Hydrological Summary
for the United Kingdom

January 2024

General

Whilst rainfall for January was close to average, a dry period mid-month was bookended by cyclonic weather patterns that included four named storms. Temperatures were close to average, and despite a cold spell that brought snow to the north, a new daily maximum temperature for January was recorded (19.9°C on 28th at Achfary, Sutherland). Rainfall was above average in north-eastern Scotland, northern England and north Wales, and average or below average elsewhere. River flows were above average across most of England, but normal in western parts of the UK. Groundwater levels rose across slow responding aquifers and were stable or receded in more responsive aquifers, but at the majority of sites they remained above normal to exceptionally high. Reservoir stocks increased, with further replenishment of Colliford and Roadford in south-west England, and only Celyn & Brenig, Daer and Grafham had deficits approaching or just exceeding 10%. Healthy reservoir stocks at national scale, coupled with an outlook over the next few months for normal to above normal groundwater levels, make the water resources situation favourable. However, further rain after a dry start to February has kept the soils wet and the groundwater levels high, maintaining an elevated risk of flooding.

Rainfall

Low pressure systems including storm 'Henk' (2nd), brought strong winds and heavy rain onto saturated ground across England and Wales from 1st-4th (with rainfall accumulations of 50-100mm), and in south Lincolnshire more than 70 properties were flooded. A transition to high pressure on 6th-7th brought colder, drier conditions that intensified into a bitterly cold spell as northerly airflows brought snow from 16th-20th to Scotland (37cm was recorded at Altaharra on the 18th), Northern Ireland and north-west England, causing over 140 school closures. By contrast, the south was cold but largely dry from 7th -19th, until a powerful jet stream began fuelling a succession of deep depressions including two named storms. 'Isha' (21st-22nd) brought heavy rain in the north (128mm was recorded at Wet Sleddale, Cumbria on the 21st) and high windspeeds (gusts of at least 80mph were widely recorded and air travel was severely impacted). Storm 'Jocelyn' (23rd-24th), although less windy, brought heavy rain (40-60mm) over high ground in western Scotland, north-west England and Wales. There was further rain on the 25th, the 29th, and associated with a fourth named storm, 'Ingunn', on the 31st. Total rainfall was 97% of the January average for the UK, with moderate anomalies (70-130% of average). The highest regional totals were for North West England and Yorkshire (at 129 and 127% of average, respectively) and the lowest for Northern Ireland and Clyde (at 75% and 77% of average, respectively). The winter so far (December-January) has seen more than 150% of average rainfall for eastern Scotland and northern England, compounding the wet autumn. The five months from September-January were the wettest on record for North East Scotland and ranked in the top three for Northumberland, Yorkshire and North West England (all in series from 1890).

River Flows

River flows began January above average (except in western Scotland) and rose further in England during the first few days, most notably in the Midlands, East Anglia and south-west England. New January peak flow maxima were established on the 2nd and 3rd (e.g. Dover Beck and Warwickshire Avon, in series from 1973 and 1938 respectively) and the Stringside recorded its highest peak flow of any month, also on the 2nd, in a record from 1966. More than 670 flood alerts and flood warnings on rivers and groundwater levels were in force on the 3rd across a broad swathe from Wessex to north-east England, and on the 4th, a major incident was declared along the Trent (when its peak flow eclipsed the January record established in 1960). More than 102,000 properties were protected from flooding, but 2,200 were inundated, with Lincolnshire, Nottinghamshire, Leicestershire and Hackney Wick among the worst affected areas. Flows receded in the south for the next fortnight, whilst rivers responded to rain or snowmelt in the north-east on 10th-11th (e.g. English Tyne) and Northern Ireland and north-west England on 15th-16th (e.g. Mourne). Flows rose sharply across the country on 20th-21st without reaching notable magnitudes, and there were subsequent responses to rainfall on rivers in Wales and the north-west on the 23rd-24th, the north of England and north Wales on the 29th, and western Scotland on the 31st. Mean monthly flows were normal in the west of the UK, and above normal, notably or exceptionally high elsewhere. Many rivers in the north and east of England recorded around 150% of their average, and some twice their usual January flow (Ythan, Lud, Witham and Stringside). Following an exceptionally wet December, average flows for the winter so far (December-January) were exceptionally high in responsive and large catchments in the north of England, and in groundwater-fed catchments in the south. Accordingly, England saw its second highest December-January and third highest September-January outflow on record (in a series from 1960).

Soil Moisture and Groundwater

Soil moisture at the end of January was high or above field capacity for much of the COSMOS-UK network. Groundwater levels at slowly responding sites on the Chalk, such as Dial Farm, Therfield Rectory and Stonor Park levels rose and moved from normal to above normal (Dial Farm and Therfield Rectory) and from above normal to exceptionally high (Stonor). At Aylesby a 46-year exceptionally high record was established for January. However, groundwater levels typically fell across much of the Chalk. For example, levels at Ashton Farm and Killyglen moved from notably and exceptionally high, respectively, into the normal range. Levels in the Jurassic limestones receded slightly, with levels at New Red Lion declining from a December record high and levels at Ampney Crucis moving from above normal back to the normal range. Levels continued to rise in the Magnesian Limestone and remained exceptionally high at Aycliffe and at Brick House Farm, the latter reaching a 44-year record for January. In the Carboniferous Limestone levels fell, moving from notably high to above normal at Alstonfield and returning to normal at Greenfield Garage and Pant y Lladron. In the Permo-Triassic Sandstones levels continued to rise at Skirwith and Llanfair D.C. but fell at Bussels No.7a. Levels at Skirwith and Bussels No.7a both moved to lower categories (notably high and above normal, respectively), while at Llanfair D.C. levels remained above normal. Exceptionally high levels continued to be observed at Lime Kiln Way in the Upper Greensand. In the Devonian sandstones levels remained in the normal range at Easter Lathrisk and moved to normal from above normal at Feddan Junction. The groundwater level rose at Royalty Observatory, in the Fell Sandstone, and was notably high.

National Hydrological Monitoring Programme
UK Centre for Ecology & Hydrology
BGS British Geological Survey

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1991-2020 average.

