Hydrological Summary

for the United Kingdom

December 2018

General

December was a mixed month, with mild changeable conditions interspersed with more wintry weather. Despite the above average temperatures across the UK for December as a whole, wintry snaps brought colder temperatures, freezing rain and some snow to the north and west. Rainfall was near average at the national scale, but this masked a marked north-south contrast. Above average rainfall was received across much of England and Wales, but some regions in the north registered substantially lower than average rainfall. December river flows were generally in the normal range, but were below normal in northern Scotland and above normal in the south-west of the UK. Soil moisture deficits (SMDs) were negligible across most of the country, but almost all groundwater levels remained in the normal range or below. The groundwater recharge season started after delayed onset, with the exception of boreholes in the Chilterns and eastern Chalk. Reservoir stocks for England and Wales were near average, although some impoundments in the north remained below average despite stocks increasing by more than a fifth relative to average (e.g. Derwent Valley and Washburn). Although a wetter December has been beneficial for the water resources situation in southern Britain, the effect of long-term rainfall deficits remains apparent. With below average reservoir stocks and groundwater levels in some areas, above average rainfall is still needed in late winter-early spring to reduce the likelihood of water resources stress in 2019. With near-zero rainfall across much of the UK in January so far and current forecasts indicating drier than average conditions over the next three months, continuing vigilance is required.

Rainfall

Changeable conditions characterised December, but these were punctuated by anticyclonic conditions which brought more wintry weather. The first ten days of December were generally wet (e.g. 65mm at Cluanie Inn, Ross and Cromarty, on the 7th), and at times, windy. A Scandinavian blocking high pressure system brought colder, drier conditions from the 10th-14th. On the 15th/16th storm 'Deirdre' arrived from the Atlantic and interacted with the colder air bringing freezing rain, snow and ice to northern and western areas, resulting in travel disruption, power outages and localised surface water flooding. 'Deirdre' marked the start of more changeable conditions which lasted until the 23rd, after which high pressure dominated to month-end. For December, rainfall was near-average at the national scale; but Wales and England south of a line from Cumbria to North Yorkshire generally received more than 110% of average with more than 150% in coastal areas of Wales and southern England, and isolated areas around the Wash. In contrast, less than 90% of average was registered in Scotland and the north of England (with the exception of south-west Scotland), with less than half the average in parts of northern Scotland. The Northumbrian, Highland, Forth and Tweed regions all received less than three-quarters of the December average, continuing long-term deficits which can be traced back to autumn 2017. For April-December, below average rainfall was registered in all regions of the UK except Solway and Clyde. It was the driest April-December for Yorkshire and Anglian regions since 2011 and for North East Scotland since 2003, both notable drought years.

River flows

Following high flows at the end of November, many responsive catchments in the north and west started December with above average flows; elsewhere river flows were below average to start the month. A series of Flood Alerts and Warnings were issued in response to rainfall in the first week. Recessions were then established from the 10th, but were interrupted by rainfall mid-month (including storm 'Deirdre'); new daily flow maxima were established on the 15th-19th for the Annacloy. In the last week recessions continued, and flows in the majority of catchments ended December below the long-term average, with new daily flow minima for seven consecutive days on the Helmsdale (in a series from 1975). For December, monthly mean flows were generally in the normal range, with above normal to exceptionally high flows recorded in south-west England (flows on the Camel were the second highest in a series from 1964), south Wales and some responsive catchments in northern England. Below normal flows were registered in catchments in parts of northern Scotland, the coastal Borders and central England, with some recording half the December average (e.g. the Naver, Scottish Tyne and Lee). The Helmsdale registered exceptionally low flows (the second lowest on record) and flows were around two fifths of average on the Colne. For April to December, flows in most catchments across the UK were in the normal range. In northern Scotland below normal flows were registered in several catchments, less than half the average was recorded on the Deveron, and flows were exceptionally low on the Helmsdale. In contrast, some catchments registered above average flows over the same period, many of which were located in the south-west of the UK, with above normal flows on the Cynon, Dart and Kenwyn.

Groundwater

SMDs at month-end were minimal across the country and in most regions decreased in December to near or wetter than average. Groundwater levels generally rose in the Chalk boreholes during December, but continued to recede in the Chilterns, East Anglia and Lincolnshire. However, levels remained below normal at half of the boreholes, and were notably low at Frying Pan Lodge and Redlands Hall. In the fast responding Chalk of Northern Ireland, levels at Killyglen rose in the first half of the month to above average but then fell, and at month-end were notably low. In the more rapidly responding Jurassic and Magnesian limestones, levels rose and remained in the normal range except at Ampney Crucis, where levels rose to above normal. Levels in the Upper Greensand at Lime Kiln Way increased and remained in the normal range. In the Permo-Triassic sandstones levels generally rose but continued to fall at Heathlanes and Nuttalls Farm. Levels remained notably low at Llanfair DC, and fell to above normal at Newbridge; elsewhere they remained in the normal range. In the Carboniferous Limestone in south Wales, levels rose to above average at Pant y Lladron, and fell at Greenfield Garage where they remained in the normal range. In the Peak District, levels at Alstonfield rose from notably low to within the normal range. Levels fell at Royalty Observatory in the Fell Sandstone, but remained 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.

