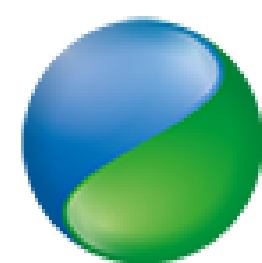




Natural  
Environment  
Research Council

# LTLS-FE: Long Term Large Scale Freshwater Ecology

Vicky Bell & Steve Lofts  
UKCEH



UK Centre for  
Ecology & Hydrology



ROTHAMSTED  
RESEARCH



British  
Geological  
Survey



**BOWBURN CONSULTANCY**  
*Specialist Ecological Advice to the Water Industry*



# Our rivers need to provide transport, food, clean water, habitat and recreation...



inews, August 19, 2022 "POO STICKS"

but reality is often different...

The Guardian view on water pollution:  
come clean on sewage

*Editorial*

Guardian, 18 Jan 2022

If the water industry is to improve its dismal performance, regulators need to be open with the public



© Pollution in Berkshire's Jubilee River. Photograph: Maureen McLean/Rex/Shutterstock

...and the future is uncertain

## EA report (2008): Potential impacts of climate change on river water quality

- *More intense rainfall and flooding could result in increased suspended solids, sediment yields and associated contaminant metal fluxes.*
- *Nutrient loads are expected to increase.*



House of Commons  
Environmental Audit Committee

## Water quality in rivers

Fourth Report of Session 2021–22

Report, together with formal minutes relating to the report

Ordered by the House of Commons to be printed 5 January 2022

*"The most recent figures published by the Environment Agency ... show that only 14% of English rivers met good ecological status and no river met good chemical status."*



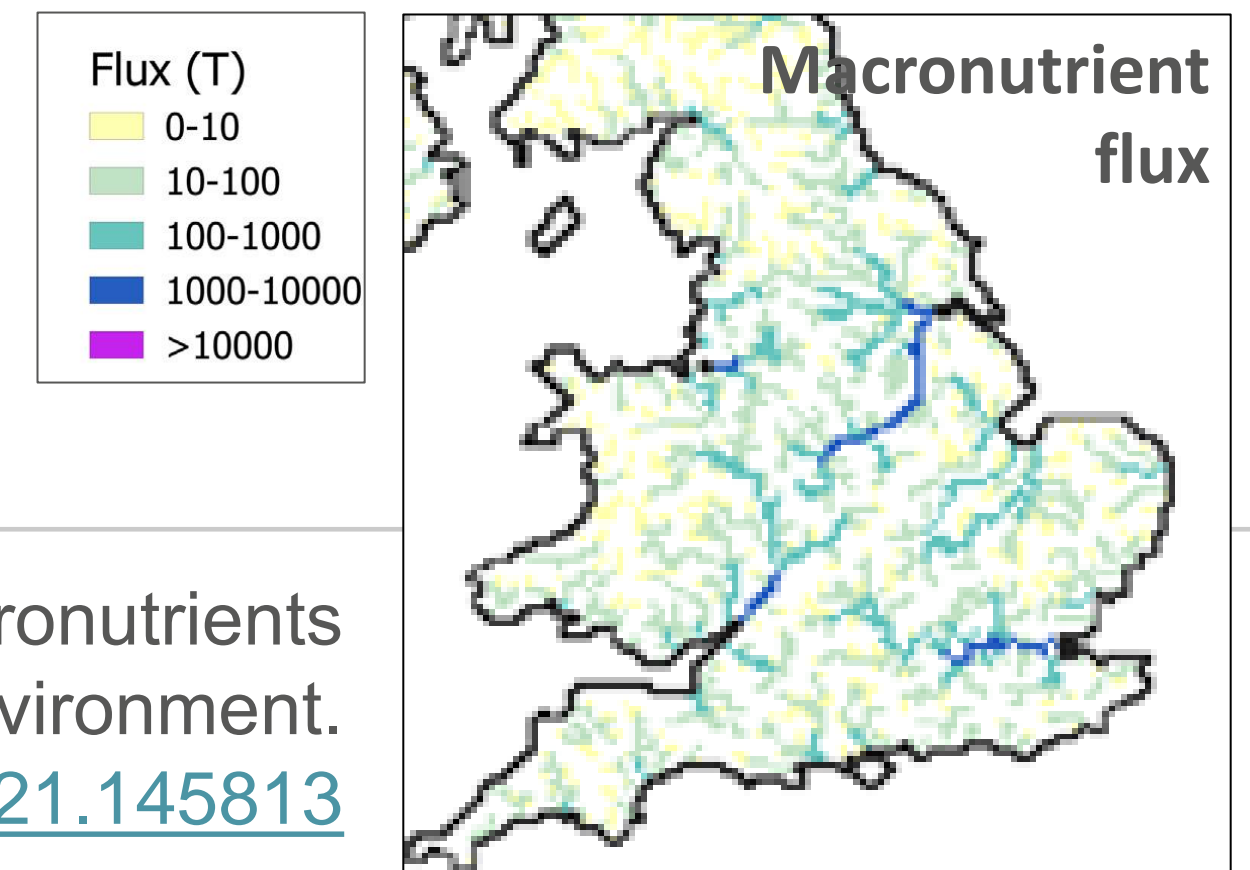
# Previous research has explored how carbon, nitrogen and phosphorus in UK rivers changed since 1800

