

Winter storms, December 2013 to January 2014

From mid-December to early January, the UK experienced a spell of extreme weather as a succession of major winter storms brought widespread impacts to the UK.

The first storm of 5 December brought very strong winds to Scotland and northern England, and a major storm surge affecting North Sea coasts. A week of quieter weather then followed, but from mid-December there was a succession of further major winter storms which continued into early January.

Initially most of the weather impacts related to the strong winds, first across the north of the UK and then affecting exposed areas further south. However, as rainfall totals accumulated the focus of concern shifted from strong winds to flooding, including large river catchments such as the Severn and Thames. Finally, in early January, strong winds, combining with high spring tides and river flows, resulted in high water levels and large waves affecting exposed coastal communities in the south and west, causing coastal flooding.

Impacts

The storm of 5 December saw Scotland's rail network shut down, 100,000 homes without power, flight cancellations at Glasgow, Edinburgh and Aberdeen, fallen trees, traffic accidents and two fatalities. During the morning of the 5th, concerns increased regarding coastal flooding mainly affecting eastern England due to a storm surge. Several hundred homes were flooded on parts of the east coast of England (for example at Boston, Lincolnshire) and many thousands of residents were evacuated from vulnerable areas. At Hemsby (Norfolk) cliff erosion resulted in several properties collapsing into the sea, while in North Wales, Rhyl (Denbighshire) was badly affected by coastal flooding. However, hundreds of thousands of properties were protected by flood defences and the Thames Barrier was closed to protect London.

The storm of 18 to 19 December again resulted in travel disruption and several thousand homes without power across western Scotland and Northern Ireland. There were also reports of some fallen trees, minor structural damage and localised flooding.

The storm of 23 to 24 December caused widespread flooding across southern England, stretching through Dorset, Hampshire, Surrey and Kent, and extensive power cuts, with around 50,000 homes remaining without power through the Christmas period. In Devon, a man was swept away in a river and there was extensive transport disruption. Rail services were cancelled due to fallen trees and Gatwick Airport was affected by flooding. Severe flooding occurred in Leatherhead, Surrey from the River Mole.

There was further stormy weather with heavy rain and strong winds on 26 to 27 December and again around 30 to 31 December. Transport disruption continued with flooded railways and fallen trees blocking roads in Wales, while Dumfries and Galloway experienced severe flooding as the River Nith burst its banks. Flooding impacts continued into the New Year period, and in early January included large-scale river flooding from the River Severn in Gloucestershire and sections of the River Thames. In a repeat of the [Exceptionally wet weather - November 2012](#), the Somerset Levels were also inundated.

A major focus of concern was high spring tides and large waves combining to cause an extreme risk of coastal flooding. The historic promenade in Aberystwyth was severely damaged by large waves, and there was further damage and flooding to coastlines elsewhere, particularly the South Coast and Welsh coastline; the stormy conditions made coastal areas extremely dangerous and in Devon a teenager died after being swept away.

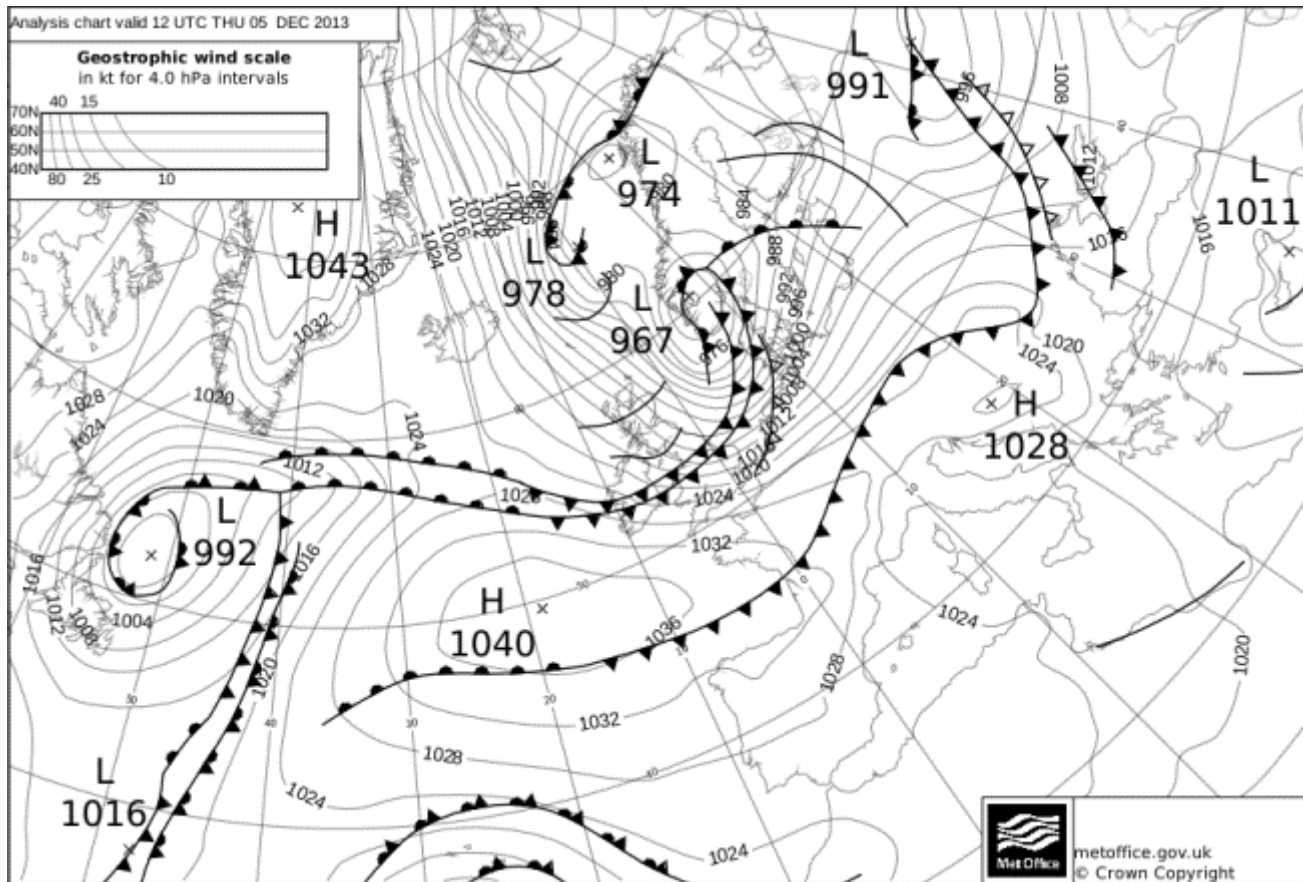
Overall the December and January storms resulted in around seven fatalities and 1,700 properties flooded across England.

Weather data

The sequence of storms affecting the UK was caused by a powerful jet stream driving a succession of low pressure systems across the Atlantic. The most significant storms occurred on 5 December, 18 to 19 December, 23 to 24 December, 26 to 27 December 2013 and 3 January 2014. These are presented in turn.

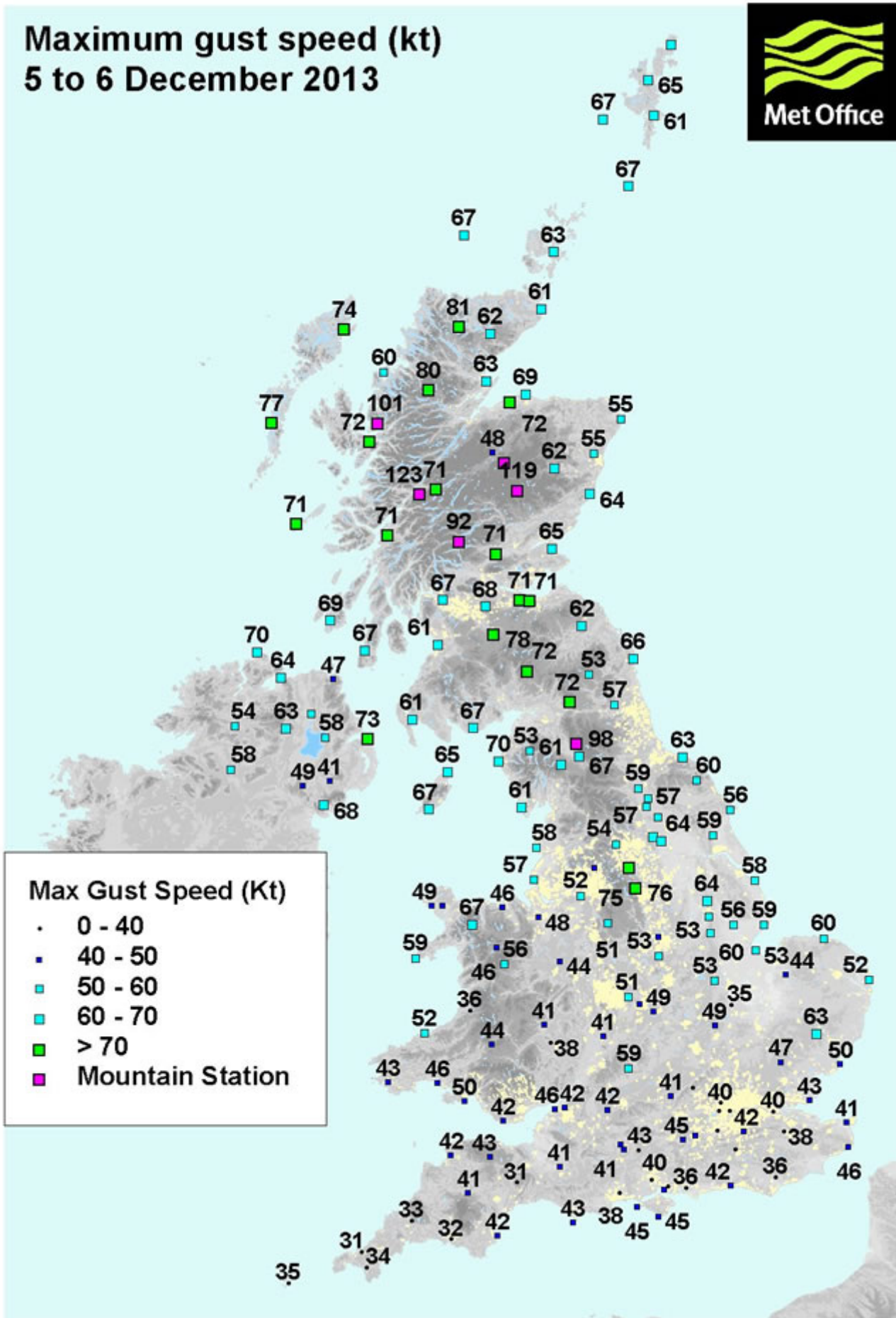
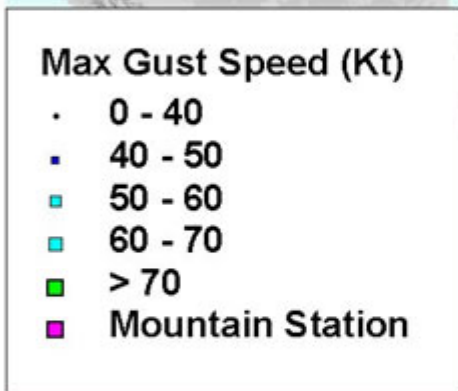
5 to 6 December

Synoptic situation at 1200 UTC 5 December 2013, showing a deep area of low pressure to the north-east of the UK bringing strong winds to the north and east, with a storm surge affecting both North Sea coasts and the North Wales coast.



