Hydrological Summary

for the United Kingdom

July 2017

General

July was an unsettled month and was very wet in some areas, particularly in southern England. The July mean temperature for the UK as a whole was near average, but it was moderately warmer in the south-east and cooler in the north-west. Some hot spells triggered thundery downpours, with associated flash flooding, including the most severe flash flood in a coastal catchment in south-west England since the Boscastle floods of August 2004. For the UK as a whole, the summer of 2017 has been exceptionally wet so far, adding to a cluster of wet June-July rainfall totals in the last decade (including 2007 and 2012, both significantly wetter than 2017; these three totals are in the top five in a record from 1910). As with these other recent summers, the wet spell has effected a transformation in the national-scale hydrological situation, albeit much less dramatically than in 2012. Long-term rainfall deficiencies have been moderated in much of the country, and above average July river flows were prevalent in northern and western Britain; correspondingly, end-of-July reservoir stocks were near-average nationally. However, the imprint of the dry winter and spring is still apparent: below average stocks persisted in some reservoirs in southern and central Britain (with >15% below for Elan Valley, Wimbleball and Bewl) and river flows remained below normal in some catchments. Similarly, July groundwater levels were notably low across much of the Chalk. While the July rainfall could have a delayed influence on late summer groundwater levels, it is increasingly likely that the autumn recharge season will begin from a below normal baseline in parts of the south, with potential implications for the longer-term water resources situation.

Rainfall

July started unsettled, particularly in areas exposed to the predominantly westerly airflow, although the south-east was largely dry for the first ten days, with hot spells (and occasional thunderstorms) associated with ridges of high pressure. During a very warm spell between 17th and 19th, thunderstorms across southern Britain brought flash flooding, with widespread reports of transport disruption and some property damage (e.g. in north Wales and Kent). A very localised downpour on the 18th caused severe flash flooding in Coverack, Cornwall. A daily total of 105mm was recorded nearby, with most falling in less than three hours; totals were likely to have been higher locally. The second half of the month was unsettled across the country, with frontal systems bringing heavy and sometimes persistent rainfalls, with further flash flooding (e.g. in Gloucester on the 25th). Rainfall totals for July were above average (with 142% for the UK as a whole) except for parts of northern Scotland. Large areas received substantially more: 170% of average was registered across a swathe of southern England, much of Northern Ireland, and parts of northern England, Wales and the Midlands. Rainfall totals for June-July combined were notably high across much of the UK, with >170% for many areas. It was the second highest June-July rainfall for Scotland and the fifth highest for the UK as a whole, in records from 1910. In some places significant rainfall accumulations extend back to late spring: it was the third highest May-July rainfall for Solway region and the fourth highest for the Southern region of England (from 1910).

River flows

Entering July, flows in many responsive rivers were above average, following the unsettled end to June. After the first week, a generally quiescent period followed, although convective rainfall around mid-month triggered some rapid flow responses in smaller catchments, with localised flood alerts. On the 18th, flash flooding from the catchment above Coverack resulted in destructive flooding in the village. A number of people had to be evacuated by rescue services, while initial estimates suggested 50 properties were flooded and there was severe damage to infrastructure. In most responsive catchments, flows increased in the final ten days, with widespread flood alerts in small catchments and urban settings. In northern and western areas, July river flows were typically in the normal range or above, and substantially above in some catchments (e.g. the Lune and the Wharfe with 189% and 171% respectively). Correspondingly, June-July runoff totals were notably high across northern Britain, with the Lune and the Spey having twice the typical runoff over this period. Across the English Lowlands, July flows were predominantly in the normal range, with below normal flows registered in parts of central England and the Welsh borders (including the Severn and the Teme) and in some groundwater fed catchments in southern England. The July flow for the Coln was the second lowest on record (after 1976) in a record from 1963. The low flows in these catchments reflects the dry spring and winter half-year, which can be seen more widely in runoff deficiencies across the English Lowlands over the last 6-12 months.

Groundwater

Following the wet June and July, end of month Soil Moisture Deficits (SMDs) declined significantly across much of the country, and were eliminated in parts of western Scotland. Across the main aquifer areas, SMDs were below average for the time of year (with the exception of parts of central England which were moderately above average). Despite the declining SMDs, groundwater levels generally fell in the Chalk and remained notably low at many sites across southern England. Compton House recorded the sixth lowest level in a 124 year record. However, levels increased slightly at Killyglen, and were above normal. In the more rapidly responding Jurassic and Magnesian limestones, levels remained within the normal range, but fell in the former and rose in the latter, reflecting regional differences in the rainfall since early June. In the Permo-Triassic sandstones, the groundwater level situation remained broadly similar as in June, although Bussells No. 7A recovered from notably low to below normal and a small rise in level was at Newbridge resulted in a record July groundwater level (the second consecutive month that a period-of-record maximum has been established). Levels in the Carboniferous Limestone fell at Alstonfield and Greenfield Garage, but increased significantly at Pant y Lladron from notably low to above normal, reflecting the high rainfall in this area. Levels in the Fell Sandstone rose at Royalty Observatory and remain above average.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

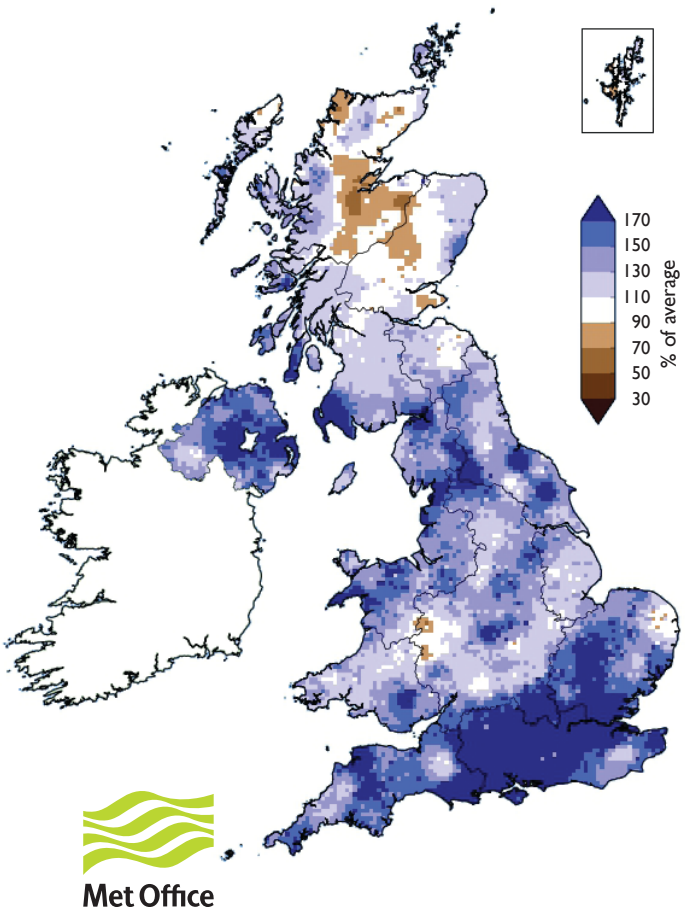
Region	Rainfall	Jul 2017	Jun17 – Jul17	RP	May17 – Jul17	RP	Feb17 – Jul17	RP	Nov16 – Jul17	RP
United Kingdom	mm	**107**	221		279		506		764	
	%	**142**	151	20-30	130	10-15	109	5-10	93	2-5
England	mm	**96**	181		238		390		588	
	%	**156**	147	10-15	132	8-12	108	2-5	96	2-5
Scotland	mm	**116**	274		327		660		1015	
	%	**123**	154	50-80	128	8-12	109	5-10	92	2-5
Wales	mm	**129**	264		336		653		948	
	%	**143**	152	8-12	131	5-10	116	5-10	91	2-5
Northern Ireland	mm	**128**	232		295		505		719	
	%	**156**	147	10-15	128	5-10	104	2-5	87	5-10
England & Wales	mm	**101**	192		252		426		638	
	%	**154**	148	10-15	132	8-12	110	2-5	95	2-5
North West	mm	**133**	278		333		597		875	
	%	**153**	167	20-35	140	10-15	120	10-15	99	2-5
Northumbria	mm	**97**	238		266		472		669	
	%	**144**	178	30-50	141	10-15	124	10-15	105	2-5
Severn-Trent	mm	**80**	145		202		348		530	
	%	**132**	118	2-5	112	2-5	100	2-5	93	2-5
Yorkshire	mm	**93**	209		256		416		611	
	%	**153**	162	15-25	141	8-12	113	2-5	99	2-5
Anglian	mm	**76**	144		209		306		441	
	%	**145**	135	5-10	134	8-12	108	2-5	98	2-5
Thames	mm	**97**	144		213		308		492	
	%	**188**	141	5-10	135	5-10	100	2-5	94	2-5
Southern	mm	**97**	159		227		335		539	
	%	**195**	159	8-12	149	10-20	105	2-5	93	2-5
Wessex	mm	**108**	171		237		376		605	
	%	**187**	150	5-10	137	5-10	103	2-5	93	2-5
South West	mm	**124**	214		271		506		785	
	%	**157**	144	5-10	121	2-5	102	2-5	86	2-5
Welsh	mm	**126**	255		326		628		916	
	%	**143**	152	8-12	131	5-10	115	5-10	92	2-5
Highland	mm	**118**	270		320		725		1176	
	%	**117**	141	10-15	115	2-5	101	2-5	88	2-5
North East	mm	**82**	218		258		459		688	
	%	**112**	152	8-12	123	2-5	107	2-5	94	2-5
Tay	mm	**89**	254		305		572		823	
	%	**108**	159	15-25	128	5-10	105	2-5	84	5-10
Forth	mm	**95**	286		334		574		799	
	%	**117**	180	>100	146	20-30	116	10-15	92	2-5
Tweed	mm	**98**	256		299		546		775	
	%	**127**	173	40-60	140	10-20	126	15-25	104	2-5
Solway	mm	**152**	349		422		764		1059	
	%	**156**	191	>100	159	70-100	129	80-120	99	2-5
Clyde	mm	**150**	335		406		801		1235	
	%	**131**	159	70-100	135	15-25	112	8-12	94	2-5

