

# Managing extreme weather and floods in the UK winter of 2013/14



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EUMeTrain: Droughts, Floods and Landslides

December 2014

## Where are you from?



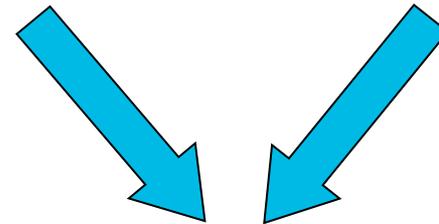
# Contents:

1. The Flood Forecasting Centre – who are we?
2. Communicating Flood Risk
3. The 2013-2014 winter period – putting it into perspective.
4. Some key weather events during this period:
  - St Jude’s Storm (28<sup>th</sup> October 2013)
  - December Surge (5-6<sup>th</sup> December 2013)
  - Severe flooding along the River Thames and the Somerset Levels (11-12<sup>th</sup> February 2014)
5. Advances in NWP
6. Conclusions

# 1. Flood Forecasting Centre - Introduction

UK government's 'Pitt Review' key recommendation (6)

*“The Environment Agency and the Met Office should **work together**, through a joint centre, to improve their technical capability to forecast, model and warn against all sources of flooding.”*



FLOODFORECASTINGCENTRE

## Flood Forecasting Centre – who are we and what do we do?

- ➔ Successful partnership between the Met Office and the Environment Agency
- ➔ Operational since April 2009, delivering **24/7 services 365 days a year to government and emergency responders**
- ➔ Aim to provide **early warning** of potential flood impacts – **increasing lead time for effective action**
- ➔ Based in the Operations Centre, Exeter
- ➔ Forecasts for all **4 sources of flooding**
- ➔ **Combining expertise** in meteorology and hydrology

## 2. Communicating Flood risk

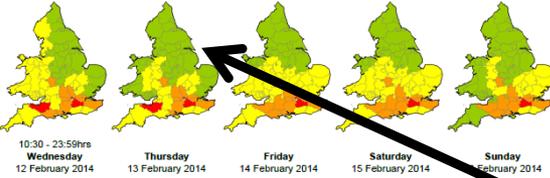
- ➡ Provide **trusted guidance** and consultancy to flood risk
- ➡ **Risk based** forecasts of flood risk for the next 5 days
- ➡ Based on **likelihood of occurrence** coupled with the **impact of the event**

Flagship product - the Flood Guidance Statement (FGS)

**FLOODFORECASTINGCENTRE**  
a working partnership between  Environment Agency |  Met Office

**Flood Guidance Statement 10:30hrs Wednesday 12 February 2014**

Our assessment of daily flood risk for England and Wales, working with flood forecasting teams in the Environment Agency and Natural Resources Wales, is as follows.



10:30 - 23:59hrs  
Wednesday 12 February 2014    Thursday 13 February 2014    Friday 14 February 2014    Saturday 15 February 2014    Sunday 16 February 2014

**HIGH flood risk for river flooding along the River Thames in Windsor & Maidenhead and Surrey through the next five days. HIGH flood risk for the Somerset Levels today and on Thursday.**

**General overview of flood risk**

Ongoing significant, and locally severe disruption from river and groundwater flooding continues in many parts of southern and central England, with the level of disruption increasing in some places. Further periods of heavy rainfall interspersed with showers are expected to affect central and southern England and Wales today and on Friday and into Saturday. This is expected to cause further disruption from river and surface water flooding, and exacerbate any groundwater flooding. Further significant disruption is possible in Dorset today from coastal flooding. The overall flood risks are as follows (see Specific Areas of Concern Map for detail):

**HIGH river flood risk for:**

- River Thames in Windsor and Maidenhead and Surrey through the next five days.
- Somerset Levels for today and Thursday, with a MEDIUM flood risk from Friday onwards.

**Medium flood risk from:**

- river flooding on the Thames in Oxfordshire, West Berkshire and Reading, and River Severn in Worcestershire for the next five days.
- coastal flooding in parts of Dorset today.
- groundwater flooding in the Croydon area of Greater London, Hambleton, Basingstoke and Lower Farnington in Hampshire and Nailbourne in Kent for the next five days.
- groundwater flooding in parts of Wiltshire and Dorset on Friday and Saturday.

**LOW flood risk from:**

- river flooding in Shropshire, Gloucestershire and Telford & Wrekin for the next five days.
- river flooding in Wrexham and Cheshire on the River Dee for the next five days.
- river flooding in Cambridgeshire, Northamptonshire, Bedford and Milton Keynes for the next five days.
- ongoing groundwater flooding in south Wiltshire and parts of Dorset and much of south-east England for the next five days.
- additional river and surface water flooding in southern England and Wales due to further heavy rainfall today, and central and southern England and Wales again on Friday and into Saturday.
- coastal flooding for the west coast of Wales and north west England today, and then along the Dorset coast on Friday and Saturday.

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**Flood Risk Matrix**  
(river, tidal/coastal, surface water & groundwater flooding)

Likelihood	High	Minimal	Minor	Significant	Severe
	Medium	Minimal	Minor	Significant	Severe
	Low	Minimal	Minor	Significant	Severe
	Very Low	Minimal	Minor	Significant	Severe
		Potential Impacts			

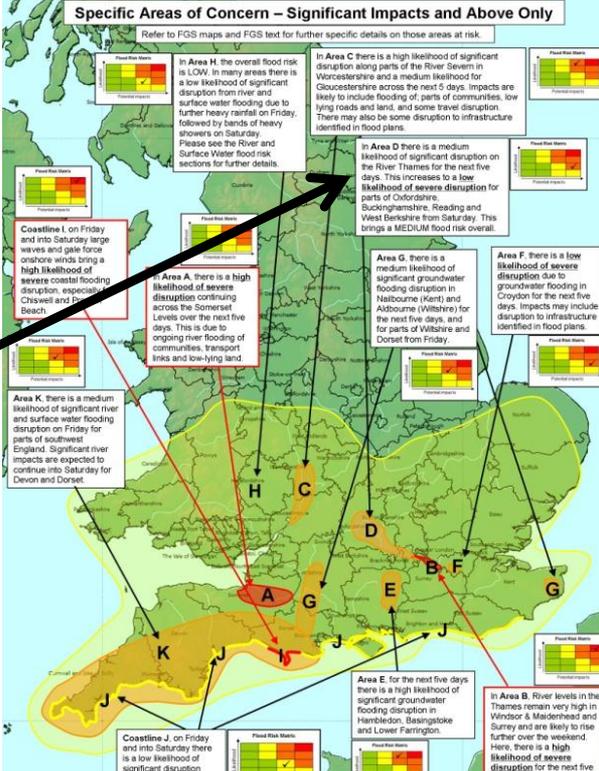
  

**Overall Flood Risk**

HIGH	Severe
MEDIUM	Significant
LOW	Minor
VERY LOW	Minimal

**Specific Areas of Concern – Significant Impacts and Above Only**

Refer to FGS maps and FGS text for further specific details on those areas at risk.



**In Area H,** the overall flood risk is LOW. In many areas there is a low likelihood of significant disruption from river and surface water flooding due to further heavy rainfall on Friday, followed by bands of heavy showers on Saturday. Please see the River and Surface Water flood risk sections for further details.

**In Area C** there is a high likelihood of significant disruption along parts of the River Severn in Worcestershire and a medium likelihood for Gloucestershire across the next 5 days. Impacts are likely to include flooding of parts of communities, low lying roads and land, and some travel disruption. There may also be some disruption to infrastructure identified in flood plans.

**In Area D** there is a medium likelihood of significant disruption on the River Thames for the next five days. This increases to a low likelihood of severe disruption for parts of Oxfordshire, Buckinghamshire, Reading and West Berkshire from Saturday. This brings a MEDIUM flood risk overall.

**Coastline I** on Friday and into Saturday large waves and gale force onshore winds bring a high likelihood of severe coastal flooding, especially in Chiswell and Beach.

**In Area A,** there is a high likelihood of severe disruption continuing across the Somerset Levels over the next five days. This is due to ongoing river flooding of communities, transport links and low-lying land.

**Area G** there is a medium likelihood of significant groundwater flooding disruption in Nailbourne (Kent) and Aldbourne (Wiltshire) for the next five days, and for parts of Wiltshire and Dorset from Friday.

**Area F** there is a low likelihood of severe disruption due to groundwater flooding in Croydon for the next five days. Impacts may include disruption to infrastructure identified in flood plans.

**Area K** there is a medium likelihood of significant river and surface water flooding disruption on Friday for parts of southwest England. Significant river impacts are expected to continue into Saturday for Devon and Dorset.

**Coastline J**, on Friday and into Saturday there is a low likelihood of significant disruption from coastal flooding.

**In Area E** for the next five days there is a high likelihood of significant groundwater flooding disruption in Hambleton, Basingstoke and Lower Farnington.

**In Area B,** River levels in the Thames remain very high in Windsor & Maidenhead and Surrey and are likely to rise further over the weekend. Here, there is a high likelihood of severe disruption for the next five days with ongoing flooding of communities and land.

## 3. The 2013-2014 winter period in context - a winter of extremes

### Key Headlines:

- ➔ **Largest East Coast surge since 1953** and largest West Coast flood since 1987
- ➔ **Record surge height** at Liverpool (Gladstone Docks)
- ➔ **Wettest winter for 250 years** across England and Wales
- ➔ **Stormiest winter for at least 20 years** and probably since records began
- ➔ **Lowest recorded pressure** in the NW for 127 years
- ➔ **Record river levels** reached along parts of **the River Thames**
- ➔ Flooding from all 4 sources concurrently at times

## FGS Calendar (highest flood risk in 5 day period) for Winter 2013/14

April						
Su	M	Tu	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May						
Su	M	Tu	W	Th	F	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June						
Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July						
Su	M	Tu	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August						
Su	M	Tu	W	Th	F	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September						
Su	M	Tu	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October						
Su	M	Tu	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November						
Su	M	Tu	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

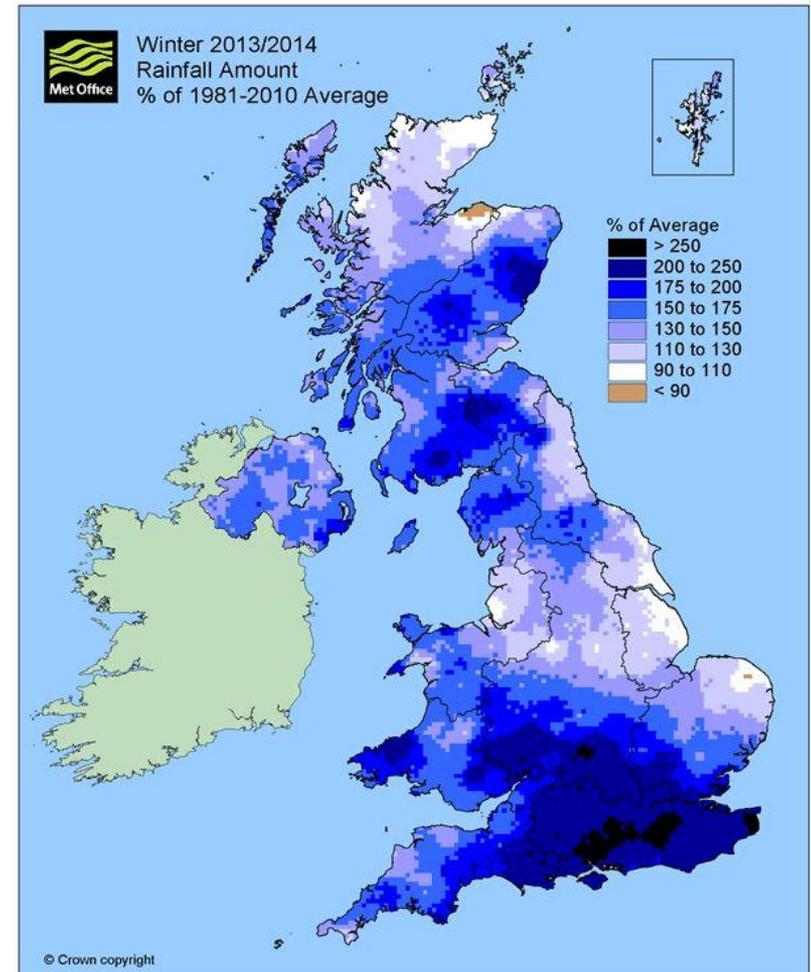
December						
Su	M	Tu	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

January						
Su	M	Tu	W	Th	F	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February						
Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

March						
Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

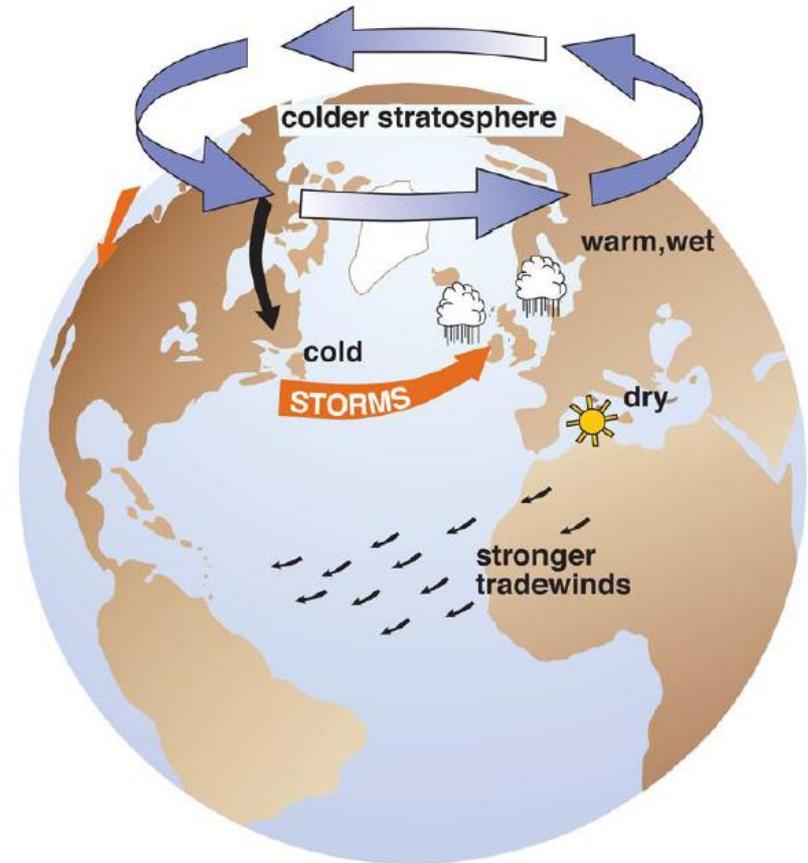
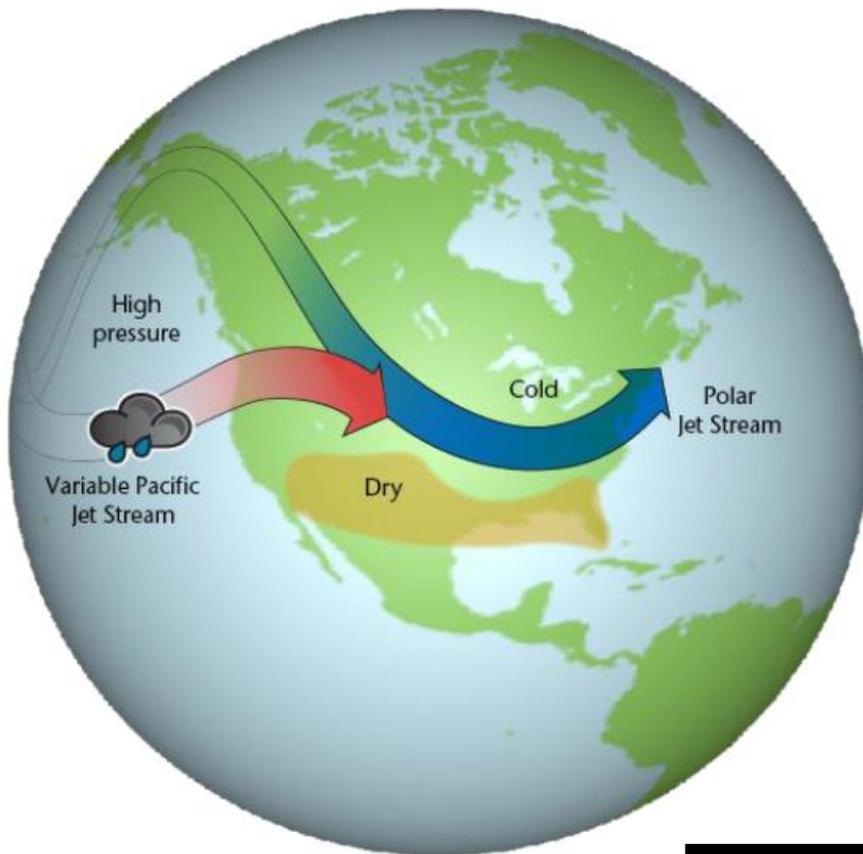
## Rainfall amounts for Winter 2013/14 (as the % of average)



