Hydrological Summary

for the United Kingdom

March 2014

General

After a tempestuous winter, weather patterns in March were more typical of a normal early spring. It was a notably mild month and rainfall totals were in the normal range at the national scale but generally below average across southern Britain and particularly dry in some eastern areas. Nonetheless, regional rainfall accumulations remain well above average across a wide range of timeframes. Generally, river flows declined substantially through March but contrasts in catchment geology exercised a strong influence on runoff patterns. Flows in permeable southern catchments remained high and groundwater flooding persisted throughout the month in some vulnerable locations (e.g. in the Chilterns and Berkshire Downs). By contrast, late-March flows were depressed in many low permeability catchments in eastern Britain. Despite mostly modest replenishment during March in some areas, stocks in all index reservoirs (or reservoir groups) remained more than 90% full entering April, and close to capacity in many. Soil moisture deficits began building from early-March across most of the English Lowlands and groundwater recharge was seasonally modest across most major aquifers. However, the legacy of the exceptional winter rainfall ensured that groundwater levels in most index wells and boreholes remain notably high for the early spring. Correspondingly, the water resources outlook is very healthy and particularly so across southern Britain.

Rainfall

Following a winter dominated by cyclonic synoptic patterns, March – which was generally sunny and mild – saw a return to more familiar spring weather patterns. After an unsettled start, high pressure predominated through a notable dry spell, especially across southern Britain. Some parts of eastern and central England recorded sequences of 15 or more days with precipitation largely restricted to fog-drip and accumulated totals less than 1mm. Sustained frontal rainfall early in the fourth week produced notable storm totals in northern Scotland (Cluanie Inn, Highland Region, reported 78.8mm on the 20th) and later in the month locally intense storms contributed to flash flooding (e.g. in Lincolnshire and Dorset). March rainfall totals were above average in some parts of the Southern Uplands of Scotland, but to the south all regions registered below average rainfall. Parts of East Anglia recorded less than 30% of the March average and for the region as a whole it was the second driest March in the last ten years. Much of eastern Scotland was also relatively dry. Nonetheless, accumulated rainfall totals over durations from two to six months remain exceptionally high. For the UK as a whole, the winter half-year (October-March) was the wettest in a series from 1910 and, with the exception of Anglian and Yorkshire, all regions were notably wet in this timeframe.

River flows

Early-March witnessed the end of a remarkable runoff episode as outflows from Great Britain fell below average (for the time of year) for the first time since the third week of December. During this period, the 90-day average outflow exceeded the previous highest, in a series from 1961, by an appreciable margin. Across much of the country, recessions through March, often punctuated by spates in Scotland, were generally steep in impermeable catchments; by the beginning of April, flows were seasonally modest and notably low in a few rivers (e.g. the Mole and Naver). In marked contrast, flows in many rivers draining permeable catchments remained notably high. Daily flows for the Lambourn exceeded previous daily maxima throughout the month and new maximum March runoff totals were established for a number of rivers draining the western Chalk outcrops and the Cotswolds. Correspondingly, groundwater flooding remained widespread and persistent (and locally aggravated by sewage contamination). Generally, however, March river flows were well within the normal range but with modest monthly runoff totals characterising rivers in parts of the English Lowlands, north Wales and northern Scotland. Nonetheless, accumulated runoff totals over timeframes up to and beyond six months are exceptionally healthy. For England & Wales, only in 2000/01 has the October-March runoff exceeded that of 2013/14, and most index catchments across southern Britain (and Northern Ireland) eclipsed previous winter half-year runoff maxima.

Groundwater

The relatively dry and mild March has meant that the groundwater recharge season may have already terminated in many lowland areas but groundwater resources remained very healthy with March levels mostly well above the normal early spring range. In the Chalk, water levels continued to rise during March in boreholes from the Chilterns northwards into Yorkshire (Wetwang is an exception), but fell throughout southern England. Levels remained exceptionally high in the North Downs and Chilterns and notably high in the South Downs (despite falls of over 10m at Chilgrove House and Compton House), but were in the normal range in parts of eastern England (from Essex to Yorkshire). The areas affected by groundwater flooding are diminishing with many Environment Agency alerts no longer extant, however it remains an issue locally, e.g. in parts of Berkshire, south London, north Hampshire and Oxfordshire. Initial analyses suggest that the overall severity in southern England is similar to that of winter 2000/01. In the Permo-Triassic sandstones, levels continued to rise in the slower to respond Midlands, but started to fall in north-west (although record monthly maximum levels were recorded for the third successive month) and south-west England, and north Wales. A second consecutive record monthly maximum level was recorded at Lime Kiln Way (Upper Greensand, south-west England). In the Magnesian Limestone, water levels fell but remain above average. In the more rapidly responding Jurassic and Carboniferous limestones, levels fell to within the normal range, by over 10m at Alstonfield (Peak District) and Pant y Lladron (south Wales).

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.