Over this period the UK landscape has been transformed by the growth of agriculture, by atmospheric pollution, and by human waste.

As part of a NERC-funded project called “**LTLS**”, (Long Term Large Scale) we modelled how these changes contributed to the quality of our rivers, over the **last 200 years** and at a **national scale**.



[www.ltls.org.uk](http://www.ltls.org.uk)



# In LTLS-FE we will use a similar modelling approach to quantify future projections of freshwater quality and biodiversity of the UK's rivers

We will use newly-available climate and socioeconomic scenarios to drive an innovative national-scale model of the potential futures of all the UK's rivers.

We will show how the combination of multiple contaminants and a changing climate might impact on our freshwater ecosystems.

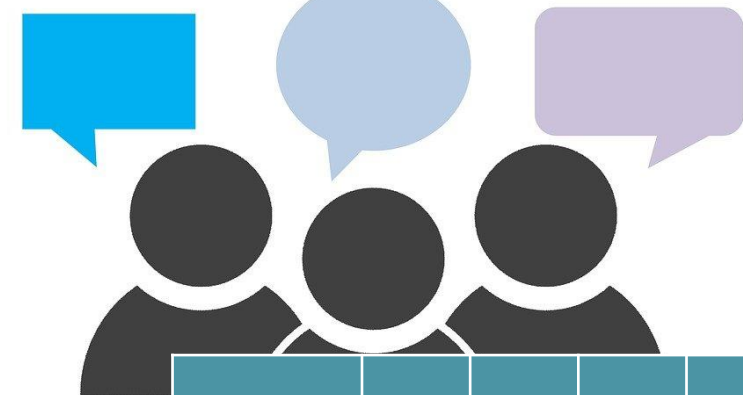
This research will:

- Identify catchments/regions most at threat from climate and contaminants
  - support policy development, and ultimately...
    - protect the UK's rivers.

