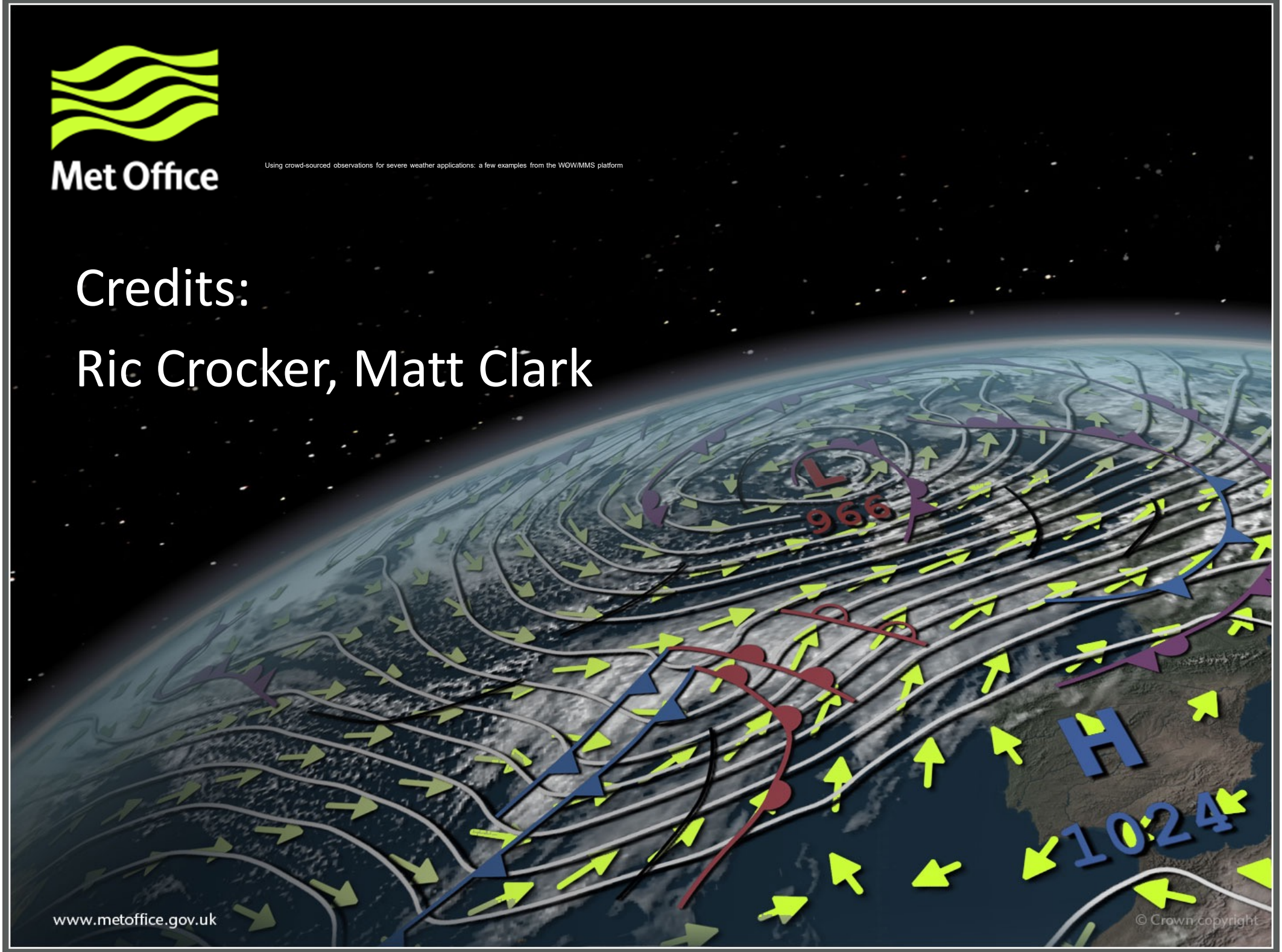
Met Office

Using crowd-sourced observations for severe weather applications: a few examples from the WOW/MMS platform

Credits:

Ric Crocker, Matt Clark



Introduction

- WOW impact observations
- What have we got ?
- How can we use them ?
- Case Study(s)
- Verification issues
- Time-to-space mapping
- Combining data sources

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7IVMW

Can ad-hoc citizen observations be used to verify weather warnings?

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(Manuscript received October 27, 2017; in revised form June 26, 2018; accepted July 30, 2018)

Abstract

National weather warnings are a major part of a national meteorological organisation's remit. These warnings convey information about periods of severe weather which forecasters have deemed likely to have an impact on the public. The impacts are typically presented on a scale running from minor up to severe. Citizen submitted impact observations have been assessed to see whether they have the potential to verify the quality of weather warnings in terms of impact rather than meteorological accuracy. The observations are shown to provide useful information which can enhance subjective assessment of specific cases. It is demonstrated that this set of observations are not yet suitable for routine objective verification due to the sporadic nature of the data and the problem of missing correct negatives when forming contingency tables.

Keywords: citizen observations, weather warnings, verification, impacts

On the Mesoscale Structure of Surface Wind and Pressure Fields near Tornadic and Nontornadic Cold Fronts

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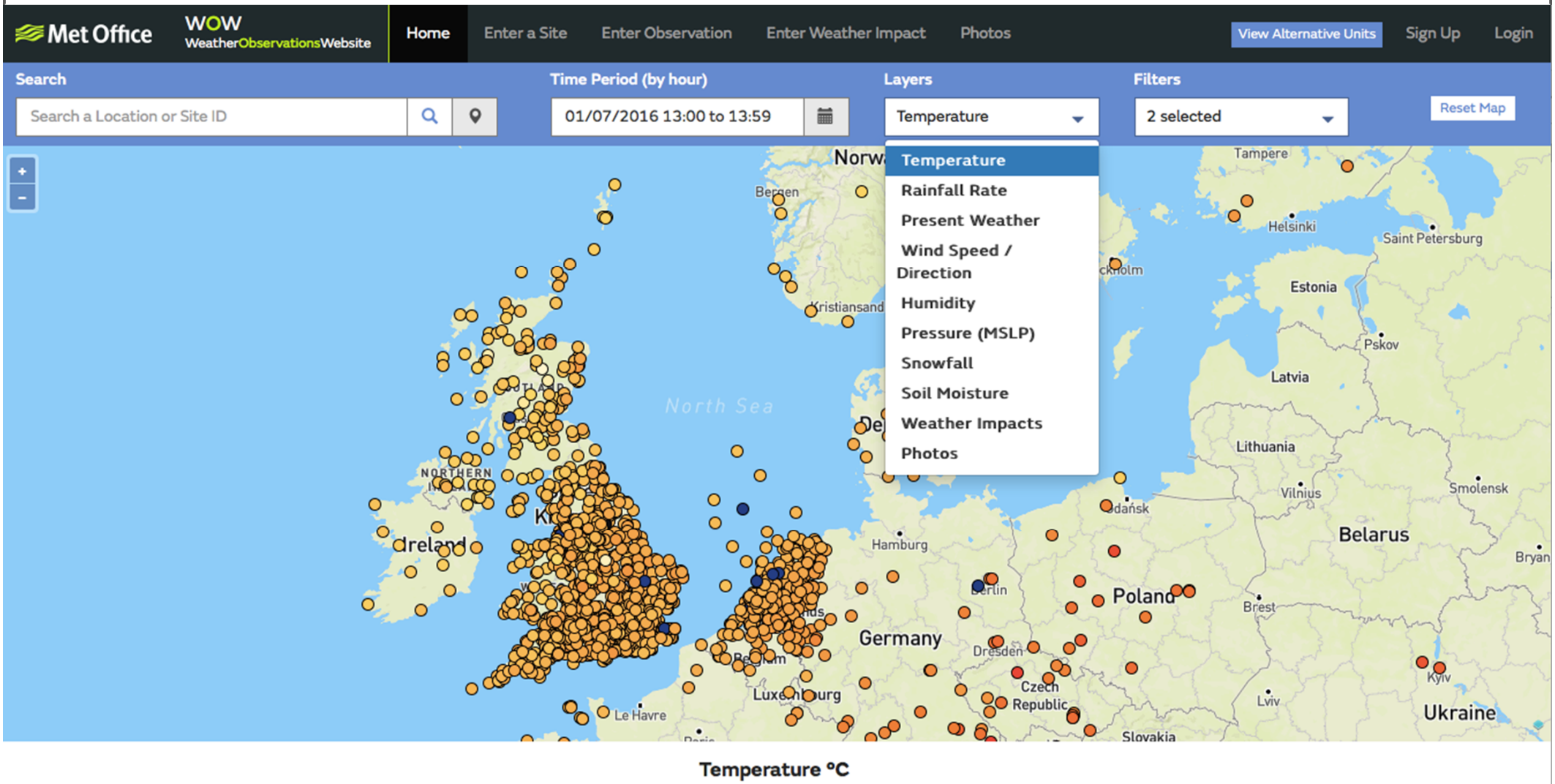
Weather Observations Website (WOW)

(wow.metoffice.gov.uk)



WOW Impact reports

4. Add a Photo

Upload a file

Jpeg, gif and png-24 image formats supported

5. Select the type of weather effects you wish to use

- [x] Travel Disruption
- [x] Property or Infrastructure Damage
- [x] Personal Health and Safety
- [x] Utility Disruption
- [x] Service or Business Disruption
- [x] Agriculture Habitat Damage
- [x] Disruption to Camping Events Leisure Activities

Continue

Choose the causes of each weather effect

1. Travel Disruption

Select an impact level

LOW	MEDIUM	HIGH	VERY HIGH
1 - Difficult travelling conditions resulting in slow moving traffic, minor delays to commuting and public transport.	2 - Longer journey times, local disruption to travel and service delays to public transport, fords impassable.	3 - Roads closed, widespread disruption to public transport and/or Police advice not to travel.	4 - Entire public transport networks suspended, prolonged road closures and/or motorists stranded in vehicles.

5. Service or Business Disruption

Select an impact level

LOW	MEDIUM	HIGH	VERY HIGH
1 - Business/school closed early.	2 - Business/school closed whole day.	3 - Multiple businesses/schools closed and some disruption to other public services.	4 - Multiple businesses/schools closed and widespread disruption to other public services.

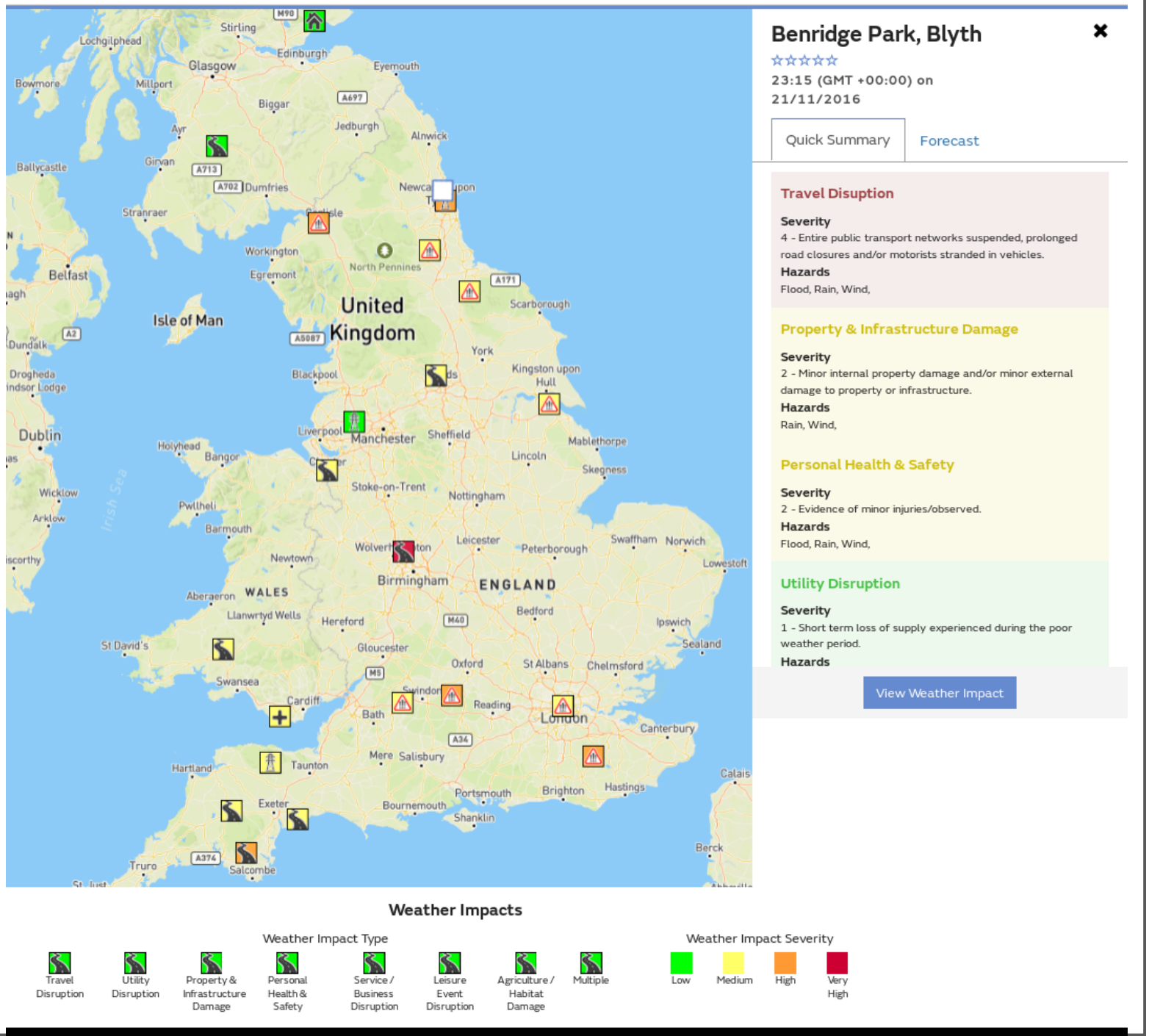
7. Disruption to Camping Events Leisure Activities

Select an impact level

LOW	MEDIUM	HIGH	VERY HIGH
1 - Minor effects on tents or recreational activities.	2 - Tents severely affected / small scale event e.g. village fair or recreational activities affected.	3 - Tents destroyed, caravans slightly affected / small scale event or recreational activities abandoned or cancelled / major event (>10,000 attendees) affected.	4 - caravans severely affected or destroyed / major events severely affected e.g. cancellation or abandonment of major music festival (>10,000 attendees).

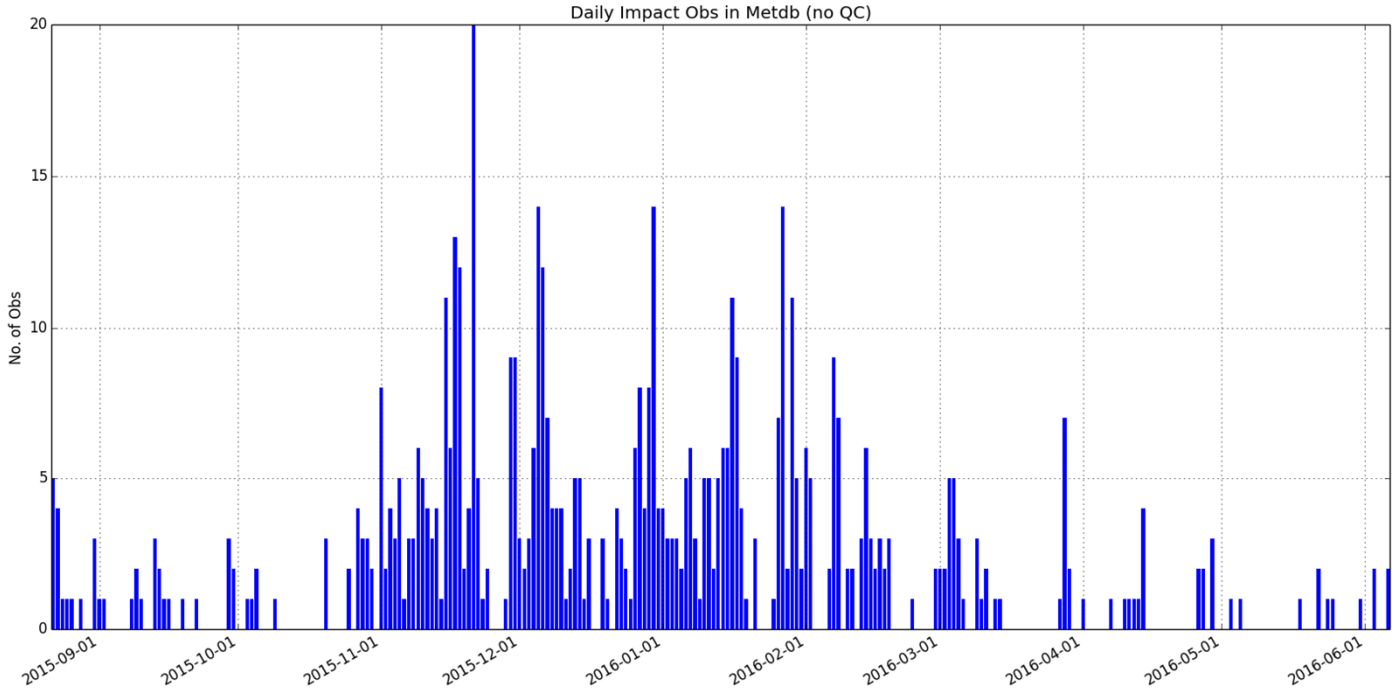
Met Office

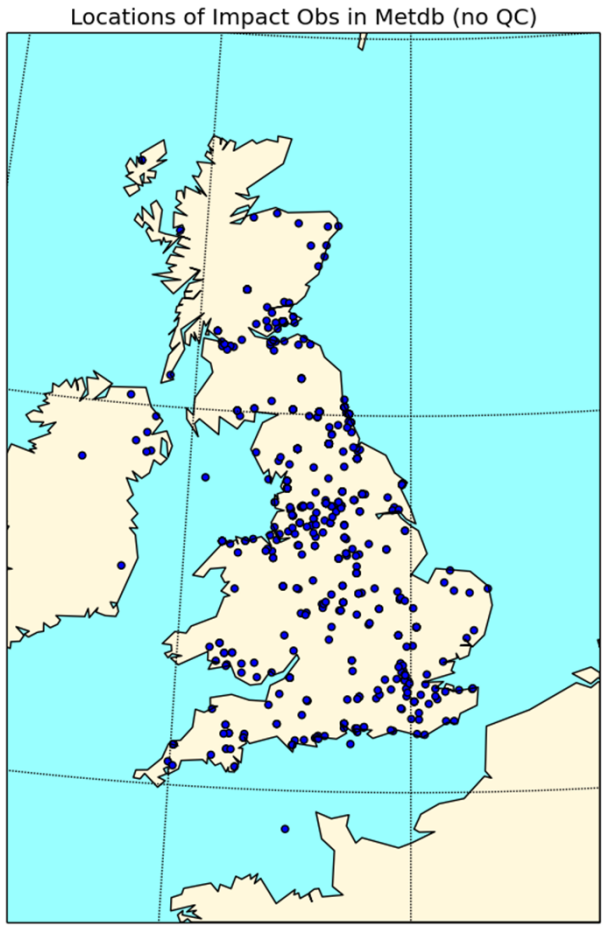
Impact Obs reported this week (up to Thurs 24th):-



Non-QC'd daily impact ops

20 Aug 15 – 07 Jun 2016





591 reports, 322 unique lat-lon positions, locations widespread

20 reports on 20/11/15

Reports are in clusters - event driven, not just regular reporting sites but significant number of the one-off reports (suggests a willingness to report events, certainly in more populated areas.

