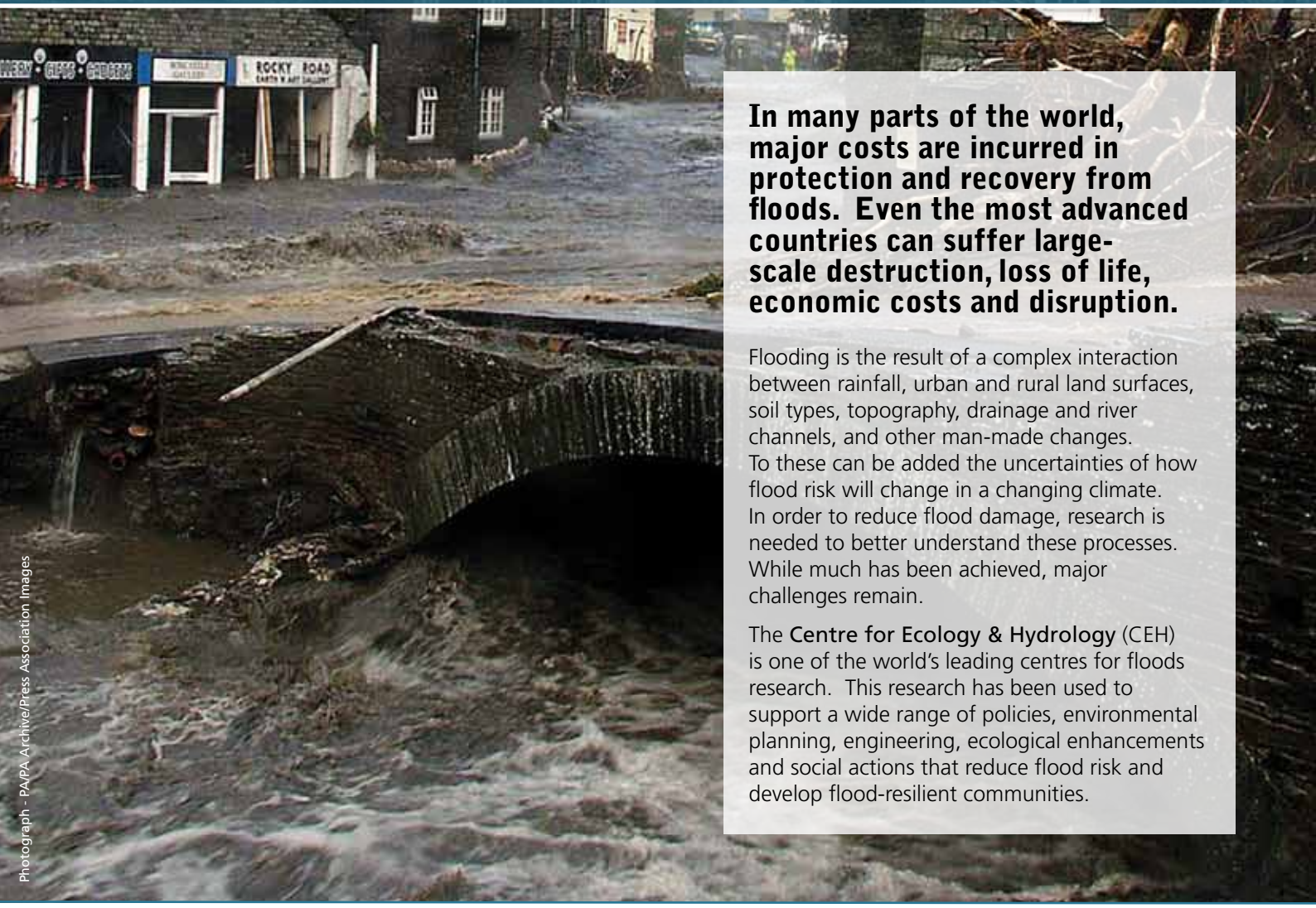
Integrated Science for Our Changing World: Understanding Floods



Photograph - PA/PA Archive/Press Association Images

In many parts of the world, major costs are incurred in protection and recovery from floods. Even the most advanced countries can suffer large-scale destruction, loss of life, economic costs and disruption.

