Hydrological Summary

for the United Kingdom

October 2024

General

October was warmer than average and drier than average at the national scale (with 84% of the typical October rainfall), in stark contrast to the exceptionally wet September seen across much of England. Nevertheless, while October saw some settled spells, a series of frontal incursions from the Atlantic (including the first named storm of the season, 'Ashley'), brought strong winds and heavy rainfall to many areas, with thundery downpours early in the month causing surface water flooding. With levels in many rivers in central and southern England already elevated following the September rainfall, fluvial flood alerts were also widespread, although impacts were limited. While peak flows were modest, October river flows were above normal across much of the English Lowlands, and groundwater levels were above normal across the main aquifer areas. Reservoir stocks increased in October and remained appreciably above average at the national scale (aside from slightly below average stocks in some Welsh impoundments). In general, the water resources situation is very healthy, although river flow deficits persist in northern Scotland, warranting ongoing vigilance. The latest Hydrological Outlook indicates a continuing contrast between normal to below normal flows in the northwest, and normal to above normal flows in the southeast, while normal to above normal groundwater levels are favoured across the UK. Early November has been very dry, however, ameliorating concerns over elevated late autumn flood risk in the south.

Rainfall

While the 1st saw heavy rainfall across eastern England, the first week of October was generally settled, under the influence of high pressure. From the 6th-9th a major Atlantic low pressure system traversed eastwards across the UK, bringing heavy rainfall and thunderstorms. Surface water flooding was reported in many areas, with localised transport disruption (e.g. in Cornwall on the 7th, and the north-east on the 9th). After a brief settled interlude, slow-moving fronts again brought heavy rainfall and associated disruption on the 15th/16th to western areas, especially around the Welsh Borders (64mm registered at Pennerly, Shropshire, on the 16th). Arriving on the 18th-20th, storm 'Ashley' was primarily notable for wind damage and coastal impacts and was unexceptional in terms of rainfall. On the 26th/27th there were downpours in north-west Britain (e.g. 74mm on the 27th at Ulpha, Cumbria). Despite the various frontal incursions, for October as a whole, Scotland, Northern Ireland and Wales were relatively dry (72%, 71% and 80% of average, respectively). England received average rainfall (101%), but with above average rainfall totals concentrated in the west (e.g. Wessex region received 124% of average) and north-east (e.g. Northumbria registered 126%). Exceptionally high two-month rainfall accumulations across much of England mainly reflect the September rainfall and again, show a remarkable contrast with the dry north and west. Accumulations over the last six months show a similar, albeit less pronounced, contrast between above average rainfall across central southern Britain, and minor deficits in northern and western areas.

River Flows

Entering October, flows in many rivers in England were elevated following the remarkably wet September – especially in the English Lowlands, where the month began with widespread fluvial flood warnings. On the 1st, the Thames registered its third highest October flow (in an exceptionally long record from 1883). In Scotland, by contrast, recessions established in September continued into early October. Mid-month, the repeated frontal incursions triggered rapid flow responses, with associated flood alerts across many areas of the UK. From the 17th-19th there were >150 flood alerts across the country, with fluvial flood warnings across western England, particularly in the Welsh borders. On the 17th, the Teme registered its third highest October peak flow (in a record from 1970) while on the 19th the Severn registered its fifth highest in a record extending back to 1927. The latter half of the month was generally more quiescent, with a majority of index rivers in recession entering November. October monthly mean flows demonstrated a marked spatial contrast: flows were below normal across most of Scotland and above normal in southern, central and north-east England, notably so in some catchments (e.g. with four times the typical October flow for the Thames and the Stour). New October maxima were registered in some primarily groundwater-fed catchments in Wessex (the Avon, Stour and Coln, all in records exceeding 50 years in length) and October outflows for the English Lowlands were the highest on record (since 1961). Two-month averages show a very similar pattern, albeit with exceptional flow deficits in north-west Scotland. Accumulations over the last 6-9 months confirm the exceptional river flows seen across southern England through 2024 to date.

Soil Moisture and Groundwater

Soil moisture levels generally declined in October, following the September wetness, and were largely in the normal range or drier than average – although above average soil moisture persisted in some areas of central southern England. Recharge was observed across most of the Chalk sites in southern England, with levels spanning the normal range to exceptionally high across the Chalk aquifer. Notably, new record highs for the end of October were established at Ashton Farm, Rockley and Stonor Park. In the Jurassic limestones, groundwater levels remained notably high, continuing to rise at New Red Lion, while at Ampney Crucis, levels were receding. In the Magnesian Limestone, levels were relatively stable and remained exceptionally high, with a new end of October maximum recorded at Brick House Farm (in a record from 1979). Groundwater levels rose in the Carboniferous Limestone of south Wales, particularly at Pant y Lladron, becoming notably high. At Alstonfield, the level increased into the above normal range. In the Permo Triassic Sandstones, levels remained above average, with some recharge observed at Llanfair D.C., Weir Farm and Bussels No.7a, and a new end of October maximum was recorded at Weir Farm. Levels were relatively stable at Skirwith. A record high for the end of October was also recorded at Lime Kiln Way in the Upper Greensand (in a 55-year series). In the Fell Sandstone at Royalty Observatory, levels fell but remained exceptionally high. Groundwater levels were within the normal range in the Devonian sandstones at both Feddan Junction and 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.

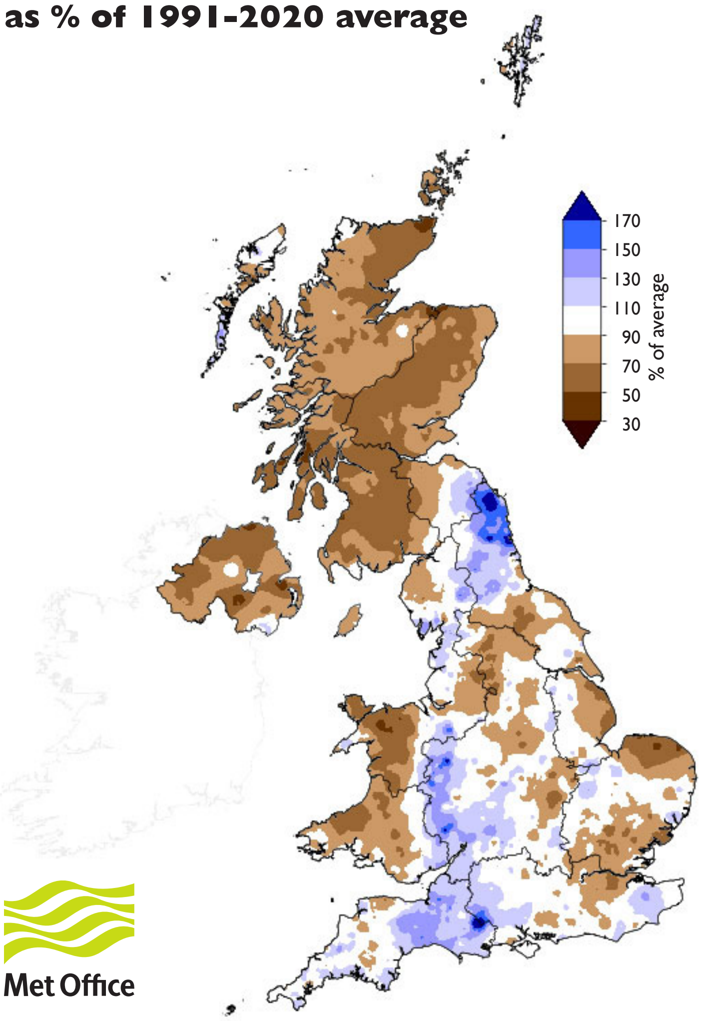
Region	Rainfall	Oct 2024	Sep24 – Oct24	RP	May24 – Oct24	RP	Feb24 – Oct24	RP	Nov23 – Oct24	RP
United	mm	**104**	217		541		900		1325	
Kingdom	%	**84**	102	2-5	101	2-5	114	15-25	114	25-40
England	mm	**91**	224		468		777		1118	
	%	**101**	141	10-15	111	2-5	129	30-50	129	>100
Scotland	mm	**122**	200		656		1067		1600	
	%	**72**	69	5-10	94	2-5	101	2-5	102	5-10
Wales	mm	**126**	281		616		1116		1711	
	%	**80**	104	2-5	93	2-5	115	8-12	117	15-25
Northern	mm	**81**	153		465		783		1131	
Ireland	%	**71**	76	2-5	85	2-5	98	2-5	98	2-5
England &	mm	**96**	232		488		823		1199	
Wales	%	**97**	133	5-10	107	2-5	126	25-40	126	70-100
North West	mm	**128**	257		683		1087		1640	
	%	**96**	106	2-5	112	2-5	124	20-30	128	70-100
Northumbria	mm	**110**	196		477		728		1085	
	%	**126**	123	2-5	107	2-5	114	5-10	119	20-35
Severn-Trent	mm	**83**	234		448		739		1033	
	%	**102**	161	20-30	110	2-5	129	30-50	129	60-90
Yorkshire	mm	**72**	190		424		696		1063	
	%	**86**	123	5-10	99	2-5	113	5-10	122	25-40
Anglian	mm	**56**	157		346		556		768	
	%	**87**	134	5-10	103	2-5	121	10-15	122	20-30
Thames	mm	**74**	239		448		739		1009	
	%	**95**	178	25-40	126	5-10	146	70-100	138	>100
Southern	mm	**95**	240		433		764		1107	
	%	**101**	153	10-15	115	2-5	141	30-50	135	50-80
Wessex	mm	**123**	300		546		914		1293	
	%	**124**	181	30-50	130	10-15	150	>100	142	>100
South West	mm	**144**	286		566		1087		1606	
	%	**105**	127	5-10	103	2-5	132	50-80	128	60-90
Welsh	mm	**126**	284		607		1096		1662	
	%	**82**	109	2-5	95	2-5	117	10-15	118	15-25
Highland	mm	**142**	242		745		1185		1800	
	%	**72**	71	5-10	95	2-5	96	2-5	97	2-5
North East	mm	**85**	166		484		800		1201	
	%	**70**	81	2-5	92	2-5	107	2-5	113	10-20
Tay	mm	**101**	150		520		894		1388	
	%	**67**	59	5-10	83	2-5	96	2-5	100	2-5
Forth	mm	**90**	148		544		910		1332	
	%	**69**	66	5-10	94	2-5	107	5-10	107	5-10
Tweed	mm	**108**	163		534		853		1244	
	%	**94**	84	2-5	103	2-5	113	5-10	115	15-25
Solway	mm	**124**	189		712		1183		1729	
	%	**72**	65	5-10	100	2-5	111	8-12	110	10-20
Clyde	mm	**131**	202		766		1255		1860	
	%	**65**	58	8-12	92	2-5	99	2-5	98	2-5

