Photo by Francesco Ungaro

UK Groundwater Drought: Historical Perspectives Re-examined

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Hydro-JULES

UK Centre for Ecology & Hydrology

British Geological Survey

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Drought, Groundwater and the UK.

What is a drought?

Generally accepted as:

However!

normal conditions

(Lloyd-Hughes 2014, p.g. 607)

Drought is also:

Unique

The hydro-meteorological factors that drive drought are unique.

+

The experiences of drought vary due to the anthropogenic context.

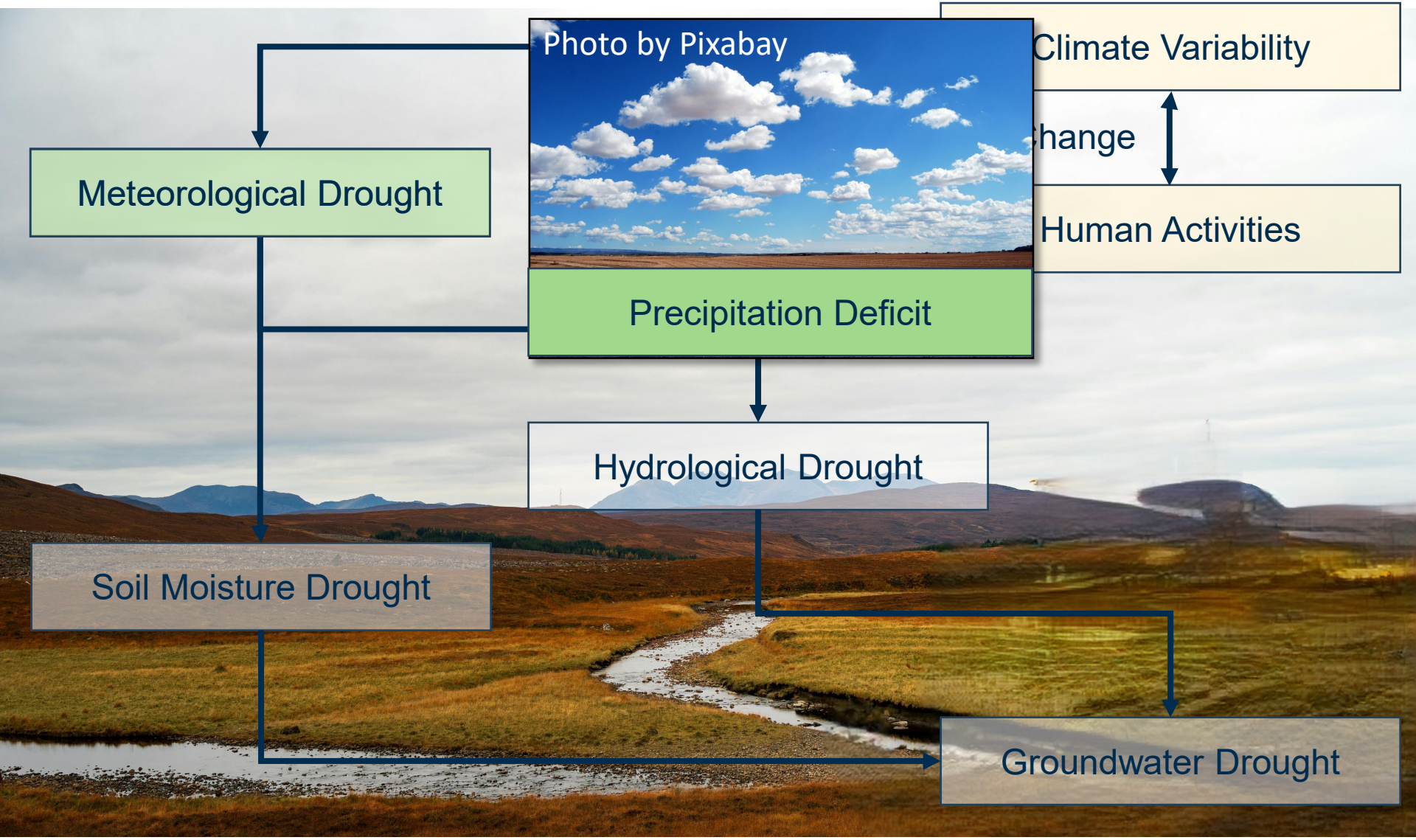
↓

Drought, as a phenomenon, is therefore complex and presents a multifaceted issue [1,2].

Drought Propagation

Photo by Michał Robak

Theme 1: Drought, Groundwater, and the UK



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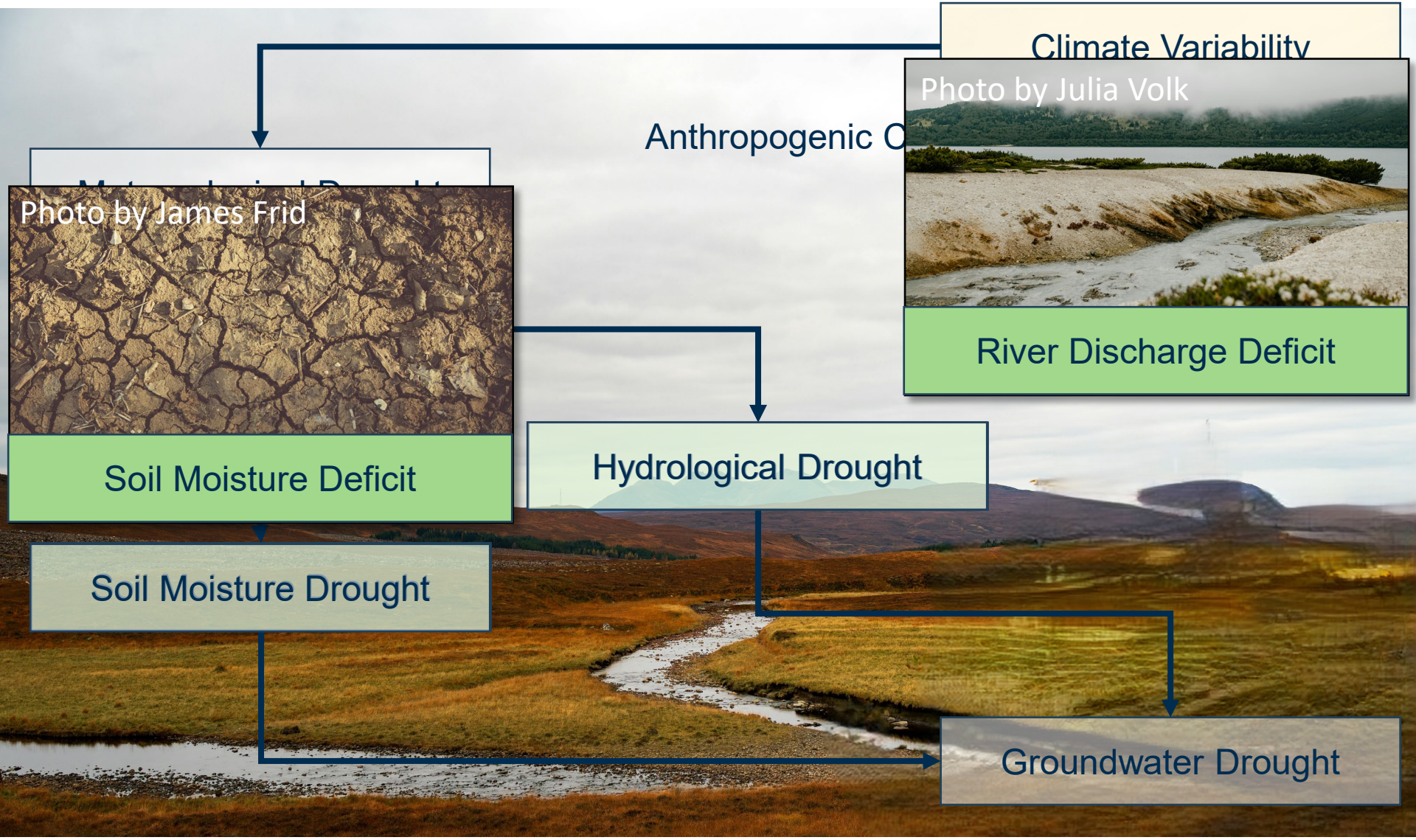

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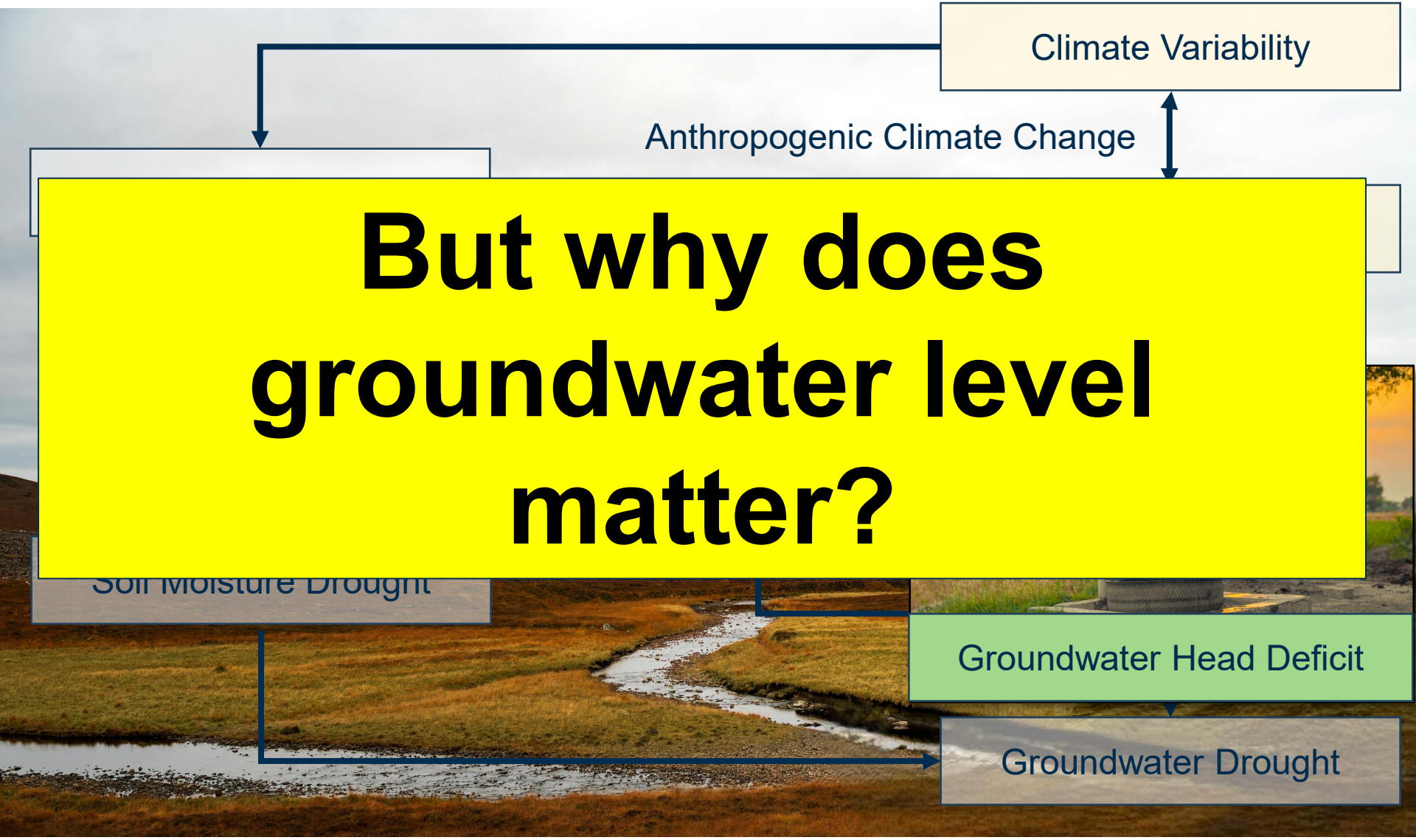

Groundwater Importance

- It is the largest active freshwater store, reflecting a 1/3 of the global freshwater supply [3,4].
- The primary source of the daily water needs for 2.5 billion people [3,4].
- Groundwater supply acts as a damper for streamflow, retaining precipitation and delaying its release into river networks.
- Buffer against hydro-climatic variations

UK Groundwater

- Groundwater provides a service valued at £8 billion to the UK Economy [3,4]
- Supporting a 1/3 of the water supply in England, a value of ~7million m^3/day
- The UK's groundwater is assessed by 895 observation boreholes, which span the mainland of the UK [3,4].

