15: Changing intensity of rainfall over Britain

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Over the past 100 years the intensity of UK precipitation has increased during winter, and to a lesser extend also during spring and autumn. This has been accompanied by more frequent spells of very wet weather and an increase in total precipitation, at least during the last 40 years.

Global climate has changed over the past 100 years or more, and this has been accompanied by changes in UK climate, principally a year-round warming together with precipation increases during winter and decreases during summer. Jones, Conway and Briffa (1997) described the precipitation variations (including rainfall and snowfall) in more detail. In this information sheet, we describe the changes in seasonal precipitation statistics that have occurred over the UK during the past century. These results are based on measurements at more than 680 rain gauges for the period since 1961, some of them providing data back to 1900. Osborn et al. (2000), Osborn and Hulme (2002) and Maraun et al. (2008) provide further details.

Winter

Figure 1 shows maps of trends in 3 characteristics of precipitation, during the period from 1961 to 2006 (the period with best data coverage). There were increases (some more than 50%) in the total precipitation over the whole country, with largest increases occurring in Scotland and north-western England. An increase in total rainfall can occur because of more wet days or because it rains harder on those days that it rains, or a combination of both. There*were* increases in the number of wet days in the western UK, but in general the increase was not large. The largest change is in the average amount of precipitation on those days that it does rain, which shows an increase across the entire UK.

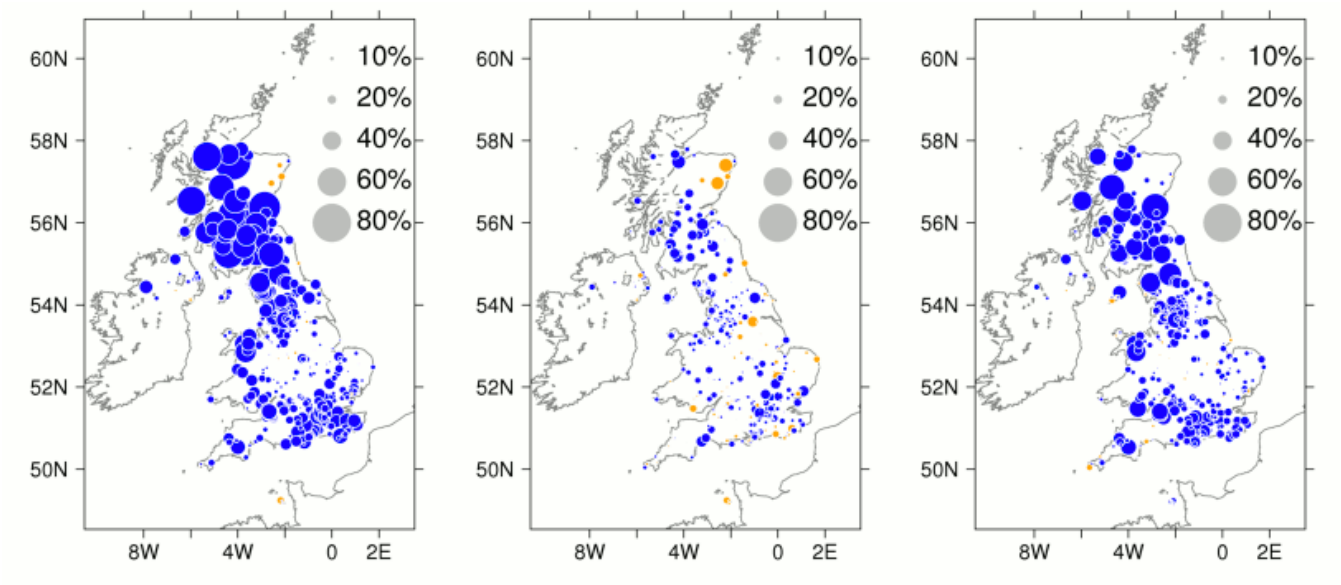

Figure 1: Winter trends (given by the size of the dots - see the key on each panel) in the total precipitation, the number of wet days and the average amount of precipitation on wet days. Increases are blue, decreases are yellow. Trends are expressed as percentage changes over the 1961 to 1995 period. From Maraun et al., 2008 (supplementary information).

