Hydrological Outlook UK

Period: From August 2020

Issued on 11.08.2020 using data to the end of July 2020

SUMMARY
The outlook for August is for a continuation of the north-west to south-east UK contrast that has been seen both in rainfall and river flows in July. River flows in the north and west are likely to be normal to above normal this month, whilst groundwater levels in this region are expected to vary significantly. Both river flows and groundwater levels in the south and east are likely to be normal to below normal for the next one to three months.

Rainfall:
Rainfall in July showed a marked north-west to south-east contrast. Parts of the north-west, and eastern Scotland saw over 170% of average July rainfall, whilst areas of southern England and the Welsh-English border received between 30 and 70%. Very little of the UK received an average amount of rainfall for July.

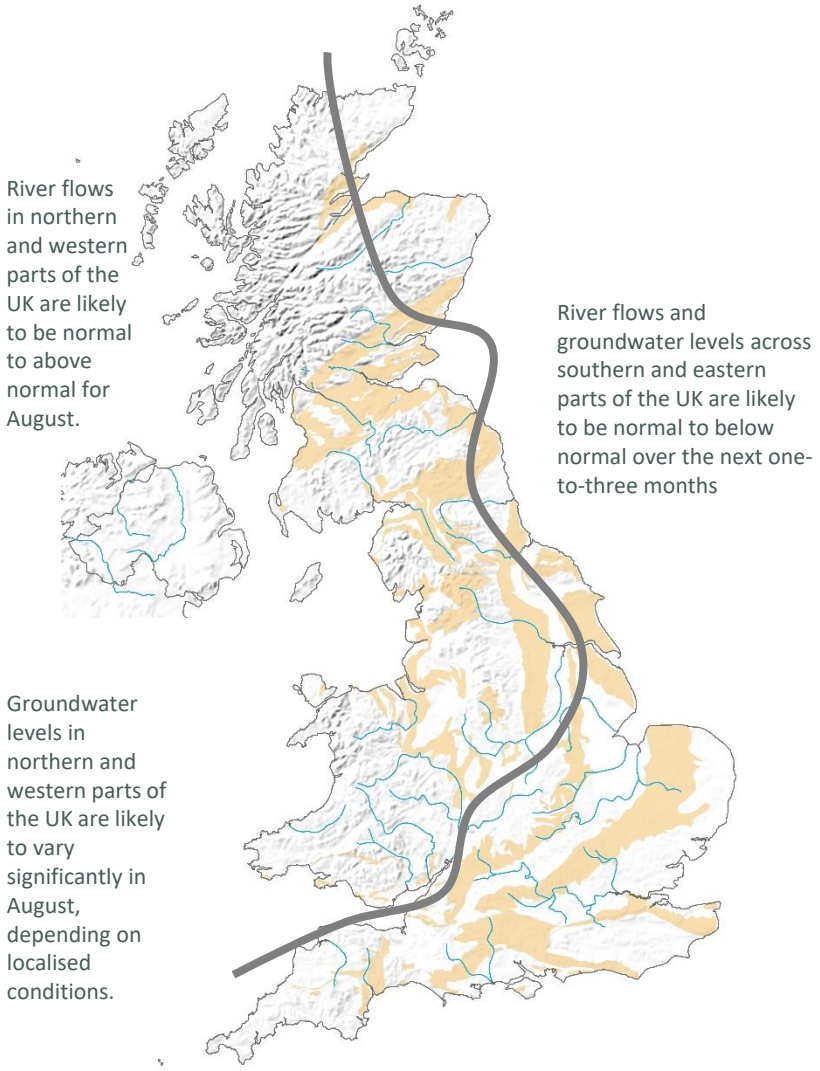
The rainfall outlook (issued by the Met Office on the 23rd July 2020) is that for August and August-September-October as a whole, above-average precipitation is slightly more likely than below-average precipitation. The probability that UK-average precipitation for August-September-October will fall into the driest of five equal categories is around 20% and the probability that it will fall into the wettest category is between 20 and 25% (the 1981-2010 probability for each of these categories is 20%).

River flows:
River flows in July strongly reflected the rainfall pattern for the month. Flows across the west, with the exception of the south-west, were above normal to exceptionally high. Record breaking high flows were experienced in several catchments in north-west England and south-west Scotland. Elsewhere along the east-coast and across central and southern England, flows were mostly normal to below normal, with a few localised catchments recording notably low flows.

The forecast is for river flows to continue to demonstrate this north-west south-east contrast throughout August. Flows in the north and west are likely to continue to be normal to above normal this month, with high and notably high flows being possible in some localised areas. Three month river flow forecasts in the north-west are less certain at this time of year. In the south (including the south-west) and east, however, flows are expected to remain normal to below normal for August and August-September-October as a whole.

Groundwater:
Groundwater levels in the UK were predominantly normal to below normal for July, but were notably and exceptionally high in the Permo-Triassic sandstones.

The outlook is for groundwater levels in the south-east to remain normal to below normal for August, with some locations falling to notably low levels over the August-October three-month period. Forecasts for groundwater levels in the Permo-Triassic sandstones of northern England and Scotland show a mixed spatial pattern with some above normal/notably high, and some below normal/notably low levels expected depending on location.



Shaded areas show principal aquifers

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

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.

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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, August, 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: August – October 2020 Issue date: 23.07.20

The forecast presented here is for August and the average of the August-September-October period for the United Kingdom as a whole. The forecast for August 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 3rd August 2020.

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

SUMMARY – PRECIPITATION:

For August and August-September-October as a whole, above-average precipitation is slightly more likely than below-average precipitation.

The probability that UK-average precipitation for August-September-October will fall into the driest of our five categories is around 20% and the probability that it will fall into the wettest of our five categories is between 20% and 25% (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.
It is therefore unsurprising that signals from the long-range models for August are weak and there is some disagreement between systems. Overall, however, there is a signal for lower-than-normal pressure near the UK and an increased likelihood of wetter-than-normal conditions (see left-hand graph of figure P2).

For August-September-October, signals are initially weak, with only a slightly greater-than-normal chance of low pressure prevailing across northern Europe. However, for the period as a whole, there is an increased likelihood of a stronger-than-normal westerly flow, and low pressure prevailing across northern Europe. This results in a modest increase in the likelihood of above-average rainfall (see right-hand graph of figure P2). The chances of below-average rainfall, however, are close to normal. Prolonged spells of dry weather are not precluded even if the Outlook period turns out to be wetter-than-normal overall.

