Hydrological Outlook UK

Period: From May 2020

Issued on 11.05.2020 using data to the end of April 2020

SUMMARY

Following recent prolonged dry weather, river flows in northern and western parts of the UK are likely to be below normal in May, with exceptionally low flows likely in some areas. The three month outlook is similar, albeit with less confidence. Elsewhere, in parts of the Midlands and south-east England, flows are likely to be normal to below normal over the next three months, with the exception of parts of central southern England where normal to above normal flows are likely. Groundwater levels are likely to be normal to above normal in May across all aquifers, with a similar picture for the next three months but with more aquifers returning to the normal range.

Rainfall:

April was a very dry month, with 40% of the typical rainfall for the UK as a whole. It was exceptionally dry (less than 25% of average) across northern England and large areas of Scotland – it was the driest April on record in some of these areas.

The rainfall outlook (issued by the Met Office on 23rd April 2020) is that for May, below-average precipitation is moderately more likely than above-average precipitation. For May-June-July as a whole, below-average precipitation is more likely than above-average precipitation. The probability that UK-average precipitation for May-June-July will fall into the driest of five equal categories is around 30% and the probability that it will fall into the wettest of these categories is 10% (the 1981-2010 probability for each of these categories is 20%).

River flows:

River flows in April were notably or exceptionally low across most of northern and western Britain, with new April minima registered in a number of catchments. In southeast England, flows were mostly in the normal range, with above normal flows in a few catchments.

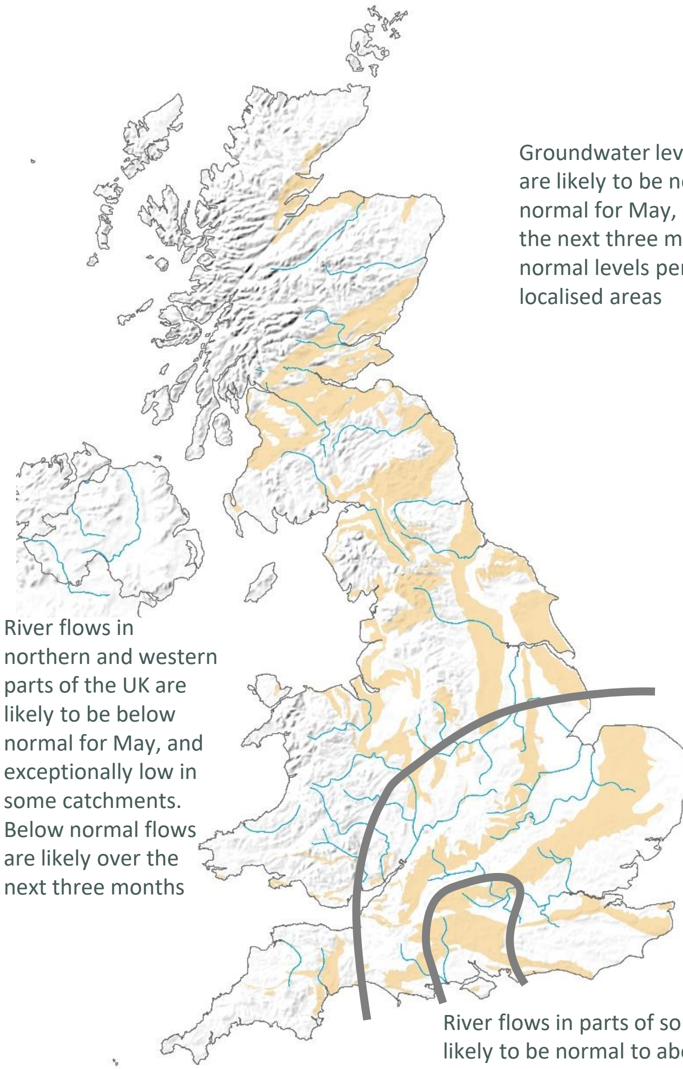
The outlook for May is for below normal flows to continue across northern and western Britain, with a high likelihood of notably or exceptionally low flows in Scotland and north-east England. In parts of the Midlands and across south-east England, the outlook is for normal to below-normal flows. The exception is for parts of central southern England where normal to above-normal flows are likely, generally in Chalk catchments where the exceptional winter rainfall continues to sustain flows. The outlook for May-July suggests a very similar contrast between northern and western/southern and eastern areas, although there is less confidence in the three-month projections for responsive western catchments at this time of year.

Groundwater:

Generally, groundwater levels declined across the UK in April. However, levels were mostly normal or above normal, with exceptionally high (sometimes record breaking) levels in the Permo-Triassic sandstones of central and northern England.

The outlook is for groundwater levels across the UK to continue receding in most areas, but the current normal to above normal levels are likely to persist through May. Over the three month period (May-July), levels are generally expected to return to their normal range across the UK, however above normal levels are likely to persist in parts of the southern Chalk and in the Permo-Triassic sandstones.

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



Groundwater levels across the UK are likely to be normal to above normal for May, and normal over the next three months, with above normal levels persisting in localised areas

River flows in northern and western parts of the UK are likely to be below normal for May, and exceptionally low in some catchments. Below normal flows are likely over the next three months

River flows in parts of south-east England and the Midlands are likely to be normal to below normal in May and over the next thee months

River flows in parts of southern England are likely to be normal to above normal over the next three months

Shaded areas show principal aquifers

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Hydrological Outlook UK

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:
http://www.hydoutuk.net/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	Black	> 95
Notably high flow	Blue	87-95
Above normal	Cyan	72-87
Normal range	Green	28-72
Below normal	Yellow	13-28
Notably low flow	Orange	5-13
Exceptionally low flow	Red	< 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.

Copyright:

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:

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t: 01491 692371 e: enquiries@hydoutuk.net

Reference for the Hydrological Outlook:

Hydrological Outlook UK, 2020, May, UK Centre for Ecology and Hydrology, Oxfordshire UK, Online, http://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
Scottish Environment Protection Agency: http://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:
www.metoffice.gov.uk/public/weather/forecast/#?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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Met Office 3-month Outlook

Period: May – July 2020 Issue date: 23.04.20

The forecast presented here is for May and the average of the May-June-July period for the United Kingdom as a whole. The forecast for May will be superseded by the long-range information on the public weather forecast web page (www.metoffice.gov.uk/public/weather/forecast/#?tab=regionalForecast), starting from 1st May 2020.

This forecast is based on information from observations, several numerical prediction systems and expert judgement.

SUMMARY – PRECIPITATION:

For May, below-average precipitation is moderately more likely than above-average precipitation. For May-June-July as a whole, below-average precipitation is more likely than above-average precipitation.

The probability that UK-average precipitation for May-June-July will fall into the driest of our five categories is around 30% and the probability that it will fall into the wettest of our five categories is 10% (the 1981-2010 probability for each of these categories is 20%).

CONTEXT:

There are fewer global drivers of UK weather patterns at this time of year compared to the winter, so predictability of precipitation amounts tends to be lower. This means there are typically only small shifts in the likelihood of above- and below- average precipitation. Despite that, as discussed in the Outlook for temperature, the confidence in signals from long-range systems from global prediction centres is higher than normal for this time of year. These signals suggest a greater-than-usual chance of high pressure near the UK, and thereby an increased likelihood of drier-than-normal conditions.

For May, and May-June-July as a whole, below-average rainfall is more likely than above-average rainfall (see graphs of figure P2), reflecting the greater likelihood of above-average pressure. There remains a realistic chance of above-average rainfall, however, albeit less likely. In addition, spells of more unsettled, wet and windy weather are not precluded even if the Outlook period is drier-than-normal overall.