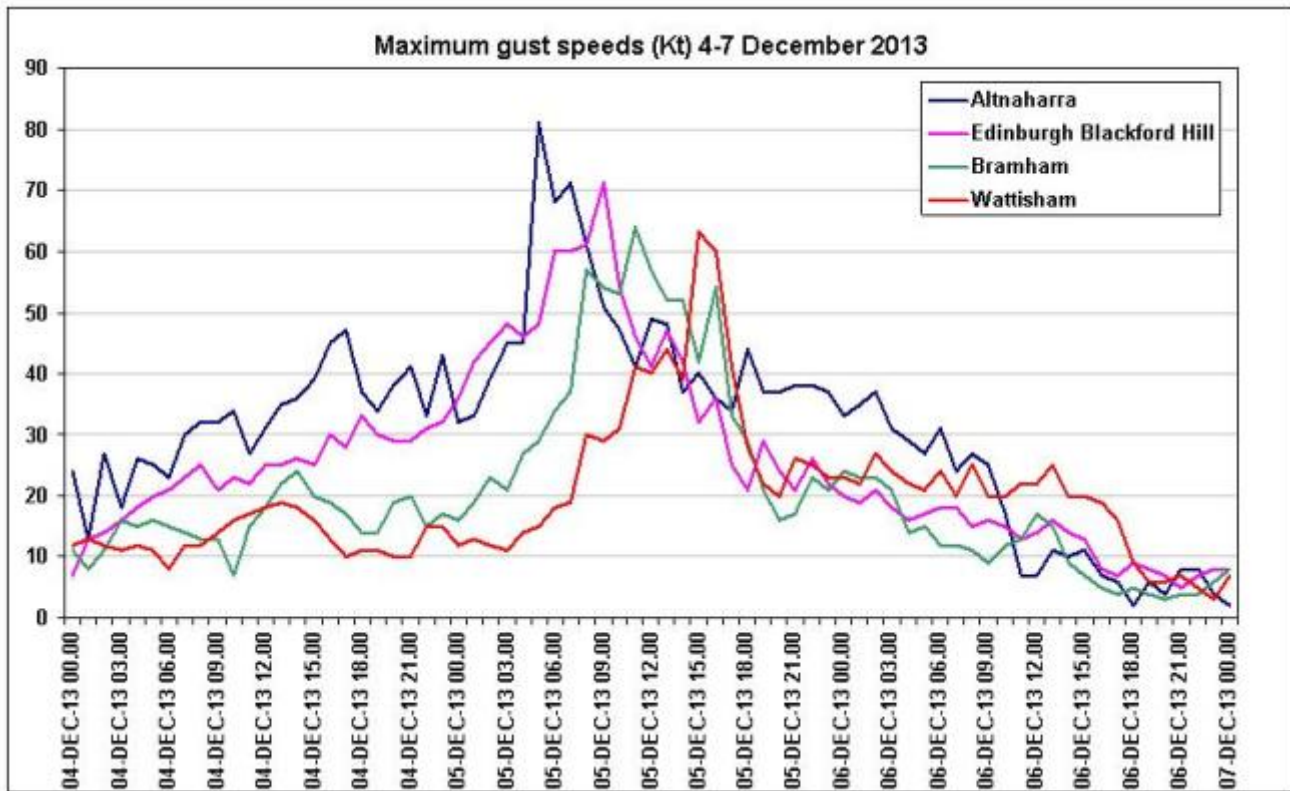
The map below shows maximum gust speeds 5 to 6 December 2013. Winds gusted widely at 60 to 70 kt across Scotland, with Altnaharra (Sutherland) recording a gust of 81 kt (93 mph). The mountain station at Aonach Mor (at an elevation of 1130 m a.s.l.) recorded a gust of 123 kt (142 mph). Gusts also exceeded 60 kt along North Sea and Irish Sea coasts and over 70 kt in the Western Isles.

Maximum gust speed (kt) 5 to 6 December 2013

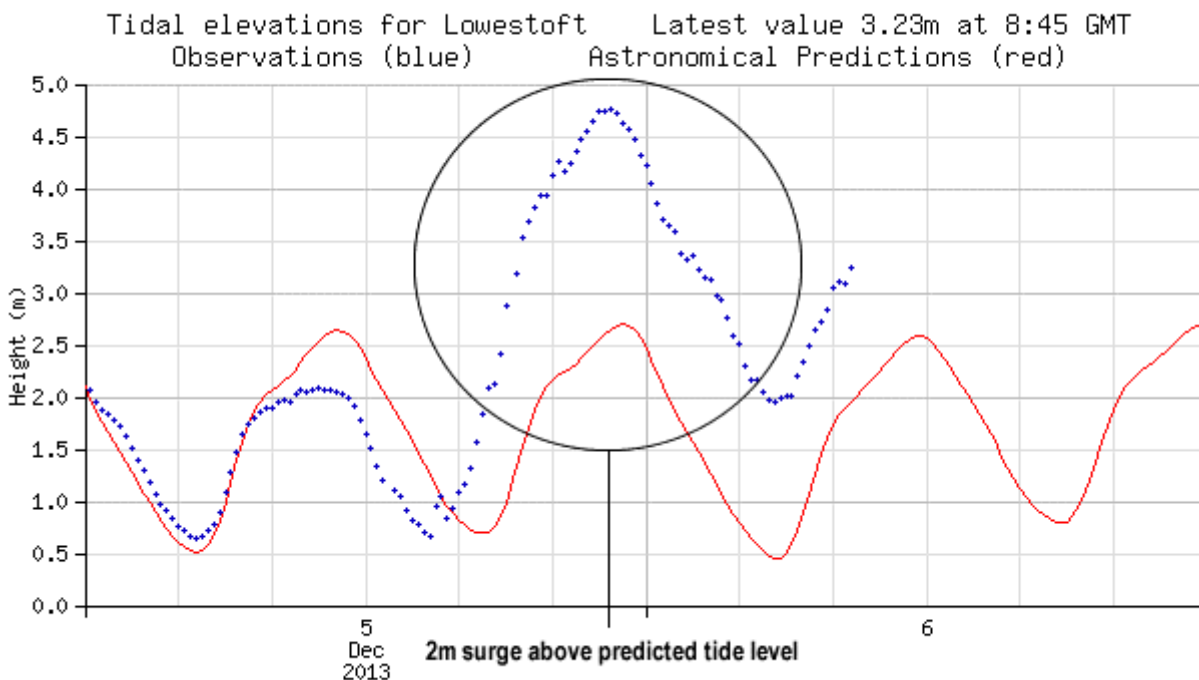


The chart below shows hourly maximum gust speeds at four locations from north-west to south-east: Altnaharra (Sutherland), Edinburgh Blackford Hill, Bramham (West Yorkshire) and Wattisham (Suffolk). Wind

speeds peaked at Altnaharra in the hour to 0500 UTC - whereas they peaked at Wattisham in the hour to 1500 UTC on 5 December 2013.

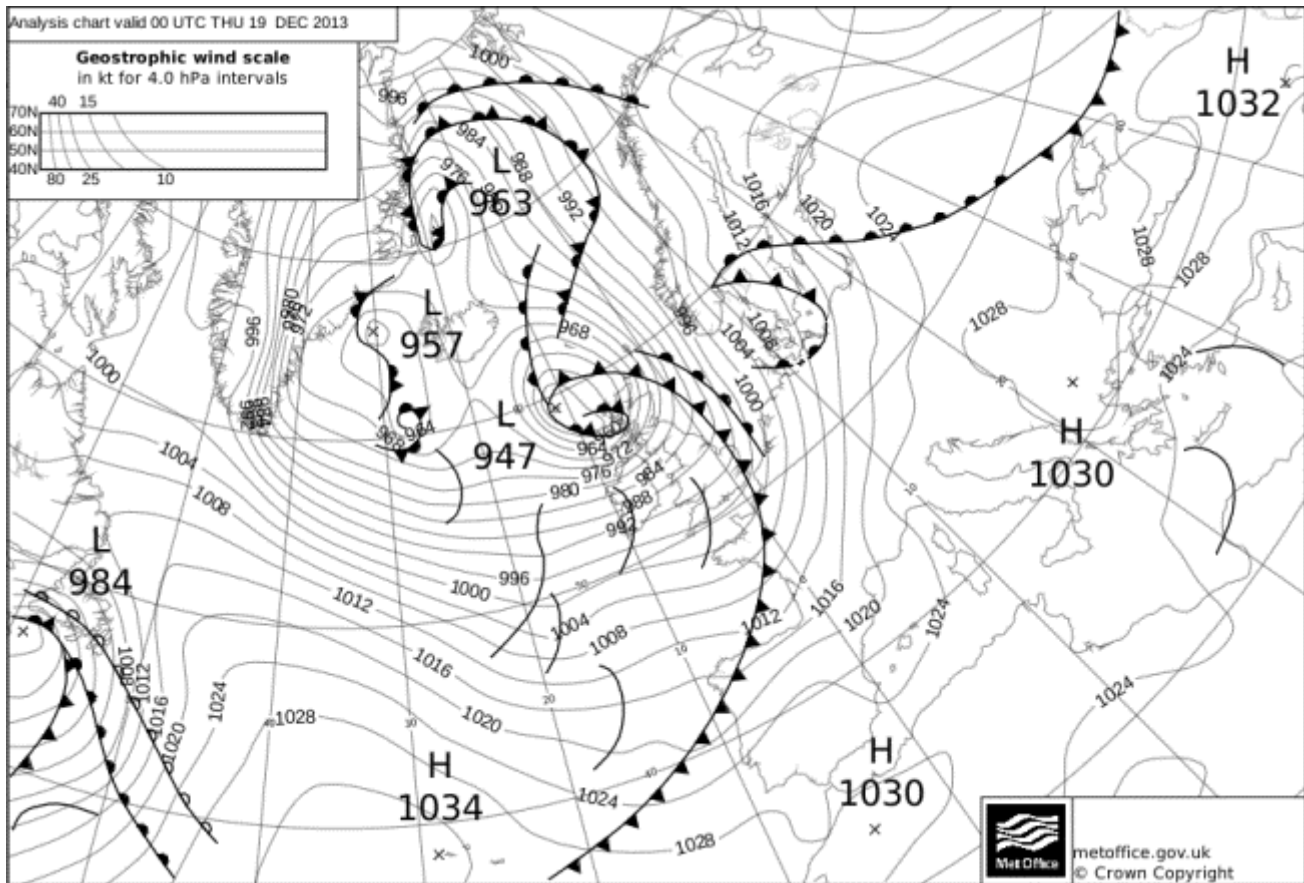


The combination of low pressure and strong winds led to a significant storm surge affecting North Sea coasts, although the north coast of Wales was also affected. The figure below shows predicted and observed tide elevations at Lowestoft (Suffolk) on 5 to 6 December 2013, courtesy of the [National Oceanography Centre](#). The surge was 2 m above predicted high water and coincided with high tide. Winds were north-westerly so the surge moved along the shore.



