Hydrological Summary

for the United Kingdom

November 2018

General

November was a mixed month with settled and cold periods interspersed with mild and stormy interludes. Although rainfall for the UK was near average there were distinct spatial variations, it was drier than average in a band from East Anglia to north-west England and in northern Scotland, and wetter than average in southern England and southern Scotland. Month-end soil moisture deficits (SMDs) remained above average across much of the country, but were eradicated in parts of southern England and Northern Ireland. River flows in western areas were above normal, but elsewhere they remained largely in the normal range or below with exceptionally low flows in catchments in central England and northern Scotland. Groundwater levels continued to fall at the majority of sites in November and were in the normal range or below for the time of year although there was some recharge at faster responding sites. Whilst there was some seasonal recovery in reservoir stocks, most impoundments remained below average, particularly so in England (e.g. 40% below average at Derwent Valley and a third below average at Ardingly). For England and Wales as a whole late November stocks were the fourth lowest in a series from 1990 and the lowest after 2003. Given the current water resources situation, and that any recharge to reservoir stocks and groundwater levels will be starting from a below normal baseline, above average rainfall will be required to return conditions to the normal range in central and eastern England. Although December so far has been wetter than average, forecasts for the winter period remain uncertain.

Rainfall

Following a settled start to November, southerly winds brought mild and wet weather to most parts of the country until mid-month. On the 7th, Atlantic frontal systems pushed rain north-eastwards across the British Isles causing pluvial flooding and widespread transport disruption in Northern Ireland, and the London to Cornwall rail line was closed at Dawlish, Devon. On the 9th, another system brought further rainfall (44mm was recorded at Logan Botanical Garden, Dumfries & Galloway), and caused disruption in Northern Ireland, south-west England (power was lost to 19,000 properties), and in south-west Wales (where residents were rescued from properties in Milford Haven). A high-pressure system over Scandinavia brought settled conditions for most of the second half of November until the 27th. Successive fronts brought heavy rainfall until month-end (56mm was recorded at Keswick on the 29th) and road, rail and ferry travel was disrupted in Scotland, Wales and Northern Ireland. November rainfall for the UK was near average although this masked regional differences. Above average rainfall was recorded in bands across southern Scotland, Northern Ireland, and southern England and Wales, with localised areas receiving more than of 170% of average. Elsewhere, below average rainfall was recorded, with less than 50% of average in parts of north-west England and the far north of Scotland. For the autumn (September-November), most regions in England and Northern Ireland received below average rainfall, particularly so in southern Britain (e.g. the Anglian region recorded three quarters of average). For the summer and autumn combined (June-November) large areas of England received less than 70% of the average rainfall and the Anglian region recorded two thirds of average.

River flows

Recessions established at the end of October continued into early November, with new November daily flow minima set in catchments in southern England and Northern Ireland (e.g. the Coln and Lagan). Flows increased on the 9th/10th with new November daily flow maxima established in many catchments (e.g. the Dart, Tamar and Nith). Recessions resumed in the majority of catchments mid-month, until the 27th-29th when new daily flow maxima were set (e.g. Scottish Dee, Dart, Cynon and Annacloy). November monthly mean flows remained in the normal range or below for the time of year in the majority of catchments. Flows were notably or exceptionally low and less than a third of average in many catchments (e.g. the Naver, Warwickshire Avon, Soar and Coln) with the latter recording its second lowest November mean flows in a record from 1963. In contrast, notably high flows were recorded on the Scottish Dee, Nith and Cree (the latter recorded its fifth highest November mean flows in a record from 1963). Mean river flows for the autumn (September-November) were less than half the average in a number of catchments across England and Scotland, and around a third of average on the Deveron, Tweed, Tyne, Soar and Coln. In contrast, flows in western Scotland and southern Wales were above normal, notably so on the Carron and Nevis with the latter recording its second highest mean autumn flows in a record from 1982. A similar pattern exists over six months (June-November) although low flows in catchments in central England and northern Scotland were more extreme (the Soar recorded its lowest June-November flows in a record since 1972). The outflows from England were below average for the majority of days over the June-November period.

Groundwater

In areas with above average rainfall, SMDs decreased and were eradicated in parts of southern Britain and Northern Ireland. However, SMDs persisted in central and eastern England. Groundwater levels at the majority of the Chalk index sites continued to recede during November although at faster responding sites across southern England recharge commenced. Levels stabilised by the end of the month and rose overall at West Woodyates Manor. At Killyglen, levels also rose to the normal range despite a lowest record level in October. Elsewhere levels remained in the normal range or below, exceptionally so at Chilgrove House. In the more rapidly responding Jurassic and Magnesian limestones, levels continued to fall and were in the normal range, except at Ampney Crucis, where despite responding to recharge, levels remained below normal. Groundwater levels in the Upper Greensand at Lime Kiln Way stabilised and remained in the normal range. In the Permo-Triassic sandstones, levels rose at Skirwith and Newbridge, the latter registered as notably high. Levels stabilised at Llanfair DC where they were notably low and fell in the Midlands where they remained in the normal range. Levels in the Carboniferous Limestone in south Wales rose overall and remained in the normal range. In the Peak District, levels stabilised at Alstonfield and were notably low. In the Fell Sandstone at Royalty Observatory, levels fell and remained in the normal range.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

