Hydrological Summary

for the United Kingdom

September 2015

General

September was a dry and cool month; it was the coldest September since 1993 in the Central England Temperature series, and despite some unsettled spells there were periods of fine sunny weather. The UK registered just over half of the long-term average rainfall for September. All regions of the UK were drier than average, many substantially so, with the exception of Southern England. Scotland was particularly dry; in a series from 1910 only five Septembers have been drier. Most catchments in northern Britain registered normal to below normal flows, with notably low flows for the time of year in much of western Scotland and northern England. Further south, flows in many catchments remained above normal. Below average rainfall meant that soil moisture deficits generally did not decline substantially in September. This allowed the continuation of seasonal recessions in most boreholes and groundwater levels generally remained in the normal range or just below. Stocks fell in the majority of index reservoirs but generally were above average for the time of year, notably so in some impoundments in the west of the UK. The onset of groundwater recharge will be sensitive to late autumn rainfall, but overall reservoir stocks for England and Wales remain above average and as such the water resources situation remains healthy entering the late autumn, a time when aquifer recharge typically commences.

Rainfall

High pressure brought dry and settled conditions to the UK at the beginning and end of September. These periods were separated by an unsettled spell mid-month when Atlantic low pressure systems drove frontal rainfall eastwards across the country. Hawarden (north Wales) recorded 40mm of rainfall on the 2nd and the same event caused surface water flooding and transport disruption on the Wirral. Further notable daily rainfall totals were recorded during the unsettled spell mid-month: 53mm at Milford Haven (Pembrokeshire) on the 14th; 48mm at Loftus (near Middlesbrough) on the 15th; and 37mm at the Isle of Portland (Dorset) on the 16th. For the UK, September was dry with 56% of the long-term average rainfall. Deficiencies were larger still in the north and west, with Northern Ireland and Scotland receiving 50% and 38% of the long-term average, respectively. Large parts of central and western Scotland were particularly dry, receiving less than 30% of the September average. The Clyde region registered its fourth driest September in a series from 1910, though September 2014 was drier. In contrast, above average rainfall was largely confined to Kent and parts of East Anglia. For the summer half-year (April-September), large areas of the Severn-Trent and Thames regions registered below average rainfall. Rainfall totals generally were above average along the south coast, in Northern Ireland and parts of central Scotland.

River flows

Due to the low rainfall, September was generally lacking in seasonally high flows and there were few reported instances of fluvial flooding. On the 2nd, watercourses in the Moreton area of the Wirral burst their banks, causing transport disruption and the evacuation of 100 properties. Despite this, many rivers in the north-west of the UK were in recession during most of September; by month-end, flows on the Clyde approached seasonal minima. In the north-east of the UK, river flows generally remained near or below average throughout the month, with the exception of some catchments in North Yorkshire (e.g. the Dove) where moderately high flows were recorded mid-month. In the south, flows were seasonally high at the start of September and decreased through the first fortnight with some moderately high flows thereafter. For September overall, average flows were below normal across most of northern Britain, with the exceptions of Yorkshire and north-east Scotland. A number of rivers registered around a quarter of the average flow. In southern Britain the picture was more mixed, reflecting the variation in catchment properties. In the southern coastal counties, September average flows were above normal, predominantly due to wet conditions in August. A new maximum average flow for September was established for the Great Stour, a catchment which drains one of the few areas which registered above average rainfall in both August and September. Outflows from the UK for September were below average overall, influenced by recessions in Scotland. For the summer half-year (April-September), river flows were below normal in a band from Wessex to the Humber estuary, and the Scottish Tyne registered half of the long-term average flow in response to rainfall deficiencies over the same period. Conversely, above normal river flows were mostly confined to Northern Ireland and some catchments draining the Scottish Highlands.

Groundwater

Soil moisture deficits remained similar to those at the end of August for most regions in England and Wales, but were closer to average. Consequently, the majority of the index boreholes continued their seasonal recessions in September. In the Chalk, levels were average or below, except at Ashton Farm where they were notably high following an increase in September. Increases were also observed at West Woodyates Manor, Compton House and Chilgrove House (all in Dorset or the western South Downs). Levels in the Jurassic limestones were similar to, or below, those recorded recorded at the end of August. In the Magnesian Limestone, levels fell but remained in the normal range. In the slower responding Permo-Triassic sandstones, levels fell at all of the index boreholes. With the exceptions of Llanfair DC and Skirwith, levels were normal or above. A new period of record month-end maximum level was recorded at Newbridge (for the fourth consecutive month) and levels remained notably high at Nuttalls Farm. In the fast responding Carboniferous Limestone, levels fell and remained in the normal range at Alstonefield. In south Wales, levels rose at Greenfield Garage and fell at Pant y Lladron, but levels remained above normal in both boreholes.

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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.

