Hydrological Summary

for the United Kingdom

March 2018

General

March heralded an unusually wintry and remarkably cold start to spring 2018. Spells of mild and wet weather were interrupted by two periods of snow, ice and blizzard conditions that brought widespread disruption. Across the UK, monthly mean temperatures generally registered more than 1.5°C below average. A minimum temperature of -10.7°C was recorded at Cawdor Castle (Nairnshire) on the 1st. In contrast with the very dry February, March rainfall for the UK was notably above average, exceptionally so in southern England and the Midlands which received almost twice the average. In contrast, north-west England and western Scotland received less than 75% of the average. River flows were generally above normal with exceptionally high flows recorded in south-west England and south-east Scotland. Conversely, some catchments in western Scotland and Northern Ireland registered around half of the average. Reservoir stocks were above average in all but a few northern impoundments and many in the south continued to recover from the unseasonably low stocks recorded at the beginning of the year (e.g. Bewl was at full capacity by the end of March). Seasonal recovery of groundwater levels continued at most sites and levels were generally in the normal range or higher, apart from in the slower responding Chalk of south-east England. Overall, wet weather late in the recharge season has significantly improved the outlook for the remainder of spring and summer 2018. In localised parts of the Chalk aquifer (e.g. the Chilterns) low groundwater levels and river flows may persist, although current low flows and levels are not exceptional.

Rainfall

An exceptionally cold easterly airflow, which began in late February, continued into early March and brought widespread snow, ice and freezing rain as UK transport networks were severely affected and thousands of schools closed. A deep low-pressure system reached south-west England on the 1st bringing snow showers and a red weather warning was issued for wind and snow in Wales and south-west England. Exceptional snow depths of 55cm in St Athan (South Glamorgan) on the 3rd and 57cm in Little Rissington (Gloucestershire) on the 4th were recorded and significant snow drifts on higher ground were reported (up to 3m on Exmoor). As temperatures rose, homes in Wales, southern England, the Midlands and Scotland faced water supply problems; at its peak over 20,000 homes in London were left without water. Low pressure systems dominated mid-month; 70.6mm was recorded at Trassey Slievenaman (County Down) on the 14th. An easterly airflow returned on the 17th, bringing snow and ice once again, albeit less severe than at the start of the month. After a brief dry spell, unsettled weather returned for the remainder of the month. For March overall, most regions in England received over 150% of average rainfall, with South West England and Wessex receiving over 190%, ranking as the fifth wettest March on record (both in series from 1910). In contrast, Scotland and North West England received less than 75% of average. For the winter half-year (October-March), the UK received marginally below average rainfall with areas of central Scotland receiving less than 70% of the long-term average.

River flows

Flows generally started the month below average and in some cases remained low during the first week of the month approaching the daily minima (e.g. the Nevis). Elsewhere, unsettled conditions led to increased flows; 15 Flood Warnings were issued in south-west England and property flooding was reported in Penzance on the 2nd due to high river levels and high tides and new daily flow maxima were recorded in eastern Scotland (e.g. the Whiteadder on the 6th). The slow thaw meant that, for the most part, rivers were capable of absorbing snow melt and by mid-month flows were largely in recession. River flows increased towards month-end across the UK in response to heavy rainfall and new daily flow maxima were recorded across the country. For March, monthly mean flows were generally above normal and the March outflows from England & Wales were amongst the highest in the last 35 years (in a series from 1961). Flows in south-west England were notably high or exceptional, with the highest March average flows recorded on the Tone, Exe and Warleggan (in records greater than 45 years). In contrast, flows in some catchments in Northern Ireland and western Scotland were below normal; the Ewe, Carron, Ness and Nevis all registered less than half of the March average. For the winter half-year (October-March), flows were generally within the normal range, with above normal flows recorded in south-west England, south Wales, northern England and Northern Ireland and notably high flows for the Ribble and Bush. Below normal flows were registered in northern Scotland, notably so on the Scottish Dee, and in some groundwater influenced catchments of south-east England.

Groundwater

The above average rainfall and near-zero soil moisture deficits in March meant the delayed seasonal recovery of groundwater levels continued at a majority of sites. Levels generally increased throughout the Chalk but declined at boreholes on the South Downs. Levels in the Chalk remained within the normal range for March but were exceptionally high at Ashton Farm and notably high at Wetwang and West Woodyates Manor. Levels remained below average at Stonor Park, Dial Farm and across the North Downs. In the more rapidly responding Jurassic limestones, water levels responded to the March recharge, leading to exceptionally high levels at Ampney Crucis. In the Magnesian limestone levels also generally increased. Levels in the Upper Greensand at Lime Kiln Way continued to rise but remained below normal. In the north-western part of the Permo-Triassic sandstones, levels fell at Newbridge and stabilised at Skirwith (reflecting the lower rainfall in March in these areas) but remained well above average. Elsewhere, levels generally rose but remained in the normal range or below, with the exceptions of Bussels No. 7A where they became notably high and Nuttalls Farm where levels fell. Levels remained in the normal range or below in the Midlands and north-east Wales. In the rapidly responding Carboniferous Limestone levels rose during March to above normal, exceptionally so at Pant y Lladron. In the Fell Sandstone at Royalty Observatory, levels increased and were above normal for the time of year.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

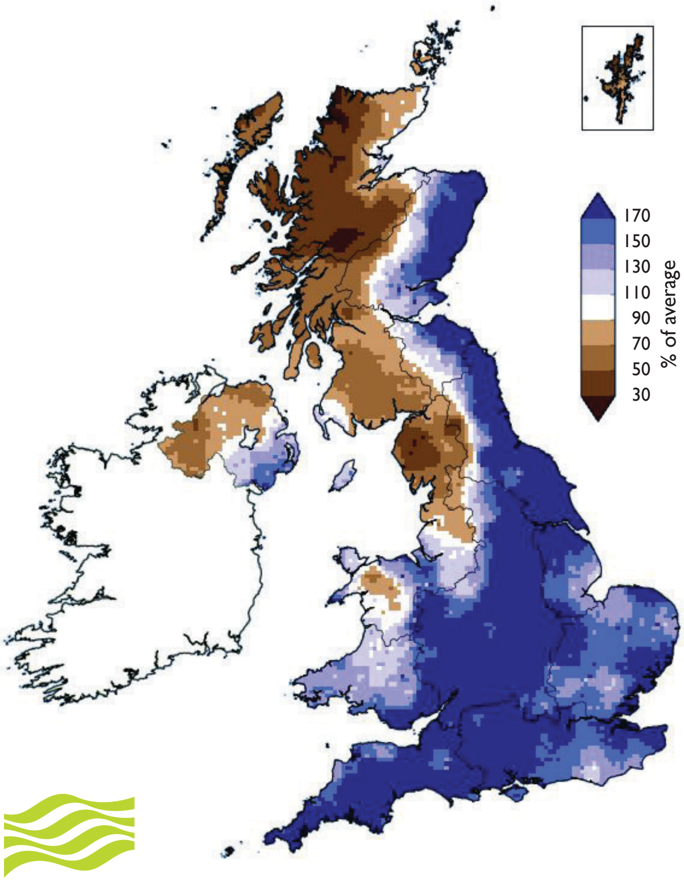
Region	Rainfall	Mar 2018	Jan18 – Mar18	RP	Oct17 – Mar18	RP	Jul17 – Mar18	RP	Apr17 – Mar18	RP
United Kingdom	mm	**104**	302		629		960		1166	
	%	**112**	101	2-5	95	2-5	105	2-5	103	2-5
England	mm	**102**	237		458		723		885	
	%	**162**	116	2-5	97	2-5	108	2-5	105	2-5
Scotland	mm	**99**	373		848		1248		1523	
	%	**72**	85	2-5	91	2-5	98	2-5	100	2-5
Wales	mm	**151**	420		858		1291		1525	
	%	**133**	112	2-5	99	2-5	111	5-10	107	2-5
Northern Ireland	mm	**86**	331		648		1046		1242	
	%	**90**	112	5-10	101	2-5	115	20-30	109	10-15
England & Wales	mm	**109**	263		513		801		973	
	%	**156**	115	2-5	98	2-5	109	2-5	105	2-5
North West	mm	**74**	291		711		1122		1347	
	%	**75**	94	2-5	100	2-5	112	5-10	110	5-10
Northumbria	mm	**104**	249		484		744		937	
	%	**157**	116	2-5	102	2-5	108	2-5	107	2-5
Severn-Trent	mm	**105**	222		412		655		797	
	%	**185**	123	2-5	100	2-5	109	2-5	102	2-5
Yorkshire	mm	**110**	248		442		720		904	
	%	**171**	120	5-10	96	2-5	109	2-5	107	2-5
Anglian	mm	**74**	166		311		513		662	
	%	**169**	122	2-5	99	2-5	108	2-5	106	2-5
Thames	mm	**93**	196		366		601		727	
	%	**182**	117	2-5	94	2-5	108	2-5	101	2-5
Southern	mm	**99**	231		419		662		802	
	%	**171**	117	2-5	89	2-5	103	2-5	100	2-5
Wessex	mm	**132**	265		503		757		899	
	%	**197**	119	2-5	97	2-5	107	2-5	102	2-5
South West	mm	**185**	404		733		1096		1281	
	%	**194**	123	5-10	97	2-5	109	2-5	104	2-5
Welsh	mm	**150**	406		823		1235		1461	
	%	**138**	114	2-5	100	2-5	110	5-10	107	2-5
Highland	mm	**79**	394		1034		1463		1777	
	%	**46**	71	2-5	90	2-5	96	2-5	98	2-5
North East	mm	**105**	219		496		789		1016	
	%	**133**	86	2-5	86	2-5	97	2-5	100	2-5
Tay	mm	**132**	339		645		964		1209	
	%	**111**	86	2-5	79	5-10	87	2-5	90	2-5
Forth	mm	**114**	326		607		914		1170	
	%	**109**	97	2-5	85	2-5	93	2-5	97	2-5
Tweed	mm	**109**	304		556		851		1071	
	%	**135**	115	5-10	95	2-5	103	2-5	104	2-5
Solway	mm	**94**	411		865		1334		1630	
	%	**75**	103	2-5	97	2-5	108	5-10	110	10-20
Clyde	mm	**108**	488		1048		1550		1855	
	%	**65**	93	2-5	94	2-5	101	2-5	102	2-5

