Hydrological Summary
for the United Kingdom

April 2016

General
April was a cool and wet month, with some unsettled weather and a very wintry spell in the final week. All regions were colder than average, and nationally the monthly temperature was 0.9°C below the long-term average (although not exceptional; 2012 and 2013 were colder). It was also wetter than average in most regions, although not significantly so except in some isolated areas, while in south-west Britain it was relatively dry. The snowfall in the final week was unusually widespread for late April, while in northern Britain some seasonally significant accumulations occurred even at low altitudes. Occasional periods of heavy rainfall triggered localised surface water flooding and modest river flow spates, but overall river flows for April were largely in the normal range or moderately above. Groundwater levels receded at the majority of sites, but remained in the normal range or slightly above for April, except in northern England and southern Scotland where exceptional levels persisted following the wet winter. Reservoir levels were just above average at the national scale, and above 90% of capacity in all but a few northern impoundments, where they were only slightly below. Overall, the water resources outlook for the remainder of spring and summer 2016 is healthy.

Rainfall
April started unsettled, as westerly airflows brought frequent showers and some persistent frontal rainfall to northern and western areas (with 104.6mm registered on Skye on the 2nd). An easterly airflow became established in the second week, but unsettled conditions continued; around mid-month, an array of frontal systems, including embedded convective cells, brought thunderstorms and intense rainfall to parts of central and eastern England (with 41mm in Hull on the 12th), with localised surface water flooding bringing some transport disruption (e.g. in the Thames Valley on the 15th). The second half of April was dominated by a northerly airstream, bringing cold and showery conditions, with the final week seeing widespread wintry showers and significant late-spring snowfall; on the 28th/29th persistent snowfall resulted in some transport disruption in Scotland and northern England. April rainfall totals were above average at the national scale (123% of average for the UK as a whole) and for a majority of regions. The highest totals were in parts of northern Britain, East Anglia and central western England; localised pockets of >150% were widespread. North-east Scotland as a whole received 157% of average, with >170% along parts of the coast. In contrast, south-west England saw 74% of average, while south Wales and parts of East Sussex and Kent were also drier than average, as were isolated parts of western Scotland. Generally, the first two months of spring has seen a reversal of the typical rainfall gradient for the UK: parts of western Scotland saw less than 70% of average over this timeframe, while parts of eastern England received over 150%. This contrasts markedly with the preceding winter which, due to a predominance of westerly airflows, saw an exaggeration of the typical north-west/south-east rainfall gradient.

River flows
River flows were above average entering April in most index rivers in the north and west, and many rivers saw spates continue in the first week in response to the unsettled weather conditions. Intense rainfall mid-month triggered rapid flow increases in some responsive catchments in central and south-east England. Overall, however, despite the unsettled complexion to the first half of the month, there were few fluvial flood alerts – in stark contrast to previous months – and there were no notable peak flows reported from across the network of index catchments. Although interrupted by spates, the typical pattern of seasonal river flow recession can be discerned at a majority of sites, particularly through the latter half of the month (and throughout April in south-west Britain), although the last week saw further flow responses in parts of northern Britain. Average river flows for April were in the normal range or above, with the highest monthly flows in central and eastern England (e.g. the Colne, Derwent), north Wales and the Welsh borders (e.g. the Severn, Welsh Dee), areas that received above average rainfall over the last two months. In many groundwater-fed rivers (e.g. the Coln and the Itchen) elevated flows also reflect above average rainfall for 2016 so far. While above normal flows were registered on the Nith and the Cree in south-west Scotland, flows in north-west Scotland were below average, although all but the Nevis were within the normal range. Similarly, in south-west Britain, river flows were below average but remained in the normal range. For the last two months combined, runoff accumulations show a similar spatial pattern to April. Over longer timeframes, runoff accumulations are largely well above average and exceptional in the north and west, reflecting the wet winter.

Groundwater
Soil moisture deficits increased through April, but were still modest for the time of year, and well below the long-term mean across the major aquifer areas (reflecting the above average rainfall and cooler temperatures of the spring so far). In the Chalk, groundwater levels were in the normal range or above at all index sites. In slower responding boreholes, levels continued to rise from Oxfordshire to Lincolnshire, but the seasonal recession that started in March continued in both Yorkshire (with Wetwang falling from exceptionally high to notably high) and across southern England. Throughout the Permo-Triassic sandstones, levels continued to fall or were stable, with the exception of Heathlanes where there was a moderate increase. In south-west England, the Midlands and north Wales levels remained in the normal range or just above, but in north-west England they were still notably high at Skirwith, and at Newbridge in southern Scotland they were exceptionally high for the time of year. In the Jurassic limestones, levels rose slightly and remained in the normal range at New Red Lion, but fell from exceptionally high (caused by a response to the very high March rainfall in this area) to above average at Ampney Crucis (Cotswolds). Levels remained very high in the Magnesian Limestone, with a second consecutive record monthly maximum recorded at Brick House Farm. Levels in the Carboniferous Limestone fell during April but remained in the normal range in both south Wales and at Alstonefield in Derbyshire.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

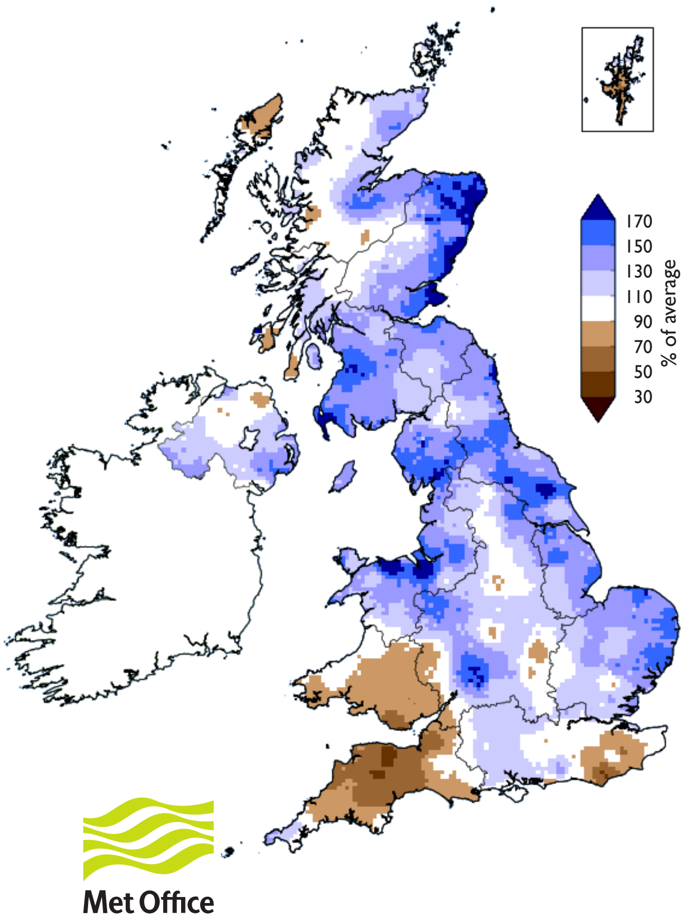
Area	Rainfall	Apr 2016	Feb16 – Apr16	RP	Nov15 – Apr16	RP	Aug15 – Apr16	RP	May15 – Apr16	RP
United	mm	**82**	283		859		1089		1364	
Kingdom	%	**123**	116	5-10	145	>>100	124	80-120	127	>100
England	mm	**67**	223		604		809		1003	
	%	**121**	125	5-10	141	50-80	126	10-20	124	10-15
Scotland	mm	**104**	363		1190		1449		1846	
	%	**130**	110	2-5	146	>>100	121	30-50	128	>100
Wales	mm	**90**	362		1207		1480		1789	
	%	**111**	119	2-5	157	>>100	131	50-80	132	50-80
Northern	mm	**81**	263		852		1089		1378	
Ireland	%	**115**	105	2-5	144	>>100	122	>>100	125	>100
England &	mm	**70**	243		688		901		1112	
Wales	%	**119**	123	5-10	144	>100	127	15-25	126	15-25
North West	mm	**98**	325		1119		1337		1628	
	%	**147**	129	10-15	179	>>100	142	>>100	140	>100
Northumbrian	mm	**85**	200		770		954		1187	
	%	**144**	107	2-5	177	>>100	147	>>100	145	>100
Severn-Trent	mm	**70**	224		534		706		892	
	%	**128**	133	8-12	137	20-30	120	5-10	119	5-10
Yorkshire	mm	**79**	250		705		911		1124	
	%	**136**	136	10-15	164	>>100	143	60-90	140	50-80
Anglian	mm	**60**	164		355		514		673	
	%	**131**	129	5-10	121	5-10	113	2-5	113	2-5
Thames	mm	**60**	201		447		635		779	
	%	**117**	133	5-10	125	5-10	117	2-5	113	2-5
Southern	mm	**51**	184		502		758		905	
	%	**98**	112	2-5	121	2-5	122	5-10	118	2-5
Wessex	mm	**50**	238		565		801		983	
	%	**90**	123	5-10	120	5-10	115	2-5	115	2-5
South West	mm	**53**	295		832		1151		1405	
	%	**74**	108	2-5	120	5-10	116	5-10	118	50-10
Welsh	mm	**86**	348		1145		1415		1711	
	%	**109**	119	2-5	156	>>100	130	40-60	131	40-60
Highland	mm	**111**	426		1295		1570		2010	
	%	**119**	106	2-5	129	20-35	108	5-10	117	10-20
North East	mm	**101**	230		752		982		1247	
	%	**157**	111	2-5	153	>100	131	25-40	132	20-35
Tay	mm	**93**	287		1166		1425		1813	
	%	**138**	98	2-5	162	>>100	136	>100	143	>>100
Forth	mm	**88**	274		1040		1223		1576	
	%	**141**	107	2-5	168	>>100	133	>100	140	>100
Tweed	mm	**86**	243		970		1133		1423	
	%	**143**	115	2-5	192	>>100	151	>>100	150	>>100
Solway	mm	**117**	392		1352		1621		1994	
	%	**146**	124	10-15	175	>>100	141	>>100	143	>>100
Clyde	mm	**116**	448		1468		1769		2260	
	%	**128**	114	5-10	151	>>100	122	30-50	131	>100

