Hydrological Summary

for the United Kingdom

March 2015

General

For the UK as a whole, March was sunnier than average, and near average in terms of both temperature and rainfall, but the character of the weather varied through the month and there were marked spatial contrasts. Anticyclonic spells heralded more spring-like conditions, but a predominance of westerly airflows early and late in the month brought unsettled and wintry spells, which led to an exaggeration of the typical north-west/south-east rainfall gradient. Exceptional rainfall in western Scotland, aided by rapid snowmelt, led to the most significant flood event to affect major Highland rivers since the early 1990s. Elsewhere, March river flows were predominantly in the normal range, as they have been for the year so far. Similarly, with the exception of some boreholes in the Permo-Triassic sandstone and south-eastern Chalk, March groundwater levels were largely normal or slightly below. Reservoir stocks were very close to average at the national scale, with most reservoirs within a few percent of normal except in a few impoundments in southern England. Overall, the water resources outlook for the spring and summer is healthy. However, with seasonal recessions beginning from a below-average baseline in some areas, the likelihood of moderately depressed runoff and groundwater levels in the English Lowlands this summer has increased, particularly given the warm and dry start to April.

Rainfall

March began cold and unsettled, with a westerly airflow bringing heavy showers which were persistent in the west and occasionally wintry, with significant snowfall over northern hills (with 17cm recorded at Malham Tarn, North Yorkshire, on the 3rd). While high pressure began to build in the south by the end of the first week, the weather in north-western Britain was dominated by a series of vigorous depressions until mid-month. Between the 5th and the 9th a very mild, moist southwesterly flow brought persistent heavy rainfall to western Scotland. Over the 48h period up to 9am on the 8th, rainfall totals of 100mm were widespread in the north-west Highlands, with 199mm at Cluanie Inn (the four-day total was 235mm) and 197mm at Sligachan on the Isle of Skye. From the 14th high pressure became established widely, bringing largely mild and dry weather before another unsettled spell in the last week, which included gale-force winds and widespread heavy rainfall in the final days. The March rainfall total for the UK was very close to average, but masks significant regional variations. The Clyde and Highland regions received >140% of average, while rain-shadowed parts of north-east Scotland received less than half the typical March rainfall. Southern and eastern England were notably dry, with totals of <50% widespread, and <35% seen in parts of Sussex and Hampshire. Rainfall for the year so far has been near-average for Wales and Northern Ireland, but most areas of England have seen moderately below-average rainfall, with more appreciable deficits in north-east England and the far north-east of Scotland. Scotland has been notably wet over the winter half-year; the October-March rainfall for Scotland is the third highest on record (although October-March 2013/14 was wetter).

River flows

Most rivers in England and Wales were in recession in early March and for many catchments this trend continued, although interrupted with moderate flow responses mid-month, until the final week when river flows climbed steeply, especially in responsive western catchments. In western and central Scotland, persistent heavy rainfall from the 6th-8th triggered an exceptional flow response, exacerbated by antecedent wetness (with high loch and reservoir levels providing limited opportunity for flood attenuation) and a significant snowmelt contribution, as the mild airflow caused rapid melting of the substantial late-winter Highland snow cover. There were 41 flood warnings in place on the 8th, predominantly in the Highlands, with the most significant flooding in the Ness, Beauly and Conon catchments. A number of index rivers (e.g. the Ewe and the Spey) registered their highest flows since the floods of the early 1990s and the Ness attained its second highest peak flow in a record from 1972. Impacts were relatively modest, partly due to the efficacy of flood warnings and prevention measures. Property flooding was limited, but transport disruption was severe (due to landslides as well as flooding) and there was significant inundation of agricultural land. Correspondingly, March runoff totals for western and central Scotland, along with the north of Northern Ireland, were typically well above average. In contrast, some small catchments in eastern Scotland saw low runoff, with the Deveron registering only half the March average. Across England and Wales, March runoff was mostly below average but remained largely in the normal range. Short-term runoff deficiencies can be recognised in south-west England and parts of eastern Scotland and north-east England, where the January-March runoff from the Yorkshire Derwent was 76% of average. Over the winter half-year accumulated runoff was mostly in the normal range, and above normal in many Scottish catchments and the far south-east of England.

Groundwater

With dry conditions prevailing across southern and eastern England, soil moisture deficits (SMDs) began to develop across the Chalk outcrop. Groundwater levels in index boreholes generally fell in March and, with a few exceptions, were in the normal range or just below for the time of year. Levels in the Chalk receded in most areas and were below average for the time of year in the Yorkshire Wolds and at Tilshead in Wiltshire. However, modest rises (<1m) were recorded in parts of the Chilterns (Stonor Park and Therfield Rectory), Norfolk (Washpit Farm) and Lincolnshire (Aylesby). In the North Downs, Well House Inn has risen but remains normal, whereas Little Bucket Farm remains notably high despite a fall in water level. Levels in the South Downs were slightly above normal, reflecting higher late-winter rainfall in the far south-east of England. In the faster responding Jurassic and Magnesian limestones of central England, levels fell and were average or below. In the Permo-Triassic sandstones, levels were relatively stable, remaining exceptionally high at Nuttalls Farm in the Midlands and at Newbridge in south-west Scotland. Levels at Lime Kiln Way in the Upper Greensand of south-west England fell and remain in the normal range, while in the Lower Greensand of south-east England, levels remain high despite falling. In the flashy Carboniferous Limestone, levels fell and are normal in south Wales and below normal at Alstonefield (Derbyshire). As SMDs increase throughout the spring and summer, significant recharge is unlikely unless exceptional rainfall is received, with levels likely to continue their normal seasonal recessions from now until the autumn.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