Fig P1

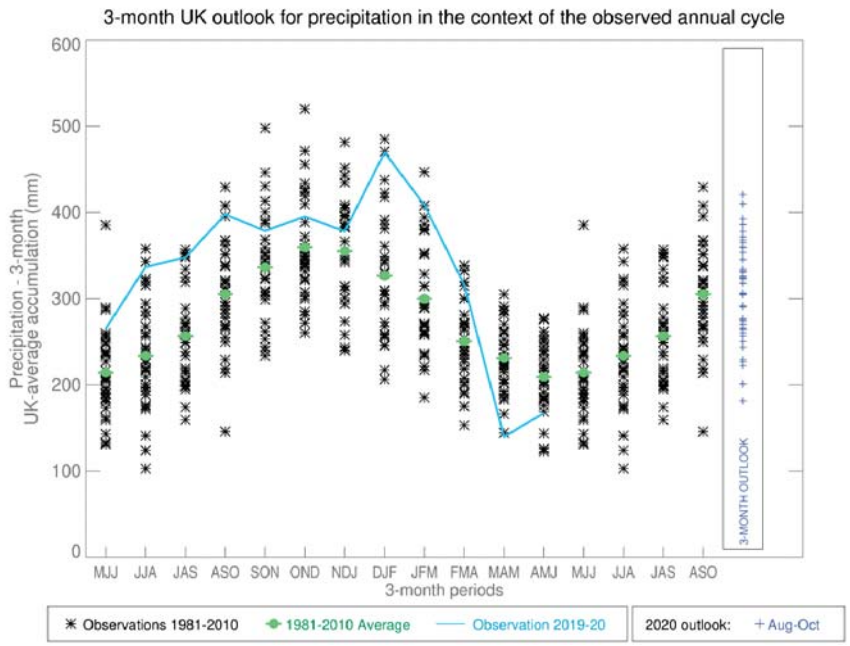


Fig P2

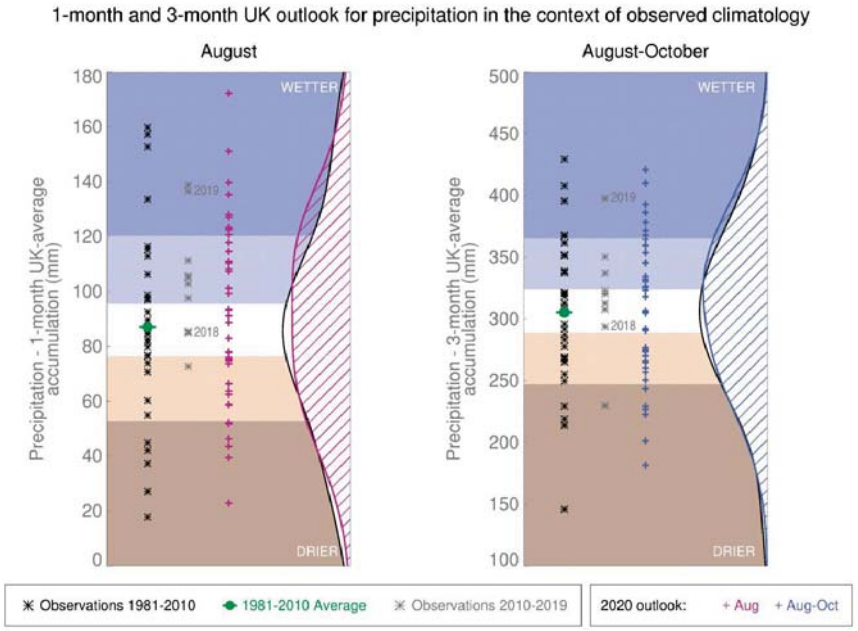
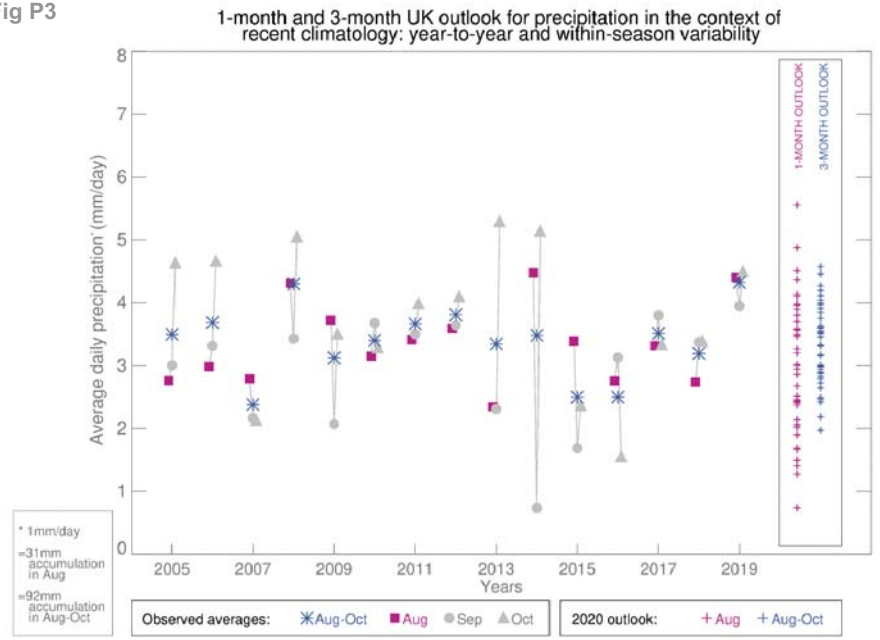


Fig P3



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: August – October 2020 Issue date: 23.07.20

The forecast presented here is for August and the average of the August-September-October period for the United Kingdom as a whole. The forecast for August 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 3rd August 2020.

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

SUMMARY – TEMPERATURE:

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

Overall, the probability that the UK-average temperature for August-September-October will fall into the coldest of our five categories is between 10% and 15%, and the probability that it will fall into the warmest of our five categories is 30% (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.

Sea surface temperatures (SSTs) continue to decline in the central and eastern tropical Pacific and are now close to La Niña thresholds. Long-range forecast models continue to predict an increased likelihood of La Niña developing later this year. There is, however, yet to be an atmospheric response with most other indicators still neutral. For this Outlook period, ENSO is most likely to be in a neutral or weak La Niña state and will therefore have limited influence on UK weather patterns.

SSTs in the North Atlantic, to the west of the UK, continue to be below normal. This may act to moderate temperatures across the UK at times during this period.

For August and August-September-October as whole, predicted circulation signals are weak but show a slightly higher chance of low pressure prevailing across northern Europe during the Outlook period. These types of patterns suggest an increased likelihood of changeable conditions affecting the UK. Whilst there is an increase in the likelihood of warmer-than-average conditions for the 3-month period, this is lower than earlier in the summer (see right-hand graph of figure T2).

While the higher probability of our warmest forecast category does suggest that the chance of spells of very warm 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

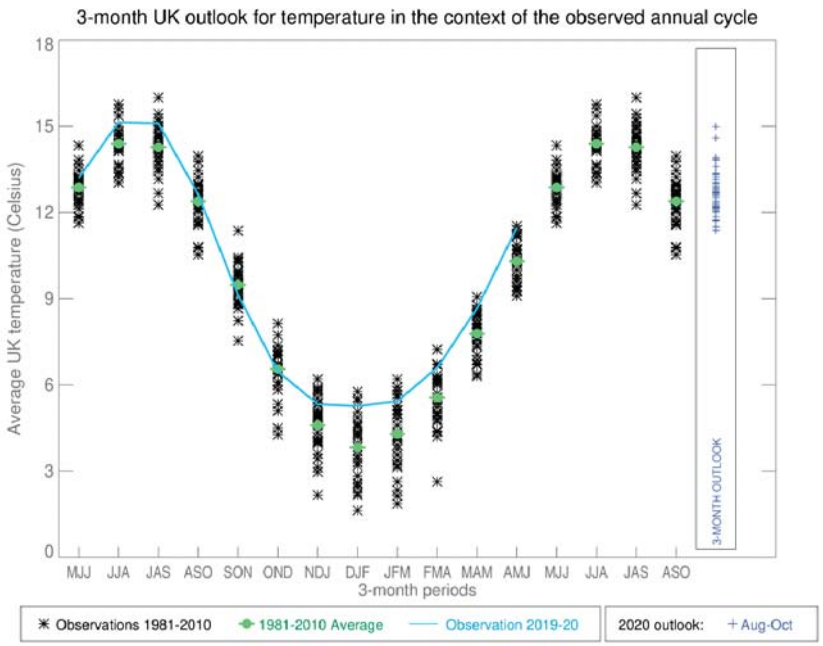


Fig T2

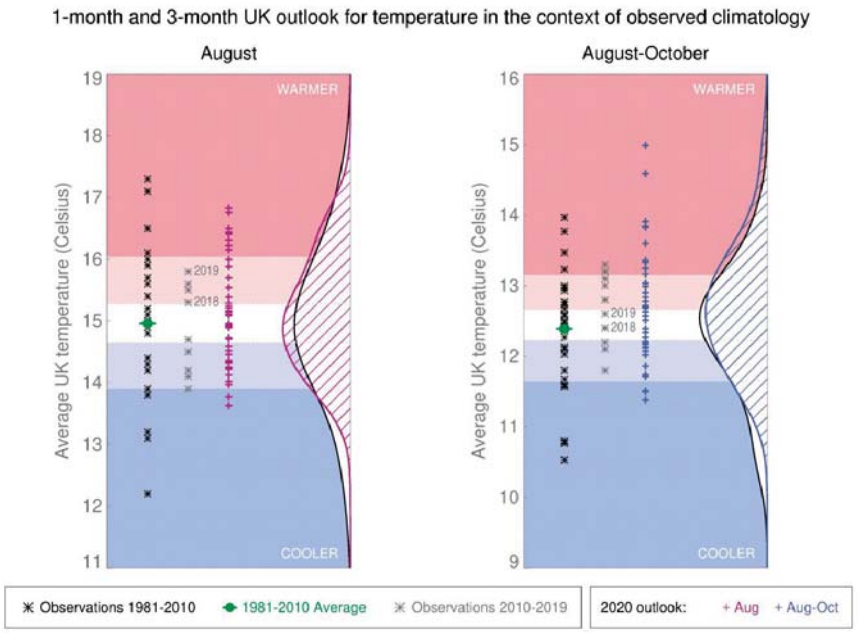
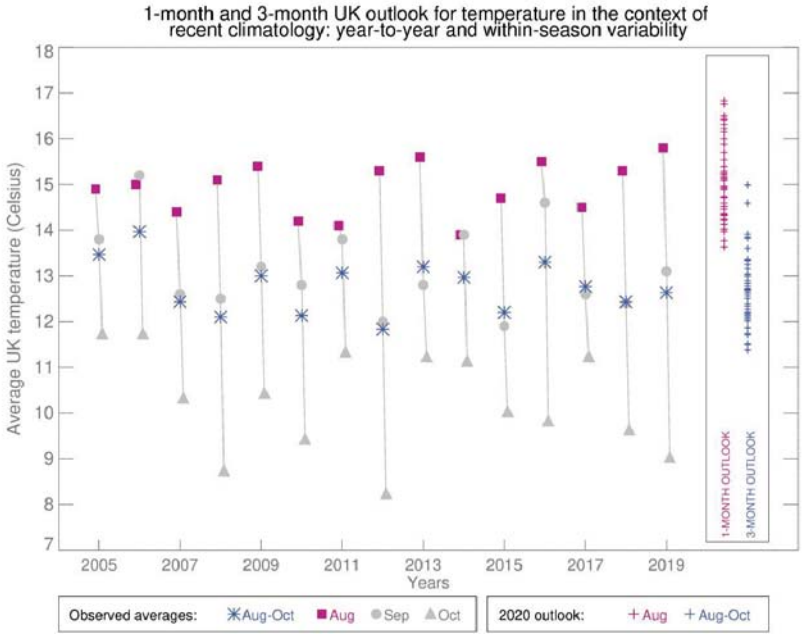


Fig T3



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UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

