

## **Storm Arwen, 26 to 27 November 2021**

**Storm Arwen brought severe winds across the UK overnight 26 to 27 November 2021, with the Met Office issuing a red warning for wind. The developing storm, tracking south to the north-east of the UK, brought northerly winds gusting widely at over 60Kt (69mph). The highest gust speed was 85Kt (98mph) at Brizlee Wood, Northumberland. This was one of the most powerful and damaging winter storms of the latest decade.**

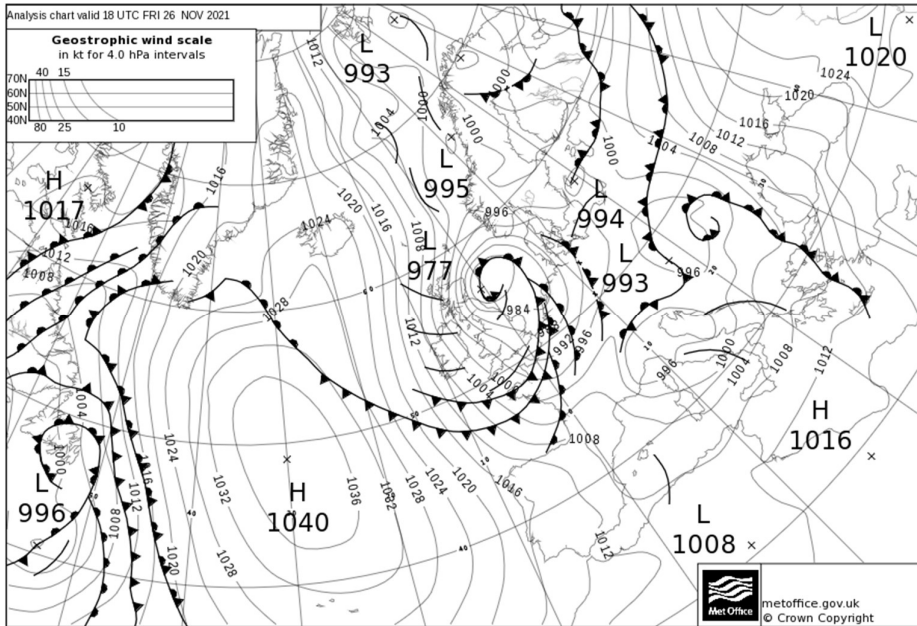
### **Impacts**

Three people died when they were hit by fallen trees in Cumbria, Aberdeenshire and Northern Ireland. Thousands of trees were felled across the north of the UK – including large mature trees – leading to major disruption. The unusual direction of the strongest winds - northerly as oppose to prevailing westerly – may have been an additional factor influencing the number of trees brought down. More than one million homes experienced a loss of power as falling trees brought down power lines, with over 100,000 homes subsequently experiencing several days without power. Rail passengers in Aberdeenshire became stuck on a train overnight and many rail services were cancelled due to trees on the line.

