travel of phenomenon if known, lofting of debris, noise accompanying event
  - Ask whether any further damage was sustained that may not readily be seen (not all damage is immediately apparent or accessible)
  - Any other known damage in the immediate vicinity or further afield?
Example 1: East Devon flash flood of 30 October 2008

- Intense, prolonged thunderstorm in the early hours caused flash flooding and large accumulations of hail in Ottery St Mary and surrounding villages.

- Several site investigations conducted over following two weeks, earliest just over 24 hours after event.

- Appeal for information via the Norman Lockyer Society's Meteorology Group (Sidmouth) provided numerous eyewitness accounts.
• Houses and other premises flooded in Coombelake and Taleford

• 1 metre (3 foot) hail drifts in fields and on roadside

• Thorne Farm Way area: houses flooded up to 1 metre (3 foot) depth, extensive hail deposits 30-60cm deep

• Many landslides along road cutting

• Many deep (30 – 60cm) hail deposits, general flooding from surface run-off

• 20 – 25cm lying hail reported in Toadpit Lane area of West Hill

• West Hill: reports of damage to conservatories due to weight of hail

• Flooding of property in Alfington

• Small sections of hedges washed away along B road

• Cars washed downstream and severe flooding along Furze Brook within Ottery St Mary

• Severe flooding along course of stream, further hail drifts, hedges washed away, properties flooded

• Extensive hail deposits up to 1 metre in depth in fields and along roadside. Deep deposits of mud and stones, small landslides

(c) Google maps (available online: maps.google.co.uk)
Example 1: East Devon flash flood of 30 October 2008

Maximum level hail depths as estimated by eyewitnesses (cm)
Example 1: East Devon flash flood of 30 October 2008

- Final hail depth map (shading) constructed by combining interpolation of eyewitness estimates of depths and assessing distribution of residual hail depths over open ground at the time of the SIs.

- Good qualitative agreement between distribution of reported hail depths, radar precipitation totals (dashed lines) and locations of the most severe flood damage (red shading).
Example 2: Microburst near York on 3 August 2011

- Localised wind damage to the east of York, associated with a severe thunderstorm
  
- Many trees snapped or uprooted, some minor damage to buildings in village of Dunnington
  
- Wind-driven hail up to marble size accompanied the storm with some minor pitting of paintwork reported

Photos courtesy and copyright Tim Prosser and Louise Hill, 2011
Example 2: Microburst near York on 3 August 2011

- Fall direction of trees was a critical piece of evidence in this case – note the diverging pattern across the main damage area.

- Also note the ‘fan-shaped’ footprint of damage in this area (as opposed to a narrow line).

- Both features are indicative of a microburst – an intense, but small scale (<4km diameter), downdraft which spreads out upon encountering the ground.
Example 3: Tornado at Monkwood, Hampshire on 3 November 2009

- One of nine tornadoes across southern England, associated with an active cold front
- Numerous site investigations were undertaken after the event, ~6 different investigators
- Most tornadoes reported in the media, additional ones found by subsequent site investigations following analysis of radar data, which showed strong circulations elsewhere along the cold front's track
- Monkwood tornado was strongest – produced some roof damage and significant tree damage
- Narrow, relatively straight damage track extending for ~2 km
Example 3: Tornado at Monkwood, Hampshire on 3 November 2009

- Many trees snapped off several metres above ground level
- Throw direction difficult to establish in places due to clear-up work having started – generally to the east (i.e. down track) where observable
- Very well-defined edge to damage track with strong gradient in the intensity of damage
Example 4: Sancreed, Cornwall tornado of 16 December 2012

- Produced by a thunderstorm which formed over the sea to the SW of Cornwall
- Narrow, well-defined damage track
- Damage track ~4.0 km long but ≤ 50m wide
- Damage to farm buildings and trees
- eyewitness information revealed additional points of damage along storm’s track e.g. second tornado track further northeast, near St Erth
Summary

- Site investigations have resulted in a credible tornado and storm damage database, from which comprehensive climatologies have been constructed.

- Applications include:
  - Meteorological research
  - Insurance industry
  - Nuclear power industry

- Please help us in our ongoing work...by reporting any incidences of storm damage to TORRO via the online form....or better still, why not join us if interested?!!

THANK YOU