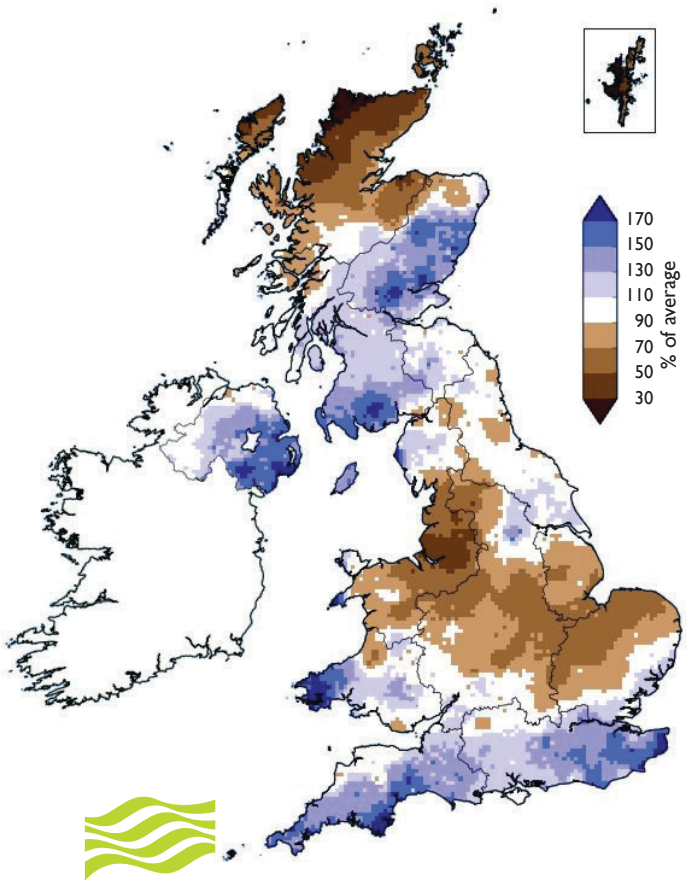
Region	Rainfall	Nov 2018	Sep18 – Nov18	RP	Jun18 – Nov18	RP	Mar18 – Nov18	RP	Dec17 – Nov18	RP
United Kingdom	mm	**123**	332		507		746		1066	
	%	**104**	99	2-5	89	2-5	93	2-5	95	2-5
England	mm	**89**	218		335		565		798	
	%	**103**	89	2-5	77	5-10	92	2-5	95	2-5
Scotland	mm	**161**	498		758		990		1412	
	%	**100**	108	2-5	101	2-5	94	2-5	93	2-5
Wales	mm	**170**	450		634		970		1410	
	%	**108**	103	2-5	89	2-5	97	2-5	99	2-5
Northern Ireland	mm	**146**	273		504		729		1090	
	%	**130**	84	2-5	87	2-5	89	2-5	96	2-5
England & Wales	mm	**100**	250		377		621		883	
	%	**104**	92	2-5	79	5-10	93	2-5	96	2-5
North West	mm	**105**	356		552		756		1107	
	%	**83**	97	2-5	87	2-5	86	5-10	91	2-5
Northumbria	mm	**88**	241		408		615		820	
	%	**98**	98	2-5	90	2-5	97	2-5	94	2-5
Severn-Trent	mm	**59**	181		280		528		735	
	%	**80**	82	2-5	69	10-20	91	2-5	94	2-5
Yorkshire	mm	**79**	215		331		563		760	
	%	**95**	93	2-5	76	5-10	92	2-5	90	2-5
Anglian	mm	**47**	133		224		412		587	
	%	**78**	75	2-5	66	10-20	86	2-5	94	2-5
Thames	mm	**82**	180		263		488		687	
	%	**110**	85	2-5	71	8-12	92	2-5	96	2-5
Southern	mm	**126**	218		332		571		815	
	%	**139**	87	2-5	81	2-5	100	2-5	102	2-5
Wessex	mm	**123**	229		331		592		841	
	%	**127**	86	2-5	75	5-10	94	2-5	95	2-5
South West	mm	**194**	361		503		825		1212	
	%	**140**	98	2-5	84	2-5	98	2-5	99	2-5
Welsh	mm	**164**	432		611		942		1364	
	%	**108**	103	2-5	89	2-5	98	2-5	100	2-5
Highland	mm	**132**	609		881		1097		1621	
	%	**68**	111	2-5	102	2-5	90	2-5	90	2-5
North East	mm	**127**	328		486		680		865	
	%	**115**	104	2-5	90	2-5	91	2-5	85	5-10
Tay	mm	**199**	456		680		928		1219	
	%	**141**	112	5-10	103	2-5	99	2-5	91	2-5
Forth	mm	**152**	349		566		795		1099	
	%	**129**	98	2-5	93	2-5	94	2-5	91	2-5
Tweed	mm	**121**	302		525		764		1028	
	%	**117**	102	2-5	100	2-5	104	2-5	100	2-5
Solway	mm	**229**	494		785		1038		1485	
	%	**145**	109	2-5	104	2-5	99	2-5	100	2-5
Clyde	mm	**219**	585		945		1217		1783	
	%	**116**	106	2-5	104	2-5	97	2-5	98	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.

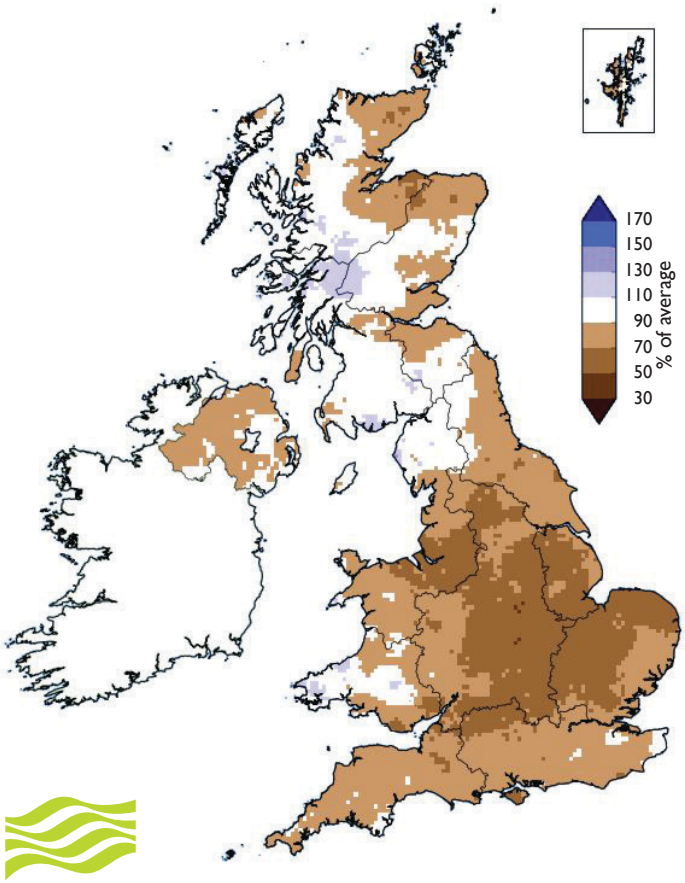
Rainfall . . . Rainfall . . .

