Hydrological Summary

for the United Kingdom

November 2017

General

November was another unsettled month, particularly in the west, with wintry conditions towards month-end in the east. At the national scale rainfall was moderately below average; only parts of northern Scotland, northern England and western Wales received above average rainfall. It was particularly dry in the Midlands, south-east England and central Scotland, with parts registering less than half the November average. Soil moisture deficits (SMDs) generally decreased across the UK during November, but at month-end soils were wetter than average in the north and drier than average in the south. River flows were generally in the normal range or below, despite the new November peak flow records established in the north-west. Flows were notably low in parts of southern England, with some catchments registering less than a third of the November average. Groundwater levels in the majority of index boreholes increased or remained stable during November, but levels remained substantially below normal across southern and eastern England. Reservoir stocks decreased relative to average at the majority of impoundments (markedly so at some, e.g. Clatworthy) but were near average at the national scale. Stocks were substantially below average at the London group (24% below) and Bewl registered the lowest November stocks on record (in a series from 1988). With limited recharge in the autumn, and depressed runoff in some parts of the south, the long-term water resources outlook will depend on rainfall over the winter and early spring. Given current groundwater levels, which reflect rainfall deficiencies built up over the last 12–18 months, appreciably above average winter rainfall will be needed to return conditions to the normal range in parts of the English Lowlands. Conversely, a continuation of the dry weather, amounting to a second successive dry winter, would increase the potential for environmental and water resources stress in 2018.

Rainfall

In the north and west November was dominated by westerly airflows bringing unsettled weather with dry, sunny (and sometimes mild) periods in between. Following a settled start to November in the south, the weather turned autumnal, although most frontal systems made little impression on the monthly rainfall totals. On the 22nd a deep low pressure system brought heavy rainfall to northern and western Britain (74mm was recorded at Hazelrigg, Lancashire). More than 70 people were rescued from their homes in Lancashire, rail services were disrupted in north Wales and western England and more than 500 properties lost power in the Blackpool area. A northerly airflow brought colder temperatures to the UK in the last week with snow settling on higher ground. On the 29th/30th, snow settled on lower ground in eastern counties of the UK with a snow depth of 10cm recorded at Fettercairn (Aberdeenshire). November rainfall was moderately below average for the UK as a whole (91%), with less than 70% registered in large parts of southern and eastern England, the Midlands and central Scotland. In contrast, more than 150% was registered in localised areas of north-west England, western Wales and northern Scotland. Despite the wet start, autumn (September-November) rainfall was near-average at the national scale but this masks the regional variations: Thames and Southern regions recorded less than 70% of long-term average rainfall, while the North West region recorded 125%. While the summer was damp for much of the UK, the dry autumn adds to notable long-term deficiencies which also reflect the dry conditions from late summer 2016 to late spring 2017.

River flows

With continuing dry weather in the south-east, flows in the more slowly responding catchments remained below average throughout November. In some groundwater-fed rivers in the Chalk, the stream network is significantly more contracted than usual for the time of year. In contrast, November flows in the north and west were characterised by moderate spates, with new daily flow maxima set in 18 catchments. Flood alerts were issued in north Wales and northern England on the 22nd/23rd, when 50 properties were flooded in Lancashire and roads were closed due to flooding. The Lune and Eden recorded their highest November peak flows (in series from 1968 and 1964, respectively), on the Eden exceeding those recorded in the regionally significant flooding episode of November 2009. Mean flows for November were largely in the normal range across Wales and northern Britain. In contrast, below normal flows dominated the English Lowlands, parts of the south-west and eastern Scotland. Flows were exceptionally low on the Great Stour, where a new minimum November average flow was recorded (in a series from 1964), and on the Lee, which recorded the lowest November monthly mean flow since 1945 (in a series from 1883). The dry autumn in south-east England has reinforced long-term river flow deficiencies which can now be traced back over the last 12-18 months.

Groundwater

Across the major aquifer areas, SMDs decreased slightly during November but soils remained drier than average for the time of year, approaching or exceeding twice the average in some areas of south-east England. In the Chalk of East Anglia and southern England groundwater levels fell at half the index sites and were all in the normal range or below for the time of year, exceptionally so at Little Bucket Farm (which is dry). Elsewhere in the chalk levels were stable or continued to rise. Levels in the more rapidly responding Jurassic and Magnesian limestones generally fell and remained within the normal range, except at Ampney Crucis where a small rise was recorded but the level fell below the normal range for November. In the Permo-Triassic sandstones, levels were stable or rose and generally remained in the normal range or below (still notably so at Bussels No. 7a), with the exception of Newbridge where levels were notably high for the time of year (after four months of record high levels). Levels in the Carboniferous Limestone rose overall during November but remained within the normal range. At Royalty Observatory, levels in the Fell Sandstone were stable and are now in the normal range for the time of year.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

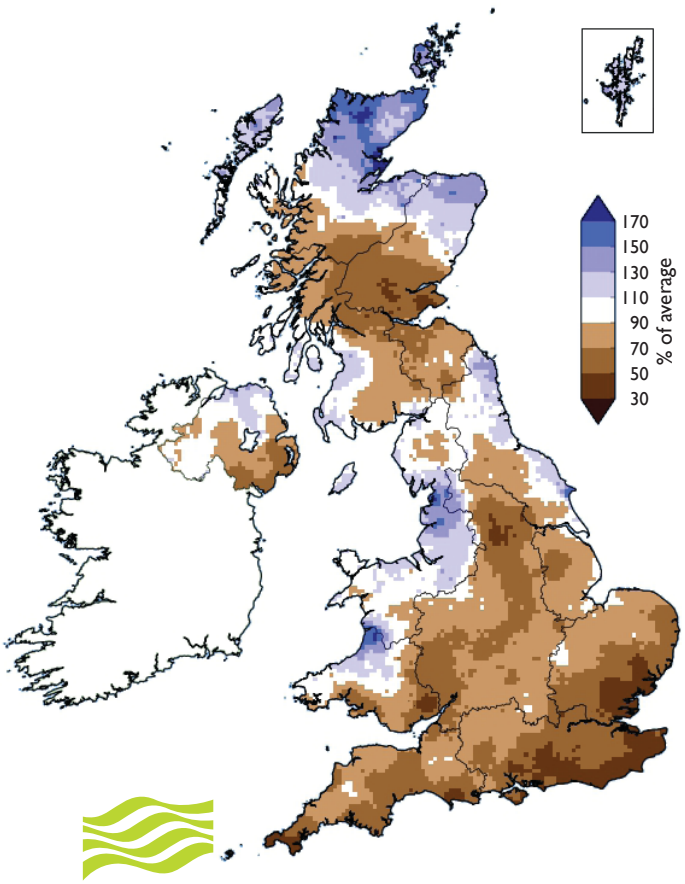
Region	Rainfall	Nov 2017	Sep17 – Nov17	RP	Jun17 – Nov17	RP	Dec16 – Nov17	RP	Jul16 – Nov17	RP
United Kingdom	mm	**108**	327		652		1091		1601	
	%	**91**	97	2-5	115	5-10	97	2-5	94	2-5
England	mm	**69**	217		473		781		1178	
	%	**80**	88	2-5	108	2-5	93	2-5	92	2-5
Scotland	mm	**160**	474		892		1520		2191	
	%	**100**	103	2-5	119	10-20	100	2-5	97	2-5
Wales	mm	**157**	442		829		1394		2014	
	%	**100**	102	2-5	116	5-10	98	2-5	94	2-5
Northern Ireland	mm	**103**	355		712		1116		1596	
	%	**92**	110	2-5	123	10-20	98	2-5	93	2-5
England & Wales	mm	**81**	248		522		866		1293	
	%	**84**	91	2-5	110	2-5	94	2-5	92	2-5
North West	mm	**143**	457		848		1320		1947	
	%	**113**	125	5-10	134	10-20	108	2-5	105	2-5
Northumbria	mm	**94**	271		571		893		1333	
	%	**104**	110	2-5	125	5-10	102	2-5	100	2-5
Severn-Trent	mm	**58**	194		409		705		1090	
	%	**78**	88	2-5	101	2-5	90	2-5	92	2-5
Yorkshire	mm	**68**	238		531		827		1241	
	%	**81**	103	2-5	123	5-10	98	2-5	97	2-5
Anglian	mm	**43**	126		331		560		877	
	%	**72**	71	5-10	97	2-5	90	2-5	91	2-5
Thames	mm	**50**	144		357		615		932	
	%	**67**	68	5-10	97	2-5	86	5-10	86	5-10
Southern	mm	**46**	147		382		660		982	
	%	**51**	59	8-12	94	2-5	83	5-10	81	8-12
Wessex	mm	**69**	203		436		755		1120	
	%	**71**	77	2-5	99	2-5	86	5-10	84	8-12
South West	mm	**96**	310		619		1053		1542	
	%	**69**	84	2-5	103	2-5	86	5-10	84	8-12
Welsh	mm	**148**	415		786		1330		1926	
	%	**98**	99	2-5	114	2-5	97	2-5	94	2-5
Highland	mm	**223**	596		1031		1811		2576	
	%	**115**	109	2-5	120	10-15	100	2-5	96	2-5
North East	mm	**127**	329		643		1022		1554	
	%	**115**	104	2-5	119	5-10	101	2-5	100	2-5
Tay	mm	**97**	334		703		1199		1755	
	%	**69**	82	2-5	106	2-5	89	2-5	88	5-10
Forth	mm	**76**	281		685		1124		1615	
	%	**64**	79	2-5	113	5-10	93	2-5	89	2-5
Tweed	mm	**80**	267		625		1036		1527	
	%	**77**	90	2-5	118	5-10	101	2-5	98	2-5
Solway	mm	**142**	487		984		1596		2207	
	%	**90**	108	2-5	131	15-25	107	5-10	98	2-5
Clyde	mm	**165**	559		1072		1823		2628	
	%	**87**	101	2-5	118	8-12	100	2-5	96	2-5

