Hydrological Summary

for the United Kingdom

November 2024

General

The first half of November was dry, cloudy and mild, in contrast to the second half which saw snow, storms and heavy rain. Total rainfall was below average in the north and, despite the first dry fortnight, average in the south – although this masks regional variation. River flows also reflected this spatial gradient, with below normal to notably low flows in the north and flows in the normal range to notably high in the south. Soils wetted up towards month-end, although they remained drier than average in eastern parts of Scotland. At most sites, groundwater levels ranged from the normal range to exceptionally high, with recharge observed in late November. Reservoir stocks at most impoundments fell relative to average, removing surpluses for some in the north (e.g. Loch Katrine, the Northern Command Zone) and for Scotland as a whole. Despite this, stocks remained near-average for each country individually. Whilst the wet start to December may have somewhat ameliorated any water resources concerns associated with the dry autumn in the north, the wetted soils and high groundwater levels continue to elevate flood risk in the south and east during the transition into winter.

Rainfall

Mild and cloudy conditions dominated during the first half of November, albeit with very little rain, until high pressure moved westwards on the 15th allowing northerly airflows to bring colder air and rain. Westerly low-pressure meeting colder air on the 19th resulted in the first of the season's snowfall affecting northern Britain, Northern Ireland, Wales and central England (e.g. 15cm was recorded in the East Midlands) and travel disruption. Cold conditions persisted, with ice and wintry showers, particularly in the north and west of the UK. There was further snowfall in south and south-west England on the 21st and in Scotland and northern England on the 23rd with the arrival of storm 'Bert'. Heavy rain associated with the storm (e.g. 150mm recorded across south Wales and Dartmoor on the 23rd/24th) along with strong winds (350,000 homes lost power) and a rapid thaw contributed to surface water flooding and at least five fatalities. Further rainfall affected Scotland and southern England on the 24th/25th, southern England on the 26th (associated with storm 'Conall'), and western Britain on the 29th/30th. Total rainfall for the UK was two-thirds of average (68%), with a marked north-south divide. Except for the Highlands (with 62% of average), all Scottish regions received less than half of average (35-44%) along with Northumbria, whilst the Thames, Wessex and South West England regions received average rainfall. High rainfall in the south accentuated this contrast over the autumn (September-November). Scotland had its driest autumn in a generation (since 1993), whilst Thames and Wessex (with 150% and 149% of average rainfall) both saw their fifth wettest autumns (all in series from 1890).

River Flows

Following high flows in mid- to late-October, November started with above average flows in most catchments with recessions already commenced or starting in the first week. Thereafter, localised flow responses interrupted recessions in some catchments in northern Scotland in the first week, but for the most part, recessions continued – new daily flow minima were recorded across eastern Scotland, north-east England and north-western parts of the UK (notably so on the Bervie and Forth for 14 and 13 continuous days from the 9th/10th, respectively). Rainfall associated with the named storms resulted in flow responses in the majority of catchments across the UK, with multiple peaks registered in Wales, western Scotland and the south of England. Between the 23rd and 28th of November, many catchments recorded top three November peak flows, whilst the Cynon and Stour registered their third highest peak flows of any month on the 24th and 25th (in series from 1958 and 1973), respectively. Mean November flows also showed a notable spatial contrast. Below normal to exceptionally low flows were registered in Scotland and northern England, some with less than half the average – including the Clyde with 35% of its average November flow (its second lowest November on record, in a series from 1958). In the south of England, however, flows were above normal to notably high, with 203% of average on the Coln. Over the autumn (September-November), this spatial contrast was further emphasised, with more catchments registering notably or exceptionally low flows across Scotland. The Cree recorded exceptionally low flows, the second lowest flows for this period in a series from 1963, with many other catchments recording two-thirds of their average. The widespread nature of low flows over this period is evident in the Scottish outflows series, which ranked as the fourth lowest for autumn in a series from 1961. In southern catchments, notably and exceptionally high flows were widespread, with the Coln, Brue and Stour establishing new autumn maxima with over 250% of their respective averages (all in series of over 50 years).

Soil Moisture and Groundwater

Overall, soil moisture levels across the UK increased towards month-end and were generally within the normal to wetter than normal range. Soil moisture deficits were eliminated in western regions and were reduced in south-eastern parts of the UK. Recharge was observed in late November across most of the Chalk sites in southern England, in the Carboniferous Limestone of south Wales, in the Permo Triassic Sandstones at Llanfair D.C. and Bussels No.7a, and in the Jurassic limestones at Ampney Crucis. Despite late recharge, levels were below normal at Killyglen. In the Chalk aquifer in eastern England, levels were stable or receding but remained within the normal to above-normal range. In the Jurassic limestones at New Red Lion levels stabilised at above normal. In the Magnesian Limestone at Aycliffe and Brickhouse Farm, levels remained exceptionally high. Levels were stable in the Permo Triassic Sandstones at Skirwith and Weir Farm, where a new November maximum was recorded. In the Upper Greensand at Lime Kiln Way, levels rose slightly and remained exceptionally high. Levels plateaued at above normal in the Fell Sandstone at Royalty Observatory. Levels continued to recede in the Devonian Sandstones (with only minor recharge recorded) and were within the normal range at Feddan Junction, but below normal at Easter Lathrisk.

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.

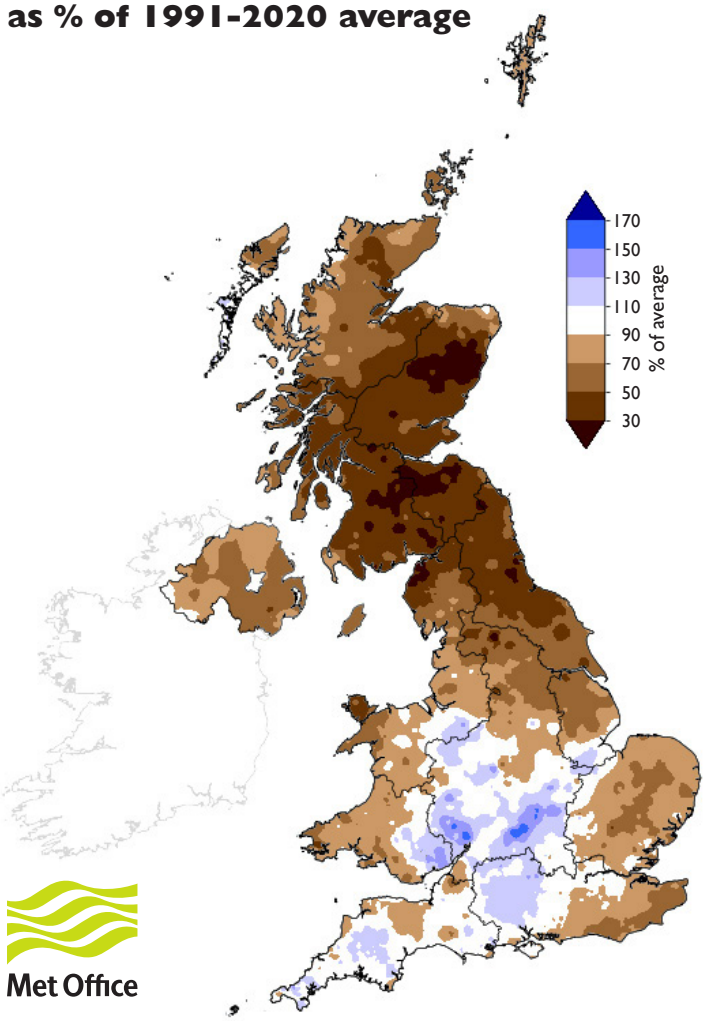
Region	Rainfall	Nov 2024	Sep24 – Nov24	RP	Jun24 – Nov24	RP	Mar24 – Nov24	RP	Dec23 – Nov24	RP
United Kingdom	mm	**84**	301		542		844		1290	
	%	**68**	89	2-5	92	2-5	103	2-5	111	15-25
England	mm	**76**	300		459		723		1082	
	%	**82**	120	5-10	100	2-5	115	8-12	125	50-80
Scotland	mm	**84**	284		657		1002		1562	
	%	**51**	62	15-25	85	2-5	93	2-5	99	2-5
Wales	mm	**134**	415		655		1045		1671	
	%	**83**	96	2-5	89	2-5	103	2-5	114	10-20
Northern Ireland	mm	**86**	239		504		785		1125	
	%	**70**	74	5-10	85	2-5	95	2-5	97	2-5
England & Wales	mm	**84**	316		486		767		1163	
	%	**82**	114	5-10	98	2-5	113	5-10	123	30-50
North West	mm	**84**	341		644		1033		1564	
	%	**63**	91	2-5	96	2-5	114	5-10	122	30-50
Northumbria	mm	**38**	234		418		700		1018	
	%	**40**	92	2-5	86	2-5	105	2-5	112	8-12
Severn-Trent	mm	**74**	308		444		695		1026	
	%	**95**	138	10-20	104	2-5	117	8-12	128	50-80
Yorkshire	mm	**51**	241		394		649		1009	
	%	**57**	99	2-5	85	2-5	102	2-5	116	10-15
Anglian	mm	**51**	209		327		502		750	
	%	**83**	117	5-10	93	2-5	105	2-5	119	10-20
Thames	mm	**82**	321		455		694		995	
	%	**104**	150	20-35	119	5-10	130	15-25	136	60-90
Southern	mm	**84**	323		451		690		1047	
	%	**85**	127	5-10	107	2-5	119	5-10	127	20-30
Wessex	mm	**105**	405		555		853		1265	
	%	**100**	149	20-35	119	5-10	132	25-40	139	>100
South West	mm	**147**	432		625		994		1557	
	%	**100**	116	5-10	100	2-5	115	8-12	124	40-60
Welsh	mm	**133**	416		645		1027		1628	
	%	**85**	100	2-5	91	2-5	105	2-5	116	10-20
Highland	mm	**119**	362		803		1109		1793	
	%	**62**	68	5-10	92	2-5	89	2-5	97	2-5
North East	mm	**46**	213		462		759		1144	
	%	**41**	67	5-10	81	5-10	97	2-5	108	5-10
Tay	mm	**57**	207		489		842		1336	
	%	**39**	52	30-50	71	10-15	87	2-5	96	2-5
Forth	mm	**45**	193		460		854		1281	
	%	**36**	55	15-25	73	5-10	98	2-5	103	5-10
Tweed	mm	**39**	202		444		817		1189	
	%	**35**	66	5-10	79	2-5	105	2-5	109	8-12
Solway	mm	**72**	260		670		1119		1669	
	%	**42**	56	10-20	84	2-5	102	2-5	106	5-10
Clyde	mm	**89**	290		759		1158		1796	
	%	**44**	53	20-35	81	2-5	90	2-5	95	2-5

