

*Impact based warning – does it work?
The Met Office's experience*

Mark Bevan

Met Office Advisor (Civil Contingencies)

Regional Workshop on Impact-based
Forecasts in Asia



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Met Office Advisor (Civil Contingencies)

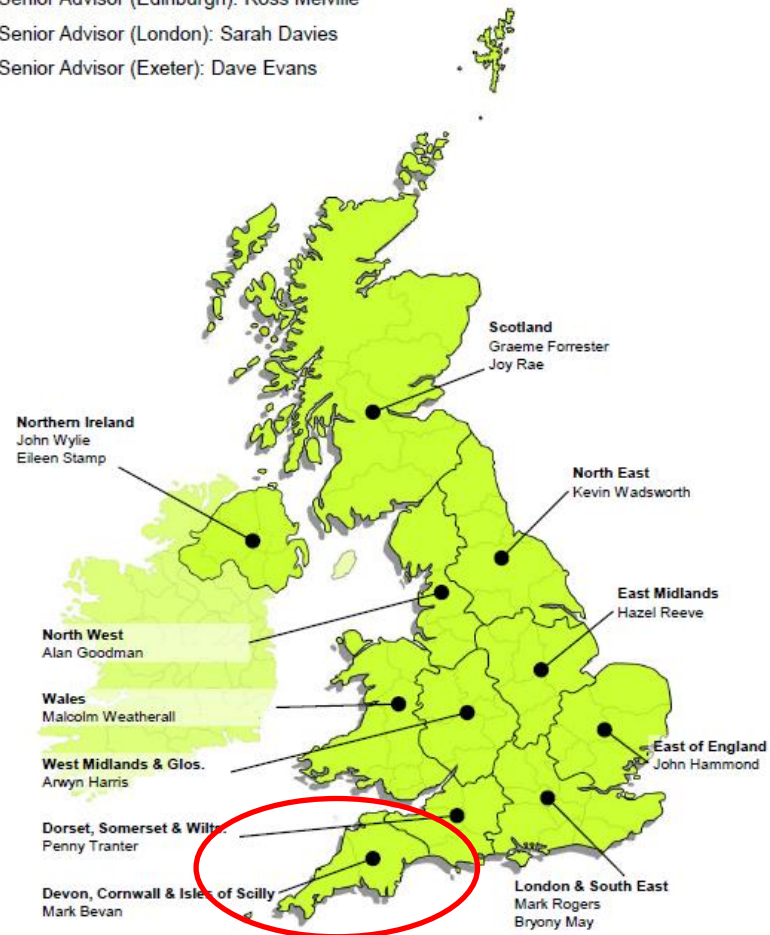
- Joined the Met Office in 2003
- Background in Defence Forecasting, including reserve military service overseas
- Forecaster at 2012 Olympic Games and 2014 Commonwealth Games
- Now part of a team of 19 Advisors spread across the UK
- Liaison between the Advisor team and the Chief Operational Meteorologist in Met Office HQ
- Responsible for communications with emergency responders in Devon, Cornwall and the Isles of Scilly

Head of Civil Contingencies: Mel Harrowsmith

Senior Advisor (Edinburgh): Ross Melville

Senior Advisor (London): Sarah Davies

Senior Advisor (Exeter): Dave Evans



Content

- Introduction – why did we develop an impact based warning service?
- National Severe Weather Warning Service
 - development of the service (2009-2011)
 - current service
 - ongoing work to update the service (2015 onwards)
- Summary
- Questions

History of NSWWS

1987 - Michael Fish's 'Hurricane' - 18 deaths, 15 million trees lost, hundreds of thousands of homes without power.

1988 - Government funded, meteorologically determined threshold based warning service begins



The original NSWWS 1988-2011

Severe gales/storms
Blizzards/drifts
Freezing rain/glazed frost/widespread icy roads

Heavy snow
Heavy rain
Widespread Dense Fog

Early warnings Issued when the forecaster had confidence that there would be “disruption” due to severe weather in the next 5 days.

Flash warnings When the forecaster had 80% or more confidence that there would be severe weather in the next few hours (up to 24 hours).

Emergency Flash Warnings These were issued with up to 24 hours notice (but usually much less than this) when extreme conditions were expected .

Motoring Unit Warnings There was a lower tier of warning aimed specifically at motorists. These gave warnings of rain, heavy enough to give spray and standing water, fog (visibility less than 200m), widespread ice, snow and wind.

The original NSWWS 1988-2011

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TOO COMPLICATED!

2009 – research undertaken into how to improve the warnings service:

- 12 public focus groups
- 7 responder workshops
- Media meetings

**‘Warning categories are too complex.
Needs to be simplified’**

**‘Weather warnings should only be
issued if severe weather is expected to
have an impact’**

2011 - Impact based NSWWS launched



So what is NSWWS?

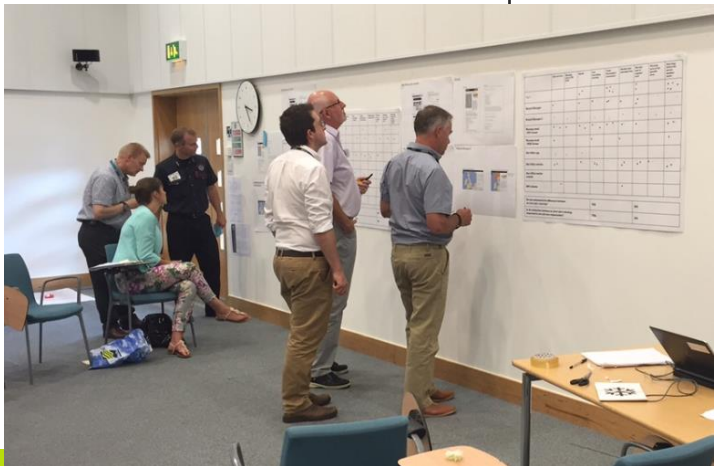
Likelihood	High				
	Medium			✓	
	Low				
	Very low				
		Very low	Low	Medium	High
	Impact				

- Impact based warnings service – providing warnings of Rain, Wind, Snow, Ice and Fog
- Forecast provides an **Expected Level of Impact** and a **Likelihood of this Impact** occurring - from this we define a ‘colour’ to attach to the warning (Yellow, Amber or Red)
- Thresholds (for example 50 mm of rain in 12 hours) are no longer used to trigger warnings, but may form part of the decision process

Understanding Impacts

Emergency responders defined the levels of impact – ensures impacts in the warnings match their perceptions and pressures.

