Hydrological Summary

for the United Kingdom

October 2018

General

October was a typically autumnal month with a mixture of settled weather and stormy spells, but with a wintry period at month-end. Although temperatures were near average, it was unseasonably warm in the second week; a high of 26.5°C was recorded at Donna Nook (Lincolnshire) on the 13th. Rainfall for the UK was moderately below average with the largest deficits in Northern Ireland, central and southern England and eastern Scotland. October soil moisture deficits (SMDs) were above average across most of the UK and in Northern Ireland they were the third highest in a series from 1961. Above average river flows were restricted to southern Wales and northern Scotland; elsewhere flows were generally in the normal range with some notably below average flows in catchments in southern and eastern Britain. Groundwater levels generally continued to recede and were in the normal range or below for the time of year, with notably low levels in parts of the Chalk. Reservoir stocks continued to fall at most impoundments in England and Northern Ireland and were more than 25% below the October average in some instances (e.g. 33% below average for Derwent Valley, 29% below average for Clatworthy). Despite substantial increases in Wales, late October reservoir storage for England & Wales was the lowest for the time of year since 2003. Given current reservoir stocks, locally depressed river flows and a delay in the onset of groundwater recharge, rainfall through the remainder of autumn and winter will be critical in determining the water resources outlook for 2019.

Rainfall

The settled weather at the end of September continued into October in the south, but it was more unsettled in the north (e.g. 128mm was recorded on the 8th at Achnagart (Ross & Cromarty)). The second week was generally dry and unseasonably warm, but ended with storm 'Callum'. On the 12th/13th, the storm tracked to the north west of the UK bringing persistent heavy rainfall (a 36-hour total of 219mm was recorded at Libanus, Brecon Beacons) and causing wide-ranging impacts: 2,000 homes lost power, flights and rail services were disrupted, landslips occurred and roads were closed due to floodwater and fallen trees. The weather generally turned more settled in the second half of the month, except for some frontal systems crossing northern Scotland (e.g. on the 23rd, 70mm was recorded at Resallach (Ross & Cromarty)). A cold spell brought wintry showers to Scotland and north-east England towards month-end, even to lower altitudes, with 6cm of lying snow recorded at Tomnavoulin (Morayshire) on the 27th. For the UK as a whole, rainfall was moderately below average (84%) for October; the Southern, Wessex and Northern Ireland regions were notably dry, registering less than 60% of average. Above average rainfall was mainly confined to north-west Scotland, part of Wales and eastern England, with some areas receiving more than 130% of average. For the autumn so far (September-October), rainfall anomalies were similar to that of September. Over the last six months (May-October) a large swathe of England registered less than 70% of average rainfall and more modest deficits of around 15% can be traced back to the start of last winter in north-east Scotland and as far back as summer 2016 for parts of southern England.

River flows

In responsive catchments, flows generally remained near to below average throughout October, with moderate flow responses to the unsettled weather of the first half of the month. Storm 'Callum' triggered rapid flow increases in most catchments in western Britain, with over 100 Flood Alerts and Warnings issued. The storm produced a notable response in Wales; new period of record maximum daily flow records were established on the Tawe and Teifi in records of 60 years, the second highest October outflow from Wales was recorded and there were some reports of property flooding. Elsewhere, in the more groundwater influenced catchments, flows generally remained below average throughout October. Mean flows for October were less than half of average in many catchments in southern and eastern England and eastern Scotland, and less than a quarter of average on the Tweed, Brue and Annacloy. In contrast, mean flows were notably high in some catchments in Wales and northern Scotland and exceptionally high on the Ewe and Carron - both registered the second highest October mean flow in series from 1970 and 1979, respectively. Mean flows for the autumn so far (September-October) were generally in the normal range across the UK and below normal in the south and east. For the summer and autumn so far (June-October), flows were below normal across much of southern and eastern Britain and exceptionally low on the Annacloy (21% of average over the five months). The Deveron, Soar and Derbyshire Derwent registered their lowest mean June-October flows in records of at least 45 years. Mean flows over the same period were the highest on record for the Carron, although in the north-east of Scotland river flow deficits are evident back to the start of last winter.

Groundwater

With below average rainfall across much of the UK in October, SMDs increased relative to average and soils generally remained drier than normal for the time of year. In the Chalk, levels at nearly all index boreholes receded during October and were in the normal range or below. At Killyglen, despite an increase mid-month due to storm 'Callum', levels were the lowest on record for the end of October (in a series from 1985). In the more rapidly responding Jurassic and Magnesian limestones, levels also fell and were in the normal range or below in the former, and in the normal range in the latter. Levels in the Upper Greensand at Lime Kiln Way fell but remained in the normal range. In the Permo-Triassic sandstones levels fell, except at Newbridge where a small rise was recorded and levels here were above normal. Elsewhere levels remained in the normal range, except for Llanfair DC where they remained below normal. Levels in the Carboniferous Limestone in south west Wales responded to the heavy rainfall from storm 'Callum' and rose at Greenfield Garage (where levels remained in the normal range), but fell at Pant y Lladron (and were notably low). In the Peak District, levels fell at Alstonfield and were below normal. In the Fell Sandstone at Royalty Observatory, levels fell and were in the normal range.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