% = percentage of 1981-2010 average *RP = Return period*

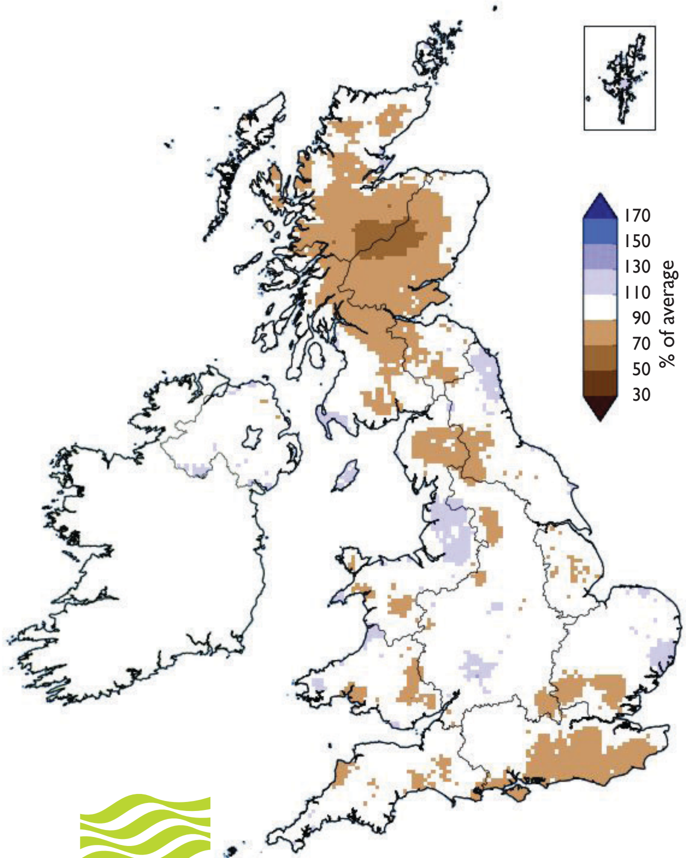
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals since January 2017 are provisional.

Rainfall . . . Rainfall . . .

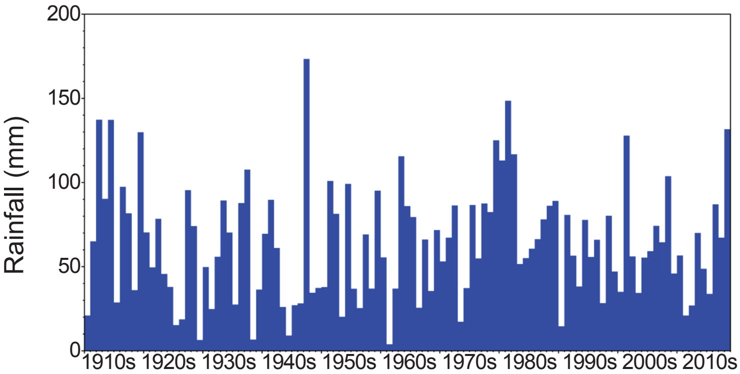
March 2018 rainfall as % of 1981-2010 average



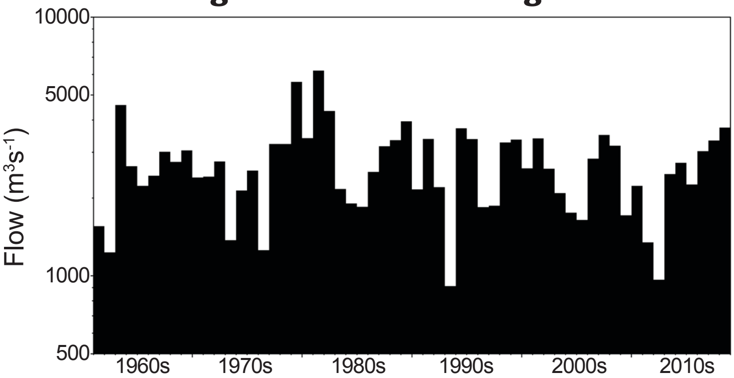
October 2017 - March 2018 rainfall as % of 1981-2010 average



March rainfall totals for Wessex



March average outflows for England & Wales



Hydrological Outlook UK

The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

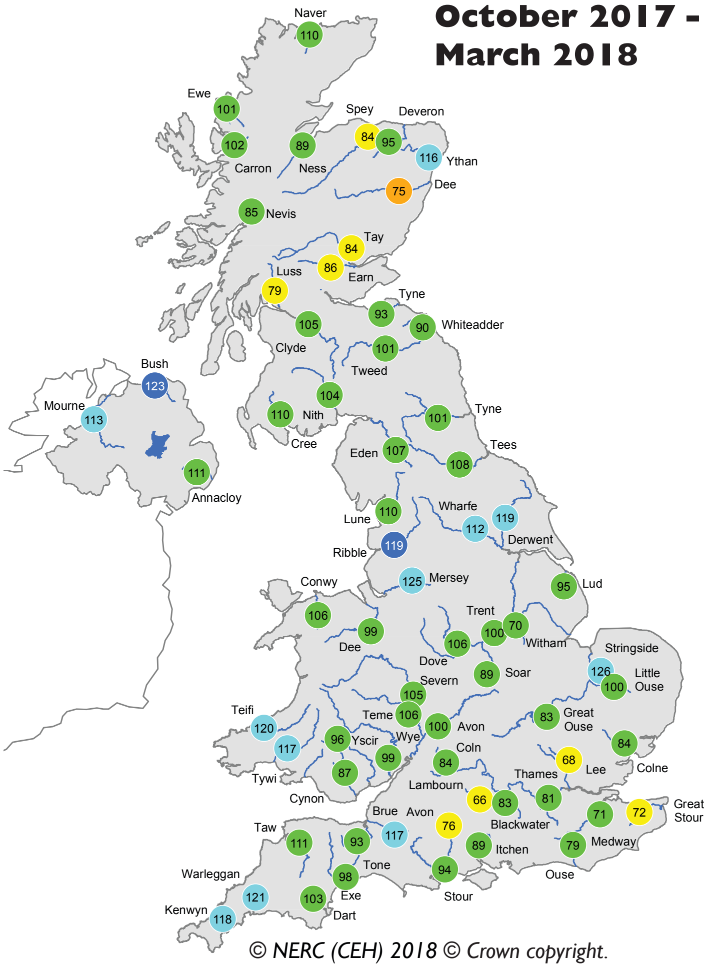
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from April 2018**
Issued: **09.04.2018**
using data to the end of March 2018

