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# Landscape predictors of channel wetted width at baseflow using air photos

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Evasion of carbon dioxide from the surface of freshwater channels accounts for a substantial proportion of its flux from the terrestrial biosphere to the atmosphere; accurate estimates of channel wetted width (WW) are required to improve predictions of this flux. We investigated which landscape and climate-related data were statistically significant predictors of WW at baseflow across a large region (2200 km$^2$) of north Wales and western England (UK) where habitat surveys suggest the majority of channels are in a near natural state. We used 25 cm pixel resolution air photos to measure channel WW at baseflow, and quantified the magnitude of the errors in these measurements. We used flow information from local gauging stations to ensure that channels were at or close to baseflow for the days on which the air photos were captured. The root mean squared difference between the field-based and air photo measurements of WW ($n$=28 sites) was small (0.14 m) in comparison to the median channel WW (3.07 m), and there was very little bias between the two sets of measurements (0.026 m).

We created a set of points along those sections of channels which were visible in air photos and used a digital terrain model to create the drainage catchments for the points and computed their catchment area (CA). We removed points with CA $<$1 km$^2$ and selected a random subset from the remaining points ($n$=472). We measured channel WW at these points from air photos and computed landscape and climate-related data for each of their catchments (mean slope, mean annual rainfall, land cover type, elevation) and also mean BFIHOST, a quantitative index relating to hydrological source of flow. We also computed the local slope at each of the selected points on the channel. As these data were not independent random variables, we used the linear mixed model framework with WW as the predictand and included the various landscape and climate-related data (including CA$^{0.5}$) as fixed effects. We included a spatial covariance function using residual maximum likelihood which computes unbiased estimates of the predictors and accounts for clustering in the sample data. There was no evidence for retaining the spatial covariance function and so we computed a linear model by ordinary least squares and selected predictors using a stepwise procedure. With the exception of land cover, all the predictors were statistically significant and accounted for 76% of the variance of channel WW. When CA$^{0.5}$ alone was used as a predictor it captured 54% of the variance. The vast majority of this difference was due to inclusion of an interaction between CA and hydrological source of flow (BFIHOST). As catchment area increases, those channels with larger mean catchment BFIHOST values (greater baseflow) have narrower channel WW by comparison to those with smaller mean BFIHOST for the same CA.