Hydrological Summary

for the United Kingdom

August 2018

General

For the UK as a whole, August 2018 was fairly typical – rainfall was near-average and it was slightly warmer than average – contrasting with the exceptional June and July. These heatwave-dominated months led to summer 2018 being the joint warmest on record for the UK. Warm, dry conditions extended into early August, as a persistent northward meander of the Jetstream continued to deflect rain-bearing systems to the north. As this pattern broke down, most areas of the country saw welcome rainfall, easing widespread agricultural drought stress and leading to modest river flow responses. Nevertheless, August was dry in some regions (e.g. Yorkshire and North East Scotland) and even in areas with abundant rainfall, soil moisture deficits remained significantly above average. August river flows were generally in the normal range or below, and groundwater levels were mostly in the normal range. While water resource pressures associated with high consumer demand eased as temperatures dropped (the planned temporary use ban for United Utilities was cancelled on the 2nd), reservoir stocks continued to fall and were more than 20% below the late August average in Wales (e.g. 29% below for the Elan Valley) and parts of the Pennines (e.g. 27% below for Derwent Valley). Combined stocks for England and Wales were the fourth lowest for late August in a record from 1988. The impact of the summer 2018 meteorological drought continues to be felt (canals remained closed in parts of northern England due to levels in feeder reservoirs) and water resource concerns remain in some northern and western areas. The outlook for groundwater is generally healthy entering the recharge season. The longer-term water resources outlook will depend on autumn/winter rainfall – current projections slightly favour a dry autumn, but with much uncertainty.

Rainfall

August began with a continuation of the blocked, anticyclonic conditions which have been prevalent since mid-June. The first week was warm and dry for much of the country (with some hot days in southern Britain) but more unsettled and cloudy in some northwestern areas. The onset of westerly airflows in the second week heralded a decisive change to more unsettled and generally cooler weather, which characterised the rest of the month. Downpours around mid-month, often associated with convective activity (e.g. 50mm at Herstmonceux, Sussex on the 10th; 79mm at Spadeadam, Cumbria on the 12th) brought some localised transport disruption (e.g. on the 9th/10th in south-east England). There were further incursions of frontal rainfall through the month, which were occasionally heavy and persistent e.g. across much of the country on the 26th, although there were notable variations in the rainfall received. The August rainfall was near-average (98%) for the UK as a whole, with above average rainfall mainly confined to the far southeast of England (with some coastal areas receiving >150% of average), the far north of England and southern Scotland. Other areas were notably dry: the Yorkshire and North East Scotland regions received 64 and 67% of average respectively, with <50% received in places, adding to existing deficits in these regions. Rainfall for the summer was below average across the UK (<60% of average for large areas of central England); it was the sixth driest summer (June-August) for England & Wales (in a record from 1910). For the North West England and Yorkshire regions it was the fourth driest May-August in records from 1910. For northwest Britain deficits can be traced back to the start of spring and to the start of the year in parts of northern Scotland.

River flows

For much of June and July 2018, most responsive index rivers were in recession and were tracking close to seasonal minima in late July. Widespread downpours in the final days of July triggered rapid increases in flow in the first days of August, before river flows generally receded again through the first week. Thereafter, in responsive catchments river flows increased following episodes of heavy rainfall but generally flows remained well below the seasonal average; flood alerts were rare and localised. Consequently, while August saw modest recovery relative to the previous months, with many catchments in northern and western areas returning to the normal range, mean flows for August were below average for much of the country. August mean flows were less than 60% of average in many catchments in southwest England (e.g. the Taw, 32%), south Wales (e.g. the Teifi, 28%), central England (e.g. the Soar, 45%) and parts of northern England (e.g. the Aire, 51%). The far north and northeast of Scotland saw notably low flows (e.g. the third lowest August mean flow on record for the Naver in a record from 1977). In south-east England mean August flows were largely in the normal range, with flows in many groundwater-fed catchments reflecting the residual effect of the wet spring. For the summer (June-August) as a whole, notably low accumulated flows were registered across western England and Wales, parts of Yorkshire and eastern Scotland (the Spey and Whiteadder registered their lowest summer mean flows in records from 1952 and 1969, respectively). More modest river flow deficits extend back to March across northwest Britain, with some exceptionally low accumulated flows in northern Scotland.

Groundwater

Given August rainfall, soil moisture deficits (SMDs) declined moderately in most regions, but increased in the areas of central and eastern England that were drier in August. While less exceptional than previous months, SMDs were still significantly above average (the mean SMD for England was 30% higher than the late August average). Groundwater levels at all the Chalk index sites receded during August as expected, with the exception of Westdean No.3 and Killyglen where small increases occurred. At month end, levels were generally in the normal range, apart from Frying Pan Lodge where they were below normal and in some eastern boreholes (Aylesby, Washpit Farm, Westdean No.3) where they were above normal. In the more rapidly responding Jurassic and Magnesian limestones levels fell and remain normal for the time of year in the former, and normal to above normal in the latter. Levels in the Upper Greensand at Lime Kiln Way fell and remained in the normal range. In the Permo-Triassic sandstones, levels fell at all sites and were generally in the normal range, but dropped to below average at Llanfair DC and above average at Newbridge. Levels in the rapidly responding Carboniferous Limestone have now returned to the normal range or above, receding at Alstonfield, and rising overall in south Wales during August. At Royalty Observatory, levels declined in the Fell Sandstone but remained above normal.

