Session HS2.2.2 Large-Sample hydrology: characterising and understanding hydrological diversity

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Title: Using the CAMELS-GB large-sample dataset to investigate controls on baseflow (BFI)

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50 word introduction: We're applying linear regression models to the CAMELS_GB dataset to investigate hydrogeological controls on baseflow, including: climatology; hydrogeology; catchment characteristics; and anthropogenic influences. For a sub-set of CAMELS_GB catchments, there is detailed information on abstractions, returns and reservoir storage that are a particular focus of the ongoing study.

Three questions from session chair and authors answers:

Q1. *What were the most important variables to predict baseflow with linear regression models?*

A1. This is an important question given that, excluding the site (gauge) ID and name, CAMELS_GB has 151 catchment attribute fields. As with any study the 'most important variables' to include in the analysis will depend on the details of the question(s) that you are asking. Since our aim is to increase process understanding through exploration and characterisation of relationships between measures of baseflow and catchment attributes in the CAMELS_GB large-sample dataset we do not have a particularly precise research question. Consequently, we have approached the issue by thinking of ways to constrain the catchment attributes that we will consider and have set ourselves four guiding principles, namely to include attributes that:

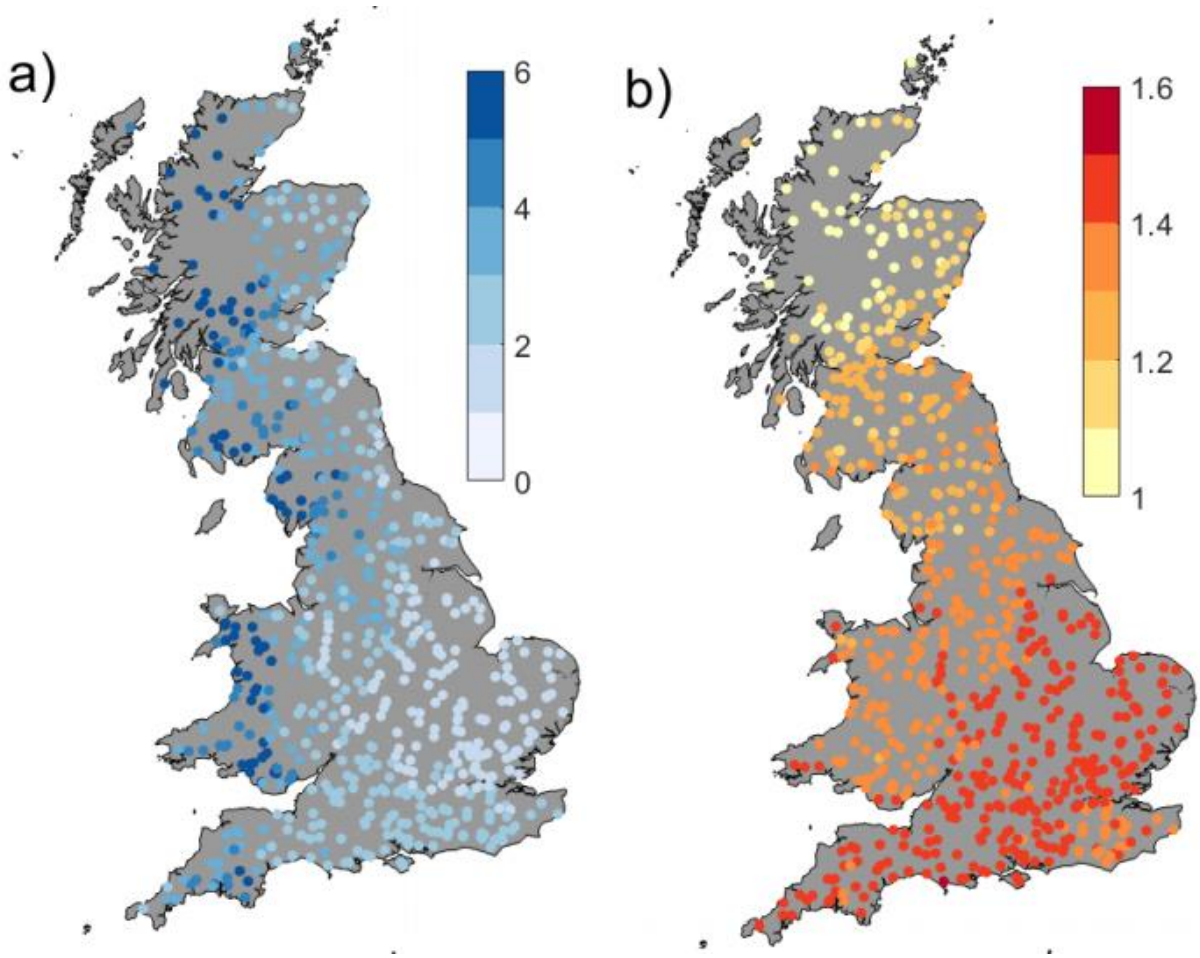
i.) appear to be largely artefact free, i.e. we QA all the data prior to use,
ii.) have no strong co-dependencies (a pre-requisite of regression modelling),
iii.) do not have a significant number of zero values across the sites, and
iv.) have a hydrogeologically plausible relationship with BFI based on our conceptual model of the systems being characterised.

