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Wetter winters and drier summers in England and Wales precipitation explained by observational and sampling bias in early records.

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The England Wales Precipitation (EWP) series 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 multi-centennial 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 Profs. Gordon Manley and Elizabeth Shaw to examine reconstructions, we show that precipitation totals for pre-1870 winters are likely biased low due to gauge under-catch of snowfall and a higher incidence of snowfall during this period. When these factors are accounted for in our reconstructions the observed trend to wetter winters in EWP is no longer evident. For summer, we find that pre-1820 precipitation totals are too high, likely due to decreasing network density and less certain data at key stations. A significant trend to drier summers is not robustly present in our reconstructions of the EWP series. While our findings are more certain for winter than summer, we highlight i) that extreme caution should be exercised when using EWP to make inferences about multi-centennial trends, and; ii) that assessments of 18th and 19th Century winter precipitation should be aware of potential snow biases in early records. Our findings underline the importance of continual re-appraisal of established long-term climate datasets as new evidence becomes available. It is also likely that the identified biases in winter EWP have distorted many other long-term European precipitation series.