

Integrated Distributed GIS Approach for Earthquake Disaster Modeling and Visualization

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Outline

- Introduction
- Motivation
- Technical Overview
- System Architecture
- Implementation Issues
- Results and Concluding Remarks
- System Demo.

Introduction

- The City of Vancouver is the largest city in BC and the fourth largest Metropolitan Center in Canada.
- Located in an active tectonic zone.
- This project was part of Canada Disaster Management Information System (CDMIS)
- Proof of Concept/ Proof of Approach Initiative.
- York University GeolCT Lab, NRCan and private sector partners were involved in this project.
- Results of this project were presented as a part of routine Emergency Exercise.

Motivation

- The need for interoperable Disaster Management Information System that allow for multi-tier decision-making process and engage different departments concerned with DM/EM issues.
- The need for effective governmental organizational response to disasters that can address various aspects of systematic and jurisdictional considerations.
- The need for Multi-dimensional Visualization tool that can provide the ease of use for non GIS Professionals.

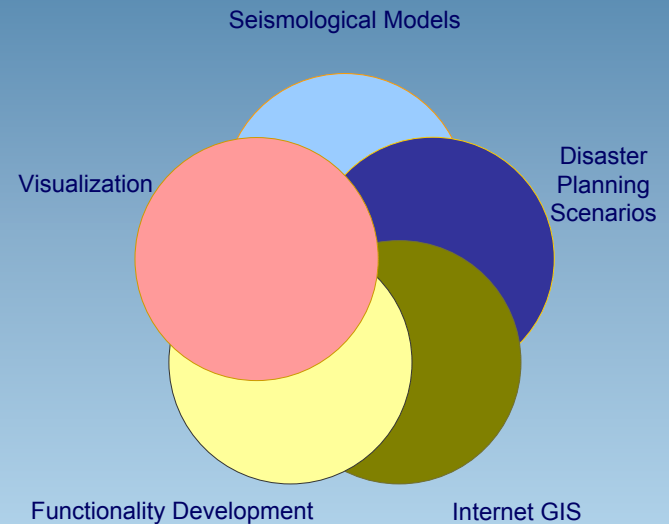
Objectives

- Demonstration of the utility of utilizing earth shake maps for earthquake modeling using GeoServNet.
- Emphasizing the importance of the spatial component of disasters through visualization.
- Providing 3D visualization perspective for the purpose of disaster management and emergency response

