Hydrological Summary

for the United Kingdom

October 2013

General

October was a stormy month, the wettest October since 2000 for England & Wales, and the wettest month of the year so far. For parts of southern England, as much rainfall fell in October as in the previous four months combined. The most significant impact of the sustained rainfall was the rapid reduction of historically high early autumn soil moisture deficits (SMDs); for England & Wales, the recovery in soil moisture levels was the second largest in a single month, behind only the sudden cessation of drought conditions in 1976. Rivers responded to persistent rainfall from mid-month, although the early-October backdrop of moderately depressed flows and very high soil moisture deficits largely restricted impacts to moderate floodplain inundations rather than extreme high flows. Reservoir stocks also benefited from the wet conditions; in Northern Ireland, Silent Valley registered its second largest increase for any single month in a series from 1993. The increase in overall stocks for England ranked second on record for the time of year, resulting in reservoir storage that was comfortably above average. After concerns at the beginning of October about the timing of the onset of groundwater recharge, the moderation of SMDs across most aquifer outcrops allowed infiltration to commence, suggesting a healthy overall picture for water resources approaching the winter season.

Rainfall

The variety of synoptic patterns exhibited in October was typically autumnal, although conditions were generally unsettled throughout. Southerly air flows caused mild, albeit mixed, weather in early-October with widespread rainfall on the 3rd (60mm was reported at Aberdaron, Caenarfon). Anticyclonic conditions in mid-month brought northerly air flows and cold, predominantly dry conditions, albeit with sporadic outbreaks of rain, most notably on the 11th/12th when 62mm was recorded at Herstmonceux, East Sussex. Thereafter, south-westerlies drove a succession of vigorous low pressure systems across the UK culminating on the 27th/28th with the 'St Jude' storm, one of the most powerful of recent years, which developed to the south-west of the UK and swiftly tracked north-eastwards across southern England. Significant short-duration rainfall was recorded (e.g. 50mm overnight at Otterbourne, Hampshire) but totals were generally suppressed by the speed of the storm; its defining characteristic was strong (often gale-force) winds which were most damaging across southern England, and peaked at 99mph at The Needles (Isle of Wight). The winds brought down hundreds of trees, cutting off power to 625,000 customers and causing serious travel disruption. October registered 120-200% of the long-term average rainfall for most regions of the UK, and was the second wettest October since 1987 for many areas of southern, central and eastern England. More notably, it was only the second occasion since 1910 that October rainfall exceeded that of the preceding four months for the Southern region of England. Deficiencies in accumulated precipitation over the year so far were generally moderated, and remain most apparent in northern and western areas of Scotland, the only region in the UK to receive near-average rainfall in October.

River flows

The first half of October generally witnessed the continuation of suppressed river flows from the summer and early autumn, but persistent rainfall heralded recoveries from mid-month. Flows in eastern areas (away from the South East) mostly returned to the normal range but elsewhere above average flows were prevalent over the last fortnight. Localised flash flooding was reported in Cornwall on the 3rd, south Wales from the 19th-21st and southern Scotland on the 22nd. The passage of the St Jude storm on the 27th/28th triggered eight Flood Warnings (all in the South West) and 144 Flood Alerts, although impacts were limited to moderate floodplain inundations affecting many regions of the UK as catchments became saturated towards month-end; daily flows rarely registered new maxima. For October, south Wales, the South West and the Midlands exhibited above normal flows; elsewhere, river flows fell within the normal range, or below for the far north of Scotland. The Spey recorded below average flows on every day for four consecutive calendar months, only the second time this has occurred in a record back to 1952. Nevertheless, river flows throughout northern Scotland remained above daily minima for the time of year. Despite witnessing the wettest month of the year, river flow accumulations for 2013 remain below average for many responsive catchments in north Wales, northern England and northern Scotland, notably so in the far north of Scotland.

Groundwater

The most important impact of the wet October in water resources terms was the significant moderation of large SMDs across most outcrop areas. However, some index boreholes report mid-month levels and this, together with the depth to the water table, implies that the late-October infiltration may not yet be reflected in the hydrographs. Water levels fell in the majority of the Chalk index wells during October with the exception of some faster responding sites (Compton House, Ashton Farm, Houndean Bottom and Westdean No.3) near the south coast. However, levels were within the normal range, with the exception of Yorkshire (Wetwang and Dalton Holme) and parts of southern England (West Woodyates Manor and Chilgrove House) where they were below normal. In the Permo-Triassic sandstones, water levels were generally above seasonal averages but continued to fall in the slowly responding aquifers of the Midlands. In the Magnesian Limestone, water levels declined but remained high, particularly further north (Swan House). In the Jurassic limestone aquifers, levels were within the normal range at New Red Lion in the Lincolnshire Limestone (where they fell) and Ampney Crucis in the Cotswolds (where they increased). In the fast responding Carboniferous Limestone, levels were above average in the Peak District and south Wales following notably low levels at the end of September; an increase of ~25m during October was observed at Pant y Lladron.