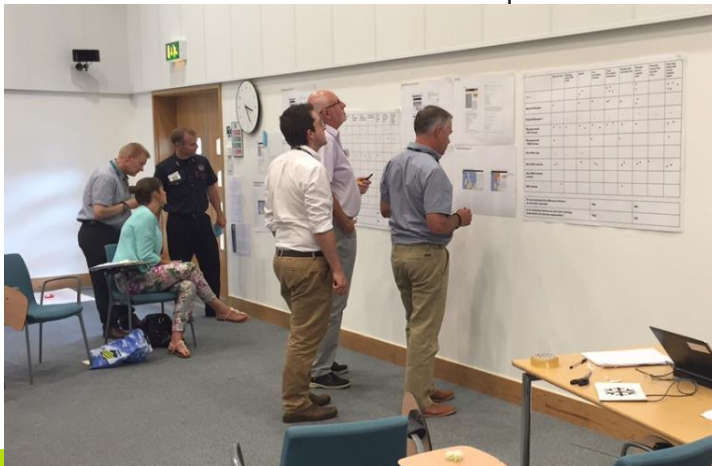
Impact Levels for All Weather Types			
Very Low	Low	Medium	High
<p>On the whole, day to day activities not affected but some localised, small scale impacts occur</p> <p>A few transport routes affected.</p>	<p>Some short lived disruption to day to day routines in affected areas</p> <p>Incidents dealt with under 'business as usual' response by emergency services</p> <p>Some transport routes and travel services affected. Some journeys require longer travel times.</p>	<p>Injuries with danger to life</p> <p>Disruption to day to day routines and activities.</p> <p>Short-term strain on emergency responder organisations.</p> <p>Transport routes and travel services affected. Longer journey times expected. Some vehicles and passengers stranded.</p> <p>Disruption to some utilities and services.</p> <p>Damage to buildings and property.</p>	<p>Danger to life</p> <p>Prolonged disruption to day to day routines and activities</p> <p>Prolonged strain on emergency responders organisations.</p> <p>Transport routes and travel services affected for a prolonged period. Long travel delays. Vehicles and passengers stranded for long periods.</p> <p>Disruption to utilities and services for a prolonged period.</p> <p>Extensive damage to buildings and property.</p>



Understanding Impacts

Emergency responders defined the levels of impact – ensures impacts in the warnings match their perceptions and pressures.

Impact Levels for All Weather Types			
Very Low	Low	Medium	High
<p>On the whole, day to day activities not affected but</p> <p>‘NORMAL WEATHER’</p> <p>affected.</p>	<p>Some short lived disruption to day to day</p> <p>‘BUSY DAY’</p> <p>incidents dealt with under 'business as usual' response by emergency services</p> <p>Some transport routes and travel services affected. Some journeys require longer travel times.</p>	<p>Injuries with danger to life</p> <p>SHORT TERM STRAIN ON EMERGENCY SERVICES</p> <p>Transport routes and travel services affected. Longer journey times expected. Some vehicles and passengers stranded.</p> <p>Disruption to some utilities and services.</p> <p>Damage to buildings and property.</p>	<p>Danger to life</p> <p>PROLONGED STRAIN ON EMERGENCY SERVICES</p> <p>Transport routes and travel services affected for a prolonged period. Long travel delays. Vehicles and passengers stranded for long periods.</p> <p>Disruption to utilities and services for a prolonged period.</p> <p>Extensive damage to buildings and property.</p>



The Process

GATHER INTELLIGENCE

Forecast of 'severe weather'

- Some questions to consider
- Forecast uncertainty?
- Impact uncertainty?
- Intensity of weather?
- Time of day?
- Time of year?
- Location? Rural or urban?
- What is 'normal' for the area?
- Local vulnerabilities?
- Recent conditions?

Consult Civil Contingencies Advisors

Seek information from emergency responders & partner organisations

High			?		?
Medium				?	
Low					?
Very low				?	
	Very low	Low	Medium	High	
	Impact				

Review Warning

Finalise and issue (or update) warning

High					
Medium					
Low				✓	
Very low					
	Very low	Low	Medium	High	
	Impact				

ISSUE

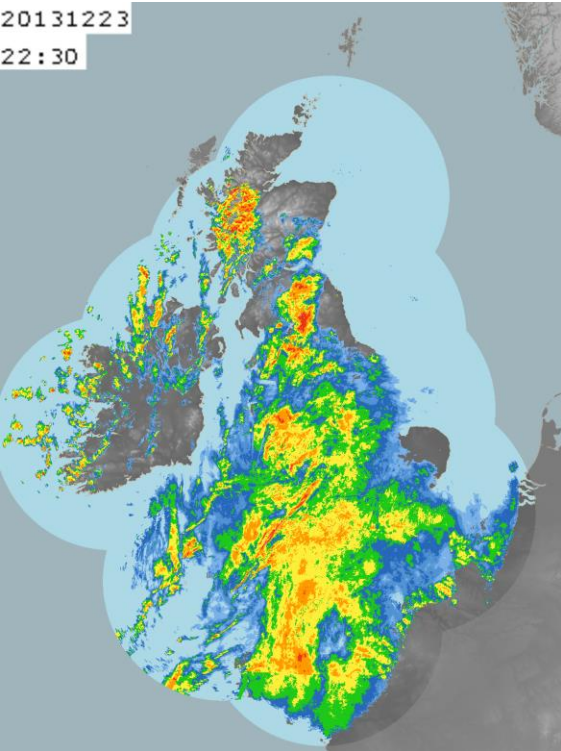
Monitor weather / forecast & impacts

EVALUATE & UPDATE

- Some questions to consider
- Are the impacts as expected?
- Are the timings as expected?
- Are impacts within the warning area?

High				?	
Medium				?	
Low				✓	
Very low					
	Very low	Low	Medium	High	
	Impact				

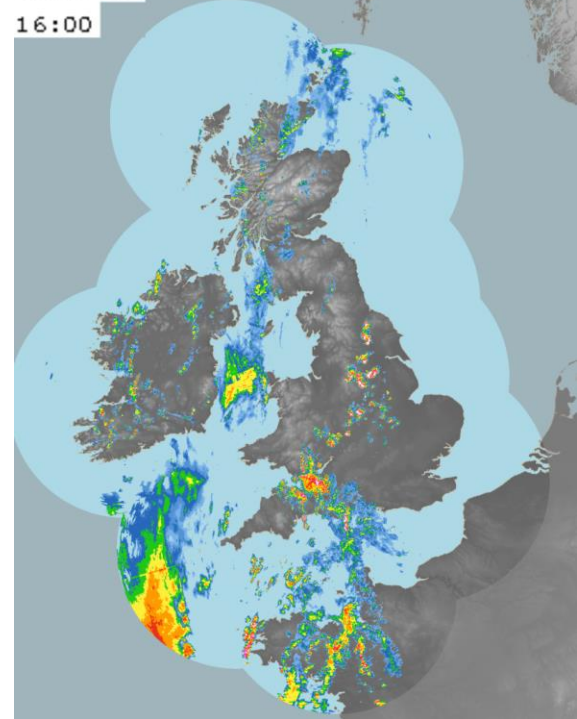
What is the message?



Isolated medium impacts

Likelihood	High				
	Medium				
	Low			✓	
	Very low				
		Very low	Low	Medium	High
Impact					

20150822



Convective



Dynamic



Likelihood	High				
	Medium		✓		
	Low				
	Very low				
		Very low	Low	Medium	High
Impact					

Widespread low impacts

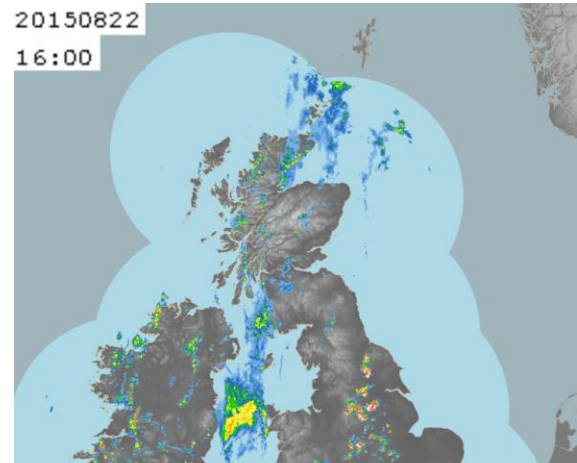
What is the message?



