Hydrological Summary

for the United Kingdom

March 2021

General

March was largely dry and settled, interspersed with some unsettled periods. It was a month of two halves in terms of temperatures, with cold weather bringing some precipitation as snow in the first half of the month. In contrast to the previous three months, rainfall was below average across much of the UK, with only parts of northern and western Britain recording above average rainfall. River flows were generally in the normal range, with notably high flows in some catchments in north-west and south-east England. Soil moisture deficits increased slightly across most of the UK following the predominantly dry weather, but remained near average for the time of year. The seasonal recession of groundwater levels began in most index boreholes, however levels remained in the normal range or above for the time of year, and exceptionally high in some boreholes. There were modest declines in reservoir levels in most impoundments across the UK, but stocks remained near average at the national scale. Outlooks over the winter months suggested increased flood risk, however with increased soil moisture deficits and climbing evapotranspiration rates through the spring so far, this risk has now subsided and the water resources outlook for the UK overall looks healthy. However, with little appreciable rainfall so far in April and river flows receding across most of the UK, vigilance may be needed in more responsive catchments under continued dry weather, which is consistent with the short-term outlook.

Rainfall

The start of March was dominated by high pressure and a north-easterly airflow, bringing cold weather with little appreciable rainfall until an unsettled period towards mid-month. Wet and windy weather carried by the Jet Stream (e.g. 80mm recorded at Capel Curig, Caernarfonshire on the 10th) brought a wide range of impacts, including railway closures in West Yorkshire and the Midlands, power outages in the Scottish Islands, south-west England and south Wales and closures and speed restrictions on several bridges and roads due to high wind speeds. Whilst warmer and drier conditions under high pressure prevailed across the much of the UK to month-end, unsettled conditions returned to the north and west in the last week. The persistent heavy rain (e.g. 177mm recorded at Seathwaite, Cumbria on the 29th) caused disruption on a number of main roads in Scotland on the 28th and 29th. For March overall, rainfall was moderately below average for the UK, with large parts of the country recording less than 70% of average and isolated areas along the south and east coasts recording less than half the average. In contrast, rainfall was above average in north-west England and Scotland, with some upland areas recording more than 170% of average. For the winter half-year (October-March), the UK as a whole received 116% of average rainfall, with below average rainfall confined to the far north of Scotland. For the Northumbria region, the winter half-year 2020/2021 was the third wettest since 1910 (behind 2015/2016 and 1938/1939).

River flows

The recessions established at the end of February continued through the first week of March. In many catchments, there were modest increases in flows between the 10th and 13th, with flood alerts and warnings spread across much of the UK, although there were no reports of property flooding. Recessions then resumed and continued until month-end, except in the north and west which saw swift flow responses in the last few days – the second highest March daily flow was recorded on the Lune on the 28th (in a series from 1959). Mean river flows for March were in the normal range across the majority of England, Wales and Northern Ireland. Flows in a few catchments (the Taw, Tamar and Soar) were below normal, and less than half the average on the Annacloy. In contrast, flows were notably high and more than one and half times the average in responsive catchments in the north-west (Lune, Leven and Cumbrian Derwent) and some groundwater-influenced catchments in East Anglia (Stringside and Wensum). Average flows over the winter half-year (October-March) were notably high across much of England, Wales and Northern Ireland and exceptionally high in some western catchments. New record mean flows for the winter half-year were set on the Teifi, Tywi and Stringside, all in series of at least 55 years. Outflows for England & Wales over the same period were the fourth highest on record in a series from 1961.

Groundwater

With a soil moisture deficit beginning to develop across the south and east of England where rainfall was below average in March, groundwater levels fell at most Chalk sites. Levels were in the normal range in Berkshire, Wessex and the South Downs and above normal elsewhere, with exceptionally high levels in northern East Anglia and some groundwater flood alerts remaining in place at the end of the month (mostly in Hertfordshire). Levels rose in the Magnesian Limestone and were exceptionally high, with a record high for March set at Brick House Farm. Groundwater levels fell in the Jurassic limestones, but remained in the normal range or above. In the Carboniferous Limestone levels fell and were in the normal range. Levels continued to rise and were exceptionally high in the northern Permo-Triassic sandstones, with a record high at Weir Farm for the third consecutive month. At Nuttalls Farm and Bussels No.7a levels fell and moved into or towards the normal range. In the Upper Greensand at Lime Kiln Way levels fell and were above normal for the time of year; levels also fell at Royalty Observatory in the Fell Sandstone.

Note: Due to unforeseen circumstances no data are available for Scotland.

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 1981-2010 average.

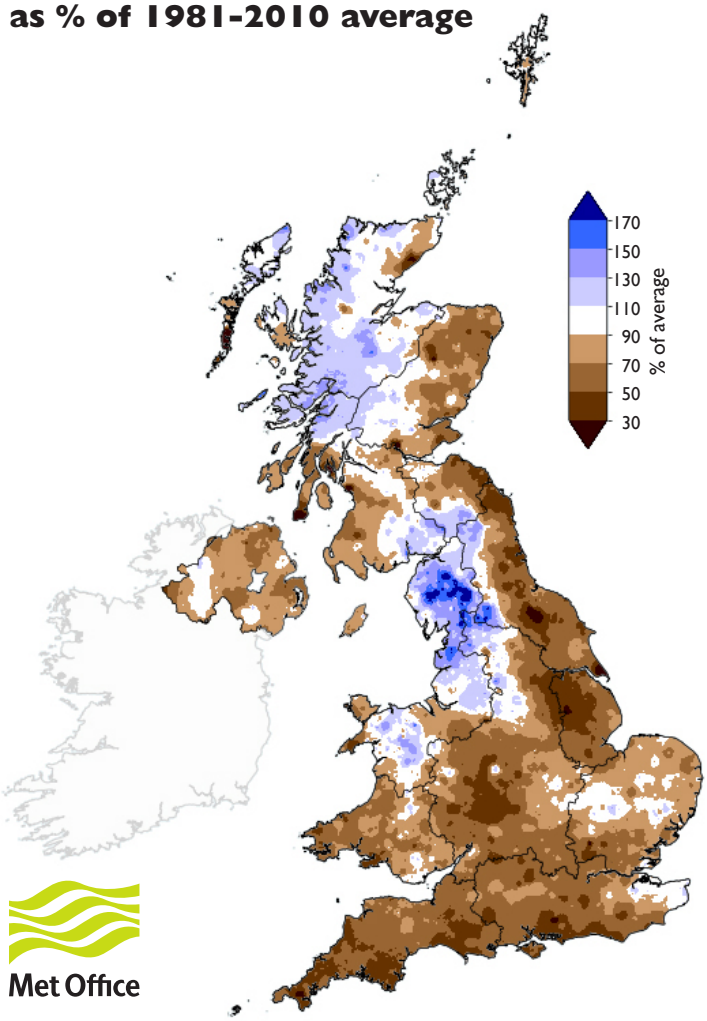
Region	Rainfall	Mar 2021	Jan21 – Mar21	RP	Oct20 – Mar21	RP	Jul20 – Mar21	RP	Apr20 – Mar21	RP
United Kingdom	mm	**84**	323		766		1055		1223	
	%	**91**	108	5-10	116	20-30	115	20-35	108	8-12
England	mm	**50**	247		580		800		926	
	%	**79**	121	5-10	124	10-20	120	8-12	110	2-5
Scotland	mm	**140**	418		1005		1379		1606	
	%	**103**	95	2-5	108	8-12	109	10-15	106	5-10
Wales	mm	**97**	460		1056		1423		1615	
	%	**85**	123	5-10	122	15-25	122	20-30	114	8-12
Northern Ireland	mm	**74**	300		714		1067		1248	
	%	**78**	102	2-5	111	10-15	117	40-60	110	10-20
England & Wales	mm	**56**	276		646		885		1020	
	%	**81**	121	5-10	123	10-20	120	10-15	110	5-10
North West	mm	**129**	439		919		1317		1501	
	%	**132**	141	50-80	129	70-100	131	>100	122	50-80
Northumbria	mm	**55**	308		618		853		976	
	%	**83**	144	40-60	130	30-50	124	10-20	112	5-10
Severn-Trent	mm	**41**	223		508		711		831	
	%	**73**	124	2-5	123	8-12	118	5-10	106	2-5
Yorkshire	mm	**55**	284		580		834		967	
	%	**85**	138	10-20	126	10-20	127	10-15	115	5-10
Anglian	mm	**33**	171		404		581		667	
	%	**75**	125	5-10	129	10-15	122	5-10	107	2-5
Thames	mm	**31**	176		492		664		773	
	%	**61**	105	2-5	126	5-10	119	5-10	108	2-5
Southern	mm	**37**	199		573		709		801	
	%	**64**	101	2-5	121	5-10	110	2-5	100	2-5
Wessex	mm	**40**	208		577		760		901	
	%	**59**	94	2-5	111	2-5	107	2-5	102	2-5
South West	mm	**51**	334		858		1110		1308	
	%	**54**	101	2-5	114	5-10	111	2-5	106	2-5
Welsh	mm	**89**	439		1017		1372		1562	
	%	**82**	123	5-10	123	15-25	123	20-30	114	10-15
Highland	mm	**198**	458		1127		1464		1759	
	%	**115**	83	2-5	98	2-5	96	2-5	97	2-5
North East	mm	**69**	246		705		961		1119	
	%	**88**	97	2-5	123	15-25	119	10-15	111	5-10
Tay	mm	**116**	387		952		1298		1482	
	%	**98**	99	2-5	116	10-20	117	15-25	111	8-12
Forth	mm	**92**	363		823		1187		1344	
	%	**88**	107	5-10	116	15-25	120	40-60	112	10-20
Tweed	mm	**74**	353		751		1053		1205	
	%	**92**	134	20-30	129	70-100	128	60-90	118	15-25
Solway	mm	**125**	473		1037		1535		1753	
	%	**99**	118	8-12	116	20-30	125	>100	118	70-100
Clyde	mm	**159**	529		1236		1769		2022	
	%	**97**	101	2-5	111	10-15	115	20-30	111	15-25

