Hydrological Summary

for the United Kingdom

August 2016

General

August was a mild month and many places experienced sunshine and showers. In northern England and northern Scotland, wetter conditions were interspersed with drier, more settled periods. Drier conditions prevailed in the south and east of the UK, central Scotland and Northern Ireland although were punctuated by unsettled weather conditions. Above average temperatures were registered in all regions and the hottest day of the year so far was recorded on the 23rd in Faversham, Kent (34.1°C). Variable river flow responses reflected the distribution of rainfall throughout August, but almost all monthly mean flows were in the normal range or above. Changes in soil moisture deficits (SMDs) in August reflected the spatial distribution of rainfall; SMDs increased in eastern Scotland and the south and east of Britain whilst soils wetted up in northern England and western Scotland. Groundwater levels followed their usual seasonal recession although remained in the normal range or above. On the whole, reservoir stocks continued to fall (as is normal for the time of year) and despite some substantial decreases in some southern reservoirs, stocks for England and Wales remained above average. As autumn begins, the water resources outlook for the UK remains healthy, the commencement of groundwater recharge is dependent on autumn rainfall.

Rainfall

An active low pressure system brought heavy rainfall to the south of England at the start of August (30mm was recorded at Liscombe (Bracknell) on the 2nd). Thereafter, the south-east was dominated by high pressure bringing dry, settled conditions. In northern England and northern Scotland, frontal systems brought unsettled conditions and large rainfall totals were recorded in many regions throughout the month, including 42mm at Blencathra (Cumbria) on the 3rd and 79mm at Achnagart (north-west Scotland) on the 11th/12th. This was followed by a short dry spell over the 14th-16th when the maximum three day accumulated rainfall total for the UK was less than 3mm. Localised flash flooding occurred in Cumbria on the 22nd (48mm was registered at Levens Hall) and in the Midlands on the 27th, when a convective storm delivered 32mm to Church Lawford (Warwickshire). Northern Ireland, south and east England and much of eastern Scotland received less than 90% of average rainfall with parts of eastern Scotland registering less than 70% and pockets of East Anglia experienced less than half the average. In contrast, parts of northern England, and northern and southern Scotland registered more than 130% of average, with over 170% received in the Western Isles and parts of northern England. Over July-August, there was a distinct north-south rainfall gradient. All but a few areas of central and southern England recorded below average rainfall, with localised parts receiving less than 50%. Conversely, parts of Scotland, north Wales and northern England received more than 150% of average and small areas more than 170%. Summer (June-August) was wetter than average for much of the UK, particularly in the Western Isles, eastern Scotland and Cumbria and below average rainfall was generally limited to southern England.

River flows

Flow responses in southern catchments reflected the drier conditions, although recessions were interrupted by high flows at the start and towards month-end; new maximum daily flows were recorded on the 1st/2nd in southern England (the Mole and Warleggan) and south Wales (the Cynon and Tawe). Flows in the north and west were highly variable, responding to the numerous rainfall events; new maximum daily flows were established in Wales, northern England and southern Scotland through the course of the month. A new maximum peak flow for August was established on the Lune on the 22nd (in a record from 1979) substantially exceeding the previous maximum. Average monthly river flows were generally in the normal range for August, with some above normal flows in responsive catchments in northern Scotland, northern England and Wales and above or notably above normal flows in less responsive catchments in southern England (the Lambourn and Itchen). August mean flows on the Carron were in the normal range after recording a new maximum July mean flow. Notably low flows were recorded on the Tone (for the second consecutive month) and the Soar, both registering around half the August average – amongst the lowest August flows on record (in records from 1961 and 1972, respectively). Average flows for July to August showed a similar pattern, notably the Dart was below normal and the Tone and Soar notably low, reflecting the strong rainfall gradient evident over the two month period. Average flows for the summer (June-August) were much the same as July-August but with a higher proportion of above normal flows across England.

Groundwater

SMDs increased over south-east England, in some cases, to above the long term average. In the Chalk, water levels were in seasonal recession. All the indicator boreholes were in the normal range, except Well House Inn and Little Bucket Farm that were above average and Dial Farm where the level remained below the seasonal average. Levels fell in the Permo-Triassic sandstones, including Heathlanes and Nuttalls Farm which registered small increases in July. Levels remained in the normal range in south-west England and above normal in the Midlands; but fell from notably high to above average at Skirwith and remained exceptionally high at Newbridge. In the Jurassic limestones, levels fell and remained in the normal range at New Red Lion, and above normal at Ampney Crucis. Levels fell and were in the normal range at Aycliffe in the Magnesian Limestone aquifer. Levels in the Carboniferous Limestone remained in the same category as last month, falling at Alstonefield but remaining above normal for the end of August. In south Wales, levels fell at Pant y Lladron in the second part of the month but rose overall, remaining in the normal range and fell, remaining below normal, at Greenfield Garage.