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

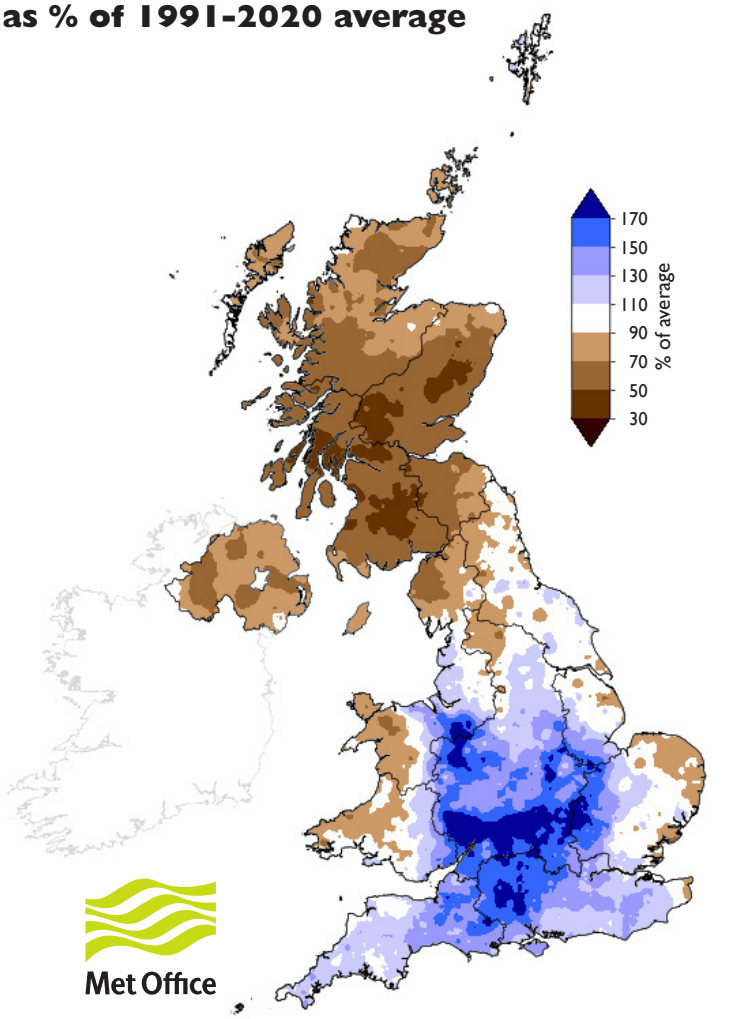
Important note: Figures in the above table may be quoted provided their source is acknowledged. Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1890; 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 . . .

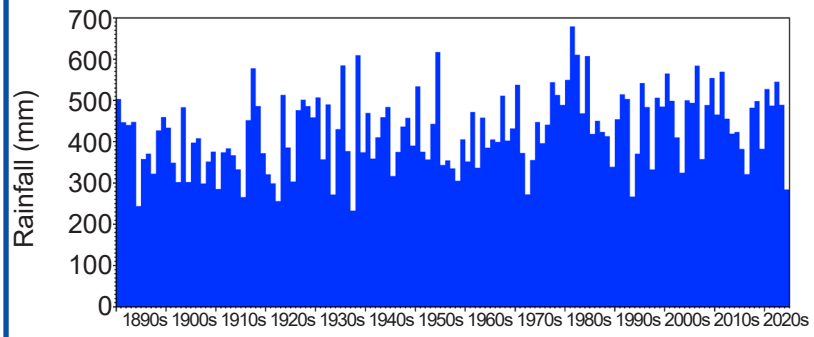
November 2024 rainfall as % of 1991-2020 average



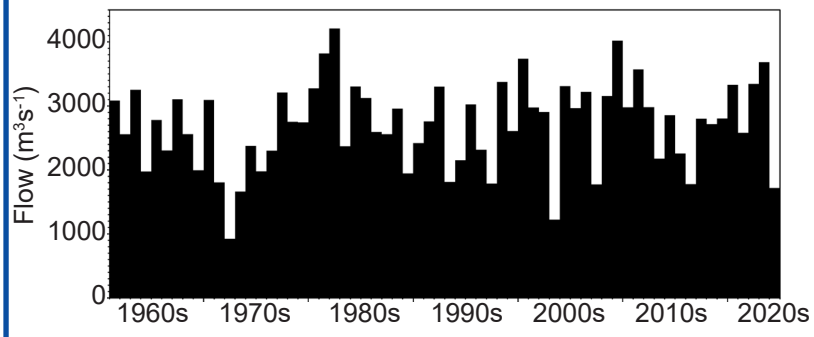
September 2024 - November 2024 rainfall as % of 1991-2020 average



