

OPERATIONAL SEASONAL HYDROLOGICAL FORECASTING IN THE UK

Christel Prudhomme

with contributions from Vicky Bell, Cecilia Svensson, Chris Jackson, Jon Mackay, Jamie Hannaford, Helen Davies, Ali Rudd, Richard Davis

HEPEX – Seasonal Hydrological Forecasting Workshop
21-23 Sep 2015, Norrköping, Sweden



Two complementary operational systems

- Hydrological Outlook UK
 - UK wide projections
 - Outlooks: focus 1 to 3 months
 - Based on three methods
 - Summary maps for range of users
- Water Situation Report for England
 - England only
 - Outlooks: March and October
 - Single method: ensemble Streamflow Projection
 - Report on near past and outlook for decision-makers in the Environment Agency for England

Methods

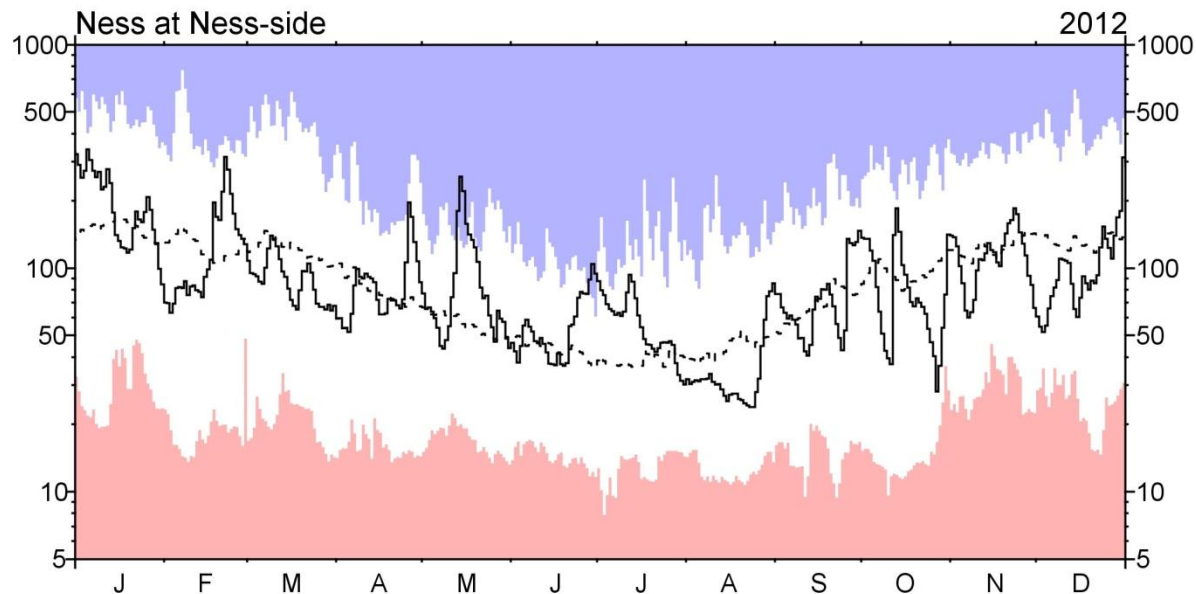
Methods	Forecast horizon
Persistence and analogy (river flow only)	1 and 3 months
Modelled from forecast rainfall	1 and 3 months
Ensemble Streamflow Prediction (WSR)	Up to 12 months

Methods: 1) Statistical methods

Persistence and historical analogues

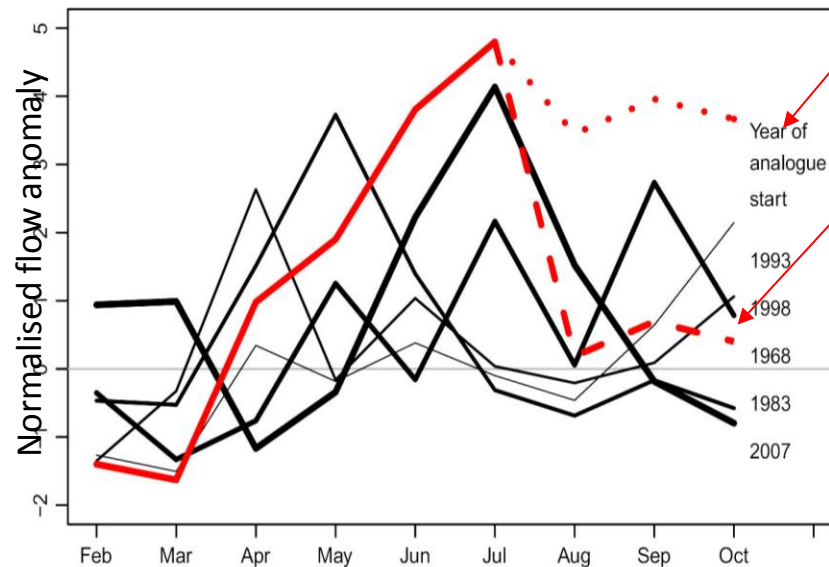
Persistence forecasts

- Simplest of the forecasts
- Flow anomaly now = flow anomaly next month
- Standardised anomalies = seasonal cycle accounted for



Historical analogues

- Five analogues from the past flow record
- Similarity in the past will persist into the near future
- Weighted mean flow forecast
- Shifted weighted mean forecast