# The proposed LTLS-FE research into freshwater futures:

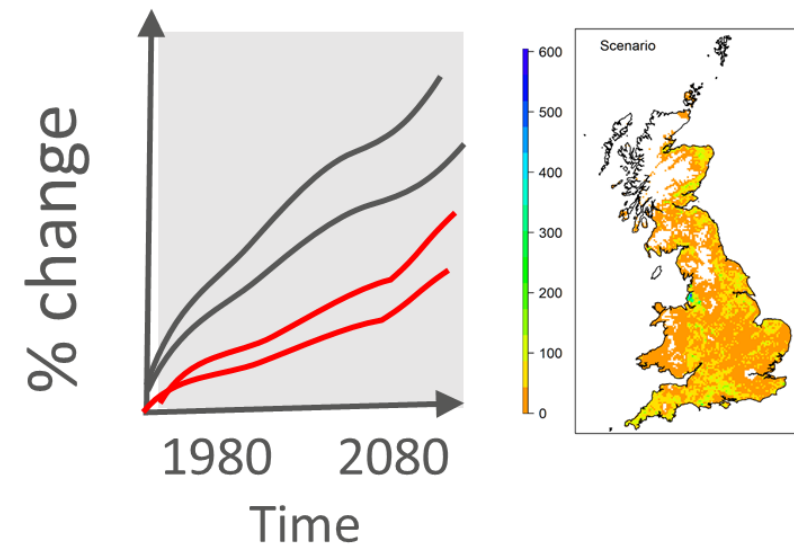


Stakeholder workshop



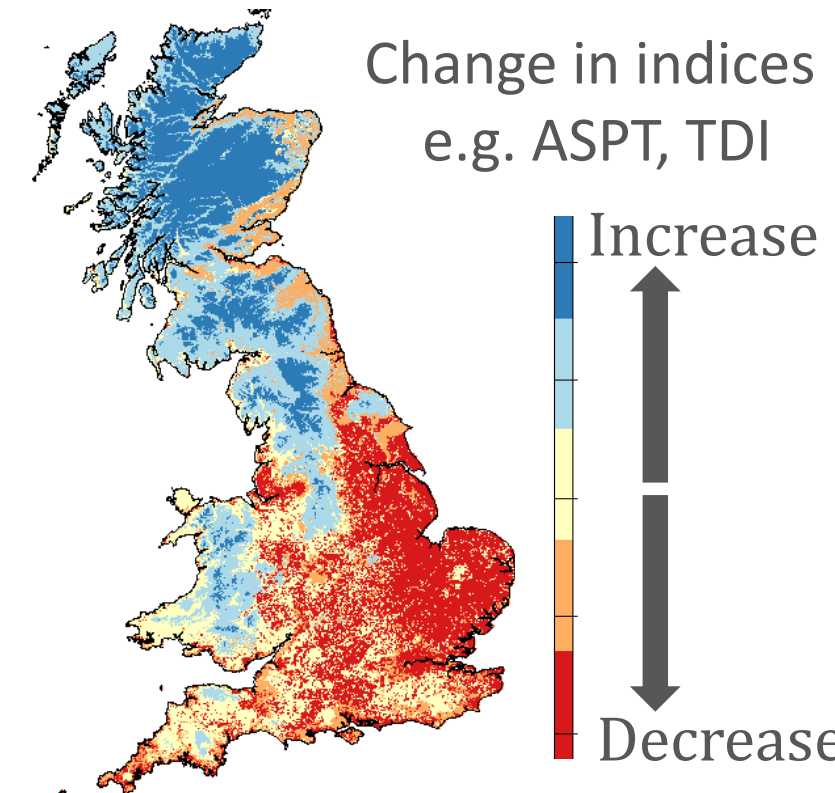
SSP	1	2	3	4	5	Multiple future scenarios
RCP						
2.6	X					
4.5		X		X		
6.0						
8.5						