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

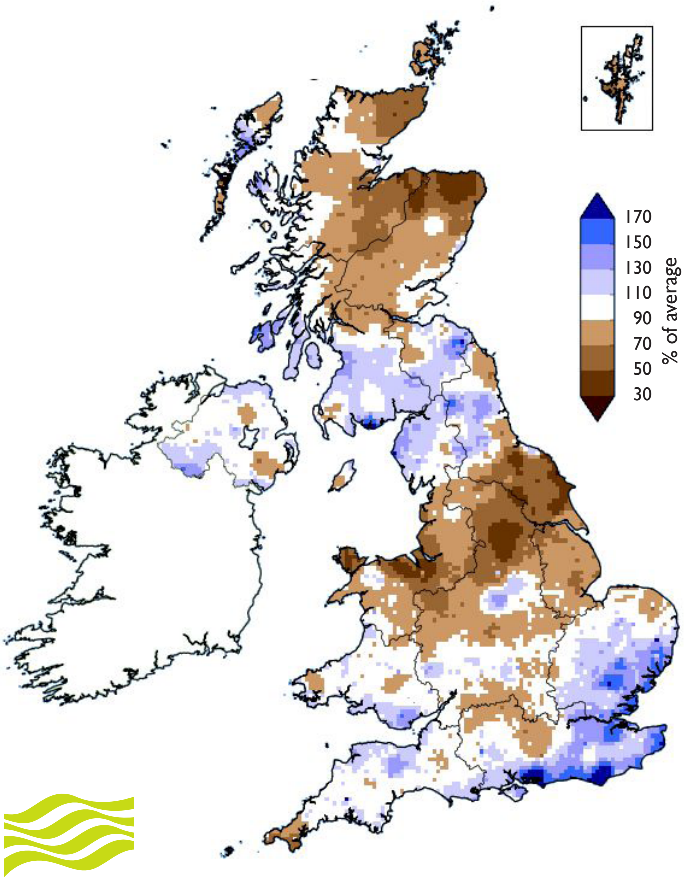
Region	Rainfall	Aug 2018	Jun18 – Aug18	RP	May18 – Aug18	RP	Mar18 – Aug18	RP	Jan18 – Aug18	RP
United	mm	**85**	176		224		415		613	
Kingdom	%	**98**	75	5-10	74	10-20	89	2-5	91	2-5
England	mm	**67**	118		164		347		482	
	%	**98**	62	10-20	66	15-25	94	2-5	95	2-5
Scotland	mm	**107**	260		306		492		766	
	%	**96**	90	2-5	83	5-10	83	5-10	86	2-5
Wales	mm	**102**	184		248		520		789	
	%	**98**	66	8-12	69	10-20	93	2-5	96	2-5
Northern	mm	**102**	232		290		457		702	
Ireland	%	**105**	91	2-5	89	2-5	92	2-5	101	2-5
England &	mm	**72**	127		176		371		525	
Wales	%	**98**	63	10-20	67	15-25	94	2-5	95	2-5
North West	mm	**99**	196		232		401		618	
	%	**98**	73	5-10	68	15-25	79	8-12	86	5-10
Northumbria	mm	**80**	166		194		374		519	
	%	**108**	80	2-5	74	8-12	96	2-5	96	2-5
Severn-Trent	mm	**56**	99		162		348		465	
	%	**87**	53	15-25	66	10-20	97	2-5	96	2-5
Yorkshire	mm	**46**	116		149		348		486	
	%	**64**	58	10-20	59	20-35	92	2-5	93	2-5
Anglian	mm	**58**	91		134		279		371	
	%	**102**	56	10-20	63	10-20	92	2-5	94	2-5
Thames	mm	**57**	83		144		308		412	
	%	**101**	52	10-20	67	8-12	97	2-5	95	2-5
Southern	mm	**77**	114		170		353		485	
	%	**137**	73	5-10	81	2-5	110	2-5	106	2-5
Wessex	mm	**68**	102		152		362		496	
	%	**106**	57	10-20	64	10-20	100	2-5	96	2-5
South West	mm	**87**	142		184		464		684	
	%	**106**	62	8-12	60	15-25	97	2-5	96	2-5
Welsh	mm	**99**	179		242		509		765	
	%	**98**	67	8-12	69	10-20	94	2-5	97	2-5
Highland	mm	**113**	272		324		488		802	
	%	**92**	86	2-5	80	5-10	72	15-25	76	5-10
North East	mm	**54**	158		191		352		466	
	%	**67**	71	5-10	66	15-25	81	5-10	77	15-25
Tay	mm	**80**	224		264		472		679	
	%	**84**	88	2-5	79	5-10	89	2-5	85	2-5
Forth	mm	**82**	217		248		446		658	
	%	**88**	86	2-5	77	5-10	90	2-5	91	2-5
Tweed	mm	**98**	224		255		462		657	
	%	**117**	97	2-5	86	2-5	105	2-5	105	2-5
Solway	mm	**141**	292		341		545		862	
	%	**118**	97	2-5	89	2-5	91	2-5	99	2-5
Clyde	mm	**150**	360		417		632		1013	
	%	**106**	102	2-5	94	2-5	89	2-5	95	2-5

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

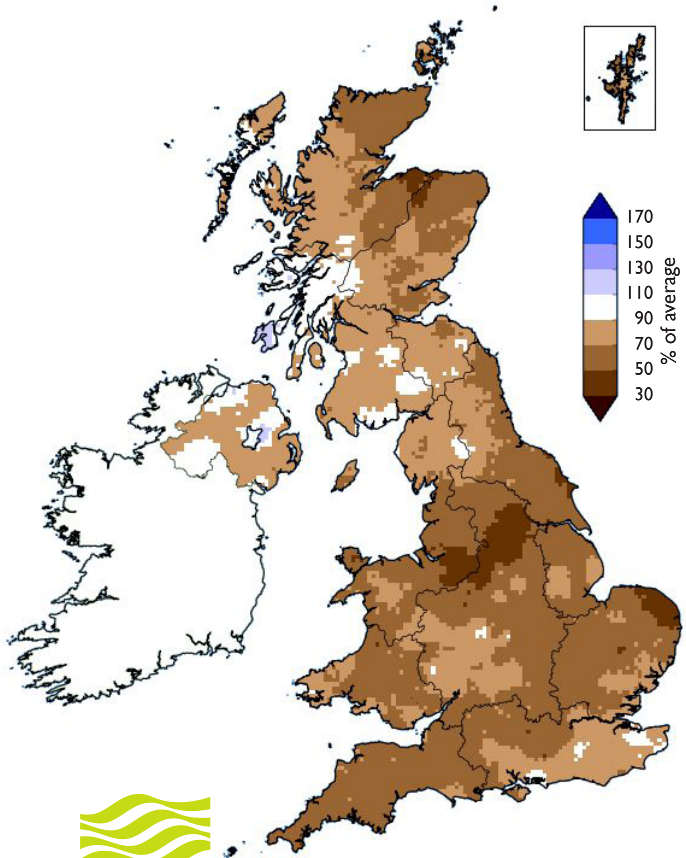
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 2018 are provisional.

Rainfall . . . Rainfall . . .

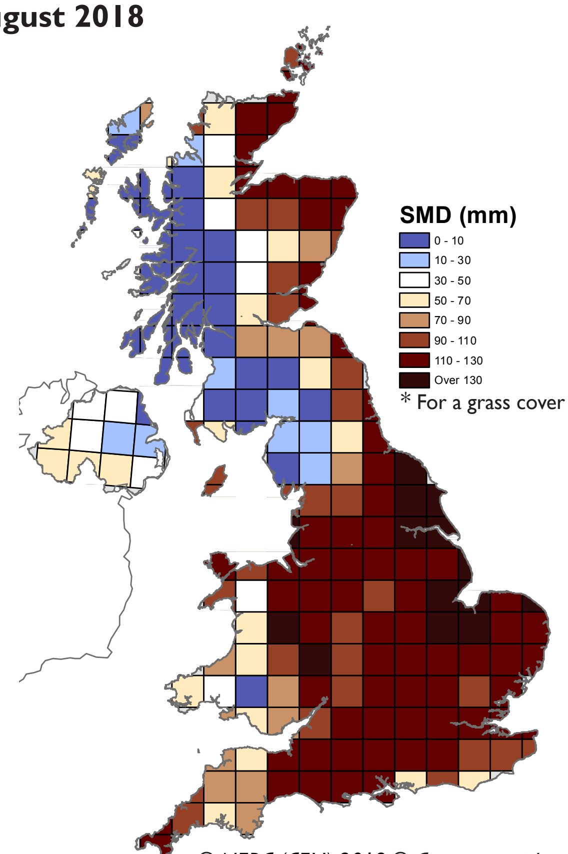
August 2018 rainfall as % of 1981-2010 average



