Hydrological Summary

for the United Kingdom

March 2020

General

March was a characteristically transitional spring month: an unsettled first half with wet and occasionally wintry conditions gave way to a largely fine and dry second half. Average temperatures for the month were typical and rainfall totals were near-average or below (markedly so in eastern Britain). While March was relatively quiescent, meteorologically, it was notable for the continuing hydrological response to the exceptionally wet February. River flows were substantially above average across large parts of the country, with notable peak flows in some catchments early in the month. Correspondingly, the widespread floodplain inundations seen in late February continued into early March, with more modest property damage than prior months but significant disruption and locally severe impacts. The risk of further flooding diminished as more settled anticyclonic conditions prevailed in the second half of March, resulting in rapid drying of soils and steep recessions in responsive rivers. While groundwater recessions commenced at over half the index boreholes by month-end, levels increased in some boreholes and notable or exceptionally high March levels were widespread (with groundwater flood warnings, e.g. in Dorset into the final week). Given above-average March groundwater levels and flows, and near-average reservoir stocks at the national scale, the water resources situation is healthy. However, the continued intensification of soil moisture deficits (SMDs) and river flow recessions into early April, coupled with current outlooks which favour drier spring conditions, suggests vigilance will be needed in more responsive catchments, as evapotranspiration rates climb through the spring.

Rainfall

March got off to an unsettled start, with strong winds (including the remnants of storm Jorge at the turn of the month) and cool and showery conditions (with some snow on higher ground) in the first few days, and more organised rainfall in southern and eastern areas on the 4th/5th. It then turned milder, with further belts of heavy rainfall on the 7th-9th (with 107mm on Skye on the 8th, and 78mm at Mickleden, Cumbria, on the 9th), and showery outbreaks through to mid-month. Anticylonic conditions then became established, bringing a more spring-like spell of dry and sunny weather. The settled conditions persisted to month-end and, while there were frontal incursions in the west and a wintry outbreak in eastern areas on the 28th, the majority of England and Wales received little appreciable rainfall in the last 10 days. March rainfall was 84% of average for the UK as a whole and was substantially below average for many regions. Some eastern areas were particularly dry: Anglian and North East Scotland received around half the average, the driest March since 2011 and 2012, respectively, for these regions. In contrast, parts of western Scotland, southern England and upland areas of northern England and Wales recorded near- or modestly above-average rainfall. Exceptional rainfall accumulations over longer timescales generally reflect the remarkably wet February and the other wet months in the winter half-year.

River flows

Flows in a significant majority of rivers were exceptionally high entering March. Rainfall from storm Jorge at the turn of the month triggered Flood Warnings across western Britain – of particular concern were large rivers which were only beginning to recede from near-record levels in late February. Flood Warnings were present across the length of the river Severn in the opening days and on the 2nd, the second highest March peak flow was registered (at Bewdley, a record from 1929). While levels began to recede after the opening days, persistent floodplain inundations continued to cause impacts in low-lying downstream areas of the Severn and other major rivers (e.g. the Ouse washlands in East Yorkshire). Rainfall on the 4th/5th triggered flooding in flashy catchments in south-east England (the Sussex Ouse and the Mole registered their highest March peak flows in records from 1960 and 1973, respectively), while further heavy rainfall mid-month led to yet more widespread flood warnings and transport disruption in Wales. Thereafter, recessions generally became established, and dominated the remainder of the month, although flows in groundwater dominated catchments in central southern England remained notably high entering April. Mean monthly river flows for March were above normal to notably high in southern Scotland, Northern Ireland and across most of England and Wales, with exceptionally high flows in the Severn and some southern Chalk catchments. Flows were in the normal range in East Anglia, and notably low in several catchments in northeast Scotland. The exceptional flows in early March contributed to record-breaking flow accumulations for February-March across most of northern and western Britain, many approaching two and a half times the average for this period (although these figures are dominated by the February flows). A similar picture emerges for longer-term accumulations: exceptional winter half-year (October-March) average flows were registered across the UK and the majority of rivers across central England and south Wales saw their highest flows on record for this timeframe.

Groundwater*

Soil moisture deficits remained near-zero for the first half of March across the UK, but increased markedly with the dry spell of the last two weeks and were appreciably above the long-term average at month-end across the main aquifer areas of England. In the Chalk, groundwater levels were generally receding by the end of March, albeit from the high levels recorded in the winter meaning levels were still well above average, and exceptionally high in south-east England, with the second highest March levels on record at Houndean (after 2010) and Westdean No.3 (after 1947). In the Chilterns and East Anglia, however, levels continued to rise, but were generally normal or below normal. In the Jurassic limestones, levels fell from a record maximum last month to above normal at Ampney Crucis, and from exceptionally high to notably high at New Red Lion. In the Magnesian Limestone, by mid-month Aycliffe had receded and dropped to above normal. In the Carboniferous Limestone, data was only available for Greenfield Garage, where levels fell but remained above normal. In the Permo-Triassic sandstones, levels fell, with the exception of Weir Farm where a new record monthly maximum was established for a second successive month. Levels also remained exceptionally high at Newbridge, Skirwith and Nuttalls Farm where they were the second highest on record (after 2014, 2014 and 2002, respectively). In the Upper Greensand at Lime Kiln Way levels increased, remaining notably high, but had stabilised by the end of the month.

**Note: Due to COVID-19 restrictions, data was not available for some sites or was recorded mid-month.*

UK Centre for Ecology & Hydrology

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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