September-November rainfall for Scotland



September-November outflows for Scotland



UK Hydrological Outlook

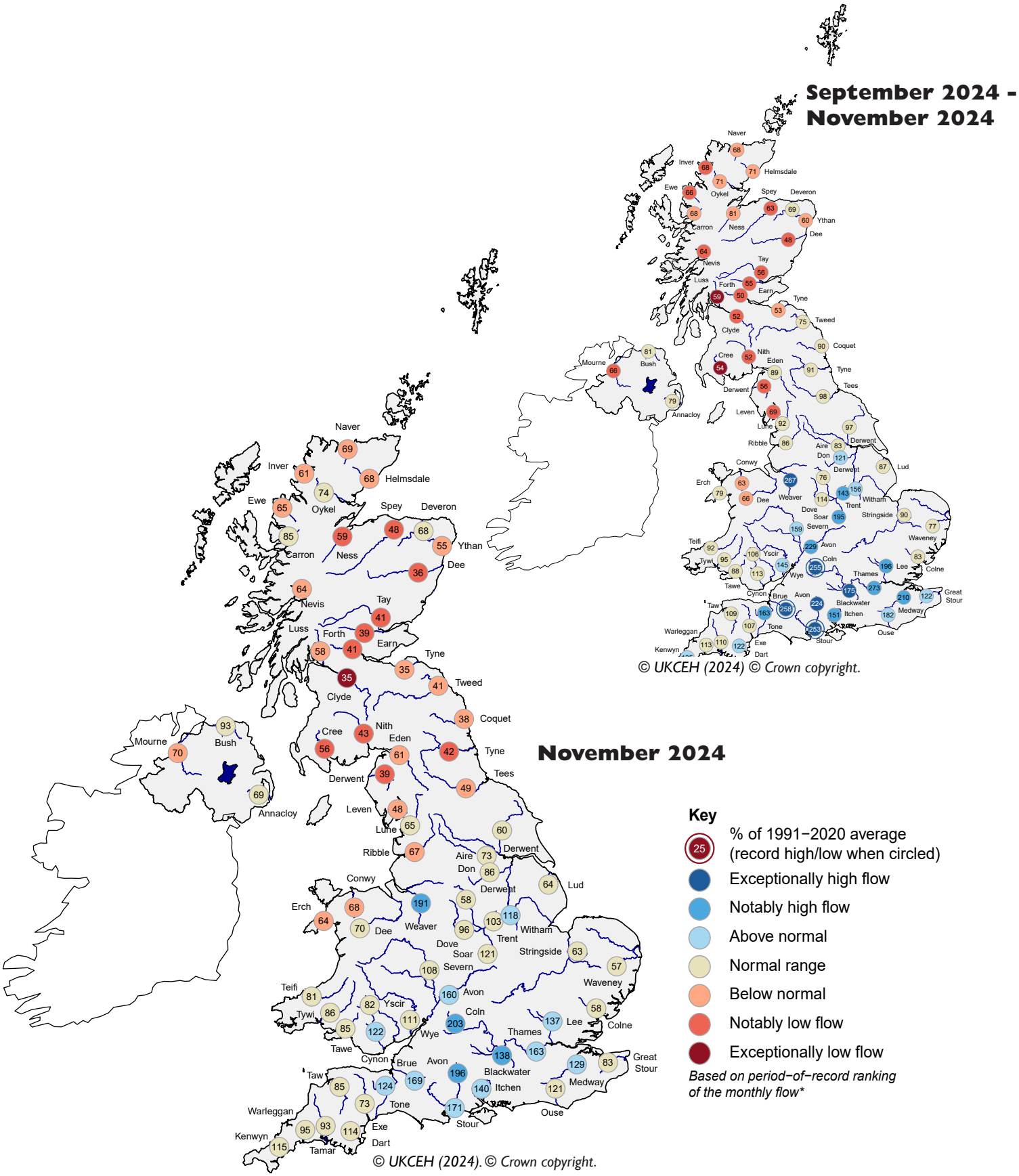
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from December 2024**
Issued: **09.12.2024**
using data to the end of November 2024

The outlook for December is for above normal river flows in south-east England, some of which will be exceptionally high. In eastern Scotland, river flows are likely to be normal to below normal, and elsewhere river flows are likely to be in the normal to above normal range. For groundwater levels, above normal levels are expected, with the exception of East Yorkshire, Lincolnshire, and Dumfries where normal levels are most likely. For December-February, the outlook is similar, although flows in eastern Scotland are likely to tend towards the normal range.

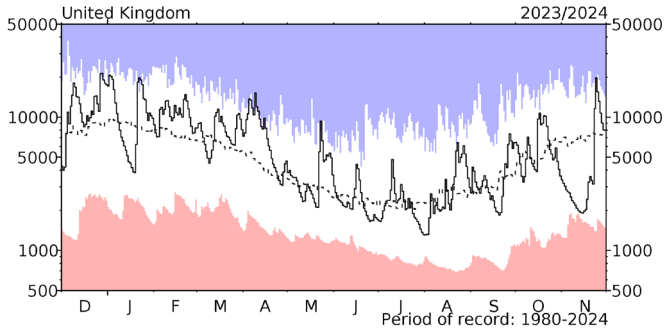
River flow . . . River flow . . .

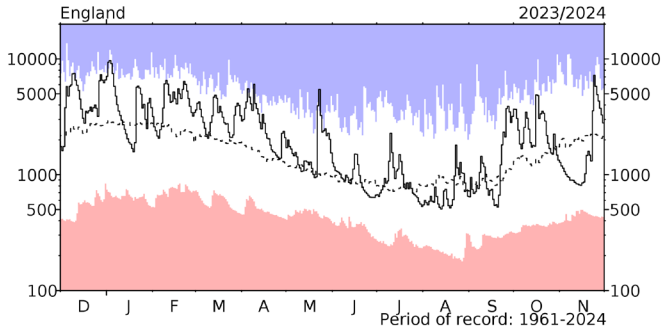


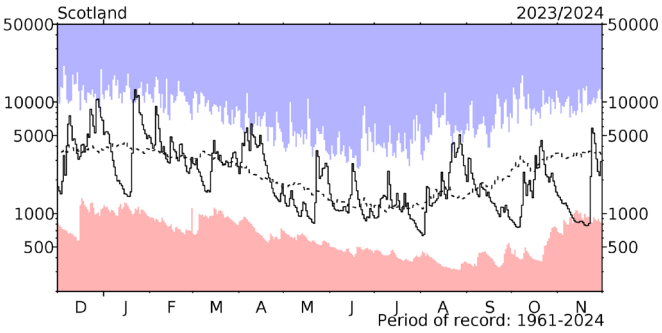
River flows

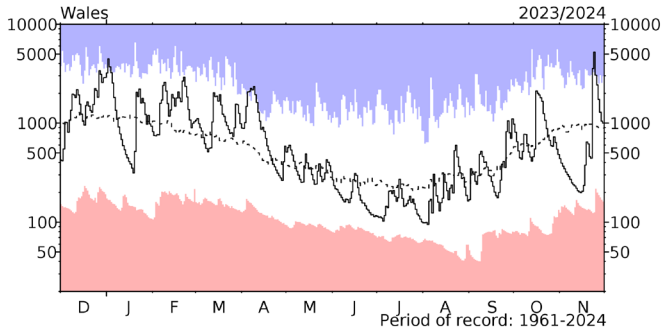
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

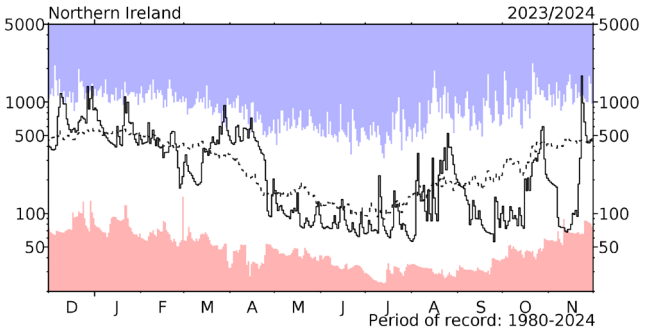
River flow . . . River flow . . .

