

Transforming Digital Research Infrastructure for Environmental Science

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UK Centre for
Ecology & Hydrology



Our purpose

To advance the vital environmental science that governments, businesses, NGOs, and researchers rely on to meet the great challenges of our time.



UK Centre for
Ecology & Hydrology

Where we are based



What we do

Environmental science to benefit the UK research community, governments, businesses and society.

Large-scale monitoring and observation networks, to measure environmental change.



What we do



Work with citizens

- Public engagement across our research, via citizen science, community engagement.
- We provide an informed, trusted, evidence-led public voice on the environment.

What we do

Large research infrastructures for:

- Monitoring
- Modelling
- Data Science



What we do

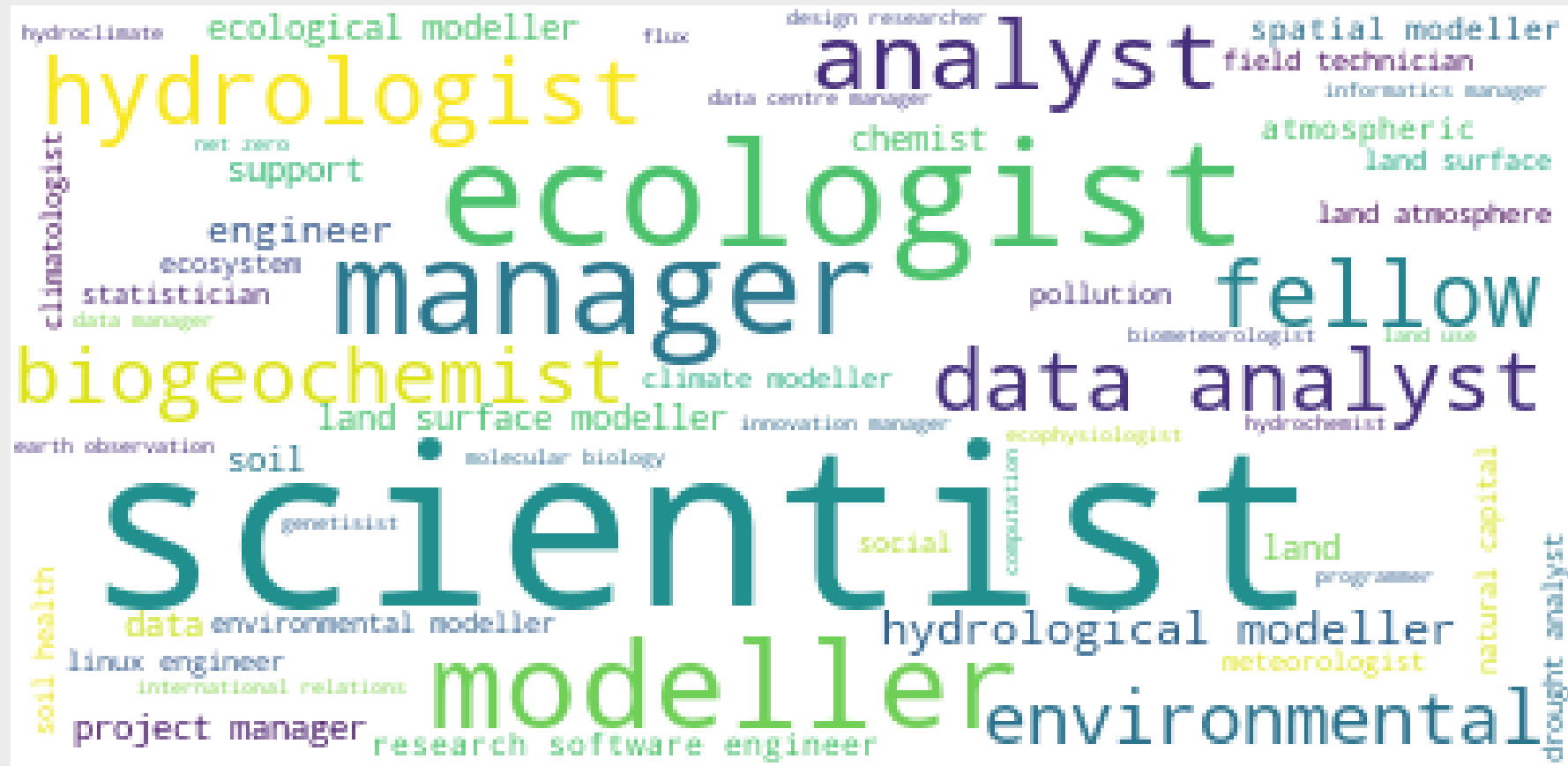
Lead efforts to tackle global challenges by working with United Nations agencies and programmes.

