

## 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.



# Science Excellence to Impact

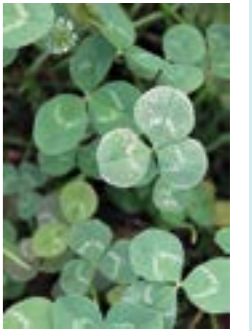


- 1988: Long Range Transport of Atmospheric Pollutants (LRTAP) Convention defines critical levels and loads approaches.
- 1989: Rosemaund experiment data used to develop better pesticide risk assessment methods for soils.



- 2001: National Expert Group on Transboundary Air Pollution (NEG-TAP) 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.

- 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.



1960s	1980s	1990s	2000s	2010s
<p><b>1960s:</b> Monitoring organochlorine insecticides in birds, the forerunner of the Predatory Bird Monitoring Scheme, provides evidence for need to withdraw their use.</p>		<ul style="list-style-type: none"> <li>1994: WHAM model advances ability to predict soil and water metal chemistry.</li> <li>1995: GB risk map of sensitivity of surface waters to acidification.</li> <li>1999: Predatory Bird Monitoring Scheme identifies unexpected long-term environmental risk to predators from anticoagulant rodenticides.</li> </ul>	<ul style="list-style-type: none"> <li>2007: ERICA Integrated Approach &amp; Tool for worldwide use in assessing radiological protection of the environment.</li> <li>2008: First model-based risk assessment for steroid oestrogens in fish for England and Wales.</li> </ul>	<ul style="list-style-type: none"> <li>2011: CEH inputs to OECD testing programme for nanomaterials. Launch of the European Nitrogen Assessment report.</li> <li>2012: Publication of the Review of Transboundary Air Pollution (RoTAP) in UK.</li> </ul>

## 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:**

- *measure or estimate how environmental concentrations of priority pollutants and their impacts vary in space and time and are driven by emission/release pathways.*

**Towards this end, by 2015:**

- *we will quantify annually the risks of impacts from acid and nitrogen concentrations and deposition on UK designated sites of high conservation value.*

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

**By 2019, we will:**

- *deliver process-based predictive models and approaches to enhance quantification of the fate, exposure, effects and mitigation outcomes for selected priority pollutants.*

**Towards this end, by 2015:**

- *we will have improved the accuracy of our models that predict transport, transformation and fate of priority air pollutants at multiple scales, including a more robust assessment of human health effects of urban air pollution.*

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

**By 2019, we will:**

- *have developed new analytical capabilities, indicators and tools to improve the throughput, realism and efficiency of hazard and risk assessment techniques for the environment and people.*

**Towards this end, by 2015:**

- *we will have delivered trained experts, new tools and approaches for more realistic assessment of environmental exposure concentrations and risks from manufactured nanomaterials.*

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

**By 2019, we will:**

- *have advanced our capabilities for assessing the risks to the environment, ecosystem services and people that are associated with future changes in human demography, land management and climate.*

**Towards this end, by 2015:**

- *we will publish a risk assessment for the effects of steroid oestrogen mixtures on fish for the rivers of England and Wales accounting for population growth and climate to 2050.*





Photos - L to R: 1 Shutterstock; 2 & 3 Gina Mills, CEH

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

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