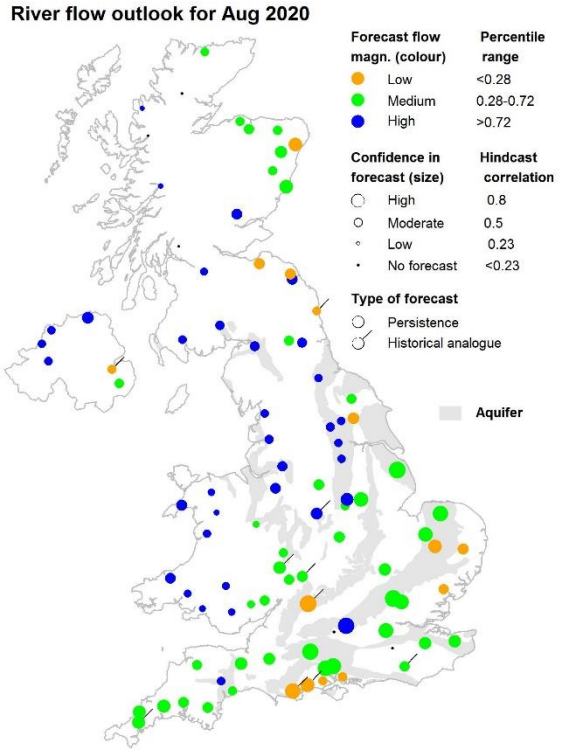
Overview

Period: August 2020 – October 2020

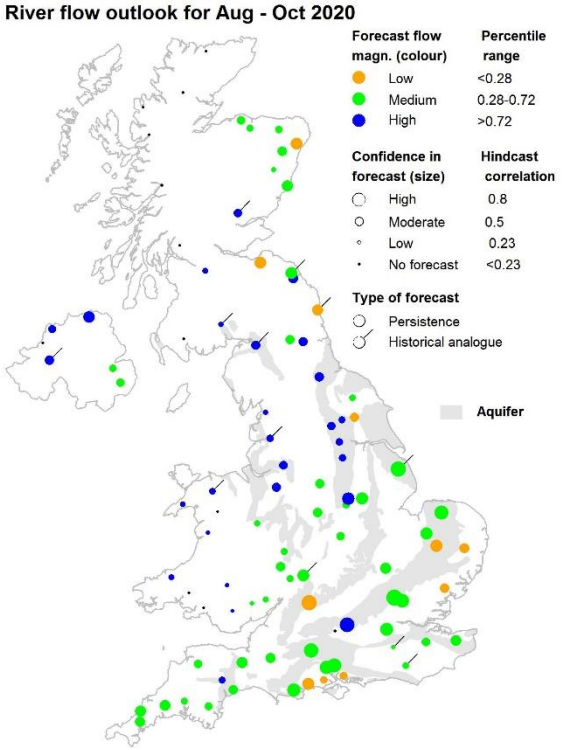
Issued on 07.08.2020 using data to the end of July 2020

SUMMARY

The outlooks for August and for August-October are for normal to below normal flows in the south and east of the UK and above normal flows elsewhere. For the three month forecast there are very few forecasts in the north-west.



1-month flow outlook



3-month flow outlook

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

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

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

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UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

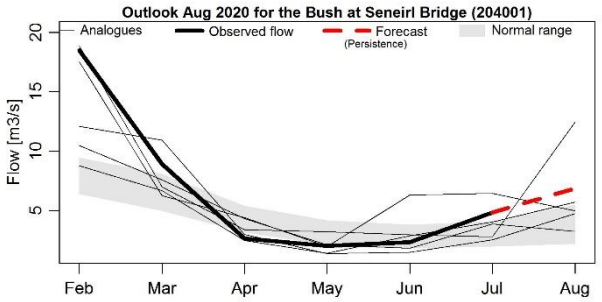
Site-based: 1 month outlook

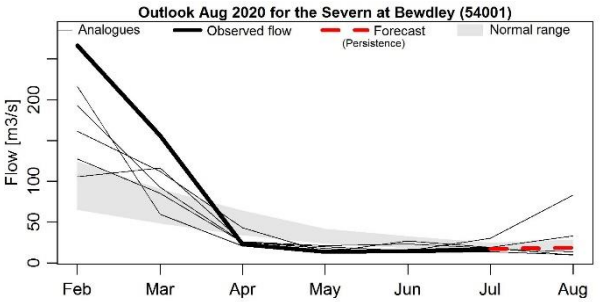
Period: August 2020

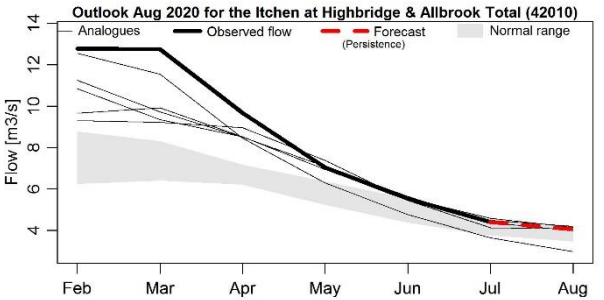
Issued on 07.08.2020 using data to the end of July 2020

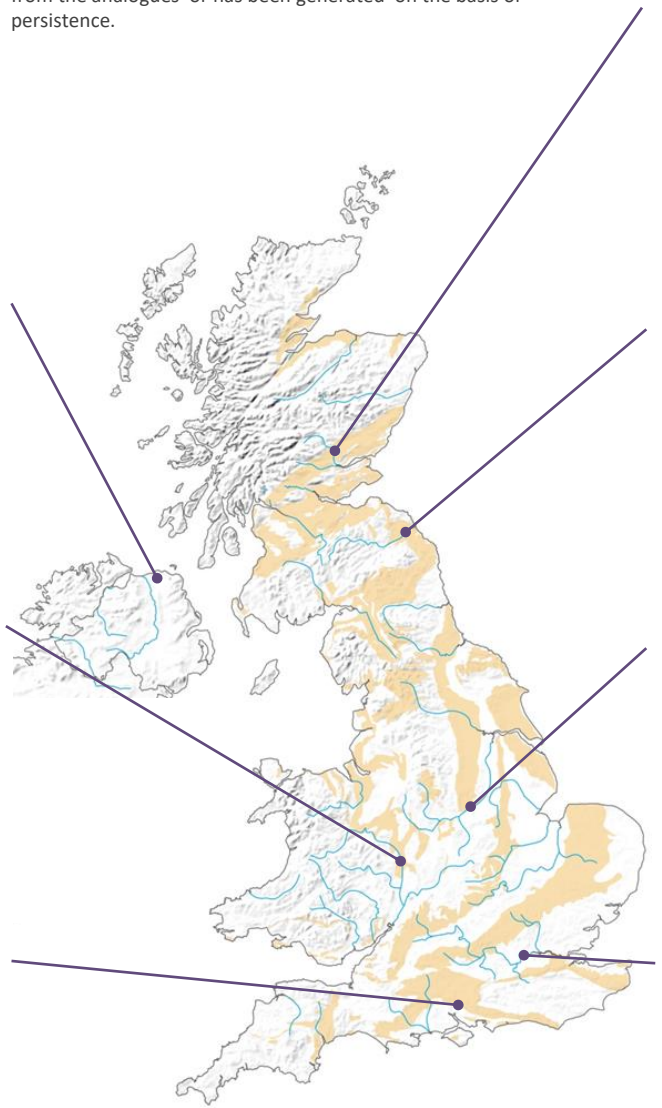
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

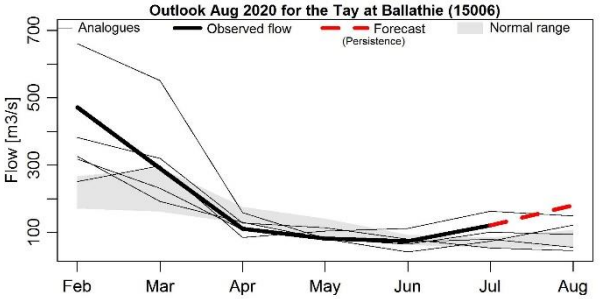
In each of the time series graphs the bold black line represents the observed flow during the past six months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows took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

