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Estimating flows for hydropower: leveraging value from national scale hydrological modelling

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National-scale estimates of flow for determining hydropower suitability are invariably dependant on some form of the Drainage Area Ratio (DAR) method, where flows at a point of interest for hydropower are assumed to be a proportion of flows measured elsewhere in the catchment, based on a fixed ratio of respective catchment areas. This method is widely used globally.

Recent UK national-scale modelling, using a variety of models, has established a significant set of reconstructed daily flows for many locations (G2G model: 260 catchments (flows: 1891-2015); GR4J model: 303 catchments (flows: 1891-2015); Decipher model: 1366 catchments (flows: 1962-2015)). These reconstructed flows supplement the national set of flow observations maintained in the UK National River Flow Archive but have the advantage that in many cases reconstructed timeseries cover a longer period than observed records. Although these are useful datasets, unless the site of hydropower interest approximates a gauged/modelled location, the problem of estimating flows at a different point, remains.

The reconstructed datasets mentioned above include a national scale 1km x 1km grid of monthly flows generated by the G2G model (1891-2015). As these are gridded flows at high spatial resolution, it may be possible to estimate daily flows at a required location, based on a variable ratio of monthly flows for the respective locations – rather than a fixed area ratio.

We propose and test a method for leveraging understanding from gridded monthly output for several locations within the Trent catchment. Daily flows at these locations are already known and were used for validation. We calculated monthly ratios of gridded flows at the sites of interest to those at a driver site, where daily flow is available. This variable monthly flow ratio was then applied to the daily flow at the driver location to estimate daily flow at the site of interest. Flow duration curves were compiled to compare flows using (i) the DAR method, (ii) the proposed flow factor method and (iii) the observed flows. Results generally indicated that the flow factor method provides good estimates (within 5 to 14% of recorded flow), and a significant improvement in flow estimation compared to the DAR method. However, for some locations, both methods performed poorly, and we explore possible reasons.