Hydrological Summary

for the United Kingdom

March 2012

General

March was an exceptionally mild month and the driest for the UK since 1953. Most of the country reported less than half the average rainfall, further intensifying the drought and extending its spatial range. Accumulated rainfall deficiencies now extend over 24-27 months across the English Lowlands and are of a magnitude expected, on average, only around once every 20-30 years. With the rainfall deficiencies disproportionately concentrated in the winter/spring periods the drought's severity has been magnified. Its range of impacts embraces agriculture, water resources and the environment; there is a heightened risk of heath and moorland fires and particular concern for the ecological health of groundwater-fed streams and wetlands – and the wildlife they sustain. The decline in reservoir stocks for England & Wales through March was the largest since 1993 and, whilst drought alleviation measures contributed to increased stocks in several impoundments, early April stocks remain the lowest on record for a few major reservoirs (including Rutland). March river flows and groundwater levels were very depressed: total outflows from Great Britain were the lowest (for March) in a series from 1961 and estimated overall storage in the Chalk aquifer was marginally lower than at the same time in 1976. The early April rainfall was very welcome for farmers and growers but with record late-March soil moisture deficits and accelerating evaporation losses, a continuing decline in runoff rates and groundwater levels may be expected in the drought-affected regions. Model analyses indicate that even above average rainfall is unlikely to see a return to normal river flows before the autumn and the recovery of groundwater stocks will be heavily dependent on rainfall through the 2012/13 winter.

Rainfall

The continuing influence of synoptic patterns that have brought drought conditions to much of western Europe were maintained through a remarkably anticyclonic March. The UK experienced exceptionally high daily maximum temperatures and a dearth of rain-bearing Atlantic low pressure systems. Many areas registered more than 25 dry days in March and, in a number of central, southern and eastern localities, more than 75% of the month's rainfall was registered in 24 hrs (on the 3/4th). Above average March rainfall totals were largely confined to coastal areas of East Anglia and Kent. Eastern Scotland was exceptionally dry (Kinloss reported a monthly total of 5mm), Northern Ireland reported its driest March for 59 years and, East Anglia aside, much of the drought-affected region recorded only 30-40% of the March average. More significantly, rainfall deficiencies over the last 13 months are exceptional. With the exception of 1975/76, no lower 13-month total (for any start month) has been recorded for the Midland region in a series from 1910. In the same timeframe, and importantly from a water resources perspective, England registered its 2nd lowest rainfall for successive winter half-years (Oct-Mar) – see page 3. In the drought-affected regions rainfall deficiencies can be traced back to the winter of 2009/10 and, whilst several similar or drier 'two-year' droughts have occurred (e.g. 1995-7, 1990-2, 1932-34, 1920-22), the hydrological severity of the current drought strongly reflects the seasonal distribution of the rainfall deficiencies (for the English Lowlands the combined rainfall over the summers of 2010 and 2011was above the long term average).

River Flows

Across most of the country, March river flows were more typical of the late summer and, whilst some useful minor spates were reported around the end of the first week (e.g. in East Anglia), seasonally very depressed runoff rates characterised most catchments around month end. Index rivers registering new late-March minimum flows showed a very wide distribution (from the Scottish Dee to the Medway, and the Camowen in Northern Ireland). March runoff totals were below average for all index rivers across the country and some recorded mean flows below those of March 1976 (e.g. the Medway and Dorset Stour) but a more convincing measure of the drought's severity in the worst-affected regions is provided by the medium-term runoff accumulations. For the winter half-year (Oct-Mar), runoff from the English Lowlands is the 2nd lowest (after 1976) in a series from 1961 whilst for the last 12 months the previous minimum (1996/97) has been eclipsed by an appreciable margin. The late-March flows imply a contraction in the stream network comparable to any experienced in the last 50 years (for the time of year). This together with the continuing failure of springs, associated (temporary) habitat loss, low oxygen levels, limited effluent dilution and the appearance of algal blooms underlines the environmental and ecological stress that is a defining characteristic of the current drought.

Groundwater

March rainfall totals for most major outcrop areas were in the 30-50% range and, with notably high March temperatures and the onset of the growing season, soil moisture deficits increased over the month. At the national scale, the smds for the end of March appreciably exceeded the previous maximum in a series from 1951 and average deficits across the English Lowlands were around 50mm (again a record for late March). Correspondingly, infiltration during March was generally minimal. Some modest increases in groundwater levels (mostly due to recharge during the winter) were evident (e.g. at Dalton Holme and Tilshead) but generally the winter recovery in groundwater resources has been extremely weak. Based on a network of seven index wells and boreholes with long records, overall storage in the Chalk for March was lower than in 1976 and, in a series from 1951, only 1992 has registered modestly lower overall aquifer storage – see page 3. Natural base levels have been reached or closely approached at a number of index wells (e.g. at Stonor and New Red Lion) – remarkably early in the year. At such sites little further decline in levels is anticipated. Elsewhere, and in the absence of near-record late-spring rainfall, recessions will continue with the prospect of overall groundwater resources being comparable with, or below, the lowest in the last 100 years by the autumn.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

