

Hydrological Summary

for the United Kingdom

General

Although unsettled for much of the first fortnight, and with a wintry tail, March saw a sustained spell of high pressure bringing widespread dry and unseasonably warm weather. With above average monthly temperatures, like each of the previous five months, it concluded the joint fourth warmest winter half-year (October – March) in the long Central England temperature series (from 1659). The warm temperatures were accompanied by low rainfall (59% of the March average for the UK as a whole), with the greatest deficits in Scotland. River flows were either in the normal range or below. Reservoir stocks fell in the north and west, most notably in western Scotland (Daer) and Yorkshire (Bradford Supply), but remained close to average at the national scale. During the warm, dry spell, soil moisture deficits (SMDs) developed across large parts of the UK. Groundwater levels rose during March at the majority of index sites across the different aquifers, except in the rapidly responding Carboniferous Limestone where they fell. At month-end, groundwater levels were generally in the normal range or below normal. Significant spring rainfall is needed for the recovery of river flows and depleted water resources in the north and west, and to sustain the recharge season particularly in the Carboniferous Limestone and in the Chalk of south-east England, allowing recovery of below-average groundwater levels.

Rainfall

During the first half of March, low pressure systems brought strong winds and outbreaks of rain (although without notable daily totals or impacts) as slow-moving fronts weakened against blocking high pressure to the east. Saharan dust, whipped up by the eastern flank of Storm 'Celia' in the Canary Islands, turned the sky yellow on the 16th. In the second half of the month, high pressure dominated, with largely dry, sunny, and warm days, and often cold nights. There were reports of localised wildfire outbreaks in Northern Ireland, northern England and Wales between the 19th and 22nd. By stark contrast, wintry conditions on the 30th-31st brought localised snow accumulations (10cm was measured at Copley, County Durham, on the 31st) and reports of several traffic collisions in the east of England. The total monthly rainfall was less than two-thirds of average for the UK as a whole, and below average across much of the country – with the exception of central parts. In western Scotland, other western areas and parts of south-east England, monthly rainfall was less than half of average (and in north-west Scotland, less than 30%). Accordingly, rainfall totals for the Highland region (where it was the ninth driest March in a series from 1910), and the Clyde and North West England regions were each less than half of their respective averages. Rainfall over the winter half-year was below average across the south of England and Wales (70 – 90%), and similarly so for the twelve months from April – March in the west of Scotland, although without regional rankings of note in either case.

River flows

River flows began the month close to average and saw responses to rainfall during the first half of March, including: the 2nd-3rd on rivers in the north and west; the 4th-5th in the east; the 8th-13th again in the north and west (the Scottish Dee recording a new daily maximum on the 12th in a long series from 1929); and the 15th-18th (predominantly in England). Thereafter flows receded, sharply in the flashier catchments, and in the second half of the month, new daily minima were established on rivers in the north and west (in some cases for multiple consecutive days, e.g. 19th-30th on the Naver and 27th-31st on the Welsh Dee in series from 1977 and 1969, respectively). Flow responses to the wintry weather at month-end were localised

and muted. Mean river flows for March were in the normal range or below normal – notably or exceptionally so on rivers in the north and west. Some rivers in western Scotland (Oykel, Ewe) and north-west England (Lune) recorded less than half of their average March flow, the Oykel (at just 15%) its lowest for March in a series from 1977. In north Wales, the Conwy and Dee recorded around a third of average, with March flows amongst the lowest four on record (both in series of more than 50 years). Over the winter half-year, flows were in the normal range on most rivers, but above normal in north-west England (e.g. Leven, Mersey), and below normal on rivers in western Scotland (the Luss), the north-east of England (the Tyne), and more commonly in the south of England (including the Thames, with two-thirds of its average flow over these six months). The mean flow on the Luss over the twelve months from April – March was the lowest in its record (in a series from 1976).

Groundwater

Small SMDs developed over major aquifers in the warm, dry conditions of the second half of March and soil moisture at month-end was generally in the normal range or drier than normal. Groundwater levels in the Chalk generally rose, but fell overall at Wetwang, Little Bucket Farm, Houndean Bottom and Compton House; levels ended the month in the normal range or below average. In the Jurassic limestones, levels rose at New Red Lion recovering to within the normal range, and fell at Ampney Crucis returning to the normal range. Levels rose in the Magnesian Limestone, remaining normal at Aycliffe, and becoming notably high at Brick House Farm. Levels fell in the Carboniferous Limestone, they returned to the normal range at Alstonfield, and in south Wales dropped below normal. In the Permo-Triassic sandstones levels generally rose, although they fell at Llanfair DC and were stable at Weir Farm; at month-end, they were in the normal range, except at Weir Farm where they were above normal. At Lime Kiln Way in the Upper Greensand, the water level was stable and remained in the normal range. The levels increased in the Fell Sandstone at Royalty Observatory and remained above normal.

Note that due to issues with data access, no data are available for Scotland.

March 2022



National Hydrological
Monitoring Programme



UK Centre for
Ecology & Hydrology



British
Geological
Survey

Rainfall . . . Rainfall . . .



Rainfall accumulations and return period estimates

Percentages are from the 1991-2020 average.

Region	Rainfall	Mar 2022	Feb22 – Mar22	Nov21 – Mar22	Oct21 – Mar22	Apr21 – Mar22
			RP	RP	RP	RP
United Kingdom	mm	50	196	447	610	1009
	%	59	109	82	91	88
England	mm	42	139	298	423	776
	%	72	112	77	89	90
Scotland	mm	62	278	662	881	1320
	%	50	106	86	94	85
Wales	mm	52	250	572	781	1312
	%	50	112	81	91	91
Northern Ireland	mm	49	194	453	579	995
	%	56	109	85	89	86
England & Wales	mm	43	154	335	471	849
	%	67	112	78	89	91
North West	mm	42	232	520	738	1173
	%	46	120	88	102	93
Northumbria	mm	44	142	330	452	761
	%	71	107	82	93	84
Severn-Trent	mm	39	145	295	394	731
	%	73	131	87	94	92
Yorkshire	mm	42	176	340	443	801
	%	71	138	89	95	93
Anglian	mm	31	93	202	273	542
	%	78	114	80	87	87
Thames	mm	40	107	210	321	673
	%	85	108	65	81	93
Southern	mm	37	96	222	362	724
	%	73	84	57	75	89
Wessex	mm	58	128	265	415	792
	%	93	98	62	79	88
South West	mm	65	176	433	631	1140
	%	73	90	69	83	92
Welsh	mm	52	237	538	743	1263
	%	53	112	80	90	91
Highland	mm	52	310	838	1071	1538
	%	34	95	89	94	84
North East	mm	57	161	386	532	977
	%	79	107	83	92	93
Tay	mm	83	271	536	716	1194
	%	77	120	78	86	87
Forth	mm	48	241	471	661	1063
	%	50	119	80	92	86
Tweed	mm	58	216	420	609	965
	%	74	130	84	100	90
Solway	mm	82	318	637	925	1341
	%	69	127	84	100	87
Clyde	mm	68	344	784	1047	1483
	%	45	107	83	92	79