% = percentage of 1981-2010 average *RP = Return period*

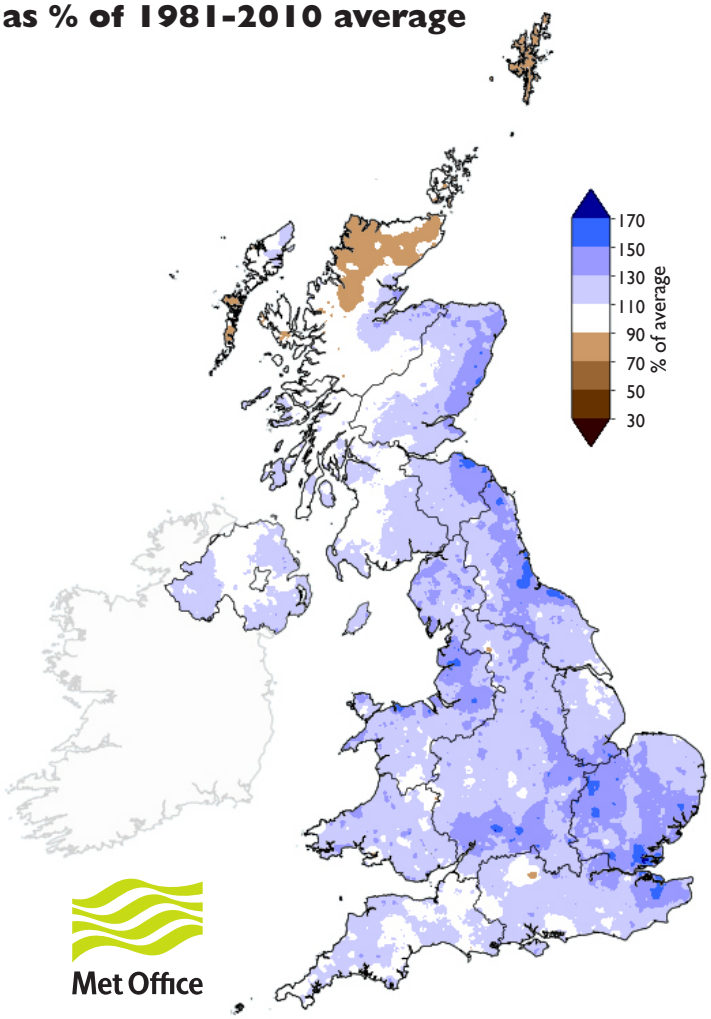
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 Janaruy 2018 are provisional.

Rainfall . . . Rainfall . . .

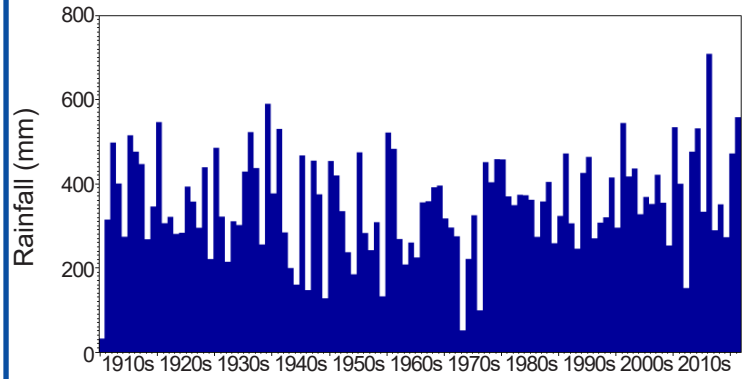
March 2021 rainfall
as % of 1981-2010 average



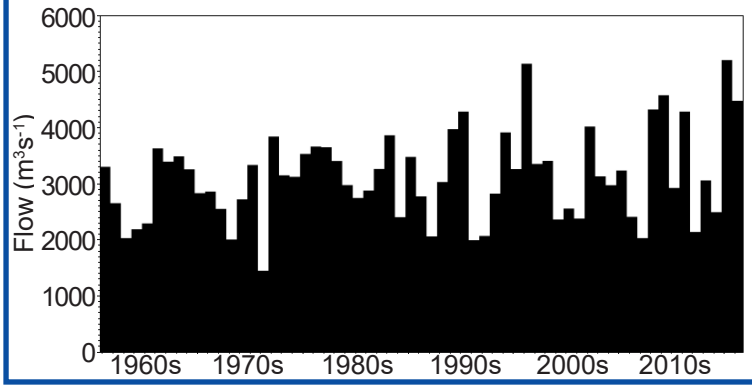
October 2020 - March 2021 rainfall
as % of 1981-2010 average