Rather than using a fixed definition of heavy precipitation (such as a threshold of, say, 15 mm on one day), it can be useful to define it in a way that depends upon the local conditions (because 15 mm is not unusual in some locations, such as north-west England, while it is considered to be more unusual at others, such as eastern England during winter). We have defined heavy precipitation in this way (Osborn et al., 2000, describe exactly how) and Figure 2 shows the contribution that heavy precipitation days make to total winter rainfall, when averaged over the UK, for each winter since 1900. There is a clear increase since the beginning of the last century, with year-by-year and decadal fluctuations superimposed. Since the mid 1980s, there have been no winters in which heavy precipitation days contributed less than 8% of the seasonal total precipitation, yet before this was quite common. On average, the contribution of heavy rainfall has increased from about 7% around 1910 to around 12% in the last years.

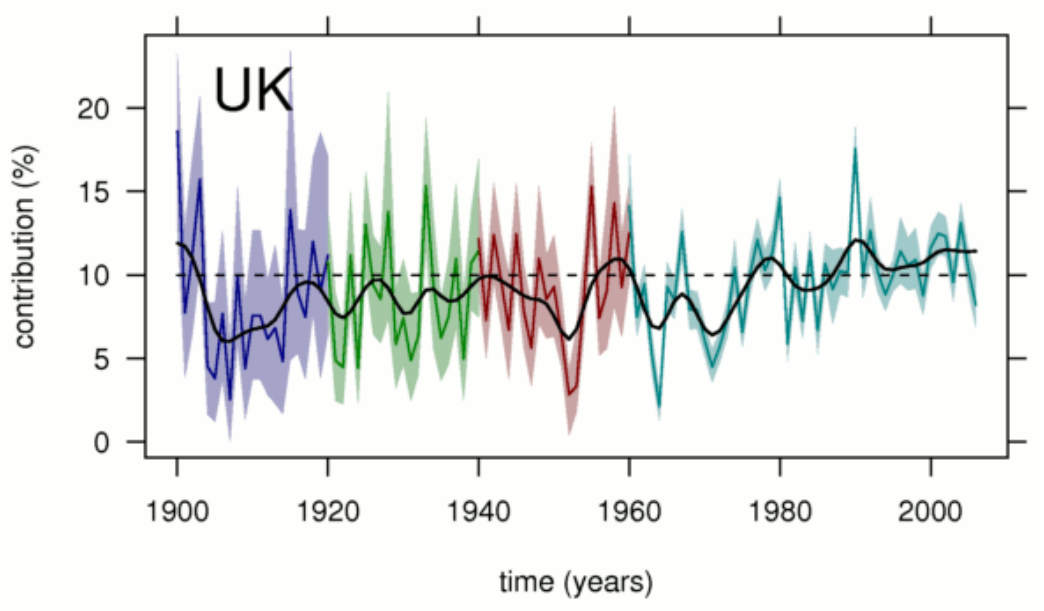

Figure 2: The contribution to each winter's total precipitation made from "heavy" precipitation days. The 1961-1995 average is indicated by the dashed line. The shading represents the uncertainty due to the incomplete spatial coverage with rain gauges. A black smoothing line to highlight decadal variations has been overlaid. The different colours depict periods with different raing gauge coverage; for example the early (purple) period was based on 37 rain gauges, while the most recent (blue-green) period was based on 544 rain gauges. From Maraun et al., 2008.

The observed increase in the intensity of single-day precipitation amounts could have detrimental impacts on soil erosion (especially since many fields are bare during winter) and could result in increased local flooding in urban areas that respond rapidly to heavy downpours. River flooding, however, typically occurs after a number of days of heavy rainfall. To assess whether multi-day precipitation has changed, we counted how many days each winter fell at the end of a 5-day spell of "very wet" weather. Figure 3 shows that this has also increased, when averaged over the UK.

