Hydrological Summary
for the United Kingdom

March 2019

General

March was a month of two halves; unsettled weather dominated the first two weeks whilst the latter part was notably dry with settled conditions. Rainfall in March was notably above average, exceptionally so in Northern Ireland, Wales, north-west England and the Scottish Borders. Consequently, river flows in these areas were generally notably high and in some cases exceptionally so – a number of catchments in north Wales and north-west England recorded more than twice the average flow. Elsewhere, flows remained in the normal range and below normal flows persisted in central and eastern England. Reservoir stocks underwent something of a recovery during March, with only a handful of impoundments in eastern and south-west England remaining below average. Soil Moisture Deficits increased across the country (the only exception being the Highland region) and were above average at month-end. Groundwater levels were below normal in central and eastern England, notably so in East Anglia, and were generally in the normal range elsewhere. Whilst water resource concerns have been allayed to some extent by rainfall in March and early April, these low groundwater levels highlight the need for additional rainfall to alleviate potential water resource pressure later in 2019. However, increasing evaporation rates will limit the effectiveness of rainfall and potential for recharge, suggesting below normal groundwater levels are likely to persist through the summer in the south-east.

Rainfall

After an initially settled start, low pressure systems from the north Atlantic dominated the first two weeks bringing westerly and northwesterly winds and frequent rainfall, interspersed with brighter and showery weather. Rain spread to northern areas ahead of storm 'Freya' on the 3rd, and by the 4th, strong winds (gusts of 76mph were recorded at Mumbles, Swansea) and rain moved north-eastwards across the rest of the country. Less volatile depressions swept in from the west thereafter; 52mm was recorded at Libanus (Brecon Beacons) on the 6th and 50mm at Capel Curig (north Wales) on the 7th. On the 12th, storm 'Gareth' brought strong winds and heavy rainfall (64mm was recorded at Shap, Cumbria). Further rainfall continued over the next days and some isolated pluvial flooding was reported in Yorkshire and Cumbria. Following this unsettled period, high pressure prevailed from the 18th to month-end leading to mild, dry and at times sunnier conditions. March rainfall for the UK was 143% of the long-term average, with a number of regions receiving in excess of 170% of the average. Northern Ireland and the Tweed and Solway regions recorded their wettest March, and the UK as a whole recorded its fifth wettest March (all in a series from 1910). For the winter half year (October – March), most areas received below average rainfall with parts of north-east Britain recording less than 75%. For the UK as a whole, this represents the third consecutive dry winter half-year, notably so in northern Britain.

River flow

Starting the month at or below average, flows quickly rose in response to unsettled conditions. Following a number of stormy interludes over the first two weeks, new daily flow maxima for March were recorded on the 16th at a number of sites draining from north-west England and Wales (e.g. South Tyne, Wharfe, Conwy, Dee and Ribble). There were more than 100 Flood Alerts and Warnings in force on the 16th across the north and west of Britain, flooding occurred on the Nith and Irwell and flood barriers were assembled along the Severn in Worcestershire and Shropshire. Daily outflows for Great Britain were the highest for March on record (in a series from 1961) between the 13th and 17th, representing the spatial coverage of high flows. From the 18th, recessions began across the UK, leading to most catchments ending the month with below average flows. March monthly mean flows were generally above average, exceptionally so in Wales, Northern Ireland, north-west England and the Scottish Borders. A number of catchments in these areas (e.g. Leven, Mersey, Conwy and Welsh Dee) recorded more than twice the average flow and the Mourne recorded its highest mean March flow in a record from 1983. Monthly outflows in Northern Ireland for March were the third highest in a record since 1980. Elsewhere flows remained in the normal range and below normal flows persisted in central and eastern England. For the winter half-year (October – March), long-term flow deficits remain evident. Flows in England and eastern Scotland were generally below normal, notably and in some cases exceptionally so in central England and eastern Britain. Over this period, the Helmsdale recorded its lowest flows in a record from 1975 and a number of catchments recorded less than half of the average (e.g. Scottish Tyne, Great Ouse, Colne and Warwickshire Avon).

Groundwater

Groundwater levels at most Chalk boreholes rose during March, although Dial Farm and Therfield Rectory did not record any winter recharge. Levels at most sites remained below normal to notably low, and Dial Farm became exceptionally low. Levels at Wetwang and at sites in southern coastal counties were in the normal range and in some cases above normal, despite receding in the second half of the month. In the rapidly responding Jurassic limestones, levels rose overall but remained below normal at New Red Lion and became above average at Ampney Crucis, despite a mid-month recession. Levels rose in the Magnesian limestones, but remained below normal at both index sites. Levels in the Upper Greensand at Lime Kiln Way rose slowly and ended the month back within the normal range. In the Permo-Triassic sandstones, levels rose at Llanfair DC, Skirwith and Newbridge, but fell slightly in the Midlands and at Bussells No 7a. Levels remained below normal at Llanfair DC but were in the normal range elsewhere, with the exception of Newbridge where despite falling in the later part of the month levels remained exceptionally high, reflecting the high rainfall. In the Carboniferous Limestone, levels rose in the first half of the month, but receded subsequently in south Wales into the normal range. At Alstonfield levels rose to notably high whilst levels at Royalty Observatory rose slowly in the first half of the month and remained below average.

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.

