Hydrological Summary
for the United Kingdom

November 2015

General
November was notably mild and dull, and very wet and windy in some parts. It was the third warmest November (in a record from 1910) for the UK and the dullest in a record from 1929. It was also a stormy month, with a series of vigorous depressions bringing heavy rainfall and strong winds that caused significant disruption. These included the first named storms ('Abigail', 'Barney' and 'Clodagh') to affect the British Isles, following a Met Office/Met Éireann pilot initiative to introduce official storm names. The persistent heavy rainfall in November effected a hydrological transformation in much of northern and western Britain. Many rivers that saw depressed October flows yielded exceptional flows in November, associated with floodplain inundations that caused disruption but generally modest impacts. However, the exceptional rainfall eliminated soil moisture deficits in northern and western Britain which, along with the high late autumn river flows, has made many areas highly vulnerable to flooding in early winter (as witnessed in the first week of December). With the highest rainfall occurring across the upland gathering grounds of many major impoundments, reservoir stocks increased steeply (the third largest monthly increase in UK total stocks, in a record from 1995) and were above average in all but a few southern reservoirs. With most rain-bearing systems making only a modest impression in the south, river flows and groundwater levels in the English Lowlands were moderately below average but mostly in the normal range. Overall, the water resources situation is favourable entering the winter.

Rainfall
After a dry first few days, November was mostly very unsettled, with a moist southwesterly flow bringing abundant rainfall. It was particularly unsettled from the 6th to the 20th, as a sequence of frontal systems – including 'Abigail' on 12th/13th and 'Barney' on 17th/18th, separated by a multi-fronted Hurricane remnant – brought gale-force winds and persistent heavy rainfall, particularly to north-western areas. Notable daily rainfall totals were registered (78.4mm fell at Alltdearg House, Skye on the 8th and 96.8mm fell at Capel Curig, north Wales, on the 10th) although the primary feature of the heavy rainfall was its persistence (the associated 72h rainfall total for Capel Curig was 199mm). A brief northerly interlude brought a cold snap on 21st-23rd - with snow across the country, including southern England, and at relatively low levels - before westerly airflows returned and the month ended unsettled. At the national scale, November was wet (154% of average for the UK) but saw considerable spatial variations. Much of northern England and Wales and southern Scotland received over twice the typical November rainfall; it was the second wettest November (after 2009) in a record from 1910 for North West England. Elsewhere, monthly rainfall totals were near-average, with moderately below average totals in southern England and north-east Scotland. Owing to the dry September/October, autumn rainfall totals were only moderately above average in northern England. Below average rainfall was received in southern England, northern Scotland and parts of Wales and the West Midlands. In the far north of Scotland, some areas received <70% of the autumn average; it was the driest autumn since 2003 in the Highland region.

River flows
In northern and western Britain, November was a transformative month in terms of river flows. In the first week of November, flows in responsive catchments were near- or below-average, continuing the trend of the early autumn. From around the 6th, river flows increased rapidly and thereafter flood alerts and warnings became prevalent and widespread. There were particular concerns on the 14th/15th, with severe flood warnings in north-west England prompting evacuations in Kendal and Egremont. Flooding caused limited property damage, but transport disruption was widespread in northern England, southern Scotland and Northern Ireland. November peak flow records were established for a number of catchments in northern England (including the Ribble, Lune and Wharfe, all with records extending back to 1960 or earlier) and Northern Ireland, while the South Tyne saw its third highest peak flow, for any month, in a record from 1962. For November as a whole, average river flows were above normal across most of northern Britain and exceptionally high in north Wales and northern England; the Wharfe registered its highest November average flow in a record from 1956. Across the English Lowlands and in northern Scotland, November average flows were mostly in the normal range, with low flows in a few catchments in north-east Scotland and on the Lud in Lincolnshire. River flow accumulations for the autumn were in the normal range or below across most of the UK, with above average flows in northern England reflecting the wet November. Moderate autumn runoff deficiencies can be seen for northern Scotland and parts of central and eastern England, and can be traced back to the spring in some catchments.

Groundwater
Soil moisture deficits (SMDs) were moderately above-average at the end of November in parts of central and eastern England, but were all but eliminated across the rest of the country. Correspondingly, groundwater levels in a majority of index boreholes started to rise, marking the onset of the recharge season. In the Chalk of southern England, levels generally increased, with a rise of over 10m recorded at Chilgrove House in the South Downs. However, levels stabilised or continued their seasonal recession across most of the Chilterns and eastern England where SMDs persisted. Levels were generally closer to the normal monthly range than they were in October, but at both Tilshead (Wiltshire) and Dalton Holme (Yorkshire) remained notably low. In the Jurassic and Magnesian limestones, levels increased and were in the normal range or above. In the slower responding Permo-Triassic sandstones, levels rose, except in the West Midlands where modest decreases were recorded at Heathlanes and Nuttalls Farm; levels were in the normal range or above, with notably high levels at Newbridge in south-west Scotland. Levels in the rapidly responding Carboniferous Limestones of south Wales and the Peak District increased, with a rise of nearly 25m recorded at Pant y Lladron.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