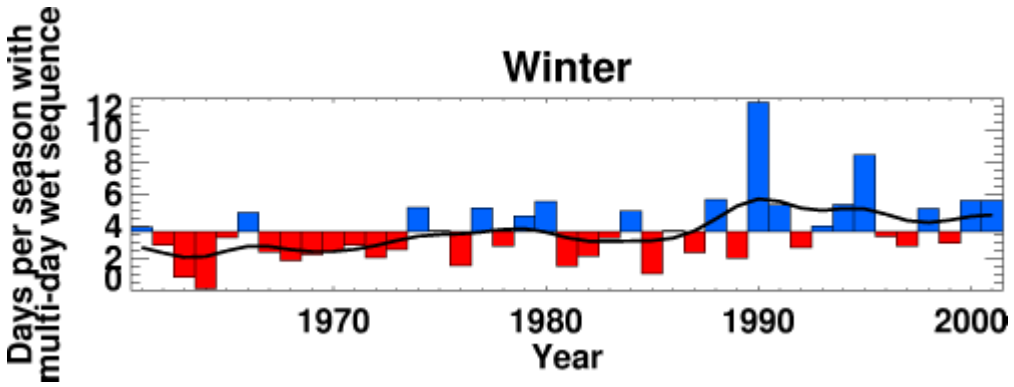

Figure 3: The number of days each winter that fell at the end of a 5-day spell of "very wet" weather, indicating the number of days per winter on which there is a risk of flooding. These are indicated by red (below average) and blue (above average) bars, and a black smoothing line to highlight decadal variations has been overlaid.

Spring

Figure 4 shows that there is far less uniformity in the changes that have occurred during Spring. While total precipitation in Scotland and along the west coast of Wales and England has increased, mainly due to an increase in the amount falling on wet days (though the number of wet days has increased slightly), the changes in the centre, south and east of England are different. There, trends towards less total precipitation can be identified. Interestingly, in some regions the intensity of rain has increased, but a decreasing number of wet days resulted in an overall reduction in total precipitation.

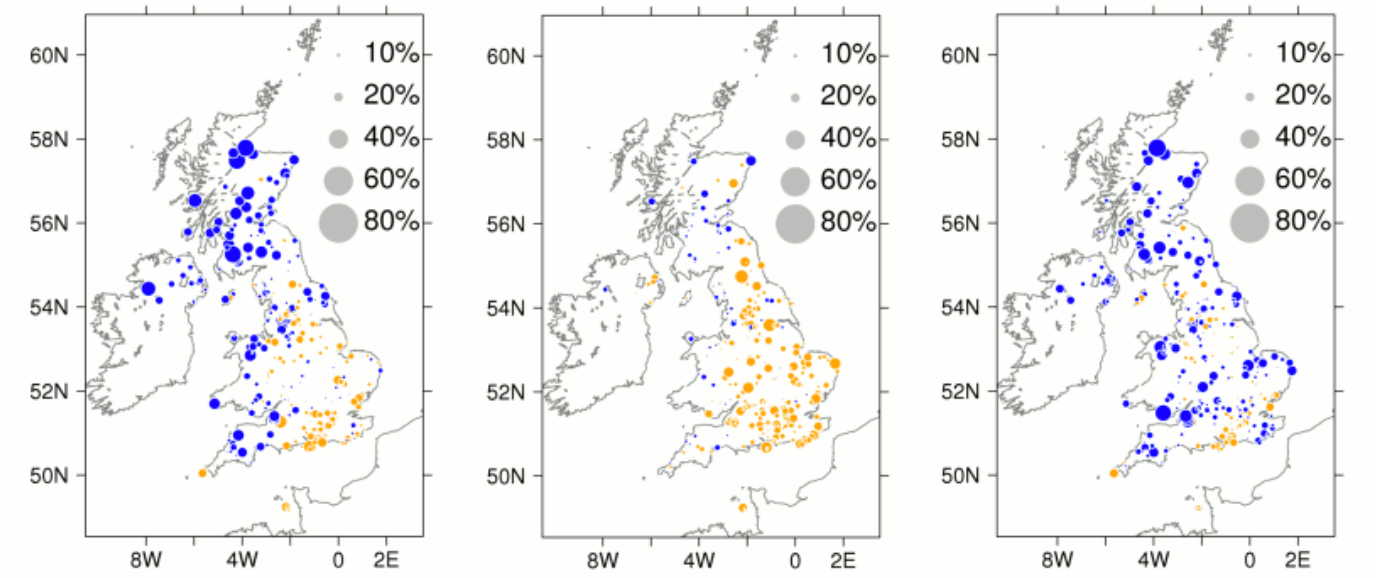

Figure 4: Spring trends (given by the size of the dots - see the key on each panel) in the total precipitation, the number of wet days and the average amount of precipitation on wet days. Increases are blue, decreases are yellow. Trends are expressed as percentage changes over the 1961 to 1995 period. From Maraun et al., 2008 (supplementary information).

