Hydrological Summary

for the United Kingdom

April 2012

General

Britain's climate is inherently capricious but there are few modern parallels to the hydrological contrasts experienced through the spring of 2012. March was exceptionally warm and recorded the lowest rainfall for the UK since 1953. April was the coldest since 1989 and the wettest in the last 100 years at least. The rainfall greatly moderated drought conditions and was particularly useful for farmers and growers. As the month advanced however, the focus of short-term hydrological concern switched rapidly from drought stress to flood risk (and the ecological impact of wetland inundations). With shallow soils saturated, runoff rates increased dramatically in many areas. Localised flash flooding was common and flood warnings were in operation for rivers across much of England and Wales during the final week. Contrary to the normal seasonal trend, reservoir stocks increased through April and overall stocks for England & Wales exceeded the early May average. However, whilst stocks generally increased usefully throughout the drought-afflicted regions, early May stocks remained the lowest on record (in series from 1988) at Bewl and Ardingly; and seasonally depressed at Rutland. The decline in soil moisture deficits through April was remarkable, allowing groundwater recharge to re-commence during the latter half of the month. Early indications suggest that the seasonally late pulse of recharge will, in many areas, ensure that groundwater levels remain above historical minima through the summer and, given normal rainfall patterns, provide a foundation for a sustained groundwater recovery through the late autumn and winter.

Rainfall

Early April witnessed a decisive change in synoptic patterns, associated with a shift in a meander of the jet stream, bringing much cooler and wetter conditions across most of the UK. Significant sleet and snow falls were experienced across northern Britain in the first week – extending down to the Midlands on the 4th when particularly large accumulations were reported from Yorkshire. For England & Wales, provisional data indicate that April was the wettest in the Met Office's series (from 1910) as well as the wettest in the instrumented era (from 1766); it also exceeded the March figure by an unprecedented margin (>110mm). The April rainfall totals exhibited substantial spatial variability but much of the drought-affected region reported well over twice the average rainfall, rising to >300% in some areas (e.g. parts of Lincolnshire). Such exceptional rainfall has eliminated short-term rainfall deficiencies and substantially reduced medium and long term deficiencies; return periods associated with cumulative regional rainfall totals since March 2010 are typically less than half the corresponding figure for the end of March (see Table 1). For England & Wales as a whole rainfall over the last 25 months is now greater than that registered during the corresponding periods in the extended droughts of the 1970s and 1990s. Nonetheless, the recent rainfall generally accounts for only 20-30% of the regional shortfalls since the development of drought conditions in the spring of 2010. For the Midland region, the 2010-12 rainfall (April-April) is still the second lowest in the last 112 years at least.

River flows

Following exceptionally steep recessions through March, totals outflows from Britain as a whole were the lowest in the 50-year series for early April and seasonally very depressed runoff rates characterised most river basins. Thereafter, and excepting some baseflow-dominated streams, flows increased dramatically across much of the UK. By the final week, moderate floodplain inundations were very common and there were >100 flood alerts/warnings across England and Wales. The River Tone in Somerset exemplified this transformation, registering its lowest early-April flows and, thence, eclipsing late-April daily maxima in a series of over 50 years. Rivers registering similar contrasts showed a very wide distribution. The increased runoff greatly moderated environmental stress, in drought-affected headwaters particularly, but the associated flooding did impact on some important wetlands (included the Ouse Washes where nesting sites were inundated). Mean flows for April were well below average in parts of Scotland and Northern Ireland (the Camowen in particular) and some groundwater-fed rivers in the English Lowlands; elsewhere April runoff was generally well above average. However, medium- and long-term runoff accumulations remain depressed in the drought-affected regions. Notwithstanding the healthy April flows, runoff since March 2011 for the English Lowlands closely equates to that recorded 1996-97 – the lowest in this timeframe in a series from 1961. As notably, runoff for some groundwater-fed streams and rivers (e.g. the Dorset Stour) over the last two years remain the lowest on record.

Groundwater

The record April rainfall rapidly eliminated the exceptionally high late-March soil moisture deficits across the outcrop areas of most major aquifers. This allowed significant infiltration to re-commence although its benefit is only captured to a limited degree in the April groundwater levels; the responsiveness of individual wells reflects the characteristics of the aquifer and the depth to the depressed water-tables, and can result in markedly different time lags between surface infiltration and groundwater level response. Steep increases in groundwater levels were registered in the Jurassic Limestone where levels at Ampney Crucis are above the early May average and an exceptional increase of over four metres in a day (29/30th April) was reported for the Carboniferous Limestone in South Wales. Notable recent groundwater level rises have also been recorded for the more responsive Chalk outcrops (e.g. at Chilgrove) but more muted responses typify most of the aquifer and Lime Kiln Way is below the lowest recorded April level. Levels continued to fall across most of the slow-responding Permo-Triassic sandstones outcrops; April levels at the Heathlanes borehole fell below any recorded (for any month) in a series from 1972. Overall, the situation in terms of the groundwater resources outlook is considerably healthier than could have been anticipated a month ago. The full impact of the recent wet period on groundwater levels is not yet evident but there should have been enough recharge to lift groundwater levels above summer minima, and in some aquifers to restore levels towards normal seasonal ranges.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

