Hydrological Summary

for the United Kingdom

July 2016

General

July featured a mixture of sunshine and showers bookending a warm and briefly very hot spell mid-month during which temperatures peaked at 33.5°C at Brize Norton (Oxfordshire). Aside from this spell, periods of persistent unsettled weather delivered substantial rainfall predominantly to northern and western regions of the UK, resulting in an exaggerated north-west / south-east rainfall gradient. Whilst parts of Scotland, Northern Ireland, northern England and north Wales were considerably wetter than average, much of southern England registered less than half of the average rainfall. For England it was the driest July since 1999. Changes in soil moisture deficits (SMDs) in July reflected the rainfall gradient, with soils wetting up in the north and west and SMDs increasing in the south and east. River flows for July were above average across the majority of the UK, substantially so in western Scotland, Wales and East Anglia, but below normal in parts of south-west England. Groundwater levels fell or remained stable in almost all index boreholes (as expected for the time of year) but largely remained in the normal range or above. Reservoir stocks for England & Wales fell slightly but remained above average for the time of year, appreciably so for some impoundments in the north and west. With groundwater levels and reservoir stocks generally near or above average, the water resources outlook remains healthy for the remainder of the summer and early autumn.

Rainfall

A succession of Atlantic cyclonic systems predominantly tracking to the north of the UK brought unsettled conditions over the first half of July. This moist south-westerly airflow delivered persistent rainfall across the north and west of the country; on the 9th, 67mm was recorded at Capel Curig (north Wales), 50mm of which fell in 12 hours. Although south-east England was largely dry in July, thunderstorms on the 12th delivered heavy rainfall in parts of East Anglia (e.g. 47mm at Lingwood, Norfolk). The third week of July saw warm and briefly very hot temperatures across the UK, a period which was broken by intense thunderstorm activity particularly across northern Britain. On the 20th, lightning caused property damage in Scotland and 98mm was recorded at Nunraw Abbey (East Lothian). Thereafter, further unsettled weather characterised the final week of the month, with northern and western areas of the UK once again predominantly experiencing most of the rainfall. Whilst it is expected that northern and western areas are wetter than the south and east, these differences were particularly exaggerated in July. Rainfall totals were the second and fourth largest on record for July (in series from 1910) for the Western Isles and Shetland Islands, respectively. In contrast, parts of the far south of England received less than a fifth of average rainfall and less than 5mm was recorded on the Isle of Wight. For the summer so far (June-July), rainfall totals were above average across the majority of the UK; for the Shetland Islands, it was the wettest such period since 1956.

River flows

Despite the unsettled conditions in the first half of July, river flows were generally in recession at the start of the month following high flows at the end of June. Consequently, on the 1st, the Little Ouse established a new maximum July daily flow. In general, event rainfall totals were rarely extreme, resulting in moderately rather than exceptionally high flows through the first fortnight in northern and western areas, with a few exceptions. On the 9th, the Conwy registered a new maximum July daily flow by a wide margin in a 52-year record. During the warm and dry spell in the third week, recessions were established across large parts of the UK, reflected in the outflows from England & Wales. The thunderstorms which broke this spell across northern Britain resulted in the highest flows of the month, triggering flood alerts in all regions of Scotland on the 20th/21st. Thereafter, flows generally remained near average through to month-end as unsettled weather returned. For July, average river flows in almost all index catchments were in the normal range or above, notably or exceptionally so in north Wales, Norfolk and north-west Scotland. The Carron established a new maximum July mean flow in a series from 1979, almost 250% of average. Conversely, in south-west England many rivers recorded around half of the average July flow, with below normal flows in Cornwall and notably low flows on the Tone. Average flows over the summer so far were in the normal range or above throughout the UK, with the exception of the Tone in south-west England where flows were notably low. The Carron, Ythan and Stringside established new maxima for June-July average flows, and the Colne registered more than three times its average flow.

Groundwater

Soil moisture deficits increased sharply across the English Lowlands in response to the dry conditions although soils remained wetter than average for the time of year. In the Chalk, levels in most boreholes were in recession but remained in the normal range. At Well House Inn and Little Bucket Farm levels were above average and at Dial Farm increases ceased but levels remained below average. In the Permo-Triassic sandstones, levels generally continued to fall and stabilised at Heathlanes and Nuttalls Farm. Levels remained in the normal range in south-west England and above normal in the Midlands but were notably high at Skirwith and remained exceptionally high at Newbridge, although the latter was no longer a new record. In the Jurassic limestones, levels fell but remained in the normal range at New Red Lion and above normal at Ampney Crucis. Levels fell but remained above average in the Magnesian Limestone aquifer of north-east England. In the Carboniferous Limestone, levels rose to above normal during July at Alstonefield in the Peak District, whilst in south Wales they fell; in the east (Pant y Lladron) levels returned to the normal range and in the west (Greenfield Garage) remained below normal.

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.

