Reanalysis-based storylines of 1976

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National Centre for Atmospheric Science
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1. Introduction

How has climate change affected the intensity of extreme weather?

If extreme events from the past were to occur today, in a warmer and wetter world, would their impacts be different?

The ReBASE project uses **reanalysis-based storylines** to answer these questions.

The focus here is on how the summer of 1976 might be experienced in a modern climate.

2. Reanalysis storylines

We reconstruct the weather of 1975-1976 using the 20th Century Reanalysis (20CRv3) system which uses:

- **observed** SSTs, sea ice, and atmospheric CO_2
- assimilates only **surface pressure** observations

We then re-run the reanalysis with:

- **modern** SSTs, sea ice, and atmospheric CO_2...
- ...while assimilating the **same pressure observations**

This translates the global weather patterns of 1975-1976, and the impacts of extreme events, into a warmer modern climate.

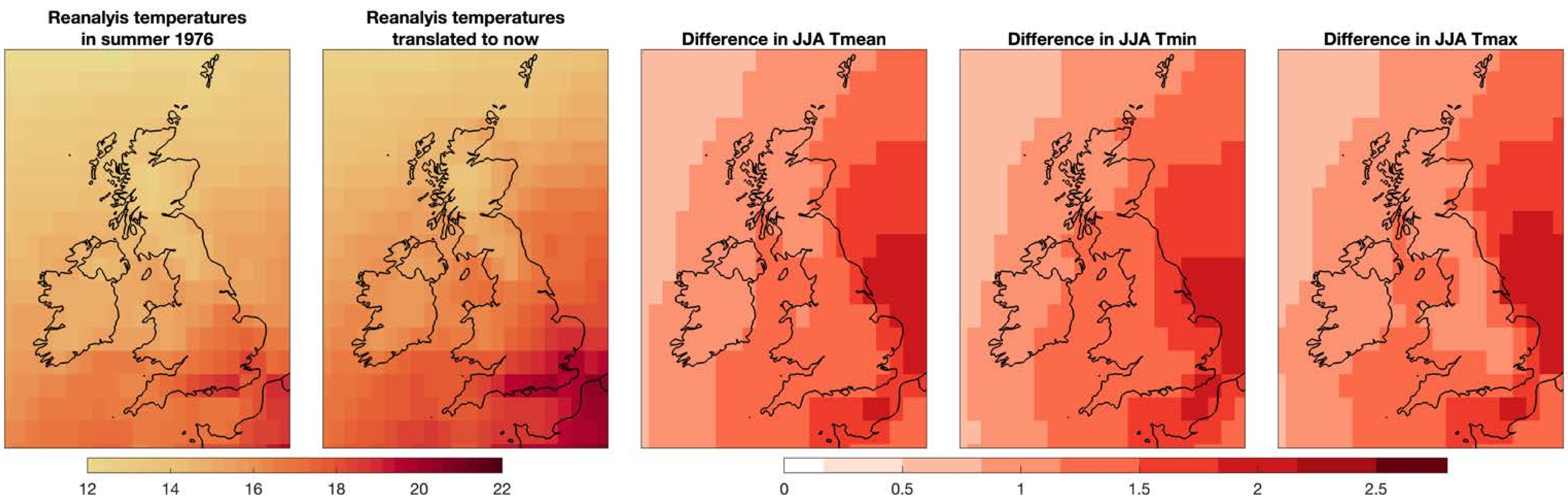

Figure 1: The summer of 1976, translated into a modern climate, is around 1.5°C warmer, with the largest changes over England in Tmin.

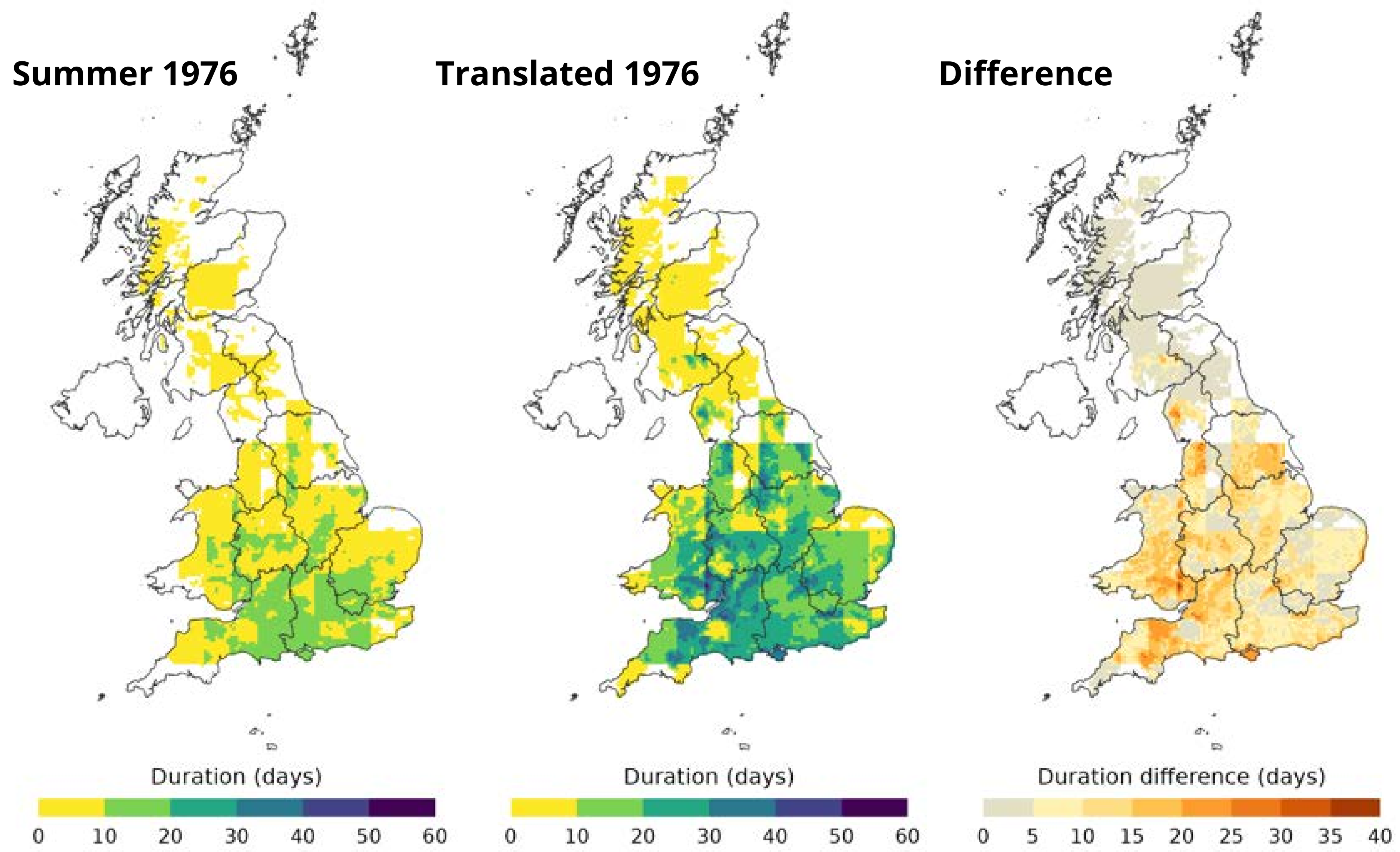

Figure 2: The length of the longest heatwave at each location around the UK gets longer in a warmer translated summer of 1976

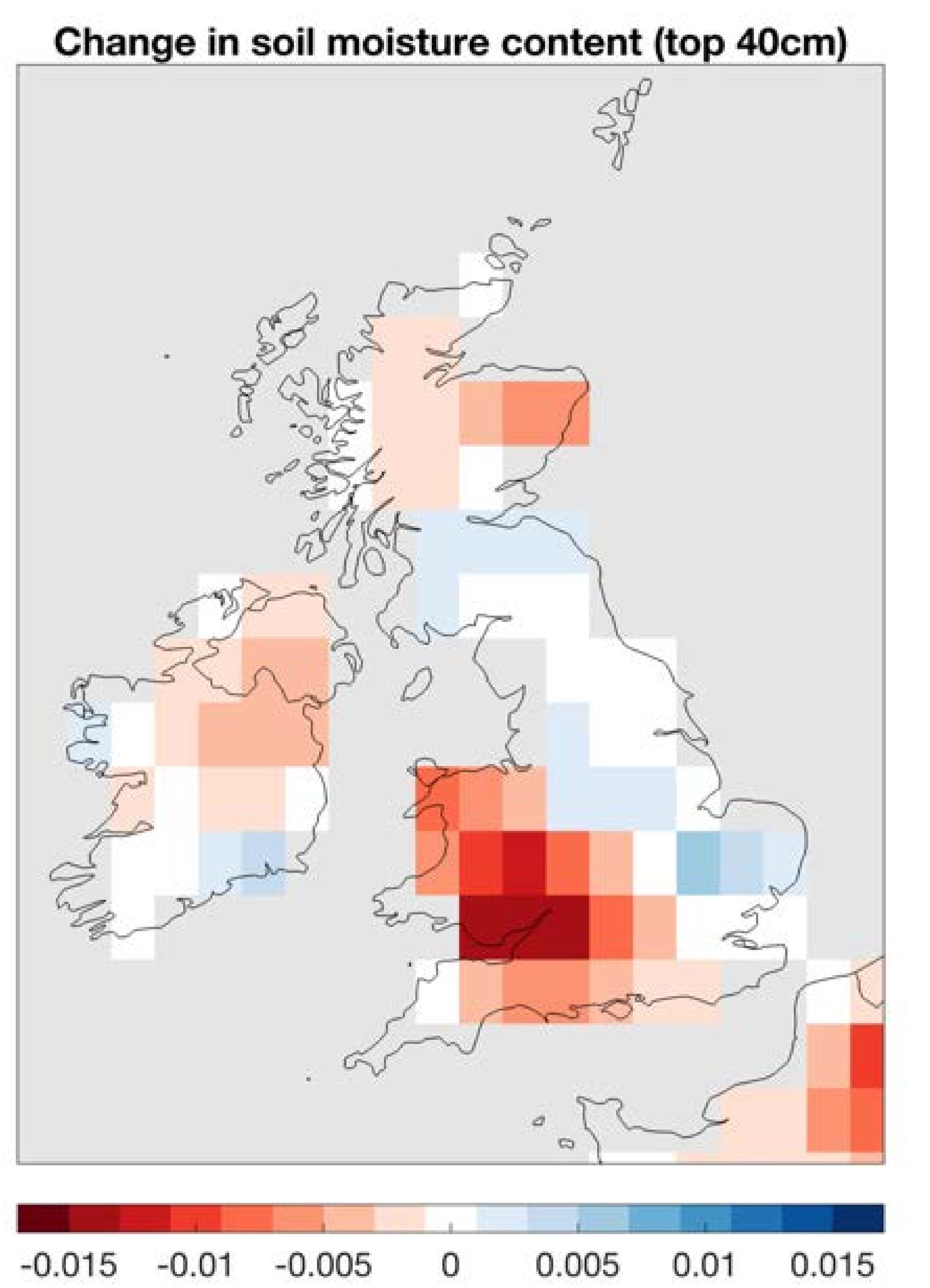

Figure 3: Change in average soil moisture content (top 40cm) during last month of the drought

3. Wider context

The ReBASE project is producing similar historical reconstructions for other past extreme events, including heatwaves, wildfires, floods, droughts and windstorms. It is also producing a reanalysis for the modern 2014-2025 period, which is translated into a cooler climate to highlight how climate change has already affected recent extreme events.

All data will be made openly available.

Caveats

- The reanalysis does not include changes in tropospheric aerosols which may mean that temperature changes are underestimated
- 20CRv3 runs at 0.7deg resolution which is much coarser than e.g. ERA5

Climate change impacts on hydrological droughts across Great Britain

Rosanna Lane, Alison Rudd and Alison Kay

1. Introduction

- Most drought projections for Great Britain are underpinned by a single climate model structure (the Hadley Centre model) through the widespread use of UKCP18 Regional projections.
- Yet we know that climate model choice is a key uncertainty in future river flow projections.
- Here, we compare hydrological drought projections based on UKCP18 Regional to projections from a wider array of regional climate models.

2. Methods

- River flow simulations were produced using the Grid-to-Grid hydrological model, with inputs from (1) the UKCP18 Regional perturbed-parameter ensemble (12 members), and (2) the Euro-CORDEX-UK multi-model ensemble (42 members).
- Droughts were extracted from monthly mean flows using a threshold approach.
- We explored changes between time slices associated with set global warming levels (GWLs) as well as fixed baseline (1980-2010) and future (2050-2080) periods.

3. Results

We see an increase in GB-average drought severity across nearly all UKCP18 ensemble members (Fig 1). However, the Euro-CORDEX members show smaller changes in GB-average drought severity, with the ensemble mean indicating no change.

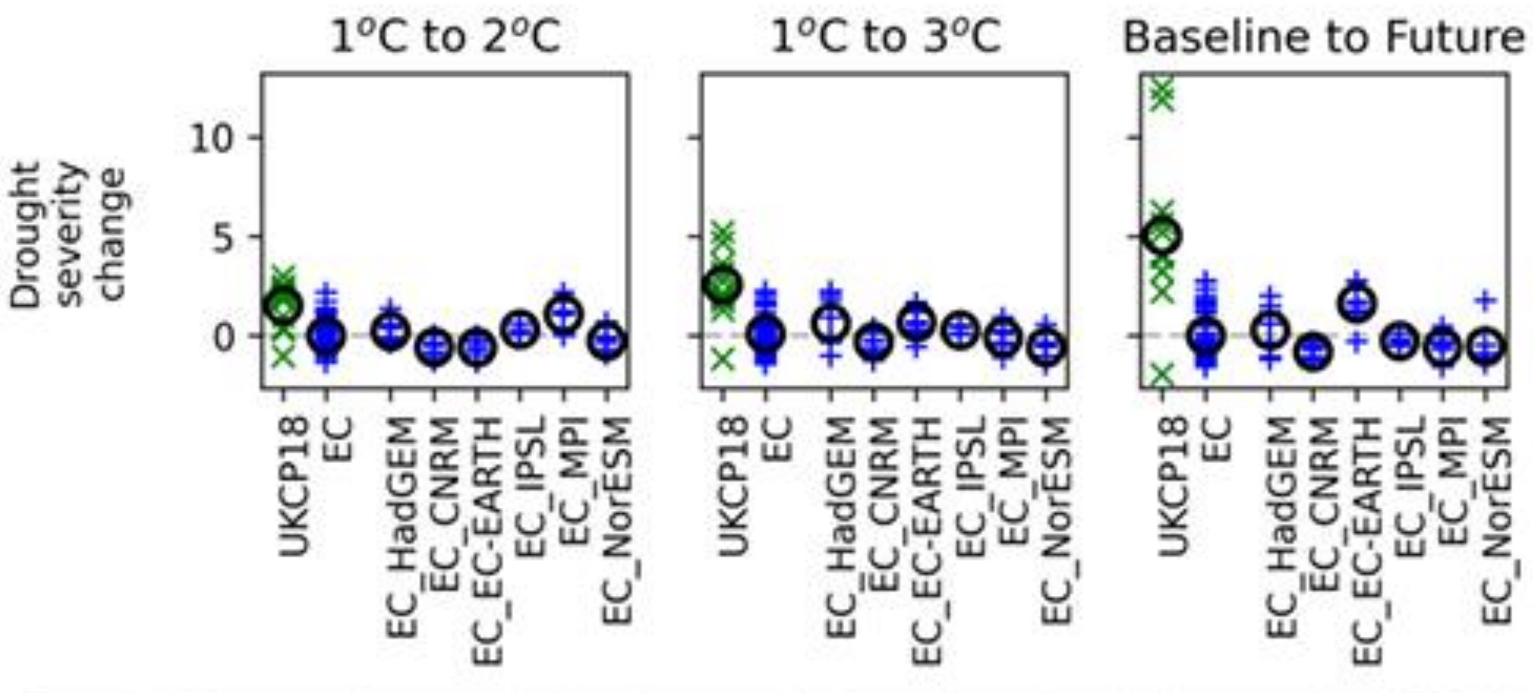

Figure 1. GB-mean changes in drought severity (intensity x duration) across the UKCP18 (x) and Euro-CORDEX (+) ensemble members.

Both ensembles indicate a change in drought seasonality, with an increase in the frequency of summer droughts (Fig 2). However, there is a striking difference between the UKCP18 and Euro-CORDEX ensembles, with UKCP18 indicating far more extreme increases in drought occurrence.

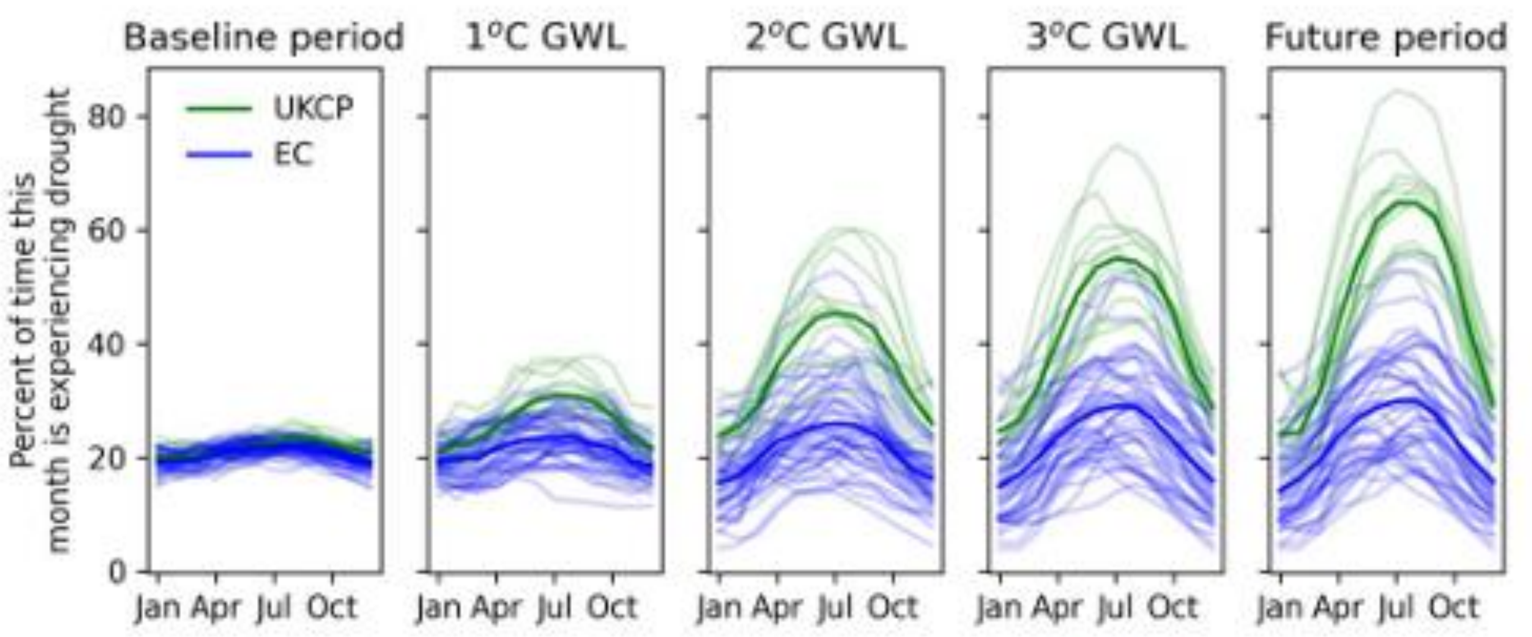

Figure 2. GB-mean drought seasonality across the UKCP18 (green) and Euro-CORDEX (blue) ensemble members, for the baseline period (1980-2010), periods associated with 1-3°C global warming (dates specific to each different ensemble member), and the future period (2050-2080) . Bold lines show the ensemble mean.

