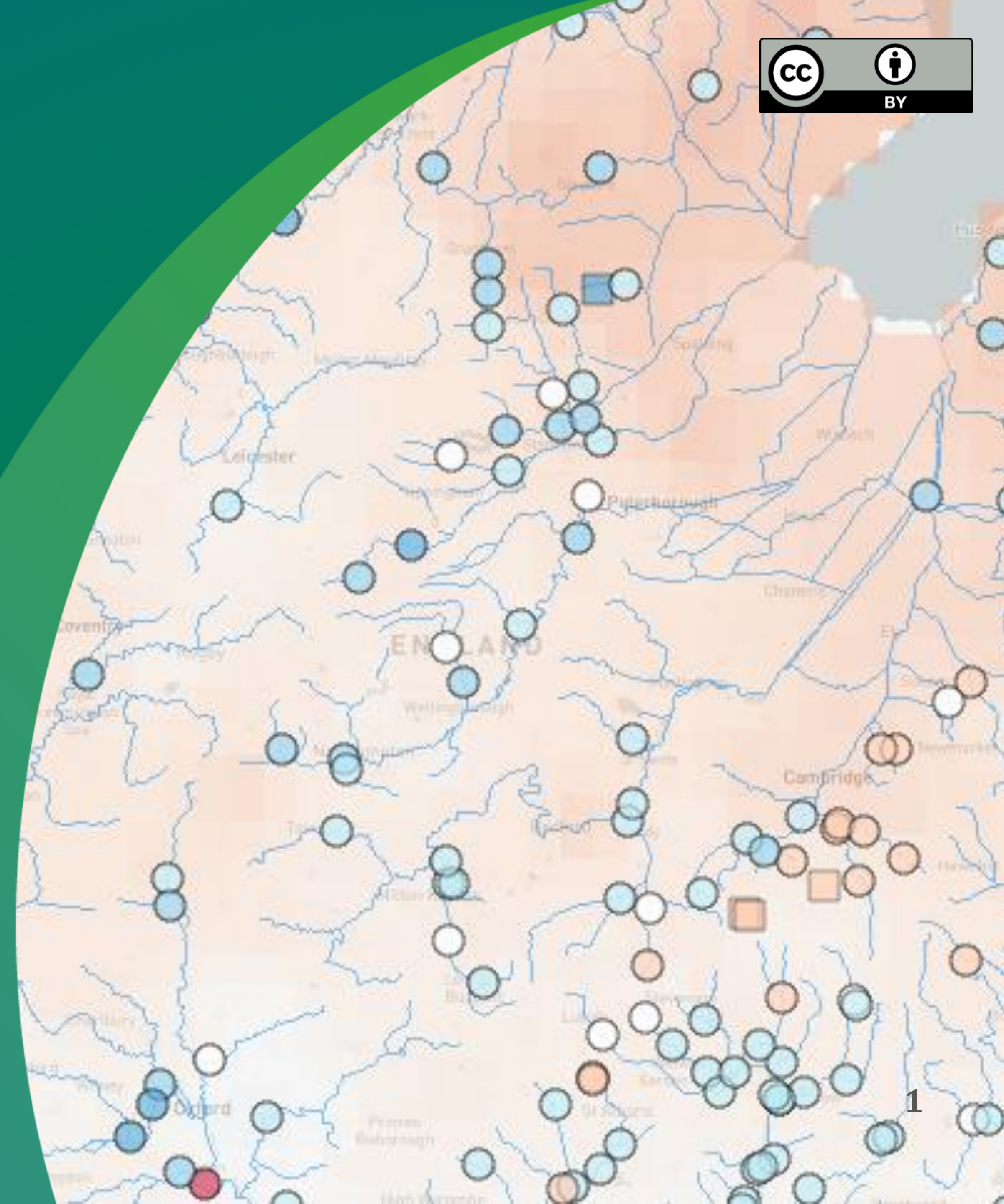


Dynamic Real-time Hydrological Status Monitoring in the UK

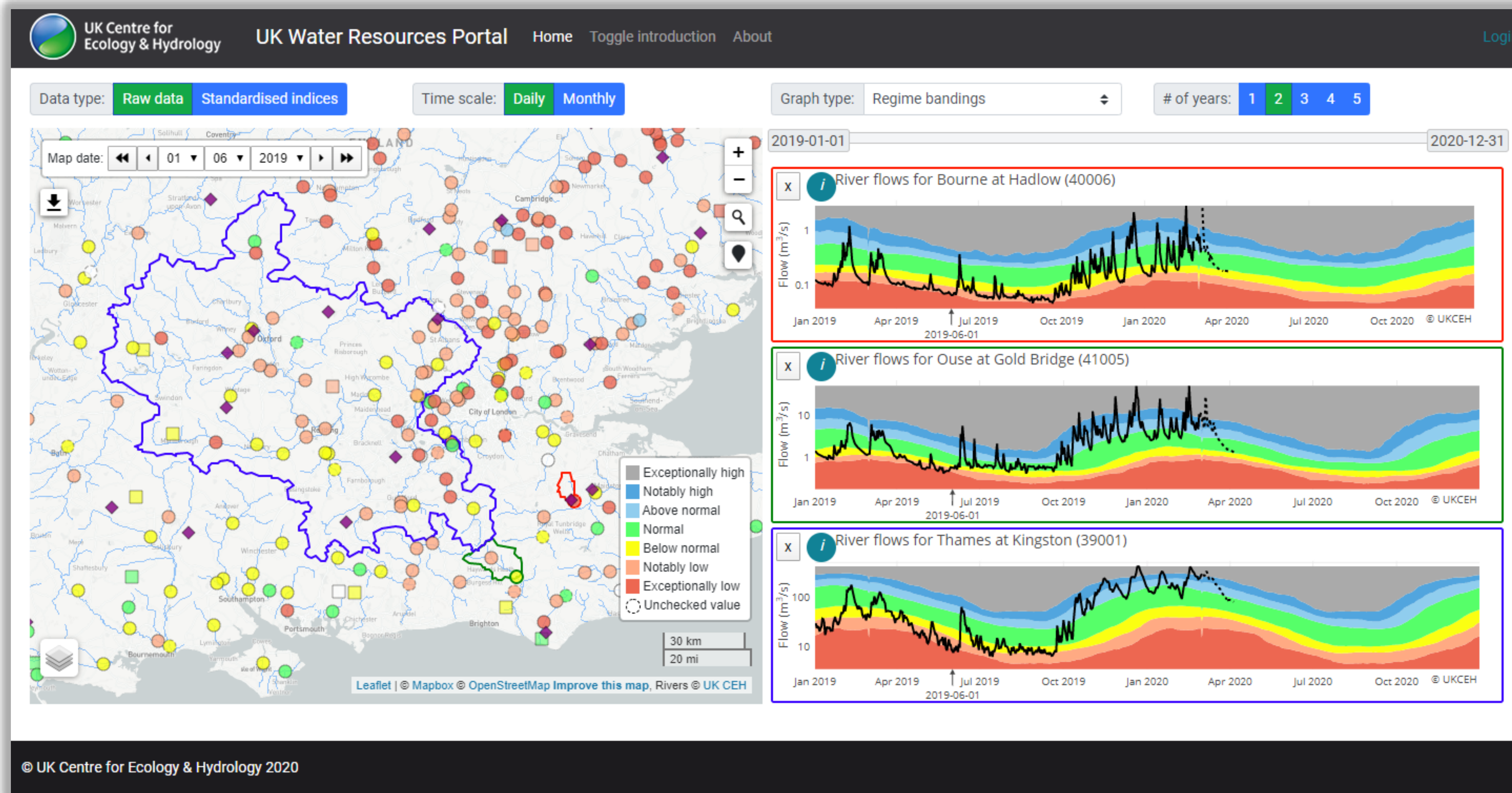
Lucy J. Barker¹, Gemma Nash²,
Matt Fry¹, Jamie Hannaford¹ &
Maliko Tanguy¹

¹ UK Centre for Ecology & Hydrology, Wallingford, UK

² UK Centre for Ecology & Hydrology, Edinburgh, UK



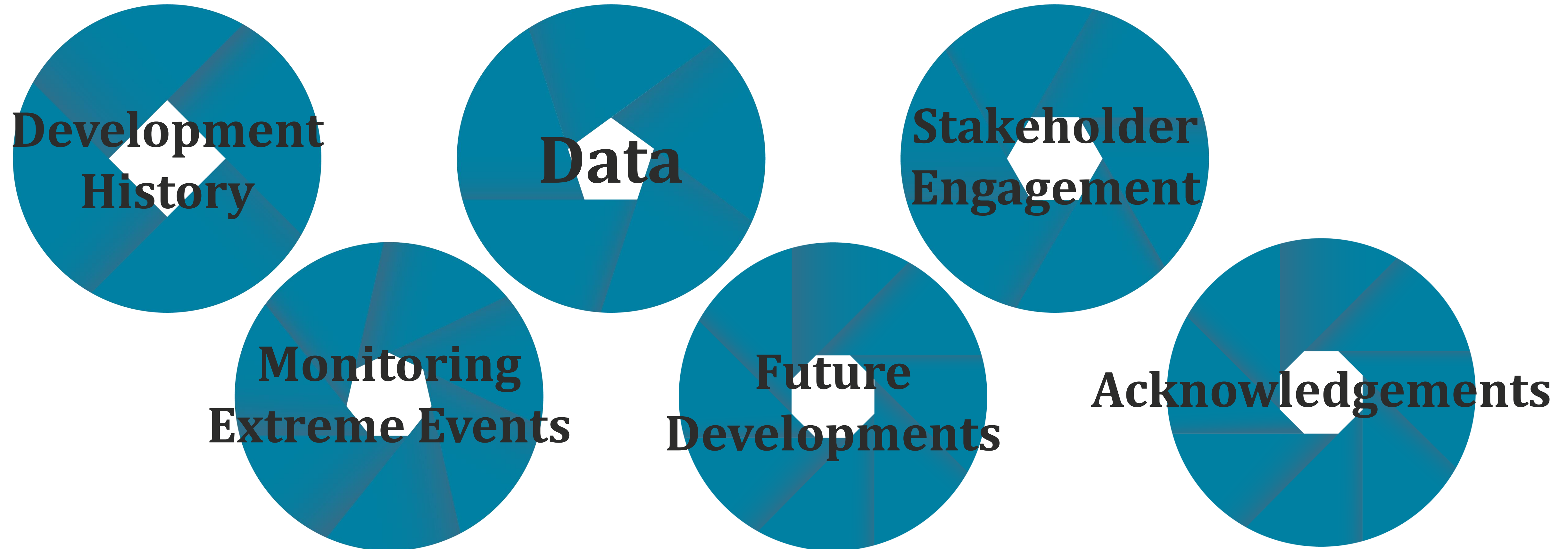
What is the UK Water Resources Portal?



An interactive web-based tool for high-resolution hydrological status assessment in (near) real-time