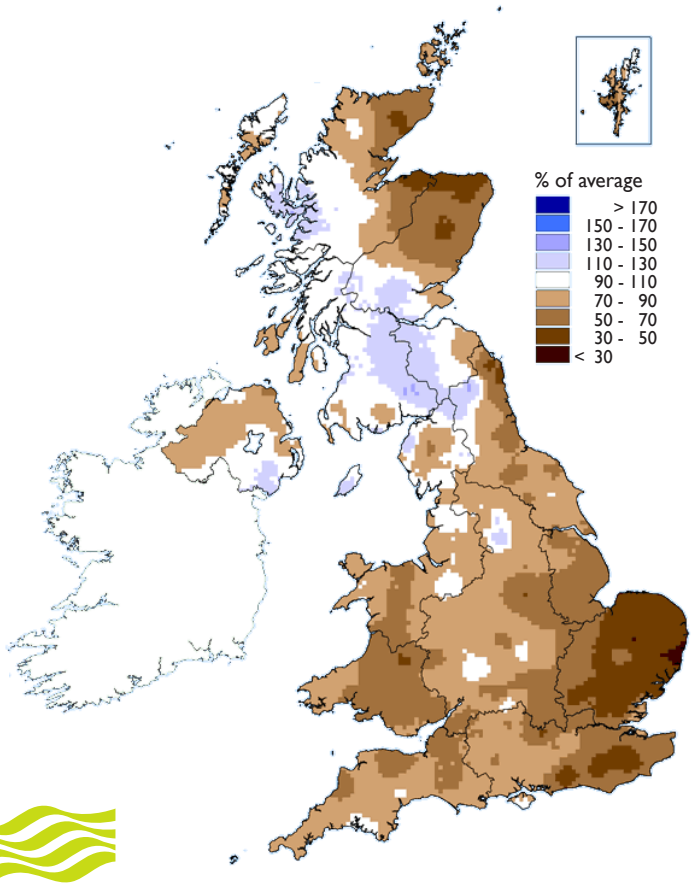
Area	Rainfall	Mar 2014	Jan14 – Mar14	RP	Oct13 – Mar14	RP	Jul13 – Mar14	RP	Apr13 – Mar14	RP
United Kingdom	mm	**81**	428		868		1078		1282	
	%	**87**	146	>100	137	>>100	123	40-60	119	30-50
England	mm	**49**	328		649		816		955	
	%	**76**	159	>100	143	50-80	128	10-15	118	5-10
Scotland	mm	**132**	549		1169		1442		1738	
	%	**100**	132	15-25	132	>100	119	20-30	121	40-60
Wales	mm	**81**	595		1159		1405		1633	
	%	**71**	158	>100	140	80-120	125	15-25	120	10-20
Northern Ireland	mm	**83**	421		780		979		1245	
	%	**89**	141	60-90	123	>100	109	5-10	113	10-15
England & Wales	mm	**54**	365		720		898		1048	
	%	**75**	159	>100	143	70-100	127	10-20	119	5-10
North West	mm	**92**	440		879		1172		1380	
	%	**92**	143	60-90	129	25-40	122	8-12	118	5-10
Northumbrian	mm	**61**	287		606		823		982	
	%	**89**	137	15-25	135	20-35	127	8-12	120	5-10
Severn-Trent	mm	**46**	297		575		739		882	
	%	**77**	158	50-80	143	30-50	127	8-12	118	5-10
Yorkshire	mm	**55**	298		560		729		873	
	%	**82**	144	20-30	126	5-10	116	2-5	109	2-5
Anglian	mm	**24**	186		388		511		611	
	%	**52**	137	8-12	128	5-10	113	2-5	103	2-5
Thames	mm	**36**	342		640		770		885	
	%	**67**	202	>100	172	>100	144	30-50	128	10-15
Southern	mm	**37**	407		814		932		1053	
	%	**63**	208	>>100	183	>100	152	40-60	137	20-30
Wessex	mm	**51**	419		811		948		1076	
	%	**73**	183	>>100	163	>100	138	20-35	126	10-15
South West	mm	**78**	518		1035		1235		1409	
	%	**81**	151	50-80	140	40-60	126	10-15	118	5-10
Welsh	mm	**78**	574		1121		1362		1582	
	%	**71**	159	>100	141	>100	126	15-25	121	10-20
Highland	mm	**162**	576		1332		1645		2022	
	%	**100**	113	5-10	122	15-25	113	5-10	117	10-20
North East	mm	**51**	353		713		889		1083	
	%	**66**	146	30-50	135	20-30	118	2-5	115	2-5
Tay	mm	**111**	544		1127		1319		1561	
	%	**93**	142	20-35	144	>100	125	20-30	124	20-30
Forth	mm	**118**	426		930		1146		1339	
	%	**115**	133	15-25	138	>100	123	20-30	119	10-20
Tweed	mm	**94**	376		787		1011		1194	
	%	**117**	150	40-60	146	>100	134	25-40	126	10-20
Solway	mm	**133**	639		1257		1552		1857	
	%	**108**	164	>>100	149	>>100	134	>100	133	>>100
Clyde	mm	**175**	717		1447		1783		2130	
	%	**109**	142	30-50	135	>100	121	20-35	123	50-80

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

Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals since October 2013 are provisional.

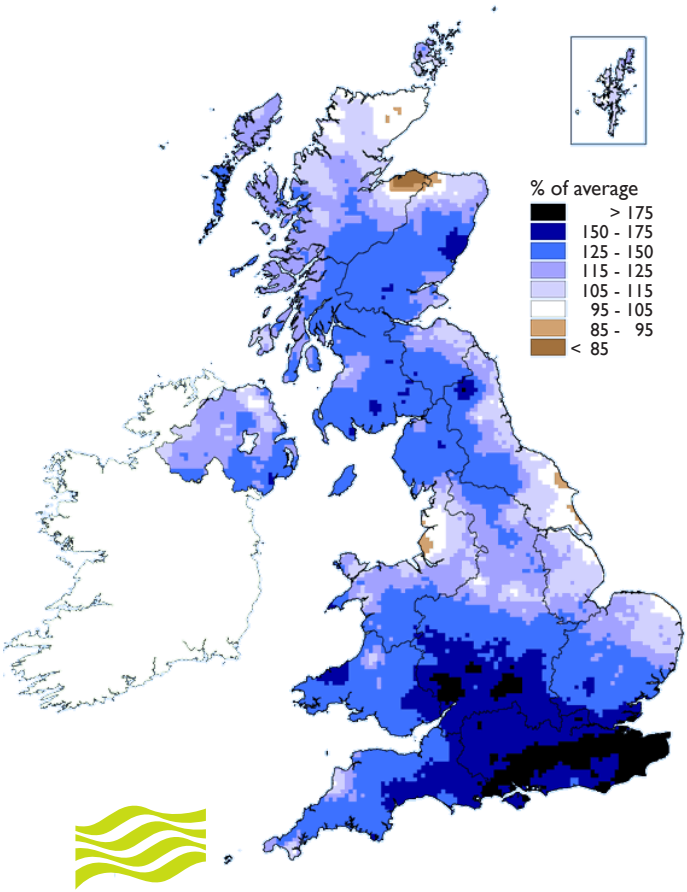
Rainfall . . . Rainfall . . .

