

Data-Driven Approaches to Hydrological Science

Welcome and Introduction

Helen Baron

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Our planet.
Decoded.

Overview

- Welcome!
- Introduction to projects:

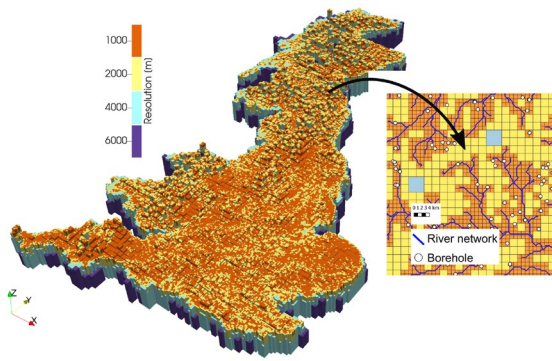
Hydro-JULES

Floods & Droughts Research Infrastructure

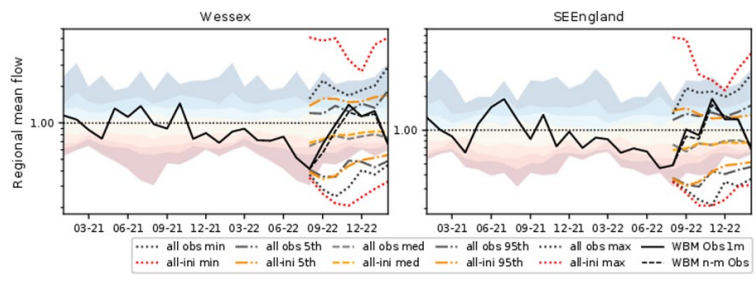


Hydro-JULES

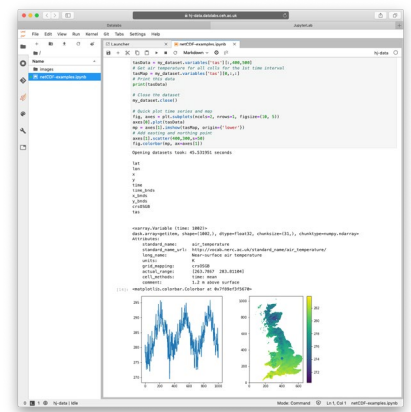
Advanced modelling and data infrastructures to understand floods and water scarcity in the UK and internationally



Modelling



Analysis



Data and Access

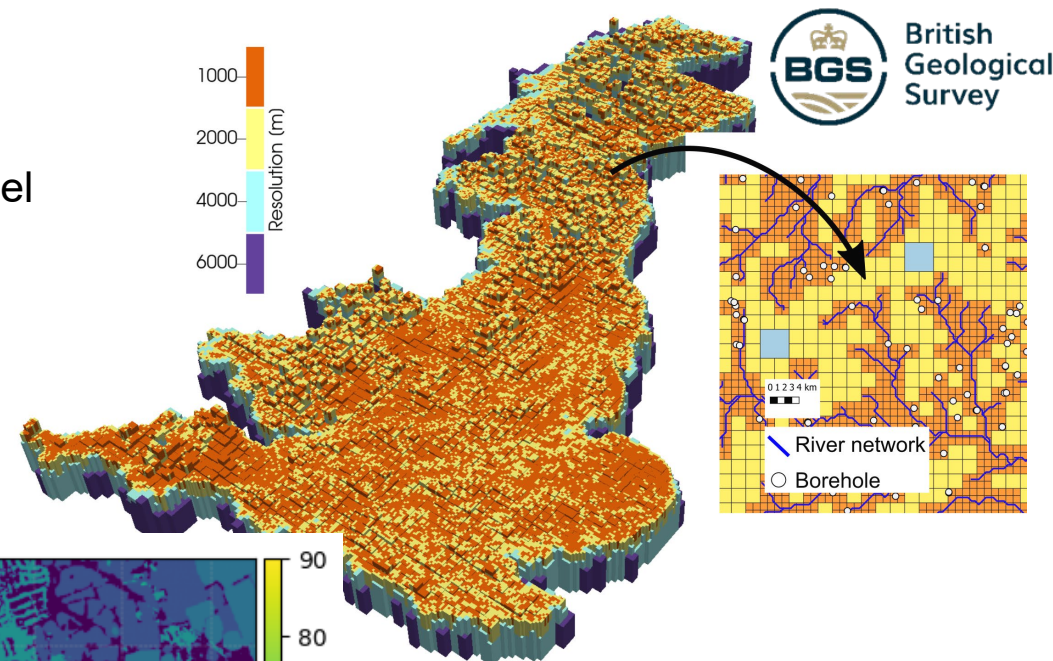
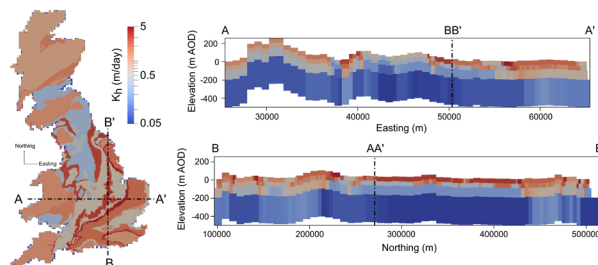
Modelling

British Groundwater Model

3-D time-variant groundwater dynamics (MODFLOW6)