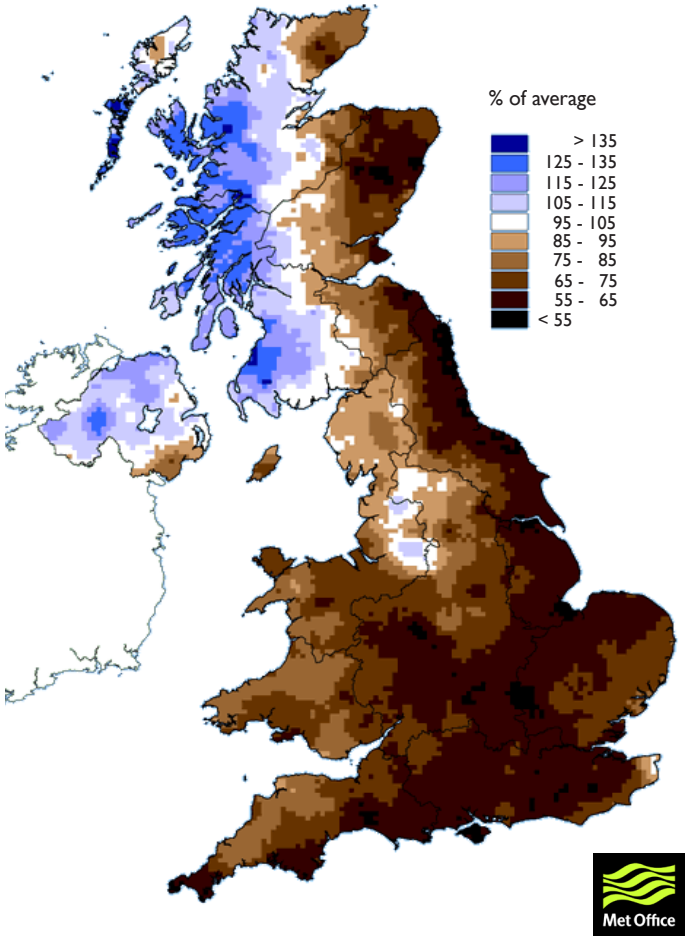
Area	Rainfall	Mar 2012	Oct11 - Mar12		Mar11 - Mar12		Oct10 - Mar12		Apr10 - Mar12	
				RP		*RP*		*RP*		*RP*
United Kingdom	mm	**37**	593		1156		1645		2090	
	%	**40**	92	2-5	98	2-5	95	2-5	96	2-5
England	mm	**27**	331		672		1029		1356	
	%	**41**	72	10-20	76	30-50	80	30-50	83	25-40
Scotland	mm	**57**	993		1922		2604		3203	
	%	**43**	112	8-12	122	60-90	112	15-25	111	10-20
Wales	mm	**32**	653		1226		1817		2372	
	%	**28**	78	8-12	82	10-20	82	20-30	86	10-20
Northern Ireland	mm	**22**	694		1264		1749		2257	
	%	**23**	108	5-10	105	2-5	100	2-5	102	2-5
England & Wales	mm	**27**	375		748		1137		1496	
	%	**38**	73	10-20	77	30-40	81	30-45	84	20-35
North West	mm	**29**	643		1293		1856		2352	
	%	**29**	93	2-5	101	2-5	99	2-5	100	2-5
Northumbria	mm	**17**	323		793		1254		1595	
	%	**25**	71	15-25	88	5-10	98	2-5	96	5-10
Midlands	mm	**23**	286		543		823		1140	
	%	**39**	70	20-30	66	>100	70	>100	75	80-120
Yorkshire	mm	**22**	349		688		1078		1384	
	%	**33**	77	5-10	78	15-25	85	10-15	85	15-20
Anglian	mm	**32**	193		421		655		944	
	%	**70**	63	25-40	65	>100	72	70-100	78	30-50
Thames	mm	**25**	235		512		794		1060	
	%	**46**	62	20-35	68	40-60	74	50-70	76	40-60
Southern	mm	**29**	283		571		959		1222	
	%	**49**	62	20-35	68	80-120	78	25-40	78	30-50
Wessex	mm	**28**	328		680		1029		1326	
	%	**41**	65	20-30	73	40-60	75	70-100	77	80-120
South West	mm	**31**	543		968		1484		1907	
	%	**32**	72	10-15	74	30-50	76	50-80	79	40-70
Welsh	mm	**31**	621		1169		1730		2271	
	%	**29**	77	8-12	82	10-20	81	25-40	86	15-25
Highland	mm	**79**	1309		2399		3115		3801	
	%	**49**	120	10-20	128	60-90	111	10-15	111	10-15
North East	mm	**16**	428		1096		1574		2102	
	%	**20**	80	10-15	107	2-5	106	2-5	111	2-5
Tay	mm	**34**	726		1617		2295		2847	
	%	**29**	92	2-5	117	15-25	112	10-15	112	10-15
Forth	mm	**39**	654		1430		2052		2539	
	%	**38**	97	2-5	116	10-15	113	10-15	112	8-12
Tweed	mm	**26**	470		1138		1676		2067	
	%	**32**	86	2-5	110	2-5	112	5-10	108	2-5
Solway	mm	**52**	960		1840		2591		3164	
	%	**43**	112	5-10	120	30-50	114	20-30	112	10-20
Clyde	mm	**74**	1343		2440		3286		3960	
	%	**46**	125	25-40	129	>100	117	30-40	114	15-25

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

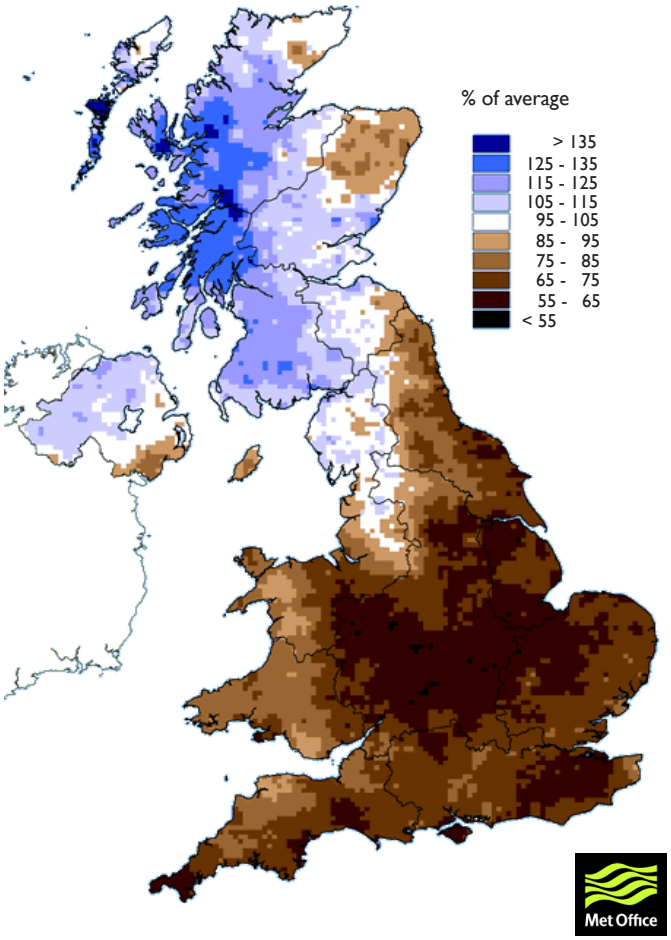
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