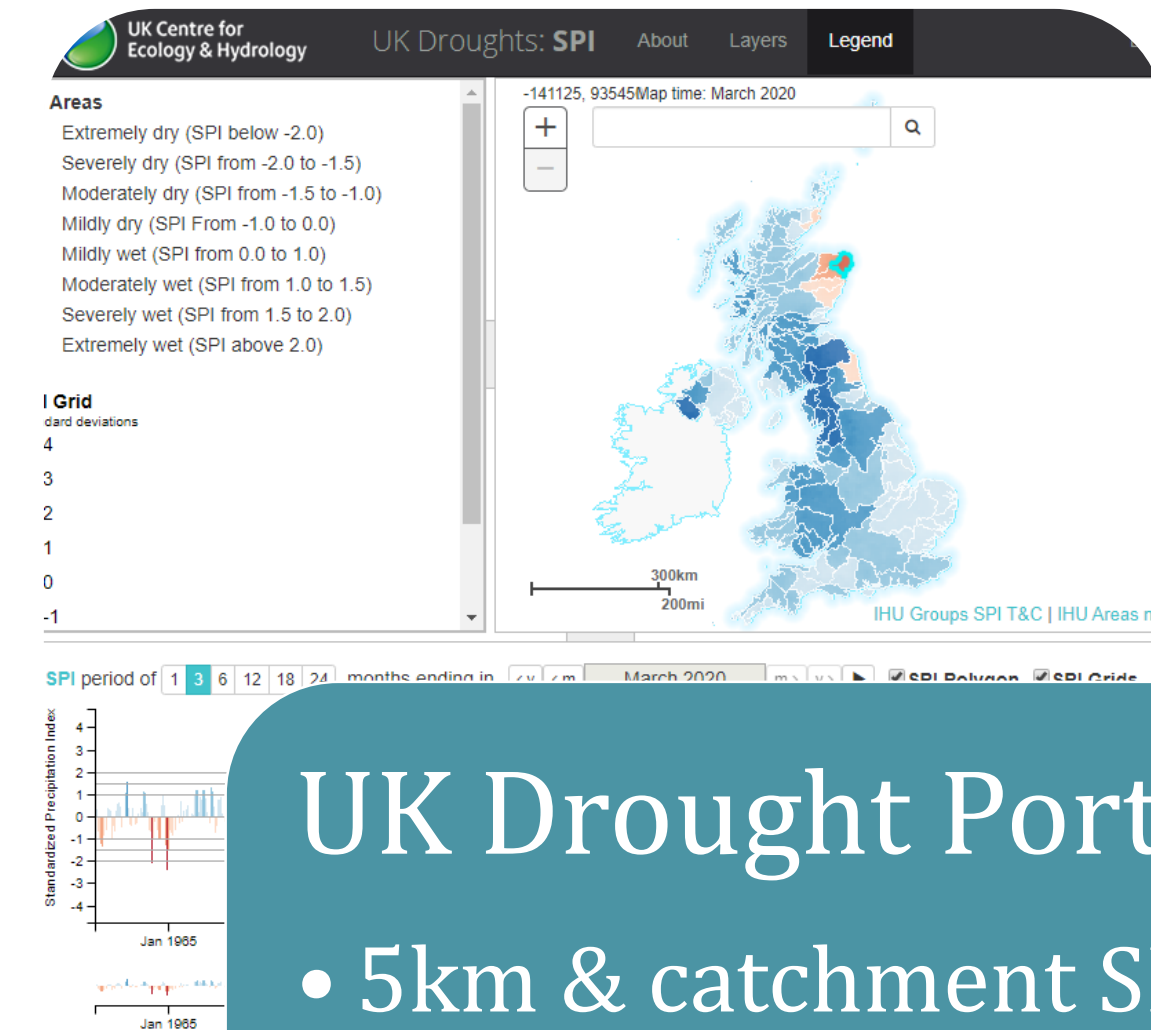
UK Water Resources Portal



Click on a circle for more info



Development History

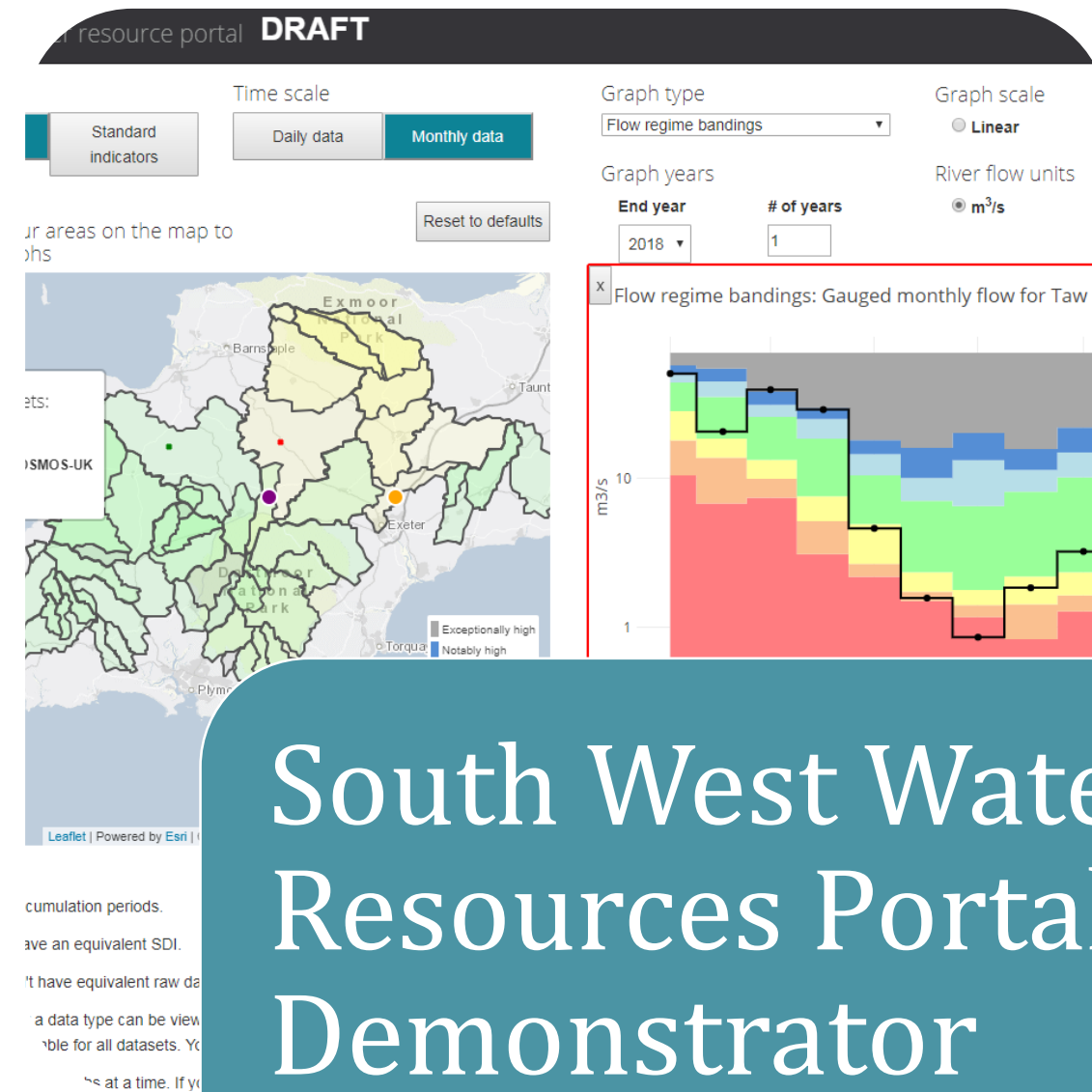


UK Drought Portal

- 5km & catchment SPI
- SPI back to 1961
- Monthly updates from June 2016



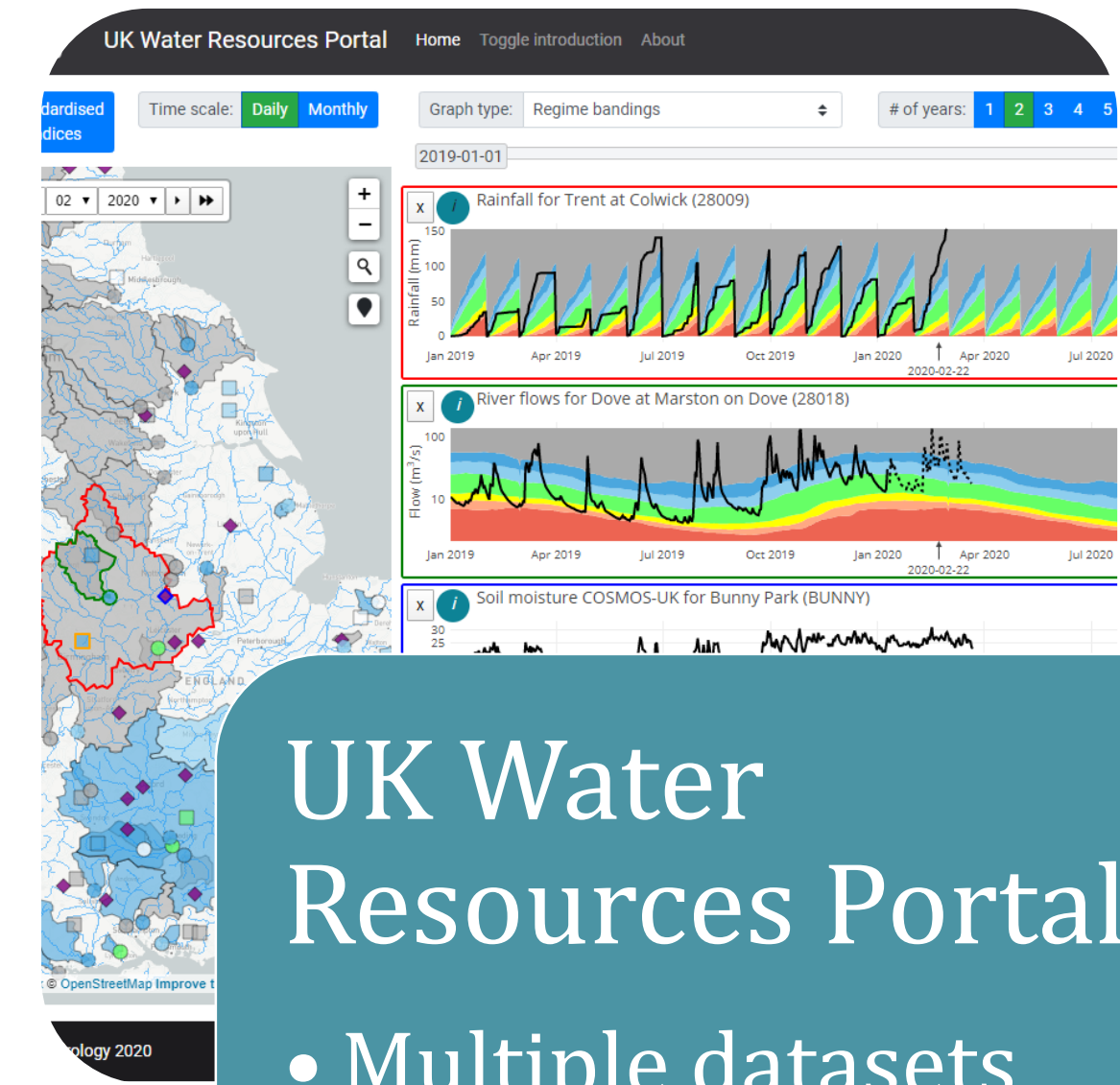
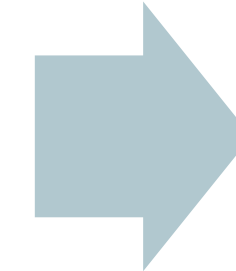
[More Info](#)



South West Water Resources Portal Demonstrator

- Multiple datasets
- Regional demonstrator
- Stakeholder co-design

[More Info](#)



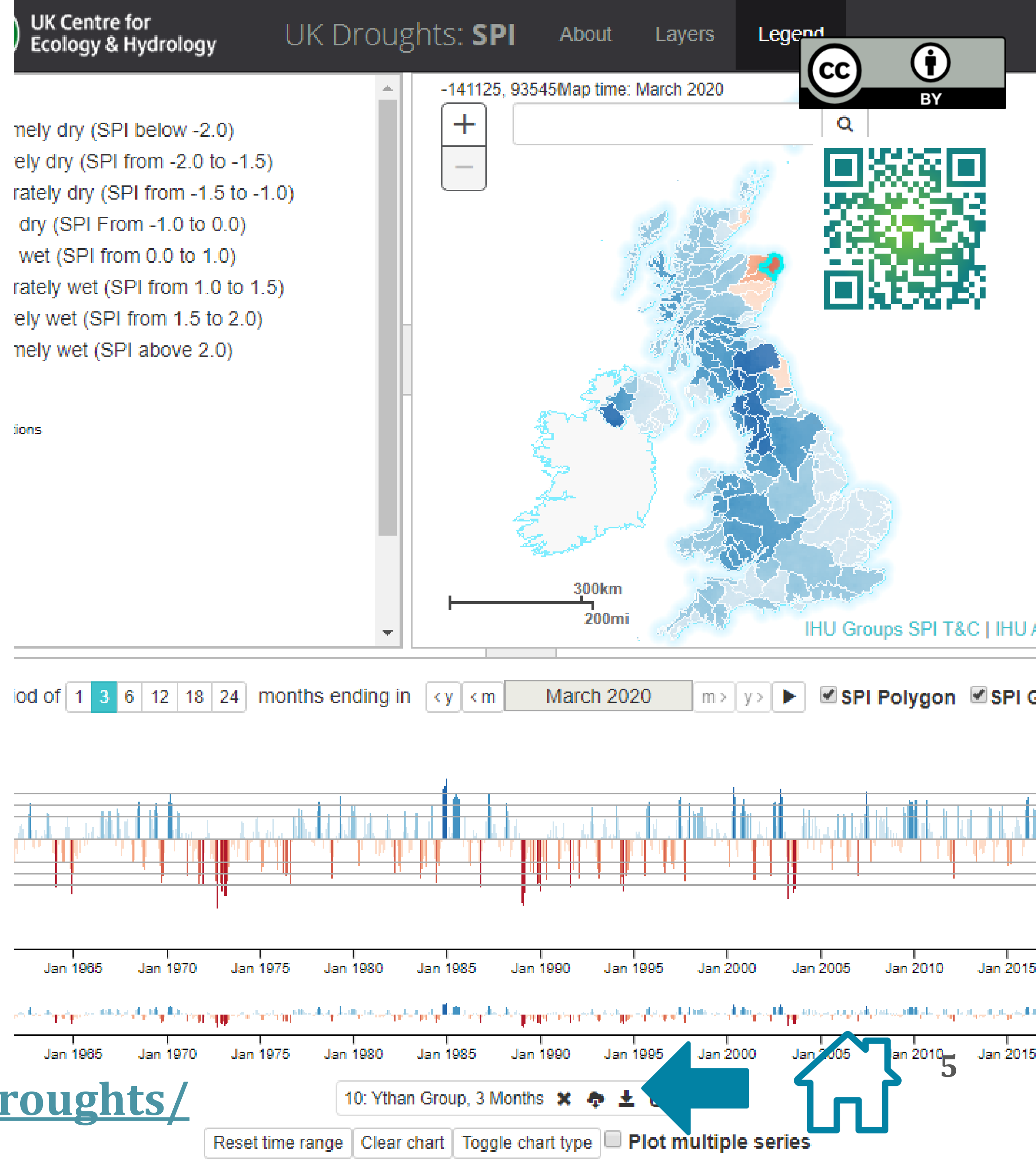
UK Water Resources Portal

- Multiple datasets
- Near real-time updates
- Stakeholder co-design
- Launched March 2020