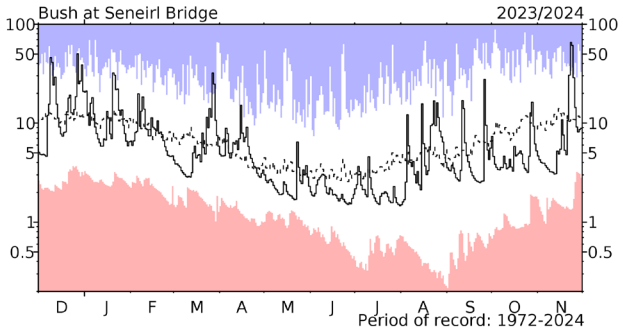


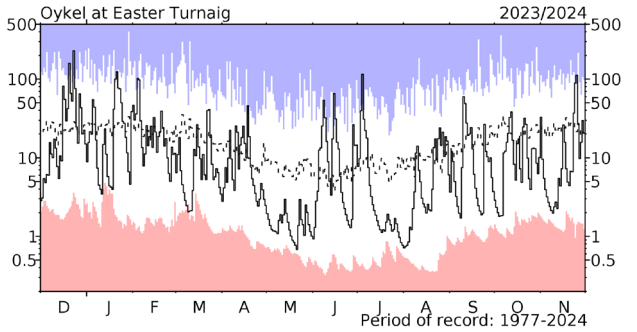


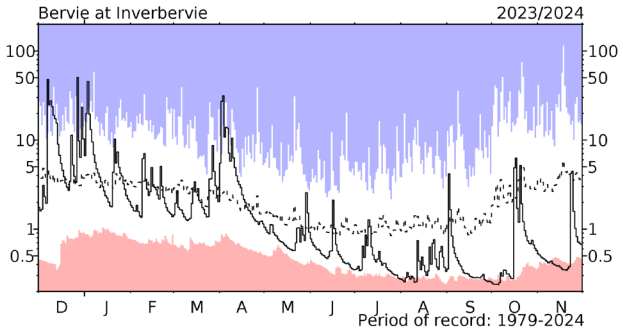


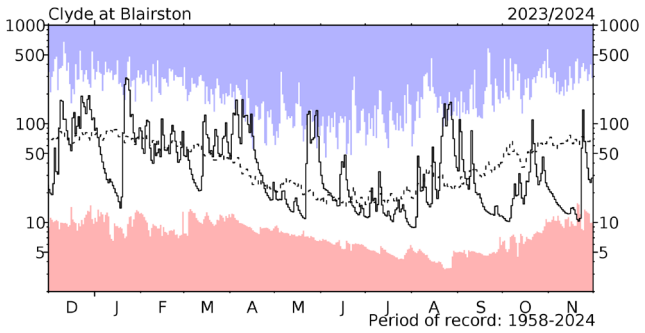


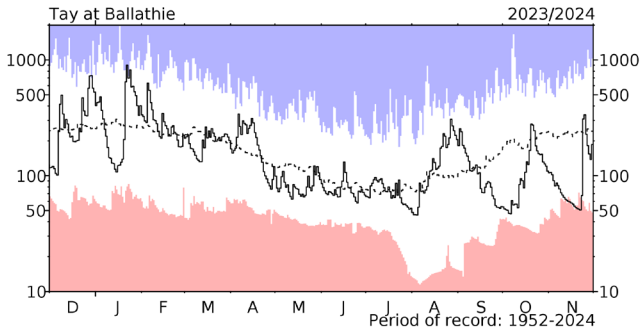








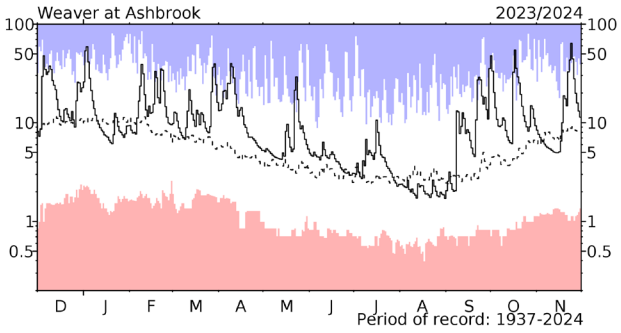


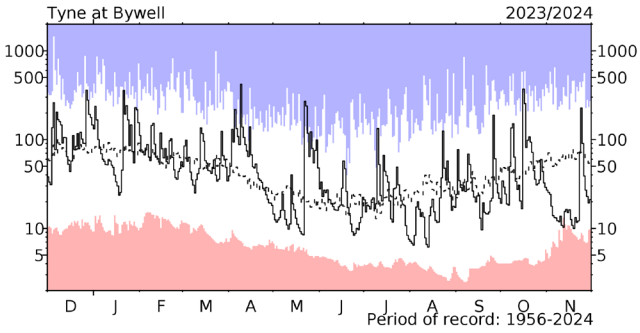


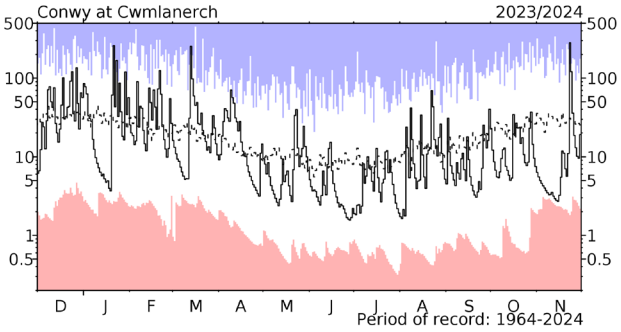
River flow hydrographs

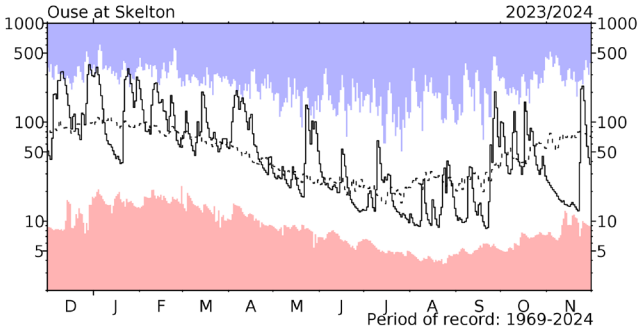
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to August 2023 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

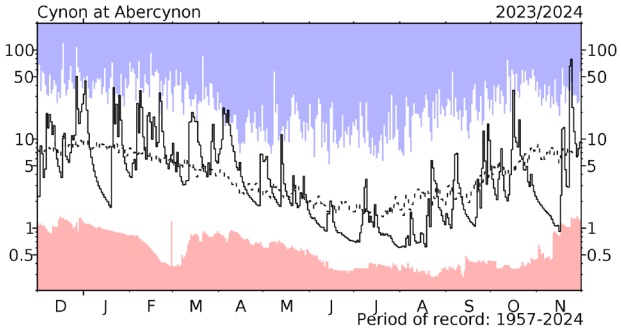
River flow . . . River flow . . .

