Using Curated Datasets

National River Flow Archive

Royal Geographical Society with IBG

Advancing geography and geographical learning

https://nrfa.ceh.ac.uk/

National River Flow Archive

The National River Flow Archive (NRFA) is a body that collects and collates flow data from river gauging stations all over the UK as well as a variety of other hydrometric and climate data associated with rivers. This data is then used to deliver guidance to the UK government and inform policy makers about the management of flooding, ecology and land use in flood plains.

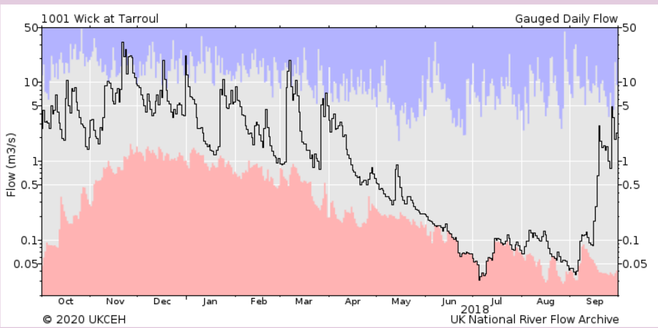
How do I access the data?

The above link is for the National River Flow Archive website. In the menu bar, the **Data Tab** provides a further menu and **Search For Data** takes the user through to a river map of the UK with all its gauging stations marked on it. Scrolling below the map one can see a list of all the gauging stations (1581 of them). Selecting any one of these takes the user through to a profile page for that gauging station. However, an easier way to find specific data is to focus the map on the right location and select the gauging station from there. In the profile that this takes one to, there is detailed information about the stations location, including its grid reference and the size of the catchment area where it records.

The next tab (the **Daily Flow Data**) has a comprehensive list of flow rates which are both shown in the graph and available for download by selecting the **Download Flow Data** button. It is free to download any data providing you give the NRFA some information about how you plan to use the data and agree to their data licence. The hydrograph that is displayed can be altered to show different years as well as be converted into a flow duration curve graph. A few of the gauging stations also have the ability to provide **Live Data** and this tab takes the user to a graph which, when the cursor is hovered over it, shows maximum, minimum and mean flow rates. The use of the word 'live' is a liberal description of the data in some cases but at most it provides data from 48 hours previously.

In the **Peak Flow** data tab, data can be gathered on the **Annual Maximum Flow** values to be witnessed each year, **Peak Flow Ratings**, **Catchment Descriptors** and **Peaks Over Threshold** (or peak flow rates that are greater than a given threshold). These can be viewed by selecting them from the **Data Type** drop down menu. The data is displayed both as a graph and in a table. The **Catchment Info** tab gives both a written description of the catchment in question, and also allows one to find more information about the nature of the catchment through the drop down **Spatial Data** menu. From here one can view data on **Elevation**, **Land Cover**, **Geology** and **Rainfall**. The **Photo Gallery** tab provides a number of photographs of the gauging station in question and its surroundings.

Example of a Daily Flow Data Record



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How can I use this in my teaching?

Studying rivers and the movement of water through a landscape is a popular topic that spans both human and physical geography. In the latter, having knowledge of and access to river flow data can show how catchment areas and drainage basins act in the real world and how differences in geomorphology and geology can have an impact on how water moves over and through the land. Data can be easily paired with weather and climate data to show the connections between the different systems as well as how fluvial hydrology has changed over time with regards to a changing climate.

With these studies there are equally strong links to environmental topics such as flooding and how humans are tasked with managing river courses more sustainably. The position and influence of settlements on river flow data is a common study point and students can enjoy using river flow data to predict where and when management strategies should be implemented.

Curriculum Links

This curated dataset links to a number of parts of the National Curriculum and is relevant to GCSE and A Level Specifications.

Key Stage Three: An understanding of physical geography relating to hydrology.

An understanding of how human and physical processes interact to influence and change landscapes and environments.

GCSE: A knowledge and understanding of the UK's geography, both in overview and with some in depth study to include its physical and human landscapes and environmental challenges.

An overview of how humans use, modify and change ecosystems and environments in order to obtain water resources.

A detailed study of water resources, recognising the changing characteristics and distribution of demand and supply, past and present impacts of human intervention, and issues related to their sustainable use and management at a variety of scales.

A Level: A knowledge and understanding of the distribution and size of the most important stores of water on land.