Hydrogeological parameterisation based on 3-D geological model



High-resolution flood modelling

Case study for Oxford (with U.o.Birmingham)

Exploring use of DAWN GPU/AI supercomputer

DAWN

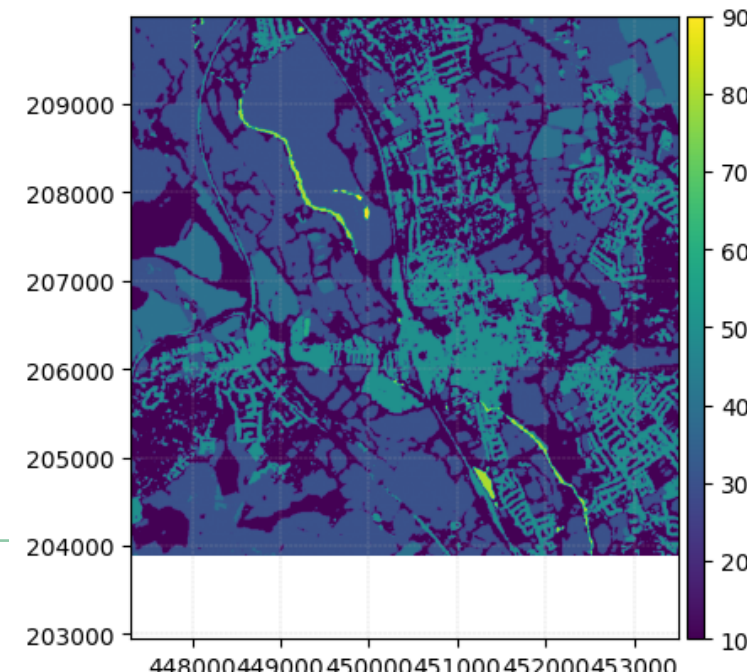
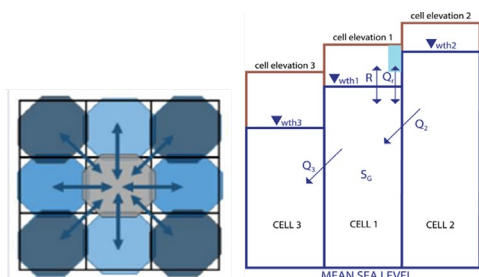


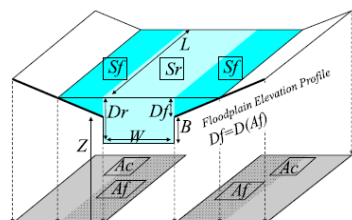
Image credits: Marco Bianchi, Steve Cole

Integrated models

New processes into JULES



Groundwater



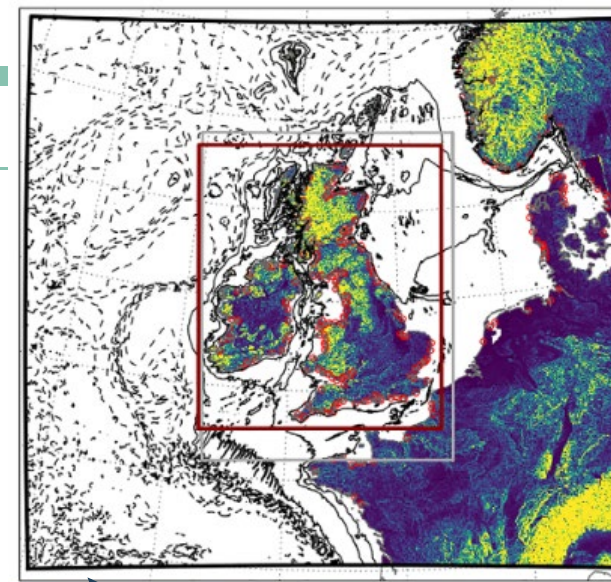
Rivers and inundation



Water management

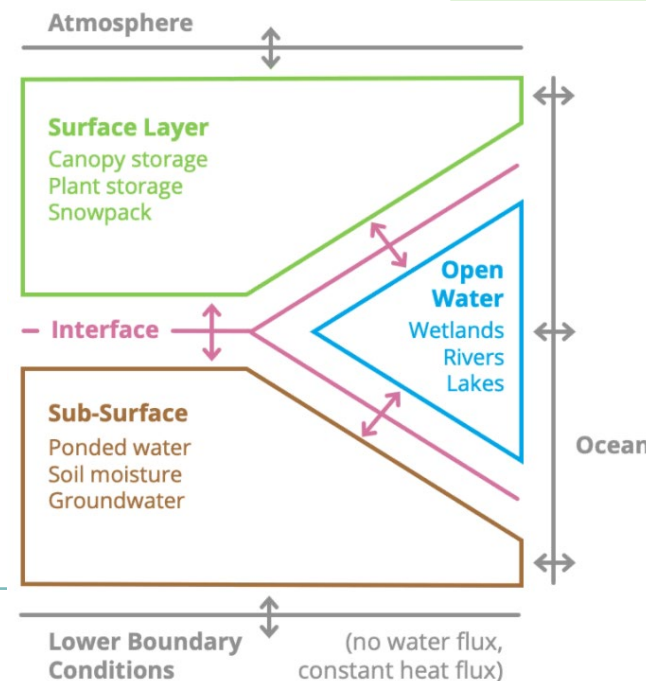
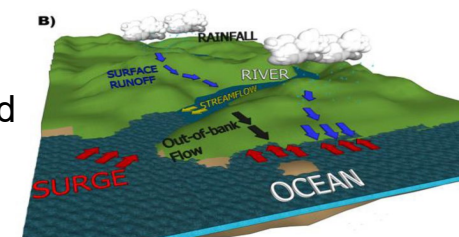