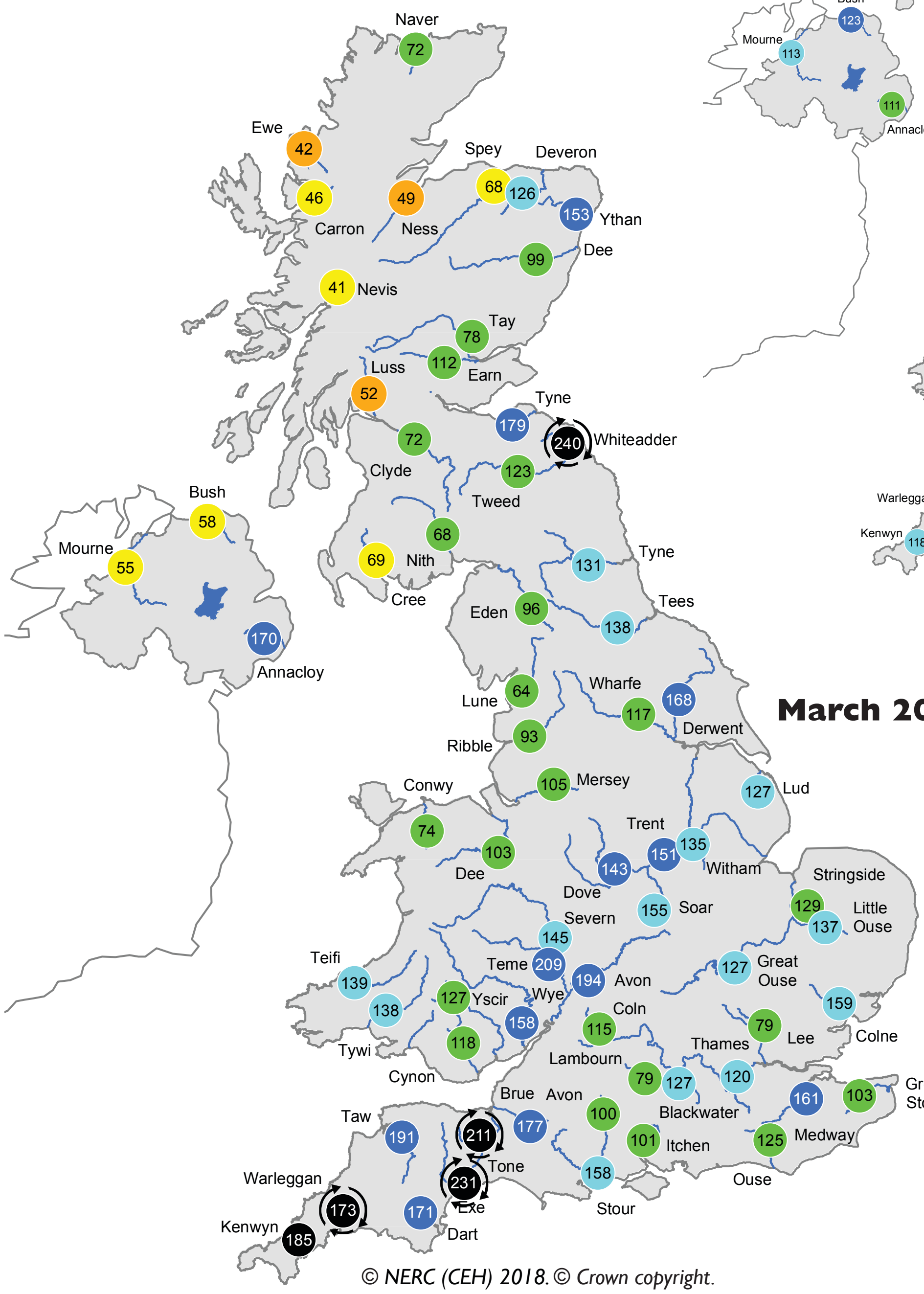
River flows are most likely to be normal in the north-west of the UK, and normal to above normal elsewhere during April and the coming three months. The possible exceptions, where normal to below normal flows are likely, are slowly responding groundwater fed catchments in the Chilterns and Berkshire Downs. Groundwater levels are most likely to be normal for the coming three months except in parts of northern England and southern Scotland where above normal levels are likely to persist.

River flow . . . River flow . . .

October 2017 - March 2018



March 2018



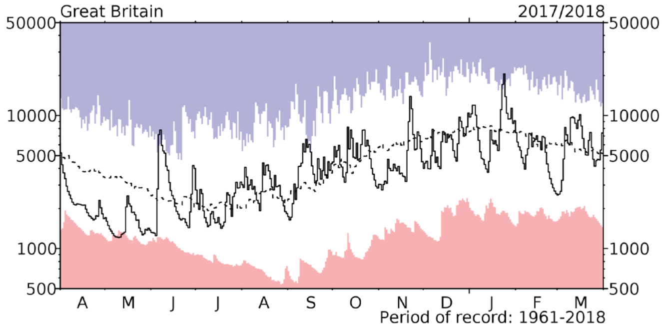
Key

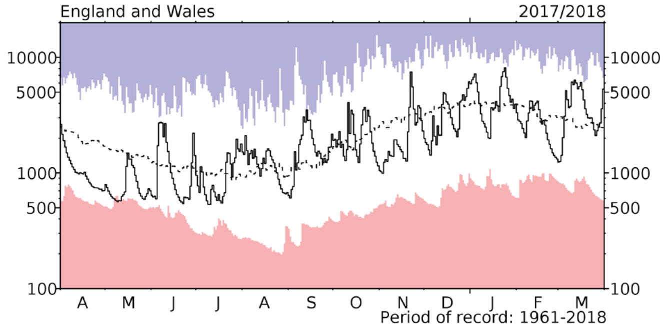
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

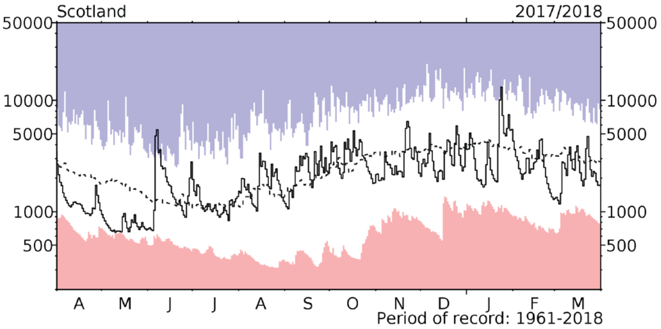
*Based on ranking of the monthly flow**

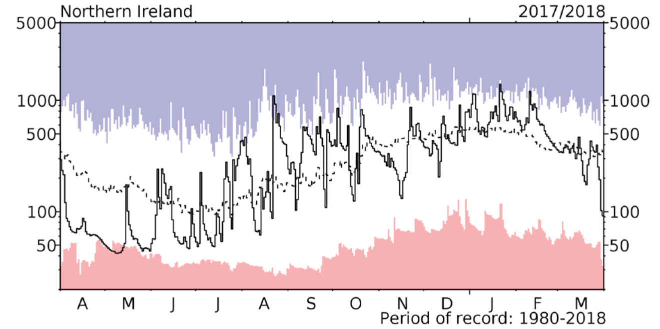
River flows

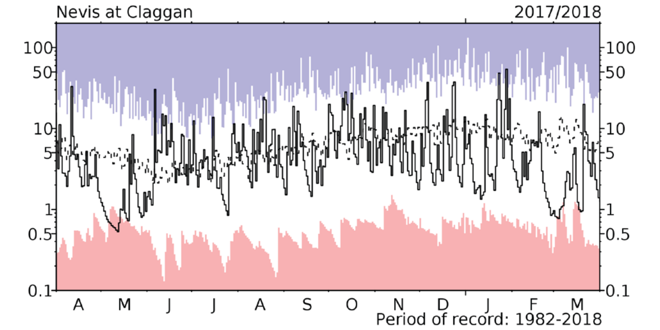
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the averaging period on which these percentages are based is 1981-2010. Percentages may be omitted where flows are under review.