Lead the way in international environmental research by adopting innovative technology.



Who we are - Skills

A large breadth of work = large breadth of roles



Who we are - Tools

A large breadth of work = large breadth of tools used!



What about you?

Code: 3641195 at [slido.com](https://www.slido.com)

How many of these tools do you have expertise in?



UKCEH Science Areas

National Capability and
Digital Research

Environmental Pressures
and Responses

Land-Atmosphere
Interactions

Biodiversity and Land Use

Water and Climate Science

IT and Scientific Computing



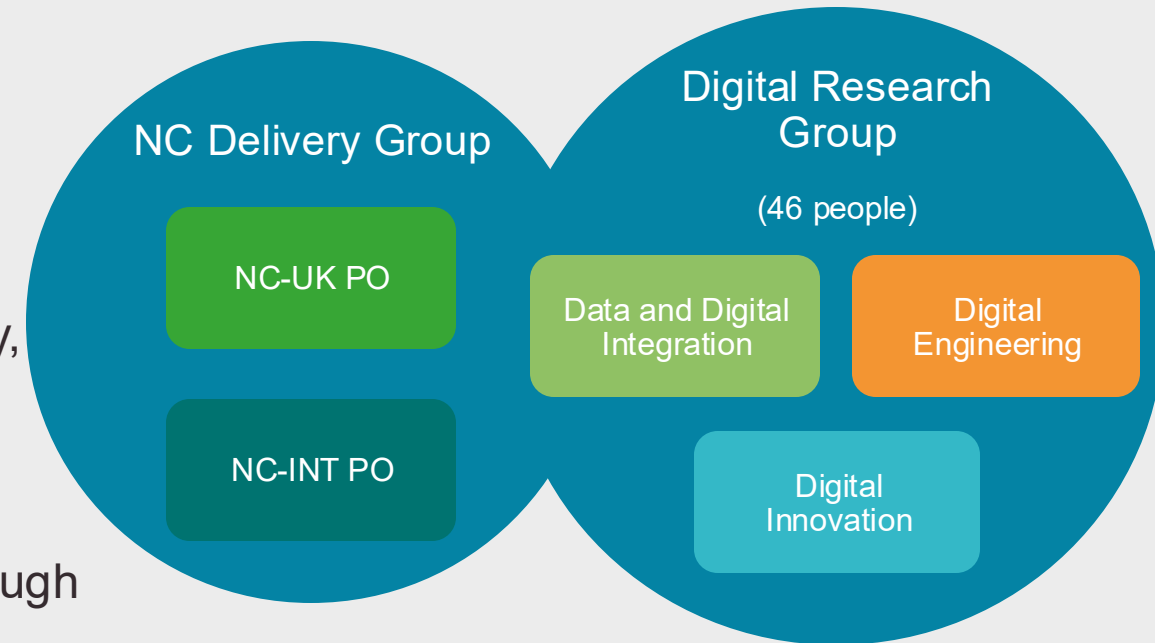
National Capability & Digital Research Science Area

NC Delivery

- Bringing together Programme management teams for our larger National Capability programmes

