Hydrological Summary

for the United Kingdom

January 2016

General

Wet and mild conditions again dominated the UK in January contributing to the warmest and wettest November-January on record. It was the fourth wettest January for the UK (in a series from 1910) with all regions registering above average rainfall; more than double the average was recorded in north-eastern areas and along the south coast. Although unsettled and stormy at the beginning and end (including named storm 'Gertrude' on the 28th/29th), a cold snap mid-month brought snow to many regions, with the deepest falls in northern and upland areas. Soils across the UK remained saturated following the wet conditions in January and the previous two months. In north-east Scotland many rivers established new monthly mean flow records (for the second consecutive month in some cases). A number of these rivers also established new January peak flow records (for the Don and Ythan these were the highest for any month); several burst their banks and caused extensive and severe flooding. Average outflows from Great Britain were the highest on record for January. Reservoirs across the country remained close to capacity and stocks for England & Wales were appreciably above average. Groundwater levels responded to recharge and the majority of levels were in the normal range or above. With soils saturated, river flows and groundwater levels above normal and further unsettled weather at the beginning of February, there is an enhanced risk of fluvial and groundwater flooding across parts of the UK.

Rainfall

Vigorous low pressure systems brought substantial rainfall in January, although these were punctuated by a spell of high pressure mid-month. An exceptionally cyclonic period brought south-easterly winds and delivered heavy rainfall to north-east Scotland in the first ten days of the month. In Aberdeenshire, 104mm was recorded on the 3rd at Spittal of Glenmuick and Fyvie recorded 145mm across the first week (thus breaking its January rainfall record in only seven days). Heavy rainfall caused damage to the runway at Aberdeen airport on the 7th, as well as widespread disruption to road and rail travel across Scotland in the first ten days. A drier cold snap mid-month brought snowfall (e.g. 6cm at Spadeadam, Cumbria on the 14th) and transport disruption to northern areas (e.g. on the 8th in Scotland). From the 21st to month-end a south-westerly air flow heralded the return of unsettled conditions, most notably on the 26th/27th and 28th/29th (storm 'Gertrude', delivering 78mm at Kinlochewe, north-west Scotland) resulting in landslides, power cuts and transport disruption across parts of Scotland, Cumbria and Northern Ireland. For the Tweed region, it was the wettest January on record and the second wettest month after December 2015 (in a series from 1910). Coastal parts of eastern Scotland and North Yorkshire received over 250% of average rainfall and much of the south coast received in excess of 175% of average. Many regions in northern England and southern Scotland recorded their wettest three month period on record, by a wide margin for Northumbrian, Forth, Tweed and Solway. Eglwyswrw (south-west Wales) recorded 83 consecutive days of rainfall ending on the 17th January, closely approaching the UK record of 89 days.

River flows

Following heavy rainfall around the turn of the year, flows were high in many rivers at the start of the month. New January peak flow records were registered in north-east Scotland on the 7th: the Deveron recorded a new January maxima; the Don a new maxima for any month; and the Ythan a new maxima for any month by a wide margin. Flows on the Ythan and Don established new daily maxima for more than 10 consecutive days, illustrating the sustained nature of high flows over this period, with extensive floodplain inundations in north-east Scotland and numerous evacuations. A sub station flooded causing power cuts in Port Elphinstone, Kintore and Ellon on the 8th. With the settled conditions mid-month, recessions became established across the UK; flows in many rivers fell below average following steep declines. River flows then increased towards month-end across the UK in response to heavy rainfall brought by a succession of frontal systems, including 'Gertrude'. Over 100 flood alerts and warnings were issued on the 27th along the south coast and in northern and western areas. Average river flows in January were above normal in the majority of catchments with exceptionally high flows registered in north-eastern and parts of south-western Britain. January mean flow records were exceeded on the Deveron, Ythan, Dee, Tay, Scottish Tyne, Whiteadder and Tweed with most of these having also recorded new monthly mean flows in December. Average flows over November-January were the highest on record for any three month period for many rivers across the north and west of the UK. Correspondingly, average outflows from Great Britain for the same period were also the highest on record for any three month period (in a series from 1961).

Groundwater

The saturated soils throughout the UK meant groundwater levels responded to recharge in all aquifers. Levels were in the normal range or above, apart from two slowly responding sites in the Chalk of central and eastern England. At fast responding sites, the rapid rise in levels that commenced in December continued into January. Levels in many aquifers fell mid-month, but generally rose again by month-end (e.g. in the Chalk of the South Downs, parts of the Cotswolds limestones, most of the Permo-Triassic sandstones and the Carboniferous Limestone of south Wales). At month-end, water levels in the Chalk were notably or exceptionally high (at Wetwang and along the south coast) where levels responded rapidly to the exceptional rainfall, or in the normal range and rising at slowly responding sites. However, groundwater flooding in the south-east of England was localised and minor, with a few flooded cellars and surcharged sewers. Levels in the Permo-Triassic sandstones were generally in the normal range, with the exception of north-west England and south-west Scotland where they were higher due to the exceptional rainfall over the last three months; a record monthly level was again recorded at Newbridge. Levels rose in the Magnesian Limestone index boreholes, with a record maximum January level recorded at Brick House Farm.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

