Hydrological Summary *for the* United Kingdom

June 2017

General

June was generally pleasant, with prolonged spells of hot, dry weather but was bookended by intense downpours at the start and end of the month. The hottest June day since 1976 was recorded at Heathrow Airport on the 21st (34.5°C) and for the first time since 1995, June temperatures exceeding 30°C were recorded on five consecutive days in the UK. Despite a lot of fine, dry weather it was the wettest June on record for Scotland and the sixth wettest June for the UK as a whole (both in series from 1910). Soil moisture deficits (SMDs) decreased across the UK with the exception of south-east England. River flows were predominantly below normal in southern England but above normal to exceptionally high in northern and western Britain. Some catchments registered almost half the June average and others more than twice the average. Groundwater levels at the majority of index sites fell during June as they followed their usual seasonal recession, and by month-end ranged from normal to notably low. Stocks fell in most reservoirs in southern England with several small impoundments in the south-west more than 10% below average, and Bewl more than 20% below average, for June. However, stocks for England and Wales remained near average. Groundwater levels in south-east England remained below normal and are likely to do so for the remainder of the summer except in the most extreme of rainfall scenarios. Consequently, there is a continued possibility of localised water resource pressures and ecological stress (particularly where there has been a contraction of the stream network) in south-east England.

Rainfall

Low pressure systems at the beginning and towards the end of June sandwiched high pressure with a warm southerly/south-westerly airflow, which brought stable, dry conditions mid-month. One of the deepest low pressure systems since the 1950s traversed the UK on the 5th/6th with notable rainfall totals, e.g. 81mm at Capel Curig (Wales) on the 5th, 58mm at Loftus (North Yorkshire) on the 6th, followed by 112mm at Torwinny (Moray) on the 7th. The intense rainfall resulted in localised surface water flooding causing road and rail disruption in eastern Scotland. Following a warm and dry interlude in the middle fortnight, a deep low pressure system and thunderstorms towards month-end brought localised surface water flooding, road and rail disruption in north-east England on the 21st, south-east England on the 27th (e.g. 90mm was registered at Santon Downham, Norfolk) and southern and eastern England on the 28th. For June overall, more than twice the average rainfall was registered in a band across much of southern and eastern Scotland, northern England and coastal Wales, while most of northern and western Britain received more than 170% of average. Despite parts of south-east England receiving over 130% of average June rainfall, most fell on the 5th and 27th (at Wallingford 71% of the June total fell on these days), with very little rain on the intervening days. In contrast, central and southern England received below average rainfall, with areas of the Welsh borders and north of London receiving 50-70% of average. Longer-term rainfall deficits are still evident over the last nine to twelve months; it was the sixth and seventh driest July-June for the Southern and South West regions, respectively, in series from 1910.

River flows

Recessions established during May continued into early June, with new daily flow minima set in nine catchments, some of which were amongst those that recorded new daily flow maxima in response to the heavy rainfall on the 5th/6th (e.g. the Dee and the Tyne in Scotland). Recessions resumed in the majority of catchments mid-month, although in western Scotland flows remained high throughout due to the persistent wet conditions. Flows in all but the slower responding catchments in the south-east and catchments in south Wales responded to heavy rainfall towards month-end; new daily flow maxima were recorded in catchments in eastern Scotland and northern England. New June peak flow maxima were recorded on the Spey and the Naver on the 6th and the Lossie, Deveron and Ythan on the 7th, in some cases substantially exceeding the previous June maximum. For June as a whole, below normal to notably low average flows were registered in the south and east of the UK, with flows around half the average recorded on the Teme, Coln, Brue and Tone. In contrast, flows in the north and west were above normal to notably high with exceptionally high flows recorded in northern Scotland. Thirteen index catchments recorded more than twice the average for June, the Lossie more than three times. Outflows from Scotland in June were the sixth highest in a series from 1961. Average flows over the nine month period October 2016-June 2017 were notably low across much of the country with many catchments recording flows less than two thirds of average. Exceptionally low flows were recorded on the Taw and Dart (ranking second and third lowest on record for the October-June period, respectively, both in 59 year records). New minima were registered on the Faughan and Annacloy for this period in records from 1976 and 1979, respectively.

Groundwater

The predominantly hot, dry weather caused SMDs to further develop in south-east England, whilst the heavy rainfall reduced month-end SMDs across the rest of the UK. In the Chalk, groundwater levels were generally notably low across southern England, those at Little Bucket Farm were particularly low. However, the high rainfall in Yorkshire, Northern Ireland and East Anglia produced small rises in levels at Wetwang (returning to normal from below normal), Killyglen and Frying Pan Lodge, both of which rose from notably low to below normal. In the more rapidly responding Jurassic and Magnesian limestones, levels were in the normal range in June. Levels generally fell in the Permo-Triassic sandstones and remained in the same range as at the end of May apart from Llanfair D.C., which dropped to notably low. However, a small rise in level was recorded at Newbridge producing a new June maximum level. Levels in the Carboniferous Limestone fell and were below average at Alstonfield and notably low at Pant y Lladron. Levels fell at Royalty Observatory in the Fell Sandstone, but remained 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.