The UKCP18 members show potentially large increases in drought severity across the southeast (Fig 3), which isn't as apparent in the Euro-CORDEX ensemble. Some Euro-CORDEX members indicate increasing drought severity in northern regions which we don't see in UKCP18.

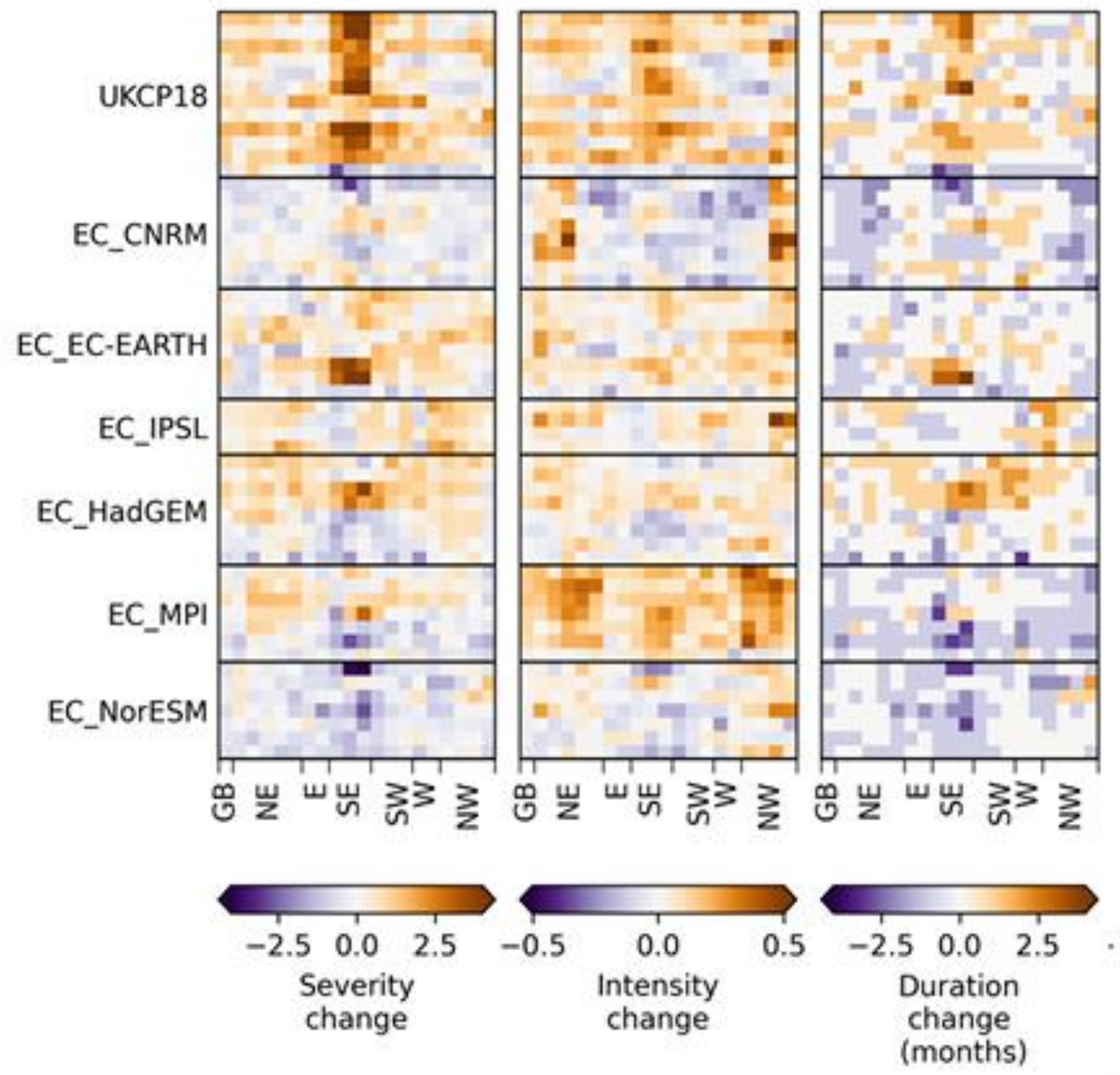

Figure 3. Heatmaps of changes in drought severity, intensity and duration between 1°C to 3°C global warming levels. Within each heatmap, each row is a different ensemble member, and each column shows a different region of GB.

4. Key messages

- The magnitude and spatial pattern of future drought changes is strongly dependent on climate model choice.
- The UKCP18 Regional ensemble indicates increasingly severe droughts across GB (and especially in the southeast), while the EuroCORDEX-UK ensemble indicates little change in GB-average drought severity.
- Most projections agree that summer droughts will become increasingly frequent in a warmer climate.

Full paper available here:

Storylines to understand hydrological extremes under climate change

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UKCEH CANARI Centre Climate Biodiversity Water

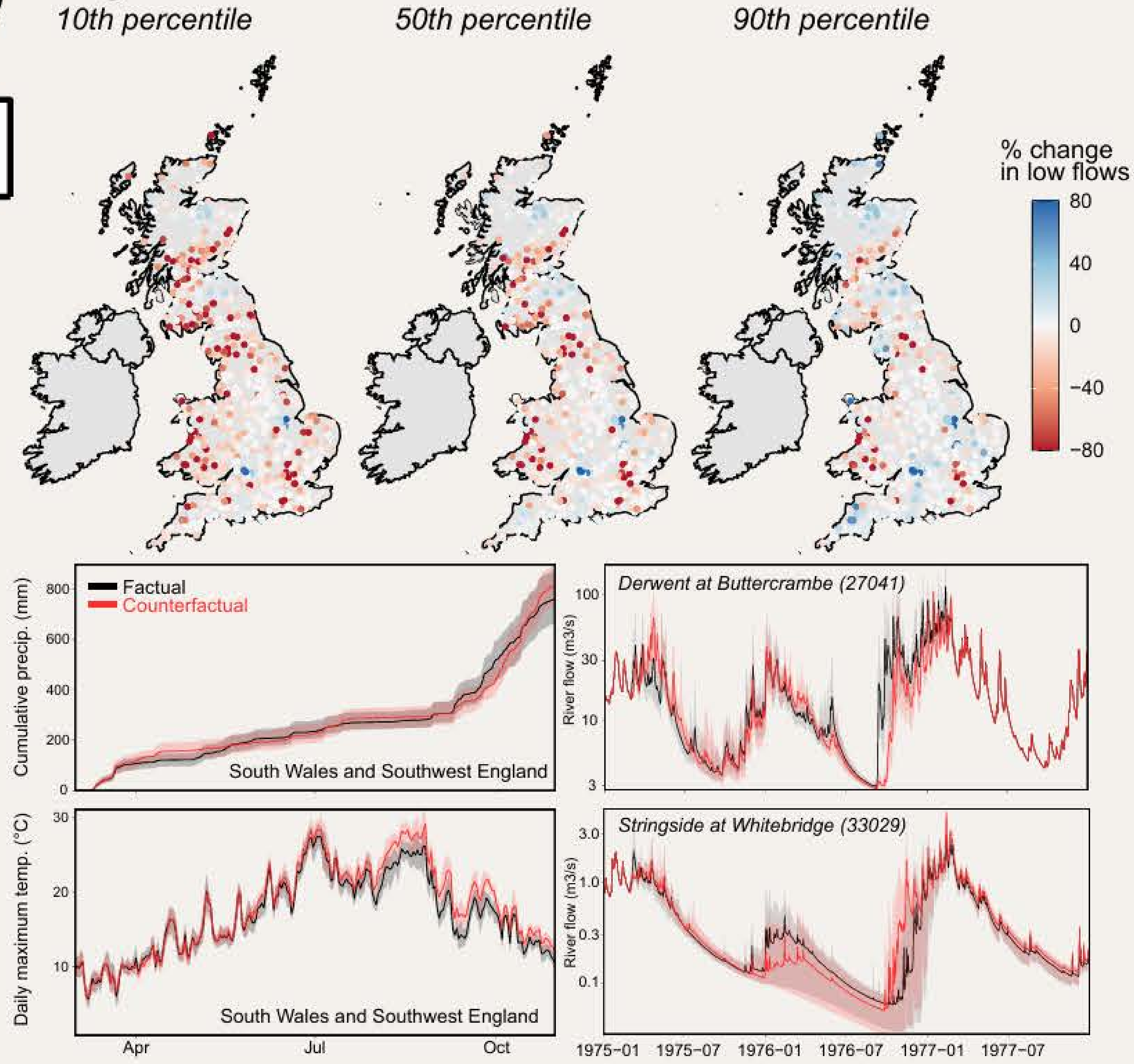
WHAT IF?

What if the 1976 drought occurred now?

Collaborators: Ed Hawkins, Anna Murgatroyd, Ben Smith, Rosanna Lane

An 80-member ensemble of atmospheric simulations reproducing the weather of 1976 (factual) with increased SSTs matching a 2020s climate (counterfactual) are used to drive hydrological models. Counterfactual simulations are warmer than the factual 1976 event, with similar total rainfall, although even drier rainfall sequences can occur. Counterfactual hydrological simulations show that low flows would further reduce, especially across NE England, Wales and Southwest England (**Figure 1**). Some catchments show a lengthening of prolonged low flows (e.g. Derwent) while others show a more rapid drought termination (e.g. Stringside).

Figure 1



What if winter 1975/76 was drier?

Winter half-year 1975/76 saw <50% of long term average rainfall over southeast regions and was characterised by strong La Niña conditions and a NAO+/EA- atmospheric circulation pattern. Alternative La Niña winters, associated with the same circulation configuration, that could happened by chance are sampled from large ensemble seasonal hindcast archives (e.g. SEAS5), following an UNSEEN approach. Hydrological simulations with these alternative plausible winters show that river flows could have further reduced across catchments in East Anglia (e.g. Wensum and Nar) given a drier winter with similar atmospheric circulation configuration (**Figure 2**).

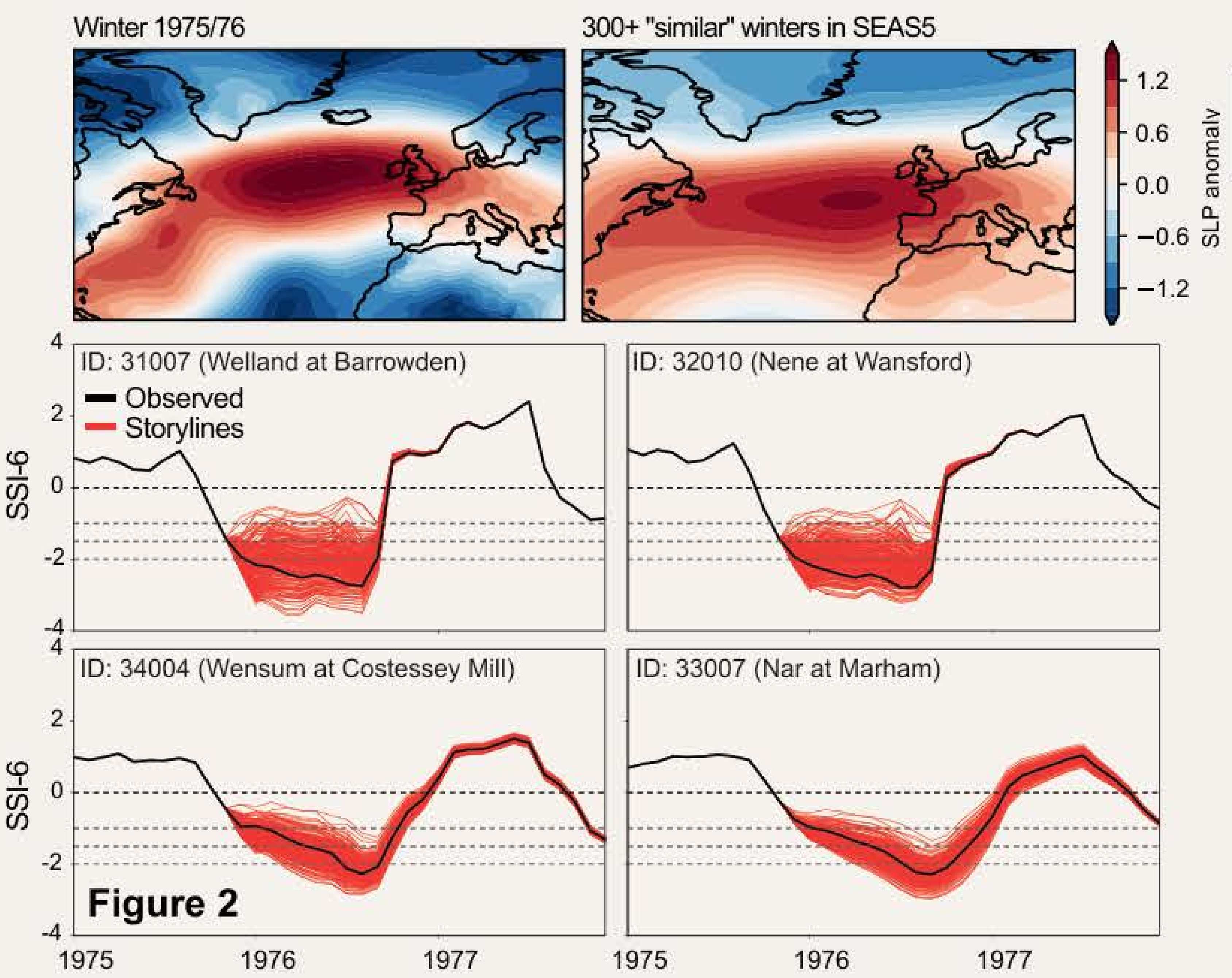


Figure 2

What if future jet stream changes are large?

Collaborators: Ben Harvey, UKCEH CANARI team

Dry summers are often characterised by a northward shift of the North Atlantic Jet Stream (like 1976). A 40-member large climate ensemble (CANARI-LE) shows a wide range of possible changes in the jet latitude at 4°C GWL. Simulated river flows driven by the CANARI-LE shows diverging storylines of low flow changes based on either a small shift in jet latitude or a extreme northerly shift. An extreme northerly shift could lead to 1-in-10-year low flows occurring in 66% of years in the Anglian region (**Figure 3**). An ensemble mean masks extreme changes and results in a washed-out signal.