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

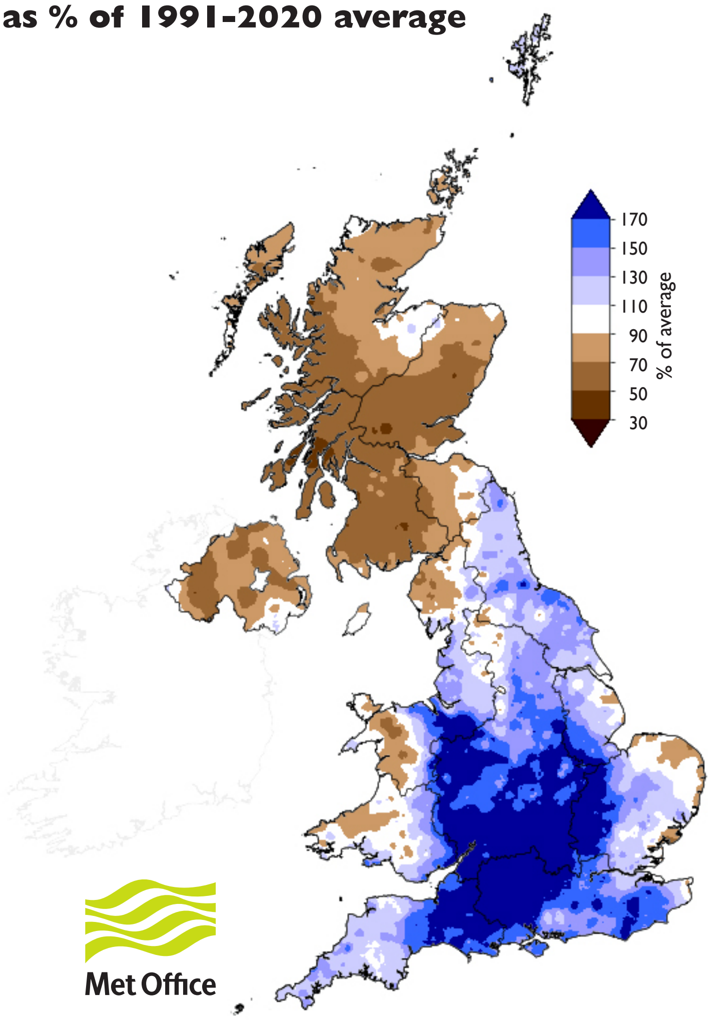
Important note: Figures in the above table may be quoted provided their source is acknowledged. Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability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

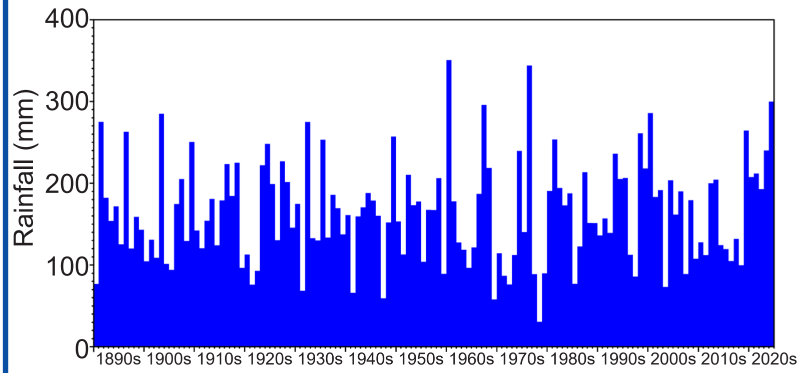
October 2024 rainfall as % of 1991-2020 average



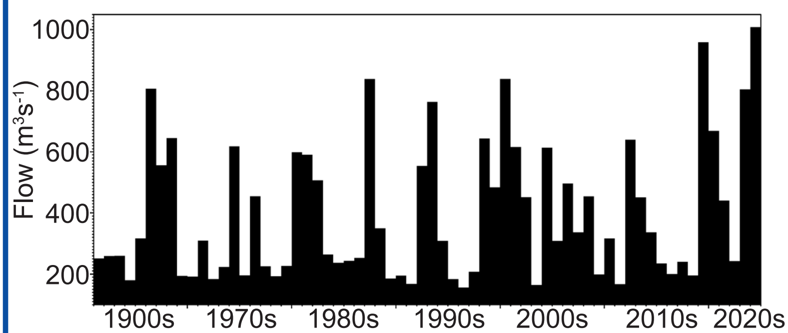
September 2024 - October 2024 rainfall as % of 1991-2020 average



September-October rainfall for Wessex region



October mean 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.