May 2018 - August 2018 rainfall as % of 1981-2010 average



MORECS Soil Moisture Deficits* August 2018



Hydrological Outlook UK

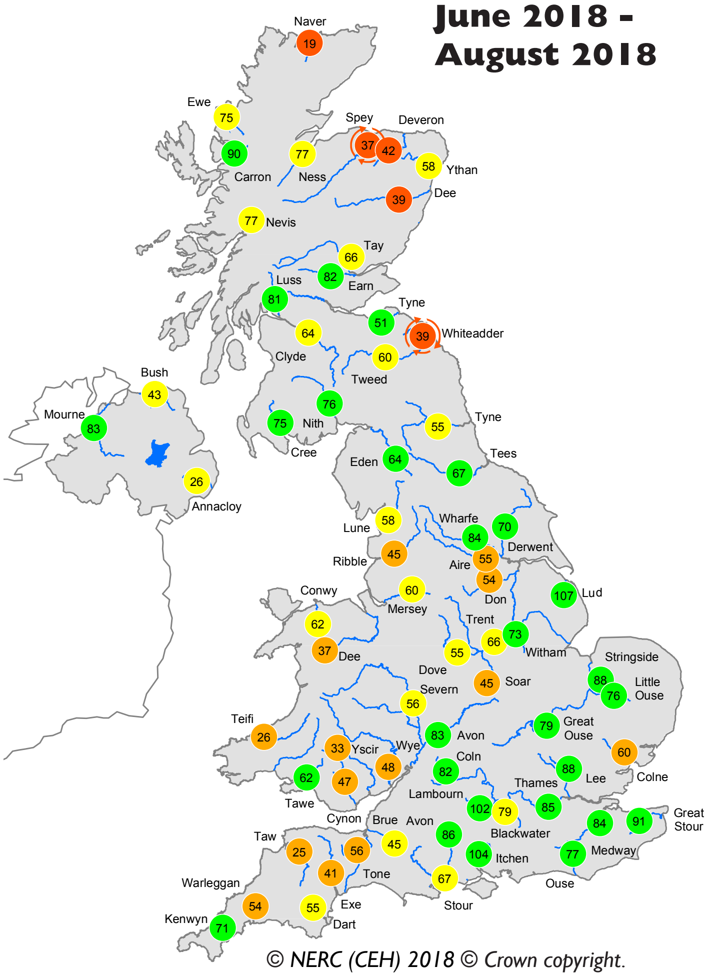
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

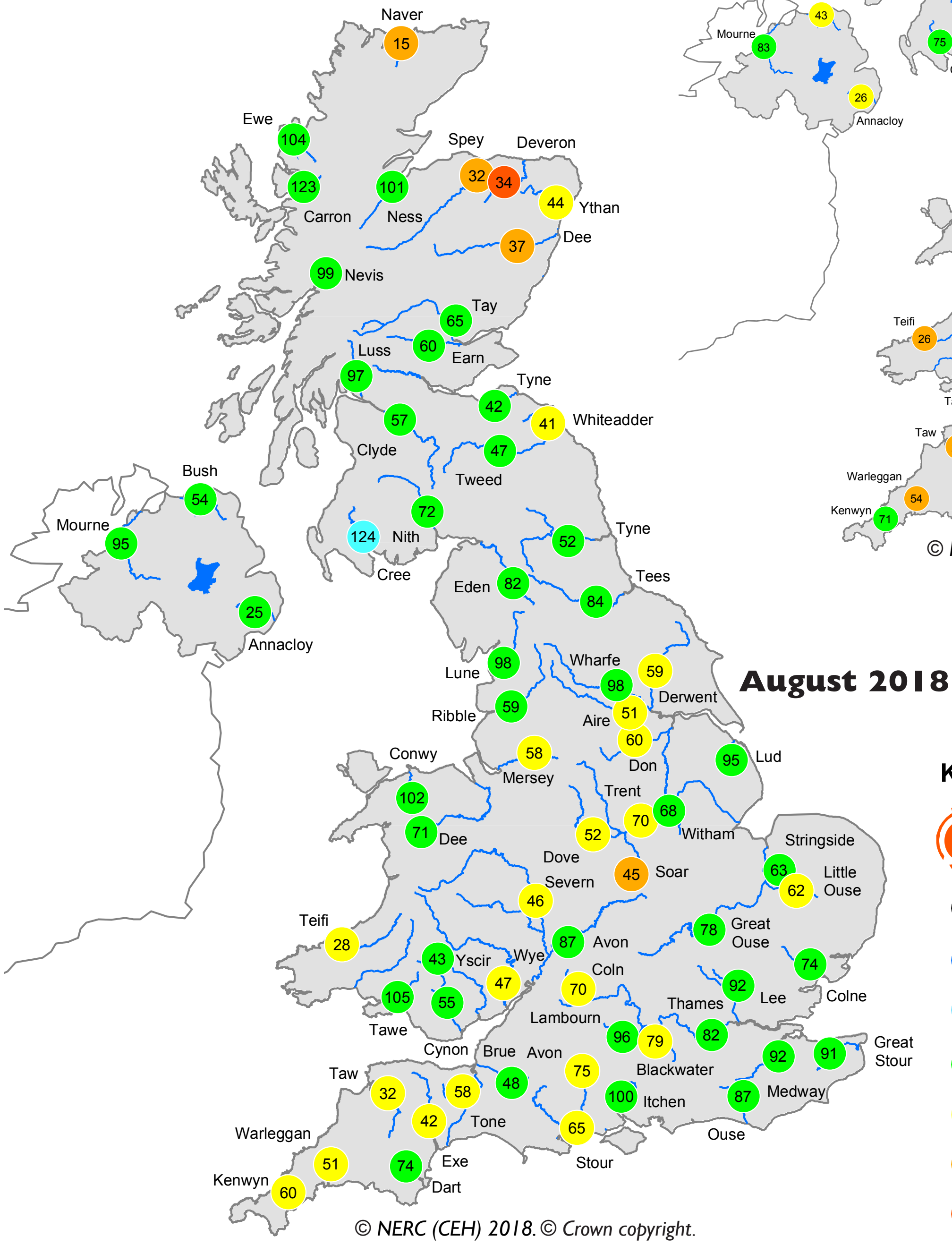
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from September 2018**
Issued: **12.09.2018**
using data to the end of August 2018

The Outlook for September is for river flows to be in the normal range or below normal across most of the UK, with the exception of northeast Scotland where below normal flows are more likely. The outlook is similar for the autumn as a whole, with normal to below normal flows likely across the country. September groundwater levels are most likely to be in the normal range across the country, with a few exceptions, and normal to below normal levels are likely for the autumn. The three month outlook is more uncertain at this transitional time of year, with the timing and magnitude of autumn rainfall being highly influential for the longer-term situation.

River flow . . . River flow . . .





