Hydrological Outlook UK

Period: From June 2020

Issued on 08.06.2020 using data to the end of May 2020

SUMMARY

River flows across most parts of the UK are likely to be below normal in June and in the three months to August. In places flows may be notably or exceptionally low. The exceptions to this are south-east England and north-west of Scotland where river flows during this period will be normal to below normal. Groundwater levels will generally be normal in June and in the period to August although with significant local variability.

Rainfall:

With the exception of north-west Scotland, where rainfall was above average, most parts of the UK had below normal rainfall during May, with southern areas being extremely dry.

The rainfall outlook for June (as issued by the Met Office on 21st May 2020) is that below-average precipitation is more likely than above-average precipitation.

For June-July-August as a whole, below-average precipitation is slightly more likely than above-average precipitation. The probability that UK-average precipitation for June-July-August will fall into the driest of five categories is 25% and the probability that it will fall into the wettest of five categories is between 15% and 20% (the 1981-2010 probability for each of these categories is 20%).

River flows:

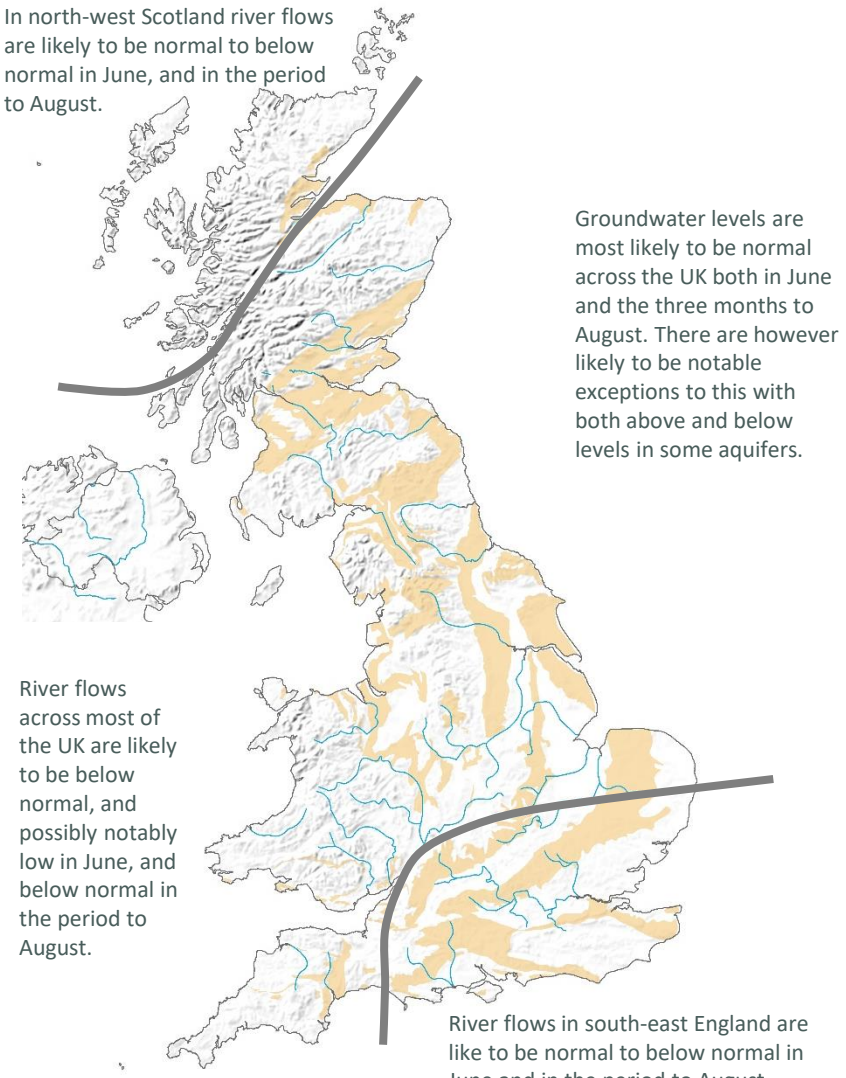
May river flows were notably, or exceptionally, low in a wide band extending from south-west England to north-east Scotland. Flows in south-east England were generally normal although with some localised exceptions where flows were above and below normal. In north-west Scotland river flows were normal to above normal.

This pattern of river flows is likely to be maintained into June and the period to August, with below normal flows across most of the UK. In places flows may be notably low. Groundwater fed rivers in south-east England are likely to have flows in the normal range, as a consequence of the above average winter rainfall, but other rivers in the same area are most likely to have below normal flows. Normal to below normal flows are most likely in north-west Scotland.

Groundwater:

Many observed groundwater levels were normal during May, but other sites recorded above and below normal levels. For example, there were exceptionally high levels in the Permo-Triassic sandstone of Cheshire, and notably low levels in the Limestone of south Wales.

Normal groundwater levels are predicted to prevail over the UK in the next month, with above normal and notably high levels in some Chalk sites in the south of England. Normal to exceptionally high groundwater levels are predicted at some sites in the Permo-Triassic sandstones of the north-west. Below normal to exceptionally low levels are predicted in southern Wales and Scotland. Over three months, normal conditions are predicted to prevail throughout the UK, with above normal to notably high levels predicted in some Chalk sites in the south of England.



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

UK Centre for Ecology & Hydrology | British Geological Survey, Natural Environment Research Council | 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

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	> 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.

Your use of the Content is entirely at your own risk. We make no warranty, representation or guarantee that the Content is error free or fit for your intended use.

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:

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, 2020, June, 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/

UK Centre for Ecology & Hydrology · British Geological Survey, Natural Environment Research Council · 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

Met Office 3-month Outlook

Period: June – August 2020 Issue date: 21.05.20

The forecast presented here is for June and the average of the June-July-August period for the United Kingdom as a whole. The forecast for June 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 29th May 2020.

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

SUMMARY – PRECIPITATION:

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

The probability that UK-average precipitation for June-July-August will fall into the driest of our five categories is 25% and the probability that it will fall into the wettest of our five categories is between 15% and 20% (the 1981-2010 probability for each of these categories is 20%).

CONTEXT:

As stated in the temperature Outlook, there is a relative lack of global drivers of UK weather patterns at this time of year, which causes predictability of precipitation amounts to be lower. This means there are typically only small shifts in the likelihood of above- and below-average precipitation.
Despite that, agreement between long-range systems from global prediction centres is higher than normal for June. There is a signal for a greater-than-usual chance of high pressure near the UK, and therefore an increased likelihood of drier-than-normal conditions (see left-hand graph of figure P2).

For June-July-August as a whole, signals are weak, with only a slightly greater-than-normal chance of high pressure near the UK. This results in a modest increase in the likelihood of below-average rainfall (see right-hand graph of figure P2). The chances of above-average rainfall, however, are only marginally less than usual. Spells of more unsettled, wet and windy weather are not precluded even if the Outlook period turns out to be drier-than-normal overall.

Fig P1

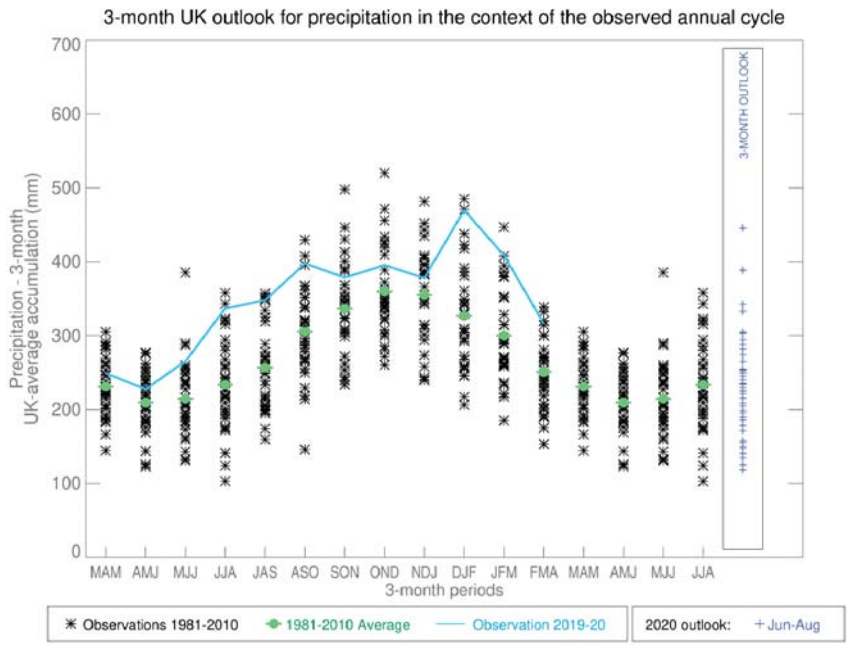


Fig P2

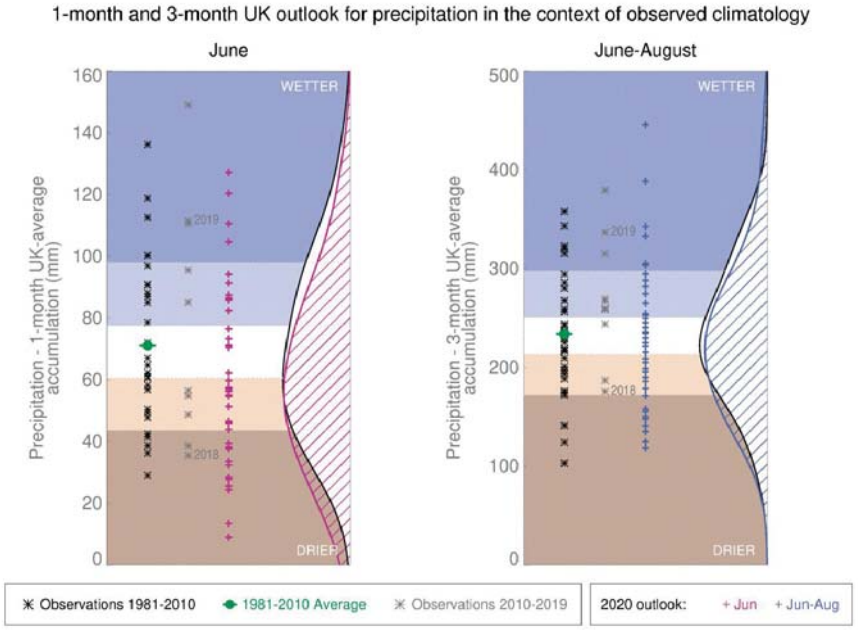
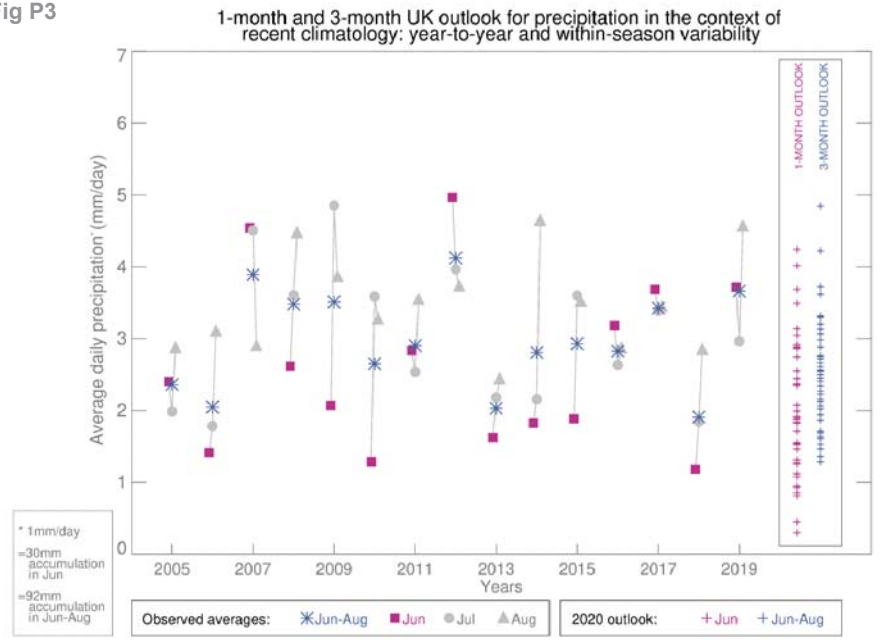


