UK Hydrological Outlook

Delivered in partnership by: UK Centre for Ecology & Hydrology

Period: From March 2023 Issued on 08.03.2023 using data to the end of February 2023

SUMMARY The Outlook for March and for March-April-May as a whole is for river flows and groundwater levels to be normal to below normal across the UK. Notably low river flows and groundwater levels may persist across large parts of central and southern England. Above normal groundwater levels are likely in some parts of the Chalk and Permo-Triassic sandstones.

Rainfall:

Rainfall for February has been extremely low, with less than 30 percent of average seen across almost the entirety of central and southern England and Wales. Below average rainfall was also seen across the rest of the UK, with the exception of the northern Scottish highlands that saw average to slightly above average rainfall for February.

The forecast (issued by the Met Office on 27.02.2023) shows a higher than average likelihood (1.5 times the normal chance) that March, and March-April-May will be dry for the UK overall, with a decreased likelihood of a wet March and spring. Despite this UK-wide context, there is a greater chance of wetter spells of weather over southern parts of the UK in March, with north and north-eastern areas more likely to be drier than average.

River flows:

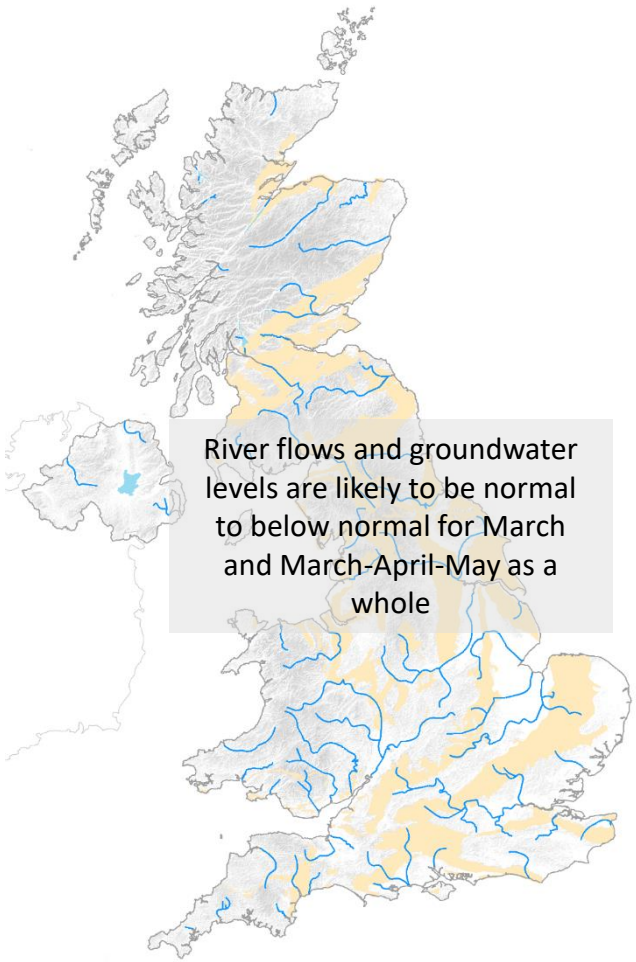
River flows in February closely followed the rainfall pattern received, with normal to exceptionally low flows across the UK, with the exception of parts of the Scottish highlands. Record breaking low flows were recorded in the Trent, Warleggan and Annacloy, with exceptionally low flows seen across large parts of central and south-western England.

River flows for March and March-April-May as a whole are likely to remain normal to below normal, with a high chance of exceptionally low flows in places. Flows in southern England and Wales may increase from their February levels in March due greater amounts of rainfall anticipated in these regions.

Groundwater:

Groundwater levels in February were generally normal to below normal, with some above normal levels recorded in the south-eastern Chalk and sandstones of central England. Levels responded quickly to February's low rainfall and started an early recession at several sites. Record breaking low levels were recorded in Greenfield Grange in south Wales.

Groundwater levels are likely to be normal to below normal across most of England and Wales for the next three months, and likely notably low in parts of the Chalk of southern England and the Jurassic limestones. Above normal levels are expected to continue in the eastern South Downs Chalk and northern Permo-Triassic sandstones.



Shaded areas show principal aquifers

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

HYDROLOGICAL OUTLOOK UK

March 2023

UK Centre for Ecology & Hydrology · British Geological Survey · Department for Infrastructure An Roinn Bonneagair www.infrastructure-ni.gov.uk · Environment Agency · Met Office · Cyfoeth Naturiol Cymru Natural Resources Wales · SEPA Scottish Environment Protection Agency

UK Hydrological Outlook

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About the 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 and 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 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, PDM and CLASSIC hydrological models and by the EA using CATCHMOD. Hydrogeological modelling uses the R-groundwater model run by BGS and CATCHMOD run by the EA. Supporting documentation is available from the Outlooks website:
https://www.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 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 Hydrological Outlook Partnership excludes all warranties or representations (express or implied) in respect of the Content.

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From April 2018 the 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 Hydrological Outlook, and the derivation of the maps, plots and interpretation provided in this outlook, please visit the Hydrological Outlook UK 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.

Contact:

Hydrological Outlooks UK, UK Centre for Ecology & Hydrology, Wallingford, Oxfordshire, OX10 8BB
t: 01491 692371 e: enquiries@hydoutuk.net

Reference for the Hydrological Outlook:

Hydrological Outlook UK, 2023, March, UK Centre for Ecology and Hydrology, Oxfordshire UK, Online, https://www.hydoutuk.net/latest-outlook/

Other Sources of Information:

The 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:
Environment Agency: https://flood-warning-information.service.gov.uk/map
Natural Resources Wales: https://flood-warning.naturalresources.wales/
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/#?tab=regionalForecast

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

Monthly mean river flows simulated by the Grid-to-Grid hydrological model

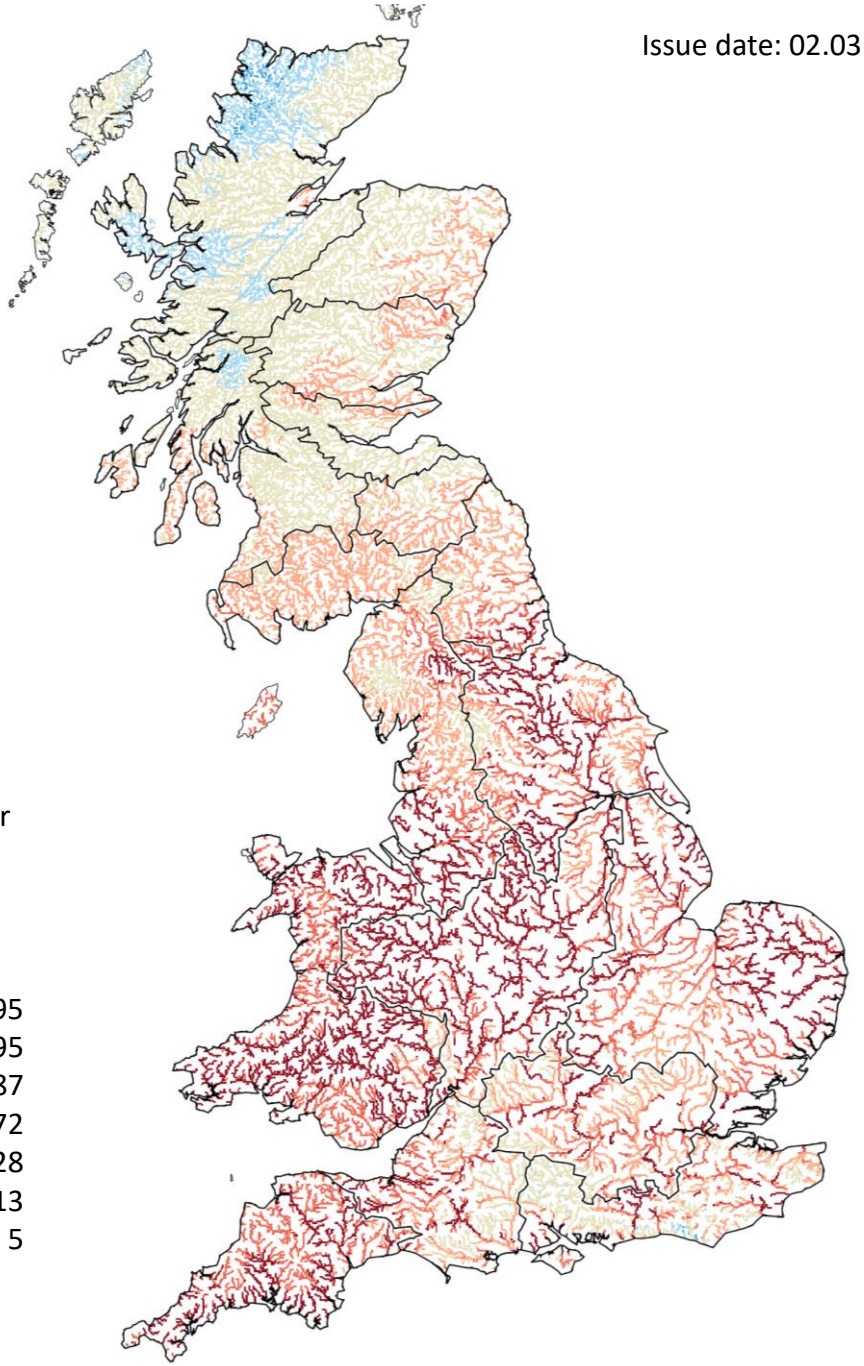
Period: March 2023

Issue date: 02.03.2023

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 28 February 2023

Issue date: 02.03.2023

These maps are based on Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean. To highlight areas that are particularly wet or dry, the storage anomaly is presented here using a colour scale highlighting water storage relative to historical extremes. The maps below show the "relative wetness" which combines maps previously shown separately as the "relative wetness" and "relative dryness".