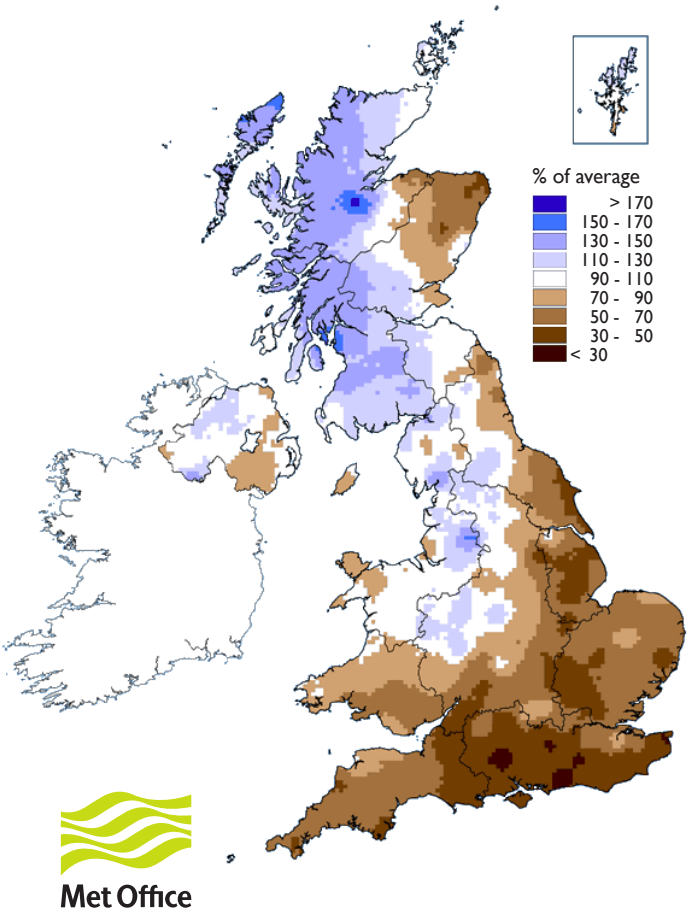
Area	Rainfall	Mar 2015	Jan15 – Mar15	RP	Oct14 – Mar15	RP	Jul14 – Mar15	RP	Apr14 – Mar15	RP
United Kingdom	mm	**96**	328		739		965		1188	
	%	**103**	112	5-10	116	10-15	110	2-5	110	5-10
England	mm	**49**	193		475		649		844	
	%	**75**	93	2-5	105	2-5	101	2-5	105	2-5
Scotland	mm	**172**	545		1143		1459		1720	
	%	**131**	131	15-25	129	80-120	121	25-40	120	25-40
Wales	mm	**98**	373		864		1081		1348	
	%	**86**	99	2-5	104	2-5	96	2-5	99	2-5
Northern Ireland	mm	**94**	307		746		964		1155	
	%	**100**	103	2-5	117	25-40	107	2-5	104	2-5
England & Wales	mm	**56**	217		528		709		914	
	%	**78**	95	2-5	105	2-5	100	2-5	103	2-5
North West	mm	**112**	344		760		996		1197	
	%	**113**	112	2-5	112	2-5	104	2-5	103	2-5
Northumbrian	mm	**66**	198		454		628		826	
	%	**96**	94	2-5	101	2-5	97	2-5	101	2-5
Severn-Trent	mm	**54**	166		421		580		782	
	%	**91**	88	2-5	104	2-5	100	2-5	104	2-5
Yorkshire	mm	**61**	175		430		618		818	
	%	**91**	85	2-5	97	2-5	98	2-5	102	2-5
Anglian	mm	**25**	113		321		487		653	
	%	**56**	83	2-5	106	2-5	108	2-5	110	2-5
Thames	mm	**27**	151		404		554		737	
	%	**50**	89	2-5	108	2-5	104	2-5	107	2-5
Southern	mm	**24**	202		531		699		871	
	%	**40**	103	2-5	119	2-5	114	2-5	114	2-5
Wessex	mm	**33**	203		513		681		900	
	%	**47**	88	2-5	103	2-5	99	2-5	106	2-5
South West	mm	**59**	318		711		891		1149	
	%	**61**	93	2-5	96	2-5	91	2-5	96	2-5
Welsh	mm	**93**	354		822		1035		1298	
	%	**85**	98	2-5	103	2-5	96	2-5	99	2-5
Highland	mm	**230**	706		1421		1826		2123	
	%	**141**	138	10-20	130	30-50	125	25-40	123	25-40
North East	mm	**67**	232		630		947		1136	
	%	**86**	96	2-5	120	5-10	126	8-12	120	5-10
Tay	mm	**137**	431		939		1194		1448	
	%	**115**	113	5-10	120	10-15	113	5-10	115	5-10
Forth	mm	**130**	405		819		1013		1253	
	%	**126**	126	10-15	122	15-25	109	2-5	111	5-10
Tweed	mm	**95**	318		721		917		1140	
	%	**118**	126	5-10	134	30-50	121	5-10	121	5-10
Solway	mm	**154**	522		1155		1389		1641	
	%	**126**	134	25-40	136	>100	120	10-20	118	10-20
Clyde	mm	**225**	697		1411		1724		2024	
	%	**140**	138	20-35	132	80-120	117	10-20	117	15-25

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

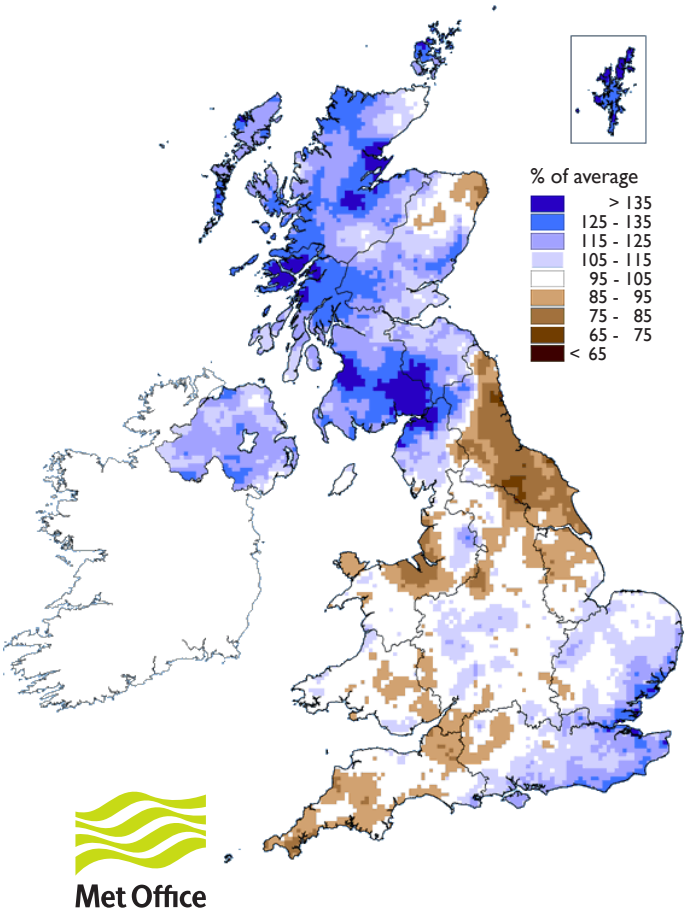
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 November 2014 (inclusive) are provisional.

Rainfall . . . Rainfall . . .

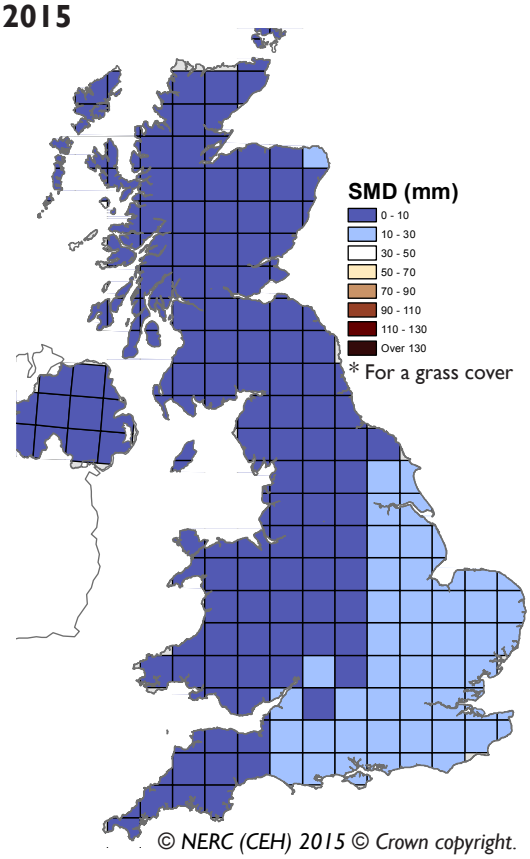
March 2015 rainfall as % of 1971-2000 average