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

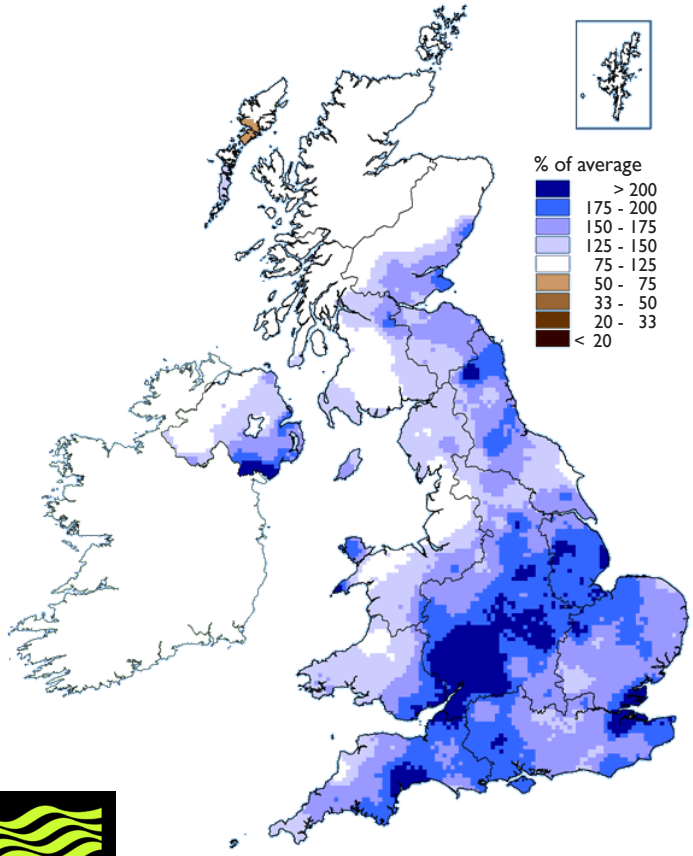
Area	Rainfall	Oct 2013	Jun 13 – Oct 13	RP	Jan 13 – Oct 13	RP	Oct 12 – Oct 13	RP	Aug 12 – Oct 13	RP
United Kingdom	mm	**161**	414		805		1246		1470	
	%	**143**	97	2-5	95	2-5	105	2-5	108	2-5
England	mm	**139**	337		626		1002		1180	
	%	**170**	101	2-5	97	2-5	112	2-5	115	5-10
Scotland	mm	**181**	504		1023		1550		1833	
	%	**118**	92	2-5	91	2-5	97	2-5	101	2-5
Wales	mm	**223**	528		999		1591		1879	
	%	**152**	101	2-5	95	2-5	106	2-5	109	2-5
Northern Ireland	mm	**160**	451		939		1277		1501	
	%	**139**	102	2-5	106	2-5	105	2-5	107	2-5
England & Wales	mm	**151**	363		678		1083		1277	
	%	**166**	101	2-5	96	2-5	111	2-5	113	2-5
North West	mm	**173**	523		878		1381		1713	
	%	**138**	109	2-5	95	2-5	107	2-5	115	2-5
Northumbria	mm	**132**	391		706		1071		1311	
	%	**175**	117	2-5	107	2-5	119	5-10	126	15-25
Midlands	mm	**133**	327		605		931		1099	
	%	**188**	105	2-5	100	2-5	113	2-5	115	5-10
Yorkshire	mm	**121**	327		601		959		1173	
	%	**157**	100	2-5	93	2-5	108	2-5	115	2-5
Anglian	mm	**103**	239		447		712		808	
	%	**179**	91	2-5	91	2-5	108	2-5	106	2-5
Thames	mm	**119**	272		538		863		975	
	%	**169**	94	2-5	96	2-5	113	2-5	111	2-5
Southern	mm	**157**	305		596		978		1099	
	%	**178**	97	2-5	98	2-5	114	2-5	112	2-5
Wessex	mm	**166**	333		652		1094		1276	
	%	**190**	99	2-5	96	2-5	116	5-10	117	5-10
South West	mm	**212**	445		890		1519		1763	
	%	**167**	101	2-5	96	2-5	115	5-10	117	8-12
Welsh	mm	**218**	517		974		1548		1828	
	%	**154**	102	2-5	96	2-5	107	2-5	110	2-5
Highland	mm	**188**	531		1150		1731		2039	
	%	**104**	84	5-10	87	2-5	91	2-5	94	2-5
North East	mm	**112**	337		679		1022		1188	
	%	**110**	86	5-10	90	8-12	98	2-5	99	2-5
Tay	mm	**178**	420		898		1398		1627	
	%	**132**	89	2-5	90	2-5	100	2-5	102	2-5
Forth	mm	**178**	441		832		1273		1518	
	%	**151**	99	2-5	93	2-5	102	2-5	106	2-5
Tweed	mm	**155**	438		785		1198		1454	
	%	**162**	115	2-5	104	2-5	115	2-5	122	8-12
Solway	mm	**203**	582		1119		1687		2036	
	%	**131**	106	2-5	102	2-5	109	2-5	114	8-12
Clyde	mm	**229**	635		1245		1897		2249	
	%	**121**	94	2-5	92	2-5	99	2-5	102	2-5

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

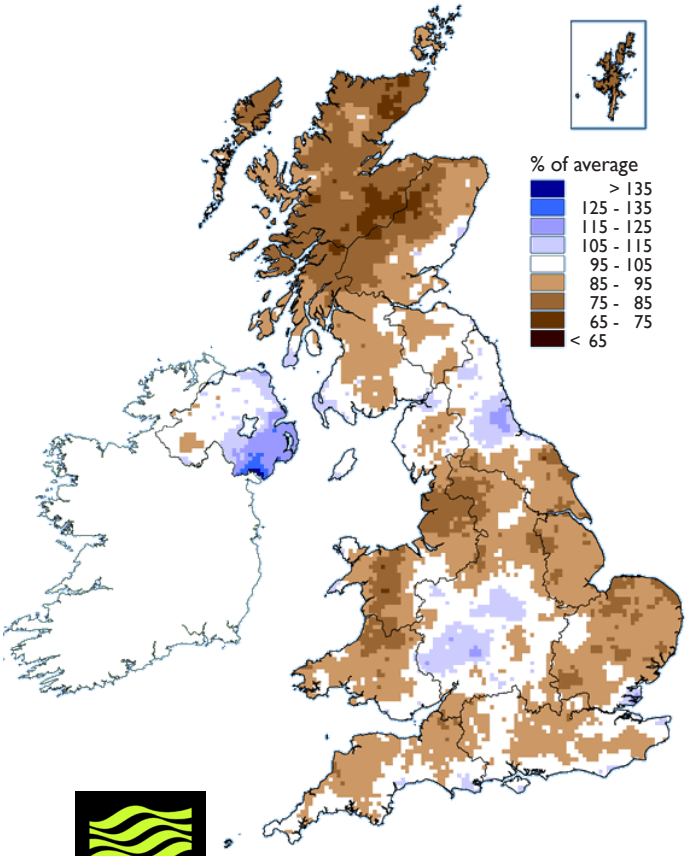
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

Rainfall . . . Rainfall . . .

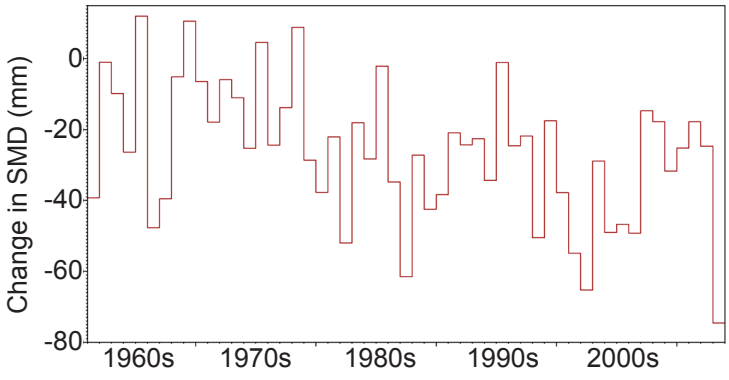
October 2013 rainfall as % of 1971-2000 average



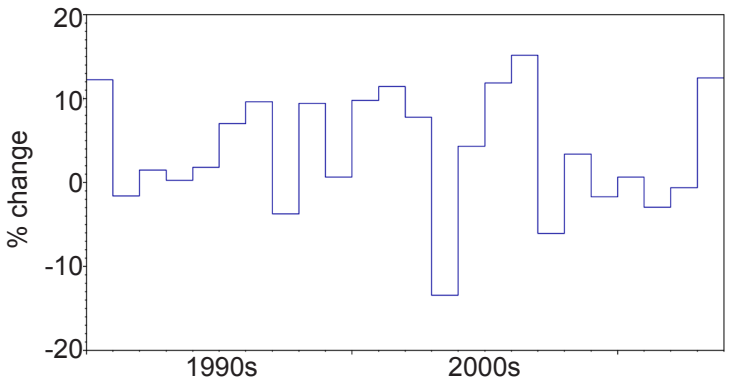
January 2013 - October 2013 rainfall as % of 1971-2000 average