March 2014 rainfall
as % of 1971-2000 average



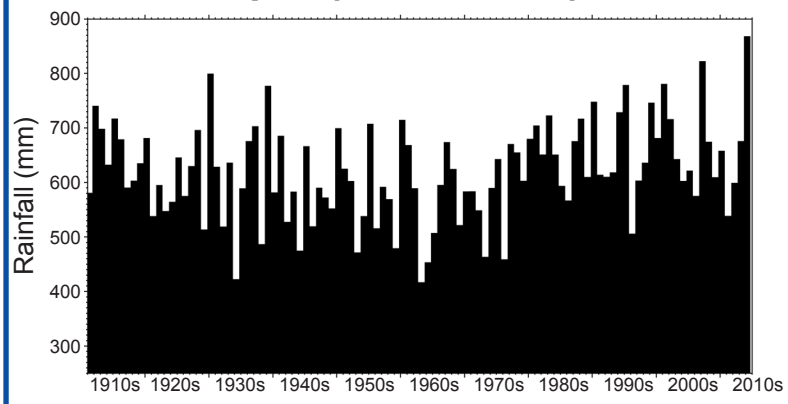
Met Office

October 2013 - March 2014 rainfall
as % of 1971-2000 average

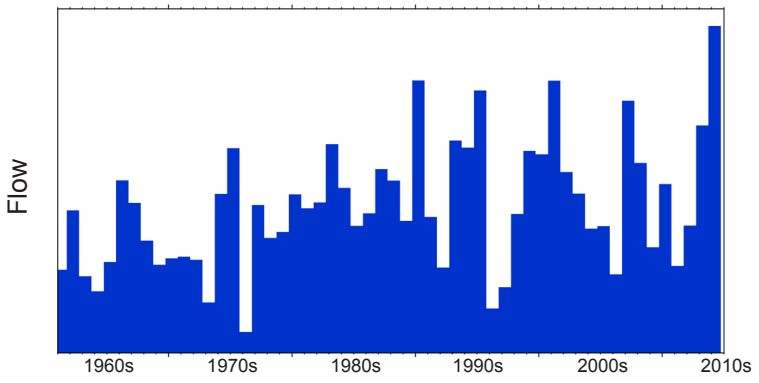


Met Office

UK winter half-year (October-March) rainfall



Water year max 90-day average outflows from GB



Met Office

Met Office 3-month outlook Updated: March 2014

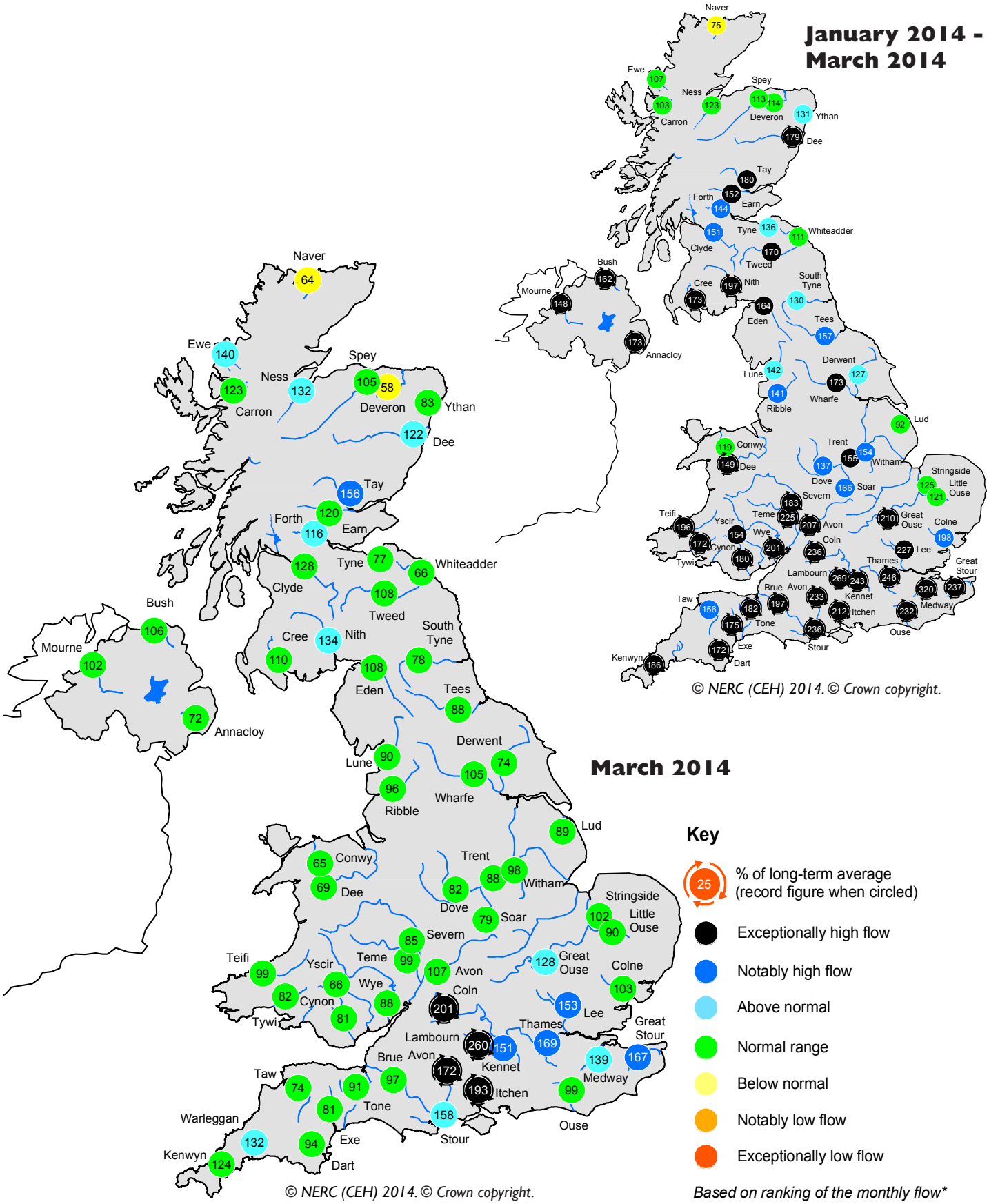
Latest predictions for UK precipitation are largely indistinguishable from climatology for April-May-June as a whole.

The probability that UK precipitation for April-May-June will fall into the driest of our five categories is between 10 and 15% and the probability that it will fall into the wettest category is between 20 and 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.

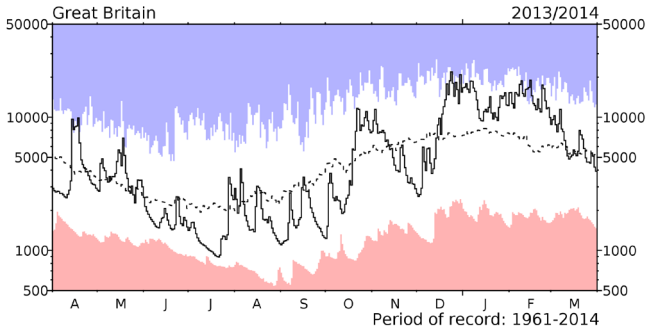
River flow . . . River flow . . .

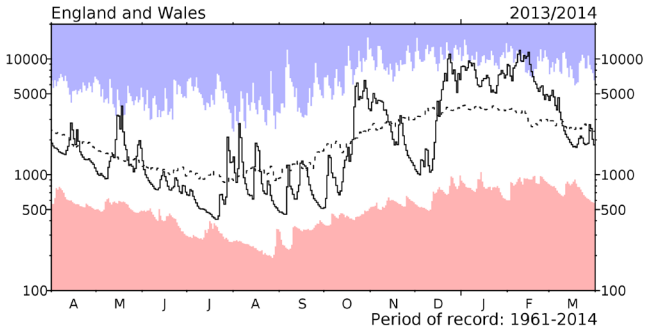


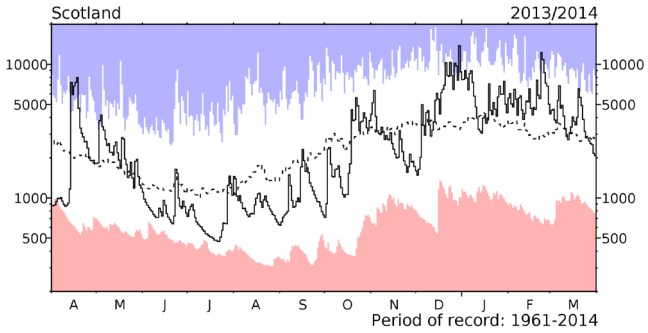
River flows

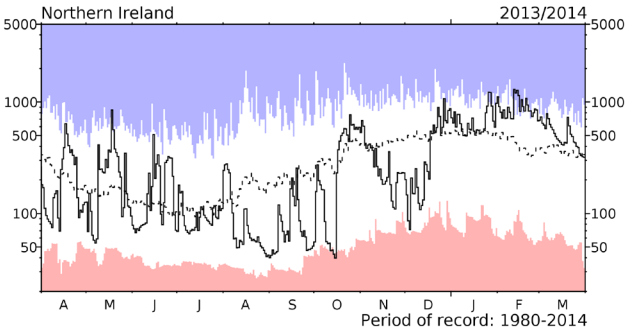
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

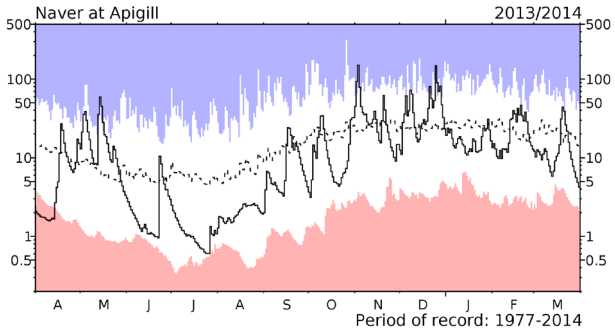
River flow . . . River flow . . .

