Water Resource Associates

A network of consultants in hydraulics, hydrology, groundwater & environmental issues

Project title: **Integrated Nitrogen in Catchments Model (INCA)**

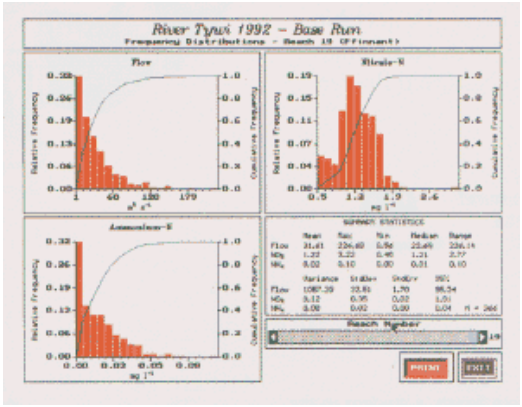
Summary: Developing an integrated hydrological and water quality model for catchments to stimulate flow, nitrate and ammonia both in time and space.

Client: National Power	**Financed by:** National Power
Period of assignment: 1997-9	**Location**: United Kingdom
Project Value: £60 000	**WRA services**: £60 000
In co-operation with: University of Reading	

Background:

A new model has been developed for assessing multiple sources of nitrogen in catchments. The INCA model is process based and uses mass balance and reaction kinetic equations to simulate the principal mechanisms operating. Modelled processes include mineralisation, nitrification, denitrification, immobilisation, plant uptake and nitrogen fixation. Both surface soil zones and groundwater zones are simulated together with leaching of water into the river system. The land phase and river channels are modelled so that a semi-distributed description of oxidised and reduced nitrogen across the catchment can be obtained.

Upland system – River Irthing, Cumbria



INCA model – Frequency distributions

Detail of Model

The model can simulate up to six different land uses; forest, arable, surface vegetation (grazed or fertilised) and moorland. Sources of nitrogen can be from atmospheric deposition (i.e. From local or remote sources such as power stations, industry or vehicles), from point sources such as sewage discharges, from distribute sources such as agricultural fertilisers or from natural organic sources of nitrogen.

INCA is a daily simulation model with built in hydrological mass balance equations. Daily time series of model outputs at any reach boundary can be obtained and compared with observed data. Other outputs include statistical summaries, distribution graphs of water quality and profiles down the river system. INCA enables the user to calculate nitrogen loads from different land uses and information on annual and daily fluxes can be obtained.

In addition, it is possible to evaluate scenarios of environmental change to assess impacts on flow, loads and water quality. Scenarios to be tested can include land use change (e.g. Moorland to forest), changing atmospheric deposition (e.g. impacts of new atmospheric emission protocols), or changing agricultural practice (e.g. decreasing/ increasing fertiliser applications).

The model is user friendly with a simple menu system and high quality graphical displays. INCA is a valuable tool for research to evaluate nitrogen balance in catchments and river systems or in experimental plot studies. It is also a valuable teaching tool as it enables the user to ask questions about catchment dynamics, groundwater/surface water interactions, processes controlling nitrogen behaviour and environmental change issues.

INCA and associated manuals and papers can be obtained from Professor Whitehead.

Project Number 000025

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