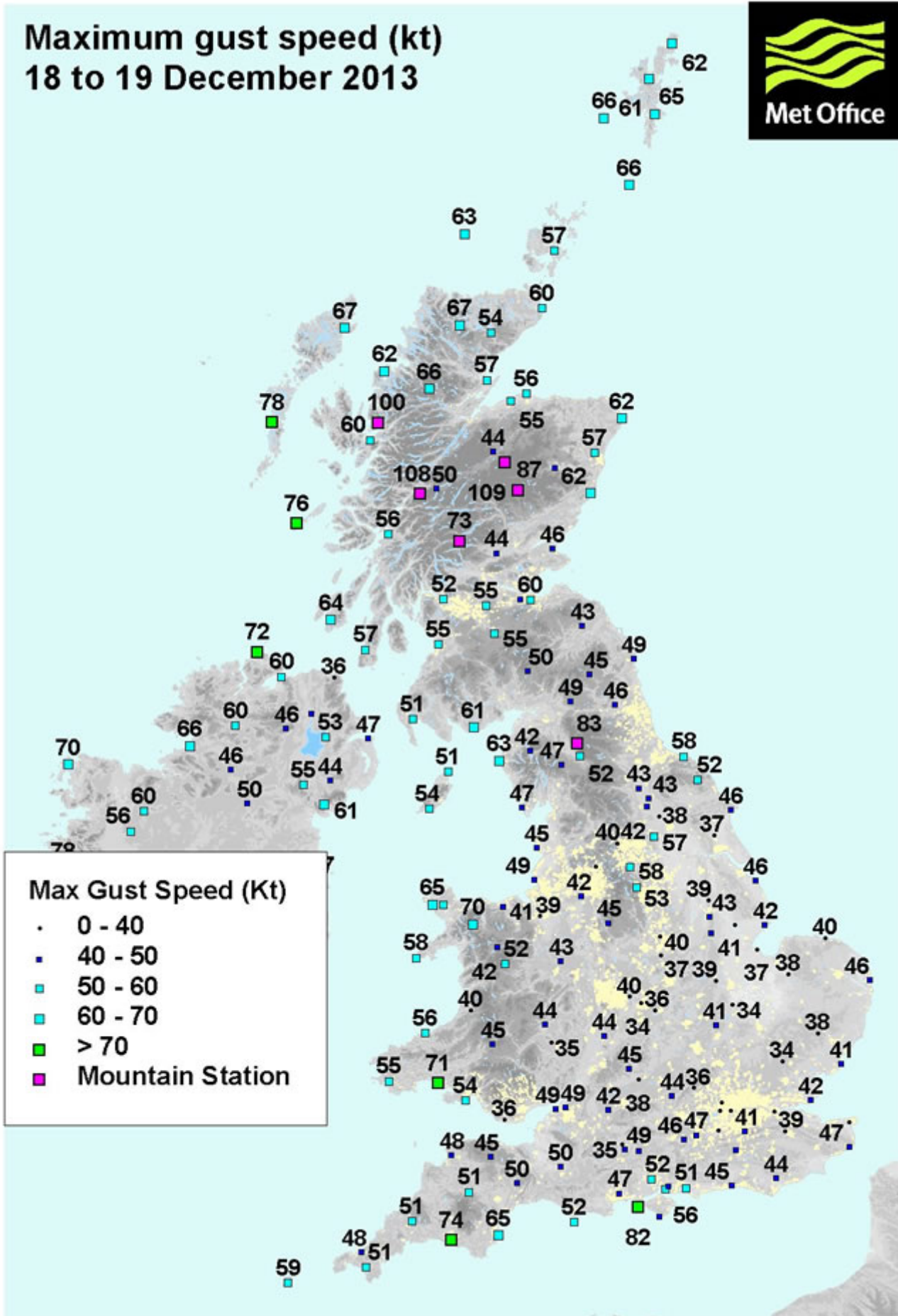
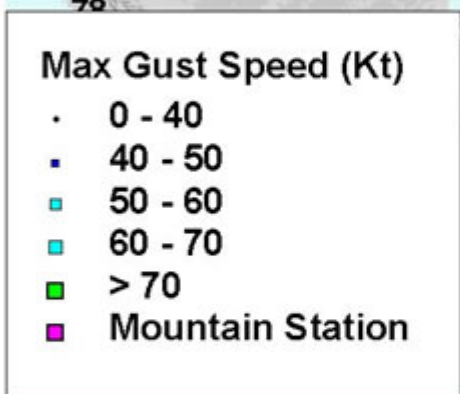
18 to 19 December

Synoptic situation at 0000 UTC 19 December 2013, showing a deep area of low pressure to the north-west of Scotland.



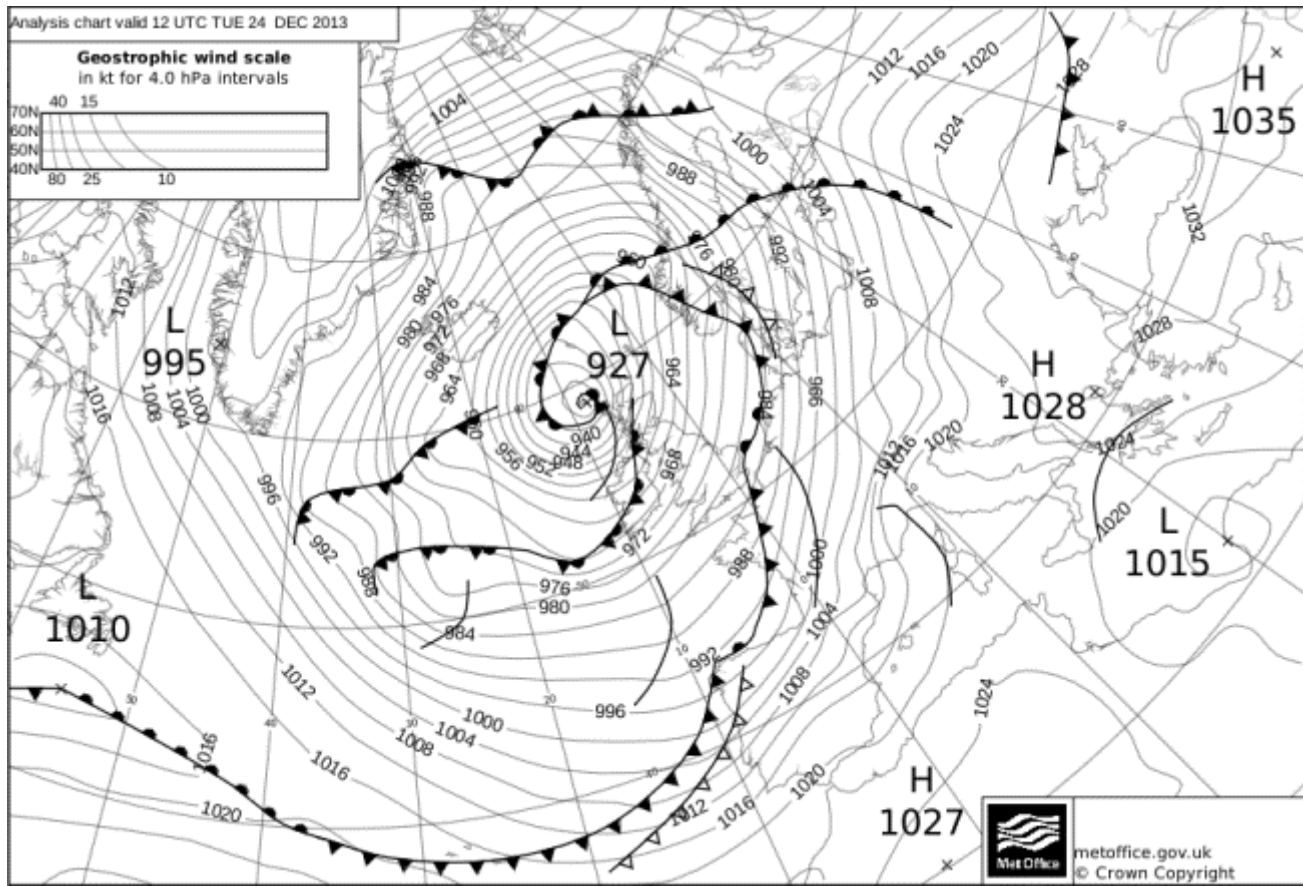
The map below shows maximum gust speeds 18 to 19 December 2013. Winds gusted widely at 60 to 70 kt around exposed coastlines of the north and west, with gusts exceeding 70 kt in the Western Isles, South Wales and South Coast. 74 kt (85 mph) was recorded at Plymouth and 82 kt (94 mph) at Needles Old Battery (Isle of Wight), while winds gusted at over 100 kt across the Scottish mountain summits.

Maximum gust speed (kt) 18 to 19 December 2013



23 to 24 December

Synoptic situation at 1200 UTC 24 December 2013, showing an exceptionally deep area of low pressure to the north-west of Scotland.