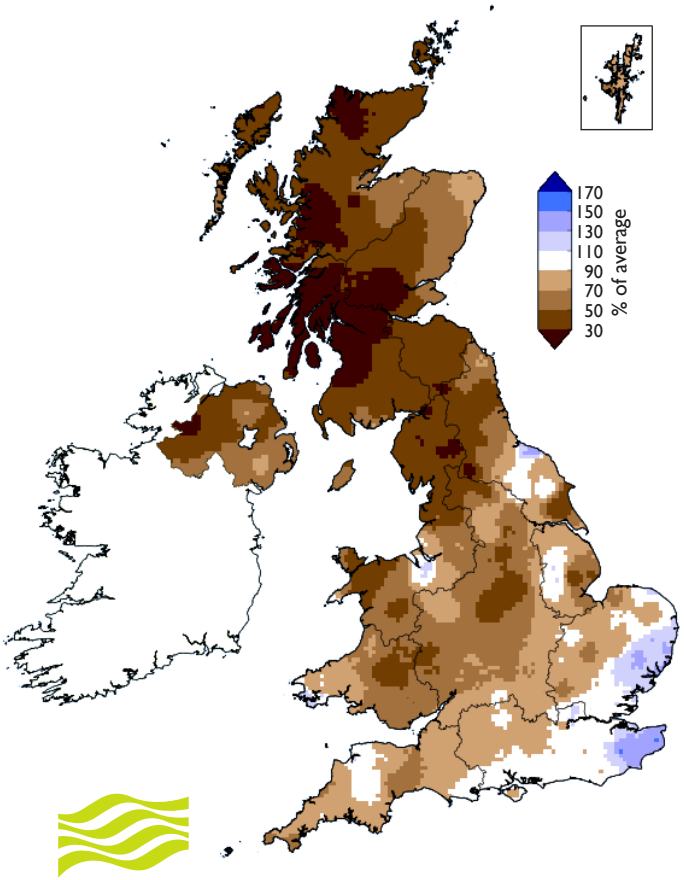
Area	Rainfall	Sept 2015	Jul15 – Sep15	RP	Apr15 – Sep15	RP	Jan15 – Sep15	RP	Aug14 – Sep15	RP
United Kingdom	mm	**54**	271		482		810		1225	
	%	**56**	111	2-5	109	2-5	110	2-5	114	8-12
England	mm	**53**	233		372		565		847	
	%	**74**	123	2-5	103	2-5	100	2-5	104	2-5
Scotland	mm	**51**	318		638		1183		1790	
	%	**38**	100	2-5	116	2-5	123	15-25	125	80-120
Wales	mm	**75**	324		551		924		1413	
	%	**64**	111	2-5	104	2-5	102	2-5	104	2-5
Northern Ireland	mm	**47**	281		517		824		1281	
	%	**50**	109	2-5	110	2-5	107	2-5	116	15-25
England & Wales	mm	**56**	245		397		615		926	
	%	**72**	121	2-5	103	2-5	100	2-5	104	2-5
North West	mm	**49**	275		506		849		1273	
	%	**48**	99	2-5	104	2-5	107	2-5	109	2-5
Northumbrian	mm	**38**	234		397		595		851	
	%	**54**	118	2-5	106	2-5	102	2-5	103	2-5
Severn-Trent	mm	**42**	184		322		488		745	
	%	**63**	103	2-5	92	2-5	91	2-5	99	2-5
Yorkshire	mm	**47**	229		388		563		811	
	%	**69**	122	2-5	107	2-5	99	2-5	100	2-5
Anglian	mm	**50**	193		293		406		618	
	%	**91**	127	2-5	99	2-5	94	2-5	103	2-5
Thames	mm	**55**	205		311		462		706	
	%	**87**	127	2-5	97	2-5	94	2-5	102	2-5
Southern	mm	**77**	259		370		571		899	
	%	**107**	153	5-10	113	2-5	110	2-5	117	2-5
Wessex	mm	**63**	266		393		596		889	
	%	**82**	140	5-10	109	2-5	101	2-5	104	2-5
South West	mm	**82**	365		532		850		1258	
	%	**83**	150	5-10	117	2-5	106	2-5	105	2-5
Welsh	mm	**73**	317		535		889		1356	
	%	**64**	112	2-5	104	2-5	101	2-5	103	2-5
Highland	mm	**55**	323		703		1409		2129	
	%	**35**	89	2-5	113	2-5	124	10-20	124	30-50
North East	mm	**54**	287		498		729		1125	
	%	**61**	128	2-5	119	2-5	111	2-5	119	5-10
Tay	mm	**46**	321		594		1026		1576	
	%	**41**	119	2-5	124	2-5	119	5-10	125	25-40
Forth	mm	**34**	275		526		931		1334	
	%	**32**	107	2-5	115	2-5	120	5-10	118	10-20
Tweed	mm	**35**	241		445		763		1172	
	%	**44**	110	2-5	108	2-5	115	2-5	123	10-15
Solway	mm	**53**	331		620		1143		1781	
	%	**42**	104	2-5	112	2-5	121	10-20	127	60-90
Clyde	mm	**48**	375		771		1468		2197	
	%	**29**	94	2-5	118	2-5	127	20-30	127	80-120

% = 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 2015 (inclusive) are provisional.

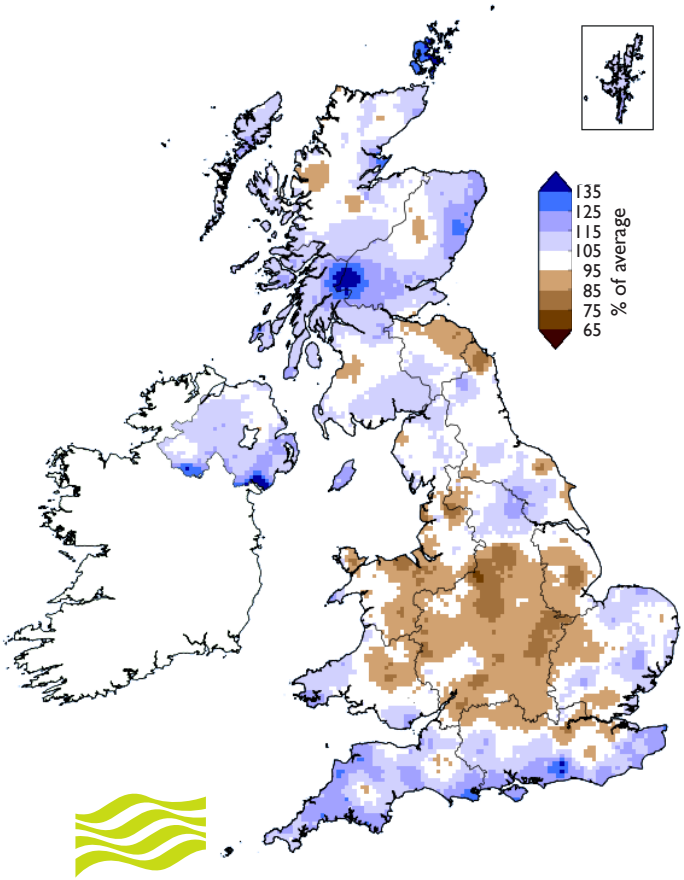
Rainfall . . . Rainfall . . .

