Hydrological Summary

for the United Kingdom

January 2014

General
The intensely cyclonic conditions of late-December continued into January, resulting in an exceptionally wet and windy (but notably mild) start to 2014. A succession of vigorous low pressure systems brought gale force winds, exceptionally strong swells (causing extensive coastal damage and tidal flooding) and persistent frontal rainfall. With heavy rain falling on already saturated ground, flood alerts were widespread and sustained through January, but peak river flows were generally not exceptional; rather, January was notable for the persistence and spatial extent of floodplain inundation, particularly from large, slowly responding rivers and in low-lying areas such as the Somerset Levels. Throughout January, comparatively few properties were flooded (in part due to the effectiveness of flood alleviation measures) but the prolonged nature of the inundation caused widespread transport disruption, damage to agricultural land and isolation of some communities. With the severe storms continuing into early February, flooding continued and intensified in some major river basins (e.g. the Thames and the Severn). Groundwater flooding became increasingly prevalent through January and into early-February, as aquifers responded to the rainfall accumulated since mid-December. There is a very high risk of further fluvial and groundwater flooding over the coming months – in vulnerable areas, the risk of groundwater flooding will remain high throughout the spring (as occurred following the exceptionally wet autumn/winter of 2000/2001). Additionally, with record groundwater levels in the southern Chalk and the highest January reservoir stocks for England & Wales in a record from 1988, the water resource outlook for 2014 is exceptionally healthy.

Rainfall
In the first week of January, the passage of several deep depressions brought severe gales (which, exacerbated by high spring tides, inflicted severe damage to western coastlines, e.g. at Aberystwyth on the 3rd) and heavy rainfall (e.g. 68mm at Tyndrum on the 3rd, and 67mm at Achnagart on the 7th) to many parts of the UK. The next two weeks remained very unsettled, with several depressions bringing persistent rainfall to southern Britain; 48mm was reported at Charlwood, Surrey, on the 16th, but daily rainfall totals were generally more modest. January ended as it began, with a relentless sequence of low pressure systems bringing persistent frontal rain and gale force winds in the final week, which continued unabated into February. The most notable feature of the January rainfall was its persistence – the highest number of rain days (>1mm) registered for January in the NCIC record for southern England (from 1961). Correspondingly, much of central and southern England received over twice the average rainfall for January, with over three times the average received in some localities. Parts of eastern Scotland also received more than twice the average. Northernmost Scotland, by contrast, was dry – parts of the far north-west received less than 60% of the average. It was the wettest January on record for England (in a record from 1910) and, provisionally, the wettest January in the England & Wales rainfall series (from 1766). Outstanding two-month accumulations were also registered: it was the highest rainfall total for December/January (in records from 1910) for the Thames, Southern and Wessex regions, and the second wettest two-month period, for any calendar months, in these regions. It was the joint highest December/January total for Scotland (where December was considerably wetter than January).

River flow
Following the exceptional rainfall from mid-December, flows in many index rivers were substantially above average entering 2014, and continued to increase following the heavy rainfall in early-January. By the 4th, 100 flood warnings and >200 flood alerts applied, across all regions of the UK. By the 6th, the Thames had risen to its highest levels since 2003, heralding a prolonged spell of floodplain inundation which caused severe transport disruption throughout the catchment, and by mid-month resulted in property flooding in the lower reaches. A major incident was declared on the Somerset Levels on the 24th, following over three weeks of inundation (with over 16,000 acres of land reported as flooded) which cut off isolated communities such as Muchelney; efforts to alleviate the situation by pumping away floodwater extended into early-February against a worsening situation. Generally, January was notable for the persistence of high flows rather than the magnitude of extremes. Peak river flows were not exceptional, although new January maxima were registered for several index rivers in the Thames catchment (e.g. the Pang and the Blackwater) and in parts of the south-west (e.g. the Brue in Somerset and the Dart in Devon). The protracted nature of the high flows is illustrated by the average January flows, which were the highest on record for a substantial majority of index catchments across southern Britain. Correspondingly, the total outflows for Lowland England for January were the highest on record (from 1961) for any month. It was the highest January average flow for the Thames by a considerable margin, in a record from 1883. In contrast, the Naver and the Carron in the far north of Scotland registered below average January flows. In general however, runoff over the last two months has been exceptional: the combined December/January outflows for Great Britain were the second highest on record (from 1961).

Groundwater
The rapid rises in responsive aquifer units in late-December, coupled with equally dramatic increases in January (e.g. >10m at Stonor and Little Bucket Farm), has led to exceptionally high groundwater levels across the southern Chalk outcrop, with new January maxima established for six Chalk boreholes. In Sussex, the Chilgrove House well overflowed (there have been around six similar artesian episodes in a record extending back to 1836), across southern England the emergence of groundwater was observed in bournes, e.g. the South Winterbourne (Dorset), Aldbourne (Berkshire), Lavant (Hampshire) and Nailbourne (Kent). In the northern and eastern Chalk, which was drier in December, levels increased but remained below average. In the Permo-Triassic sandstones, levels were above normal in the Midlands and north Wales, but exceptionally high in the north-west and south-west, with record monthly levels recorded at Newbridge, Skirwith and Bussels. In other aquifers, levels were typically above average, with Ampney Crucis (Jurassic limestone) registering exceptional levels. With rising water levels in the southern Chalk, concerns over sewer surcharging and groundwater flooding heightened through January; flood alerts were widespread across the southern Chalk (from Dorset to Kent, but predominantly in the west), and were also issued for the Lower Greensand in south-west Surrey. The high water levels on the interfluves will gradually feed into the lower parts of catchments over a period of weeks to months, and it is likely groundwater flooding will persist well into the spring. In some of the major river valleys (e.g. the Thames Valley), elevated groundwater levels in superficial sands and gravels are exacerbating current flooding and the risk of future flooding.

Centre for Ecology & Hydrology
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British Geological Survey
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