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

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

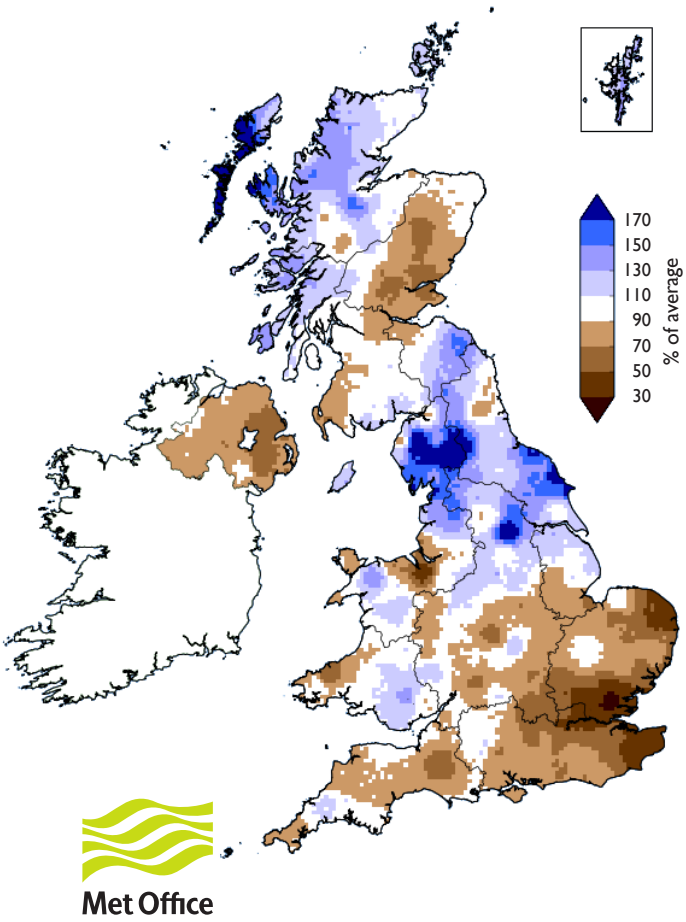
Area	Rainfall	Aug 2016	Jul16 – Aug16	RP	Jun16 – Aug16	RP	Mar16 – Aug16	RP	Sep15 – Aug16	RP
United Kingdom	mm	**88**	170		271		504		1314	
	%	**110**	116	2-5	125	2-5	115	2-5	122	70-100
England	mm	**68**	109		209		412		973	
	%	**105**	93	2-5	117	2-5	116	2-5	120	5-10
Scotland	mm	**120**	264		359		629		1766	
	%	**121**	142	2-5	136	5-10	115	2-5	123	70-100
Wales	mm	**109**	192		331		627		1750	
	%	**108**	110	2-5	129	2-5	119	2-5	129	30-50
Northern Ireland	mm	**70**	172		268		484		1295	
	%	**77**	104	2-5	114	2-5	103	2-5	117	50-80
England & Wales	mm	**74**	120		226		441		1081	
	%	**105**	96	2-5	119	2-5	117	2-5	122	10-15
North West	mm	**140**	246		376		606		1651	
	%	**147**	142	2-5	149	5-10	125	5-10	141	>>100
Northumbrian	mm	**96**	168		247		417		1145	
	%	**135**	131	2-5	131	2-5	111	2-5	139	>100
Severn-Trent	mm	**63**	101		211		416		883	
	%	**101**	90	2-5	121	2-5	122	2-5	118	5-10
Yorkshire	mm	**92**	140		221		443		1084	
	%	**140**	118	2-5	122	2-5	122	2-5	135	25-40
Anglian	mm	**40**	71		174		354		668	
	%	**77**	74	5-10	115	2-5	123	5-10	112	2-5
Thames	mm	**38**	58		153		364		765	
	%	**70**	60	10-15	99	2-5	117	2-5	110	2-5
Southern	mm	**36**	57		153		345		848	
	%	**67**	58	10-20	99	2-5	110	2-5	110	2-5
Wessex	mm	**58**	74		170		392		916	
	%	**89**	66	8-12	99	2-5	111	2-5	107	2-5
South West	mm	**78**	108		213		421		1268	
	%	**94**	75	5-10	98	2-5	93	2-5	106	2-5
Welsh	mm	**105**	181		315		603		1671	
	%	**106**	107	2-5	126	2-5	118	2-5	128	25-40
Highland	mm	**149**	309		396		716		1943	
	%	**135**	151	5-10	135	5-10	114	2-5	113	8-12
North East	mm	**72**	187		315		511		1235	
	%	**103**	137	2-5	156	5-10	126	2-5	131	25-40
Tay	mm	**77**	192		308		522		1712	
	%	**93**	123	2-5	136	2-5	108	2-5	136	>100
Forth	mm	**77**	183		275		469		1459	
	%	**94**	119	2-5	124	2-5	104	2-5	129	70-100
Tweed	mm	**98**	201		274		462		1365	
	%	**132**	145	2-5	134	2-5	113	2-5	144	>>100
Solway	mm	**113**	252		338		613		1865	
	%	**106**	130	2-5	124	2-5	111	2-5	134	>>100
Clyde	mm	**144**	316		410		732		2116	
	%	**115**	135	5-10	127	2-5	112	2-5	122	50-80

% = percentage of 1971-2000 average *RP = Return period*

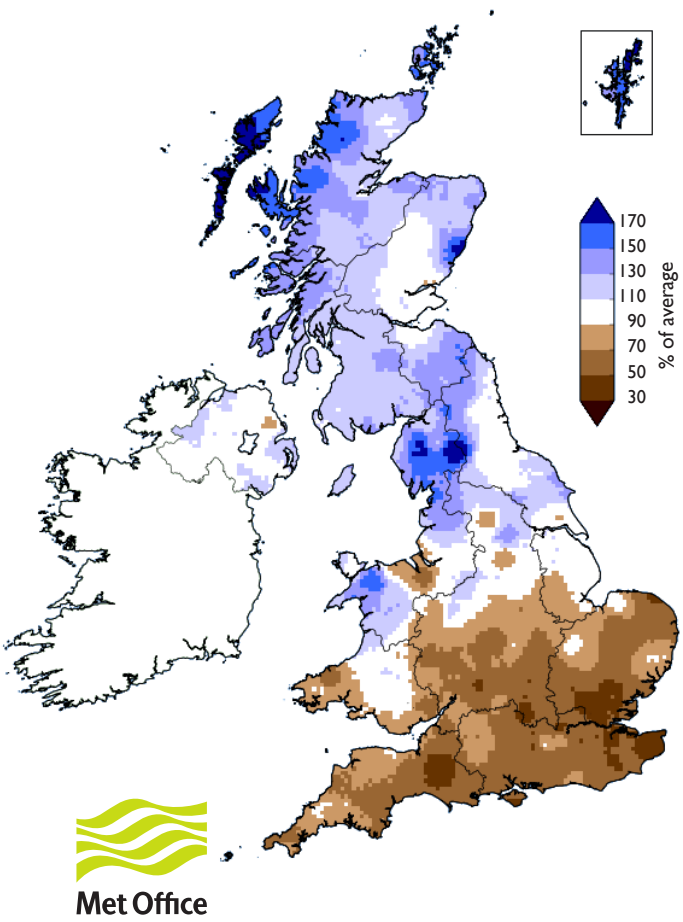
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 from February 2016 (inclusive) are provisional.

Rainfall . . . Rainfall . . .

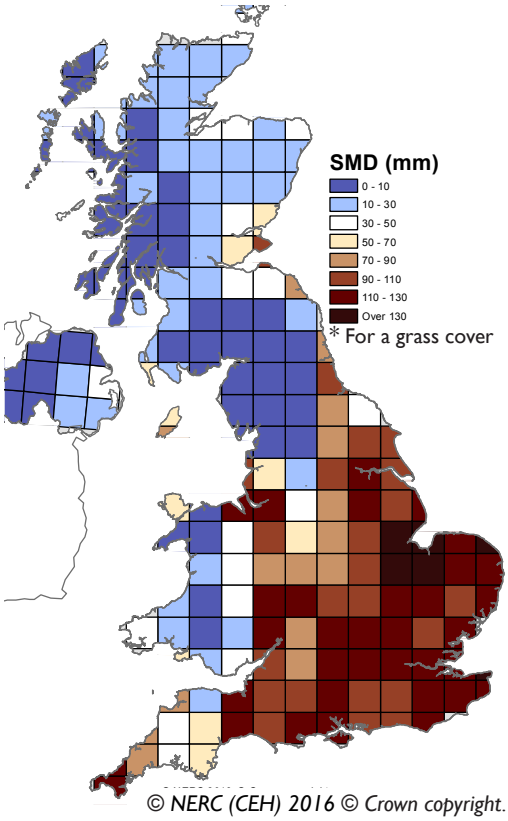
August 2016 rainfall
as % of 1971-2000 average