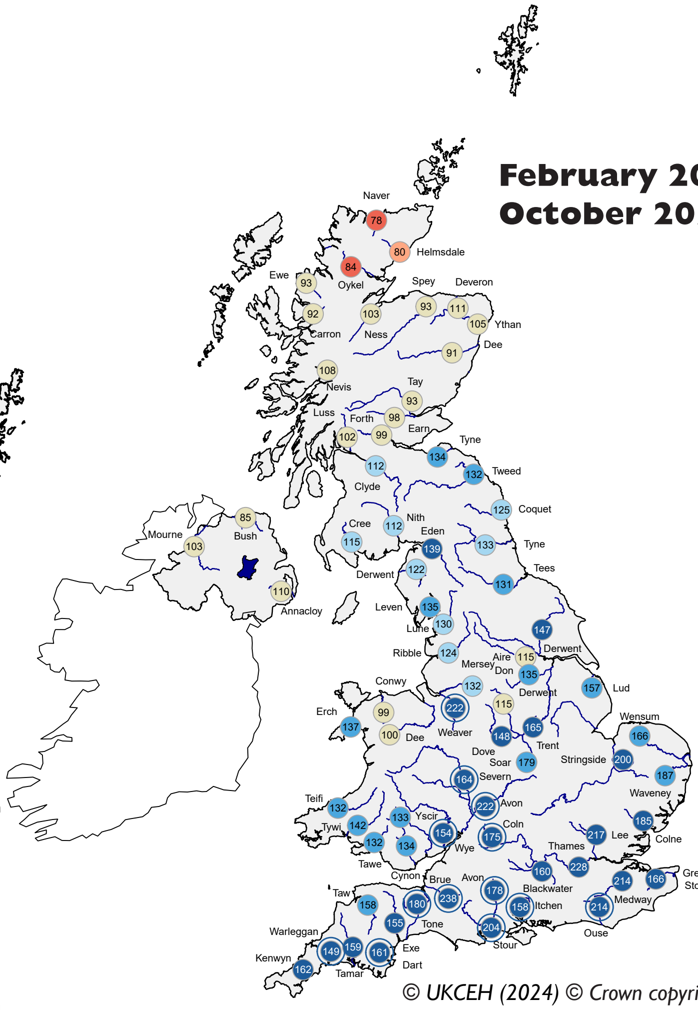
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from November 2024**
Issued: **08.11.2024**
using data to the end of October 2024

The outlook for November is for above normal river flows in central and southern England, and some of these flows will be exceptionally high. Elsewhere river flows are likely to be in the normal to below normal range. For groundwater levels, above normal levels are expected, with the exception of East Yorkshire, Lincolnshire, Sussex and south Wales where normal levels are most likely. For November-January, the outlook is similar.

River flow . . . River flow . . .

February 2024 - October 2024



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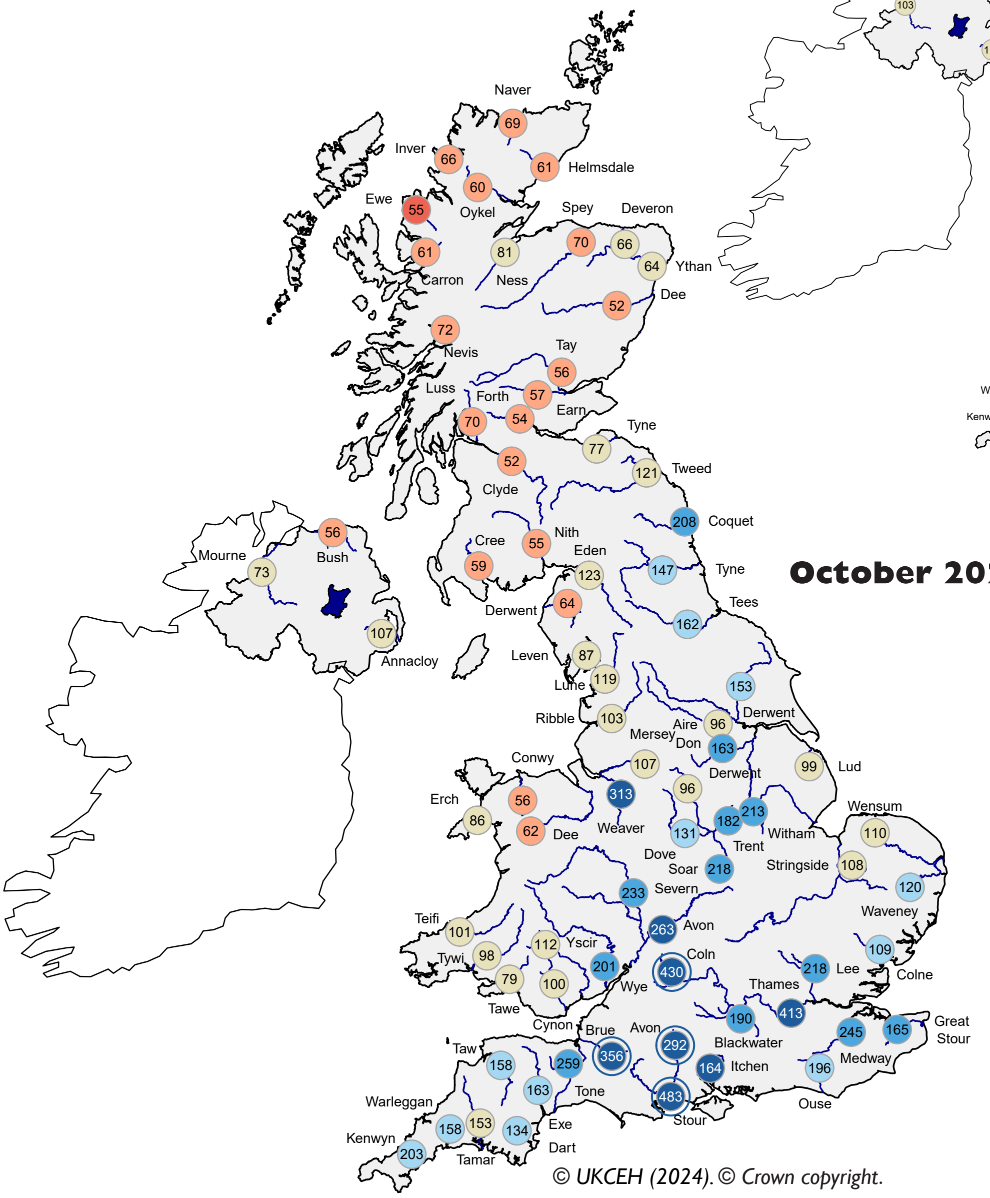
October 2024



Key

- 25 — % of 1991–2020 average (record high/low when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*Based on period–of–record ranking of the monthly flow**

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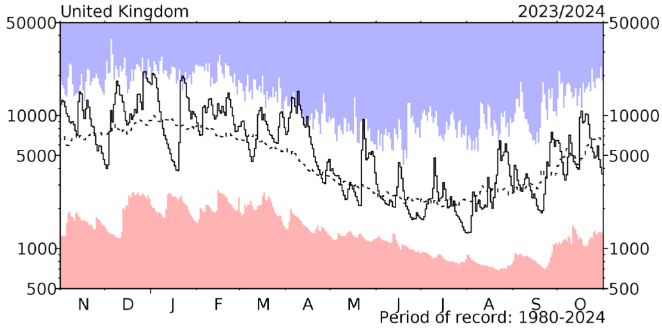
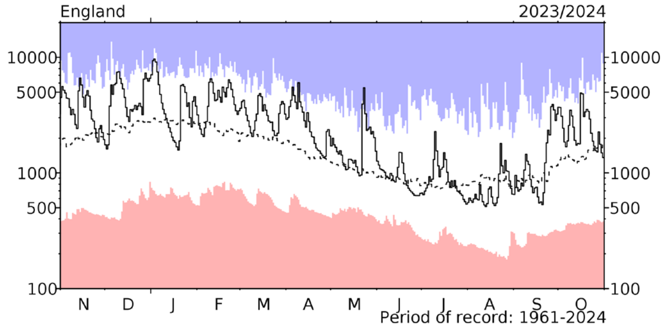
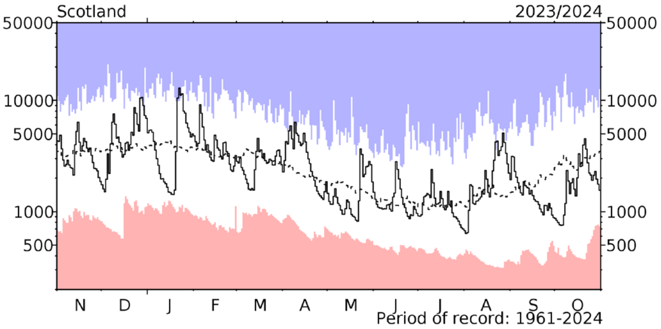
River flows

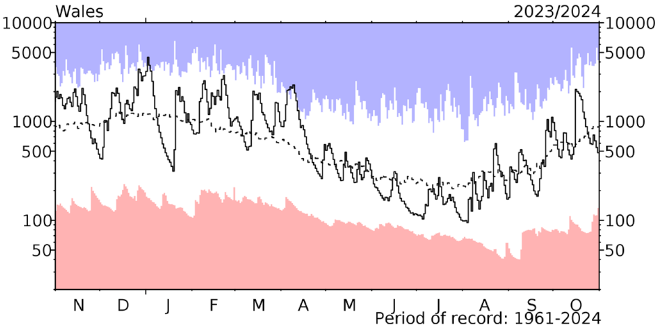
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

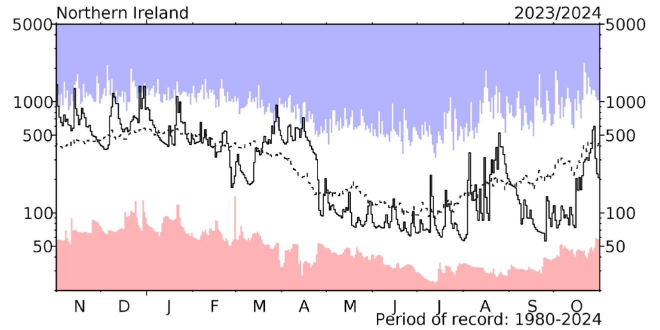
River flow . . . River flow . . .