October - March rainfall for Northumbria region



October - March mean outflows for England & Wales



Hydrological Outlook UK

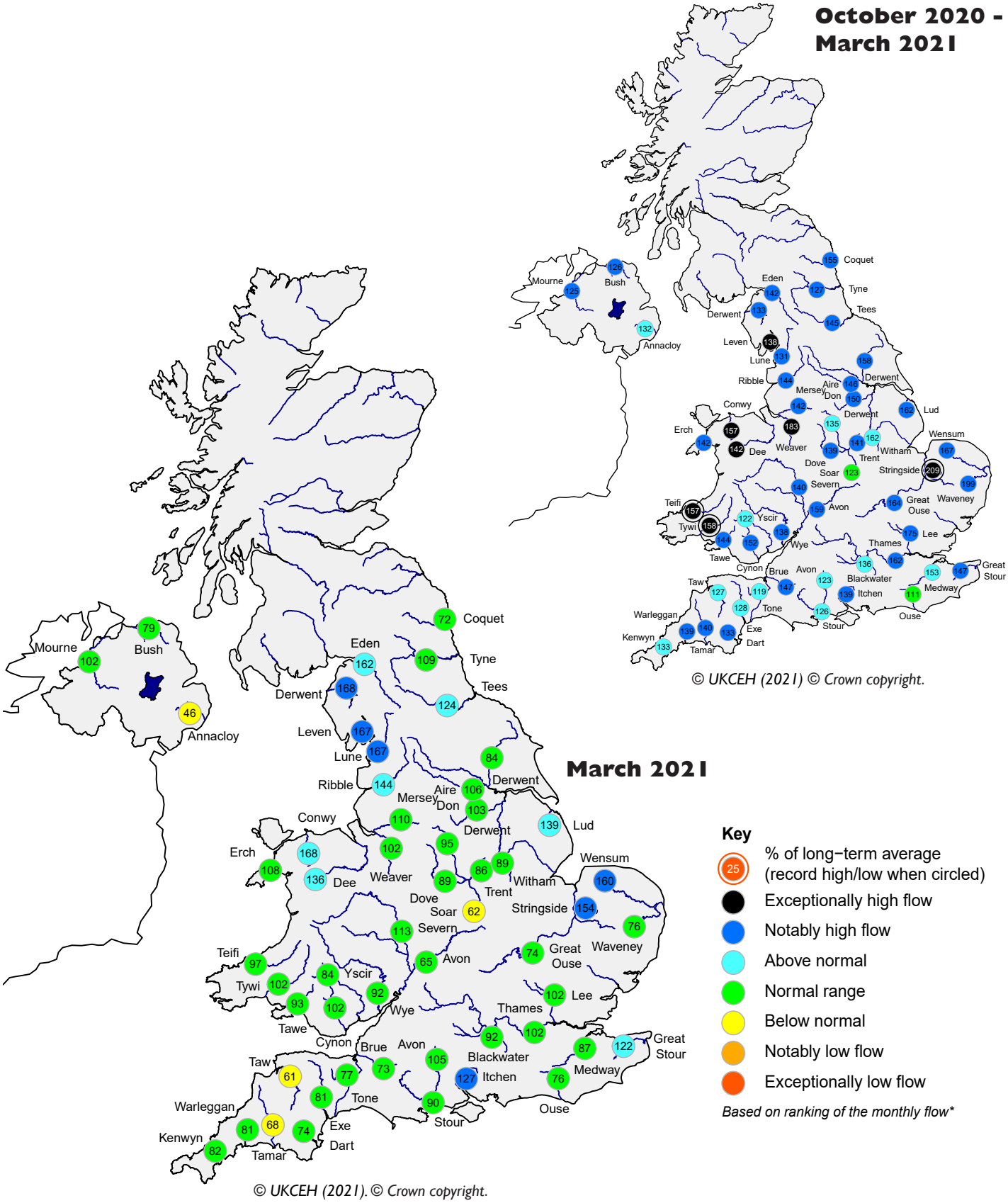
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from April 2021**
Issued: **09.04.2021**
using data to the end of March 2021

The outlook for April, and for the next three months is for river flows and groundwater levels in the south-east of England to be normal to above normal, with above normal flows being most likely in the groundwater fed catchments in this region. Elsewhere, river flows are likely to be within the normal range over the next three months. Groundwater levels across the UK are likely to show local variability over the April-May-June period.

River flow . . . River flow . . .

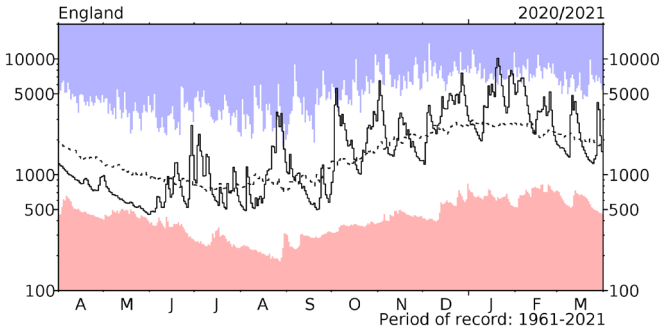


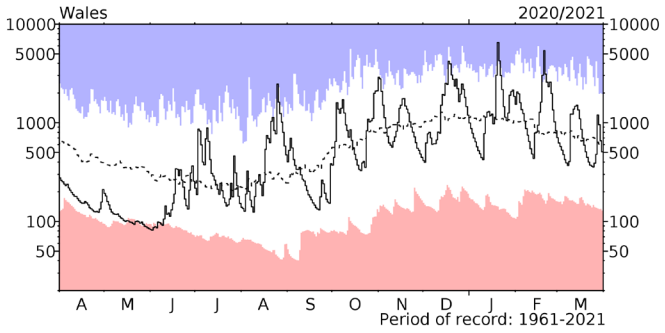
River flows

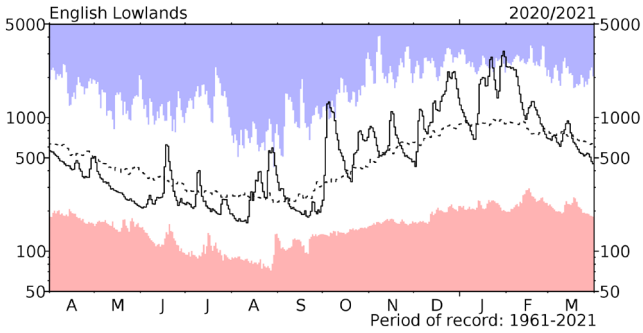
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the averaging period on which these percentages are based is 1981-2010. Percentages may be omitted where flows are under review.

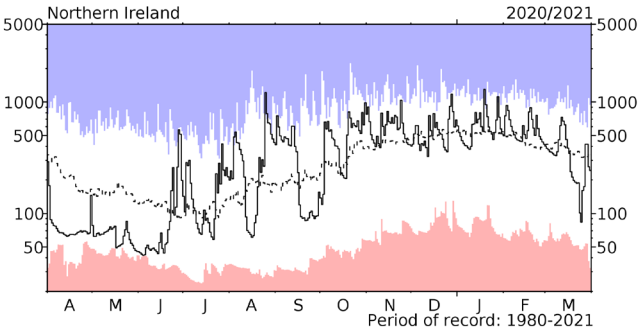
Note: Due to unforeseen circumstances no data are available for Scotland.

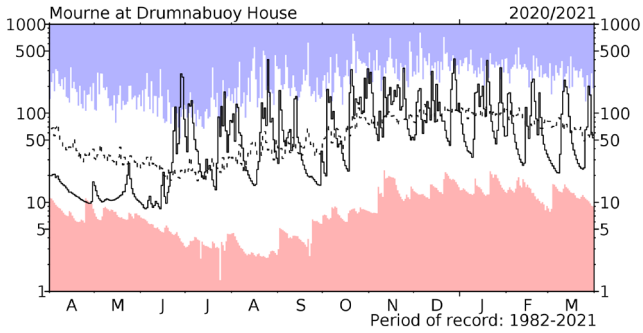
River flow . . . River flow . . .