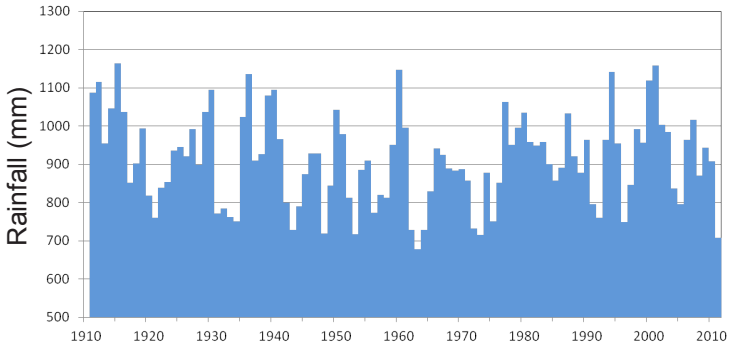
October 2011 - March 2012 rainfall as % of 1971-2000 average



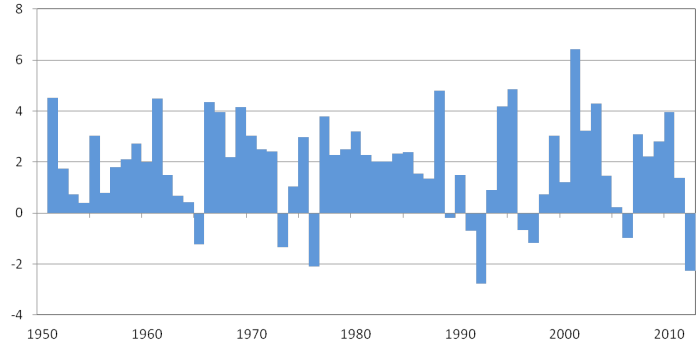
March 2011 - March 2012 rainfall as % of 1971-2000 average



Oct - Mar 2-yr rainfall accumulations for England



Index of overall Chalk storage for March



Met Office 3-month outlook

Updated: April 2012

The forecast for average UK rainfall slightly favours drier-than-average conditions for April-May-June as a whole, and also slightly favours April being the driest of the 3 months.

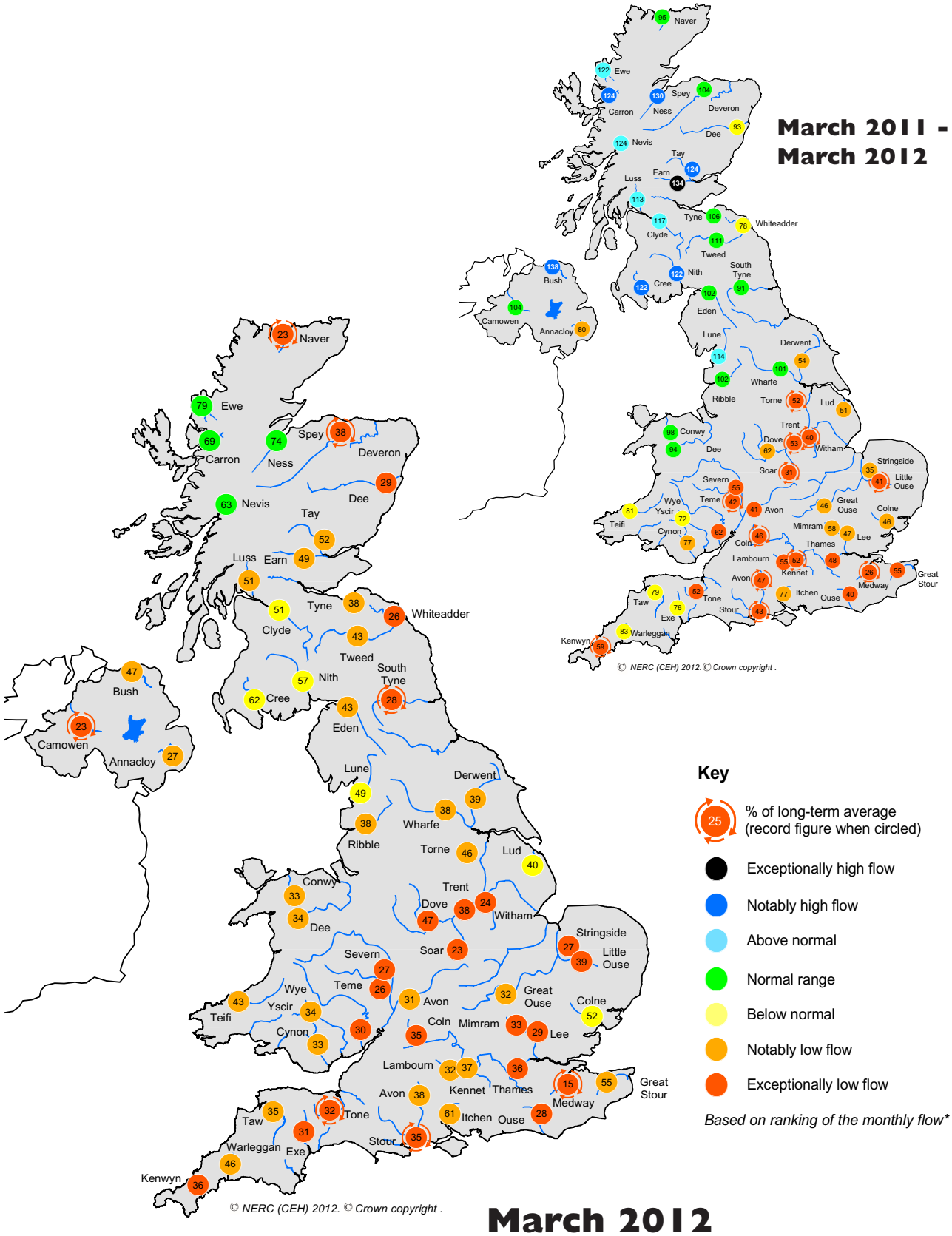
With this forecast, the water resources situation in southern, eastern and central England is likely to deteriorate further during the April-May-June period.

The probability that UK precipitation for April-May-June will fall into the driest of our five categories is 20-25% whilst the probability that it will fall into the wettest of our five categories is 10-15% (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.

