Hydrological Summary

for the United Kingdom

December 2017

General

December was a mixed month and was subject to a range of weather types, in contrast to the predominantly westerly conditions that prevailed for much of 2017. The UK average temperature was typical for December but mild spells were punctuated with much colder periods, including a widespread wintry interlude mid-month. Generally, December was relatively dry across northern Britain and wetter in the south, which has moderated long-term rainfall deficiencies in the English Lowlands. Correspondingly, Soil Moisture Deficits (SMDs) diminished, while modest groundwater recharge was observed in the majority of boreholes and river flows returned to the normal range in many responsive catchments. While the rainfall was welcome from a water resources perspective, groundwater levels remained notably low in parts of the Chalk and flows were below normal in some groundwater-dominated rivers of southern England. Similarly, while reservoir stocks increased in the south, end-of-December stocks remained below average in some impoundments, e.g. the London group, Wimbleball and Bewl, the latter being 26% below average at month-end (leading to a drought permit application in early January). At least average rainfall is needed through the remaining winter or early spring months in order to reduce the risk of water resources pressure in parts of south-east England later in 2018.

Rainfall

The first few days of December were settled, before a low pressure system (storm 'Caroline') crossed the UK on the 6th/7th, bringing strong winds and showers, particularly to the north and west. A cold north-westerly flow heralded a wintry spell from the 8th to the 16th; on the 10th, heavy snowfall across Wales and central England (with 31cm recorded at Sennybridge, Powys) caused widespread disruption, while heavy rainfall was received in south-west England (e.g. Liscombe received 47mm). Thereafter, westerly airflows returned, bringing mild conditions before an unsettled final week, when several low pressure systems (including storm 'Dylan' in the final days) brought further strong winds and heavy and sometimes wintry precipitation (e.g. 42mm at Weybourne, Norfolk on the 27th). The December rainfall was near-average for the UK as a whole, but with a north-south gradient: Scotland and much of northern England were drier than average, particularly in the east, while southern England was mainly wetter than average, particularly in the Cotswolds and East Anglia. This gradient was particularly marked in eastern Britain: the Tay and Yorkshire regions registered 65% of average, while Anglian region registered 158%. For October-March, significantly below average rainfall was received across most of the UK, particularly in eastern Scotland and parts of north-east and south-east England (with 68% received in Southern region). For 2017 as a whole, rainfall was near-average for most regions, with the dry spring and autumn countered by a generally damp summer. Significant long-term deficiencies can be seen over longer periods in southern England: Southern region registered its lowest rainfall since 1996 for the 18-month July-December period.

River flows

Entering December, flows in many responsive rivers were in recession and tracking below average. Flows typically climbed through the first half of the month in response to the unsettled conditions (with some localised flood alerts, e.g. in south-west England on the 10th/11th) before receding in the third week. Thereafter, frontal systems triggered rapid flow responses, with flood alerts over the Christmas period in many western areas before more widespread flood alerts across southern and central England in the following days. Particularly steep increases occurred in parts of eastern England in the closing days; the Stringside registered its second highest peak flow in a record from 1967. Average river flows for December were predominantly in the normal range across the UK, with the exception of some above normal flows in the far north of Scotland and below normal flows in south-east Scotland and parts of southern England – the latter mostly reflecting a cluster of groundwater dominated catchments. Broadly similar patterns can be seen for runoff accumulations since the start of autumn, although below normal flows are more apparent in the south over this period. For longer-term accumulations since the spring, a more pronounced gradient can be seen between above normal flows in the north-west and below normal flows in the English Lowlands. For 2017 as a whole, most catchments away from the west coast saw below normal runoff, and notably low average annual flows were observed in many catchments in southern England: the Great Stour registered its second lowest annual average flow (after 1996) and the Medway its third lowest, in records from 1964 and 1956 respectively. In contrast, some western catchments saw above normal annual runoff and the Nith registered its highest annual average flow in a record from 1957.

Groundwater

Across much of the Chalk and Jurassic limestone outcrops, December rainfall was above average and residual SMDs fell sharply (although remained above average for the end of December). Apart from Therfield Rectory and Aylesby, where small decreases occurred, groundwater levels in the Chalk index boreholes generally increased with significant rises recorded at some sites (e.g. West Woodyates Manor). However, due to the late onset of recharge, levels from East Anglia to Wiltshire and across the North Downs remained low to notably low for the time of year, with Little Bucket Farm remaining dry for the third consecutive month. In the more rapidly responding Jurassic limestones, levels at Ampney Crucis rose from below normal to notably high in response to significant recharge, but at New Red Lion levels were stable and below normal. In the Magnesian limestones, levels increased or remained stable and were in the normal range. In the Permo-Triassic sandstones, groundwater levels were stable or increased and were in the normal range, with the exception of Llanfair DC (where levels remained below average) and Newbridge (where levels were above normal). In the Carboniferous Limestone, levels rose overall during December but remained within the normal range apart from at Pant y Lladron where levels were above normal. At Royalty Observatory, levels in the Fell Sandstone were stable and remained in the normal range for the time of year.

Centre for Ecology & Hydrology
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British Geological Survey
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

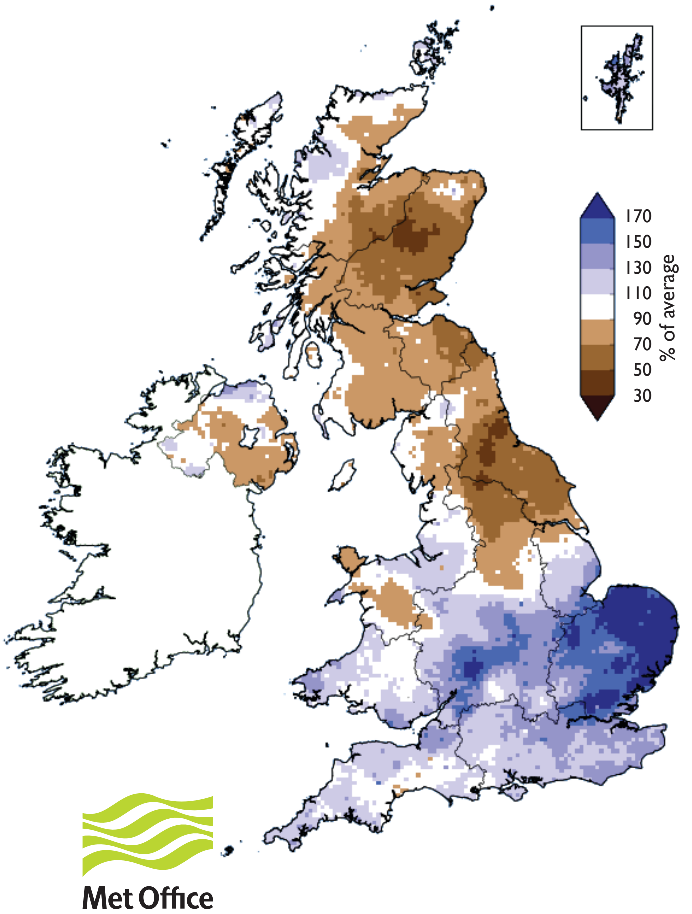
Region	Rainfall	Dec 2017	Oct17 – Dec17	RP	Jul17 – Dec17	RP	Jan17 – Dec17	RP	Jul16 – Dec17	RP
United	mm	**119**	327		658		1132		1624	
Kingdom	%	**102**	91	2-5	107	2-5	101	2-5	93	2-5
England	mm	**98**	221		486		844		1182	
	%	**114**	84	2-5	105	2-5	100	2-5	91	5-10
Scotland	mm	**140**	475		875		1513		2242	
	%	**89**	98	2-5	106	2-5	100	2-5	96	2-5
Wales	mm	**177**	438		871		1489		2061	
	%	**110**	91	2-5	110	2-5	105	2-5	93	2-5
Northern	mm	**107**	317		715		1145		1614	
Ireland	%	**94**	92	2-5	116	5-10	101	2-5	92	2-5
England &	mm	**109**	250		539		933		1303	
Wales	%	**113**	85	2-5	106	2-5	101	2-5	91	2-5
North West	mm	**128**	420		831		1370		1956	
	%	**98**	106	2-5	121	5-10	112	5-10	102	2-5
Northumbria	mm	**66**	235		496		909		1331	
	%	**76**	90	2-5	104	2-5	104	2-5	99	2-5
Severn-Trent	mm	**90**	190		434		762		1070	
	%	**117**	82	2-5	103	2-5	98	2-5	89	5-10
Yorkshire	mm	**57**	193		471		840		1219	
	%	**66**	77	5-10	105	2-5	100	2-5	94	2-5
Anglian	mm	**85**	145		347		623		863	
	%	**158**	82	2-5	102	2-5	100	2-5	90	2-5
Thames	mm	**95**	170		405		691		937	
	%	**136**	76	2-5	104	2-5	97	2-5	85	5-10
Southern	mm	**111**	189		431		754		999	
	%	**127**	68	5-10	97	2-5	95	2-5	80	10-20
Wessex	mm	**118**	238		492		846		1163	
	%	**121**	81	2-5	101	2-5	96	2-5	85	8-12
South West	mm	**163**	328		691		1167		1608	
	%	**113**	78	2-5	103	2-5	95	2-5	85	8-12
Welsh	mm	**173**	418		830		1424		1974	
	%	**113**	90	2-5	109	2-5	104	2-5	93	2-5
Highland	mm	**189**	640		1069		1791		2678	
	%	**98**	110	2-5	111	5-10	100	2-5	96	2-5
North East	mm	**64**	278		570		1013		1493	
	%	**70**	87	2-5	102	2-5	100	2-5	95	2-5
Tay	mm	**87**	307		625		1172		1735	
	%	**65**	72	5-10	87	2-5	87	2-5	84	8-12
Forth	mm	**94**	280		588		1116		1627	
	%	**79**	76	2-5	90	2-5	93	2-5	88	2-5
Tweed	mm	**80**	252		548		1042		1541	
	%	**78**	79	2-5	98	2-5	102	2-5	97	2-5
Solway	mm	**136**	454		923		1627		2258	
	%	**86**	93	2-5	112	5-10	110	8-12	98	2-5
Clyde	mm	**174**	559		1061		1831		2724	
	%	**91**	96	2-5	106	2-5	101	2-5	97	2-5