November 2018 rainfall as % of 1981-2010 average



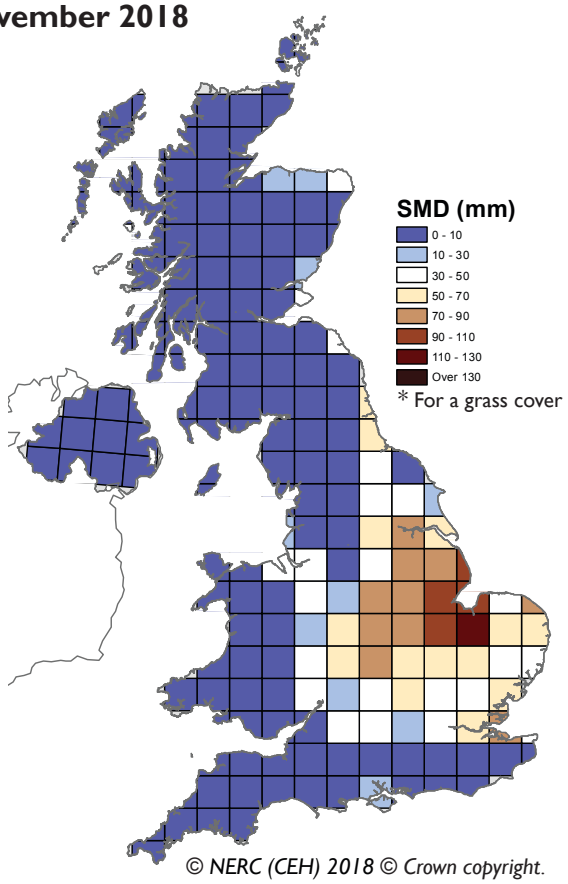
Met Office

June 2018 - November 2018 rainfall as % of 1981-2010 average



Met Office

MORECS Soil Moisture Deficits* November 2018



Hydrological Outlook UK

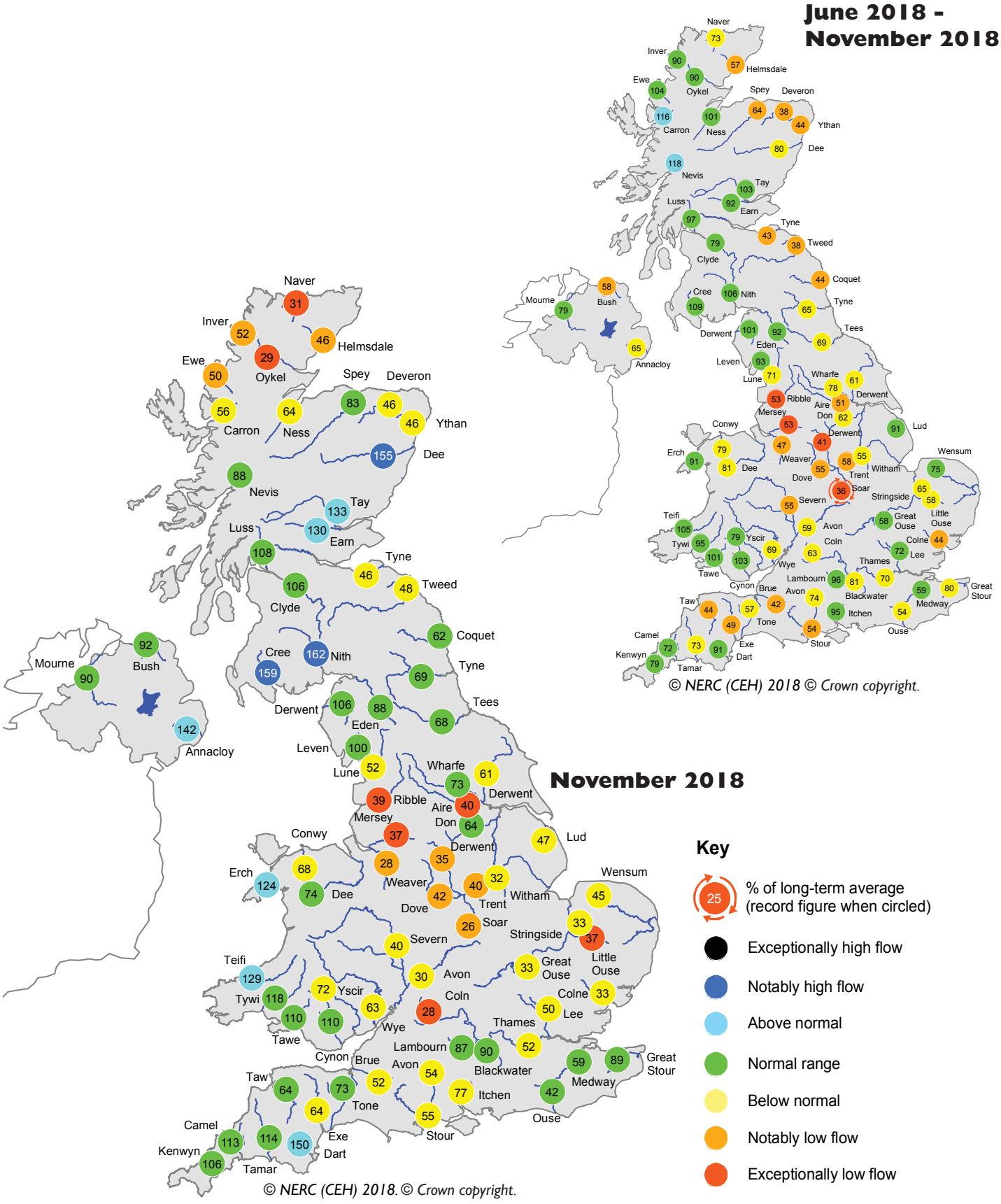
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from December 2018**
Issued: **11.12.2018**
using data to the end of November 2018

Following a wetter end to November and a wet start to December, the one month outlook for large parts of the UK is for normal to above normal flows. As a result of longer-term rainfall deficits, in north-east Scotland flows are likely to be below normal and, for a large area of central and eastern England, below normal river flows are likely to persist through the winter. December groundwater levels are likely to be in the normal range or below across the main aquifers, with below normal levels likely over the next three months in parts of the southern and eastern Chalk.

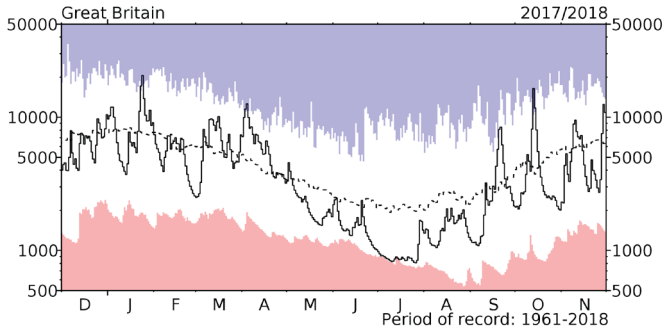
River flow . . . River flow . . .

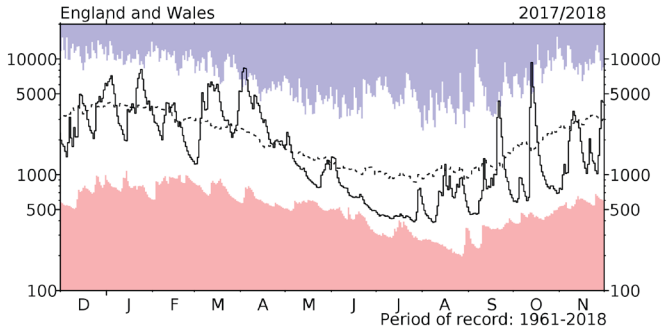


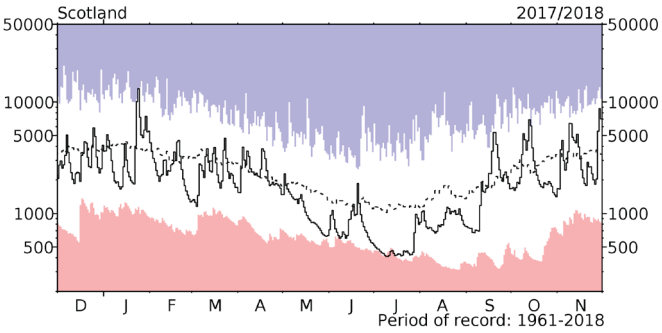
River flows

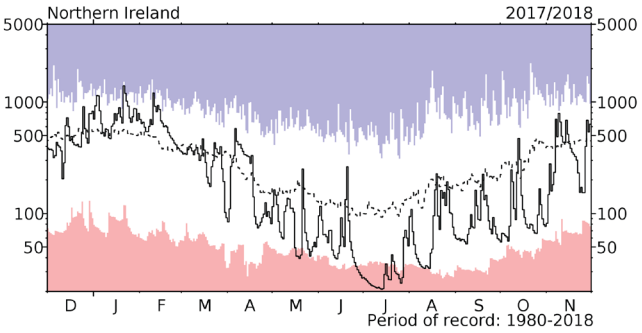
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

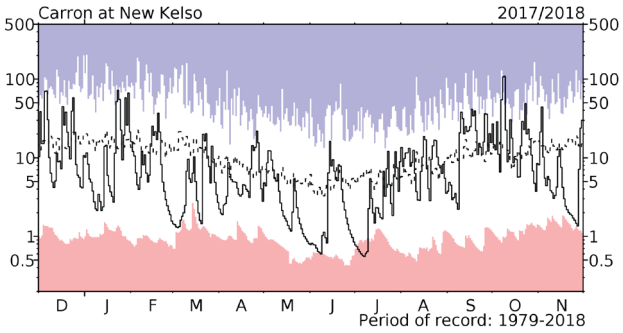
River flow . . . River flow . . .