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

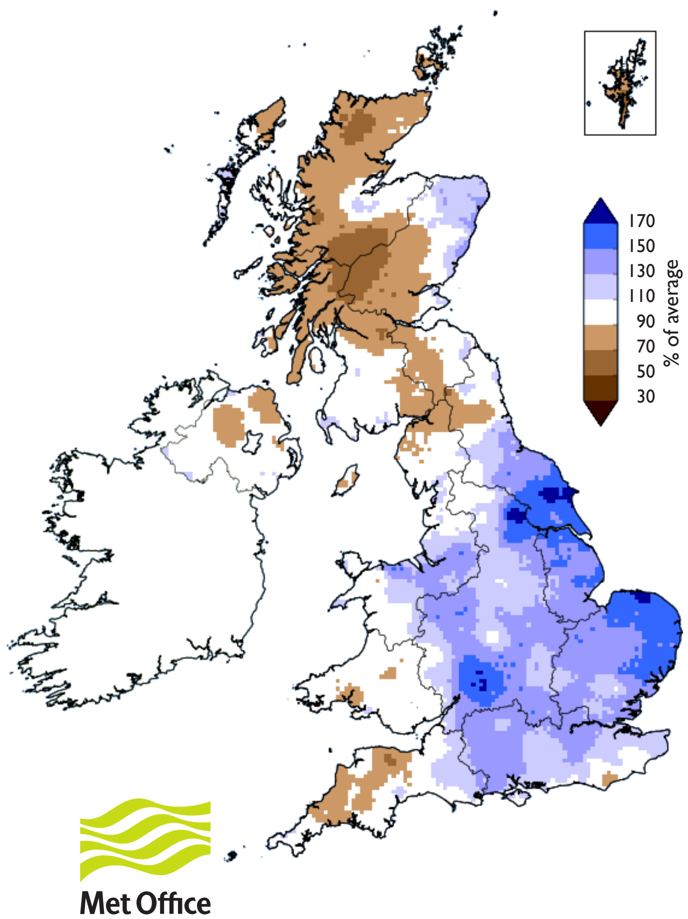
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 January 2016 (inclusive) are provisional.

Rainfall . . . Rainfall . . .

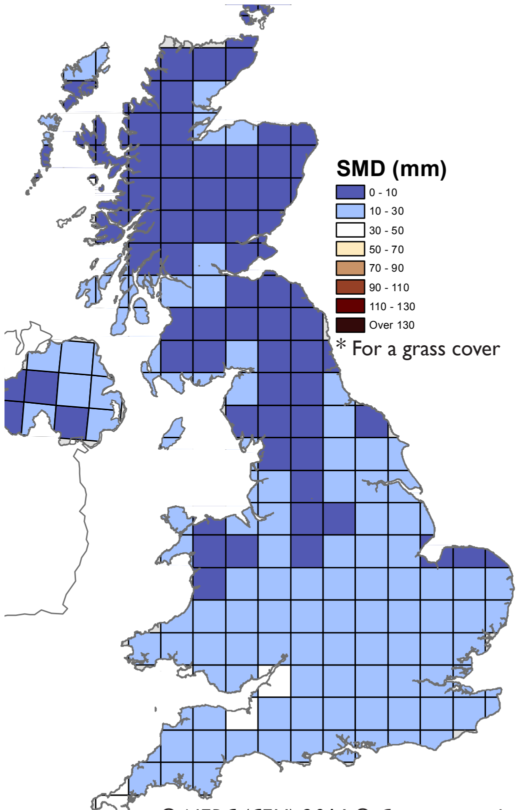
April 2016 rainfall as % of 1971-2000 average



March 2016 - April 2016 rainfall as % of 1971-2000 average



MORECS Soil Moisture Deficits* April 2016



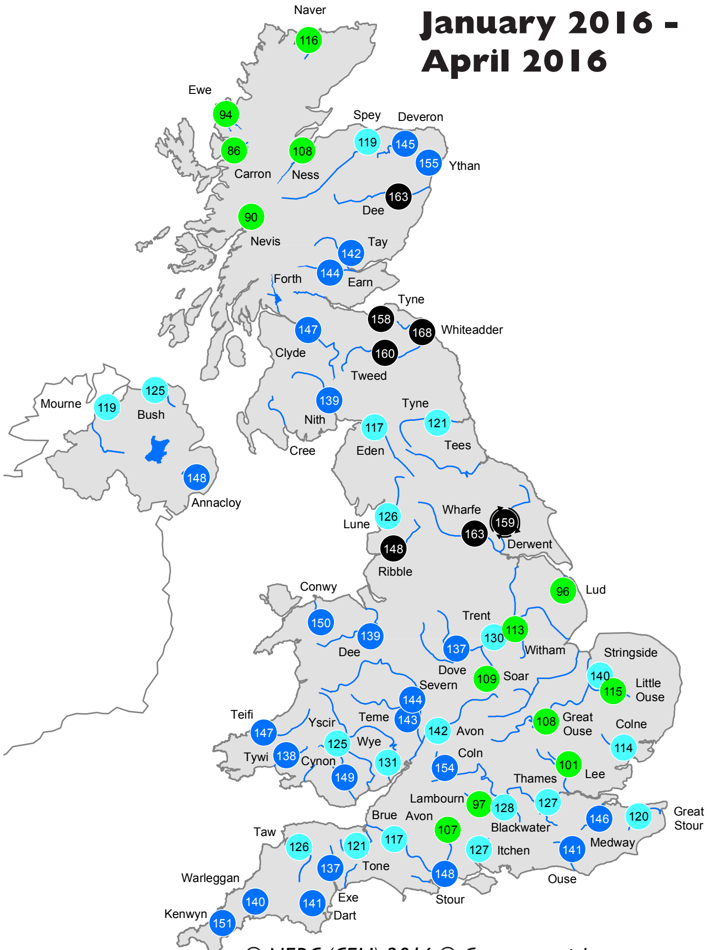
Met Office 3-month outlook Updated: April 2016

Predictions for UK precipitation show a slight increase in the probability of above-average rainfall for May. For May-June-July as a whole, the forecast for UK precipitation suggests that the chances of above- and below-average rainfall are fairly balanced. The probability that UK precipitation for May-June-July will fall into the driest of our five categories is between 20% and 25% and the probability that it will fall into the wettest of our five categories is 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 . . .