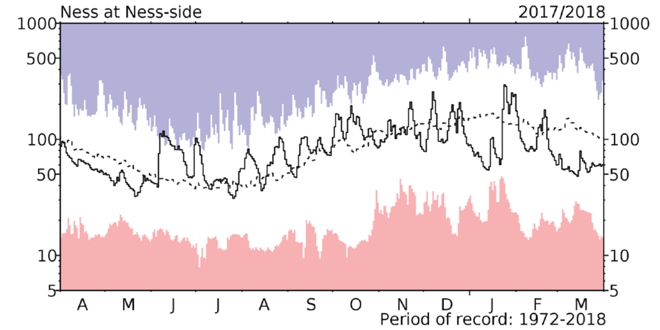


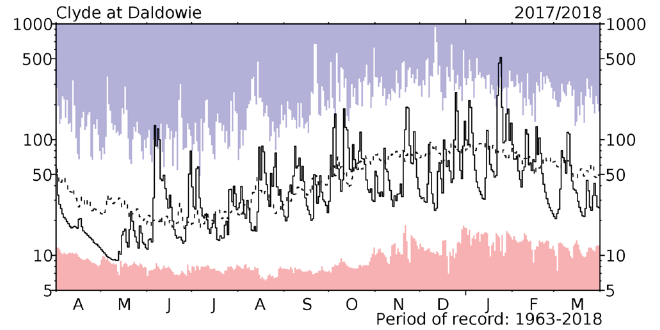


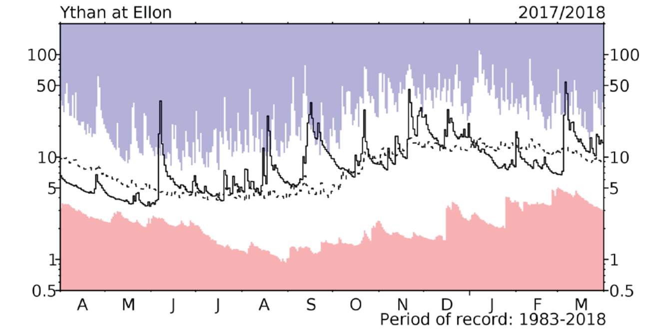


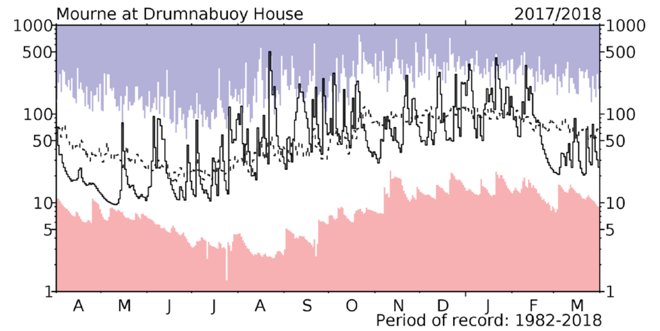


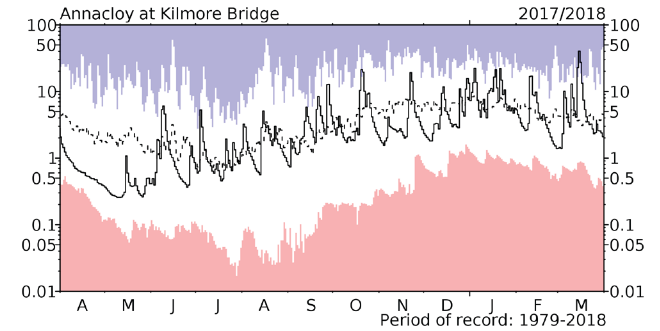








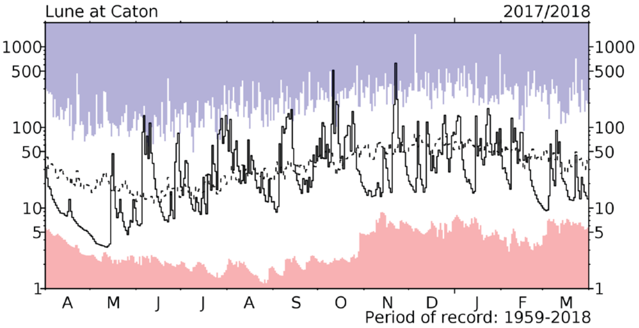


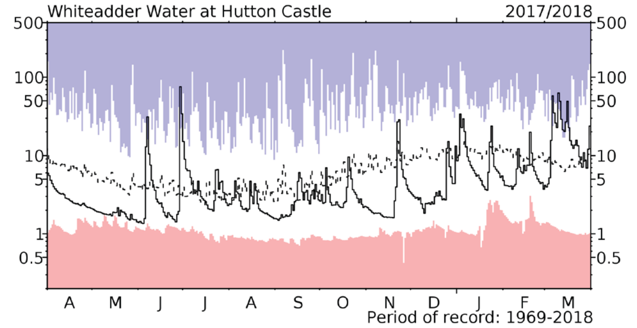


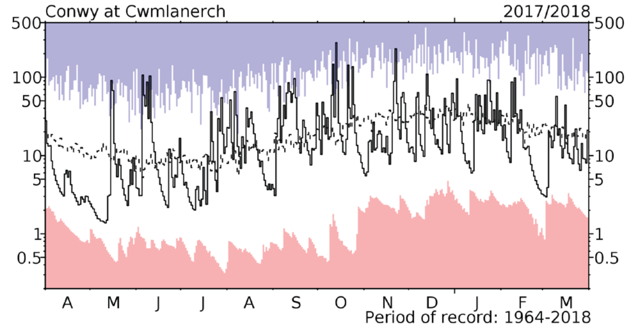
River flow hydrographs

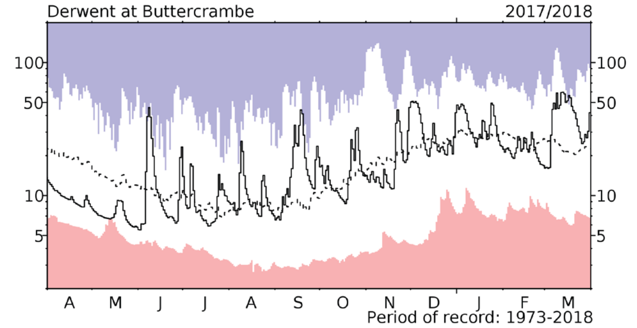
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to April 2017 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

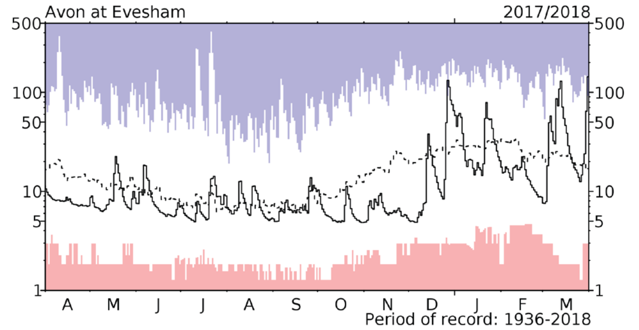
River flow . . . River flow . . .

