Hydrological Summary

for the United Kingdom

August 2013

General

August was a mixed month but saw some spells of good summer weather: it was the warmest August since 2004, and rainfall was below average across most of the country, and appreciably so in parts of England and eastern Scotland. The dry spell through the latter part of the month concludes a summer that contrasts markedly with the run of wet summers observed since 2007 – it was the warmest summer since 2006 and the driest since 1996 in England & Wales. The generally stable conditions were occasionally punctuated by unsettled weather, with some locally intense downpours. Some of the highest rainfall totals were in northern and western areas, bringing runoff recoveries in responsive catchments which had seen depressed flows in July; as such, August river flows across most of the UK were in the normal range. Below-average flows in northern Scotland and some permeable catchments in southern England, coupled with below-average groundwater levels in parts of the southern Chalk, reflect moderate rainfall deficits extending back to the start of 2013. Nevertheless, the water resources situation remains relatively healthy for late summer. Reservoir stocks at the end of August were above average for England and Wales as a whole and appreciably so in some impoundments in Wales and northern England; in contrast, stocks in some reservoirs in southern England (e.g. Ardingly, Clatworthy and Wimbleball) and eastern Scotland (where stocks have been affected by maintenance works) were around 10% below average. The warmth and dryness of the last three months has resulted in the highest late-summer soil moisture deficits for a decade, which will likely result in further recessions in groundwater levels and groundwater-fed river flows, and could delay the onset of the autumn recharge season.

Rainfall

August started dry and hot (1st August was the hottest day for seven years, with 34.1°C at Heathrow) but changeable weather dominated through the first week, particularly in northern and western areas, with heavy rainfall on the 4th/5th, including 61 mm in 24h at Porthmadog, north Wales. Settled conditions then returned to the English Lowlands, but further frontal rainfall occurred in western areas before spreading across the UK between the 15th and the 18th. The rest of the month saw a good deal of stable weather associated with high pressure conditions, particularly in the last week – although intense downpours on the 24th caused surface water flooding in south Essex (with 58 mm recorded at Shoeburyness, much of which fell in four hours), bringing significant property damage and disruption. August rainfall was below average in most regions: the UK rainfall was 89% of average, with above average rainfall confined to localised parts of Wales, northern England (Wales and Northumbria regions received >110% of average), Cornwall, the Western Isles and coastal Kent and Essex. August was particularly dry in parts of central southern England, eastern Scotland and Northern Ireland, with half the monthly total registered in these localities. The summer as a whole was notably dry in southern and eastern England (the ninth driest summer in a record from 1910 for southern region) and parts of eastern and north-west Scotland. Rainfall deficits can be traced back to the start of 2013 in a majority of regions: Northern Ireland is the only region to register above average rainfall accumulations over this timeframe.

River flows

Flows in many responsive index rivers were relatively high entering August, following the substantial rainfall in the last few days of July. Rapid flow responses occurred in some western catchments following the heavy downpours around the 5th, leading to some notable spates: peak flows on the Lune (north-west England) and the Cynon (south Wales) registered as the second and fourth highest for August in records from 1959 and 1957, respectively. River flows responded similarly briskly to heavy rainfall mid-month, with the Dyfi (west Wales) exceeding its previous August maximum peak flow by a considerable margin on the 15th (in a record from 1963). Thereafter, recessions became established in the majority of index rivers across the UK. As a result, monthly runoff totals for August were within the normal range across the majority of index catchments, with above average runoff confined to a few catchments in areas of northern England and south Wales. Below-average runoff was observed in some catchments in south-east England, principally in permeable catchments (e.g. the Stringside in Anglian region and the Dorset Stour), and northern Scotland (the Spey and Naver). The Tone (Somerset) also saw notably low August runoff. Runoff for the summer as a whole was in the normal range across England and Wales, but depressed in parts of south-west England and much of Scotland – it was the third lowest June-August runoff accumulation for the Naver (northern Scotland) in a record from 1977. Below average runoff has been a feature of 2013 so far in catchments across northern and western Britain, reflecting rainfall deficits over this period; near- to above-average flows in lowland catchments over the same timeframe largely reflect a residual influence of the exceptionally wet end to 2012.

Groundwater

End of August soil moisture deficits (SMDs) were substantial over most of England (the highest August SMDs since 2003 for the English Lowlands as whole) as a result of long-term rainfall deficits and warm summer temperatures, with some of the highest SMDs occurring across the Chalk aquifers of central southern England. In late summer, SMDs normally inhibit groundwater recharge, and levels in aquifers are expected to recess steadily. Over the majority of the Chalk, groundwater levels continued to recede, with observation wells reporting normal levels in all areas except in parts of southern England which have low storage capacity, where levels are just below average. Across most other aquifers, in the Permo-Triassic sandstones and the limestones, levels are either normal or above average. The exceptions are to be found in south Wales, where levels in the very responsive Carboniferous Limestone boreholes of Greenfield Garage and Pant y Lladron are below their normal range, and in northern England and Scotland where levels in the Permo-Triassic aquifers are notably high, as the effects of last year's wet conditions are still manifest – although levels are dropping. Swan House in the Magnesian Limestone of north-east England remains at near record levels. Moving into the early autumn, with relatively high soil moisture deficits in southern England, groundwater levels can be expected to continue to recede, which could lead to below-average levels becoming more widespread in the autumn.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

