Hydrological Outlook UK

Period: From September 2020

Issued on 09.09.2020 using data to the end of August 2020

SUMMARY

The outlook for September is for river flows within the normal range in the south-east and groundwater levels below normal to exceptionally low along the south coast, with normal to above normal river flows and groundwater levels elsewhere. The three-month outlook is for a continuation of river flows within the normal range in the south-east with no strong signal elsewhere, and groundwater level outlooks over the seasonal timeframe ultimately determined by the onset of the recharge season.

Rainfall:

Rainfall in August was substantially above average for the majority of the UK, more than 150% of average across Wales, Northern Ireland, central and southern Scotland, and most of England. The only exceptions were Kent, coastal fringes of East Anglia and, notably, the far north of Scotland.

The rainfall outlook (issued by the Met Office on 20 August 2020) is that for September and September-October-November as a whole, above-average precipitation is slightly more likely than below-average precipitation. The probability that UK-average precipitation for September-October-November will fall into the driest of five equal categories is 20% and the probability that it will fall into the wettest category is between 25% and 30% (the 1981-2010 probability for each of these categories is 20%).

River flows:

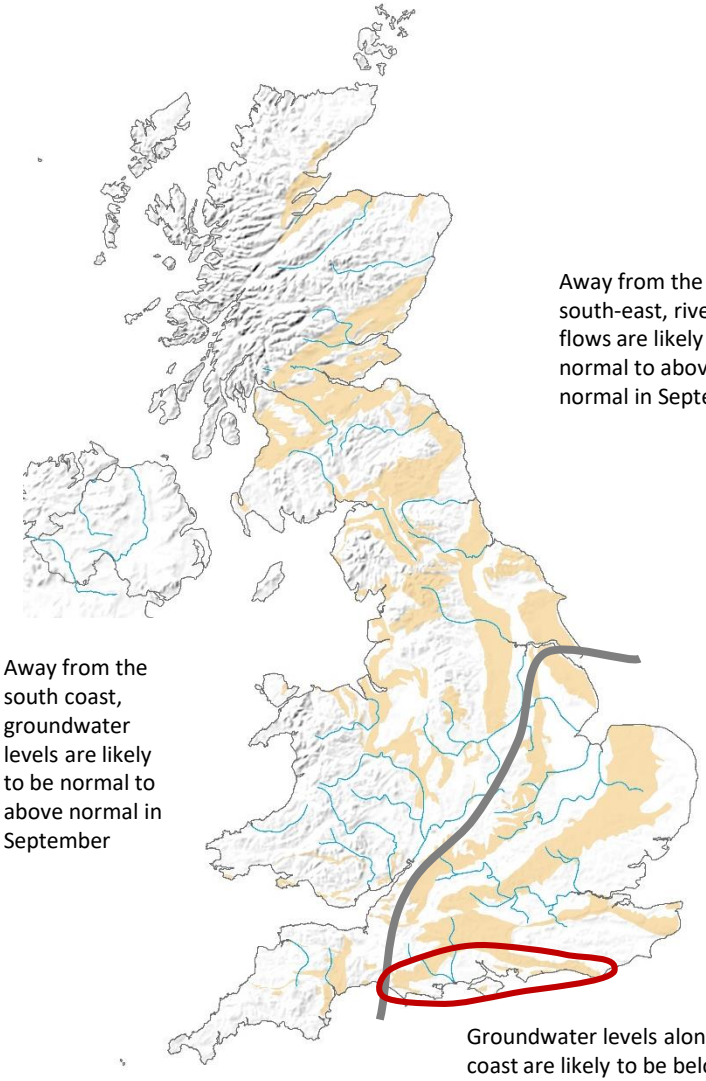
River flows in August were above average across a broad swathe from the south-west to the north-east, notably or exceptionally so in Northern Ireland, Wales and north-west England. Flows were within the normal range in south-east England and below normal or lower in north-east Scotland.

The September outlook is for flows within the normal range in the south-east and normal to above normal flows elsewhere. Nevertheless, in localised catchments of the south-east, either above normal or below normal flows are likely in September. Over the three-month timeframe, a similar eventuality of flows within the normal range is likely. Further north and west, there is no strong signal over three months, so flows within the normal range are most likely.

Groundwater:

Groundwater levels in August were generally below normal in the southern Chalk and normal to above normal in the aquifers further north and west.

For September, there is a strong suggestion that groundwater levels will be below normal to exceptionally low in the Chalk of the south coast. For the remainder of the Chalk and all other aquifers, the one-month outlook is for normal to above normal levels, and locally exceptionally high levels in the sandstones of southern Scotland. Over three months, the outlook is complicated by the timing of recharge, meaning there is some uncertainty.



Shaded areas show principal aquifers

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Hydrological Outlook UK

About the Hydrological Outlook:

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

Data and Models:

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

Climate forecasts are produced by the Met Office. Hydrological modelling is undertaken by UKCEH using the Grid-to-Grid, PDM and CLASSIC hydrological models and by the EA using CATCHMOD. Hydrogeological modelling uses the R-groundwater model run by BGS and CATCHMOD run by the EA. Supporting documentation is available from the Outlooks website:
http://www.hydoutuk.net/methods

Presentation:

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

	Percentile range of historic values for relevant month
Exceptionally high flow	> 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.

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Further information:

For more detailed information about the Hydrological Outlook, and the derivation of the maps, plots and interpretation provided in this outlook, please visit the Hydrological Outlook UK website.

The website features a host of other background information, including a wider range of sources of information which are used in the preparation of this Outlook.

Contact:

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t: 01491 692371 e: enquiries@hydoutuk.net

Reference for the Hydrological Outlook:

Hydrological Outlook UK, 2020, September, 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: September – November 2020 Issue date: 20.08.20

The forecast presented here is for September and the average of the September-October-November period for the United Kingdom as a whole. The forecast for September 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 28th August 2020.

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

SUMMARY – PRECIPITATION:

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

The probability that UK-average precipitation for September-October-November will fall into the driest of our five categories is 20% and the probability that it will fall into the wettest of our five categories is between 25% and 30% (the 1981-2010 probability for each of these categories is 20%).

CONTEXT:

On average, autumn is one of the wettest times of the year in the UK (see figure P1). Atlantic depressions typically become more intense, bringing more frequent spells of wet and windy weather.
As stated in the temperature Outlook, the developing La Niña event in the Pacific Ocean increases the likelihood of westerly winds from the Atlantic, which are associated with wetter- and windier-than-average conditions.

For both September and September-October-November as a whole, long-range prediction systems are consistent with this pattern, implying an increased chance of a wet autumn compared to normal (see graphs of figure P2). The likelihood of spells of windy or even stormy weather is greater than usual. It is, however, worth noting that whilst there is an increased likelihood of above-average precipitation, the chances of below-average precipitation remain similar to normal.