Overview of the approach

■ Key considerations

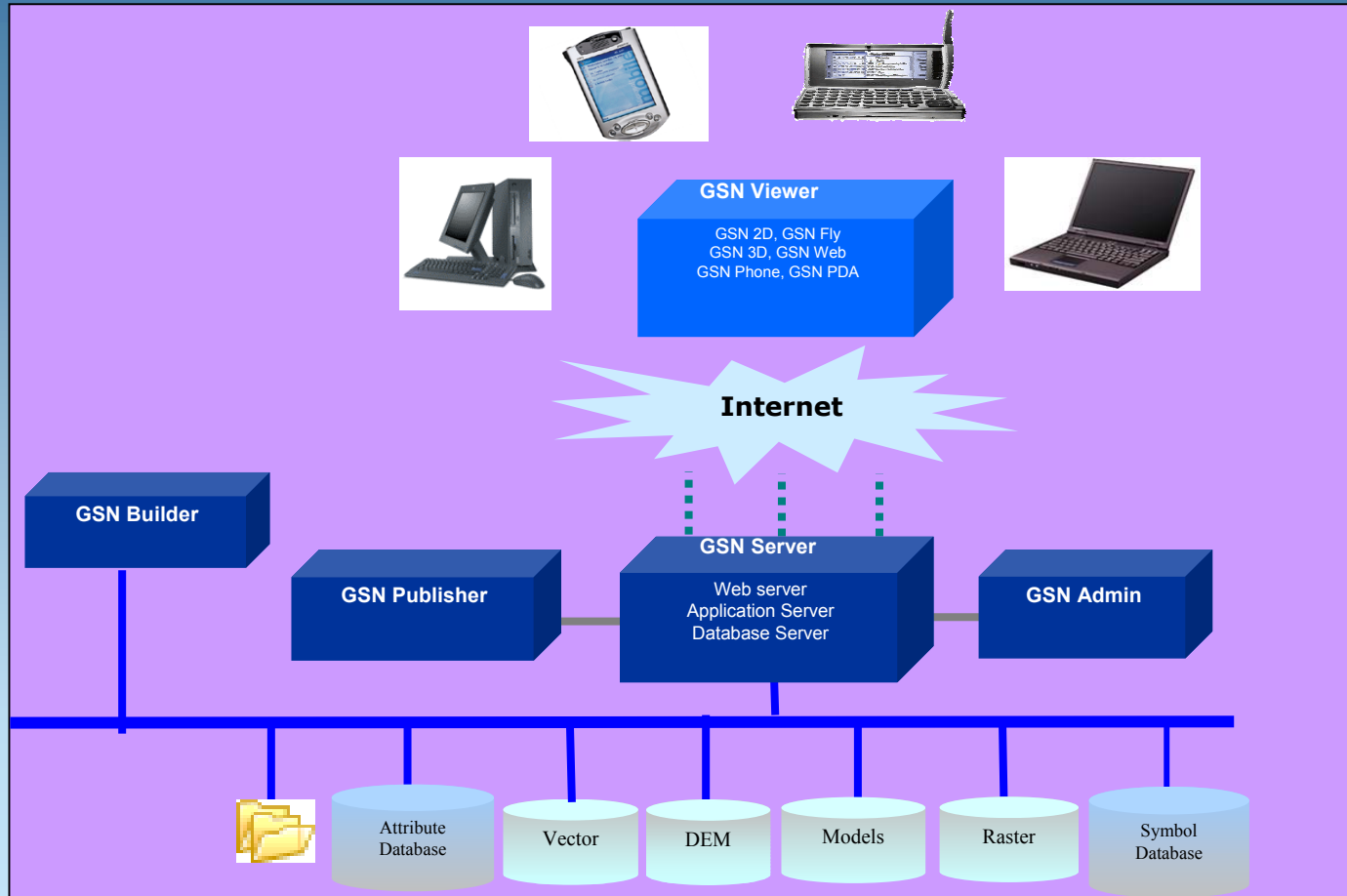
- ❑ Disaster planning scenarios were used to provide a relative context to 2D/3D visualization for disasters and emergency situations
- ❑ Supporting data sets used to demonstrate the effectiveness of integrating different data sources and visualization concepts
- ❑ Allowing for interoperable real time simulation and visualization.
- ❑ Addressing the effectiveness of GIS interoperability for effective multi-level decision-making