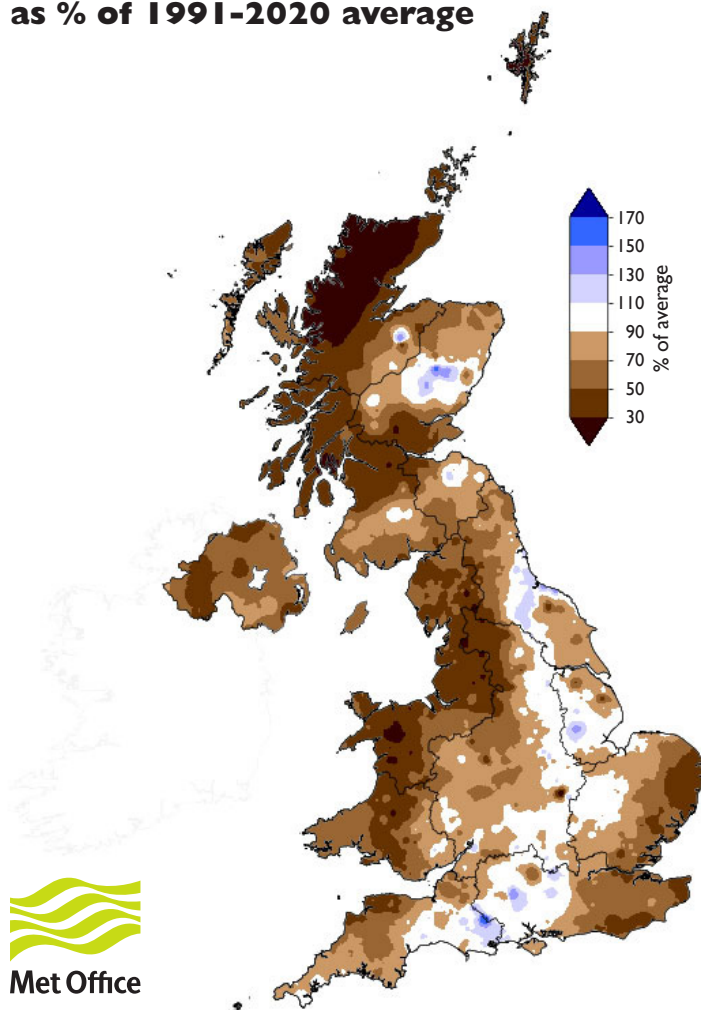
% = percentage of 1991-2020 average

RP = Return period

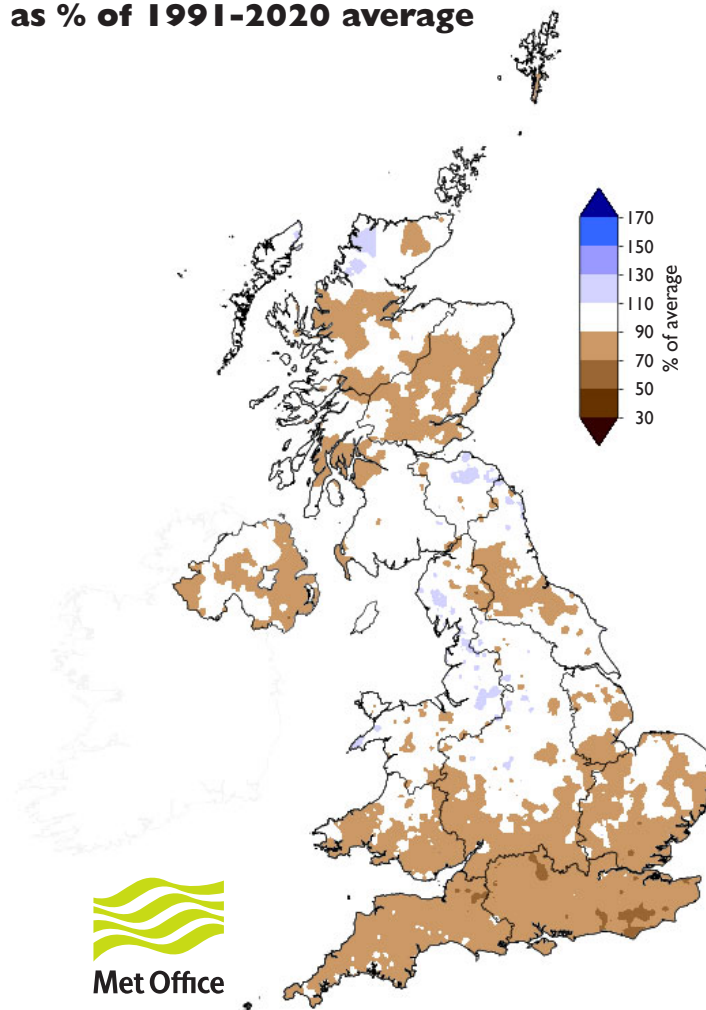
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals since January 2018 are provisional.

Rainfall . . . Rainfall . . .

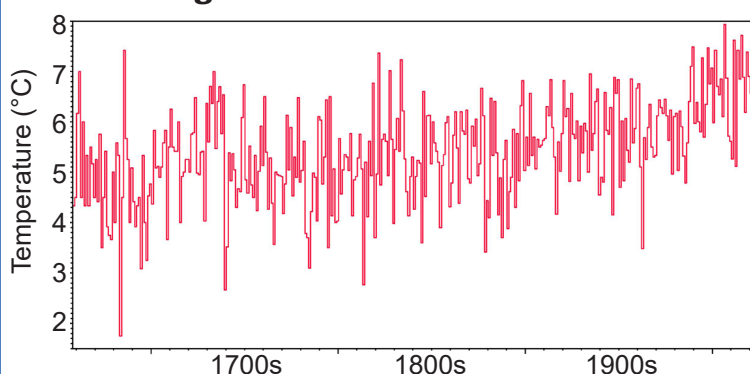
**March 2022 rainfall
as % of 1991-2020 average**