Fig P1

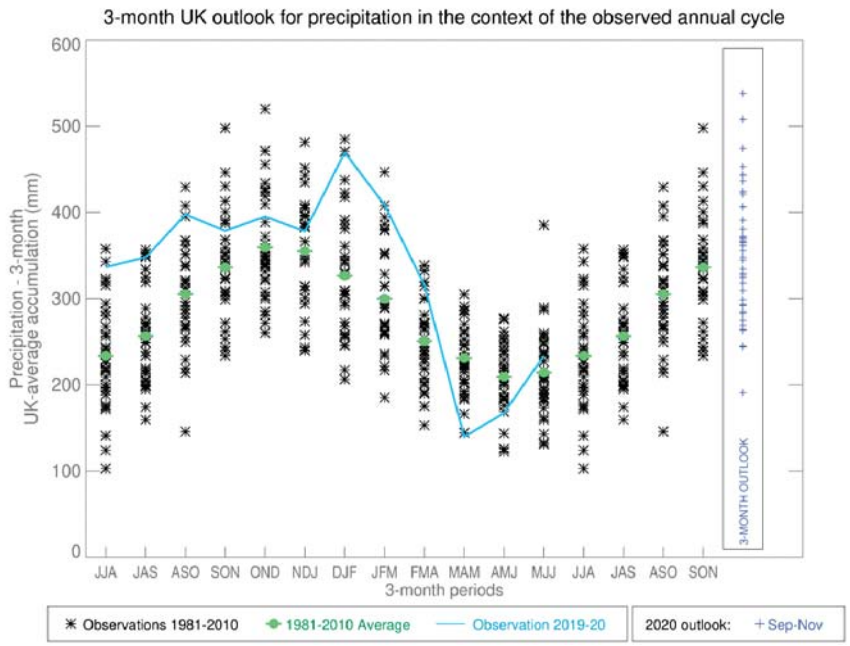


Fig P2

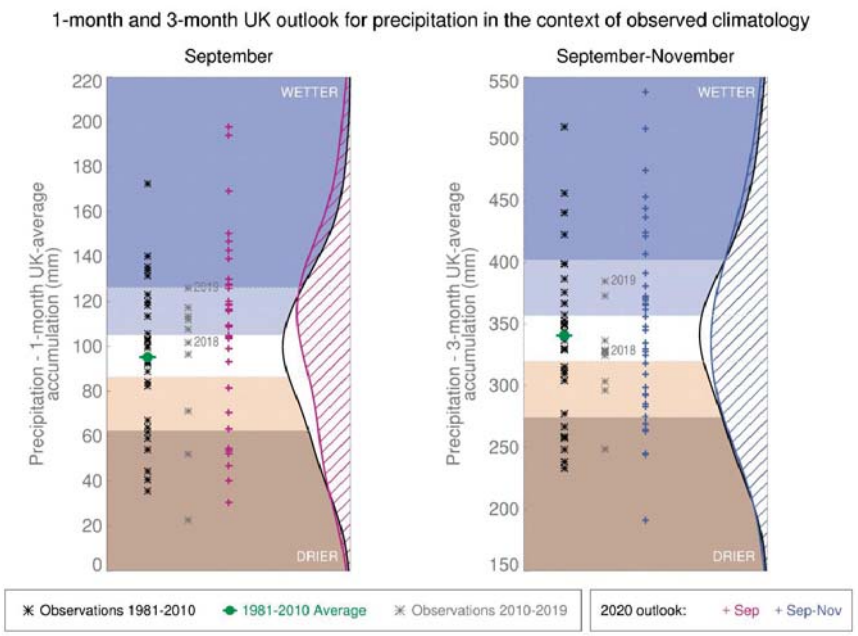
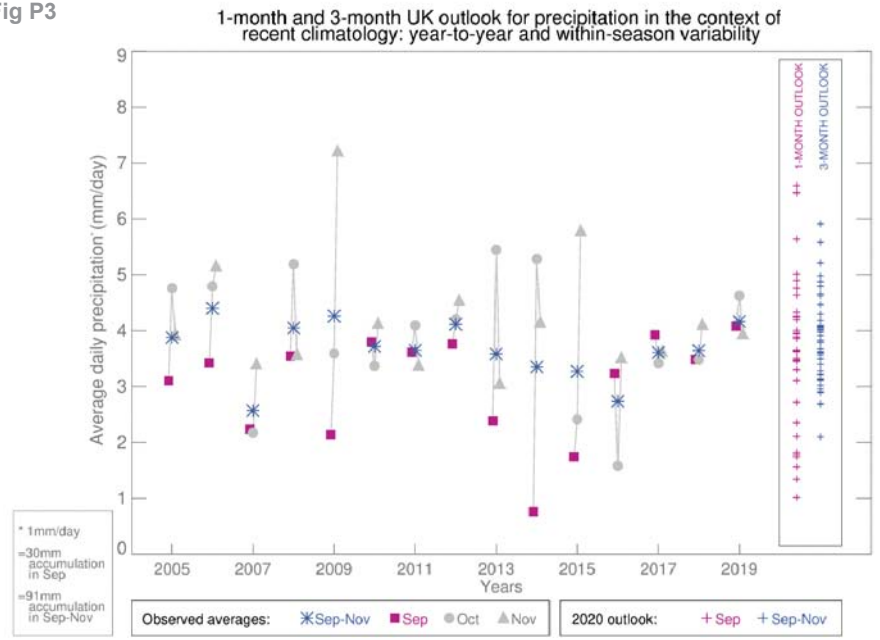


Fig P3



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: September – November 2020 Issue date: 20.08.20

The forecast presented here is for September and the average of the September-October-November period for the United Kingdom as a whole. The forecast for September 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 28th August 2020.

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

SUMMARY – TEMPERATURE:

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

Overall, the probability that the UK-average temperature for September-October-November will fall into the coldest of our five categories is between 5% and 10%, and the probability that it will fall into the warmest of our five categories is 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) start to be more influential at this time of year, particularly later in the period, with predictability higher than in the summer months.

Sea surface temperatures (SSTs) continue to decline in the central and eastern tropical Pacific and it is very likely that La Niña will develop during the forecast period. In autumn, La Niña influences UK weather patterns by moderately increasing the likelihood of winds from the west off the Atlantic Ocean. This would act to increase the chances of cooler-than-average conditions early in the season, and warmer-than-average conditions later on.

Following the recent heatwave, above-average SSTs have been established around the UK, which increases the chances of warmer-than-average weather conditions in September.

For both September and September-October-November as a whole, the Met Office long-range prediction system and other systems from prediction centres around the world are in good agreement in showing an increased likelihood of winds from the west. As noted above, this increases the likelihood of below-average temperatures at the start of the season and above-average temperature towards the end of the season. Overall, there is a shift towards warmer-than-average conditions, consistent with the observed warming of the climate over the past 10 years (see graphs of figure T2).

The relatively high probability of our warmest forecast category 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 arise from a range of types of weather, not just sunny and dry conditions.

Fig T1

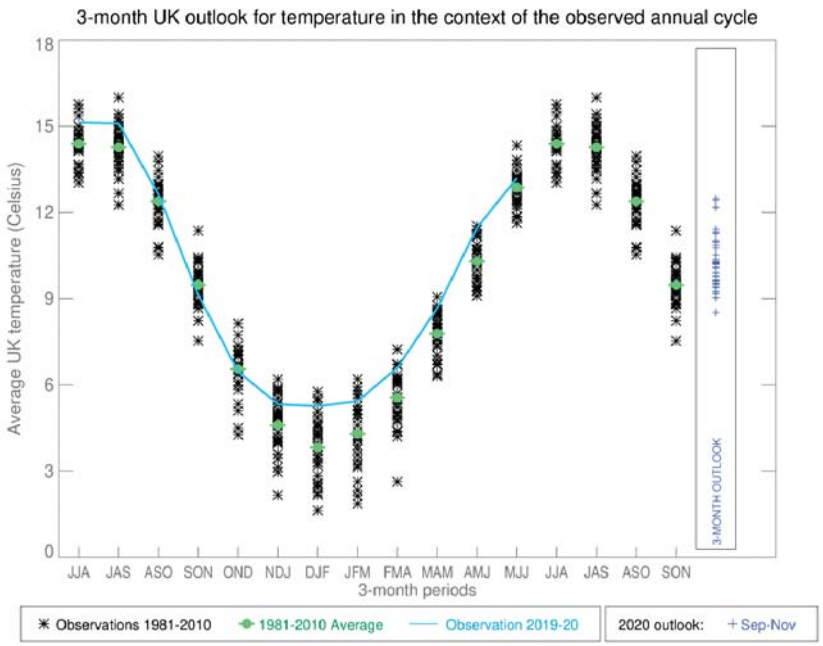


Fig T2

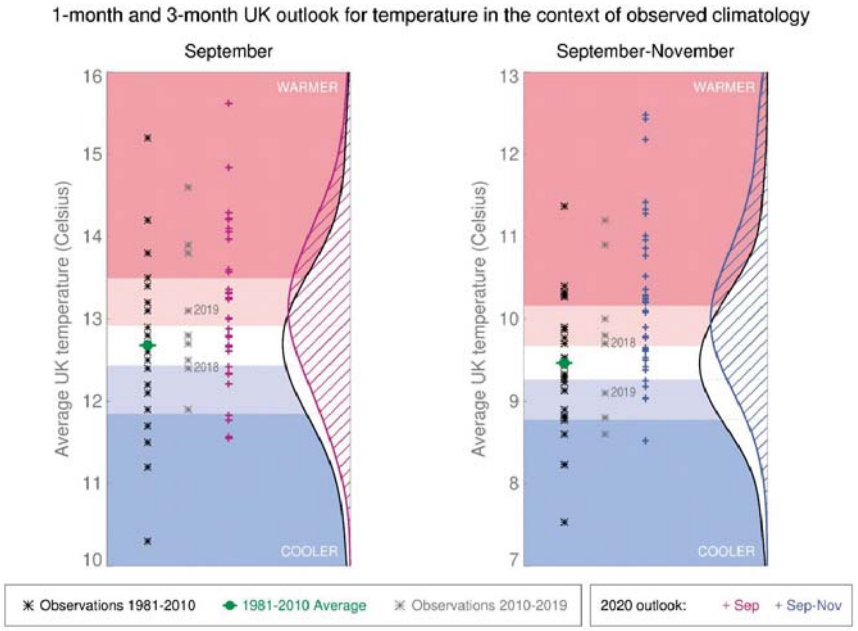
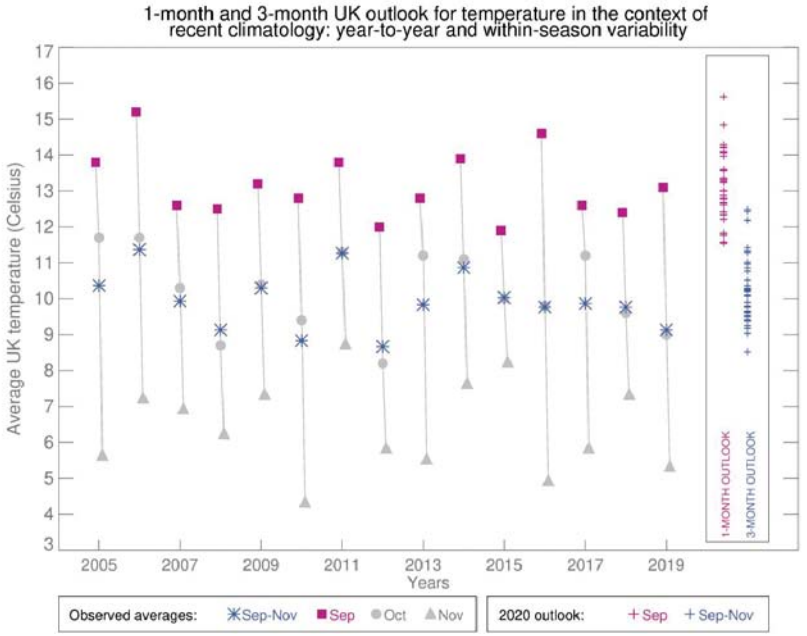


Fig T3



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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

