UK Hydrological Outlook

Delivered in partnership by: UK Centre for Ecology & Hydrology

Period: From July 2024

Issued on 09.07.2024 using data to the end of June 2024

SUMMARY The outlook for July suggests normal to above normal river flows in south-east England and normal flows elsewhere. For the July-September period, normal river flows are expected across the country. Groundwater levels are forecasted to be above normal in July, with normal to above normal levels anticipated for the July-September period.

Rainfall:

In contrast to previous wet months, June saw below average rainfall across England, Wales, and Northern Ireland, with some regions in southern and central England receiving less than 50% of their typical June rainfall. Northern Scotland, however, experienced above-average rainfall, particularly in the far north. According to the Met Office forecast issued on 01.07.2024, likelihoods for all the possible rainfall outcomes (dry, near-average and wet) are close to normal in July and in the July-September period.

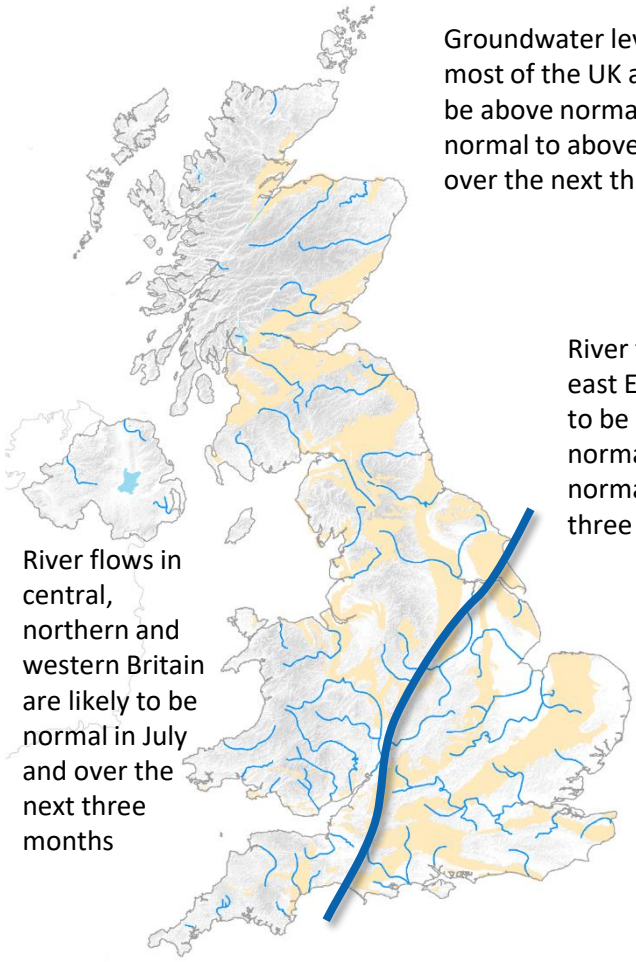
River flows:

River flows in June were generally normal across the country, though there was some variation. Above normal river flows were observed at some sites in south-east England, central, and northern Britain, while below normal flows were recorded at some sites in south Wales and south-west England. The forecast for July is for normal to above normal river flows in south-east England, with a likelihood of notably high flows persisting in some groundwater-fed catchments. Elsewhere, normal flows are expected. Outlooks suggest that below normal flows may continue in Wales and south-west England, although early July rainfall reduces this likelihood. Similarly, the July-September outlook favours normal flows across the country, with a chance of above normal flows persisting in parts of the south-east, particularly in groundwater-fed rivers.

Groundwater:

Groundwater levels in June were mostly above normal, and notably or exceptionally high levels were widespread across the country, with a few sites registering new June maxima.

The outlook for July is for a continuation of normal to above normal levels across most of the UK, with locally notably high (and occasionally exceptional) levels expected. The three-month outlook is similar, although in some of the faster responding boreholes such as those in central, northern England and south Wales, levels are expected to recede towards normal.



Groundwater levels across most of the UK are likely to be above normal in July and normal to above normal over the next three months

River flows for south-east England are likely to be normal to above normal in July and normal over the next three months

River flows in central, northern and western Britain are likely to be normal in July and over the next three months

Shaded areas show principal aquifers

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UK HYDROLOGICAL OUTLOOK

July 2024

UK Hydrological Outlook

Delivered in partnership by: UK Centre for Ecology & Hydrology

About the UK Hydrological Outlook:

This document presents an outlook for the UK water situation for the next 1-3 months and beyond, using observational datasets, meteorological forecasts and a suite of hydrological modelling tools. The outlook is produced in a collaboration between the UK Centre for Ecology & Hydrology (UKCEH), British Geological Survey (BGS), the Met Office, the Environment Agency (EA), Natural Resources Wales (NRW), the Scottish Environment Protection Agency (SEPA), and for Northern Ireland, the Department for Infrastructure – Rivers (DfIR).

Data and Models:

The UK Hydrological Outlook depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. Historic river flow and groundwater data are sourced from the UK National River Flow Archive and the National Groundwater Level Archive. Contemporary data are provided by the EA, SEPA, NRW and DfIR. These data are used to initialise hydrological models, and to provide outlook information based on statistical analysis of historical analogues.

Climate forecasts are produced by the Met Office. Hydrological modelling is undertaken by UKCEH using the Grid-to-Grid and GR6J hydrological models. Hydrogeological modelling uses the AquiMod model run by BGS.
Supporting documentation is available from the Outlooks website:
https://hydoutuk.net/about/methods

Presentation:

The language used in the summary presented overleaf generally places flows and groundwater levels into just three classes, i.e. below normal, normal, and above normal. However, the underpinning methods use as many as seven classes as defined in the graphic to the right, i.e. the summary uses a simpler classification than some of the methods. On those occasions when it is appropriate to provide greater discrimination at the extremes the terminology and definitions of the seven class scheme will be adopted.

	Percentile range of historic values for relevant month
Exceptionally high flow	> 95
Notably high flow	87-95
Above normal	72-87
Normal range	28-72
Below normal	13-28
Notably low flow	5-13
Exceptionally low flow	< 5

Disclaimer and liability:

The UK Hydrological Outlook partnership aims to ensure that all Content provided is accurate and consistent with its current scientific understanding. However, the science which underlies hydrological and hydrogeological forecasts and climate projections is constantly evolving. Therefore any element of the Content which involves a forecast or a prediction should not be relied upon as though it were a statement of fact. To the fullest extent permitted by applicable law, the UK Hydrological Outlook Partnership excludes all warranties or representations (express or implied) in respect of the Content.

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From April 2018 the UK Hydrological Outlook is supported by the Natural Environment Research Council funded UK-SCAPE and Hydro-JULES Programmes.

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Further information:

For more detailed information about the UK Hydrological Outlook, and the derivation of the maps, plots and interpretation provided in this outlook, please visit the UK Hydrological Outlook website. The website features a host of other background information, including a wider range of sources of information which are used in the preparation of this Outlook. Dynamic access to many of the outputs of the UK Hydrological Portal are available on the UK Hydrological Outlooks Portal.

Contact:

UK Hydrological Outlooks, UK Centre for Ecology & Hydrology, Wallingford, Oxfordshire, OX10 8BB
t: 01491 838800 e: https://hydoutuk.net/contact

Reference for the UK Hydrological Outlook:

UK Hydrological Outlook, 09 July 2024, UK Centre for Ecology & Hydrology, Oxfordshire UK, Online, https://www.hydoutuk.net/latest-outlook/

Other Sources of Information:

The UK Hydrological Outlook should be used alongside other sources of up-to-date information on the current water resources status and flood risk.

Environment Agency Water Situation Reports: provides summary of water resources status on a monthly and weekly basis for England: https://www.gov.uk/government/collections/water-situation-reports-for-england

Flood warnings are continually updated, and should be consulted for an up-to-date and localised assessment of flood risk:
i. Environment Agency: https://flood-warning-information.service.gov.uk/map
ii. Natural Resources Wales: https://flood-warning.naturalresources.wales/
iii. Scottish Environment Protection Agency: https://www.sepa.org.uk/flooding.aspx

Hydrological Summary for the UK: provides summary of current water resources status for the UK: https://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk

UK Met Office forecasts for the UK: https://www.metoffice.gov.uk/

UK Water Resources Portal: monitor the UK hydrological situation in near real-time including rainfall, river flow, groundwater and soil moisture from COSMOS-UK: https://eip.ceh.ac.uk/hydrology/water-resources/

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UK Centre for Ecology & Hydrology

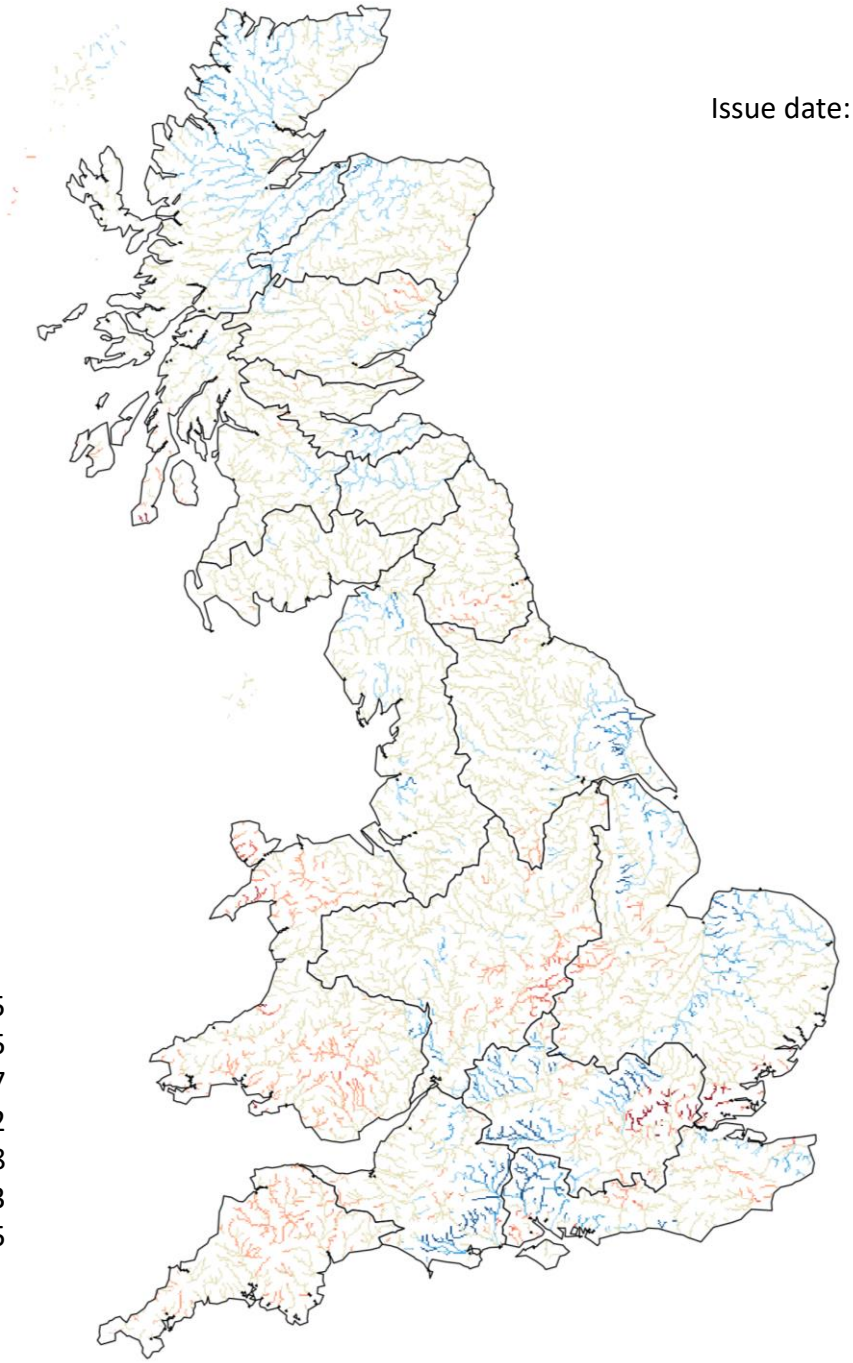
June's mean river flows simulated by the Grid-to-Grid hydrological model

Issue date: 02.07.2024

This map shows the simulated monthly mean flow across Great Britain for last month, ranked in terms of 54 years of historical flow estimates (1963 – 2016).

These flows are produced by the 1km resolution Grid-to-Grid (G2G) hydrological model, which is run up to the end of each calendar month using observed rainfall and MORECS potential evaporation as input.

Note that the G2G model provides estimates of natural flows.



Flow estimate for each river pixel ranked in terms of historic % flow estimates (1963-2016)

Exceptionally high flow	> 95
Notably high flow	87-95
Above normal	72-87
Normal range	28-72
Below normal	13-28
Notably low flow	5-13
Exceptionally low flow	< 5

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UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 30 June 2024

Issue date: 02.07.2024

These maps are based on Grid-to-Grid (G2G) hydrological model simulated subsurface water storage (water in the soil and groundwater), expressed as an anomaly from the historical monthly mean. To highlight areas that are particularly wet or dry, the storage anomaly is presented relative to historical extremes. Rainfall in WET areas with high positive relative wetness could result in flooding in the coming days/weeks. Areas of negative relative wetness indicate locations which are particularly DRY, and little or no rain in these areas could potentially lead to (or prolong) a drought. Maps of soil moisture only are available on the next page.