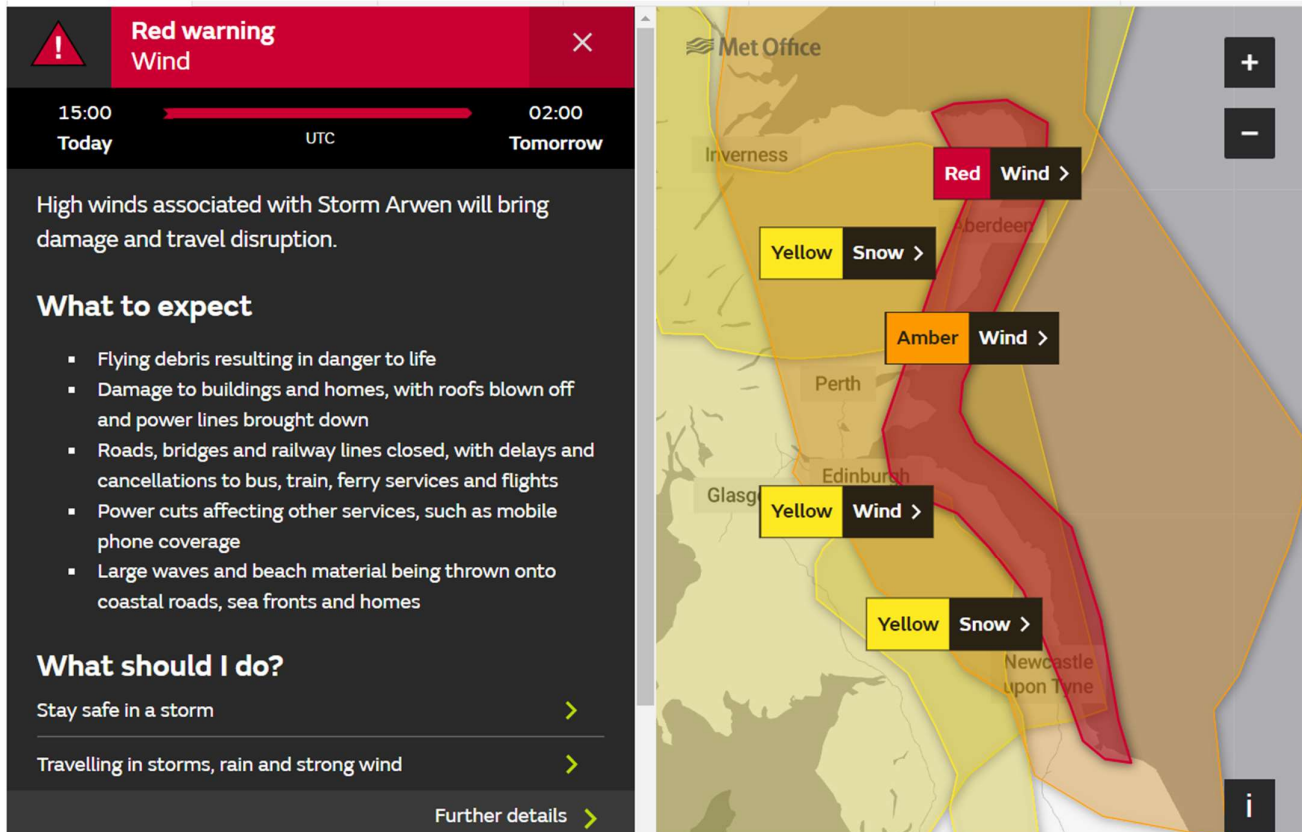
The strong winds also brought various reports of structural damage to buildings. There was severe disruption on roads with fallen trees blocking roads, overturned vehicles due to high winds and snow accumulations across the Pennines. Ferry services between Scotland and Northern Ireland were cancelled. Lying snow caused significant disruption across parts of the Pennines, with 15cm of lying snow in Buxton, Derbyshire. Schools were closed for two days across Aberdeenshire in the aftermath of the storm. The National Trust reported the loss of many mature trees, including 50 trees at Bodnant Gardens, Conwy. The storm brought large waves and dangerous conditions around the UK, particularly along the north east coastline. Sadly, hundreds of grey seal pups were lost from beaches along the North Sea coast.

### **Weather data**

The analysis chart at 1800 UTC 26 November 2021 shows storm Arwen in the North Sea bringing some exceptionally strong winds to parts of north-east England and eastern Scotland and a strong northerly airstream of Arctic Maritime air across the UK.



The image below shows the Met Office red warning issued for storm Arwen covering the east coast of eastern Scotland and north-east England. The last named storm with a red warning was storm Dennis in February 2020 (red rain warning). The last time a red warning was issued for wind only was storm Gertrude in January 2016.



The image below shows the Met Office shipping forecast issued at 2200 UTC 25 November 2021 for Cromarty. The Seagreen buoy located in the North Sea east of the Scottish mainland was reported to have recorded wave heights of 10 to 11 metres during storm Arwen, with a maximum wave height of over 13 metres.

GALE WARNING

Issued: 22:01 (UTC) on Thu 25 Nov 2021

Gale force 8 veering northwesterly imminent, then veering northeasterly and increasing violent storm force 11 later

WIND

Northwest 6 to gale 8, veering north severe gale 9 to violent storm 11, perhaps hurricane force 12 for a time later.

SEA STATE

Rough or very rough, becoming high or very high.