September 2015 rainfall as % of 1971-2000 average



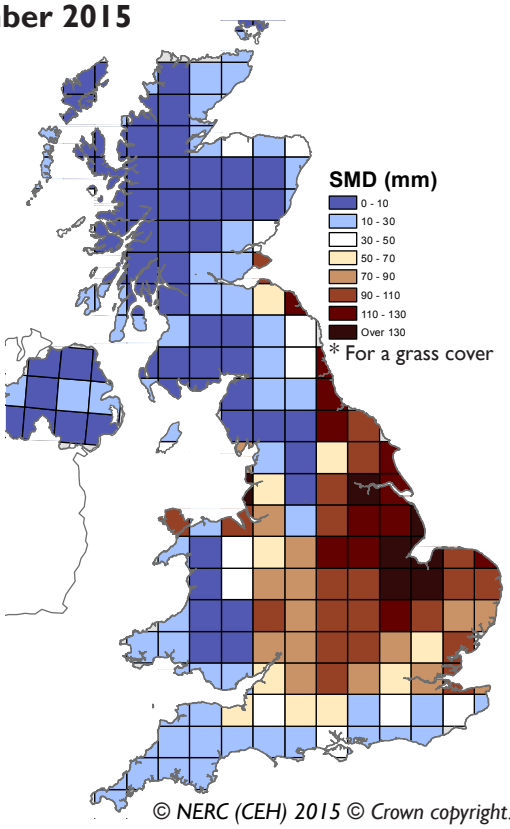
Met Office

April 2015 - September 2015 rainfall as % of 1971-2000 average



Met Office

MORECS Soil Moisture Deficits* September 2015



Met Office

Met Office 3-month outlook Updated: September 2015

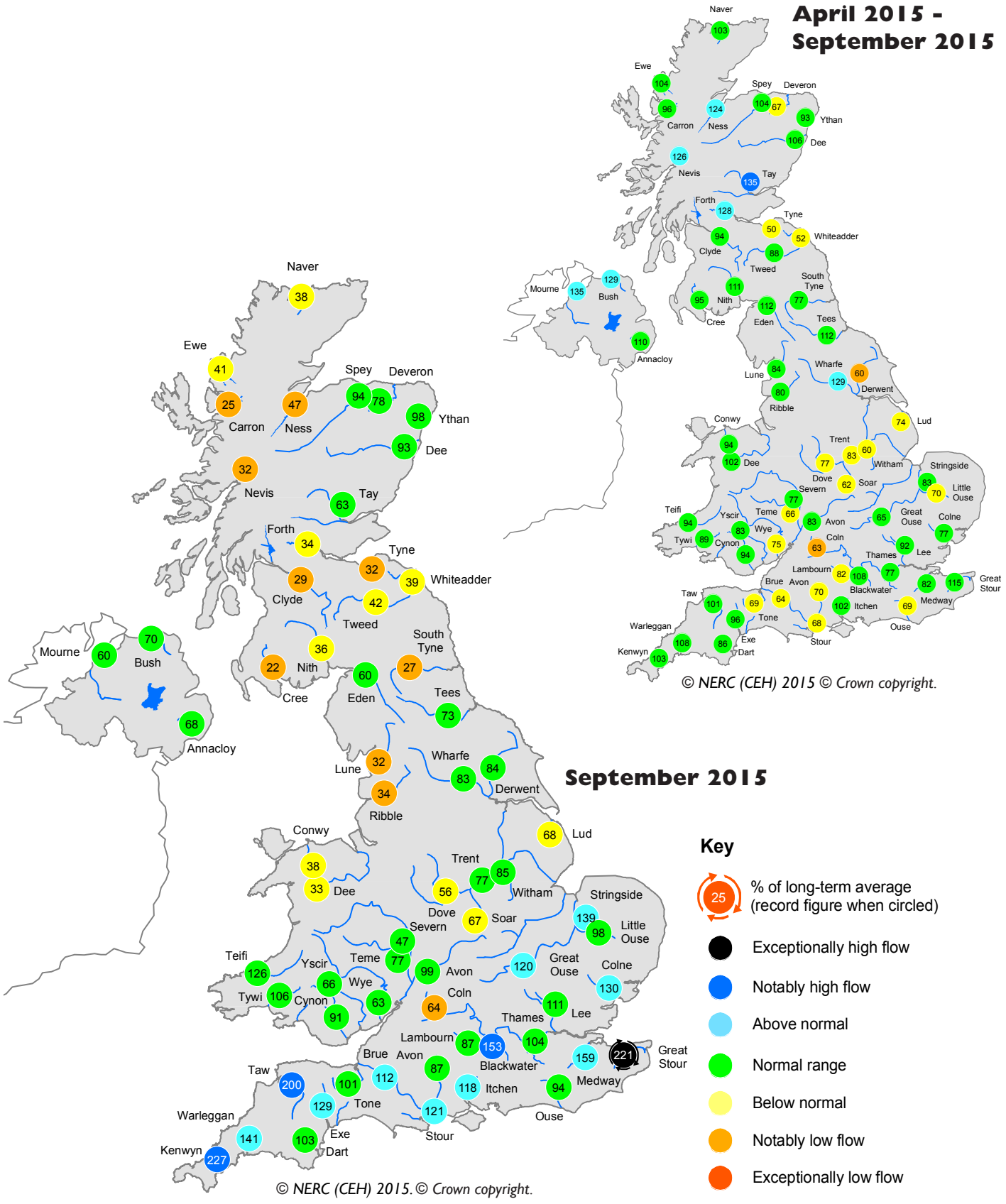
For October-November-December precipitation is more likely to be above-average than below-average.

The probability that UK precipitation for October-November-December will fall into the driest of our five categories is 15% and the probability that it will fall into the wettest of our five categories is 35% (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.

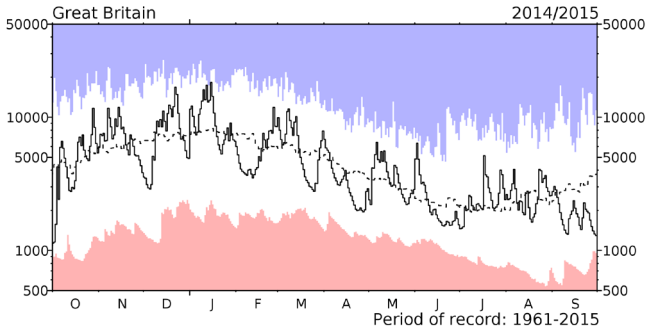
River flow . . . River flow . . .

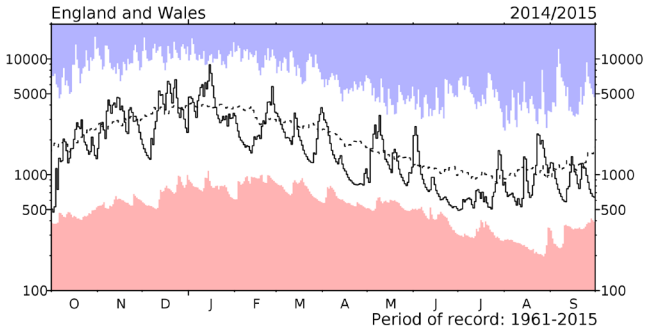


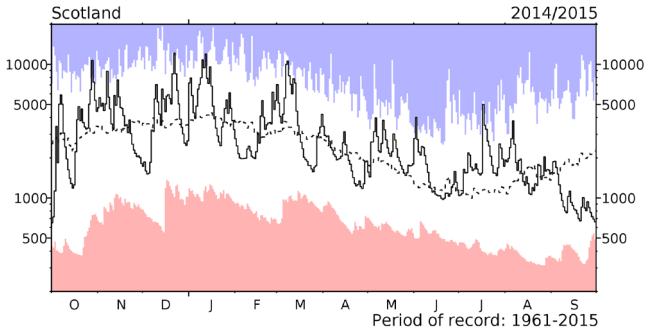
River flows

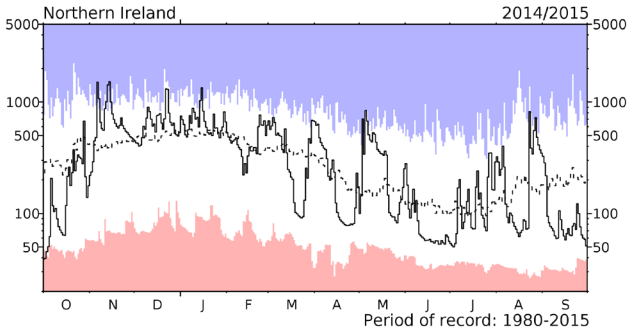
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

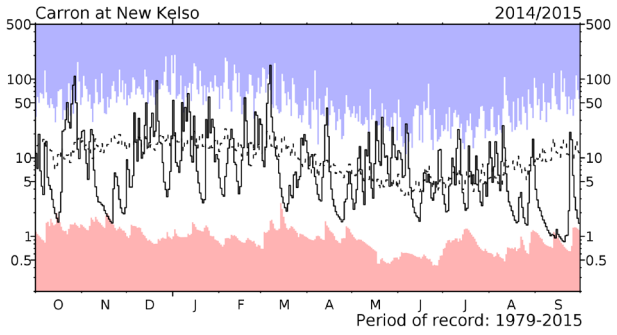
River flow . . . River flow . . .