Sep - Oct changes in MORECS SMDs for England



Sep - Oct % change in reservoir stocks for England



Met Office 3-month outlook Updated: October 2013

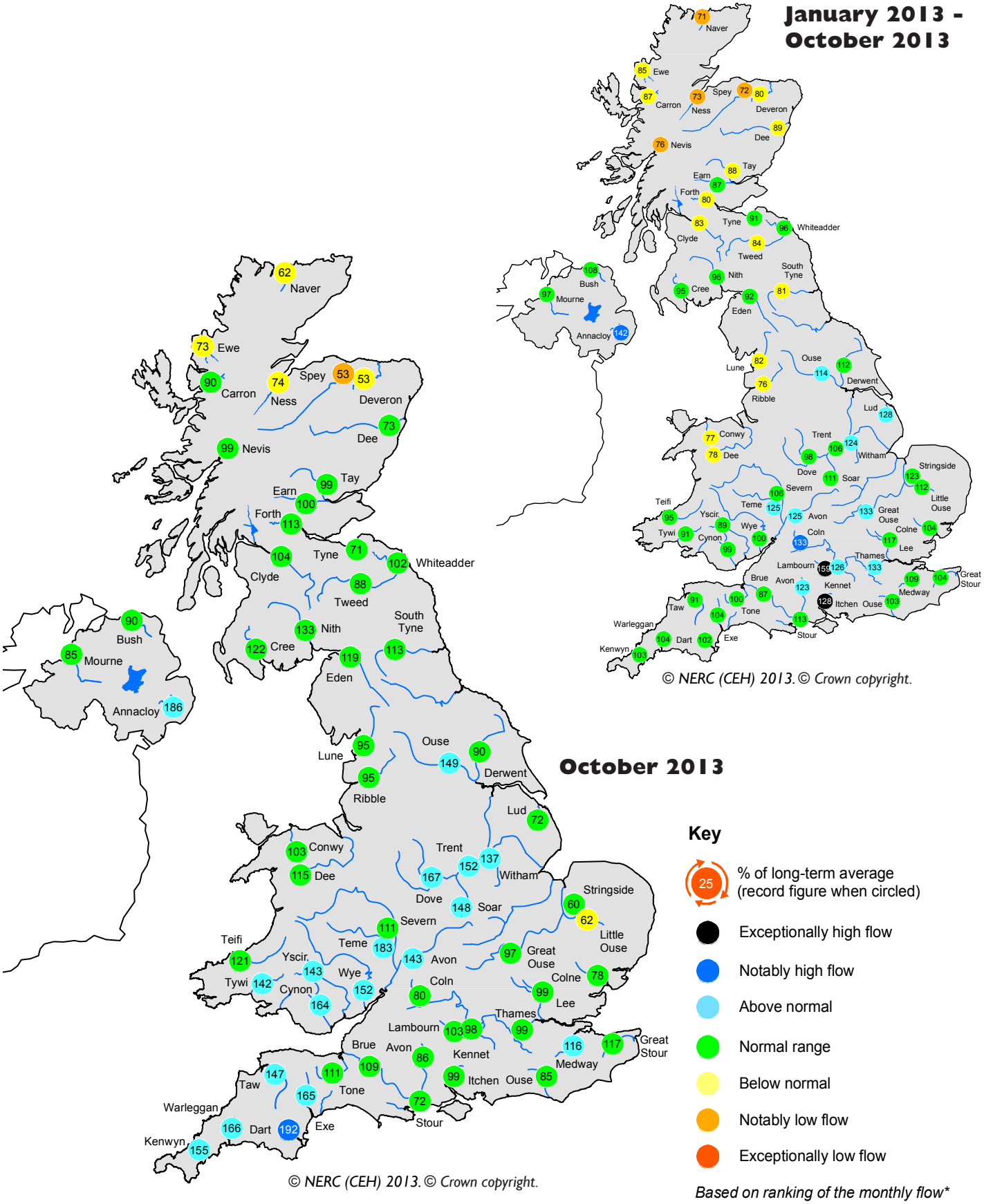
For November-December-January as a whole the signal for precipitation is similar to climatology, with only a slightly higher probability of above-average than below-average rainfall.

The probability that UK precipitation for November-December-January will fall into the driest of our five categories is close to 15% and the probability that it will fall into the wettest category is approximately 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.

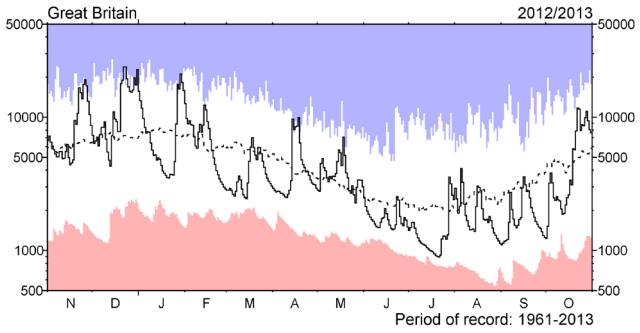
River flow . . . River flow . . .

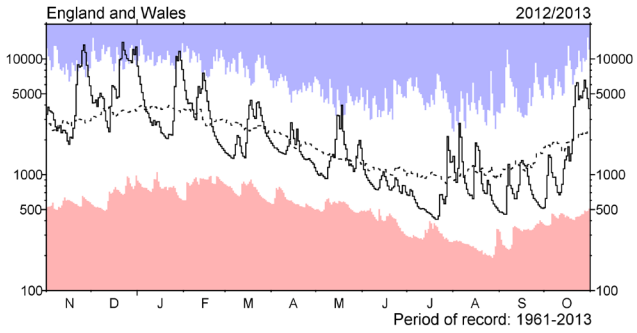


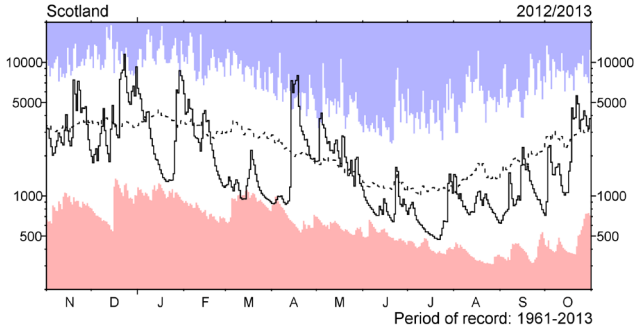
River flows

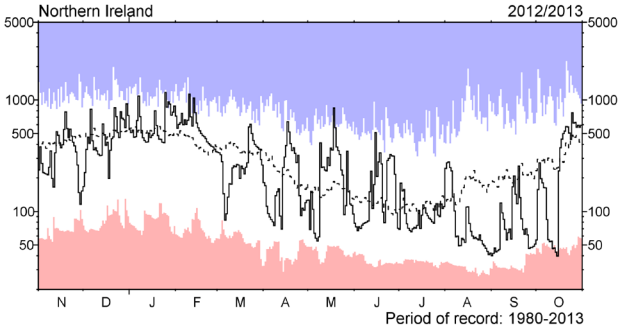
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

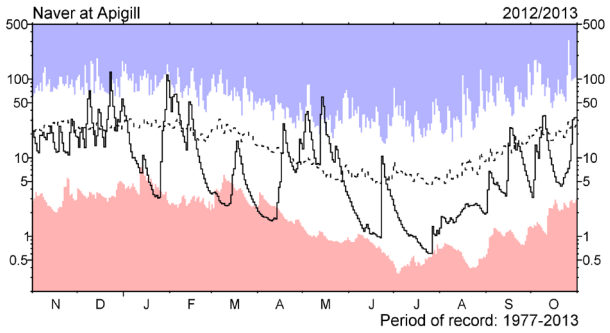
River flow . . . River flow . . .