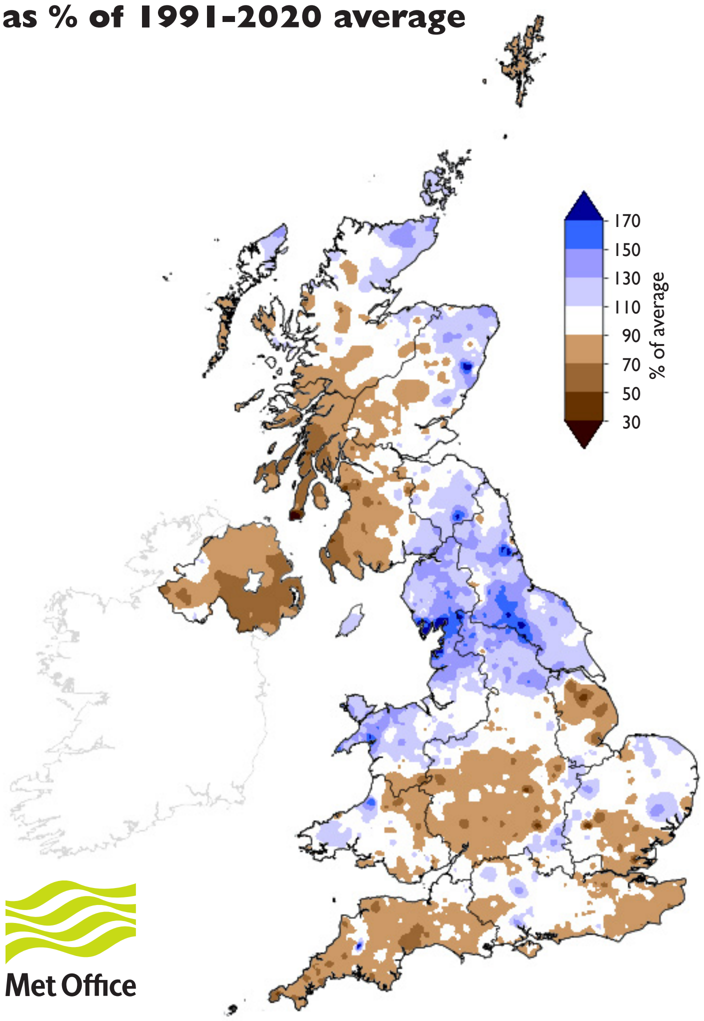
Region	Rainfall	Jan 2024	Dec23 – Jan24	RP	Oct23 – Jan24	RP	Sep23 – Jan24	RP	Feb23 – Jan24	RP
United	mm	**118**	306		597		716		1282	
Kingdom	%	**97**	124	10-15	121	25-40	123	30-50	111	15-25
England	mm	**85**	230		488		570		1040	
	%	**102**	133	8-12	138	40-60	135	25-40	121	30-50
Scotland	mm	**165**	411		732		900		1567	
	%	**93**	117	5-10	107	5-10	112	10-15	100	2-5
Wales	mm	**162**	420		803		959		1647	
	%	**104**	128	5-10	124	10-20	126	15-25	114	10-15
Northern	mm	**86**	256		539		685		1390	
Ireland	%	**75**	109	2-5	114	10-20	122	40-60	121	>>100
England &	mm	**96**	256		531		623		1123	
Wales	%	**103**	132	8-12	135	30-50	133	25-40	119	25-40
North West	mm	**163**	393		704		861		1538	
	%	**129**	145	30-50	132	30-50	134	60-90	121	50-80
Northumbria	mm	**98**	251		527		610		1065	
	%	**119**	144	15-25	148	>100	142	>100	118	25-40
Severn-Trent	mm	**65**	213		449		523		957	
	%	**91**	140	8-12	144	40-60	139	25-40	120	20-35
Yorkshire	mm	**100**	262		515		599		1070	
	%	**127**	156	20-30	151	>100	146	50-80	124	50-80
Anglian	mm	**50**	142		340		397		752	
	%	**95**	130	5-10	145	30-50	139	20-30	120	10-20
Thames	mm	**68**	174		393		463		887	
	%	**95**	120	2-5	132	10-20	131	10-15	123	10-20
Southern	mm	**80**	199		521		575		1002	
	%	**92**	111	2-5	141	15-25	134	10-20	123	10-20
Wessex	mm	**87**	246		537		619		1145	
	%	**92**	127	5-10	136	15-25	134	15-25	127	30-50
South West	mm	**112**	324		668		776		1422	
	%	**81**	113	2-5	118	5-10	118	5-10	114	10-15
Welsh	mm	**154**	400		770		918		1586	
	%	**104**	128	5-10	124	10-20	126	15-25	114	10-15
Highland	mm	**213**	489		829		1013		1768	
	%	**97**	113	5-10	101	2-5	105	2-5	95	2-5
North East	mm	**108**	298		636		739		1227	
	%	**107**	148	70-100	147	>100	143	>100	115	25-40
Tay	mm	**151**	384		779		939		1540	
	%	**92**	123	5-10	128	50-80	133	>100	111	15-25
Forth	mm	**130**	326		617		751		1297	
	%	**96**	122	8-12	118	15-25	122	25-40	105	5-10
Tweed	mm	**121**	297		549		654		1162	
	%	**112**	133	20-30	122	30-50	123	30-50	107	8-12
Solway	mm	**150**	415		641		834		1540	
	%	**89**	120	8-12	94	2-5	104	2-5	98	2-5
Clyde	mm	**167**	453		790		1000		1783	
	%	**77**	105	2-5	95	2-5	102	2-5	94	2-5

% = percentage of 1991-2020 average *RP = Return period*

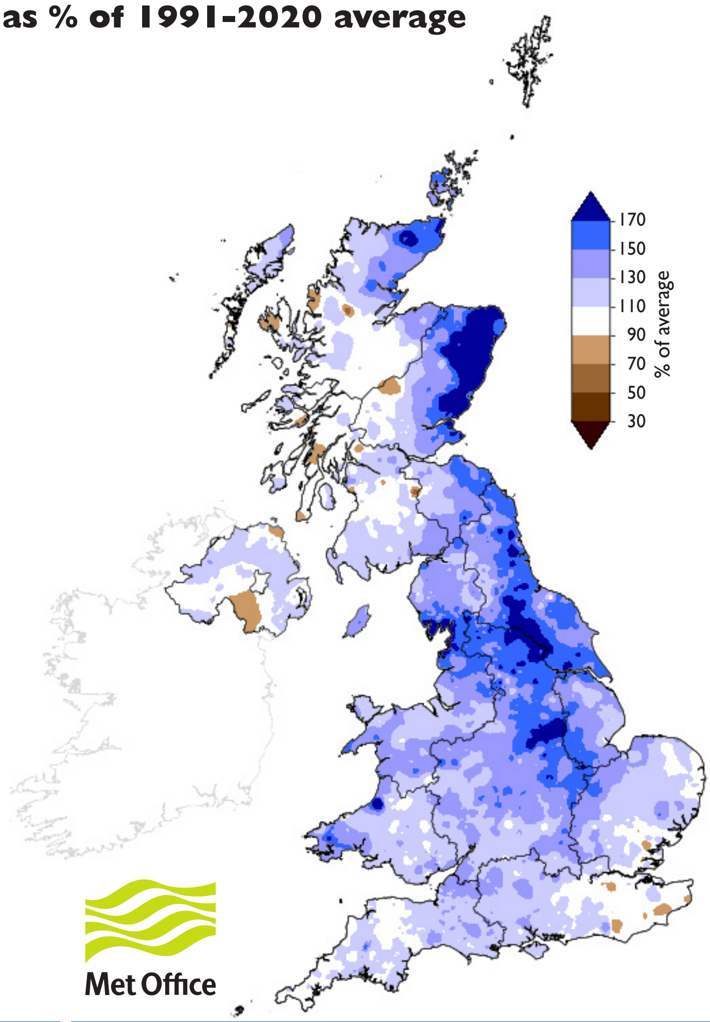
Important note: Figures in the above table may be quoted provided their source is acknowledged. Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1836; 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 January 2023 are provisional. Source: Data from HadUK-Grid dataset at 1km resolution v1.2.0.0.

Rainfall . . . Rainfall . . .

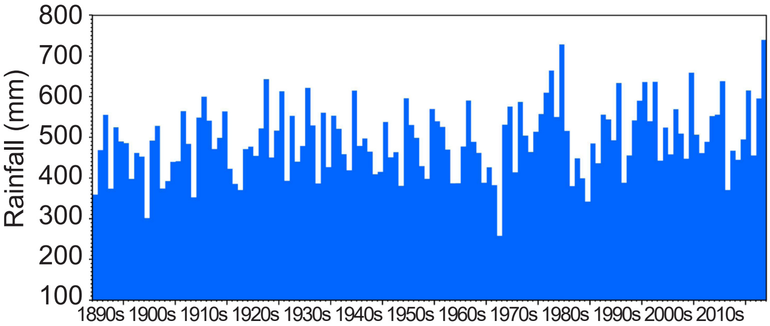
January 2024 rainfall as % of 1991-2020 average



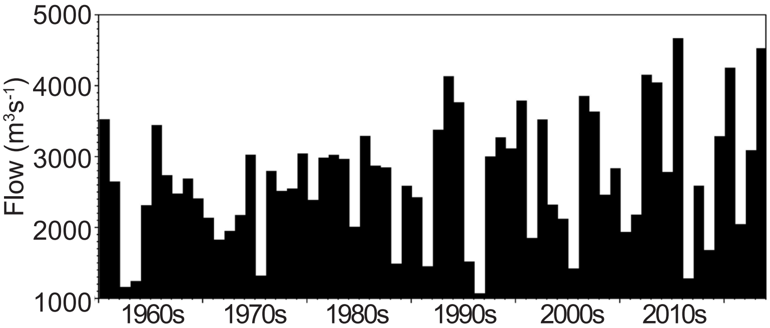
December 2023 - January 2024 rainfall as % of 1991-2020 average