Isolated medium impacts

20150822
16:00

Likelihood	High				
	Medium				
	Low			✓	
	Very low				
		Very low	Low	Medium	High
Impact					



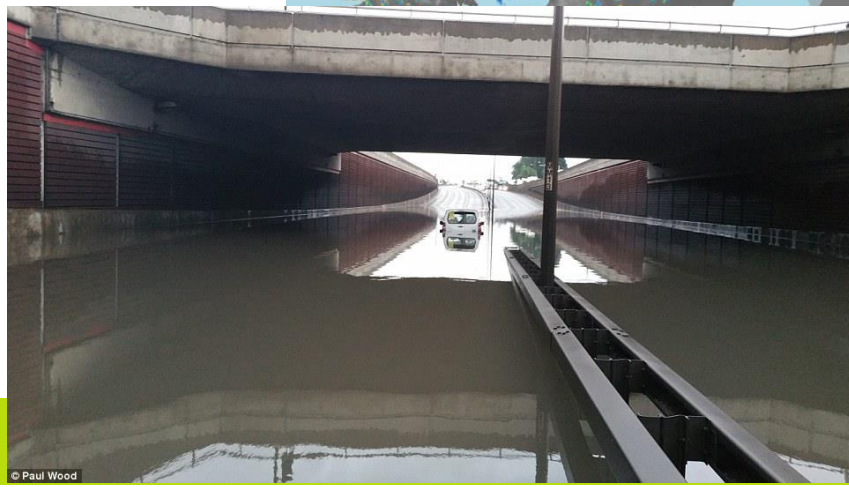
Convective?



Dynamic?

Likelihood	High				
	Medium		✓		
	Low				
	Very low				
		Very low	Low	Medium	High
Impact					

Widespread low impacts

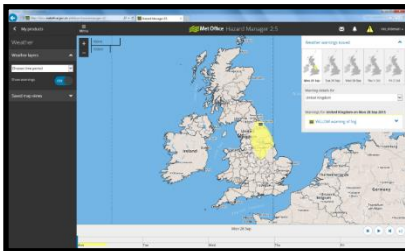


Where do the warnings go?

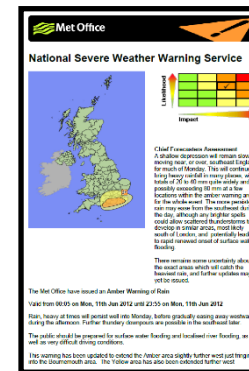
Television and Radio



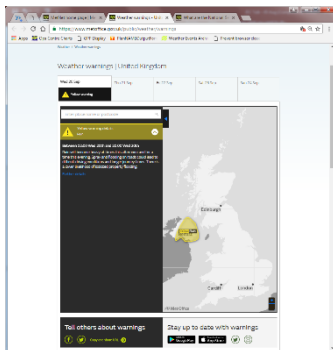
Hazard Manager web service for responders



Email



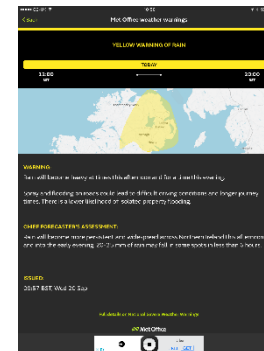
Public Website



Social Media



Mobile App

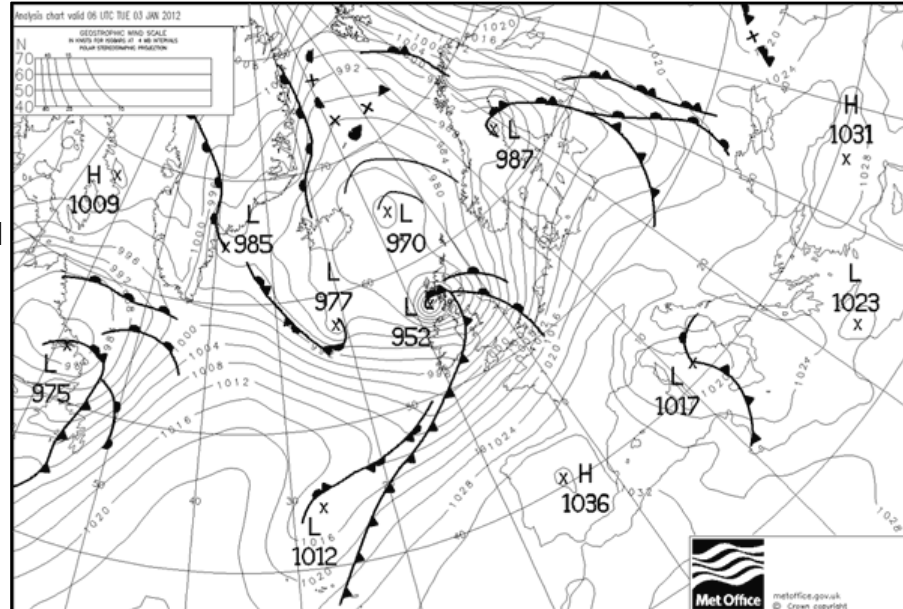


Past Event – South Scotland

3 January 2012

A deep area of low pressure tracked across northern parts of Scotland bringing gale to severe gale force winds across the UK with Scotland's Central Belt worst affected.

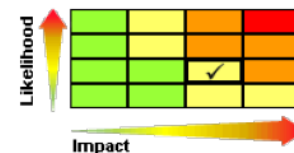
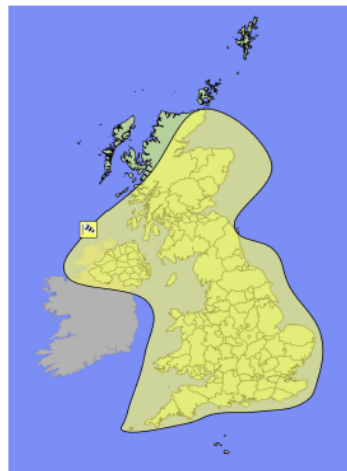
Synoptic Chart at
0600 on Tuesday 3rd
January 2012



Past Event – South Scotland

3 January 2012

A warning was originally issued on the 31st December 2011 and updated on the 1st January 2012 suggesting gusts of 60-70 locally 80 mph.



Chief Forecasters Assessment
A deep depression is expected to affect the UK on Tuesday bringing very windy conditions to most regions for a time. Strongest winds are expected across parts of Northern Ireland, northern England and, more especially, Scotland, including the Central Lowlands. Here there is the potential for gusts to reach 60 to 70 MPH and, perhaps, locally 80 MPH over coasts and hills. Elsewhere gusts between 45 and 55 MPH are expected at times, and up to 60 or 70 MPH in exposed western and southern coastal areas in England and Wales. Some hill snow is also in prospect for parts of Scotland for a time.

The Met Office have issued a **Yellow Alert of Wind**

Valid from 03:00 on Tue, 03rd Jan 2012 until 18:00 on Tue, 03rd Jan 2012

A spell of wet and very windy weather will affect the UK during Tuesday. The public should be aware of the possibility of disruption due to strong winds, e.g. to travel, on Tuesday morning in most parts and during the afternoon across northeastern Scotland. A spell of heavy rain will also affect many regions, with a risk of localised flooding over parts of Wales and northwest England.