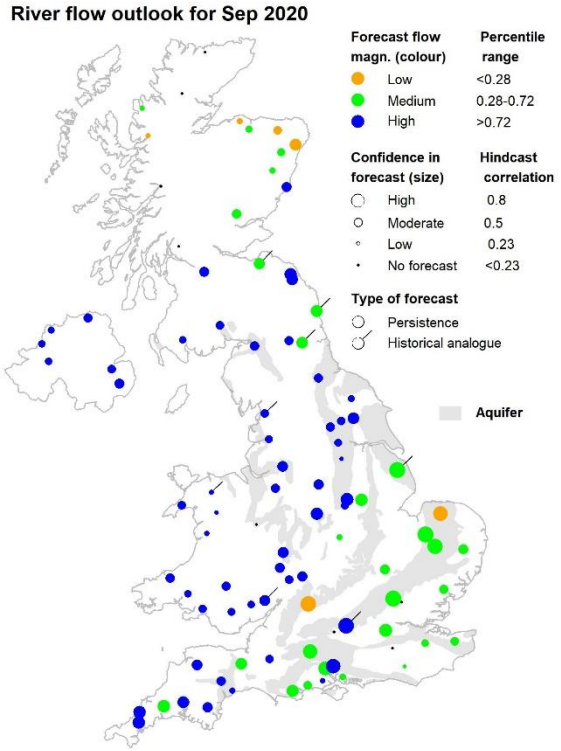
Overview

Period: September 2020 – November 2020

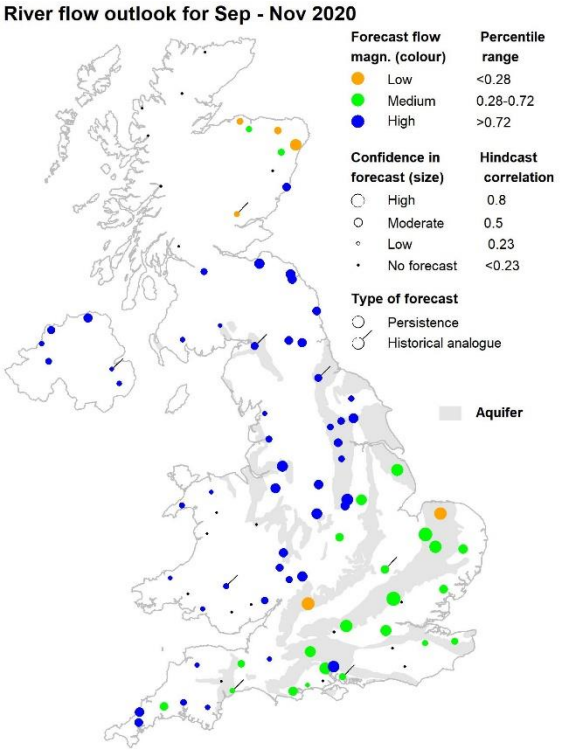
Issued on 04.09.2020 using data to the end of August 2020

SUMMARY

The outlooks for September and for September-November are for normal to below normal flows in the southeast and northeast of the UK, with predominantly above normal flows elsewhere. Note that there are very few forecasts available for the northwest.



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

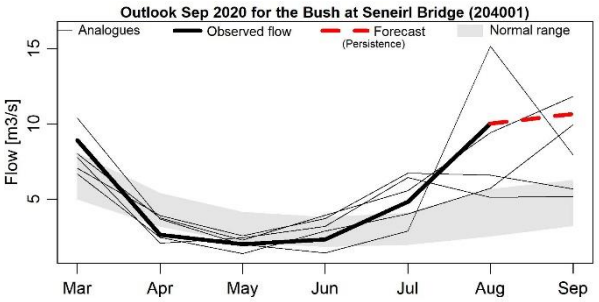
Site-based: 1 month outlook

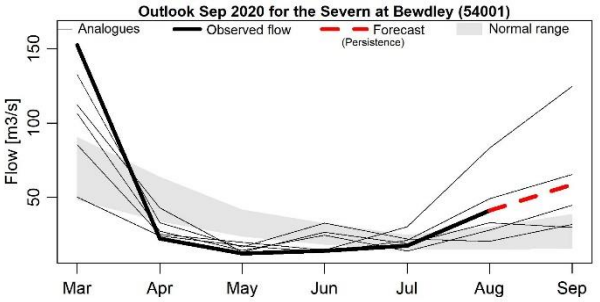
Period: September 2020

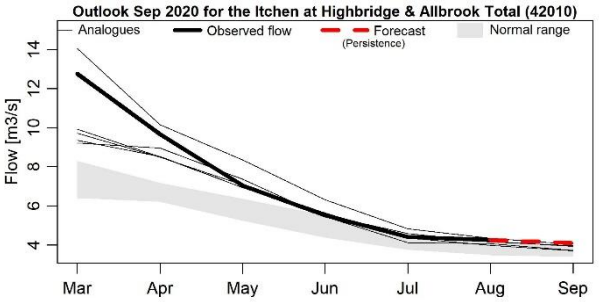
Issued on 04.09.2020 using data to the end of August 2020

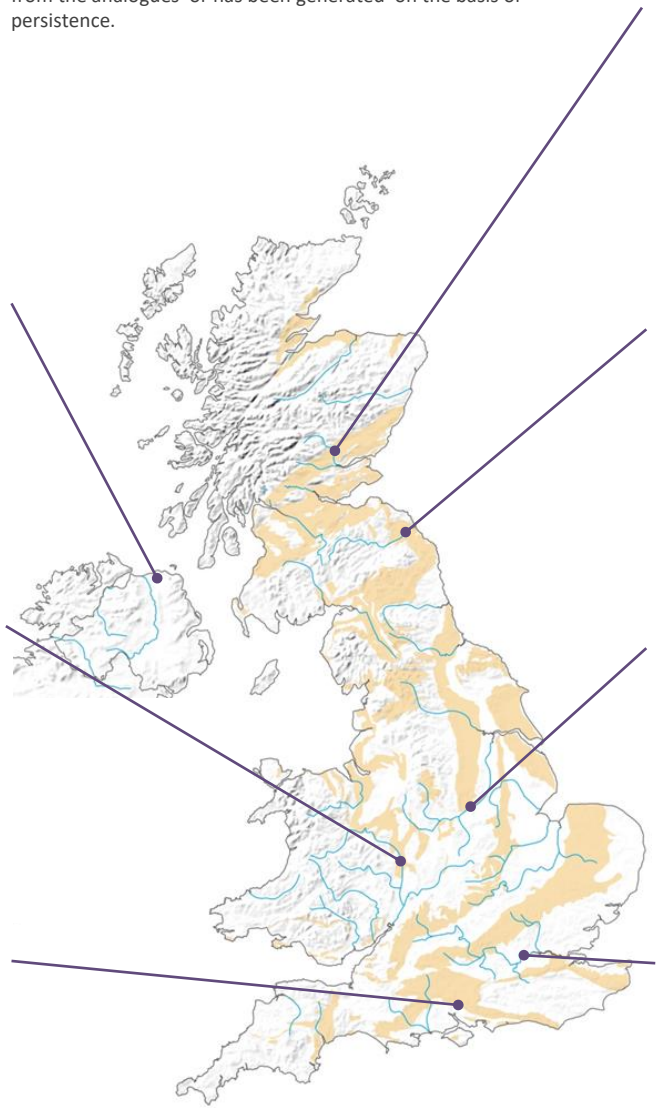
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

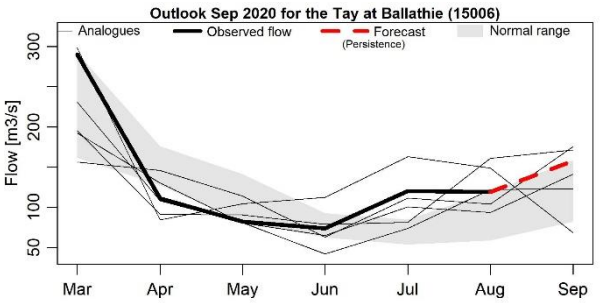
In each of the time series graphs the bold black line represents the observed flow during the past six months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows took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