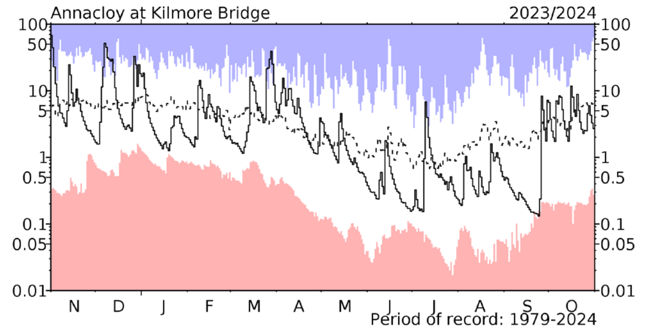


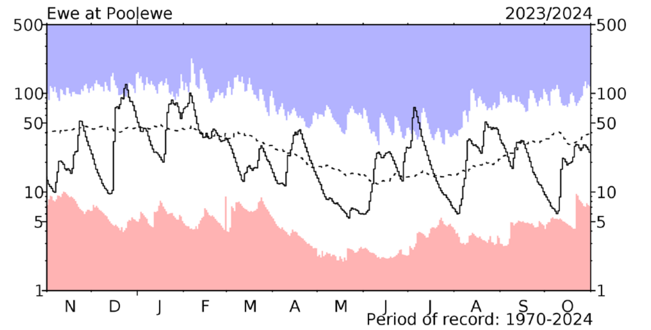


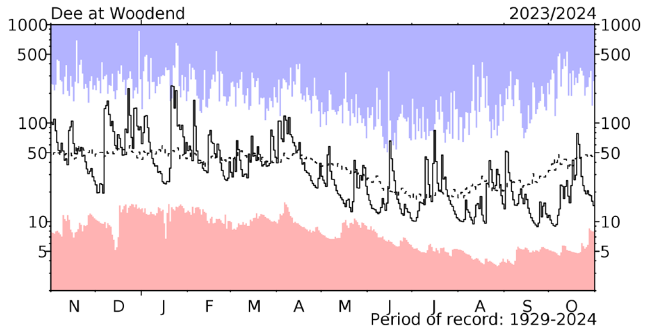


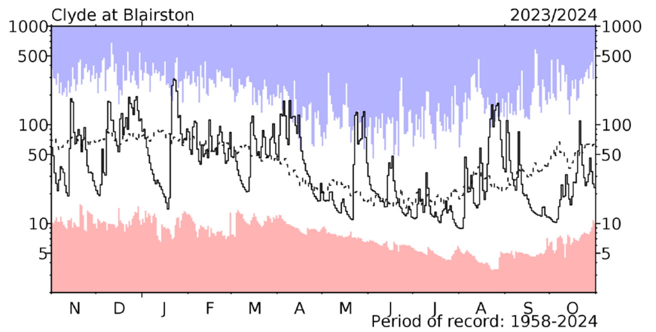


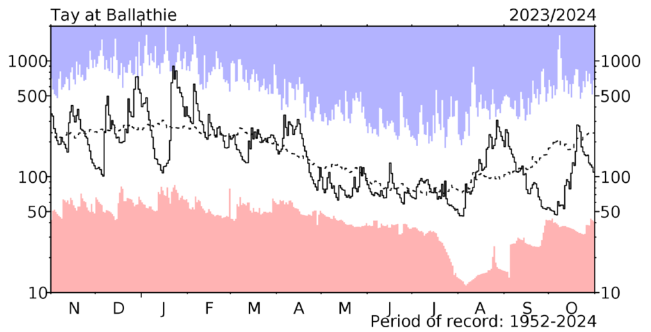








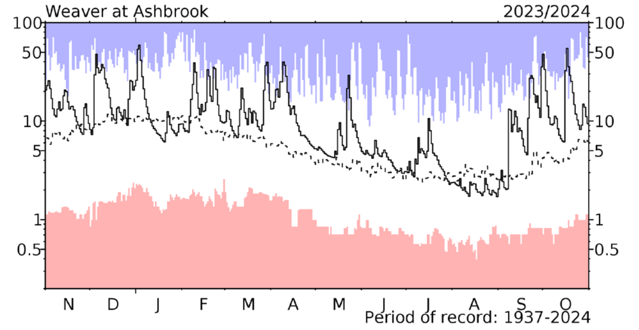


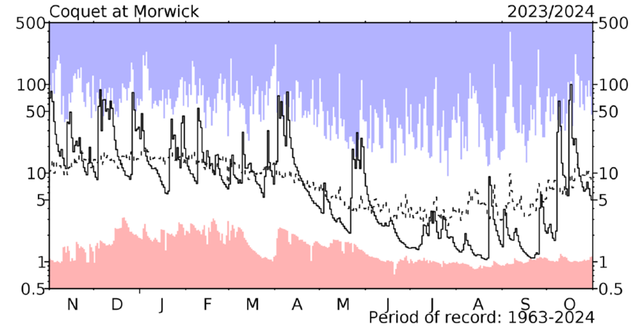


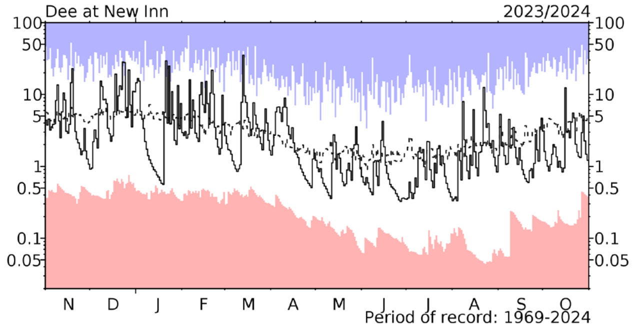
River flow hydrographs

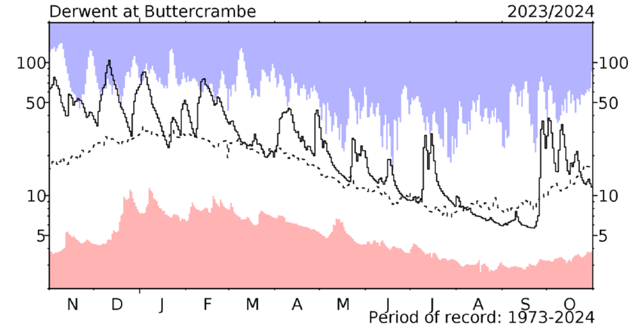
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to August 2023 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

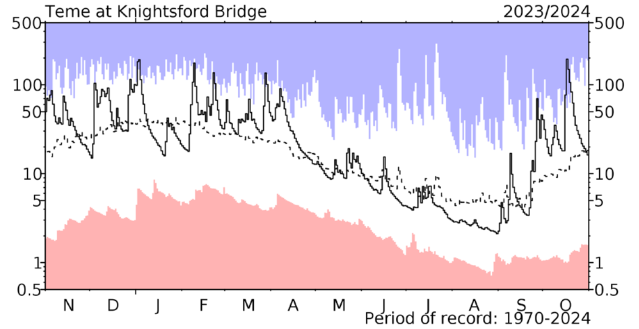
River flow . . . River flow . . .