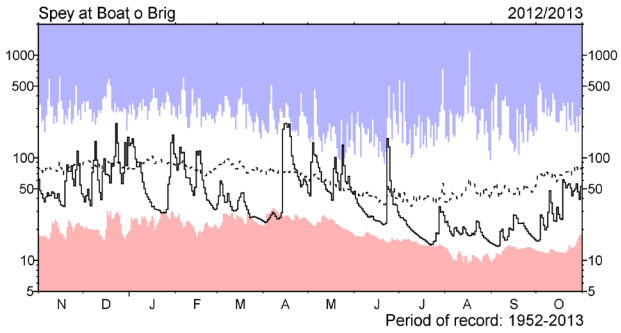


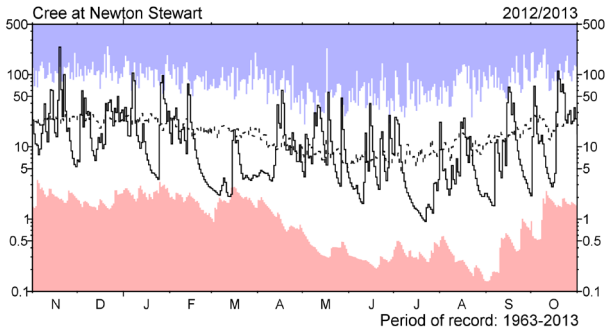


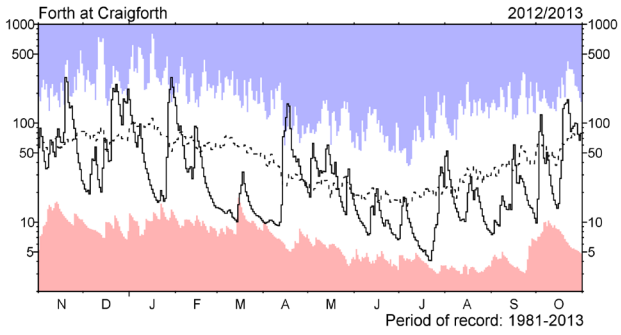


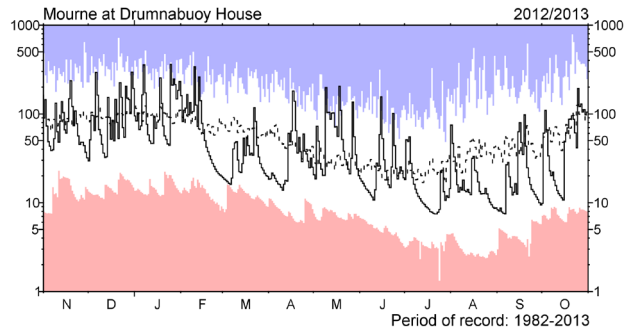


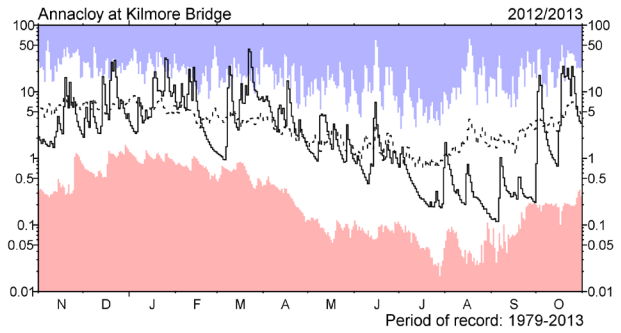








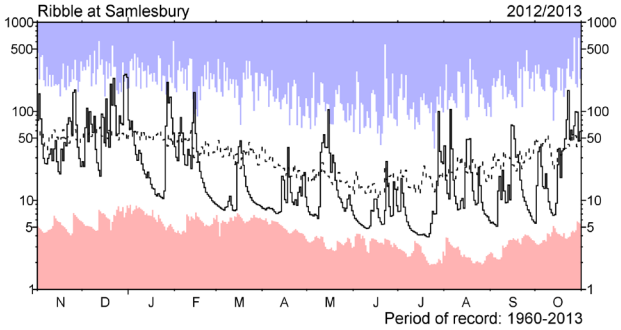


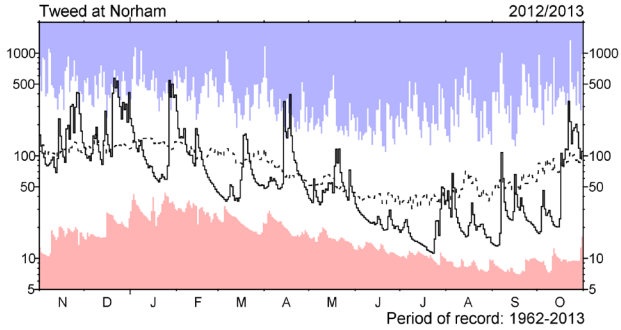


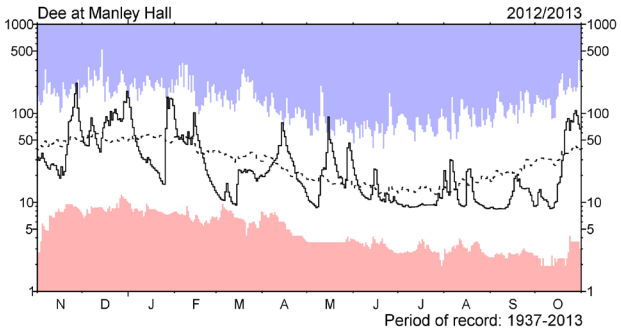
River flow hydrographs

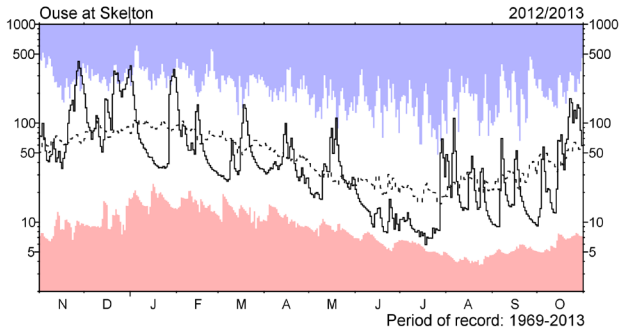
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to November 2012 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the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

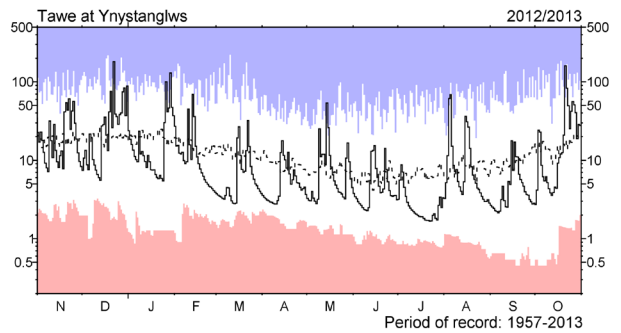
River flow . . . River flow . . .