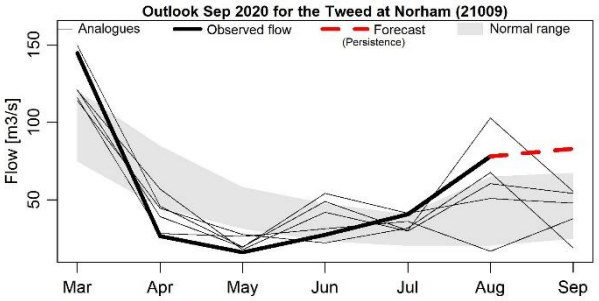


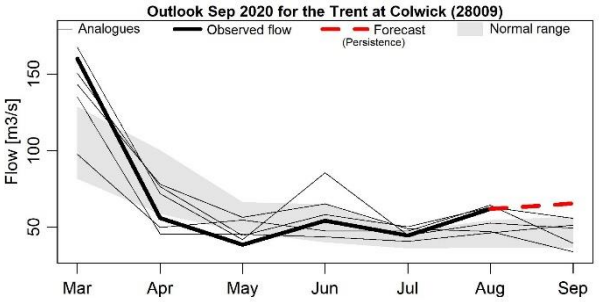


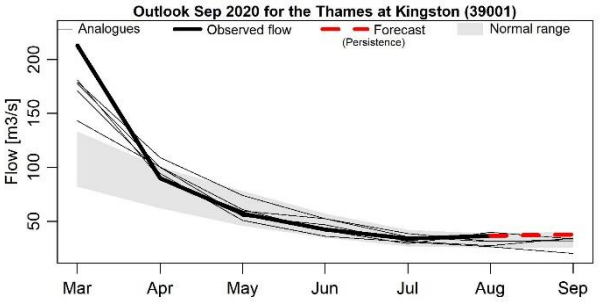












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RIVER FLOW ANALOGY

September 2020

UK Centre for Ecology & Hydrology

Outlook based on hydrological persistence and analogy

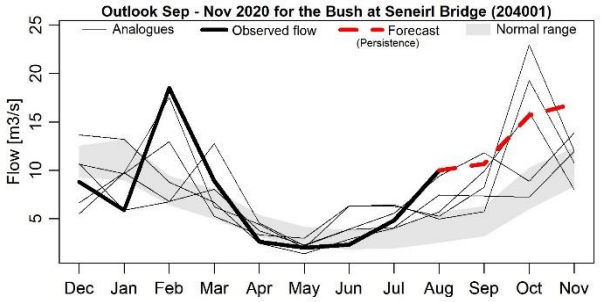
Site-based: 3 month outlook

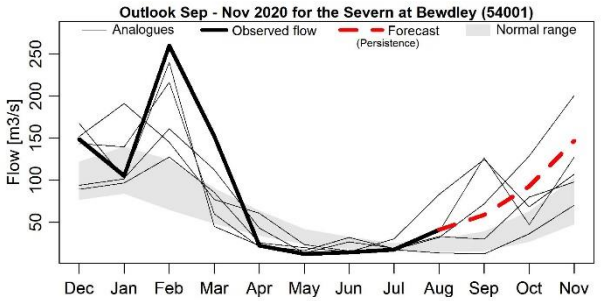
Period: September – November 2020

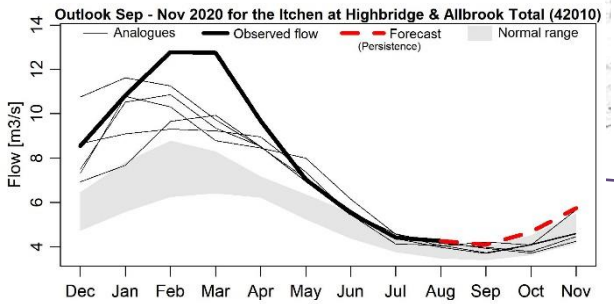
Issued on 04.09.2020 using data to the end of August 2020

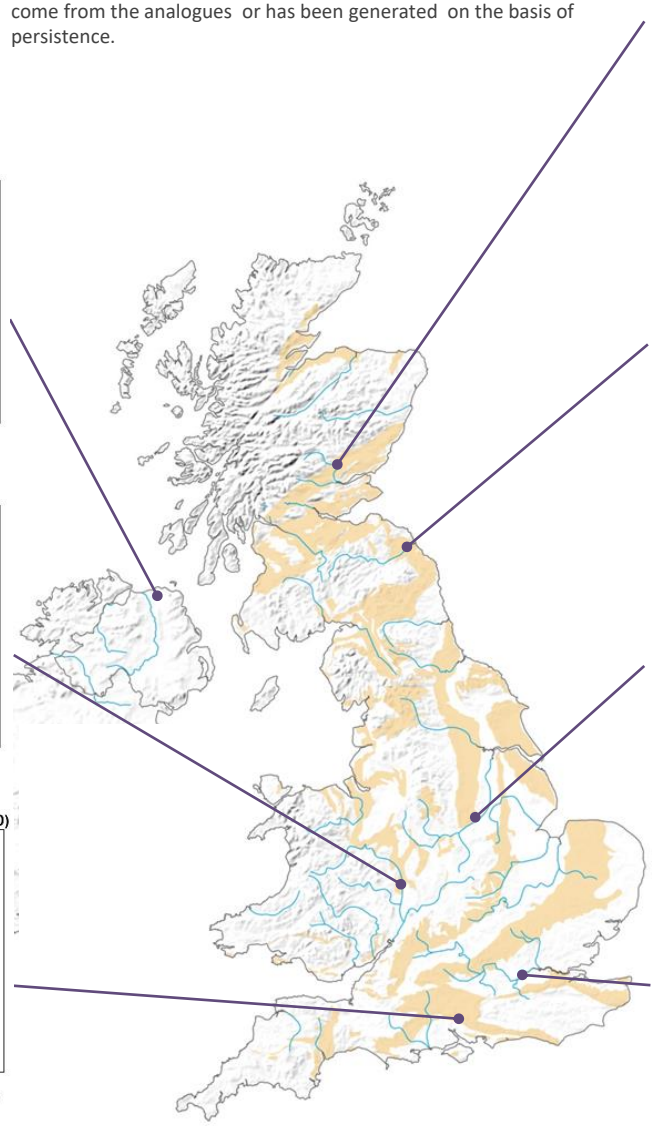
These figures provide insight into the hydrological analogue methodology for a set of sites from across the UK.

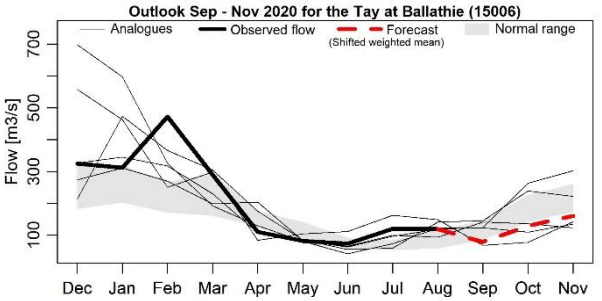
In each of the time series graphs the bold black line represents the observed flow during the past nine months. The grey band indicates the normal flow range (the normal band includes 44% of observed flows in each month). The selected analogues are shown as thin lines and the trajectories that flows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

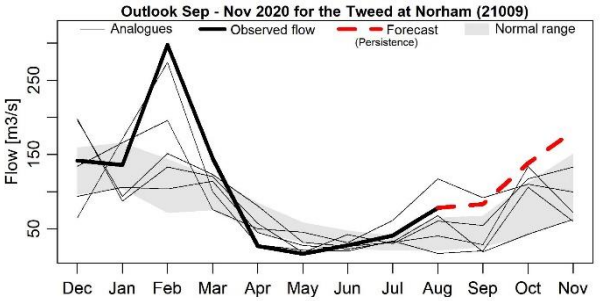


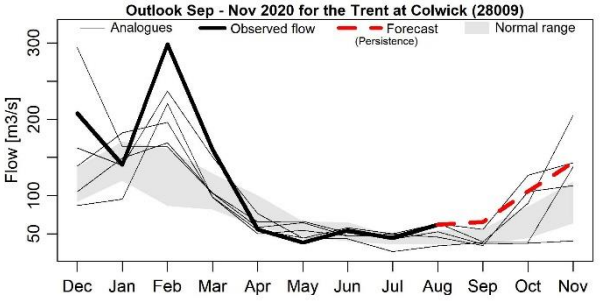


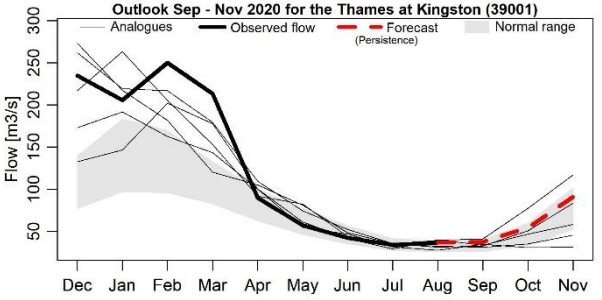












RIVER FLOW ANALOGY

September 2020

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UK Centre for Ecology & Hydrology

British Geological Survey

Environment Agency

Outlook based on modelled flow from historical climate

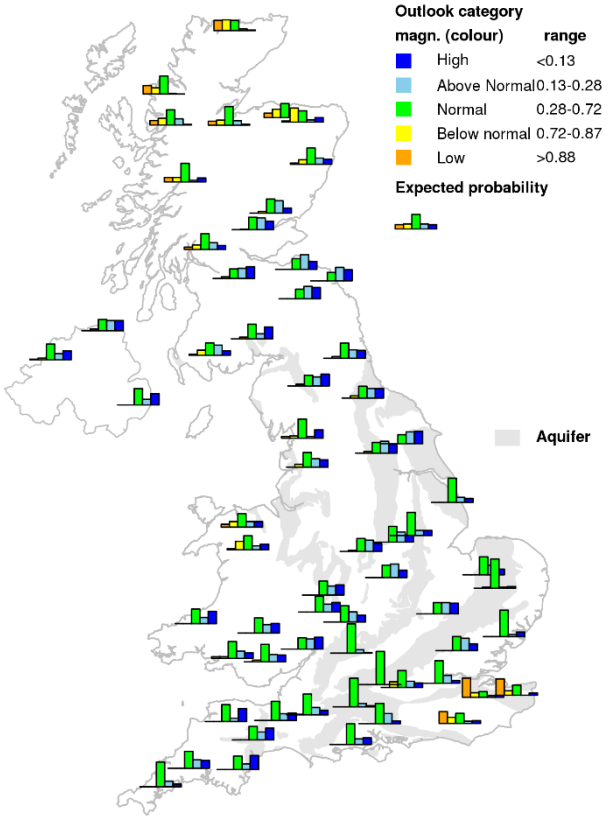
Overview

Period: September 2020 – February 2021

Issued on 03.09.2020 using data to the end of August

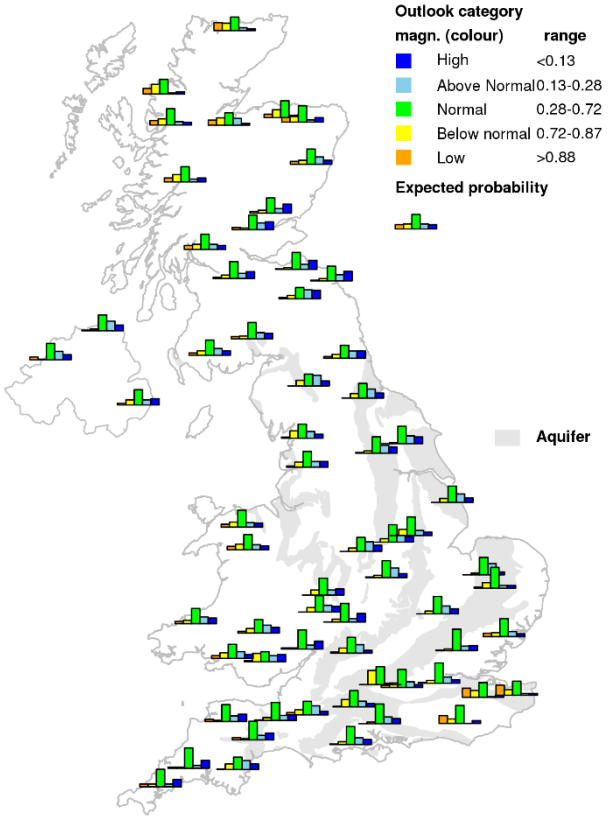
September river flows are likely to be normal to above normal for most of the UK following widespread heavy rainfall in August. Flows in northern Scotland and the far south-east of England are likely to be normal to below normal. Over the next 3 months flows are likely to be normal to above normal for most of the UK.