July 2016 - August 2016 rainfall
as % of 1971-2000 average



MORECS Soil Moisture Deficits*
August 2016



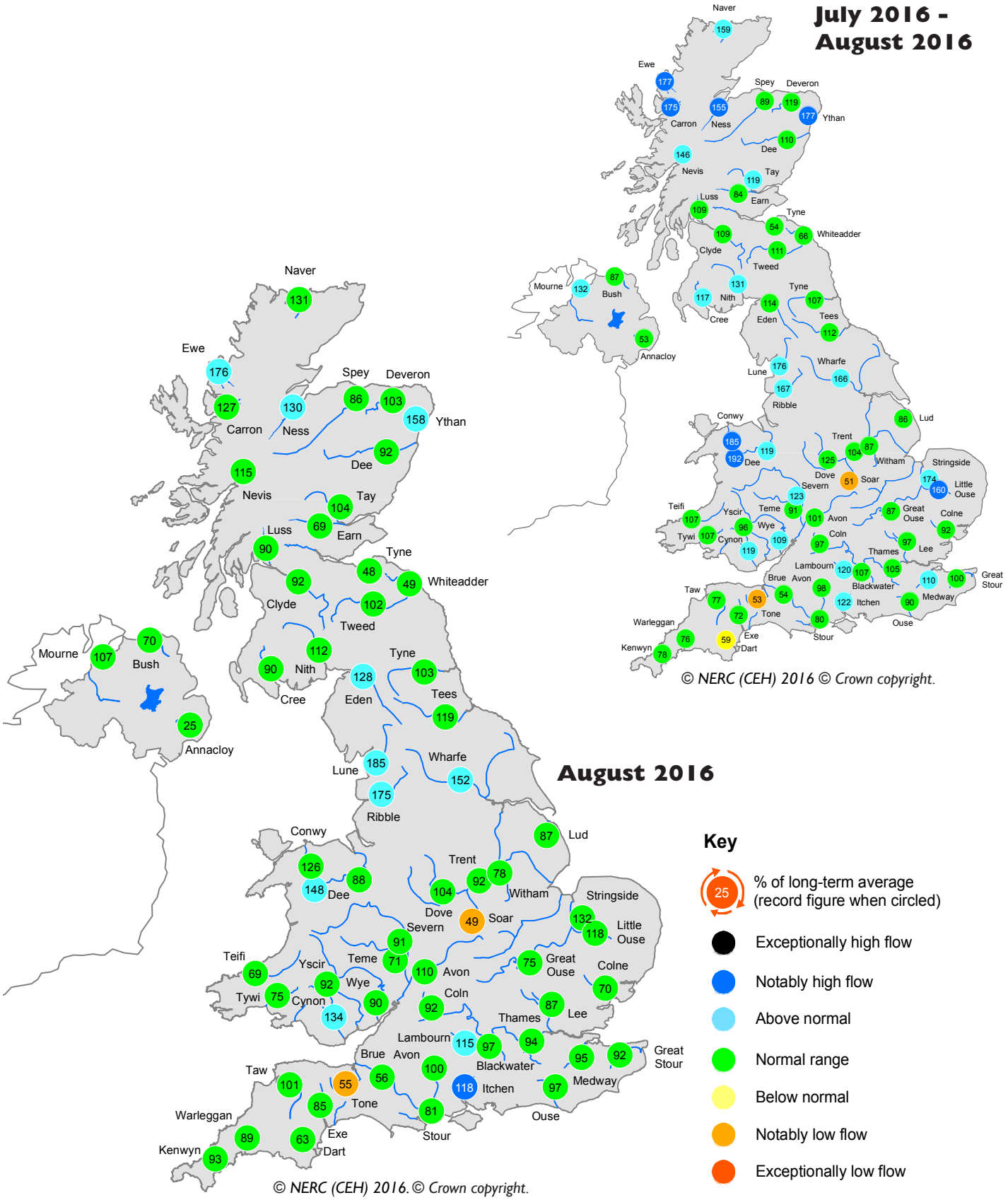
Met Office
3-month outlook
Updated: August 2016

For September, the forecast for UK precipitation suggests that the chances of above- and below-average rainfall are fairly balanced. For September-October-November as a whole, above-average precipitation is considered slightly more probable than below-average. The probability that UK precipitation for September-October-November will fall into the driest of our five categories is between 15 and 20% and the probability that it will fall into the wettest of our five categories is around 25% (the 1981-2010 probability for each of these categories is 20%).

The complete version of the 3-month outlook may be found at:
http://www.metoffice.gov.uk/publicsector/contingency-planners
This outlook is updated towards the end of each calendar month.

The latest shorter-range forecasts, covering the upcoming 30 days, can be accessed via:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_weather.html
These forecasts are updated very frequently.

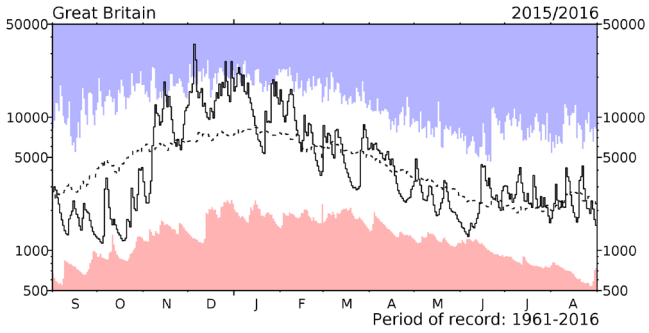
River flow . . . River flow . . .

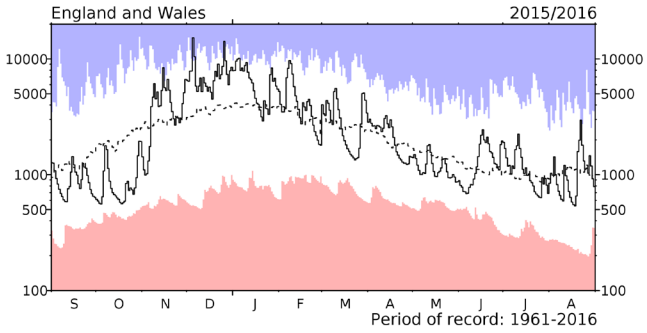


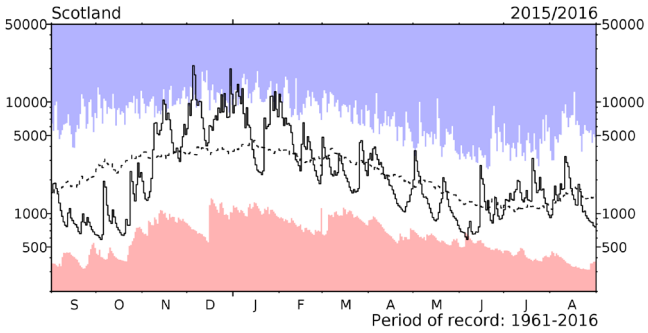
River flows

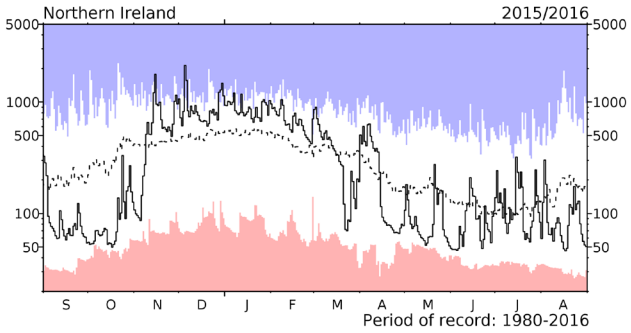
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

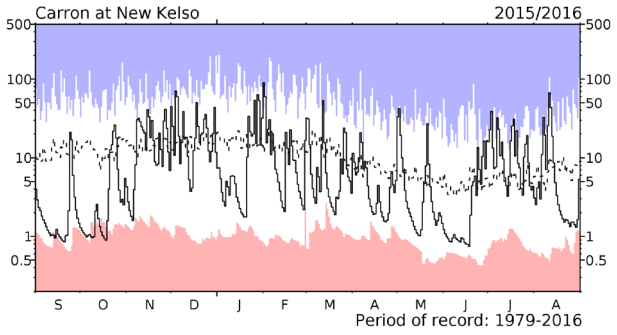
River flow . . . River flow . . .