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

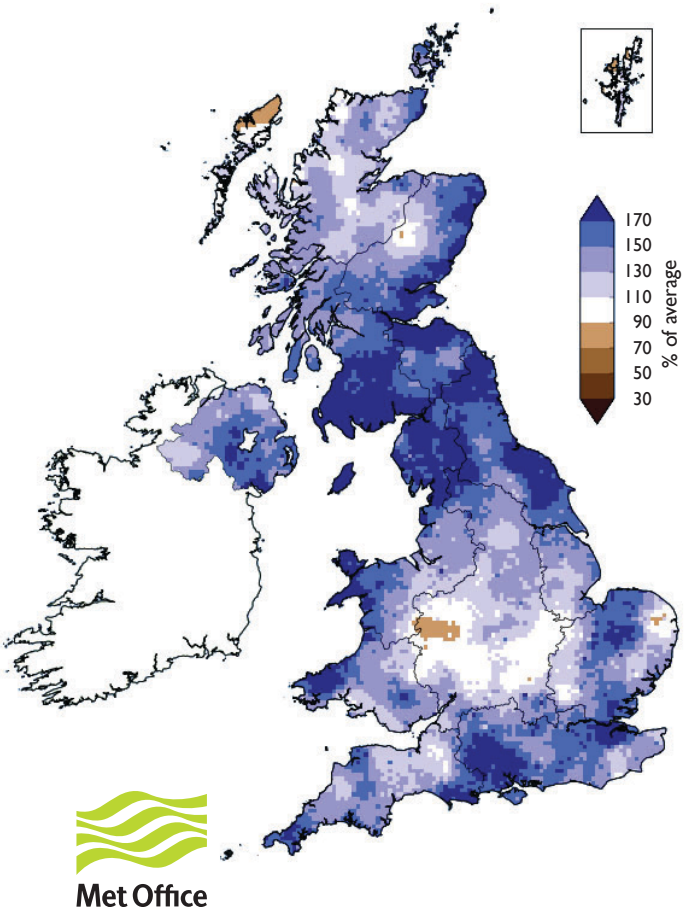
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

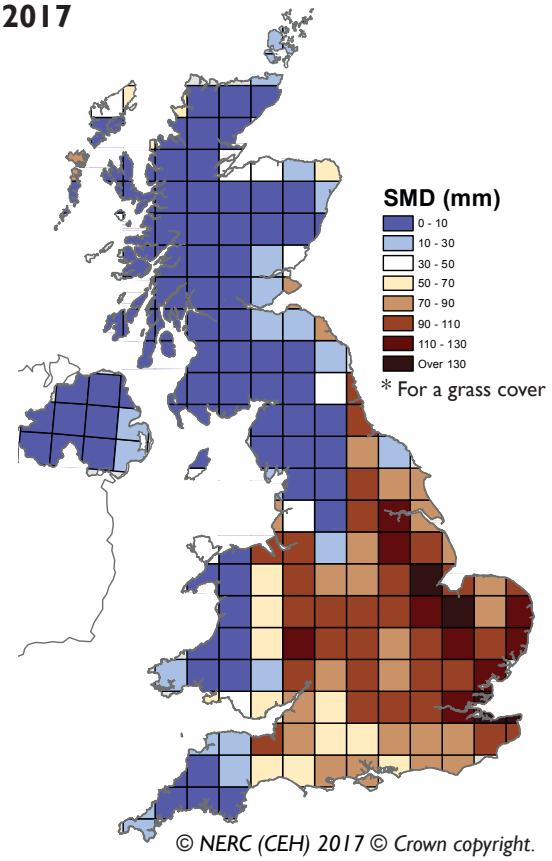
July 2017 rainfall
as % of 1981-2010 average



