Environment Canada Environnement Canada

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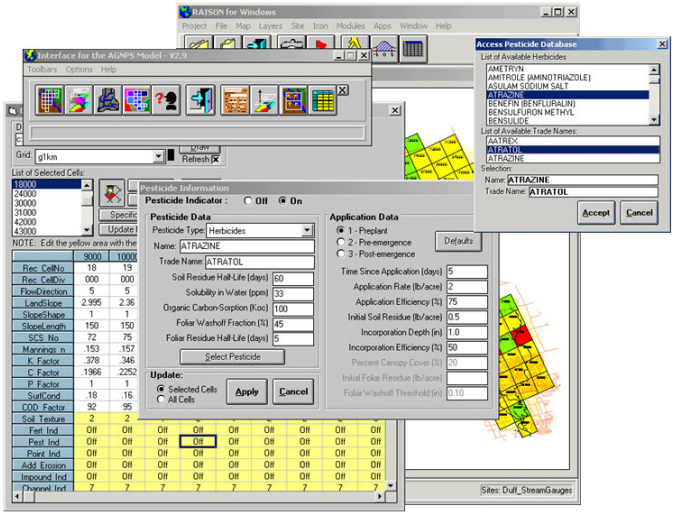
RAISON Technology

Capturing Knowledge—Making Better Decisions

The Problem

Environmental problems are complex. Often, they are multidisciplinary, bridging the physical, chemical and ecological sciences. Frequently they are multifaceted involving air, water, soil and biota. Although data and predictive models are readily available to support research on complex environmental issues, researchers can run into difficulty when using them.

Data are often in disparate formats covering varying time spans and spatial scales. Connecting models from different disciplines can also produce problems because of differing scales and difficulties in matching assumptions and applicability. A tool is needed to pull it all together, trim the extraneous information and fill gaps so that decision makers can ask questions and receive coherent answers.



Model integration in the decision support system RAISON.
Selection of pesticide data in a non-point source pollution model.

Canada

Seeking Solutions through S&T

In 1993, at an event on Information Technology in Government sponsored by the Treasury Board of Canada, a gold medal was awarded for the pioneering work on the RAISON System and its application to the acid rain problem, and a silver medal for its project management.

This tool is a decision support system—computer software that helps decision makers locate relevant information and create accurate summaries, risk analyses and optimal solutions. In essence, it provides scientific answers to management questions.

In the 1980s, Environment Canada scientists developed an environmental decision support system called RAISON (Regional Analysis by Intelligent System ON microcomputer). RAISON was initially intended to support managers dealing with the acid rain problem. It included a database that stored air, water, soil and biota data from federal, provincial and other agencies, and could statistically summarize the data, produce time trend plots or show spatial distributions on a map.

The main focus was the expert system component that could capture scientific knowledge such as rules to select appropriate models and data for a given problem. Not only were various computer models from scientists of different disciplines assembled, but the scientific knowledge associated with the assumptions and proper usage of the models and data were also captured. These components worked seamlessly together and were generically designed so the system was adaptable beyond the acid rain problem: for example in the diagnosis of conditions of drinking water wells, mine effluent discharges and Great Lakes water quality data analysis.

In the 1990s, the DOS version of RAISON was upgraded to work in the Windows environment, modules were upgraded and new features added based on user feedback. Desktop applications for issues now included watershed management, toxic substances, wildlife habitats and benthic assessment.

In the 2000s, the Internet paved the way for public access to scientific information and data, and heightened interest in communication of environmental problems to a wide range of users. RAISON Technology was upgraded as web-based technology to supplement desktop applications. Collaborative modelling was started where scientists could jointly develop integrated models from different disciplines and media using web-based technology. These technologies speed up collaborative efforts and make data analysis and model applications more transparent.