User Distribution of Impact reports

One site made 43 reports

246 sites made 1 report

(out of 591 reports)

Do we have a mix of enthusiasts and sporadic users?

QC is important as we will see later.

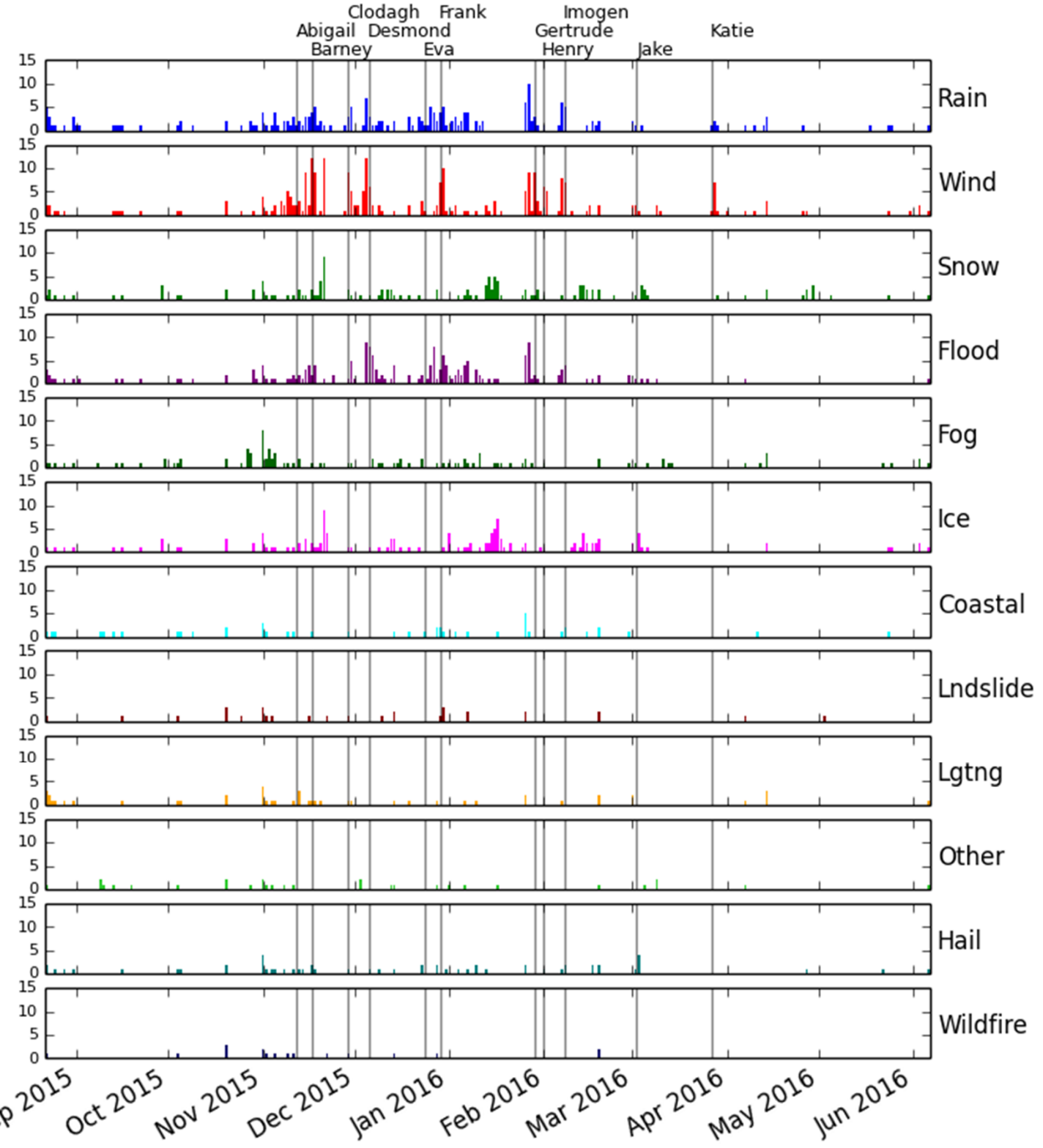
Total No. of Reports Made	No. of Unique Sites
43	1
33	1
17	1
13	2
10	2
9	2
8	1
7	2
6	1
5	1
4	8
3	15

Reports by weather hazard

Rain, snow, ice, wind and flood occur frequently.

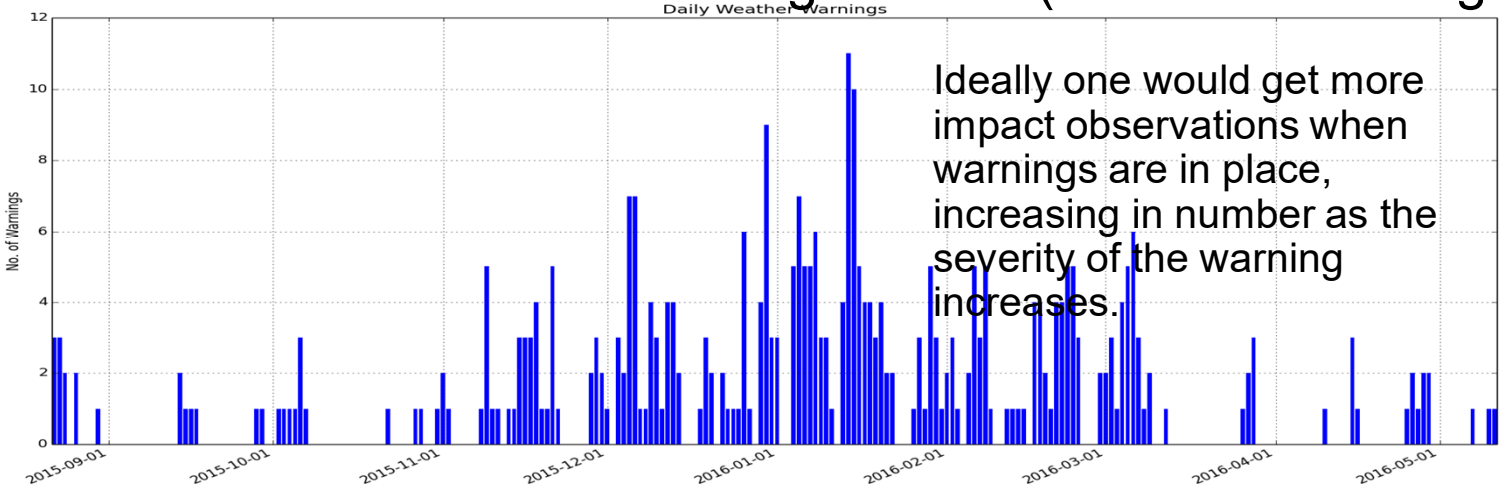
Wildfires appear to occur with some regularity (suspect)

Noticeable similarity between rain and flood, and snow and ice.



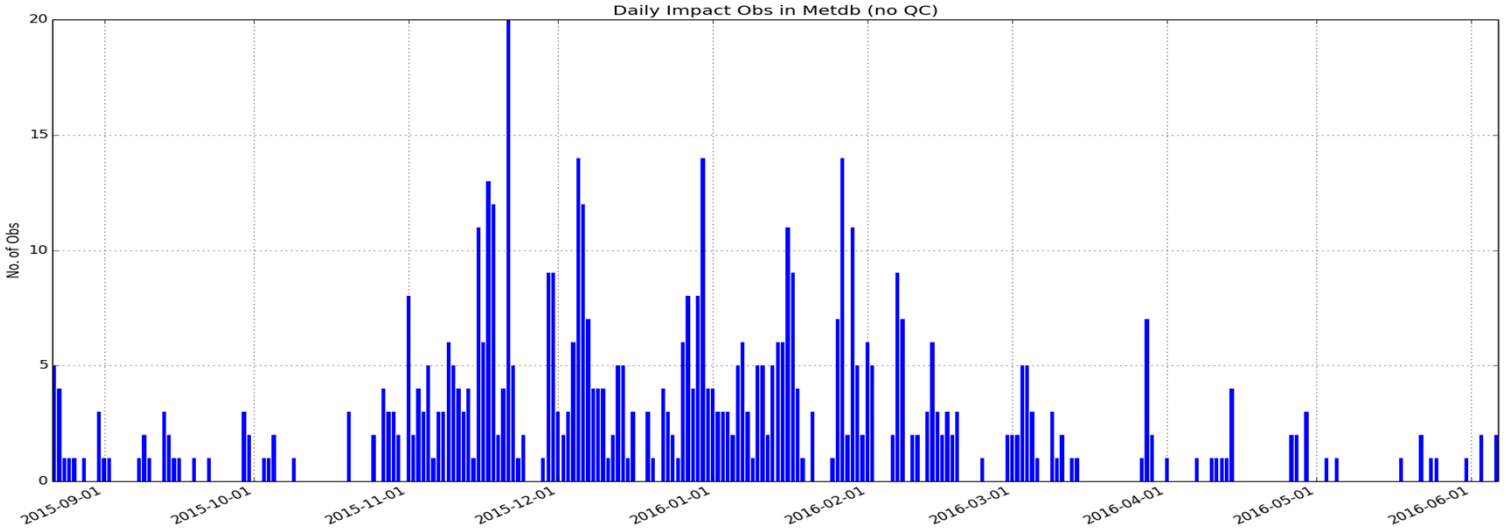
What can we assess?-

National Severe Weather Warning Service (Weather Warnings)



Ideally one would get more impact observations when warnings are in place, increasing in number as the severity of the warning increases.

Time series has roughly same distribution as impact obs, though they are not directly linked



Met Office

Case:-

Strongest gust

81mph

Capel Curig

Date named	Date of impact
4 Dec 2015	5 - 6 Dec 2015

Severe gales with gusts up to 81 mph were accompanied by record-breaking rainfall which brought flooding to areas across the north of England. Honister Pass in Cumbria recorded 341.4mm of rainfall in the 24-hours up to 1800 GMT on 5 December 2015 making a new UK record.

Storm Desmond Weather Warnings + Impact Obs

Red warnings issued.

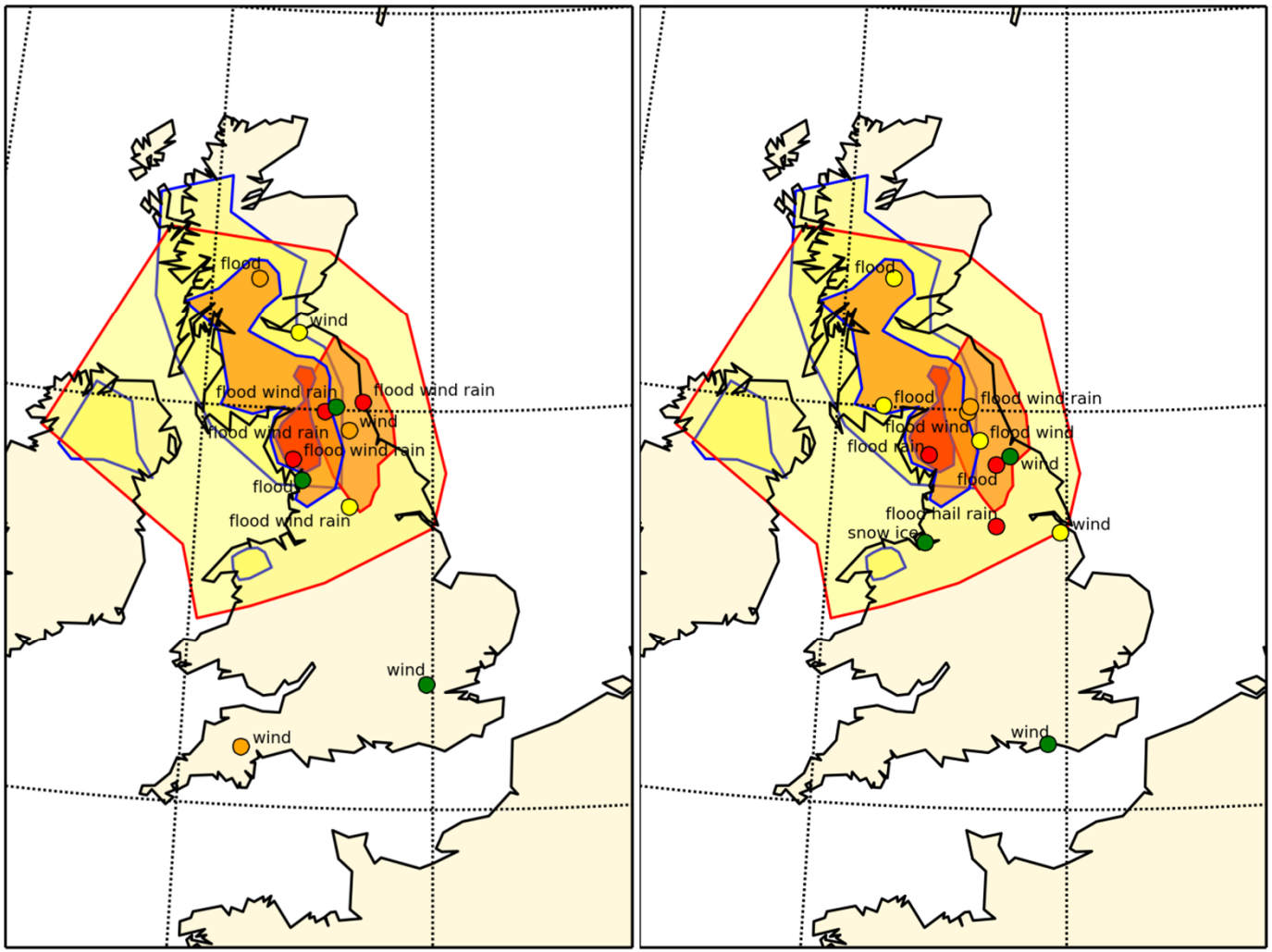
5 - 6th Dec 2015

Observer interpretation of severity can be variable.

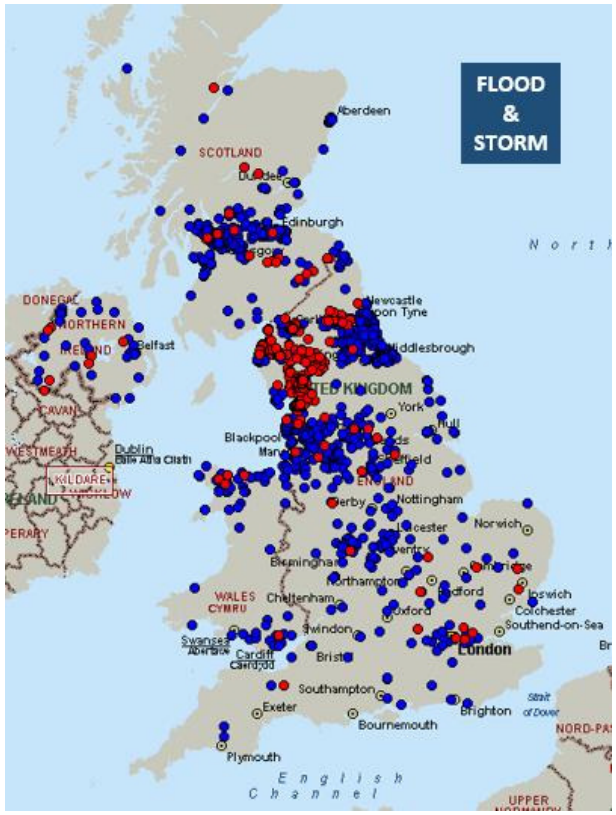
Vast majority of impact ops in the warning area.

Some impacts outside the area.

Warning border colour
- Rain
- Wind
- Snow
- Ice
- Fog
- Multiple

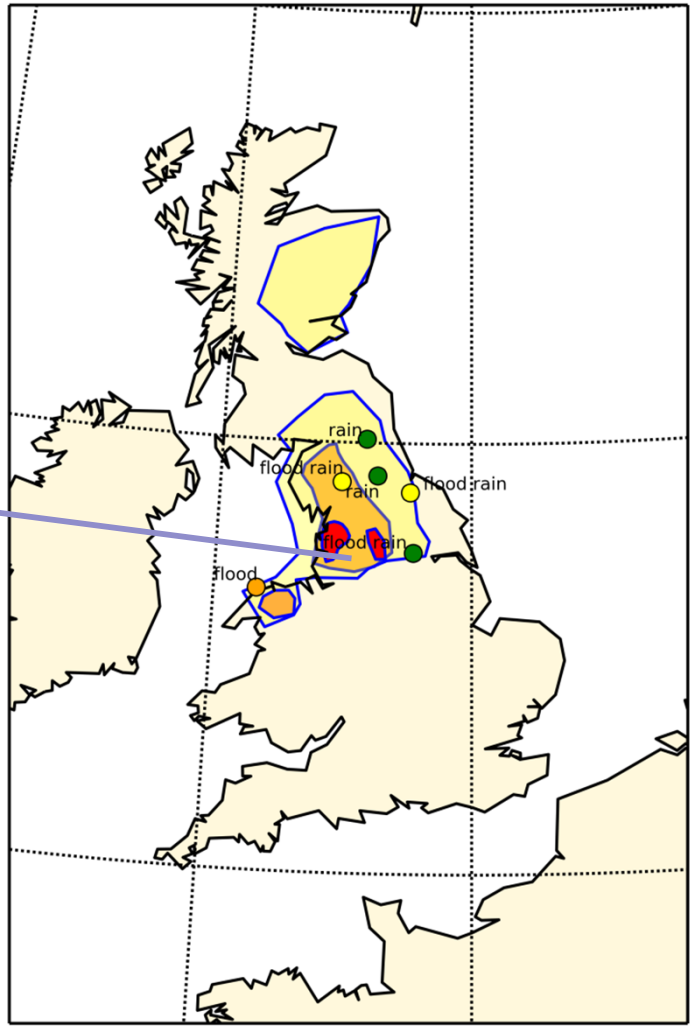


Storm Desmond - Aftermath



Insurance Claims

Case :- Boxing Day 2015



Verification

Obs Space – 80% HR

Storm Gertrude (Obs space)		Observed Impact	
		Yes	No
Warning	Yes	8	0
	No	2	0

Warnings Space – 60% HR

Storm Gertrude (Warnings Space)		Warning	
		Yes	No
Observed Impact	Yes	3	0
	No	2	0

Also:-
Can hedge by issuing large area warnings to ensure any obs are covered.