June 2017 - July 2017 rainfall
as % of 1981-2010 average



MORECS Soil Moisture Deficits*
July 2017



Hydrological Outlook UK

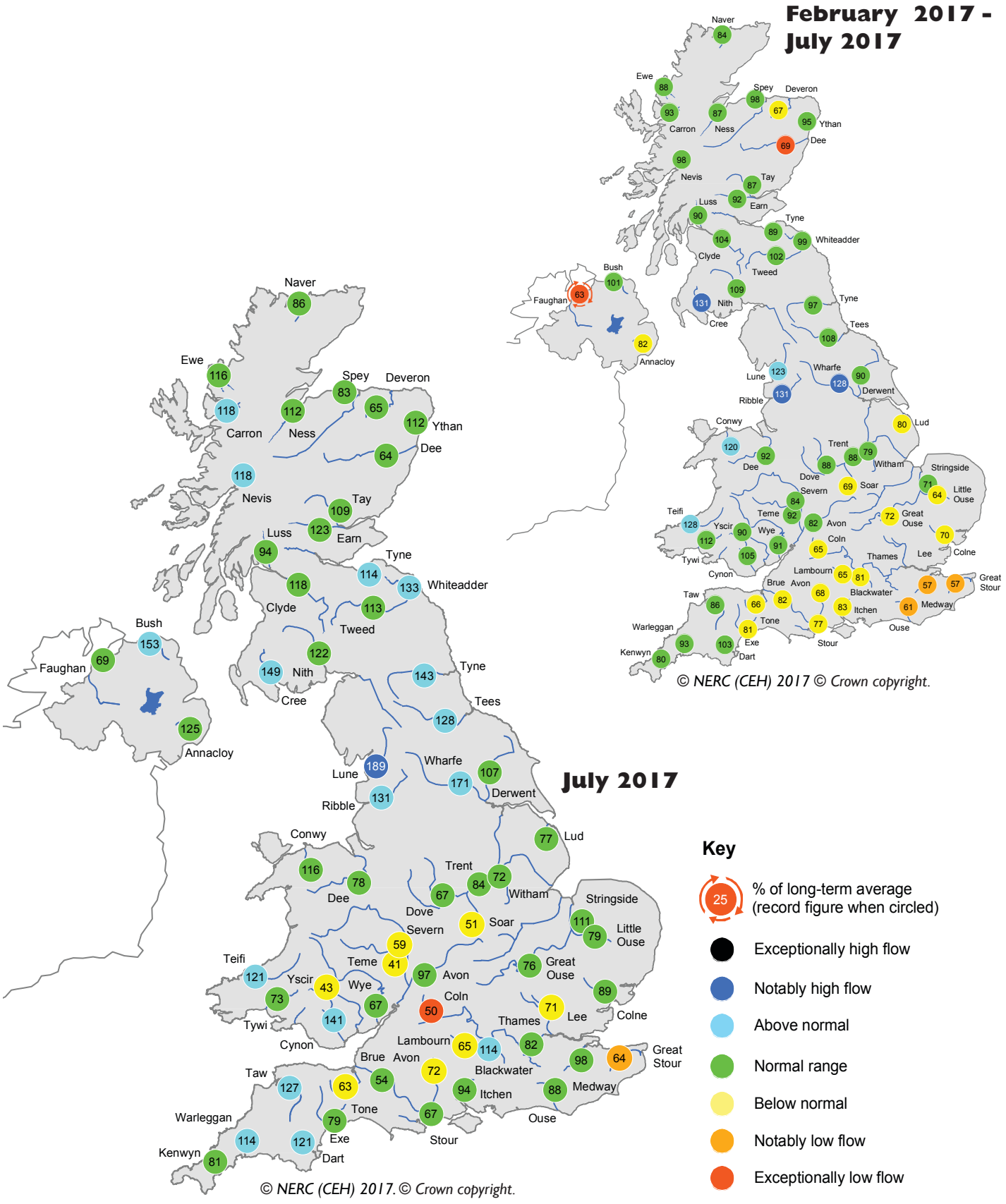
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from August 2017**
Issued: **10.08.2017**
using data to the end of July 2017

The one month outlook is for river flows to be normal to above normal across much of northern and western Britain, with above-normal groundwater levels in some northern areas. In south-east England and parts of central England, river flows and groundwater levels are likely to be normal to below normal, with notably low levels in some areas of the southern Chalk. The three month outlook is for a broadly similar situation to continue, but with a tendency for more river flows and groundwater levels to enter the normal range.

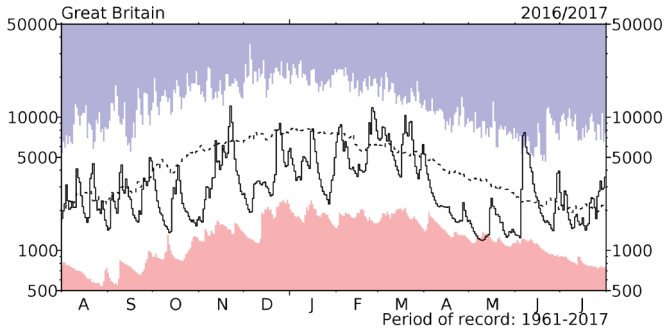
River flow . . . River flow . . .

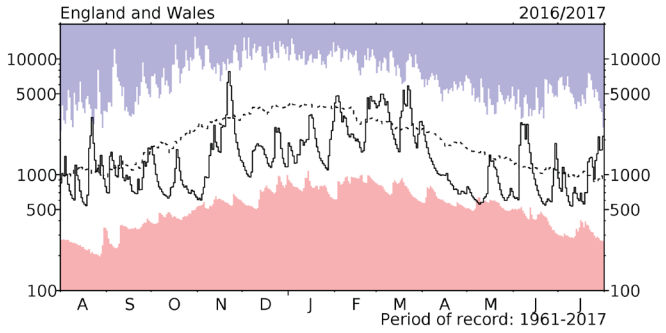


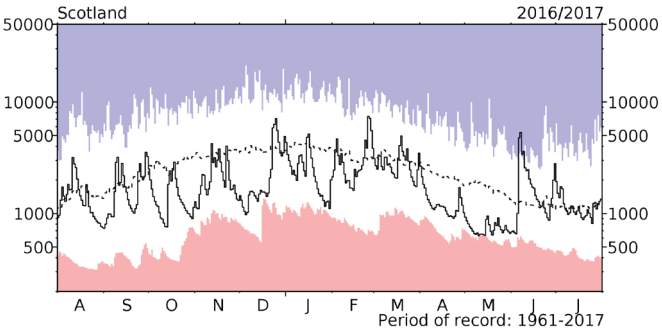
River flows

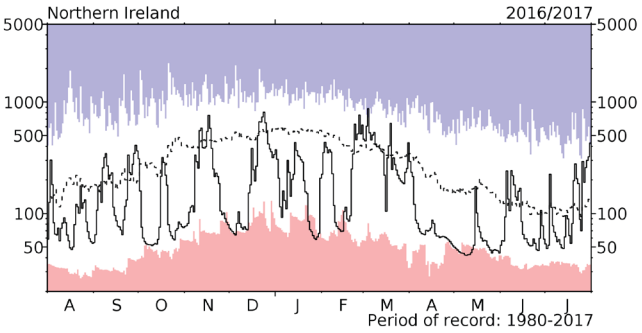
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

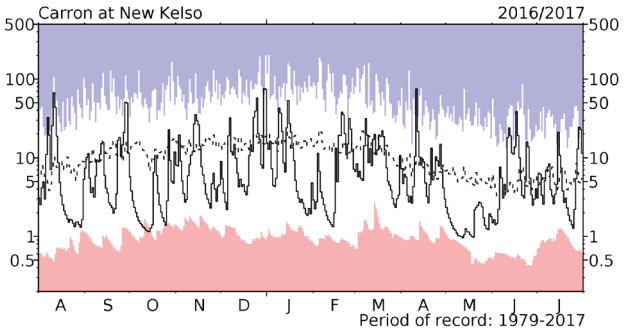
River flow . . . River flow . . .