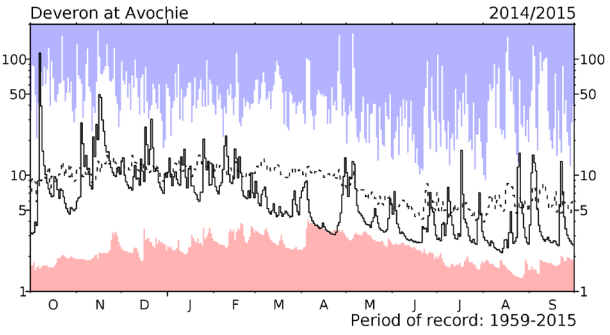


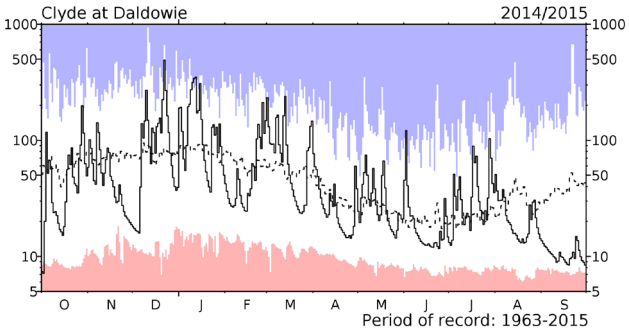


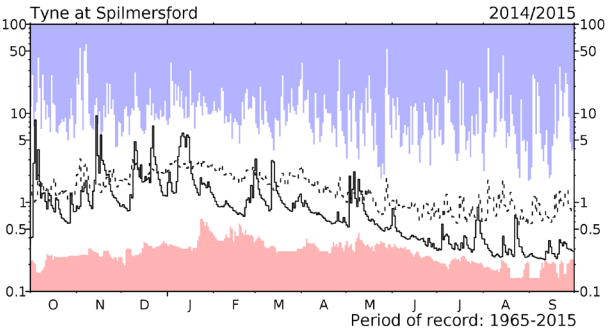


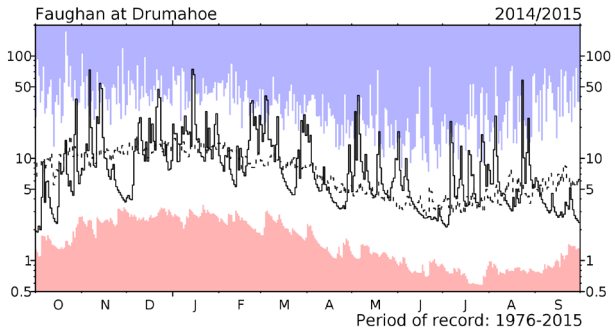


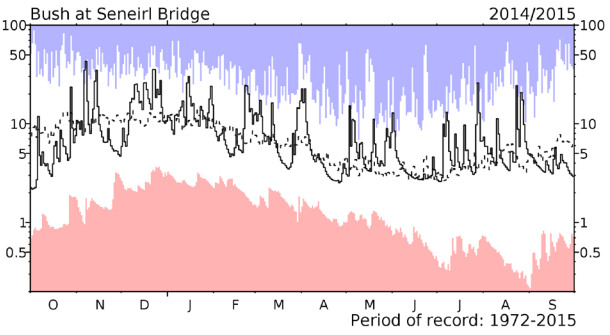








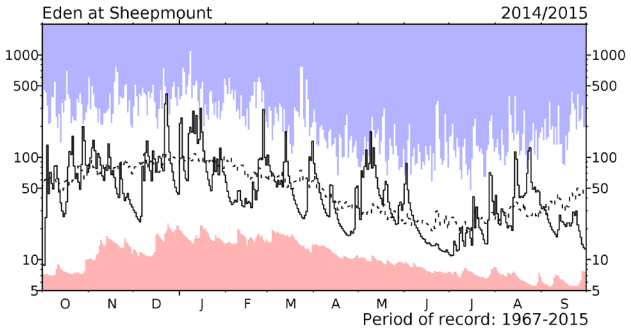


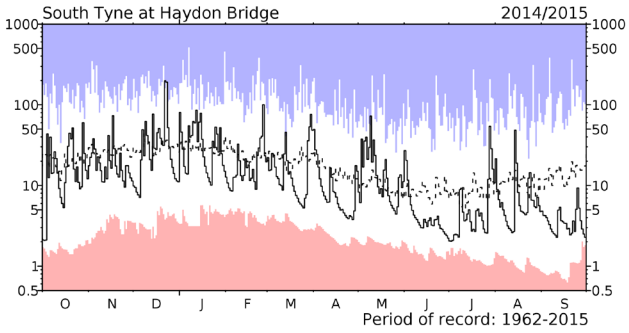


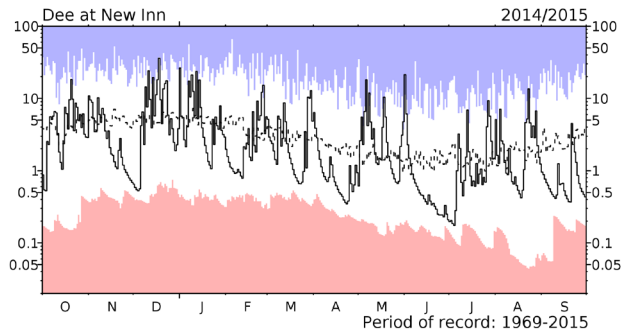
River flow hydrographs

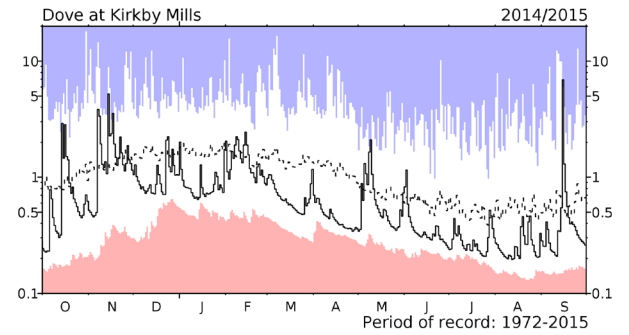
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to October 2014 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

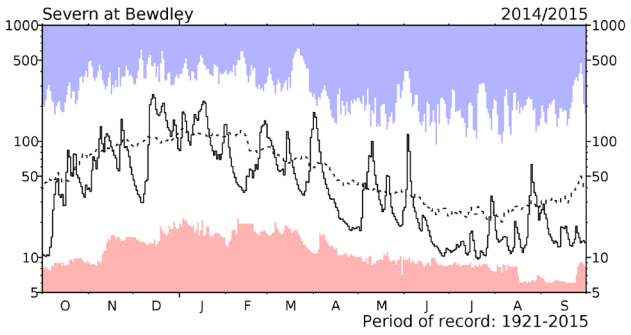
River flow . . . River flow . . .