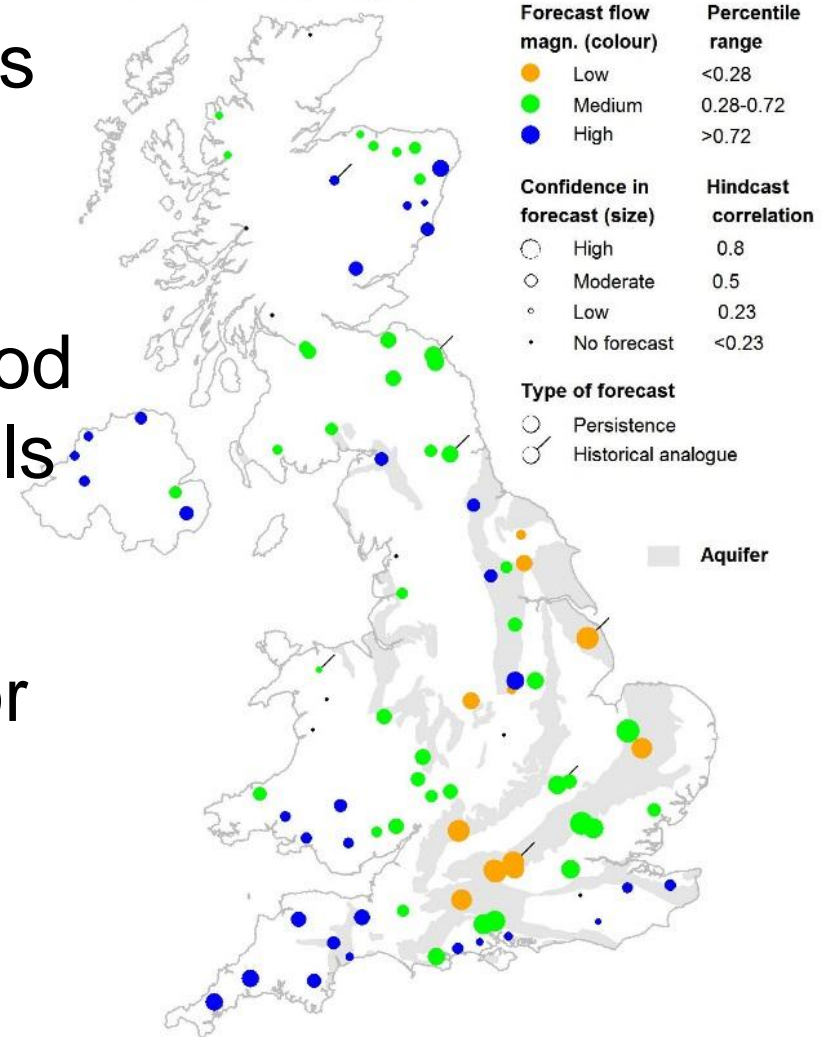
Shifted weighted mean forecast

Weighted mean forecast

Persistence and historical analogues

- Observed flow from various river authorities
- For each location and calendar month, use method with best reforecasting skills
- Categorical forecast
- Size of dots = skill indicator
- Poor skill in the north and west, particularly in winter/spring

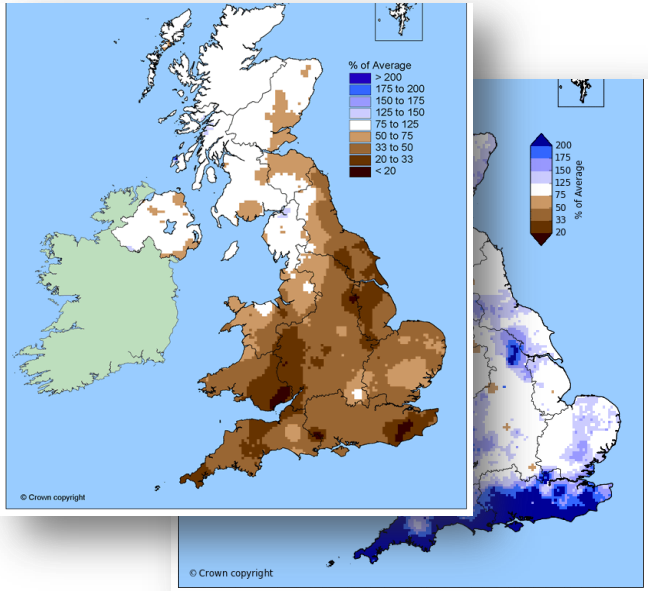
River flow outlook for Sep 2015



Method 2

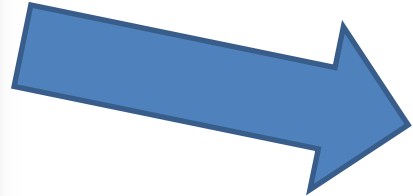
Modelling river flows from rainfall forecasts

Hydrological ensemble forecast: initialisation

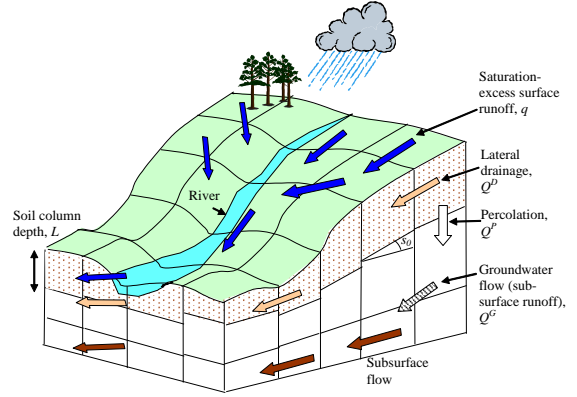


From Met Office by email
5 years of 5-km near-past daily
rainfall

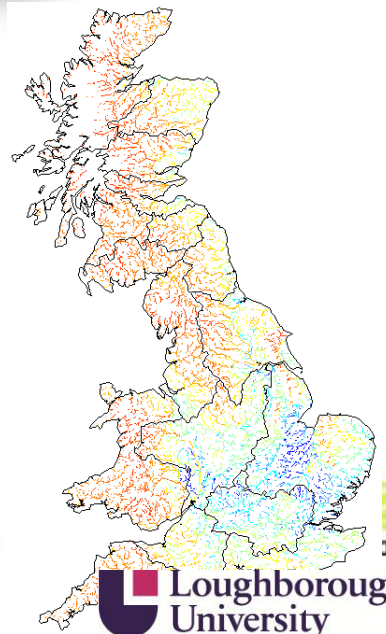
At CEH
1-km gridded
hydrological model
(G2G)