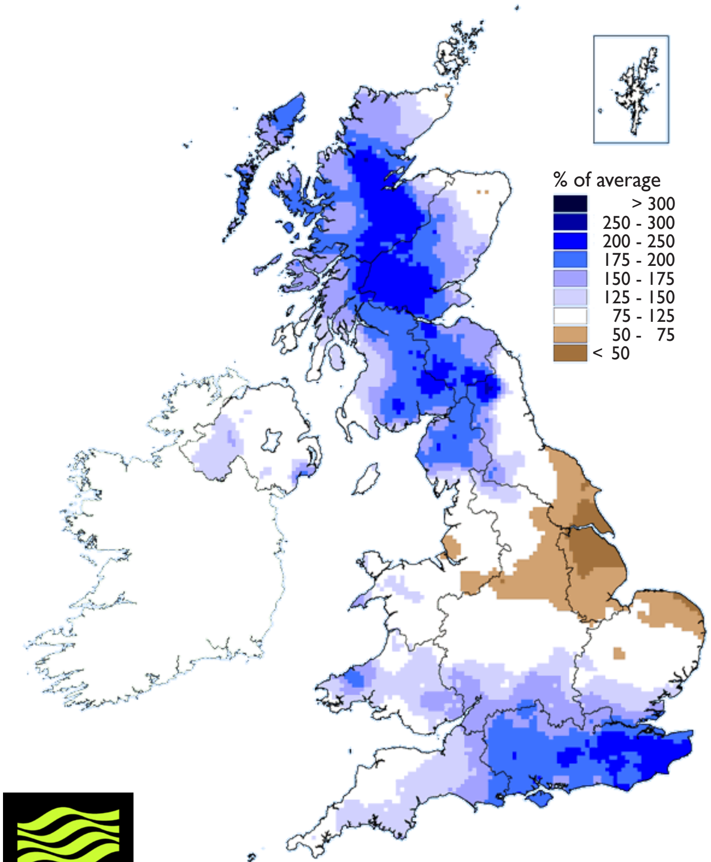
Region	Rainfall	Jan 2014	Dec 13 – Jan 14	RP	Oct 13 – Jan 14	RP	Feb 13 – Jan 14	RP	Aug 12 – Jan 14	RP
United	mm	**184**	369		622		1161		1936	
Kingdom	%	**156**	157	>100	136	50-80	108	2-5	114	10-20
England	mm	**158**	275		481		895		1527	
	%	**191**	163	50-80	147	30-50	111	2-5	120	10-20
Scotland	mm	**205**	501		815		1518		2477	
	%	**124**	155	70-100	128	30-50	106	2-5	108	5-10
Wales	mm	**269**	491		831		1470		2490	
	%	**177**	158	40-60	137	20-30	108	2-5	115	5-10
Northern	mm	**171**	308		531		1160		1864	
Ireland	%	**143**	132	15-25	116	8-12	105	2-5	107	2-5
England &	mm	**174**	305		530		974		1660	
Wales	%	**188**	162	50-80	144	30-50	110	2-5	119	10-20
North West	mm	**184**	366		628		1236		2171	
	%	**152**	147	15-25	127	8-12	106	2-5	117	8-12
Northumbria	mm	**122**	251		450		926		1624	
	%	**149**	150	15-25	140	15-25	113	2-5	127	50-80
Midlands	mm	**148**	227		422		840		1398	
	%	**199**	150	15-25	145	20-30	112	2-5	120	10-15
Yorkshire	mm	**136**	223		401		818		1459	
	%	**168**	132	5-10	126	5-10	102	2-5	117	5-10
Anglian	mm	**99**	150		302		611		1018	
	%	**186**	138	5-10	137	10-15	103	2-5	111	2-5
Thames	mm	**184**	309		490		845		1345	
	%	**168**	223	>>100	180	>100	122	5-10	125	15-25
Southern	mm	**211**	385		623		970		1559	
	%	**256**	230	>>100	187	>100	126	8-12	128	15-25
Wessex	mm	**212**	379		619		991		1729	
	%	**229**	200	>>100	172	>100	116	2-5	128	25-40
South West	mm	**229**	419		735		1276		2301	
	%	**163**	146	20-30	137	15-25	107	2-5	121	15-25
Welsh	mm	**259**	474		804		1427		2416	
	%	**177**	159	50-80	138	20-35	109	2-5	116	5-10
Highland	mm	**179**	552		924		1765		2811	
	%	**89**	139	10-20	118	8-12	103	2-5	102	2-5
North East	mm	**179**	333		543		1028		1622	
	%	**183**	179	>>100	142	15-25	109	2-5	109	2-5
Tay	mm	**230**	522		792		1355		2232	
	%	**147**	178	>100	142	50-80	108	2-5	111	5-10
Forth	mm	**155**	406		655		1167		1984	
	%	**122**	164	70-100	136	40-60	104	2-5	111	5-10
Tweed	mm	**147**	358		569		1081		1848	
	%	**146**	177	>100	147	60-90	115	2-5	125	20-30
Solway	mm	**261**	550		844		1591		2666	
	%	**168**	177	>>100	138	30-50	114	5-10	120	30-50
Clyde	mm	**266**	602		981		1803		3009	
	%	**132**	153	40-60	128	20-30	104	2-5	109	5-10

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

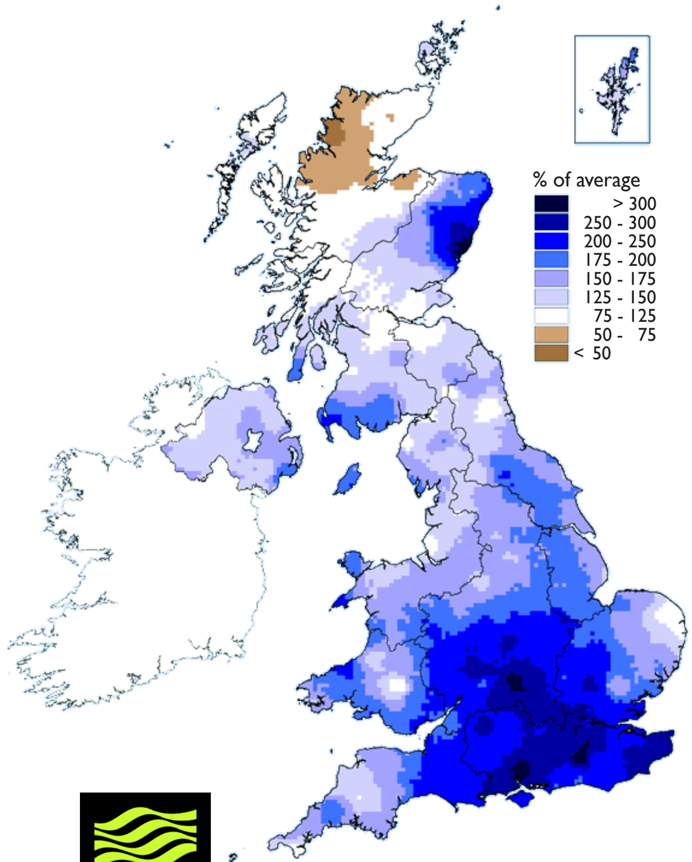
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

Rainfall . . . Rainfall . . .

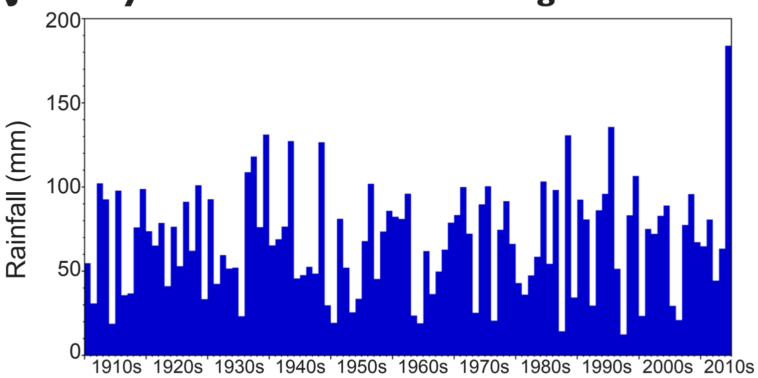
December 2013 rainfall as % of 1971-2000 average



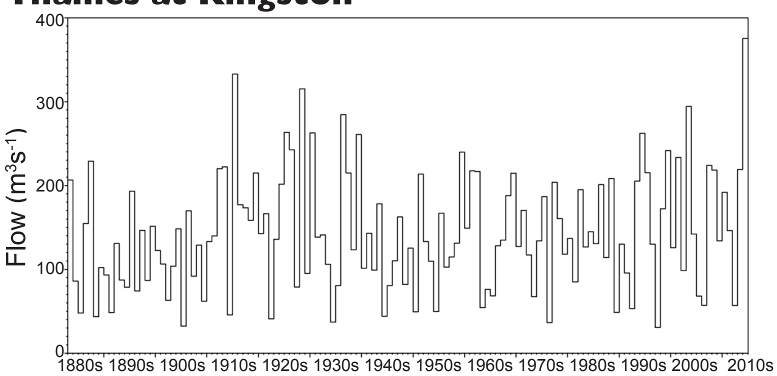
January 2014 rainfall as % of 1971-2000 average



January rainfall for Thames Region



Average January naturalised flows for the Thames at Kingston



Met Office 3-month outlook Updated: January 2014

For February-March-April, predictions for rainfall are very uncertain and largely indistinguishable from climatology.