Digital Research

- Driving and delivering digital research infrastructure for environmental science in line with UKCEH's Digital Strategy, encompassing:
 1. Enhancing the governance, integration and impact of digital assets (e.g., data, methods, models, tools)
 2. Developing novel and automated DRI technologies through an agile and customer-first approach
 3. Researching and exploring emerging technologies, techniques and societal issues for DRI's success (e.g., AI, sustainability, transparency, inclusivity)



Digital Research Group

Who we are:

- Large interdisciplinary team
- Experts in DRI for Environmental Science
- Empowering science to be faster, more collaborative, more impactful

We're not just supporting science we're transforming how it happens

What we do:

Moving to research-led approach covering

- Data stewardship
- AI and Data Science
- Software engineering and infrastructure
- Responsible innovation

Creating DRI for real-world science challenges

Why it matters:

We enable stakeholders to:

- Discover, access, integrate data
- Adopt emerging technologies
- Collaborate across disciplines
- Increase sustainability

Serving scientists, policymakers, health researchers, charities

Building a broad, inclusive stakeholder community

3 Teams, 1 Group

Data & Digital Integration

Purpose: To govern and provide FAIR and impactful digital objects that take advantage of digital research infrastructure and support the environmental science community.

Digital Engineering

Purpose: To drive technical innovations and develop software for core digital research infrastructure at UKCEH, meeting a variety of stakeholder needs across environmental science domains.

Digital Innovation

Purpose: To lead interdisciplinary and strategic research that explores new technologies, approaches or problem spaces for digital research infrastructure in environmental science.

What the hell is DRI? And what does it mean to you?

Wrong answers only ;)

Code: 3641195 at [slido.com](https://www.slido.com)

Some suggestions for starters:

- Draft Research Intentions
- Dreaded ResearchFish Interrogations
- Design and Rigorous Integration
- I'm sure you can do better...



What does Digital Research Infrastructure mean to us:

Digital Research Infrastructure

Bring together datasets, models, data science methods, and analysis and visualisation tools and platforms to explore the interaction of complex environmental systems.

Monitoring infrastructure

- For gathering environmental data (e.g., sensors, Internet of Things devices, citizen science applications, etc.)

Computational infrastructure

- For processing and storing environmental science data (e.g., personal devices such as laptops, data centres such as the Environmental Information Data Centre (EIDC), Polar, JASMIN, etc.)