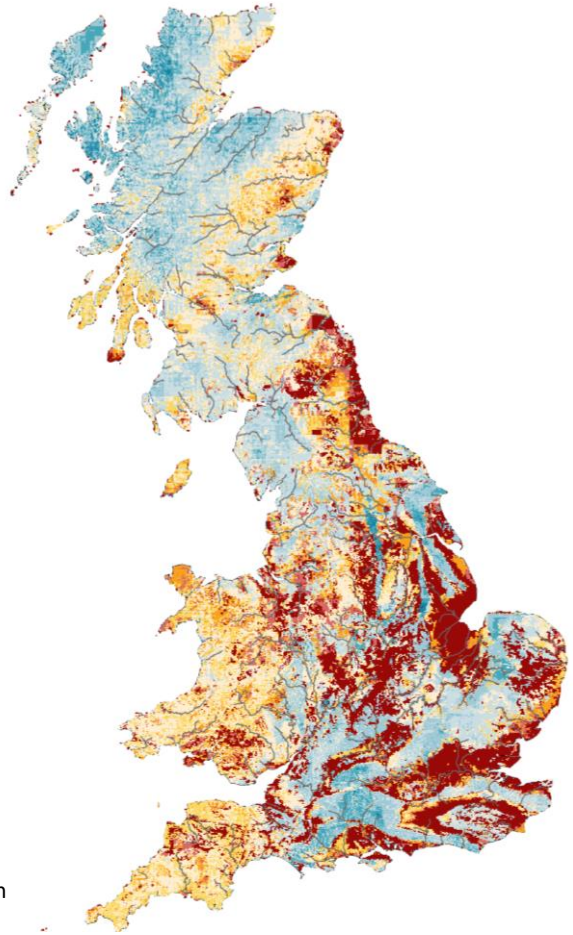
SUMMARY: Subsurface water stores have depleted due to the much lower than average rainfall over June across much of Great Britain. Areas with deeper stores remain slightly above normal, while areas with shallower stores have significantly depleted.

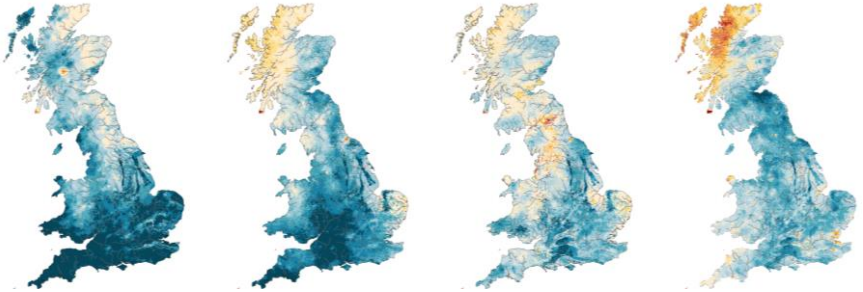
Relative wetness

Water storage anomaly as a % of maximum (positive wetness) or minimum (negative wetness) storage anomaly (zero indicates average value)

High (very wet)	>80
	60-80
Medium wetness	40-60
	20-40
Low wetness	0.01-20
Average conditions	-0.01-0.01
Low dryness	-20--0.01
	-40--20
Medium dryness	-60--40
	-80--60
High (very dry)	<-80
Major rivers	

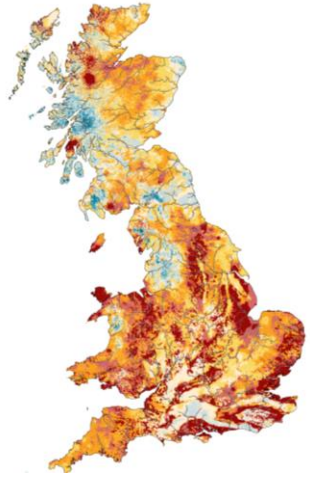
Labels refer to estimated storage on final day of named month



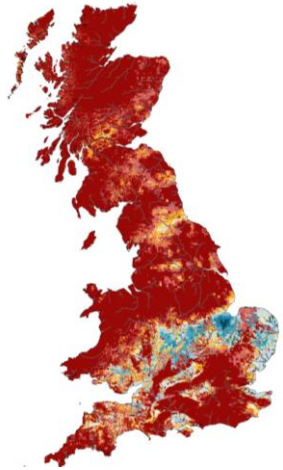


February March April May

June 2023



August 1976*



*Example month displaying extreme negative wetness

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UK Centre for Ecology & Hydrology

Current Daily Simulated Soil Moisture Conditions

Based on soil moisture estimated for 30 June 2024

Issue date: 02.07.2024

These maps are based on Grid-to-Grid (G2G) hydrological model simulated soil moisture, expressed as an anomaly from the historical monthly mean. To highlight areas that are particularly wet or dry, the soil moisture anomaly is presented relative to historical extremes. These maps are not a forecast; rather an indication of current conditions. Soil moisture will often look similar to total storage (shown on the previous slide), since total storage comprises both soil moisture and storage in the saturated zone.

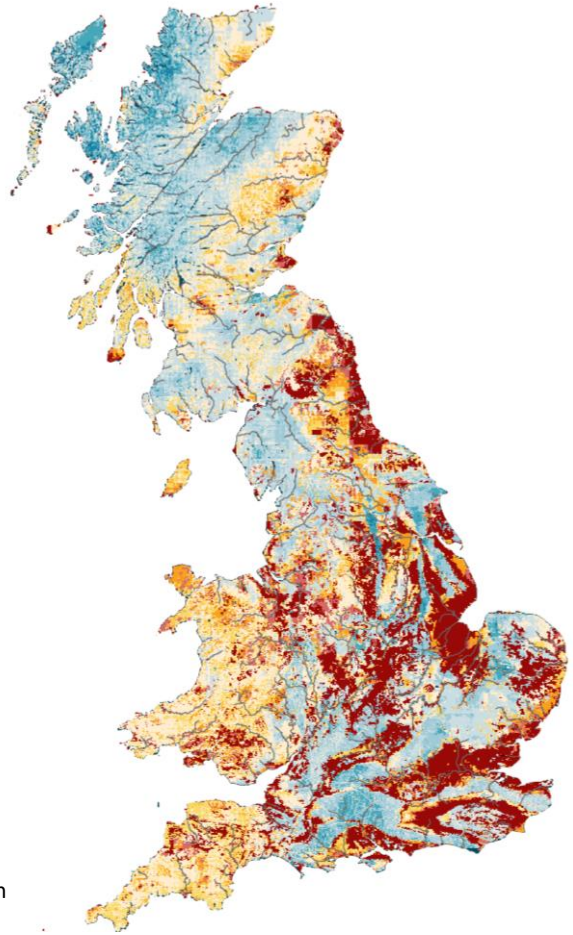
SUMMARY: Soil water stores have depleted due to the much lower than average rainfall over June across much of Great Britain. Areas with deeper stores remain slightly above normal, while areas with shallower stores have significantly depleted.

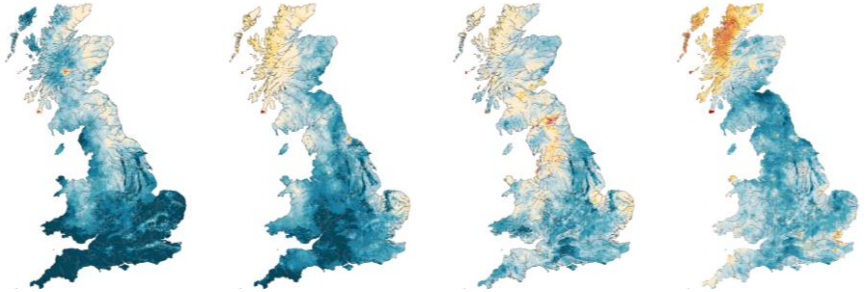
Relative wetness

Soil moisture anomaly as a % of maximum (positive wetness) or minimum (negative wetness) storage anomaly (zero indicates average value)

High (very wet)	>80
	60-80
Medium wetness	40-60
	20-40
Low wetness	0.01-20
Average conditions	-0.01-0.01
Low dryness	-20--0.01
	-40--20
Medium dryness	-60--40
	-80--60
High (very dry)	<-80
Major rivers	

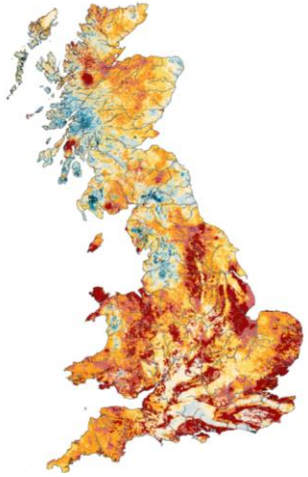
Labels refer to estimated storage on final day of named month





February March April May

June 2023



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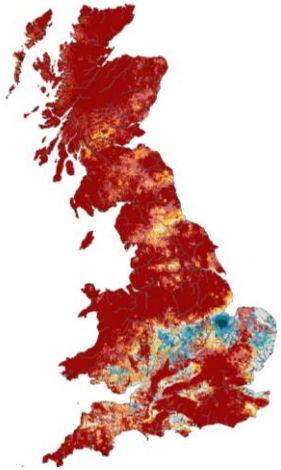

*Example month displaying extreme negative wetness

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UK Centre for Ecology & Hydrology

Estimate of Additional Rainfall Required to Overcome Dry Conditions

Based on subsurface water storage estimated for 30 June 2024

Issue date: 02.07.2024

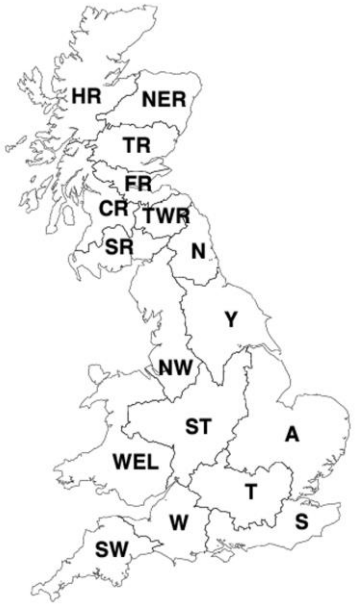
CURRENT CONDITIONS

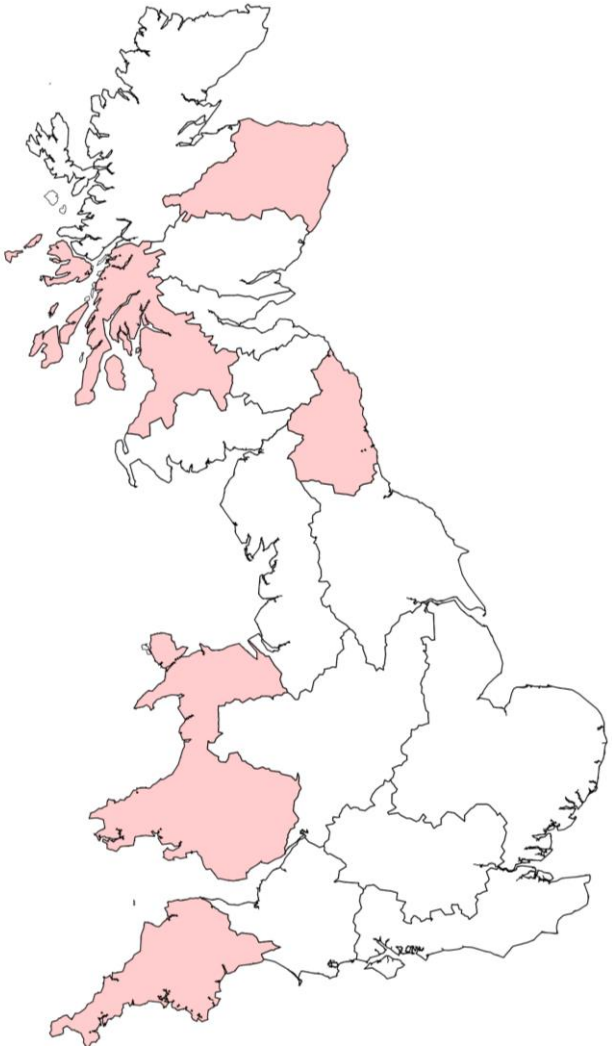
These maps show the Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean (1981-2010), presented on a 1km grid and as regional means. Subsurface storage deficits, i.e. where the subsurface water storage anomaly is less than zero, are highlighted in red/pink.

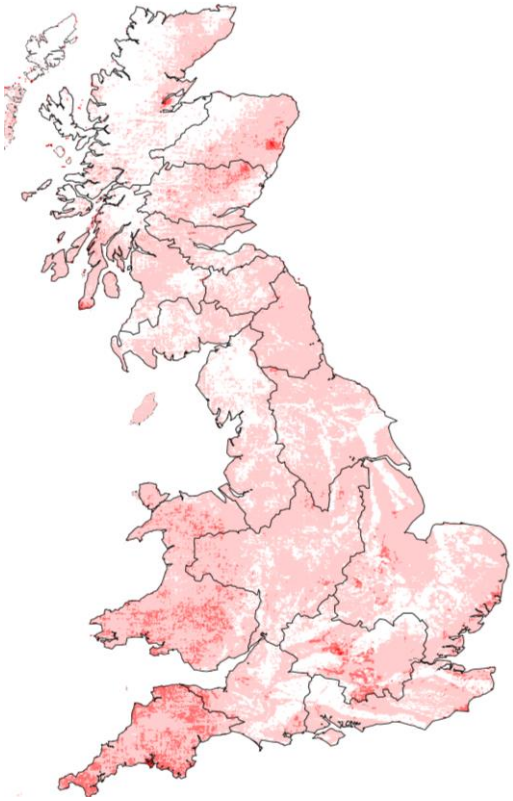
The subsurface storage deficit (mm) can be interpreted as an estimate of additional rainfall that would be required in future months to overcome dry conditions (i.e. rainfall in addition to what is expected on average). Regional mean values of additional rainfall required are provided in the table below.