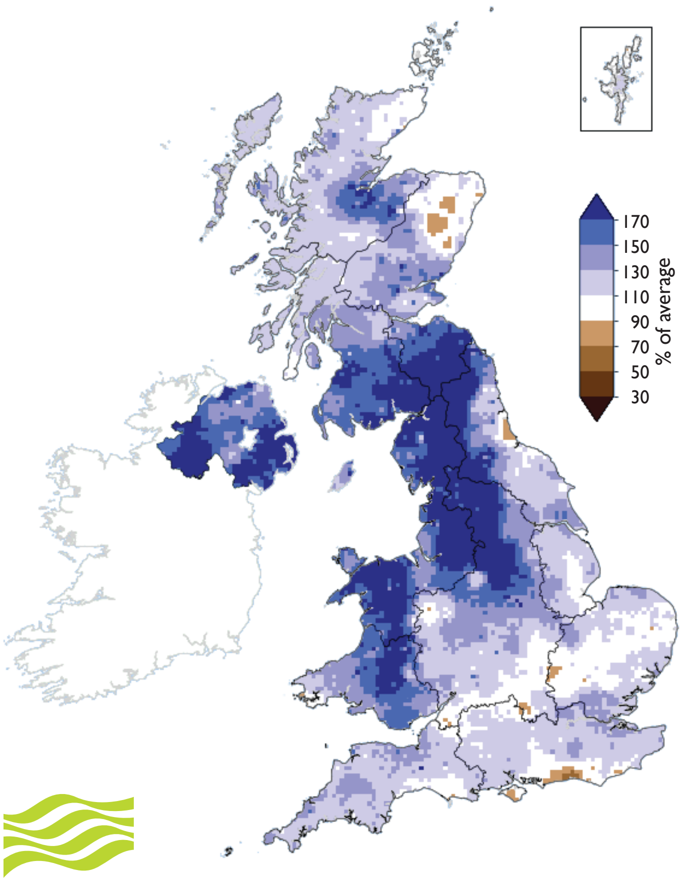
Region	Rainfall	Mar 2019	Feb19 – Mar19		Jan19 – Mar19		Oct18 – Mar19		Apr18 – Mar19	
				RP		*RP*		*RP*		*RP*
United Kingdom	mm	**133**	206		269		616		1031	
	%	**143**	114	5-10	90	2-5	93	2-5	91	2-5
England	mm	**89**	138		175		432		738	
	%	**142**	112	2-5	86	2-5	92	2-5	87	5-10
Scotland	mm	**185**	292		394		850		1417	
	%	**136**	111	5-10	90	2-5	91	2-5	93	2-5
Wales	mm	**192**	285		374		881		1394	
	%	**168**	129	5-10	100	2-5	102	2-5	98	2-5
Northern Ireland	mm	**159**	234		286		611		1039	
	%	**167**	131	10-20	97	2-5	95	2-5	91	2-5
England & Wales	mm	**103**	158		203		494		829	
	%	**148**	116	2-5	89	2-5	94	2-5	90	2-5
North West	mm	**184**	264		332		692		1156	
	%	**188**	141	20-30	107	2-5	97	2-5	94	2-5
Northumbria	mm	**113**	158		180		405		753	
	%	**171**	121	2-5	84	2-5	85	2-5	86	5-10
Severn-Trent	mm	**83**	122		155		364		672	
	%	**146**	112	2-5	86	2-5	88	2-5	86	5-10
Yorkshire	mm	**105**	145		176		413		724	
	%	**162**	115	2-5	85	2-5	90	2-5	86	5-10
Anglian	mm	**50**	79		103		273		507	
	%	**114**	95	2-5	75	2-5	87	2-5	81	5-10
Thames	mm	**59**	104		135		355		609	
	%	**116**	105	2-5	80	2-5	91	2-5	85	5-10
Southern	mm	**66**	125		158		444		738	
	%	**113**	110	2-5	80	2-5	94	2-5	92	2-5
Wessex	mm	**79**	138		180		489		768	
	%	**118**	105	2-5	81	2-5	94	2-5	87	2-5
South West	mm	**121**	195		269		741		1094	
	%	**127**	100	2-5	82	2-5	98	2-5	89	2-5
Welsh	mm	**181**	271		356		842		1338	
	%	**166**	128	5-10	100	2-5	102	2-5	98	2-5
Highland	mm	**219**	354		519		1023		1680	
	%	**127**	105	5-10	94	2-5	89	2-5	93	2-5
North East	mm	**99**	145		207		514		854	
	%	**126**	93	2-5	82	2-5	89	2-5	84	8-12
Tay	mm	**156**	239		283		714		1191	
	%	**131**	104	2-5	72	2-5	87	2-5	89	2-5
Forth	mm	**143**	209		242		570		1013	
	%	**137**	104	2-5	72	2-5	80	2-5	84	2-5
Tweed	mm	**154**	212		234		518		965	
	%	**192**	134	10-20	89	2-5	89	2-5	94	2-5
Solway	mm	**222**	345		413		939		1523	
	%	**176**	144	30-50	103	2-5	105	5-10	102	2-5
Clyde	mm	**226**	355		459		1031		1740	
	%	**137**	113	5-10	88	2-5	92	2-5	96	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.

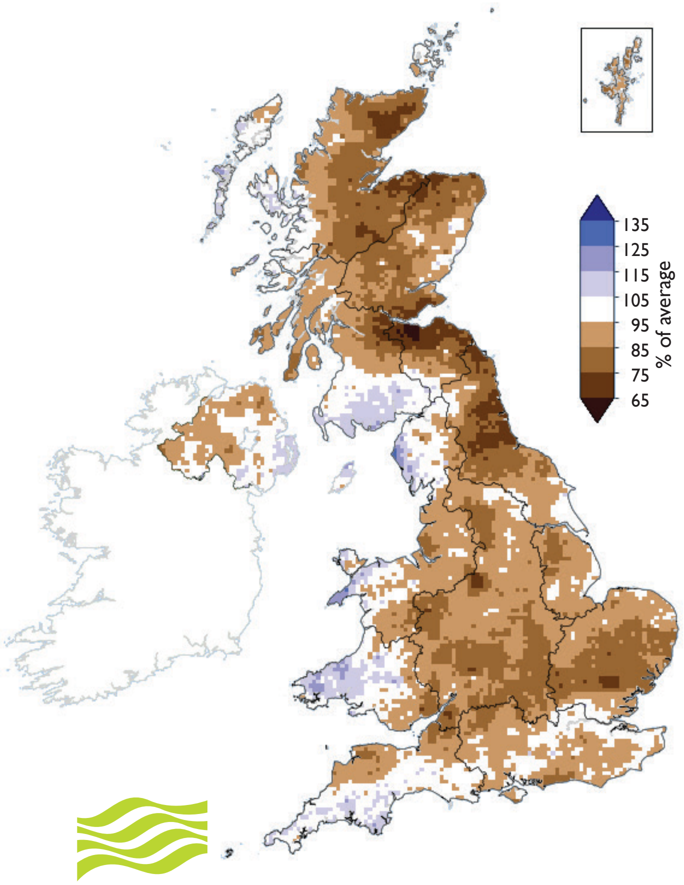
Rainfall . . . Rainfall . . .