Digital tools

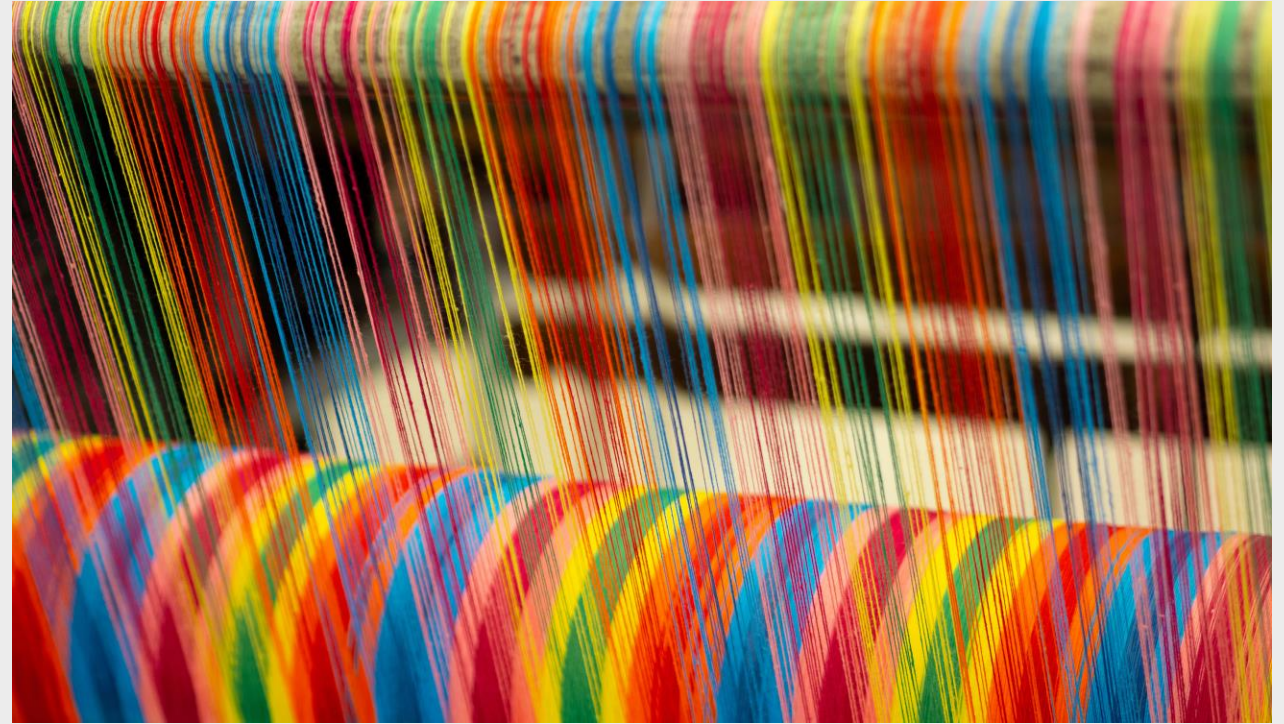
- To support development, analysis, visualisation and collaboration in environmental science (e.g., DataLabs, EIDC Catalogue, Data Stewardship Wizard, UK Resources Portal, R Shiny applications, etc.)

How do we "do" DRI: our core principles

Embedding co-design and engagement with a diverse range of stakeholders to transform the societal and scientific impact of our digital research infrastructure

Driving continuous innovation in our digital research infrastructure and services, learning from the environmental science and research communities, and shaping best practices

Fostering inclusive, interdisciplinary collaboration and skills sharing across our teams and partnerships to build and sustain a thriving digital research ecosystem



Taking digital tools that researchers use, and making them: better, easier, and more efficient.

From cradle to the grave

- We aim to cover inception to production.
- Not all projects need to become "production" level
- But we want to be able to move as seamlessly as possible when they do.
- Digital Engineering tends to work in Agile/Scrum/Kanban
- Digital Innovation leans more Kanban
- Data and Digital uses different methods again.
- Need to ensure all areas work together

Theory meets practice

- Agile is great for Digital Engineering
- Until it's not
- Science (or scientists) don't work in agile
- Hardware and streaming data don't work great with Scrum methodology.
- Have pivoted to Kanban for projects in prototyping stages
- Scrum is good for large teams and pre-defined projects
 - We still have many projects where it is a single RSE or DS, kanban works better
 - How do we feed back to development using Scrum?

Playing nice with others

- Researchers don't use agile
- We can get them to adopt Kanban sometimes
- Large projects need management
- PRINCE2 has been used as a template
- Additional layer of "Technical leads" was brought in to fill the knowledge gaps.

Early bird gets the worm

- Get in early
- The earlier we engage with researchers, the more practices we can embed.
- Far easier to enhance something later if best practices were observed at the beginning.
- We have to champion each other.
 - Researchers may request a Data Scientist, and RSE, or a Data Manager.
 - We need to gently nudge them as to how other parts of Digital Research can help them.