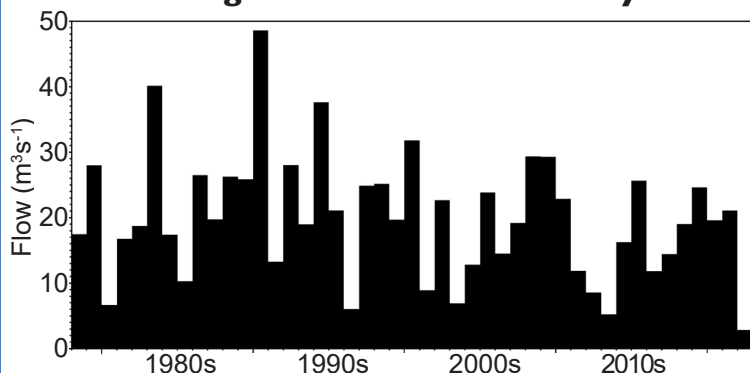
**October 2021 - March 2022 rainfall
as % of 1991-2020 average**



October - March average temperatures for Central England



March average river flows on the Oykel



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/

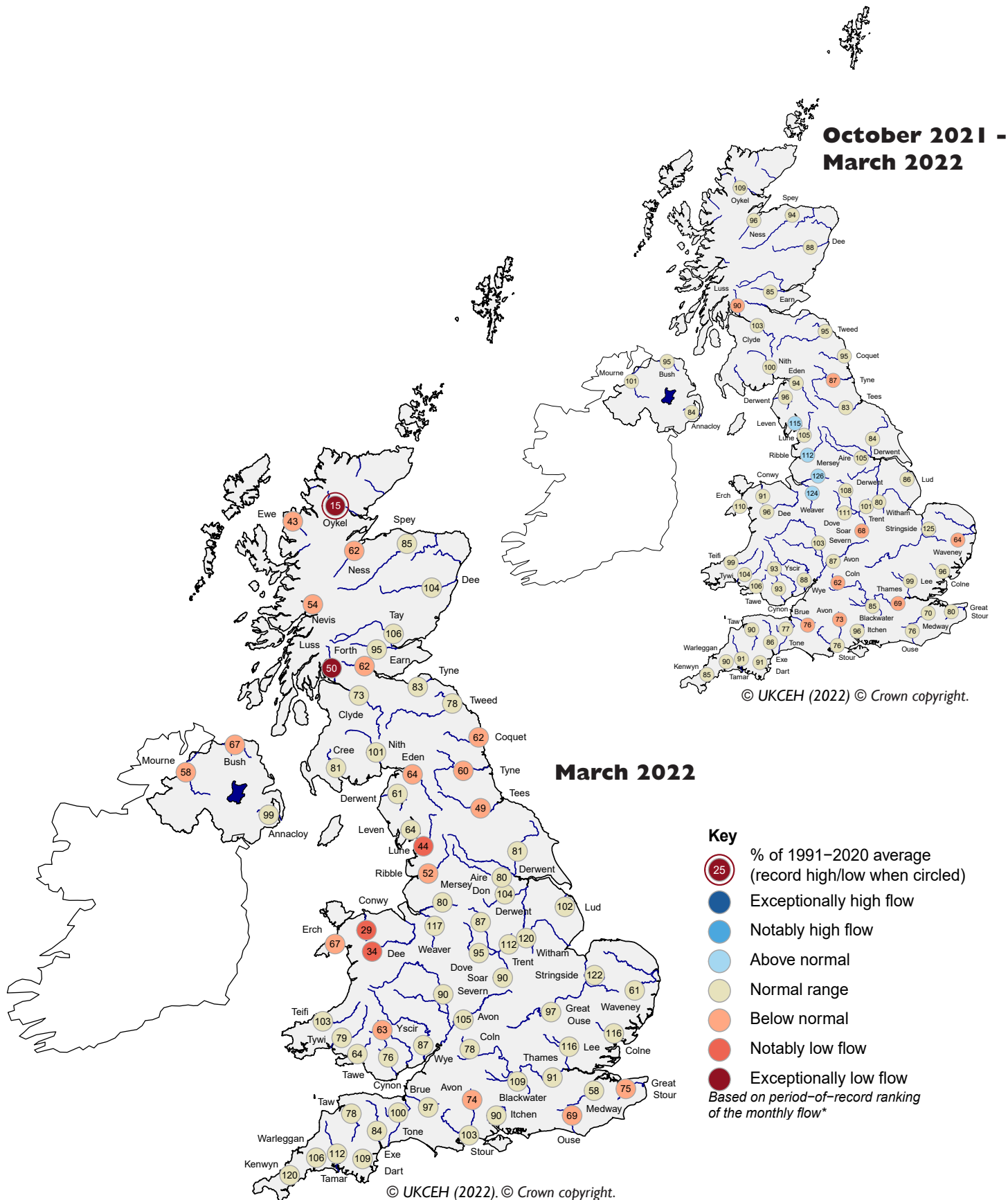
Period: from April 2022

Issued: 08.04.2022

using data to the end of March 2022

The outlook for most of the UK for river flows is that they are most likely to be within the normal range, for both April and the three-month timeframe (April-June). In some catchments in southern England, normal to below normal flows are likely over the next three months. For groundwater, normal to below normal levels are likely in most boreholes, both in April and over the three-month timeframe.