These maps do not provide a forecast and are not maps of soil moisture. Instead they indicate areas which are particularly wet or dry. Rainfall in areas with high positive relative wetness could result in flooding in the coming days/weeks. Areas of negative relative wetness provide an indication of locations which are particularly dry, and little or no rain in these areas could potentially lead to (or prolong) a drought.

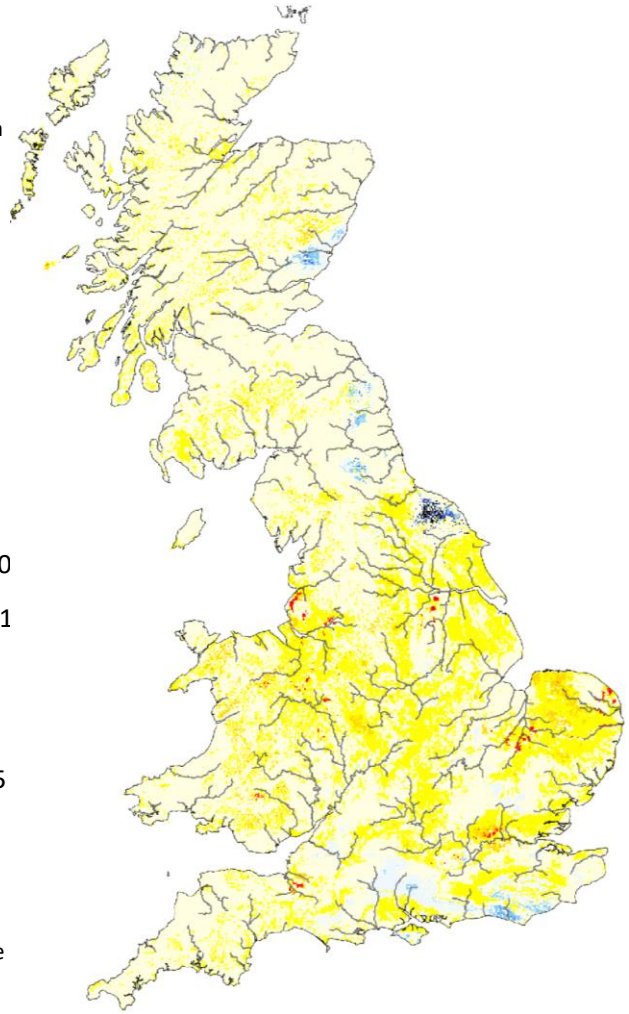
SUMMARY : At the end of February, subsurface water levels were lower (drier) than normal in most of Great Britain.

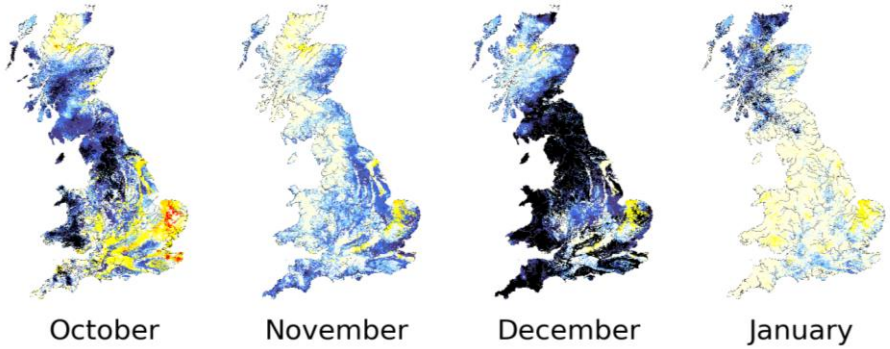
Relative wetness

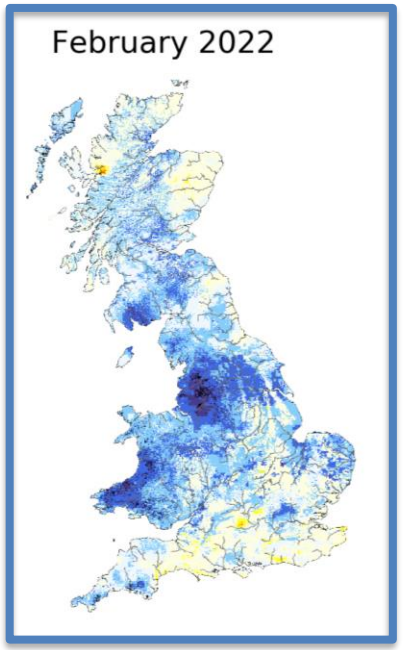
Water storage anomaly as a % of maximum (positive wetness) or minimum (negative wetness) storage anomaly (zero indicates average value)

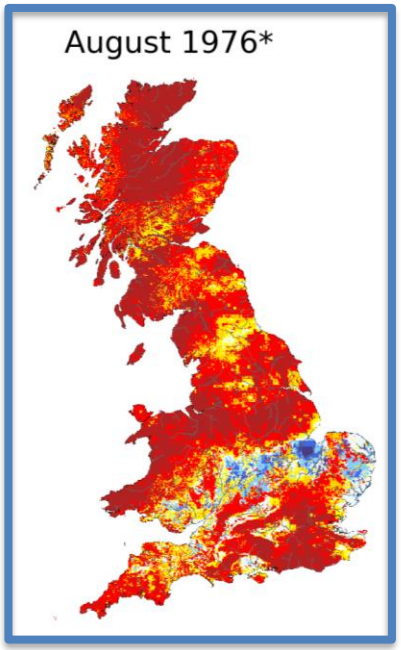
High (very wet)	>100
	75-100
Medium wetness	50-75
	25-50
Low wetness	0.01-25
Average conditions	-0.01-0.0
Low dryness	-25--0.01
	-50--25
Medium dryness	-75--50
	-100--75
High (very dry)	<-100
Major rivers	

Labels refer to estimated storage final day of named month









*Example month displaying extreme negative wetness

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OUTLOOK BASED ON CURRENT CONDITIONS

March 2023

UK Centre for Ecology & Hydrology

Return Period of Rainfall Required to Overcome Dry Conditions

Period: March 2023 - August 2023

Issue date: 02.03.2023

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 few months.

These maps do not provide a drought forecast. Instead they indicate the return period of rainfall required to overcome the dry conditions for the following 6 months based on current conditions.

SUMMARY: During March most of Great Britain will require rainfall with a return period of between 5 – 25 years to return to normal. The Anglian region requires an additional 3 months of rainfall with a return period of 5 - 10 years to return to average conditions for the time of year.

Mar

Apr

May

Jun

Jul

Aug

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

SCOTLAND

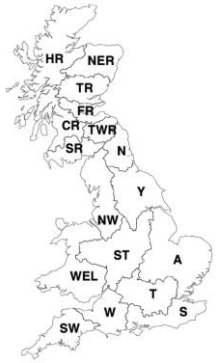
HR	Highlands Region
NER	North East Region
TR	Tay Region
FR	Forth Region
CR	Clyde Region
TWR	Tweed Region
SR	Solway Region

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



NORTHERN IRELAND
This method cannot currently be used in Northern Ireland

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OUTLOOK BASED ON CURRENT CONDITIONS

March 2023

UK Centre for Ecology & Hydrology

Estimate of Additional Rainfall Required to Overcome Dry Conditions

Based on subsurface water storage estimated for 28 February 2023

Issue date: 02.03.2023

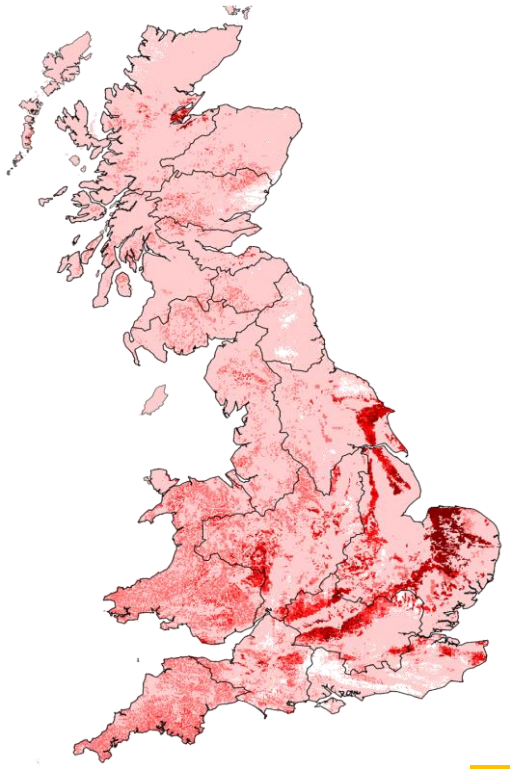
OUTLOOK BASED ON CURRENT CONDITIONS

March 2023

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.