October 2014 - March 2015 rainfall as % of 1971-2000 average



MORECS Soil Moisture Deficits* March 2015



Met Office 3-month outlook Updated: March 2015

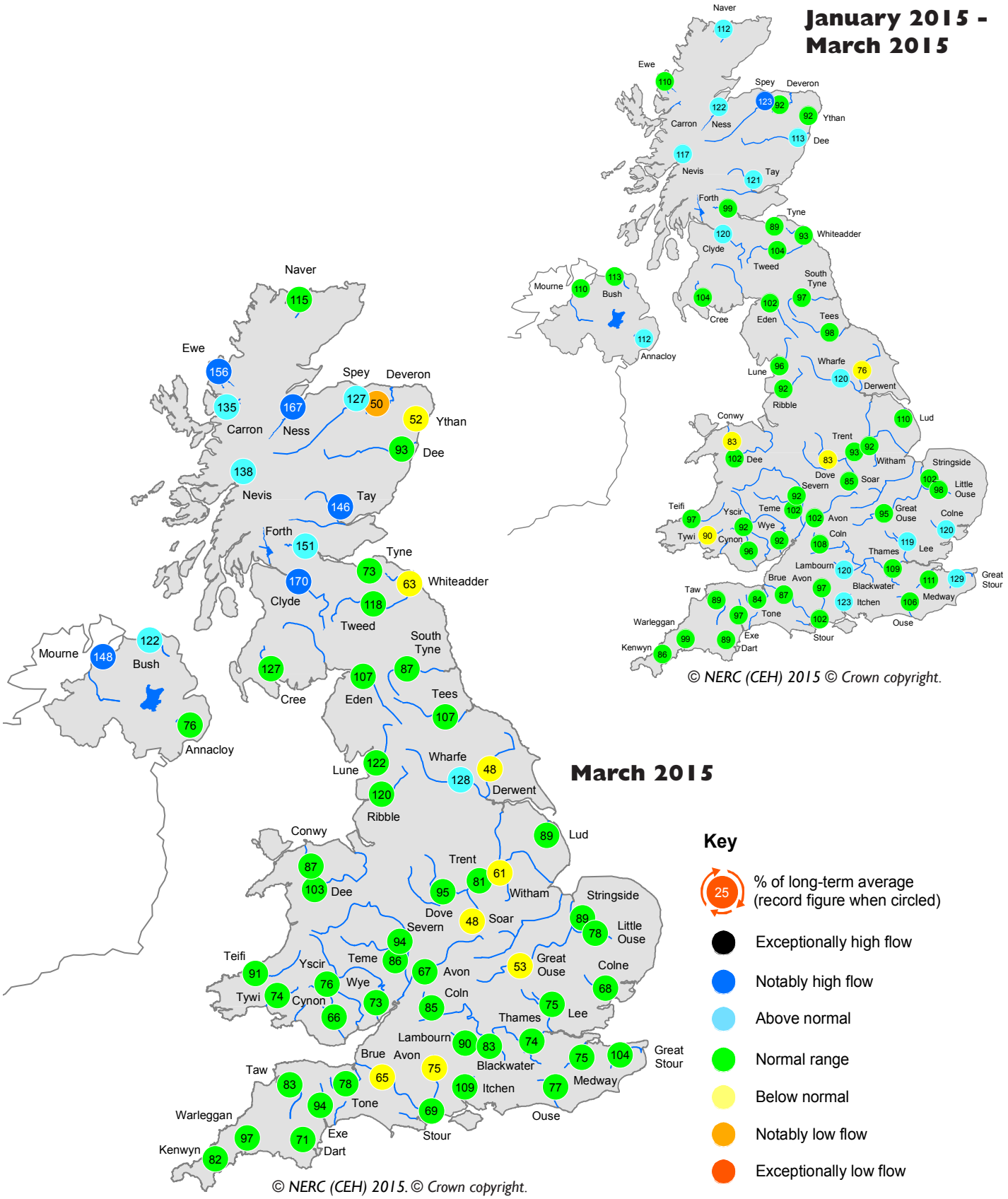
For April-May-June, there is a slight shift away from climatology towards above-average precipitation but there is a wide spread of possible outcomes.

The probability that UK precipitation for April-May-June will fall into the driest of our five categories is around 20% 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.

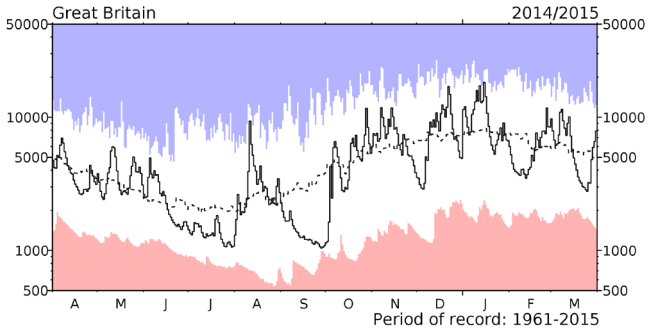
River flow . . . River flow . . .

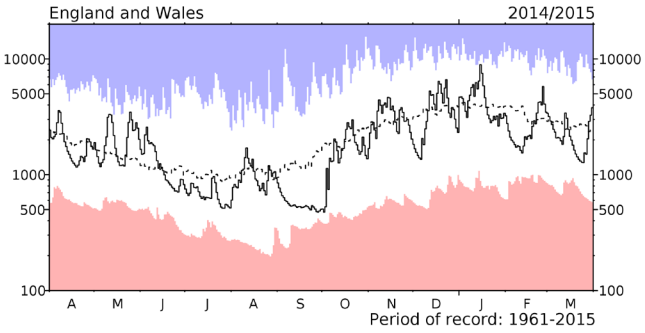


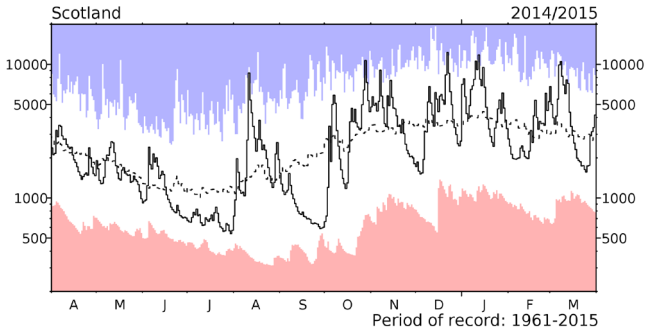
River flows

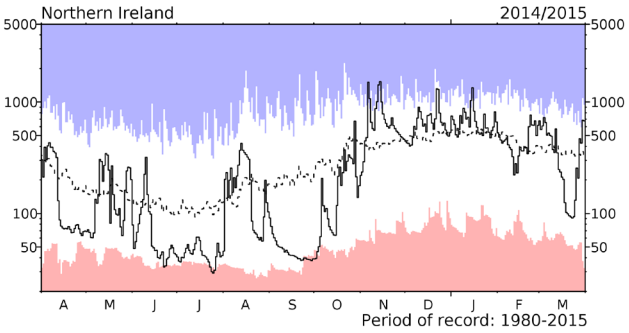
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

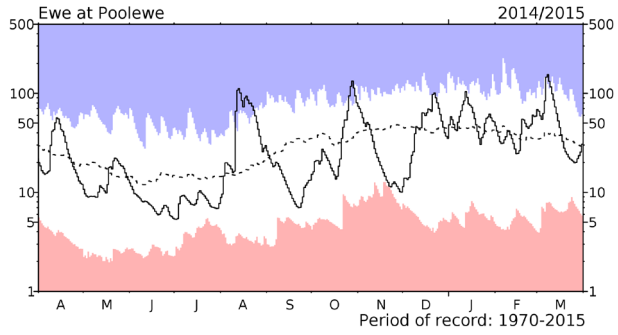
River flow . . . River flow . . .