× 2800

Olympic-sized swimming pools

UK Groundwater

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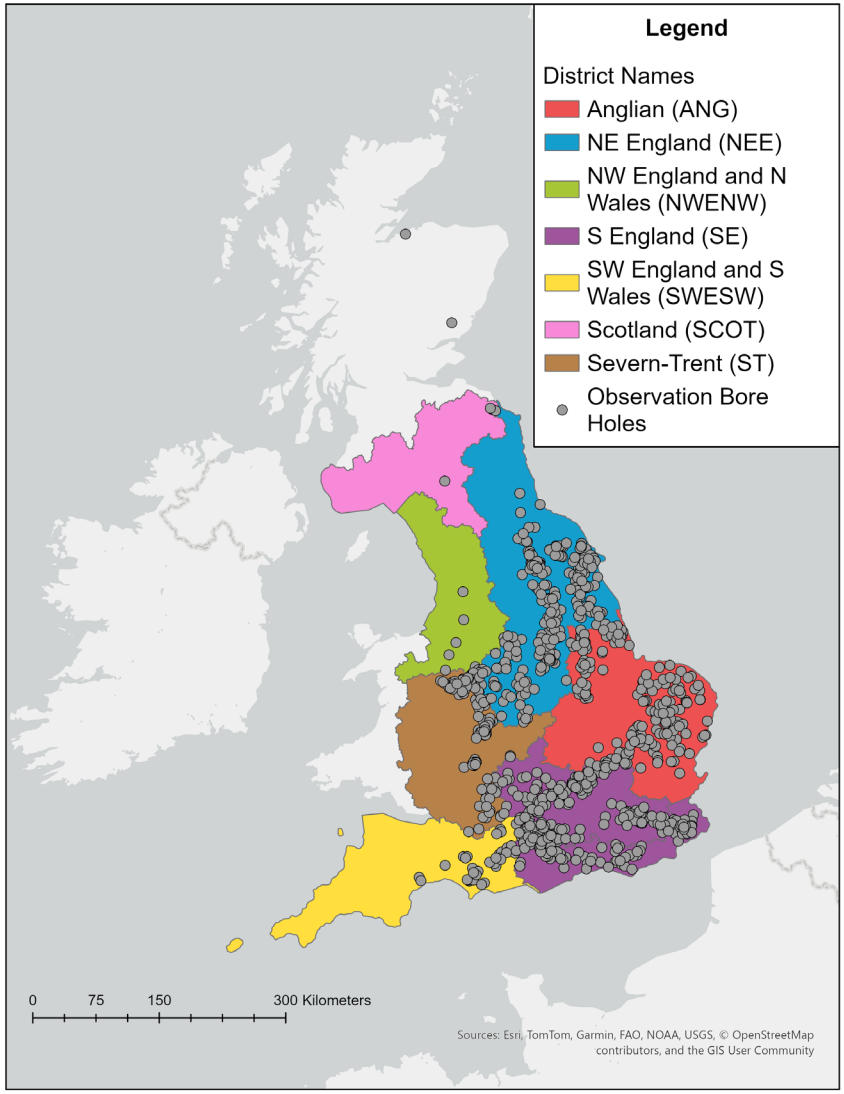
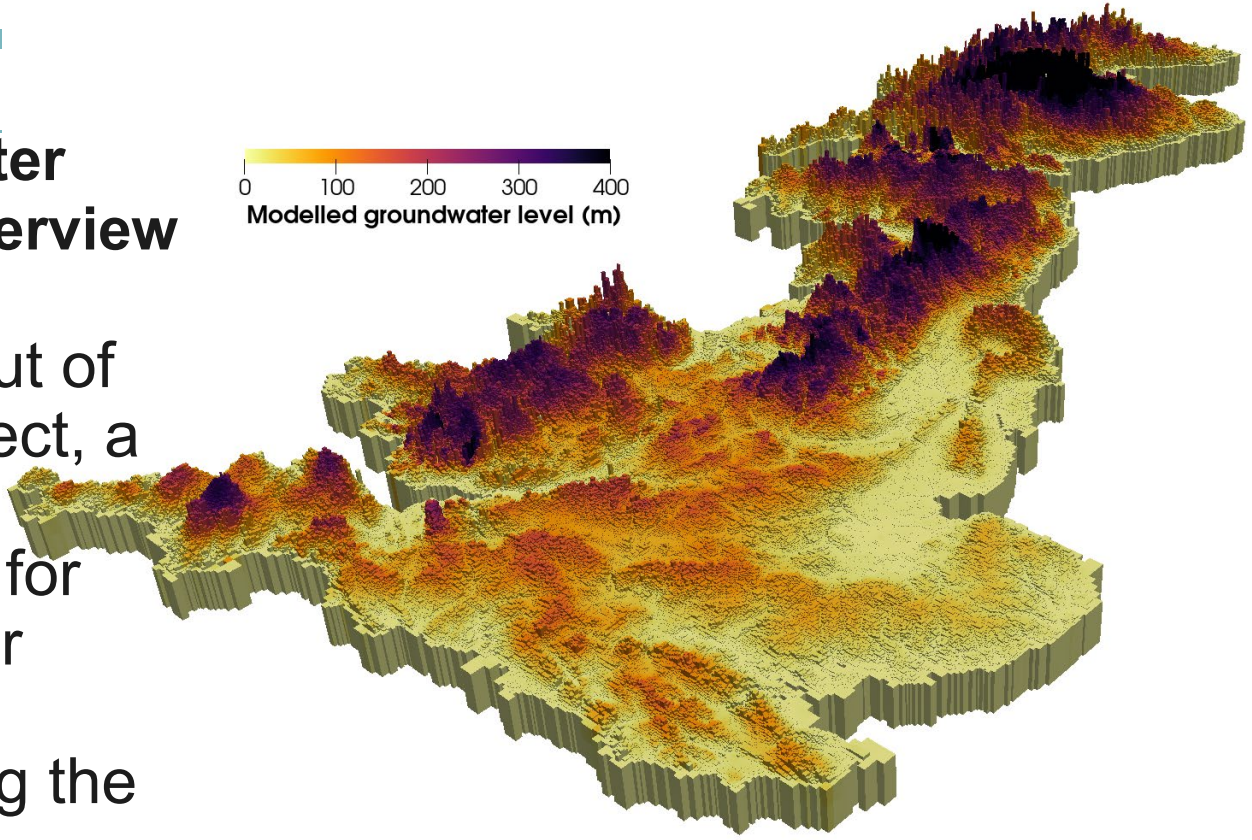
- Supporting a 1/3 of the water supply in England, a value of ~7million m^3/day [3,4]
- For this study, the UK's groundwater is assessed by a sub-selection 895 observation boreholes, which span the mainland of the UK.



Study Background

The British Groundwater Model (BGWM): an Overview

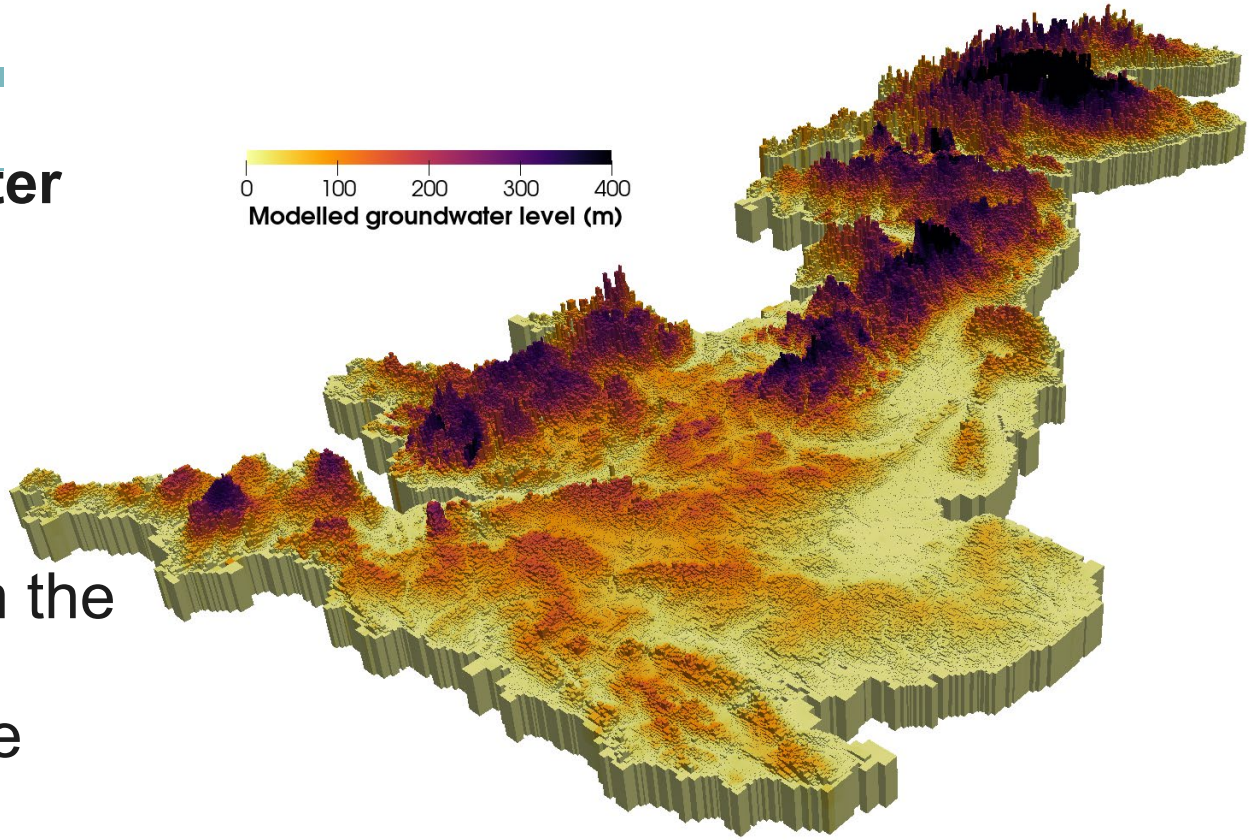


The BGWM is an output of the Hydro-JULES project, a numerical model that provides a unique tool for simulating groundwater drought resources at a national scale, covering the mainland UK.

British Groundwater Model

Bianchi, M., et al., *Simulation of national-scale groundwater dynamics in geologically complex aquifer systems: an example from Great Britain.* Hydrological Sciences Journal, 2024. 69(5): p. 572–591.