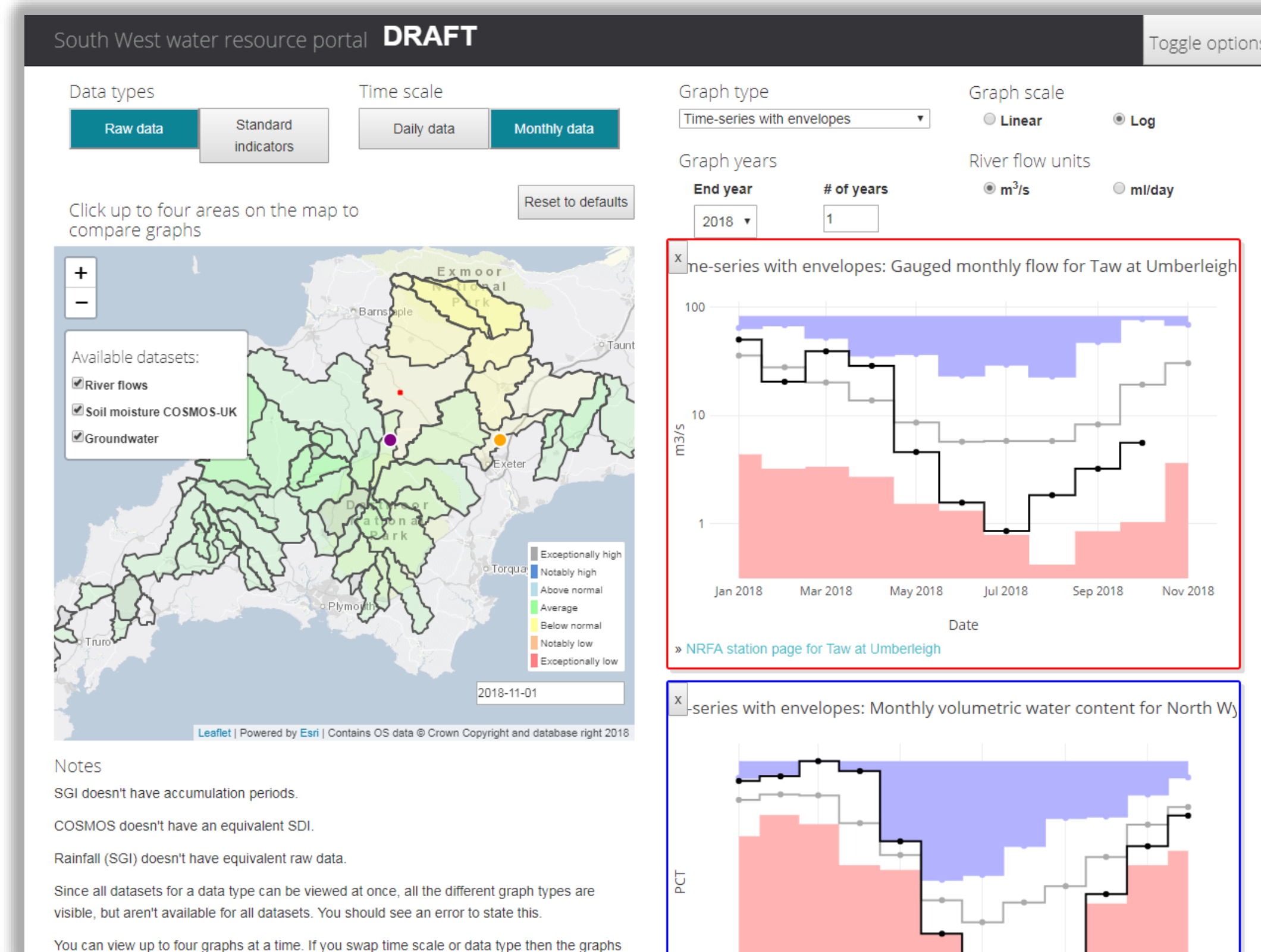
[More Info](#)


UK Drought Portal

- *A web-based tool for high-resolution drought mapping and time series plotting in near-real-time*
- Standardised Precipitation Index (SPI) for 5km grid and catchments across the UK back to 1961
- Free data downloads
- Developed to meet UK user needs for drought monitoring

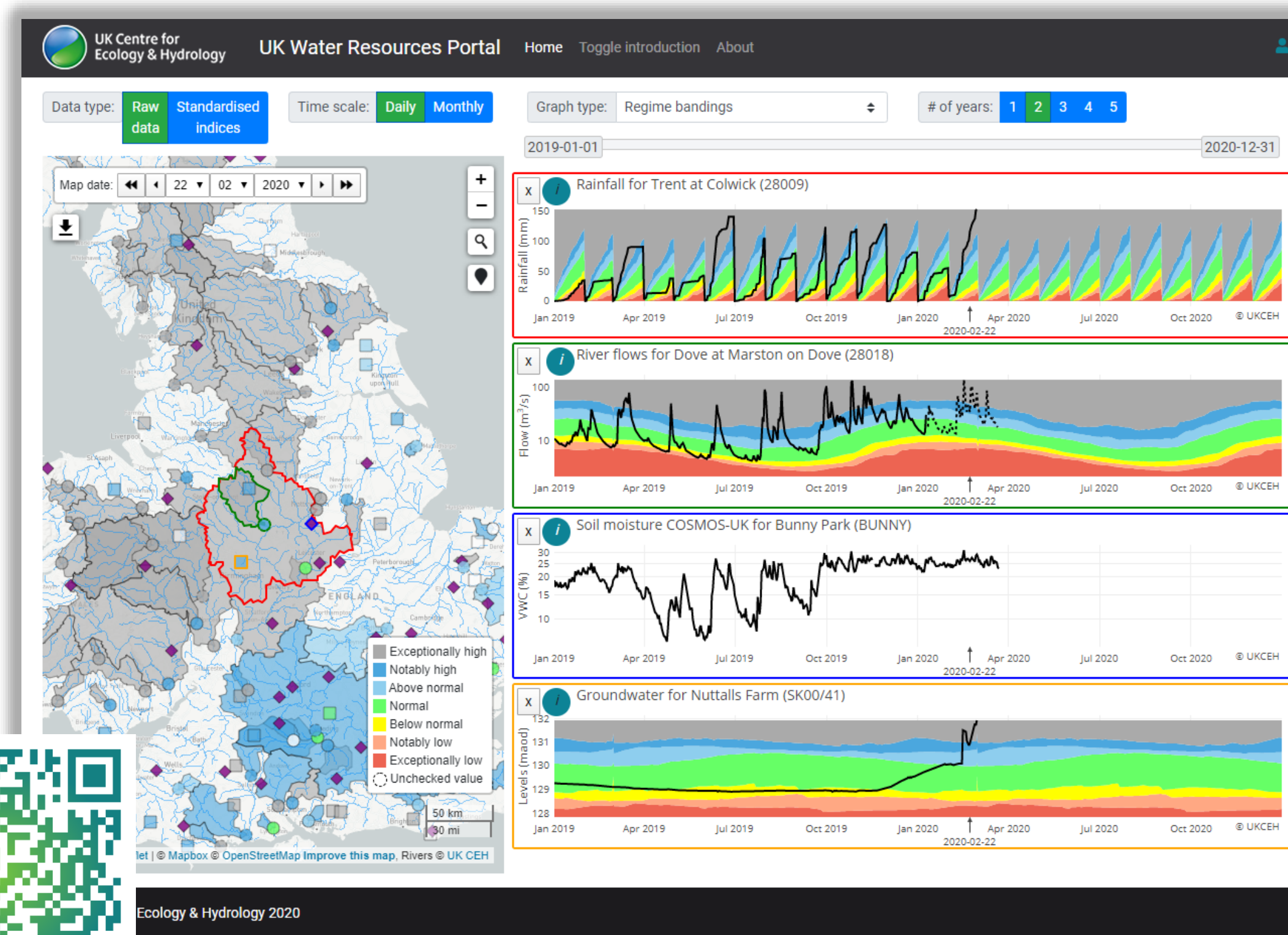
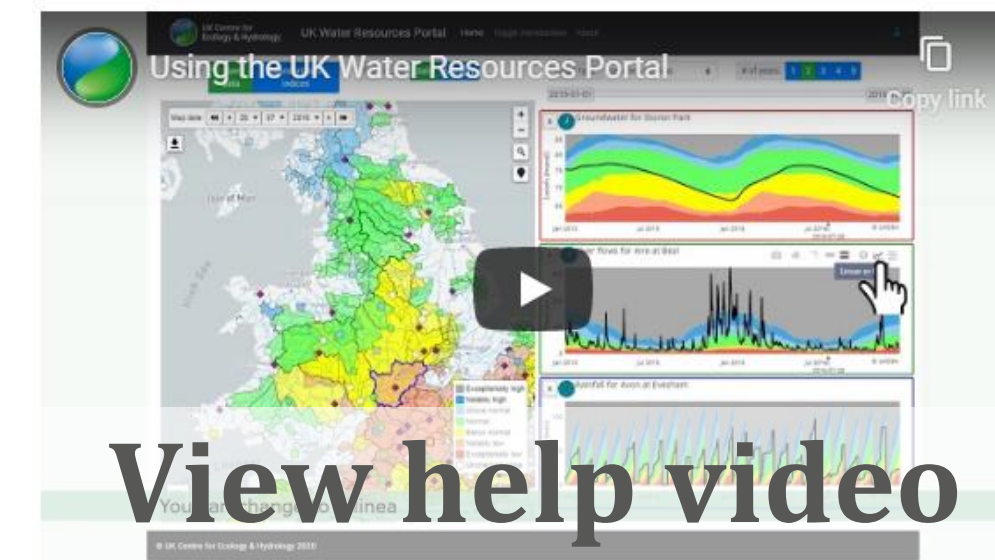


South West Water Resources Portal Demonstrator



- Developed to demonstrate how multiple data types could be brought together in one place
- Co-designed with Environment Agency & South West Water
- Tested with a range of stakeholders 
- Included rainfall, river flow, groundwater and soil moisture data
- Real-time river flow data: [EA Hydrology Data Service](#)
- Real-time soil moisture data: [COSMOS-UK](#)