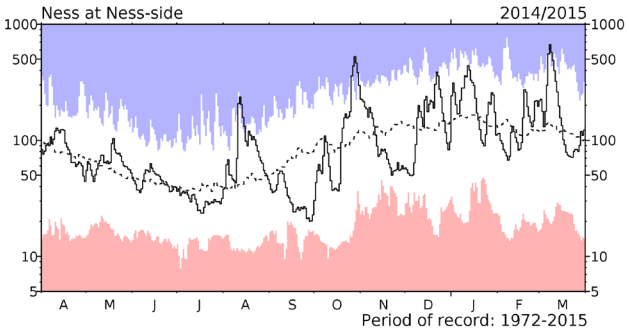


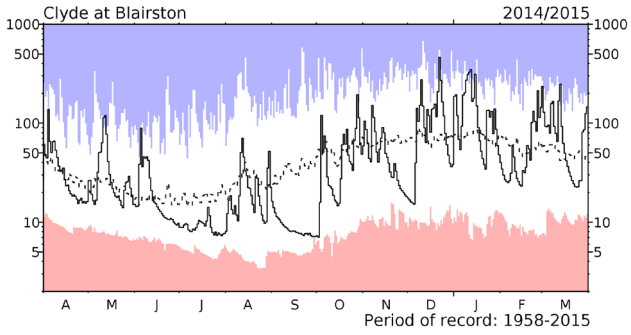


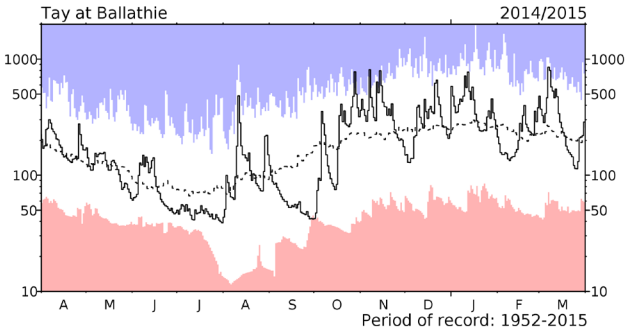


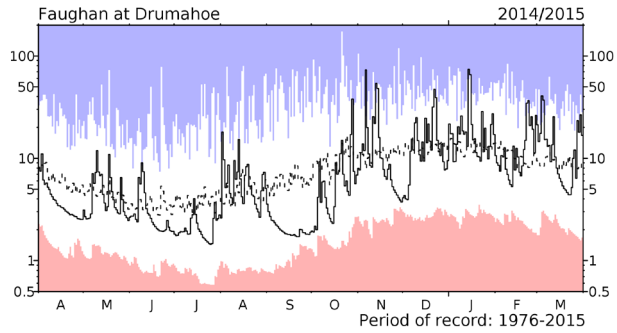


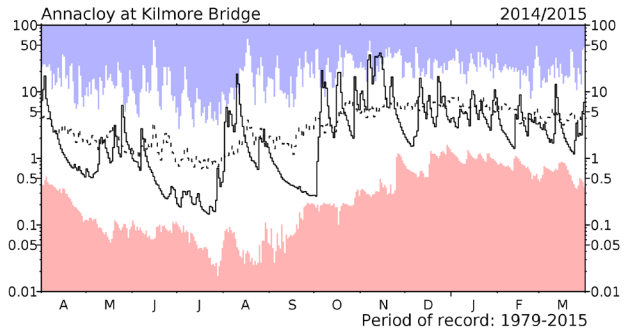








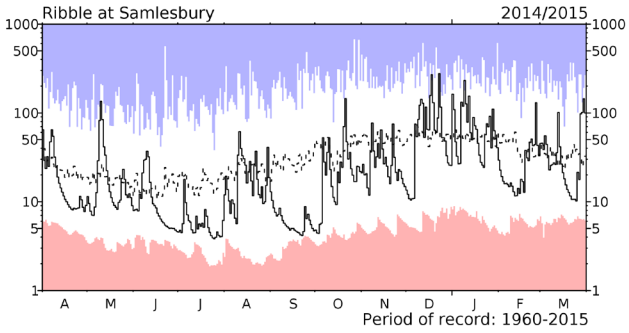


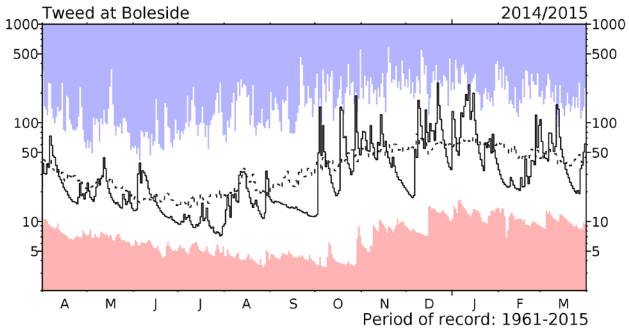


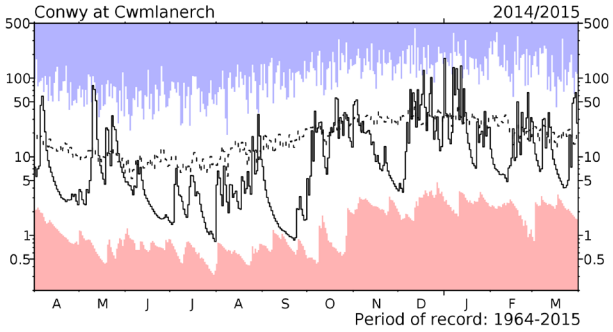
River flow hydrographs

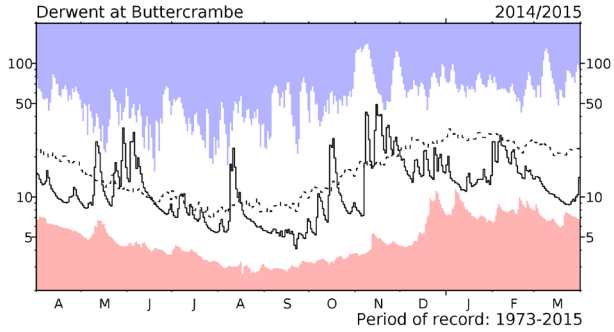
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2014 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed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

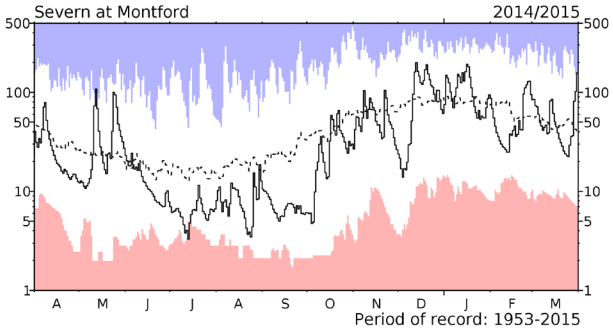
River flow . . . River flow . . .

