

THE AUTUMN 2000 RAINS AND FLOODS

- *Wettest autumn on record*
- *Evidence of increasing frequency*
- *Links to climate change*

Autumn¹ 2000 was the wettest since records began in 1766. Most parts of the UK experienced the heaviest rainfall and most extreme floods for many years. This has raised concerns over whether such events are becoming more common and whether this can be attributed to climate change.

This note describes the rainfall over the UK in Autumn 2000, outlines evidence regarding trends in such extreme events, and explores possible links with climate change.

THE AUTUMN 2000 RAINS

During Autumn 2000, extreme levels of rain fell across the UK (Box 1), with the heaviest across England and Wales. Here, a total of 489mm (19.25 inches) fell between September and November (Table 1). The rainfall varied across the country (Table 2), with particularly heavy rainfall in Yorkshire the south east of England.

Rainfall was most extreme in October. The last column in Table 2 shows just how unusual the rains were, by giving the 'rainfall anomaly' - i.e. the rainfall recorded in October as a percentage of the normal October rainfall². These data show, for instance, that SE England experienced rainfall (195mm) that was over two and a half times the October norm. This figure itself masks finer detail of more local measurements. Indeed, over some parts of East Sussex, a total of 350mm of rain fell in October - over three times the norm.

Another way of looking at how extreme the rains were is to examine how frequently similar intensities have occurred in the past. Figure 1 shows the 'return period' for the October 2000 rains. This is the number of years that might be expected between such events. At the extreme, in parts of East Sussex, Kent and NW England the return period of the rainfall experienced is more than 200 years - i.e. that such an event is expected only once in 200 years.

This of course does *not* mean that such an event will occur on a regular cycle, once every 200 years, but that, averaged over a long time period, a frequency of this magnitude is likely. More widely, for much of Yorkshire and SE England, the rainfall experienced in those locations has an expected return period of between 100 and 200 years.



BOX 1 RAINFALL DURING AUTUMN 2000

Overall, rainfall across the UK in Autumn 2000 was nearly twice the normal (the average for the period between 1961 and 1990).

September was generally unsettled, with very wet periods between 14th and 19th, and later between 24th and 27th. By the end of the month, all regions (except for Northern Scotland) had experienced higher than average rainfall, with the most extreme in northern and eastern England and the Midlands. Overall, it was the wettest September since 1981.

October started with mixed weather. Most places had spells of rain or showers, sometimes heavy. The 9th to the 12th was a very wet period. A slow moving area of heavy rain and showers affected Sussex and adjacent areas of Kent on the 11th and 12th. Torrential downpours gave 100-150mm of rain overnight in many places causing severe local flooding: Plumpton in East Sussex received 144 mm of rain in 24 hours. The middle of the month was changeable, as belts of rain and showers moved across the region, but the end of the month saw showers in many places, with the most frequent and heaviest in the west. These culminated in a severe storm and heavy rain during the 29th to 30th. Flooding was widespread especially in the south as another 50mm of rain fell. By the end of the month, October 2000 turned out to be the wettest October since 1903, and the second wettest on record.

November began with a very wet period, and it remained wet throughout the rest of the month (particularly between the 21st and 27th). Overall, it was the wettest November since 1970.

Source: The Meteorological Office, Monthly Assessments, September, October and November, 2000

TABLE 1 ENGLAND AND WALES RAINFALL, AUTUMN 2000

Period	Rainfall (mm)	Wettest since
September	133	1981
October	188	1903
November	168	1970
Autumn	489	1766 (when records began)