The British Groundwater Model (BGWM): Application

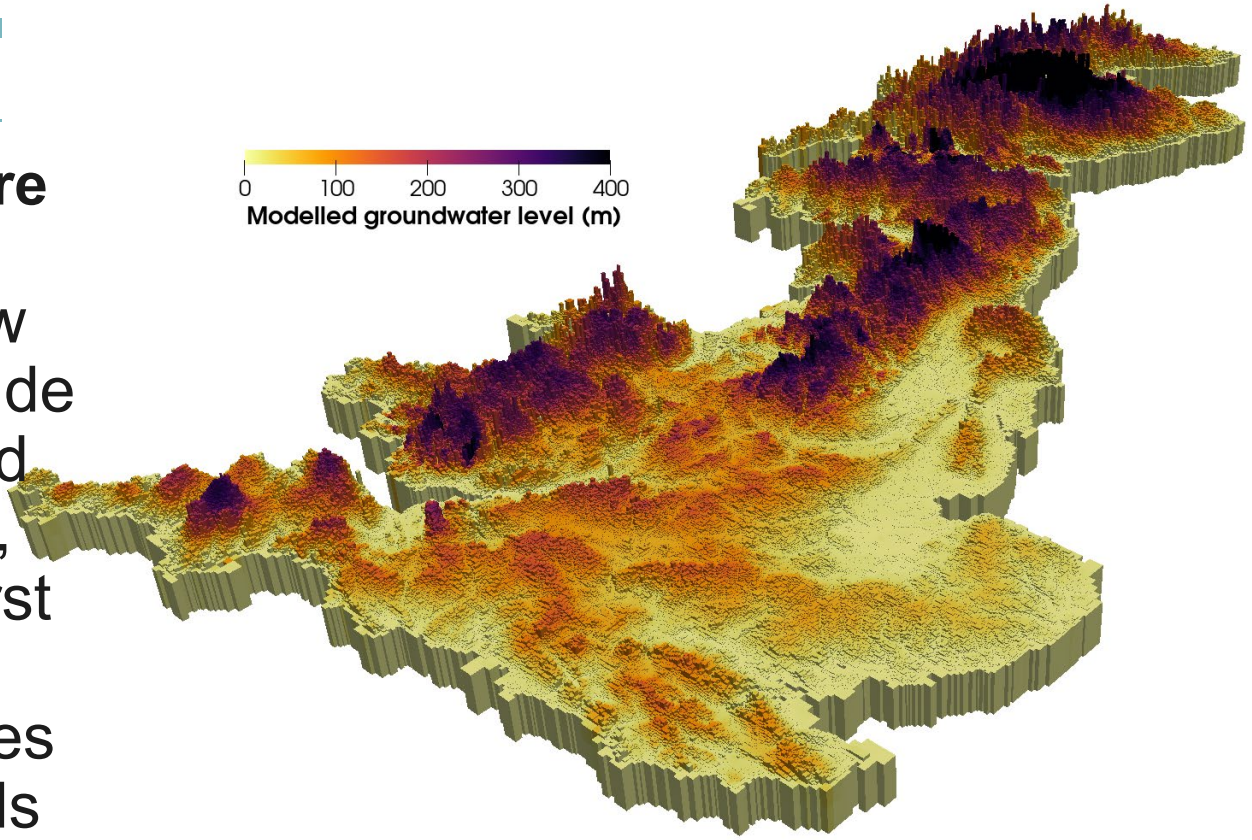


This project uses the simulated outputs of groundwater level from the British Groundwater to assess the ability of the BGWM to identify observed droughts.
It also assesses the ability of the BGWM to simulate the behaviour seen in observation boreholes.
This project also provides comments on the diagnostic drivers for the observed drought behaviour.

British Groundwater Model

Presentation Structure

The rest of this presentation will show these outputs alongside the work of Bloomfield and Marchant (2013), which is one of the first quantifications of groundwater resources during drought periods for the UK.



British Groundwater Model

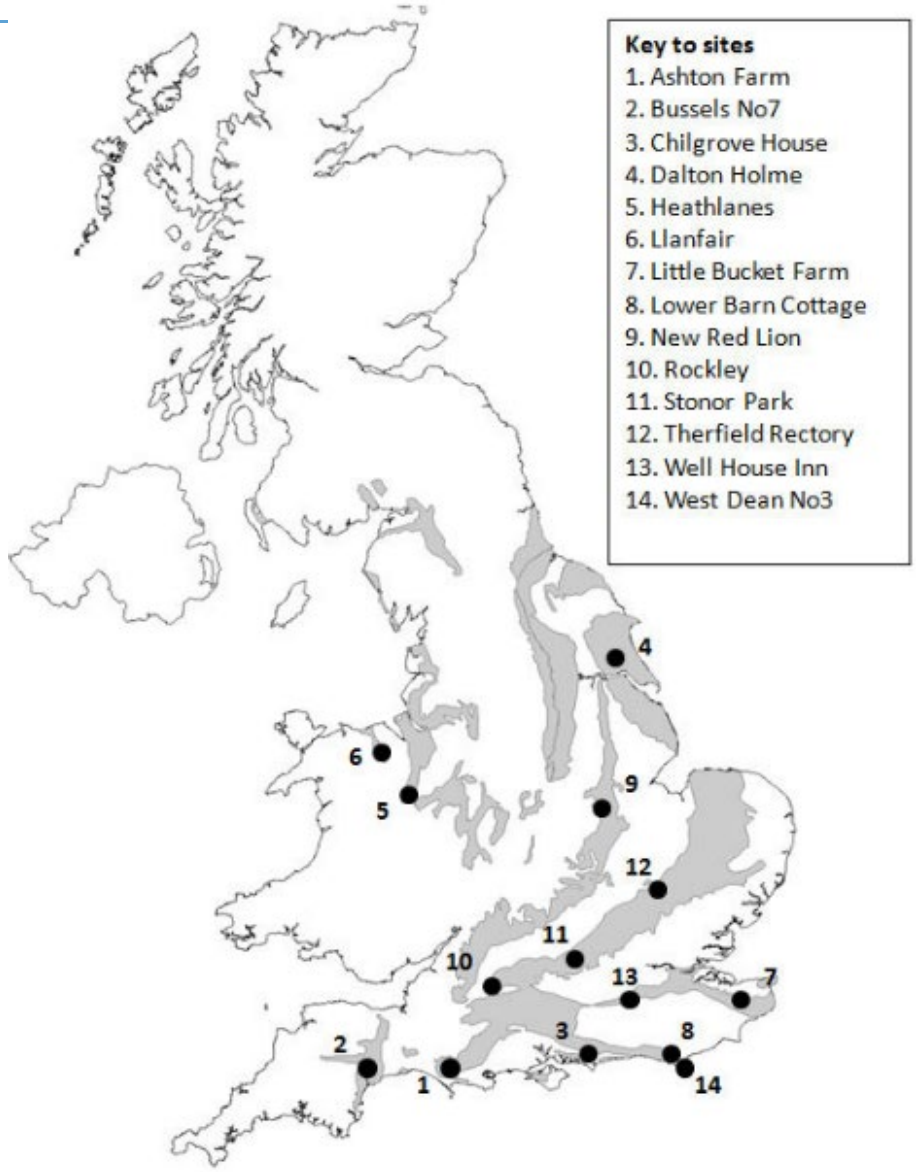
This project critically reviews the strengths of the BGWM in producing a holistic output of groundwater drought across the UK Mainland.

Current UK Understanding of Groundwater Drought

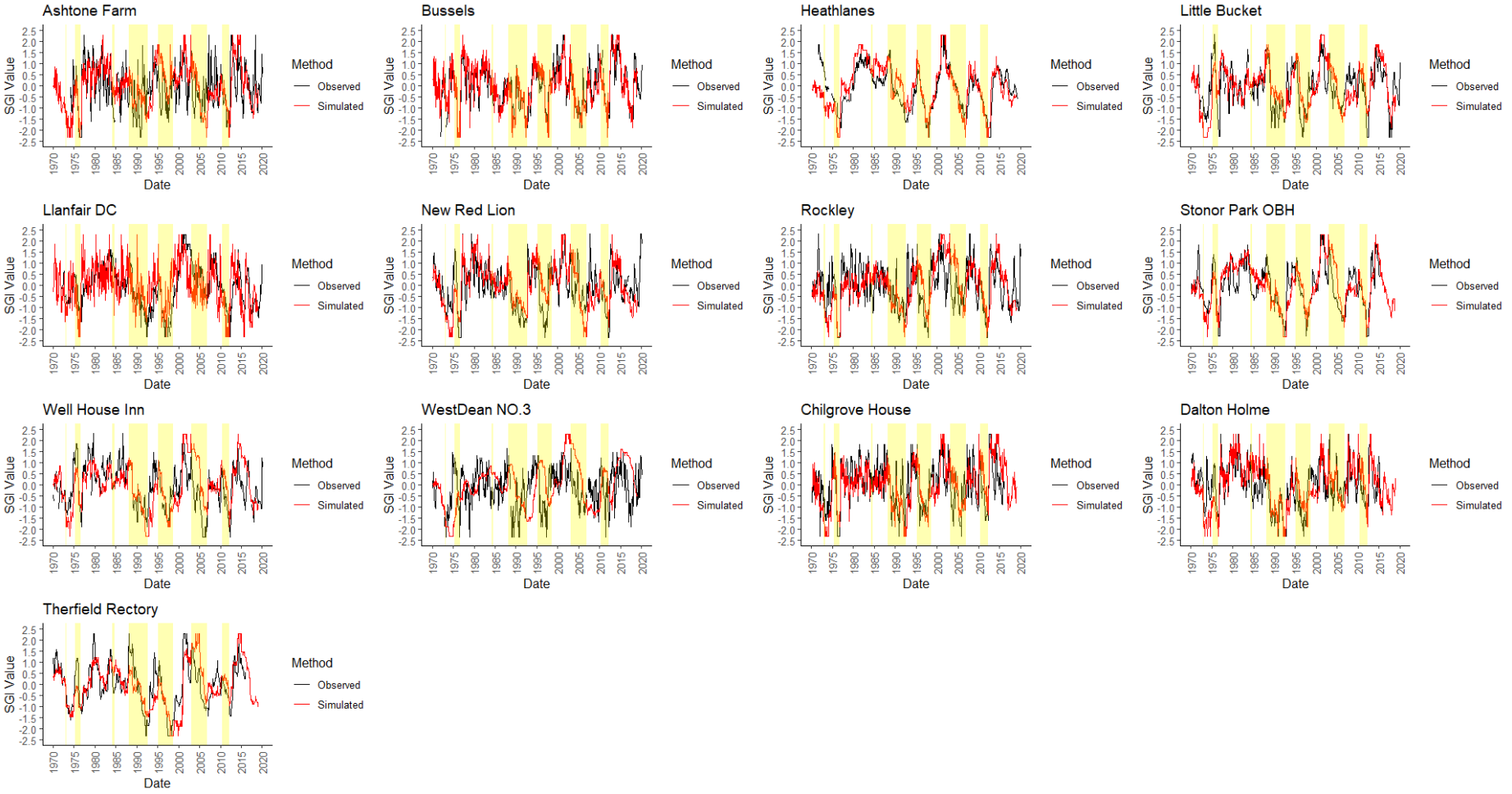
Bloomfield and Marchant (2013)

The paper sets out a practice to calculate the **standardised groundwater level index (SGI)**, a quantitative measure of the status of groundwater resources during a drought.

Bloomfield and Marchant (2013) applied this methodology to the 14 sites that are part of the UK's long-term observation network; their locations can be seen to the right.



Theme 3 - Current UK Understanding of Groundwater Drought



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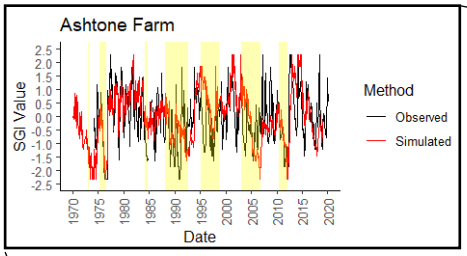