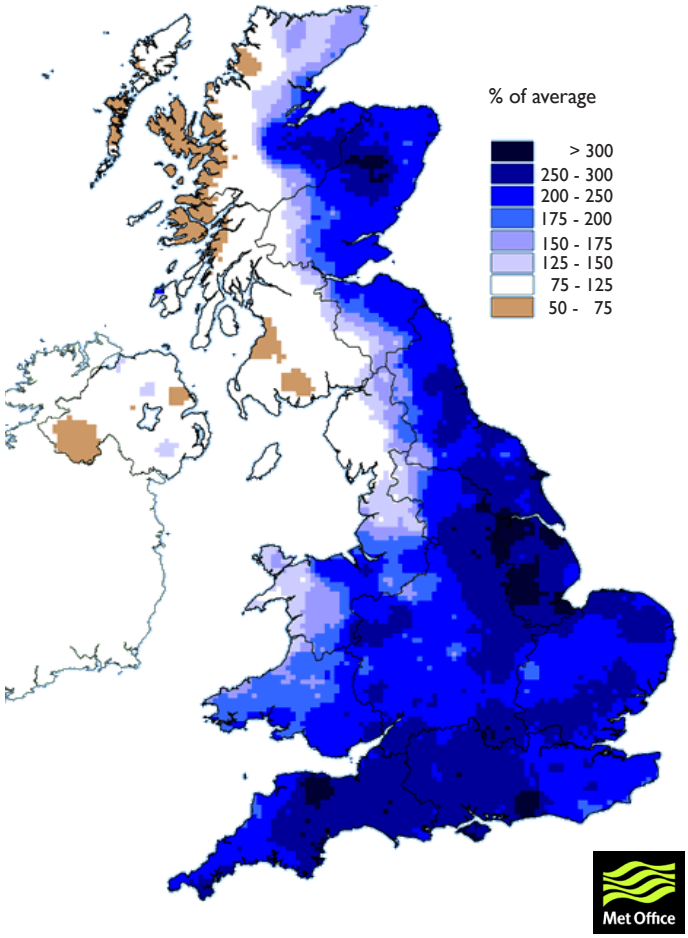
Area	Rainfall	Apr 2012	Oct11 - Apr12	RP	Mar11 - Apr12	RP	Oct10 - Apr12	RP	Apr10 - Apr12	RP
United Kingdom	mm	**127**	719		1283		1772		2217	
	%	**191**	102	2-5	103	2-5	99	2-5	99	2-5
England	mm	**134**	465		806		1163		1490	
	%	**242**	90	2-5	86	8-12	87	8-12	88	10-20
Scotland	mm	**116**	1109		2038		2720		3319	
	%	**144**	114	10-20	123	80-120	113	15-25	112	15-25
Wales	mm	**161**	814		1386		1977		2533	
	%	**199**	88	2-5	88	5-10	86	10-15	90	8-12
Northern Ireland	mm	**67**	761		1331		1816		2324	
	%	**95**	107	5-10	104	2-5	100	2-5	101	2-5
England & Wales	mm	**138**	513		886		1275		1634	
	%	**234**	90	2-5	86	8-12	87	8-12	88	10-15
North West	mm	**103**	746		1396		1959		2455	
	%	**154**	99	2-5	104	2-5	101	2-5	101	2-5
Northumbria	mm	**136**	458		929		1389		1730	
	%	**230**	89	2-5	97	2-5	103	2-5	101	2-5
Midlands	mm	**133**	419		676		956		1273	
	%	**244**	90	2-5	77	20-35	78	50-80	81	35-50
Yorkshire	mm	**148**	497		836		1226		1532	
	%	**254**	98	2-5	89	5-10	93	2-5	91	5-10
Anglian	mm	**118**	311		539		773		1061	
	%	**260**	88	2-5	78	15-25	81	15-25	85	10-20
Thames	mm	**134**	369		646		928		1194	
	%	**263**	86	2-5	80	8-12	82	10-20	82	15-25
Southern	mm	**132**	415		703		1092		1355	
	%	**254**	82	2-5	79	10-20	85	8-12	84	10-20
Wessex	mm	**154**	482		834		1183		1480	
	%	**274**	86	2-5	84	5-10	83	10-20	83	20-35
South West	mm	**190**	733		1158		1674		2097	
	%	**265**	89	2-5	84	5-10	82	10-20	84	10-20
Welsh	mm	**159**	780		1328		1889		2429	
	%	**202**	88	2-5	88	5-10	86	10-15	89	8-12
Highland	mm	**115**	1425		2514		3230		3916	
	%	**124**	120	15-20	128	60-90	111	10-15	111	10-15
North East	mm	**175**	603		1271		1749		2277	
	%	**273**	101	2-5	117	5-10	113	2-5	116	5-10
Tay	mm	**139**	866		1757		2434		2986	
	%	**206**	101	2-5	121	30-50	115	15-25	115	20-30
Forth	mm	**109**	763		1539		2161		2648	
	%	**175**	103	2-5	119	15-25	116	15-25	114	10-15
Tweed	mm	**114**	584		1253		1791		2181	
	%	**190**	97	2-5	114	5-10	115	8-12	111	2-5
Solway	mm	**80**	1040		1920		2672		3244	
	%	**100**	111	5-10	119	30-50	114	15-25	112	10-20
Clyde	mm	**88**	1430		2528		3374		4047	
	%	**97**	122	20-35	127	80-120	116	25-40	114	15-25

% = percentage of 1971-2000 average *RP = Return period*

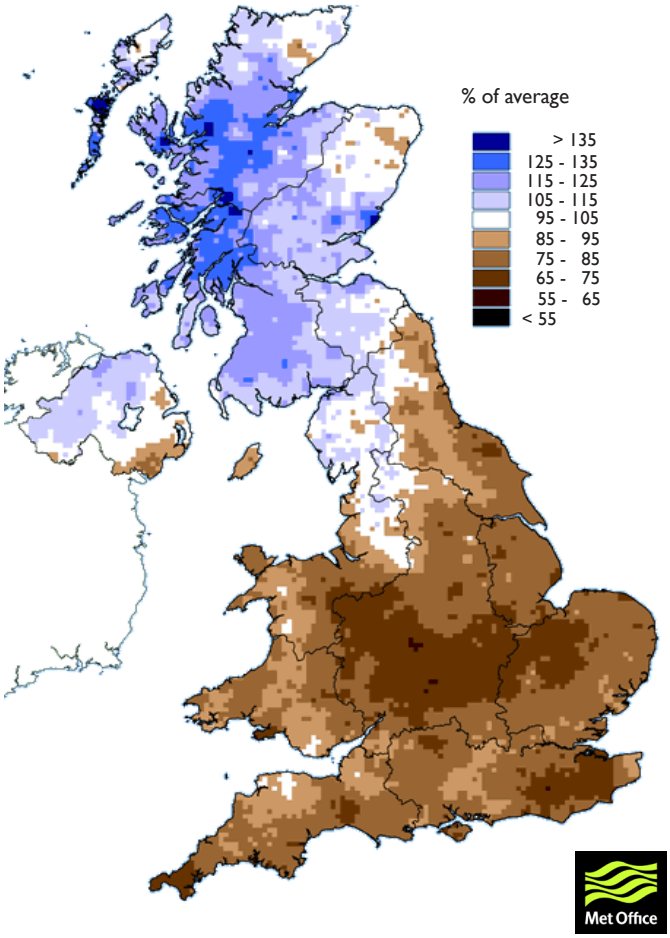
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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. All monthly rainfall totals since October 2011 are provisional.

Rainfall . . . Rainfall . . .