Fig P3



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: June – August 2020 Issue date: 21.05.20

The forecast presented here is for June and the average of the June-July-August period for the United Kingdom as a whole. The forecast for June 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 29th May 2020.

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

SUMMARY – TEMPERATURE:

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

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

CONTEXT:

Global drivers of UK weather, such as the El Niño-Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD), have a smaller influence at this time of year. This means seasonal predictability tends to be lower than in winter.

ENSO is likely to remain in a neutral phase during the Outlook period. Sea surface temperatures (SSTs) in the tropical central and eastern Pacific have fallen recently, and there is an outside chance of a La Niña event developing later in the period. This is less likely than the continuation of neutral conditions, however, and it is unlikely ENSO will influence UK weather patterns.

SSTs remain below average in the mid-North Atlantic Ocean to the 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. However, this influence is not as large as in recent years such as the warm summer of 2018. The seas around the UK are currently warmer-than-average and this increases the likelihood of above-average temperatures.

For June, the Met Office seasonal prediction system, along with systems from other prediction centres around the world, indicates an increased likelihood of high pressure near the UK. For June-July-August as whole, signals are generally weak, with slightly higher chances of high pressure near the UK than of other weather patterns. High pressure would lead to more settled weather and, combined with the warming climate, this means greater-than-usual chances of above-average temperatures (see graphs of figure T2). 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 weather throughout the whole 3-month period. 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

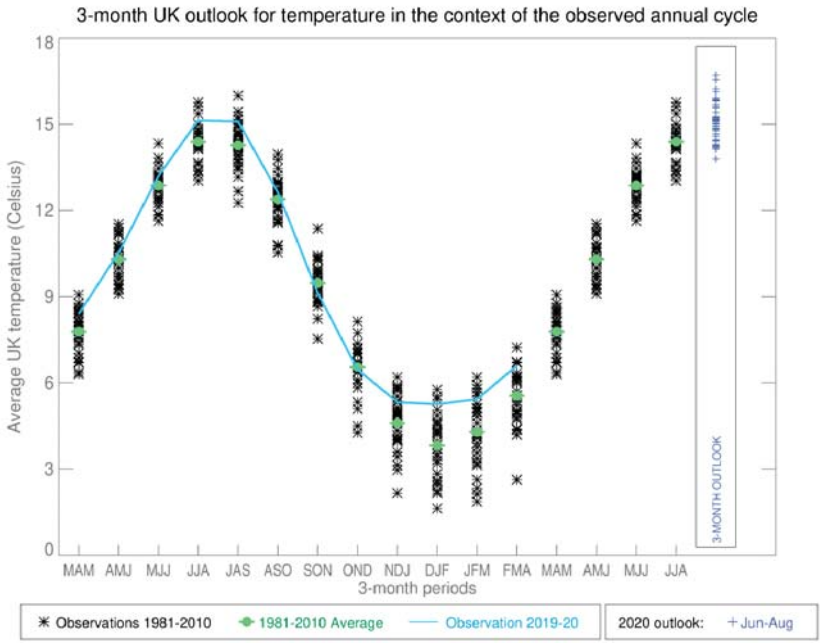


Fig T2

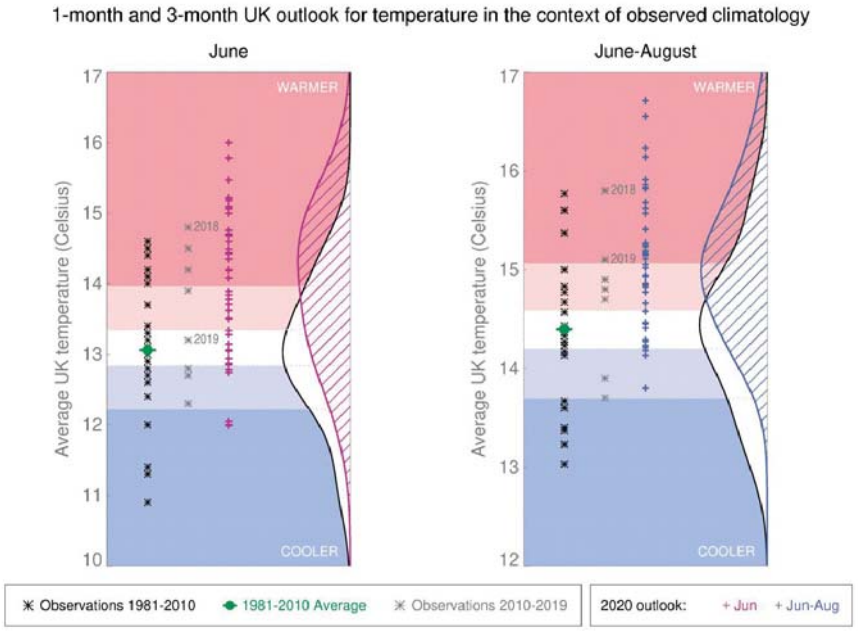
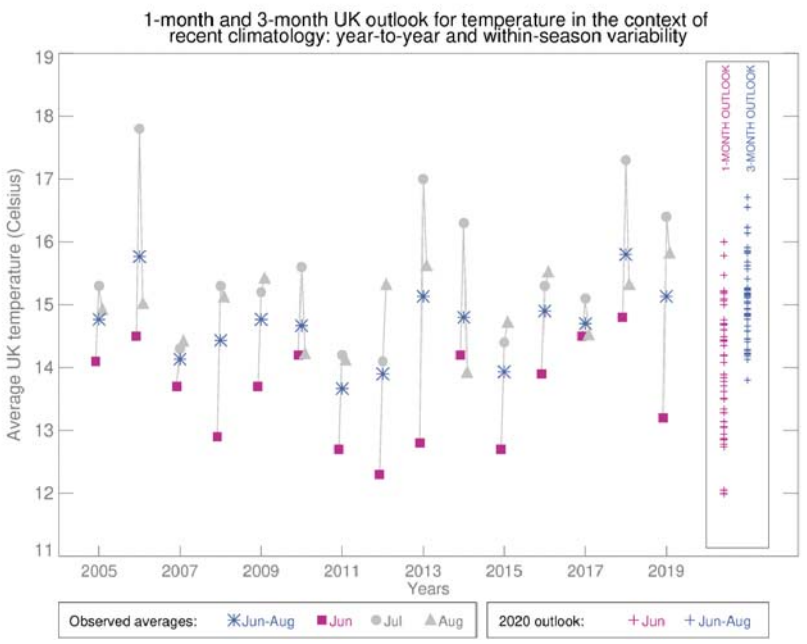


Fig T3



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.

UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

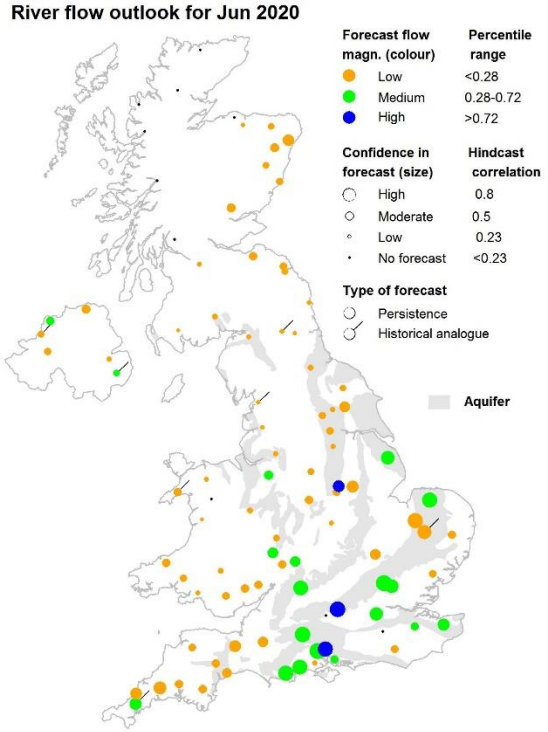
Overview

Period: June 2020 – August 2020

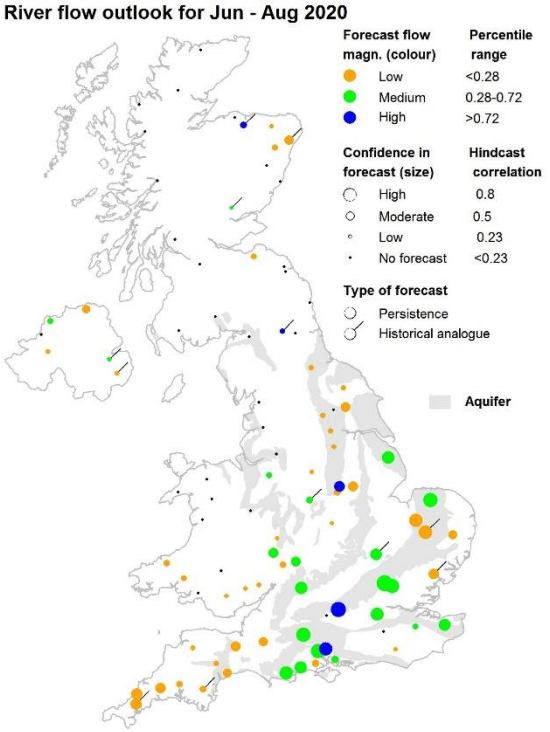
Issued on 04.06.2020 using data to the end of May 2020

SUMMARY

The outlooks for June and for June-August are for normal to below normal flows for most of the UK except for catchments on the Chalk in the south-east where normal flows are more likely. Please note that not many forecasts are available for the north-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.

