

Flooding in Cumbria December 2015

Heavy rainfall from Friday 4 to Sunday 6 December led to widespread flooding in Cumbria and across other parts of northern Britain.

The flooding resulted from some exceptionally high rainfall totals across the Cumbrian fells, exceeding 300mm and breaking existing UK rainfall records. These floods followed recent severe flooding affecting Cumbria in November 2009 and major floods in Carlisle in January 2005. 341.4mm of rain fell at Honister Pass, Cumbria, in 24-hours to 1800 GMT on 5 December 2015, a new UK rainfall record, while at Thirlmere 405.0mm also set a new record for two consecutive rain-days (0900 - 0900 GMT).

Impacts

The severe flooding which resulted was exacerbated by the already very wet ground conditions, partly as a result of [Storm Desmond](#). Many parts of north-west Britain had already recorded more than twice the monthly average rainfall during November. Across north-west England and North Wales, [November 2015](#) was the second wettest November in a series from 1910; only November 2009 was wetter.

Several thousand homes and businesses were inundated with floodwater across Cumbria, with parts of Lancashire, Northumberland and southern Scotland also affected. Carlisle was worst hit by severe flooding from the River Eden, but many other towns and villages in the area were also affected by flooding, and tens of thousands of homes across Cumbria and Lancashire were without power for several days. A number of bridges were swept away by floodwater, including Pooley Bridge, Ullswater, built in 1764.

There were two fatalities and many road and rail links were cut, including the West Coast Main Line. Schools and hospitals were closed in the flood affected areas. In the Yorkshire Dales, Malham Cove waterfall briefly flowed again for the first time in living memory. Storm Desmond also caused considerable flooding problems elsewhere across parts of County Tyrone, County Fermanagh, and the Republic of Ireland.

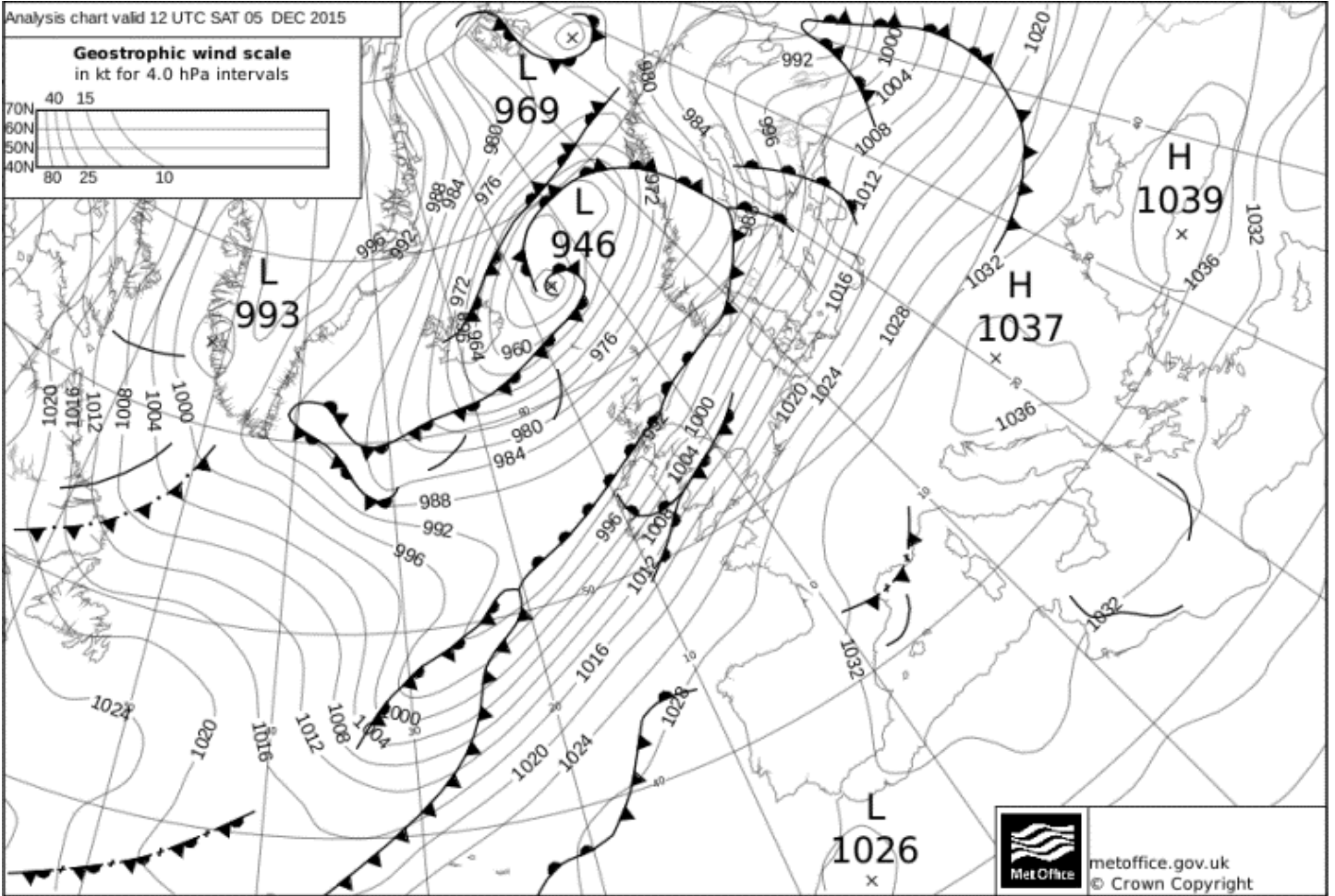
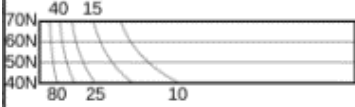
Storm Desmond also caused disruption from some very strong winds, gusting at 50 to 60 Kt in exposed coastal locations, but by far the greatest impact was from the flooding.