UK Water Resources Portal



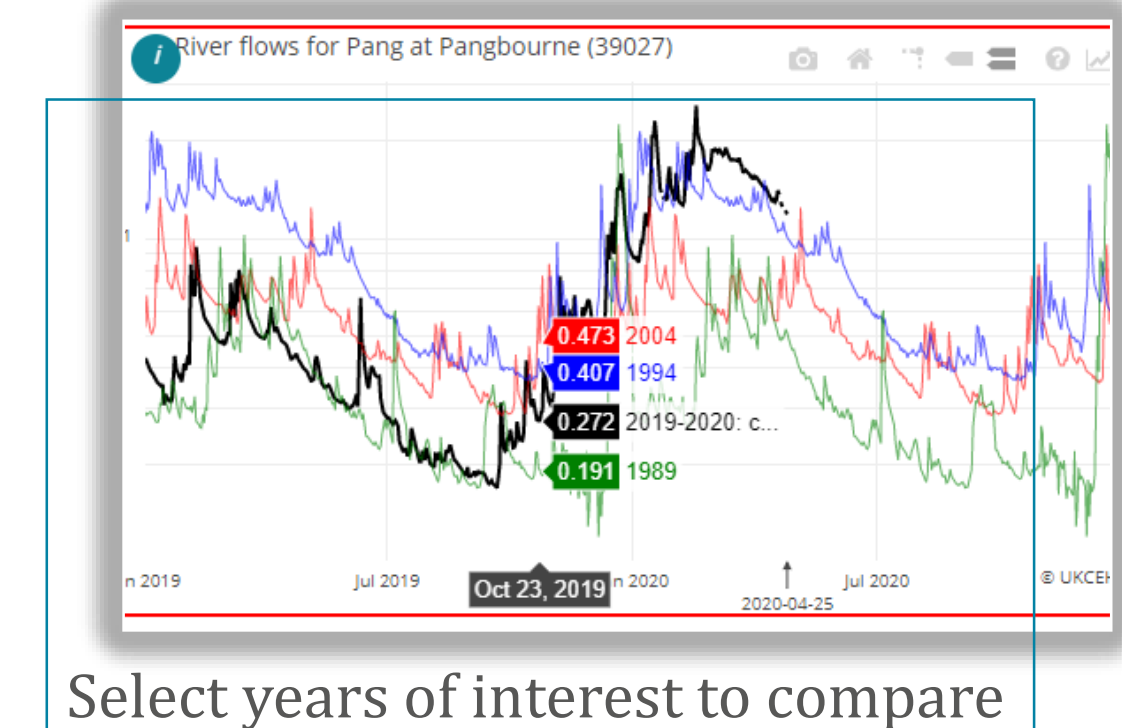
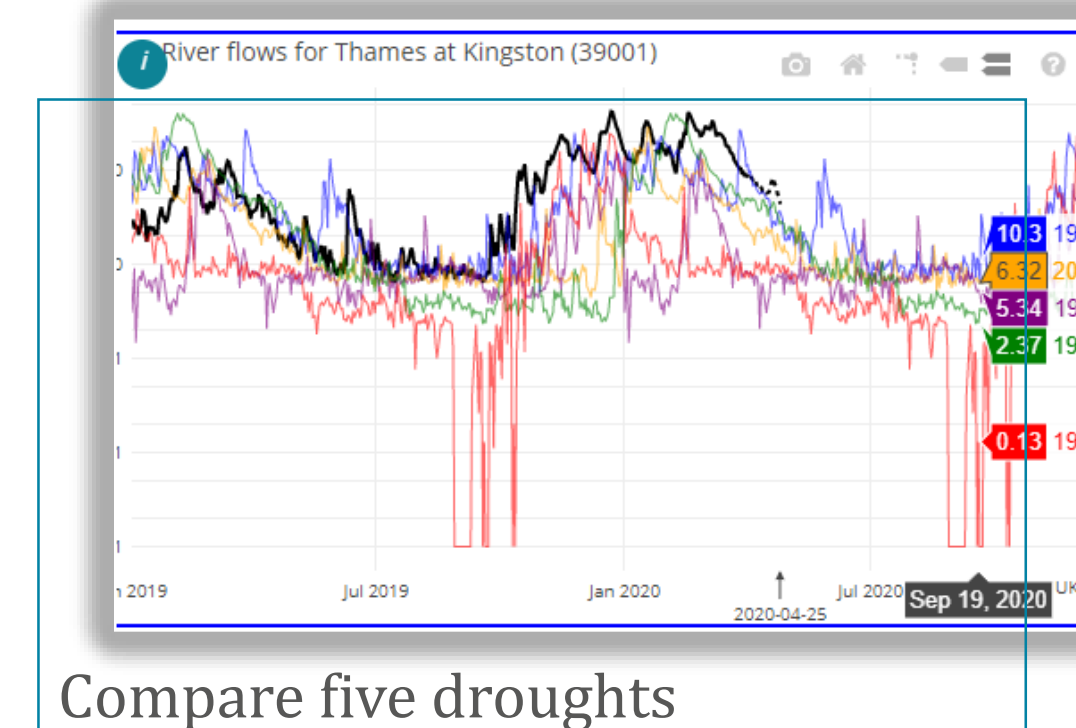
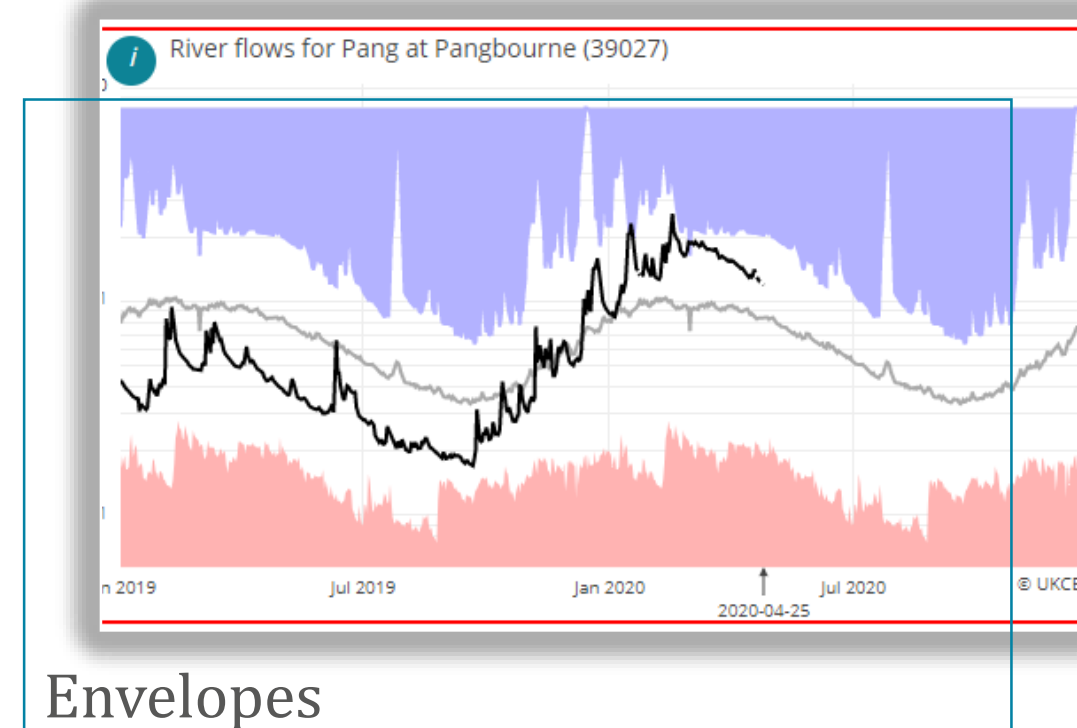
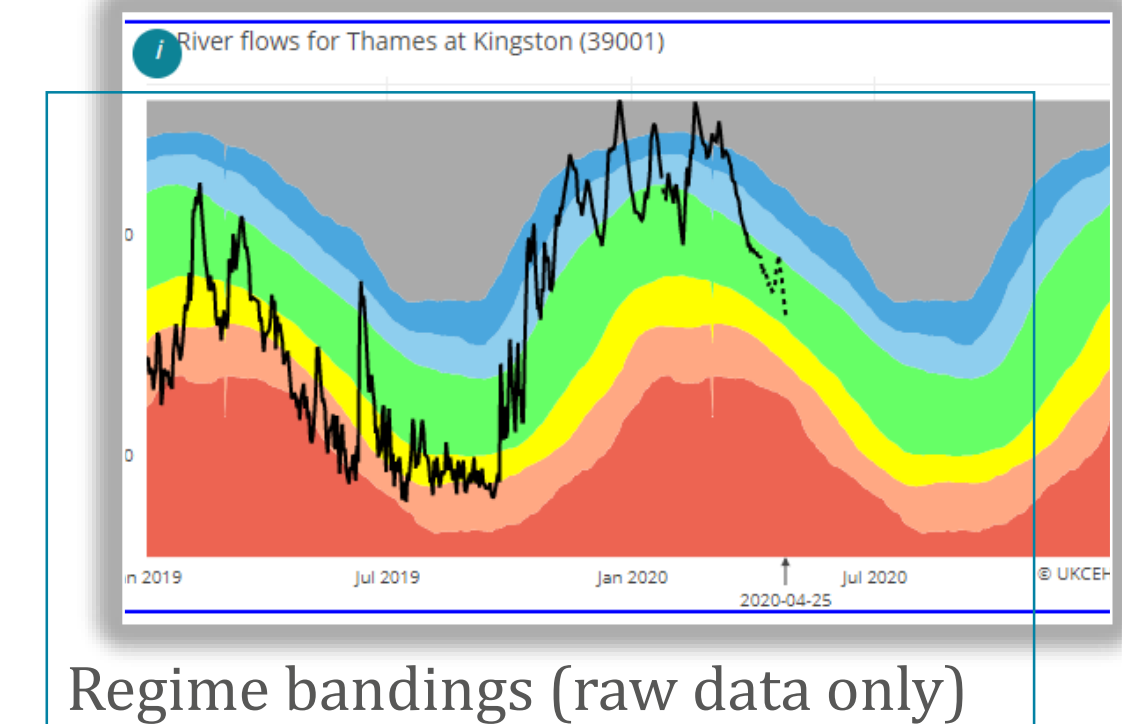
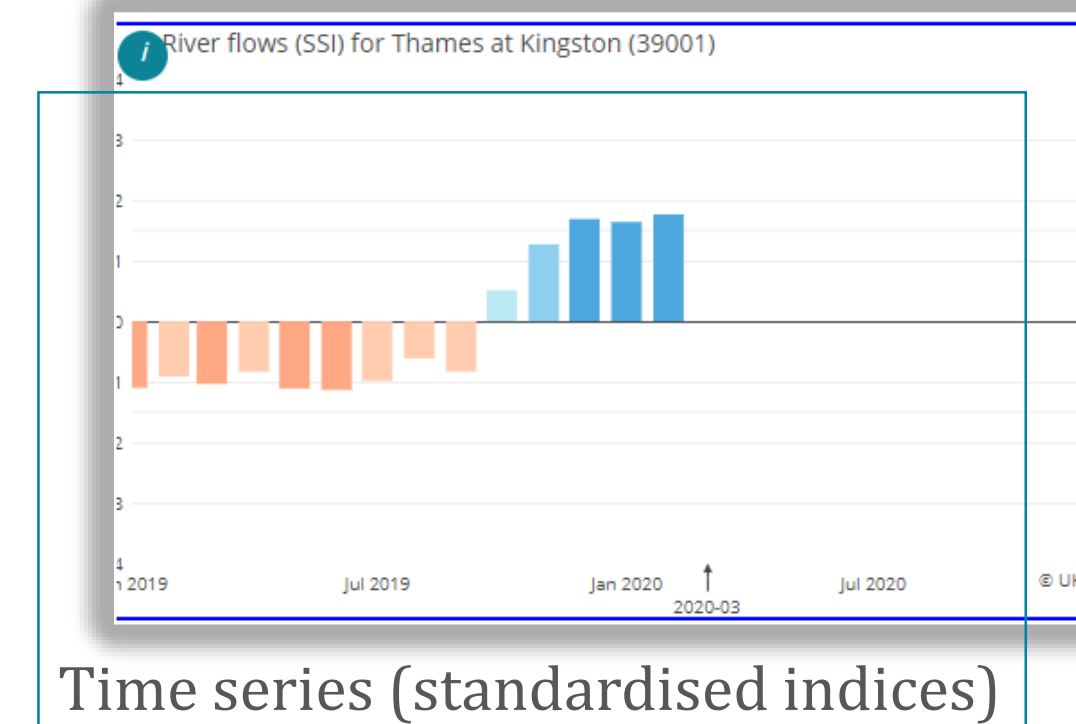
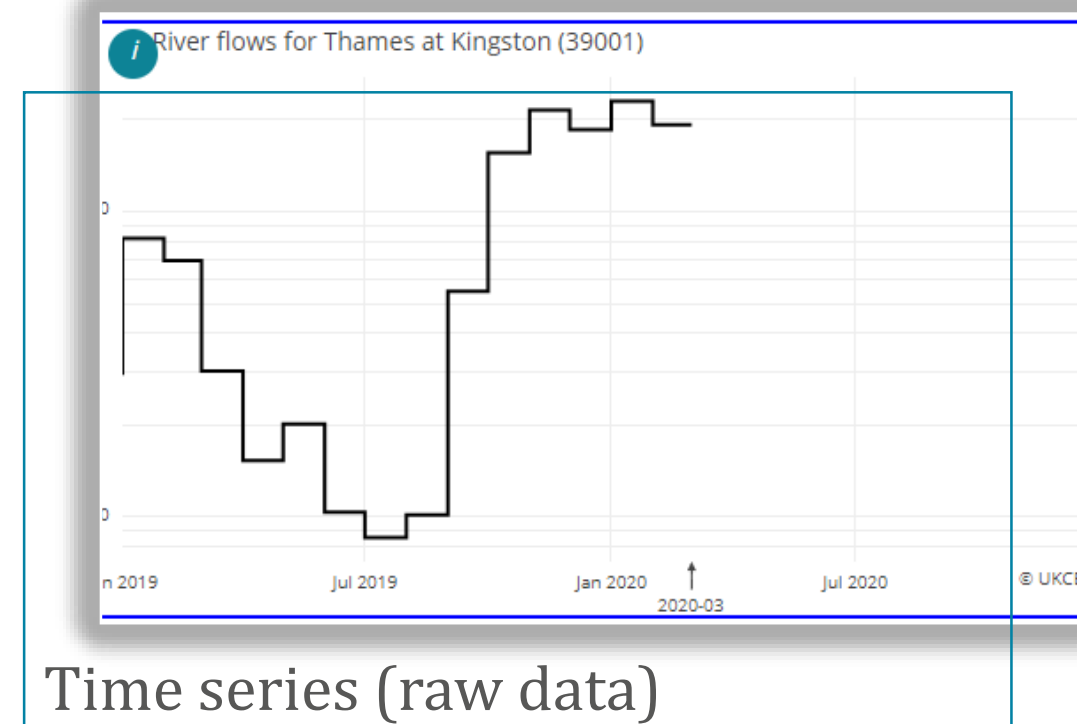
- Expanded the South West Water Resources Portal demonstrator concept to the national scale with rainfall, river flow, soil moisture and groundwater level data in (near) real-time
- Launched as a demonstrator in July 2019
- Launched operationally in March 2020
- Tested with a range of stakeholders with feedback contributing to the design and functionality
- Range of plotting styles available



www.eip.ceh.ac.uk/hydrology/water-resources/

UK Water Resources Portal plotting styles

- Stakeholder engagement highlighted that it was important to be able to visualise data in a range of ways
- The plotting styles are available for the raw data (daily and monthly) and the monthly standardised indices (except bandings)





UK Water Resources Portal Data

Both raw data and standardised indices are available in the UK Water Resources Portal.



See what data are available for each variable here

Click for more information on each data type

Standardised Indices



Rainfall



© Pixabay

River flows



© NRFA, UKCEH

UK National River Flow Archive

Soil Moisture



© COSMOS-UK, UKCEH

Groundwater



© British Geological Survey



Data

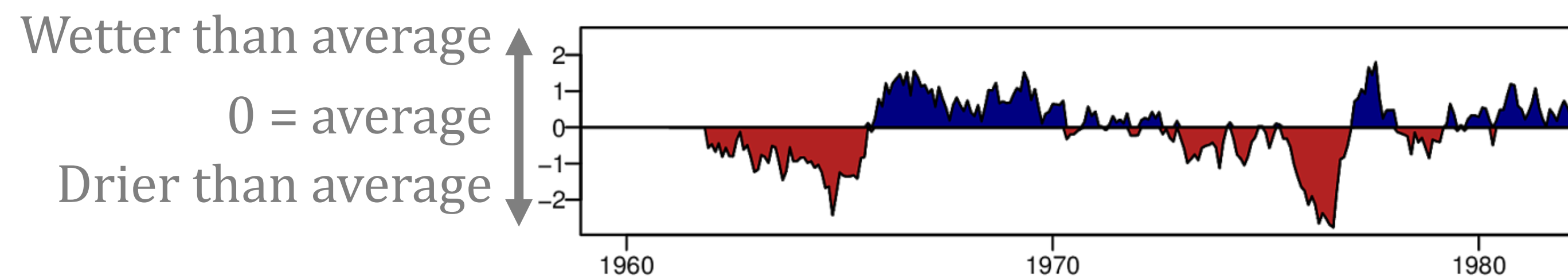
Raw data and standardised indices are available in the UK Water Resources Portal – these are the data types available:

Variable	Raw data – daily & monthly (unit)	Standardised Indices (name of index)
Rainfall – 5km grid		<div>✓</div> <div>(Standardised Precipitation Index, SPI)</div>
Rainfall - catchments	<div>✓</div> <div>(mm)</div>	<div>✓</div> <div>(Standardised Precipitation Index, SPI)</div>
Rainfall – river basins		<div>✓</div> <div>(Standardised Precipitation Index, SPI)</div>
River flows	<div>✓</div> <div>(m³/s)</div>	<div>✓</div> <div>(Standardised Streamflow Index, SSI)</div>
Groundwater levels	<div>✓</div> <div>(m above ordnance datum, maod)</div>	<div>✓</div> <div>(Standardised Groundwater Index, SGI)</div>
Soil moisture	<div>✓</div> <div>(volumetric water content, %)</div>	



Standardised indices

- Based on SPI developed for rainfall
- Comparable over time and space
- Variations for streamflow, groundwater etc.
- User-defined accumulation periods (1, 3, 6 months etc.)