Regional estimate of additional rainfall required (mm)

	SCOTLAND	
0	HR	Highlands Region
1	NER	North East Region
0	TR	Tay Region
0	FR	Forth Region
0	CR	Clyde Region
0	TWR	Tweed Region
0	SR	Solway Region
	ENGLAND	
8	N	Northumbria
0	NW	North West
0	Y	Yorkshire
0	ST	Severn Trent
0	A	Anglian
0	T	Thames
0	W	Wessex
0	S	Southern
22	SW	South West
	WALES	
13	WEL	Welsh







Water storage deficit (anomaly; mm)

- >125
- 100-125
- 75-100
- 50-75
- 25-50
- 0-25
- <0

July 2024

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Return Period of Rainfall Required to Overcome Dry Conditions

Period: July 2024 - December 2024

Issue date: 02.07.2024

CURRENT CONDITIONS

These maps show the return period of the rainfall required to overcome dry conditions simulated using the Grid-to-Grid (G2G) hydrological model. The maps are coloured according to the return period of accumulated rainfall required to overcome the estimated current subsurface water storage deficit over the next one to six months (areas with no storage deficit will always be white). These maps do not provide a drought forecast; instead they indicate whether particularly heavy rainfall would be required to return to normal conditions for the time of year.

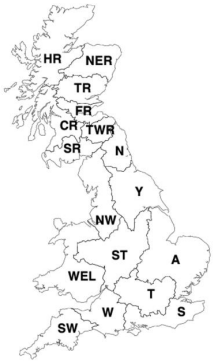
SUMMARY: Although select parts of Great Britain exhibit modest subsurface water storage deficits, none will require particularly abnormal (>5-year return period) rainfall to return to typical conditions for the time of year.

Jul

Aug

Sep

SCOTLAND
HR Highlands Region
NER North East Region
TR Tay Region
FR Forth Region
CR Clyde Region
TWR Tweed Region
SR Solway Region
ENGLAND
N Northumbria
NW North West
Y Yorkshire
ST Severn Trent
A Anglian
T Thames
S Southern
W Wessex
SW South West
WALES
WEL Welsh



Oct

Nov

Dec

Rainfall amount (Probability)		Return period (years)
Low (Likely)	>20%	<5
	<20%	5-10
	<10%	10-25
	< 4%	25-50
High (Less likely)	< 2%	50-100
	< 1%	100-200
Extreme (Unlikely)	<0.5%	>200

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July 2024

UK Centre for Ecology & Hydrology

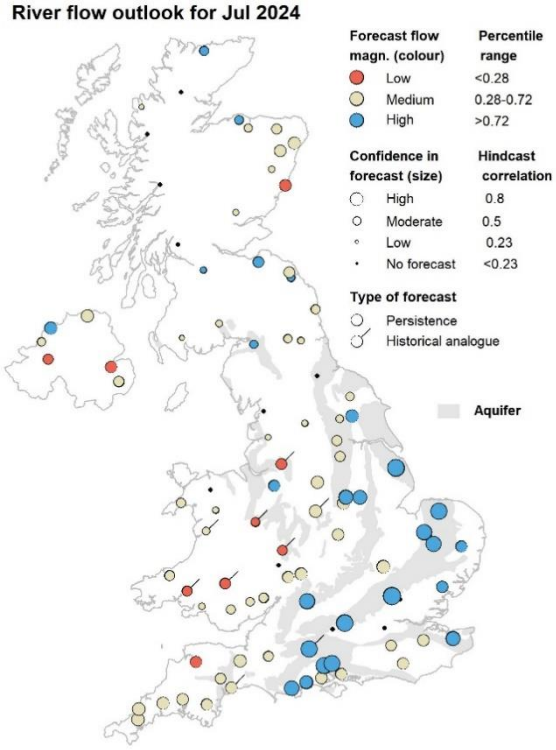
Outlook based on hydrological persistence and analogy

Overview

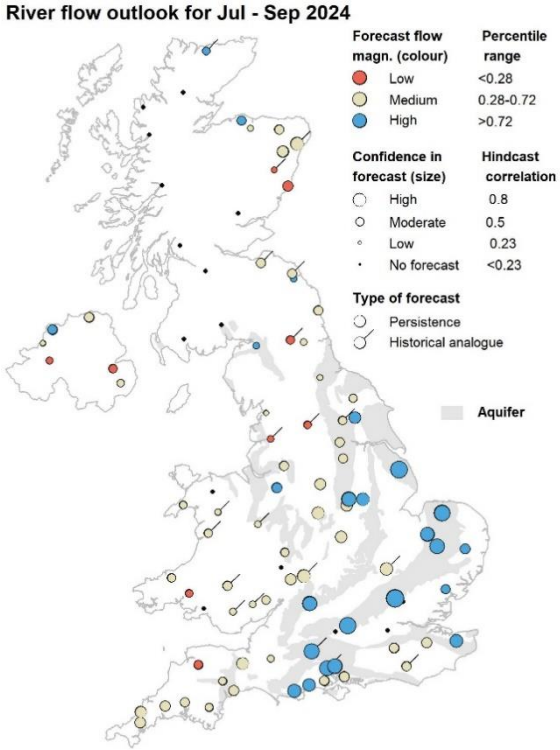
Period: July 2024 – September 2024

Issued on 08.07.2024 using data to the end of June 2024

SUMMARY:
The July and July – September outlooks both indicate that river flows in south-east England are likely to be normal to above normal. Elsewhere, river flows are likely to be in the normal range, although with some below normal flows in south-west England, Wales and Northern Ireland possible. Note that the confidence of the forecasts in north-western areas is low.



1-month flow outlook



3-month flow outlook

Outlooks from hydrological analogues are based on a comparison of river flow during recent months with flows during the same months in previous years at a set of approximately 90 sites from across the UK. These sites are depicted on the two maps. Years with observed flows that most closely resemble current conditions are identified as the best analogues and the outlook is based on extrapolating from current conditions based on these analogues.

It is, however, often the case that a simpler forecast based on the persistence of river flow provides a better forecast than provided by analogy. This is particularly true for slowly responding catchments associated with aquifer outcrops.

Both methods are considered at each site and the forecast from the method with the higher confidence is presented. A simple classification of flows is used (high, medium and low) as indicated by the colours of the dots, with the confidence of the forecast being represented by the size of the dot. A tag on the dot indicates which method has been used in each instance.

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Outlook based on hydrological persistence and analogy

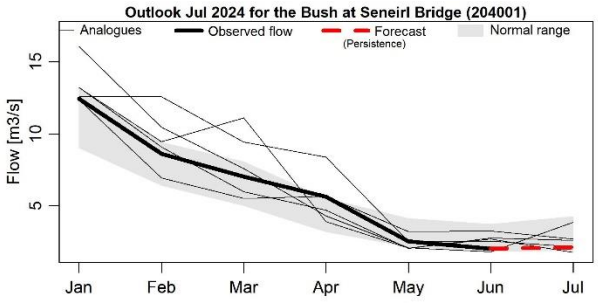
Site-based: 1 month outlook

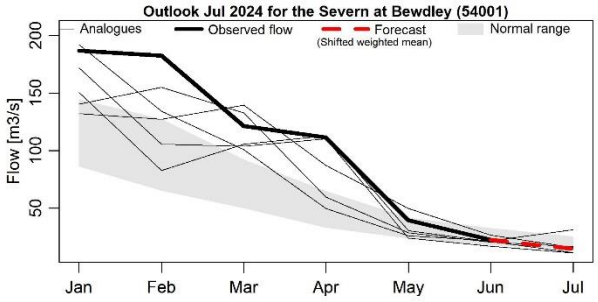
Period: July 2024

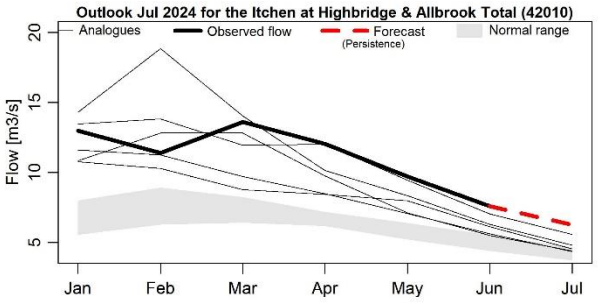
Issued on 08.07.2024 using data to the end of June 2024

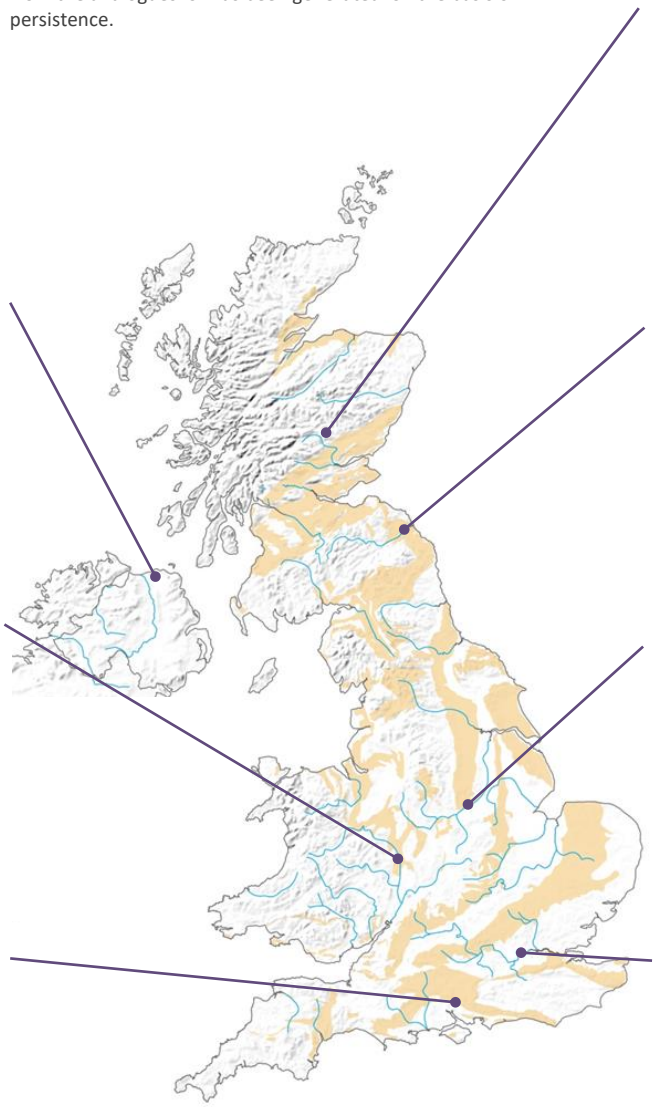
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

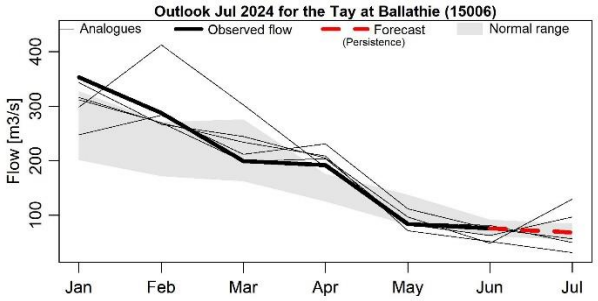
In each of the time series graphs the bold black line represents the observed flow during the past six months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows took in the following month are also shown. The forecast is shown as the dashed red line, and in each plot it states whether this has come from the analogues or has been generated on the basis of persistence.

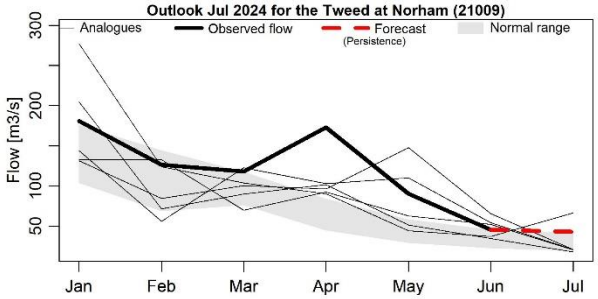


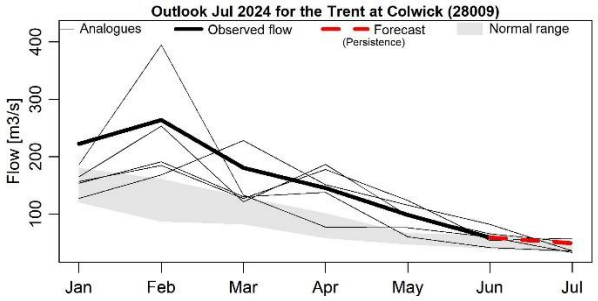


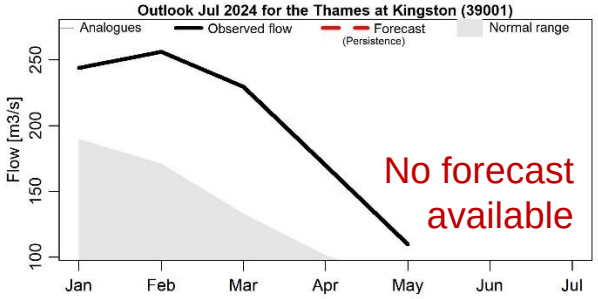












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Outlook based on hydrological persistence and analogy