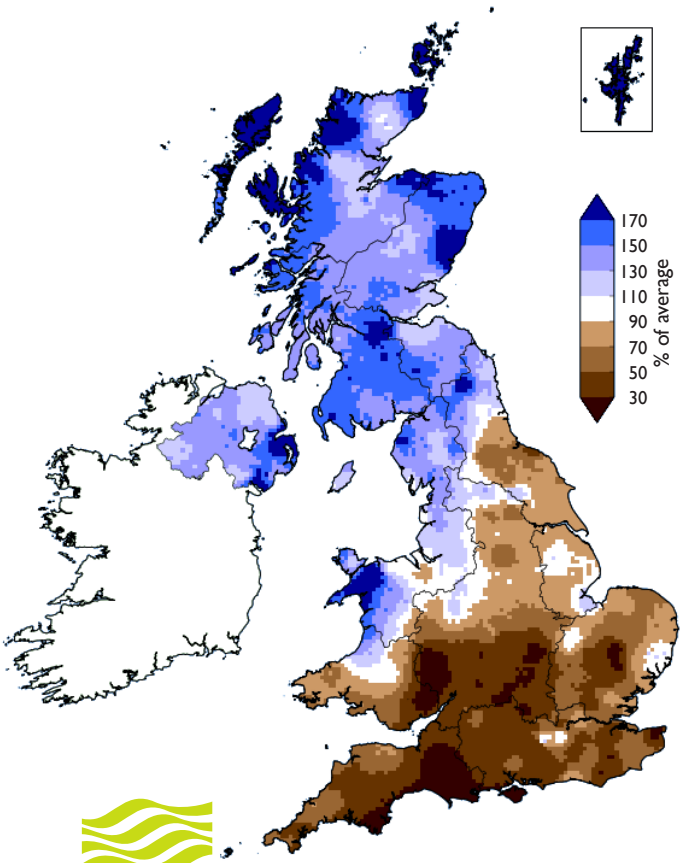
Area	Rainfall	Jul 2016	Jun16 – Jul16	RP	Feb16 – Jul16	RP	Nov15 – Jul16	RP	Aug15 – Jul16	RP
United Kingdom	mm	**81**	183		530		1107		1337	
	%	**123**	135	5-10	120	10-15	140	>>100	124	80-120
England	mm	**41**	142		417		798		1003	
	%	**79**	125	2-5	120	5-10	133	50-80	124	10-20
Scotland	mm	**144**	239		680		1507		1767	
	%	**167**	145	10-15	120	8-12	143	>>100	123	50-80
Wales	mm	**83**	222		673		1518		1791	
	%	**112**	143	2-5	125	5-10	152	>>100	132	60-90
Northern Ireland	mm	**102**	199		523		1112		1349	
	%	**138**	137	2-5	113	2-5	138	>>100	122	80-120
England & Wales	mm	**47**	153		453		898		1111	
	%	**85**	128	2-5	121	5-10	137	>100	125	15-25
North West	mm	**105**	236		608		1402		1620	
	%	**135**	151	5-10	128	10-20	165	>>100	139	>100
Northumbrian	mm	**72**	151		384		953		1137	
	%	**126**	128	2-5	106	2-5	156	>>100	138	>100
Severn-Trent	mm	**37**	147		426		735		907	
	%	**75**	132	2-5	128	8-12	132	15-25	121	5-10
Yorkshire	mm	**48**	129		426		881		1087	
	%	**89**	112	2-5	120	5-10	147	>100	135	20-35
Anglian	mm	**32**	134		347		537		696	
	%	**70**	135	2-5	127	8-12	122	5-10	116	2-5
Thames	mm	**20**	115		381		627		815	
	%	**47**	116	2-5	125	5-10	123	5-10	117	5-10
Southern	mm	**21**	117		360		678		934	
	%	**47**	117	2-5	114	2-5	120	5-10	121	5-10
Wessex	mm	**16**	112		422		749		984	
	%	**34**	105	2-5	119	2-5	118	5-10	115	2-5
South West	mm	**30**	135		480		1017		1336	
	%	**49**	101	2-5	101	2-5	114	2-5	112	2-5
Welsh	mm	**76**	211		645		1443		1713	
	%	**107**	139	2-5	124	5-10	150	>>100	131	50-80
Highland	mm	**160**	247		775		1645		1919	
	%	**169**	134	5-10	117	5-10	130	50-80	112	5-10
North East	mm	**115**	243		512		1034		1265	
	%	**173**	185	15-25	127	5-10	151	>>100	134	40-60
Tay	mm	**115**	231		579		1458		1717	
	%	**156**	162	8-12	114	2-5	156	>>100	136	70-100
Forth	mm	**105**	198		530		1296		1479	
	%	**148**	141	5-10	115	5-10	157	>>100	131	70-100
Tweed	mm	**103**	176		465		1192		1355	
	%	**159**	136	2-5	115	2-5	170	>>100	143	>100
Solway	mm	**139**	225		688		1648		1916	
	%	**160**	136	2-5	124	10-20	162	>>100	137	>>100
Clyde	mm	**172**	265		816		1837		2137	
	%	**160**	135	5-10	122	10-15	147	>>100	124	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 January 2016 (inclusive) are provisional.

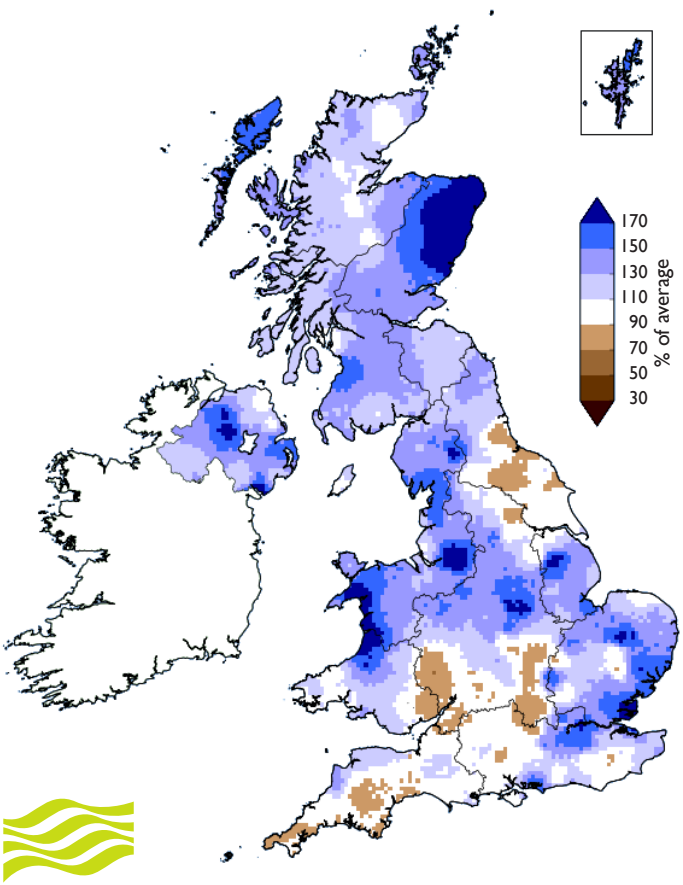
Rainfall . . . Rainfall . . .