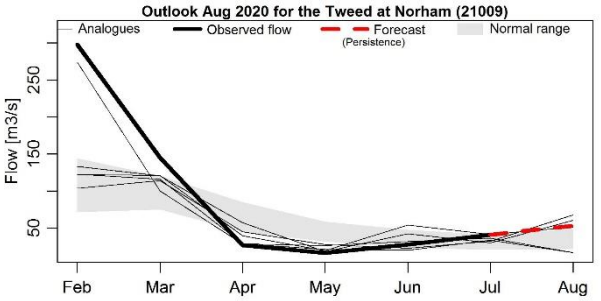


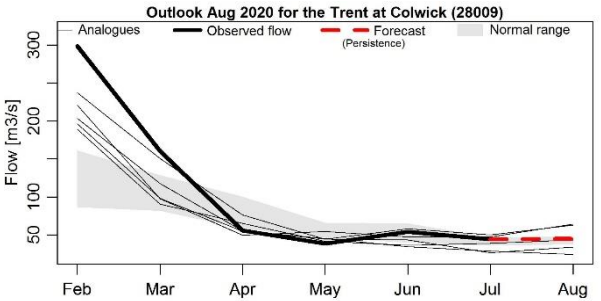


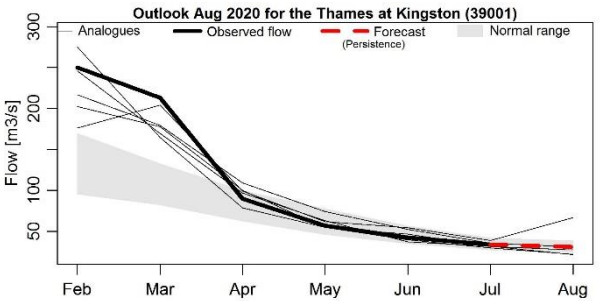












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RIVER FLOW ANALOGY

August 2020

UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

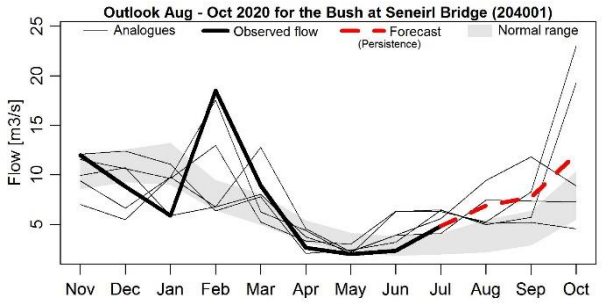
Site-based: 3 month outlook

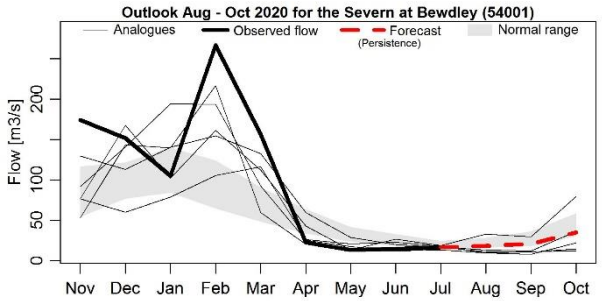
Period: August – October 2020

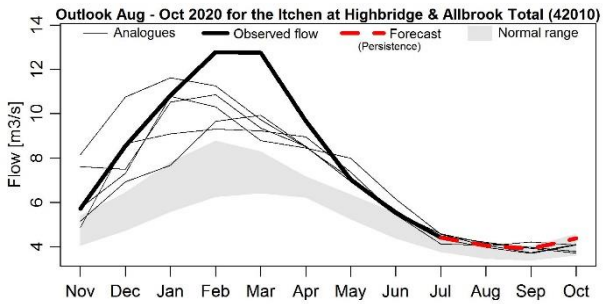
Issued on 07.08.2020 using data to the end of July 2020

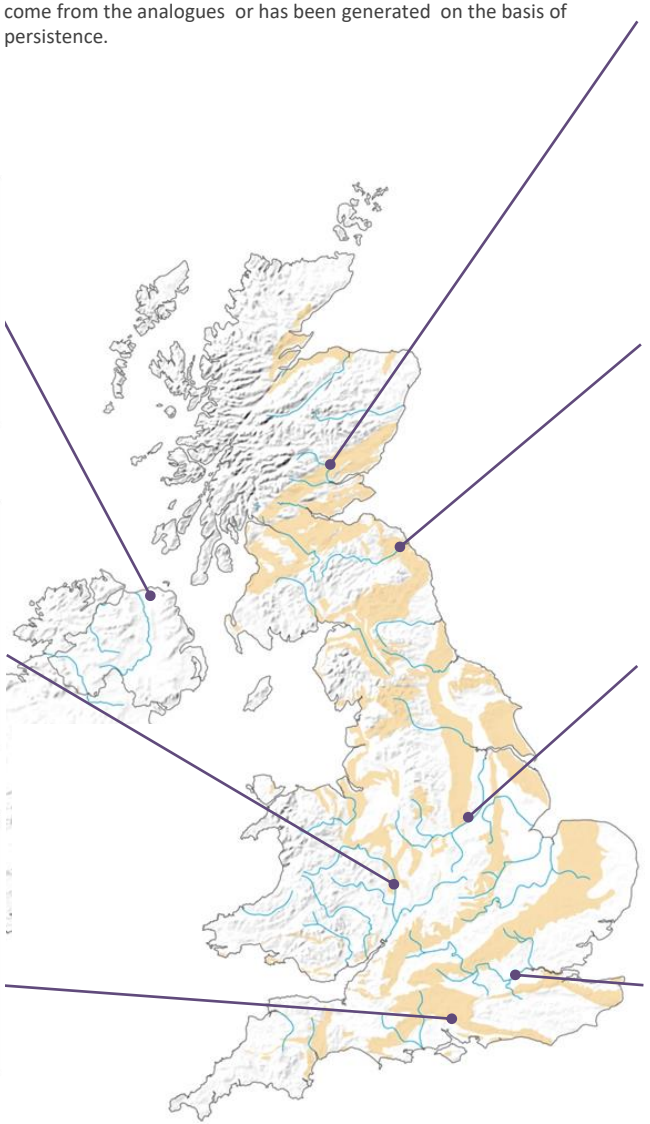
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

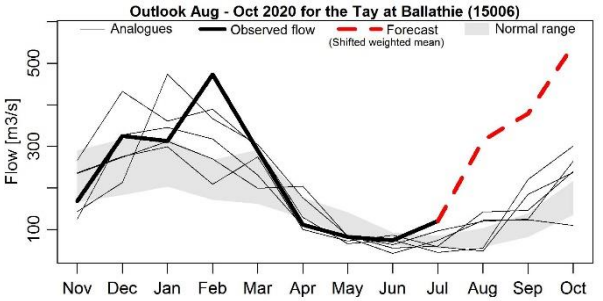
In each of the time series graphs the bold black line represents the observed flow during the past nine months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows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

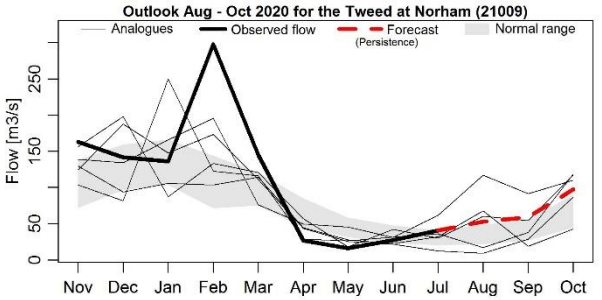


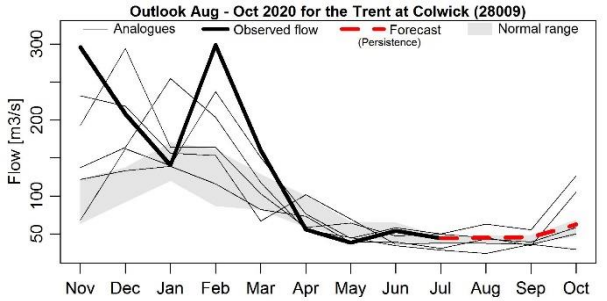


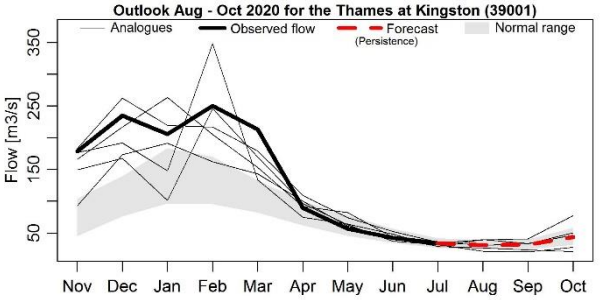












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RIVER FLOW ANALOGY

August 2020

UK Centre for Ecology & Hydrology

British Geological Survey

Environment Agency

Outlook based on modelled flow from historical climate

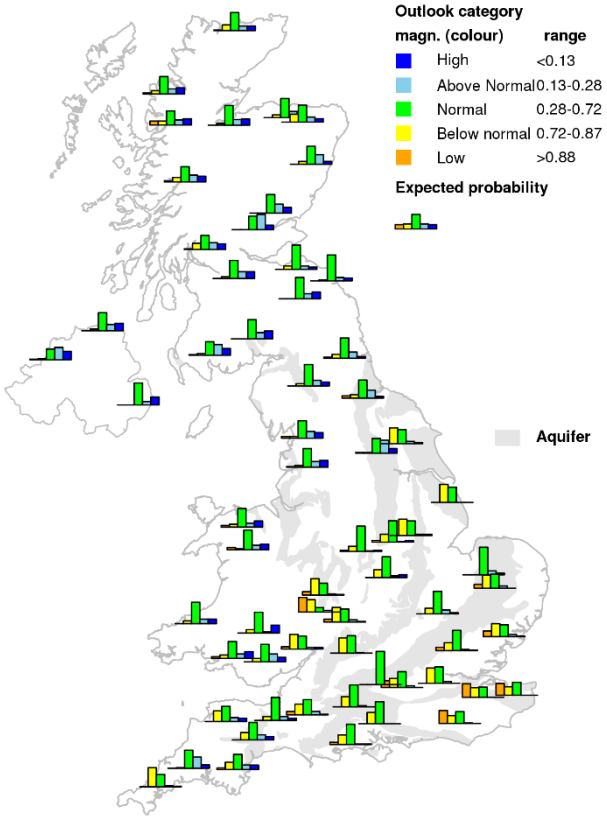
Overview

Period: August 2020 – January 2021

Issued on 05.08.2020 using data to the end of July

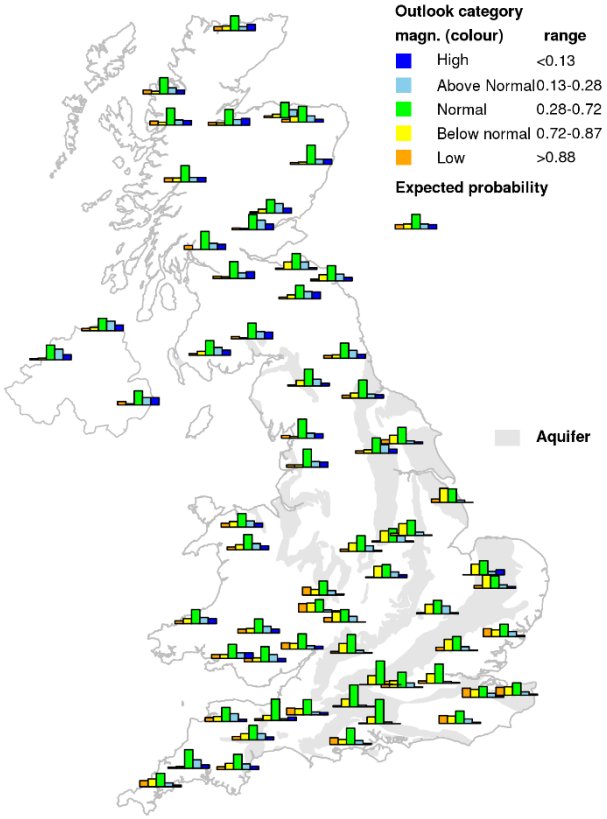
August river flows across northern and western areas of the UK are likely to be normal to above normal; whilst flows in the south east are normal to below normal, with flows likely to be low in some localised catchments. Normal to below normal flows are expected to persist in the three month period in the south east areas of the UK.