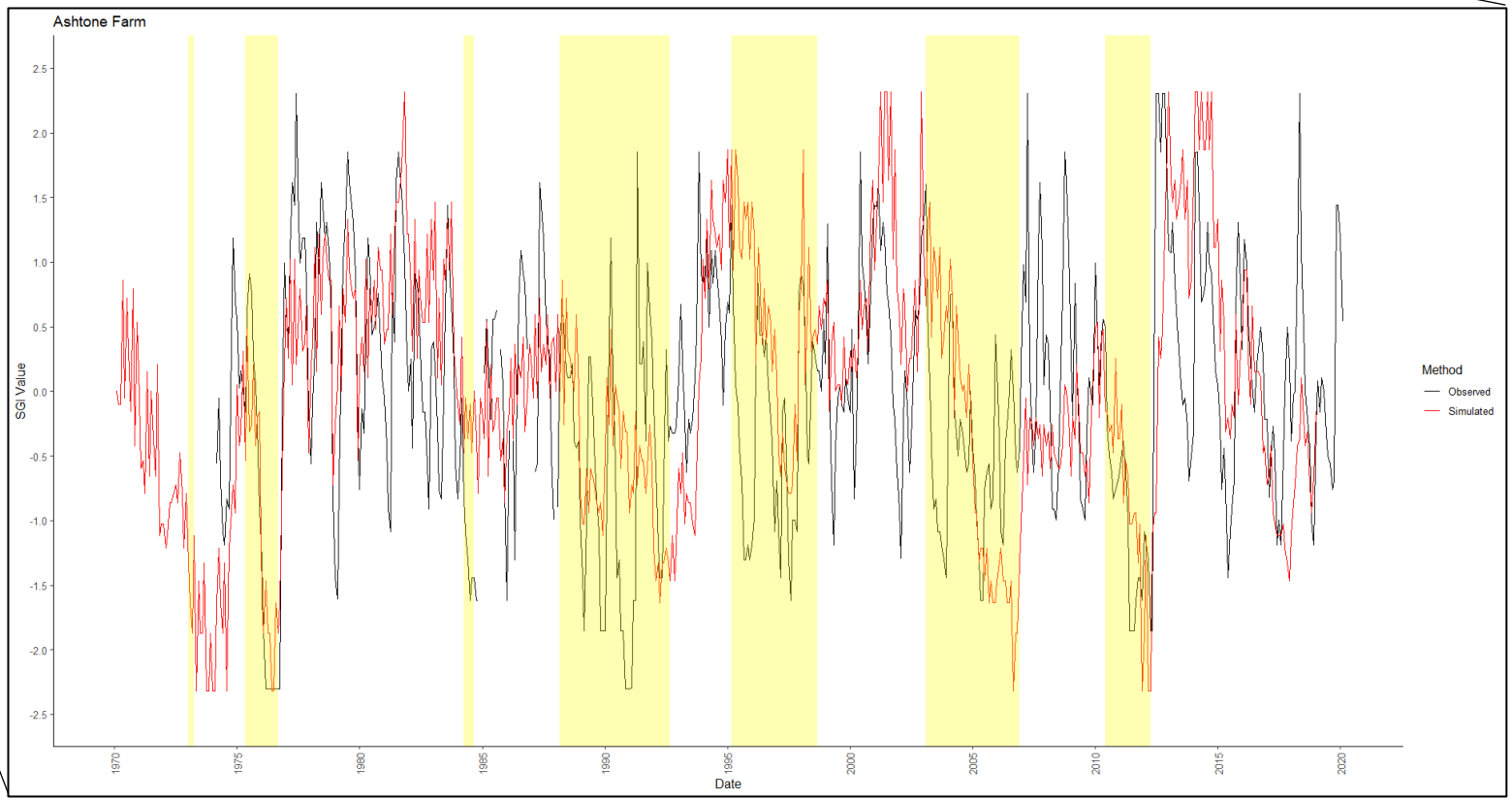

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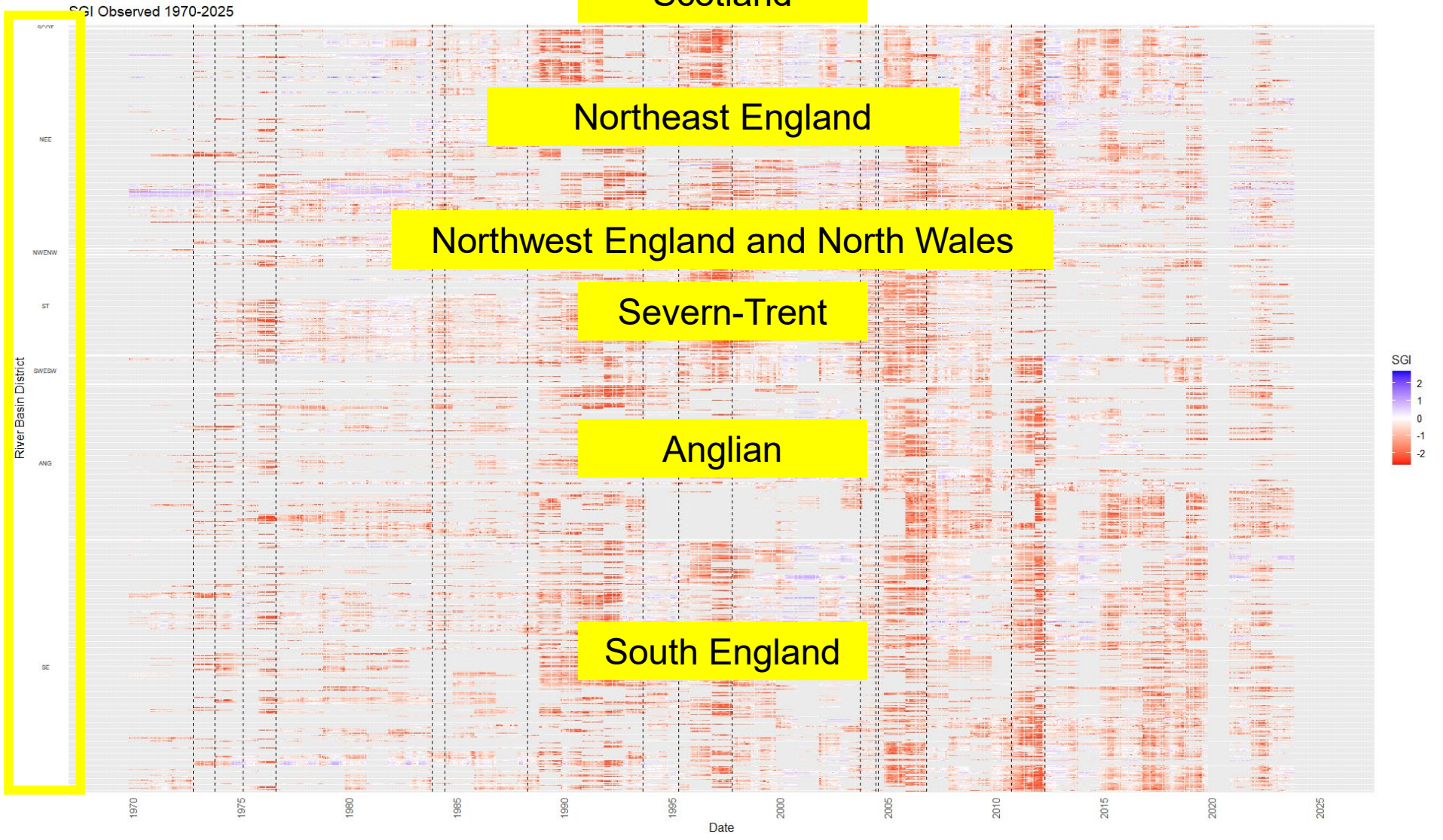

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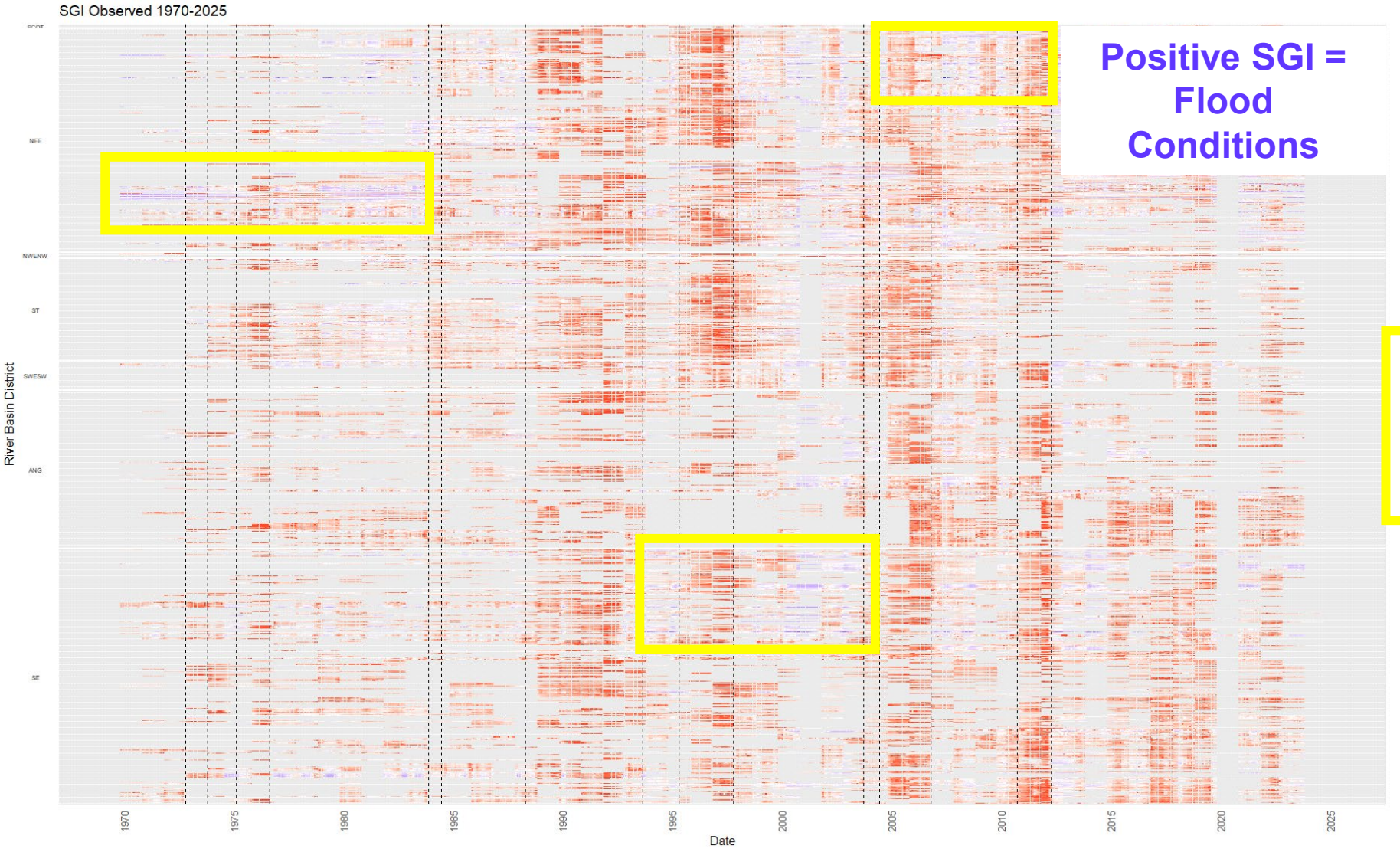

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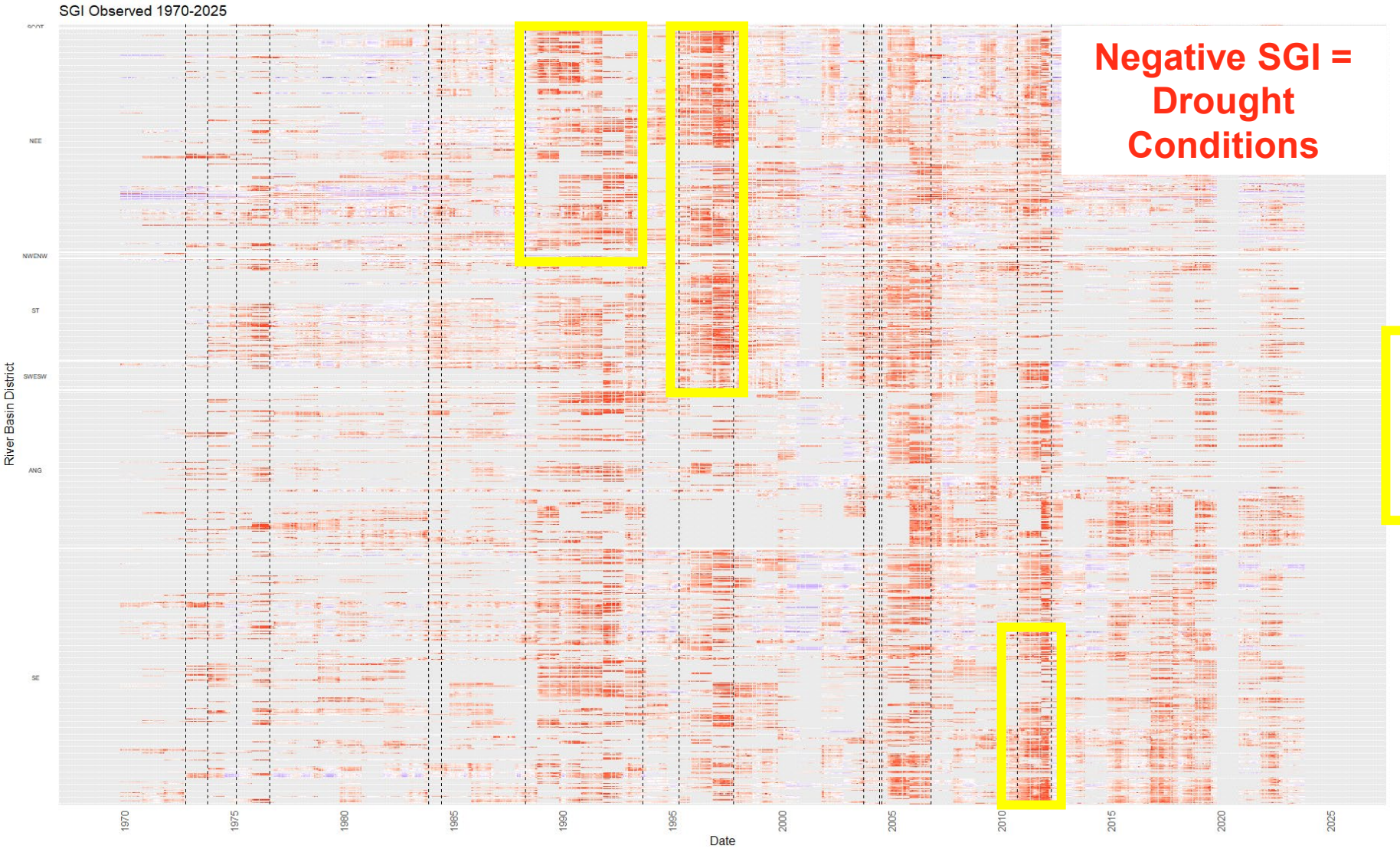