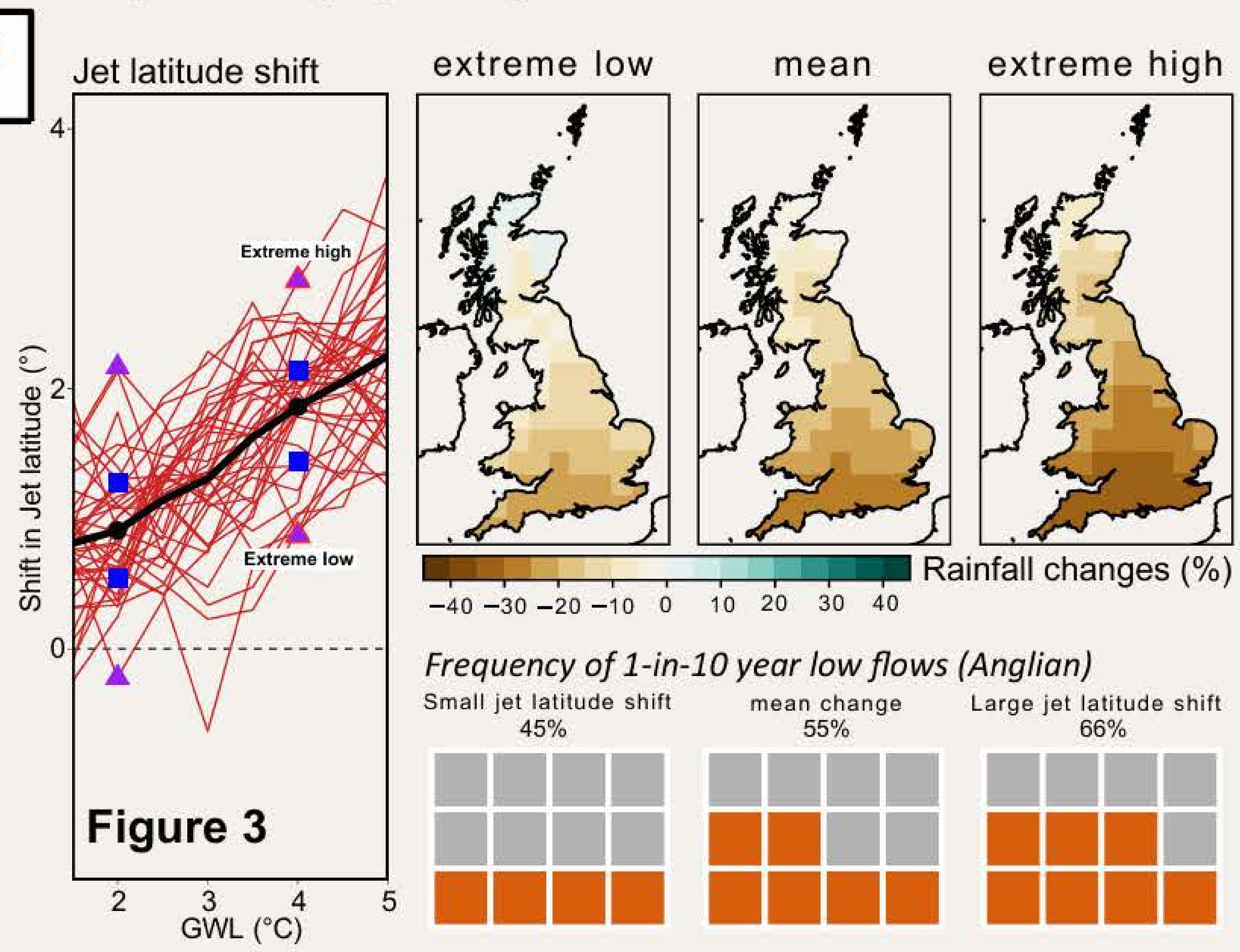


Figure 3

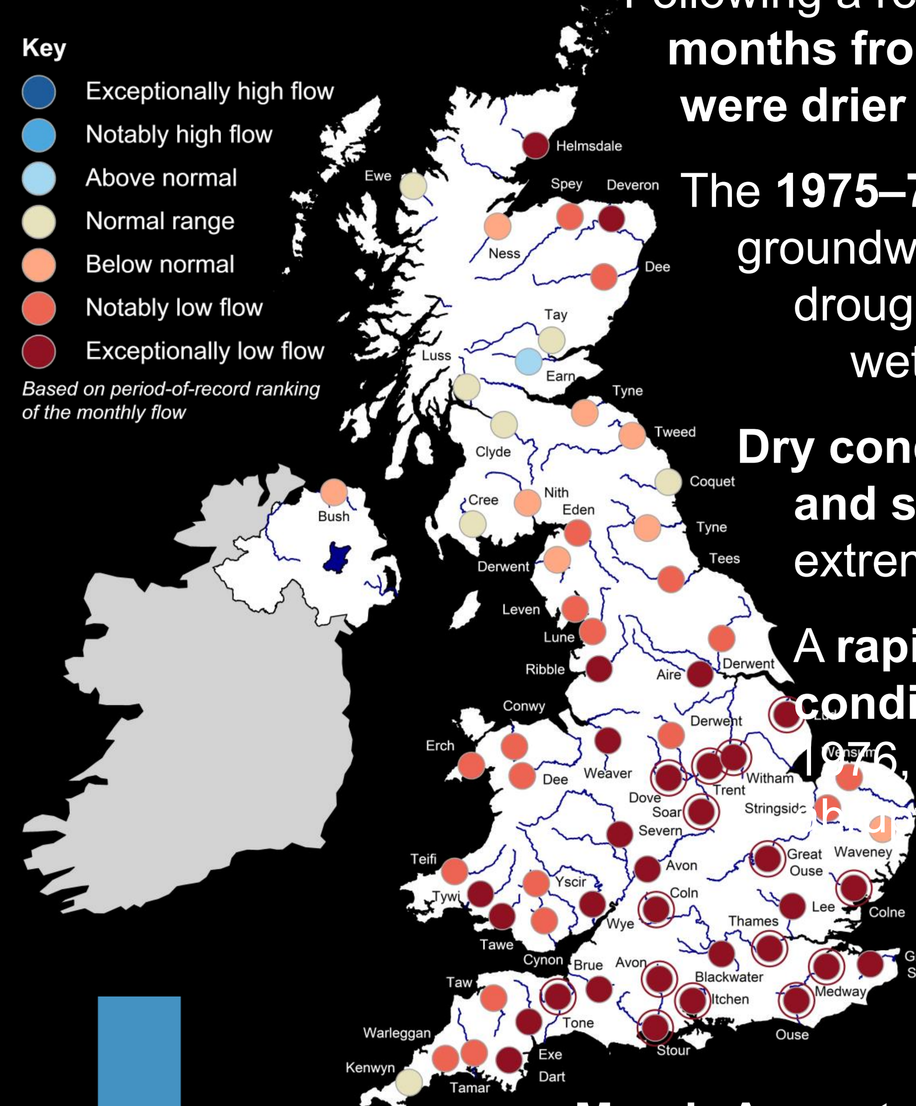
UKCEH
Our planet. Decoded.

The 1976 Drought Revisited: 50 years on, does it remain the benchmark?

Steve Turner, Rachael Armitage, Lucy Barker, Jamie Hannaford, and the National Hydrological Monitoring Programme Team

The 1976 drought remains one of the most severe hydrological events in the UK and is entrenched in the national memory. After recent droughts in 2025, 2022 and 2018, we assess the severity and impact of 1976 using long hydro-climate data records

WHAT HAPPENED AND WHEN?



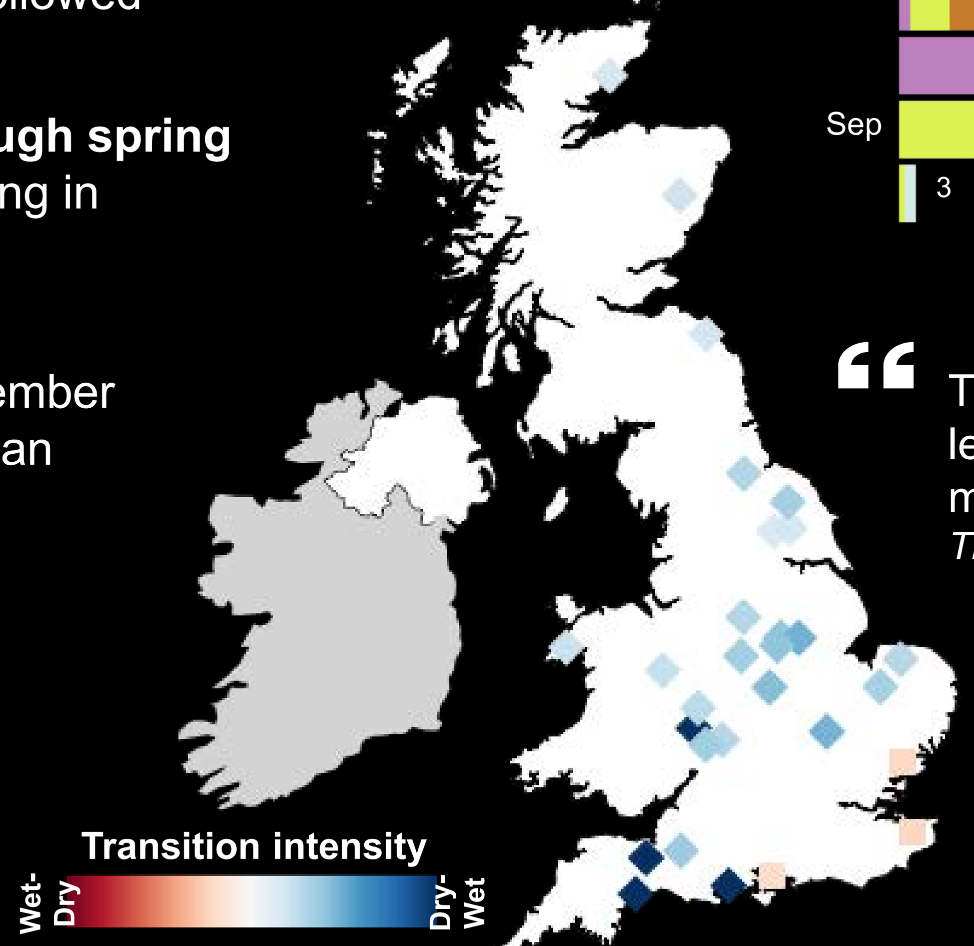
Following a relatively wet early winter, **most months from February 1975 onwards were drier than average.**

The 1975–76 winter was notably dry, limiting groundwater recharge, unlike some recent droughts (e.g. 2025), which followed wetter winters.

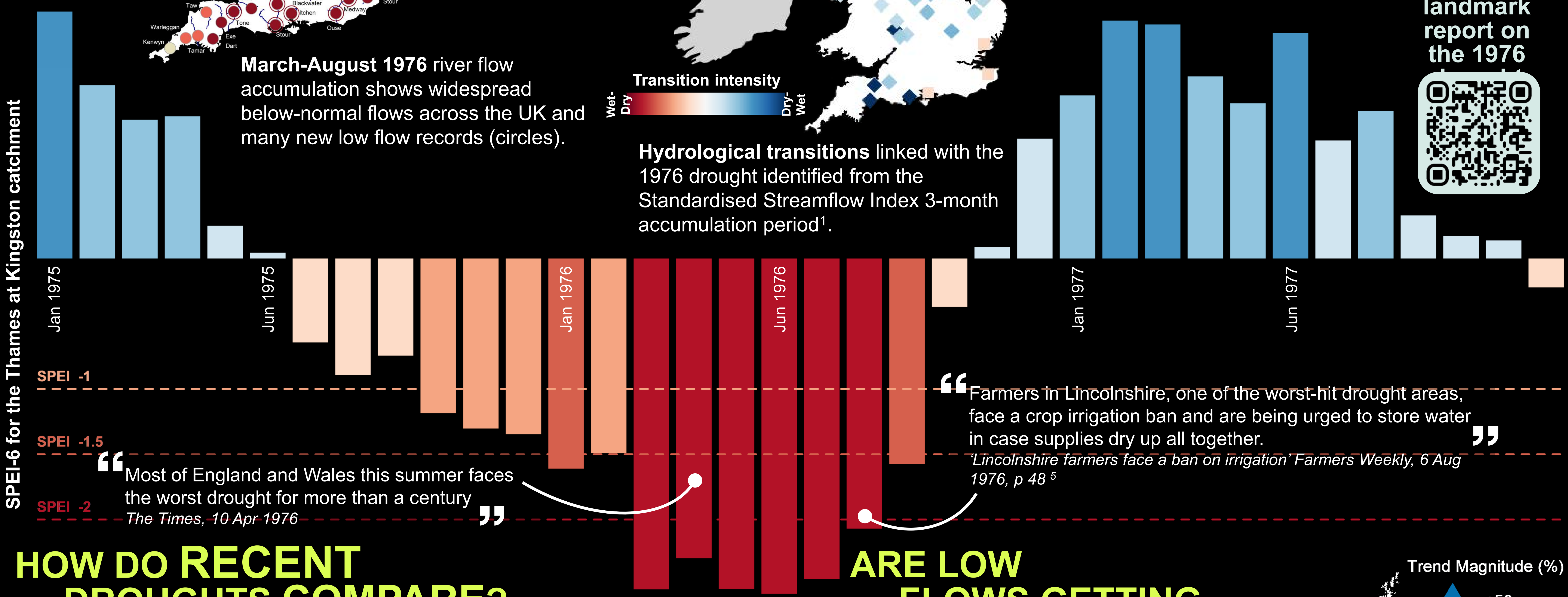
Dry conditions persisted through spring and summer 1976, culminating in extreme drought by August.

A **rapid transition to wetter conditions** occurred in September 1976, bringing the drought to an [illegible]t end.

March-August 1976 river flow accumulation shows widespread below-normal flows across the UK and many new low flow records (circles).



Hydrological transitions linked with the 1976 drought identified from the Standardised Streamflow Index 3-month accumulation period[1].



"Most of England and Wales this summer faces the worst drought for more than a century"
The Times, 10 Apr 1976

"Farmers in Lincolnshire, one of the worst-hit drought areas, face a crop irrigation ban and are being urged to store water in case supplies dry up all together."
'Lincolnshire farmers face a ban on irrigation' Farmers Weekly, 6 Aug 1976, p 48 [5]

WHAT WERE THE IMPACTS?

"Every time you went out, you had five-gallon containers in the car…you never came home, or arrived at somebody's house without water"
Historic Droughts Oral Histories[2]

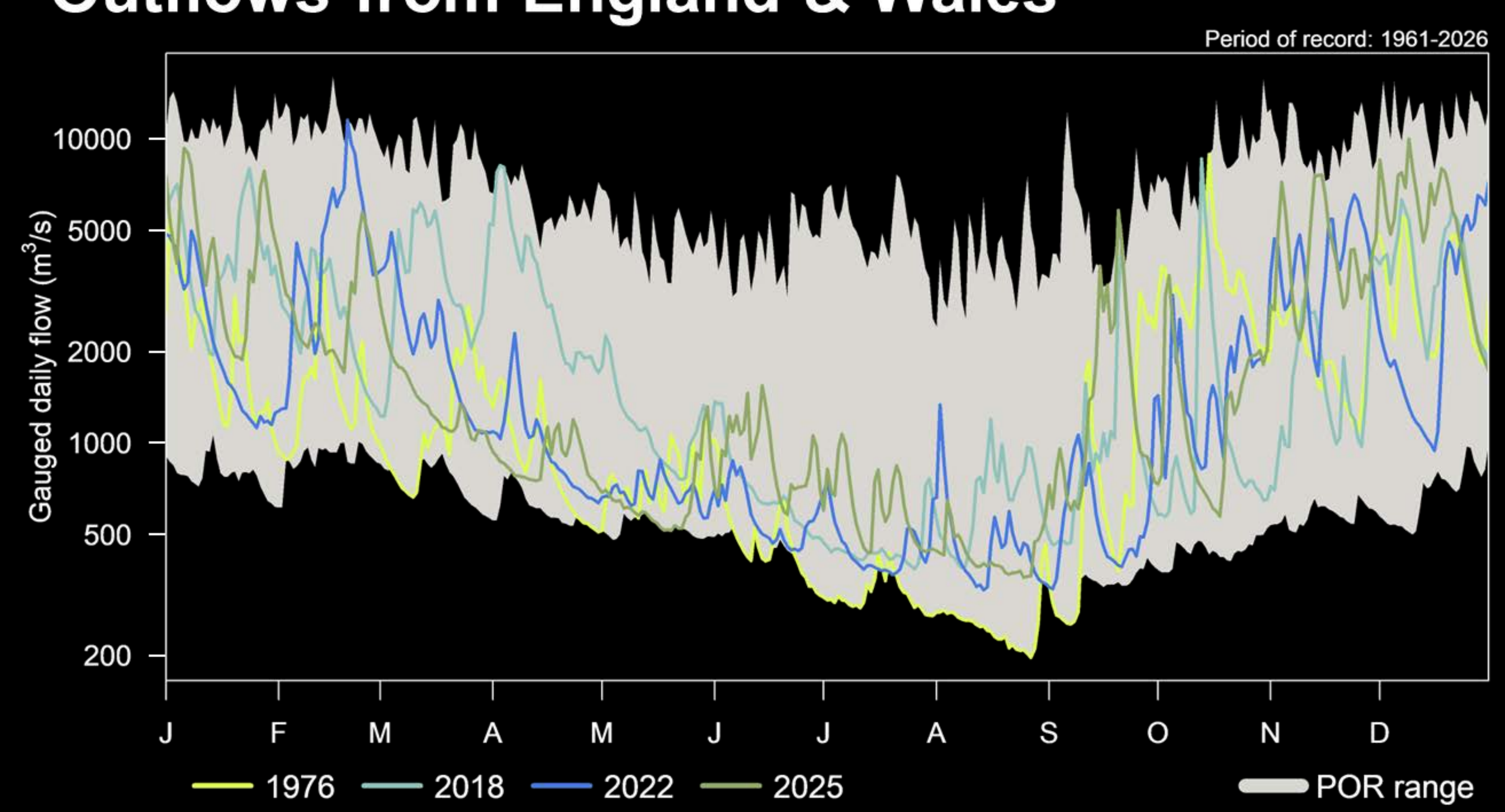
Drought impact reports for the UK in 1976 from the European Drought Impact report Inventory[3] (EDII)

"The Drought Act 1976 was introduced as an emergency legislative response, enabling rapid implementation of measures to manage water shortages."
The 1975-76 Drought - a contemporary and retrospective review[4]

Read the landmark report on the 1976

HOW DO RECENT DROUGHTS COMPARE?

Outflows from England & Wales



For England & Wales, 1976 set record low outflows throughout the summer – well below those of recent droughts.

Compare current hydrological conditions to 1976

Number of NHMP catchments with monthly mean record low flows during March-August:

170 in 1976	**13** in 2018	**17** in 2022	**45** in 2025

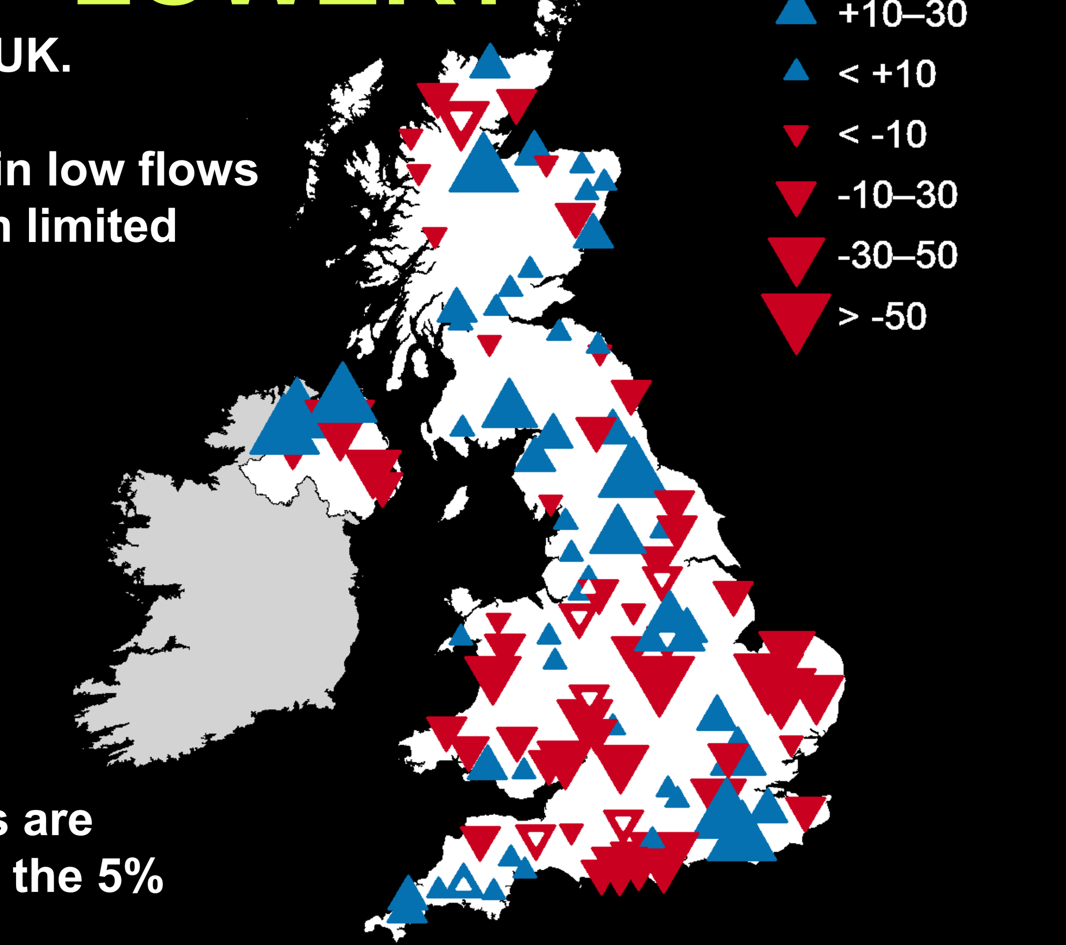
ARE LOW FLOWS GETTING LOWER?