Weather data

The analysis chart for 1200 GMT on 5 December shows a deep Atlantic low pressure system to the east of Iceland, with associated fronts stretching across northern Britain. The UK was located in a mild, moist south-westerly airstream with these fronts bringing exceptionally prolonged and heavy rainfall as the air was forced to rise across high ground. This mechanism, known as a 'warm conveyor', brought extreme orographic enhancement to the rainfall, with the chart remarkably similar to the [Heavy rainfall/flooding in the Lake District, Cumbria - November 2009](#) and [Floods in Carlisle - January 2005](#) Cumbria flood events.

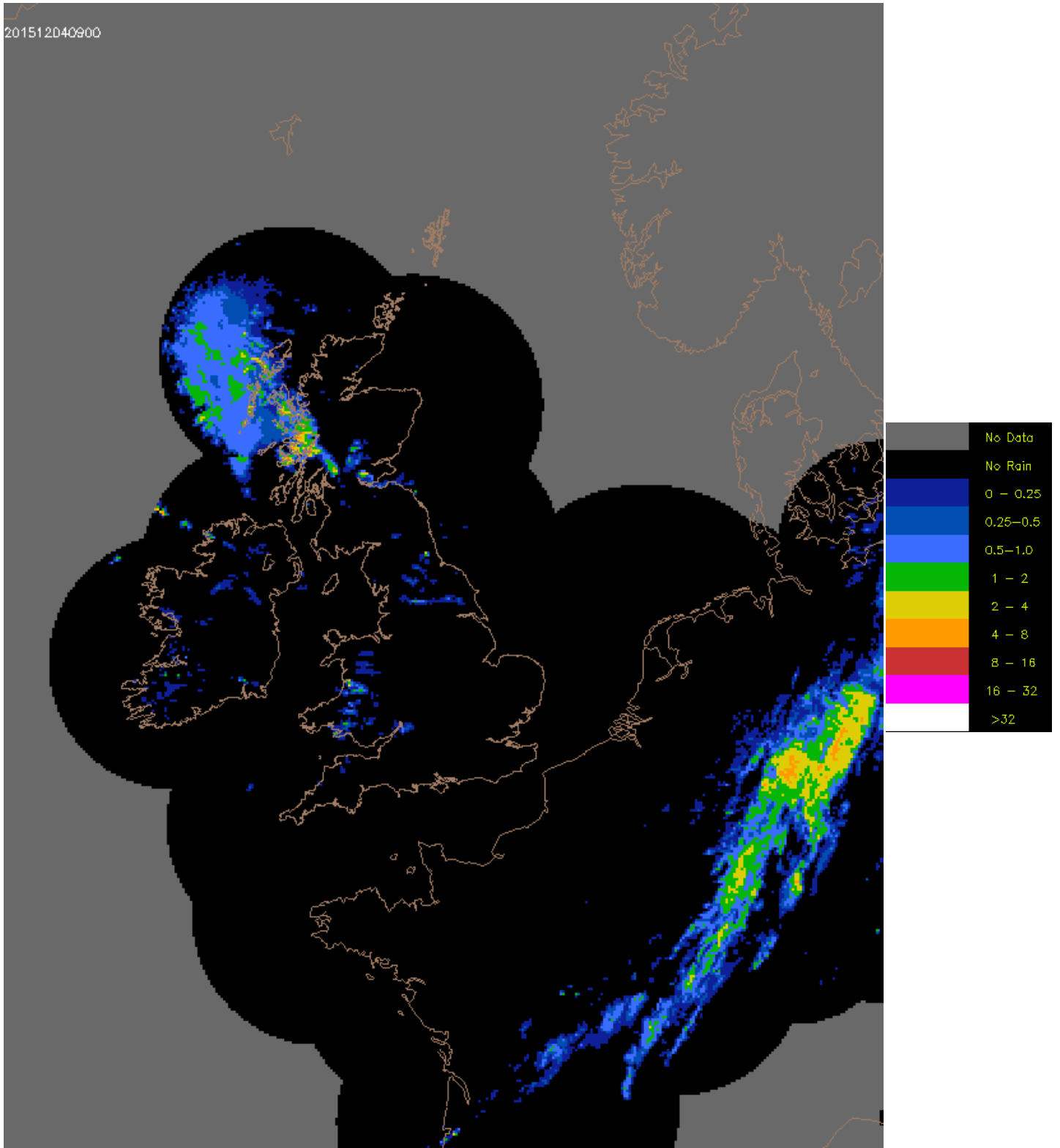
Analysis chart valid 12 UTC SAT 05 DEC 2015

