CEH SCIENCE AREAS

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

SCIENCE AREA SUMMARY

POLLUTION & ENVIRONMENTAL RISK

Providing the scientific knowledge, evidence and risk assessments needed for sustainable management of chemicals while protecting people, the environment and its services.

Context

Chemicals include such substances as pharmaceuticals, radionuclides, macronutrients such as phosphorus and nitrogen, trace gases and elements, particulates, and organic and inorganic compounds. They are used in, and directly or indirectly released from, processes and products that are essential for people's health, nutrition and well-being. However, chemicals and their breakdown products have hazardous properties which can pose a risk to the environment, ecosystem services and human health. Risk assessments, based on fundamental knowledge of transport, fate, exposure and effects, are essential for safe chemical use and release.

Our Research

CEH has world-class capability for integrated long-term monitoring, residue analysis, laboratory and field experimentation and multi-scale modelling of chemicals in the environment. Our close links with national and international policy-makers will ensure that the new knowledge we generate translates through to policies and mitigation strategies that deliver safe management of chemicals, now and in the future.

Focussing on priority and newly-emerging pollutants, we will study transport, fate, exposure and effects to discover and predict impacts on organisms, ecosystems, the services they deliver, and human health.

Research activity will include:

- quantifying spatial and temporal trends in fate, behaviour, exposure and effects for atmospheric, aquatic and terrestrial systems.
- development of transport and bioavailability models to explain variability and reduce uncertainties in estimates of environmental concentrations and exposure.
- development of exposure-response models, in particular for scenarios such as chronic low level exposure, exposure to chemical mixtures and simultaneous exposure to chemical and non-chemical stressors.
- studies on how interactions between environmental conditions, climate change and air quality impact on human and ecosystem health.
- identifying traits that underpin sensitivity and adaptation to assess risks to key organisms, food security, ecosystem services and biodiversity.
- development of new approaches and tools for hazard screening, risk assessment and source apportionment for emergent technologies.
- assessing the importance of the impacts of specific pollutants relative to other stressors.
- determining the pollution risks to ecosystem services.
- exploration of how chemical risks vary with likely future climate and demographic change, increasing urbanisation and a move towards low carbon economies.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Science Excellence to Impact

1960s

1960s: Monitoring organochlorine insecticides in birds, the forerunner of the Predatory Bird Monitoring Scheme, provides evidence for need to withdraw their use.

1980s

1988: Long Range Transport of Atmospheric Pollutants (LRTAP) Convention defines critical levels and loads approaches.

1989: Rosemaund experiment data used to develop better pesticide risk assessment methods for soils.

1990s

1994: WHAM model advances ability to predict soil and water metal chemistry.

1995: GB risk map of sensitivity of surface waters to acidification.

1999: Predatory Bird Monitoring Scheme identifies unexpected long-term environmental risk to predators from anticoagulant rodenticides.

2000s

2001: National Expert Group on Transboundary Air Pollution (NEGTAP) report.

2005: "Chernobyl Catastrophe and Consequences" publication summarises 20 years of research to determine the major environmental impacts of Chernobyl disaster.

2005: MIXTOX risk assessment techniques for chemical mixtures.

2007: ERICA Integrated Approach & Tool for worldwide use in assessing radiological protection of the environment.

2008: First model-based risk assessment for steroid oestrogens in fish for England and Wales.

2010s

2010: Model of water quality developed allowing realistic EU-scale risk assessments for emerging contaminants released "down-the-drain".

2010: New ozone risk assessment methods for international protocols.

2011: CEH inputs to OECD testing programme for nanomaterials.

Launch of the European Nitrogen Assessment report.

2012: Publication of the Review of Transboundary Air Pollution (RoTAP) in UK.

Future Research Objectives

To undertake short and long-term monitoring to quantify concentrations, pools, fluxes and impacts of key environmental pollutants.

By 2019, we will:

- *have assessed the levels of threat to biota in UK rivers from sequential waste water treatment works discharges and from emerging pollutants.*
- *identify threshold phosphorus concentrations needed to attain improved ecological status in UK rivers.*
- *have assessed the extent and significance of changing concentrations of emergent pollutants and biocides in terrestrial wildlife sentinels.*
- *establish the capability to utilise smart sensors to monitor personal exposure to ambient air pollution.*

Reduce uncertainty with which we predict the environmental dynamics, bioavailability and impacts of environmental pollutants.

By 2019, we will have:

- *developed models to project future metal accumulation and risk in agricultural soils.*
- *evaluated the extent to which simple exposure assumptions ensure wildlife is protected from ionising radiation.*
- *updated inventories of UK habitats and designated sites at risk from acidification and eutrophication and developed methods for calculating biodiversity-based critical loads.*
- *helped develop a process-based model to predict the interactive effects of ozone and nitrogen.*

Improve hazard screening and risk assessment processes for current and emerging technologies.

By 2019, we will have developed:

- *new analytical techniques for detecting emerging environmental contaminants of concern.*
- *methods to predict the bioavailability of nanoparticles and track their accumulation and internal distribution in organisms.*
- *improved models for predicting radionuclide transfer to organisms.*
- *practical approaches to quantify and mitigate contaminant impacts on protected sites, ecosystem function and services.*

Assess how, in our changing world, environmental risk will change in the future.

By 2019, we will have:

- *developed methods to model river flows and pollutant exposures under predicted climate and socio-economic changes in Europe and developing countries.*
- *estimated the potential impacts of a large-scale Icelandic volcanic eruption on sensitive UK habitats.*
- *developed process-based models to predict the impacts of ozone in a changing climate.*



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Partnerships

Our projects link closely to other CEH science areas and, outside of CEH, are typically delivered in partnership with national and international collaborators and policy-makers. This includes operation of national networks for monitoring atmospheric air pollutants, operation of monitoring supersites, leading international programmes, and modelling from plot to UK and international scales.

Our scientific findings, data and expertise support a diverse array of regulatory agencies, policy-makers, national and international advisory committees, emergency planners and industry (see box).

Data from many of our projects are available through the **CEH Information Gateway** or from other dedicated websites such as **UK-AIR**, **the UK Pollutant Deposition portal** and the **Air Pollution Information System (APIS).**

National stakeholders	International stakeholders
Defra	European Commission
Chemicals Regulatory Directorate	European Environment Agency
Health & Safety Executive	United Nations Convention on Long-range Transboundary Air Pollution (LRTAP)
Nuclear Decommissioning Authority	European Chemicals Agency (ECHA)
Environment Agency	European Food Safety Authority (EFSA)
Scottish Environmental Protection Agency	International Atomic Energy Agency
Natural Resources Wales	European Chemical Industry Council (CEFIC)
JNCC and its devolved countryside agencies	International Fertiliser Industry Association (IFA)
Forestry Commission	Metals and nanotechnology industries
NGOs	

Contact

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