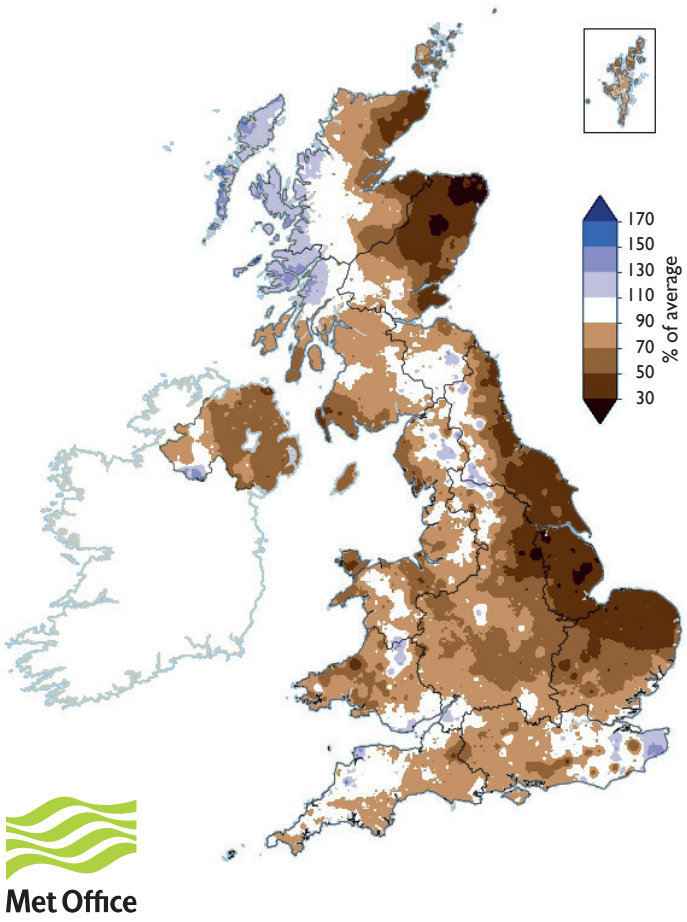
Region	Rainfall	Mar 2020	Feb20 – Mar20	RP	Oct19 – Mar20	RP	Jul19 – Mar20	RP	Apr19 – Mar20	RP
United Kingdom	mm	**78**	287		804		1152		1380	
	%	**84**	160	>100	121	60-90	126	>>100	122	>>100
England	mm	**49**	204		619		877		1068	
	%	**78**	166	30-50	132	25-40	132	30-50	126	50-80
Scotland	mm	**123**	399		1057		1544		1808	
	%	**90**	151	50-80	114	15-25	122	>100	119	>100
Wales	mm	**94**	383		1076		1456		1763	
	%	**83**	173	>100	125	20-35	125	30-50	124	70-100
Northern Ireland	mm	**69**	291		698		1054		1303	
	%	**72**	163	>100	109	5-10	116	25-40	115	40-60
England & Wales	mm	**55**	228		682		956		1163	
	%	**79**	168	40-60	130	25-40	130	40-60	126	60-90
North West	mm	**86**	372		869		1365		1603	
	%	**88**	199	>>100	122	20-35	136	>100	131	>>100
Northumbria	mm	**52**	207		554		890		1109	
	%	**79**	159	30-50	117	5-10	130	25-40	127	50-80
Severn-Trent	mm	**42**	197		590		851		1077	
	%	**74**	181	40-60	143	40-60	141	>100	138	>>100
Yorkshire	mm	**45**	233		640		923		1109	
	%	**70**	186	>100	140	40-60	140	40-60	131	70-100
Anglian	mm	**22**	104		408		570		734	
	%	**51**	125	2-5	130	10-15	120	5-10	117	5-10
Thames	mm	**42**	153		523		692		848	
	%	**83**	154	5-10	134	10-20	124	5-10	118	5-10
Southern	mm	**52**	187		631		802		950	
	%	**90**	164	10-15	134	10-20	125	8-12	119	5-10
Wessex	mm	**57**	203		680		902		1082	
	%	**85**	155	8-12	131	10-20	127	10-20	122	10-20
South West	mm	**89**	317		1013		1329		1545	
	%	**94**	162	15-25	134	25-40	132	25-40	126	20-35
Welsh	mm	**89**	361		1035		1402		1702	
	%	**82**	171	70-100	125	20-35	125	30-50	125	70-100
Highland	mm	**167**	480		1261		1778		2070	
	%	**97**	143	20-30	110	8-12	116	15-25	114	15-25
North East	mm	**38**	180		603		927		1210	
	%	**48**	116	5-10	105	2-5	114	5-10	119	15-25
Tay	mm	**88**	363		960		1375		1638	
	%	**74**	158	30-50	117	15-25	124	50-80	122	80-120
Forth	mm	**91**	345		886		1298		1539	
	%	**88**	172	>100	125	60-90	131	>>100	128	>100
Tweed	mm	**79**	295		729		1122		1344	
	%	**99**	187	>>100	125	40-60	136	>100	131	>100
Solway	mm	**100**	395		1018		1604		1843	
	%	**80**	165	>100	114	15-25	130	>>100	124	>>100
Clyde	mm	**161**	522		1330		1964		2219	
	%	**97**	166	80-120	119	30-50	128	>100	122	>100

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

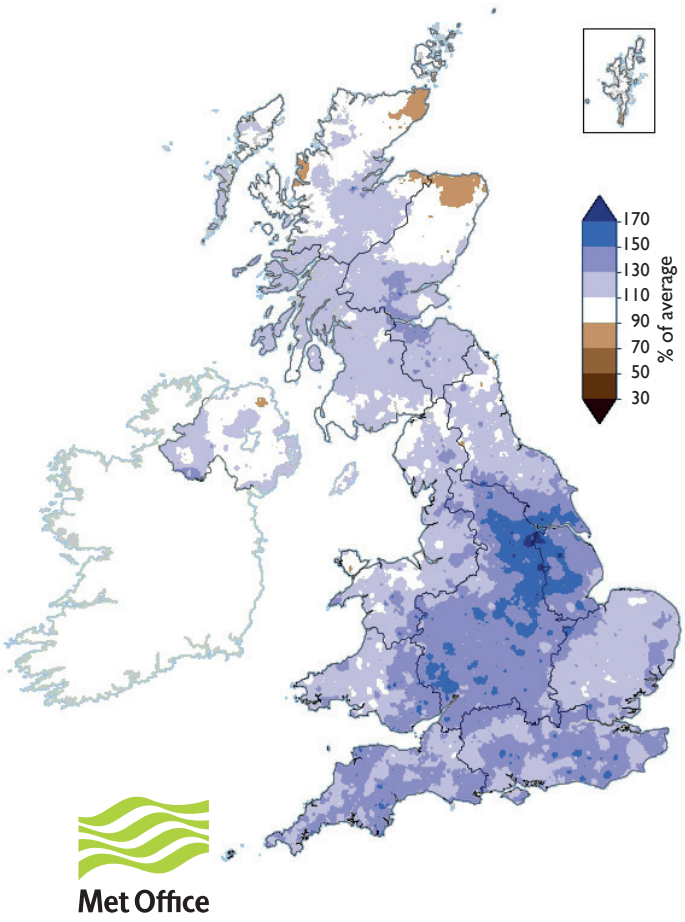
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

Rainfall . . . Rainfall . . .

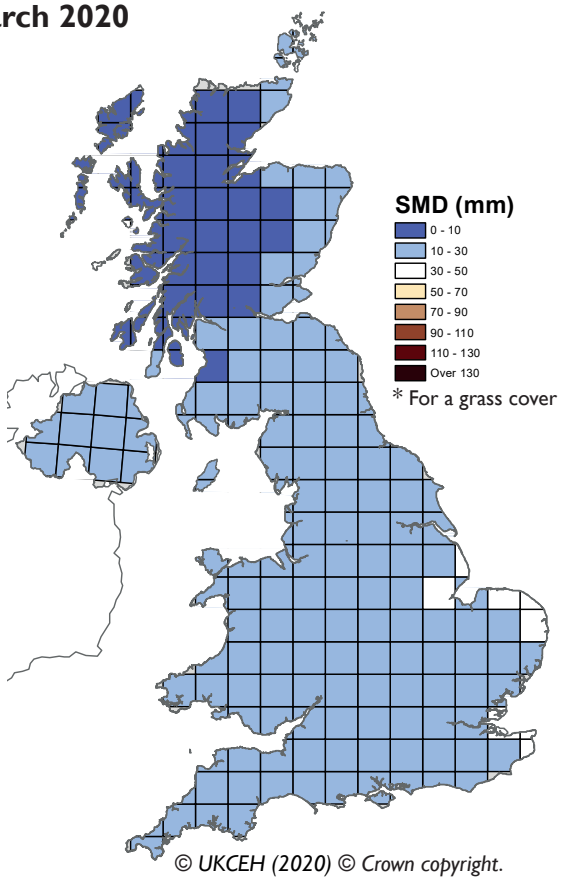
March 2020 rainfall
as % of 1981-2010 average