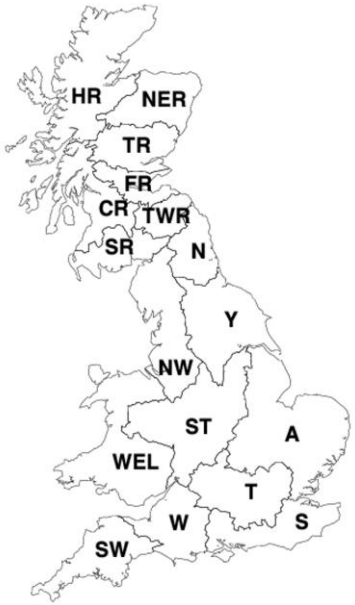
Subsurface storage deficits, i.e. where the subsurface water storage anomaly is less than zero, are highlighted by the red/pink colours.

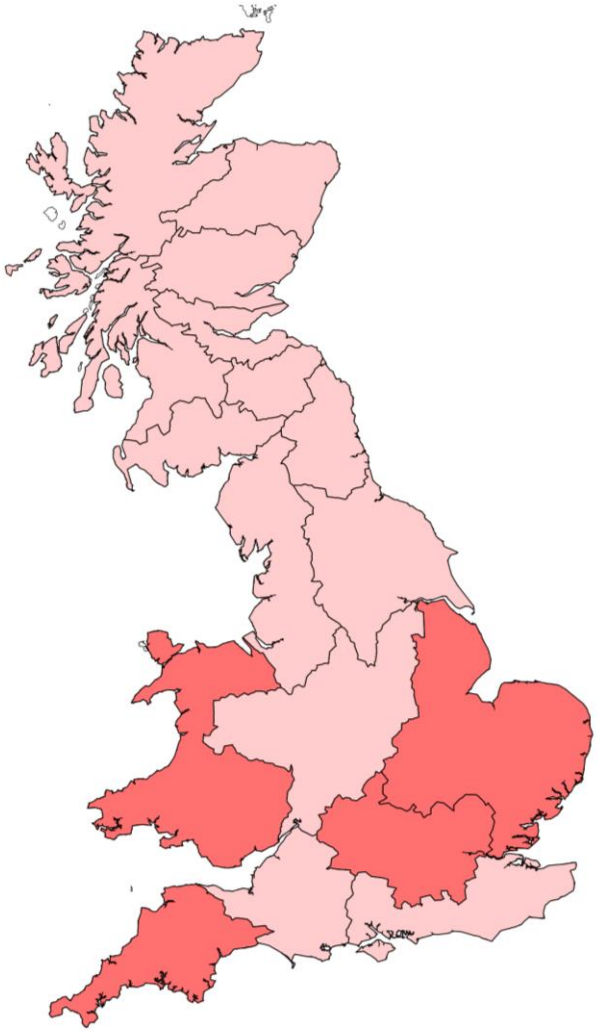
The subsurface storage deficit (mm) can be interpreted as an estimate of additional rainfall that would be required in future months to overcome dry conditions (i.e. rainfall in addition to what is expected on average). Regional mean values of additional rainfall required are provided in the table below.



Regional estimate of additional rainfall required (mm)

	SCOTLAND	
11	HR	Highlands Region
9	NER	North East Region
12	TR	Tay Region
12	FR	Forth Region
12	CR	Clyde Region
11	TWR	Tweed Region
14	SR	Solway Region
	ENGLAND	
5	N	Northumbria
14	NW	North West
19	Y	Yorkshire
24	ST	Severn Trent
39	A	Anglian
32	T	Thames
17	W	Wessex
5	S	Southern
26	SW	South West
	WALES	
26	WEL	Welsh





Water storage deficit (anomaly; mm)

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

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UK Centre for Ecology & Hydrology

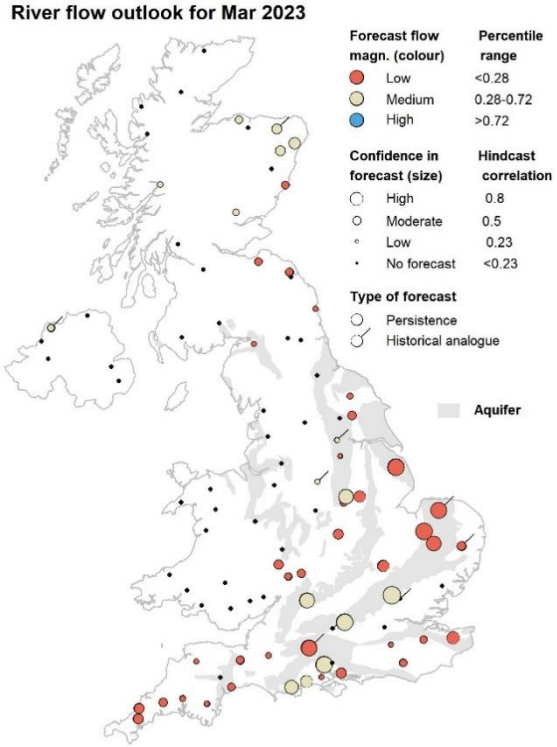
Outlook based on hydrological persistence and analogy

Overview

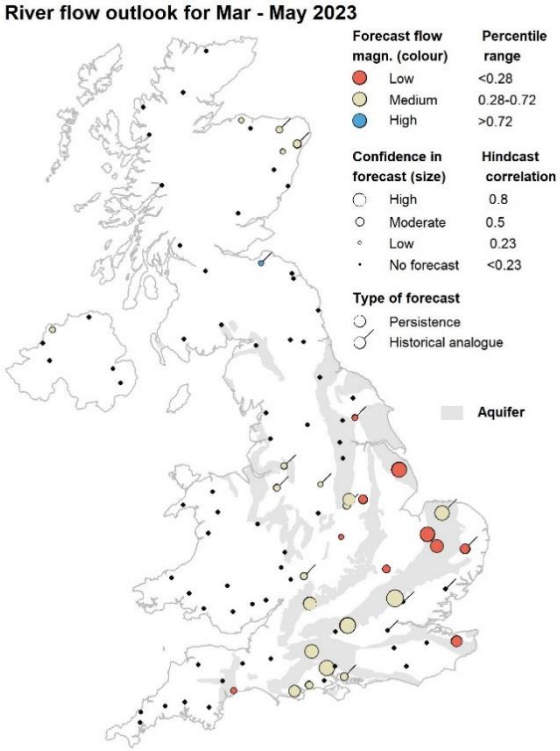
Period: March 2023 – May 2023

Issued on 07.03.2023 using data to the end of February 2023

SUMMARY:
The outlook for March is for mainly normal to below normal flows in southern, central and eastern Britain. Over the March to May period, flows in these areas tend towards the normal range, with the exception of East Anglia, which remains below normal. Please note there are few forecasts for the north and west of the country.



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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UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

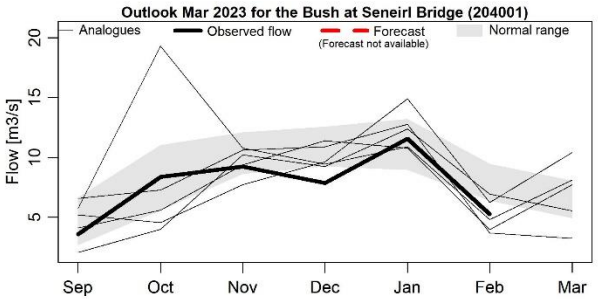
Site-based: 1 month outlook

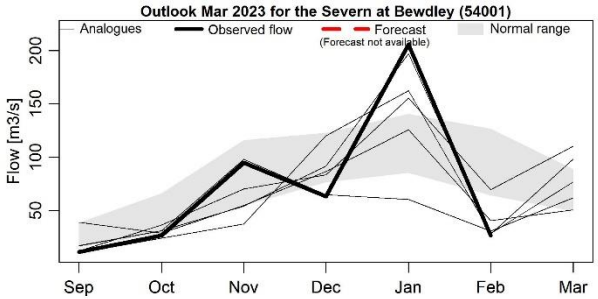
Period: March 2023

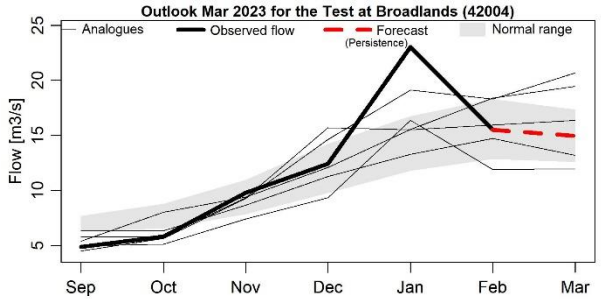
Issued on 07.03.2023 using data to the end of February 2023