Key

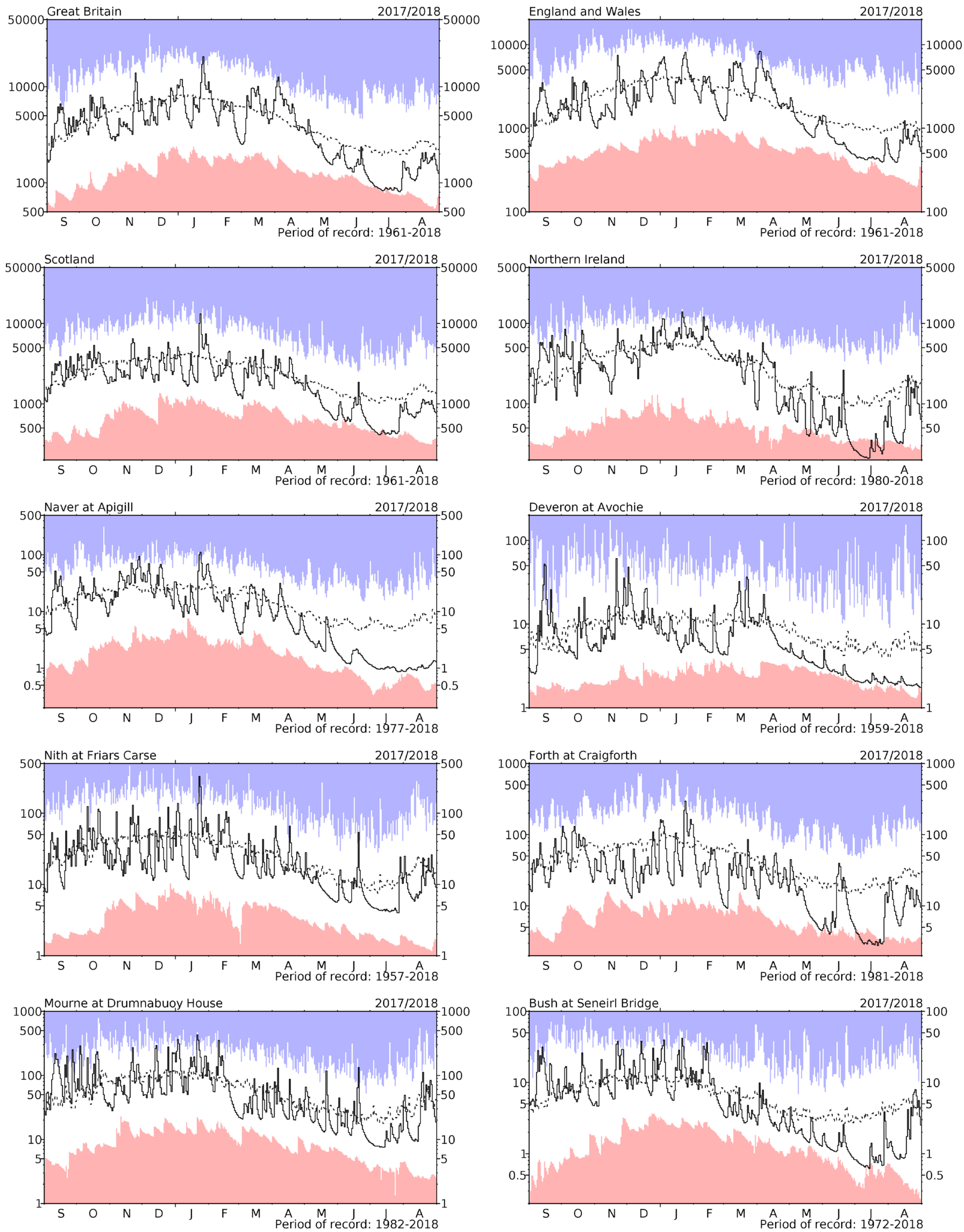
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*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.

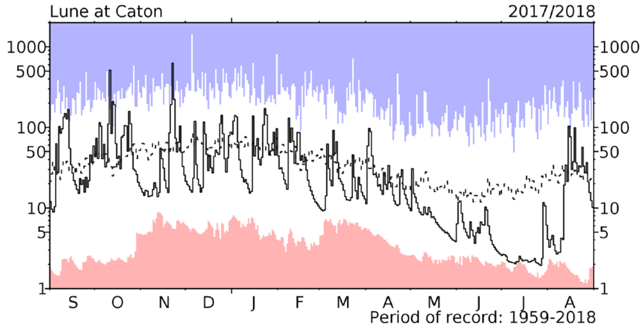
River flow . . . River flow . . .

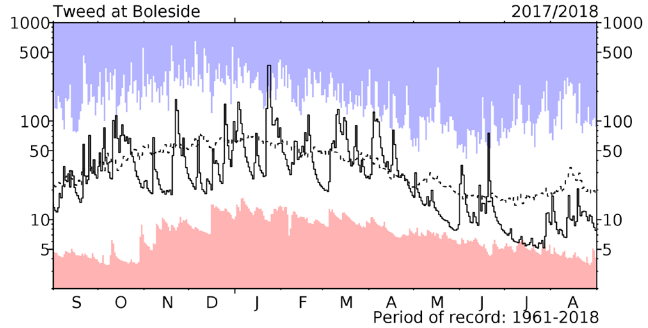


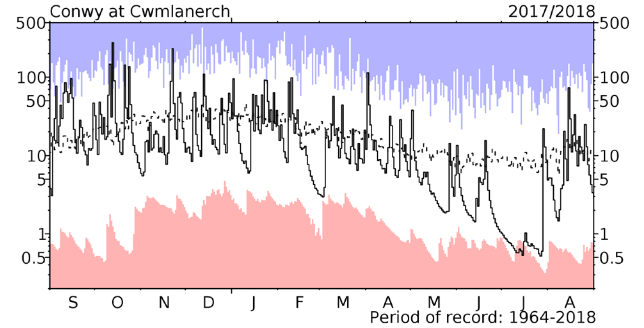
River flow hydrographs

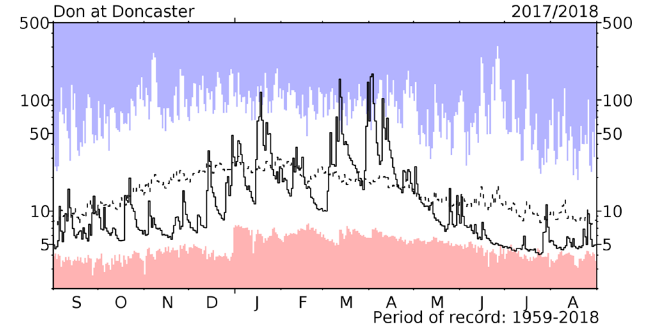
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to September 2017 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

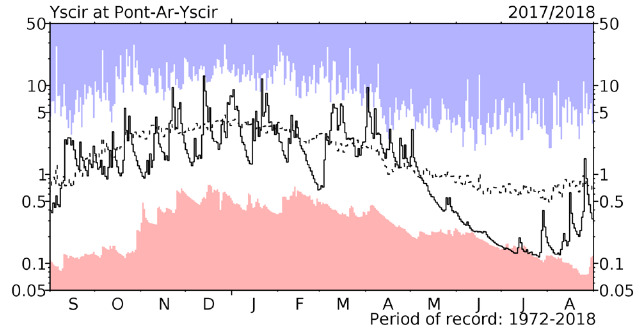
River flow . . . River flow . . .