## Impacts on UK public and infrastructure



# Why was the winter so severe?

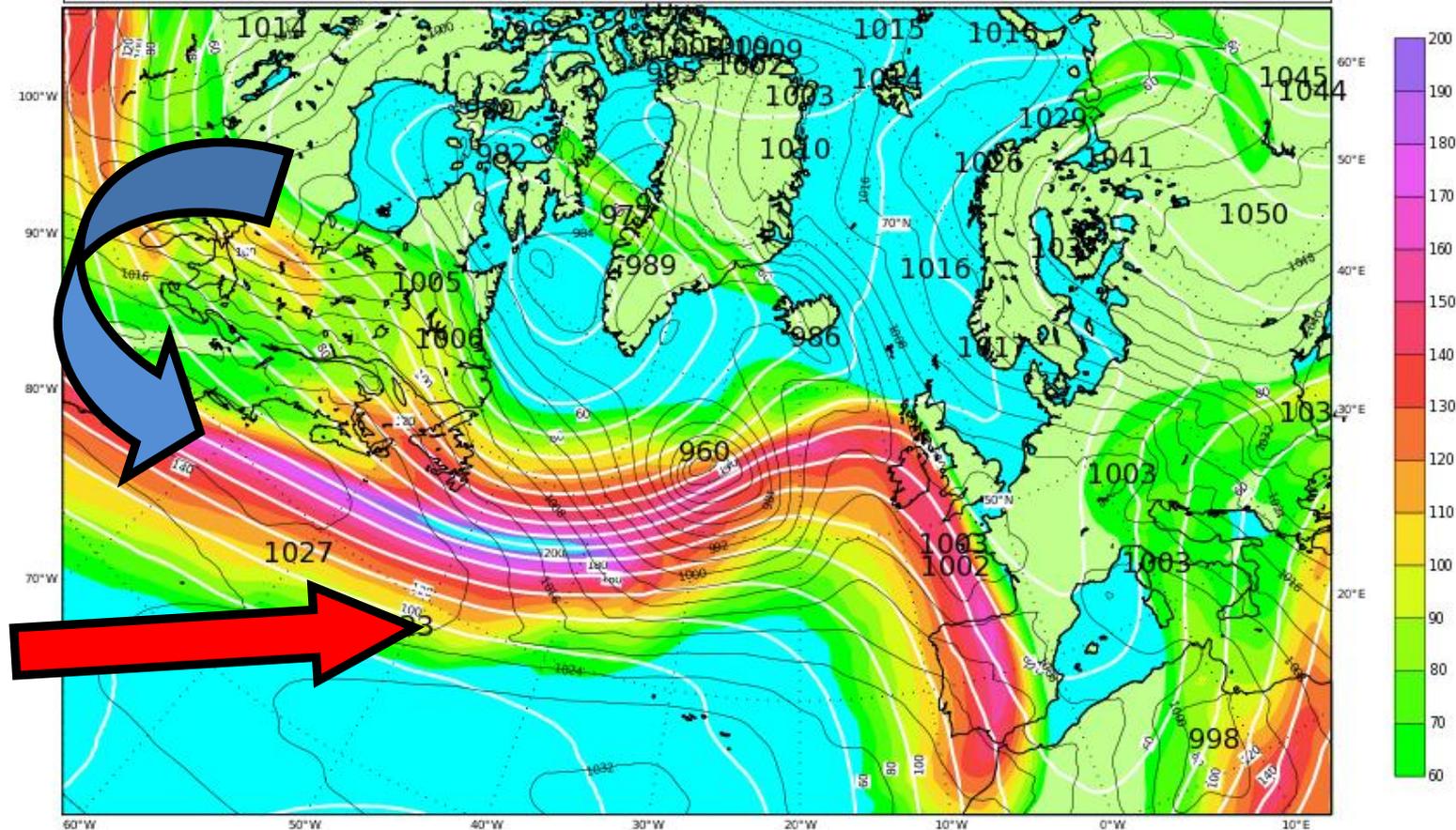


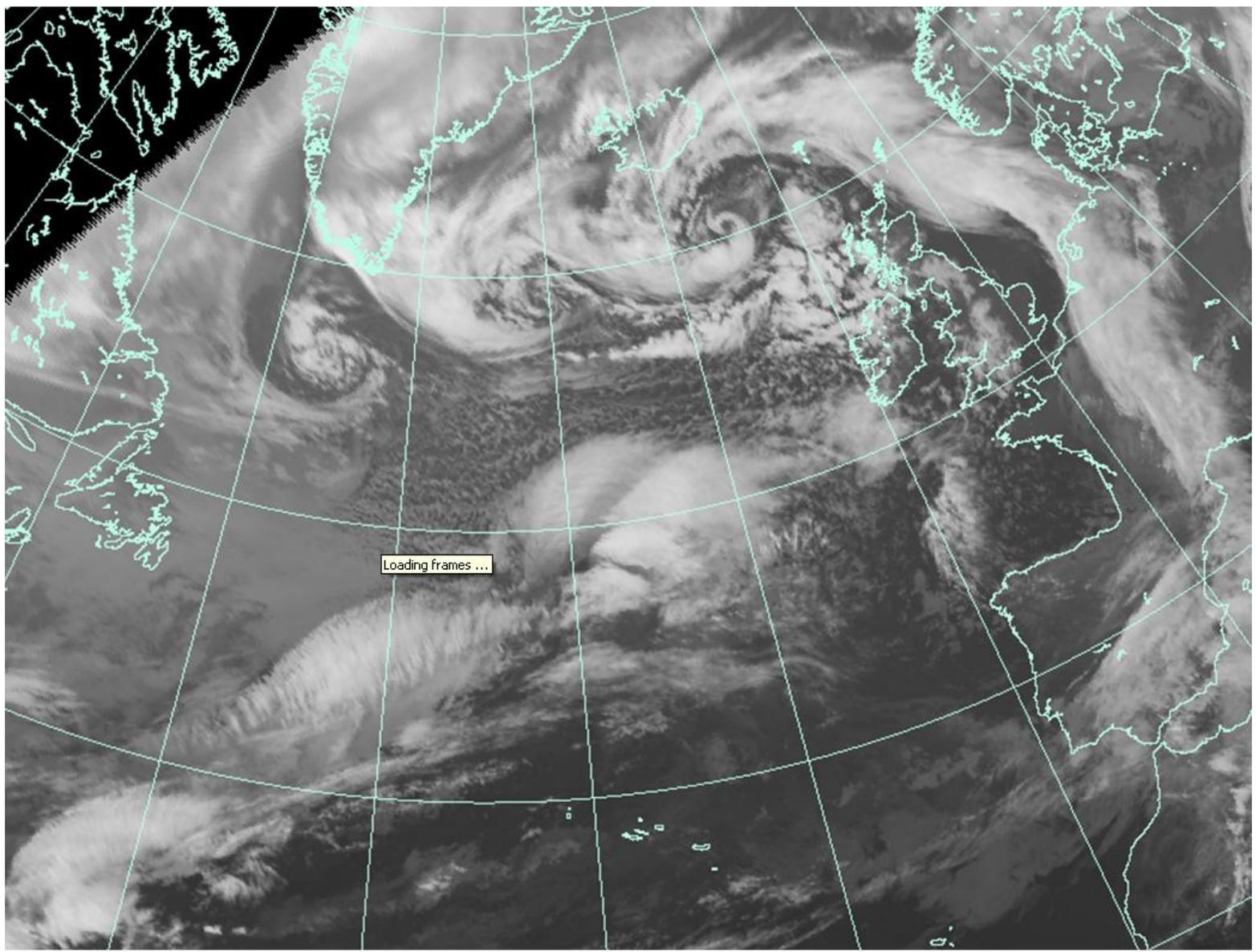
This pattern started around mid-December and then kept repeating itself through the rest of the winter

## Why was the winter so severe?

QG00 20140130 T+18 Verifying 18z 20140130

White Contours: 250hPa gph, Black Contours: MSLP, Colour: 250hPa Wind speed (knots)





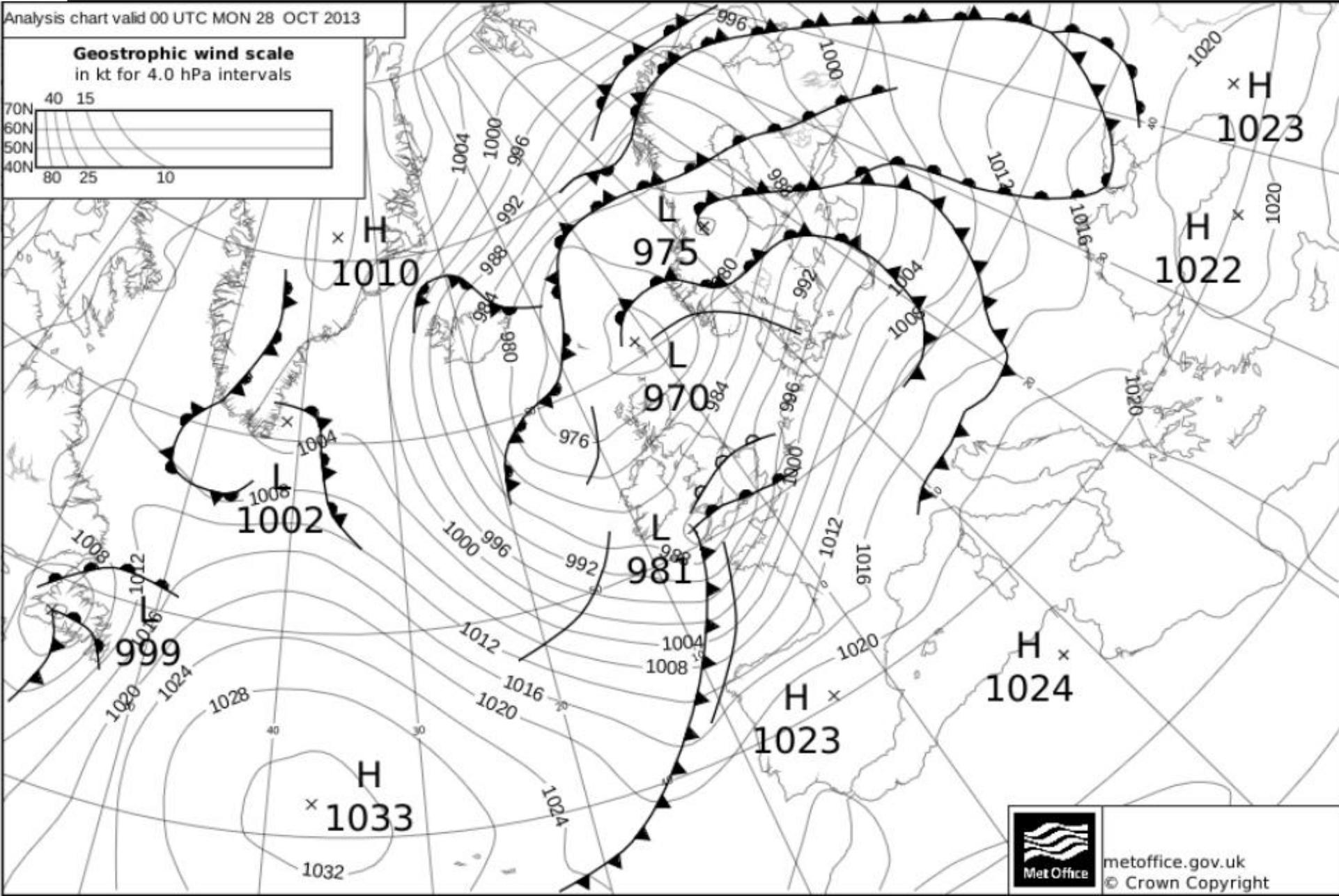
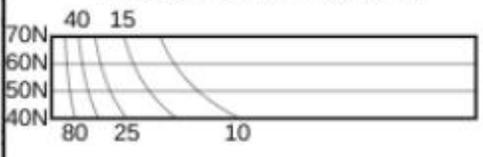
## 4. Key Events

### October 28<sup>th</sup> 2013 - St Jude's Storm

- ➔ Met Office warns of a storm leading to disruption across southern England five days ahead of the event
- ➔ Storm brought severe gales, heavy persistent rain and river and coastal flooding
- ➔ Led to widespread disruption to the power, road, rail and ferry networks and localised flooding
- ➔ Four people were killed

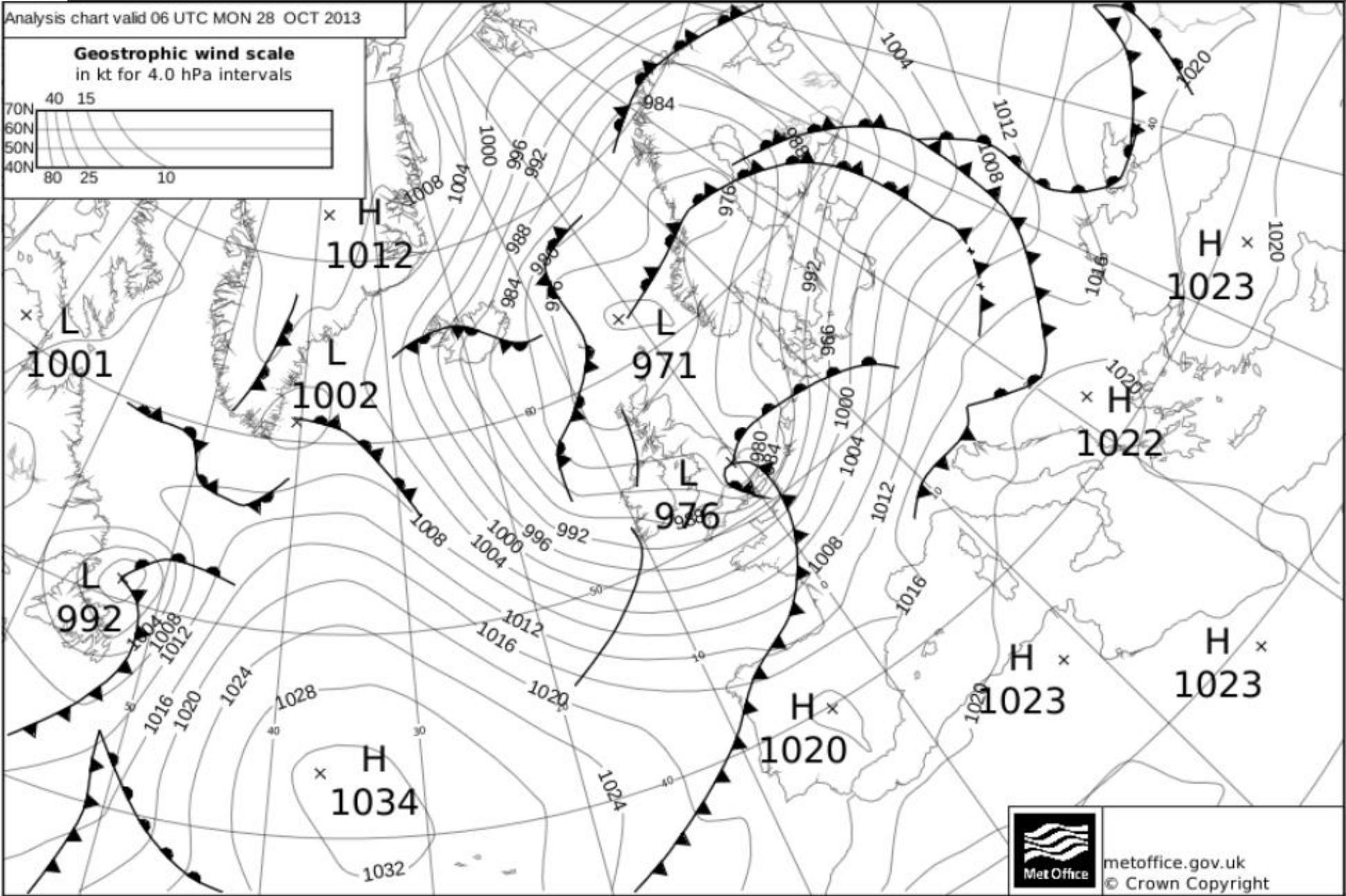
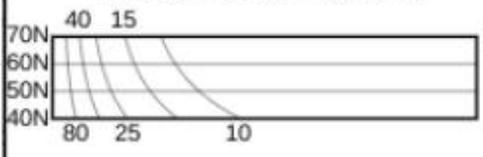
Analysis chart valid 00 UTC MON 28 OCT 2013

**Geostrophic wind scale**  
in kt for 4.0 hPa intervals



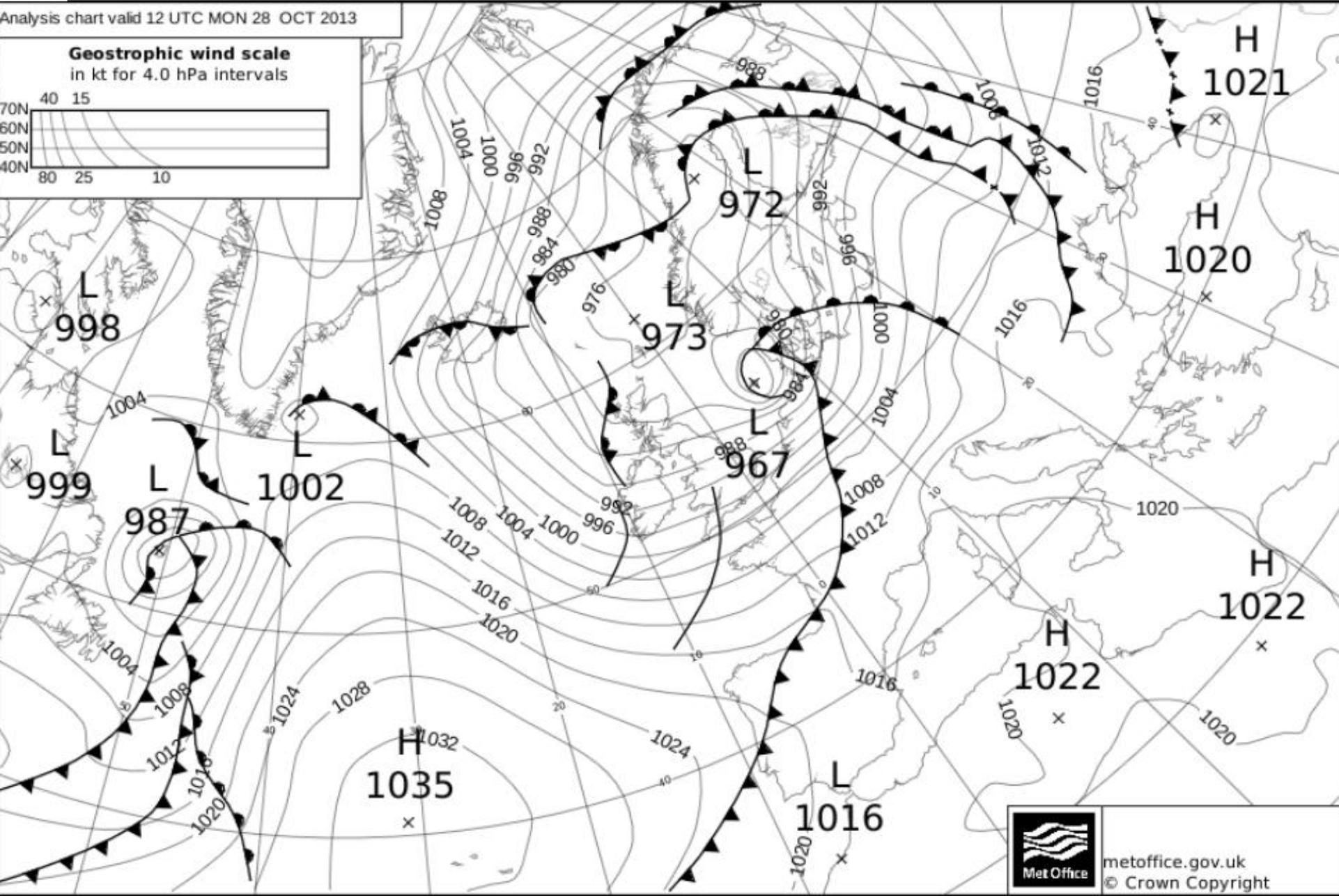
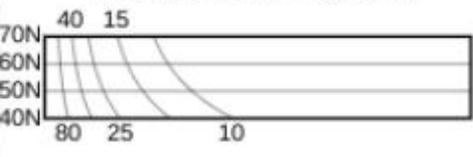
Analysis chart valid 06 UTC MON 28 OCT 2013