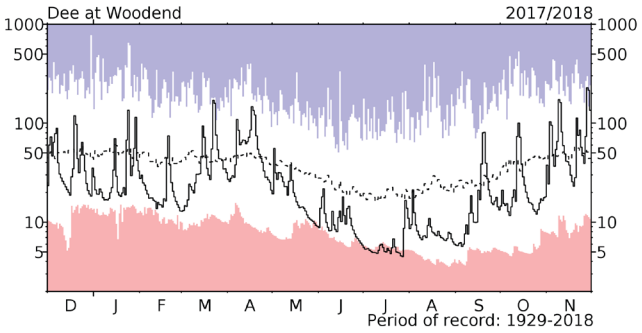


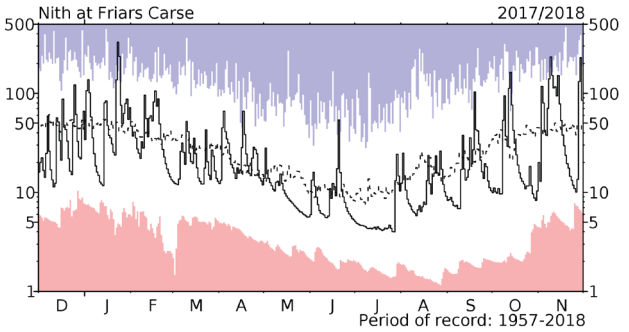


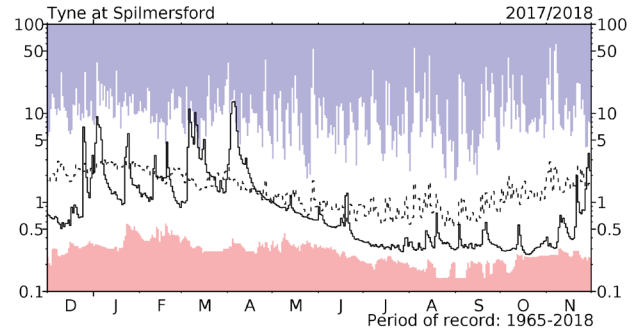


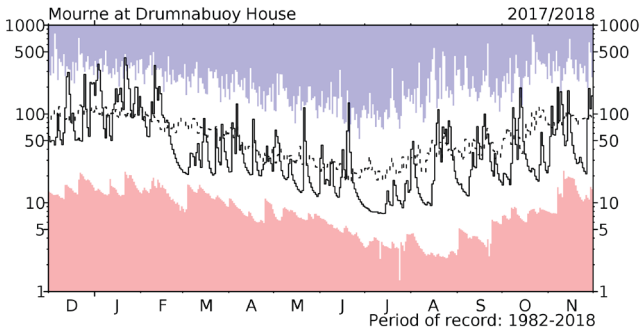


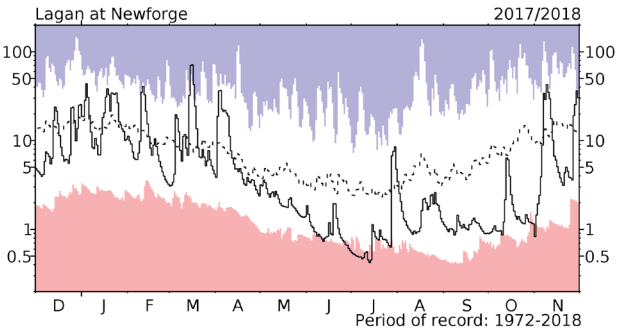








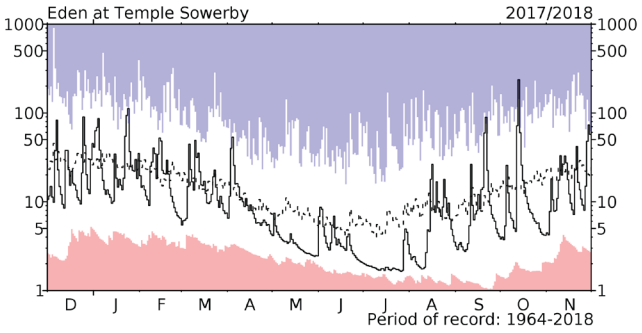


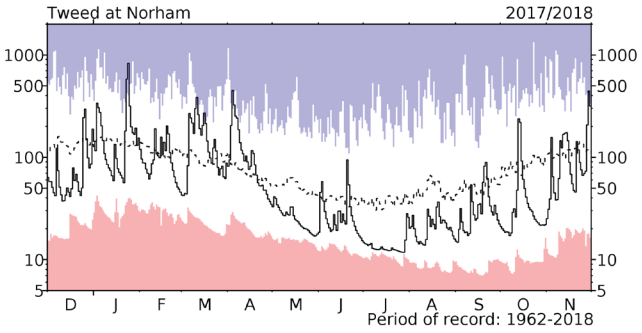


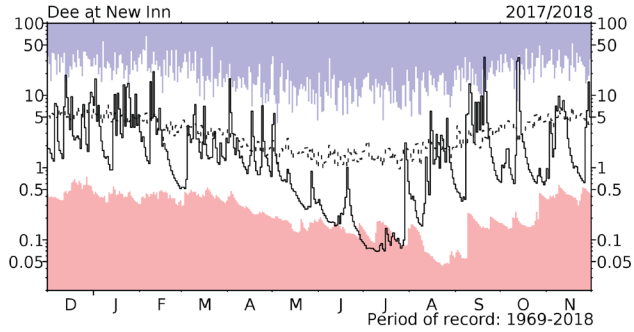
River flow hydrographs

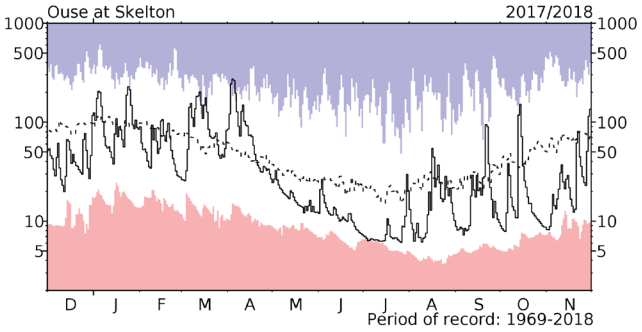
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to December 2017 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

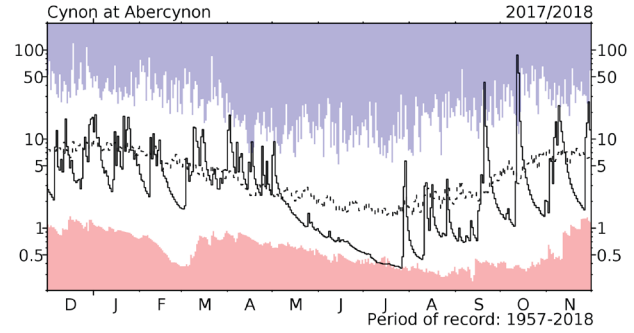
River flow . . . River flow . . .