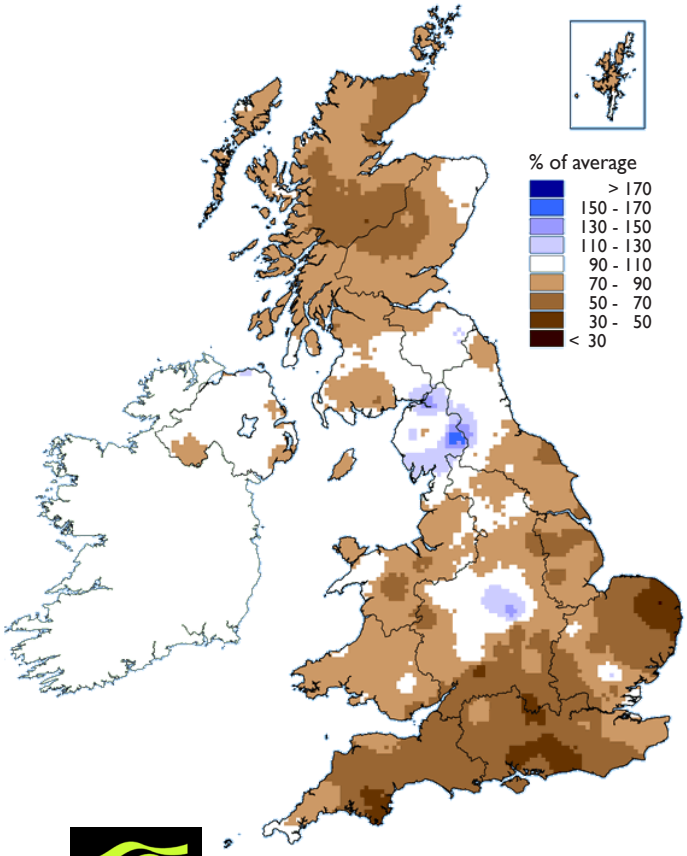
Area	Rainfall	Aug 2013	Jun13 – Aug13	RP	Mar13 – Aug13	RP	Jan13 – Aug13	RP	Sep12 – Aug13	RP
United Kingdom	mm	**72**	182		402		572		1126	
	%	**89**	84	5-10	92	5-10	89	5-10	105	2-5
England	mm	**57**	143		309		430		895	
	%	**87**	80	5-10	87	5-10	87	5-10	110	2-5
Scotland	mm	**89**	228		519		750		1425	
	%	**89**	86	5-10	94	2-5	90	2-5	99	2-5
Wales	mm	**111**	226		473		689		1412	
	%	**110**	88	2-5	89	5-10	87	5-10	104	2-5
Northern Ireland	mm	**57**	223		498		713		1162	
	%	**62**	94	2-5	106	2-5	106	2-5	105	2-5
England & Wales	mm	**64**	155		332		466		966	
	%	**92**	82	5-10	88	5-10	87	5-10	109	2-5
North West	mm	**97**	265		451		608		1300	
	%	**102**	105	2-5	93	2-5	88	5-10	111	2-5
Northumbria	mm	**79**	192		383		510		1005	
	%	**112**	101	2-5	102	2-5	99	2-5	122	5-10
Midlands	mm	**49**	153		317		428		836	
	%	**78**	88	2-5	93	2-5	91	2-5	111	2-5
Yorkshire	mm	**63**	162		325		435		910	
	%	**96**	89	2-5	90	2-5	87	5-10	113	2-5
Anglian	mm	**43**	100		227		306		614	
	%	**83**	66	8-12	79	5-10	81	5-10	103	2-5
Thames	mm	**38**	97		263		365		742	
	%	**70**	63	8-12	84	5-10	85	5-10	107	2-5
Southern	mm	**47**	95		259		385		843	
	%	**88**	62	10-15	82	5-10	85	5-10	109	2-5
Wessex	mm	**36**	108		277		426		944	
	%	**54**	63	10-15	78	8-12	83	5-10	110	2-5
South West	mm	**78**	148		376		586		1304	
	%	**94**	68	5-10	83	5-10	84	5-10	109	2-5
Welsh	mm	**108**	219		461		669		1371	
	%	**110**	88	2-5	90	5-10	88	5-10	105	2-5
Highland	mm	**113**	236		595		860		1635	
	%	**103**	80	8-12	95	2-5	88	2-5	95	2-5
North East	mm	**52**	177		380		522		936	
	%	**74**	88	5-10	94	5-10	92	5-10	99	2-5
Tay	mm	**52**	174		436		651		1224	
	%	**62**	77	8-12	90	5-10	87	5-10	97	2-5
Forth	mm	**50**	186		401		580		1132	
	%	**61**	84	5-10	88	5-10	86	5-10	100	2-5
Tweed	mm	**73**	213		418		556		1099	
	%	**98**	105	2-5	102	2-5	96	2-5	116	2-5
Solway	mm	**88**	270		573		814		1529	
	%	**83**	99	2-5	104	2-5	99	2-5	109	5-10
Clyde	mm	**104**	281		601		894		1736	
	%	**82**	87	2-5	92	2-5	90	2-5	100	2-5

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

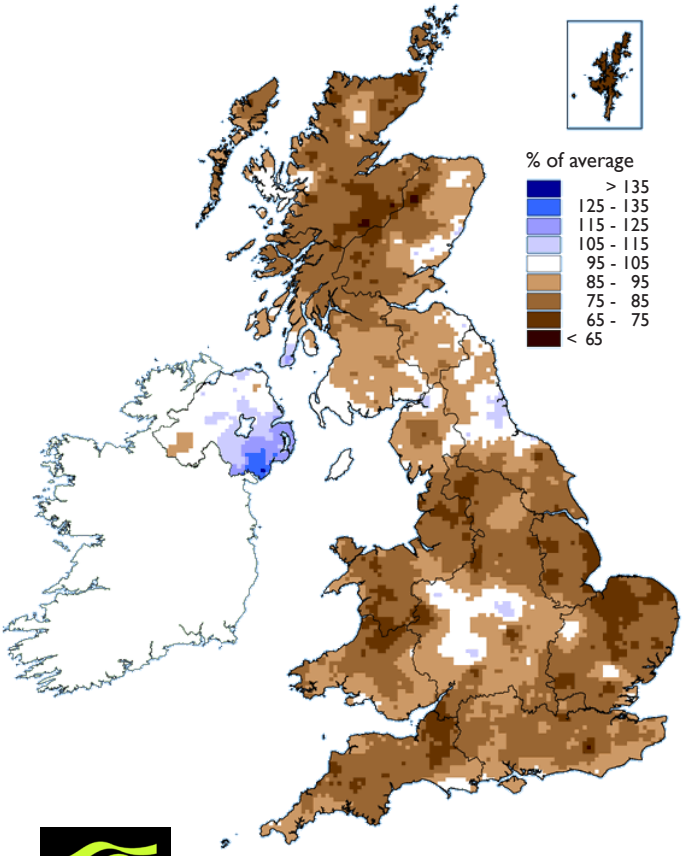
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 March 2013 are provisional.

Rainfall . . . Rainfall . . .

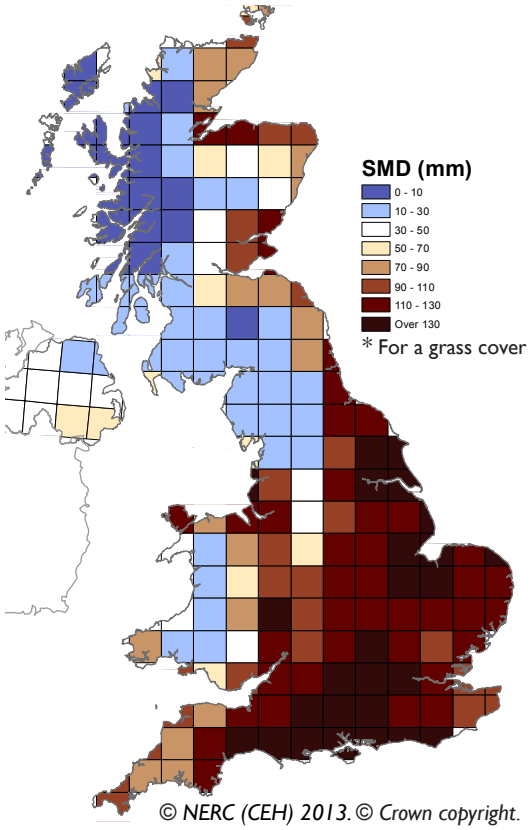
June 2013 - August 2013 rainfall as % of 1971-2000 average