**Geostrophic wind scale**  
in kt for 4.0 hPa intervals



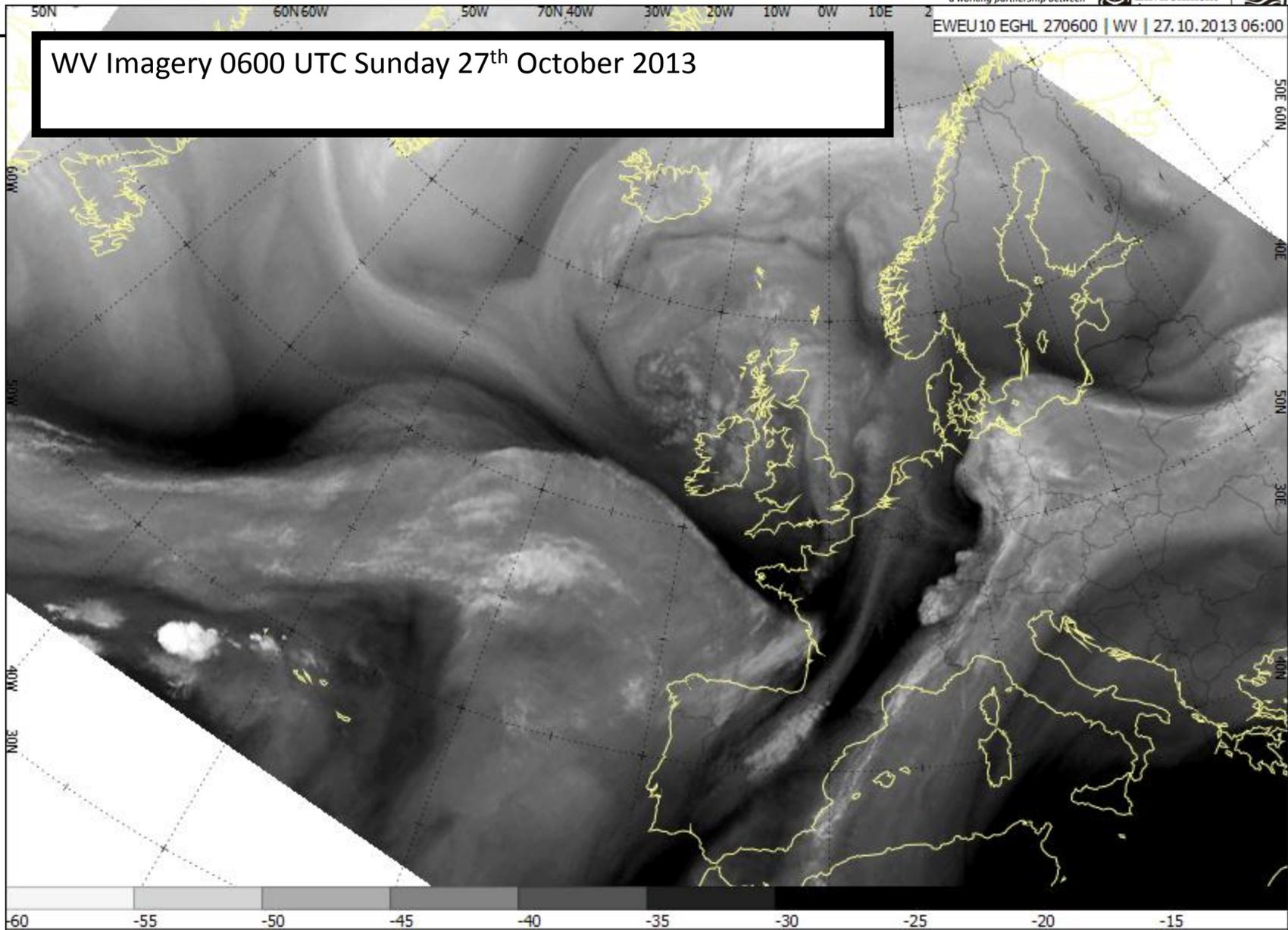
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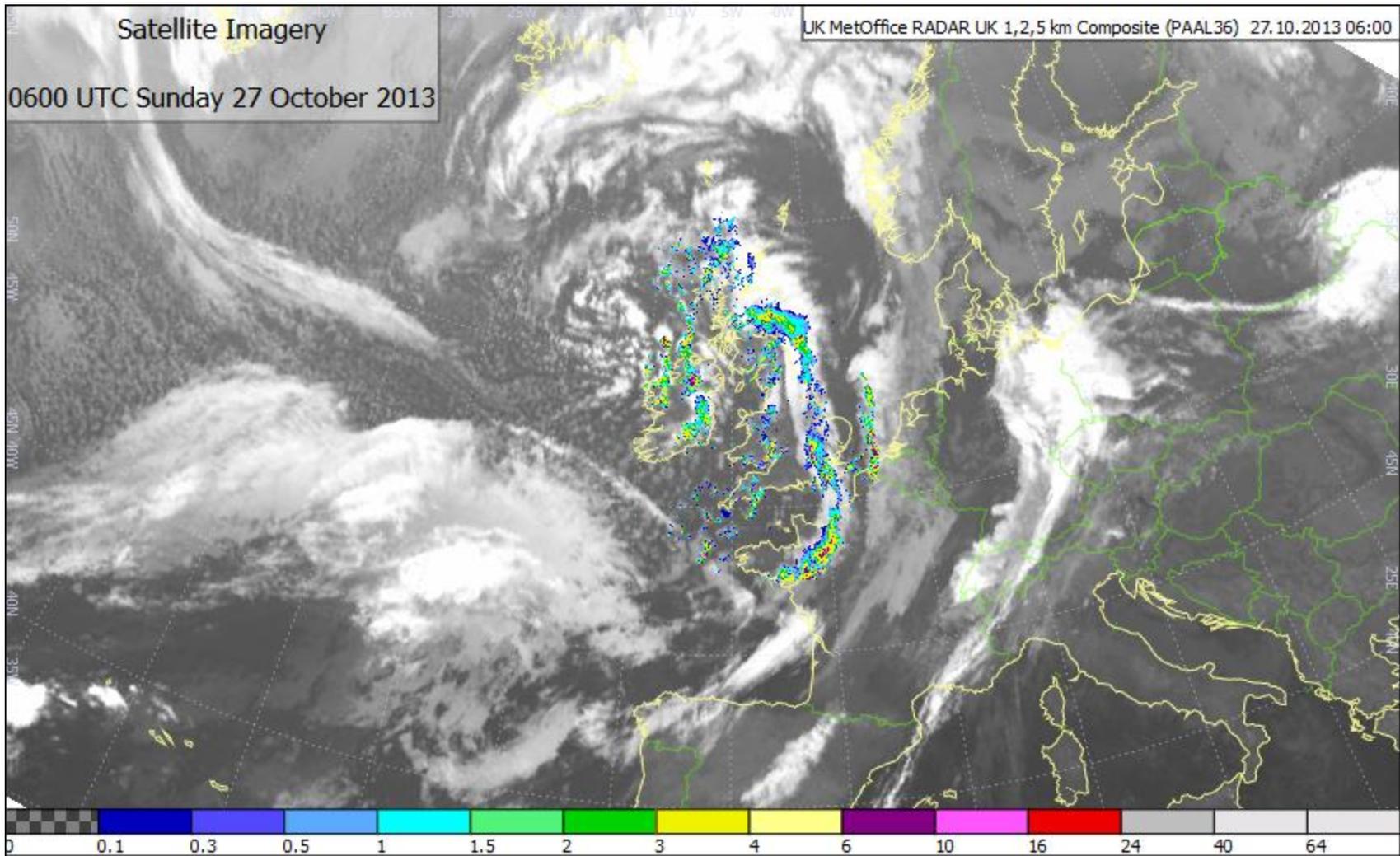
**Geostrophic wind scale**  
in kt for 4.0 hPa intervals



EWEU10 EGH1 270600 | WV | 27.10.2013 06:00

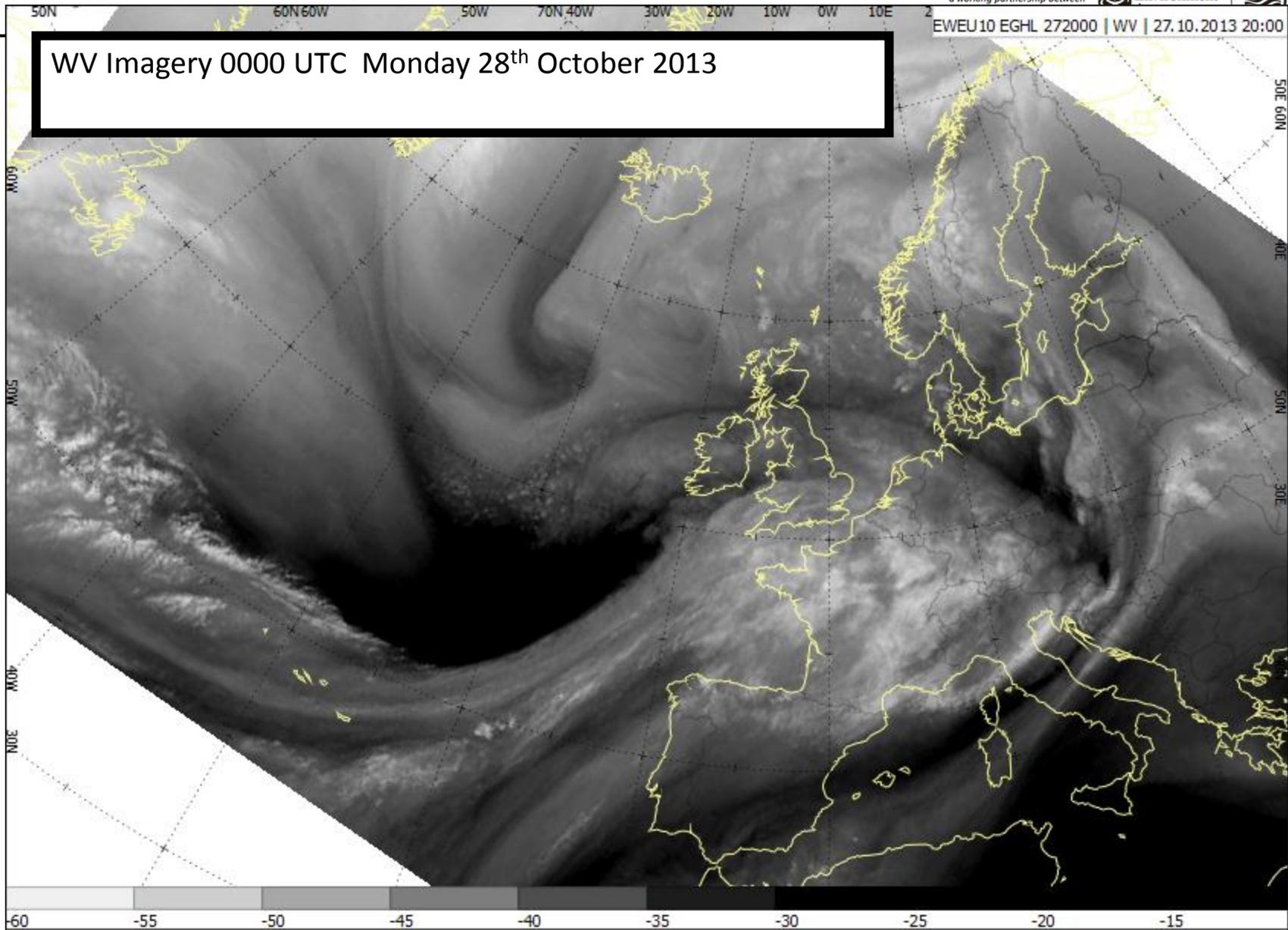
WV Imagery 0600 UTC Sunday 27<sup>th</sup> October 2013