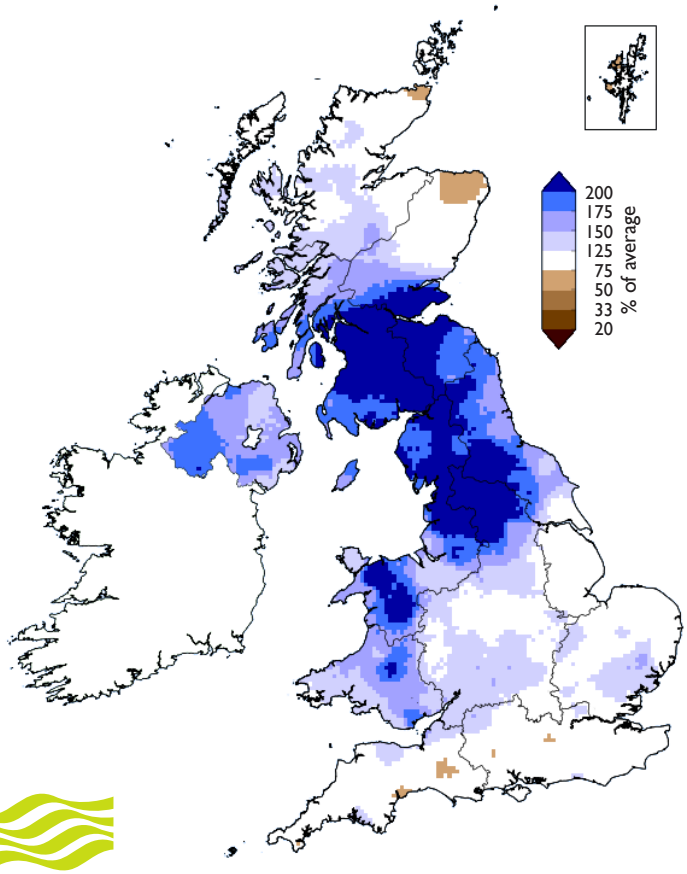
Area	Rainfall	Nov 2015	Sep15 – Nov15	RP	Jun15 – Nov15	RP	Mar15 – Nov15	RP	Dec14 – Nov15	RP
United Kingdom	mm	**176**	302		574		826		1192	
	%	**154**	93	2-5	106	2-5	108	2-5	110	5-10
England	mm	**119**	234		448		602		821	
	%	**145**	99	2-5	108	2-5	102	2-5	100	2-5
Scotland	mm	**245**	384		743		1144		1737	
	%	**154**	86	2-5	105	2-5	115	5-10	121	20-35
Wales	mm	**268**	419		724		993		1427	
	%	**175**	100	2-5	107	2-5	105	2-5	104	2-5
Northern Ireland	mm	**184**	302		579		864		1232	
	%	**167**	95	2-5	104	2-5	110	2-5	111	2-5
England & Wales	mm	**139**	260		486		656		905	
	%	**152**	100	2-5	108	2-5	103	2-5	101	2-5
North West	mm	**261**	386		657		955		1350	
	%	**209**	109	2-5	109	2-5	114	2-5	115	5-10
Northumbrian	mm	**165**	276		504		701		910	
	%	**198**	120	2-5	121	2-5	116	2-5	110	2-5
Severn-Trent	mm	**102**	197		378		531		717	
	%	**144**	94	2-5	99	2-5	96	2-5	95	2-5
Yorkshire	mm	**159**	290		507		691		882	
	%	**201**	130	5-10	125	2-5	118	2-5	109	2-5
Anglian	mm	**67**	164		332		433		571	
	%	**119**	97	2-5	104	2-5	95	2-5	95	2-5
Thames	mm	**75**	183		357		466		637	
	%	**113**	91	2-5	101	2-5	91	2-5	91	2-5
Southern	mm	**82**	219		431		536		768	
	%	**99**	90	2-5	109	2-5	96	2-5	99	2-5
Wessex	mm	**94**	219		455		581		803	
	%	**108**	87	2-5	108	2-5	96	2-5	93	2-5
South West	mm	**139**	300		635		809		1182	
	%	**105**	84	2-5	111	2-5	100	2-5	98	2-5
Welsh	mm	**249**	396		695		952		1359	
	%	**170**	99	2-5	107	2-5	104	2-5	103	2-5
Highland	mm	**253**	397		778		1275		2058	
	%	**125**	73	5-10	93	2-5	109	2-5	120	15-25
North East	mm	**103**	234		524		745		1008	
	%	**103**	81	2-5	107	2-5	107	2-5	106	2-5
Tay	mm	**202**	331		683		1016		1444	
	%	**154**	87	2-5	113	2-5	118	5-10	114	5-10
Forth	mm	**254**	349		659		971		1370	
	%	**222**	103	2-5	118	2-5	123	10-15	121	10-20
Tweed	mm	**210**	303		558		808		1137	
	%	**224**	112	2-5	118	2-5	119	2-5	119	5-10
Solway	mm	**320**	459		809		1181		1761	
	%	**215**	107	2-5	116	2-5	121	8-12	126	25-40
Clyde	mm	**358**	520		960		1469		2228	
	%	**191**	96	2-5	111	2-5	123	15-25	129	60-90

% = 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 2015 (inclusive) are provisional.

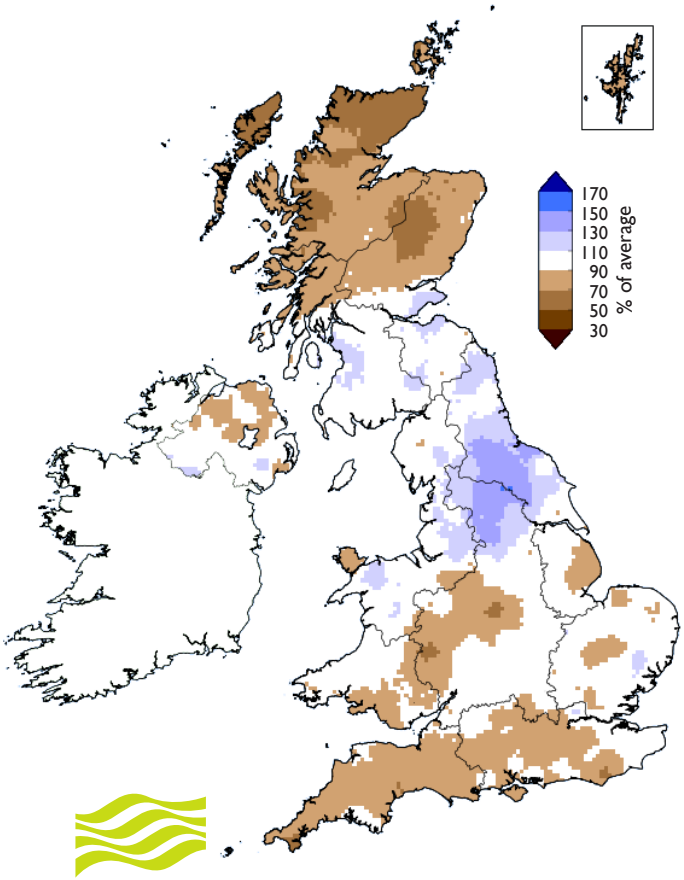
Rainfall . . . Rainfall . . .