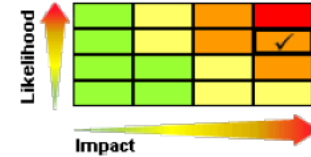
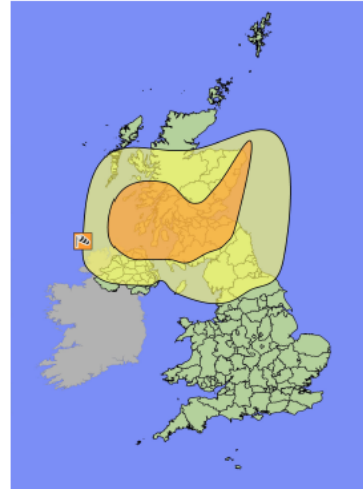
For more details please go to:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_warnings.html

Issued by the Met Office at 11:29 on Sat, 31st Dec 2011

Past Event – South Scotland

3 January 2012

An Amber wind warning was issued on 2nd January 2012 suggesting gusts of 70-80 mph locally 90 mph through the Central Belt.



Chief Forecasters Assessment
A deep depression will affect the UK on Tuesday bringing very windy conditions to much of the north of the UK, gusts widely reaching 60 to 70 MPH. Strongest winds are expected across northern parts of Northern Ireland and, more especially, Scotland, including the Central Lowlands. Here gusts will reach 70 to 80 MPH, perhaps locally 90 MPH.

The Met Office have issued an Amber Warning of Wind

Valid from 04:00 on Tue, 03rd Jan 2012 until 18:00 on Tue, 03rd Jan 2012

A spell of wet and very windy weather will affect the UK during Tuesday. The public should be aware of the possibility of disruption due to strong winds, e.g. to travel. The windiest conditions will mainly be during Tuesday morning, but, over northeastern Scotland also into the afternoon. A spell of heavy rain will also affect many regions, leading to localised flooding, and parts of northern Scotland will also be affected by snow.

For more details please go to:

http://www.metoffice.gov.uk/weather/uk/uk_forecast_warnings.html

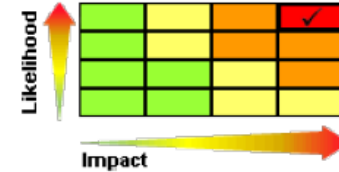
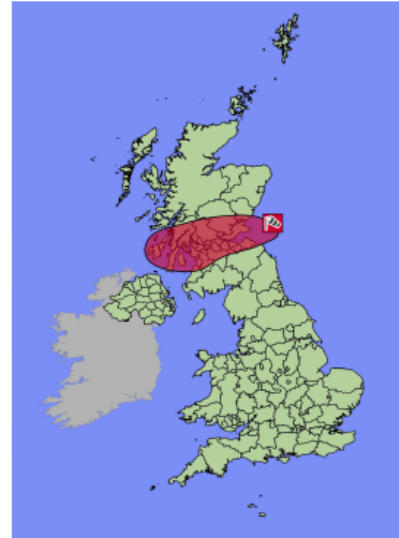
Issued by the Met Office at 11:29 on Sat, 31st Dec 2011

Updated by the Met Office at 12:13 on Mon, 02nd Jan 2012

Past Event – South Scotland

3 January 2012

An Red wind warning was issued on 3rd January 2012 suggesting gusts of 85-95 mph through the Central Belt.



Chief Forecasters Assessment
The strongest winds will move east through the central belt of Scotland over the next few hours, with a high risk of damaging gusts.

The Met Office have issued a Red Warning of Wind

Valid from 08:15 on Tue, 03rd Jan 2012 until 12:00 on Tue, 03rd Jan 2012

Storm force winds will affect the central belt of Scotland at first this morning, leading to widespread disruption to travel and the potential for damage to buildings. Gusts will reach 85-95 mph.

For more details please go to:

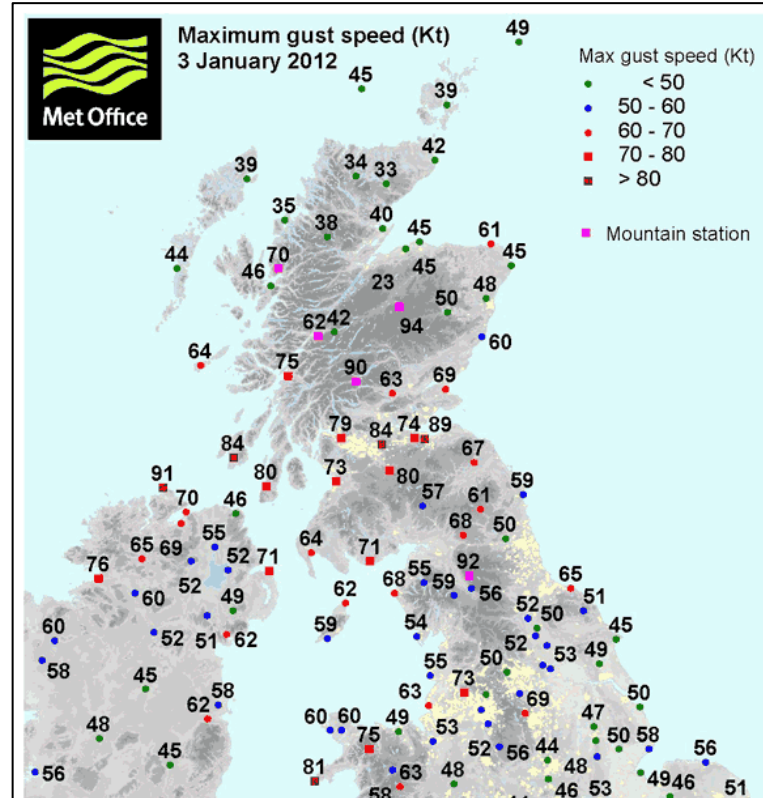
http://www.metoffice.gov.uk/weather/uk/uk_forecast_warnings.html

Issued by the Met Office at 08:14 on Tue, 03rd Jan 2012

Past Event – South Scotland

3 January 2012

Wind gusts of 75-85 knots (86-97 mph) occurred through the Central belt with a gust of 89 knots (102 mph) at Blackford Hill, Edinburgh.





Past Event – South Scotland 3 January 2012

- Rail services from Edinburgh to Glasgow were suspended
- The Forth, Tay and Kingston road bridges were closed
- Ferry services were delayed and flights cancelled
- 100,000 Scottish homes and businesses were left without power
- Several buildings were damaged
- Fallen trees blocked roads and rail lines

It was very windy across other parts of the UK too with severe disruption and 2 deaths.

Does it work? – Verification of individual Warnings

All Amber and Red warnings are subjectively verified after the event.

Assess the warning in terms of: Impact Level (0-3)
 Impact Timings (0-3)
 Impact Location (0-3)

Impact information sought from: Responders
 Media Reports
 Social Media

Verification carried out internally then subject to external audit – rolling two year average.

Target of 72% of warnings scoring 6 or more (rising to 80% by 2020), with less than 20% scoring 3 or fewer.

Does it work? - Feedback

Feedback is regularly sought from both Emergency Responders and the Public



Responders surveyed every two years.
Met Office Advisors attend debriefs after
severe events



Public surveyed by telephone after
Amber or Red Warnings are issued

Does it work? - Feedback

2017 survey of Emergency Responders – 1377 responders interviewed.