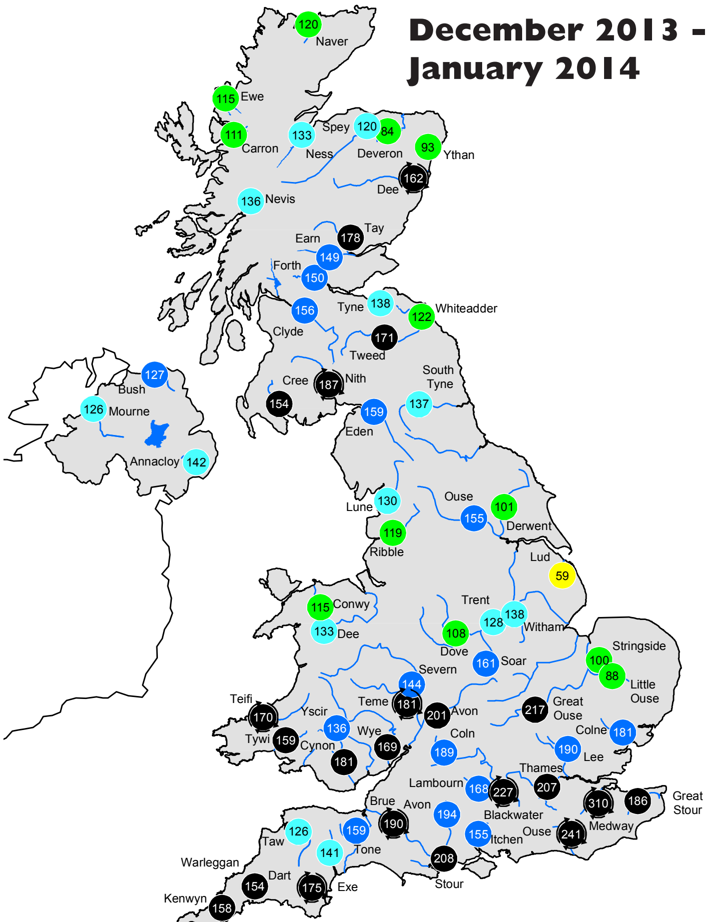
The probability that UK precipitation for February-March-April will fall into the wettest of our five categories is between 20 and 25% and the probability of falling into the driest of our five categories is between 15 and 20% (the 1981-2010 probability for each of these categories is 20%).

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 . . .

December 2013 - January 2014



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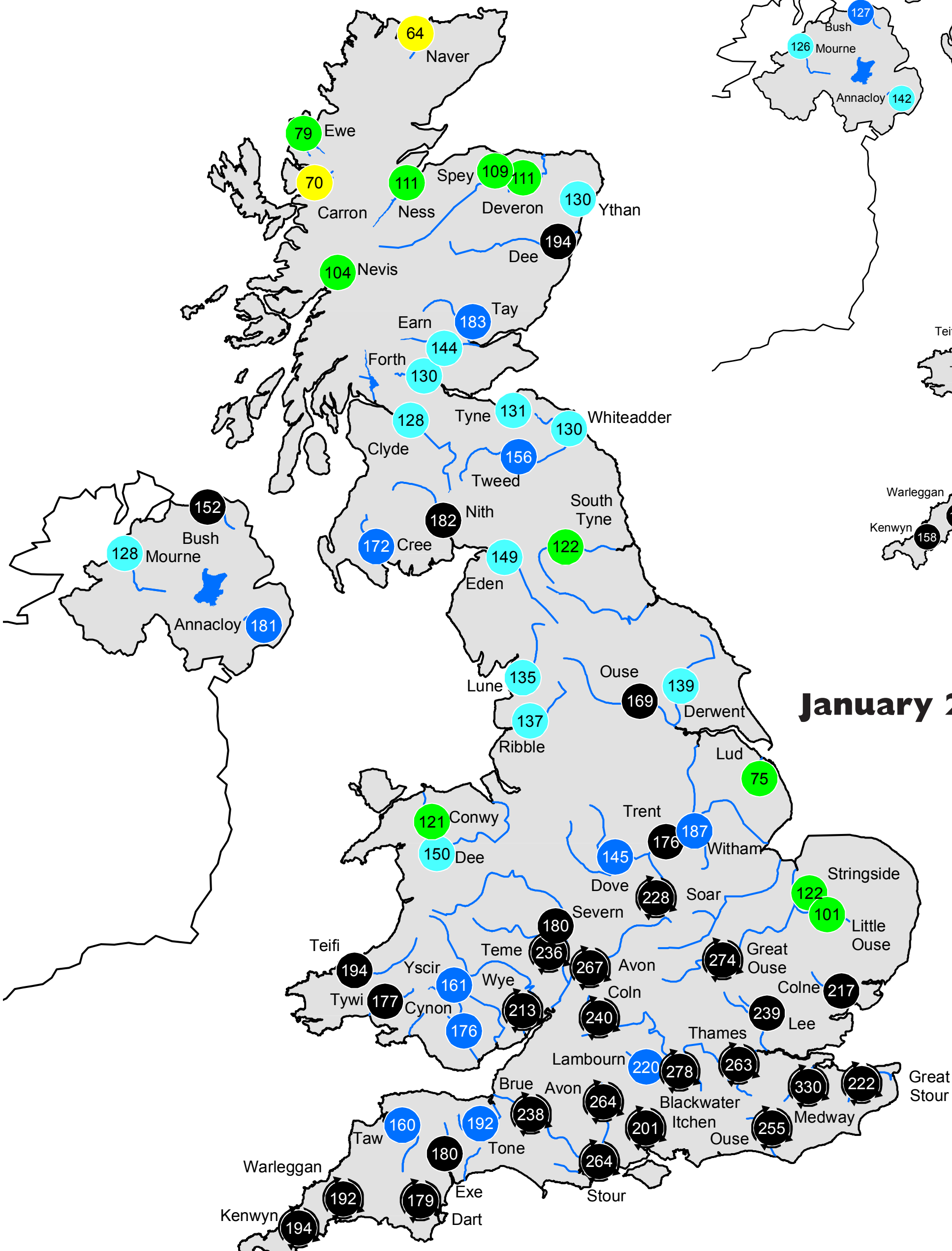

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January 2014

Key

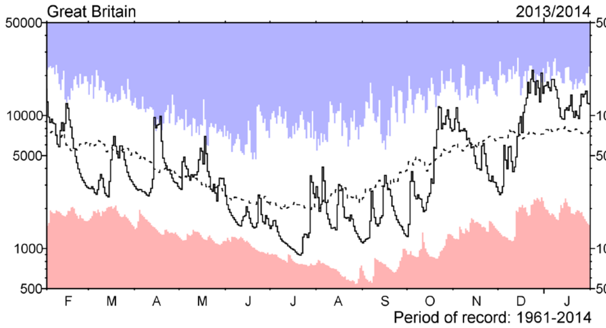
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