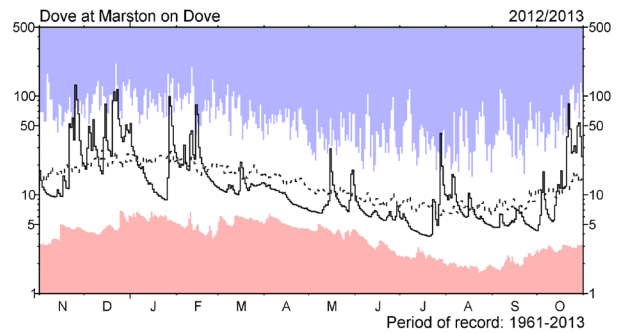


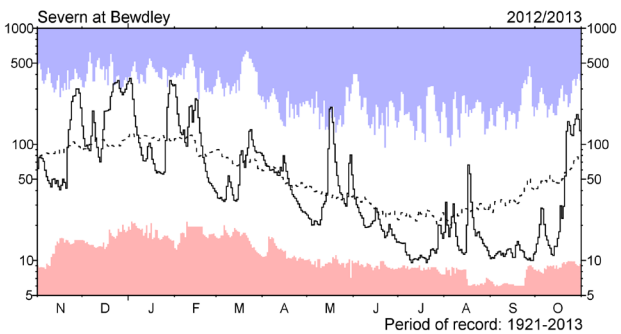


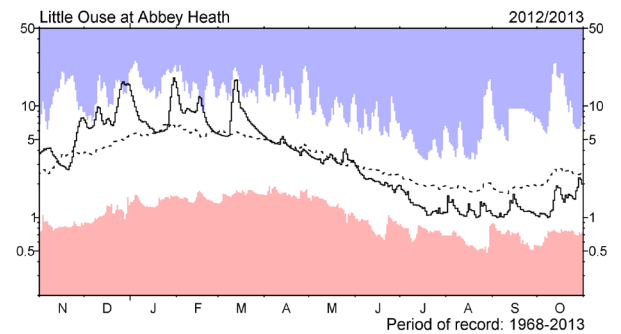


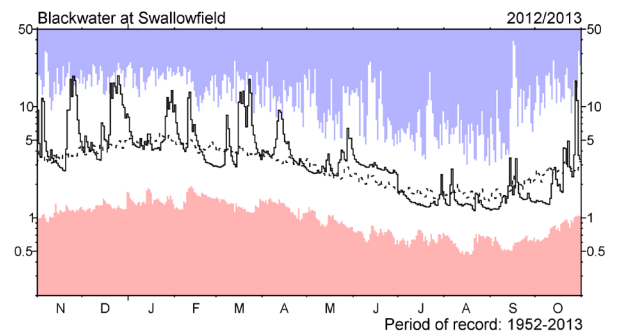


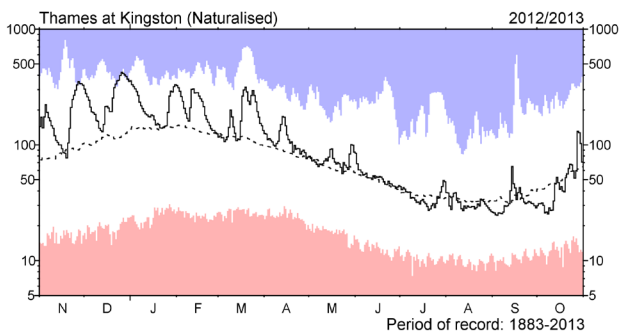


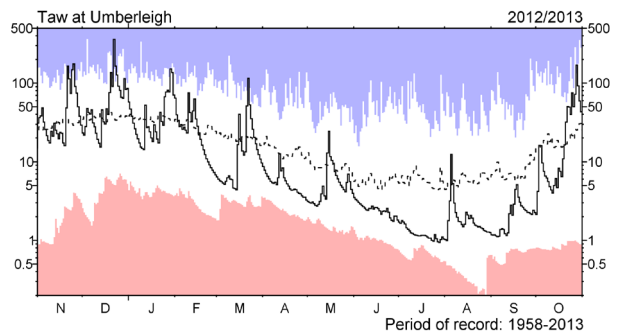


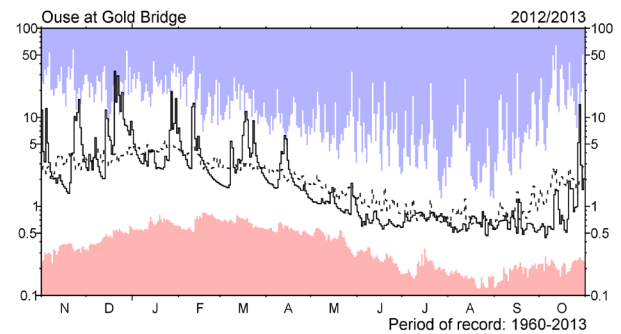




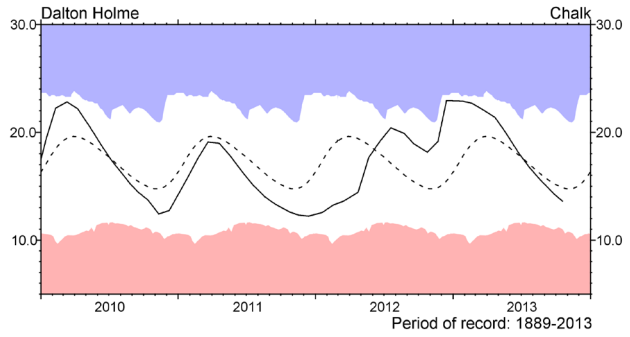


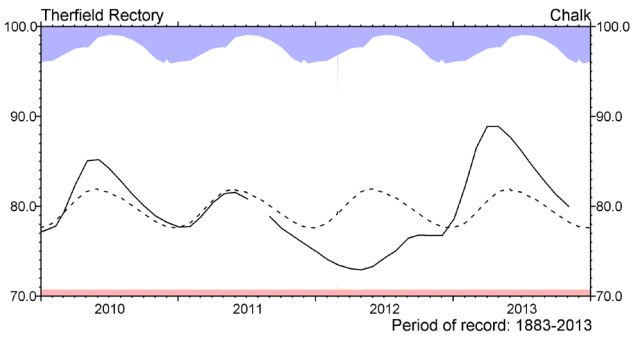


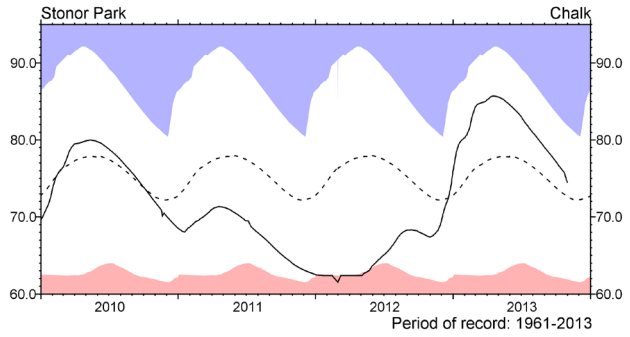


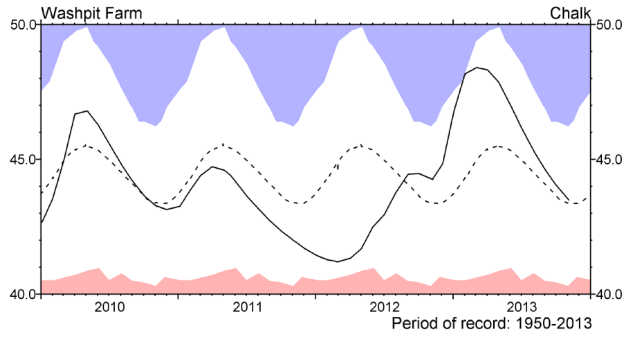