1-month river flow outlook starting Sep 2020



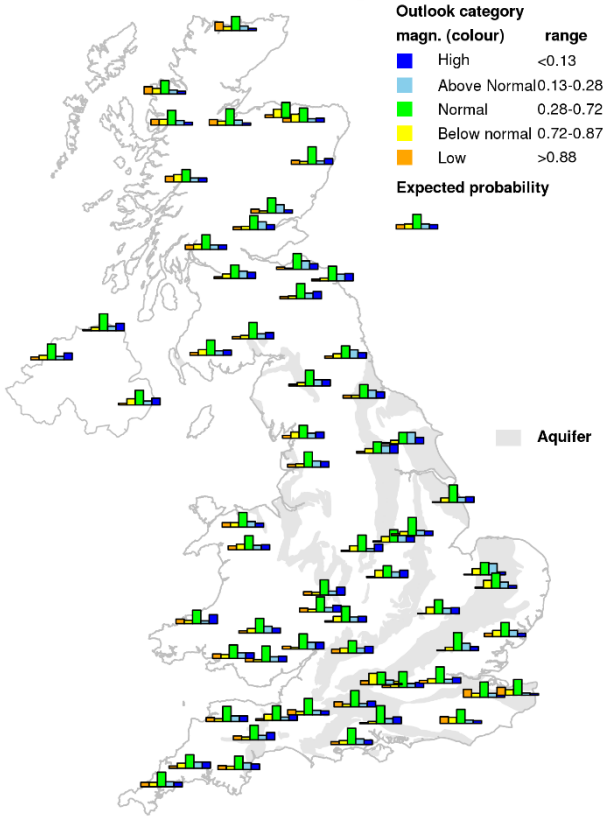
This outlook is based on monthly ensembles of historical sequences of observed climate (rainfall and potential evapotranspiration) that form input to a hydrological model. The outputs are probabilistic simulations of the average river flow over the forecast period (1 to 12 months ahead), at each location.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

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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

September 2020

UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 31st August 2020

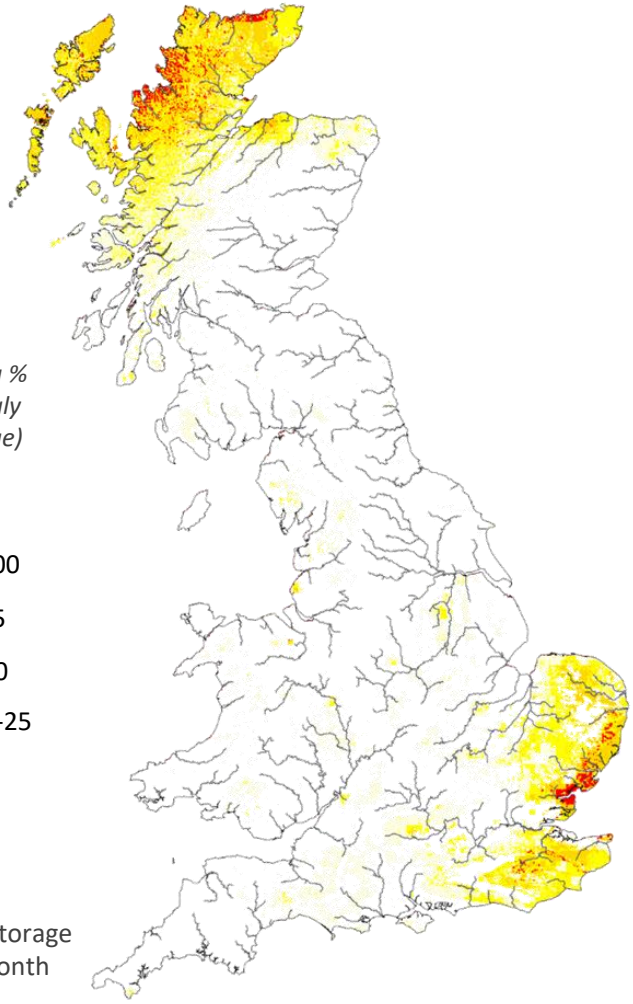
Issue date: 04.09.2020

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 August, the majority of the country is not experiencing relative dryness levels higher than average for this time of year. The north-west Highlands and patches of Anglia and the South East are experiencing relative dryness levels higher than average.

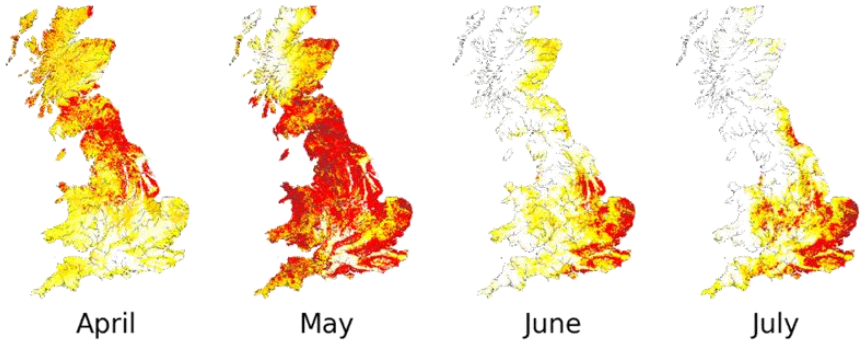
Relative Dryness

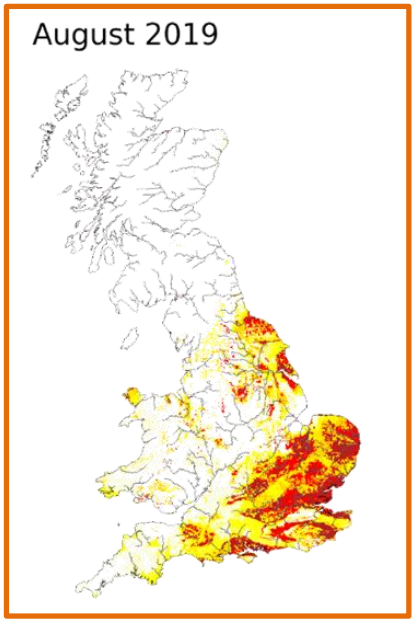


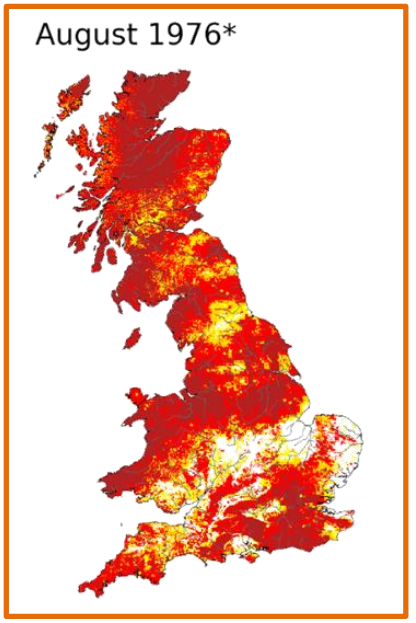
Water storage anomaly as a % of minimum storage anomaly (zero indicates average value)

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

September 2020

UK Centre for Ecology & Hydrology

Current Daily Simulated Subsurface Water Storage Conditions

Based on subsurface water storage estimated for 31st August 2020

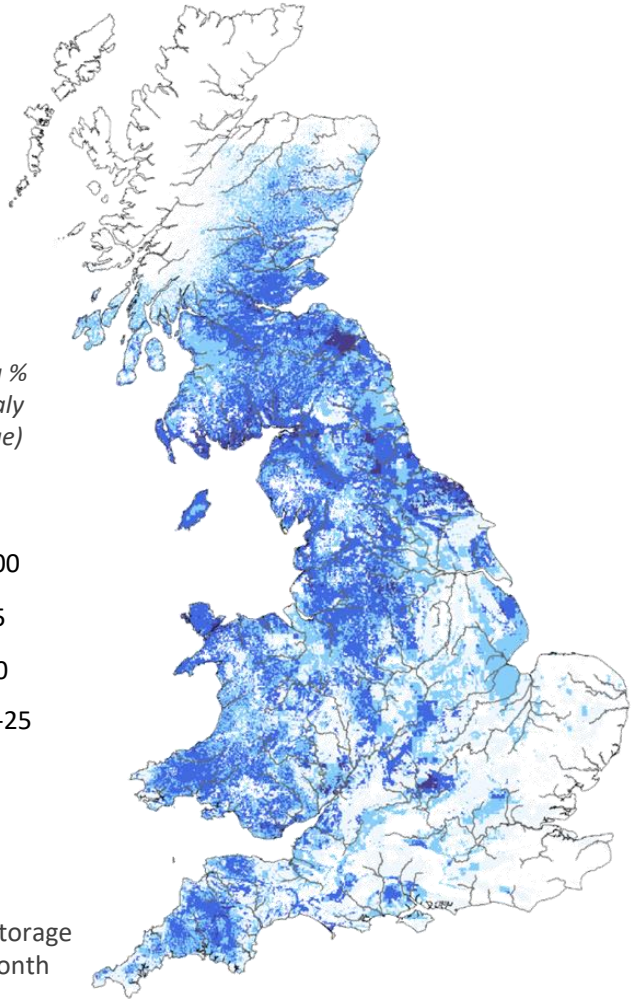
Issue date: 04.09.2020

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 August, the majority of the country is experiencing relative wetness levels higher than average for this time of year, particularly across Wales, the north of England and southern Scotland.