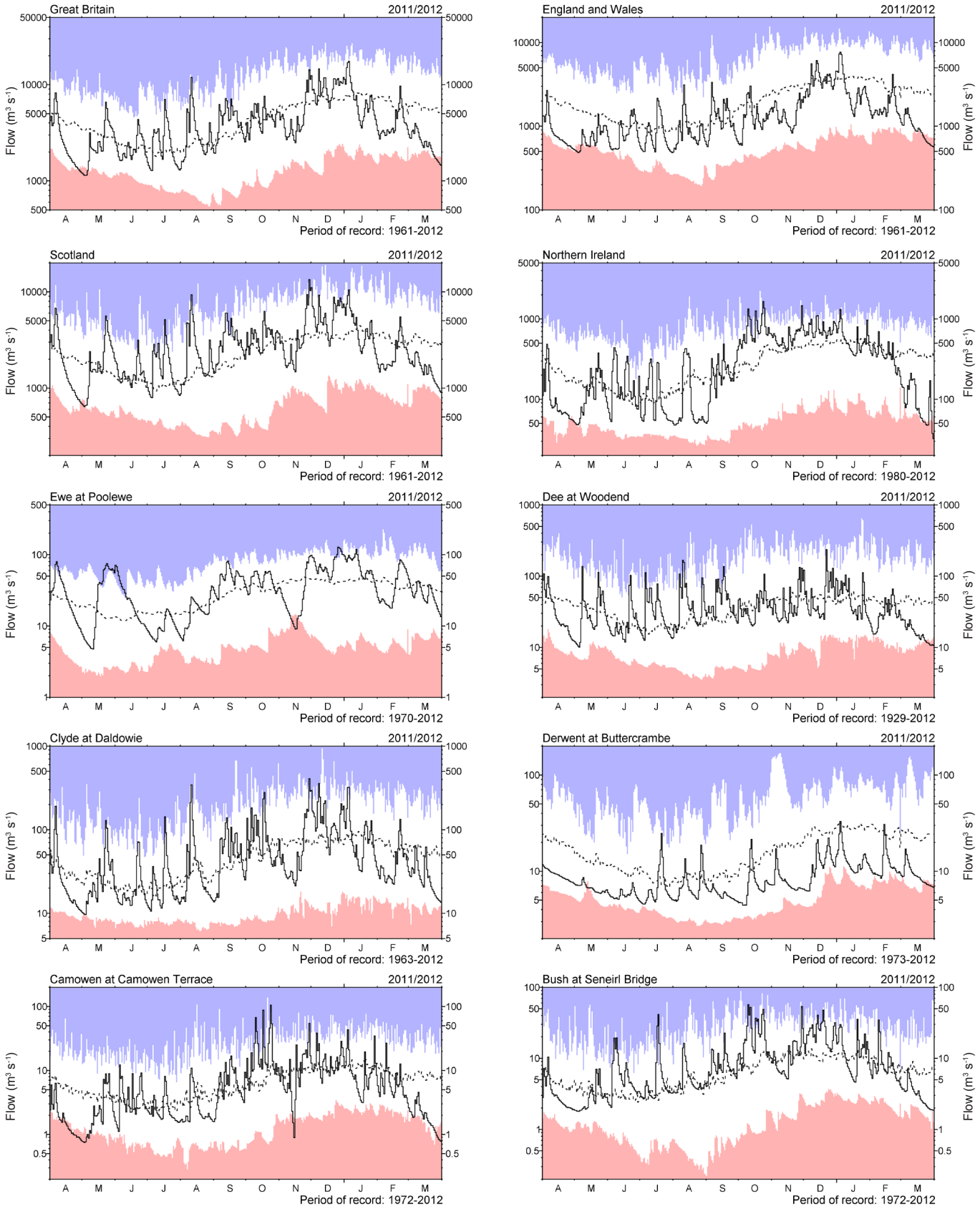
River flow . . . River flow . . .



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.

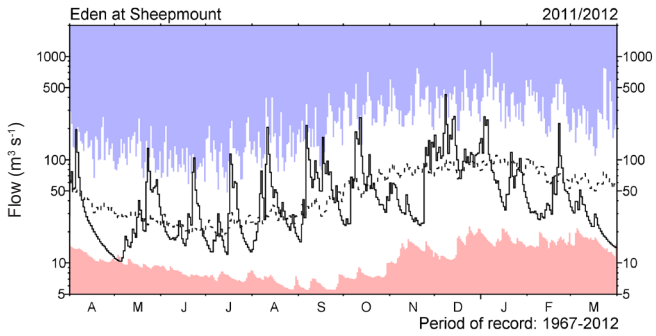
River flow . . . River flow . . .

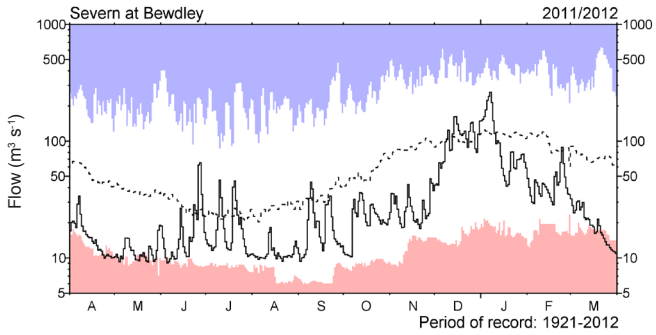


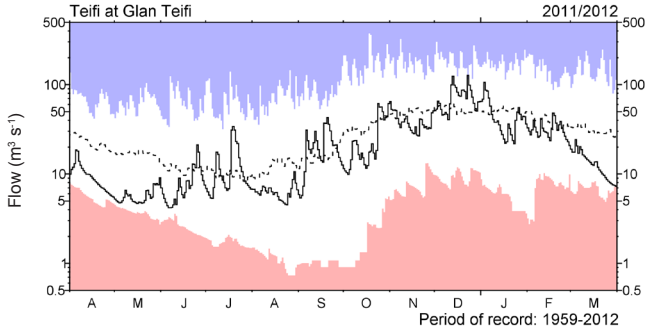
River flow hydrographs

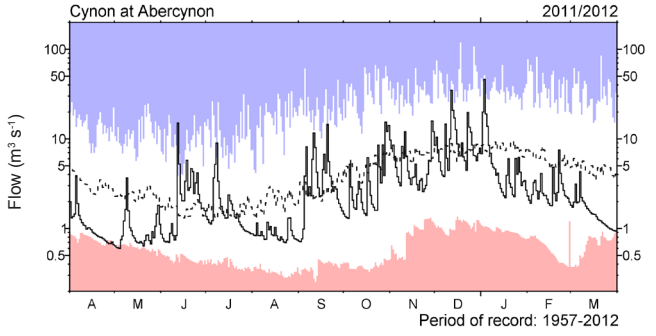
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2011 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed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

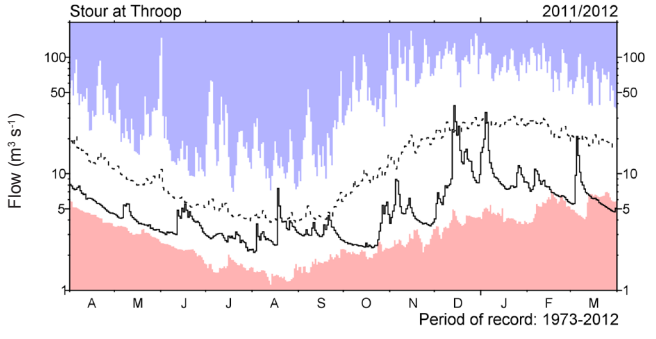
River flow . . .