1-month river flow outlook starting Aug 2020



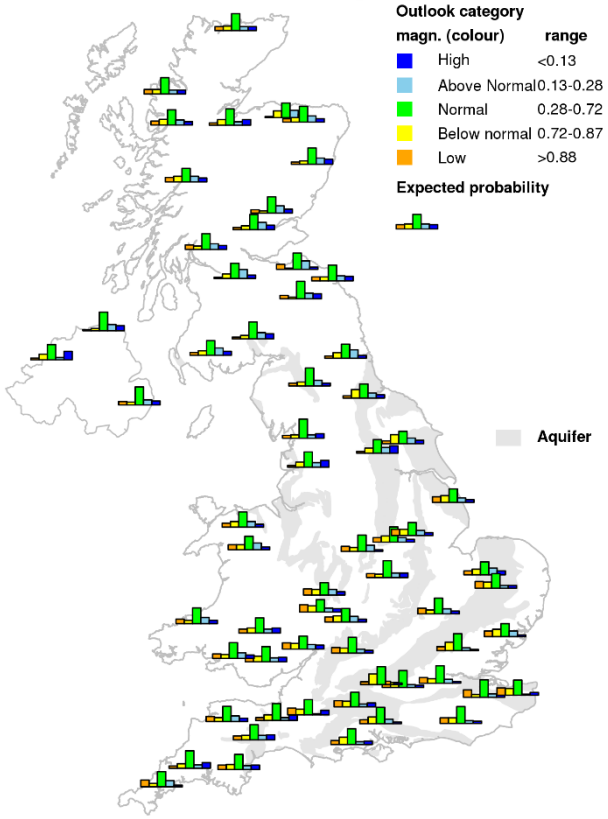
This outlook is based on monthly ensembles of historical sequences of observed climate (rainfall and potential evapotranspiration) that form input to a hydrological model. The outputs are probabilistic simulations of the average river flow over the forecast period (1 to 12 months ahead), at each location.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

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.

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RIVER FLOW FROM HISTORICAL CLIMATE

August 2020

UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 31st July 2020

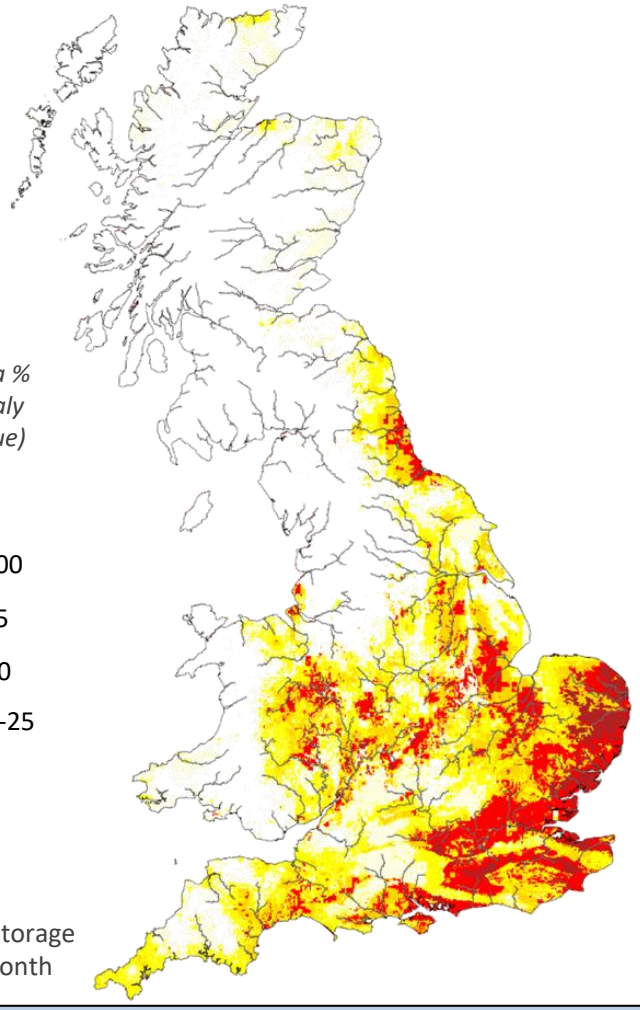
Issue date: 05.08.2020

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 July, many areas across southern and central England are experiencing relative dryness levels much higher than average for this time of year. Eastern Wales and some areas of north eastern England are also experiencing relative dryness levels higher than average.

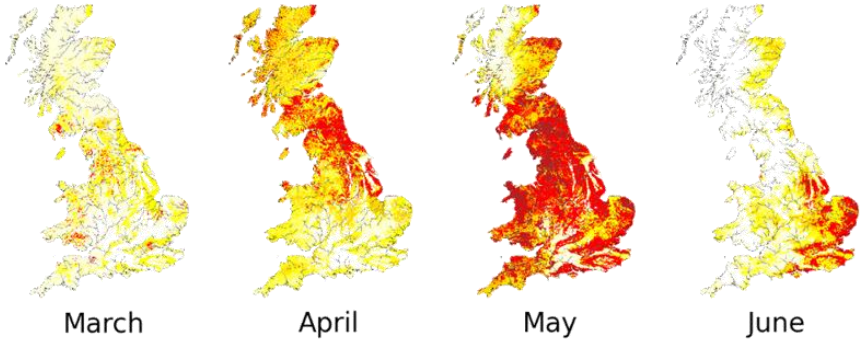
Relative Dryness

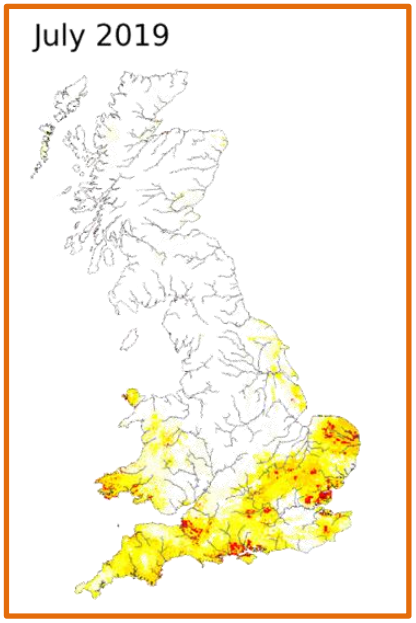


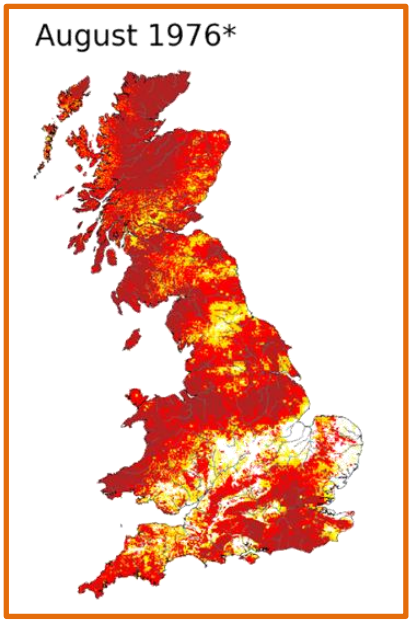
Water storage anomaly as a % of minimum storage anomaly (zero indicates average value)

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

Labels refer to estimated storage on *final day* of named month







*Example month displaying extreme relative dryness

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OUTLOOK BASED ON CURRENT CONDITIONS

August 2020

UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 31st July 2020

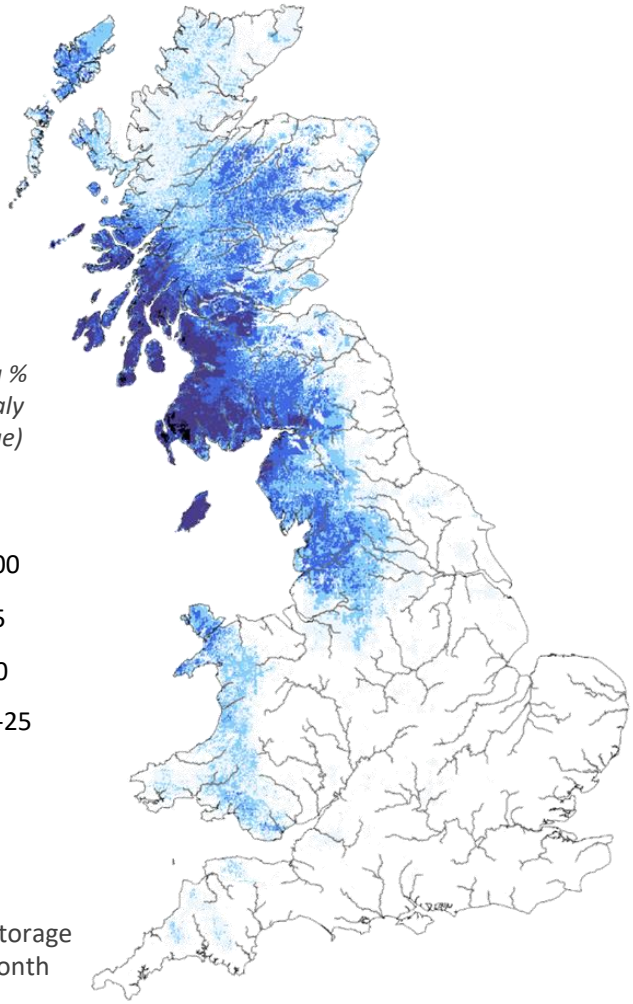
Issue date: 05.08.2020

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 July, the majority of regions across Scotland are experiencing relative wetness levels higher than average for this time of year, particularly the Solway and Clyde regions. North west England and some areas of western Wales are also experiencing higher relative wetness levels than average.