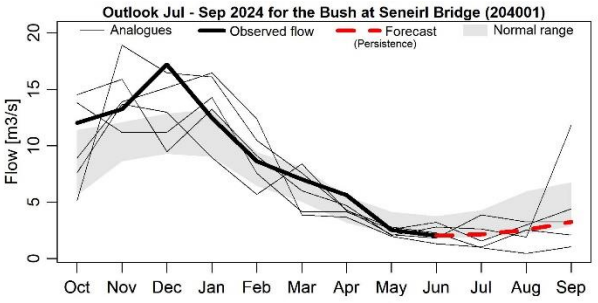
Site-based: 3 month outlook

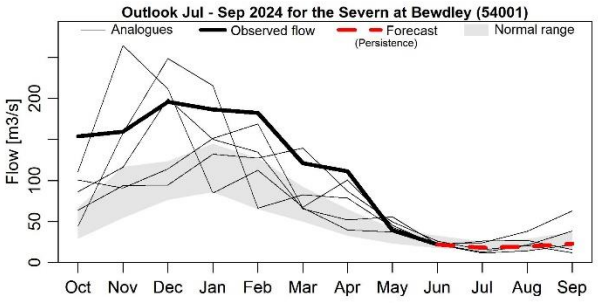
Period: July 2024 – September 2024

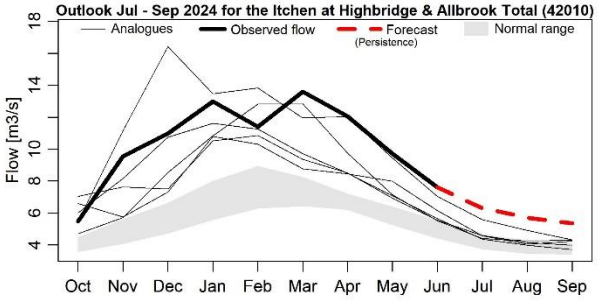
Issued on 08.07.2024 using data to the end of June 2024

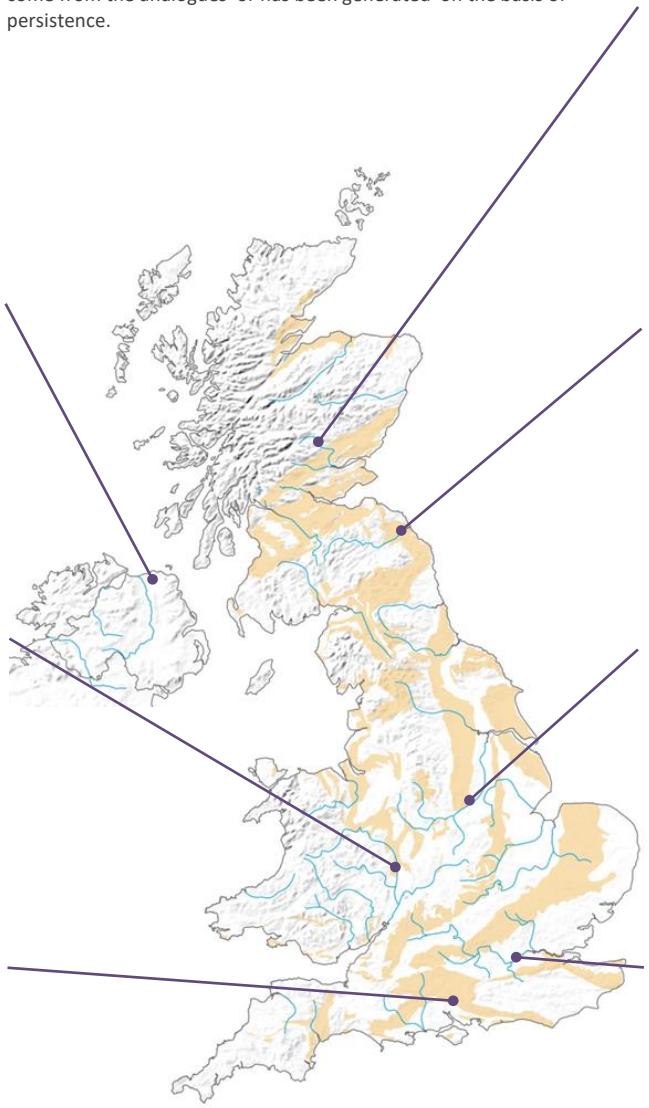
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

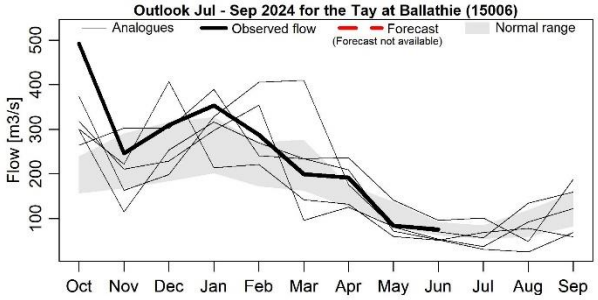
In each of the time series graphs the bold black line represents the observed flow during the past nine months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows took in the following three months are also shown. The forecast is shown as the dashed red line, and in each plot it states whether this has come from the analogues or has been generated on the basis of persistence.

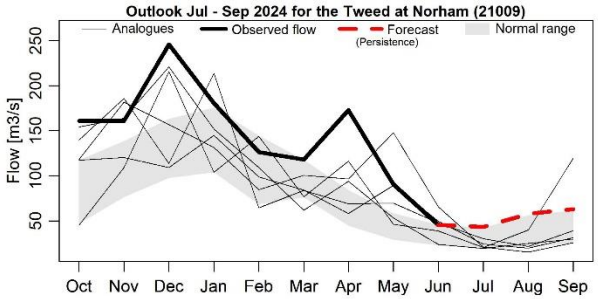


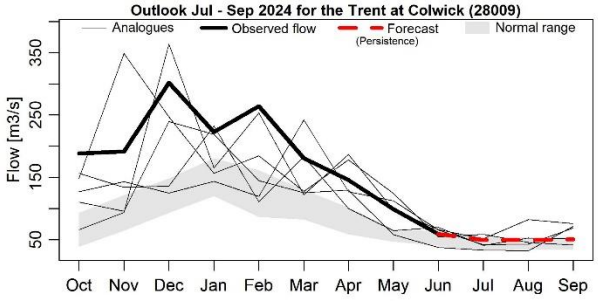


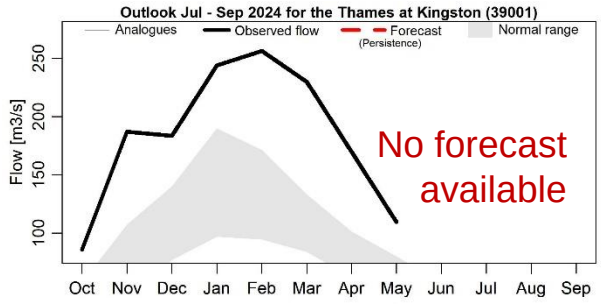












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RIVER FLOW ANALOGY

July 2024

UK Centre for Ecology & Hydrology

British Geological Survey

Environment Agency

Outlook based on modelled flow from historical climate

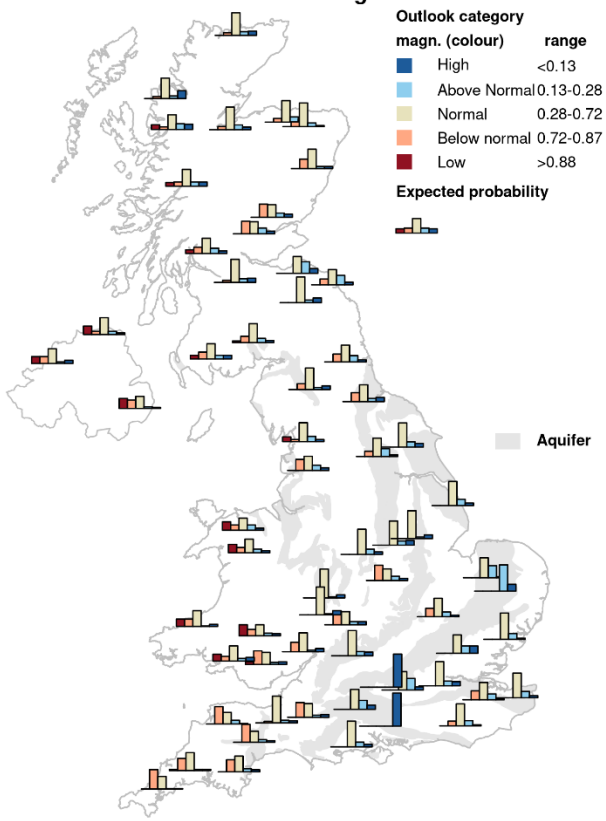
Overview

Period: July 2024 – December 2024

Issued on 02.07.2024 using data to the end of June 2024

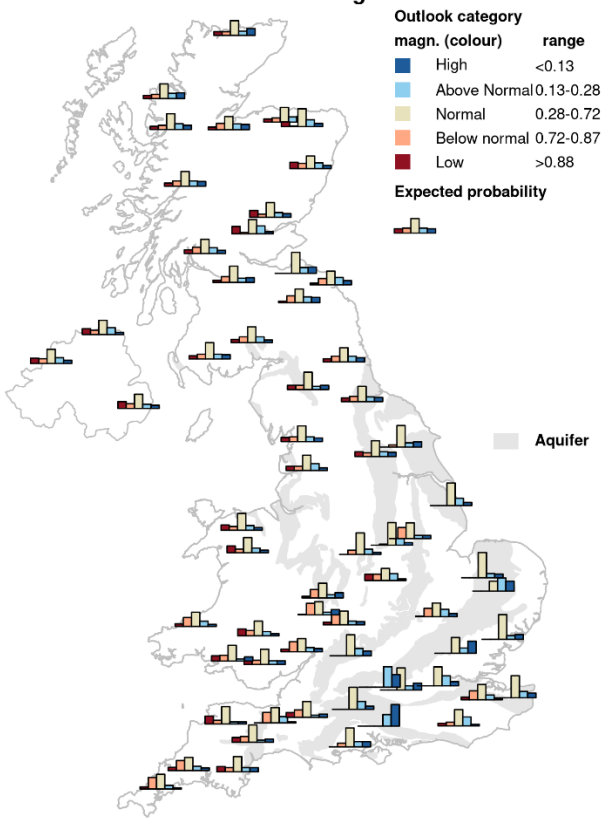
The outlook for July indicates that flows are likely to be normal to below normal for Wales, south-west England, and Northern Ireland. Elsewhere in the UK flows are likely to be within the normal range, with some catchments in southern England likely to have above normal to high flows. The July-September outlook shows that this pattern is likely to persist over the coming few months, with flows remaining above normal in some catchments in the south.

1-month river flow outlook starting Jul 2024



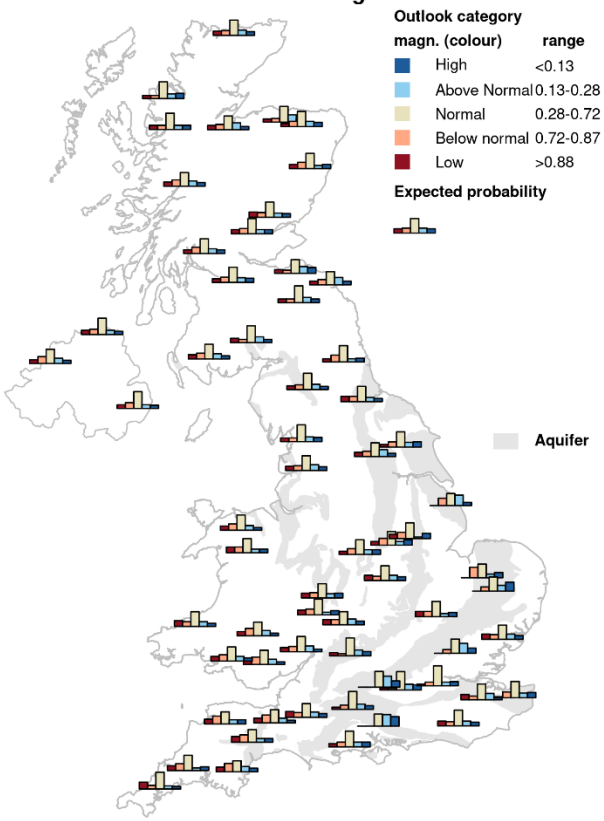
This outlook is based on monthly ensembles of historical sequences of observed climate (rainfall and potential evapotranspiration) that form input to a hydrological model. The outputs are probabilistic simulations of the average river flow over the forecast period (1 to 12 months ahead), at each location. The simulations are generated by the GR6J conceptual rainfall-runoff model from INRAE (France) calibrated on observed or naturalised flows.

3-month river flow outlook starting Jul 2024



The bar plot maps show the outlook distribution for 1, 3 and 6-month period for 64 catchments across England and Wales. Each bar plot represents the probabilistic distribution of the simulated river flow compared to the historical river flow, for the same n-month period. The probabilities fall within five categories, classified as: low, below normal, normal, above normal and high.

6-month river flow outlook starting Jul 2024



This outlook is based entirely on historical sequences and therefore does not contain any knowledge of the state of the atmosphere and ocean. It is hence possible that some of the historical sequences used might be inconsistent with current large-scale atmospheric conditions and would therefore be unlikely to occur in the next few months.

Please note that *Outlooks based on modelled flow from historical climate* from October 2023 onwards were generated using GR6J model, whereas until September 2023, they were produced using GR4J model. For more details, please see the section on River flow from historical climate at this link: https://hydoutuk.net/about/methods/river-flows

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UK Centre for Ecology & Hydrology

British Geological Survey

Environment Agency

Outlook based on modelled flow from historical climate

Overview

This outlook is based on monthly ensembles of historical sequences of observed climate (rainfall and potential evapotranspiration) that form input to a hydrological model. The outputs are probabilistic simulations of the average river flow over the forecast period (1 to 12 months ahead), at each location. The simulations are generated by the GR6J conceptual rainfall-runoff model from INRAE (France) calibrated on observed or naturalised flows.