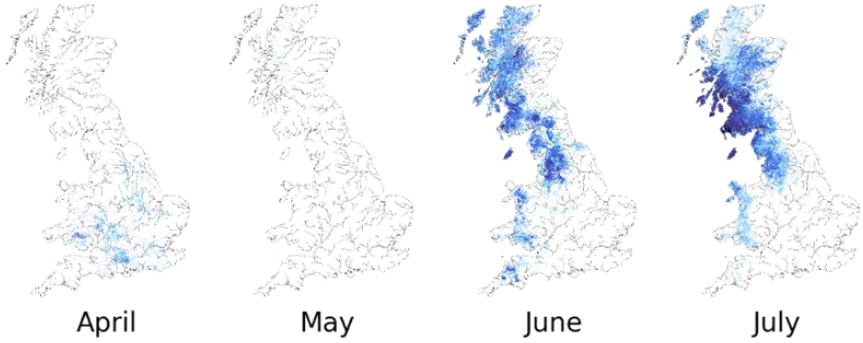
Relative Wetness

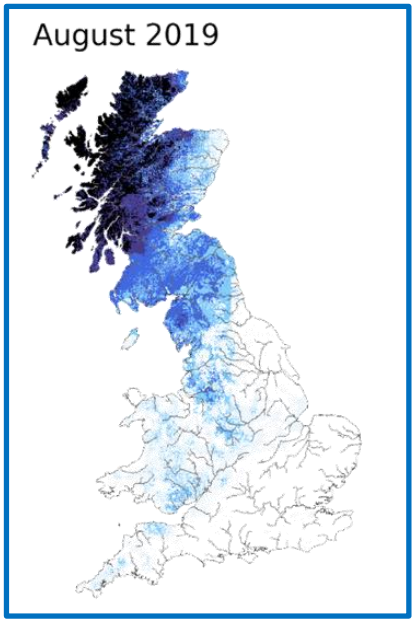


Water storage anomaly as a % of maximum storage anomaly (zero indicates average value)

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

September 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: September 2020 – February 2021

Issue date: 04.09.2020

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 September, the Southern region will require rainfall with a 5 to 10 year return period to return to average conditions. The rest of the country will not require particularly unusual rainfall (less than 5 year return periods) to return to average conditions.

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.

Sep

Oct

Nov

Dec

Jan

Feb

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

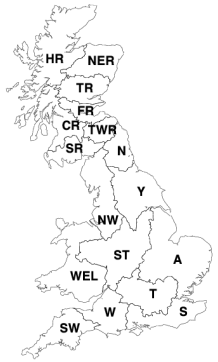
HR	Highlands Region
NER	North East Region
TR	Tay Region
FR	Forth Region
CR	Clyde Region
TWR	Tweed Region
SR	Solway Region

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

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 August 2020

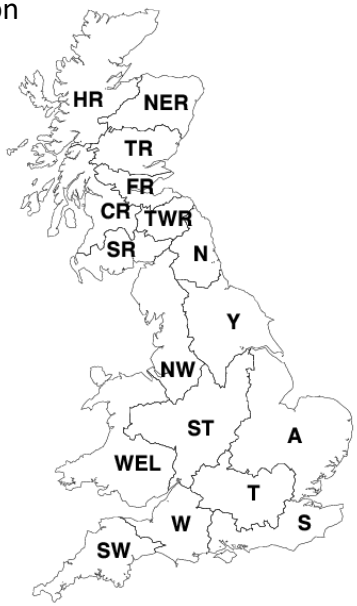
Issue date: 04.09.2020

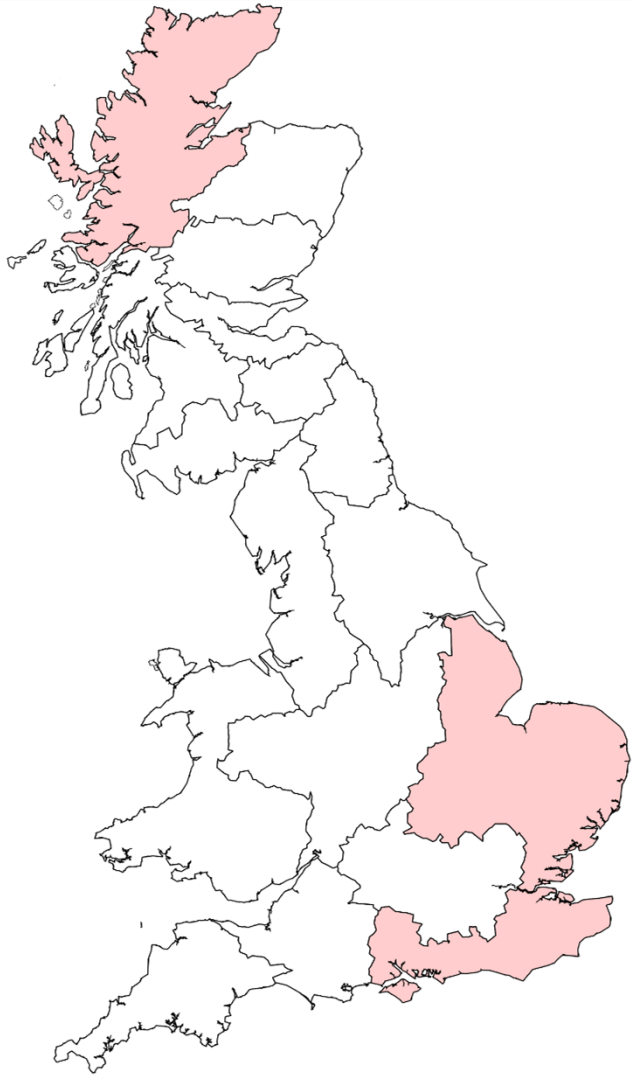
These maps show the Grid-to-Grid (G2G) hydrological model simulated subsurface water storage, expressed as an anomaly from the historical monthly mean (1981-2010), presented on a 1km grid and as regional means.
Subsurface storage deficits, i.e. where the subsurface water storage anomaly is less than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

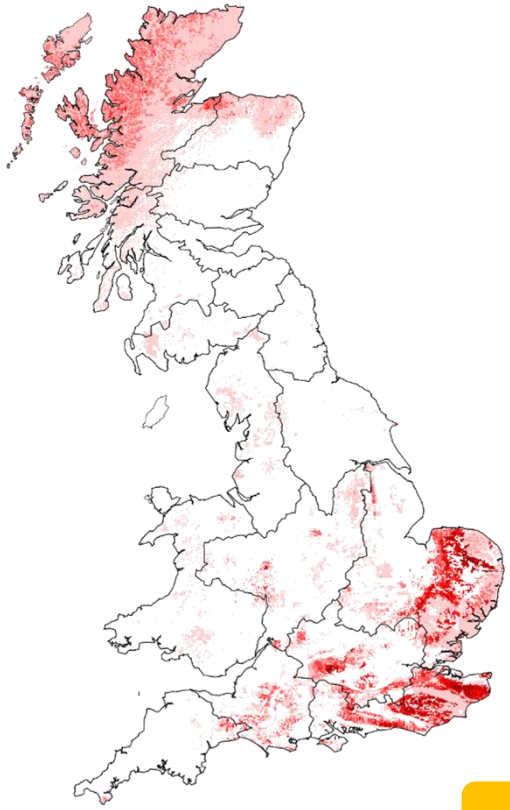
The **subsurface storage deficit (mm)** can be interpreted as an estimate of additional rainfall that would be required in future months to overcome dry conditions (i.e. rainfall in addition to what is expected on average). Regional mean values of additional rainfall required are provided in the table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

Regional estimate of additional rainfall required (mm)

	SCOTLAND	
17	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	
0	N	Northumbria
0	NW	North West
0	Y	Yorkshire
0	ST	Severn Trent
5	A	Anglian
0	T	Thames
0	W	Wessex
20	S	Southern
0	SW	South West
	WALES	
0	WEL	Welsh







Water storage deficit (anomaly, mm)

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

OUTLOOK BASED ON CURRENT CONDITIONS

September 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: September 2020 – November 2020

Issued on 04.09.2020 using data to the end of July

SUMMARY: During September, river flows across much of the country are most likely to be in the *Normal range* to *Above normal*. River flows across central and eastern regions (and in the South West) are most likely to be *Above normal*, while *Notably high flows* are likely in some regions across southern Scotland and northern England.