September to January rainfall for North East Scotland



December to January outflows for England



UK Hydrological Outlook

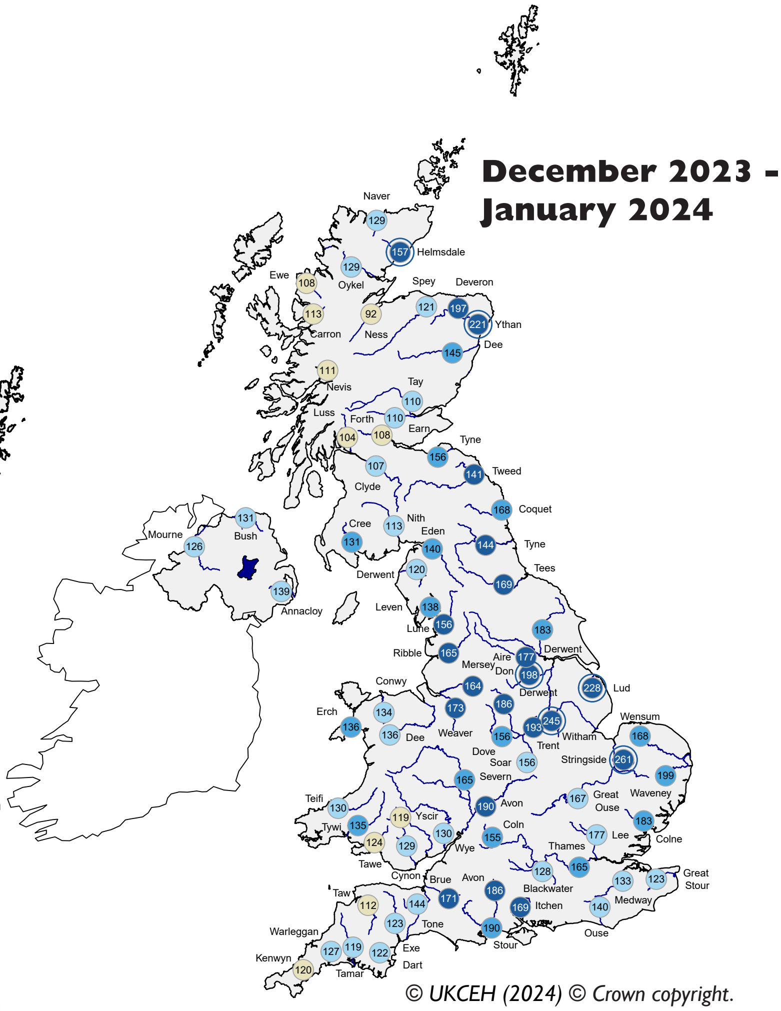
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

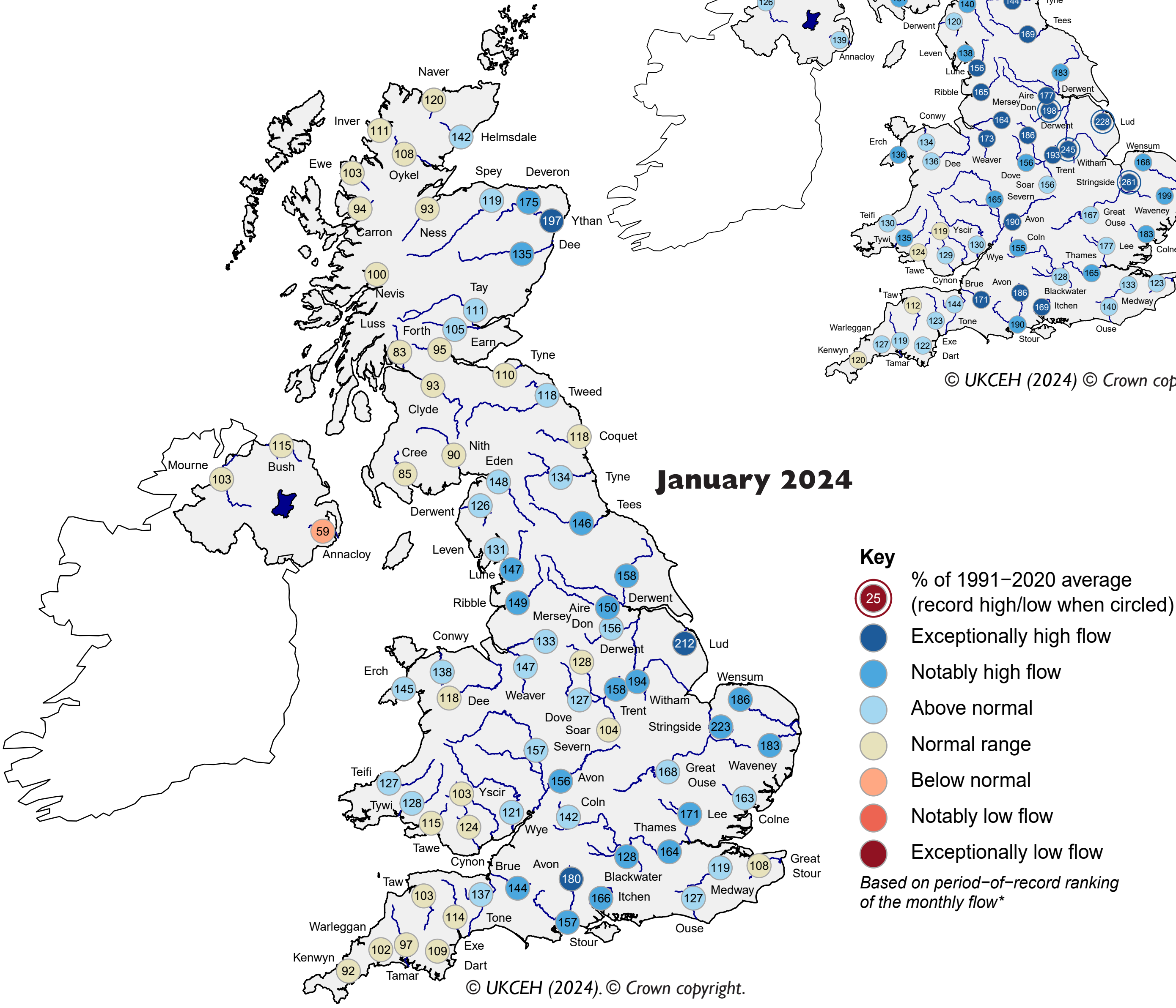
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from February 2024**
Issued: **08.02.2024**
using data to the end of January 2024

The outlook for February is for normal to above normal flows, and normal to exceptionally high groundwater levels to be seen across northern and eastern parts of the UK. Flows in south-western Britain and Northern Ireland are likely to be normal to below normal for February. This pattern is likely to persist for river flows over the next three months, whilst groundwater levels are likely to recess to be normal to above normal, with some normal to below normal exceptions.

River flow . . . River flow . . .

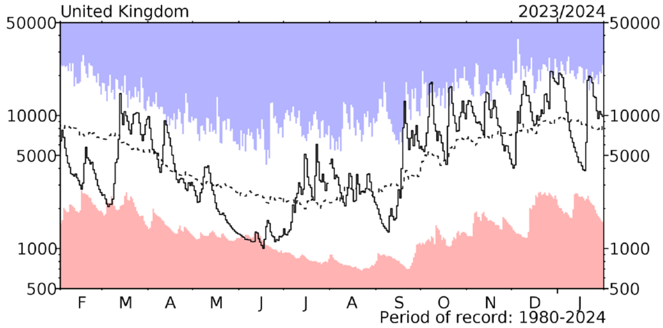


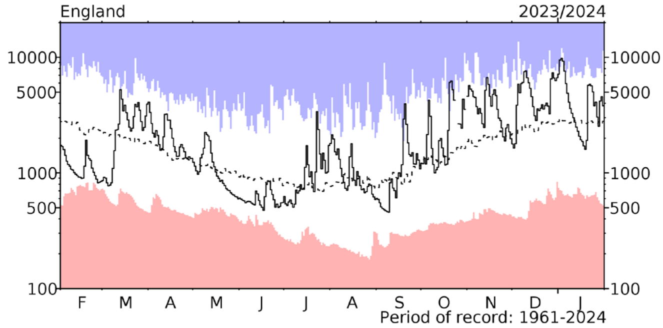


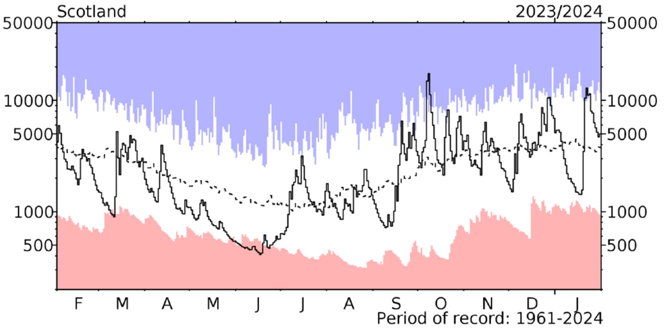
River flows

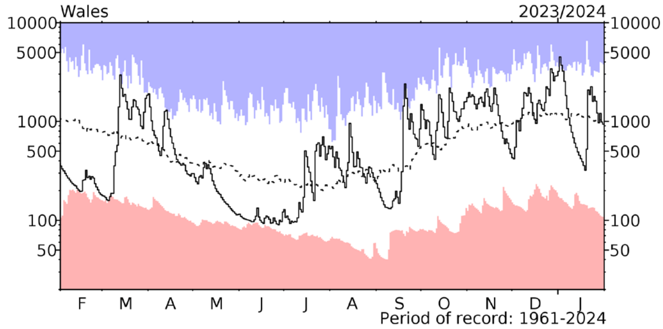
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. The categories of the spots are based on the full period-of-record data whereas the percentages are based on the 1991-2020 averaging period for consistency between rainfall and river flows. Percentages may be omitted where flows are under review.