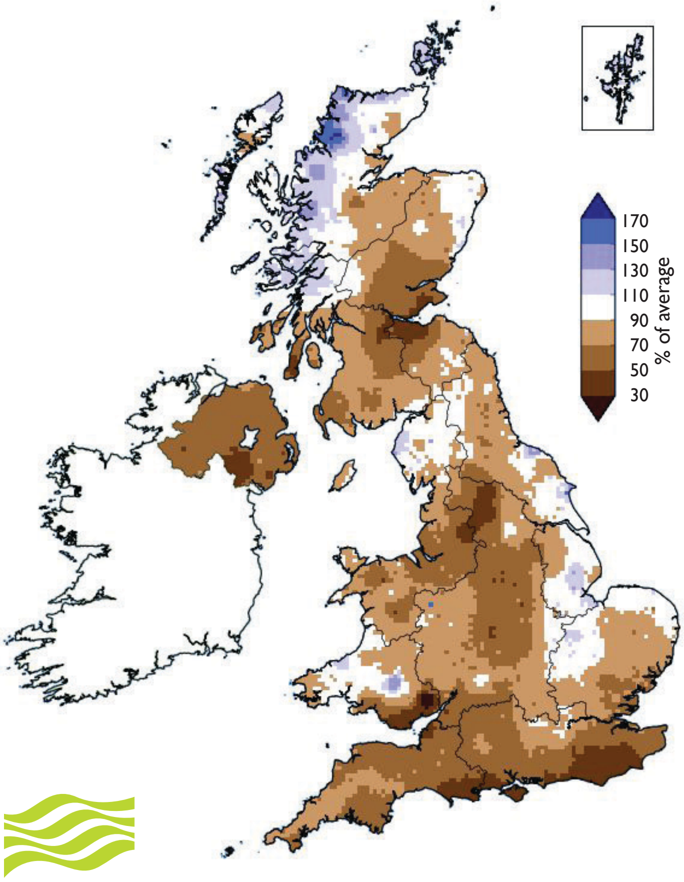
Region	Rainfall	Oct 2018	Sep18 – Oct18	RP	May18 – Oct18	RP	Feb18 – Oct18	RP	Nov17 – Oct18	RP
United	mm	**104**	209		433		688		1051	
Kingdom	%	**84**	96	2-5	83	5-10	89	2-5	93	2-5
England	mm	**67**	129		292		521		777	
	%	**74**	81	2-5	72	10-20	89	2-5	92	2-5
Scotland	mm	**164**	338		644		920		1415	
	%	**97**	112	2-5	96	2-5	90	2-5	93	2-5
Wales	mm	**136**	280		529		880		1386	
	%	**82**	101	2-5	83	5-10	93	2-5	98	2-5
Northern	mm	**70**	127		417		657		1057	
Ireland	%	**58**	60	8-12	77	8-12	83	5-10	93	2-5
England &	mm	**77**	150		325		570		861	
Wales	%	**76**	85	2-5	74	10-15	90	2-5	93	2-5
North West	mm	**114**	251		482		721		1144	
	%	**83**	104	2-5	83	5-10	86	5-10	94	2-5
Northumbria	mm	**75**	153		347		586		818	
	%	**88**	98	2-5	83	5-10	96	2-5	94	2-5
Severn-Trent	mm	**56**	122		283		504		731	
	%	**70**	84	2-5	73	8-12	91	2-5	94	2-5
Yorkshire	mm	**63**	136		285		530		749	
	%	**77**	91	2-5	71	10-20	90	2-5	89	2-5
Anglian	mm	**56**	86		220		402		583	
	%	**89**	73	2-5	66	10-15	88	2-5	93	2-5
Thames	mm	**59**	98		242		438		652	
	%	**75**	72	2-5	69	10-15	87	2-5	91	2-5
Southern	mm	**52**	91		262		491		733	
	%	**53**	57	5-10	71	8-12	91	2-5	92	2-5
Wessex	mm	**58**	106		258		508		785	
	%	**58**	63	5-10	63	20-30	85	5-10	89	2-5
South West	mm	**94**	167		351		692		1114	
	%	**67**	73	2-5	66	15-25	86	2-5	91	2-5
Welsh	mm	**131**	268		510		853		1338	
	%	**82**	100	2-5	83	5-10	93	2-5	98	2-5
Highland	mm	**229**	477		801		1074		1731	
	%	**116**	135	15-25	106	2-5	90	2-5	96	2-5
North East	mm	**107**	201		392		602		863	
	%	**90**	97	2-5	79	5-10	84	5-10	85	5-10
Tay	mm	**121**	258		521		791		1109	
	%	**79**	97	2-5	87	2-5	88	2-5	83	5-10
Forth	mm	**86**	197		446		700		1016	
	%	**65**	83	2-5	79	5-10	85	2-5	84	2-5
Tweed	mm	**87**	181		435		707		985	
	%	**78**	94	2-5	89	2-5	99	2-5	96	2-5
Solway	mm	**131**	265		606		914		1391	
	%	**76**	90	2-5	90	2-5	91	2-5	94	2-5
Clyde	mm	**181**	366		782		1116		1732	
	%	**89**	100	2-5	97	2-5	91	2-5	95	2-5

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

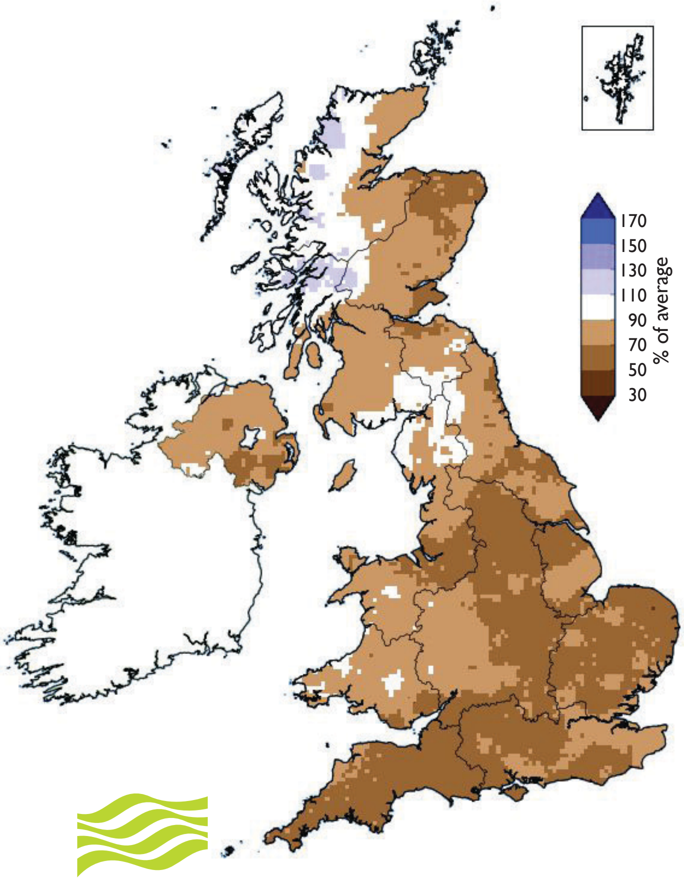
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

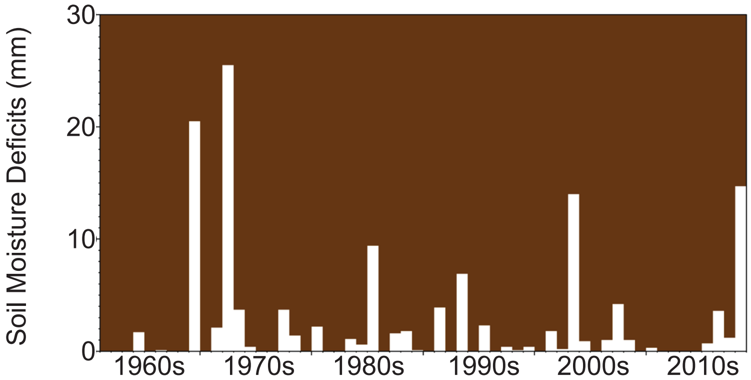
October 2018 rainfall as % of 1981-2010 average



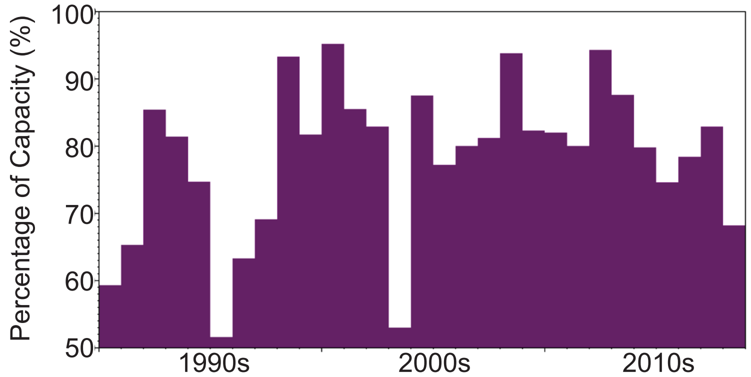
May 2018 - October 2018 rainfall as % of 1981-2010 average



End of October SMDs for Northern Ireland



End of October reservoir stocks 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.