November 2015 rainfall as % of 1971-2000 average



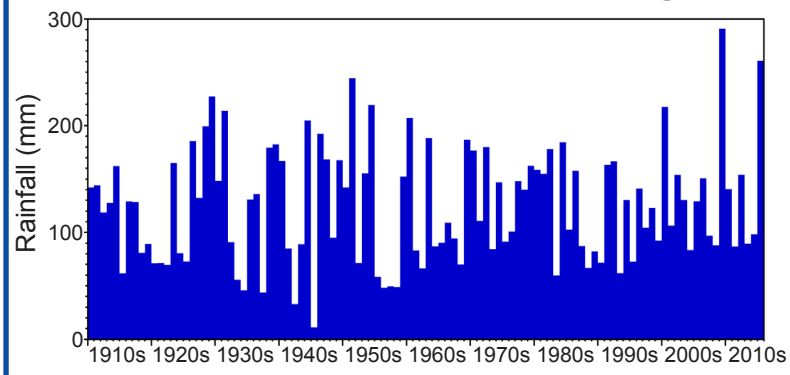
Met Office

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

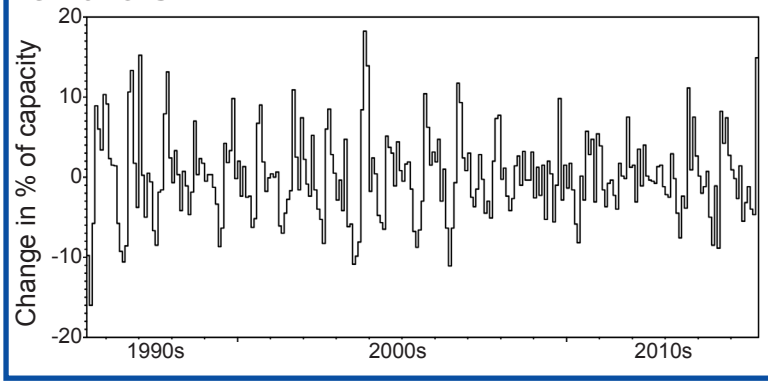


Met Office

November rainfall for North West England



Month to month change in reservoir stocks for the UK



Met Office

Met Office 3-month outlook Updated: November 2015

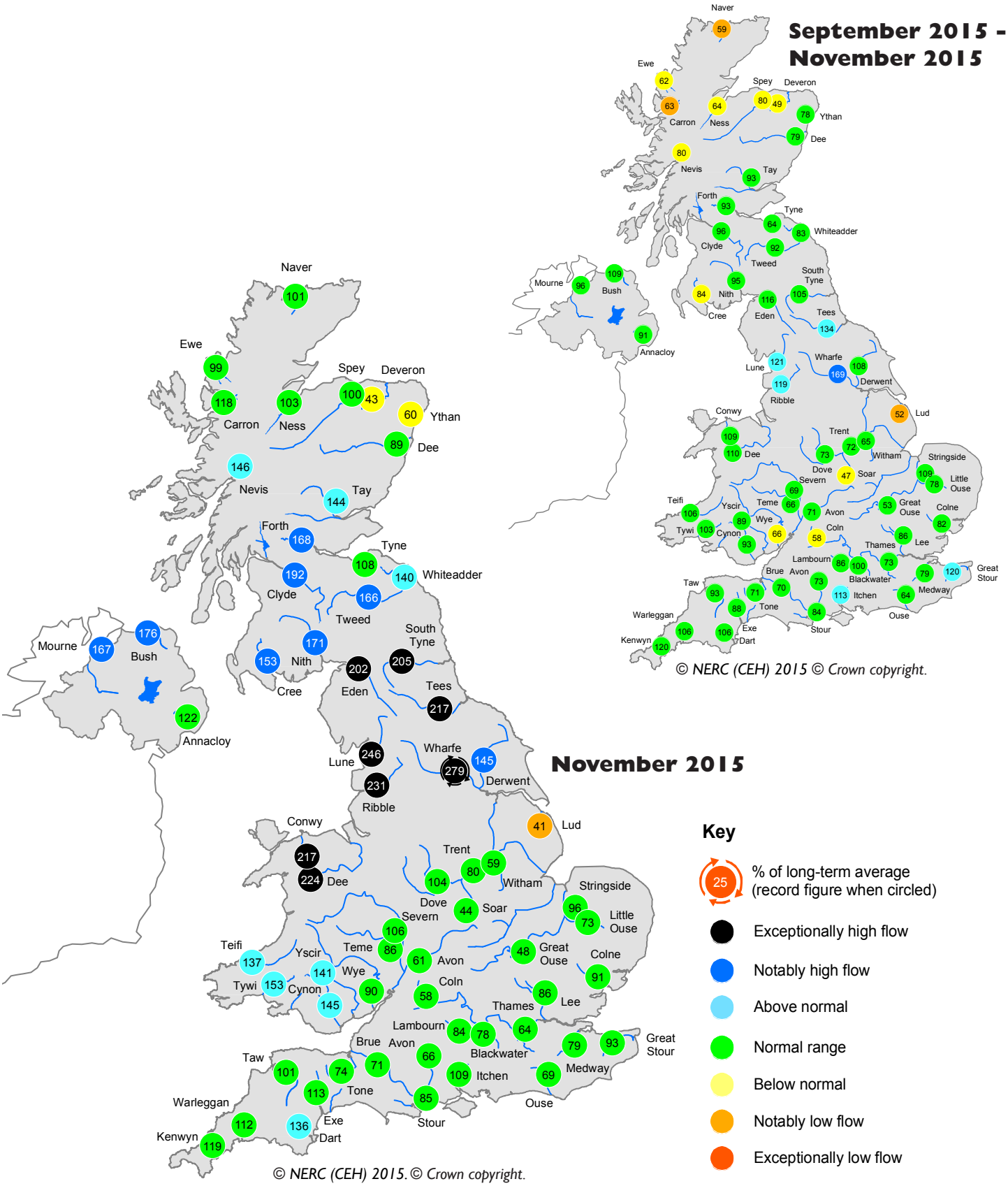
For December and December-January-February as a whole above-average precipitation is more probable than below-average.

The probability that UK-average precipitation for December-January-February will fall into the driest of our five categories is between 10% and 15% and the probability that it will fall into the wettest of our five categories is 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.

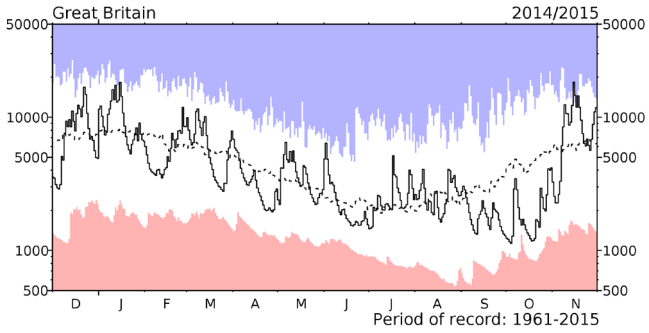
River flow . . . River flow . . .

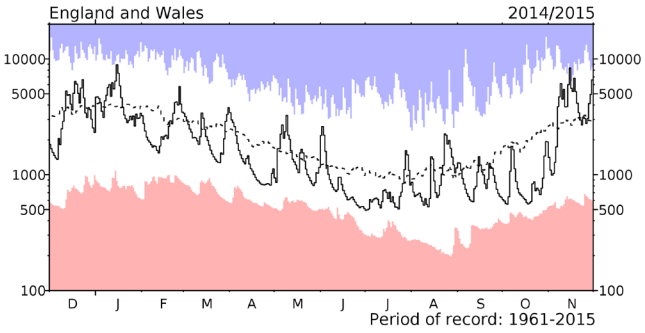


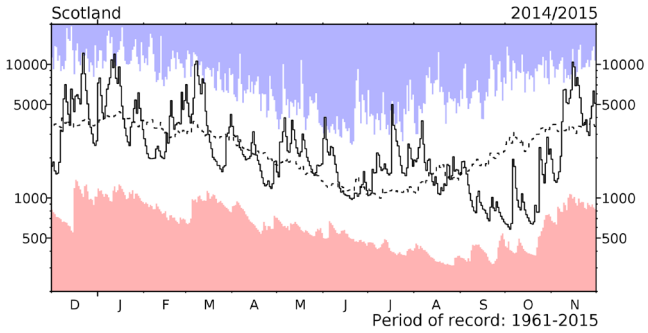
River flows

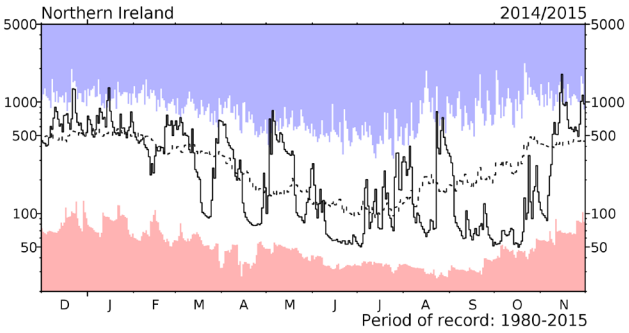
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

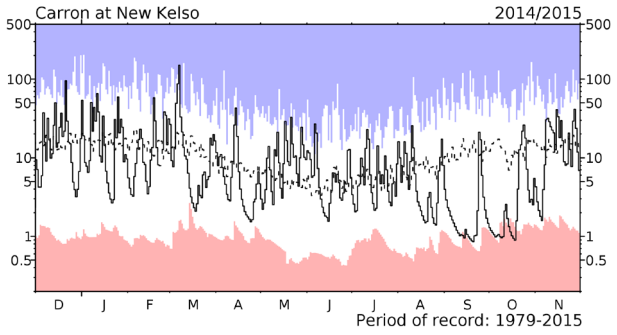
River flow . . . River flow . . .