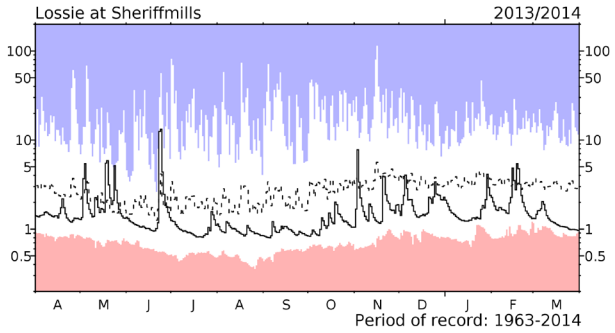


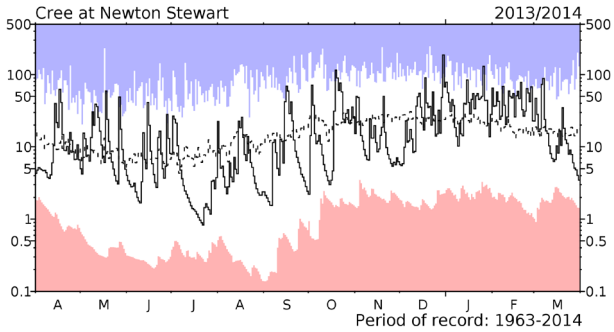


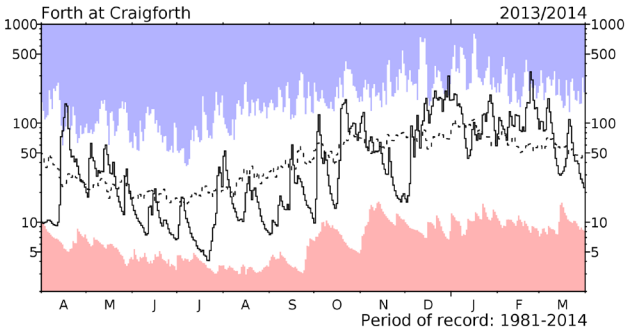


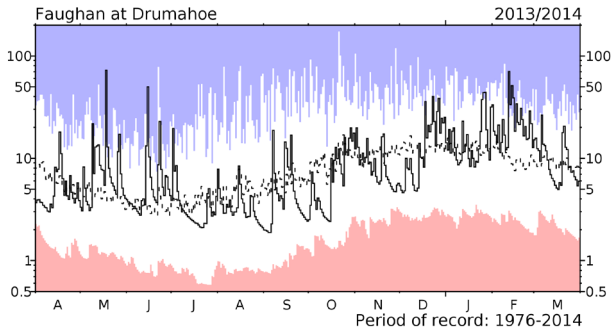


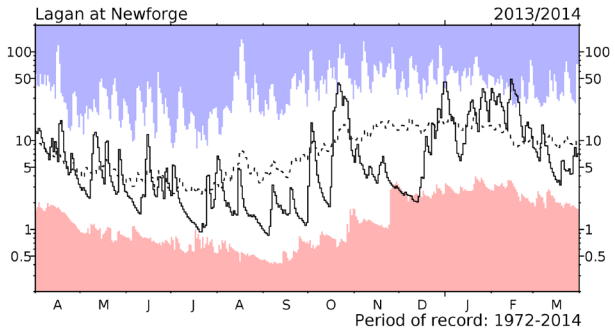








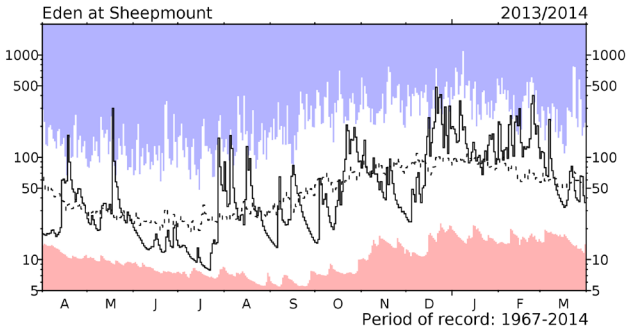


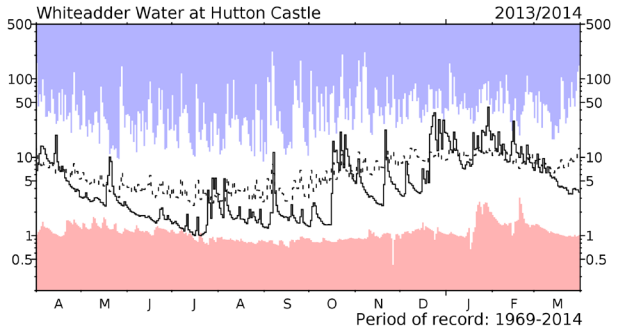


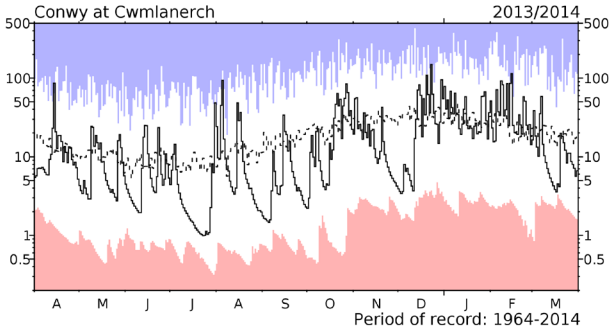
River flow hydrographs

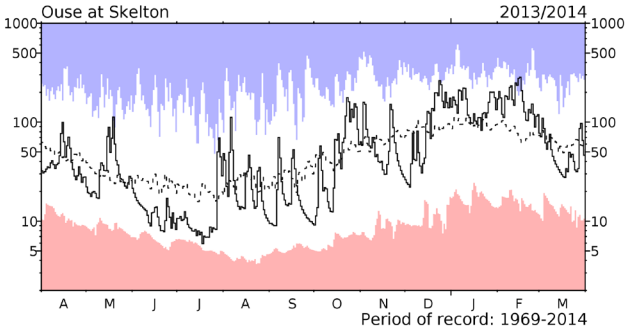
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2013 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

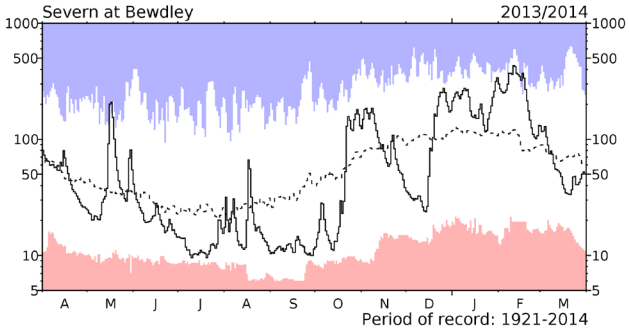
River flow . . . River flow . . .