Mixed signals across the UK.

Increases and decreases in low flows are broadly balanced, with limited statistical significance.

47% increasing
53% decreasing

~7% of decreasing trends are statistically significant to the 5% level (hollow triangles).



Low flow (Q95) trends for spring-summer (March to August) using 60 years of observed data from NHMP stations (1965–2025).

Standard NRFA trend testing method[6].

National Hydrological Monitoring Programme

CANARI

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Could the 1976 UK Drought Have Been Predicted a Year in Advance?

UKCEH
Our planet. Decoded.

Amulya Chevuturi, Marilena Oltmanns, Wilson Chan, Eugene Magee, Maliko Tanguy, Cecilia Svensson, Ben Harvey, Jamie Hannaford

North Atlantic

TELECONNECTION

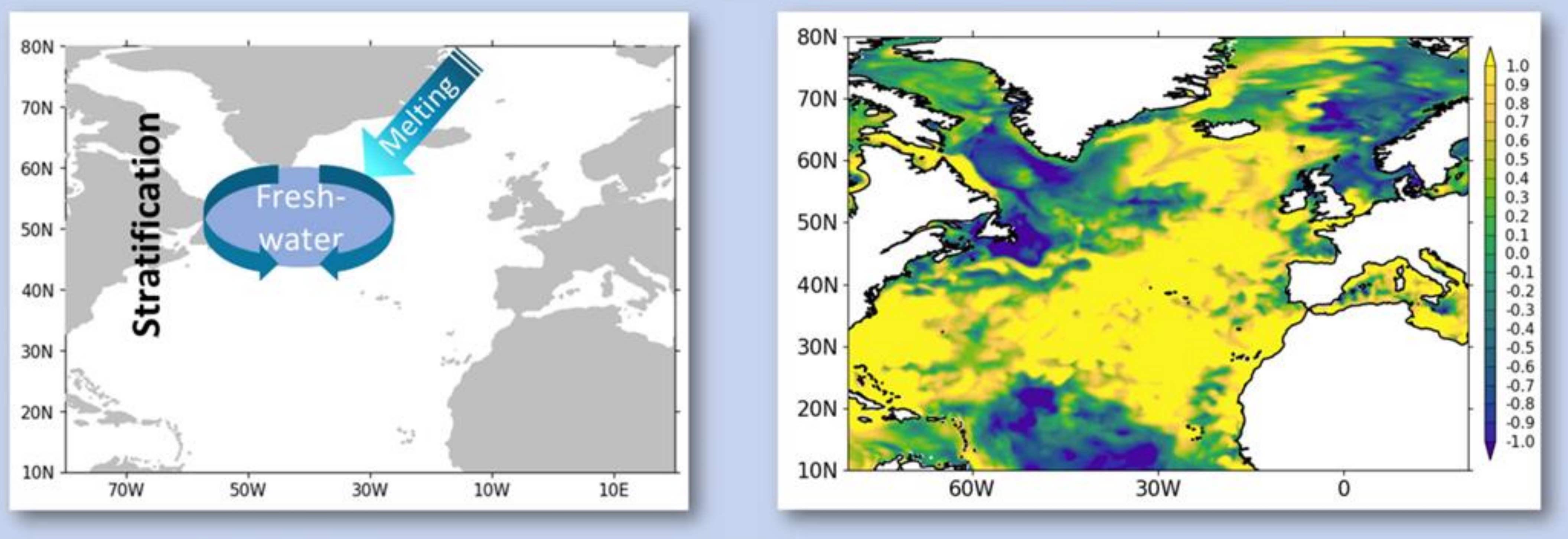


Figure 1: Freshwater from the Arctic to the subpolar North Atlantic (left). 1974 June-July-August (JJA) sea surface salinity standardised anomalies (1958 – 2022) with ORAS5 reanalysis (right).

Teleconnection link: Summer two years before the droughts, large freshwater release from the Arctic enters the subpolar North Atlantic Ocean as a large cold anomaly, leading to stratification and enhanced surface cooling in winter.

1976 link: *A large-scale freshening event, known as the Great Salinity Anomaly (GSA), affected the North Atlantic in the early 1970s.*

1974 JJA

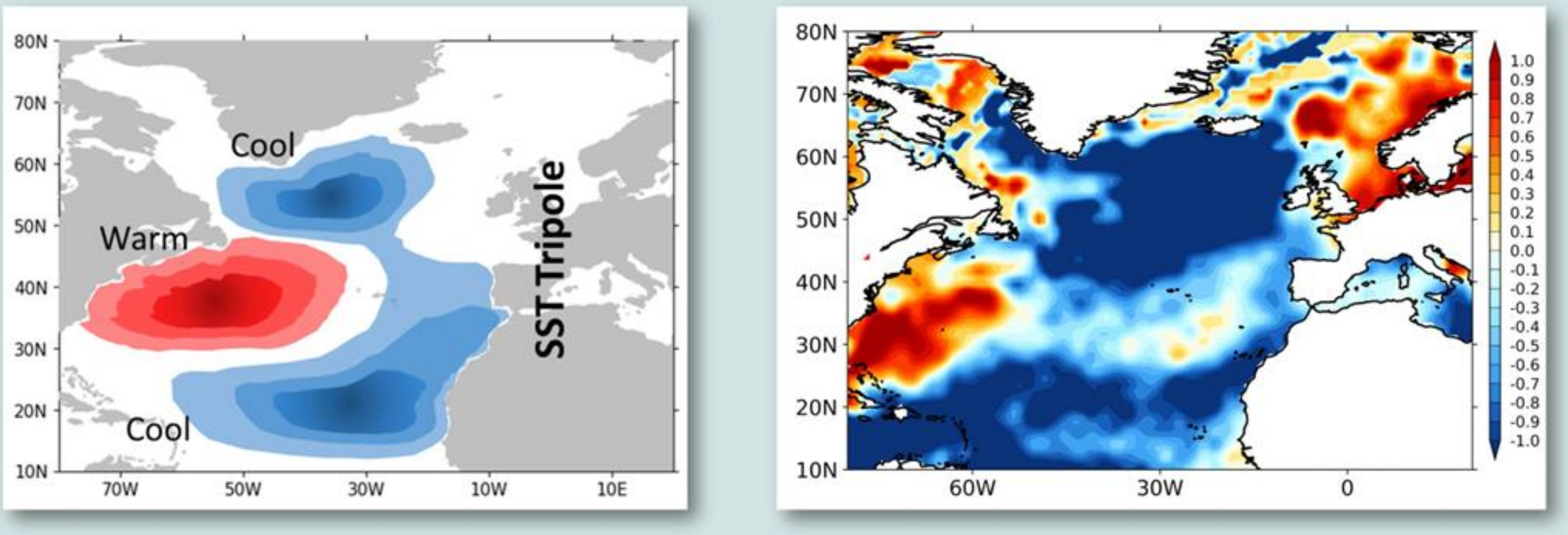


Figure 2: North Atlantic sea surface temperature (SST) tripole pattern (left). 1975 January-February-March (JFM) SST standardised anomalies (1950 – 2022) with HadISST dataset (right).

Teleconnection link: Salinity anomalies influence meridional SST gradients and atmospheric feedbacks, generating the North Atlantic SST tripole pattern in the winter one year before the UK drought.

1976 link: *Cold anomalies over the subpolar gyre and the tropical North Atlantic, and warm anomalies in the intervening region.*

1975 JFM

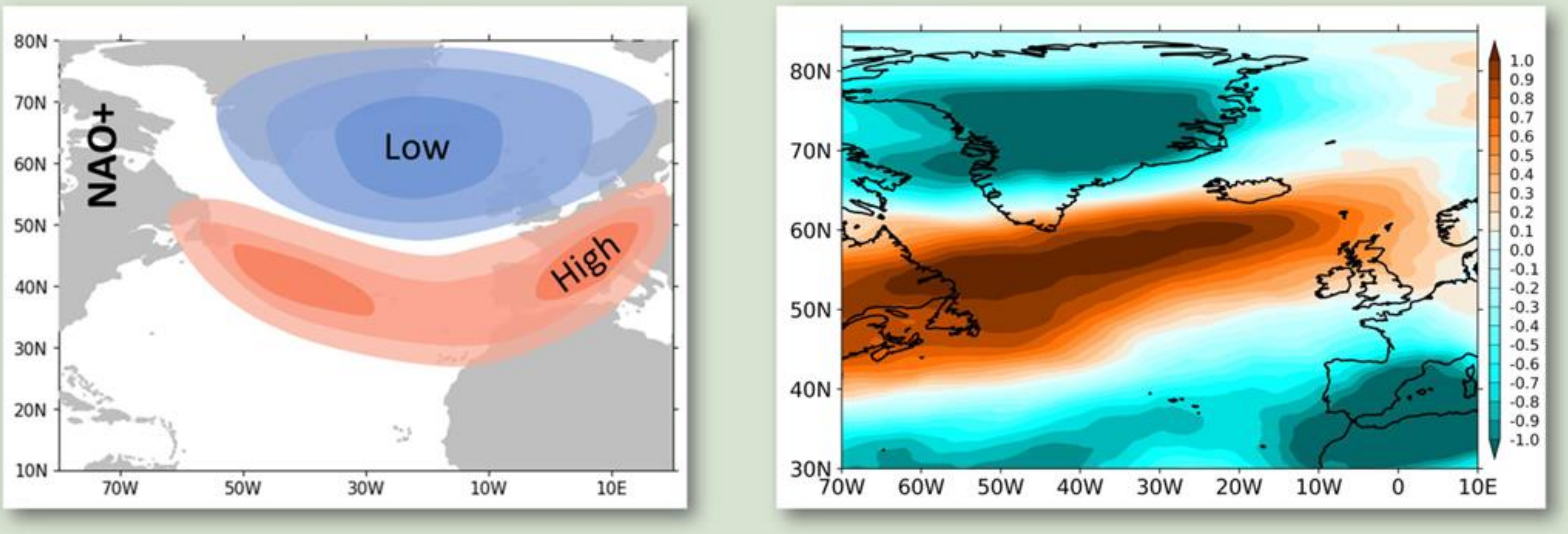


Figure 3: Positive phase of the North Atlantic Oscillation (NAO) pattern (left). 1976 JFM u-wind standardised anomalies (1950 – 2022) at 500hPa with ERA5 reanalysis (right).

Teleconnection link: SST gradient feedbacks lead to circulation pattern similar to the positive phase of the NAO, with prevalence of strong westerly winds during the winter preceding the UK drought.

1976 link: *Low pressure anomalies over Greenland and high anomalies over parts of Atlantic Ocean and the UK.*

1976 JFM

UK

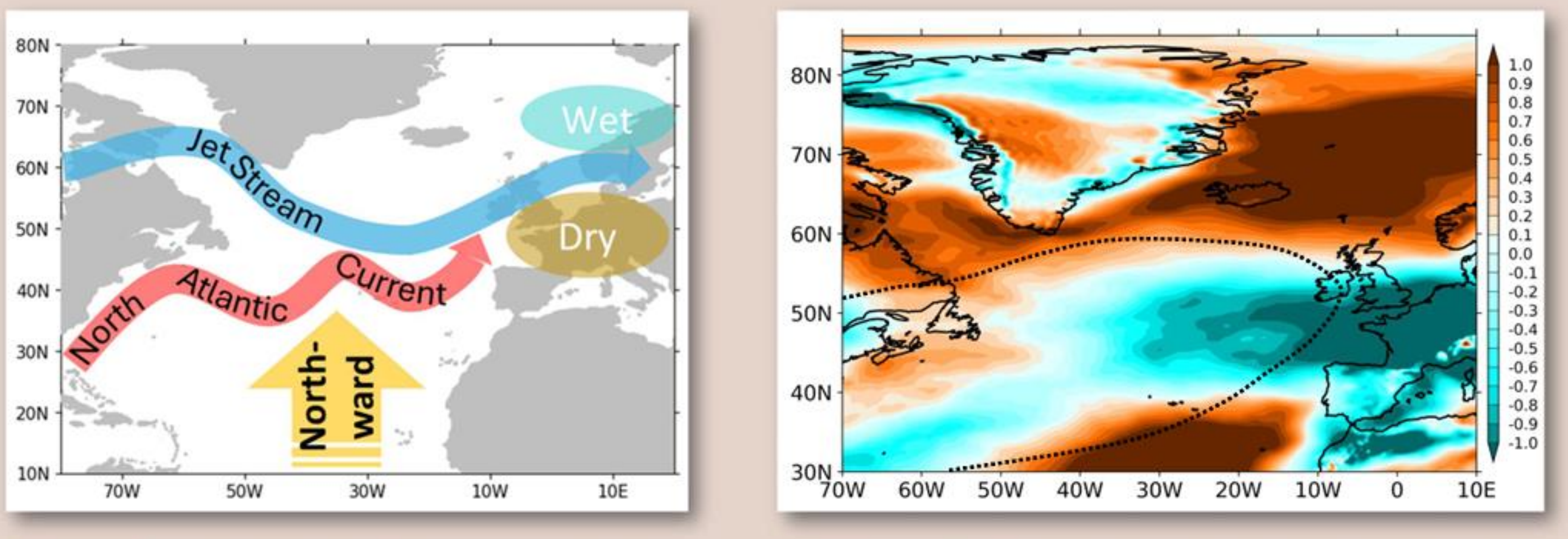
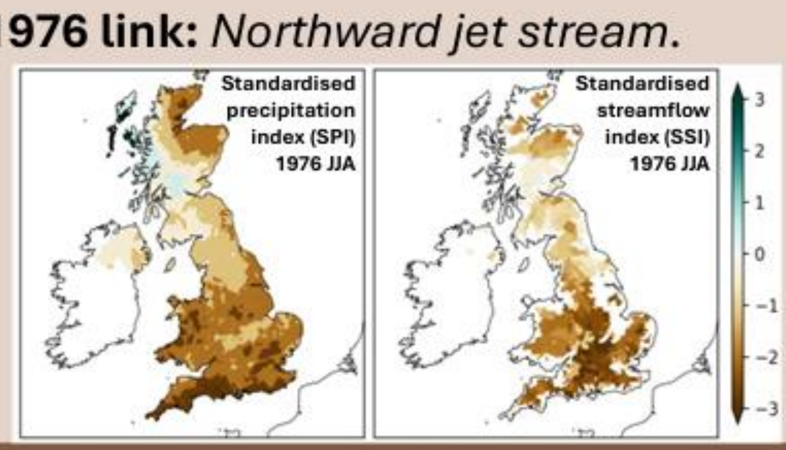


Figure 4: Northward shift of North Atlantic Jet Stream (left). 1976 JJA u-wind standardised anomalies (shaded) and climatology (contour) (1950 – 2022) at 850hPa with ERA5 reanalysis (right).

Teleconnection link: Ocean-atmosphere feedbacks shift the North Atlantic Current and Jet Stream northwards, leading to UK droughts.

1976 link: *Northward jet stream.*



1976 JJA

So, could the 1976 drought have been predicted?

Yes. The sequence of oceanic and atmospheric changes shown here is now understood as a teleconnection pathway linking North Atlantic salinity anomalies to UK summer droughts. The 1976 drought exhibited detectable precursor signals more than a year in advance, suggesting that such events may be predictable at seasonal-to-interannual lead times.

Drought risk modelling and forecasting framework to inform the implementation of the National Water Scarcity Policy Plan in Scotland

Stevenson[1], J.L., Schurch[2], N., Adams[1], K., Gagkas[1], Z., Jabloun, M[1]., Naha, S[3]., Frantsuzova, A.[2], & Glendell, M[1].
[1]The James Hutton Institute, Craigiebuckler, Aberdeen, UK; [2] Biomathematics and Statistics Scotland, Aberdeen, UK; [3] HR Wallingford, Oxford, UK.
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Introduction

By 2050 droughts may almost double in parts of Scotland[1], impacting a range of water users. Here, we showcase multiple tools to inform future adaptation responses:

- a drought risk modelling and forecasting framework to inform the implementation of the National Water Scarcity Plan in Scotland.
- an open-source R package, *wscall,* combining multi-window rolling-average smoothing approach with a history-matching framework to characterize hydrological drought events in near-real-time.
- a probabilistic catchment-scale water resources decision-support tool to evaluate drought risk to 2050.

