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The Incorporation of GIS in Radiological Transportation Accident Consequence Assessments*

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INTRODUCTION

Potential impacts of transportation accidents must be addressed in documents prepared under the National Environmental Protection Act (NEPA) as amended or in other environmental-related documents when the transportation of radioactive materials is considered. Estimating the potential human health consequences from the release and dispersion of radioactive materials following such an accident involves a number of interrelated computational models and a variety of input parameters. The RISKIND radiological transportation risk computer program [1] was developed to provide these types of estimates for local scenarios. However, it is often difficult to gain a full understanding of the initial problem and consequences by looking solely at numerical input and tables of results. To permit better-informed decisions, visualization of the site-specific geographic area and the potential spread of contamination can provide greater understanding. Thus, a geographic information system (GIS) component has been integrated with RISKIND to provide visualization capabilities as well as site-specific and computational benefits.

DESCRIPTION

The addition of GIS functionality to a health risk model in the past has been relegated to large GIS workstations or expensive software involving risk analyses conducted in separate stages, often with the manual transfer of data between stand-alone GIS systems and risk analysis software. Over the past several years, GIS programming objects with increasing capabilities have

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become available for embedding in applications written for desktop PCs. These programming objects provide the GIS functionality required for overlaying risk results on maps of affected areas interactively and managing data, such as the local population density, required in risk analysis. These capabilities have been added to RISKIND without the need for purchase of expensive GIS software.

The SylvanMaps®/OCX map control was selected for incorporation into the RISKIND program, which runs under the Windows™ operating system. This map control was selected because it: (1) provides the desired GIS functionality (including intersection and area calculation routines, as well as built-in panning and zooming capabilities); (2) is programmable in Microsoft (MS) VisualBasic 6 (the same language as used for the RISKIND interface); (3) stores data in an MS Access database (a common database format); (4) provides import capabilities for common GIS formats (SHP, MIF, DLG, DWG, and DXF); (5) provides the potential for future extension to Internet applications via its sister application, SylvanMaps.NET®; and (6) permits royalty-free distribution of its run-time libraries with a developer's application.

Two new windows were added to RISKIND to accommodate the new GIS component. One window provides for user input to control the appearance of the map display, and the second window provides the display of the map information as shown in Figure 1. An interactive map display was designed to allow the user to position the location of a hypothetical accident as well as the location of individual receptors if individual risk is being estimated. For population risks, concentration contours from accidental airborne releases of contaminants are overlaid on the local area map. Intersection of this air concentration layer with an underlying population data layer (e.g., census block or group data) yields the number of affected persons for use in the health risk estimates.

RESULTS

The benefits of integrating the GIS component into RISKIND include provision of enhanced visualization and computational capabilities without sacrificing ease of use. It is important that, during the decision-making process, stakeholders and the public understand the potential accident risks associated with a proposed action. The radiological risk models simulate many complex interactions, the implications of which are not always clearly conveyed to the analyst, sponsors, or stakeholders by the numerical results. Visualization puts the numbers in perspective and adds to the site-specific nature of the analysis, as shown in Figure 1. Additionally, because the distribution of potential receptors within a contaminant plume determines their potential exposure, population exposure estimates with the integrated code have been seen to vary by more than a factor of 2 from estimates based on an average population density for the same number of affected persons.

Thus, the GIS component has added enhanced computational capabilities in the areas of database management and new tools in the form of standard GIS functions for the manipulation (numerical analysis) and customizable display (presentation) of data. This functionality was attained by fully integrating the GIS component into a small desktop application without the added cost of GIS software or a separate workstation. The integration was accomplished in a way that minimizes the GIS learning curve and supports multiple GIS data formats so that the health risk analyst can use existing geographic data with a minimum of effort.

REFERENCES

1. Yuan, Y.C., S.Y. Chen, B.M. Biwer, and D.J. LePoire, 1995, *RISKIND — A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, ANL/EAD-1, Argonne National Laboratory, Argonne, Ill., Nov.

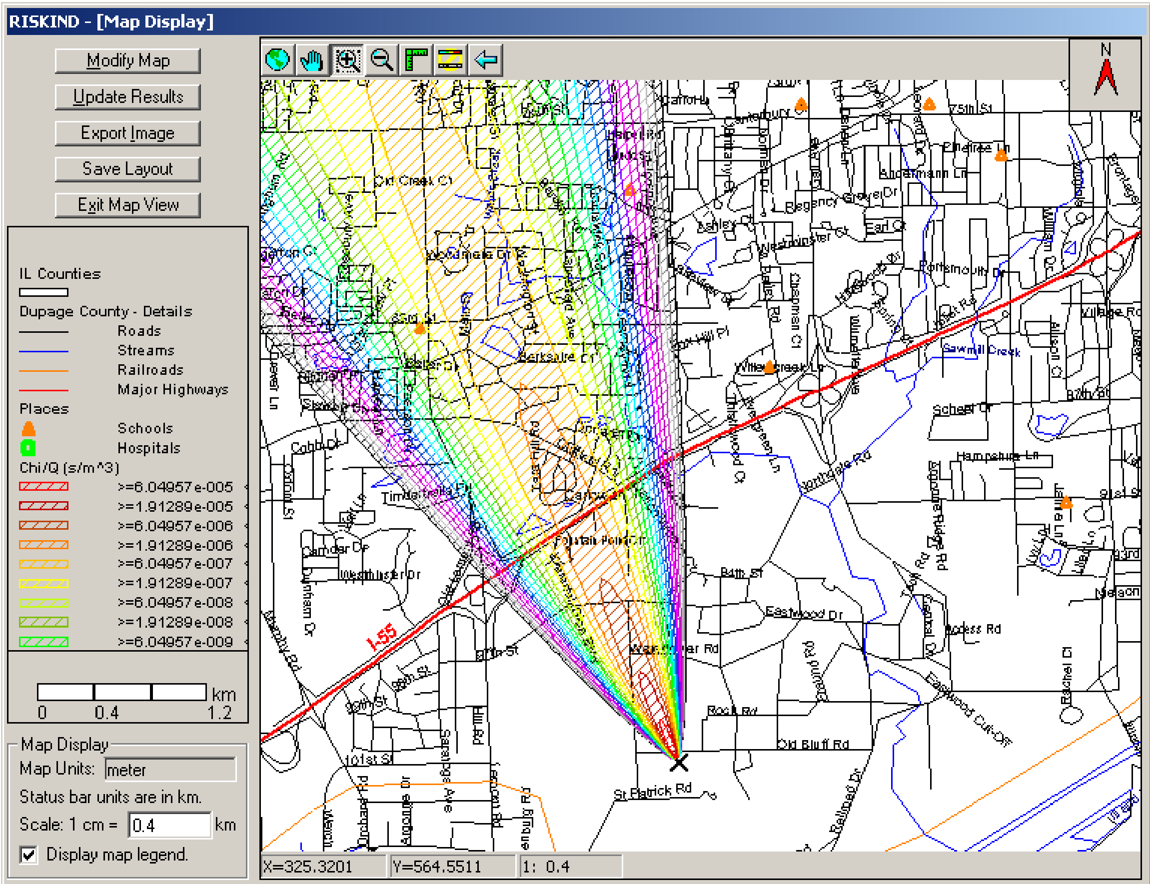

Figure 1. Local Map Display Showing Nearby Schools and Waterways with a Potential Contaminant Plume Released from a Hypothetical Accident Location