Wettest on record: The Cumbrian deluge of 18-20 November 2009

by Philip Eden

I have, in the last ten years, made a career of criticising politicians and journalists for using the word 'unprecedented' to describe weather events which may be unusual but which are far from unprecedented. For those tasked with maintaining the national infrastructure, in this case flood defences, it is the soft option because it allows them – by invoking the unforeseeable – to divert responsibility for their failure.

After the summer floods of 2007 I found myself waiting to be interviewed on 'Newsnight' alongside Phil Woolas, then a junior environment minister. He was practising answers to likely questions, and that word 'unprecedented' kept appearing, over and over. So I wagged my finger at him and said "If you use that word once in your interview I will describe dozens of precedents when I go in for mine, and that will make you look at best poorly briefed, at worst plain foolish." What happened? Well, his first answer in the studio began: "I'm not saying these floods are unprecedented, but …."

This time, though, it's different. The rains which hit the Cumbrian mountains last week were most certainly without precedent in the instrumental record, and that goes back to 1844 in this particular part of the UK. The prolonged downpour was caused by a longlasting flow of warm and very moist air which had originated over sub-tropical waters of the Atlantic. Such airflows occur frequently in the UK, especially in autumn and winter, and are known in the forecasting trade as 'warm conveyors'.

Each one is slightly different, and a rare coincidence of favourable factors is required to produce the exceptional quantities of rain which we saw between Wednesday evening and the early hours of Friday over the Lake District. On this occasion those factors included:

1) a source region for this 'warm conveyor' far south of the Azores between latitudes 28 and 32 degN, where the ocean is normally very warm. The air in contact with it would also be warm and humid; indeed, the warmer a mass of air is, the greater quantity of moisture it can hold. I can only recall one or two previous examples of an airflow originating so near the tropics in three decades of forecasting.

2) sea temperatures in this source region some 2 to 3degC above the November average, enhancing the potential absorption of moisture by the airstream. This is the only aspect of the downpour which climate change may have contributed to, but it should also be said that large parts of the north Atlantic, especially in middle latitudes, have been colder than normal this month.

3) unusually strong winds in the warm conveyor, bringing the warm and moist air more rapidly to the UK with consequently less modification from the cooler waters around Britain; these winds also constantly refreshed the supply of moist air so that the system was not able to "rain itself out". In effect, the stronger the flow is, the more efficient is the rain-making process.

4) the fact that the warm conveyor got stuck over Cumbria for a period of 34 hours, which, although not in itself unusual, maintained the steady downpour over a long enough period to build up such exceptional quantities of water. Snowdonia, Galloway, and Dumfriesshire were also badly hit, but in these regions the rain did not last quite as long.

The geography of Cumbria itself enhances the amount of rain that falls within its confines, as warm, moist air has to rise over the mountains, cools as it rises, and is forced to drop much of its moisture as it cools.

So, the Lake District is a naturally very wet part of the country, and the hamlet of Seathwaite in Borrowdale is, on average, the wettest inhabited place in England with a mean annual rainfall for the standard reference period 1971-2000 of 3400mm (134in). Traditionally, rainfall has been measured once per day at 9am, although these days most

rain-gauges are automated and are able to log rainfall every hour. During last week, 39mm (1.52in) fell on Monday – that is, during the 24 hours beginning at 9am on Monday, 61mm (2.39in) on Tuesday, 143mm (5.61in) on Wednesday, and 247mm (9.71in) on Thursday.

The prolonged steady downpour which triggered the flooding began at 8pm on Wednesday and ended at 6am on Friday, depositing a total of 378mm (14.87in) in 34 hours. During that deluge, the peak 24-hour rainfall was 316mm (12.46in).

At this point in the analysis I would normally caution about comparing totals for *any* 24-hour period with totals for the traditional 9am-9am rainfall day. It is much easier to break existing records if you can select your starting time, and it is only in the last 20 years that we have had an adequate network of automatic gauges capable of recording hourly rainfall. Thus the 9am-9am figure for Thursday/Friday was not a new national record for a rainfall day; that record is still held by Martinstown, Dorset, when 279mm (11in) of rain fell in a storm of true tropical intensity which lasted just ten hours, on July 18, 1955.

However, on this occasion, the maximum 24-hour rainfall of 316mm was actually higher than any previously recorded total for two consecutive rainfall days of 315mm (12.41in). So we can reasonably say that this was the heaviest 24-hour fall in the UK's instrumental record.

Our published records of extreme rainfall over periods greater than one rainfall day are incomplete. But scavenging for what material is available it appears that Seathwaite has also established new records for all of these longer periods:

2 consec rainfall days: 395.6mm (previous known record 315mm) 18-19th
3 consec rainfall days: 456.4mm (previous known record 394mm) 17-19th
4 consec rainfall days: 495.0mm (previous known record 422mm) 16-19th
5 consec rainfall days: 505.0mm (previous known record 455mm) 15-19th
6 consec rainfall days: 563.2mm (previous known record 486mm) 17-22th
7 consec rainfall days: 601.8mm (previous known record 505mm) 16-22th
8 consec rainfall days: 644.8mm 17-24th
9 consec rainfall days: 683.4mm 16-24th
10 consec rainfall days: 696.2mm 16-25th
14 consec rainfall days: 792.0mm 12-25th
15 consec rainfall days: 800.4mm 11-25th

There is always the caveat that gauges at high-level unoccupied sites, notably on The Stye, and at Styhead Tarn and Sprinkling Tarn, will have been 30 to 40 per cent wetter, but these instruments are read only once per month. However, the previously held 2-day to 6-day records were also logged at Seathwaite (in December 1864), and, I believe, represent the highest rainfall for the respective periods at any inhabited location in the UK.

Major rainfall events in the UK - those that trigger serious flooding - fall into several different categories, defined by intensity, longevity, and geographical extent. Short period downpours, say lasting 12 hours or less, will produce truly destructive floods in small river catchments and serious surface flooding in urban areas. Examples include Boscastle (2004 and 1957), Lynmouth (1952), Louth (1920) and Ilkley (1900). 'Warm conveyor' rains which may last for anything between 24 and 72 hours were responsible for the Carlisle flood in 2005 and also for the Conwy valley flood the previous year; other examples include the Glasgow region (1994), Inverness (1989), the Welsh Valleys (1929) and Cumbria again (1864). Repeated bouts of heavy rain, sometimes spread over weeks or even months, occasionally contributed to by melting snow, produce extensive long-lasting floods along our great rivers - the Thames, the Severn, the Trent, the Yorkshire Ouse - as in summer 2007, autumn 2000, summer 1968, spring 1947, autumn 1894 and autumn 1852. Practically every decade has a once-in-200-year flood somewhere in the UK.