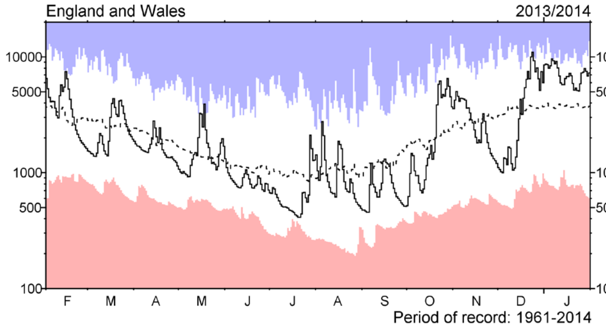
*Based on ranking of the monthly flow**

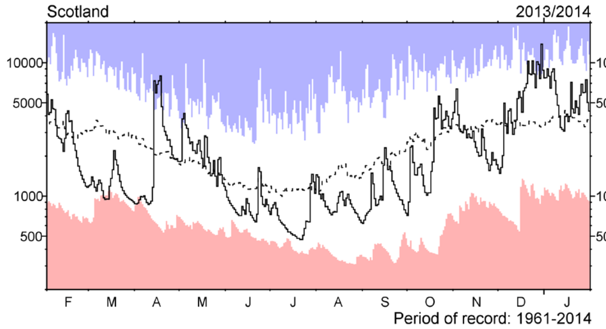
River flows

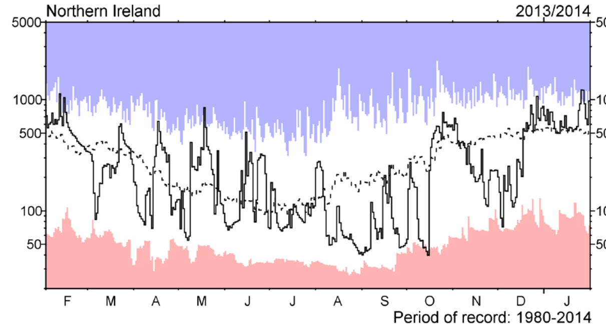
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

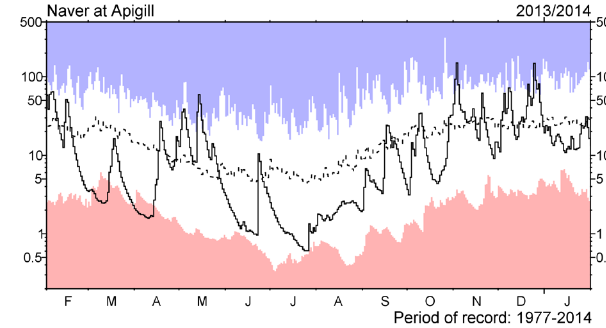
River flow . . . River flow . . .