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

Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals since January 2017 are provisional.

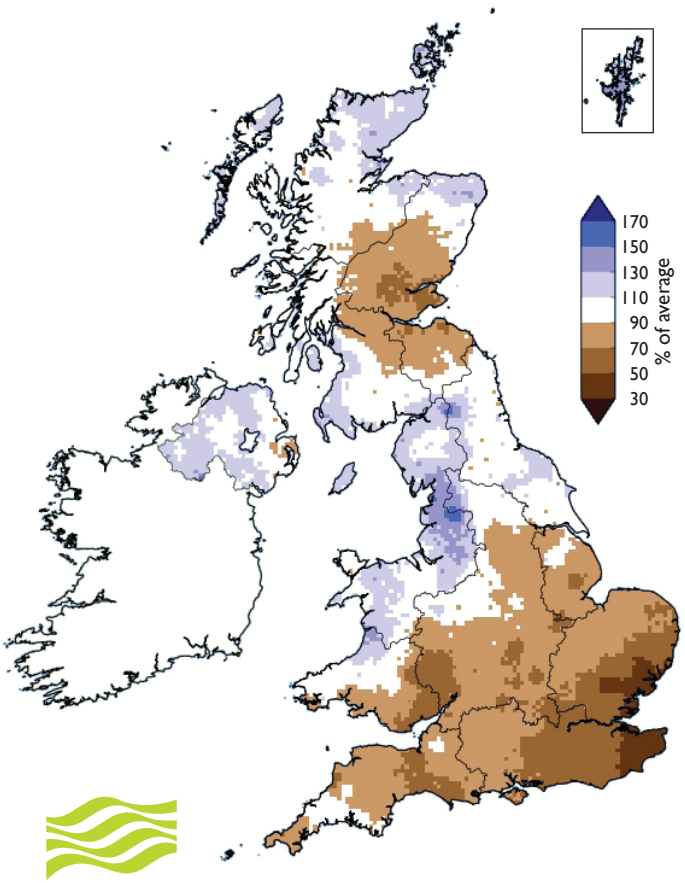
Rainfall . . . Rainfall . . .

November 2017 rainfall as % of 1981-2010 average



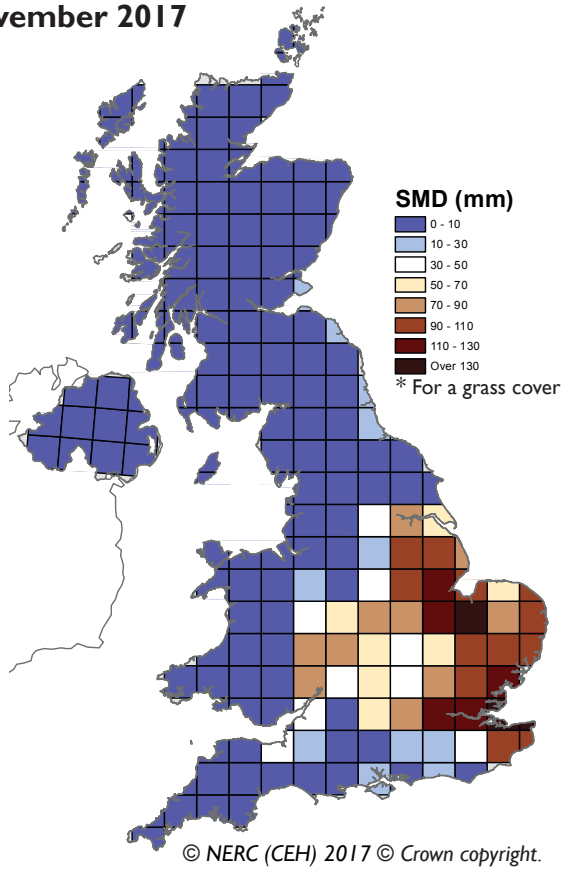
Met Office

September 2017 - November 2017 rainfall as % of 1981-2010 average



Met Office

MORECS Soil Moisture Deficits* November 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.