A warning with no observed impact does not mean it is wrong!

Matt Clark

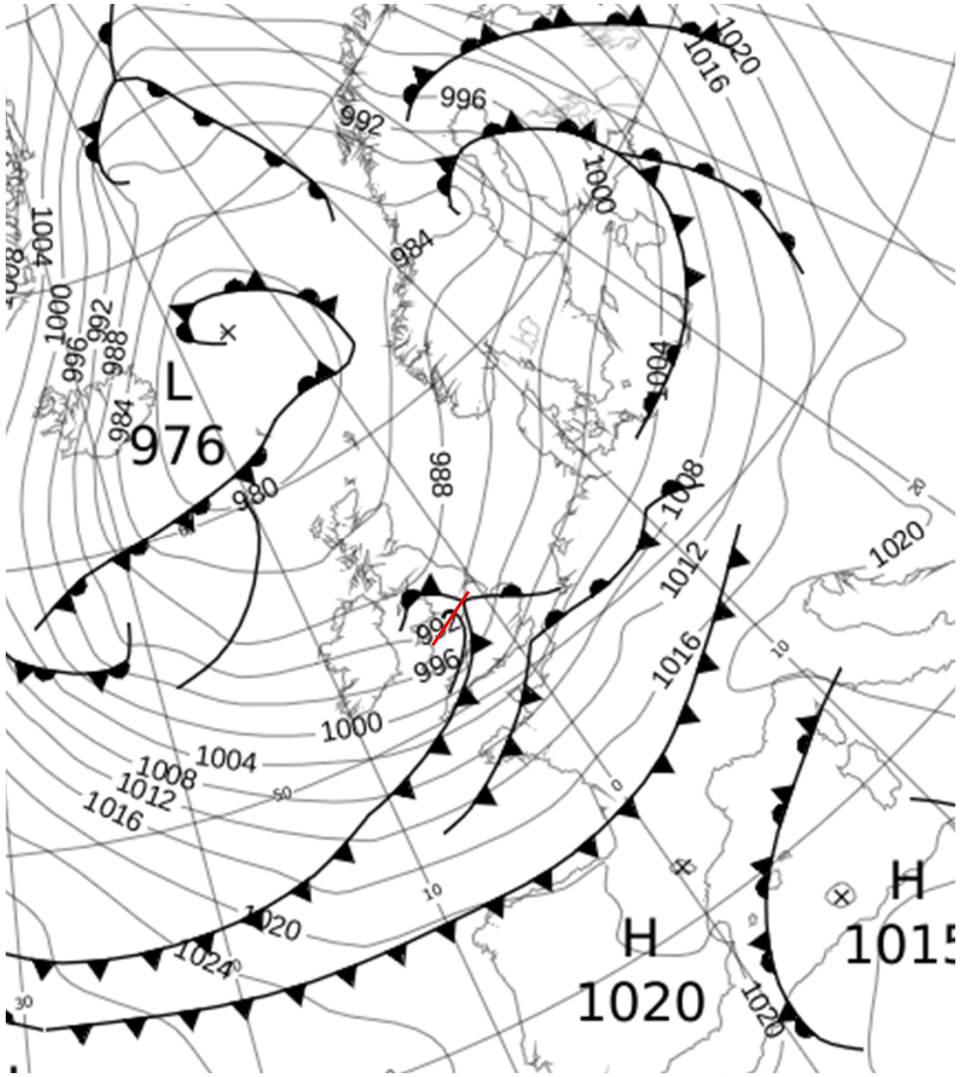
Wind storm

17 November 2016 (2 days before *Angus*)

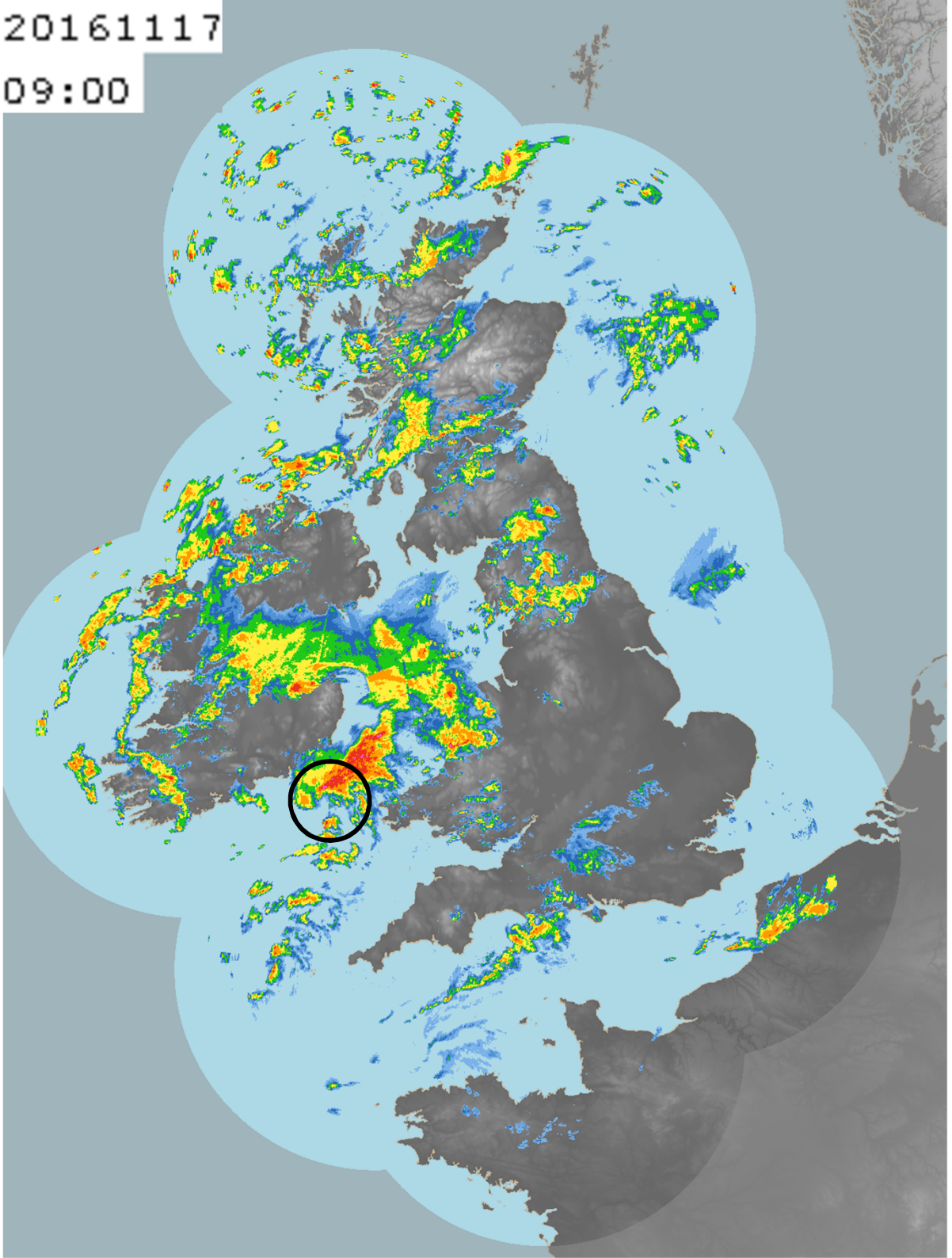
- Narrow swath of intense wind damage across Wales and the Midlands

- Aberystwyth area and Shropshire particularly badly affected (73 knot gust recorded at Shawbury)