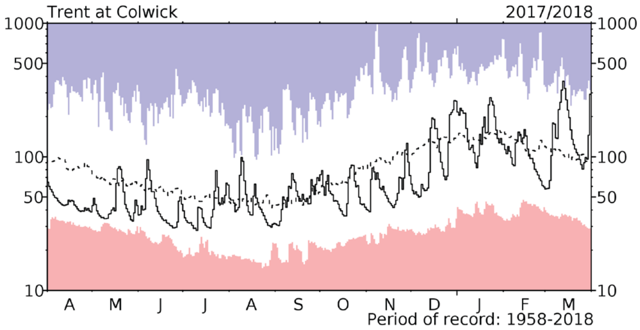


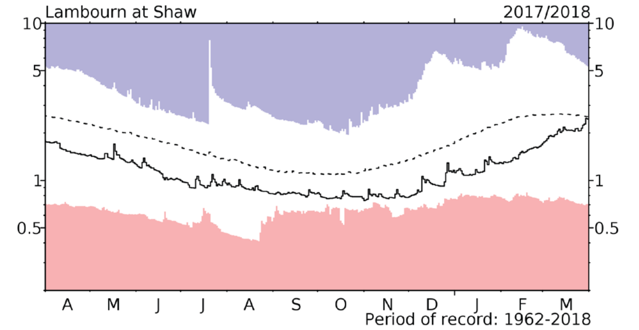


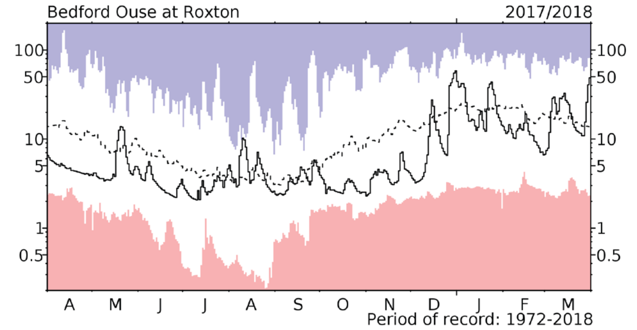


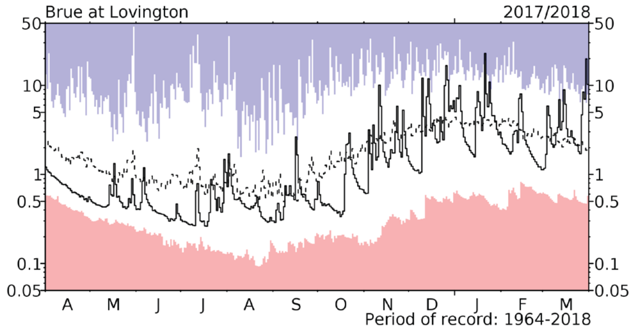


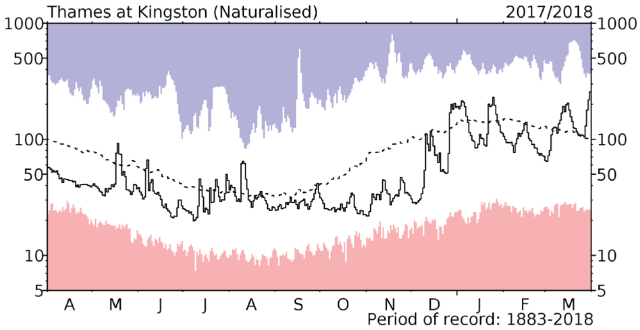


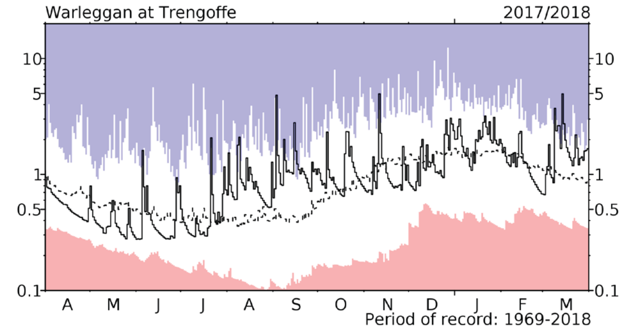


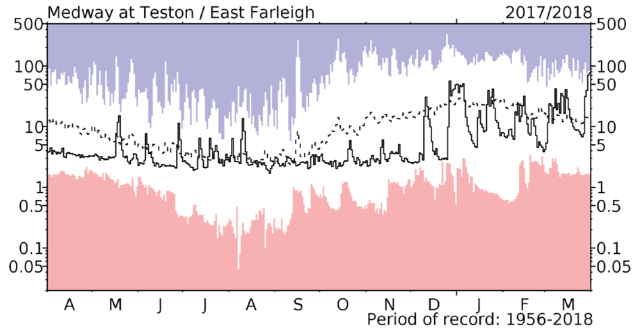




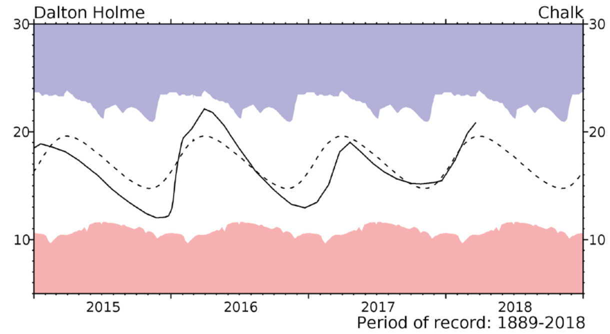


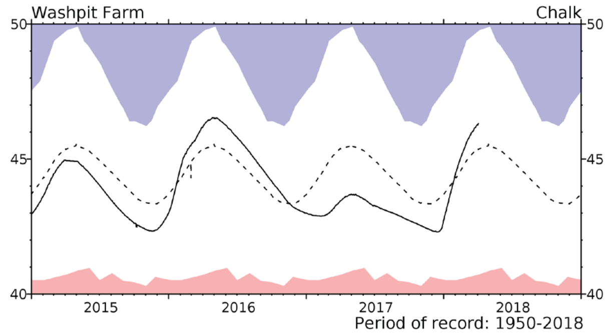


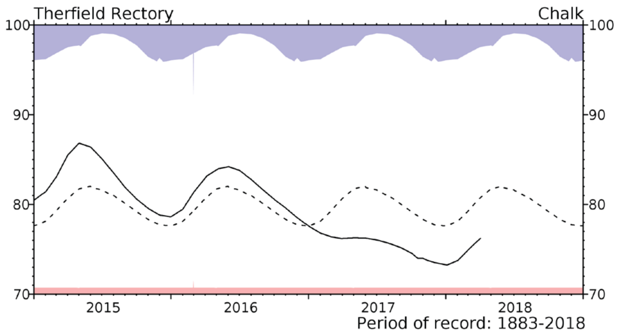


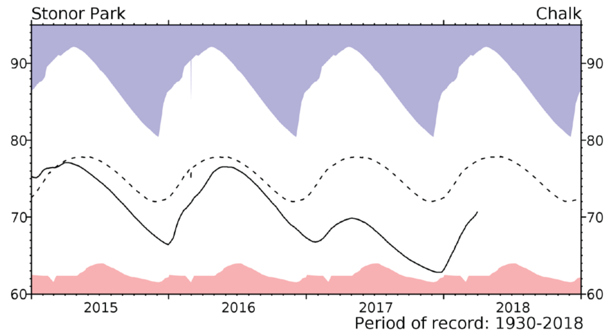