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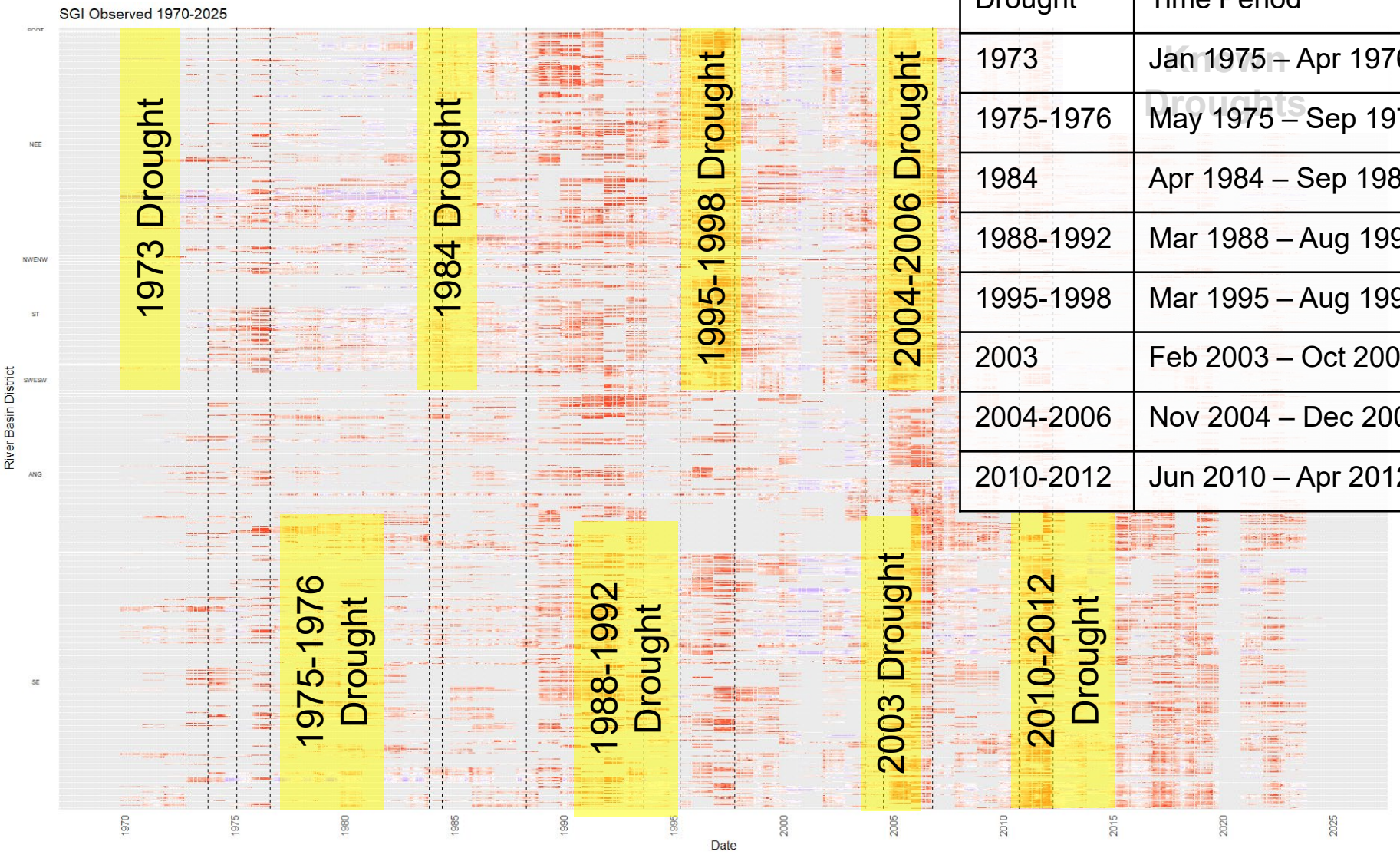

Drought	Time Period
1973	Jan 1975 – Apr 1976
1975-1976	May 1975 – Sep 1976
1984	Apr 1984 – Sep 1984
1988-1992	Mar 1988 – Aug 1992
1995-1998	Mar 1995 – Aug 1998
2003	Feb 2003 – Oct 2003
2004-2006	Nov 2004 – Dec 2006
2010-2012	Jun 2010 – Apr 2012

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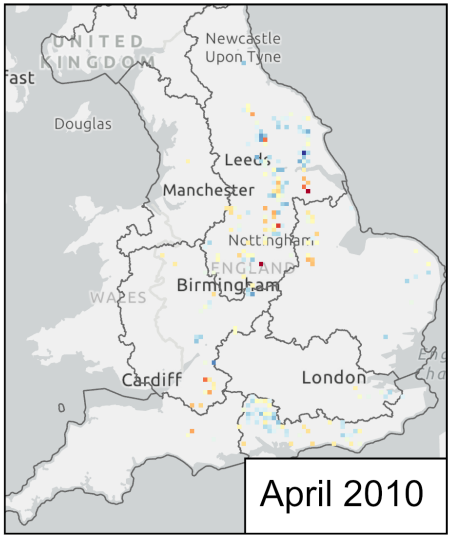
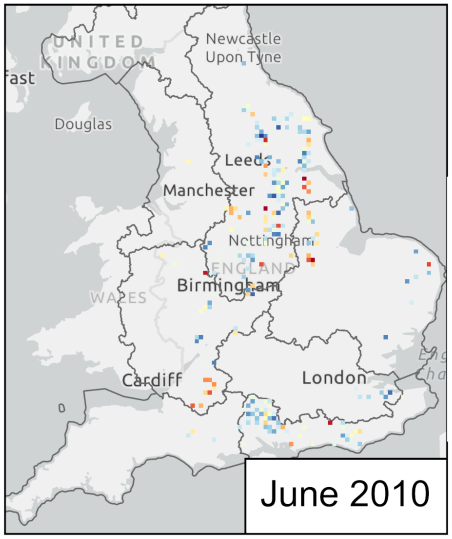




The 2010-2012 Drought: Observed

From Drought to Flood

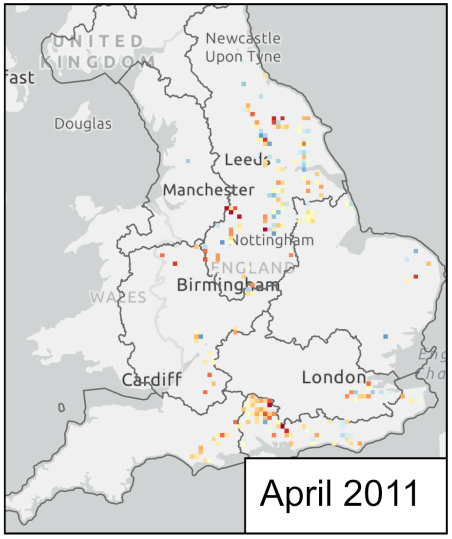
Legend

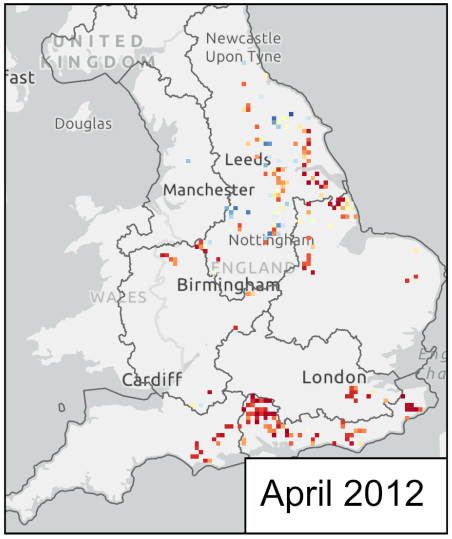
Standardised Groundwater Index (SGI)

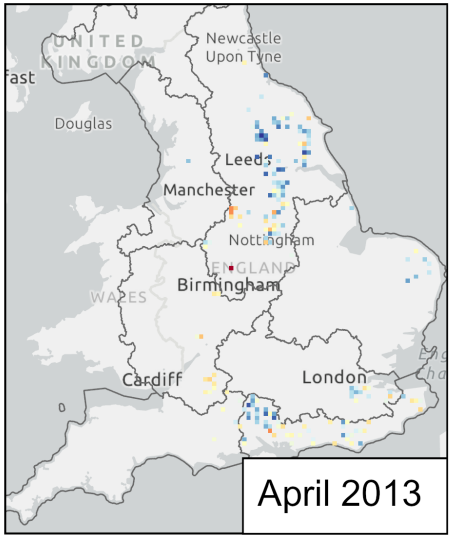
2.5

-2.5

Distrinct Boundaries







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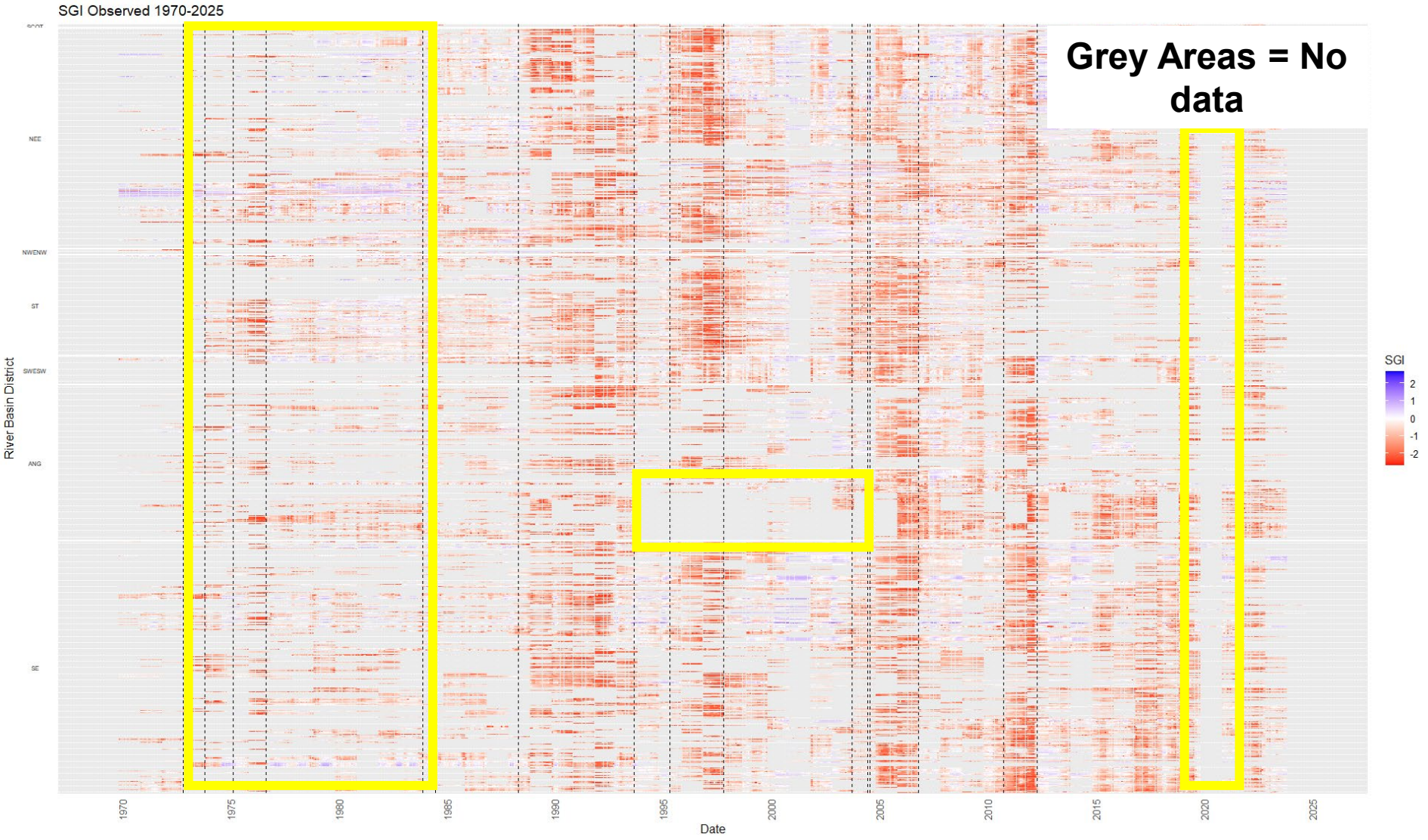