July 2016 rainfall
as % of 1971-2000 average



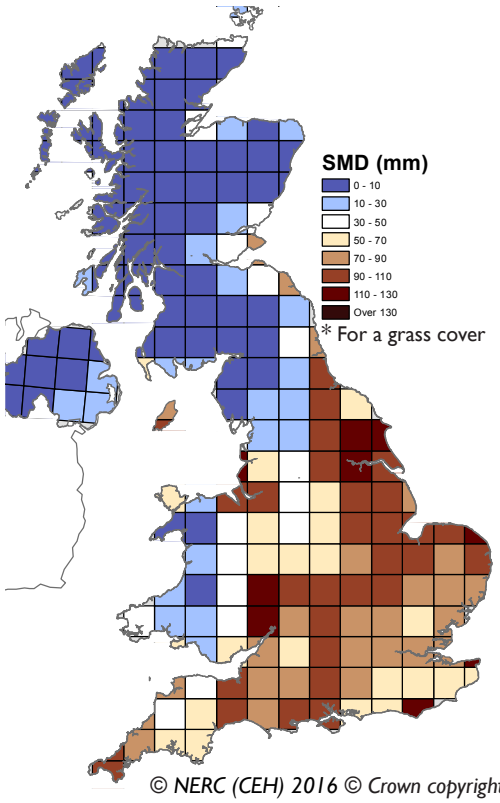
Met Office

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



Met Office

MORECS Soil Moisture Deficits*
July 2016



Met Office

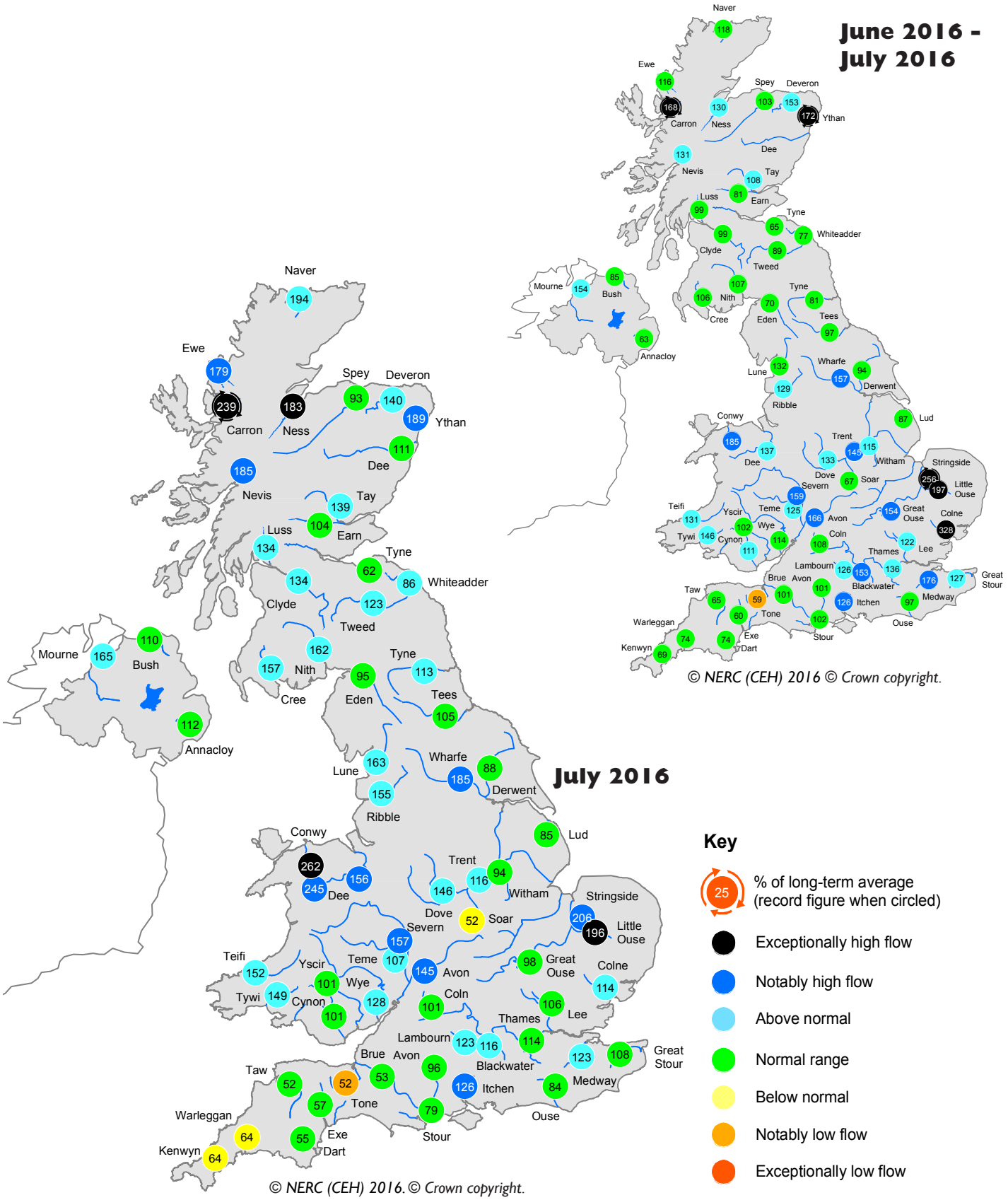
Met Office
3-month outlook
Updated: July 2016

For August, above-average precipitation is considered slightly more probable than below-average. For August-September-October as a whole, the forecast for UK precipitation suggests that the chances of above- and below-average rainfall are fairly balanced. The probability that UK precipitation for August-September-October 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 20% (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.

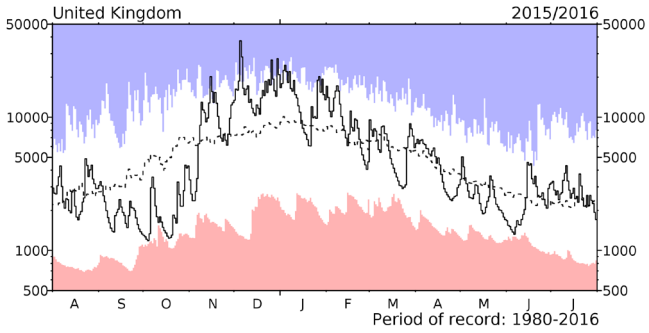
River flow . . . River flow . . .

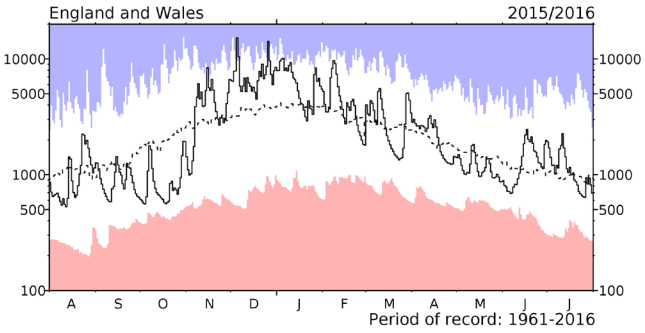


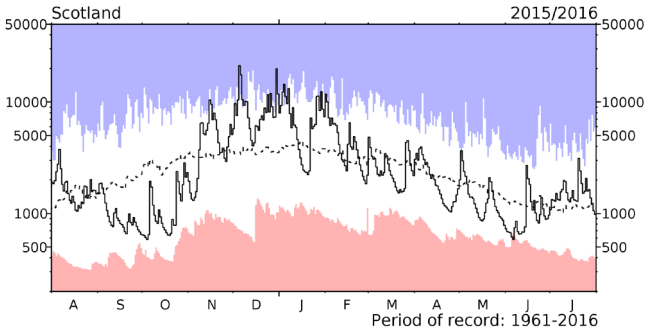
River flows

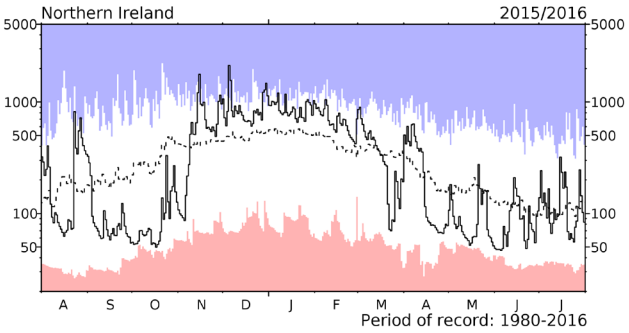
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much 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.

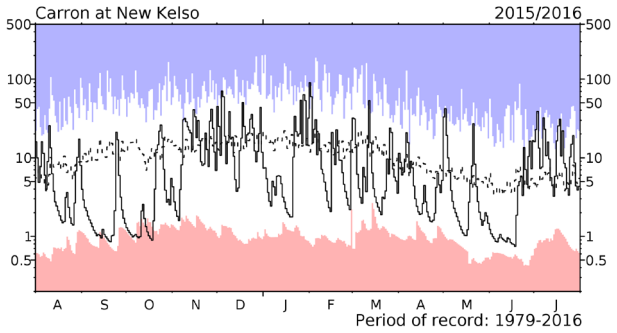
River flow . . . River flow . . .