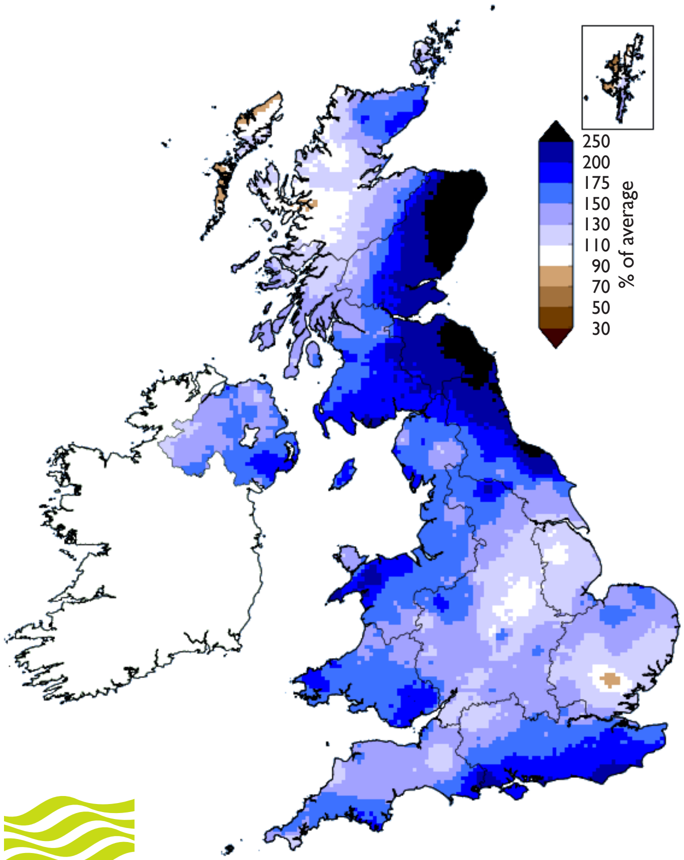
Area	Rainfall	Jan 2016	Dec15 – Jan16	RP	Nov15 – Jan16	RP	May15 – Jan16	RP	Feb15 – Jan16	RP
United	mm	**185**	415		591		1099		1321	
Kingdom	%	**158**	177	>>100	169	>>100	132	80-120	123	60-90
England	mm	**129**	266		385		793		921	
	%	**156**	157	30-50	154	50-80	126	8-12	114	2-5
Scotland	mm	**258**	609		854		1501		1878	
	%	**156**	188	>>100	177	>>100	135	>100	131	>100
Wales	mm	**264**	623		891		1482		1704	
	%	**173**	200	>>100	192	>>100	141	80-120	126	20-30
Northern	mm	**179**	400		584		1111		1347	
Ireland	%	**150**	171	>>100	170	>>100	130	>100	122	>100
England &	mm	**148**	316		455		888		1029	
Wales	%	**160**	167	>100	162	>100	129	10-20	116	5-10
North West	mm	**198**	550		811		1339		1584	
	%	**163**	221	>>100	218	>>100	147	>100	136	>100
Northumbrian	mm	**185**	410		575		1008		1148	
	%	**226**	245	>>100	232	>>100	159	>>100	140	>100
Severn-Trent	mm	**100**	215		317		671		785	
	%	**135**	141	8-12	142	10-20	115	2-5	105	2-5
Yorkshire	mm	**134**	314		473		918		1045	
	%	**165**	186	>100	192	>>100	148	60-90	130	25-35
Anglian	mm	**69**	126		193		513		596	
	%	**129**	115	2-5	116	2-5	109	2-5	100	2-5
Thames	mm	**100**	176		251		591		691	
	%	**145**	127	2-5	122	2-5	109	2-5	100	2-5
Southern	mm	**152**	238		320		732		838	
	%	**184**	142	5-10	128	2-5	121	5-10	109	2-5
Wessex	mm	**140**	238		332		765		880	
	%	**151**	125	2-5	120	2-5	115	2-5	103	2-5
South West	mm	**211**	360		498		1084		1271	
	%	**149**	126	5-10	119	2-5	118	5-10	107	2-5
Welsh	mm	**253**	593		842		1418		1628	
	%	**173**	199	>>100	190	>>100	140	70-100	125	15-25
Highland	mm	**245**	638		891		1584		2075	
	%	**122**	161	40-60	149	80-120	120	10-20	121	15-25
North East	mm	**235**	450		553		1063		1240	
	%	**241**	241	>>100	194	>>100	144	70-100	131	30-50
Tay	mm	**296**	667		869		1485		1776	
	%	**188**	227	>>100	204	>>100	153	>100	141	>>100
Forth	mm	**234**	534		789		1323		1595	
	%	**185**	215	>>100	217	>>100	152	>>100	142	>>100
Tweed	mm	**243**	538		748		1203		1405	
	%	**242**	266	>>100	254	>>100	164	>>100	149	>>100
Solway	mm	**304**	713		1033		1669		2017	
	%	**195**	229	>>100	225	>>100	154	>>100	145	>>100
Clyde	mm	**297**	707		1064		1858		2338	
	%	**148**	180	>100	183	>>100	139	>100	135	>100

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

Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals from March 2015 (inclusive) are provisional.

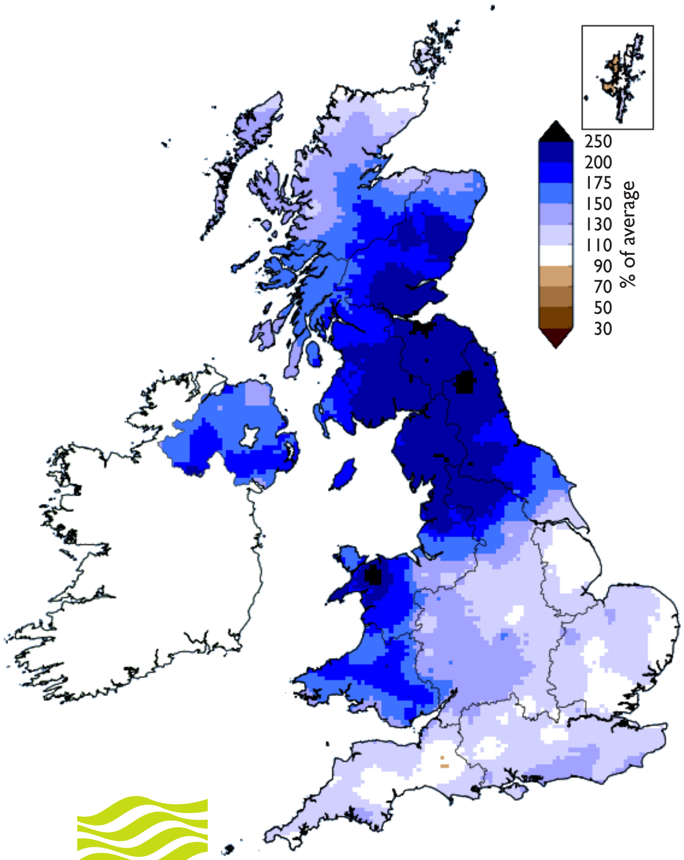
Rainfall . . . Rainfall . . .