Fig P1

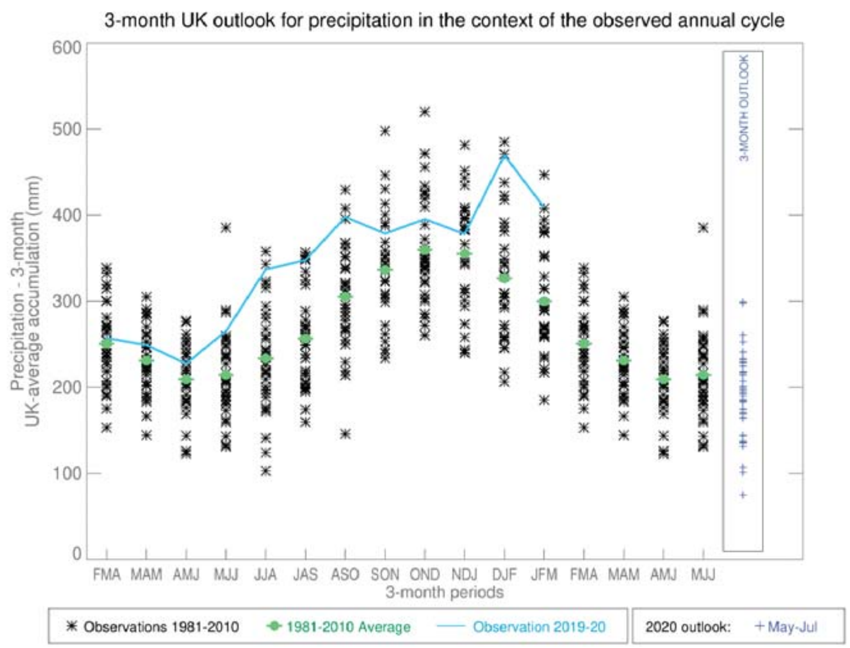


Fig P2

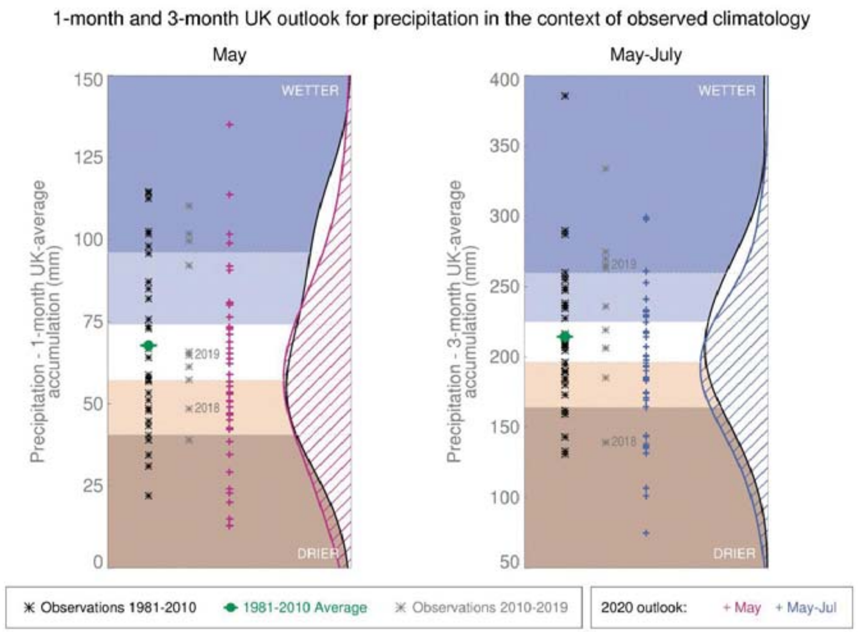
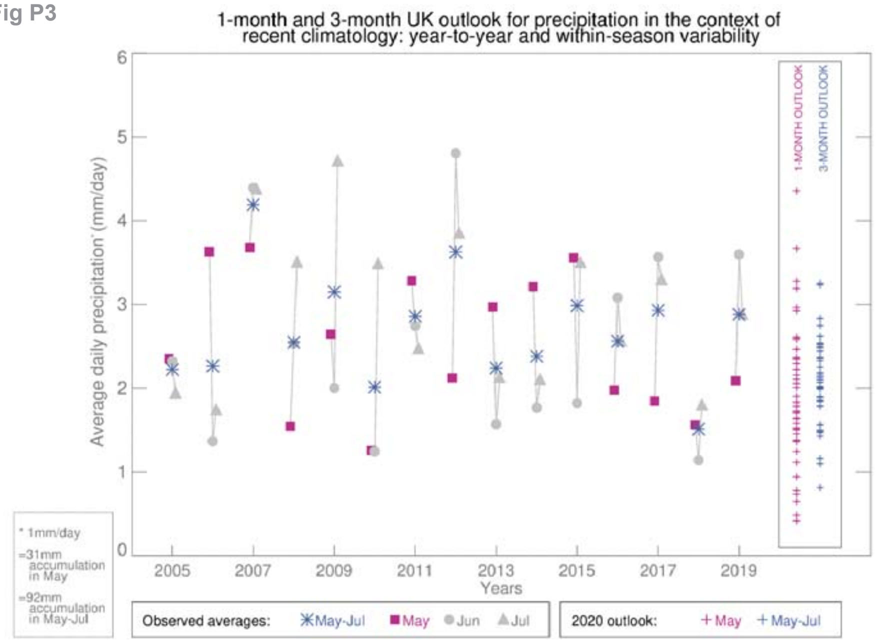


Fig P3



This Outlook provides an indication of possible temperature and rainfall conditions over the next 3 months. It is part of a suite of forecasts designed for contingency planners.

The Outlook should not be used in isolation but should be used with shorter-range and more detailed (30-day, 15-day and 1-to-7-day) forecasts and warnings available to the contingency planning community from the Met Office.

Met Office 3-month Outlook

Period: May – July 2020 Issue date: 23.04.20

The forecast presented here is for May and the average of the May-June-July period for the United Kingdom as a whole. The forecast for May will be superseded by the long-range information on the public weather forecast web page (www.metoffice.gov.uk/public/weather/forecast/#?tab=regionalForecast), starting from 1st May 2020.

This forecast is based on information from observations, several numerical prediction systems and expert judgement.

SUMMARY – TEMPERATURE:

For May and May-June-July as a whole, above-average temperatures are more likely than below-average temperatures.

Overall, the probability that the UK-average temperature for May-June-July will fall into the coldest of our five categories is between 5% and 10%, and the probability that it will fall into the warmest of our five categories is between 50% and 55% (the 1981-2010 probability for each of these categories is 20%).

CONTEXT:

The El Niño-Southern Oscillation (ENSO) is currently in a neutral phase and is likely to remain so throughout this forecast period. It is therefore not expected to have a significant effect on UK weather. Sea surface temperatures are below average across the North Atlantic Ocean west of the UK. This pattern has been linked to greater incidence of high pressure in summer, implying increased chances of higher-than-normal temperatures in the Outlook period. For May and May-June-July as a whole, the Met Office long-range prediction system shows an increase in the likelihood of high pressure near the UK. While confidence is typically lower at this time of year than in winter, there is better agreement between prediction systems from centres around the world than is usual at this time of year. High pressure would lead to more settled weather for the UK and, combined with the warming climate, this means a greater-than-usual chance of above-average temperature (see graphs of figure T2). Nevertheless, cooler-than-normal conditions remain a possibility, albeit with a smaller likelihood.

While the relatively high probability of our warmest forecast category does suggest that the chance of spells of very hot weather is increased compared to usual, it does not imply extreme or unseasonal weather throughout the whole 3-month period. Indeed, the Outlook does not identify weather for a particular day or week. The increased likelihood of this category could mean more days with temperatures that are above average to a more modest degree. Above-average temperatures can also arise from a range of types of weather, not just sunny and dry conditions.

Fig T1

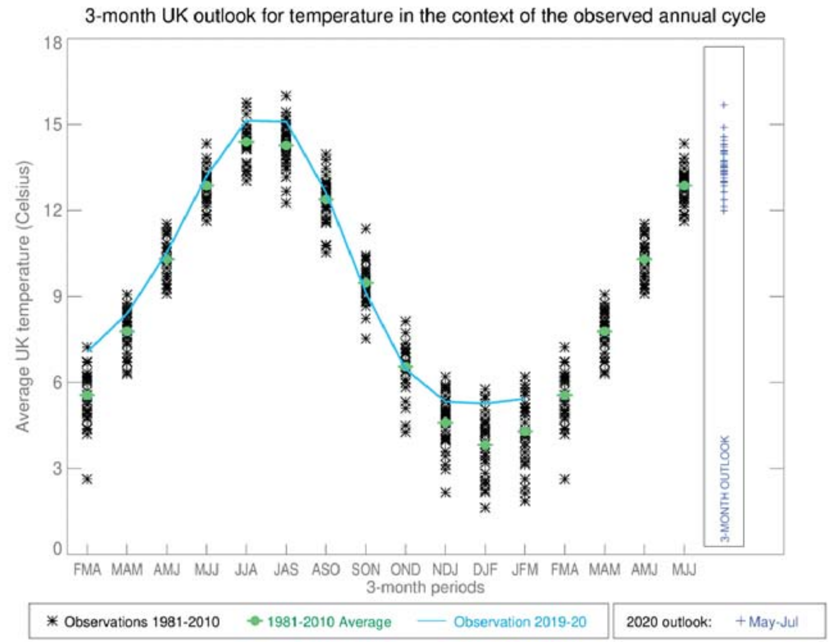


Fig T2

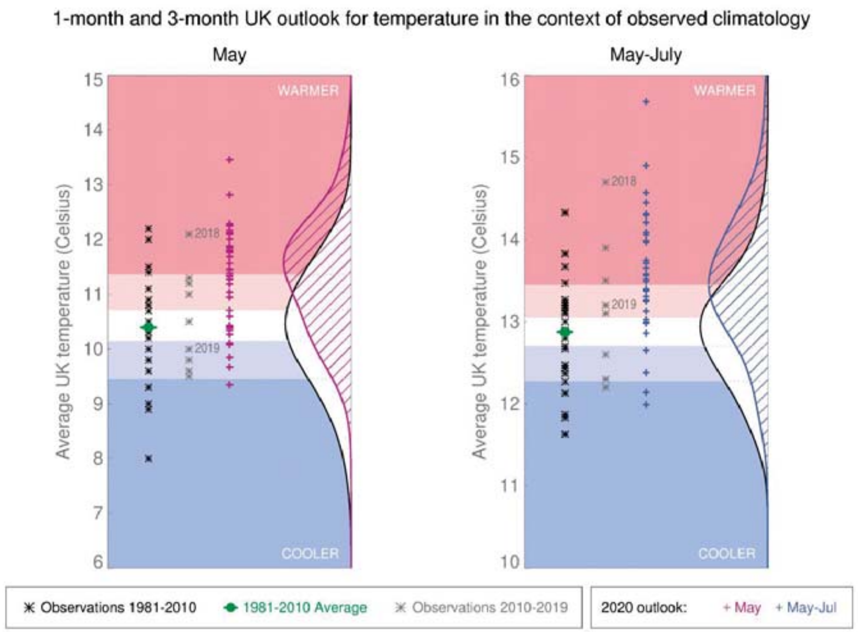
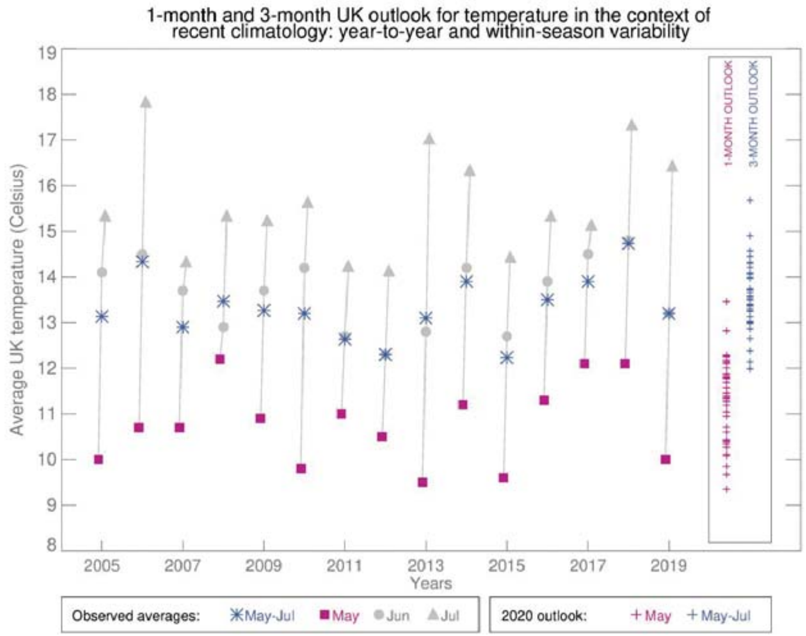


Fig T3



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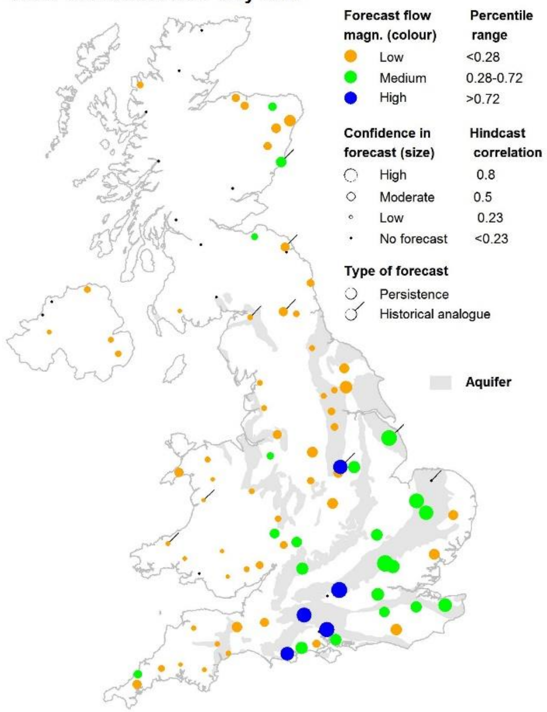
Period: May 2020 – July 2020