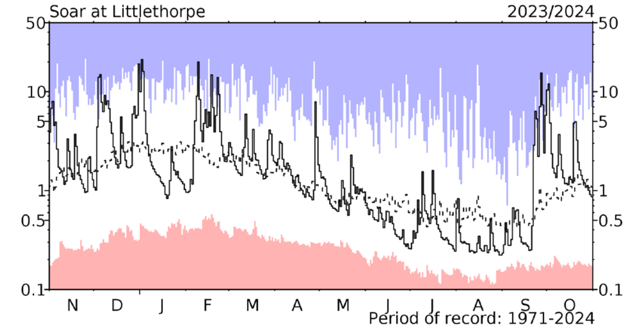


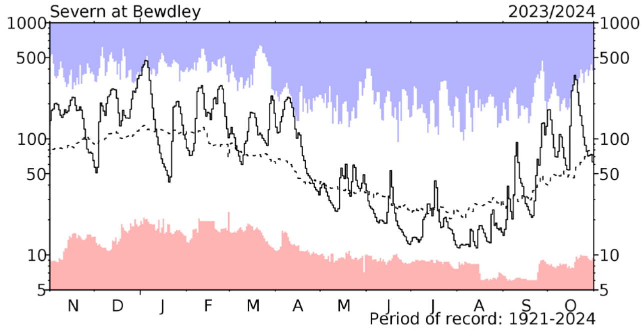


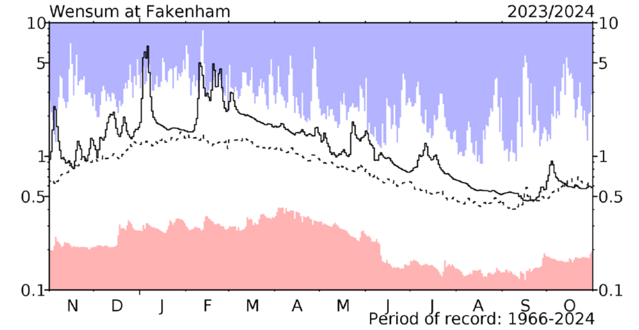


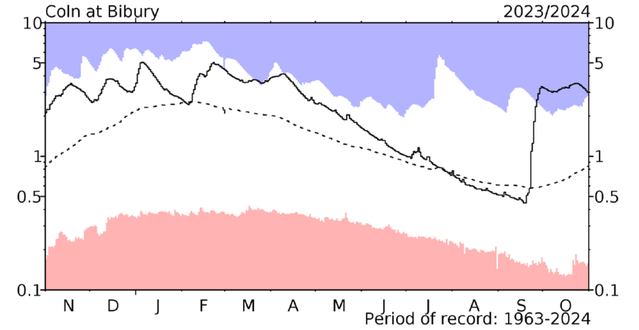


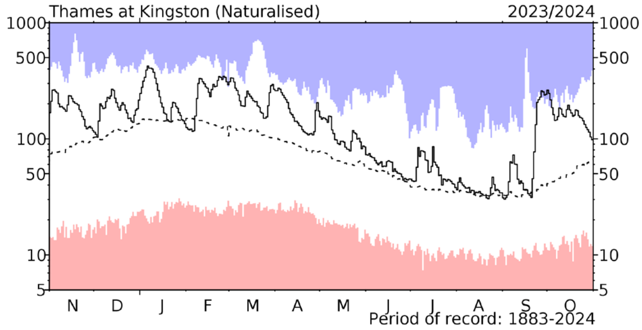


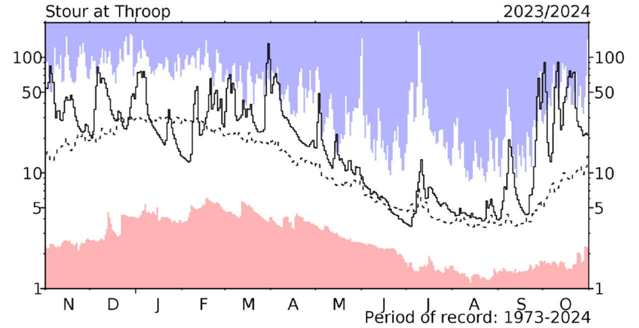


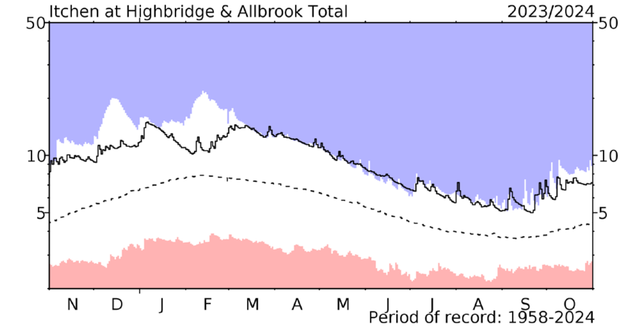




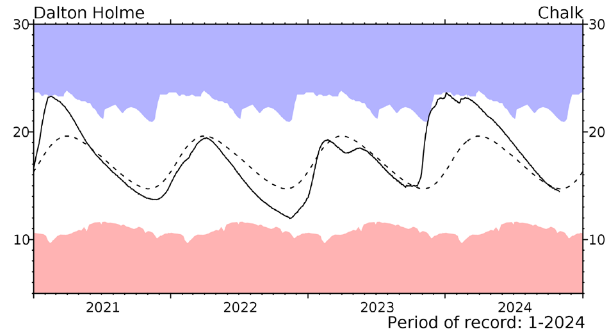


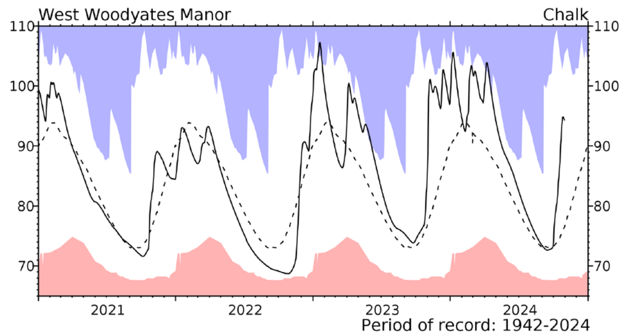


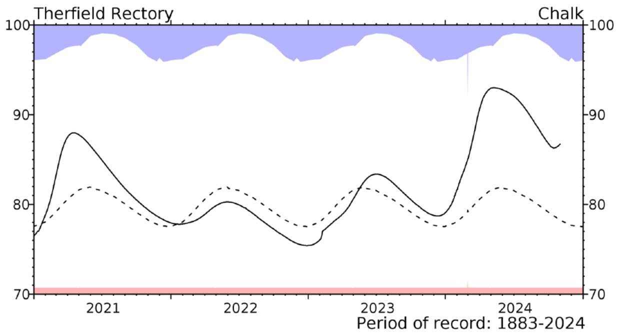


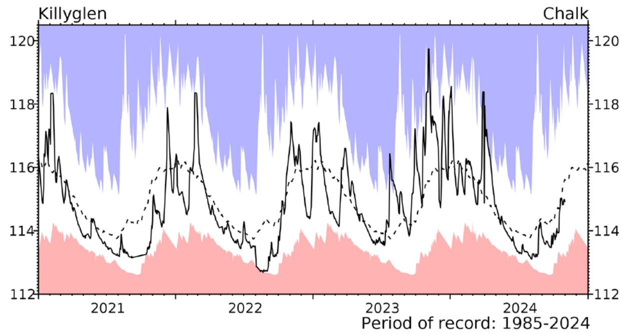