January 2013 - August 2013 rainfall as % of 1971-2000 average



MORECS Soil Moisture Deficits* August 2013



Met Office 3-month outlook Updated: August 2013

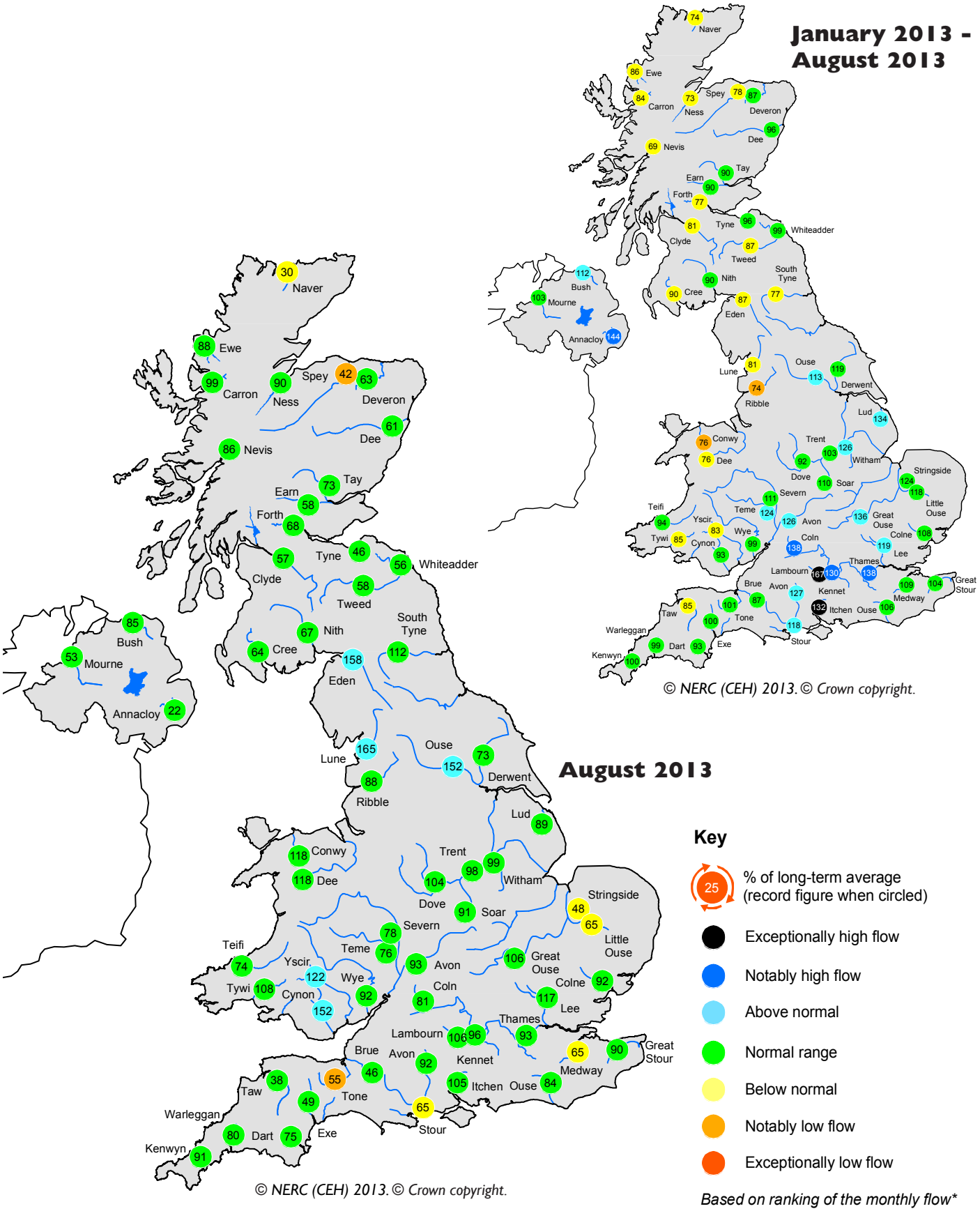
For September-October-November as a whole the forecast signal is similar to climatology, but with slightly higher probabilities for near-average rainfall.

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

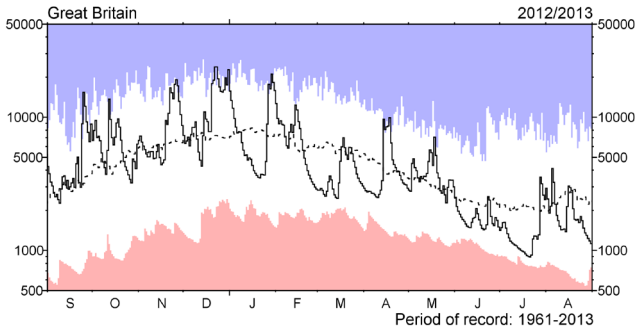
River flow . . . River flow . . .

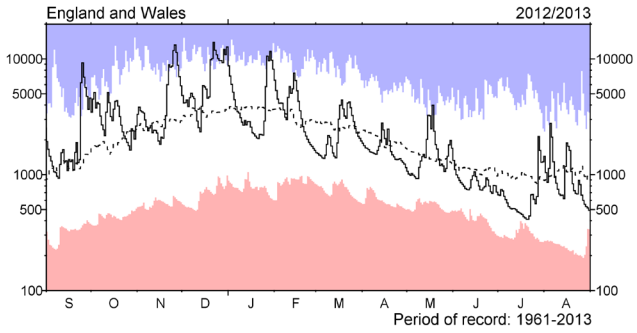


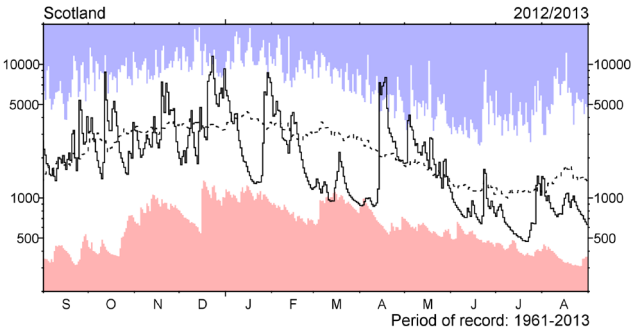
River flows

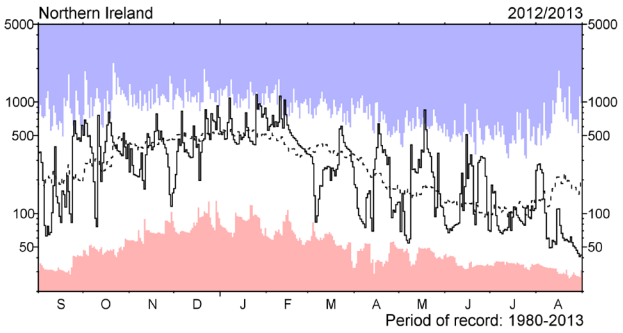
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

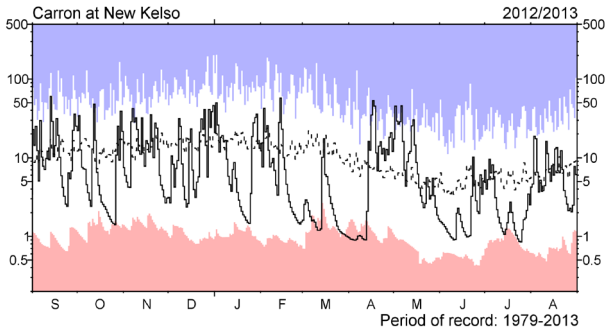
River flow . . . River flow . . .