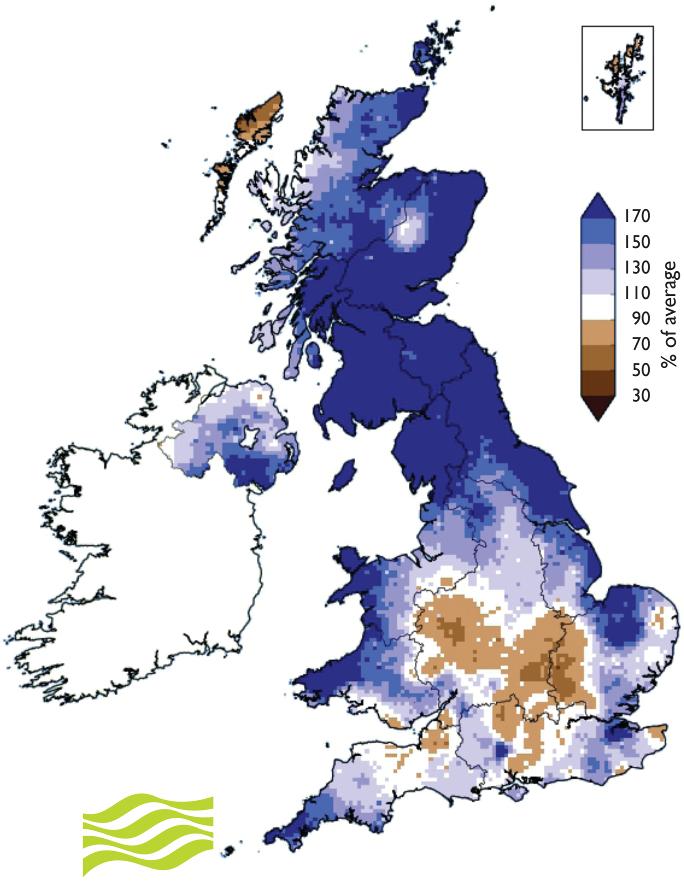
Region	Rainfall	Jun 2017	May17 – Jun17		Apr17 – Jun17		Oct16 – Jun17		Jul16 – Jun17	
				RP		*RP*		*RP*		*RP*
United	mm	**114**	172		206		705		966	
Kingdom	%	**160**	124	5-10	99	2-5	81	8-12	86	5-10
England	mm	**85**	142		161		529		696	
	%	**138**	120	2-5	91	2-5	82	5-10	82	5-10
Scotland	mm	**158**	212		275		966		1367	
	%	**189**	130	5-10	111	2-5	82	5-10	90	2-5
Wales	mm	**134**	206		234		864		1189	
	%	**162**	124	2-5	93	2-5	77	8-12	84	5-10
Northern	mm	**104**	167		196		636		899	
Ireland	%	**137**	113	2-5	87	2-5	73	25-40	79	20-30
England &	mm	**91**	151		171		575		764	
Wales	%	**143**	121	5-10	92	2-5	81	5-10	83	5-10
North West	mm	**145**	200		224		781		1125	
	%	**182**	132	5-10	101	2-5	83	5-10	92	2-5
Northumbria	mm	**141**	169		193		626		835	
	%	**213**	140	5-10	106	2-5	95	2-5	96	2-5
Severn-Trent	mm	**66**	122		142		479		636	
	%	**104**	102	2-5	80	2-5	81	5-10	81	5-10
Yorkshire	mm	**117**	163		184		561		747	
	%	**171**	134	5-10	101	2-5	87	2-5	89	2-5
Anglian	mm	**68**	133		149		403		516	
	%	**126**	128	5-10	100	2-5	87	2-5	83	5-10
Thames	mm	**47**	116		126		421		531	
	%	**93**	109	2-5	79	2-5	77	5-10	74	10-20
Southern	mm	**62**	131		141		471		568	
	%	**123**	127	2-5	90	2-5	75	5-10	71	15-25
Wessex	mm	**62**	129		142		535		672	
	%	**112**	111	2-5	82	2-5	77	5-10	76	10-20
South West	mm	**91**	147		185		709		916	
	%	**129**	101	2-5	83	2-5	73	10-20	75	15-25
Welsh	mm	**129**	200		226		833		1144	
	%	**160**	124	2-5	92	2-5	78	8-12	84	5-10
Highland	mm	**152**	201		314		1126		1610	
	%	**167**	113	2-5	112	2-5	79	2-5	89	2-5
North East	mm	**136**	176		227		689		923	
	%	**193**	129	5-10	113	2-5	89	2-5	91	2-5
Tay	mm	**164**	216		245		812		1110	
	%	**215**	139	5-10	107	2-5	77	10-15	83	5-10
Forth	mm	**191**	239		256		755		1039	
	%	**246**	162	20-35	119	5-10	82	2-5	86	2-5
Tweed	mm	**158**	201		219		731		994	
	%	**223**	147	10-15	110	2-5	94	2-5	97	2-5
Solway	mm	**197**	270		296		958		1335	
	%	**231**	161	25-40	116	2-5	83	2-5	90	2-5
Clyde	mm	**185**	256		305		1147		1662	
	%	**192**	138	8-12	107	2-5	82	2-5	91	2-5

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

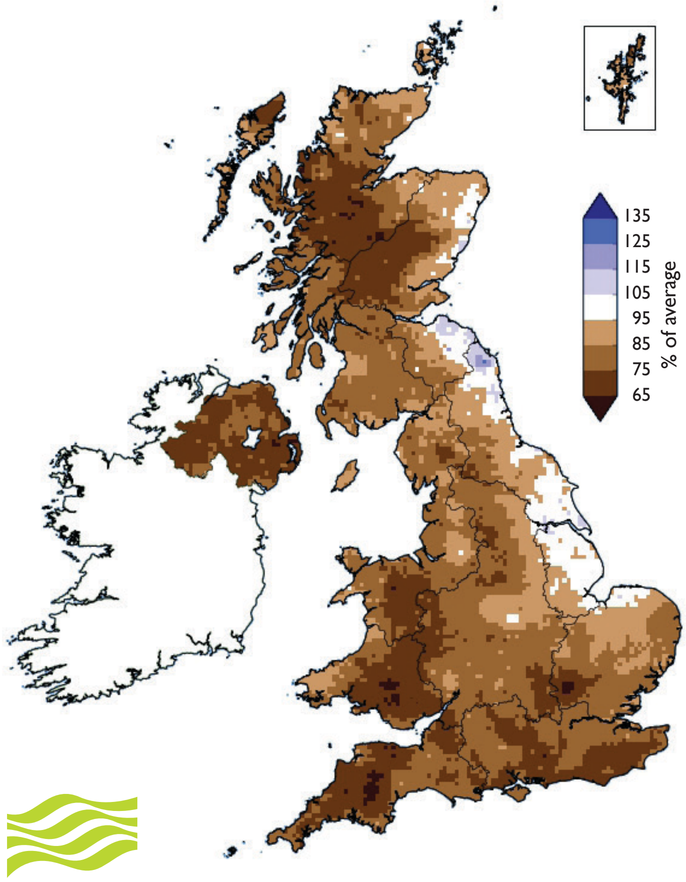
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

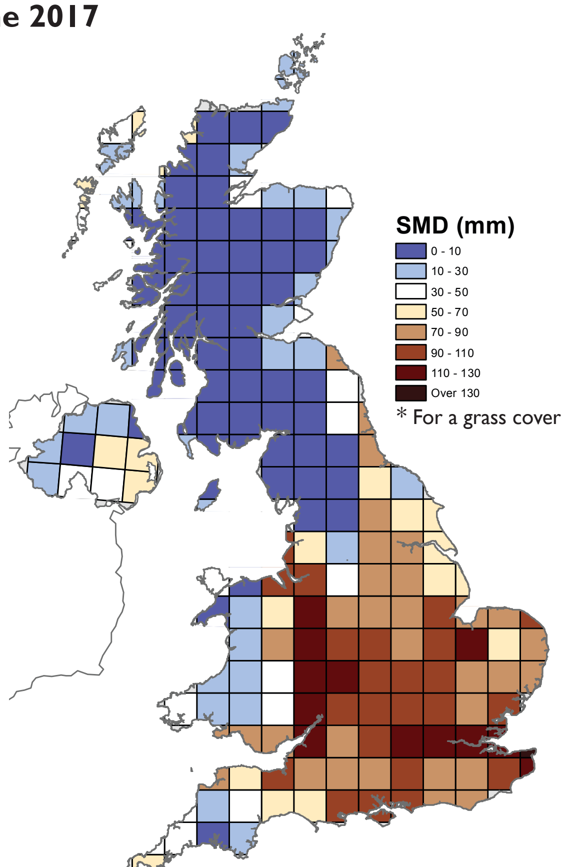
June 2017 rainfall
as % of 1981-2010 average