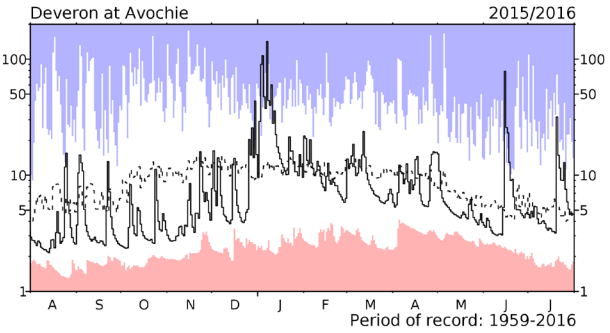


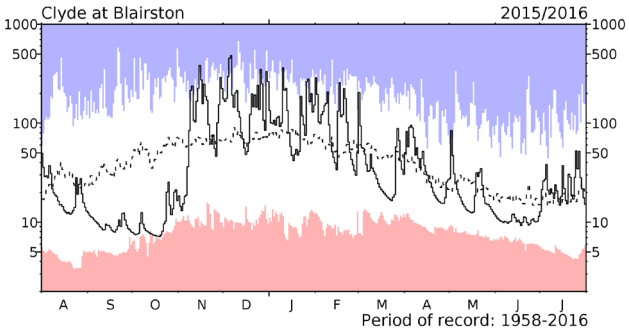


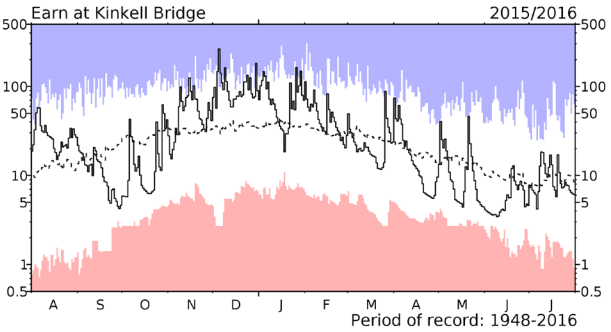


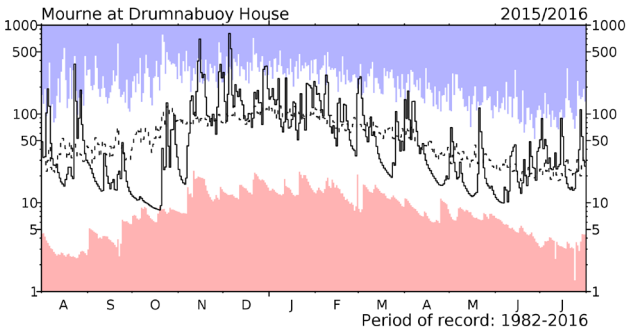


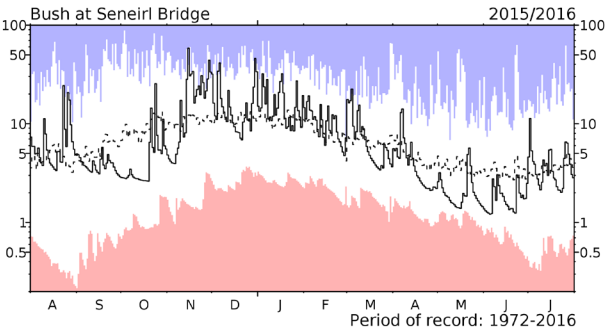








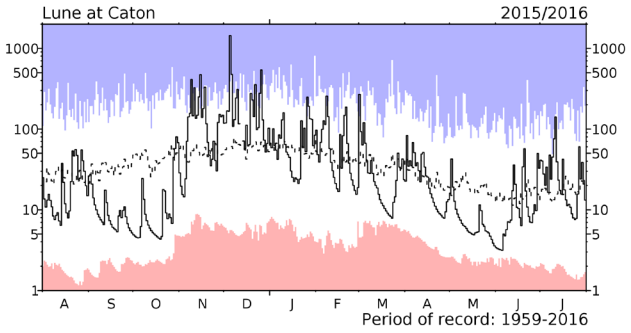


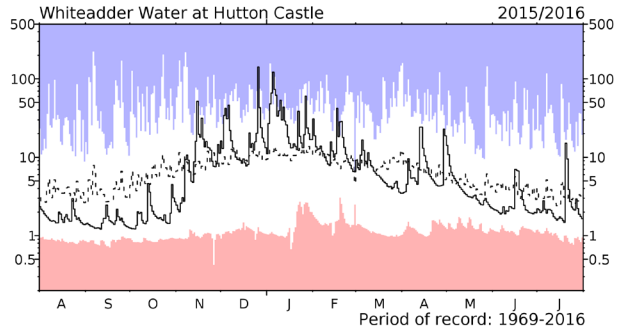


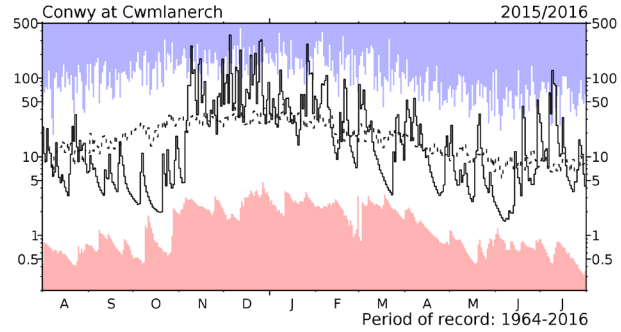
River flow hydrographs

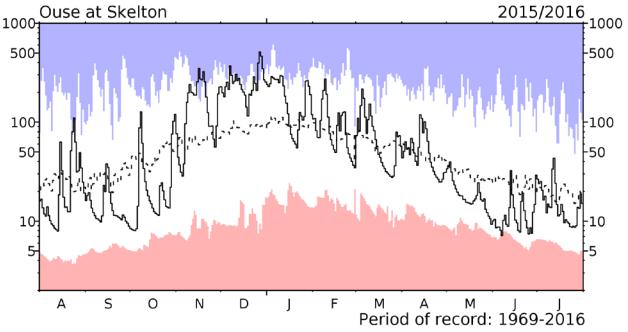
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to August 2015 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the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

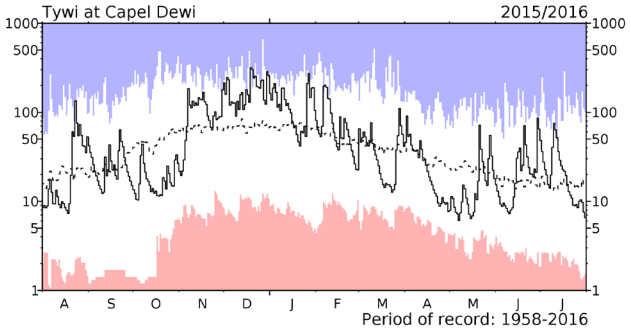
River flow . . . River flow . . .