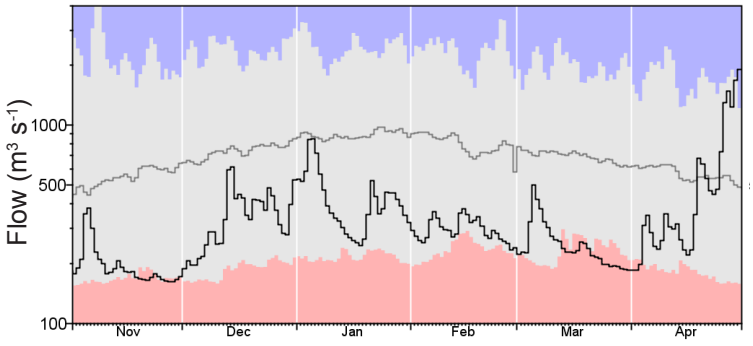
April 2012 rainfall as % of 1971-2000 average



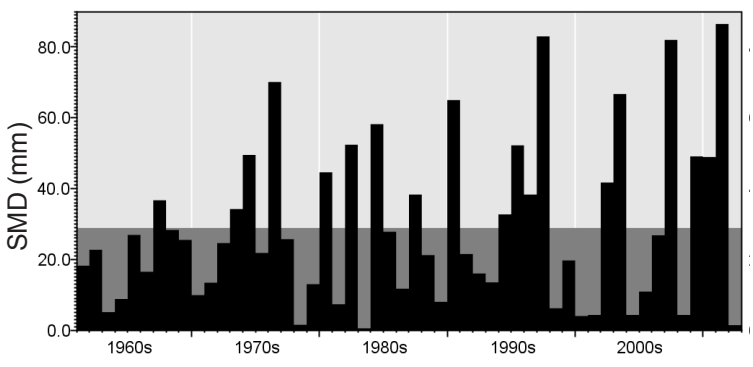
March 2011 - April 2012 rainfall as % of 1971-2000 average



Daily outflows from the English Lowlands



MORECS end-of-April SMDs across the Chalk outcrop



Met Office 3-month outlook

Updated: May 2012

For UK average rainfall, the predicted probabilities slightly favour above normal values during both May and May-June-July. However, confidence in this prediction is not high, and there is still a significant probability of below normal rainfall.

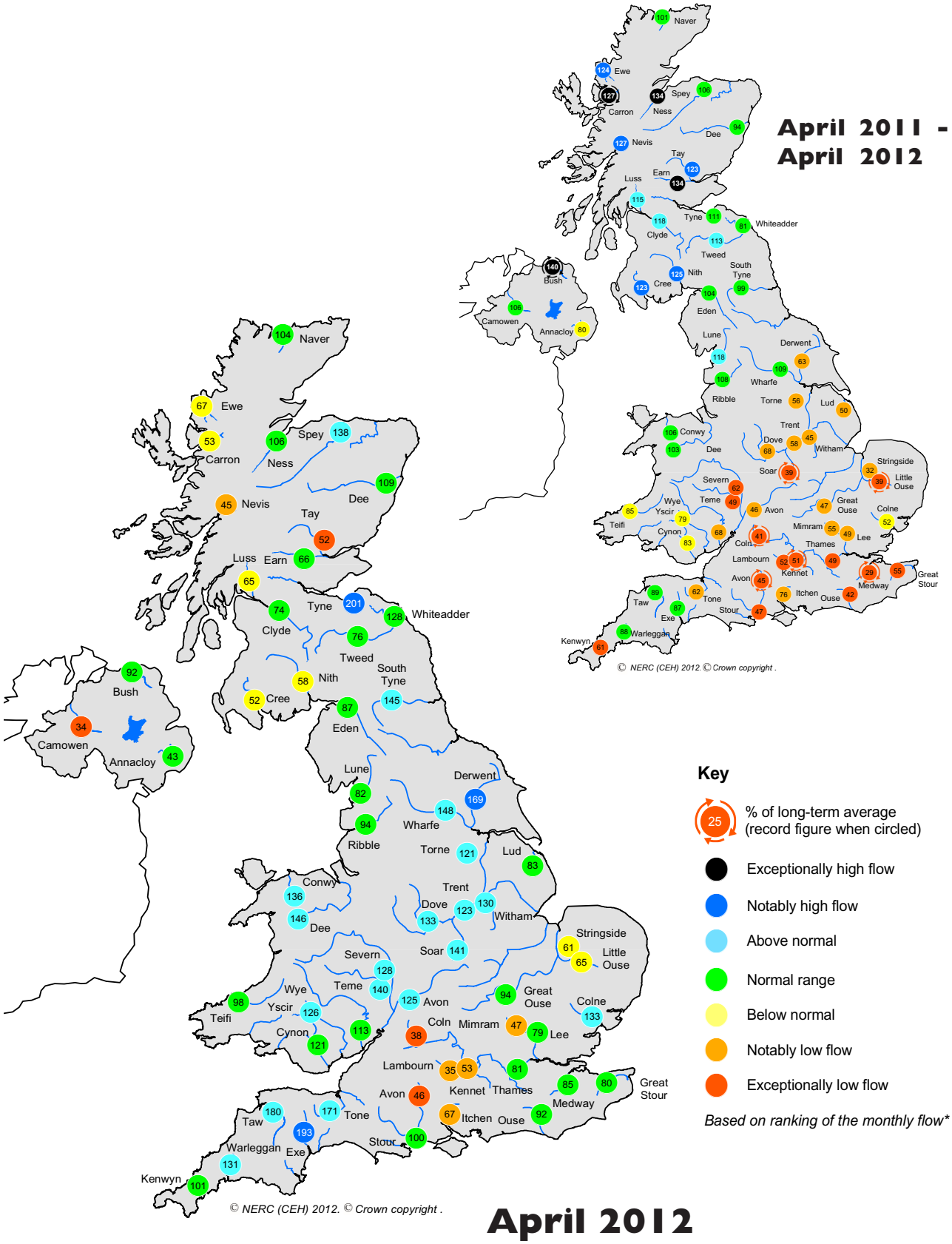
Whilst the wet weather of recent weeks will have had a positive effect on soil moisture, with all that that implies for agriculture, it is unlikely to yet have had a significant impact on groundwater supplies. With the forecast for May and May-June-July not favouring a continuation of the current very wet spell, groundwater resources in southern, eastern and central England are very unlikely to recover during this period.

The probability that UK average rainfall for May-June-July will fall into the driest of our five categories is around 15%, whilst the probability that it will fall into the wettest of our five categories is around 30% (the 1971-2000 climatological probability for each of these categories is 20%).

The complete version of the 3-month outlook may be found at:
http://www.metoffice.gov.uk/publicsector/contingency-planners
This outlook is updated towards the end of each calendar month.

The latest shorter-range forecasts, covering the upcoming 30 days, can be accessed via:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_weather.html
These forecasts are updated very frequently.