Issued on 06.05.2020 using data to the end of April 2020

SUMMARY

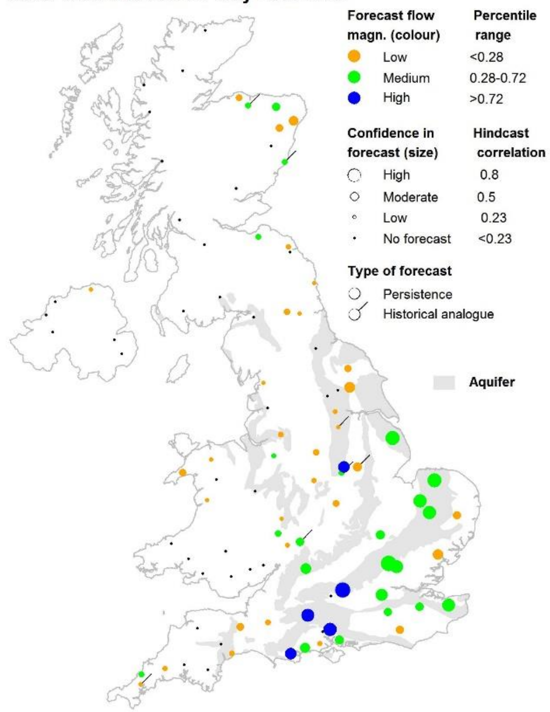
The outlooks for May and for May-July are for normal to below normal flows for most of the UK with the exception of south-east England where normal to above normal flows are more likely. Please note that not many forecasts are available for the north-west of the country.

River flow outlook for May 2020



1-month flow outlook

River flow outlook for May - Jul 2020



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

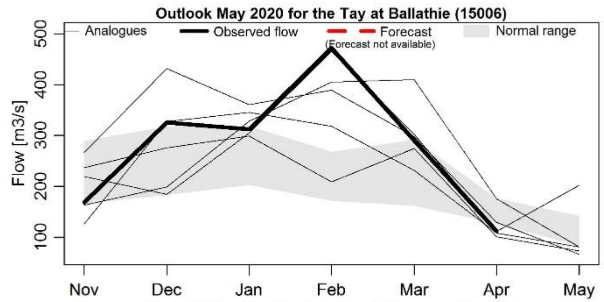
Site-based: 1 month outlook

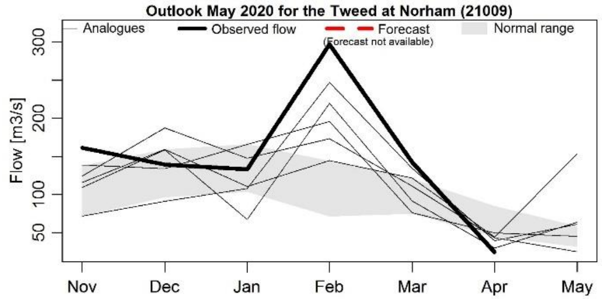
Period: May 2020

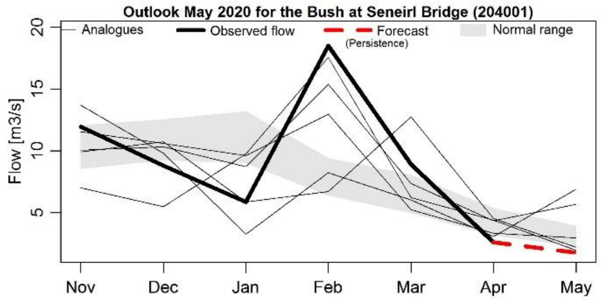
Issued on 06.05.2020 using data to the end of April 2020

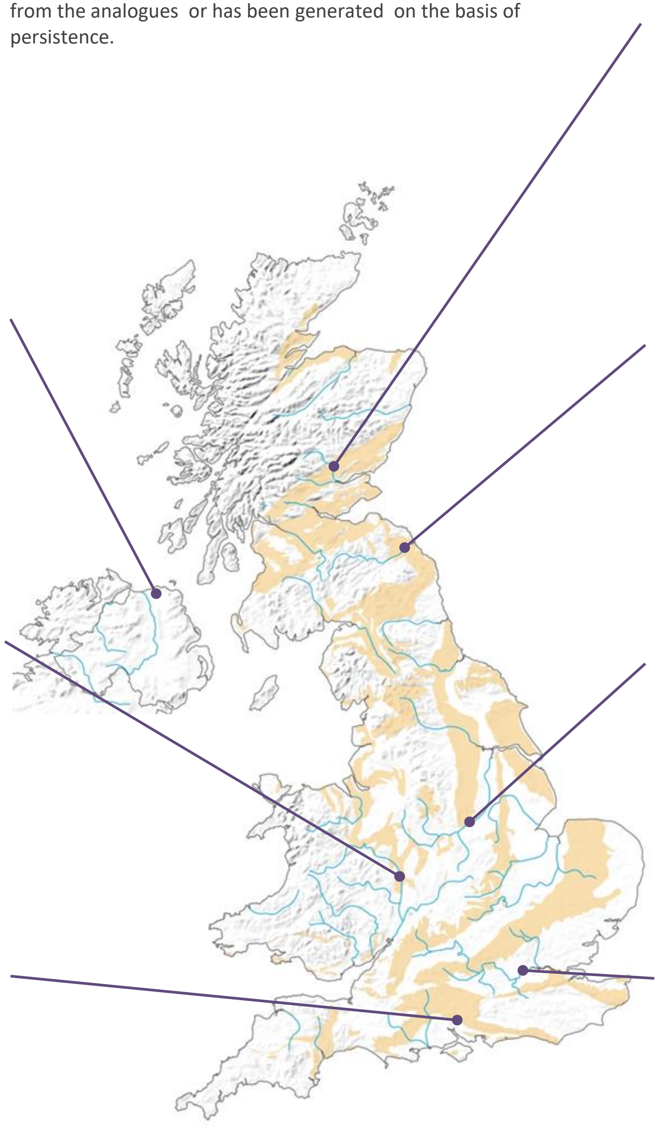
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

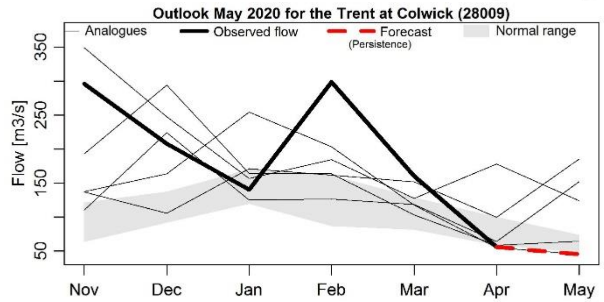
In each of the time series graphs the bold black line represents the observed flow during the past six months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows took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

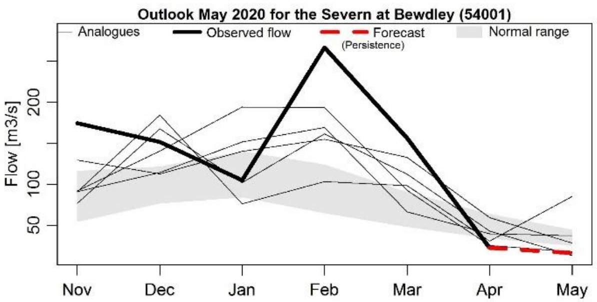


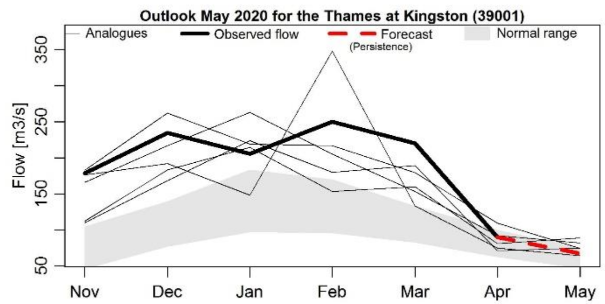


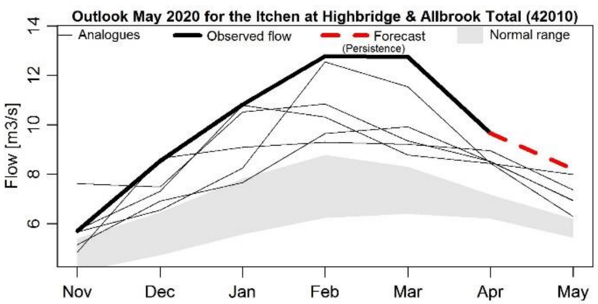












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Outlook based on hydrological persistence and analogy

UK Centre for Ecology & Hydrology

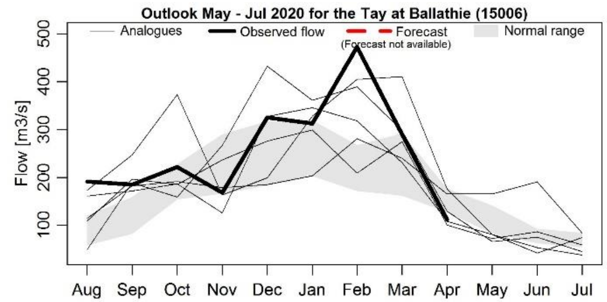
Site-based: 3 month outlook

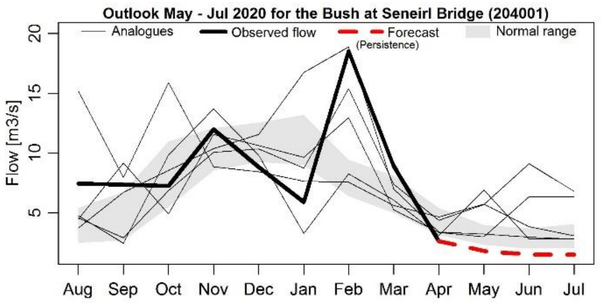
Period: May – July 2020

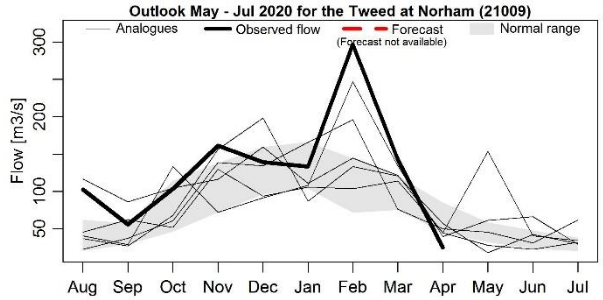
Issued on 06.05.2020 using data to the end of April 2020