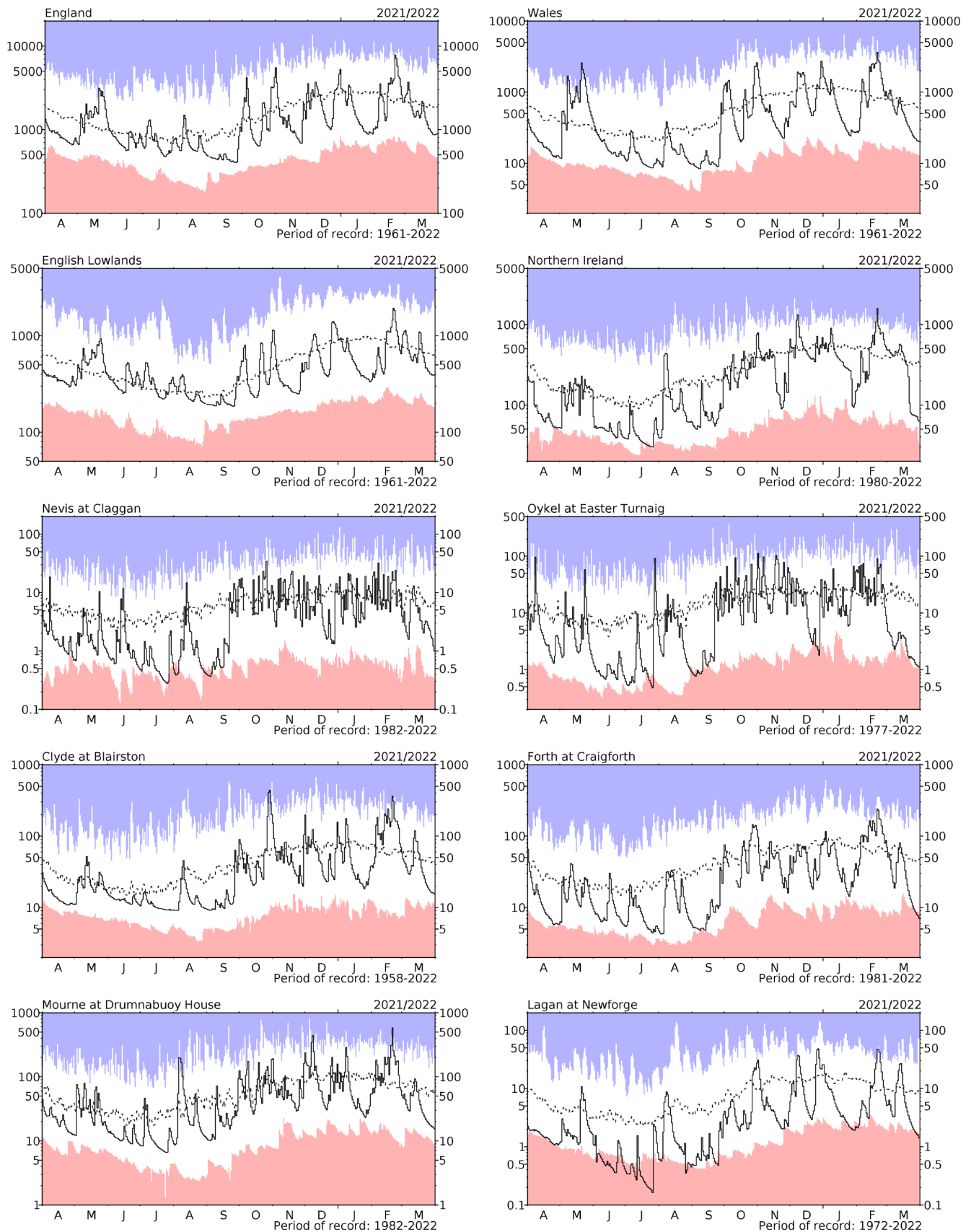
River flow ... River flow ...



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.

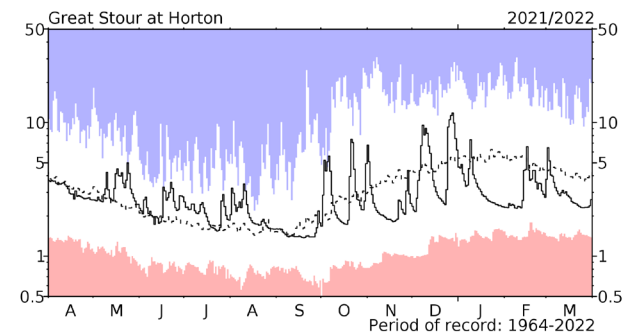
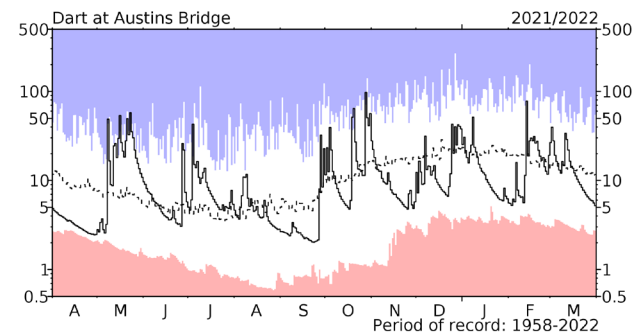
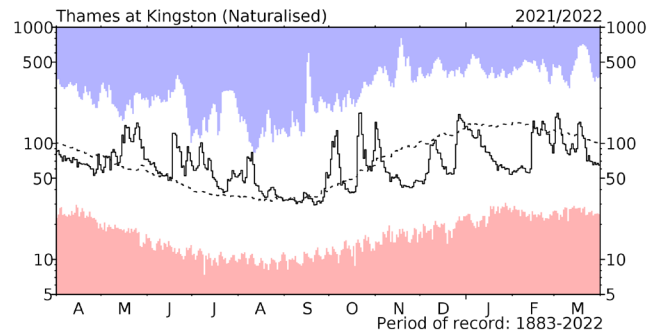
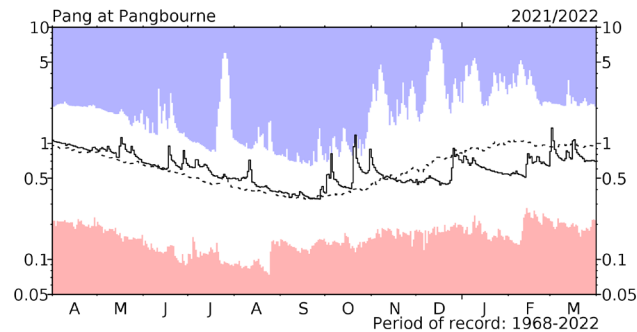
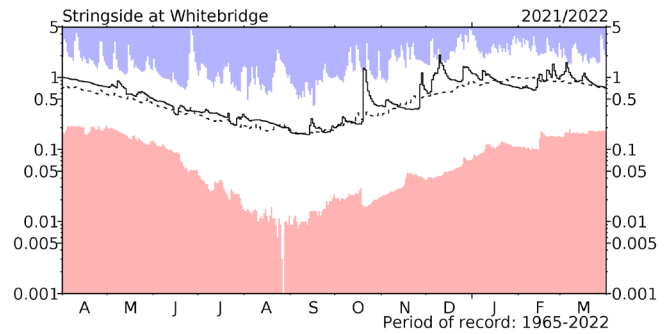