The stack diagrams show the variation over time of the outlook distribution for a number of individual catchments. Each graph represents variation over time of the number of simulated river flows, in each month ensemble, that fall within each of seven categories: exceptionally low, notably low, below normal, normal, above normal, notably high and exceptionally high. The categories represent cumulative flow conditions, e.g. For 3-month, the simulated total 3-month flow compared to the historical 3-month flow distribution. The monthly variations can be compared to the long-term average distribution of river flows (shown as columns on the right of each timeline graph).

This outlook is based entirely on historical sequences and therefore does not contain any knowledge of the state of the atmosphere and ocean. It is hence possible that some of the historical sequences used might be inconsistent with current large-scale atmospheric conditions and would therefore be unlikely to occur in the next few months.

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RIVER FLOW FROM HISTORICAL CLIMATE

July 2024

UK Centre for Ecology & Hydrology

Met Office

Outlook based on modelled flow using historical weather analogues

Period: July 2024 – September 2024

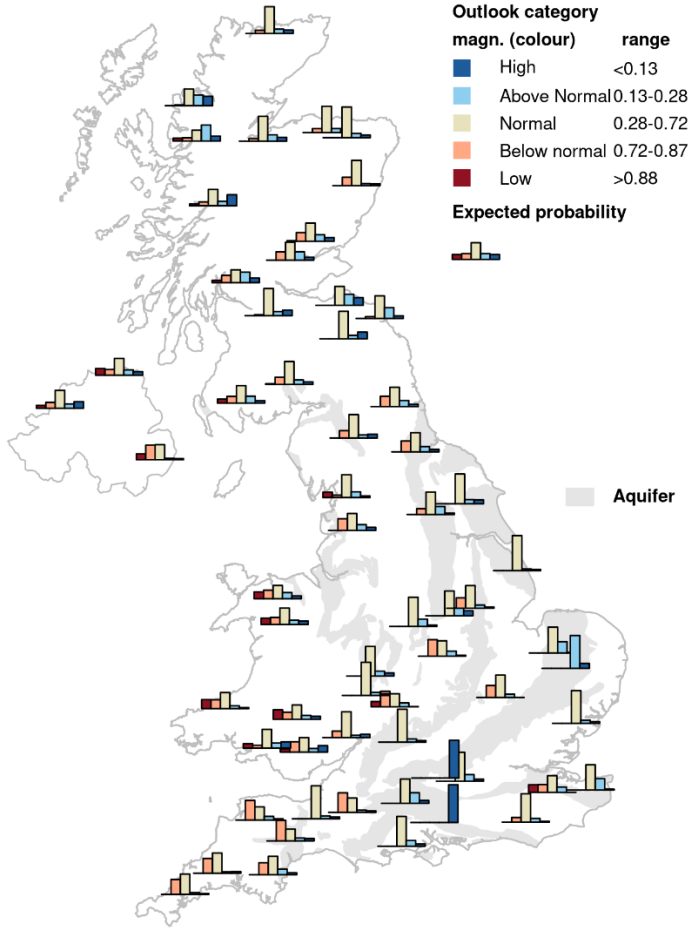
Issued on 02.07.2024 using data to the end of June 2024

The outlook for July indicates that flows are likely to be normal to below normal for Wales and south-west England. In some southern catchments flows are likely to be high. Throughout the rest of the UK, flows are likely to be within the normal range. The July-September outlook indicates a slight shift towards more normal flows across the UK. Flows for some catchments in the south of England are likely to remain high.

The historical weather analogues method uses Met Office predictions of average weather 1 and 3 months ahead to provide inputs to a hydrological model. Like the ESP method, observed rainfall and temperature data from past years are used to drive the predictions, however, the analogue method constrains the selection of past rainfall using the weather conditions in the meteorological forecasts (which are summarised for this forecast in the Met Office likelihood of impacts blocks underneath the maps). For each member of the Met Office forecast ensemble, the 10 analogues that best match the predicted average weather pattern (surface pressure map) over the forecast period are selected. Precipitation and temperature sequences constructed from the selected analogue scenarios are corrected to account for historic trends and used as inputs to hydrological models. Here, the GR6J model is run using these inputs, creating an ensemble of hydrological forecasts.

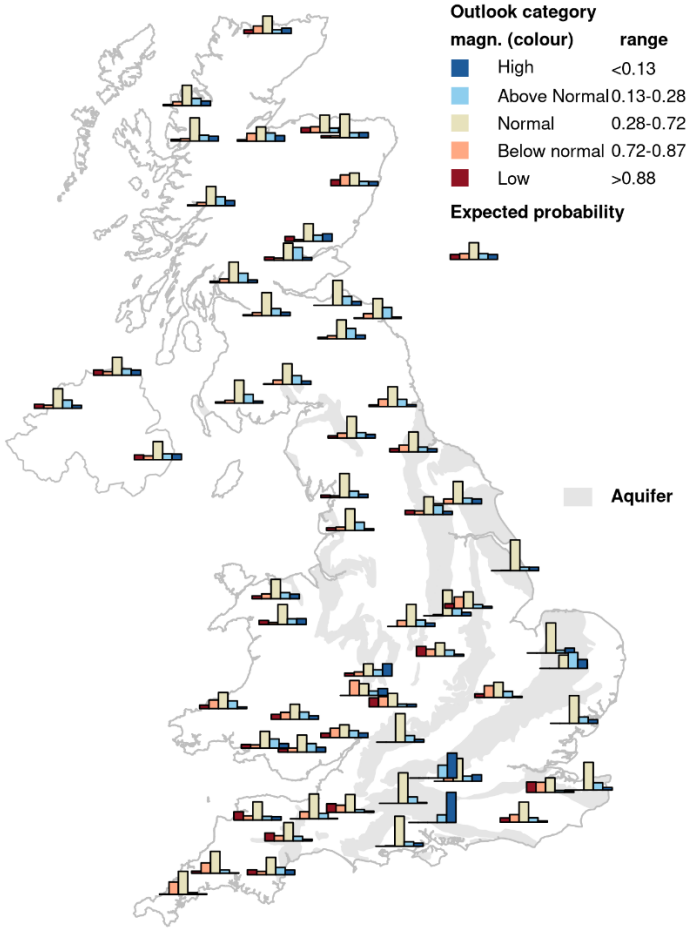
The outputs shown in the maps are the likelihoods of different outcomes for the average river flow over the one-month and three-month forecast periods at each location. The outlooks maps show the distribution for 64 catchments across the United Kingdom. Each bar plot represents the likelihood of the simulated river flow compared to the historical river flow, for the same n-month period. The probabilities fall within five categories, classified as: low, below normal, normal, above normal and high. The expected climatological probability of ensemble members in each of these categories is shown under the legend.

1-month river flow outlook starting Jul 2024



Met Office 1-month likelihood of precipitation impact

3-month river flow outlook starting Jul 2024



Met Office 3-month likelihood of precipitation impact

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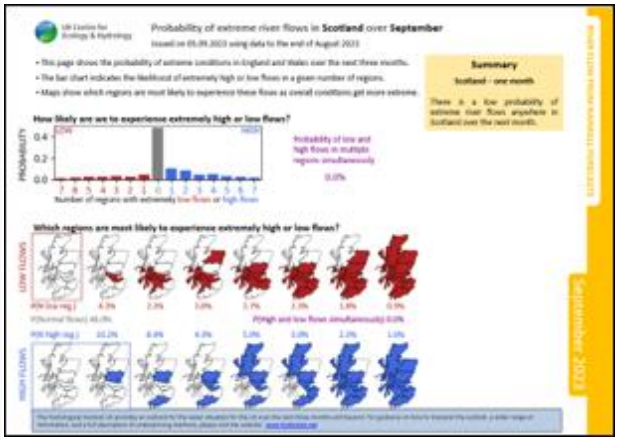
UK Centre for Ecology & Hydrology

Forecasts of river flows using Met Office rainfall forecasts

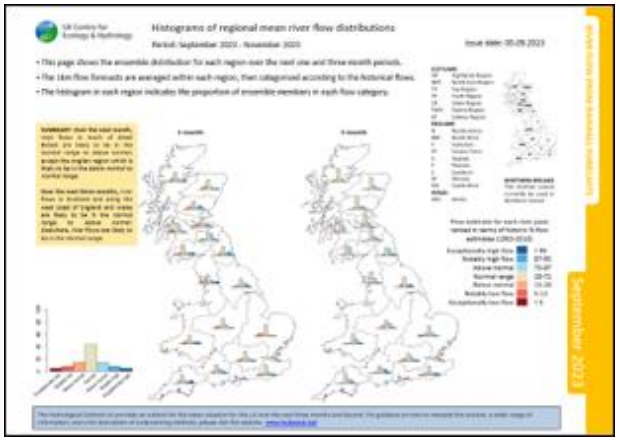
- These (yellow edged) pages summarise river flow forecasts produced by the UKCEH Water Balance Model.
- This model uses an ensemble of rainfall forecasts provided by the Met Office and a hydrological model to forecast river flows for the next one- and three-months ahead.
- A detailed description of these forecast products can be found on the final page, and a full technical description is given in the documentation available via the Hydrological Outlook website.
- Additional forecast products are available on the Hydrological Outlook Portal, via the website.

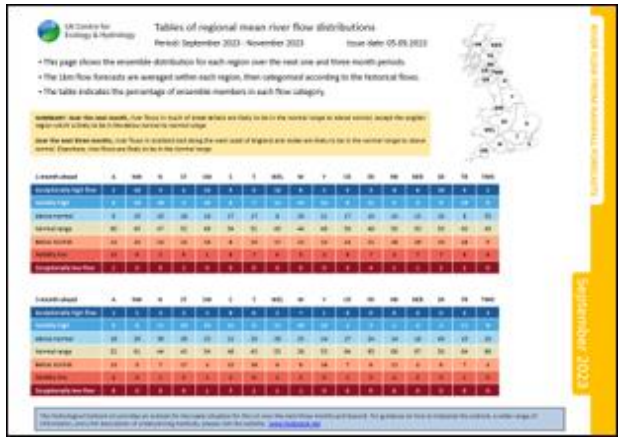
Probability of extreme river flows



- **Use these pages if you are interested in extreme conditions across multiple regions.**
- These pages summarise the risk of extremely high or low flows being observed across GB.
- The four pages show the risk for **Scotland** and for **England & Wales** over the next one and three months.
- The slides indicate the **probability of widespread extreme conditions** and which regions are most likely to experience extremely high or low flows.

Regional mean river flow distributions





- **Use these pages if you are interested in the ensemble distribution in a single region.**
- The first page shows the ensemble distribution as a histogram for each region.
- The second page shows the percentage of ensemble members in each band for each region.

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RIVER FLOW FROM RAINFALL FORECASTS

July 2024

UK Centre for Ecology & Hydrology

Probability of extreme river flows in **Scotland** over **July**

Issued on 02.07.24 using data to the end of June 2024

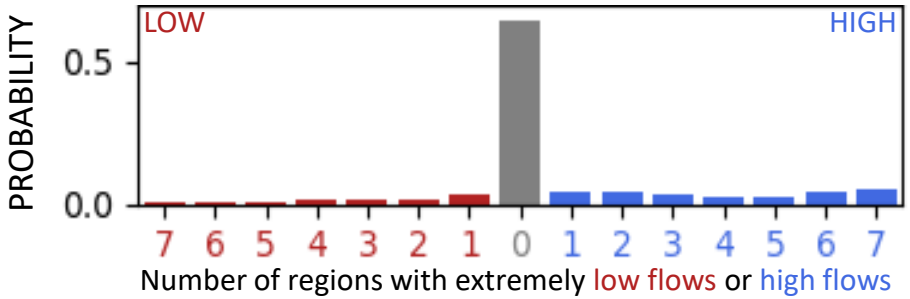
This page shows the **probability of extreme conditions in Scotland** over the next month. The bar chart indicates the likelihood of extremely high or low flows in a given number of regions. Maps show which regions are most likely to experience these flows as overall conditions get more extreme.

Summary

Scotland – one month

Extreme flows are not likely to occur in Scotland over July.