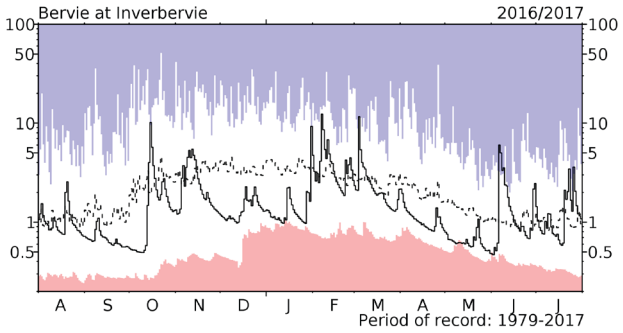


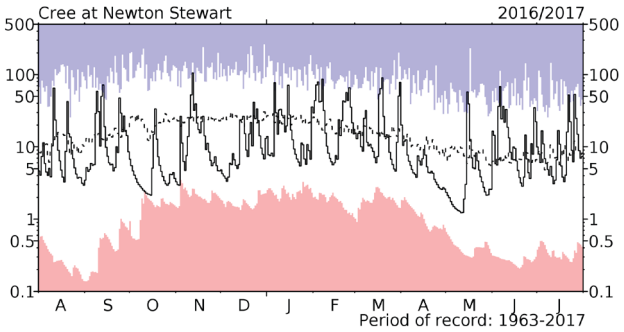


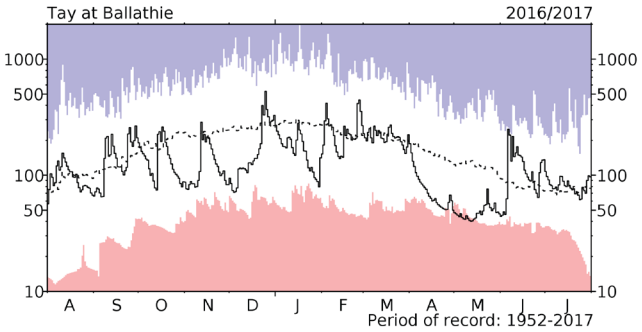


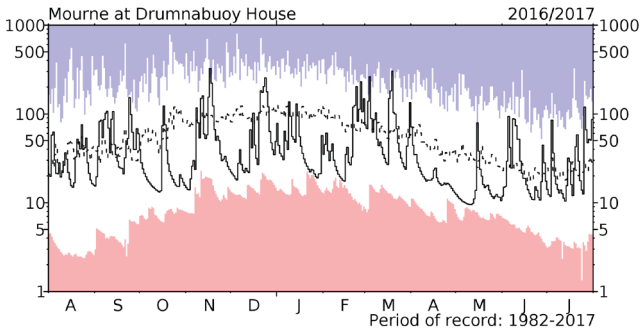


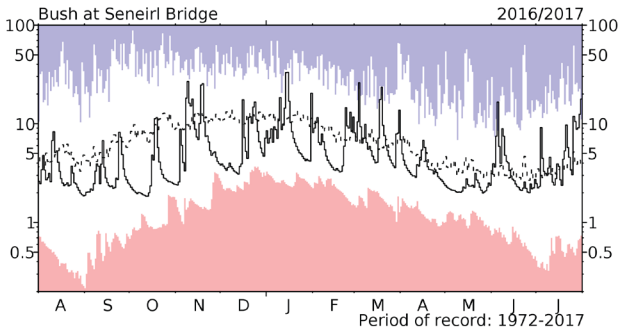








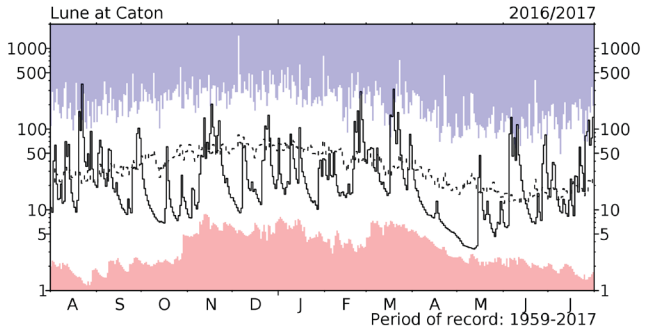


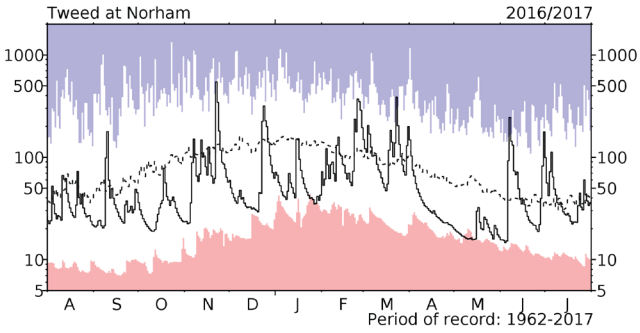


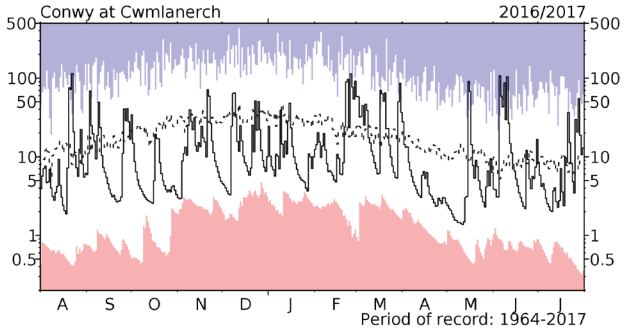
River flow hydrographs

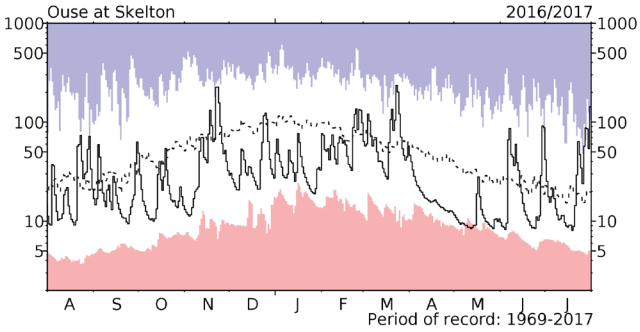
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to August 2016 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

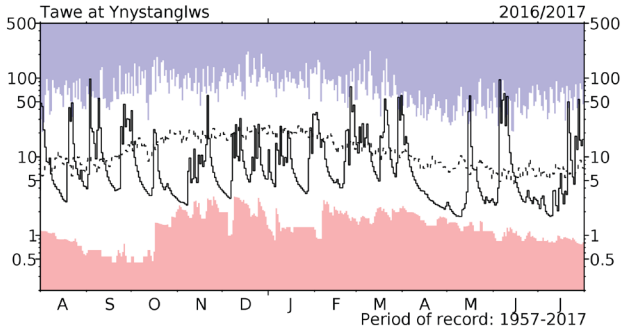
River flow . . . River flow . . .