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

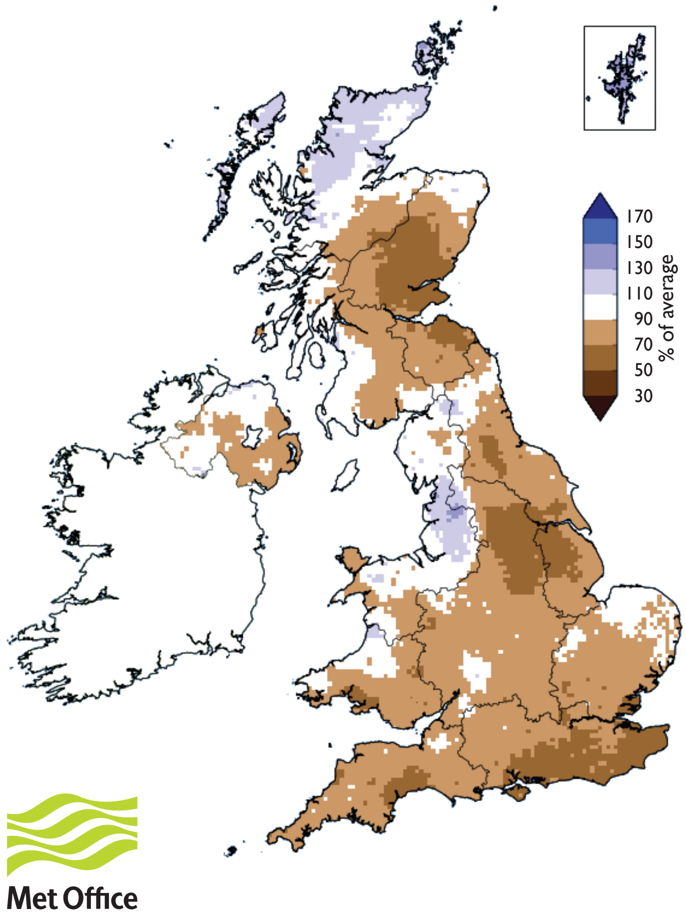
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 2017 are provisional.

Rainfall . . . Rainfall . . .

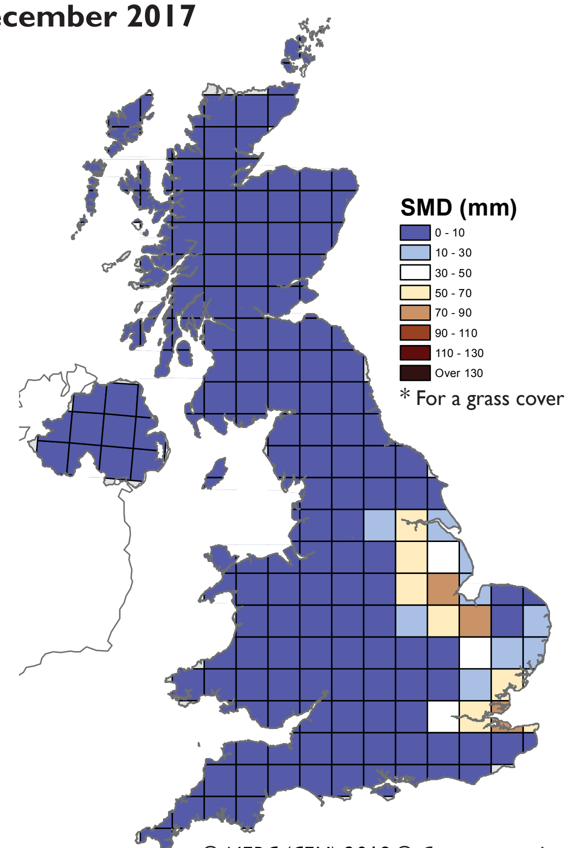
December 2017 rainfall as % of 1981-2010 average



October 2017 - December 2017 rainfall as % of 1981-2010 average



MORECS Soil Moisture Deficits* December 2017



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.

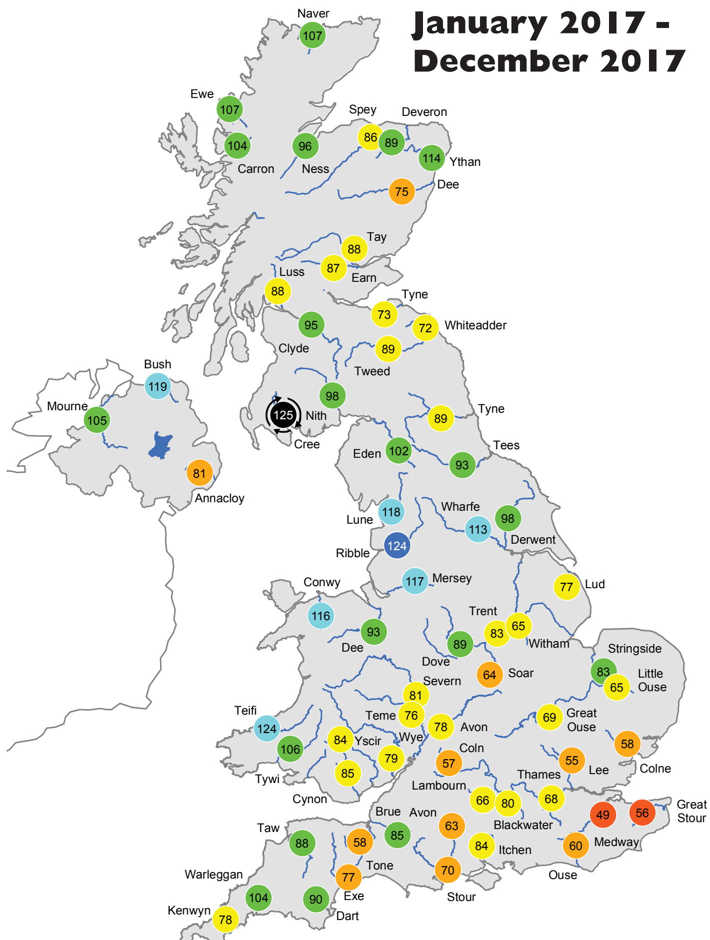
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from January 2018**
Issued: **09.01.2018**
using data to the end of December 2017