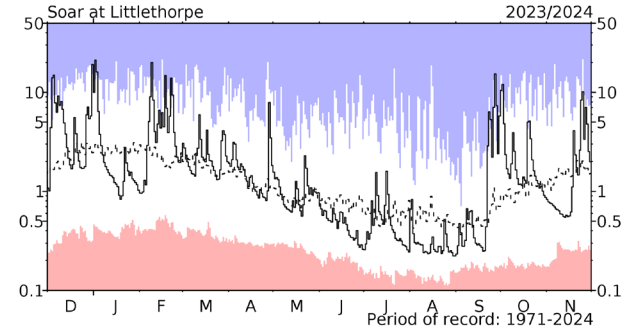


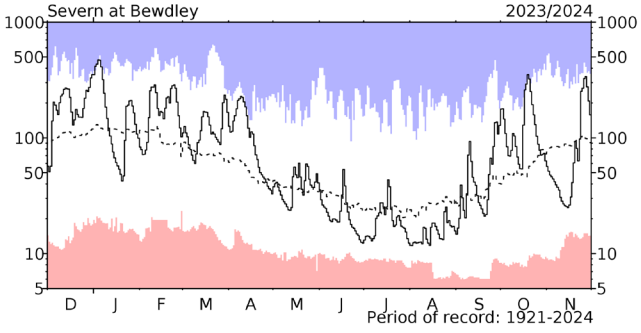


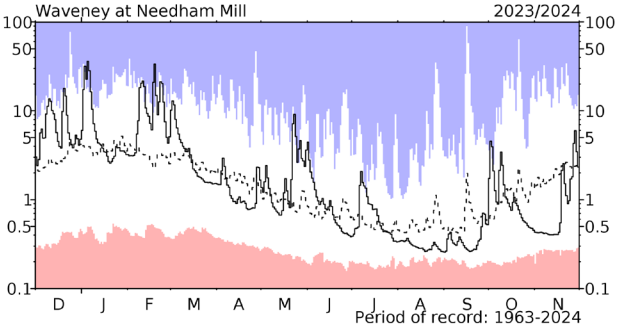


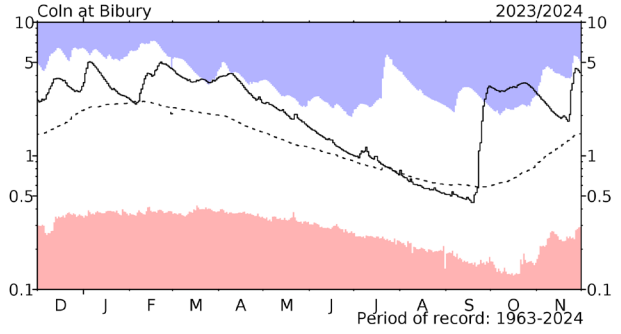


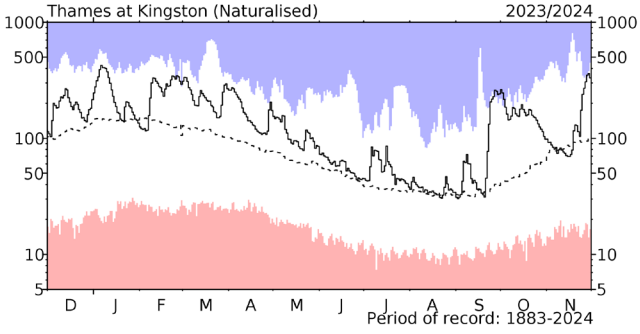


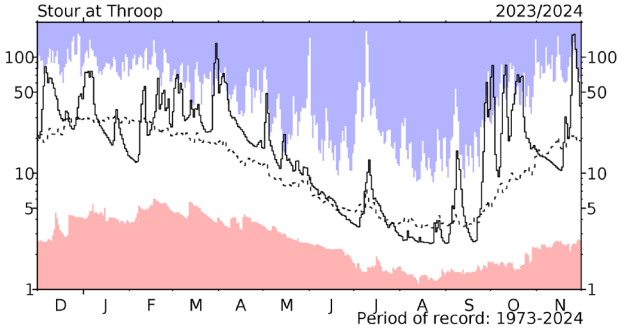


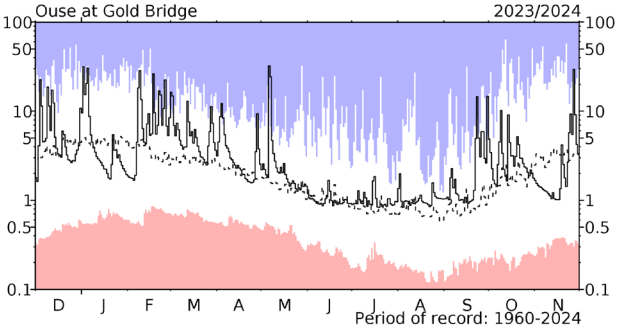




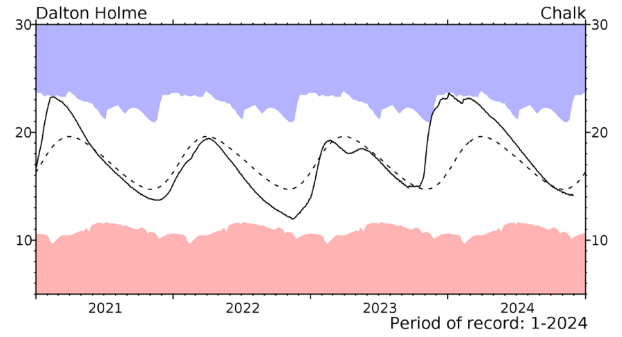


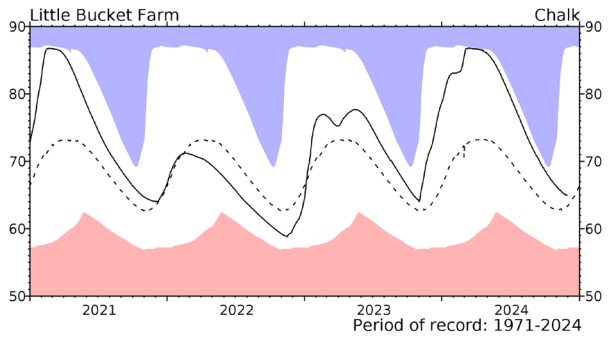


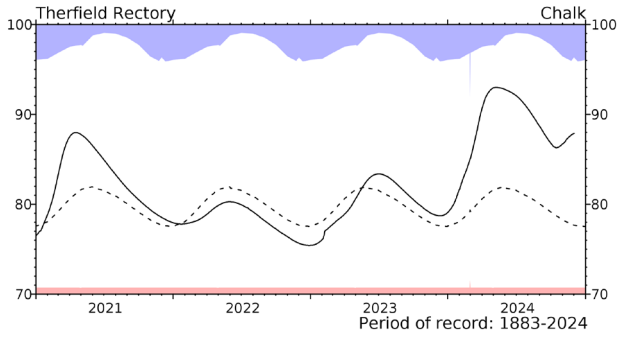


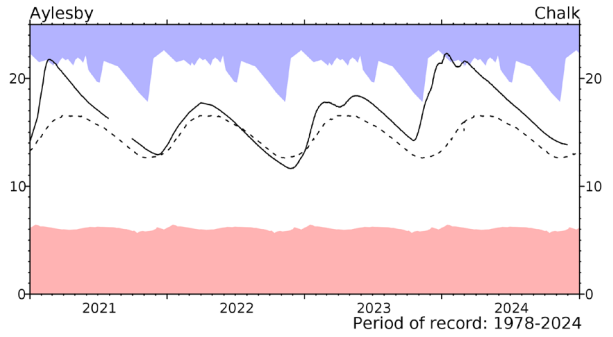


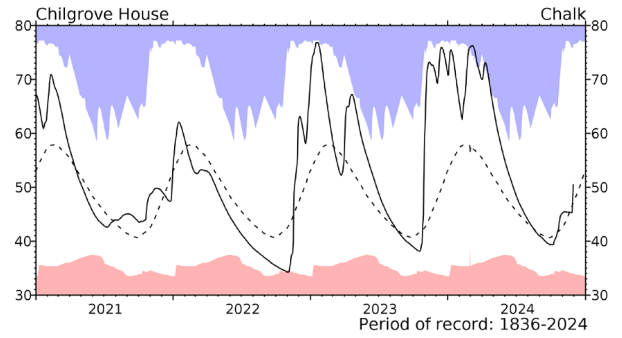
Groundwater…Groundwater

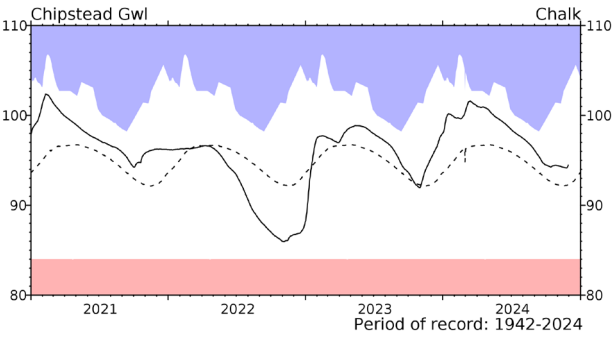


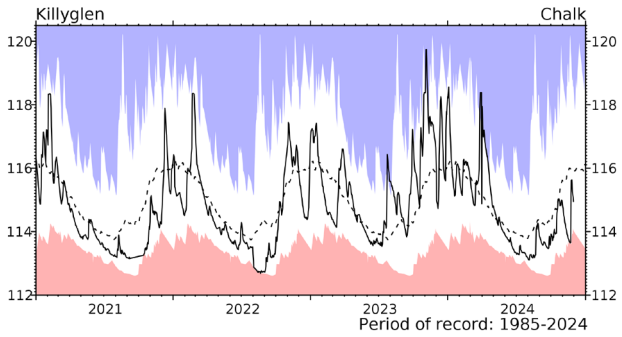


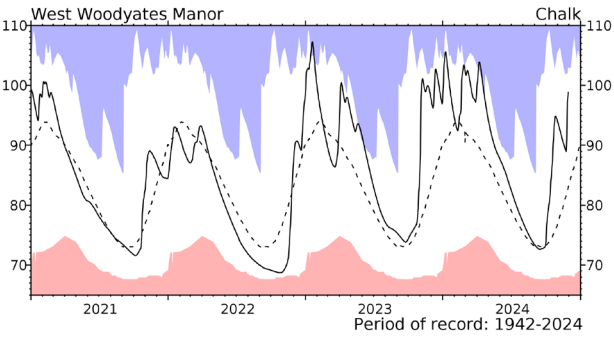


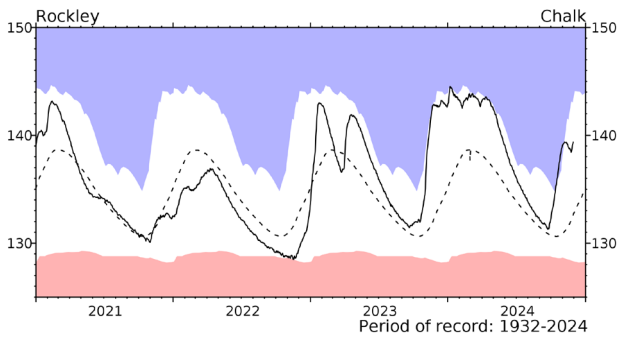


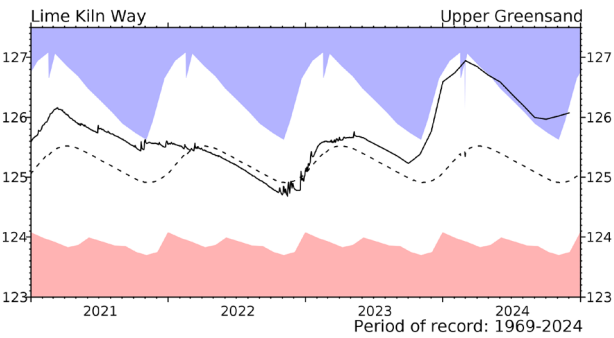






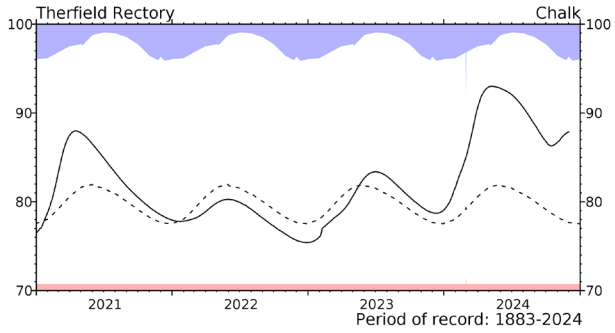


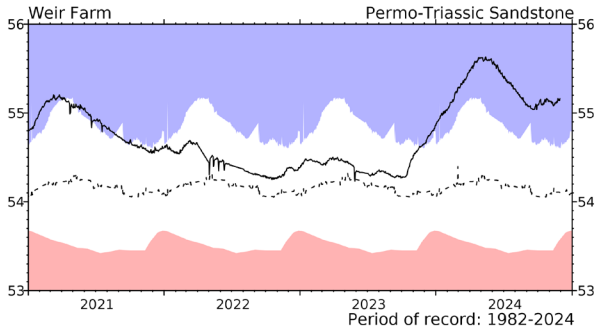


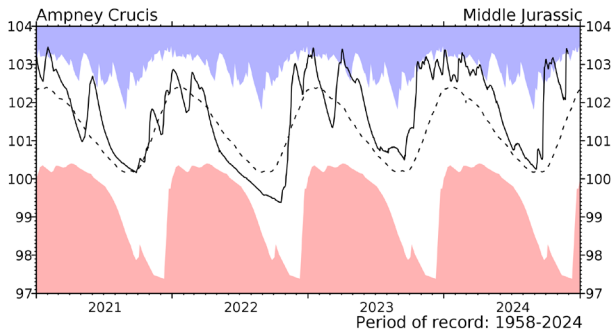


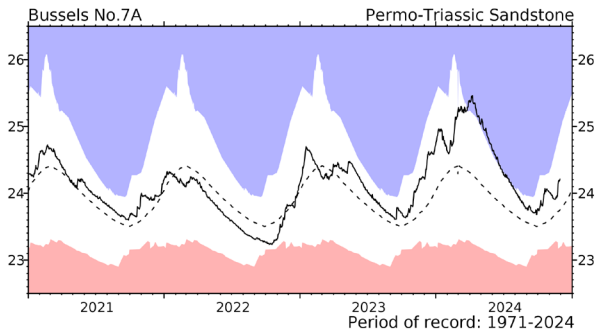
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

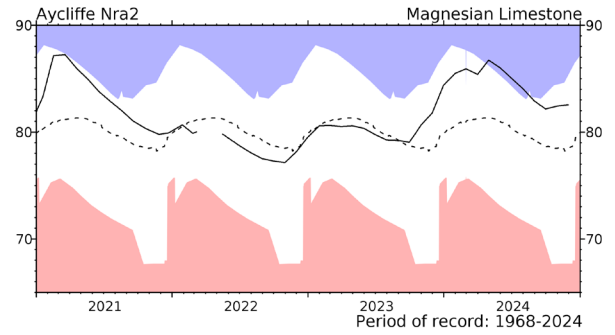
Groundwater … Groundwater

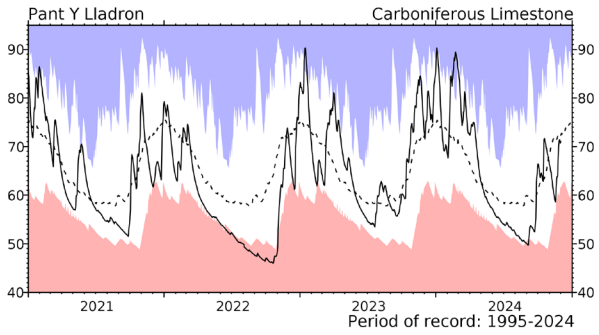


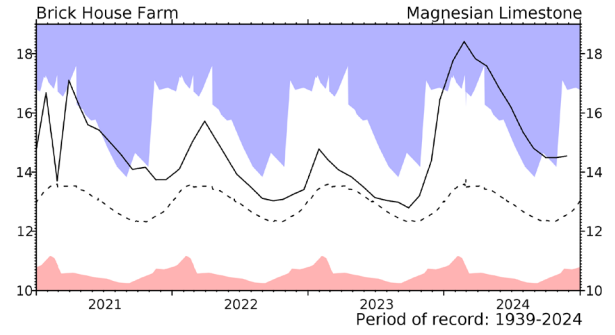


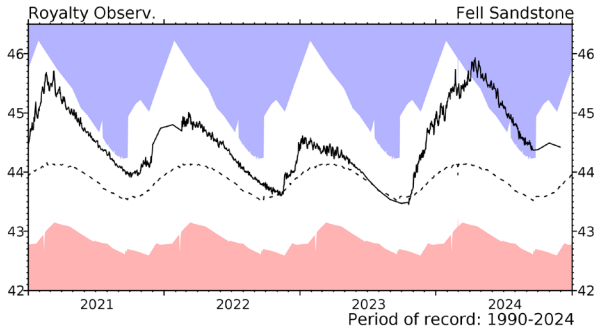


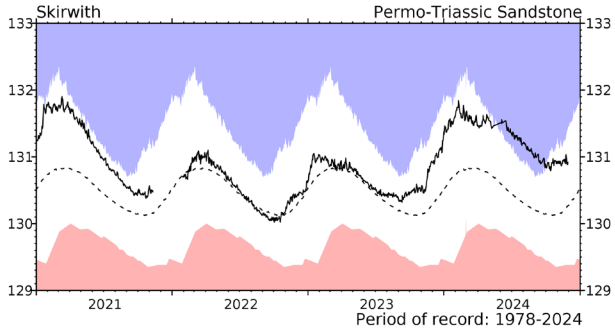


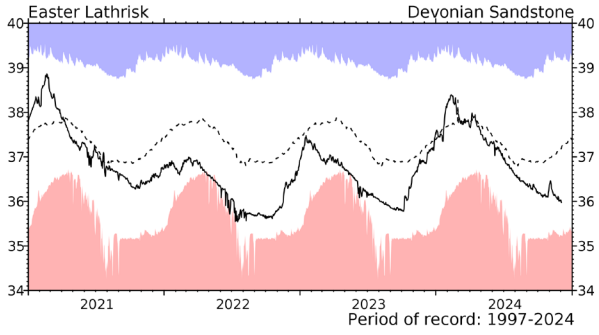


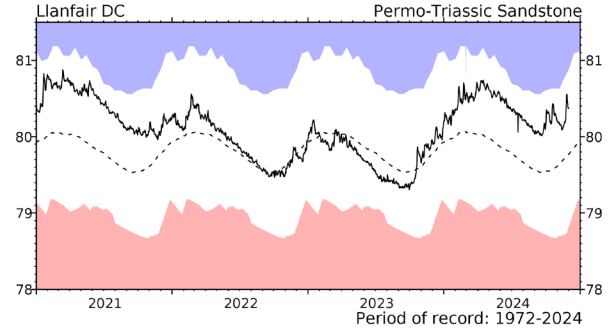


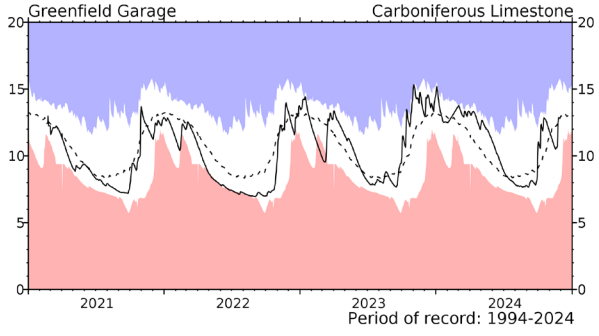


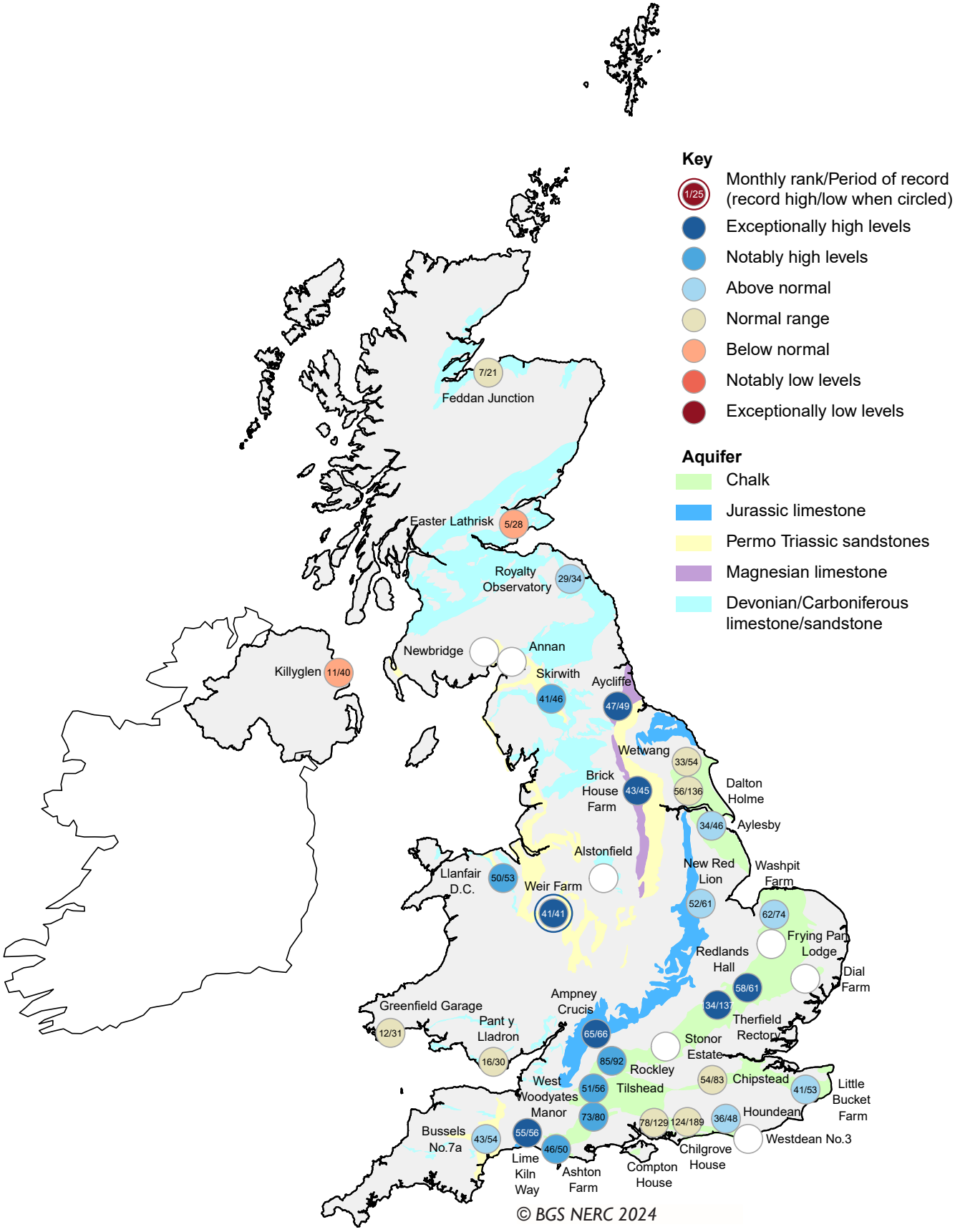










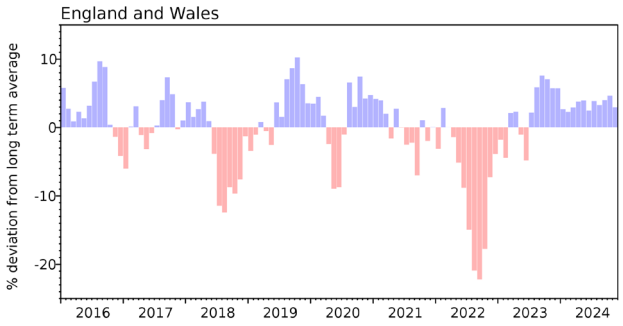


Groundwater levels - November 2024

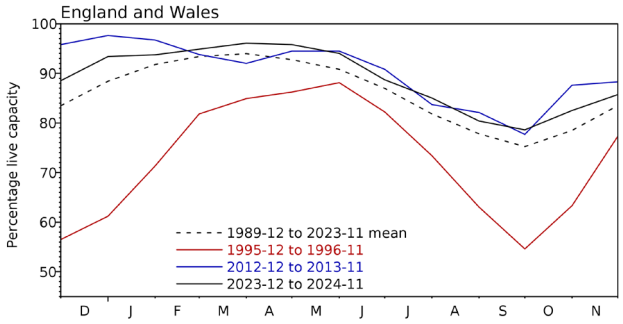
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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)	2024 Sep	2024 Oct	2024 Nov	Nov Anom.	Min Nov	Year* of min	2023 Nov	Diff 24-23
North West	N Command Zone	•	124929	76	80	79	-1	44	1993	89	-10
	Vyrnwy		55146	93	87	92	8	33	1995	100	-8
Northumbrian	Teesdale	•	87936	91	100	99	15	39	1995	99	-1
	Kielder		(199175)	80	82	85	-2	55	2007	90	-5
Severn-Trent	Clywedog		49936	90	83	90	8	43	1995	86	4
	Derwent Valley	•	46692	54	76	78	-1	9	1995	96	-18
Yorkshire	Washburn	•	23373	72	81	82	5	16	1995	91	-9
	Bradford Supply	•	40942	69	81	84	1	20	1995	100	-16
Anglian	Grafham		(55490)	86	86	88	5	47	1997	82	6
	Rutland		(116580)	83	88	90	9	57	1995	90	0
Thames	London	•	202828	82	82	84	3	52	1990	87	-3
	Farmoor	•	13822	88	99	90	1	52	1990	97	-7
Southern	Bewl		31000	64	62	63	-1	33	2017	67	-4
	Ardingly		4685	60	81	100	26	14	2011	80	20
Wessex	Clatworthy		5662	55	94	100	21	16	2003	100	0
	Bristol	•	(38666)	62	81	89	19	27	1990	97	-7
South West	Colliford		28540	67	71	76	5	25	2022	67	9
	Roadford		34500	83	89	93	19	19	1995	62	30
	Wimbleball		21320	58	69	78	4	34	1995	100	-22
	Stithians		4967	51	58	67	-1	29	2001	89	-22
Welsh	Celyn & Brenig	•	131155	76	76	80	-7	50	1995	72	8
	Brianne		62140	100	100	100	4	72	1995	100	0
	Big Five	•	69762	70	77	81	-2	49	1990	86	-5
	Elan Valley	•	99106	71	78	90	-3	47	1995	99	-9
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	90	90	90	3	45	2003	98	-8
	East Lothian	•	9317	89	100	100	9	38	2003	100	0