March 2019 rainfall as % of 1981-2010 average



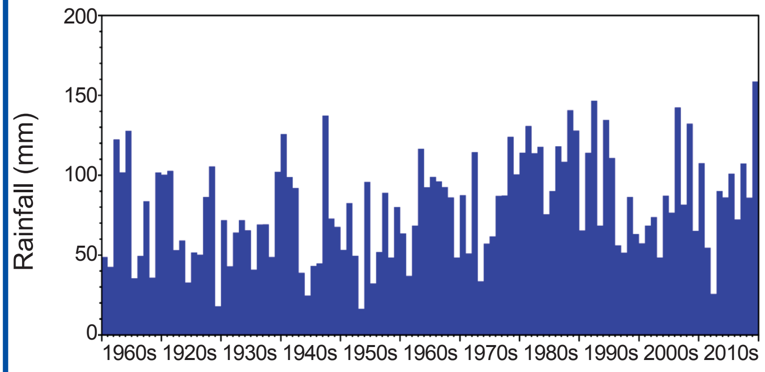
Met Office

October 2018 - March 2019 rainfall as % of 1981-2010 average

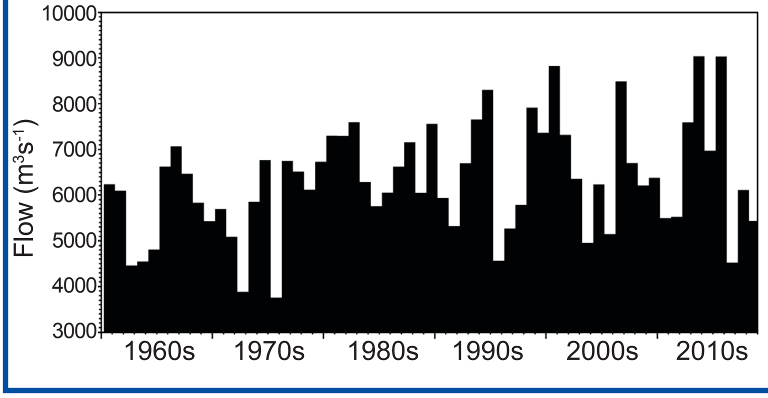


Met Office

March rainfall totals for Northern Ireland



Winter half year (Oct-Mar) average outflows from Great Britain



Hydrological Outlook UK

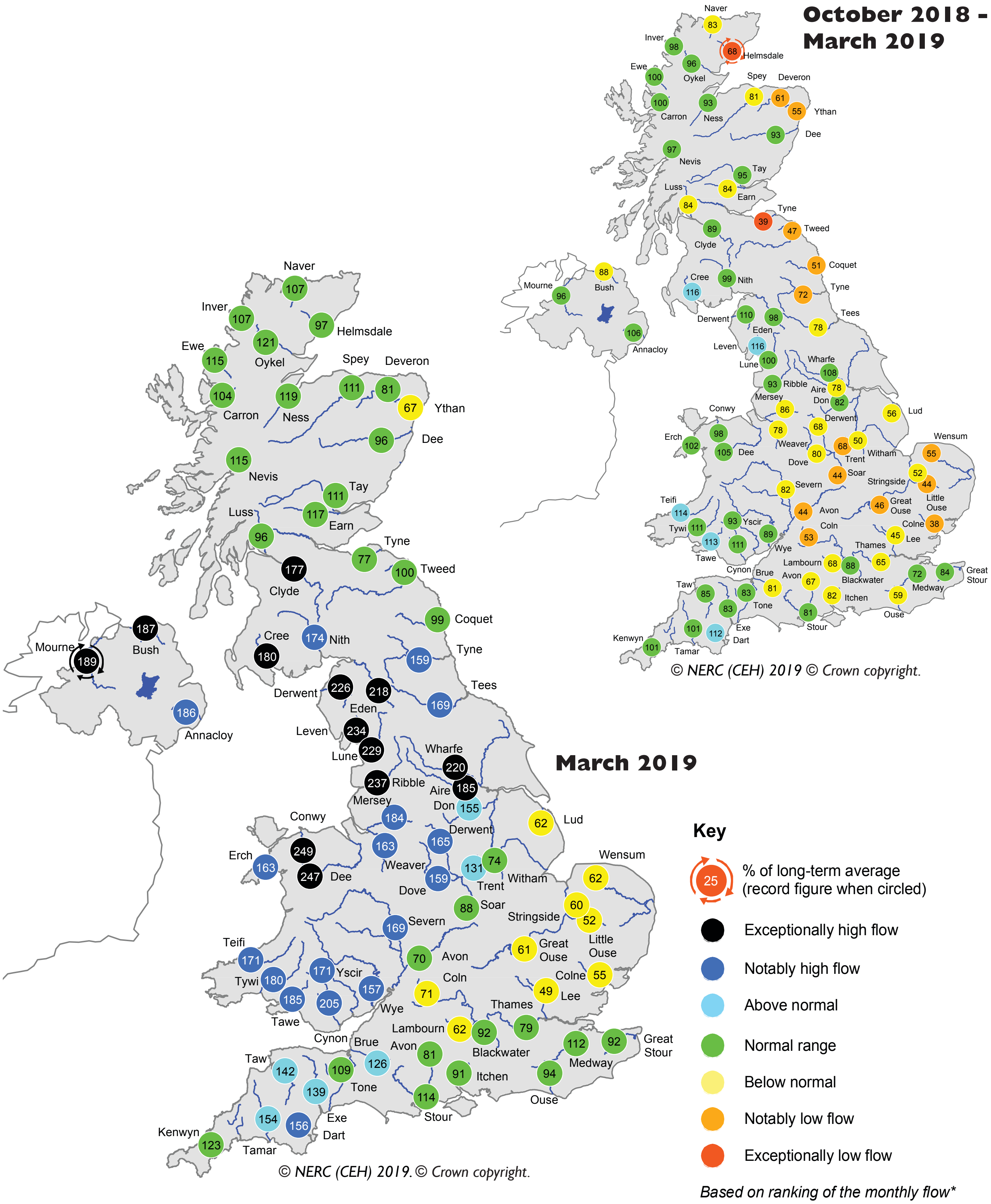
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from April 2019**
Issued: **08.04.2019**
using data to the end of March 2019

River flows and groundwater levels are likely to be in the normal range across most of the UK during April and for the period to June. The exception to this is an area of central, southern and eastern England where below normal river flows and groundwater levels are likely for the same period.

River flow . . . River flow . . .



October 2018 - March 2019

© NERC (CEH) 2019 © Crown copyright.

March 2019

© NERC (CEH) 2019. © Crown copyright.

Key

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

● Exceptionally high flow

● Notably high flow

● Above normal

● Normal range

● Below normal

● Notably low flow

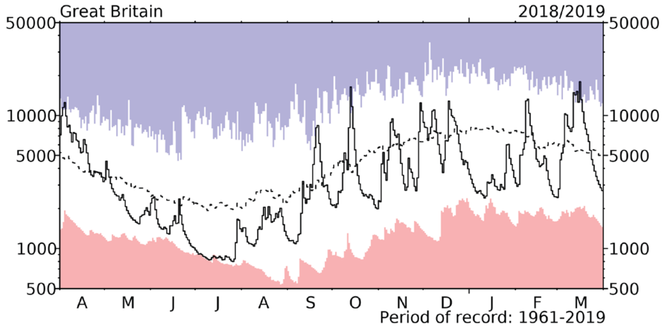
● Exceptionally low flow

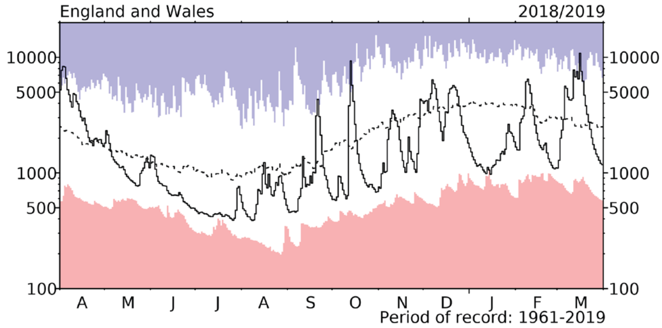
*Based on ranking of the monthly flow**

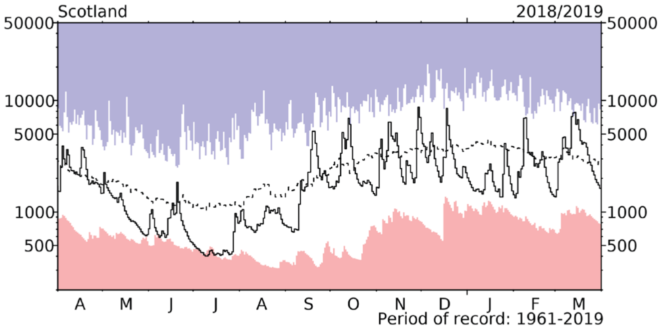
River flows

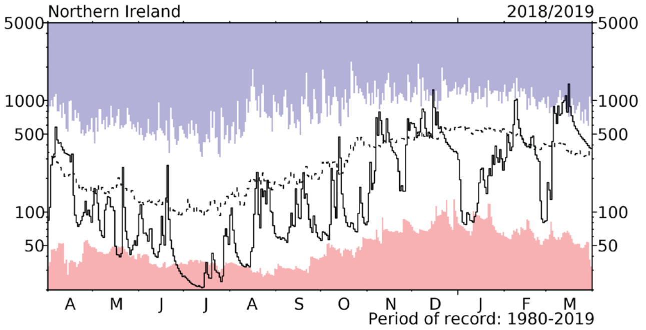
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

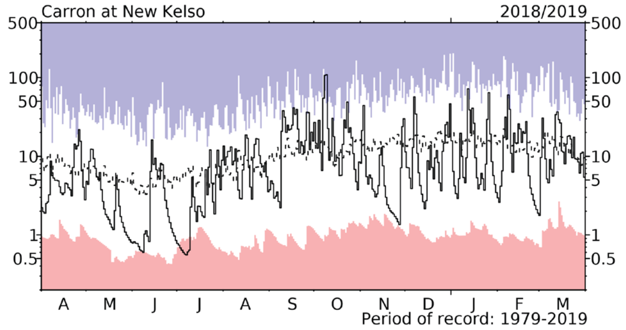
River flow . . . River flow . . .