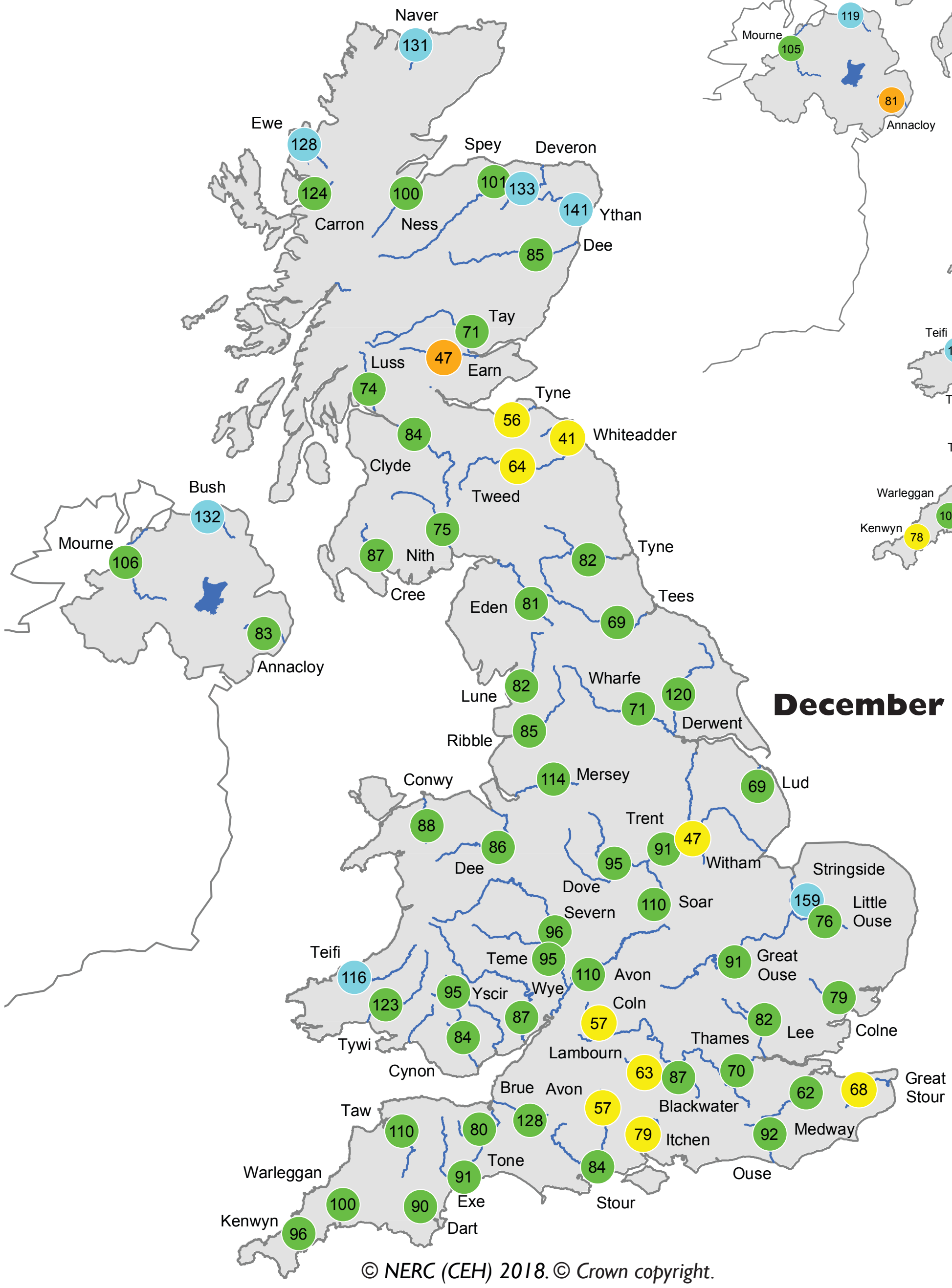
The one-month and three-month outlooks for parts of south-east England are for below normal groundwater levels and normal to below normal river flows. Elsewhere in the UK, river flows and groundwater levels are most likely to be within the normal range in January and normal to above normal for the January to March period. Whilst below normal river flows are likely in some localised areas, the rainfall over the last fortnight coupled with a forecast for above-average rainfall ensures that, in general for the UK, above normal flows are more likely than below normal flows.

River flow . . . River flow . . .

January 2017 - December 2017



December 2017



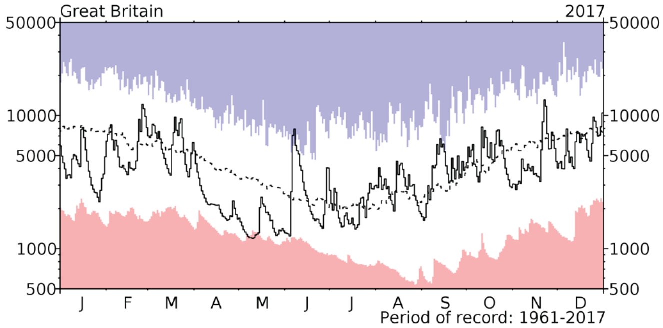
Key

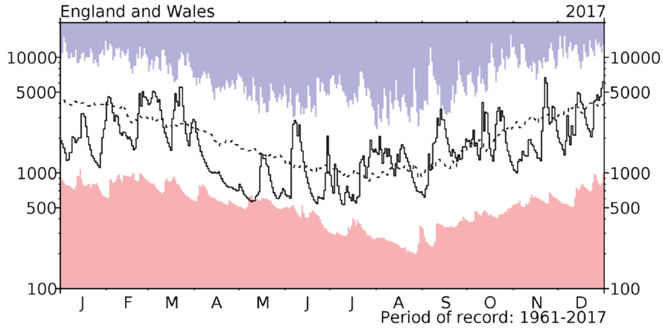
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

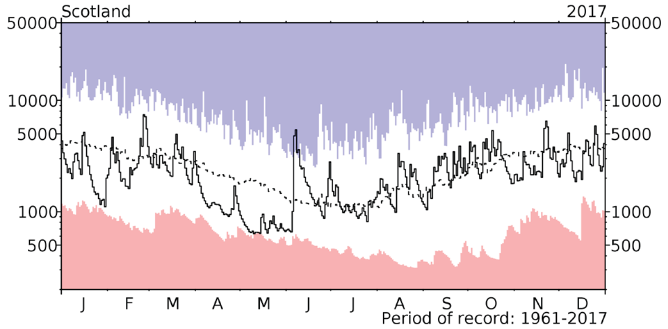
*Based on ranking of the monthly flow**

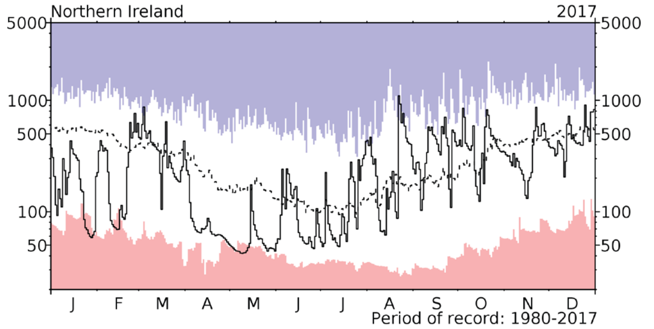
River flows

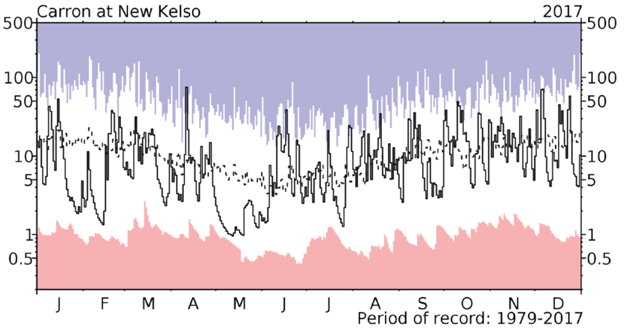
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