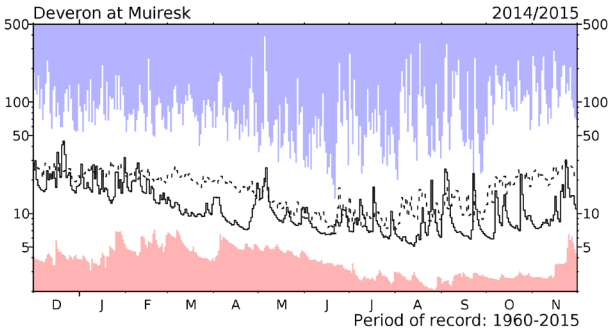


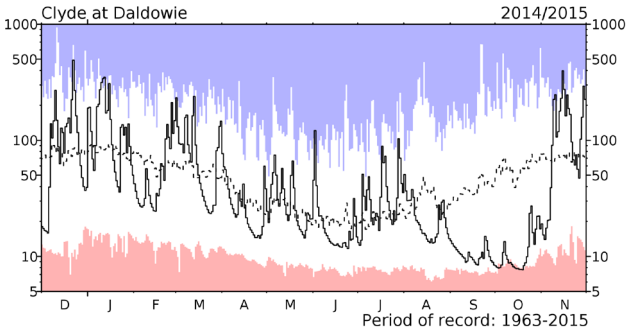


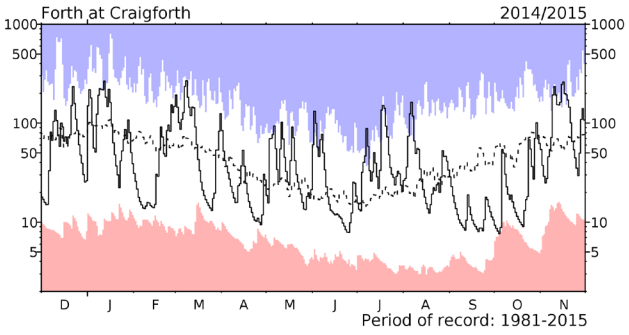


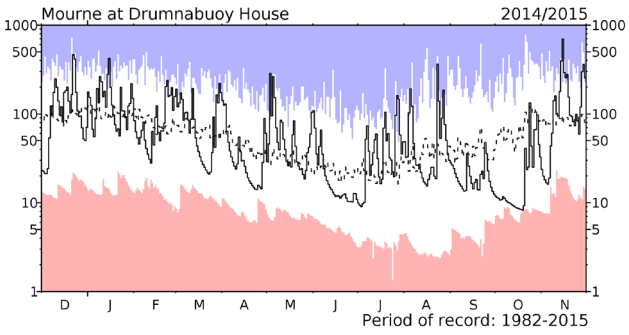


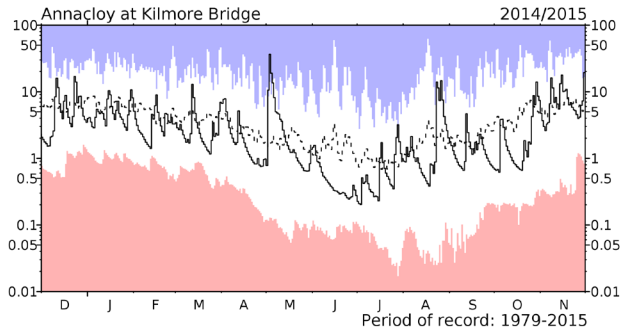








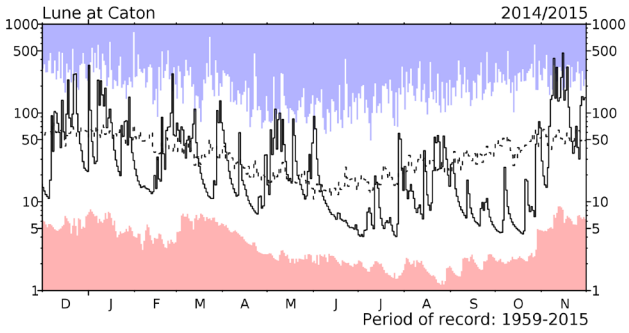


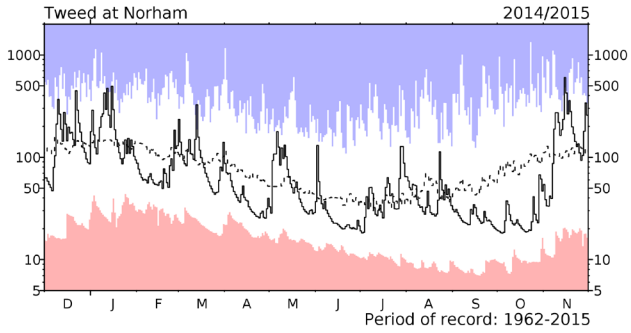


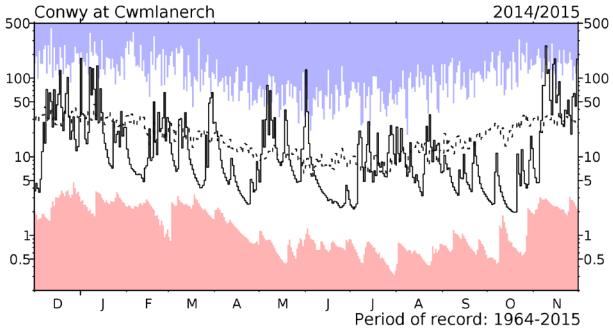
River flow hydrographs

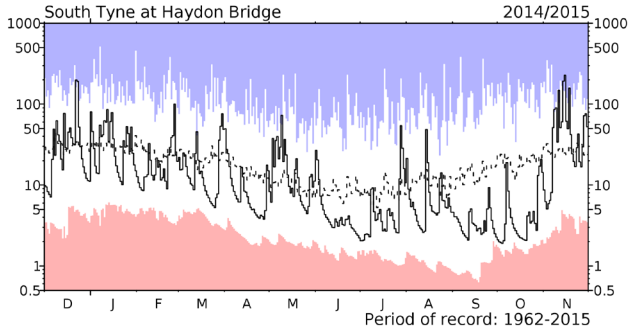
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to December 2014 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the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

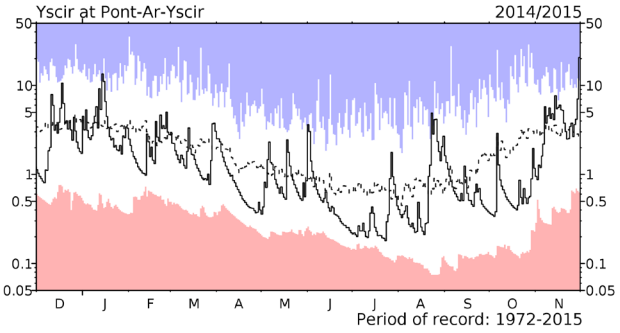
River flow . . . River flow . . .