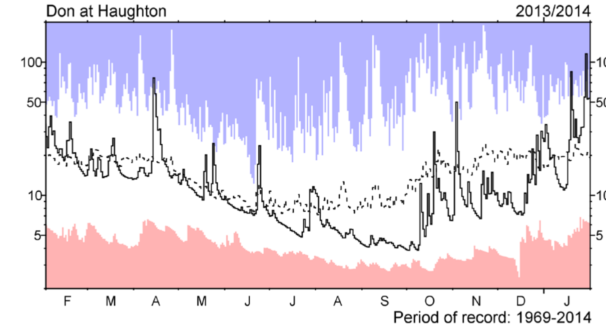


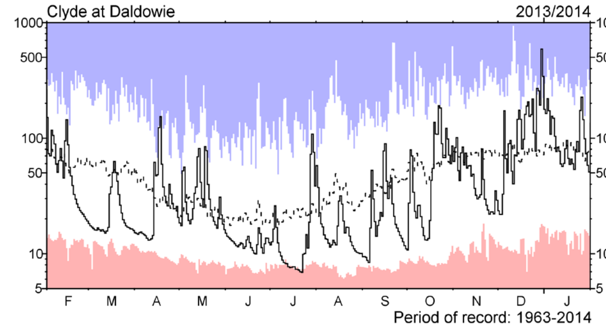


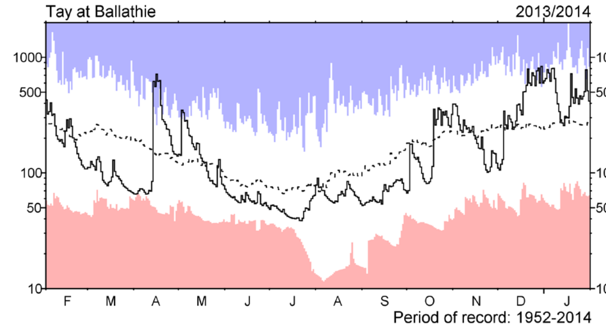


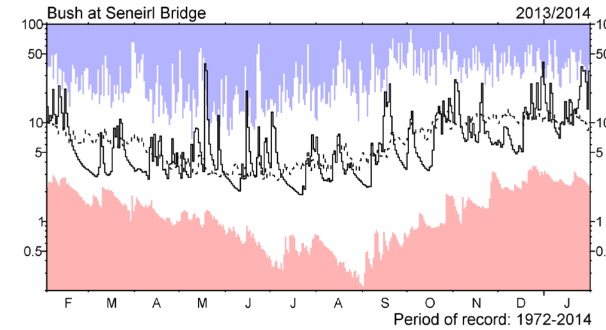


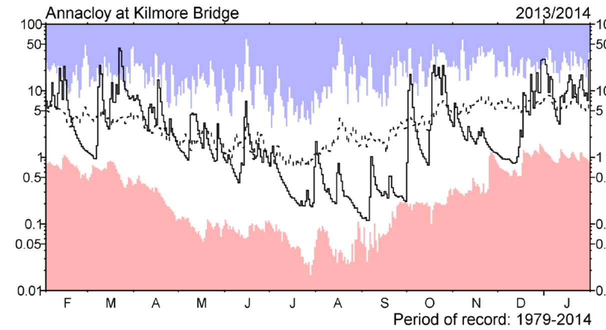






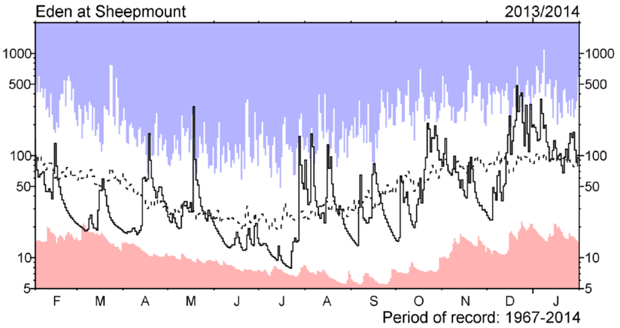


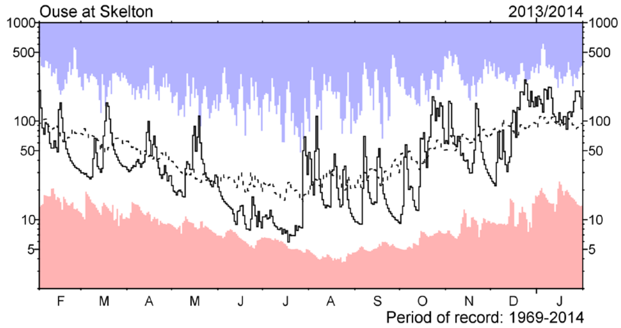


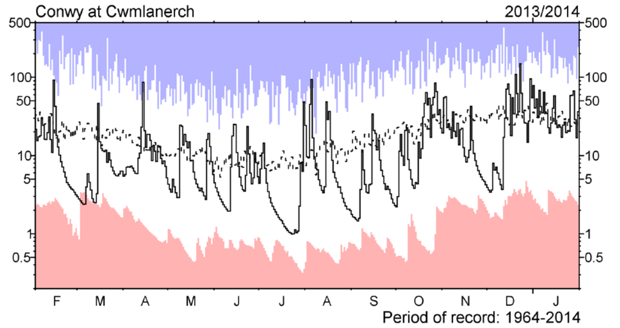


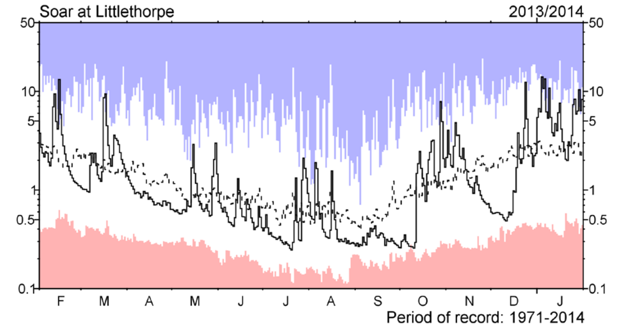
River flow hydrographs

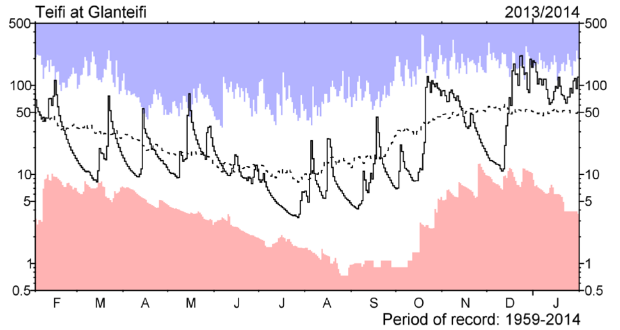
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to February 2013 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the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