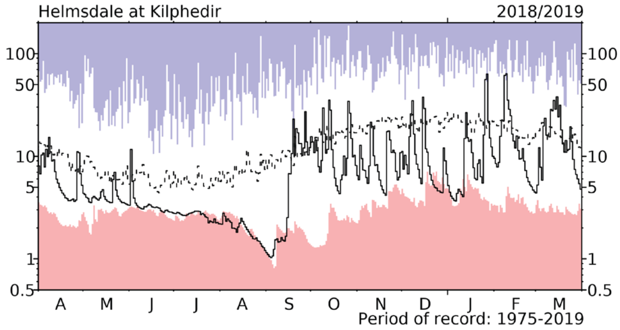


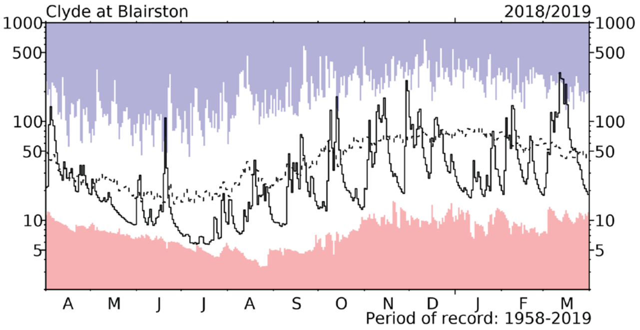


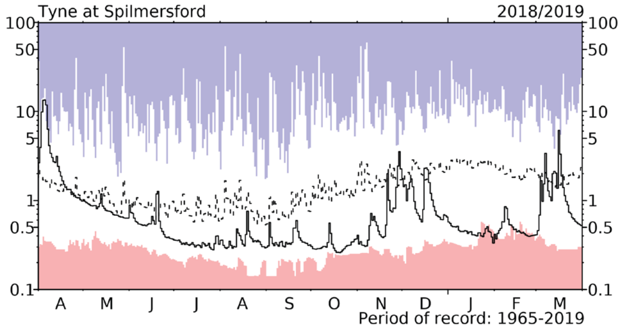


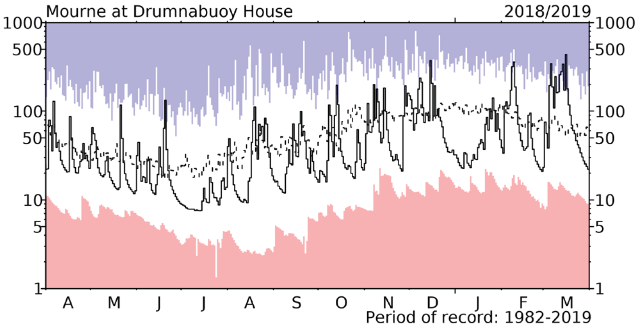


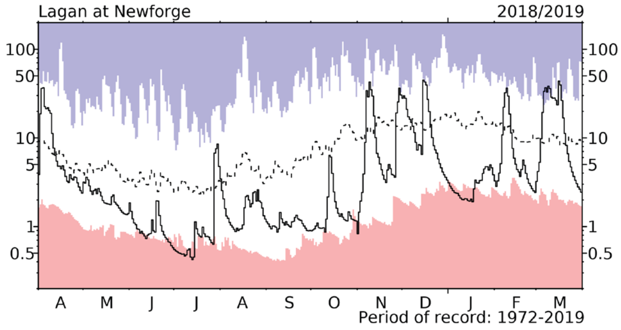










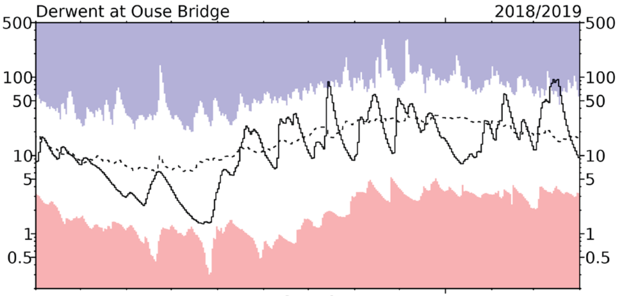


River flow hydrographs

*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to April 2018 (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.

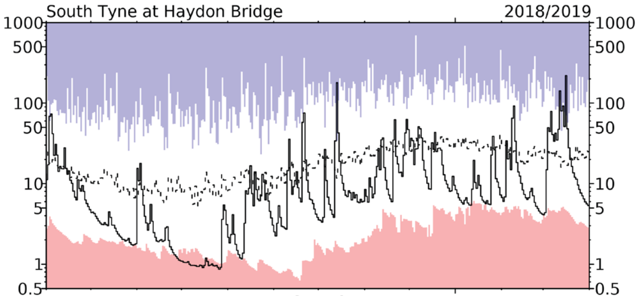
River flow . . . River flow . . .