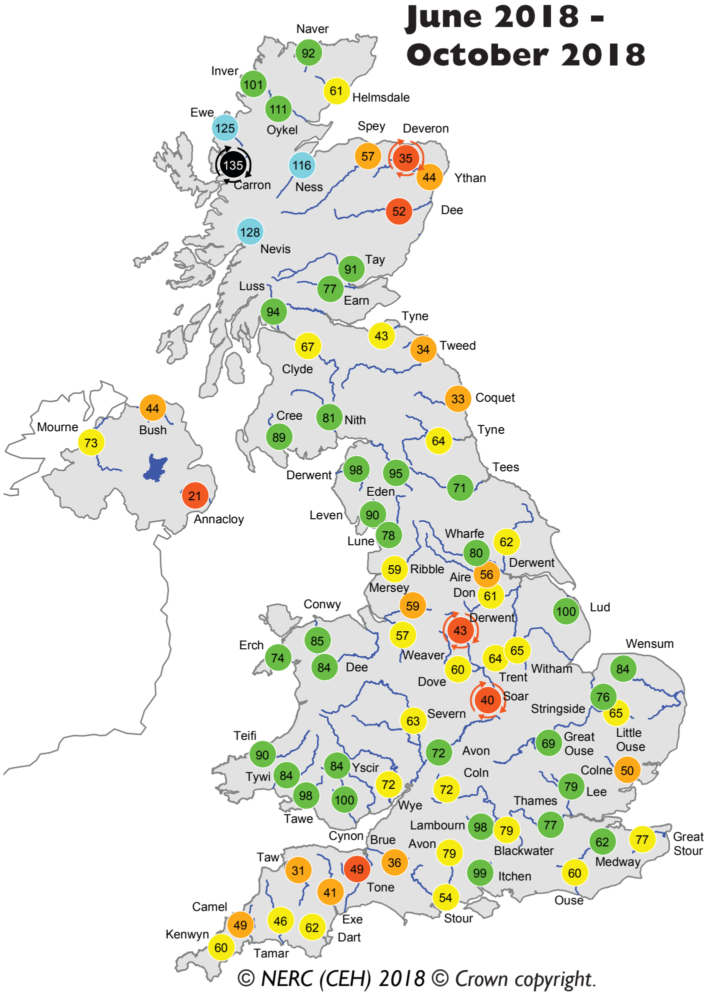
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from November 2018**
Issued: **08.11.2018**
using data to the end of October 2018

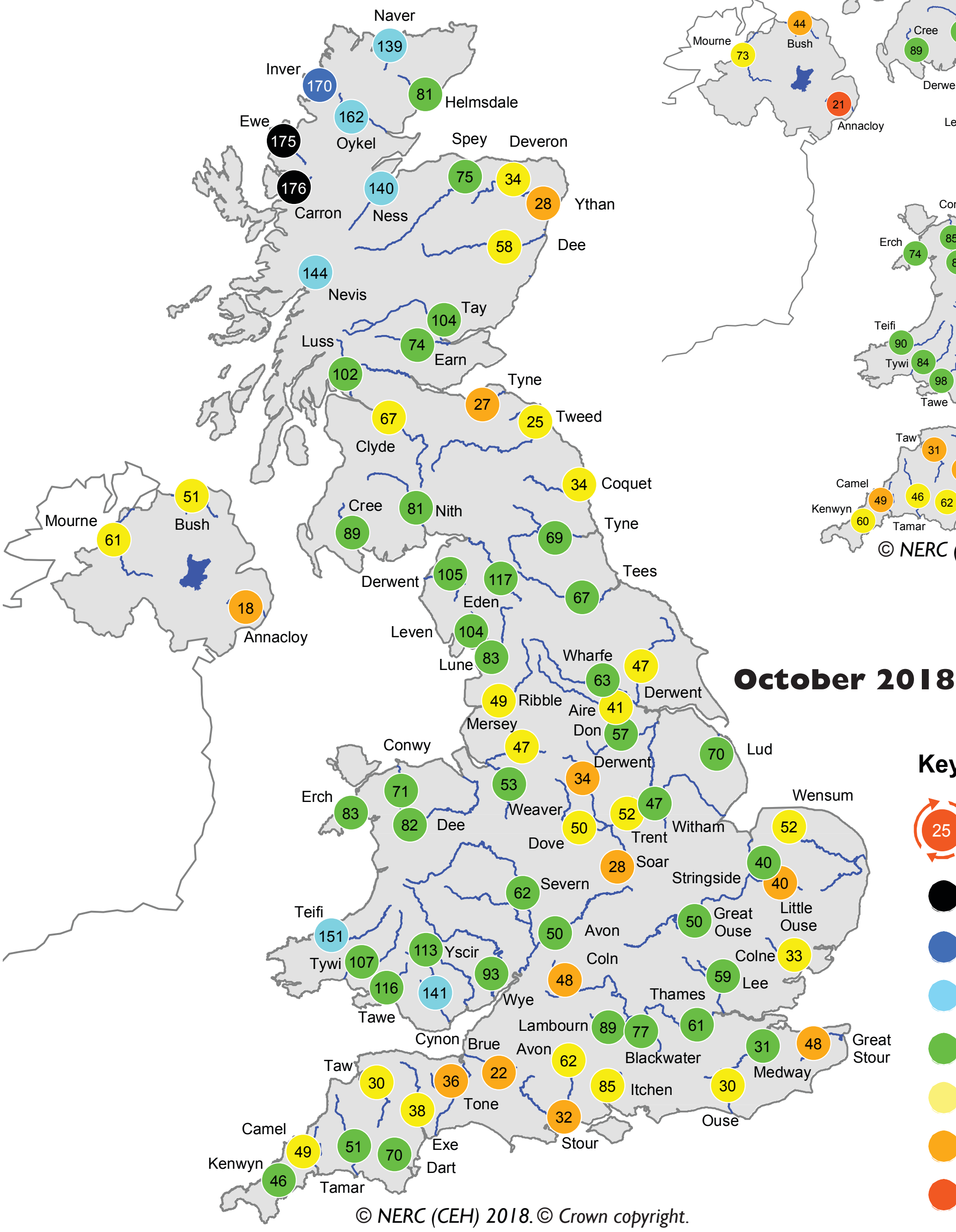
The outlook for November is for normal to below normal river flows across the English Lowlands and normal to below normal groundwater levels in the Chalk of southern England, with some notably low levels especially in the south-western part of the aquifer. Elsewhere, river flows are generally likely to be within the normal range and groundwater levels are mostly likely to be normal to below normal. The three-month outlook for river flows and groundwater levels is predominantly similar to the one-month outlook, with river flows and groundwater levels likely to be normal to below normal in parts of the south-east and within the normal range elsewhere.

River flow . . . River flow . . .

June 2018 - October 2018



October 2018



Key

25 % of long-term average (record figure when circled)