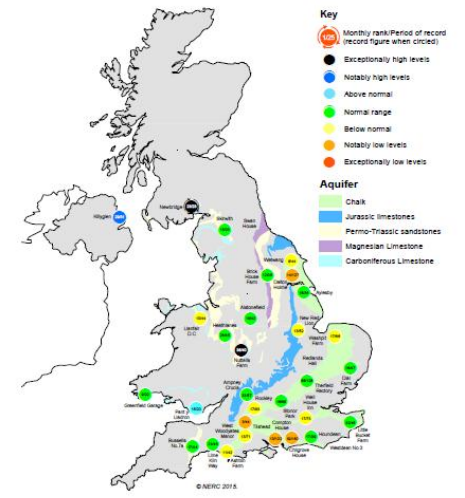
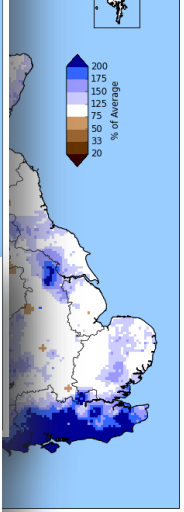
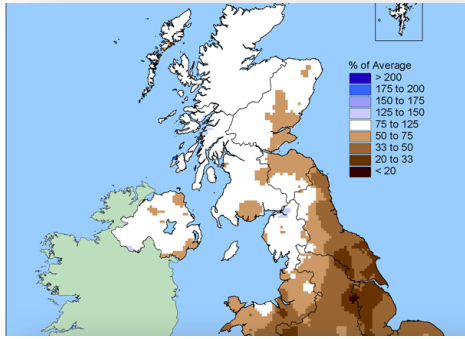
40-km near past PET



Initial store/ river flow
state at last day of
previous month



Hydrological ensemble forecast: initialisation

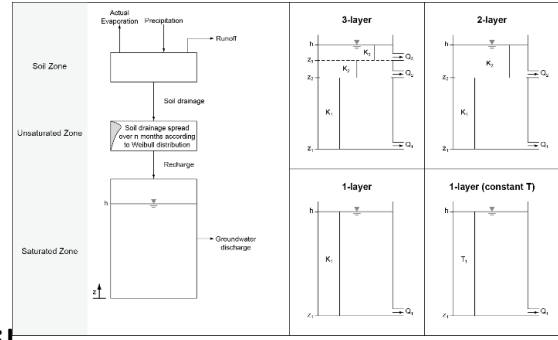


From Met Office by email
5 years of 5-km near-past daily rainfall

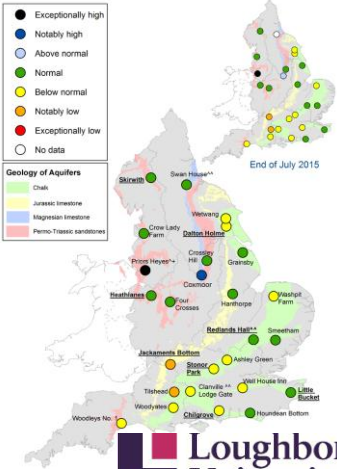
At BGS
Lumped conceptual groundwater model (AQUIMOD)

40-km near past PET

From river authorities by email
Observed groundwater levels ~ last day previous month



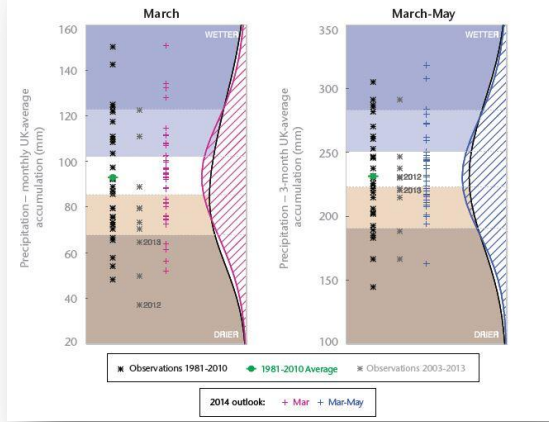
Initial groundwater level at last day of previous month



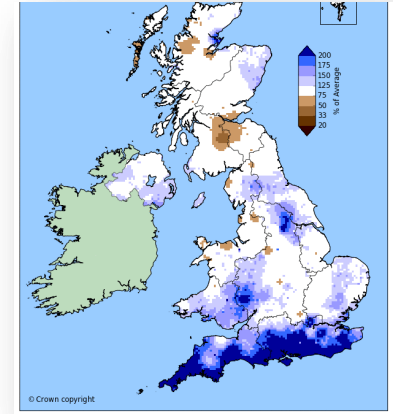
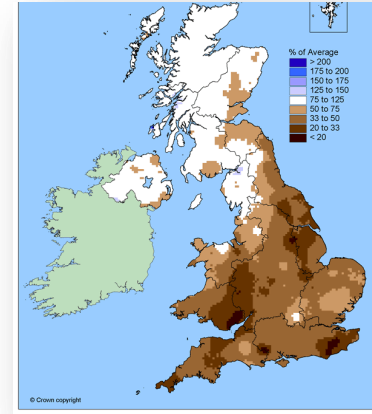
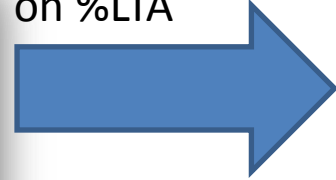
Hydrological ensemble forecast

