Wetter winters and drier summers in the UK explained by data errors and biases

Conor Murphy (1), Robert Wilby (2), Tom Matthews (2), Peter Thorne (1), Ciaran Broderick (1), Rowan Fealy (1), Julia Hall (3), Shaun Harrigan (4), Philip Jones (5), Gerard McCarthy (1), Neil Macdonald (6), Simon Noone (1), and Ciara Ryan (1)

(1) Irish Climate Analysis and Research UnitS (ICARUS), Department of Geography, Maynooth University, Co. Kildare, Ireland., (2) Department of Geography, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK., (3) Institute of Hydraulic Engineering and Water Resources Management, Technische Universität Wien, Vienna, Austria., (4) European Centre for Medium-Range Weather Forecasts (ECMWF), Shinfield Park, Reading, RG2 9AX, UK., (5) Climatic Research Unit, University of East Anglia, Norwich, Norfolk, NR4 7TJ, UK., (6) School of Environmental Sciences, University of Liverpool, Liverpool, UK.

Long-term, quality assured records underpin our understanding of climate variability and change. Globally, few such records extend to the 18th Century, particularly for precipitation. The England Wales Precipitation (EWP) series is a notable exception that provides a continuous monthly record from 1766. EWP has found widespread use across diverse fields of research including: trend detection, evaluation of climate model simulations, as a proxy for mid-latitude atmospheric circulation, a predictor in long-term European gridded precipitation datasets, the assessment of drought and extremes, tree-ring reconstructions and as a benchmark for other regional series. A key finding from EWP has been the trends towards wetter winters and drier summers. We statistically reconstruct winter and summer EWP using independent, quality-assured temperature, pressure and circulation indices. Using a sleet and snow series for the UK derived by Prof. Gordon Manley and Prof. Elizabeth Shaw to examine reconstructions, we show that precipitation totals for pre-1870 winters are biased low due to gauge under-catch of snowfall and a higher incidence of snowfall during this period. When these factors are accounted for the trend to wetter winters in EWP is no longer evident. For summer, we find that pre-1820 precipitation totals are too high due to decreasing network density and uncertain data at key stations. A significant trend to drier summers is not robustly present in our reconstructions of the EWP series, with significance depending on start/end year and predictors used in model reconstructions. Our findings challenge current assumptions about historic climate variability and change in north-western Europe. It is also likely that the identified biases in EWP have distorted many other long-term European precipitation series.