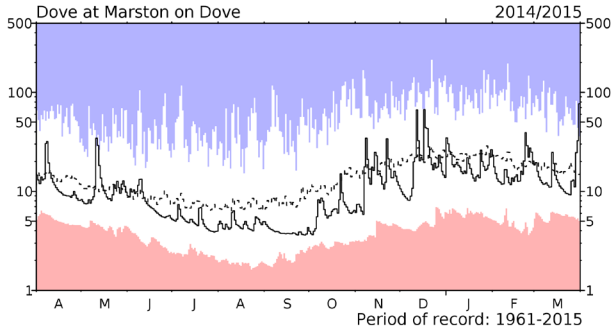


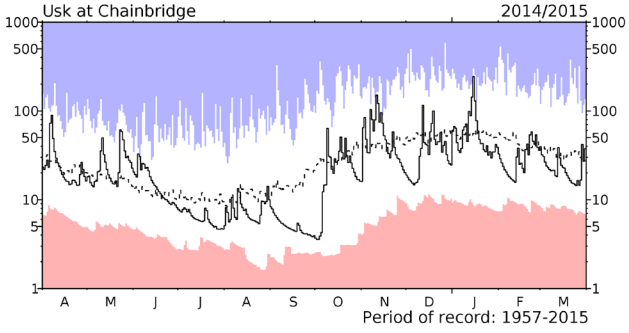


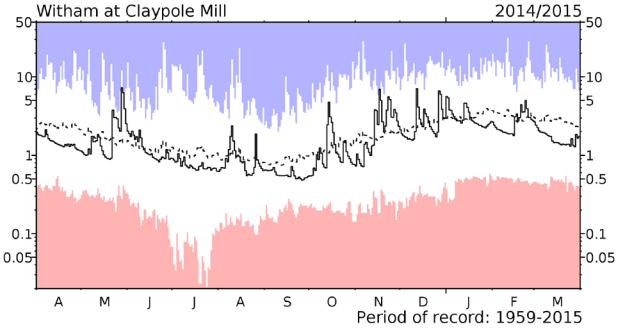


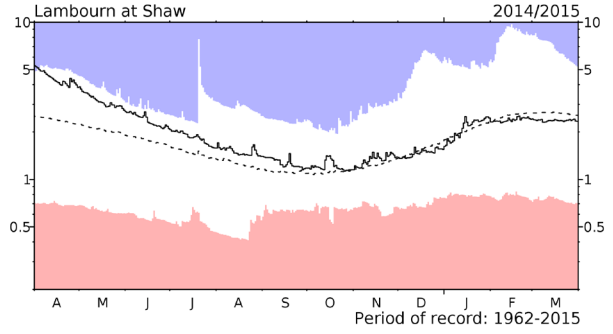


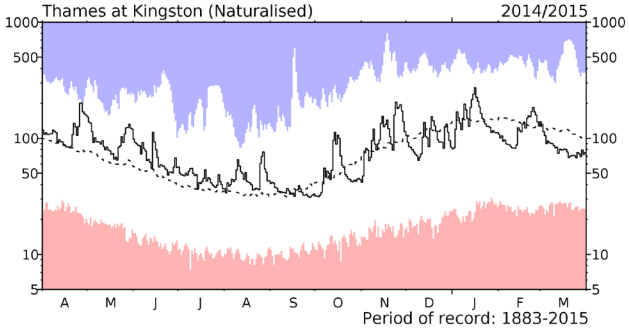


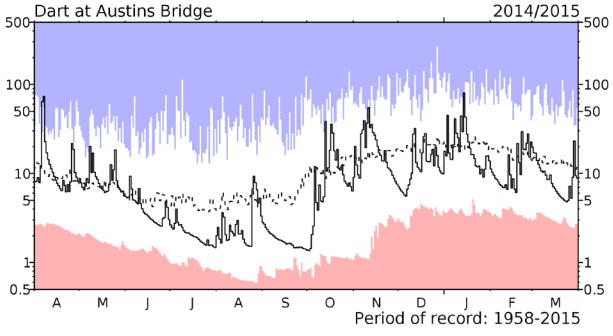


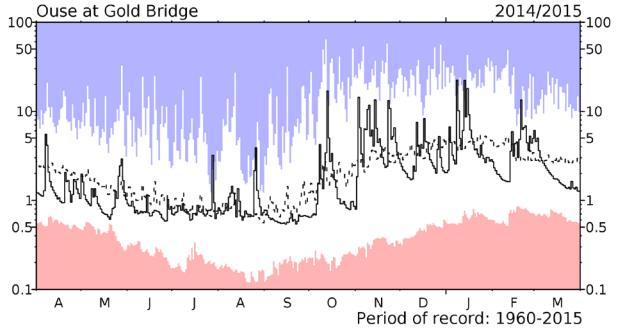




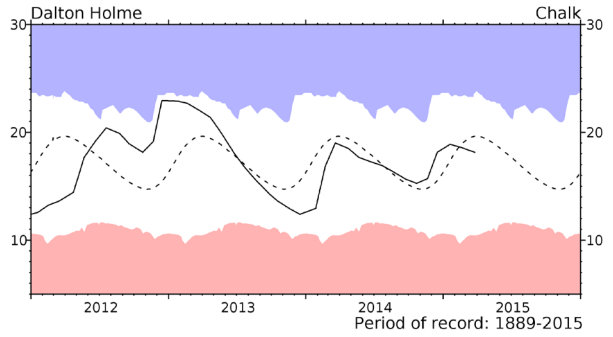


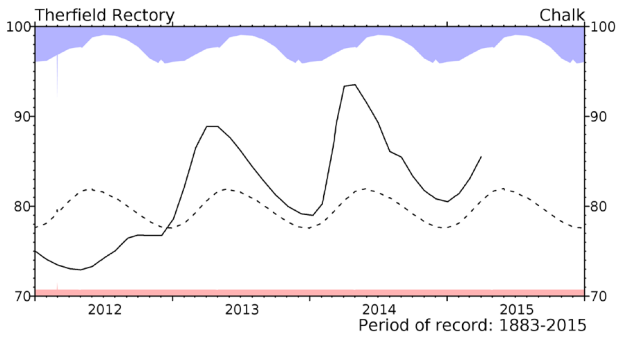


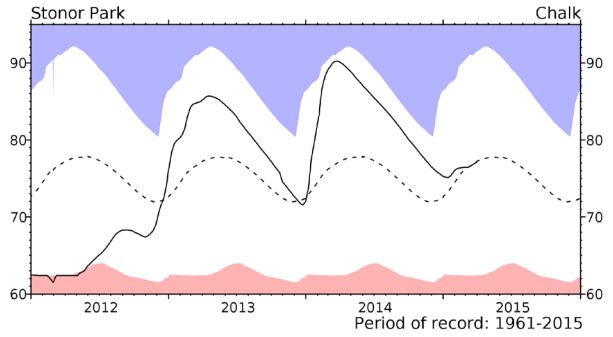


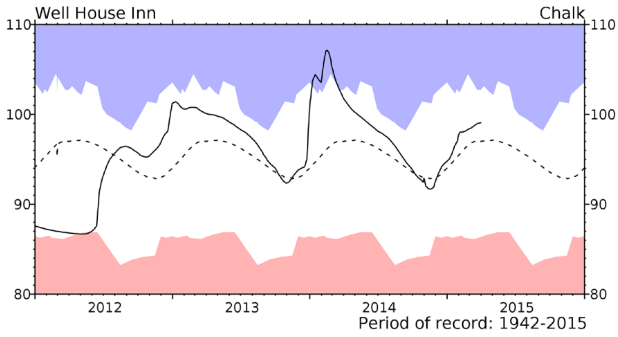