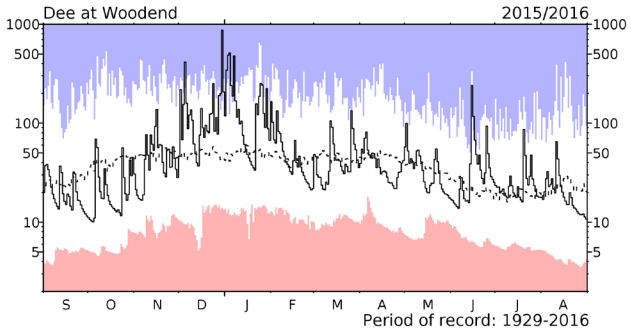


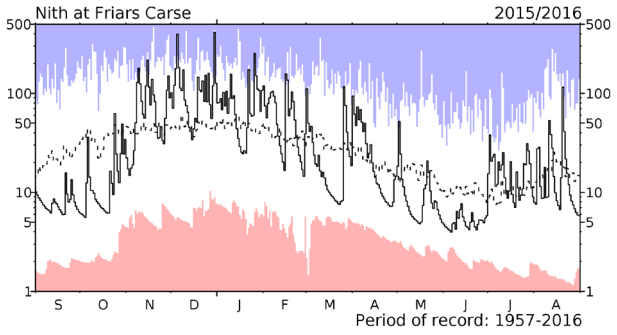


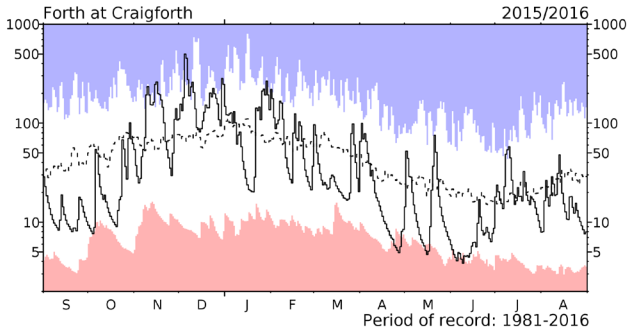


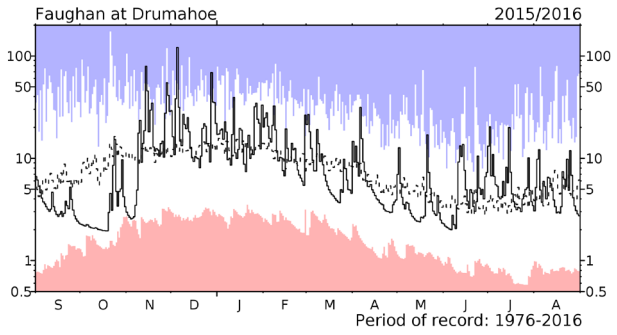


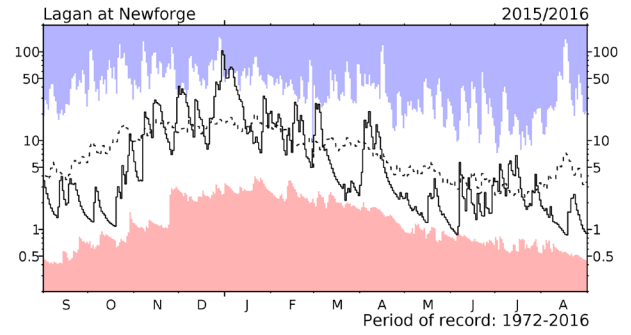








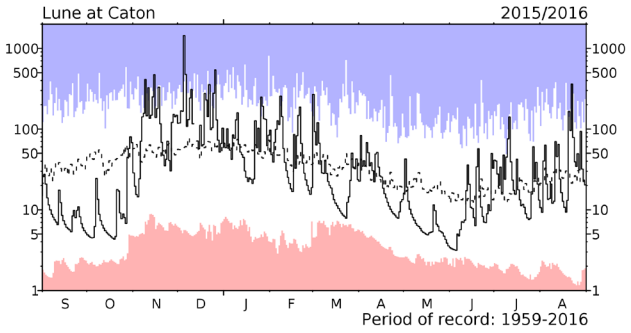


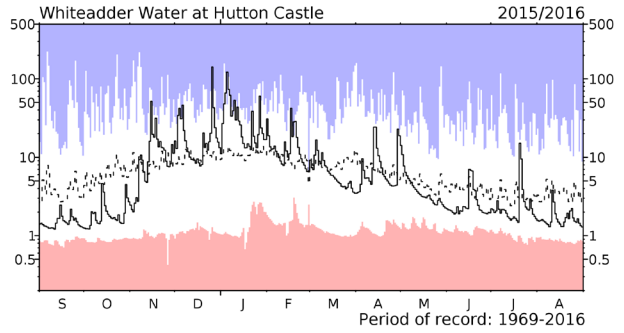


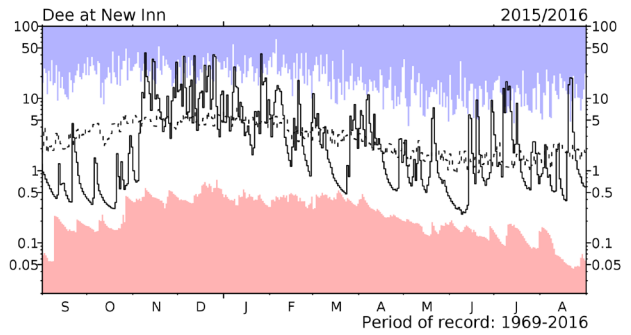
River flow hydrographs

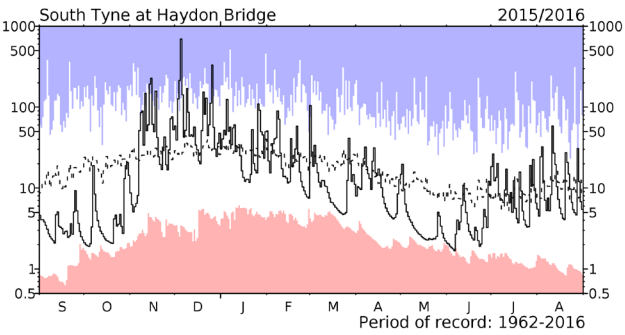
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to September 2015 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

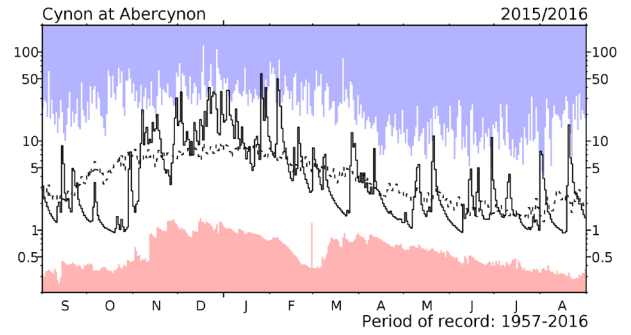
River flow . . . River flow . . .