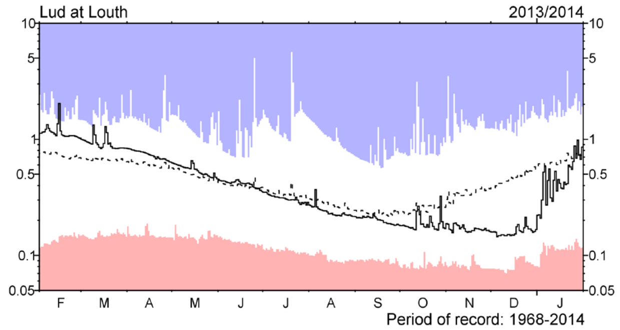

Eden at Sheepmount
2013/2014
Period of record: 1967-2014

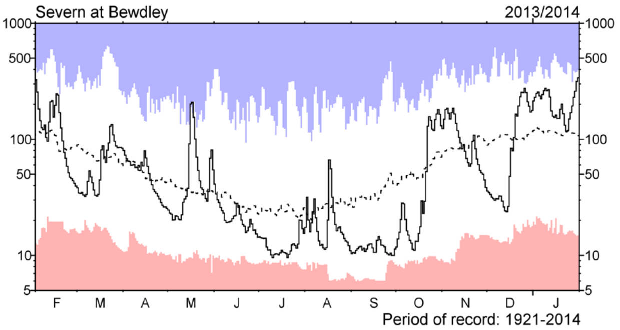

Ouse at Skelton
2013/2014
Period of record: 1969-2014

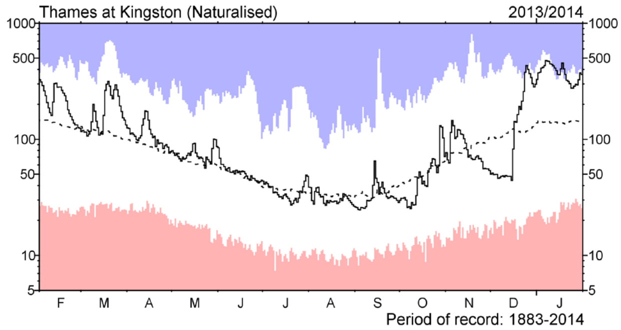

Conwy at Cwmlanerch
2013/2014
Period of record: 1964-2014

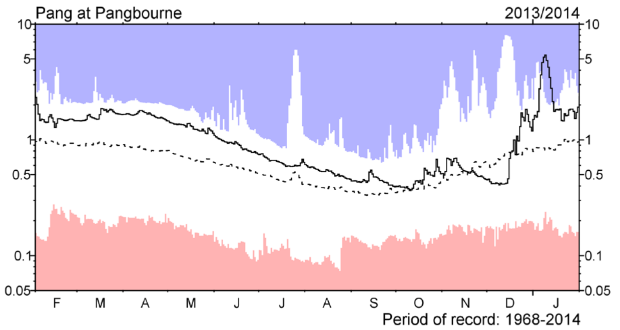

Soar at Littlethorpe
2013/2014
Period of record: 1971-2014

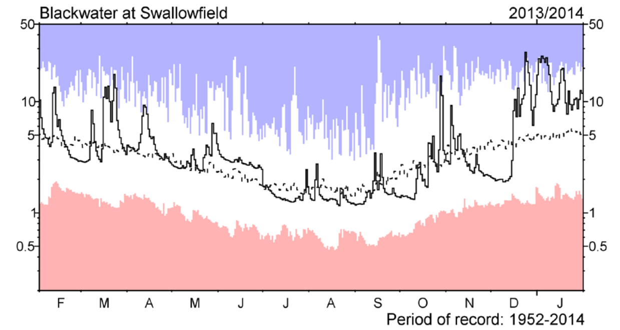

Teifi at Glanteifi
2013/2014
Period of record: 1959-2014

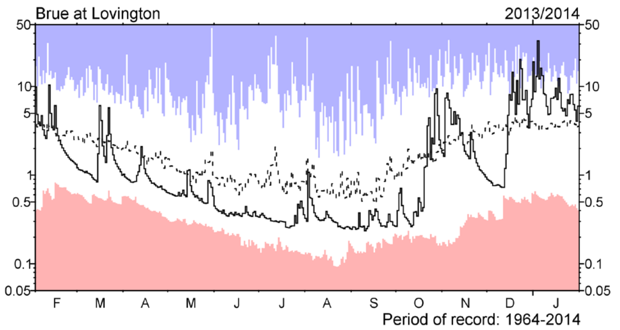

Lud at Louth
2013/2014
Period of record: 1968-2014

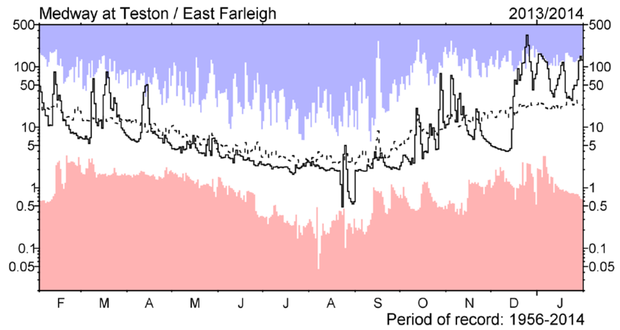

Severn at Bewdley
2013/2014
Period of record: 1921-2014


Thames at Kingston (Naturalised)
2013/2014
Period of record: 1883-2014

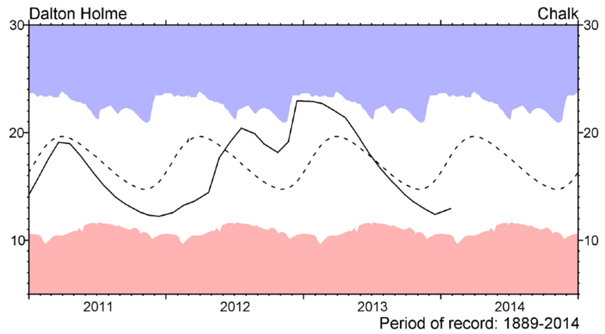

Pang at Pangbourne
2013/2014