The contribution that heavy precipitation events have made to the total spring rainfall (Figure 5) shows quite strong variability over time, though there is an indication of an underlying century-long trend towards more intense precipitation.

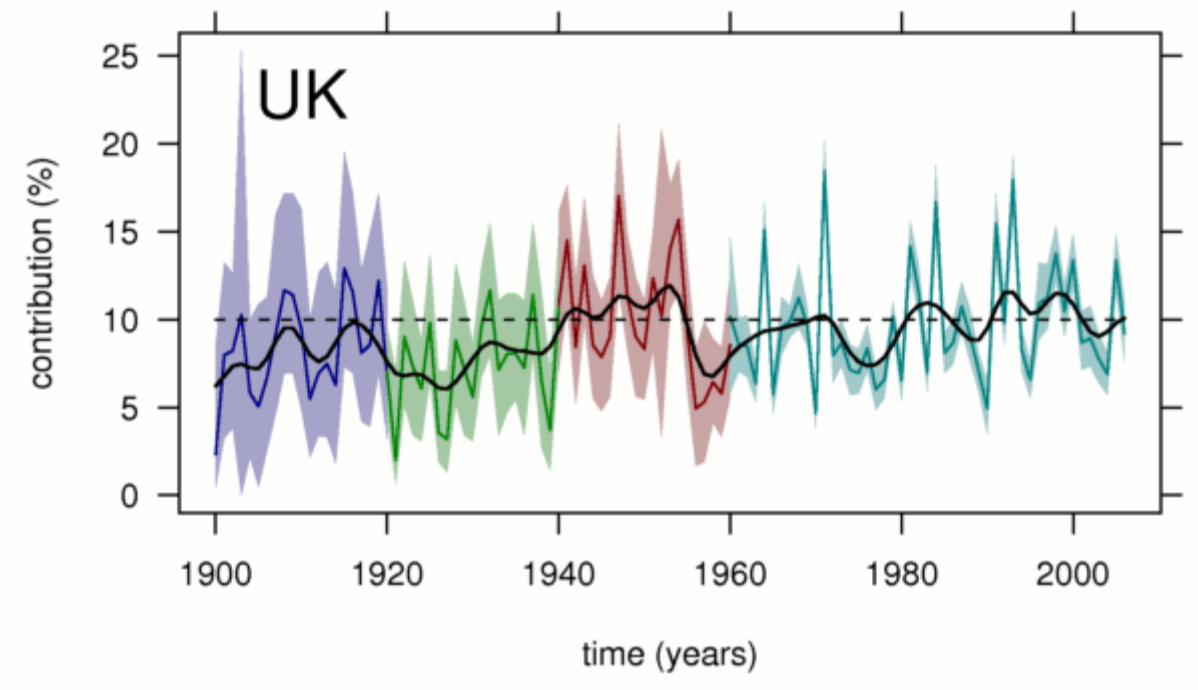

Figure 5: The contribution to each spring's total precipitation made from "heavy" precipitation days.The 1961-1995 average is indicated by the dashed line. A black smoothing line to highlight decadal variations has been overlaid. The different colours depict periods with different rain gauge coverage. From Maraun et al., 2008.