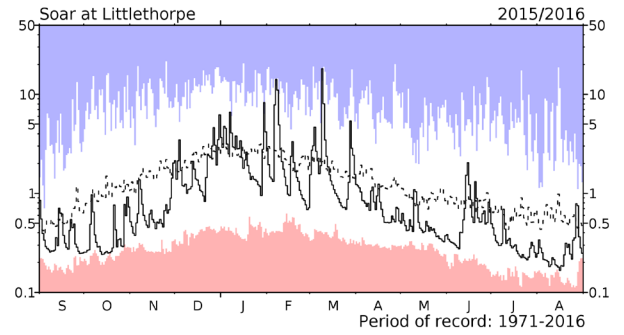


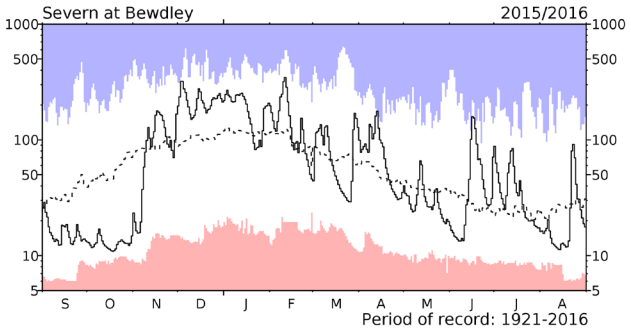


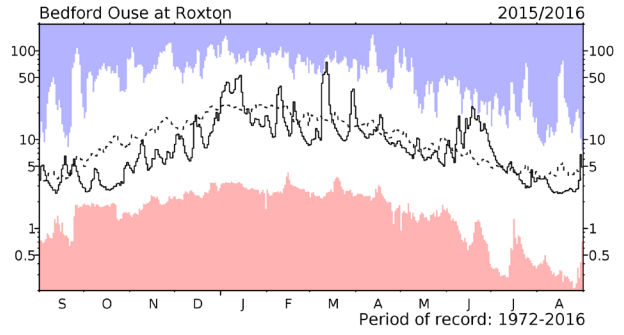


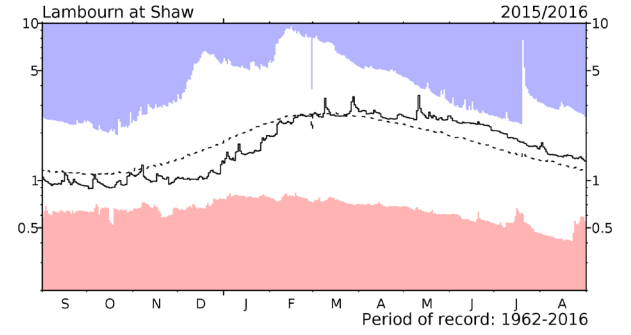


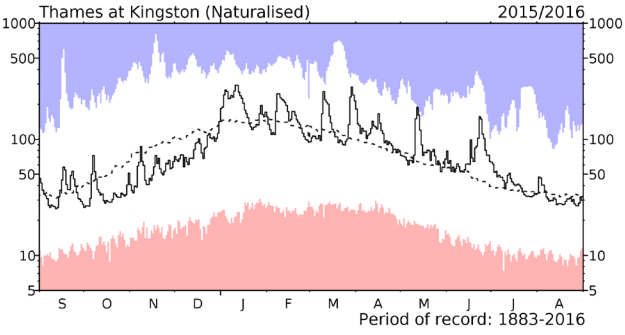


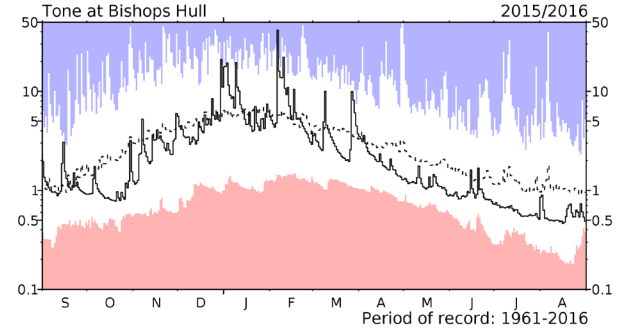


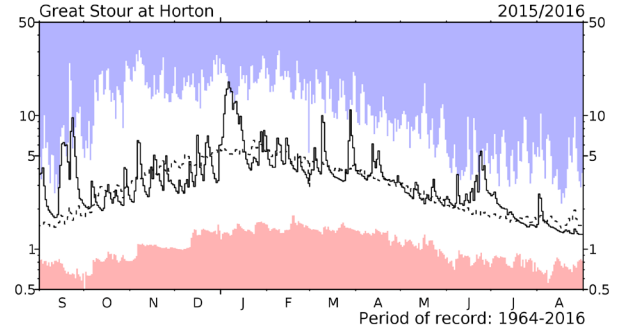




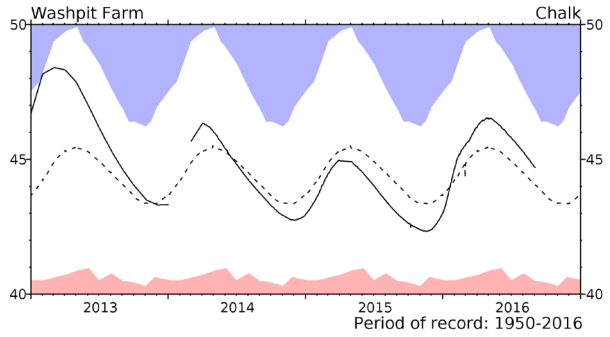


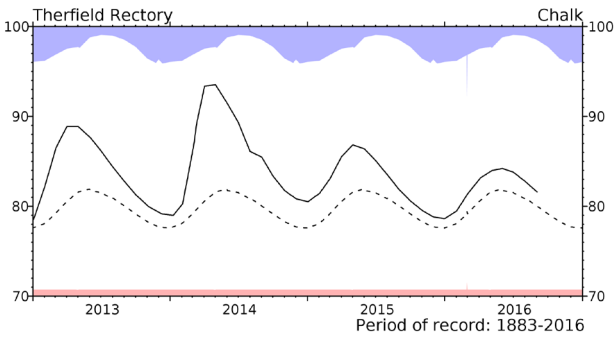


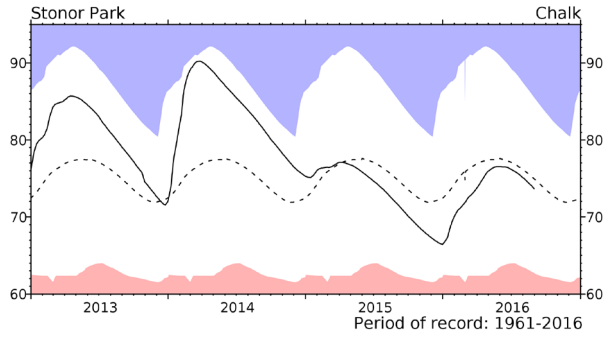


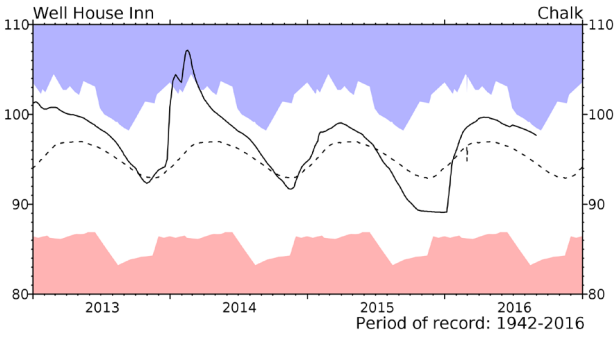


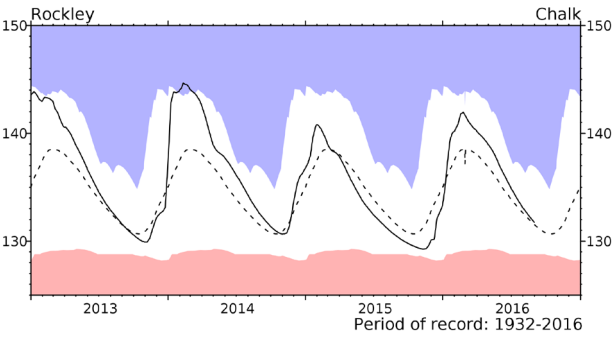
Groundwater…Groundwater