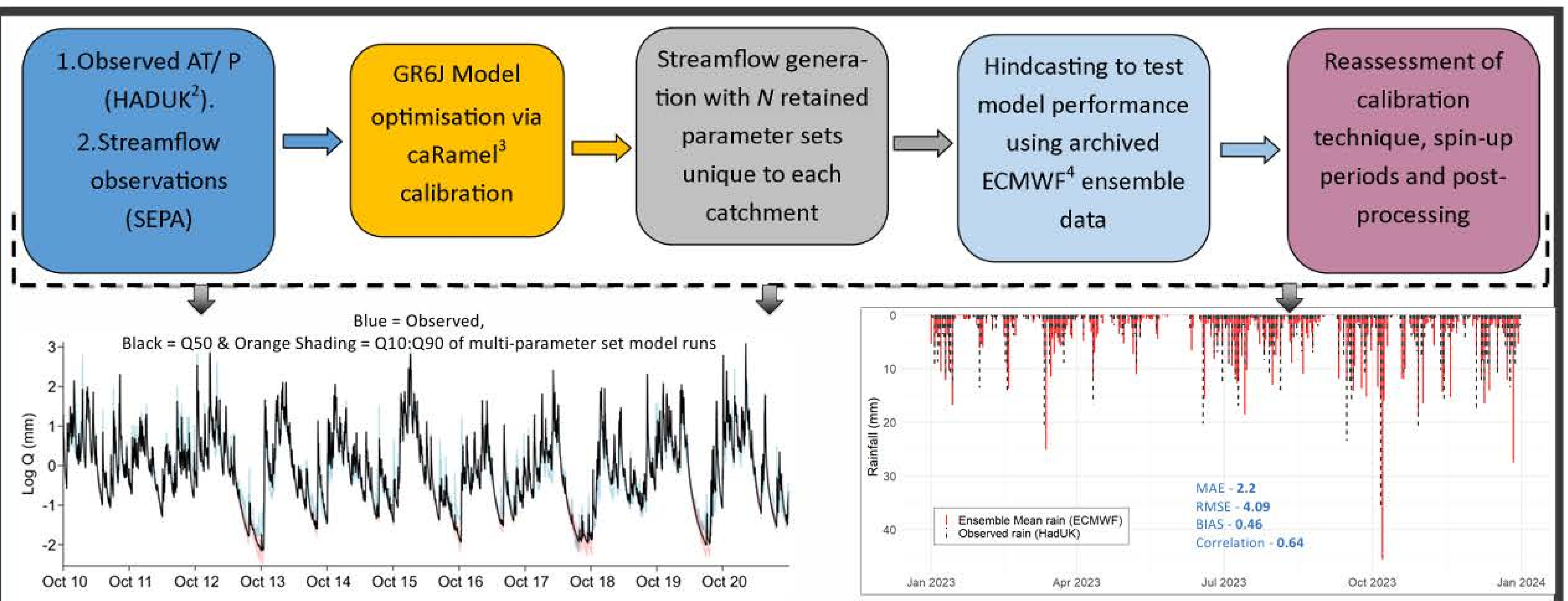

Figure 1 Schematic of low-flow prediction modelling workflow (top), with representative Q simulations during calibration (bottom left) and European Centre for Medium Range Weather Forecast (ECMWF) ensemble mean P predictions in relation to observed data (bottom right). The GR6J model is used in conjunction with 14-day rainfall forecasts from ECMWF to simulate streamflow in 81 catchments.

wscall - probabilistic modelling of drought periods:

- Multi-timescale smoothing helps improve drought detection and reduce early-stopping.
- Better at bridging of short rainfall periods.
- More conservative identification of starts/ends.
- History-matching probabilistic early warnings based on live monitoring of 320 river gauge stations.

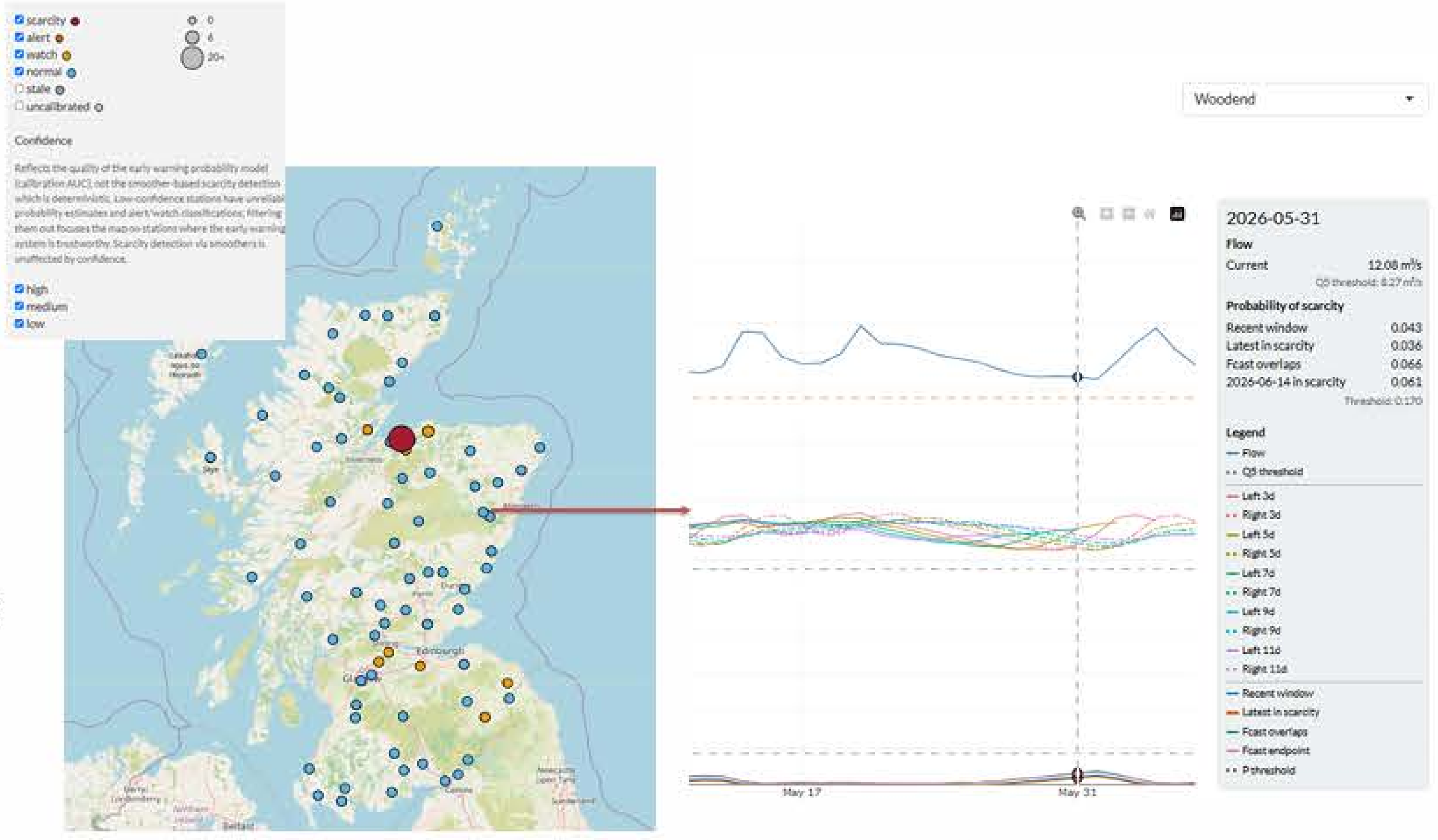

Figure 2 *wscall* user interface showing the home page for catchment filtering (left) and multi-timescale smoothing for the River Dee (Woodend; right).

Probabilistic catchment scale water resources management decision-support tool -

Leveraging meteorological, hydrological, agricultural and socioeconomic drought indicators across future scenarios to understand sectoral vulnerabilities.

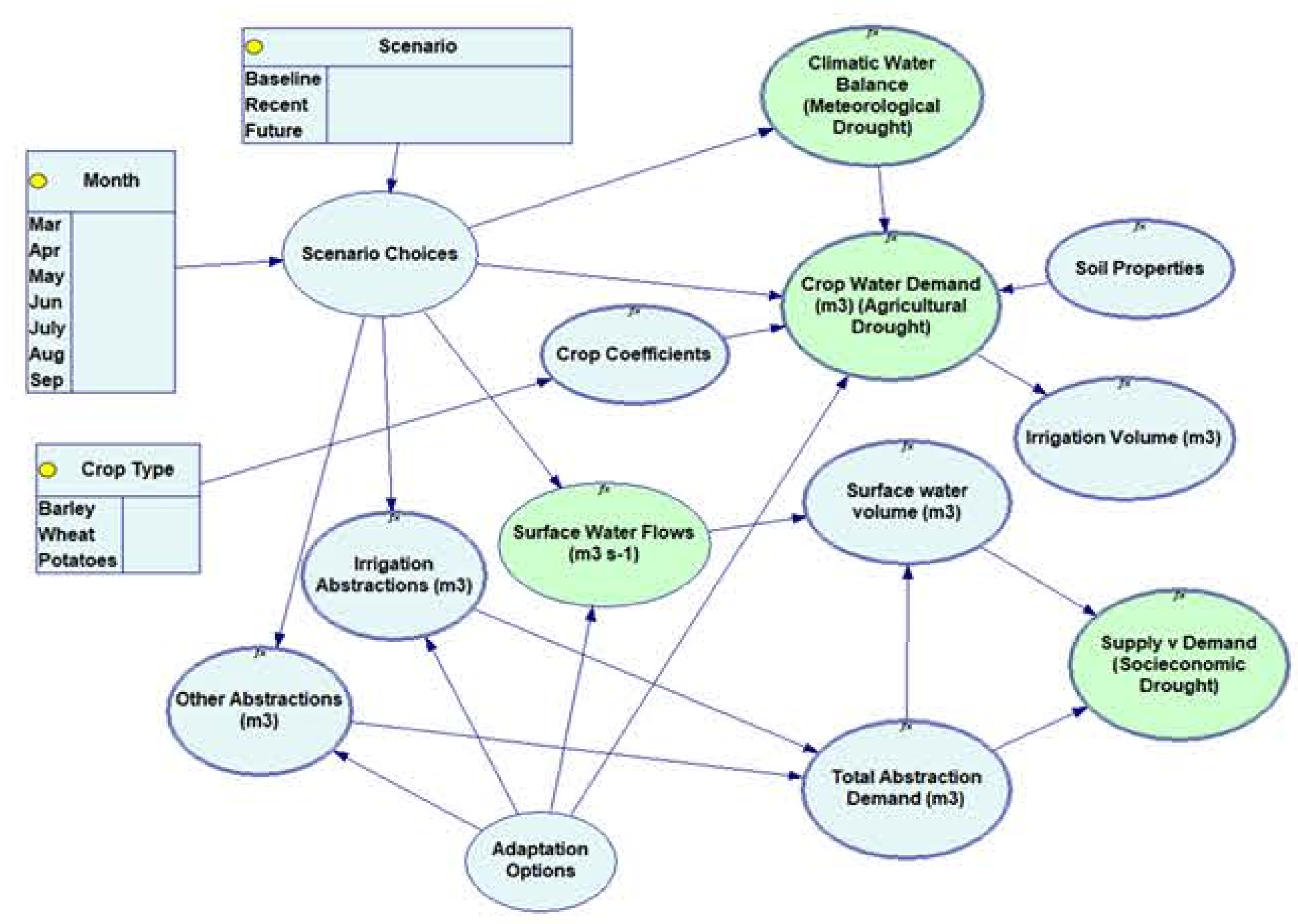

Figure 3 Schematic of catchment-scale water resources decision-making support tool

Outlook:

- **Inclusion of semi-distributed and AI (LSTM) based models for streamflow prediction across Scotland.**
- **Multi-model integration with *wscall* to provide probabilistic low-flow predictions and inform drought alerts.**
- **Upscaling of Bayesian network-based decision support tool for water resources management across Scotland**

References
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RESAS
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Modelling the impact of a 1976 drought equivalent climate on England's current water resources

Dan Bazely[1], Alice Blackwell[2], David Pritchard[3], Jonny Wilson[4]

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Environment Agency

1. Summary

This study assesses **how the present-day water resources system would perform under equivalent 1976 climate conditions using a national scale water resources system simulation model.**

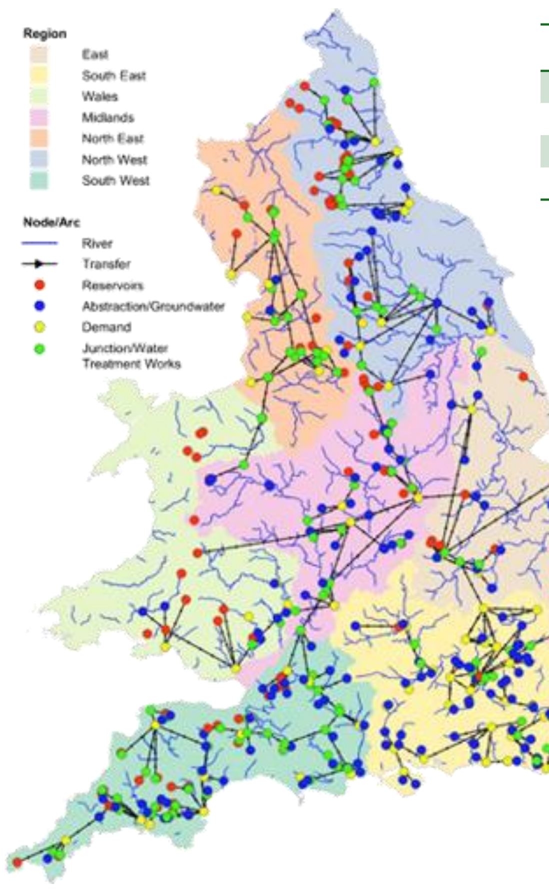
- Modelling results suggest that the present-day supply system is much more resilient to a repeat 1976 event, with the occurrence of level 4 restrictions (rota cuts/standpipes) removed or reduced to less severe level 1 and 2 restrictions (media campaigns and TUBs).
- Improvements in modelled supply system resilience may be partly explained by a 37% increase in reservoir storage since 1976. However, the results are likely overly optimistic due to methodological constraints (e.g. mathematical optimisation & simplified conceptualisation). Additionally, modern Level of Service (LoS) determination using reservoir control curves generally indicates lower restriction levels than 1976 methods.
- Modelling alternative realisations of the 1976 event shows that ~16% and ~24% lower flows on the River Thames would trigger level 3 and level 4 restrictions in London, respectively. An additional ~150-400 Ml/d of supply would be needed to prevent system failure (Level 4 restrictions). The scale of vulnerability of the present-day system to climatic uncertainty demonstrates the need for new large-scale water supply options and ambitious demand management.
- Model outputs have been validated against both observed and benchmark datasets, with good agreement.

2. Method – National Water Resources System Simulation Modelling

Modern Predicted Level of Service (LoS) for the 1976 Drought

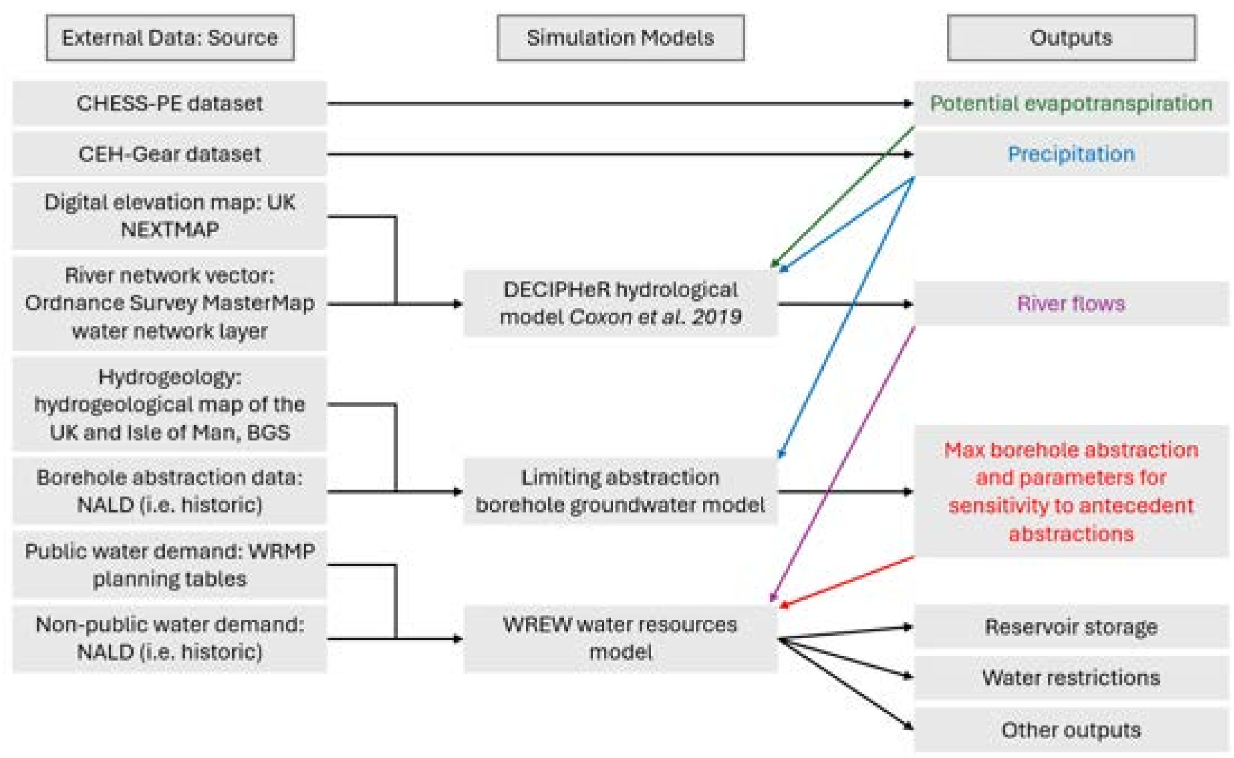
We use a national scale water resources system simulation model (Water Resources Model of England and Wales – WREW, Dobson et al., 2020) to simulate LoS. The table below defines the LoS restrictions:

Level of Service (LoS)	Description
1	Voluntary Reductions
2	Temporary Use Ban (TUBs)
3	Non-essential Use Ban (NEUBs)
4	Emergency Drought Order



The WREW model :
- Covers 91 out of 128 WRZs
- Represents >90% demand

Spatial configuration of WREW, representing major supply infrastructure, river networks, and water transfers (>2 Ml/d) used to simulate and optimise water allocation on a national scale.