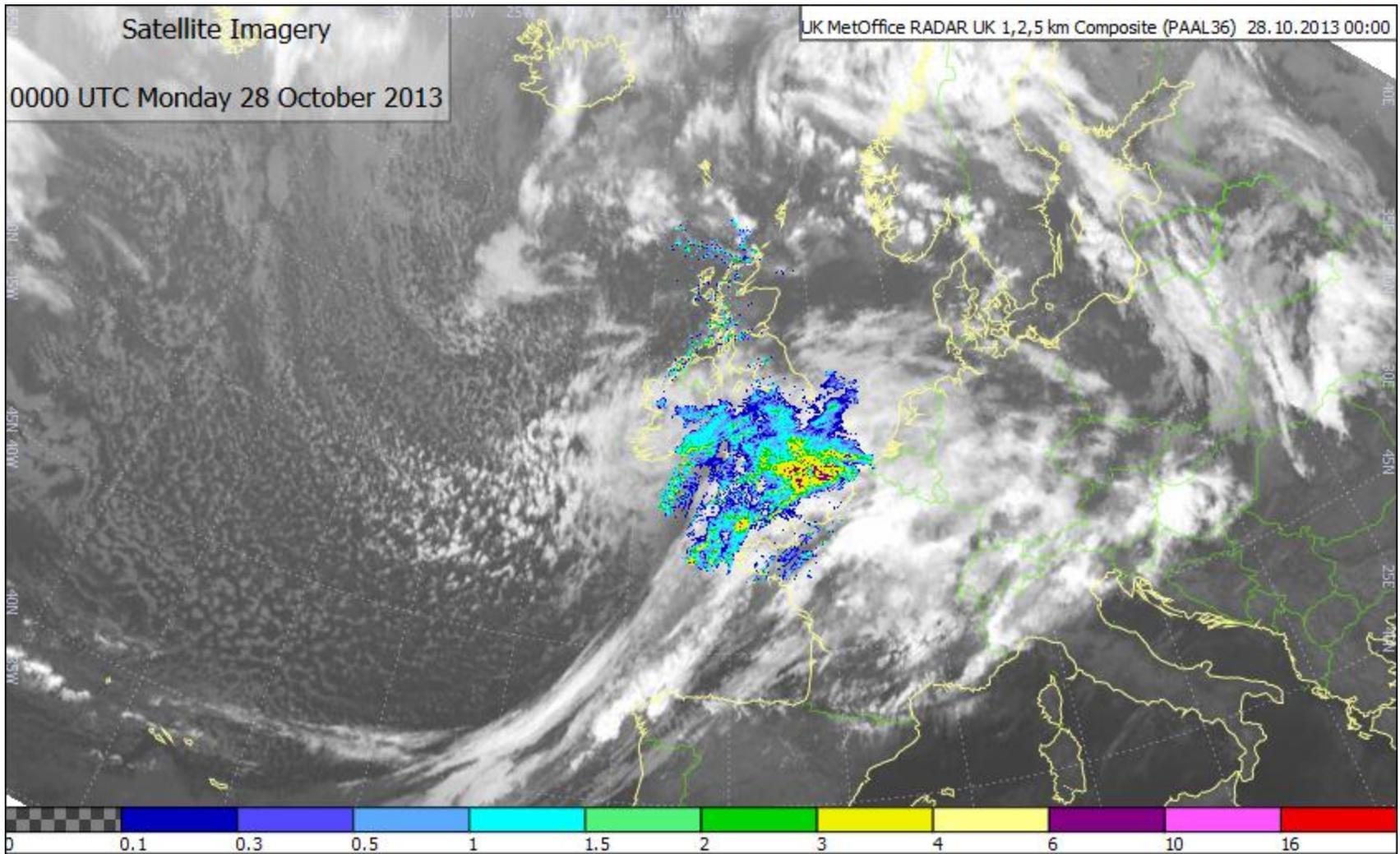




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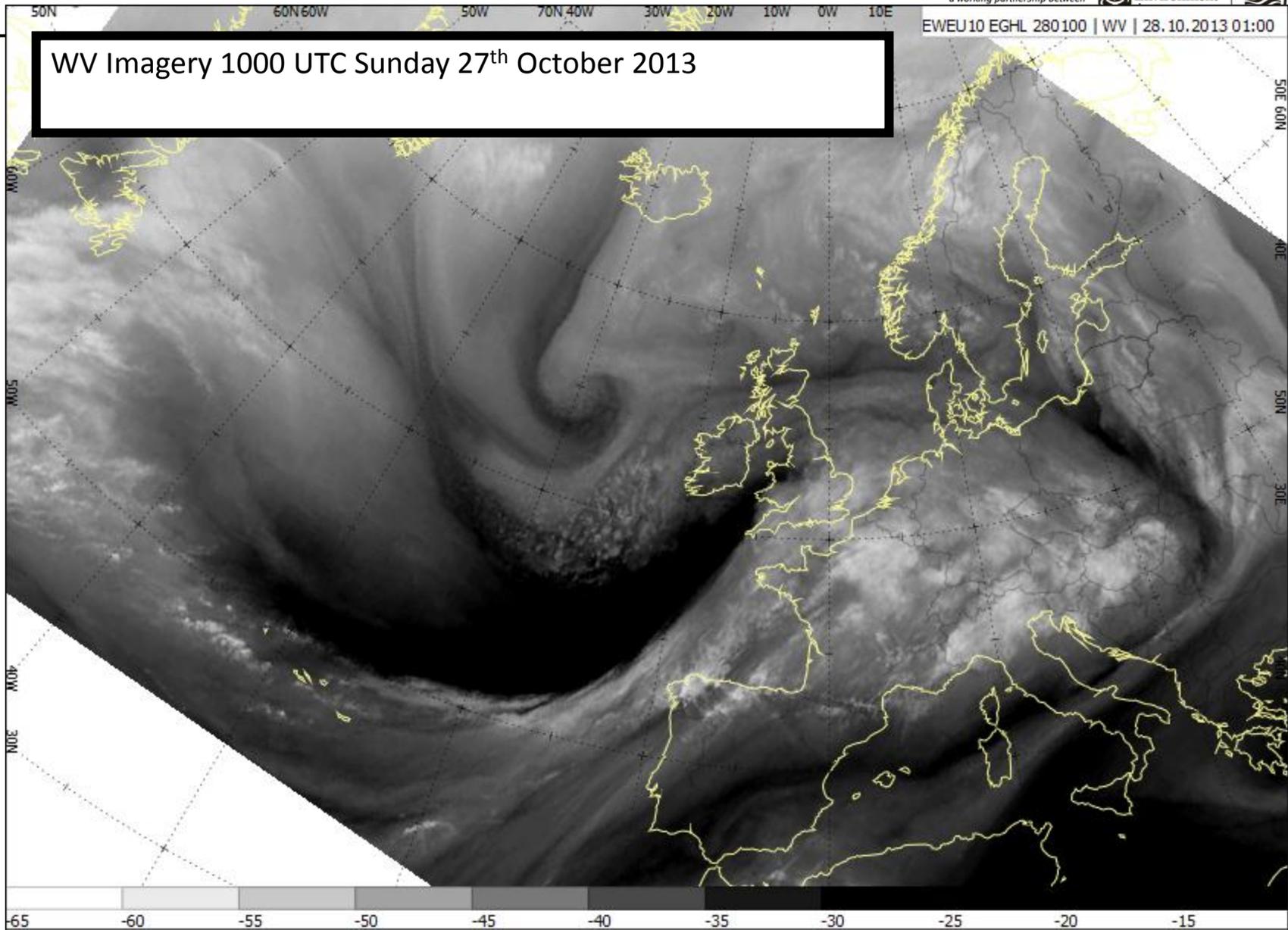
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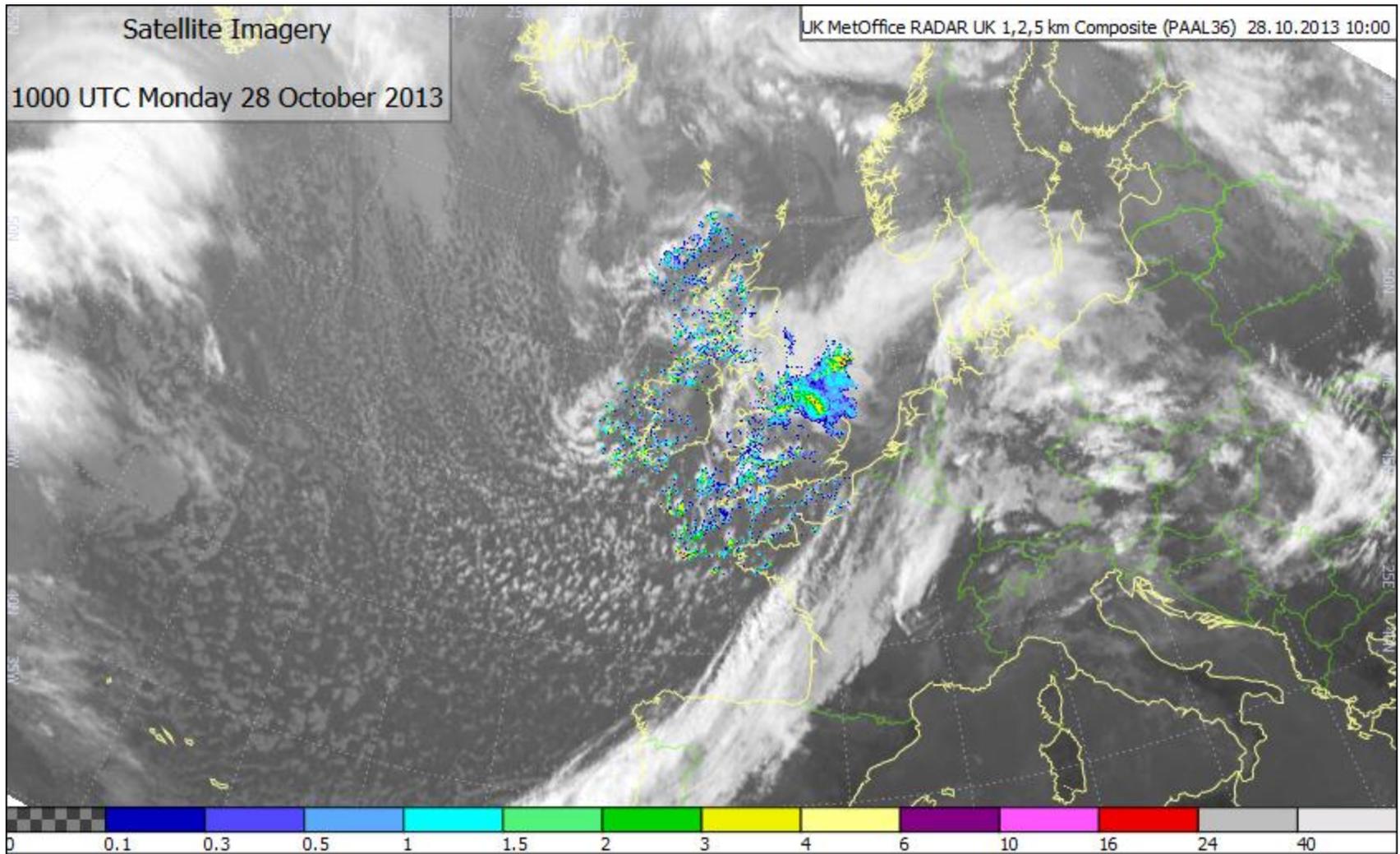




EWEU10 EGH1 280100 | WV | 28.10.2013 01:00

WV Imagery 1000 UTC Sunday 27<sup>th</sup> October 2013





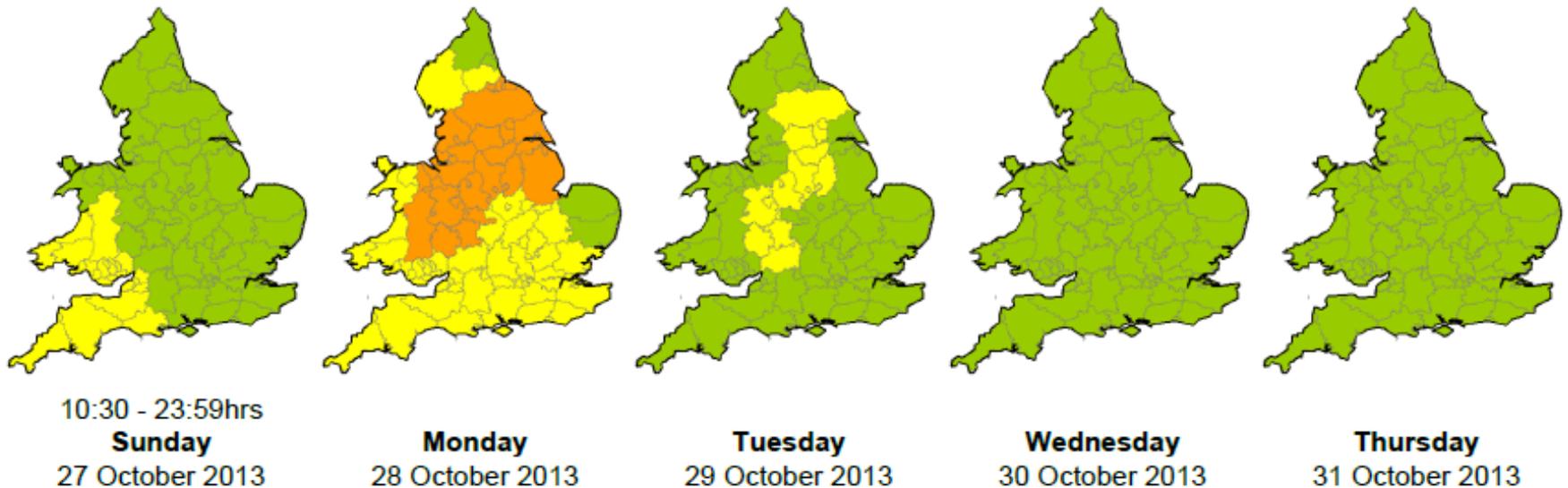
- ➔ RADAR and Infrared [Satellite loop](#)
- ➔ Water Vapour [Satellite loop](#)
- ➔ FGS and AOC for St Jude's Storm

# FLOODFORECASTINGCENTRE

a working partnership between  Environment Agency |  Met Office

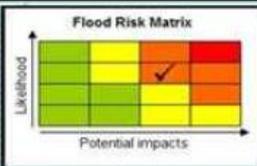
## Flood Guidance Statement 10:30hrs Sunday 27 October 2013

Our assessment of daily flood risk for England and Wales, working with flood forecasting teams in the Environment Agency and Natural Resources Wales is below.

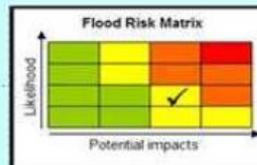
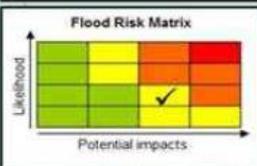


**Monday 28 October 2013**

In **Area A**, there is a medium likelihood of significant disruption from surface water flooding, which brings a **MEDIUM** flood risk overall. There is also a low likelihood of significant disruption from river flooding. Possible flooding impacts could include significant travel disruption, flooding affecting properties, communities and also key sites identified in flood plans (such as utility and transport infrastructure).

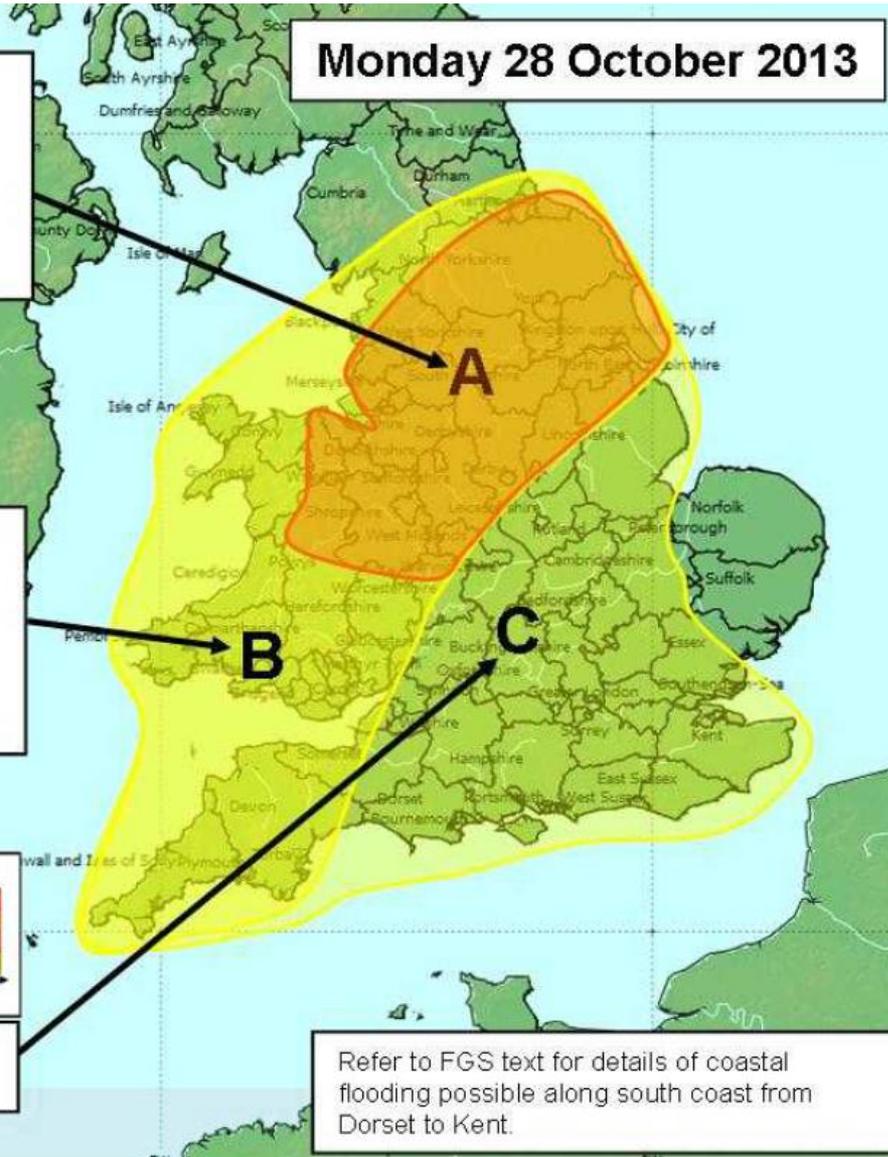


In **Area B**, there is a low likelihood of significant disruption from surface water flooding and a very low likelihood of significant disruption from river flooding. This brings a **LOW** flood risk overall. Possible flooding impacts could include significant travel disruption, flooding affecting properties, communities and also key sites identified in flood response plans (such as utility and transport infrastructure).



In **Area C**, there is also a low likelihood of significant disruption from surface water flooding. This brings a **LOW** flood risk overall.

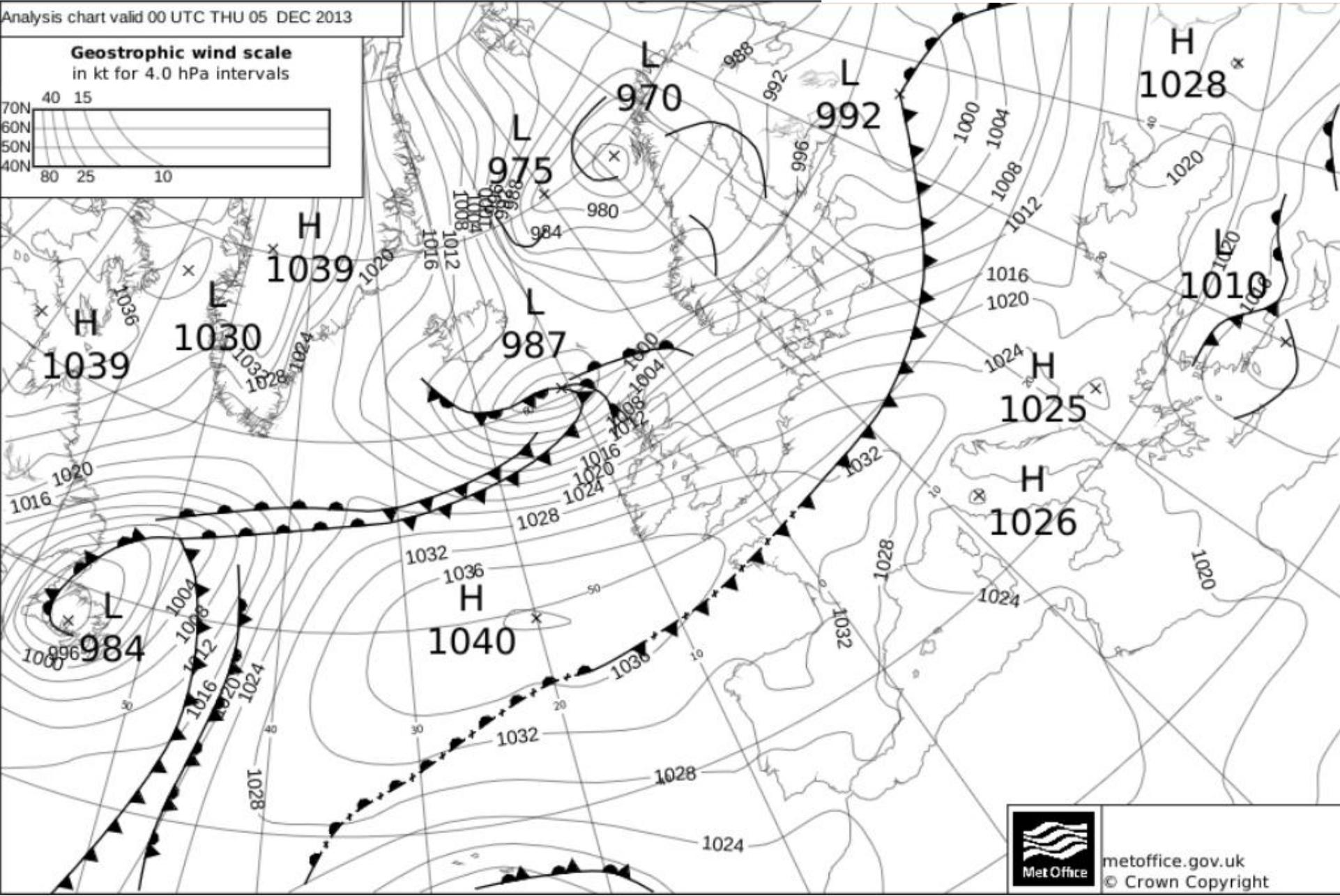
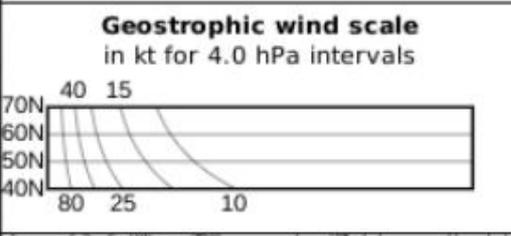
Refer to FGS text for details of coastal flooding possible along south coast from Dorset to Kent.