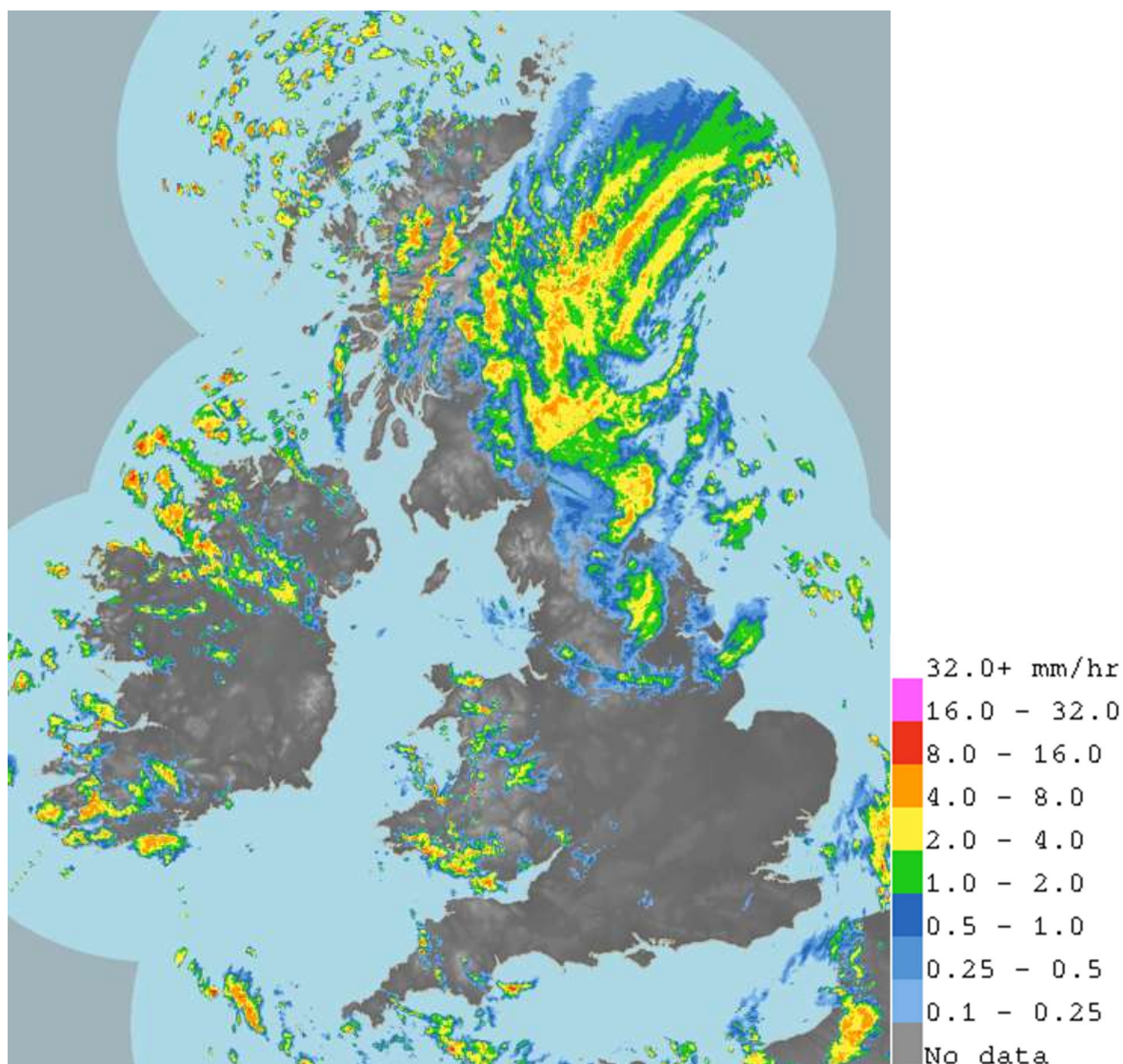
WEATHER

Rain or squally showers.