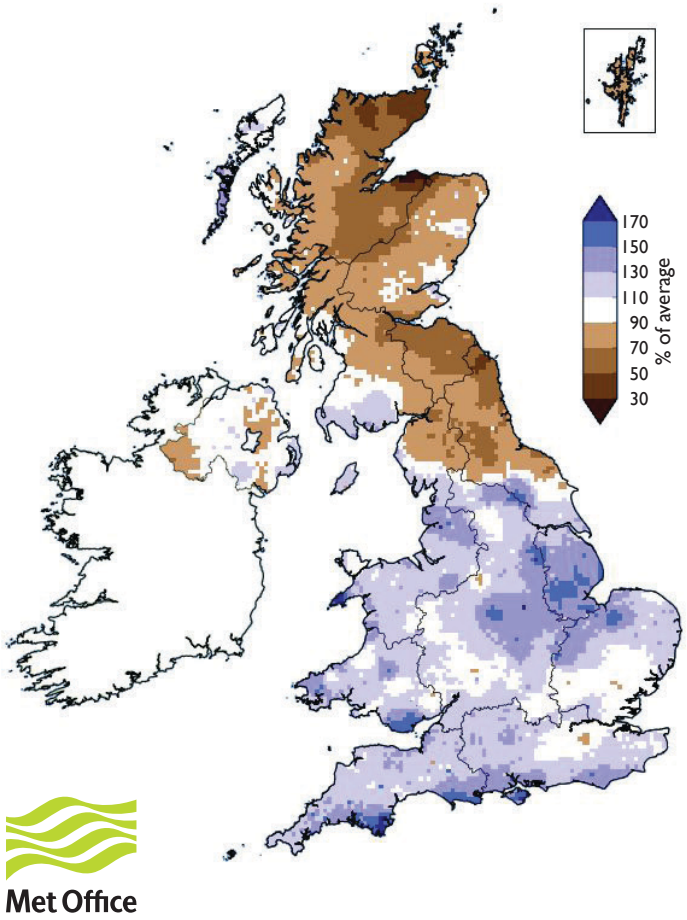
Region	Rainfall	Dec 2018	Nov18 – Dec18	RP	Sep18 – Dec18	RP	Apr18 – Dec18	RP	Jan18 – Dec18	RP
United Kingdom	mm	**120**	242		451		761		1064	
	%	**102**	103	2-5	100	2-5	92	2-5	95	2-5
England	mm	**100**	189		318		563		800	
	%	**116**	110	2-5	96	2-5	88	2-5	95	2-5
Scotland	mm	**131**	292		630		1023		1395	
	%	**84**	92	2-5	102	2-5	95	2-5	92	2-5
Wales	mm	**201**	371		652		1020		1440	
	%	**126**	117	2-5	109	2-5	98	2-5	102	2-5
Northern Ireland	mm	**110**	256		382		753		1084	
	%	**96**	113	2-5	87	2-5	90	2-5	96	2-5
England & Wales	mm	**114**	214		364		626		889	
	%	**119**	111	2-5	99	2-5	90	2-5	97	2-5
North West	mm	**142**	247		497		824		1116	
	%	**108**	96	2-5	100	2-5	91	2-5	92	2-5
Northumbria	mm	**61**	150		303		573		822	
	%	**71**	85	2-5	91	2-5	87	5-10	94	2-5
Severn-Trent	mm	**94**	153		275		518		739	
	%	**123**	102	2-5	93	2-5	86	2-5	95	2-5
Yorkshire	mm	**95**	174		310		548		797	
	%	**111**	103	2-5	98	2-5	87	5-10	95	2-5
Anglian	mm	**67**	114		200		405		570	
	%	**125**	101	2-5	87	2-5	83	5-10	91	2-5
Thames	mm	**79**	161		259		474		670	
	%	**112**	111	2-5	92	2-5	87	2-5	94	2-5
Southern	mm	**108**	234		326		580		810	
	%	**123**	131	5-10	96	2-5	97	2-5	102	2-5
Wessex	mm	**128**	251		357		588		853	
	%	**131**	129	5-10	98	2-5	89	2-5	97	2-5
South West	mm	**185**	378		545		825		1229	
	%	**128**	134	5-10	107	2-5	92	2-5	100	2-5
Welsh	mm	**191**	356		624		983		1389	
	%	**125**	117	2-5	109	2-5	98	2-5	102	2-5
Highland	mm	**144**	275		753		1161		1555	
	%	**75**	71	5-10	102	2-5	93	2-5	86	2-5
North East	mm	**72**	199		400		647		865	
	%	**79**	99	2-5	98	2-5	85	5-10	85	5-10
Tay	mm	**112**	310		568		908		1246	
	%	**84**	113	2-5	105	2-5	96	2-5	93	2-5
Forth	mm	**90**	242		439		771		1098	
	%	**75**	102	2-5	92	2-5	89	2-5	91	2-5
Tweed	mm	**76**	197		377		730		1034	
	%	**73**	95	2-5	94	2-5	96	2-5	101	2-5
Solway	mm	**167**	395		660		1110		1522	
	%	**104**	125	5-10	108	2-5	103	2-5	103	2-5
Clyde	mm	**171**	390		756		1281		1769	
	%	**90**	103	2-5	102	2-5	100	2-5	98	2-5

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

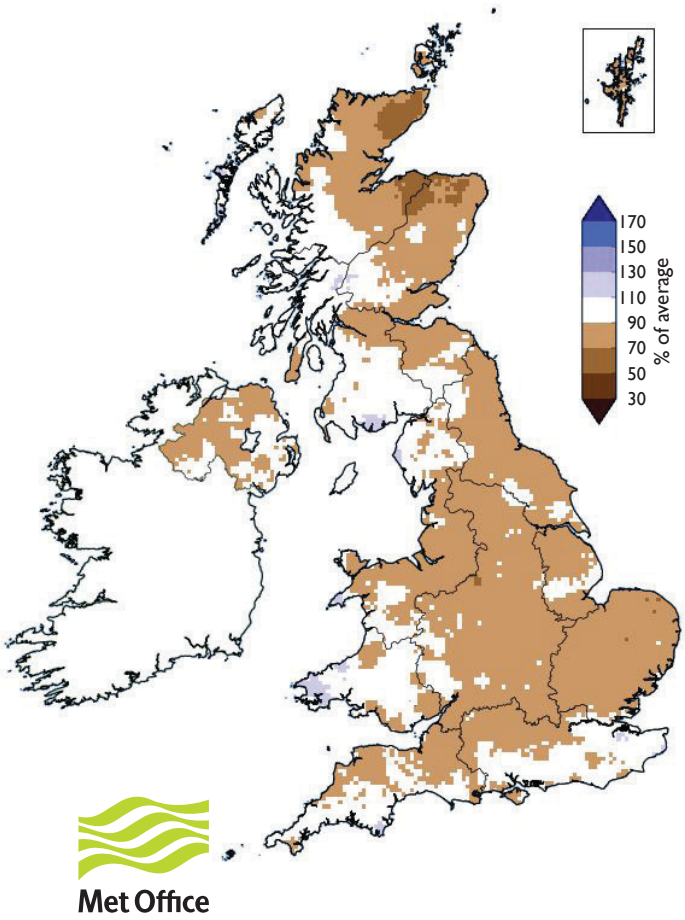
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

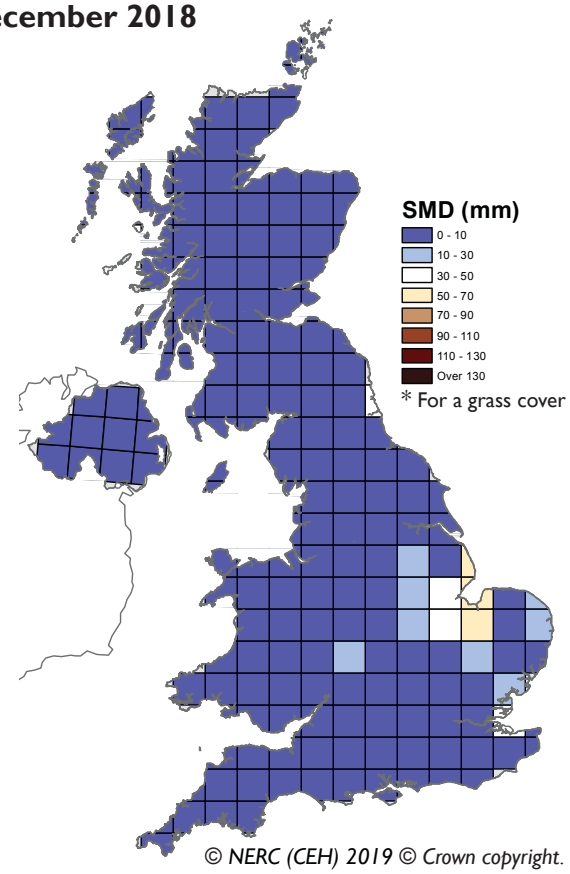
December 2018 rainfall as % of 1981-2010 average