January 2016 rainfall as % of 1971-2000 average



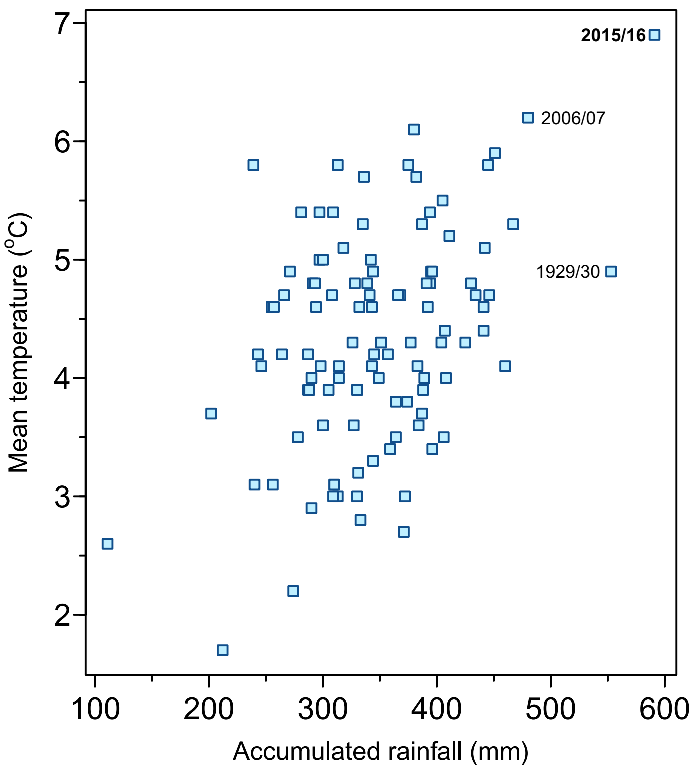
Met Office

November 2015 - January 2016 rainfall as % of 1971-2000 average



Met Office

November - January temperature and rainfall for the UK



Met Office 3-month outlook Updated: January 2016

Met Office

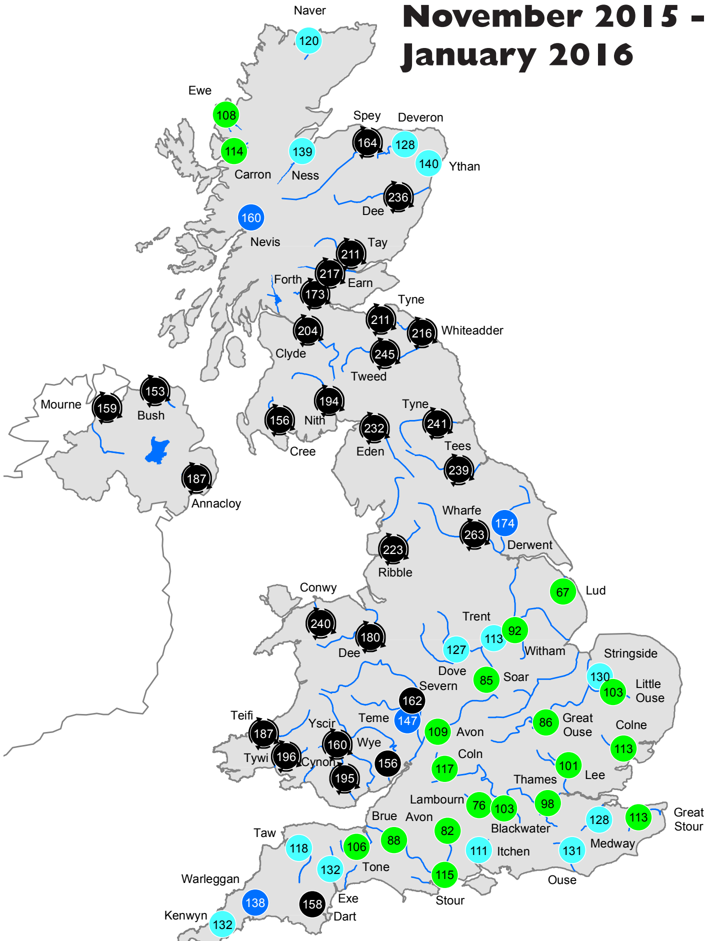
For February-March-April both above and below-average precipitation is equally probable. The probability that UK-average precipitation for February-March-April will fall into the driest of our five categories is around 20% and the probability that it will fall into the wettest of our five categories is also around 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.

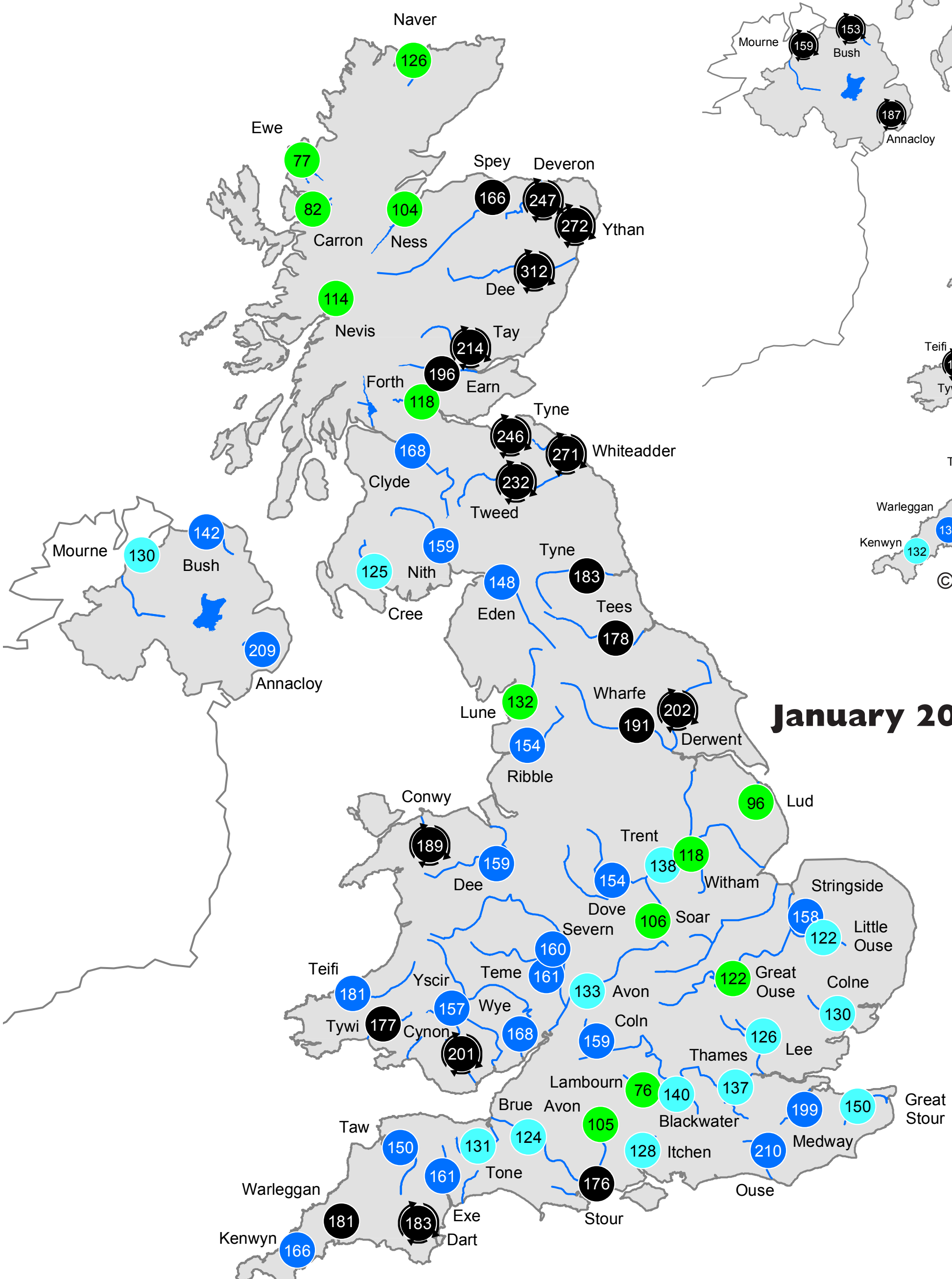
River flow . . . River flow . . .

November 2015 - January 2016



© NERC (CEH) 2016 © Crown copyright.

January 2016



© NERC (CEH) 2016. © Crown copyright.

Key

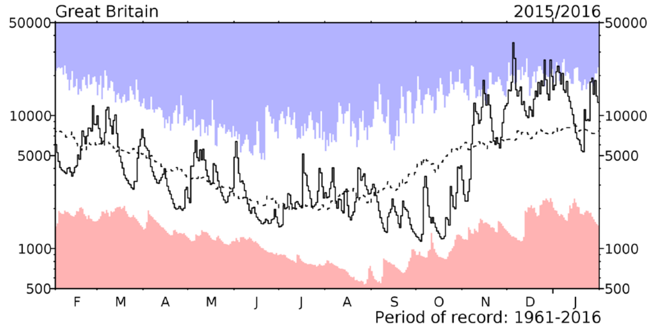
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

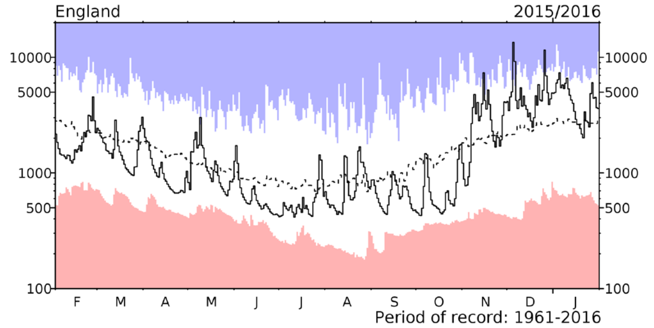
*Based on ranking of the monthly flow**

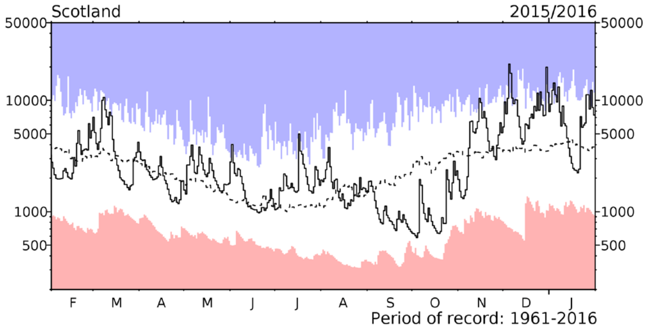
River flows

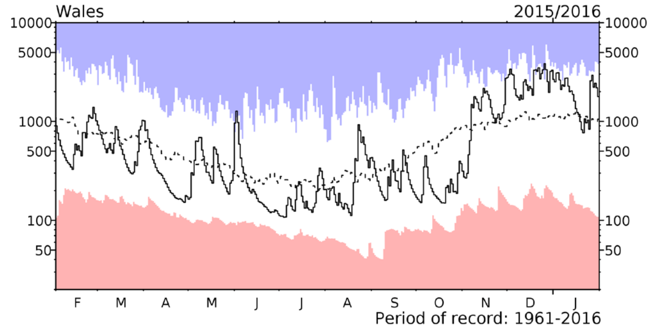
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