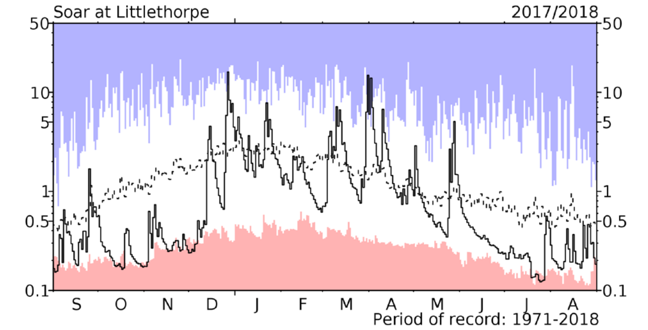


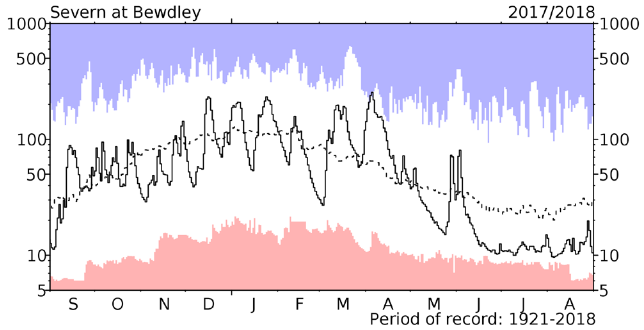


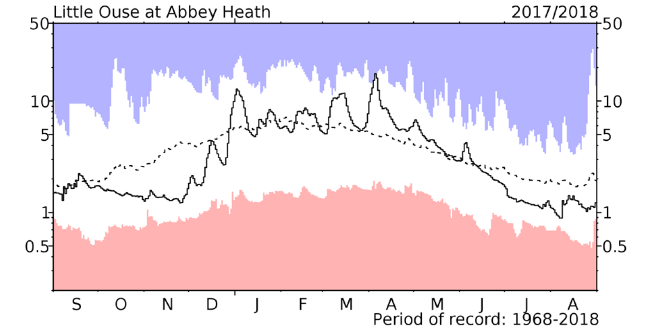


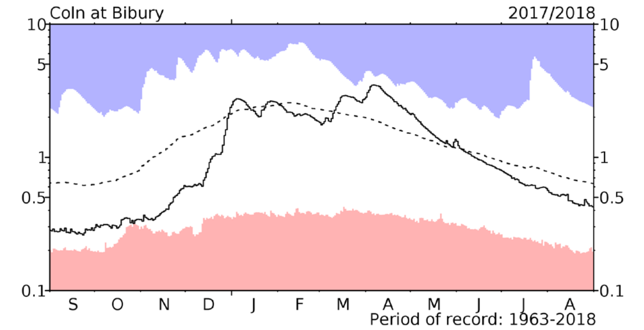


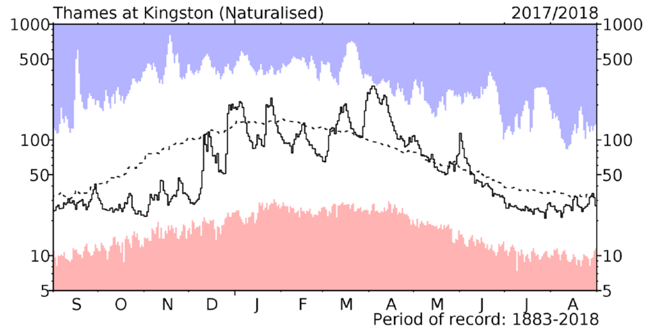


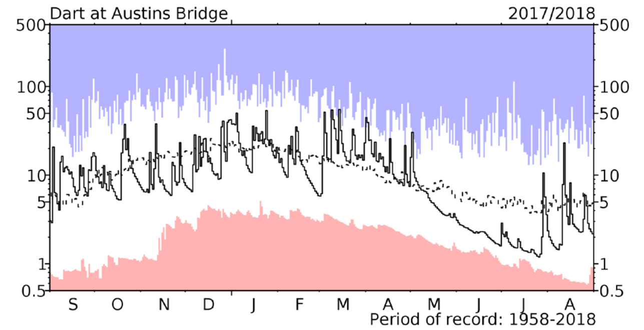


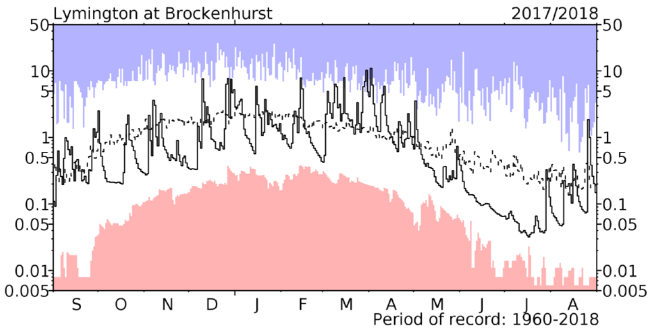




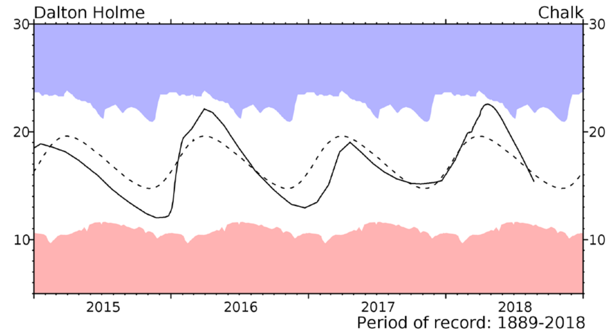


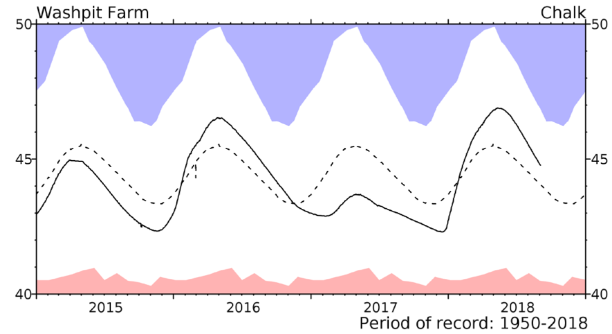


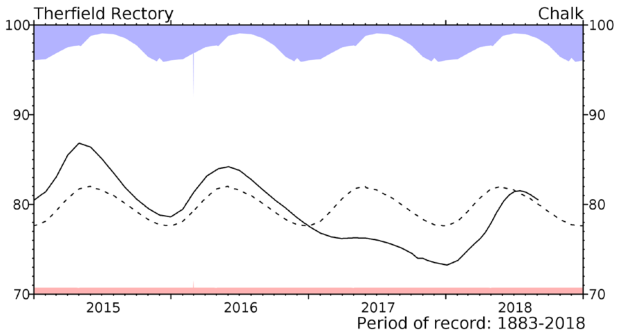


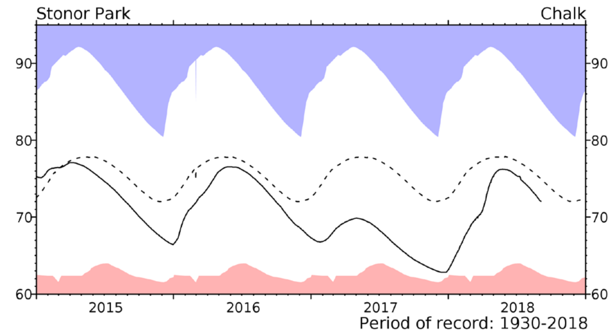


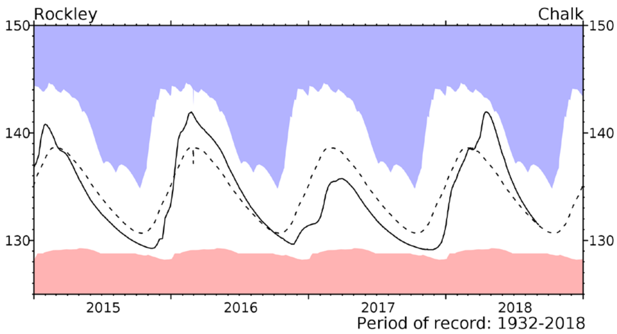
Groundwater . . . Groundwater

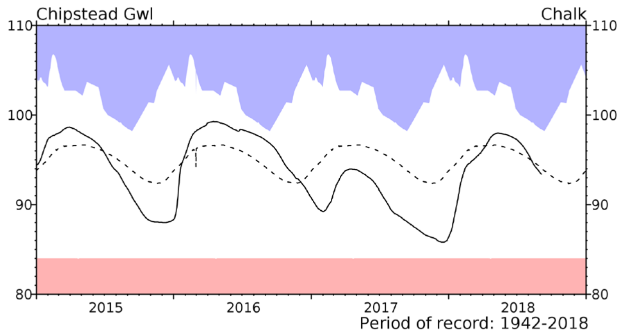


