Automated GIS-based Planning and Management Support System

GIS-Based Planning and Management Support System for Emergency Events involving Atmospheric Releases of Hazardous Materials

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Summary
Numerous atmospheric dispersion models, with a wide range of features are available for assessing potential emergency response situations. A rational planning decision support system for emergency events must consider a hierarchy of atmospheric dispersion models for emergency response analyses. Appropriate data gathered from various models have to be organized and displayed logically to determine the size and scope of emergency management programs. The GIS-based planning and decision support system presented here can be utilized alternative models to characterize the spatial extent of a hazardous release under plausible scenarios, and enable easy comparison and sharing of results. Models in this system include ALOHA, ISC, AERMOD, CALPUFF, and HPAC. Model platform dependent issues are mitigated using GIS-based front ends to facilitate systematic automation of several GUI-based dispersion models. Model platform dependent issues are mitigated using GIS-based front ends to facilitate systematic automation of several GUI-based dispersion models.

Multiple Scales/Levels of Atmospheric Dispersion Models for Emergency Response Support

Potential effect of buildings on plume dispersion in urban areas: for the same prevailing wind characteristics and chemical release, the plume profile can be significantly different, depending on the building profiles around the release location.

Hierarchy of atmospheric dispersion models for emergency response analysis:
Simpler models need to be evaluated and compared with more detailed ("research laboratory" grade) models.

Modeling Results Obtained with an Automated GIS-based Planning and Management Support System

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Programs

GIS-Based Support System

Desktop GIS Applications Supported: ArcMap, ArcView, QuantumGIS, etc. • full GIS functionalities such as spatial query of modeling results • customized display of spatially-based modeling results

Geodatabases Supported: ArcGIS, Oracle Spatial, PostGIS, etc. • modeling results archived in shapefiles, layers, etc. • spatial data saved in multiple formats (vectors, rasters, CAD, etc.) • centralized access to spatial data by desktop and web applications

Web-Based Map Servers Supported: ArcGIS, MapServer, etc. • allow access/visualization to spatially-based modeling results through web browser • provide development interfaces that can be used to create additional web-based analysis and visualization tools

GUI Automation Sub-System

Problem: • Emergency event response planning typically requires multiple model simulations to generate possible outcomes for various scenarios. • A series of repetitive commands need to be executed manually for models that are purely GIS-based, without a scripting interface • This increases chances for human errors, and could hinder the decision-making process, especially when time is limited

Solution: • The Graphical User Interfaces (GUI) automation sub-system will facilitate systematic automation of several GIS-based dispersion models • Substantial time and effort savings by replacing manual input of recurring combination of keystrokes and mouse events with a script

Atmospheric Dispersion Modeling in Urban Terrain

Five urban locations for which HPAC provides urban terrain data: New Orleans, New York, Oklahoma City, Salt Lake City, and Washington DC.

Plume dispersion calculations by HPAC (a) urban option selected (left), and (b) without the urban option (right)

Air入市 locations of Hazardous Atmospheric pollutants (a,b) developed by NOAA

(a) Provides "levels of concern" at downwind locations of the chemical release based on the toxicological physical characteristics of the released chemical, atmospheric conditions, and source strength and release rate

(b) Displays "Transport" plot of the area affected by the release where concentration may exceed user set threshold levels

Scope and Part: is used by trained emergency responders

Building/Structure + Meteorological Data = Atmospheric Dispersion

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