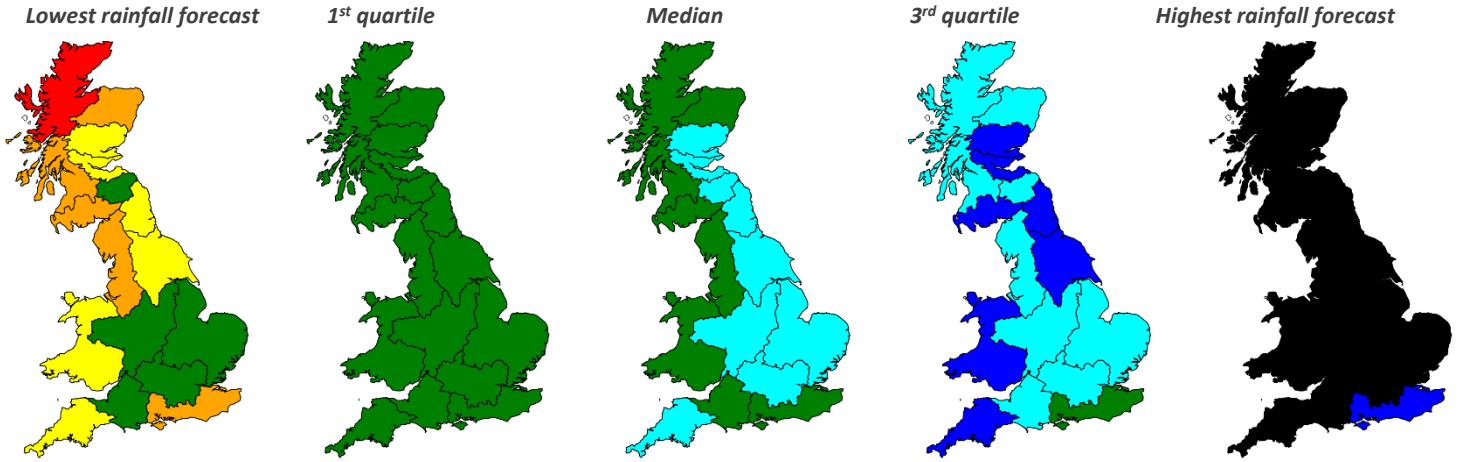
Over the next 3 months river flows across the country are most likely to be *Normal* to *Above normal.*

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.

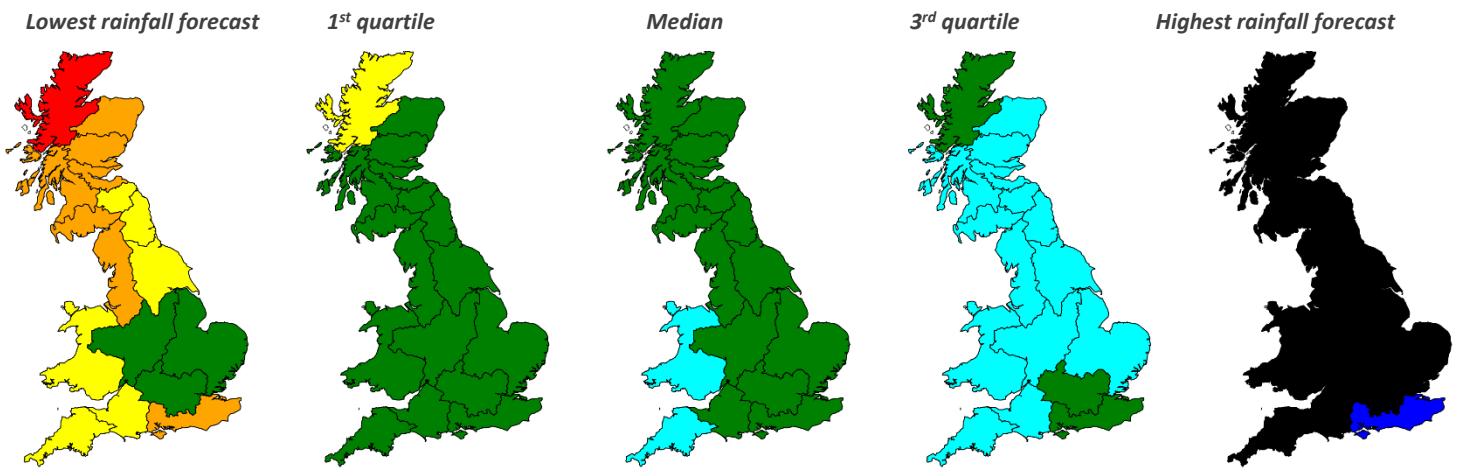
Regional forecast monthly-mean river flows are derived from the average of 1km river flow estimates within each region and ranked in terms of 54 years of historical flow estimates (1963 – 2016).

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.

1-month flow outlook



3-month flow outlook



Key

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

SCOTLAND

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

ENGLAND

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

WALES

WEL	Welsh

NORTHERN IRELAND

This method cannot currently be used in Northern Ireland

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RIVER FLOW FROM RAINFALL FORECASTS

September 2020

UK Centre for Ecology & Hydrology

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

Period: September 2020 – November 2020 Issue date: 04.09.2020

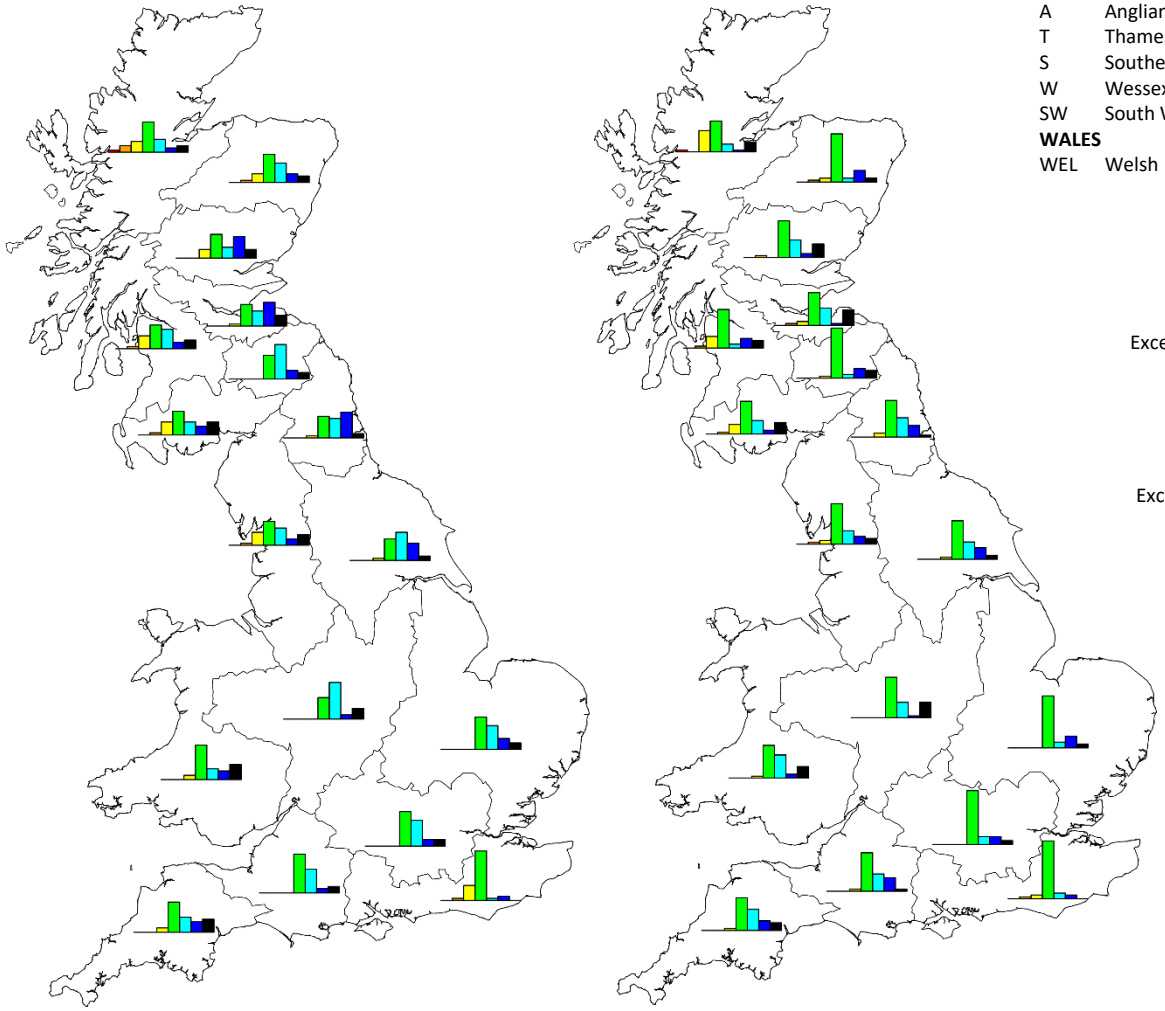
The regional maps illustrating the regional river flows for five members of the Met Office ensemble of rainfall forecasts give some indication of the range of possible river flows in the coming months. As noted previously, the actual flows could be more extreme than the flows generated by either the 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 September, river flows across much of the country are most likely to be in the *Normal range* to *Above normal*. River flows across central and eastern regions (and in the South West) are most likely to be *Above normal*, while *Notably high flows* are likely in some regions across southern Scotland and northern England.

Over the next 3 months river flows across the country are most likely to be *Normal* to *Above normal.*

1-month *3-month*



SCOTLAND

HR	Highlands Region
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WALES

WEL	Welsh

NORTHERN IRELAND
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Percentile range of historic values for relevant month

Exceptionally high flow	> 95
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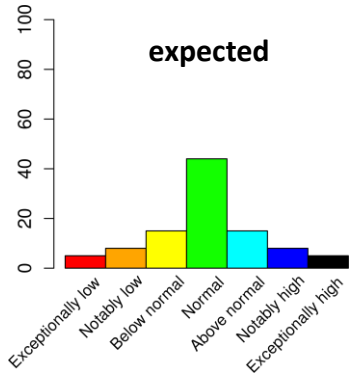

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RIVER FLOW FROM RAINFALL FORECASTS

September 2020

UK Centre for Ecology & Hydrology

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

Period: September 2020 – November 2020 Issue date: 04.09.2020

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 September, river flows across much of the country are most likely to be in the *Normal range* to *Above normal*. River flows across central and eastern regions (and in the South West) are most likely to be *Above normal*, while *Notably high flows* are likely in some regions across southern Scotland and northern England.