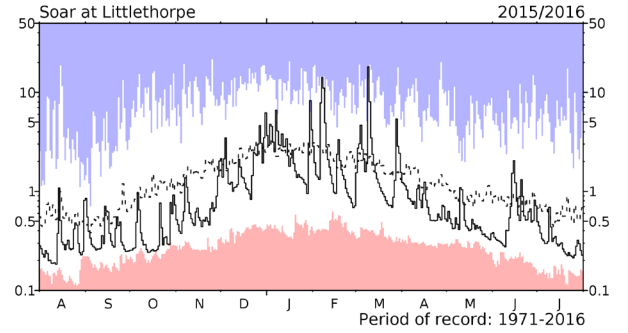


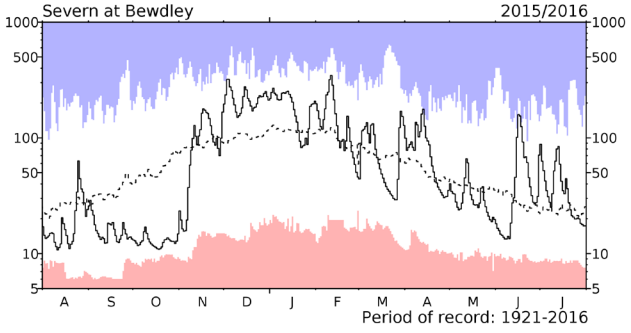


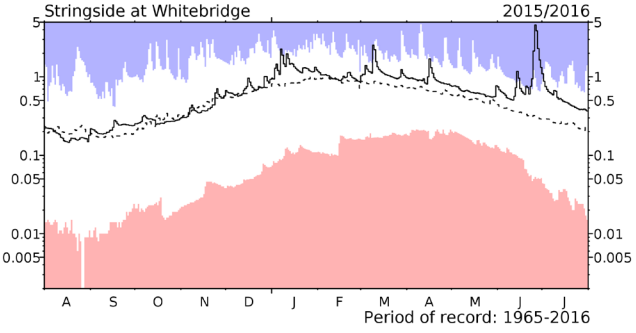


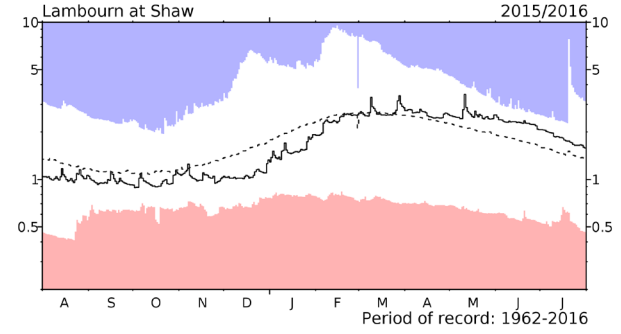


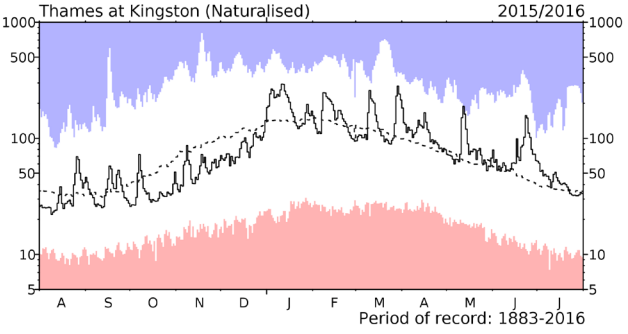


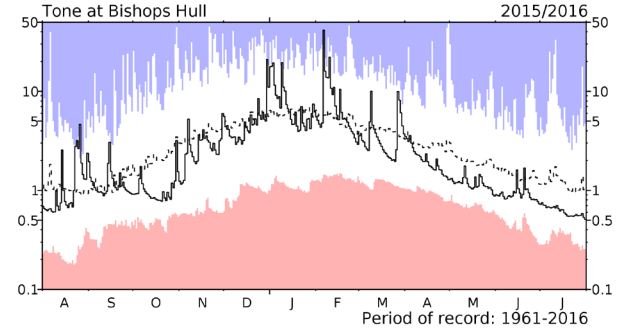


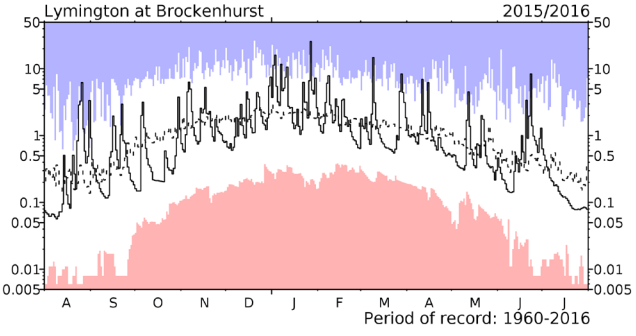




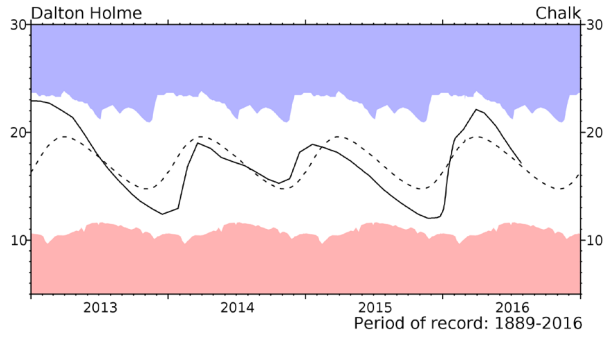


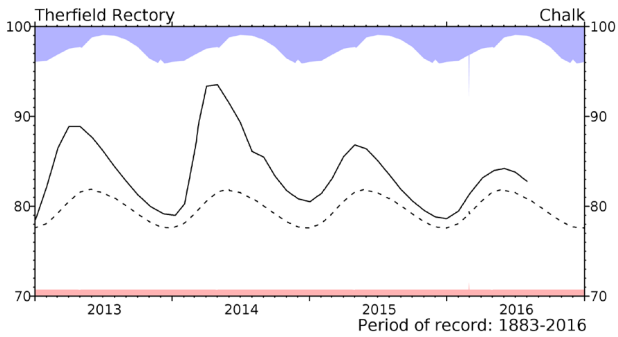


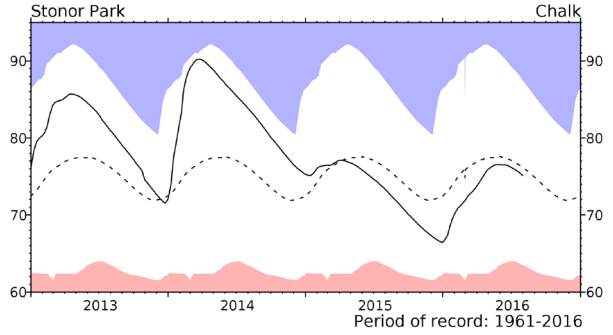


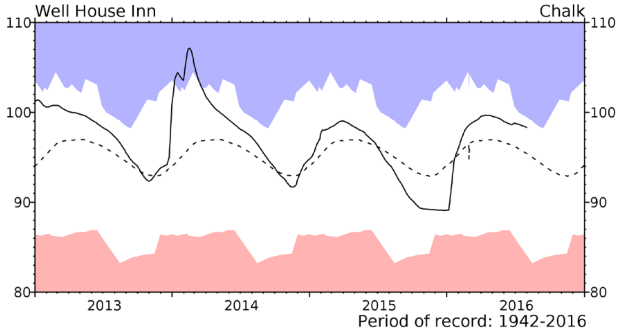