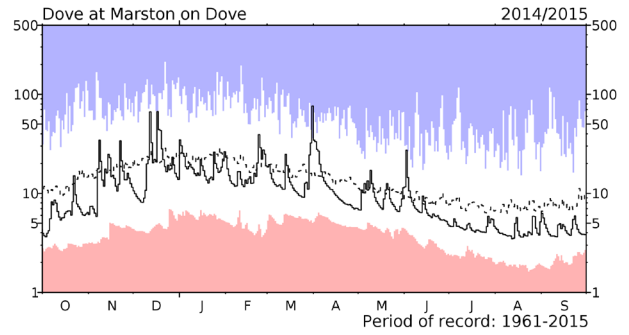


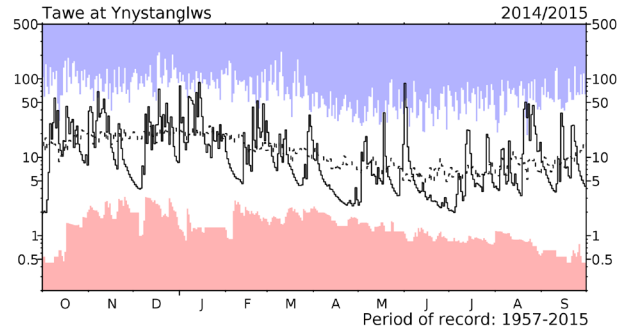


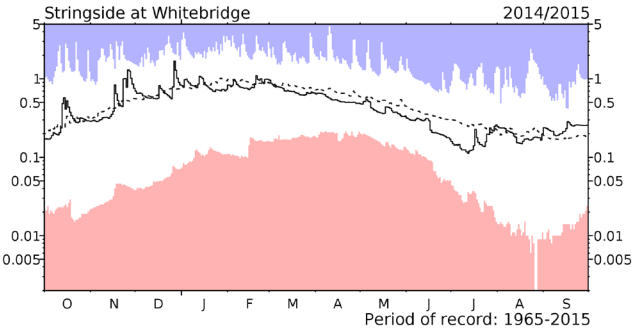


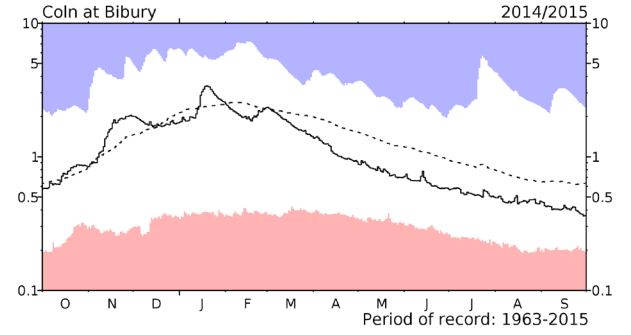


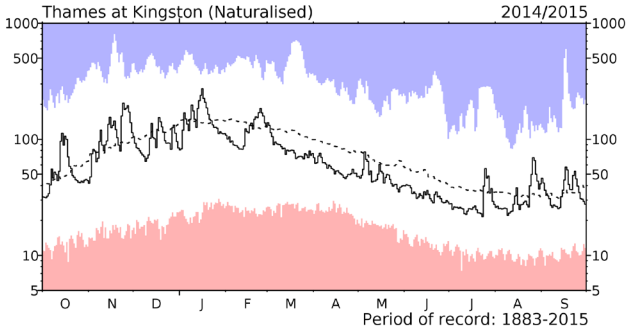


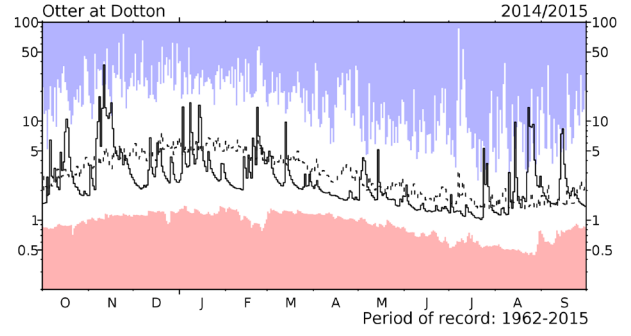


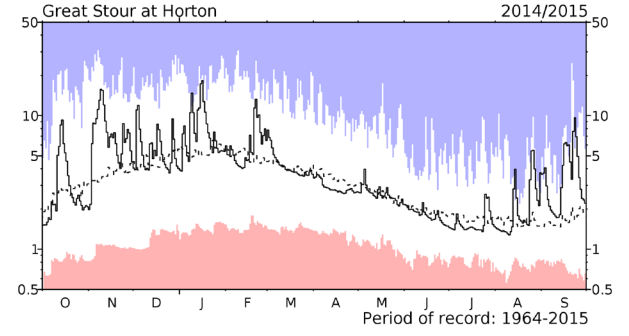




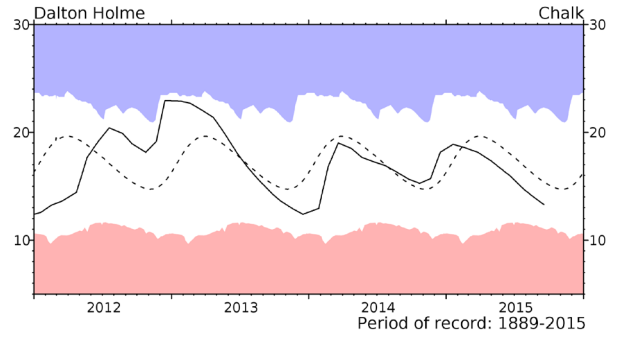


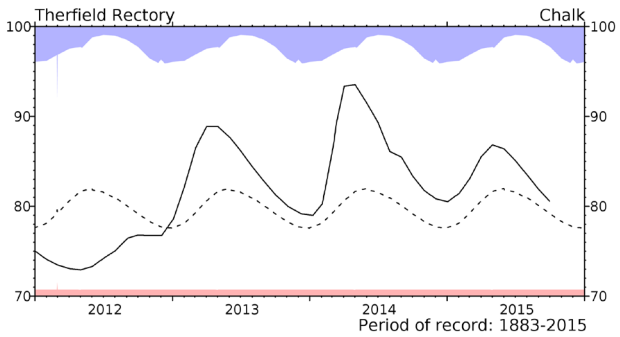


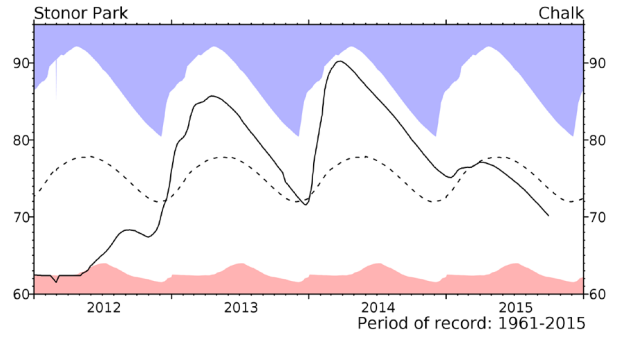


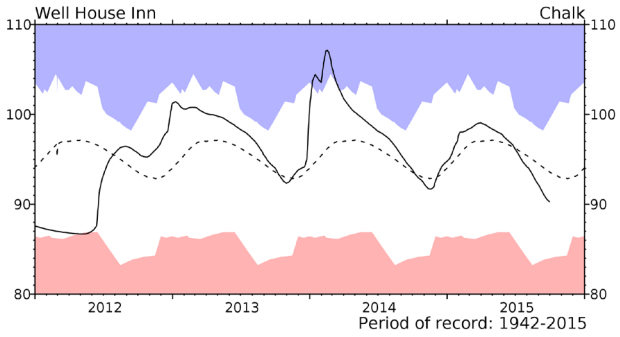


