Hydrological Summary
for the United Kingdom

December 2020

General

December was an unsettled and very wet month, a fitting end to the third wettest year (after 2000 and 2012) for the UK in a series from 1910. Rainfall was above average across the majority of the UK, exceptionally so across East Anglia and north-east Scotland (recording their wettest and second wettest Decembers since 1929, respectively). River flows generally far exceeded December averages across England and Wales, notably so in south Wales and eastern and south-western England, and exceptionally so in East Anglia where flows were two to three times the average. Soil moisture deficits were near-zero across the whole of the UK, the wettest soils for late December at a national scale since 2012 and comparable with 2000. Groundwater levels rose and were in the normal range or above, with some exceptionally high levels. Reservoir stocks in December were above average at a national scale, notably so in Yorkshire, south-west England and Northern Ireland. Saturated soils across the country and high river flows and groundwater levels imply an elevated risk that rainfall will bring fluvial and groundwater flooding episodes through the remainder of the winter.

Rainfall

December featured a succession of cyclonic systems, predominantly under a south-westerly airflow, though colder spells bookended the month and brought significant snow and ice. The first of those (2nd-5th) caused travel disruption in parts of Scotland. With successive spells of unsettled weather generating rainfall over saturated ground, surface water flooding causing significant disruption was a recurrent feature of December, including in East Anglia on the 4th/5th, in Merseyside on the 8th, and in south-west Britain around mid-month. Most notably, on the 18th, 72mm fell at Llyn-y-Fan Blaenau (Carmarthen) and properties were evacuated in Cornwall. Further substantial rainfall followed across the festive period punctuated by storm 'Bella' on the 26th/27th when 109mm was recorded at Honister Pass (Cumbria). Over a three-day period across Christmas, sections of major roads in the south-east were closed, a flooded sub-station in Cirencester (Gloucestershire) caused power outages on Christmas Day, and surface water flooded properties across a broad swathe of counties from south Wales to Norfolk. Thereafter, under a colder airflow snow and ice returned, causing significant disruption to transport in Staffordshire on the 28th and Yorkshire on the 29th. Overall, December rainfall was substantially above average (139% of the long-term average for the UK). Rainfall exceeded 150% of average across a broad swathe of Wales, eastern Scotland, and central, eastern and north-eastern England. In the East Anglia and North East Scotland regions, rainfall approached twice the average as the third and fifth wettest Decembers in series from 1910, respectively. Rainfall for 2020 overall (January-December) was above average across a majority of the UK, particularly so across western regions. Areas in north-west England, south-west Scotland and western Northern Ireland recorded more than 130% of average.

River flows

At the start of December, river flows were generally below average but with catchments close to saturation flows swiftly responded to the succession of weather systems. On the 4th, heavy rainfall generated high flows in East Anglia; the Stringside recorded its fourth highest peak flow for any month (in a series from 1965). For catchments throughout England and Wales, successive weather systems maintained high flows throughout December, only receding towards month-end. On the 18th-19th, the Teifi, Fowey and Tywi overtopped, leading to significant flooding in Carmarthen from the latter. For the Teifi, this was a new peak flow maximum for December, and peak flows both here and on the Tywi were amongst the top five on record for any month (in series from 1959 or earlier). On the 24th, a new peak flow maximum for December (and third highest for any month in a series from 1963) was recorded on the Waveney, and flood risk from the Great Ouse necessitated the evacuation of 1,300 homes in Bedfordshire on Christmas Day. On the 26th-27th, storm 'Bella' triggered an exceptional response; peak flows on the Great Ouse and Little Ouse were the highest on record for any month in series from 1972 or earlier, for the latter by a substantial margin (150% of the previous maximum), and 1,000 properties were evacuated as flows increased on the Nene. Mean river flows for December were substantially above average across the majority of England and Wales. Notably high flows were recorded in catchments in eastern, south-eastern and south-western areas. Flows in the Weaver, Warwickshire Avon, Tamar and catchments across East Anglia were exceptionally high. On the Colne, flows were almost three and a half times the average, and new December monthly maxima were recorded on the Warleggan and Stringside (in series from 1969 or earlier). Near average flows were restricted to Northern Ireland and parts of northern England. Mean river flows over 2020 (January-December) were notably high in southern England and exceptionally high in Wales and north-west England. New January-December flow maxima were established for the Lune, Conwy and Cynon, recording around 150% of their averages in series from 1964 or earlier; the Mourne also recorded a new maximum in a series from 1982. Annual mean outflows from England & Wales in 2020 were the third highest in a series from 1961, only surpassed by the significant flooding of 2000 and 2012.

Groundwater

With the absence of soil moisture deficits, groundwater levels rose at virtually all index sites and at the end of December were in the same or higher category than November, the exception being Washpit Farm that fell to notably high. Levels rose in the Chalk with recharge commencing at Therfield Rectory, Aylesby and Dial Farm, although the level at the latter was still below normal. In the Jurassic and Magnesian limestones, levels rose and were above normal, with a new maximum December level (in a 63-year record) recorded at Ampney Crucis. In the fast responding Carboniferous Limestone, exceptionally high levels were recorded at Alstonfield and Pant y Lladron. In both the Upper Greensand (Lime Kiln Way) and Fell Sandstone (Royalty Observatory), levels rose and were notably high and above average, respectively. In the Permo-Triassic sandstones, recharge was observed at all sites apart from Nuttalls Farm, and levels were above normal (exceptionally so at Weir Farm) except at Bussels No.7a where they remained in the normal range.