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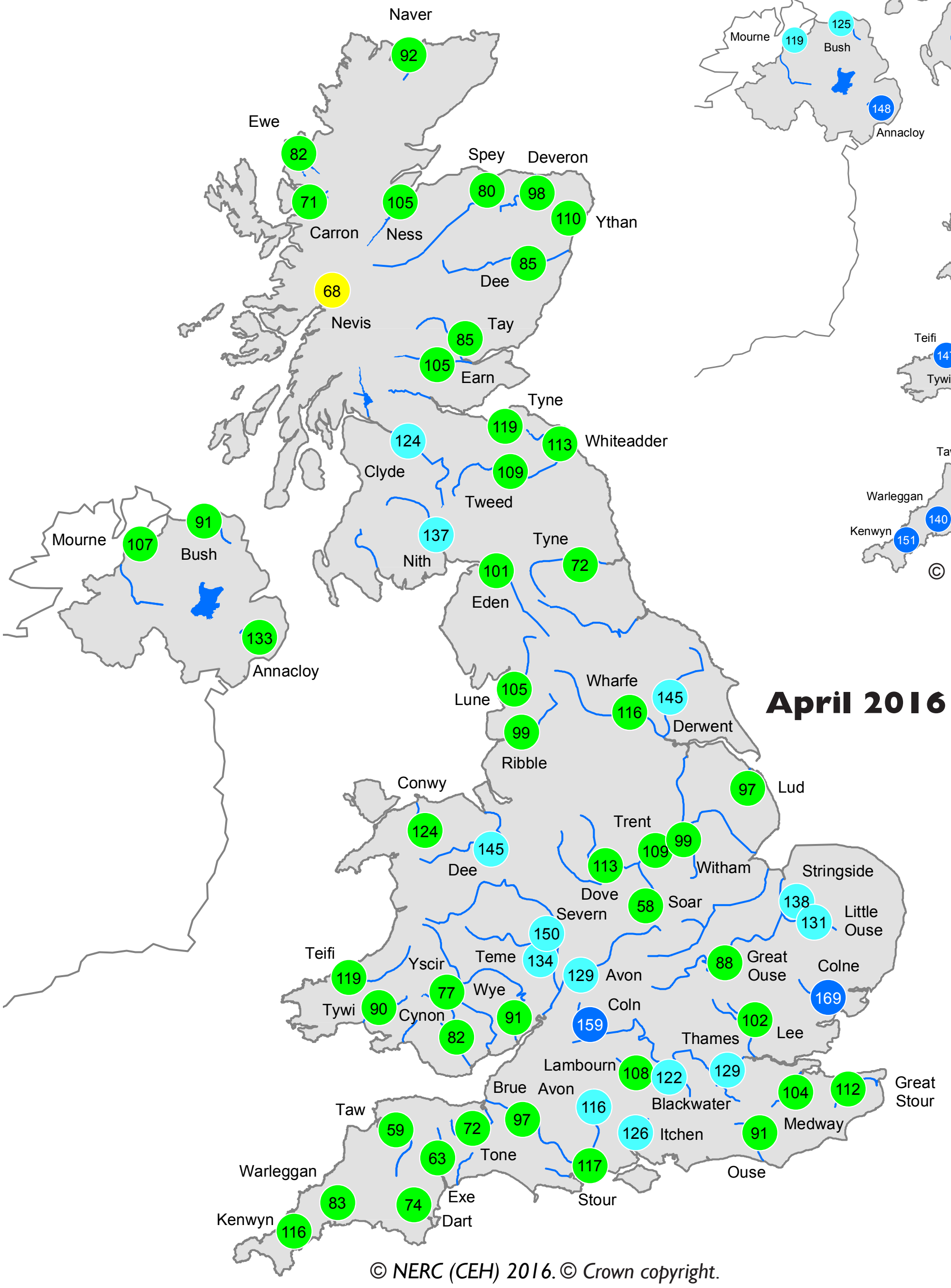

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Key

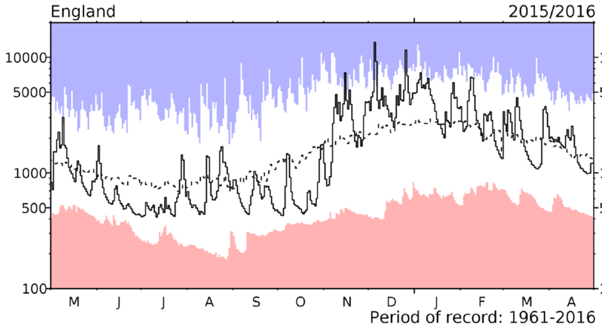
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

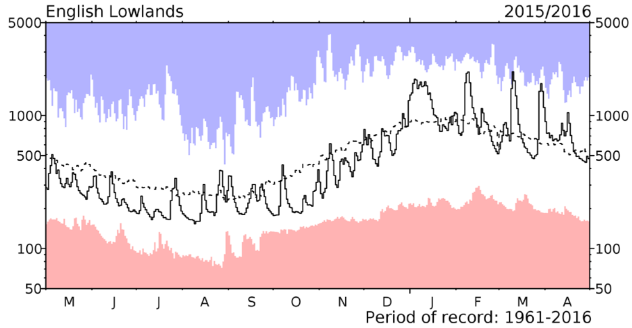
*Based on ranking of the monthly flow**

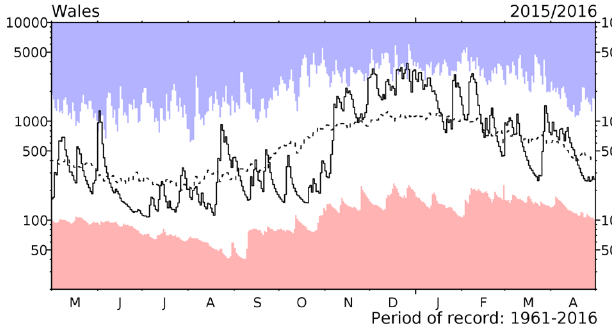
River flows

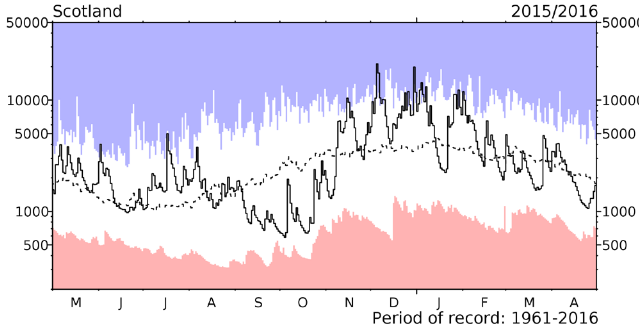
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

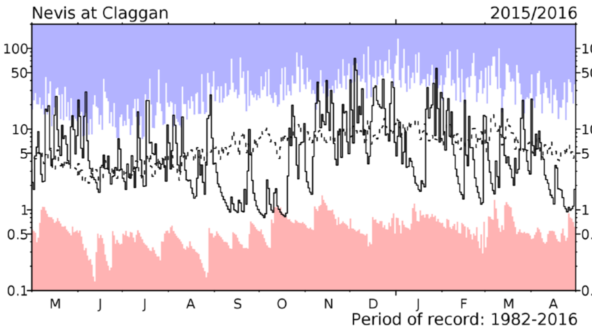
River flow . . . River flow . . .