Of the People, By the People, For the People

- Building DRI for all environmental science
- We could build the most beautifully written software and pipelines, but it is pointless unless it is used.
- Co-design and stakeholder engagement is key
- We need to bring it into as many projects as possible
- More chance we can re-use that software/pipeline/code for future projects

Case Study #1

FDRI



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Floods and Droughts Research Infrastructure (FDRI)

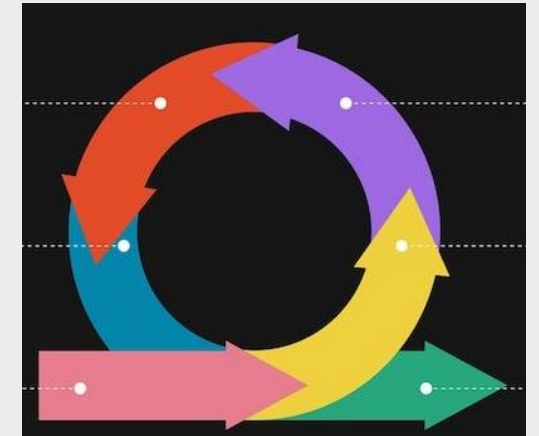
"Scalable systems to collect and analyse diverse, near real-time data from monitoring sites and catchments"



Field Engineers



External Cloud Providers



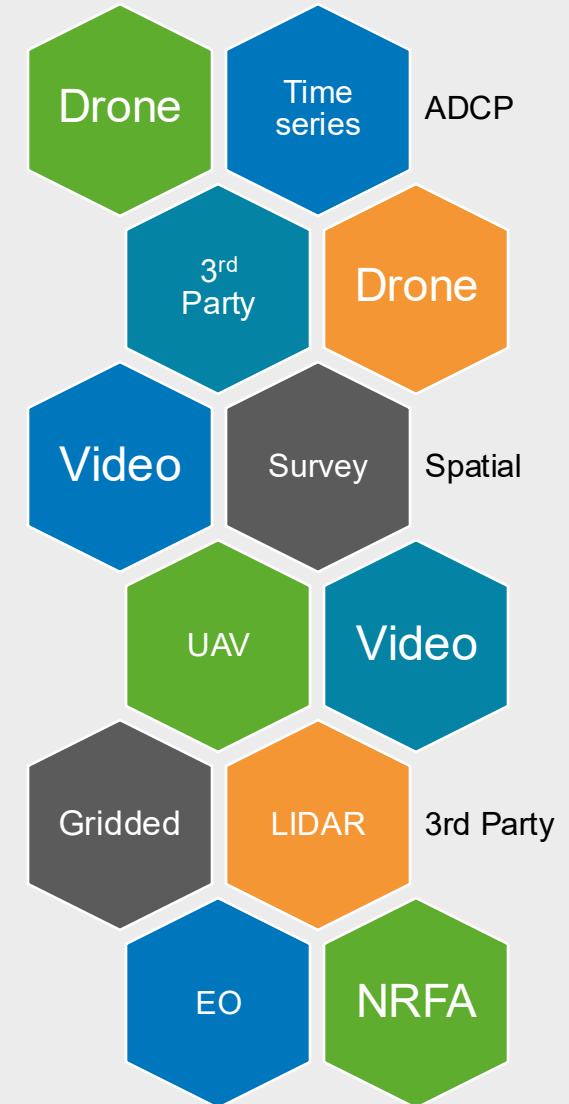
Agile Development

COMPONENTS OF A HYDROLOGICAL DATA COMMONS



Data Types

- Time series from sensors
- Gridded data
- LIDAR Data (1m UK)
- Spatial survey data
- Drone data
- Image data from Phenocams & more
- Video data from UAV
- Trail camera data



FDRI – How did it work?

- Dev team adopted Agile and SCRUM
- SCRUM Master hired to help
- **Main criticism from devs:**
 - Lack of flexibility in the sprint process
- **Main criticism from others:**
 - Difficult to engage with development process

FDRI – How does it work?

- Transition to Kanban
- “Show & Tell”s adapted into different formats to suit varied audiences
- Adoption of “good enough” Agile by RSEs
- Development of Community Conversations

Case Study #2

Spatial Data Explorer



Challenge

- Navigating the complex and fragmented landscape of UKCEH's digital objects is difficult for both existing and new users.
- This limits discoverability, accessibility and re-use.