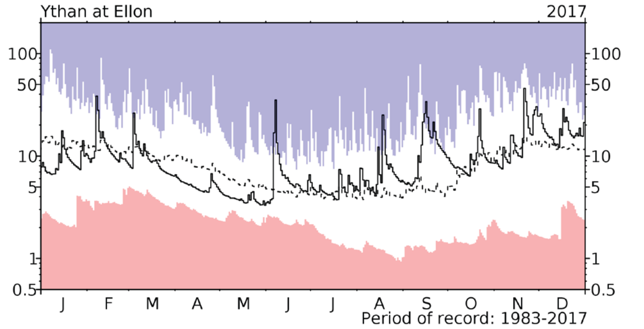


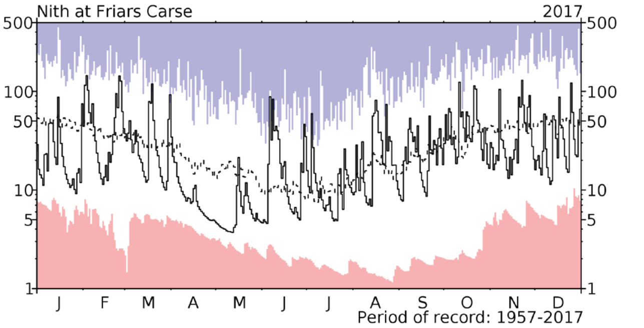


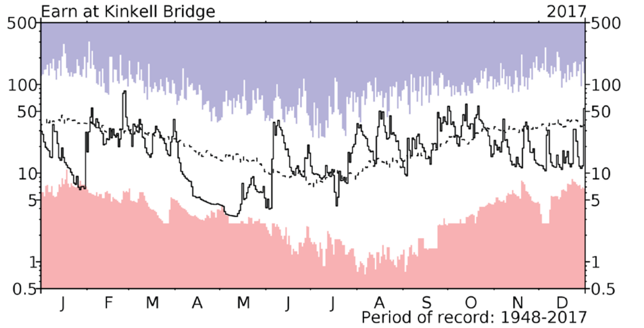


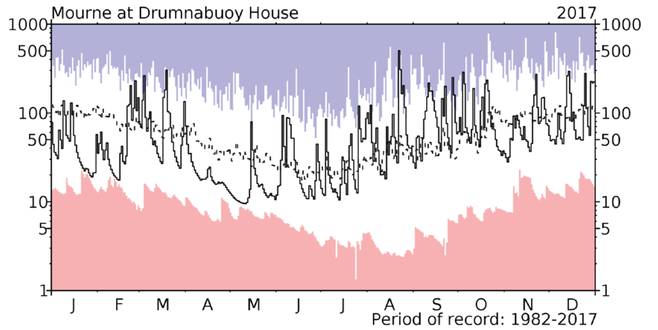


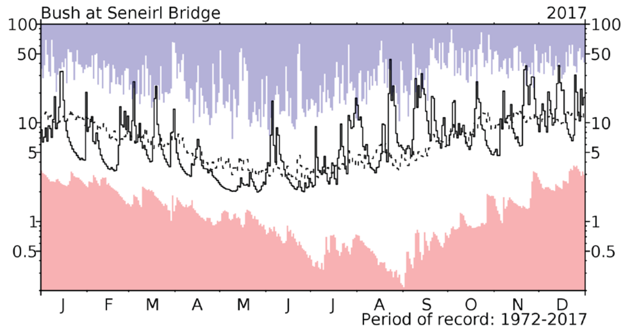






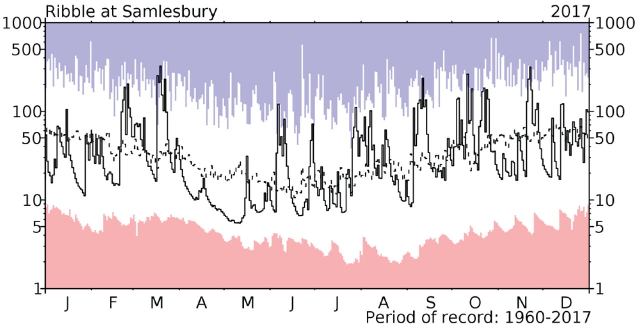


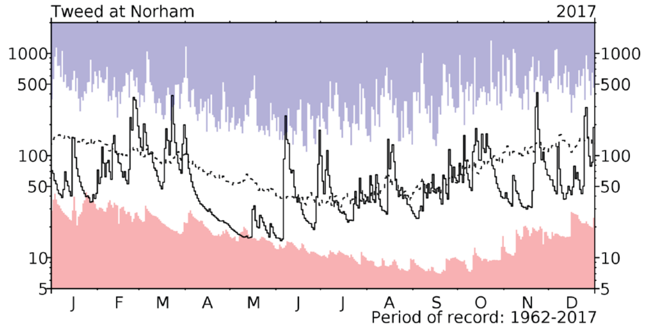


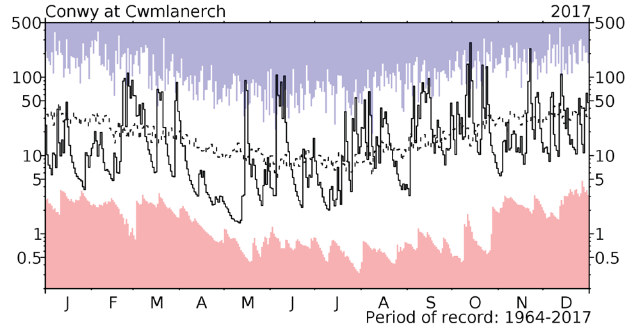


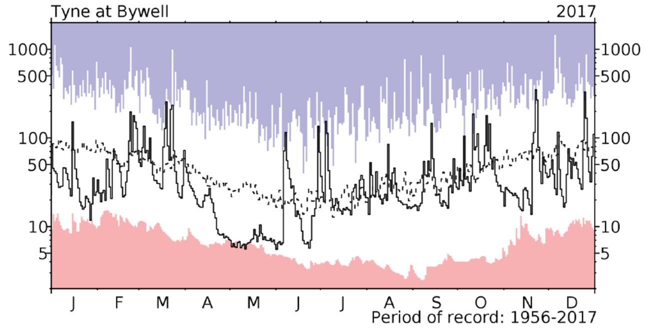
River flow hydrographs

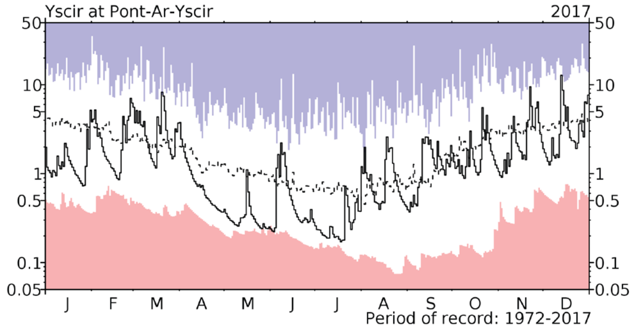
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to January 2017 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