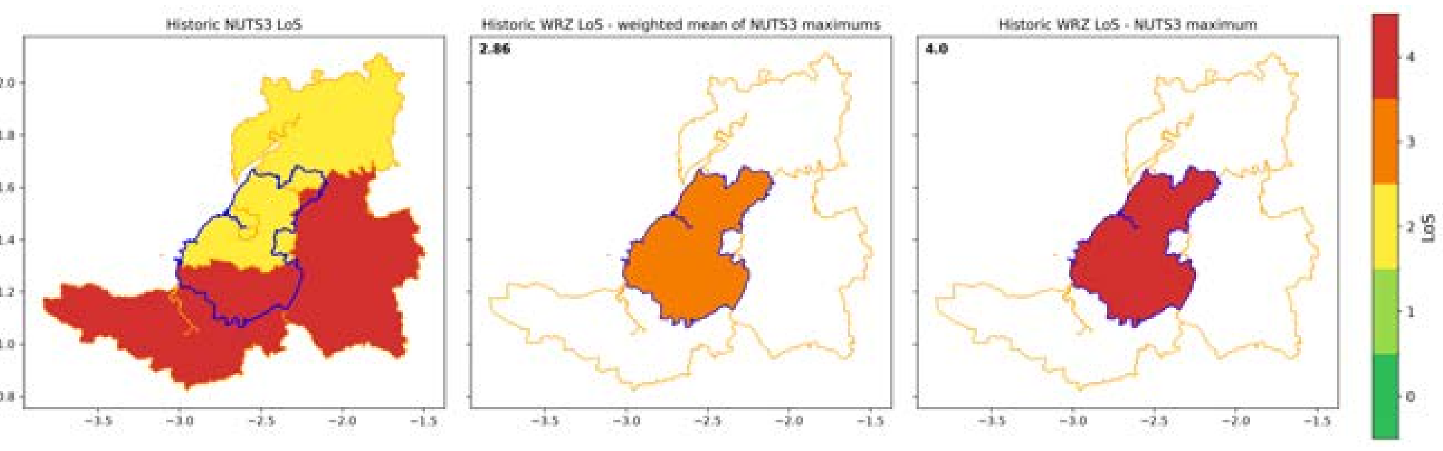


WREW modelling workflow, showing how meteorological inputs drive hydrological and groundwater models to generate inflows, which are then allocated through the water supply network to meet demand and produce reservoir storage and level-of-service outputs.

Historical Level of Service (LoS) for the 1976 Drought

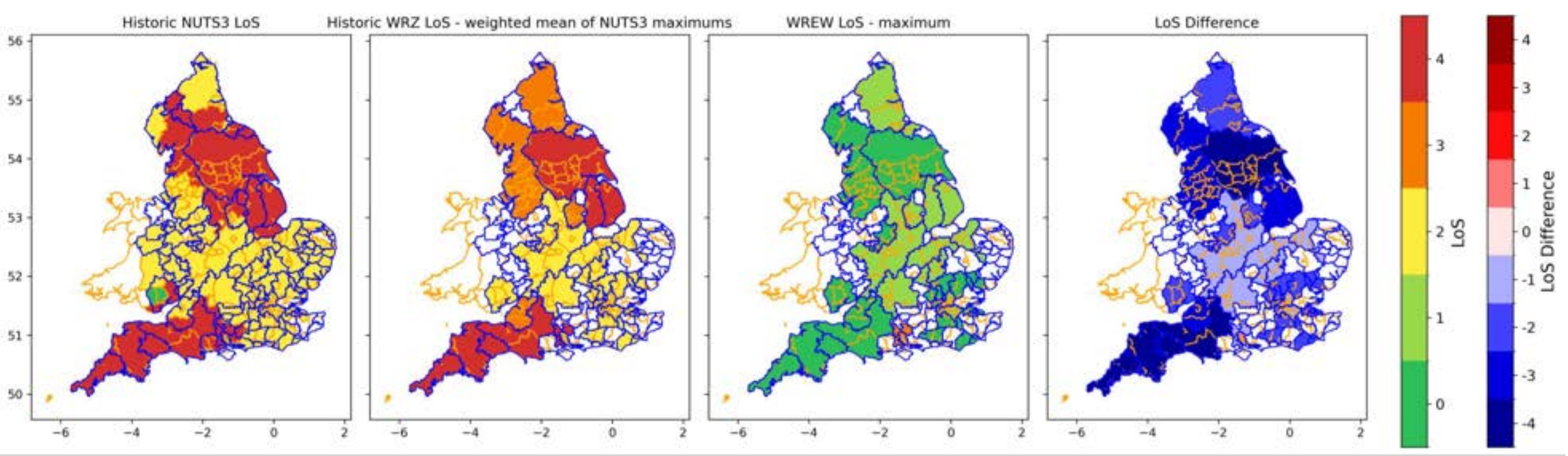
Example of LoS aggregation from NUTS3 (Nomenclature of Territorial Units for Statistics 3) areas (orange outline; Durant & Counsell, 2020) to WRZ scale (blue outline) for the Bristol WRZ in August 1976 .

Left: maximum historical LoS in each NUTS3 area overlapping the WRZ. Middle: WRZ LoS calculated using a weighted mean of the NUTS3 values. Right: WRZ LoS defined by the maximum NUTS3 value.



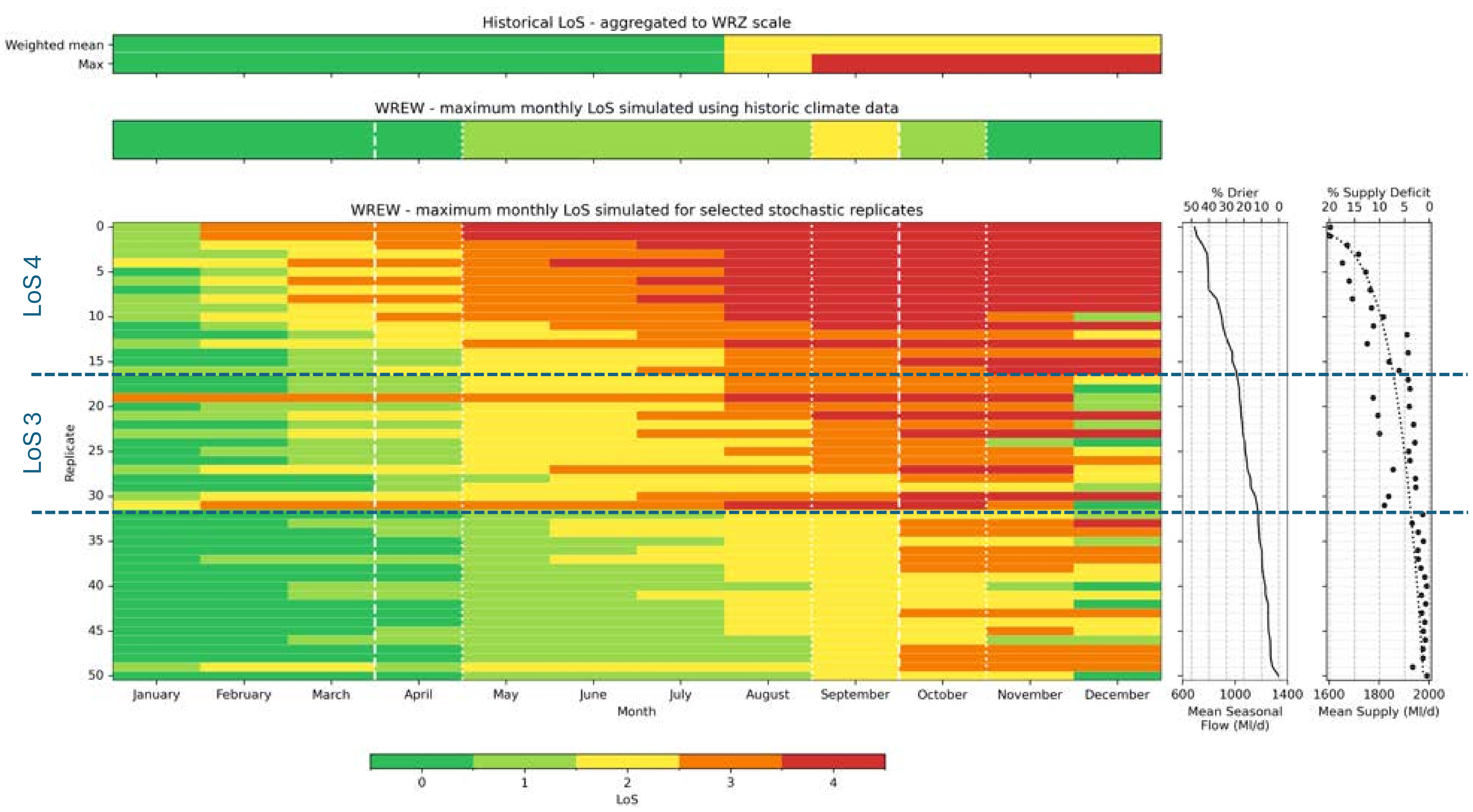
3. Results

Comparing Historical LoS to Predicted Modern LoS



National-scale comparison of Level of Service (LoS) in August 1976, showing raw NUTS3 restrictions (left), WRZ-level historical LoS aggregated using a weighted mean (centre-left), WREW-simulated LoS under 1976 conditions (centre-right), and the difference between historical and modelled LoS (right).

What Alternative Outcomes Could a 1976-Equivalent Drought Have?

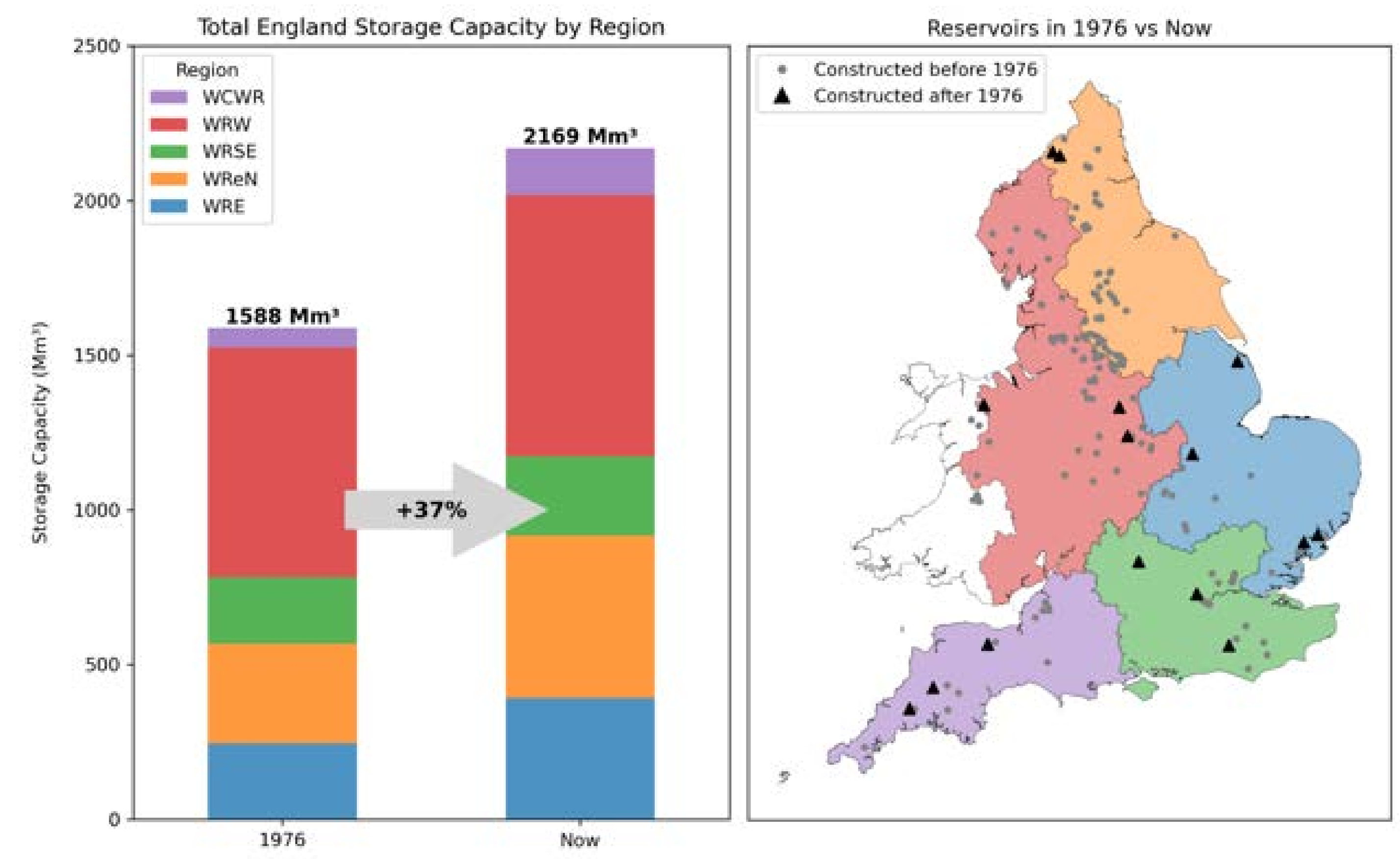


Comparison of LoS timeseries for the London WRZ, showing observed historical LoS (top), WREW-simulated LoS under 1976 conditions (middle) and from selected drier stochastic realisations (bottom; AtkinsRéalis et al., 2025). The stochastic results highlight the possibility of increased severity and duration of restrictions during 1976-equivalent scenarios.

Stochastic analysis shows system failure (LoS 4) occurs when River Thames flows are ~≥24% lower than modelled for 1976, equivalent to a ~7.5% (~150 Ml/d) reduction in London supply; with an additional ~400 Ml/d required to prevent LoS 4 in the driest realisation.

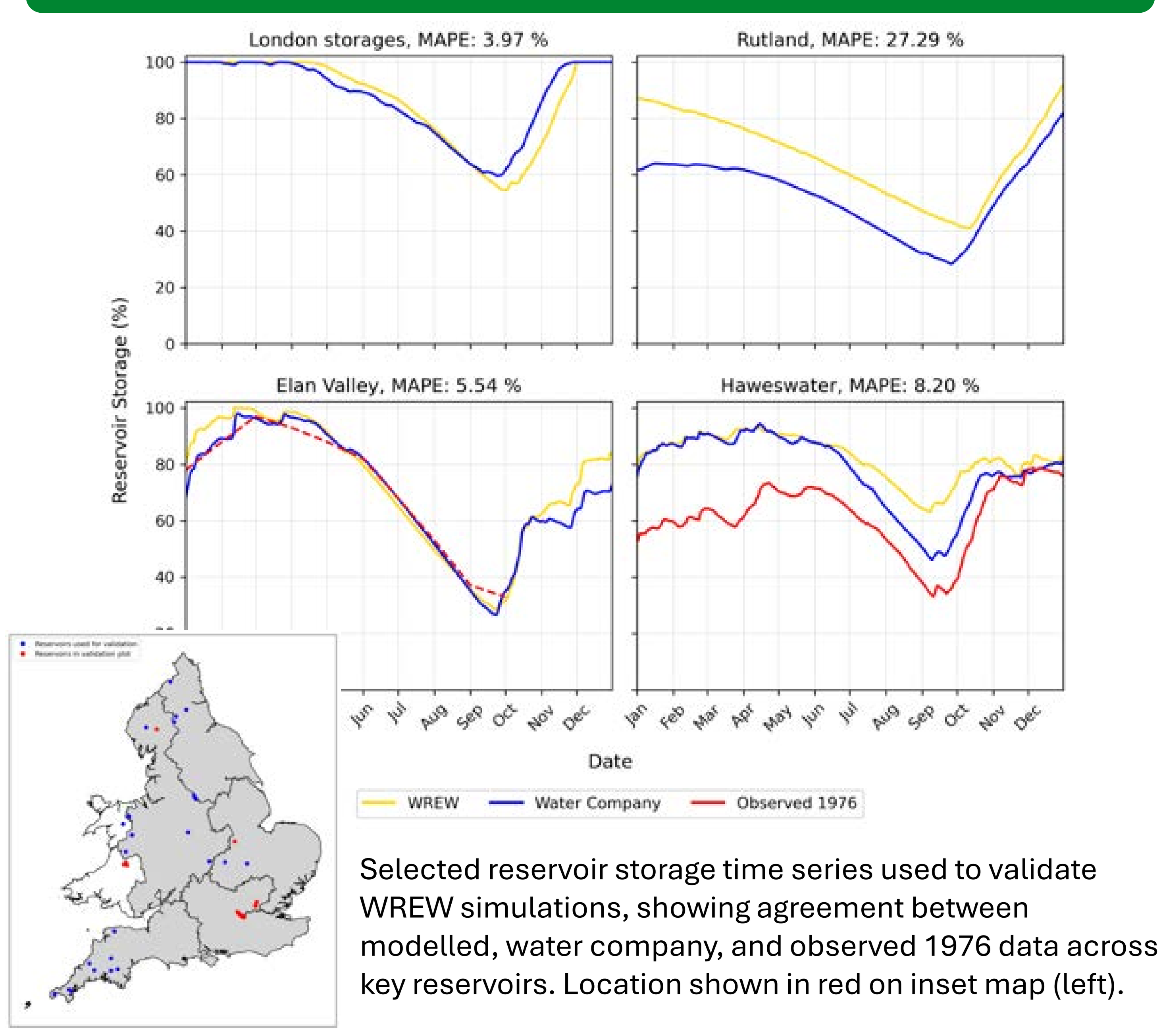
4. How Has The Supply System Changed?

Comparing Reservoir Storage from 1976 to Present Day



A comparison of total reservoir storage capacity between 1976 and present day, for the five Water Resources Regions in England (left). A map showing the locations of reservoirs within the five Water Resources Regions in England and whether they were constructed before or after 1976 (right).

5. Model Validation



Selected reservoir storage time series used to validate WREW simulations, showing agreement between modelled, water company, and observed 1976 data across key reservoirs. Location shown in red on inset map (left).

References:

AtkinsRéalis; Petch, L., Wade, S.D., Parker, J. (2025) Stochastic Weather Generation: National Stochastic Dataset. Prepared for the Environment Agency.