Period of record: 1968-2014

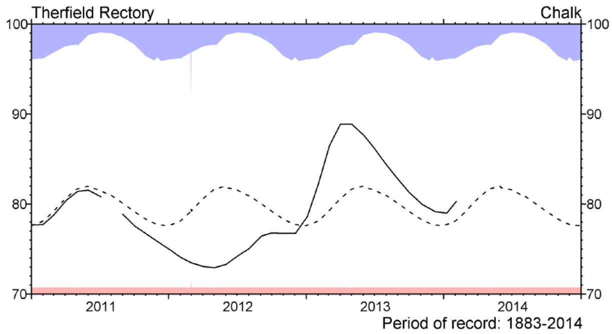

Blackwater at Swallowfield
2013/2014
Period of record: 1952-2014

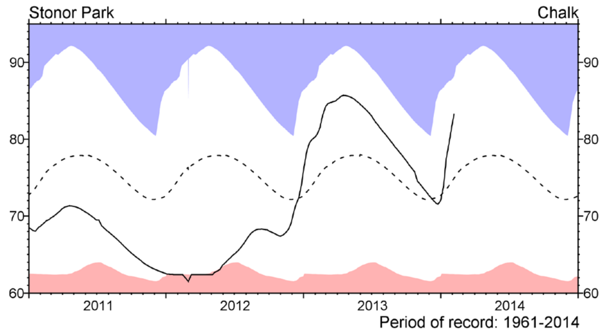

Brue at Lovington
2013/2014
Period of record: 1964-2014

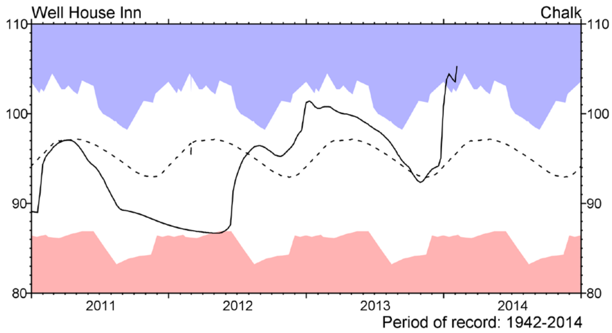

Medway at Teston / East Farleigh
2013/2014
Period of record: 1956-2014

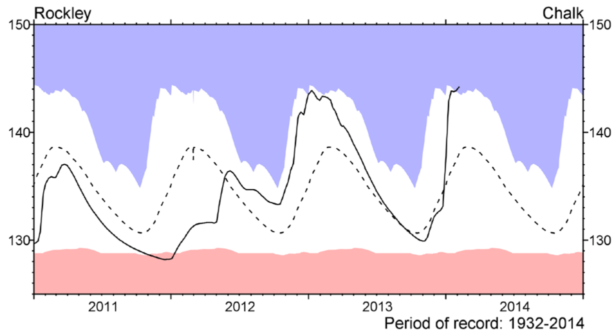
Groundwater . . . Groundwater

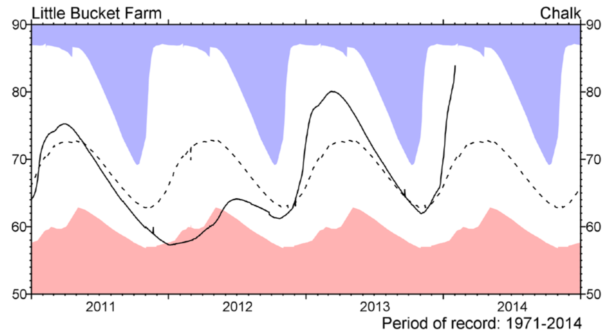


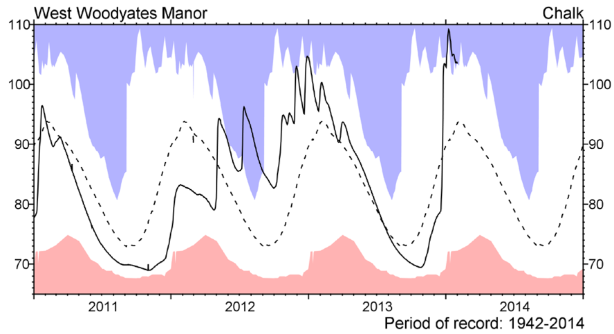


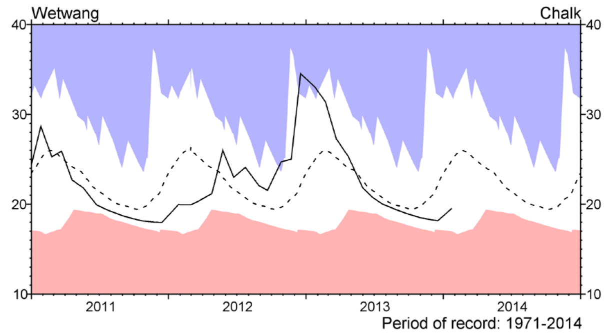


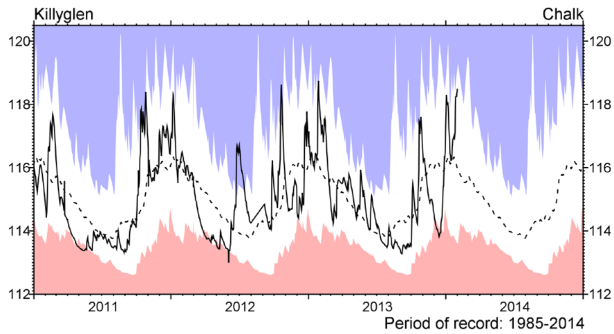


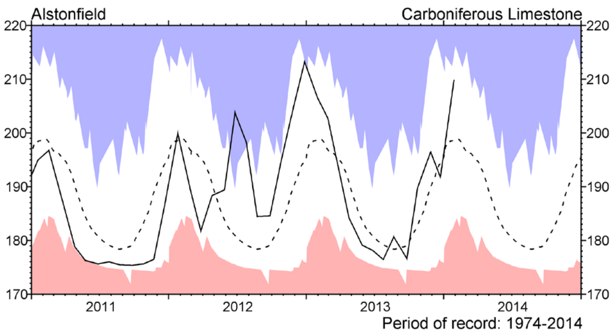






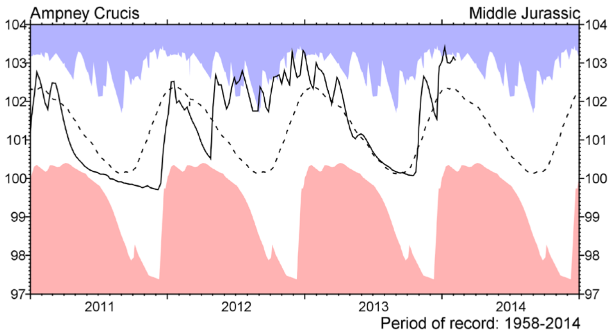


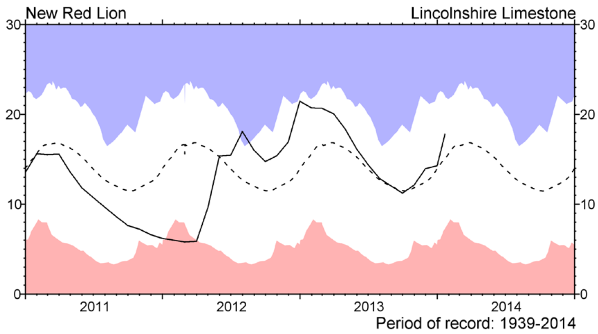


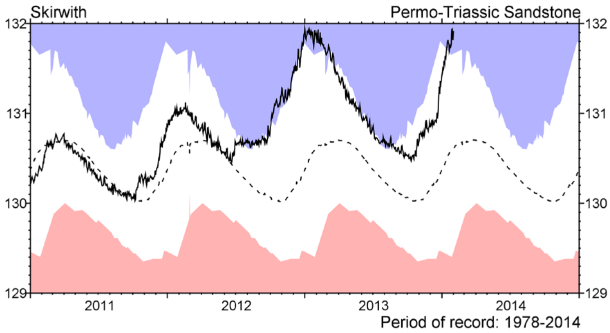


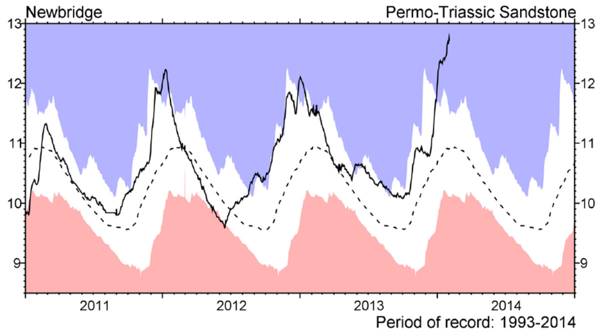
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