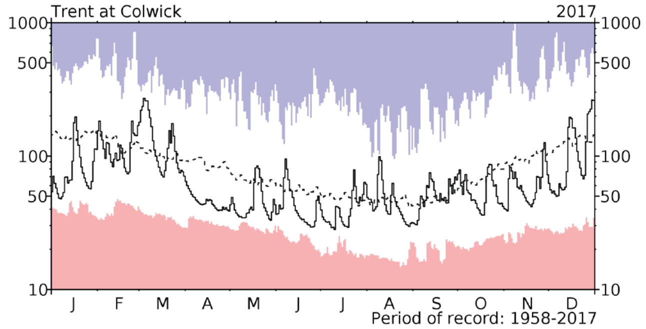

Ribble at Samlesbury
2017
Period of record: 1960-2017

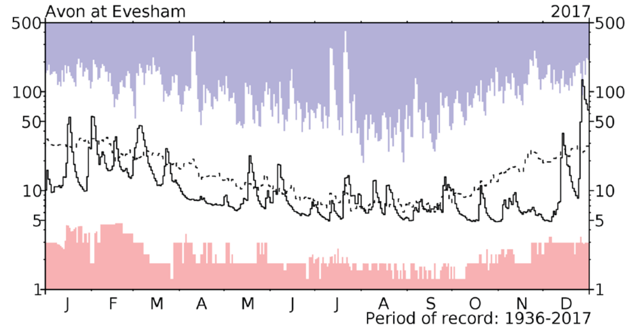

Tweed at Norham
2017
Period of record: 1962-2017

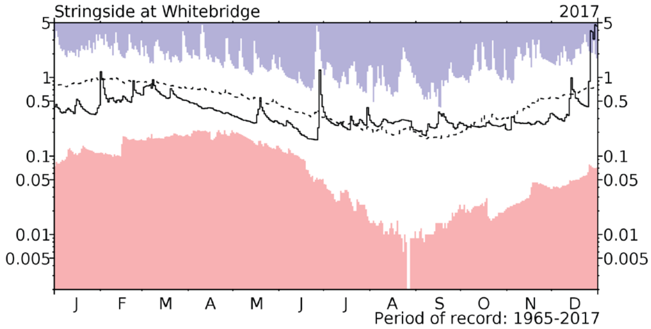

Conwy at Cwmlanerch
2017
Period of record: 1964-2017

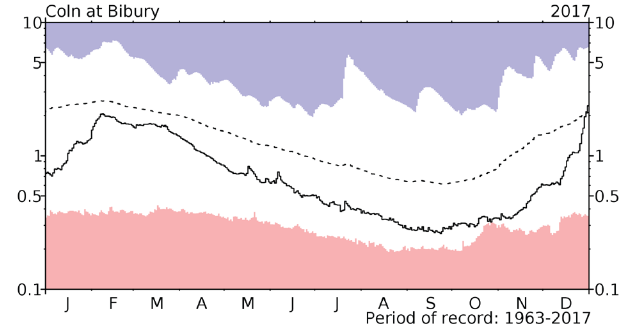

Tyne at Bywell
2017
Period of record: 1956-2017

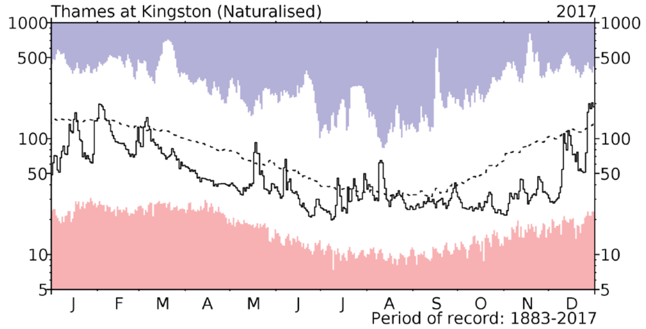

Yscir at Pont-Ar-Yscir
2017
Period of record: 1972-2017

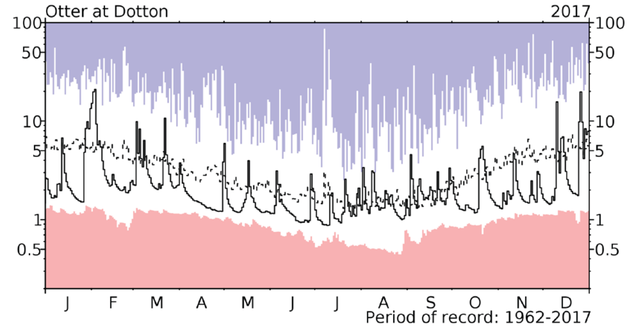

Trent at Colwick
2017
Period of record: 1958-2017

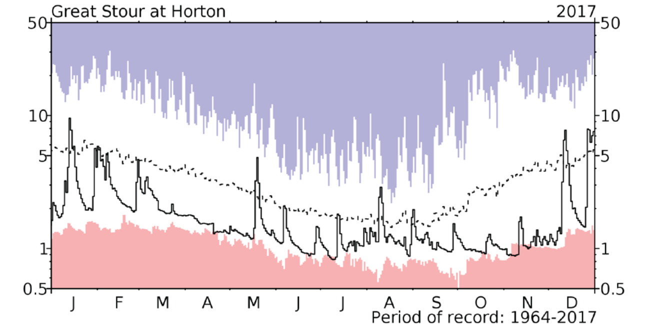

Avon at Evesham
2017
Period of record: 1936-2017


Stringside at Whitebridge
2017
Period of record: 1965-2017

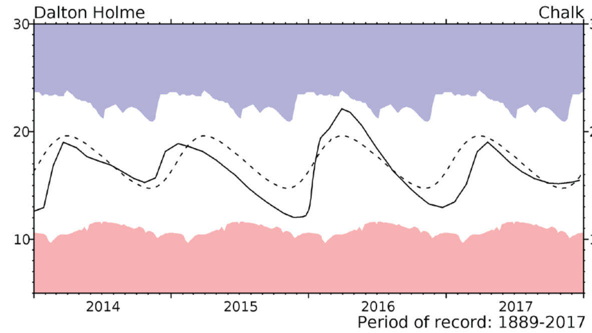

Coln at Bibury
2017
Period of record: 1963-2017