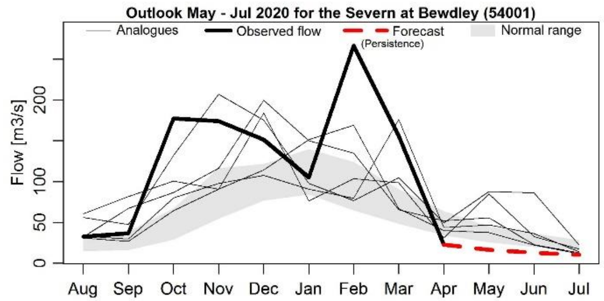
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

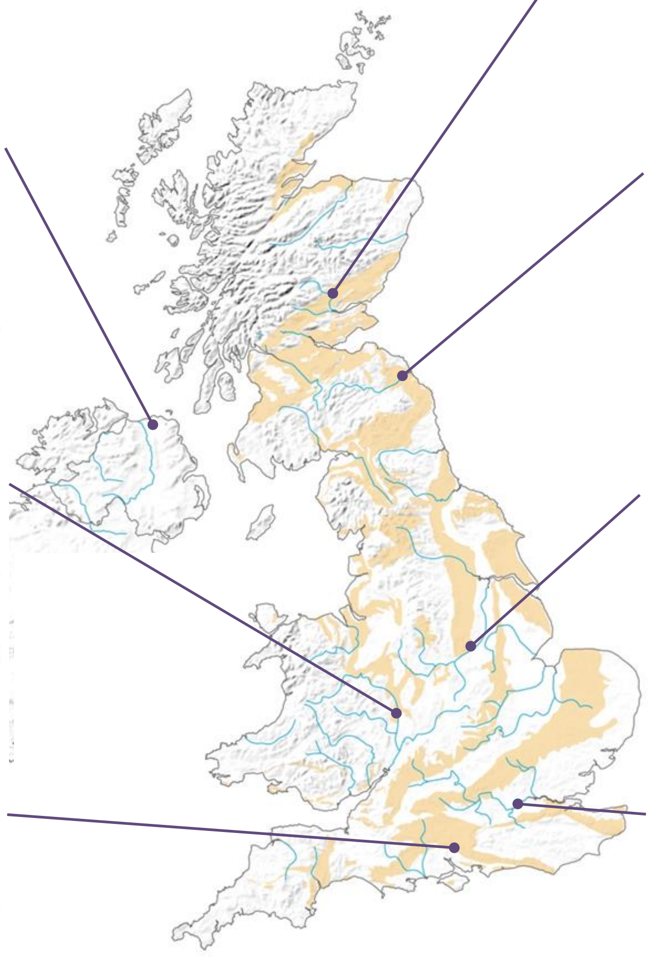
In each of the time series graphs the bold black line represents the observed flow during the past nine months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows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

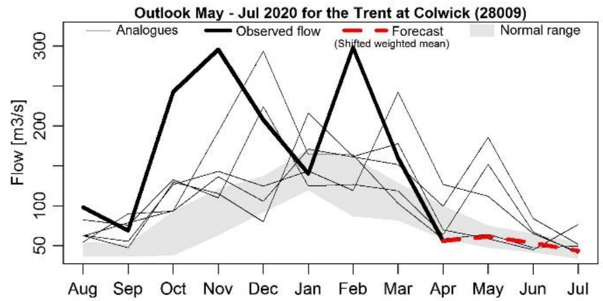


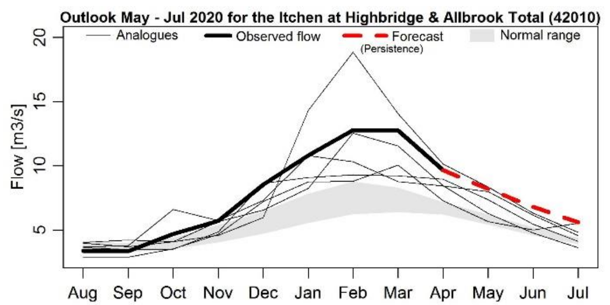


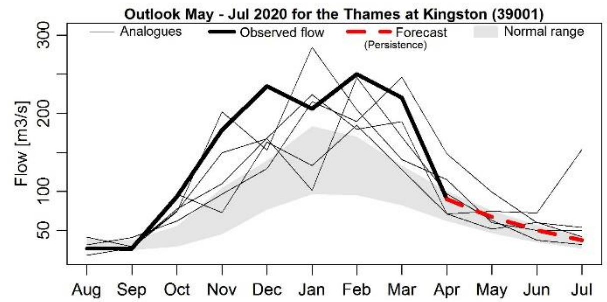












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Outlook based on modelled flow from historical climate

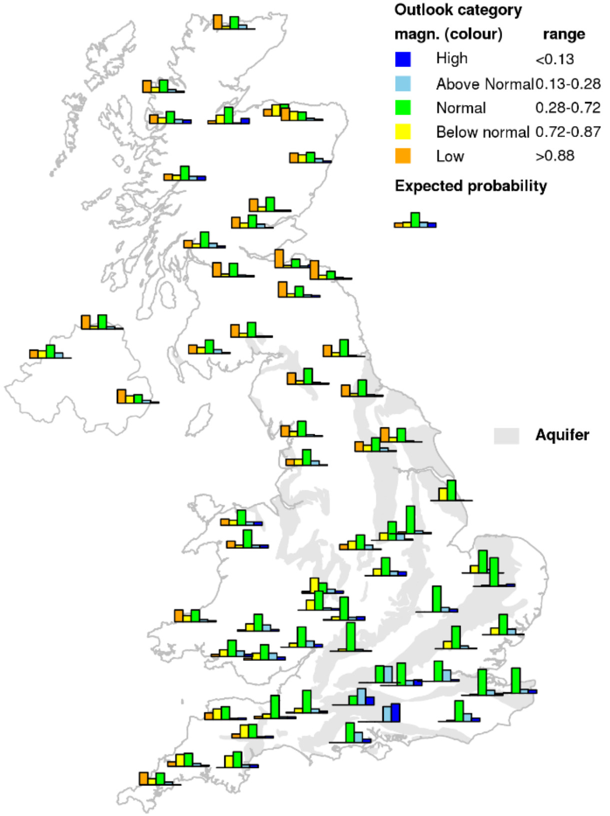
Overview

Period: May 2020 – October 2020

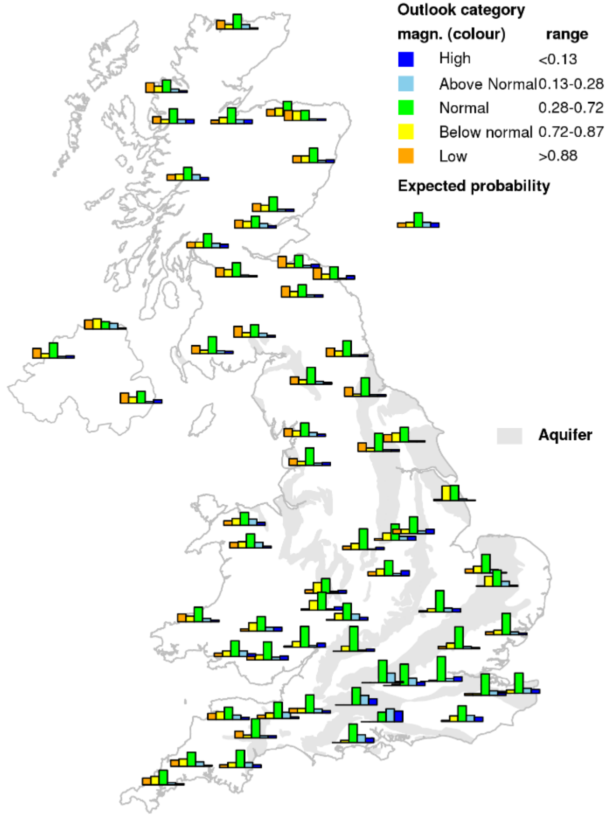
Issued on 06.05.2020 using data to the end of April

River flows in northern and western parts of the UK are likely to be below normal for May, and normal to below normal over the next three months. River flows across the majority of central and southern England and Wales are likely to be within the normal range for the next three months, with the exception of a few catchments in Hampshire which are likely to be above normal for May, and normal to above normal for the three month period May-June-July.

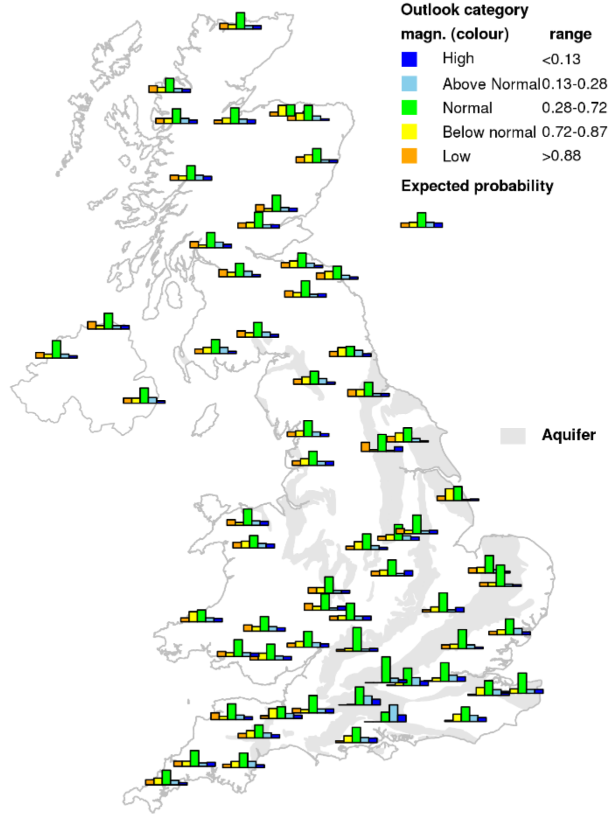
1-month river flow outlook starting May 2020



3-month river flow outlook starting May 2020



6-month river flow outlook starting May 2020



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 3, 6 and 12-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
NATURAL ENVIRONMENT RESEARCH COUNCIL
Environment Agency

Outlook based on modelled flow from historical climate

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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).

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UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 30th April 2020

Issue date: 05.05.2020

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 relative dryness.