A knowledge and understanding of the pathways which control cycling between land, ocean, atmosphere and cryosphere, and the processes which control transfers within and between them at a range of time and space scales.

A knowledge and understanding of processes including runoff generation and catchment hydrology.

The following specifications make particular reference to the use of flow rates and river processes:

GCSE:			A Level:		
AQA	Cambridge IGCSE	Edexcel A	AQA	CIE	Edexcel
Edexcel B	Eduqas A	Eduqas B	Eduqas		
OCR A	OCR B				

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An example data walk-through

A student wished to compare river flow rates in catchment areas of different sizes. They wanted to see if there was any clear difference in flow rates in larger catchments compared to those seen in smaller ones. They had a theory that larger catchments would collect larger volumes of water which would result in less friction in channels between the water and the channel sides, resulting in faster flowing rivers and (therefore higher average flow rates).

First the student went to the home page of the NRFA data site and studied the table underneath the gauging station map. Using the table sort function, the student rearranged the list of gauging stations so they read from smallest to largest. The student noted five catchments with an area of less than 30km^2, five catchments with an area of between 500 and 1500km^2 and five catchments with an area greater than 4000km^2.

The profiles of each of these fifteen gauging stations were studied. From the **Station Info** the student noted the actual size of the catchment and from the **Daily Flow Data** tab they recorded the Mean Flow. The data table below was able to be produced from this data.

	Size of catchment (km^2)	Mean flow (m^3/s)	Mean flow of the five sites (m^3/s)
Wendover Springs - Wendover	10	0.082	0.349
Gass Water - Welltrees	14	0.462	
Hodge Beck - Bransdale Weir	19	0.345	
St. Neot - Craigshill Wood	23	0.717	
Wittle - Quidenham	28	0.138	
Sow - Milford	591	6.333	15.357
Colne - Denham	743	4.098	
Avon - Warwick	1012	8.187	
Teviot - Ormiston Mill	1110	20.951	
Dee - Woodend	1370	37.217	
Tay - Ballathie	4587	171.896	103.839
Lower Bann - Movanagher	5210	92.052	
Trent - North Muskham	8231	89.558	
Thames - Walton	9877	58.249	
Severn - Haw Bridge	9895	107.438	

On this occasion, with the fifteen sites considered in the study, the student's theory appears to have been seen to be true. However, the student recognised the limitations of drawing conclusion from a small data set and also recognised the scope within the method to carry out a more wide ranging statistical test to measure the extent of any kind of correlation between catchment area and average flow rate.

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Suggested delivery activities

Real World Rivers

Students can think about the different variables that may affect the mean flow rate recorded at gauging stations over time. Students should think of long term effects such as settlement size and situation to the river, catchment shape and size as well as geological factors rather than the day to day changes that could occur in any catchment. With these variables, and their possible influence on flow rate in mind, students should investigate whether their ideas are correct in real life.

Students can look at their particular variable and suggest ways they could visually present the data alongside their flow rate in a creative yet appropriate way.

Fieldtrip Preparation

Before going out to do fieldwork in a river catchment area, students can collect data on the river in question in the classroom and map features of the catchment area that may affect results. Students can then compare their primary data with the secondary data available from the NRFA site once they are back from the field.

Students can hypothesise the degree to which day-to-day changes not recorded on the NRFA site (such as prevailing weather conditions) may have influenced their results in the field. Students can also compare the accuracy of their methods for collecting data with the level of recording equipment available at a gauging station and discuss the influence this may have on results.

Virtual Transects

Students can choose a large UK river such as the Thames, the Dee or the Severn and using GIS, plot the flow rate (and other connected data as appropriate) onto a map. This is likely to give them with the means to analyse the extent to which the Bradshaw model is true to real life as well as providing opportunities to find correlations between the data. Students who choose different rivers to one another can compare their GIS patterns with each other and see if certain rivers exhibit data closer matched to the Bradshaw Model than others. Where rivers do not appear to follow the model, students can discuss reasons why this might be the case.

Regression Analysis

Regression Analysis is a statistical method for finding a line of best fit in a correlation graph when the plots may be placed in such as way that it is difficult to draw the line (and therefore predict other values) by eye. The analysis provides the researcher with three correlated plot points which can then be joined to form a straight line on the graph.