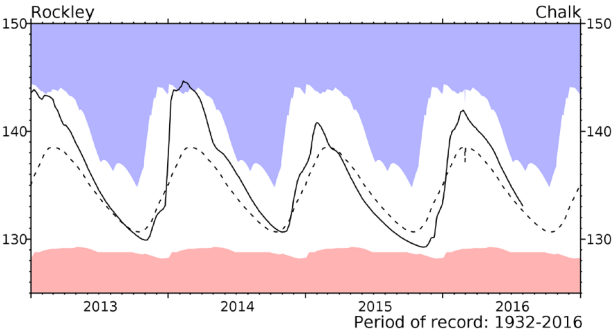
Groundwater…Groundwater

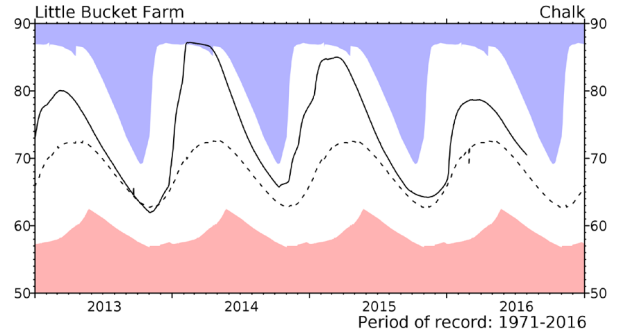


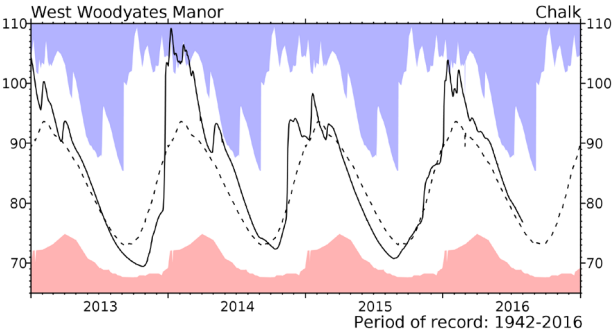


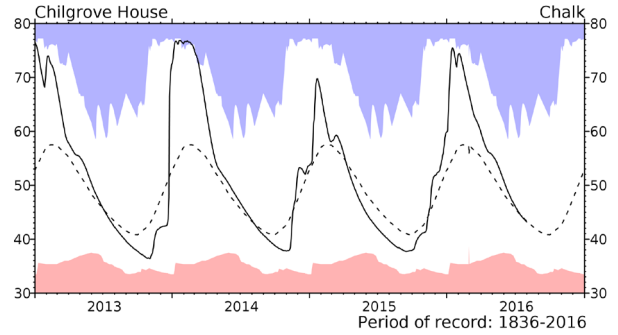


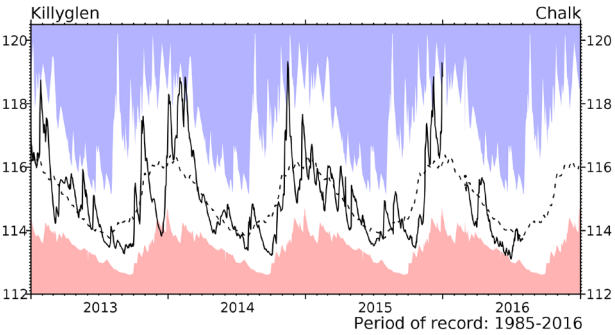


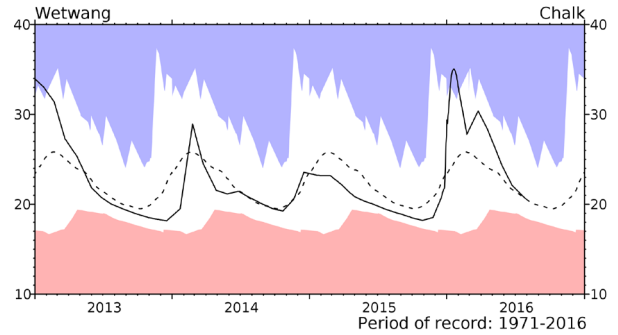






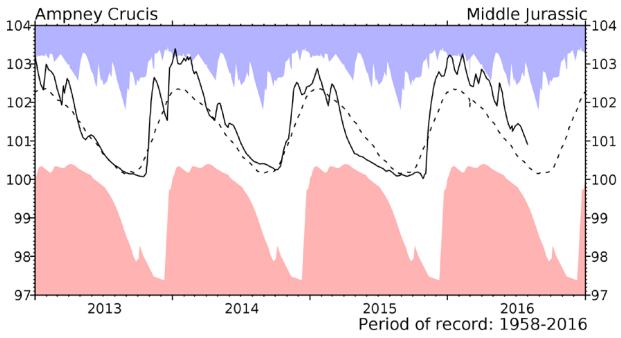


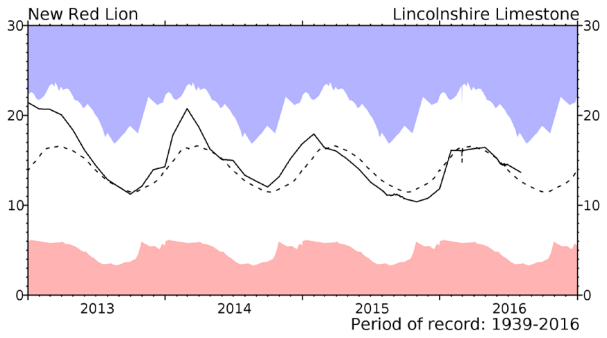


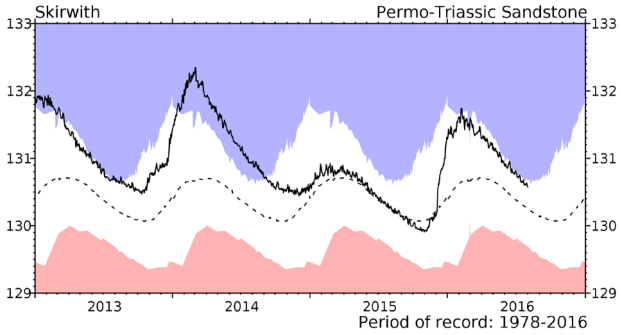


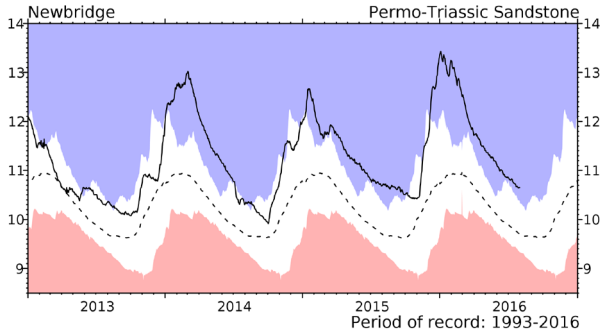
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