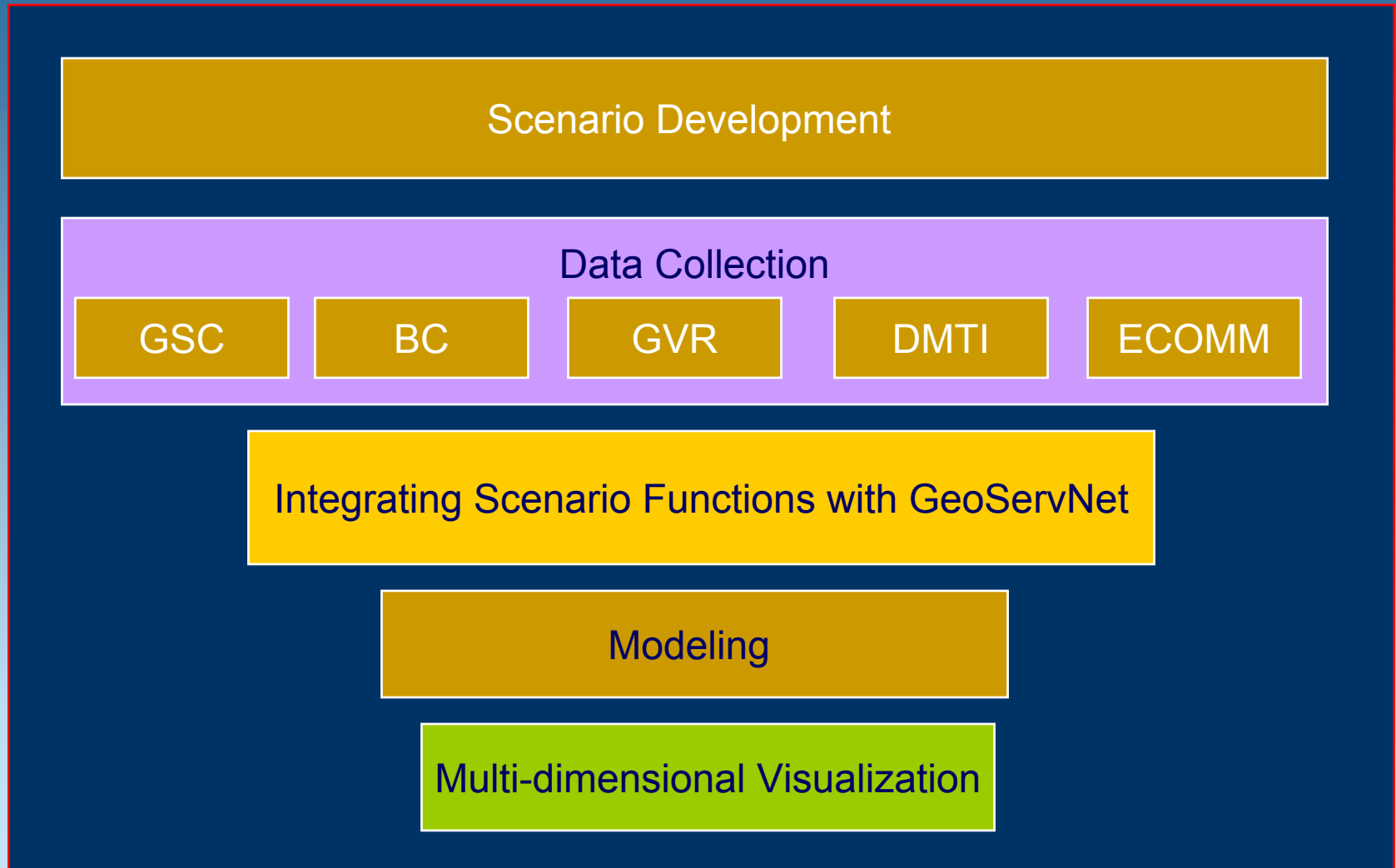
System Overview

- Developed by GeoICT Lab, York University, GeoServNet (GSN) is a 2d/3d interactive Internet GIS package.
- GSN can handle raster, vector, DEM and attributes data types and link them together.
- GSN modules are: GSNBuilder, GSNAdministrator, GSNPublisher, and GSNViewer.
- GSN integrate different data formats in a single framework seamlessly.
- GSN 2D and 3D viewers work together enabling the end-user to view complex data structures.

System Architecture



Methodology



Scenario Storyline

- November 28, 2002 @ 7:56am PST
- Location: Latitude 49.45 Longitude 123.941
- The earthquake is shallow and at magnitude 7.3MMI with no surface rupture.
- At this magnitude and location, it is plausible to have the following occur;
 - Landslide on Hornby Island
 - Fracture building damage in the City of Vancouver
 - Dam breach (assumed)
 - Flood Inundation in the west coast (Tsunami Wave)



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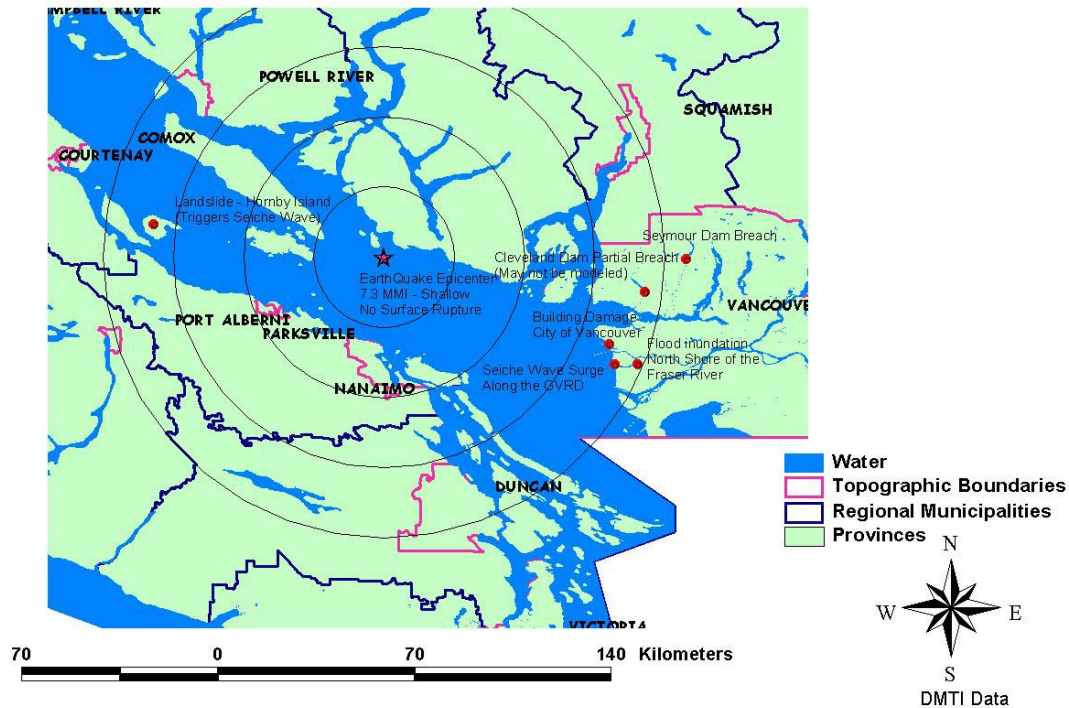