Dobson, B., Coxon, G., Freer, J., Gavin, H., Mortazavi-Naeini, M., & Hall, J. W. (2020). The spatial dynamics of droughts and water scarcity in England and Wales. Water Resources Research, 56, p.e2020WR027187.

Durant, M.J. and Counsell, C.J. (2018). Inventory of reservoirs amounting to 90% of total UK storage. NERC Environmental Information Data Centre.

Durant, M.J. and Counsell, C.J. (2020). Historic droughts inventory of drought references to water resources 1890-2015. [Data Collection]. Colchester, Essex: UK Data Service.

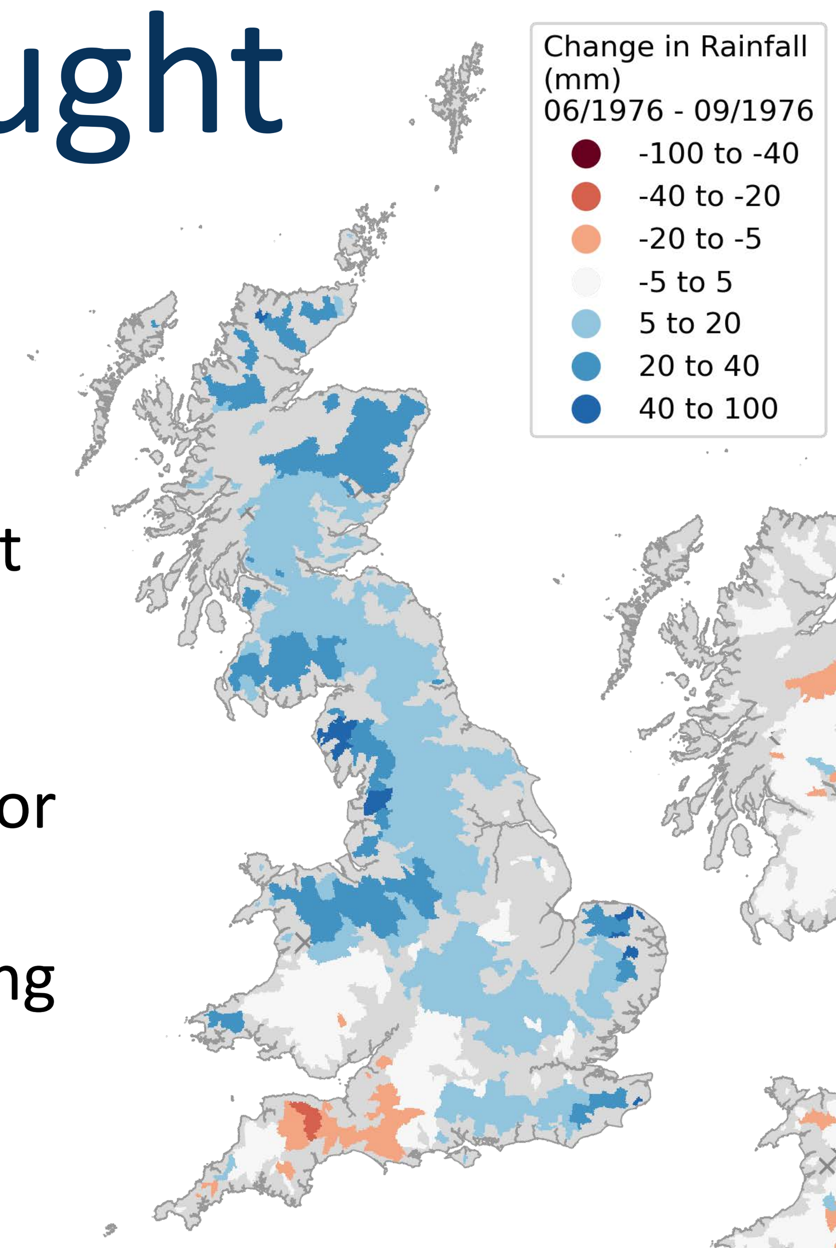
Physically Based Modelling of the 1976 Drought

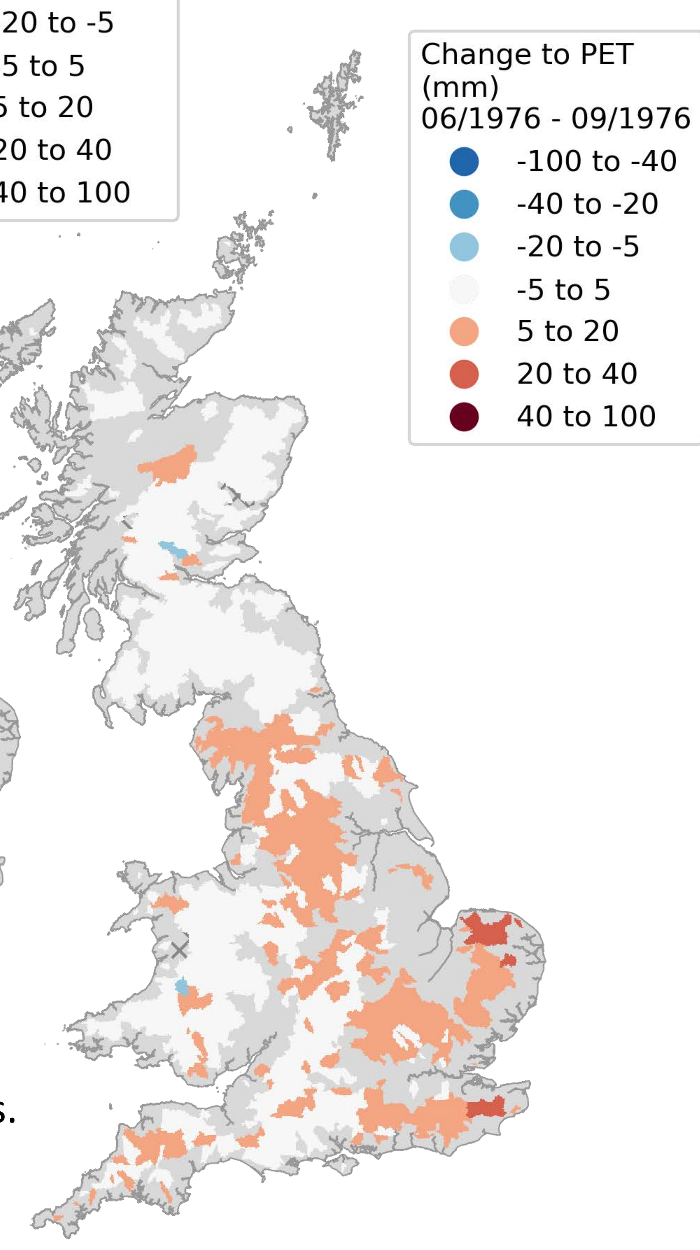
Introduction

- 1976 is a benchmark drought in hydrological science.
- Physics-based modelling allows us to robustly alter simulation parameters and drivers, such as rainfall.
- SHETRAN has been used for many hydrological impact studies in the past, including climate change.

Methodology

- 555 autocalibrated catchment simulations.
  NSE: 0.70-0.96, mean 0.82.
- Historical weather swapped for analogous climate data.
- Perturbed with 2°C of warming to explore how the drought could present if it occurred again in the near future.

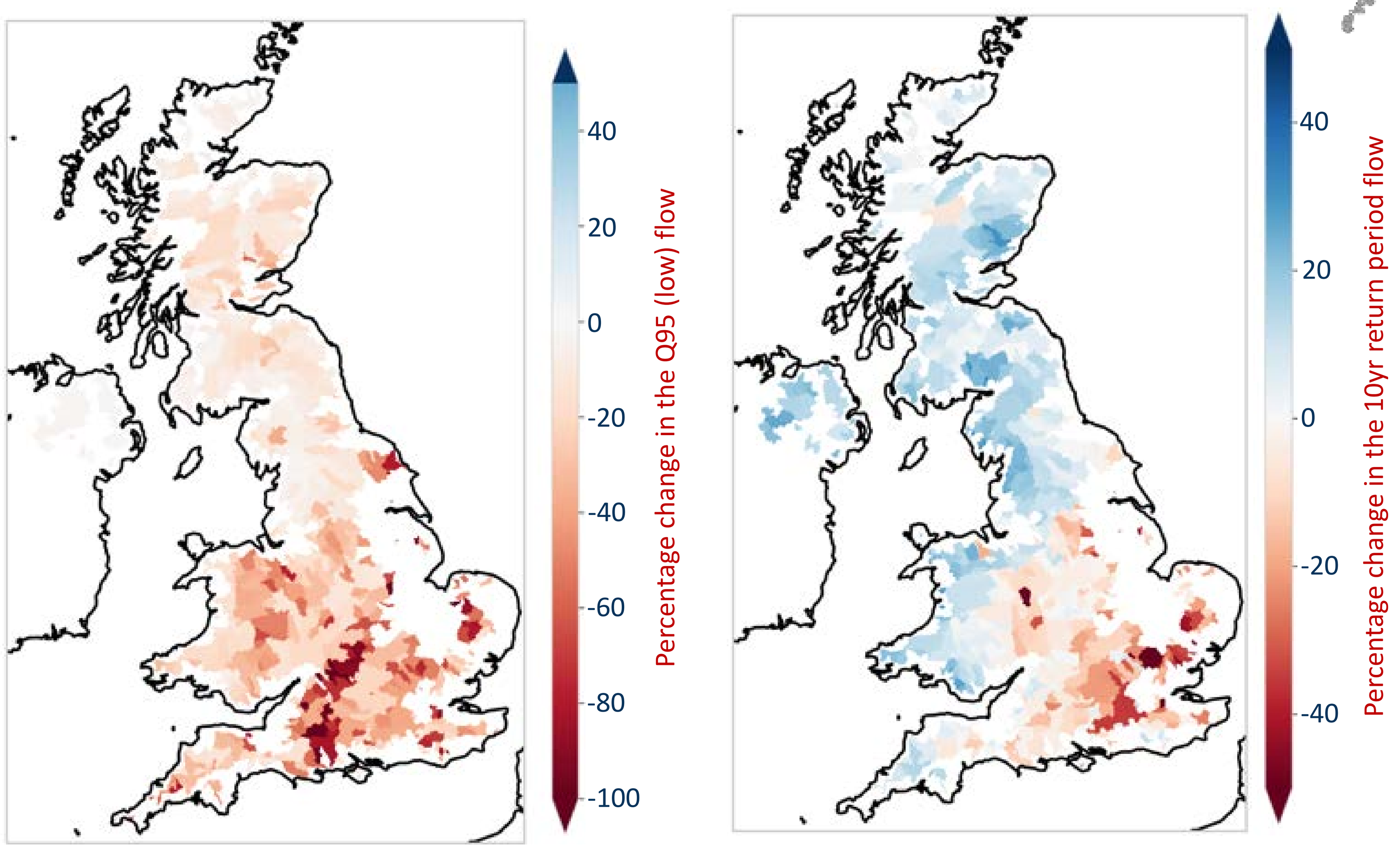




Counterfactual Meteorology
Relative to factual simulations.

Expectations

- A 2°C climate will have warmer, wetter winters and hotter, drier summers.
- Previous modelling suggests lower low flows and higher high flows, with the southeast generally drier.
- *"If the 1976 drought occurred in 2030, it would be more severe across Britain".*



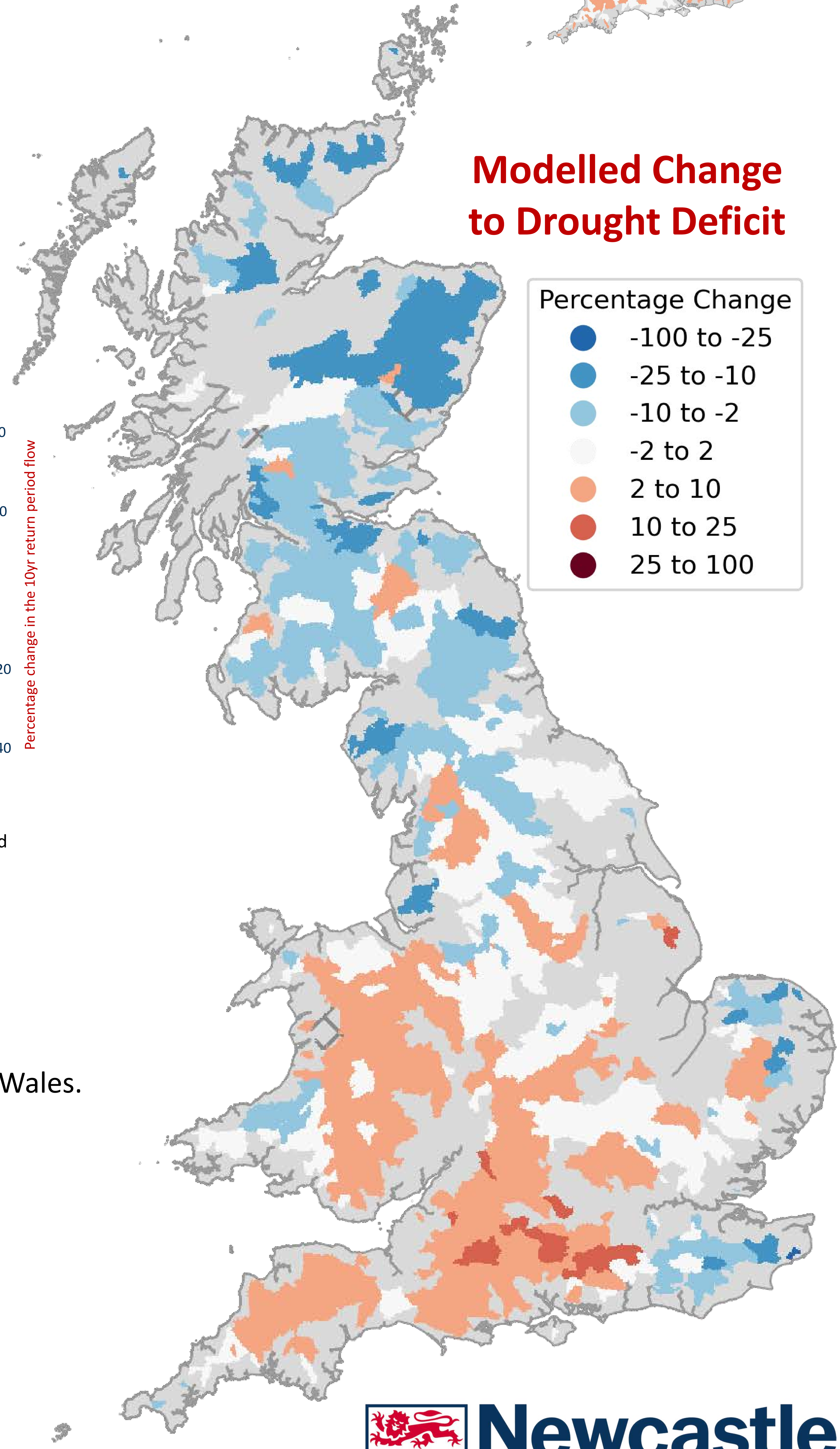
Previous modelling of low (Q95) and peak flows. Smith et al., 2024 - Physically Based Modelling of UK River Flows Under Climate Change

Initial Findings

- Modelled droughts over the 1976 summer period differ from long term UKCP18 projections (above).
- Droughts intensify in the southwest of England and Wales.
- Droughts lessen in Scotland and southeast England.

Next Steps

- Identify the drivers of flow responses.
- Investigate flow dynamics in 'wetting' catchments.
- Couple flows to a water resources model (WREW).



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Research Associate in Hydrology
With Anna Murgatroyd & Ellie McGrady

Newcastle University

The water efficiency problems we face

The amount of water we use has...

doubled in the last 60 years

...and, as our population grows and climate change persists, there is growing pressure on our water supply

The challenge is real, and requires action now from everyone. England faces a projected...
5 billion litre daily shortfall by 2055.

Average personal water use of 137 litres per day is among the highest in Europe. Around 15% of rivers are already over-abstracted. This is not a future risk, it requires action today.

An average household in England uses around **137 litres of water per day per person!**

Yet recent studies in EA's 'National Framework for Water Resources' show the public thinks they use around 20 litres.

Business water use is also rising and many businesses are not motivated to save water, despite a target of 9% reduction in business water use by 2038 in the Environment Act 2021.

There's a 1 in 4 chance over the next 30 years that households and businesses will experience water supply cuts

There are already ambitious plans to address the deficit including:

- Metering
- Leakage reduction
- New supply options like reservoirs
- Water recycling
- Upgrades to water treatment works

However...

over half of what's needed to fill the daily gap will need to come from reducing demand for water...

...around 2,000 million litres of water per day!

Introducing the Water Efficiency Campaign

The Water Efficiency Campaign (WEC) is an evidence-based, audience-led behaviour change campaign designed to help people across England and Wales value and use water differently in the public interest. It is funded via water companies under statutory obligations set through Ofwat's Price Review (PR24), with funding ringfenced specifically for this purpose and separate from individual company marketing activity.

'Let's Save Water' is the public-facing campaign delivered under the WEC. The WEC is administered and implemented by 23red Collective, an independently appointed Delivery Body, selected through a competitive procurement process to deliver the campaign on behalf of the 16 water companies. The campaign operates within a clear governance framework, with joint oversight from the water companies and public interest bodies including Ofwat, Defra, the Environment Agency, the Welsh Government and Natural Resources Wales.

It will be launching this summer- watch this space as you won't miss it!

