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ESRI Homeland Security GIS Summit

Paper #1014

Title of Paper:

Port Security through Spatial Information Management

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Abstract:

Introduction: EarthData used we-based decision support architecture built around ESRI ArcGIS Server, Oracle DBMS, and a proprietary 3D rendering engine to combine sources of geospatial, tabular, and real-time data collected within the jurisdictional area of a U.S. east coast port.

Purpose: This project evaluated the capabilities of virtual 3D architecture to identify, locate, track, and interrogate data over the Web.

Method: The project used six application domains: marine, environmental, emergency response, property management, port operations, and port security. Analytical models included the national Hurricane Center's SLOSH and NOAA's Hazardous Material and Spills Division's GNOME models.

Results: Users selected and displayed intelligent 3D objects, received data streams to track and communicate changes in real-time, generated 2D and 3D maps, and created "what-if" scenarios.

Conclusion: The system supports safety, management, and operations' functions such as spill response simulation, environmental planning, search and rescue, and shipping traffic management.

Paper Body:

A Prototype for Better Port Management

More than 2 billion tons of domestic and international freight along with approximately 3.3 million barrels of oil and nearly 150 million ferry and cruise ship passengers move through our nation's waterways each year. Balancing this growing volume of goods and people with security, environmental, and other concerns is a major challenge to port authorities across the country.

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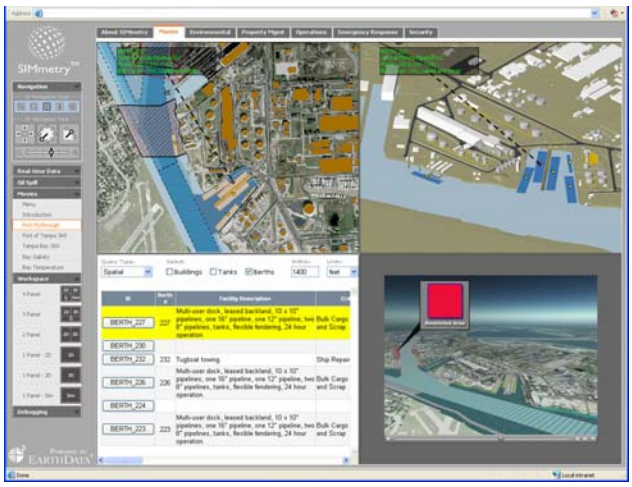
Working in partnership with NOAA Coastal Services Center, EarthData Solutions is developing a prototype decision-support tool for improved port operations.

The NOAA prototype is based on EarthData's SIMmetry system architecture, which delivers 2D GIS fully synchronized with 3D thematic mapping, query and analysis capabilities, and analytical model results. Organized around user application domains, the NOAA prototype guides users through a query and analysis process tailored to particular problem sets or use cases. Data views and context-driven queries have been customized for environmental, property, and port operations managers as well as security, marine, and emergency response personnel.

The entire tool, data and functionality, resides on the SIMmetry server; authorized users can interact with it through a secure web browser. This ability to view 3D perspectives and thematic maps over the web from any computer is one of SIMmetry's most unique and useful features. Intelligent 3D objects, including buildings, warehouses, tanks, and berths, are linked to a relational database. A 3D view is displayed when the user selects an object of interest through a spatially defined search query.

Using database or spatial queries, users can interactively create thematic maps in 2D and 3D with SIMmetry's web interface.



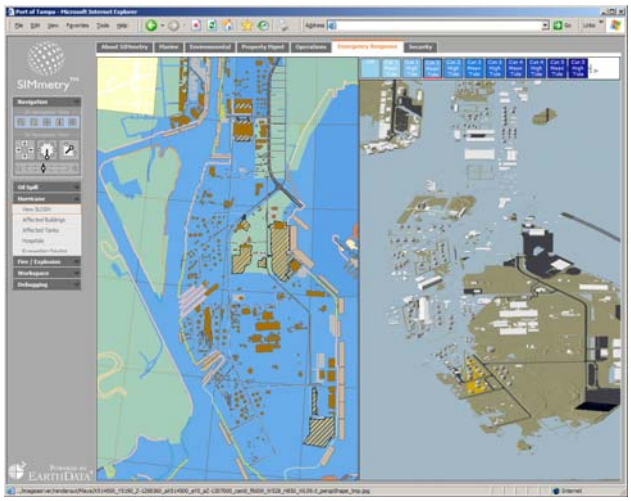
Examples might be:

- the port real estate manager wants to find all warehouse space of a certain size available on or after a specified date
- the port operations manager wants to see which berths are occupied in a given time period and the contact person for each
- the environmental manager wants to see where hazardous materials are stored in relationship to environmentally sensitive shoreline
- a recreational boater wants to familiarize him/herself with shipping channels, restricted areas and navigation markers

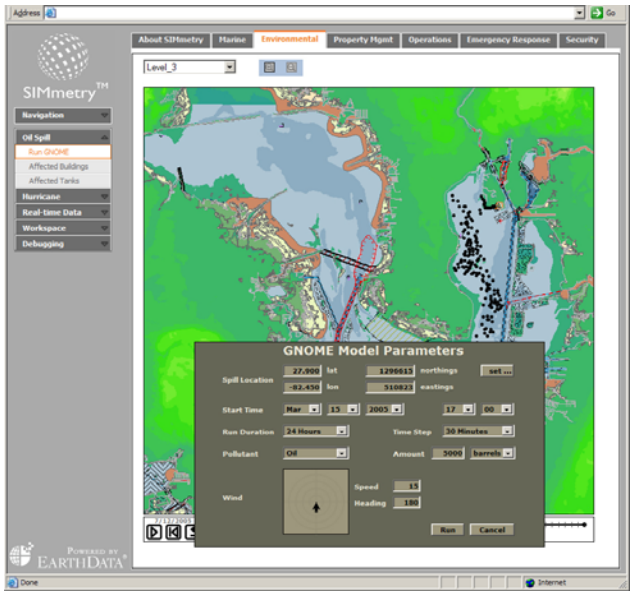
- the port security officer wants to know which tanks are filled with hazardous materials

- An emergency manager wants to know how port infrastructure is likely to be affected by a Category 2 hurricane occurring at high tide

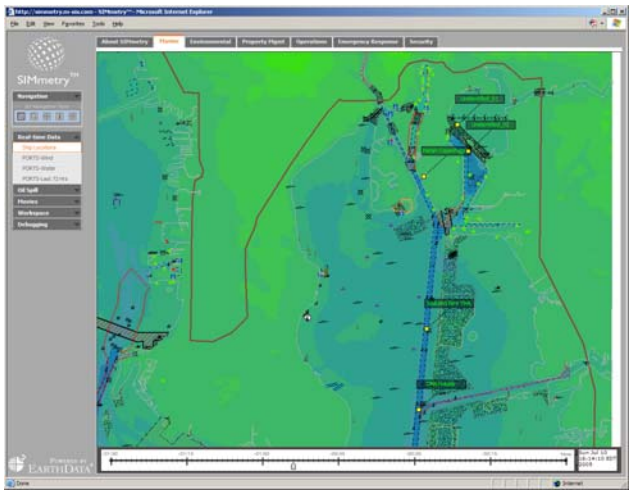
Analytical models, which forecast or track dynamic events over time, can also be integrated into the same web interface. The prototype incorporates two NOAA-supported analytical models: the Storm, Lake and Overland Surge from Hurricanes (SLOSH) model maintained and operated by the National Hurricane Center, and the General NOAA Oil Modeling Environment (GNOME) developed by the Hazardous Materials and Spills Division of NOAA's Office of Response and Restoration.



SLOSH model outputs show the extent of storm surge mapped over topography. Storm surge heights are transformed into an elevated water surface, which is used to inundate the 3D model of the port.



The GNOME model allows resource managers and port operators to develop realistic oil spill scenarios for planning purposes.



In the NOAA prototype, SIMmetry is also used to visualize dynamic data streams, tracking changes in real-time and communicating them to the user interface. Oceanographic conditions, monitored in real-time by NOAA's Physical Oceanographic Real-Time System, are accessible through 3D and 2D graphical objects. Simulated GPS coordinate data demonstrates the ability to track a ship entering and docking at the port facility.

The SIMmetry system, powered by ESRI GIS Server and ArcSDE along with EarthData's integration of 3D rendering and time series models, demonstrates the potential to use web-based GIS analysis and visualization technologies to further situational awareness for day-to-operations, security monitoring, and emergency response.

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