- Associated with a small frontal wave which moved rapidly ENE



Surface analysis chart valid 1200 UTC 17 November 2016
(Red line = damage track)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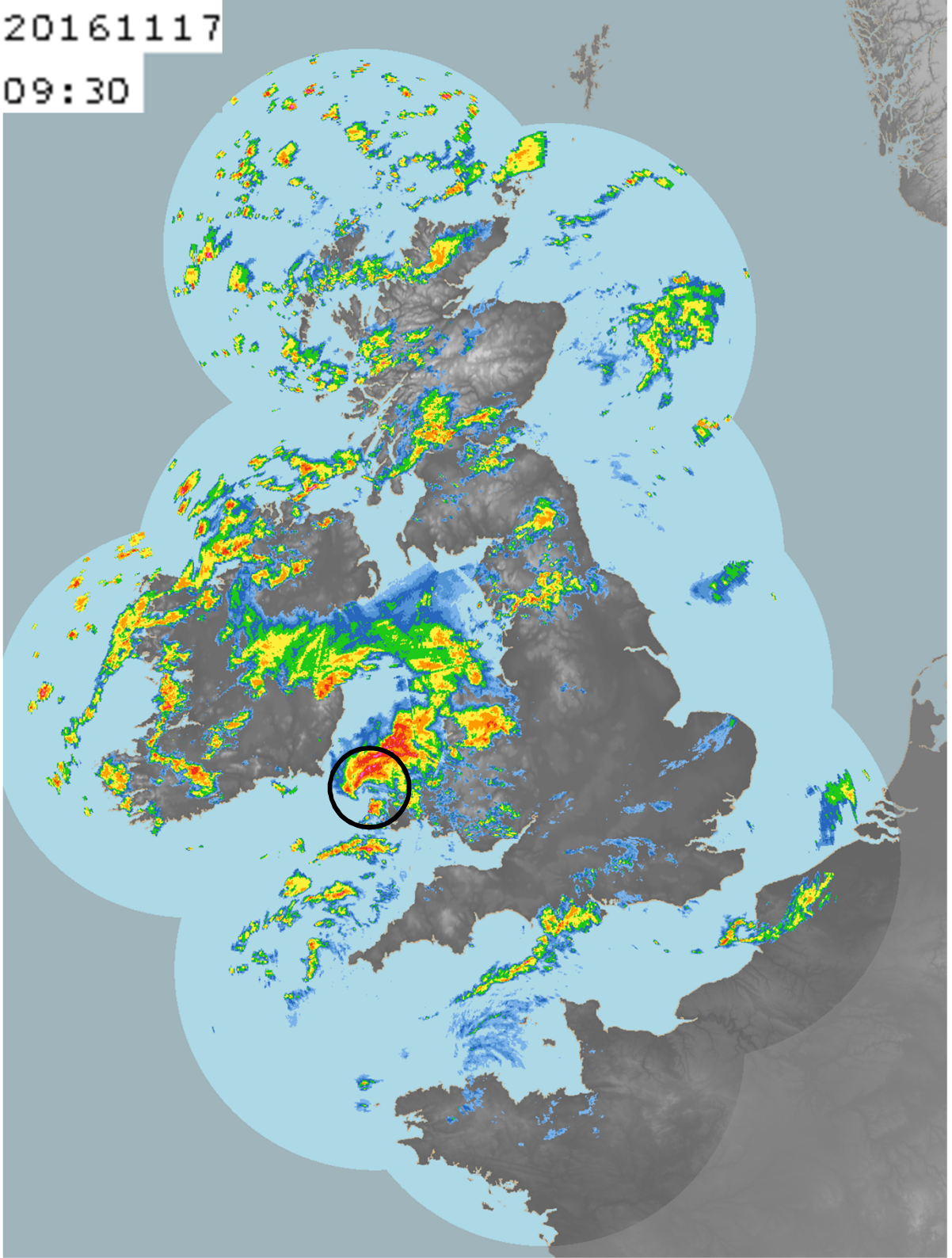
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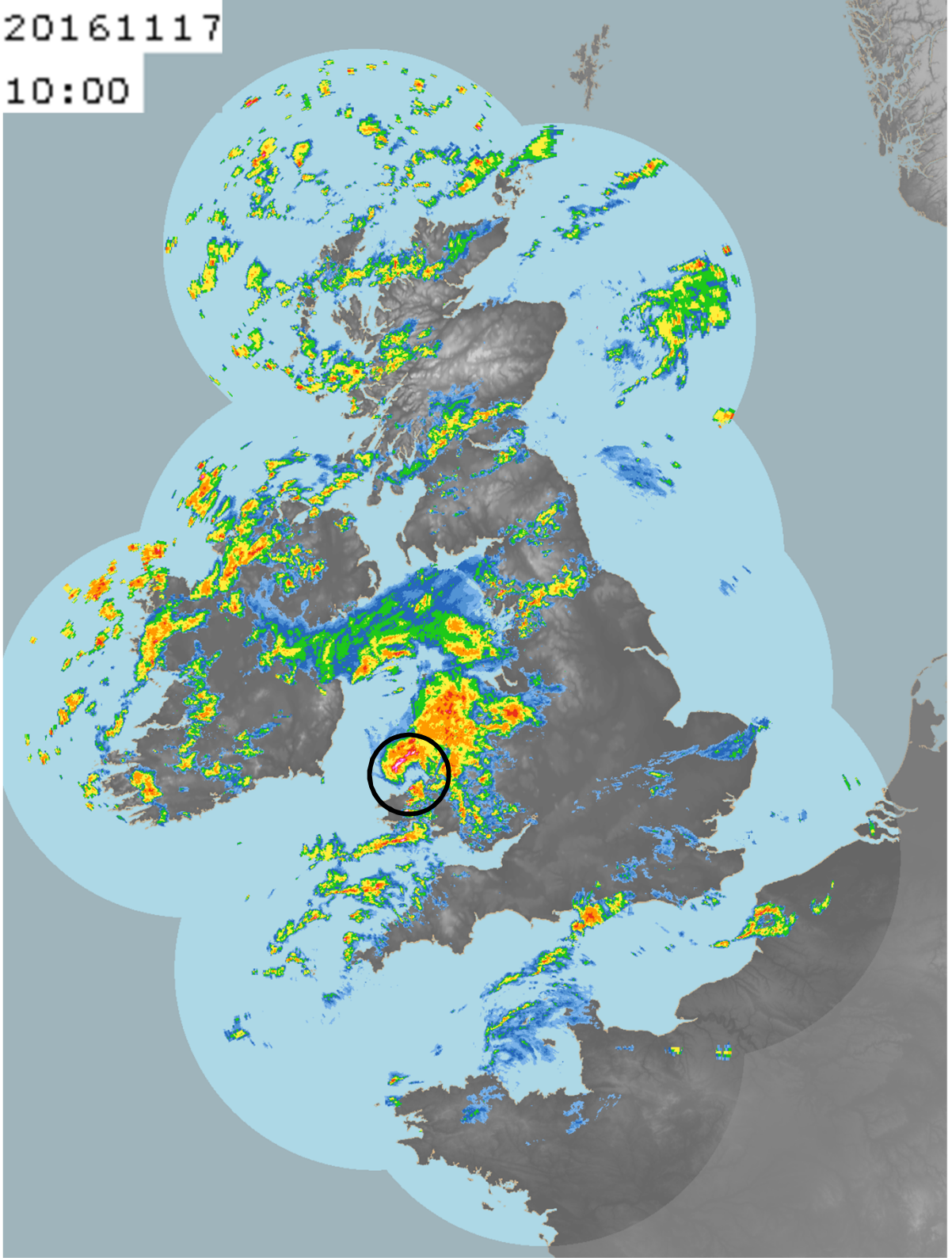
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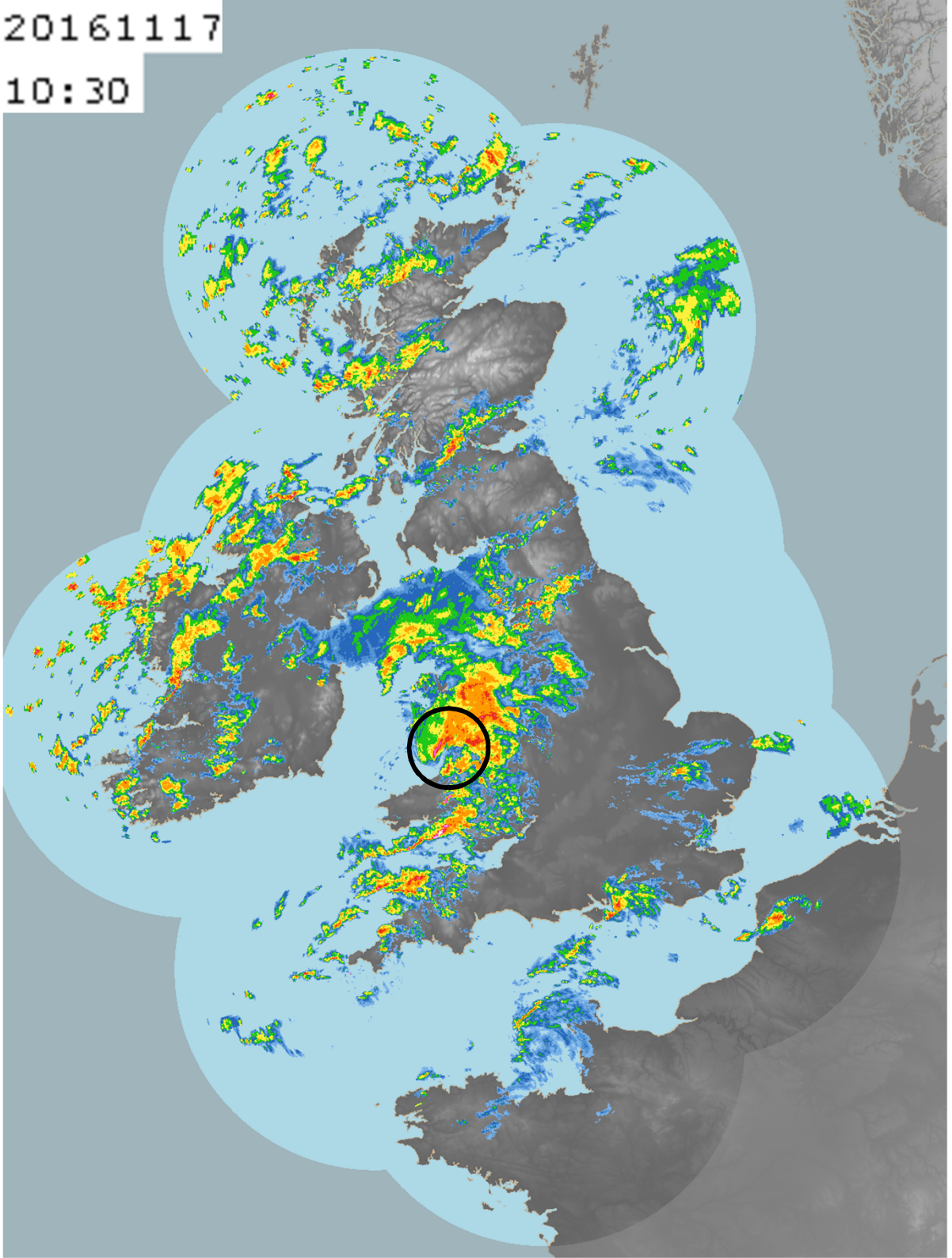
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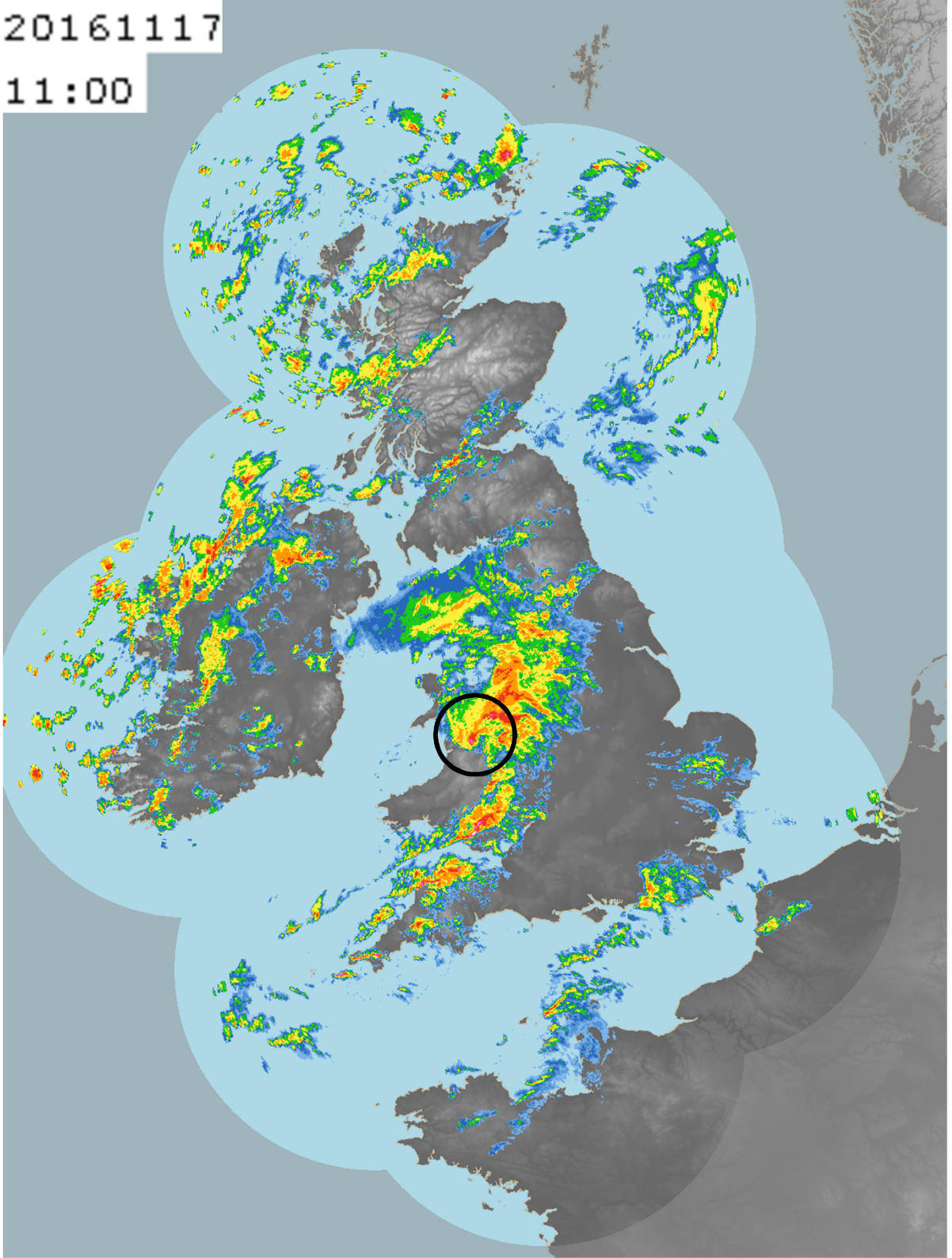
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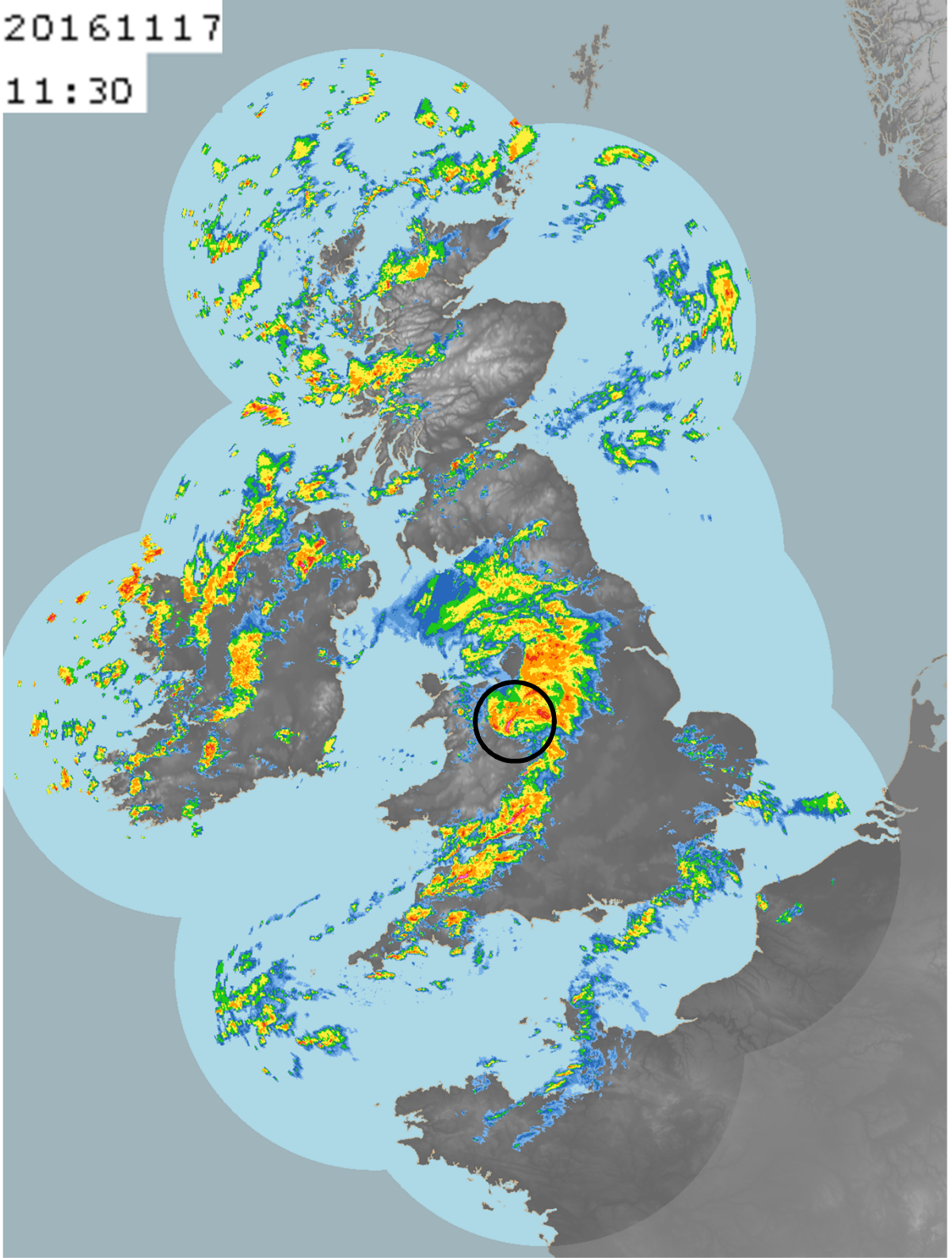
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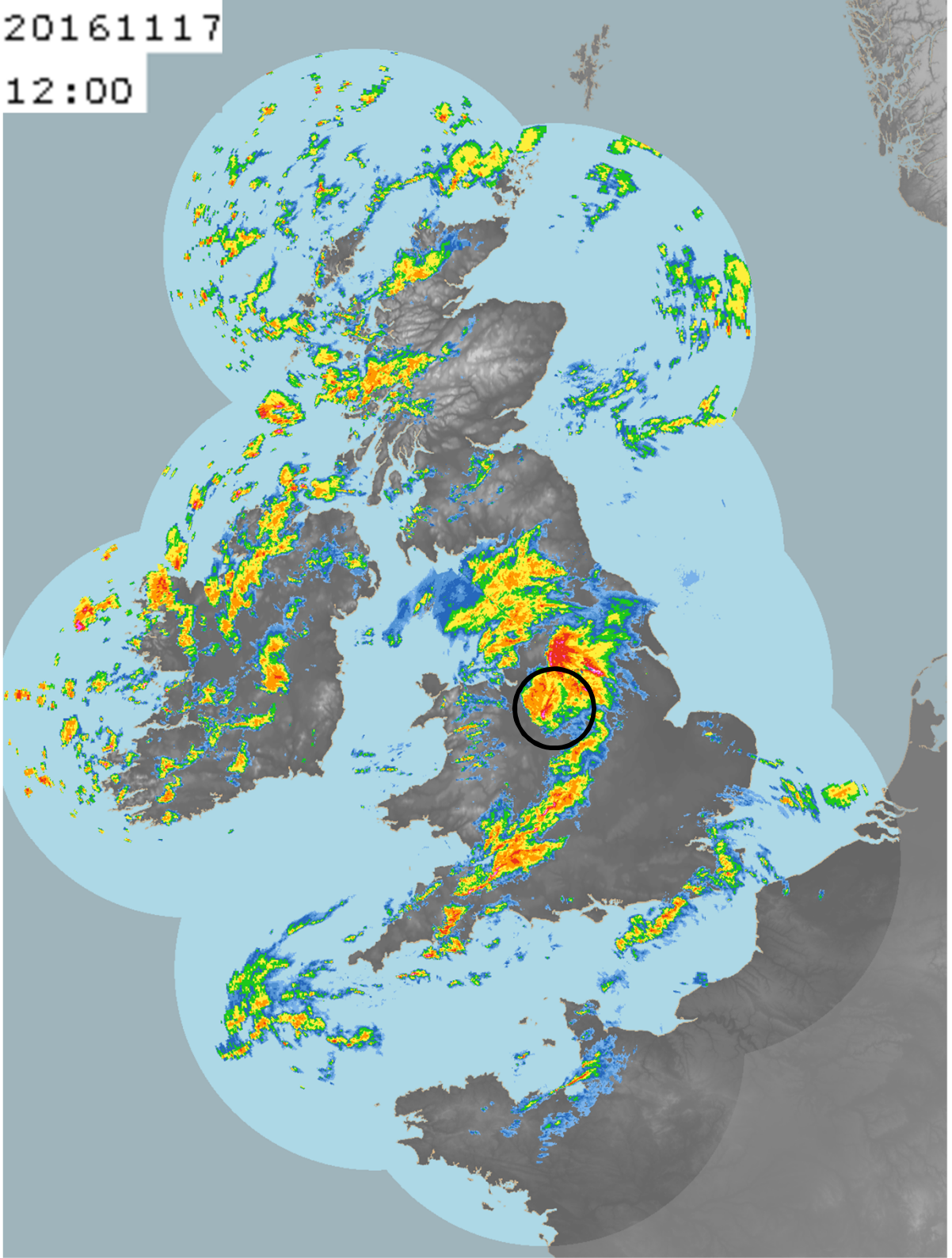
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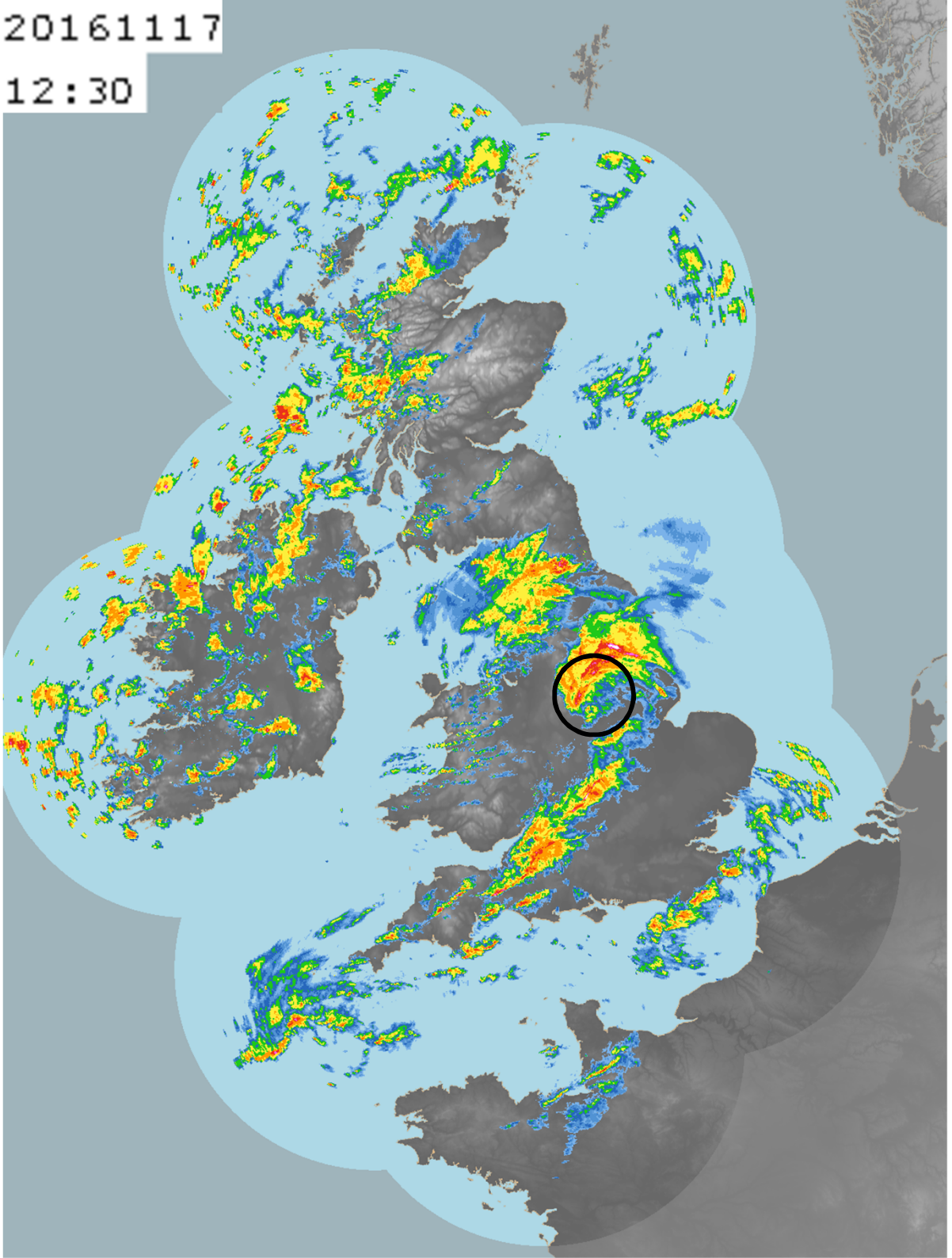
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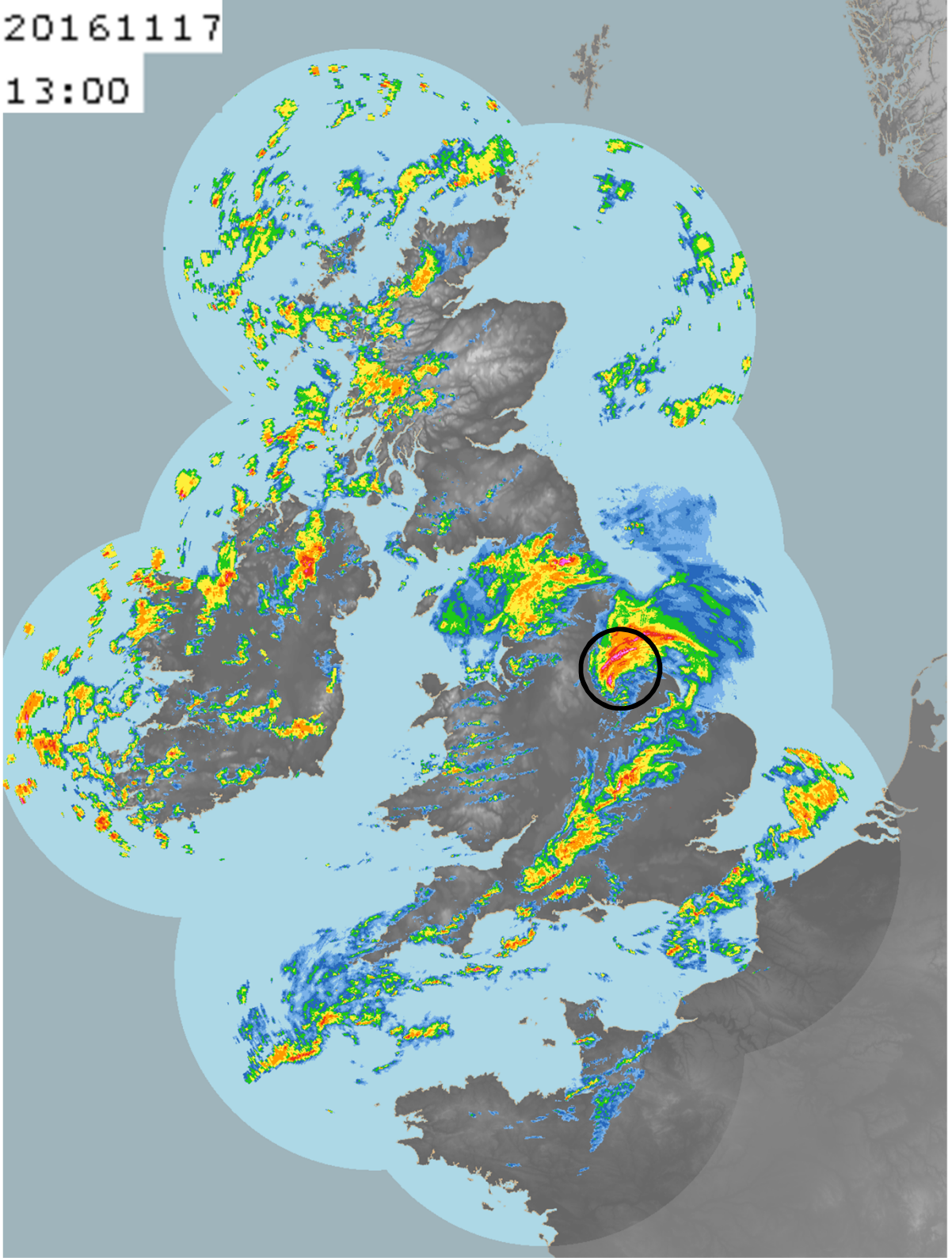
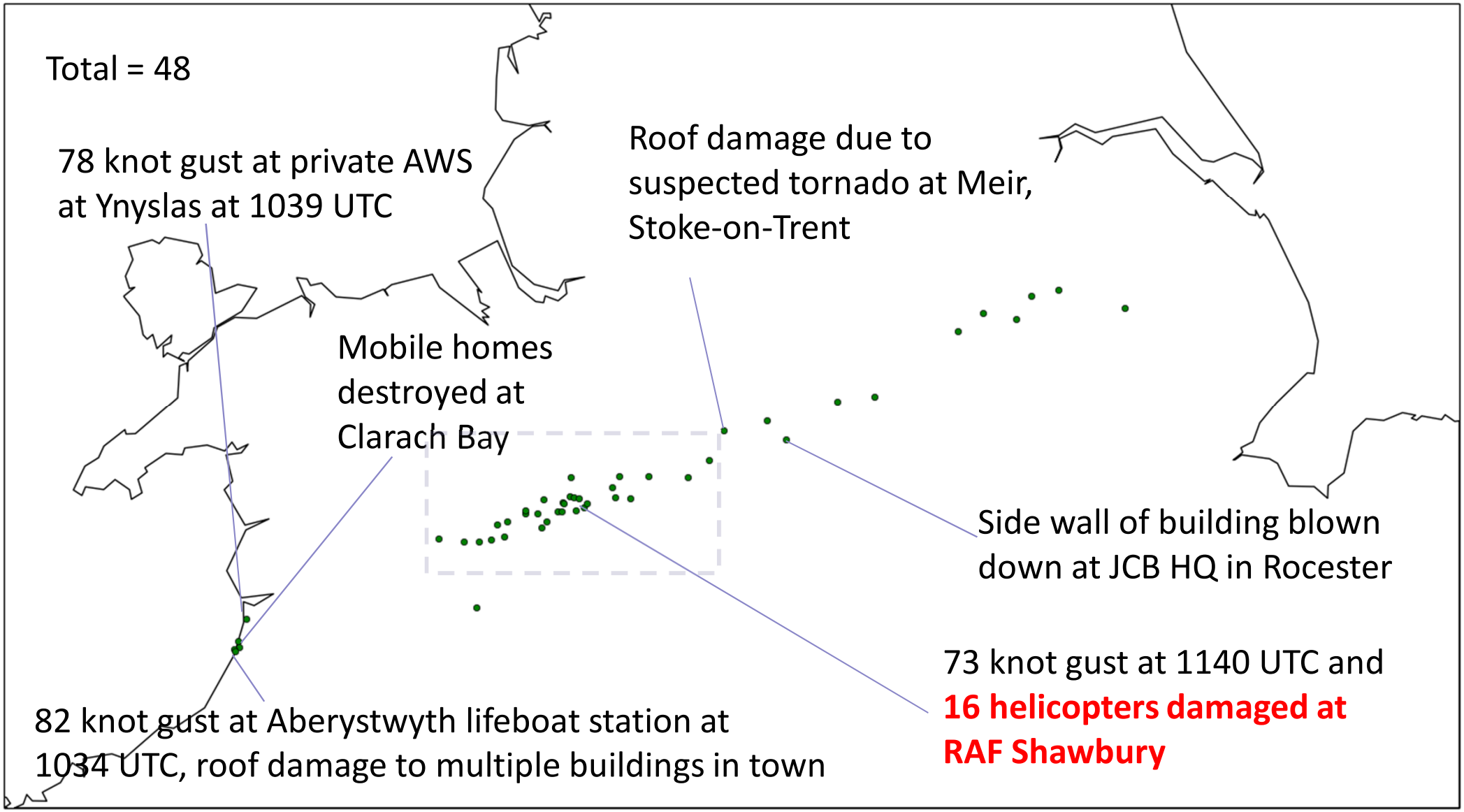
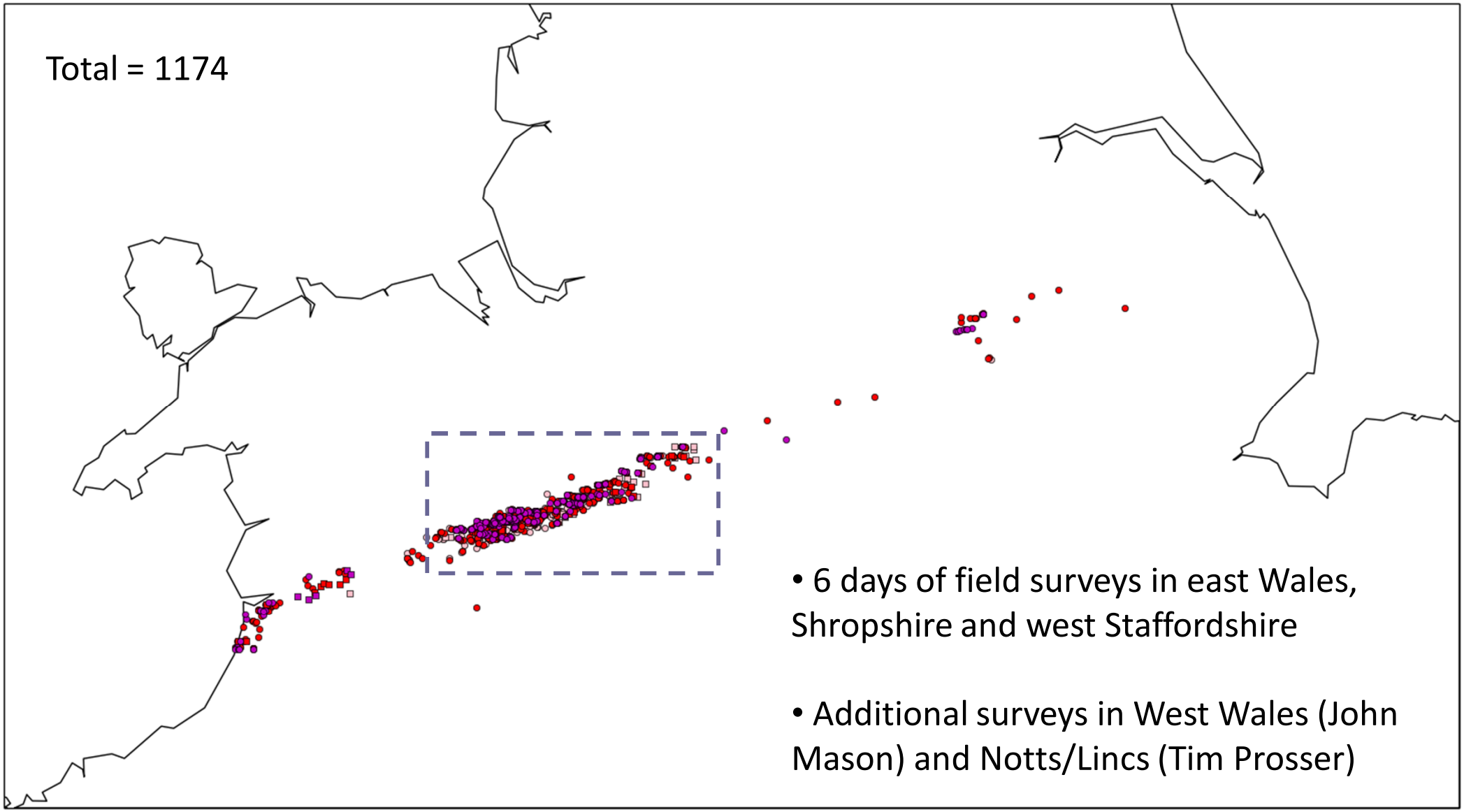