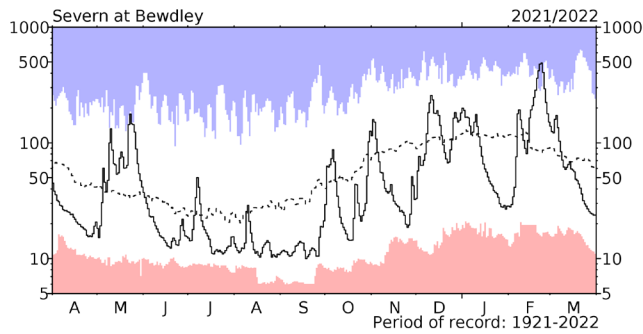
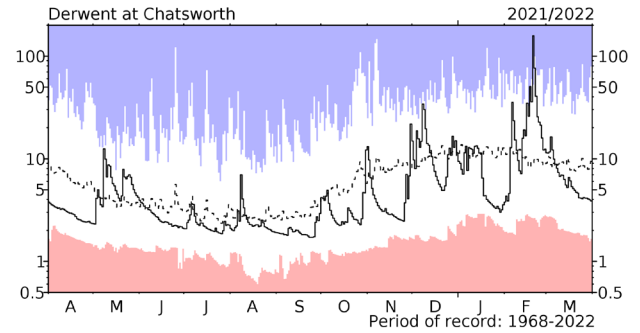
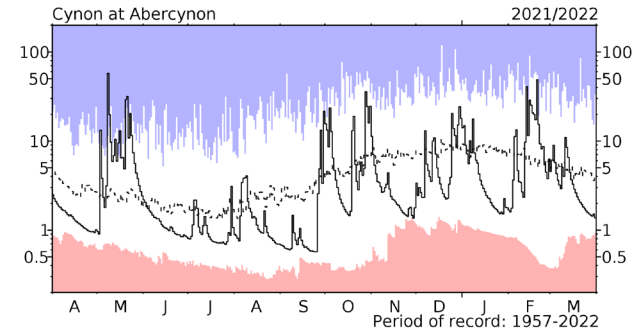
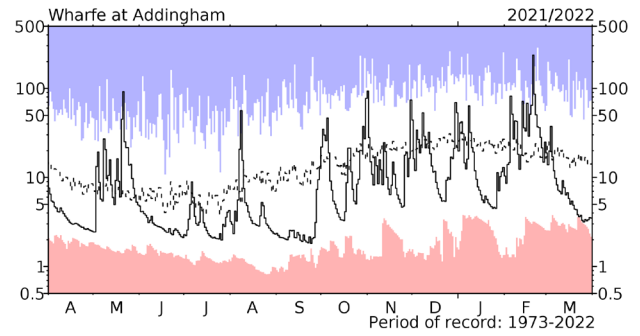
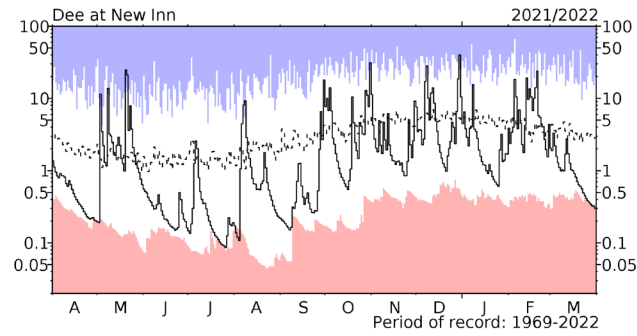
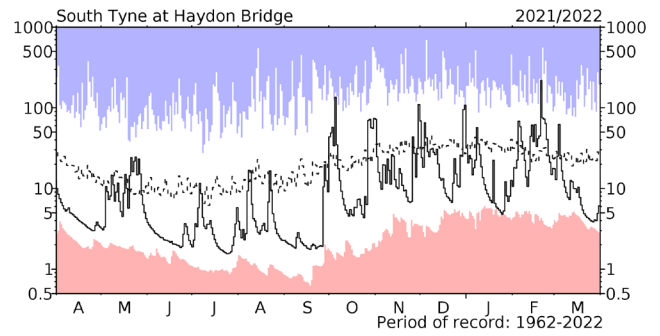
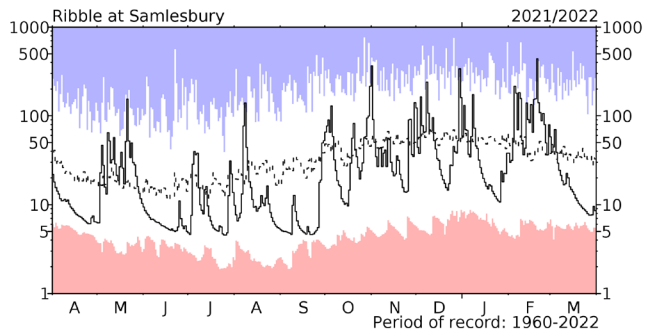
River flow ... River flow ...