April 2018 - December 2018 rainfall as % of 1981-2010 average



MORECS Soil Moisture Deficits* December 2018



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Hydrological Outlook UK

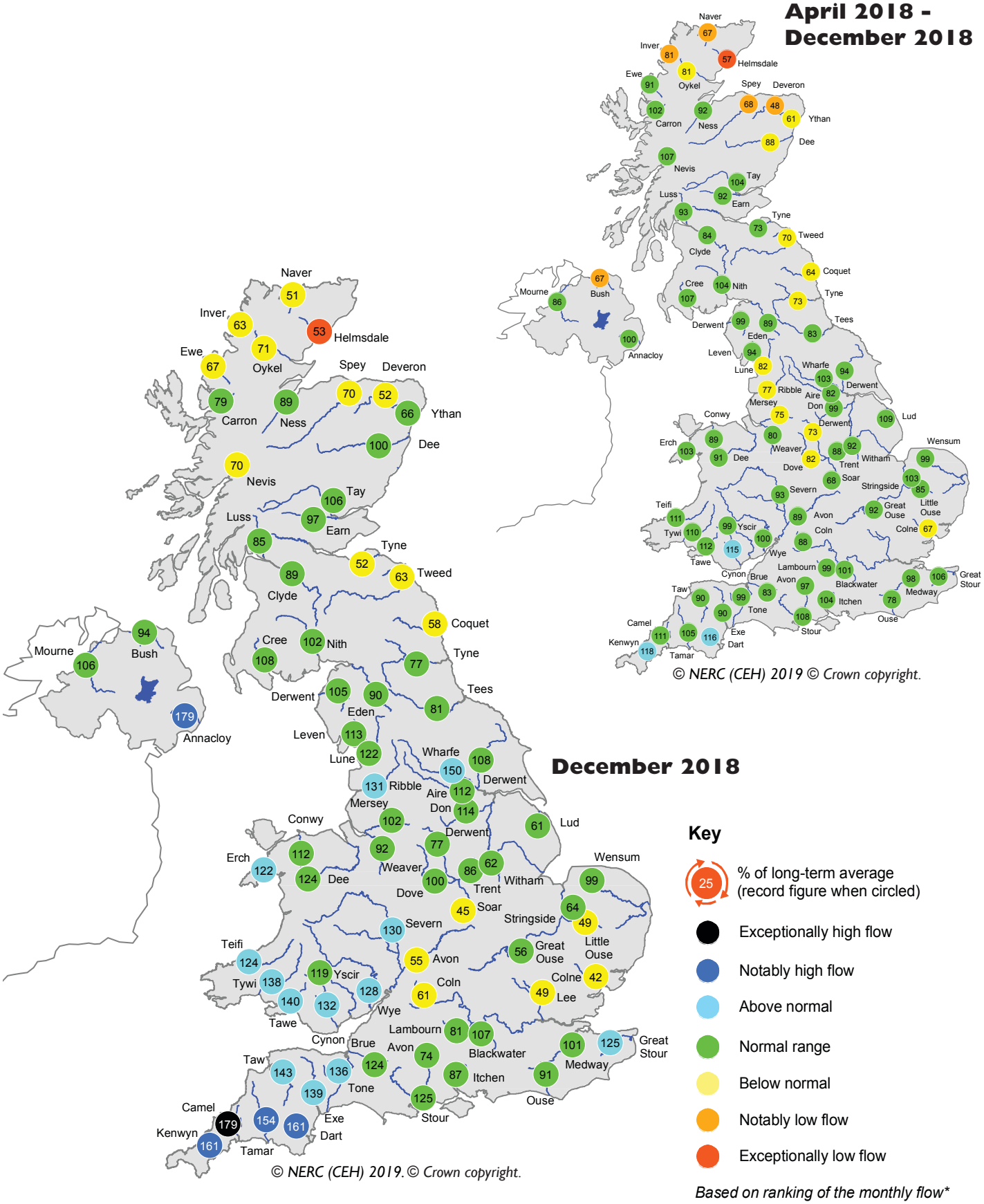
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from January 2019**
Issued: **08.01.2019**
using data to the end of December 2018

The one-month outlook is for below normal river flows in parts of south-east England, normal to below normal flows in north-east Scotland, and elsewhere flows are most likely to be in the normal range. The outlook is similar for the January-March period, though with normal to below normal flows in south-east England. For groundwater levels in the Chalk of the Chilterns, the outlook over both one- and three-month timeframes is for below normal levels. Elsewhere, over both one- and three-months, the outlook is for groundwater levels within the normal range.

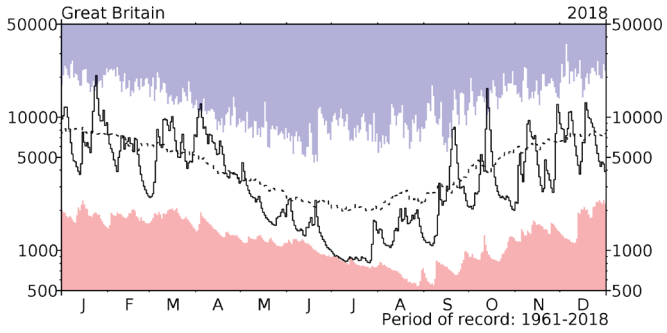
River flow . . . River flow . . .

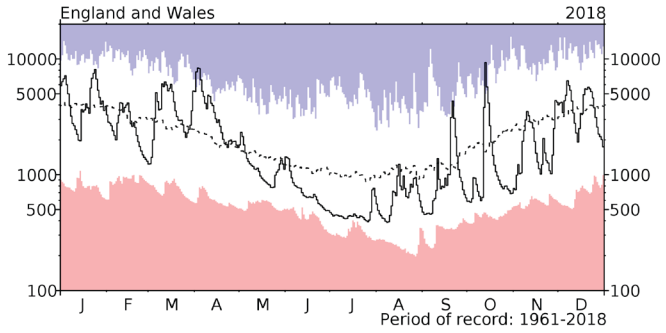


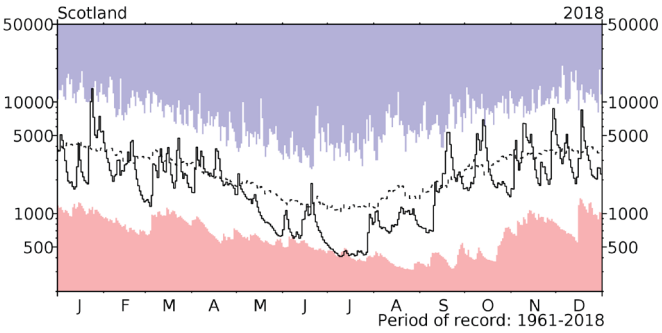
River flows

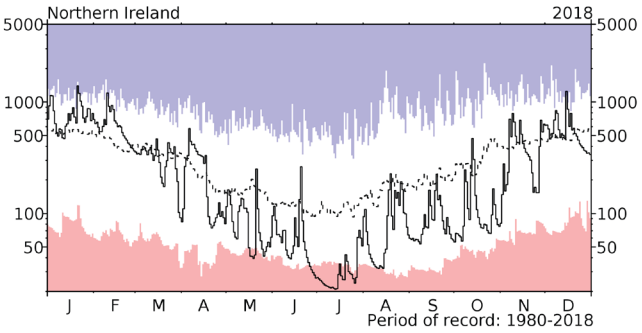
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

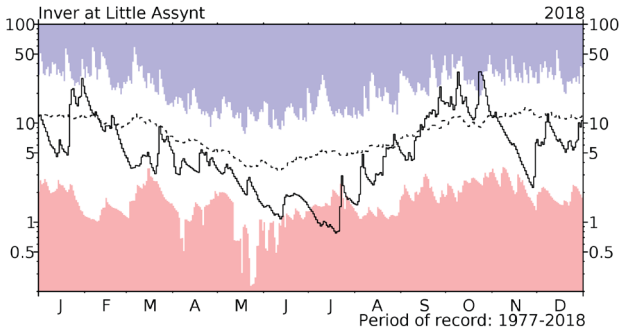
River flow . . . River flow . . .