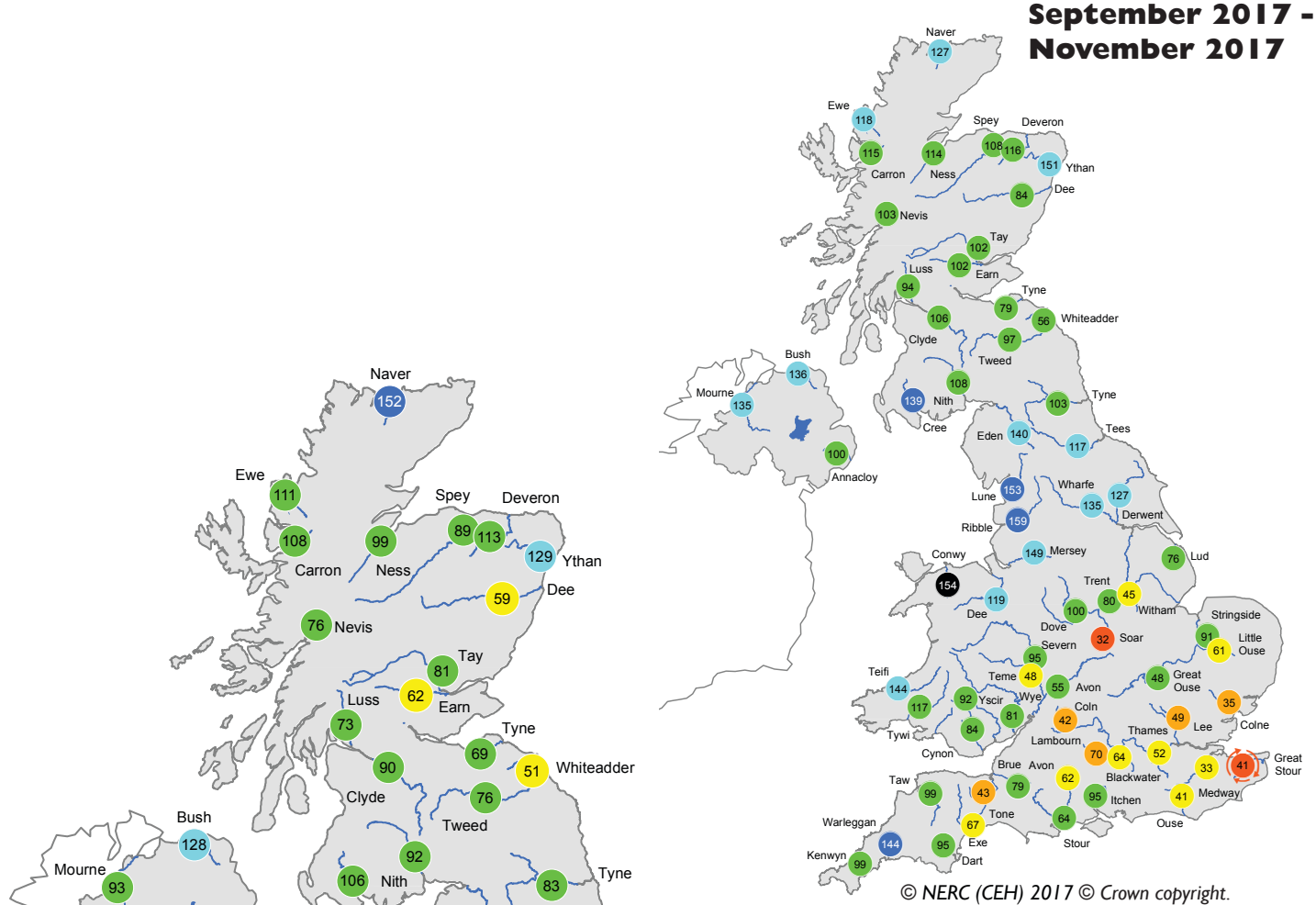
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from December 2017**
Issued: **12.12.2017**
using data to the end of November 2017

In south-east England groundwater levels are likely to be below normal, and potentially exceptionally low in places, during December and for the next three months. In south-central and south-eastern parts of the UK river flows are likely to be normal to below normal during December and for the next three months. Elsewhere in the UK river flows and groundwater levels are likely to be normal to above normal in the same period.

River flow . . . River flow . . .

September 2017 - November 2017



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November 2017

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Key

25 % of long-term average (record figure when circled)

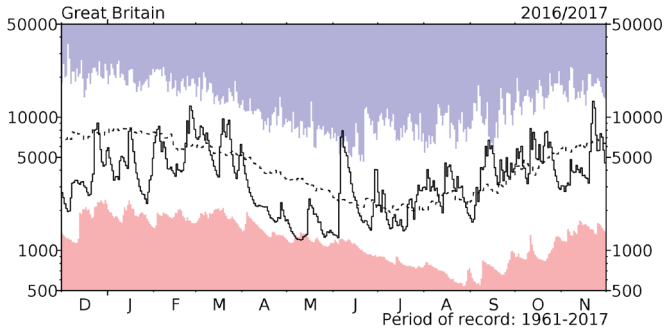
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

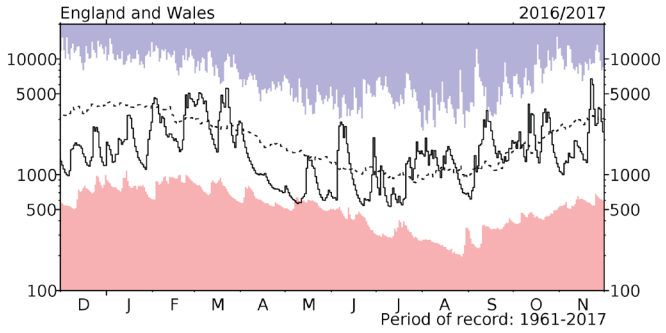
*Based on ranking of the monthly flow**

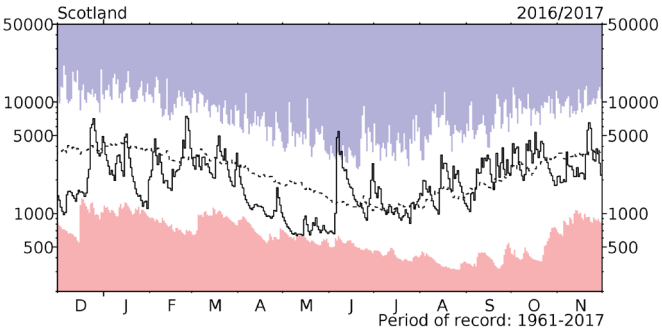
River flows

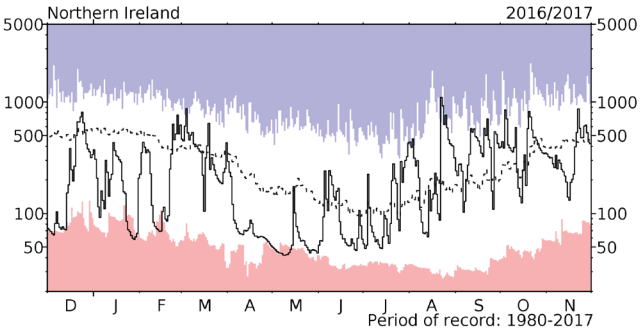
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

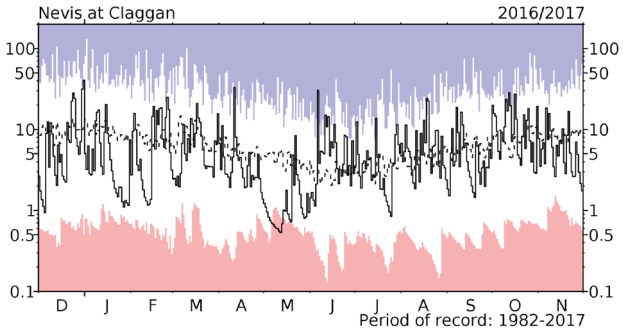
River flow . . . River flow . . .