October 2019 - March 2020 rainfall
as % of 1981-2010 average



MORECS Soil Moisture Deficits*
March 2020



Hydrological Outlook UK

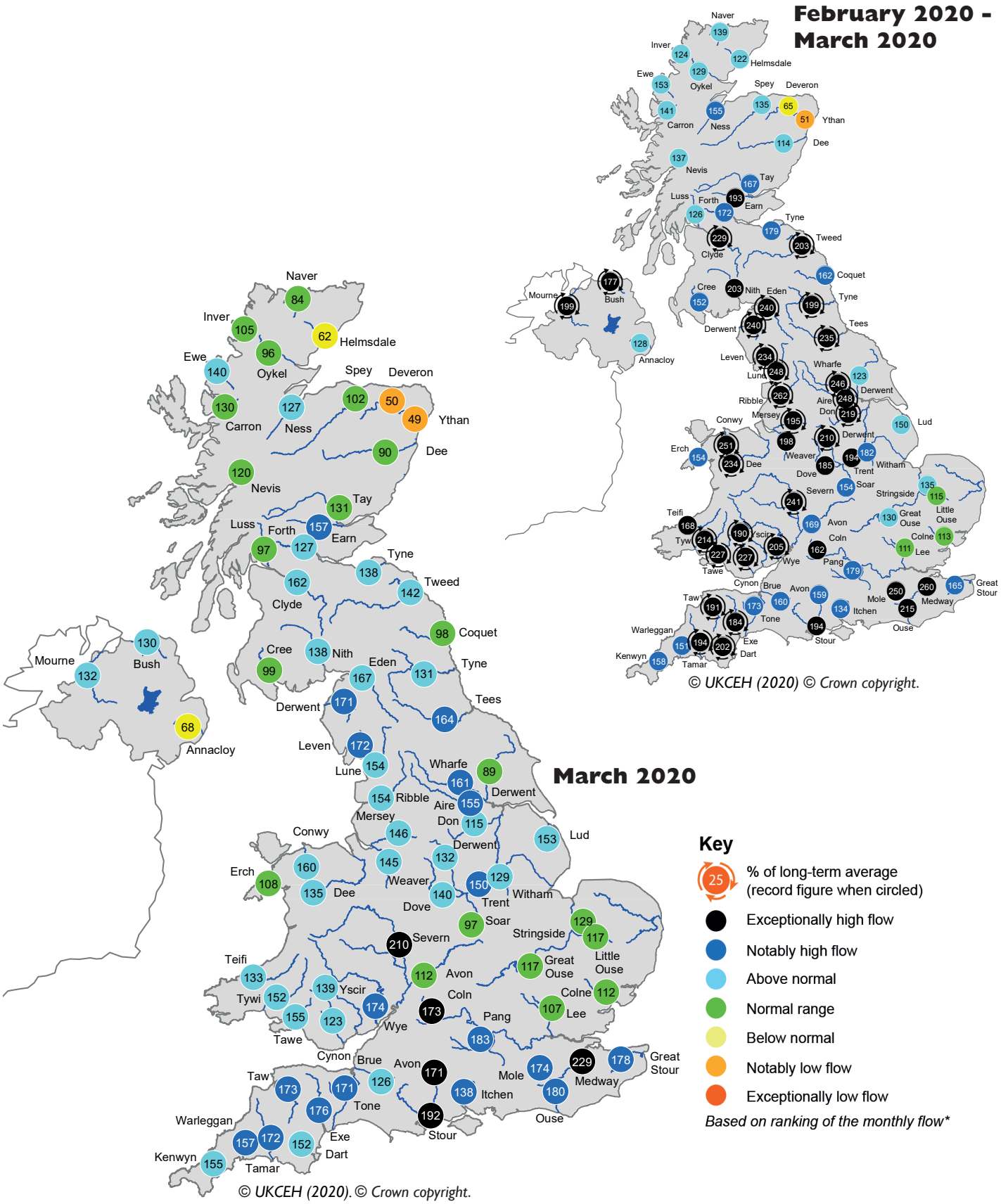
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from April 2020**
Issued: **08.04.2020**
using data to the end of March 2020

The outlook is for river flows in northern and western parts of the UK to be normal to below normal for April and over the next three months. Flows across central southern England and the East Midlands are likely to be normal to above normal for April, and within the normal range for the three month period April-June. Both river flows and groundwater levels are expected to be within the normal range in East Anglia for April and over the three months to June. Elsewhere, groundwater levels are likely to be normal to above normal for April, and normal over the next three months, with a few localised exceptionally high levels expected in the Permo-Triassic sandstones.

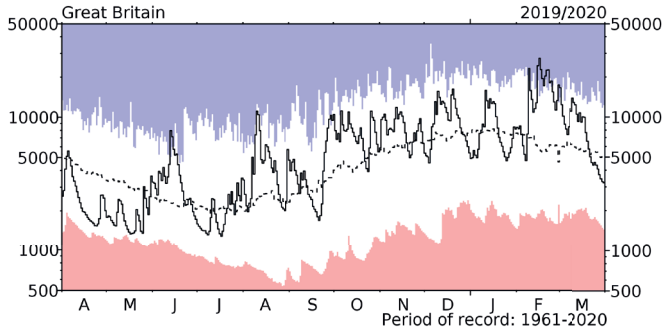
River flow . . . River flow . . .

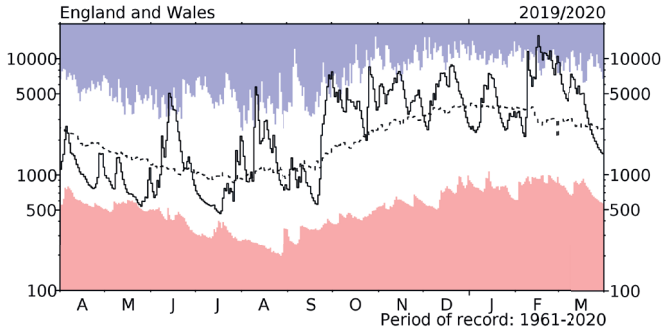


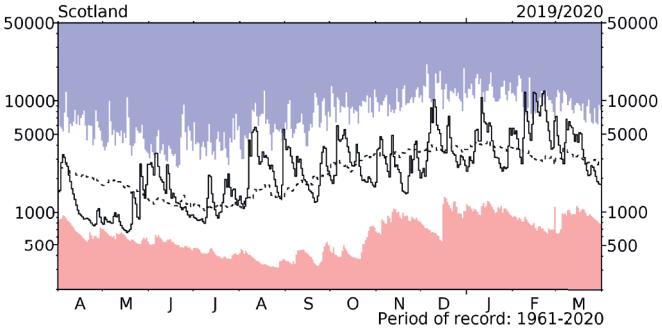
River flows

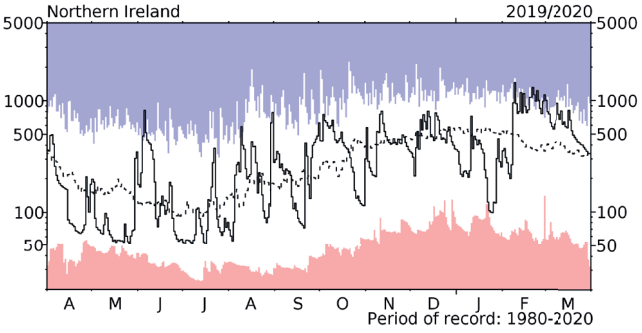
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

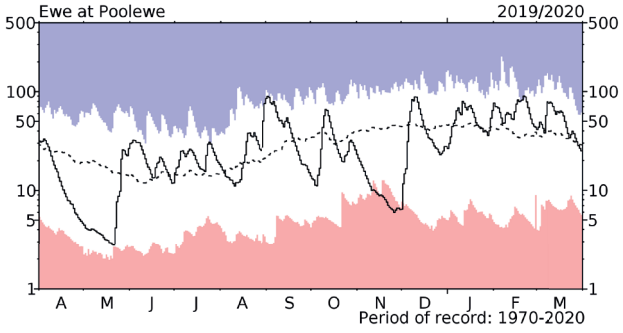
River flow . . . River flow . . .