October 2016 - June 2017 rainfall
as % of 1981-2010 average



MORECS Soil Moisture Deficits*
June 2017



Hydrological Outlook UK

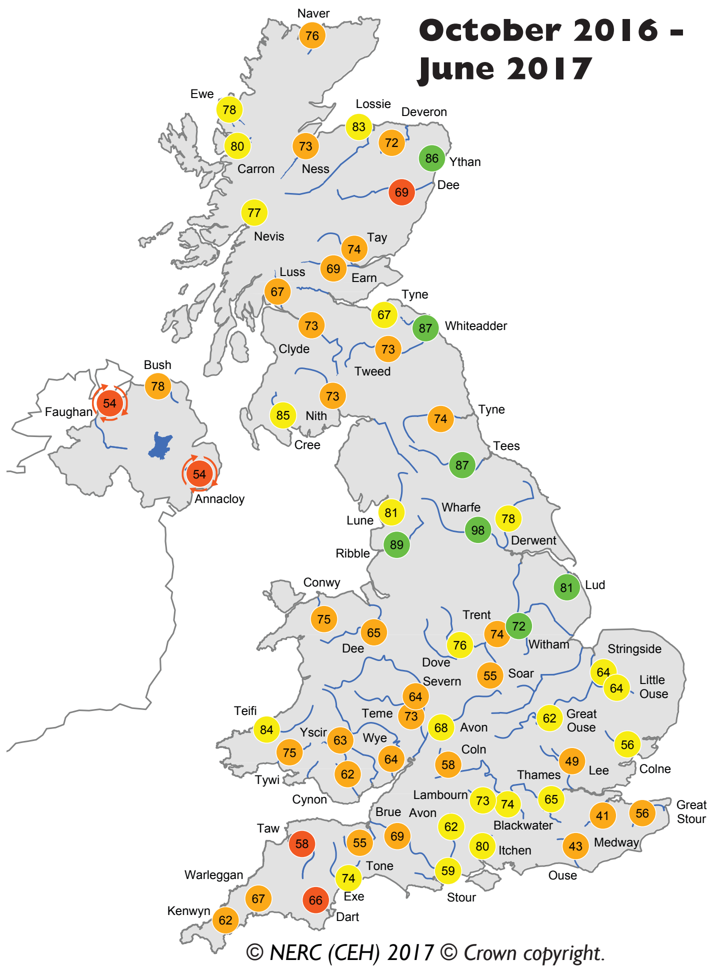
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

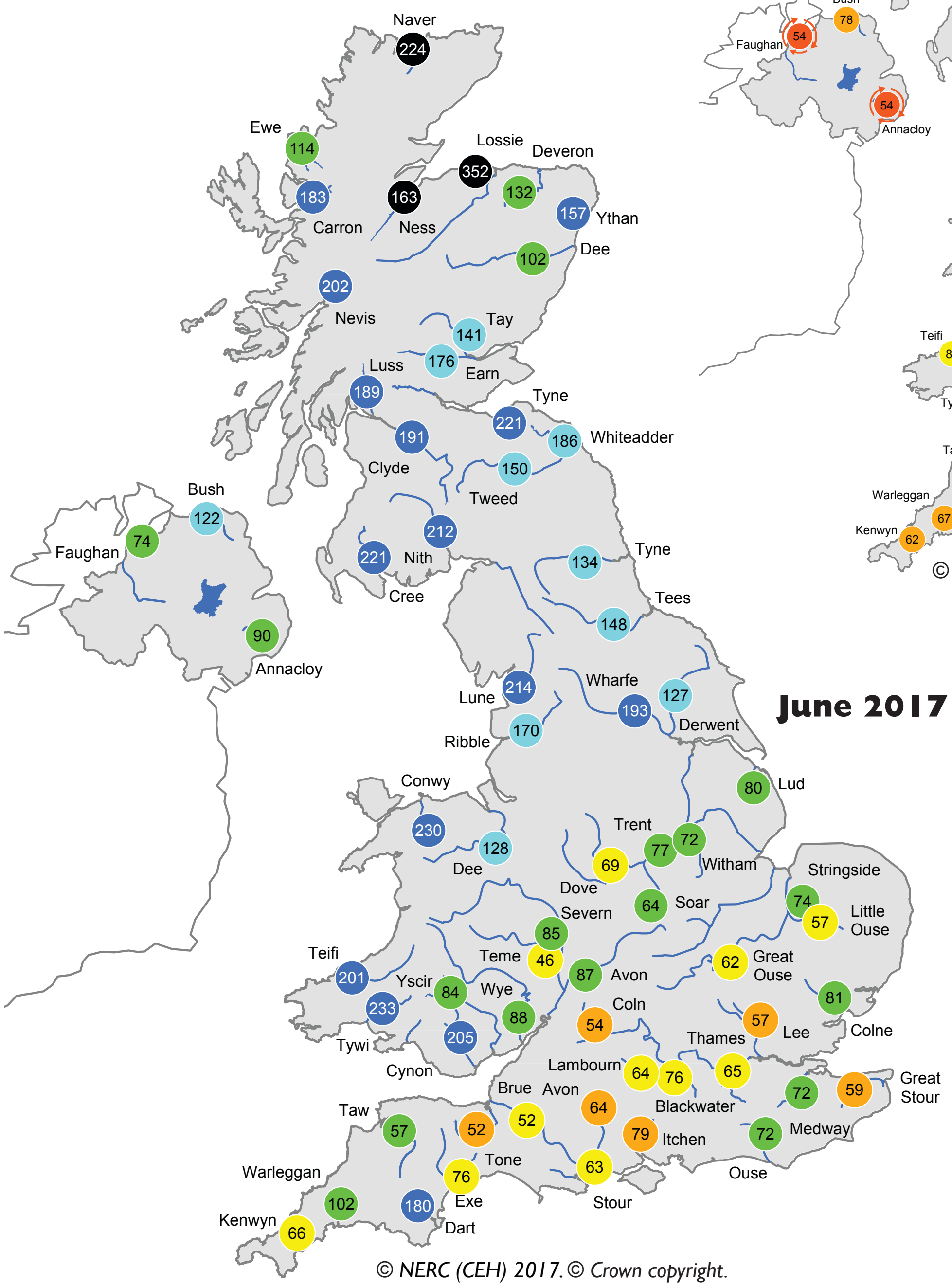
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from July 2017**
Issued: **11.07.2017**
using data to the end of June 2017

The one month outlook is for river flows to be below normal in the south-east of the UK, and possibly notably low in groundwater fed catchments. These low flows are likely to persist into the autumn. Elsewhere river flows are likely to be in the normal to above normal range both in July and for the coming three months. Much the same regional variation is expected in groundwater levels with the south-east experiencing low to notably low levels until the autumn. In other parts of the UK groundwater levels are most likely to be in the normal range with the exception of aquifers in the border region of Scotland where groundwater levels will remain above normal.

River flow . . . River flow . . .





Key

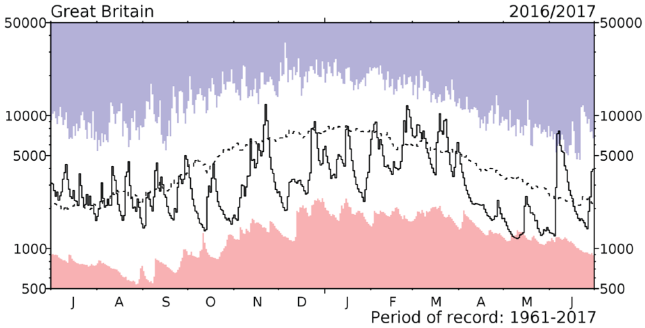
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