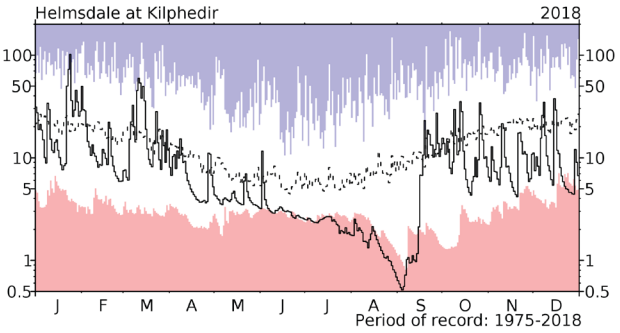


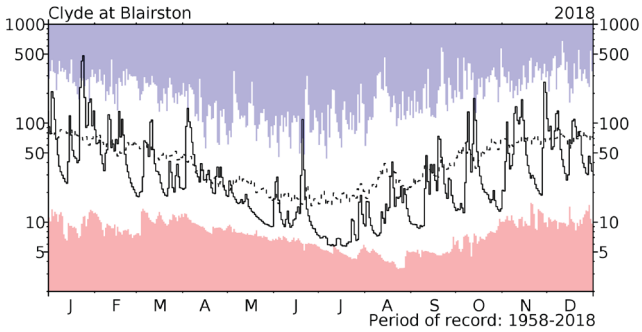


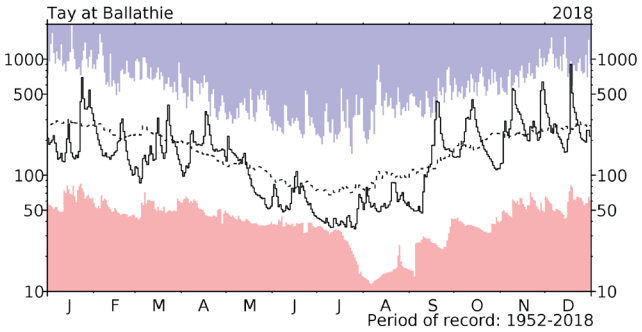


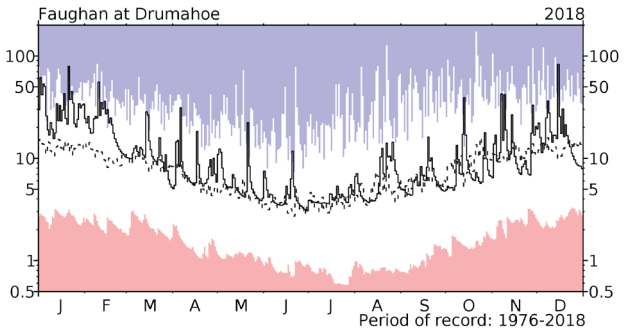


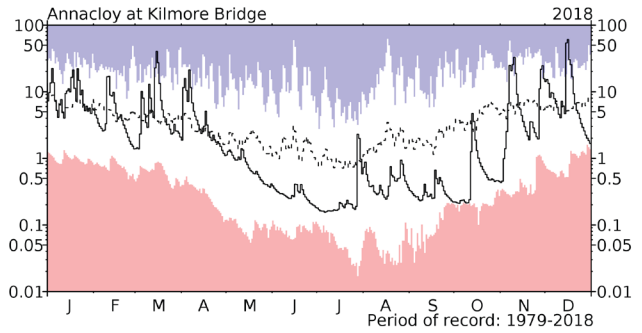








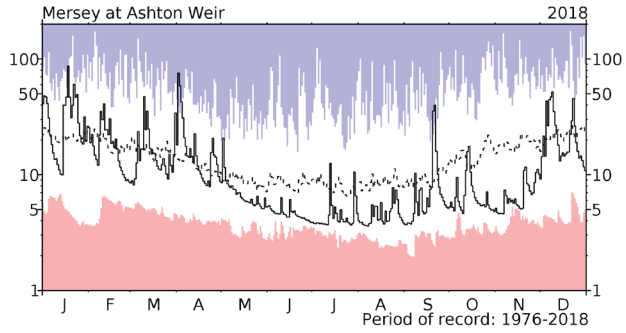


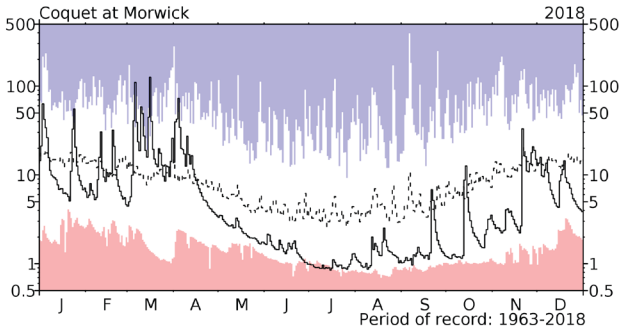


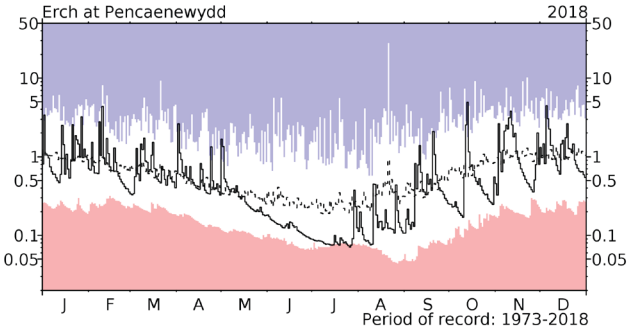
River flow hydrographs

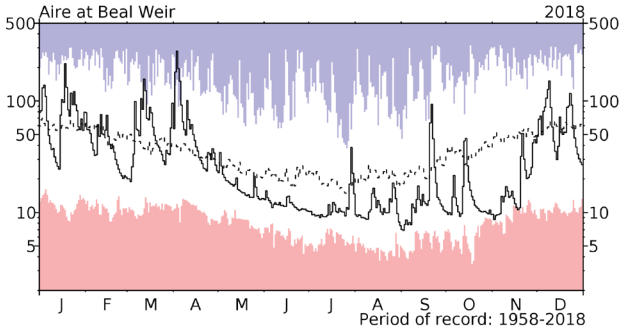
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to January 2018 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

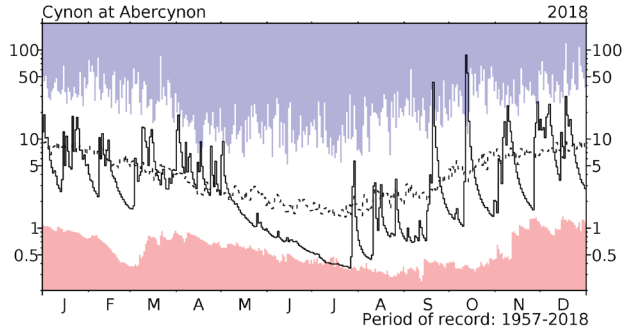
River flow . . . River flow . . .