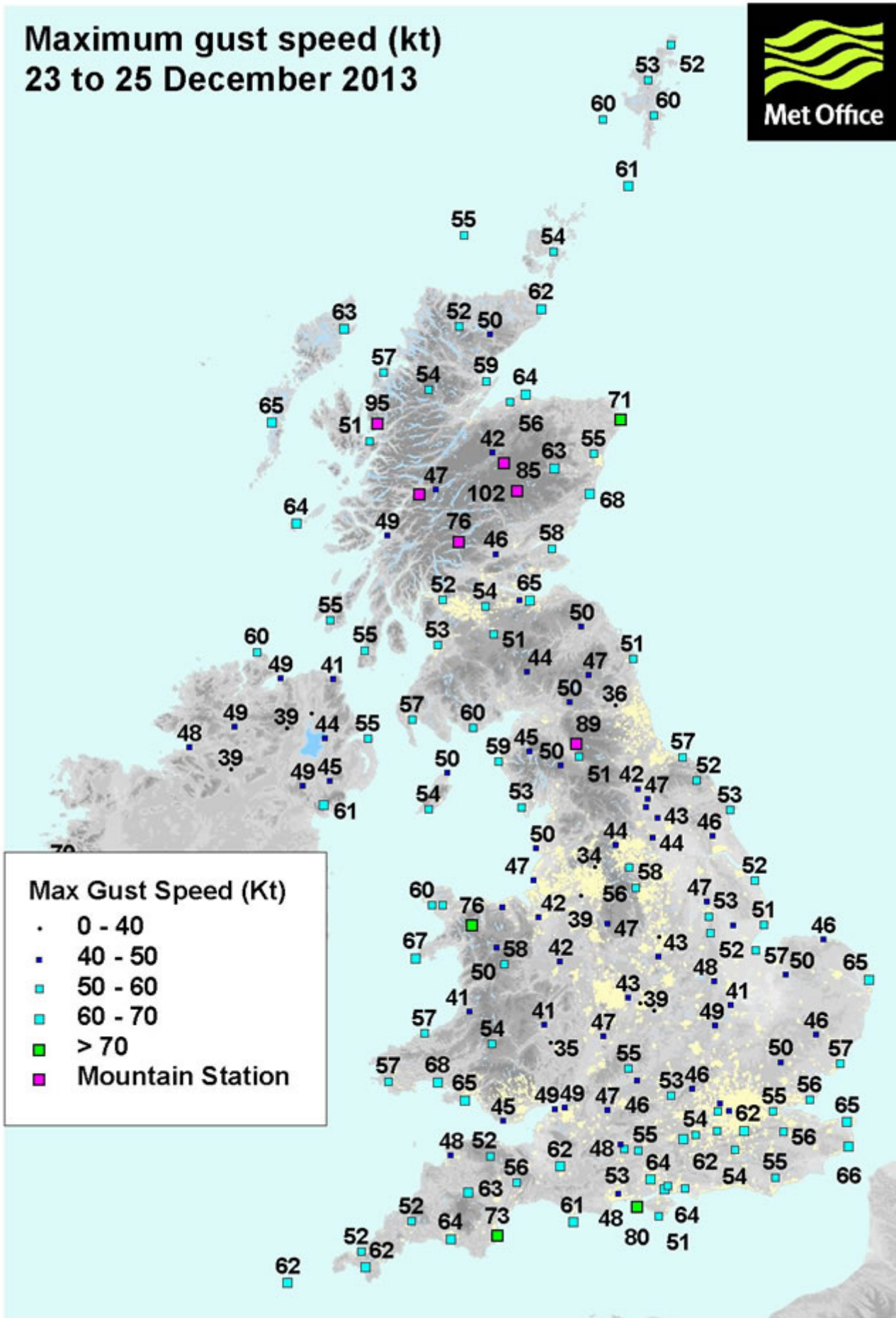
The map below shows maximum gust speeds 23 to 25 December 2013. Winds gusted at again at 60 to 70 kt across much of Scotland, the coast of Wales and South Coast of England. A gust of over 100 kt was again recorded across Scotland's mountain summits.

Maximum gust speed (kt) 23 to 25 December 2013



Max Gust Speed (Kt)

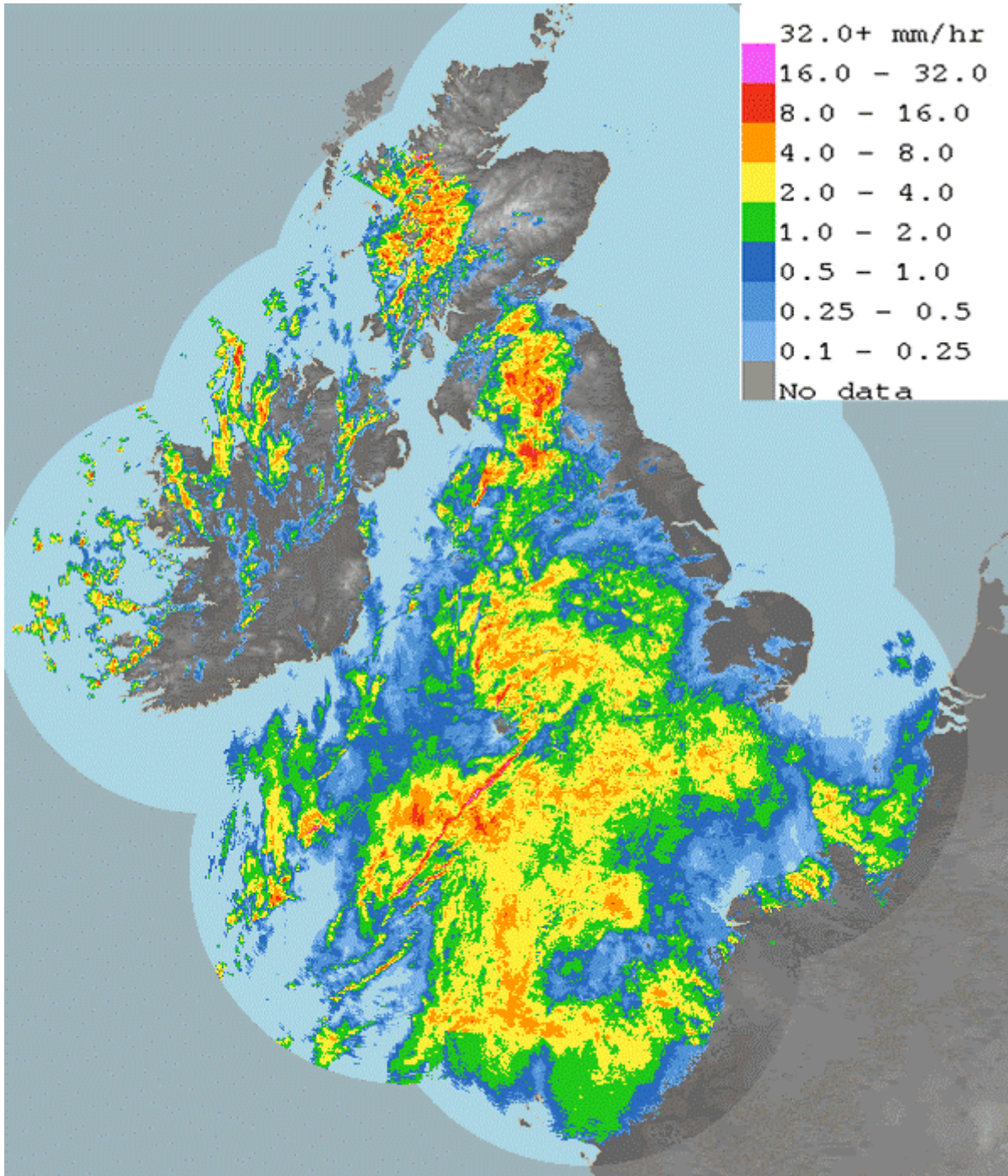
- 0 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- > 70
- Mountain Station



The storm of 23 to 24 December brought particularly heavy rain to southern England and Wales, with a swathe from Dorset to Kent recording 50 to 70 mm, causing significant flooding problems. Rainfall totals for the 24 hours to 0900 UTC on 24th included 66.8 mm at Fontmell Magna (Dorset), 66.7 mm at Boscombe Down

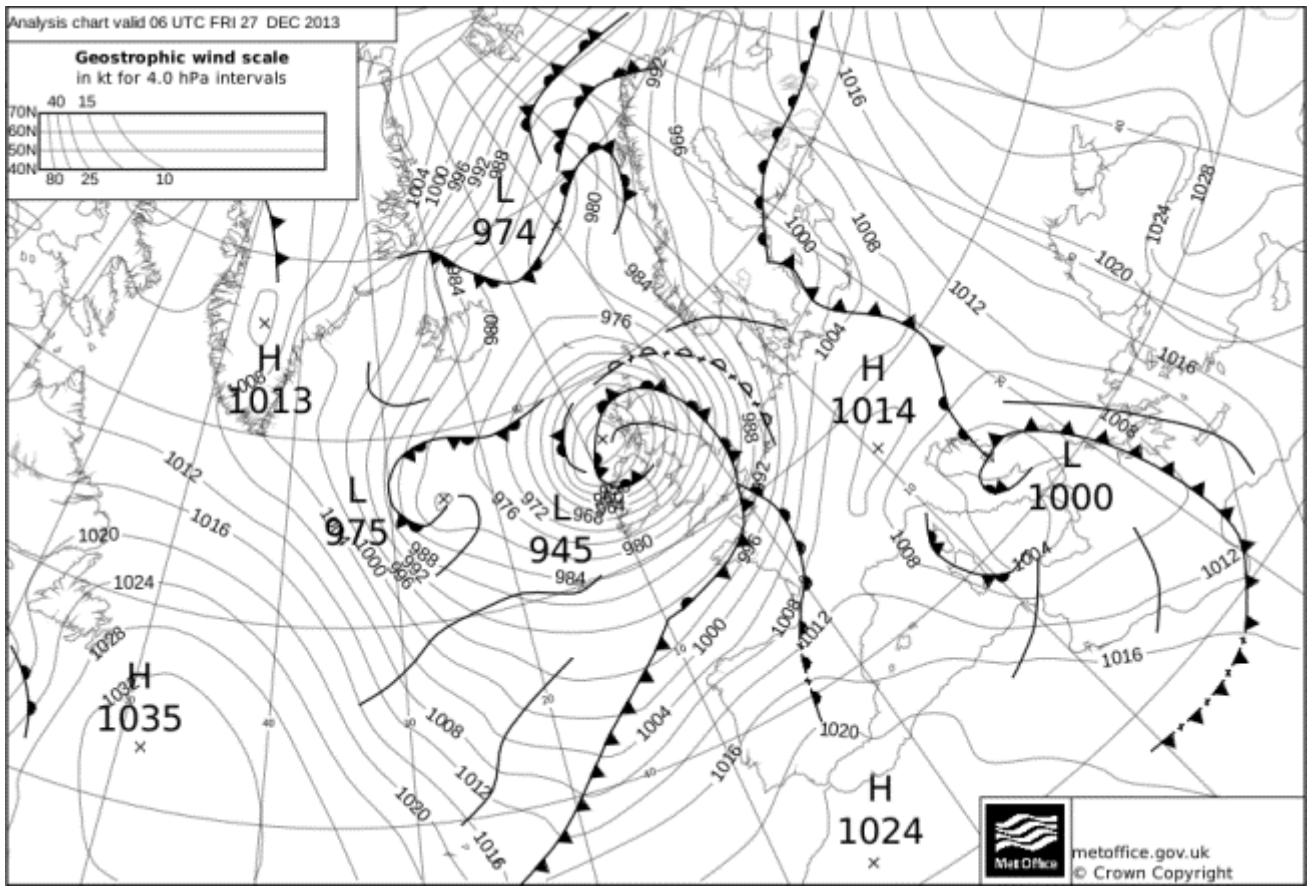
(Wiltshire), 61.0 mm at Mickleham (Surrey) and 63.2 mm at Wych Cross (East Sussex) - these totals being typically around two-thirds or more of the December average rainfall amount.

This rain-radar image at 2200 UTC 23 December 2013 provides an indication of the extent and intensity of the rainfall across the south and west of the UK during this event.