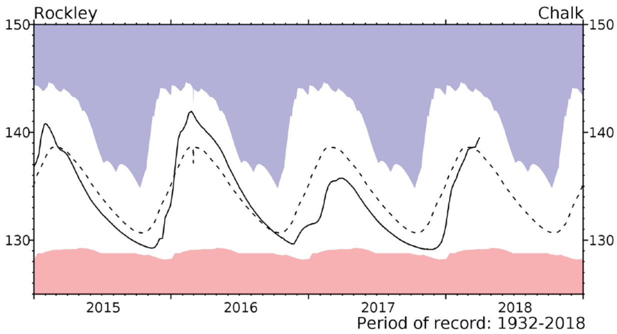
Groundwater . . . Groundwater

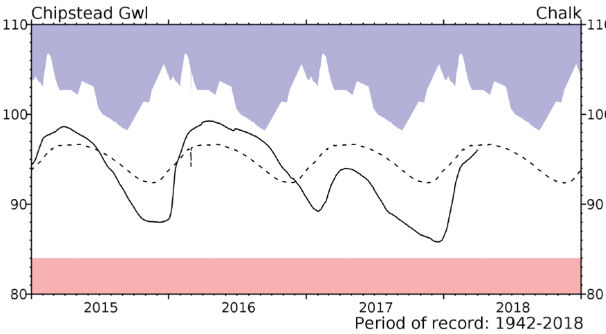


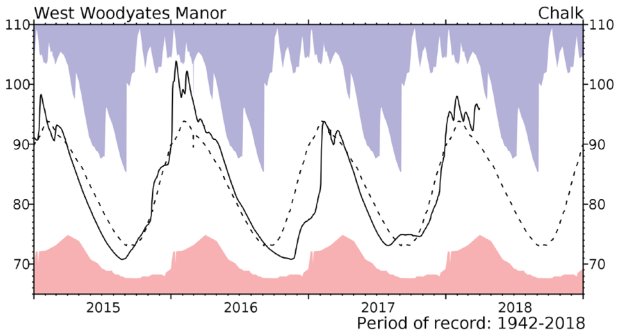


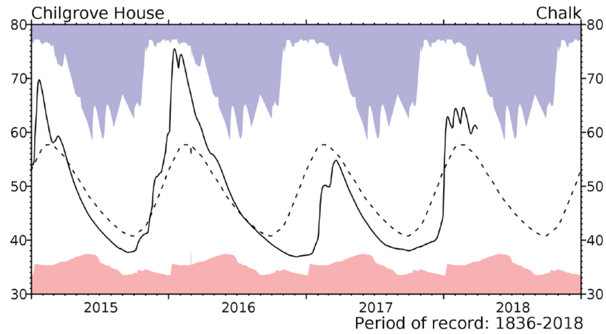


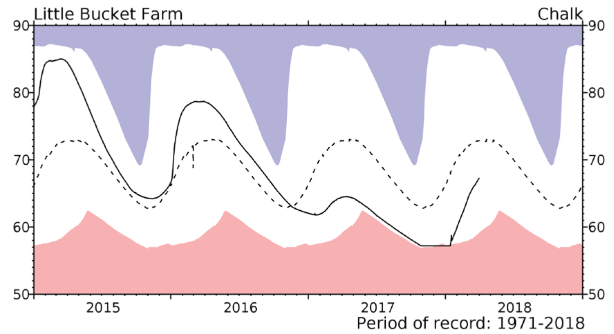


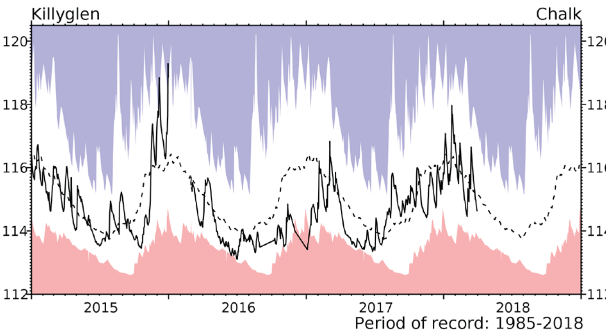






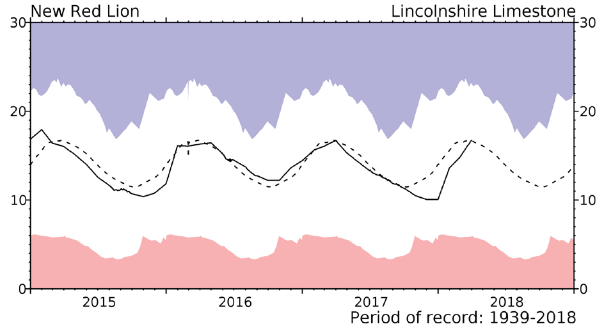




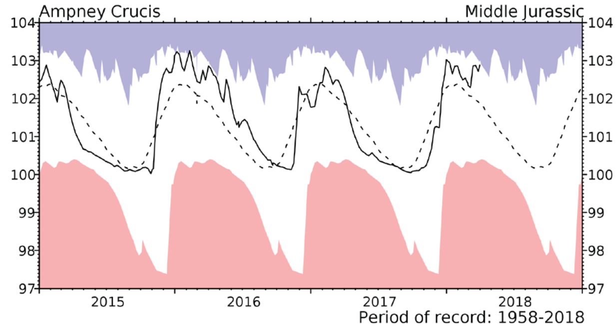


Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation.