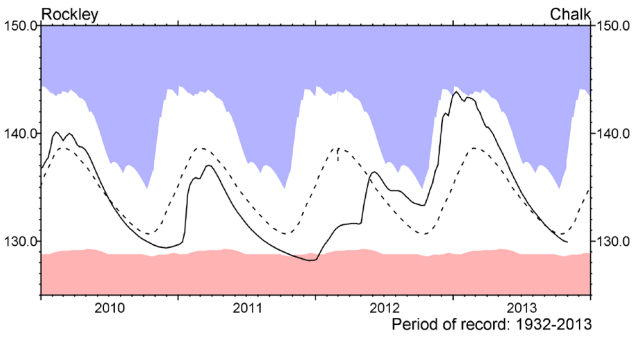
Groundwater…Groundwater

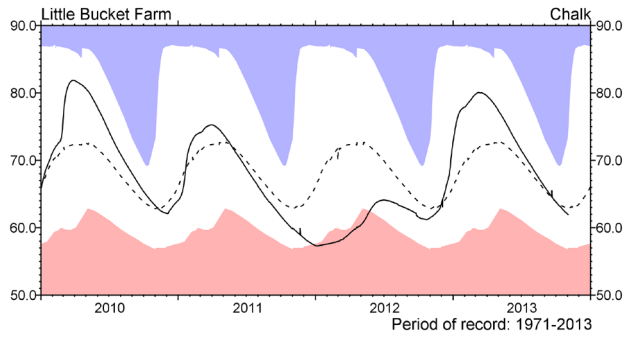


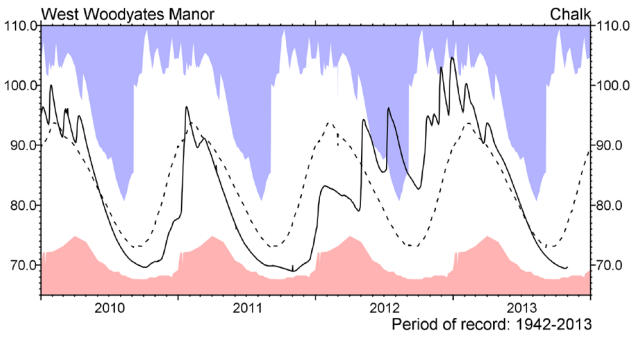


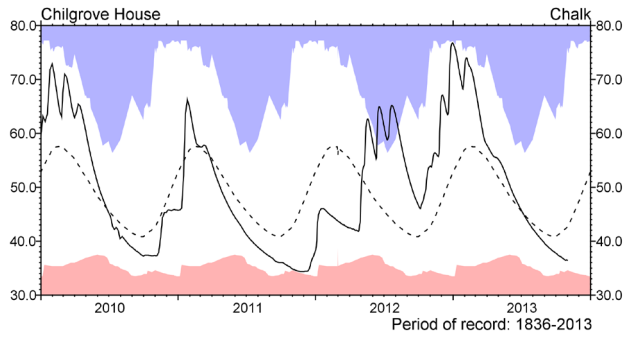


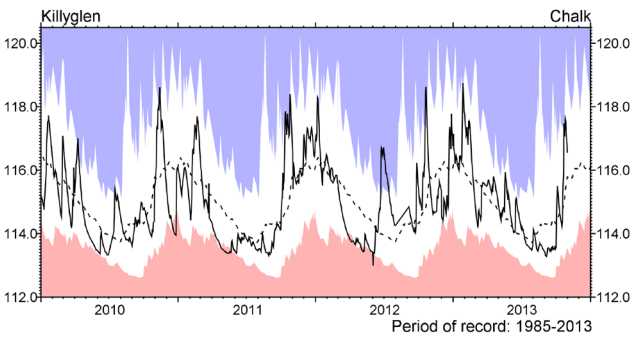


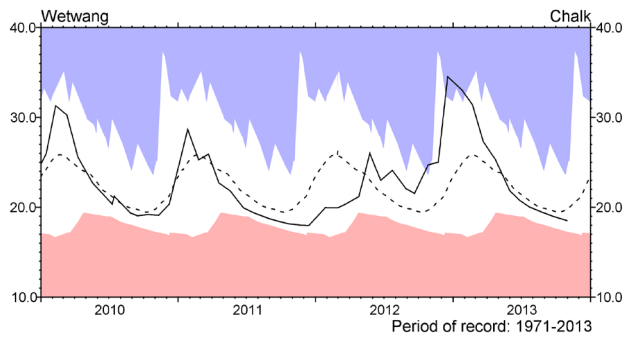






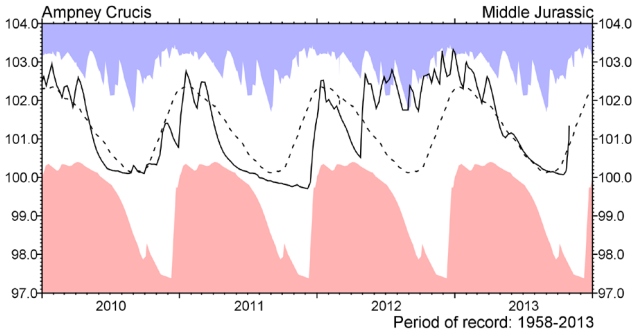


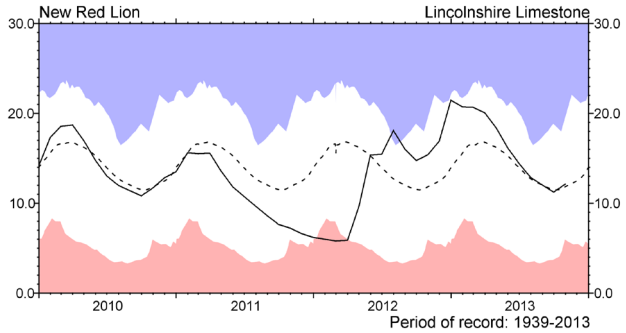


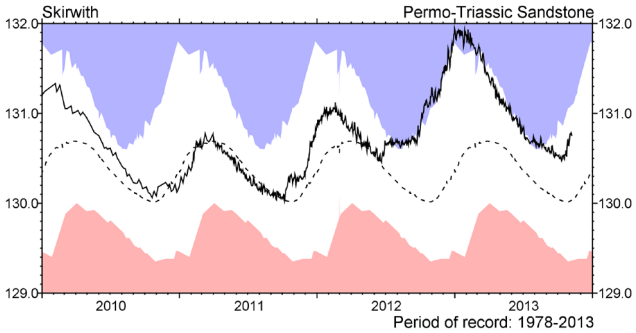


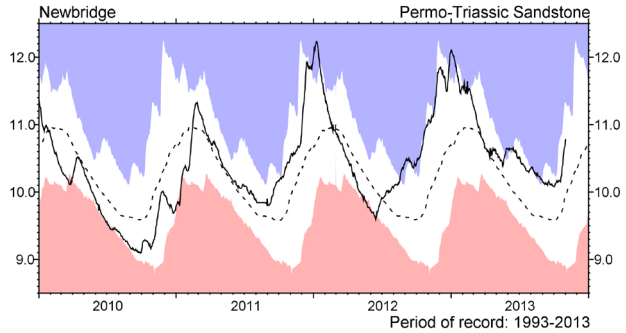
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