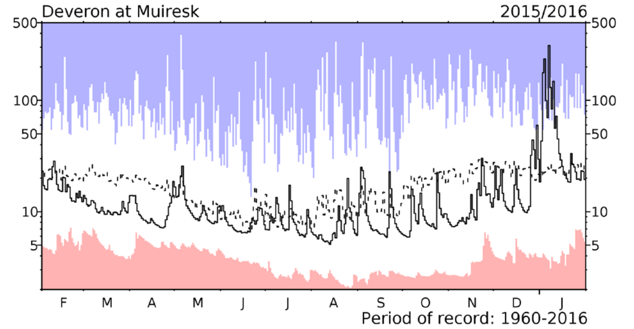
River flow . . . River flow . . .

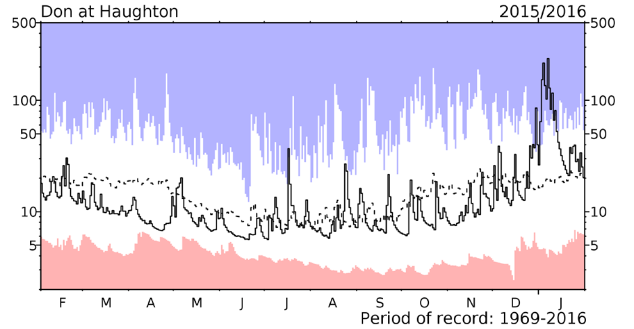


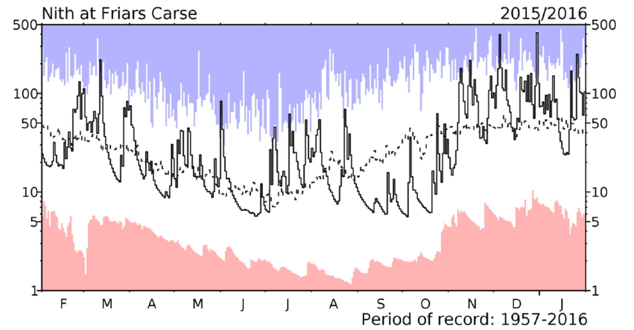


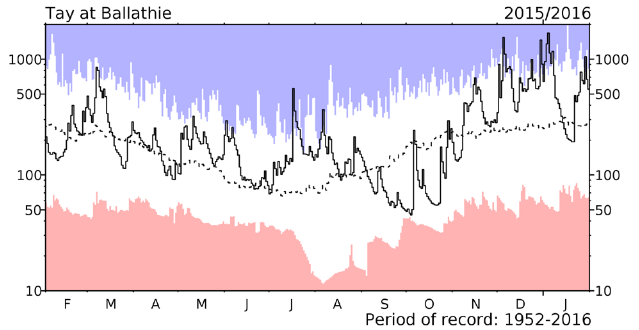


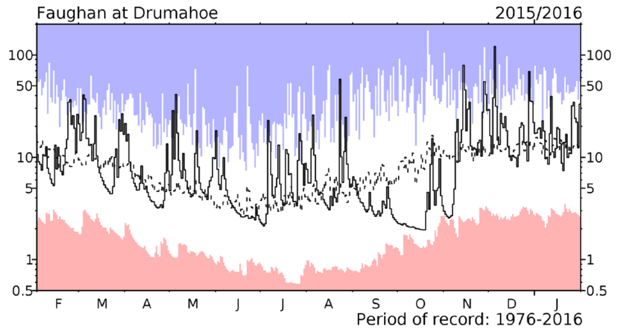


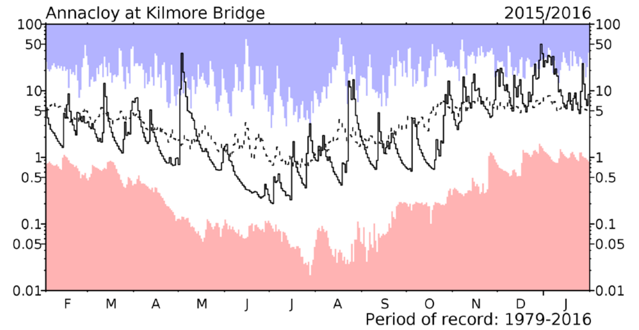






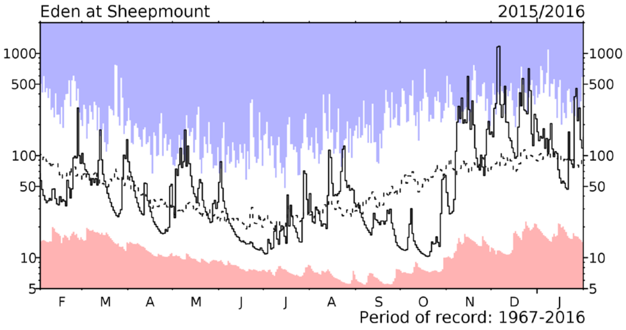


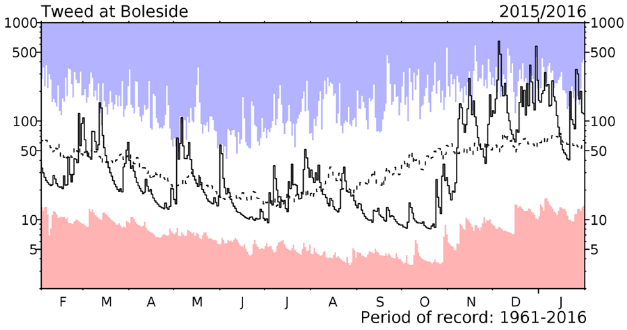


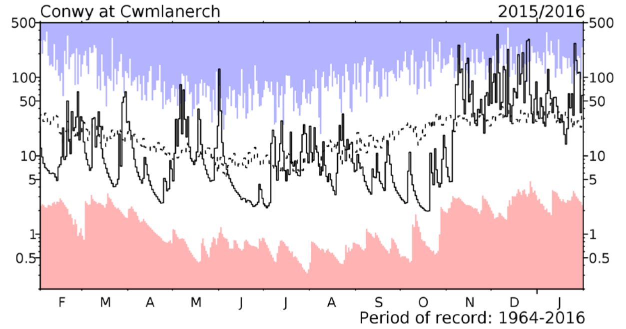


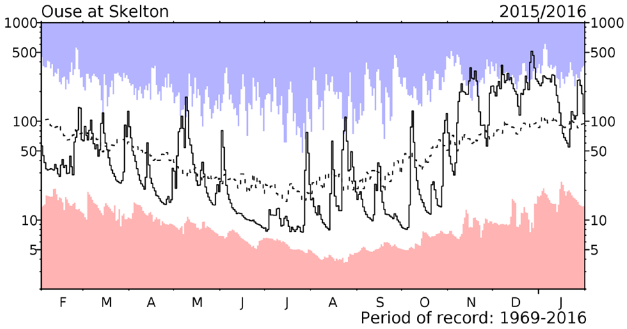
River flow hydrographs

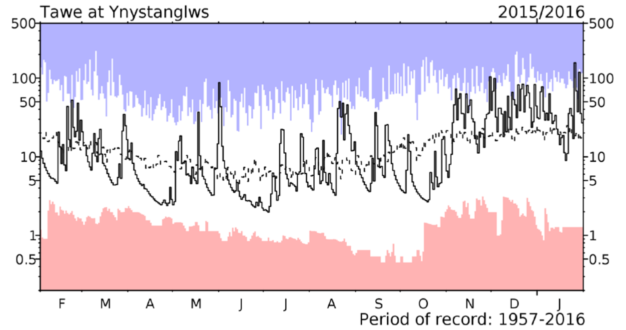
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to February 2015 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