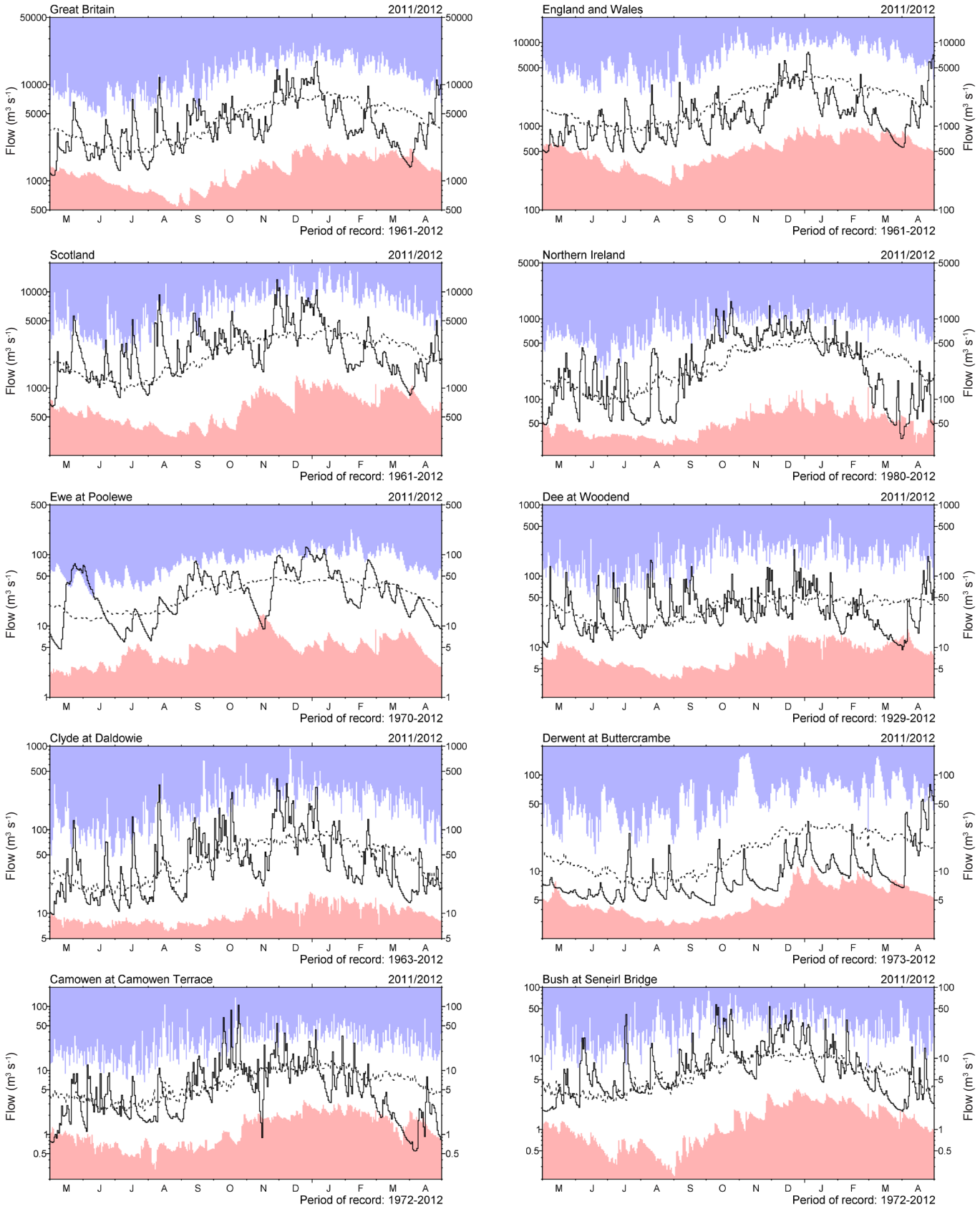
River flow . . . River flow . . .



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 period of record on which these percentages are based varies from station to station. Percentages may be omitted where flows are under review.

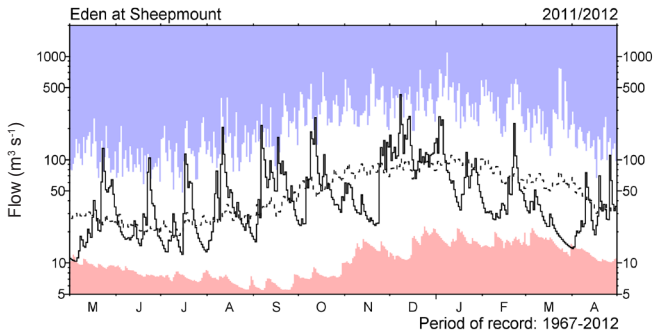
River flow . . . River flow . . .

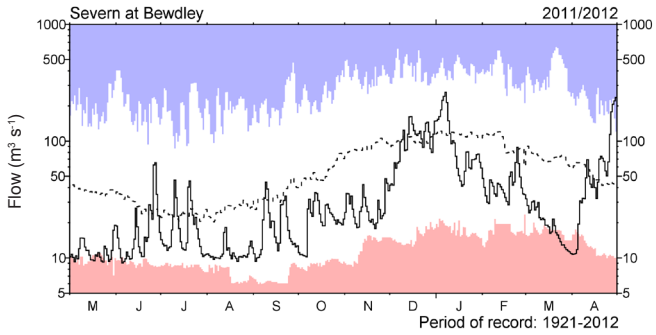


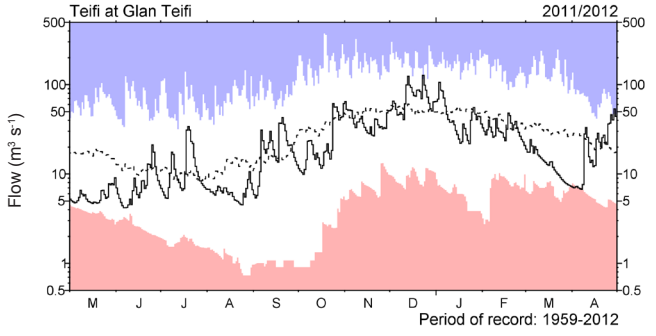
River flow hydrographs

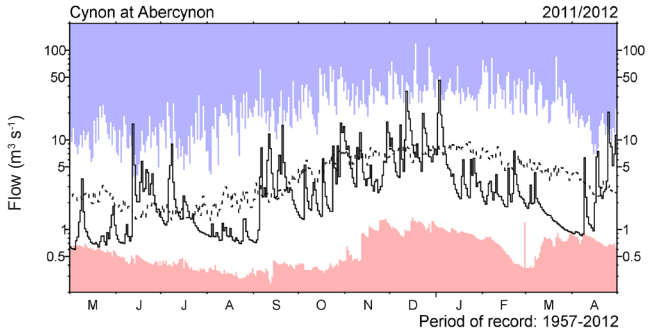
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to May 2011 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

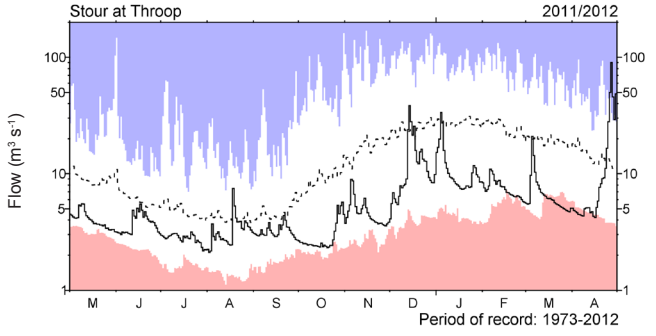
River flow . . .