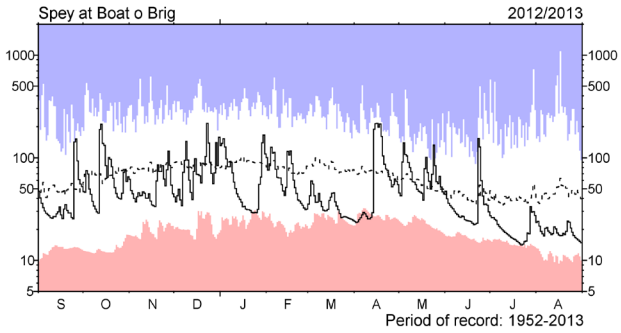


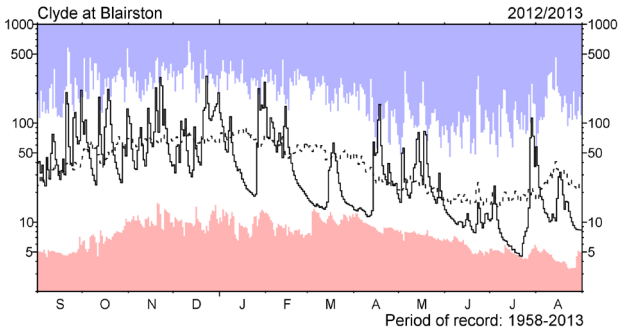


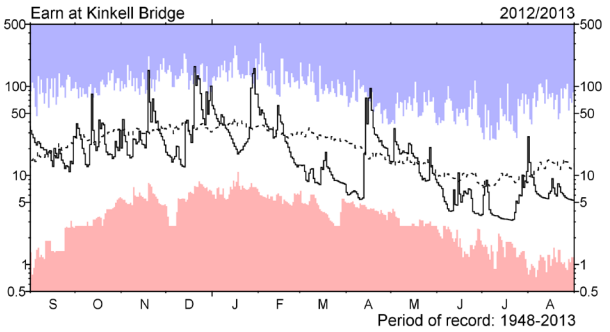


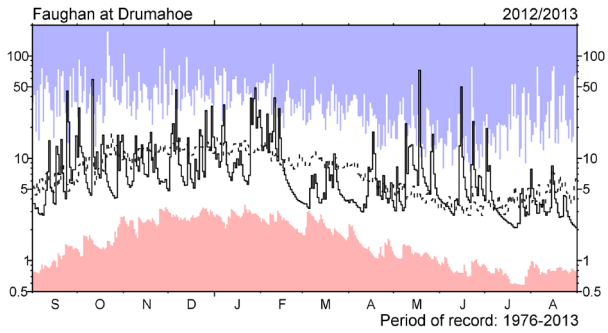


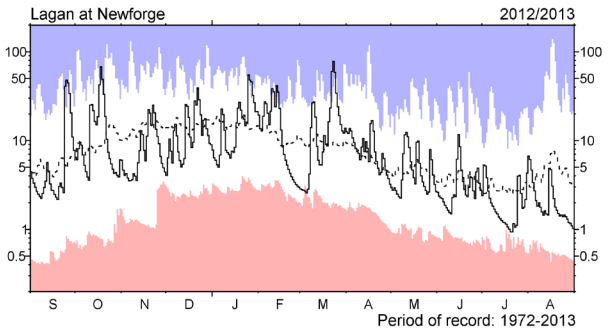








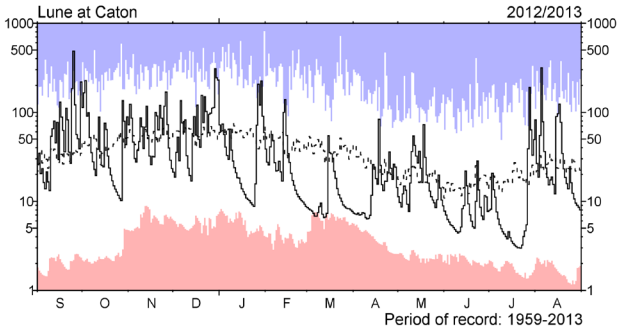


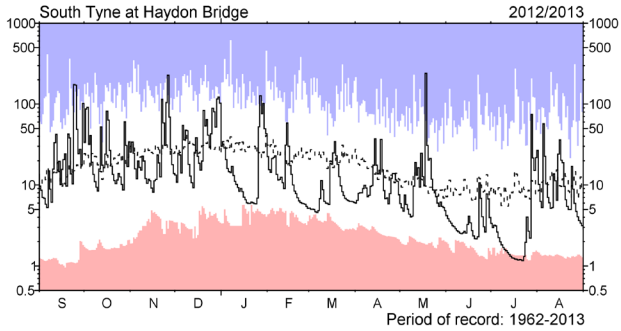


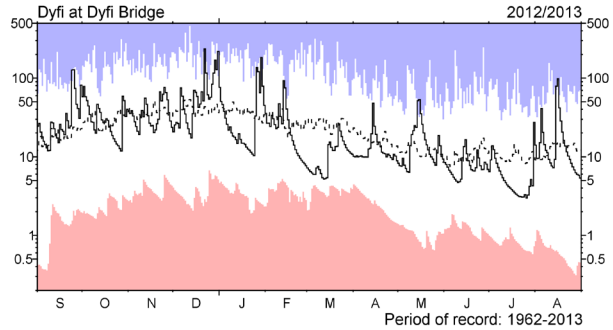
River flow hydrographs

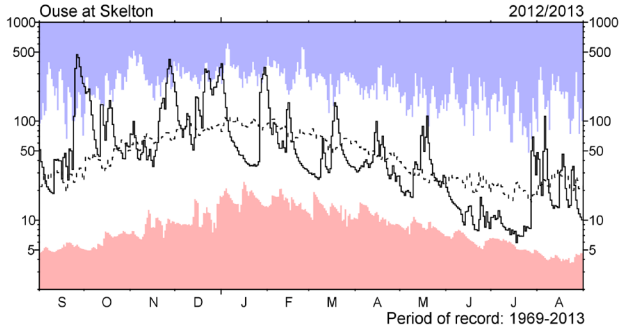
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to September 2012 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

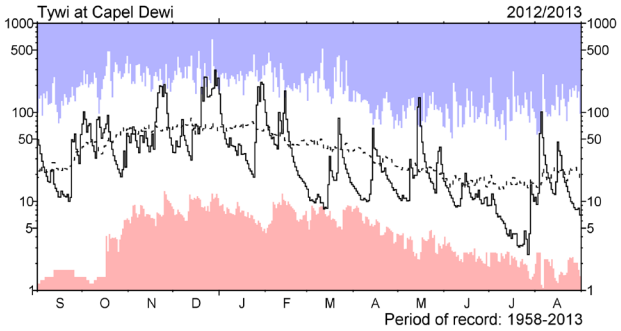
River flow . . . River flow . . .