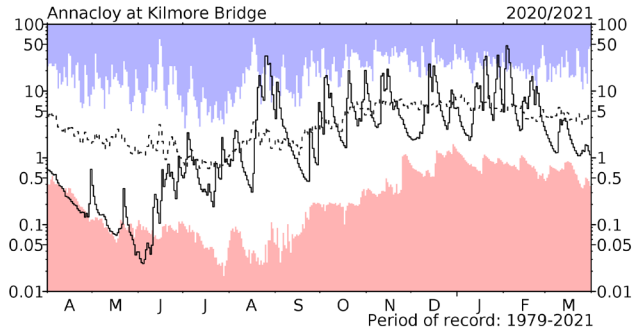


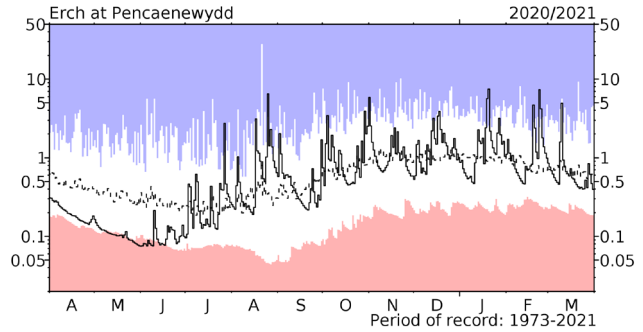


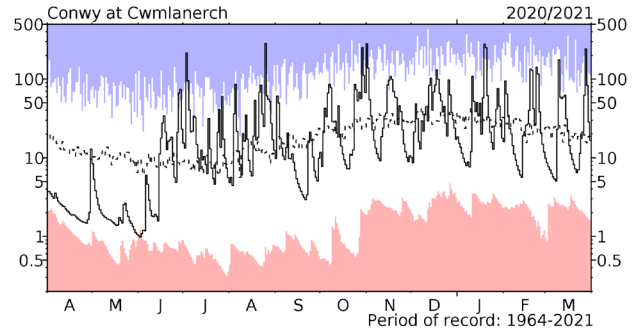


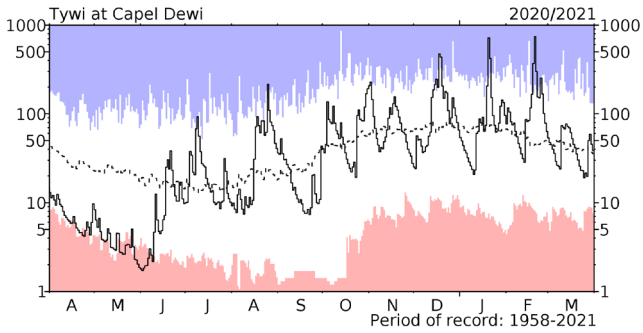


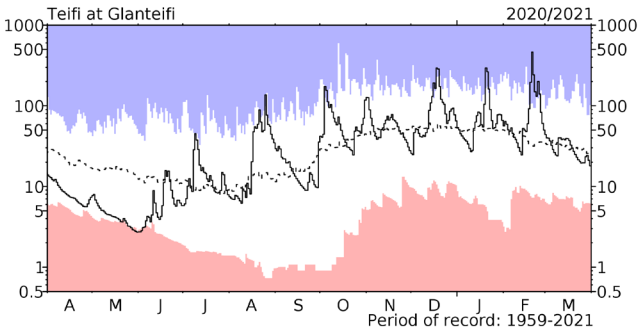








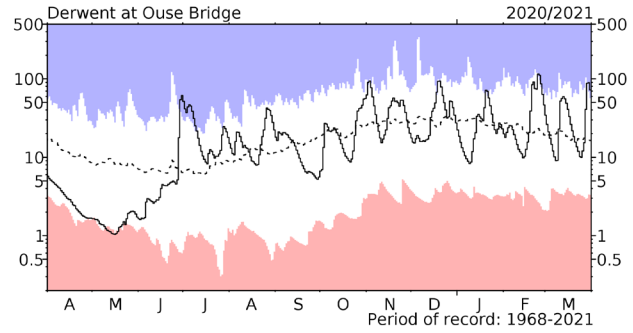


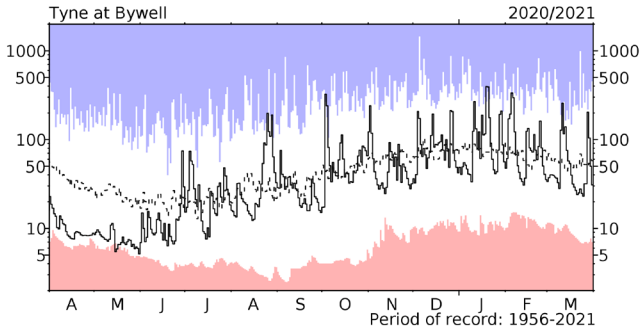


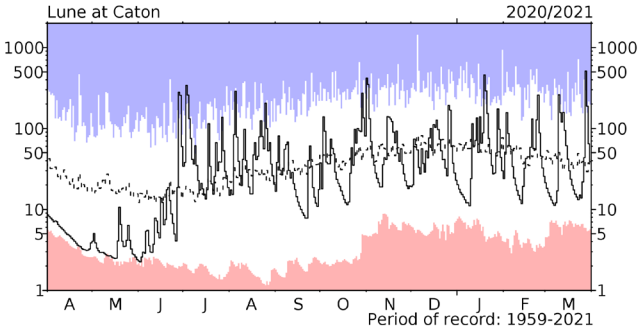
River flow hydrographs

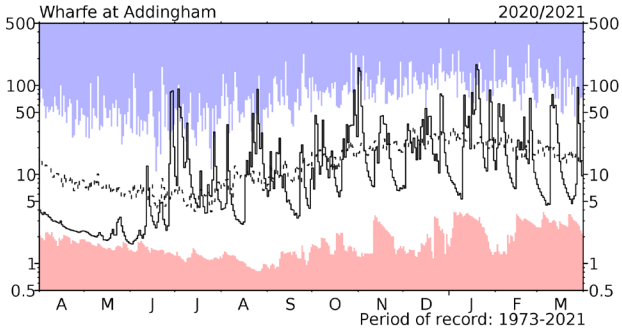
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to April 2020 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

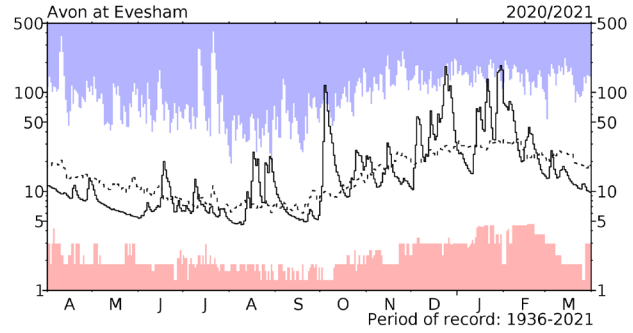
River flow . . . River flow . . .