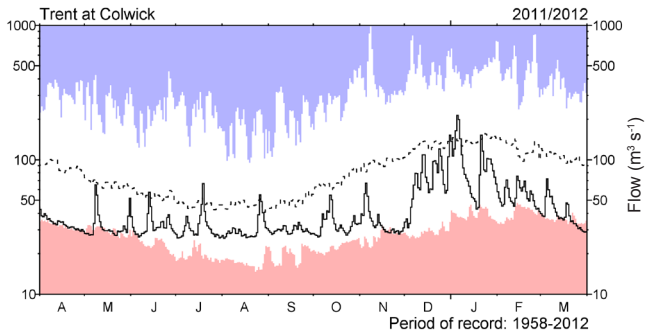


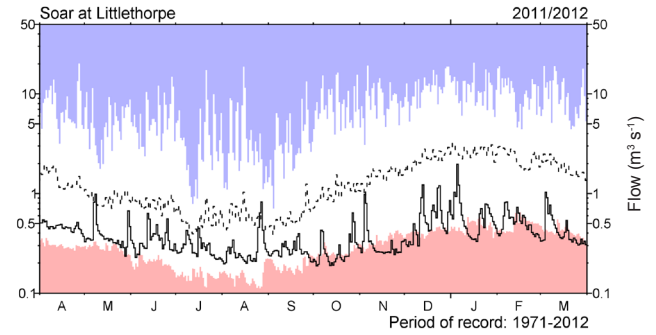


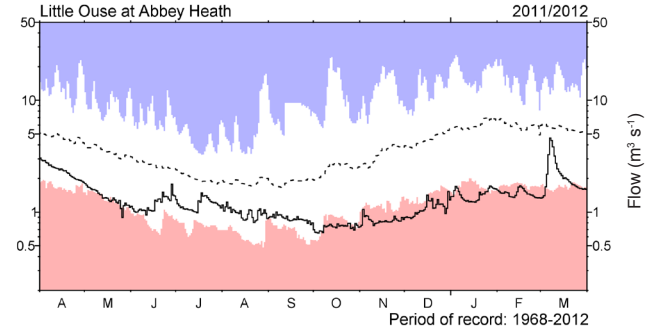


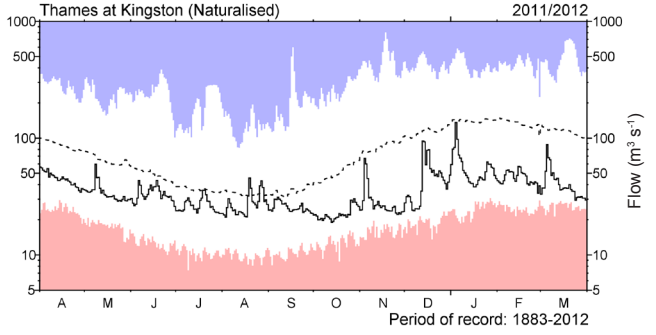


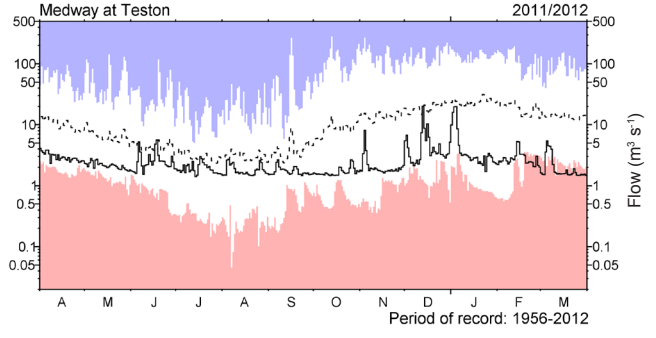
River flow . . .











Notable runoff accumulations (a) October 2011 - March 2012, (b) April 2010 - March 2012

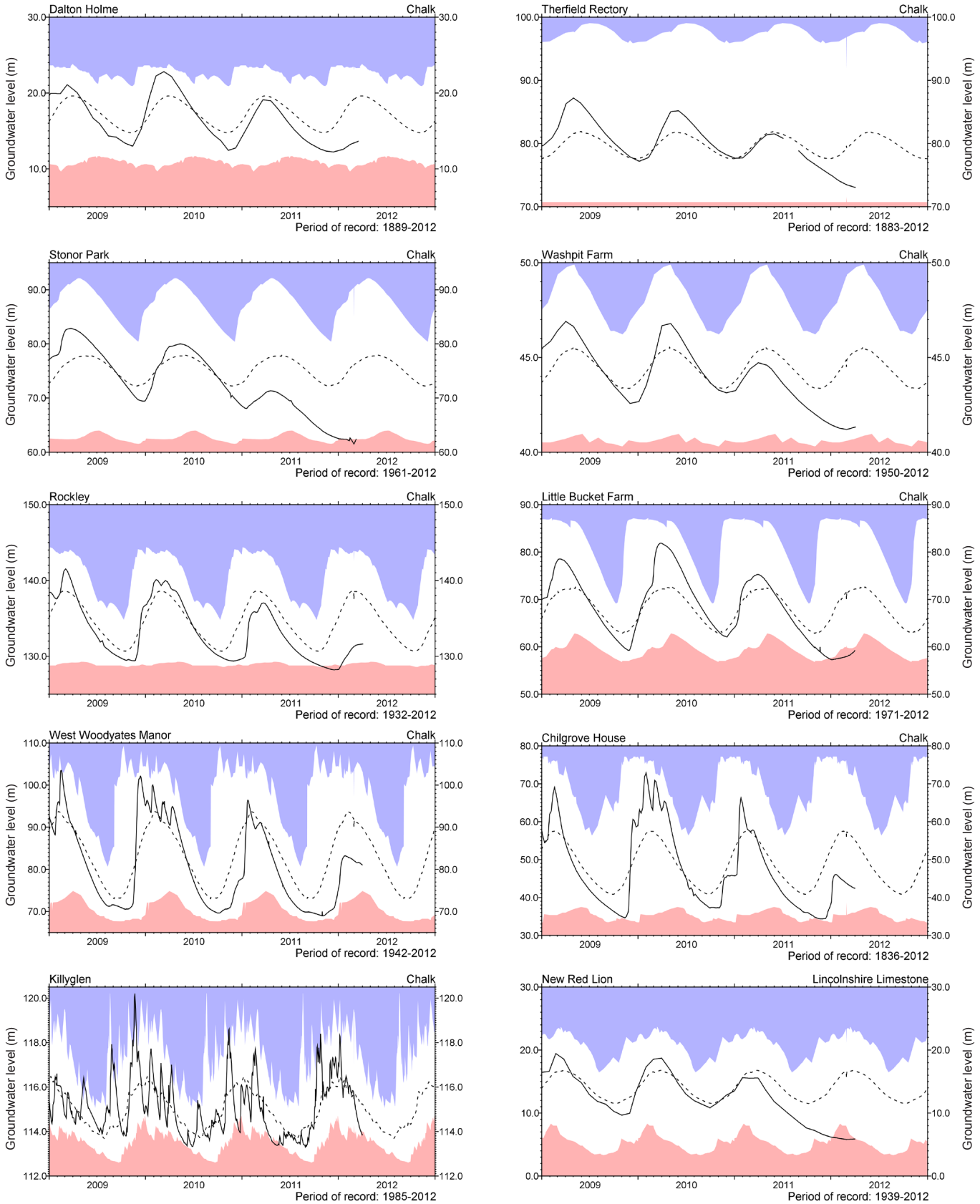
	River	%lta	Rank
a)	Bervie	45	1/33
	Trent	51	2/54
	Soar	24	1/41
	Witham	25	2/53
	Little Ouse	28	1/42
	Mimram	45	2/58
	Lambourn	44	1/50
	Coln	32	2/49
	Medway	19	1/52