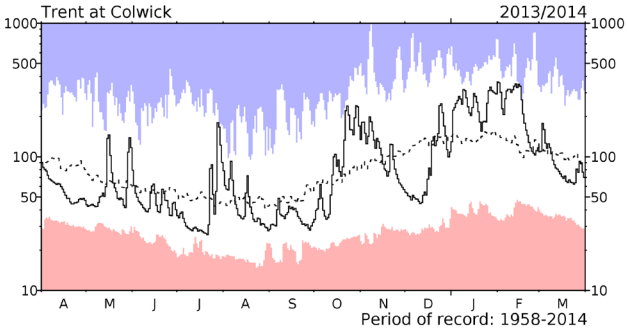


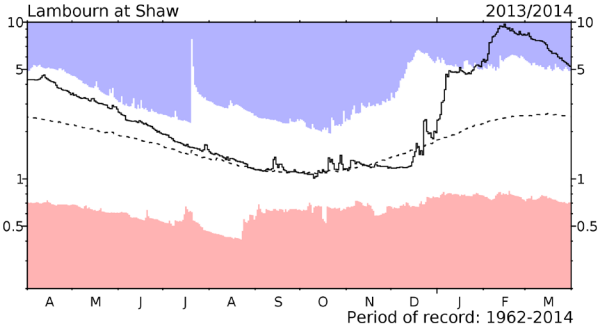


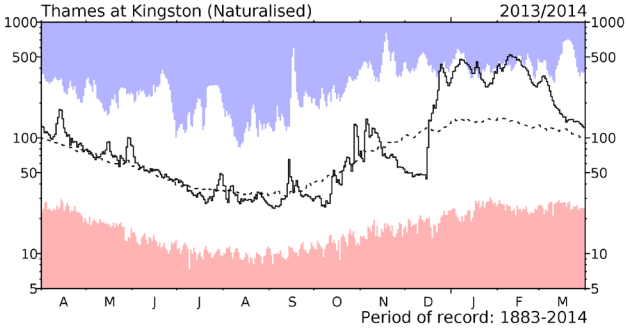


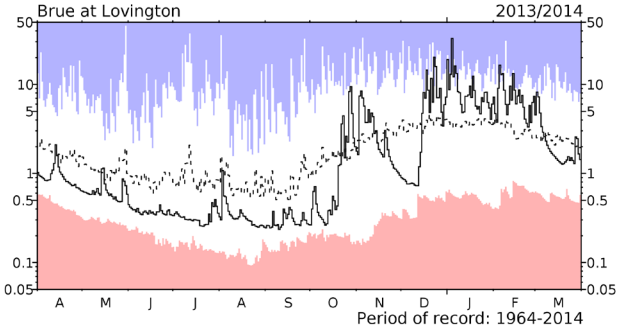


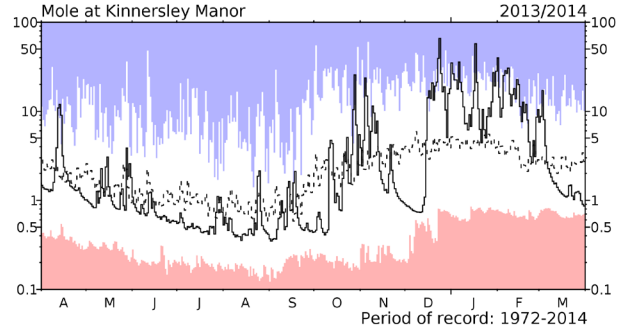


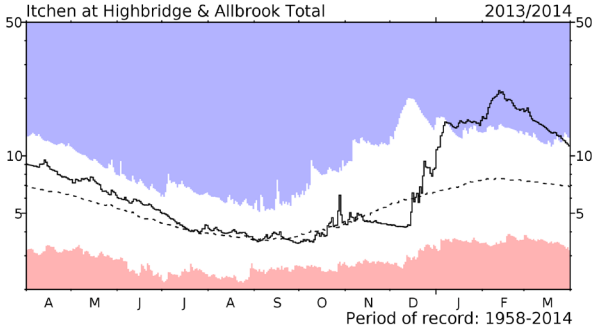


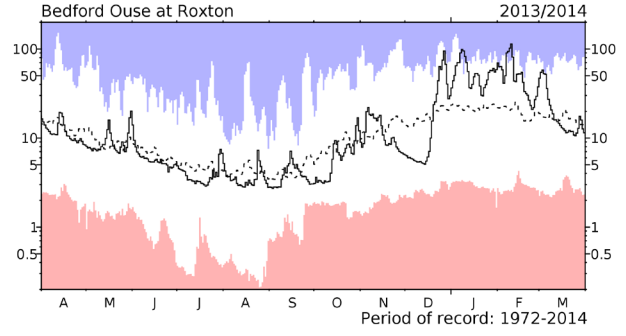




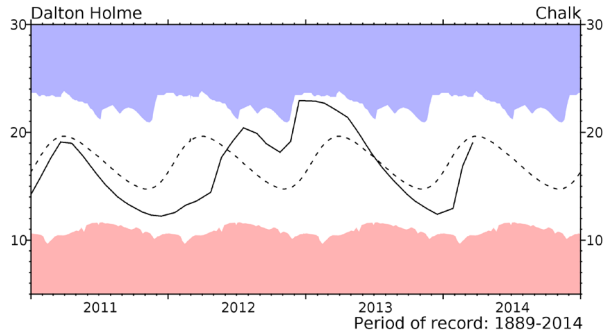


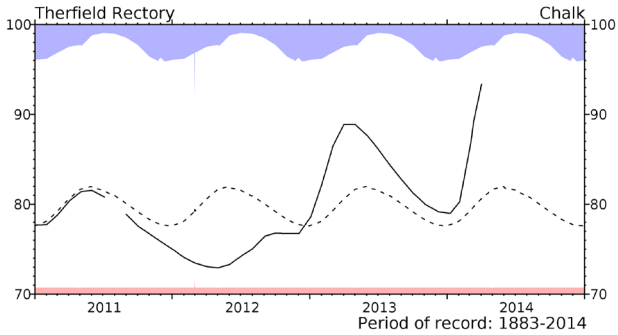


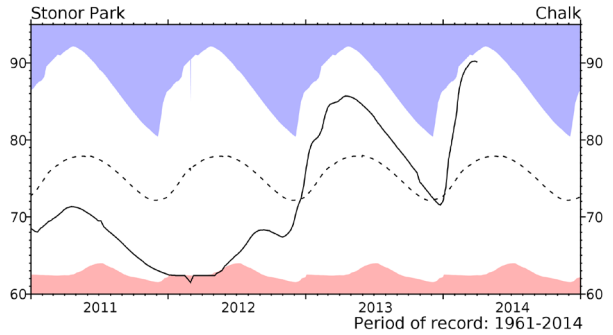


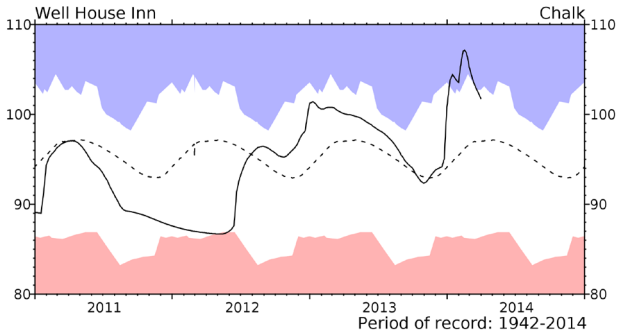