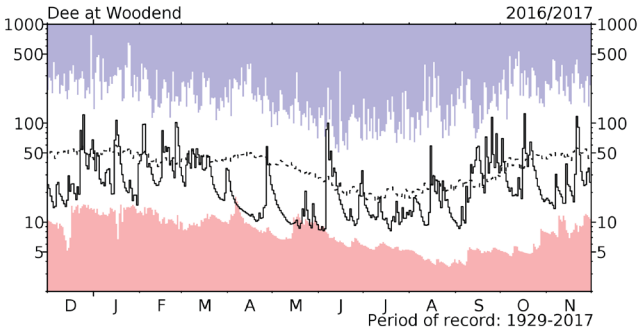


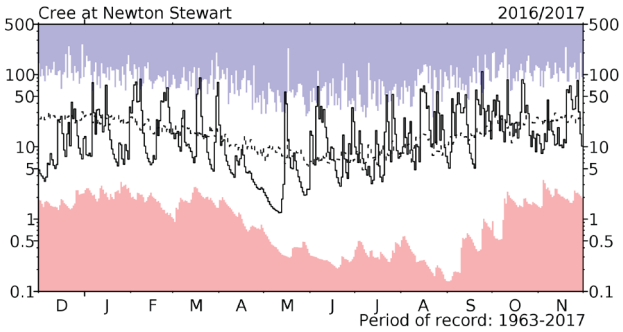


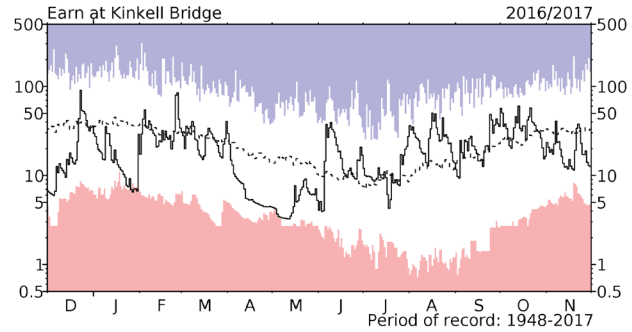


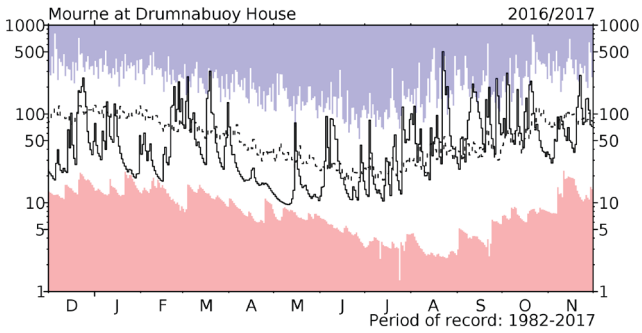


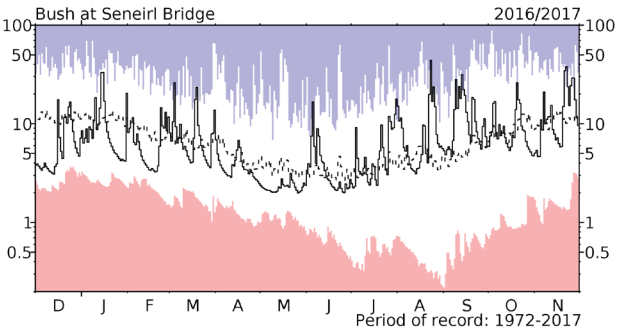








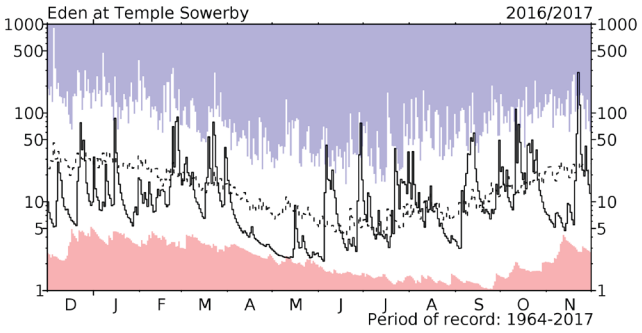


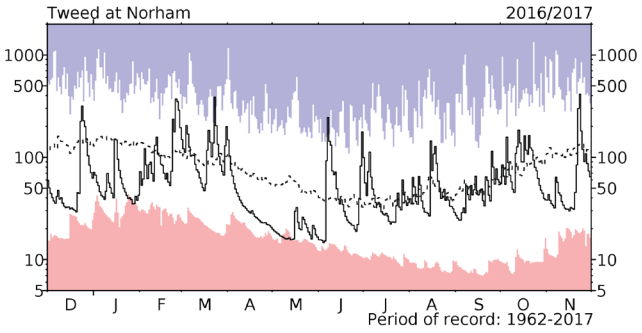


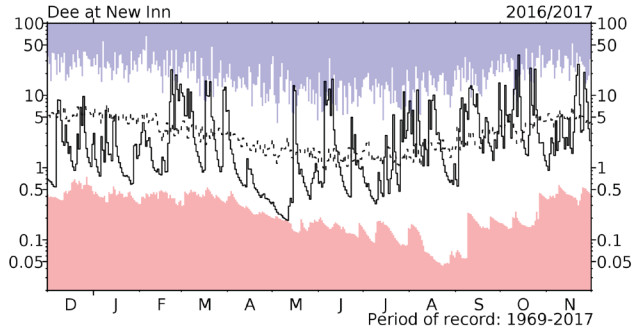
River flow hydrographs

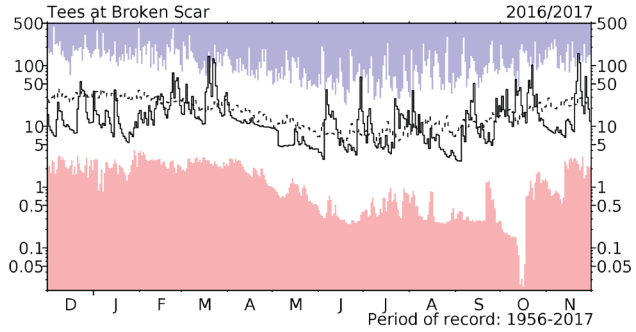
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to December 2016 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

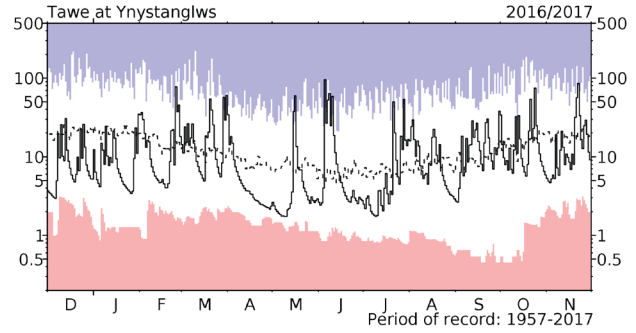
River flow . . . River flow . . .

