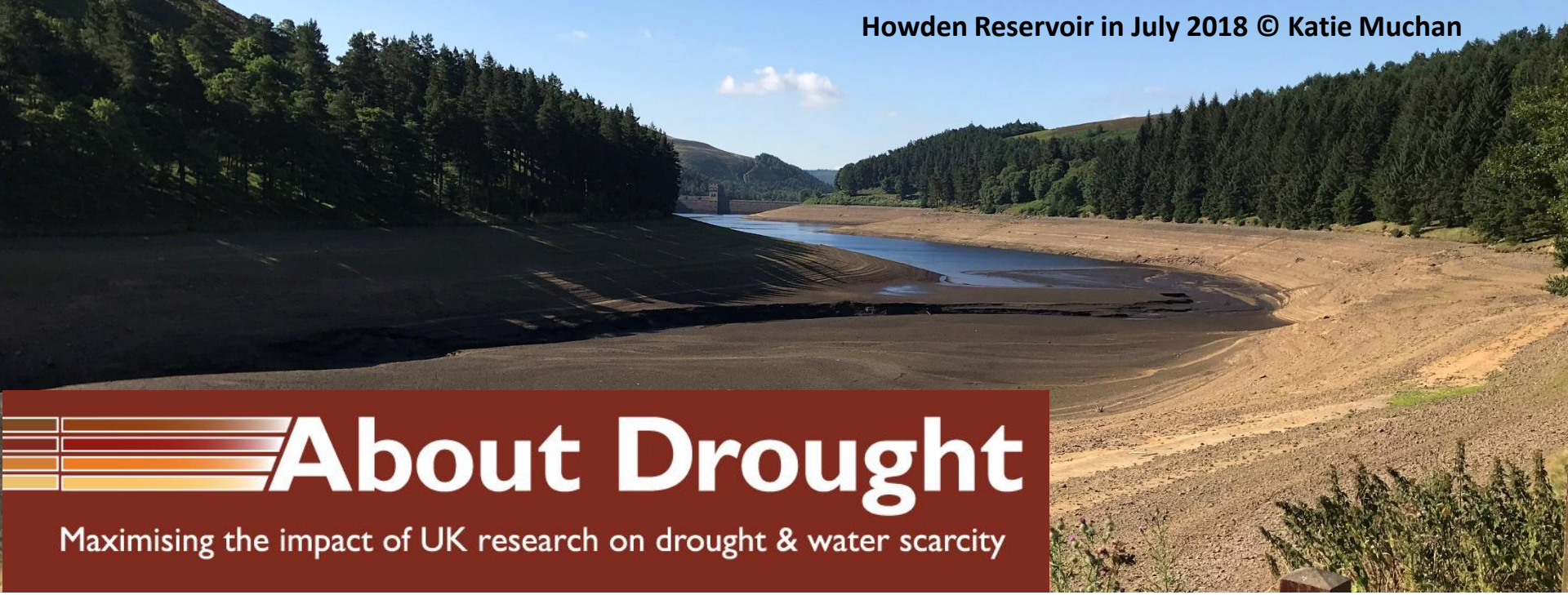


Engaging diverse stakeholders and publics with outputs from the Drought and Water Scarcity Programme (**ENDOWS**)

Jamie Hannaford, Centre for Ecology & Hydrology

CIWEM Conference: are we fit for 2050? 5th December 2018

Historic Droughts

MaRIUS
Managing the risks, impacts and uncertainties of droughts and water scarcity

IMPETUS
IMPROVING PREDICTIONS OF UK DROUGHT

Drought Risk and You

About Drought

Maximising the impact of UK research on drought & water scarcity

The UK Drought and Water Scarcity Programme

£12.5m, five year (2014 – 2019) interdisciplinary programme

WP1: Quantification of the roles of multiple drivers and their impacts during historic periods of drought & water scarcity, and methods to support decision-making

Historic Droughts. £1.5m Lead PI: Jamie Hannaford, CEH.

WP2: Forecasting droughts & water scarcity, and methods to support decision-making

IMPETUS. £2m. Lead PI: Len Shaffrey, University of Reading

WP3: Impacts of droughts & water scarcity, and methods to support decision-making

MaRIUS. £3.4m. Lead PI: Jim Hall, University of Oxford

DRY. £3.6m. Lead PI: Lindsey McEwen, University of the West of England

WP4: Knowledge Synthesis.

ENDOWS. £2m. Lead PI: Jamie Hannaford, CEH

NERC SCIENCE OF THE ENVIRONMENT

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

EPSRC Engineering and Physical Sciences Research Council

BBSRC bioscience for the future

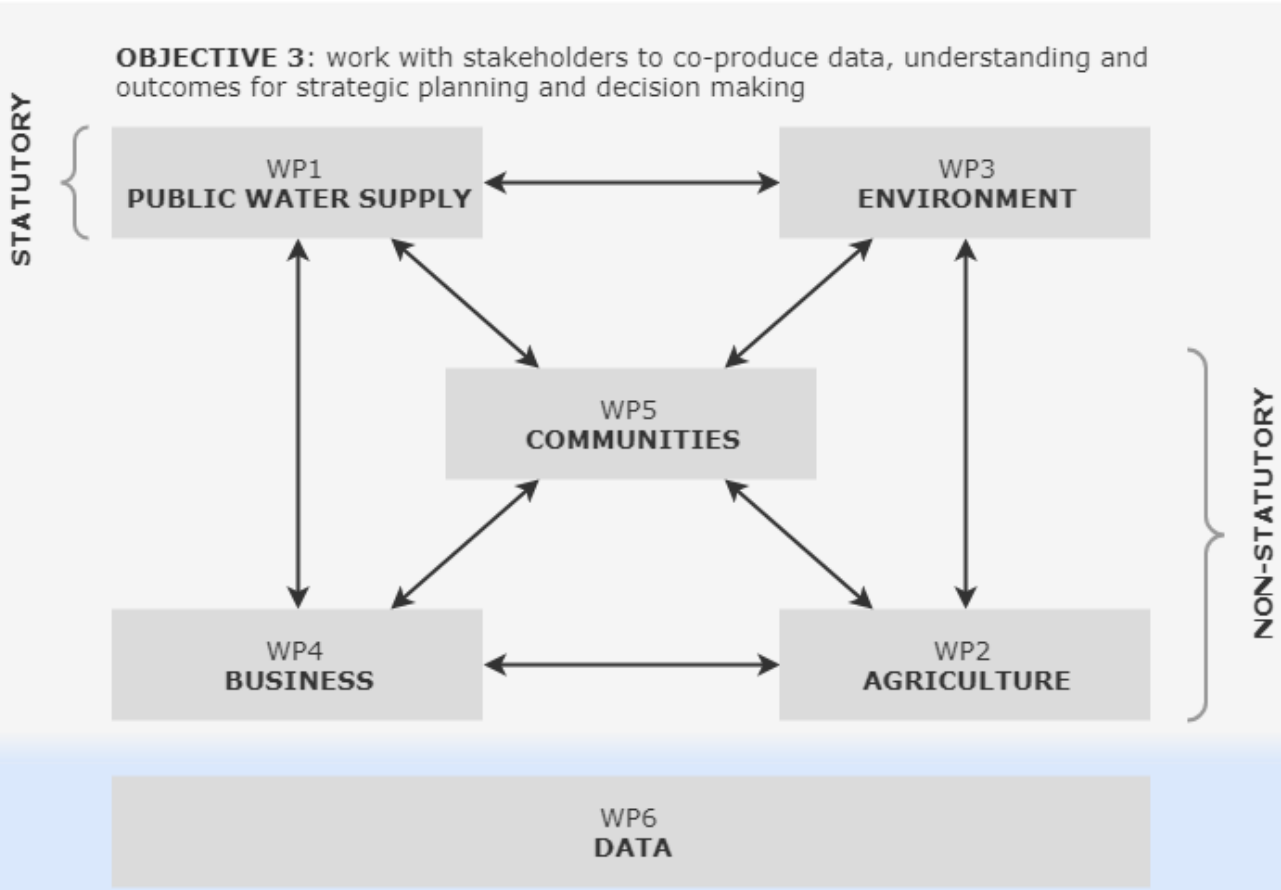
Arts & Humanities Research Council

ENDOWS aims to:

- **Integrate scientific and methodological advances from across the four funded projects**, with the aim of synthesising and interpreting the results and findings from the individual projects
- Ensure DWS programme **datasets are accessible**, easy to understand and use by a wide range of audiences
- Work with stakeholders and the wider public to **embed DWS programme data, understanding and outcomes into drought decision-making** and planning at strategic & operational levels through co-production
- Co-design and deliver an **engagement strategy to enhance stakeholder and public discourse around drought and water scarcity**, promote uptake of the research and outputs, and document and evaluate the beneficial impacts of the DWS Programme.