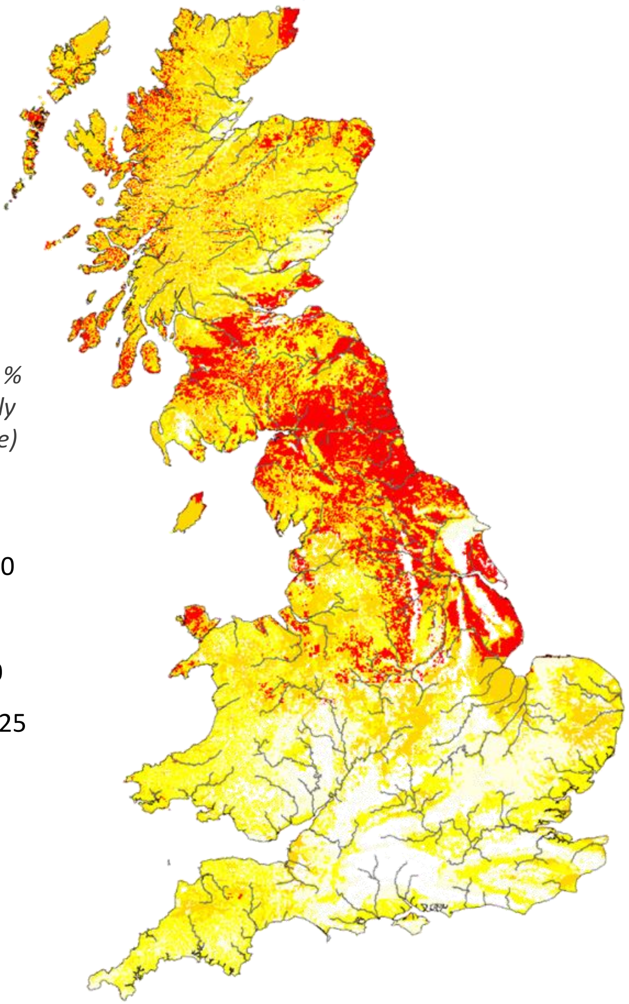
These maps do not provide a drought forecast and are not maps of soil moisture. Instead they indicate areas where subsurface water storage approaches or exceeds its historical minimum. A lack of rainfall in the high 'relative dryness' areas could lead to (or prolong) a drought.

SUMMARY: At the end of April, the majority of the country is experiencing relative dryness levels that are higher than average for this time of year, with southern Scotland and the north of England experiencing high relative dryness.

Relative Dryness

Water storage anomaly as a % of minimum storage anomaly (zero indicates average value)

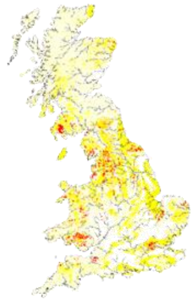
High (very dry)	>100
	75-100
Medium	50-75
	25-50
Low	0.01-25
(No dryness)	<0
Main rivers	



January

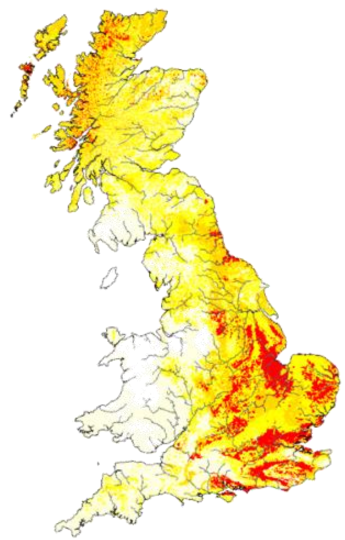
February

March

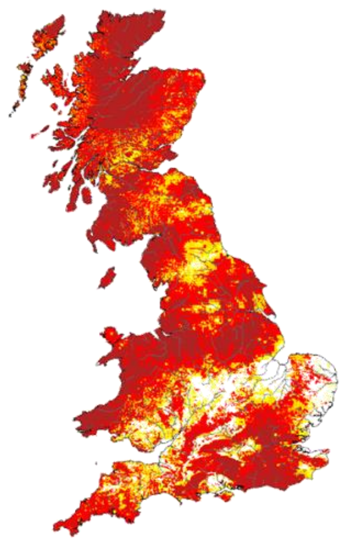


April

May 2019



August 1976*



*Example month displaying extreme relative dryness

May 2020

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Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 30th April 2020

Issue date: 05.05.2020

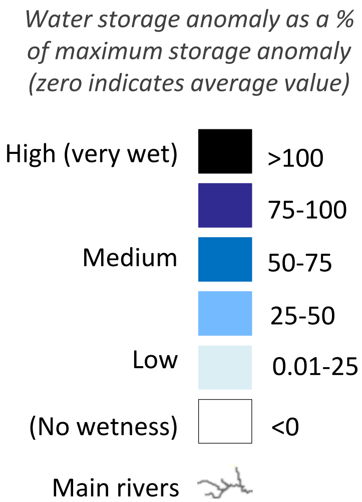
OUTLOOK BASED ON CURRENT CONDITIONS

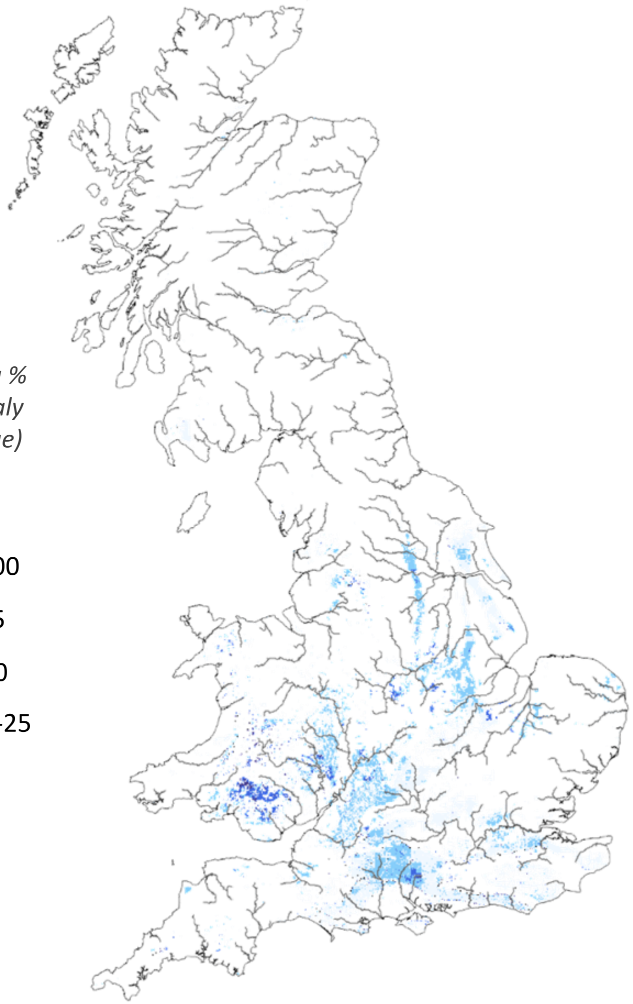
These maps are based on Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean. To highlight areas that are particularly wet or dry, the storage anomaly is presented here using a colour scale highlighting water storage relative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

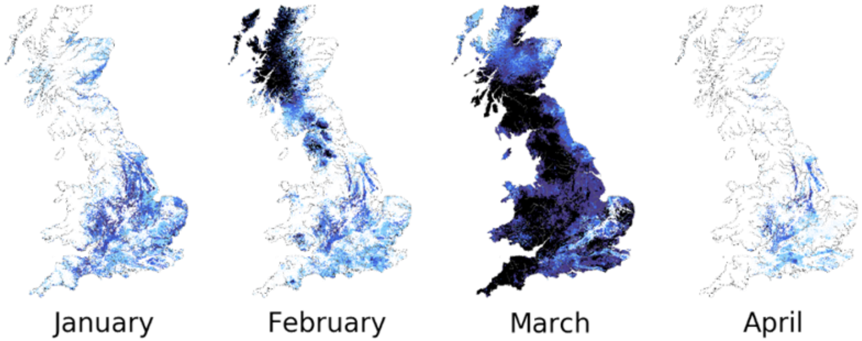
These maps do not provide a flood forecast and are not maps of soil moisture. Instead they indicate areas where subsurface water storage approaches or exceeds its historical maximum. Rainfall in the high 'relative wetness' areas could result in flooding.

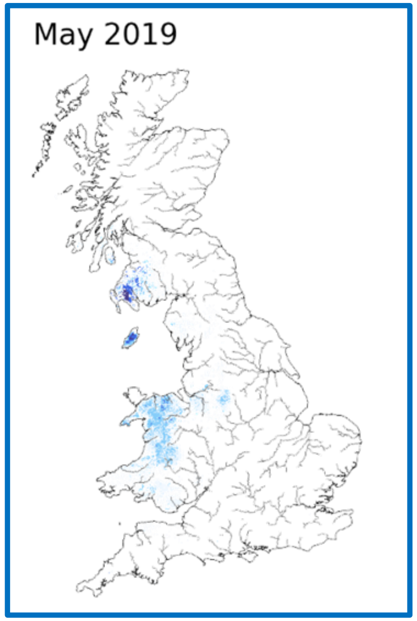
SUMMARY: At the end of April, most of the country is not experiencing relative wetness levels above average for this time of year.

Relative Wetness









*Example month displaying extreme relative wetness

May 2020

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Current Daily Simulated Subsurface Water Storage Conditions

Relative Dryness

- The relative dryness map highlights areas where current estimates of **subsurface water storage** (from the G2G hydrological model, calculated for the last day of last month) are particularly ***low***.
- The map indicates areas where the ground is dry compared to the monthly **average** storage (for the period 1981 to 2010), and shows this relative to the historical **minimum** storage level (for 1971 to 2010).
- Relative dryness calculation: $R_d\ (\%) = \dfrac{(S_{average} - S)}{(S_{average} - S_{min})} \times 100$

  $= \dfrac{\text{(average storage for this month - storage at end of last month)}}{\text{(average storage for this month - historical minimum storage)}} \times 100$
- A value of $\boldsymbol{R_d}$ **= 100** shows that a region is very dry, and indicates that the storage is as low as the minimum value ever estimated by the model for this month.
- A value of $\boldsymbol{R_d}$ **= 0** indicates that the storage in the region matches the monthly average value. *Negative relative dryness values will show up as part of the relative wetness map.*
- The map **does not provide a drought forecast**. A lack of rainfall in the high 'relative dryness' areas **could** lead to (or prolong) a drought.