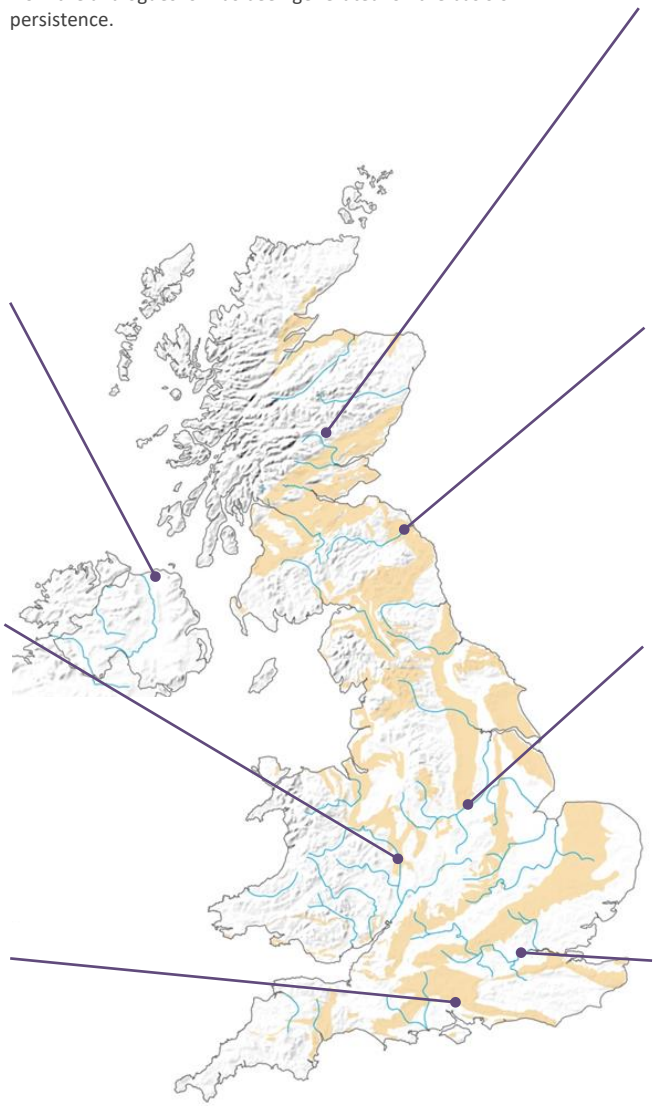
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

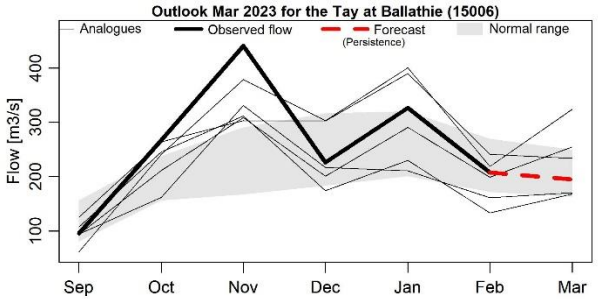
In each of the time series graphs the bold black line represents the observed flow during the past six months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows took 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.

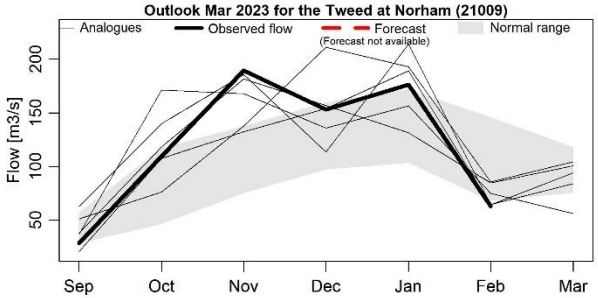


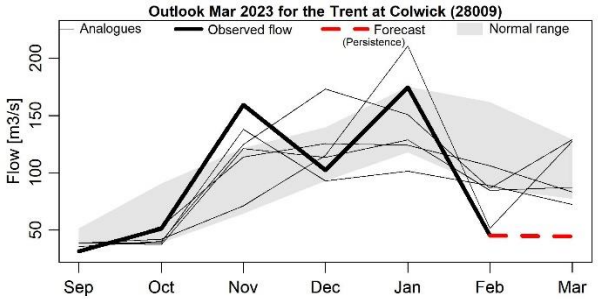












No forecast available

RIVER FLOW ANALOGY

March 2023

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UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

Site-based: 3 month outlook

Period: March 2023 – May 2023

Issued on 07.03.2023 using data to the end of February 2023

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

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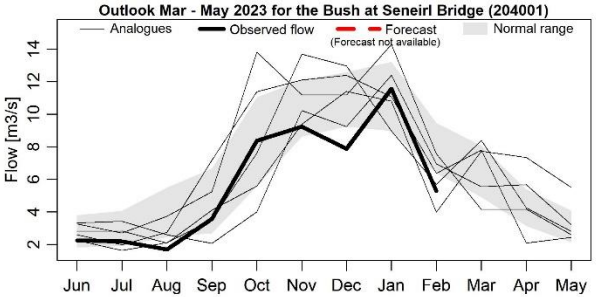