Derwent at Ouse Bridge 2018/2019



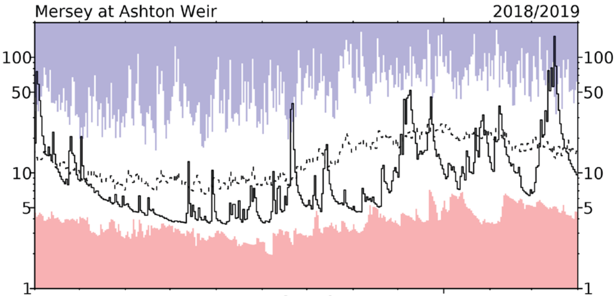
Period of record: 1968-2019

South Tyne at Haydon Bridge 2018/2019



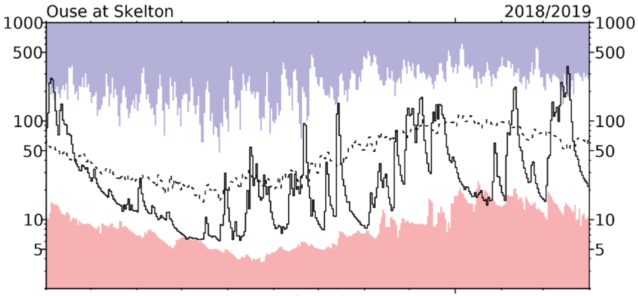
Period of record: 1962-2019

Mersey at Ashton Weir 2018/2019



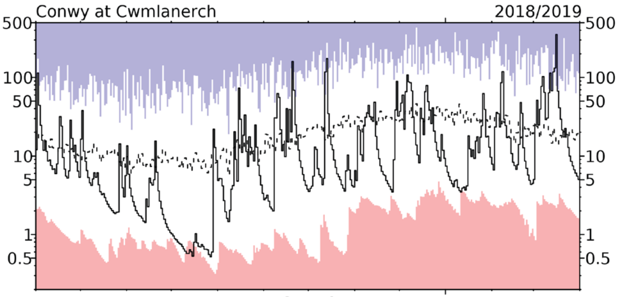
Period of record: 1976-2019

Ouse at Skelton 2018/2019



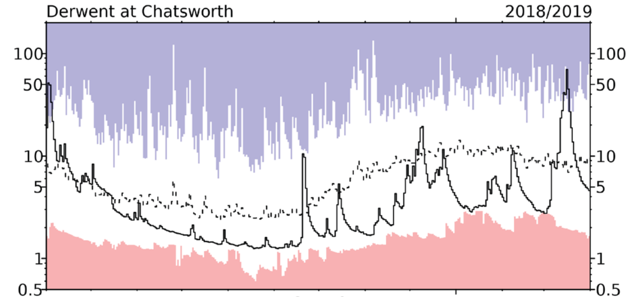
Period of record: 1969-2019

Conwy at Cwmlanerch 2018/2019



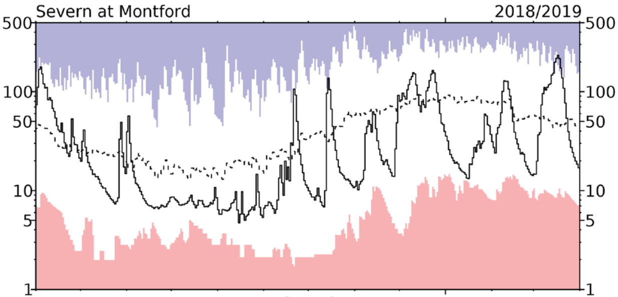
Period of record: 1964-2019

Derwent at Chatsworth 2018/2019



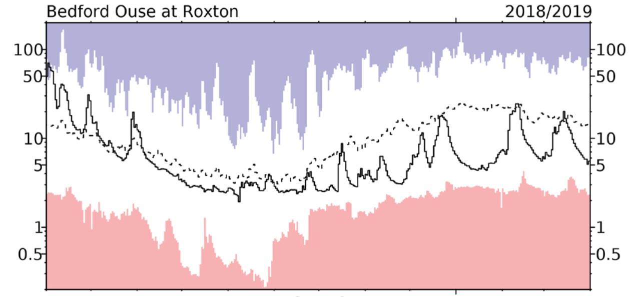
Period of record: 1968-2019

Severn at Montford 2018/2019



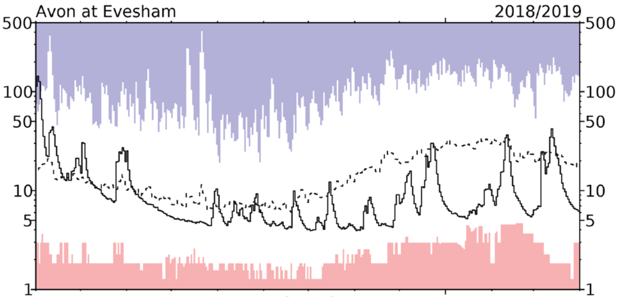
Period of record: 1953-2019

Bedford Ouse at Roxton 2018/2019



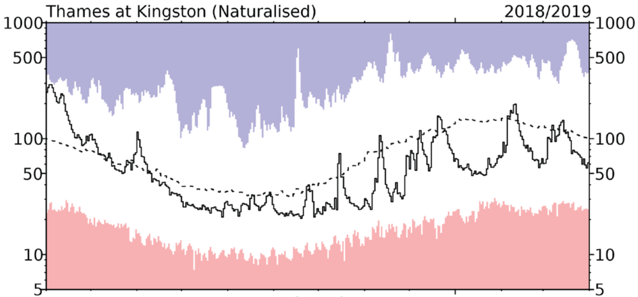
Period of record: 1972-2019

Avon at Evesham 2018/2019



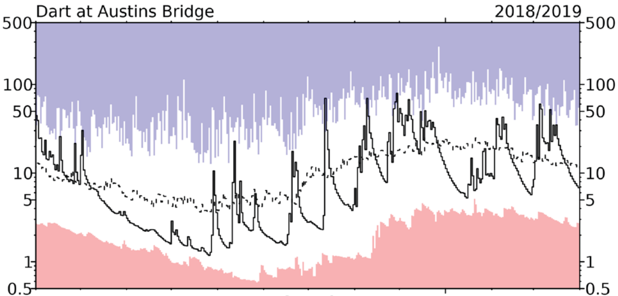
Period of record: 1936-2019