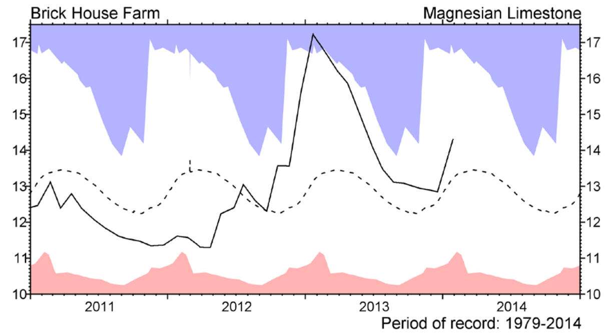
Groundwater ... Groundwater

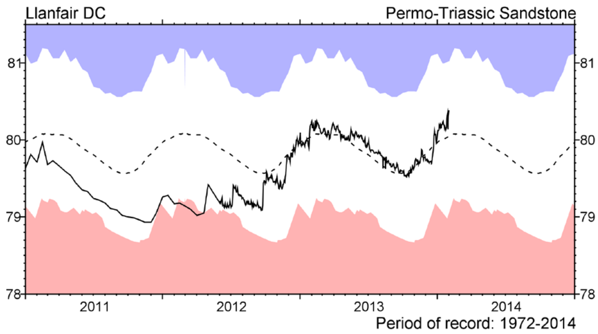


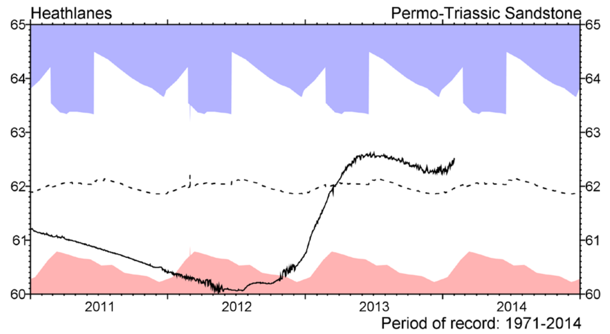


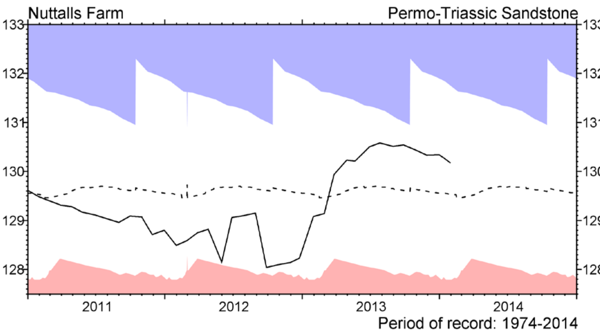


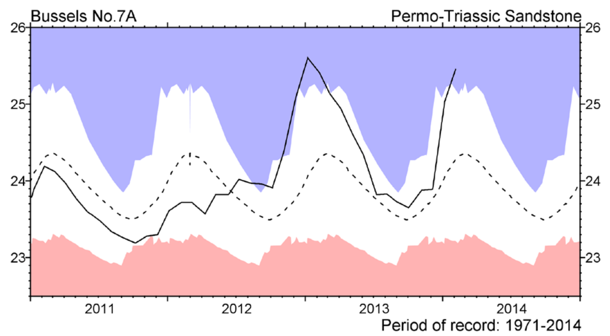


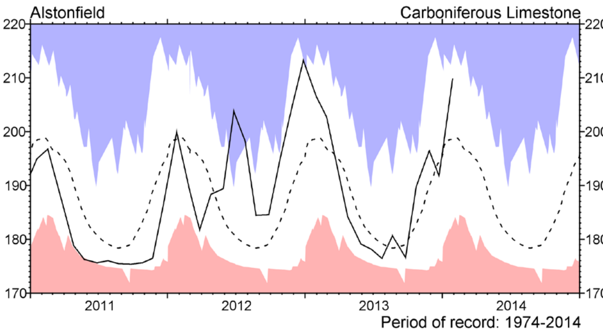










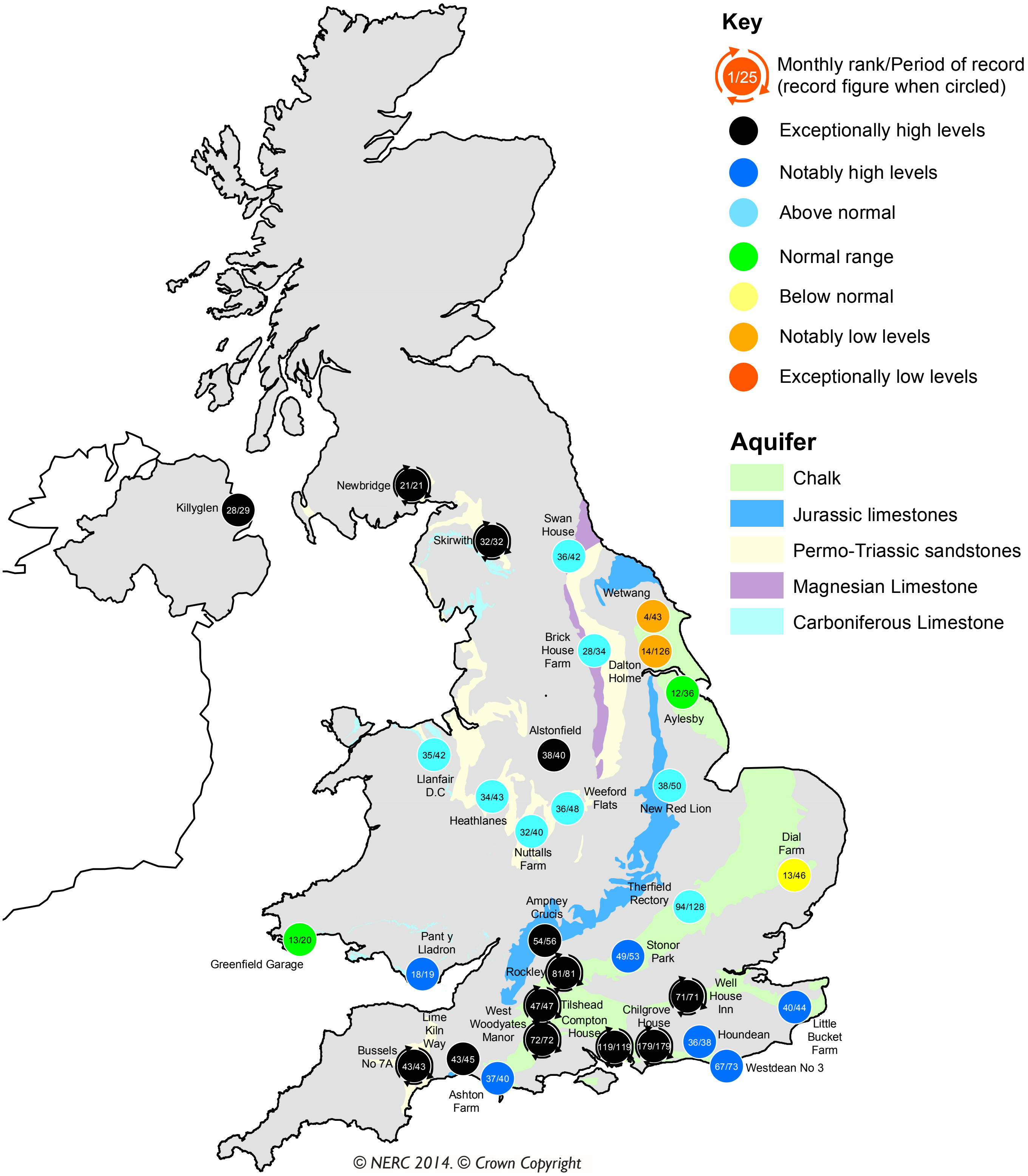


Groundwater levels January / February 2014

Borehole	Level	Date	Jan av.	Borehole	Level	Date	Jan av.	Borehole	Level	Date	Jan av.
Dalton Holme	12.94	27/01	17.17	Chilgrove House	76.68	04/02	56.26	Brick House Farm	14.30	28/01	13.05
Therfield Rectory	80.27	03/02	77.66	Killyglen (NI)	118.48	31/01	116.20	Llanfair DC	80.38	31/01	79.96
Stonor Park	83.25	05/02	73.19	Wetwang	19.48	22/01	24.36	Heathlanes	62.51	31/01	61.84
Tilshead	99.71	31/01	91.18	Ampney Crucis	103.08	05/02	102.34	Nuttalls Farm	130.18	29/01	129.51
Rockley	144.18	05/02	136.35	New Red Lion	17.77	21/01	14.89	Bussels No.7a	25.45	04/02	24.15
Well House Inn	105.24	05/02	94.87	Skirwith	132.00	31/01	130.59	Alstonfield	209.76	28/01	198.61
West Woodyates	103.57	31/01	91.62	Newbridge	12.72	02/02	10.88				

Levels in metres above Ordnance Datum

Groundwater...Groundwater

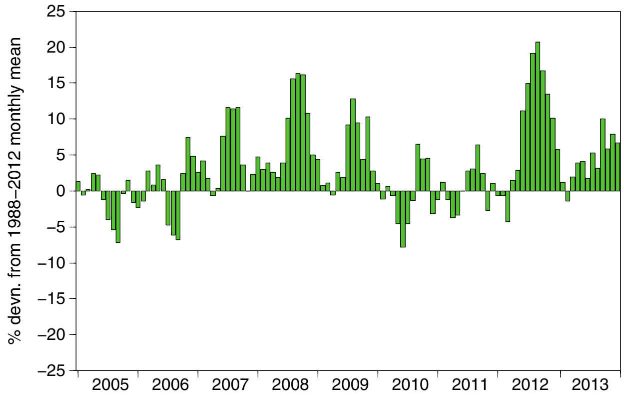


Groundwater levels - January 2014

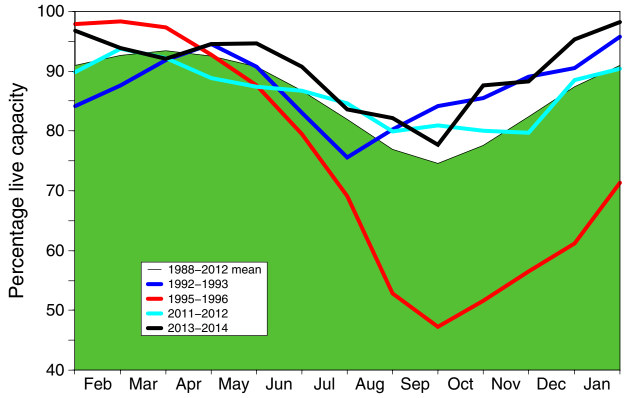
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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



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 Nov	2013 Dec	2014 Jan	Jan Anom.	Min Jan	Year* of min	2013 Jan	Diff 14-13
North West	N Command Zone	•	124929	81	94	100	8	63	1996	96	4
	Vyrnwy		55146	83	100	100	7	45	1996	99	1
Northumbrian	Teesdale	•	87936	97	100	100	8	51	1996	97	3
	Kielder		(199175)	89	100	97	3	85	1989	98	-1
Severn Trent	Clywedog		44922	87	87	92	4	62	1996	96	-4
	Derwent Valley	•	39525	89	98	101	6	15	1996	100	1
Yorkshire	Washburn	•	22035	92	95	98	8	34	1996	97	1
	Bradford Supply	•	41407	79	91	100	6	33	1996	99	1
Anglian	Grafham		(55490)	89	89	93	7	67	1998	73	20
	Rutland		(116580)	86	89	95	10	68	1997	96	-1
Thames	London	•	202828	94	96	96	6	70	1997	96	1
	Farmoor	•	13822	92	84	100	10	72	2001	95	5
Southern	Bewl		28170	80	91	100	19	37	2006	99	1
	Ardingly**		4685	84	100	100	8	41	2012	100	0
Wessex	Clatworthy		5364	100	100	100	4	62	1989	100	0
	Bristol	•	(38666)	69	83	100	14	58	1992	96	4
South West	Colliford		28540	75	83	98	15	52	1997	100	-2
	Roadford		34500	81	91	100	19	30	1996	99	1
	Wimbleball		21320	66	76	100	10	59	1997	100	0
	Stithians		4967	81	100	100	12	38	1992	100	0
Welsh	Celyn & Brenig	•	131155	89	100	100	5	61	1996	100	1
	Brianne		62140	91	100	100	3	84	1997	99	1
	Big Five	•	69762	92	98	100	7	67	1997	96	4
	Elan Valley	•	99106	100	100	100	3	73	1996	100	0
Scotland(E)	Edinburgh/Mid-Lothian	•	97639	81	100	100	6	72	1999	97	3
	East Lothian	•	10206	73	100	100	2	68	1990	100	0
Scotland(W)	Loch Katrine	•	111363	87	94	95	2	85	2000	87	8
	Daer		22412	100	100	98	0	90	2013	90	8
	Loch Thom	•	11840	100	100	100	2	90	2004	100	0
Northern Ireland	Total+	•	56800	87	89	93	2	75	2002	100	-7
	Silent Valley	•	20634	85	89	100	13	46	2002	100	0

( ) 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.

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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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

NERC SCIENCE OF THE ENVIRONMENT

02/2014