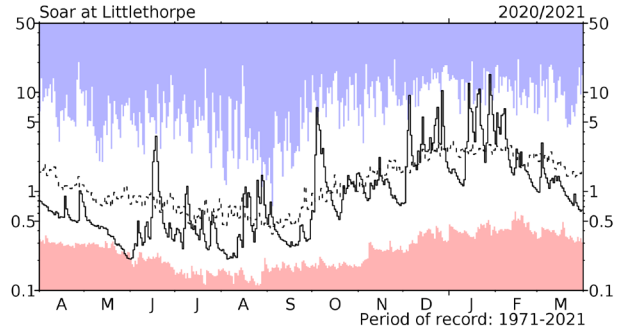


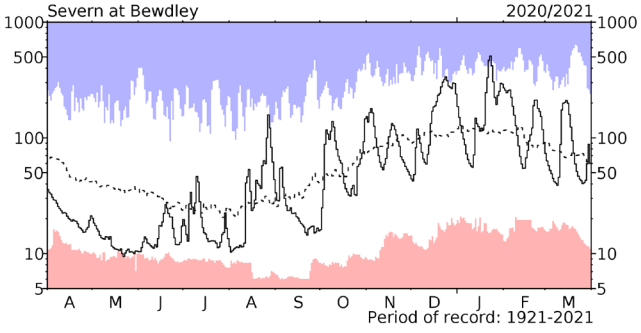


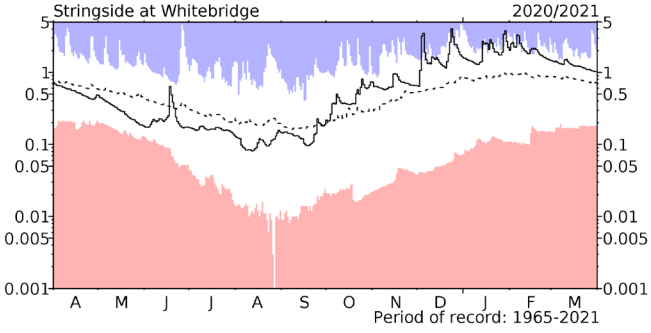


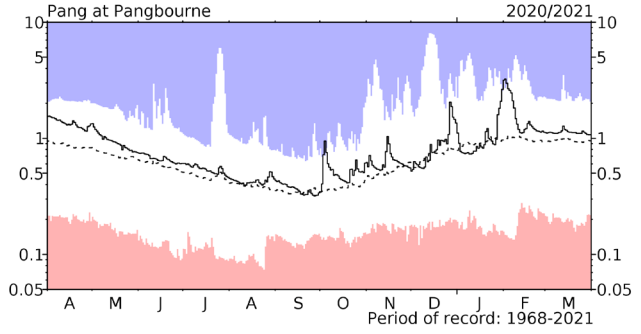


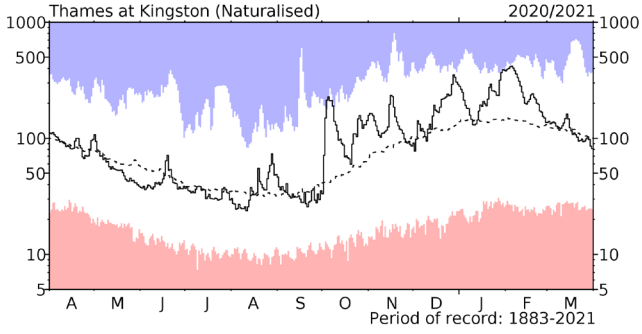


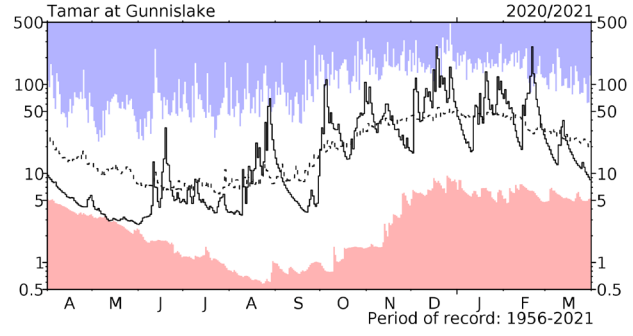


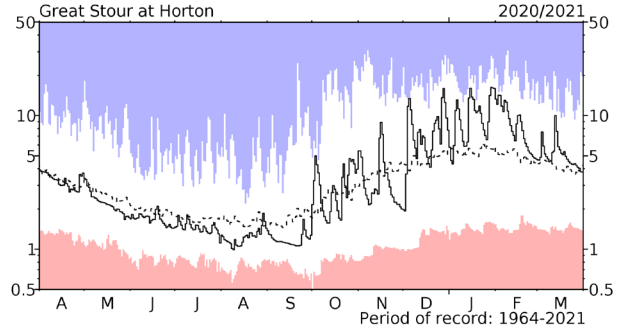




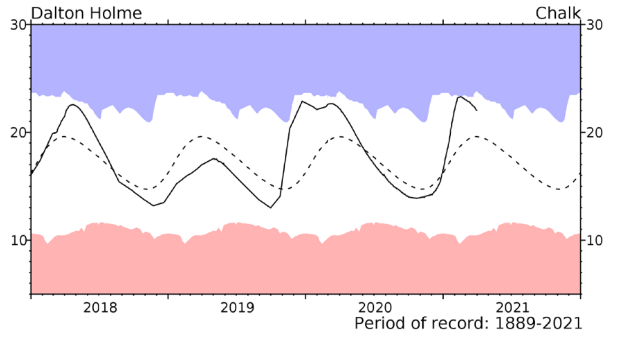


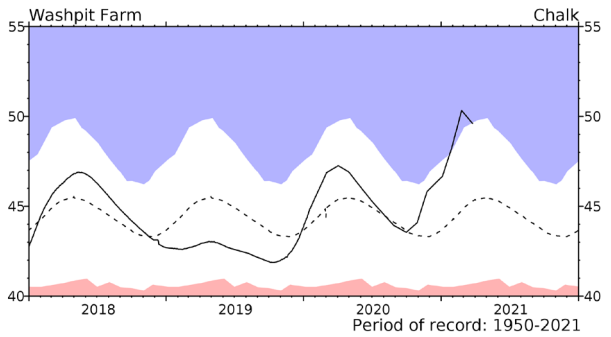


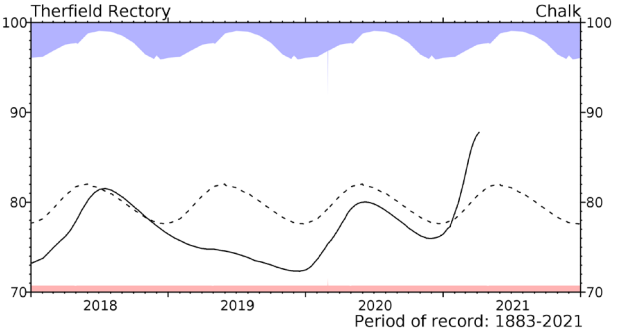


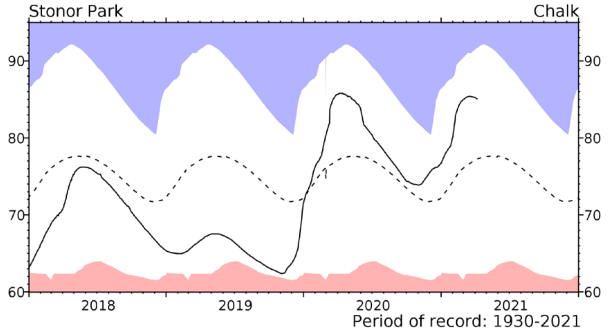


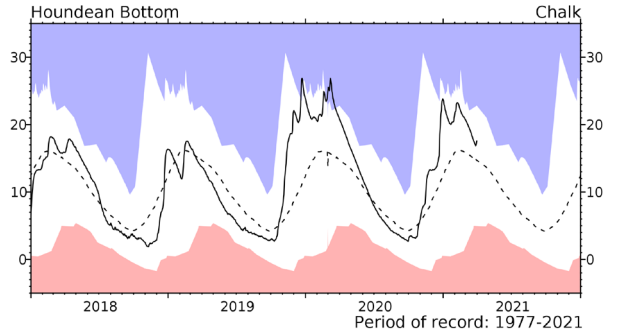
Groundwater…Groundwater

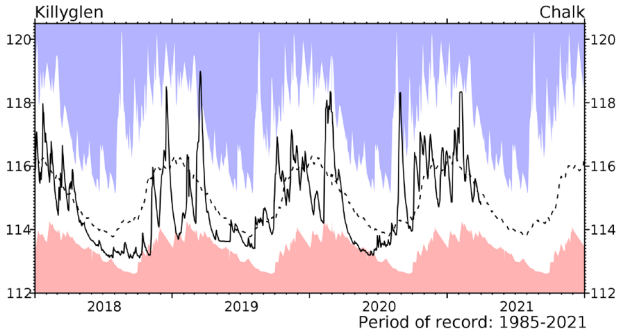