Thames at Kingston (Naturalised) 2018/2019



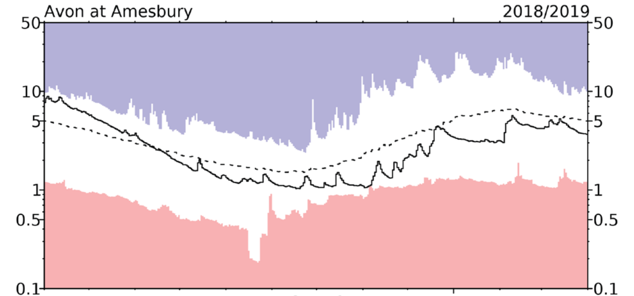
Period of record: 1883-2019

Dart at Austins Bridge 2018/2019



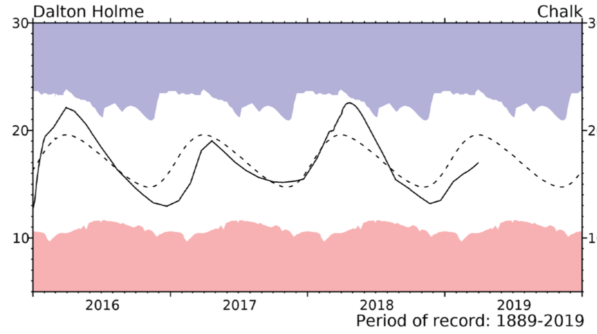
Period of record: 1958-2019

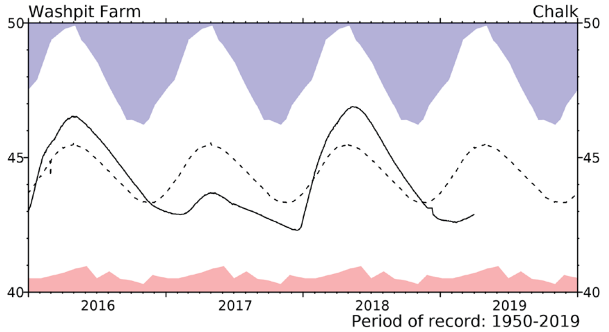
Avon at Amesbury 2018/2019

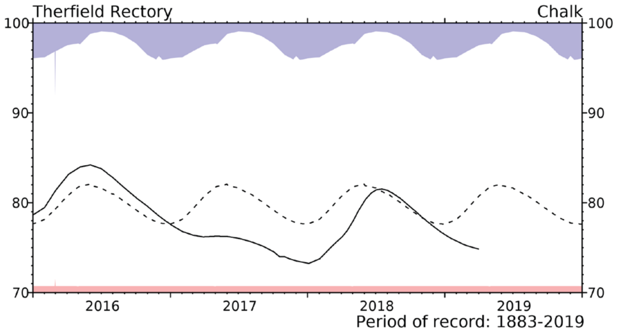


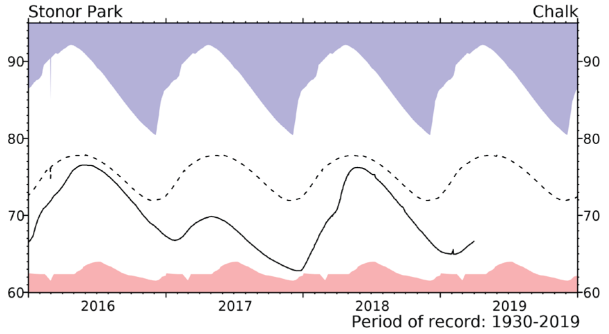
Period of record: 1965-2019

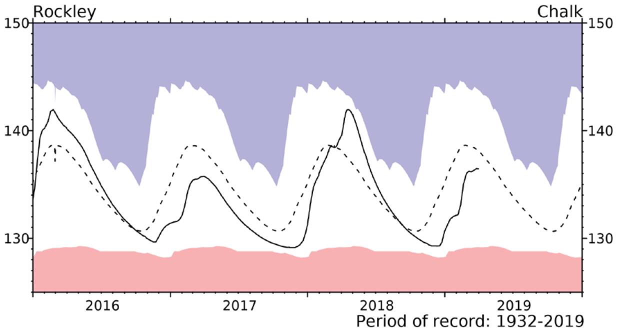
Groundwater . . . Groundwater

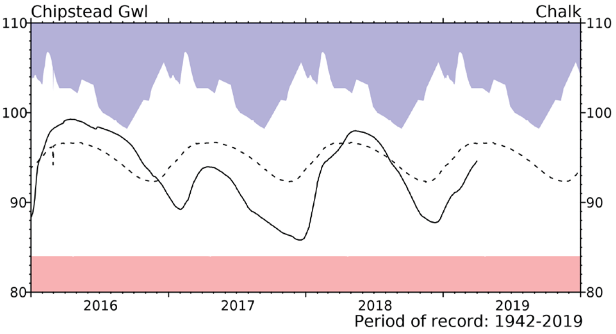


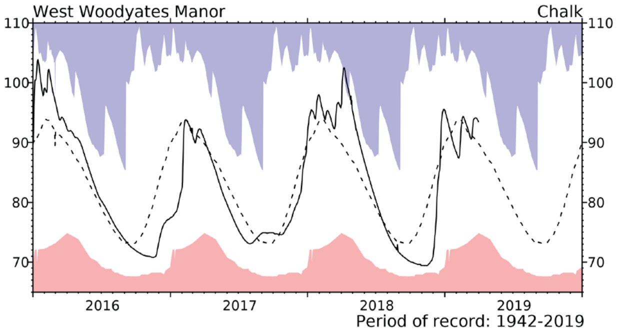


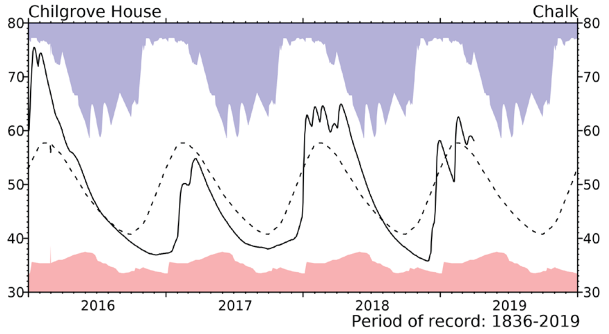


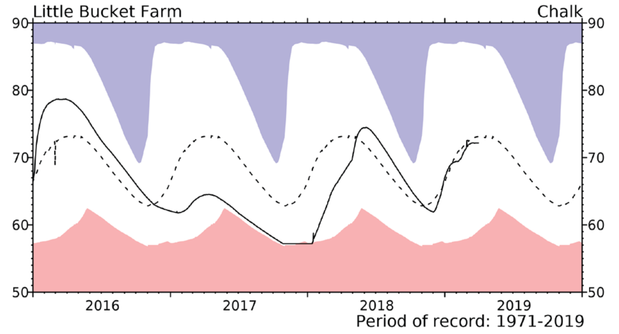


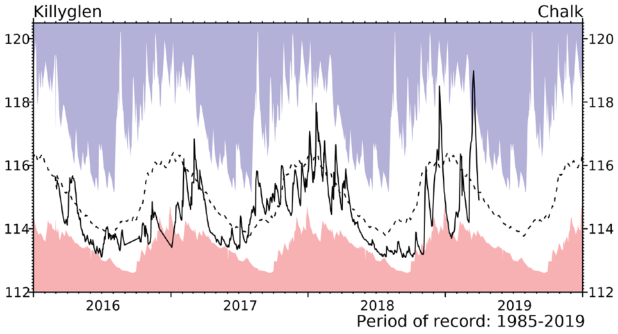






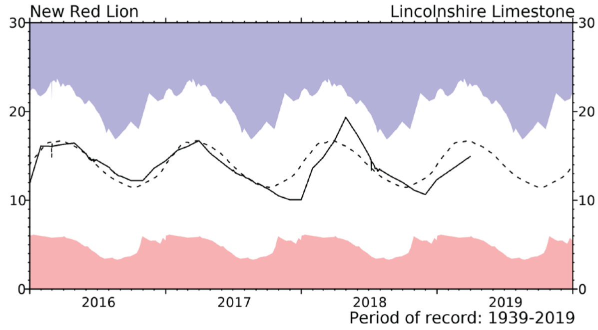


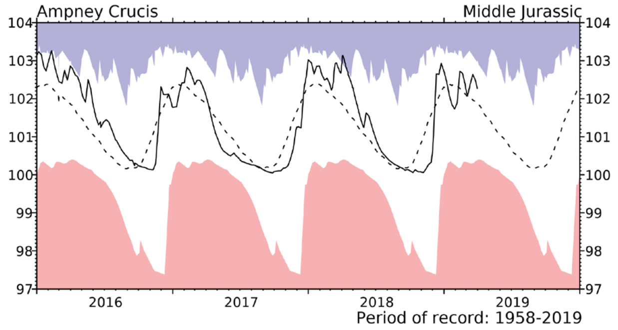


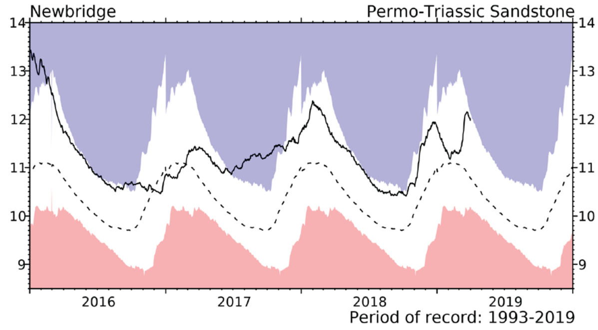


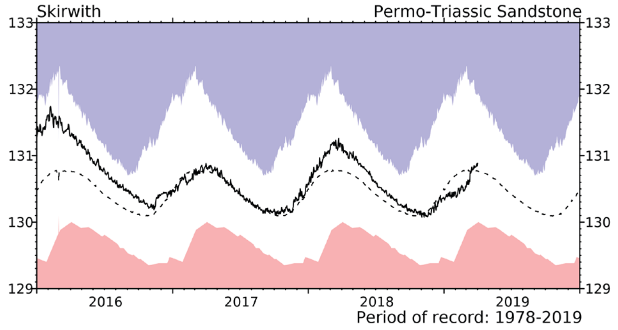
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