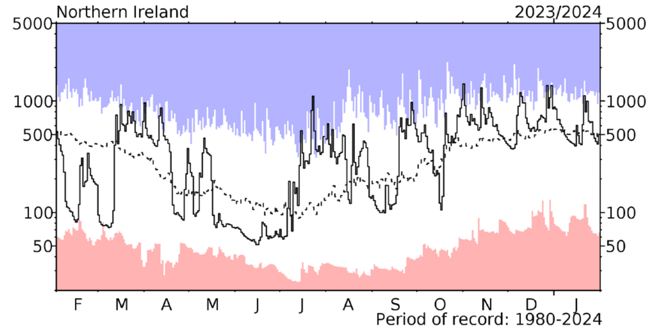
River flow . . . River flow . . .

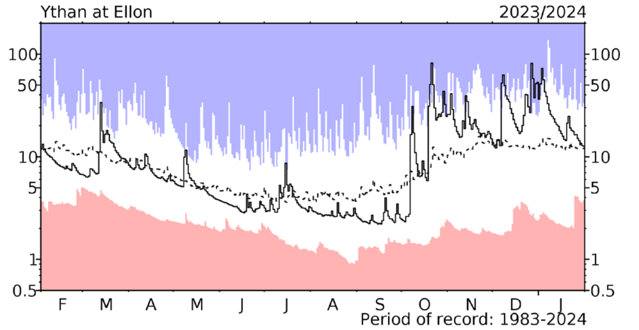


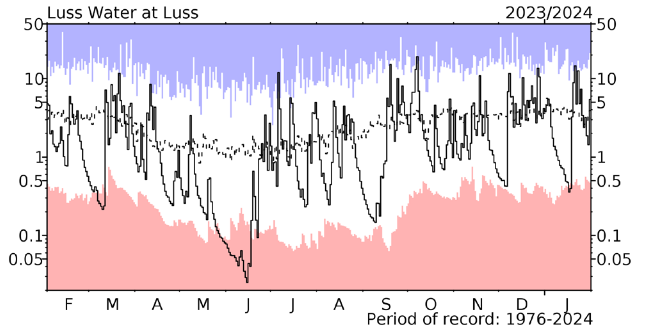


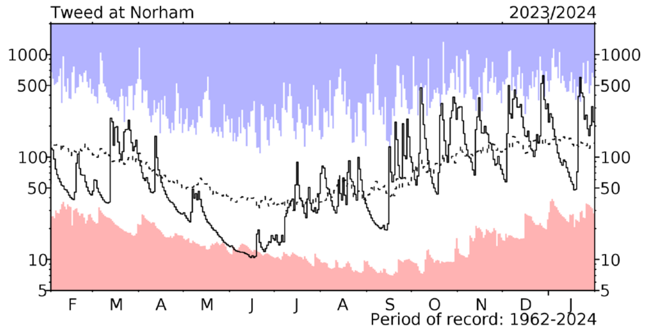


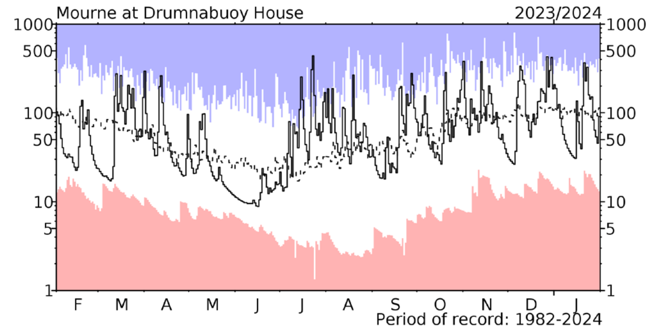


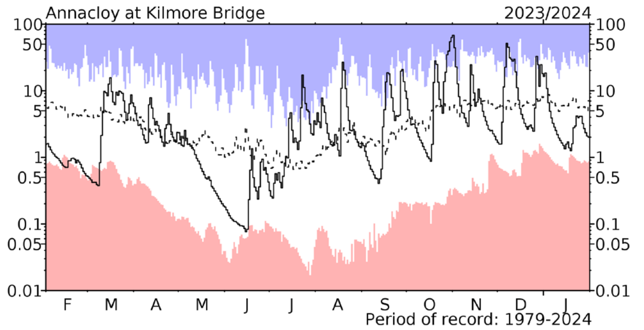








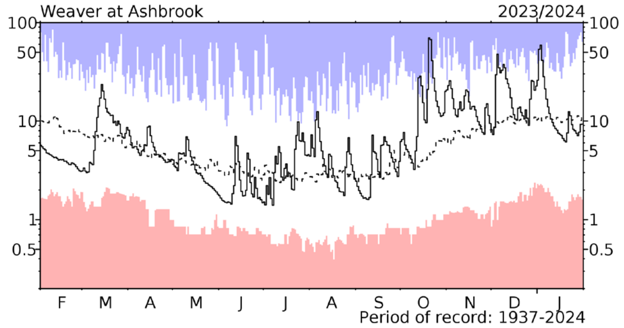


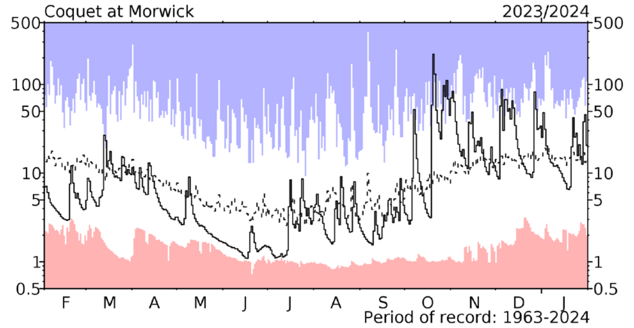


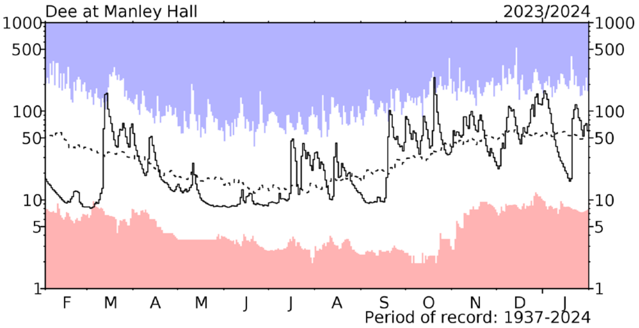
River flow hydrographs

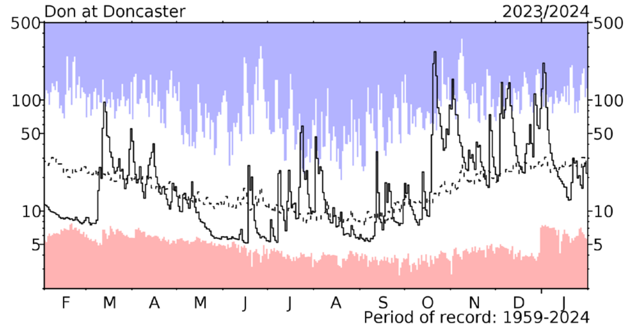
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to January 2023 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

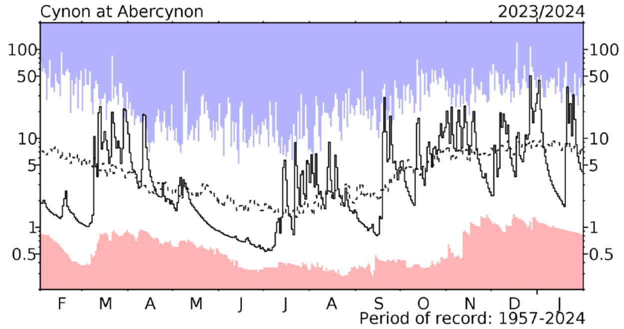
River flow . . . River flow . . .