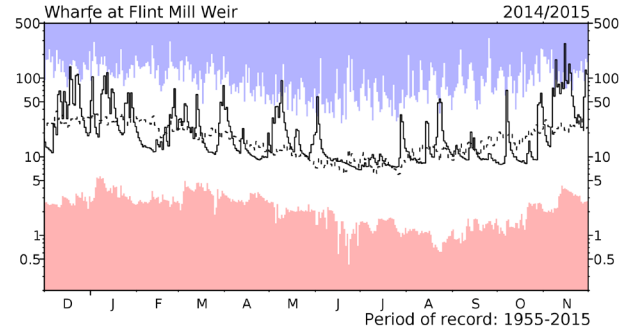


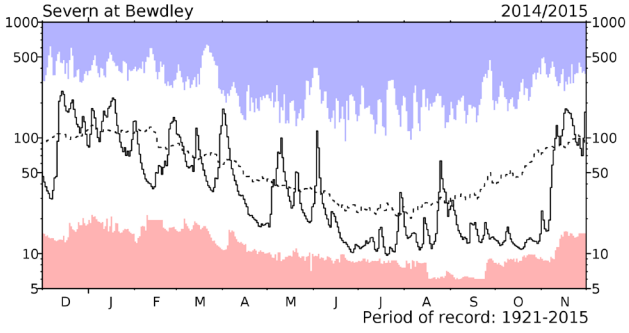


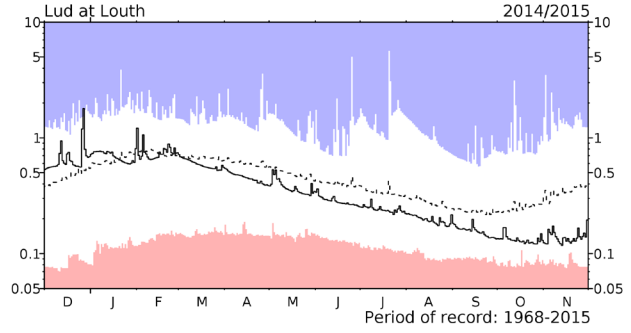


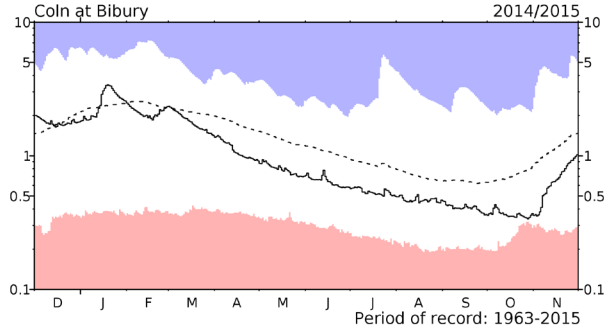


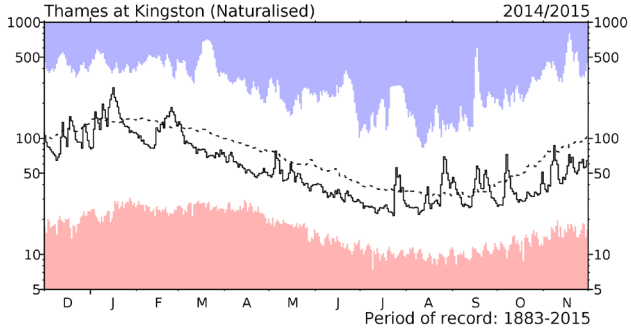


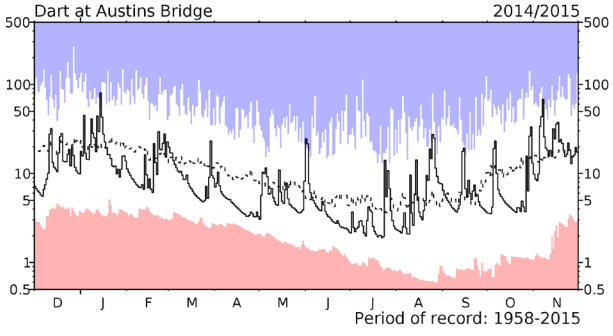


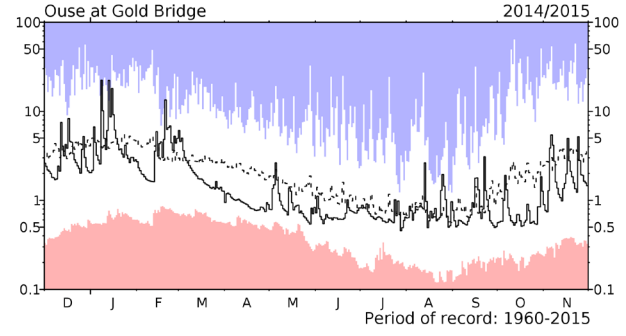




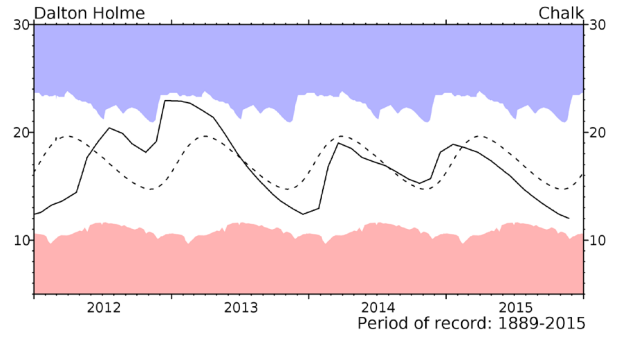


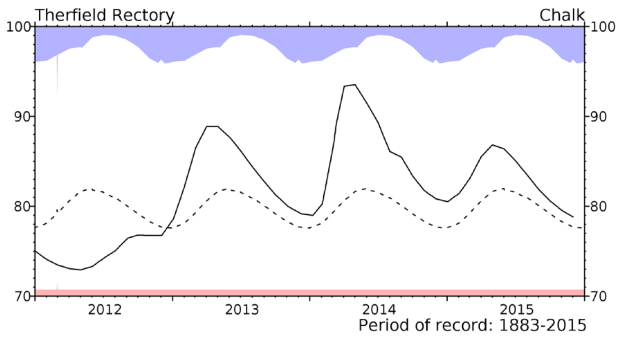


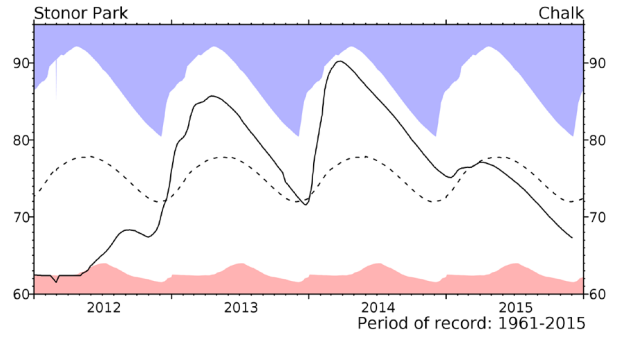


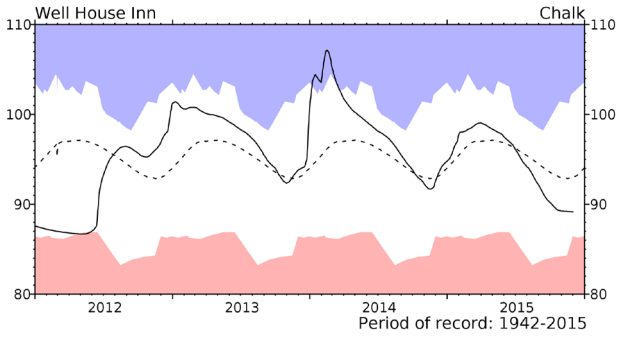