26 to 27 December

Synoptic situation at 0600 UTC 27 December 2013, with another deep area of low pressure to the west of Scotland



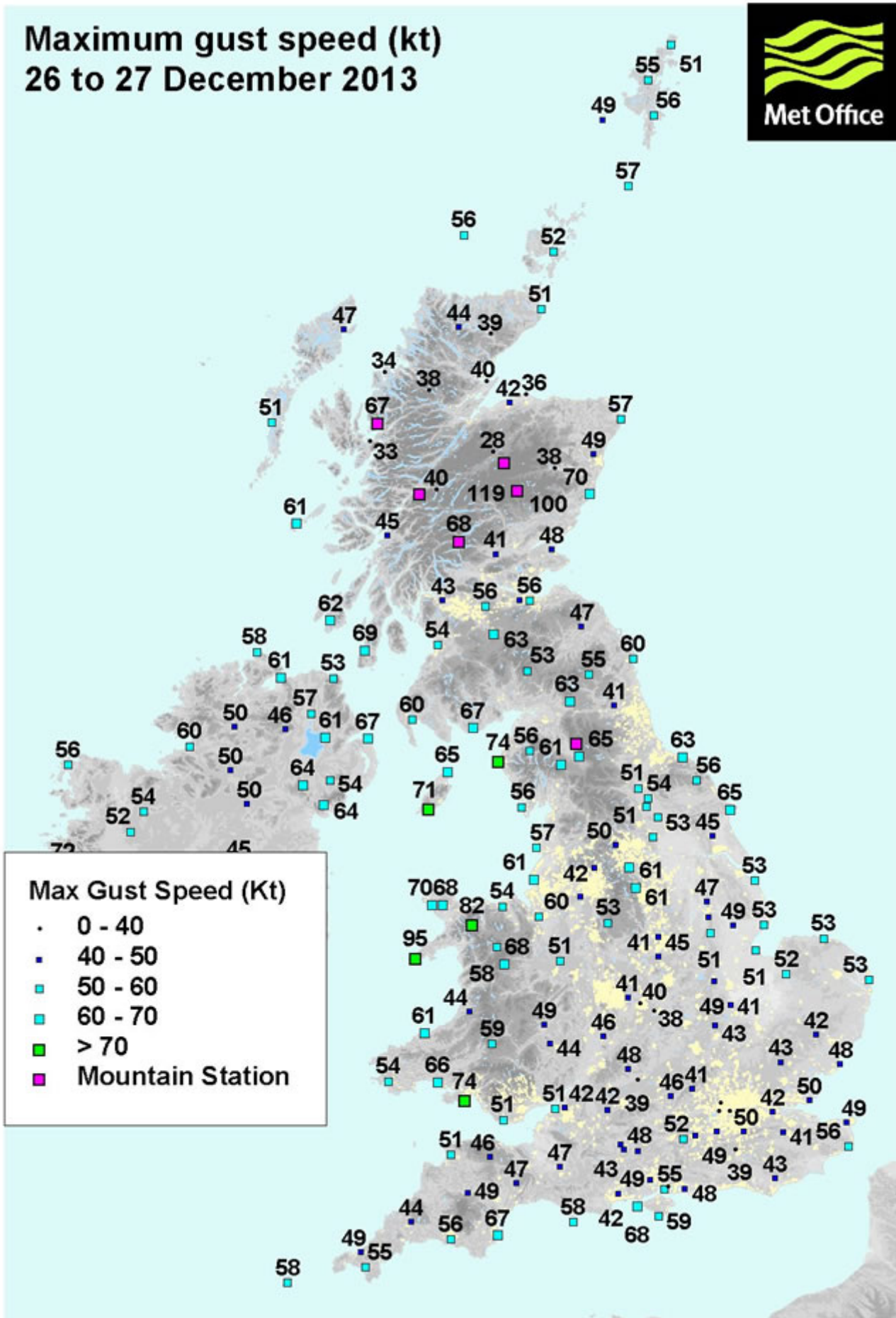
The map below shows maximum gust speeds 26 to 27 December 2013. Winds again gusted widely at 50 to 60 kt, with the strongest winds around Irish Sea coasts. Aberdaron and Capel Curig (both Gwynedd) recorded gusts of 95 kt (109 mph) and 82 kt (94 mph) respectively, while Cairngorm Summit (1237 m a.s.l.) recorded a gust of 119 kt (137 mph).

Maximum gust speed (kt) 26 to 27 December 2013



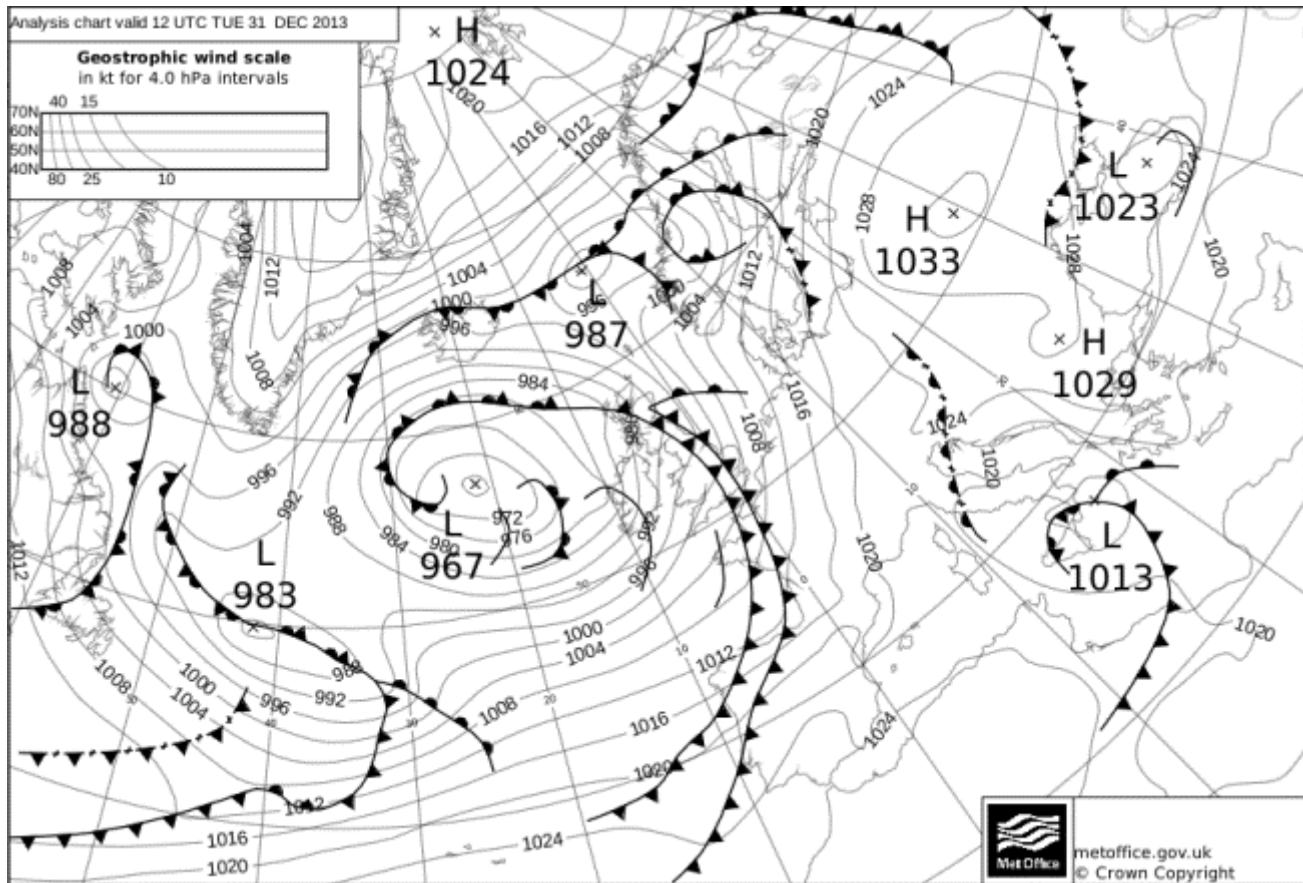
Max Gust Speed (Kt)

- 0 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- > 70
- Mountain Station



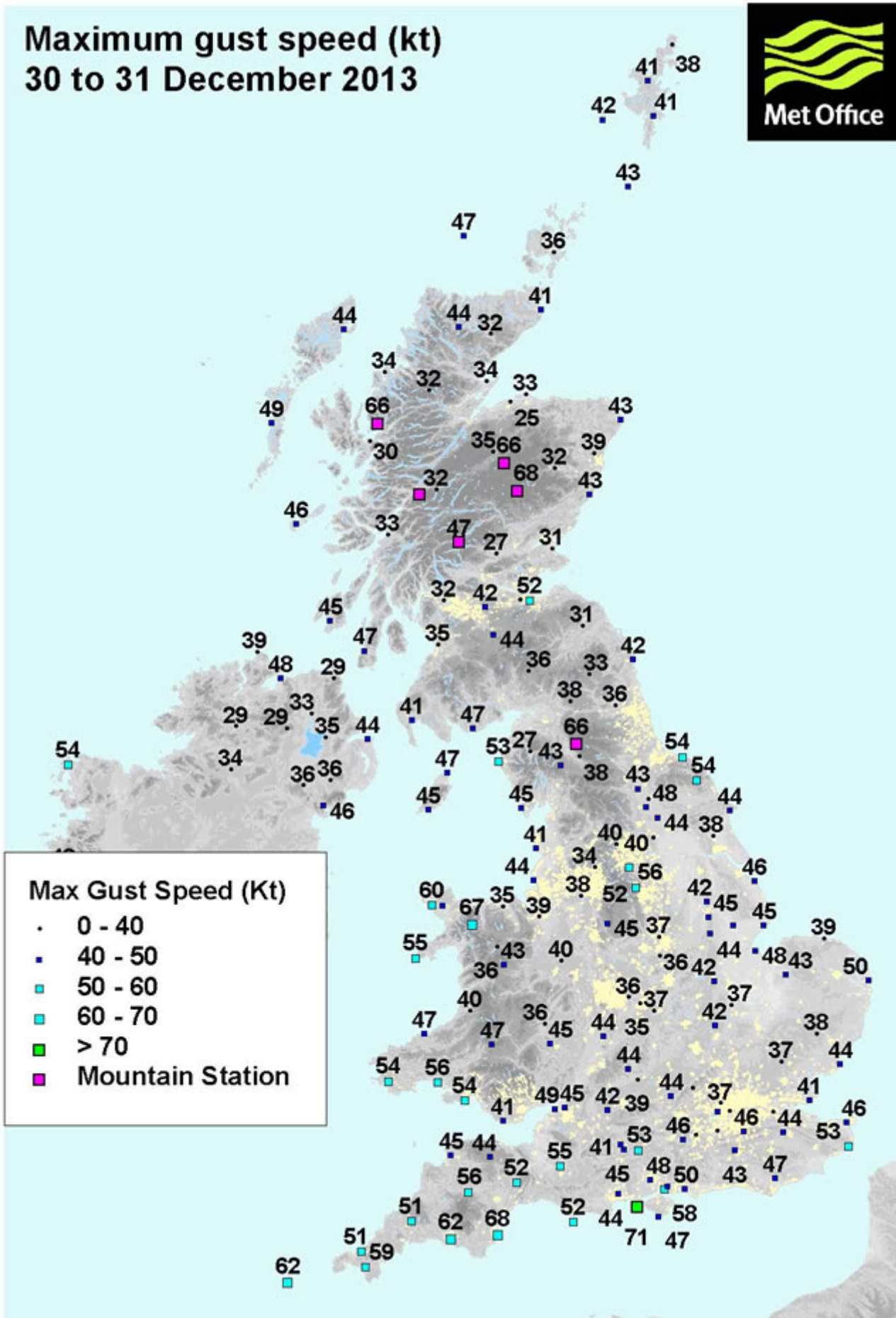
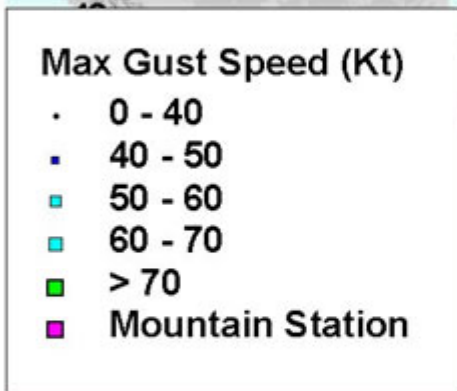
30 to 31 December

Synoptic situation at 1200 UTC 31 December 2013, with low pressure continuing to dominate the UK's weather, bringing further strong winds accompanied by heavy rain.