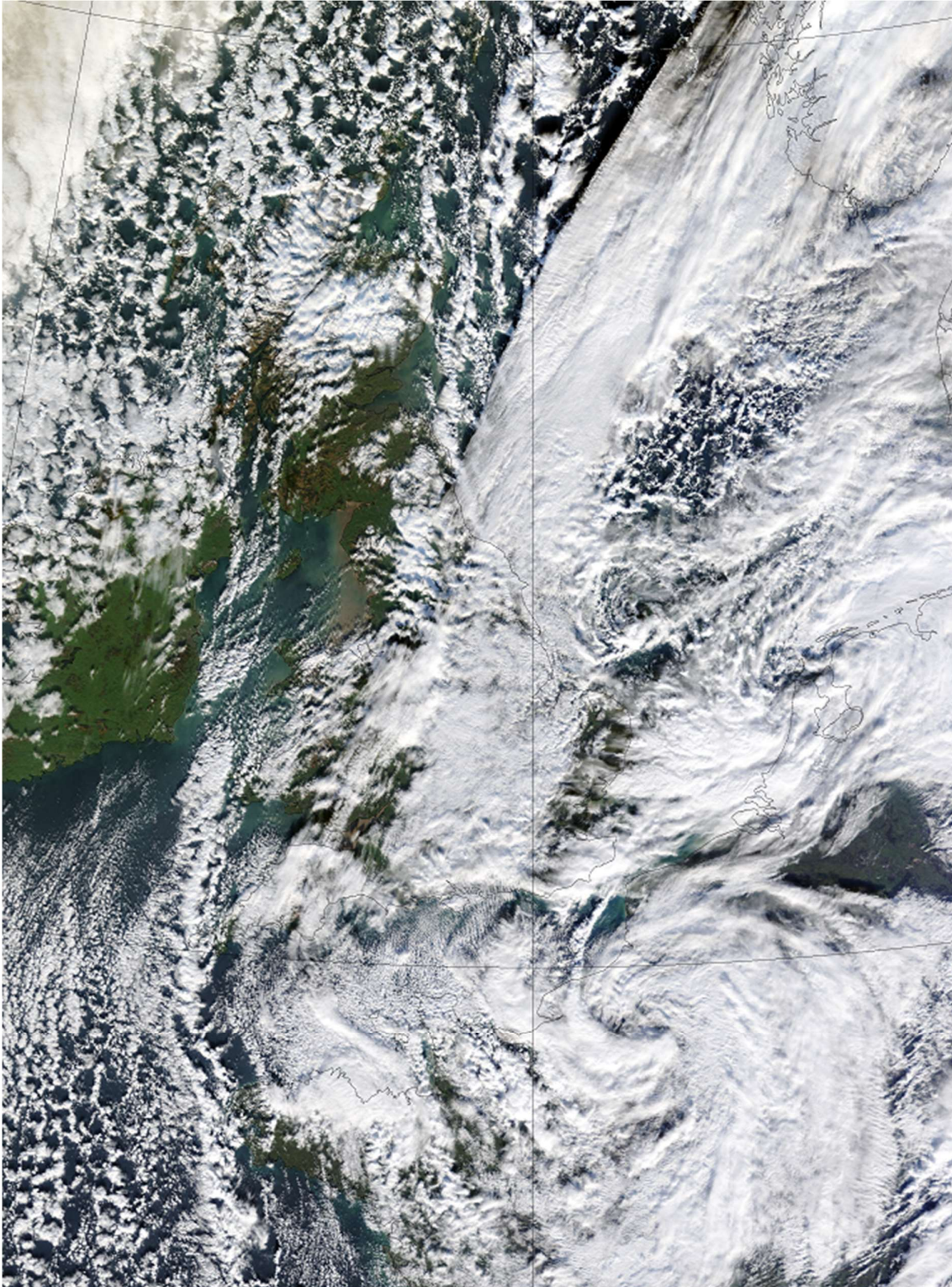
VISIBILITY

Moderate or poor.

The rain-radar image below at 1800 UTC 26 November 2021 shows rain associated with storm Arwen across north-east England and eastern Scotland, much of this falling as snow to give atrocious weather conditions in exposed locations.