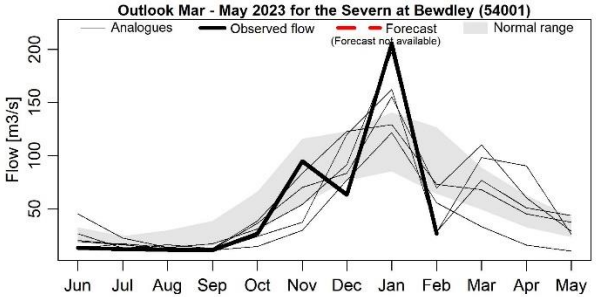

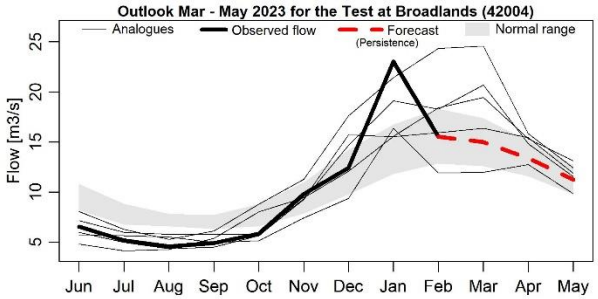

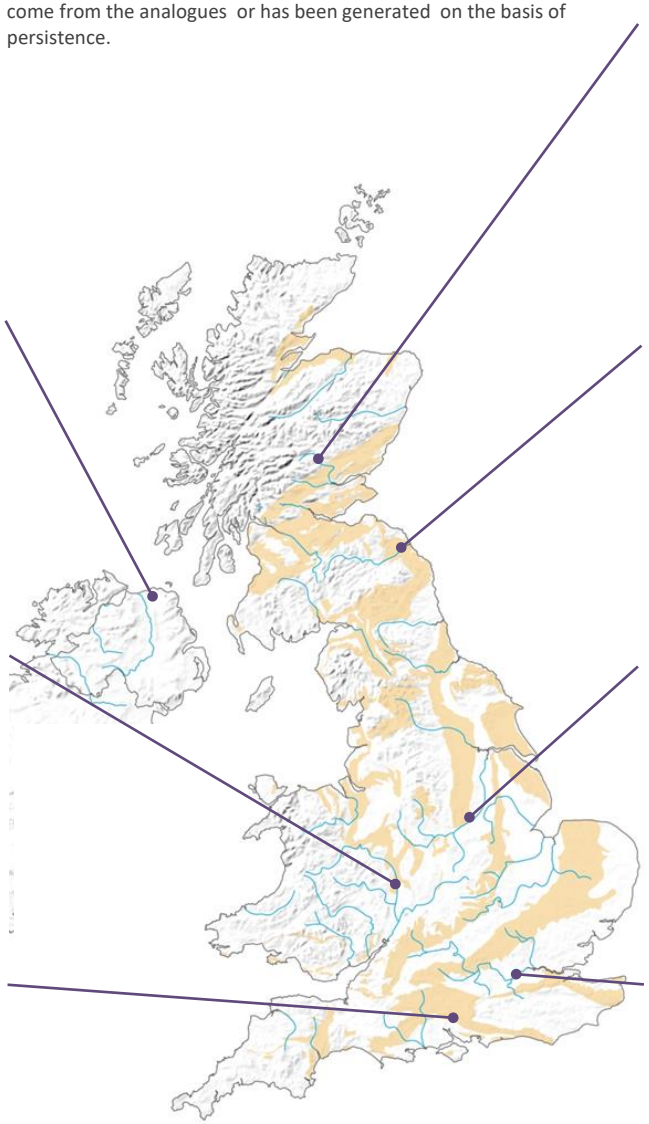

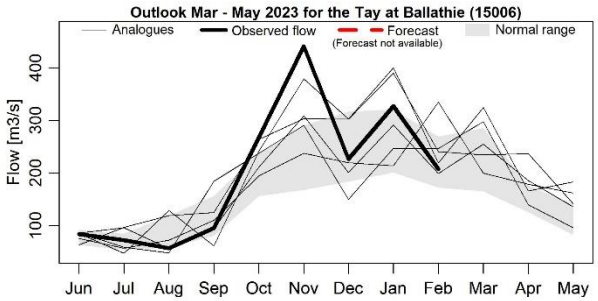

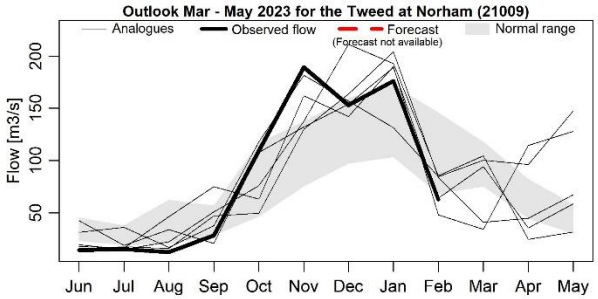

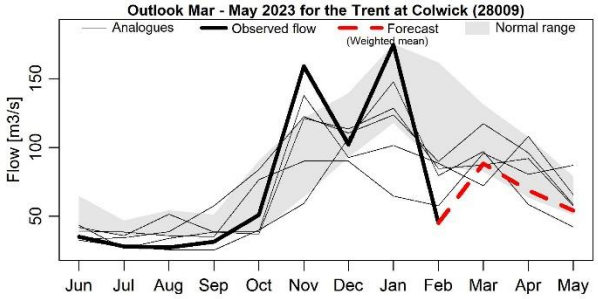

No forecast available

RIVER FLOW ANALOGY

March 2023

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UK Centre for Ecology & Hydrology

British Geological Survey

Environment Agency

Outlook based on modelled flow from historical climate

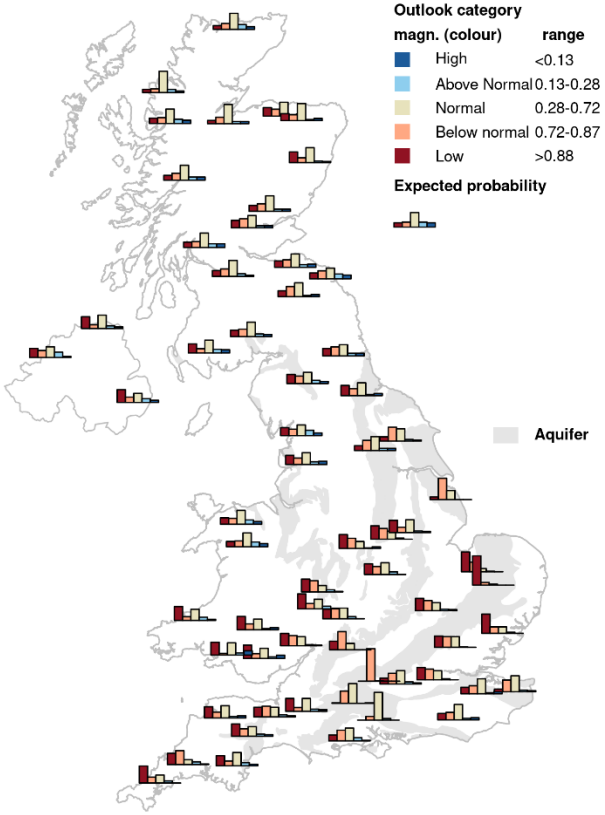
Overview

Period: March 2023 – August 2023

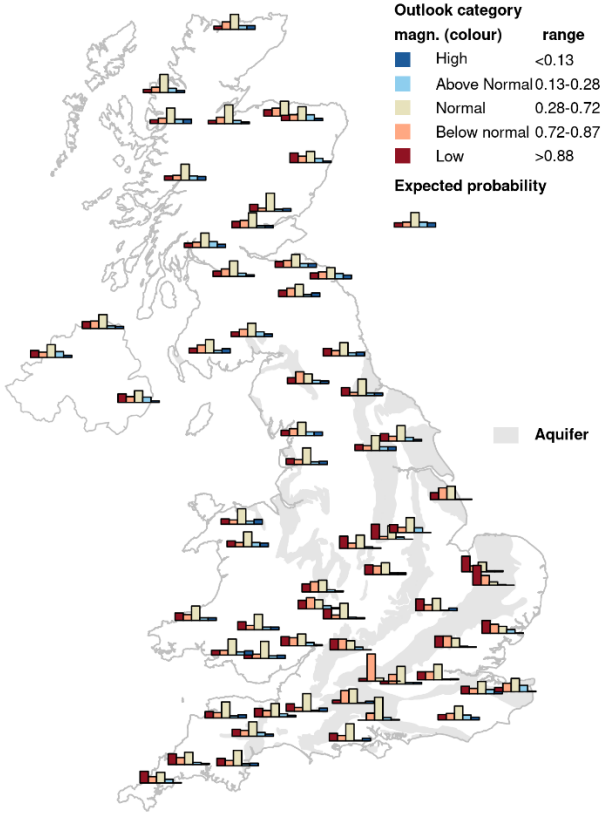
Issued on 06.02.2023 using data to the end of February 2022

The outlook for March indicates that flows are most likely to be normal to below normal across Northern Ireland, southwestern Scotland, southern Wales and most of England except in East Anglia, where flows are expected to be low. Flows are expected to be normal for the rest of the UK. The March-April-May outlook indicates that flows are expected to mostly return to normal, except in parts of southern and southeastern England where they are expected to remain normal to below normal.

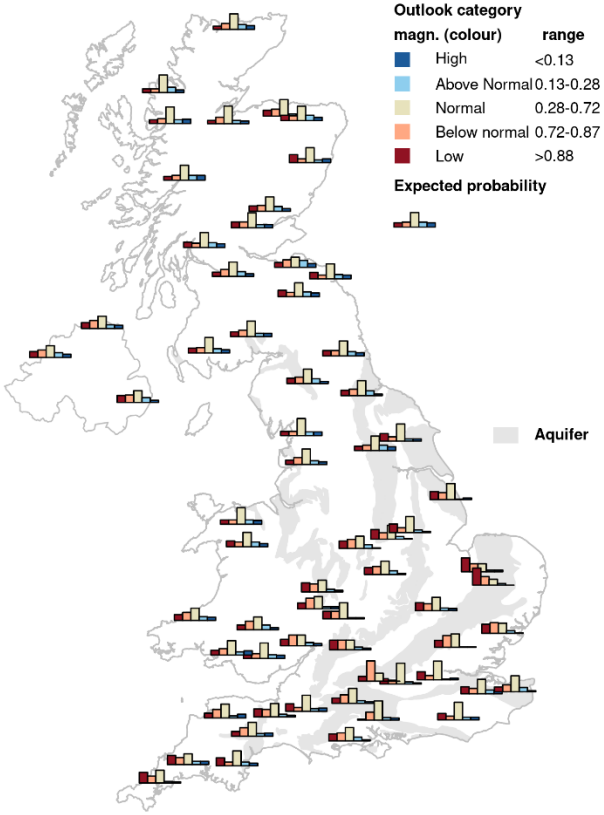
1-month river flow outlook starting Mar 2023



3-month river flow outlook starting Mar 2023



6-month river flow outlook starting Mar 2023



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 GR4J conceptual rainfall-runoff model from IRSTEA (France) calibrated on observed or naturalised flows.

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.

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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UK Centre for Ecology & Hydrology

British Geological Survey

Environment Agency

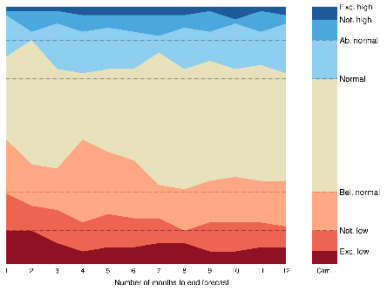
Outlook based on modelled flow from historical climate