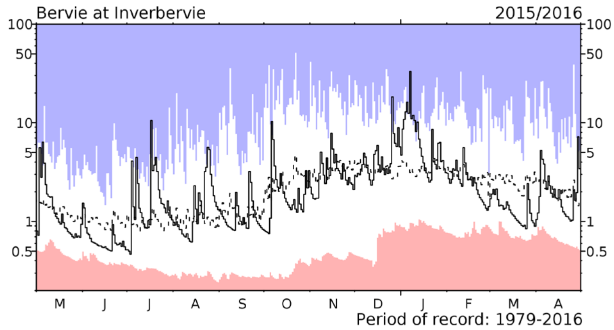


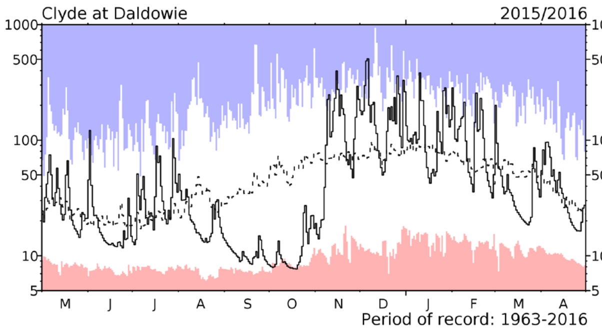


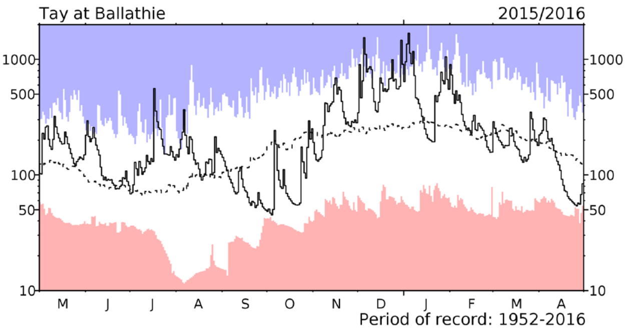


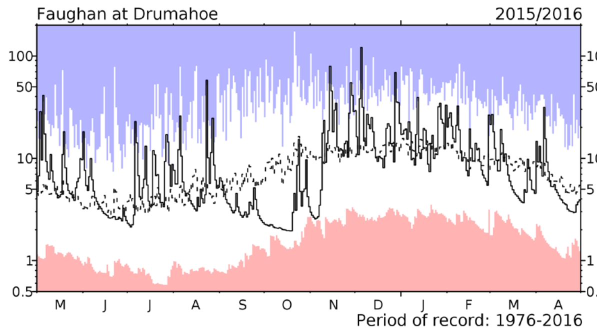


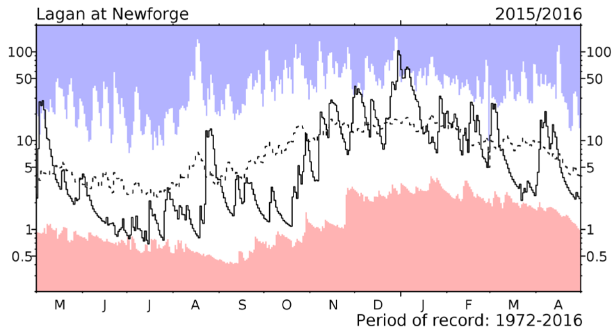






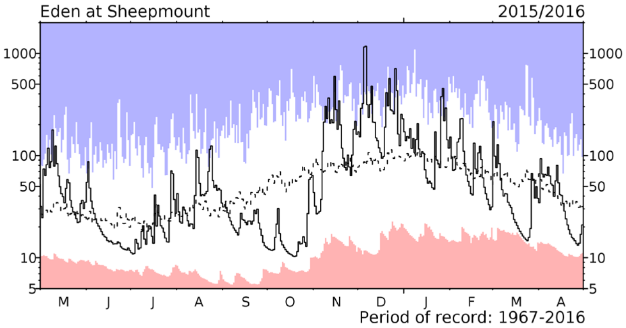


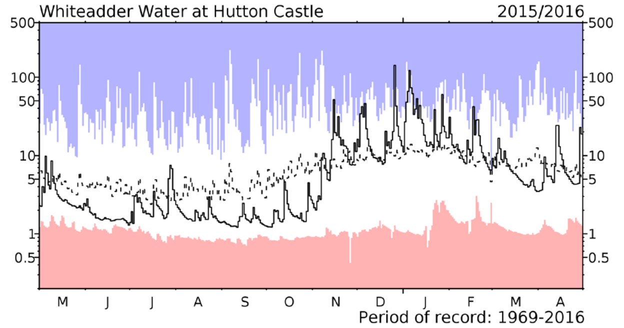


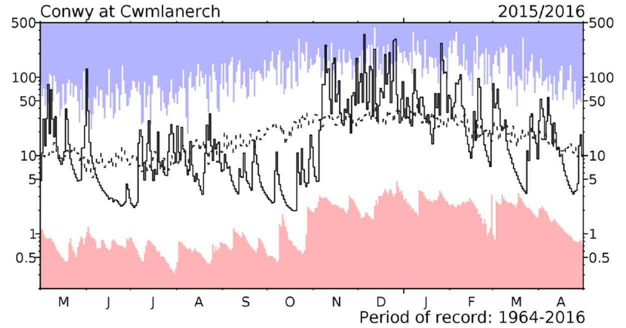


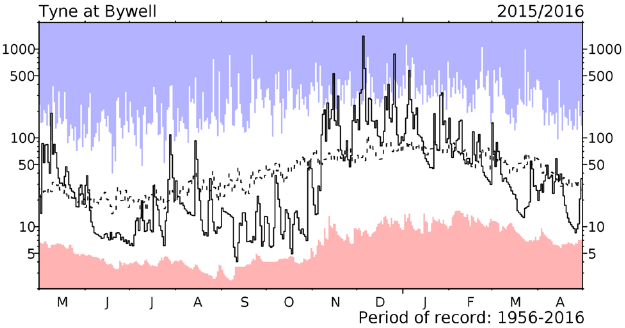
River flow hydrographs

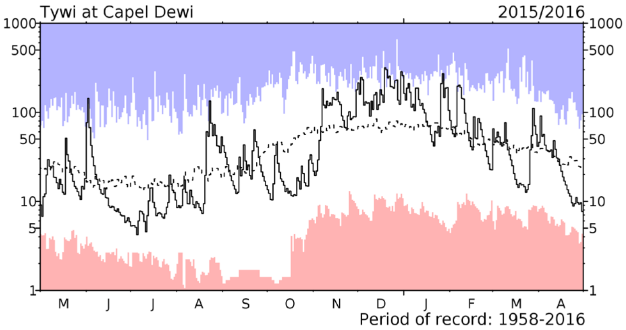
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to May 2015 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed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

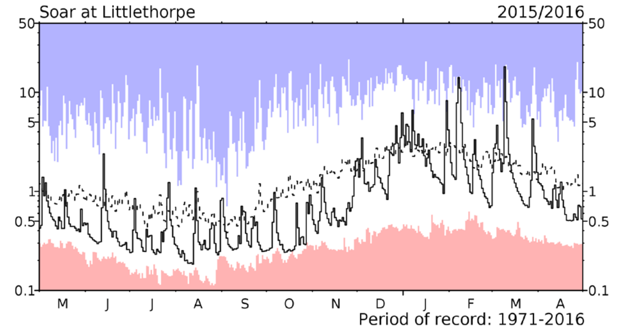

Eden at Sheepmount
2015/2016
M J J A S O N D J F M A
Period of record: 1967-2016

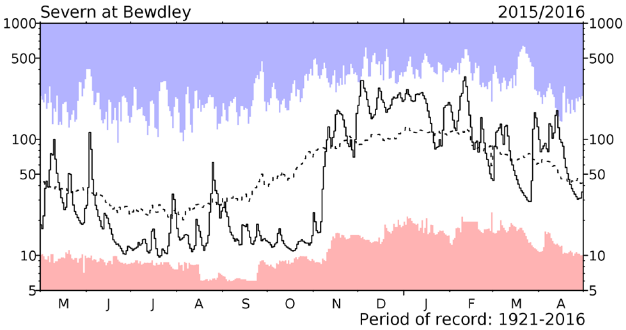

Whiteadder Water at Hutton Castle
2015/2016
M J J A S O N D J F M A
Period of record: 1969-2016