92% of
Responders are
satisfied with
NSWWS



82% feel they
get about the right
number of
warnings

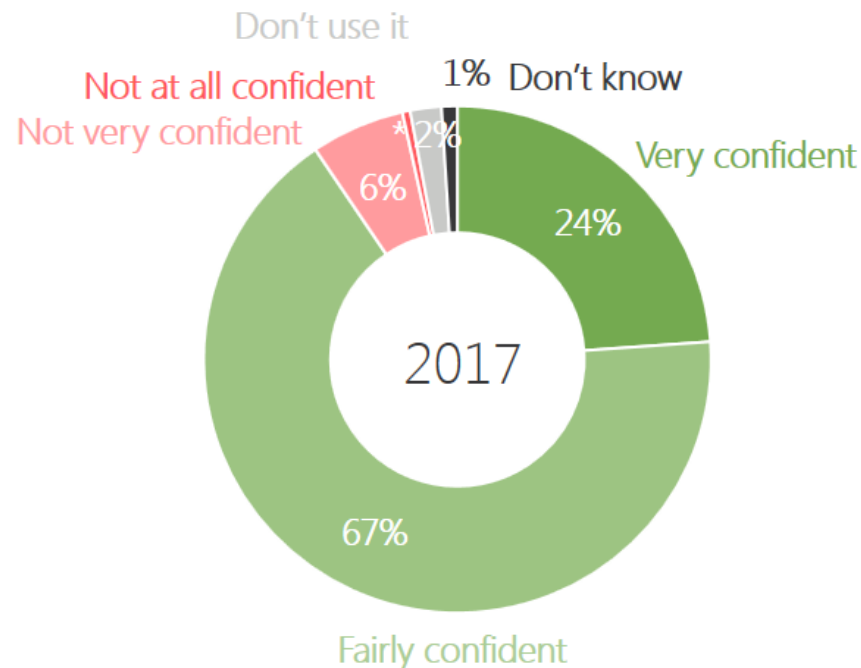


86% say they
use the weather
impact matrix

Does it work? - Feedback

2017 survey of Emergency Responders – 1377 responders interviewed.

To what extent are you confident or not in your ability to use the National Severe Weather Warning Service weather impact matrix to assist you in making decisions?



Does it work? - Feedback

25% of responders made suggestions for improvements

I appreciate this is difficult but I feel there are **too many yellow warnings** which can neutralise the impact of the service. However, by their nature these will be more frequent..... Perhaps consider yellows as alerts or risk awareness raising whereas continue to provide warnings for amber or red scenarios.

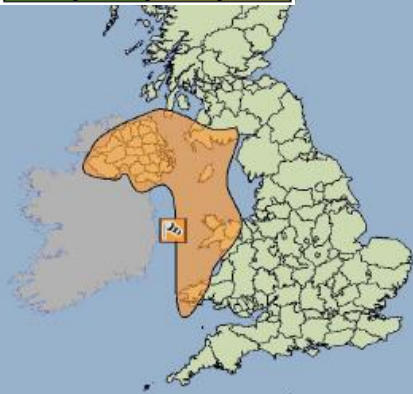
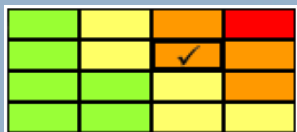
Make the **access** to the systems using a tablet easier, at the moment there seems to be **limited functionality** using a tablet or smart phone. Perhaps an app would be of benefit?

Fewer warnings. Seem to get far to many warnings when there is high wind or rain which is just normal winter weather.

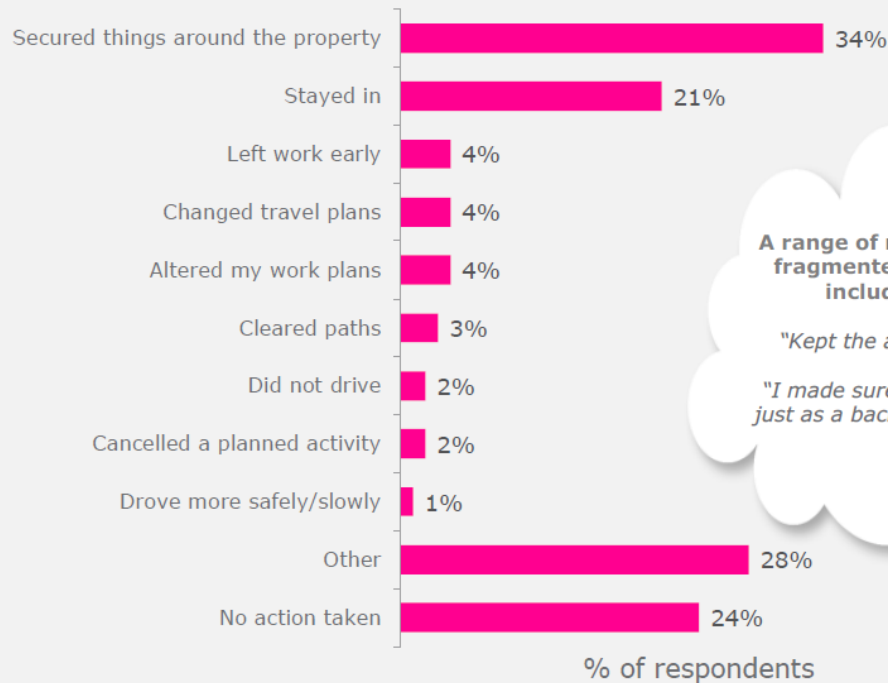
If there was a way of making it **more regional** as the emails cover national information and I only need to see information relevant to my region.

Be more **locally specific**. This is why I usually wait for the Civil Contingencies Advisor to send it, rather than actively find and read it

Ad-hoc public surveys post event



Q) What action, if any, did you take as a result of the severe weather warning? For example, please think about whether you changed any plans to travel or how you travelled, etc. as well as anything you did around your property



76% took action

A range of more individual and fragmented comments were included as 'other':

"Kept the animals in and safe"

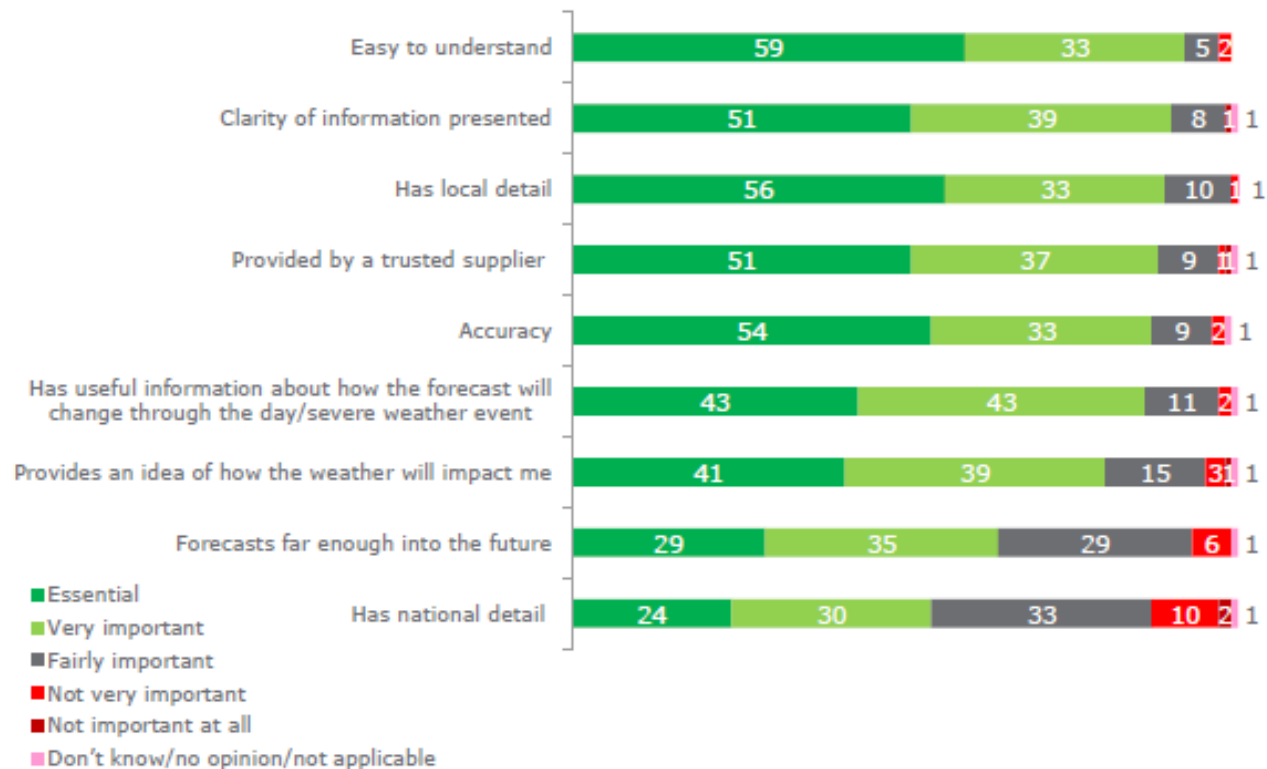
"I made sure I had coal in. It was just as a back up in case electricity went off"