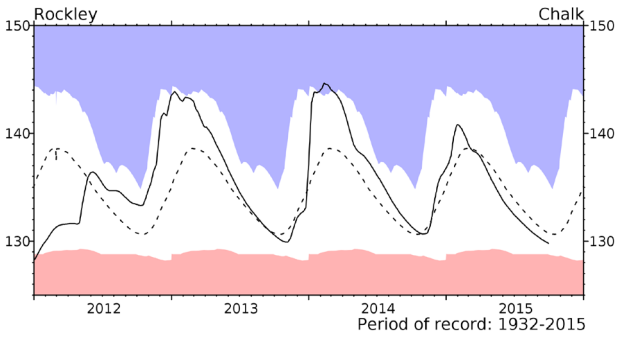
Groundwater…Groundwater

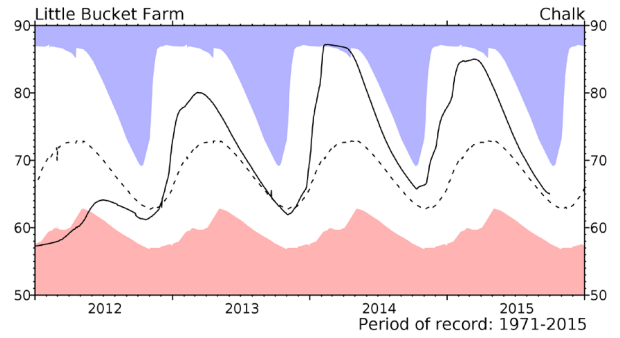


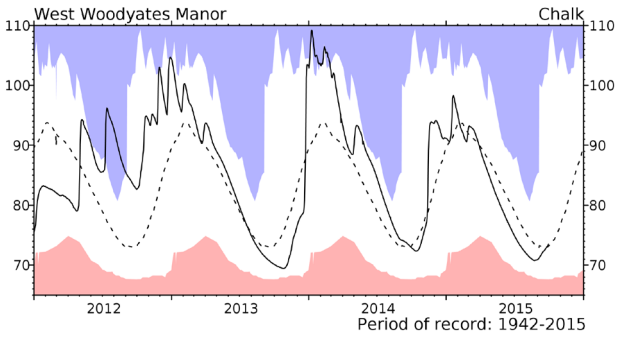


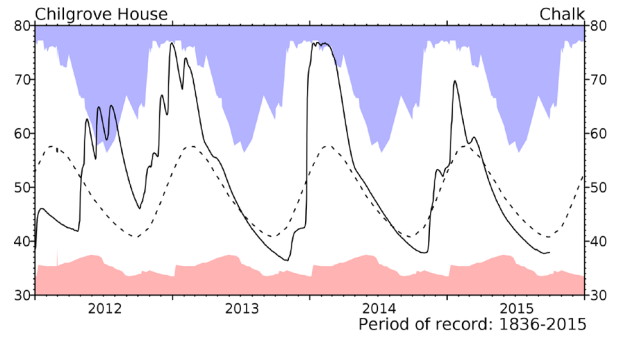


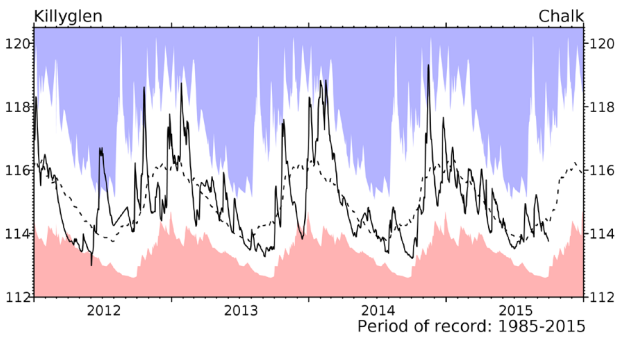


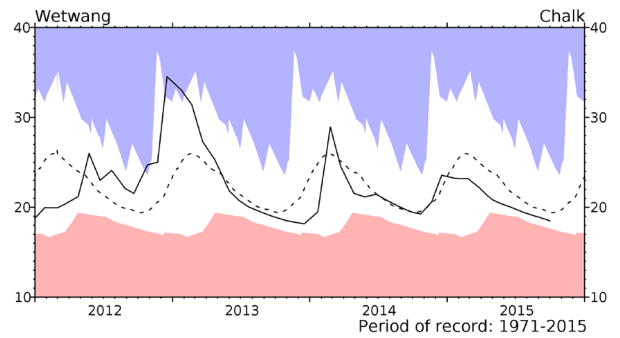






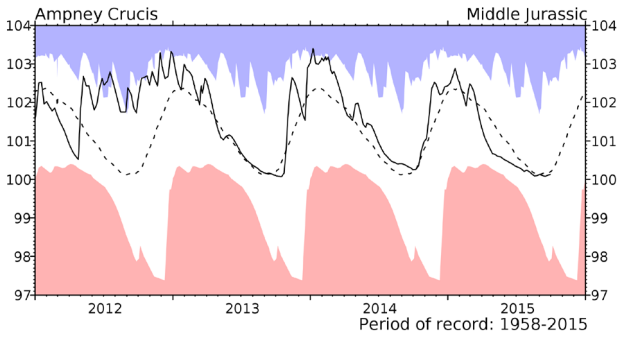


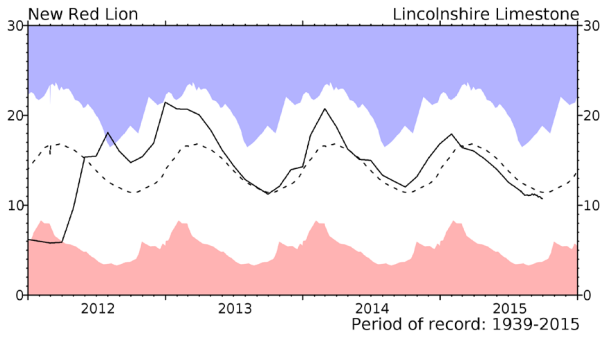


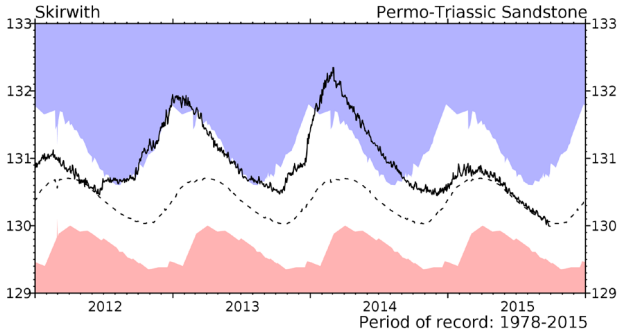


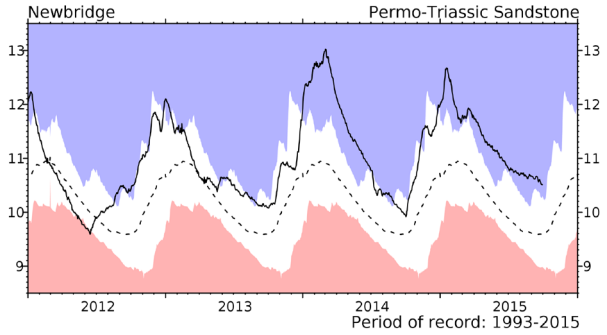
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