Relative Wetness

- The relative wetness map highlights areas where current estimates of **subsurface water storage** (from the G2G hydrological model, calculated for the last day of last month) are particularly ***high***.
- The map indicates areas where the ground is wet compared to the monthly **average** storage (for the period 1981 to 2010), and shows this relative to the historical **maximum** storage level (for 1971 to 2010).
- Relative wetness calculation: $R_w\ (\%) = \dfrac{(S - S_{average})}{(S_{max} - S_{average})} \times 100$

  $= \dfrac{\text{(storage at end of last month - average storage for this month)}}{\text{(historical maximum storage - average storage for this month)}} \times 100$
- A value of $\boldsymbol{R_w}$ **= 100** shows that a region is very wet, and indicates that the storage is as high as the maximum value ever estimated by the model for this month.
- A value of $\boldsymbol{R_w}$ **= 0** indicates that the storage in the region matches the monthly average value. *Negative relative wetness values will show up as part of the relative dryness map.*
- The map **does not provide a flood forecast**. Rainfall in the high 'relative wetness' areas **could** result in flooding.

Return Period of Rainfall Required to Overcome the Dry Conditions

UK Centre for Ecology & Hydrology

Period: May 2020 – October 2020

Issue date: 05.05.2020

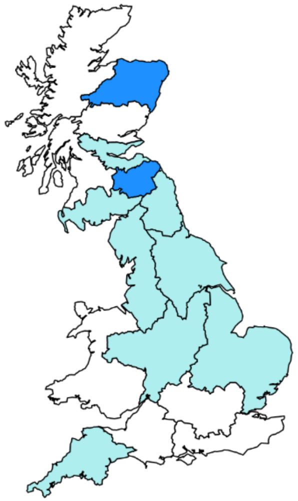
These maps show the **return period** of the rainfall required to overcome dry conditions simulated using the Grid-to-Grid (G2G) hydrological model. The maps are coloured according to the return period of accumulated rainfall required to overcome the estimated current subsurface water storage deficit 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.

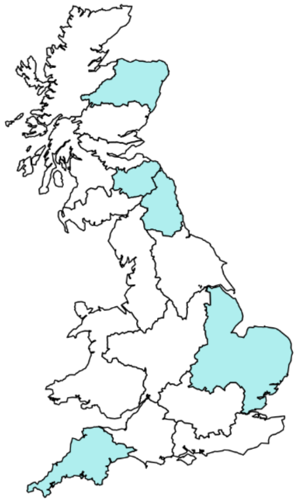
SUMMARY: Through May multiple regions across the UK will require a rainfall amount with a 5 to 10 year return period in order to return to average conditions for the time of year. The Tweed and North East Regions of Scotland will require higher amounts to return to average conditions: rainfall with a 10 to 25 year return period.

Some of this anticipated dryness persists into June, but from July until October Britain will not require particularly unusual rainfall (0 to 5 year return periods) to return to average conditions for the time of year.

May



Jun



Jul

Aug

Sep

Oct

Rainfall amount / Probability			*Return period (years)*
Low (this rain is likely to occur)	> 20%	white	0 - 5
	< 20%	light blue	5 - 10
	< 10%	mid blue	10 - 25
	< 4%	blue	25 - 50
High (less likely)	< 2%	dark blue	50 - 100
	< 1%	purple	100 - 200
Extreme (unlikely but still possible)	< 0.5%	red	>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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Return Period of Rainfall Required to Overcome the Dry Conditions

Method

- 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 rainfall required to overcome the estimated current subsurface water storage deficit.

- For **dry areas** within a Hydrological Outlook region, i.e. where subsurface water storage anomaly < 0, we estimate ***regional average subsurface water storage deficit*** *(mm)* from the last day of the most recent G2G model run.

- For each region we also estimate the ***regional monthly average rainfall total*** *(mm)* (for the period 1971-2000).

- For each of the next 6 months, we estimate the rainfall total (including what is normally expected for each month) required to overcome the dry conditions.
  - To overcome the dry conditions by the end of month 1:

    rainfall required (mm) = regional monthly average rainfall for month 1 + regional average storage deficit
  - To overcome the dry conditions by the end of month 2 (more likely):

    rainfall required (mm) = regional monthly average rainfall for months 1 and 2 + regional average storage deficit
  - To overcome the dry conditions by the end of month *n* (likely):

    rainfall required (mm) = regional monthly average rainfall for months 1 to *n* + regional average storage deficit

- Using Tabony tables we estimate the return period of the ***rainfall required*** in each region and over the next 1 to 6 months to overcome the dry conditions.

- The return period results are displayed as regional maps with the colour scale based on the return period (years) of the rainfall required to replenish subsurface stores over the next 1, 2, .., 6 months ahead.

- Note: 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.

Estimate of Additional Rainfall Required to Overcome Dry Conditions

UK Centre for Ecology & Hydrology

Based on subsurface water storage estimated for 30th April 2020

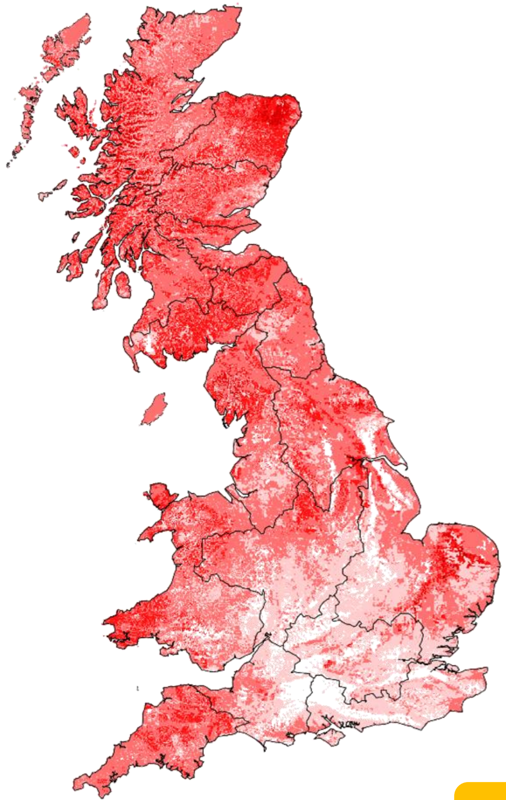
Issue date: 05.05.2020

OUTLOOK BASED ON CURRENT CONDITIONS

May 2020

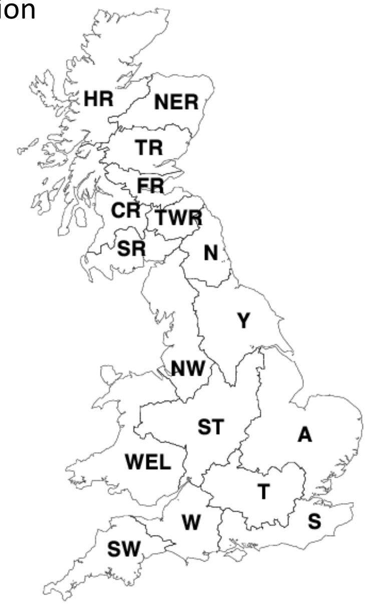
These maps show the Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean (1981-2010), presented on a 1km grid and as regional means.
Subsurface storage deficits, i.e. where the subsurface water storage anomaly is less than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

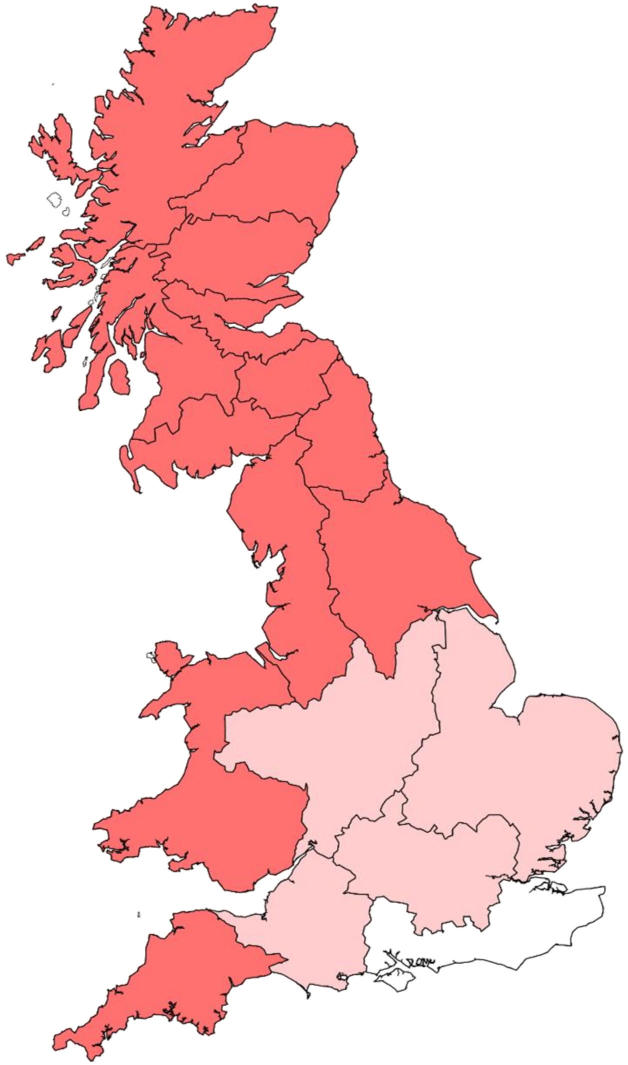
The **subsurface storage deficit (mm)** can be interpreted as an estimate of additional rainfall that would be required in future months to overcome dry conditions (i.e. rainfall in addition to what is expected on average). Regional mean values of additional rainfall required are provided in the table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

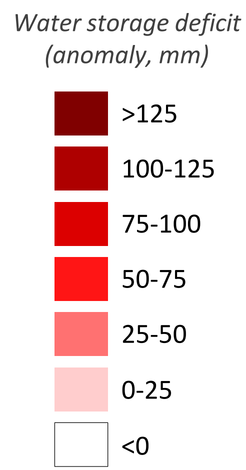


Regional estimate of additional rainfall required (mm)

	SCOTLAND	
38	HR	Highlands Region
48	NER	North East Region
39	TR	Tay Region
39	FR	Forth Region
41	CR	Clyde Region
46	TWR	Tweed Region
44	SR	Solway Region
	ENGLAND	
34	N	Northumbria
34	NW	North West
29	Y	Yorkshire
18	ST	Severn Trent
22	A	Anglian
1	T	Thames
3	W	Wessex
0	S	Southern
39	SW	South West
	WALES	
29	WEL	Welsh







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Outlook Based on Modelled Flow from Rainfall Forecasts