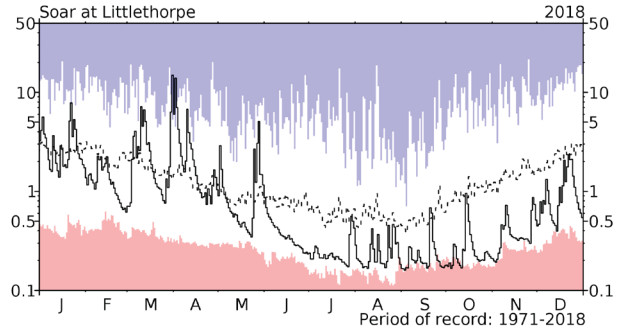


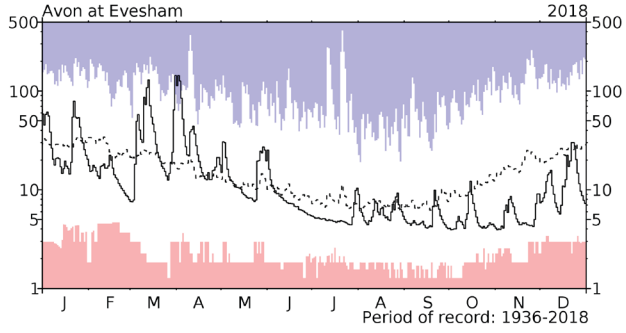


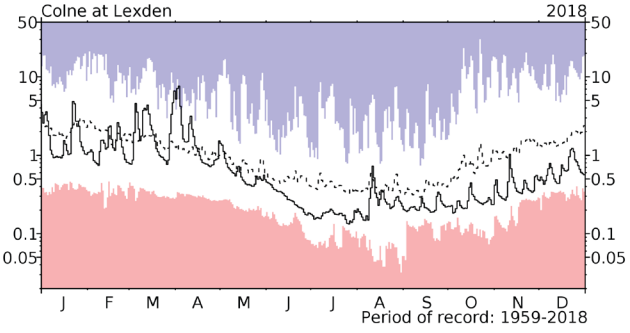


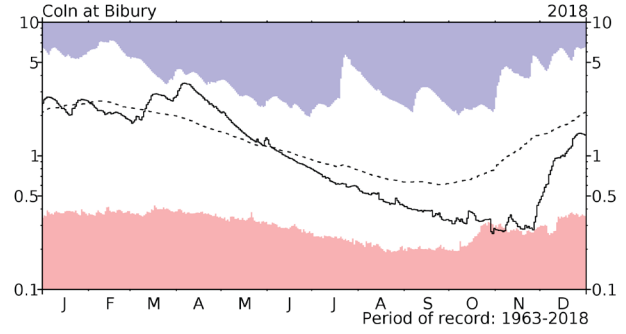


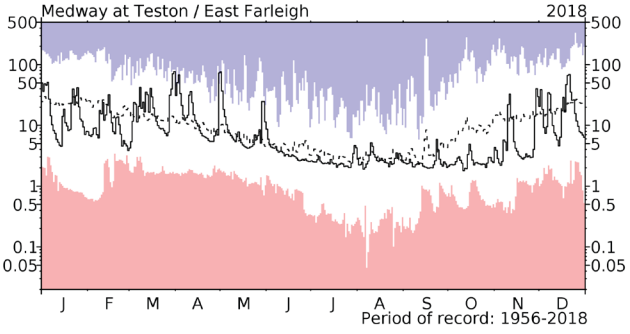


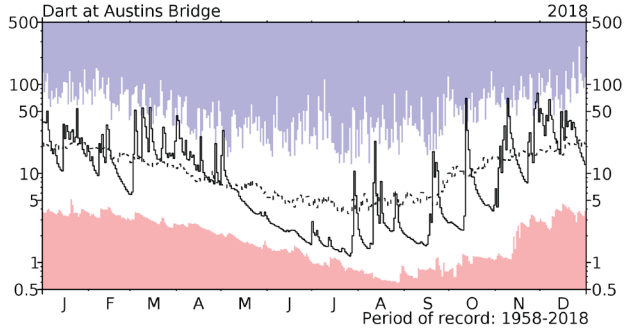


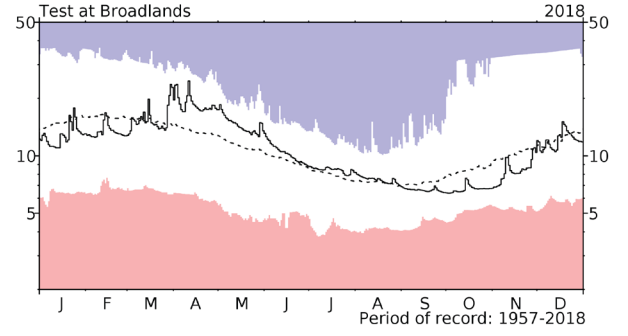




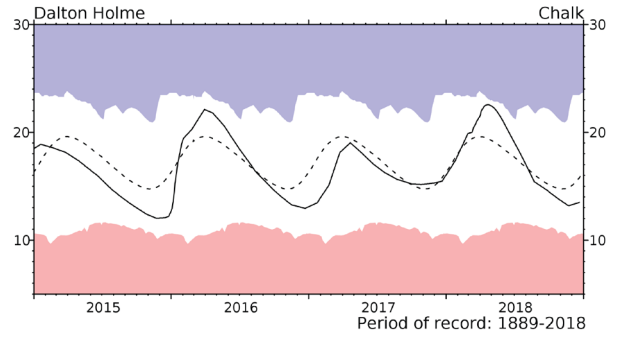


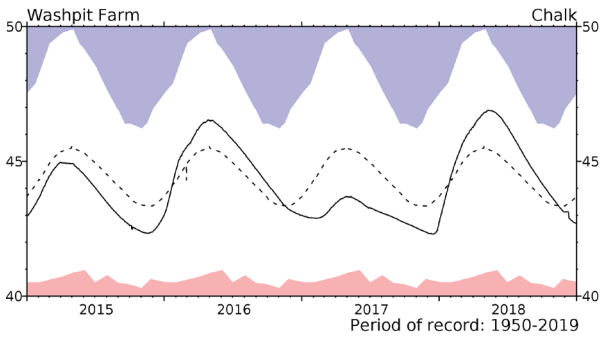


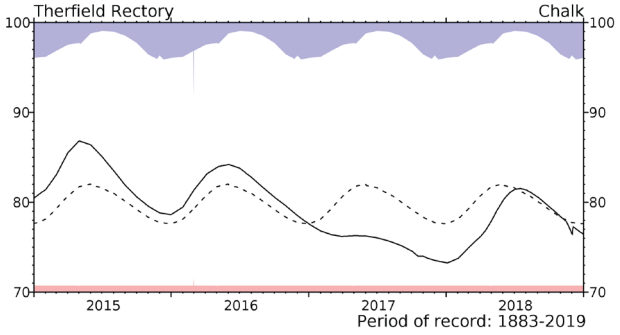


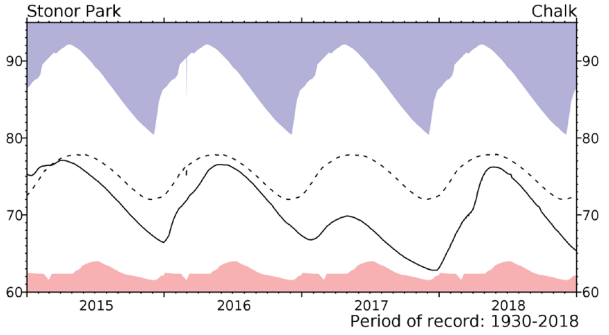


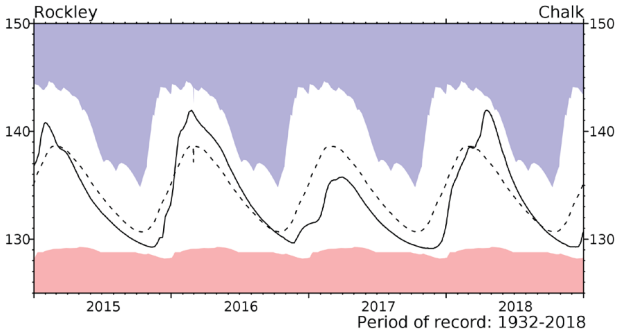
Groundwater…Groundwater

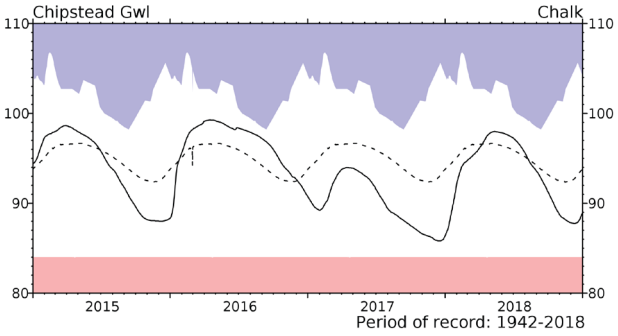


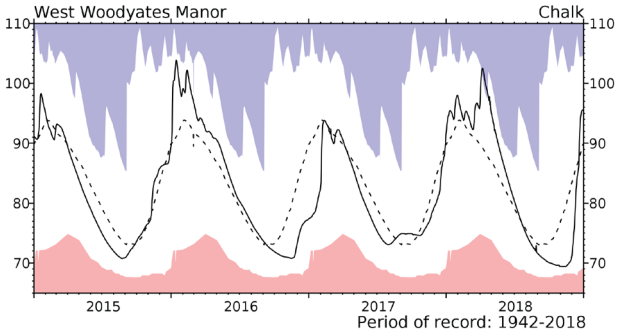