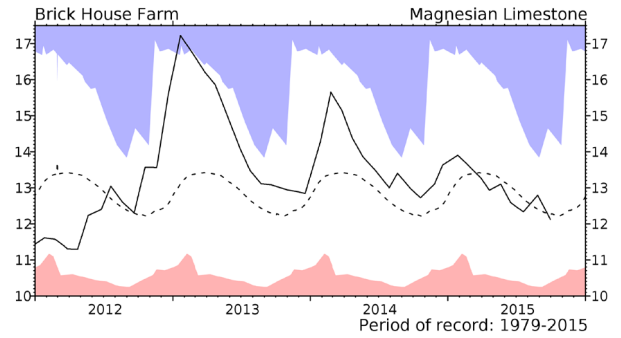
Groundwater ... Groundwater

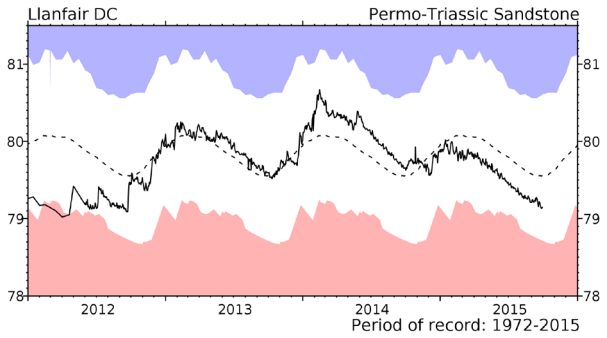


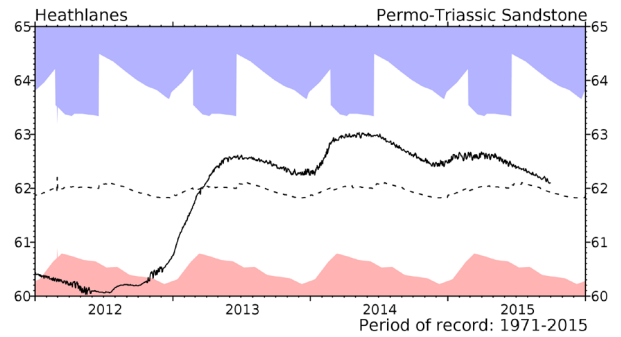


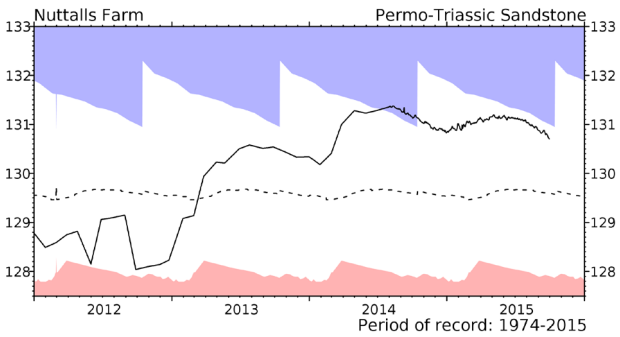


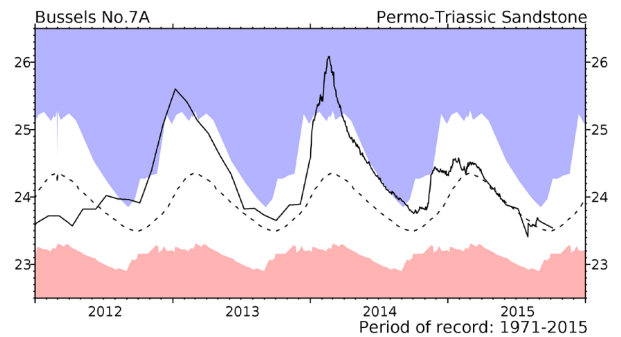


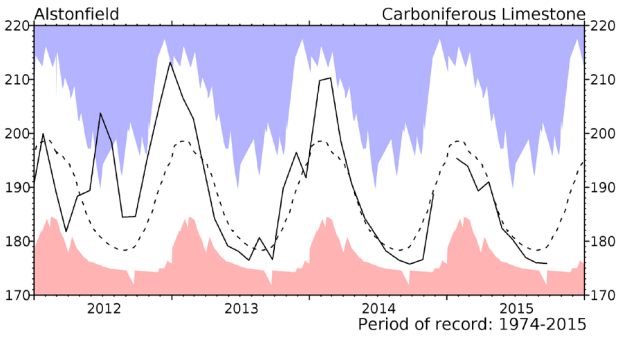








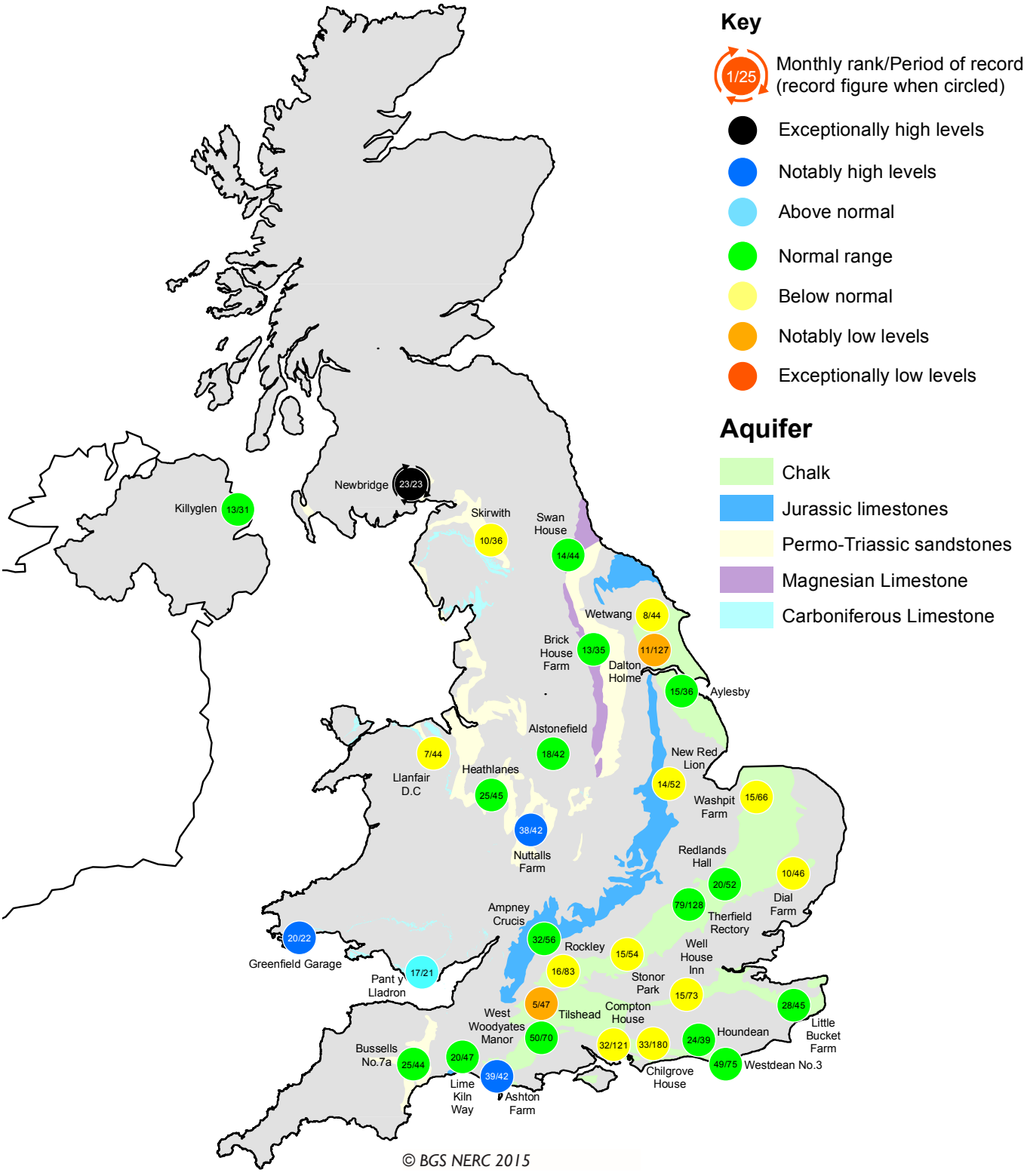




Groundwater levels September / October 2015

Borehole	Level	Date	Sep av.	Borehole	Level	Date	Sep av.	Borehole	Level	Date	Sep av.
Dalton Holme	13.28	18/09	15.45	Chilgrove House	37.95	30/09	40.74	Brick House Farm	12.12	30/09	12.37
Therfield Rectory	80.55	30/09	80.02	Killyglen (NI)	113.76	30/09	114.35	Llanfair DC	79.15	30/09	79.55
Stonor Park	70.16	30/09	74.42	Wetwang	18.46	01/10	19.72	Heathlanes	62.10	30/09	61.96
Tilshead	79.50	30/09	81.31	Ampney Crucis	100.13	30/09	100.17	Nuttalls Farm	130.70	30/09	129.64
Rockley	129.79	30/09	131.10	New Red Lion	10.70	30/09	11.67	Bussells No.7a	23.54	06/10	23.53
Well House Inn	90.26	30/09	93.93	Skirwith	129.99	30/09	130.16	Alstonefield	175.83	23/09	178.53
West Woodyates	73.50	30/09	73.18	Newbridge	10.51	30/09	9.68				

Levels in metres above Ordnance Datum

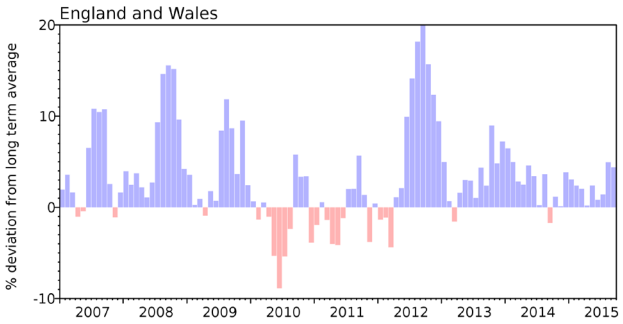


Groundwater levels - September 2015

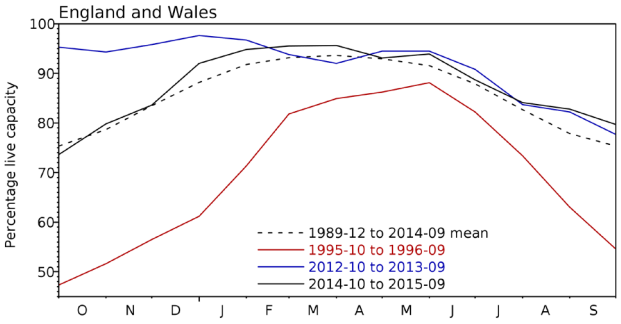
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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)	2015 Jul	2015 Aug	2015 Sep	Sep Anom.	Min Sep	Year* of min	2014 Sep	Diff 15-14
North West	N Command Zone	•	124929	70	71	58	0	13	1995	49	9
	Vyrnwy		55146	86	87	78	10	26	1995	60	18