Q Base: 432 (all respondents who saw the specific warning)

Q) Please can you tell me how important or unimportant each of the following elements of a National Severe Weather Warning are?

Also investigate views of the service as a whole



NSWWS – Next Generation

- Extend maximum lead time from 5 days to 7 days (in response to improved modelling and forecast capability)
- Add two new weather types to the scope of NSWWS – ‘Thunderstorm’ and ‘Lightning’
- Remove Weather Icons – use words to prevent misinterpretation
- Reduce meteorological jargon and emphasise impacts – use plain language
- Improve presentation of warnings - clarify overlapped areas during complex situations
 - improve public website and mobile app display
- Improve communication in short lead time situations

Addition of ‘Thunderstorm’ and ‘Lightning’ Warnings

Improve communication of severe convection – previously only option was to issue a ‘Rain’ warning.

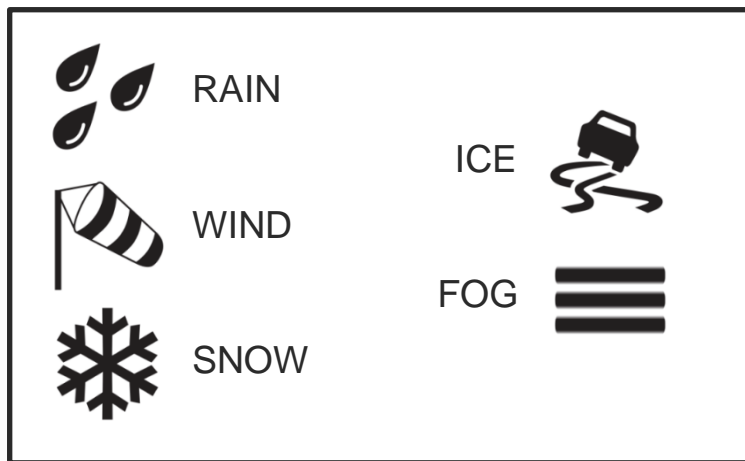
Public testing showed that ‘Thunderstorm’ was understood as a combination of Heavy Rain, Strong Winds, Hail and Lightning

So...

Thunderstorm warning – to be used when all thunderstorm hazards are present

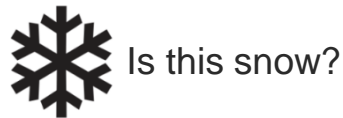
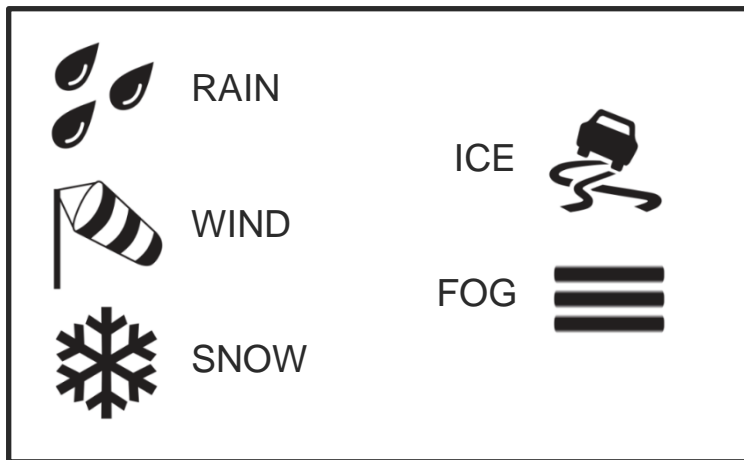
Lightning warning – for use when precipitation / wind is not expected to be a problem – for example elevated instability where lightning impacts on power networks are the main concern.

Remove Weather Icons – use words to prevent misinterpretation

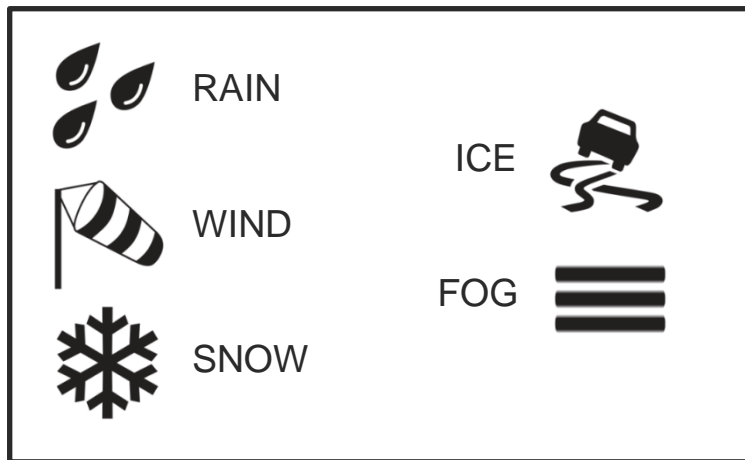


Public research showed that the audience did not always identify the weather type correctly from icons alone

Remove Weather Icons – use words to prevent misinterpretation



Remove Weather Icons – use words to prevent misinterpretation

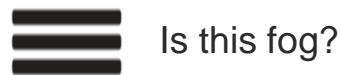
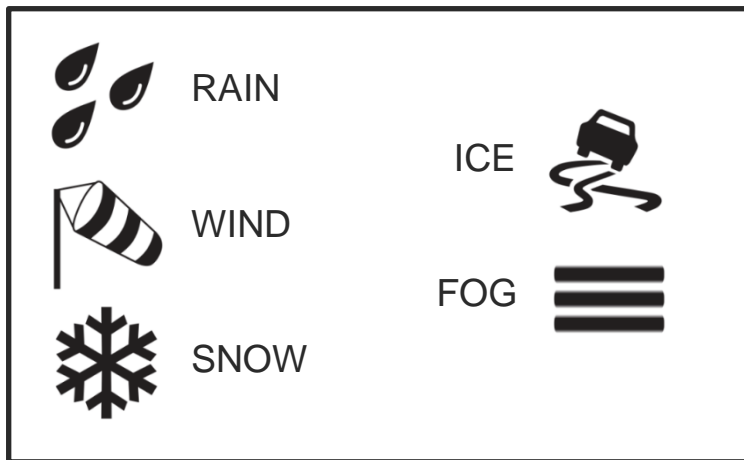


Is this snow?