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

UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

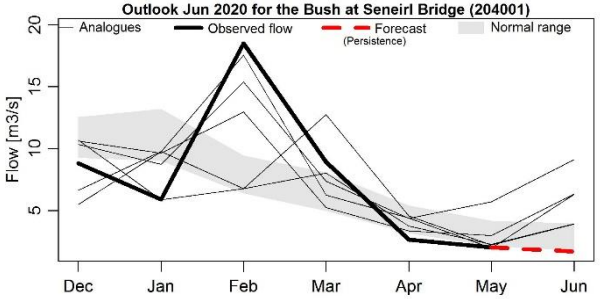
Site-based: 1 month outlook

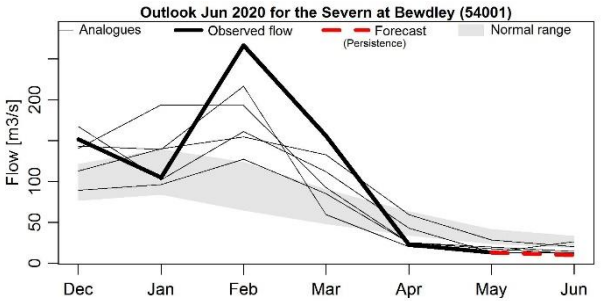
Period: June 2020

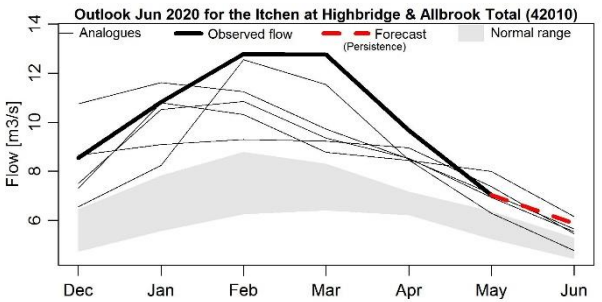
Issued on 04.06.2020 using data to the end of May 2020

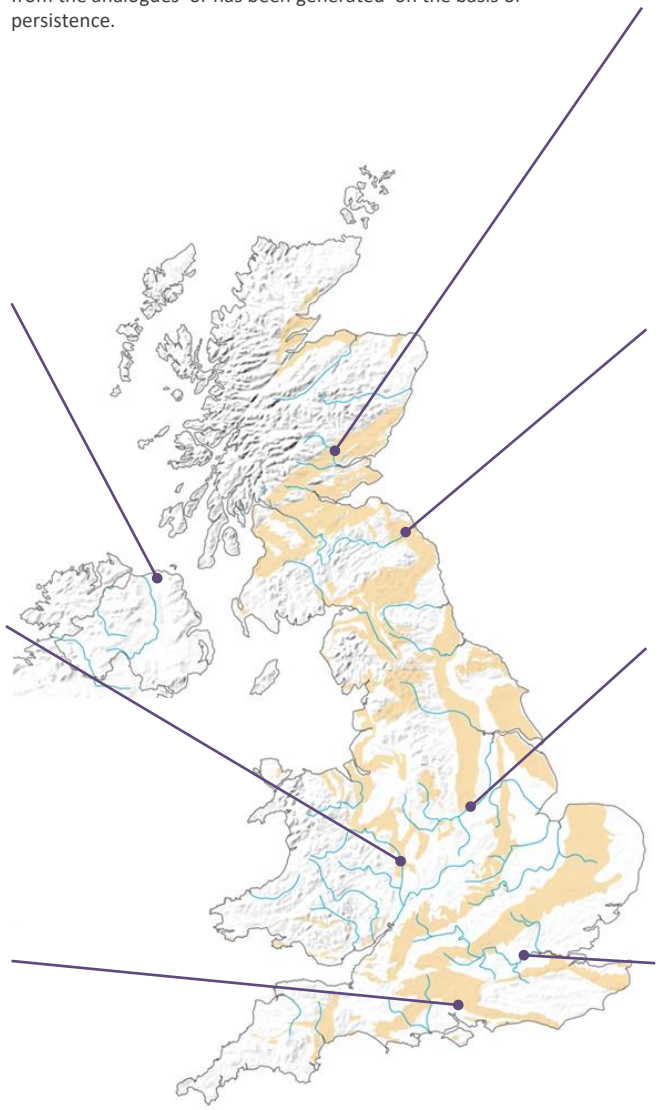
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

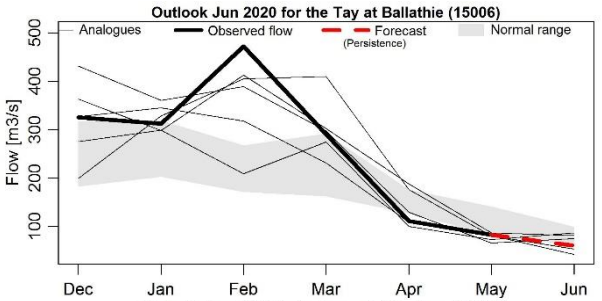
In each of the time series graphs the bold black line represents the observed flow during the past six months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows took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

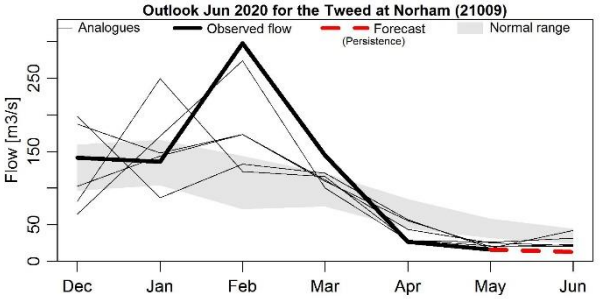


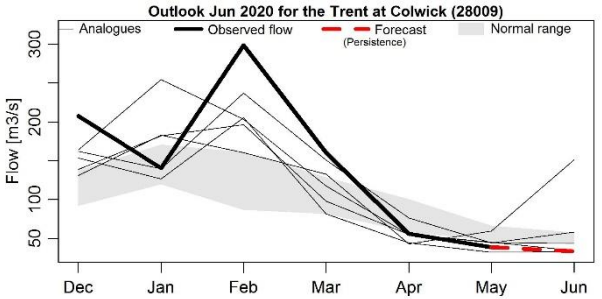


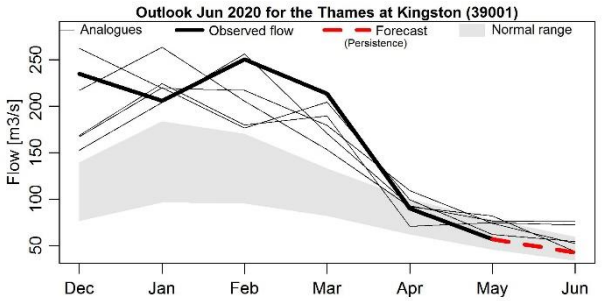












The Hydrological Outlook UK provides an outlook for the water situation for the UK over the next three months and beyond. For guidance on how to interpret the outlook, a wider range of information, and a full description of underpinning methods, please visit the website: www.hydoutuk.net

RIVER FLOW ANALOGY

June 2020

UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

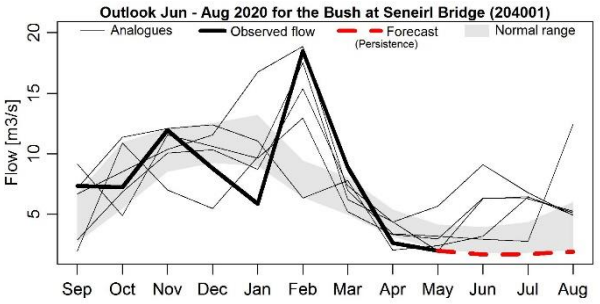
Site-based: 3 month outlook

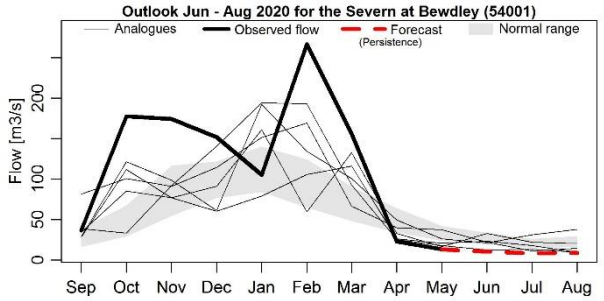
Period: June – August 2020

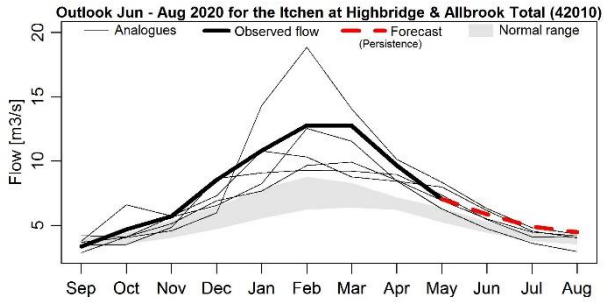
Issued on 04.06.2020 using data to the end of May 2020

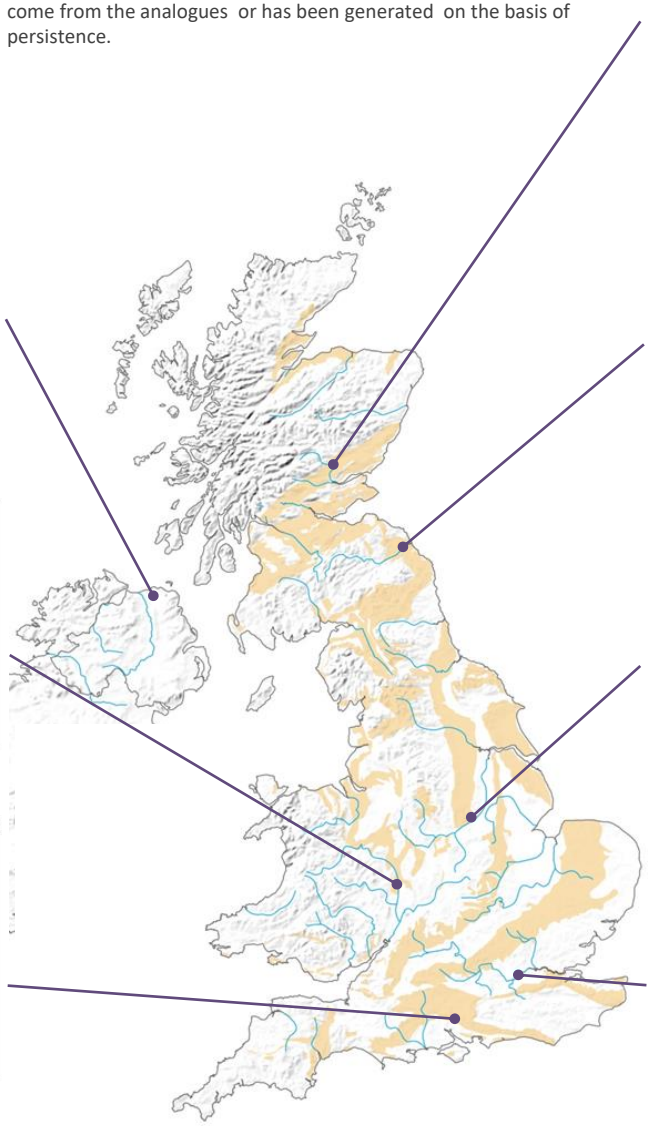
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

