CEH SCIENCE AREAS

Biosphere-Atmosphere Interactions
Ecological Processes & Resilience
Environmental Informatics
Monitoring & Observation Systems
Natural Capital
Pollution & Environmental Risk
Soil
Sustainable Land Management
Water Resources

SCIENCE AREA SUMMARY

NATURAL HAZARDS

Science to improve the prediction and understanding of the threats and impacts posed by natural hazards and development of management and resilience strategies.

Context

Natural hazards have been identified by the National Security Review as some of the most significant risks to the UK in terms of economic, social and environmental consequences. Natural hazards are increasingly a concern for humanity, as both the rate and impact of natural disasters are rising because of increased societal vulnerability, caused by trends in climate, population growth, urbanisation and land-use. The over-arching science challenge is to increase our understanding of the nature of threats from natural hazards, to improve our predictions and forecasts of the onset, frequency, magnitude and duration of such events. The knowledge and methodologies developed will allow us to better mitigate the impacts on people and the environment, thereby improving our management of natural hazards.

Our Research

CEH plays a vital role in understanding the nature and threats that natural hazards pose by developing the underpinning science to understand and reduce their damaging impacts, and to support the implementation of mitigation strategies. The prediction of hydro-meteorological, biological and air quality hazards will facilitate the design of management systems and improve societal resilience to extreme events. The hazards include floods and droughts, threats from parasites, pathogens and invasive non-native species and threats from natural air pollution incidents.

This involves monitoring and modelling in the following core areas:

- the development of physical and statistical models to better quantify the current and future risks from extreme rainfall and floods at multiple temporal and spatial scales.
- improved understanding of the processes driving the onset, development and termination of droughts and their impacts, leading to a drought monitoring and prediction system.
- enhancing development of modelling tools and techniques to forecast flows from days to years to decades ahead, including real-time and seasonal flood forecasting and the detection of impacts of environmental change.
- understanding the threat posed by pathogens by investigating the role they play in the equilibrium of ecosystems, and the extent to which they are regulated by native biodiversity.
- improved understanding of the threat posed by invasive non-native species to further inform management through prediction, prevention, early detection and rapid response.
- improved understanding of the threat and the UK preparedness to future natural air quality incidents, for example volcanic eruptions.
- advancing more generic aspects of natural hazards such as: understanding interdependence of hazards; characterizing and communicating uncertainty; and enhancing integrated risk assessments.

Centre for Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

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Science Excellence to Impact

1980: Low Flows Study report provides basis for national low flow estimation methods.

1981: Microcomputer-based flood warning system for Haddington in Scotland and Market Harborough in England.

1991: Application of a generic, modular and configurable River Flow Forecasting System (RFFS) to Yorkshire rivers.

1991: Micro-FSR launched as the first PC package to encapsulate FSR methods.

1994: HYRAD (HYdrological RADar) weather radar real-time receipt, processing and display system launched.

2003: CEH flood forecasting models rolled out across the Environment Agency.

2004: CEH provides the hydrological expertise for the Government's Future Flooding Foresight programme.

2005: Publication of the Revitalised Flood Hydrograph Model (ReFH).

2010: CEH monitoring shows UK livestock not at risk from toxic fluoride fall-out from Icelandic volcanic ash.

2011: CEH chairs COST Action on European procedures for flood frequency estimation.

2012: CEH leads the completion of the first phase of the GB Non-Native Species Information Portal.

2012: Mosquito vector for West Nile virus first found in UK.

1970s	1980s	1990s	2000s	2010s

1975: Publication of the Flood Studies Report (FSR) describing methods for flood estimation.

1976: Real-Time Flow Forecasting System for the River Dee, including use of weather radar, to support integrated reservoir system management for water supply and flood mitigation.

1983: First digitised river networks produced.

1985: First publication of the Probability Distributed hydrological Model (PDM).

1985: First controlled field release of Genetically Modified Virus for the control of plant pests.

1999: CEH co-ordinates the HYREX (HYdrological Radar EXperiment).

1999: Launch of the Flood Estimation Handbook (FEH).

2006: First publication of the Grid-to-Grid (G2G) distributed hydrological model; by 2011 this is in operational use for real-time flood forecasting across Britain.

2008: CEH expertise and research underpins publication of the Defra Invasive Non-Native Species Framework Strategy.

2008: CEH expertise contributes to the scientific understanding of the 2007 summer floods in the UK, and the subsequent publication of the Pitt review.

2009: CEH leads the development of the first Defra indicator "Impacts of Invasive Species".

2013: Proposal for EU legislation to address invasive alien species and protect biodiversity.

2013: CEH leads the Surface Water Flooding component of the Natural Hazards Partnership Hazards Impact Model (NHP HIM).

2013: CEH chairs COST Action European information system for alien species.

Future Research Objectives

Improve understanding of the threats to people and the environment from natural hazards.

By 2019, we will:

- *make available a new web system to deliver key hydrological variables required by the FEH methods of flood risk estimation, used widely throughout the UK.*

- *publish an approach to horizon scanning for invasive non-native species.*

- *provide tools and techniques for improved seasonal forecasting of river flows, groundwater recharge and soil moisture at a range of temporal spatial scales.*

Improve predictions and forecasting of the onset, frequency and magnitude of natural hazards.

By 2019, we will:

- *provide a tool for forecasting surface water flooding for operational use, and further develop the hydrological tools underpinning operational fluvial flood forecasting systems.*

- *deliver new systems to predict the arrival of invasive non-native species with particular focus on their pathways of arrival, spread and associated disease pathogens.*

- *have developed a drought monitoring and prediction system to estimate the frequency, magnitude, character and impacts of drought.*

How can we mitigate the impacts and improve our management of natural hazards?

By 2019, we will:

- *have developed tools and knowledge to support flood and drought management policy under long-term environmental, including climate, change.*

- *make available tools and guidance on predicting the impact on human populations and ecosystems of terrestrial and aquatic pathogens.*

- *provide web-based tools for seasonal forecasting of river flows for operational use to support flood and drought management in the UK and overseas.*

- *supply predictions of the arrival and spread of invasive non-native species underpinned by rigorous risk assessment methods and used effectively within systems for prevention and early warning.*

CENTRE FOR ECOLOGY & HYDROLOGY

Partnerships

Natural Hazards research in CEH is built on both our own expertise and that of our partners. Our key customers are Government departments (Cabinet Office, Defra, DECC), the EU, and regulatory and operational bodies such as the Environment Agency, Scottish Environment Protection Agency, Met Office, and Natural Resources Wales. We will continue to work in partnership to deliver data and tools to support flood and drought risk management and through the Natural Hazards Partnership with Public Health England, Health and Safety Laboratory, Ordnance Survey, BGS and others.

New countrywide Flood Forecasting Systems based on CEH's Grid-to-Grid Model have been implemented across Britain through collaboration with the Environment Agency, Scottish Environment Protection Agency, Met Office and Deltares.

CEH developed and maintains the early-warning and surveillance system for invasive non-native species within GB. This component of the GB Non-Native Species Information Portal is underpinned by horizon-scanning, which is also led by CEH in collaboration with the Marine Biological Association, British Trust for Ornithology, Botanical Society of the British Isles and others. This work is funded by Defra and in partnership with the Non-Native Species Secretariat.

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