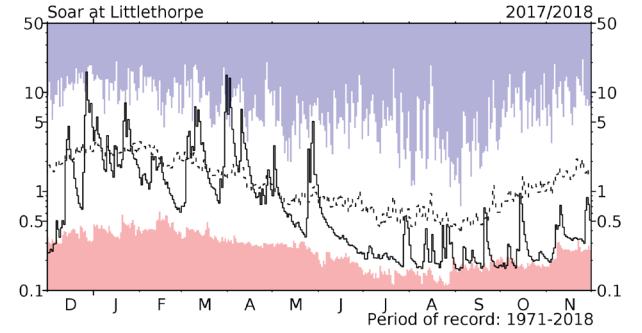


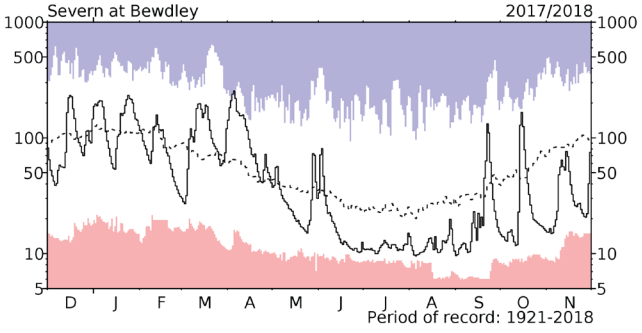


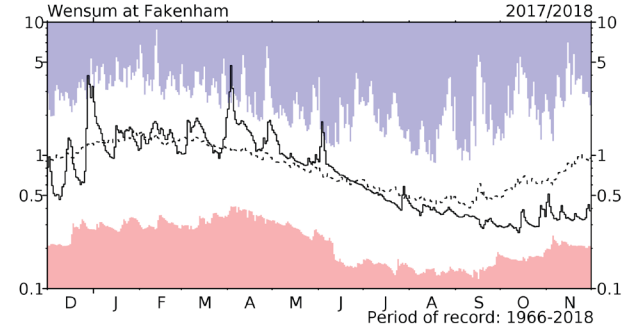


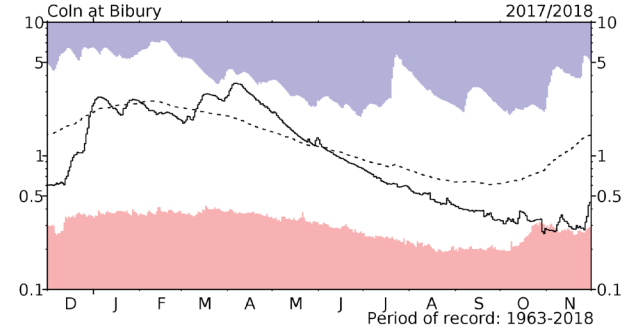


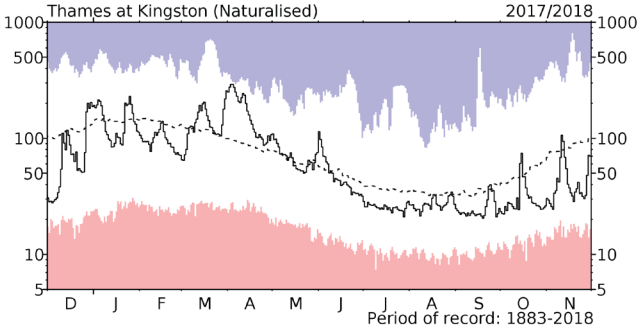


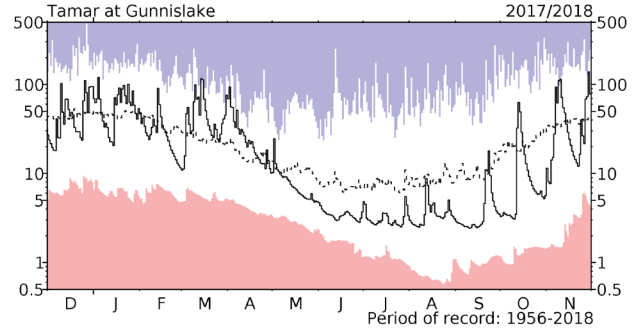


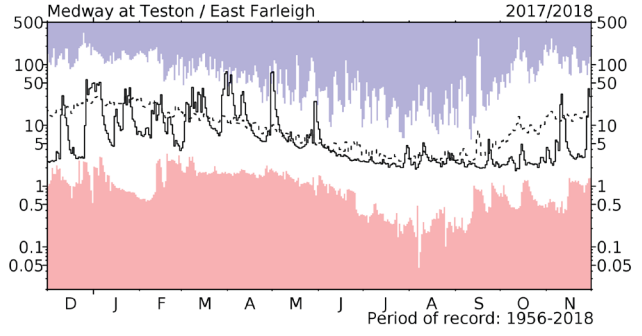




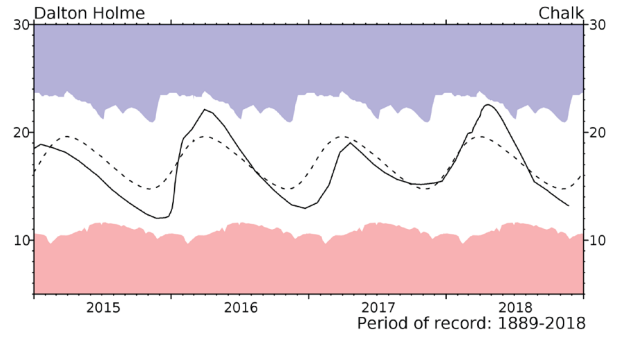


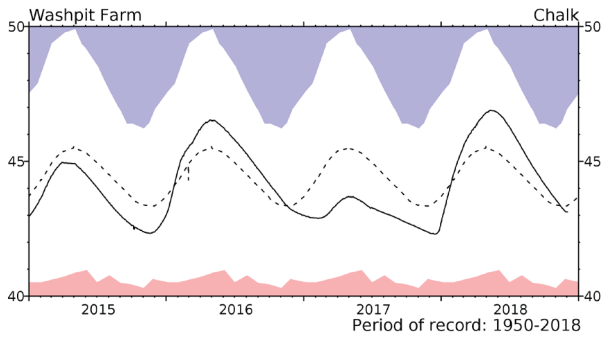


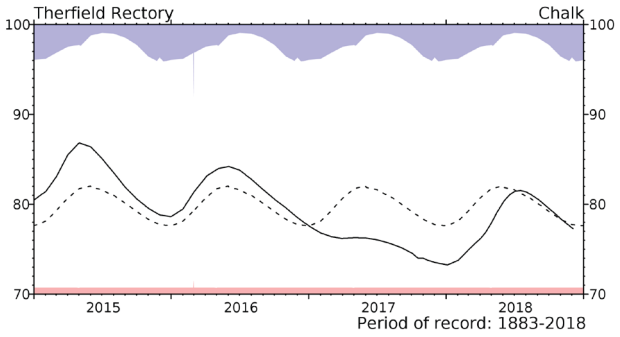


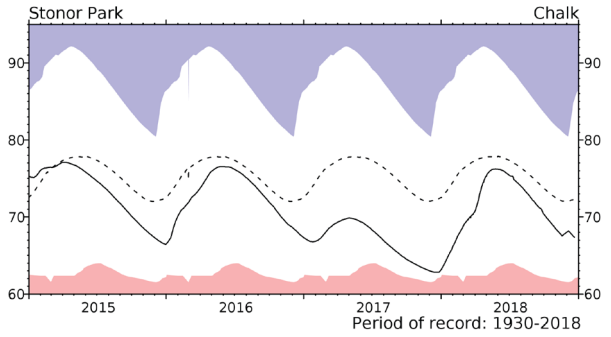