20161117
13:00

Damage reports shortly after event



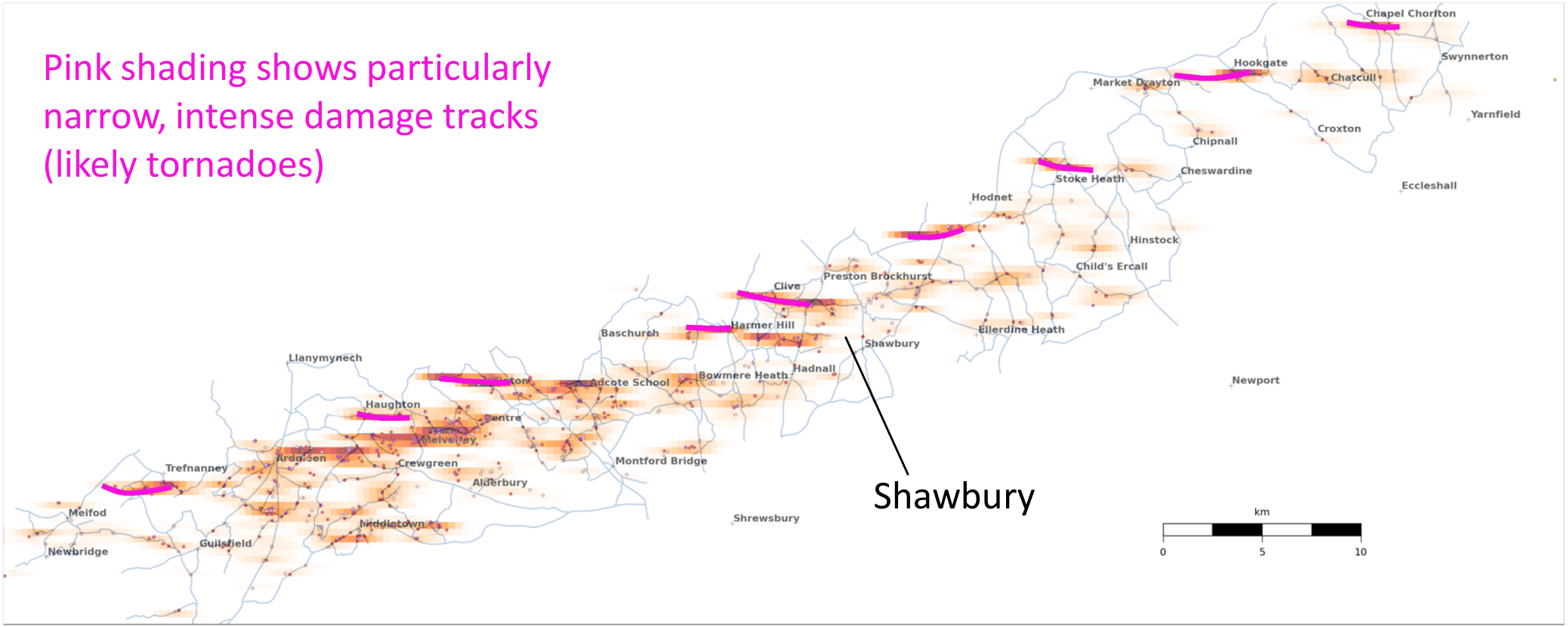
Damage points after damage surveys



Damage points with objective swathes (shading) – Shropshire area

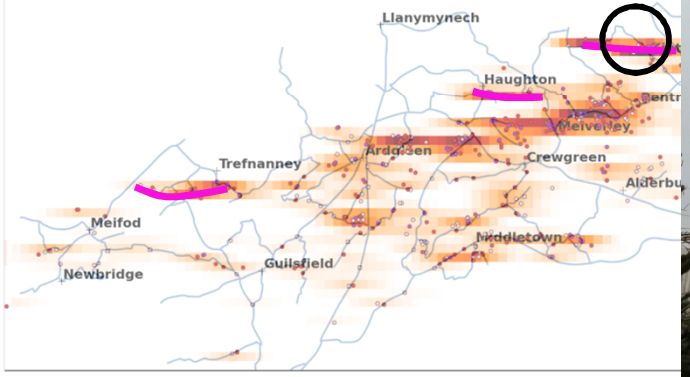
- Orange shading is an intensity-weighted count of damage points on a 0.3 km grid
- Darker colours denote higher intensity-weighted densities

Damage points with objective swathes (shading) – Shropshire area

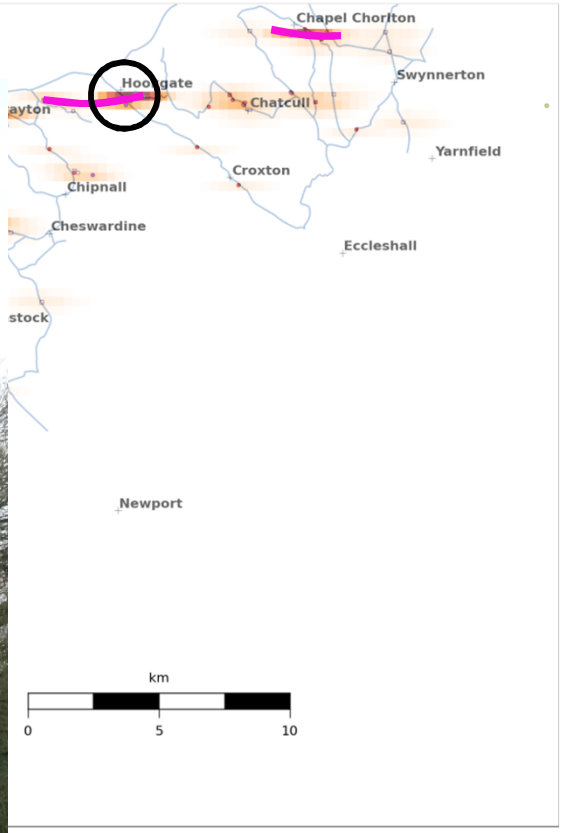


e swathes

rea

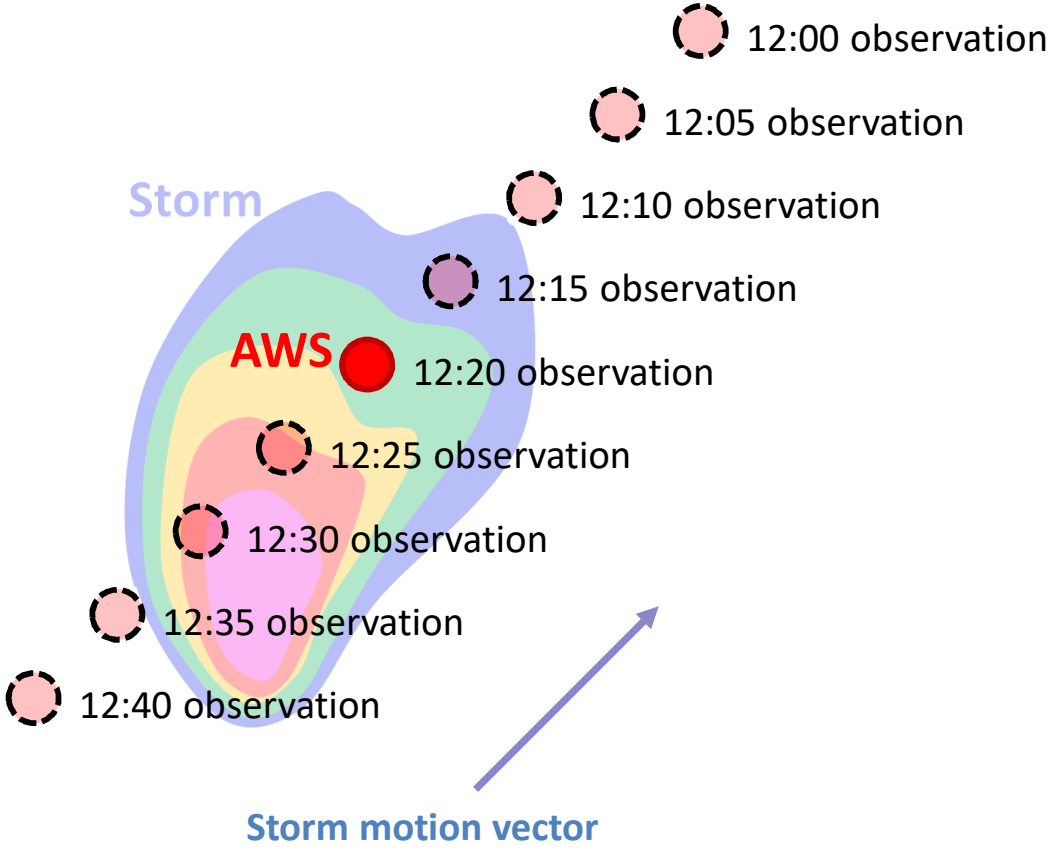


Damage points with objective swathes (shading) – Shropshire area



Time compositing

Storm-relative location of shifted data point is the same as that of the AWS at each observation time