JULES
Joint UK Land
Environment Simulator



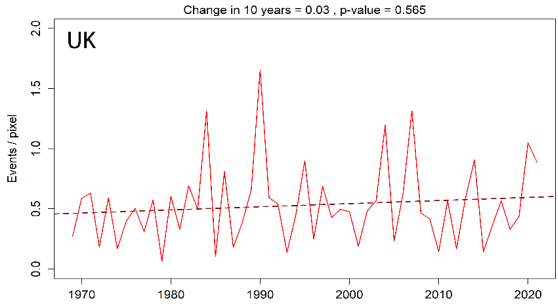
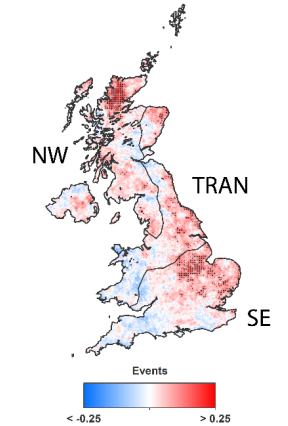
Met Office land-atmosphere-ocean models

Flooding as a coupled compound hazard

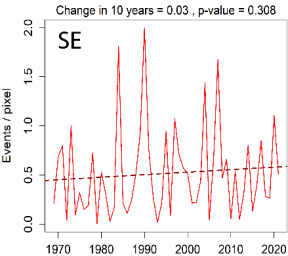
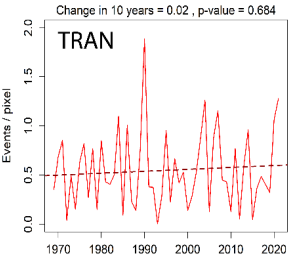
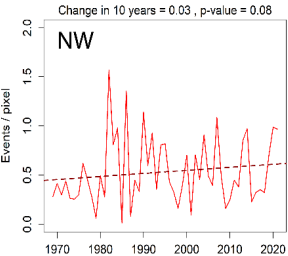


UniFHy modelling framework
(also for water quality)

Hydrological impacts of climate change

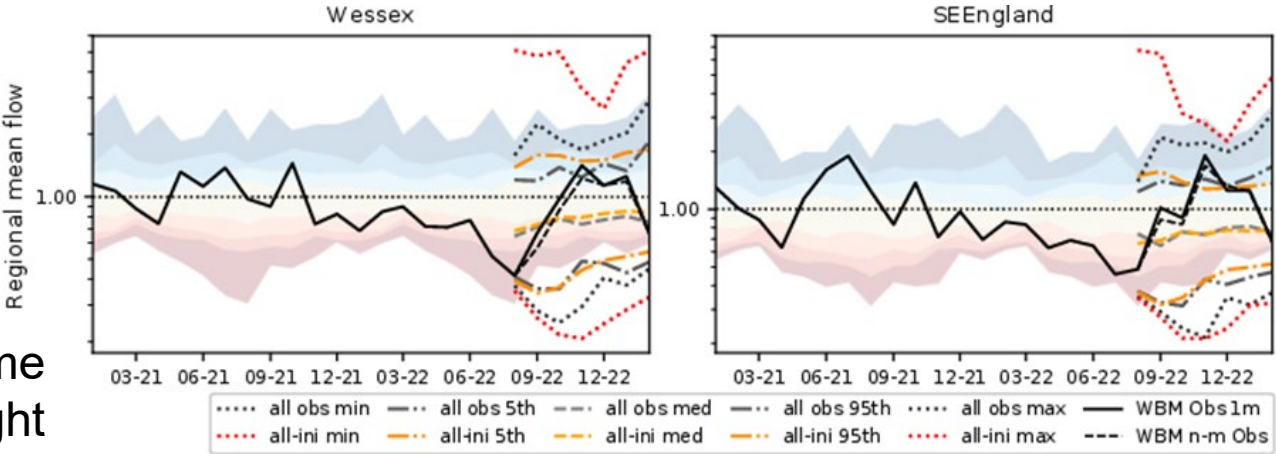
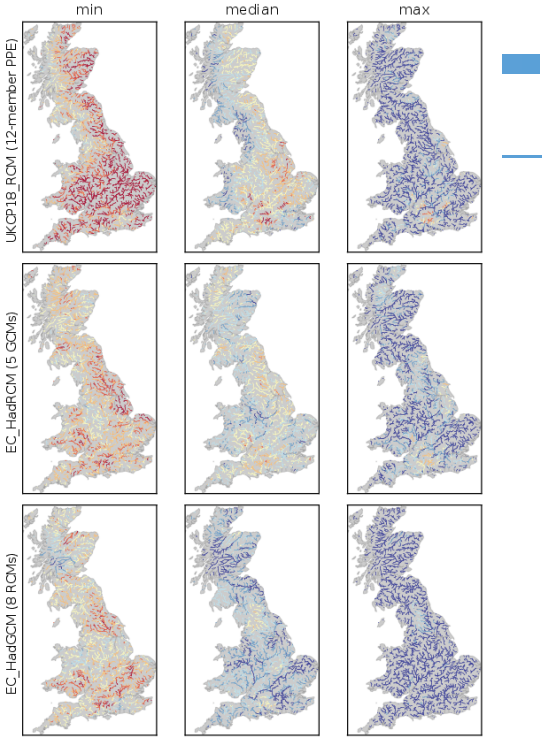


Changes in future high flows in EuroCORDEX-UK



Frequency of historical flash droughts

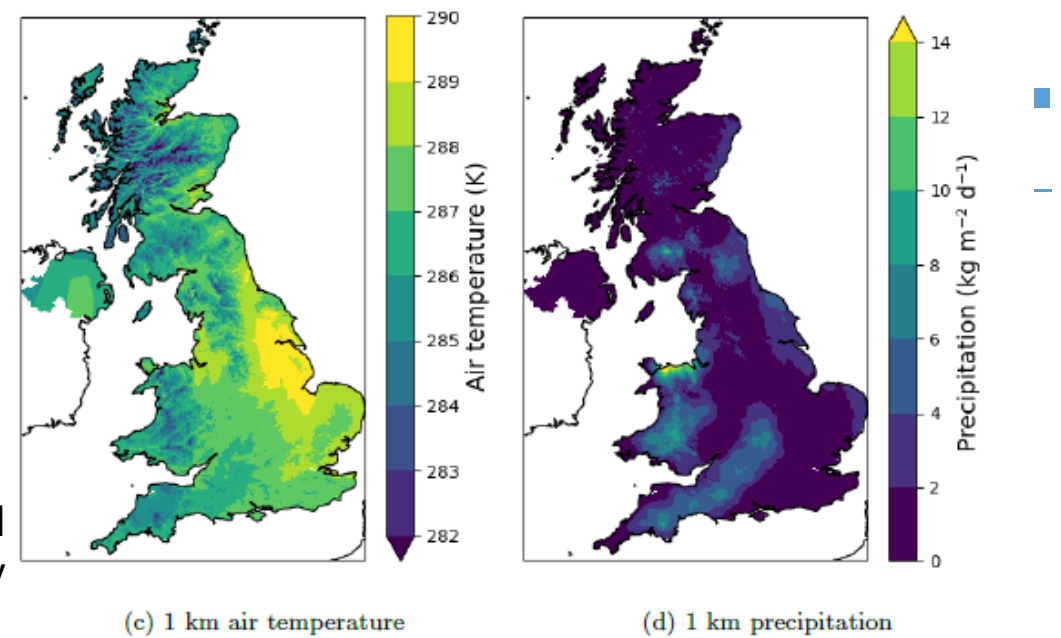
UNSEEN events - more extreme than the 2022 drought