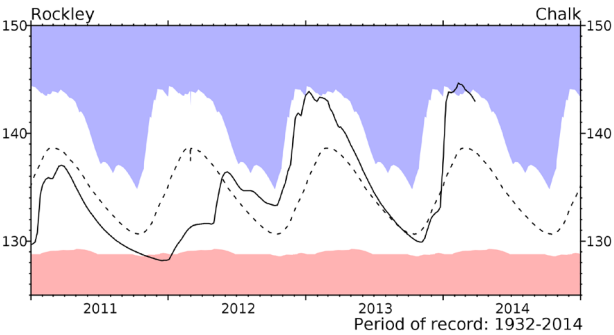
Groundwater…Groundwater

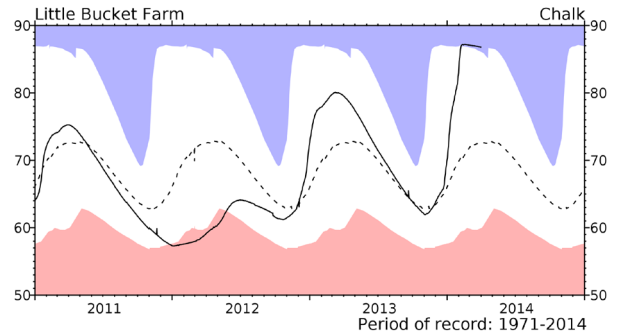


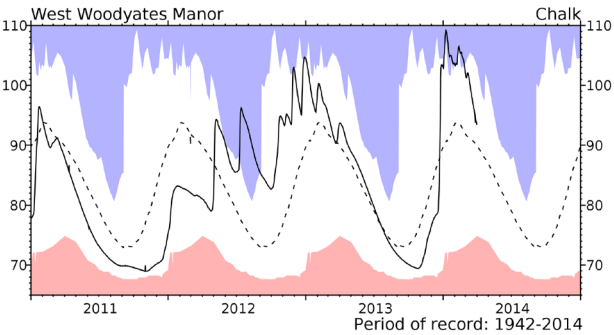


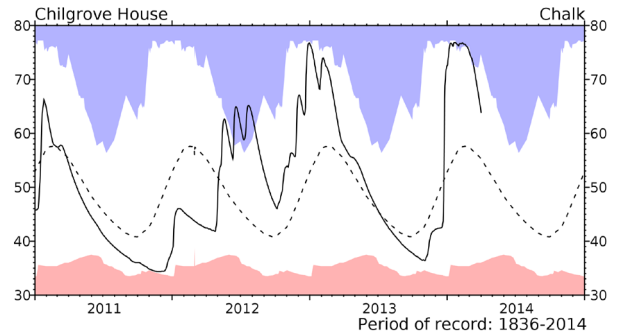


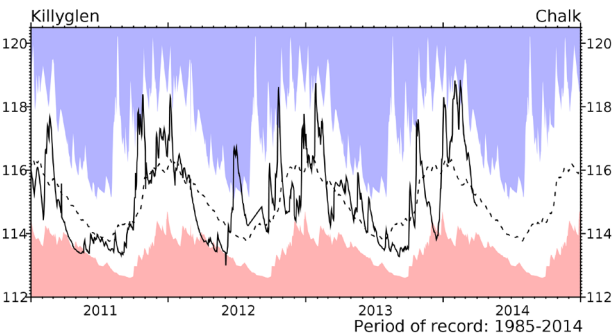


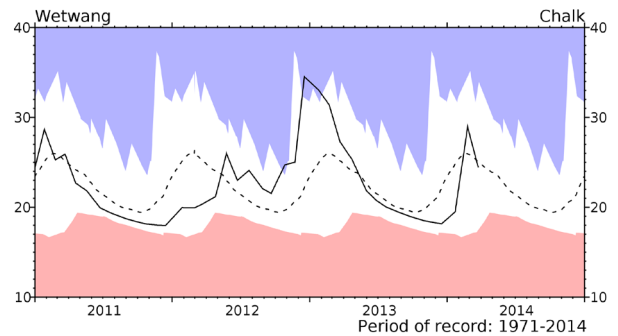






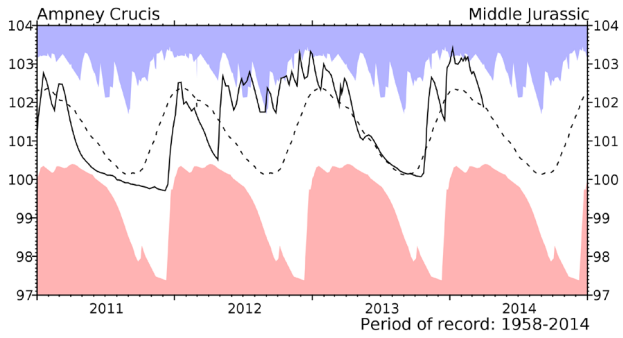


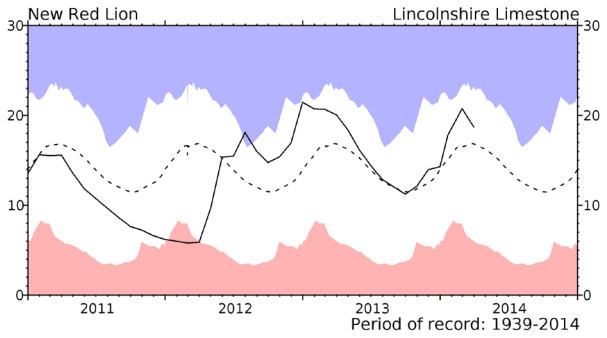


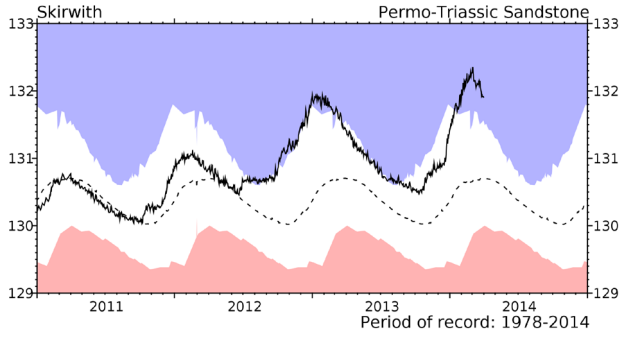


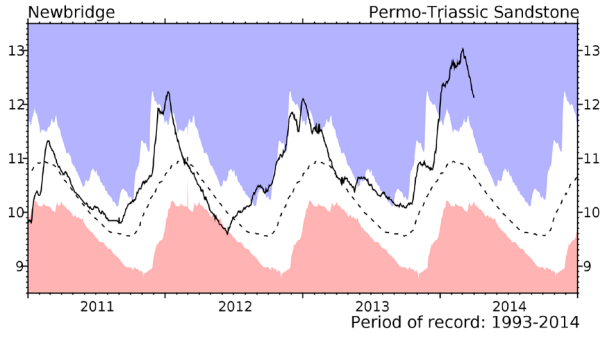
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