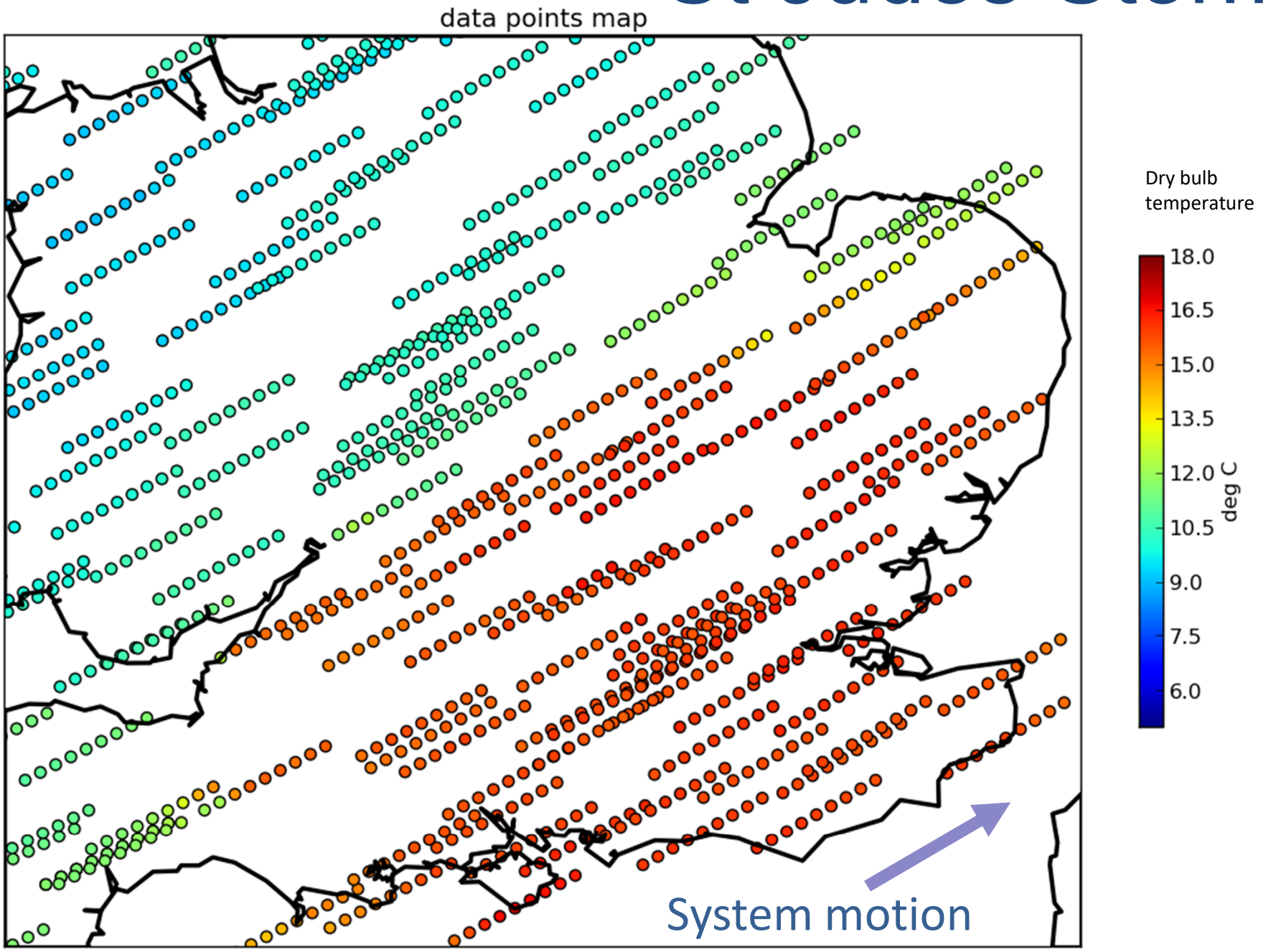


Analysis time = 1220 UTC

Compositing window = 40 minutes (1200 – 1240)

St Judes Storm

0430 UTC



Matt Clark, Obs R&D

Surface analyses using MMS and WOW data with Clee Hill radar reflectivity

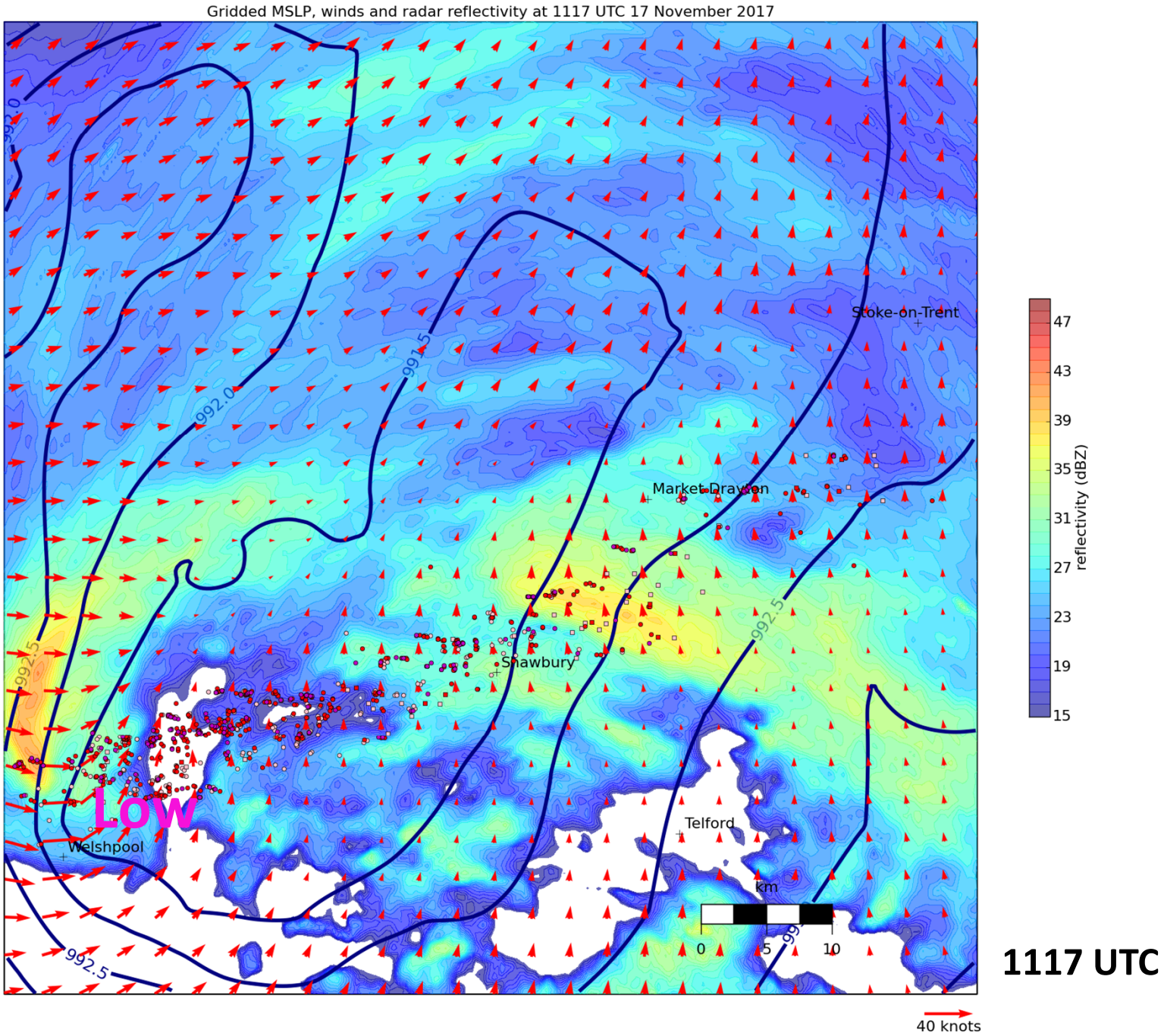
KEY:

Shading = radar reflectivity

Arrows = wind vectors (on 3 km grid)

Blue lines = MSLP contours at 0.5 hPa intervals

Red/pink dots = damage locations



1117 UTC

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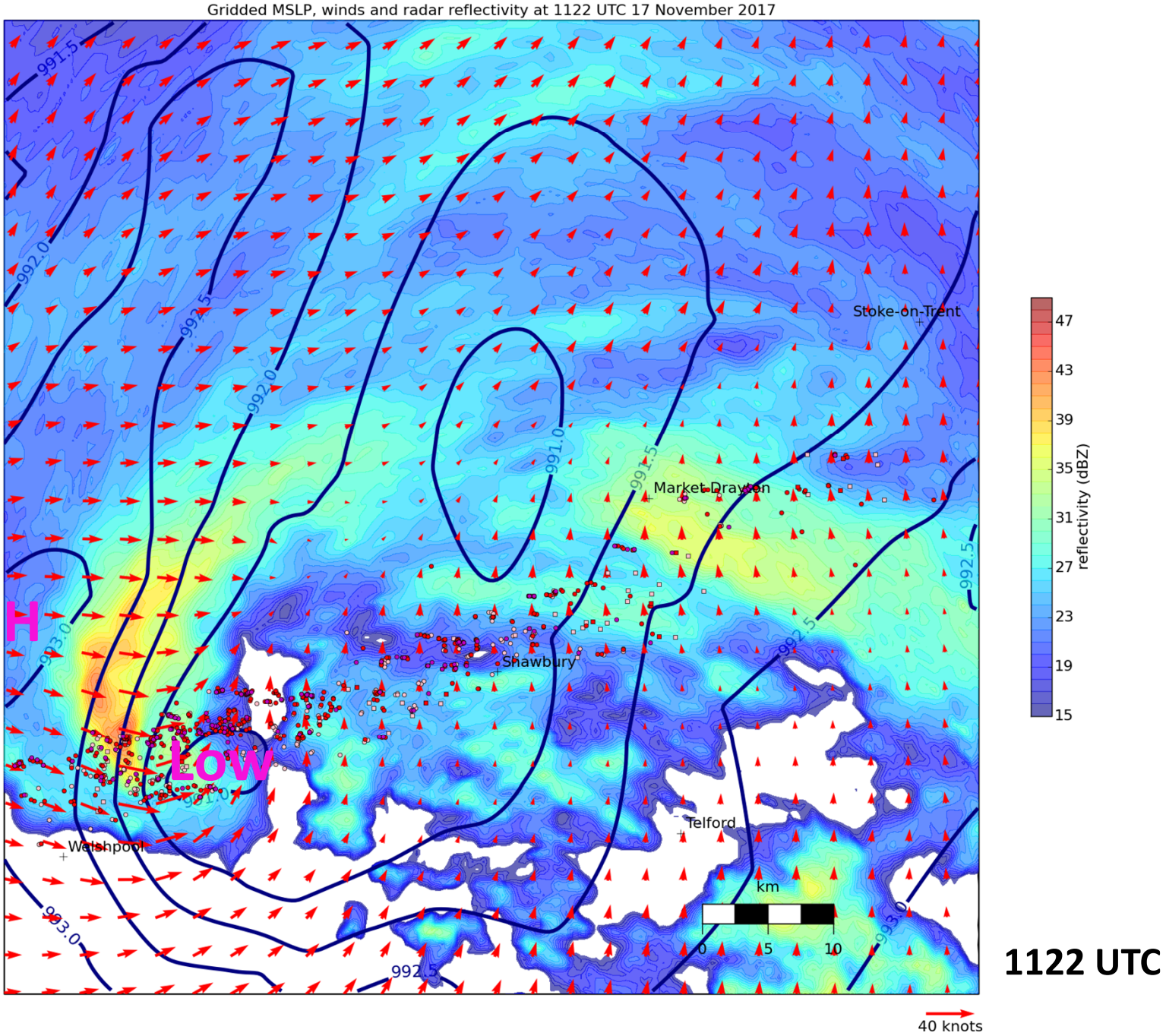

1122 UTC

Surface analyses using MMS and WOW data with Clee Hill radar reflectivity

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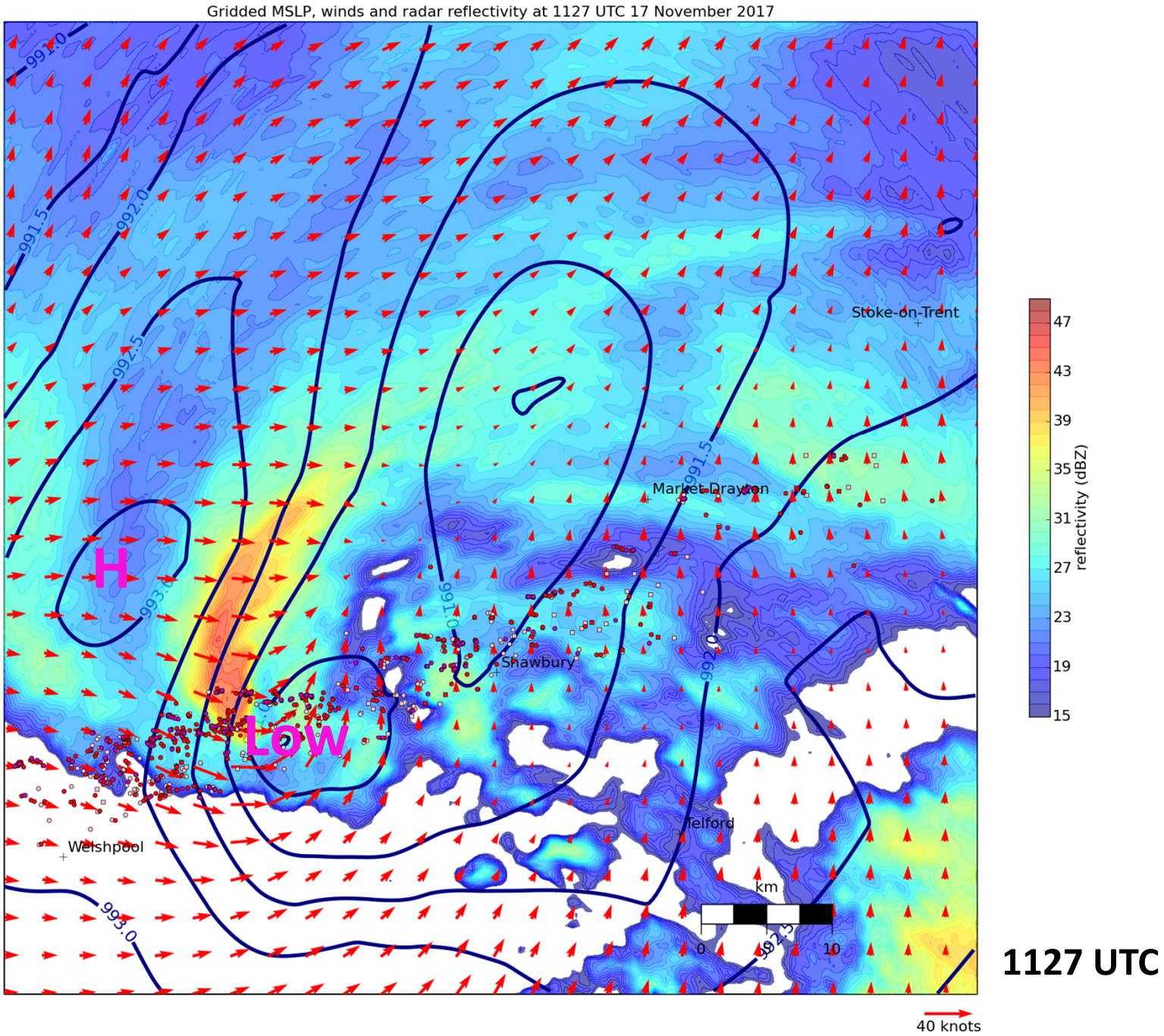

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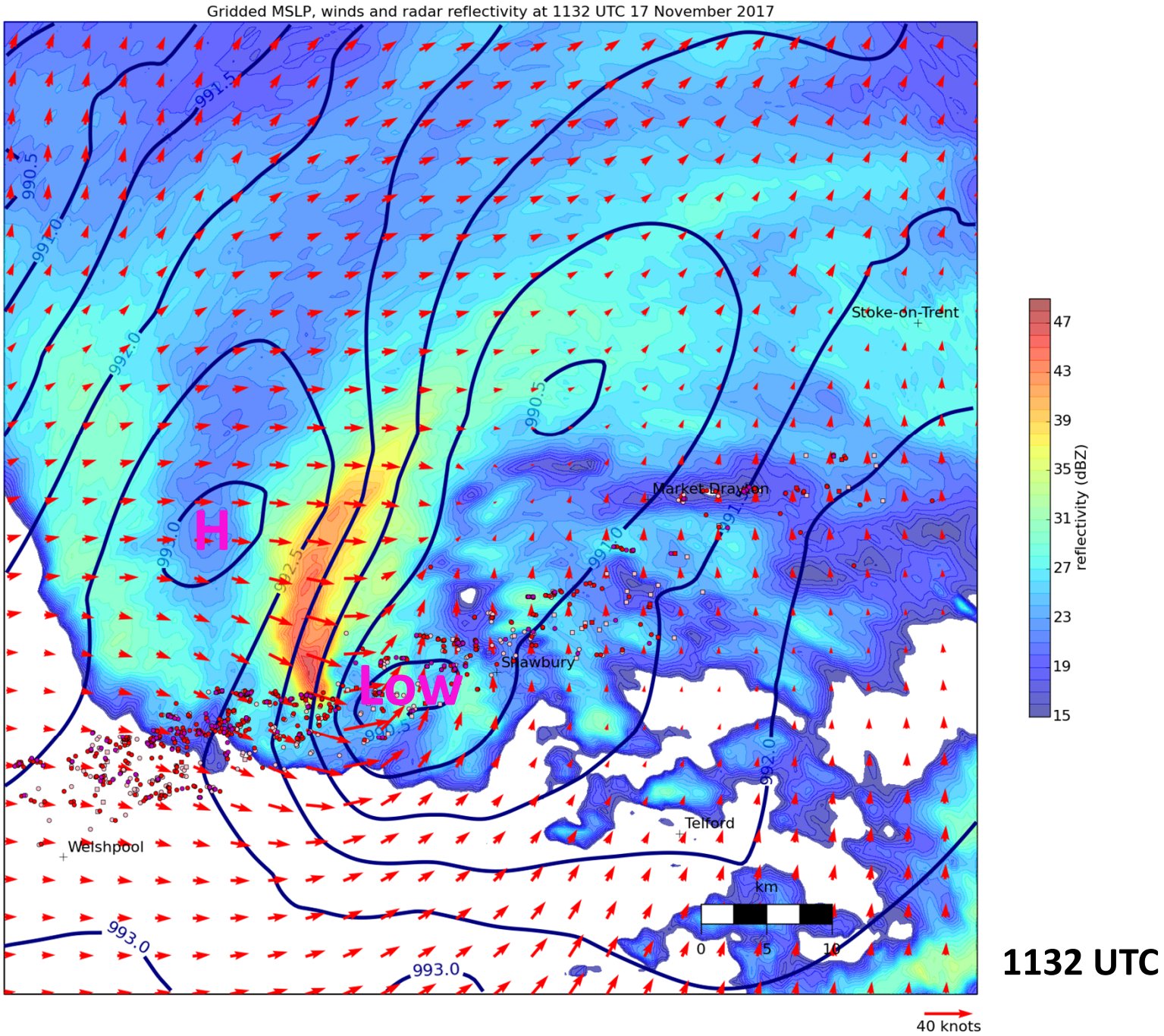