About Drought

Maximising the impact of UK research on drought & water scarcity



OBJECTIVE 4: co-design and deliver an engagement strategy to enhance stakeholder and public discourse around drought and water scarcity

Potential Resources

- Case studies
- Podcasts
- Models & data
- Websites & portals
- Art
- Policy guidance, etc.

Potential Tools

- Sector workshops
- Websites & portals
- Social media
- Webinars
- Roadshows
- Hackathons, etc.

WP7
ENGAGEMENT & EVENTS

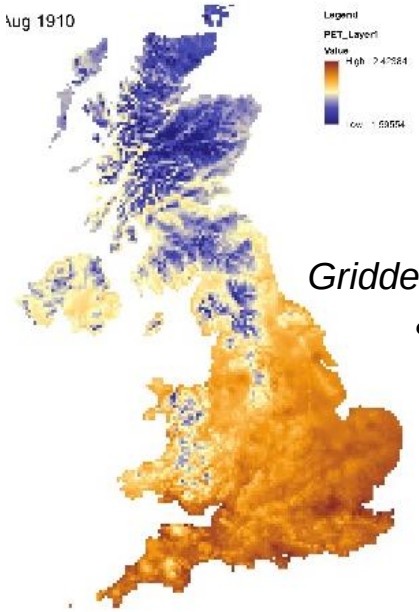
WP8
MANAGEMENT & INTEGRATION

About Drought

Maximising the impact of UK research on drought & water scarcity

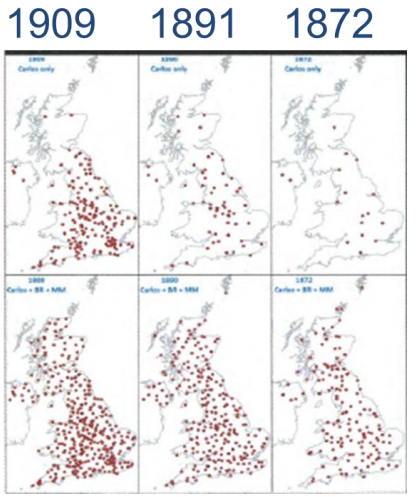
Expanding our knowledge of past drought variability

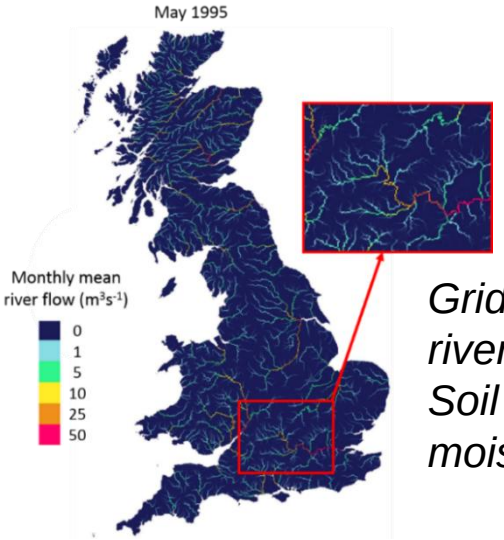
- **Rainfall:** rescued data to expand 19thC coverage
- **PE:** daily 5km grids, 1891-2015
- **Soil moisture:** monthly 1km grids, 1891-2015
- **River flows:** daily flows, 1891-2015, >450 catchments, multiple models
- **Groundwater:** monthly levels, 1891-2015, 54 boreholes



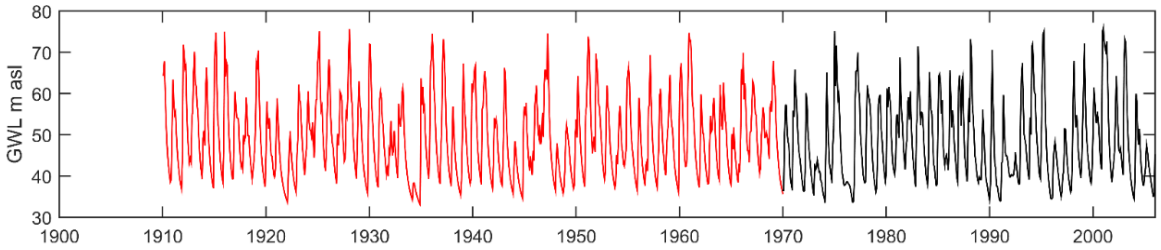
Gridded rainfall and PET

Improved coverage of early rainfall data





Gridded river flow/ Soil moisture



River flow and groundwater level reconstructions

All freely available:
www.eidc.ac.uk

About Drought

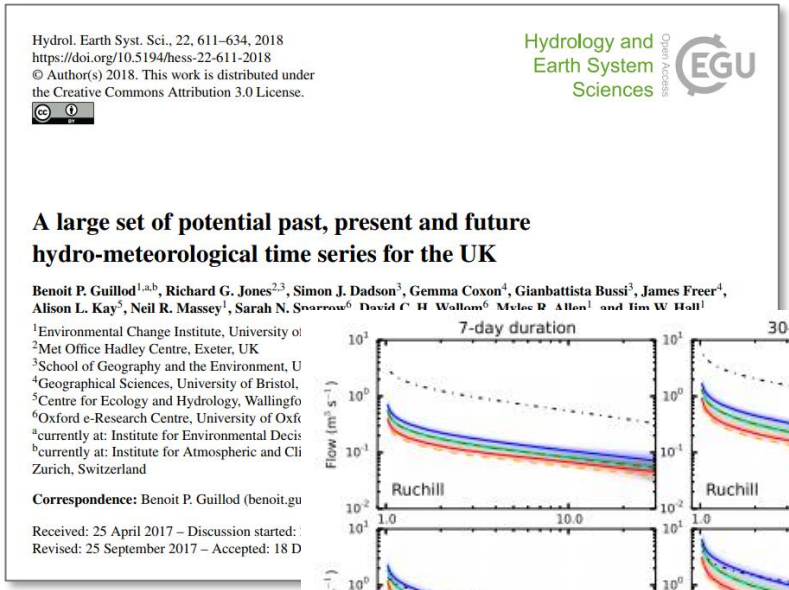
Maximising the impact of UK research on drought & water scarcity

The MaRIUS Event Set

‘Weather@home’ RCM climate data

- Three timeslices:
  - 100 x Baseline (1900 – 2006)
  - 100 x Near Future (2020 – 2049)
  - 100 x Far Future (2070 – 2099)
- Data available on **CEDA** http://www.ceda.ac.uk/
- Run through hydrological models available on **EIDC** www.eidc.ac.uk

Spatially consistent projections, large ensembles giving range of plausible droughts



Hydrol. Earth Syst. Sci., 22, 611–634, 2018
https://doi.org/10.5194/hess-22-611-2018