From Met Office – by email
42-member ensemble
national rainfall forecasts

1-month and 3-month UK outlook for precipitation in the context of observed climatology



At CEH and BGS
Simple spatial
distribution based
on %LTA

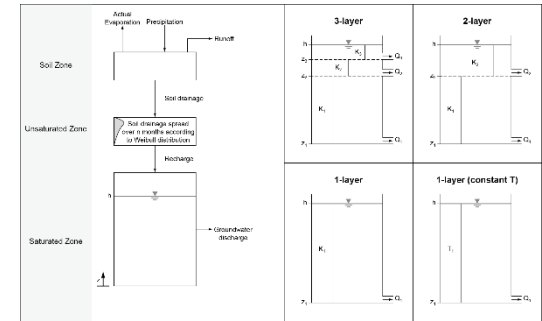
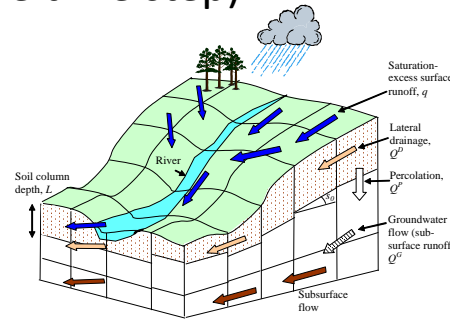
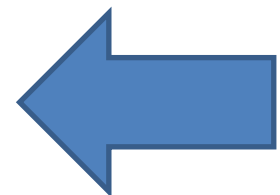


CEH
1-km gridded Water
Balance Model
(single time step)

BGS
Lumped conceptual
groundwater model
(AQUIMOD)

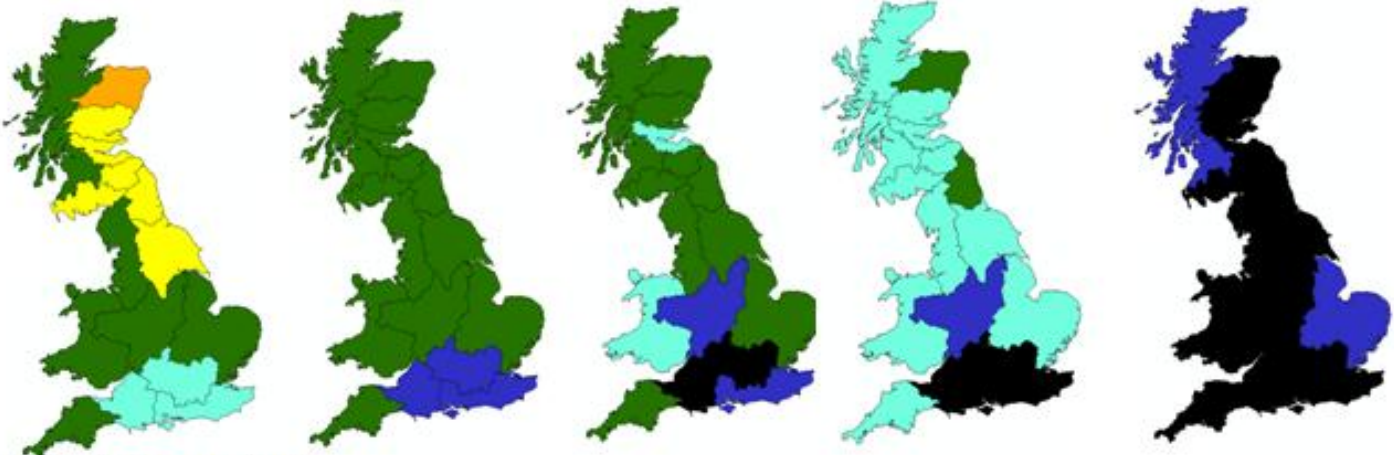
CEH
1- and 3- month
mean river flow

BGS
1- and 3-month
instantaneous



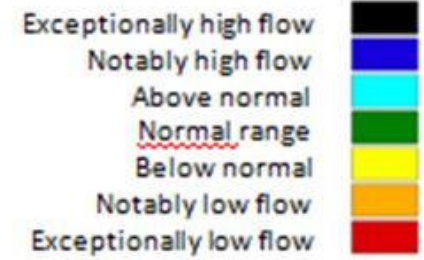
Ensemble Mean Flow forecasts

Lowest rainfall forecast 1st quartile Median 3rd quartile Highest rainfall forecast



1-month flow outlook

Lowest rainfall forecast 1st quartile Median 3rd quartile Highest rainfall forecast



