

CASE STUDY

CUSTOMER

UK and devolved governments
and international organisations

DELIVERABLE

Tools that monitor, track and
model metal pollution

OUTCOMES

Contributing to 85% cost savings
in USA copper risk assessments

Contributing to 23% reduction in
quality standards failures for zinc

Research leading to wider
improvements to human and
environmental health



The Biotic Ligand Model-based normalization approach has transformed the way in which metals risk assessment takes place in Europe."

Dr Christian Schlekot

Senior Environmental
Toxicologist, NiPERA (Nickel
Producers Environmental
Research Association)

Tracking metal behaviour to ensure a safe environment

Improving human health, producing new environmental
quality standards and saving millions of pounds worldwide

The challenge

Metals are central to modern society, but they pose risks to our health and environment. Cadmium pollution of soils impacts crop yield and quality, while mercury released into rivers has severely affected human health.

These risks come with great economic costs – in the UK regulatory compliance costs relating to metal releases to freshwaters exceed £100 million per year, and losses due to crop contamination in China are estimated at more than \$US 3 billion per year.

Understanding the environmental behaviour of metals and to what degree people, plants and animals might be exposed is critical for protecting our health, and that of the environment.

The research

The Centre for Ecology & Hydrology (CEH) develops tools to better understand how metals move through and affect humans and the environment. CEH's world-leading model, WHAM (Windermere Humic Aqueous Model), predicts the chemistry of more than 40 metals, of various different forms, in soils and water.

The capabilities of WHAM have underpinned development of other models and methodologies:

- the Biotic Ligand Model - predicts how metal toxicity in freshwaters varies with water chemistry. Both the US and UK have used it to set water quality standards for metals.



Photo - Rio Tinto 2006



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The development of WHAM has significantly advanced our understanding of metals' fate in natural environments... WHAM has been used as the exclusive speciation component of Environmental Quality Standards derivation procedures for Europe... and the United States."

Dr Eric Van Genderen

Manager, Environment & Sustainability, International Zinc Association

- the Intermediate Dynamic Model for Metals - predicts metal dynamics through soils and into surface waters. It has been used to predict environmental risk due to deposition and long-term risks of metals entering agricultural soils.
- CHemistry of the Uplands Model-Annual Metals (CHUM-AM) - predicts soil and surface water concentrations of metals in UK catchments.
- the Critical Loads approach - identifies acceptable limits for atmospheric metal deposition to European soils to prevent terrestrial ecosystem damage.
- WHAM-FTOX - a version of WHAM that models the combined effect of metals and acidity on organisms.

The outcomes

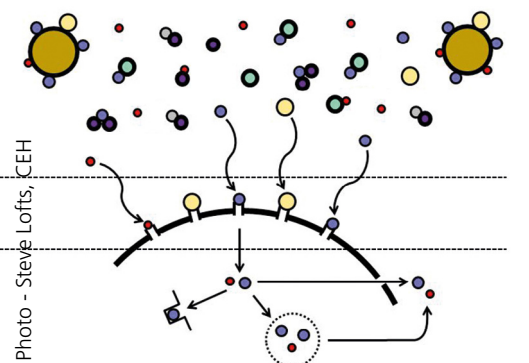
CEH's WHAM has been at the core of several robust and flexible metals risk assessment tools.

As an integral component of the Biotic Ligand Model (BLM) it has informed policy development in:

- United States - costs associated with site-specific water quality criteria for copper fell by 85% with the introduction of new water quality criteria.
- Europe - annual additional costs of compliance with proposed Environmental Quality Standards for metals have been estimated to be £170m p.a. for non-phased compliance by 2027. By reducing failures of copper and zinc quality standards by 16% and 23% respectively, the BLM has the potential to save millions of pounds.

WHAM is also used across Europe as part of the Critical Loads approach, informing UK government policies and contributing to international air pollution protocol negotiations.

CEH's metal chemistry risk assessment tools are transparent, economically efficient, improve human and environmental health, and decrease costs for regulators and private industries.



Example process from WHAM



Effect of airborne metal from smelting

The CEH projects described here have multiple partners across the UK, Europe and worldwide that are too numerous to mention individually. Please visit our website for partner details.



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