Hydrology and Earth System Sciences
EGU
Open Access

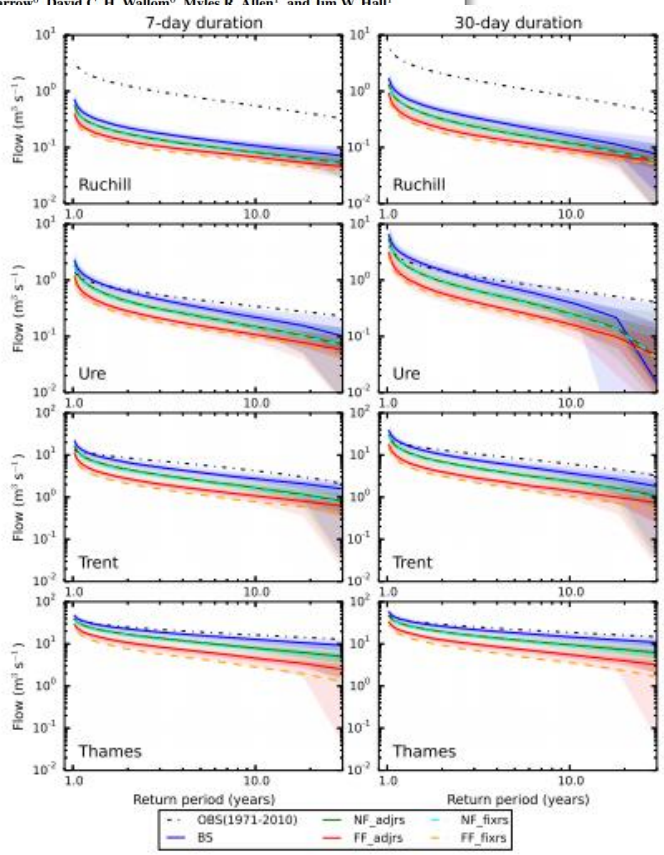
A large set of potential past, present and future hydro-meteorological time series for the UK

Benoit P. Guillod[1,a,b], **Richard G. Jones**[2,3], **Simon J. Dadson**[3], **Gemma Coxon**[4], **Gianbattista Bussi**[3], **James Freer**[4], **Alison L. Kay**[5], **Neil R. Massey**[1], **Sarah N. Sparrow**[6], **David C. H. Wallom**[6], **Myles R. Allen**[1], **and Jim W. Hall**[1]

[1]Environmental Change Institute, University o
[2]Met Office Hadley Centre, Exeter, UK
[3]School of Geography and the Environment, U
[4]Geographical Sciences, University of Bristol,
[5]Centre for Ecology and Hydrology, Wallingfo
[6]Oxford e-Research Centre, University of Oxf
[a]currently at: Institute for Environmental Decis
[b]currently at: Institute for Atmospheric and Cli
Zurich, Switzerland

Correspondence: Benoit P. Guillod (benoit.gu

Received: 25 April 2017 – Discussion started:
Revised: 25 September 2017 – Accepted: 18 D



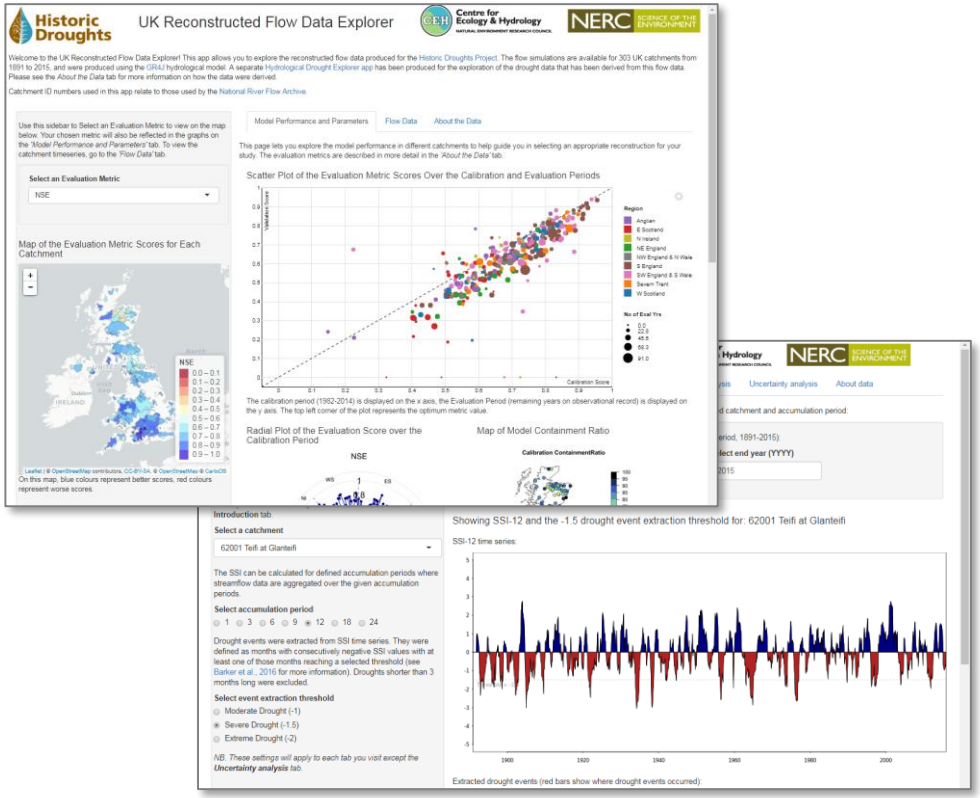
Future low flows using MaRIUS projections run through hydrological models (Kay et al. 2018)

About Drought

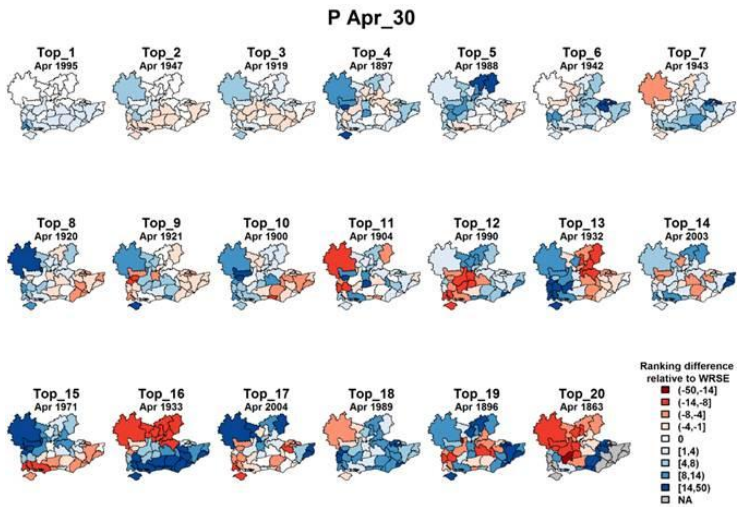
Maximising the impact of UK research on drought & water scarcity

ENDOWS WS1.1: consistent ‘Drought Libraries’ for long-term planning

Available now: explore the drought data with web apps



Coming soon: Prototype Drought Libraries and applications in stress-test case studies



Draft Library outputs from Oct 2018 Oxford Workshop. Second workshop in early 2019

https://shiny-apps.ceh.ac.uk/reconstruction_explorer/

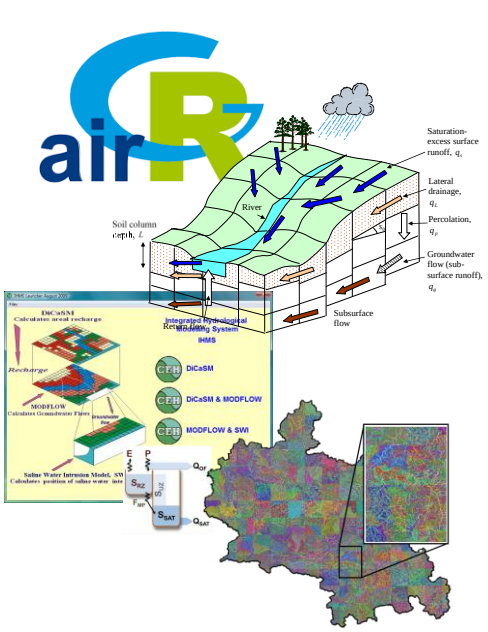
https://shiny-apps.ceh.ac.uk/hydro_drought_explorer/

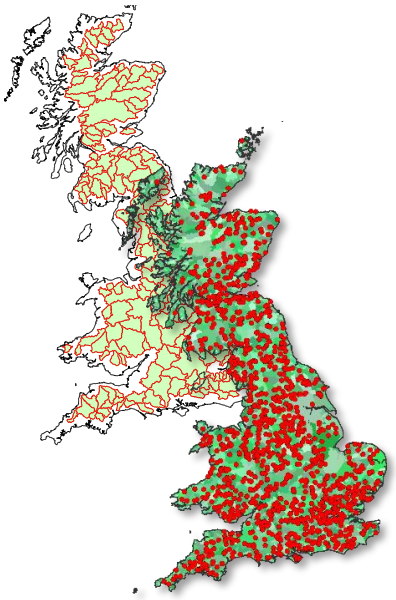
ENDOWS Leads: Simon Parry, Luke Harrington