Geostrophic wind scale
in kt for 4.0 hPa intervals

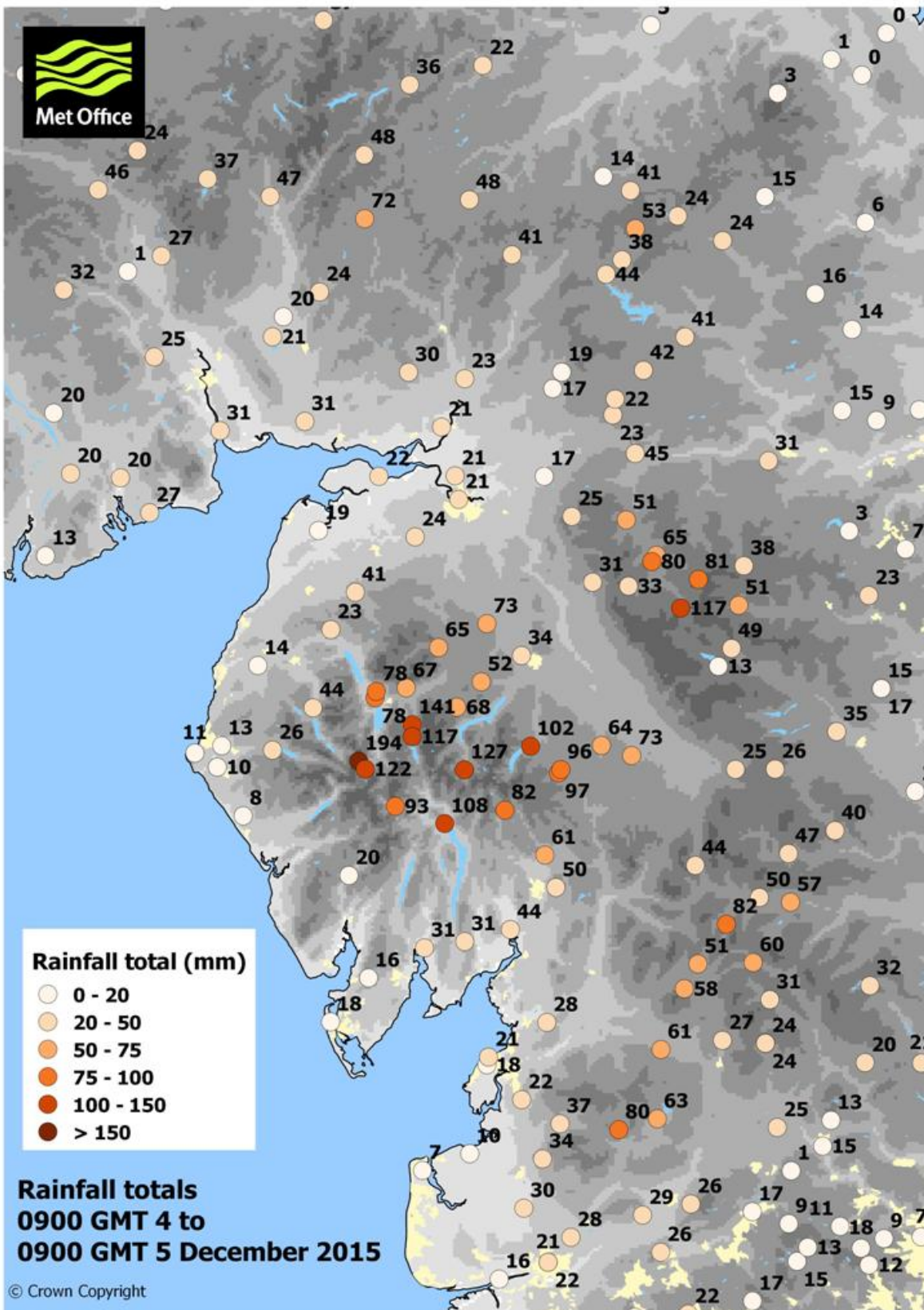


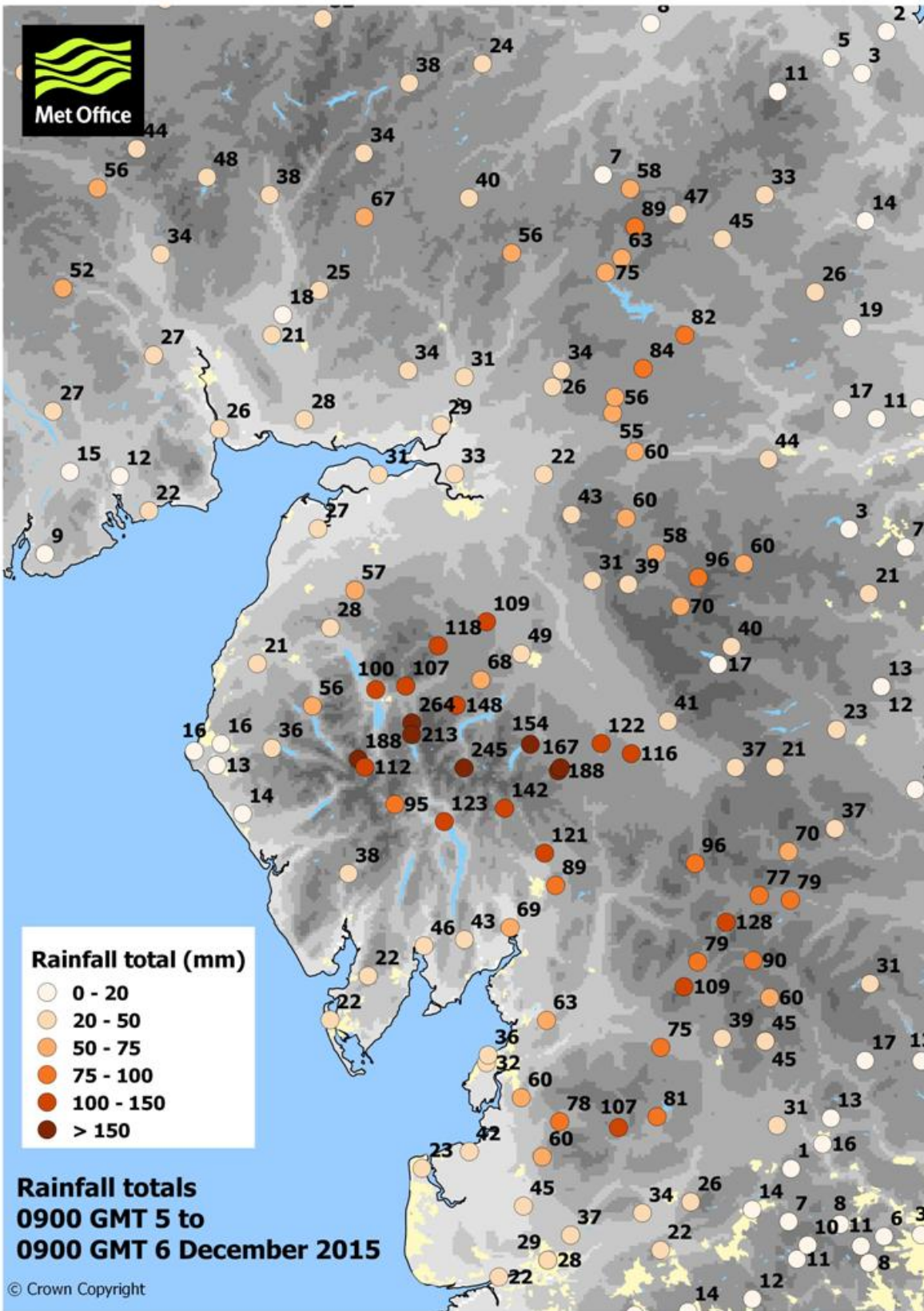
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The rain-radar imagery below from 0900 GMT 4 December to 1200 GMT 6 December shows the fronts associated with storm Desmond bringing heavy rain to western Scotland, north-west England and much of Ireland, with the heaviest rain across the hills and mountains; the most prolonged rainfall occurred across the Lake District.



The figures below show rainfall totals for the 'rain-days' of 4 December 2015 and 5 December 2015 (0900 - 0900 GMT).