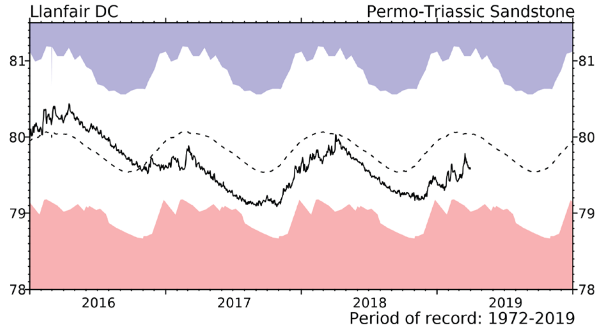
Groundwater ... Groundwater

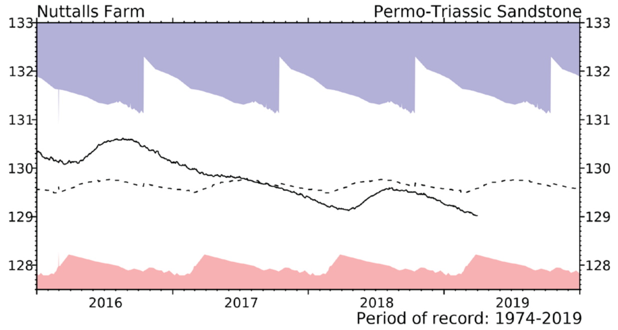


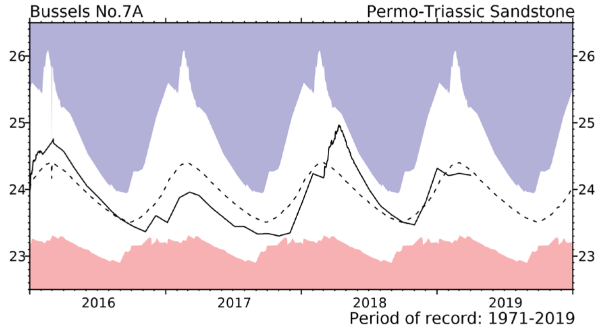


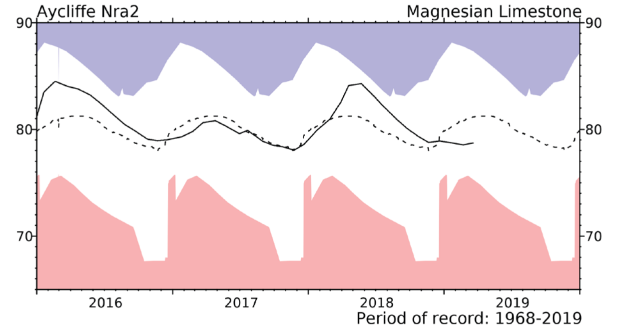


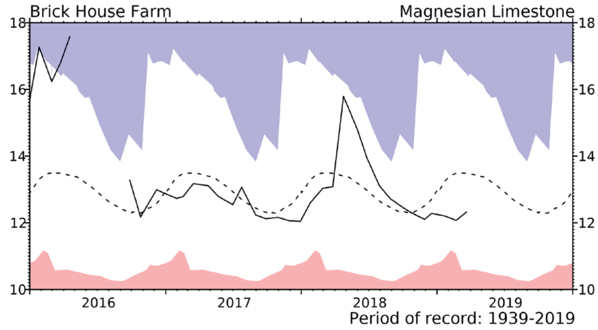


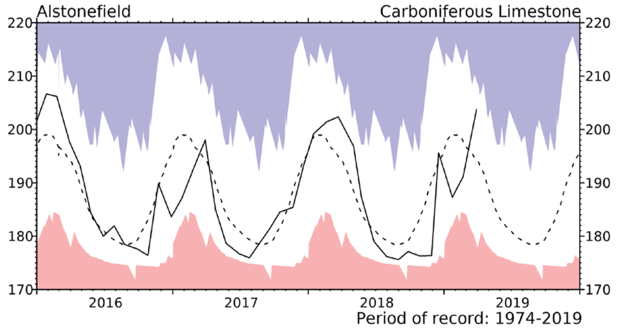


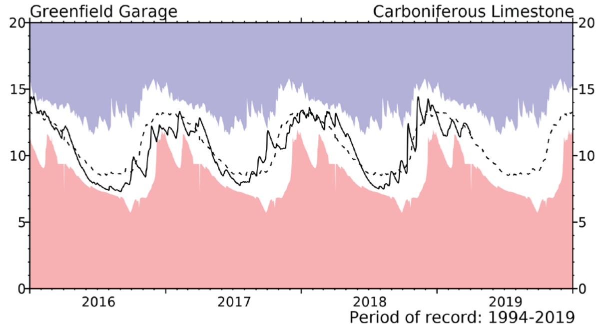


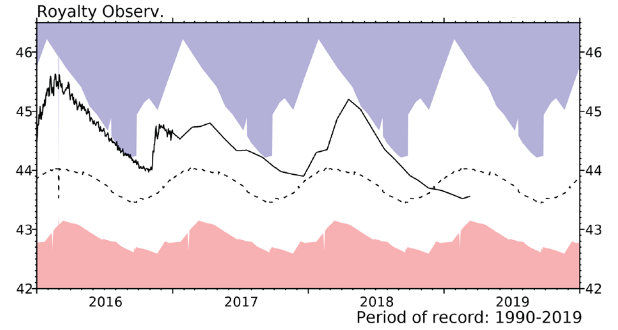




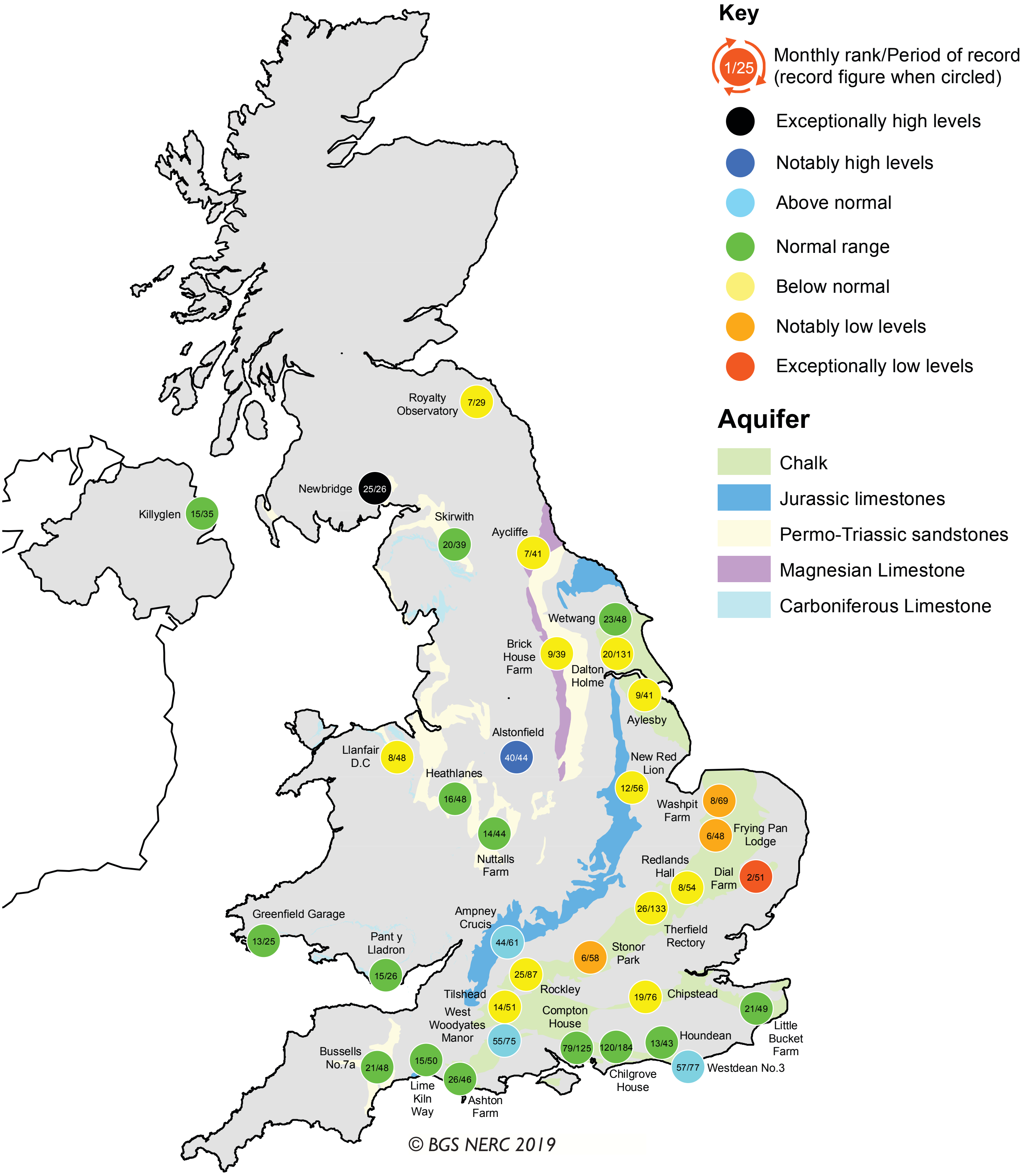








Groundwater…Groundwater

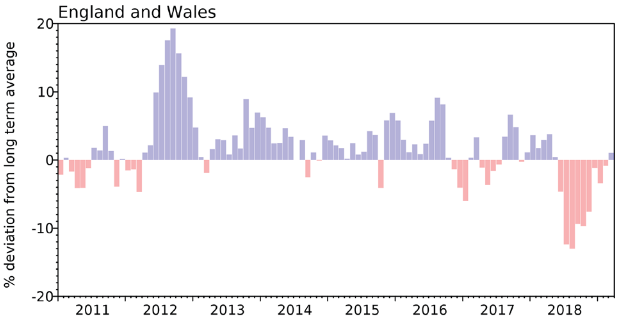


Groundwater levels - March 2019

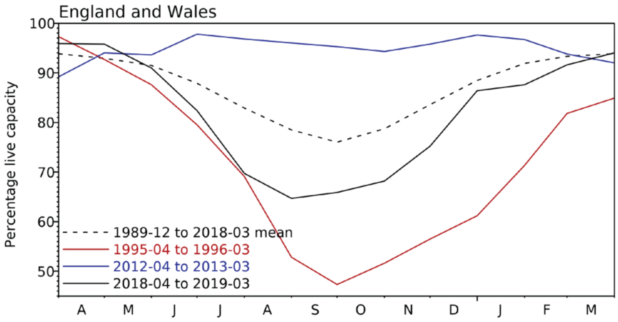
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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)	2019 Jan	2019 Feb	2019 Mar	Mar Anom.	Min Mar	Year* of min	2018 Mar	Diff 19-18
North West	N Command Zone	•	124929	84	93	95	4	77	1993	83	13
	Vyrnwy		55146	89	98	99	4	64	1996	100	-1
Northumbrian	Teesdale	•	87936	98	98	97	4	77	2003	99	-1
	Kielder		(199175)	82	89	94	3	81	1993	91	3
Severn-Trent	Clywedog		49936	94	95	99	3	86	1996	100	-1
	Derwent Valley	•	46692	78	83	97	1	54	1996	100	-3
Yorkshire	Washburn	•	23373	87	95	95	2	70	1996	99	-4
	Bradford Supply	•	40942	74	78	88	-7	59	1996	99	-12
Anglian	Grafham		(55490)	72	78	86	-5	77	1997	96	-9
	Rutland		(116580)	82	90	89	-2	73	2012	95	-6
Thames	London	•	202828	94	92	91	-4	88	1990	96	-6
	Farmoor	•	13822	97	93	98	4	80	2013	96	2
Southern	Bewl		31000	95	98	100	10	49	2012	100	0
	Ardingly		4685	75	95	99	1	51	2012	100	-1
Wessex	Clatworthy		5364	95	99	100	3	82	1992	100	0
	Bristol	•	(38666)	80	89	97	3	71	1992	99	-2
South West	Colliford		28540	78	83	88	-1	58	1997	100	-12