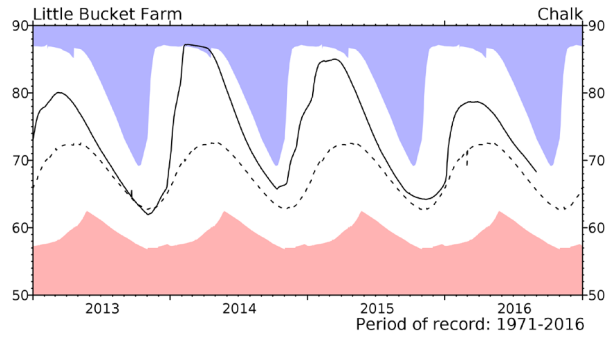


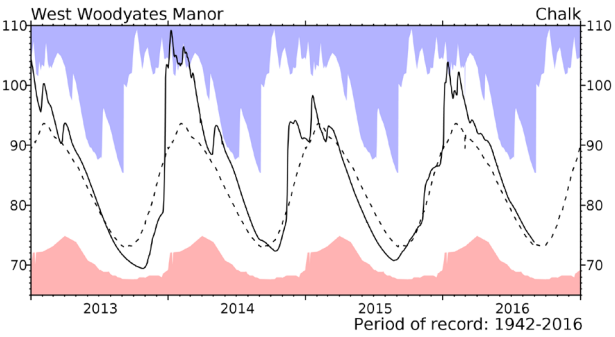


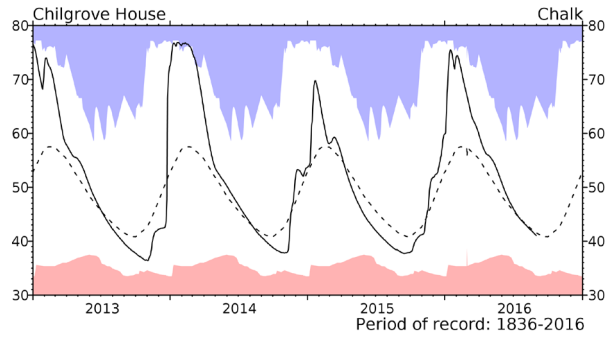


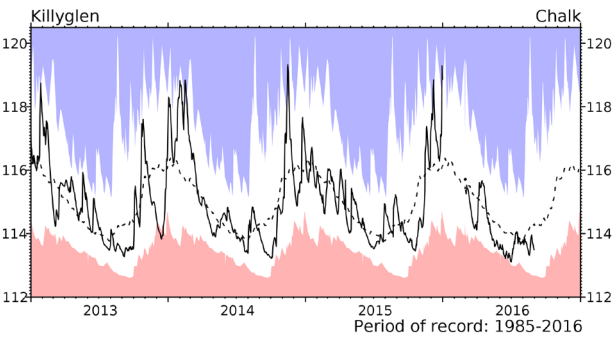


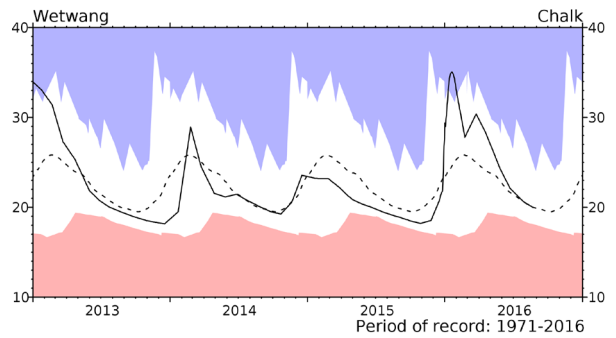






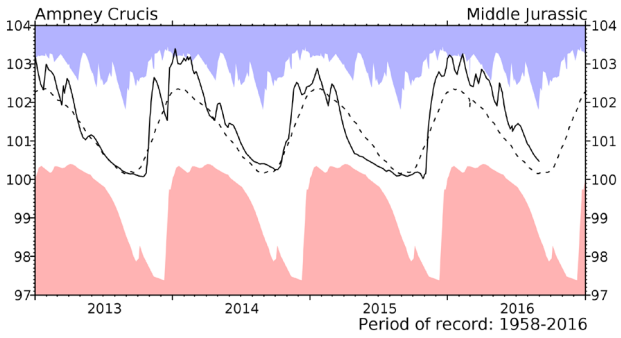


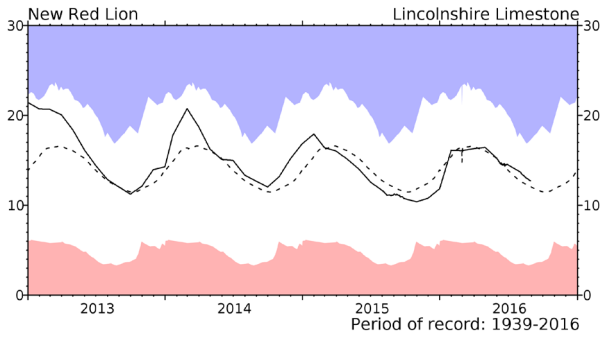


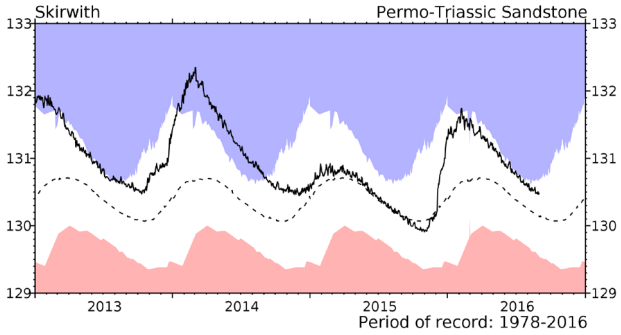


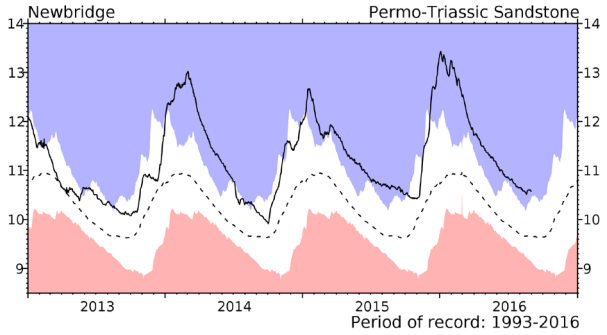
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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. The latest recorded levels are listed overleaf.