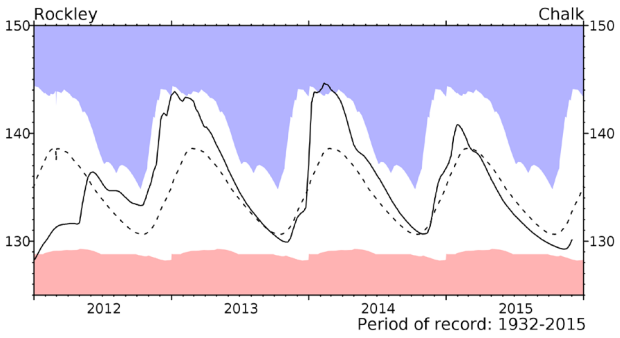
Groundwater…Groundwater

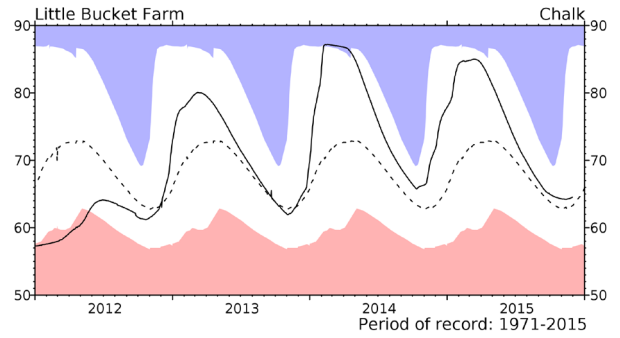


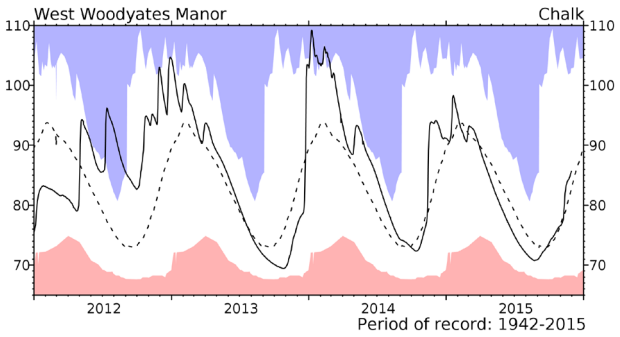


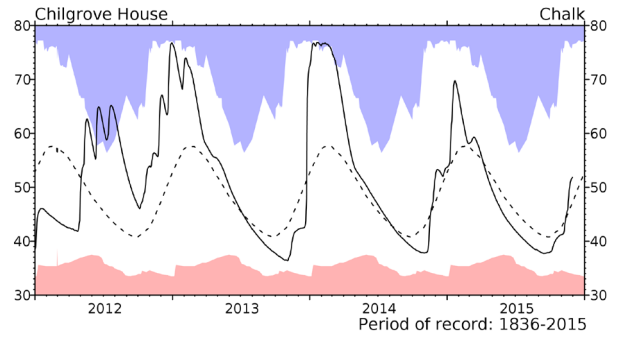


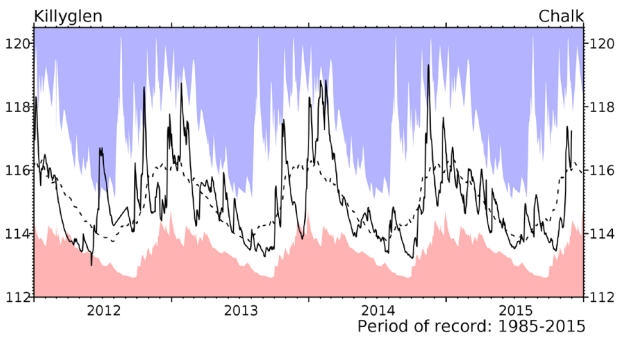


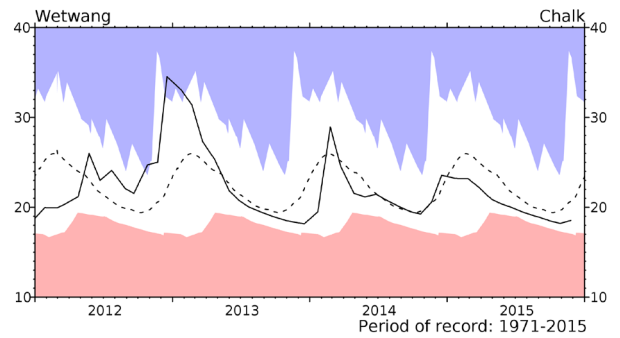






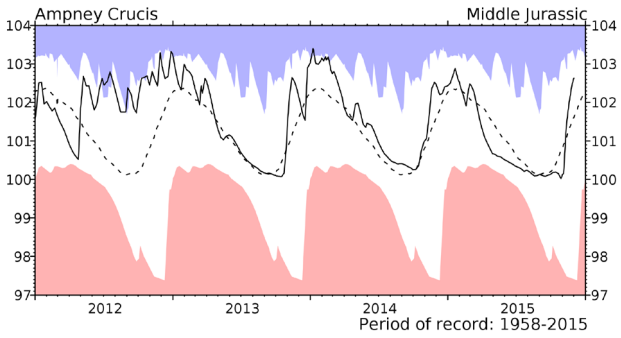


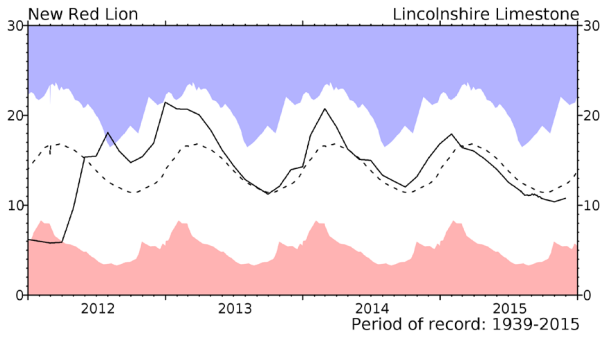


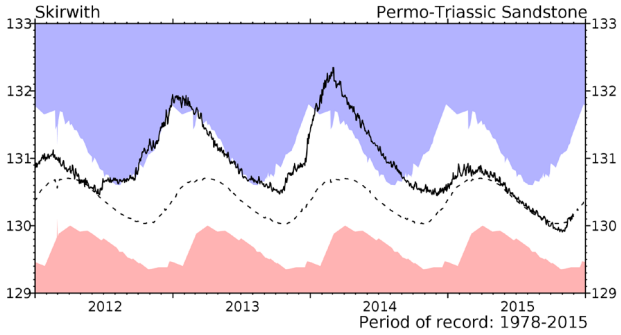


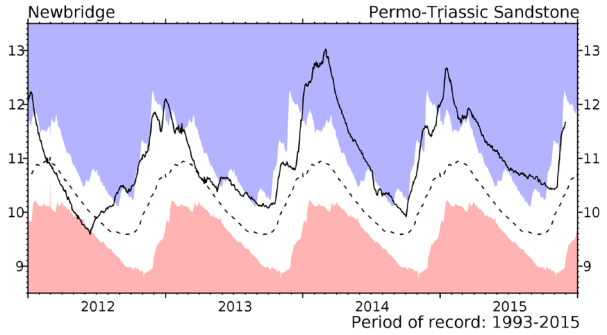
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