Flooding is the result of a complex interaction between rainfall, urban and rural land surfaces, soil types, topography, drainage and river channels, and other man-made changes. To these can be added the uncertainties of how flood risk will change in a changing climate. In order to reduce flood damage, research is needed to better understand these processes. While much has been achieved, major challenges remain.

The **Centre for Ecology & Hydrology** (CEH) is one of the world's leading centres for floods research. This research has been used to support a wide range of policies, environmental planning, engineering, ecological enhancements and social actions that reduce flood risk and develop flood-resilient communities.

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SCIENCE FOR TODAY

Effective flood protection of houses and businesses, rail networks and motorways, bridges and drainage, energy and water supply systems, as well as many other critical infrastructures requires strategic long-term research using the best available science, research facilities and people.

A UK standard method for estimating floods

Engineers, planners, regulators and policy-makers have been able to work together far more effectively by using a standard method for estimating the likely magnitude of floods. Incorporating the latest science with national datasets, the Flood Estimation Handbook (FEH) provides essential information to support flood policy-making, planning and design across the entire UK.

Reservoir safety

It is more than 80 years since the UK has suffered a major dam or reservoir failure resulting in substantial loss of life – 16 lives were lost at Dolgarrog in north Wales in 1925. In part, this is due to rigorous reservoir safety studies that assess the complex combinations of risks. This requires integrating the knowledge and analytical tools of flood hydrology, meteorology, climatology, geosciences and engineering.

Pictured below: Ulley Reservoir, close to failure during floods in 2007

Photograph - Owen Humphreys/PA Wire

Properties at risk

Government policies are driving the development of more sophisticated flood risk mapping tools. These tools are being linked to assess wider impacts, e.g. on human health, greenhouse gases.

CEH developed the first national flood risk maps in the UK in 1995. Advances have continued as regulators have taken forward new mapping methods. People can immediately see whether their property is located in a flood-prone area. Emergency services now plan and direct their efforts to those areas most at risk. Flood risk maps have radically transformed the insurance sector, enabling the industry to develop more competitive flood risk products.

Environmental benefits of flooding

Not all impacts of flooding are negative. Floods maintain river channels and deposit nutrient-rich sediments on floodplains. The diversity of plants, animals and food in river and riparian ecosystems has created some of our most cherished wildlife areas. The challenge is to maintain the ecological benefits of floods, while not endangering life and property.

Datasets

The availability of high-quality datasets of past and present meteorology, river flows and catchment properties is vital in the development of new scientific methods. Through the National Hydrological Monitoring Programme, CEH is constantly improving the management and accessibility of floods data.

Photograph - NTI/UPPA/Photoshot

Photograph - South West News Service/Rex Features

Walham substation, Gloucestershire, July 2007

SCIENCE TO TACKLE THE CHALLENGES OF THE FUTURE

New research is improving existing tools and providing the capacity to respond to a broad range of future challenges. These challenges include the impacts of a changing climate, land management, and increasing urbanisation.

Innovations that apply advances in monitoring, computing and science are required to reduce uncertainties, and deliver evidence which policy-makers and the public can trust. Earth Observation, access to floods-related information through the internet, and the need for solutions to complex multi-sectoral issues are supporting major advances in flood science.

Climate change

The predicted impacts of climate change are that the size and frequency of future floods will change across the UK and throughout the world. Advice is needed now to inform decisions which will have long-term implications. Decision-makers need better information about the uncertainty in both climate model predictions and in how catchment processes may change in a future climate. The new CEH Grid-to-Grid (G2G) hydrological model is being used to assess future flood risk at local levels.