Overview

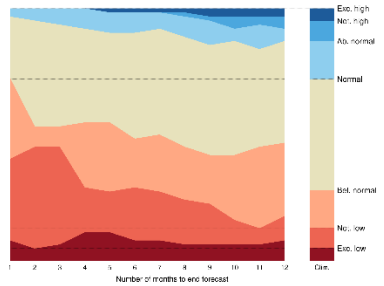
RIVER FLOW FROM HISTORICAL CLIMATE

March 2023

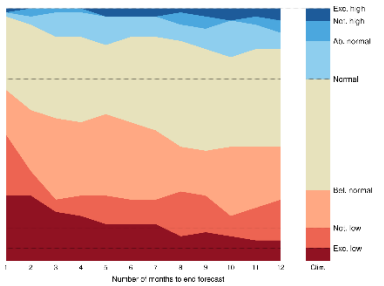
Mourne 201010

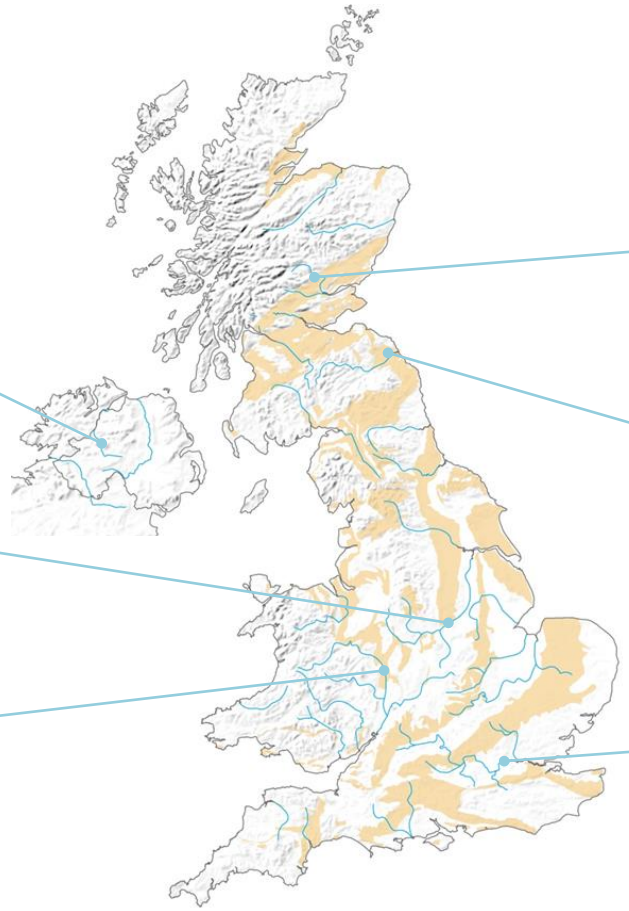


Trent 28009

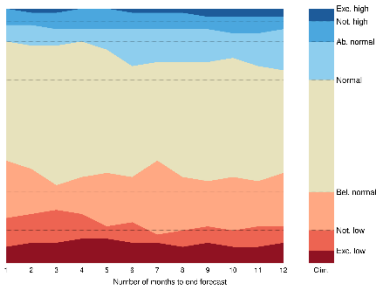


Severn 54032

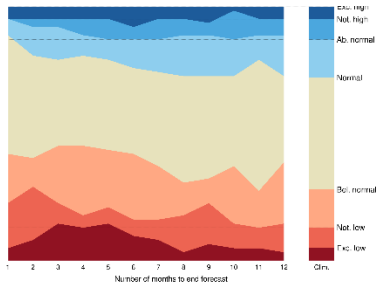




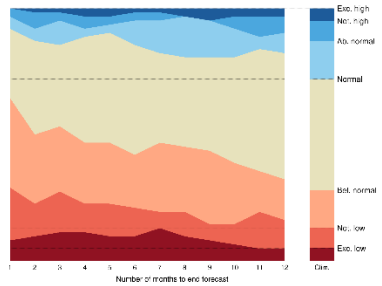
Tay 15006



Tweed 21009



Thames 39001



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 GR4J conceptual rainfall-runoff model from IRSTEA (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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UK Centre for Ecology & Hydrology

Outlook based on Modelled Flow from Rainfall Forecasts

Period: March 2023 – May 2023

Issued on 02.03.2023 using data to the end of January

SUMMARY: During March, river flows are likely to be in the *Normal range* or *Below normal* across most of Great Britain and in the *Below normal range* or lower for the Severn Trent, Thames and Anglian regions.

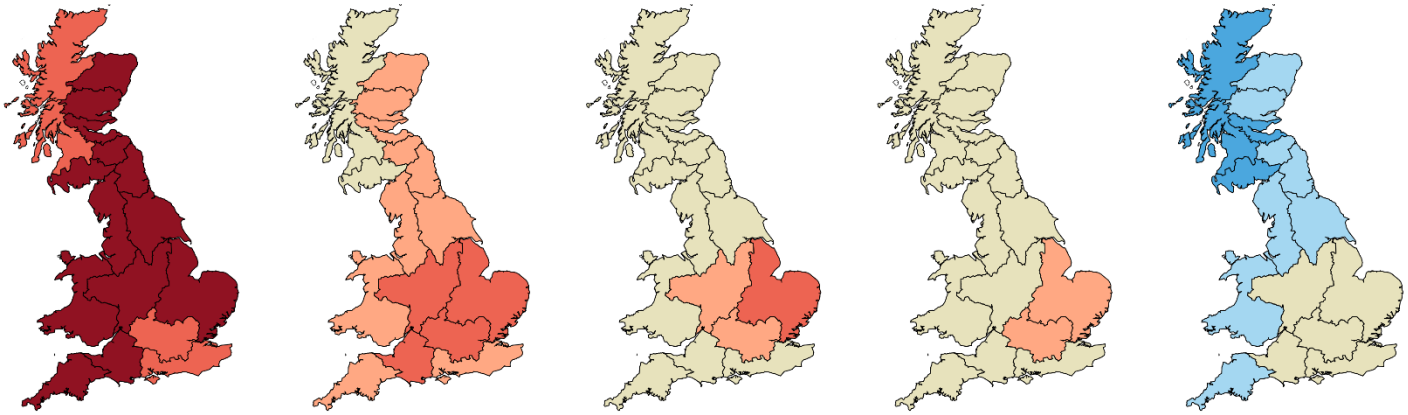
Over the next 3 months river flows will likely be in the *Normal range* or *Below normal* in much of the country, with the North West region of England, central England and eastern Scotland more likely to be in the *Below normal range* or lower.

These forecasts are produced by using five members of the Met Office rainfall forecast ensemble as input to a water balance hydrological model to provide the five estimates of river flows shown on the left for one month and three months ahead.

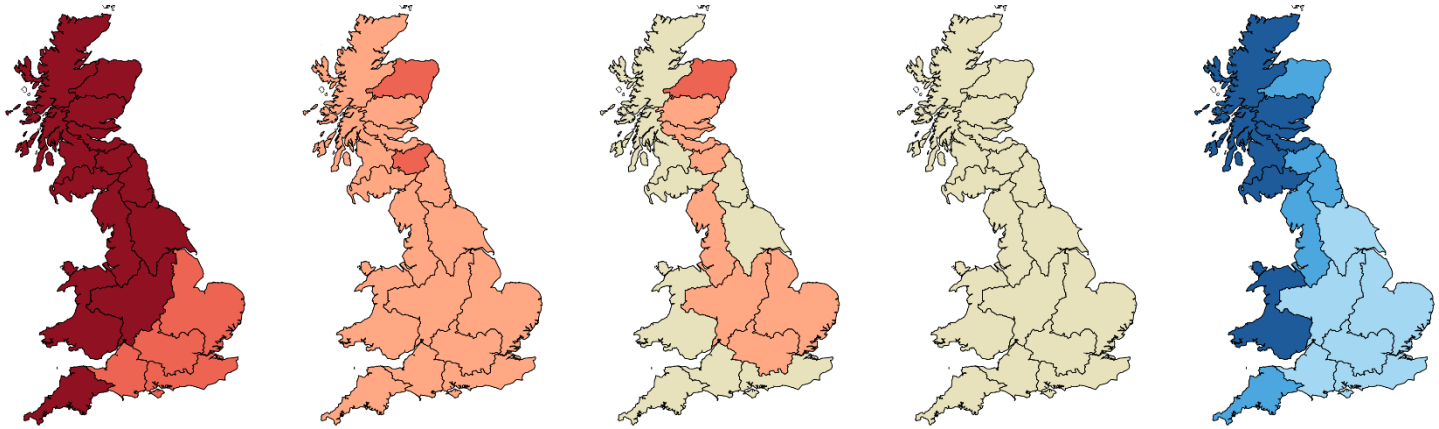
Regional forecast monthly-mean river flows are derived from the average of 1km river flow estimates within each region and ranked in terms of 54 years of historical flow estimates (1963 – 2016).

The five maps illustrate the wide range of possible flows and while there is a 50% chance of flows between the 1st and 3rd quartiles, actual flows may be more extreme than the flows derived using the highest or lowest rainfall forecasts.