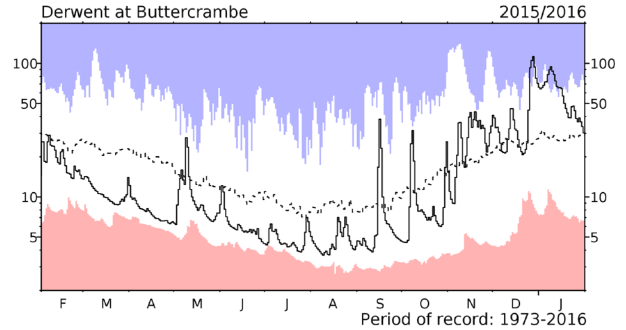

Eden at Sheepmount
2015/2016
Period of record: 1967-2016

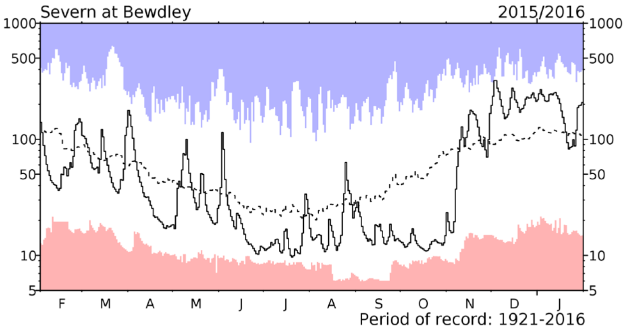

Tweed at Boleside
2015/2016
Period of record: 1961-2016

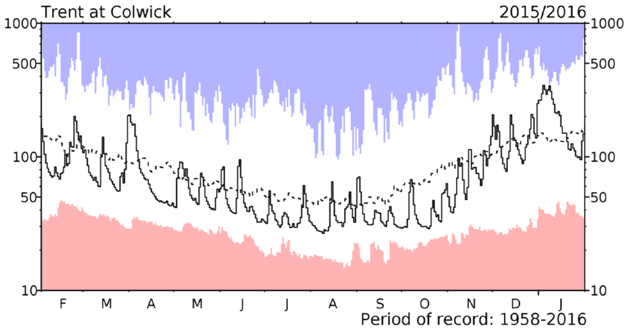

Conwy at Cwmlanerch
2015/2016
Period of record: 1964-2016

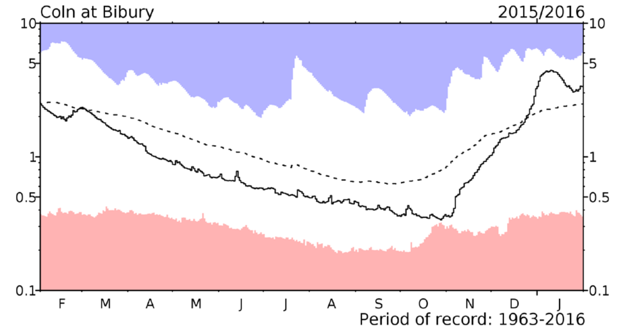

Ouse at Skelton
2015/2016
Period of record: 1969-2016

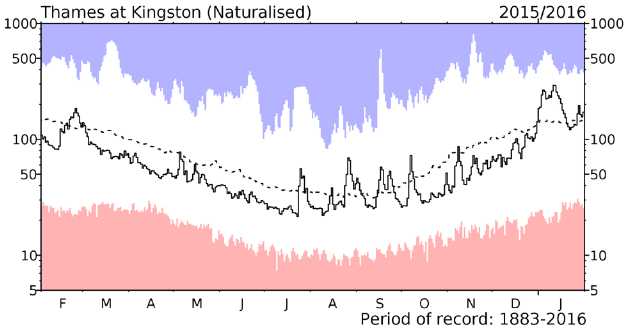

Tawe at Ynystanglws
2015/2016
Period of record: 1957-2016

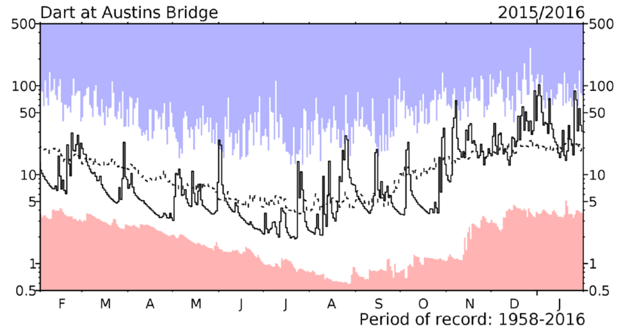

Derwent at Buttercrambe
2015/2016
Period of record: 1973-2016

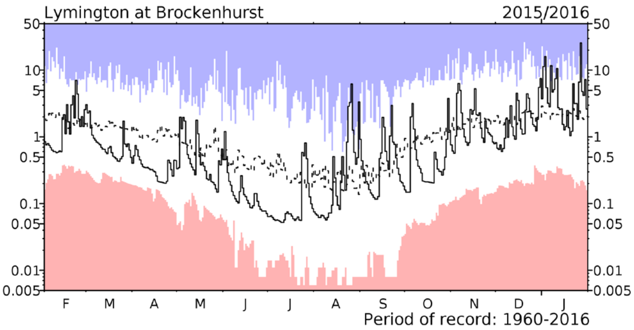

Severn at Bewdley
2015/2016
Period of record: 1921-2016


Trent at Colwick
2015/2016
Period of record: 1958-2016

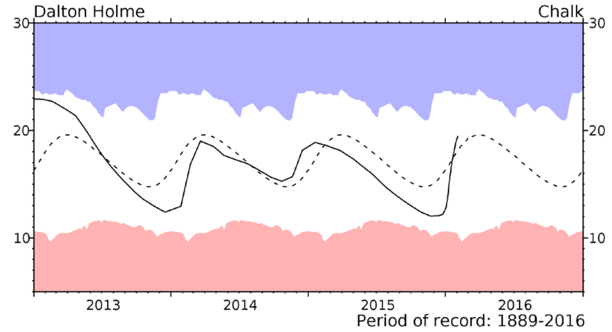

Coln at Bibury
2015/2016
Period of record: 1963-2016