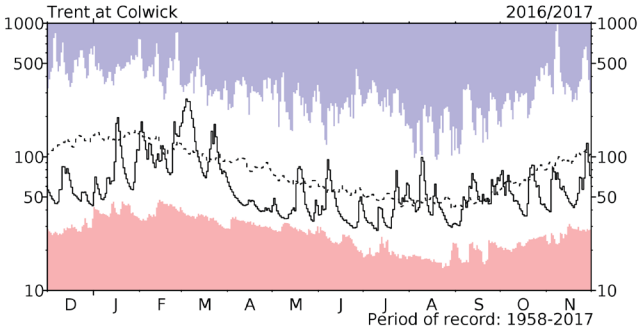


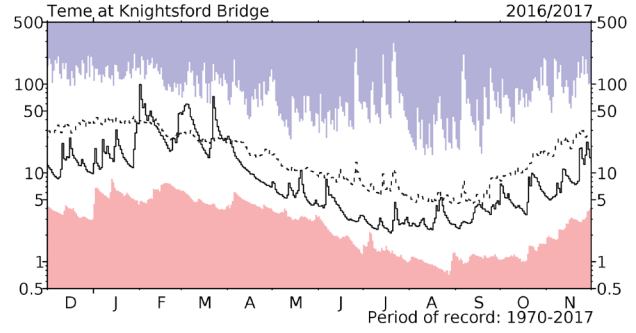


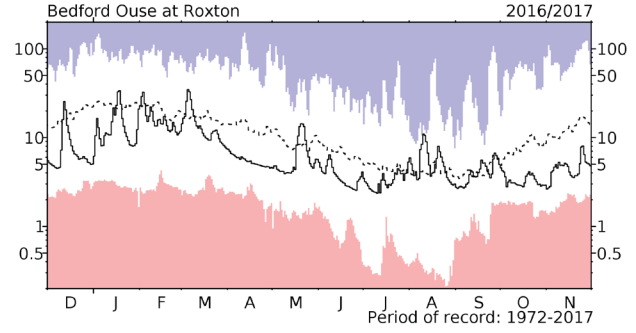


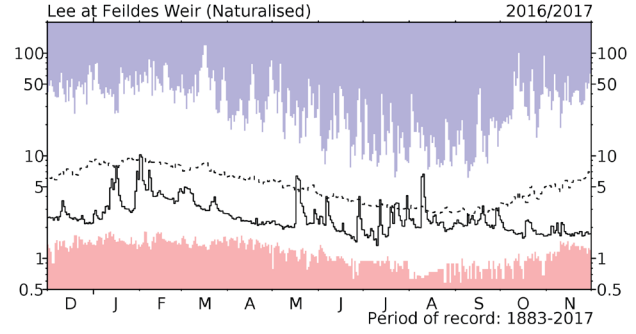


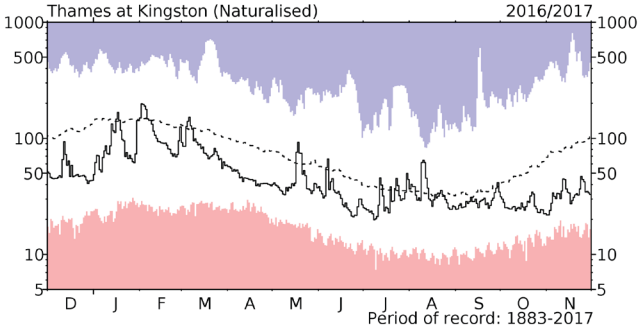


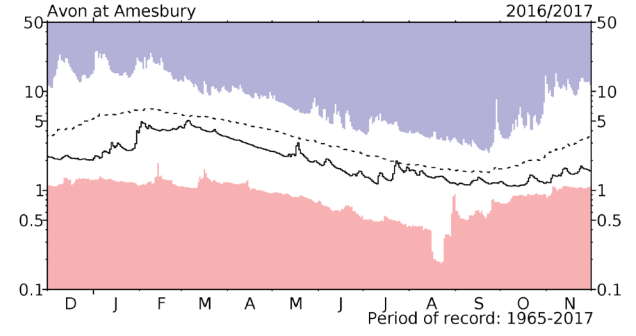


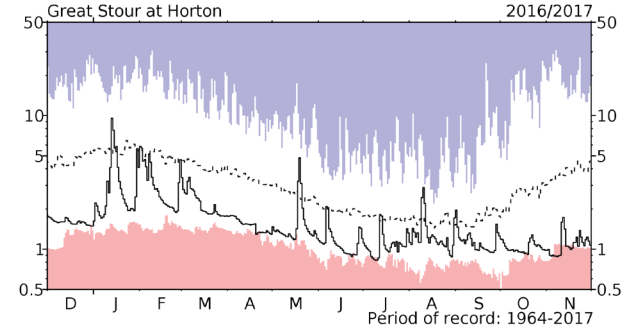




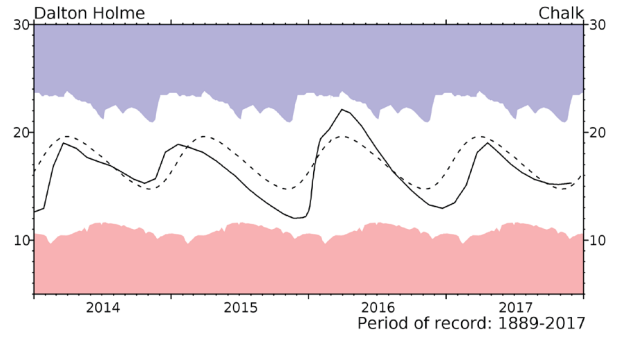


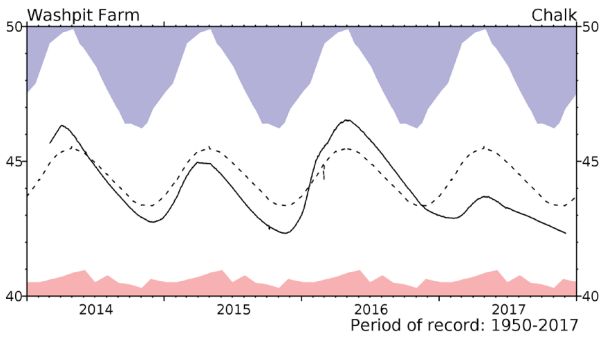


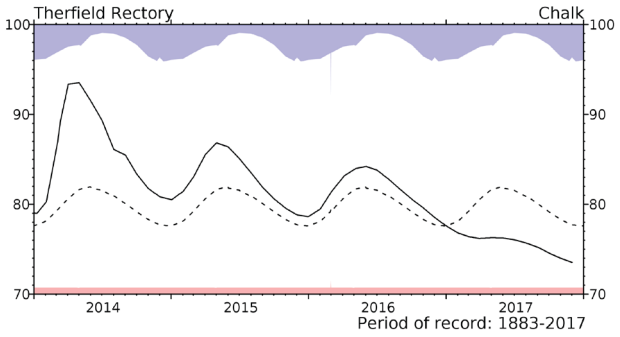


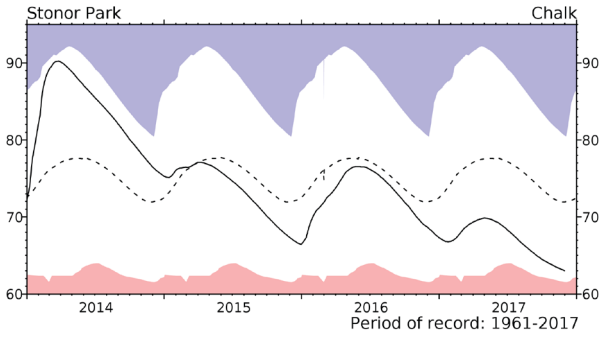


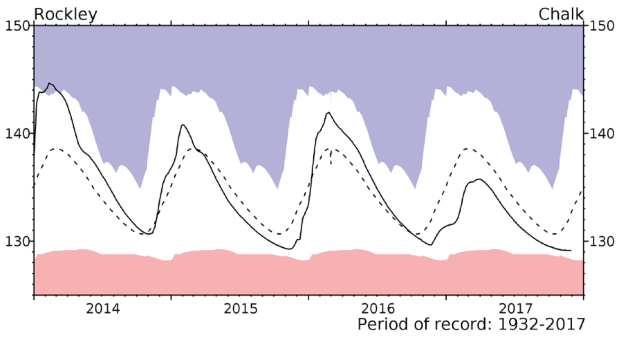
Groundwater…Groundwater

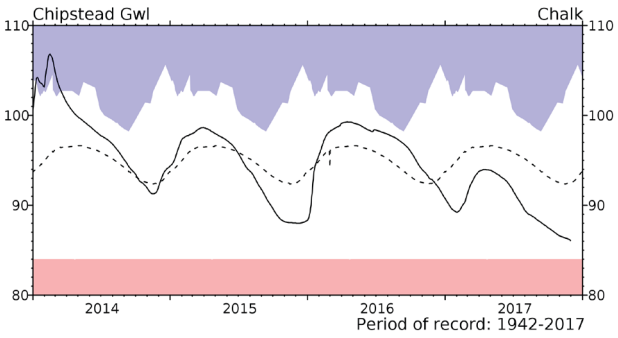


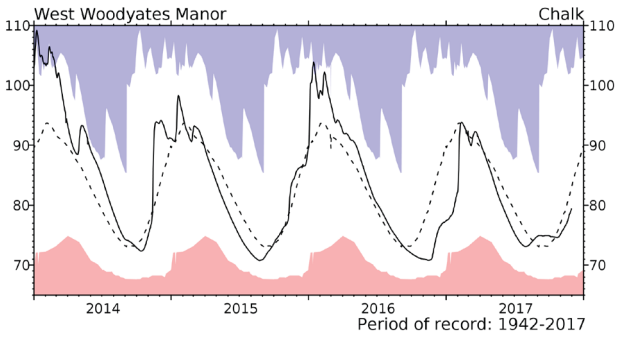


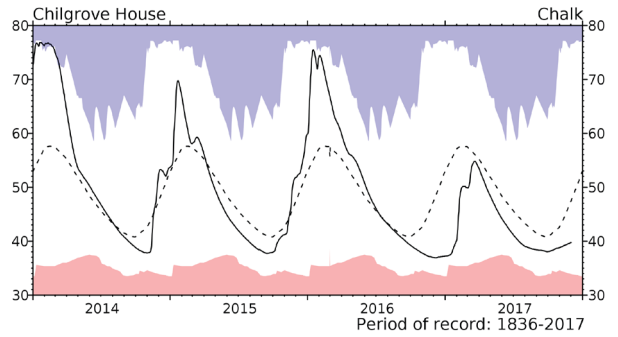


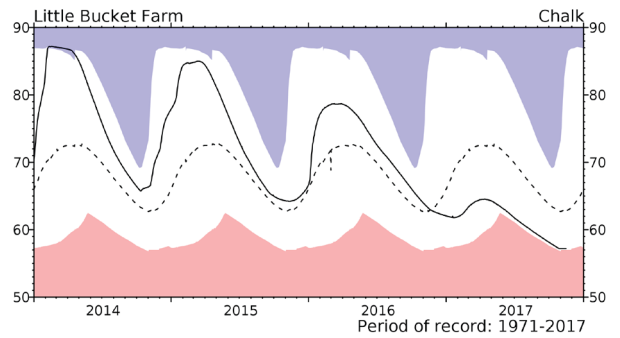


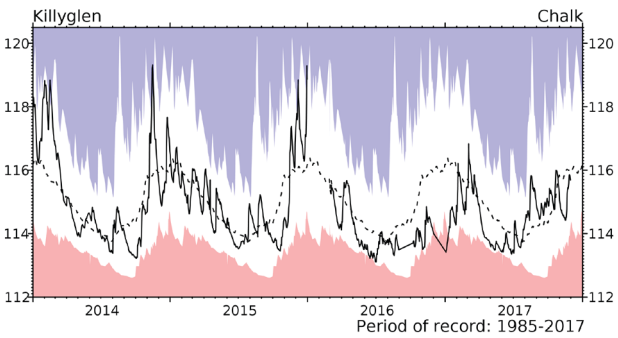






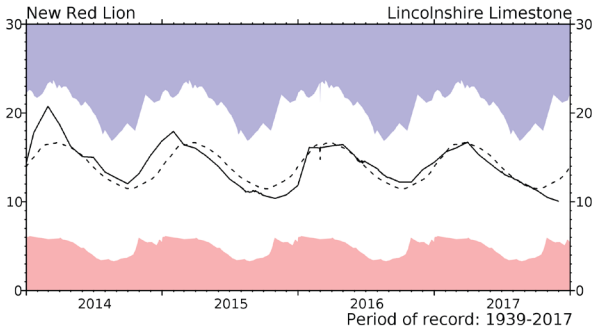




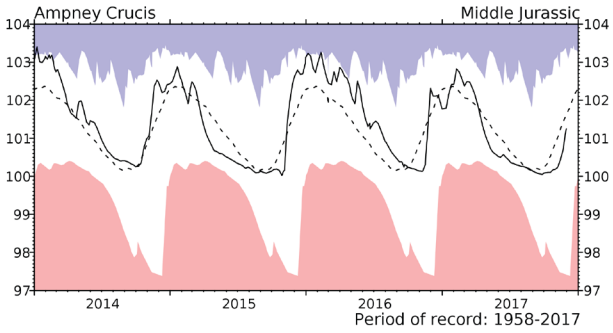


Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

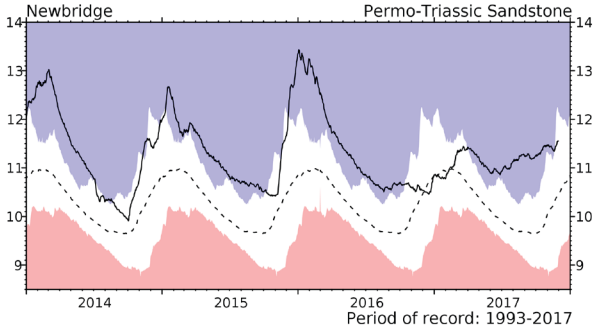