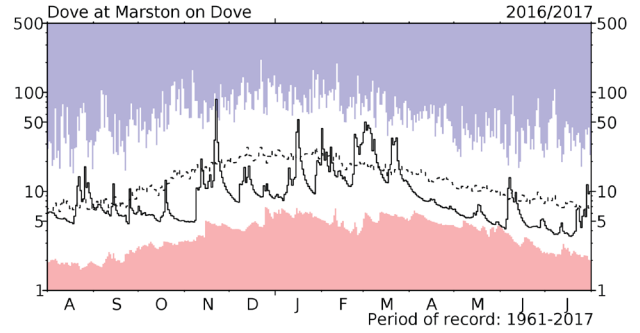


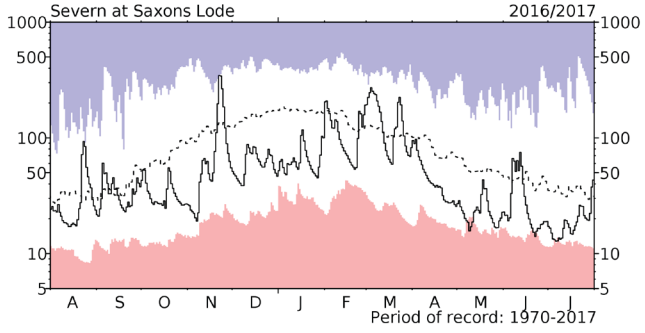


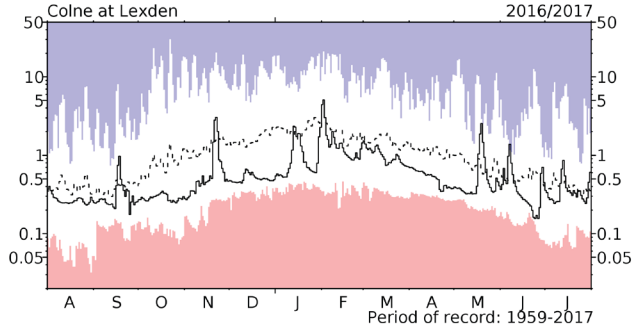


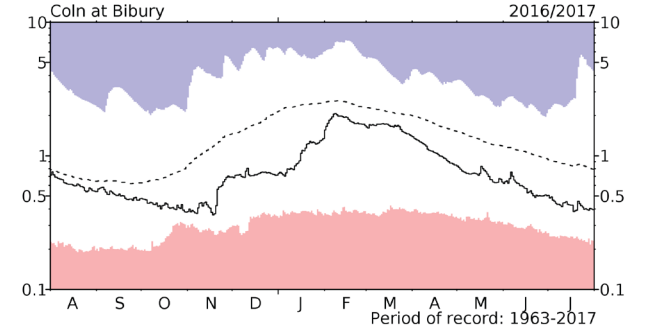


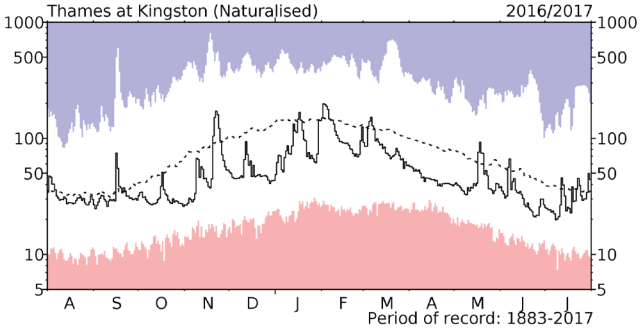


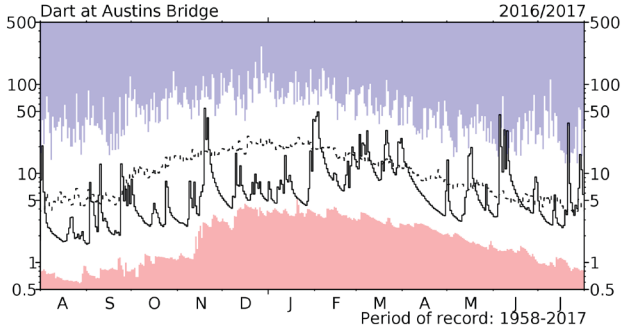


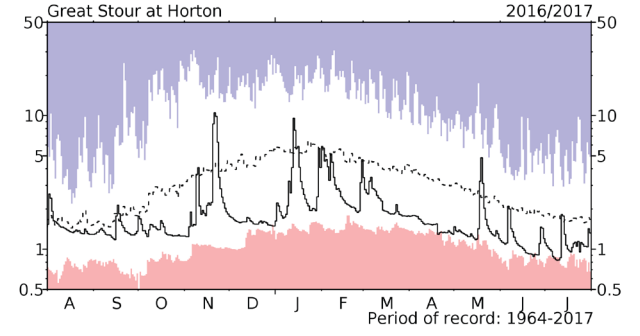




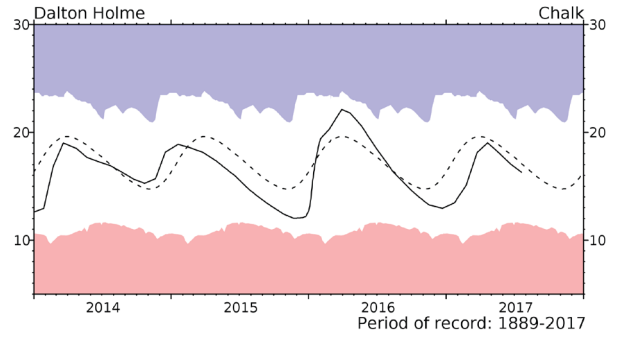


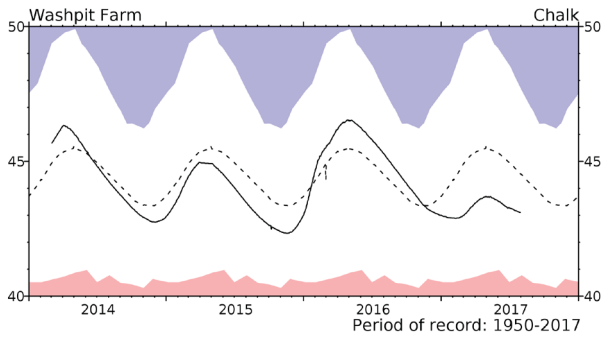


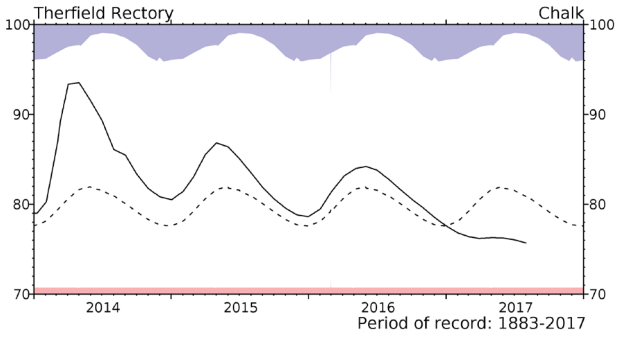


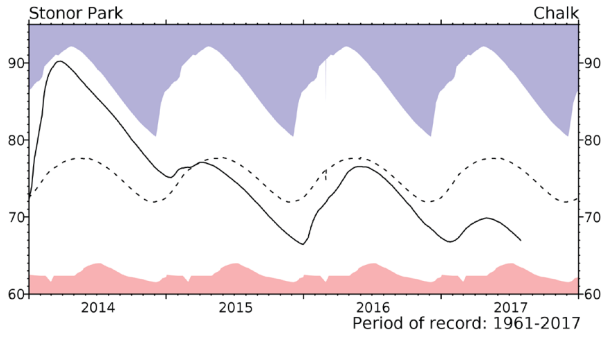