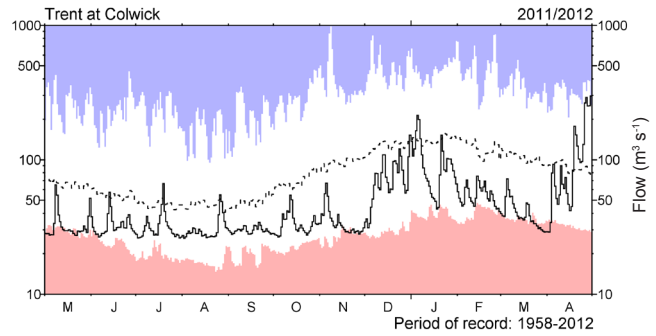


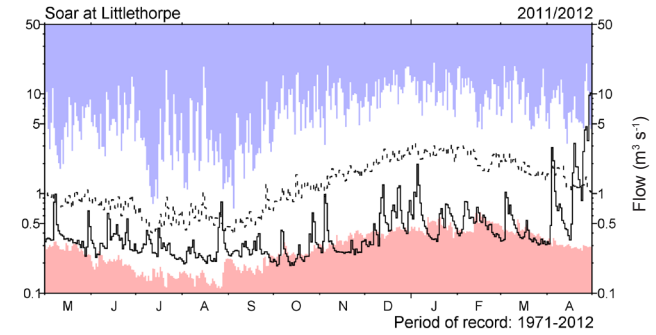


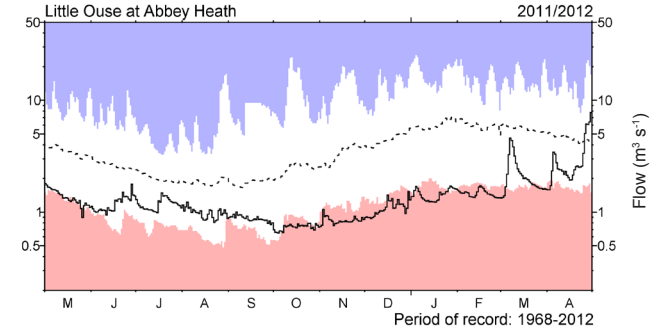


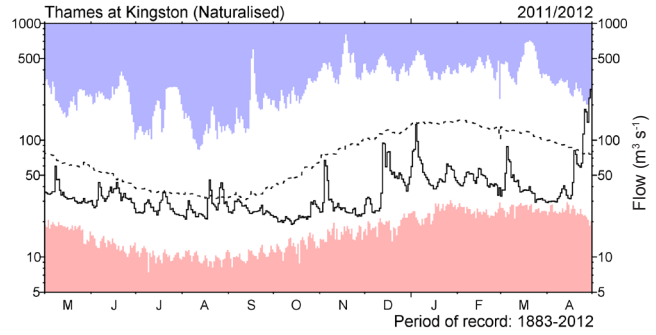


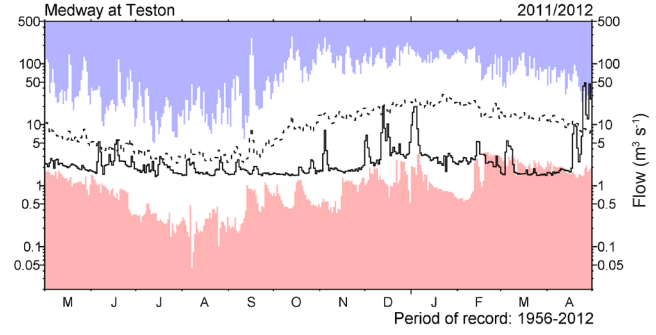
River flow . . .











Notable runoff accumulations (a) Feb - Apr 2012, (b) Oct 2011 - Apr 2012, (c) Apr 2010 - Apr 2012

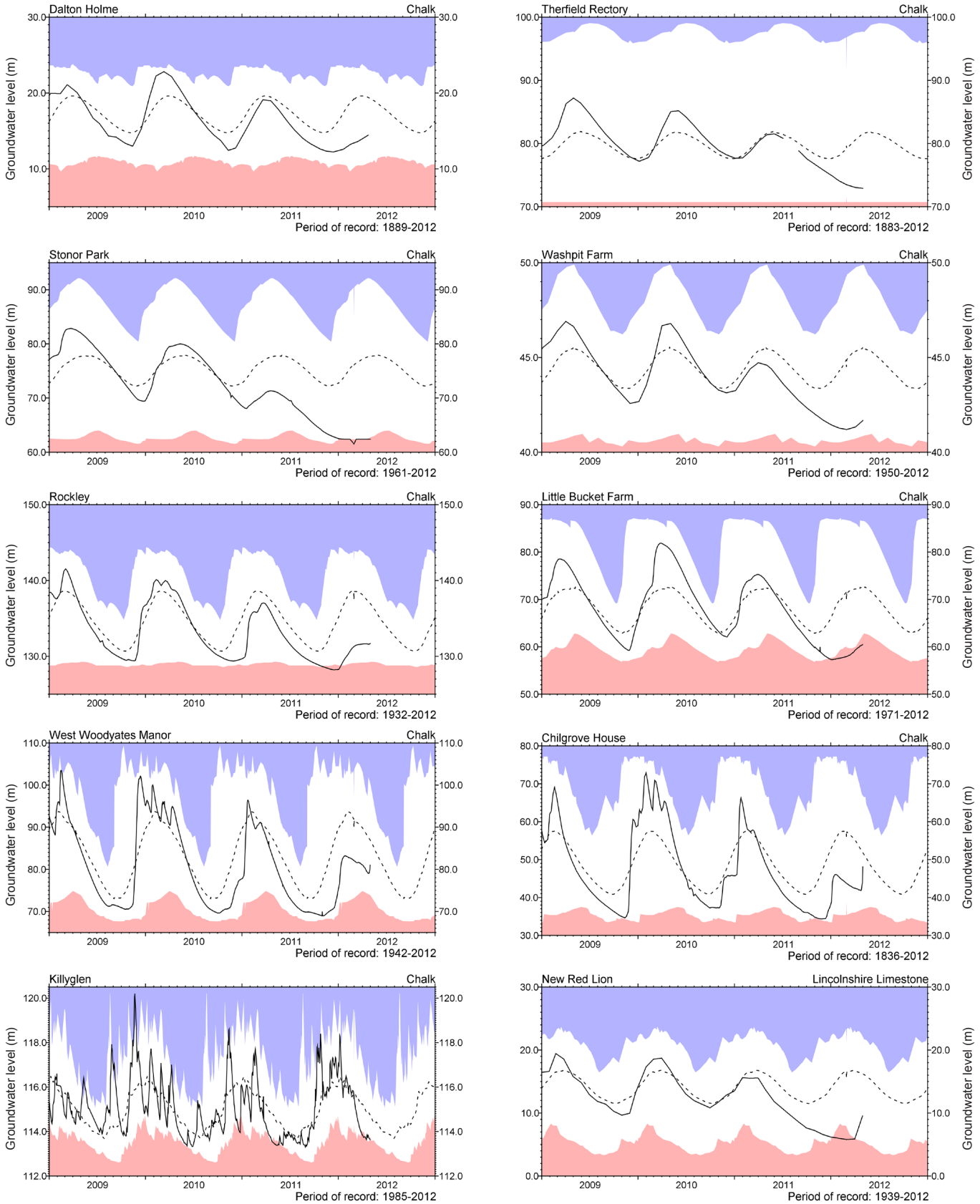
	River	%lta	Rank
a)	Tay	61	3/60
	Forth	57	2/31
	Mimram	39	2/60
	Medway	33	2/53
	Test	55	3/55
	Itchen	64	3/54
	Naver	52	2/35
	Camowen	47	2/40
	Annacloy	55	1/33