- Previously little used in the UK
- Tested appropriate distributions ([Svensson et al. 2017](#))
- Investigated drought characteristics & propagation ([Barker et al. 2016](#))

Standardised Precipitation Index
(McKee, 1993)

Standardised Streamflow Index
(Vicente-Serrano et al. 2012)

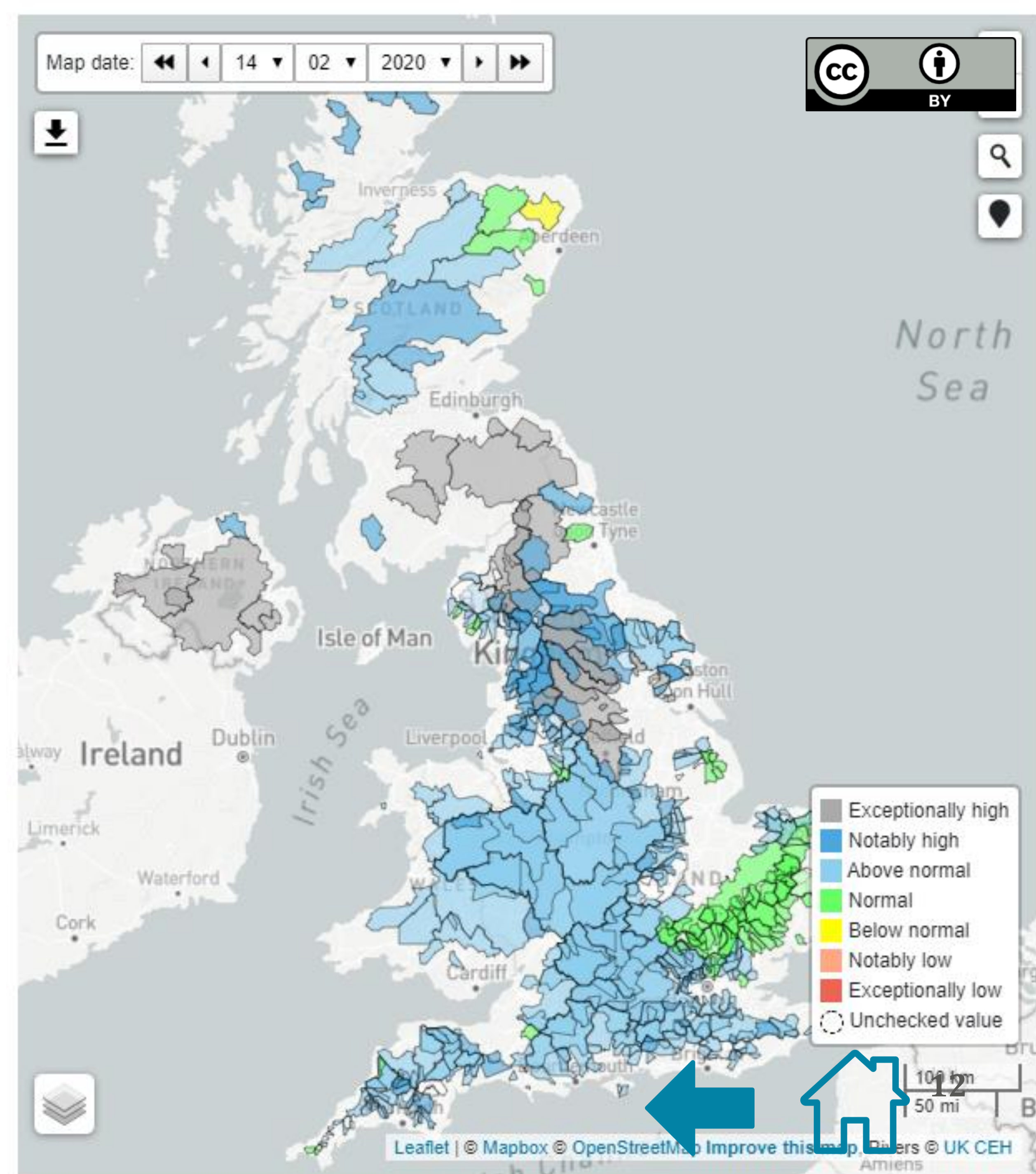
Standardised Groundwater Index
(Bloomfield & Marchant, 2013)

Index value	Severity category
>2.00	Extremely wet
1.50-1.99	Severely wet
1.00-1.49	Moderately wet
0 – 0.99	Mildly wet
0 - -0.99	Mildly dry
-1.00 - -1.49	Moderately dry
-1.50 - -1.99	Severely dry
<-2.00	Extremely dry



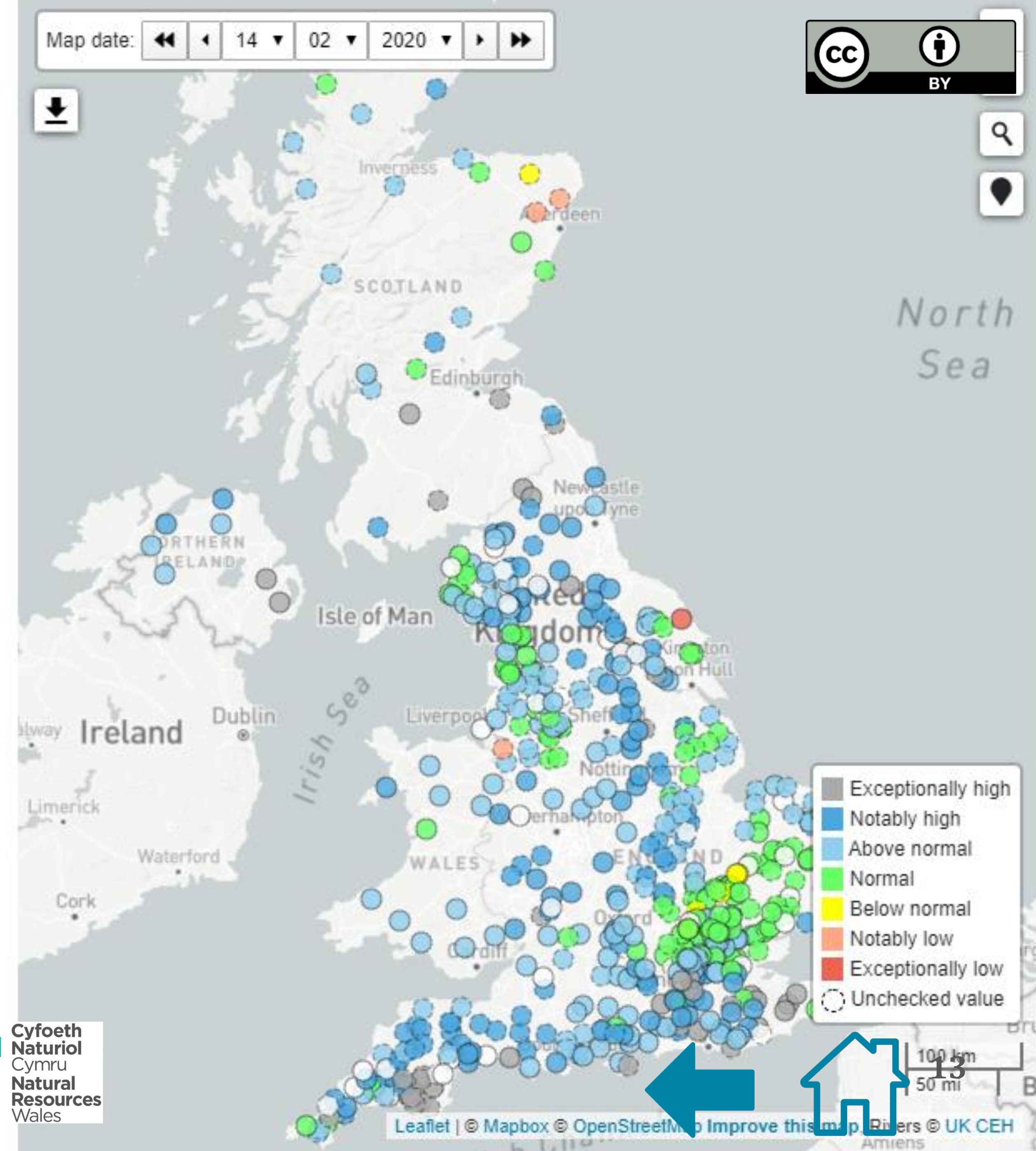
Rainfall data

- Data received each month from the UK Met Office
- Catchment daily rainfall
- Standardised Precipitation Index for 5km grids, catchments and river basins
- Daily rainfall grids may be added in the future



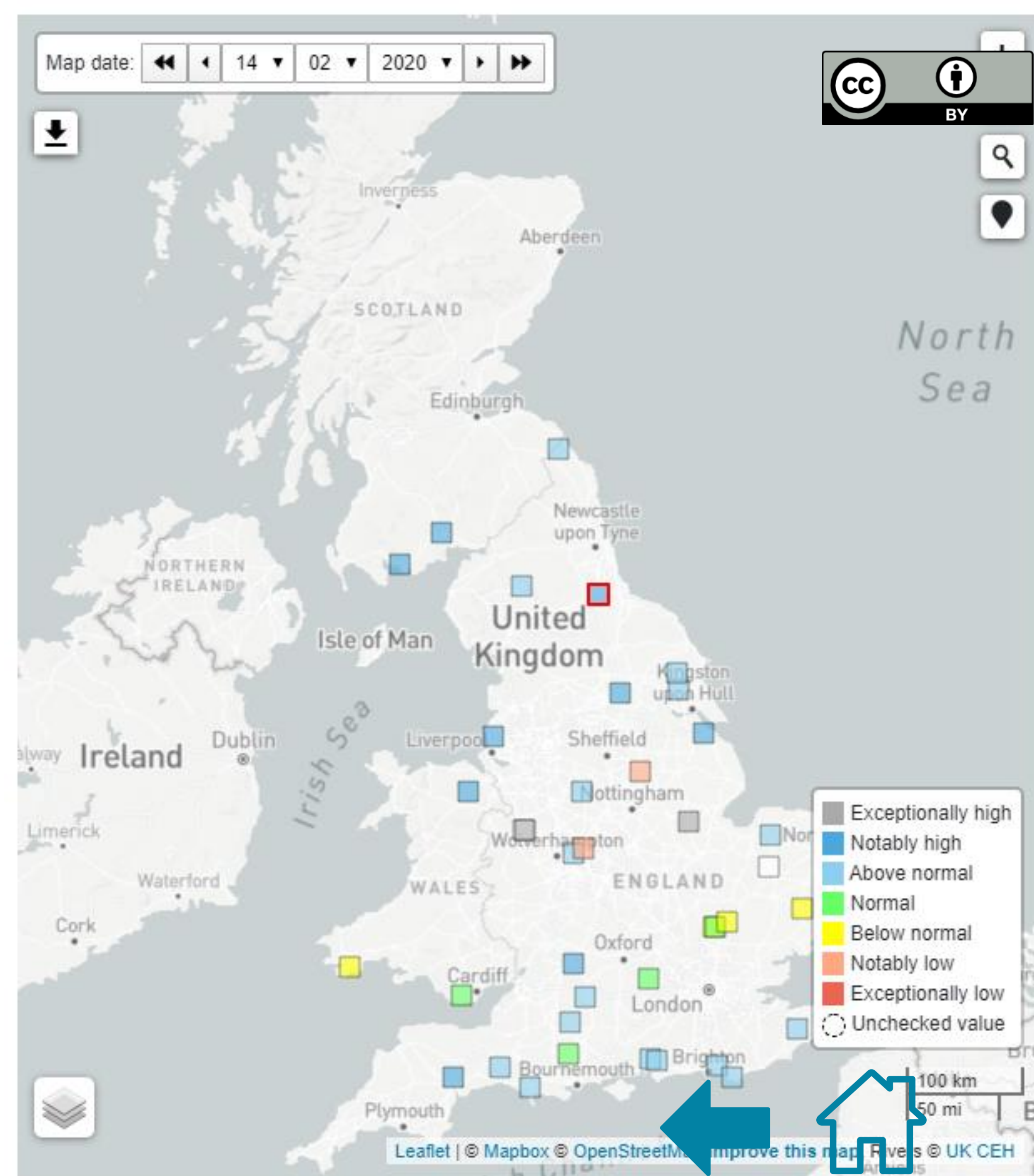
River flow data

- Live river flows in England from the [Environment Agency Hydrology Data Service API](#) for >800 river flow gauges
- Monthly updates of flows for catchments in Scotland, Wales, Northern Ireland and England, from UK regulators via the [National Hydrological Monitoring Programme](#)
- Monthly updates of SSI for all gauges