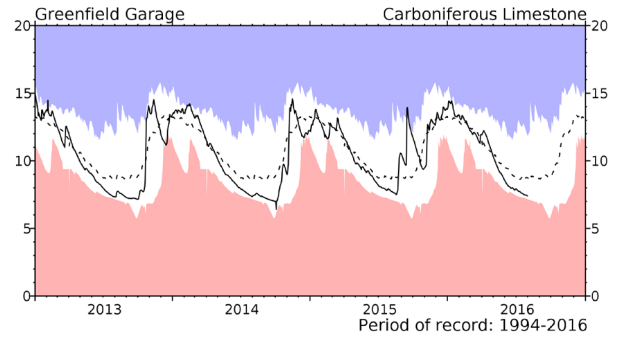
Groundwater ... Groundwater

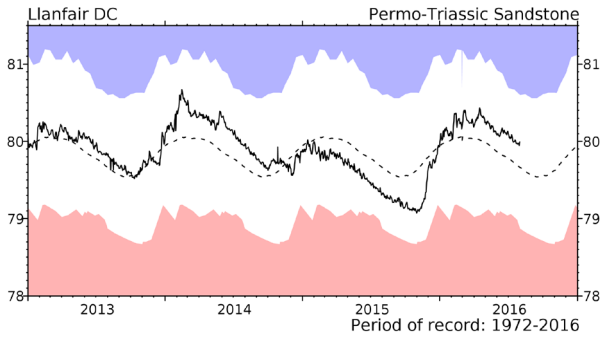


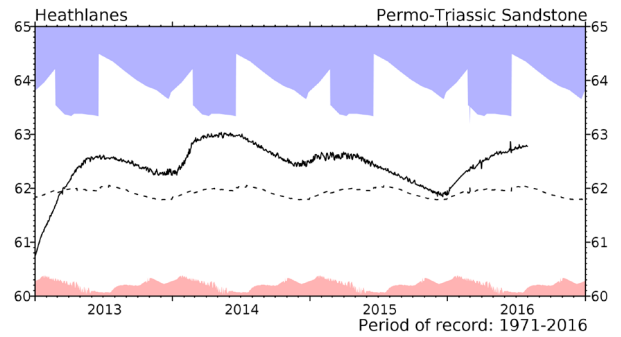


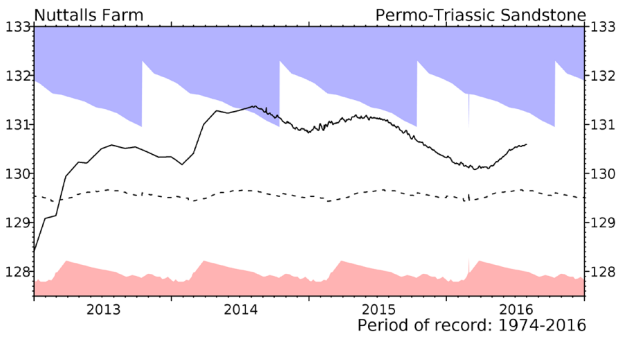


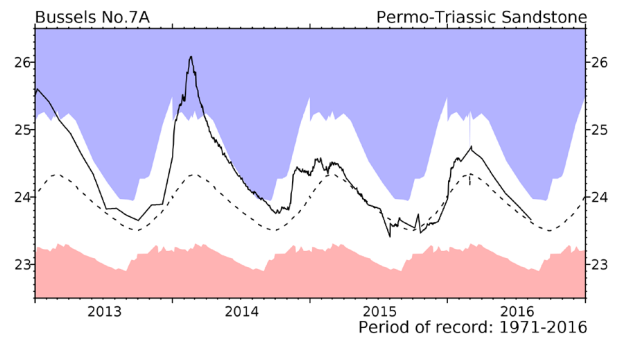


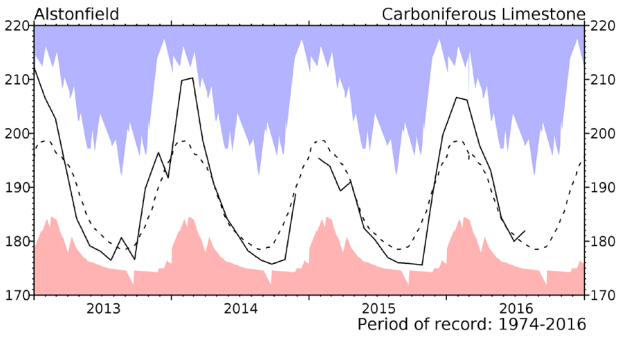








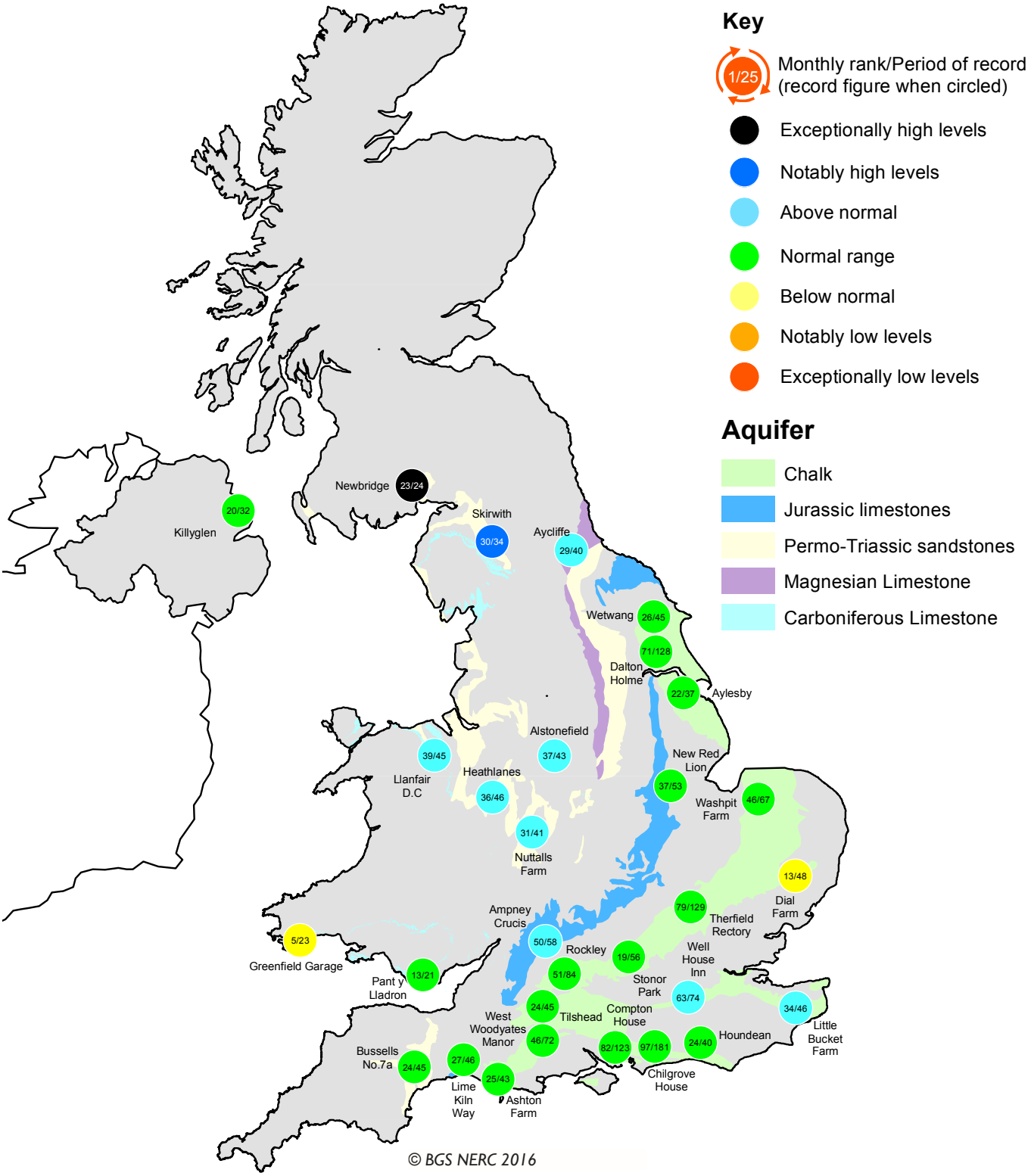




Groundwater levels July / August 2016

Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.
Dalton Holme	17.16	27/07	17.20	Chilgrove House	43.12	31/07	43.65	Aycliffe NRA2	81.31	27/07	79.97
Therfield Rectory	82.76	01/08	81.56	Killyglen (NI)	113.72	31/07	113.88	Llanfair DC	79.99	31/07	79.74
Stonor Park	75.10	31/07	76.99	Wetwang	20.60	28/07	20.92	Heathlanes	62.77	31/07	62.08
Tilshead	83.98	31/07	84.94	Ampney Crucis	100.91	31/07	100.50	Nuttalls Farm	130.59	31/07	129.68
Rockley	133.09	31/07	133.22	New Red Lion	13.65	03/08	13.19	Bussells No.7a	23.66	09/08	23.75
Well House Inn	98.30	31/07	95.75	Skirwith	130.57	01/08	130.35	Alstonefield	181.92	27/07	179.74
West Woodyates	76.83	31/07	77.15	Newbridge	10.65	31/07	9.89				

Levels in metres above Ordnance Datum

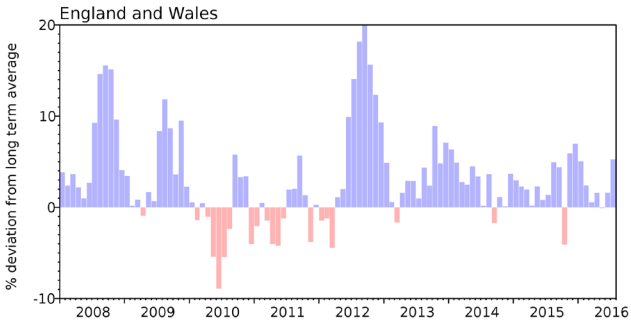


Groundwater levels - July 2016

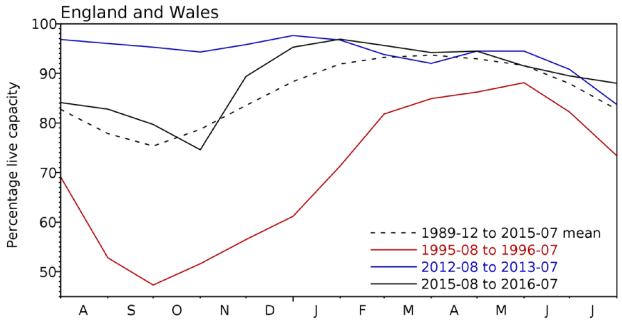
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 May	2016 Jun	2016 Jul	Jul Anom.	Min Jul	Year* of min	2015 Jul	Diff 16-15
North West	N Command Zone	•	124929	74	65	64	1	23	1984	70	-6
	Vyrnwy		55146	96	95	94	18	45	1984	86	8
Northumbrian	Teesdale	•	87936	80	74	76	1	45	1989	82	-6