Trends in pollutants from runoff, abstraction, groundwater recharge, erosion

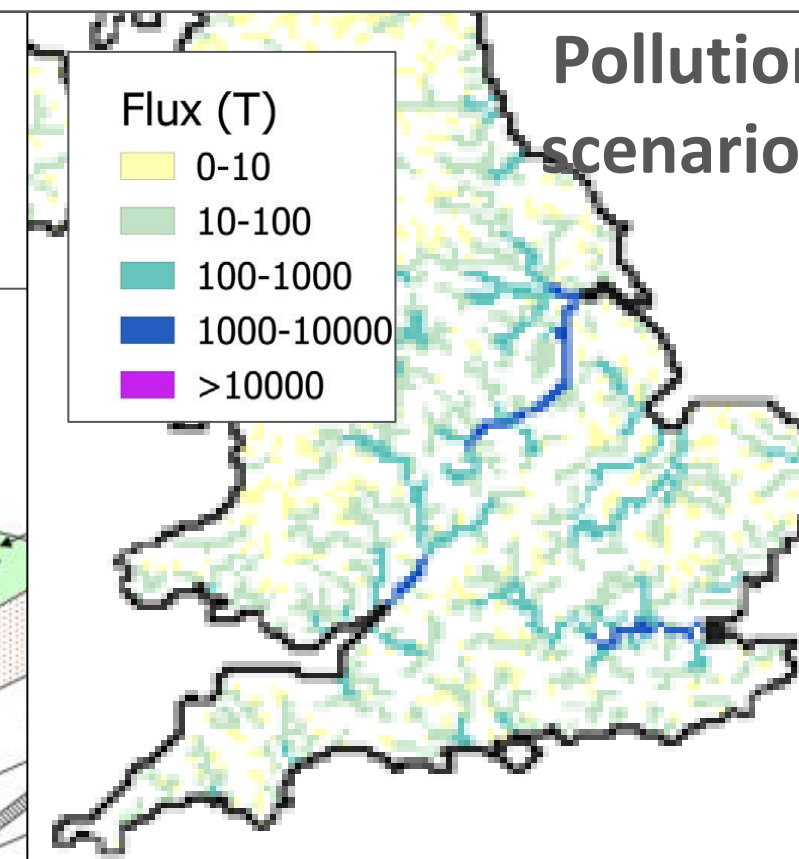


Biodiversity scenarios

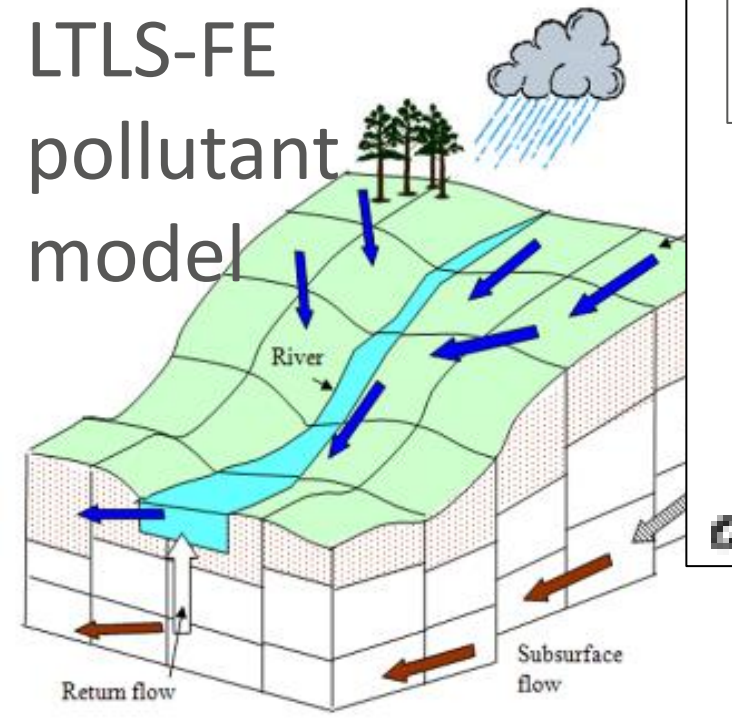
Change in indices e.g. ASPT, TDI



Pollution scenarios



LTLS-FE pollutant model

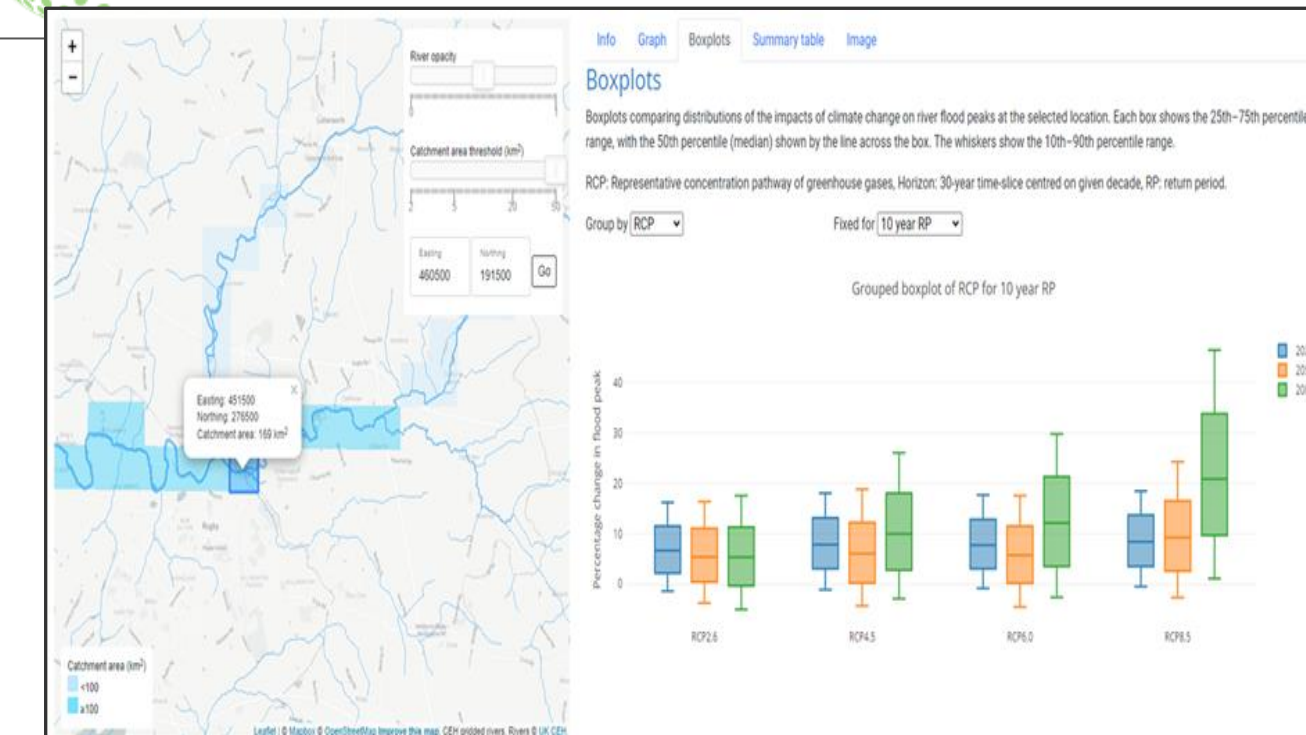


ANALYSES AND PUBLICATIONS TO SUPPORT DECISION MAKING



MODEL/DATA DISSEMINATION

# Hydro-JULES

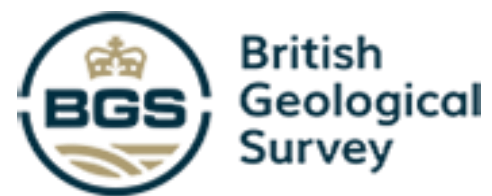


WEB DISSEMINATION TOOLS

# Meet the project team:



- **UKCEH:** Vicky Bell and Steve Lofts (co-leads), David Cooper, Gemma Nash, Bryan Spears, Sam Harrison, Ponnambalam Rameshwaran (“Ramesh”), Richard Ellis, Jacky Chaplow, Jasmine Pullen + new RAs
- **Rothamsted Research:** Andy Whitmore, Alice Milne, Ryan Sharp
- **BGS:** Dan Lapworth, Lei Wang, Barbara Palumbo-Roe, Matt Ascott, Ben Marchant
- **Cardiff University:** Ian Vaughan + PDRA
- **Bowburn Consultancy:** Martyn Kelly
- **Cross-sectoral expertise:** hydrology, agriculture, ecology, geology, biogeochemistry, modelling and software
- Many have worked together on previous projects (e.g. LTLS, ASSIST)
- **Stakeholder Advisory Board:** UK Government Departments, regulatory bodies, the water industry via UKWIR, Coal Authority, and other statutory bodies (7 Letters of Support).