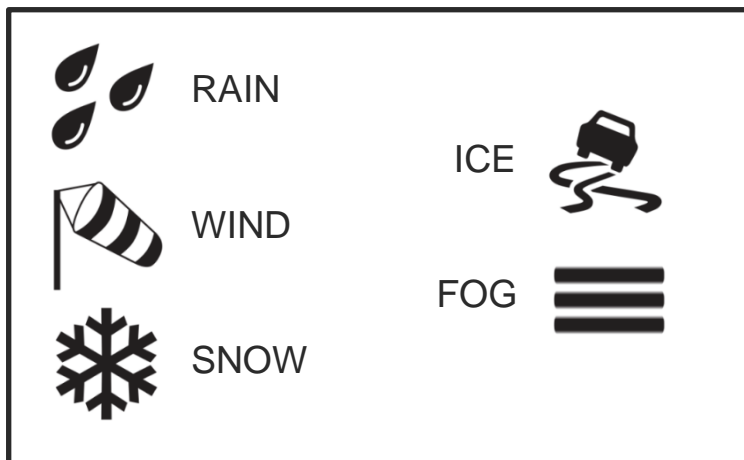
Or ice?



Remove Weather Icons – use words to prevent misinterpretation

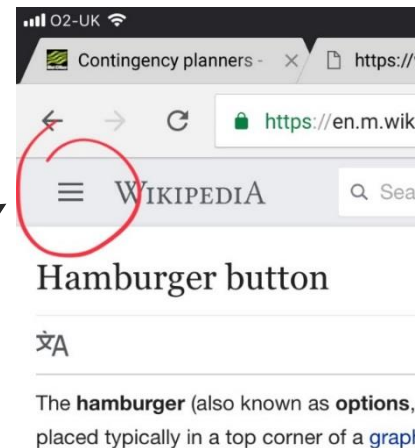


Remove Weather Icons – use words to prevent misinterpretation

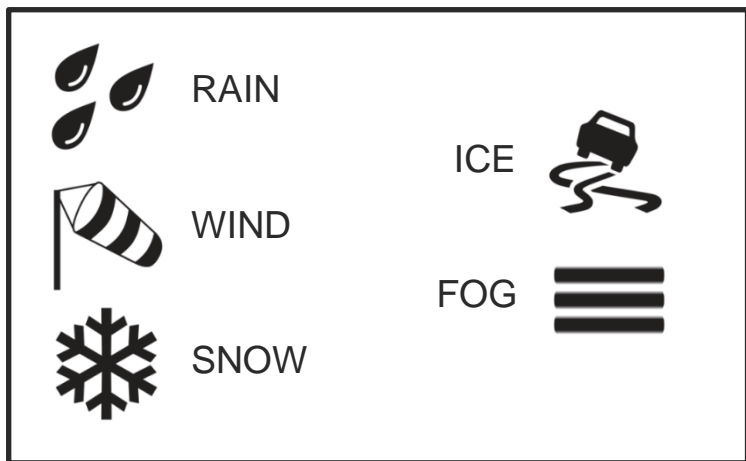


Is this fog?

Or a menu button?



Remove Weather Icons – use words to prevent misinterpretation



Icons are being replaced with plain text

RAIN

THUNDERSTORM

SNOW

ICE

LIGHTNING

FOG

Presentation and Language

Feedback from the public showed that warnings were seen as too complicated – both in terms of language and display.

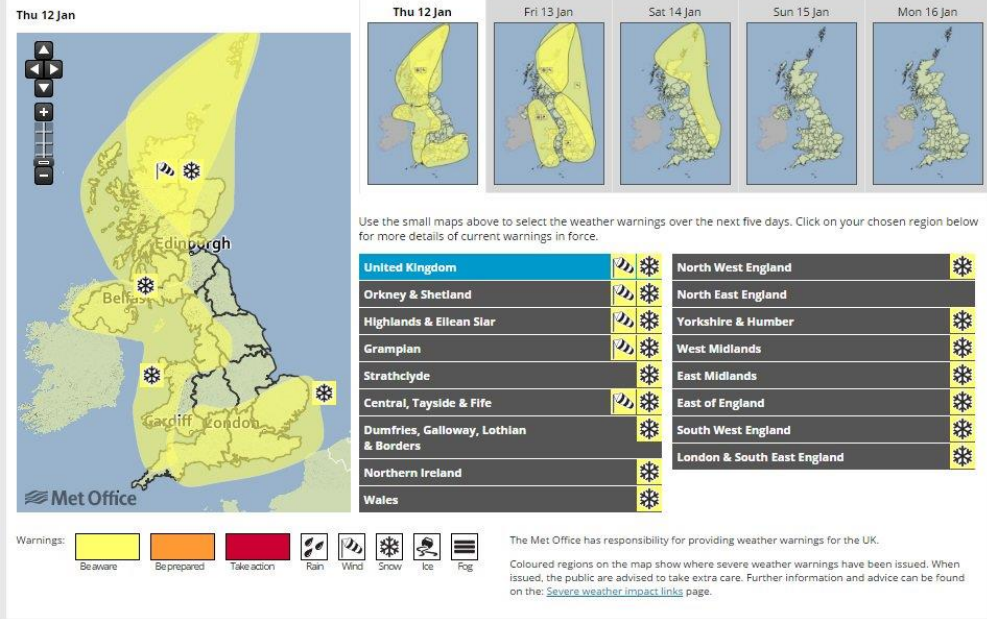
The matrix was not well understood by the public but remains in demand from Emergency Responders.

‘Too many warnings’ – especially low impact Yellow warnings

Improve presentation of warnings

Met Office Weather Warning Overview: United Kingdom

Issued on Thu 12 Jan



Improve presentation of warnings

Met Office Weather Warning Overview: United Kingdom

Issued on Thu 12 Jan

Thu 12 Jan

Thu 12 Jan Fri 13 Jan Sat 14 Jan Sun 15 Jan Mon 16 Jan

Use the small maps above to select the weather warnings over the next five days. Click on your chosen region to see more details of current warnings in force.

United Kingdom			North West England	
Orkney & Shetland			North East England	
Highlands & Eilean Siar			Yorkshire & Humber	
Grampian			West Midlands	
Strathclyde			East Midlands	
Central, Tayside & Fife			East of England	
Dumfries, Galloway, Lothian & Borders			South West England	
Northern Ireland			London & South East England	
Wales				



The Met Office has responsibility for providing weather warnings for the UK.

Coloured regions on the map show where severe weather warnings have been issued. When issued, the public are advised to take extra care. Further information and advice can be found on the: [Severe weather impact links](#) page.

Weather warnings | United Kingdom

Mon 16 Oct Tue 17 Oct Wed 18 Oct Thu 19 Oct Fri 20 Oct

Amber warning Yellow warning

Enter place name or postcode

Amber warning details
Wind

Between 15:00 Mon 16th and 22:00 Mon 16th

A spell of very windy weather is expected on Monday in association with ex-Ophelia. Longer journey times and cancellations are likely, as road, rail, air and ferry services will be affected as well as some bridge closures. There is a chance that power cuts may occur, with the potential for disruption to services, such as mobile phone coverage. Damage to property is likely, such as tiles blown from roofs, as well as waves around coastal districts with beach material being thrown onto coastal roads, sea fronts and properties. This leads to the potential for injuries and danger to life.