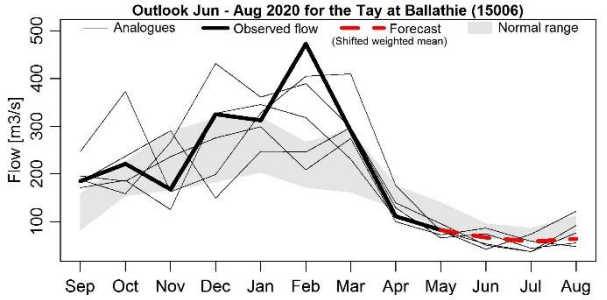
In each of the time series graphs the bold black line represents the observed flow during the past nine months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows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

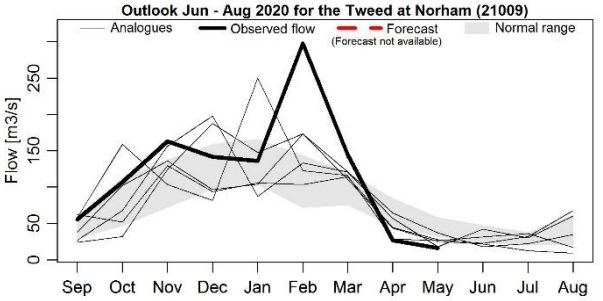


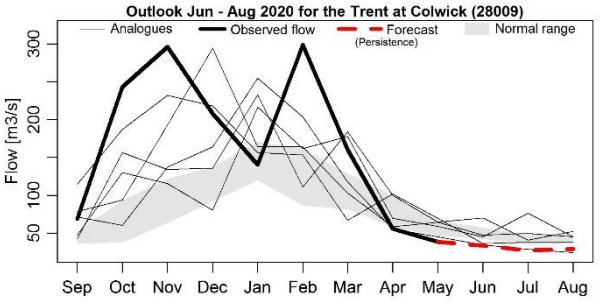


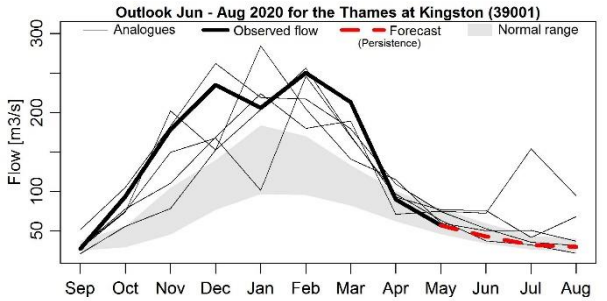












The Hydrological Outlook UK provides an outlook for the water situation for the UK over the next three months and beyond. For guidance on how to interpret the outlook, a wider range of information, and a full description of underpinning methods, please visit the website: www.hydoutuk.net

RIVER FLOW ANALOGY

June 2020

UK Centre for Ecology & Hydrology

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment Agency

Outlook based on modelled flow from historical climate

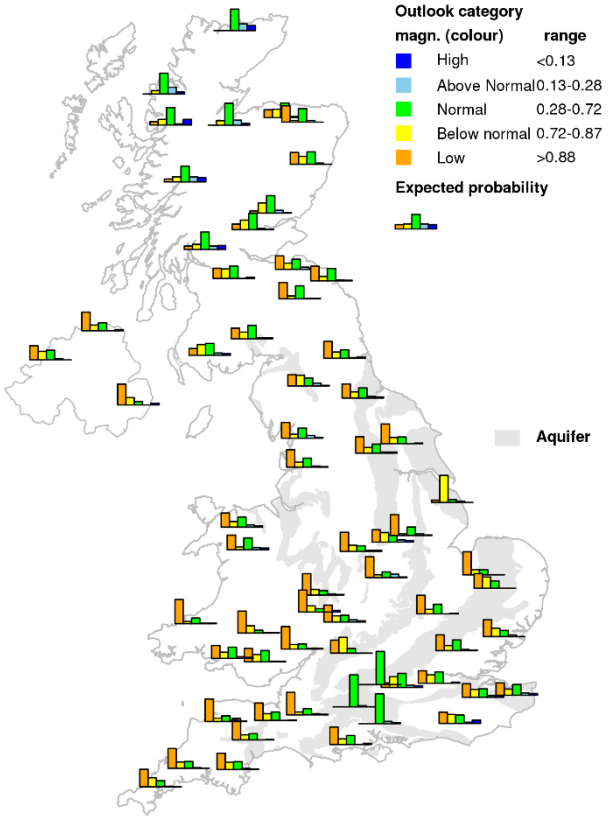
Overview

Period: June 2020 – November 2020

Issued on 04.06.2020 using data to the end of May

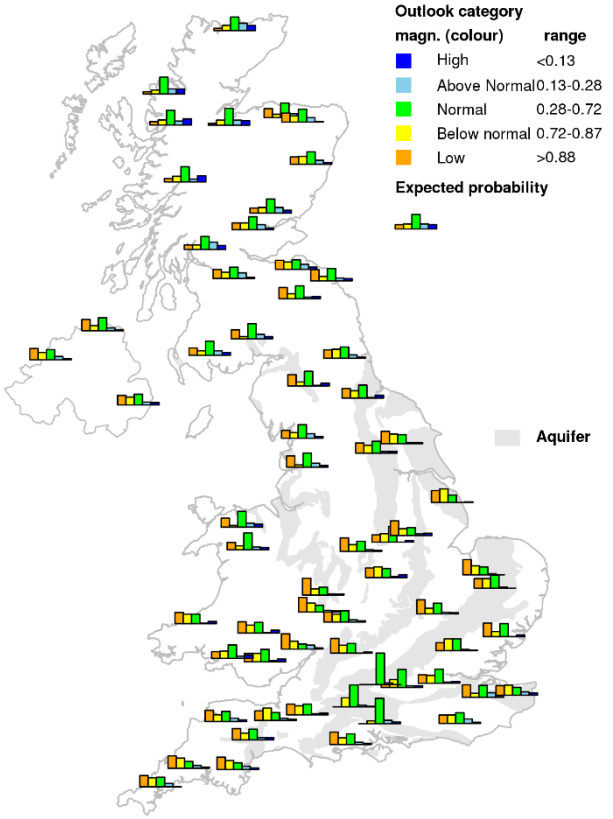
River flows across the majority of the UK are likely to be low for June, and below normal for the next three months. The exceptions to this are north western Scotland, and a few catchments of central southern England, where river flows are likely to be within the normal range.

1-month river flow outlook starting Jun 2020



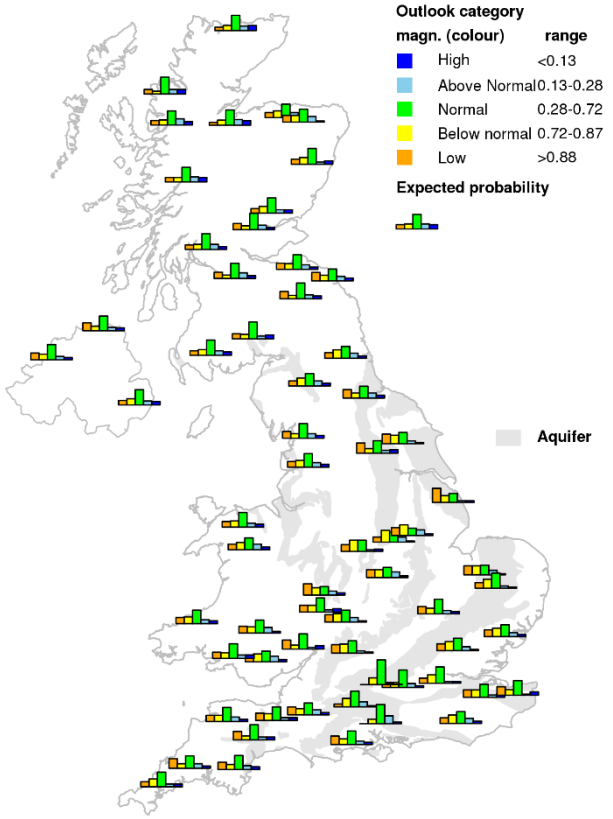
This outlook is based on monthly ensembles of historical sequences of observed climate (rainfall and potential evapotranspiration) that form input to a hydrological model. The outputs are probabilistic simulations of the average river flow over the forecast period (1 to 12 months ahead), at each location. The simulations are generated by the GR4J conceptual rainfall-runoff model from IRSTEA (France) calibrated on observed or naturalised flows.

3-month river flow outlook starting Jun 2020



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.