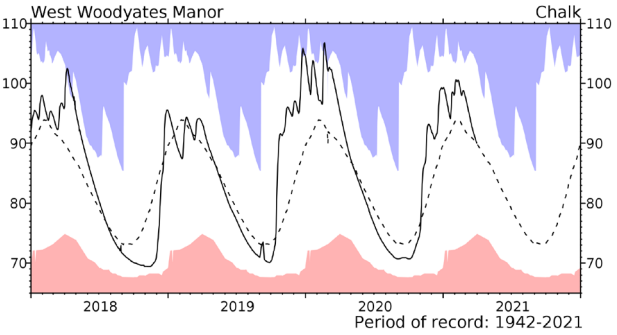


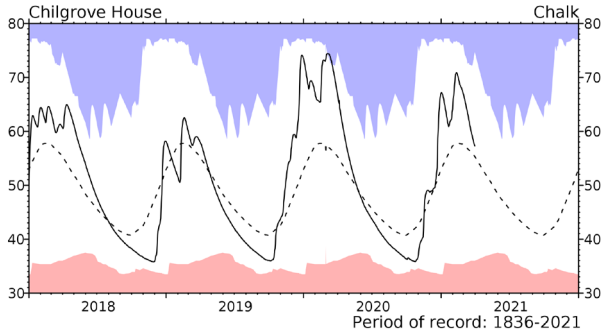


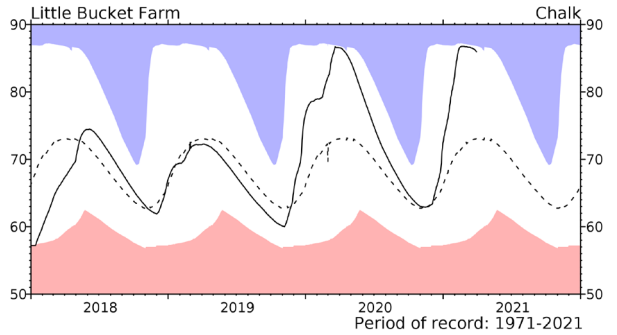


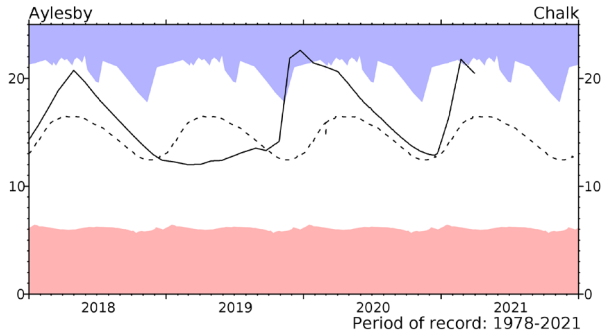






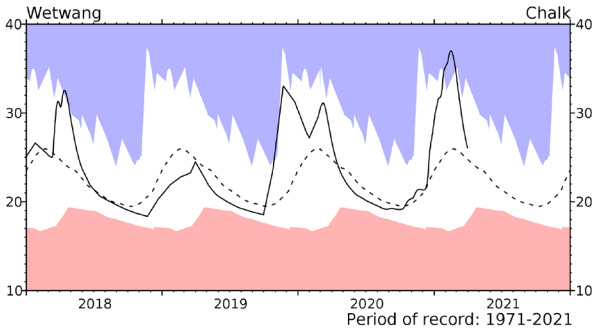


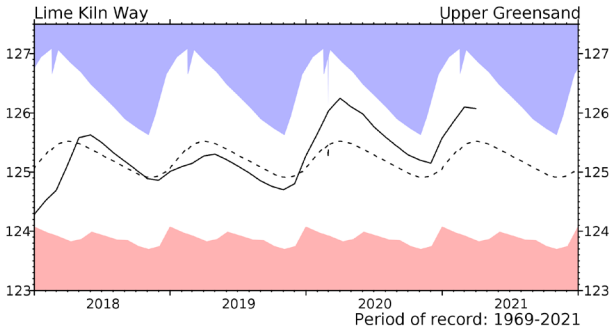


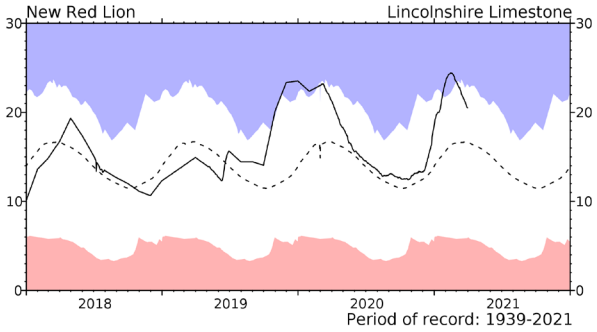


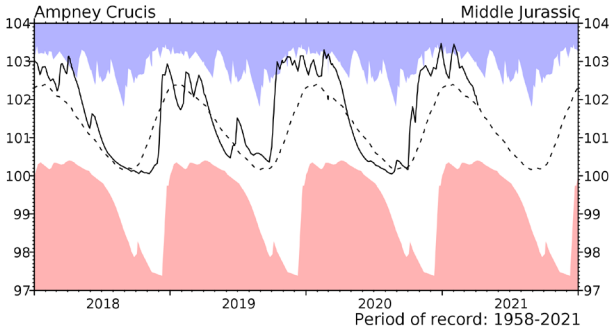
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is 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 2017. Note that most groundwater levels are not measured continuously and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation.