Further details

Yellow warning details
Wind

Edinburgh Belfast Cardiff London

Met Office



Too many yellows? Warning types since 2011

Likelihood	High		66	17	12
	Medium		1836	218	16
	Low			731	25
	Very low			350	8
		Very low	Low	Medium	High
Impact					

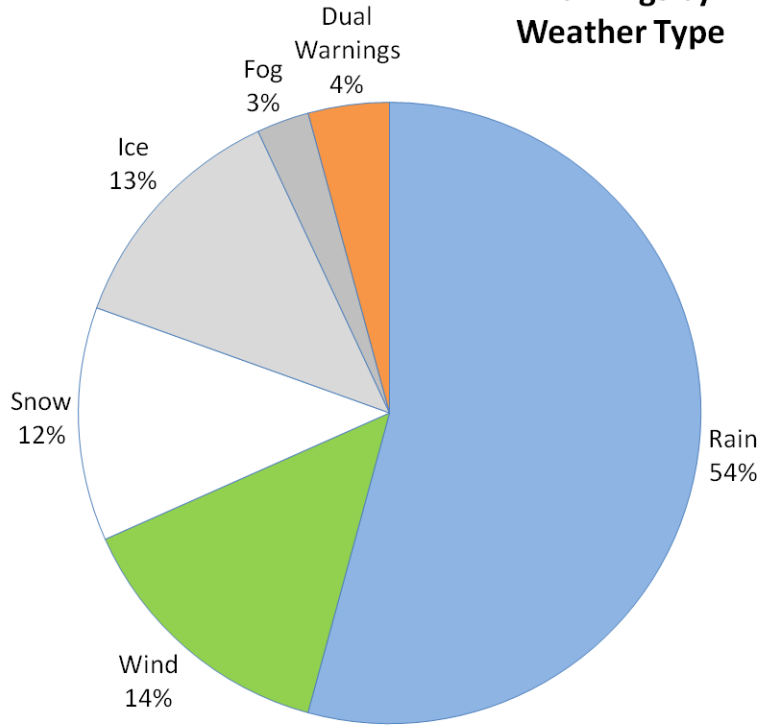
Yellow Warnings
Amber Warnings
Red Warnings
Total Warnings

2991
276
12
3279

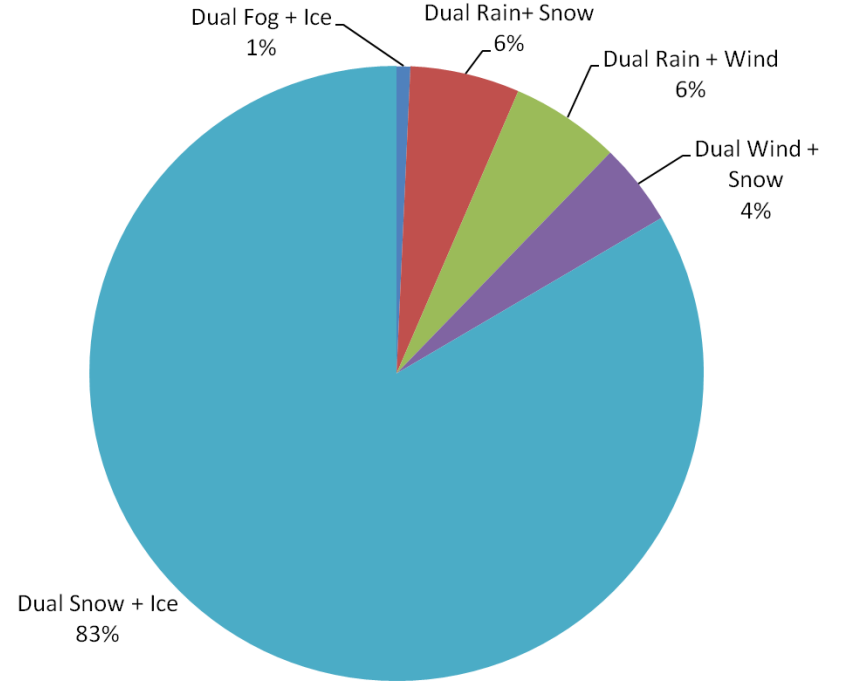
Low Impact
Medium Impact
High Impact

1902
1316
61

Warnings by Weather Type



Dual Warnings by Weather Types



Changing forecaster behaviours

- Change in language use – less meteorological jargon.
‘An occluded front may bring 30 mm of rain in an hour this evening causing surface water flooding’

Becomes:

‘There is a small chance that heavy rain this evening could lead to flooding developing rapidly.’

- ‘Chief Forecasters Assessment’ section renamed as ‘Further details’.
- Aim to reduce the number of low impact Yellow warnings – increase in risk appetite.

Naming storms

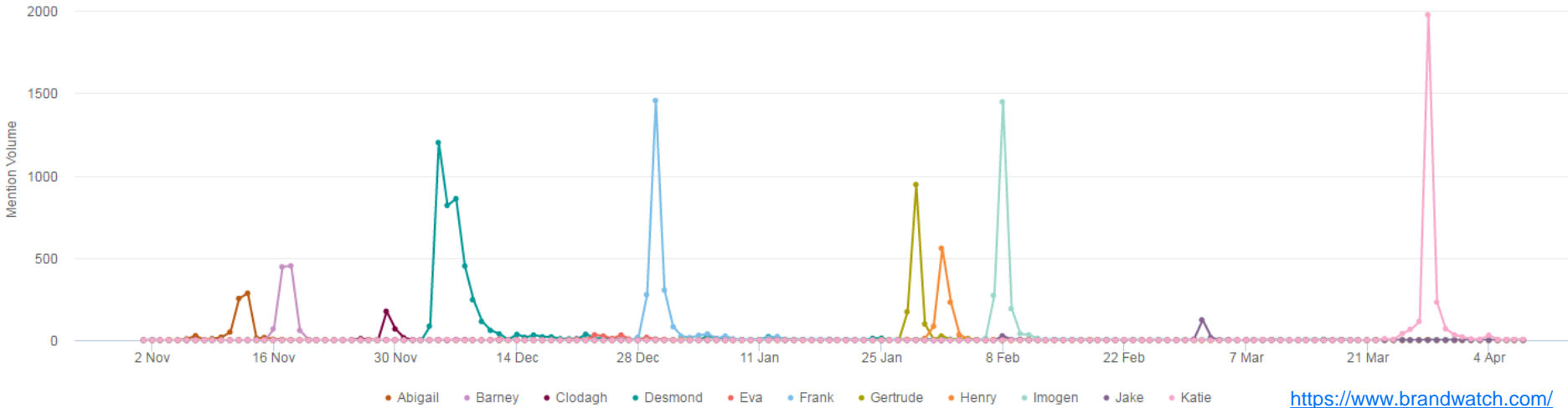
Since Autumn 2015 some severe weather systems have been assigned names as the impact on the UK and the Republic of Ireland. Either:

- Amber/Red warning for Wind (or system expected to require one)
- Amber/Red warning for another weather element, but with wind a significant factor.

This is a joint programme in partnership with Met Éireann, the Irish Met Service.



Naming Storms - Does it work?



Naming Storms - Does it work?

2000
1500

Storm Desmond: CLIMATE CHANGE 'may have played a role' in deadly and unprecedented weather

CLIMATE change may have played a role in the "unprecedented" Storm Desmond has caused a "number of" deaths and devastated thousands of homes.



Summary

- NSWWS in general is well received and understood.
- Emergency responders benefit from the support of the Met Office Civil Contingencies Advisors which they view as ‘part of the service’
- Ongoing work to update the service in view of user feedback.
- Behaviours of the forecasters as important as the design of the service.

Any questions?

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