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



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



Key

	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

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

NORTHERN IRELAND
This method cannot currently be used in Northern Ireland

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OUTLOOK BASED ON CURRENT CONDITIONS

March 2023

UK Centre for Ecology & Hydrology

Outlook based on Modelled Flow from Rainfall Forecasts

Period: March 2023 - May 2023

Issue date: 02.03.2023

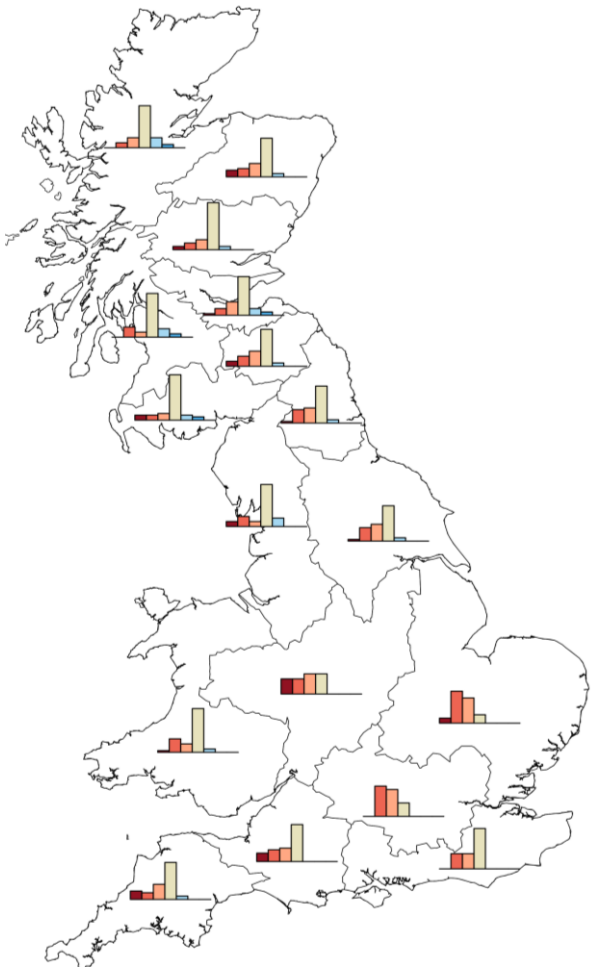
The regional maps illustrating the regional river flows for five members of the Met Office ensemble of rainfall forecasts give some indication of the range of possible river flows in the coming months. As noted previously, the actual flows could be more extreme than the flows generated by either the lowest or highest members of the rainfall ensemble.

The bar charts (below) give further insight into the range of river flow forecasts by considering all members of the forecast rainfall ensemble. The regional bar charts show the percentage of ensemble forecasts falling in each of the flow categories as generated by the monthly-resolution water-balance model. As before results are averaged by region then ranked in terms of 54 years of historical regional flow estimates (1963 – 2016).

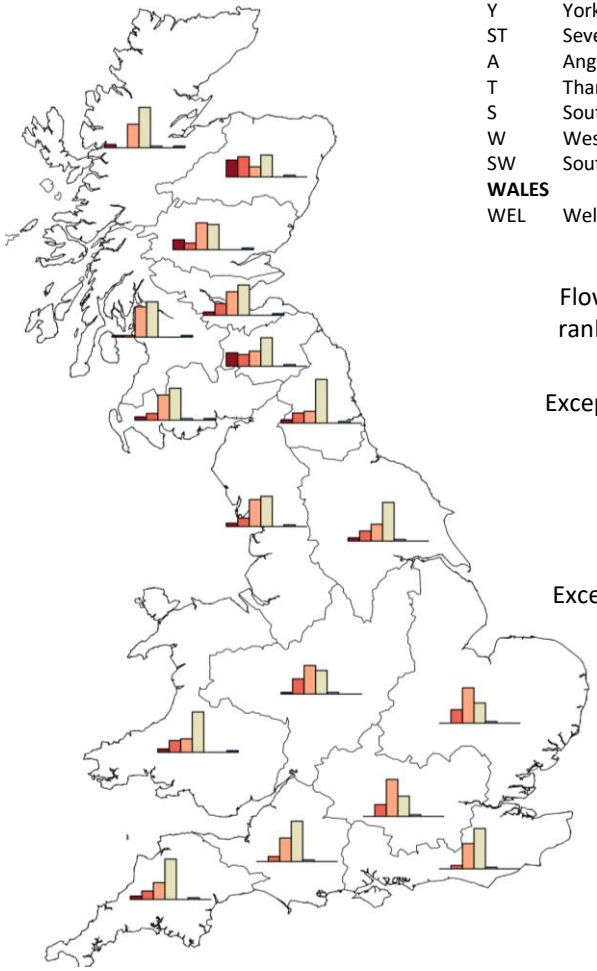
SUMMARY: During March, river flows are likely to be in the *Normal range* or *Below normal* across most of Great Britain and in the *Below normal range* or lower for the Severn Trent, Thames and Anglian regions.

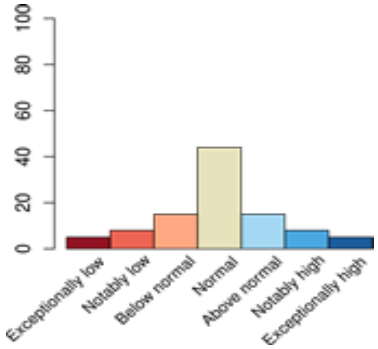
Over the next 3 months river flows will likely be in the *Normal range* or *Below normal* in much of the country, with the North West region of England, central England and eastern Scotland more likely to be in the *Below normal range* or lower.

1-month



3-month





SCOTLAND

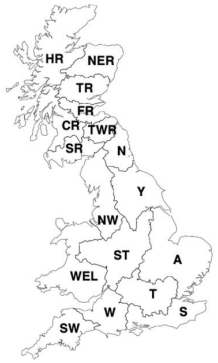
HR	Highlands Region
NER	North East Region
TR	Tay Region
FR	Forth Region
CR	Clyde Region
TWR	Tweed Region
SR	Solway Region

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



NORTHERN IRELAND
This method cannot currently be used in Northern Ireland

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

Outlook based on Modelled Flow from Rainfall Forecasts

Period: March 2023 - May 2023

Issue date: 02.03.2023

The maps illustrating the regional river flows for five members of the Met Office ensemble of rainfall forecasts give some indication of the range of possible river flows in the coming months. As noted previously, the actual flows could be more extreme than the flows generated by either the lowest or highest members of the rainfall ensemble.

The tables below give further insight into the range of river flow forecasts by considering all members of the forecast rainfall ensemble. The numbers in the tables are the percentage of ensemble forecasts falling in each of the flow categories as generated by the monthly-resolution water-balance model. As before results are averaged by region then ranked in terms of 54 years of historical regional flow estimates (1963 – 2016).

SUMMARY: During March, river flows are likely to be in the *Normal range* or *Below normal* across most of Great Britain and in the *Below normal range* or lower for the Severn Trent, Thames and Anglian regions.

Over the next 3 months river flows will likely be in the *Normal range* or *Below normal* in much of the country, with the North West region of England, central England and eastern Scotland more likely to be in the *Below normal range* or lower.

SCOTLAND

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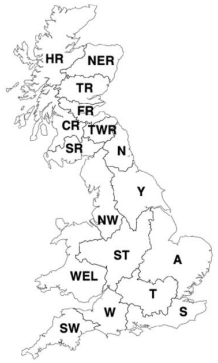
TWR	Tweed Region
SR	Solway Region

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



NORTHERN IRELAND
This method cannot currently be used in Northern Ireland

1-month ahead	A	NW	N	ST	SW	S	T	WEL	W	Y	CR	FR	HR	NER	SR	TR	TWR
Exceptionally high flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notably high	0	0	0	0	0	0	0	0	0	0	5	5	5	0	5	0	0
Above normal	0	12	5	0	5	0	0	5	0	5	12	10	14	5	7	5	5
Normal range	12	60	52	29	52	57	19	62	52	50	62	55	60	55	64	67	52
Below normal	36	7	21	29	21	21	38	12	19	24	7	19	14	19	10	14	21
Notably low	45	14	19	21	10	21	43	19	17	19	14	10	7	12	7	10	14
Exceptionally low flow	7	7	2	21	12	0	0	2	12	2	0	2	0	10	7	5	7

3-month ahead	A	NW	N	ST	SW	S	T	WEL	W	Y	CR	FR	HR	NER	SR	TR	TWR
Exceptionally high flow	0	0	0	0	0	0	0	2	0	0	2	2	2	0	2	2	0
Notably high	0	2	2	0	2	0	0	0	0	0	0	0	0	2	0	0	2
Above normal	2	0	0	2	0	2	2	0	2	2	0	0	2	0	2	0	0
Normal range	29	43	62	33	57	57	29	57	57	55	50	43	57	31	45	36	40
Below normal	50	38	17	40	24	36	52	19	33	24	43	33	33	14	36	38	21
Notably low	19	12	14	21	12	5	17	17	7	14	2	17	0	29	10	10	17
Exceptionally low flow	0	5	5	2	5	0	0	5	0	5	2	5	5	24	5	14	19