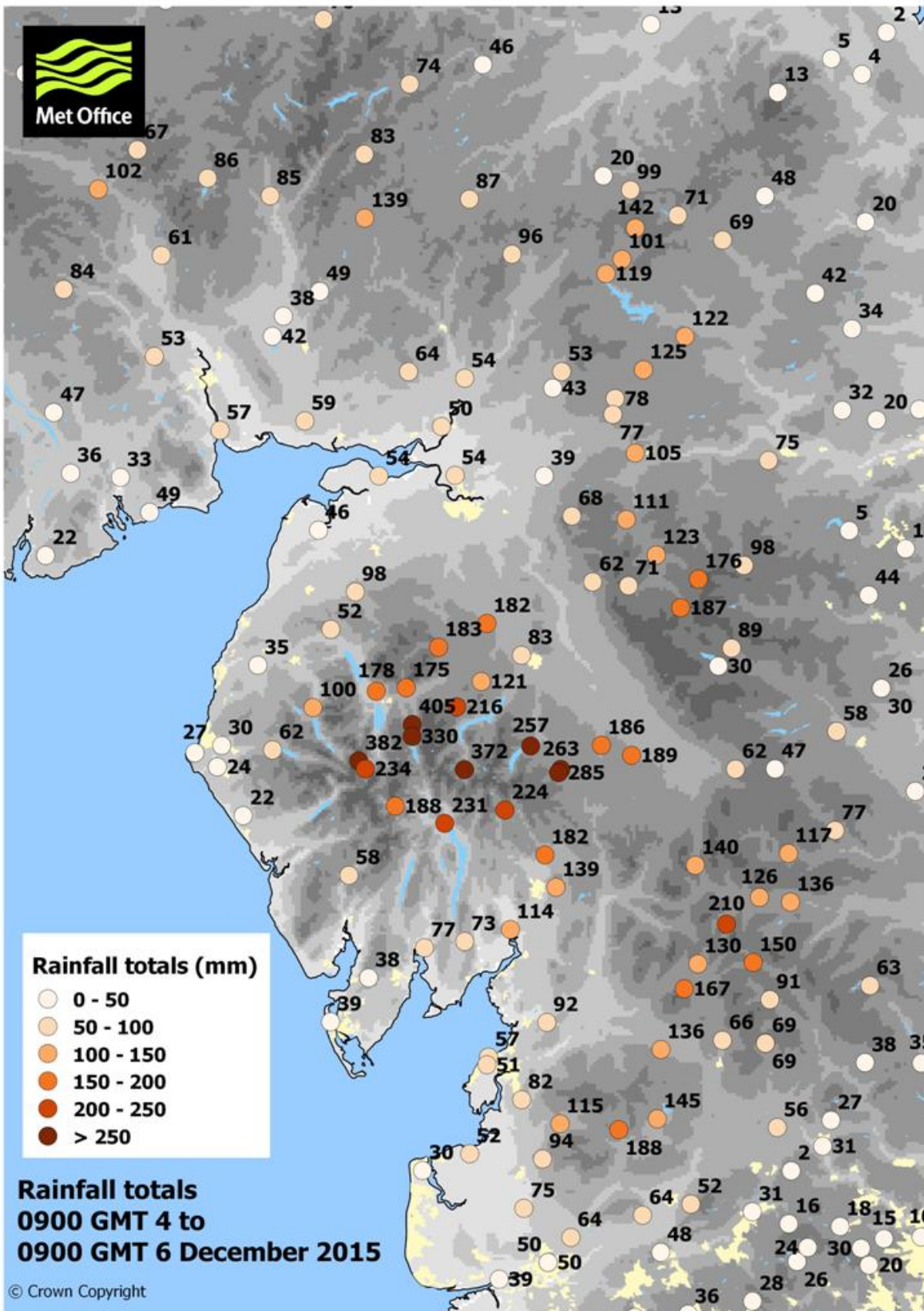
Rainfall total (mm)