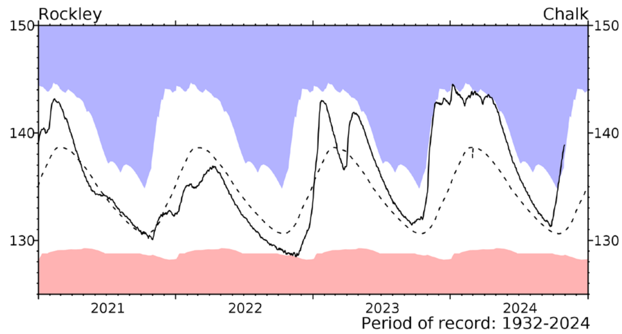
Groundwater . . . Groundwater

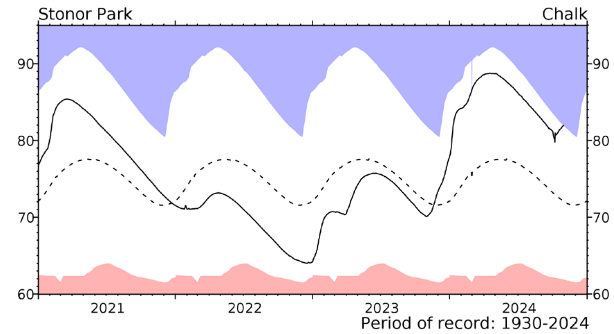


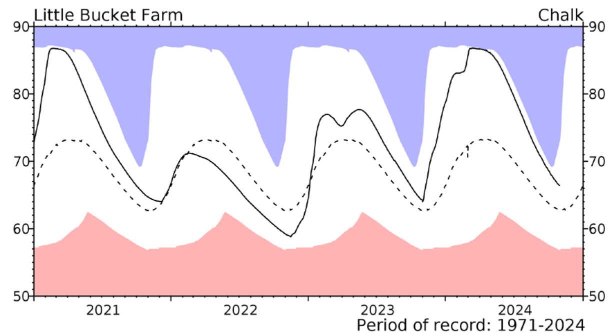


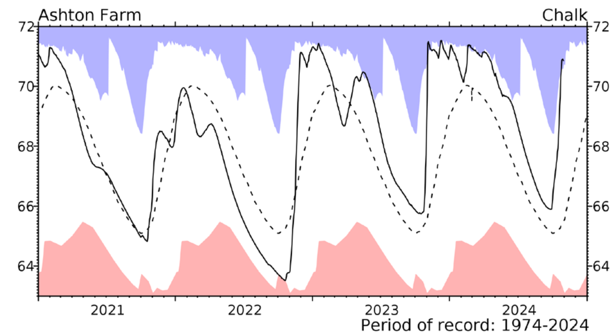


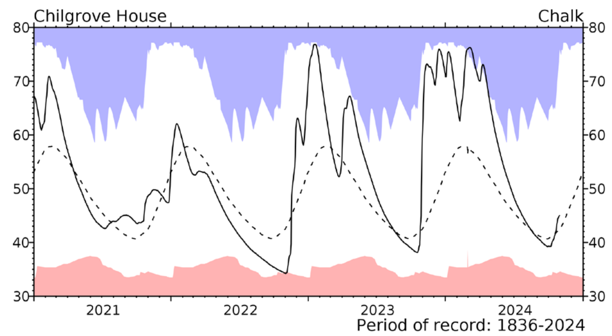


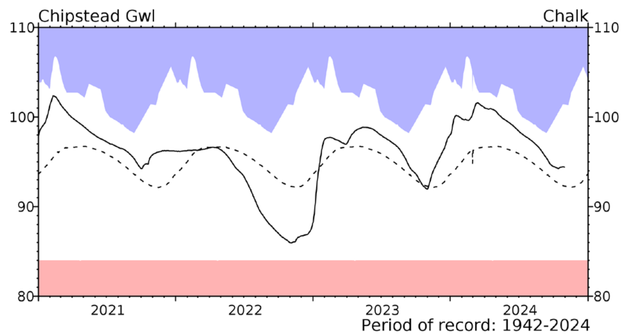






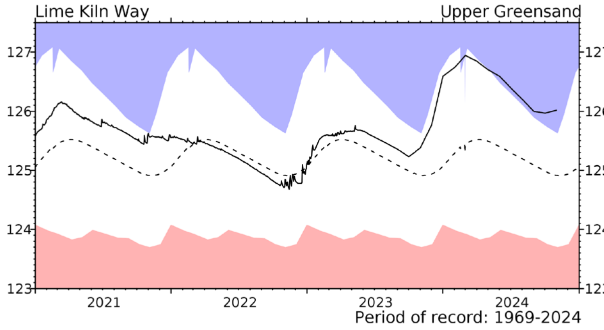


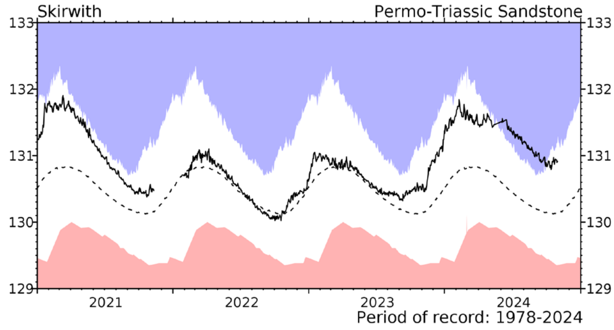


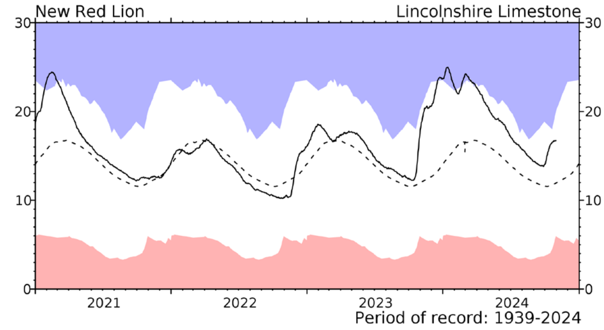


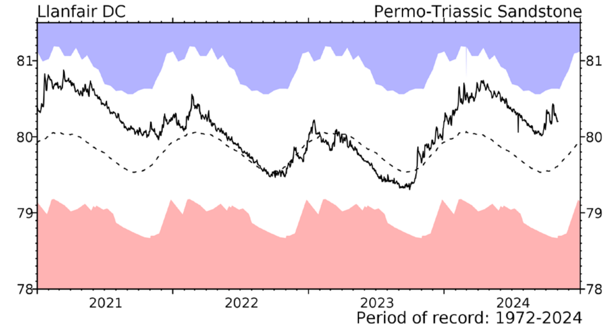
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

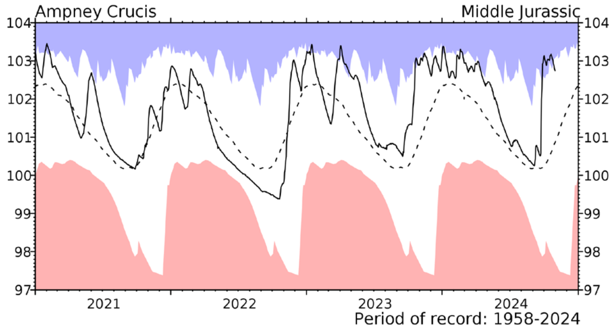
Groundwater . . . Groundwater

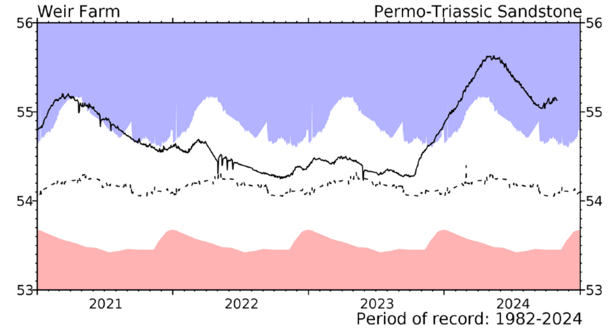


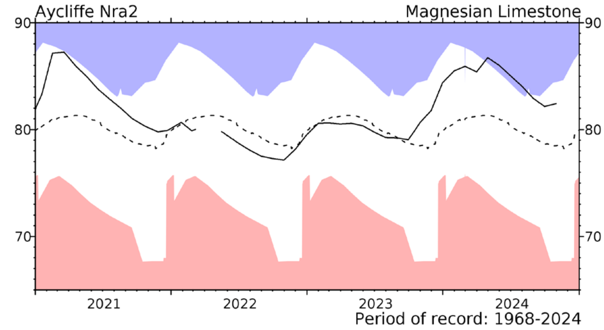


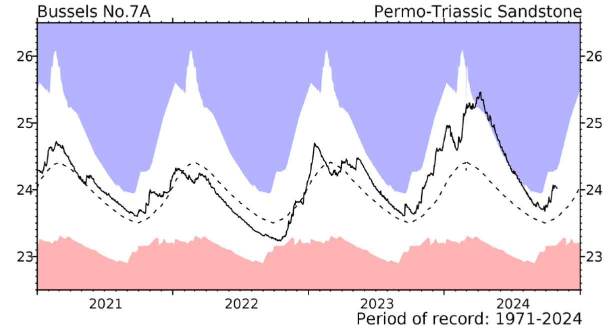


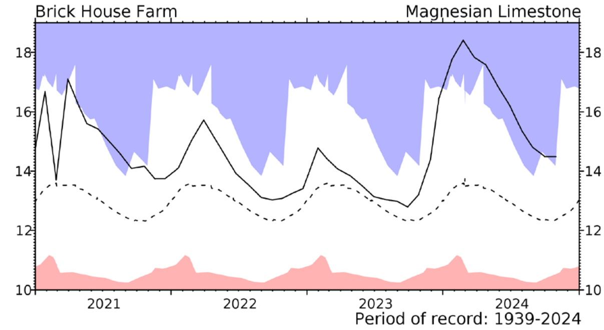


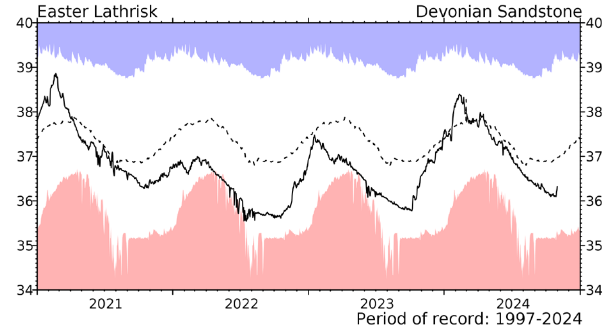


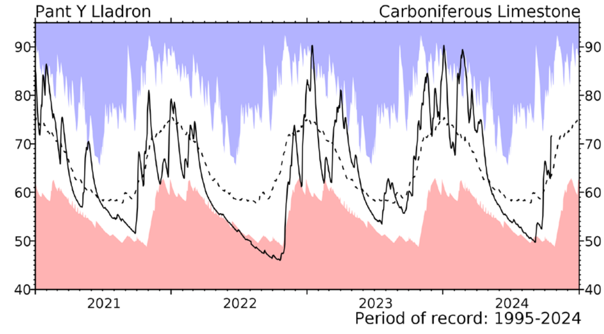


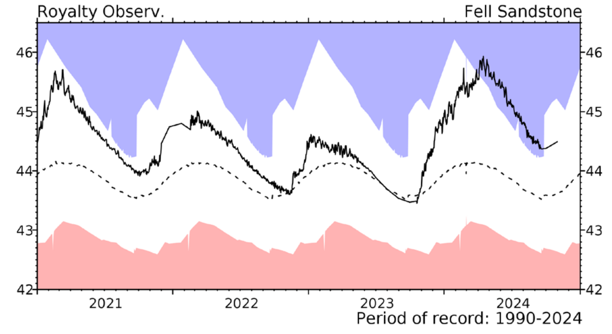




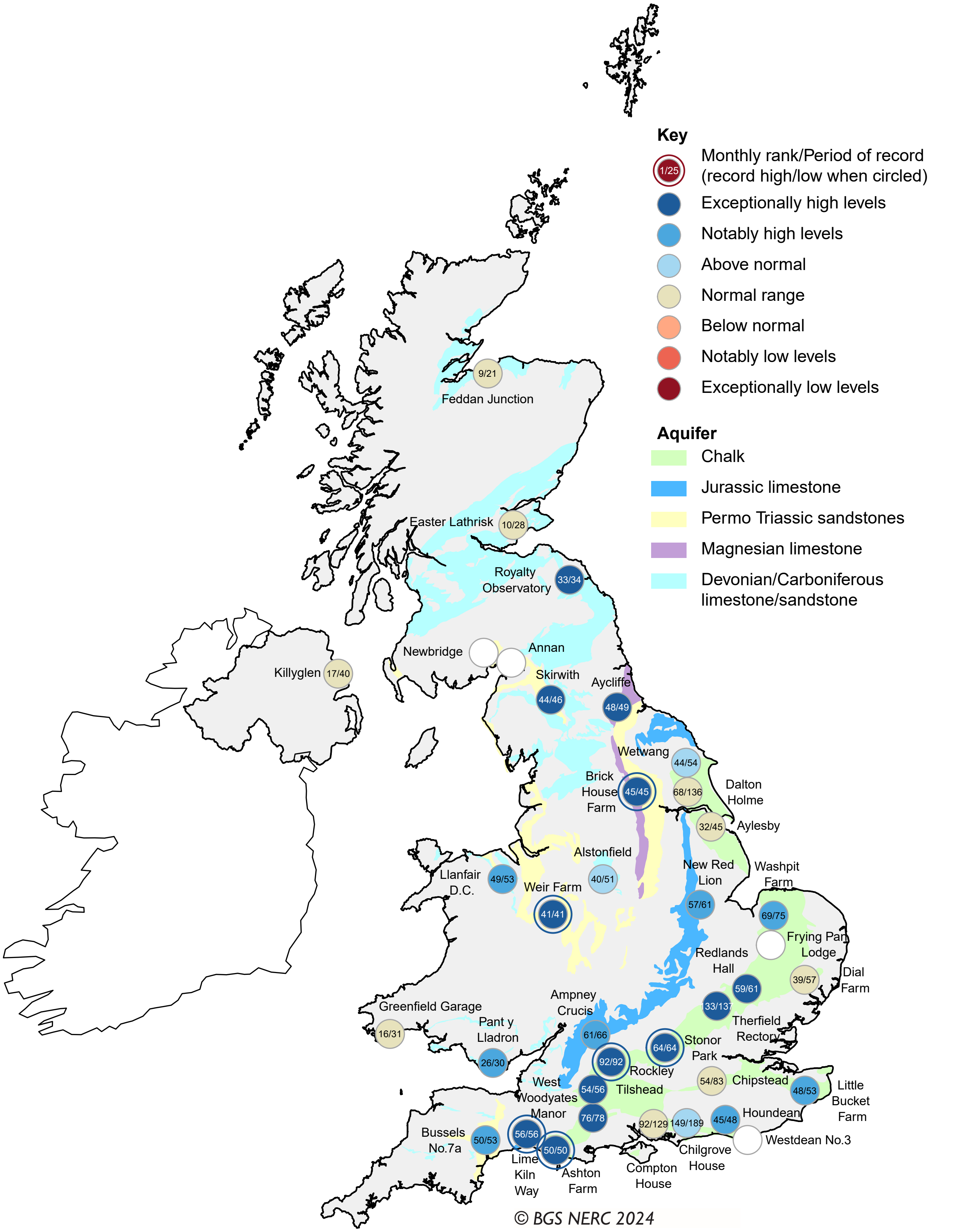








Groundwater . . . Groundwater

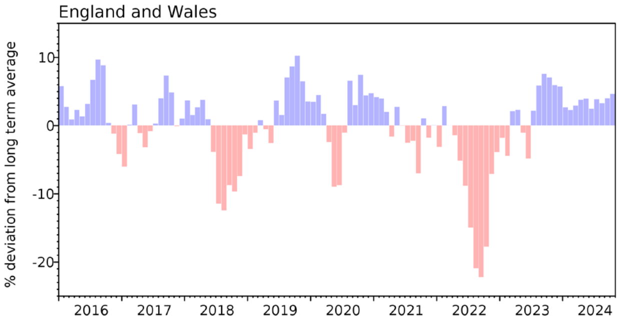


Groundwater levels - October 2024

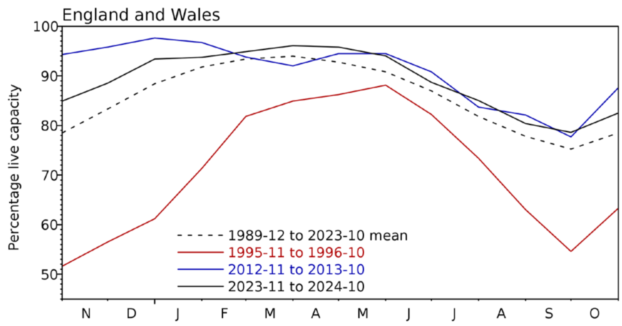
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 Aug	2024 Sep	2024 Oct	Oct Anom.	Min Oct	Year* of min	2023 Oct	Diff 24-23
North West	N Command Zone	•	124929	73	76	80	11	33	2003	80	0
	Vyrnwy		55146	97	93	87	9	25	1995	100	-14
Northumbrian	Teesdale	•	87936	91	91	100	22	33	1995	100	0
	Kielder		(199175)	89	80	82	-5	63	1989	85	-3
Severn-Trent	Clywedog		49936	97	90	82	5	38	1995	85	-2
	Derwent Valley	•	46692	60	54	75	5	15	1995	93	-18
Yorkshire	Washburn	•	23373	73	72	81	11	15	1995	93	-11
	Bradford Supply	•	40942	69	69	81	7	16	1995	99	-18
Anglian	Grafham		(55490)	91	86	86	3	44	1997	85	1
	Rutland		(116580)	84	83	88	9	59	1995	85	3
Thames	London	•	202828	83	82	82	5	46	1996	91	-9
	Farmoor	•	13822	96	88	99	10	43	2003	91	8
Southern	Bewl		31000	64	64	62	2	33	1990	67	-5
	Ardingly		4685	66	60	81	18	15	2003	44	37
Wessex	Clatworthy		5662	60	55	94	31	14	2003	81	13
	Bristol	•	(38666)	61	62	81	18	24	1990	78	3
South West	Colliford		28540	76	67	71	4	15	2022	52	20
	Roadford		34500	87	83	89	20	18	1995	55	33
	Wimbleball		21320	66	58	69	5	18	2022	83	-14
	Stithians		4967	60	51	58	0	14	2022	57	1
Welsh	Celyn & Brenig	•	131155	77	76	76	-7	48	1989	67	9
	Brianne		62140	94	100	100	7	57	1995	100	0
	Big Five	•	69762	70	70	77	1	38	2003	78	-1
	Elan Valley	•	99106	66	71	78	-7	37	1995	96	-18