6-month river flow outlook starting Jun 2020



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

UK Centre for Ecology & Hydrology

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment Agency

Outlook based on modelled flow from historical climate

Overview

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

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

RIVER FLOW FROM HISTORICAL CLIMATE

June 2020

UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 31st May 2020

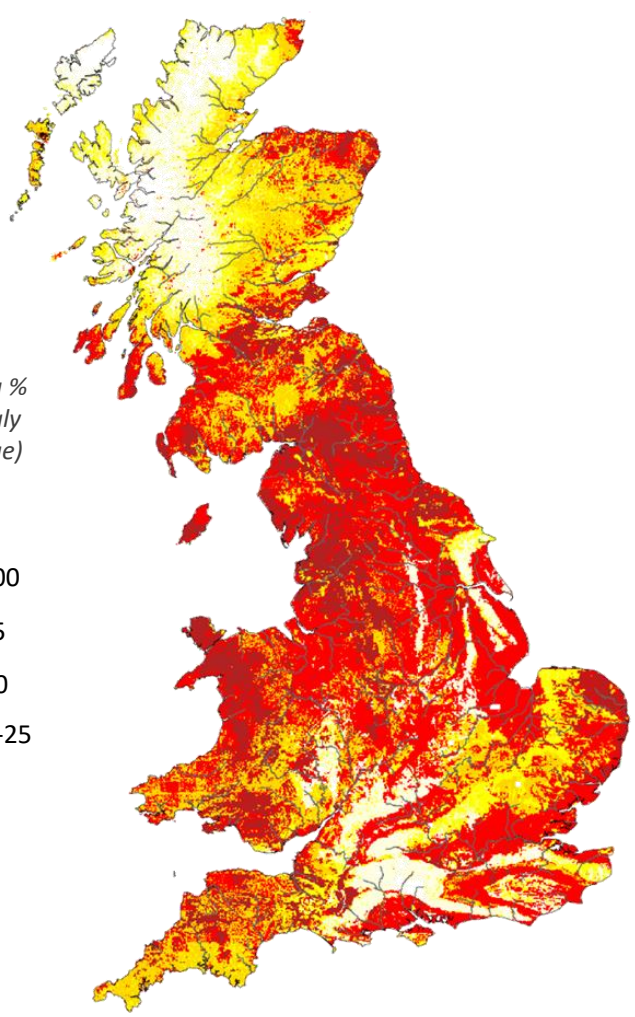
Issue date: 05.06.2020

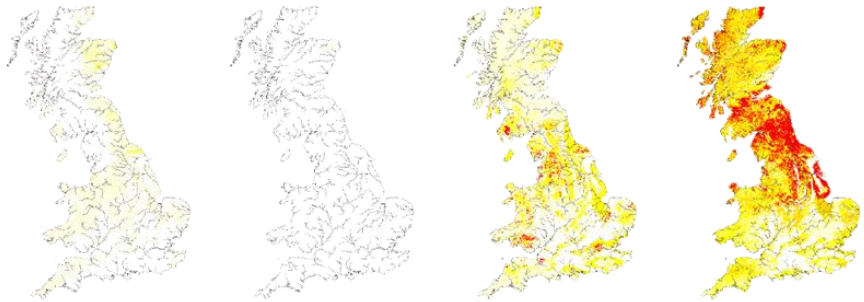
These maps are based on Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean. To highlight areas that are particularly wet or dry, the storage anomaly is presented here using a colour scale highlighting water storage relative 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 May, the majority of the country is experiencing relative dryness levels that are much higher than average for this time of year. Some of north-west Scotland is experiencing average relative dryness levels.

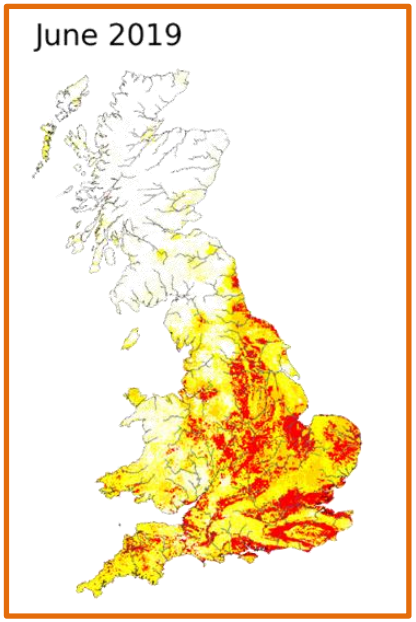
Relative Dryness

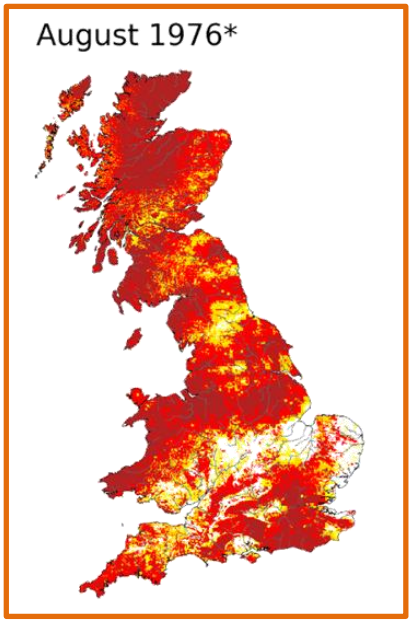




Water storage anomaly as a % of minimum storage anomaly (zero indicates average value)

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





*Example month displaying extreme relative dryness

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

UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 31st May 2020

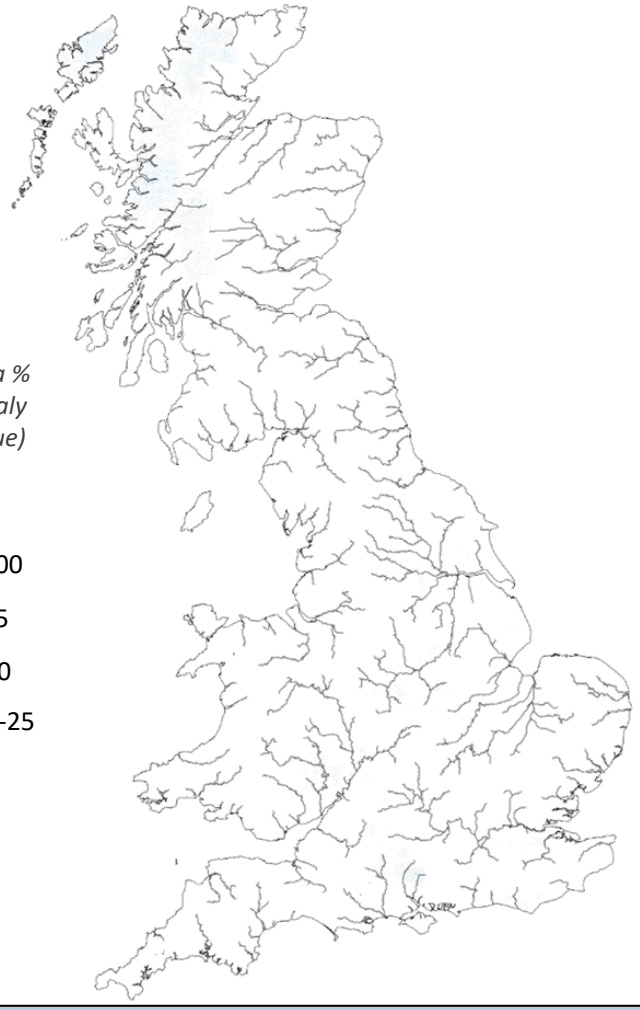
Issue date: 05.06.2020

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 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.

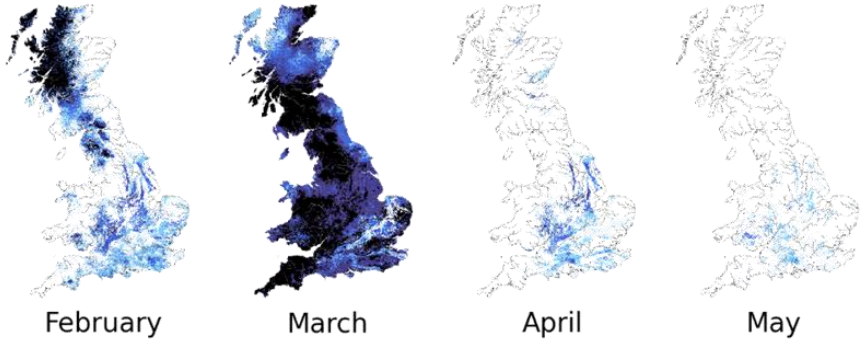
SUMMARY: At the end of May, most of the country is *not* experiencing relative wetness levels above average for this time of year.

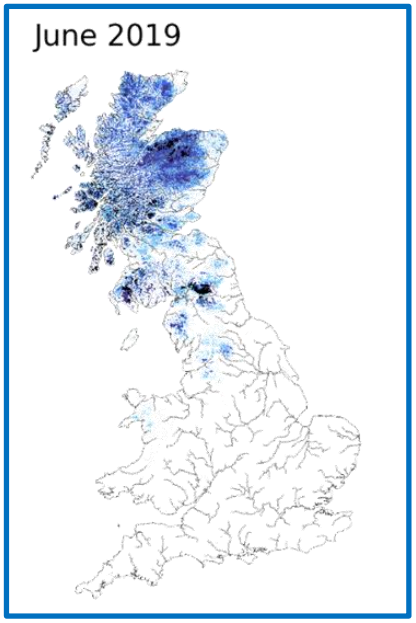
Relative Wetness



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

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





*Example month displaying extreme relative wetness

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

OUTLOOK BASED ON CURRENT CONDITIONS

June 2020

UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

OUTLOOK BASED ON CURRENT 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: $R_d\,(\%) = \frac{(S_{average} - S)}{(S_{average} - S_{min})} \times 100$

  $= \frac{\text{(average storage for this month - storage at end of last month)}}{\text{(average storage for this month - historical minimum storage)}} \times 100$
- 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: $R_w\,(\%) = \frac{(S - S_{average})}{(S_{max} - S_{average})} \times 100$

  $= \frac{\text{(storage at end of last month - average storage for this month)}}{\text{(historical maximum storage - average storage for this month)}} \times 100$
- 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.