Over the next 3 months river flows across the country are most likely to be *Normal* to *Above normal.*

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	9	15	6	15	18	0	9	21	9	6	12	15	9	9	18	12	9
Notably high flow	15	9	35	6	15	6	9	12	6	24	9	32	6	12	12	29	12
Above normal	32	24	26	50	21	3	35	15	32	38	26	21	18	26	18	15	47
Normal range	44	32	29	29	41	68	47	47	53	29	32	29	41	38	32	32	32
Below normal	0	18	3	0	6	21	0	6	0	3	18	3	15	12	18	12	0
Notably low flow	0	3	0	0	0	3	0	0	0	0	3	0	9	3	3	0	0
Exceptionally low flow	0	0	0	0	0	0	0	0	0	0	0	0	3	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	5	8	3	21	11	0	5	16	3	5	11	21	13	5	16	18	11
Notably high flow	16	11	16	3	13	5	11	5	18	16	13	3	3	16	5	5	13
Above normal	8	18	26	21	29	8	11	32	24	24	5	24	11	5	18	24	5
Normal range	71	55	50	55	45	79	74	45	53	53	53	45	42	66	45	50	68
Below normal	0	5	5	0	3	5	0	3	3	3	16	5	29	5	13	0	3
Notably low flow	0	3	0	0	0	3	0	0	0	0	3	3	0	3	3	3	0
Exceptionally low flow	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0

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Outlook based on modelled groundwater level & climate forecast

Overview

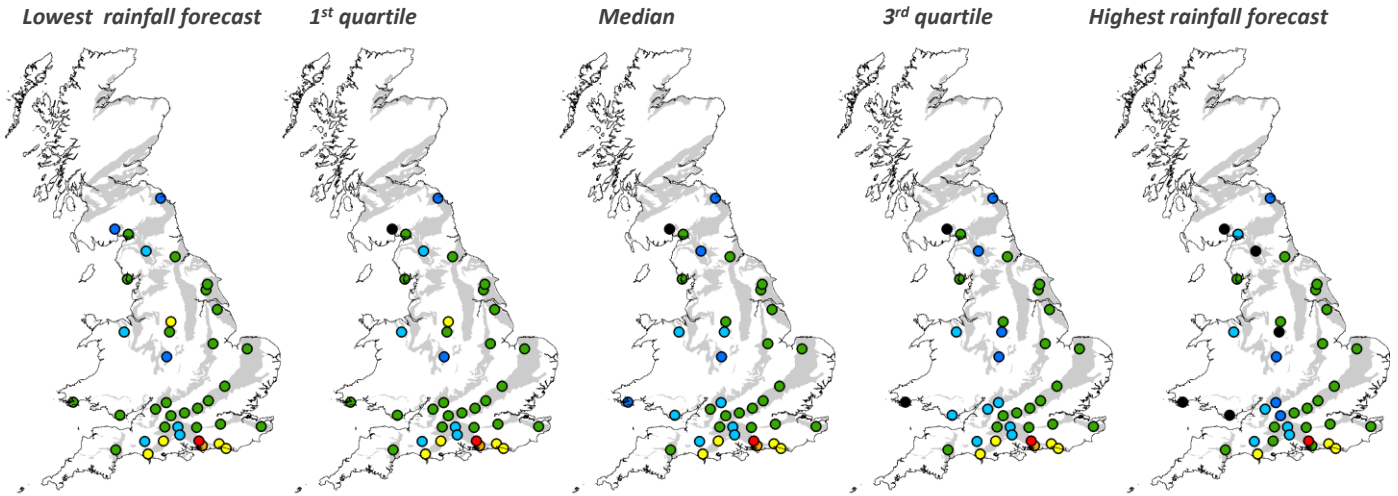
Period: September 2020 – November 2020

Issued on 07.09.2020 using data to the end of August

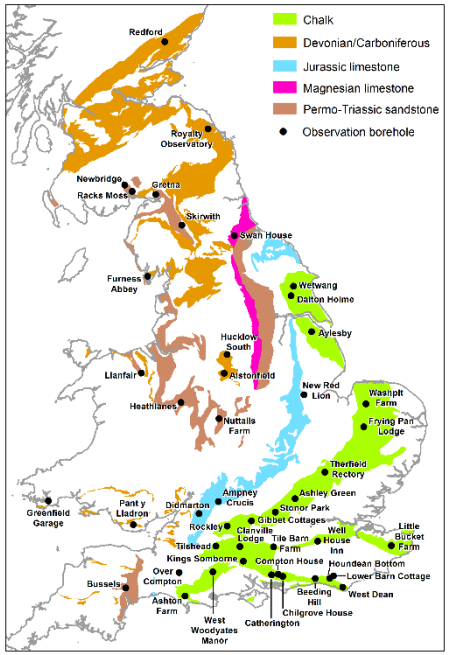
Normal groundwater levels are predicted in the Chalk aquifer of East of England in both the 1 and 3 month forecasts. In the Chalk of the South of England, below normal to exceptionally low levels are predicted in the 1 month forecast, becoming more normal in the 3 month forecast. Elsewhere, groundwater levels are predicted to be above normal in the 1 month forecast, but with localised extremes such as exceptionally high levels in the Permo-Triassic sandstones at Newbridge. 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

September 2020

UK Centre for Ecology & Hydrology

British Geological Survey

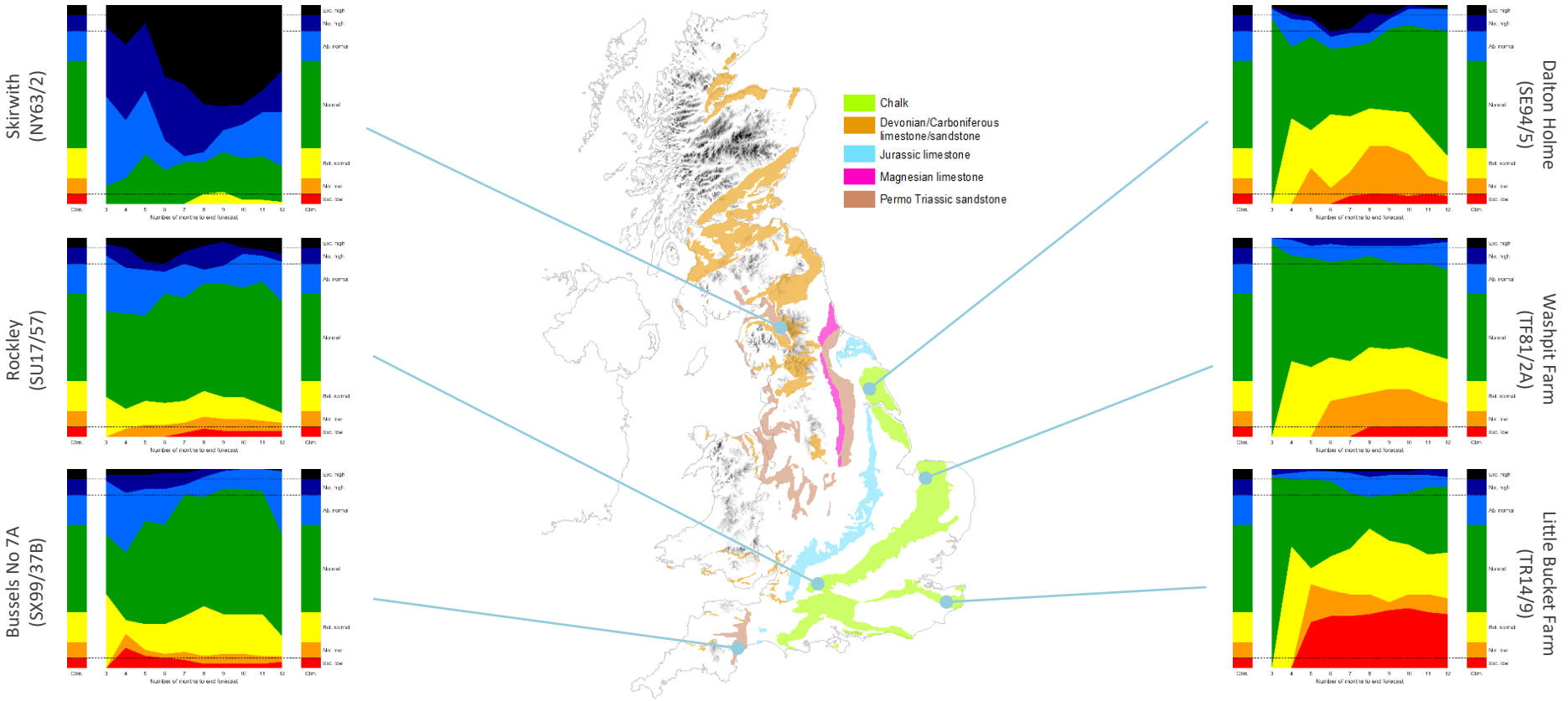
Environment Agency

Outlook based on modelled groundwater from historical climate

Period: September 2020 – August 2021

Issued on 07.09.2020 using data to the end of August

Over the next three to 6 months sites will transition from generally normal conditions to below normal conditions, particularly in the Chalk of the East of England. However, at Skirwith in the Permo-Triassic sandstone above normal to notably high groundwater levels are predicted for the next 12 months.



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

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

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

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