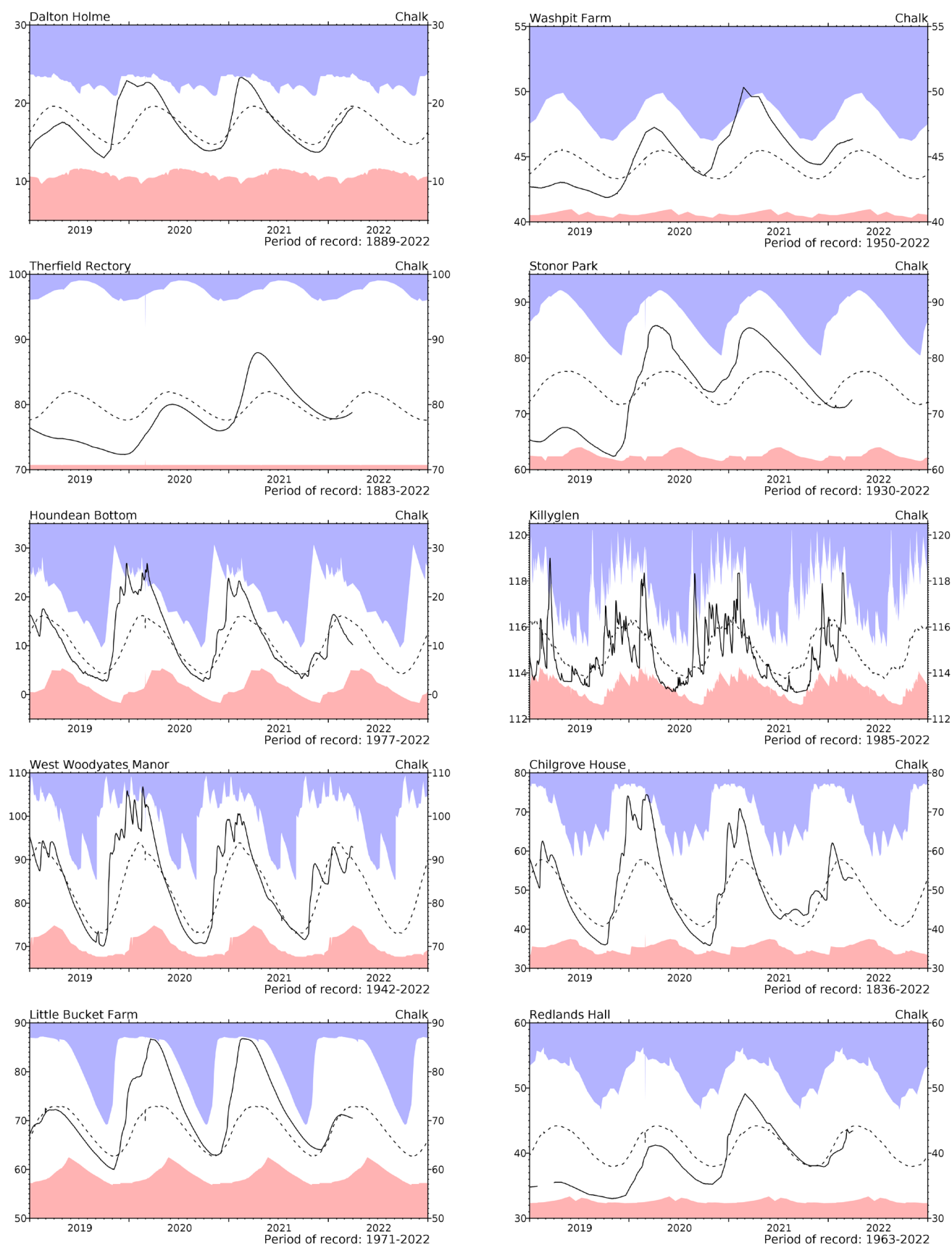
River flow hydrographs

*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to April 2021 (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 ...

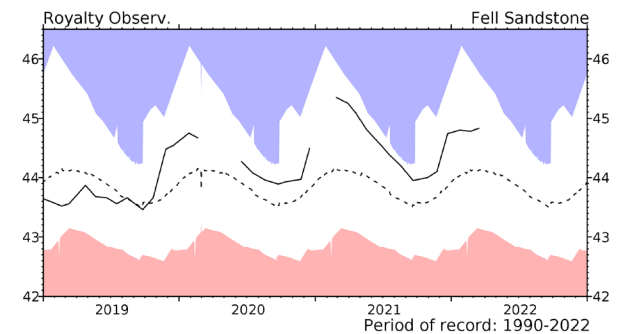
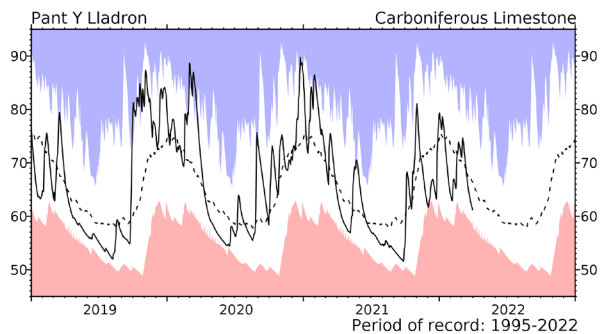
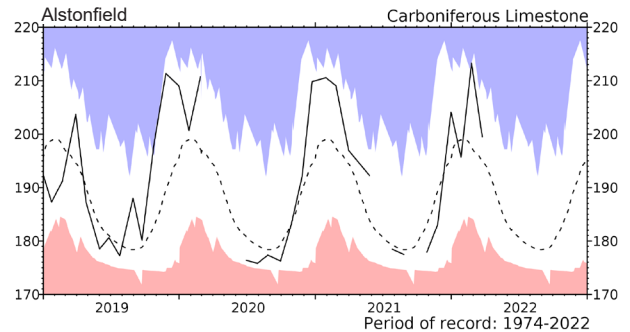
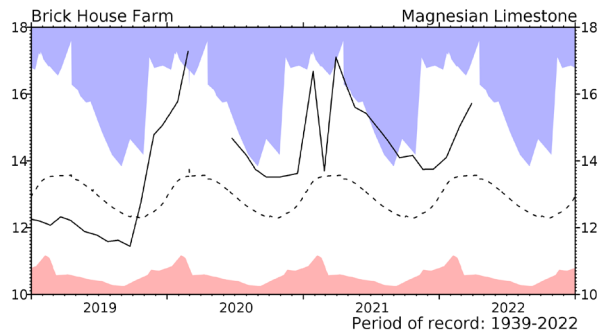
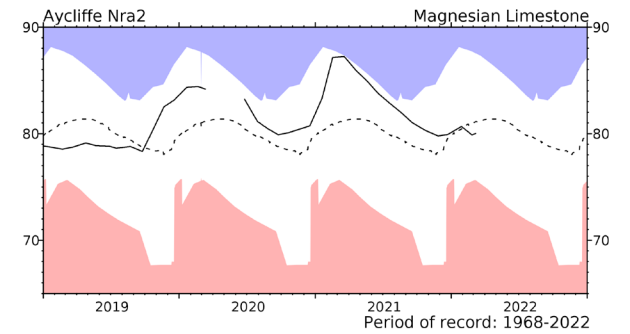
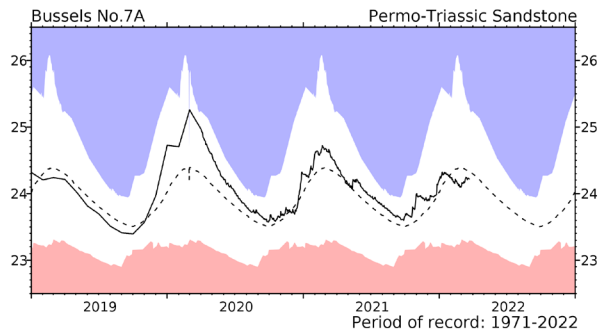
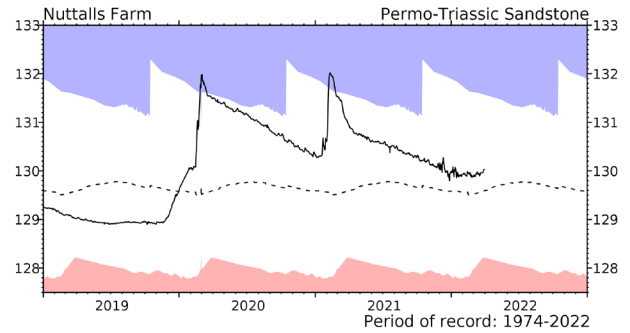
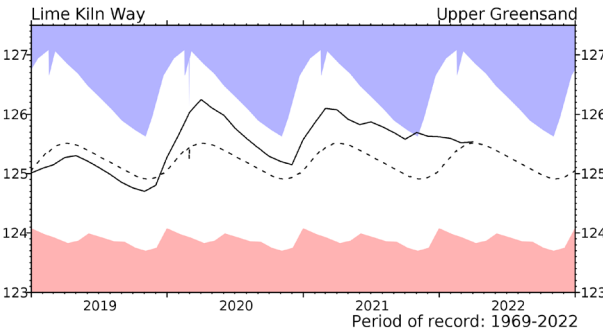
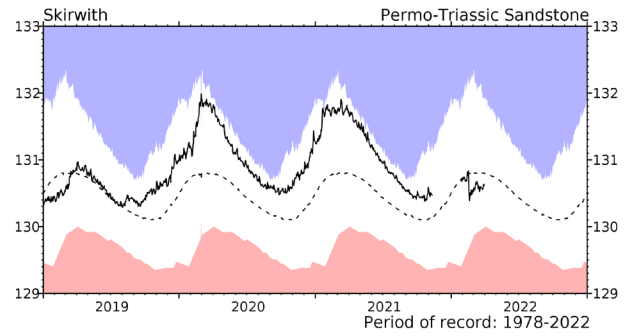
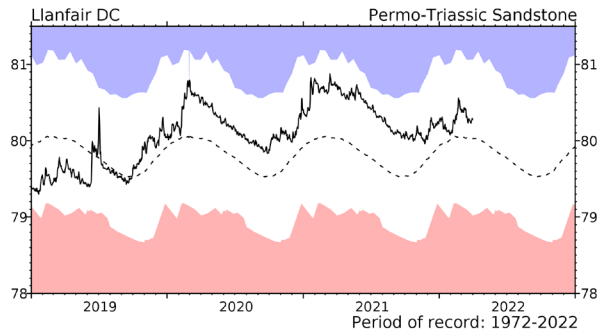
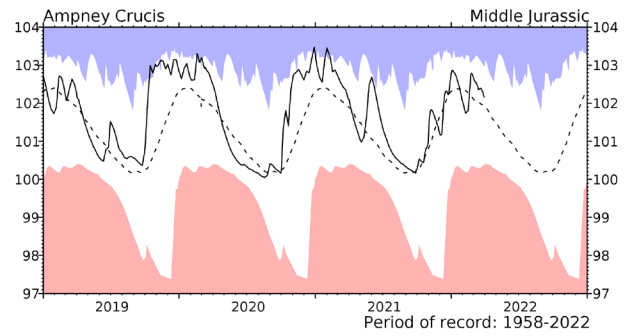
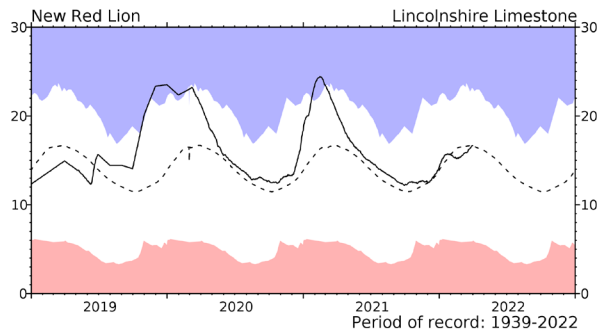