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

UK Centre for Ecology & Hydrology

British Geological Survey

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

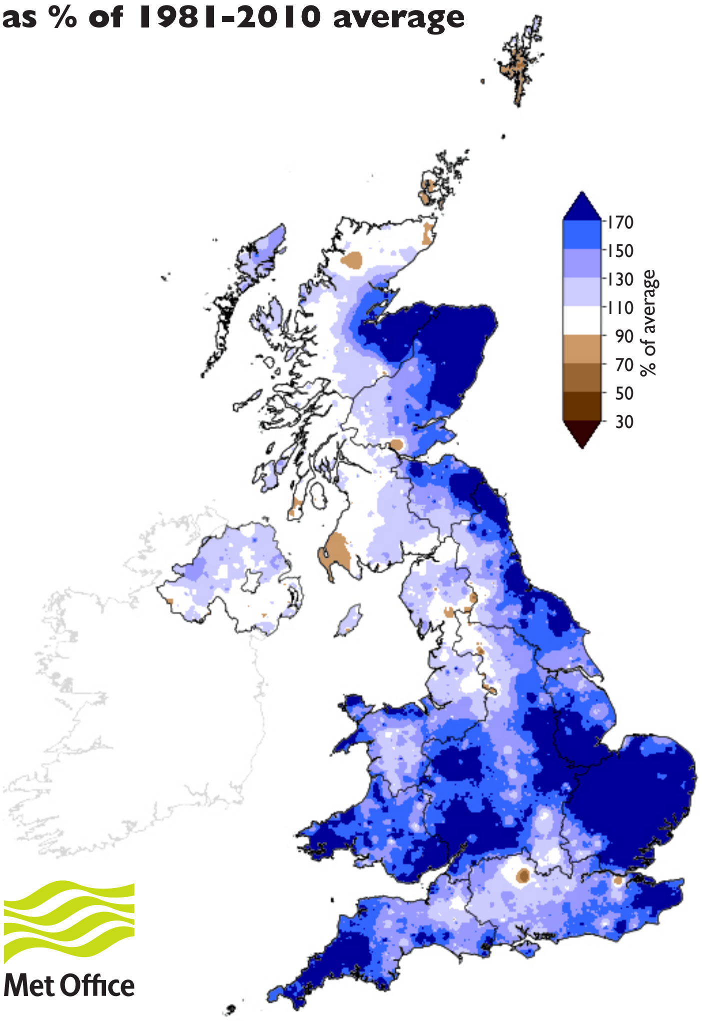
Region	Rainfall	Dec 2020	Oct20 – Dec20	RP	Jul20 – Dec20	RP	Apr20 – Dec20	RP	Jan20 – Dec20	RP
United	mm	**162**	442		732		899		1308	
Kingdom	%	**139**	123	10-15	119	10-20	109	5-10	116	50-80
England	mm	**131**	333		553		679		954	
	%	**152**	127	8-12	120	5-10	106	2-5	113	5-10
Scotland	mm	**196**	588		961		1188		1797	
	%	**125**	121	10-15	117	10-15	111	5-10	119	50-80
Wales	mm	**256**	597		963		1155		1680	
	%	**160**	123	5-10	122	8-12	111	2-5	119	15-25
Northern	mm	**129**	414		767		948		1308	
Ireland	%	**114**	120	5-10	124	15-25	113	5-10	115	25-40
England &	mm	**148**	369		609		744		1053	
Wales	%	**153**	126	8-12	120	5-10	107	2-5	114	8-12
North West	mm	**155**	480		878		1063		1552	
	%	**118**	122	5-10	128	10-20	117	5-10	127	70-100
Northumbria	mm	**129**	311		546		669		934	
	%	**150**	119	5-10	115	2-5	102	2-5	107	2-5
Severn-Trent	mm	**124**	285		488		608		865	
	%	**162**	123	5-10	116	2-5	102	2-5	111	5-10
Yorkshire	mm	**121**	295		549		682		969	
	%	**141**	118	2-5	122	5-10	108	2-5	115	5-10
Anglian	mm	**103**	233		410		497		649	
	%	**192**	132	8-12	121	5-10	102	2-5	104	2-5
Thames	mm	**98**	316		488		597		815	
	%	**140**	142	10-20	126	5-10	109	2-5	114	5-10
Southern	mm	**129**	374		510		602		859	
	%	**148**	136	8-12	115	2-5	100	2-5	108	2-5
Wessex	mm	**135**	368		551		693		979	
	%	**138**	125	5-10	114	2-5	105	2-5	111	2-5
South West	mm	**240**	524		777		974		1414	
	%	**167**	124	5-10	115	2-5	109	2-5	115	8-12
Welsh	mm	**249**	578		933		1123		1621	
	%	**162**	125	8-12	123	8-12	112	5-10	119	15-25
Highland	mm	**225**	669		1006		1301		2074	
	%	**117**	115	5-10	104	2-5	105	2-5	115	20-30
North East	mm	**181**	459		716		874		1130	
	%	**198**	143	25-40	128	10-20	115	5-10	111	5-10
Tay	mm	**193**	564		911		1095		1627	
	%	**144**	132	10-20	127	10-20	115	5-10	121	40-60
Forth	mm	**153**	461		825		982		1481	
	%	**128**	124	10-15	127	25-40	113	5-10	123	70-100
Tweed	mm	**156**	398		701		852		1263	
	%	**151**	125	10-15	125	10-20	112	5-10	123	40-60
Solway	mm	**178**	564		1062		1280		1859	
	%	**112**	115	5-10	128	20-30	118	10-20	125	80-120
Clyde	mm	**205**	707		1240		1493		2263	
	%	**107**	121	8-12	124	15-25	116	10-20	125	80-120

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

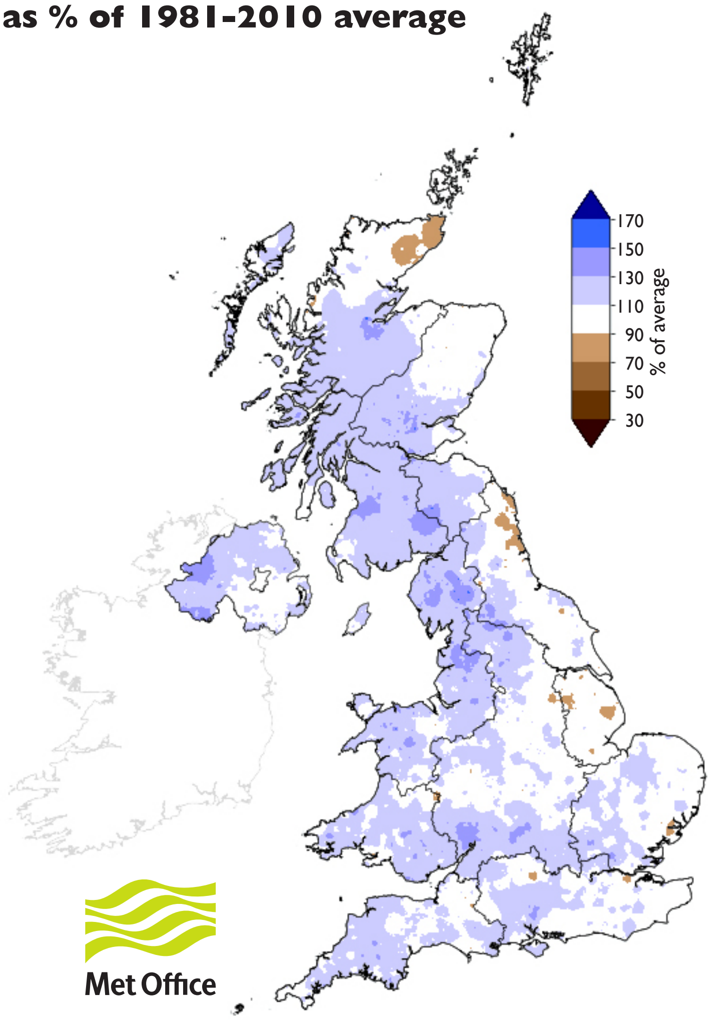
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 December 2017 are provisional.

Rainfall . . . Rainfall . . .

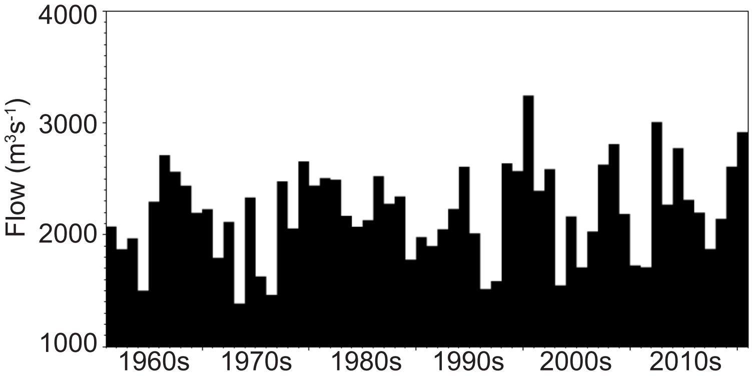
December 2020 rainfall as % of 1981-2010 average



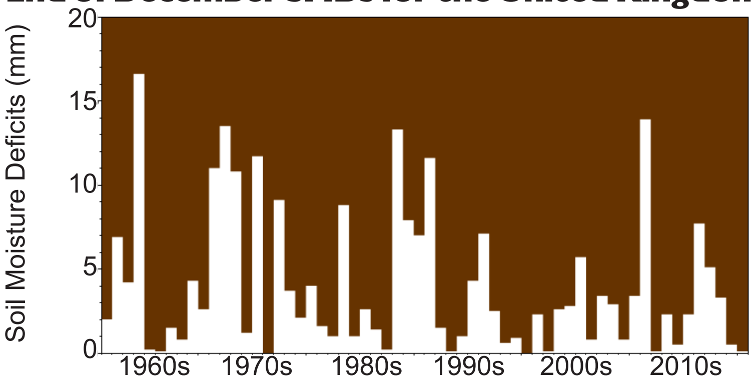
January 2020 - December 2020 rainfall as % of 1981-2010 average