# Dec 5-6<sup>th</sup> 2013 – East and West Coast Surge

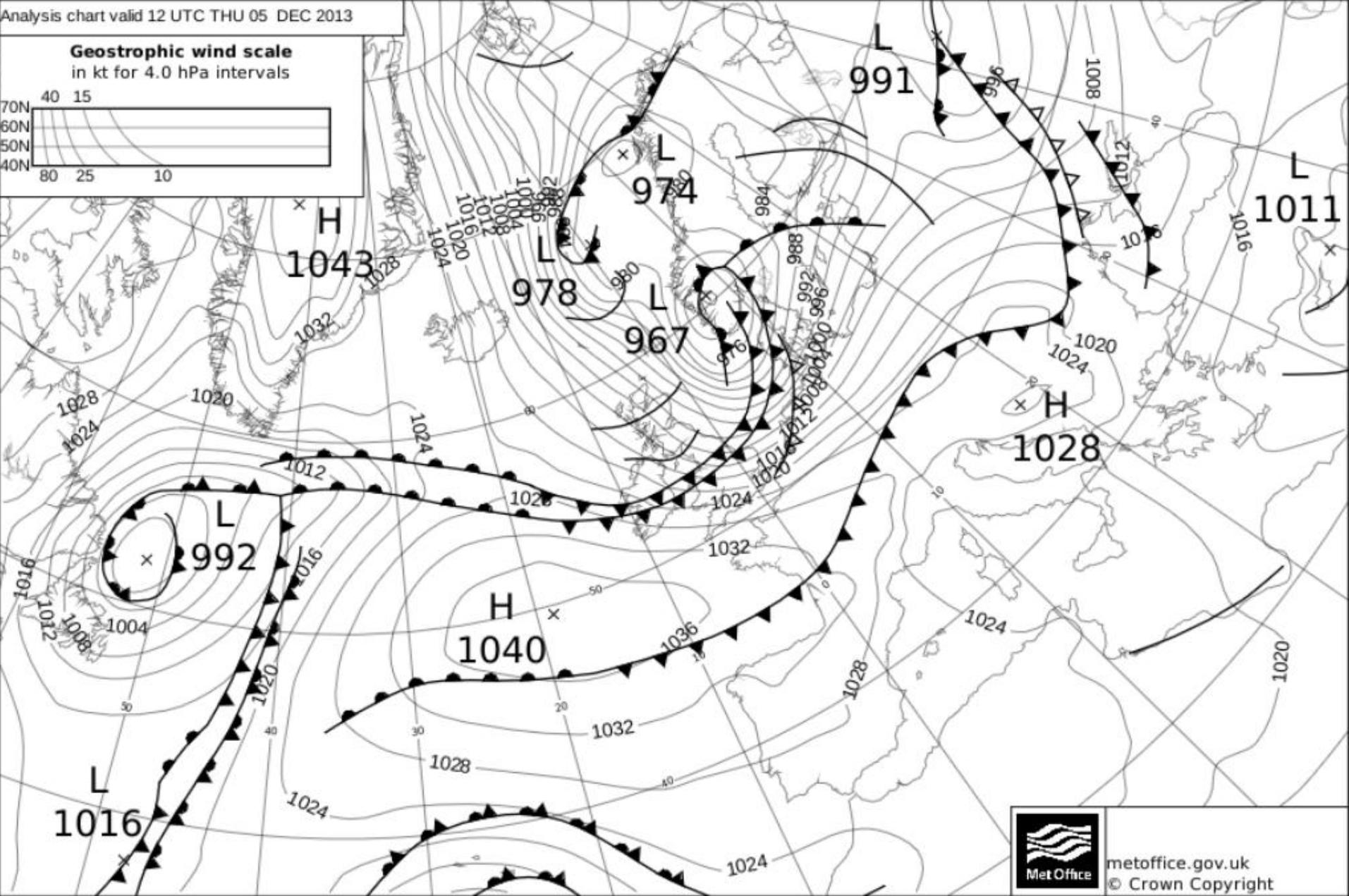
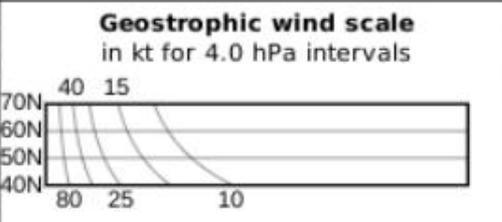
- ➔ FFC identify the risk of a large surge seven days before it occurs – although low in confidence.
- ➔ The risk is escalated as the event approaches and confidence increases
- ➔ Frequent communication between the FFC, partner organisations and customers as the event nears.
- ➔ Further escalation of the risk based on confidence and impacts

Analysis chart valid 00 UTC THU 05 DEC 2013





Analysis chart valid 12 UTC THU 05 DEC 2013

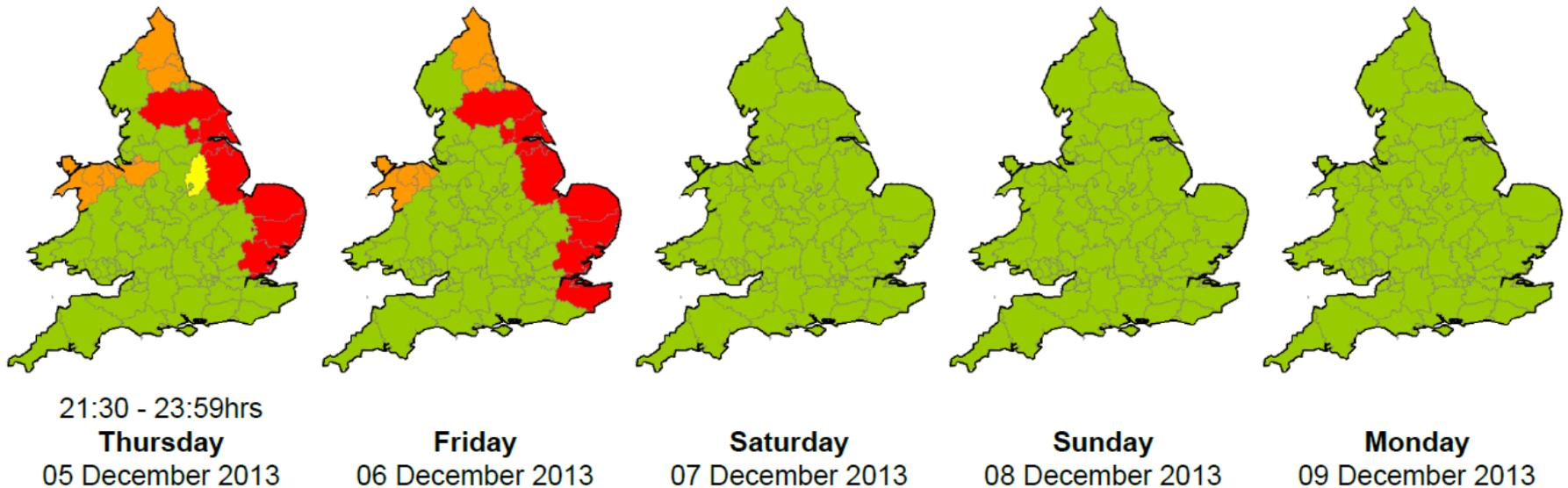


- ➡ Infrared [Satellite loop](#)
- ➡ Water Vapour [Satellite loop](#)
- ➡ FGS for December Surge
- ➡ Area of Concern Map for December Surge

# FLOODFORECASTINGCENTRE

## Flood Guidance Statement 21:30hrs Thursday 05 December 2013

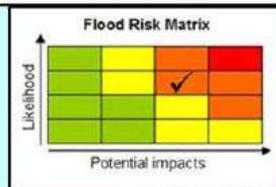
Our assessment of daily flood risk for England and Wales, working with flood forecasting teams in the Environment Agency and Natural Resources Wales, is below.



## Thursday 5 & Friday 6 December High and Medium flood risk:

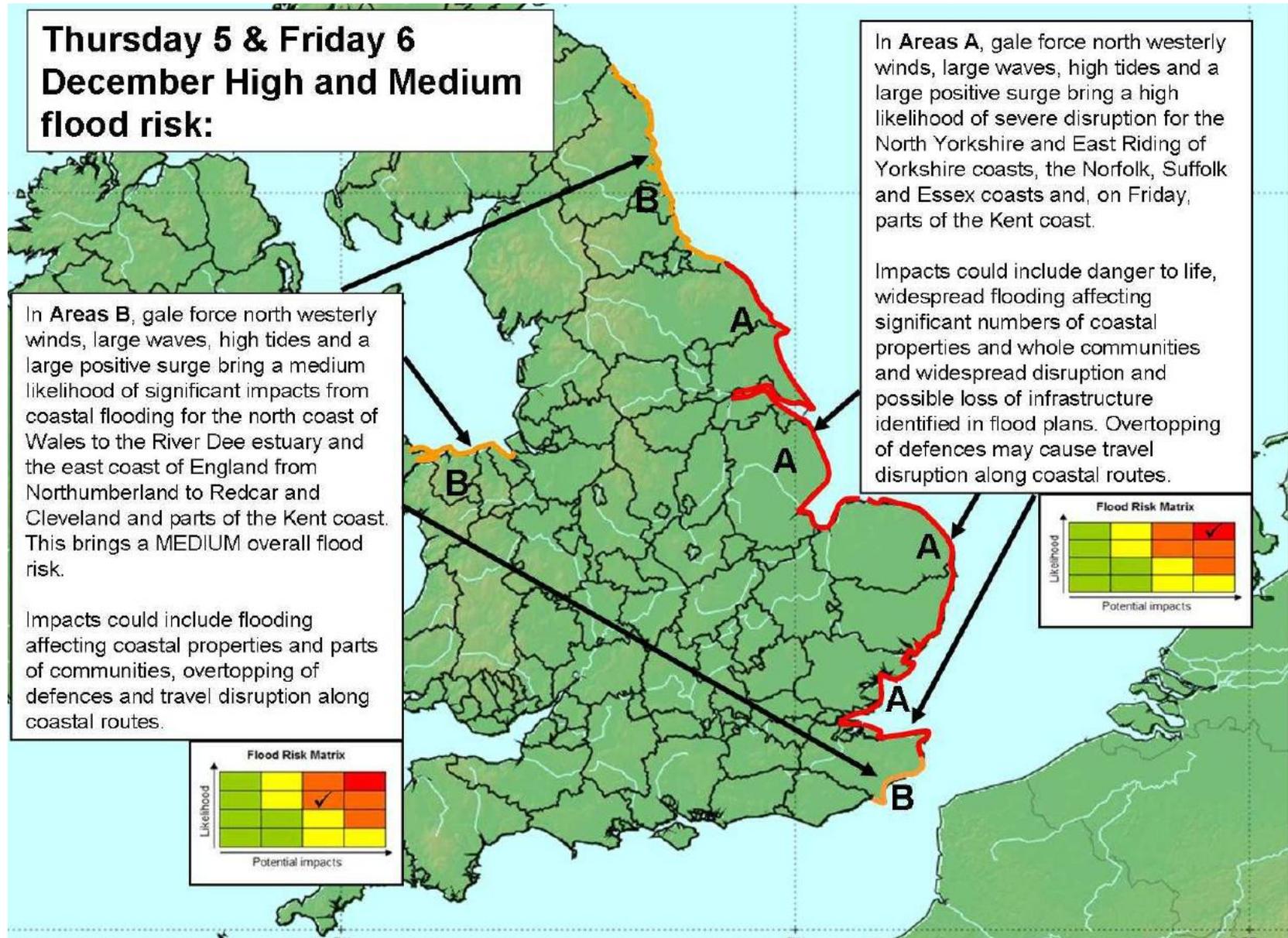
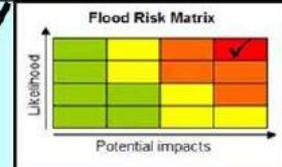
In **Areas B**, gale force north westerly winds, large waves, high tides and a large positive surge bring a medium likelihood of significant impacts from coastal flooding for the north coast of Wales to the River Dee estuary and the east coast of England from Northumberland to Redcar and Cleveland and parts of the Kent coast. This brings a **MEDIUM** overall flood risk.

Impacts could include flooding affecting coastal properties and parts of communities, overtopping of defences and travel disruption along coastal routes.



In **Areas A**, gale force north westerly winds, large waves, high tides and a large positive surge bring a high likelihood of severe disruption for the North Yorkshire and East Riding of Yorkshire coasts, the Norfolk, Suffolk and Essex coasts and, on Friday, parts of the Kent coast.

Impacts could include danger to life, widespread flooding affecting significant numbers of coastal properties and whole communities and widespread disruption and possible loss of infrastructure identified in flood plans. Overtopping of defences may cause travel disruption along coastal routes.



## Tidal surge December 2013



5 December saw the most serious tidal surge in over 60 years, here's a look at some of the facts surrounding the event:



**160,000**

warnings sent to homes and businesses



**18,000**

people evacuated



**London**

saw highest tide since the Thames Barrier's completion in 1984



**800,000**

properties protected by Environment Agency flood defences



**2,800**

kilometres of flood defences put to the test along the coast



**64** severe flood warnings

in place across the UK at the peak

"Our thoughts remain with those people who have been affected by flooding"  
- Paul Leinster, Chief Executive, Environment Agency

## Properties flooded during December 2013 flood

Approximate numbers of properties flooded (Environment Agency figures)

Map Compiled:

7 December 2013 08h05

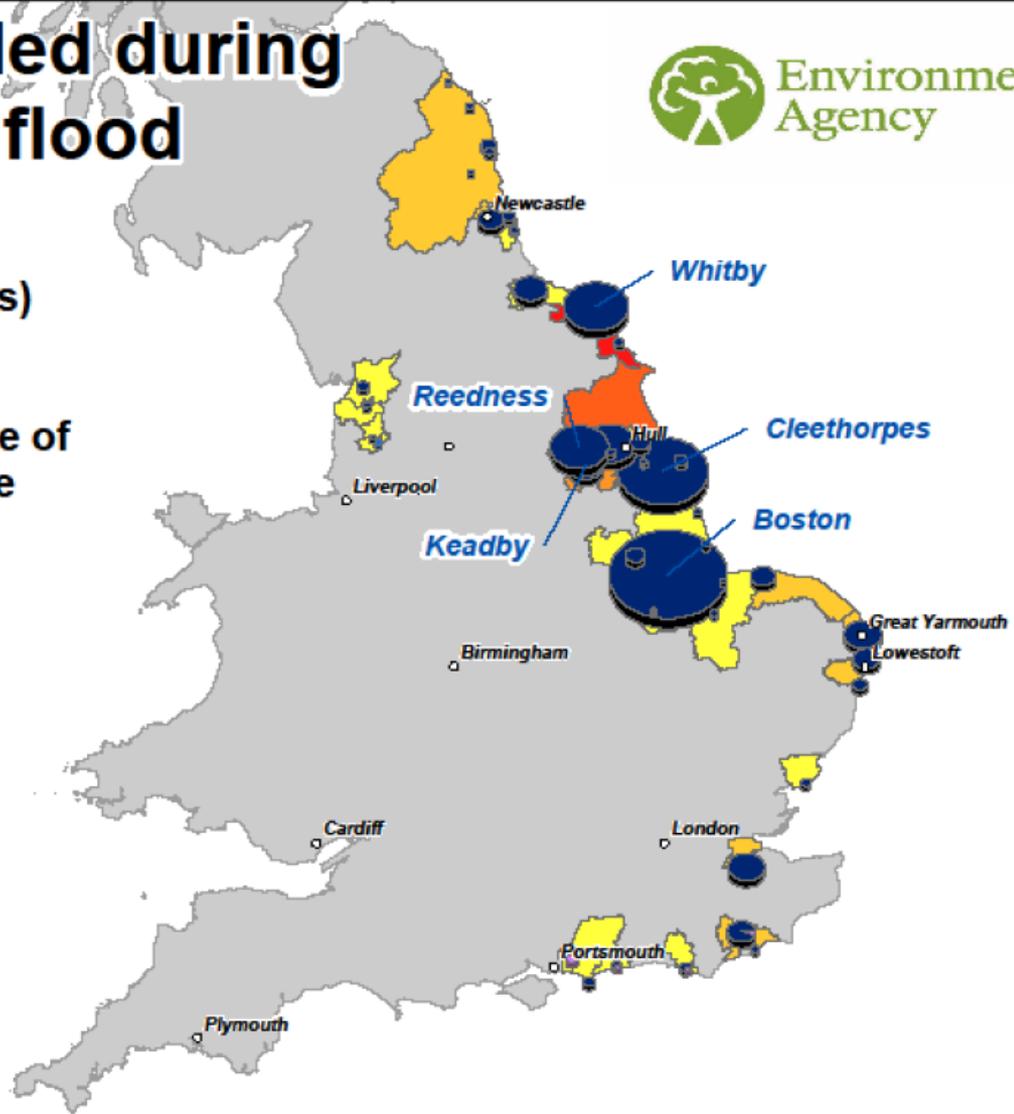
NOTE: Information on source of flooding is subject to change



- River
- Sea
- Other

District/Unitary/Metropolitan Properties flooded

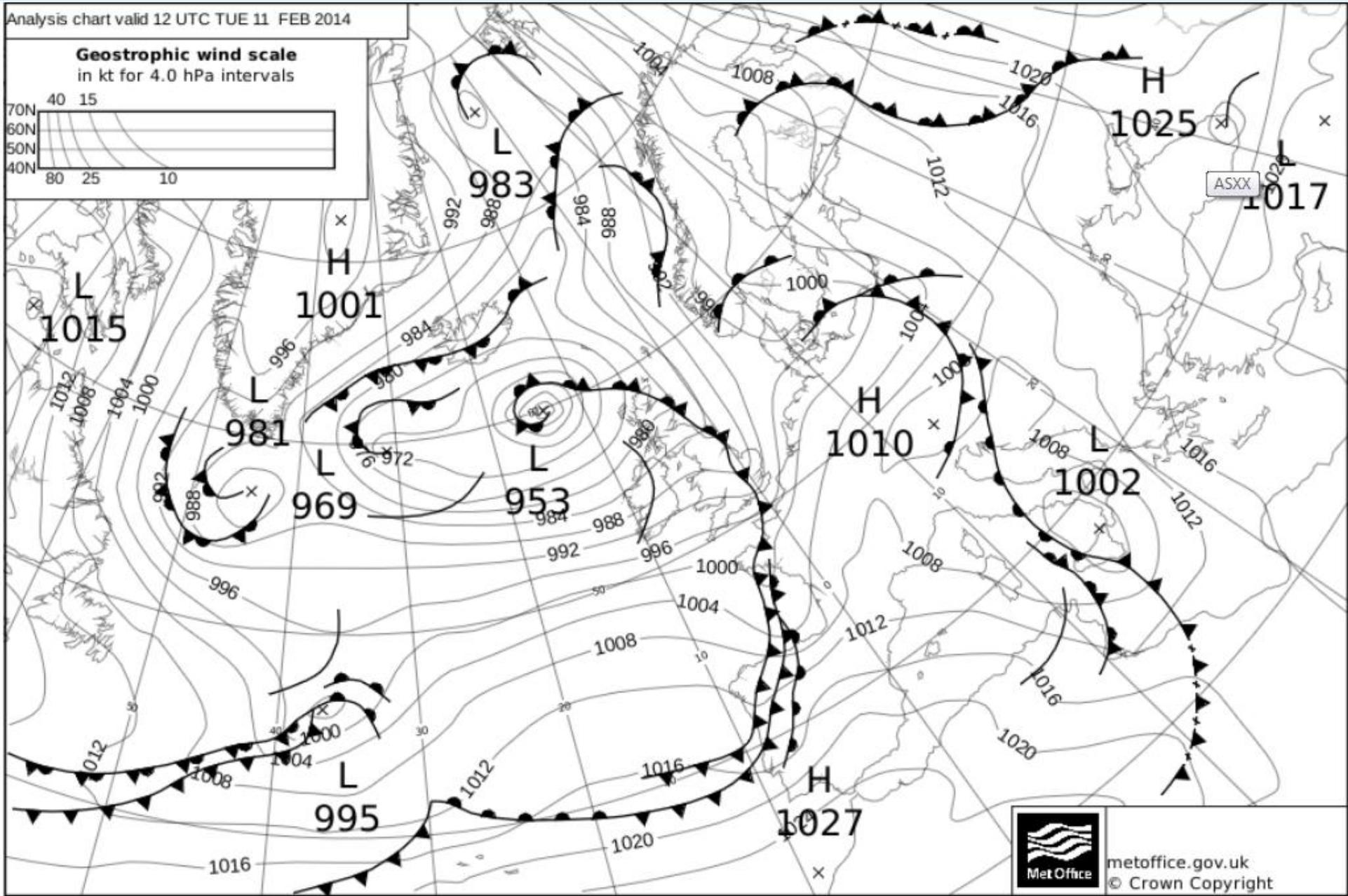
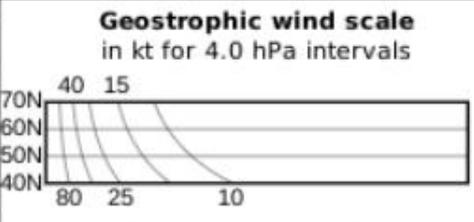
- 1 - 10
- 11 - 50
- 51 - 100
- 101 - 200
- 201 - 400