Groundwater … Groundwater



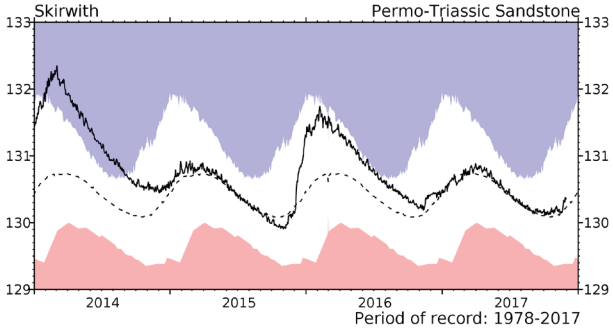
Period of record: 1939-2017



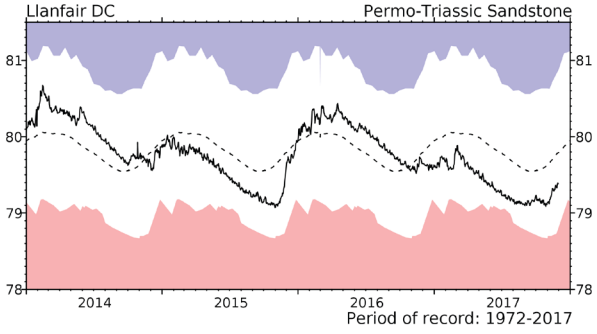
Period of record: 1958-2017



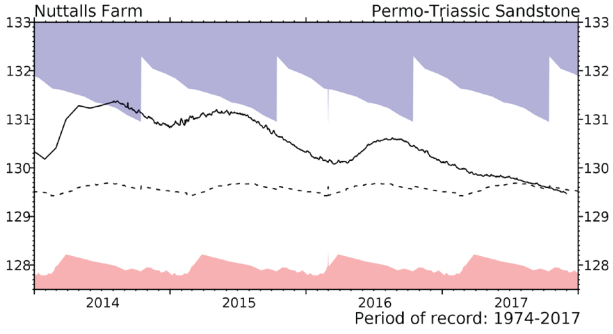
Period of record: 1993-2017



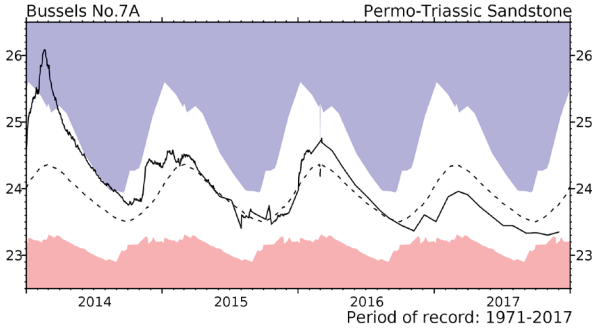
Period of record: 1978-2017



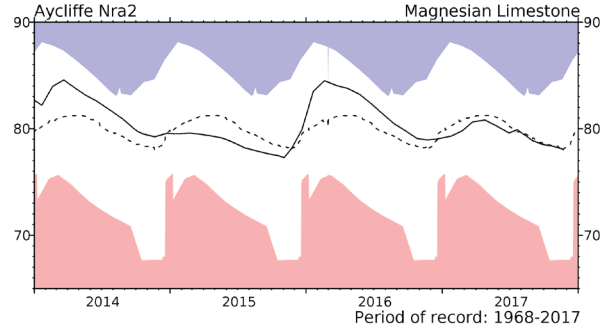
Period of record: 1972-2017



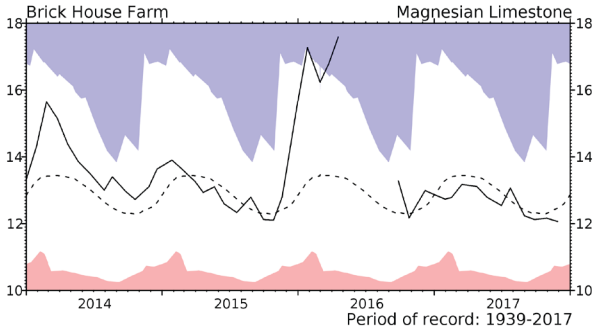
Period of record: 1974-2017



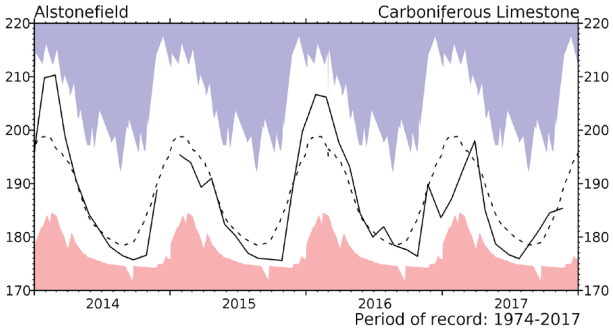
Period of record: 1971-2017



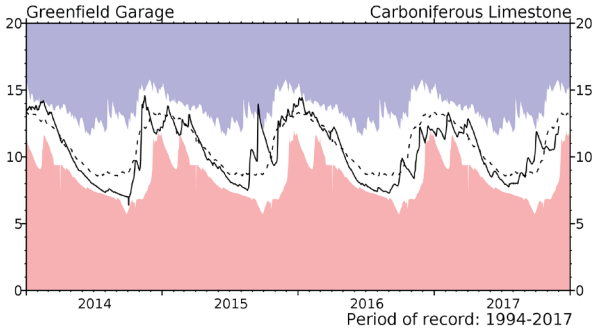
Period of record: 1968-2017



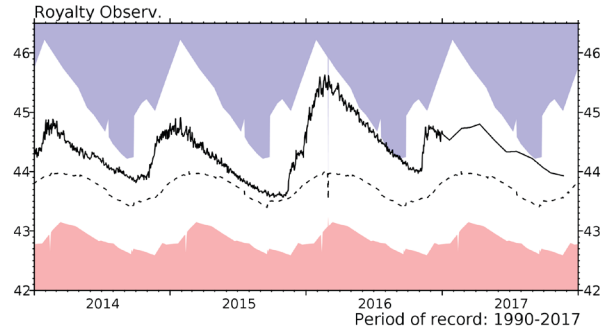
Period of record: 1939-2017



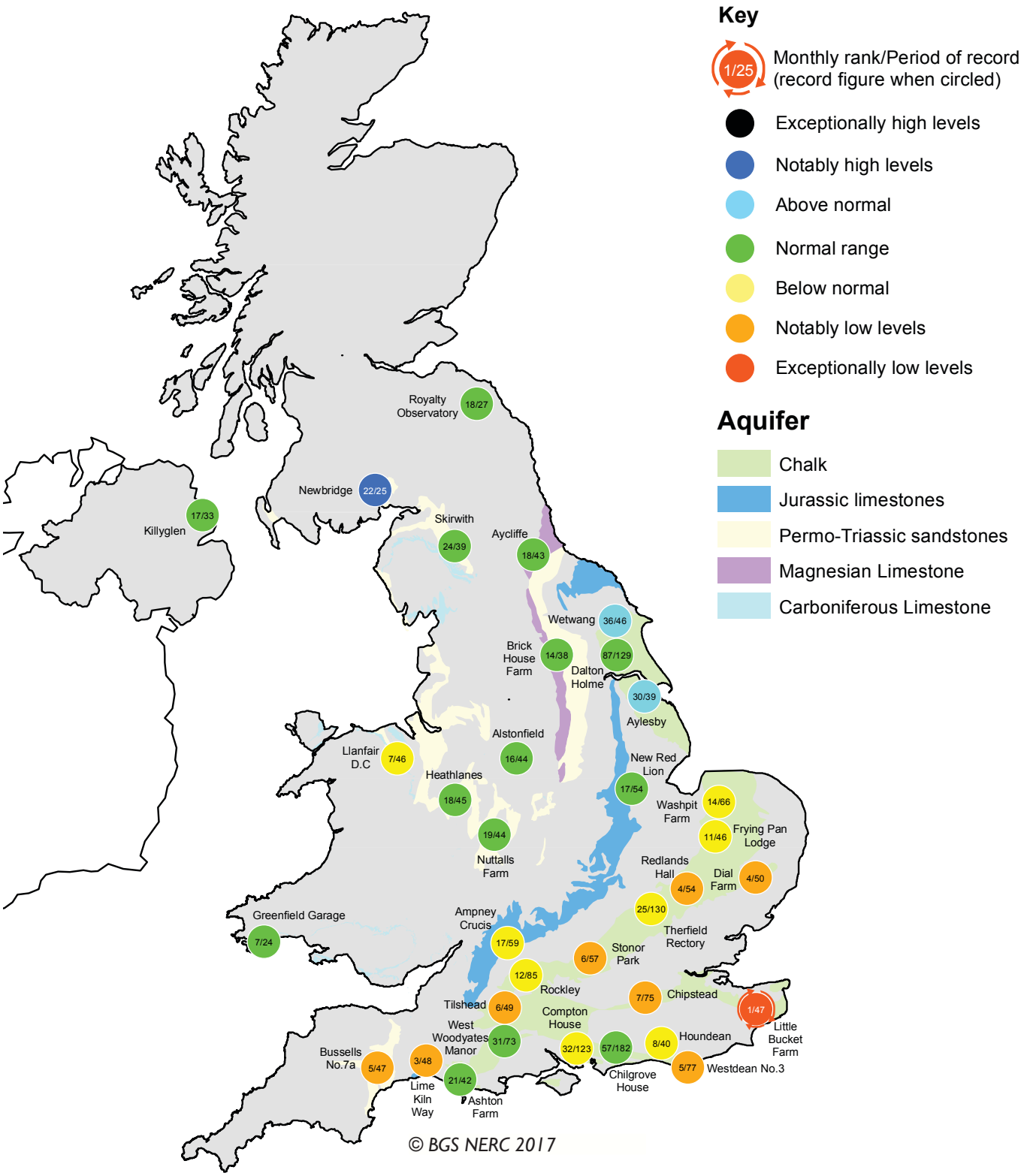
Period of record: 1974-2017



Period of record: 1994-2017



Period of record: 1990-2017

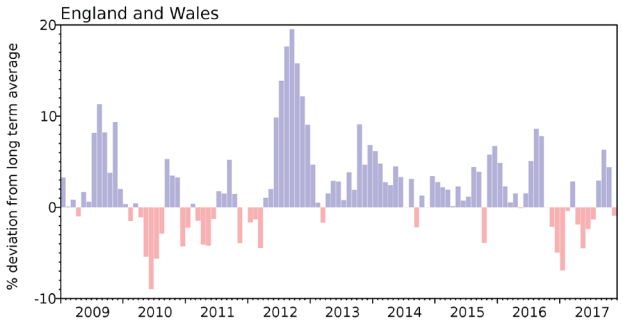


Groundwater levels - November 2017

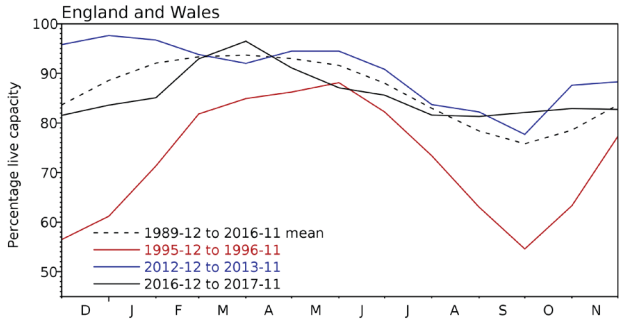