Flood forecasting

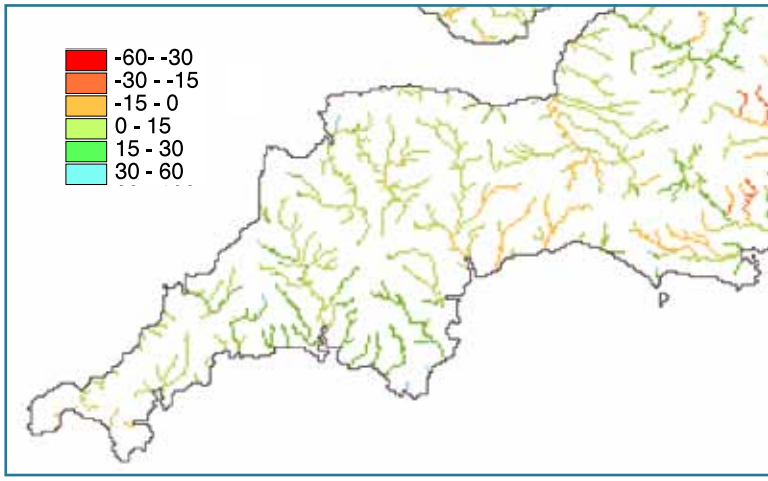
The UK's major rivers are managed using systems of relief channels, embankments, flood plains and reservoir storage. These systems enable flood managers to minimise damage, and allow flood waters to pass as safely as possible to the sea. Numerical models of the catchment are used to simulate and forecast what will happen in the real world. New CEH hydrological models of the UK are improving the coverage and warning time of the flood forecasting systems that support our national flood management capabilities.

Weather radar

There is an urgent requirement to improve the accuracy of rainfall estimates at very fine spatial resolution for use in flood forecasting. This is a very challenging area. Through novel analysis of radar and on-line raingauge data, CEH is researching methods that will make better use of weather radar data.

Future data requirements

Effective protection for sudden events such as floods is hampered by a lack of data. New data collection technologies and procedures are required to collect continuous data from many sites, especially in urban areas.



G2G model output showing predictions of percentage change in peak river flows from the 1970s to 2080s

CEH research

CEH is one of the world's leading centres for floods research. It provides a major part of the UK's national capability in the delivery of strategic environmental science and understanding to support floods-related policies. This is being integrated with research into land use, ecosystems, water resources, pollution, soils and atmosphere to tackle the complex environmental challenges of the future.

A recent review by Pricewaterhouse Coopers LLP (PwC) indicated savings to the UK of between £7-35million per annum from just one of the outputs of CEH's floods research, the Flood Estimation Handbook (FEH).

Working with others

CEH delivers its science through many routes, including collaborative partnerships. We work with the Met Office through the Joint Centre for Hydro-Meteorological Research, the Environment Agency (including their joint Flood Forecasting Centre), other NERC Research Centres, the wider academic community and industry in the UK, EU and worldwide.

Photograph - GPA Images/Rex Features

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Additional information

The provision of information suitable for the general public is an essential part of CEH's role in enabling citizens to understand, prepare and respond to flooding. The following web links provide additional information:

CEH Science Strategy	www.ceh.ac.uk/science/corpstrat.html
CEH Water Programme	www.ceh.ac.uk/sci_programmes/water.html
National River Flow Archive (NRFA)	www.ceh.ac.uk/data/nrfa/index.html
Summer 2007 Floods Appraisal	www.ceh.ac.uk/documents/CEH_FloodingAppraisal.pdf
Flood Estimation Handbook (FEH)	www.ceh.ac.uk/feh
Joint Centre for Hydro-Meteorological Research	www.jchmr.org
Climate & Water	www.eu-watch.org
EA/Met Office Joint Flood Forecasting Centre	www.ffc-environment-agency.metoffice.gov.uk
DEFRA – Floods	www.defra.gov.uk/Environ/Fcd/default.htm
EA – Flood Risk Map	http://maps.environment-agency.gov.uk/wiyby/wiybyController
SEPA Flood Map	www.multimap.com/clients/places.cgi?client=sepa
Tidal Storm Surges	www.pol.ac.uk/ntslf/model.html
Natural Environment Research Council (NERC)	www.nerc.ac.uk

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