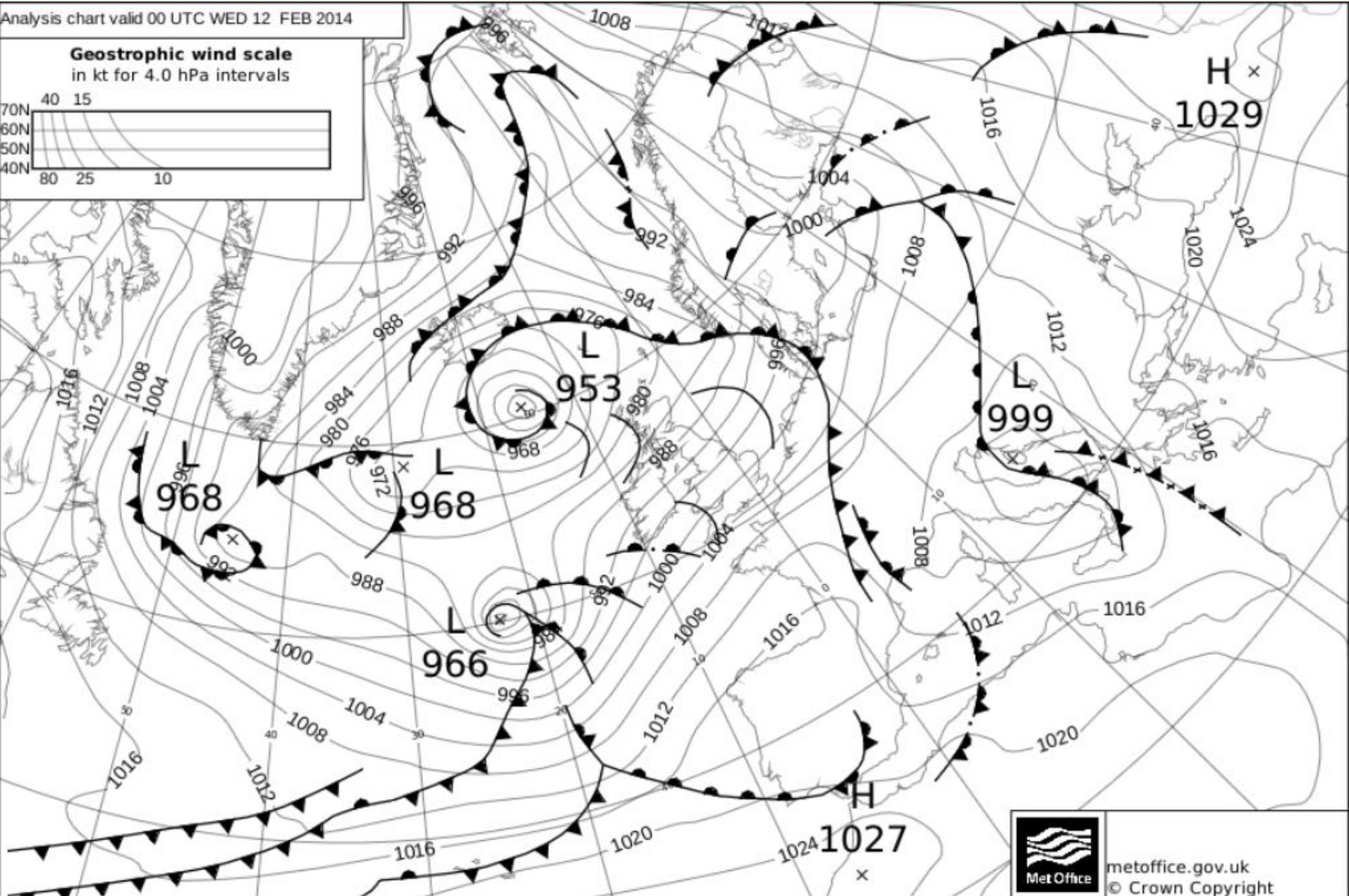
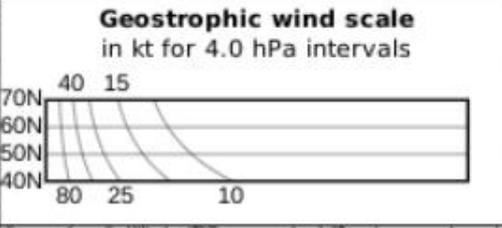
# Feb 11-12<sup>th</sup> 2014 - Widespread Flooding: River Thames and Somerset Levels

- ➔ Widespread heavy rainfall over saturated ground
- ➔ Leads to severe flooding across the Somerset Levels and along parts of the River Thames
- ➔ Significant river flooding along parts of the River Severn and groundwater flooding in the south and southeast of England
- ➔ Storm force winds and exceptional swells along south and west coasts with Hurricane force winds in some parts of west Wales

Analysis chart valid 12 UTC TUE 11 FEB 2014

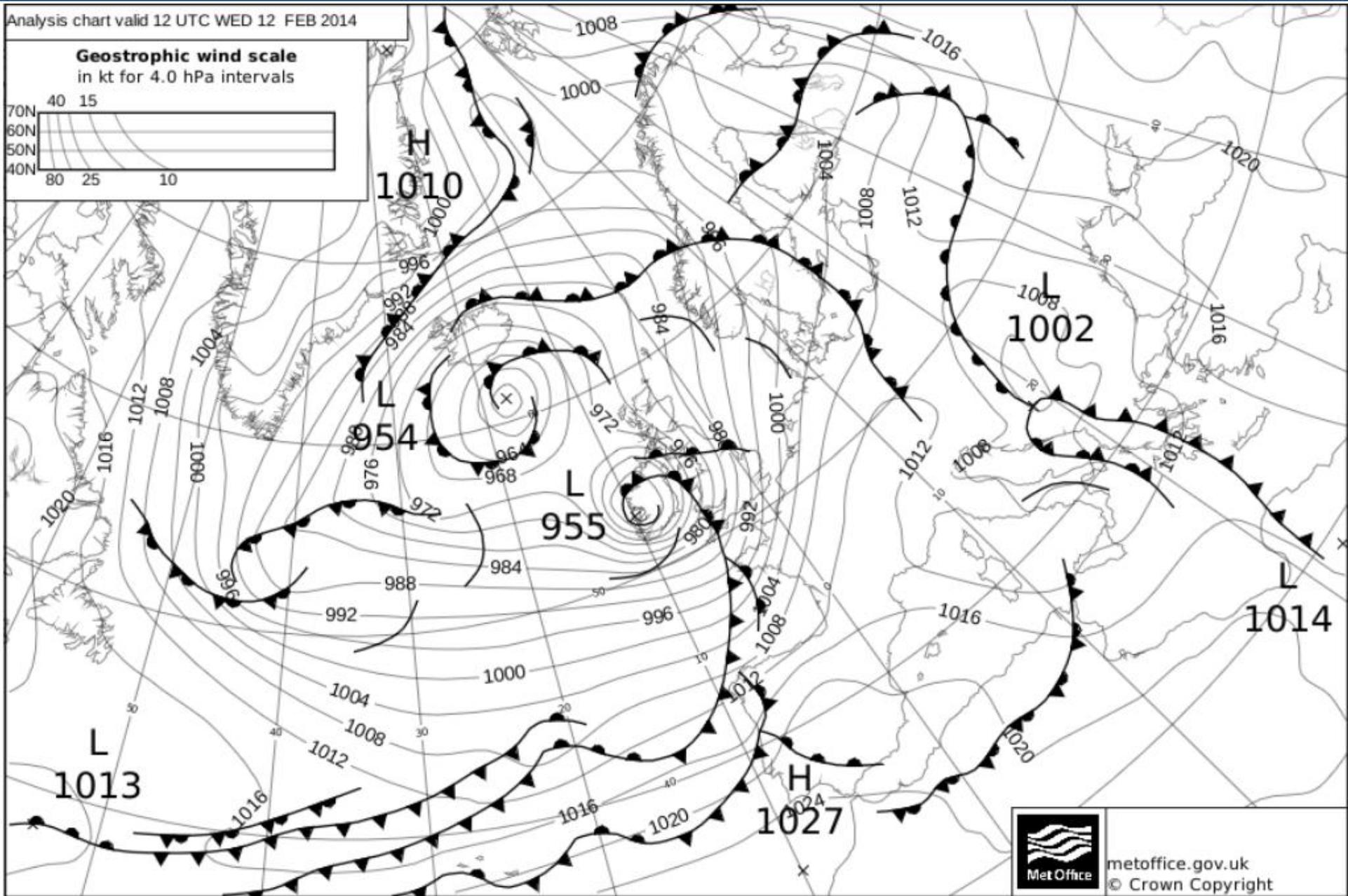
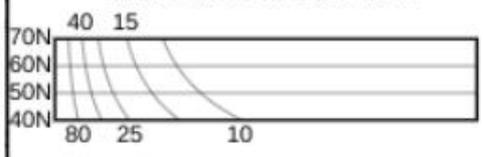


Analysis chart valid 00 UTC WED 12 FEB 2014



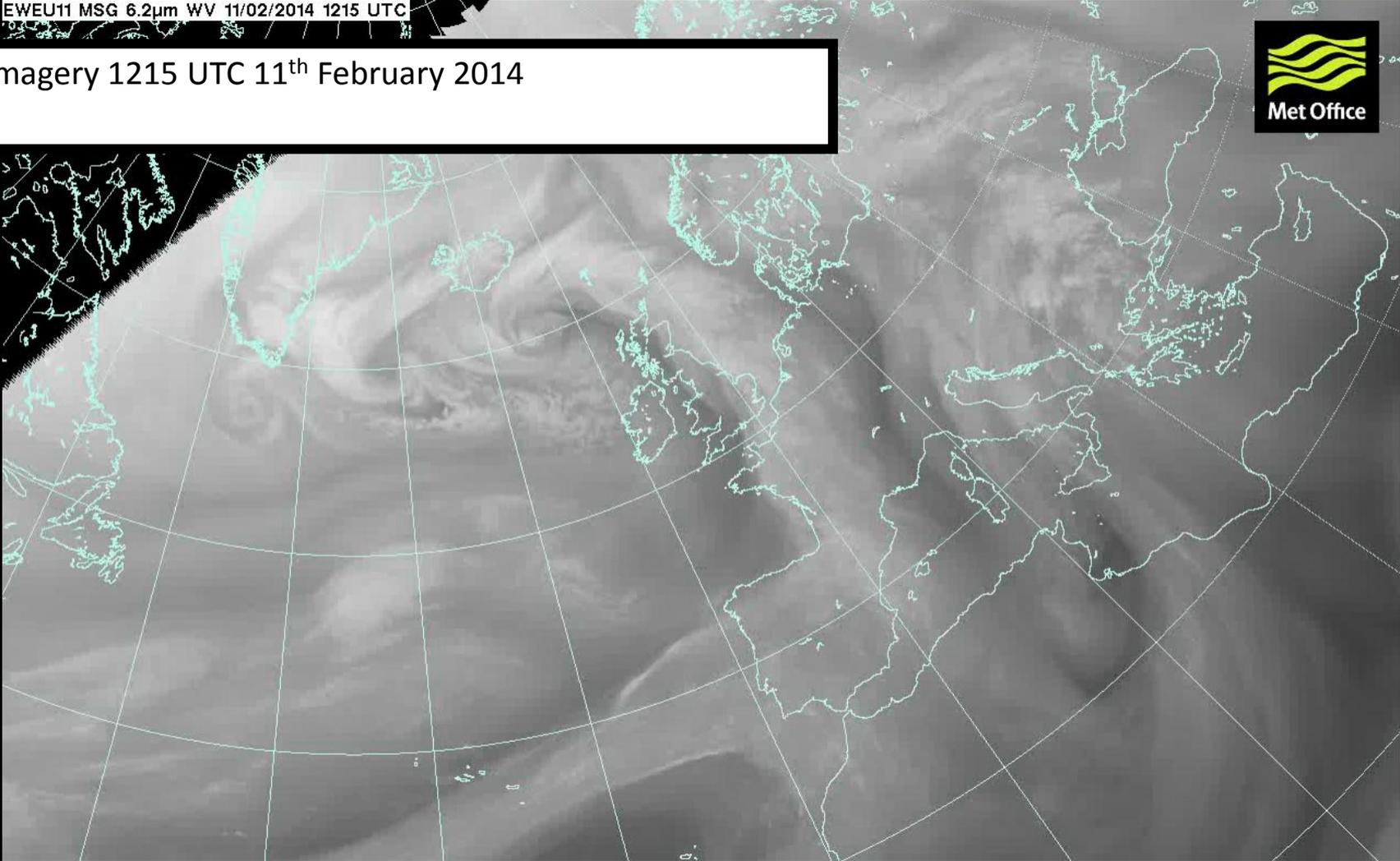
Analysis chart valid 12 UTC WED 12 FEB 2014

**Geostrophic wind scale**  
in kt for 4.0 hPa intervals



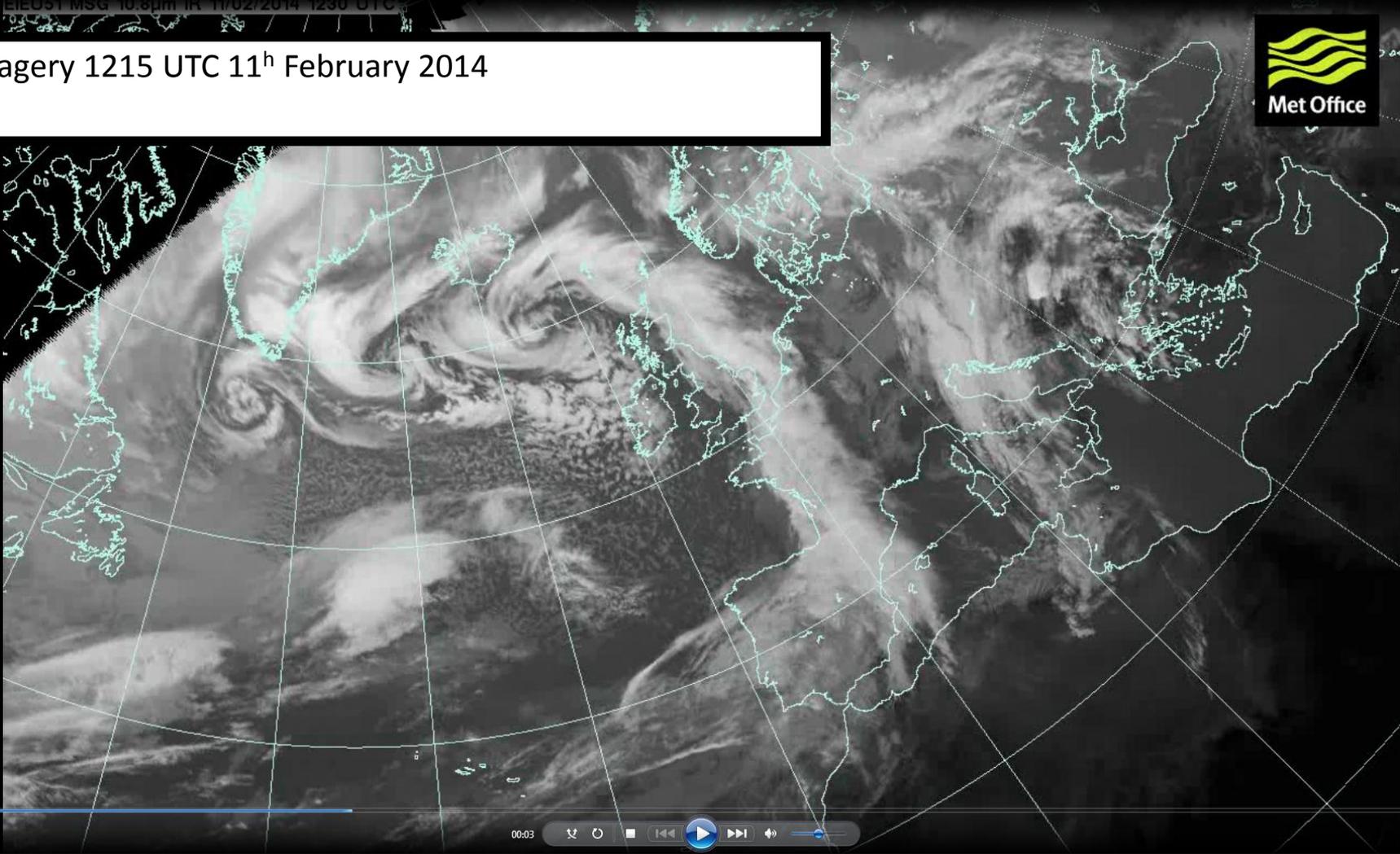
EWEU11 MSG 6.2µm WV 11/02/2014 1215 UTC

WV Imagery 1215 UTC 11<sup>th</sup> February 2014



February Floods IR EIEU51 MSG 10.6µm IR 11/02/2014 1230 UTC

IR Imagery 1215 UTC 11<sup>h</sup> February 2014

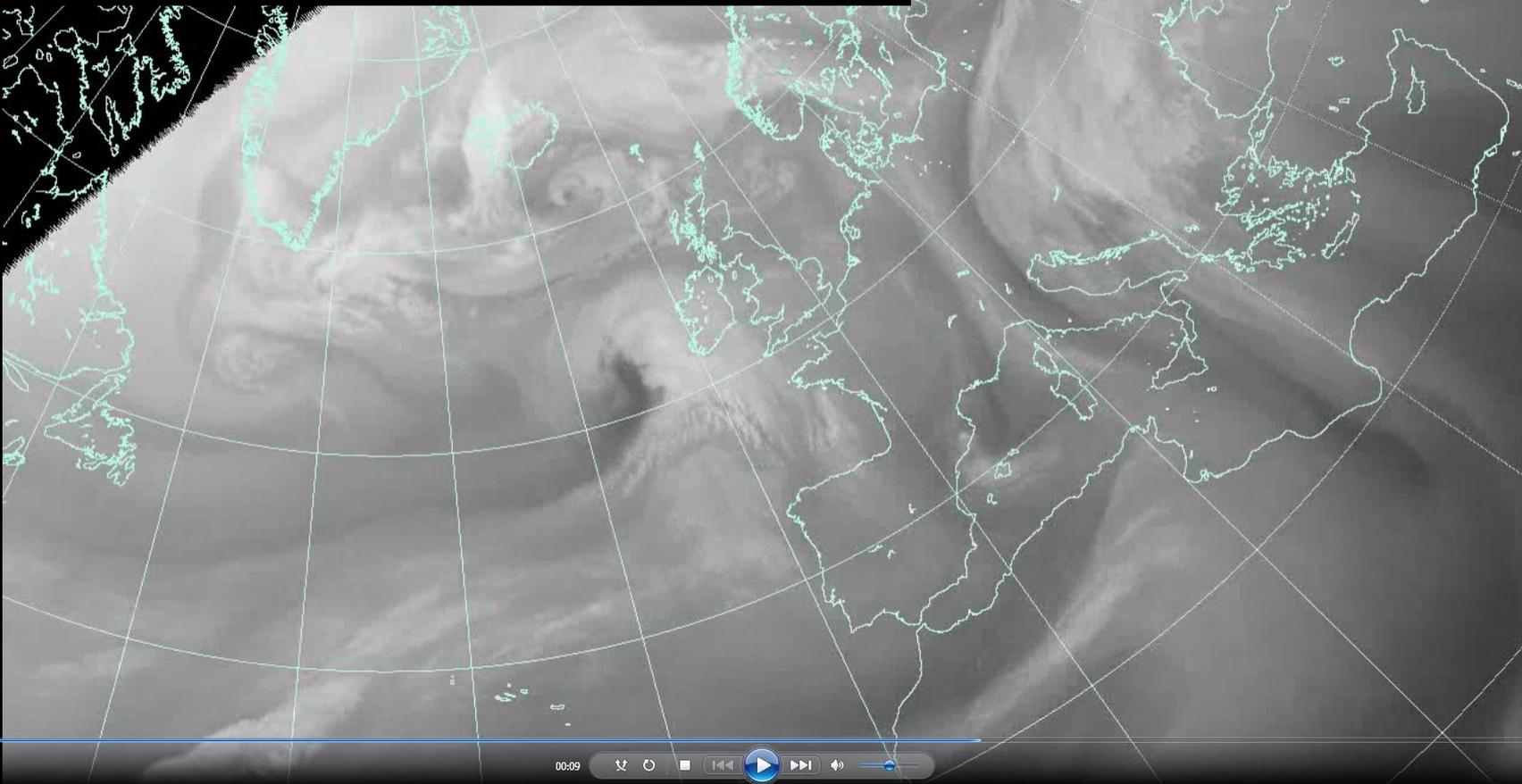


00:03

A set of standard video player controls including a play button, a progress bar, and various navigation icons like back, forward, and full screen.