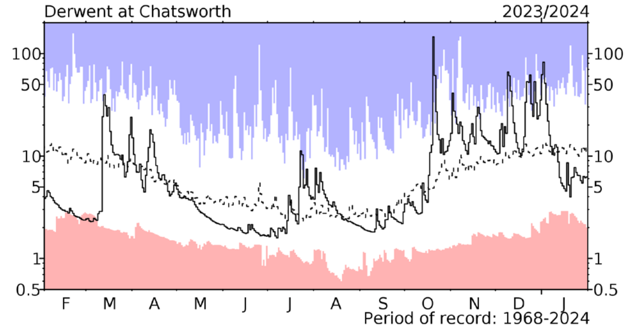


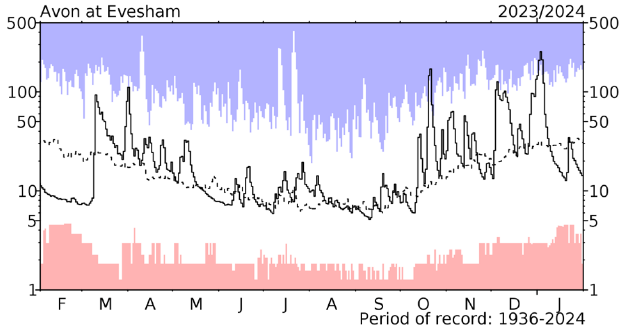


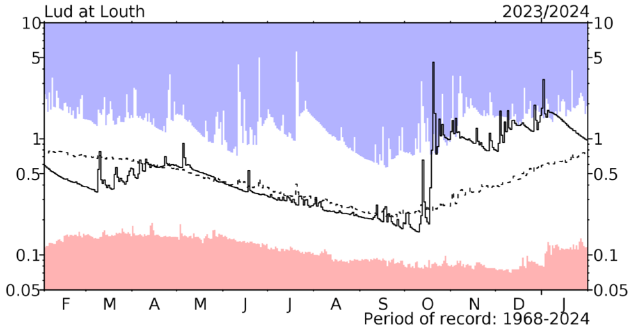


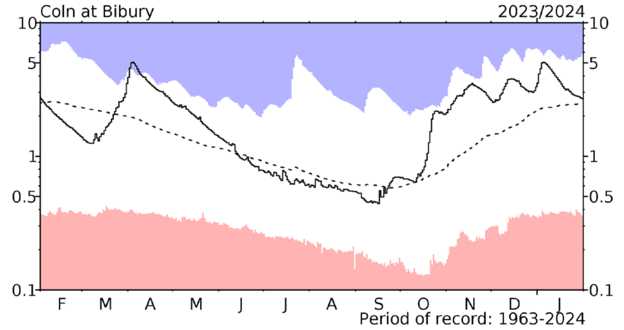


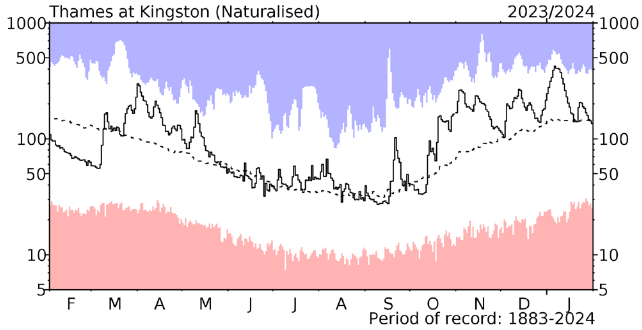


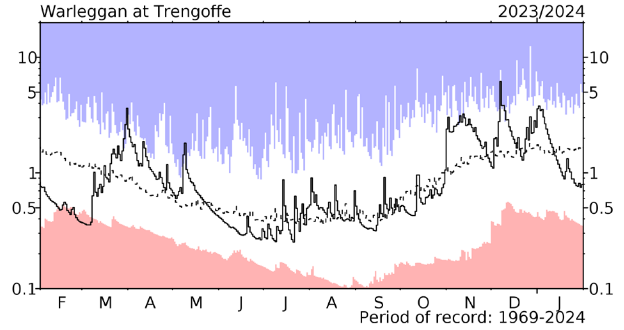


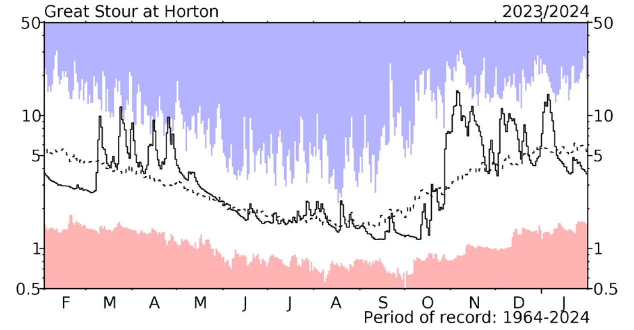




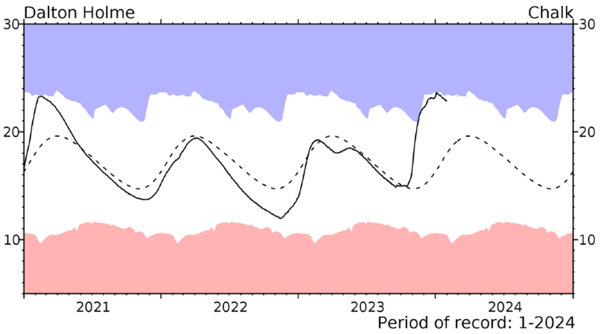


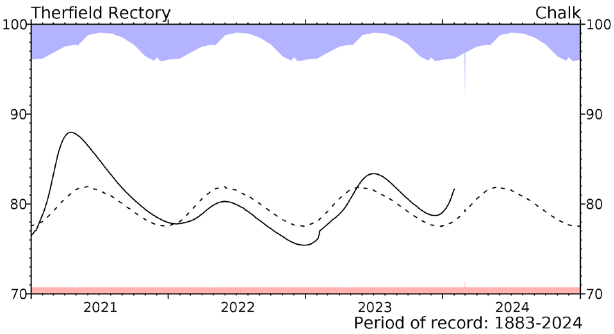


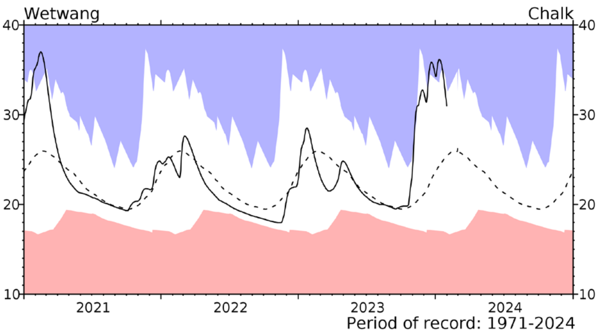


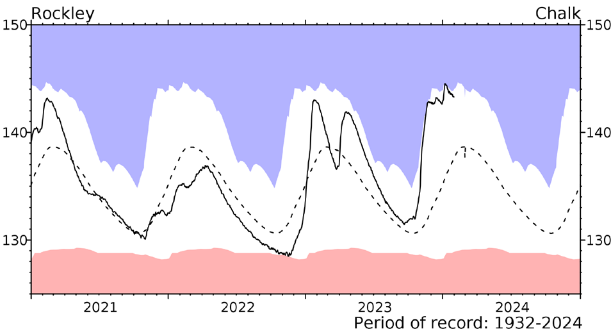


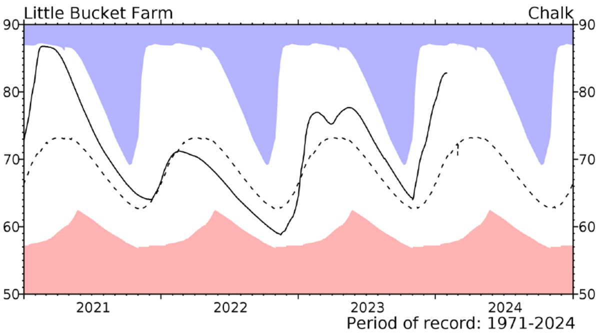
Groundwater . . . Groundwater

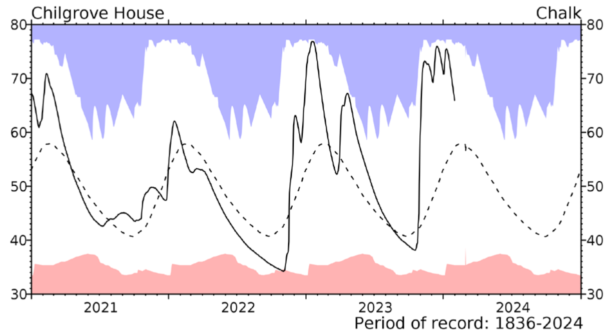