January - December outflows for England & Wales



End of December SMDs for the United Kingdom



Hydrological Outlook UK

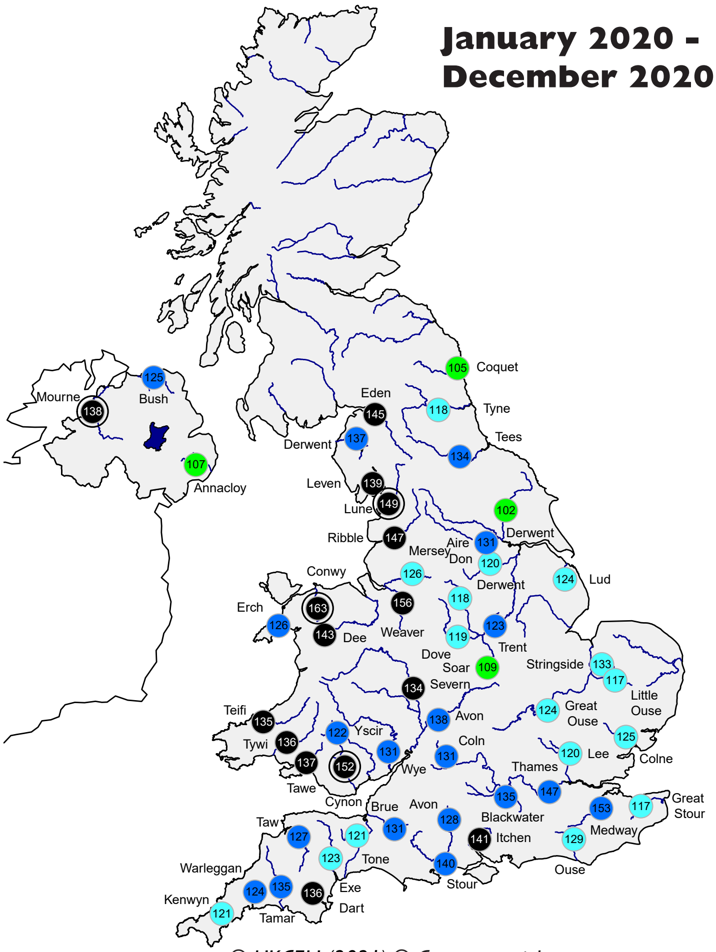
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

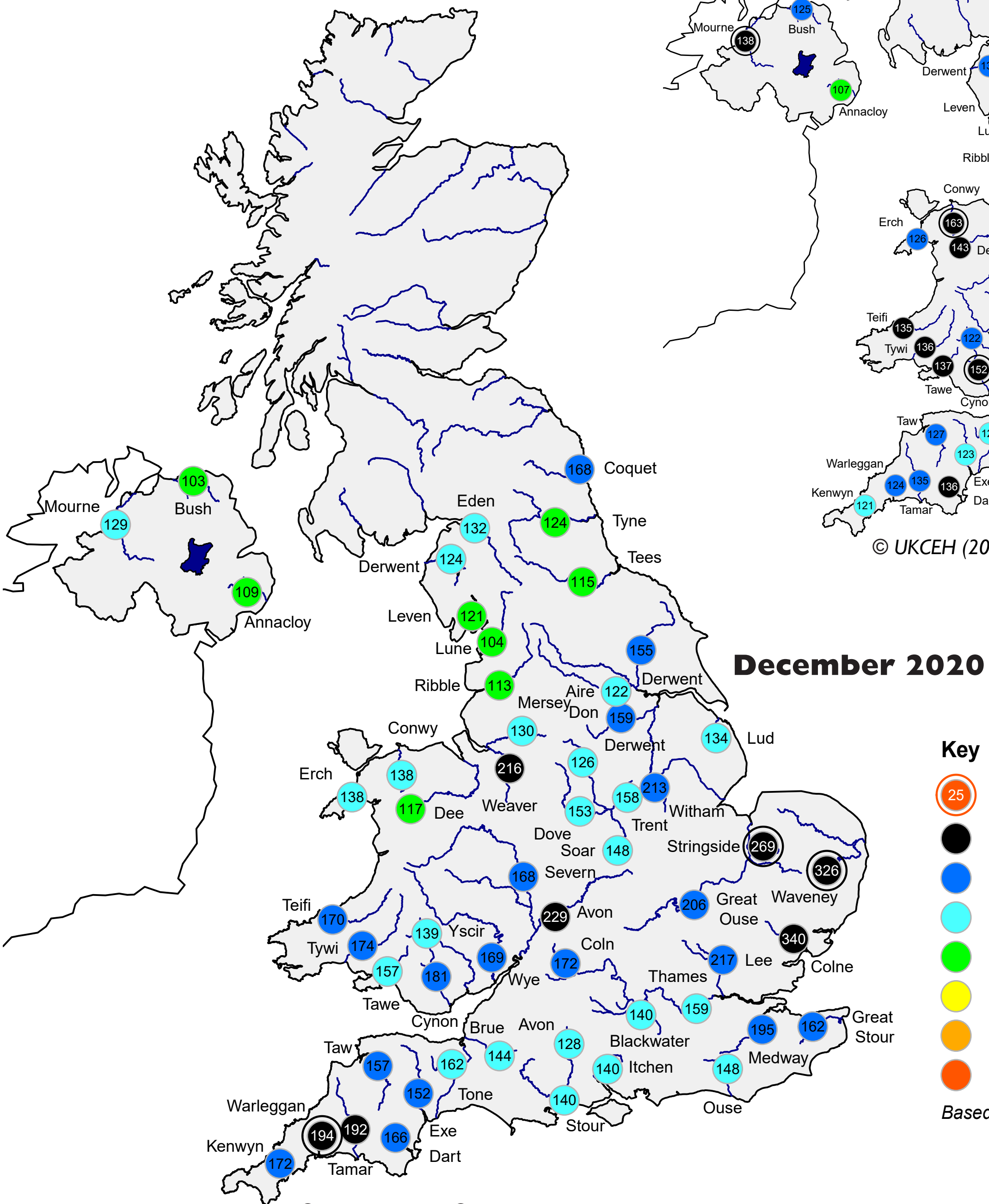
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from January 2021**
Issued: **13.01.2021**
using data to the end of December 2020

River flows in January are likely to be normal to above normal in southern, central and eastern England and are most likely to be within the normal range elsewhere. River flows over the three-month timeframe are most likely to be within the normal range throughout the UK, though above normal flows are most likely in some catchments in the south-east (predominantly in East Anglia). The outlook for groundwater is for normal to above normal levels in all aquifers, both in January and for the January-March timeframe.

River flow . . . River flow . . .