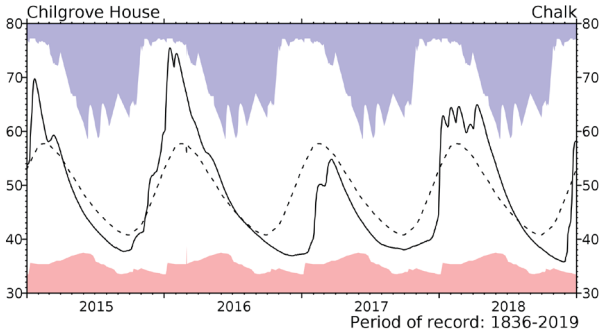


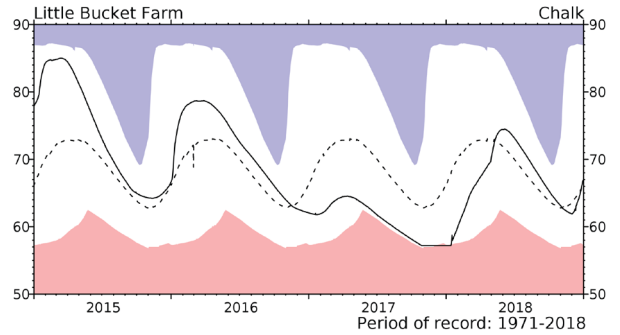


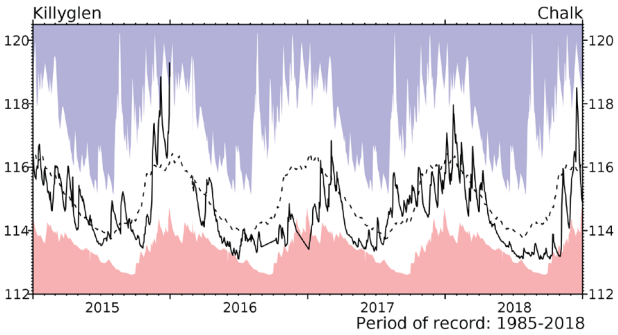






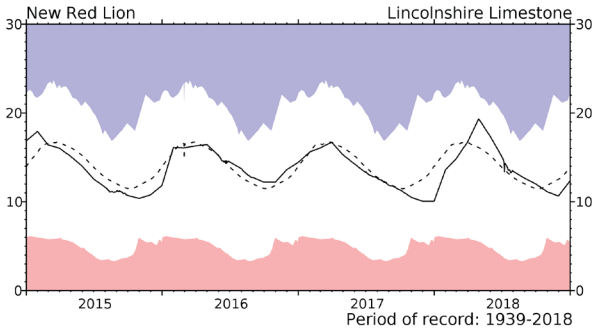




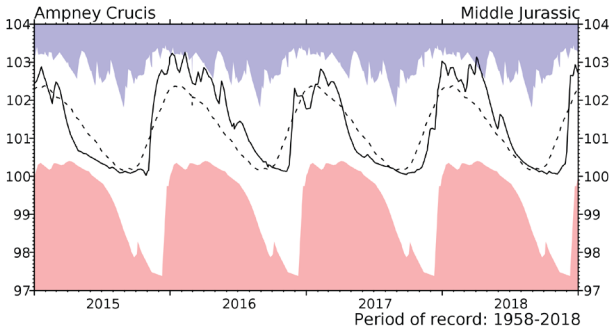


Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

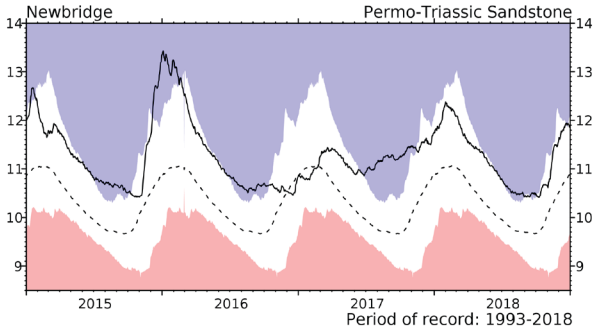
Groundwater … Groundwater



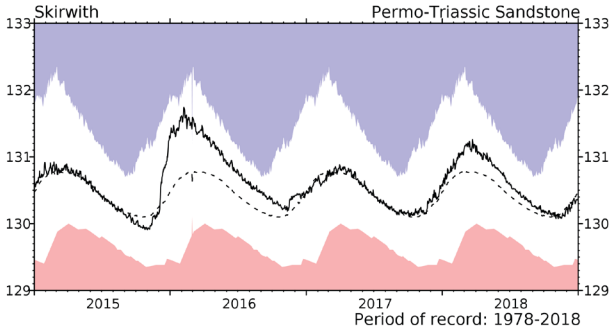
Period of record: 1939-2018



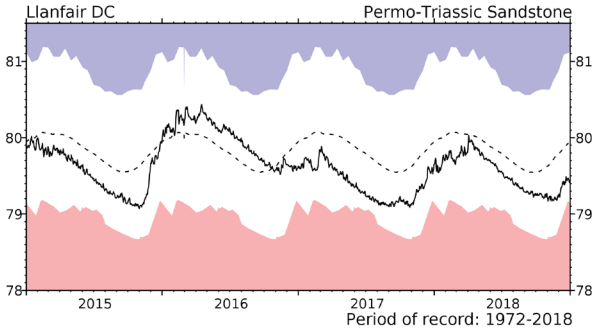
Period of record: 1958-2018



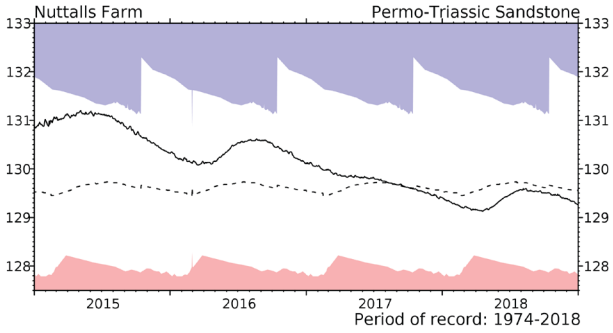
Period of record: 1993-2018



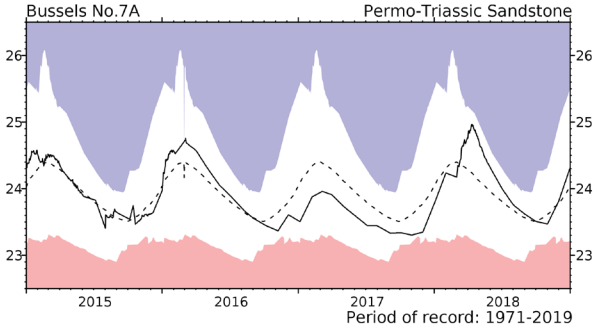
Period of record: 1978-2018