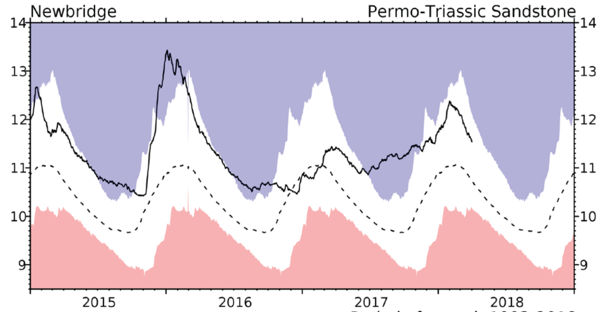
Groundwater... Groundwater



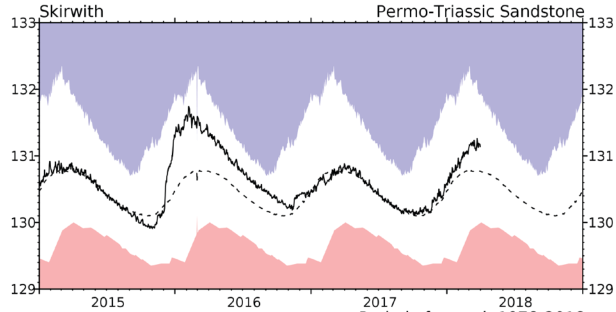
Period of record: 1939-2018



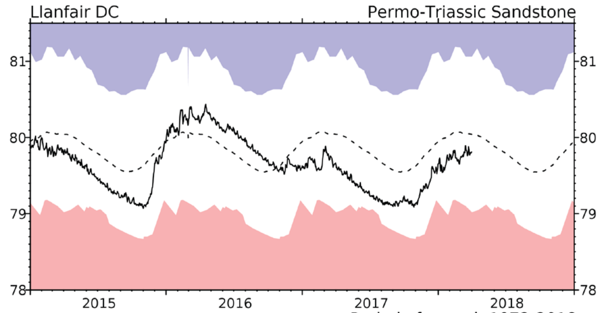
Period of record: 1958-2018



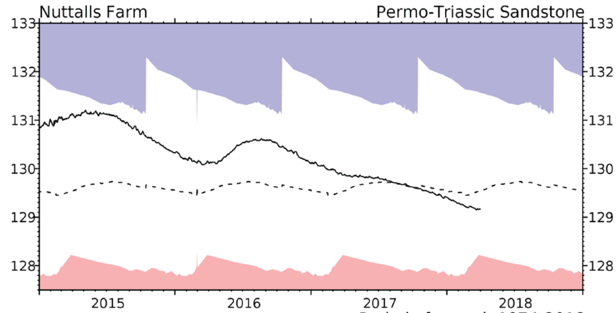
Period of record: 1993-2018



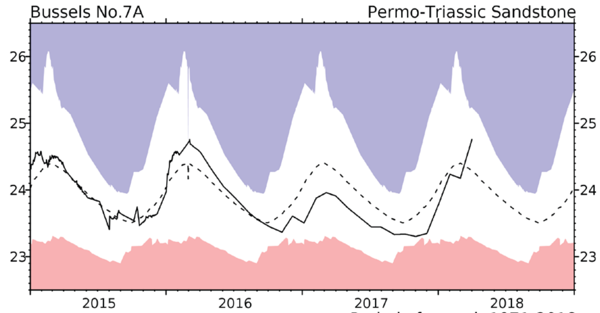
Period of record: 1978-2018



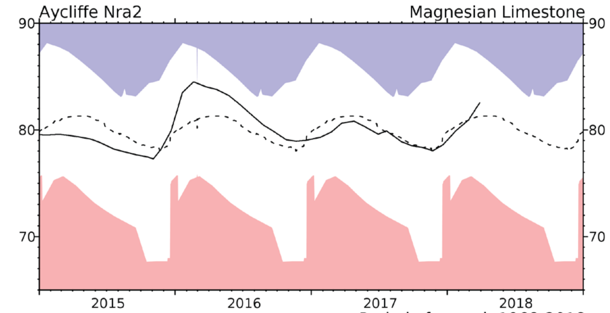
Period of record: 1972-2018



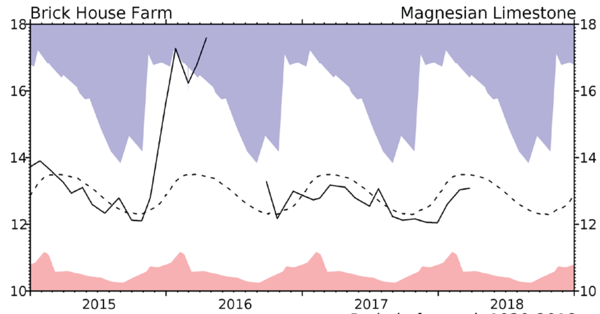
Period of record: 1974-2018



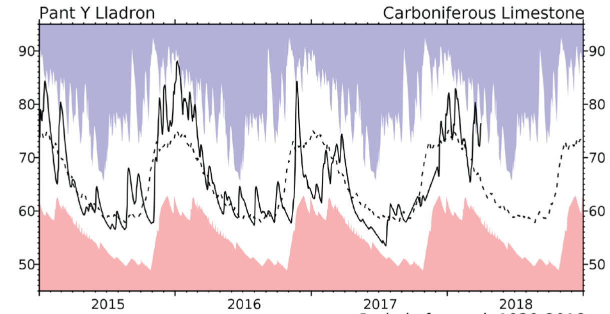
Period of record: 1971-2018



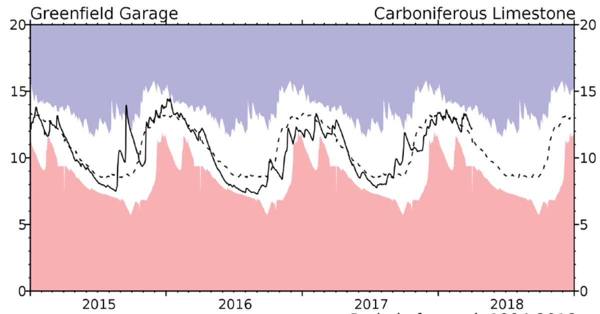
Period of record: 1968-2018



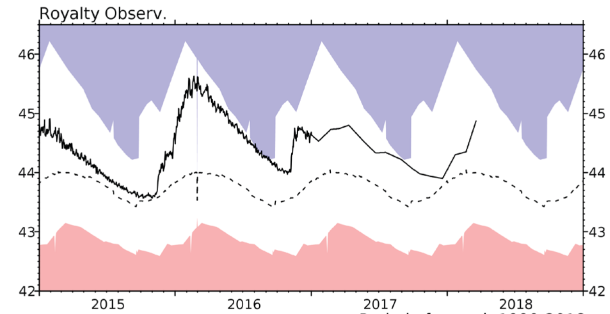
Period of record: 1939-2018



Period of record: 1939-2018

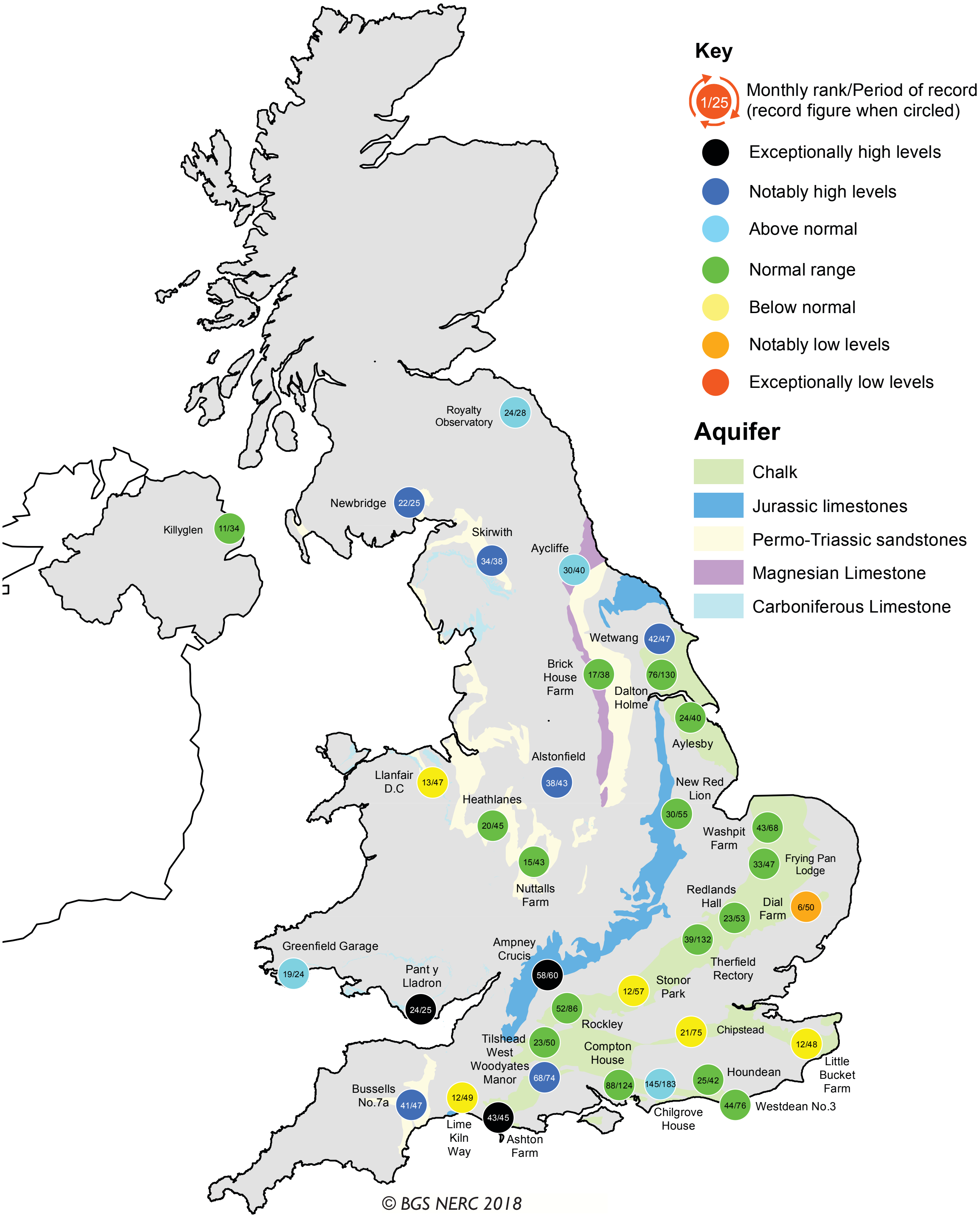


Period of record: 1994-2018



Period of record: 1990-2018

Groundwater...Groundwater

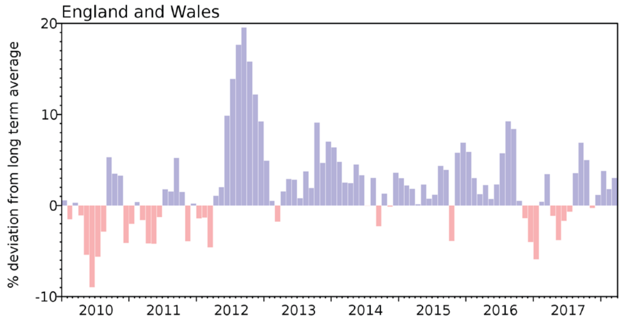


Groundwater levels - March 2018

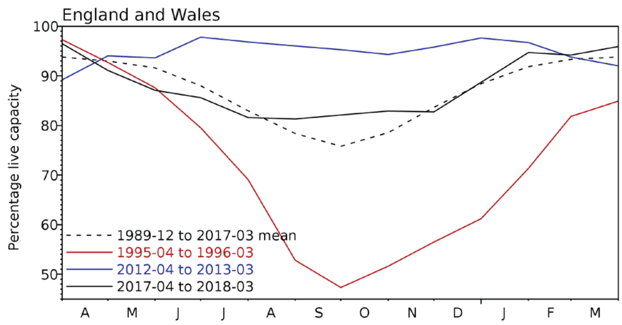
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. The rankings are designed as a qualitative indicator, and ranks at extreme levels, and when levels are changing rapidly, need to be interpreted with caution.