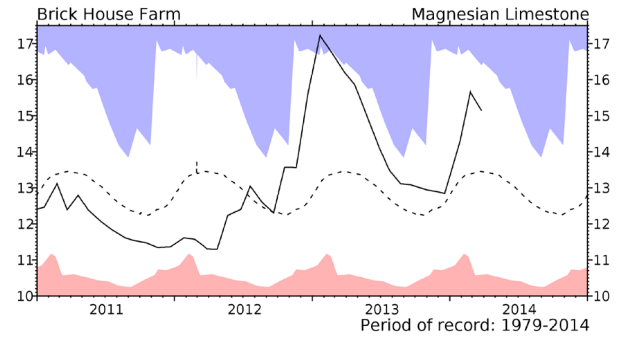
Groundwater ... Groundwater

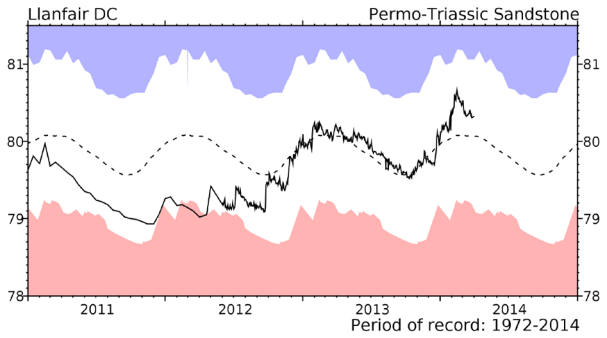


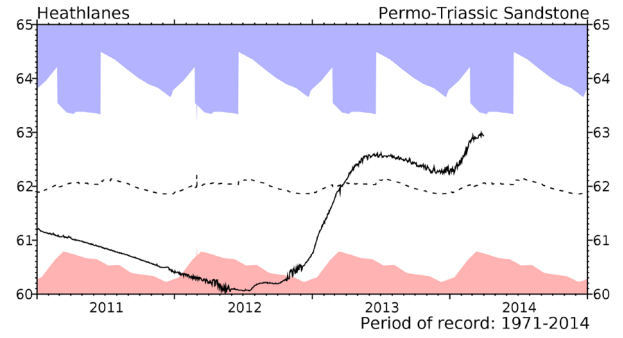


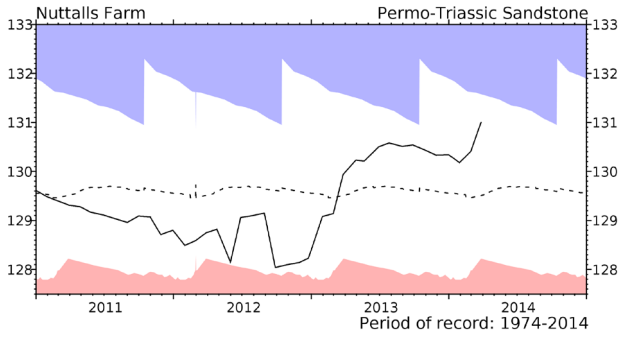


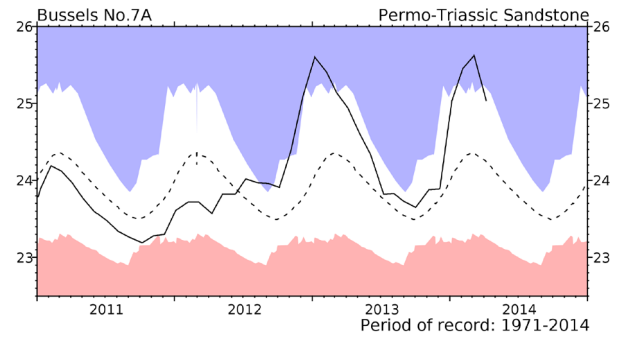


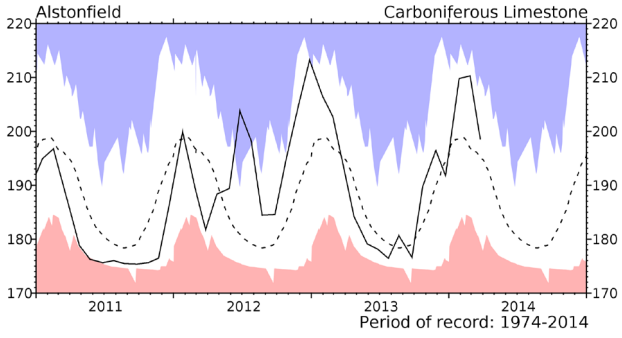








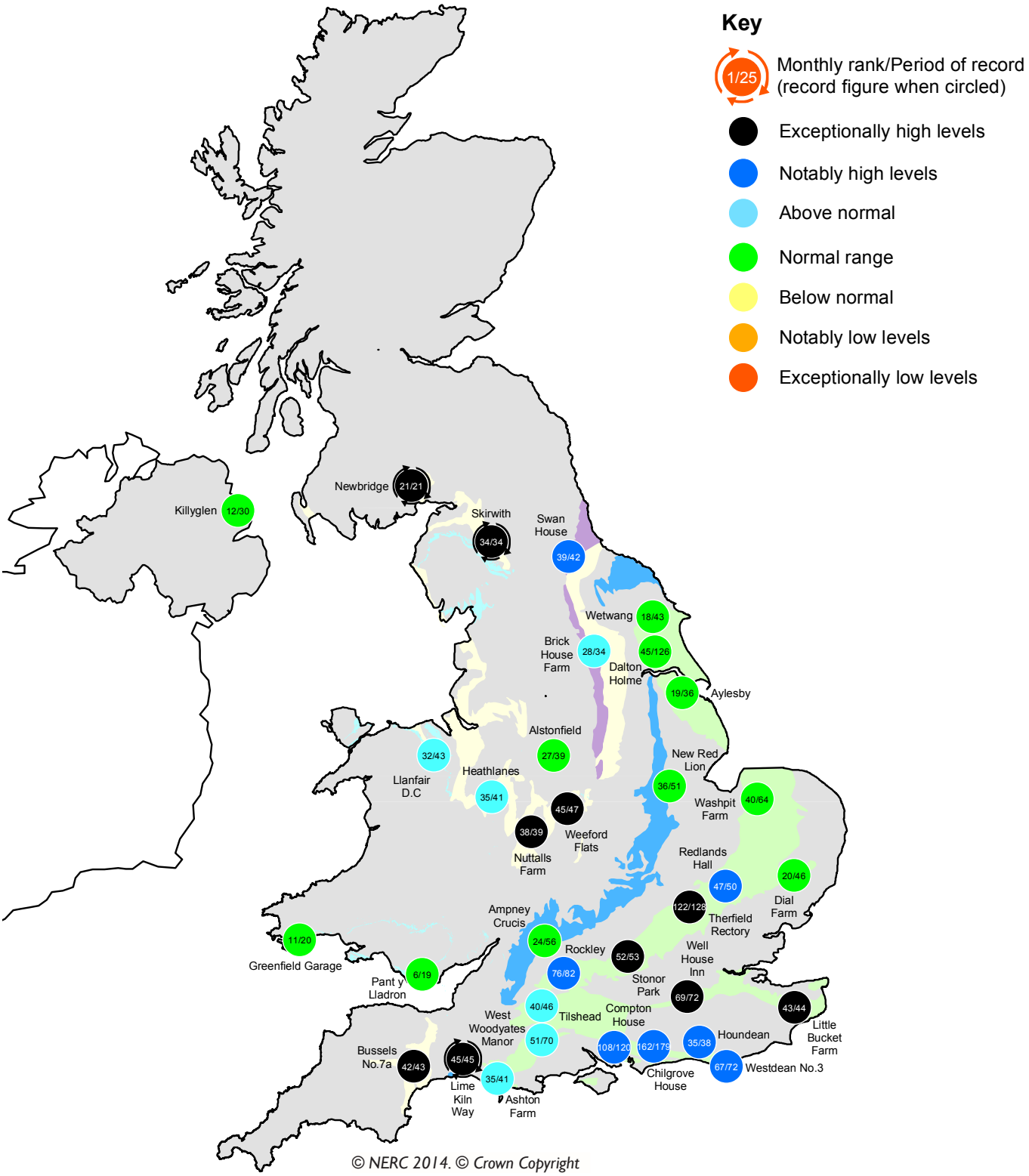




Groundwater levels March / April 2014

Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.
Dalton Holme	19.00	20/03	19.48	Chilgrove House	63.66	01/04	55.57	Brick House Farm	15.15	05/03	13.40
Therfield Rectory	93.34	02/04	79.32	Killyglen (NI)	114.87	31/03	115.42	Llanfair DC	80.32	31/03	80.04
Stonor Park	90.14	31/03	76.58	Wetwang	24.49	24/03	25.38	Heathlanes	62.94	31/03	61.93
Tilshead	98.02	31/03	93.78	Ampney Crucis	101.88	31/03	101.99	Nuttalls Farm	131.00	27/03	129.45
Rockley	142.98	26/03	138.42	New Red Lion	18.69	31/03	16.53	Bussels No.7a	25.04	07/04	24.33
Well House Inn	101.76	31/03	96.88	Skirwith	131.91	31/03	130.75	Alstonfield	198.57	25/03	195.36
West Woodyates	93.51	31/03	90.69	Newbridge	12.13	31/03	10.82				

Levels in metres above Ordnance Datum

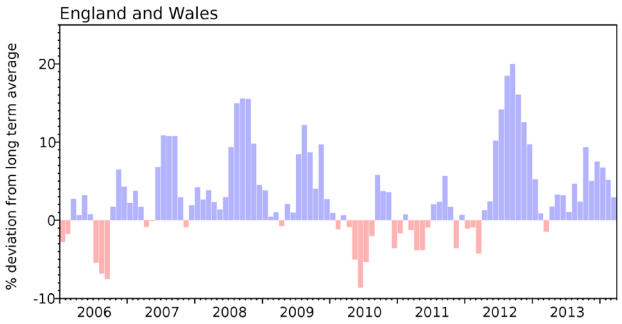


Groundwater levels - March 2014

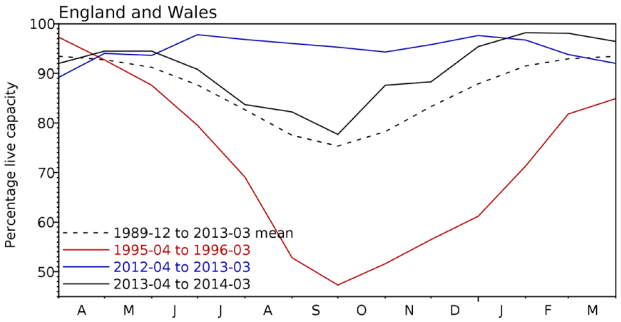
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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)	2014 Jan	2014 Feb	2014 Mar	Mar Anom.	Min Mar	Year* of min	2013 Mar	Diff 14-13
North West	N Command Zone	•	124929	100	100	93	2	77	1993	81	12
	Vyrnwy		55146	100	100	99	4	64	1996	92	7
Northumbrian	Teesdale	•	87936	100	100	100	7	77	2003	83	17
	Kielder		(199175)	97	99	93	1	81	1993	86	7
Severn-Trent	Clywedog		44922	92	91	96	1	86	1996	97	-1
	Derwent Valley	•	39525	101	99	94	-1	54	1996	90	4
Yorkshire	Washburn	•	22035	98	96	92	-1	70	1996	95	-3