- 0 - 20
- 20 - 50
- 50 - 75
- 75 - 100
- 100 - 150
- > 150

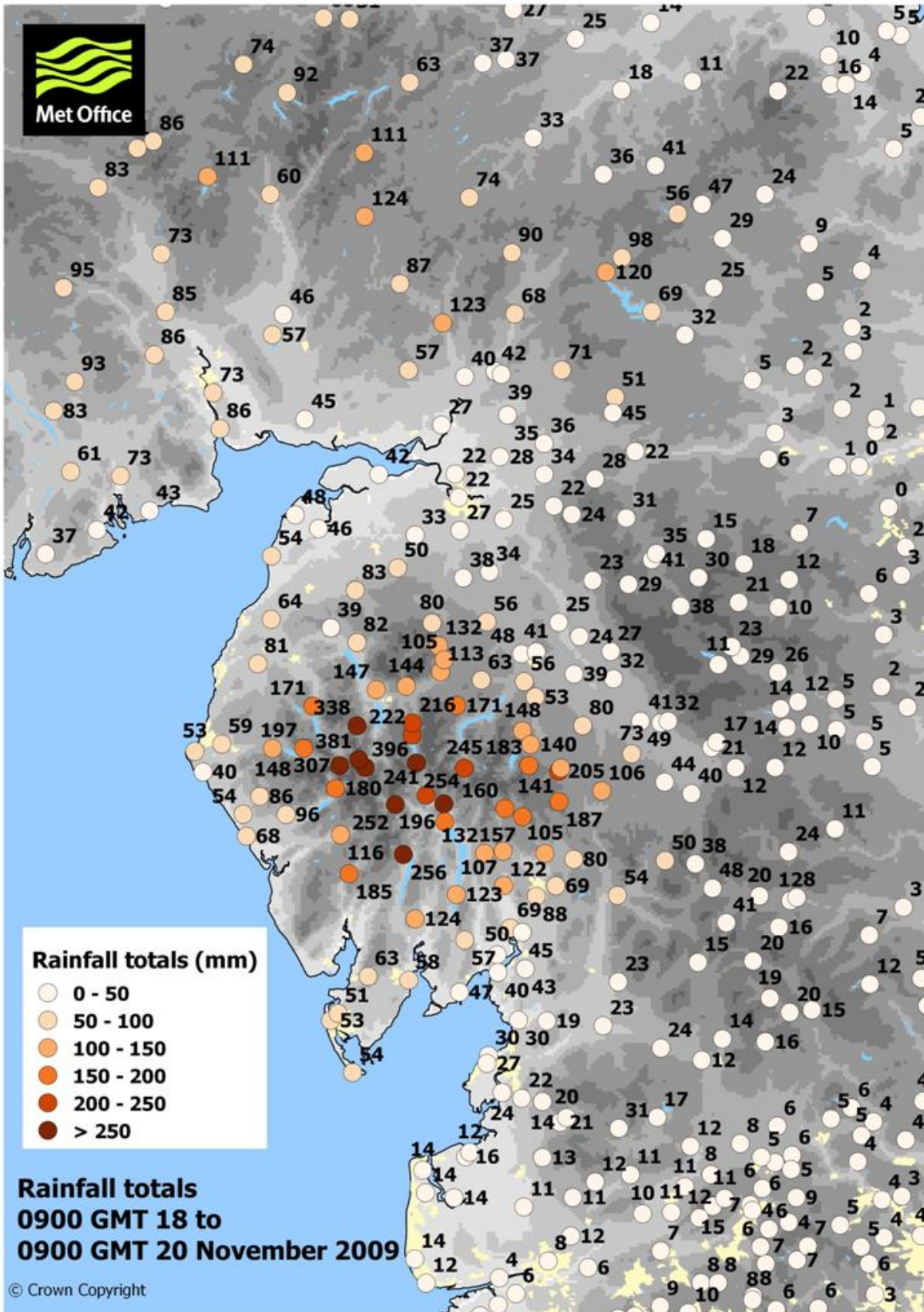
**Rainfall totals
0900 GMT 5 to
0900 GMT 6 December 2015**