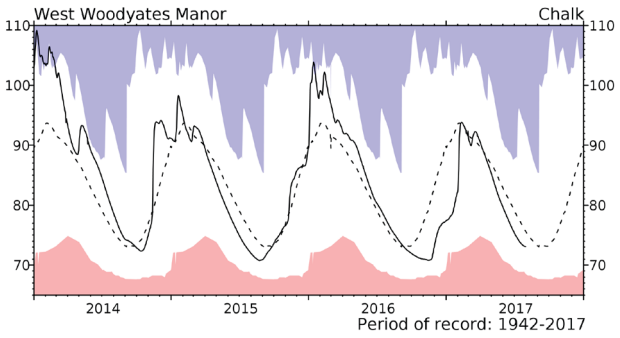
Groundwater…Groundwater

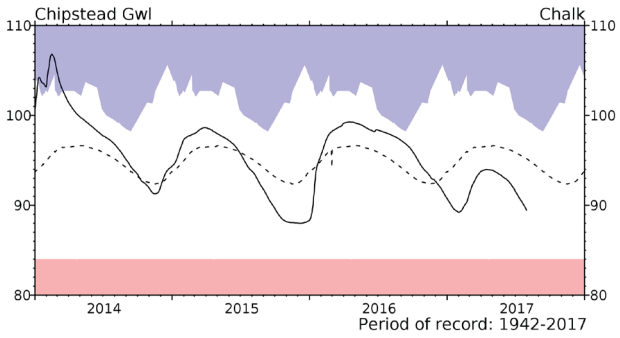


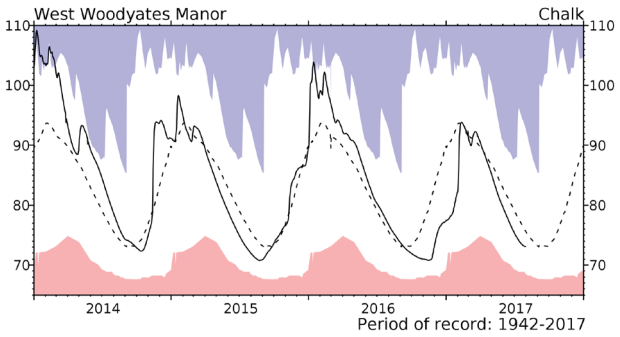


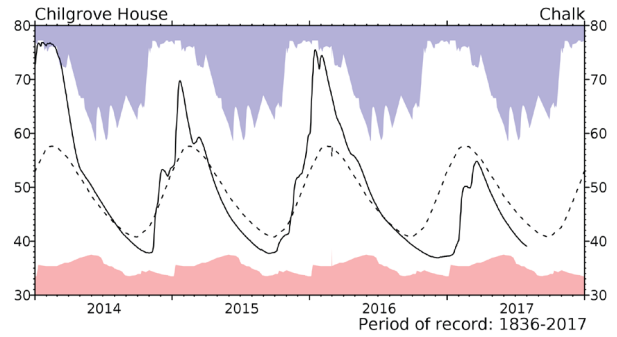


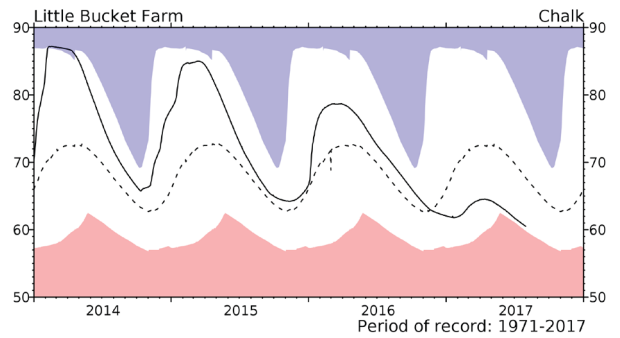


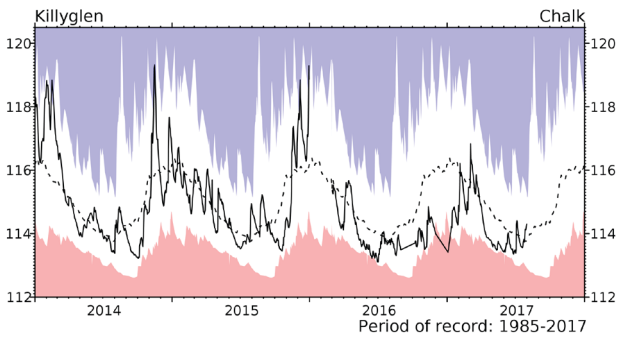






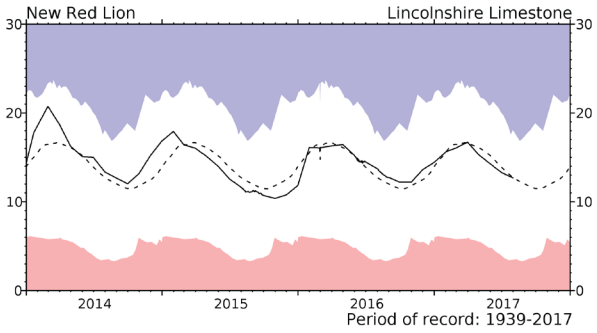


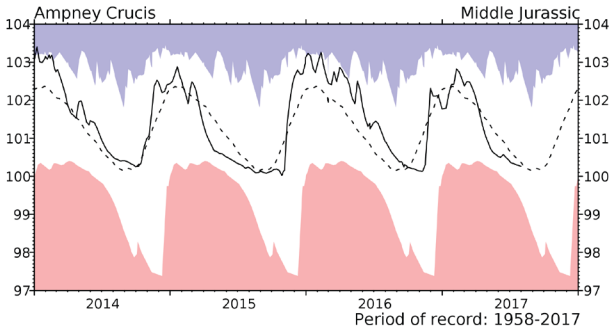


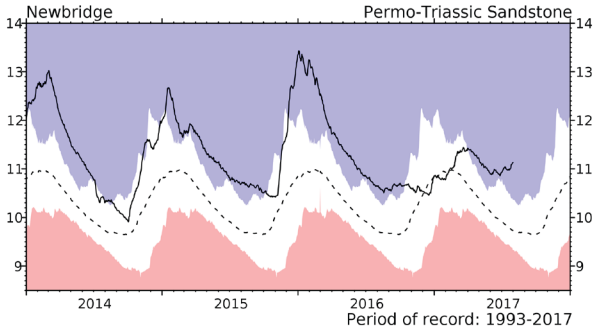


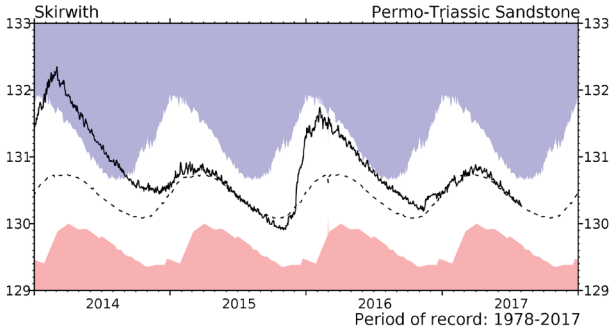
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