1132 UTC

Surface analyses using MMS and WOW data with Clee Hill radar reflectivity

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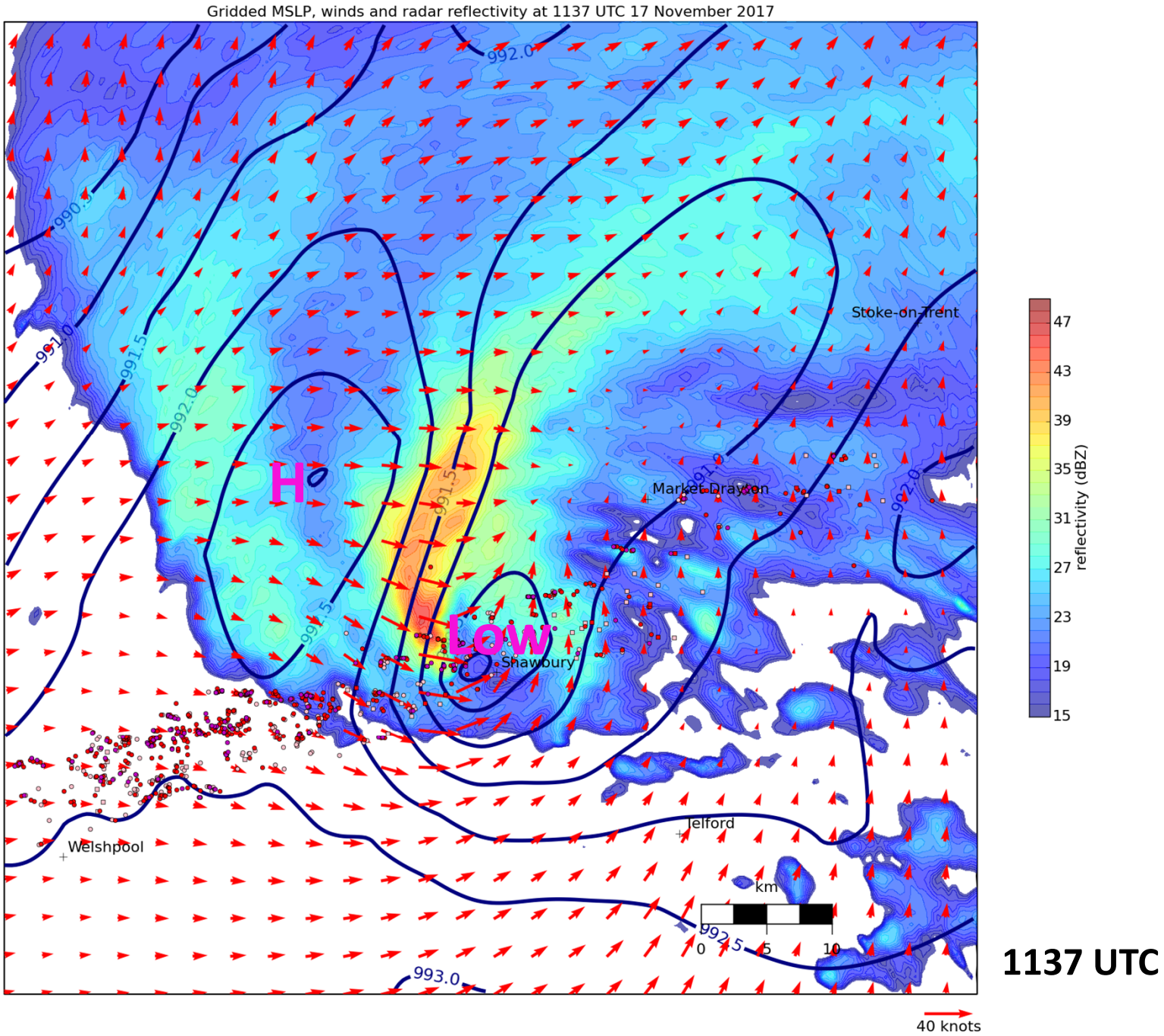

1137 UTC

Surface analyses using MMS and WOW data with Clee Hill radar reflectivity

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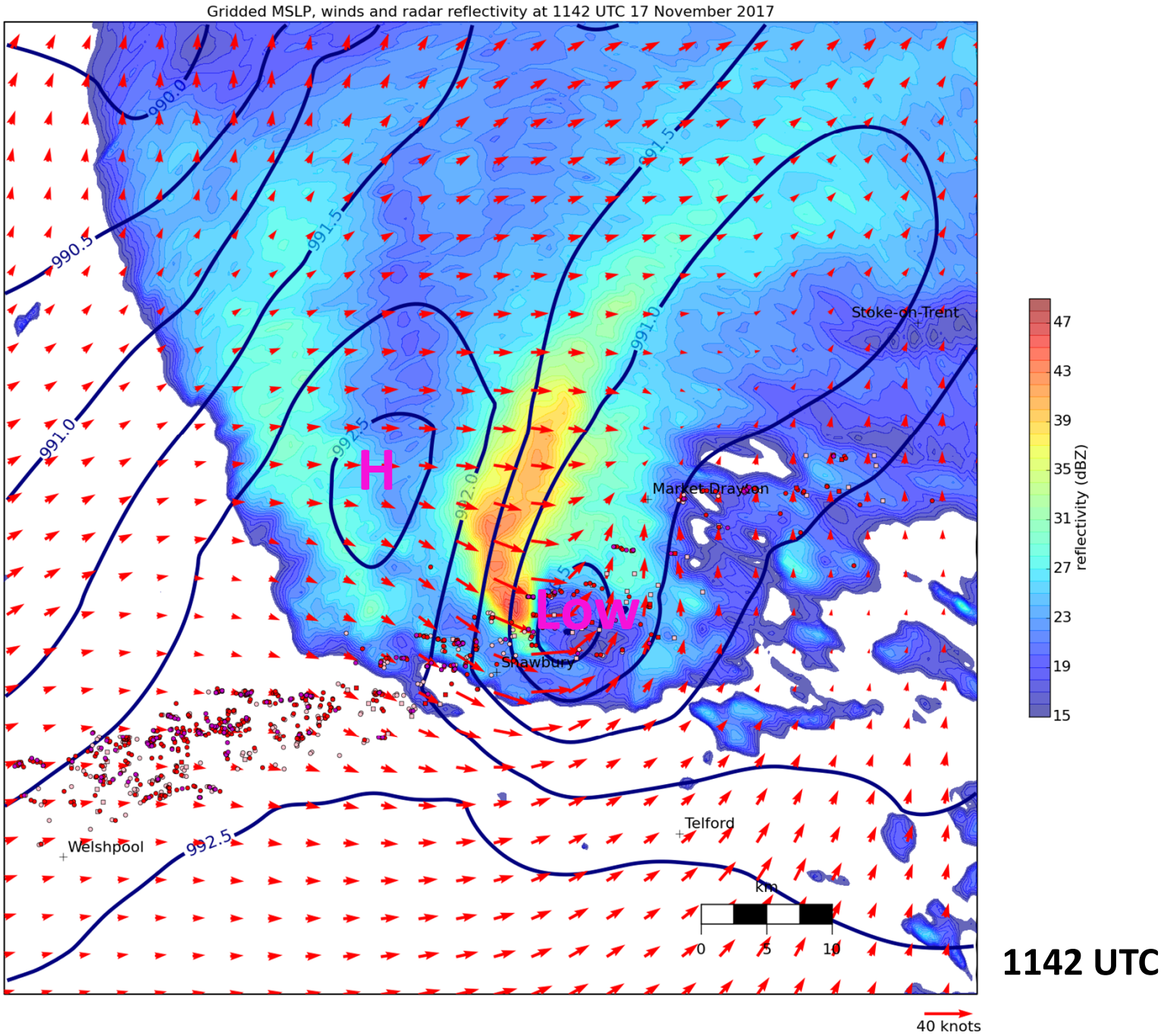

1142 UTC

Surface analyses using MMS and WOW data with Clee Hill radar reflectivity

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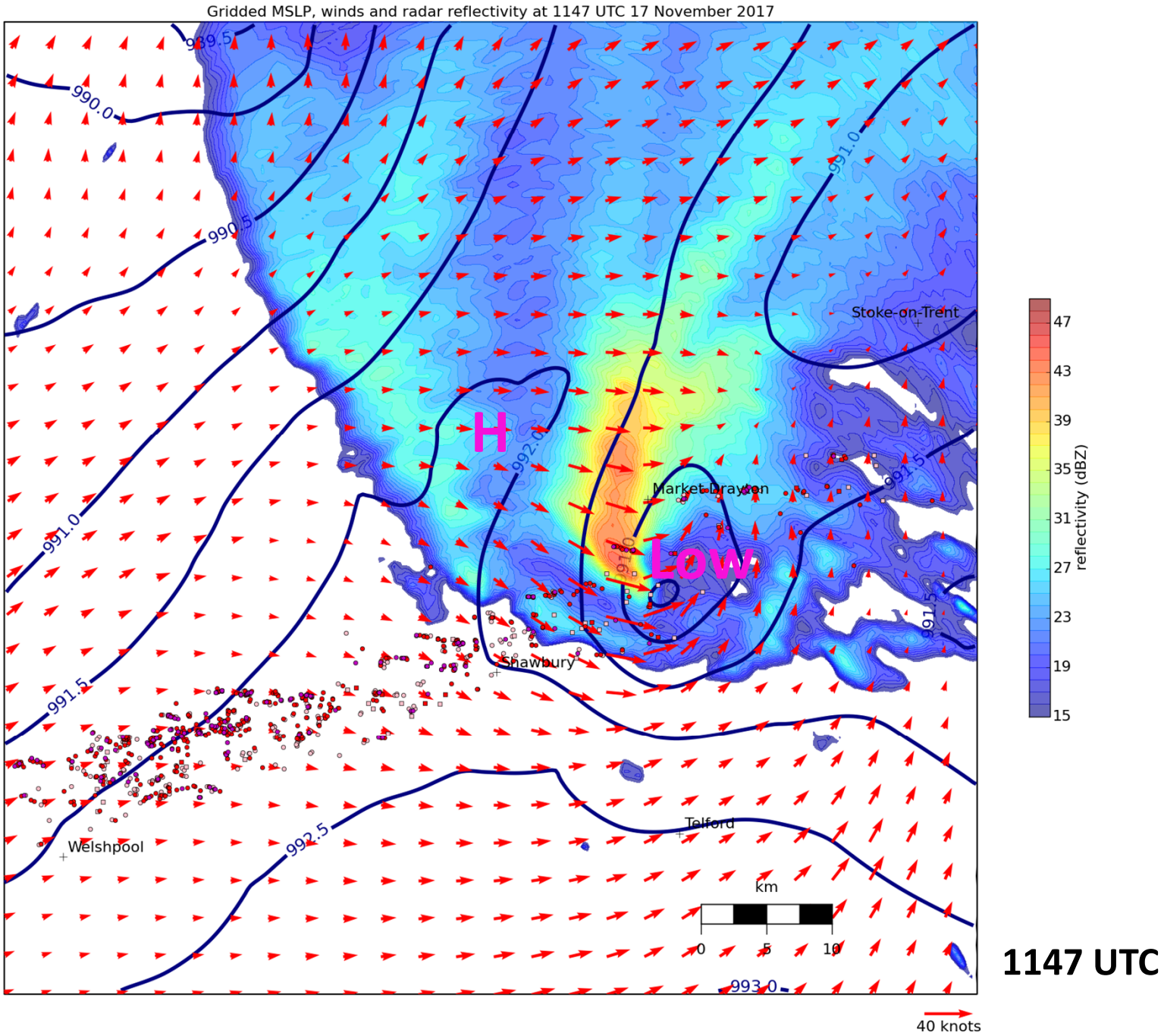

1147 UTC

Surface analyses using MMS and WOW data with Clee Hill radar reflectivity

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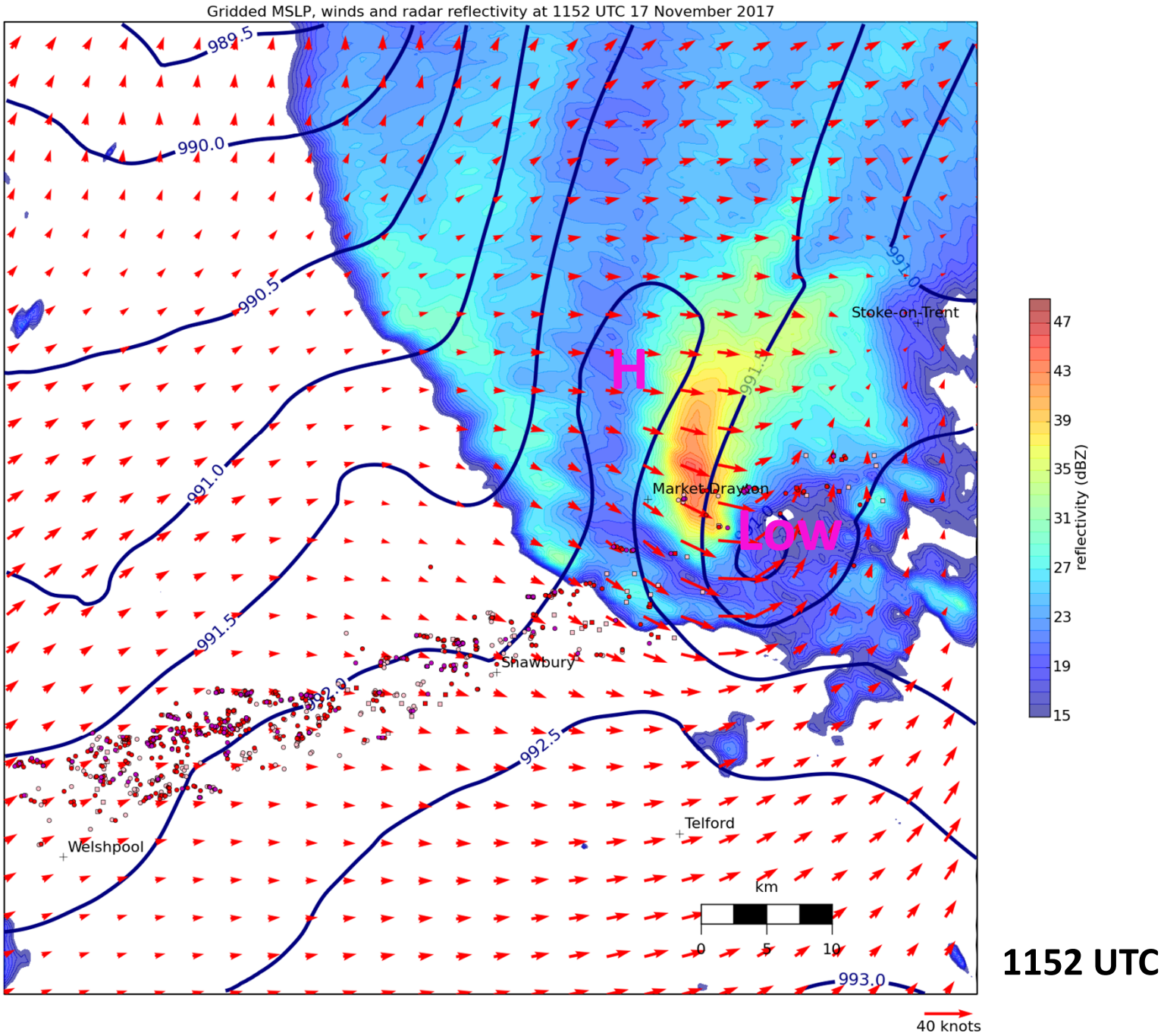
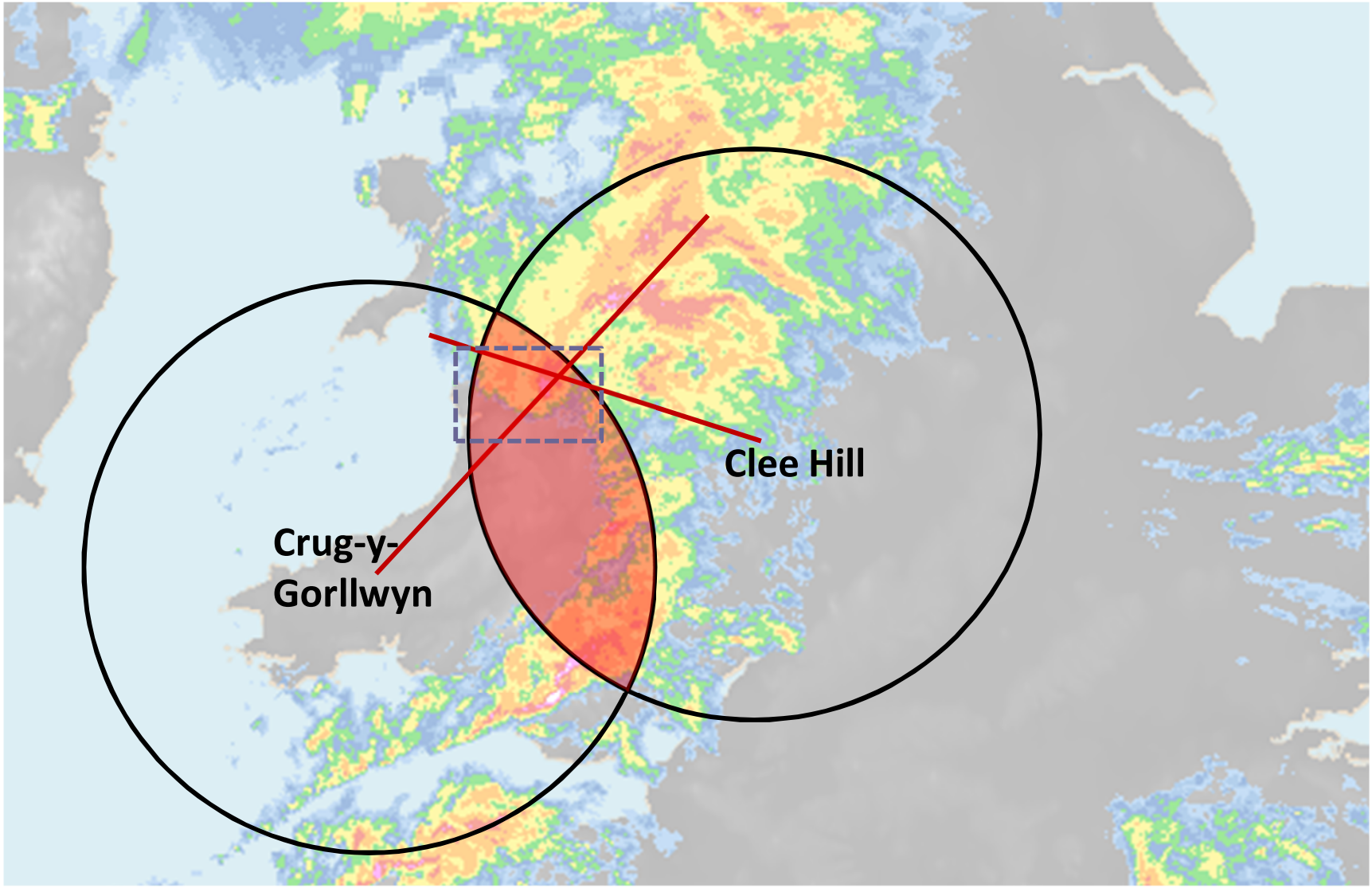