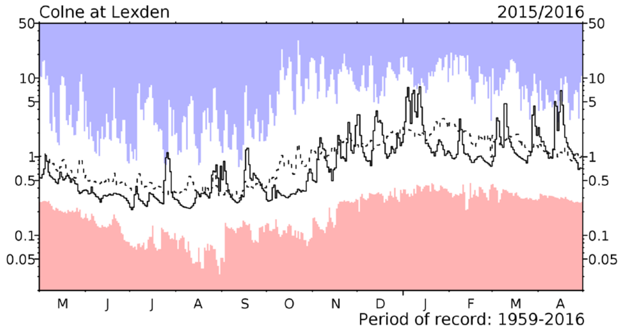

Conwy at Cwmlanerch
2015/2016
M J J A S O N D J F M A
Period of record: 1964-2016

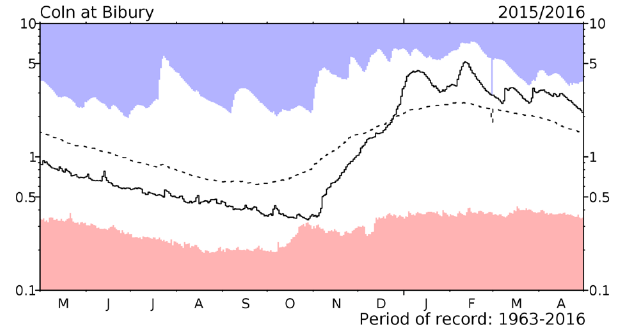

Tyne at Bywell
2015/2016
M J J A S O N D J F M A
Period of record: 1956-2016

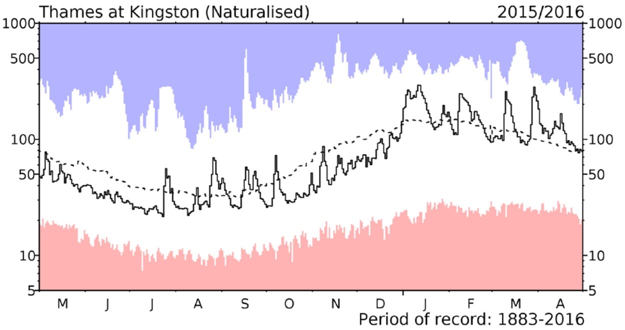

Tywi at Capel Dewi
2015/2016
M J J A S O N D J F M A
Period of record: 1958-2016

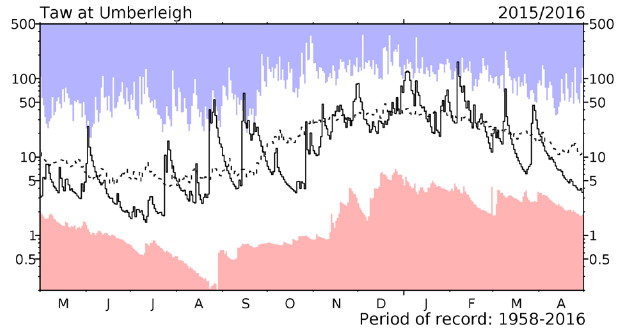

Soar at Littlethorpe
2015/2016
M J J A S O N D J F M A
Period of record: 1971-2016

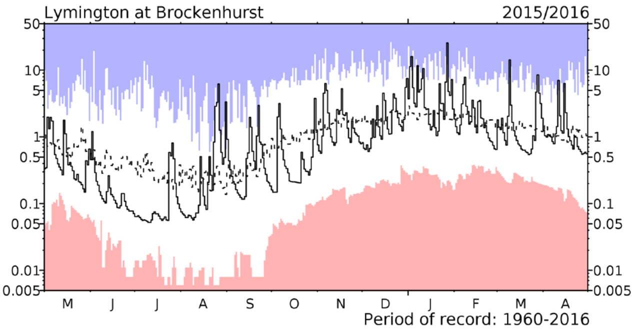

Severn at Bewdley
2015/2016
M J J A S O N D J F M A
Period of record: 1921-2016


Colne at Lexden
2015/2016
M J J A S O N D J F M A
Period of record: 1959-2016


Coln at Bibury
2015/2016
M J J A S O N D J F M A
Period of record: 1963-2016


Thames at Kingston (Naturalised)
2015/2016
M J J A S O N D J F M A
Period of record: 1883-2016


Taw at Umberleigh
2015/2016
M J J A S O N D J F M A
Period of record: 1958-2016


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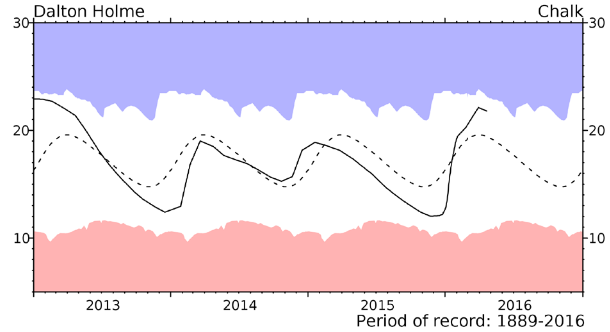
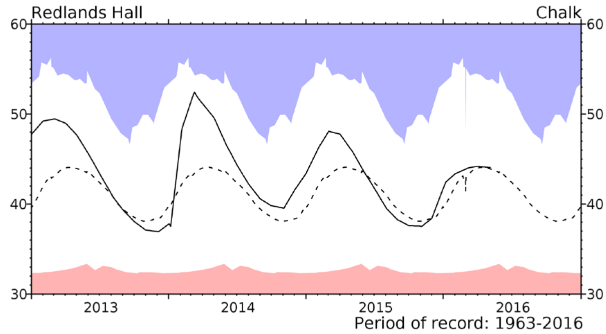
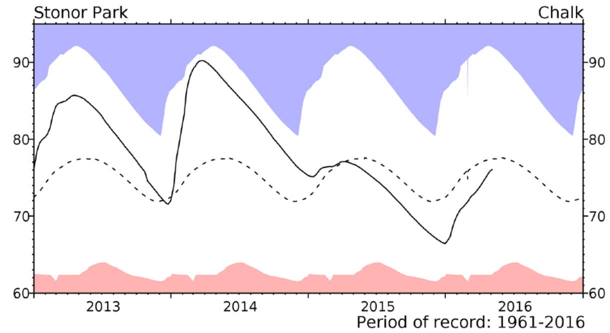
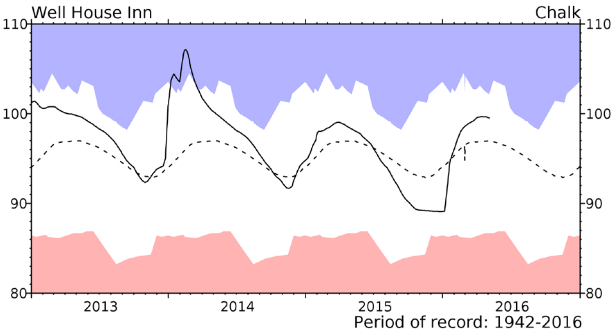
Period of record: 1960-2016