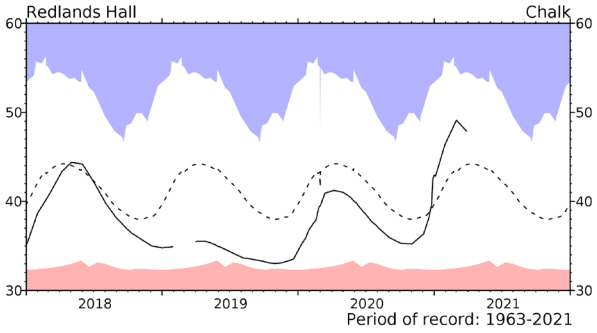
Groundwater…Groundwater

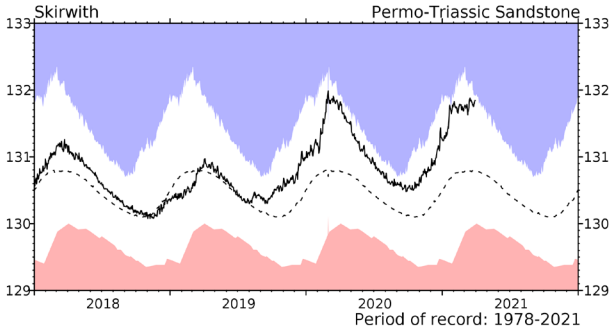


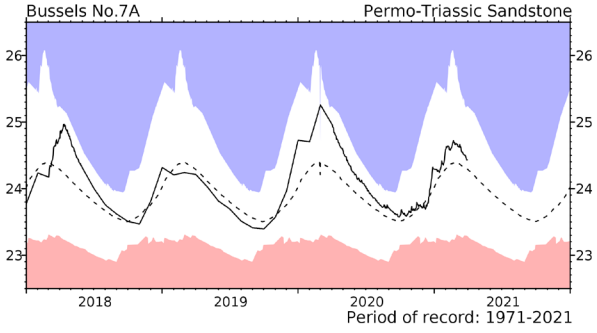


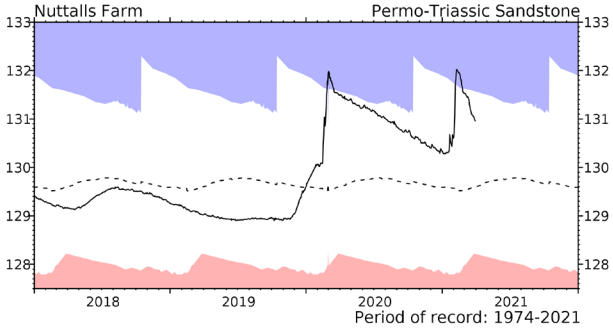


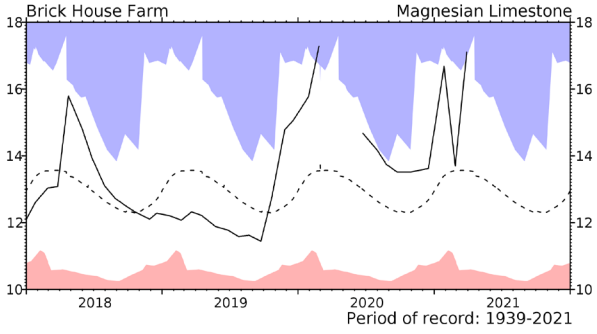


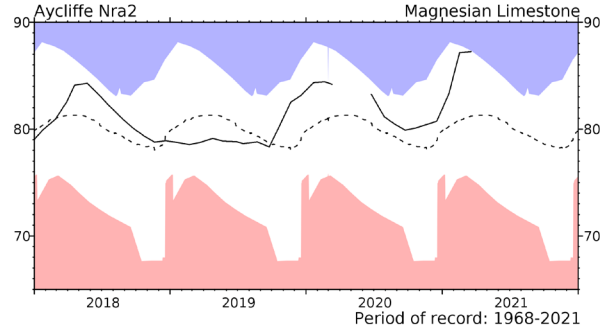


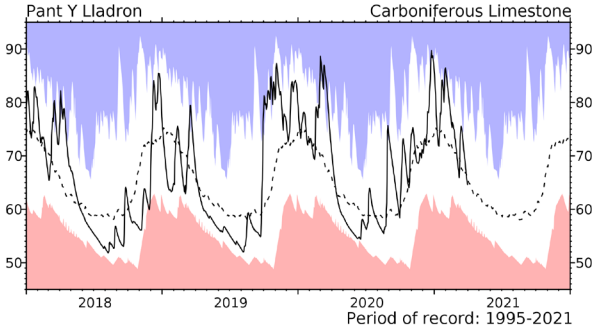


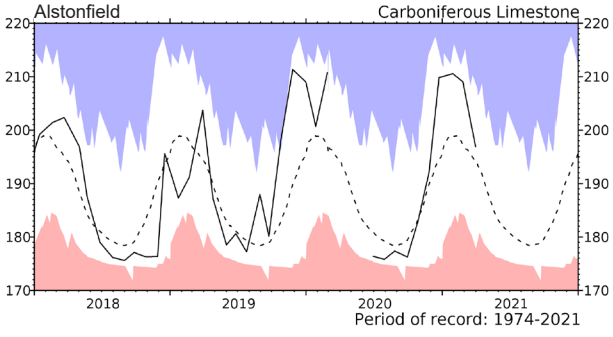


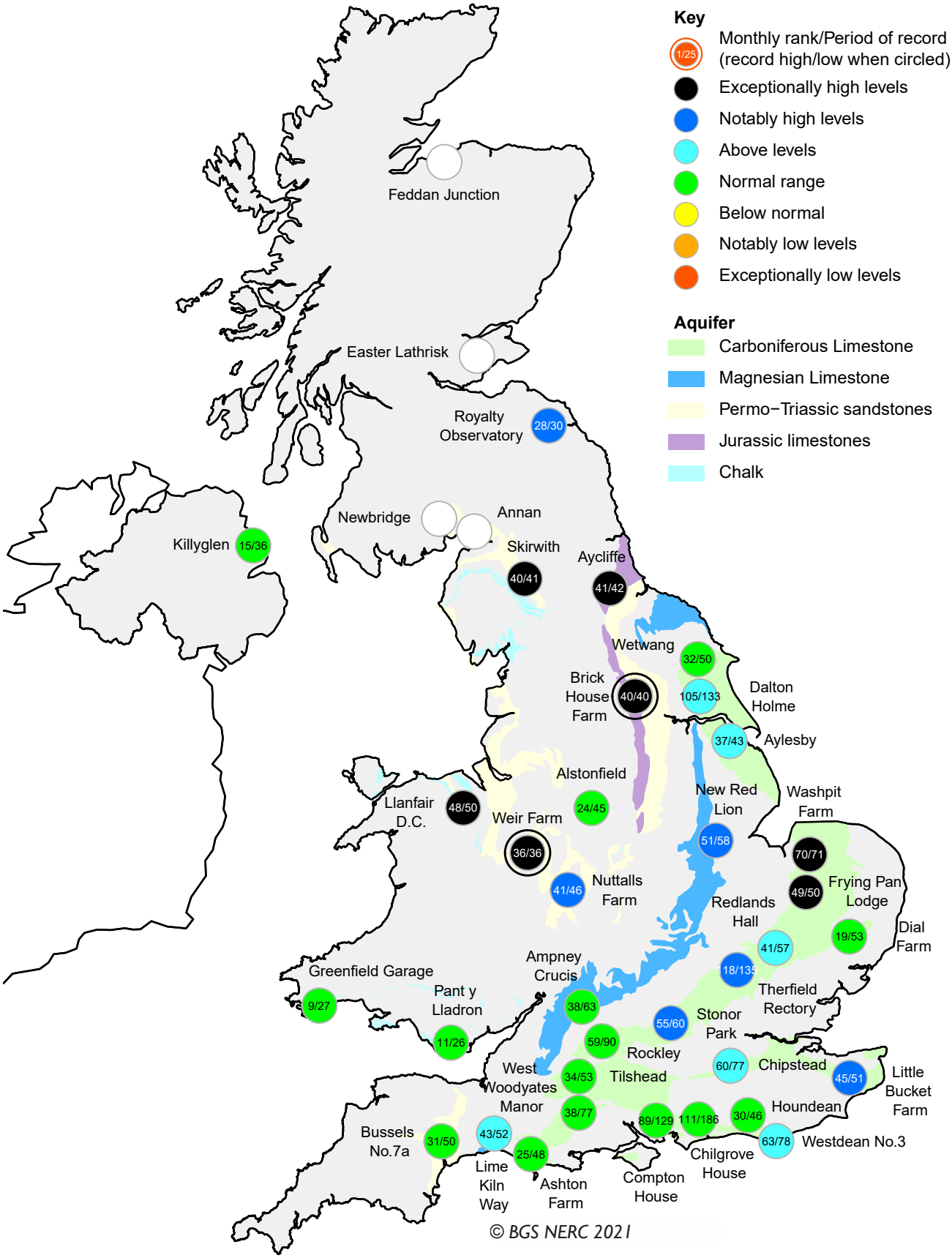












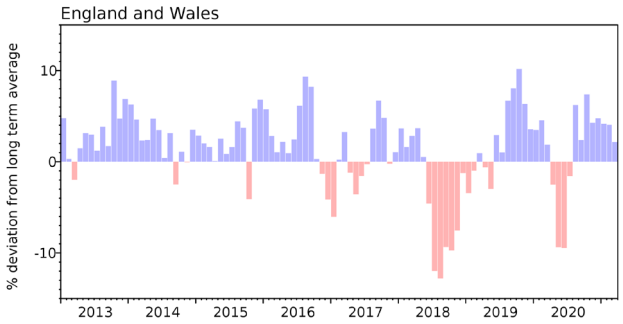
Groundwater levels - March 2021

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.