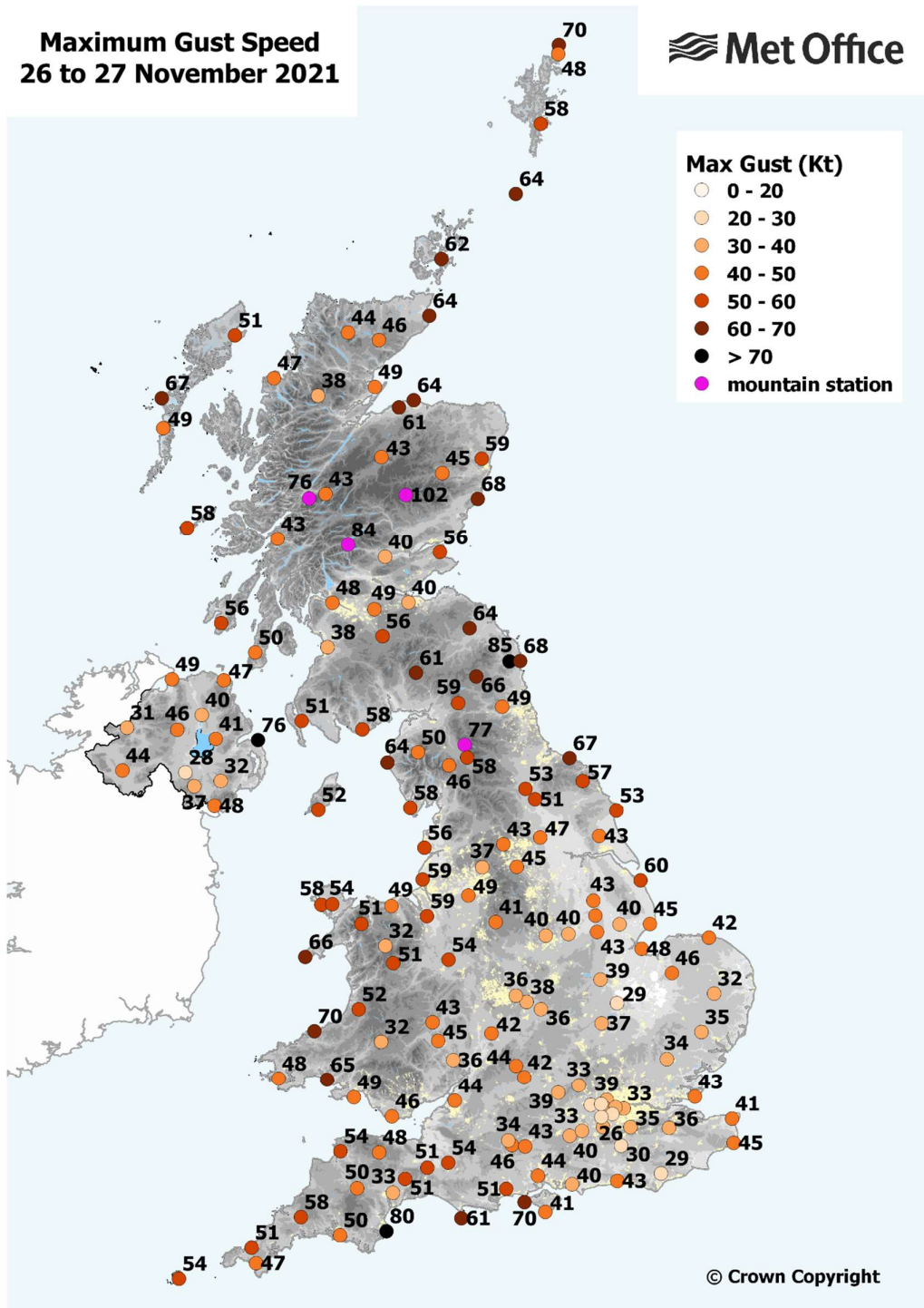


The satellite image at 1105UTC on 27 November 2021 shows the centre of storm Arwen over the Netherlands – having tracked south down the North Sea coast overnight, with the UK in a bitterly cold northerly airstream. Lying snow is visible across parts of the Pennines and Southern Uplands. Image copyright Met Office / NOAA / NASA.

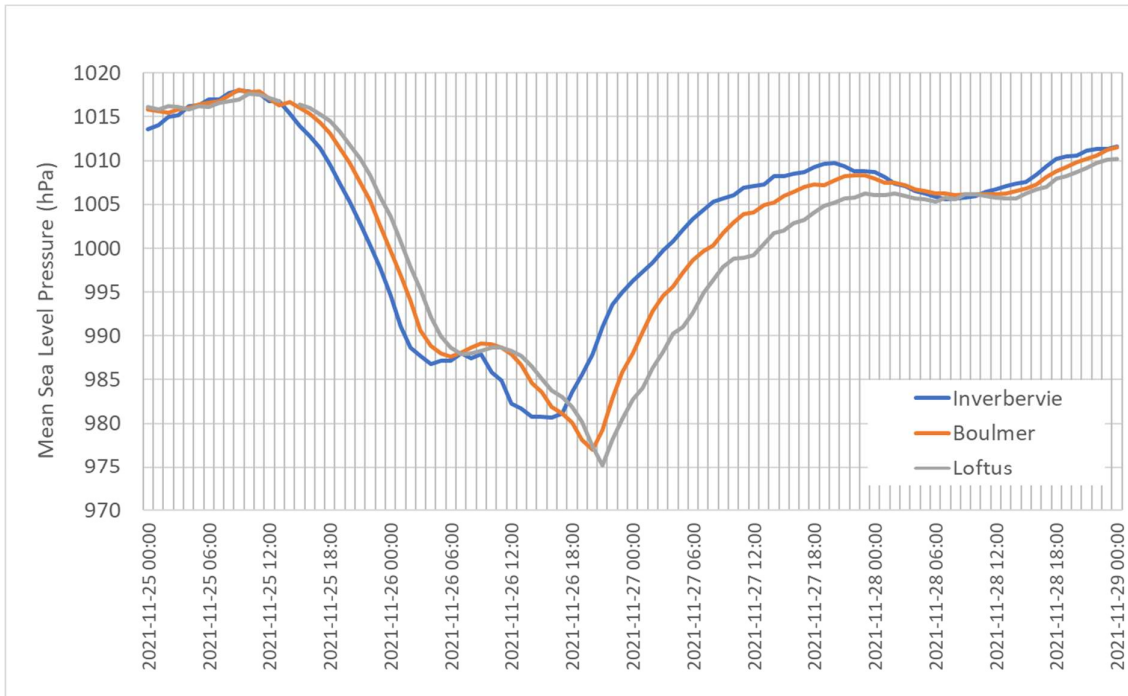


The map below shows maximum gust speeds from storm Arwen. Wind gusts reached 50 to 60Kt (58 to 69mph) widely, exceeding 60Kt in many exposed coastal locations. The highest gusts were 85Kt (98mph) at Brizlee Wood (Northumberland), 80Kt (92mph) at Berry Head (Devon), 76Kt (87mph) at Orlock Head (County Down) and 70Kt (81mph) at Saxa Vord (Shetland), Aberporth (Dyfed) and Needles Old Battery (Isle of Wight). Almost 40% of the UK wind network recorded gusts of over 50Kt and 24 stations over 60Kt. Across the Grampians, winds gusted at over 100mph with a gust of 102Kt (117mph) recorded at Cairnwell (Aberdeenshire) – at 928masl. The wind direction was generally northerly. This was relatively unusual; the normal prevailing wind direction for the UK, including for the majority of major Atlantic storms, being westerly.