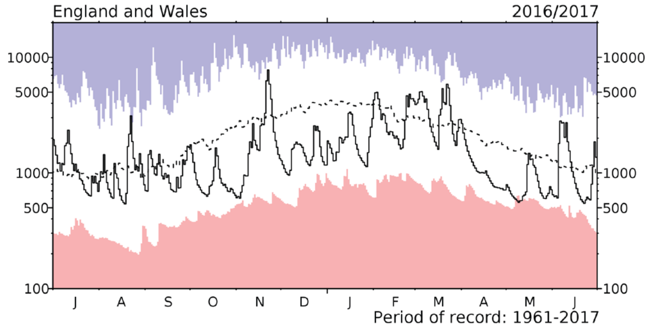
*Based on ranking of the monthly flow**

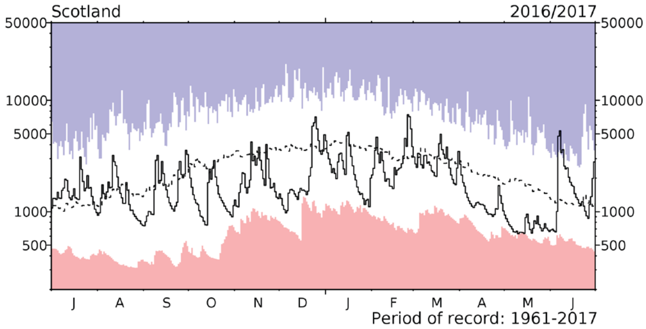
River flows

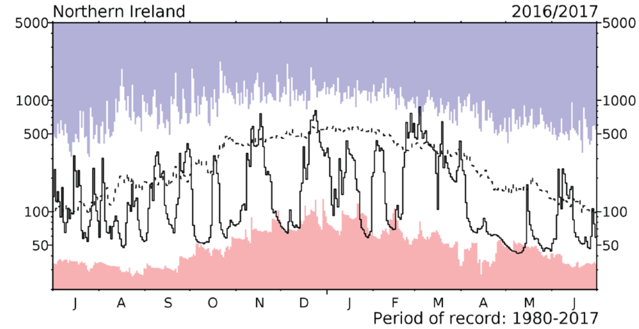
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

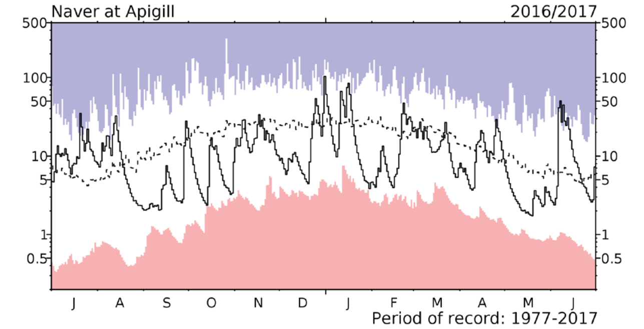
River flow . . . River flow . . .

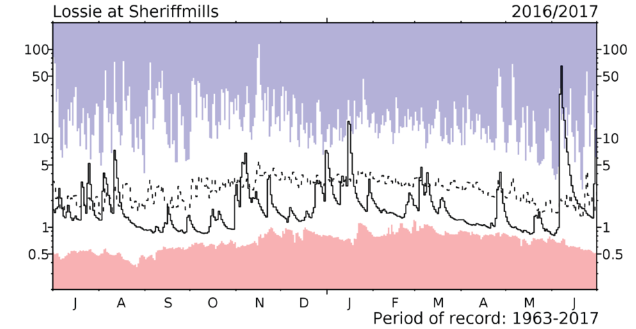


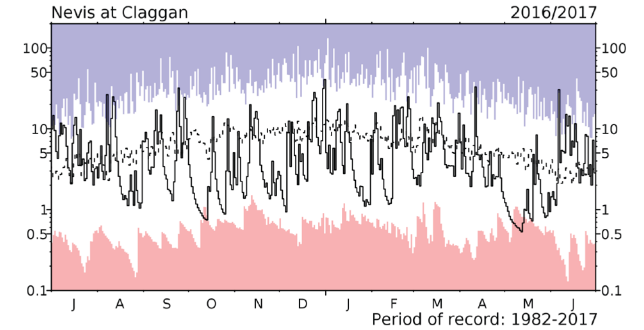


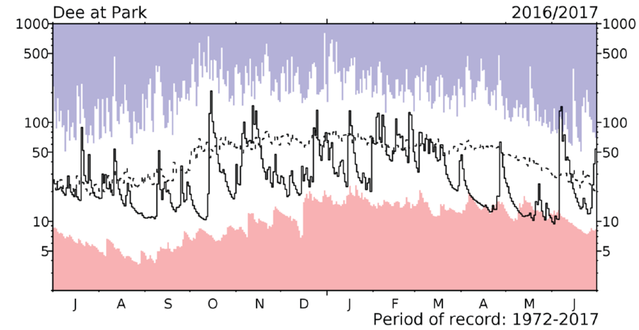


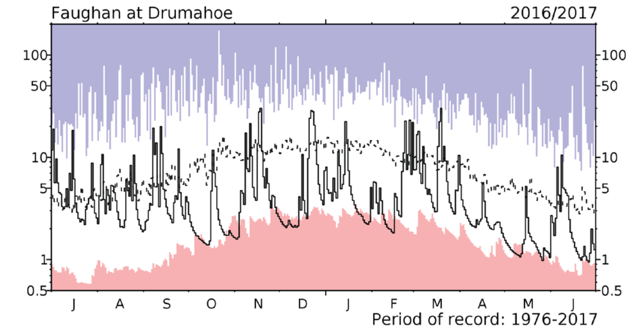


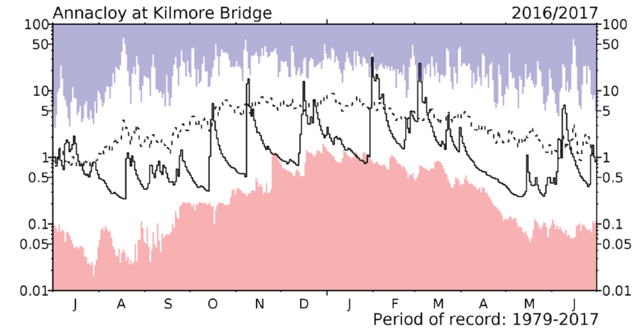








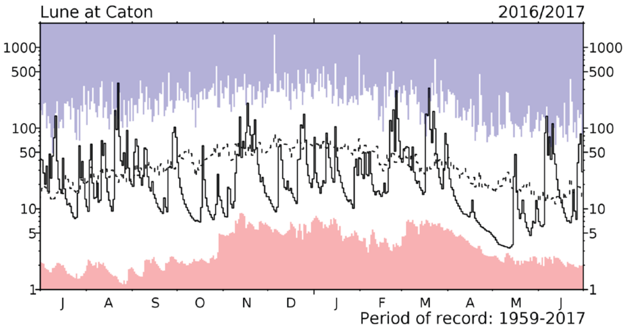


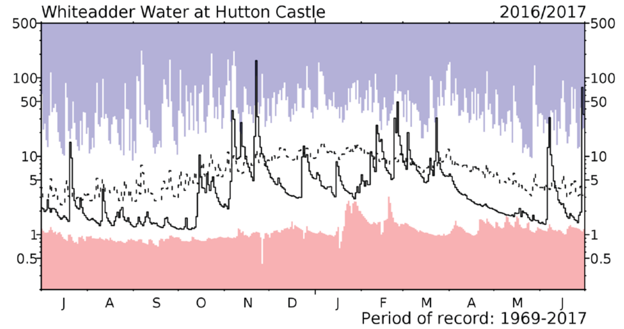


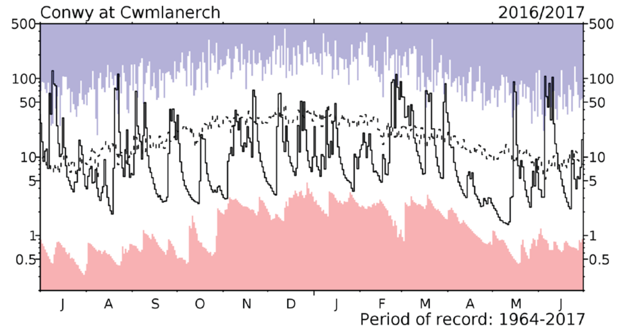
River flow hydrographs

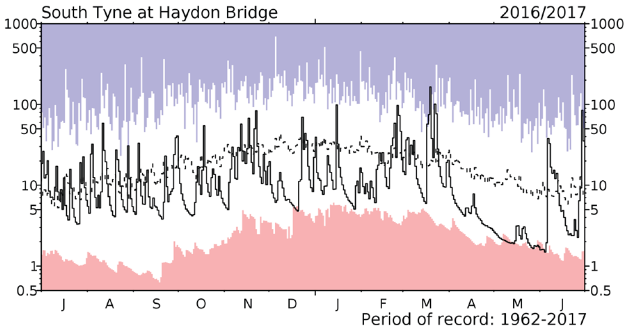
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to July 2016 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