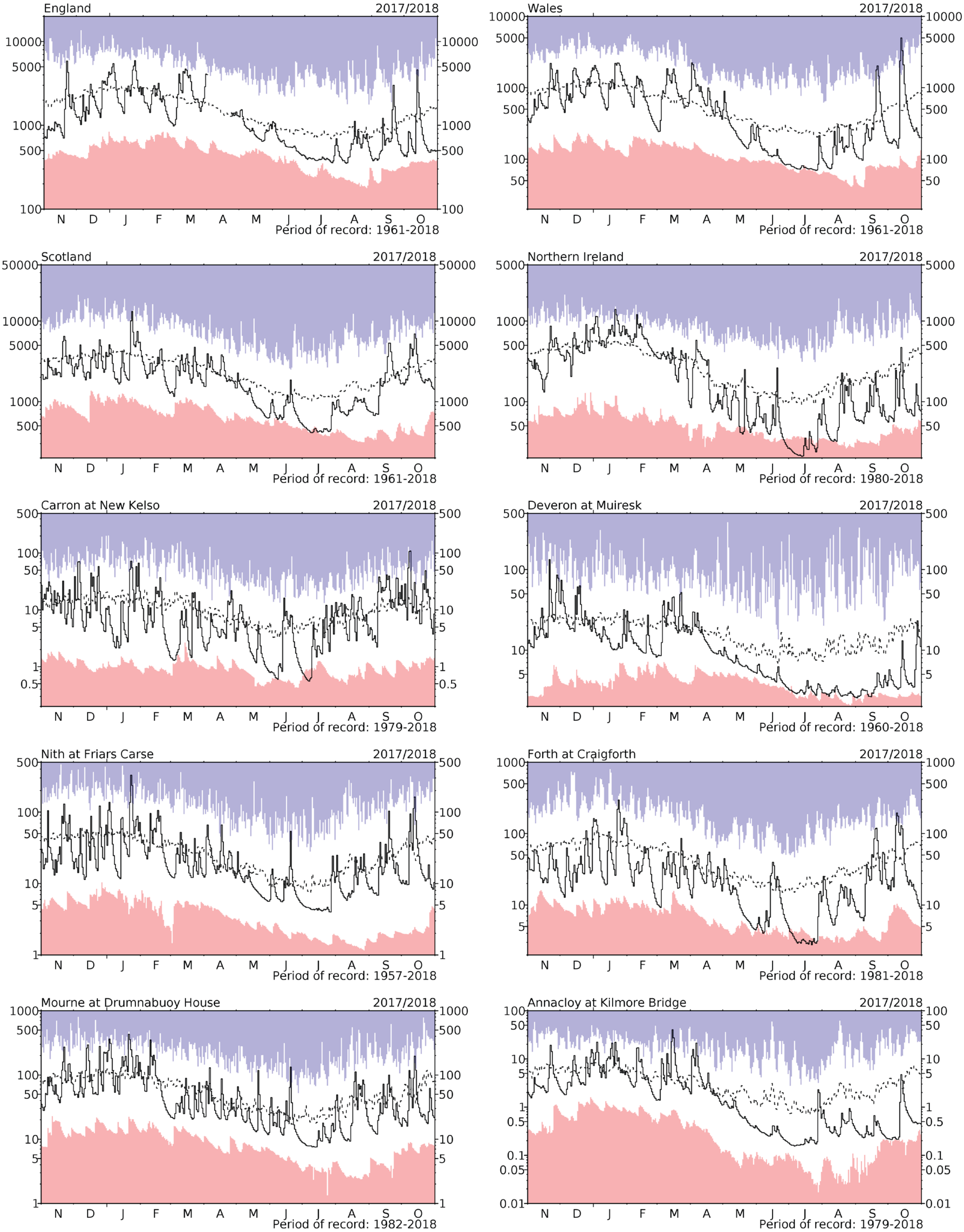
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*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.

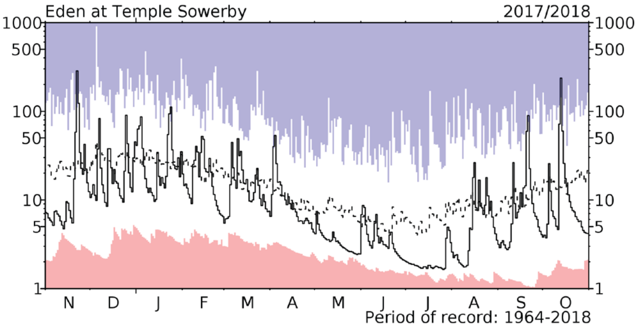
River flow . . . River flow . . .

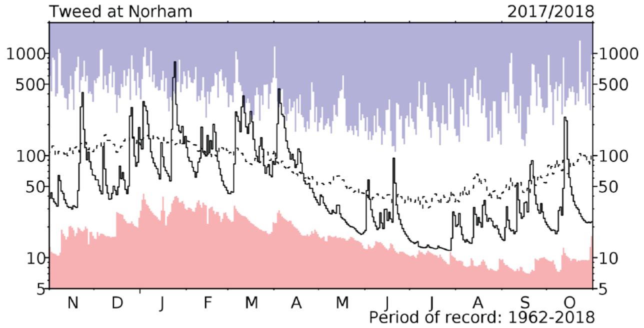


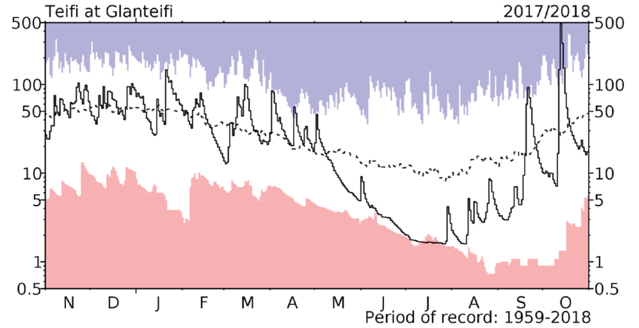
River flow hydrographs

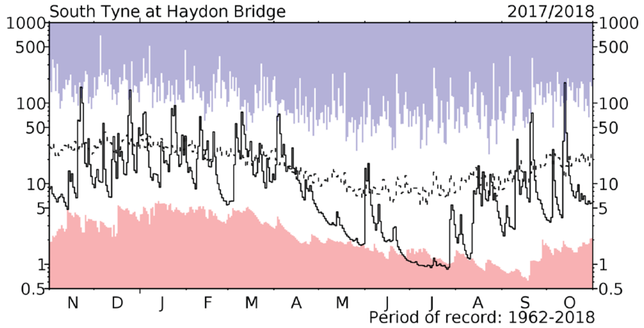
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to November 2017 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

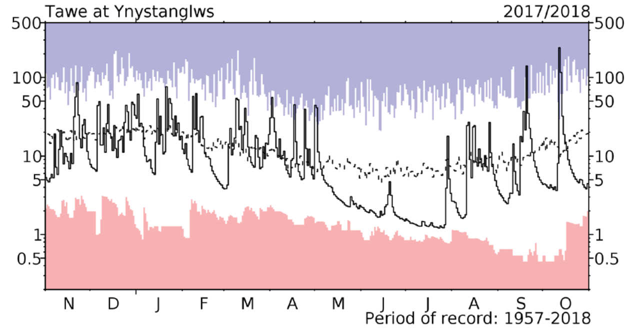
River flow . . . River flow . . .