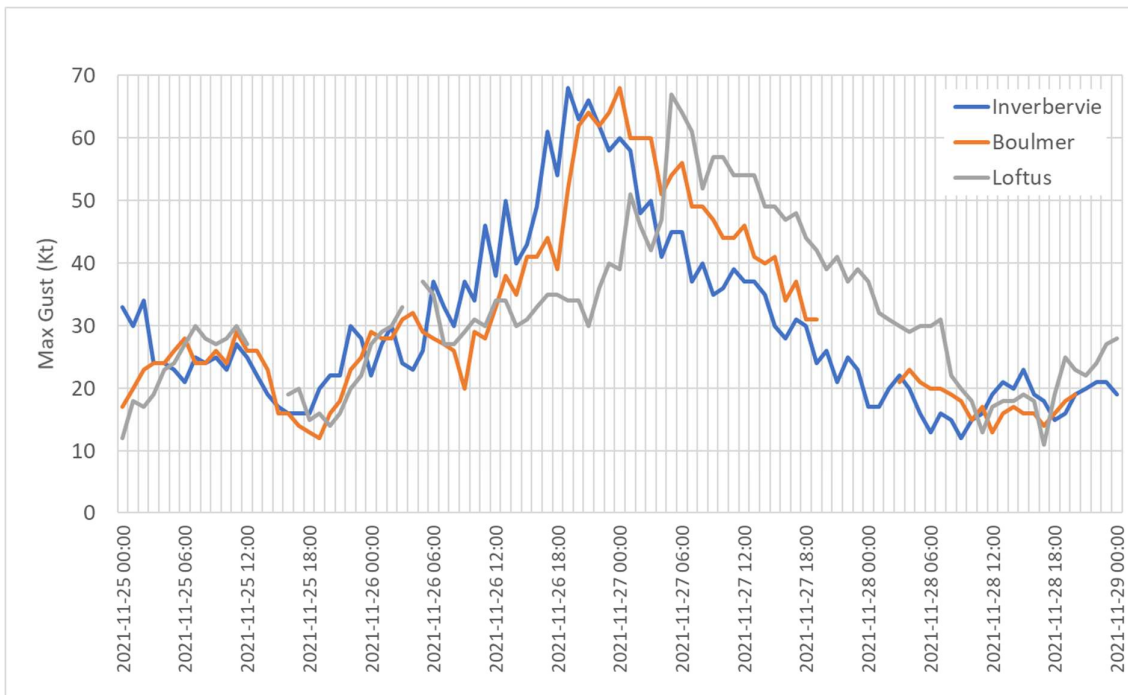
**Maximum Gust Speed  
26 to 27 November 2021**



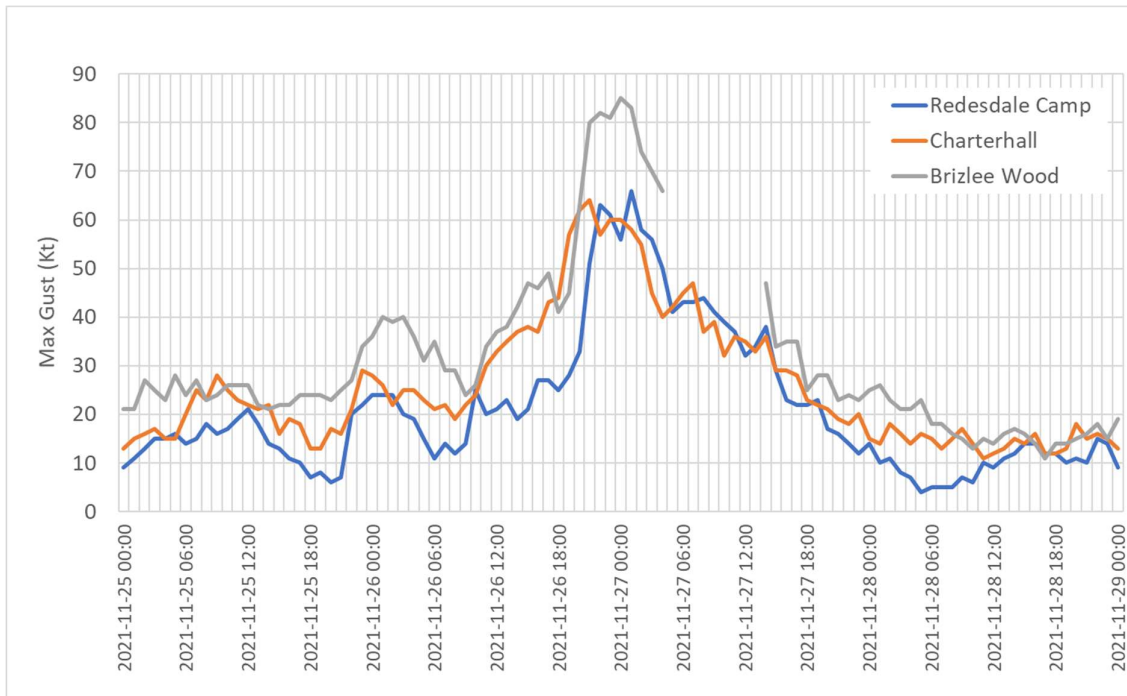
The chart below shows hourly mean sea level pressure at Inverbervie (Kincardineshire), Boulmer (Northumberland) and Loftus (North Yorkshire) – all located in the red warning area. The chart shows the rapid fall and rise in pressure associated with the passage of storm Arwen; with the steep rise in pressure after 1800UTC on 26th coinciding with peak wind speeds.