Source: The Meteorological Office

TABLE 2 AUTUMN 2000 RAINFALL ACROSS THE UK

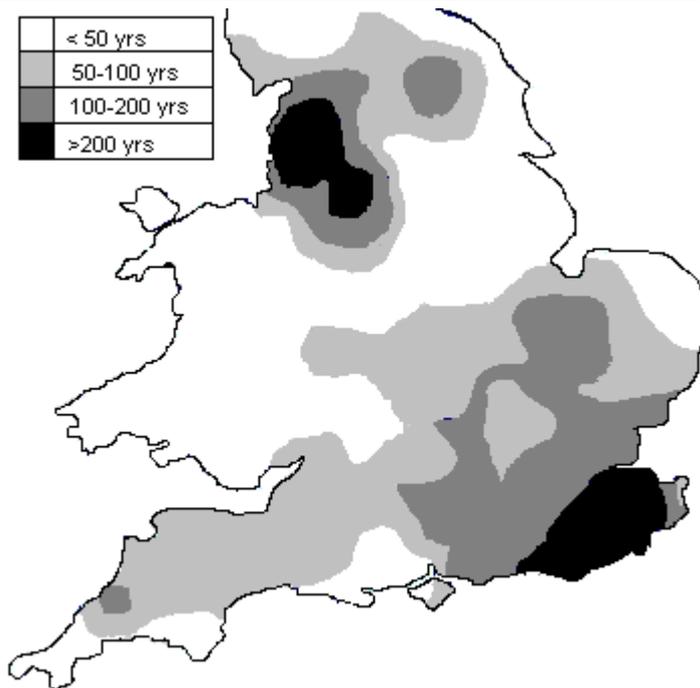
Region	Monthly rainfall in each region (mm) (figures are rounded to nearest mm)			October rainfall as a percentage of the norm
	Sep	Oct	Nov	
SE England	103	195	157	268
East Anglia	77	126	116	241
Southern England	100	160	143	231
Midlands	109	137	138	214
NW England & N Wales	161	248	243	199
SW England & S Wales	139	223	201	197
N England	135	171	178	195
E & NE England	108	115	141	184
England sub-total	112	164	156	218
Wales sub-total	157	255	246	190
N Ireland sub-total	122	167	152	149
Scotland sub-total	148	221	164	144
UK total	129	192	166	186

Source: The Meteorological Office

¹ Autumn is taken to be September - November

² averaged over the period 1961-1990 - the period for which current climatic norms are defined.

FIGURE 1 EXPECTED FREQUENCY (YEARS) OF THE OCTOBER 2000 RAINFALL IN ENGLAND AND WALES



Source: The Meteorological Office

TRENDS IN HEAVY RAINFALL

The weather in the UK is notoriously changeable. Extreme rainfall has occurred throughout the historical record³. However, the recent events have raised questions about **whether such extreme rainfall is becoming more frequent**.

Studies undertaken at the University of East Anglia, have examined daily precipitation observations for a 35-year period (1961-1995) from 110 weather stations around the UK⁴. Each 'wet' day (a day with more than 0.1mm rain) was allocated to one of ten categories, covering the lightest to heaviest rainfall. To determine whether any trends have occurred over a longer time period, the researchers compared the trend in the 35-year data set with that from older records (back to 1931). The research has shown a marked change in the distribution of heavy rainfall:

- In **winter**, there has been a statistically significant⁵ shift towards heavier rainfall – in particular, this shift is most marked in the heaviest rainfall category. This means that winter rainfall is increasing, but also that it is becoming heavier. This trend is most apparent over central and eastern parts of Britain.
- In **spring and autumn**, the picture is less clear –

with some regions showing a shift towards more intense rainfall, but others showing the reverse.

- In **summer**, at most locations, there has been a shift towards lighter rainfall. This pattern is strongest in south-central and northern England and in eastern Scotland.

LINKS TO CLIMATE CHANGE?

The recent rains, and consequent flooding, have been popularly linked with climate change. However, before this can be definitively verified, it is worth reviewing the evidence for such claims.

In 1995, the Intergovernmental Panel on Climate Change⁶ (IPCC) concluded "*the balance of evidence suggests a discernible human influence on global climate*". This followed from predictions made using detailed and complex mathematical models of the climate, and comparing these with global observations. Since 1995, work shows that the global temperature record can only be explained when human activities are included. This increases the confidence of claims that human activity has been a major cause of climate change over the last 50 years.

However, attributing locally observed trends across Europe or the UK to climate change is more problematic. Predictions indicate that the frequency of heavy rainfall days will double or triple over the next 100 years, but it is difficult (many climate scientists would say, impossible) to link explicitly any one weather-related event, such as the recent rainfall, uniquely to human-induced climate change.

The apparent increase in the intensity of winter rainfall across the UK could be explained by 'natural' events operating at a regional scale. For example, there are shifts in wind patterns caused by fluctuations in the atmosphere-ocean system in the North Atlantic. These can increase the frequency of stormy and wet conditions across the UK.

Overall, researchers conclude that the **increase in rainfall intensity is consistent with results from several recent global climate change model experiments**, which predict an increase in extreme rainfall events over the UK. However, further work and observations are needed to identify whether any more precise climate change signals are emerging in local weather events.

Parliamentary Copyright 2000. The Parliamentary Office of Science and Technology, 7 Millbank, London SW1P 3JA, tel: [020] 7219 2840. See also www.parliament.uk/post/home.htm

³ Which stretches back to 1766 - the longest continuous rainfall record in the world.

⁴ Osborn, T.J., Hulme M., Jones, P.D. and Basnett, T.A. (2000). Observed trends in the daily intensity of United Kingdom precipitation, *International Journal of Climatology* 20, 347-364.

⁵ i.e. more than would be expected to occur just by chance.

⁶ A syndicate of 2000 climate scientists and professionals established by the UN in 1988 to undertake predictions of climate change and examine solutions.