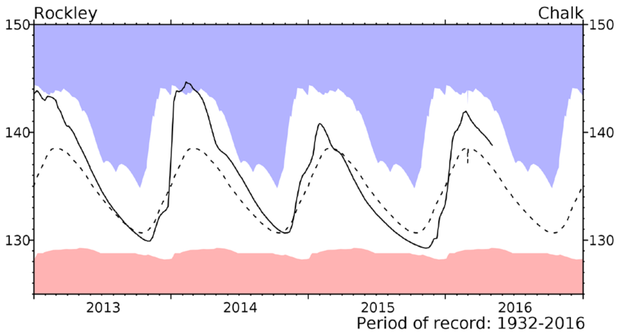
Groundwater . . . Groundwater

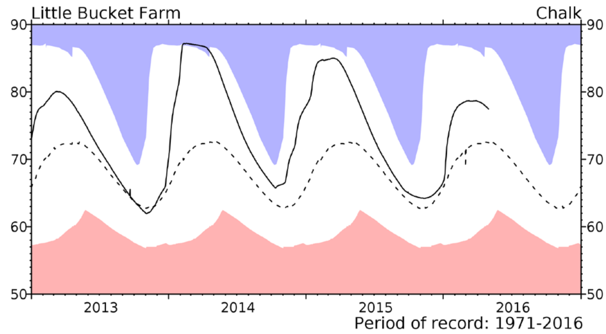


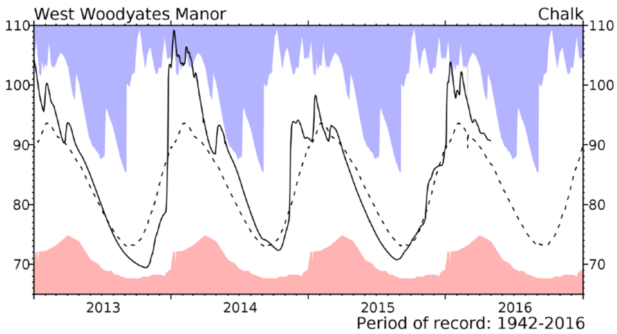


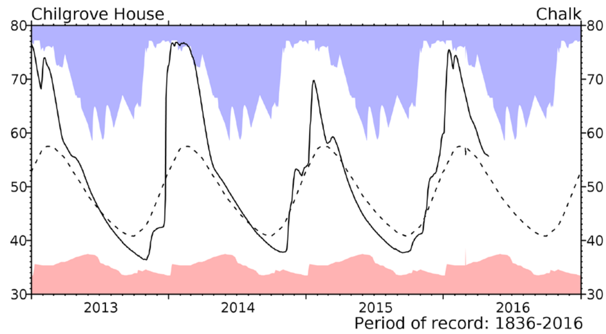


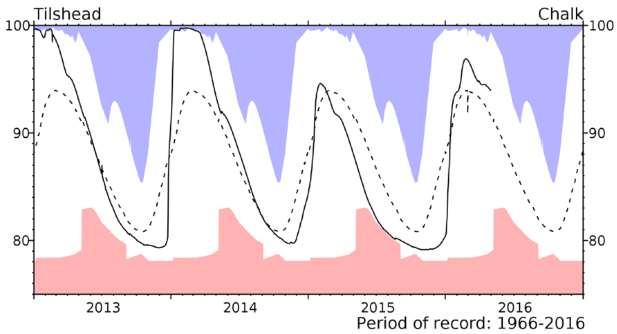


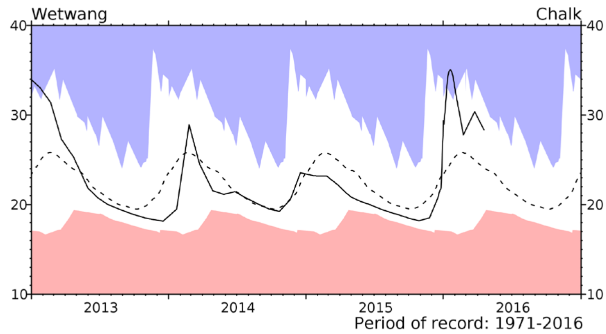






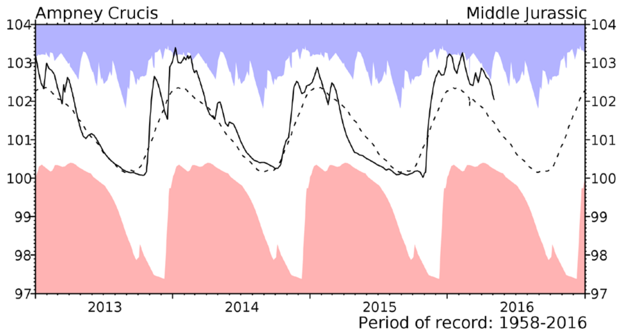


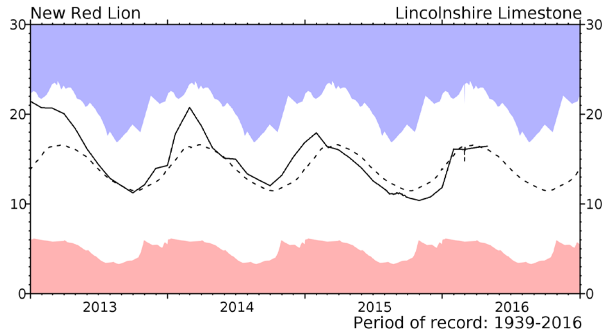


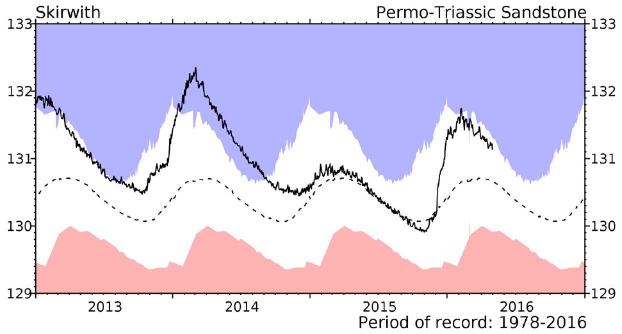


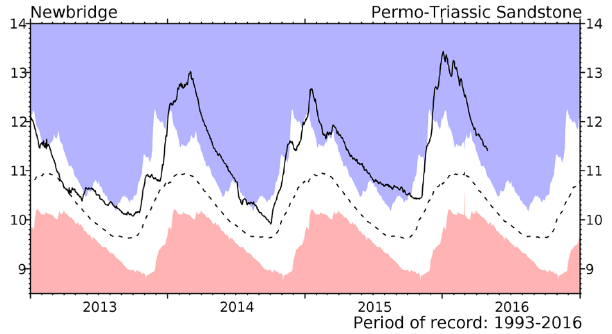
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