The chart below shows hourly maximum gust speeds at these same three stations, with peak gusts of 68Kt (78mph) recorded at Inverbervie and Boulmer, and 67Kt (77mph) at Loftus. At each station, winds gusted at over 50Kt (58mph) for around 8 hours from the evening of the 26th to the morning of the 27th during the passage of storm Arwen.

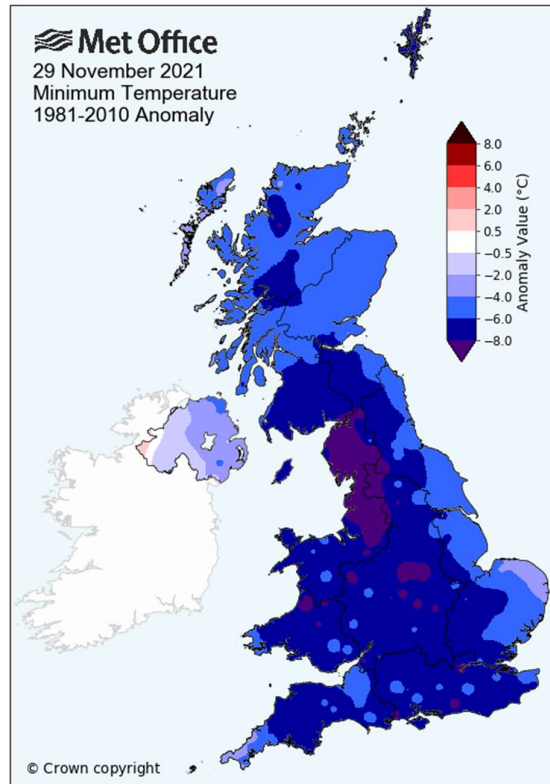
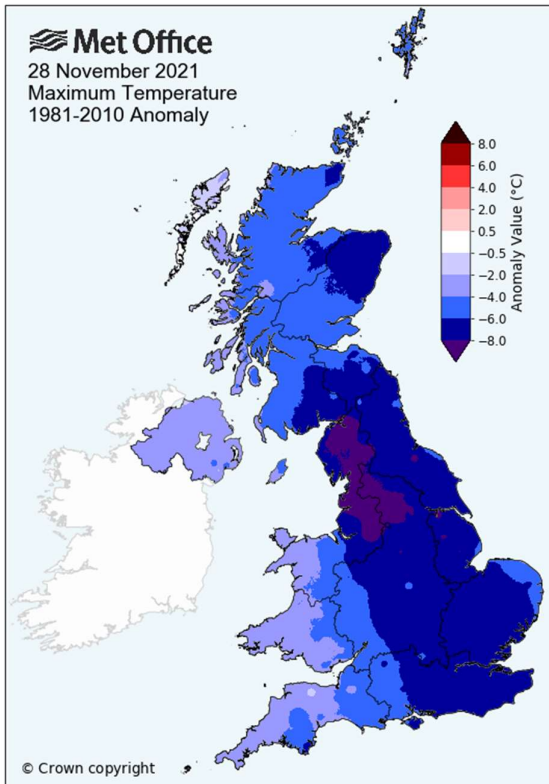


The chart below shows hourly gust speeds at Redesdale Camp (Northumberland), Charterhall (Borders) and Brizlee Wood (Northumberland). Peak wind speeds reached 64Kt (74mph) at Charterhall and 66Kt (76mph) at Redesdale Camp, while gust speeds at Brizlee Wood exceeded 80Kt (92mph) for several hours, with a peak gust of 85Kt (98mph). (Note a data outage at Brizlee wood during 27 November). A wind gust as high as this is exceptional for this part of the UK; the wind gust record for north-east England being 93Kt (107mph) at Lynemouth (Northumberland) on 17 December 1979. Brizlee Wood is located on a hill 5km to the west of Alnwick and it is likely the interaction of the northerly airflow with the local topography will have influenced the very high wind gusts observed at this station.



The northerly airstream associated with storm Arwen also brought some very low temperatures for the time of year. The maps below show daily maximum temperatures on 28 November and daily minimum temperatures on 29 November (these both referring to the 24-hour period 0900 UTC 28th to 0900 UTC 29th). Daily maximum and minimum temperatures were both notably low – at least 8°C below the November 1981-2020 long-term average across north-west England - with daily maximum of -0.3°C at Shap (Cumbria) and a daily minimum of -8.7°C. The low temperatures combined with the strong northerly airflow led to significant windchill.