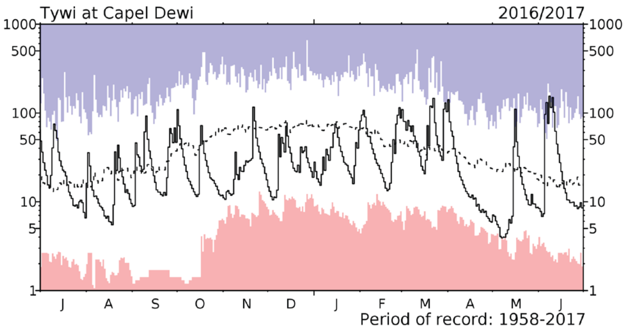
River flow . . . River flow . . .

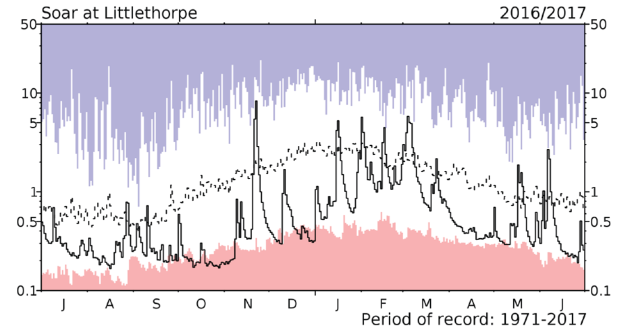


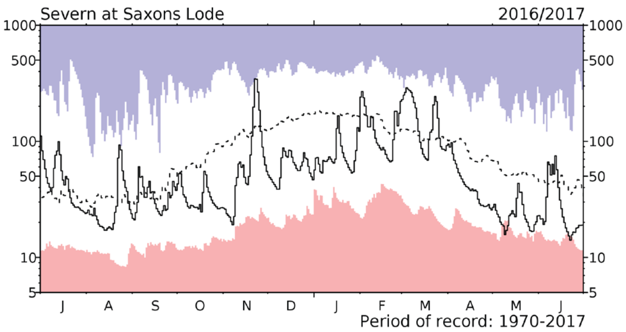


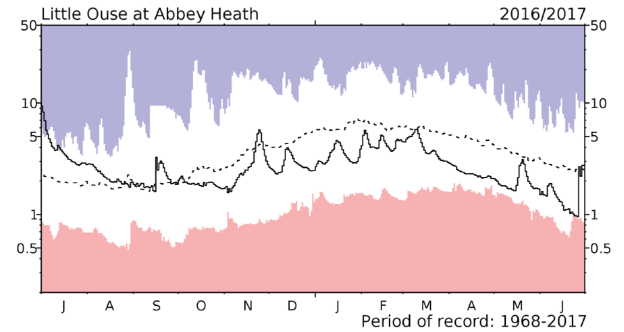


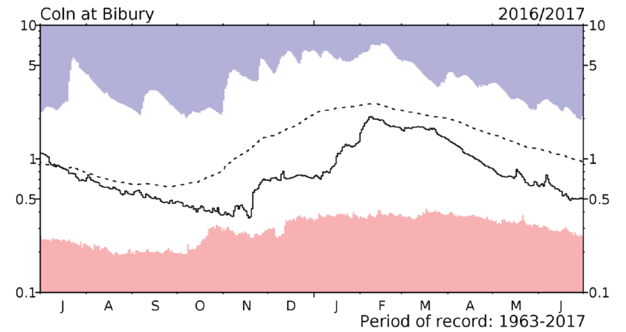


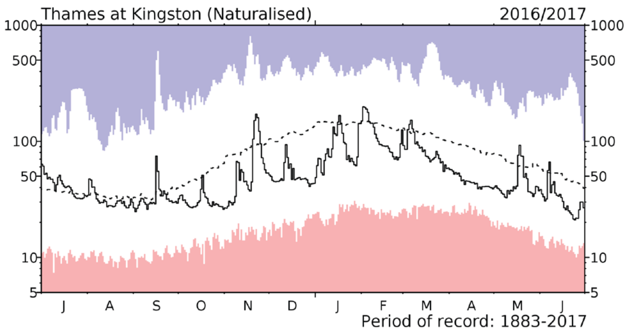


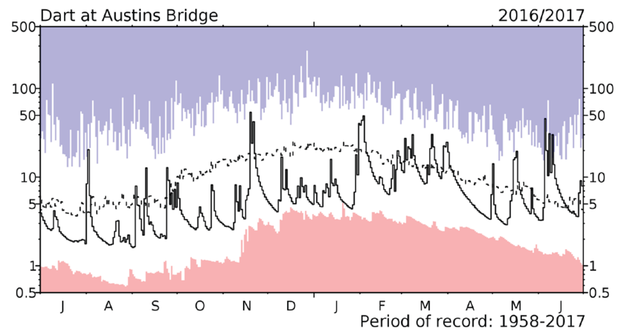