Key

- 25 — % of long−term average (record high/low when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

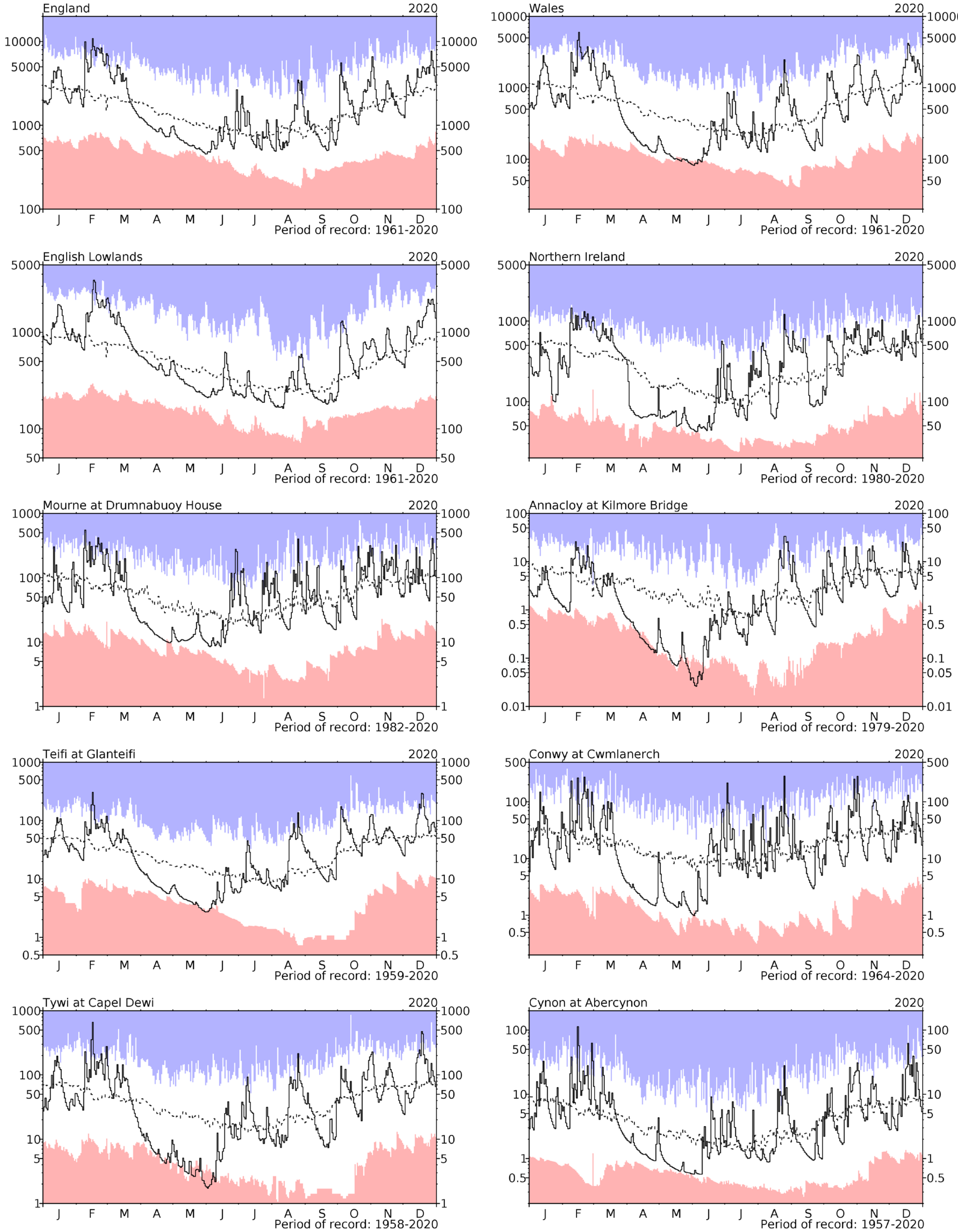
*Based on ranking of the monthly flow**

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.

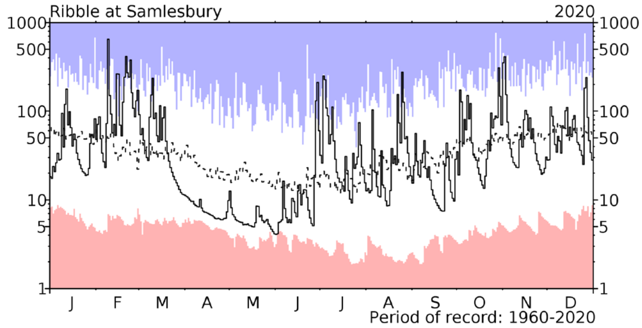
River flow . . . River flow . . .

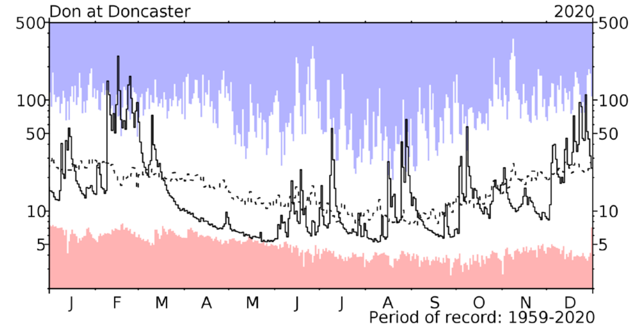


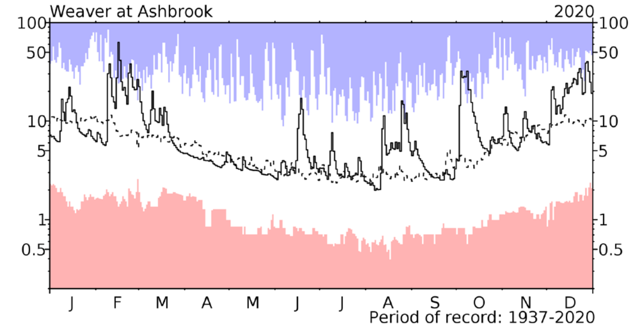
River flow hydrographs

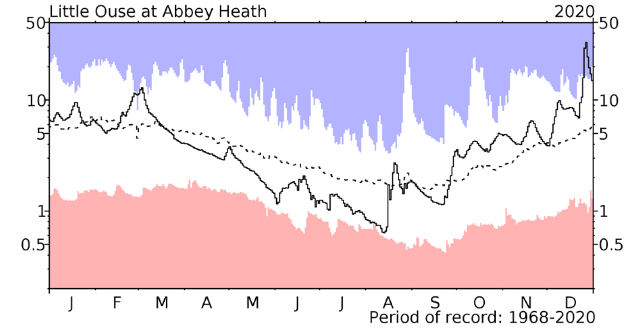
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to January 2020 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed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

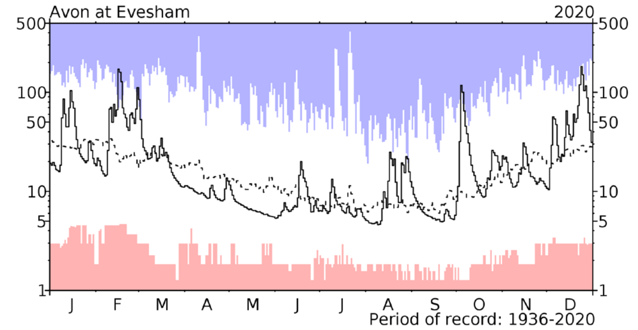
River flow . . . River flow . . .