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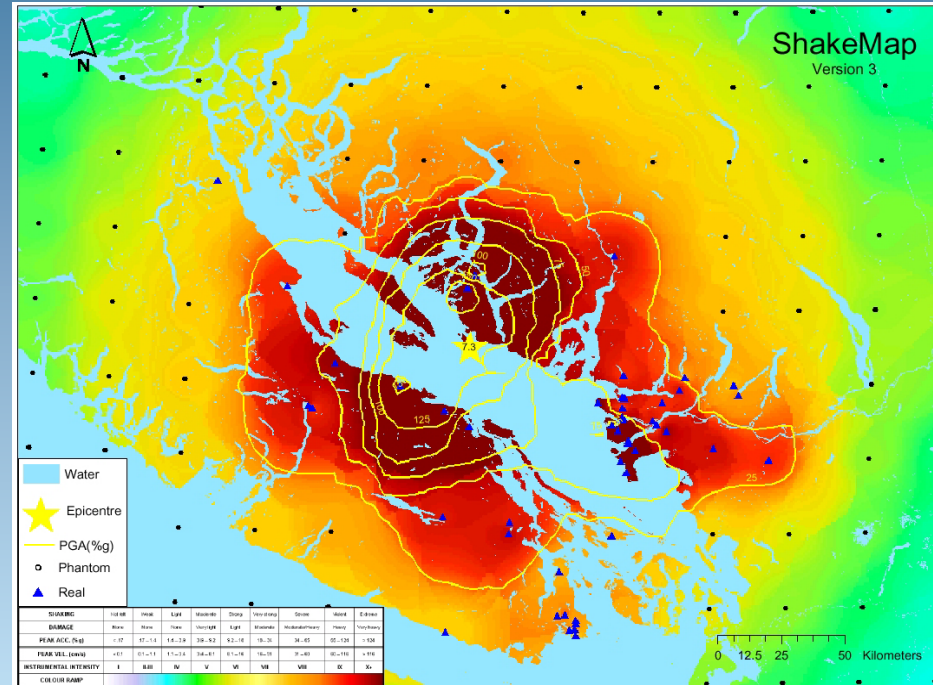


CDMIS Senario Locations for GVRD Earthquake Exccercise



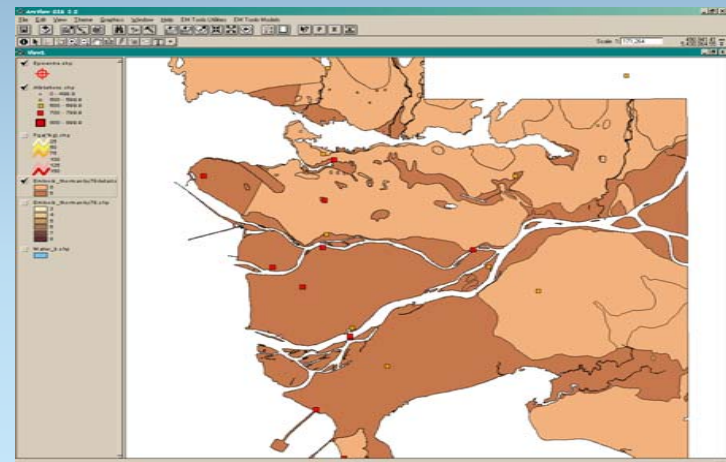
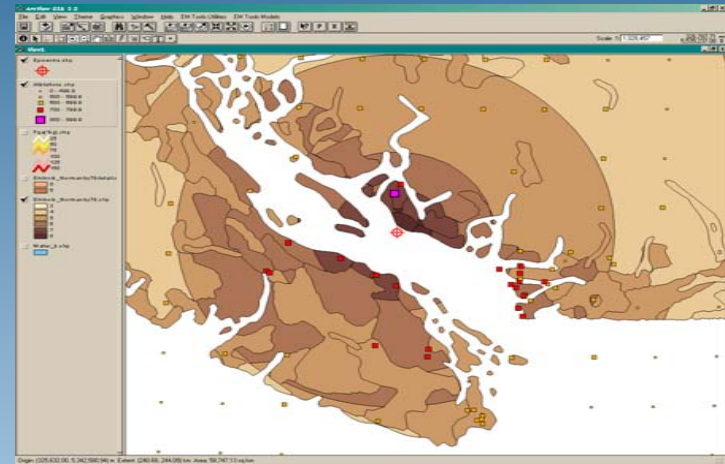
Analysis and Processing - Shakemap

- Earth Shake Maps are representation of ground motion recorded and extrapolated from knowledge of surface conditions.