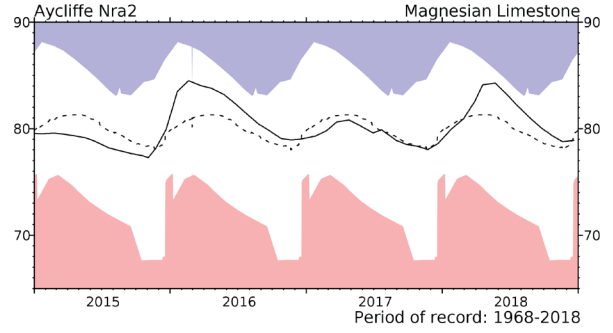
Period of record: 1972-2018



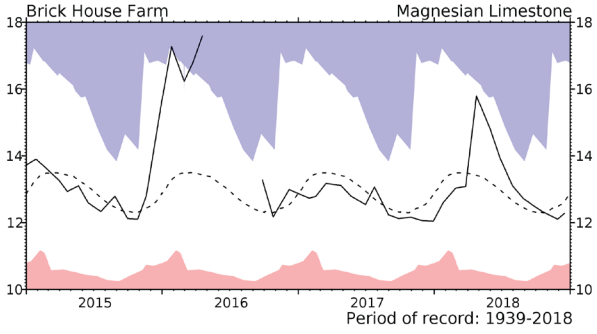
Period of record: 1974-2018



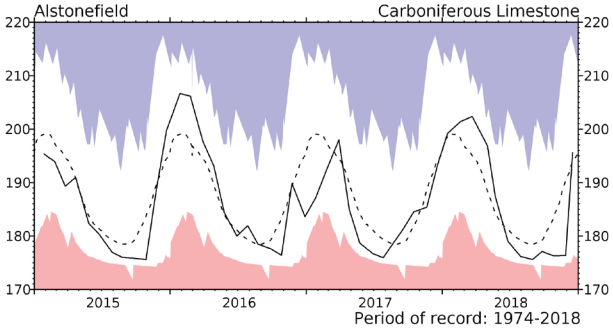
Period of record: 1971-2019



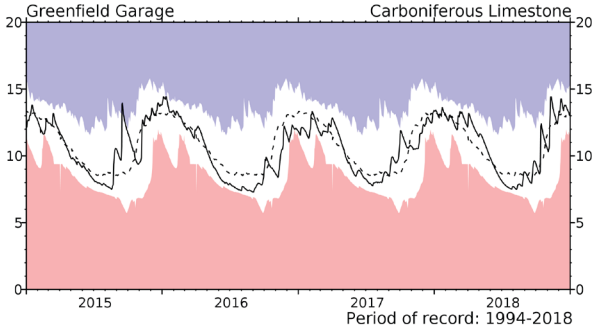
Period of record: 1968-2018



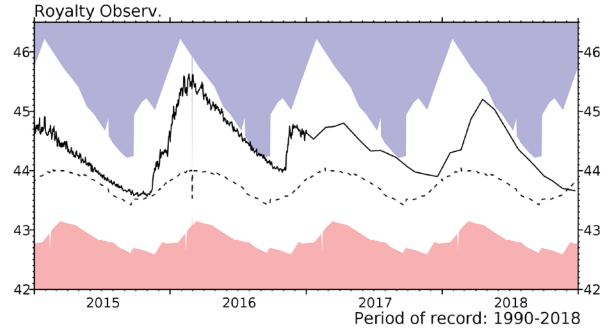
Period of record: 1939-2018



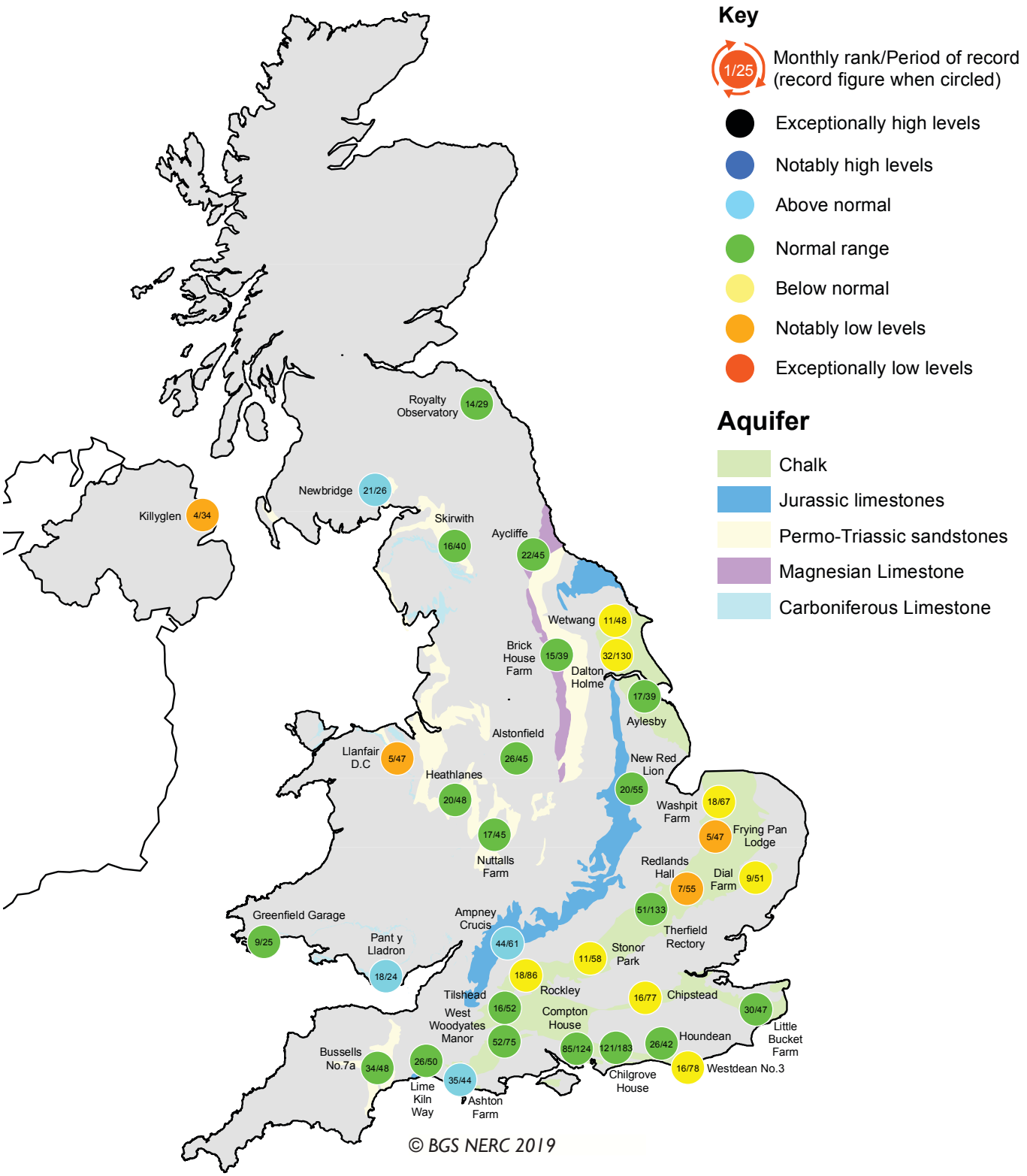
Period of record: 1974-2018



Period of record: 1994-2018



Period of record: 1990-2018



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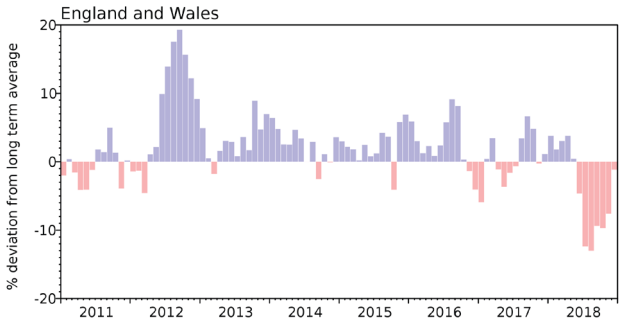
Groundwater levels - December 2018