Q2. *You are using CAMELS-GB. Is the regional variability in climatology in the UK large enough to see an effect on baseflow?*

A2. There are characteristic NW-SE gradients in climatology across the UK, with the NW and west of the UK being significantly wetter and cooler and the SE dryer and warmer (Coxon et al., 2020). The figure below illustrates the gradients in (a) average precipitation (mm/d), and (b) PET (mm/d). There are similar gradients in seasonal climate variables.

Due to the relatively strong correlations between PPT and PET, we are currently using aridity (PPT/PET) in the regression analysis. Aridity values in CAMELS_GB ranges from 0.12 to 0.96 with a mean of 0.51, i.e. in terms of aridity the GB fall broadly in the 'dry subhumid' category (Middleton and Thomas, 1997), consistent with it being in the temperate oceanic climate class of the Koppen climate classification system (Kottek et al, 2006). However, due to the climate gradients in GB, some catchments in the SE are characterised as being 'arid' while others in parts of the NW of GB would be classed as 'humid'.

The question however, is if these gradients in aridity are large enough to see an effect on baseflow. To date, whenever aridity has been included as a term in a stepwise regression model (work is still in progress), yes aridity has been seen to be a significant parameter in the resulting model.



Q.3 *How do you integrate anthropogenic effects in your analysis?*

A.3 Camels GB is unusual as a large-sample hydrology data set in that includes some detailed information about anthropogenic effects on catchments. It includes a class of attributes called 'Human Influence Attributes'. These include information on mean daily surface water and groundwater abstractions, mean daily discharges, and information in the number and capacity of reservoirs in a given catchment. Coxon et al. (2020a) provide detailed information about the derivation of these attributes. Unfortunately, these anthropogenic attributes are only available for a sub-set of the 671 catchments in the data set. They are only available for 430 catchments in England.

We are currently building two sets of regression models. One set without the anthropogenic attributes and one set including the anthropogenic attributes in the initial parameter set. In both cases we are using stepwise regression to investigate which catchment attributes are significant in characterising baseflow. By comparing the two sets of model results we hope to show a.) if anthropogenic effects are significant, and b.) if they are, how much of the observed baseflow can be explained by such attributes.

We also hope to explore the use of Machine Learning methods (Addor et al 2018) applied to the same data. This would potentially enable us to provide a complementary view in on the effects and relative importance of anthropogenic attributes on baseflow.

Additional notes and information from the authors:

The CAMESL_GB dataset (Coxon et al., 2020b) is available for downloading from UKCEH's EIDC website at https://catalogue.ceh.ac.uk/documents/8344e4f3-d2ea-44f5-8afa-86d2987543a9

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