UK Centre for Ecology & Hydrology

Return Period of Rainfall Required to Overcome the Dry Conditions

Period: June 2020 – November 2020

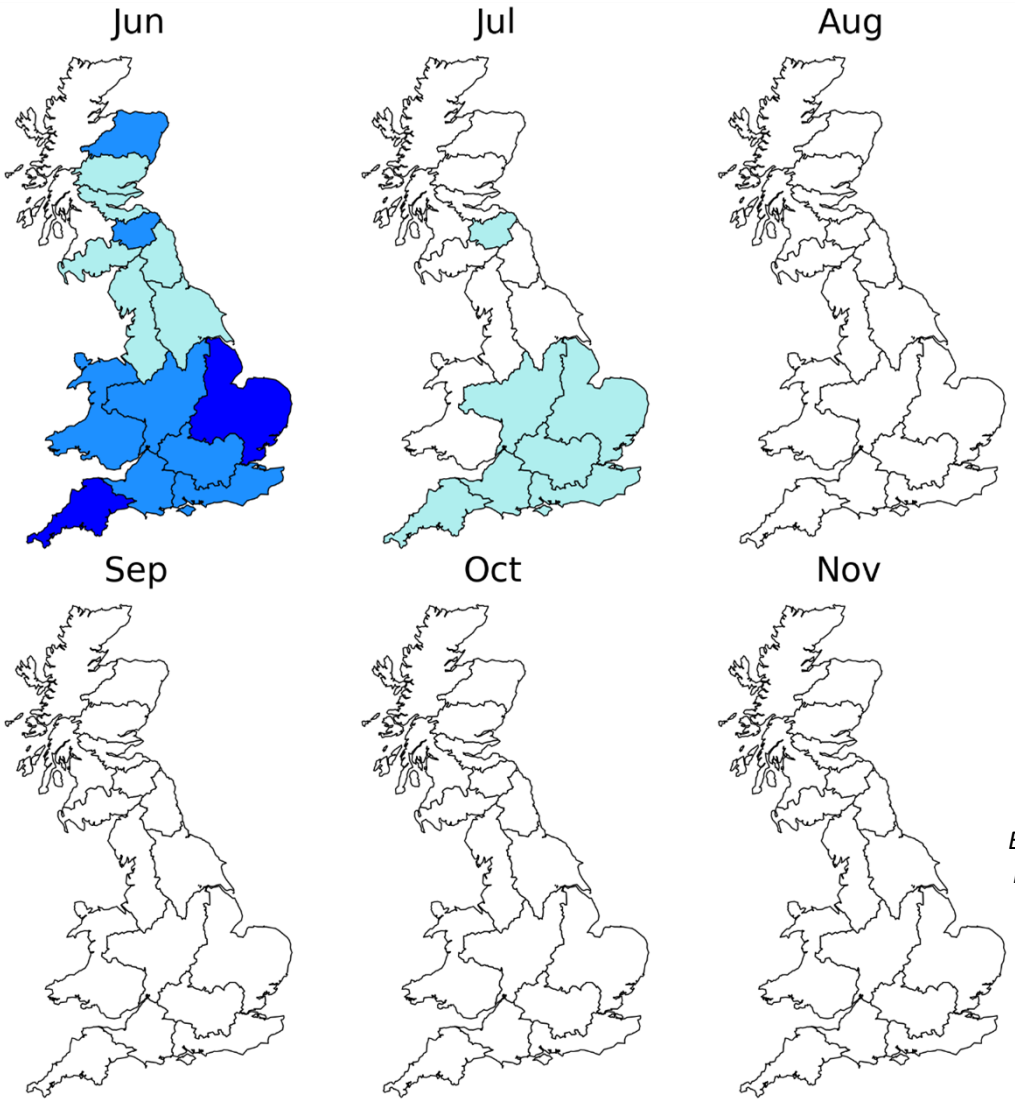
Issue date: 05.06.2020

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 June, the majority of the country will require a rainfall amount with at least a 5 year return period to return to average conditions for the time of year.
Some eastern Scottish regions, Welsh, and central and southern England regions will require rainfall with a 10 to 25 year return period. Anglian and South West regions will require rainfall with a 25 to 50 year return period.
Only western Scotland regions will not require particularly unusual rainfall (less than 5 year return periods) to return to average conditions.

Some of this anticipated dryness persists into July, particularly in central and southern England, but from August until October Britain will not require particularly unusual rainfall (less than 5 year return periods) to return to average conditions for the time of year.



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

Rainfall amount / Probability		*Return period (years)*
Low (this rain is likely to occur)	> 20%	< 5
	< 20%	5 - 10
	< 10%	10 - 25
	< 4%	25 - 50
High (less likely)	< 2%	50 - 100
	< 1%	100 - 200
Extreme (unlikely but still possible)	< 0.5%	>200

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

OUTLOOK BASED ON CURRENT CONDITIONS

June 2020

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.

UK Centre for Ecology & Hydrology

Estimate of Additional Rainfall Required to Overcome Dry Conditions

Based on subsurface water storage estimated for 31st May 2020

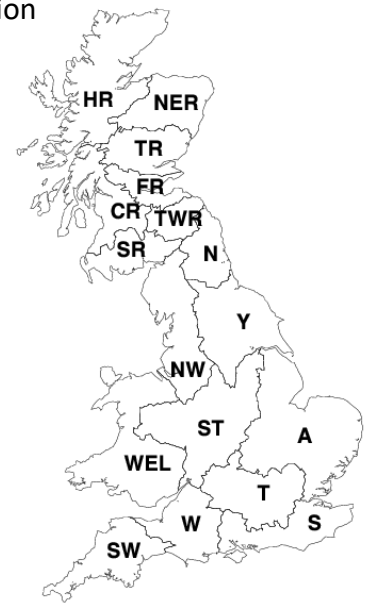
Issue date: 05.06.2020

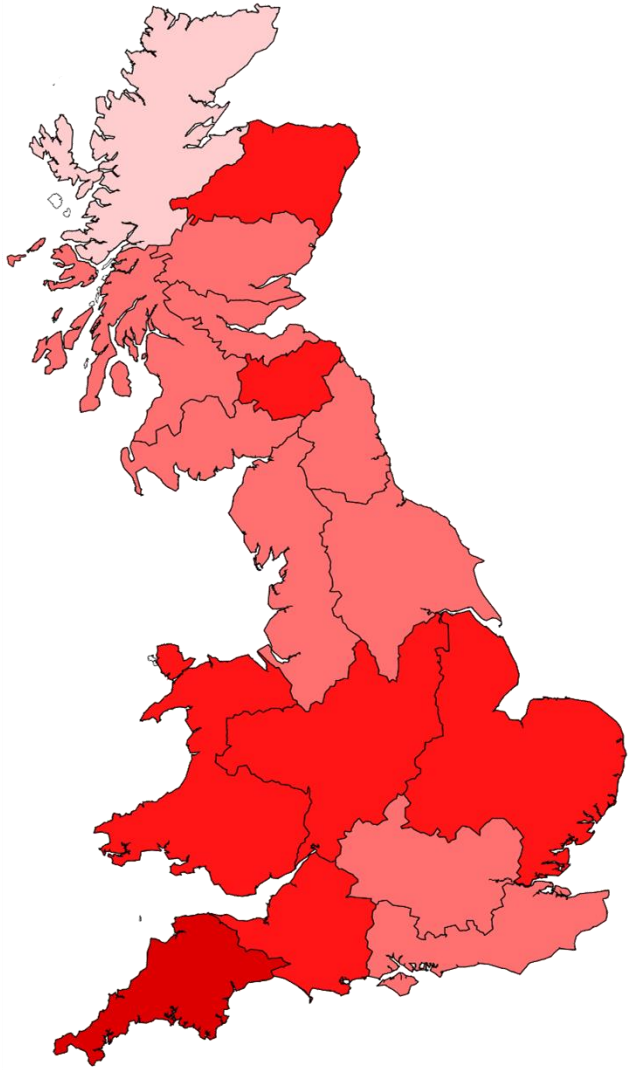
These maps show the Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean (1981-2010), presented on a 1km grid and as regional means.
Subsurface storage deficits, i.e. where the subsurface water storage anomaly is less than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

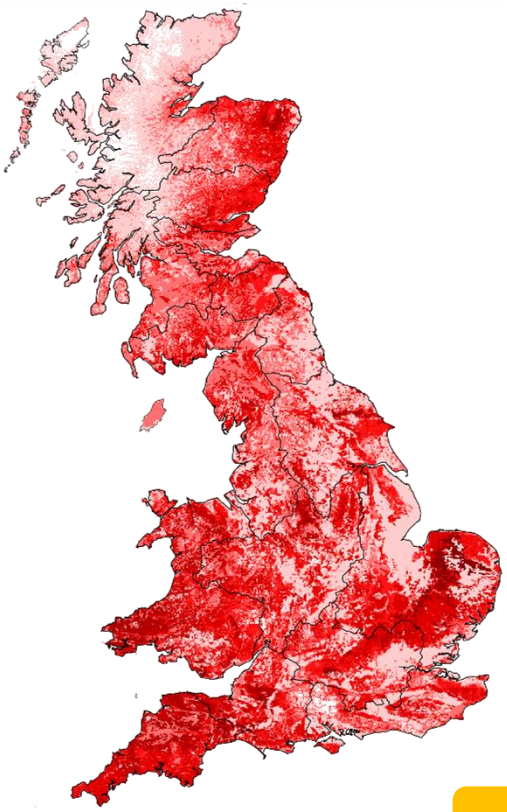
The **subsurface storage deficit (mm)** can be interpreted as an estimate of additional rainfall that would be required in future months to overcome dry conditions (i.e. rainfall in addition to what is expected on average). Regional mean values of additional rainfall required are provided in the table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

Regional estimate of additional rainfall required (mm)

	SCOTLAND	
12	HR	Highlands Region
54	NER	North East Region
48	TR	Tay Region
46	FR	Forth Region
30	CR	Clyde Region
56	TWR	Tweed Region
49	SR	Solway Region
	ENGLAND	
31	N	Northumbria
44	NW	North West
39	Y	Yorkshire
52	ST	Severn Trent
55	A	Anglian
48	T	Thames
52	W	Wessex
40	S	Southern
82	SW	South West
	WALES	
67	WEL	Welsh







Water storage deficit (anomaly, mm)

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

OUTLOOK BASED ON CURRENT CONDITIONS

June 2020

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

UK Centre for Ecology & Hydrology

Outlook Based on Modelled Flow from Rainfall Forecasts

Overview

Period: June 2020 – August 2020

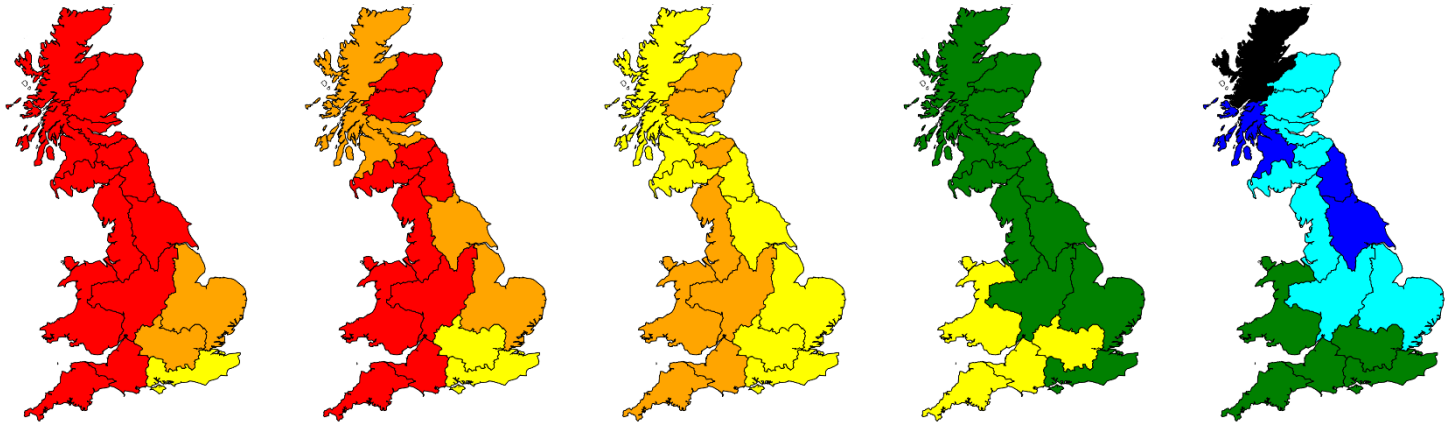
Issued on 05.06.2020 using data to the end of May

SUMMARY: During June, river flows in western Scotland and eastern England are most likely to be *Below normal* or lower. River flows in eastern Scotland, Wales, and central and western England are most likely to be *Notably low* or lower.