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British Geological Survey

Outlook based on modelled groundwater level & climate forecast

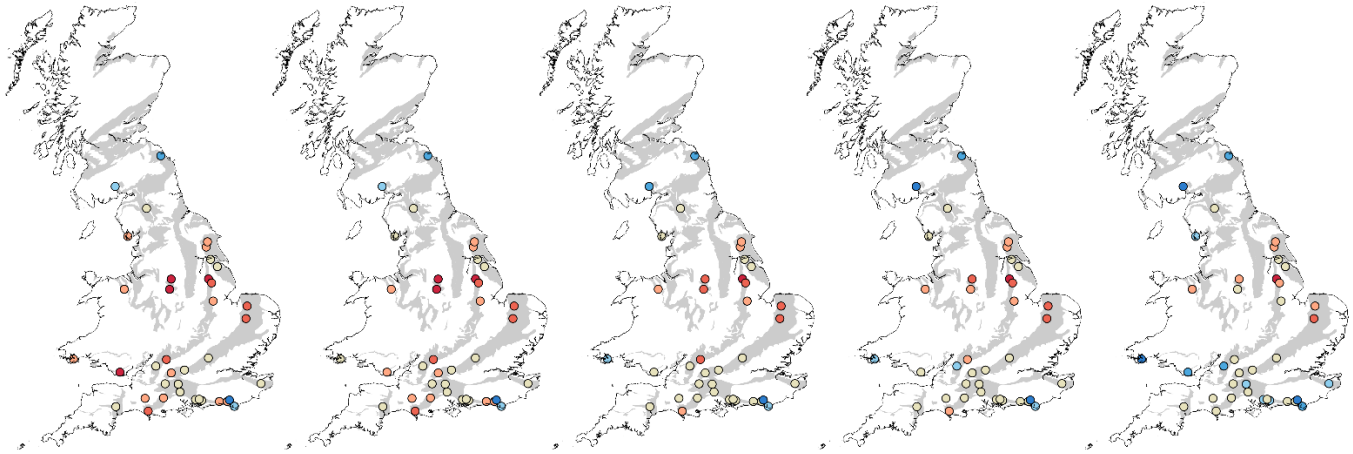
Overview

Period: March 2023 – May 2023

Issued on 07.3.2023 using data to the end of February

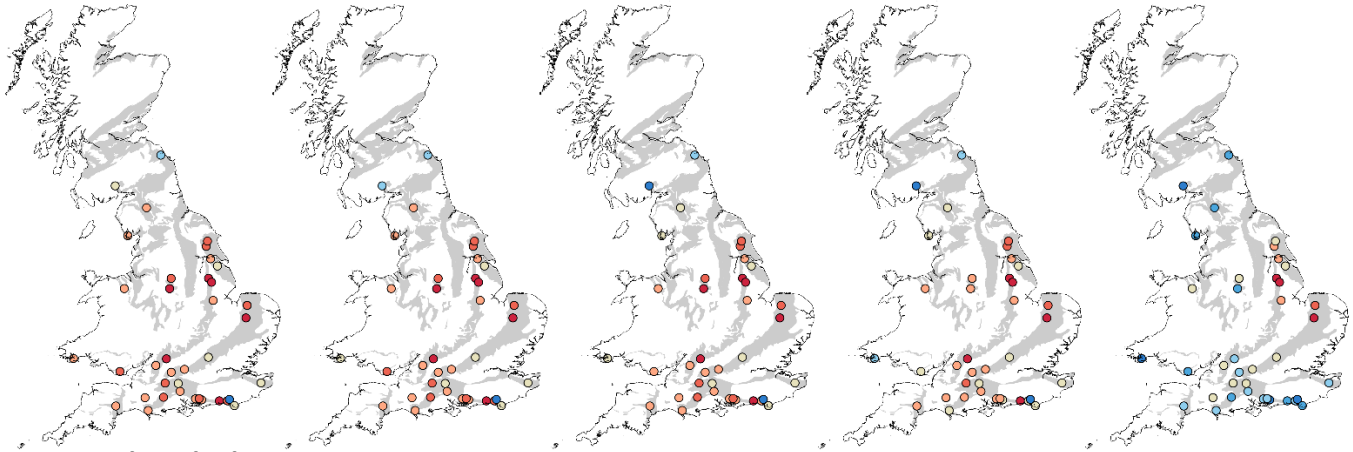
Groundwater levels are responsive to rainfall over this part of the year, and the forecasts reflect this. Under median rainfall conditions, normal to below normal groundwater levels are expected at most sites in the next month. Above normal continue to be forecast in the eastern South Downs Chalk and the northern Fell Sandstone and Permo-Triassic sandstones. The 3 month forecasts have a similar regional distribution in all but the highest rainfall scenario, with levels expected to be below normal at many sites where they were normal, and becoming notably low to exceptionally low elsewhere, particularly in the Jurassic limestones.

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*

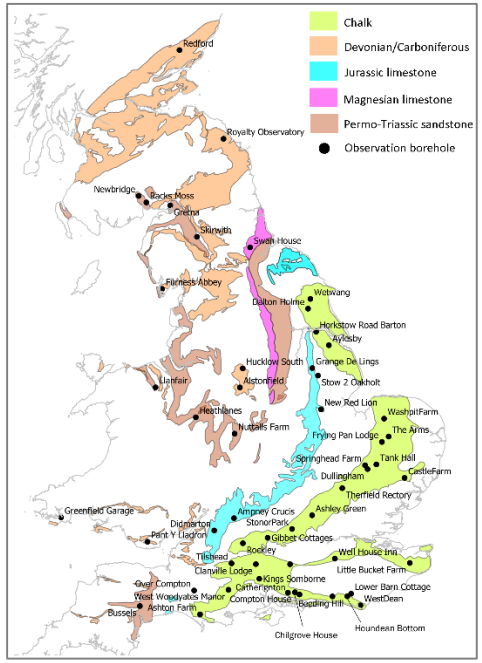


3-month outlook

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

March 2023

UK Centre for Ecology & Hydrology

British Geological Survey

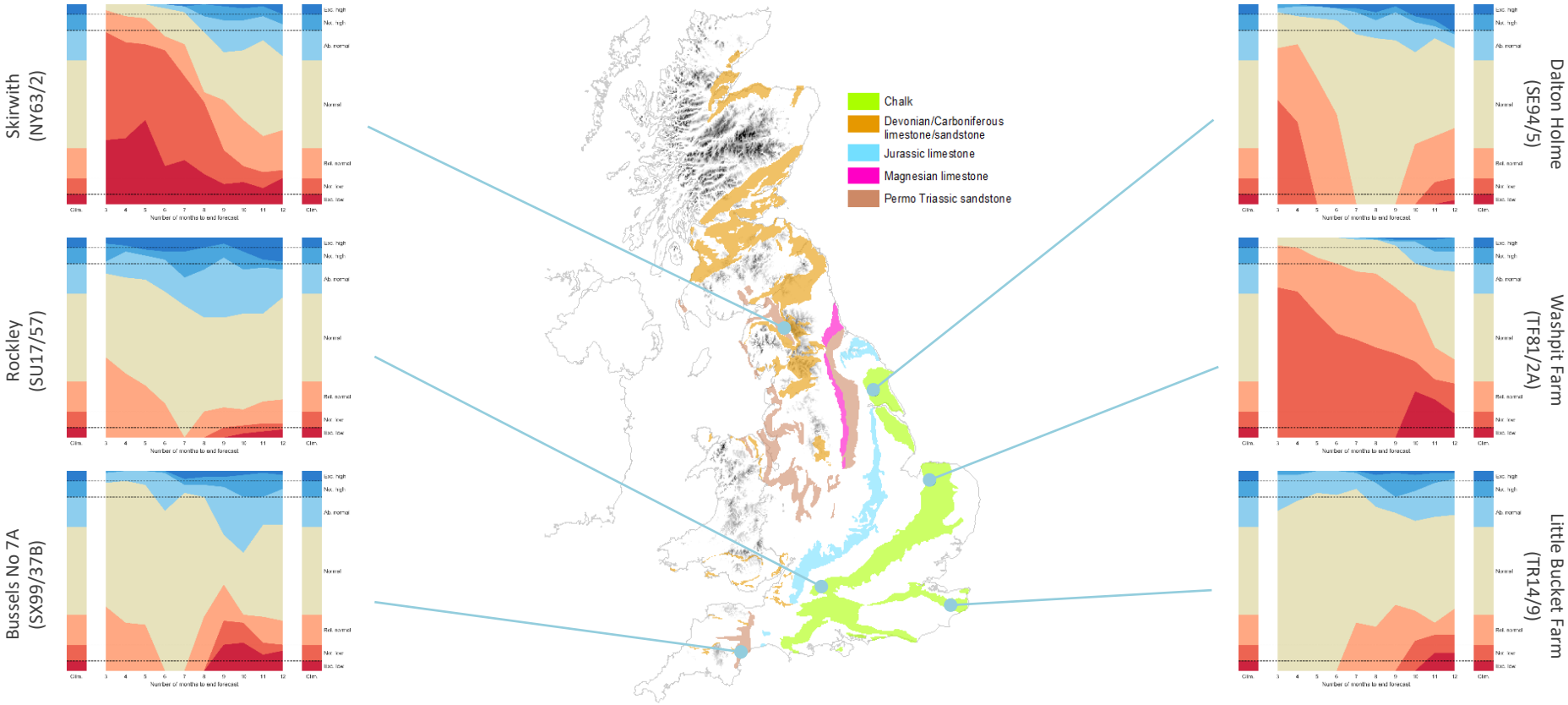
Environment Agency

Outlook based on modelled groundwater from historical climate

Period: March 2023 – February 2024

Issued on 07.2.2023 using data to the end of February

Groundwater levels at Skirwith and Washpit Farm are expected to be below normal to notably low for much of the next year. Skirwith may experience exceptionally low levels over the next 6 month period. Predominantly normal levels are forecast for Rockley, Bussels No 7A and Little Bucket Farm over the next 3 to 12 months. Dalton Holme levels are expected to be below normal to notably low some 3 to 5 months from now, beyond 6 months ahead the levels will depend on rainfall.



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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