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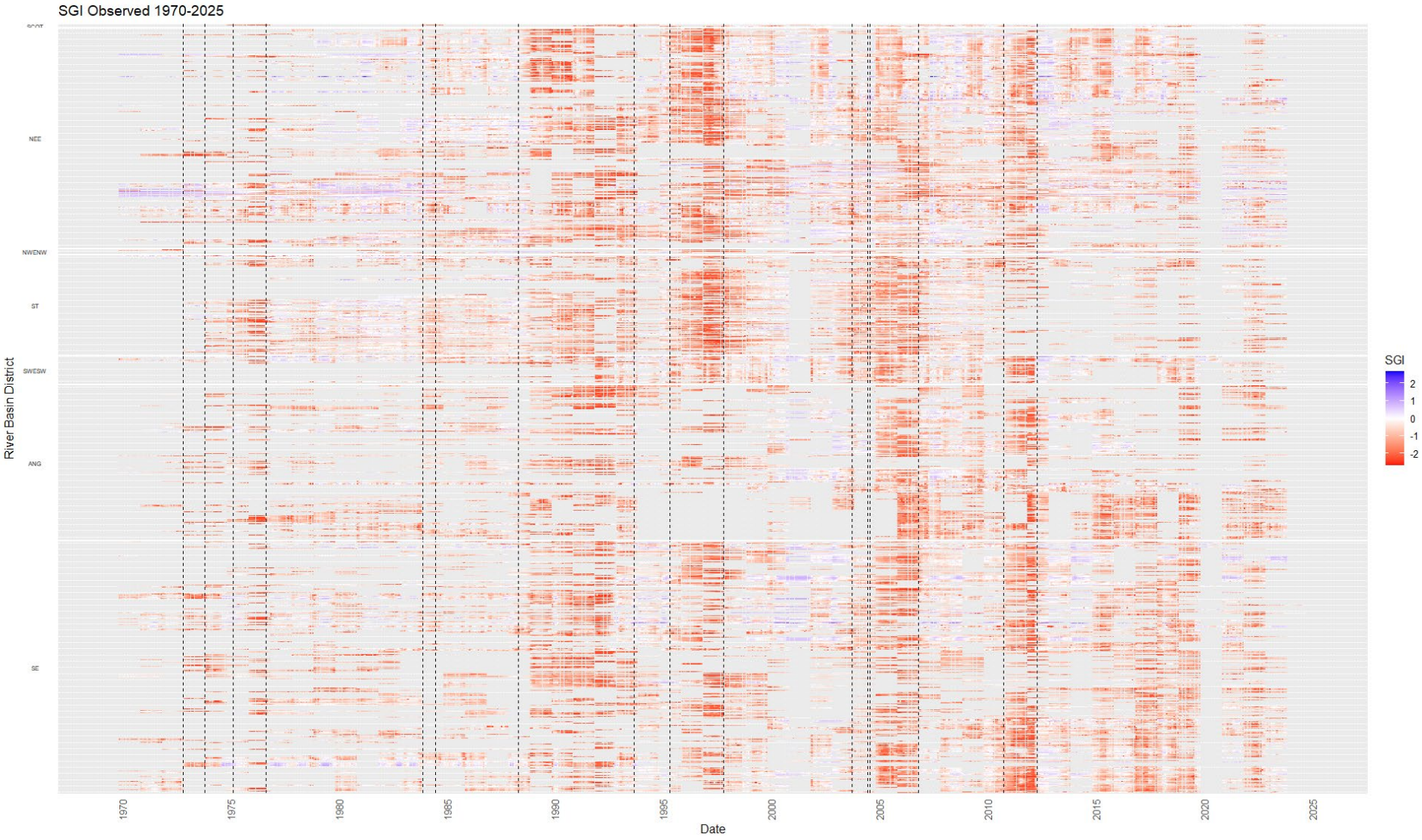
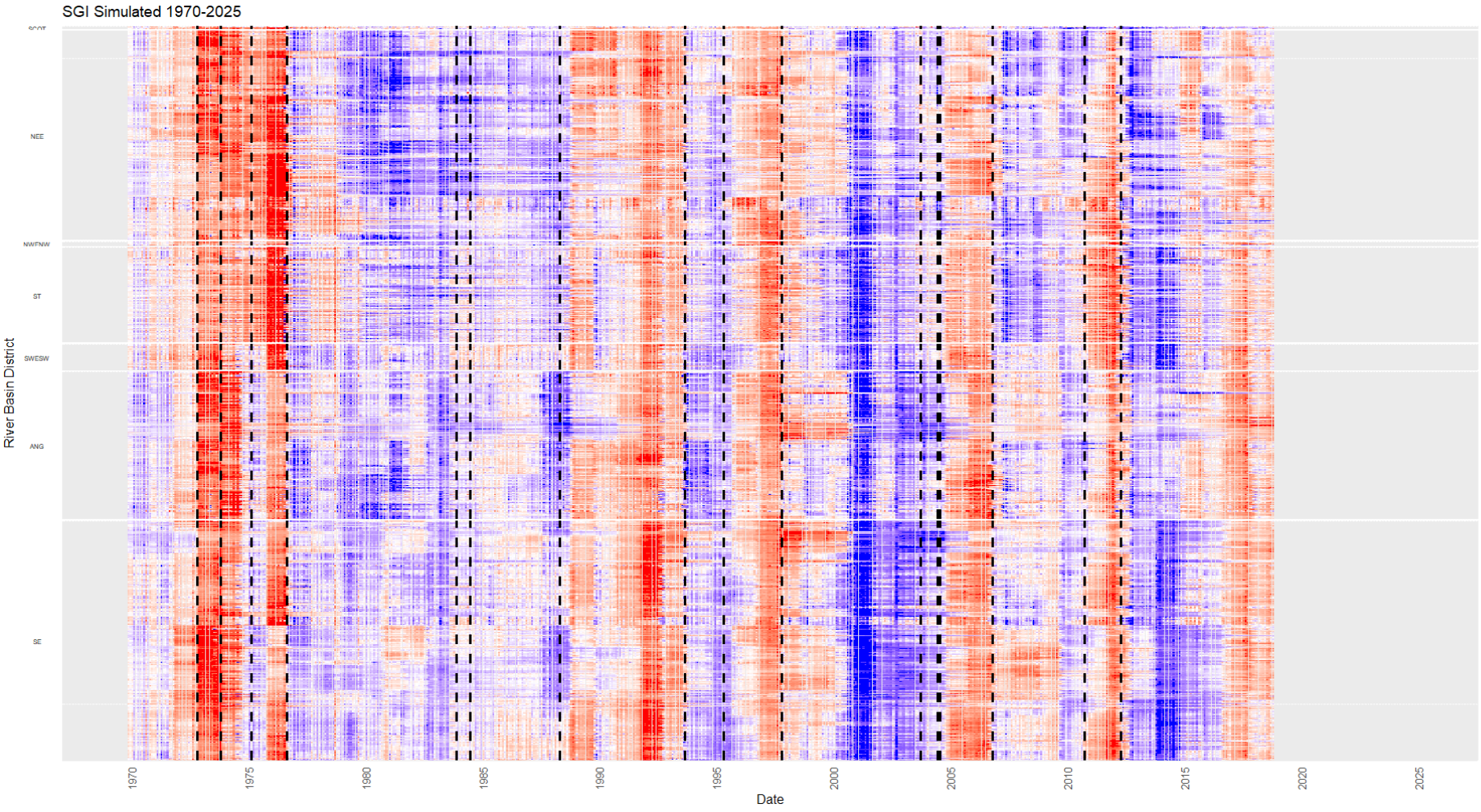


Theme 4 – A New Evaluation



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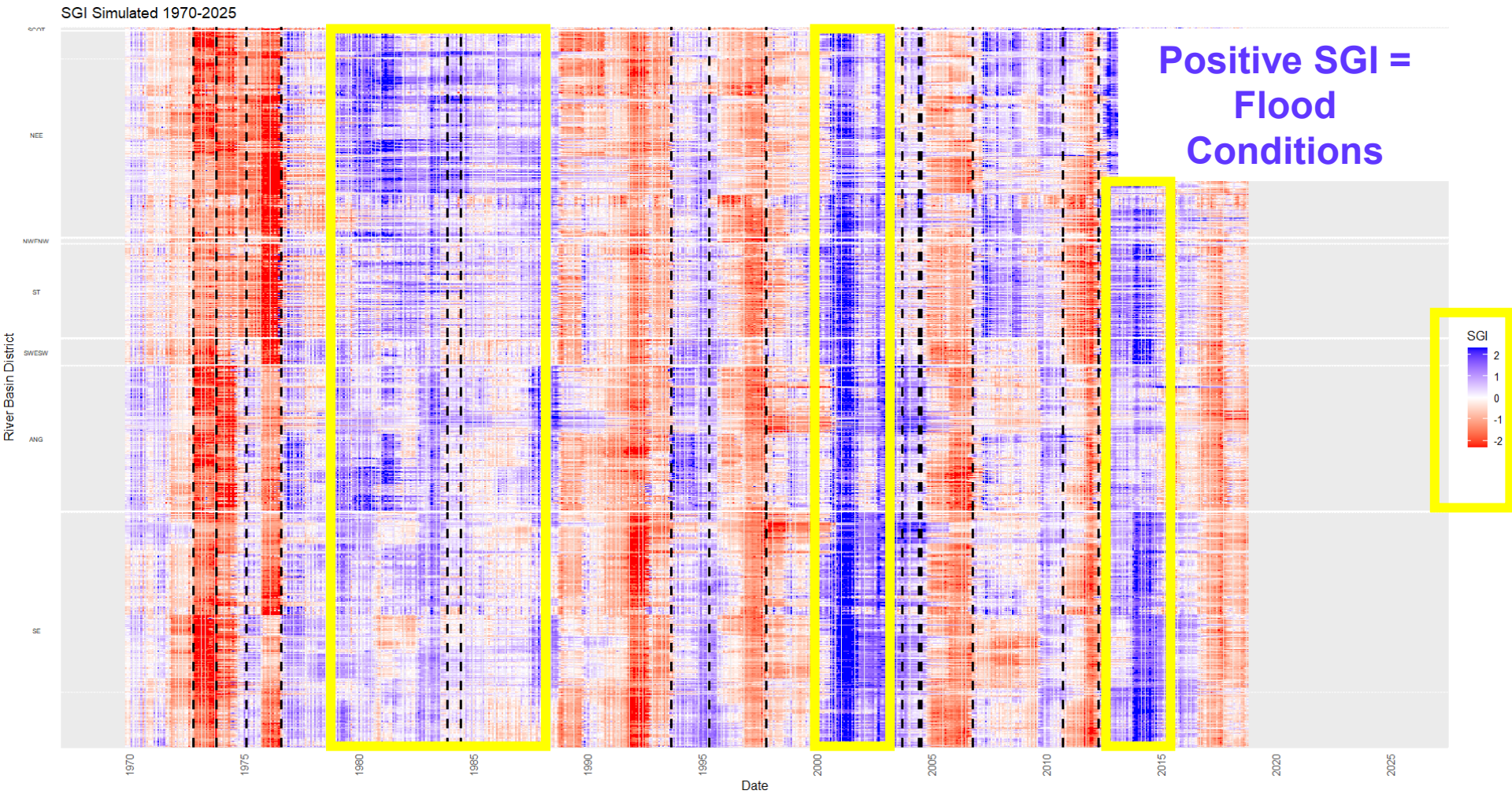