+ Stakeholder  
Advisory Board

# Key freshwater quality challenges

Identifying key chemical and nutrient stressors

Simulation of ecological effects due to multiple physical and chemical stressors

Providing useful, plausible and coherent future scenarios to work from

Useful dissemination of outputs to stakeholders for policy and scientific purposes

Robust, integrated simulation of chemicals and nutrients in freshwaters

“Because most ecosystems are subject to multiple stressors, the success of offsetting global change in this way relies upon an understanding of how different stressors interact”

“In response to climatic warming, management that reduces other stressors at local or regional scales may be an effective way of reducing ecological impacts and increasing resilience”

**Vaughan & Gotelli (2019) Nature Comms 10.**

# LTLS-FE project structure

## WP1

- **Pollutant prioritisation** for focused modelling;
- UK-SSPs, RCPs linked to provide basis for **projection of future chemical and nutrient inputs**;
- Terrestrial models for **release of chemicals and nutrients to freshwaters**

## WP2

- Modelling of the **transport, transformation and fate of nutrients and chemicals** in rivers, accounting for **projected hydrological changes**;
- Modelling of **multiple stressor effects** at national, policy-relevant scales and **forecast biodiversity changes under future scenarios**

## WP3

- **Work with stakeholders** to use scenario outcomes to support **long term policy and planning**.
- **Outputs made openly available** for use in follow-on projects
- Models incorporated into **open-source framework**.
- Website and web-dissemination tools for **exploration of freshwater futures**





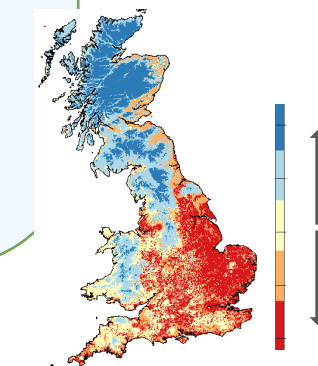
# LTLS-FE: Aims



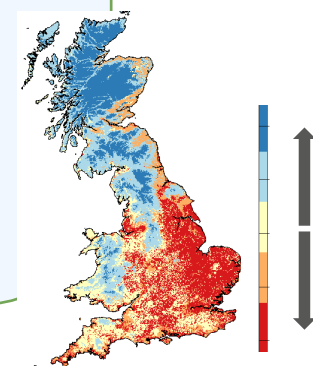
First use of **novel, integrated** and **coherent** scenarios of alternative UK futures to **generate trends** in chemical inputs to UK freshwaters and UK water management trends



**First forecasts of changes** to river chemistry and ecosystems at a national scale, accounting for **complex and changing patterns of multiple stressors**



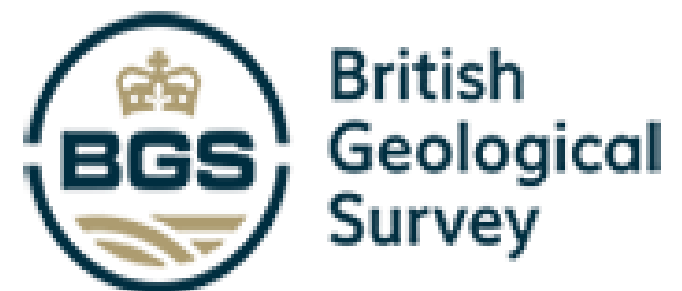
**Unprecedented insights into long-term multiple stressor impacts** on river systems, allowing us to examine a broad swathe of physico-chemical stressors simultaneously



**Distinctive, useful and usable** outcomes for science, policy and society – developed with continuous stakeholder involvement



# Thank you



# LTLS-FE Integrated modelling:

