Hydrological Summary for the United Kingdom

December 2024

General

December was characterised by unsettled weather, with a succession of weather fronts delivering wind, rain, and snow. Notably, storm 'Darragh', the fourth named storm of the 2024/2025 season contributed to turbulent conditions. Rainfall totals for the month were above average for the UK, however, this concealed significant regional variability. River flows were normal or above normal, but exceptions were evident in south-west England and eastern Northern Ireland where some catchments recorded below normal flows. Soil moisture continued to increase and was normal or above normal, and groundwater levels in major aquifers were also predominantly normal or above normal for the time of year. However, in Northern Ireland, the Midland Valley area of Scotland, and South Wales, groundwater levels ranged from below normal to exceptionally low, reflecting the drier-than-usual conditions in these areas. Reservoir stocks saw a slight increase relative to average, and remained above average for the time of year, with only minor deficits persisting at isolated impoundments and for Wales as a whole. The combination of saturated soils in many regions, high groundwater levels and a three-month Outlook that favours normal to above normal river flows in the north and west, means flood risk will remain elevated.

Rainfall

December commenced with typical Atlantic-based weather, bringing rain and wintry showers to northern and western Britain. From the 6th to the 8th, these conditions intensified with storm 'Darragh', accompanied with the second red warning for wind in 2024. The associated low-pressure system and weather fronts brought widespread rainfall of 50-75mm over upland parts of Wales, with some areas, such as Capel Curig (Conwy), recording 100mm. 'Darragh' caused significant disruption, particularly around the coasts of Wales and south-west England, due to high winds and heavy rain and led to several fatalities, power outages affecting over 2.3 million customers, and widespread transport disruption. Following the storm, high-pressure brought calmer and colder conditions, but unsettled weather returned on the 15th, with prolonged rainfall in the north-west Highlands (e.g. 55mm recorded at Kinlochewe, Highland). Between the 17th and 22nd, windy and unsettled conditions persisted, leading to surface-water flooding in south Wales on the 18th. From the 23rd, there was widespread fog, drizzle, and rain, with some particularly unsettled conditions and outbreaks of rain in western Scotland (e.g. 69mm recorded at Achnagart, Highland on the 30th) and on New Year's Eve, a slow-moving band of heavy rain affected north-west Britain. This led to further travel disruption, with rail services cancelled in western Scotland, and high winds causing the cancellation of Edinburgh's Hogmanay celebrations. Total rainfall for the UK was above average (110%), with a mixed spatial pattern. Northern Scotland recorded above average rainfall, with the Highland region experiencing its fifth wettest December (in a series since 1890). Northern and central England also saw above average rainfall. Conversely, below normal rainfall was recorded in Northern Ireland, the Borders, south Wales, and southern England. December concluded a wetter-than-average year for some regions, with Thames and Severn Trent registering their third and fifth wettest years, respectively, in records from 1890.

River Flows

Following an unsettled end to November in southern Britain, December commenced with above average flows in this region, although recessions started or continued during the first week. In northern Britain, river flows began the month below normal. Unsettled weather prompted significant flow responses during storm 'Darragh'. The Yorkshire Dove recorded its highest peak flow of any month (more than doubling the previous record from January 2021; in a series from 1972), whilst the Yscir recorded its second highest December peak flow on the 7th (in a series since 1973). The Wye flooded houses and businesses in Builth Wells (Powys). A brief period of high-pressure allowed recessions to recommence, until unsettled weather led to further significant flows and multiple peaks, particularly in north Wales and north-western England. On New Year's Eve, due to persistent heavy rain, the Conwy, Dee and Ribble all recorded their second highest December peak flows (in series of at least 55 years), and flooding across Greater Manchester, led to evacuations in Stockport and Didsbury. Mean December flows showed a varied picture, with above normal flows in Wales, northern Scotland, and central and southern England. The Carron and Oykel recorded their highest mean December flows (in series of at least 47 years). Conversely, flows in northern England and the Borders were generally normal, whilst in south-west England and eastern Northern Ireland, December mean flows were normal or below normal (e.g. the Annacloy recorded less than two-thirds of the December average). The mean flows for 2024 (January-December) highlight the notably wet year, particularly in southern Britain. Much of central and southern England registered exceptionally high flows, and new records were established for January-December in many catchments, such as the Warwickshire Avon, Coln and Trent (all with records of at least 60 years, and the Avon's since 1937). Correspondingly, 2024 outflows for the English Lowlands were the highest on record, whilst Great Britain saw its third highest outflows (both in series since 1961).

Soil Moisture and Groundwater

Soil moisture levels across the UK continued to increase and at month-end were generally within the normal range or wetter. Recharge was observed across most Chalk sites in England in early to mid-December following storm 'Darragh'. However, by the end of the month, groundwater levels generally receded to, or remained at normal or above normal levels. Despite late recharge in the Chalk at Killyglen in Northern Ireland, groundwater levels remained exceptionally low for December. In the Jurassic limestones, groundwater levels rose to above normal at New Red Lion, while at Ampney Crucis, levels receded to normal. Levels rose in the Magnesian Limestone at Brick House Farm, remaining exceptionally high, but were largely stable at Aycliffe. Levels in the Carboniferous Limestone continued to fall, with below-normal levels observed at Greenfield Garage and Pant y Lladron. Levels at Alstonfield remained stable, though still above normal for December. In the Permo-Triassic Sandstones, levels continued to rise at Llanfair D.C. and Weir Farm, where a new end-of-December maximum was recorded (in a series from 1982). At Bussels No. 7A and Skirwith, levels remained stable, ranging from normal to above normal. Exceptionally high levels persisted at Lime Kiln Way in the Upper Greensand. In the Carboniferous Sandstone at Royalty Observatory, groundwater levels rose and remained above normal. At Easter Lathrisk in the Devonian Sandstone, levels remained stable, although they were notably low for this time of year.

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.

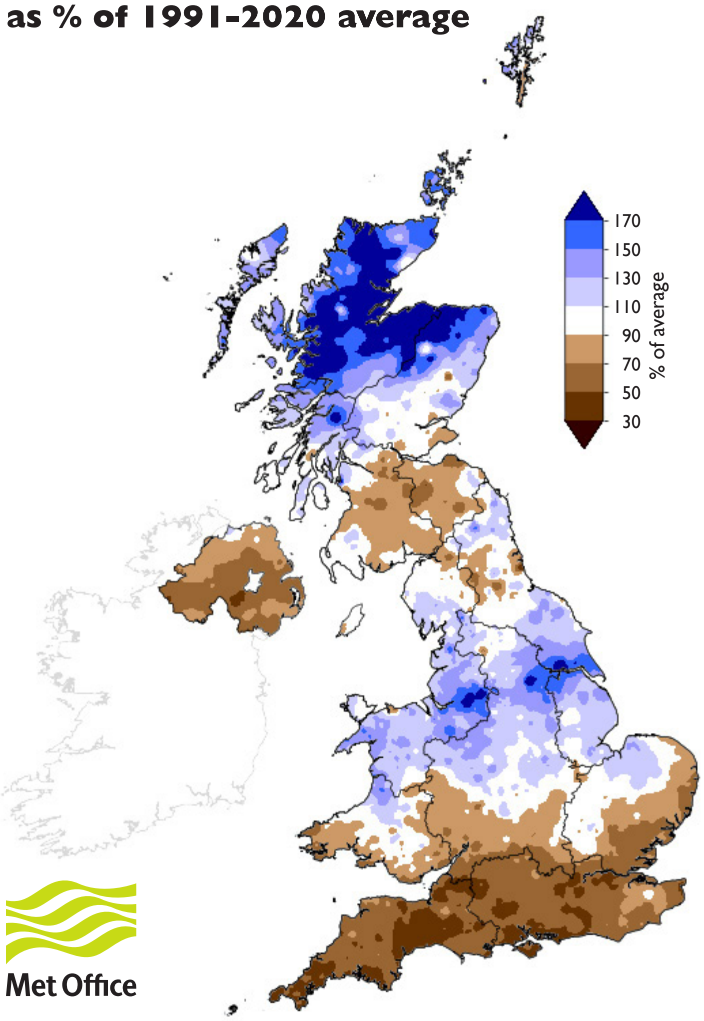
Region	Rainfall	Dec 24	Oct24 – Dec24	RP	Jul24 – Dec24	RP	Apr24 – Dec24	RP	Jan24 – Dec24	RP
United	mm	**139**	327		627		876		1241	
Kingdom	%	**110**	88	2-5	98	2-5	102	2-5	107	8-12
England	mm	**82**	249		507		711		1020	
	%	**89**	91	2-5	105	2-5	107	2-5	117	20-30
Scotland	mm	**232**	438		798		1121		1548	
	%	**133**	86	2-5	93	2-5	99	2-5	98	2-5
Wales	mm	**187**	448		795		1074		1600	
	%	**107**	90	2-5	97	2-5	99	2-5	109	5-10
Northern	mm	**84**	252		528		740		1040	
Ireland	%	**69**	70	8-12	83	5-10	86	5-10	90	2-5
England &	mm	**97**	276		547		760		1099	
Wales	%	**93**	91	2-5	103	2-5	106	2-5	116	15-25
North West	mm	**173**	385		747		1080		1507	
	%	**119**	93	2-5	102	2-5	112	5-10	117	20-35
Northumbria	mm	**90**	239		469		711		955	
	%	**98**	87	2-5	93	2-5	102	2-5	105	2-5
Severn-Trent	mm	**91**	248		501		690		970	
	%	**111**	103	2-5	114	5-10	111	5-10	121	20-30
Yorkshire	mm	**108**	231		453		678		954	
	%	**120**	88	2-5	95	2-5	102	2-5	110	5-10
Anglian	mm	**56**	164		356		511		714	
	%	**97**	89	2-5	101	2-5	103	2-5	113	5-10
Thames	mm	**49**	206		486		652		939	
	%	**67**	89	2-5	121	5-10	117	5-10	128	30-50
Southern	mm	**56**	234		488		650		984	
	%	**59**	82	2-5	105	2-5	105	2-5	119	10-20
Wessex	mm	**53**	281		588		778		1159	
	%	**53**	92	2-5	116	5-10	113	5-10	127	40-60
South West	mm	**81**	372		673		905		1427	
	%	**53**	85	2-5	96	2-5	98	2-5	113	10-20
Welsh	mm	**176**	434		775		1046		1558	
	%	**105**	91	2-5	98	2-5	100	2-5	111	8-12
Highland	mm	**354**	615		1023		1360		1871	
	%	**167**	103	2-5	104	2-5	105	2-5	101	2-5
North East	mm	**164**	295		554		827		1119	
	%	**160**	88	2-5	94	2-5	102	2-5	105	5-10
Tay	mm	**168**	327		592		891		1271	
	%	**113**	73	5-10	78	5-10	89	2-5	91	2-5
Forth	mm	**130**	264		537		866		1215	
	%	**98**	68	5-10	80	5-10	96	2-5	98	2-5
Tweed	mm	**93**	240		492		798		1106	
	%	**80**	70	5-10	82	2-5	98	2-5	102	2-5
Solway	mm	**158**	354		755		1125		1563	
	%	**89**	68	5-10	86	2-5	97	2-5	99	2-5
Clyde	mm	**240**	459		912		1273		1750	
	%	**112**	75	2-5	88	2-5	94	2-5	92	2-5

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

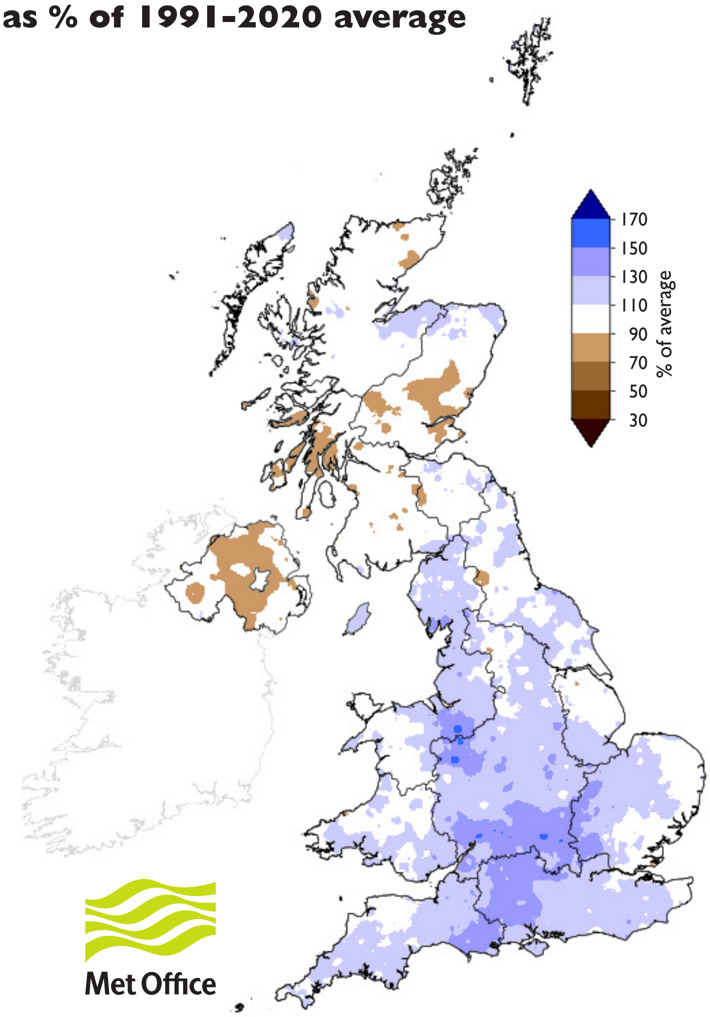
Important note: Figures in the above table may be quoted provided their source is acknowledged. Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability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

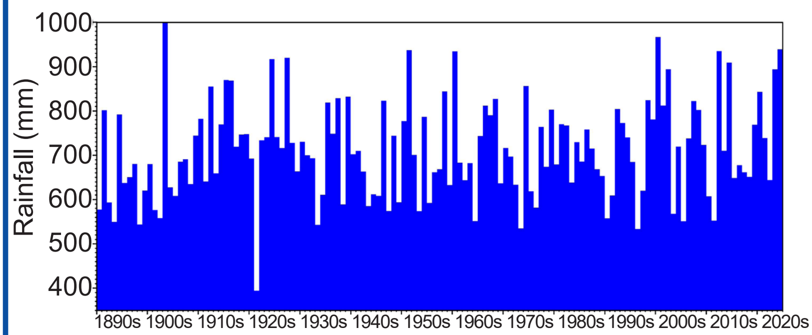
December 2024 rainfall as % of 1991-2020 average



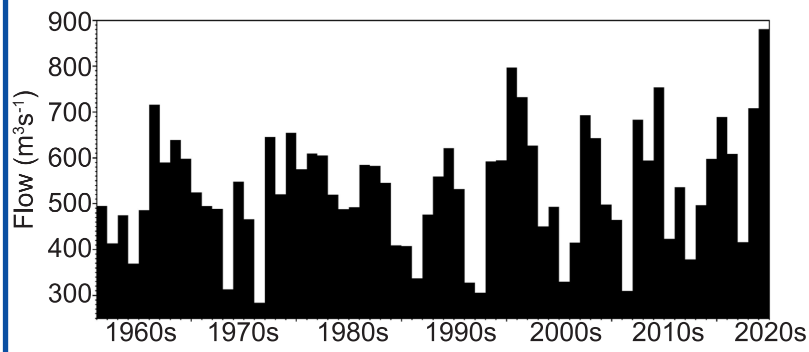
January 2024 - December 2024 rainfall as % of 1991-2020 average



January-December rainfall for Thames region



January-December outflows for the English Lowlands



UK Hydrological Outlook

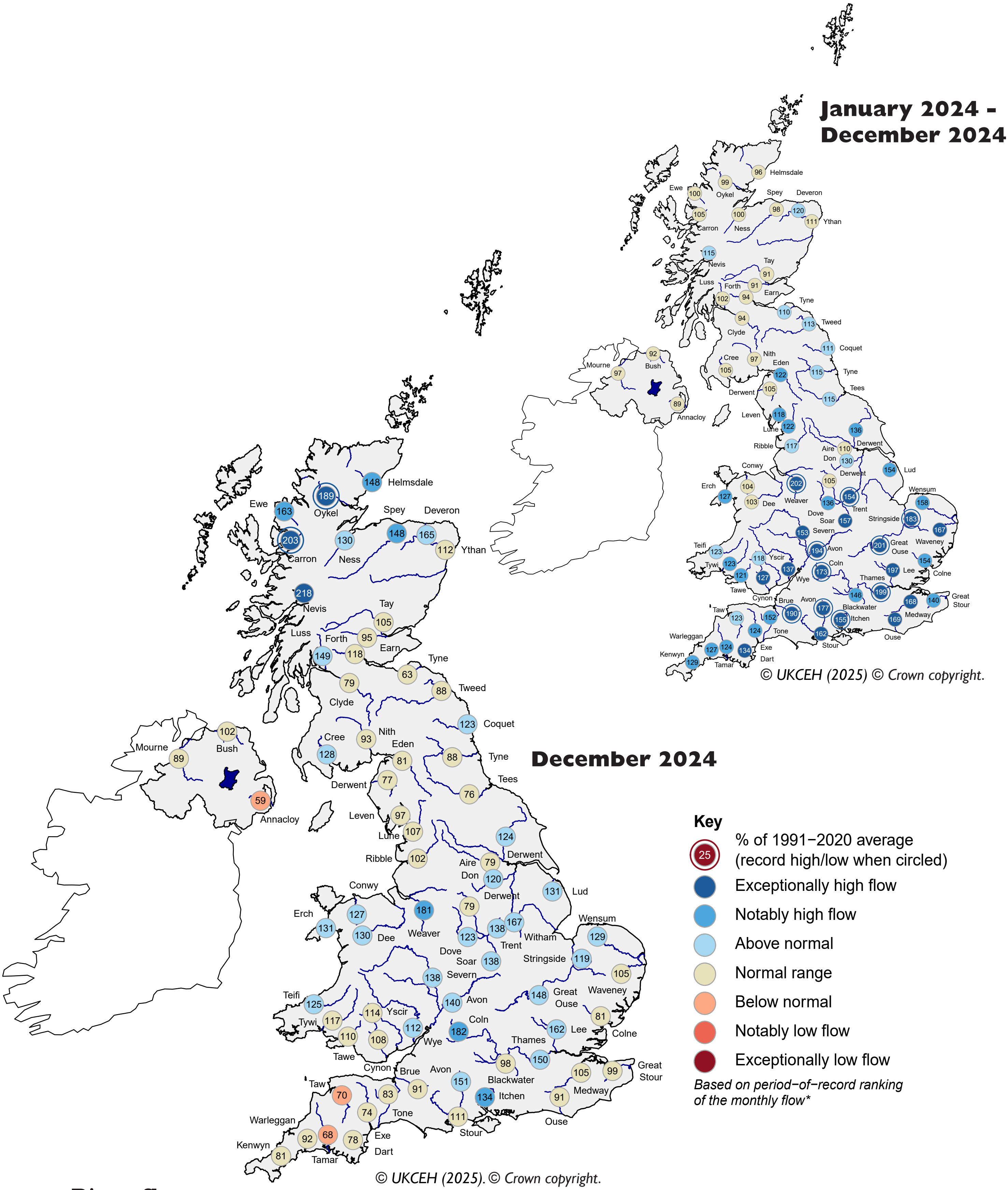
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from January 2025**
Issued: **10.01.2025**
using data to the end of December 2024

The river flow outlook for January favours normal flows across the UK, although above normal flows may persist in parts of central and southern England that have seen the highest rainfall in recent weeks. In contrast, January-March outlook favours wetter conditions that are more likely to manifest themselves in normal to above normal flows in the north and west, with normal flows most likely elsewhere. While groundwater is a more mixed picture (reflecting both recent rainfall patterns and aquifer properties), normal to above normal levels are expected across the UK over the January-March period.

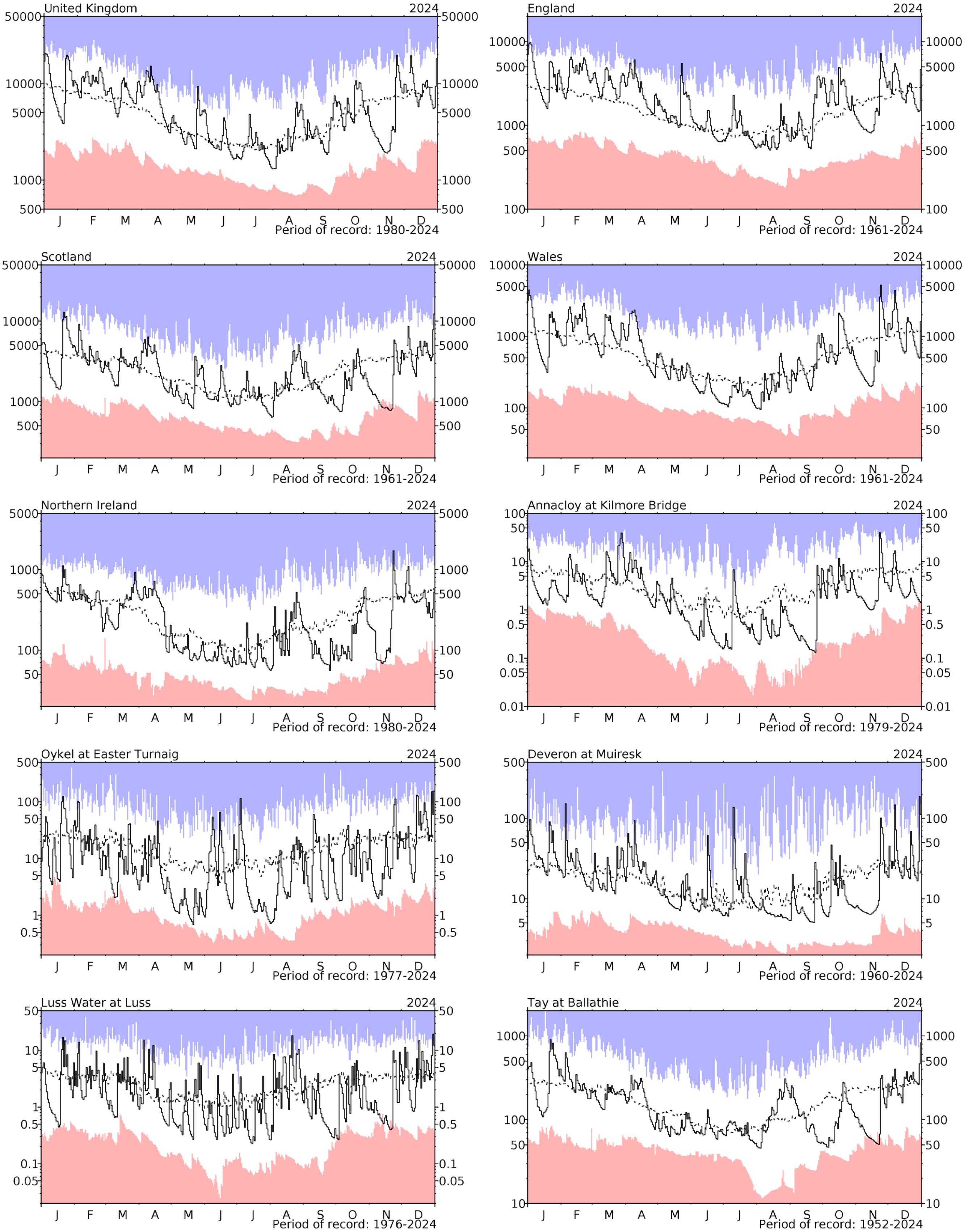
River flow . . . River flow . . .



River flows

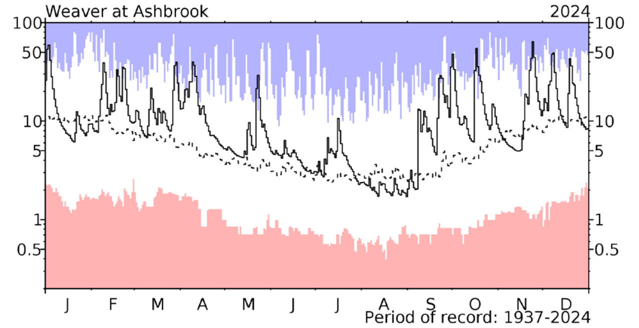
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

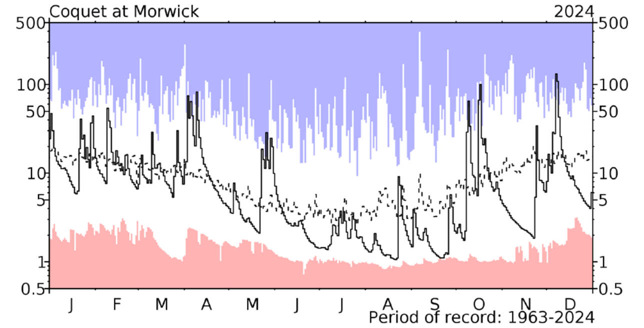
River flow . . . River flow . . .

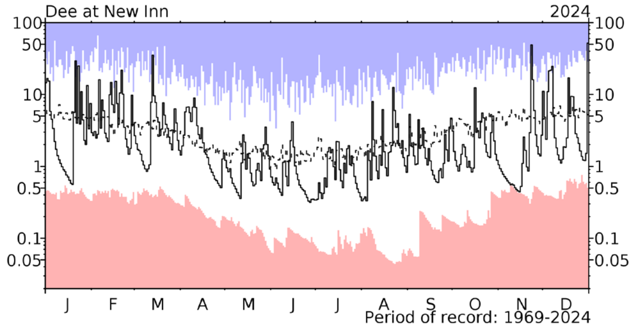


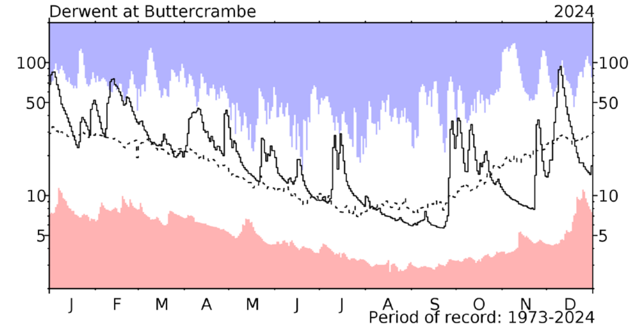
River flow hydrographs

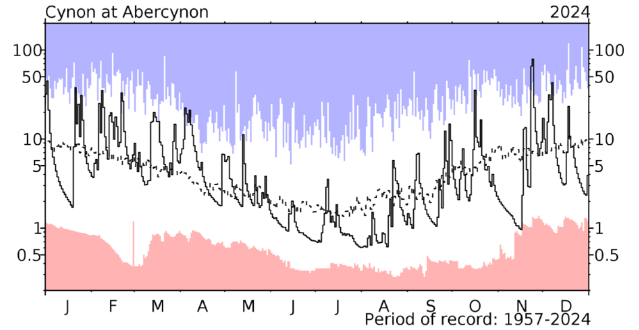
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to August 2023 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

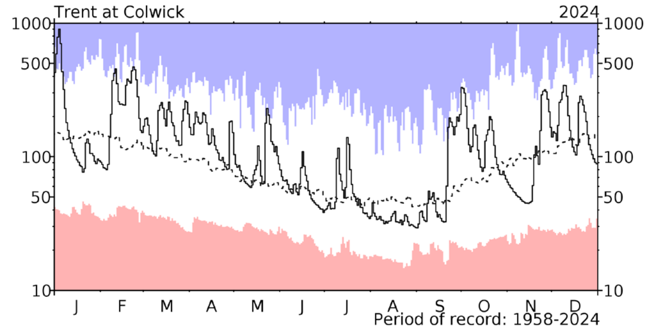

Weaver at Ashbrook
2024
J F M A M J J A S O N D
Period of record: 1937-2024

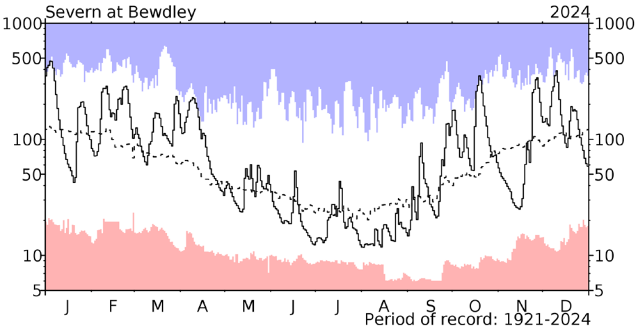

Coquet at Morwick
2024
J F M A M J J A S O N D
Period of record: 1963-2024

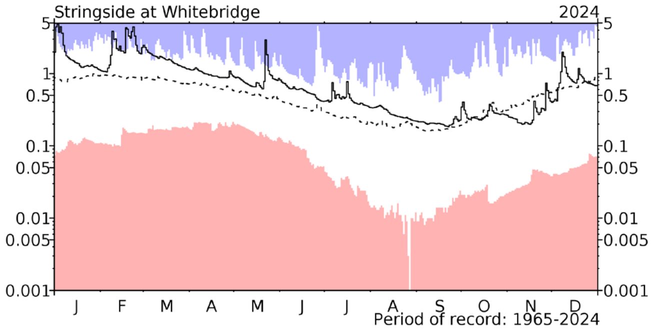

Dee at New Inn
2024
J F M A M J J A S O N D
Period of record: 1969-2024

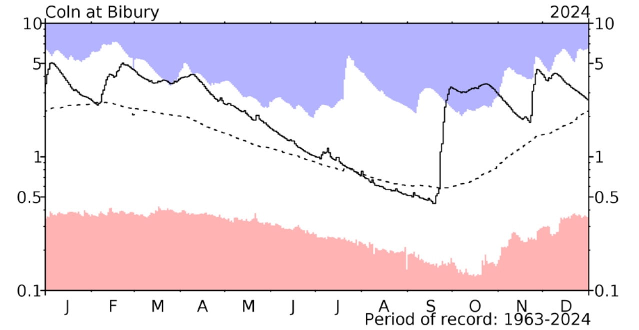

Derwent at Buttercrambe
2024
J F M A M J J A S O N D
Period of record: 1973-2024

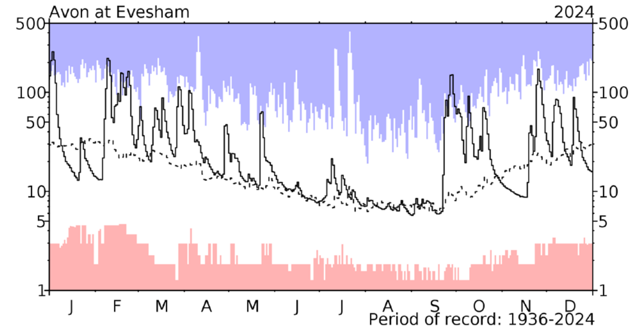

Cynon at Abercynon
2024
J F M A M J J A S O N D
Period of record: 1957-2024

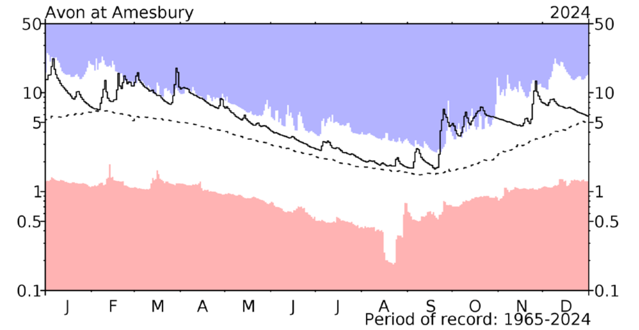

Trent at Colwick
2024
J F M A M J J A S O N D
Period of record: 1958-2024

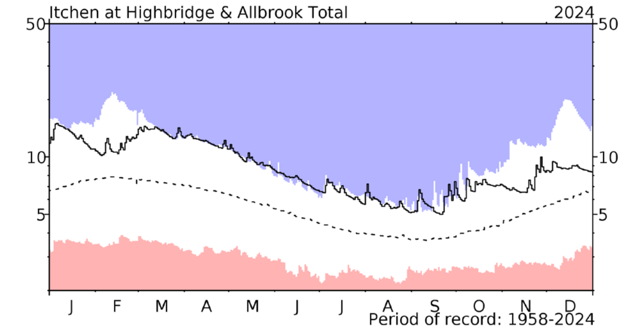

Severn at Bewdley
2024
J F M A M J J A S O N D
Period of record: 1921-2024


Stringside at Whitebridge
2024
J F M A M J J A S O N D
Period of record: 1965-2024

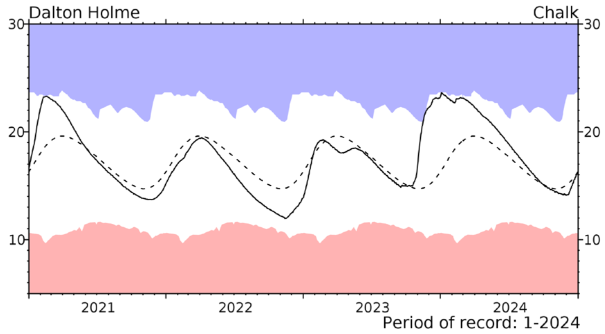

Coln at Bibury
2024
J F M A M J J A S O N D
Period of record: 1963-2024

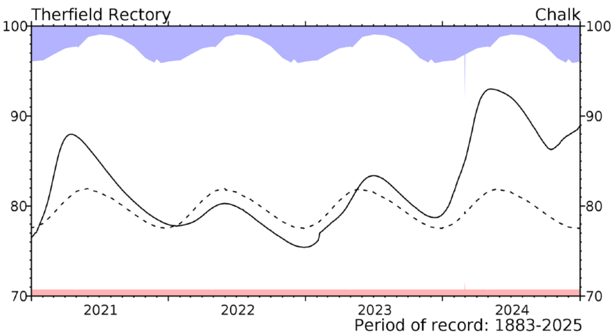

Avon at Evesham
2024
J F M A M J J A S O N D
Period of record: 1936-2024

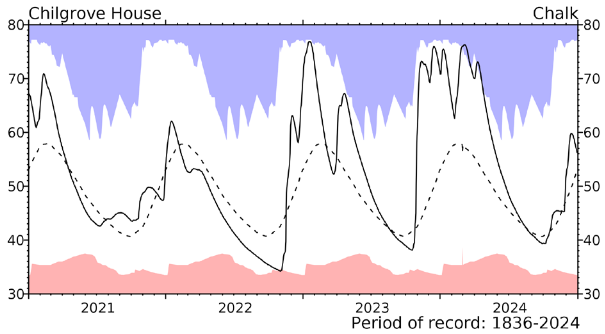

Avon at Amesbury
2024
J F M A M J J A S O N D
Period of record: 1965-2024

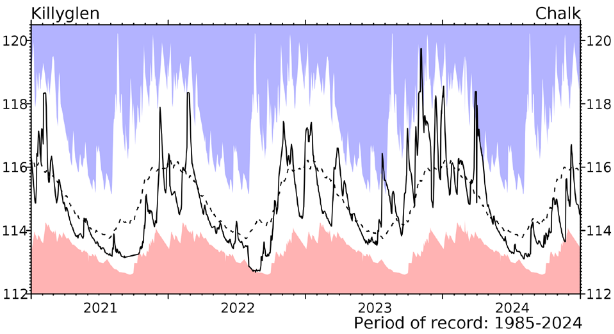

Itchen at Highbridge & Allbrook Total
2024
J F M A M J J A S O N D
Period of record: 1958-2024

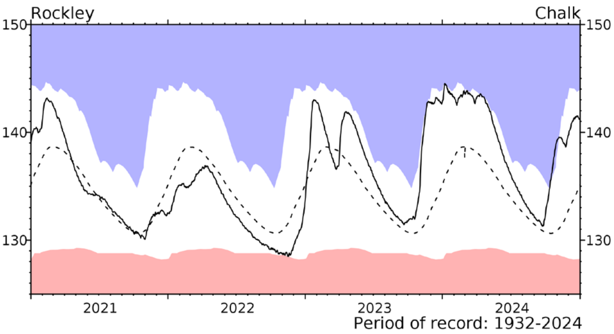
Groundwater . . . Groundwater

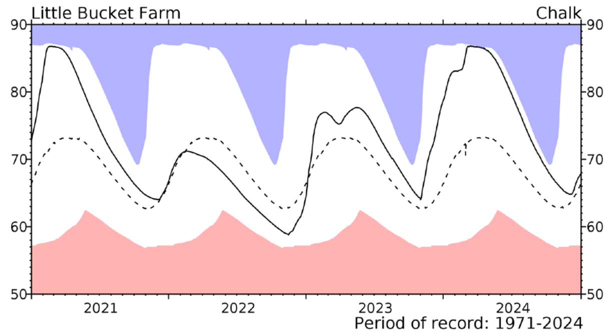


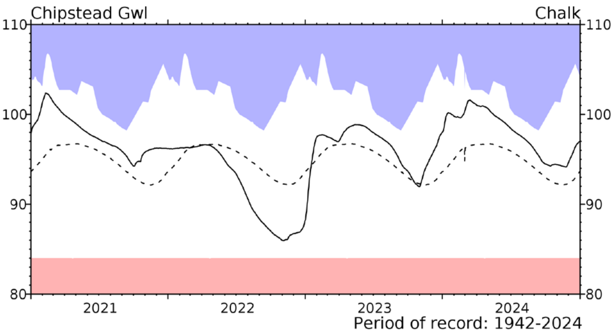


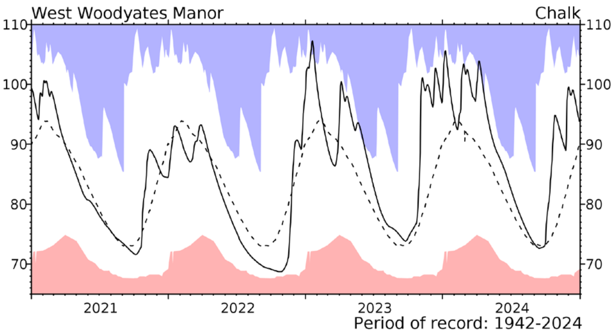


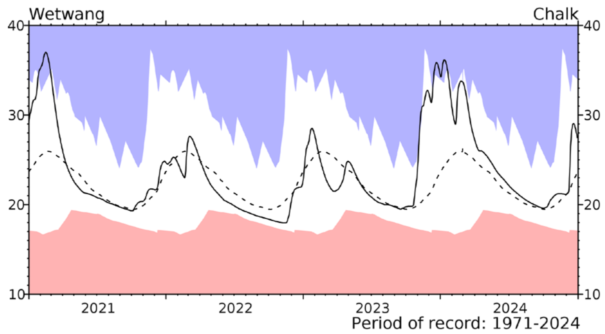


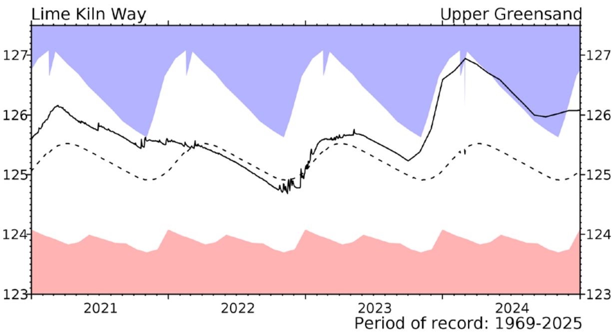






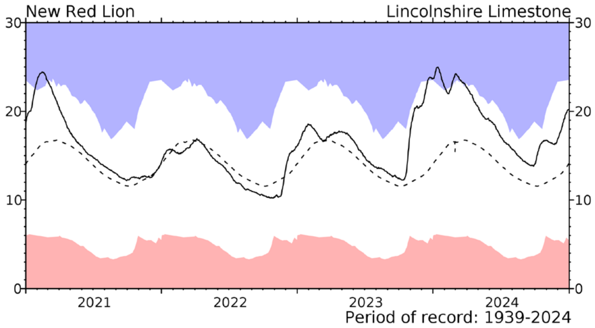


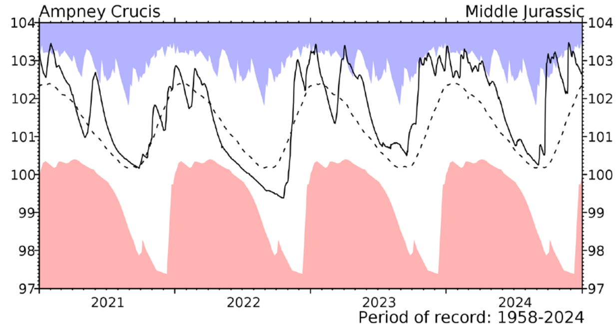


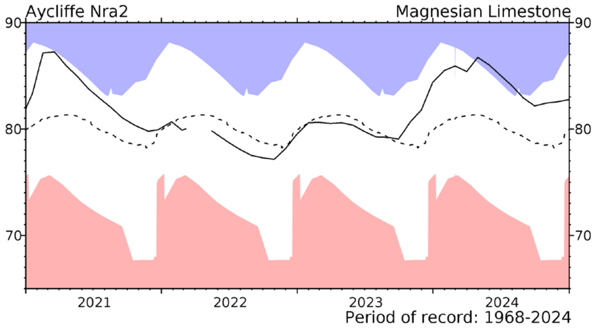


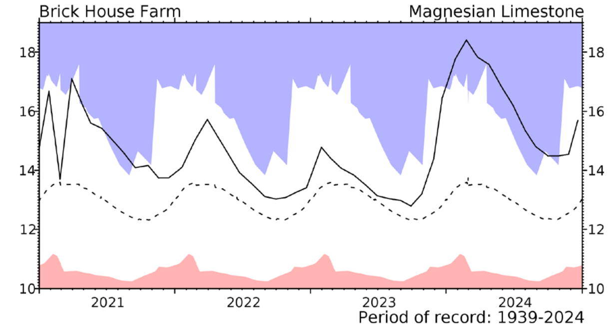
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

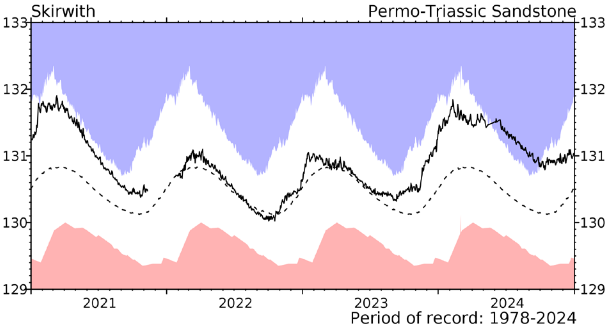
Groundwater . . . Groundwater

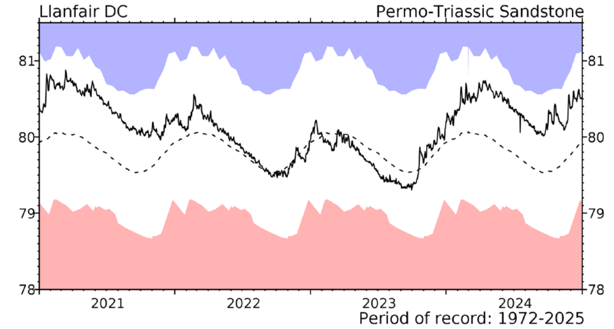


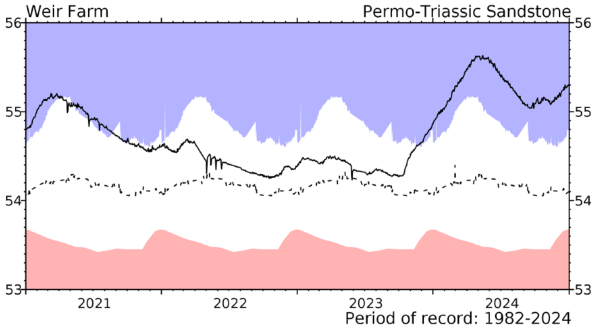


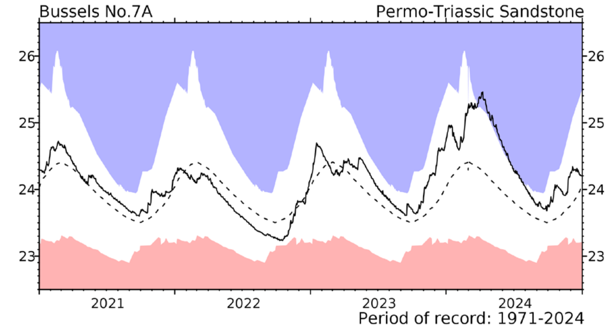


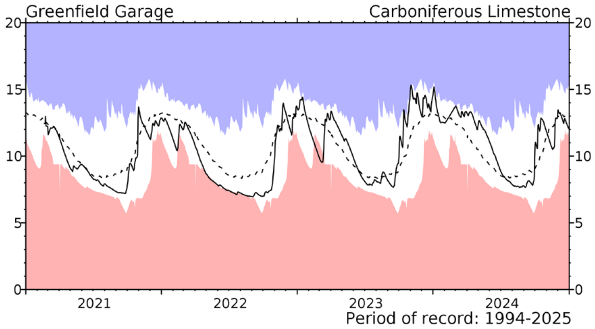


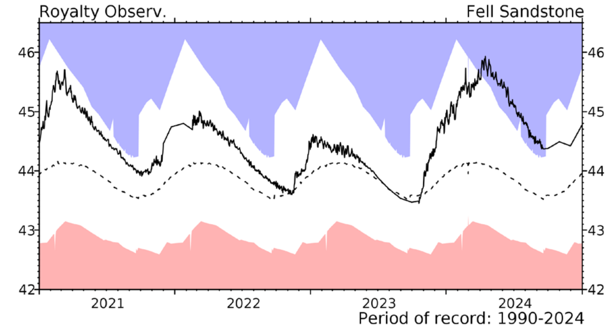


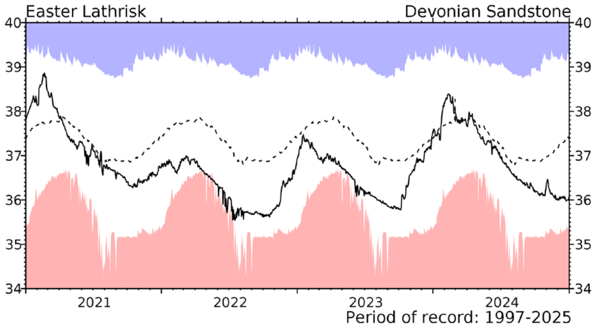


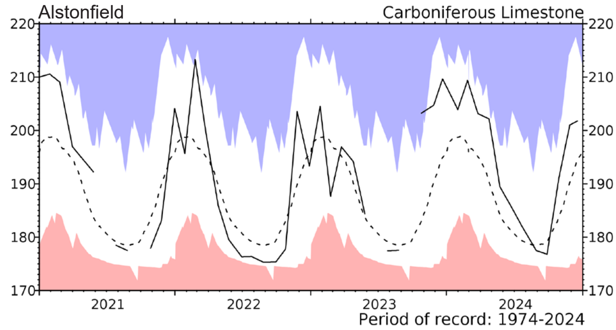




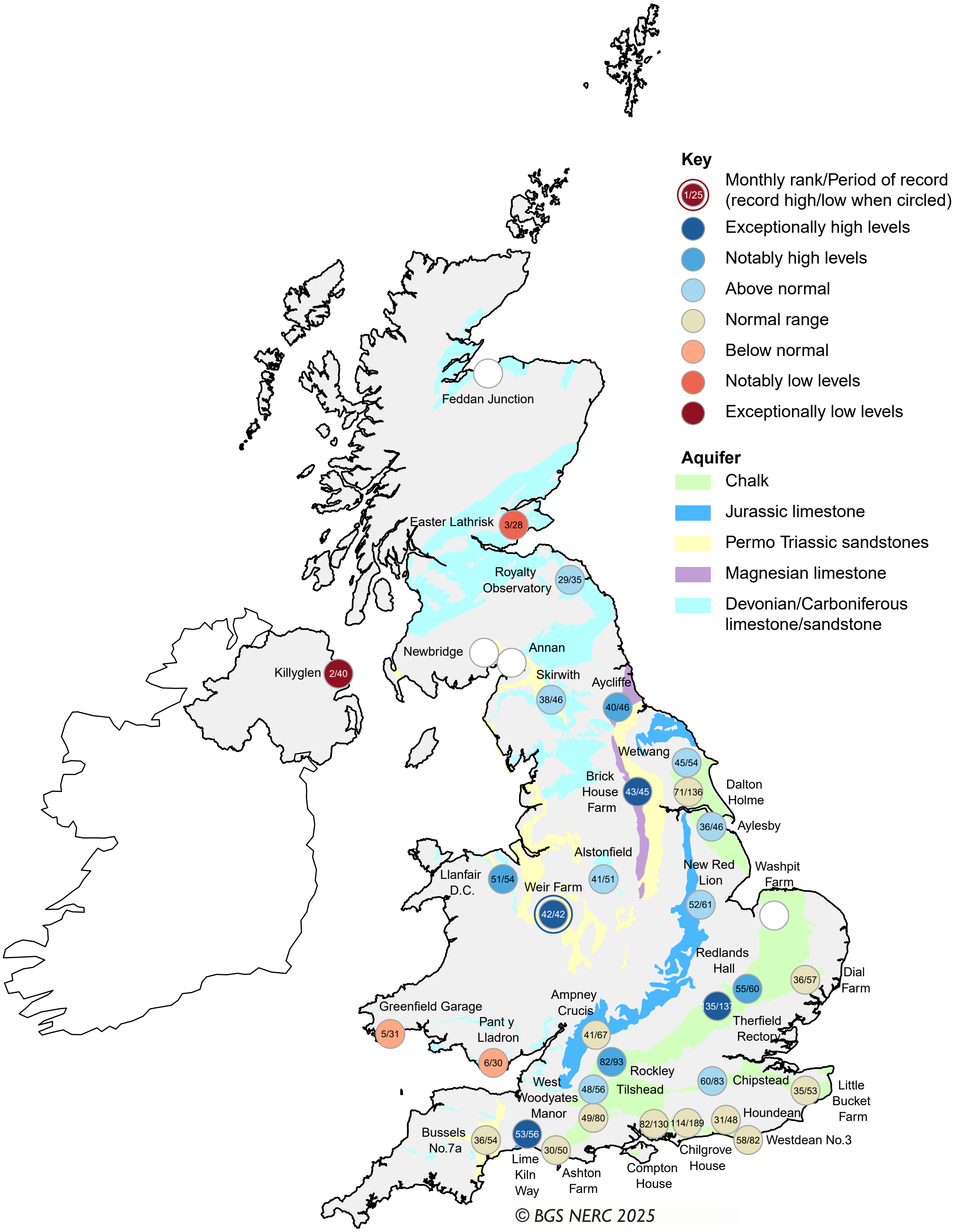








Groundwater . . . Groundwater

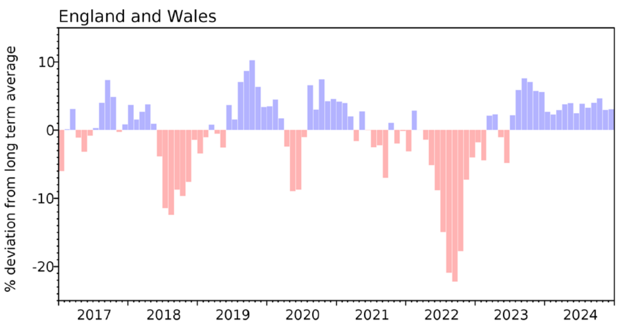


Groundwater levels - December 2024

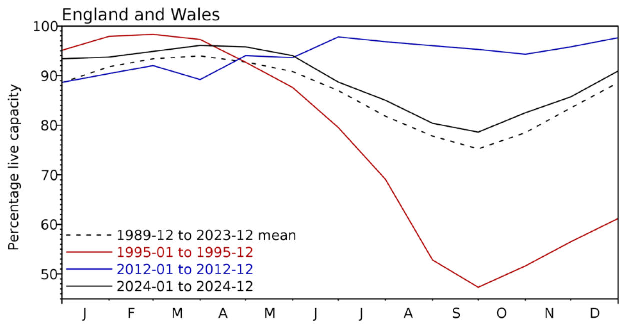
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

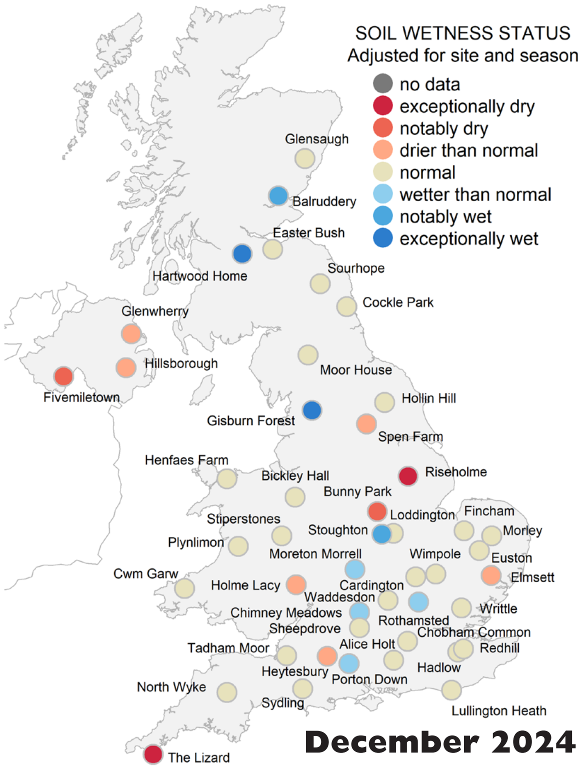
Area	Reservoir		Capacity (Ml)	2024 Oct	2024 Nov	2024 Dec	Dec Anom.	Min Dec	Year* of min	2023 Dec	Diff 24-23
North West	N Command Zone	•	124929	80	79	85	-2	51	1995	100	-15
	Vyrnwy		55146	87	92	98	6	35	1995	100	-2
Northumbrian	Teesdale	•	87936	100	99	100	9	41	1995	100	0
	Kielder		(199175)	82	85	89	-2	70	1989	99	-10
Severn-Trent	Clywedog		49936	83	90	86	1	54	1995	100	-14
	Derwent Valley	•	46692	76	78	95	4	10	1995	100	-5
Yorkshire	Washburn	•	23373	81	82	92	5	23	1995	89	3
	Bradford Supply	•	40942	81	84	92	1	22	1995	100	-8
Anglian	Grafham		(55490)	86	88	91	8	57	1997	82	10
	Rutland		(116580)	88	90	92	9	60	1990	92	0
Thames	London	•	202828	82	84	95	8	60	1990	89	6
	Farmoor	•	13822	99	90	97	7	71	1990	85	12
Southern	Bewl		31000	62	63	68	-4	34	2005	66	2
	Ardingly		4685	81	100	100	14	30	2011	100	0
Wessex	Clatworthy		5662	94	100	100	8	54	2003	100	0
	Bristol	•	(38666)	81	89	93	12	40	1990	100	-7
South West	Colliford		28540	71	76	79	2	35	2022	73	6
	Roadford		34500	89	93	95	17	20	1989	82	13
	Wimbleball		21320	69	78	87	4	46	1995	100	-13
	Stithians		4967	58	67	75	-5	33	2001	100	-25
Welsh	Celyn & Brenig	•	131155	76	80	82	-11	54	1995	80	2
	Brianne		62140	100	100	100	2	76	1995	100	0
	Big Five	•	69762	77	81	86	-4	67	1995	98	-12
	Elan Valley	•	99106	78	90	100	3	56	1995	100	0
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	90	90	93	1	60	1998	98	-5
	East Lothian	•	9317	100	100	96	-1	48	1989	100	-4
Scotland(W)	Loch Katrine	•	110326	100	91	100	8	75	2007	99	1
	Daer		22494	91	91	84	-13	83	1995	86	-2
	Loch Thom		10721	92	90	100	3	80	2007	100	0
Northern Ireland	Total+	•	56800	88	90	90	1	61	2001	100	-9
	Silent Valley	•	20634	100	99	94	6	39	2001	100	-6

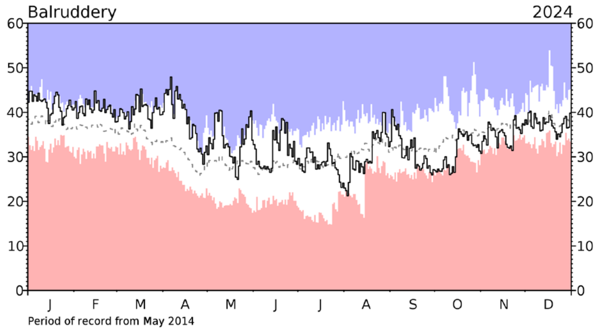
( ) figures in parentheses relate to gross storage • denotes reservoir groups *last occurrence

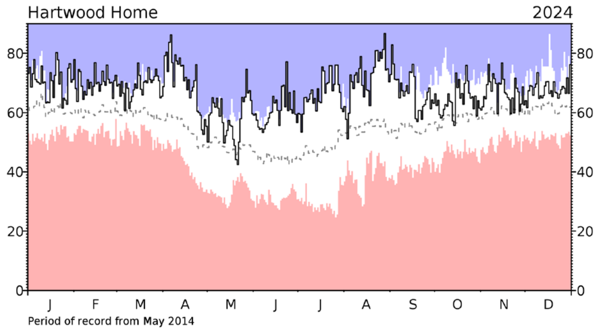
+ excludes Lough Neagh

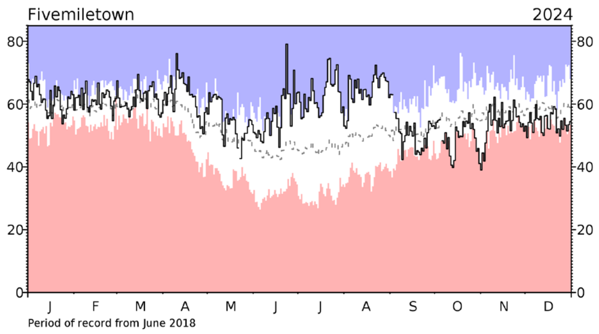
Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed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

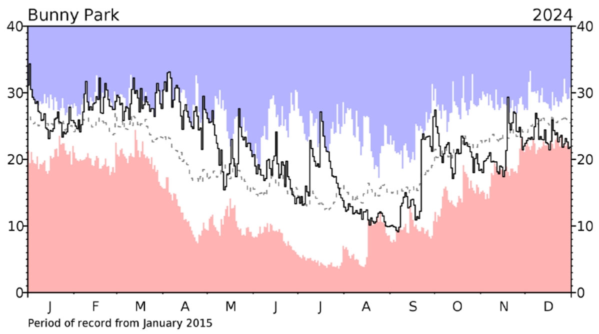
Soil Moisture . . . Soil Moisture

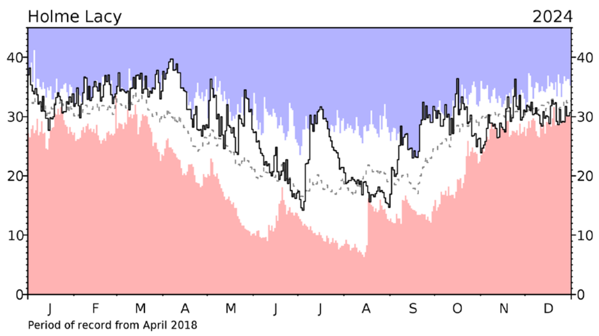












Soil moisture levels across the COSMOS-UK network were largely stable through the month, with wet conditions persisting through the winter months due to the frequent rainfall and limited evaporation. The majority of sites reported soil moisture within expected ranges for this time of year, with regional variations reflecting local precipitation patterns and soil characteristics. In Scotland, sustained rainfall led to high soil moisture levels at some sites (e.g. Balruddery, Hartwood Home). In central and southern England and Northern Ireland, relatively low rainfall rates means that some sites saw a decrease in soil moisture levels through the month (e.g. Bunny Park, Fivemiletown, Holme Lacy).

Overall, relatively frequent precipitation throughout the month has maintained soil moisture levels within typical seasonal ranges across much of the UK, though with regional variations leading to steady decreases in soil moisture at some sites.

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