	River	%lta	Rank
a)	Great Stour	43	1/47
	Ouse	29	1/52
	Wallington	28	1/58
	Tone	56	2/51
	Cree	129	48/49
	Mourne	134	30/30
	Faughan	132	36/36
	Bush	149	38/38

	River	%lta	Rank
b)	Avon (Amesbury)	58	1/46
	Stour	56	1/38
	Piddle	65	1/45
	Kenwyn	67	1/42
	Brue	58	1/44
	Teme	56	1/41
	Wye (Redbrook)	66	1/74
	Usk (Chain Bridge)	66	1/54

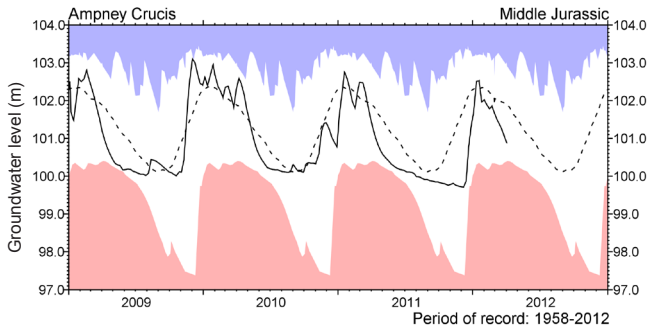
lta = long term average
Rank 1 = lowest on record

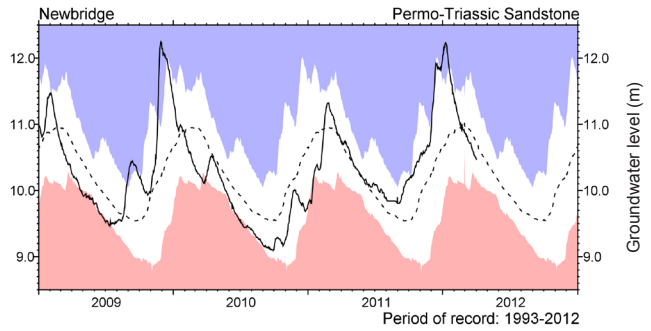
Groundwater . . . Groundwater

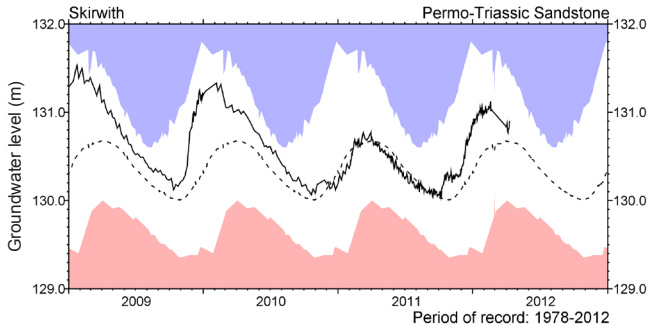


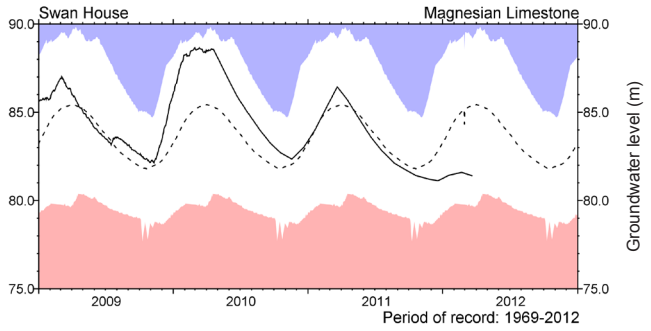
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