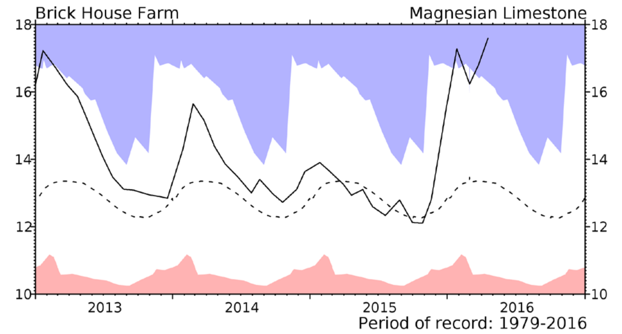
Groundwater… Groundwater

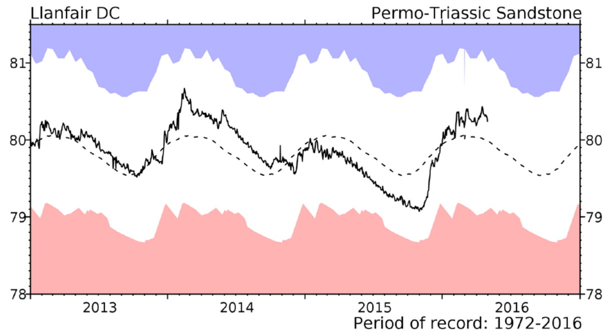


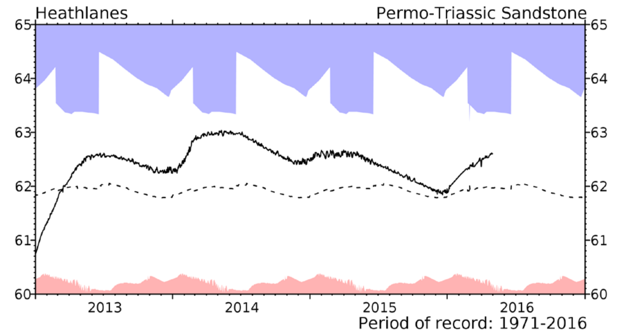


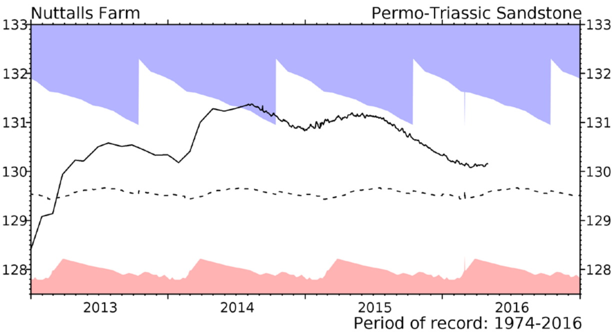


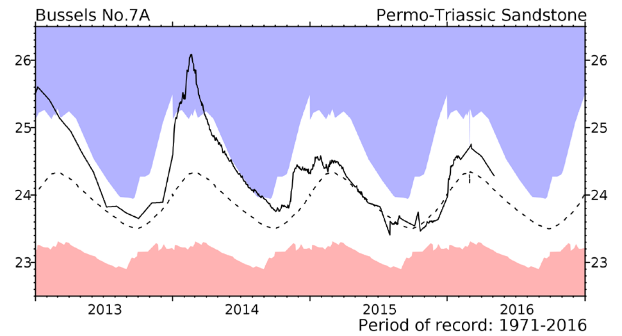


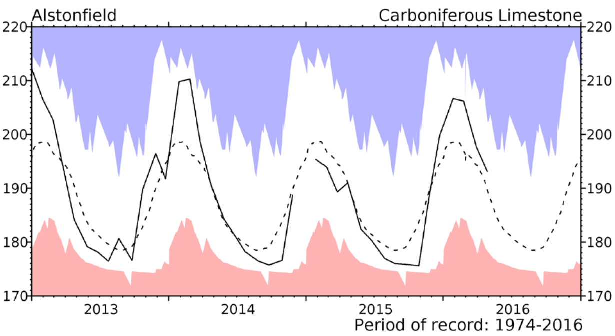










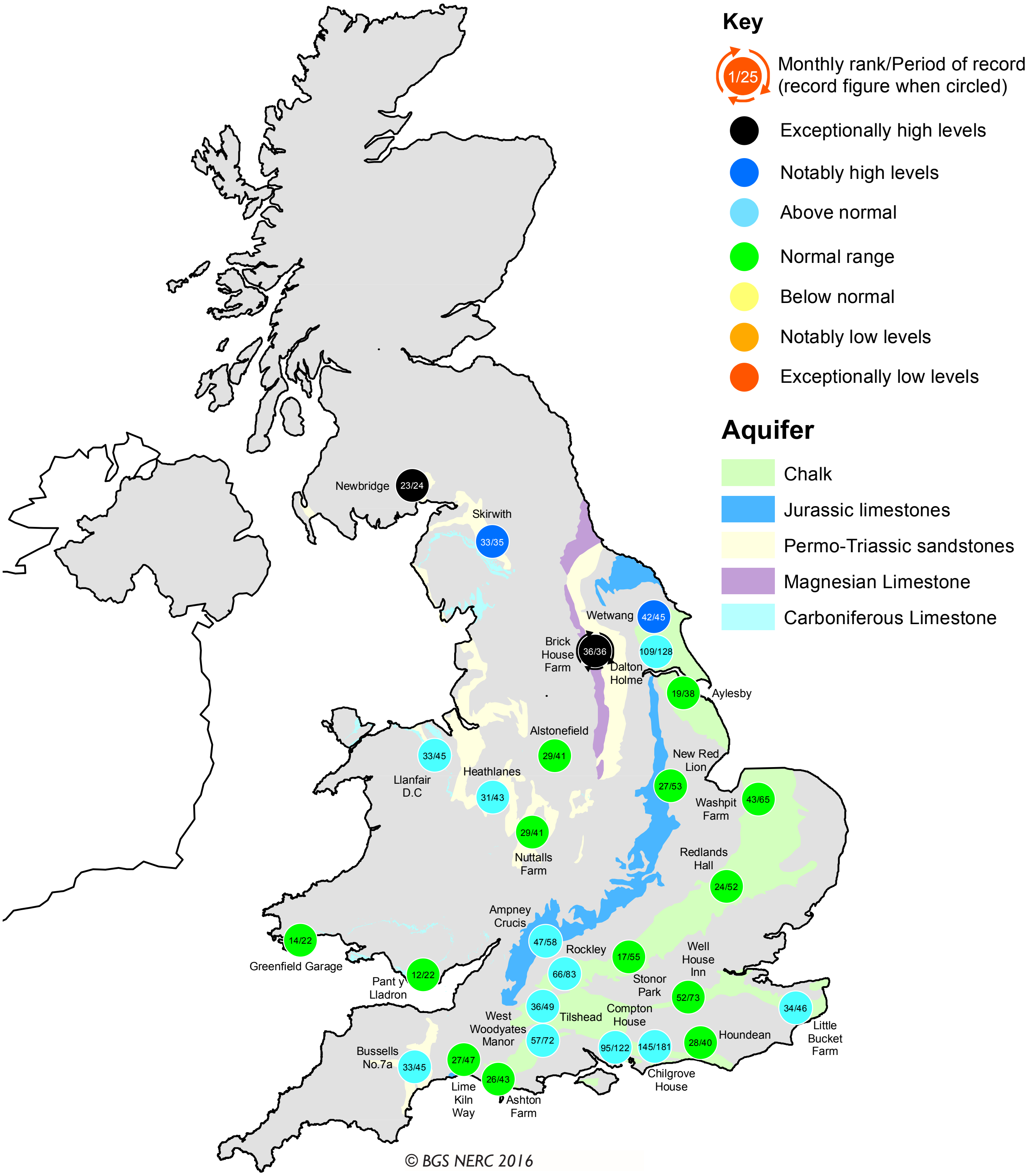


Groundwater levels April / May 2016

Borehole	Level	Date	Apr av.	Borehole	Level	Date	Apr av.	Borehole	Level	Date	Apr av.
Dalton Holme	21.79	20/04	19.46	Chilgrove House	55.57	30/04	52.30	Brick House Farm	17.59	18/04	13.40
Redlands Hall	44.04	04/05	44.17	Little Bucket Farm	77.44	30/04	73.24	Llanfair DC	80.24	30/04	80.03
Stonor Park	76.05	04/05	77.58	Wetwang	28.32	18/04	23.87	Heathlanes	62.60	30/04	62.02
Tilshead	93.95	30/04	92.43	Ampney Crucis	102.04	04/05	101.67	Nuttalls Farm	130.15	30/04	129.62
Rockley	138.80	04/05	137.52	New Red Lion	16.42	30/04	16.16	Bussells No.7a	24.28	04/05	24.20
Well House Inn	99.51	04/05	97.15	Skirwith	131.12	30/04	130.74	Alstonefield	193.09	27/04	192.12
West Woodyates	90.65	30/04	88.35	Newbridge	11.41	30/04	10.63				