	Kielder		(199175)	90	90	92	2	66	1989	95	-3
Severn-Trent	Clywedog		44922	100	100	98	13	50	1976	94	4
	Derwent Valley	•	39525	95	91	88	15	43	1996	79	9
Yorkshire	Washburn	•	22035	84	77	69	-5	50	1995	69	0
	Bradford Supply	•	41407	82	76	73	1	38	1995	73	1
Anglian	Grafham		(55490)	93	89	93	3	66	1997	93	-1
	Rutland		(116580)	94	95	93	8	74	1995	87	6
Thames	London	•	202828	97	98	91	4	73	1990	80	11
	Farmoor	•	13822	98	96	97	1	84	1990	99	-2
Southern	Bewl		28170	94	93	88	12	45	1990	74	15
	Ardingly		4685	100	100	93	8	65	2005	72	21
Wessex	Clatworthy		5364	79	76	63	-11	43	1992	67	-4
	Bristol	•	(38666)	94	89	79	3	53	1990	72	7
South West	Colliford		28540	96	90	84	6	47	1997	78	7
	Roadford		34500	89	90	86	8	46	1996	79	7
	Wimbleball		21320	90	80	72	-7	53	1992	76	-5
	Stithians		4967	91	81	73	3	39	1990	66	7
Welsh	Celyn & Brenig	•	131155	100	97	100	11	65	1989	92	8
	Brianne		62140	97	100	98	8	67	1995	97	1
	Big Five	•	69762	95	92	88	10	41	1989	77	11
	Elan Valley	•	99106	93	93	97	14	53	1976	86	11
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	94	86	86	3	51	1998	88	-2
	East Lothian	•	9374	99	98	98	9	72	1992	93	5
Scotland(W)	Loch Katrine	•	110326	87	76	81	6	53	2000	94	-13
	Daer		22412	84	78	84	3	56	2013	97	-13
	Loch Thom	•	10798	100	100	100	15	59	2000	100	0
Northern Ireland	Total+	•	56800	86	79	80	2	54	1995	86	-6
	Silent Valley	•	20634	87	79	77	3	42	2000	87	-10

( ) 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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