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	93	90	90	8	48	2003	95	-5
	East Lothian	•	9317	95	89	100	14	38	2003	100	0
Scotland(W)	Loch Katrine	•	110326	97	83	100	13	40	2003	88	12
	Daer		22494	96	84	91	0	42	2003	85	6
	Loch Thom		10721	100	91	92	2	63	2020	91	1
Northern	Total+	•	56800	77	77	88	6	39	1995	99	-11
Ireland	Silent Valley	•	20634	79	83	100	21	34	1995	100	0

( ) 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.

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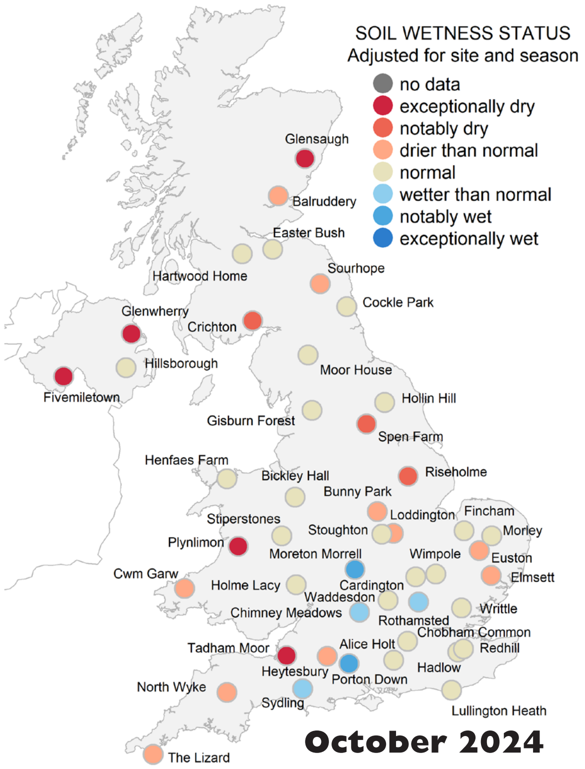
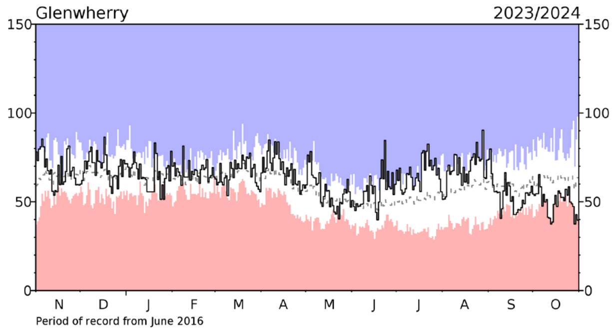
Soil Moisture . . . Soil Moisture

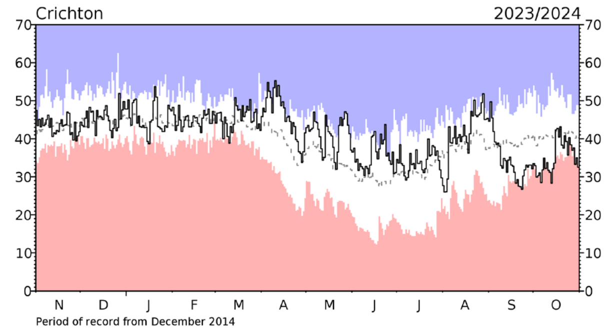


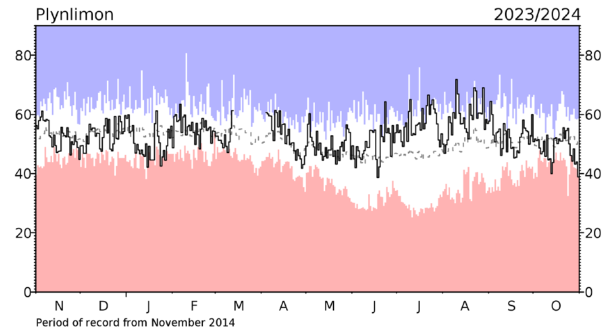
At the end of October, soil moisture levels across the UK were generally within the normal range for the time of year.

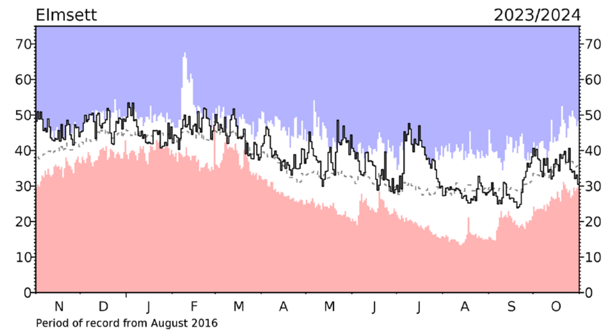
Soil moisture decreased across the COSMOS-UK network compared to September, following the drier conditions in October after the very wet end to September. Generally, soil moisture levels at most COSMOS-UK sites are within the normal range for the time of year, with some exceptions. Plynlimon and Cym Garw in Wales are much drier than normal, as are some sites across southern and eastern England (e.g. Bunny Park, Elmsett and Riseholme). Sites in Northern Ireland (e.g. Fivemiletown and Glenwherry) and Scotland (e.g. Crichton) remain below field capacity. Meanwhile, some sites continue to maintain high soil moisture levels resulting from record rainfall in September (e.g. Chimney Meadows, Moreton Morrell and Rothamsted).

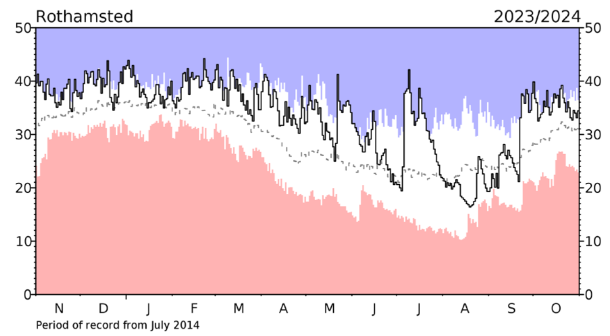
Overall, soil moisture levels across the UK were drier than the previous month, but they mostly remain within the normal range for the time of year.











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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