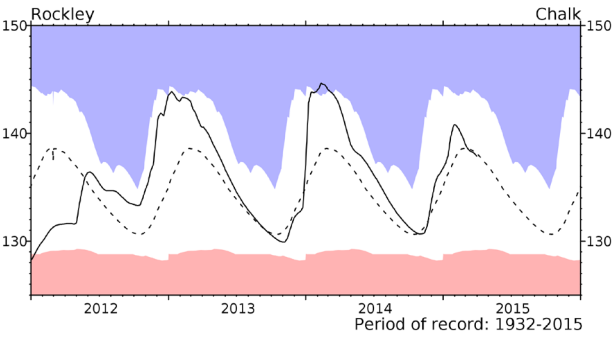
Groundwater…Groundwater

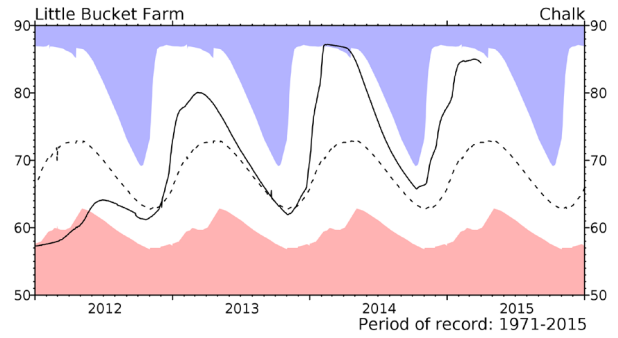


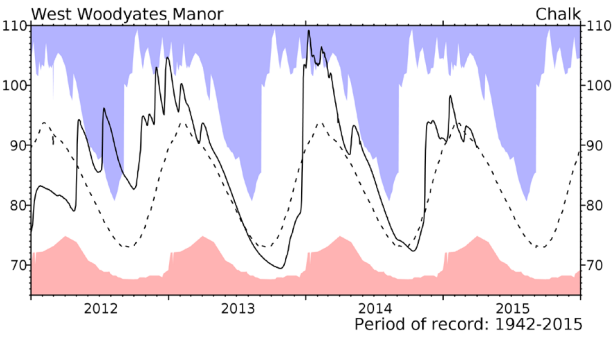


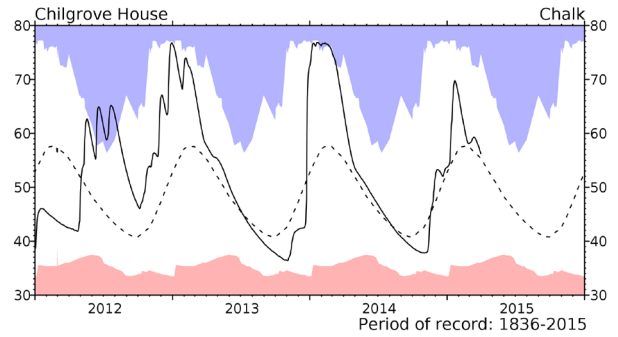


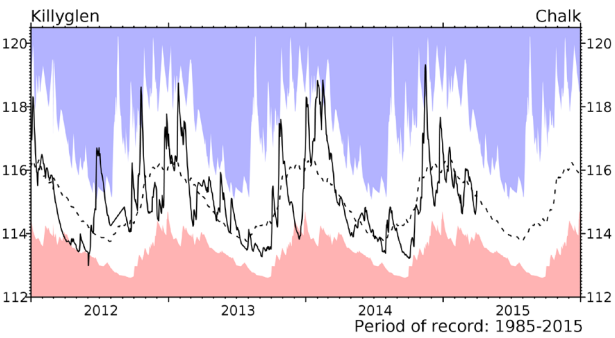


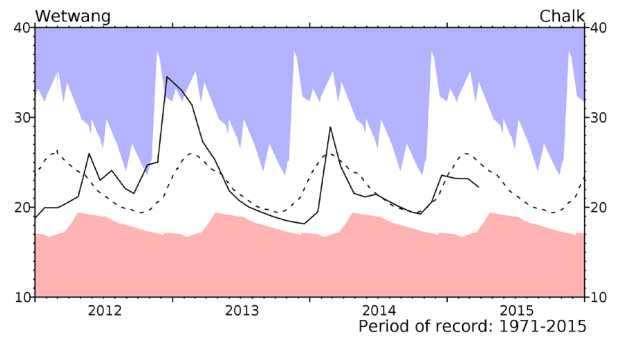






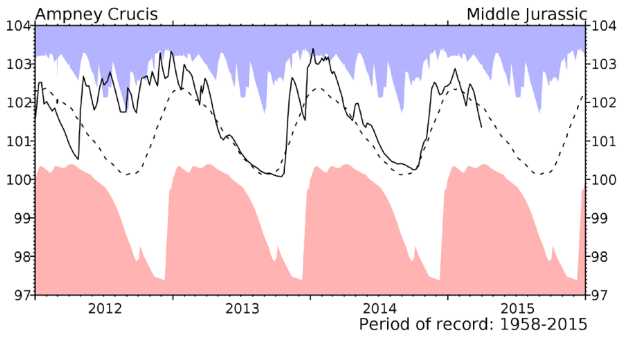


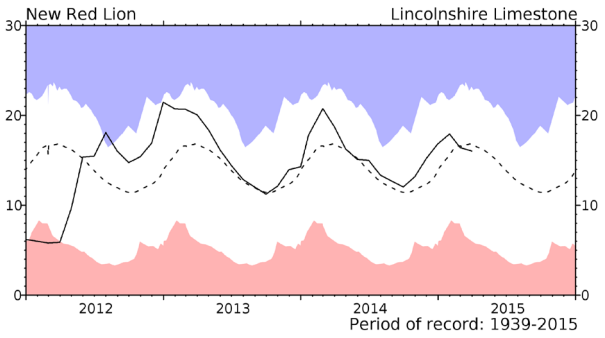


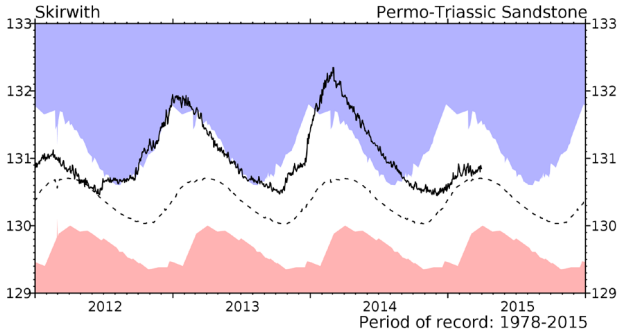


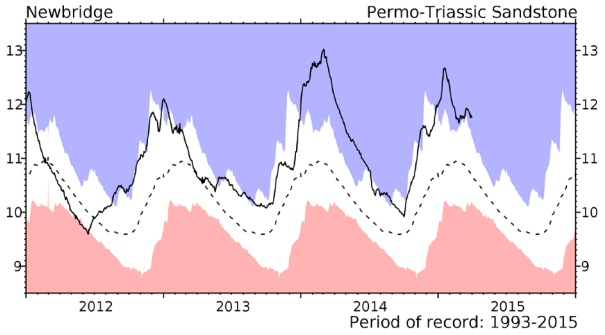
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