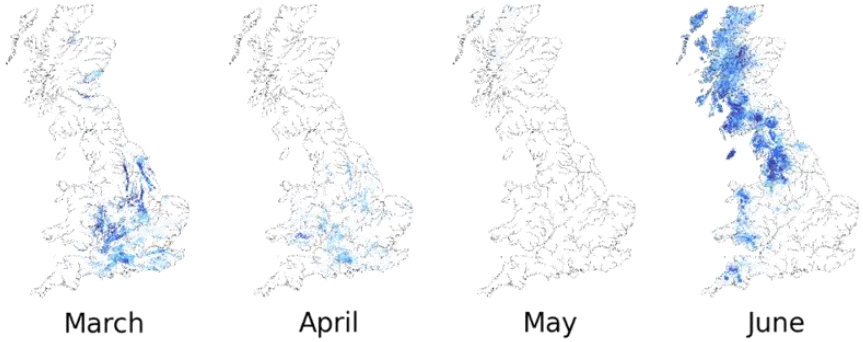
Relative Wetness

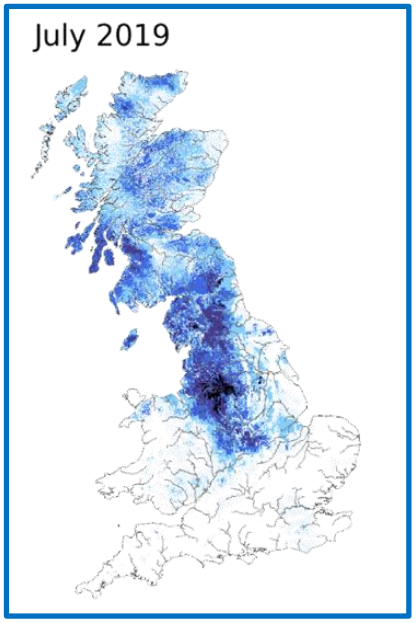


Water storage anomaly as a % of maximum storage anomaly (zero indicates average value)

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

Labels refer to estimated storage on *final day* of named month





*Example month displaying extreme relative wetness

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OUTLOOK BASED ON CURRENT CONDITIONS

August 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: August 2020 – January 2021

Issue date: 05.08.2020

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 August, the majority of the country will not require particularly unusual rainfall (less than 5 year return periods) to return to average conditions. Anglian, Thames and Southern regions will require rainfall with a 5 to 10 year return period; this persists into September in the Southern region.

From August until December, Britain will not require particularly unusual rainfall (< 5 year return periods) to return to average conditions for the time of year.

Aug

Sep

Oct

Nov

Dec

Jan

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

SCOTLAND

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

ENGLAND

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

WALES

WEL	Welsh

NORTHERN IRELAND

This method cannot currently be used in Northern Ireland

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OUTLOOK BASED ON CURRENT CONDITIONS

August 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 July 2020

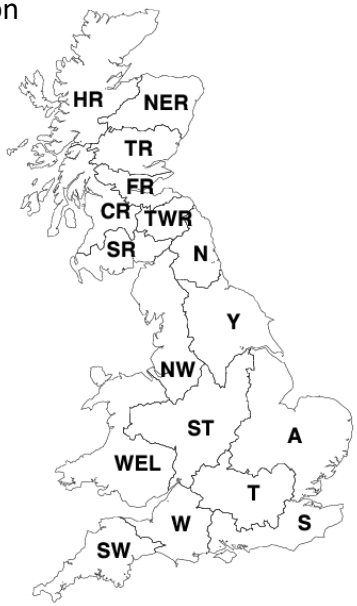
Issue date: 05.08.2020

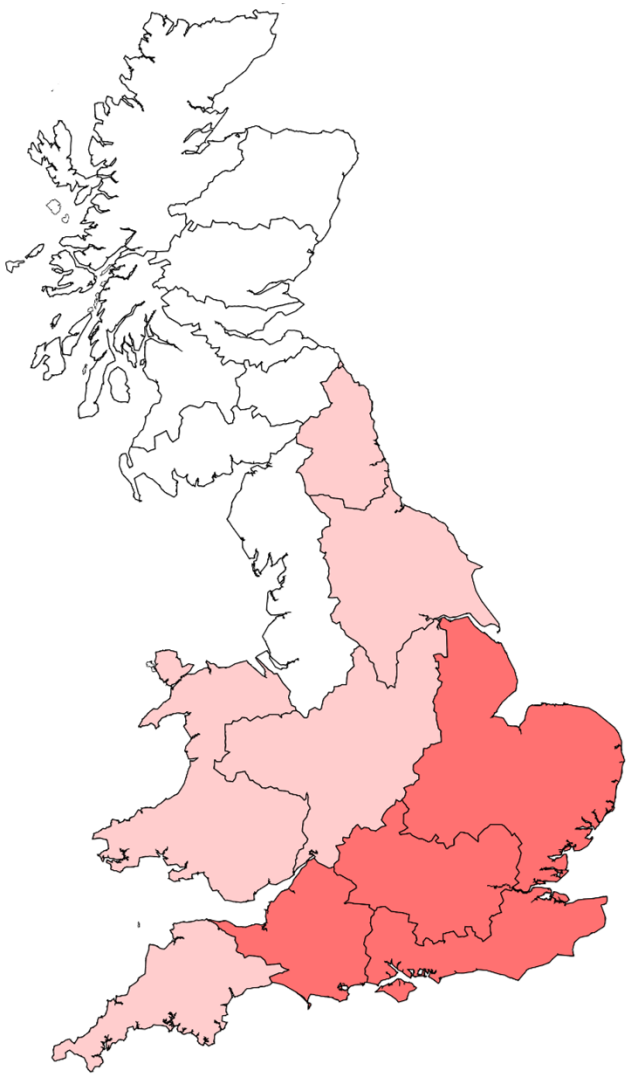
These maps show the Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean (1981-2010), presented on a 1km grid and as regional means.
Subsurface storage deficits, i.e. where the subsurface water storage anomaly is less than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

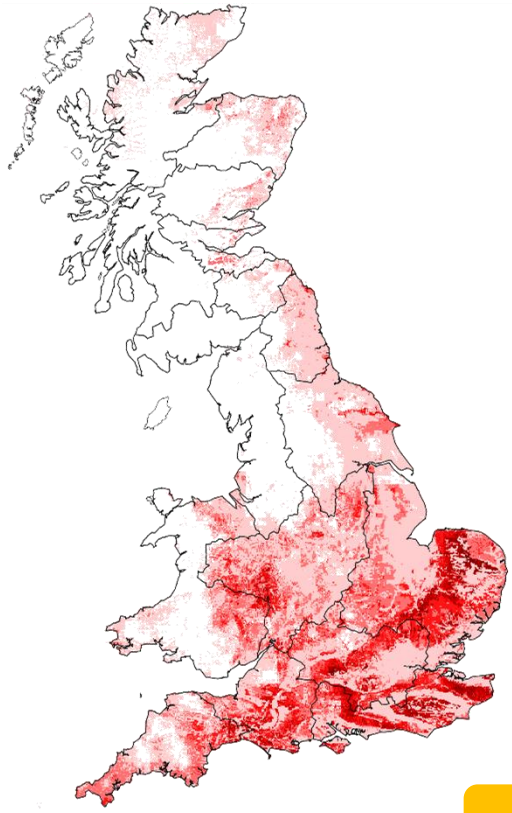
The **subsurface storage deficit (mm)** can be interpreted as an estimate of additional rainfall that would be required in future months to overcome dry conditions (i.e. rainfall in addition to what is expected on average). Regional mean values of additional rainfall required are provided in the table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

Regional estimate of additional rainfall required (mm)

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







Water storage deficit (anomaly, mm)

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

OUTLOOK BASED ON CURRENT CONDITIONS

August 2020

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UK Centre for Ecology & Hydrology