Want to know more? Get in touch with our stakeholder team:
Stakeholder@ofwat.gov.uk

Ofwat

Water Efficiency Campaign

A Dry Topic? Learning from the past through archival histories of ’76 and creative community workshops

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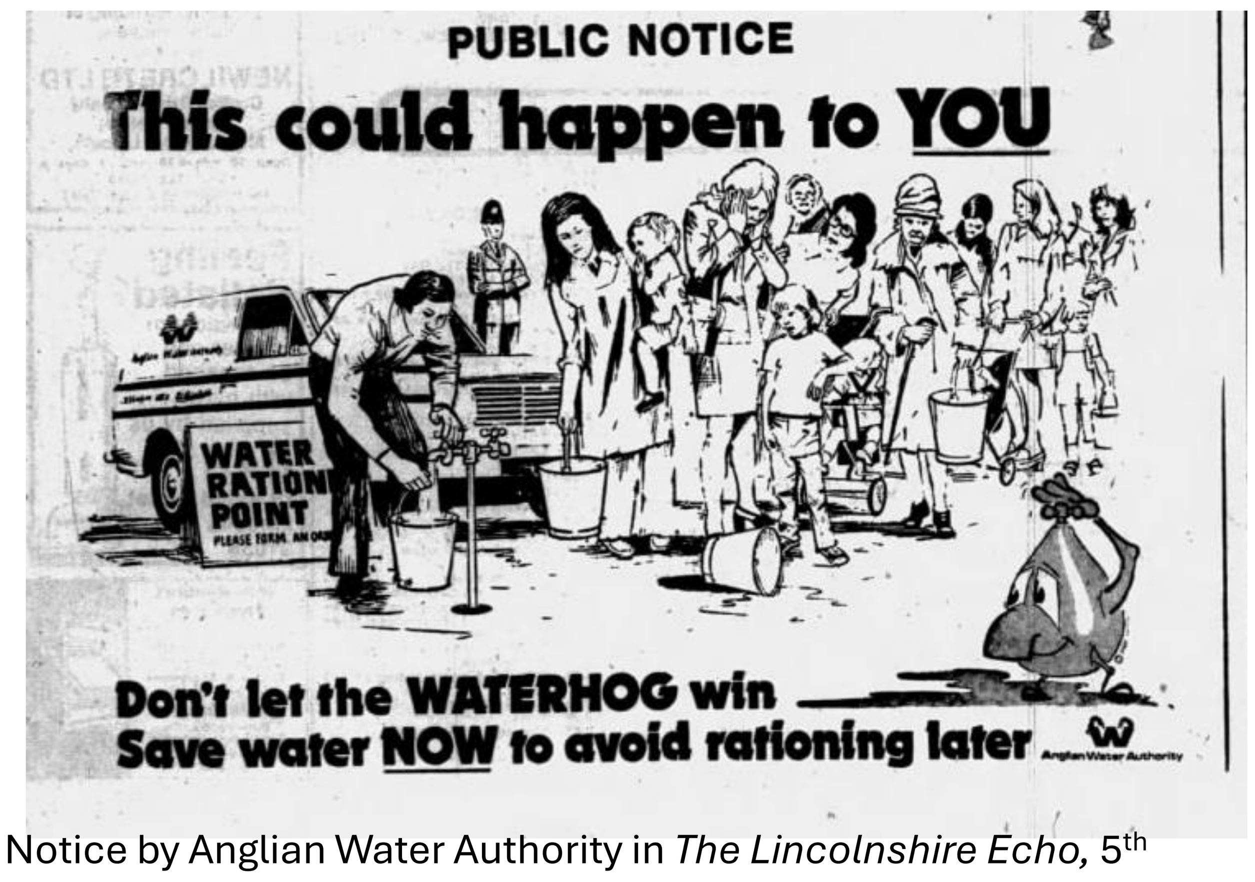
Supervisors
Prof. Briony McDonagh
Dr Gill Hughes
Dr Ed Brookes

Notice by Yorkshire Water Authority in *The Yorkshire Post*, 3rd September 1976



Notice by Anglian Water Authority in *The Lincolnshire Echo,* 5th August 1976

Creative Community Workshops

- Workshops have so far been conducted in five locations across Yorkshire (Hull, Hebden Bridge, Riddlesden, Richmond, and Goole)
- Following pilot engagement activities, the chosen creative methods were collage or creative writing
- The creative activity was used as a stimulus to encourage critical reflections on how households would cope with a drought requiring severe restrictions now

Summary of doctoral project

This doctoral project seeks to

1. understand what archival sources can tell us about the expected role of households during the 1976 drought and how domestic users coped with water restrictions and the threat of water rationing, with a focus on Yorkshire.
2. explore to what extent we can use these archival histories creatively in community engagement settings to learn from the past to prepare for future severe and extreme droughts

How did the voluntary savings campaign characterise domestic consumers?

- The voluntary savings campaign launched by the Regional Water Authorities (RWAs) and the National Water Council appealed to the sense of civic duty of citizens.
- The campaigns tended to imagine the consumer as a rational actor
- Although appeals were often aimed at a male coded ‘householder’, the regular labour of water-saving was regarded as a task predominantly for women in the home
- There was the assumption that female labour would provide the flexibility to cope with interruptions to supply to domestic consumers

Community workshop in Goole. May 2026.

“Use Washing Machines Less Often
Ask your Mum to wait until she has a full load of washing before using her machine. If she is used to washing two or three times a week, she should try to cut down to once or twice a week minimum”

Turn Taps Off Tightly
Make it your personal job to go around the house making sure that all taps are turned right off. If a tap keeps on dripping ask Dad to call the plumber – now”

Thames Water Authority *‘I’m a water saver’* Leaflet for schoolchildren – The National Archives: FV 39/11

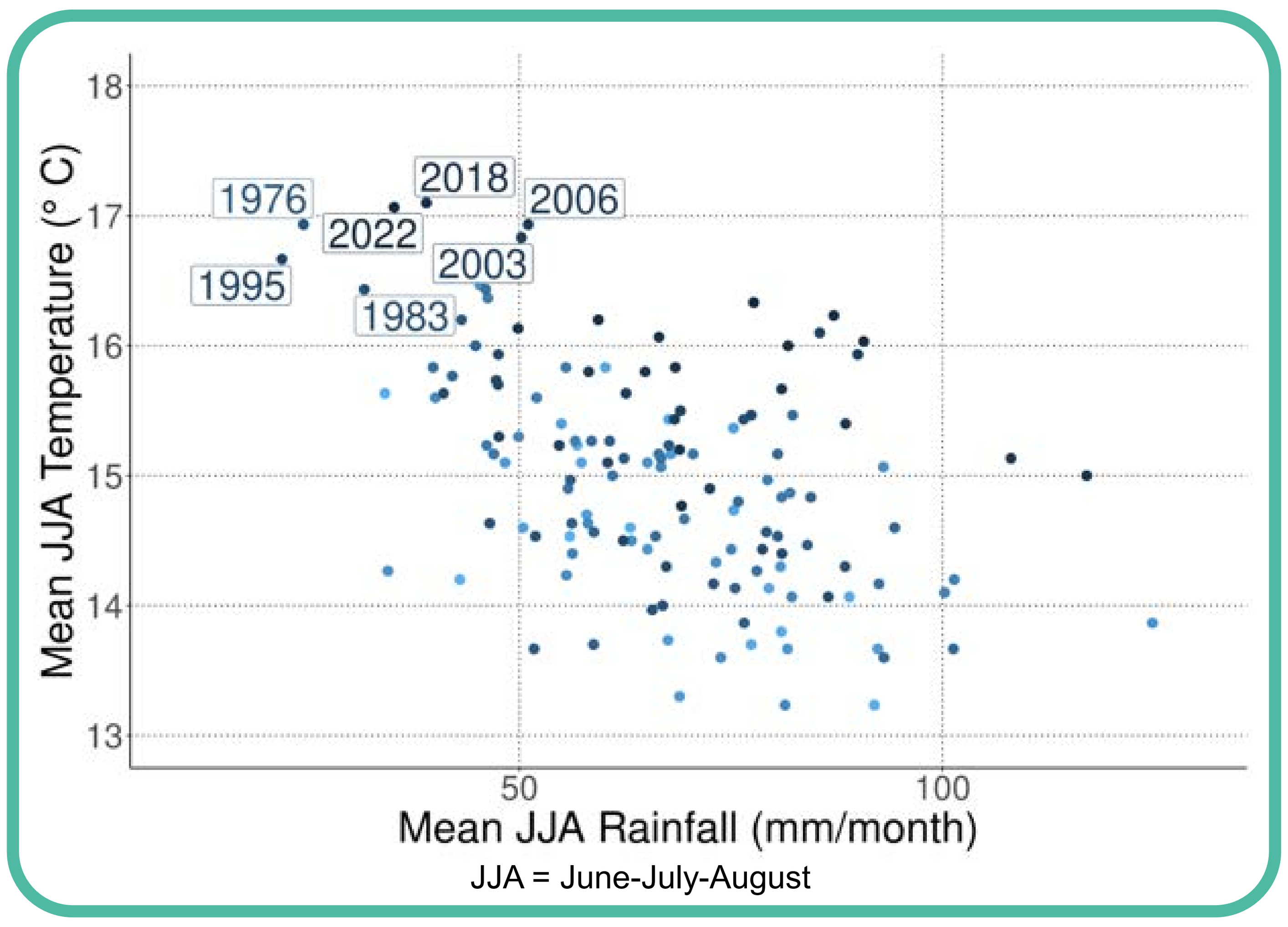
Collage produced at a workshop in Riddlesden. June 2026.

The changing probability of hot and dry summers in England

Isabel Rushby[1], Philip Sansom[1], Joe Osborne[1], Richard Davis[2], Julie Morris[2]

Background

- Extreme hot days and heatwaves can significantly increase water demand, placing additional stress on water resources and the environment, particularly during drought events.
- The UK climate projections suggest that summers in England will be both hotter and drier in the future, but summers have recently become hotter and slightly wetter.
- Even without significant changes in the probability of dry summers over past decades in the UK, the increasing temperature trend is impacting the joint probability of hot and dry summers. This affects the probability of certain hydrological conditions, such as the drought conditions seen in 2022, occurring.
- The changing probability of the historical hot-dry events of 1976 and 2022 have been studied before, however there are other hot-dry summers (for example, 2003 and 2006) which historically have been notable events with short term impacts.
- For water resource planning, it is useful to understand whether summers at least as hot and dry as these challenging events are more likely to occur due to climate change.



JJA = June-July-August

Research questions

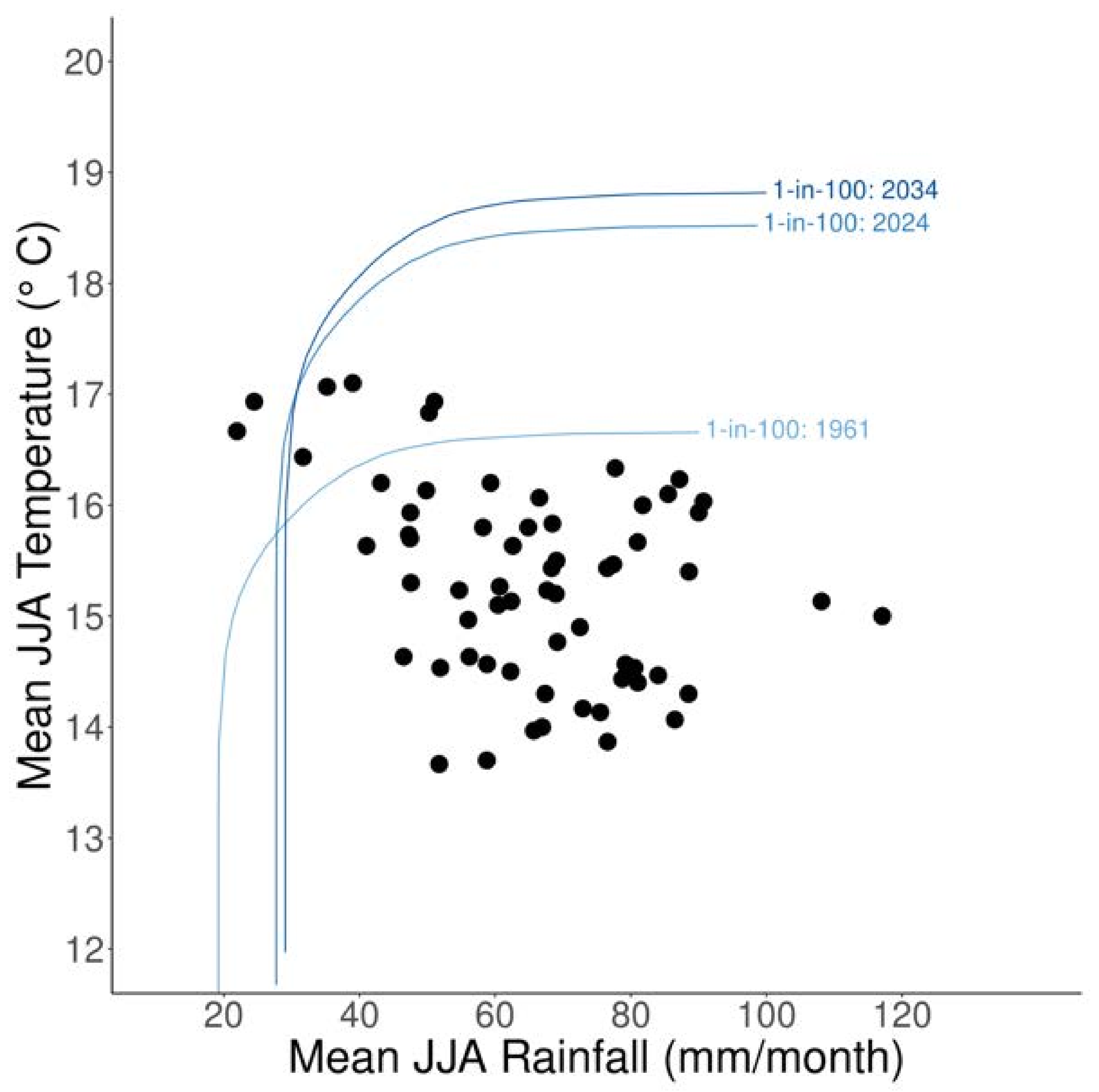
1. How have the joint probabilities of events at least as hot and dry as key historical summers (1976, 1983, 1995, 2003, 2006, 2018, and 2022) changed?
2. How are these probabilities expected to change over the next ten years?

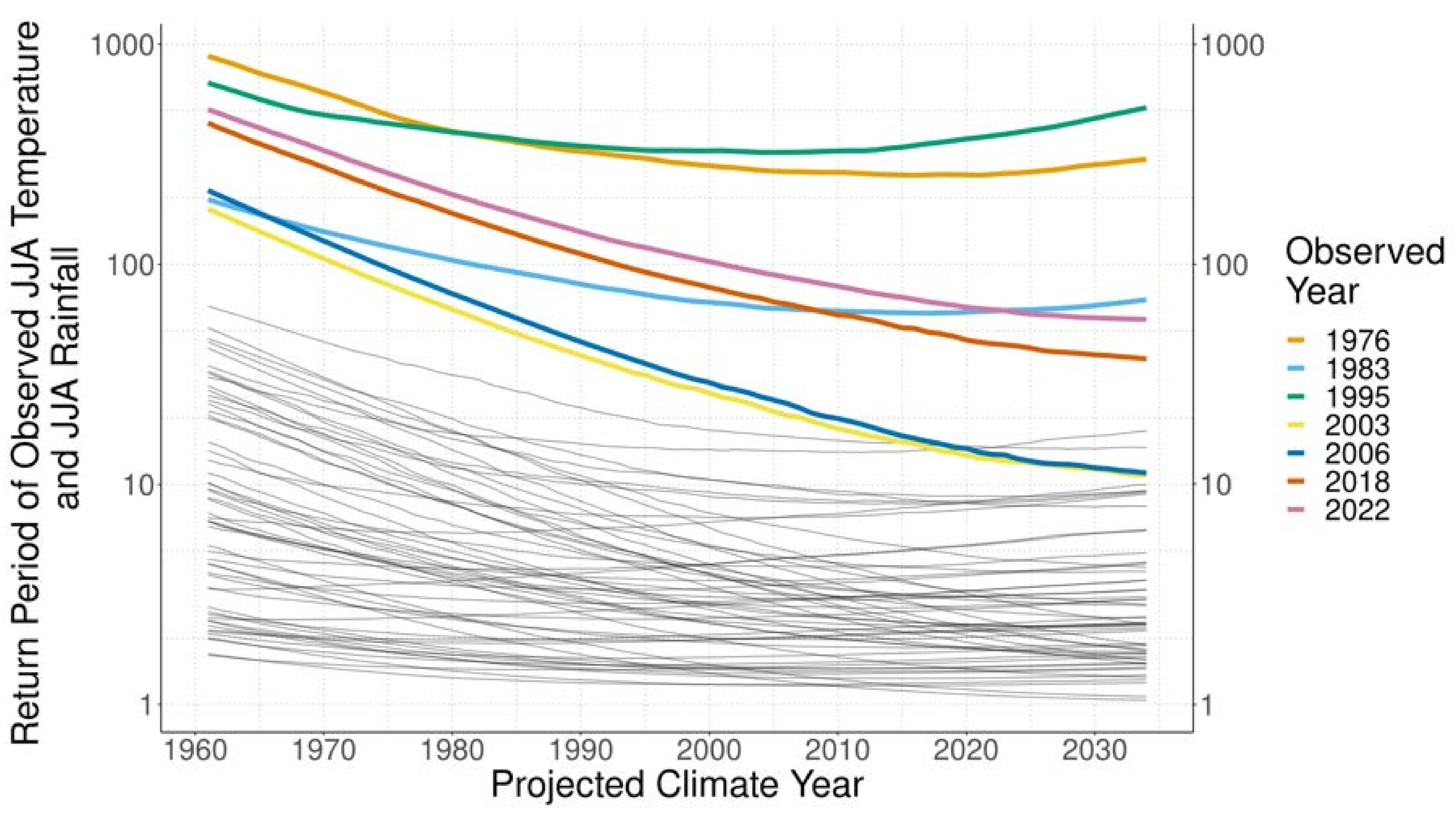
Method

Observations and climate model data + Trends fit to temperature and rainfall time series + Statistical multivariate extreme value analysis; conditional extremes models = Changing probabilities of observed hot-dry summers in both historical and future years

Results

The probability of hot-dry conditions has increased over recent years and will continue to do so, driven primarily by the temperature trend.





- A 2018-like event (in terms of summer-average temperature and rainfall) is 10 times more likely to occur in 2024 than it was in 1961.
- A 2018-like event now has a return period of 43 years, expected to become 37 years in 2034.
- However, the probability of some particularly dry summers has decreased in recent years, due to the slight observed increase in summer precipitation, although this trend is expected to reverse in coming decades as summers become drier, as well as hotter.

The findings of this study will support the Environment Agency to understand the changing probability of a range of historical hot-dry events, in order to assess and better plan for present-day challenges in drought management.

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