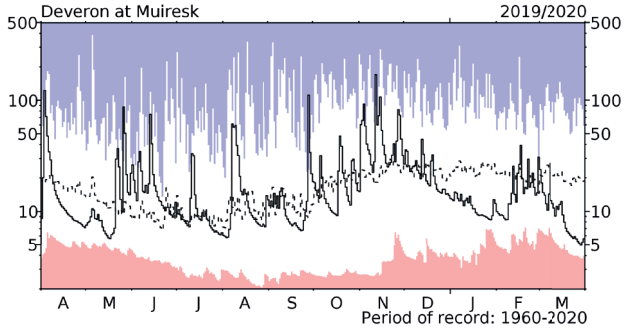


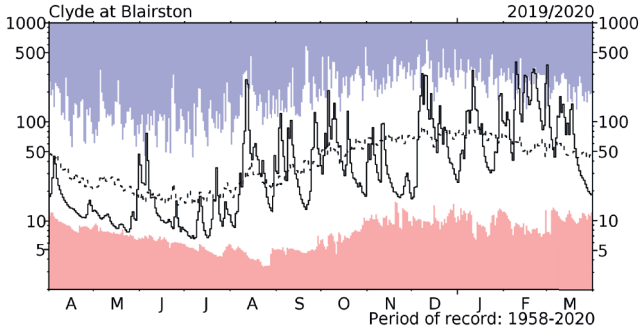


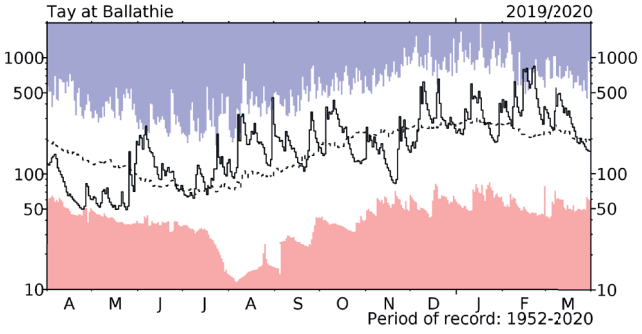


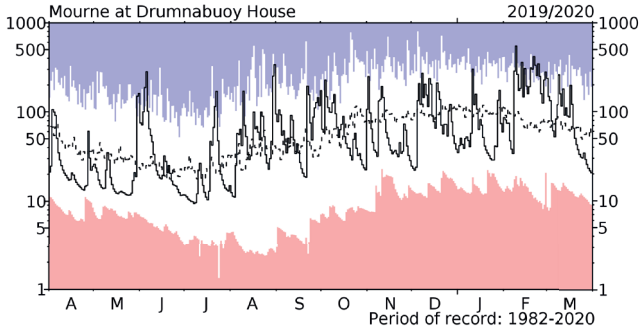


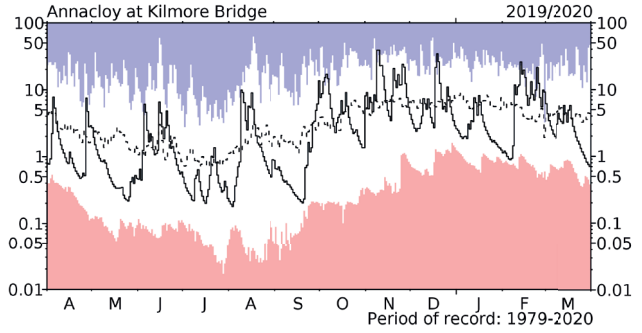








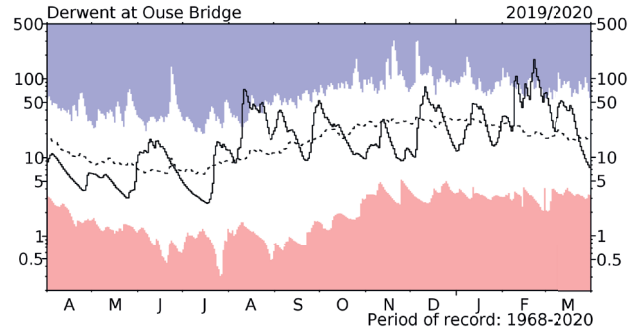


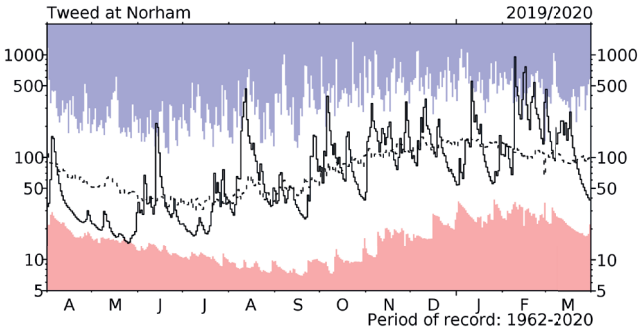


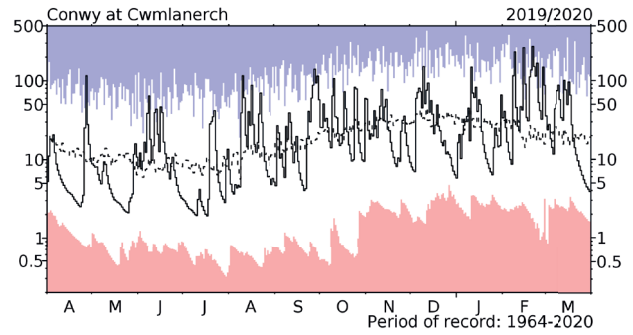
River flow hydrographs

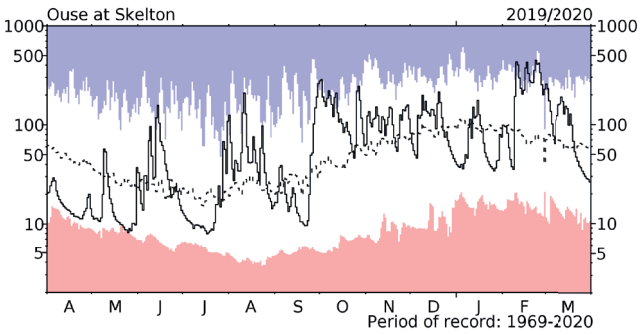
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to April 2019 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

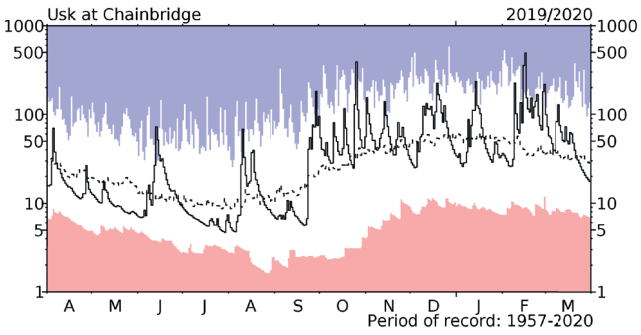
River flow . . . River flow . . .