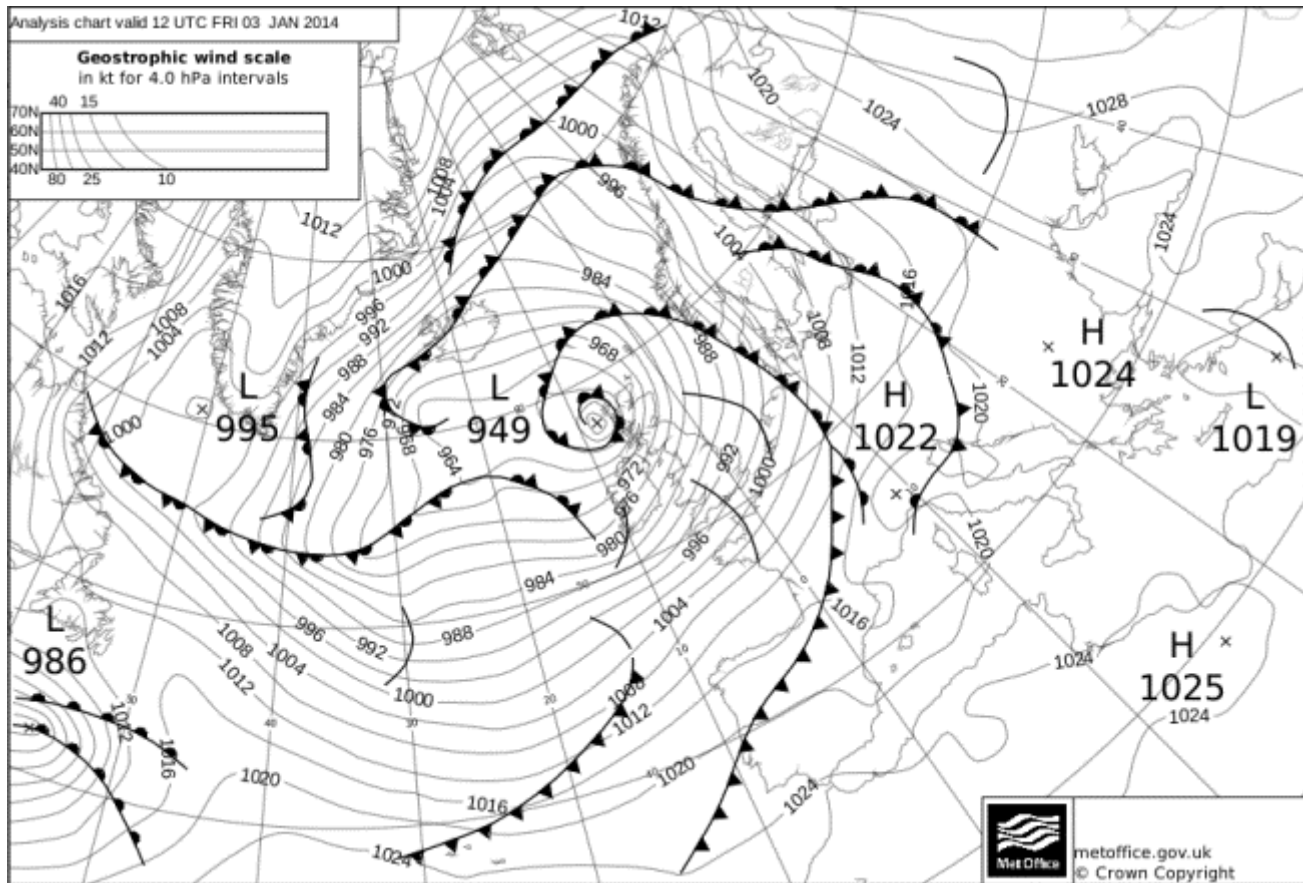
The map below shows maximum gust speeds 30 to 31 December 2013. The focus of the concern about the severe weather shifted from strong winds to heavy rain. Nevertheless, winds still gusted at 50 to 60 kt around exposed coastlines of the south and west.

Maximum gust speed (kt) 30 to 31 December 2013



3 January

Synoptic situation at 1200 UTC 3 January 2014, with another deep area of low pressure to the west of Scotland



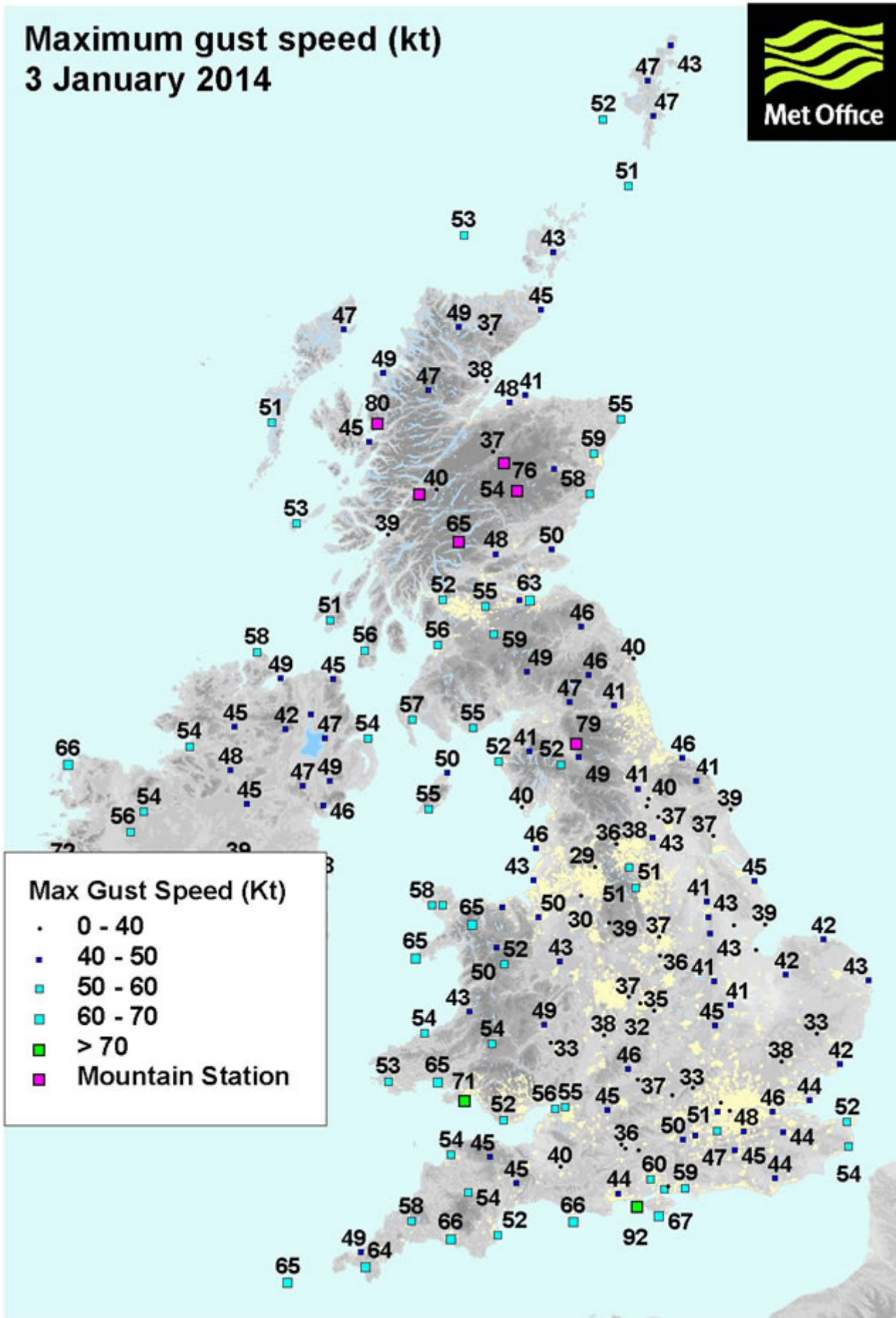
The map below shows maximum gust speeds on 3 January 2014. Once again, winds gusted at 60 to 70 kt around exposed coastlines of the south and west, with 92 kt (106 mph) at Needles Old Battery (Isle of Wight) and 71 kt (82 mph) at Mumbles Head (Swansea).

Maximum gust speed (kt) 3 January 2014



Max Gust Speed (Kt)