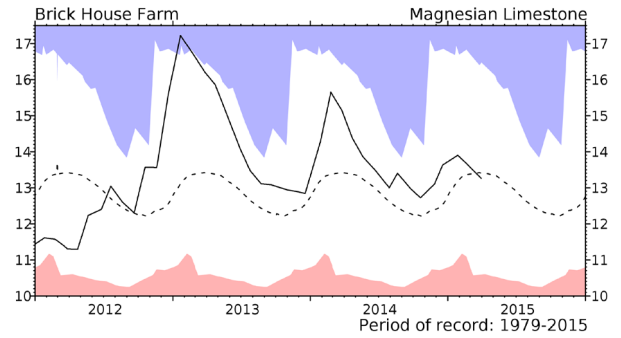
Groundwater ... Groundwater

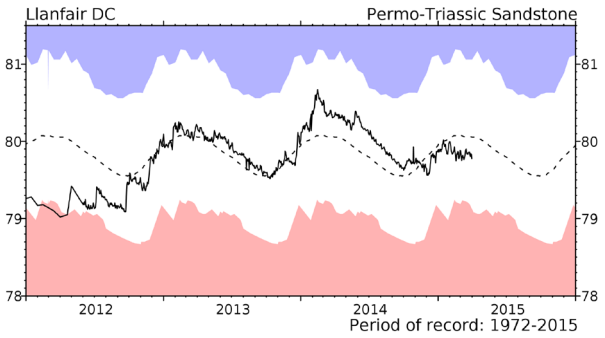


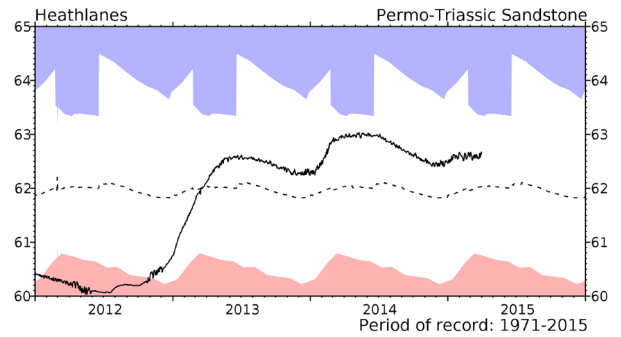


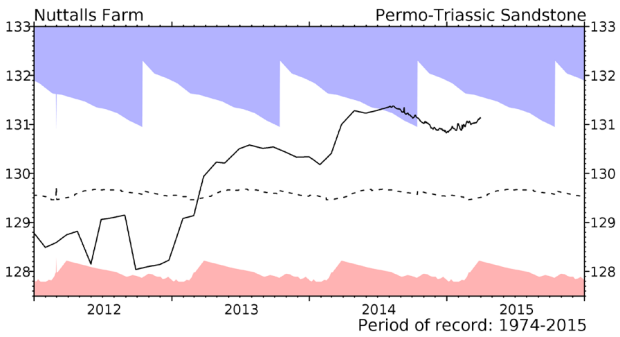


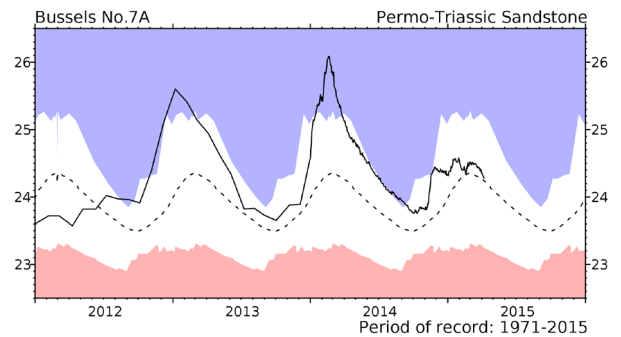


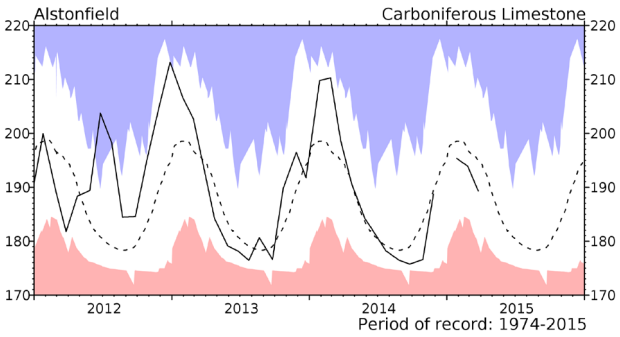








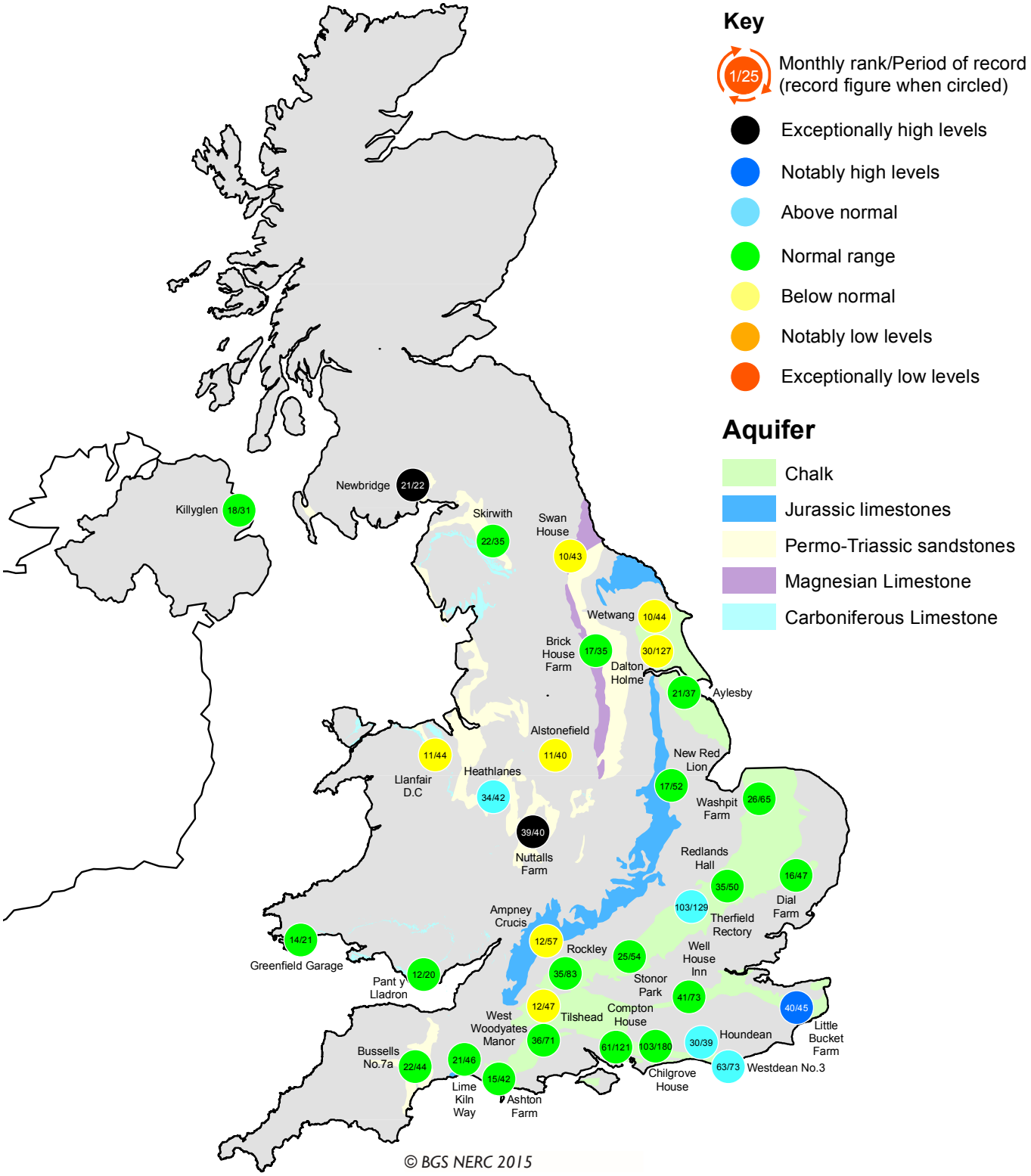




Groundwater levels March / April 2015

Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.
Dalton Holme	18.13	26/03	19.48	Chilgrove House	56.08	31/03	55.65	Brick House Farm	13.26	30/03	13.45
Therfield Rectory	85.49	01/04	79.39	Killyglen (NI)	115.33	31/03	115.43	Llanfair DC	79.78	31/03	80.05
Stonor Park	77.09	31/03	76.83	Wetwang	22.24	25/03	25.36	Heathlanes	62.67	31/03	61.96
Tilshead	91.10	31.03	93.89	Ampney Crucis	101.36	31/03	102.00	Nuttalls Farm	131.13	31/03	129.49
Rockley	137.87	31/03	138.48	New Red Lion	16.02	31/03	16.58	Bussells No.7a	24.28	07/04	24.36
Well House Inn	99.04	31/03	96.97	Skirwith	130.79	31/03	130.79	Alstonefield	189.30	25/03	195.44
West Woodyates	89.62	31/03	90.80	Newbridge	11.76	31/03	10.91				

Levels in metres above Ordnance Datum

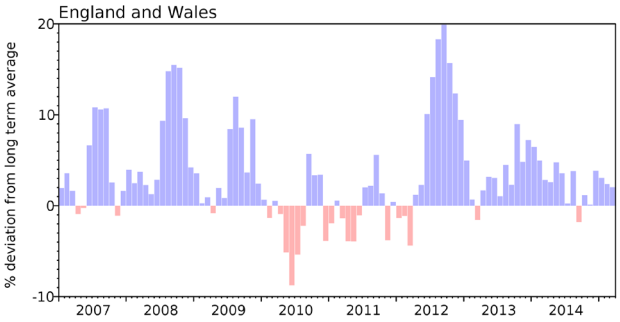


Groundwater levels - March 2015

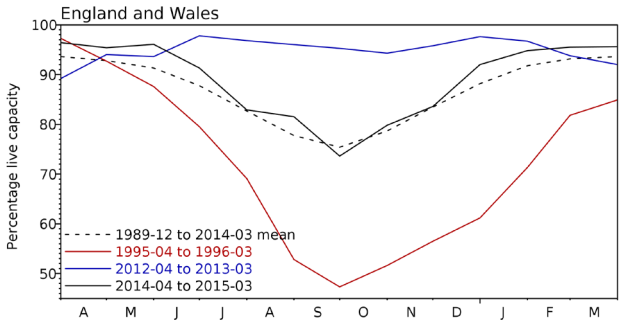
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 Jan	2015 Feb	2015 Mar	Mar Anom.	Min Mar	Year* of min	2015 Mnt	Diff 15-14
North West	N Command Zone	•	124929	98	94	96	5	77	1993	93	3
	Vyrnwy		55146	94	92	100	6	64	1996	99	1
Northumbrian	Teesdale	•	87936	99	100	95	2	77	2003	100	-5
	Kielder		(199175)	94	96	91	-1	81	1993	93	-2
Severn-Trent	Clywedog		44922	93	96	99	4	86	1996	96	3
	Derwent Valley	•	39525	100	100	101	6	54	1996	94	7
Yorkshire	Washburn	•	22035	87	86	95	2	70	1996	92	3
	Bradford Supply	•	41407	99	100	98	4	59	1996	100	-2
Anglian	Grafham		(55490)	76	83	92	1	77	1997	95	-3
	Rutland		(116580)	95	95	96	5	73	2012	96	0
Thames	London	•	202828	96	93	92	-2	88	1990	95	-2
	Farmoor	•	13822	96	93	99	4	80	2013	99	-1
Southern	Bewl		28170	85	90	92	3	49	2012	100	-8
	Ardingly		4685	100	100	100	3	51	2012	100	0
Wessex	Clatworthy		5364	100	100	100	3	82	1992	98	2
	Bristol	•	(38666)	95	99	99	6	71	1992	99	0
South West	Colliford		28540	87	91	93	6	58	1997	100	-7
	Roadford		34500	91	95	95	10	37	1996	97	-2
	Wimbleball		21320	100	100	100	4	78	1996	99	1
	Stithians		4967	75	84	88	-7	52	1992	100	-13
Welsh	Celyn & Brenig	•	131155	94	97	99	0	72	1996	100	-1
	Brianne		62140	98	100	98	1	90	1993	97	1
	Big Five	•	69762	97	98	98	2	78	1993	98	0
	Elan Valley	•	99106	100	100	99	2	89	1993	98	1
Scotland(E)	Edinburgh/Mid-Lothian	•	97639	91	92	95	0	71	1998	99	-4
	East Lothian	•	10206	100	99	99	0	95	2012	100	-1