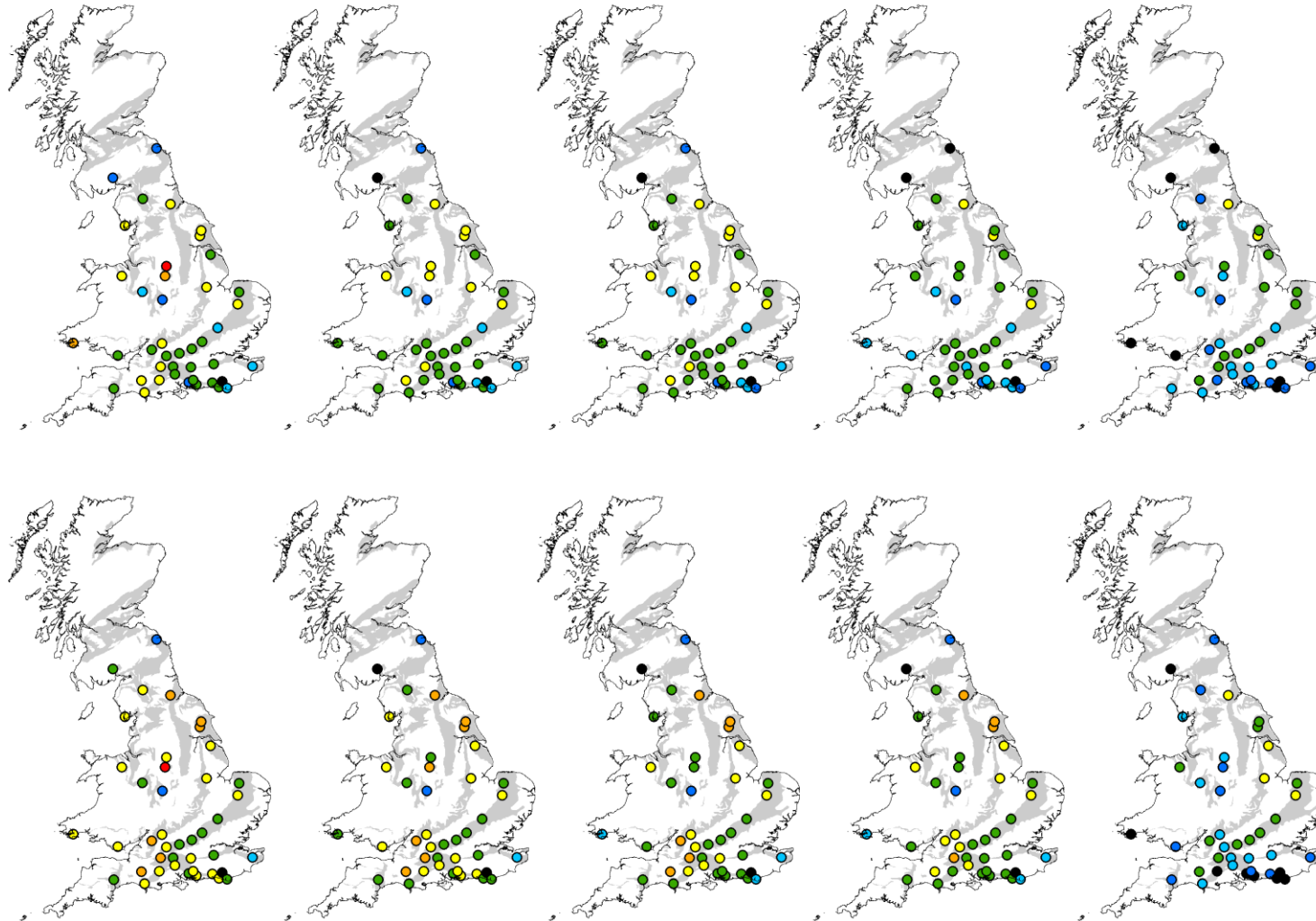
Ensemble Groundwater Level forecasts

Lowest rainfall forecast 1st quartile

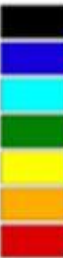
Median

2nd quartile

Highest rainfall forecast



Exceptionally high flow
Notably high flow
Above normal
Normal range
Below normal
Notably low flow
Exceptionally low flow

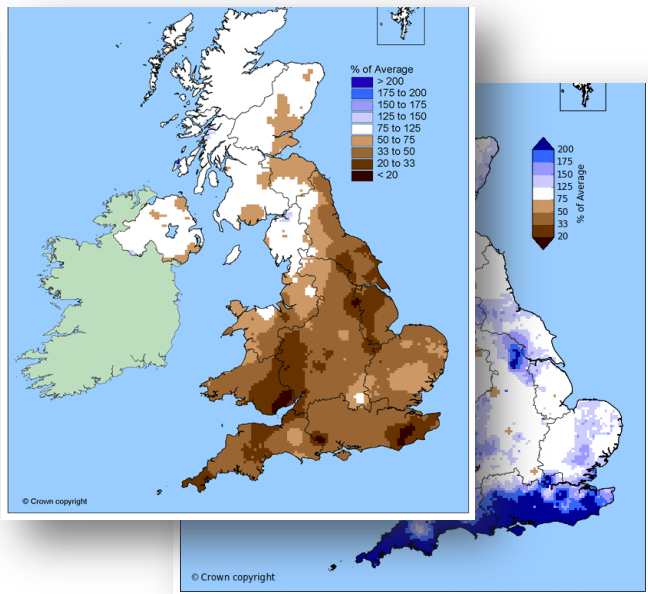


Method 3

Ensemble Streamflow Prediction (ESP)



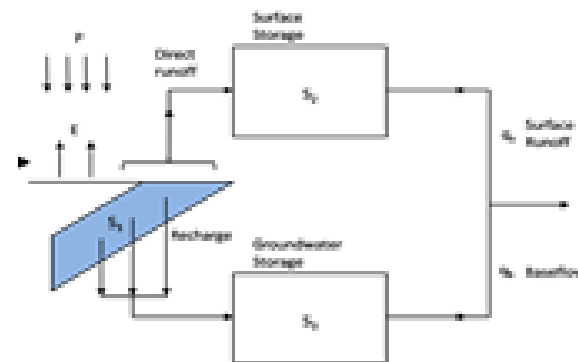
Ensemble Streamflow Prediction: initialisation