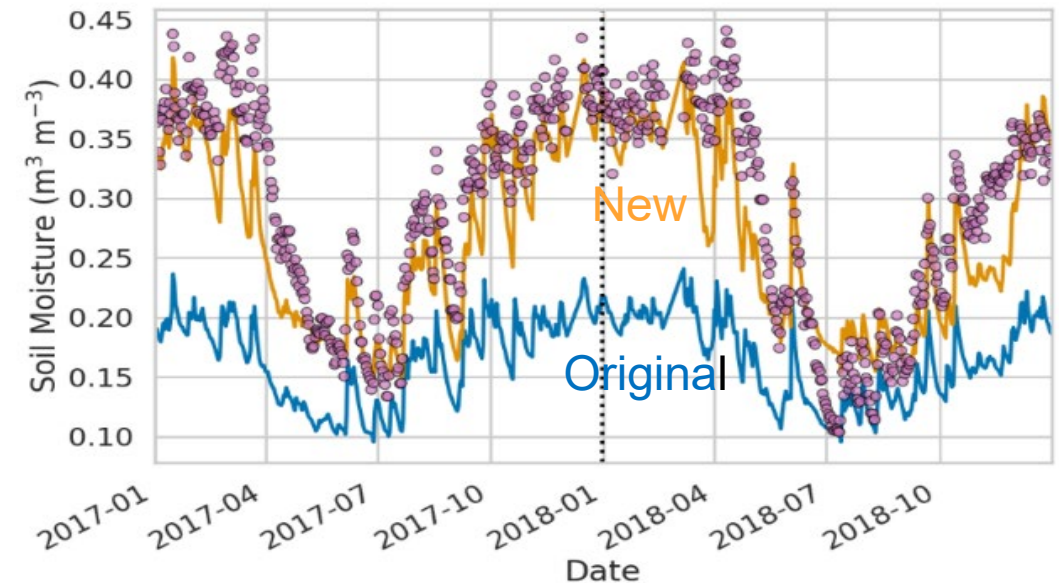
Data and data assimilation

New datasets – e.g. sub-daily river flow, driving data for models

Downscaled
meteorology

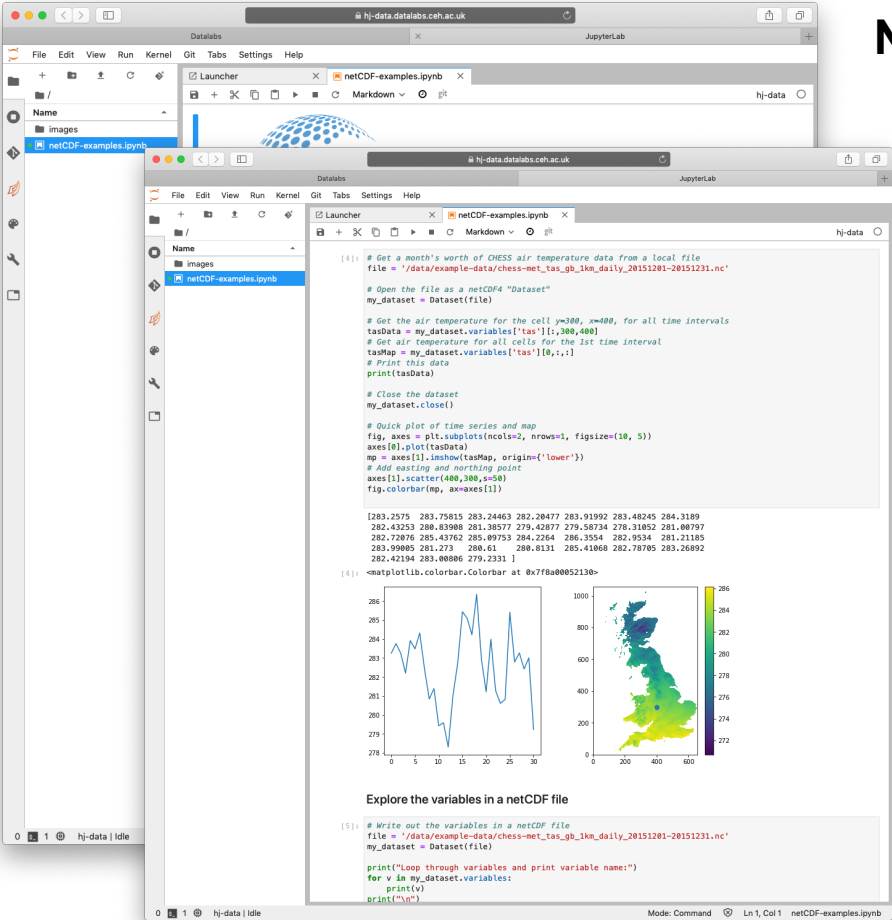


Bringing data and models together - data assimilation of COSMOS-UK soil moisture data to improve JULES simulations

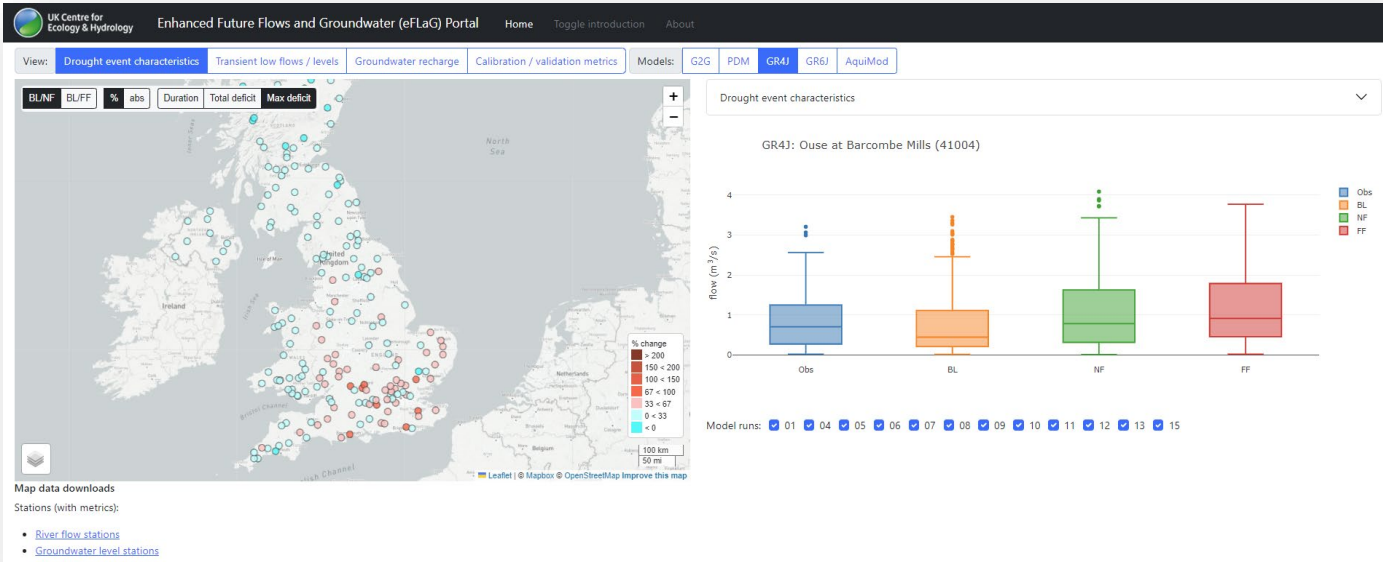


Access to data and workbenches

Notebooks



Portals and workbenches – making data and tools available



eFLaG Portal with multi-model dataset of future hydrological projections

Floods and Droughts Research Infrastructure (FDRI)

- £38M infrastructure investment
- Delivered by UKCEH and partners
- Enabling the science that will provide resilience from future floods and droughts
- Super-charging new field monitoring and data driven research



What is FDRI and why does it matter?