Regression Analysis works when there is an apparent relationship between two variables. For example, students could find the line of best fit in a graph of flow rate against percentage urban land use in the catchment. A guide to calculating regression can be found on the next page.

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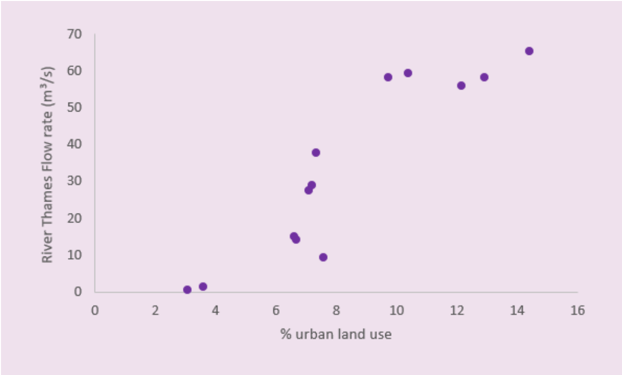
A Guide to Calculating Regression Lines using NFRA Data

Regression Analysis is a statistical method that researchers use to find a line of best fit in an analysis of two variables when plotted against each other. Rather than using the subjectivity of drawing a line of best fit by eye, regression analysis provides the researcher with three plot points which can be added to the graph and between which a line of best fit can be drawn. This gives the researcher the means to predict any outcome in the x variable when one knows the y variable and vice versa. In this example the student wanted to use regression line analysis to create a line of best fit on a graph plotting flow rates against percentage urban land use in the catchment. This would help them to predict flow rates for other catchment areas displaying urban land use.



Worked example:

The student extracted and downloaded data plots of flow rate (x) and percentage urban land use (y) from all the gauging stations along the course of the River Thames. From the dataset they removed any stations no longer in operation and then plotted the following graph (top left).

The deviations were calculated and added to a data table. A deviation (d_x and d_y) is the urban land use value (x minus the mean urban land use value (x bar)). Further calculations (d_x^2 and d_xd_y) were also calculated as in the table left:

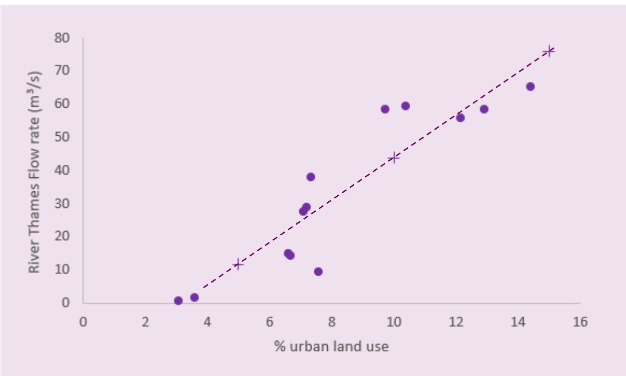
% Urban land use (x)	Flow rate (m^3/s) (y)	d_x	d_x^2	d_y	d_xd_y
14.40	65.30	6.03	36.35	32.16	193.92
7.21	28.74	-1.16	1.35	-4.39	5.10
6.67	14.05	-1.70	2.89	-19.09	32.47
7.10	27.50	-1.27	1.61	-5.64	7.17
10.38	59.19	2.01	4.04	26.06	52.36
6.62	14.91	-1.75	3.07	-18.23	31.91
7.33	37.76	-1.04	1.08	4.63	-4.82
3.61	1.39	-4.76	22.66	-31.74	151.11
3.07	0.57	-5.30	28.10	-32.57	172.63
12.17	55.75	3.80	14.43	22.61	85.90
12.94	58.25	4.57	20.88	25.11	114.75
9.72	58.21	1.35	1.82	25.07	33.83
7.60	9.15	-0.77	0.59	-23.99	18.49
(x bar) 8.37	(y bar) 33.13		Σ = 138.88		Σ = 894.82

The regression line (how a value for y alters as one alters x independently) is calculated using the following equation:

$$y = a + bx$$

where $$b = \frac{\Sigma (d_xd_y)}{\Sigma d_x^2}$$

In this case, b = 6.44



The student then finds the intercept value of y (that where the x value is 0, known as a), by using a = y bar - bx bar

In this case a = -20.77

With values of a and b established, the student is now ready to find alternative values of y using y = a + bx

They choose one value of x from the maximum values of the range, another from the minimum values of the range and another from the middle in order to make a total of three plots.

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