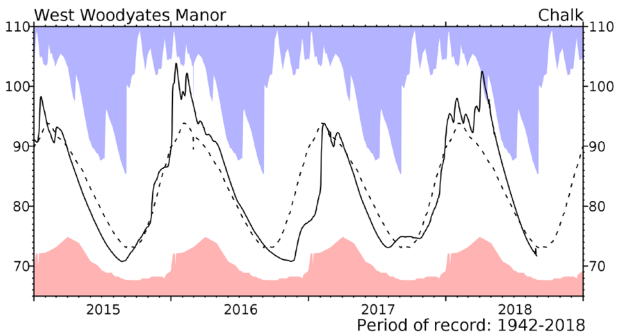


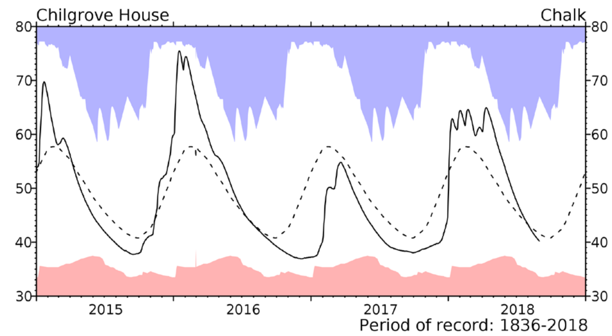


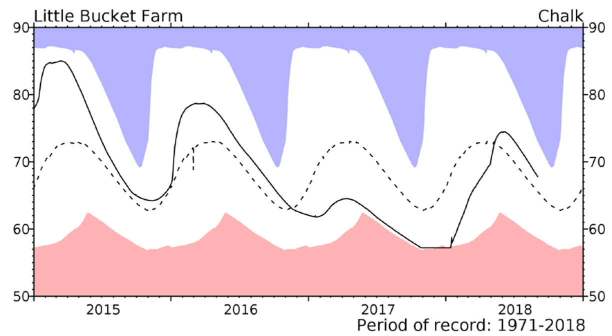


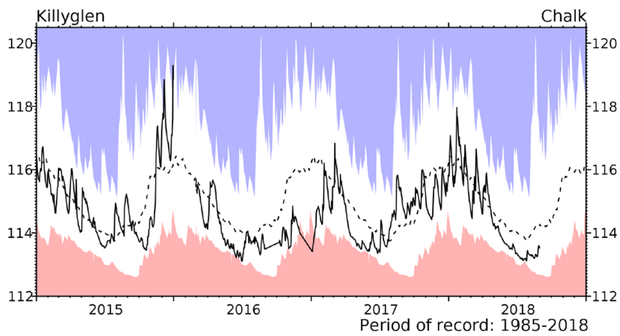




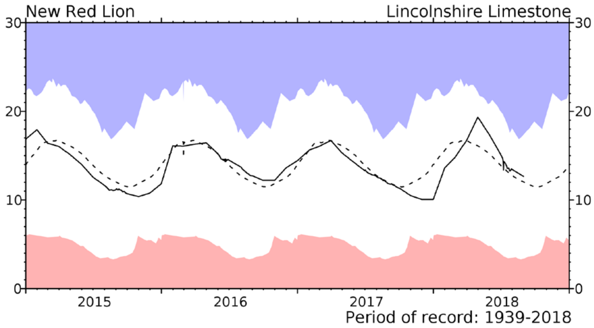


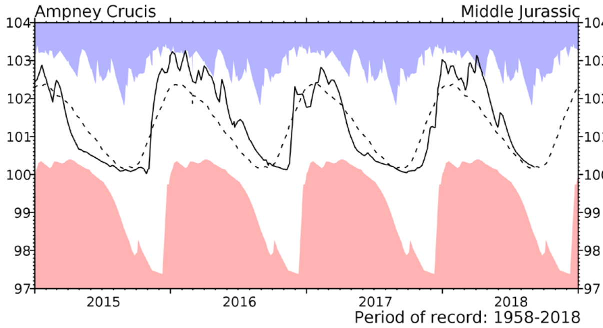


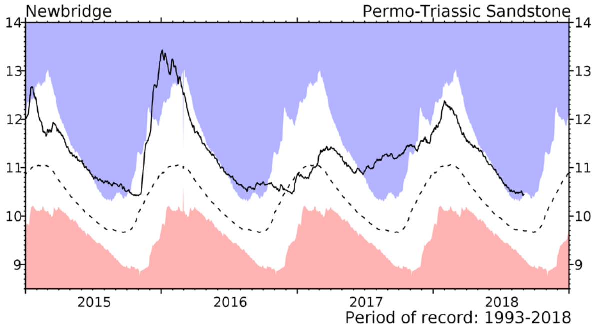


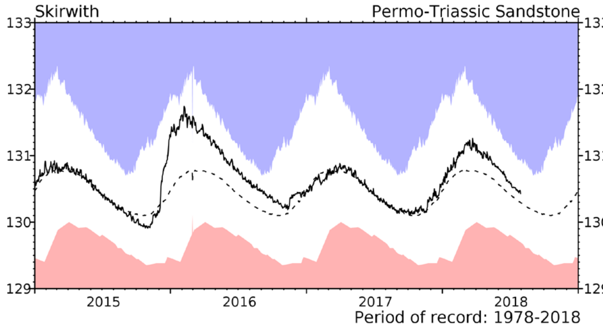


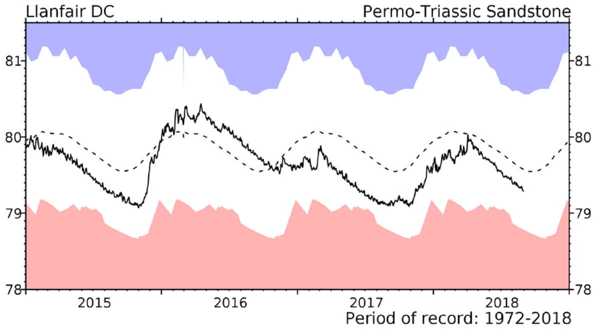
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is 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.

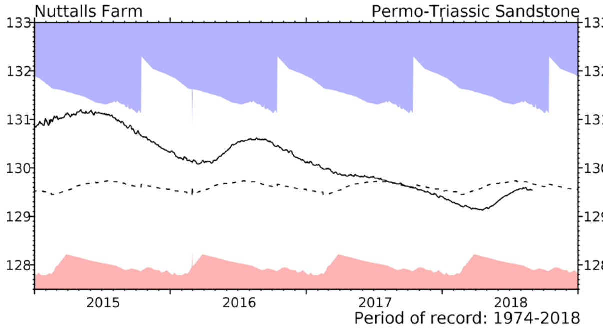

New Red Lion
Lincolnshire Limestone
2015 2016 2017 2018
Period of record: 1939-2018