The first whole system approach to hydrological monitoring in the UK



An accessible, comprehensive network of instrumentation



Open-source digital platform, near real-time integrated data

Creating a cohesive, well-informed hydrological community



Integrating technological co-innovation



Training and development

Transforming our response to hydrological extremes



Better long-term predictions and short-term forecasts

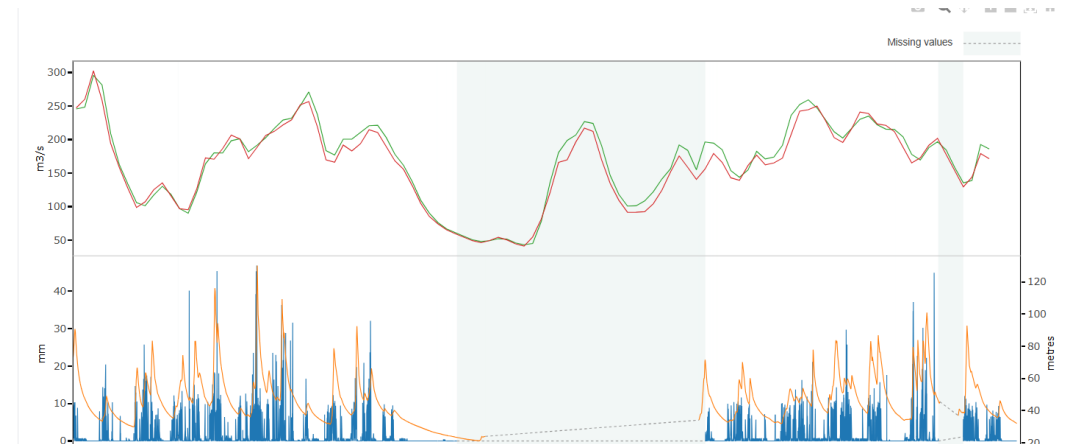


Providing the tools for smarter water management

Gold standard sensor monitoring data

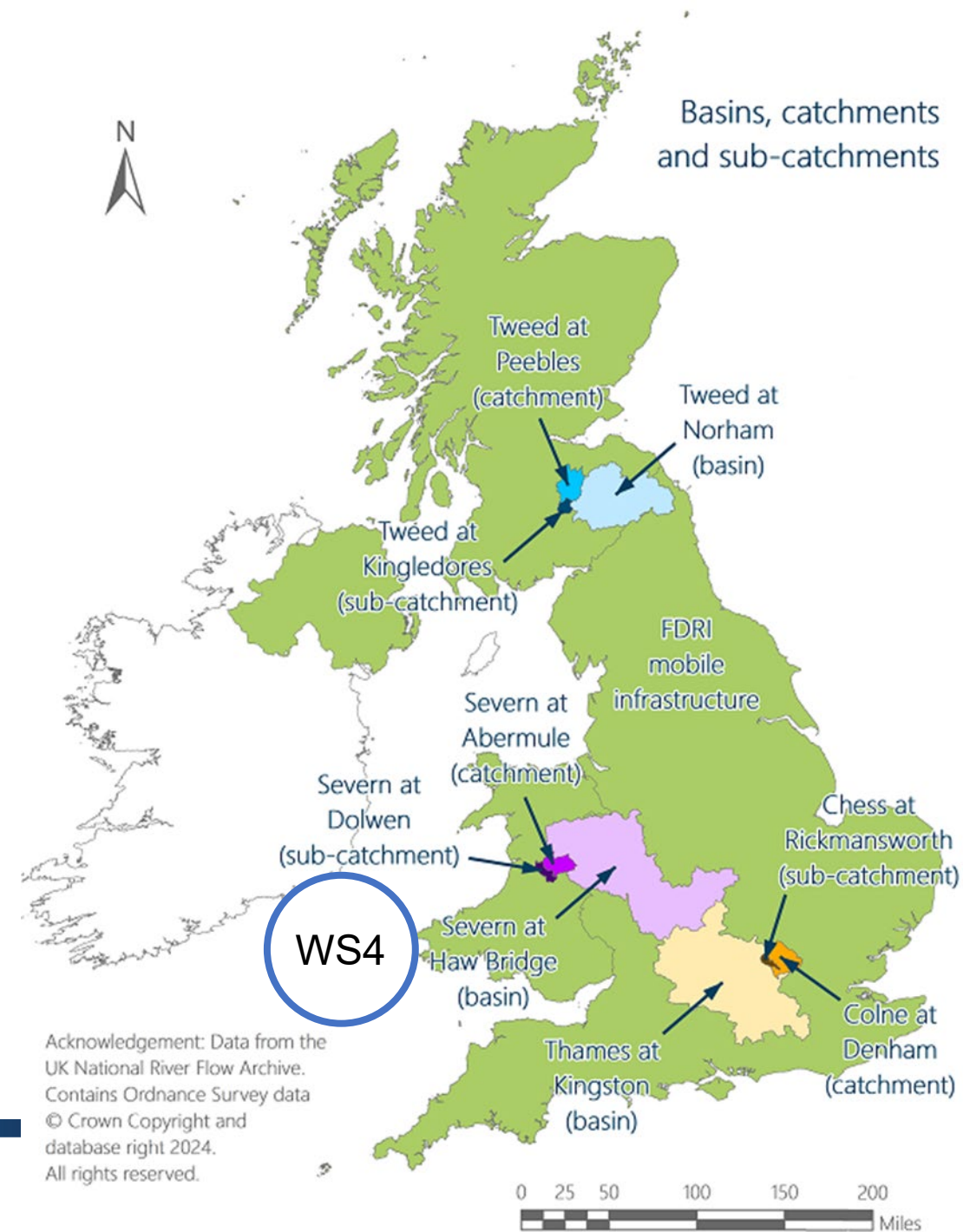
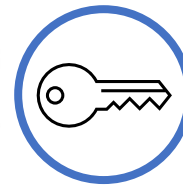
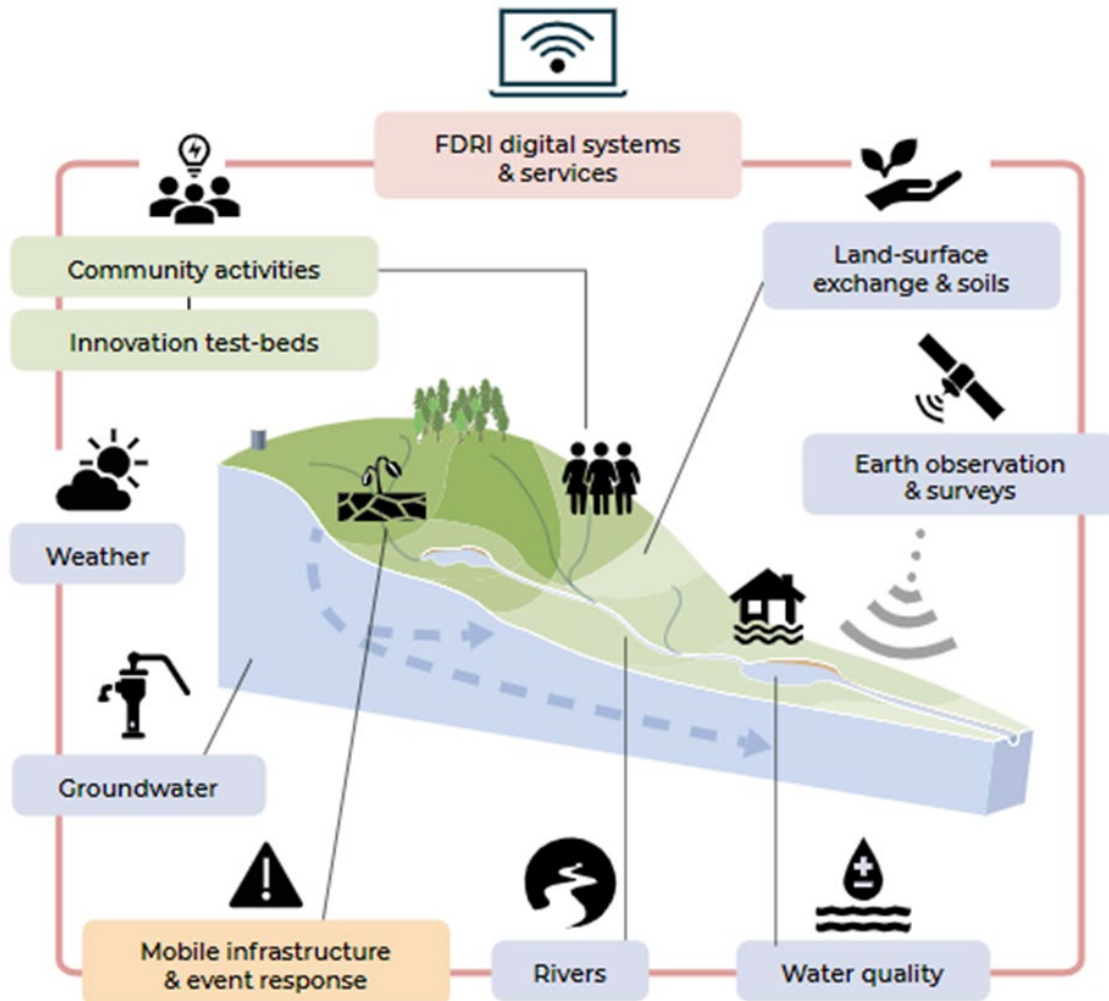
We are super-charging work towards best practice for environmental sensor data:

- Field monitoring protocols and equipment
- Use of cloud for hosting operational systems
- Automated quality control
- Feeding monitoring data into analysis and research



New observations

Fixed instruments in three sub-catchments
Mobile instruments elsewhere



National datasets

UK-Flow15 dataset published, October 2025 (189 downloads)

CAMELS-GBv2 published, October 2025 (346 downloads).

WS6

Developing new 15-minute 1km gridded rainfall dataset

Combined these can feed into regularly updated flood event datasets

 UKCEH | Environmental Information Data Centre

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Description

Format

Spatial information

Temporal information

Provenance & quality

Licensing & constraints

Supplemental information

Correspondence

Authors

Additional metadata

Funding

Download/Access

Filelli, F. et al [see all authors](#)

Sub-hourly river flow data observations from 1369 river gauges in the UK, 1948-2023 (UK-Flow15)

<https://doi.org/10.5285/211710ac-f01b-4b52-807f-373babb1c368>

[Download ↓](#) [Supporting docs 📄](#) [Cite this dataset ↗](#)

[View record as ▾](#)

This dataset provides a coherent, quality-controlled collection of 15-minute river flow observations from across the United Kingdom. It brings together more than 1,300 gauging stations and over 50,000 station-years of data collected by the main UK measuring authorities - the Environment Agency (England), Scottish Environment Protection Agency, Natural Resources Wales, the Department for Infrastructure (Northern Ireland), and the UK Centre for Ecology & Hydrology. The records span from 1948 to the present day and represent the first national-scale compilation of sub-daily flow data in a consistent format.