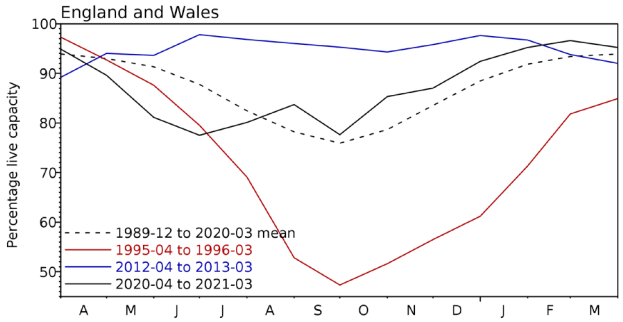
Note: Due to unforeseen circumstances no data are available for Scotland.

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)	2021 Jan	2021 Feb	2021 Mar	Mar Anom.	Min Mar	Year* of min	2020 Mar	Diff 21-20
North West	N Command Zone	•	124929	96	96	100	8	77	1993	93	7
	Vyrnwy		55146	98	98	99	3	64	1996	98	1
Northumbrian	Teesdale	•	87936	95	92	82	-11	77	2003	88	-6
	Kielder		(199175)	92	99	93	1	81	1993	92	1
Severn-Trent	Clywedog		49936	94	96	98	3	86	1996	97	1
	Derwent Valley	•	46692	99	97	97	1	54	1996	96	1
Yorkshire	Washburn	•	23373	96	82	83	-11	70	1996	94	-11
	Bradford Supply	•	40942	100	99	91	-3	59	1996	97	-6
Anglian	Grafham		(55490)	83	82	92	1	77	1997	88	4
	Rutland		(116580)	93	96	96	5	73	2012	95	1
Thames	London	•	202828	94	96	97	3	88	1990	95	3
	Farmoor	•	13822	89	98	98	3	80	2013	99	-1
Southern	Bewl		31000	88	90	92	1	49	2012	99	-7
	Ardingly		4685	100	100	100	2	51	2012	100	0
Wessex	Clatworthy		5662	100	100	100	3	82	1992	100	0
	Bristol	•	(38666)	99	99	97	3	71	1992	98	-1
South West	Colliford		28540	87	93	94	6	58	1997	92	2
	Roadford		34500	99	100	97	11	37	1996	99	-2
	Wimbleball		21320	100	100	100	3	78	1996	100	0
	Stithians		4967	100	100	98	3	52	1992	100	-3
Welsh	Celyn & Brenig	•	131155	100	100	97	-1	72	1996	96	1
	Brianne		62140	100	99	97	-1	90	1993	97	0
	Big Five	•	69762	99	98	97	1	78	1993	97	0
	Elan Valley	•	99106	96	100	96	-2	89	1993	100	-4
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	99	99	98	3	71	1998	97	1
	East Lothian	•	9317	100	100	100	1	95	2012	100	0
Scotland(W)	Loch Katrine	•	110326	99	100	98	5	74	2010	95	3
	Daer		22494	100	99	99	2	77	2013	95	4
	Loch Thom		10721	93	100	88	-9	83	2020	83	5
Northern Ireland	Total+	•	56800	100	99	96	5	83	2002	98	-1
	Silent Valley	•	20634	100	99	93	5	57	2000	96	-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.

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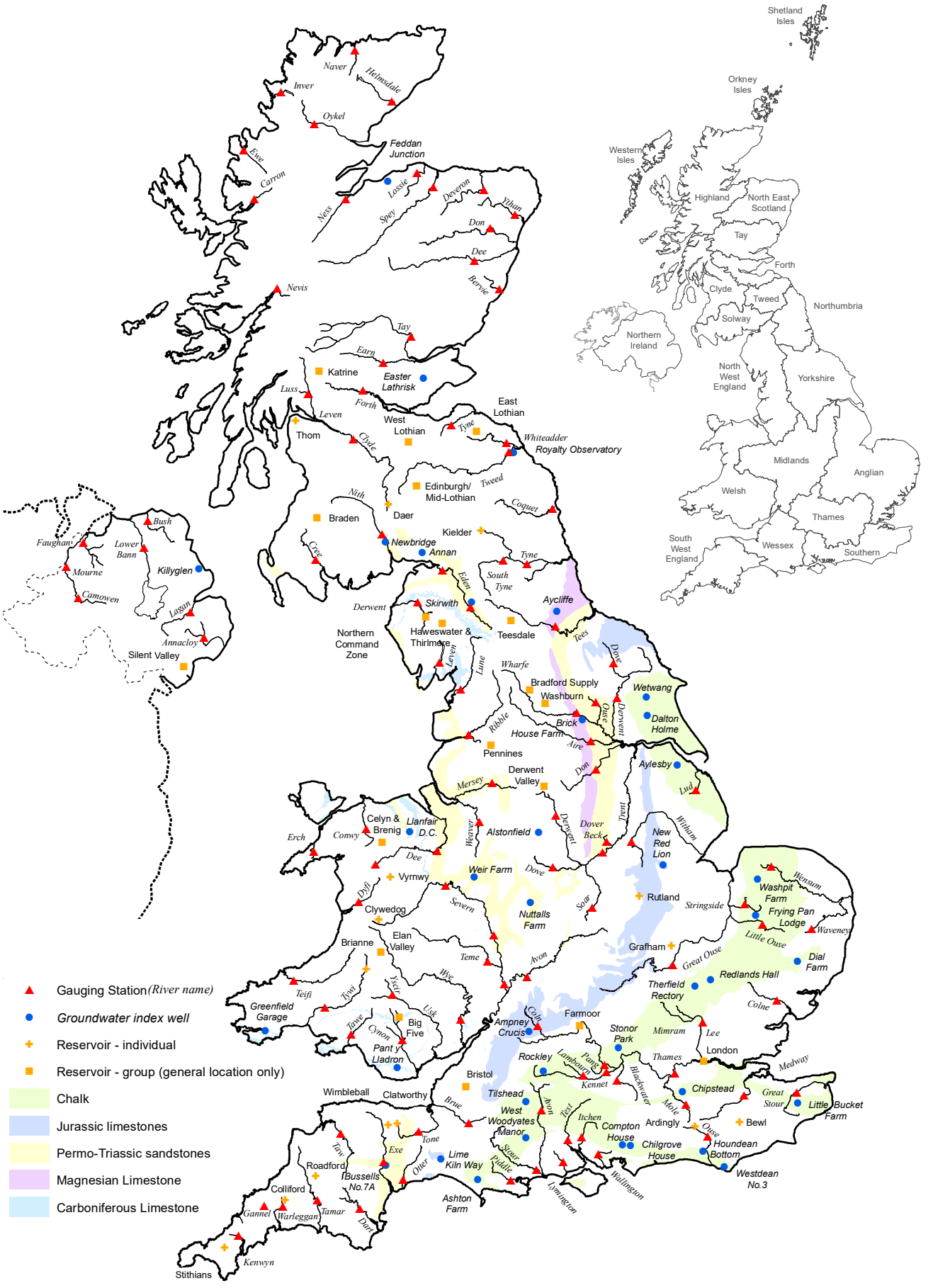
Location map…Location map



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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 1981-2010 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.

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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