	River	%lta	Rank
b)	Little Ouse	34	1/42
	Lambourn	43	1/50
	Pang	34	2/43
	Great Stour	47	1/47
	Ouse	35	1/51
	Mourne	128	30/30
	Faughan	128	36/36
	Bush	145	38/38

	River	%lta	Rank
c)	Soar	51	1/39
	Coln	58	1/47
	Avon (Amesbury)	57	1/46
	Stour	57	1/38
	Piddle	65	1/45
	Kenwyn	69	1/42
	Tone	61	1/50
	Usk (Chain Bridge)	68	1/54

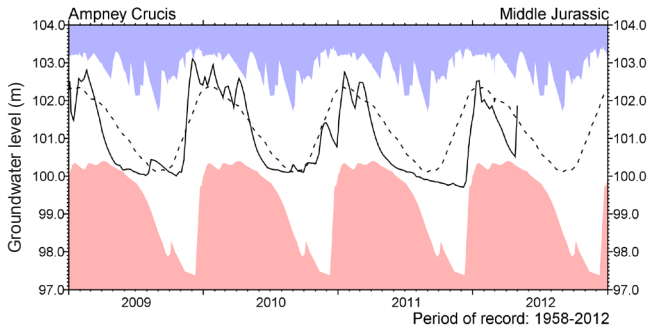
lta = long term average; Rank 1 = lowest on record

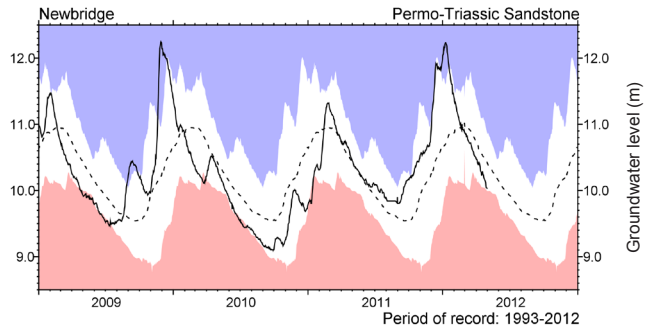
Groundwater . . . Groundwater

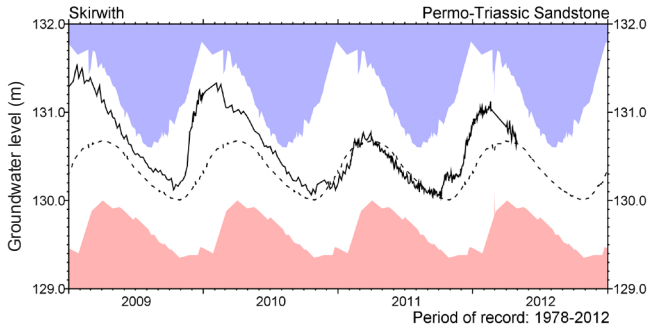


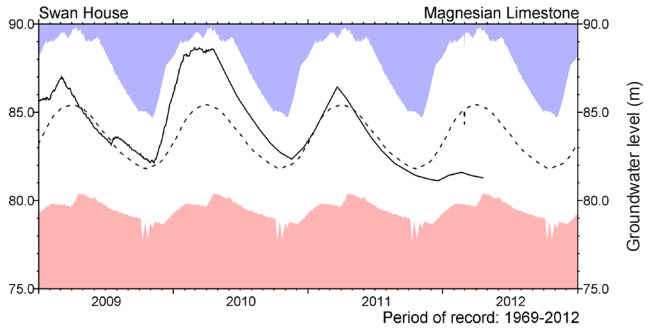
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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. The latest recorded levels are listed overleaf.