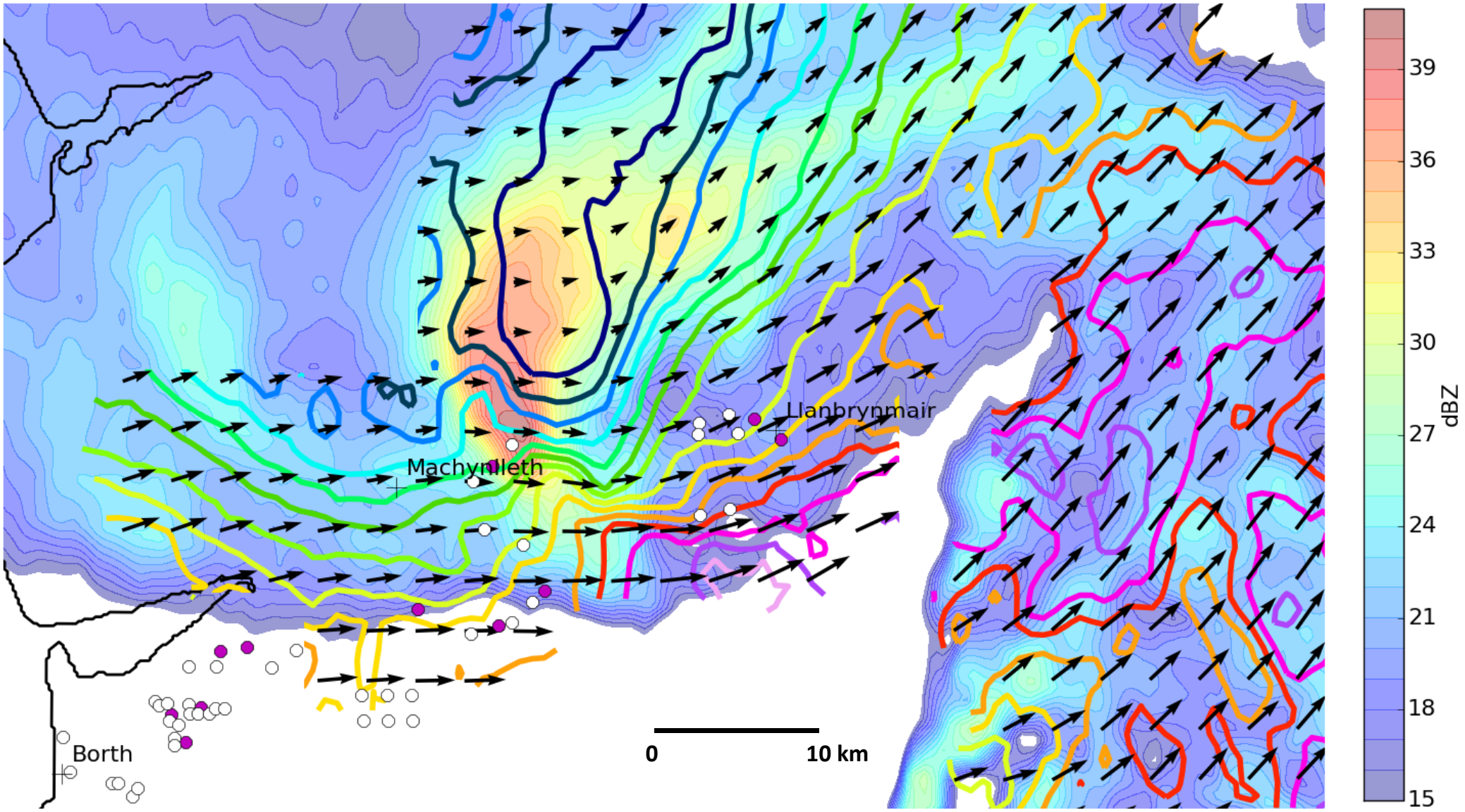
1152 UTC

Dual Doppler analysis



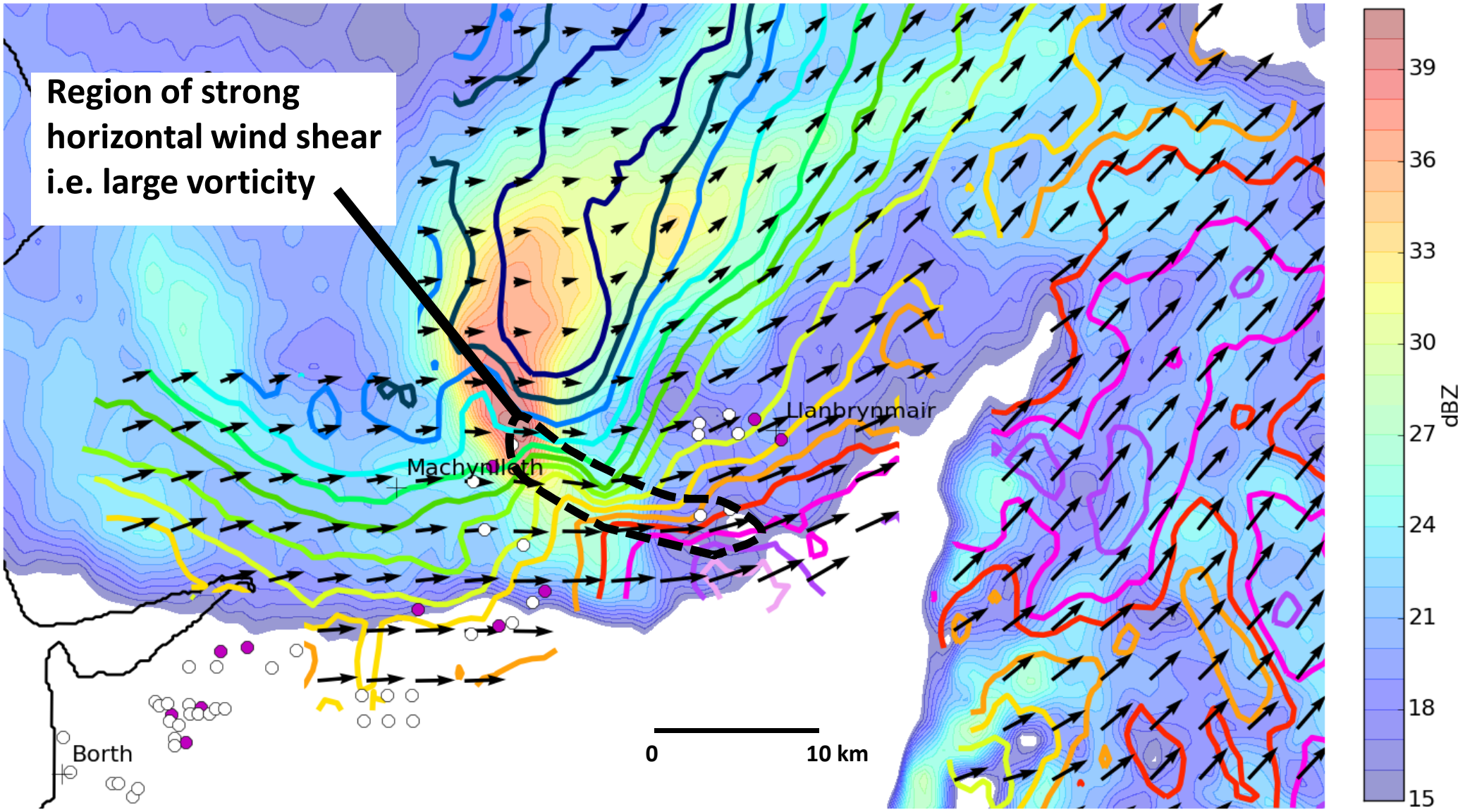
1100 UTC

1052 UTC dual Doppler analysis: winds at 1.6 km AGL



Coloured contours = ground-relative wind speed (pink = 40 m/s +) ; arrows = wind vectors; shading = radar reflectivity

1052 UTC dual Doppler analysis: winds at 1.6 km AGL



Coloured contours = ground-relative wind speed (pink = 40 m/s +) ; arrows = wind vectors; shading = radar reflectivity

Comments

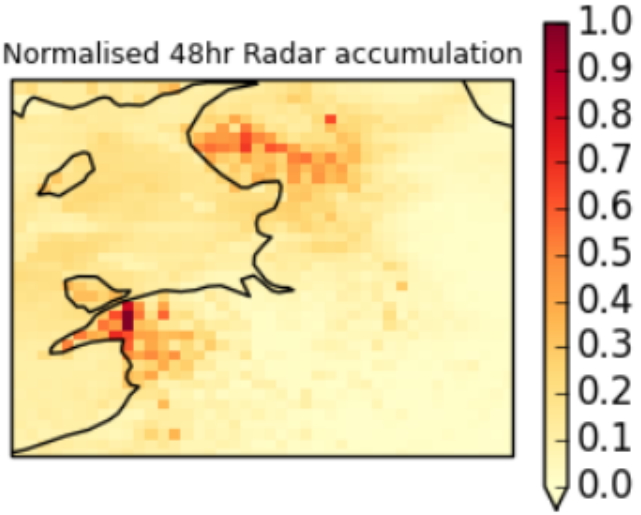
- Surface analyses and dual Doppler analyses are capable of resolving details on the storm scale

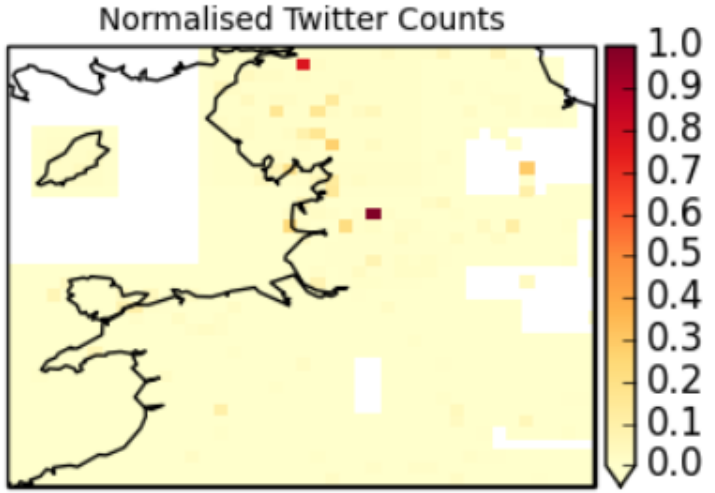
- Maximum insight is gained by bringing multiple data sources together (including crowd-sourced data e.g WOW)

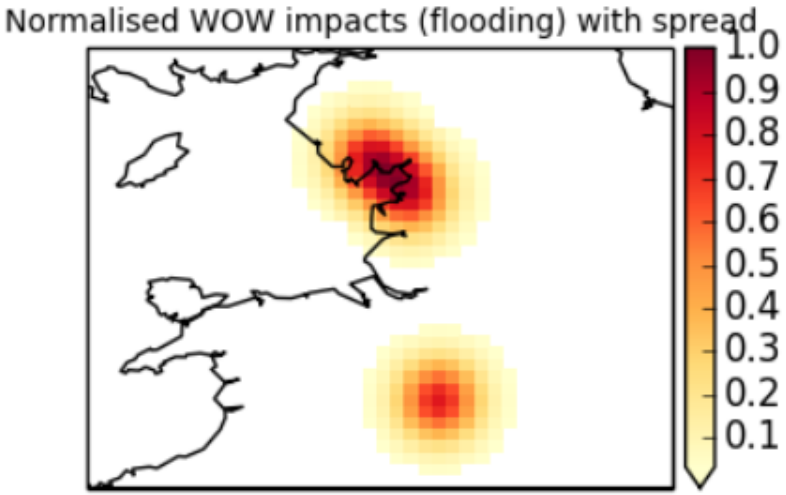
- Similar analyses, if produced in real-time, have considerable potential for Op Centre use in severe weather situations

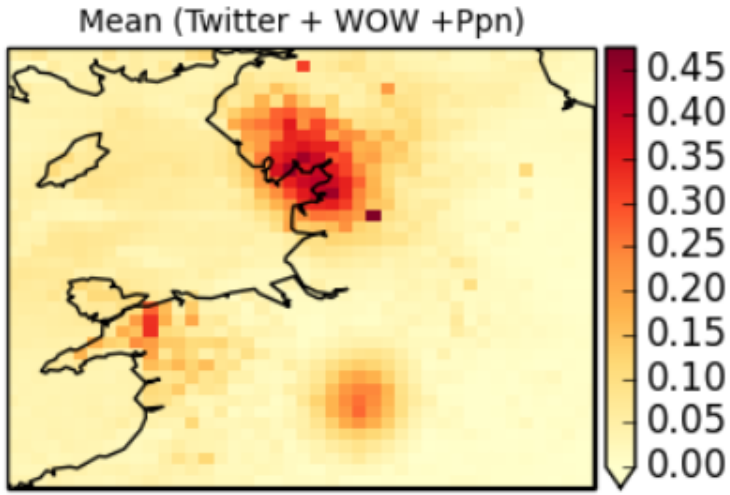
Combining data sources… example 1

Rain case for 22 November 2017. Flooding over Cumbria and North Wales.





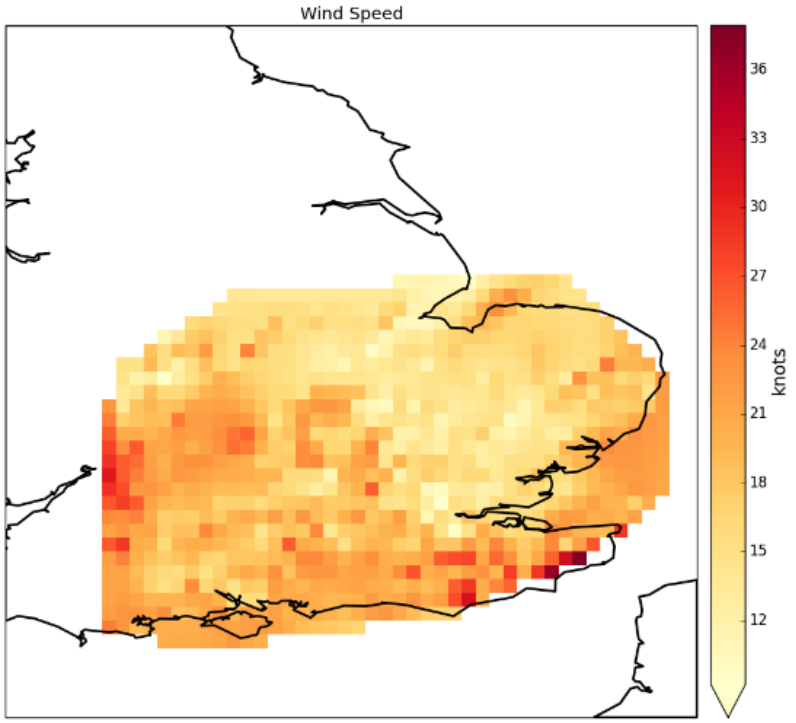


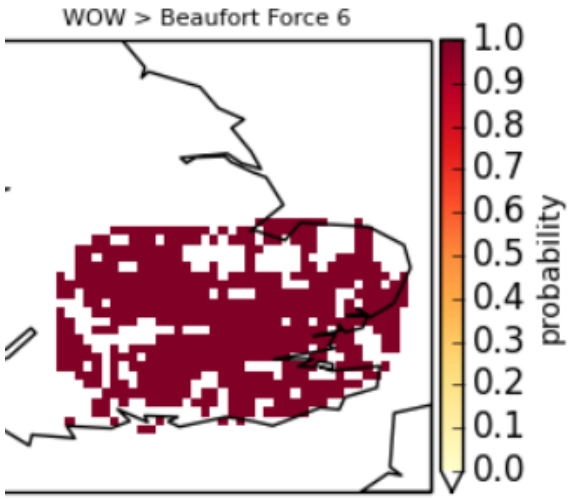


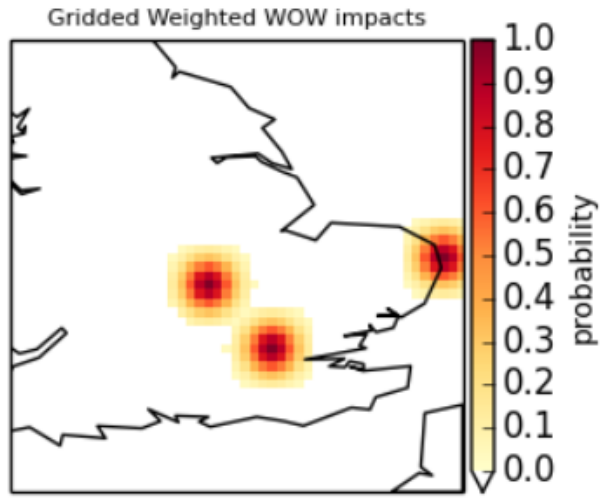
From Crocker, 2017

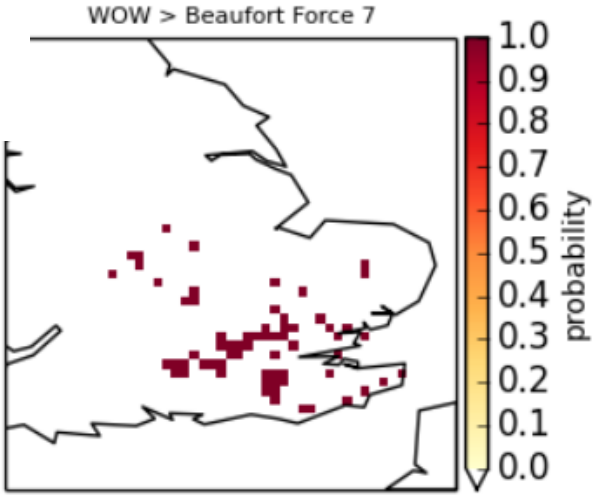
Surface analyses … example 2

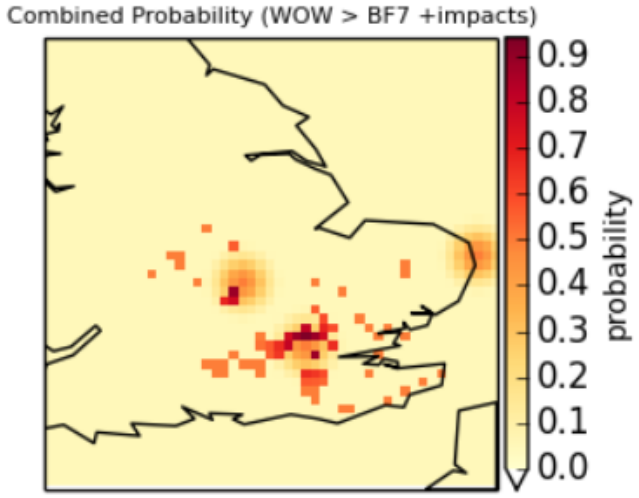
South East of England on 13 September 2017 (Storm Aileen)











A lot more work to be done!

Conclusions

WOW and MMS observations have the density to provide sufficient detail for surface analyses.

WOW impact observations can enhance the picture for case-studies but for routine assessment the sporadic nature and small sample size give problems with consistency.

The differences between solicited (WOW) v unsolicited (Tweets) is clear → “few v many” but the quality must still be checked carefully.

Synthesising observation types has to be the way forward.