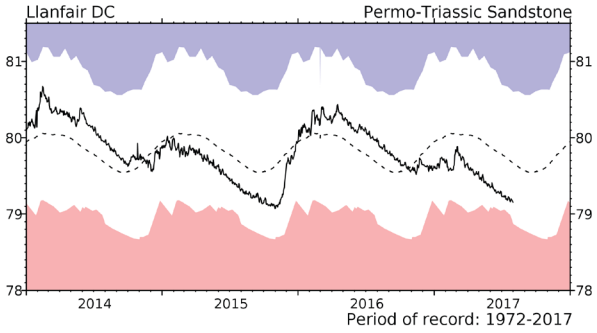
Groundwater … Groundwater

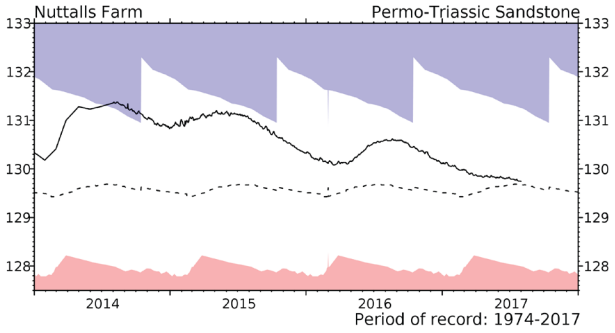


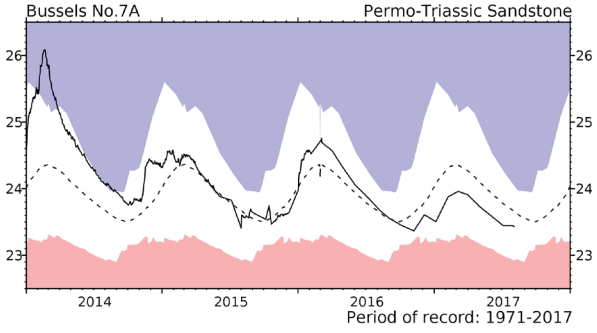


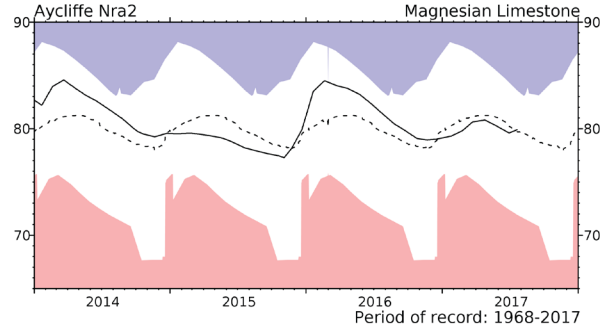


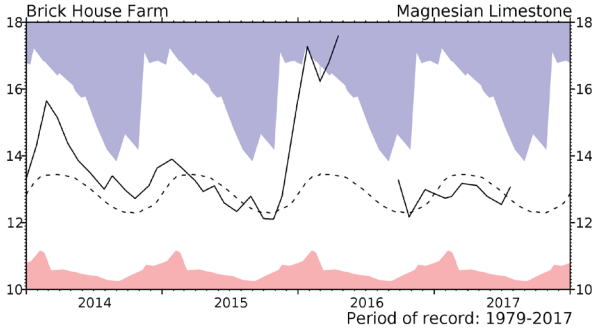


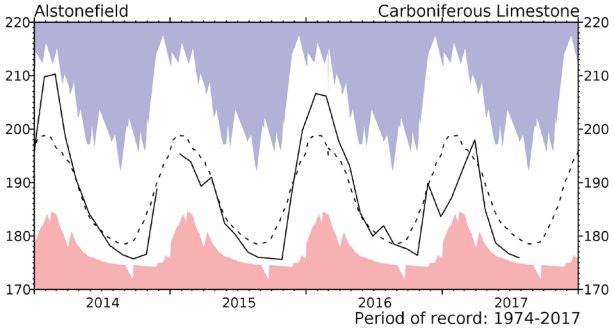


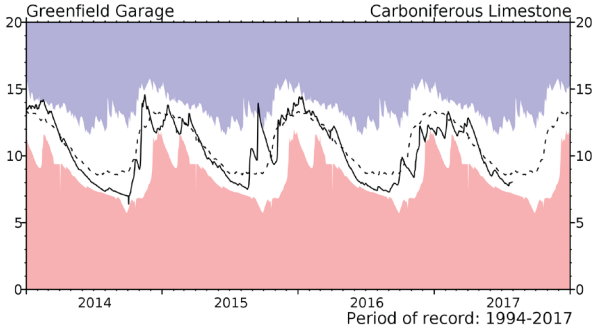


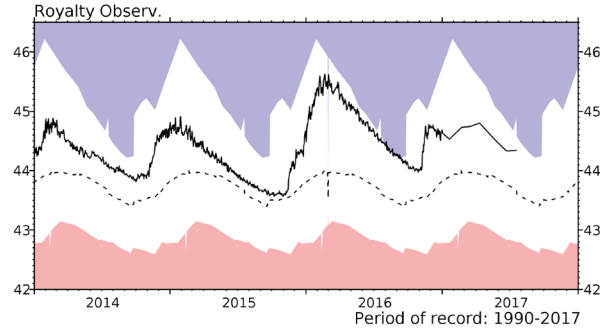


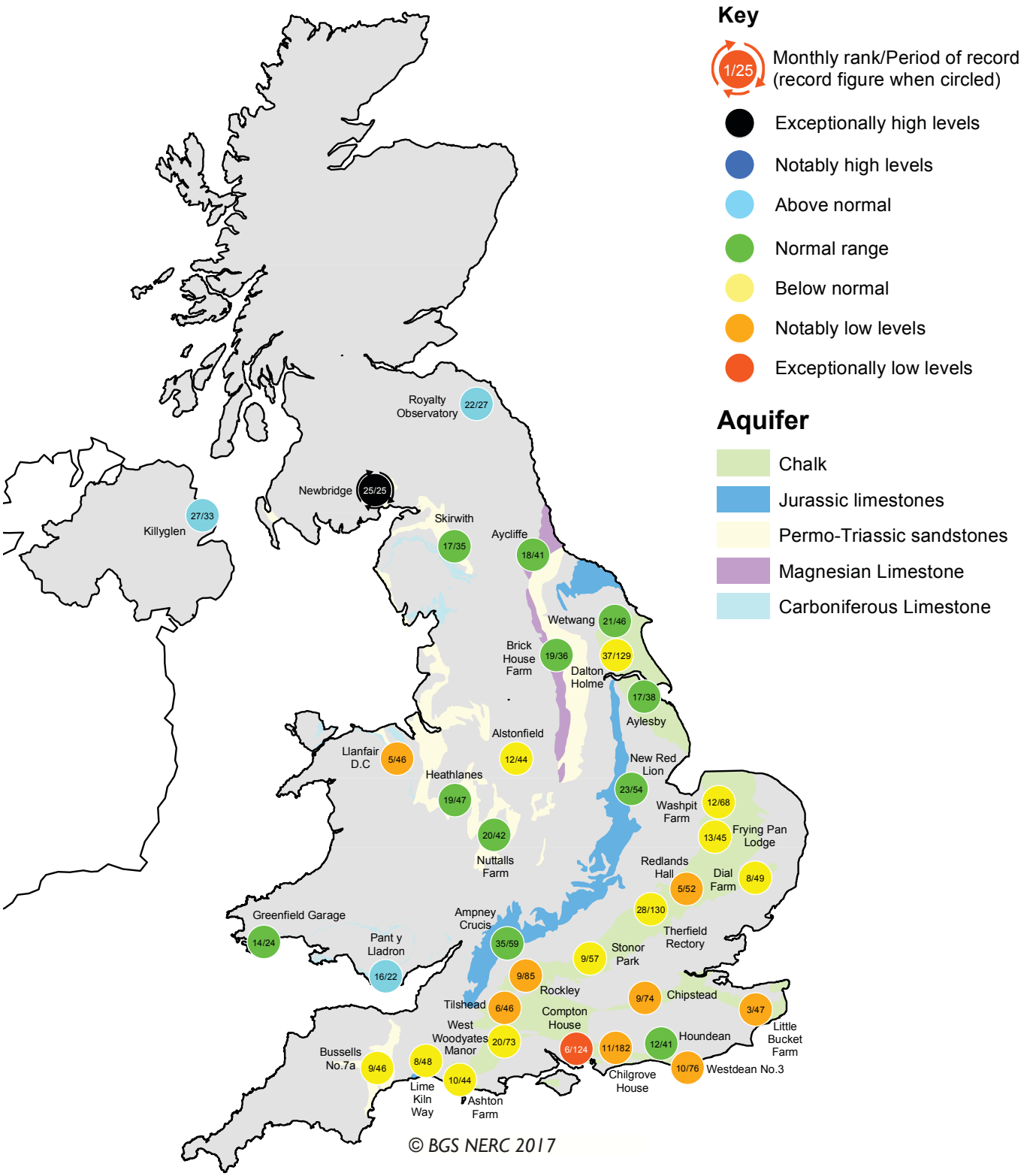










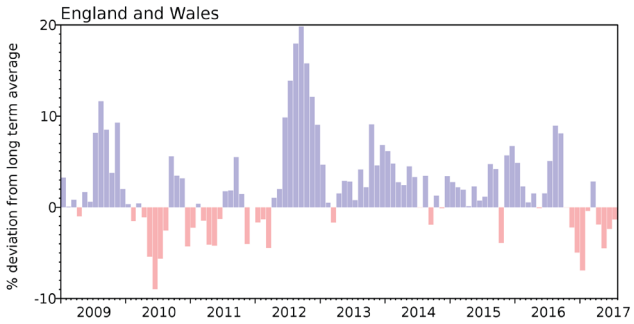


Groundwater levels - July 2017

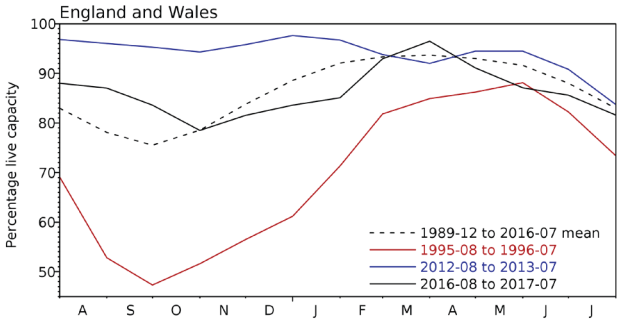
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 May	2017 Jun	2017 Jul	Jul Anom.	Min Jul	Year* of min	2016 Jul	Diff 17-16
North West	N Command Zone	•	124929	76	78	72	8	23	1984	64	7
	Vyrnwy		55146	92	95	93	16	45	1984	94	-1
Northumbrian	Teesdale	•	87936	67	76	81	6	45	1989	76	6
	Kielder		(199175)	87	92	89	0	66	1989	92	-3
Severn-Trent	Clywedog		44922	98	96	82	-4	50	1976	98	-16
	Derwent Valley	•	39525	76	76	66	-8	43	1996	88	-22
Yorkshire	Washburn	•	22035	84	80	80	6	50	1995	69	12
	Bradford Supply	•	41407	73	74	72	0	38	1995	73	-2
Anglian	Grafham		(55490)	96	94	94	4	66	1997	93	1
	Rutland		(116580)	97	93	91	5	74	1995	93	-2
Thames	London	•	202828	97	89	82	-5	73	1990	91	-9
	Farmoor	•	13822	97	94	99	3	84	1990	97	2