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 Sep	2017 Oct	2017 Nov	Nov Anom.	Min Nov	Year* of min	2016 Nov	Diff 17-16
North West	N Command Zone	•	124929	77	88	82	3	44	1993	69	12
	Vyrnwy		55146	97	98	93	11	33	1995	82	12
Northumbrian	Teesdale	•	87936	98	98	98	15	39	1995	90	8
	Kielder		(199175)	82	87	83	-3	55	2007	82	2
Severn-Trent	Clywedog		44922	92	85	87	6	43	1995	89	-2
	Derwent Valley	•	39525	68	80	85	6	9	1995	94	-9
Yorkshire	Washburn	•	22035	79	87	86	10	16	1995	74	12
	Bradford Supply	•	41407	80	91	91	9	20	1995	81	10
Anglian	Grafham		(55490)	94	94	94	11	47	1997	86	8
	Rutland		(116580)	90	85	81	1	57	1995	85	-4
Thames	London	•	202828	71	60	59	-24	52	1990	81	-23
	Farmoor	•	13822	93	95	94	5	52	1990	87	7
Southern	Bewl		28170	43	36	33	-31	33	2017	58	-25
	Ardingly		4685	81	81	87	13	14	2011	48	39
Wessex	Clatworthy		5364	69	68	65	-14	16	2003	58	7
	Bristol	•	(38666)	61	61	67	-1	27	1990	66	1
South West	Colliford		28540	81	98	88	15	42	1995	66	22