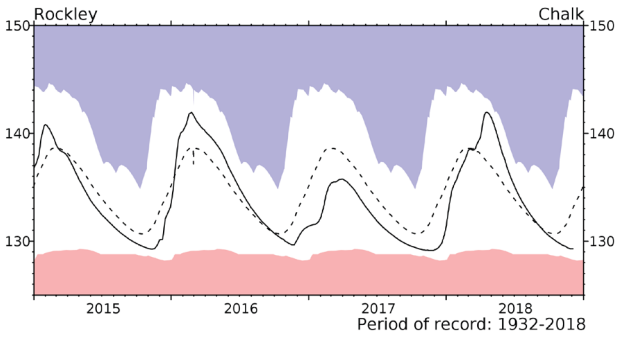
Groundwater…Groundwater

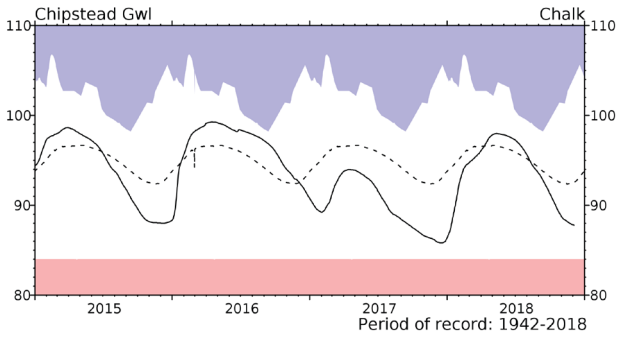


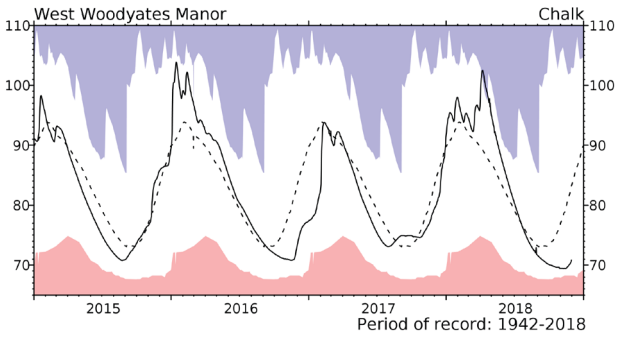


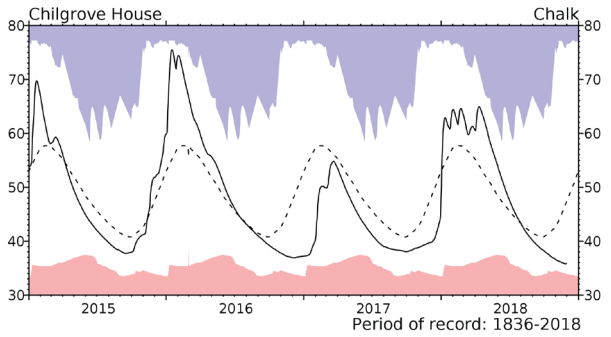


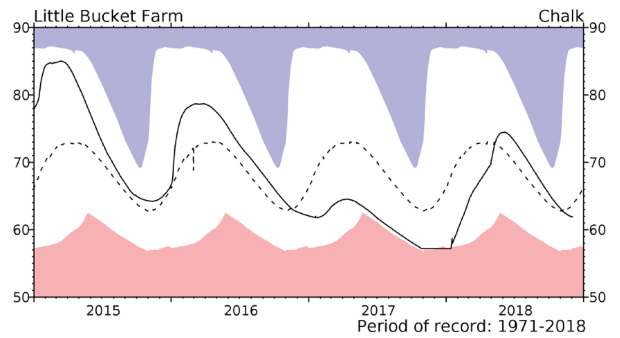


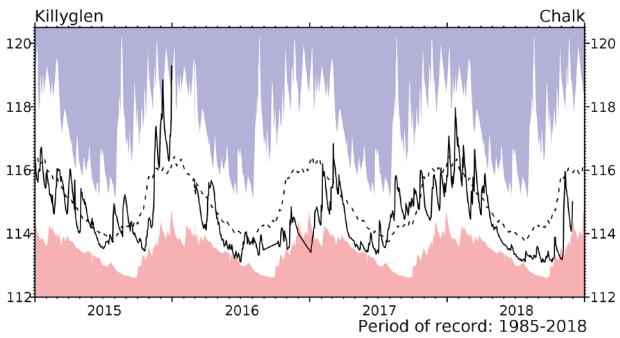






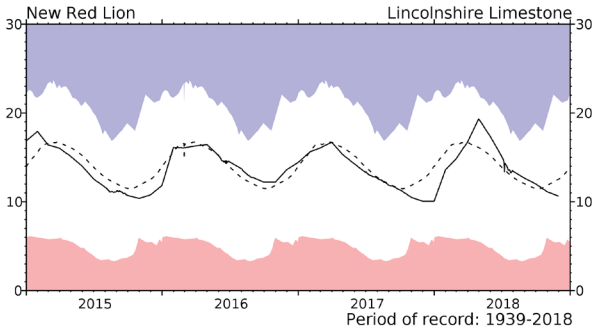


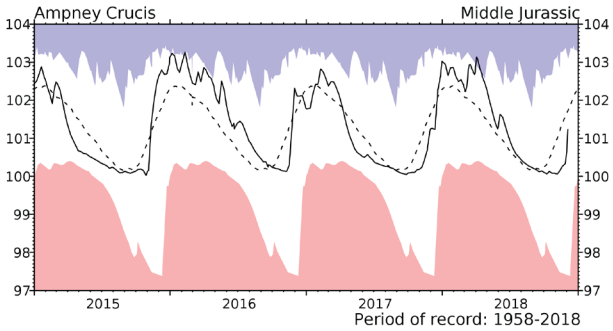


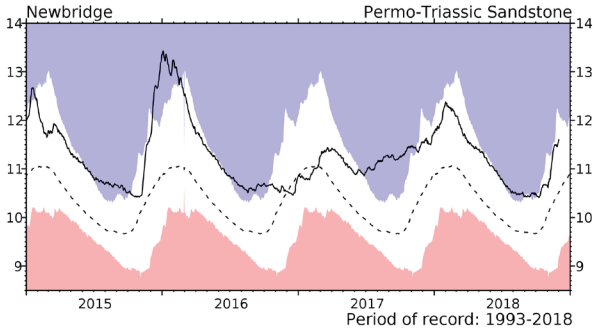


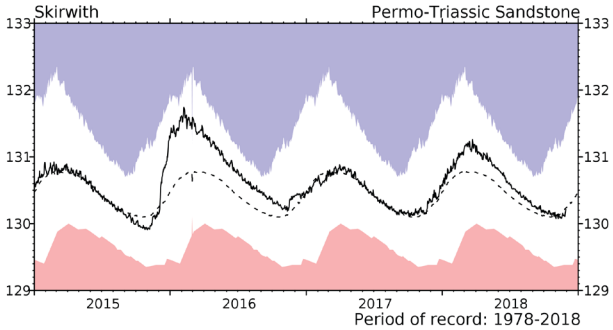
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