Outlook Based on Modelled Flow from Rainfall Forecasts

Overview

Period: August 2020 – October 2020

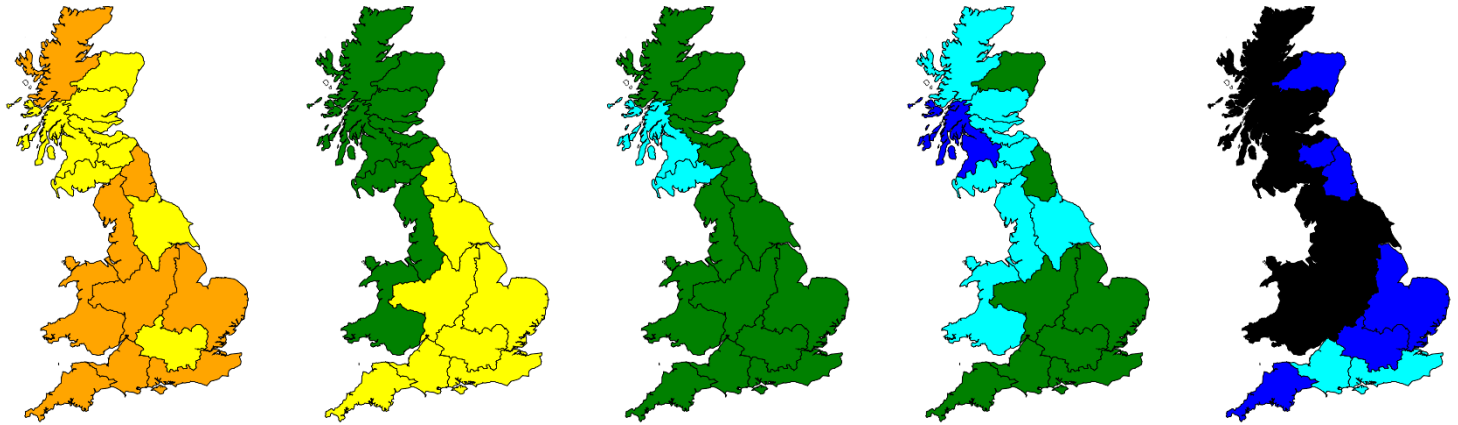
Issued on 05.08.2020 using data to the end of July

SUMMARY: During August, river flows across the majority of the country are most likely to be in the *Normal range*. River flows in regions across England may be *Below normal*; river flows in Wales and Scotland (particularly across southern Scottish regions) may be *Above normal*.

Over the next 3 months this pattern generally continues. River flows across the country are most likely to be in the *Normal range*, with the possibility of *Below normal* river flows in central and southern regions and the possibility of *Above normal* river flows in western and northern regions.

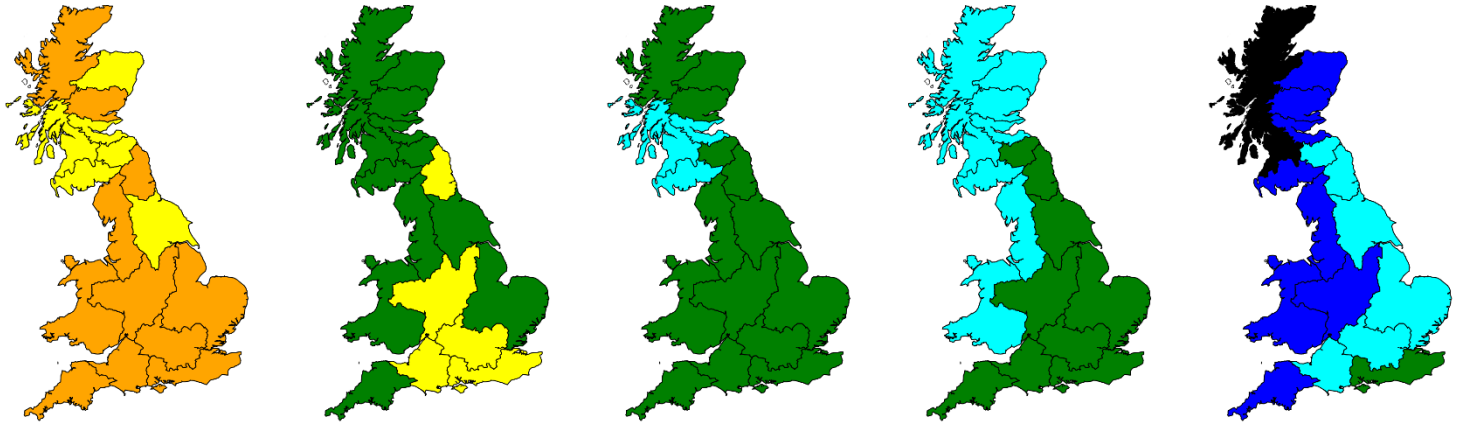
1-month flow outlook

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
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ENGLAND

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T	Thames
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W	Wessex
SW	South West

WALES

WEL	Welsh

NORTHERN IRELAND

This method cannot currently be used in Northern Ireland

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RIVER FLOW FROM RAINFALL FORECASTS

August 2020

UK Centre for Ecology & Hydrology

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

Period: August 2020 – October 2020

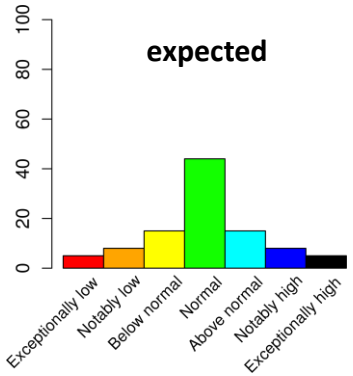
Issue date: 05.08.2020

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.

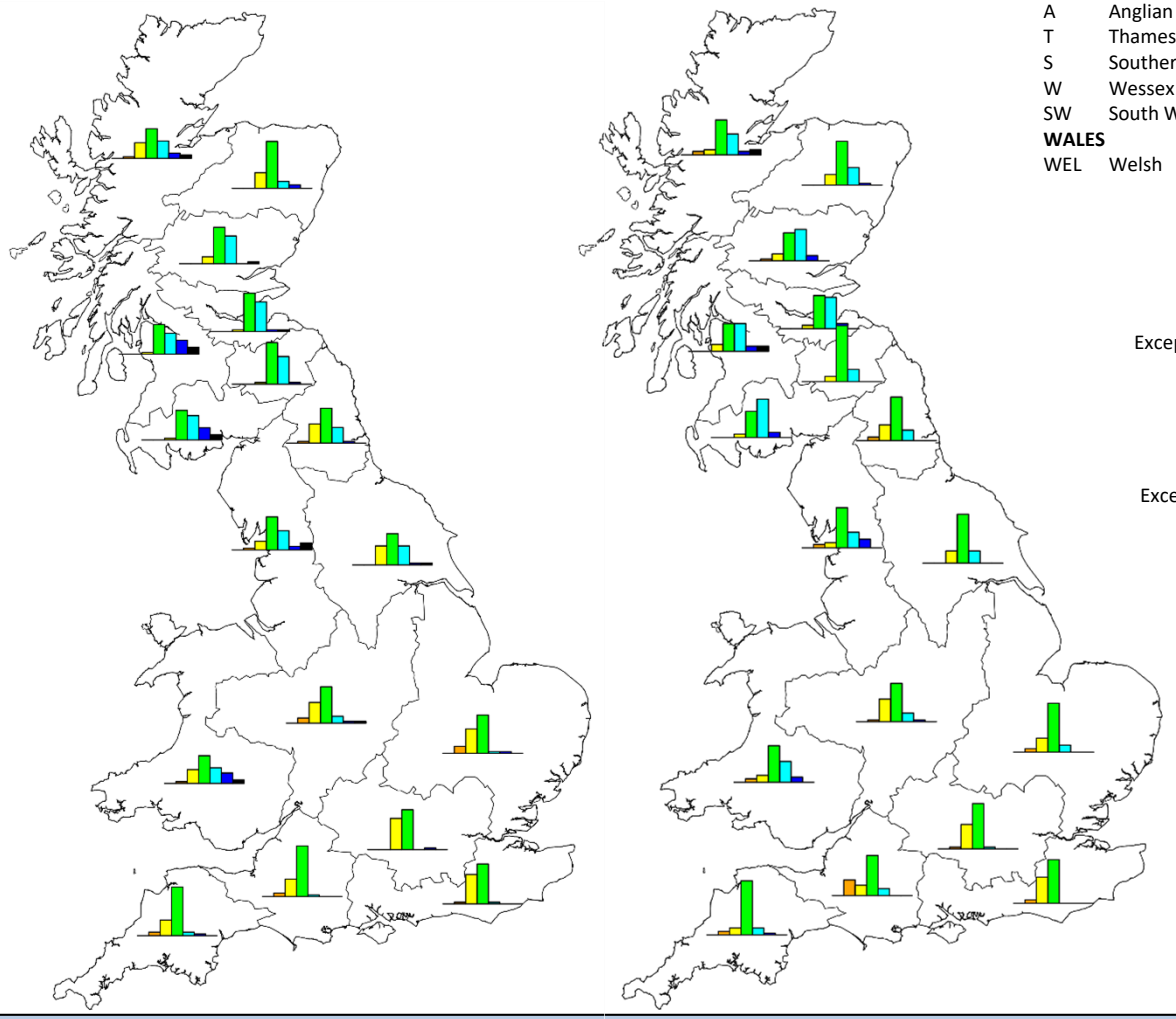
The bar charts (below) give further insight into the range of river flow forecasts by considering all members of the forecast rainfall ensemble. The regional bar charts show the percentage of ensemble forecasts falling in each of the flow categories as generated by the monthly-resolution water-balance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

SUMMARY: During August, river flows across the majority of the country are most likely to be in the *Normal range*. River flows in regions across England may be *Below normal*; river flows in Wales and Scotland (particularly across southern Scottish regions) may be *Above normal*.

Over the next 3 months this pattern generally continues. River flows across the country are most likely to be in the *Normal range*, with the possibility of *Below normal* river flows in central and southern regions and the possibility of *Above normal* river flows in western and northern regions.