Over the next 3 months river flows across the majority of England and Wales are most likely to be *Below normal* or lower, with a higher chance of *Notably low flows* in the Anglian and South West regions. River flows in western Scotland are most likely to be in the *Normal range* or lower, while eastern Scotland is most likely to experience *Below normal* or lower flows.

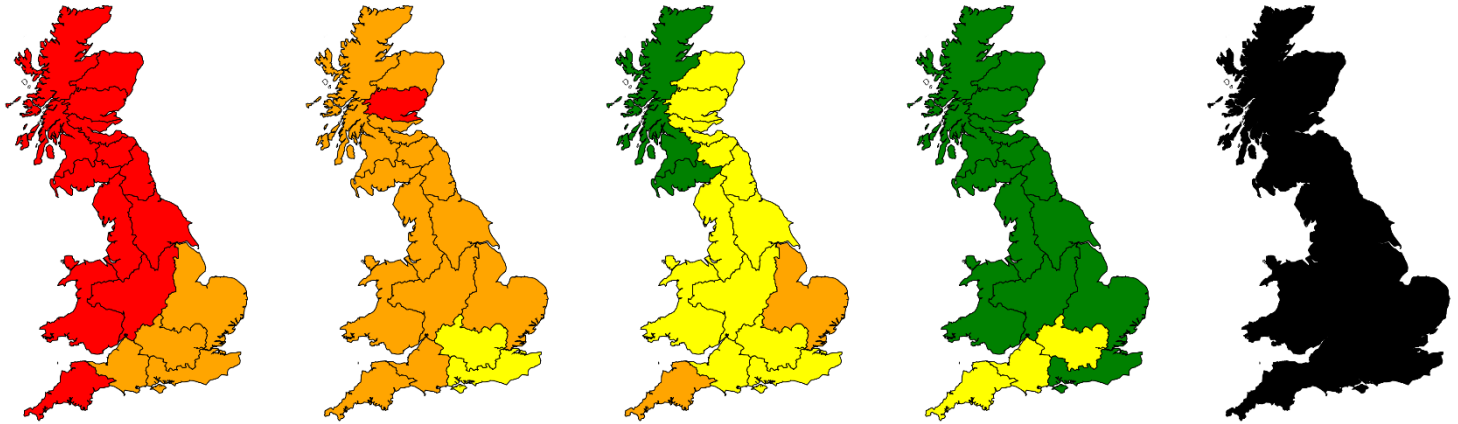
1-month flow outlook

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

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

RIVER FLOW FROM RAINFALL FORECASTS

June 2020

UK Centre for Ecology & Hydrology

Outlook Based on Modelled Flow from Rainfall Forecasts 1- and 3-month variability

Period: June 2020 – August 2020

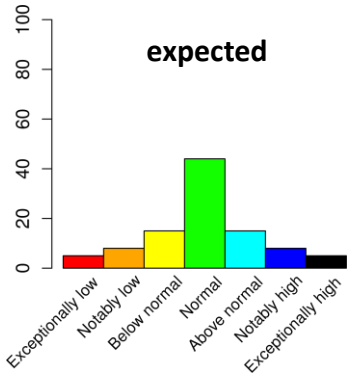
Issue date: 05.06.2020

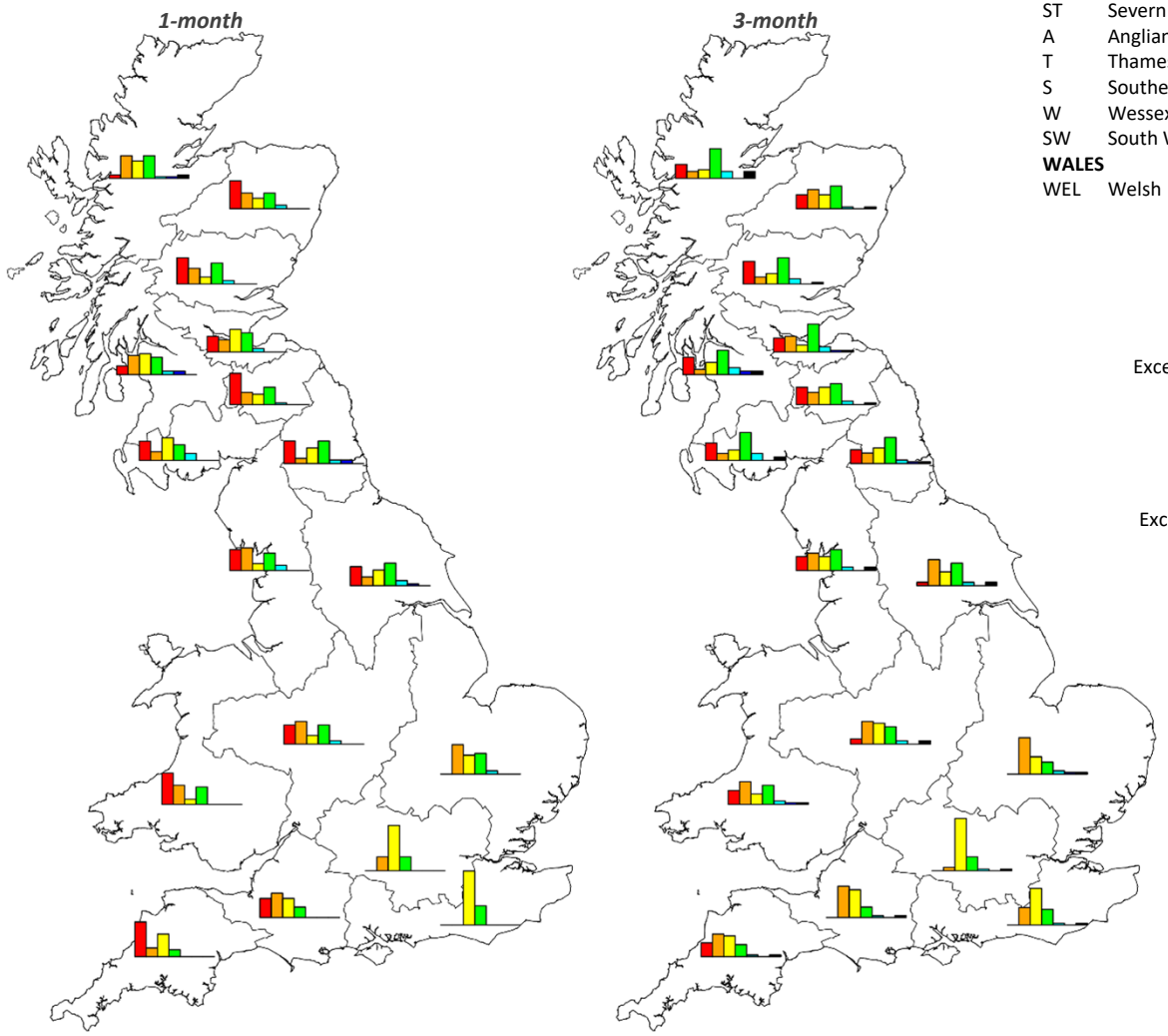
The regional maps illustrating the regional river flows for five members of the Met Office ensemble of rainfall forecasts give some indication of the range of possible river flows in the coming months. As noted previously, the actual flows could be more extreme than the flows generated by either the 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 June, river flows in western Scotland and eastern England are most likely to be *Below normal* or lower. River flows in eastern Scotland, Wales, and central and western England are most likely to be *Notably low* or lower.

Over the next 3 months river flows across the majority of England and Wales are most likely to be *Below normal* or lower, with a higher chance of *Notably low flows* in the Anglian and South West regions. River flows in western Scotland are most likely to be in the *Normal range* or lower, while eastern Scotland is most likely to experience *Below normal* or lower flows.





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

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

RIVER FLOW FROM RAINFALL FORECASTS

June 2020

UK Centre for Ecology & Hydrology

Outlook Based on Modelled Flow from Rainfall Forecasts 1- and 3-month variability

Period: June 2020 – August 2020

Issue date: 05.06.2020

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).

SUMMARY: During June, river flows in western Scotland and eastern England are most likely to be *Below normal* or lower. River flows in eastern Scotland, Wales, and central and western England are most likely to be *Notably low* or lower.

Over the next 3 months river flows across the majority of England and Wales are most likely to be *Below normal* or lower, with a higher chance of *Notably low flows* in the Anglian and South West regions. River flows in western Scotland are most likely to be in the *Normal range* or lower, while eastern Scotland is most likely to experience *Below normal* or lower flows.

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

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	5	0	0	0	0
Notably high flow	0	0	5	0	0	0	0	0	0	2	5	0	2	0	0	0	0
Above normal	5	7	5	5	0	0	0	0	0	7	5	5	2	5	10	5	2
Normal range	29	24	31	26	10	26	19	24	14	31	24	26	31	21	21	29	24
Below normal	26	10	21	12	31	74	62	7	26	21	29	31	24	14	31	10	14
Notably low flow	40	31	7	31	12	0	19	26	33	12	26	17	31	21	12	21	17
Exceptionally low flow	0	29	31	26	48	0	0	43	26	26	12	21	5	38	26	36	43

3-months ahead	A	NW	N	ST	SW	S	T	Welsh	W	Y	CR	FR	HR	NER	SR	TR	TWR
Exceptionally high flow	2	5	2	5	2	2	2	2	2	5	5	2	10	2	5	2	2
Notably high flow	2	0	2	0	0	0	0	2	0	0	5	2	0	0	0	0	0
Above normal	5	5	5	5	2	2	2	5	2	5	10	7	10	2	10	7	5
Normal range	17	29	36	24	17	21	19	26	17	31	33	38	40	31	38	36	29
Below normal	24	19	21	29	29	50	74	14	48	19	17	10	12	19	14	14	24
Notably low flow	50	24	14	31	31	24	2	31	31	36	7	21	10	26	10	10	17
Exceptionally low flow	0	19	19	7	19	0	0	19	0	5	24	19	19	19	24	31	24

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

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Outlook based on modelled groundwater level & climate forecast