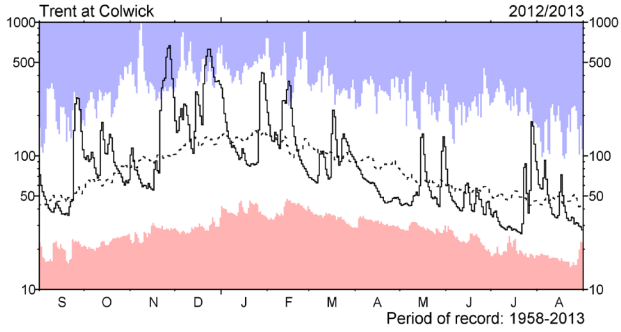


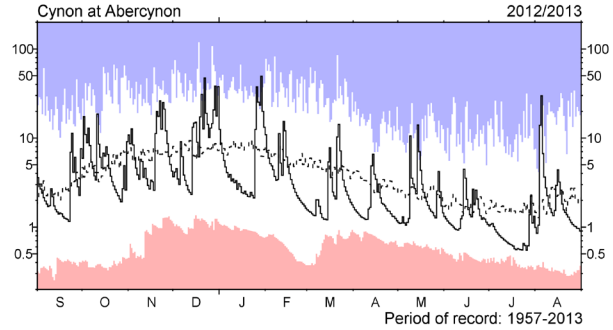


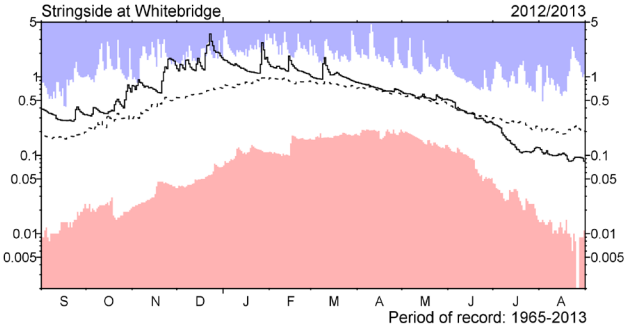


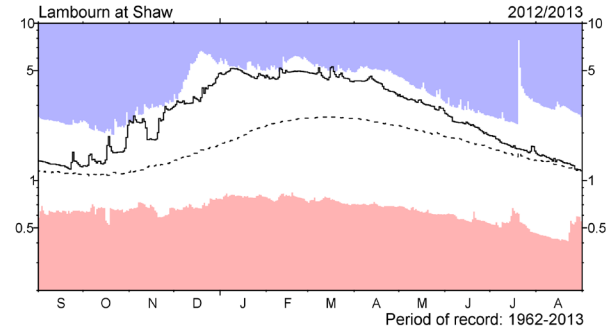


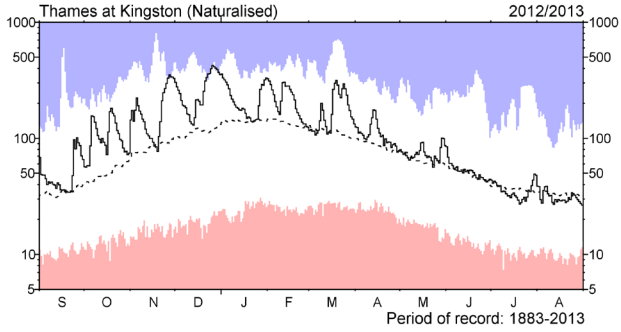


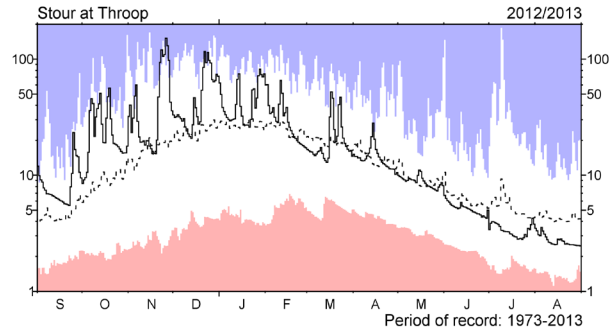


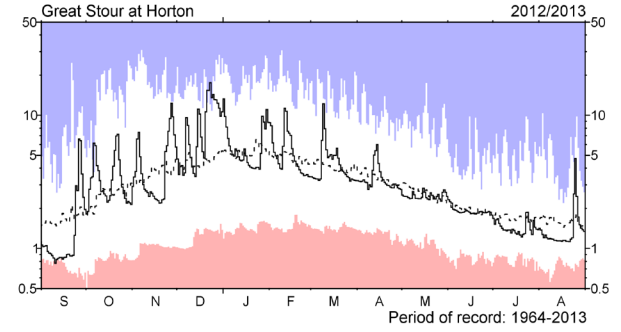




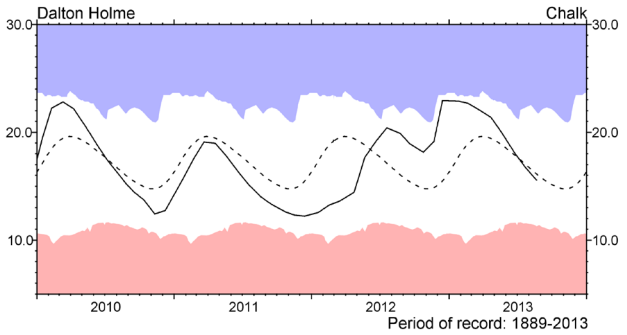


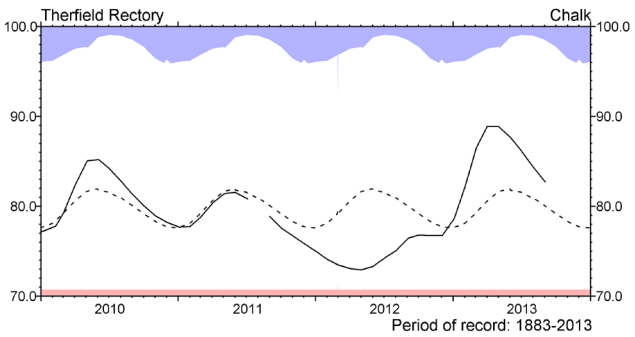


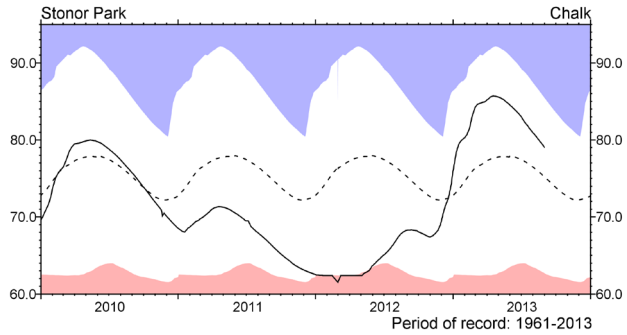


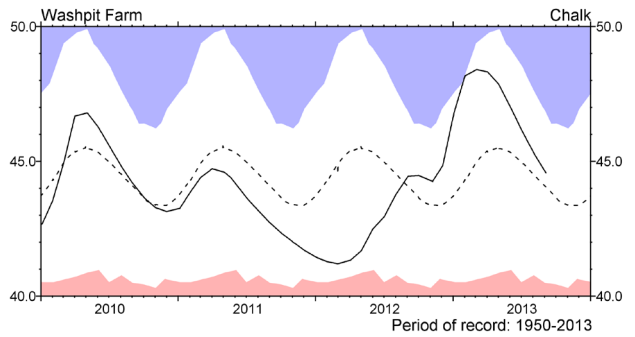