Overview

Period: May 2020 – July 2020

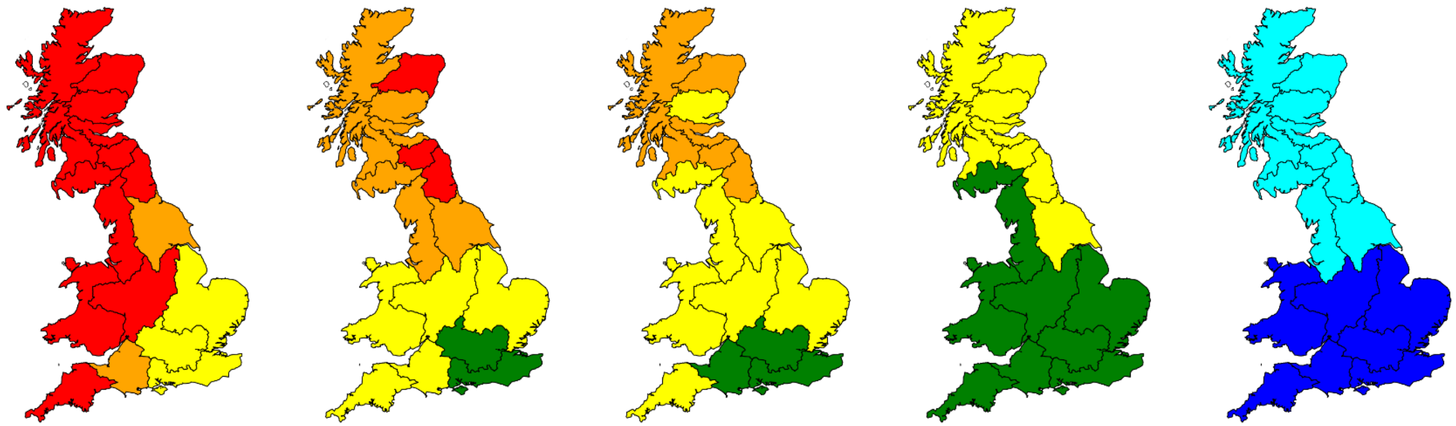
Issued on 05.05.2020 using data to the end of April

SUMMARY: During May, river flows across Scotland are most likely to be *Notably low flows*, with some eastern regions potentially experiencing *Exceptionally low flows*. River flows across the majority of England and Wales are most likely to be *Below normal*; only south east England is most likely to experience river flows in the *Normal range*.

Over the next 3 months river flows across the country follow a similar pattern, with the majority of regions most likely to experience flows *Below normal* or lower; Scotland and north England are still likely to experience *Notably low flows.*

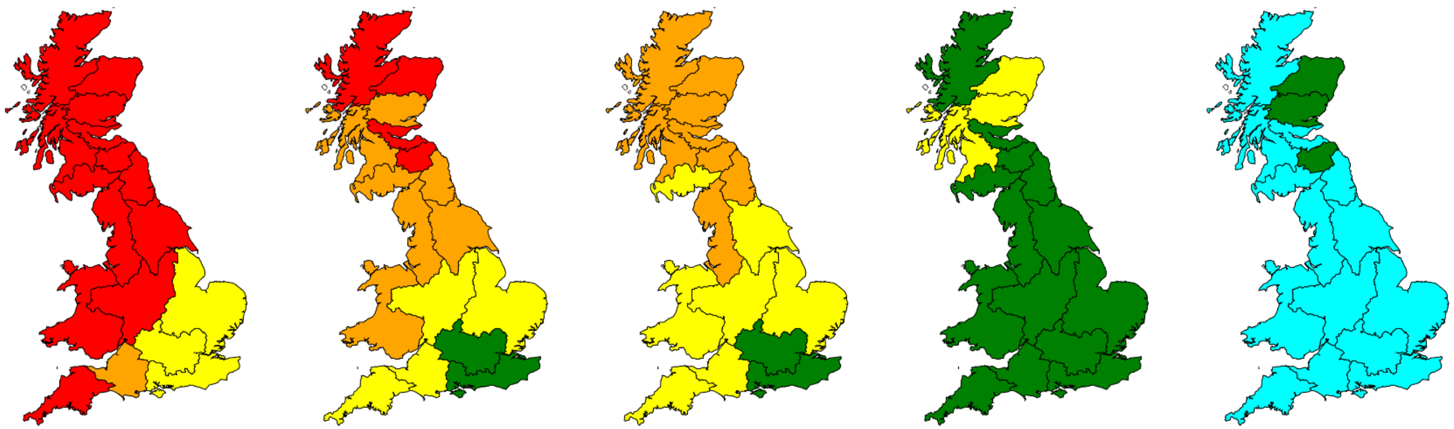
1-month flow outlook

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



3-month flow outlook

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



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.

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 Modelled Flow from Rainfall Forecasts 1- and 3-month variability

Period: May 2020 – July 2020

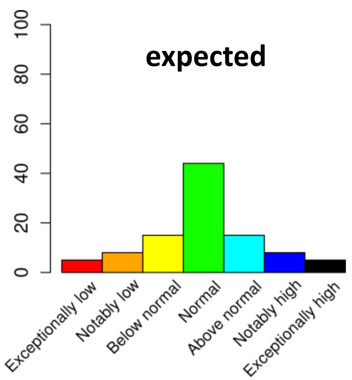
Issue date: 05.05.2020

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.

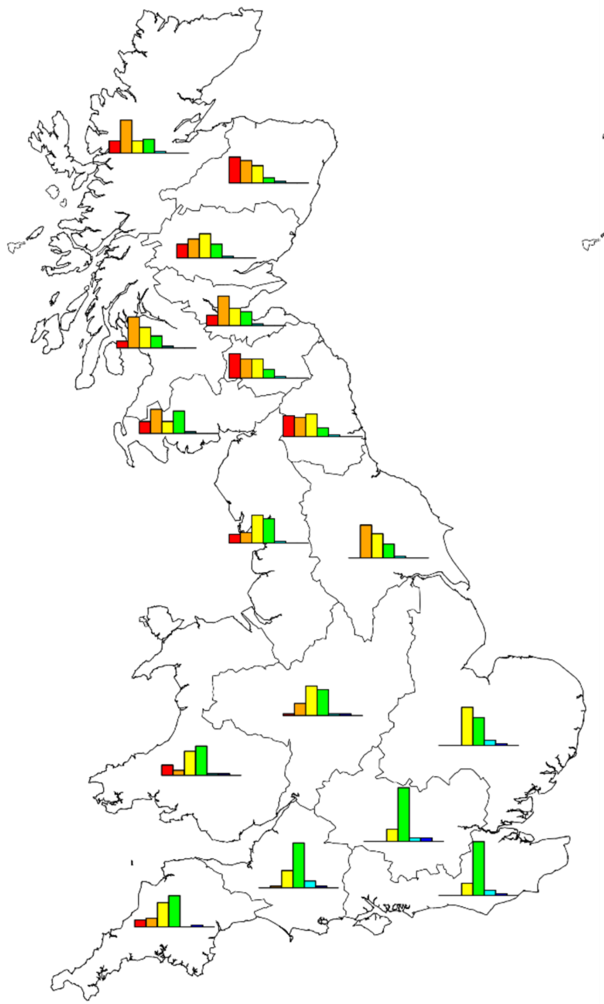
The bar charts (below) give further insight into the range of river flow forecasts by considering all members of the forecast rainfall ensemble. The regional bar charts show the percentage of ensemble forecasts falling in each of the flow categories as generated by the monthly-resolution water-balance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

SUMMARY: During May, river flows across Scotland are most likely to be *Notably low flows*, with some eastern regions potentially experiencing *Exceptionally low flows*. River flows across the majority of England and Wales are most likely to be *Below normal*; only south east England is most likely to experience river flows in the *Normal range*.

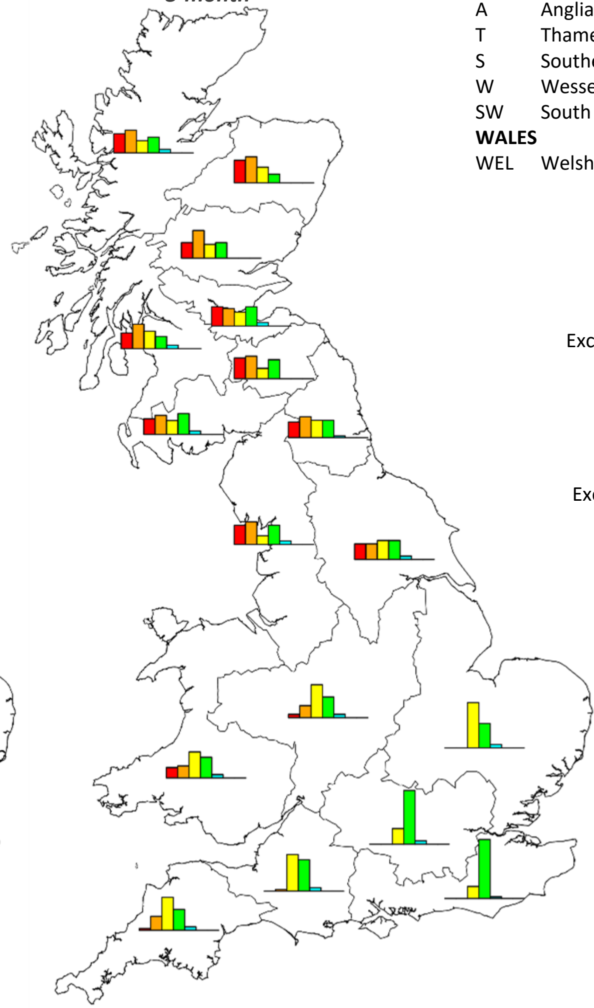
Over the next 3 months river flows across the country follow a similar pattern, with the majority of regions most likely to experience flows *Below normal* or lower; Scotland and north England are still likely to experience *Notably low flows.*



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

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

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UK Centre for Ecology & Hydrology

Outlook Based on Modelled Flow from Rainfall Forecasts

1- and 3-month variability

Period: May 2020 – July 2020

Issue date: 05.05.2020

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).

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

SUMMARY: During May, river flows across Scotland are most likely to be *Notably low flows*, with some eastern regions potentially experiencing *Exceptionally low flows*. River flows across the majority of England and Wales are most likely to be *Below normal*; only south east England is most likely to experience river flows in the *Normal range*.