	Roadford		34500	71	74	79	4	19	1995	67	12
	Wimbleball		21320	76	53	55	-19	34	1995	51	4
	Stithians		4967	75	81	80	14	29	2001	75	5
Welsh	Celyn & Brenig	•	131155	93	91	94	6	50	1995	91	3
	Brianne		62140	100	100	100	5	72	1995	91	9
	Big Five	•	69762	77	79	84	1	49	1990	80	4
	Elan Valley	•	99106	80	89	100	7	47	1995	91	9
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	84	87	89	3	45	2003	83	6
	East Lothian	•	9374	98	95	97	8	38	2003	100	-3
Scotland(W)	Loch Katrine	•	110326	95	99	100	9	65	2007	88	12
	Daer		22412	86	98	99	2	73	2003	79	20
	Loch Thom		10798	89	100	100	5	72	2003	93	7
Northern Ireland	Total+	•	56800	98	99	98	12	59	2003	73	25
	Silent Valley	•	20634	100	99	96	15	43	2001	64	32

( ) figures in parentheses relate to gross storage

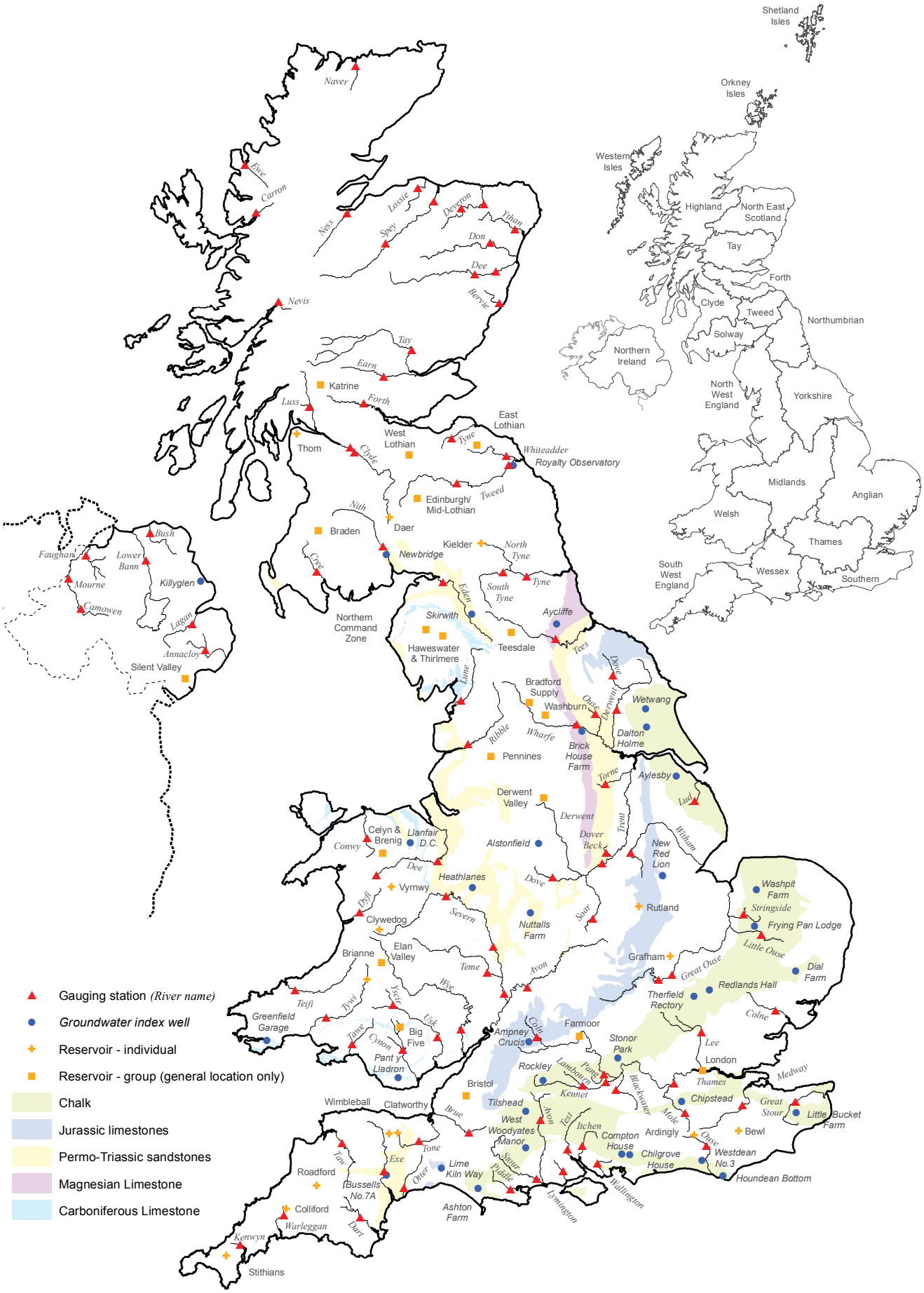
• denotes reservoir groups

*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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