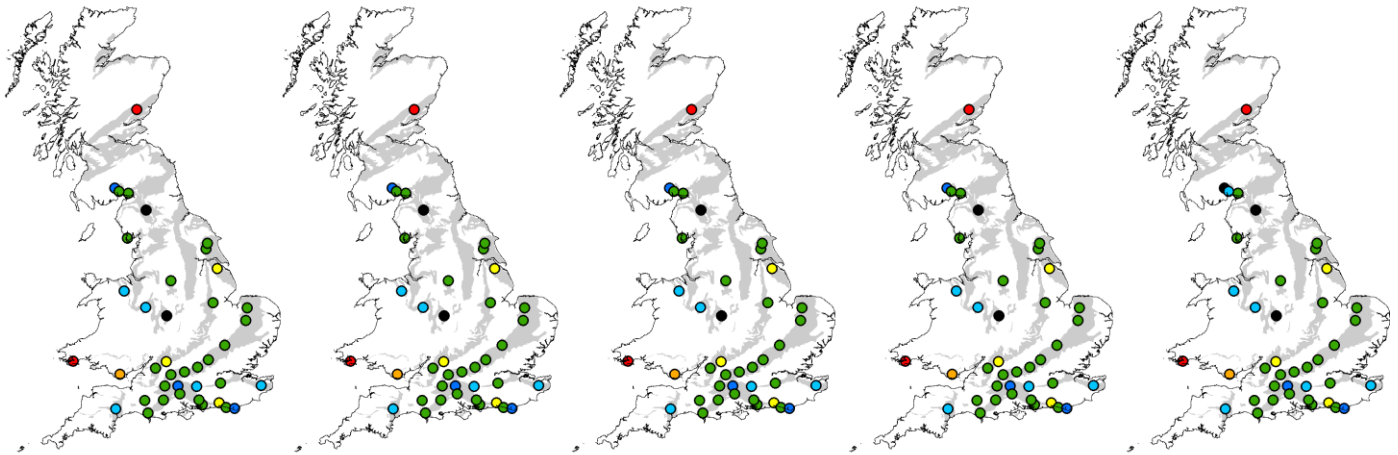
Overview

Period: June 2020 – August 2020

Issued on 08.06.2020 using data to the end of May

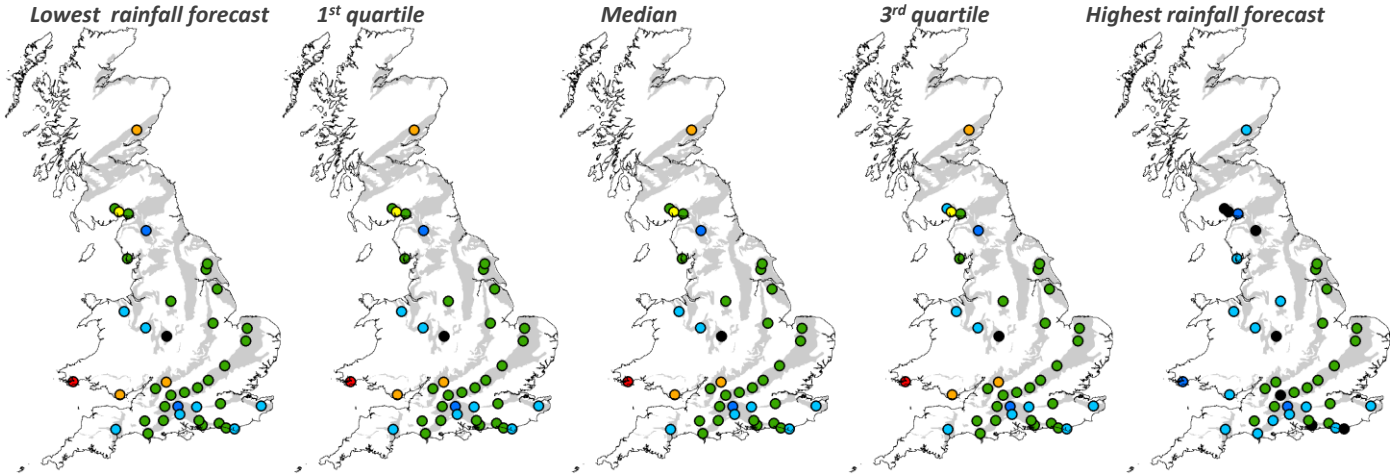
Normal groundwater levels are predicted to prevail over the UK in the next month, with above normal and notably high levels in some Chalk sites in the South of England. Normal to exceptionally high groundwater levels are predicted at some sites in the Permo-Triassic sandstones of the North-West. Below normal to exceptionally low levels are predicted in southern Wales and Scotland. Over 3 months, normal conditions are predicted to prevail throughout the UK, with above normal to notably 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*

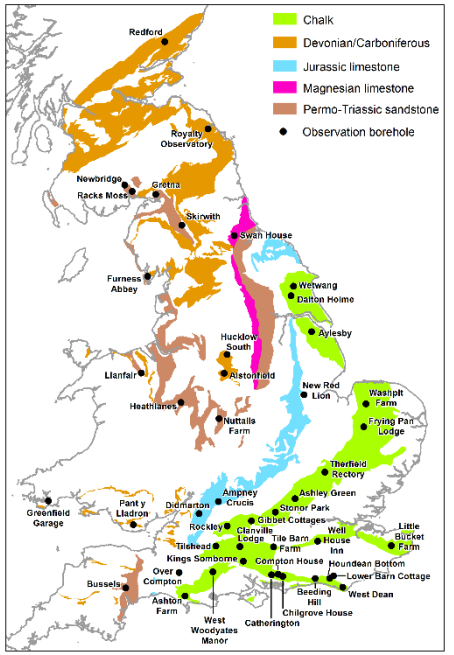


3-month outlook

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



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 FROM CLIMATE FORECASTS

June 2020

UK Centre for Ecology & Hydrology

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment Agency

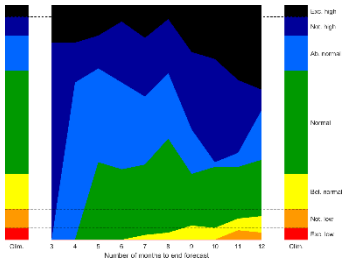
Outlook based on modelled groundwater from historical climate

Period: June 2020 – May 2021

Issued on 08.06.2020 using data to the end of May

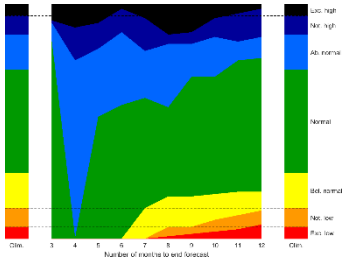
Normal conditions are expected across much of the UK over the next 12 months. In the Chalk of eastern England, below normal levels are likely in the latter 4 months of the year. Above normal to exceptionally high levels are predicted in the Permo-Triassic sandstones at Skirwith for the next 4 months,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

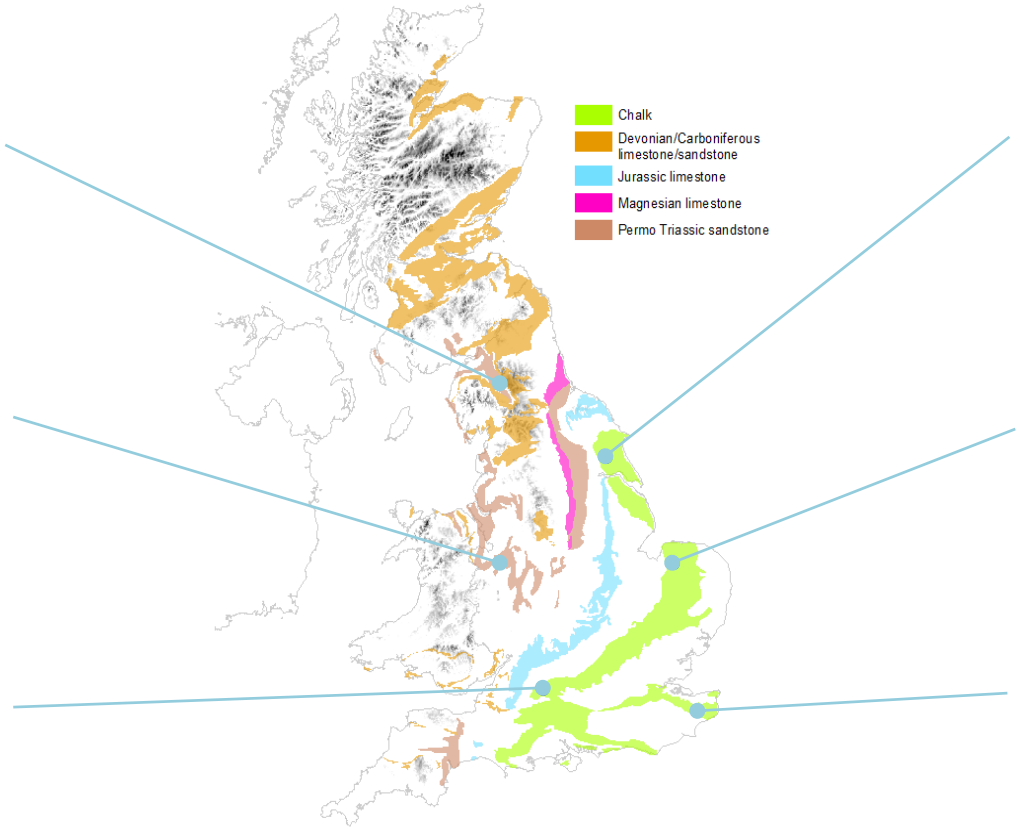
Skirwith (NY63/2)



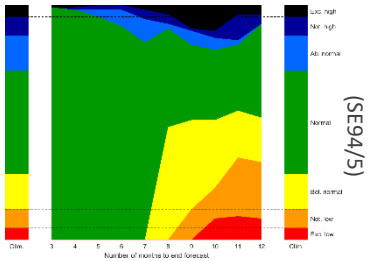
Heathlanes (SJ62/112)

Rockley (SU17/57)

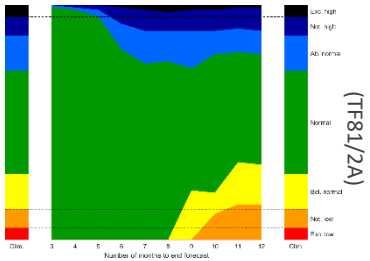




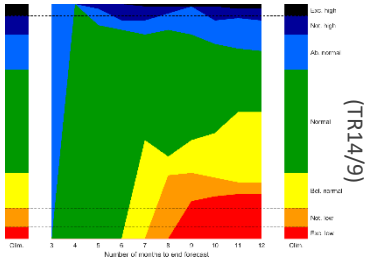
Dalton Holme (SE94/5)



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