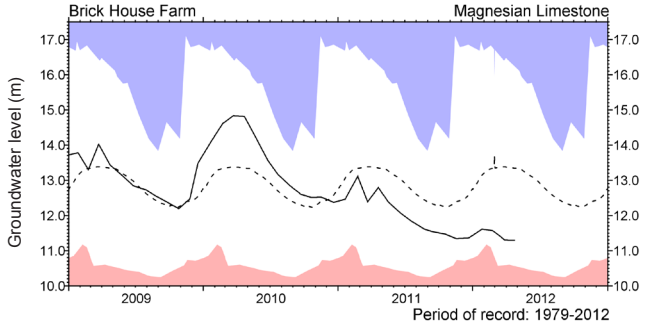
Groundwater . . . Groundwater

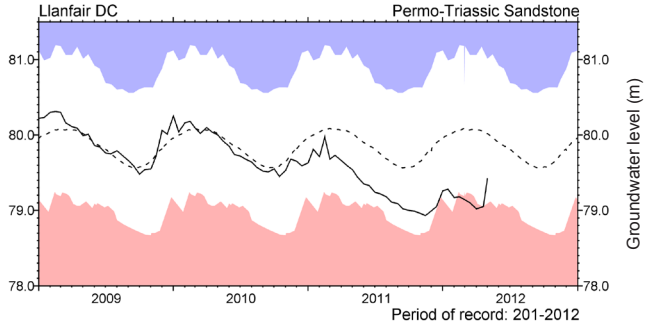


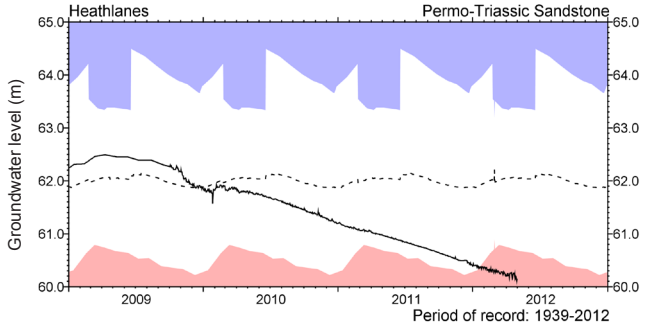


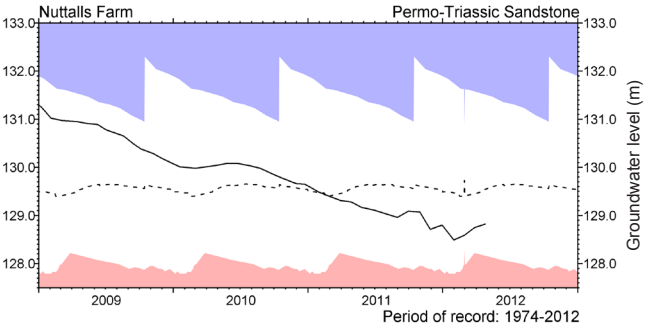


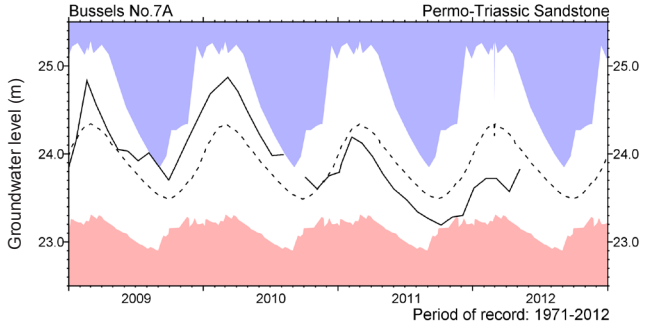


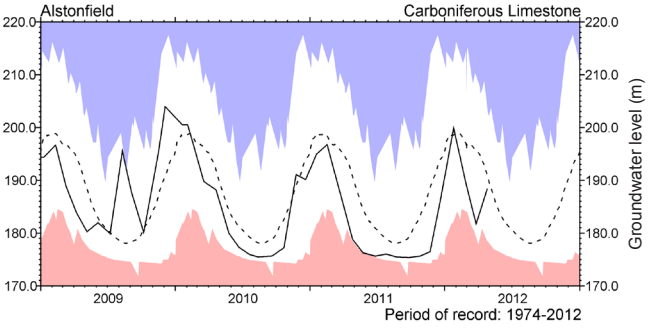










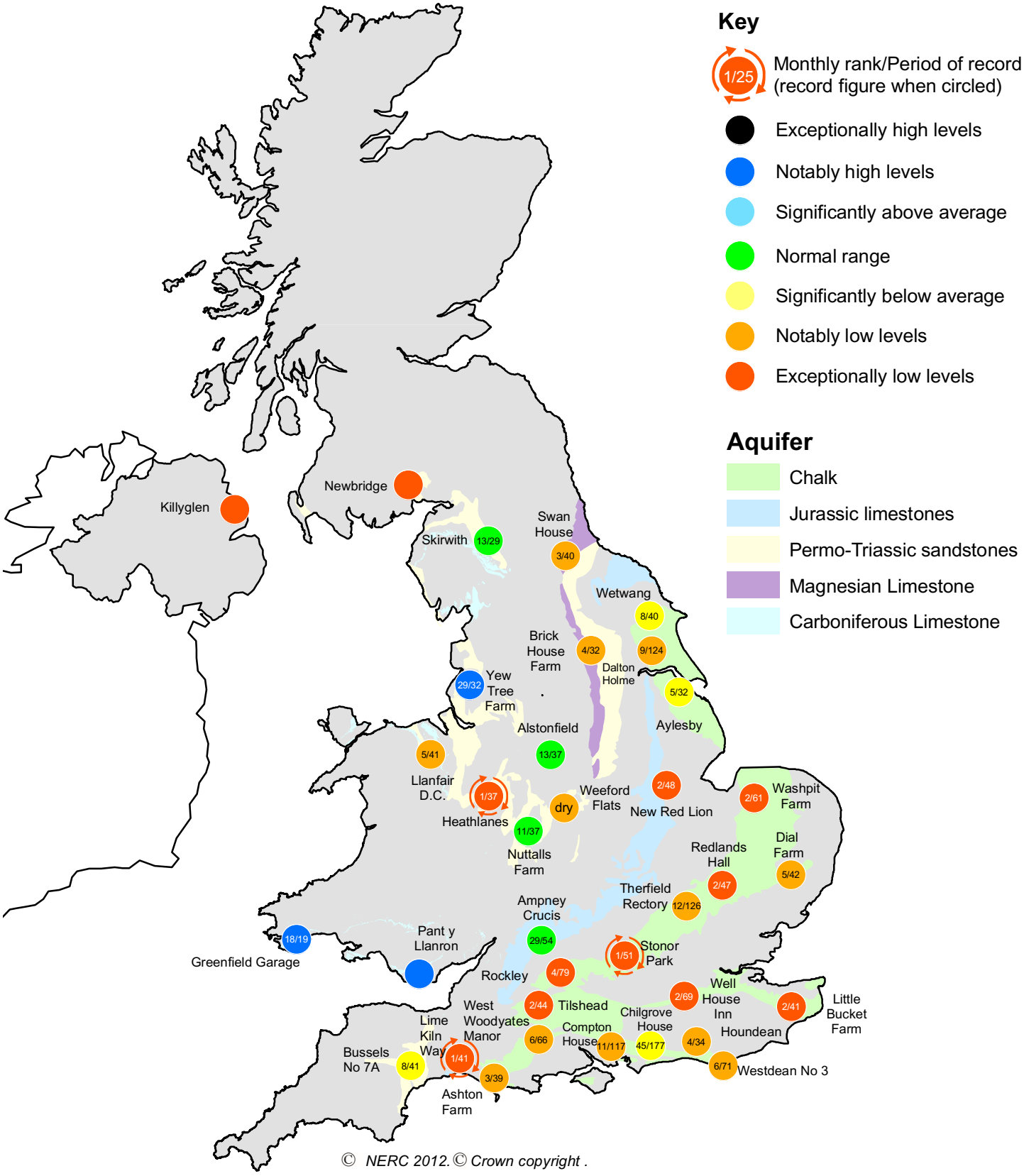


Groundwater levels April / May 2012

Borehole	Level	Date	Apr av.	Borehole	Level	Date	Apr av.	Borehole	Level	Date	Apr av.
Dalton Holme	14.43	23/04	19.51	Chilgrove House	48.32	01/05	52.30	Brick House Farm	11.29	23/04	13.37
Therfield Rectory	72.90	01/05	80.65	Killyglen (NI)	113.63	30/04	114.89	Llanfair DC	79.42	01/05	80.05
Stonor Park	62.37	01/05	77.50	New Red Lion	9.56	30/04	16.28	Heathlanes	60.14	30/04	62.02
Tilshead	81.78	30/04	92.62	Ampney Crucis	101.85	01/05	101.69	Nuttalls Farm	128.82	25/04	129.53
Rockley	131.68	01/05	137.54	Newbridge	10.03	30/04	10.53	Bussels No.7a	23.82	07/05	24.17
Well House Inn	86.67	01/05	97.18	Skirwith	130.63	30/04	130.68	Alstonfield	188.33	25/04	192.52
West Woodyates	81.02	30/04	88.43	Swan House	81.28	19/04	85.40				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



Groundwater levels - April 2012

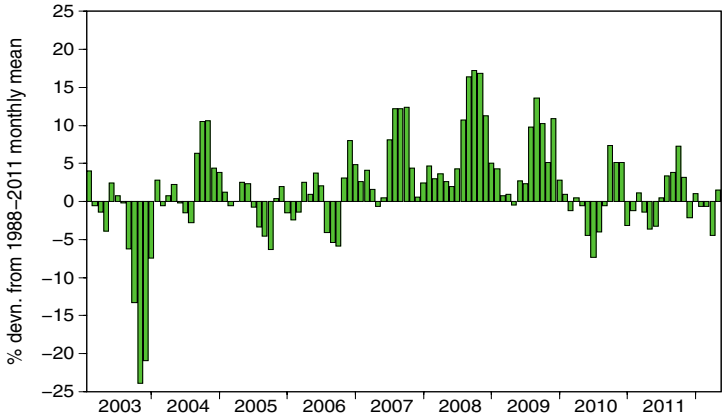
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

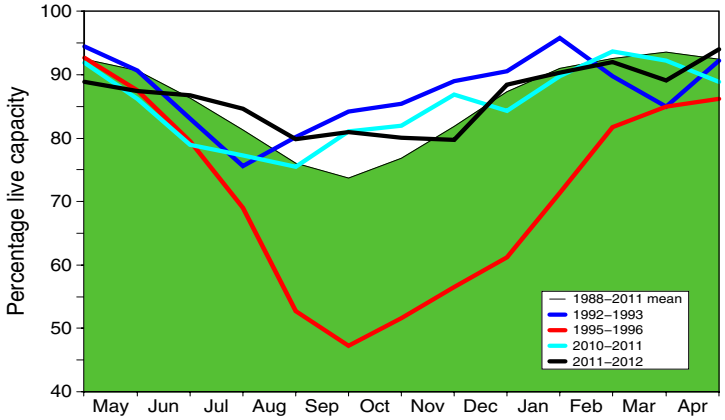
ii. Yew Tree Farm levels are now received quarterly.

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



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2012 Mar	Apr	May	May Anom.	Min May	Year* of min	2011 May	Diff 12-11
North West	N Command Zone	•	124929	93	84	**83**	-5	74	2003	86	-3
	Vyrnwy		55146	96	91	**100**	8	70	1996	87	13
Northumbrian	Teesdale	•	87936	98	92	**100**	9	74	2003	88	12
	Kielder		(199175)	92	88	**91**	0	85	1990	90	1
Severn Trent	Clywedog		44922	96	99	**99**	2	85	1988	97	2
	Derwent Valley	•	39525	99	90	**99**	7	54	1996	77	22
Yorkshire	Washburn	•	22035	97	96	**100**	10	76	1996	80	20
	Bradford supply	•	41407	99	90	**98**	8	60	1996	83	15
Anglian	Grafham		(55490)	95	96	**96**	3	73	1997	90	6
	Rutland		(116580)	71	73	**85**	-7	72	1997	89	-4
Thames	London	•	202828	96	97	**98**	4	86	1990	96	2
	Farmoor	•	13822	100	100	**97**	0	81	2000	100	-3
Southern	Bewl		28170	40	49	**60**	-30	60	2012	92	-32
	Ardingly*		4685	46	51	**69**	-31	69	2012	99	-30
Wessex	Clatworthy		5364	100	92	**100**	7	81	1990	84	16
	Bristol WW	•	(38666)	79	80	**91**	-2	83	2011	83	8