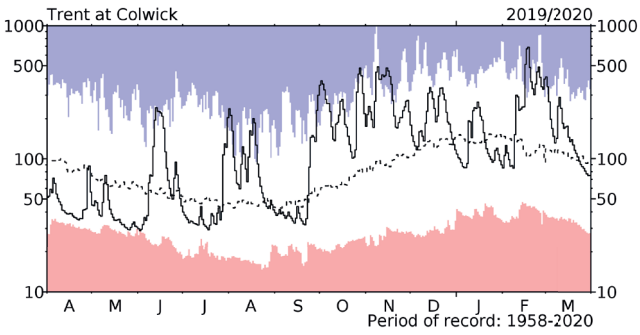


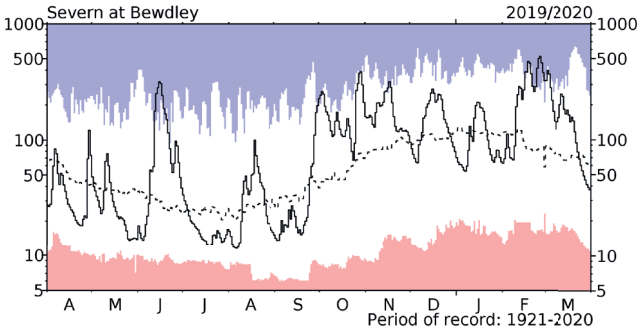


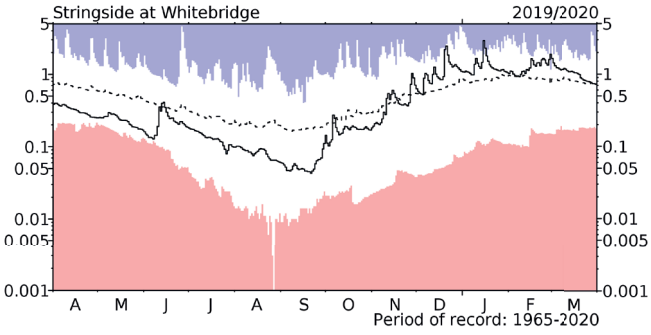


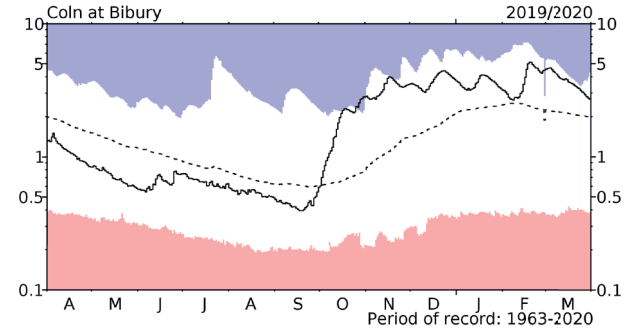


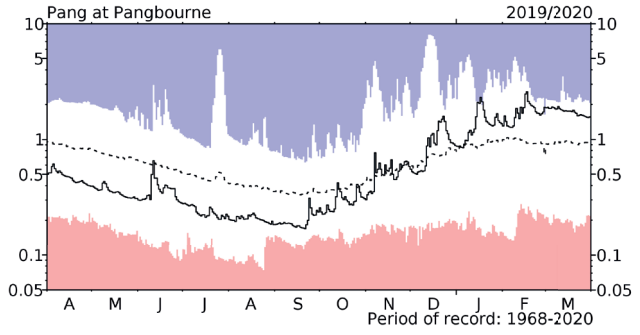


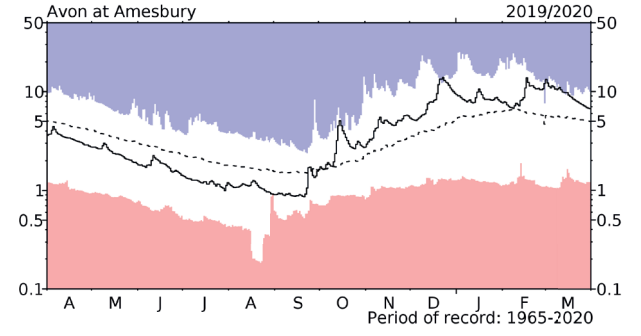


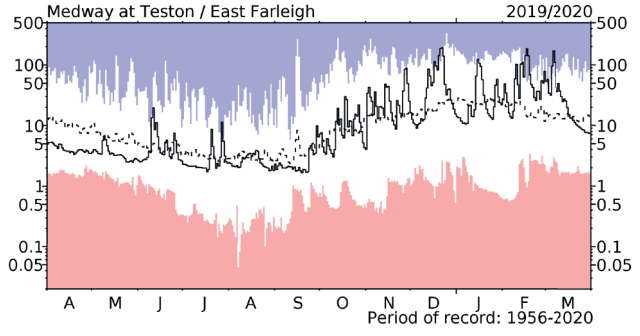




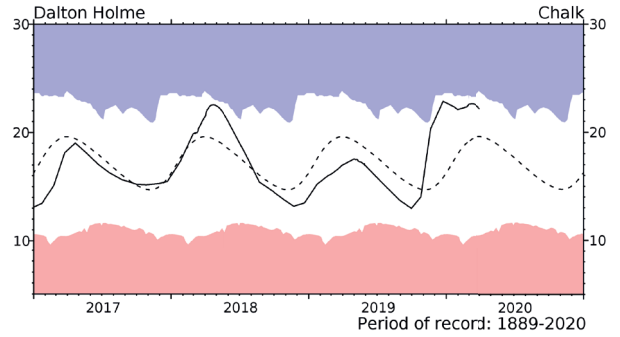


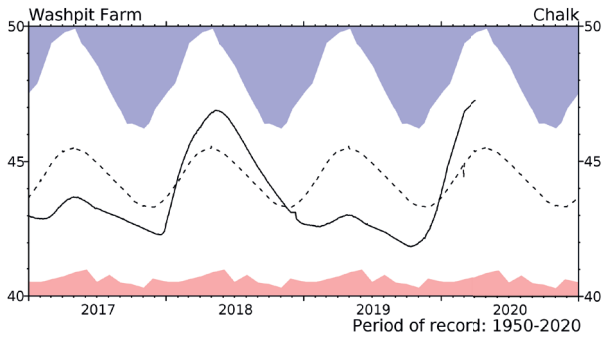


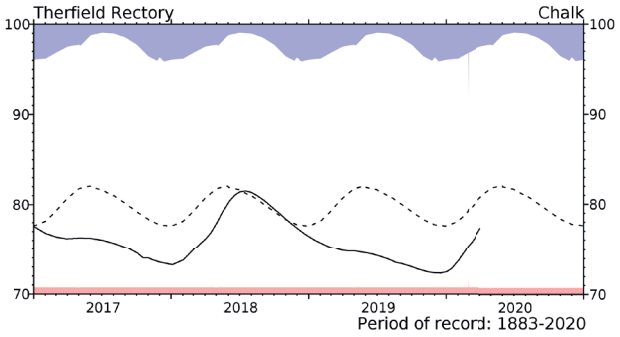


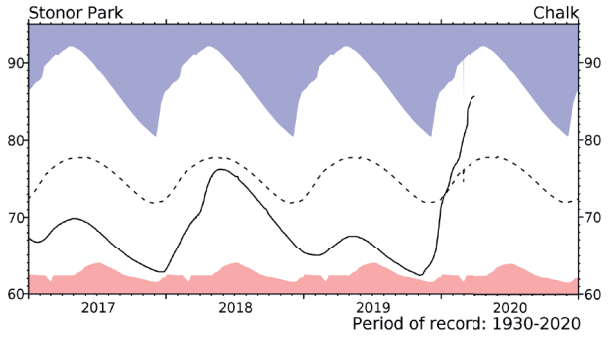