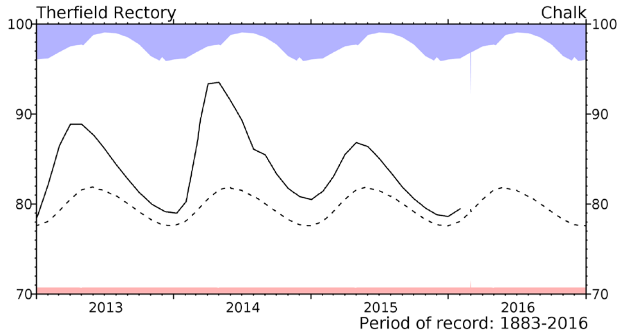

Thames at Kingston (Naturalised)
2015/2016
Period of record: 1883-2016

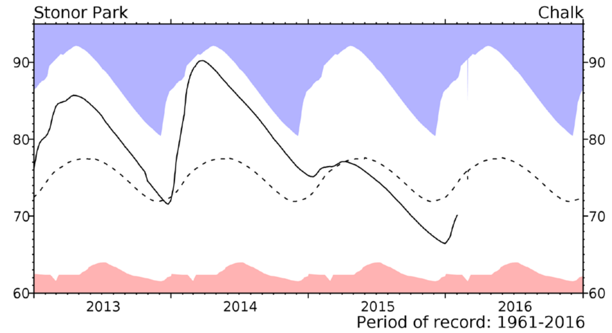

Dart at Austins Bridge
2015/2016
Period of record: 1958-2016

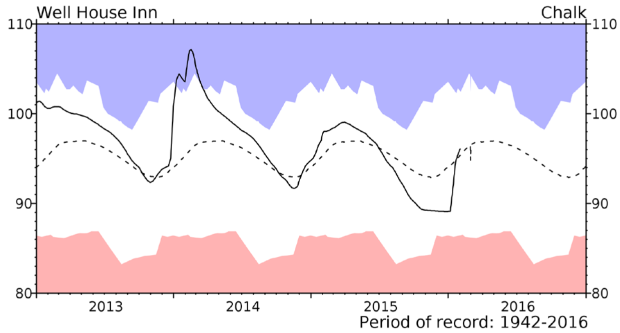

Lymington at Brockenhurst
2015/2016
Period of record: 1960-2016

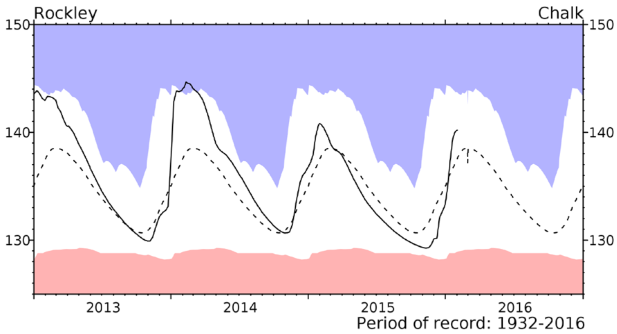
Groundwater . . . Groundwater

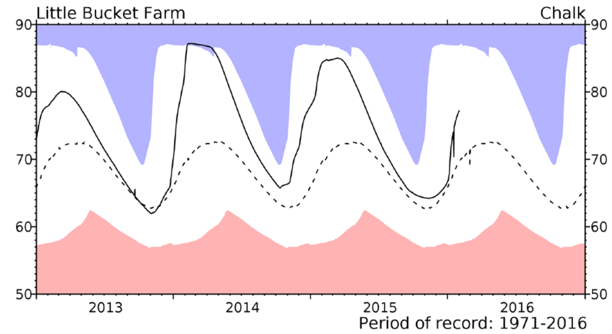


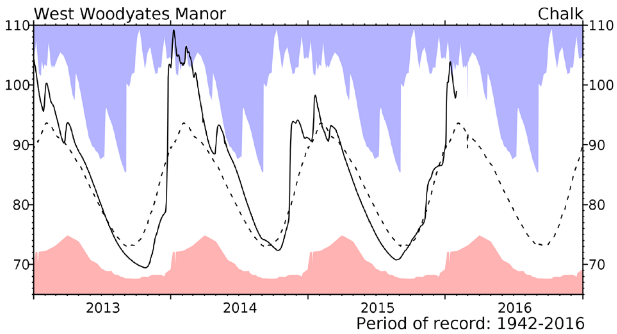


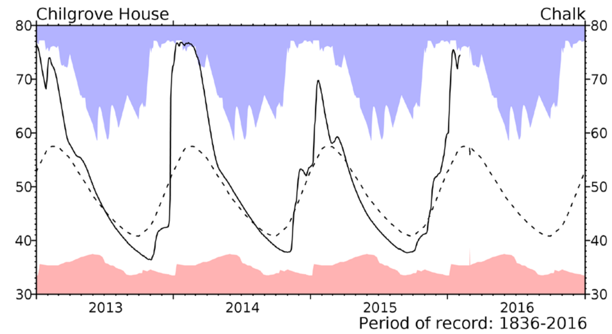


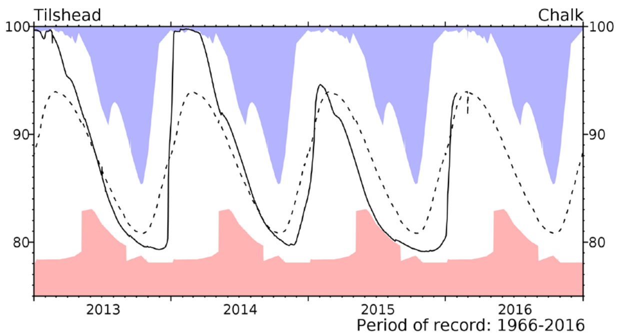


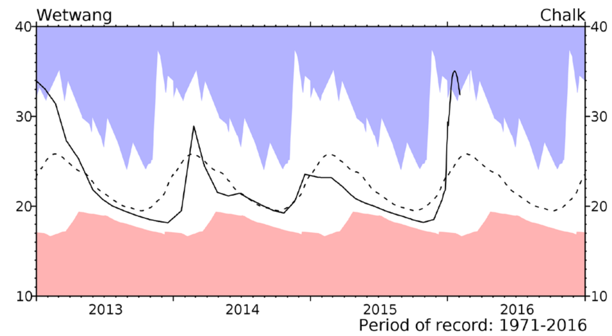






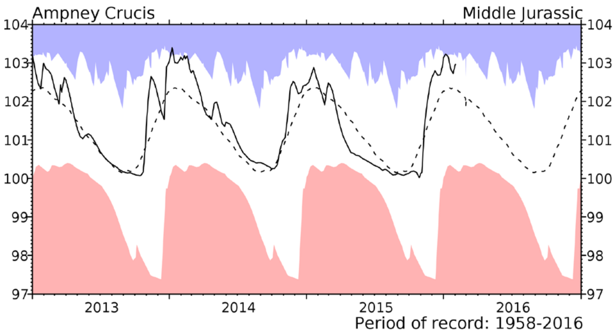


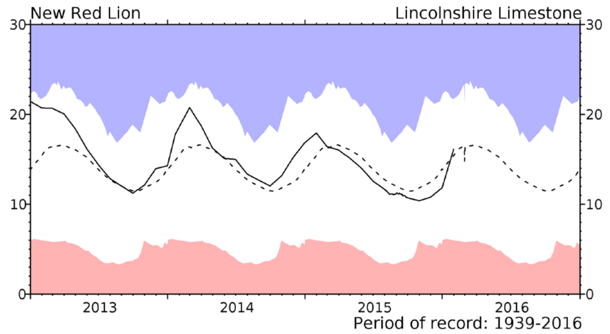


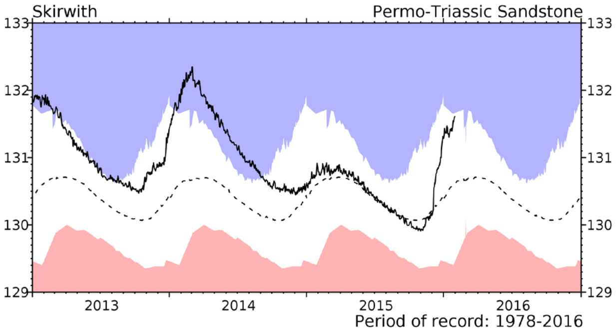


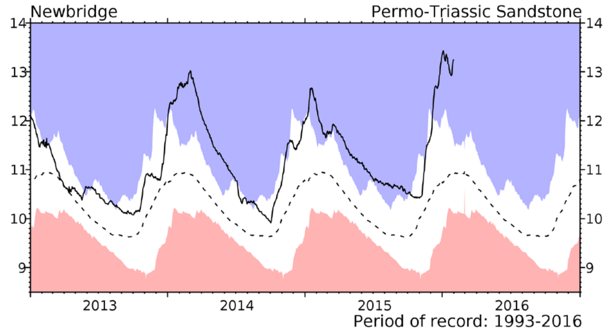
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