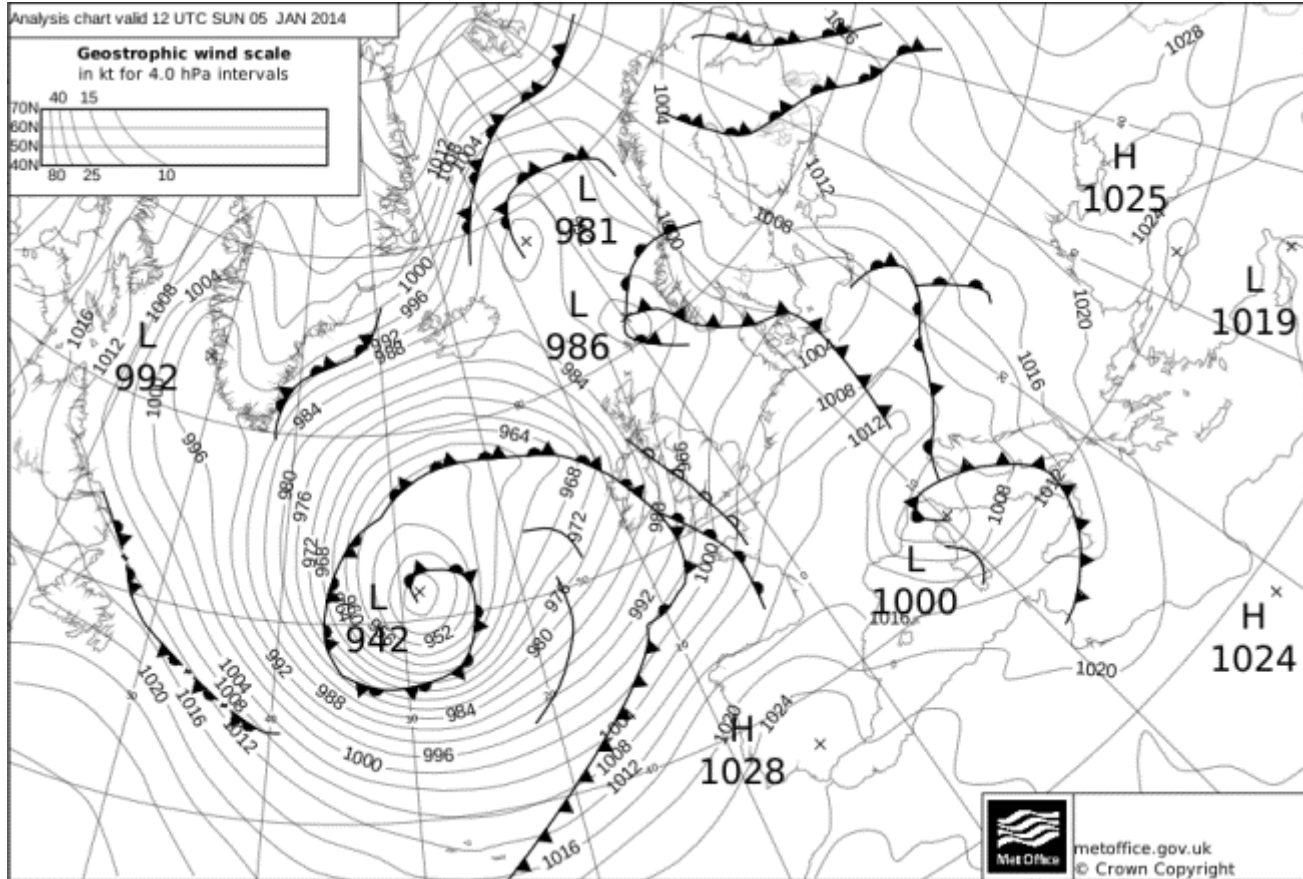
- 0 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- > 70
- Mountain Station



5 January

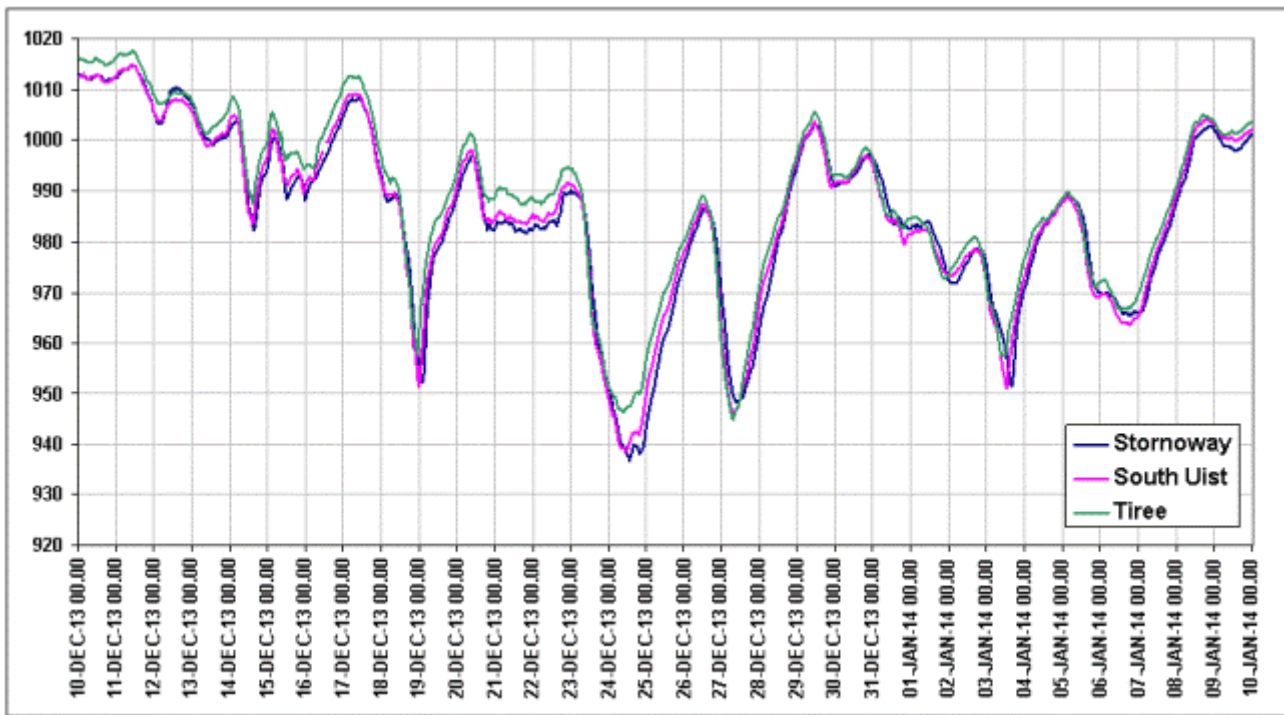
In early January, the focus of concern again shifted to coastal flooding, particularly affecting exposed locations in South West England and South Wales. A large area of low pressure in the north Atlantic, driving strong winds and coinciding with high spring tides resulted in exceptionally high waves affecting coastal communities along the South Coast of England and west coast of Wales. In estuaries, the potential flood risk was exacerbated by high runoff from rivers.

Synoptic situation at 1200 UTC 5 January 2014, with a deep area of low pressure in mid-Atlantic driving very large waves towards western and southern coasts.



Pressure

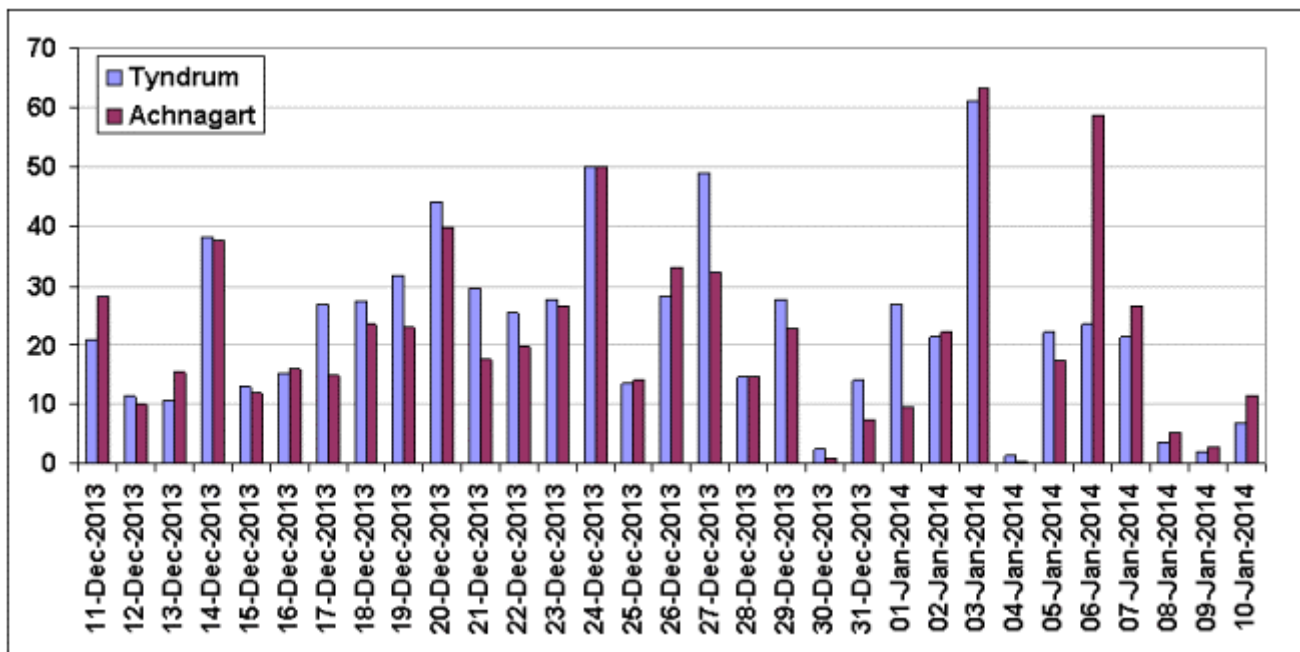
The graph below shows mean sea level pressure recorded at three Hebridean stations: Stornoway, South Uist and Tìree from 10 December 2013 to 10 January 2014. The four pronounced downward spikes are the storms of 18 to 19 December, 23 to 24 December, 27 to 28 December 2013 and 3 January 2014 respectively. For each of these events the pressure approached or fell below 950 hPa; readings as low as this are relatively rare for UK land stations. The lowest reading was 936 hPa at Stornoway on 24 December; the lowest UK pressure recorded since 1886 (Burt, 2007).



Rainfall

The succession of deep Atlantic low pressure systems resulted in an exceptionally wet spell, both across much of Scotland and South East England. Although each individual event was not outstanding, it was their rapid succession, with further rain falling on already saturated ground that caused the significant flooding problems.

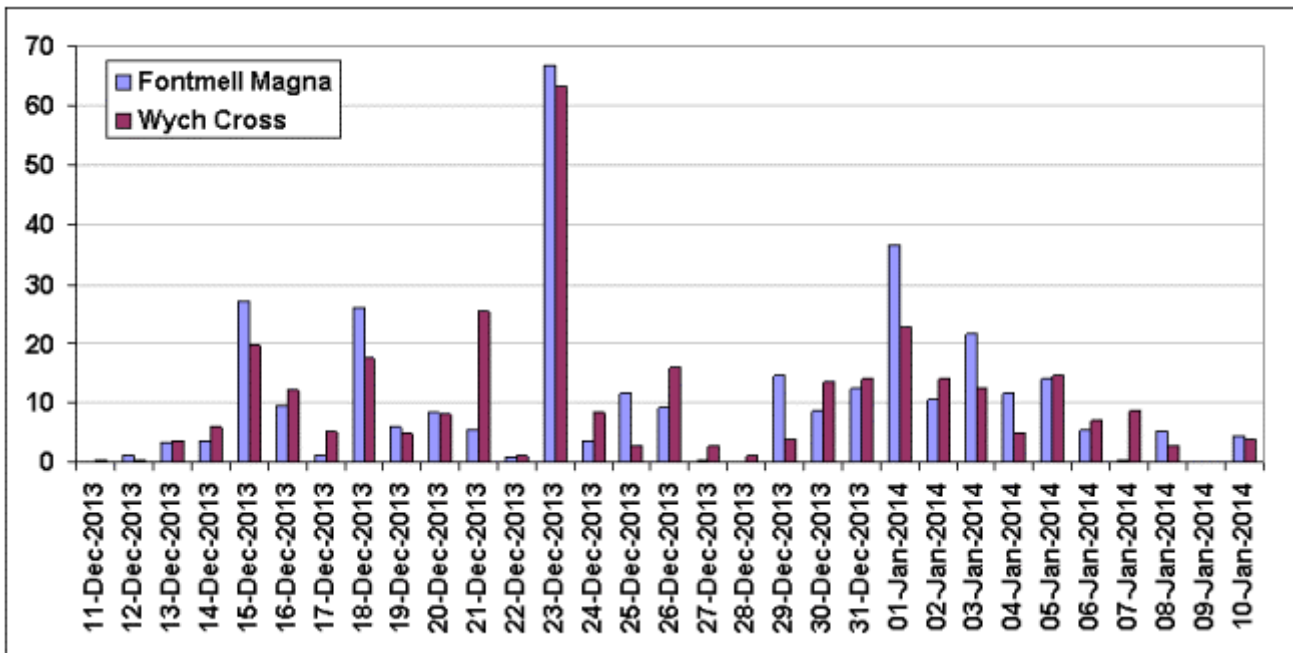
The chart below shows daily rainfall totals for two stations in the West Highlands, Tyndrum and Achnagart, from 11 December 2013 to 10 January 2014 inclusive; these stations recording 711 and 675 mm of rain respectively for this 31 day period, around twice the December average. More than 10 mm of rain fell for 19 consecutive days from 11 to 29 December, with an average daily amount of around 25 mm (1 inch).