Southern	Bewl		28170	68	62	56	-21	45	1990	88	-32
	Ardingly		4685	99	91	84	-2	65	2005	93	-9
Wessex	Clatworthy		5364	84	75	65	-9	43	1992	63	2
	Bristol	•	(38666)	88	81	72	-4	53	1990	79	-7
South West	Colliford		28540	81	77	74	-4	47	1997	84	-10
	Roadford		34500	72	70	67	-11	46	1996	86	-19
	Wimbleball		21320	82	74	63	-15	53	1992	72	-9
	Stithians		4967	90	83	76	5	39	1990	73	3
Welsh	Celyn & Brenig	•	131155	92	88	88	-1	65	1989	100	-12
	Brianne		62140	93	98	97	7	67	1995	98	-1
	Big Five	•	69762	86	85	81	3	41	1989	88	-7
	Elan Valley	•	99106	89	79	68	-15	53	1976	97	-29
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	80	85	82	-1	51	1998	86	-4
	East Lothian	•	9374	93	100	100	10	72	1992	98	2
Scotland(W)	Loch Katrine	•	110326	75	84	83	8	53	2000	81	2
	Daer		22412	69	80	78	-4	56	2013	84	-6
	Loch Thom		10798	72	74	71	-14	59	2000	100	-29
Northern Ireland	Total+	•	56800	81	83	84	7	54	1995	80	5
	Silent Valley	•	20634	78	81	82	8	42	2000	77	5

( ) figures in parentheses relate to gross storage

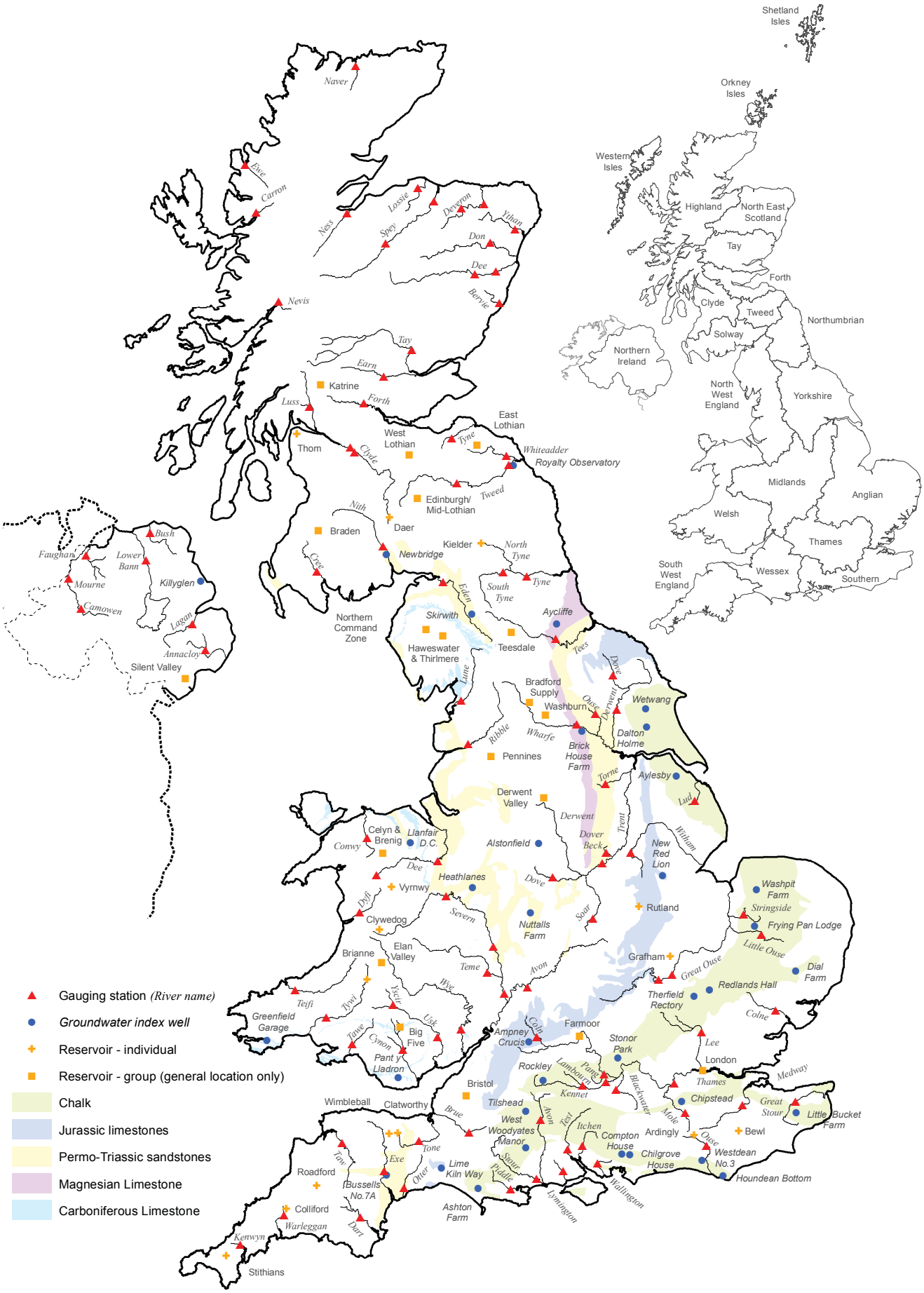
• denotes reservoir groups

*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.

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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