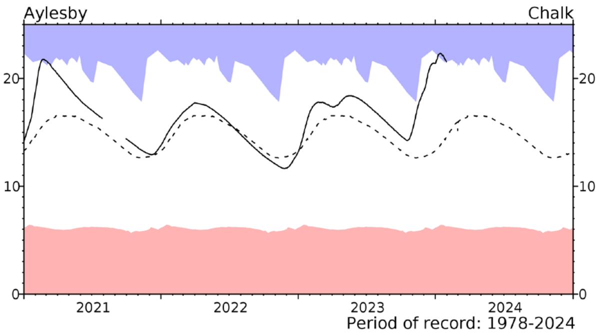


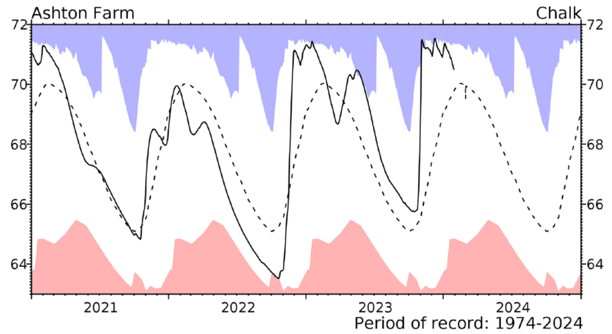


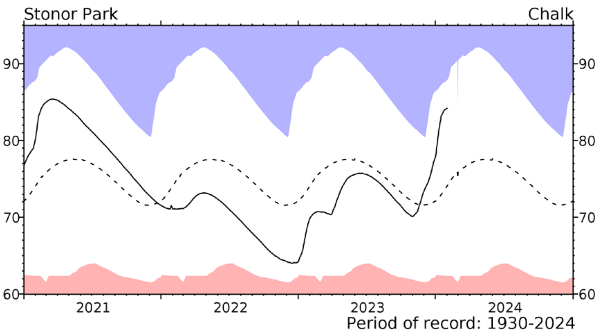


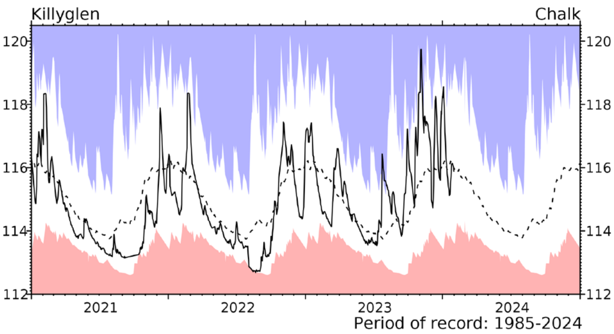






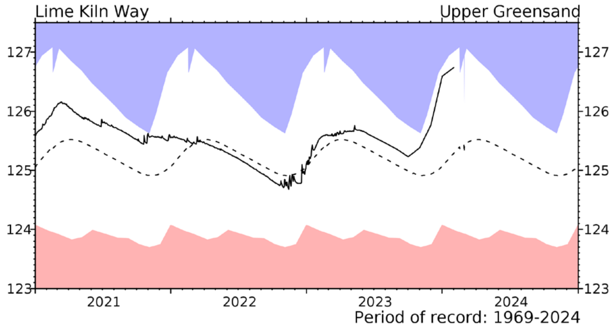


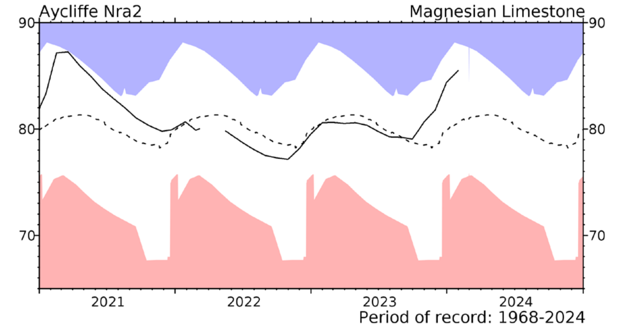


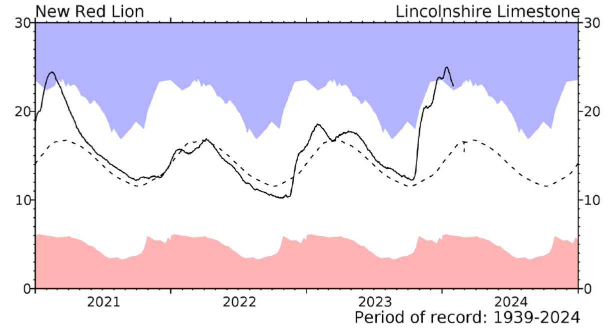


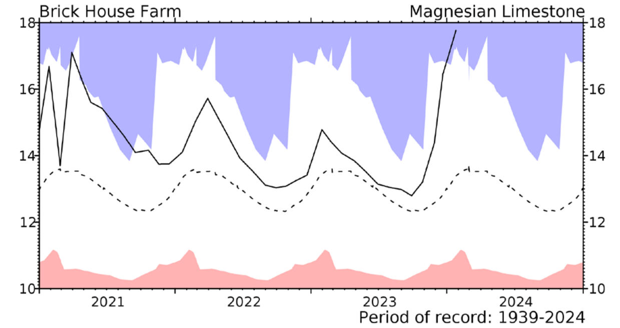
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is 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 calculated with data from the start of the record to the end of 2020. 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.