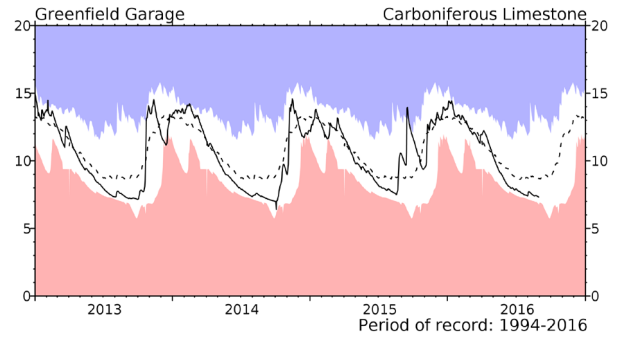
Groundwater ... Groundwater

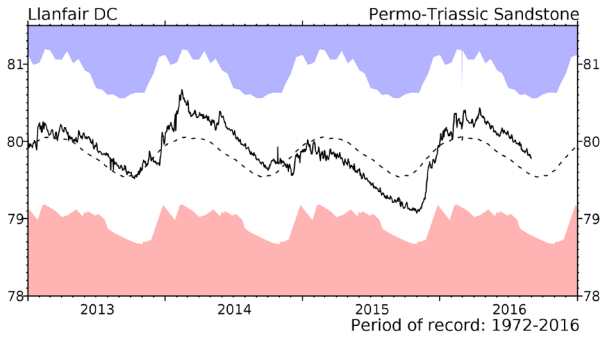


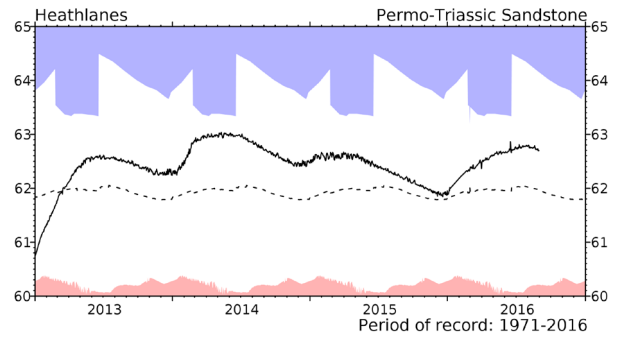


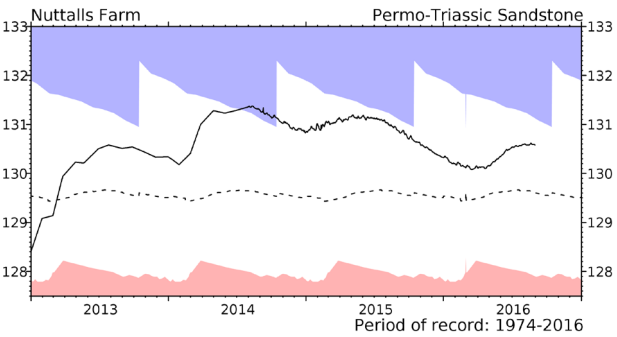


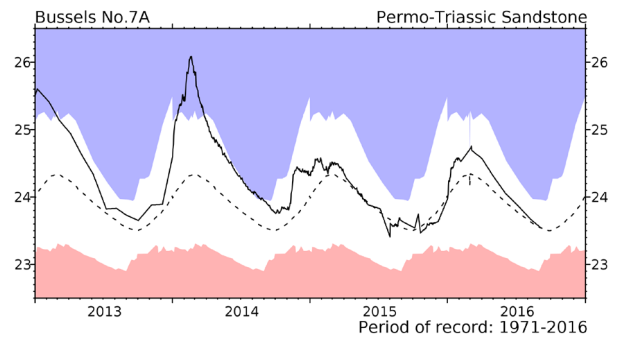


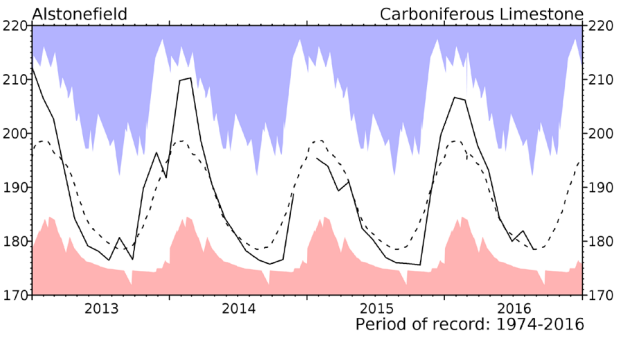








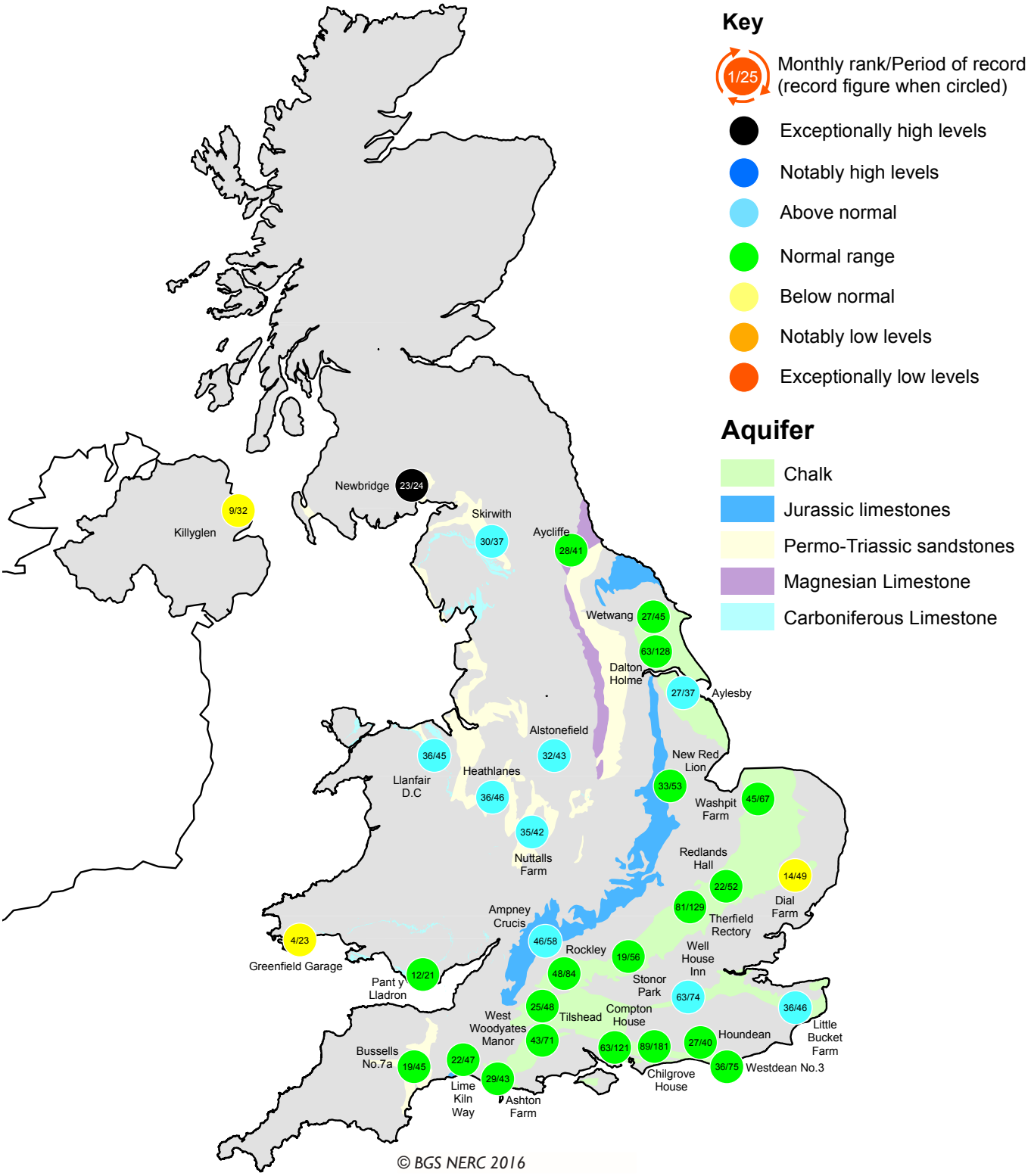




Groundwater levels August / September 2016

Borehole	Level	Date	Aug av.	Borehole	Level	Date	Aug av.	Borehole	Level	Date	Aug av.
Washpit Farm	44.70	02/09	44.47	Chilgrove House	41.02	31/03	41.76	Aycliffe NRA2	80.44	25/08	79.48
Therfield Rectory	81.58	02/09	80.94	Killyglen (NI)	113.49	31/08	114.07	Llanfair DC	79.78	31/08	79.63
Stonor Park	73.64	31/08	75.72	Wetwang	19.95	23/08	20.03	Heathlanes	62.70	31/08	62.05
Tilshead	81.71	31/08	82.89	Ampney Crucis	100.47	31/08	100.25	Nuttalls Farm	130.58	31/08	129.72
Rockley	131.74	31/08	132.08	New Red Lion	12.72	29/08	12.32	Bussells No.7a	23.55	02/09	23.62
Well House Inn	97.64	31/08	94.85	Skirwith	130.46	31/08	130.25	Alstonefield	178.44	24/08	178.52
West Woodyates	73.82	31/08	74.18	Newbridge	10.58	31/08	9.77				

Levels in metres above Ordnance Datum

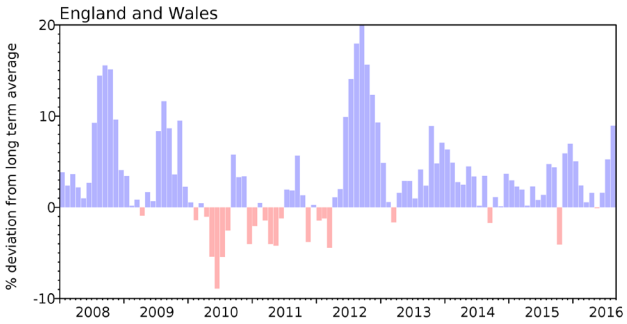


Groundwater levels - August 2016

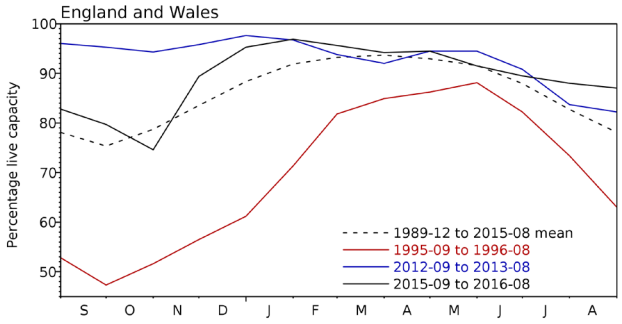
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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)	2016 Jun	2016 Jul	2016 Aug	Aug Anom.	Min Aug	Year* of min	2015 Aug	Diff 16-15
North West	N Command Zone	•	124929	65	64	72	14	15	1984	71	1
	Vyrnwy		55146	95	94	98	27	36	1995	87	11
Northumbrian	Teesdale	•	87936	74	76	88	17	38	1995	81	7