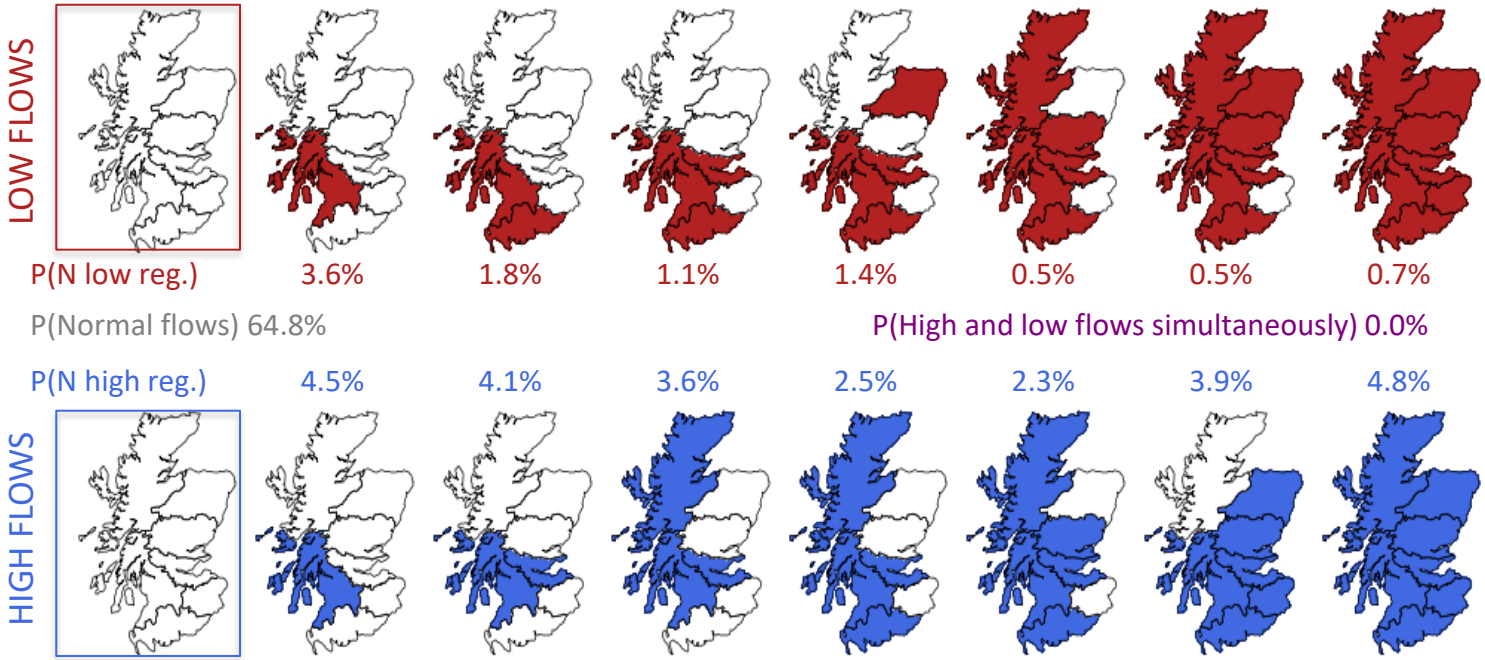
How likely are we to experience extremely low or high flows?



Probability of low and high flows in multiple regions simultaneously

0.0%

Which regions are most likely to experience extremely low or high flows?



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RIVER FLOW FROM RAINFALL FORECASTS

July 2024

UK Centre for Ecology & Hydrology

Probability of extreme river flows in **Scotland** over **July to September**

Issued on 02.07.24 using data to the end of June 2024

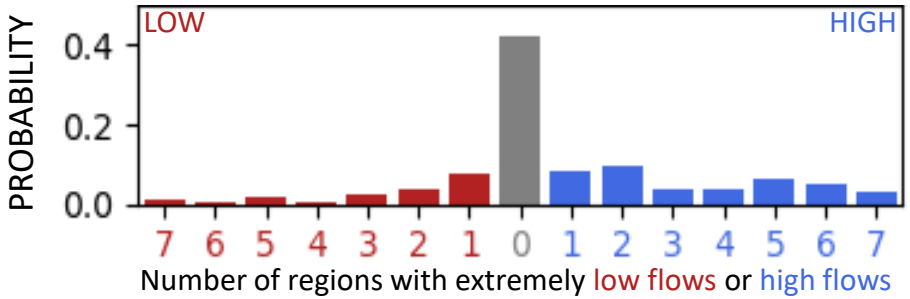
This page shows the **probability of extreme conditions in Scotland** over the next three months. The bar chart indicates the likelihood of extremely high or low flows in a given number of regions. Maps show which regions are most likely to experience these flows as overall conditions get more extreme.

Summary

Scotland – three months

Extreme flows are unlikely in Scotland over July-September. If they occur, high flows are likely to be localised to central Scotland.

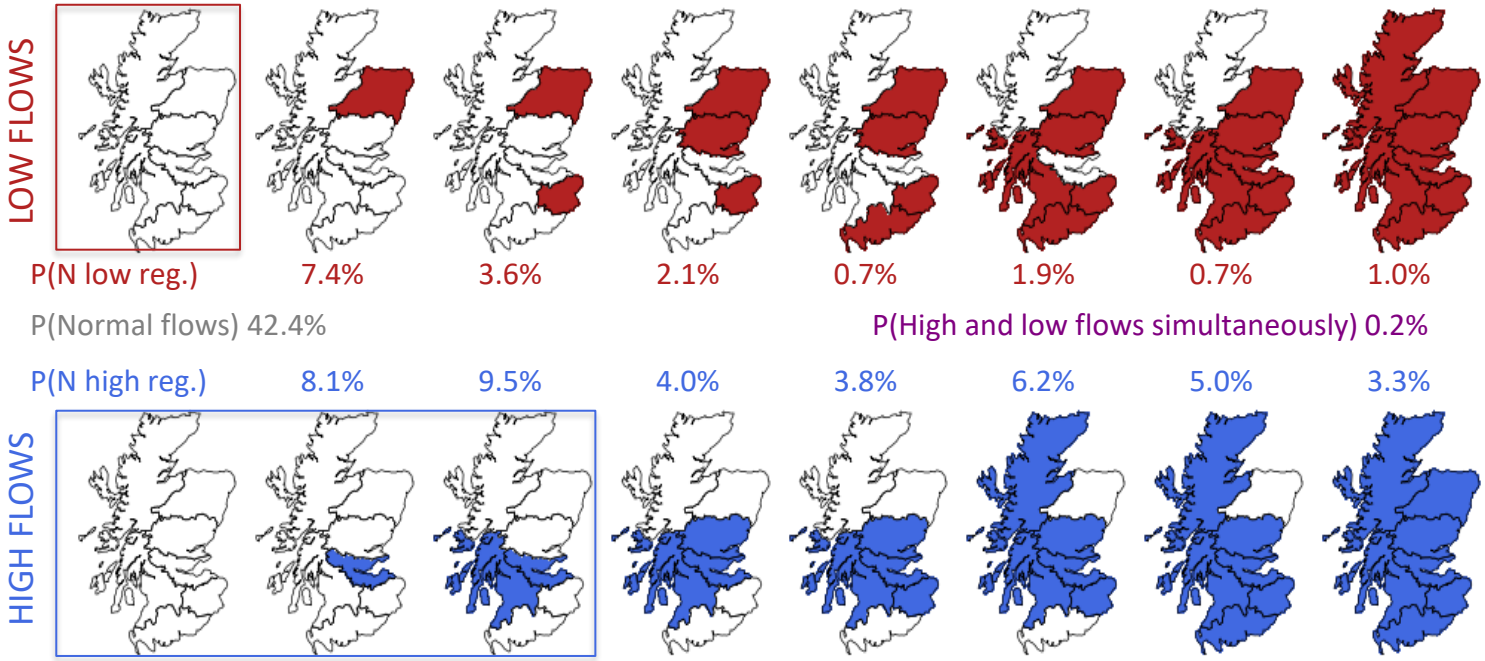
How likely are we to experience extremely low or high flows?



Probability of low and high flows in multiple regions simultaneously

0.2%

Which regions are most likely to experience extremely low or high flows?



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RIVER FLOW FROM RAINFALL FORECASTS

July 2024

UK Centre for Ecology & Hydrology

Probability of extreme river flows in **England and Wales** over **July**

Issued on 02.07.24 using data to the end of June 2024

RIVER FLOW FROM RAINFALL FORECASTS

July 2024

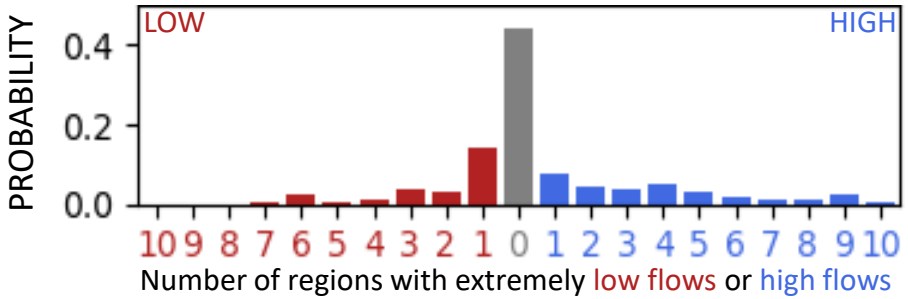
This page shows the **probability of extreme conditions in England and Wales** over the next month. The bar chart indicates the likelihood of extremely high or low flows in a given number of regions. Maps show which regions are most likely to experience these flows as overall conditions get more extreme.

Summary

England and Wales – one month

Extreme flows are unlikely to occur in England and Wales over July. If they occur, high flows are most likely to be found in Wales.

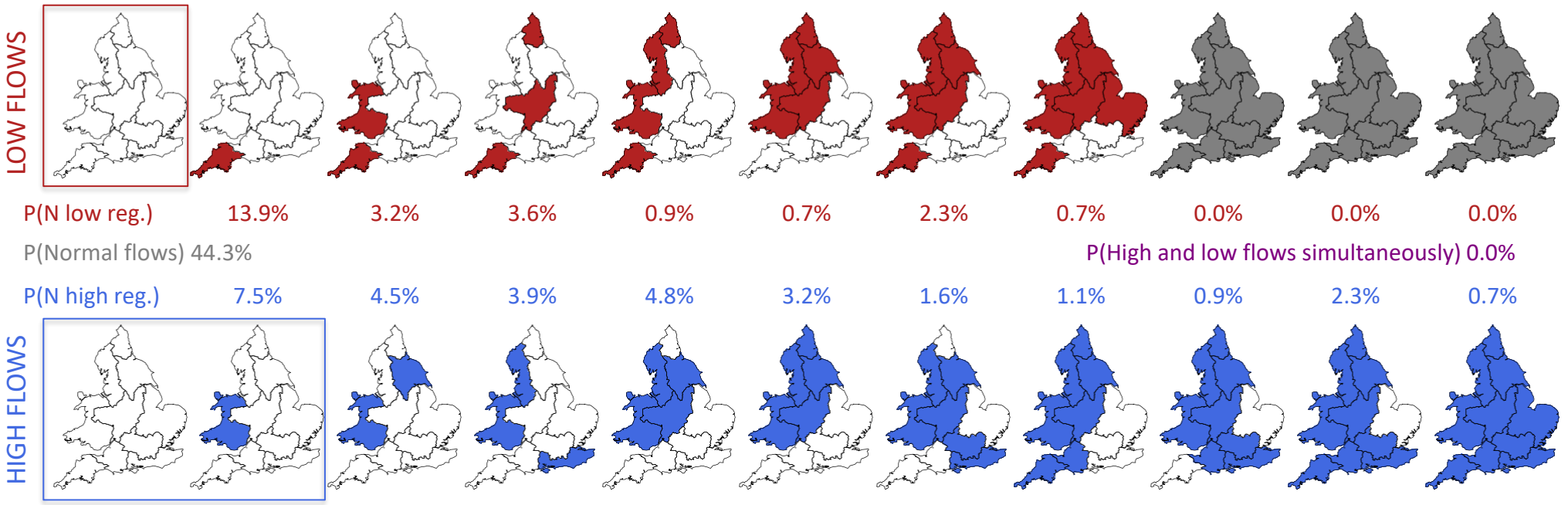
How likely are we to experience extremely low or high flows?



Probability of low and high flows in multiple regions simultaneously

0.0%

Which regions are most likely to experience extremely low or high flows?



P(N low reg.)	13.9%	3.2%	3.6%	0.9%	0.7%	2.3%	0.7%	0.0%	0.0%	0.0%
P(N high reg.)	7.5%	4.5%	3.9%	4.8%	3.2%	1.6%	1.1%	0.9%	2.3%	0.7%

P(Normal flows) 44.3%

P(High and low flows simultaneously) 0.0%

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UK Centre for Ecology & Hydrology

Probability of extreme river flows in **England and Wales** over **July to September**

Issued on 02.07.24 using data to the end of June 2024

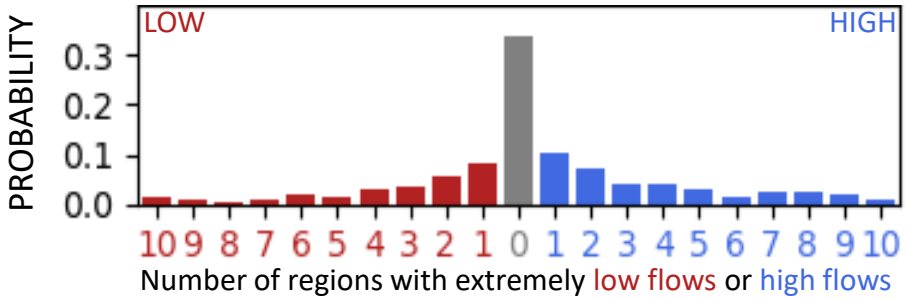
This page shows the **probability of extreme conditions in England and Wales** over the next three months. The bar chart indicates the likelihood of extremely high or low flows in a given number of regions. Maps show which regions are most likely to experience these flows as overall conditions get more extreme.

Summary

England and Wales – three months

Extreme flows are unlikely to occur in England and Wales over July-September. If they occur, high flows are most likely to be found in Wales.

