



An hourly precipitation dataset for the UK: quality control, climatology, variability and trends

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UK (multi-) daily precipitation records have been comprehensively analysed over recent years, however sub-daily precipitation is less well understood. Sub-daily extremes may be associated with flash flooding, particularly in urban areas, and it is likely that changes to the intensity and frequency of climatic and hydrologic extremes as a result of climate change will have large impacts on UK communities. An improved understanding of observed short-duration extremes is therefore required before future change may be assessed.

This paper describes the construction of a dataset of UK hourly precipitation, based on the compilation of three different sources of rain gauge data. Significant problems in the use of tipping bucket rain gauges for the analysis of long term climate and climate variability are recognised, including non-recording of precipitation, high frequency of tipping and the recording of accumulated totals. The quality control procedures undertaken are described along with the validation of accumulated 24h totals against a gridded daily precipitation dataset for the UK which demonstrates the reliability of the data for climatological analysis.

The dataset is used to establish an up-to-date, spatially extensive, sub-daily seasonal precipitation climatology for the UK for a range of accumulations from 1h to 24h for the period 1992-2011. Longer term trends and variability are examined over longer periods (>30 years) where sufficiently long records exist. Particular attention is paid to extreme events which are defined using a range of methods including Extreme Rainfall Alert (ERA) thresholds issued by the UK Flood Forecasting Centre, annual maxima, peaks-over-threshold and extreme value theory.

Initial analysis of the climatology of extreme events reflects the different mechanisms that generate sub-daily precipitation, for example, in most seasons hourly precipitation is more intense to the west of the UK, decreasing to the east. However, in summer the greatest intensities are in the south and the lowest in northern Scotland. However, in most parts of the UK the largest hourly totals generally occur in summer, indicating the importance of convection as a precipitation generating mechanism.

Analysis of longer records indicates significant long term trends in mean hourly precipitation intensity are observed but few significant trends in annual maxima are detected. Significant break points in the time series are also detected and may in some cases suggest a shift in the precipitation regime. The longest time series (>40 years) show evidence of increased mean hourly intensities in winter, consistent with observations at the daily timescale but no significant trends may be identified in extremes though there are periods of high frequency of events which indicates the need to investigate the clustering of extremes and the potential for “flood rich” periods.

A high-quality hourly precipitation dataset has a number of additional useful applications including the validation of high resolution regional climate model outputs (e.g. 1.5km outputs from the Convective Extremes (CONVEX) project modelling experiments), construction of a gridded, sub-daily precipitation dataset and the potential to improve the operation of the UKCP09 Weather Generator.