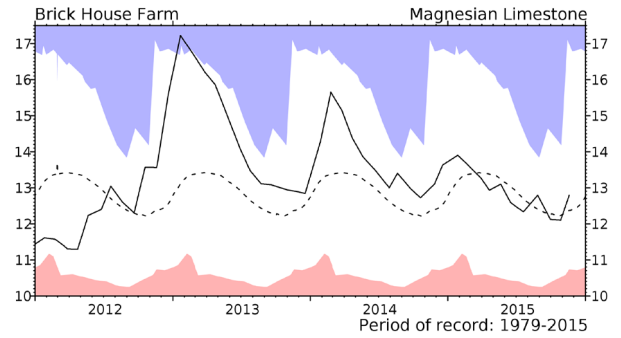
Groundwater ... Groundwater

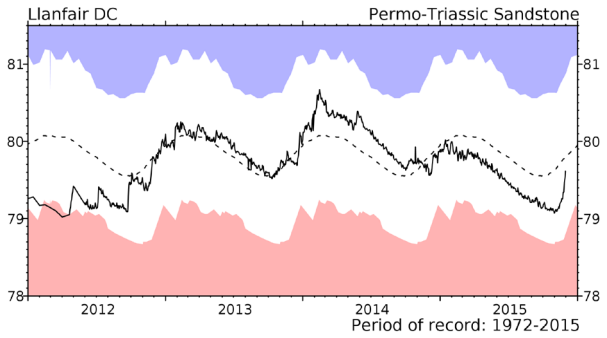


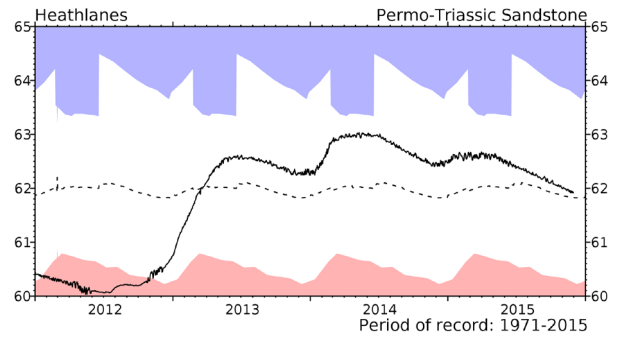


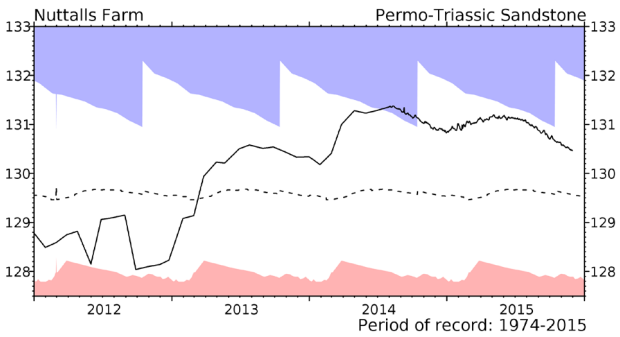


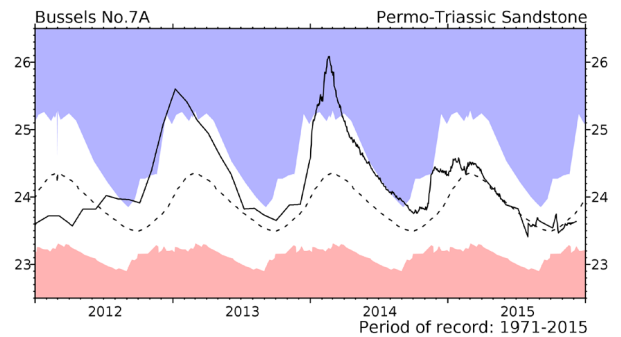


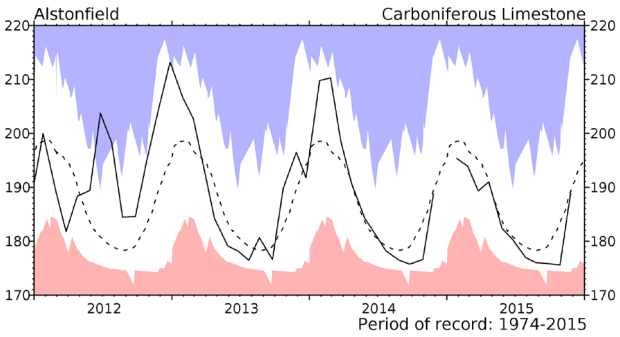








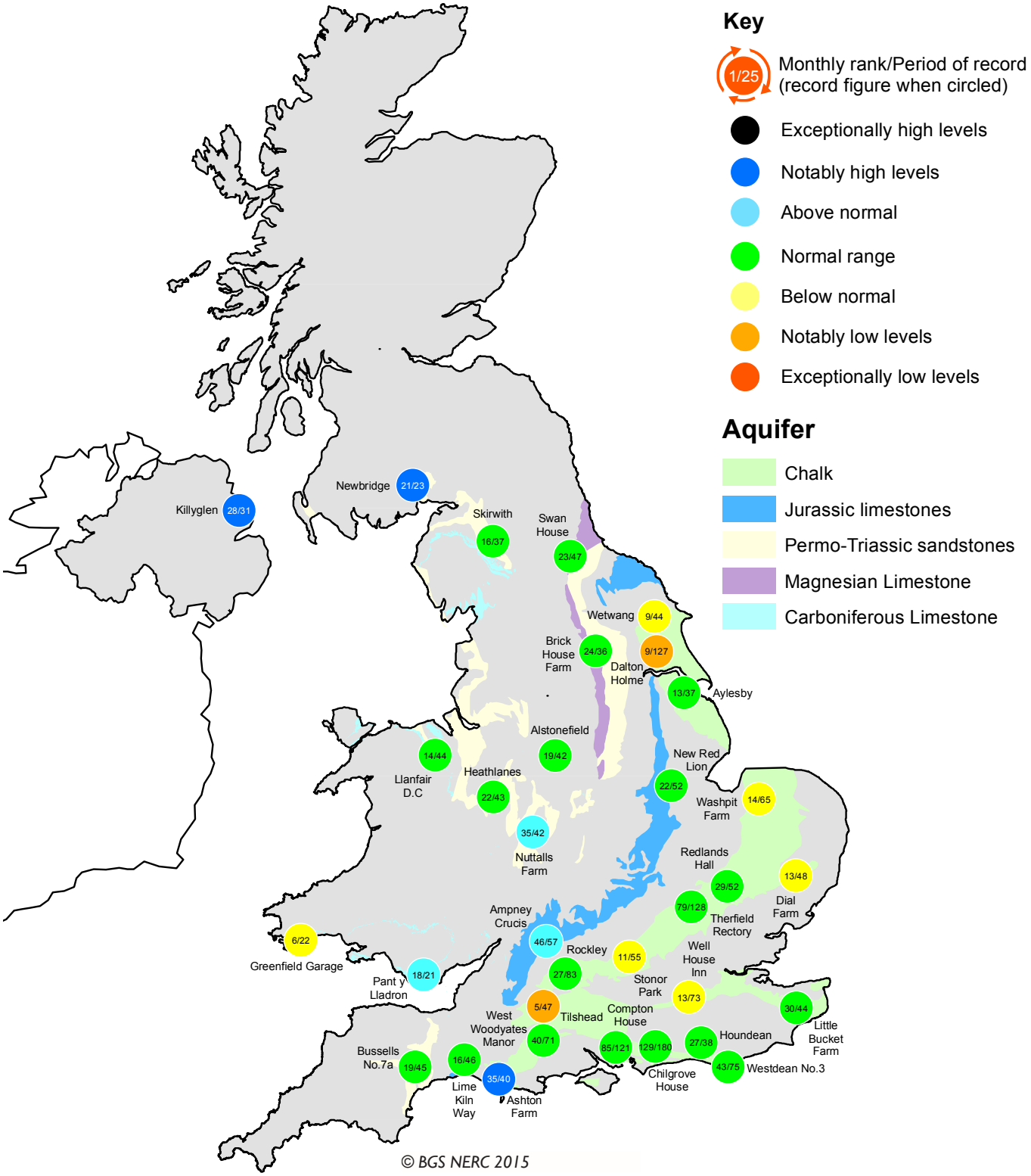




Groundwater levels November / December 2015

Borehole	Level	Date	Nov av.	Borehole	Level	Date	Nov av.	Borehole	Level	Date	Nov av.
Dalton Holme	12.01	23/11	14.80	Chilgrove House	51.77	30/11	46.37	Brick House Farm	12.79	19/11	12.38
Therfield Rectory	78.80	01/12	78.23	Killyglen (NI)	117.24	30/11	115.95	Llanfair DC	79.61	30/11	79.67
Stonor Park	67.32	01/12	72.13	Wetwang	18.51	25/11	20.27	Heathlanes	61.92	30/11	61.84
Tilshead	79.20	30/11	82.49	Ampney Crucis	102.63	01/12	101.25	Nuttalls Farm	130.47	30/11	129.61
Rockley	130.12	01/12	131.64	New Red Lion	10.76	30/11	12.34	Bussells No.7a	23.63	07/12	23.67
Well House Inn	89.14	01/12	92.86	Skirwith	130.14	30/11	130.15	Alstonefield	188.80	25/11	187.52
West Woodyates	85.67	30/11	80.67	Newbridge	11.66	30/11	10.29				

Levels in metres above Ordnance Datum

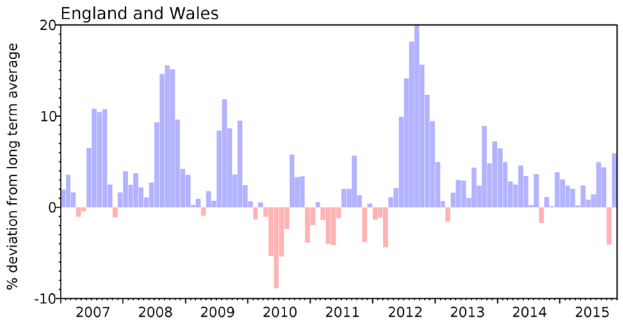


Groundwater levels - November 2015

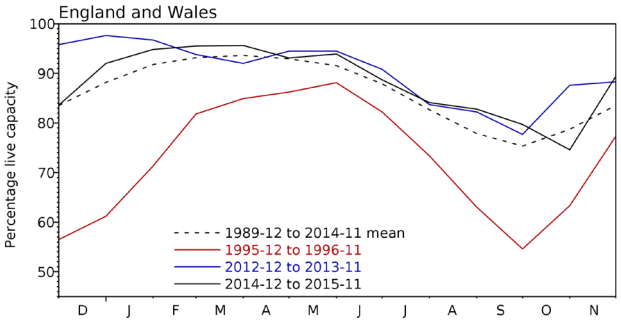
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 Sep	2015 Oct	2015 Nov	Nov Anom.	Min Nov	Year* of min	2014 Nov	Diff 15-14
North West	N Command Zone	•	124929	58	50	84	5	44	1993	74	9
	Vyrnwy		55146	78	75	96	14	33	1995	74	22