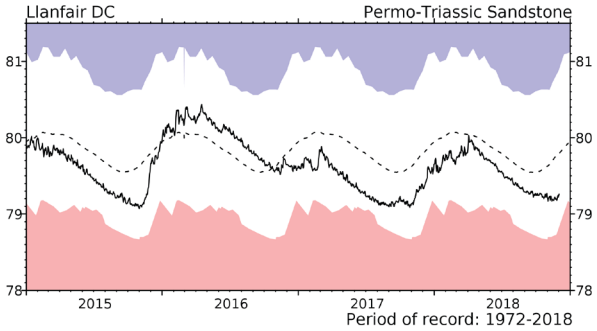
Groundwater ... Groundwater

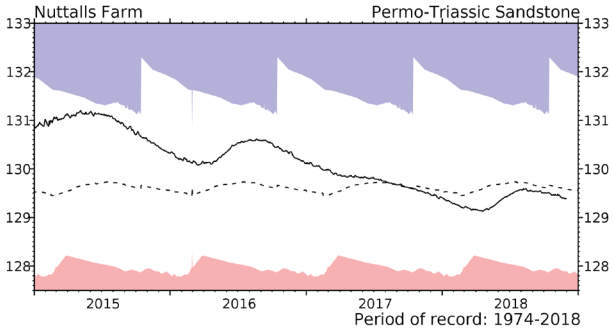


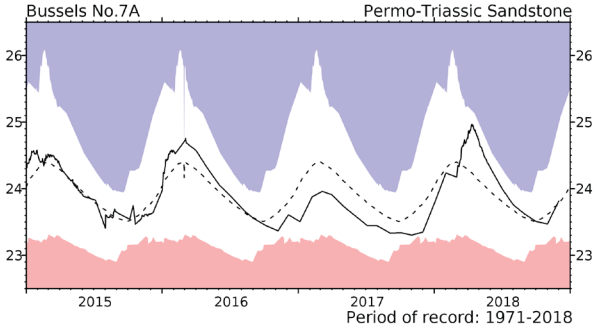


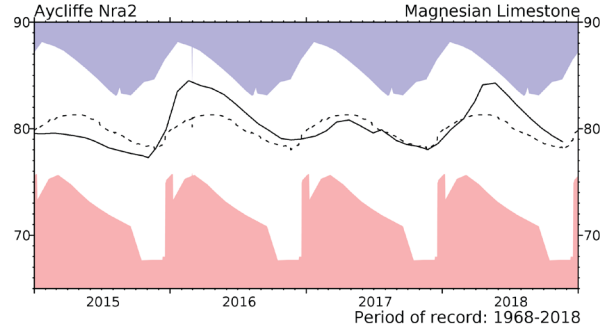


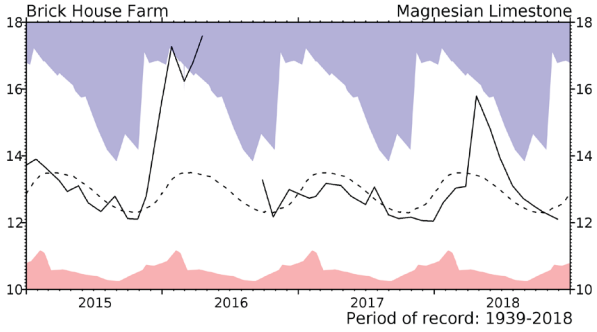


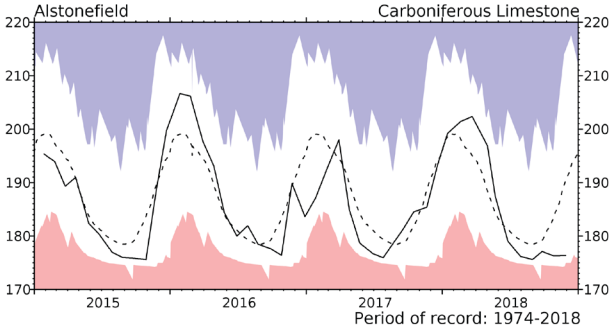


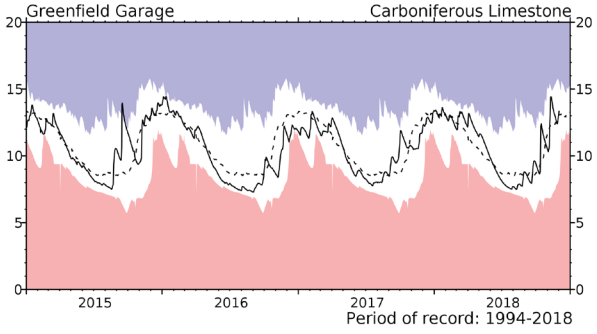


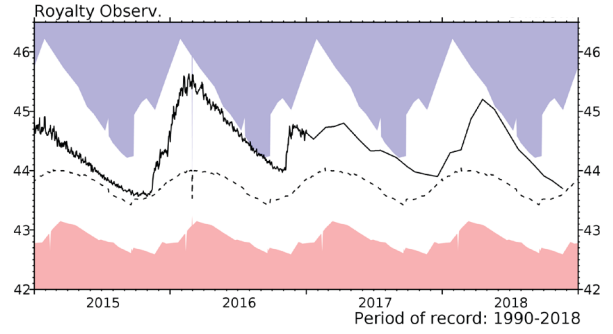


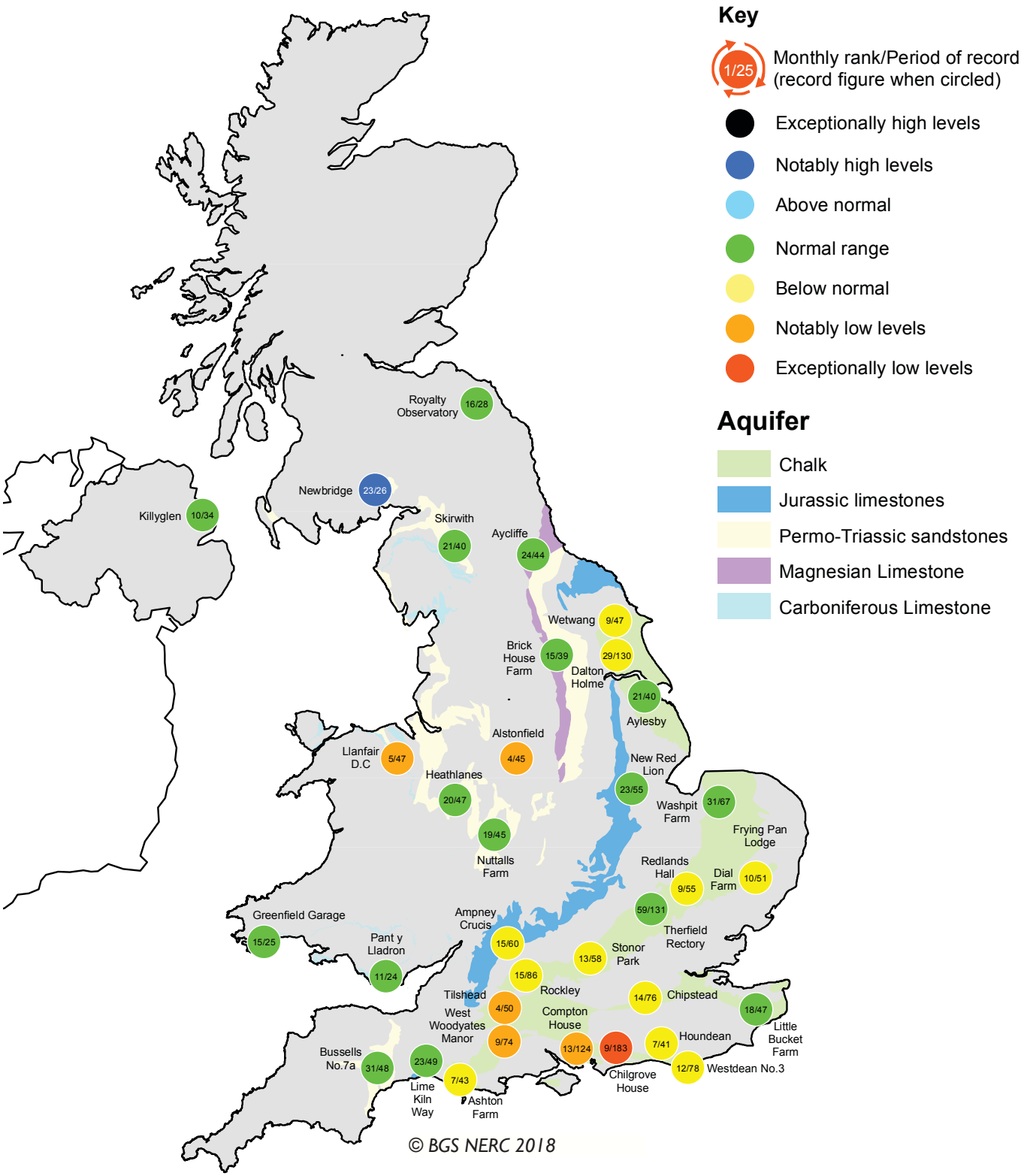










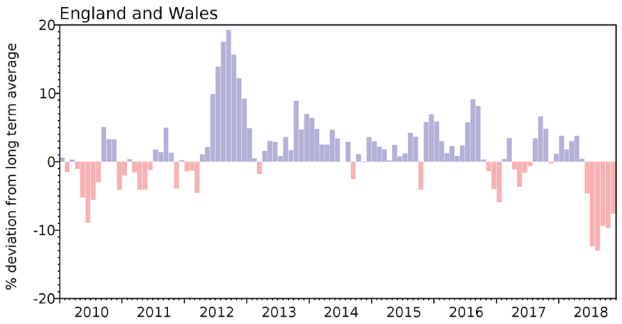


Groundwater levels - November 2018

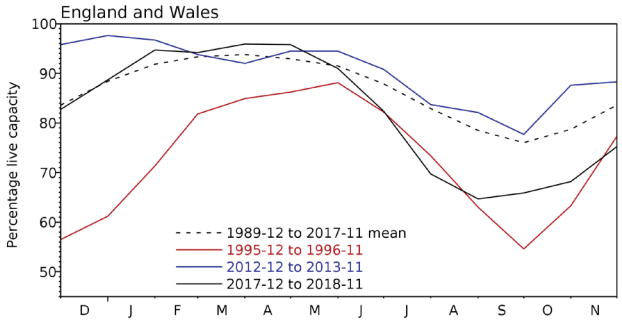
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 Sep	2018 Oct	2018 Nov	Nov Anom.	Min Nov	Year* of min	2017 Nov	Diff 18-17
North West	N Command Zone	•	124929	56	67	84	6	44	1993	82	3
	Vyrnwy		55146	73	74	81	-1	33	1995	93	-12
Northumbrian	Teesdale	•	87936	66	74	86	3	39	1995	98	-12
	Kielder		(199175)	80	80	82	-4	55	2007	83	-1
Severn-Trent	Clywedog		49936	71	79	87	6	43	1995	87	0
	Derwent Valley	•	46692	41	37	40	-40	9	1995	85	-46
Yorkshire	Washburn	•	23373	45	44	60	-16	16	1995	86	-26
	Bradford Supply	•	40942	49	46	54	-29	20	1995	91	-37
Anglian	Grafham		(55490)	74	70	60	-23	47	1997	94	-33
	Rutland		(116580)	82	79	77	-2	57	1995	81	-4
Thames	London	•	202828	62	57	61	-21	52	1990	59	3