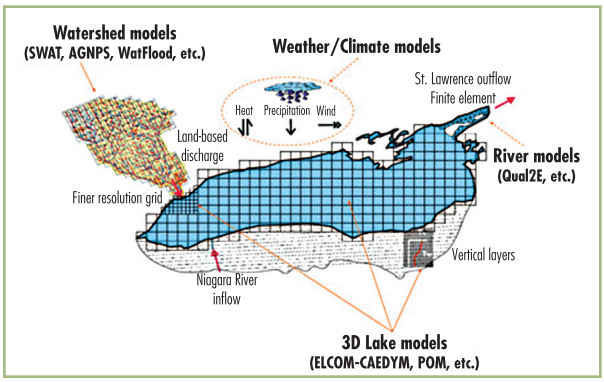
Photo: Photos.com, 2010

Transforming Knowledge into Action

Who can use these results?

Since the RAISON System is a generic technology, it is easily applied to many environmental problems and has been used by policy and decision makers at local, national and international levels to take action on various environmental issues.

An example of long-term application is the Integrated Assessment Model (IAM) for acid rain, which covers 30 years and over 10 000 lakes. IAM assembles and links air, water, soil, wildlife, fish, ecological and economic data and models developed and provided by federal, provincial and other partners. This decision support system consists of several modules designed to offer scientific answers to a set of management questions. For example, based on average air trajectories, it can identify the top five provinces or states in North America that may have emitted most of the sulphur dioxide that could eventually deposit on a given site in Canada.



Schematic of the framework for integrated environmental modelling by coupling weather-watersheds-lake models.

IAM and its results were used by Environment Canada and partners in the Canadian Acid Deposition Science Assessments in 1985, 1990, 1997 and 2004. It provided the only avenue to see what was improving. Over these two decades, new and improved models, including those on nitrogen oxides, were incorporated in the IAM, and new data, particularly from Western Canada, were added.

RAISON has also been applied:

To a wide range of water quality issues in Canada and internationally by the United Nations Environmental Programme. Knowledge generated through the analysis of water quality data is made publicly available on web-based platforms such as the Canadian Information System for the Environment, RésEau and GEMS/Water.

To develop and apply watershed management plans in Canada (e.g., the Capilano and Seymour Lake watersheds in British Columbia, and the Grand River, Rouge and Duffins watersheds in Ontario), as well as Australia, Brazil, China, Malawi and Mexico.

To Canadian mine and pulp and paper effluent issues, using a coupled modelling-expert system approach, and to drinking water protection in Ontario.

To predict concentrations of priority toxic chemicals in water, sediment and biota in support of the Canada–Ontario Agreement and the Canada–United States Strategy for Virtual Elimination of Toxic Substances in the Great Lakes Basin.

To air quality issues in Ontario such as the Hamilton Air Quality Initiative.

To develop the river models component of ChemSim (Chemical Simulation) and the Integrated Lakes Modelling System that supported Environment Canada's CEPA program by providing the Risk Assessment Directorate with modelling technology that has helped evaluate over 25 000 chemicals.

To climate change effects modelling in the Great Lakes basin for lake and stream physical and chemical conditions.

To Remedial Action Plan areas such as Toronto, Hamilton and Collingwood harbours.

To developing other major web-based systems within Environment Canada, including the Canadian Aquatic Biomonitoring Network (CABIN), WILDSPACE™ and the Lake Winnipeg Basin Initiative Information Portal.

Benefits to Canadians

RAISON technologies benefit Canadian taxpayers. Better synthesis of knowledge to make more sustainable decisions in a timely fashion can expedite cleanup and protection, giving optimum value for dollars spent on pollution reduction.

Decision makers in many jurisdictions have benefited from RAISON tools made available through technology transfer to other government agencies, and by collaboration with partners and the private sector. Without this technology transfer, these agencies and companies would not have been able to adequately carry out their mandates. More recently, the technology has been used to make data and tools available to the public and technical users online. This empowers non-traditional audiences such as the public to engage in informed discussion and program shaping.

For more information:

RAISON: *www.ec.gc.ca/INRE-NWRI/default.asp?lang=En&n=AD64403E-1*

RésEau: *www.ec.gc.ca/reseau/default.asp?lang=En&n=6BDB0B2D-1*

GEMStat: *www.gemstat.org*

CABIN: *http://ec.gc.ca/rcba-cabin/*

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