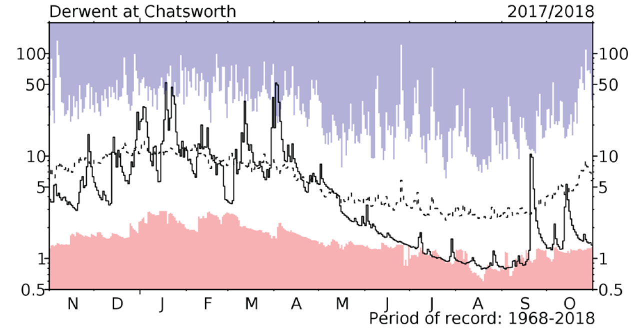


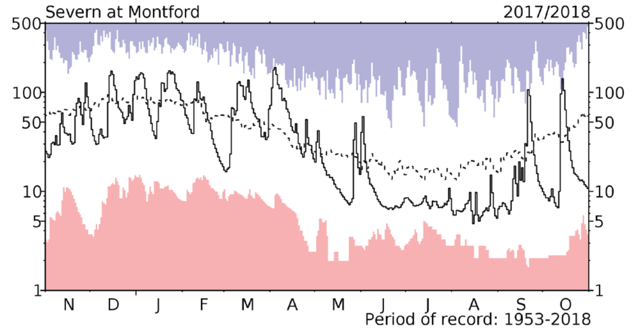


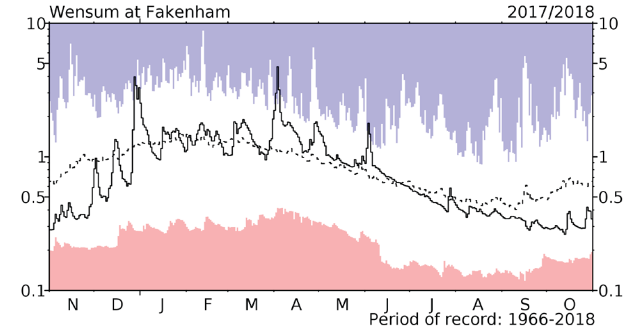


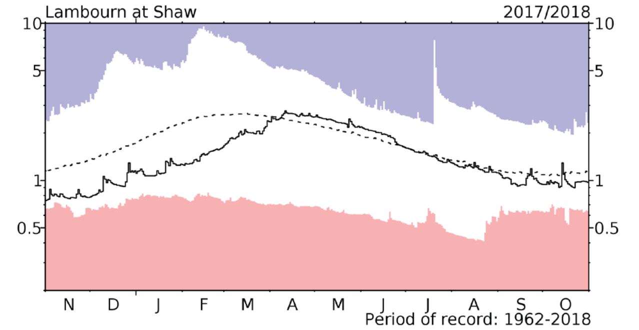


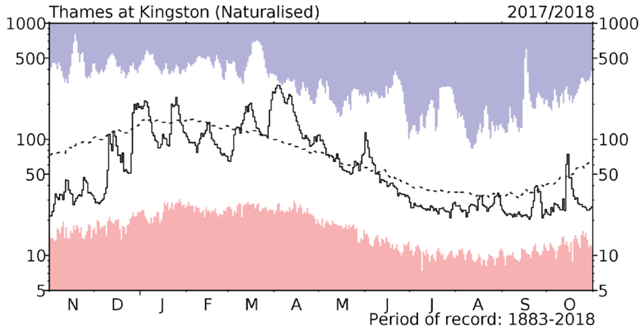


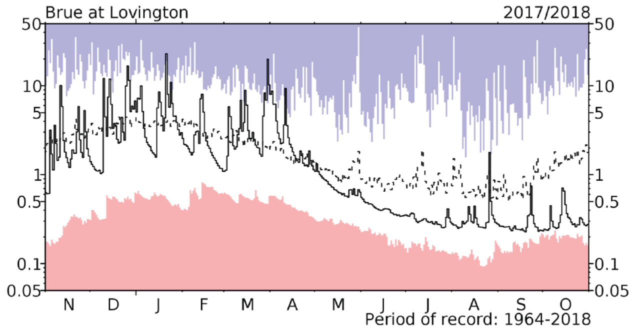


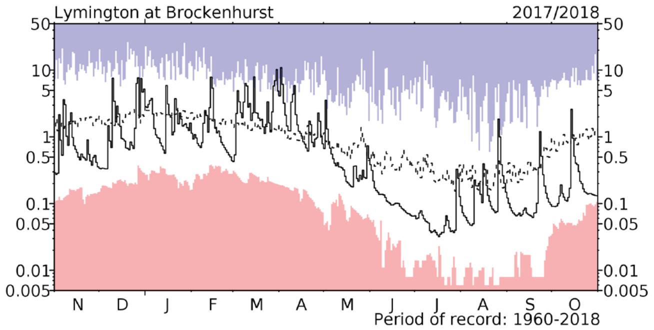




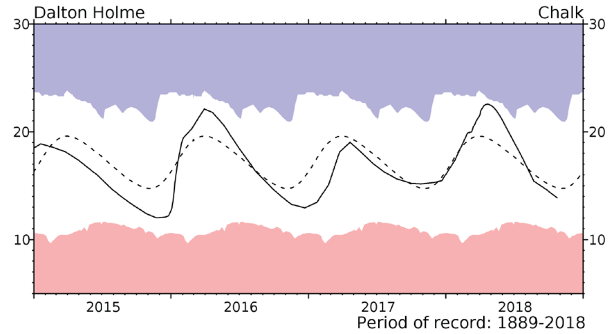


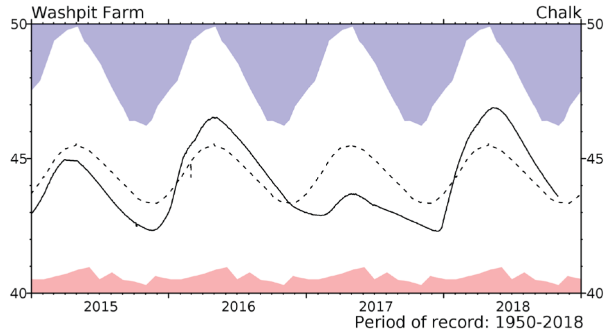


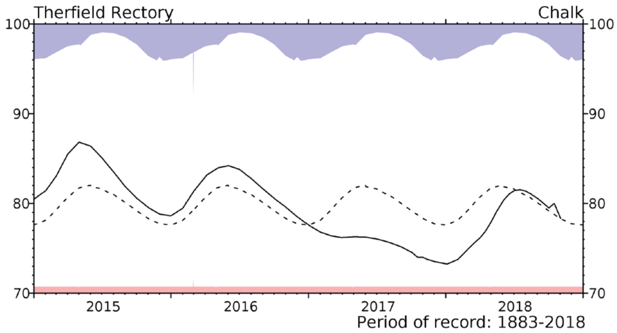


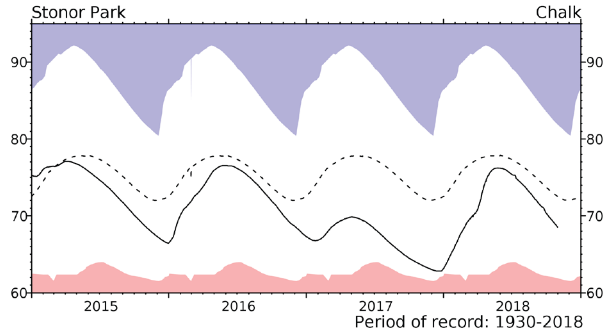