Scotland(W)	Loch Katrine	•	111363	95	98	90	-2	74	2010	92	-2
	Daer		22412	98	100	100	3	77	2013	94	6
	Loch Thom	•	11840	100	100	100	3	83	2010	100	0
Northern Ireland	Total+	•	56800	92	93	94	4	83	2002	92	3
	Silent Valley	•	20634	95	97	100	14	57	2000	96	4

( ) 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

National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP) was instigated in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS) – both are component bodies of the Natural Environment Research Council (NERC). The National River Flow Archive (maintained by CEH) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Data Sources

River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru, 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).

Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

Most rainfall data are provided by the Met Office (address opposite).

To allow better spatial differentiation the monthly rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA.

The monthly, and n-month, rainfall figures have been produced by the Met Office, National Climate Information Centre (NCIC) and are based on gridded data from raingauges. They include a significant number of monthly raingauge totals provided by the EA and SEPA. The Met Office NCIC monthly rainfall series extends back to 1910 and forms 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/Monthly_gridded_datasets_UK.pdf

The regional figures for the current month are based on limited raingauge networks so these (and the return periods associated with them) should be regarded as a guide only.

The Met Office NCIC monthly rainfall series are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

From time to time the Hydrological Summary may also refer to evaporation and soil moisture figures. These are obtained from MORECS, the Met Office services involving the routine calculation of evaporation and soil moisture throughout the UK.

For further details please contact:

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100
Email: enquiries@metoffice.gov.uk

The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

Enquiries

Enquiries should be addressed to:

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Centre for Ecology & Hydrology
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Crowmarsh Gifford
Wallingford
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OX10 8BB

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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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iii. Met Office rainfall data. © Crown copyright.

04/2015