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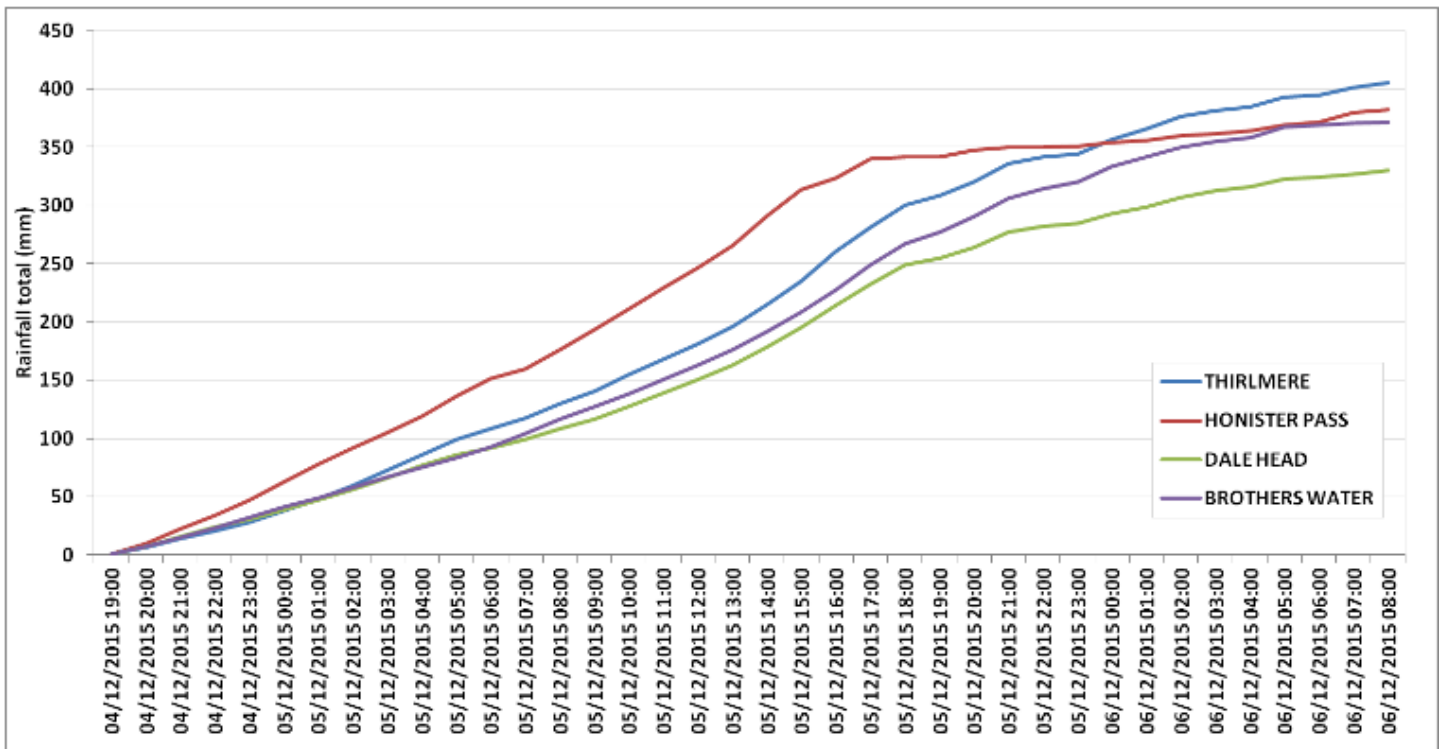
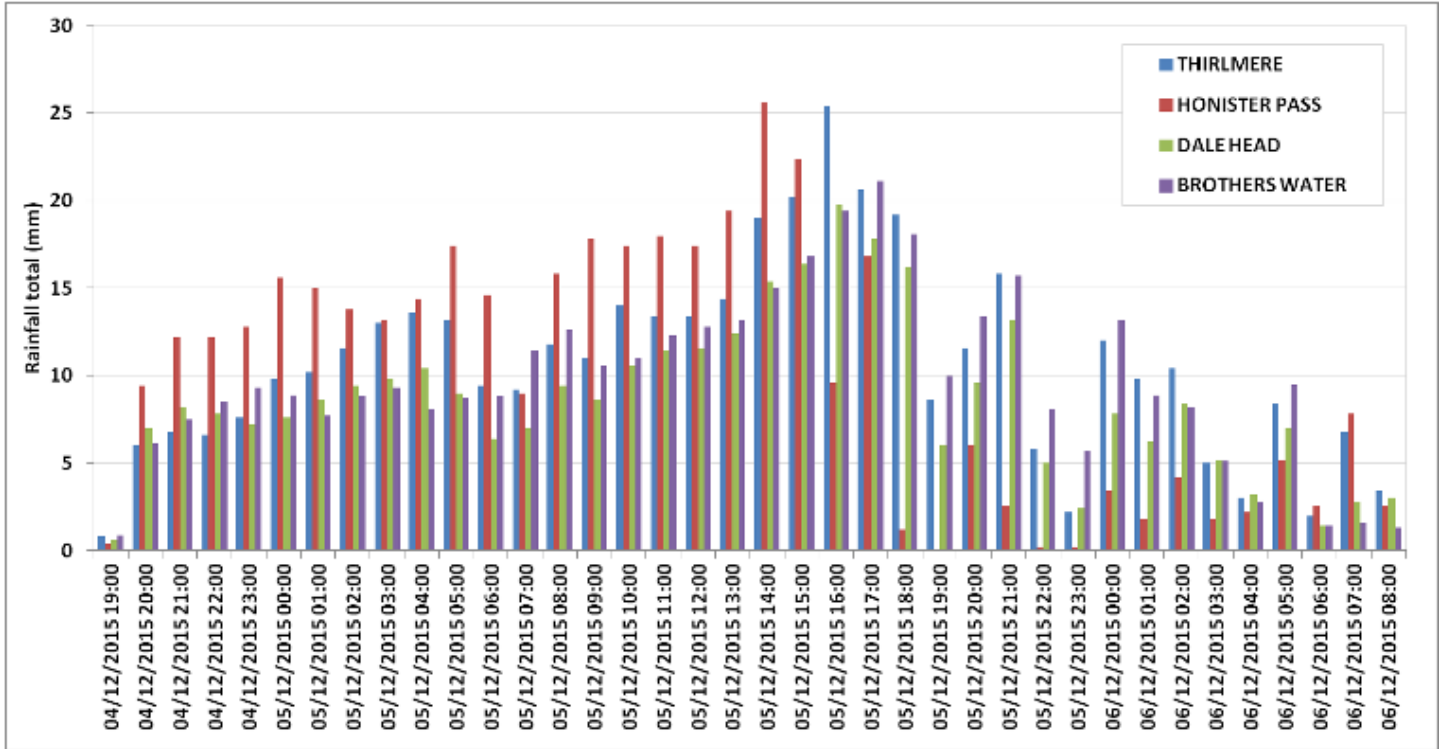
The figure below shows 48-hour totals for 4 to 5 December 2015 combined. In total low-lying coastal areas received only around 50mm or less, however much of the high ground received 100 to 150mm, with some locations exceeding 150mm. The wettest areas were across the central Cumbrian fells, which received 200 to 300mm of rainfall and in a few locations 300 to 400mm. Upland parts of the Forest of Bowland (Lancashire), the western Yorkshire Dales, North Pennines and southern Scotland also received totals of 100 to 200mm.