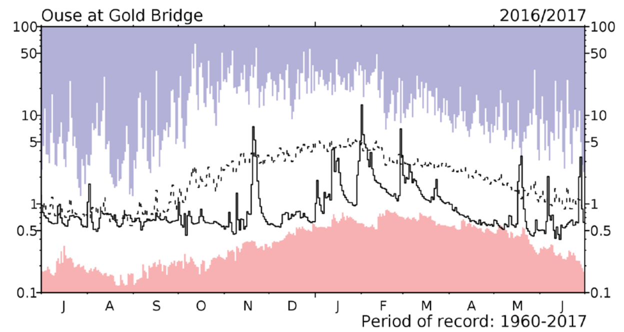




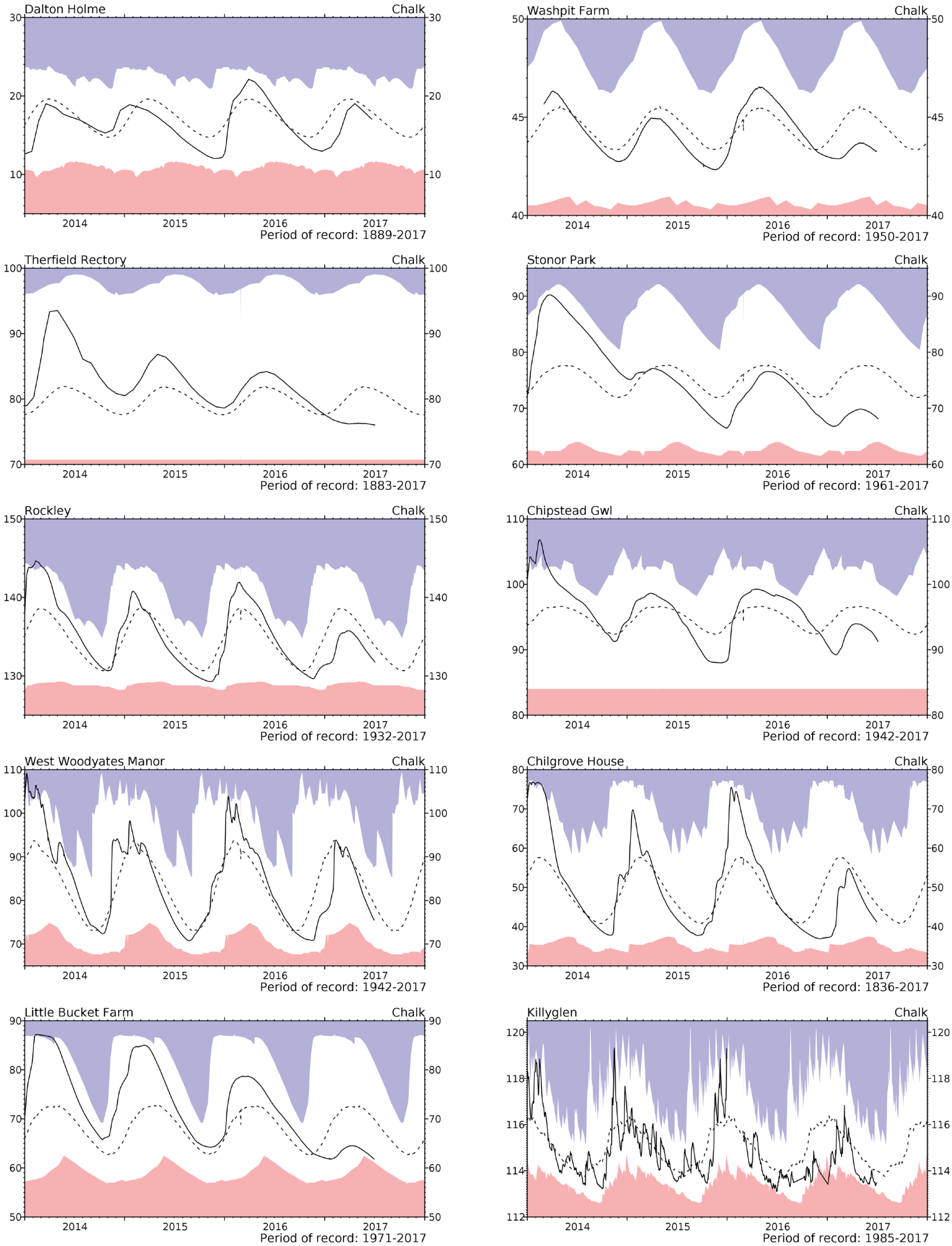






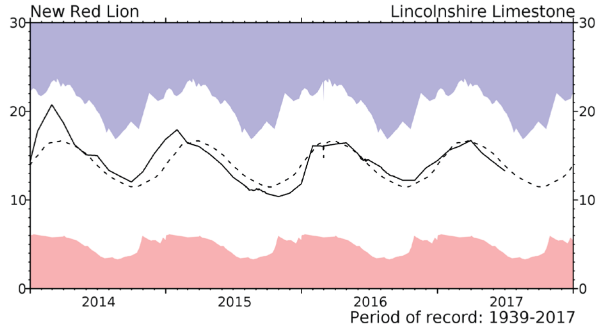


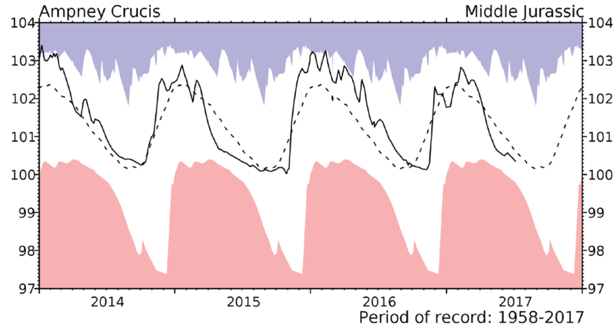
Groundwater . . . Groundwater

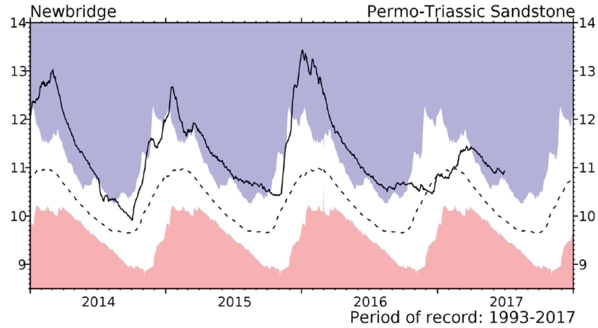


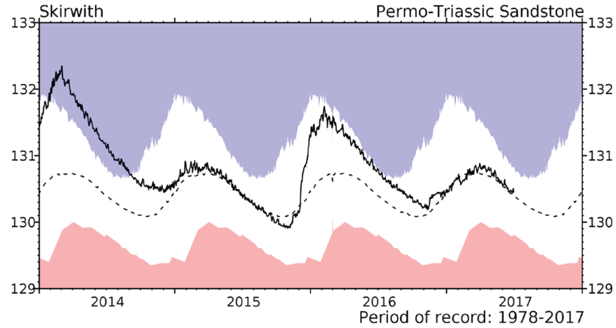
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