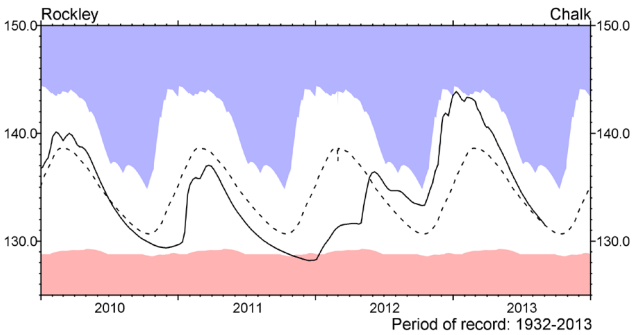
Groundwater…Groundwater

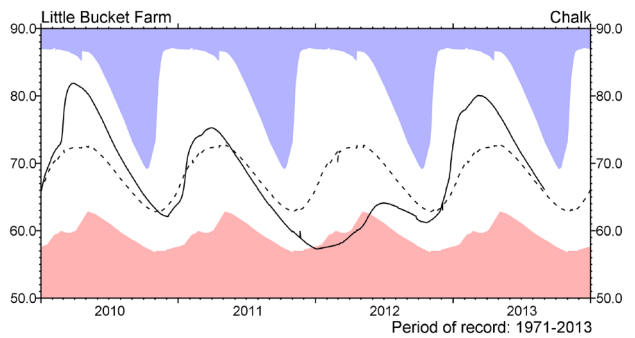


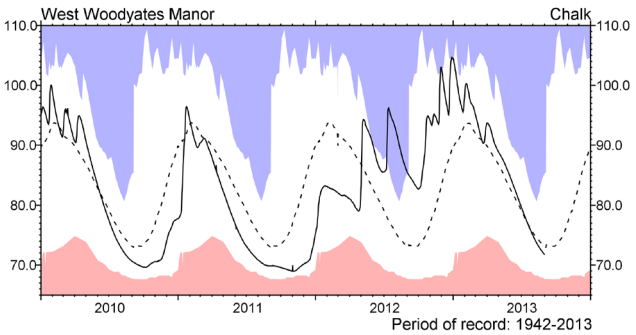


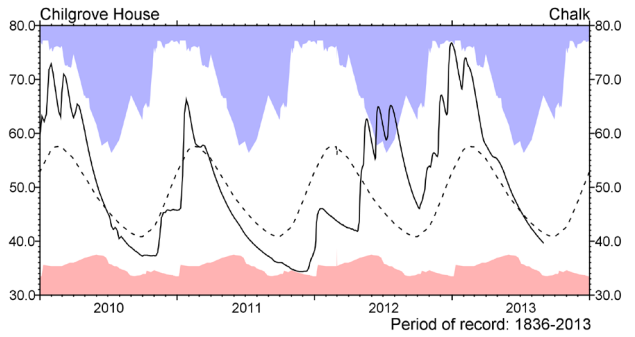


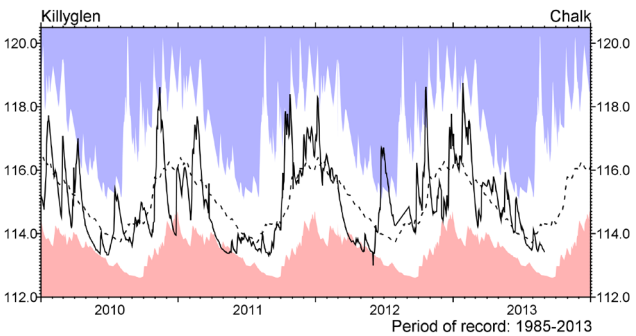


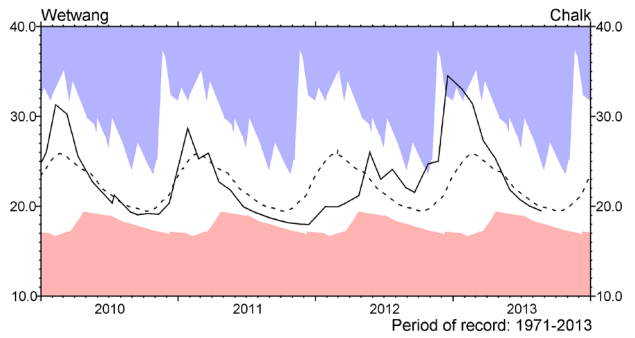






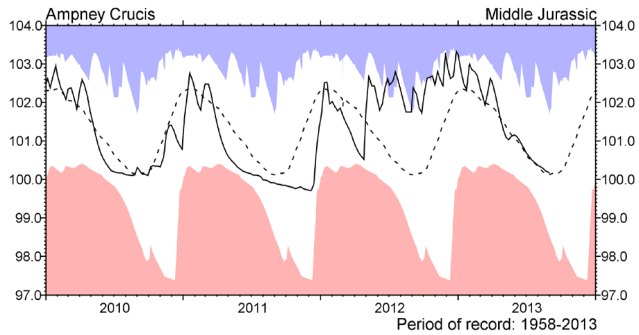


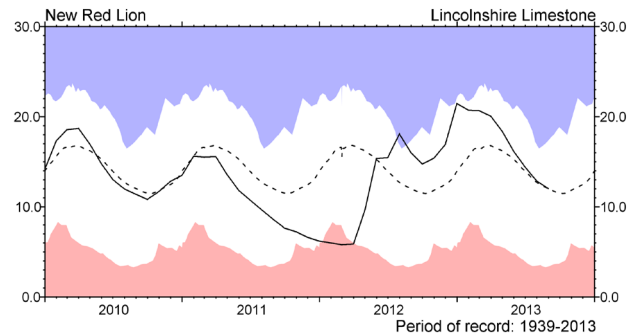


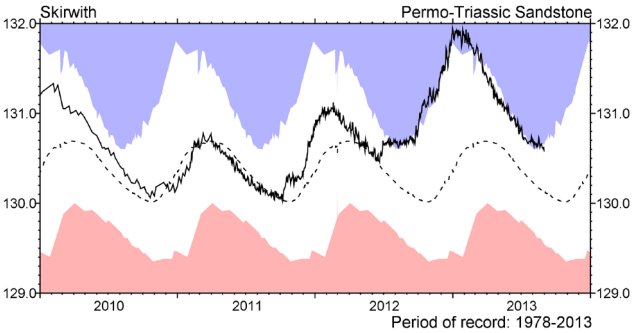


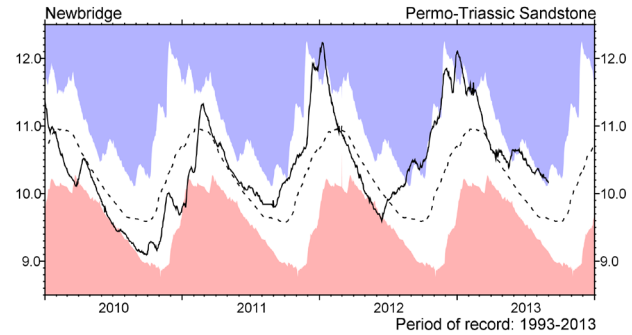
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