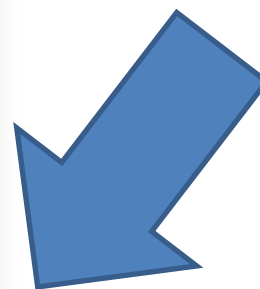
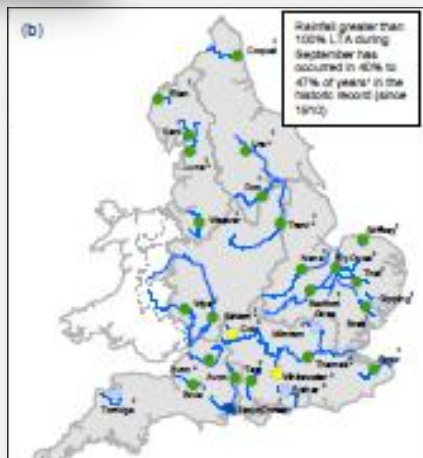
From Met Office by email
5 years of 5-km near-past daily
rainfall

At CEH and EA
Lumped conceptual
hydrological model
(PDM; CATCHMOD)

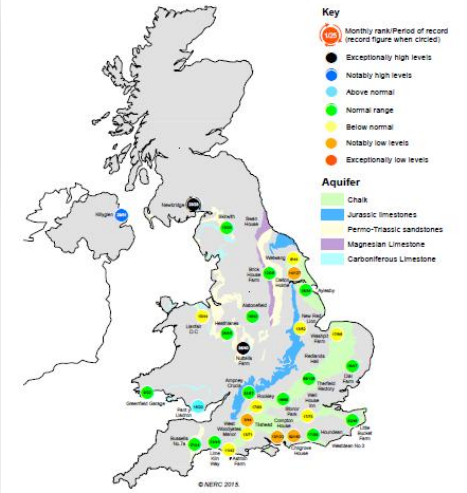
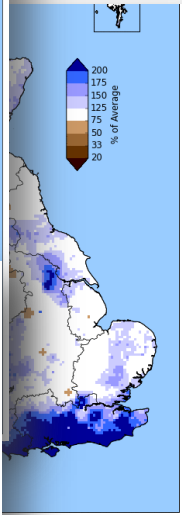
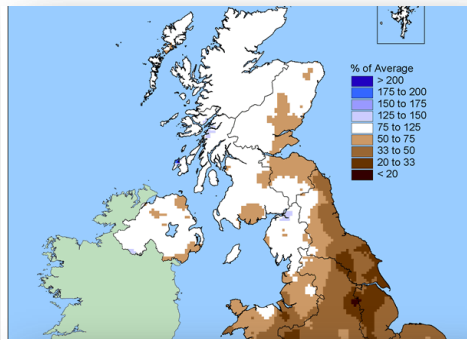
40-km near past PET



Initial river flow state
at last day of previous
month



Ensemble Streamflow Prediction: initialisation

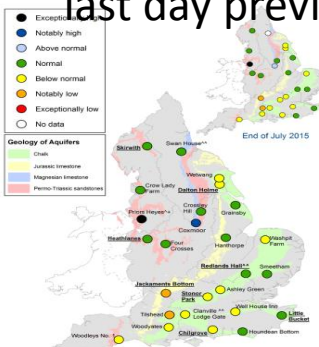
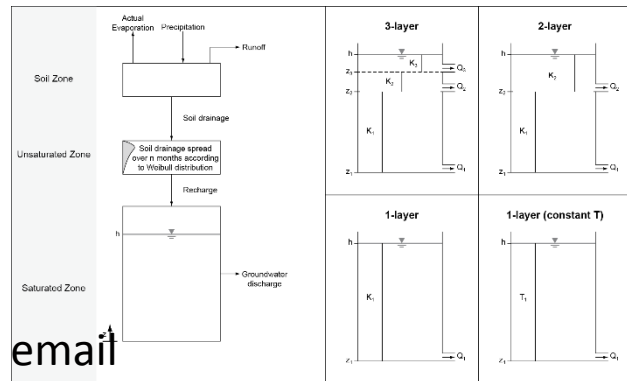


From Met Office by email
5 years of 5-km near-past daily rainfall

At BGS
Lumped conceptual groundwater model (AQUIMOD)