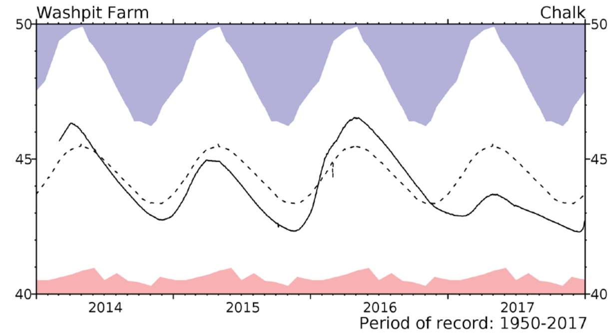

Thames at Kingston (Naturalised)
2017
Period of record: 1883-2017

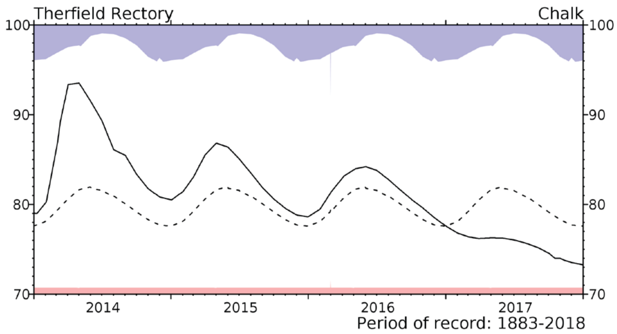

Otter at Dotton
2017
Period of record: 1962-2017

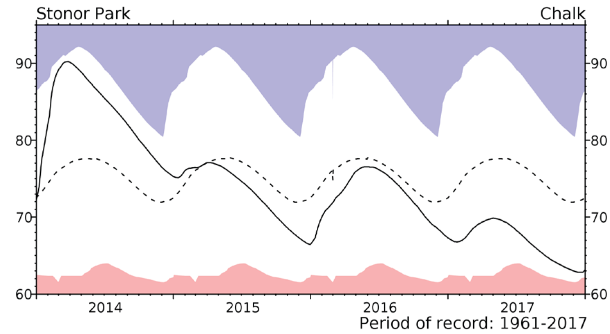

Great Stour at Horton
2017
Period of record: 1964-2017

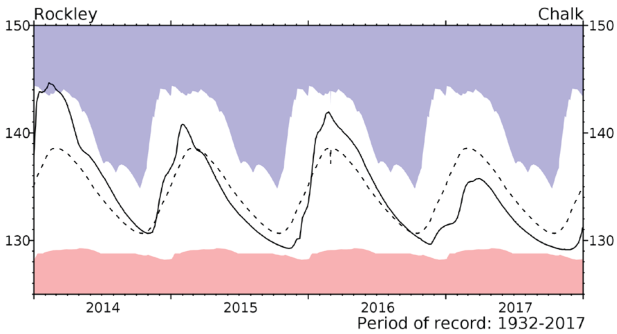
Groundwater ... Groundwater

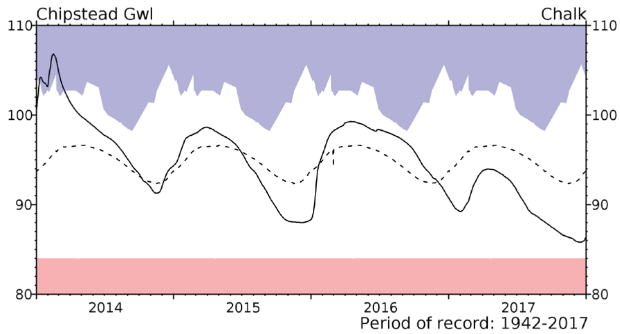


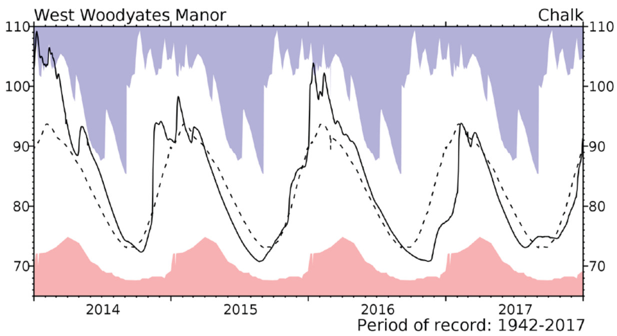


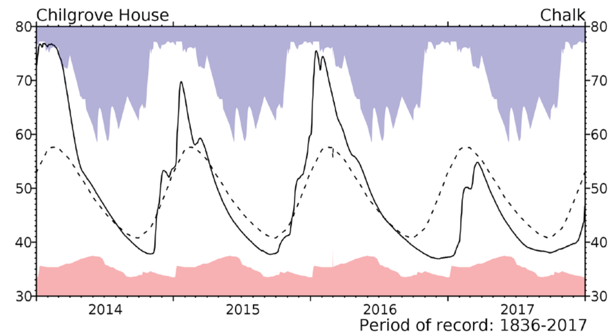


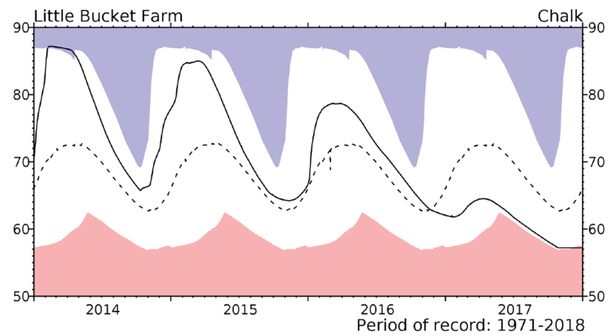


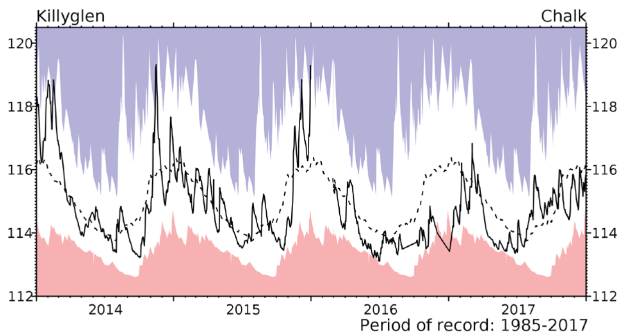






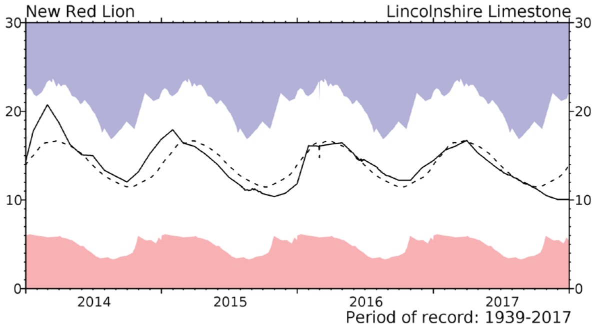


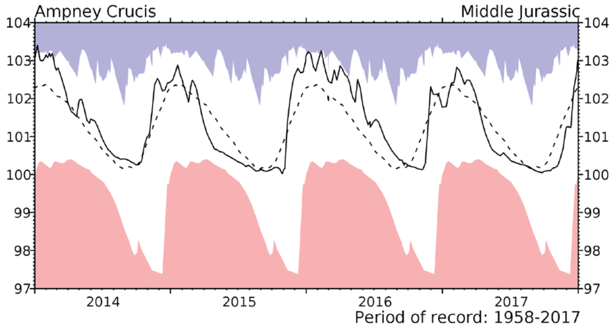


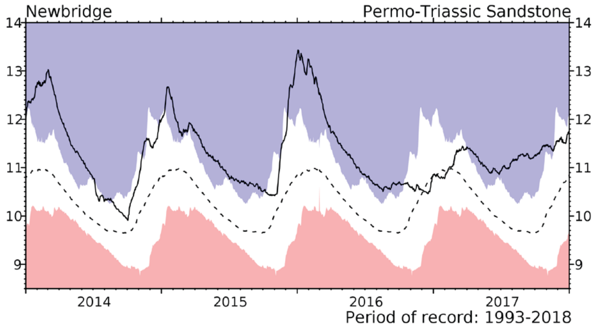


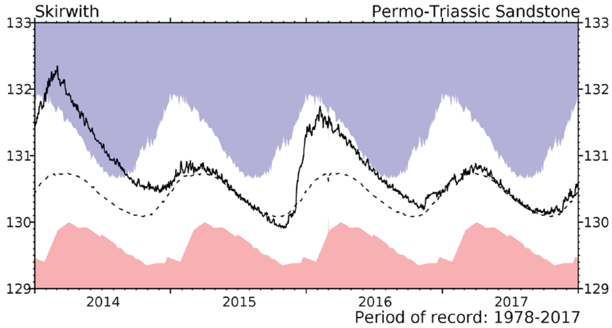
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