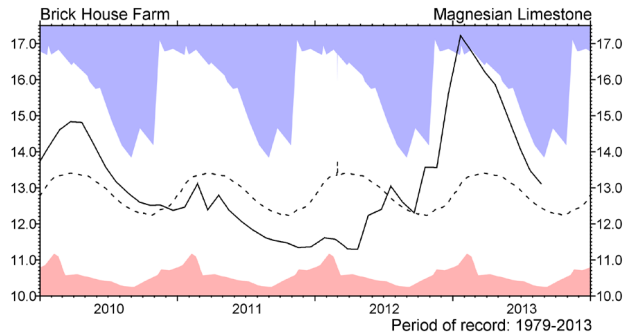
Groundwater... Groundwater

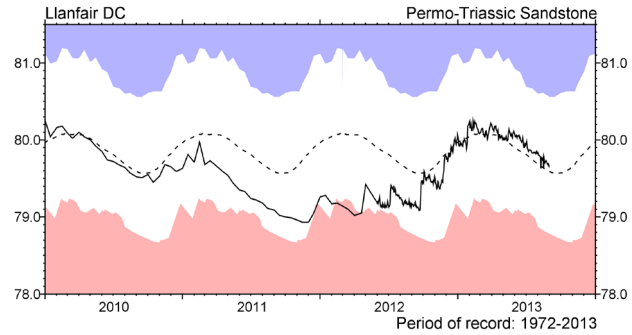


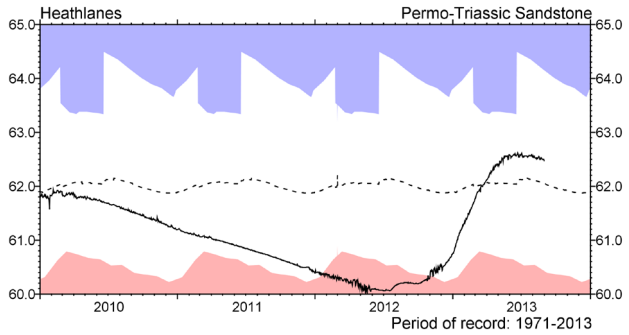


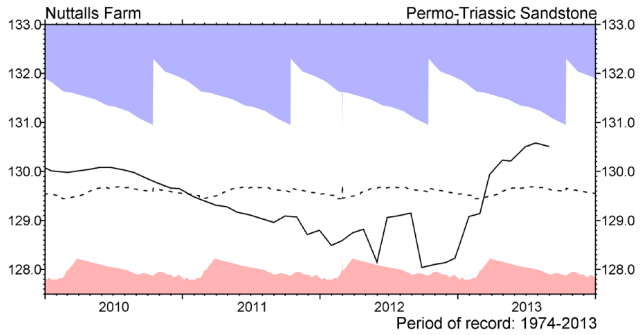


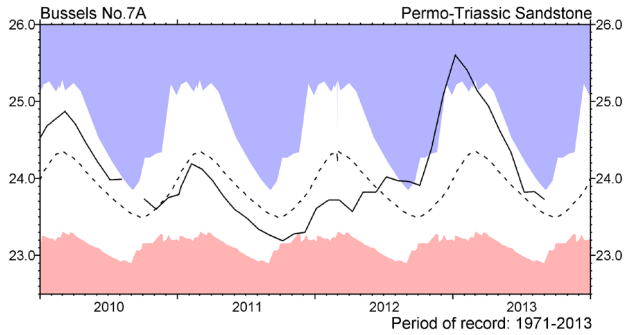


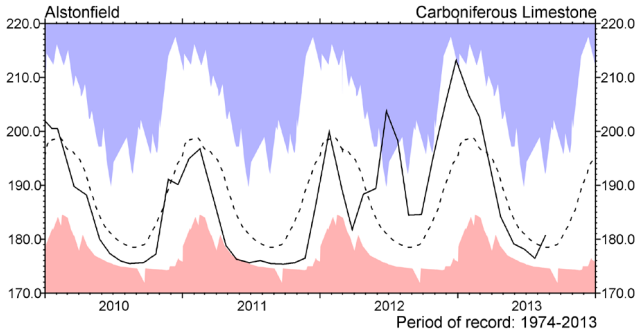








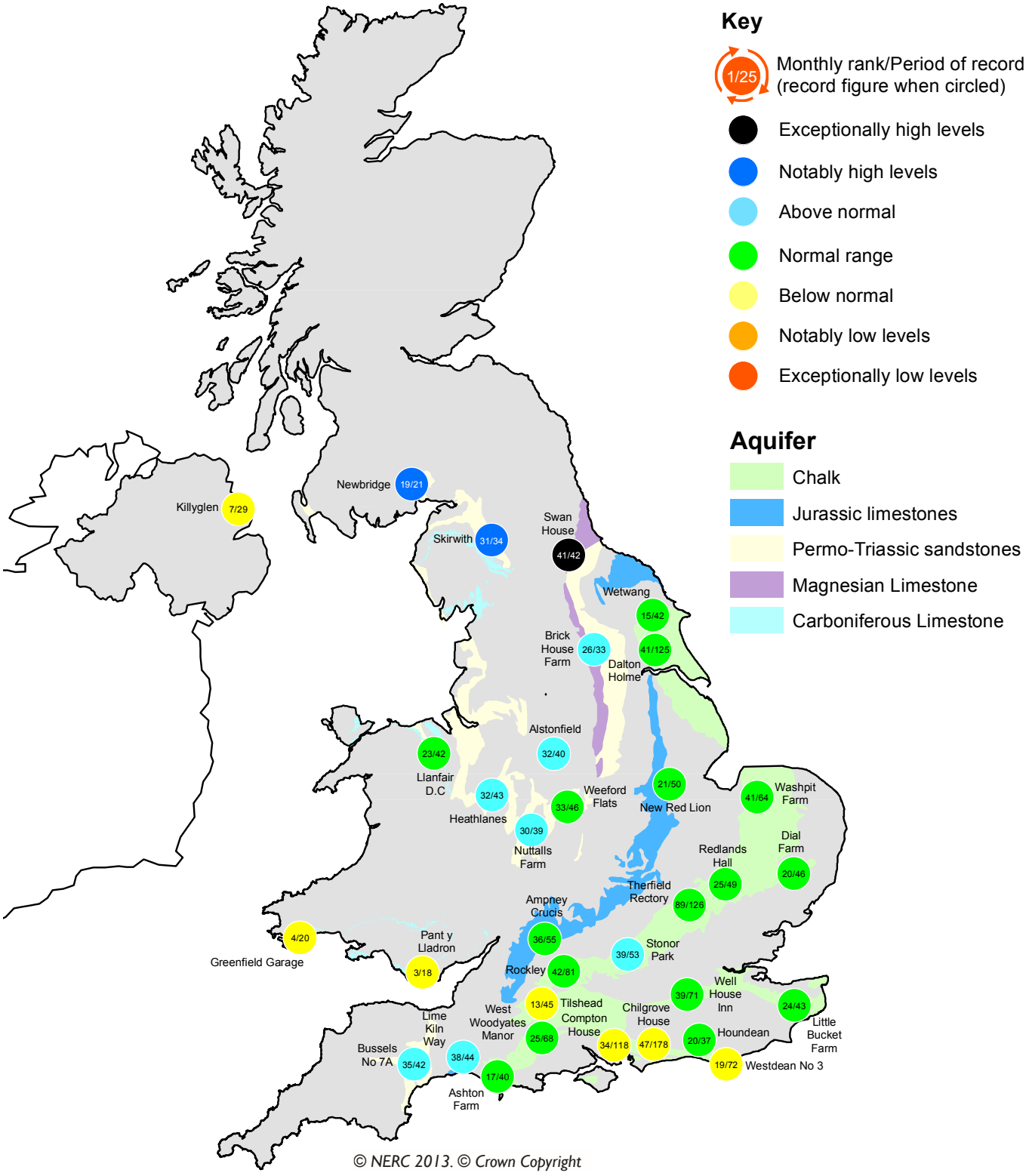




Groundwater levels August / September 2013

Borehole	Level	Date	Aug av.	Borehole	Level	Date	Aug av.	Borehole	Level	Date	Aug av.
Dalton Holme	15.55	21/08	16.28	Chilgrove House	39.62	31/08	41.78	Brick House Farm	13.11	23/08	12.52
Therfield Rectory	82.70	02/09	80.88	Killyglen (NI)	113.43	31/08	114.06	Llanfair DC	79.65	31/08	79.63
Stonor Park	79.04	31/08	75.57	Wetwang	19.48	22/08	20.07	Heathlanes	62.47	31/08	62.01
Tilshead	81.00	31/08	82.97	Ampney Crucis	100.17	31/08	100.25	Nuttalls Farm	130.51	30/08	129.62
Rockley	131.57	31/08	132.08	New Red Lion	12.01	31/08	12.35	Bussels No.7a	23.73	31/08	23.61
Well House Inn	95.49	31/08	94.83	Skirwith	130.57	31/08	130.22	Alstonfield	180.63	21/08	178.58
West Woodyates	71.79	31/08	74.21	Newbridge	10.16	31/08	9.67				

Levels in metres above Ordnance Datum



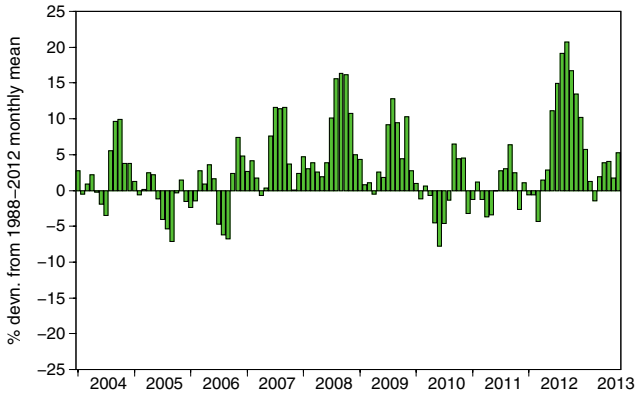
Groundwater levels - August 2013

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.

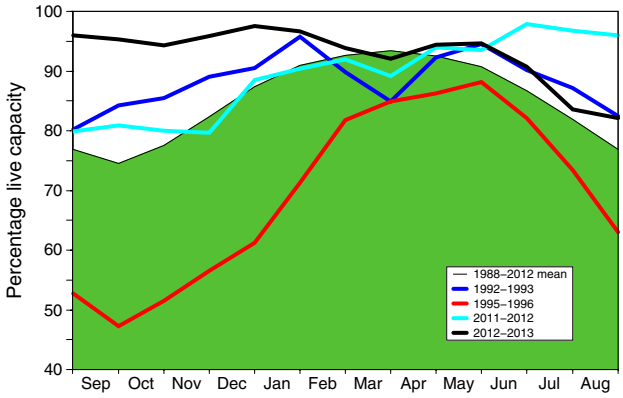
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs at end of month

Area	Reservoir		Capacity (Ml)	2013 Jun	2013 Jul	2013 Aug	Aug Anom.	Min Aug	Year* of min	2012 Aug	Diff 13-12
North West	N Command Zone	•	124929	73	64	67	9	15	1984	92	-25
	Vyrnwy		55146	94	82	80	10	36	1995	100	-20
Northumbrian	Teesdale	•	87936	90	83	93	24	38	1995	95	-2
	Kielder		(199175)	90	89	86	-2	66	1989	95	-9
Severn Trent	Clywedog		44922	99	87	90	15	27	1976	91	-1
	Derwent Valley	•	39525	76	69	65	-2	34	1995	95	-30