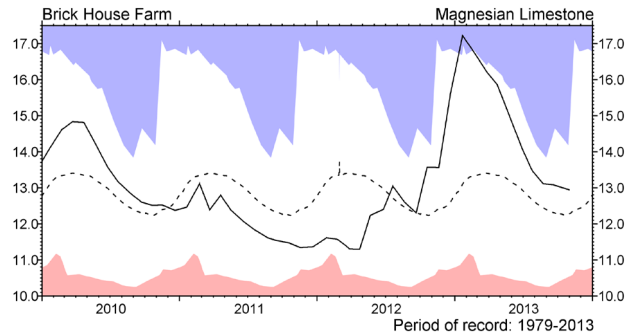
Groundwater... Groundwater

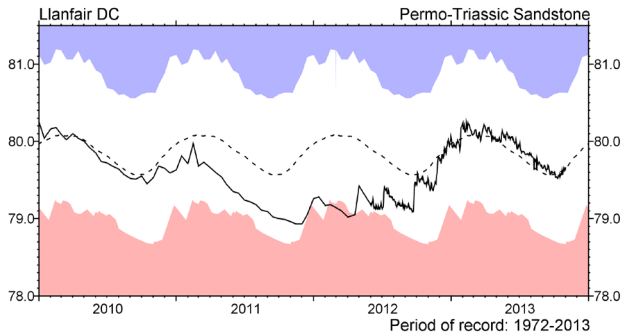


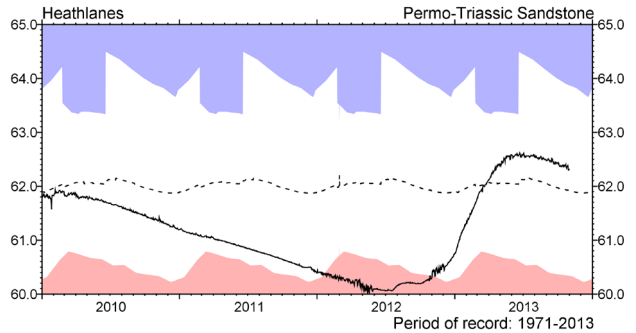


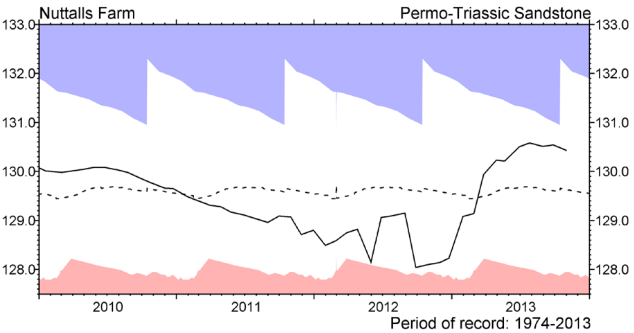


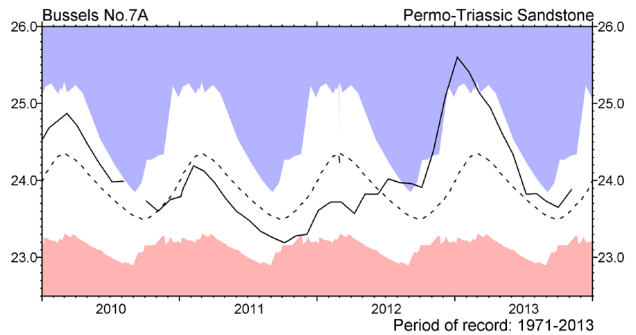


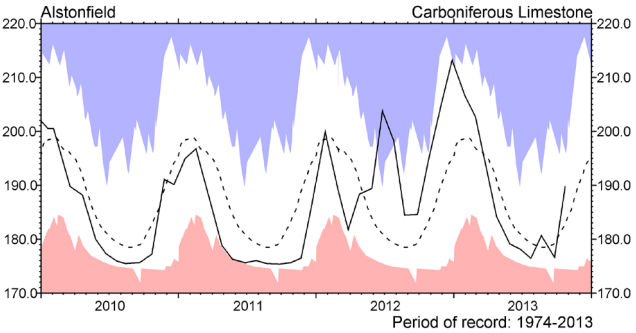








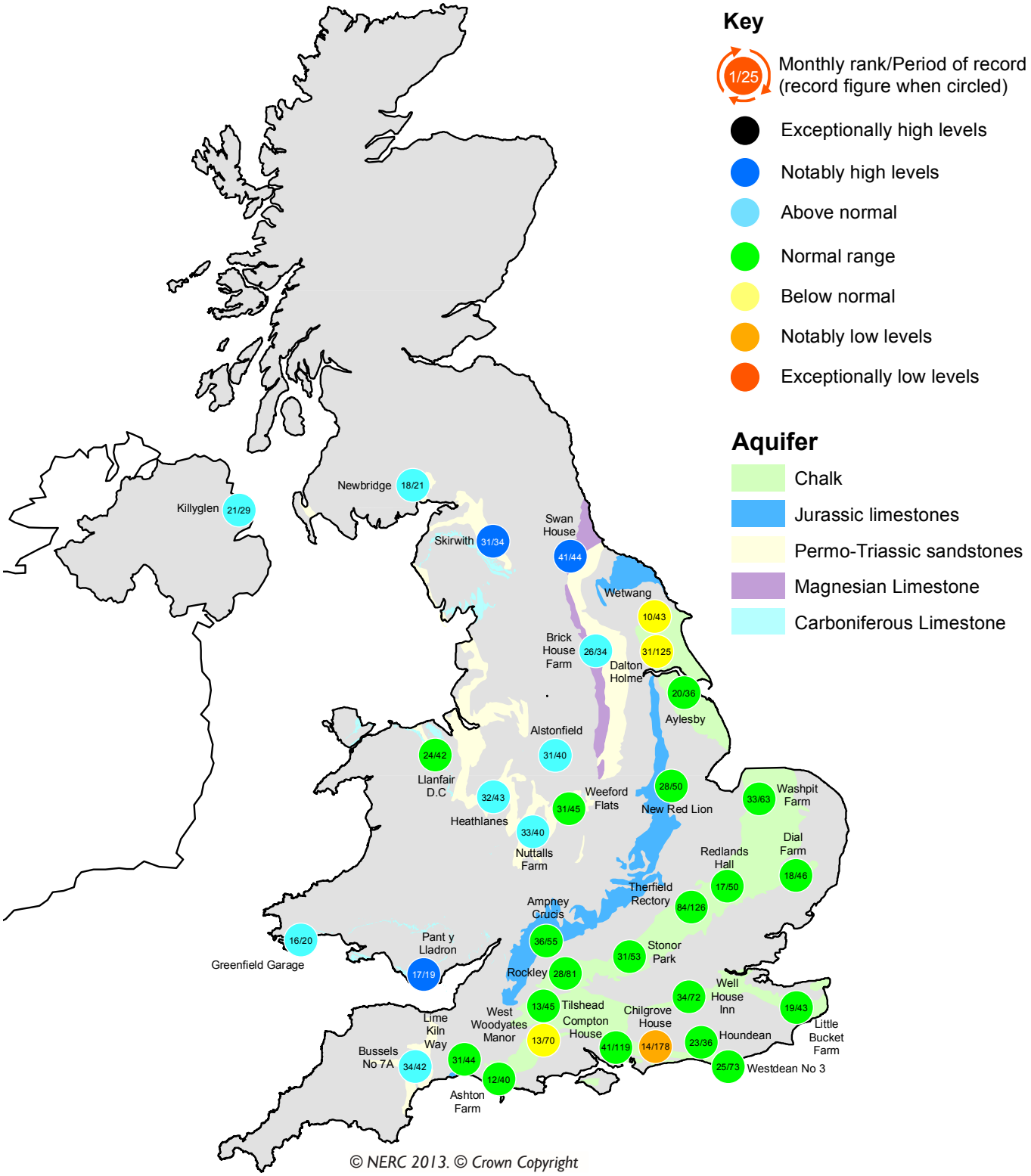




Groundwater levels October / November 2013

Borehole	Level	Date	Oct av.	Borehole	Level	Date	Oct av.	Borehole	Level	Date	Oct av.
Dalton Holme	13.61	18/10	14.90	Chilgrove House	36.40	31/10	42.28	Brick House Farm	12.94	31/10	12.28
Therfield Rectory	79.96	04/11	79.07	Killyglen (NI)	116.56	31/10	114.89	Llanfair DC	79.66	01/11	79.56
Stonor Park	74.51	31/10	72.88	Wetwang	18.5	30/10	19.46	Heathlanes	62.31	31/10	61.86
Tilshead	79.58	31/10	80.86	Ampney Crucis	101.33	31/10	100.47	Nuttalls Farm	130.43	31/10	129.61
Rockley	129.90	31/10	130.72	New Red Lion	12.12	31/10	11.57	Bussels No.7a	23.88	06/11	23.52
Well House Inn	92.34	31/10	93.05	Skirwith	130.75	07/11	130.06	Alstonfield	189.71	23/10	181.51
West Woodyates	69.61	31/10	75.01	Newbridge	10.77	01/11	9.76				

Levels in metres above Ordnance Datum

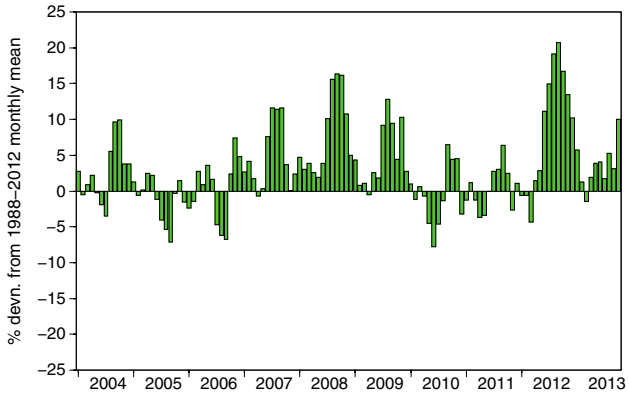


Groundwater levels - October 2013

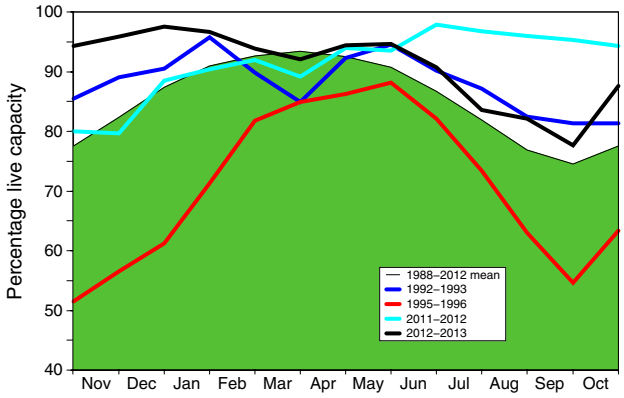
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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.

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 Aug	2013 Sep	2013 Oct	Oct Anom.	Min Oct	Year* of min	2012 Oct	Diff 13-12
North West	N Command Zone	•	124929	67	63	86	18	33	2003	96	-10
	Vyrnwy		55146	80	70	95	21	25	1995	93	2
Northumbrian	Teesdale	•	87936	93	91	100	25	33	1995	96	4