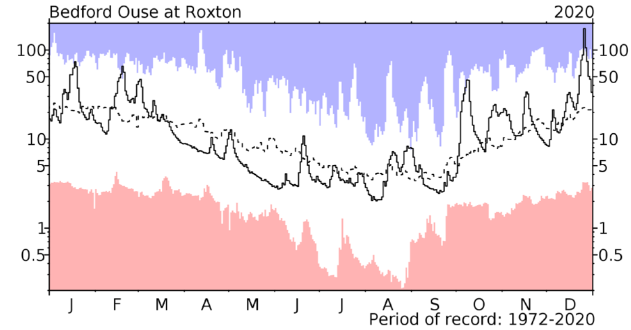


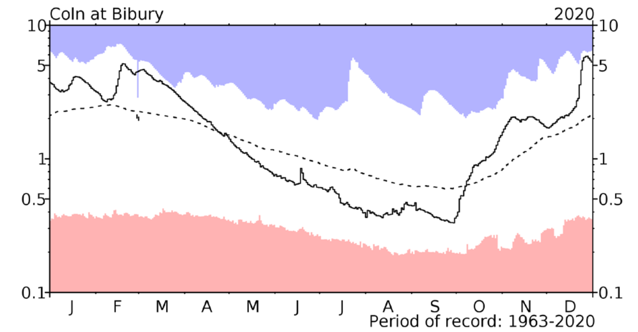


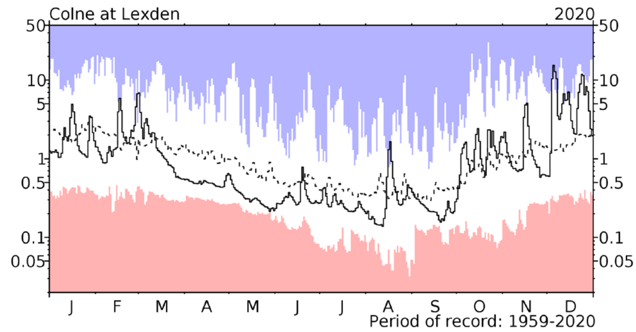


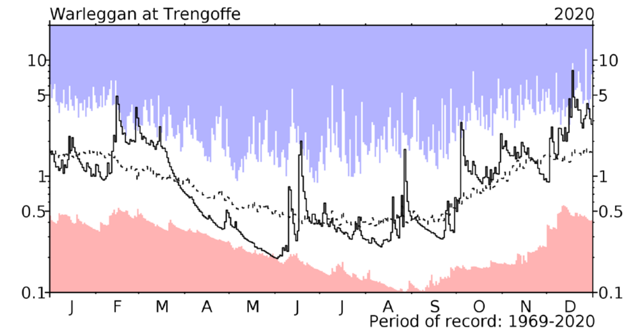


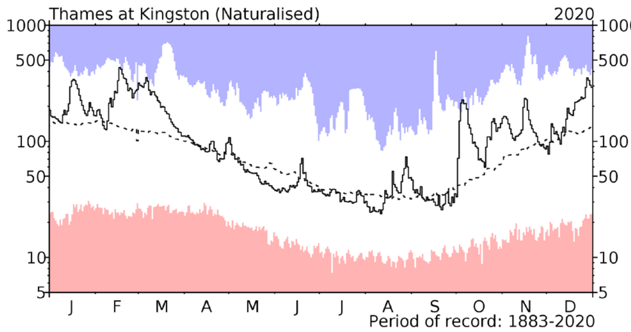


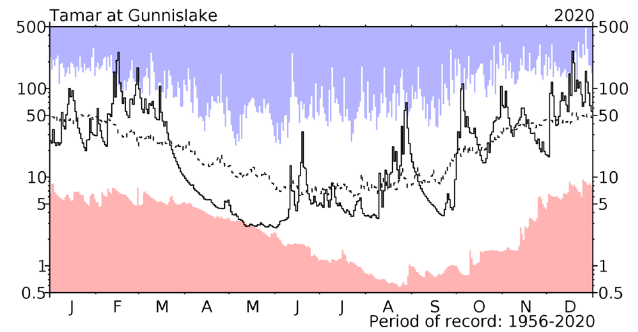


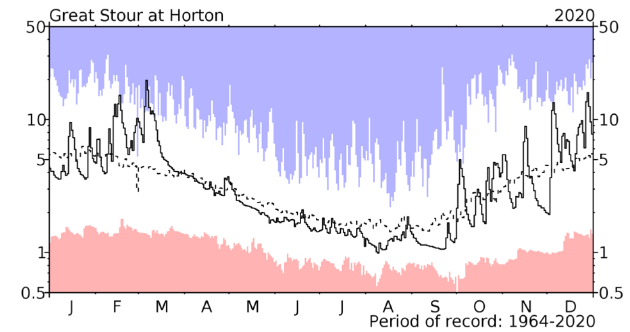




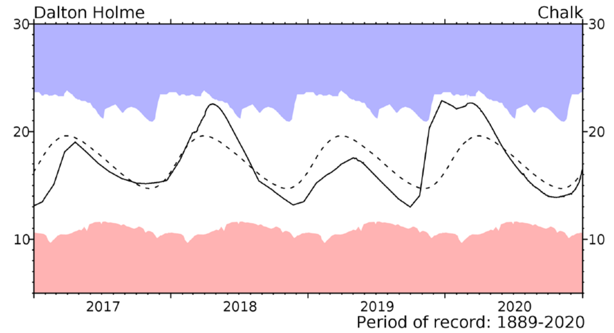


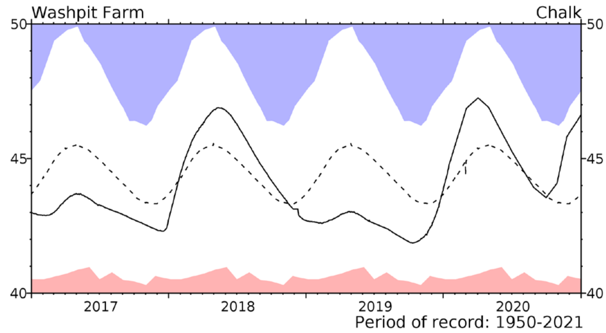


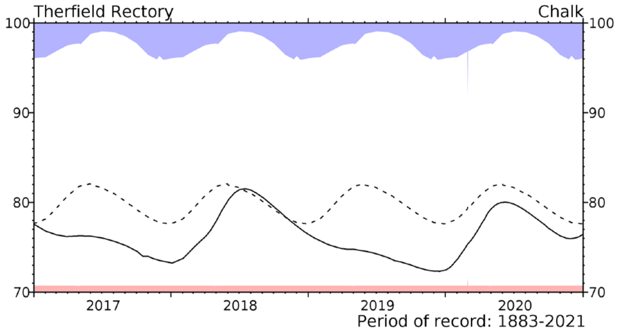


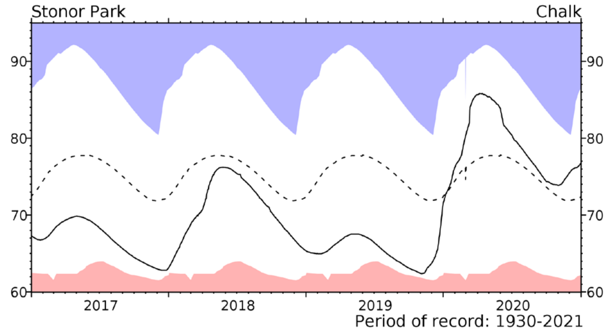