Northumbrian	Teesdale	•	87936	82	81	78	9	31	1995	74	5
	Kielder		(199175)	95	92	85	0	59	1989	83	2
Severn-Trent	Clywedog		44922	94	91	90	19	24	1989	79	11
	Derwent Valley	•	39525	79	66	57	-6	24	1989	54	3
Yorkshire	Washburn	•	22035	69	69	67	1	24	1995	54	13
	Bradford Supply	•	41407	73	72	70	3	15	1995	61	9
Anglian	Grafham		(55490)	93	94	96	12	46	1997	79	17
	Rutland		(116580)	87	84	83	5	61	1995	87	-4
Thames	London	•	202828	80	80	82	5	53	1997	87	-4
	Farmoor	•	13822	99	99	98	8	54	2003	88	10
Southern	Bewl		28170	74	68	64	1	32	1990	70	-6
	Ardingly		4685	72	62	59	-7	32	2003	67	-8
Wessex	Clatworthy		5364	67	67	69	12	25	2003	61	8
	Bristol	•	(38666)	72	71	71	8	31	1990	77	-6
South West	Colliford		28540	78	77	77	8	38	2006	71	6
	Roadford		34500	79	77	79	9	26	1995	74	5
	Wimbleball		21320	76	72	70	5	30	1995	66	4
	Stithians		4967	66	68	67	10	22	1990	54	13
Welsh	Celyn & Brenig	•	131155	92	90	86	5	39	1989	65	21
	Brianne		62140	97	100	100	14	48	1995	84	16
	Big Five	•	69762	77	81	84	15	19	1995	68	16
	Elan Valley	•	99106	86	85	79	4	33	1976	73	6
Scotland(E)	Edinburgh/Mid-Lothian	•	97639	88	85	74	-4	43	1998	66	8
	East Lothian	•	10206	93	94	89	7	52	1989	92	-3
Scotland(W)	Loch Katrine	•	111363	94	91	81	8	43	1995	55	26
	Daer		22412	97	92	81	4	32	1995	72	9
	Loch Thom	•	11840	100	100	100	19	56	1995	73	27
Northern Ireland	Total+	•	56800	86	92	88	16	29	1995	73	15
	Silent Valley	•	20634	87	97	91	22	27	1995	72	19

( ) 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://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html

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