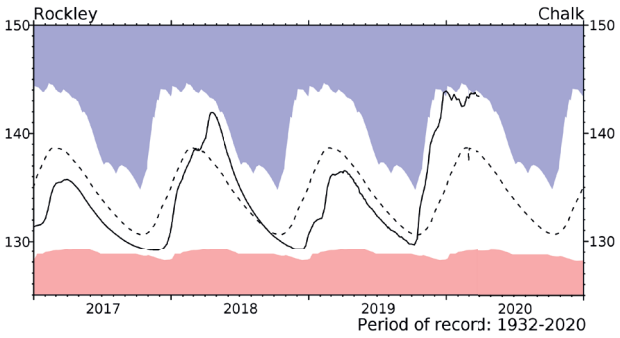
Groundwater…Groundwater

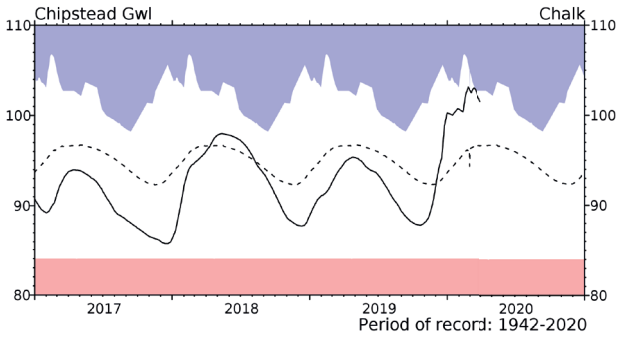


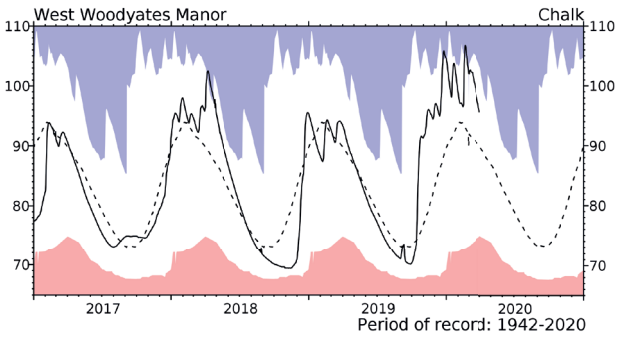


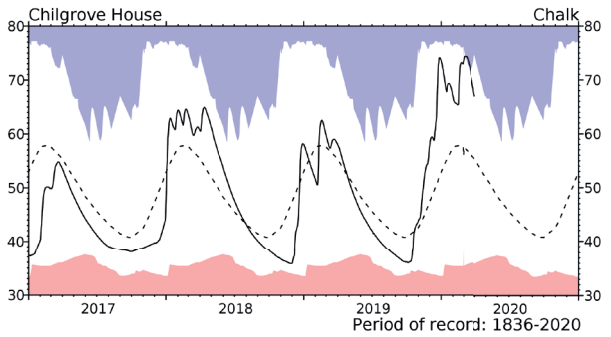


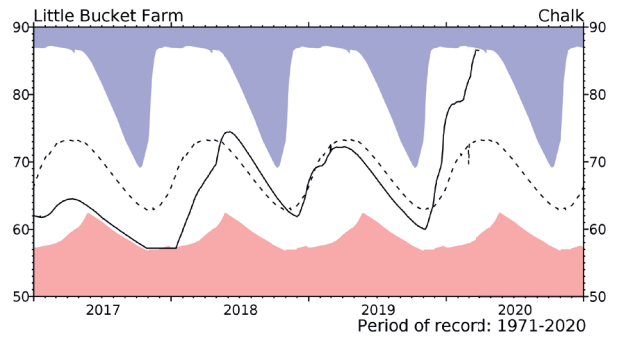


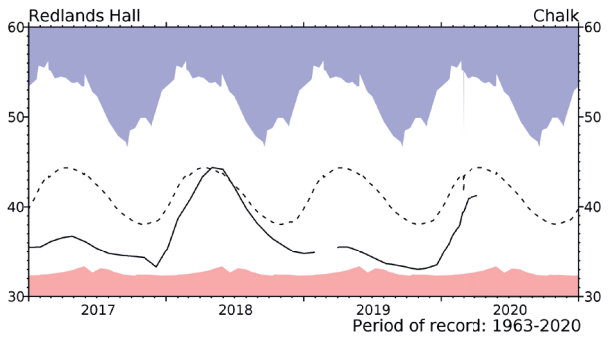






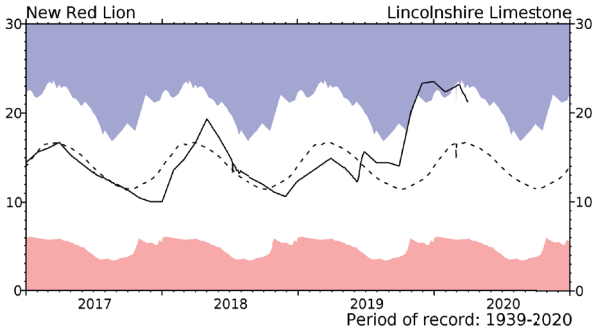


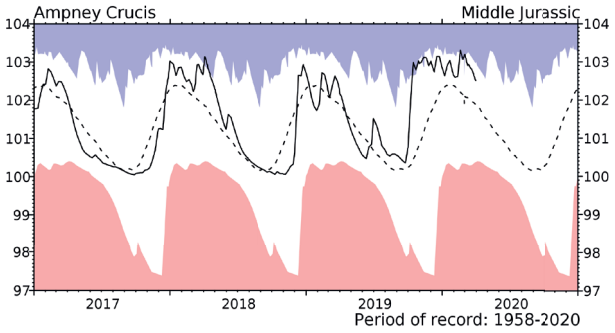


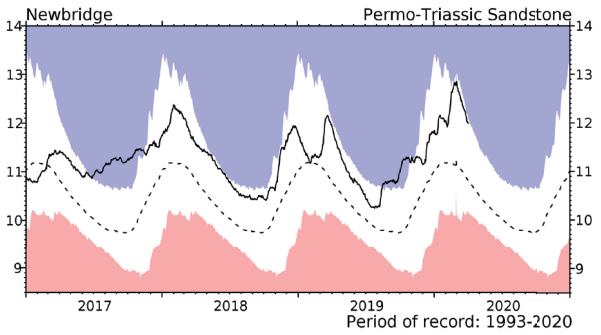


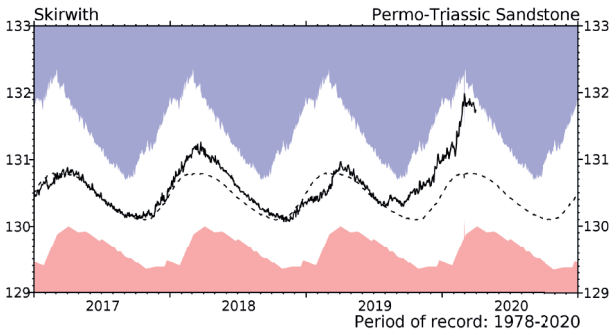
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