The dataset was created by assembling raw hydrometric records from open APIs and data requests to measuring authorities, then standardising them to a uniform 15-minute time step. A structured quality control framework was applied to identify and flag potential issues such as missing or duplicated values, irregular time steps, and implausible flow events. Each record includes a detailed quality code indicating the outcome of these checks, and a suite of accompanying metadata files provides full traceability of data provenance, quality control results, and any adjustments made during processing.

The resource is designed to support large-sample and national-scale hydrological research, particularly for applications requiring high-resolution data such as flood analysis, catchment response studies, and model calibration.

189 downloads

1,520 views

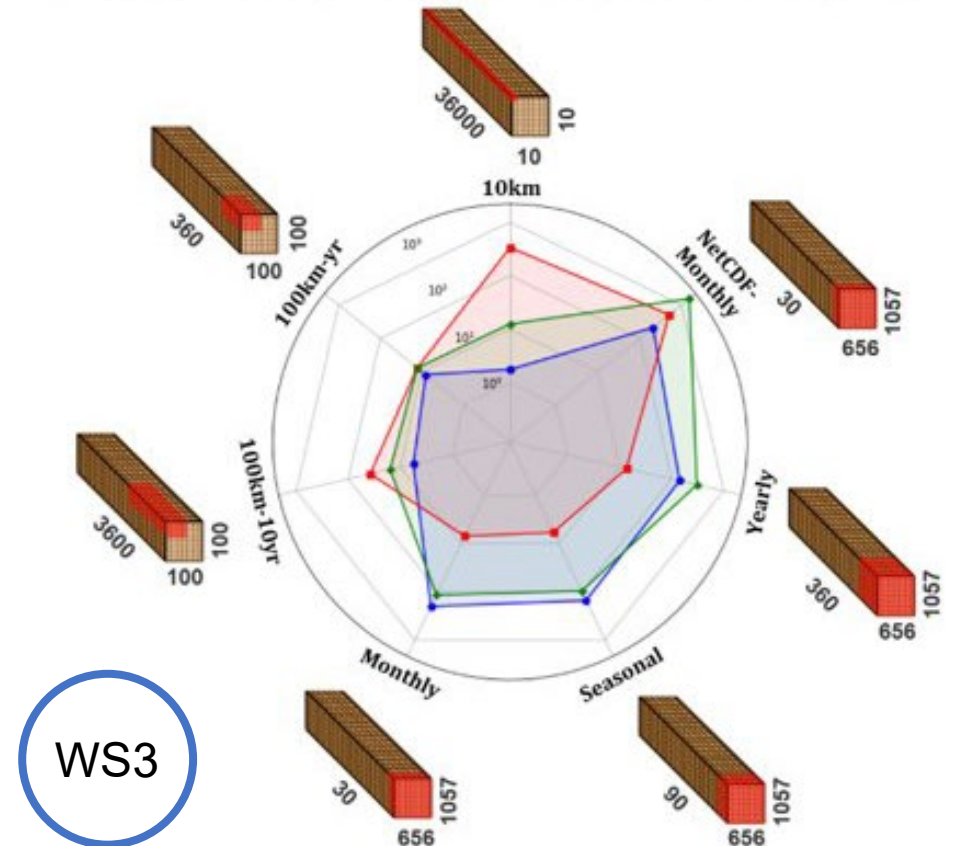
[NOTES +](#)

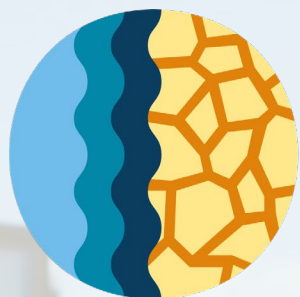
[How do we collect this information?](#)

Cloud optimised data

- New approach to delivering large and complex data such as net-CDF type gridded time series
- Example is CEH-GEAR-1hr – 25 years of hourly 1km grids for GB
- Data optimised for spatial and temporal access
- "AI ready"
- Openly available over the web for programmatic access
- Represents an advance how data can be shared by the hydrological community
- Several datasets provided

We evaluate the six differently chunked zarr files, along with original NetCDF files across the three use cases. We showcase the wall time required with each chunk type to complete calculations for the three use cases through a spiderweb plot shown below, using the colored symbols corresponding three use cases from the figure above.





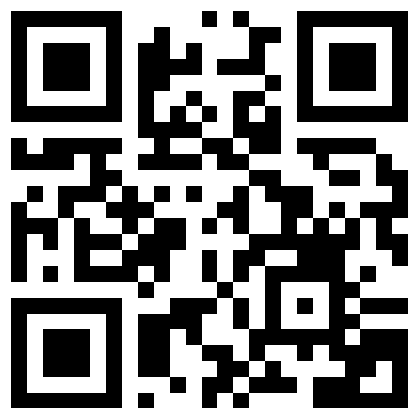
FDRI

FLOODS &
DROUGHTS
RESEARCH
INFRASTRUCTURE

SEILWAITH YMCHWIL
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Find out more

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Check out – FDRI Website



Enjoy the rest of the Summer School!



Our planet.
Decoded.