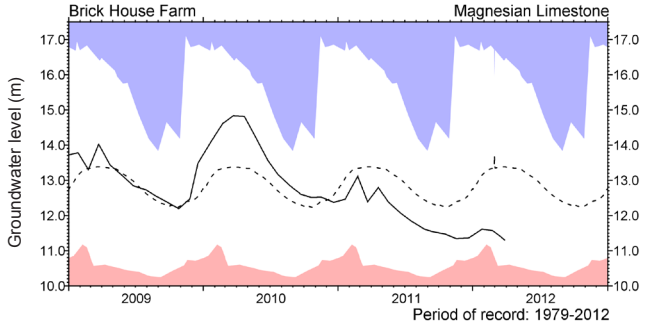
Groundwater . . . Groundwater

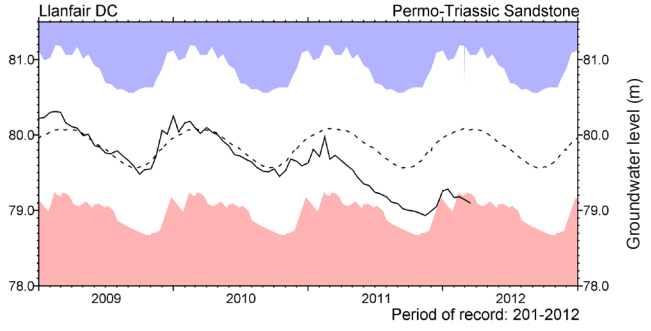


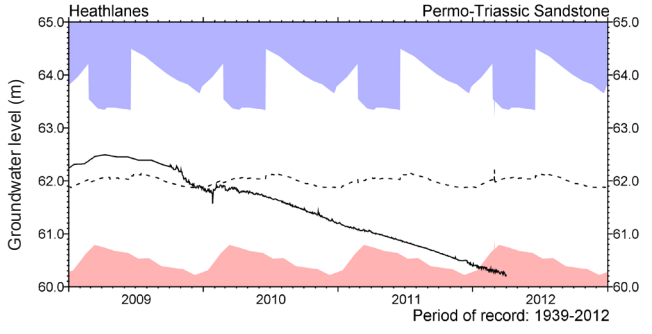


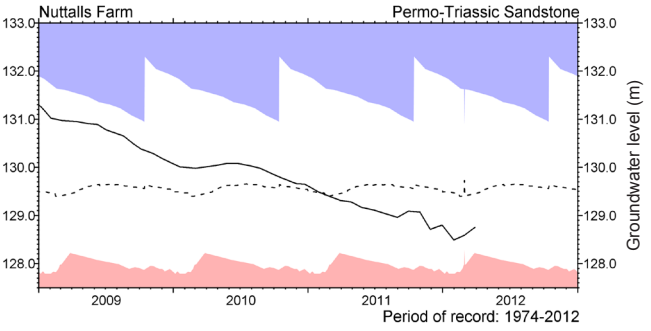


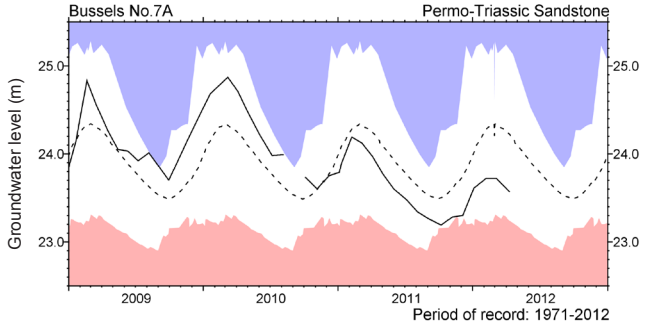


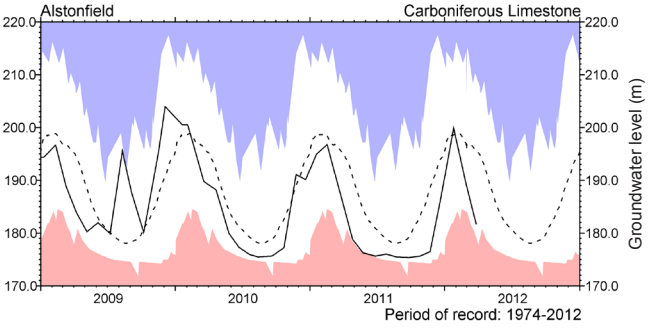










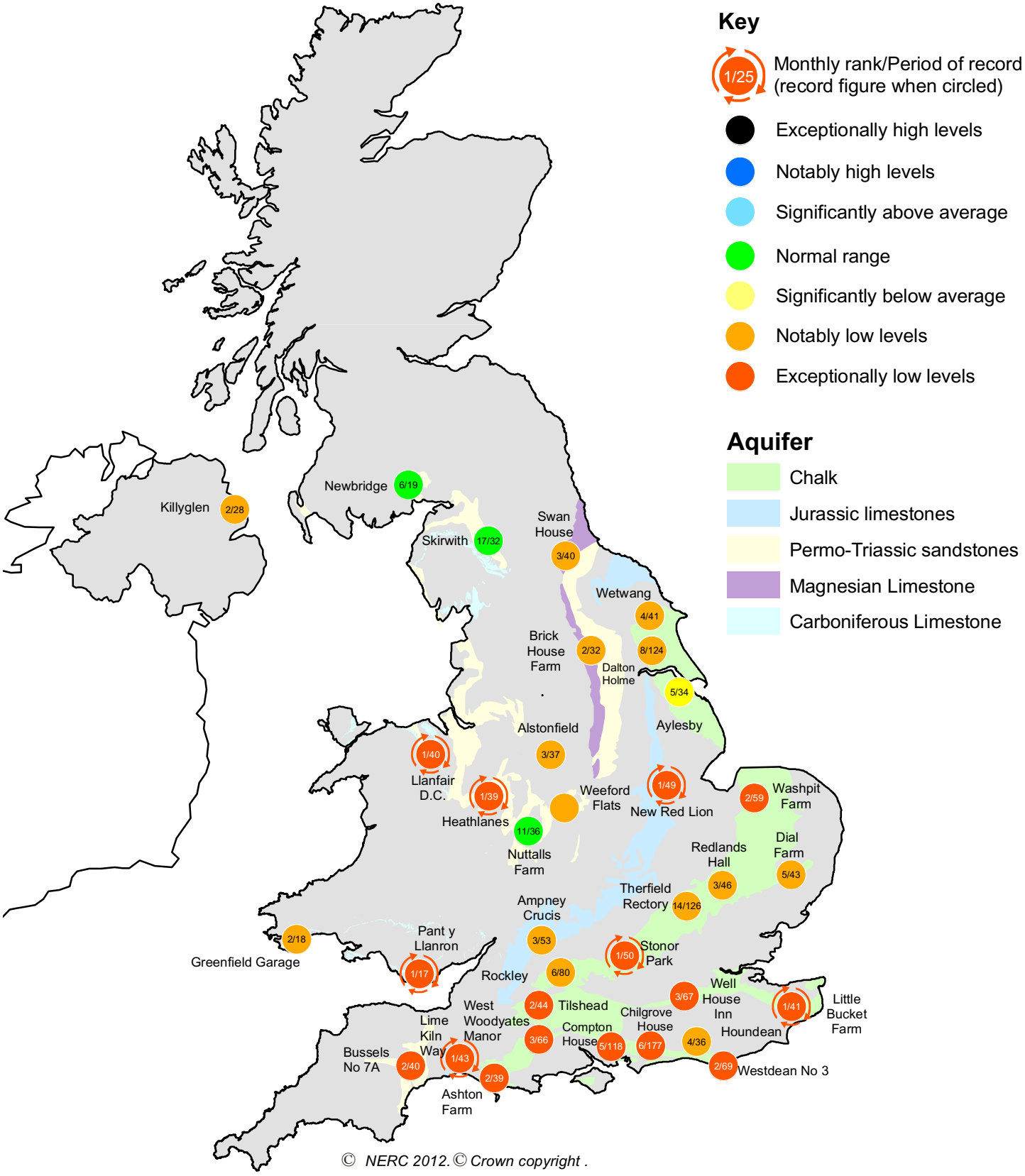


Groundwater levels March / April 2012

Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.
Dalton Holme	13.62	16/03	19.51	Chilgrove House	42.42	31/03	55.60	Brick House Farm	11.30	27/03	13.38
Therfield Rectory	73.04	02/04	79.31	Killyglen (NI)	113.85	31/03	115.46	Llanfair DC	79.10	15/03	80.06
Stonor Park	62.37	08/03	76.70	New Red Lion	5.86	31/03	16.68	Heathlanes	60.22	31/03	61.98
Tilshead	81.46	31/03	94.00	Ampney Crucis	100.88	02/04	102.00	Nuttalls Farm	128.75	28/03	129.45
Rockley	131.61	02/04	138.47	Newbridge	10.47	01/04	10.82	Bussels No.7a	23.57	09/04	24.32
Well House Inn	86.78	02/04	96.98	Skirwith	130.85	10/04	130.72	Alstonfield	181.75	26/03	195.74
West Woodyates	81.05	31/03	90.80	Swan House	81.40	20/03	85.45				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



Groundwater levels - March 2012

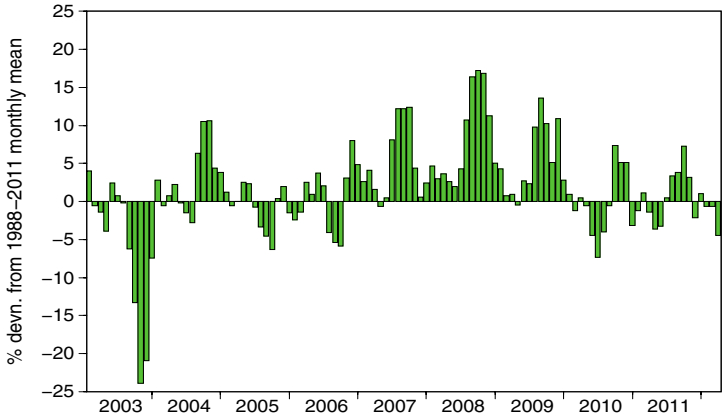
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing 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.

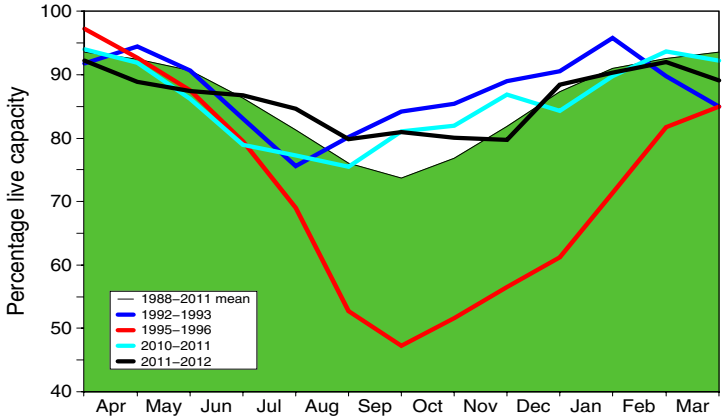
ii. Yew Tree Farm levels are now received quarterly.

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 Feb	Mar	Apr	Apr Anom.	Min Apr	Year* of min	2011 Apr	Diff 12-11
North West	N Command Zone	•	124929	96	93	**84**	-9	77	1993	91	-7
	Vyrnwy		55146	92	96	**91**	-4	64	1996	92	-1
Northumbrian	Teesdale	•	87936	96	98	**92**	-2	77	2003	92	0