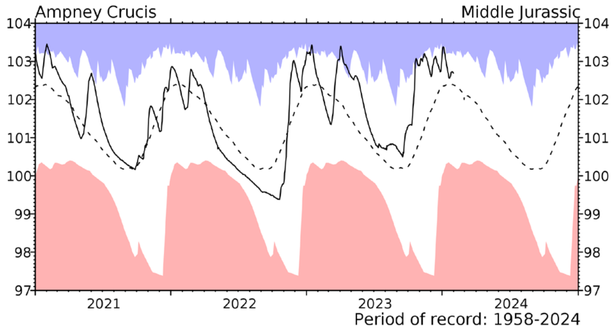
Groundwater . . . Groundwater

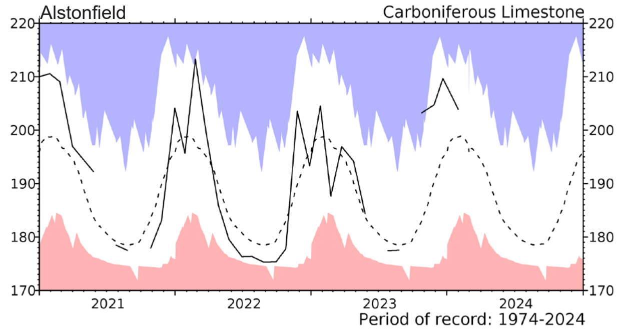


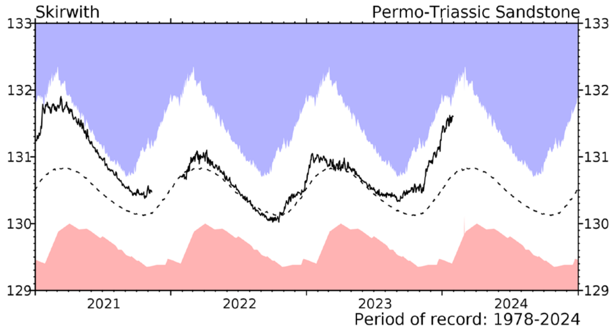


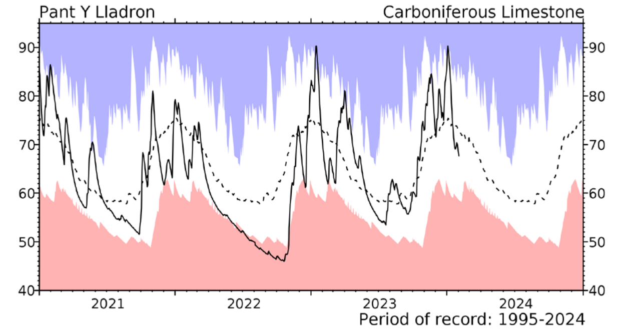


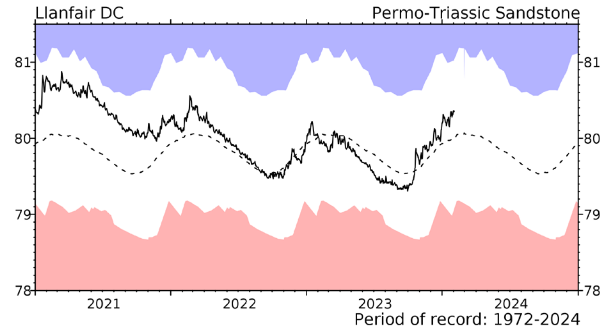


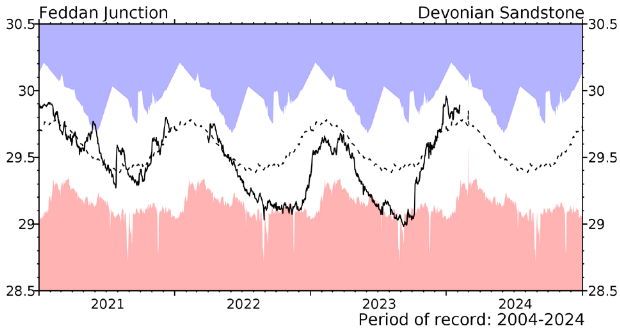


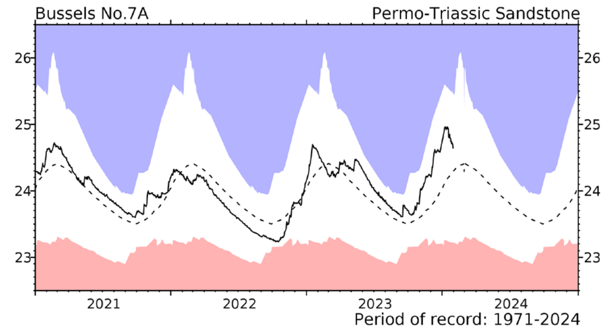


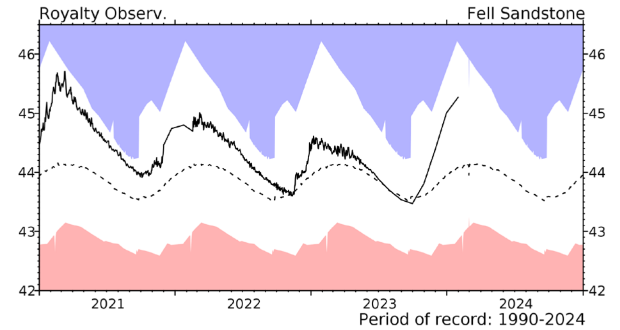




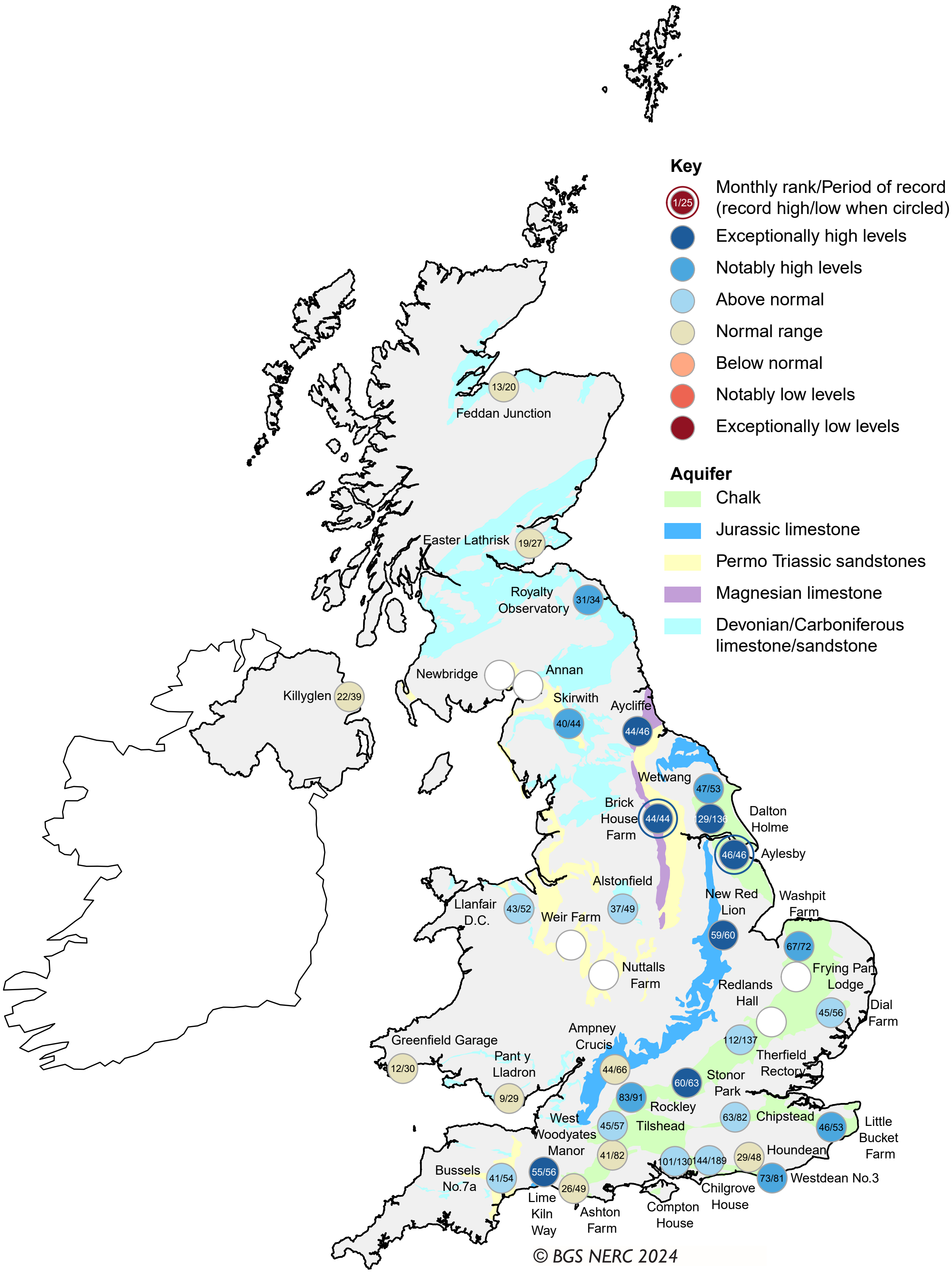








Groundwater . . . Groundwater

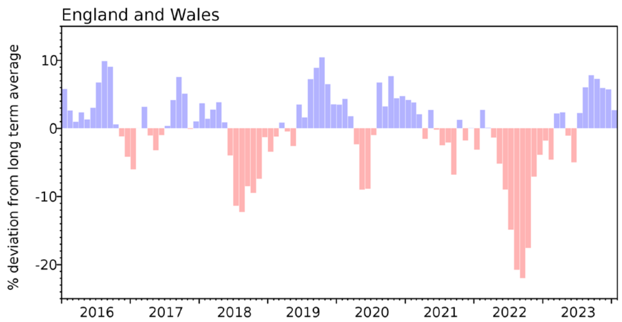


Groundwater levels - January 2024

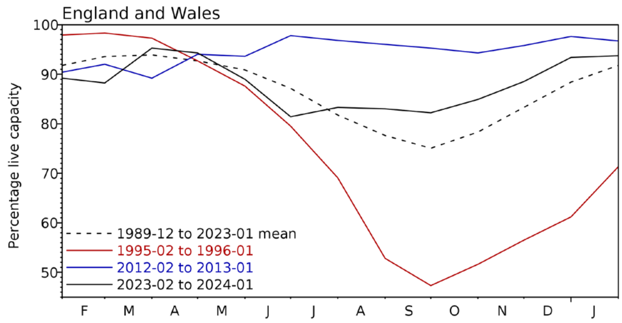
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