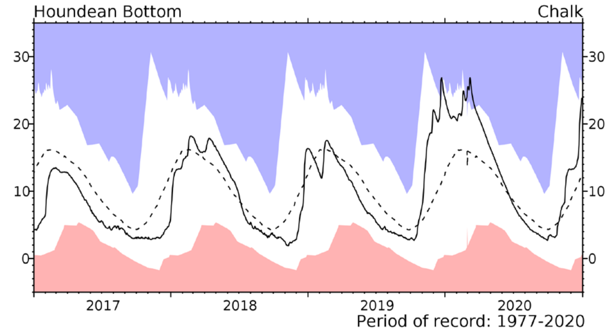
Groundwater . . . Groundwater

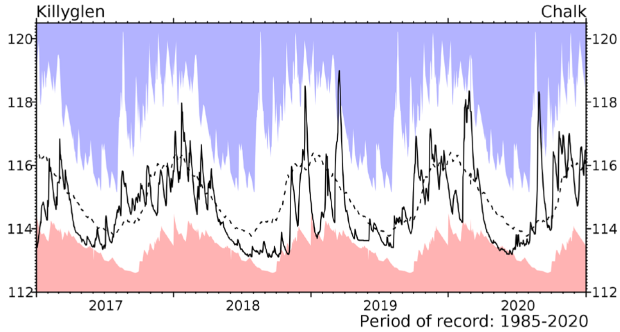


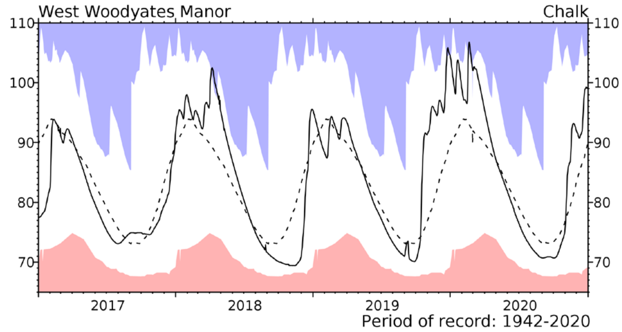


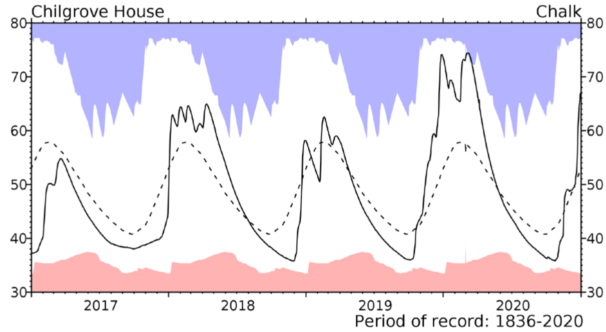


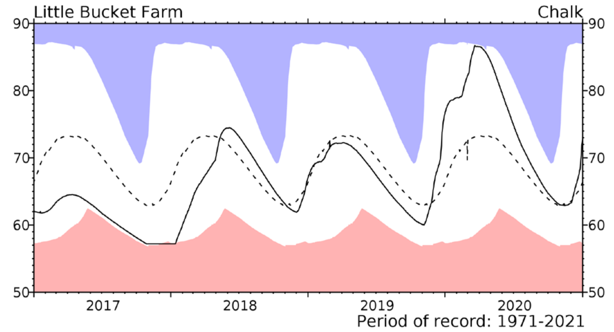


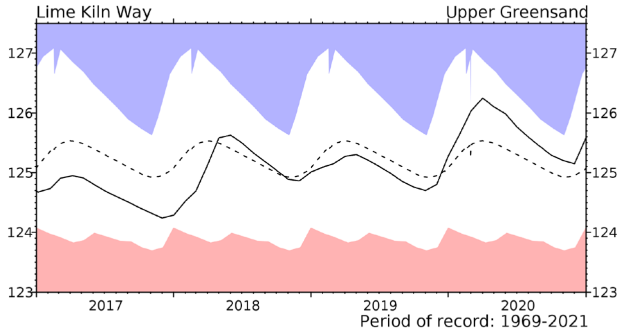






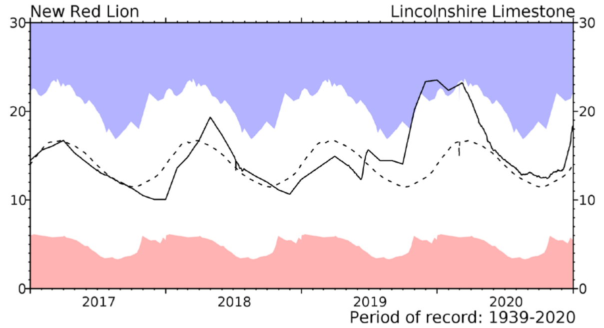


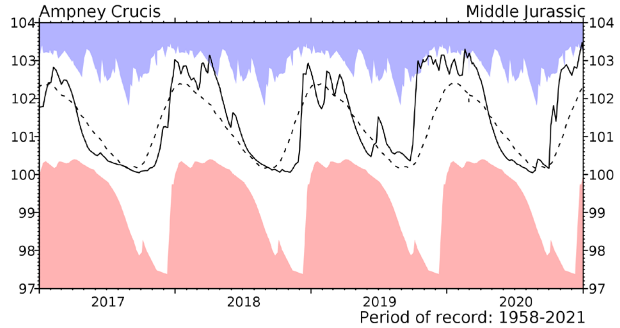


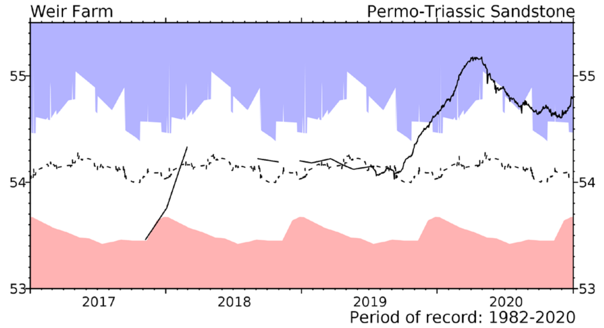


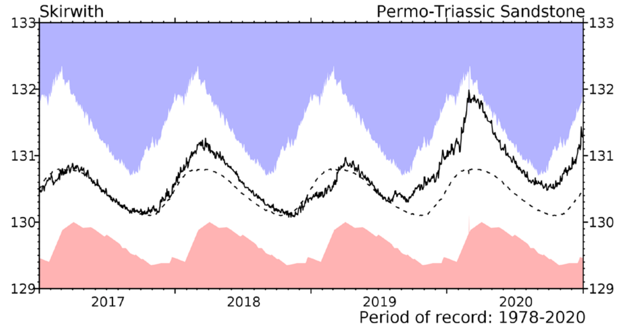
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