Groundwater...Groundwater



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 2018. 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



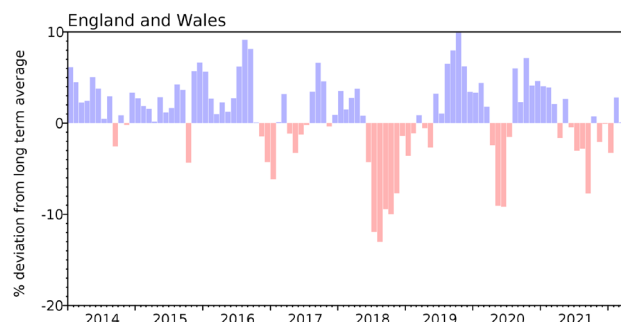
Groundwater levels - March 2022

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.

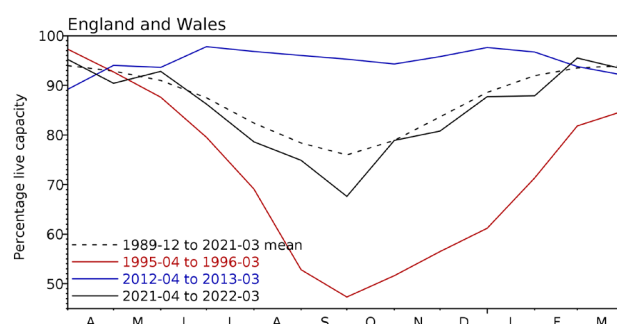
Note that due to issues with data access, no data are available for Scotland.

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)	2022 Jan	2022 Feb	2022 Mar	Mar Anom.	Min Mar	Year* of min	2021 Mar	Diff 22-21
North West	N Command Zone	• 124929	80	99	92	0	77	1993	100	-8
	Vyrnwy	• 55146	88	99	96	1	64	1996	99	-3
Northumbrian	Teesdale	• 87936	86	100	95	2	77	2003	82	13
	Kielder	(199175)	84	96	89	-3	81	1993	93	-4
Severn-Trent	Clywedog	• 49936	90	92	97	1	86	1996	98	-1
	Derwent Valley	• 46692	89	100	92	-3	54	1996	97	-5
Yorkshire	Washburn	• 23373	81	96	91	-2	70	1996	83	8
	Bradford Supply	• 40942	89	100	89	-5	59	1996	91	-2
Anglian	Grafham	(55490)	94	93	94	2	77	1997	92	2
	Rutland	(116580)	83	90	96	5	73	2012	96	0
Thames	London	• 202828	94	96	97	3	88	1990	97	0
	Farmoor	• 13822	94	87	94	-1	80	2013	98	-4
Southern	Bewl	• 31000	79	82	90	-1	49	2012	92	-2
	Ardingly	• 4685	100	100	100	2	51	2012	100	0
Wessex	Clatworthy	• 5662	100	100	100	2	82	1992	100	0
	Bristol	• (38666)	81	88	93	-1	71	1992	97	-4
South West	Colliford	• 28540	75	77	79	-9	58	1997	94	-15
	Roadford	• 34500	98	100	98	12	37	1996	97	1
	Wimbleball	• 21320	94	100	100	3	78	1996	100	0
	Stithians	• 4967	81	91	100	5	52	1992	98	2
Welsh	Celyn & Brenig	• 131155	87	92	89	-9	72	1996	97	-8
	Brianne	• 62140	94	99	94	-4	90	1993	97	-3
	Big Five	• 69762	93	100	96	0	78	1993	97	-1
	Elan Valley	• 99106	96	100	93	-4	89	1993	96	-3
Scotland(E)	Edinburgh/Mid-Lothian	• 97223	87	97	98	3	71	1998	98	0
	East Lothian	• 9317	100	100	100	1	95	2012	100	0
Scotland(W)	Loch Katrine	• 110326	94	100	97	4	74	2010	98	-1
	Daer	• 22494	91	97	84	-13	77	2013	99	-15
	Loch Thom	• 10721	100	100	95	-1	83	2020	88	7
Northern	Total*	• 56800	88	88	93	2	83	2002	96	-3
Ireland	Silent Valley	• 20634	87	99	96	8	57	2000	93	3