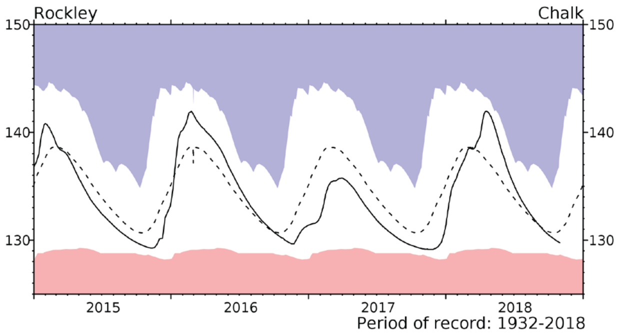
Groundwater . . . Groundwater

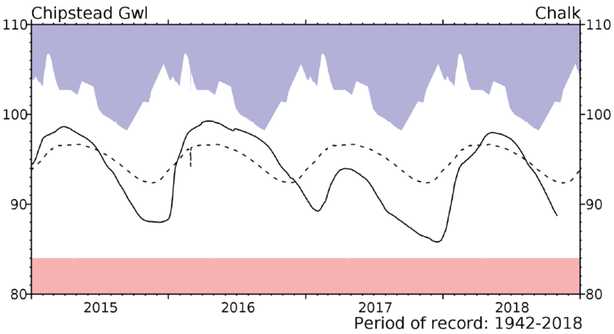


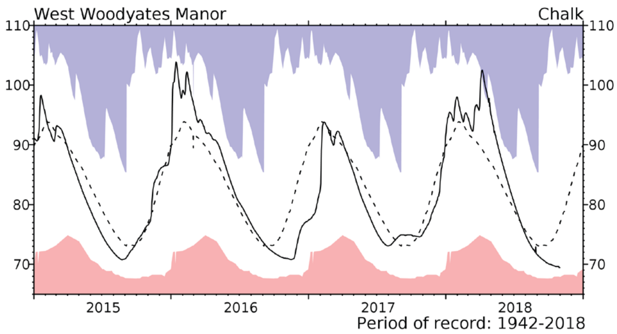


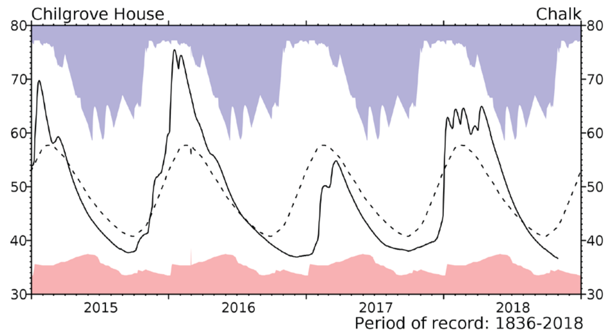


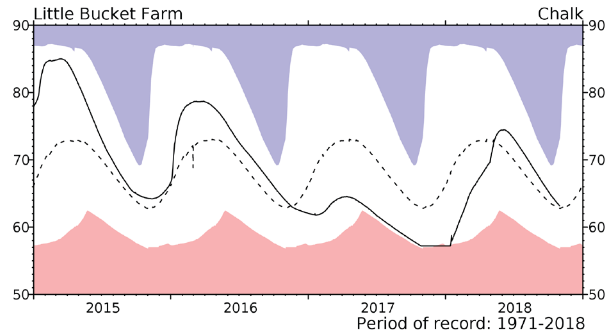


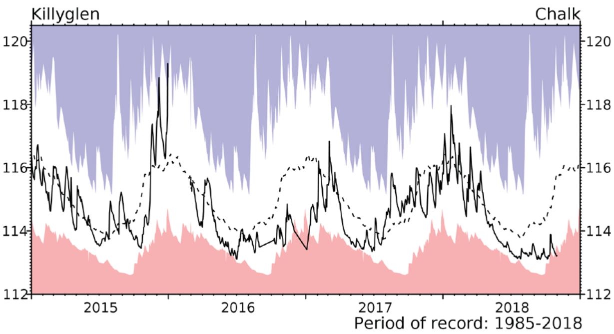






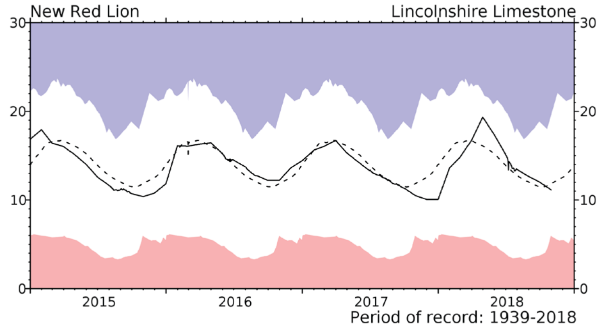


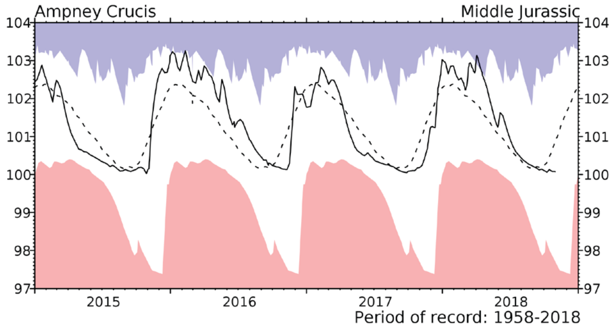


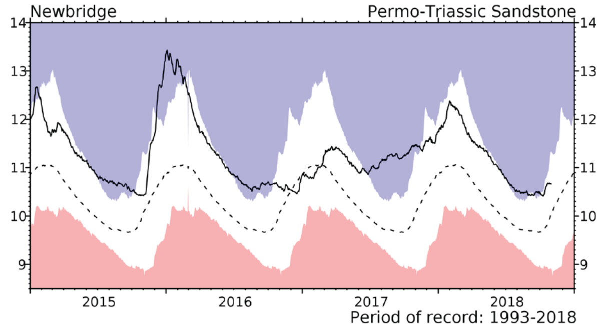


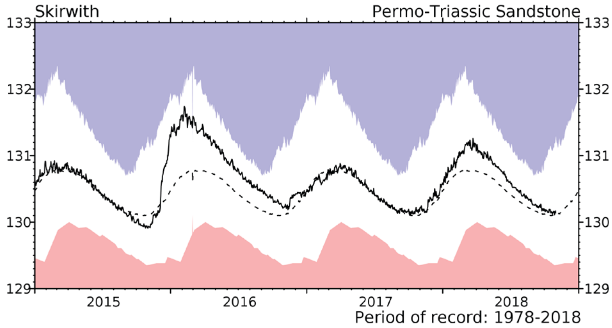
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