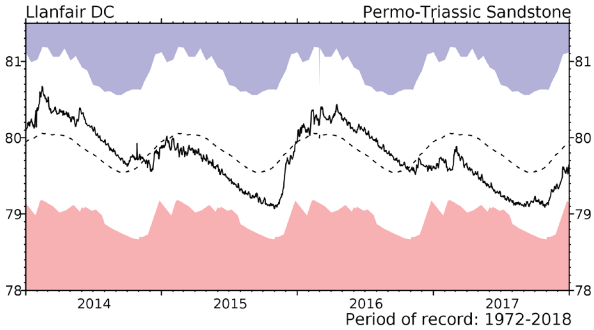
Groundwater... Groundwater

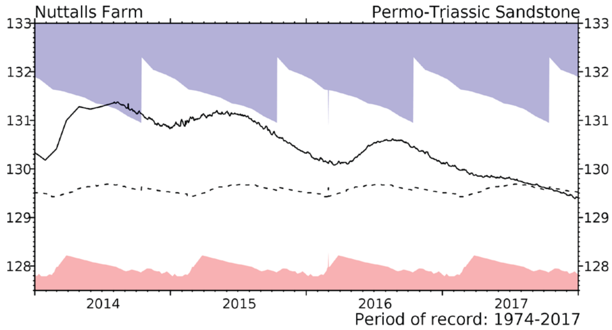


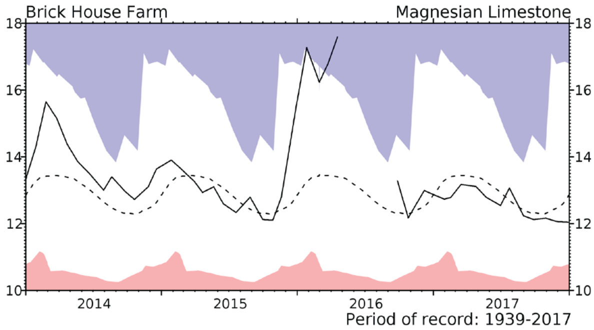


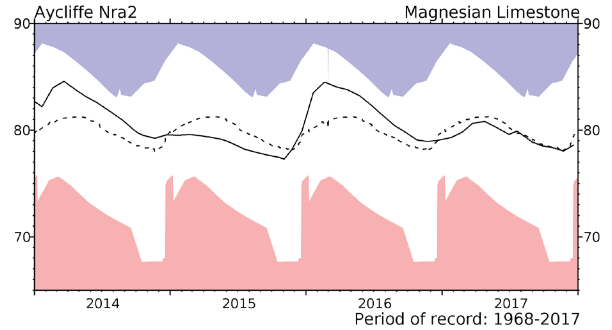


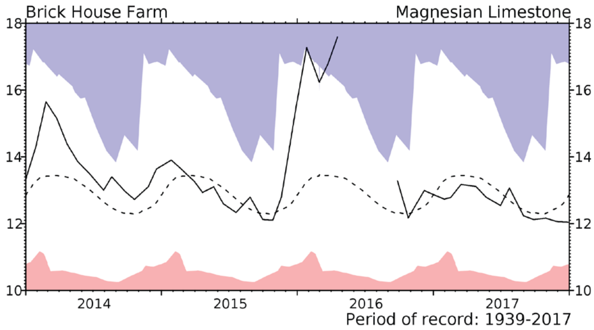


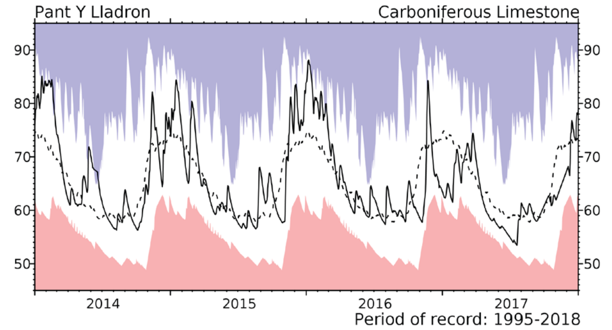


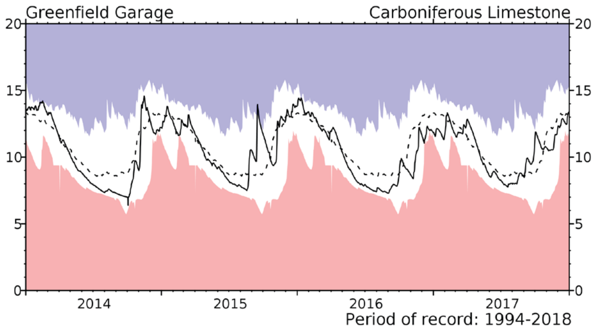


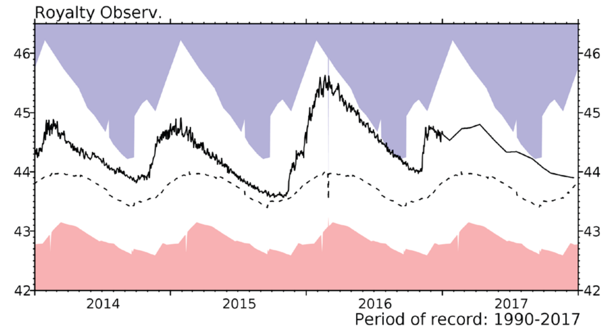




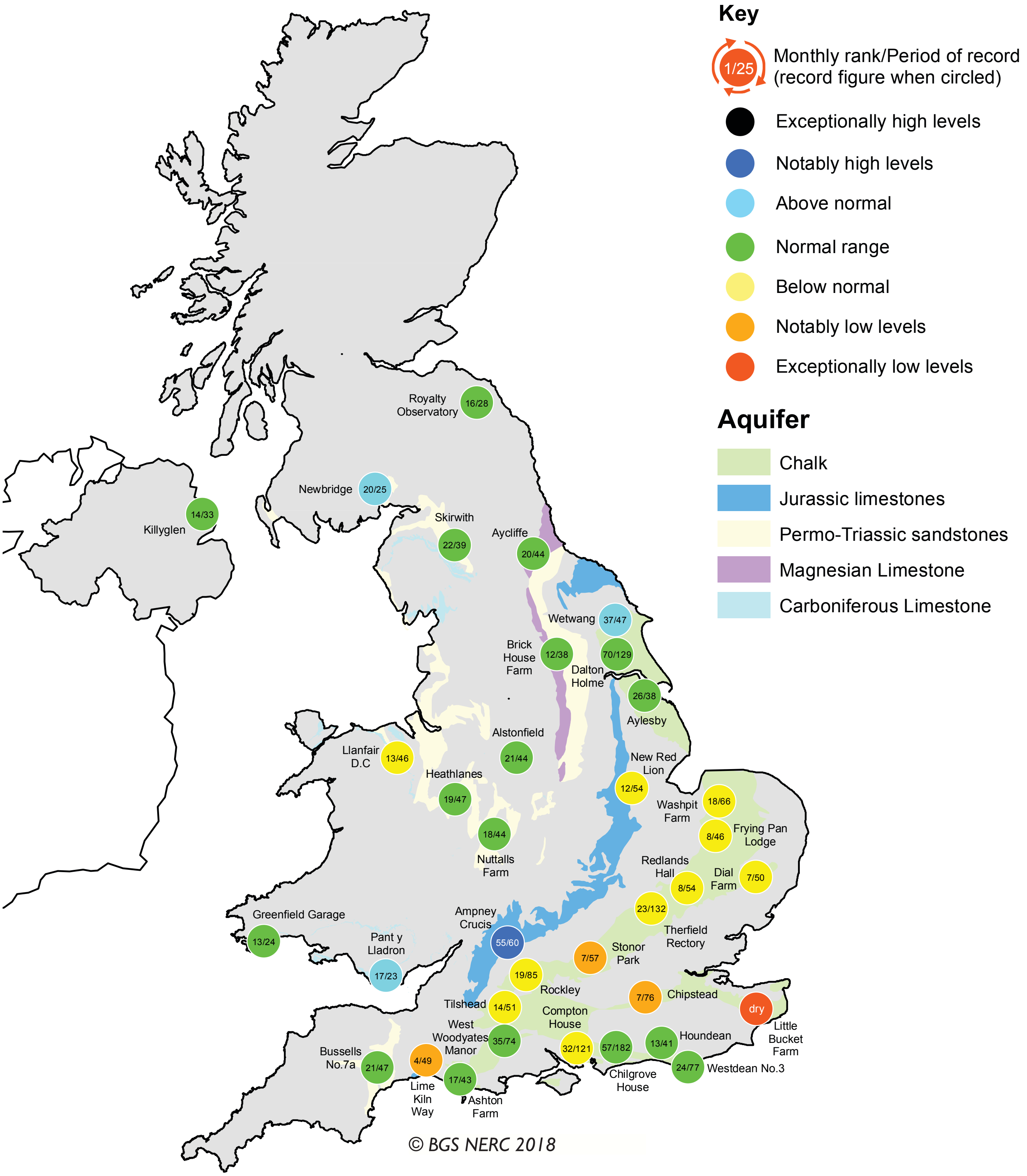








Groundwater...Groundwater

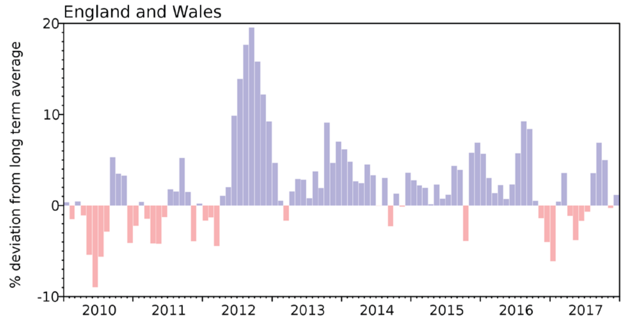


Groundwater levels - December 2017

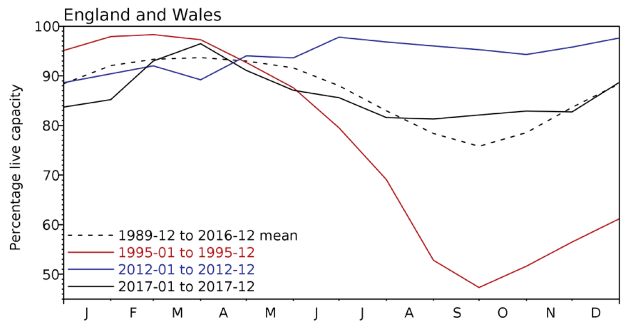
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

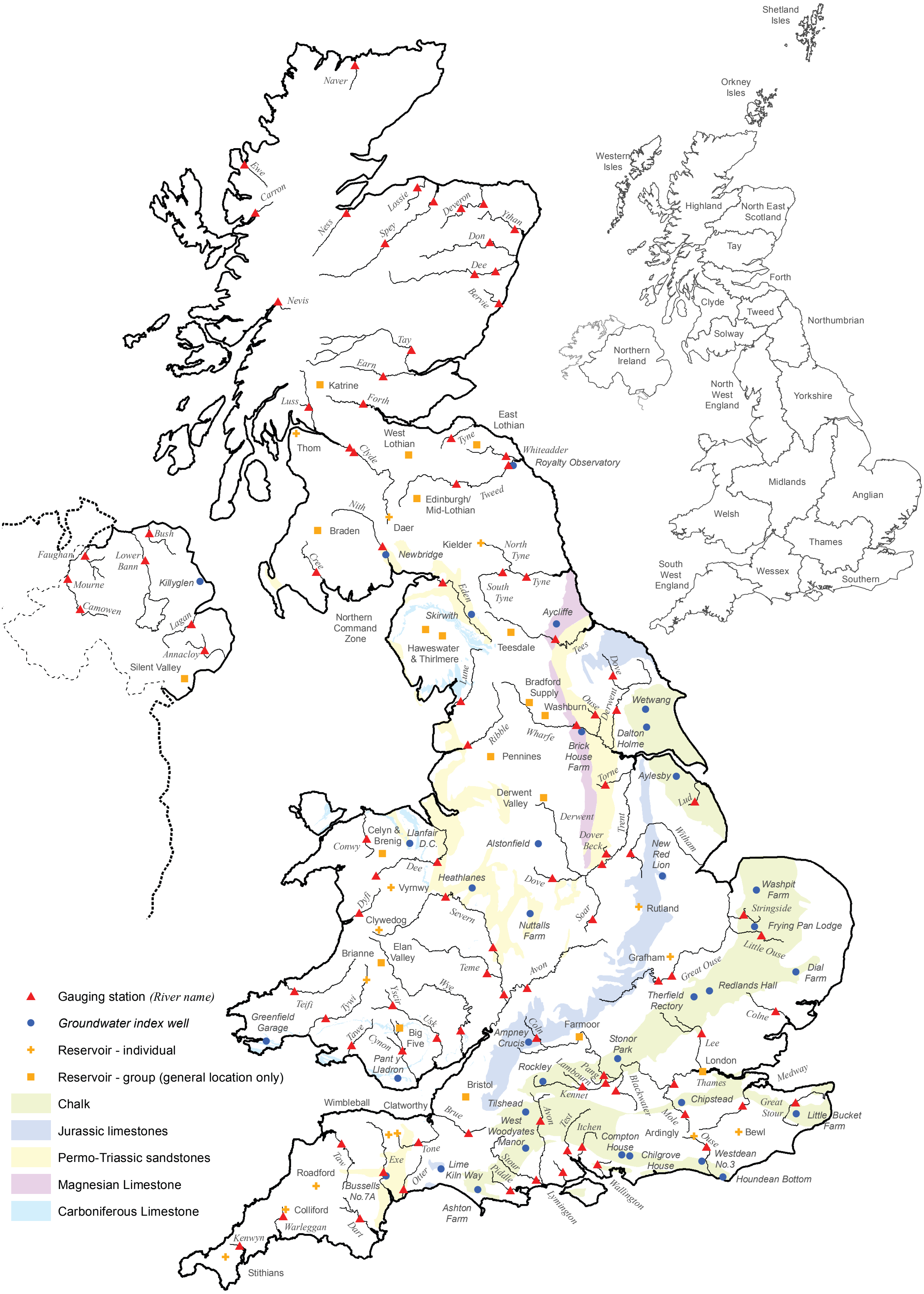
Area	Reservoir		Capacity (Ml)	2017 Oct	2017 Nov	2017 Dec	Dec Anom.	Min Dec	Year* of min	2016 Dec	Diff 17-16
North West	N Command Zone	•	124929	88	82	81	-6	51	1995	70	10
	Vyrnwy		55146	98	93	99	8	35	1995	85	15
Northumbrian	Teesdale	•	87936	98	98	100	10	41	1995	92	8
	Kielder		(199175)	87	83	91	-1	70	1989	88	3
Severn-Trent	Clywedog		49936	85	87	86	2	54	1995	87	0
	Derwent Valley	•	46692	80	85	100	9	10	1995	100	0
Yorkshire	Washburn	•	23373	87	86	86	0	23	1995	79	7
	Bradford Supply	•	40942	91	91	94	4	22	1995	80	14
Anglian	Grafham		(55490)	94	94	92	9	57	1997	78	15