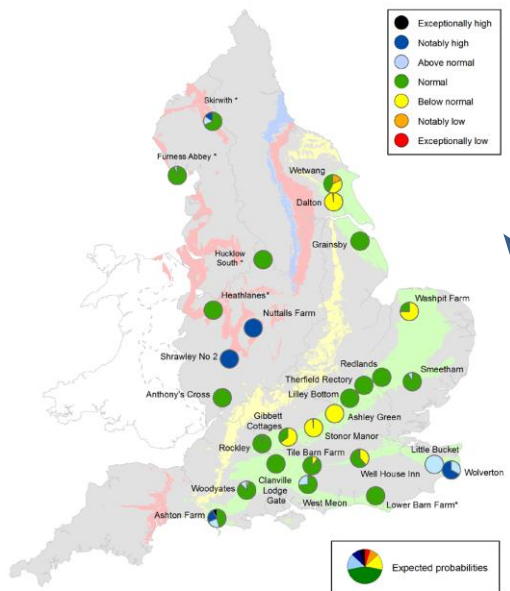
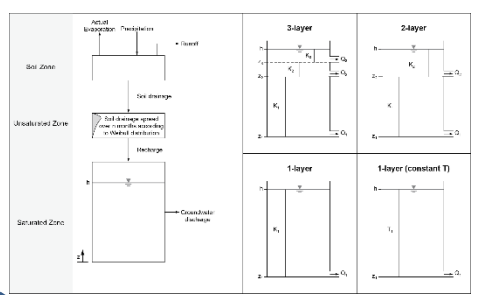
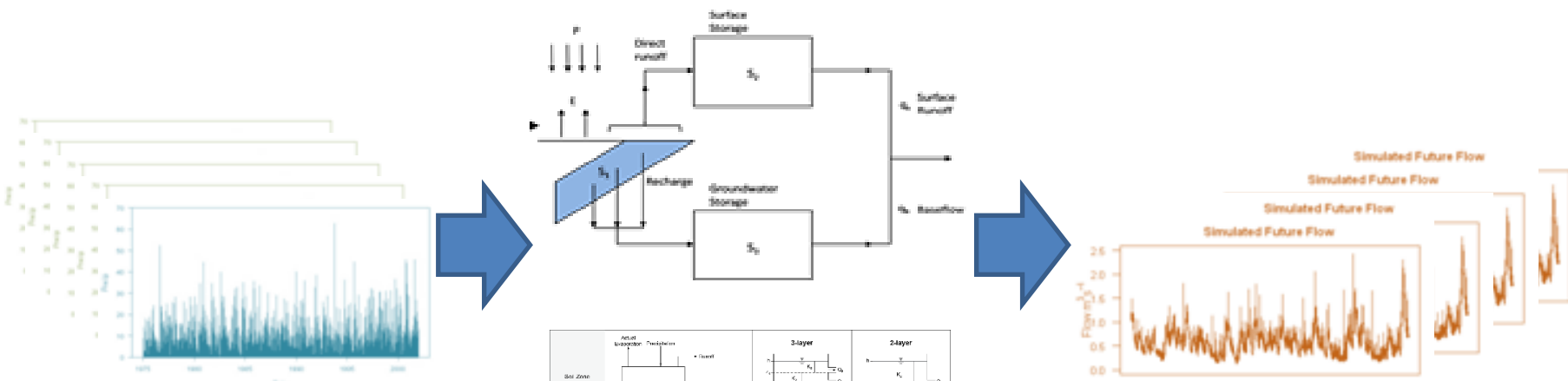
40-km near past PET

From river authorities by email
Observed groundwater levels ~
last day previous month

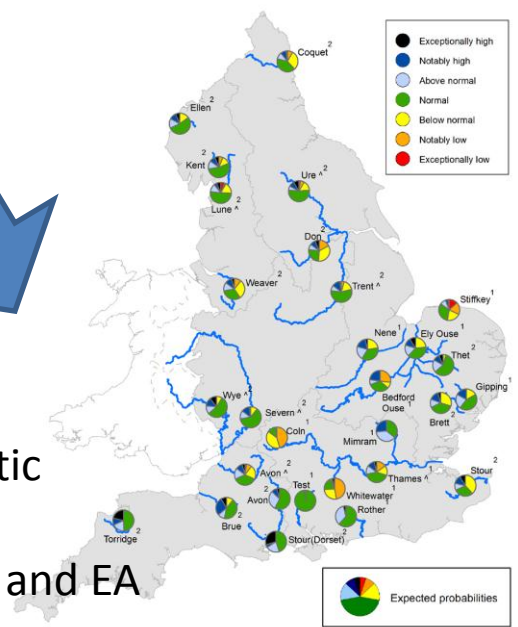


Initial groundwater level at last day of previous month

Ensemble Streamflow Prediction: outlooks



Groundwater level
probabilistic
ensemble
From BGS

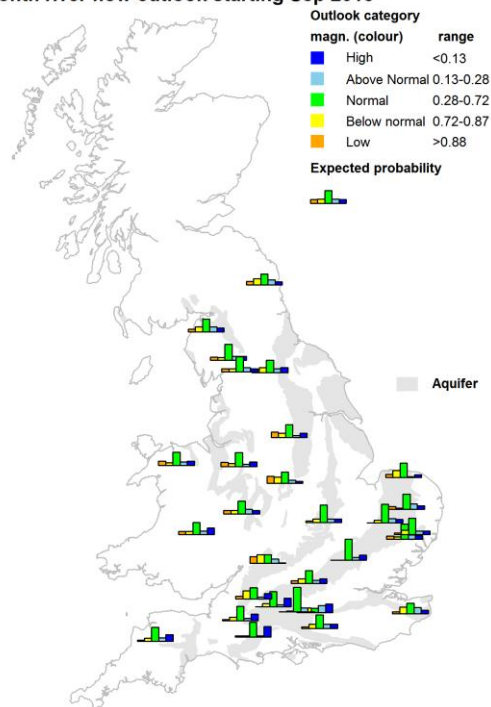


River flow
probabilistic
ensemble
From CEH and EA

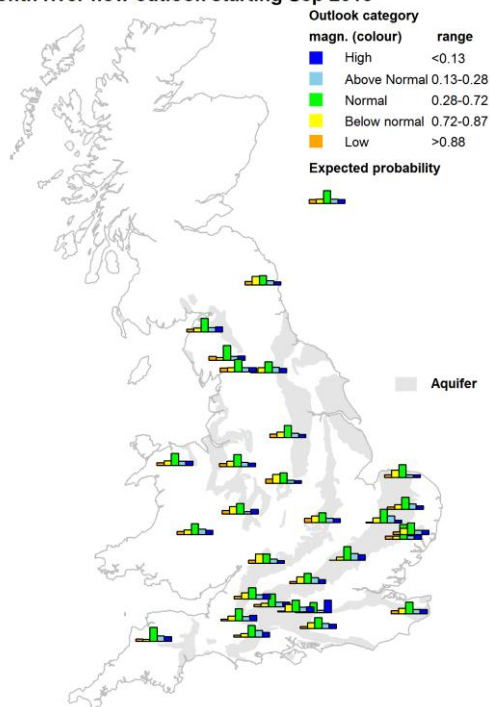
Ensemble Streamflow Prediction: outlooks

River flow : 27 sites

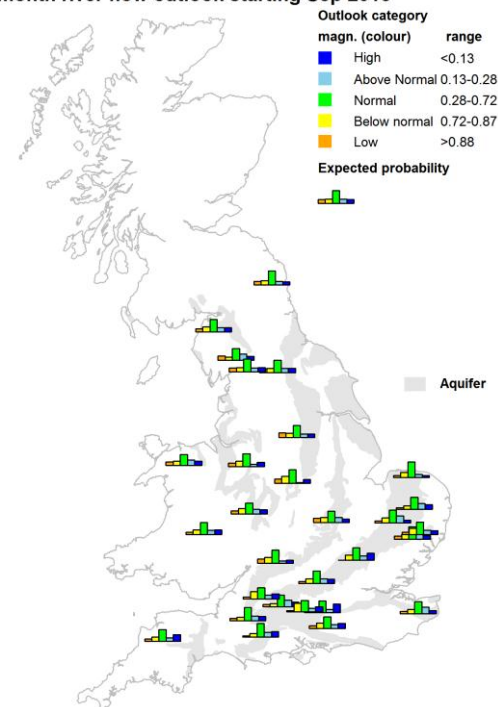
3-month river flow outlook starting Sep 2015



6-month river flow outlook starting Sep 2015



12-month river flow outlook starting Sep 2015



Monthly operation



Monthly operation; email exchanges



Monthly water situation report

England

Summary – August 2015

August rainfall totals were well above average across England for a second consecutive month at 140% of the long term average (LTA). Soil moisture deficits decreased by up to 75mm across most of England during the month, particularly across parts of north Devon and the south coast between Dorset and East Sussex. Monthly mean river flows increased compared to July at three quarters of indicator sites and remained normal or higher for the time of year at the majority of sites. Groundwater levels continued to decrease during the month at all but one indicator site. End of month groundwater levels remain normal or higher at half of the indicator sites. Reservoir stocks decreased at all but five reported reservoirs and reservoir groups during August, but remain normal or higher for the time of year at most sites. Overall stocks for England decreased to 86% of total capacity.

Rainfall

August rainfall totals ranged from 180 to 220mm across parts of Devon and Cornwall to around 50 to 55mm across parts of Lincolnshire, Bedfordshire and Oxfordshire. August rainfall totals were above the long term average (LTA) in almost all hydrological areas, with many of those covering south-east and south-west England receiving more than 200% of the LTA. Parts of the south coast between Dorset and East Sussex and the far west of Cornwall received between 250 and 280% of the August LTA (Figure 1).

August rainfall totals were normal or above normal for the time of year across the majority of England. Totals across southern and south-west England were notably high or exceptionally high. Over the 3, 6 and 12 month periods ending in August, cumulative rainfall totals were broadly normal for the time of year across most of England (Figure 2).

At a regional scale, August rainfall totals ranged from 108% of the LTA in north-west England to 192% in south-west England. Totals were classed as notably high for the time of year in south-west England, above normal in south-east England and normal elsewhere. Across England as a whole, rainfall was above normal for the time of year at 140% of the August LTA (Figure 3).

August rainfall totals were the 2nd or 3rd wettest on record in the hydrological areas covering west Cornwall, south Devon and the south coast area between Purbeck and West Sussex. In most of these hydrological areas, it was the wettest August since 1912 or 1917. In west Cornwall, the two month (July and August) rainfall total was the 2nd wettest on record with the wettest period occurring in 1912. In south-west England, the August rainfall total was the 7th wettest on record and the wettest since 1997, the two month (July and August) rainfall total was the 9th wettest on record and the wettest since 2012.

Soil moisture deficit

Soil moisture deficits (SMDs) decreased across most of England during August, in response to the above average rainfall. The largest decreases of 50 to 75mm occurred across parts of north Devon and the south coast between Dorset and East Sussex. SMDs increased by up to 20mm across parts of the far north-west, north-east and east of England. At the end of August, SMDs were smallest across south-west and much of north-west England at less than 10mm and largest across parts of Yorkshire, Lincolnshire, Norfolk and Cambridgeshire at 100 to 135mm. At the end of August, soils were much wetter than average across much of England, particularly south and south-west England. In contrast, soils were drier than average in parts of north-east and east England, particularly across North Yorkshire and Lincolnshire (Figure 4).

At a regional scale, SMDs increased slightly during August in east England, but decreased elsewhere by up to 35mm. At the end of August, regional SMDs were smaller than the LTA in all regions (Figure 5).

River flows

August monthly mean river flows increased compared to July at three quarters of indicator sites across England. However, August flows decreased compared to July at all but one indicator site in central England, half the sites in east England and three sites in the south-east. Monthly mean flows were classed as normal or above normal

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1

2nd wking day

1st week

~7th wking day 2nd week 11 to 15th



Outputs

Published on open web sites



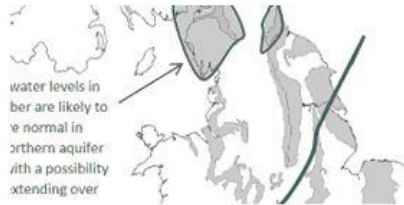
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Latest Outlook



Methods



Supporting outputs



- Published monthly since November 2013
- Accessible to the public, aimed at a wide range of audiences
-

Statistics

Water situation report for England: August 2015

From: [Environment Agency](#)
First published: 11 September 2015
Part of: [Water situation reports for England](#)

A monthly review of the water situation in England.

Document



[Monthly water situation report: August 2015](#)

PDF, 6.98MB, 23 pages

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