Levels in metres above Ordnance Datum

Groundwater...Groundwater

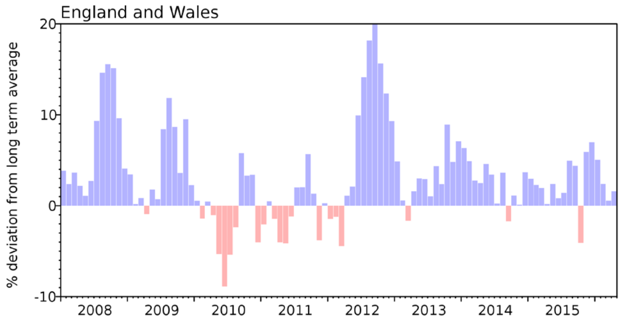


Groundwater levels - April 2016

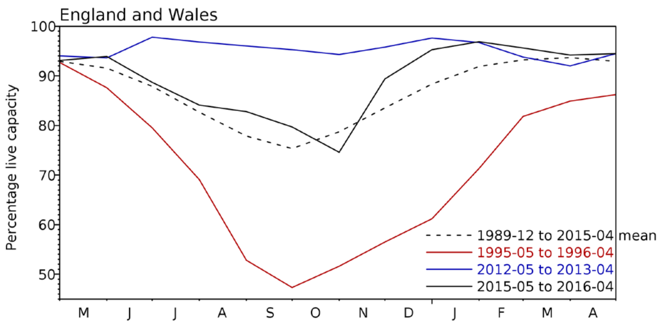
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

Reservoirs . . . Reservoirs . . .

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



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



Percentage live capacity of selected reservoirs at end of month

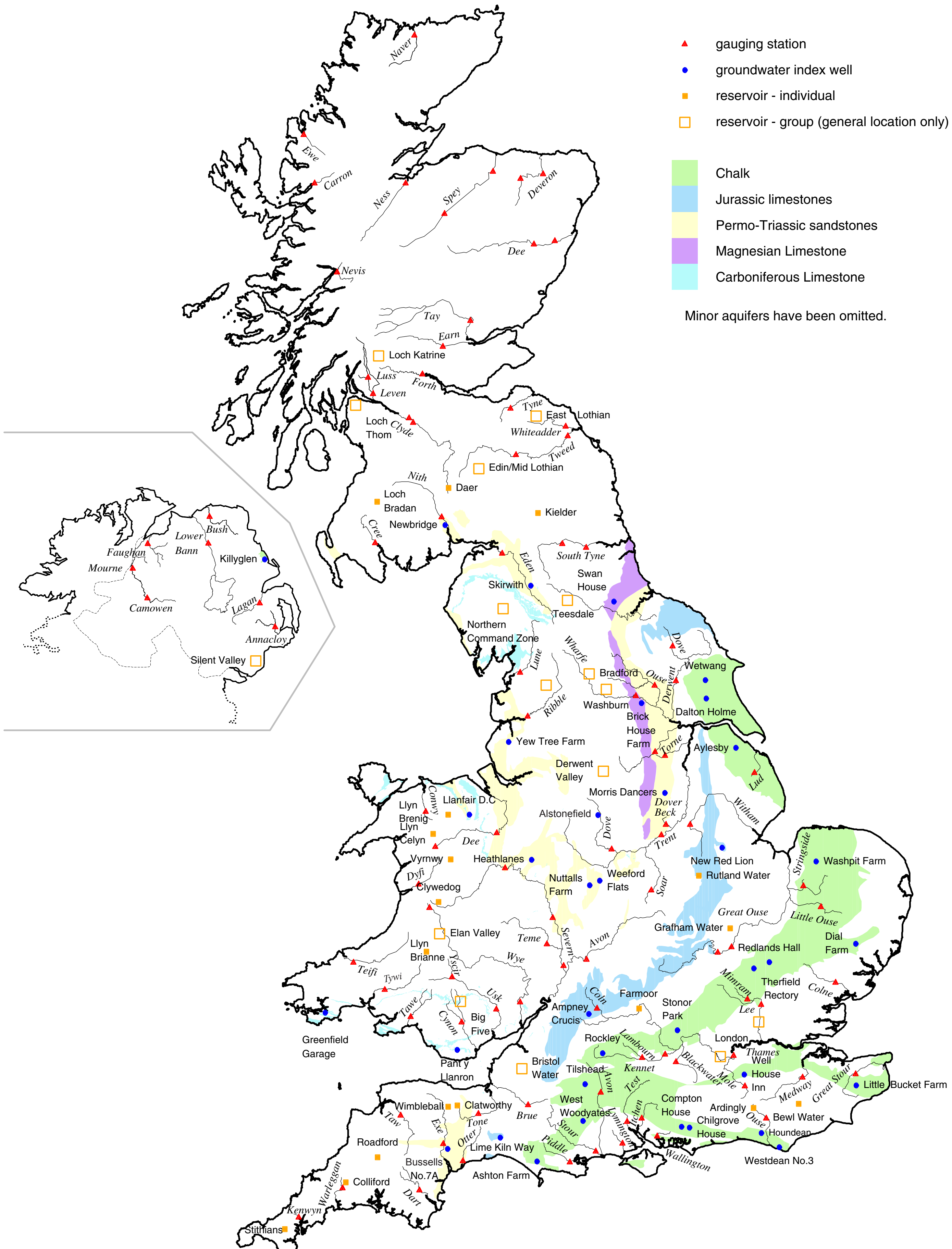
Area	Reservoir		Capacity (Ml)	2016 Feb	2016 Mar	2016 Apr	Apr Anom.	Min Apr	Year* of min	2015 Apr	Diff 16-15
North West	N Command Zone	•	124929	98	90	85	-2	65	1984	88	-3
	Vyrnwy		55146	97	99	98	5	70	1996	94	4
Northumbrian	Teesdale	•	87936	97	86	91	-1	74	2003	92	-1
	Kielder		(199175)	89	86	89	-2	85	1990	92	-3
Severn-Trent	Clywedog		44922	96	98	99	2	85	1988	99	1
	Derwent Valley	•	39525	100	100	99	7	54	1996	94	5
Yorkshire	Washburn	•	22035	95	95	91	1	76	1996	82	9
	Bradford Supply	•	41407	98	95	93	2	60	1996	94	0
Anglian	Grafham		(55490)	96	96	95	1	73	1997	95	-1
	Rutland		(116580)	95	95	93	1	72	1997	95	-3
Thames	London	•	202828	96	93	97	2	86	1990	92	5
	Farmoor	•	13822	88	82	98	1	81	2000	96	2
Southern	Bewl		28170	89	100	96	6	60	2012	92	4
	Ardingly		4685	100	95	100	1	69	2012	100	0
Wessex	Clatworthy		5364	100	100	90	-3	81	1990	89	1
	Bristol	•	(38666)	99	99	99	6	83	2011	96	3
South West	Colliford		28540	100	100	99	12	56	1997	92	7
	Roadford		34500	98	96	93	8	41	1996	93	1
	Wimbleball		21320	100	100	98	3	79	1992	96	2
	Stithians		4967	100	100	99	8	65	1992	84	15
Welsh	Celyn & Brenig	•	131155	99	100	100	2	75	1996	99	2
	Brianne		62140	96	98	99	2	86	1997	96	3
	Big Five	•	69762	92	97	94	1	85	2011	91	3
	Elan Valley	•	99106	98	99	99	3	83	2011	93	6
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	100	100	98	5	62	1998	92	6
	East Lothian	•	9374	100	100	100	2	89	1992	98	2
Scotland(W)	Loch Katrine	•	110326	95	95	88	-3	80	2010	88	0
	Daer		22412	99	94	89	-6	78	2013	89	0
	Loch Thom	•	10798	100	100	100	6	83	2010	100	0
Northern Ireland	Total+	•	56800	99	95	93	5	77	2007	89	4
	Silent Valley	•	20634	98	94	94	10	58	2000	90	3

( ) 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.

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