Scotland(W)	Loch Katrine	•	110326	83	100	91	-1	65	2007	95	-4
	Daer		22494	84	91	91	-5	73	2003	85	6
	Loch Thom		10721	91	92	90	-4	72	2003	99	-9
Northern Ireland	Total+	•	56800	77	88	90	3	59	2003	99	-9
	Silent Valley	•	20634	83	100	99	15	43	2001	99	-1

( ) figures in parentheses relate to gross storage

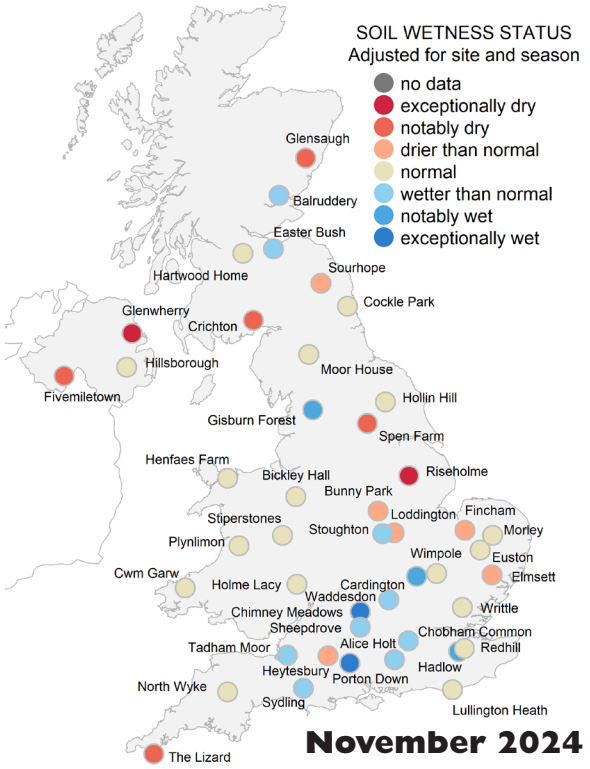
• denotes reservoir groups

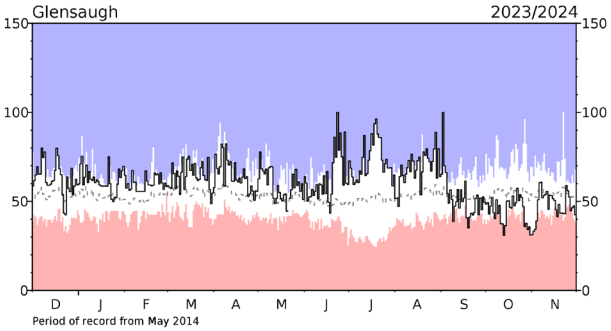
*last occurrence

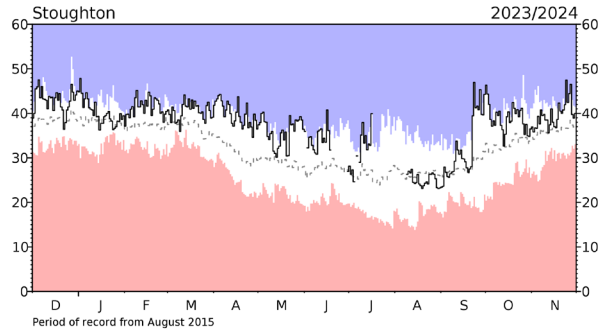
+ excludes Lough Neagh

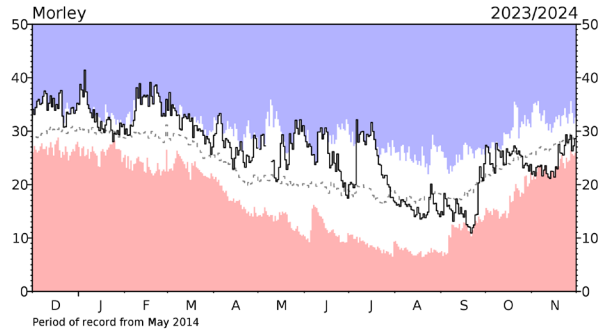
Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed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

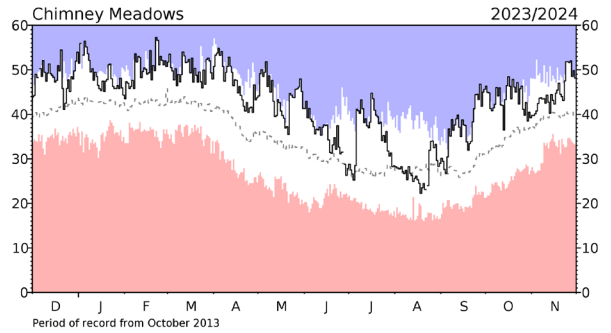
Soil Moisture . . . Soil Moisture

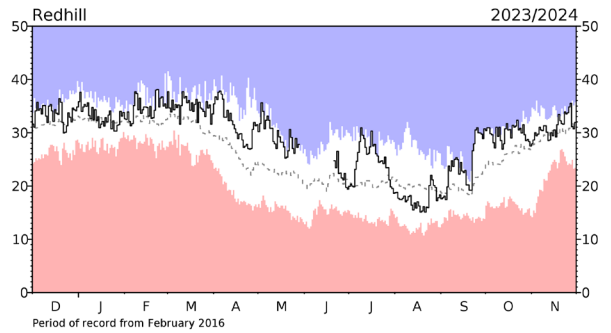












At the end of November soil moisture levels across the COSMOS-UK were higher than the previous month, generally within the normal to high range for the time of year. Wet weather late in the month caused localised increases in soil moisture, particularly at sites in central, southern, and eastern areas like Chimney Meadows, Porton Down, and Stoughton. However, the preceding drier weeks helped to mitigate against extremely wet soil moisture conditions, with many sites (such as Morley, Redhill, and Stiperstones) recording soil moisture within their normal range. Scotland had the least rainfall, and sites like Crichton and Glensaugh remain drier than normal.

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/Y006208/1 as part of the NC-UK 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.

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. These are provisional totals calculated from a sub set of Met Office registered gauges and will be subject to change once data from the complete network of Met Office registered gauges has been quality assured and gridded within the annual process of updating the HadUK-Grid dataset.

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

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