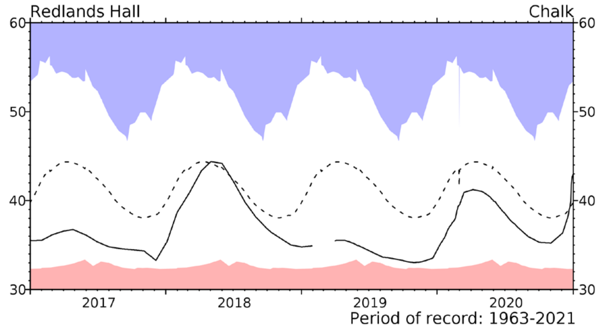
Groundwater... Groundwater

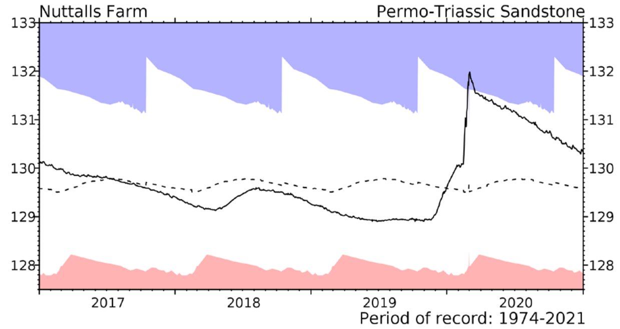


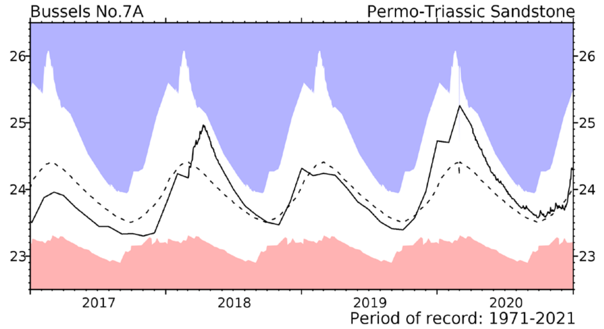


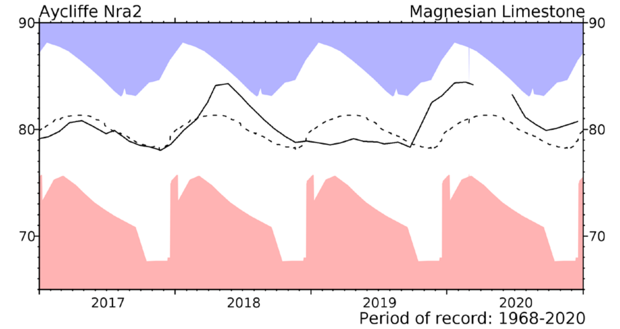


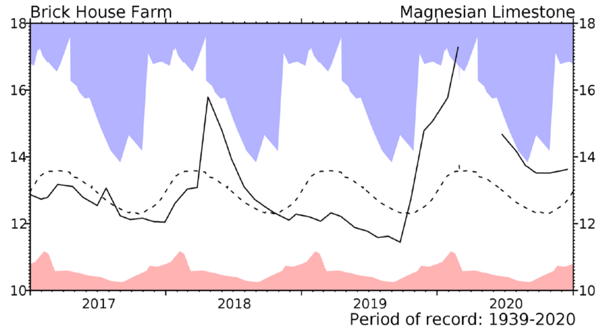


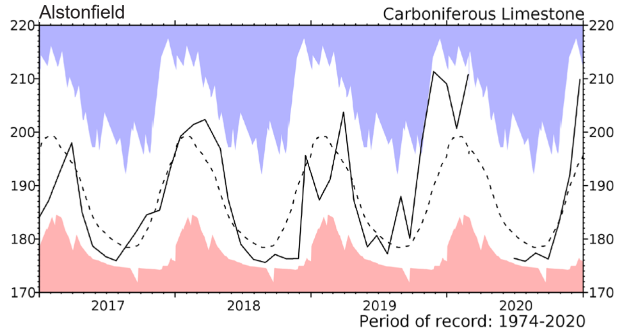


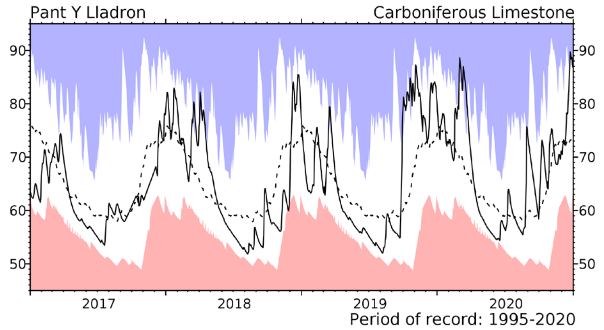


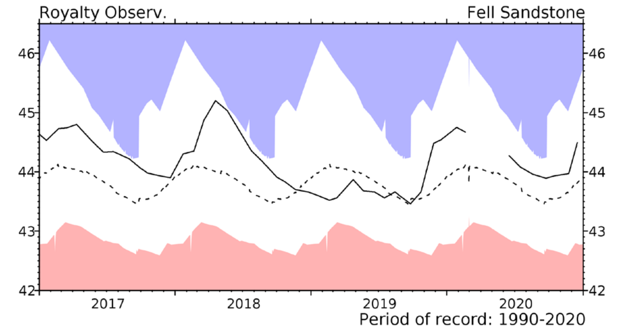


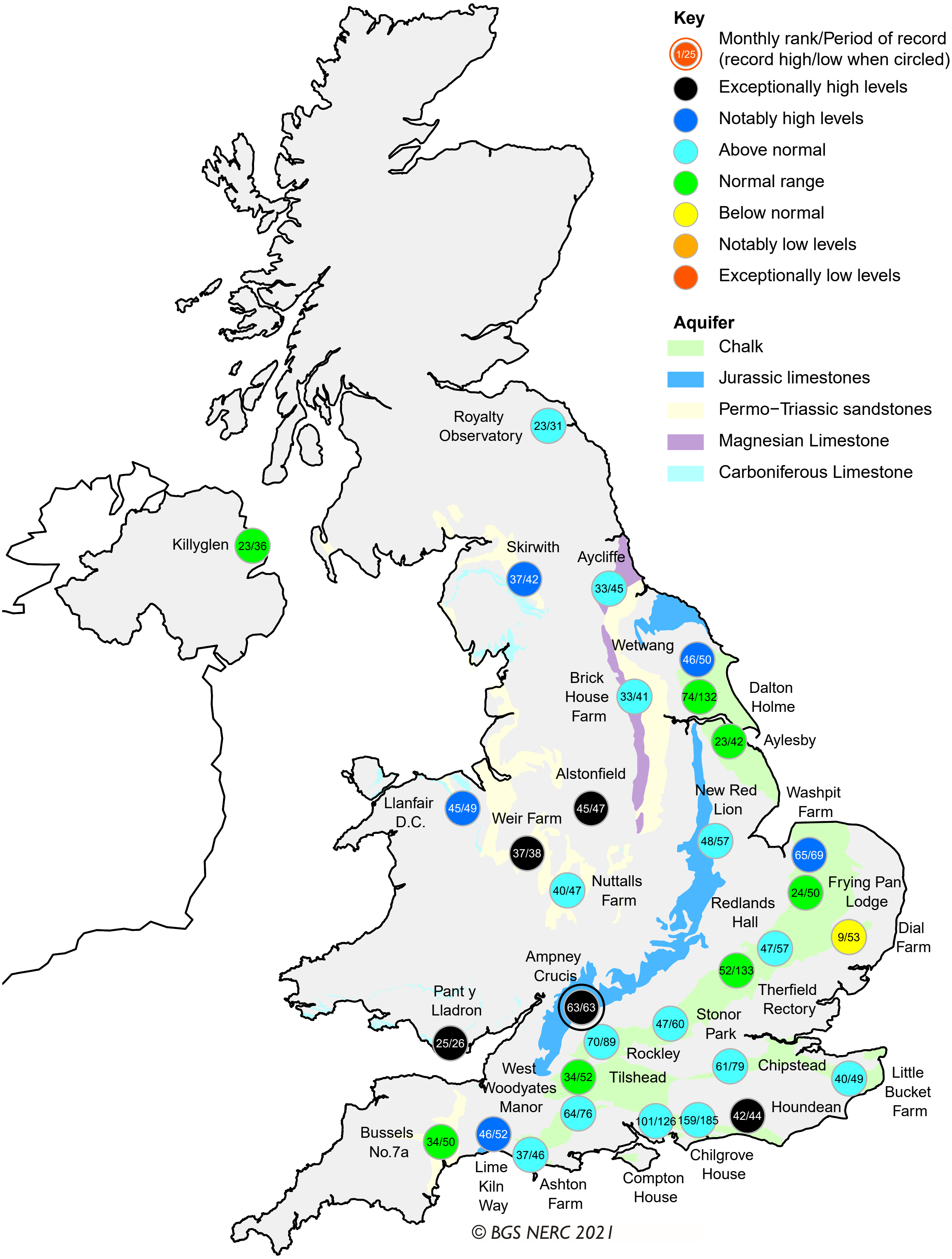












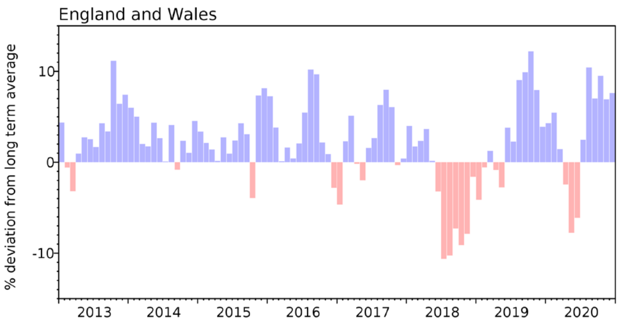
Groundwater levels - December 2020

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.