Summer

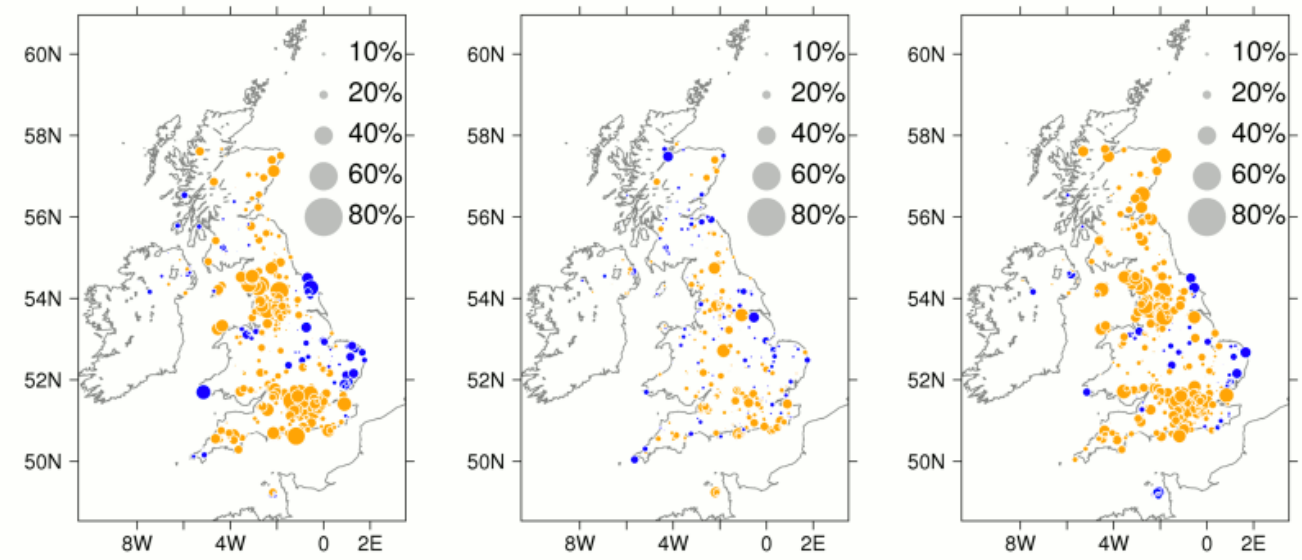

Figure 6: Summer trends (given by the size of the dots - see the key on each panel) in the total precipitation, the number of wet days and the average amount of precipitation on wet days. Increases are blue, decreases are yellow. Trends are expressed as percentage changes over the 1961 to 1995 period. From Maraun et al., 2008 (supplementary information).

Like winter, changes in precipitation around summer are fairly uniform across the UK (Figure 6). With the exception of western Scotland, Northern Ireland, the westernmost tips of England, and the English east coast, there have been decreases in total rainfall, due to a combination of fewer wet days and less rain on wet days. When averaged across the UK, the time series of the contribution of heavy rainfall to the total summer rainfall (Figure 7) shows strong multi-decadal fluctuations. These strong variations make it difficult to identify any underlying trend. Osborn et

al. (2000), for example, reported on the strong decrease of heavy summer rainfall from the peak around 1970s to the lows around 1995 (though they did note that rainfall earlier in the 20th century may have also been less intense). Recent measurements, however, have indicated a return to more normal conditions.