The December rainfall total for Scotland overall was 296 mm, 181% of the 1981-2010 long term average, making this provisionally the wettest December and the wettest calendar month in Scotland in a series from 1910, just wetter than January 1993 (294 mm).

Initially, the wettest weather was across Scotland, but rainfall totals also steadily accumulated across England and Wales. 20 to 30 mm fell across south-west England and Wales on 18th to 19th, then again on 20th and again on 21st. On 23rd, 50 to 70 mm fell across a swathe through Dorset, Hampshire, Surrey, Sussex and Kent causing significant flooding. Another 10 to 20 mm fell on 26th to 27th, with a brief respite before a further 20 to 30 mm each day on 29th, 30th and 31st in parts of the west and south. Much of South East England received over twice the December average rainfall and here it was provisionally the wettest December since 1959. However, accumulations also continued to build during the first week of 2014.

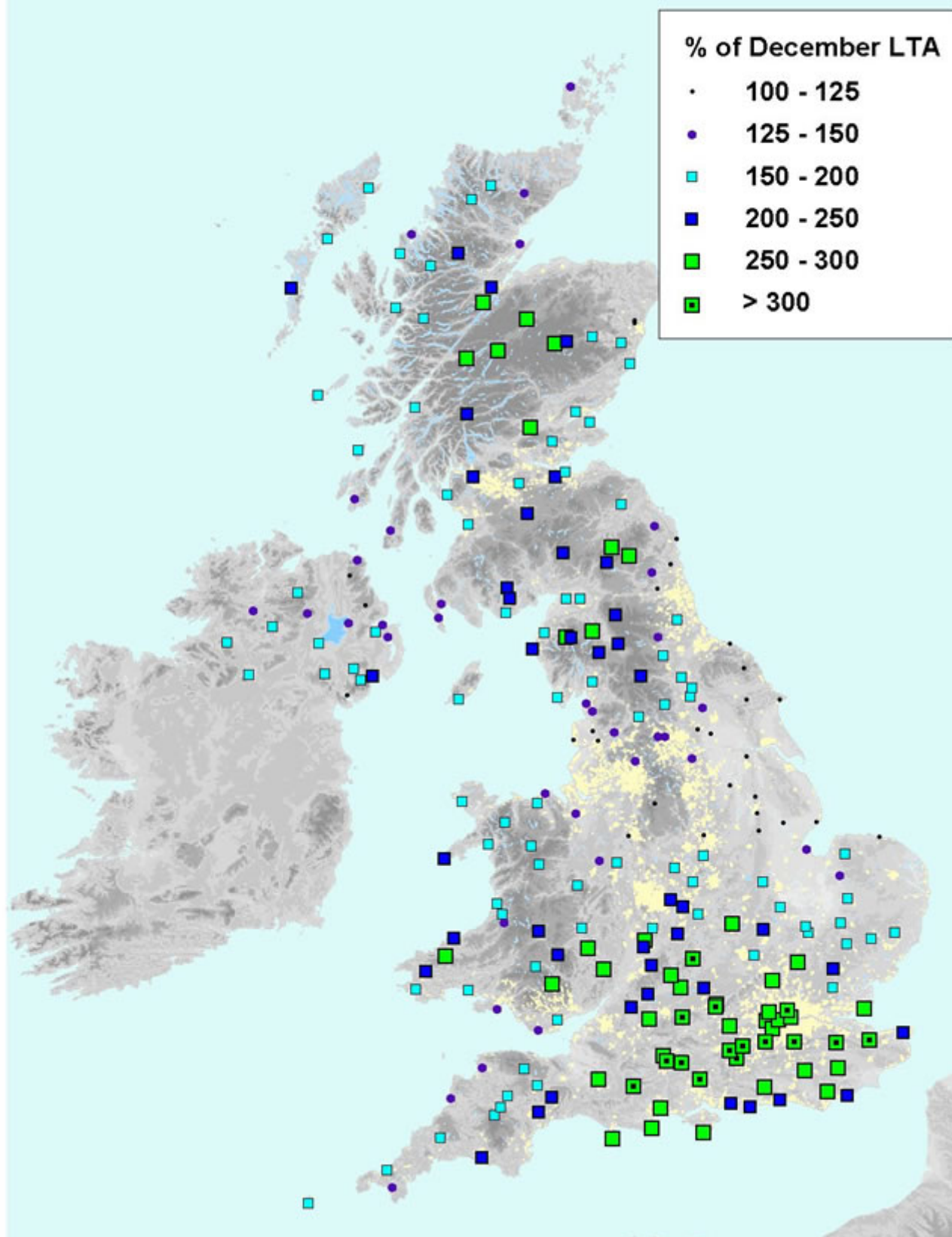
The chart below shows daily rainfall totals for two stations in southern England: Fontwell Magna (Dorset) and Wych Cross (East Sussex) for the same period 11 December 2013 to 10 January 2014. Individually, the only very wet day was 23 December, but due to the steady accumulations these stations recorded 328 mm and 320 mm of rainfall respectively through this 31-day period, around three times the December average.



The map below shows accumulated rainfall totals for the 31-day period from 11 December 2013 to 10 January 2014 as a percentage of the December 1981-2010 long term average. Many stations across southern England and Wales, and much of Scotland, received over twice the December average rainfall through this period, but with a significant area of central southern England recording over three times the December average rainfall amount.

Rainfall totals

11 Dec 2013 to 10 Jan 2014
% of December 1981-2010 average

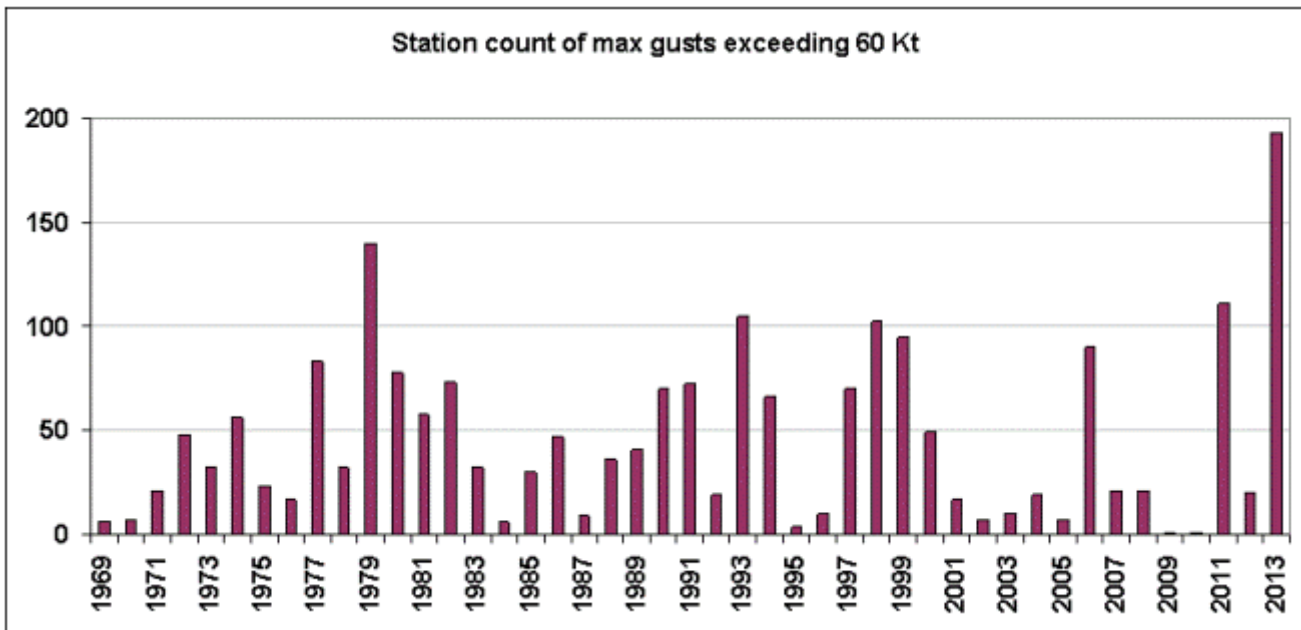


Historical storm comparison

These were major winter storms, but considered individually there are examples of comparable or more severe storms in recent years. Examples would include [Winter storms, early January 2012](#) and [Early winter storms, late 2011](#), each of which caused widespread impacts. However, it was the rapid succession of storms that made the spell exceptional.

One measure of the extent and severity of storms is the number of stations each day recording maximum gust speeds greater than 60 kt (69 mph). The analysis excludes stations with an elevation greater than 250 m.a.s.l.. These data are from the Met Office observing network and provide a series back to 1969. They give a general picture of the extent and duration of high wind events affecting the UK.

The figure below shows the count of stations for Decembers from 1969 exceeding 60 kt, and show that December 2013 was the stormiest December in this series. In recent years, December 2011 was also a stormy month, particularly across Scotland. December 2010 and 2009 were cold months (December 2010 exceptionally so) and characterised by blocked weather patterns, with an absence of storms.



The table below shows the ten stormiest calendar months in the series from 1969. December 2013 was within the top ten stormiest months and is arguably the stormiest calendar month since January 1993. Note that all the stormiest months fall in winter (December, January or February).

Station count of wind gusts exceeding 60 kt

Month	Count
Jan-1993	376
Jan-1984	298
Feb-1990	254
Dec-2013	193
Jan-1974	190
Jan-1976	177
Feb-1997	157
Jan-2005	145

Dec-1979	140
Jan-1995	133

The stormiest calendar month in the series, January 1993 was also previously the wettest calendar month in Scotland in the series from 1910, with a rainfall total comparable to December 2013. The [Monthly Weather Report for January 1993](#) notes that "*this was an extremely unsettled month, one of the stormiest ever in Scotland, which was attacked by twenty depressions.*"

Reference

Burt, 2007: The Lowest of the Lows ... extremes of barometric pressure in the British Isles, part 1 - the deepest depressions. *Weather*, **62**, pp. 4-14

Last updated: 15 July 2014