	Rutland		(116580)	85	81	84	2	60	1990	81	3
Thames	London	•	202828	60	59	76	-11	60	1990	86	-10
	Farmoor	•	13822	95	94	95	4	71	1990	95	-1
Southern	Bewl		31000	36	33	43	-29	34	2005	56	-13
	Ardingly		4685	81	87	100	16	30	2011	46	55
Wessex	Clatworthy		5364	68	65	85	-6	54	2003	65	20
	Bristol	•	(38666)	61	67	87	8	40	1990	68	19
South West	Colliford		28540	98	88	94	15	46	1995	67	27
	Roadford		34500	74	79	87	9	20	1989	64	23
	Wimbleball		21320	53	55	67	-16	46	1995	50	17
	Stithians		4967	81	80	89	11	33	2001	81	8
Welsh	Celyn & Brenig	•	131155	91	94	97	3	54	1995	94	3
	Brianne		62140	100	100	100	3	76	1995	97	3
	Big Five	•	69762	79	84	92	2	67	1995	85	7
	Elan Valley	•	99106	89	100	100	4	56	1995	91	9
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	87	89	90	-1	60	1998	86	4
	East Lothian	•	9374	95	97	99	3	48	1989	100	-1
Scotland(W)	Loch Katrine	•	110326	99	100	99	9	75	2007	93	6
	Daer		22412	98	99	100	3	83	1995	91	9
	Loch Thom		10798	100	100	100	3	80	2007	96	4
Northern Ireland	Total+	•	56800	99	98	99	12	61	2001	76	23
	Silent Valley	•	20634	99	96	99	15	39	2001	65	34

( ) 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 Rivers Agency 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.

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