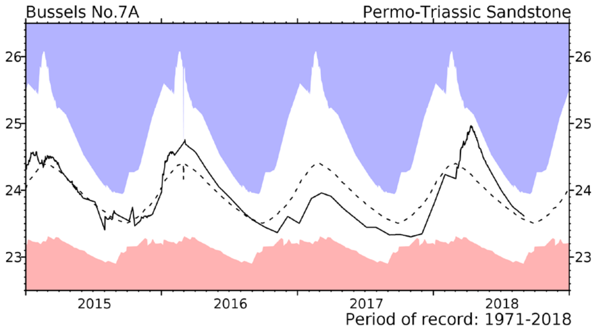

Ampney Crucis
Middle Jurassic
2015 2016 2017 2018
Period of record: 1958-2018

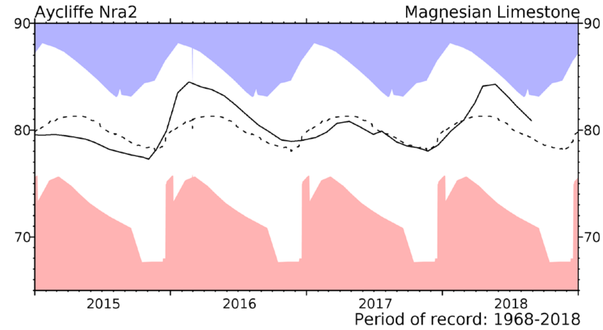

Newbridge
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1993-2018

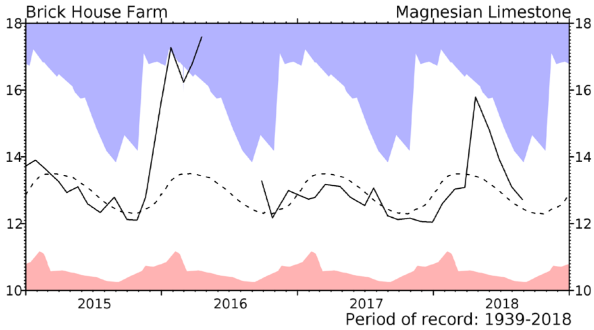

Skirwith
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1978-2018

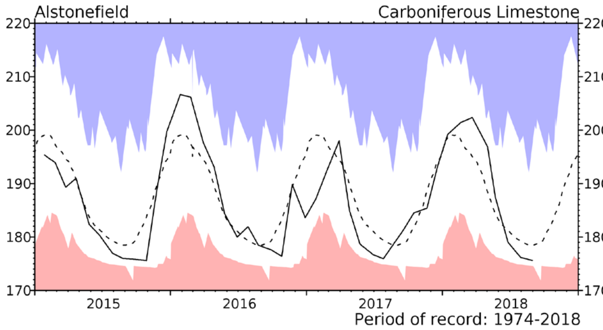

Llanfair DC
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1972-2018

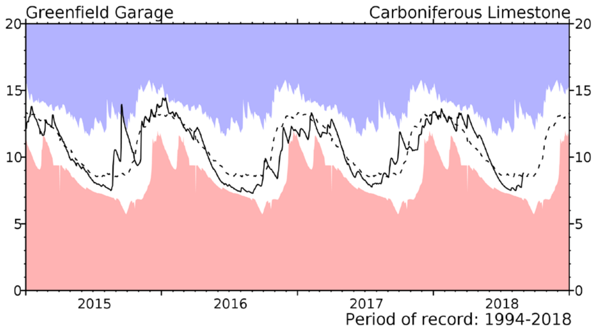

Nuttalls Farm
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1974-2018

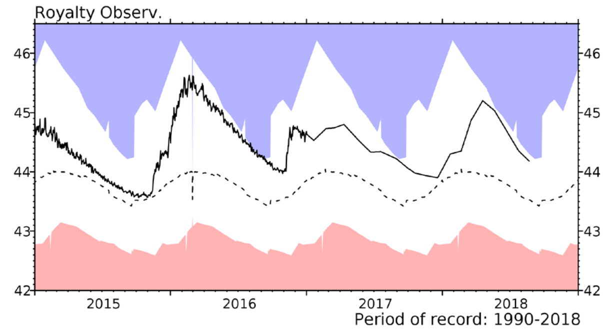

Bussels No.7A
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1971-2018


Aycliffe Nra2
Magnesian Limestone
2015 2016 2017 2018
Period of record: 1968-2018

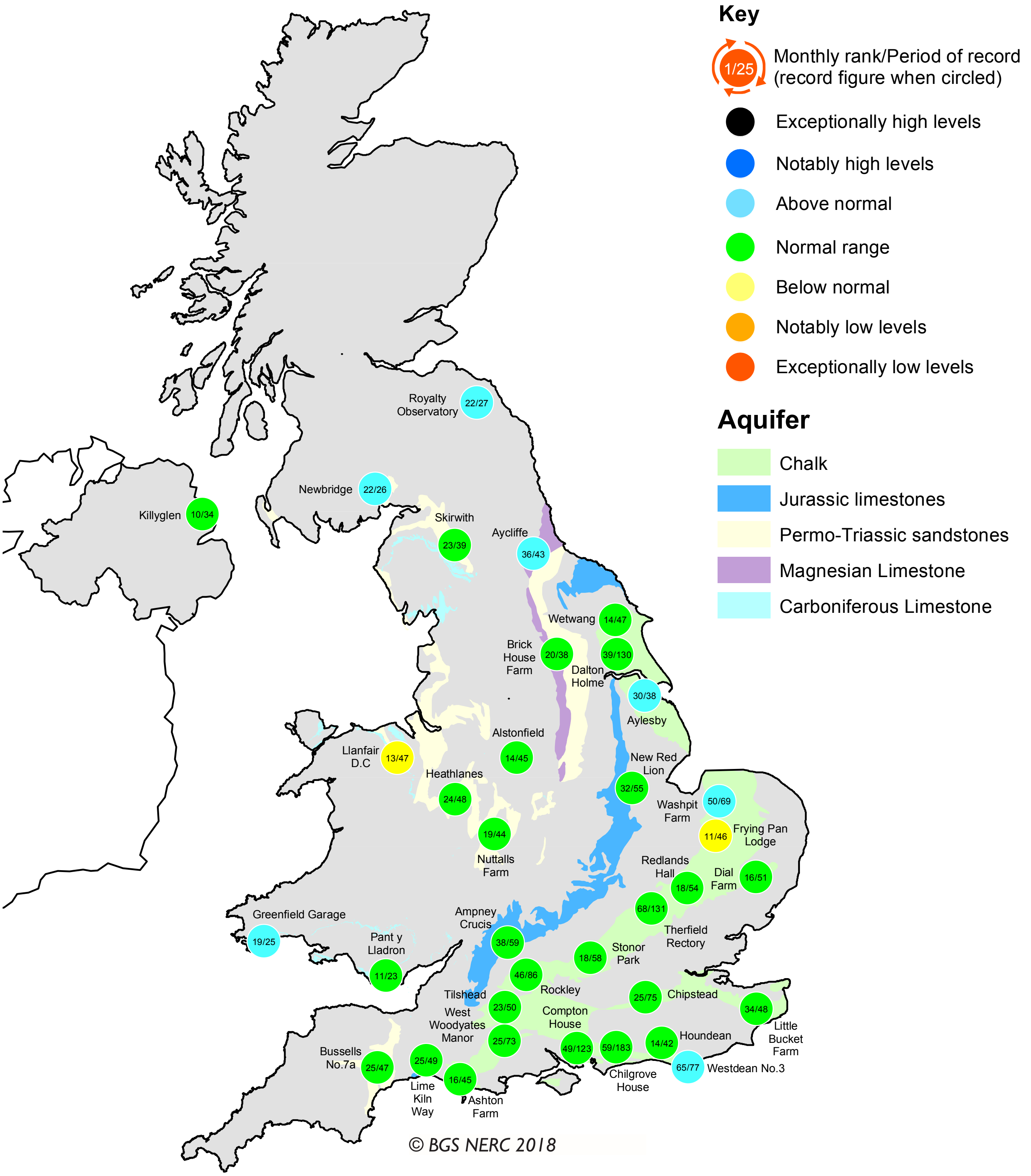

Brick House Farm
Magnesian Limestone
2015 2016 2017 2018
Period of record: 1939-2018


Alstonefield
Carboniferous Limestone
2015 2016 2017 2018
Period of record: 1974-2018


Greenfield Garage
Carboniferous Limestone
2015 2016 2017 2018
Period of record: 1994-2018