Northumbrian	Teesdale	•	87936	78	68	94	12	39	1995	88	6
	Kielder		(199175)	85	81	98	12	55	2007	95	4
Severn-Trent	Clywedog		44922	90	80	87	6	43	1995	86	2
	Derwent Valley	•	39525	57	50	81	3	9	1995	66	15
Yorkshire	Washburn	•	22035	67	69	93	17	16	1995	67	26
	Bradford Supply	•	41407	70	59	87	5	20	1995	84	4
Anglian	Grafham		(55490)	96	96	86	4	47	1997	66	20
	Rutland		(116580)	83	81	79	0	57	1995	82	-2
Thames	London	•	202828	82	81	90	7	52	1990	88	2
	Farmoor	•	13822	98	93	89	1	52	1990	69	21
Southern	Bewl		28170	64	59	62	-2	34	1990	71	-9
	Ardingly		4685	59	57	68	-7	14	2011	100	-32
Wessex	Clatworthy		5364	69	61	98	19	16	2003	84	14
	Bristol	•	(38666)	71	66	75	7	27	1990	74	1
South West	Colliford		28540	77	77	83	10	42	1995	76	7
	Roadford		34500	79	80	85	11	19	1995	78	7
	Wimbleball		21320	70	65	74	0	34	1995	75	-1
	Stithians		4967	67	64	74	8	29	2001	52	22
Welsh	Celyn & Brenig	•	131155	86	79	98	10	50	1995	81	18
	Brianne		62140	100	96	100	5	72	1995	93	7
	Big Five	•	69762	84	76	79	-5	49	1990	86	-7
	Elan Valley	•	99106	79	68	100	7	47	1995	99	1
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	74	68	86	0	45	2003	79	7
	East Lothian	•	9374	89	83	100	12	38	2003	99	1
Scotland(W)	Loch Katrine	•	110326	81	80	98	8	65	2007	90	8
	Daer		22412	81	83	99	2	73	2003	99	0
	Loch Thom	•	10798	100	100	100	6	72	2003	100	0
Northern Ireland	Total+	•	56800	88	87	96	10	59	2003	93	3
	Silent Valley	•	20634	91	89	98	17	43	2001	97	0

( ) 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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