	Kielder		(199175)	90	92	96	8	66	1989	92	4
Severn-Trent	Clywedog		44922	100	98	98	22	27	1976	91	8
	Derwent Valley	•	39525	91	88	90	23	34	1995	66	24
Yorkshire	Washburn	•	22035	77	69	68	-2	34	1995	69	-1
	Bradford Supply	•	41407	76	73	75	7	21	1995	72	3
Anglian	Grafham		(55490)	89	93	91	5	59	1997	94	-3
	Rutland		(116580)	95	93	90	8	66	1995	84	6
Thames	London	•	202828	98	91	84	2	62	1995	80	4
	Farmoor	•	13822	96	97	97	4	64	1995	99	-2
Southern	Bewl		28170	93	88	81	11	38	1990	68	13
	Ardingly		4685	100	93	80	7	47	1996	62	18
Wessex	Clatworthy		5364	76	63	53	-12	31	1995	67	-14
	Bristol	•	(38666)	89	79	71	2	43	1990	71	0
South West	Colliford		28540	90	84	76	3	43	1997	77	-1
	Roadford		34500	90	86	77	4	40	1995	77	0
	Wimbleball		21320	80	72	60	-11	40	1995	72	-12
	Stithians		4967	81	73	61	-1	30	1990	68	-7
Welsh	Celyn & Brenig	•	131155	97	100	99	17	49	1989	90	10
	Brianne		62140	100	98	99	11	55	1995	100	-1
	Big Five	•	69762	92	88	85	13	29	1995	81	4
	Elan Valley	•	99106	93	97	86	9	37	1976	85	1
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	86	86	86	7	45	1998	85	1
	East Lothian	•	9374	98	98	96	11	63	1989	94	2
Scotland(W)	Loch Katrine	•	110326	76	81	79	7	50	2000	91	-12
	Daer		22412	78	84	86	9	41	1995	92	-6
	Loch Thom	•	10798	100	100	100	17	58	1997	100	0
Northern Ireland	Total+	•	56800	79	80	77	1	40	1995	92	-15
	Silent Valley	•	20634	79	77	75	2	33	2000	97	-22

( ) 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 1971-2000 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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