() figures in parentheses relate to gross storage

• denotes reservoir groups

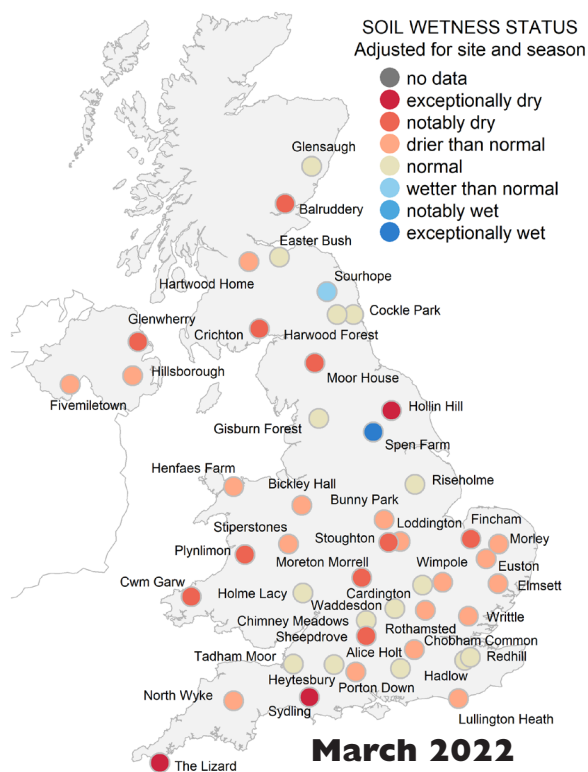
*last occurrence

+ excludes Lough Neagh

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

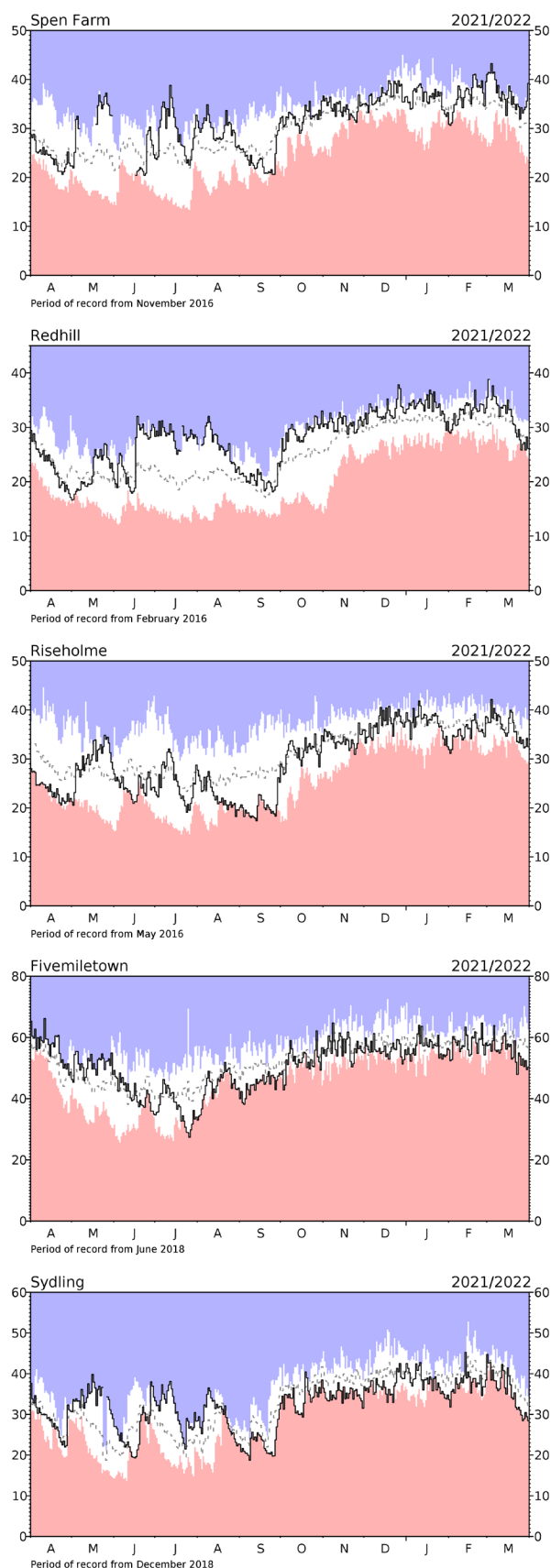
© UKCEH (2022).

Soil Moisture . . . Soil Moisture



At the end of March soil moisture is generally normal or drier-than-normal for the time of year. At the beginning of the month, areas in northern England were wet for the time of year. Despite lower-than-average total precipitation in March, these sites ended the month above field capacity (e.g. Spen Farm). Following high soil moisture in the first half of the month, soils at roughly a third of sites dried to normal levels for the time of year (e.g. Redhill and Riseholme).

Approximately two thirds of sites across the UK, which began March with normal soil moisture for the time of year, became notably dry or drier-than-normal for the time of year (e.g. Fivemiletown). Soils in the southwest of England saw a rapid drying, from wetter-than-normal to exceptionally dry for the time of year (e.g. Sydling).



Soil moisture data

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

NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the [UK Centre for Ecology & Hydrology](#) (UKCEH) and the [British Geological Survey](#) (BGS). The NHMP aims to provide an authoritative voice on hydrological conditions throughout the UK, to place them in a historical context and, over time, identify and interpret any emerging hydrological trends. Hydrological analysis and interpretation within the Programme is based on the data holdings of the [National River Flow Archive](#) (NRFA; maintained by UKCEH) and [National Groundwater Level Archive](#) (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

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

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. 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 5km resolution gridded data from rain gauges. The majority of the full rain gauge network across the UK is operated by the EA, NRW, SEPA and Northern Ireland

Water; supplementary rain gauges are operated by the Met Office. The Met Office NCIC monthly rainfall series extend back to 1910 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM (2005) available at <https://doi.org/10.1002/joc.1161>

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.

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For further details on rainfall or MORECS data, please contact the Met Office:

Tel: 0870 900 0100
Email: enquiries@metoffice.gov.uk

Enquiries

Enquiries should be directed to the NHMP:

Tel: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:

<http://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk>

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