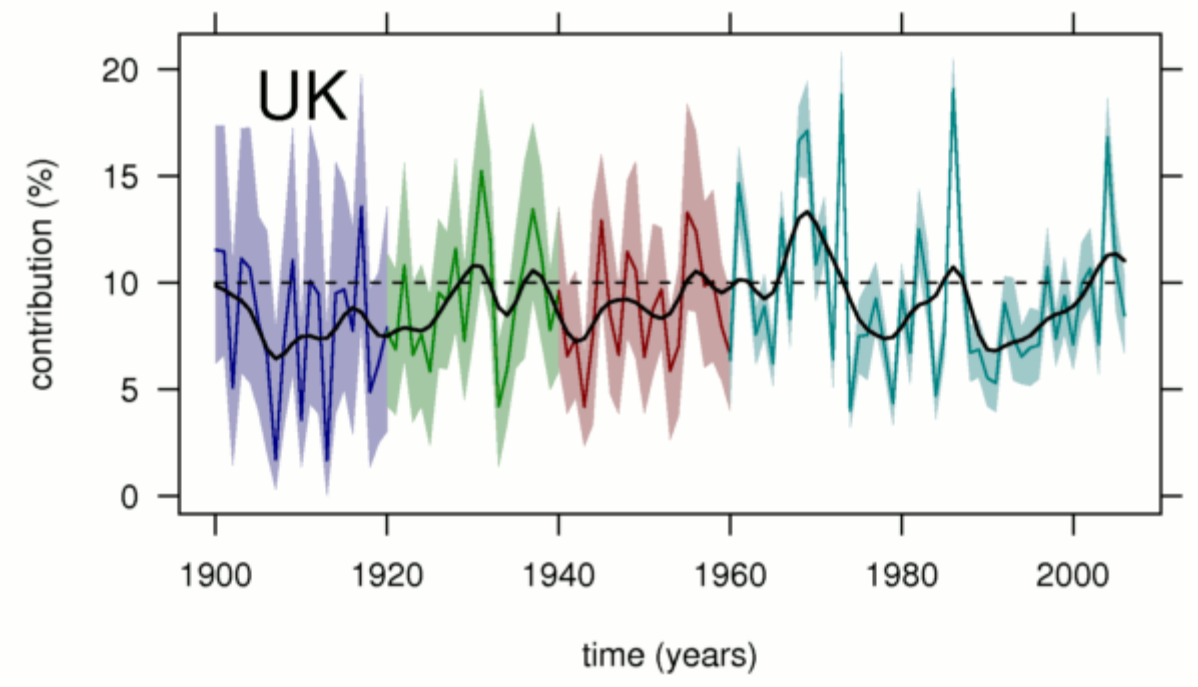

Figure 7: The contribution to each summer's total precipitation made from "heavy" precipitation days. The 1961-1995 average is indicated by the dashed line. The shading represents the uncertainty due to the incomplete spatial coverage with rain gauges. A black smoothing line to highlight decadal variations has been overlaid. The different colours depict periods with different rain gauge coverage. From Maraun et al., 2008.

Autumn

In autumn, total precipitation increased over most parts of the UK during the 1961-2006 period (Figure 8). In contrast to winter, these changes are strongest in the East of Scotland and in the South of England. The changes in the number of wet days, and the amount falling per wet day are less uniform across the UK, but are dominated by increases.

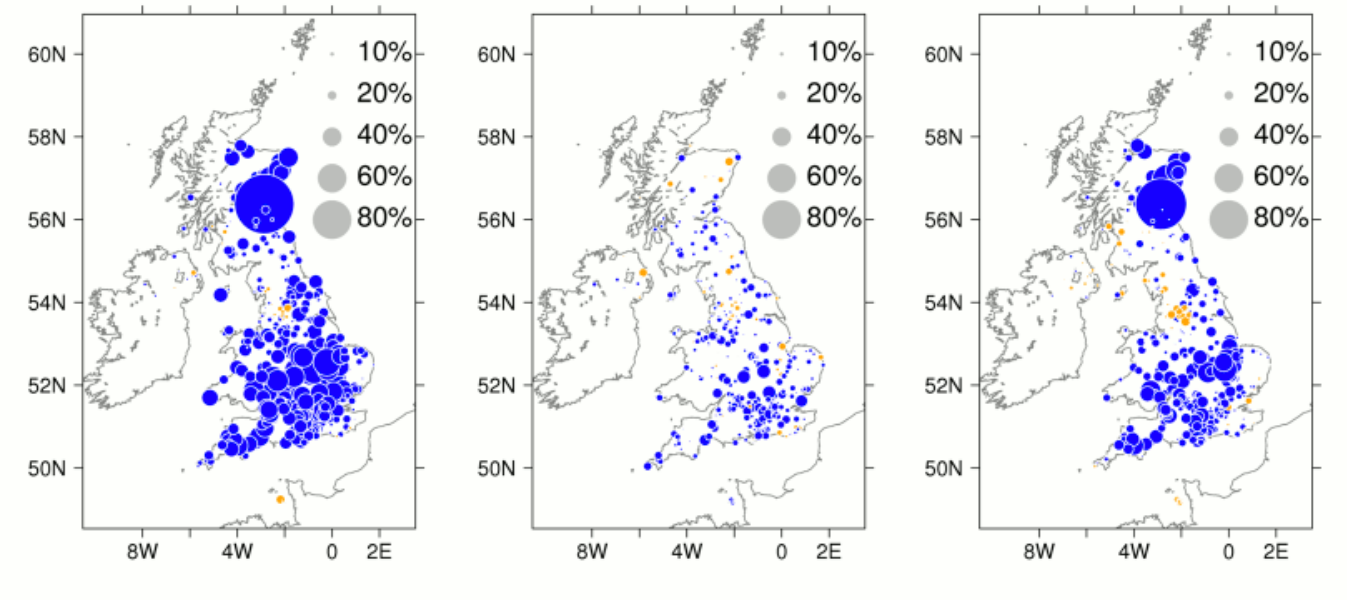

Figure 8: Autumn trends (given by the size of the dots - see the key on each panel) in the total precipitation, the number of wet days and the average amount of precipitation on wet days. Increases are blue, decreases are yellow. Trends are expressed as percentage changes over the 1961 to 1995 period. From Maraun et al., 2008 (supplementary information).