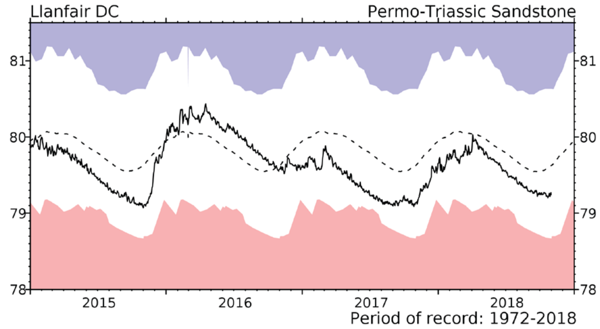
Groundwater ... Groundwater

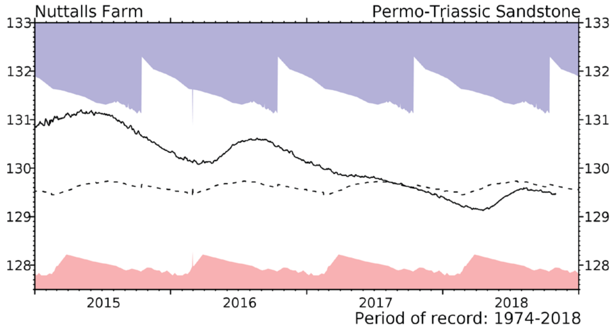


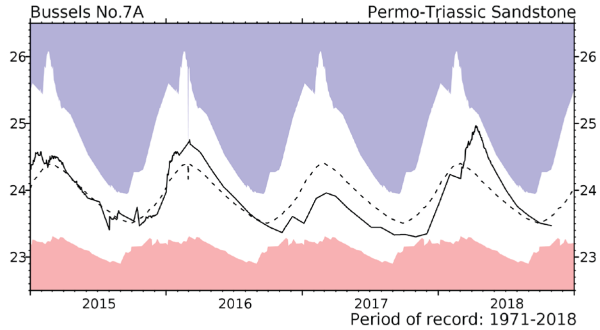


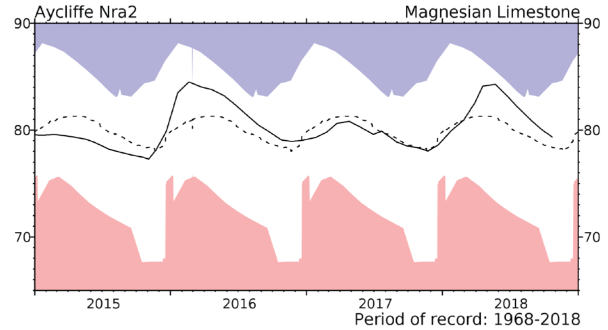


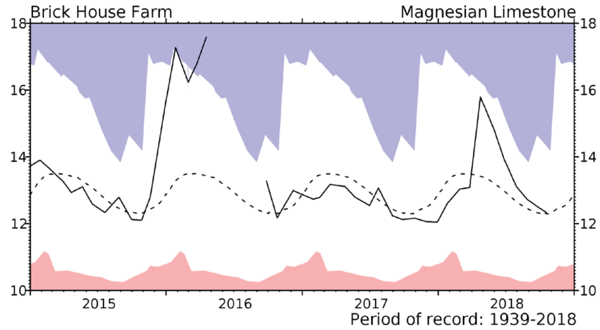


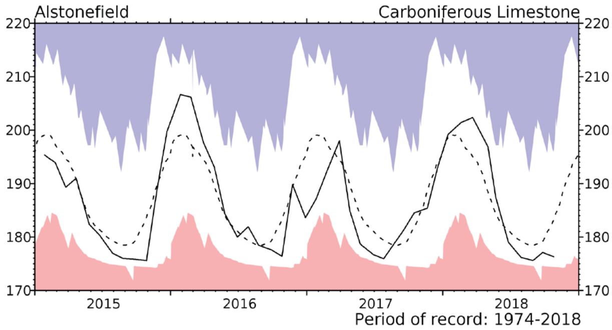


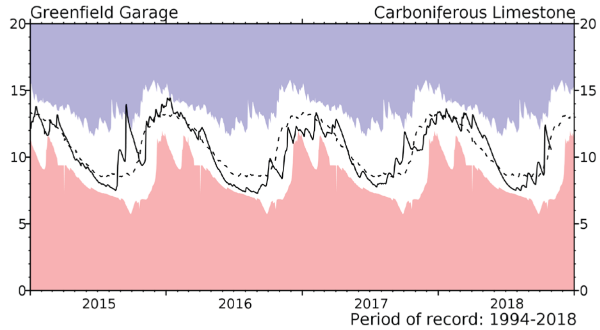


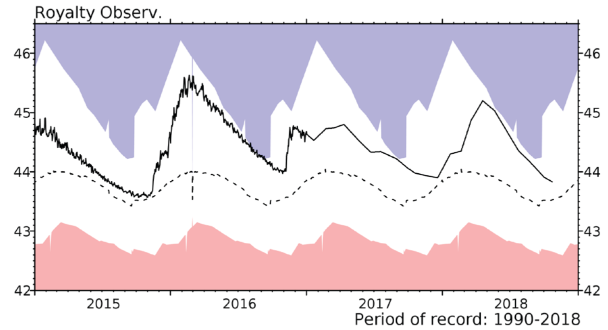




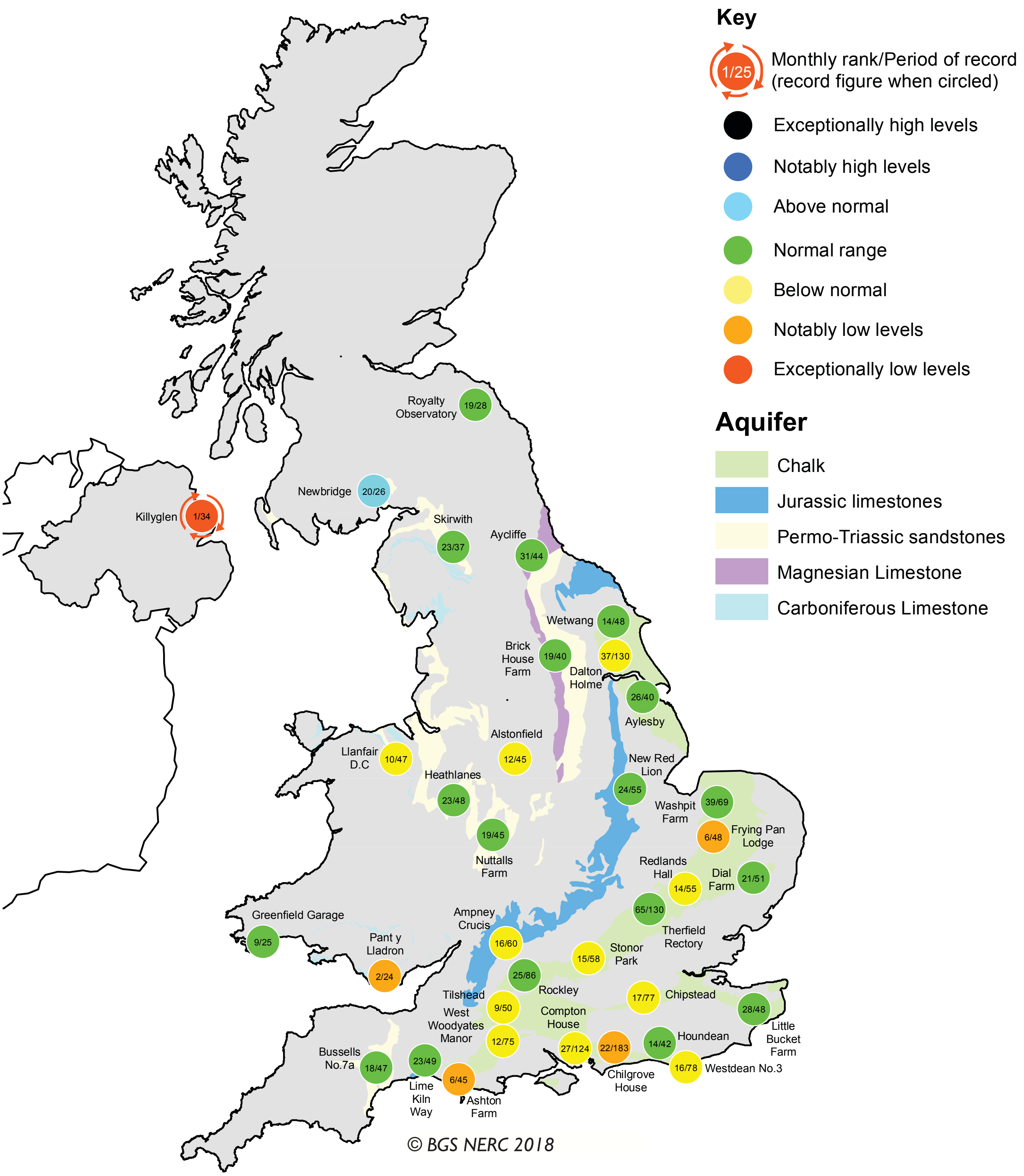








Groundwater . . . Groundwater

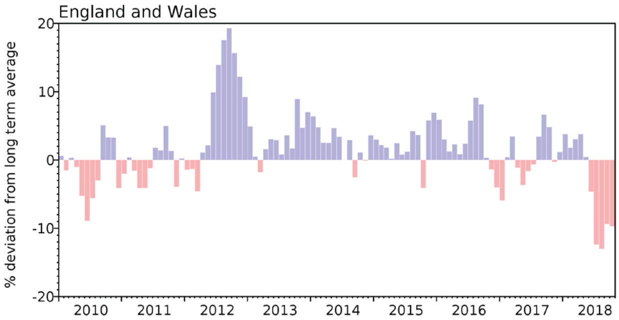


Groundwater levels - October 2018

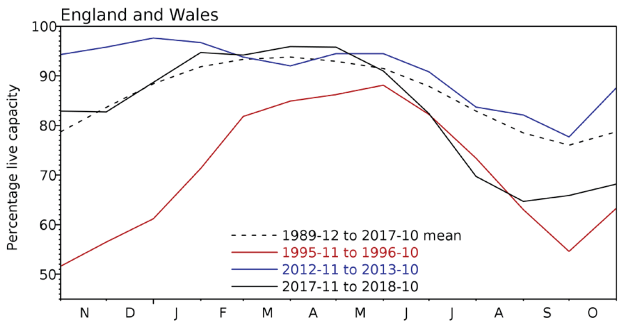
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