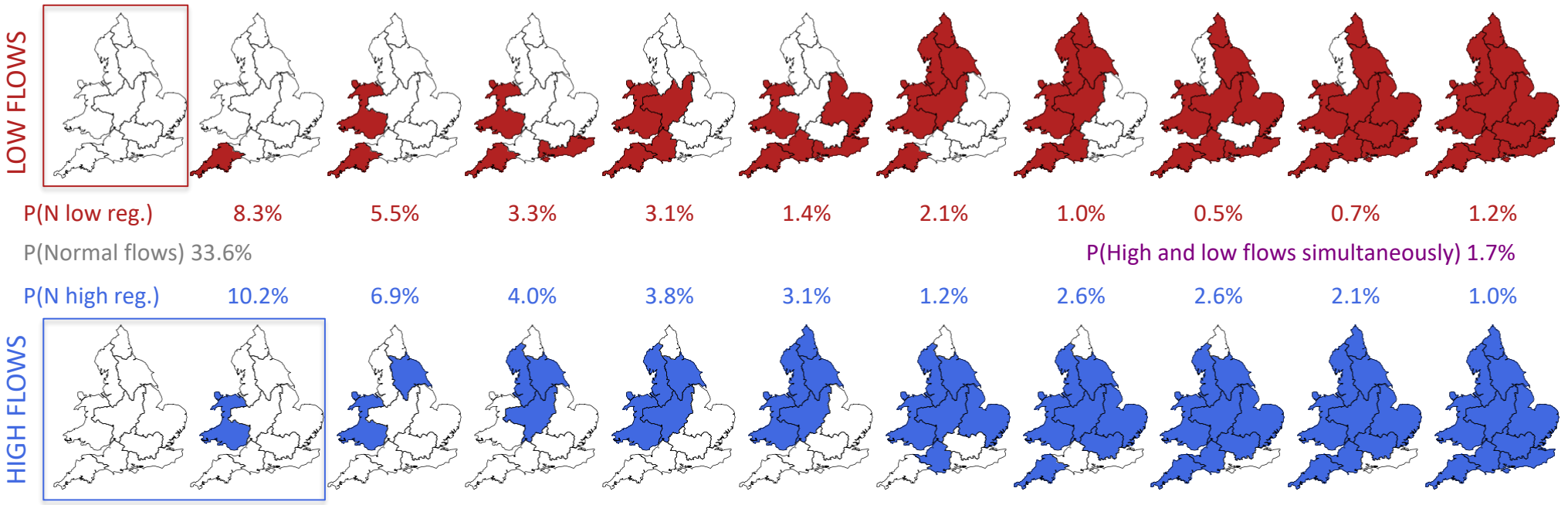
How likely are we to experience extremely low or high flows?



Probability of low and high flows in multiple regions simultaneously

1.7%

Which regions are most likely to experience extremely low or high flows?



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RIVER FLOW FROM RAINFALL FORECASTS

July 2024

UK Centre for Ecology & Hydrology

Histograms of GB regional mean river flow distributions

Period: July 2024 - September 2024

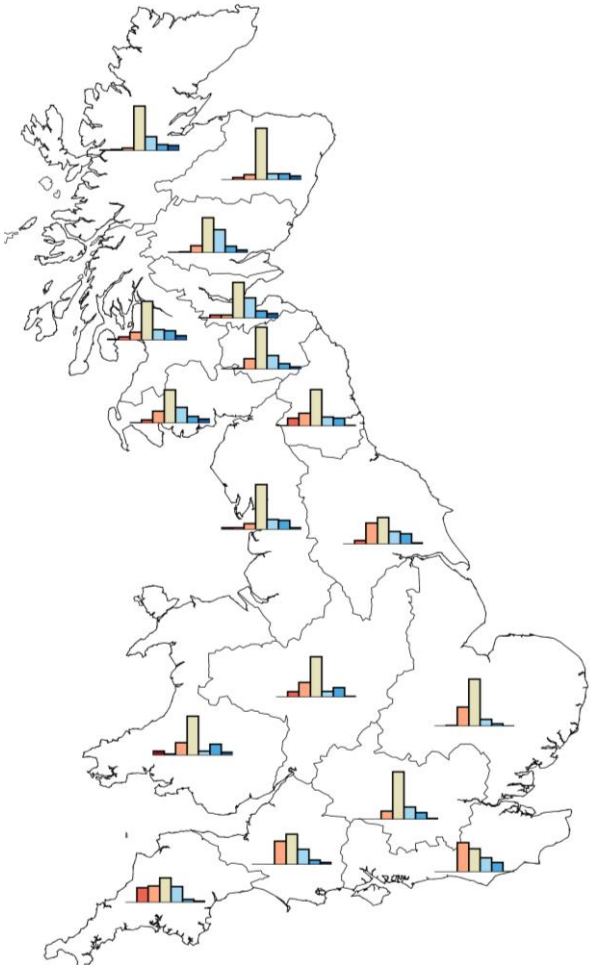
Issue date: 02.07.2024

- This page shows **the ensemble flow distribution for each region** over the next 1- and 3-month periods.
- The 1km flow forecasts are averaged within each region, then categorised according to the historical flows.
- The histogram in each region indicates the proportion of ensemble members in each flow category.

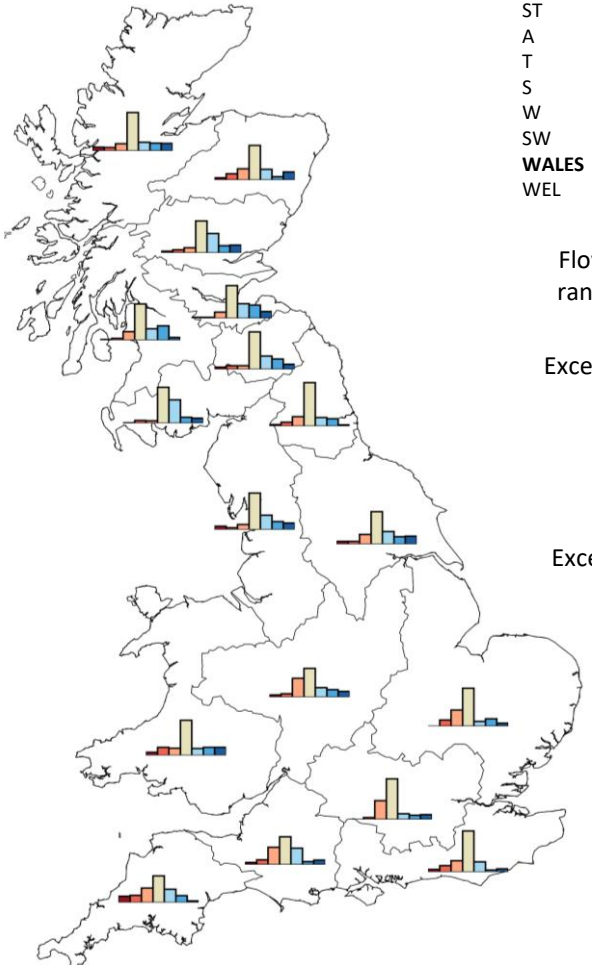
SUMMARY: Over the next month, river flows are likely to be in the *normal range* over most of Great Britain, with flows in southern and eastern Scotland likely to be in the *normal range* to *above normal*.

Over the next three months, river flows are likely to be in the *normal range* to *below normal* in southern parts of England, and in the *normal range* to *above normal* in northern England and southern parts of Scotland. Elsewhere, flows are likely to be in the *normal range*.

1-month



3-month



SCOTLAND

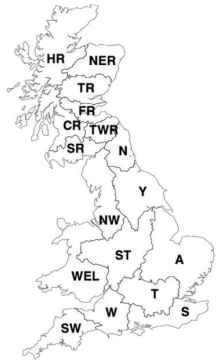
HR	Highlands Region
NER	North East Region
TR	Tay Region
FR	Forth Region
CR	Clyde Region
TWR	Tweed Region
SR	Solway Region

ENGLAND

N	Northumbria
NW	North West
Y	Yorkshire
ST	Severn Trent
A	Anglian
T	Thames
S	Southern
W	Wessex
SW	South West

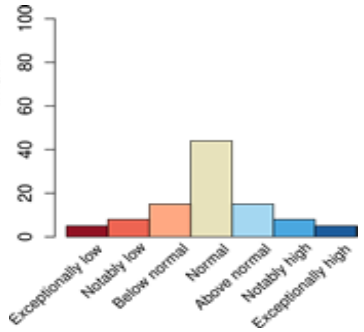
WALES

WEL	Welsh



Flow estimate for each river pixel ranked in terms of historic % flow estimates (1963-2016)

Exceptionally high flow	> 95
Notably high flow	87-95
Above normal	72-87
Normal range	28-72
Below normal	13-28
Notably low flow	5-13
Exceptionally low flow	< 5



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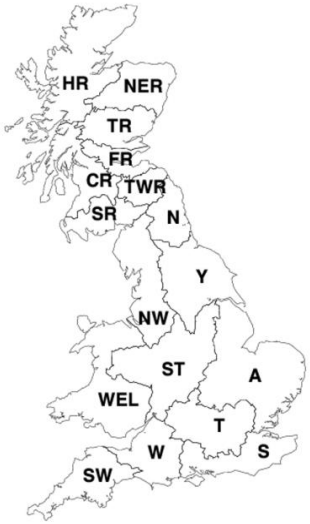
RIVER FLOW FROM RAINFALL FORECASTS

July 2024

UK Centre for Ecology & Hydrology

Tables of GB regional mean river flow distributions

Period: July 2024 - September 2024 Issue date: 02.07.2024



- This page shows **the ensemble flow distribution for each region** over the next 1- and 3-month periods.
- The 1km flow forecasts are averaged within each region, then categorised according to the historical flows.
- The table indicates the percentage of ensemble members in each flow category.

SUMMARY: Over the next month, river flows are likely to be in the *normal range* over most of Great Britain, with flows in southern and eastern Scotland likely to be in the *normal range* to *above normal*.

Over the next three months, river flows are likely to be in the *normal range* to *below normal* in southern parts of England, and in the *normal range* to *above normal* in northern England and southern parts of Scotland. Elsewhere, flows are likely to be in the *normal range*.

1-month ahead	A	NW	N	ST	SW	S	T	WEL	W	Y	CR	FR	HR	NER	SR	TR	TWR
Exceptionally high flow	0	3	1	1	2	0	1	4	3	2	6	6	7	5	6	4	3
Notably high	3	12	11	12	4	12	9	15	6	14	12	10	8	8	9	9	8
Above normal	9	13	12	8	21	18	16	6	20	17	14	27	19	8	21	30	18
Normal range	62	59	48	53	32	30	62	51	40	35	51	47	59	68	44	46	55
Below normal	25	8	17	19	22	38	11	17	31	28	11	4	4	7	16	9	14
Notably low	1	3	11	7	19	0	0	2	0	5	4	4	2	3	4	2	1
Exceptionally low flow	0	2	1	0	0	0	0	6	0	0	1	0	1	0	1	0	0

3-month ahead	A	NW	N	ST	SW	S	T	WEL	W	Y	CR	FR	HR	NER	SR	TR	TWR
Exceptionally high flow	4	9	2	8	2	4	6	10	6	11	4	9	10	10	7	10	7
Notably high	10	10	10	10	9	3	6	10	4	10	19	18	10	4	8	9	14
Above normal	6	19	11	13	18	13	8	9	22	17	15	19	11	14	31	26	18
Normal range	50	48	57	38	35	54	53	46	36	43	47	43	50	45	47	42	49
Below normal	21	7	13	24	19	15	24	10	23	13	11	8	9	15	3	7	5
Notably low	8	3	5	4	9	8	3	10	6	4	2	1	4	8	4	4	5
Exceptionally low flow	0	4	2	3	8	3	0	4	3	4	1	1	5	3	0	2	3

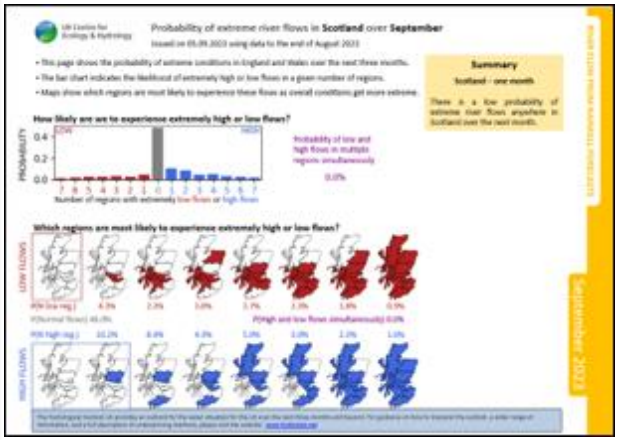
The Hydrological Outlook UK provides an outlook for the water situation for the UK over the next three months and beyond. For guidance on how to interpret the outlook, a wider range of information, and a full description of underpinning methods, please visit the website: www.hydoutuk.net

UK Centre for Ecology & Hydrology

Forecasts of river flows using Met Office rainfall forecasts

- The data on these (yellow-bordered) pages are based on approximately 400 rainfall scenarios provided by the Met Office, which are used as inputs to a water balance hydrological model.
- River flow forecasts for every 1km grid cell are ranked according to the historical flow estimates and aggregated within each region.
- A full description of this method and these summary products is given in the technical documentation available via the Hydrological Outlook website.

Probability of extreme river flows



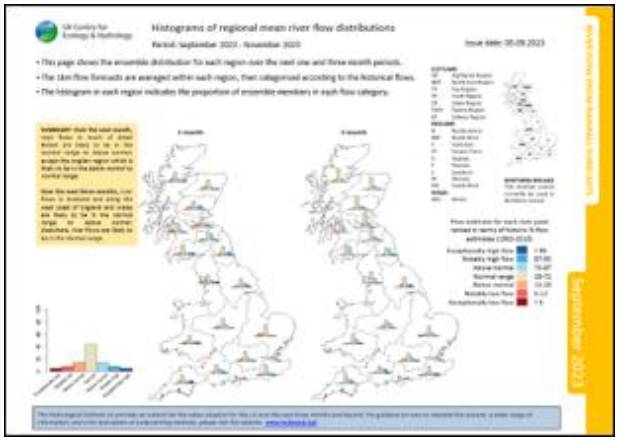
Extreme river flows are defined as those which rank in the lowest or highest 13% of historical flow estimates (1963 - 2016). This definition encompasses the 'Notably' and 'Exceptionally' high/low flow bands used elsewhere in the Outlook.