As a comparison, the figure below shows 48-hour totals for 18 to 19 November 2009. In 2009 much less rain fell across the Pennines but otherwise rainfall totals were remarkably similar. A key feature common to both events was the orographic enhancement of the rainfall across high ground, with approximately 10 times as much rain (or more) falling in the Lake District fells compared to coastal locations. This compares against a factor of approximately 3 times for annual average rainfall (3000mm compared to 1000mm).



The figure below shows hourly rainfall totals for this event, and rolling accumulations, recorded by four of the highest-recording rain-gauges located in the Lake District fells. The hourly rainfall rate for Honister Pass (located in the western Lakes) was typically around 15mm per hour, sustained for around 22 hours, compared to around 10mm per hour for the other rain-gauges (located in the central Lakes). The heaviest of the rain eased away slightly from west Cumbria at around 1800 GMT on 5 December, but continued at the other locations slightly further east. The rainfall from this event was remarkable for its duration, rather than intensity, and was notably similar in character to Seathwaite in November 2009.



The table below lists rainfall accumulations for a standard 'rain-day' when observations are made from 0900 GMT to 0900 GMT, as well as the highest 24-hour total for *any* period, and 2-day and 3-day accumulations. Two new records were set:

- 341.4mm of rain fell at Honister Pass, Cumbria, in 24-hours to 1800 GMT on 5 December 2015, a new rainfall record for *any* 24-hour period, exceeding 314.6mm at Seathwaite, Cumbria in 24-hours to 0000 GMT on 20 November 2009.*
- 405.0mm at Thirlmere set a new rainfall record for two consecutive rain-days, exceeding the previous record of 395.6mm at Seathwaite, Cumbria on 18 to 19 November 2009.

*The highest 24-hour total at Thirlmere of 322.6mm also exceeded the previous record.

Three Environment Agency rain-gauges recorded rainfall totals exceeding 200mm for the standard 'rain-day' of 5 December 2015 (0900 GMT 5th to 0900 GMT 6th). The highest total was 264.4mm at Thirlmere. This narrowly failed to exceed the UK record of 279mm at Martinstown, Dorset on 18 July 1955, but it did exceed 253.0mm at Seathwaite on 19 November 2009. The 3-day total of 450.2mm at Thirlmere also narrowly failed to exceed the UK record of 456.4mm at Seathwaite from 17 to 19 November 2009.**

Date	Honister Pass	Thirlmere	Dale Head	Hall Brothers	Water
03/12/2015	45.8	45.2	47.0	47.5	
04/12/2015	193.6	140.6	117.0	127.2	
05/12/2015	188.4	264.4	212.8	244.6	
Highest 24-hour	341.4	322.6	261.6	293.0	
2-day	382.0	405.0	329.8	371.8	
3-day	427.8	450.2	376.8	419.3	

** Standard rain-day records are important because when we compare against historical data the majority of observations are from rain-gauges read daily at 0900 GMT - with only a 24-hour total available for this period. A comparison for different durations can only be made by rain-gauges which record at a sub-daily time-scale - i.e tipping-bucket rain-gauges, for which we have much less historical data. (The Met Office midas database holds at least 200,000 station-years of daily rainfall data, but the majority of these digitized data are from 1961).