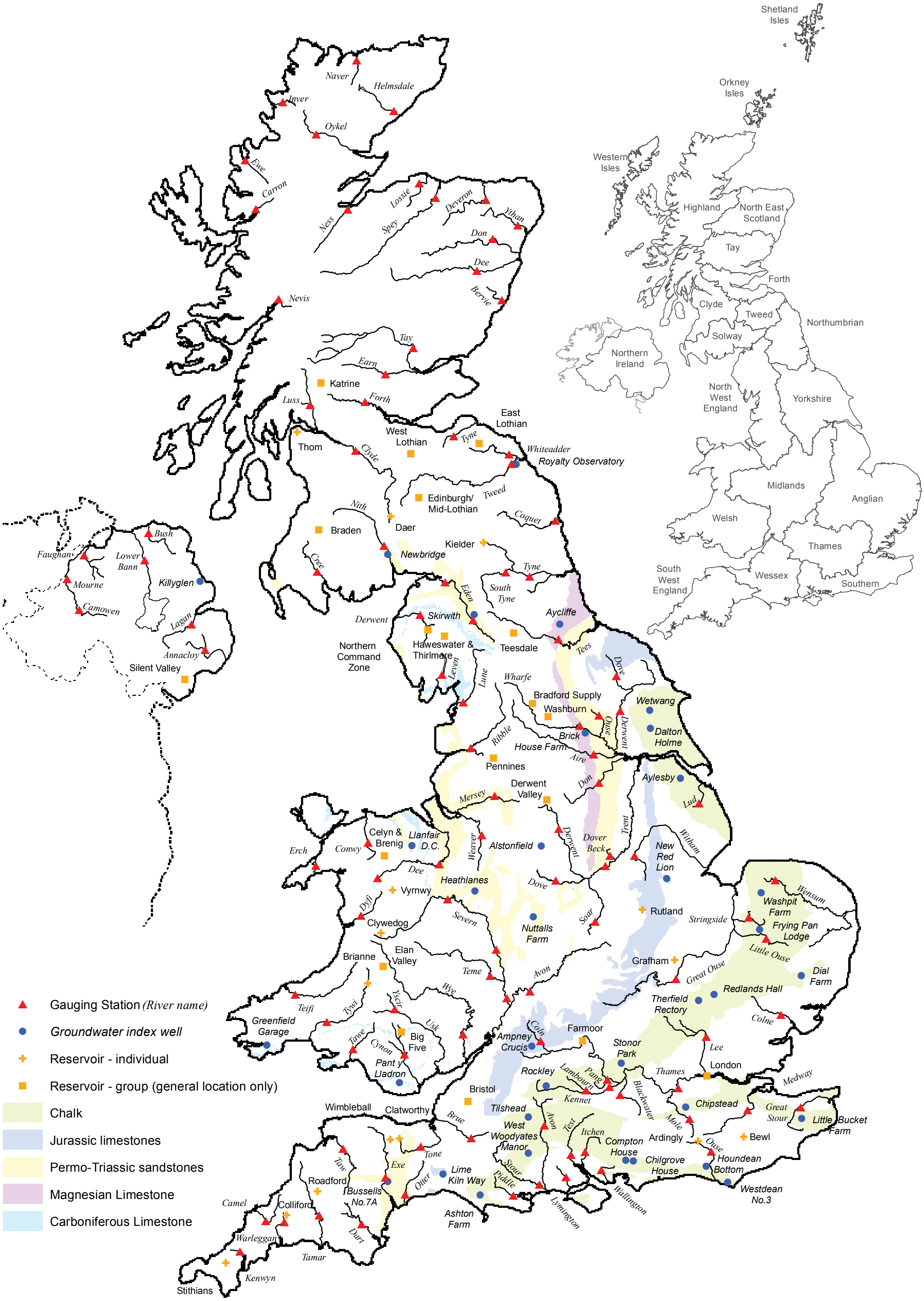
Area	Reservoir		Capacity (Ml)	2018 Aug	2018 Sep	2018 Oct	Oct Anom.	Min Oct	Year* of min	2017 Oct	Diff 18-17
North West	N Command Zone	•	124929	45	56	67	-1	33	2003	88	-21
	Vyrnwy		55146	60	73	74	-2	25	1995	98	-24
Northumbrian	Teesdale	•	87936	62	66	74	-3	33	1995	98	-25
	Kielder		(199175)	78	80	80	-6	63	1989	87	-7
Severn-Trent	Clywedog		49936	63	71	79	2	38	1995	85	-6
	Derwent Valley	•	46692	40	41	37	-33	15	1995	80	-43
Yorkshire	Washburn	•	23373	48	45	44	-26	15	1995	87	-43
	Bradford Supply	•	40942	47	49	46	-26	16	1995	91	-44
Anglian	Grafham		(55490)	79	74	70	-14	44	1997	94	-24
	Rutland		(116580)	85	82	79	0	59	1995	85	-6
Thames	London	•	202828	72	62	57	-20	46	1996	60	-3
	Farmoor	•	13822	95	90	88	0	43	2003	95	-7
Southern	Bewl		31000	78	69	64	5	33	1990	36	28
	Ardingly		4685	62	48	40	-26	15	2003	81	-41
Wessex	Clatworthy		5364	48	36	33	-29	14	2003	68	-35
	Bristol	•	(38666)	66	58	53	-9	24	1990	61	-8
South West	Colliford		28540	66	56	54	-17	38	2006	98	-45
	Roadford		34500	59	48	46	-25	18	1995	74	-28
	Wimbleball		21320	61	47	40	-26	26	1995	53	-13
	Stithians		4967	56	41	35	-23	18	1990	81	-46
Welsh	Celyn & Brenig	•	131155	61	67	71	-14	48	1989	91	-20
	Brianne		62140	72	87	100	7	57	1995	100	0
	Big Five	•	69762	52	61	73	-4	38	2003	79	-6
	Elan Valley	•	99106	48	57	73	-12	37	1995	89	-16
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	78	80	81	0	48	2003	87	-6
	East Lothian	•	9374	77	74	67	-18	38	2003	95	-28
Scotland(W)	Loch Katrine	•	110326	59	68	89	2	40	2003	99	-10
	Daer		22494	64	75	86	-4	42	2003	98	-12
	Loch Thom		10798	93	100	100	10	66	2007	100	0
Northern Ireland	Total+	•	56800	70	67	66	-15	39	1995	99	-33
	Silent Valley	•	20634	66	63	58	-19	34	1995	99	-41

( ) 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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