	Kielder		(199175)	86	85	95	9	63	1989	90	5
Severn Trent	Clywedog		44922	90	90	85	9	38	1995	87	-2
	Derwent Valley	•	39525	65	55	79	9	15	1995	98	-19
Yorkshire	Washburn	•	22035	69	62	83	13	15	1995	97	-14
	Bradford Supply	•	41407	62	54	77	4	16	1995	100	-23
Anglian	Grafham		(55490)	91	91	88	5	44	1997	92	-4
	Rutland		(116580)	80	78	78	0	59	1995	95	-17
Thames	London	•	202828	90	86	92	15	46	1996	95	-3
	Farmoor	•	13822	96	98	83	-5	43	2003	83	0
Southern	Bewl		28170	77	69	70	11	33	1990	58	12
	Ardingly**		4685	66	56	68	2	15	2003	100	-32
Wessex	Clatworthy		5364	56	47	83	21	14	2003	100	-17
	Bristol	•	(38666)	60	52	56	-6	24	1990	98	-42
South West	Colliford		28540	72	65	71	1	38	2006	92	-21
	Roadford		34500	73	69	77	7	18	1995	98	-21
	Wimbleball		21320	60	48	54	-13	26	1995	100	-46
	Stithians		4967	66	60	68	11	18	1990	100	-32
Welsh	Celyn & Brenig	•	131155	89	79	88	3	48	1989	94	-6
	Brianne		62140	99	99	100	9	57	1995	99	1
	Big Five	•	69762	84	76	89	13	38	2003	99	-10
	Elan Valley	•	99106	83	78	100	15	37	1995	100	0
Scotland(E)	Edinburgh/Mid-Lothian	•	97639	67	74	77	-4	48	2003	100	-23
	East Lothian	•	10206	87	83	82	-2	38	2003	100	-18
Scotland(W)	Loch Katrine	•	111363	65	60	87	1	40	2003	92	-5
	Daer		22412	60	58	75	-16	42	2003	99	-24
	Loch Thom	•	11840	82	81	83	-7	66	2007	100	-17
Northern Ireland	Total+	•	55540	76	71	92	13	39	1995	97	-5
	Silent Valley	•	20634	73	64	92	17	34	1995	95	-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 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

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Wallingford
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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.

11/2013