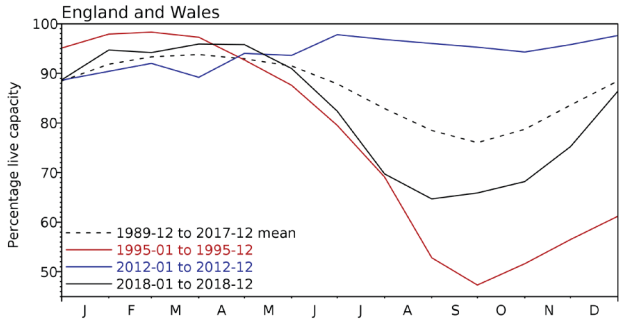
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 Oct	2018 Nov	2018 Dec	Dec Anom.	Min Dec	Year* of min	2017 Dec	Diff 18-17
North West	N Command Zone	•	124929	67	84	90	4	51	1995	81	9
	Vyrnwy		55146	74	81	88	-4	35	1995	99	-12
Northumbrian	Teesdale	•	87936	74	86	99	9	41	1995	100	-1
	Kielder		(199175)	80	82	84	-8	70	1989	91	-7
Severn-Trent	Clywedog		49936	79	87	87	2	54	1995	86	1
	Derwent Valley	•	46692	37	40	74	-16	10	1995	100	-25
Yorkshire	Washburn	•	23373	44	60	96	10	23	1995	86	10
	Bradford Supply	•	40942	46	54	76	-14	22	1995	94	-18
Anglian	Grafham		(55490)	70	60	66	-18	57	1997	92	-26
	Rutland		(116580)	79	77	82	0	60	1990	84	-2
Thames	London	•	202828	57	61	87	0	60	1990	76	11
	Farmoor	•	13822	88	94	88	-2	71	1990	95	-7
Southern	Bewl		31000	64	72	89	18	34	2005	43	46
	Ardingly		4685	40	42	70	-14	30	2011	100	-30
Wessex	Clatworthy		5364	33	52	100	9	54	2003	85	15
	Bristol	•	(38666)	53	61	82	3	40	1990	87	-5
South West	Colliford		28540	54	62	74	-5	46	1995	94	-20
	Roadford		34500	46	54	67	-11	20	1989	87	-20
	Wimbleball		21320	40	50	77	-5	46	1995	67	10
	Stithians		4967	35	55	90	11	33	2001	89	1
Welsh	Celyn & Brenig	•	131155	71	78	87	-7	54	1995	97	-10
	Brianne		62140	100	100	100	2	76	1995	100	0
	Big Five	•	69762	73	84	90	0	67	1995	92	-2
	Elan Valley	•	99106	73	94	100	3	56	1995	100	0
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	81	92	92	1	60	1998	90	2
	East Lothian	•	9374	67	76	95	-1	48	1989	99	-4
Scotland(W)	Loch Katrine	•	110326	89	99	96	5	75	2007	99	-3
	Daer		22494	86	99	98	1	83	1995	100	-2
	Loch Thom		10798	100	99	100	3	80	2007	100	0
Northern Ireland	Total+	•	56800	66	86	95	7	61	2001	99	-5
	Silent Valley	•	20634	58	85	99	14	39	2001	99	-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.

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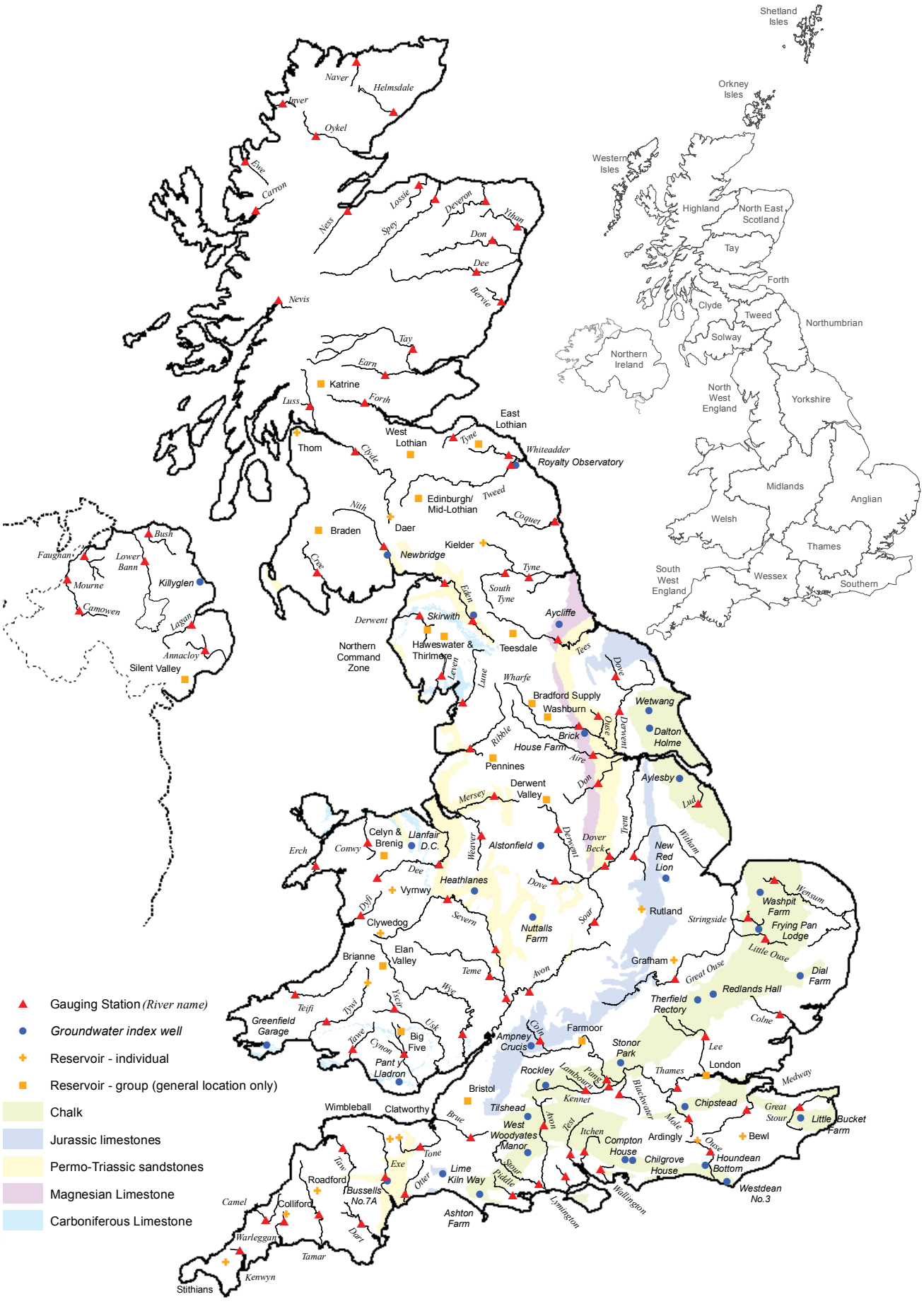
Location map…Location map



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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

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