



The Application of Time Series Analysis in the Detection of Hydrological Change: The Study of River Flows in North Wales, UK.

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In recent years many studies have sought to further the understanding of hydrological change by employing a variety of statistical techniques in order to quantify such variations. As such, hydrological time series analysis is key to the statistical exploration of changes in water resources. Retrospective time-series analysis encompasses a wide range of statistical methods for exploring data and many of these have been applied to hydrological records. The wide variety of statistical methods available, however, means that many techniques have still to be extensively tested through their application to river discharge series.

In several Atlantic margin regions of North West Europe the hydrological cycle is particularly active reflecting a leading edge position for depressions formed in the Atlantic, high levels of orographically-enhanced precipitation, high rainfall seasonality and steep basin slopes. A number of recent major flood events have also occurred within the region. As a result some authors have suggested that such areas may be more susceptible to climate change than regions where the hydrological cycle is less dynamic. The recent growth of research interest into indicators of climate change has lead to a number of published studies regarding hydrological change in the UK. However very little work has been completed looking at stream flow trends in Wales and the Welsh borders region and few studies of comparative time series analysis have been attempted.

To help address this gap, and to test for the presence of significant flow increases,

this paper presents an exploration of the variation displayed in time series of mean river flows recorded at a number of North Wales gauging stations. The study concentrates on data collected over the instrumental period, giving a mean record length of 37 years. Results of annual, seasonal and sub-seasonal analysis of river flow time series are presented for a wide geographical spread of gauging stations within the North Wales region. Trends in gauged daily flow (GDF) records are explored through a number of smoothing techniques (e.g. LOESS), non-parametric statistical techniques (e.g. Mann-Kendall, Seasonal Kendall, Sen's T) and the use of resampling methods for the estimation of test statistic significance levels. Techniques for the detection of cyclical patterns and step-changes in series means are also employed and the possible drivers of the identified variations discussed.