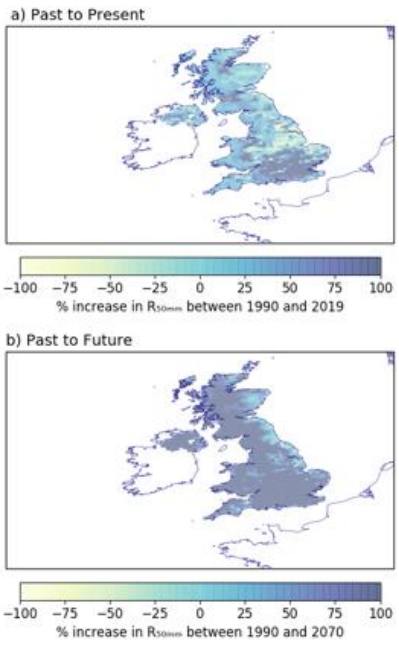
Increase in the frequency of extreme daily precipitation during autumn

Credit: The Telegraph 14 Nov 2019

Why this is important: Heavy rainfall events and subsequent flooding can cause significant disruption across the UK effecting sectors such as health, transport, agriculture and energy. Whilst it is clear extreme weather events can cause impacts in the UK, it is also now clear that the UK is experiencing different impacts due to its changing climate. As the climate continues to change in response to human activities, the UK will be subject to different frequency, severity and duration of various climate hazards and high impact weather. In order to develop effective strategies to reduce the impact of these it is important to first characterise the future changes. This will enable the characterisation of climate risks and ultimately be able to better inform adaptation planning in different sectors to support the increase in resilience of the UK to future climate variability and change.

What the UKCR programme is doing: A new analysis has been made of short period intense rainfall, the first of its type for the UK, using high resolution climate model simulations to estimate the changing risk of the extreme rainfall amounts that led to severe flooding in Yorkshire in November 2019. The study has developed a new index (R_{50mm_OND}) that represents the number of days during October/November/December with daily precipitation totals of over 50 mm. It investigates how the frequency of these extreme rainfall events has already changed UK wide and how much it is projected to change in the future. It also looks at the transient evolution of the two most extreme daily precipitation totals in October and November (R_{x2days_ON}) in the South Yorkshire region in order to examine the specific nature of the November 2019 floods. The analysis uses the HadUK-Grid observations, a 12 km resolution regional climate model from UK Climate Projections, the global climate model from the UK Climate Projections at 60 km and the global climate model HadGEM3-A at 60 km resolution.

Results so far: The results show a significant and substantial impact of human-induced greenhouse gas emissions on the risk of intense short-period rainfall in the UK of the sort that led to the November 2019 flooding in Yorkshire. Extreme daily rainfall totals in excess of 50 mm/day on a UK wide scale, seen most often in the seasons of autumn and winter, have increased noticeably between 1960-2020 with the R_{50mm_OND} increasing in the observations by 60% between the start of the 20th and 21st centuries. UKCP18 projections (12 km regional climate model under RCP 8.5) show that between 2019 and 2080, R_{50mm_OND} is projected to increase by 85%. The projections also show increases in the number of these events in almost all regions of the UK including central and eastern England, where such events have not yet been seen in the observational record. Results for R_{x2days_ON} show an increase between 1990 and 2019 which is projected to increase even further by 2070, where the probability of large R_{x2days_ON} totals is set to become noticeably higher and the intensity of the top 10% of events set to increase. The work has also demonstrated that the standard resolution climate models used for event attribution (60km resolution) are not of sufficient spatial resolution to capture extreme



Map showing the spatial distribution of the change in R_{50mm_OND} between a) 1990 and 2019 and b) 1990 and 2070 using UKCP18 regional 12km projections averaged over all ensembles over the UK. The data compares the mean of R_{50mm_OND} over the following 20 year periods a) 1981-2000 and 2009-2028 and b) 1981-2000 and 2060-2079

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daily rainfall for the UK. This is an important conclusion which endorses the strategy chosen for this work, using higher resolution simulations. However, we are still limited in the number of such simulations available for such analyses which limits the confidence in the conclusions.

What is next? The study has been written up and submitted for publication in the journal Weather and Climate Extremes. Plans are also in place to produce communication materials alongside the published paper to enable accessible summaries of the results to be disseminated to the public, journalists and policy makers.

Reference: Cotterill, D., Stott, P., Christidis, N., Kendon, E., 2021, Increase in the frequency of extreme daily precipitation in the United Kingdom in autumn, *Weather and Climate Extremes*