February Floods WV\_EWE011 MSG 6.2µm WV 12/02/2014 0430 UTC

WV Imagery 0430 UTC 12<sup>th</sup> February 2014

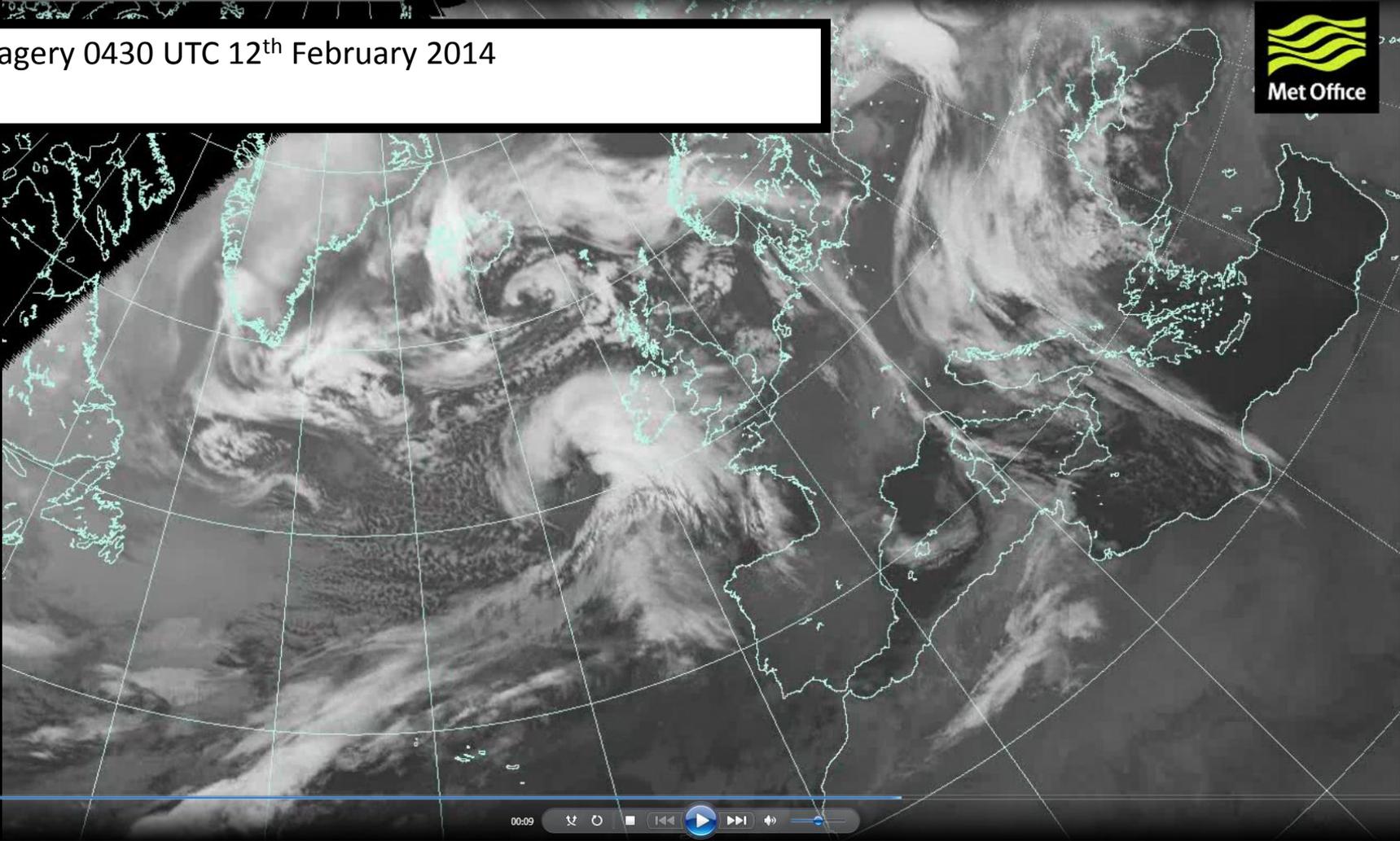


00:09



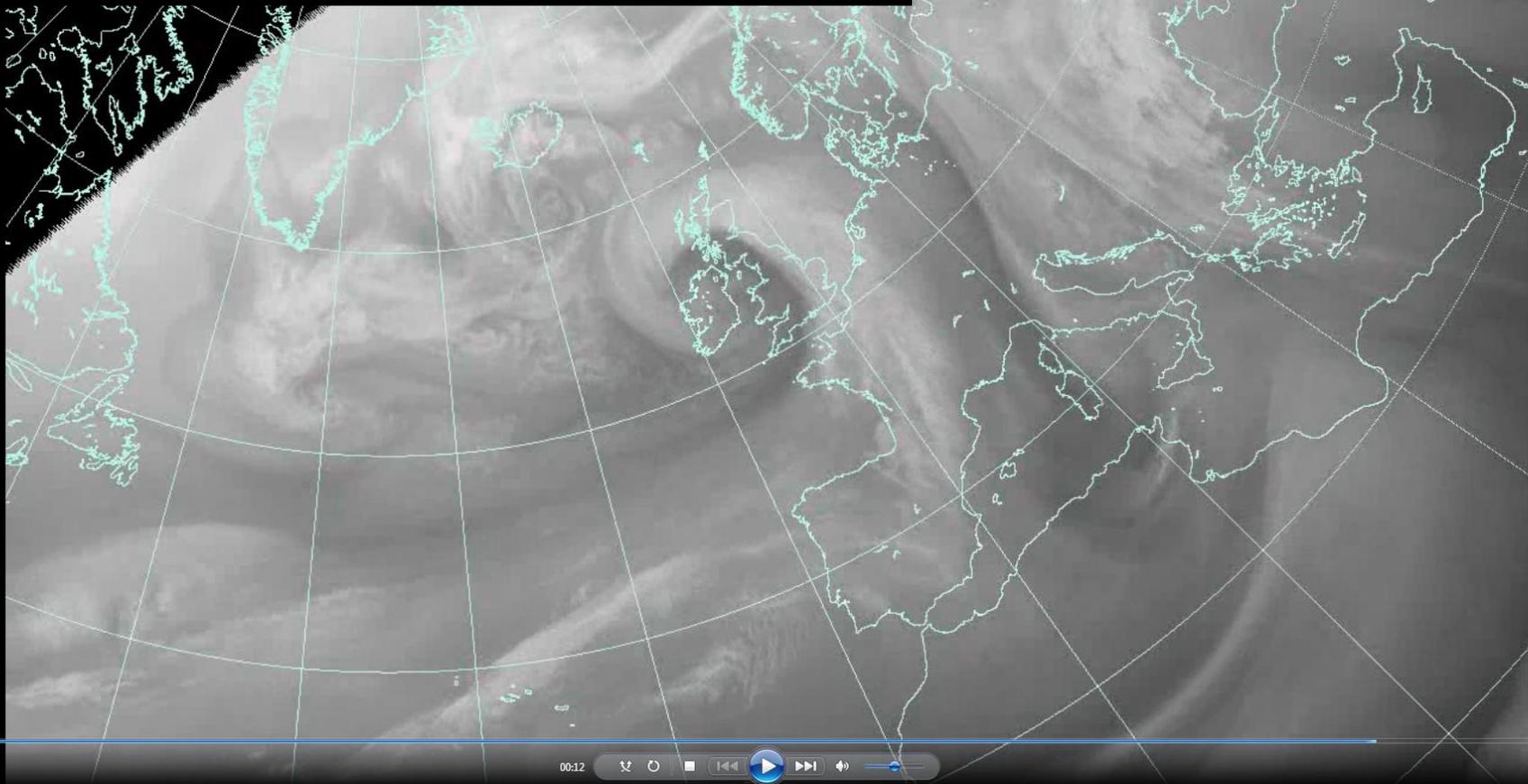
February Floods IR E1EUS1 MSG 10.6µm IR 12/02/2014 0430 UTC

IR Imagery 0430 UTC 12<sup>th</sup> February 2014



February Floods WV EWE011 MSG 6:2pm WV 12/02/2014 1445 UTC

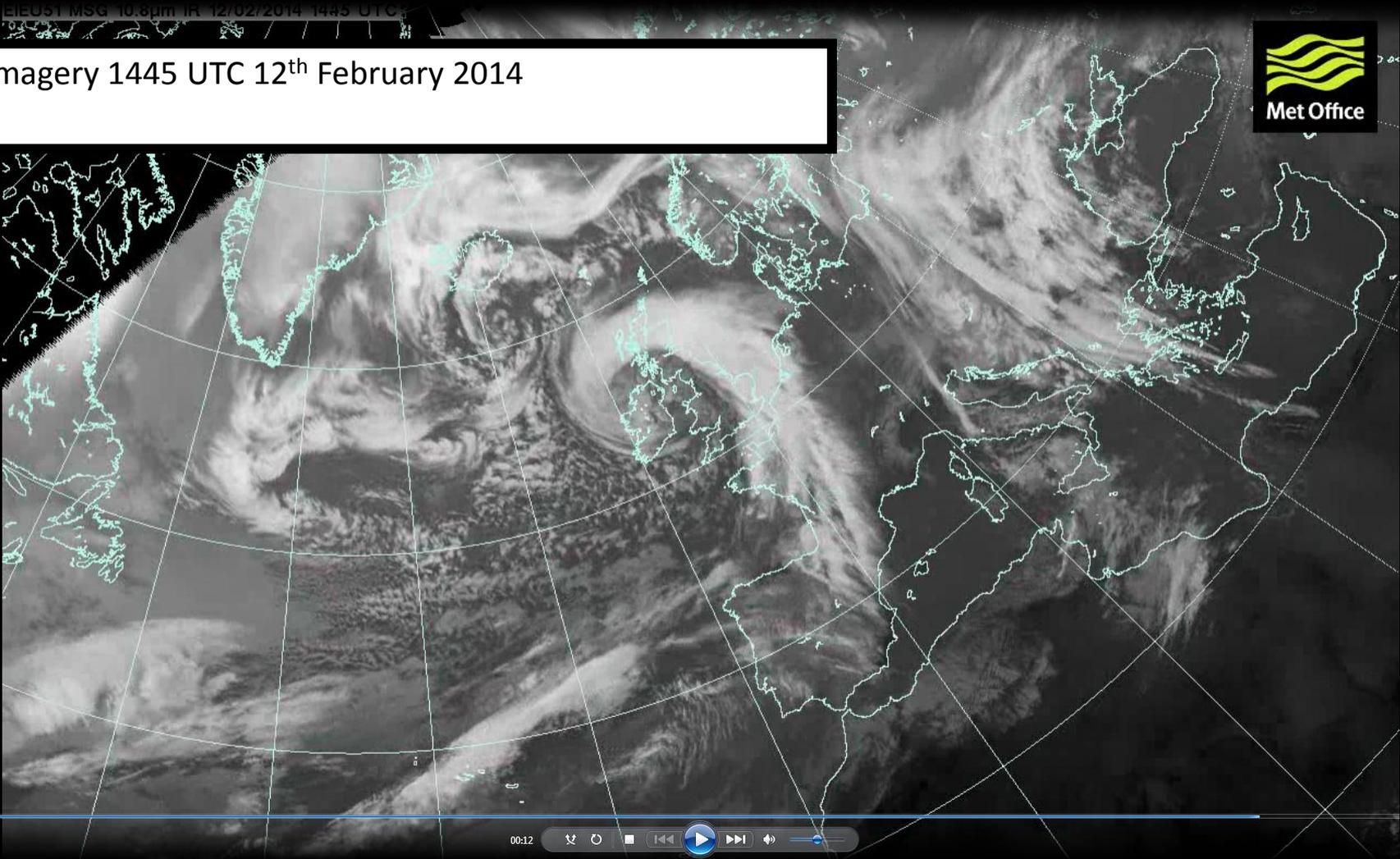
WV Imagery 1445 UTC 12<sup>th</sup> February 2014



00:12 [play/pause] [stop] [rewind] [fast forward] [volume]

February Floods IR EIEU51 MSG 10.6µm IR 12/02/2014 1445 UTC

WV Imagery 1445 UTC 12<sup>th</sup> February 2014



00:12 [play/pause] [stop] [rewind] [fast forward] [volume]

- ➔ Infrared [Satellite loop](#)
- ➔ Water Vapour [Satellite loop](#)
- ➔ FGS and AOC Maps for February 11-12<sup>th</sup> 2014

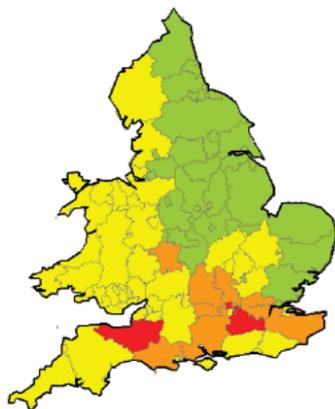
## FLOOD FORECASTING CENTRE

a working partnership between

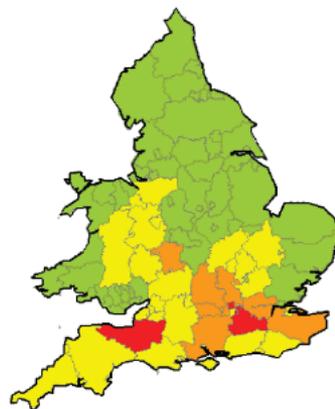


### Flood Guidance Statement 10:30hrs Wednesday 12 February 2014

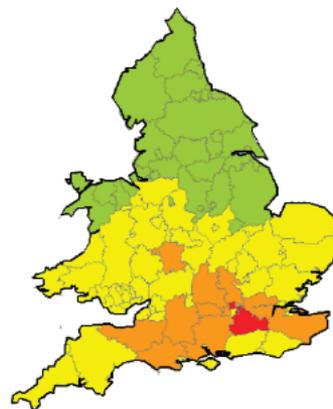
Our assessment of daily flood risk for England and Wales, working with flood forecasting teams in the Environment Agency and Natural Resources Wales, is below.