	Farmoor	•	13822	90	88	94	6	52	1990	94	1
Southern	Bewl		31000	69	64	72	10	33	2017	33	39
	Ardingly		4685	48	40	42	-33	14	2011	87	-45
Wessex	Clatworthy		5364	36	33	52	-26	16	2003	65	-13
	Bristol	•	(38666)	58	53	61	-7	27	1990	67	-6
South West	Colliford		28540	56	54	62	-12	42	1995	88	-26
	Roadford		34500	48	46	54	-21	19	1995	79	-25
	Wimbleball		21320	47	40	50	-23	34	1995	55	-5
	Stithians		4967	41	35	55	-12	29	2001	80	-25
Welsh	Celyn & Brenig	•	131155	67	71	78	-10	50	1995	94	-16
	Brianne		62140	87	100	100	5	72	1995	100	0
	Big Five	•	69762	61	73	84	0	49	1990	84	0
	Elan Valley	•	99106	57	73	94	0	47	1995	100	-6
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	80	81	92	6	45	2003	89	3
	East Lothian	•	9374	74	67	76	-13	38	2003	97	-21
Scotland(W)	Loch Katrine	•	110326	68	89	99	8	65	2007	100	-1
	Daer		22494	75	86	99	2	73	2003	99	0
	Loch Thom		10798	100	100	99	4	72	2003	100	-1
Northern Ireland	Total+	•	56800	67	66	86	1	59	2003	98	-11
	Silent Valley	•	20634	63	58	85	4	43	2001	96	-11

( ) figures in parentheses relate to gross storage

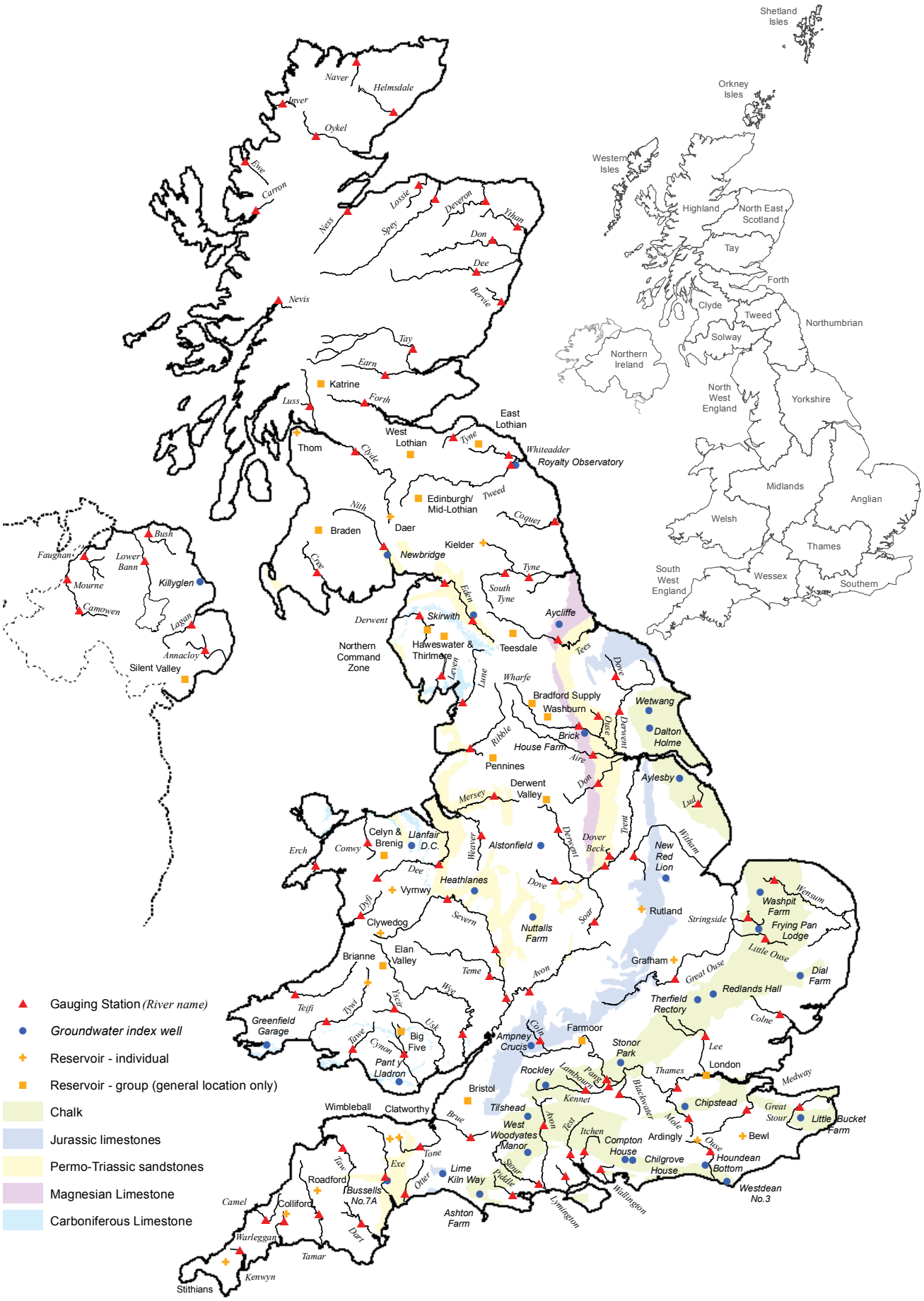
• denotes reservoir groups

*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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