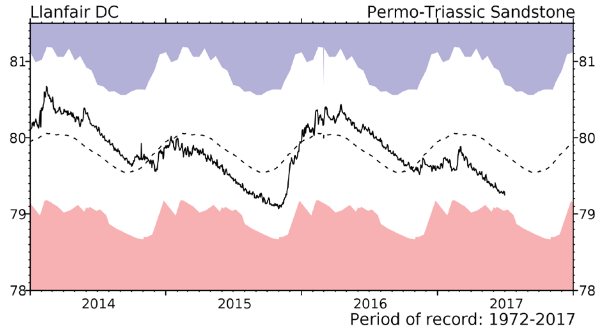
Groundwater ... Groundwater

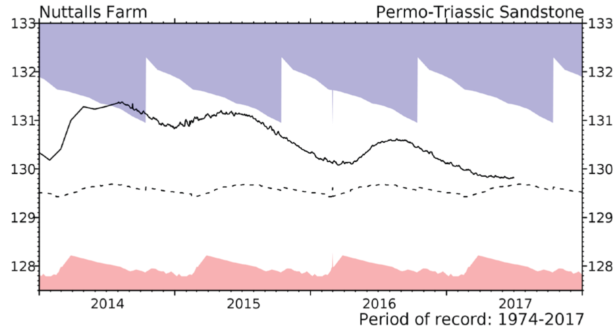


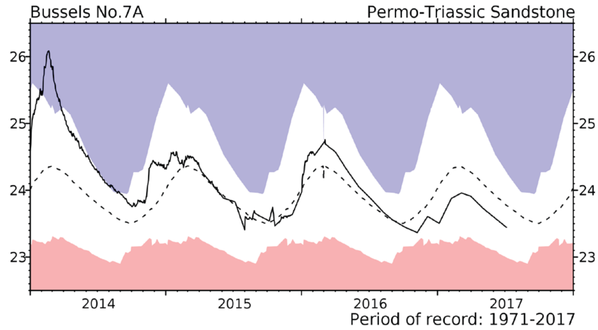


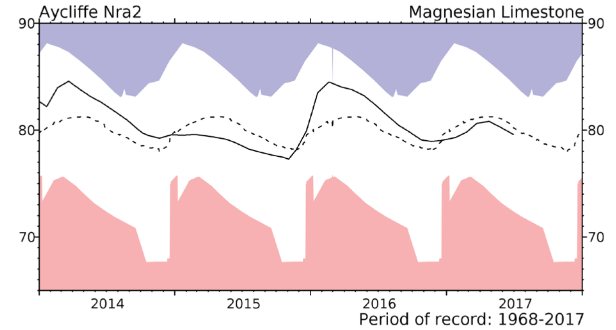


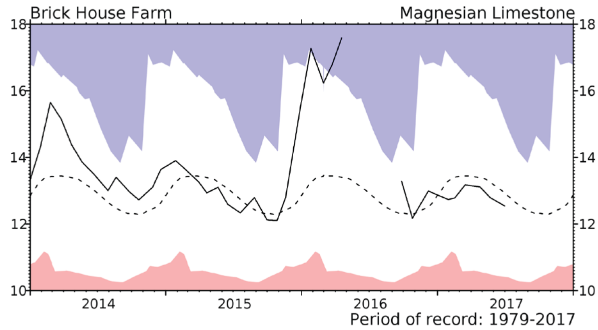


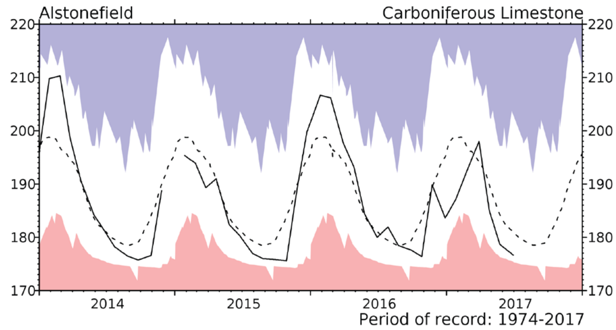


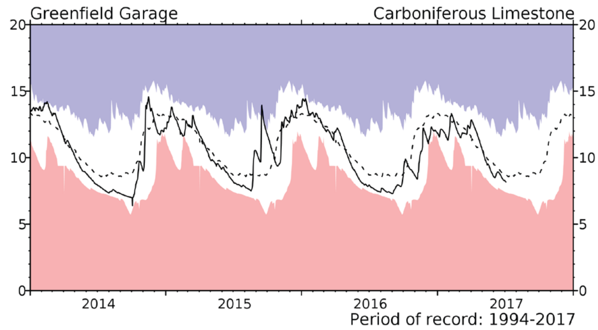


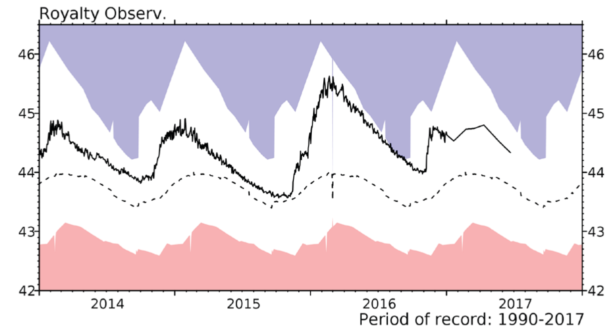


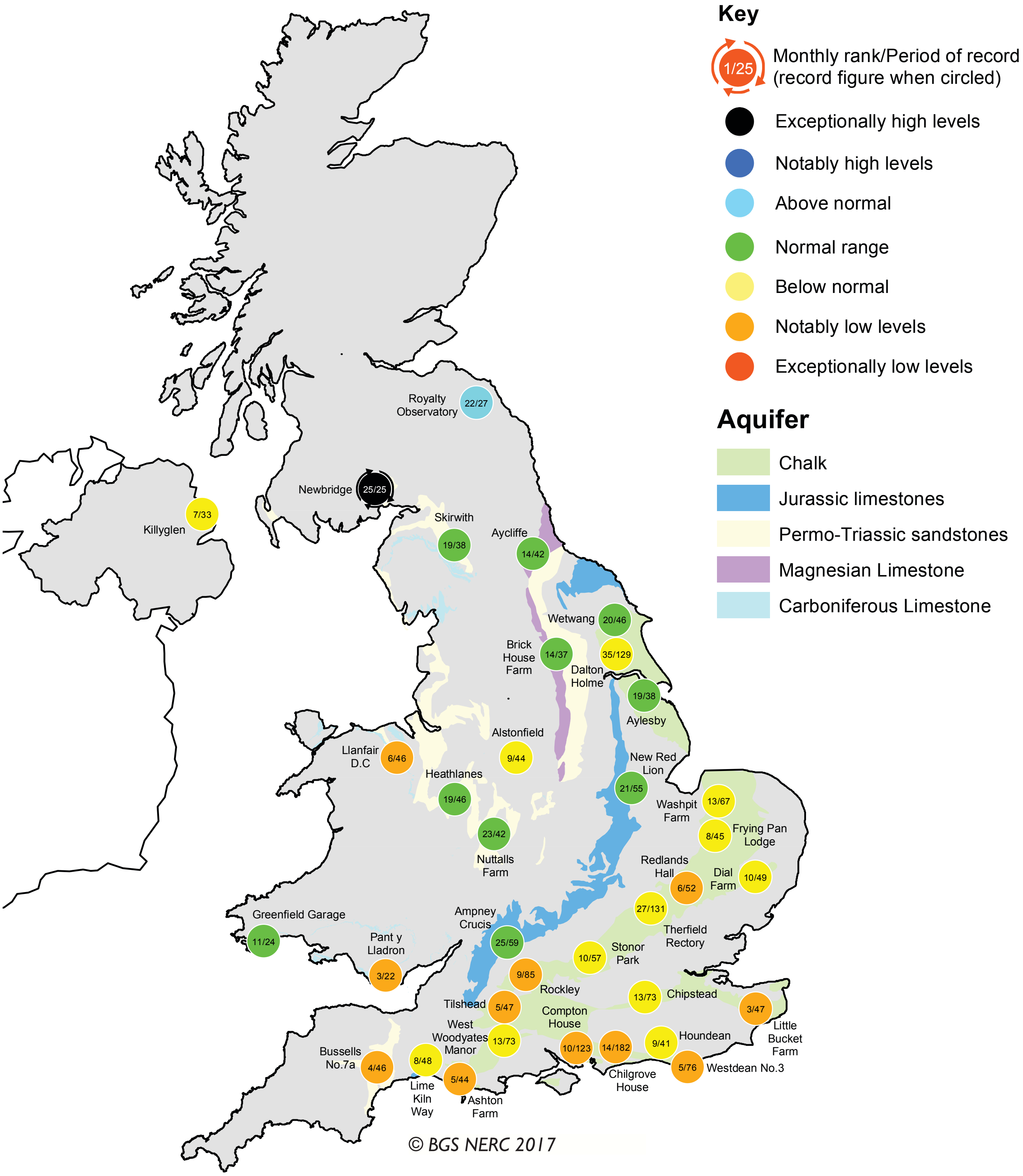










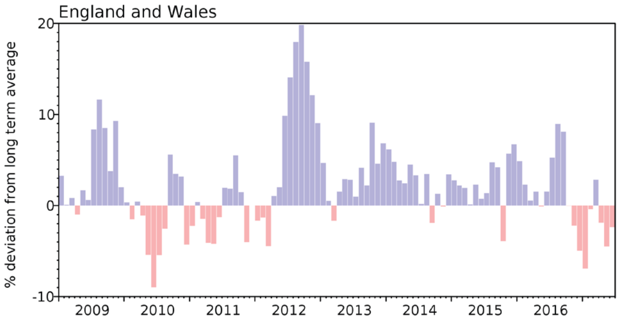


Groundwater levels - June 2017

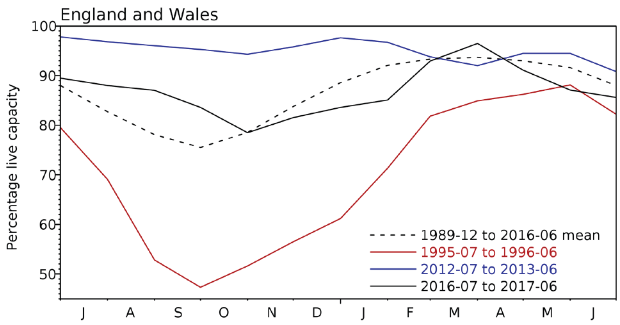
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