Yorkshire	Washburn	•	22035	83	72	69	-1	34	1995	94	-25
	Bradford supply	•	41407	77	63	62	-5	21	1995	97	-35
Anglian	Grafham		(55490)	94	92	91	5	59	1997	95	-4
	Rutland		(116580)	92	86	80	-1	66	1995	98	-18
Thames	London	•	202828	97	93	90	9	62	1995	96	-6
	Farmoor	•	13822	98	93	96	3	64	1995	93	3
Southern	Bewl		28170	93	82	77	8	38	1990	83	-6
	Ardingly		4685	98	86	66	-8	47	1996	100	-34
Wessex	Clatworthy		5364	78	70	56	-9	31	1995	98	-42
	Bristol WW	•	(38666)	83	71	60	-9	43	1990	98	-38
South West	Colliford		28540	91	82	72	0	43	1997	89	-17
	Roadford		34500	86	76	73	1	40	1995	94	-21
	Wimbleball		21320	85	74	60	-11	40	1995	100	-40
	Stithians		4967	82	72	66	4	30	1990	95	-29
Welsh	Celyn and Brenig	•	131155	99	90	89	7	49	1989	99	-10
	Brianne		62140	99	94	99	12	55	1995	100	-1
	Big Five	•	69762	95	83	84	13	29	1995	98	-14
	Elan Valley	•	99106	95	84	83	7	37	1976	100	-17
Scotland(E)	Edinburgh/Mid Lothian**	•	97639	92	82	67	-12	45	1998	100	-33
	East Lothian	•	10206	98	88	87	3	63	1989	100	-13
Scotland(W)	Loch Katrine**	•	111363	78	66	65	-7	50	2000	90	-25
	Daer**		22412	65	56	60	-17	41	1995	100	-40
	Loch Thom	•	11840	85	85	82	0	58	1997	99	-17
Northern Ireland	Total+	•	55540	91	85	76	2	40	1995	97	-20
	Silent Valley	•	20634	93	82	73	2	33	2000	100	-27

( ) figures in parentheses relate to gross storage
** stocks affected by maintenance in 2013.
+ excludes Lough Neagh
• denotes reservoir groups
*last occurrence

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; hydro-power generation may also influence reservoir stocks. Monthly figures may be artificially low due to routine maintenance or water quality issues.

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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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.

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