Reservoirs . . . Reservoirs . . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



Percentage live capacity of selected reservoirs at end of month

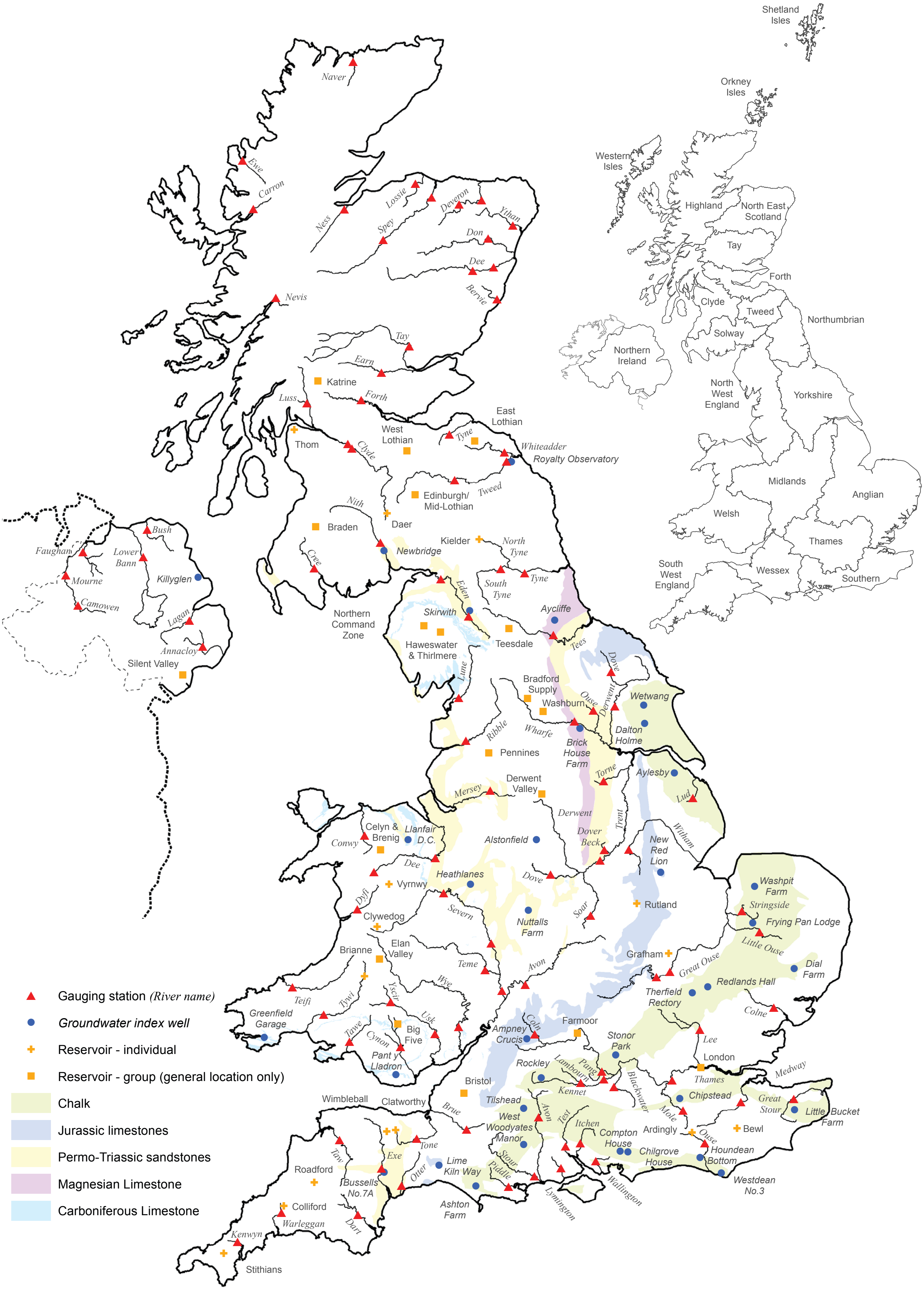
Area	Reservoir		Capacity (Ml)	2018 Jan	2018 Feb	2018 Mar	Mar Anom.	Min Mar	Year* of min	2017 Mar	Diff 18-17
North West	N Command Zone	•	124929	87	86	83	-9	77	1993	98	-16
	Vyrnwy		55146	99	96	100	5	64	1996	100	0
Northumbrian	Teesdale	•	87936	100	97	99	5	77	2003	98	1
	Kielder		(199175)	95	90	91	-1	81	1993	97	-6
Severn-Trent	Clywedog		49936	93	94	100	5	86	1996	99	1
	Derwent Valley	•	46692	100	91	100	4	54	1996	97	3
Yorkshire	Washburn	•	23373	94	96	99	6	70	1996	98	1
	Bradford Supply	•	40942	100	99	99	5	59	1996	95	4
Anglian	Grafham		(55490)	92	96	96	4	77	1997	96	0
	Rutland		(116580)	92	93	95	4	73	2012	97	-2
Thames	London	•	202828	94	95	96	2	88	1990	95	1
	Farmoor	•	13822	95	97	96	2	80	2013	96	0
Southern	Bewl		31000	64	88	100	10	49	2012	79	22
	Ardingly		4685	100	100	100	3	51	2012	100	0
Wessex	Clatworthy		5364	100	100	100	3	82	1992	100	0
	Bristol	•	(38666)	99	98	99	6	71	1992	94	5
South West	Colliford		28540	100	99	100	12	58	1997	95	5
	Roadford		34500	95	90	95	10	37	1996	76	19
	Wimbleball		21320	86	94	100	4	78	1996	93	7
	Stithians		4967	100	100	95	1	52	1992	99	-4
Welsh	Celyn & Brenig	•	131155	98	99	100	2	72	1996	100	0
	Brianne		62140	100	98	100	2	90	1993	100	0
	Big Five	•	69762	93	94	96	0	78	1993	94	2
	Elan Valley	•	99106	100	98	99	2	89	1993	100	-1
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	97	97	99	4	71	1998	92	7
	East Lothian	•	9374	100	100	100	1	95	2012	100	0
Scotland(W)	Loch Katrine	•	110326	100	98	94	2	74	2010	97	-3
	Daer		22412	100	99	91	-6	77	2013	100	-9
	Loch Thom		10798	100	100	100	3	83	2010	97	3
Northern Ireland	Total+	•	56800	99	98	98	8	83	2002	93	6
	Silent Valley	•	20634	100	98	100	13	57	2000	88	12

( ) figures in parentheses relate to gross storage • denotes reservoir groups *last occurrence

+ excludes Lough Neagh

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

Location map... Location map



NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). The NHMP aims to provide an authoritative voice on hydrological conditions throughout the UK, to place them in a historical context and, over time, identify and interpret any emerging hydrological trends. Hydrological analysis and interpretation within the Programme is based on the data holdings of the National River Flow Archive (NRFA; maintained by CEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.
River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru (NRW), the Scottish Environment Protection Agency (SEPA) and, for Northern Ireland, the Department for Infrastructure - Rivers and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (high flow and low flow data in particular may be subject to significant revision).

Details of reservoir stocks are provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The Hydrological Summary and other NHMP outputs may also refer to and/or map soil moisture data for the UK. These data are provided by the Meteorological Office Rainfall and Evaporation Calculation System (MORECS). MORECS provides estimates of monthly soil moisture deficit in the form of averages over 40 x 40 km grid squares over Great Britain and Northern Ireland. The monthly time series of data extends back to 1961.

Rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA, NRW and SEPA. The areal rainfall figures have been produced by the Met Office National Climate Information Centre (NCIC), and are based on 5km resolution gridded data from rain gauges. The majority of the full rain gauge network across the UK is operated by the EA, NRW, SEPA and Northern Ireland Water; supplementary rain gauges are operated by the Met Office. The Met Office NCIC monthly rainfall series extend back to 1910 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM (2005) available at
http://www.metoffice.gov.uk/climate/uk/about/methods

Long-term averages are based on the period 1981-2010 and are derived from the monthly areal series.

The regional figures for the current month in the hydrological summaries are based on a limited rain gauge network so these (and the associated return periods) should be regarded as a guide only.

For further details on rainfall or MORECS data, please contact the Met Office:

Tel: 0870 900 0100
Email: enquiries@metoffice.gov.uk

Enquiries

Enquiries should be directed to the NHMP:

Tel: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:

http://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk

04/2018

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