Groundwater level data

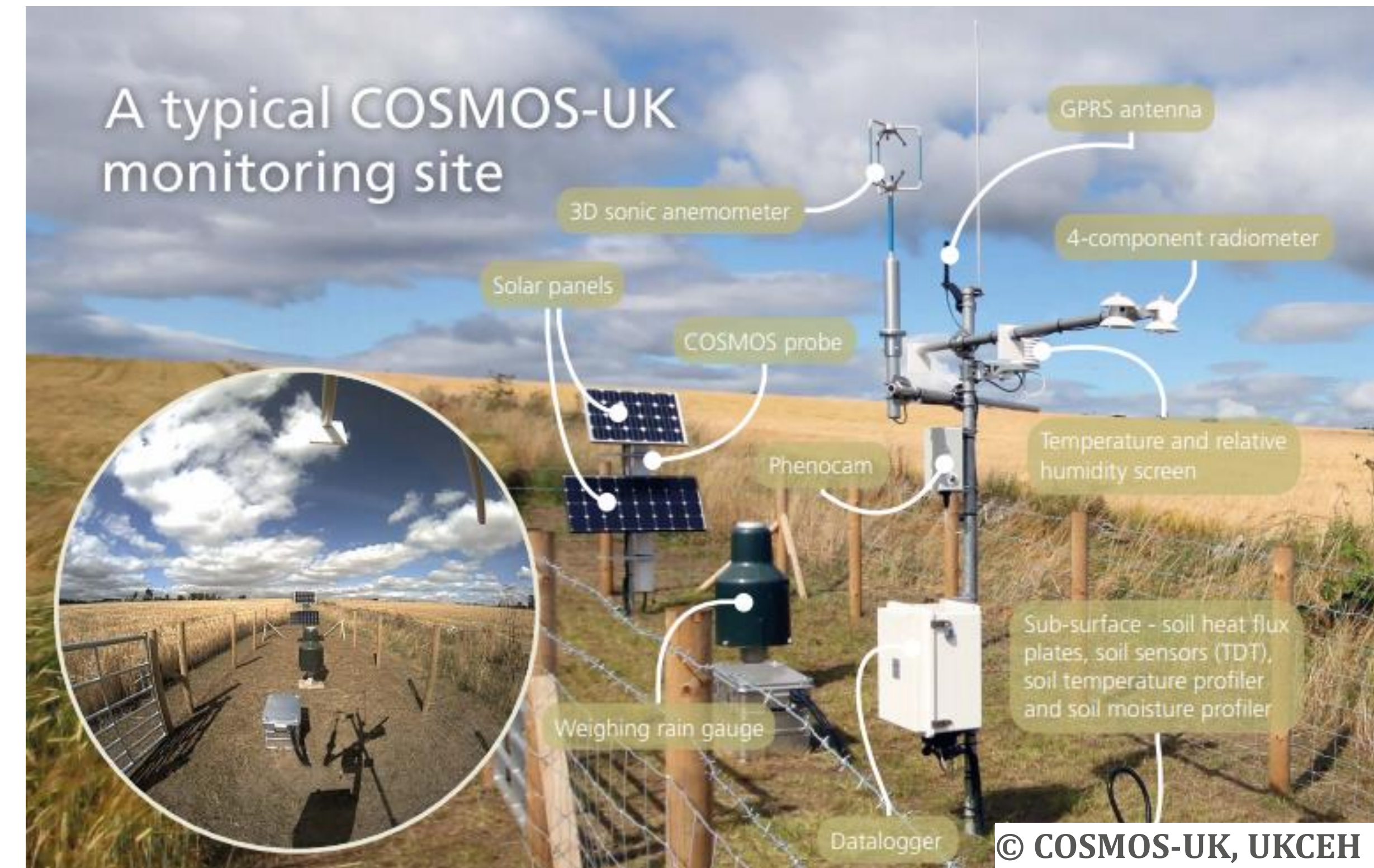
- Groundwater level data for 40 boreholes from UK regulators via the National Groundwater Level Archive at the British Geological Survey



COSMOS-UK

real-time field-scale soil moisture

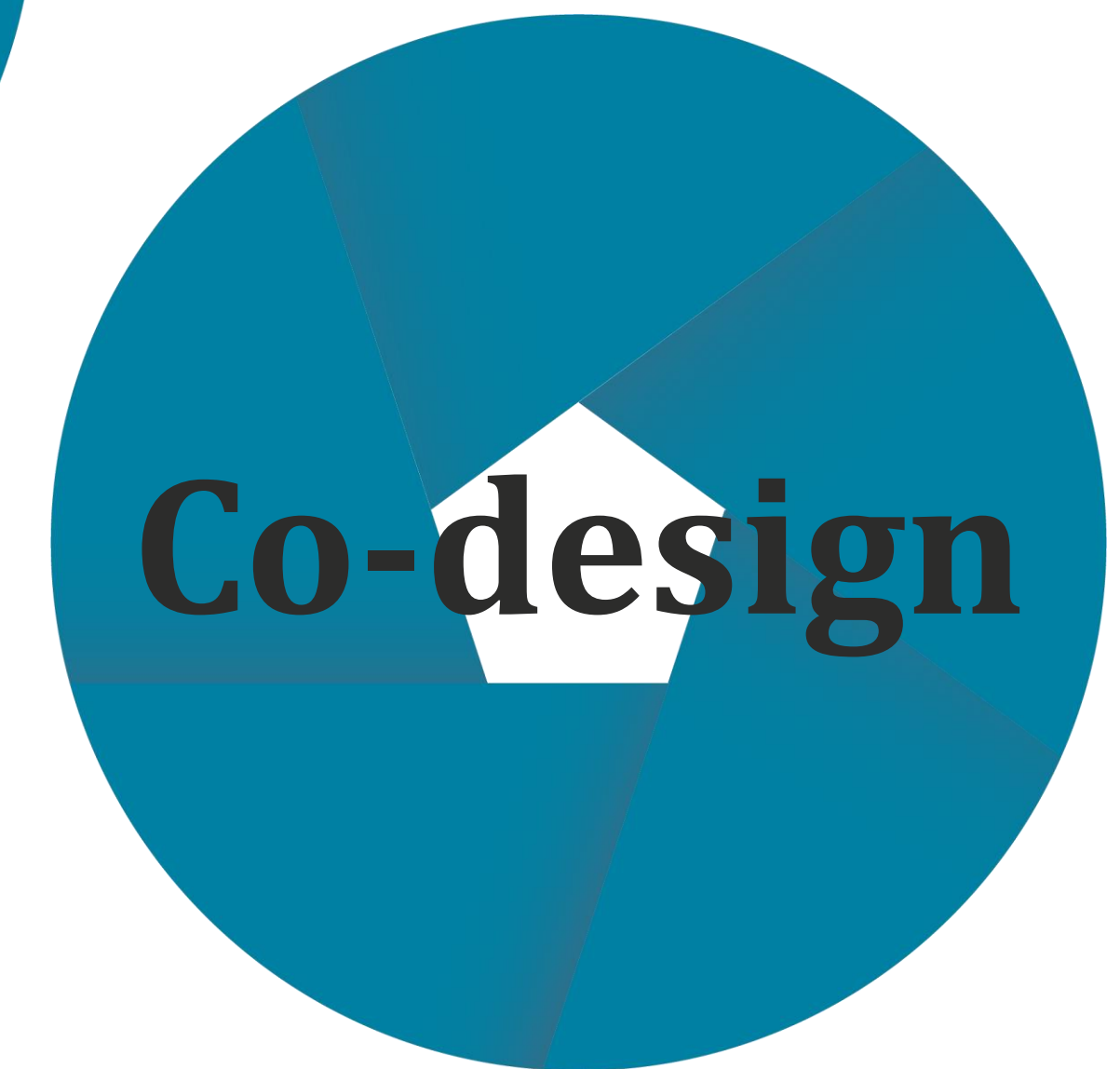
- Real-time field-scale soil moisture observations
- Network of ~50 sites across the UK covering a range of soil & vegetation types
- Use cosmic-rays to sense soil moisture
- N.B. Records too short (from 2014 onwards) to calculate standardised indices



www.cosmos.ceh.ac.uk/

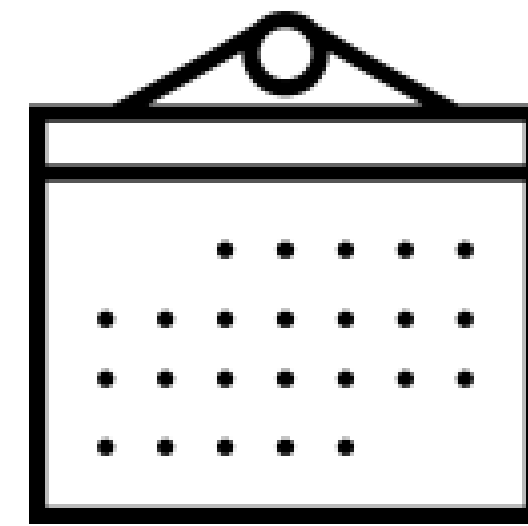
Stakeholder Engagement

- The UK Water Resources Portal has been driven by UK stakeholders from across water resources, environmental, agricultural and other sectors
- Find out more about how we have engaged with stakeholders:



UK requirements for monitoring

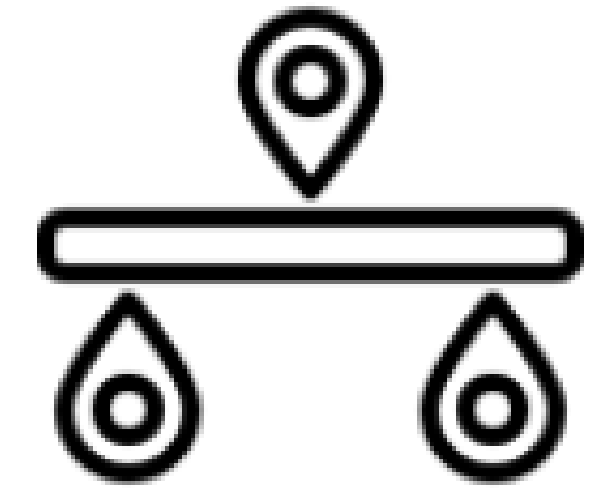
From workshops held in 2015 & 2016 we knew people wanted a way of accessing information to monitor droughts and water resources that included:



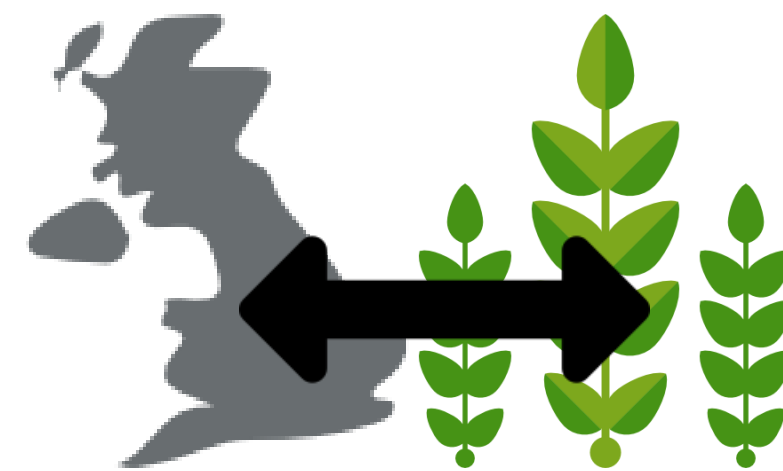
Different timescales
e.g. 1, 3, 6, 9 months



Different indices e.g.
rainfall, river flows, soil
moisture...



Historical
comparisons to
previous events



National and local scale
information

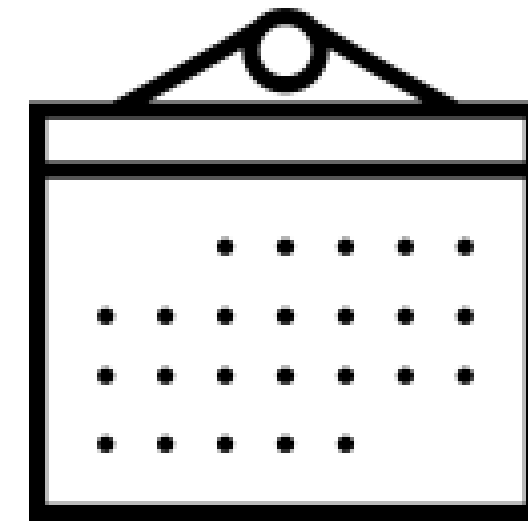
Find out more about the workshops:
Hannaford et al. 2018.
Weather Climate and Society
[DOI: 10.1175/WCAS-D-18-0042.1](https://doi.org/10.1175/WCAS-D-18-0042.1)
(open access)



And is
accessible & open

UK requirements for monitoring

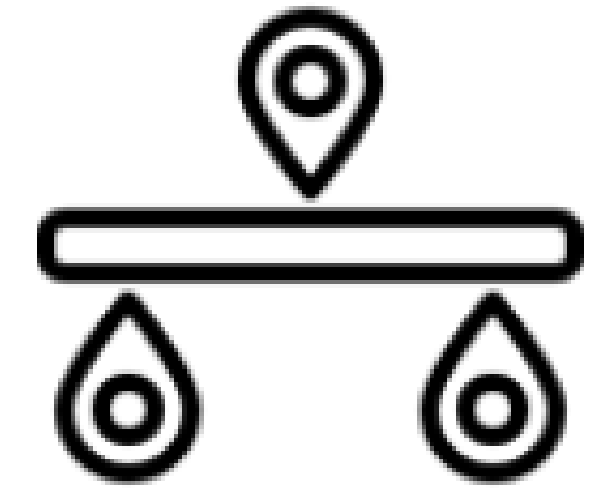
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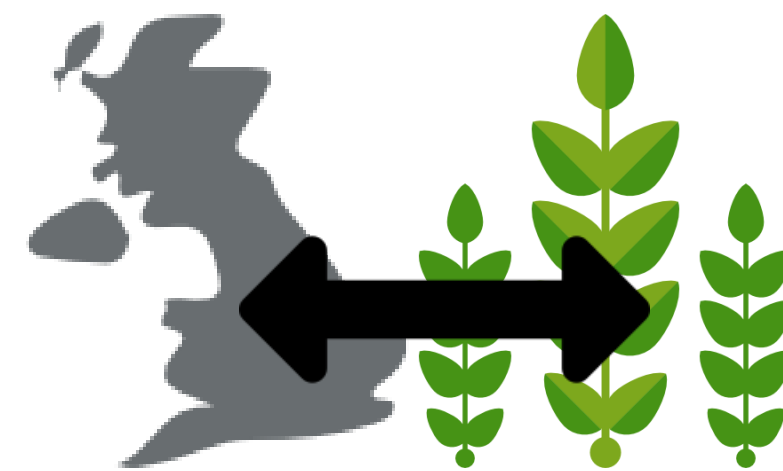
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Historical
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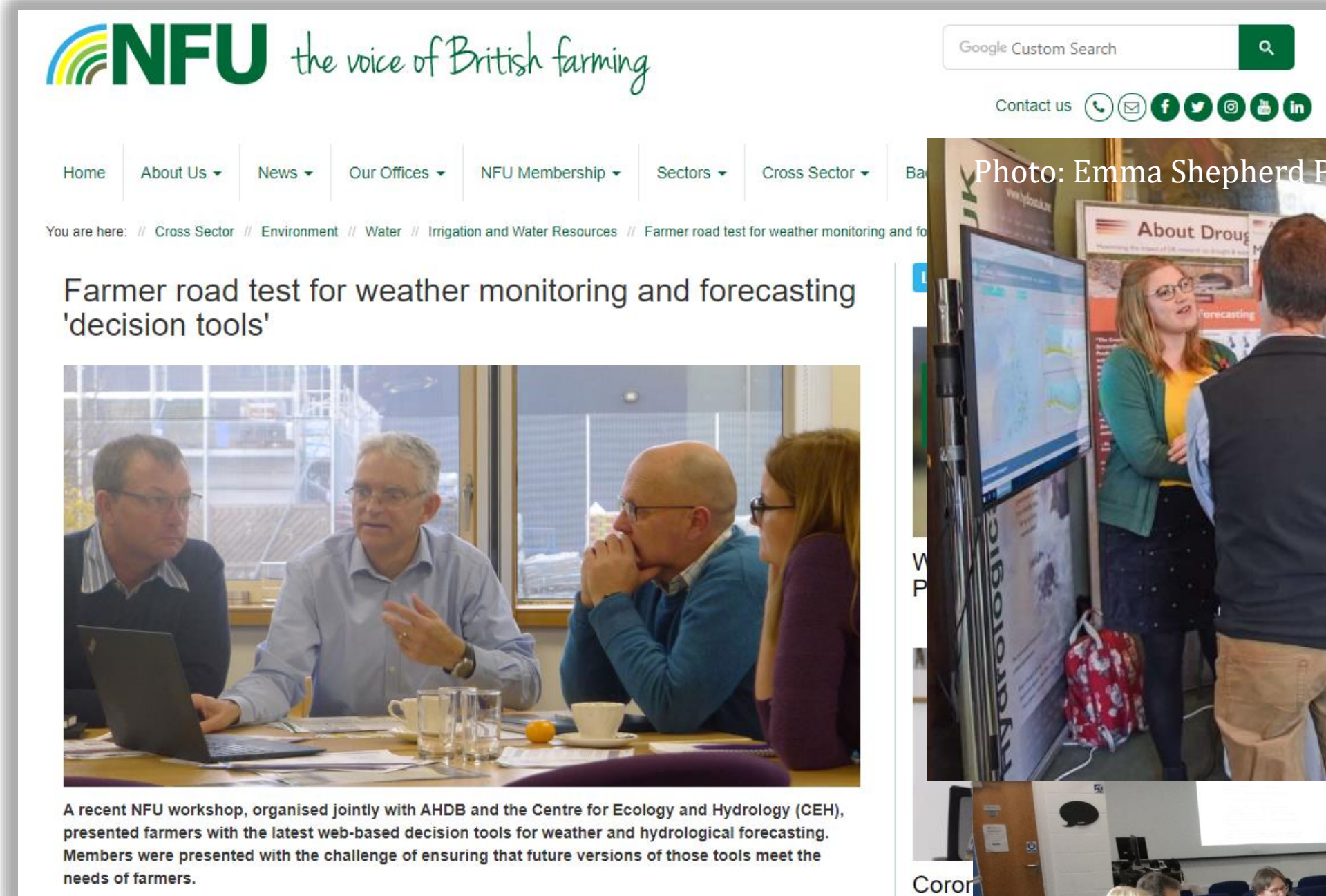
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And is
accessible & open

Stakeholder co-design & testing

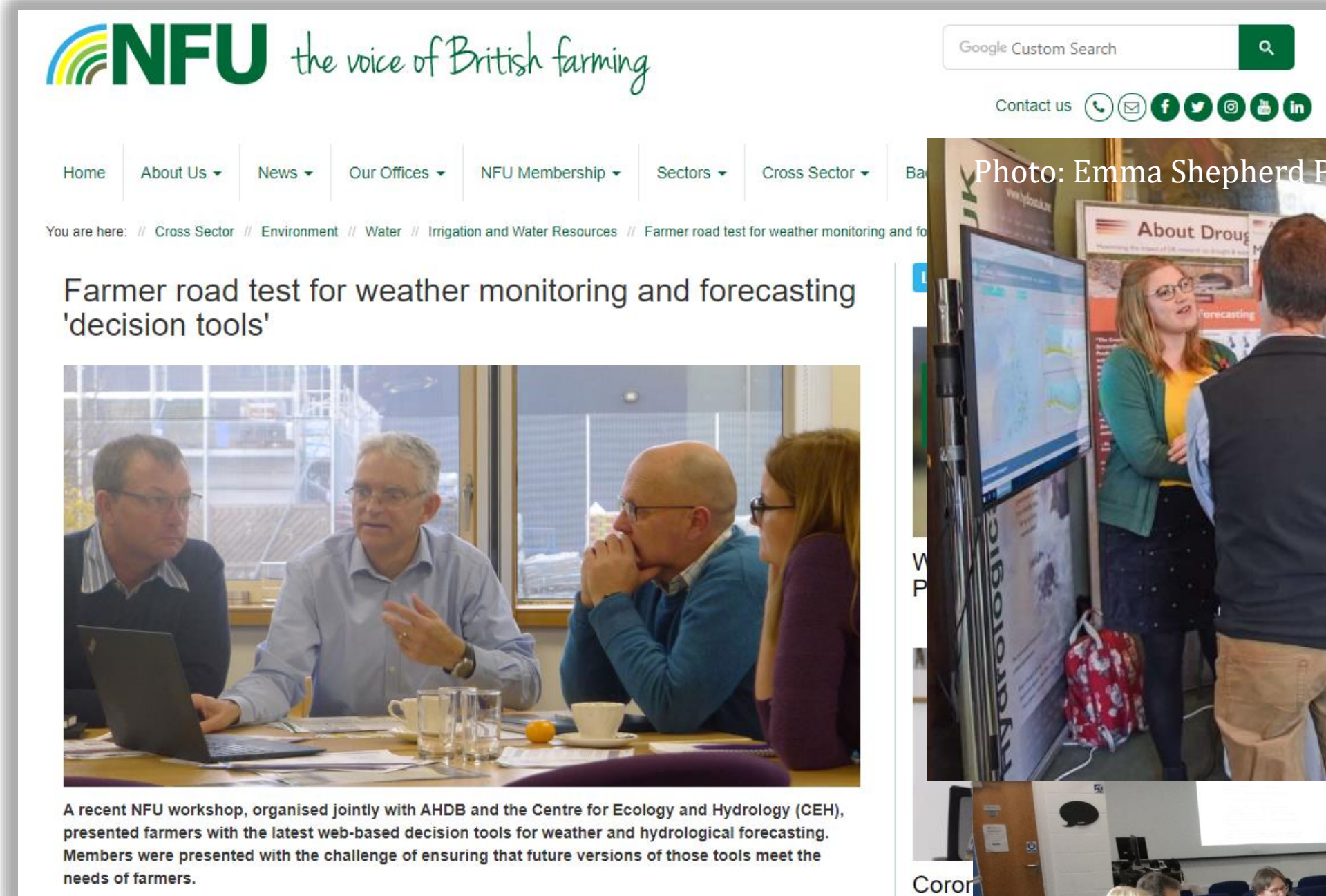


<https://www.nfuonline.com/cross-sector/environment/water/irrigation-and-water-resources/farmer-road-test-for-weather-monitoring-and-forecasting-decision-tools/>



- Initial designs were tested with the Environment Agency and South West Water using the South West Water Resources Portal Demonstrator
- The UK Water Resources Portal has then been discussed at a number of stakeholder workshops and events
- We have received feedback directly from users

Stakeholder co-design & testing



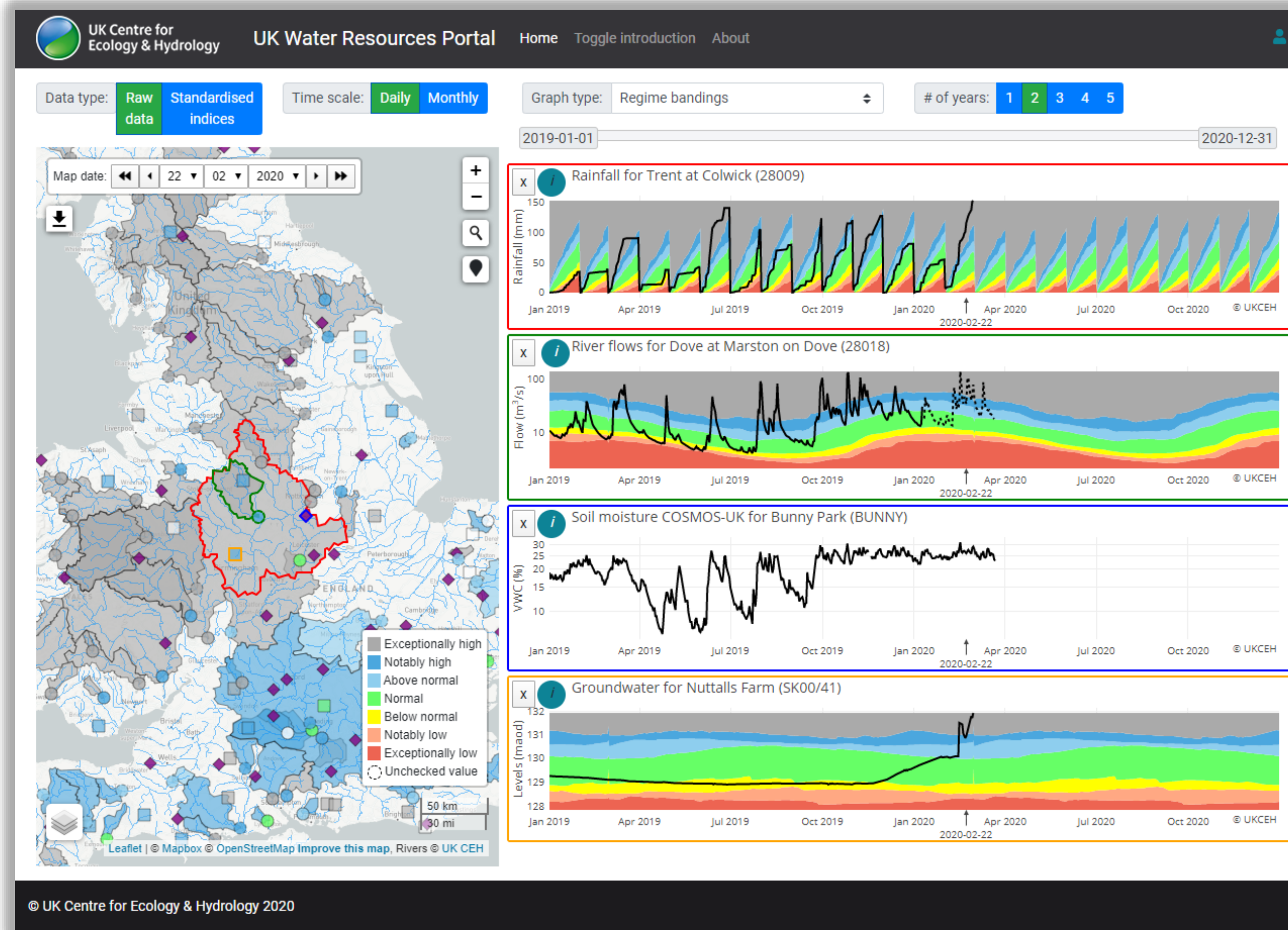
<https://www.nfuonline.com/cross-sector/environment/water/irrigation-and-water-resources/farmer-road-test-for-weather-monitoring-and-forecasting-decision-tools/>



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Monitoring extreme events

Low flows & drought

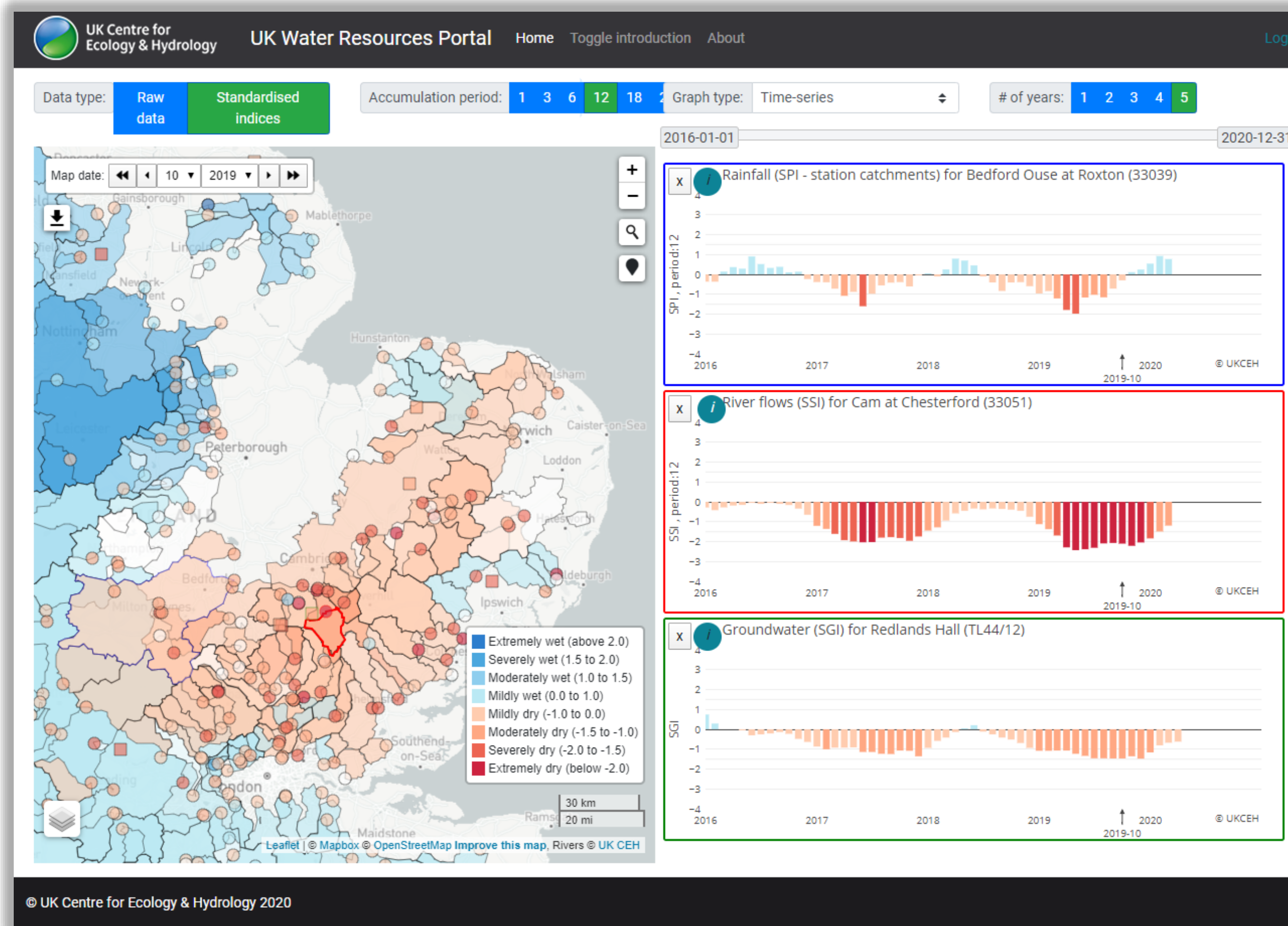


Floods

- Example: February 2020
- Wettest February on record (since 1910), with storms Ciara, Dennis and Jorge
- Exceptionally high flows across much of the UK with widespread and damaging flooding impacts
- This screen shot of the Portal shows the event as it was happening into early March



