

WATER RESOURCES

Water is a natural resource on which all life depends. Water resources are under threat in the face of environmental pressures including population growth, urbanisation, land-use change and climate change.

Context

Water is an essential resource that supports our social and economic development through meeting the requirements of agriculture, industry, households, power generation, navigation and recreation. However, the planet's water resources are already fully exploited in sustaining natural ecosystems which have developed in response to the natural availability and variability of water across the globe. An incomplete understanding of the available resource coupled with competing demands creates one of today's major global challenges.

Our Research

CEH research aims to provide insight into the relationships between the natural water resource and its dependent ecosystems, so that the impacts of pressures from our exploitation of the resource can be understood. This understanding is key to maximising the benefits provided by our water resources while minimising adverse consequences to the environment or to human development. Additionally this understanding will inform integrated water resource management and the restoration of over-exploited freshwater and wetland ecosystems.

Our research embraces ecology and hydrology, water quality and water quantity, pristine and polluted environments, short-term variability and long-term change. It aims to deliver locally and globally.

Research activity will include:

- long-term observation of surface waters, including the physical habitat, chemistry and biology of rivers, lakes and wetlands.
- development and deployment of novel monitoring techniques to quantify extremes, dynamics and fluxes of water, associated chemicals, biota and sediment.
- assessing threats of pollution to the aquatic environment and human health.
- maintaining nationally important datasets and making these available for further research, exploitation and reporting.
- understanding the nature and change of variability in water resources, water quality and ecosystem function, and identifying trends and step-changes by comparison with observed historical variability.
- attributing changes in water resources and associated ecosystems as the basis for restoration of degraded resources.
- using Earth observation data, monitoring and models to assess the status of regional and global water resources, now and in the future.
- informing strategic planning and development of water policy by applying models that deliver forecasts of the likely impacts of change on water resources availability.



Science Excellence to Impact

- 1945: Research monitoring of Cumbrian Lakes begins.
- 1965: Weekly monitoring of River Frome begins.
- 1968: Plynlimon paired catchment experiment started.
- 1968: Research monitoring of Loch Leven begins.

- 1980: Low Flow Studies Report for UK published.
- 1981: Institute of Hydrology Quality Model enables simulation of in-stream water quality.



- 1990: Development of the PROTECH model to forecast algal blooms in lakes.
- 1992: Land Ocean Interaction Study (LOIS) programme links terrestrial, freshwater, coastal and marine science.
- 1995: Hydrology of Soil Types (HOST) soil classification underpins flood and low flow estimation.
- 1998: GWAVA model enables continental scale water resource assessments.

- 2000: LOCAR Programme monitoring and modelling of lowland agricultural catchments.
- 2004: LF2000-WQX model enables chemical risk assessments for surface waters.
- 2008: Lambourn Observatory established at Boxford.
- 2009: Inception of River Thames monitoring initiative.



< 1980



1980s

- 1982: National River Flow Archive (NRFA) established to manage and disseminate UK hydrometric data.
- 1985: FRIEND programme pioneers international sharing of data and expertise.
- 1985: Probability Distributed Model of rainfall-runoff process formulated.
- 1988: Acid Waters Monitoring Network established to provide evidence for UK policy to address acidification.

1990s



2000s/2010s

- 2011: EU WATCH Programme assesses past, present and future global water resources.
- 2012: Lancaster mesocosms and Wallingford experimental flumes constructed.
- 2012: Future Flows: impacts of climate change on UK river flows and groundwater.
- 2013: Systematic review of glacier shrinkage in the Himalaya.

Future Research Objectives

Understand and represent in models the pressures, processes and fluxes that control the availability, distribution and quality of water resources nationally and globally.

By 2019, we will have:

- improved our understanding of hydrological, chemical and ecological processes through an integrated programme of long-term and large-scale monitoring and experiments.
- developed modelling frameworks that can be deployed rapidly to assess scenarios of change and the impacts of new policies.
- quantified the impact on global water resources of the response of vegetation to changes in the physical and biogeochemical environment.
- made estimates at the global scale of future water resource stresses due to changes in population, land-use and climate.
- quantified, in the context of a changing climate, the influence of urban growth on eutrophication.
- developed models of aquatic systems that link chemical concentrations and other environmental factors to biological factors.



Provide the evidence required to facilitate the management of water resources and to provide the evidence base for policy development.

By 2019, we will have:

- integrated web-based delivery of UK flood data into the NRFA.
- established delivery of the first operational Hydrological Outlook service for the UK.
- established a national inventory of lake assets and a global lake observatory based on Earth observation.
- launched a real-time service describing soil moisture across the UK.
- provided evidence-based assessments of science to support policy development.

Understand the variability and change in water systems caused by a wide range of drivers, including measures aimed at remediation.

By 2019, we will have:

- generated evidence regarding the status, and change in status, of freshwater resources and the relationships with multiple drivers of change.
- evidence of the effectiveness of remediation and restoration programmes across a range of aquatic environments.
- improved our understanding of the factors controlling algal growth in lakes, reservoirs and rivers, and derived knowledge-based phosphorus targets required to improve ecological status and sustain ecosystem services.



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Partnerships

- CEH's water resources science combines our own expertise with that of others, including universities and non-governmental organisations. Many of the activities on the timeline (pages 2/3) have been achieved through effective partnerships that integrate science across traditional science boundaries.
- Many studies (e.g. Future Flows, Low Flow Studies) are underpinned by the UK's national hydrometric data providers (Environment Agency, Scottish Environment Protection Agency, Natural Resources Wales and Rivers Agency of Northern Ireland). The key data are collated, managed and disseminated by the National River Flow Archive (NRFA). The Met Office also provides essential data and is a partner in research projects such as those delivering the Joint UK Land Environment Simulator (JULES), the UK Lake Ecological Observatory Network (UKLEON) and the Hydrological Outlook.
- CEH works closely with the British Geological Survey across a wide range of science including the NRFA, the Future Flows and Groundwater Levels project, and the Lambourn Observatory. CEH's long-standing links with the James Hutton Institute include notable collaborations on the Hydrology of Soil Types (HOST) and acidification studies.
- Many projects have built strong links into Europe, particularly with institutional partners in the PEER and Euraqua networks. Examples include WATCH, SCENES, MARS, CHES, WISER, REBECCA and Euro-limpacs. CEH is closely engaged with industry and policy-makers as a contributor to the EC Water supply and sanitation Technology Platform (WssTP) aiming to provide a common vision for water research and innovation. CEH currently represents the UK research councils on the EU Water Joint Programming Initiative.
- The FRIEND Programme and CEH's ongoing contributions of expertise, science and data to international hydrological initiatives, such as those conducted under the auspices of UNESCO and WMO, illustrate the world-wide outreach of our water resources science. Through employing our skills in water resources assessment and management, CEH projects provide direct capacity-building support to National Hydrological Services around the globe, aiding water management and supporting international development agendas.

Contact

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