	Kielder		(199175)	91	92	**88**	-4	81	1993	91	-3
Severn Trent	Clywedog		44922	93	96	**99**	4	86	1996	96	3
	Derwent Valley	•	39525	100	99	**90**	-5	54	1996	89	1
Yorkshire	Washburn	•	22035	93	97	**96**	3	70	1996	89	7
	Bradford supply	•	41407	100	99	**90**	-4	59	1996	92	-2
Anglian	Grafham		(55490)	90	95	**96**	5	77	1997	90	6
	Rutland		(116580)	69	71	**73**	-18	73	2012	90	-17
Thames	London	•	202828	92	96	**97**	2	88	1990	94	3
	Farmoor	•	13822	99	100	**100**	5	84	1992	95	5
Southern	Bewl		28170	43	40	**49**	-42	49	2012	98	-50
	Ardingly*		4685	41	46	**51**	-48	51	2012	100	-49
Wessex	Clatworthy		5364	100	100	**92**	-5	82	1992	92	0
	Bristol WW	•	(38666)	76	79	**80**	-13	71	1992	85	-5
South West	Colliford		28540	70	76	**75**	-12	58	1997	87	-12
	Roadford		34500	79	81	**81**	-4	37	1996	77	4
	Wimbleball		21320	88	94	**97**	1	78	1996	91	6
	Stithians		4967	82	90	**87**	-7	52	1992	98	-11
Welsh	Celyn and Brenig	•	131155	98	100	**98**	0	72	1996	98	0
	Brianne		62140	96	98	**91**	-7	90	1993	94	-3
	Big Five	•	69762	98	98	**93**	-3	78	1993	94	-1
	Elan Valley	•	99106	100	100	**93**	-5	89	1993	94	-1
Scotland(E)	Edinburgh/Mid Lothian	•	97639	99	99	**96**	1	71	1998	96	0
	East Lothian	•	10206	100	99	**95**	-4	95	2012	100	-5
Scotland(W)	Loch Katrine	•	111363	94	95	**94**	1	74	2010	91	3
	Daer		22412	100	100	**100**	2	93	2001	97	3
	Loch Thom	•	11840	100	99	**100**	3	83	2010	96	4
Northern Ireland	Total+	•	56920	96	98	**86**	-3	83	2002	91	-5
	Silent Valley	•	20634	96	98	**84**	-1	57	2000	90	-6

() 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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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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