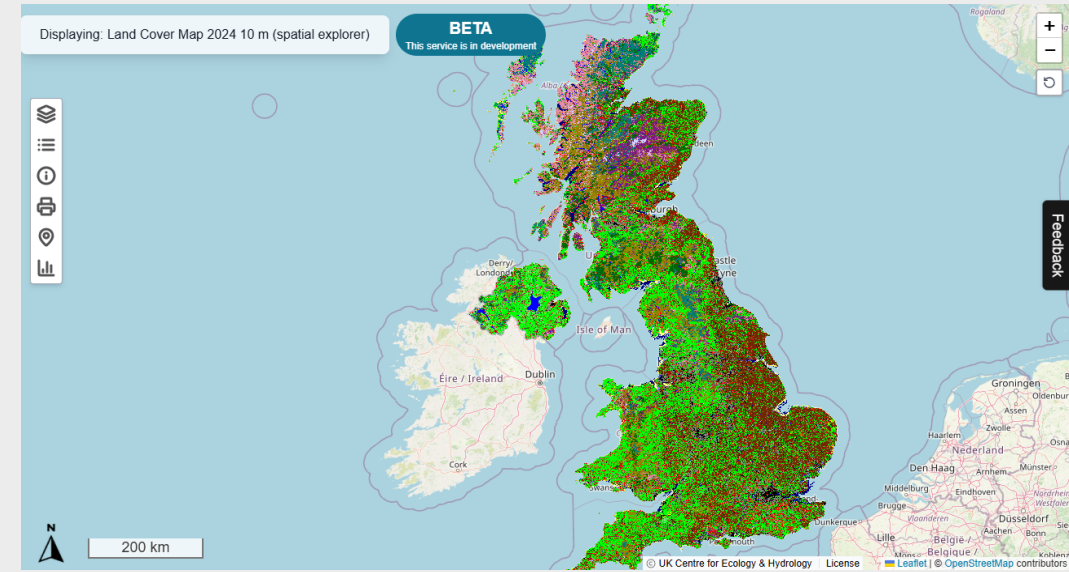
Our role

To enhance the discoverability, accessibility and reusability of UKCEH digital objects by

- improving our infrastructure
- developing user-focused tools and services
- collaborating with object owners and users to foster a culture of openness, sharing and integrative science

Co-design approach

- **"Lean UX"** approach led by colleagues in Digital Innovation (previously Design Team)
- Start with a focus group who understands community requirement
- Translate those requirements so that Digital Engineering team can build a beta product
- Follow this with **community conversations** to get feedback from wider community.
- Iterate on this (**agile**)



Q: Why not go straight to end users?
A: **Respect their time, use it wisely!**

Breaking down barriers, gradually...

- We want to extend this to other spatial subcommunities using different datasets...
- ...Without having to start again from scratch
- We now need to **iterate this co-design method**, but with a progressively **expanding group of stakeholders**, making sure everyone is heard at each stage!

Closing the loop

- The Land Cover Map is hosted by EIDC – our colleagues
- Their hard work on making data FAIR now propagates through to users
- And user experience / feedback now propagates back to EIDC

Ambitions of the Digital Research group

To enable the scientific insights and impact required to address grand challenges in environmental research through state-of-the-art digital research infrastructure.

Our work enables our stakeholders to:

- Discover, access and integrate data more effectively
- Adopt emerging technologies and best practices
- Collaborate seamlessly across disciplines and institutions
- Increase the sustainability of our research

Our strategic roadmap to 2030

Embed co-design & engagement

Driving continuous innovation

Promoting inclusive and interdisciplinary collaboration

Improving the discoverability,
accessibility and re-use of
objects

Designing and implementing
a robust, modular digital
infrastructure

Developing data science and
AI techniques to enhance
environmental research

Advancing our commitment
to responsible and ethical
innovation



Thank you

For more information
please contact:

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