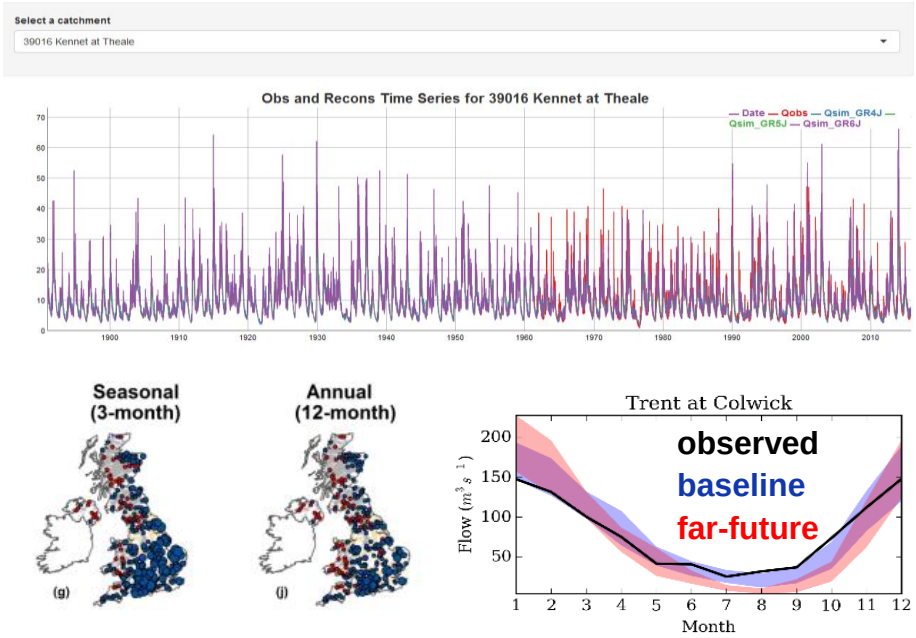
About Drought

Maximising the impact of UK research on drought & water scarcity

ENDOWS WS1.2: guidance for hydrological modelling applications







Four hydrological models…

…modelling a number of catchments…

…producing a wealth of hydrological model output for different purposes

- How well do our models simulate drought behaviour (and how/why)?
- Do these differences matter when informing decision support and drought management?

ENDOWS Lead: Gemma Coxon

About Drought

Maximising the impact of UK research on drought & water scarcity

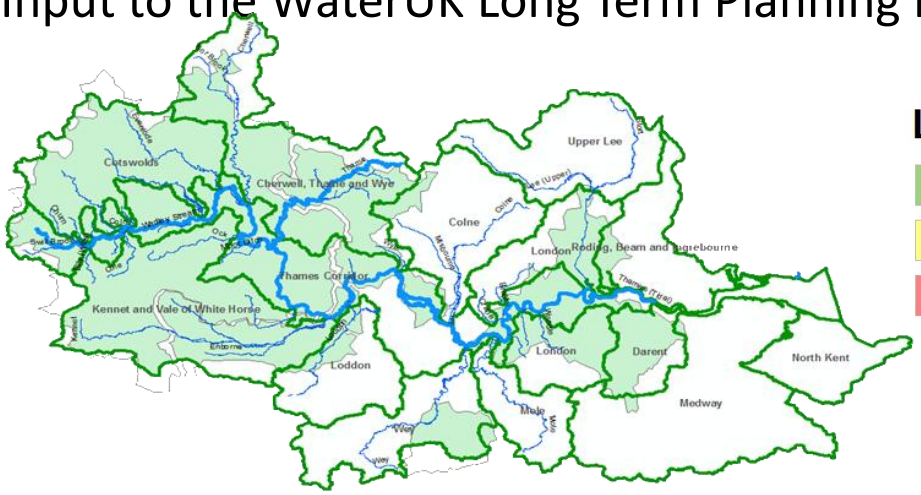
ENDOWS WS1.3: Methodologies for risk-based planning

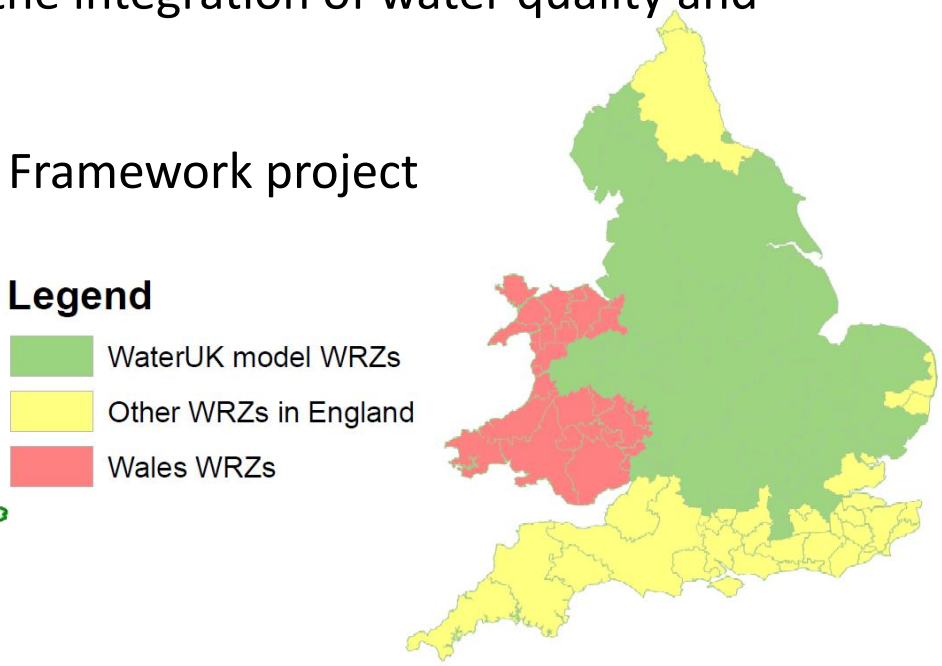
WATHNET water resources models for different scales – catchment scale and national (covers~70% of England and Wales, with further development underway).

Uses MaRIUS climatology & hydrology data to simulate water shortages from drought events up to **2049**

Frameworks for risk-based planning, and the integration of water quality and quantity

Input to the WaterUK Long Term Planning Framework project





About Drought

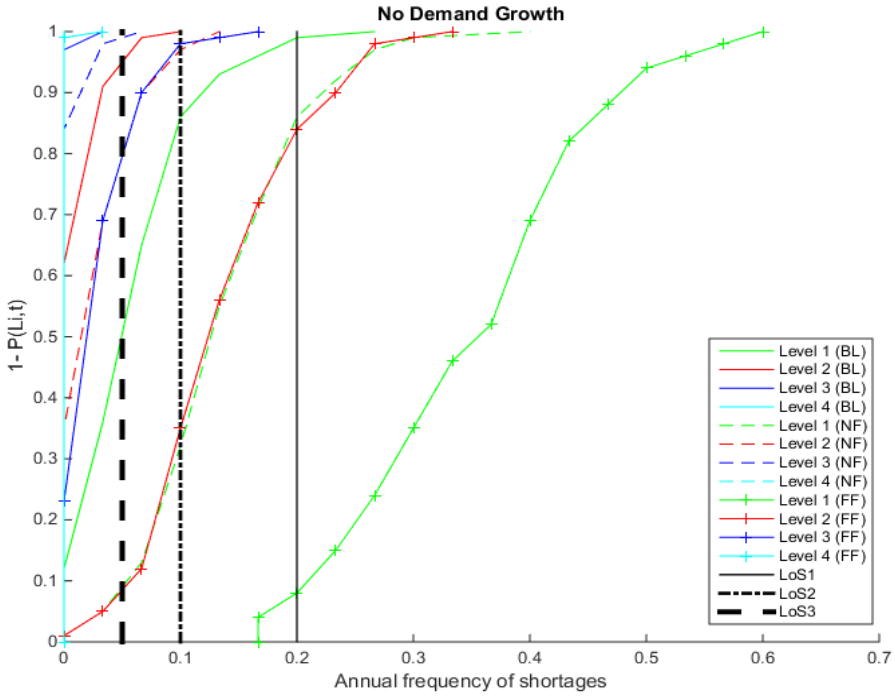
Maximising the impact of UK research on drought & water scarcity

Producing ***risk-based*** analysis of exceeding stated Levels of Service for when considering water resources *and* quality

The results shows the probability of exceeding Level of Services increases in the future, and more severe restrictions need to be implemented the further ahead into the future we look

Climate scenarios	WQQ scenarios	Probability of LoS exceedance			
		L1	L2	L3	L4
BL	WQ-with RQ	0.84	0.66	0.46	0.3
	WQ-without RQ	0.24	0.1	0.065	0.03
	NO WQ	0.18	0.07	0.025	0
NF	WQ-with RQ	1	0.96	0.92	0.45
	WQ-without RQ	0.78	0.5	0.345	0.19
	NO WQ	0.57	0.34	0.115	0.08
FF	WQ-with RQ	1	1	1	0.96
	WQ-without RQ	1	1	0.985	0.72
	NO WQ	0.99	0.96	0.75	0.22

BL= baseline climate scenario (1900 – 2006)
NF = drought in the near future (2020 – 2049)
FF = drought in the far future (2020 – 2049)
RQ=reservoir quality



Next: Directly assisting the Environment Agency's National Framework to help with its analysis (outputs by Spring 2019)

Jim Hall, Helen Gavin

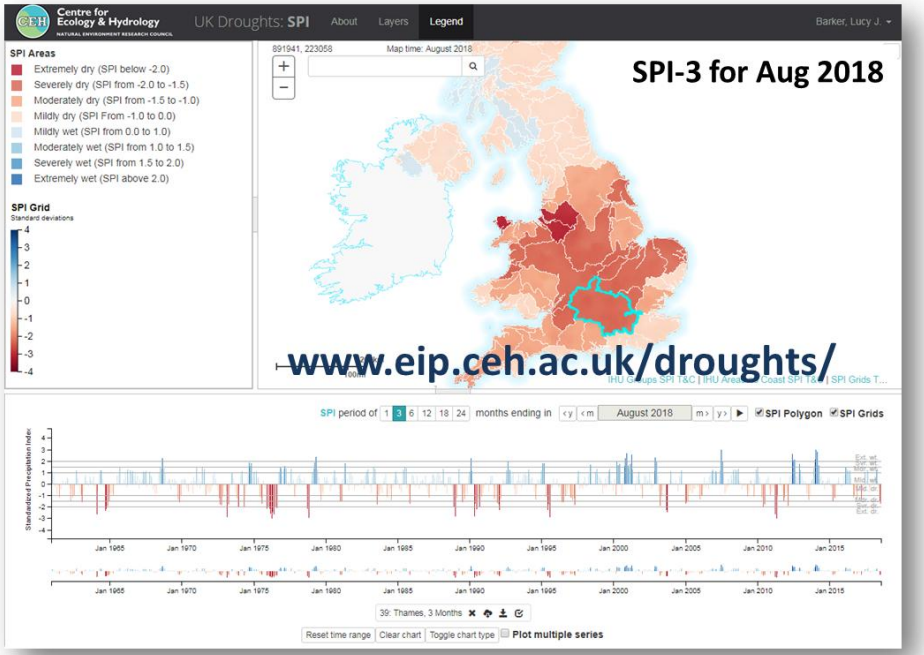
Derwent Valley Reservoirs, 28th July 2018. (Katie Muchan)

About Drought

Maximising the impact of UK research on drought & water scarcity

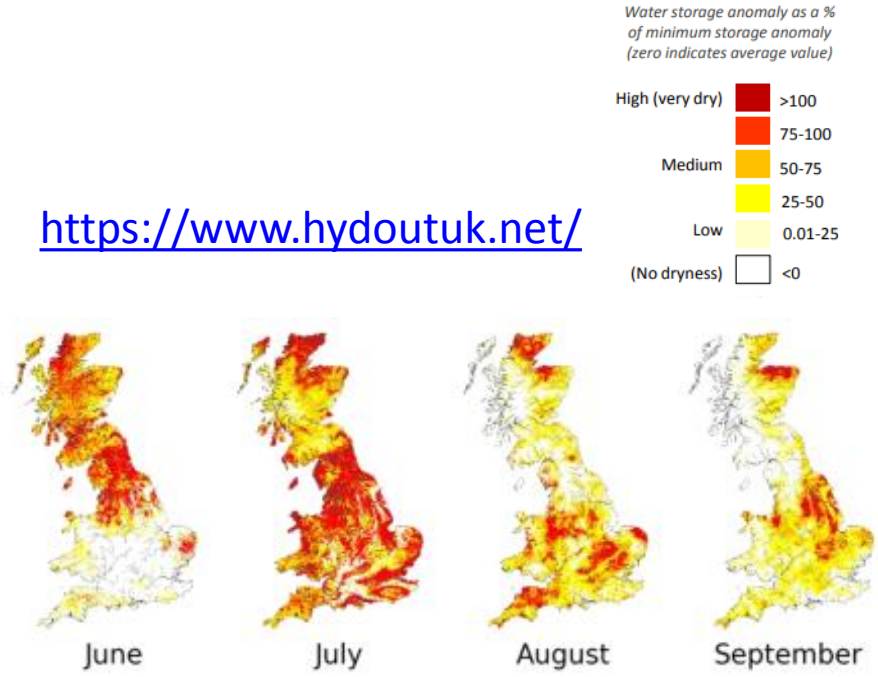
ENDOWS WS1.4: monitoring and early warning

Dynamic, interactive, real-time mapping and visualisation of drought status



The UK drought portal: interactive high-resolution drought monitoring (launched June 2017)

https://www.hydoutuk.net/

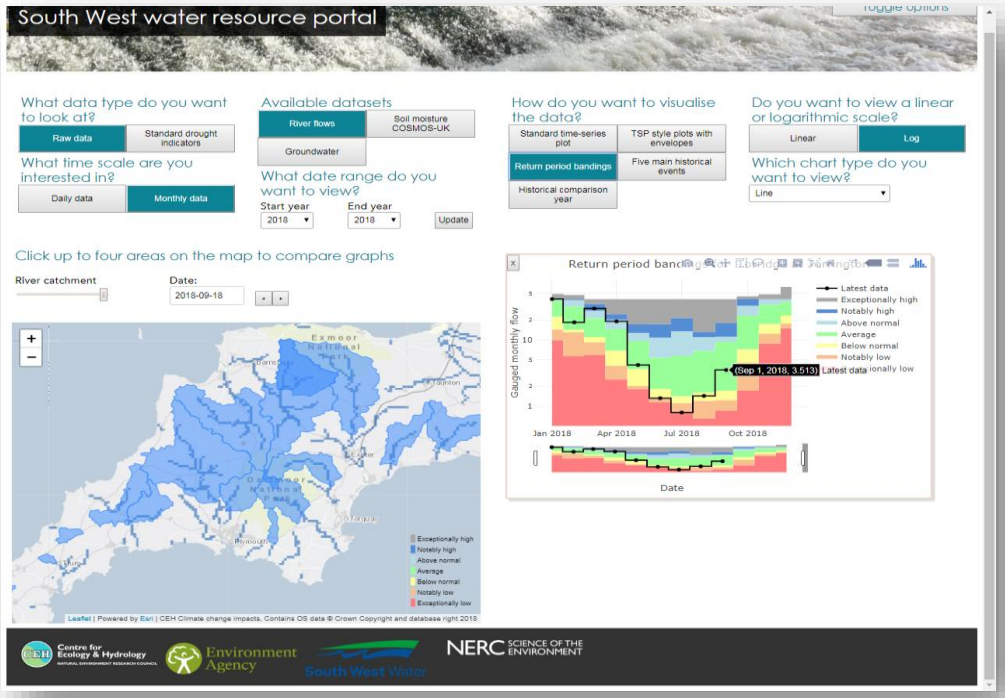


Subsurface water storage maps for the UK (launched June 2018)

About Drought

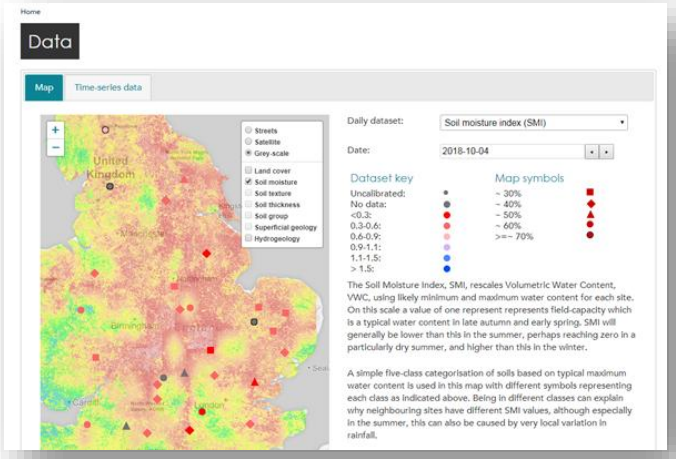
Maximising the impact of UK research on drought & water scarcity

Coming soon (early 2019)
Demonstrator portal for SW England
(featuring daily real-time river flow and customised visualisation options)



Matt Fry, Gemma Nash, Lucy Barker

Next: Anglian demonstrator
(featuring Earth Observation and COSMOS-UK soil moisture)



Real-time, wide area soil moisture
https://cosmos.ceh.ac.uk/

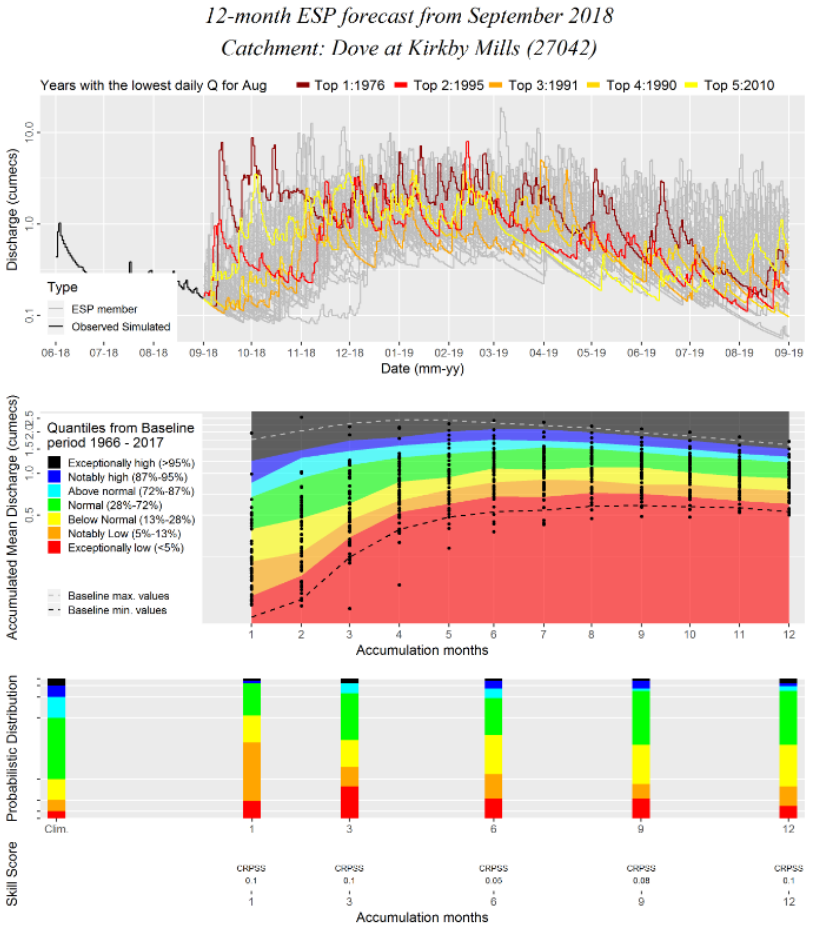
These innovations will be tested iteratively with stakeholders through 2019 and then will feature in a future version of the national UK Drought Portal

About Drought

Maximising the impact of UK research on drought & water scarcity

ENDOWS WS1.5: seasonal forecasting

- **Aim:** Work with water managers to demonstrate the benefits of drought forecasts and overcome barriers to uptake
- **Co-evaluation:** How do we co-design and evaluate the forecast reliability, uncertainties, spatial/temporal scales?
- **Case Studies:** on application of streamflow forecasts in ongoing dry weather



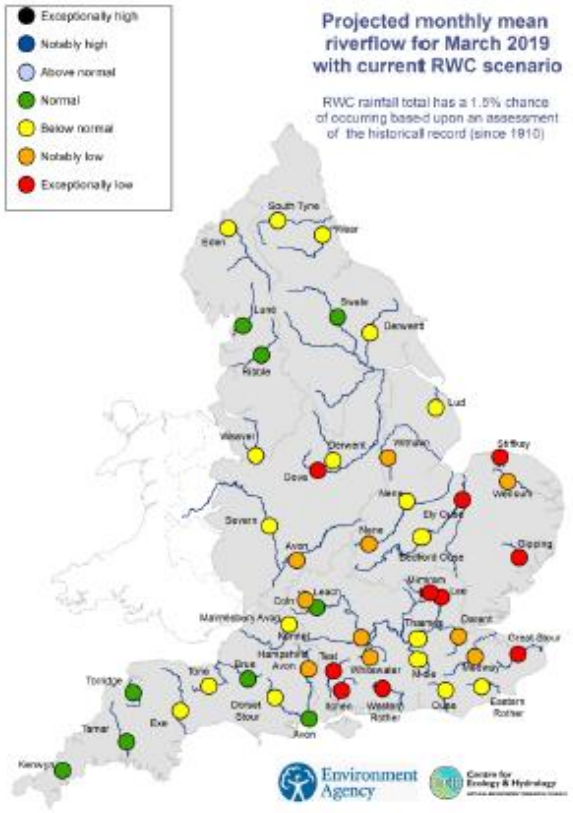
Engaging potential users with live forecasts during summer/autumn 2018

Jamie Hannaford, Maliko Tanguy, Nikos Mastrantonas, Katie Smith

Please email me for more info: jaha@ceh.ac.uk

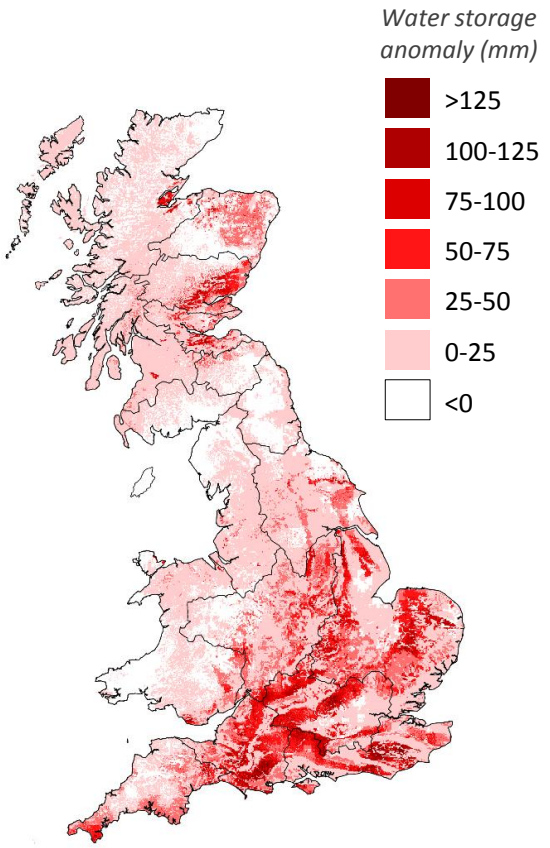
About Drought

Maximising the impact of UK research on drought & water scarcity



Providing Reasonable Worst Case Scenarios for the EA

Maliko Tanguy, Nikos Mastrantonas



How much rainfall is required to end the drought? How likely is that to occur?

Ali Rudd, Rhian Chapman, Vicky Bell

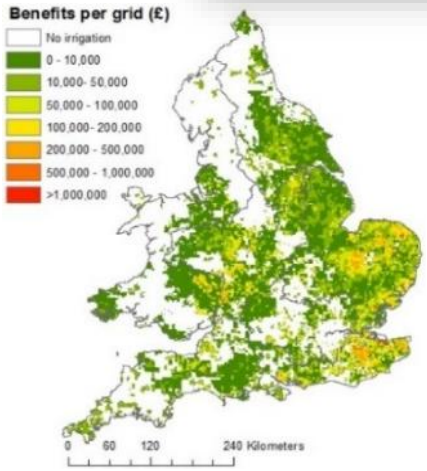
SUMMARY: During November, limited areas in south-east England would require rainfall with **a return period of 5 to 10 years** in order to overcome the dry conditions.
Over the next 6 months the majority of the country would not require particularly unusual rainfall (**0 to 5 year return periods**) to return to average conditions for this time of year.

About Drought

Maximising the impact of UK research on drought & water scarcity

Workstream 2 Agriculture

- Policy brief on irrigated agriculture under climate change
- Synthesis of drought impacts on agriculture, protected crops, nurseries
- Draft water resource strategy for farming and food (*for launch at Irrigex, February 2019*)
- Seasonal forecasting demonstrator for East Anglia
- Guidance for on-farm reservoir storage



Value of irrigation, Rey et al. 2016

Mesocosm Experiments (Harper Adams)

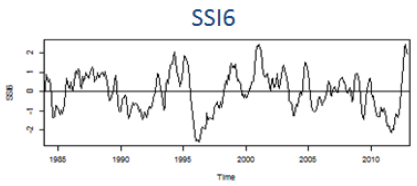
Nevil Quinn, Ian Holman, Jerry Knox, Tim Hess, Lola Rey, Ivan Grove

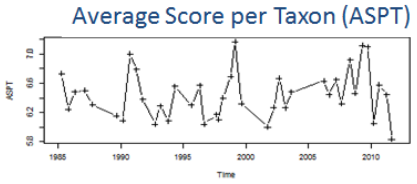
About Drought

Maximising the impact of UK research on drought & water scarcity

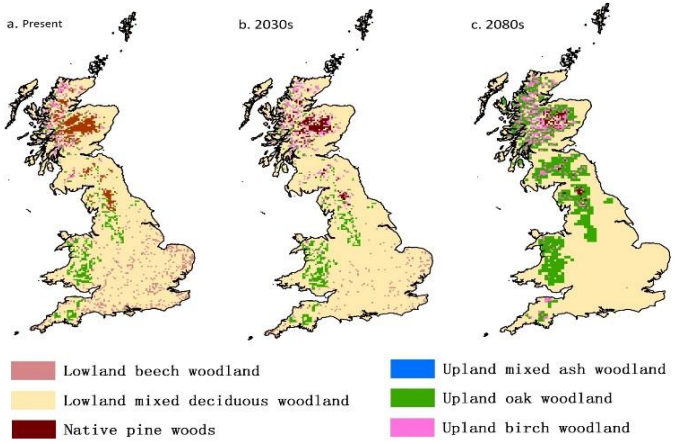
Workstream 3 Environment

- Knowledge synthesis of drought impacts on ecology, via five habitat based 'Report Cards' (*early 2019*)
- Case study on early warning tools for conservation managers (*e.g. RSPB wetlands*)
- co-development of environmental drought monitoring through case studies (e.g. *East Devon catchments*)
- High-level national workshop on e-flows and water abstraction reform





From drought indicators to ecological Impacts (Laize et al. 2017)

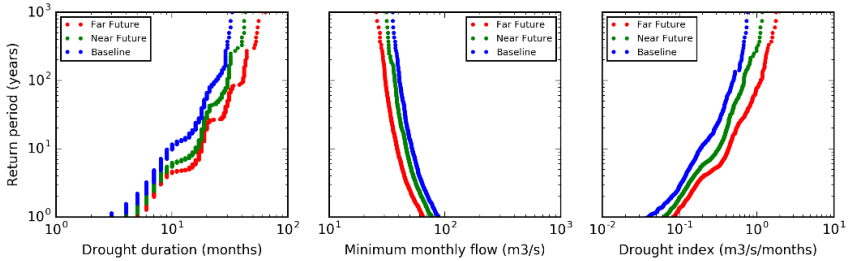


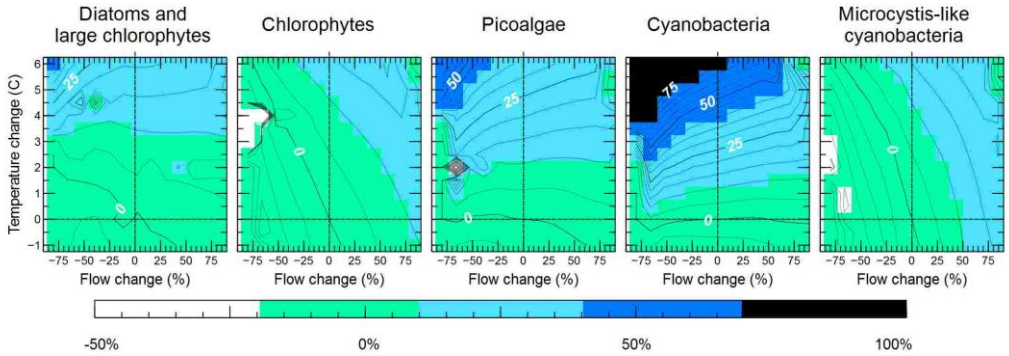
Climate Change impacts on woodlands (Berry et al. 2018)

Nevil Quinn, Francois Edwards, Cedric Laize, Pam Berry, Mark Everard, Paul Whitehead, Mike Acreman, Linda May

Workstream 4 Business

- Interface for KE for large business and SMEs
- Web-based resources/apps, with case-study resources & guidance
- Tailored workshops in collaboration with sector partners
- Case study on drought and low flow risks for the energy sector (*Energy UK River Trent case study*)





Modelling water quantity and quality to assess future drought risks for the river Trent (RWE NPower) Bussi et al. 2018

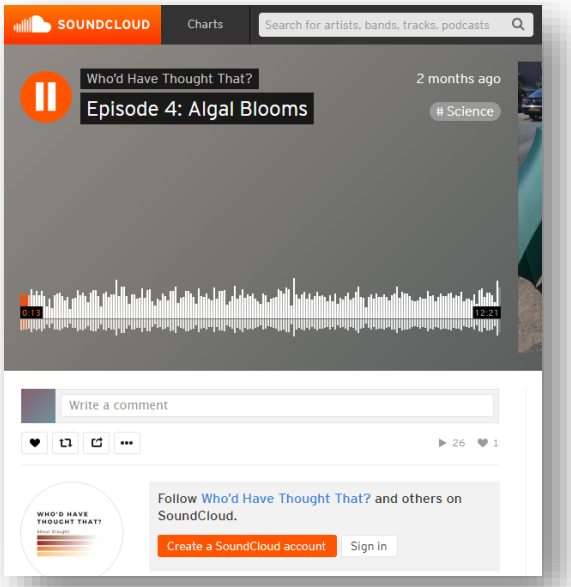
Lindsey McEwen, Tina McGuiness, Paul Whitehead, Len Shaffrey

About Drought

Maximising the impact of UK research on drought & water scarcity

Workstream 5 Communities

- Exploiting programme outputs (oral histories, linguistic corpora, digital stories)
- Interface for KE for public/communities
- Podcasts, videos (e.g. ‘Drought Myths’. ‘Who’s have known that?’ series)
- Guidance on drought communication and educational materials



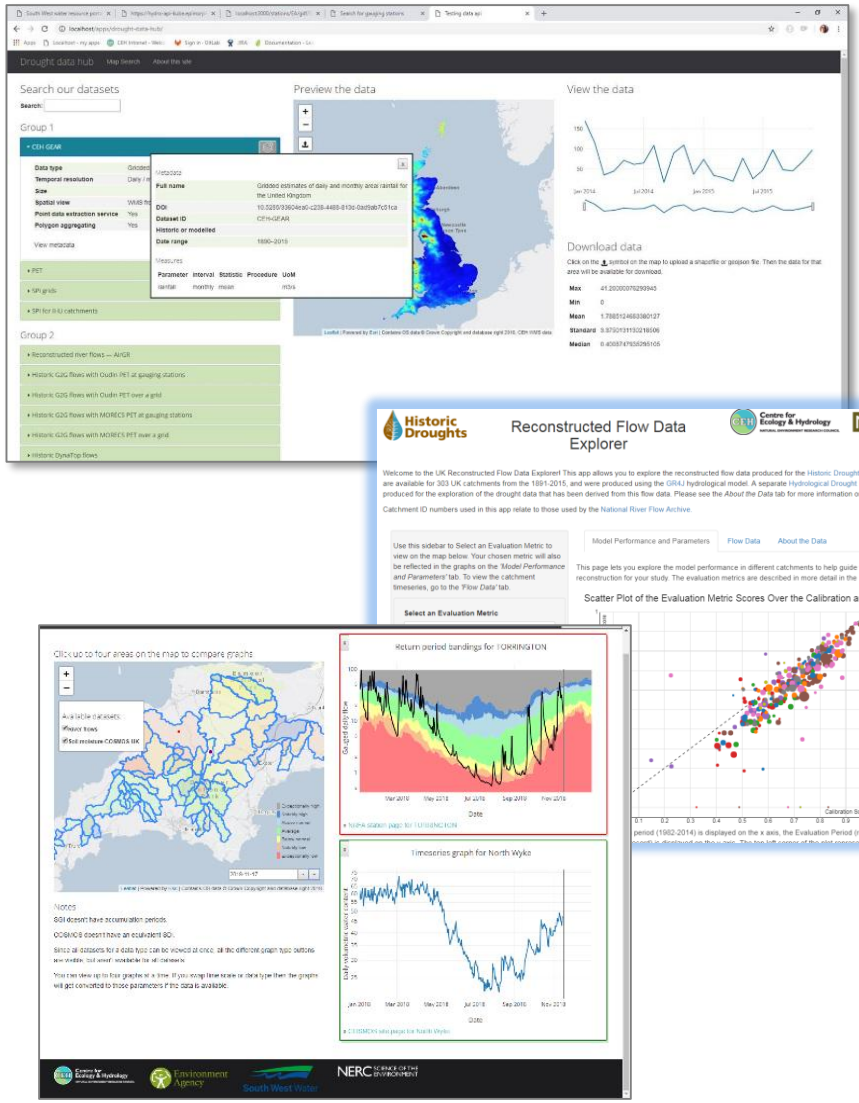
Lindsey McEwen, Rebecca Pearce, Catherina Landstrom, Carmen Dayrell, Emma Weitkamp

About Drought

Maximising the impact of UK research on drought & water scarcity

Workstream 6 Data

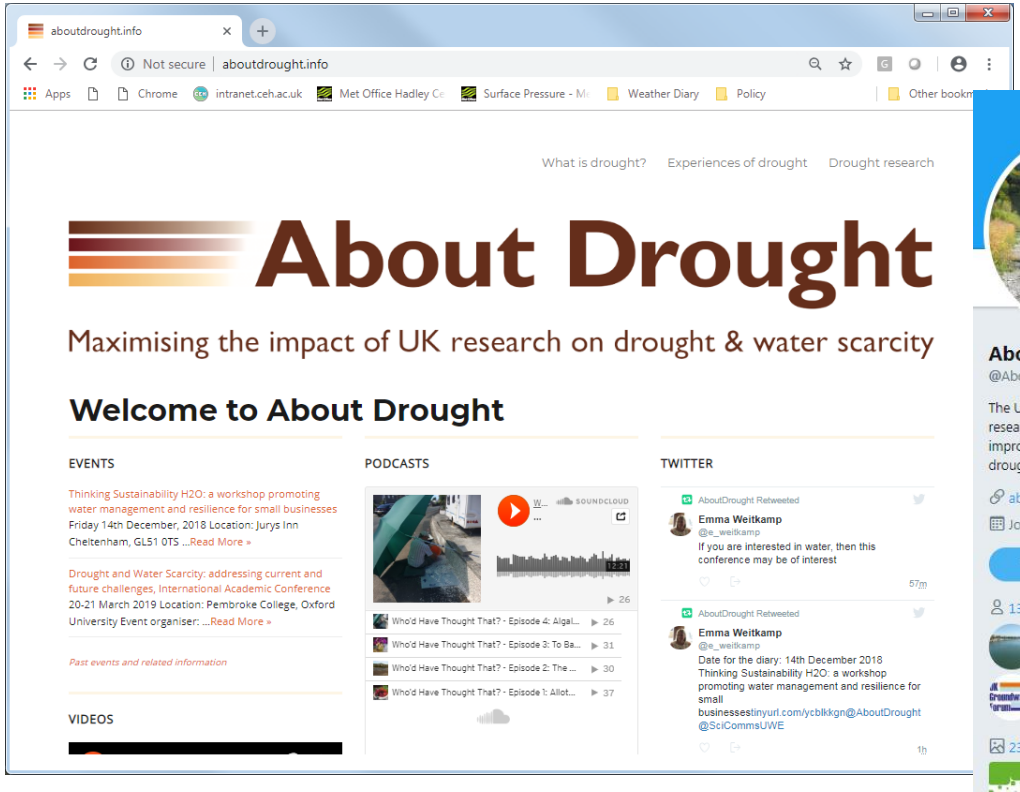
- Web-based access, data downloadable
- APIs (so programmers can get the bits they want)
- “Drought data hub” – an interface for downloading data for places of interest
- Enhanced Droughts portal
- “Shiny” applications for enabling more complex interactions (drought libraries)



Matt Fry, Gemma Nash, Vasilis Andreadis

About Drought

Maximising the impact of UK research on drought & water scarcity



http://aboutdrought.info/

@AboutDrought

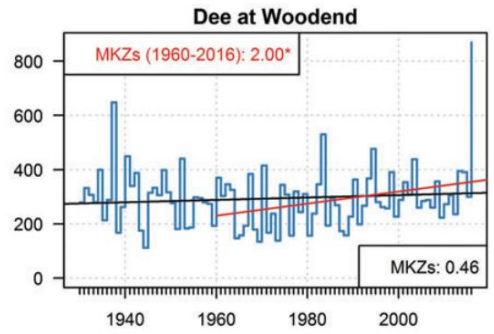
Concluding Remarks

- The droughts programme has been a major investment in interdisciplinary UK drought research over four years
- ENDOWS is now integrating this research and making it accessible and useful for a very wide range of stakeholders
- Data, models, methodologies could find application in regional and national-scale planning…
- …as well as in managing the ongoing drought
- We still have one year of ENDOWS left and welcome further opportunities to embed the research into decision-making

The Droughts programme: a seasonal summary

Droughts Past

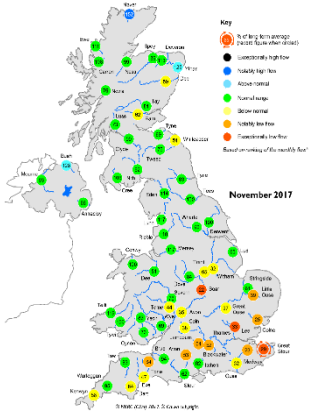
<1800s → 2017



- Historic Droughts: Expanding our understanding of past drought occurrence and characteristics
- Reconstructions of hydrometeorology (Drought Libraries)
- Understanding of past drought drivers, impacts, responses (agriculture, social, legal, media, etc)

Droughts Present

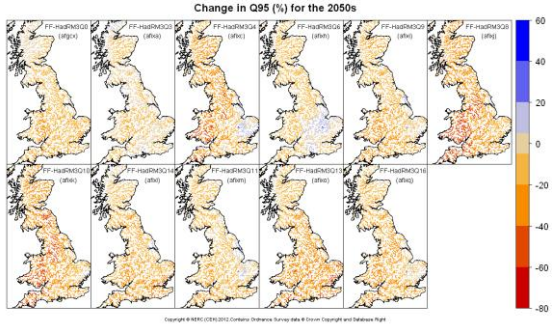
Jan → Dec



- New tools for seasonal forecasting
- Monitoring and outlooks in current 2018 drought
- Working with stakeholders to enhance drought governance and management
- Improving drought communication and reframe the discourse around drought
- Synthesis of understanding drought impacts on ecology

Droughts yet-to-come

2019 → >2100



- Event set of future climate/hydro projections
- Water supply modelling for projected water availability, quality
- Impacts on agriculture, energy, terrestrial and freshwater ecology
- Feeding data and modelling into long-term planning, options appraisal and adaptation