South West	Colliford		28540	76	75	**79**	-7	56	1997	82	-3
	Roadford		34500	81	81	**85**	0	41	1996	74	11
	Wimbleball		21320	94	97	**100**	6	79	1992	84	16
	Stithians		4967	90	87	**90**	-1	65	1992	88	2
Welsh	Celyn and Brenig	•	131155	100	98	**100**	2	75	1996	96	4
	Brianne		62140	98	91	**100**	3	86	1997	89	11
	Big Five	•	69762	98	93	**100**	7	85	2011	85	15
	Elan Valley	•	99106	100	93	**100**	4	83	2011	83	17
Scotland(E)	Edinburgh/Mid Lothian	•	97639	99	96	**95**	2	62	1998	93	2
	East Lothian	•	10206	99	95	**100**	2	89	1992	99	1
Scotland(W)	Loch Katrine	•	111363	95	94	**89**	-2	80	2010	85	4
	Daer		22412	100	100	**100**	4	87	2007	96	4
	Loch Thom	•	11840	99	100	**97**	3	83	2010	96	1
Northern Ireland	Total+	•	56920	98	86	**84**	-3	77	2007	83	1
	Silent Valley	•	20634	98	84	**80**	-2	58	2000	80	0

() figures in parentheses relate to gross storage • denotes reservoir groups +excludes Lough Neagh *last occurrence

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 1988-2011 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

*** The monthly record of Ardingly reservoir stocks is under review.**

Location map . . . Location map

National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP)[#] is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision). Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The National River Flow Archive (maintained by CEH) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Rainfall

Most rainfall data are provided by the Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of the Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS[*]. Recent figures have been produced by the Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national and regional rainfall totals for the post-1960 period were made available by the Met Office in 2004; these have been adopted by the NHMP. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.
The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

[#] Instigated in 1988
[*]MORECS is the generic name for the Met Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

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The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

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Selected text and maps are available on the WWW at
http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html
Navigate via Hydrological Summary for the UK.

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