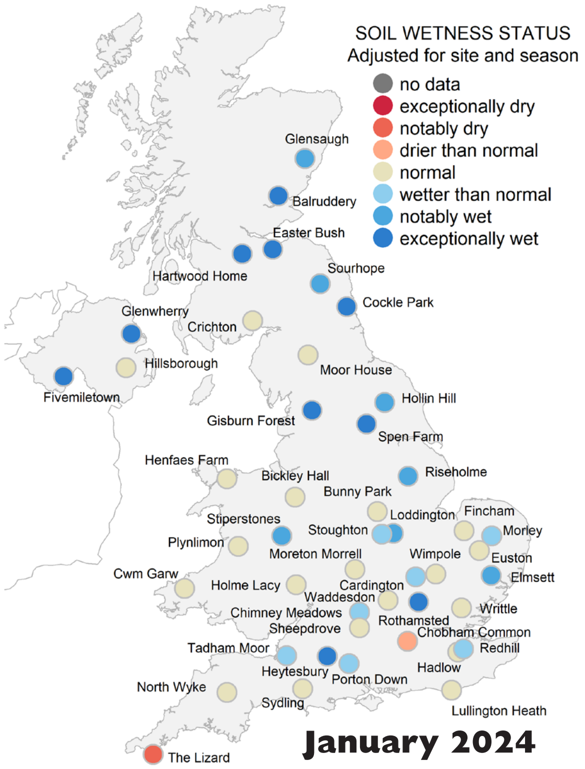
Area	Reservoir		Capacity (Ml)	2023 Nov	2023 Dec	2024 Jan	Jan Anom.	Min Jan	Year* of min	2023 Jan	Diff 24-23
North West	N Command Zone	•	124929	89	100	99	8	63	1996	95	5
	Vyrnwy		55146	100	100	100	7	45	1996	100	0
Northumbrian	Teesdale	•	87936	99	100	100	7	51	1996	92	8
	Kielder		(199175)	90	99	98	5	82	2019	90	8
Severn-Trent	Clywedog		49936	86	100	92	4	62	1996	87	5
	Derwent Valley	•	46692	96	100	96	1	15	1996	93	4
Yorkshire	Washburn	•	23373	91	89	94	3	34	1996	97	-3
	Bradford Supply	•	40942	100	100	100	6	33	1996	87	13
Anglian	Grafham		(55490)	82	82	77	-9	67	1998	75	2
	Rutland		(116580)	90	92	90	3	68	1997	96	-7
Thames	London	•	202828	87	89	92	1	70	1997	87	5
	Farmoor	•	13822	97	85	92	1	72	2001	96	-5
Southern	Bewl		31000	67		66	-16	37	2006	96	-30
	Ardingly		4685	80	100	100	7	41	2012	100	0
Wessex	Clatworthy		5662	100	100	100	4	62	1989	100	0
	Bristol	•	(38666)	97	100	99	11	58	1992	99	0
South West	Colliford		28540	67	73	78	-4	47	2023	47	31
	Roadford		34500	62	82	89	7	30	1996	61	28
	Wimbleball		21320	100	100	100	9	58	2017	100	0
	Stithians		4967	89	100	100	10	38	1992	91	9
Welsh	Celyn & Brenig	•	131155	72	80	84	-11	61	1996	78	6
	Brianne		62140	100	100	100	2	84	1997	92	8
	Big Five	•	69762	86	98	99	6	67	1997	94	5
	Elan Valley	•	99106	99	100	100	3	73	1996	96	4
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	98	98	99	5	72	1999	98	1
	East Lothian	•	9317	100	100	100	1	68	1990	100	0
Scotland(W)	Loch Katrine	•	110326	95	99	100	6	85	2000	96	4
	Daer		22494	85	86	87	-11	87	2024	90	-3
	Loch Thom		10721	99	100	99	1	90	2020	100	-1
Northern Ireland	Total+	•	56800	99	100	100	7	74	2017	96	3
	Silent Valley	•	20634	99	100	100	11	46	2002	99	1

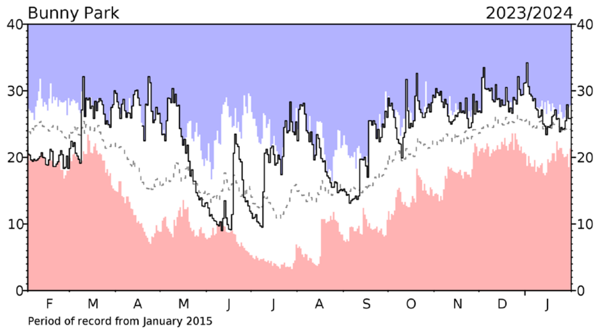
( ) figures in parentheses relate to gross storage • denotes reservoir groups *last occurrence

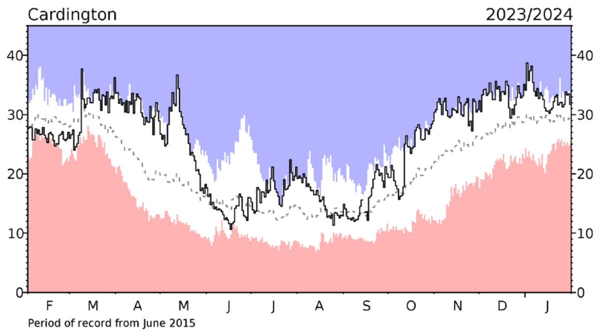
+ excludes Lough Neagh

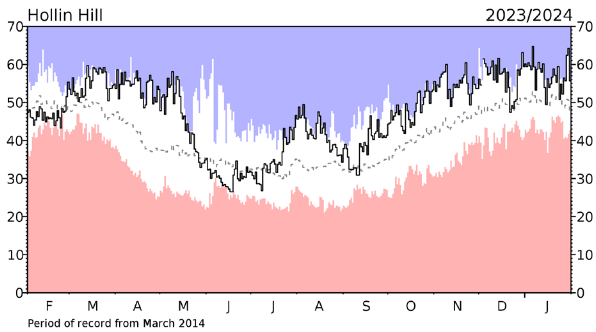
Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed 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.

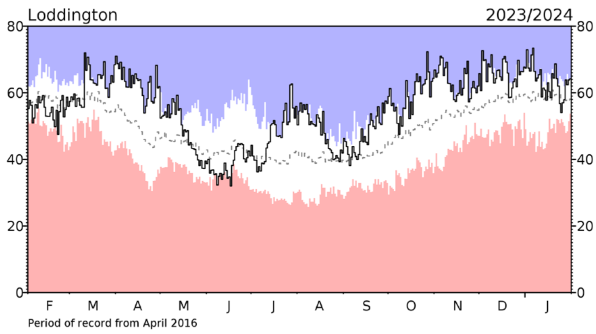
Soil Moisture . . . Soil Moisture

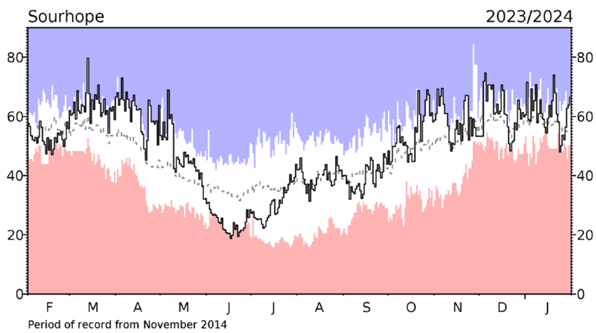












At the end of the month, soil moisture was high or above field capacity for most COSMOS-UK sites. The pattern of soil moisture at most sites followed the pattern of rainfall; a high peak at the start of the month, followed by a drop in soil moisture due to drier weather, with a gradual increase towards the end of the month (e.g. Bunny Park, Euston, Moreton Morrell). Some sites remained wet throughout the month, e.g. Cardington, Hartwood Home, Hollin Hill. Several sites had standing water on the surface, and this will be interpreted as 'soil moisture' by the integrated large area Cosmic-ray neutron sensing technique, hence soil wetness reported can be well above saturation values for those sites.

Overall, soil moisture remains high for much of the COSMOS-UK network, following a very wet December and the large storms bringing heavy rainfall across the UK in January.

Soil moisture data

These data are from UKCEH's COSMOS-UK network. The time series graphs show volumetric water content as a percentage in black together with the maximum and minimum daily values for the period-of-record of the sites. The dashed line represents the period-of-record mean VWC. For more information visit cosmos.ceh.ac.uk.

NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the UK Centre for Ecology & Hydrology (UKCEH) 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 UKCEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

The Hydrological Summary is supported by the Natural Environment Research Council award number NE/R016429/1 as part of the UK-SCAPE programme delivering National Capability.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. A location map of all sites used in the Hydrological Summary can be found on the NHMP website. 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 Department for Infrastructure - Rivers 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 the HadUK-Grid 1km 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 1836 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Hollis, 2019 available at https://doi.org/10.1002/gdj3.78

Long-term averages are based on the period 1991-2020 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: 0370 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

02/2024

UK-SCAPE
UK Status, Change and Projections of the Environment

UKRI Natural Environment Research Council