	Roadford		34500	68	71	77	-8	37	1996	95	-18
	Wimbleball		21320	83	97	100	4	78	1996	100	0
	Stithians		4967	100	99	99	5	52	1992	95	4
Welsh	Celyn & Brenig	•	131155	89	94	95	-3	72	1996	100	-5
	Brianne		62140	99	96	97	-1	90	1993	100	-3
	Big Five	•	69762	94	97	97	1	78	1993	96	1
	Elan Valley	•	99106	99	98	98	1	89	1993	99	-1
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	90	93	99	4	71	1998	99	0
	East Lothian	•	9374	98	98	99	0	95	2012	100	-1
Scotland(W)	Loch Katrine	•	110326	95	100	100	8	74	2010	94	6
	Daer		22494	96	100	98	1	77	2013	91	7
	Loch Thom		10798	99	99	99	2	83	2010	100	-1
Northern Ireland	Total+	•	56800	93	95	95	5	83	2002	98	-3
	Silent Valley	•	20634	95	98	99	11	57	2000	100	-1

( ) figures in parentheses relate to gross storage

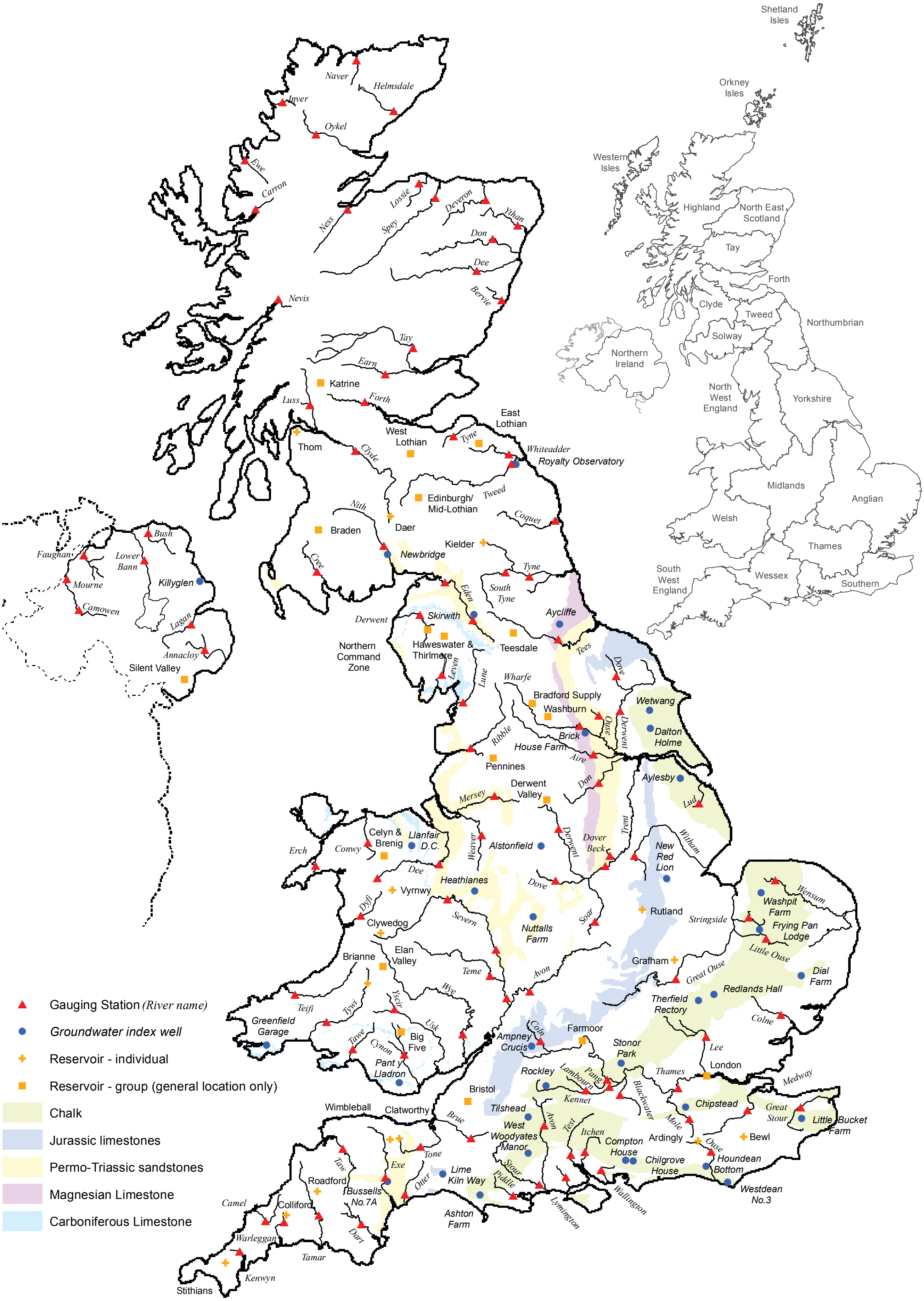
• denotes reservoir groups

*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.

The Hydrological Summary is supported by the Natural Environment Research Council award number NE/R016429/1 as part of the UK-SCAPE programme delivering National Capability.

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

Some of the features displayed on the maps contained in this report are based on the following data with permission of the controller of HMSO.

i. Ordnance Survey data. © Crown copyright and/or database right 2005. Licence no. 100017897.
ii. Land and Property Services data. © Crown copyright and database right, S&LA 145.
iii. Met Office rainfall data. © Crown copyright.

04/2019

UK-SCAPE
UK Status, Change and Projections of the Environment

NERC SCIENCE OF THE ENVIRONMENT