Royalty Observ.
2015 2016 2017 2018
Period of record: 1990-2018

Groundwater...Groundwater

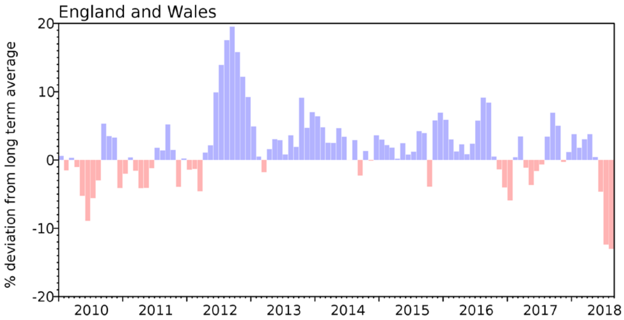


Groundwater levels - August 2018

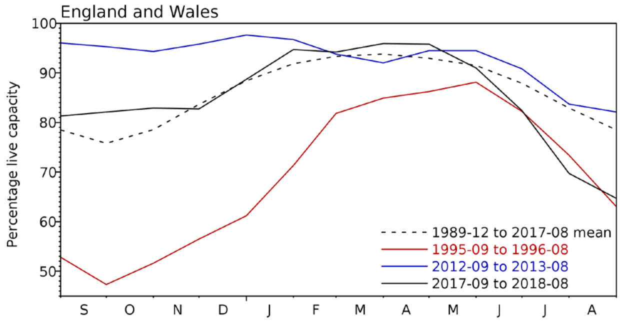
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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

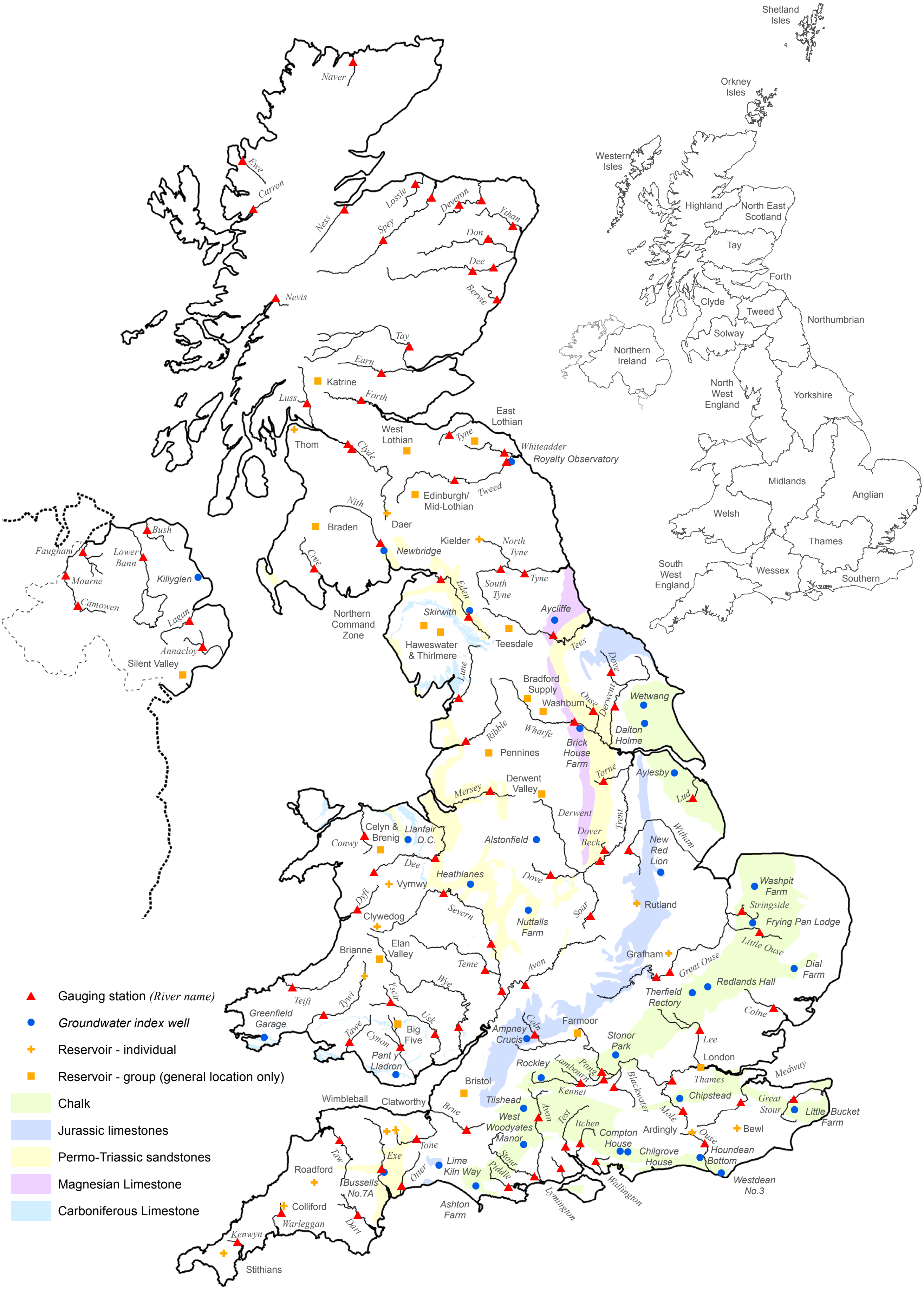
Area	Reservoir		Capacity (Ml)	2018 Jun	2018 Jul	2018 Aug	Aug Anom.	Min Aug	Year* of min	2017 Aug	Diff 18-17
North West	N Command Zone	•	124929	57	41	45	-15	15	1984	72	-27
	Vyrnwy		55146	82	69	60	-12	36	1995	97	-37
Northumbrian	Teesdale	•	87936	71	61	62	-10	38	1995	85	-23
	Kielder		(199175)	87	77	78	-10	66	1989	87	-10
Severn-Trent	Clywedog		49936	93	72	63	-15	27	1976	93	-30
	Derwent Valley	•	46692	69	52	40	-27	34	1995	61	-22
Yorkshire	Washburn	•	23373	71	57	48	-22	34	1995	77	-28
	Bradford Supply	•	40942	67	52	47	-21	21	1995	73	-26
Anglian	Grafham		(55490)	90	83	79	-7	59	1997	96	-16
	Rutland		(116580)	94	89	85	3	66	1995	91	-6
Thames	London	•	202828	94	80	72	-9	62	1995	80	-8
	Farmoor	•	13822	95	98	95	2	64	1995	91	5
Southern	Bewl		31000	93	84	78	9	38	1990	50	28
	Ardingly		4685	91	80	62	-12	47	1996	84	-22
Wessex	Clatworthy		5364	72	59	48	-17	31	1995	68	-20
	Bristol	•	(38666)	85	71	66	-3	43	1990	64	2
South West	Colliford		28540	88	75	66	-6	43	1997	76	-10
	Roadford		34500	83	70	59	-14	40	1995	68	-9
	Wimbleball		21320	86	73	61	-9	40	1995	59	2
	Stithians		4967	82	67	56	-7	30	1990	73	-17
Welsh	Celyn & Brenig	•	131155	86	71	61	-22	49	1989	89	-28
	Brianne		62140	83	71	72	-17	55	1995	99	-27
	Big Five	•	69762	72	58	52	-21	29	1995	78	-26
	Elan Valley	•	99106	77	62	48	-29	37	1976	68	-20
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	90	81	78	-1	45	1998	84	-6
	East Lothian	•	9374	94	83	77	-9	63	1989	98	-21
Scotland(W)	Loch Katrine	•	110326	80	62	59	-14	50	2000	94	-35
	Daer		22494	78	64	64	-14	41	1995	87	-23
	Loch Thom		10798	90	83	93	10	58	1997	81	12
Northern Ireland	Total+	•	56800	75	68	70	-6	40	1995	88	-18
	Silent Valley	•	20634	72	64	66	-7	33	2000	87	-21

( ) 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.

The monthly rainfall figures are provided by the Met Office NCIC and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

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

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