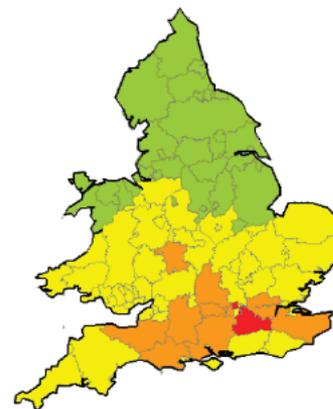
10:30 - 23:59hrs  
**Wednesday**  
12 February 2014



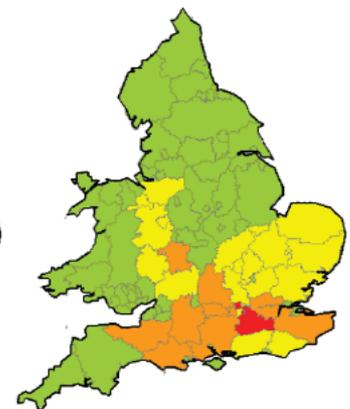
**Thursday**  
13 February 2014



**Friday**  
14 February 2014



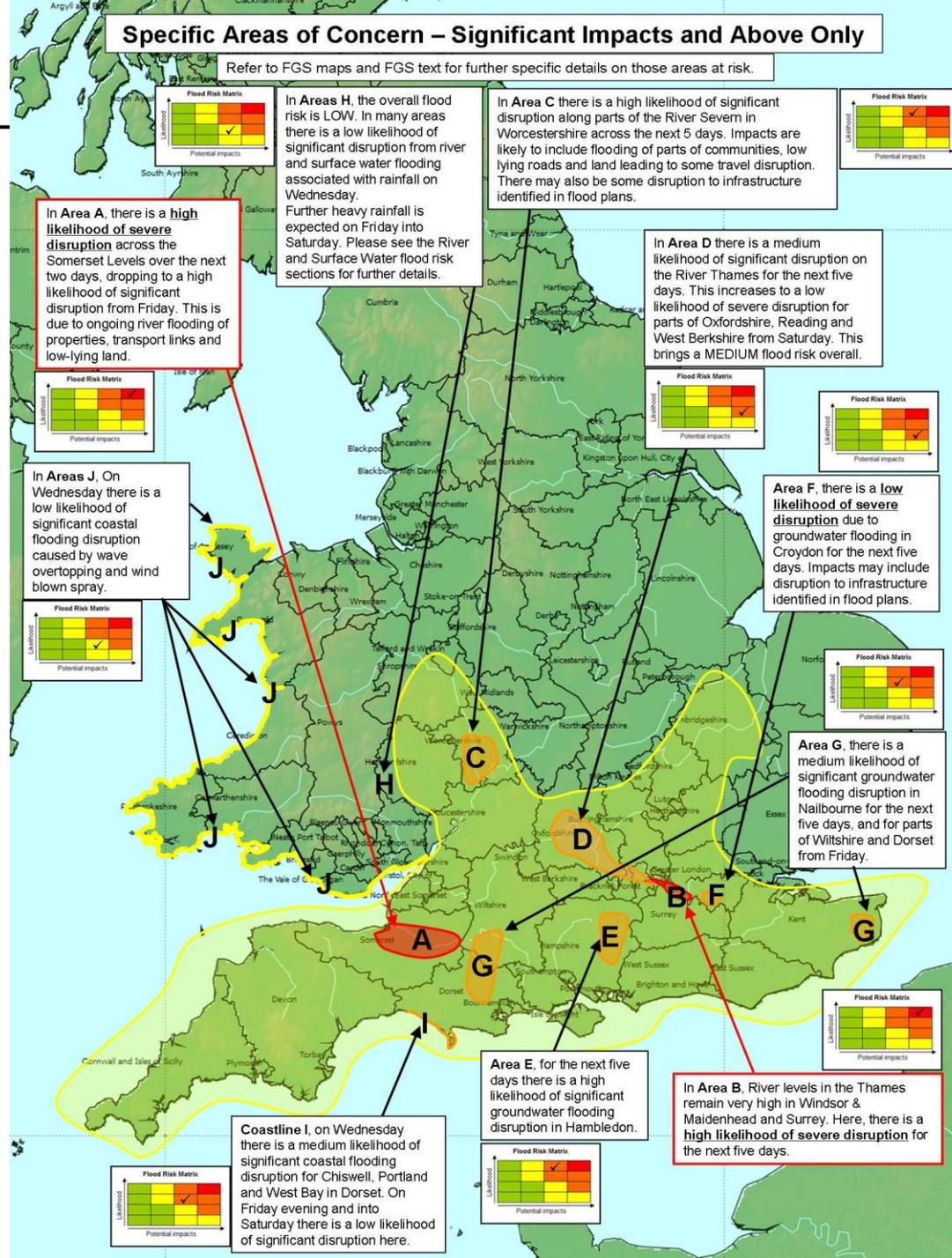
**Saturday**  
15 February 2014



**Sunday**  
16 February 2014

# Specific Areas of Concern – Significant Impacts and Above Only

Refer to FGS maps and FGS text for further specific details on those areas at risk.



In **Area A**, there is a **high likelihood of severe disruption** across the Somerset Levels over the next two days, dropping to a high likelihood of significant disruption from Friday. This is due to ongoing river flooding of properties, transport links and low-lying land.

In **Areas H**, the overall flood risk is **LOW**. In many areas there is a low likelihood of significant disruption from river and surface water flooding associated with rainfall on Wednesday. Further heavy rainfall is expected on Friday into Saturday. Please see the River and Surface Water flood risk sections for further details.

In **Area C** there is a high likelihood of significant disruption along parts of the River Severn in Worcestershire across the next 5 days. Impacts are likely to include flooding of parts of communities, low lying roads and land leading to some travel disruption. There may also be some disruption to infrastructure identified in flood plans.

In **Area D** there is a medium likelihood of significant disruption on the River Thames for the next five days. This increases to a low likelihood of severe disruption for parts of Oxfordshire, Reading and West Berkshire from Saturday. This brings a **MEDIUM** flood risk overall.

**Area F**, there is a **low likelihood of severe disruption** due to groundwater flooding in Croydon for the next five days. Impacts may include disruption to infrastructure identified in flood plans.

**Area G**, there is a medium likelihood of significant groundwater flooding disruption in Nailbourne for the next five days, and for parts of Wiltshire and Dorset from Friday.

**Area E**, for the next five days there is a high likelihood of significant groundwater flooding disruption in Hambledon.

In **Area B**. River levels in the Thames remain very high in Windsor & Maidenhead and Surrey. Here, there is a **high likelihood of severe disruption** for the next five days.

**Coastline I**, on Wednesday there is a medium likelihood of significant coastal flooding disruption for Chiswell, Portland and West Bay in Dorset. On Friday evening and into Saturday there is a low likelihood of significant disruption here.

In **Areas J**, On Wednesday there is a low likelihood of significant coastal flooding disruption caused by wave overtopping and wind blown spray.



Thames, Berkshire



Somerset Levels



Somerset Levels



Severn, Worcester

## Damage to the railway line at Dawlish, Southwest England

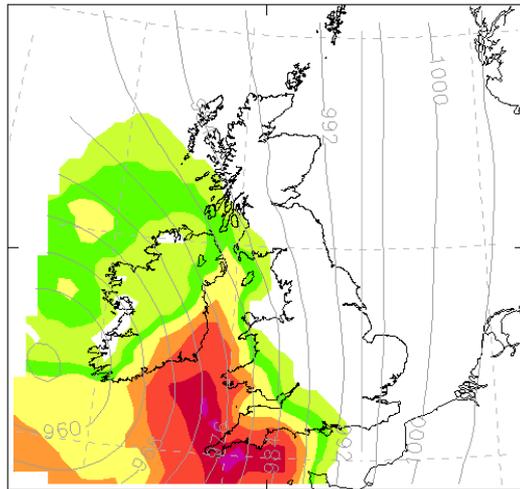


## 5. Advances and Applications in NWP:

### MOGREPS-G probability 10m wind gusts $\geq 60$ knots for overnight 4/5 Feb

MOGREPS (Global) Probability map for MaxGustSpeedUK > 60.0knots  
 VT from 18Z Tue 04/02/2014 to 21Z Tue 04/02/2014 (T+60-T+63)  
 MOGREPS CT 06Z on Sun 02/02/2014 (Ensemble Mean PMSL plotted as faint background)

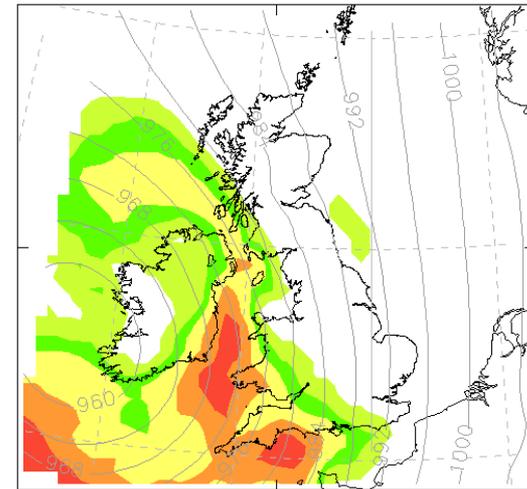
MOGREPS (Global) Probability map for MaxGustSpeedUK > 60.0knots  
 VT from 21Z Tue 04/02/2014 to 00Z Wed 05/02/2014 (T+63-T+66)  
 MOGREPS CT 06Z on Sun 02/02/2014 (Ensemble Mean PMSL plotted as faint background)



No Members

0.01 0.1 0.2 0.4 0.6 0.8 0.9 0.99

All Members



No Members

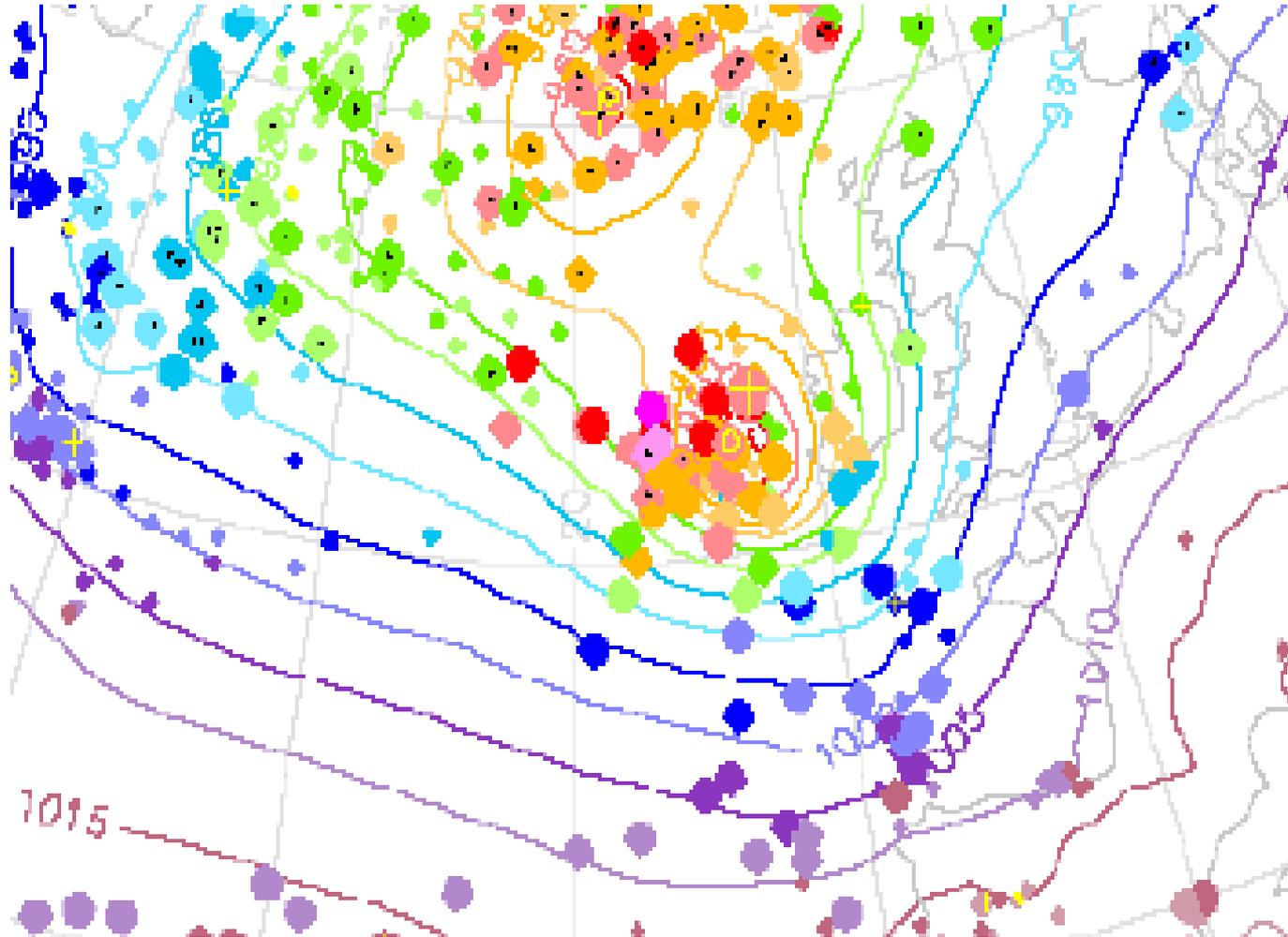
0.01 0.1 0.2 0.4 0.6 0.8 0.9 0.99

All Members

This was the first MOGREPS-G forecast with a lead time to cover this event. Significant probabilities in the South West at the 60 to 66 hour lead time.

Use of 'dalmation' plots to provide estimate of uncertainty for the windstorm on 12<sup>th</sup> February

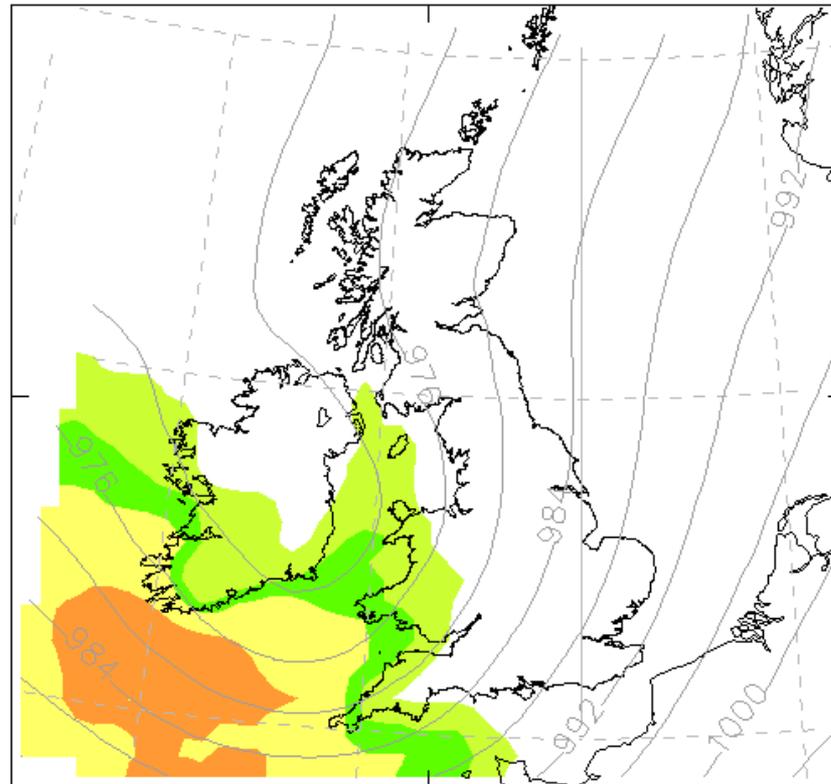
T+72 for 12Z  
Wed 12<sup>th</sup> Feb  
(from EC run  
On 9<sup>th</sup> 12Z)



## MOGREPS-G forecast consistency **animation**

### Forecasts valid 1500 to 1800 GMT Wed 12<sup>th</sup> Feb

MOGREPS (Global) Probability map for MaxGustSpeedUK > 70.0knots  
 VT from 15Z Wed 12/02/2014 to 18Z Wed 12/02/2014 (T+63-T+66)  
 MOGREPS CT 00Z on Mon 10/02/2014 (Ensemble Mean PMSL plotted as faint background)



No Members

All Members

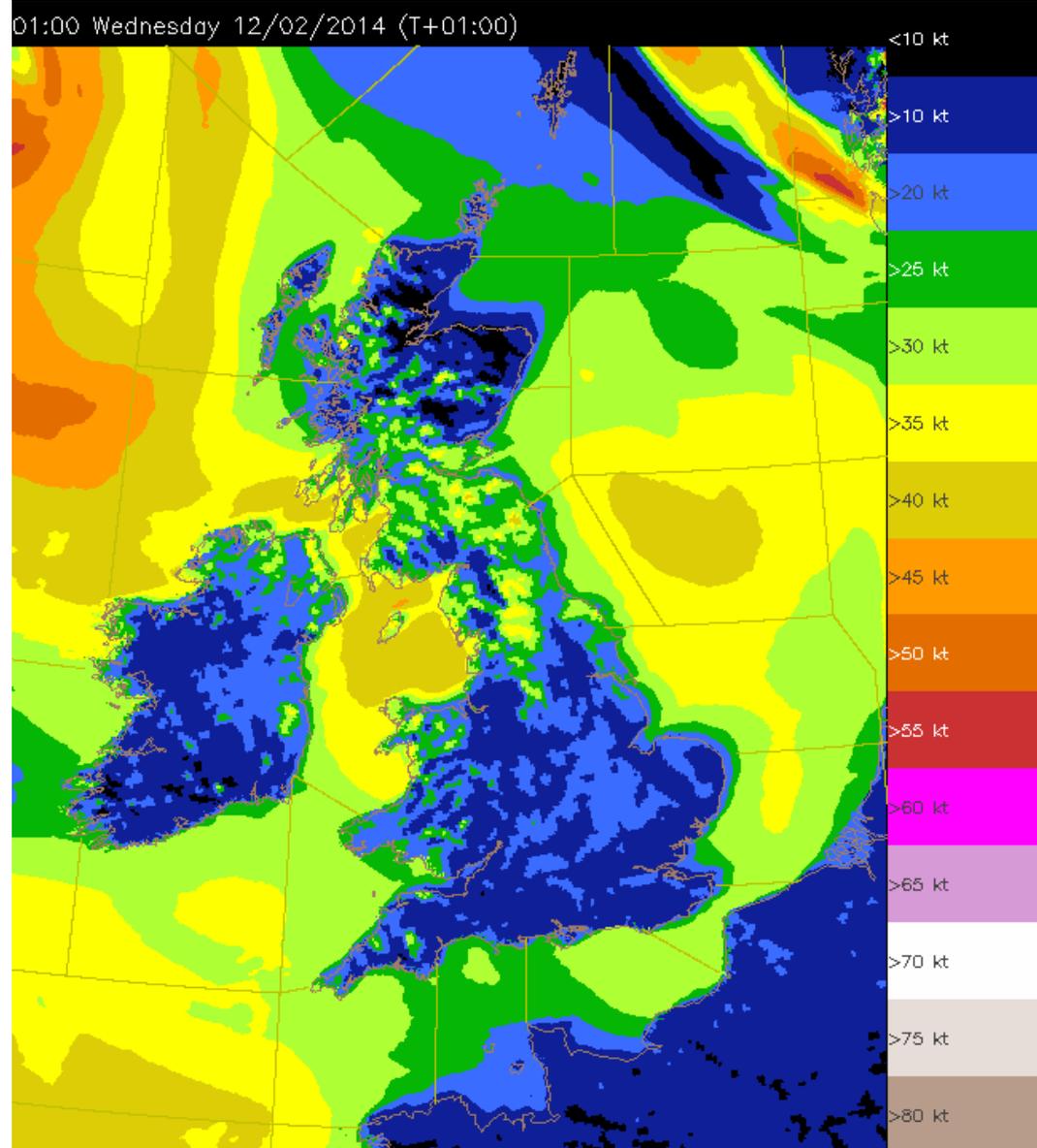
Euro 4km model

10m wind gust  
forecast

**animation** out to  
T+36 hours

00Z run 12/02/2014

Gusts > 80kts  
(145km/hr) forecast  
in places



# Effective communication

- Challenges:
- Maintaining a consistent message
- Managing the message (e.g. media hype)
- Explaining tricky concepts – uncertainty, risk
- Embracing social media

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## 6. Conclusions

- Winter 2013/14 was major challenge – high profile
- Meteorologists used variety of NWP outputs in the decision-making process
- Effective and timely warnings used for planning and mitigation

# Acknowledgements

- Charlie Pilling, Steve Stanbridge and Matt Winter, Flood Forecasting Centre
- Nick Grahame, Met Office

**Thanks for listening,  
are there any questions?**