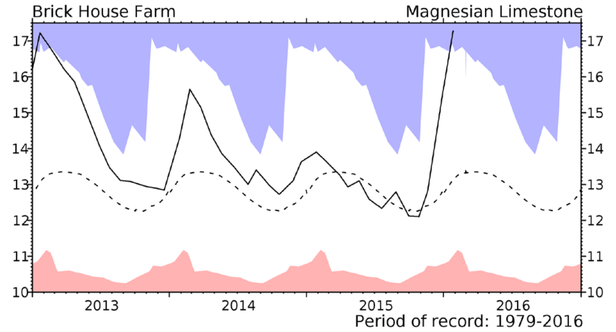
Groundwater... Groundwater

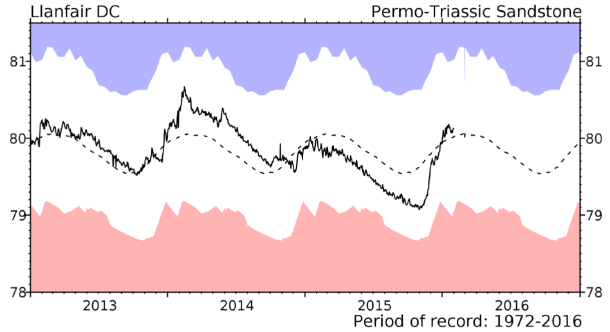


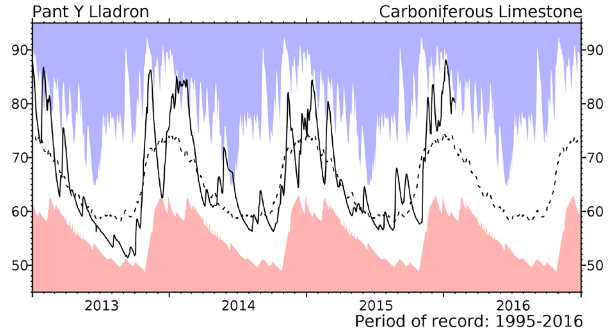


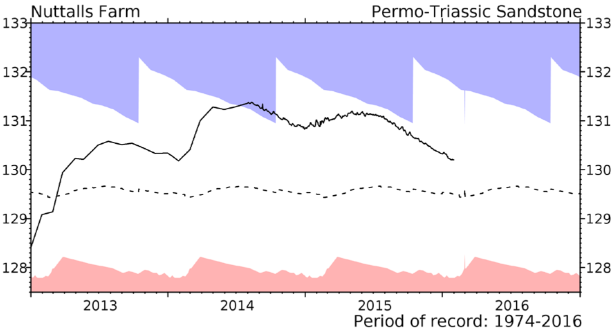


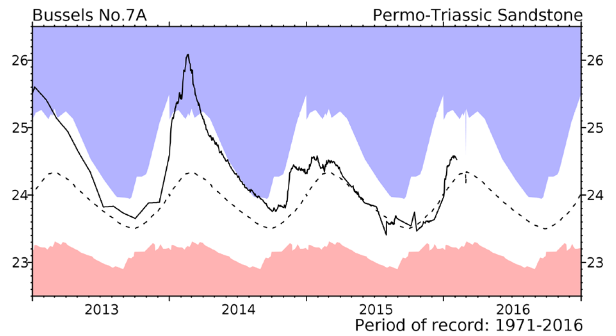


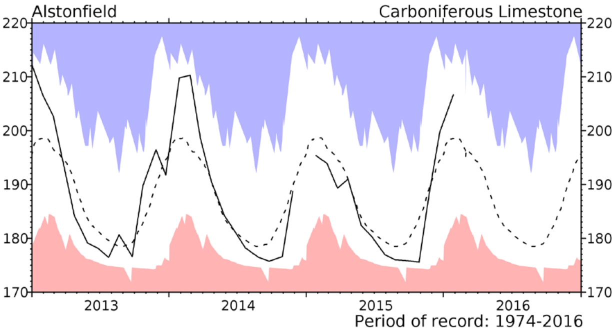










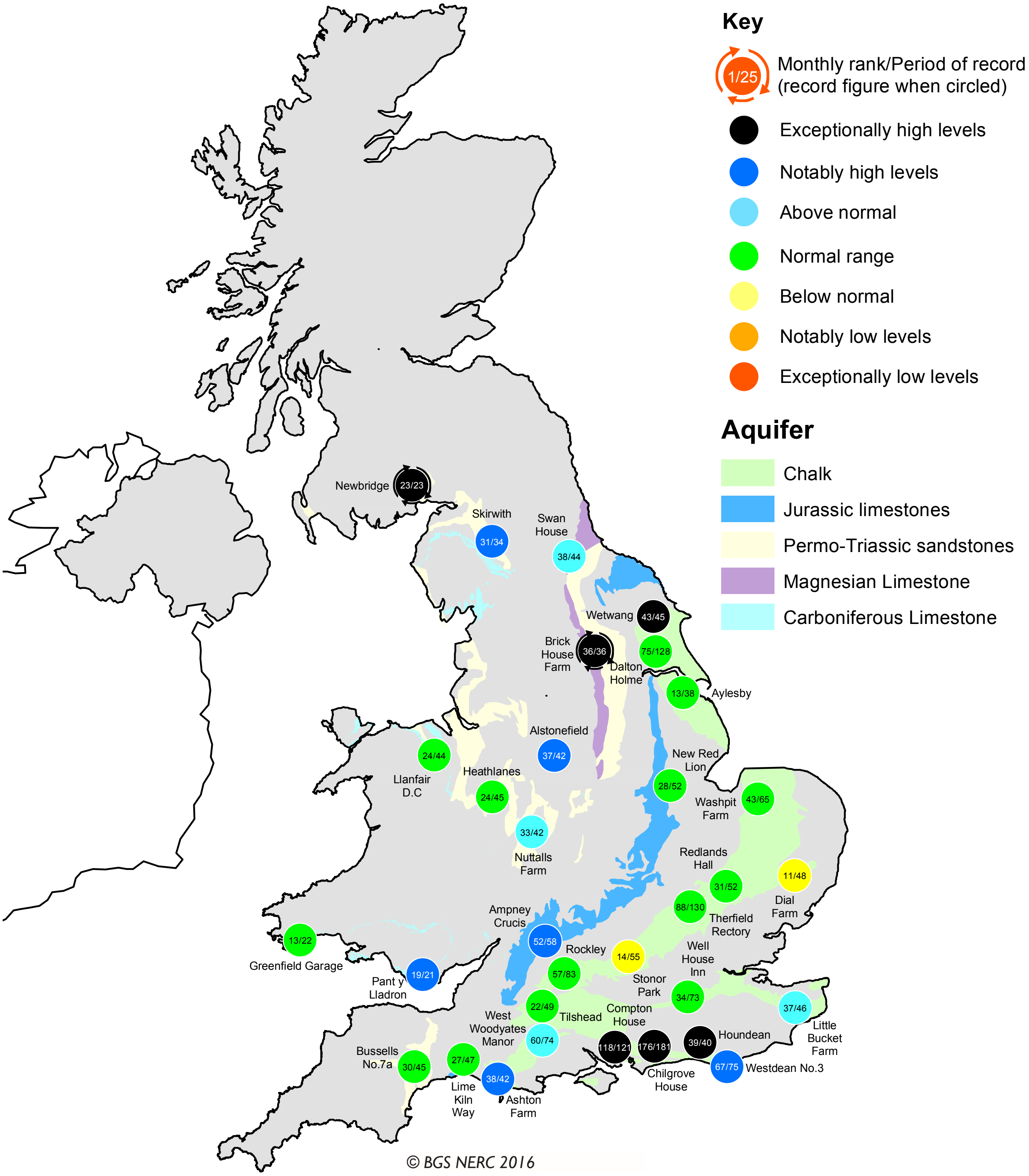


Groundwater levels January / February 2016

Borehole	Level	Date	Jan av.	Borehole	Level	Date	Jan av.	Borehole	Level	Date	Jan av.
Dalton Holme	19.46	03/02	17.15	Chilgrove House	74.41	03/02	56.41	Brick House Farm	17.27	26/01	13.11
Therfield Rectory	79.45	01/02	77.69	Little Bucket Farm	77.17	01/02	68.63	Llanfair DC	80.12	31/01	79.97
Stonor Park	70.13	01/02	73.34	Wetwang	32.34	03/02	24.21	Pant y Lladron	80.25	31/01	74.47
Tilshead	93.79	31/01	91.30	Ampney Crucis	102.96	01/02	102.36	Nuttalls Farm	130.20	31/01	129.56
Rockley	140.20	01/02	136.47	New Red Lion	16.09	31/01	15.01	Bussells No.7a	24.52	05/02	24.18
Well House Inn	96.05	01/02	95.01	Skirwith	131.61	31/01	130.63	Alstonefield	206.64	27/01	198.80
West Woodyates	98.92	31/01	91.86	Newbridge	13.24	31/01	11.02				

Levels in metres above Ordnance Datum

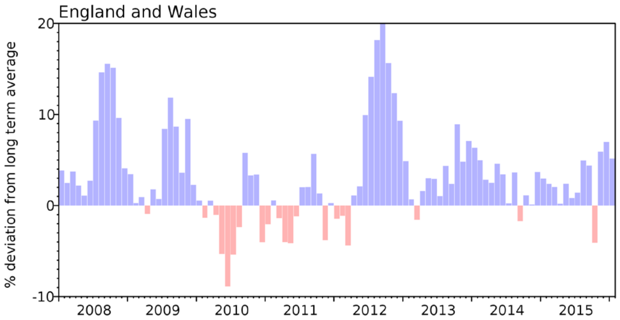
Groundwater...Groundwater



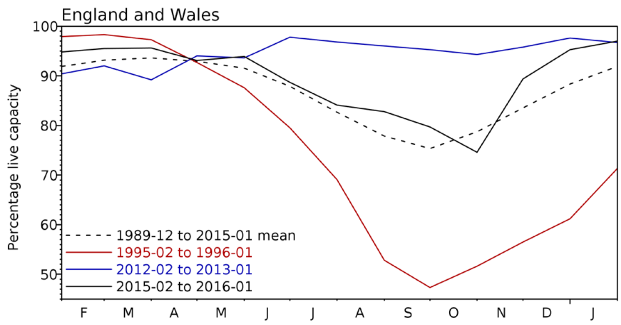
Groundwater levels - January 2016

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.

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



Percentage live capacity of selected reservoirs at end of month

Area	Reservoir		Capacity (Ml)	2015 Nov	2015 Dec	2016 Jan	Jan Anom.	Min Jan	Year* of min	2015 Jan	Diff 16-15
North West	N Command Zone	•	124929	84	100	100	7	63	1996	98	2
	Vyrnwy		55146	96	100	99	6	45	1996	94	6
Northumbrian	Teesdale	•	87936	94	100	100	7	51	1996	99	1
	Kielder		(199175)	98	97	99	5	85	1989	94	5
Severn-Trent	Clywedog		44922	87	97	97	9	62	1996	93	4
	Derwent Valley	•	39525	81	101	100	5	15	1996	100	0
Yorkshire	Washburn	•	22035	93	96	96	5	34	1996	87	9
	Bradford Supply	•	41407	87	100	97	3	33	1996	99	-2
Anglian	Grafham		(55490)	86	86	91	5	67	1998	76	15
	Rutland		(116580)	79	87	94	8	68	1997	95	-1
Thames	London	•	202828	90	96	97	6	70	1997	96	1
	Farmoor	•	13822	89	78	79	-11	72	2001	96	-17
Southern	Bewl		28170	62	70	83	1	37	2006	85	-2
	Ardingly		4685	68	91	100	7	41	2012	100	0
Wessex	Clatworthy		5364	98	100	100	4	62	1989	100	0
	Bristol	•	(38666)	75	92	99	13	58	1992	95	4
South West	Colliford		28540	83	92	100	16	52	1997	87	13
	Roadford		34500	85	96	98	16	30	1996	91	7
	Wimbleball		21320	74	92	100	9	59	1997	100	0
	Stithians		4967	74	98	100	12	38	1992	75	25
Welsh	Celyn & Brenig	•	131155	98	100	100	5	61	1996	94	6
	Brianne		62140	100	100	100	2	84	1997	98	2
	Big Five	•	69762	79	82	84	-10	67	1997	97	-13
	Elan Valley	•	99106	100	100	99	2	73	1996	100	-1
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	86	100	100	6	72	1999	91	9
	East Lothian	•	9374	100	100	100	2	68	1990	100	0
Scotland(W)	Loch Katrine	•	110326	98	99	98	5	85	2000	95	3
	Daer		22412	99	100	100	2	90	2013	98	2