Over the next 3 months river flows across the country follow a similar pattern, with the majority of regions most likely to experience flows *Below normal* or lower; Scotland and north England are still likely to experience *Notably low flows.*

1-month ahead	A	NW	N	ST	SW	S	T	Welsh	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 flow	2	0	0	2	2	2	5	2	2	0	0	0	0	0	0	0	0
Above normal	7	2	2	2	0	7	5	2	10	2	2	2	2	2	2	2	2
Normal range	38	33	12	36	43	74	74	40	62	19	17	19	19	7	31	19	12
Below normal	52	38	31	40	33	17	17	33	24	33	29	24	17	24	17	33	26
Notably low flow	0	14	26	17	12	0	0	7	2	45	43	40	45	31	33	26	26
Exceptionally low flow	0	12	29	2	10	0	0	14	0	0	10	14	17	36	17	19	33

3-months ahead	A	NW	N	ST	SW	S	T	Welsh	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 flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Above normal	5	5	2	5	5	2	5	5	5	5	5	5	5	0	5	0	0
Normal range	33	26	24	29	29	81	74	29	43	26	17	26	21	12	29	21	26
Below normal	62	12	24	45	45	17	21	36	50	26	24	19	17	21	19	19	14
Notably low flow	0	31	29	17	19	0	0	17	2	21	33	24	31	36	26	38	31
Exceptionally low flow	0	26	21	5	2	0	0	14	0	21	21	26	26	31	21	21	29

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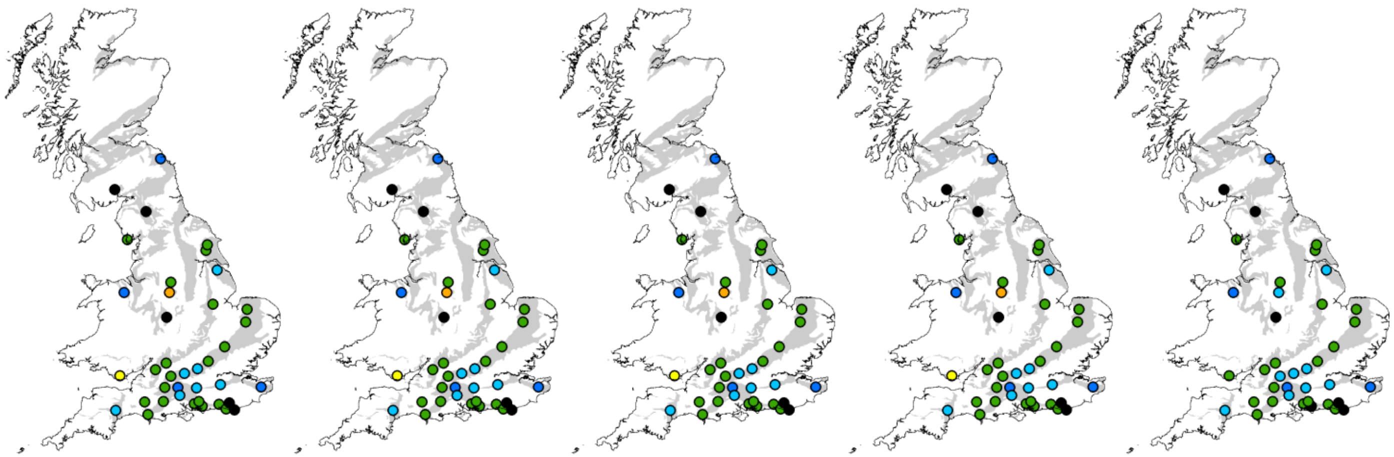
Outlook based on modelled groundwater level & climate forecast

Period: May 2020 – July 2020

Issued on 07.05.2020 using data to the end of April

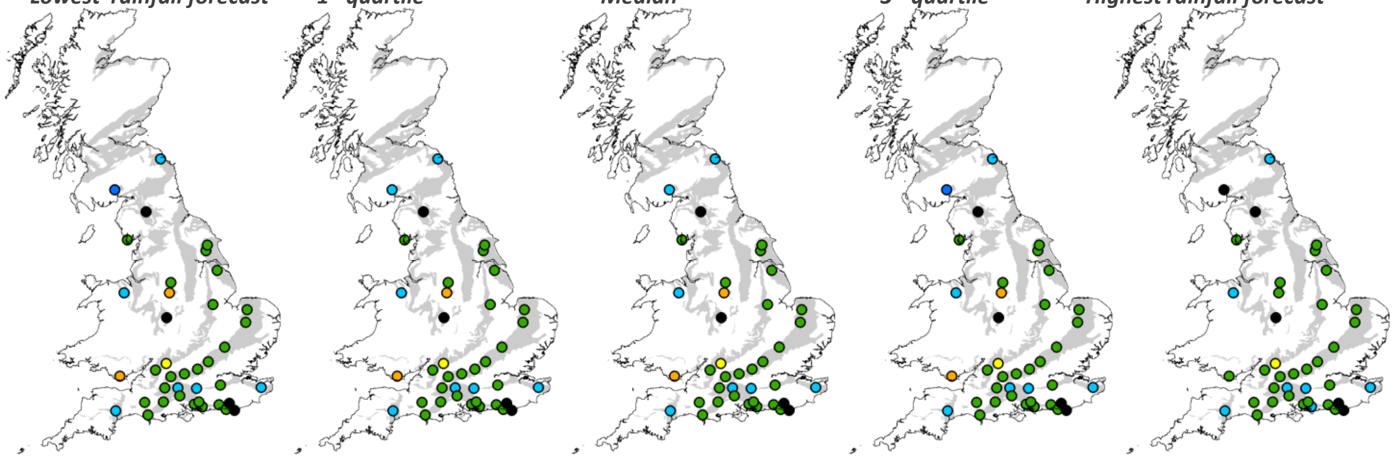
Normal to above normal groundwater levels are predicted to prevail over the UK in the next month, with exceptionally high groundwater levels in some Chalk sites in the South of England and in the Permo-Triassic sandstones of the North-West. Over 3 months, normal conditions are predicted to prevail throughout the UK, with exceptionally high levels predicted in some Chalk sites in the South of England. Note there are a reduced number of modelled sites. This is due to the temporary unavailability of data, where EA staff have been unable to either manually dip boreholes or download logger data as a consequence of Covid-19 restrictions.

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*

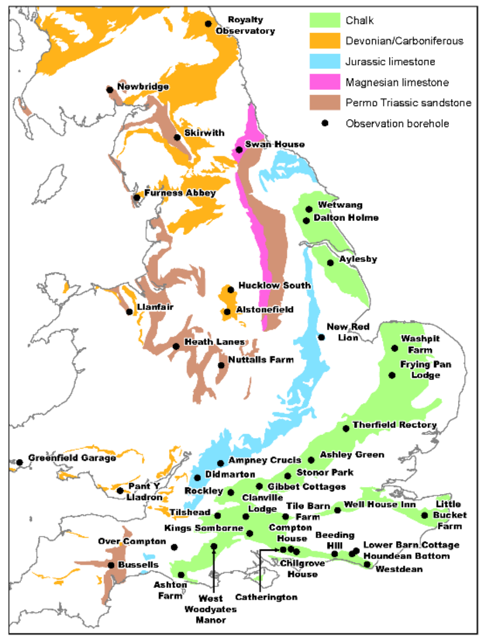


3-month outlook

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	13-28
Notably low levels	5-13
Exceptionally low levels	< 5



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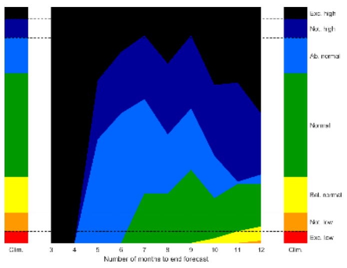
Outlook based on modelled groundwater from historical climate

Period: May 2020 – April 2021

Issued on 07.05.2020 using data to the end of April

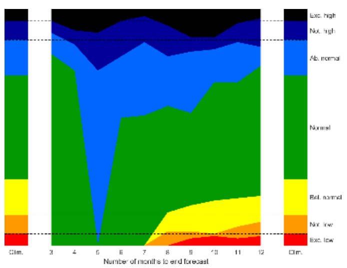
Normal conditions are expected across much of the UK over the next 12 months, below normal levels are likely in the latter 4 months of the year in the Chalk of eastern England. Exceptionally high levels are predicted in the Permo-Triassic sandstones at Skirwith for the next 4 months, remaining high for the remainder of the year. Note that Heathlanes has been abandoned with no levels since March 2019 and has been omitted.

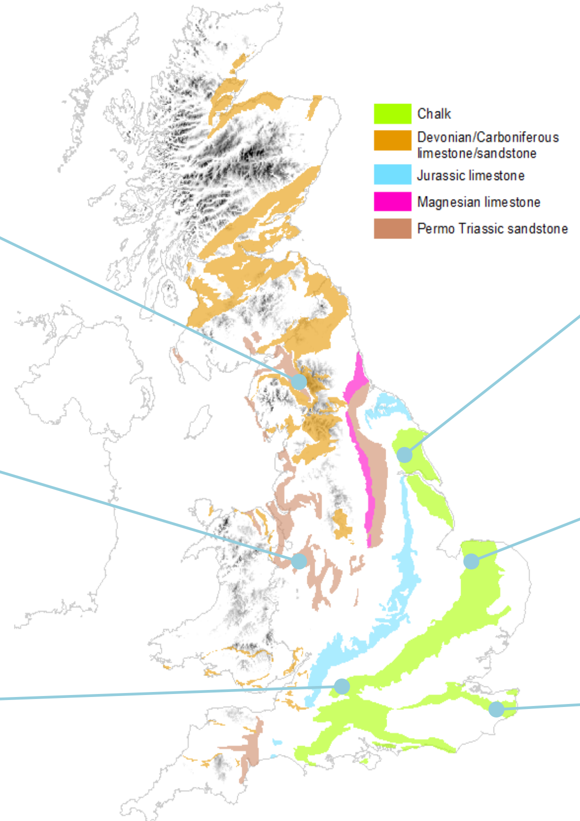
Skirwith (NY63/2)

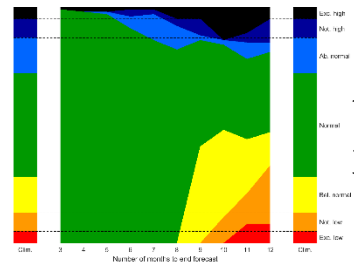


Heathlanes (SJ62/112)

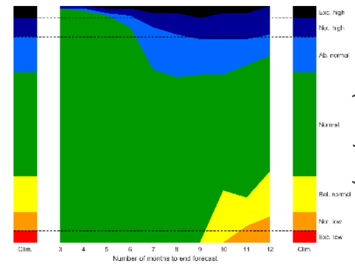
Rockley (SU17/57)



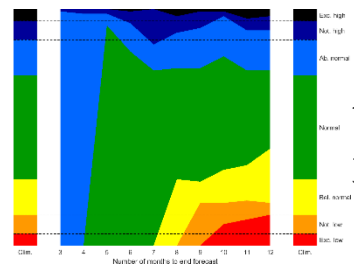




Dalton Holme (SE94/5)



Washpit Farm (TF81/2A)



Little Bucket Farm (TR14/9)

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.

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