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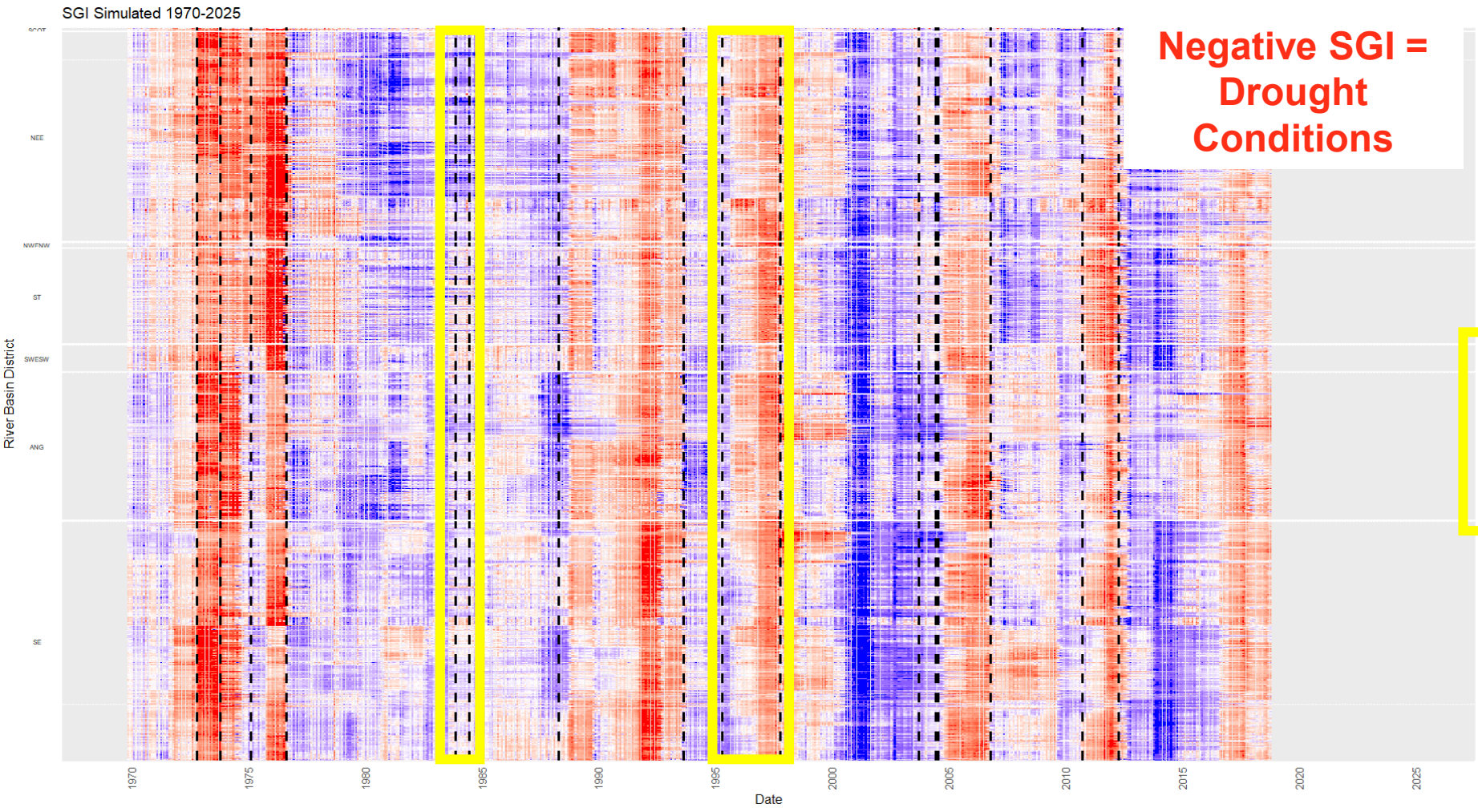

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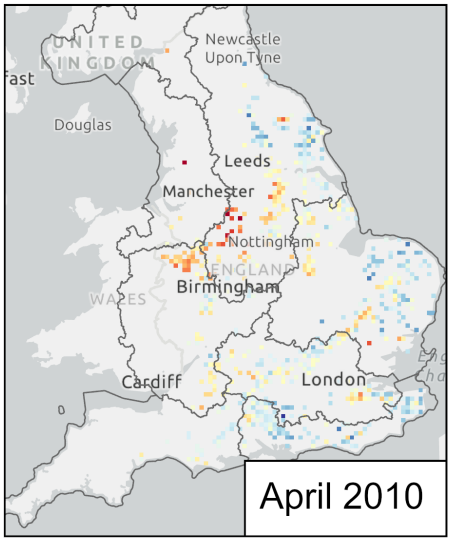

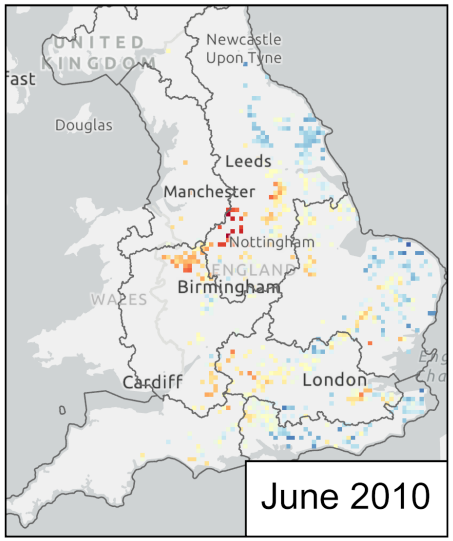

The 2010-2012 Drought: Simulated

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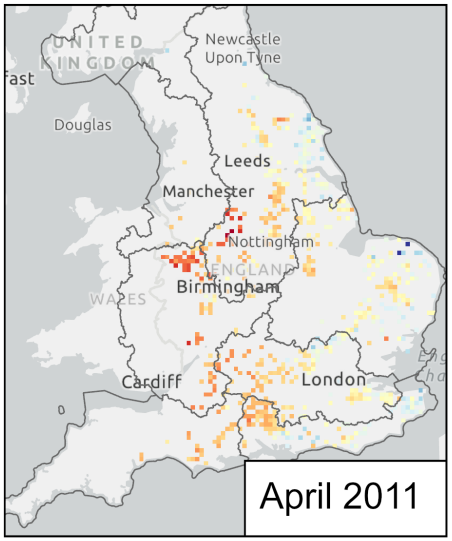

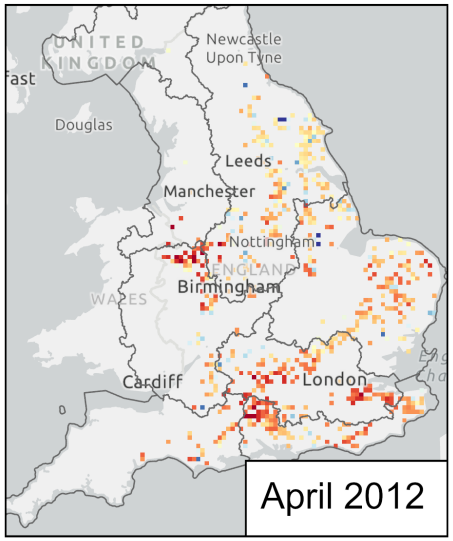

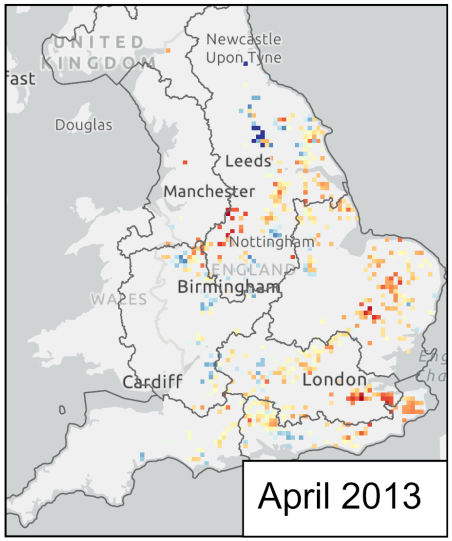

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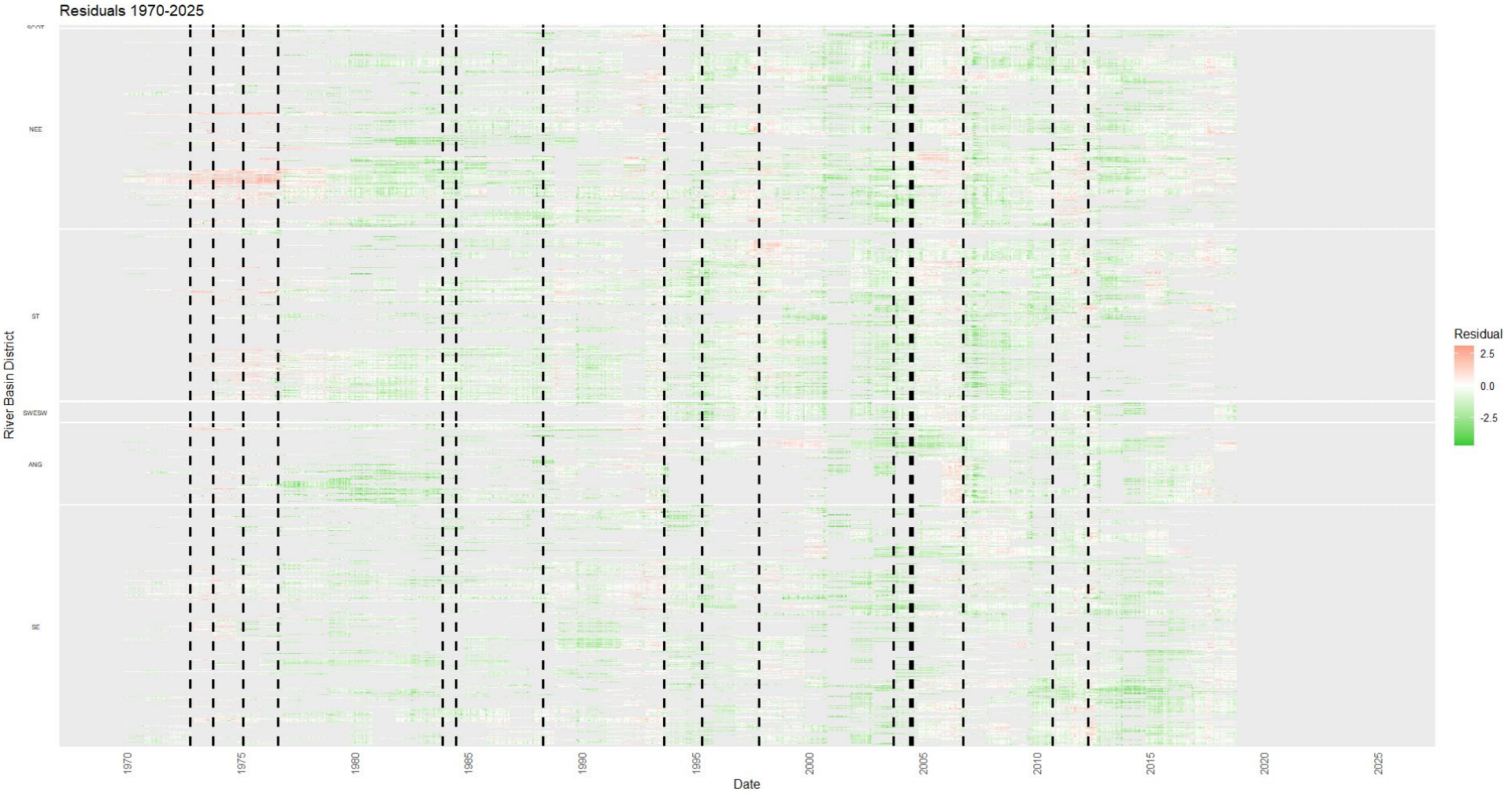