	Bradford Supply	•	41407	100	100	100	6	59	1996	91	9
Anglian	Grafham		(55490)	93	95	95	4	77	1997	88	7
	Rutland		(116580)	95	95	96	6	73	2012	96	0
Thames	London	•	202828	96	95	95	0	88	1990	96	-2
	Farmoor	•	13822	100	97	99	5	80	2013	80	19
Southern	Bewl		28170	100	100	100	11	49	2012	100	0
	Ardingly**		4685	100	100	100	3	51	2012	100	0
Wessex	Clatworthy		5364	100	100	98	3	82	1992	100	0
	Bristol	•	(38666)	100	99	99	6	71	1992	96	3
South West	Colliford		28540	98	100	100	13	58	1997	100	0
	Roadford		34500	100	99	97	13	37	1996	93	4
	Wimbleball		21320	100	100	99	3	78	1996	100	-1
	Stithians		4967	100	100	100	6	52	1992	100	0
Welsh	Celyn & Brenig	•	131155	100	100	100	2	72	1996	99	1
	Brianne		62140	100	100	97	-1	90	1993	96	1
	Big Five	•	69762	100	99	98	2	78	1993	96	2
	Elan Valley	•	99106	100	100	98	1	89	1993	92	6
Scotland(E)	Edinburgh/Mid-Lothian	•	97639	100	100	99	4	71	1998	93	6
	East Lothian	•	10206	100	100	100	1	95	2012	100	0
Scotland(W)	Loch Katrine	•	111363	95	97	92	0	74	2010	81	11
	Daer		22412	98	100	94	-3	77	2013	77	17
	Loch Thom	•	11840	100	100	100	3	83	2010	90	10
Northern Ireland	Total+	•	56800	93	94	92	4	83	2002	100	-6
	Silent Valley	•	20634	100	100	96	11	57	2000	100	-4

( ) figures in parentheses relate to gross storage • denotes reservoir groups *last occurrence

** the monthly record of Ardingly reservoir stocks is under review.

+ excludes Lough Neagh

Details of the individual reservoirs in each o 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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Crowmarsh Gifford
Wallingford
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OX10 8BB

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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iii. Met Office rainfall data. © Crown copyright.

04/2014