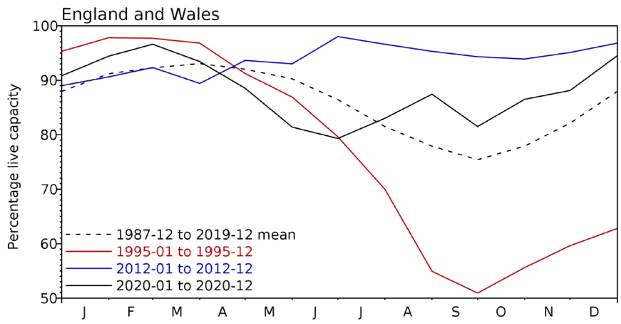
Note: Due to unforeseen circumstances no data are available for Scotland.

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

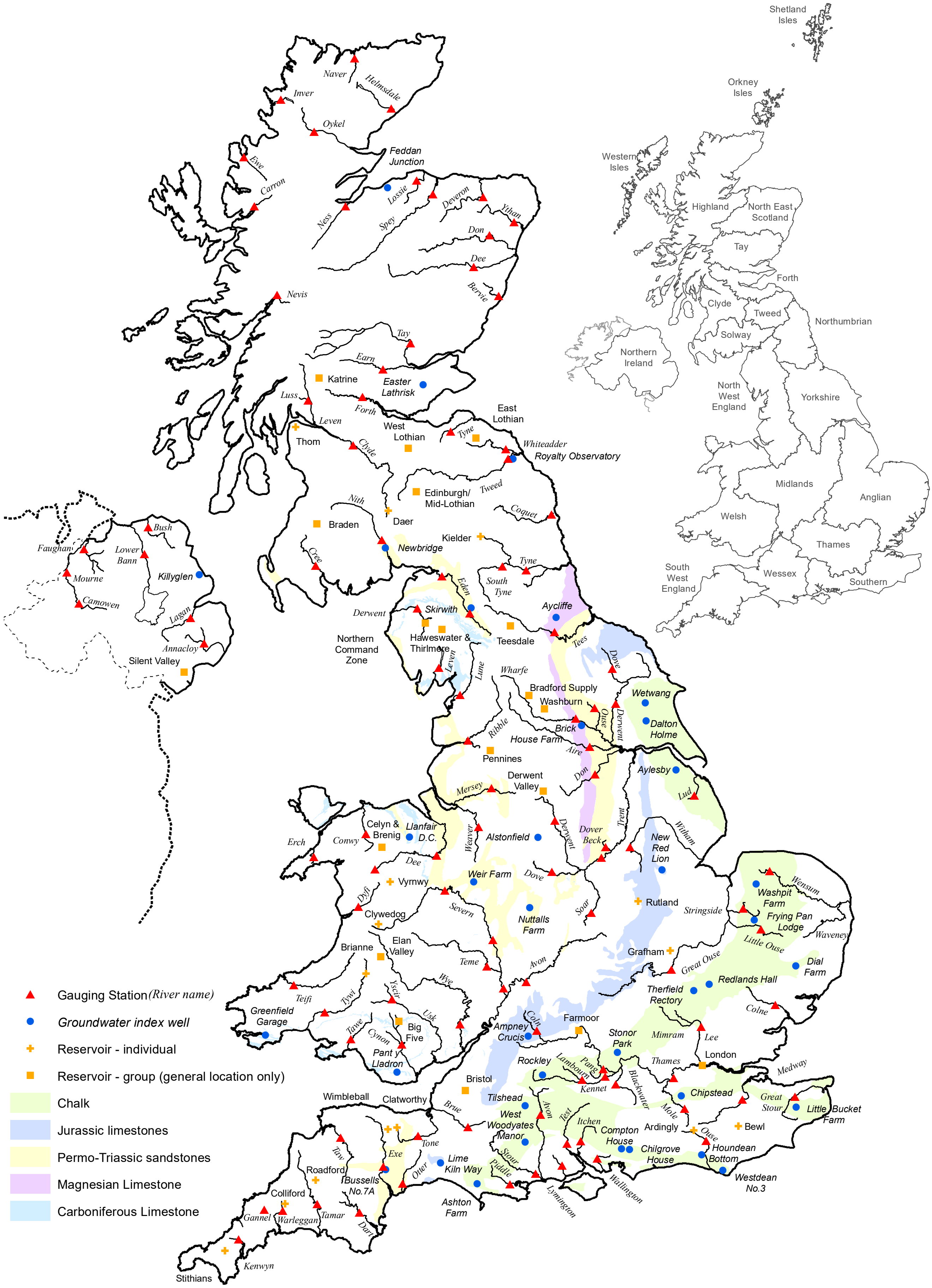
Area	Reservoir		Capacity (Ml)	2020 Oct	2020 Nov	2020 Dec	Dec Anom.	Min Dec	Year* of min	2019 Dec	Diff 20-19
North West	N Command Zone	•	124929	85	99	100	13	51	1995	85	15
	Vyrnwy		55146	98	97	100	8	35	1995	95	5
Northumbrian	Teesdale	•	87936	83	80	94	4	41	1995	99	-5
	Kielder		(199175)	86	89	89	-2	70	1989	84	5
Severn-Trent	Clywedog		49936	89	84	89	4	54	1995	88	1
	Derwent Valley	•	46692	92	91	100	9	10	1995	99	1
Yorkshire	Washburn	•	23373	97	96	98	11	23	1995	91	7
	Bradford Supply	•	40942	100	98	100	10	22	1995	100	0
Anglian	Grafham		(55490)	91	89	87	3	57	1997	88	-1
	Rutland		(116580)	88	87	87	5	60	1990	96	-9
Thames	London	•	202828	79	79	84	-3	60	1990	91	-7
	Farmoor	•	13822	98	90	78	-12	71	1990	99	-21
Southern	Bewl		31000	60	63	74	2	34	2005	89	-15
	Ardingly		4685	27	46	87	2	30	2011	100	-13
Wessex	Clatworthy		5662	93	100	100	9	54	2003	100	0
	Bristol	•	(38666)	75	83	100	21	40	1990	99	1
South West	Colliford		28540	62	66	80	1	46	1995	75	5
	Roadford		34500	68	73	90	12	20	1989	75	14
	Wimbleball		21320	65	76	100	18	46	1995	100	0
	Stithians		4967	61	73	100	20	33	2001	100	0
Welsh	Celyn & Brenig	•	131155	100	97	95	2	54	1995	89	6
	Brianne		62140	100	100	98	0	76	1995	100	-2
	Big Five	•	69762	71	76	94	4	67	1995	88	6
	Elan Valley	•	99106	86	86	100	3	56	1995	99	1
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	89	95	98	7	60	1998	94	4
	East Lothian	•	9317	100	100	100	4	48	1989	100	0
Scotland(W)	Loch Katrine	•	110326	95	96	100	9	75	2007	100	0
	Daer		22494	100	100	98	0	83	1995	100	-2
	Loch Thom		10721	63	83	92	-5	80	2007	91	1
Northern Ireland	Total+	•	56800	98	98	100	11	61	2001	100	0
	Silent Valley	•	20634	100	98	99	13	39	2001	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.

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 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.

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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