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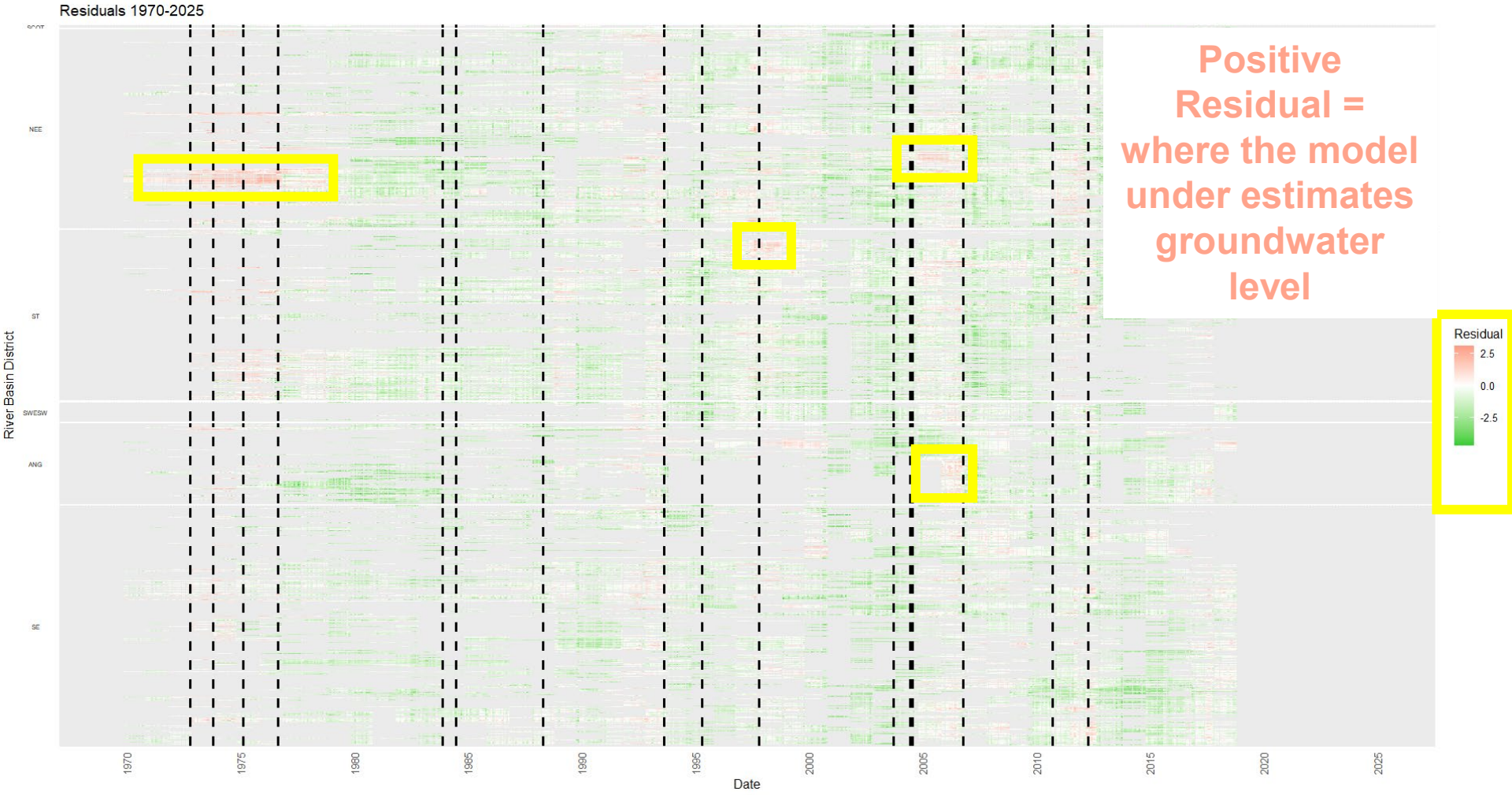

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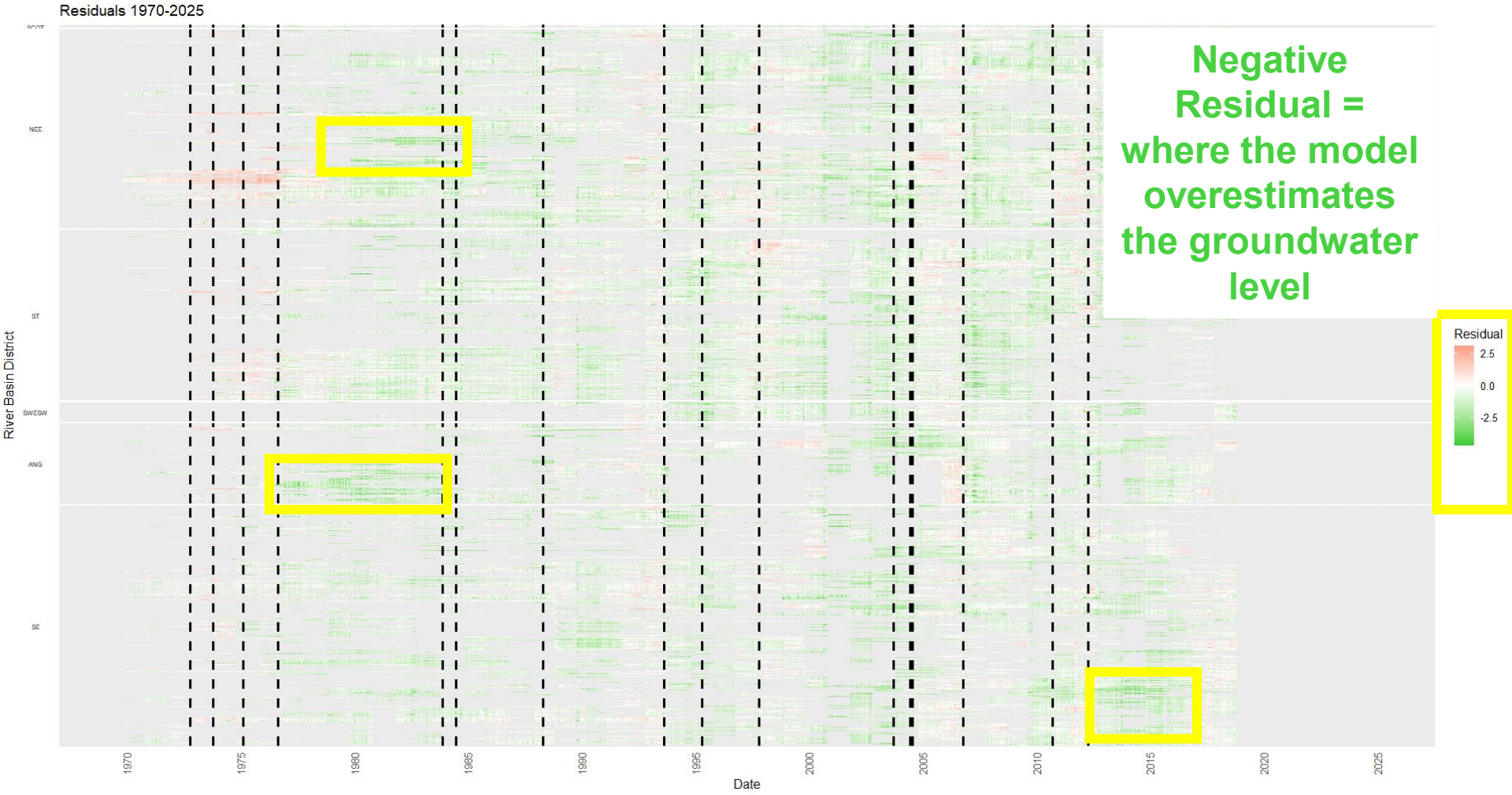
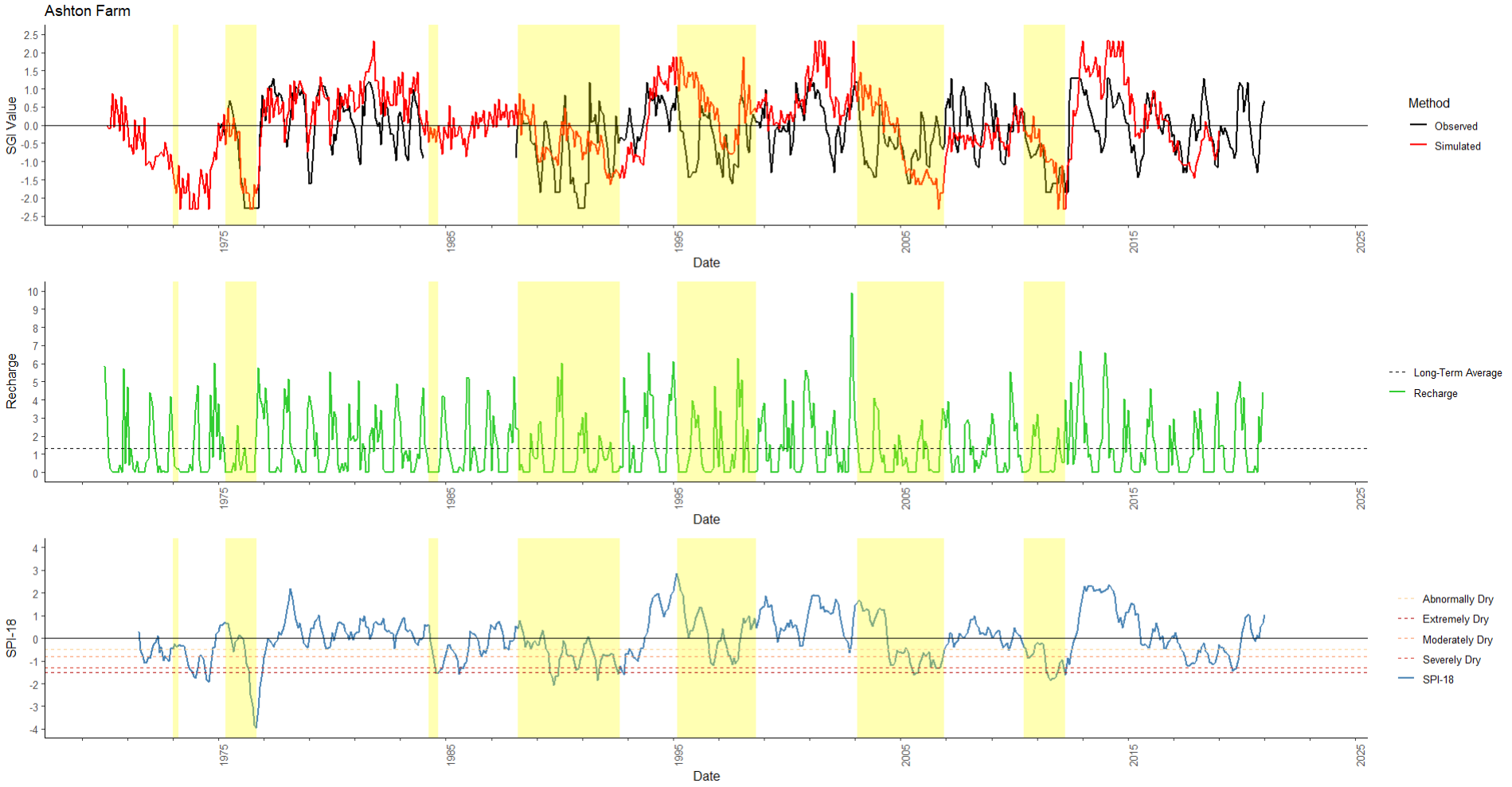


Theme 5 – Diagnostic Drivers



Conclusions

- Groundwater is fundamental in buffering against hydro-climatic variations
- Groundwater provides a significant service to the UK and its economy.
- Effective mapping of the UK's groundwater resources and it's driving fluctuations is vital for sustainable future management.

Conclusions

- BGWM provides a holistic picture of groundwater for the mainland UK where historical records don't exist.
- BGWM provides tools to inform the management of groundwater resources and improve water security in the UK.
- Future work continues to expand this scope to Offshore regions such as the Isle of Man, and Wight.

Next Steps

- More spatial plotting of the observed SGI and Simulated for known drought periods
- Critical Assessment of the diagnostic drivers for groundwater drought
- Production of paper

References

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Thank you for listening
Any Questions?

Find Out More

Hydro-JULES

British Groundwater Model

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