	Loch Thom	•	10798	100	100	100	2	90	2004	100	0
Northern Ireland	Total+	•	56800	96	99	100	8	75	2002	92	8
	Silent Valley	•	20634	98	100	100	12	46	2002	95	5

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

+ excludes Lough Neagh

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

Location map…Location map

NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). The NHMP aims to provide an authoritative voice on hydrological conditions throughout the UK, to place them in a historical context and, over time, identify and interpret any emerging hydrological trends. Hydrological analysis and interpretation within the Programme is based on the data holdings of the National River Flow Archive (NRFA; maintained by CEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru (NRW), 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).

Details of reservoir stocks are provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The Hydrological Summary and other NHMP outputs may also refer to and/or map soil moisture data for the UK. These data are provided by the Meteorological Office Rainfall and Evaporation Calculation System (MORECS). MORECS provides estimates of monthly soil moisture deficit in the form of averages over 40 x 40 km grid squares over Great Britain and Northern Ireland. The monthly time series of data extends back to 1961.

Rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA, NRW and SEPA. The areal rainfall figures have been produced by the Met Office National Climate Information Centre (NCIC), and are based on 5km resolution gridded data from rain gauges. The majority of the full rain gauge network across the UK is operated by the EA, NRW, SEPA and Northern Ireland Water; supplementary rain gauges are operated by the Met Office. The Met Office NCIC monthly rainfall series extend back to 1910 and form 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/methods

Long-term averages are based on the period 1971-2000 and are derived from the monthly areal series.

The regional figures for the current month in the hydrological summaries are based on a limited rain gauge network so these (and the associated return periods) should be regarded as a guide only.

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

For further details on rainfall or MORECS data, please contact the Met Office:

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

Enquiries

Enquiries should be directed to the NHMP:

Tel: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:

http://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk

Some of the features displayed on the maps contained in this report are based on the following data with permission of the controller of HMSO.

i. Ordnance Survey data. © Crown copyright and/or database right 2005. Licence no. 100017897.
ii. Land and Property Services data. © Crown copyright and database right, S&LA 145.
iii. Met Office rainfall data. © Crown copyright.

02/2016