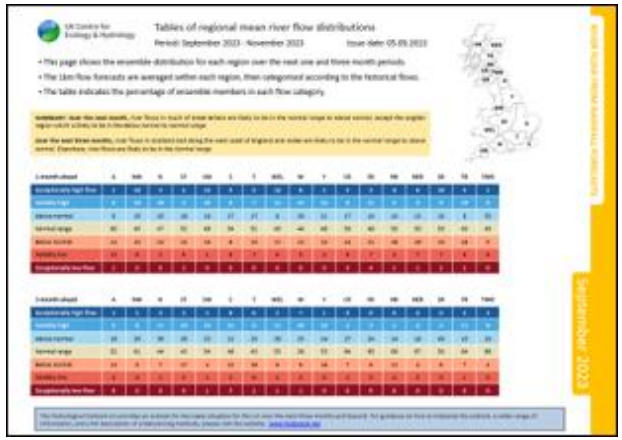
The bar chart shows the probability of a given number of regions experiencing extremely high/low flows, where scenarios showing both extremely high and extremely low flows in different regions simultaneously excluded. These probabilities are also shown beneath the maps.

Shaded regions on each map are those most likely to experience extreme flows from the set of scenarios with at least a given number of regions experiencing such flows. If shown, grey maps indicate scenarios not observed in the ensemble.

The box drawn around some maps spans the central 50% probability interval, excluding scenarios where extremely high/low flows are observed simultaneously. If these excluded cases constitute a significant probability, details are given in the yellow summary box.

Regional mean river flow distributions





The maps illustrate the ensemble distribution of regional mean river flows. The historical distribution is shown at bottom-left, and allows deviations from the normal distribution to be determined by comparing the forecast distribution to the historical distribution. A summary is given in the yellow box.

The table gives access to the data shown in the histograms. The numbers in the tables are the percentage of ensemble forecasts falling in each of the flow categories. As before results are averaged by region then ranked in terms of 54 years of historical regional flow estimates (1963 – 2016).

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British Geological Survey

Outlook based on modelled groundwater level & climate forecast

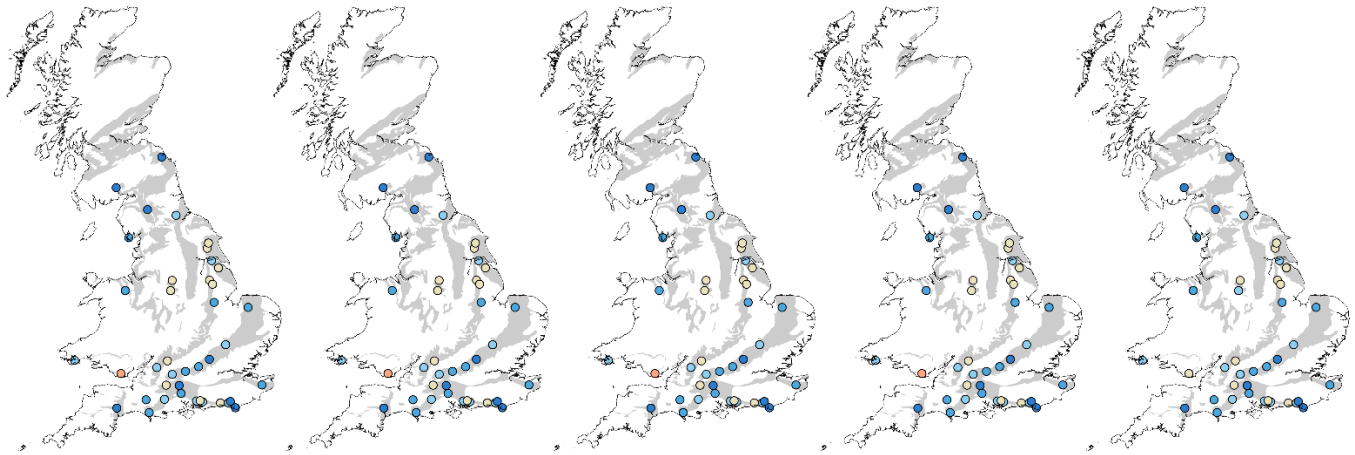
Overview

Period: July 2024 – September 2024

Issued on 08.07.2024 using data to the end of June.

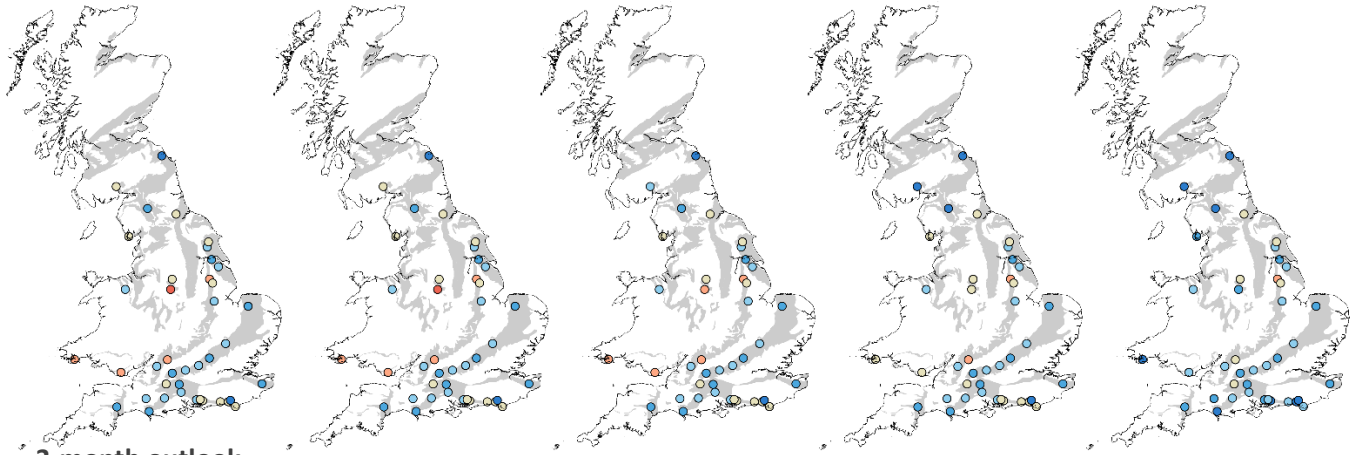
Under median rainfall conditions, groundwater levels over the next month are forecast to remain above normal to notably high across much of the UK, although in parts of central and northern England and south Wales, normal levels are anticipated. The 3-month outlook forecasts a decline in groundwater categories across the UK, and in some fast-responding regions of the Chalk and Jurassic limestone, normal to below normal levels are forecast. Groundwater levels in the Permo-Triassic Sandstones and slower responding regions of the Chalk aquifers are expected to remain similar to that of the one-month forecast.

Lowest rainfall forecast | *1st quartile* | *Median* | *3rd quartile* | *Highest rainfall forecast*



1-month outlook

Lowest rainfall forecast | *1st quartile* | *Median* | *3rd quartile* | *Highest rainfall forecast*

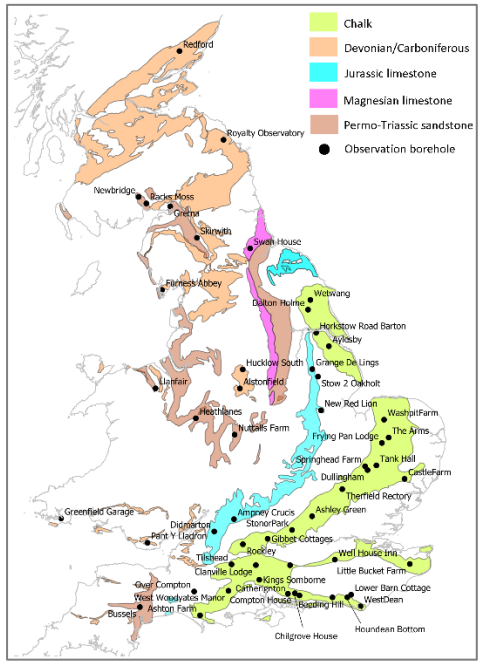


3-month outlook

These forecasts are produced by running five members of the Met Office ensemble climate forecast through groundwater models of observation borehole hydrographs at 42 sites across the country. The sites are distributed across the principal aquifers.

Based on the distribution of observed historical groundwater levels in a given month, seven categories have been derived for each site: very low, low, below normal, normal, above normal, high, and very high. The forecast groundwater level is assigned to one of these seven categories depending on where it falls within the distribution of the historically observed values.

Key	Percentile range of historic observed values for relevant month
Exceptionally high levels	> 95
Notably high levels	87-95
Above normal	72-87
Normal	28-72
Below normal	12-28
Notably low levels	5-13
Exceptionally low levels	< 5



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GROUNDWATER FROM CLIMATE FORECASTS

July 2024

UK Centre for Ecology & Hydrology

British Geological Survey

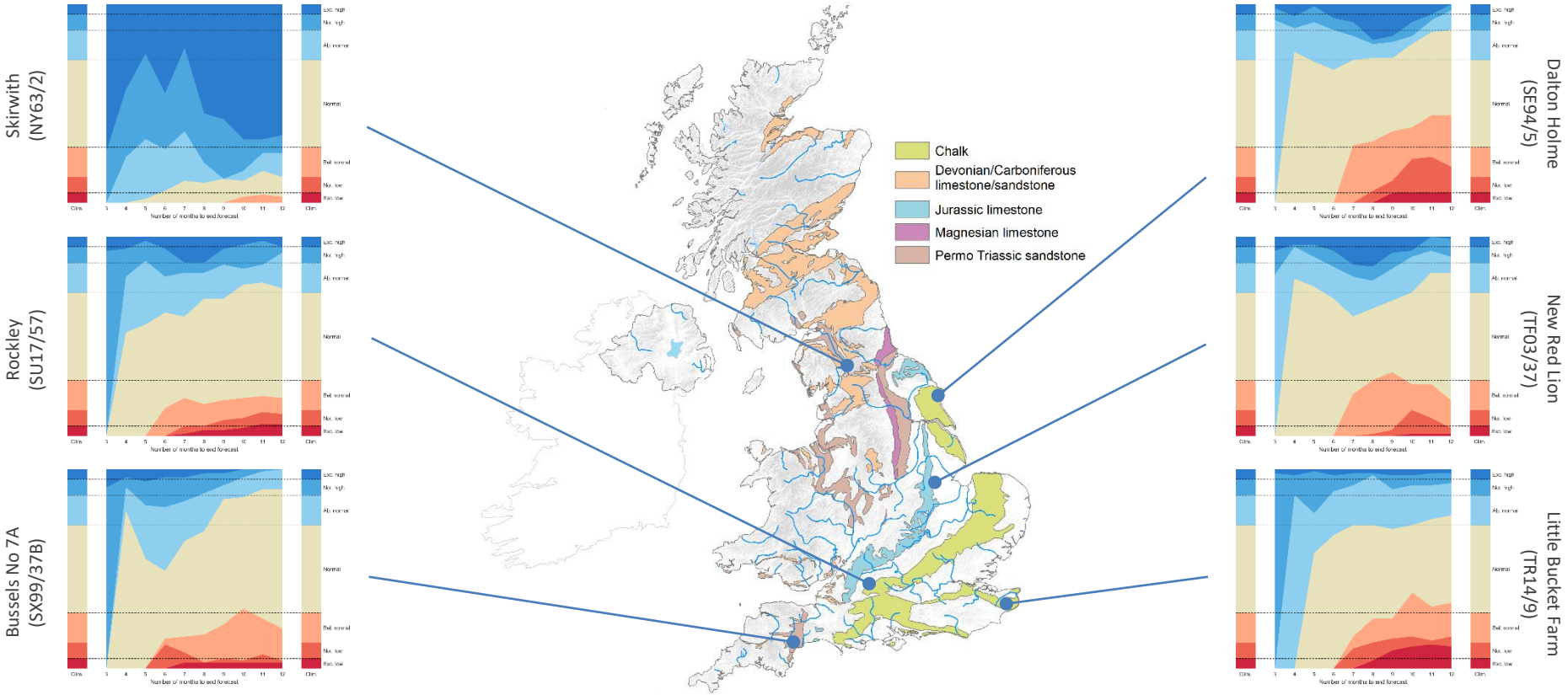
Environment Agency

Outlook based on modelled groundwater from historical climate

Period: July 2024 – June 2025

Issued on 08.07.2024 using data to the end of June.

Groundwater levels at Skirwith in the Permo-Triassic Sandstones are forecast to persist at exceptionally to notably high levels over the next 12 months. In the Chalk at Dalton Holme, the Permo-Triassic Sandstones at Bussels No 7A and the Jurassic Limestones at New Red Lion, above normal conditions are likely to continue for the next 1 - 3 months before transitioning towards more normal conditions. At Little Bucket Farm and Rockley, above normal to notably high conditions are forecast for the next 2 - 3 months, before giving way to normal conditions.



This outlook is based on monthly ensembles of historical sequences of observed climate (rainfall and potential evpotranspiration) that form input to hydrological models. The outputs are probabilistic simulations of the average groundwater level over the forecast horizon (3 to 12 months ahead), at each location.

The graphs show variation over time of the number of simulated groundwater levels in each monthly ensemble, that fall within each the seven categories: exceptionally low, notably low, below normal, normal, above normal, notably high and exceptionally high. The monthly variations can be compared to the long-term average distribution of levels, which are shown as columns on the left and right of each graph.

This outlook is based entirely on historical sequences and therefore does not contain any knowledge of the state of the atmosphere and ocean. It is hence possible that some of the historical sequences used might be inconsistent with current large-scale atmospheric conditions and would therefore be unlikely to occur in the next few months.

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