Monitoring extreme events



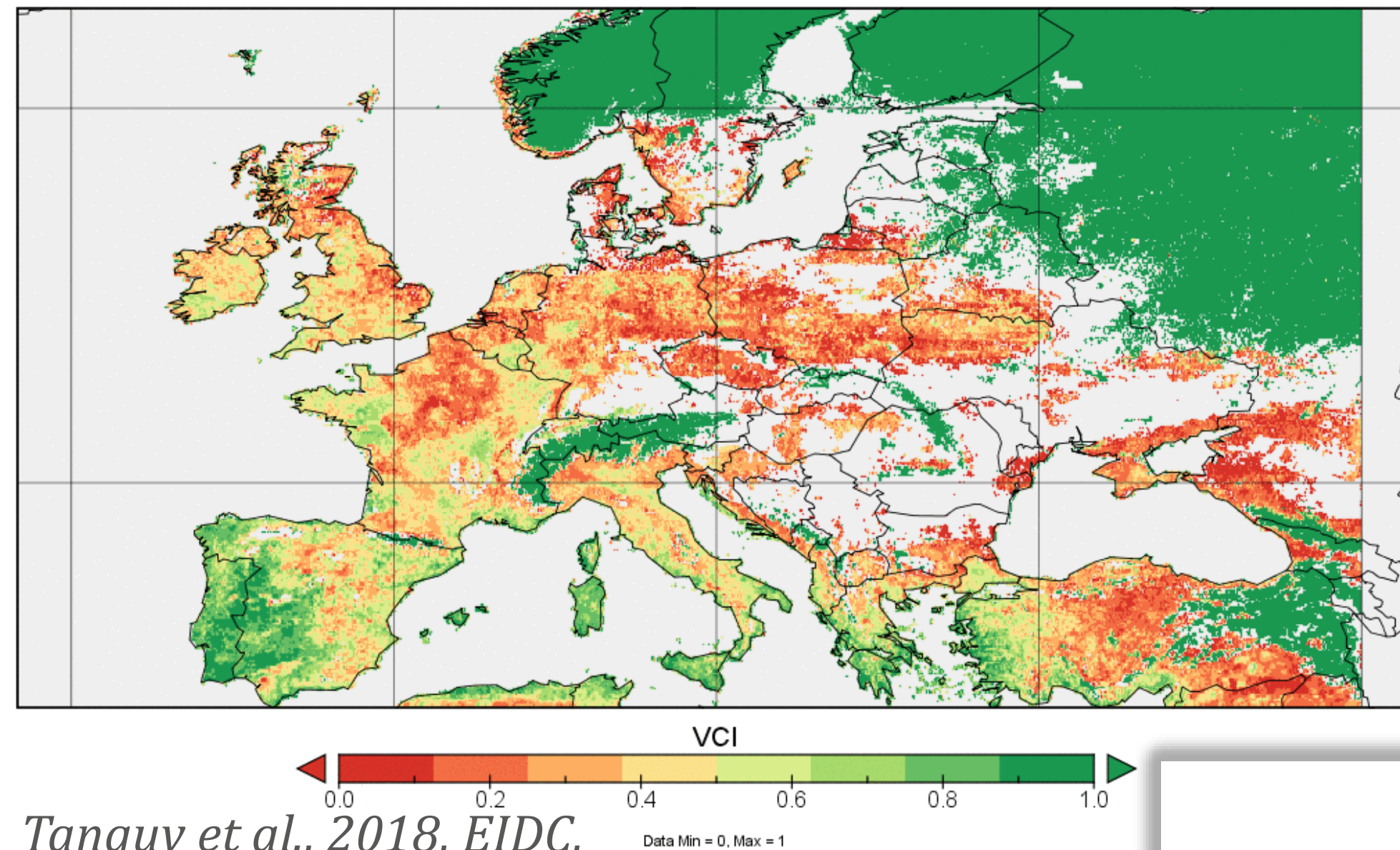
Droughts

- Example: 2018 - 2019 drought
- Rainfall, river flow and soil moisture deficits
- Long-term deficits highlighted in East Anglia shown with standardised indices
- Deficits part of a series of dry periods since 2016 which have had impacts on agriculture, the environment and water supplies



Future developments

Vegetation Condition Index (VCI)
Jan 2003

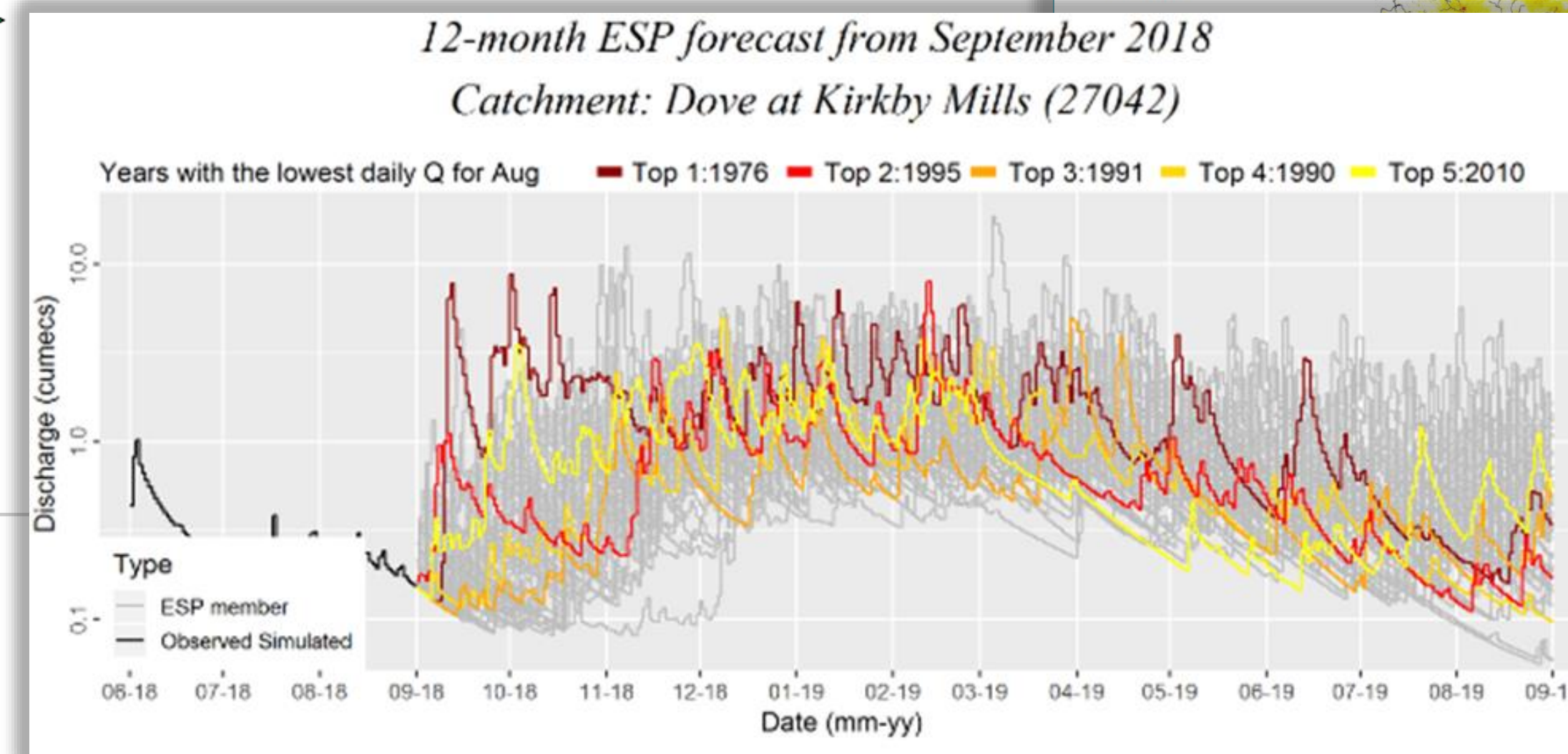
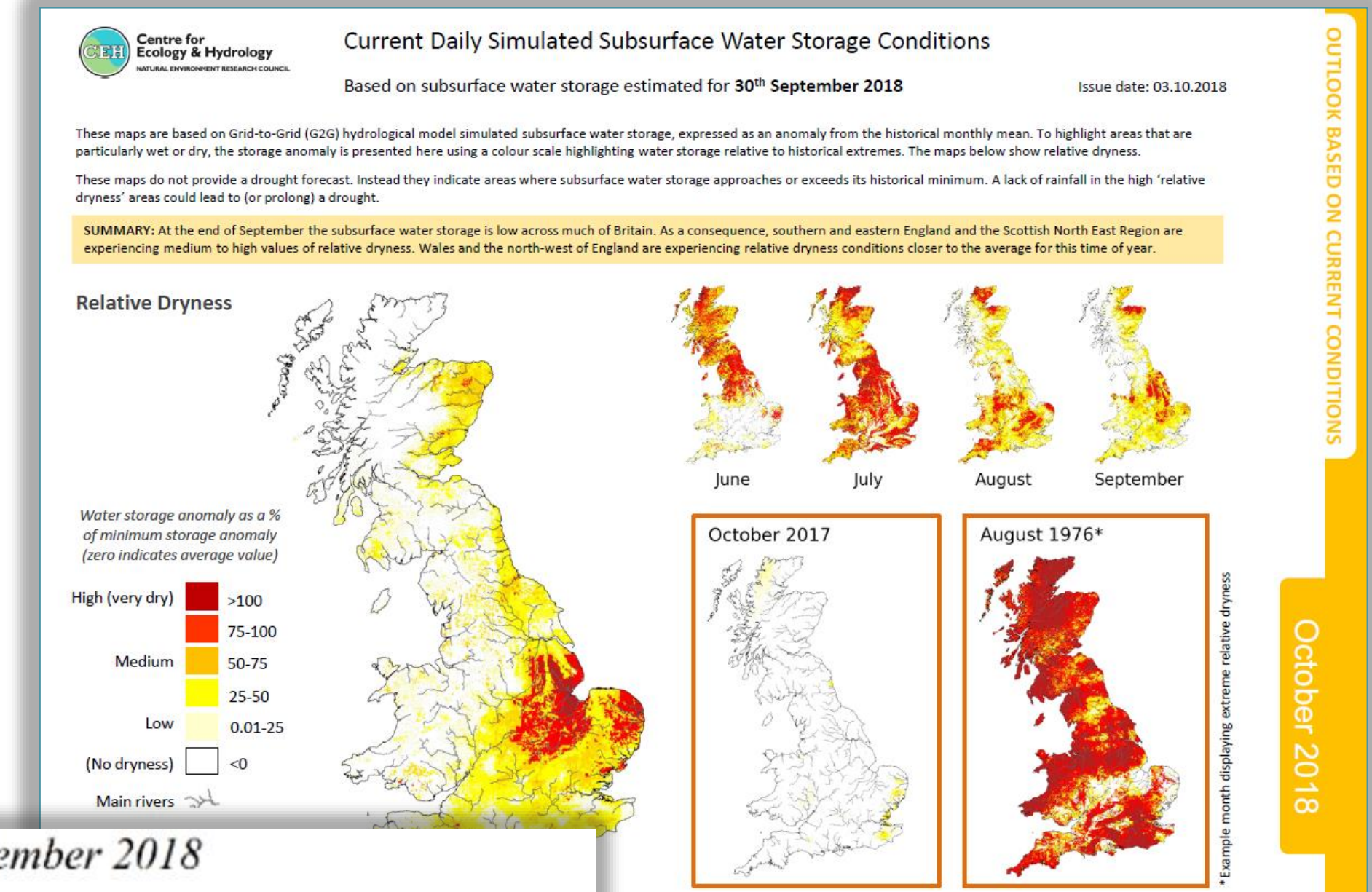


Tanguy et al., 2018, EIDC,
<https://doi.org/10.5285/4e0d0e50-2f9c-4647-864d-5c3b30bb5f4b>

See Harrigan et al. (2018) for
more info on UK ESP forecasts
<https://doi.org/10.5194/hess-22-2023-2018>

*Integrating Earth
Observations for
hard-to-monitor
variables, e.g.
vegetation condition*

*Incorporating Modelled Outputs for
ungauged locations, e.g. national-scale subsurface
dryness maps*



*Linking With Forecasts
linking situation monitoring
with seasonal predictions, via
the [Hydrological Outlook UK](#)*

Thank you

Any questions?

✉ lucybar@ceh.ac.uk |  [@lucybarkerjane](https://twitter.com/lucybarkerjane)

The UK Water Resources Portal was primarily developed in the [ENDOWS project](#) (Engaging diverse stakeholders and publics with outputs from the UK Drought and Water Scarcity Programme), funded by the Natural Environment Research Council award number NE/L01016X/1. Additional funding was provided by the Natural Environment Research Council award number NE/R016429/1 as part of the [UK-SCAPE programme](#) delivering National Capability.