Storm Arwen also resulted in some significant snow accumulations, particularly to parts of the Pennines. At 0900 UTC on 27 November, recorded snow depths included 18cm at Middleton (Derbyshire), 15cm at Buxton (Derbyshire) and 12cm at Copley (County Durham). Lying snow was recorded locally as far south as Linkenholt (Hampshire), and snow falling (although not lying) at Fontmell Magna (Dorset), Herstmonceux and Hastings (East Sussex).



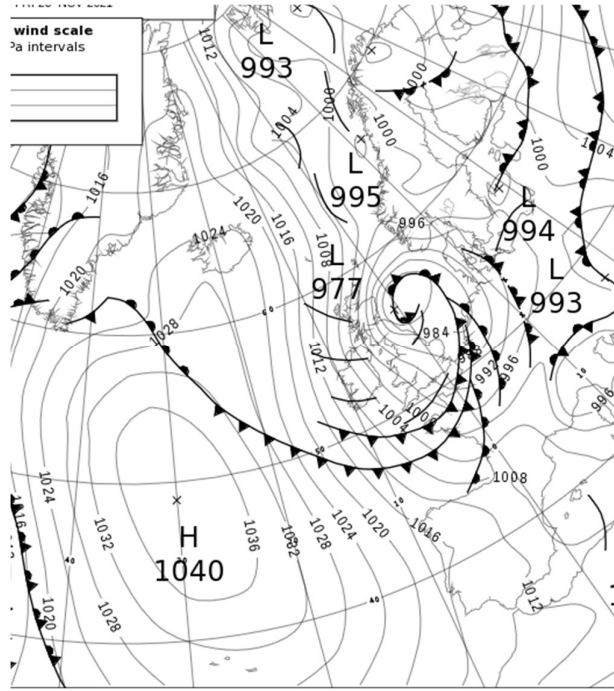
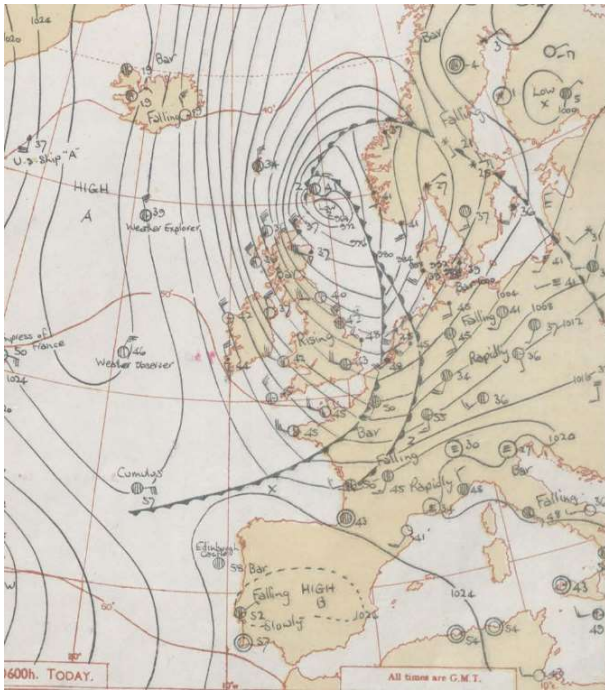
## Historical context

This was undoubtedly one of the most damaging wind storms of the latest decade. In terms of the number of stations exceeding 60Kt, the UK has experienced recent similar wind storms, for example on 9 February 2020 over 30 stations recorded gusts exceeding 60Kt from storm Ciara. However, the wind gust of 85Kt at Brizlee Wood was exceptional for the north-east of England. This was the highest gust recorded in north-east England since 89Kt (102) at Lynemouth (Northumberland) on 16 January 1984. Donna Nook (Lincolnshire) recorded 80Kt (92) on 30 October 2000, and 74Kt (85mph) was recorded at Loftus (North Yorkshire) on 12 February 2014 – during a sequence of severe winter storms. 68Kt at Boulmer on 26 November 2021 was the highest gust recorded at this station since 71Kt (82mph) on 28 January 2002.

Historically, one of the most devastating storms of this type occurred on 31 January 1953. This event resulted in the greatest storm surge on record in the North Sea, with about 160,000 hectares of eastern England flooded and over 300 people died. Winds were reported to have brought down more trees in Scotland than were normally felled in a year. On 31 January 1953, recorded gusts included 88Kt (101mph) at Aberdeen, Dyce and 74Kt (85mph) at South Shields (County Durham).

The charts below from 0600 UTC 31 January 1953 and 1800 UTC 26 November 2021 show a striking similarity. However, fortunately storm Arwen coincided with a period of neap tides (rather than spring tides).





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