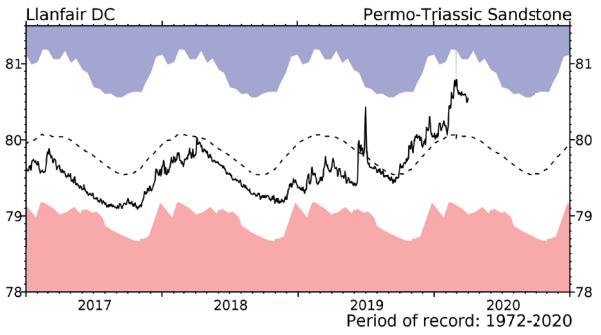
Groundwater … Groundwater

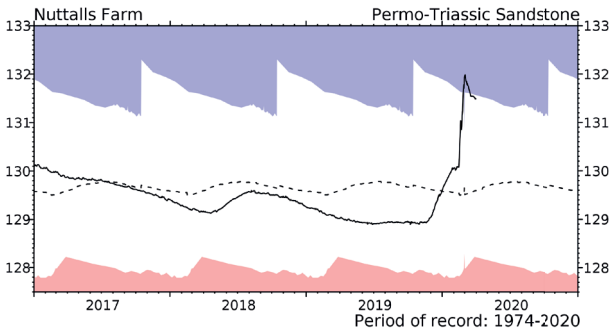


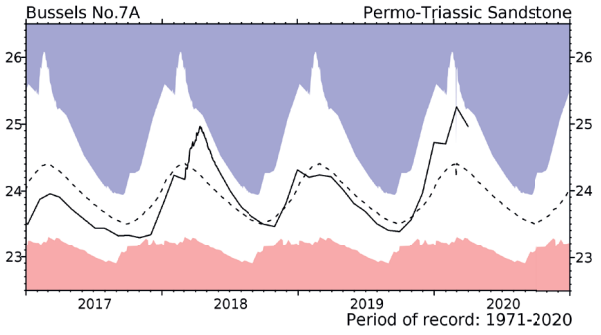


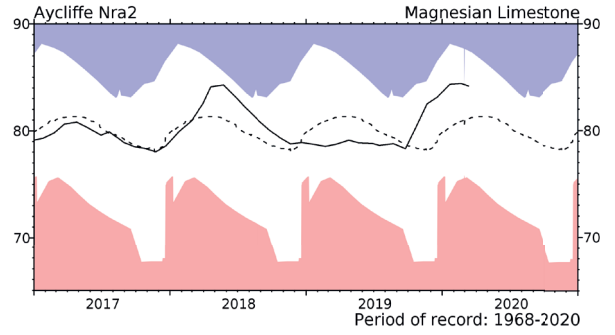


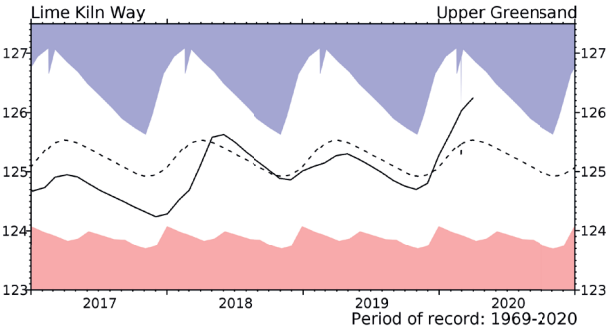


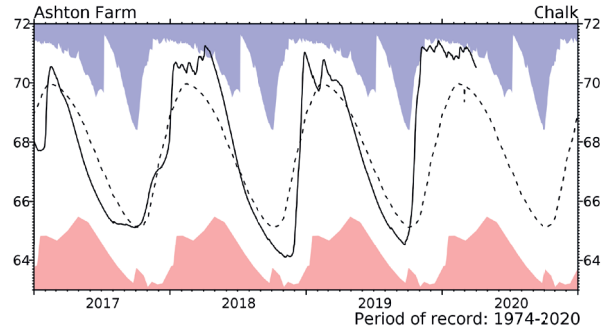


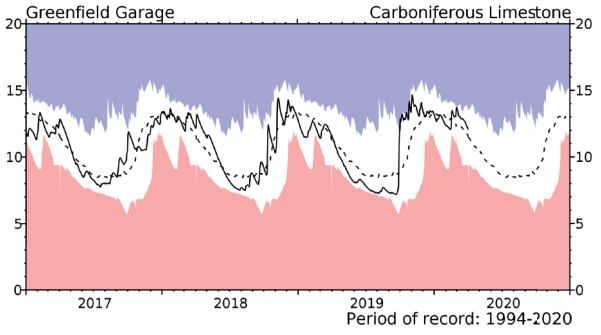


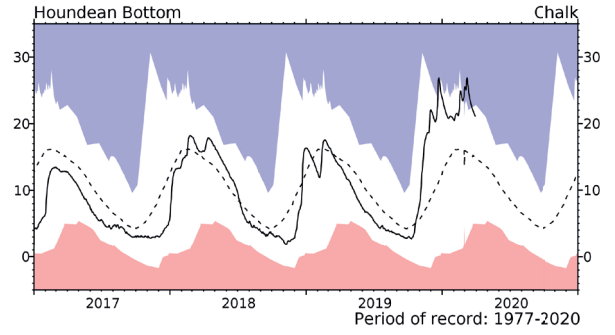


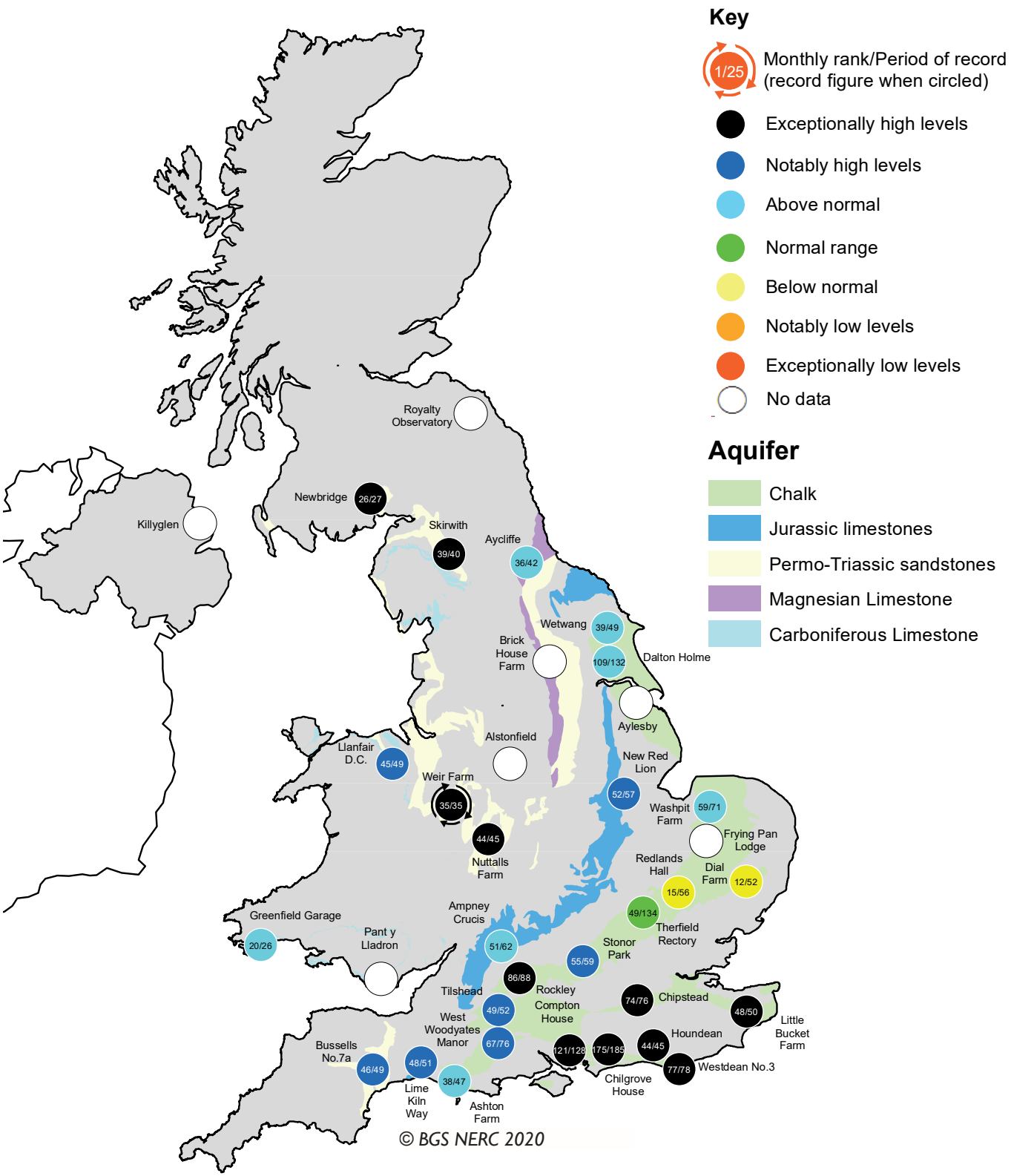










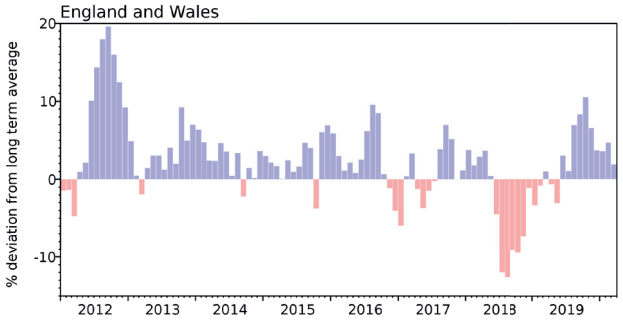


Groundwater levels - March 2020

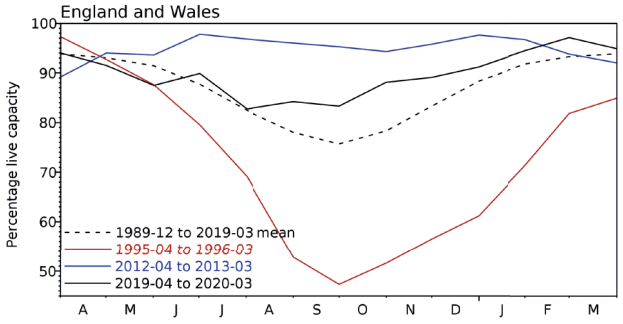
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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)	2020 Jan	2020 Feb	2020 Mar	Mar Anom.	Min Mar	Year* of min	2019 Mar	Diff 20-19
North West	N Command Zone	•	124929	98	100	93	2	77	1993	95	-2
	Vyrnwy		55146	100	100	98	2	64	1996	99	-1
Northumbrian	Teesdale	•	87936	99	99	88	-5	77	2003	97	-9
	Kielder		(199175)	91	96	92	0	81	1993	94	-2
Severn-Trent	Clywedog		49936	93	100	97	1	86	1996	99	-2
	Derwent Valley	•	46692	100	100	96	1	54	1996	97	-1
Yorkshire	Washburn	•	23373	91	97	94	0	70	1996	95	-2
	Bradford Supply	•	40942	100	100	97	3	59	1996	88	10
Anglian	Grafham		(55490)	86	82	88	-4	77	1997	86	2
	Rutland		(116580)	96	97	95	4	73	2012	89	6
Thames	London	•	202828	91	94	95	0	88	1990	91	4
	Farmoor	•	13822	97	97	99	4	80	2013	98	0