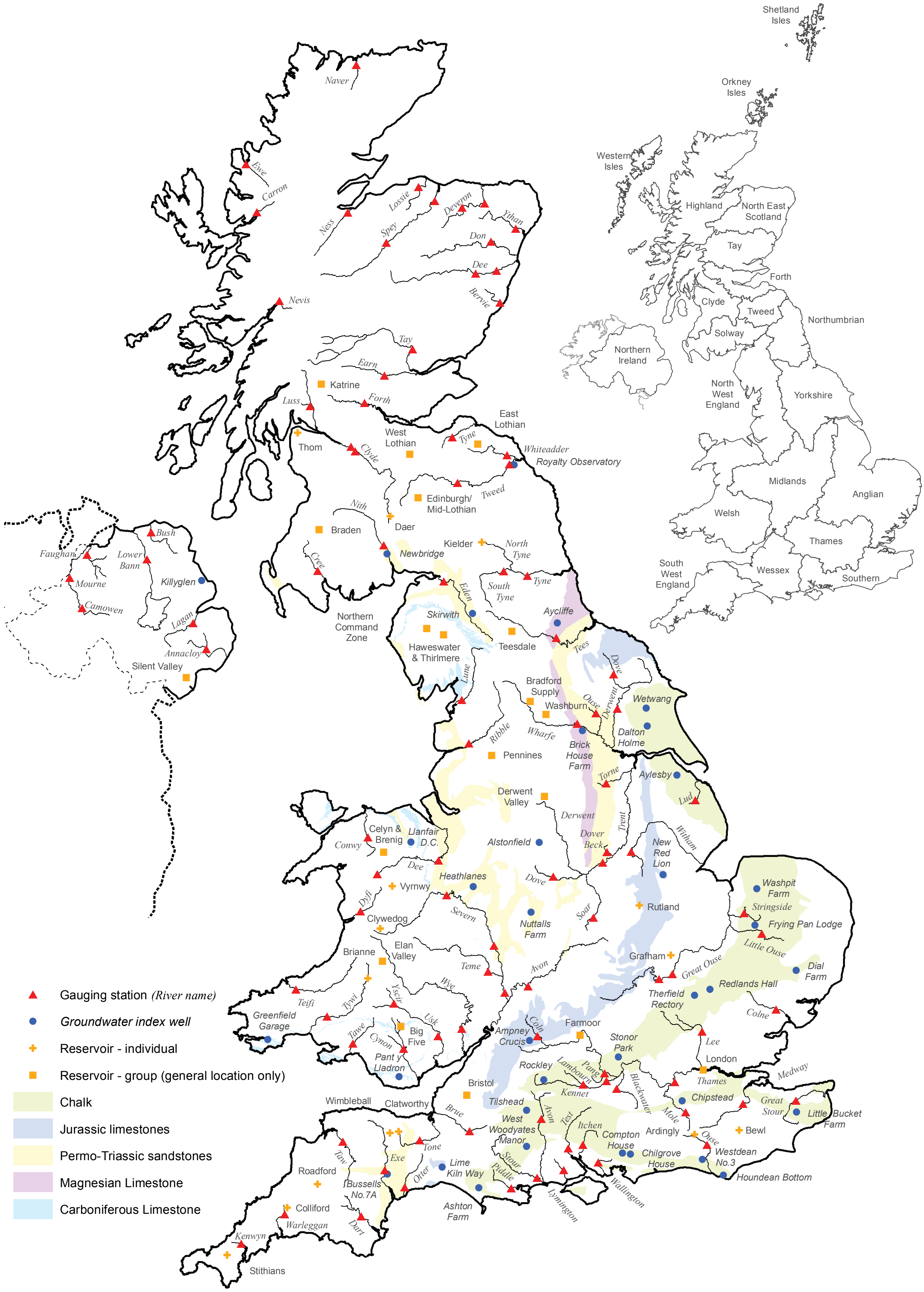
Area	Reservoir		Capacity (Ml)	2017 Apr	2017 May	2017 Jun	Jun Anom.	Min Jun	Year* of min	2016 Jun	Diff 17-16
North West	N Command Zone	•	124929	86	76	78	6	38	1984	65	13
	Vyrnwy		55146	94	92	95	13	58	1984	95	0
Northumbrian	Teesdale	•	87936	78	67	76	-5	58	1989	74	2
	Kielder		(199175)	89	87	92	1	71	1989	90	2
Severn-Trent	Clywedog		44922	100	98	96	3	32	1976	100	-4
	Derwent Valley	•	39525	86	76	76	-5	53	1996	91	-15
Yorkshire	Washburn	•	22035	89	84	80	-1	63	1995	77	2
	Bradford Supply	•	41407	84	73	74	-5	54	1995	76	-2
Anglian	Grafham		(55490)	96	96	94	1	70	1997	89	5
	Rutland		(116580)	97	97	93	4	75	1997	95	-2
Thames	London	•	202828	96	97	89	-3	85	1990	98	-8
	Farmoor	•	13822	98	97	94	-3	94	1995	96	-2
Southern	Bewl		28170	72	68	62	-22	52	1990	93	-32
	Ardingly		4685	100	99	91	-4	82	2005	100	-9
Wessex	Clatworthy		5364	91	84	75	-7	61	1995	76	-1
	Bristol	•	(38666)	93	88	81	-2	64	1990	89	-8
South West	Colliford		28540	84	81	77	-5	51	1997	90	-12
	Roadford		34500	74	72	70	-12	49	1996	90	-20
	Wimbleball		21320	91	82	74	-12	63	2011	80	-6
	Stithians		4967	94	90	83	4	53	1990	81	2
Welsh	Celyn & Brenig	•	131155	99	92	88	-7	77	1996	97	-10
	Brianne		62140	96	93	98	5	76	1995	100	-2
	Big Five	•	69762	90	86	85	0	61	1989	92	-7
	Elan Valley	•	99106	94	89	79	-10	68	1976	93	-14
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	87	80	85	-2	54	1998	86	-1
	East Lothian	•	9374	99	93	100	5	81	1992	98	2
Scotland(W)	Loch Katrine	•	110326	88	75	84	4	55	2010	76	8
	Daer		22412	79	69	80	-4	62	1994	78	2
	Loch Thom		10798	87	72	74	-14	69	2000	100	-26
Northern Ireland	Total+	•	56800	87	81	83	1	61	2008	79	4
	Silent Valley	•	20634	82	78	81	1	54	1995	79	2

( ) 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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