1-month *3-month*



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Percentile range of historic values for relevant month

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RIVER FLOW FROM RAINFALL FORECASTS

August 2020

UK Centre for Ecology & Hydrology

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

Period: August 2020 – October 2020

Issue date: 05.08.2020

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 August, river flows across the majority of the country are most likely to be in the *Normal range*. River flows in regions across England may be *Below normal*; river flows in Wales and Scotland (particularly across southern Scottish regions) may be *Above normal*.

Over the next 3 months this pattern generally continues. River flows across the country are most likely to be in the *Normal range*, with the possibility of *Below normal* river flows in central and southern regions and the possibility of *Above normal* river flows in western and northern regions.

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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	10	0	2	0	0	0	5	0	2	10	2	5	0	7	2	0
Notably high flow	2	5	2	2	2	0	2	14	0	2	19	2	7	5	17	0	2
Above normal	2	26	21	10	5	2	0	21	2	26	29	40	24	10	33	38	38
Normal range	52	45	48	50	67	55	55	38	69	43	40	52	40	64	40	50	57
Below normal	33	12	26	29	21	40	43	19	24	26	2	2	21	21	2	10	2
Notably low flow	10	2	2	7	5	2	0	2	5	0	0	0	2	0	0	0	0
Exceptionally low flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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	7	0	7	0	0	0	0
Notably high flow	0	12	0	2	2	0	0	7	0	0	7	7	5	2	7	7	0
Above normal	10	21	14	12	10	0	2	29	10	17	38	43	29	24	52	43	17
Normal range	67	55	60	52	74	60	62	50	55	67	38	45	48	60	36	38	76
Below normal	19	7	21	31	10	36	33	10	14	17	10	5	7	14	5	10	7
Notably low flow	5	5	5	2	5	5	2	5	21	0	0	0	5	0	0	2	0
Exceptionally low flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Outlook based on modelled groundwater level & climate forecast

Overview

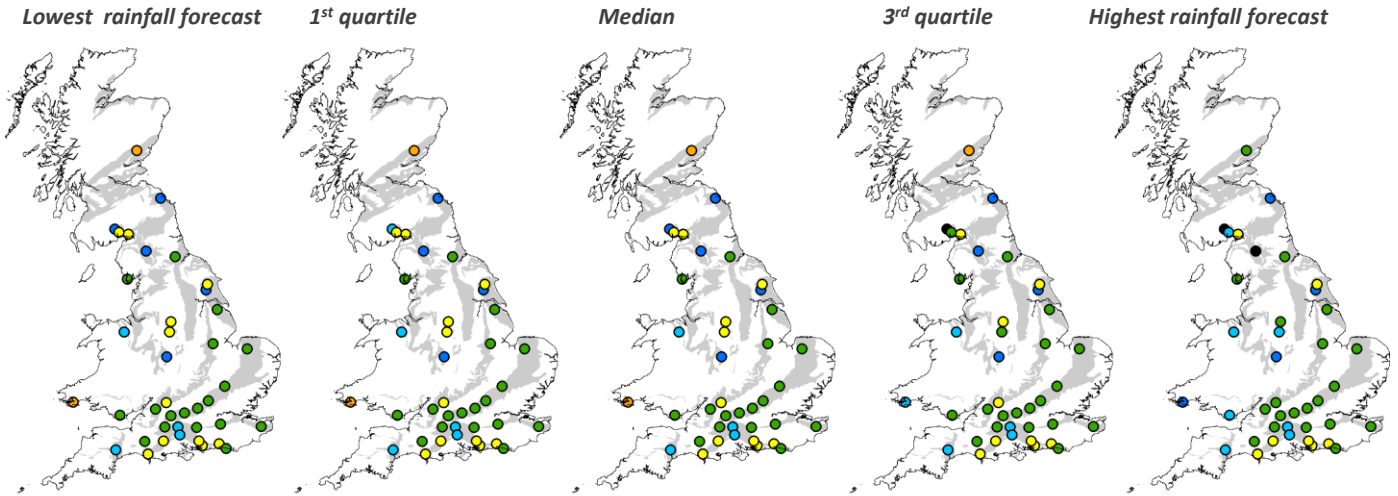
Period: August 2020 – October 2020

Issued on 10.08.2020 using data to the end of July

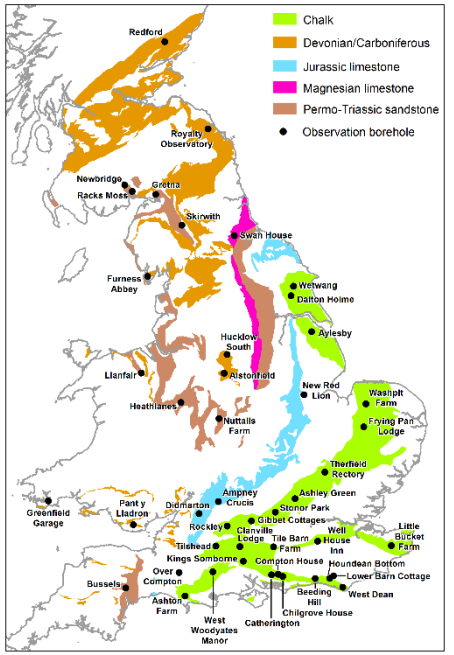
The 1 month forecast is for normal to below normal groundwater levels in the Chalk aquifer of England under all rainfall scenarios, with normal to notably low levels seen in some 3 month forecasts in southern England. In the Permo-Triassic sandstones of the North-West of England and Scotland, the forecasts vary across sites from notably high to notably low groundwater levels. 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.

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

August 2020

UK Centre for Ecology & Hydrology

British Geological Survey

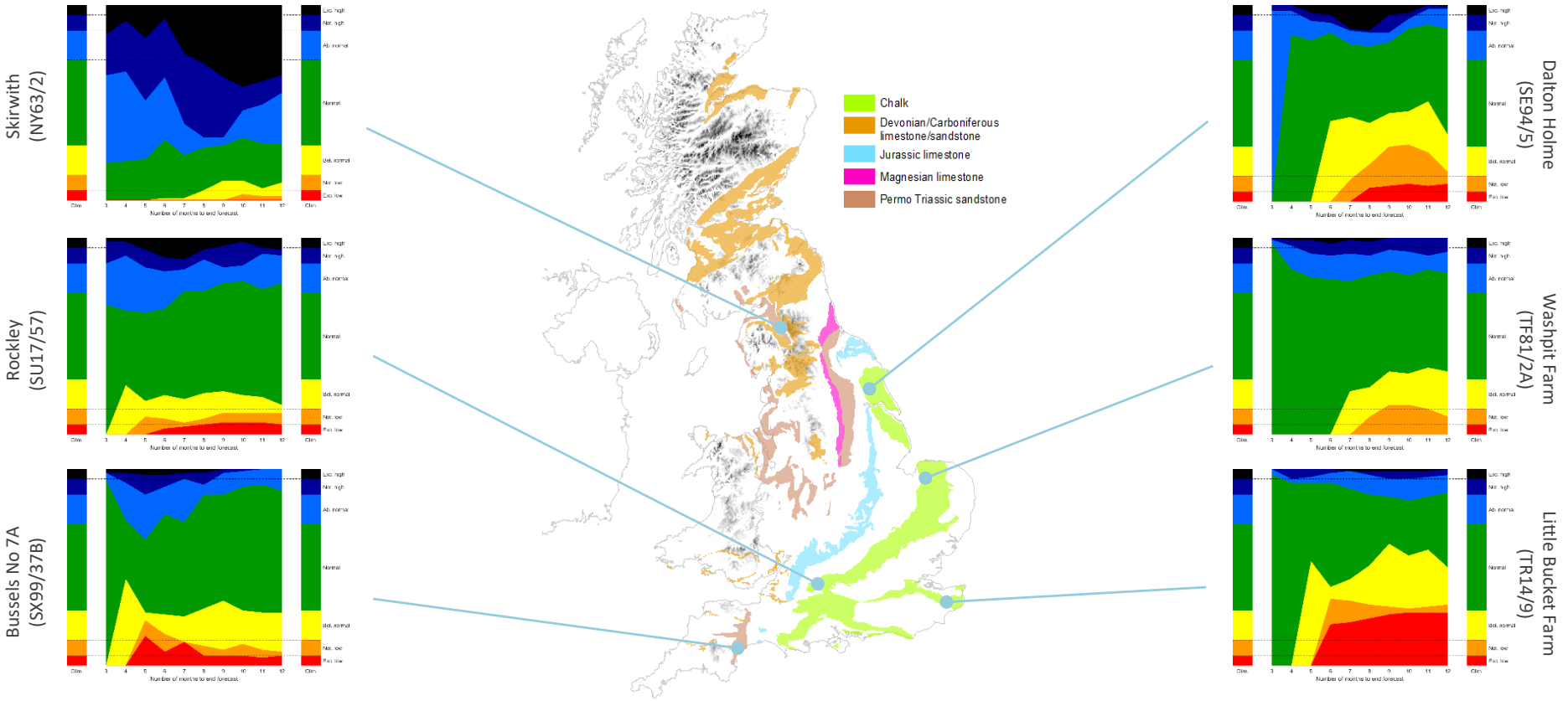
Environment Agency

Outlook based on modelled groundwater from historical climate

Period: August 2020 – July 2021

Issued on 10.08.2020 using data to the end of July

Normal conditions are expected across much of the UK over the next 6 months. In the Chalk of eastern England, below normal levels are likely to prevail in the latter 6 months of the year, with below normal to exceptionally low levels predicted at Little Bucket Farm. In the Permo-Triassic sandstones at Skirwith above normal to notably high levels are predicted for the next 6 months, becoming notably to exceptionally high for the remainder of the year.



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