These recent increases in the amount of rain falling on wet-days are reflected in the increased contribution from heavy precipitation days during Autumn (Figure 9), and earlier measurements suggest that these changes from 1961-2006 are part of a century-long increase in precipitation intensity over the UK.

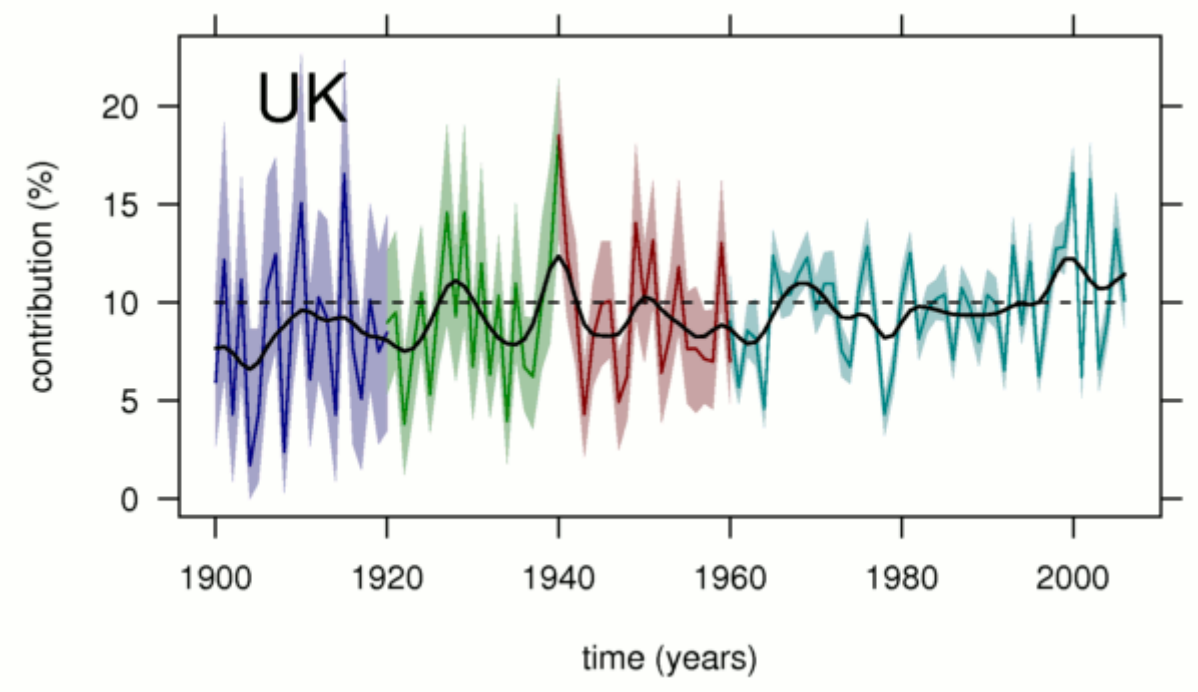

Figure 9: The contribution to each autumn's total precipitation made from "heavy" precipitation days. The 1961-1995 average is indicated by the dashed line. The shading represents the uncertainty due to the incomplete spatial coverage with rain gauges. A black smoothing line to highlight decadal variations has been overlaid. The different colours depict periods with different rain gauge coverage. From Maraun et al., 2008.

UK rainfall and climate change

It is not yet possible to say whether these observed changes in UK rainfall characteristics can be attributed to man-made climate change, because (although they can have very significant

impacts) the changes may not be outside the range of variation that could occur naturally. Nevertheless, it *is* possible to say that the changes are consistent with scenarios of man-made climate change, based on climate model simulations. These simulations indicate a trend towards larger rainfall totals during winter and reductions in summer (especially in southern UK), and an increase in the intensity of precipitation (especially during winter); see Jones and Reid (2001).

References

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