Southern	Bewl		31000	93	98	99	9	49	2012	100	-1
	Ardingly		4685	100	100	100	3	51	2012	99	1
Wessex	Clatworthy		5662	100	100	100	3	82	1992	100	0
	Bristol	•	(38666)	98	99	98	5	71	1992	97	1
South West	Colliford		28540	81	89	92	4	58	1997	88	5
	Roadford		34500	82	98	99	13	37	1996	77	21
	Wimbleball		21320	100	100	100	3	78	1996	100	0
	Stithians		4967	100	100	100	6	52	1992	99	1
Welsh	Celyn & Brenig	•	131155	93	97	96	-2	72	1996	95	1
	Brianne		62140	99	100	97	0	90	1993	97	0
	Big Five	•	69762	98	98	97	1	78	1993	97	0
	Elan Valley	•	99106	98	100	100	3	89	1993	98	2
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	99	100	97	2	71	1998	99	-2
	East Lothian	•	9317	100	100	100	1	95	2012	99	1
Scotland(W)	Loch Katrine	•	110326	100	100	95	2	74	2010	100	-5
	Daer		22494	100	100	95	-2	77	2013	98	-3
	Loch Thom		10721	90	100	83	-14	83	2020	99	-16
Northern Ireland	Total+	•	56800	96	100	98	7	83	2002	95	2
	Silent Valley	•	20634	94	100	96	9	57	2000	99	-2

( ) figures in parentheses relate to gross storage

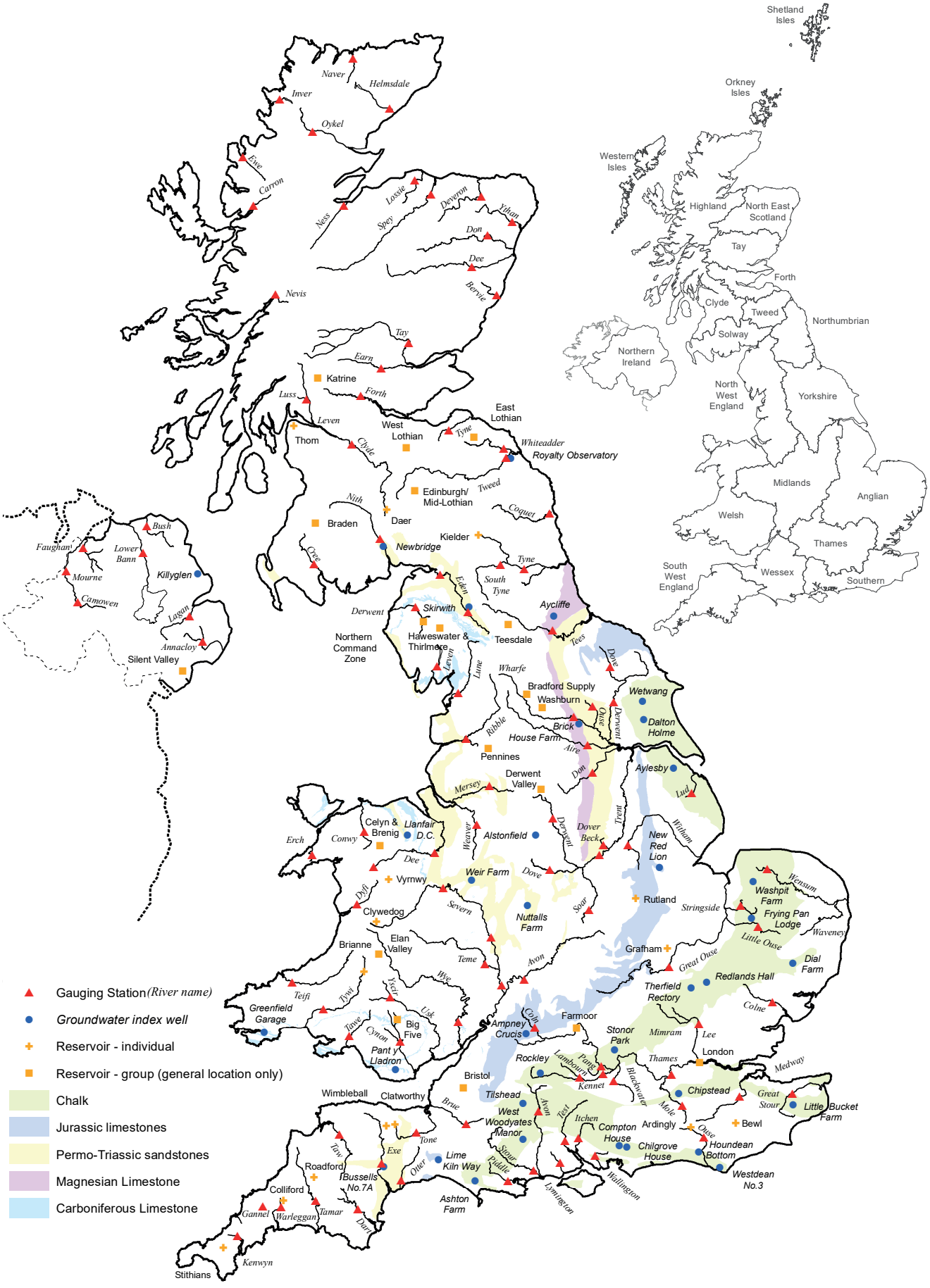
• denotes reservoir groups

*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.

Location map…Location map



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 http://www.metoffice.gov.uk/climate/uk/about/methods

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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