Analysis and Processing - Validation

- Accuracy assessment analysis was done.
- Earth Shakemap was compared with WM-Tools package using the same parameters.
- There was general agreement between the two maps information

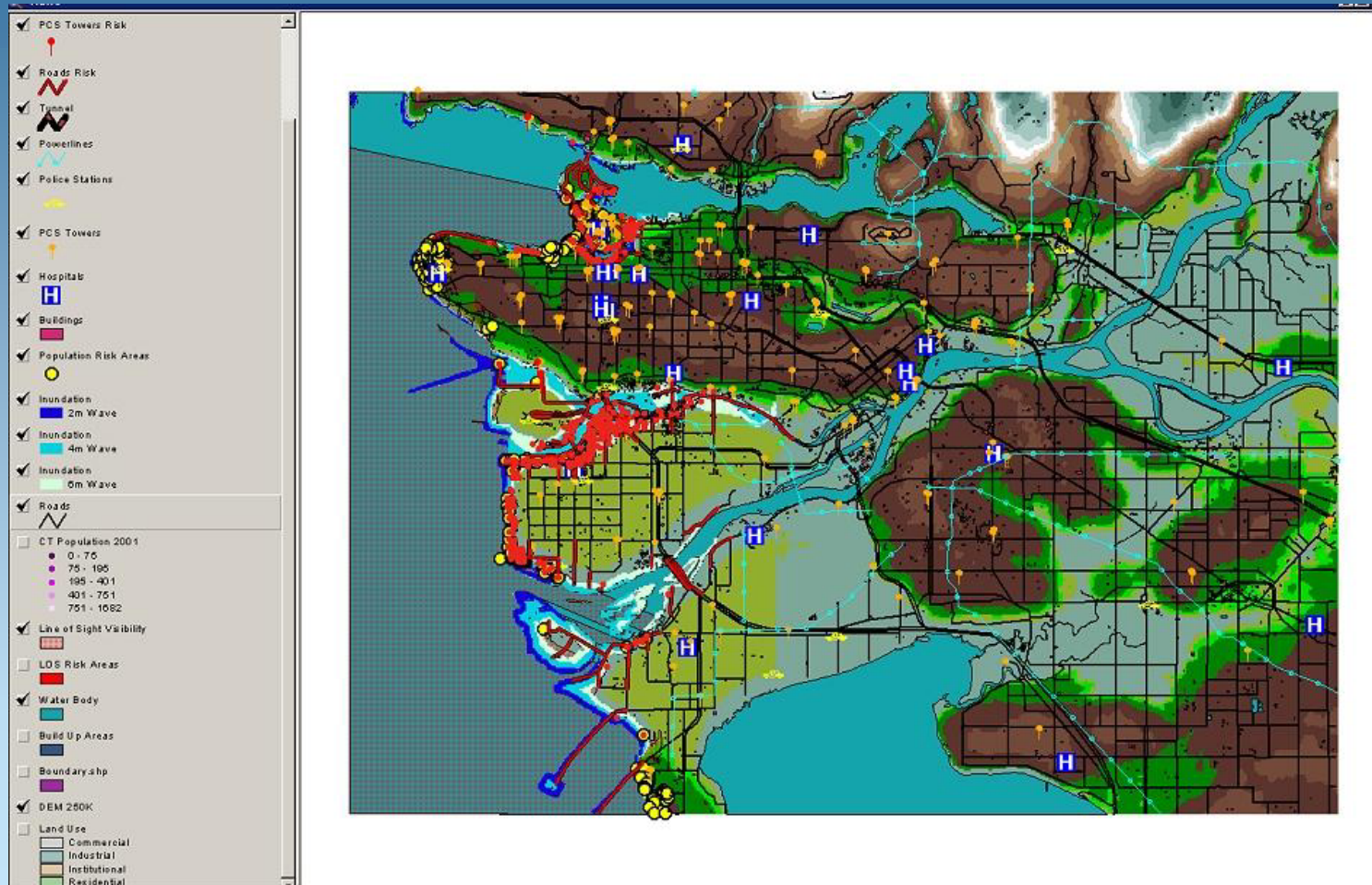


Analysis and Processing

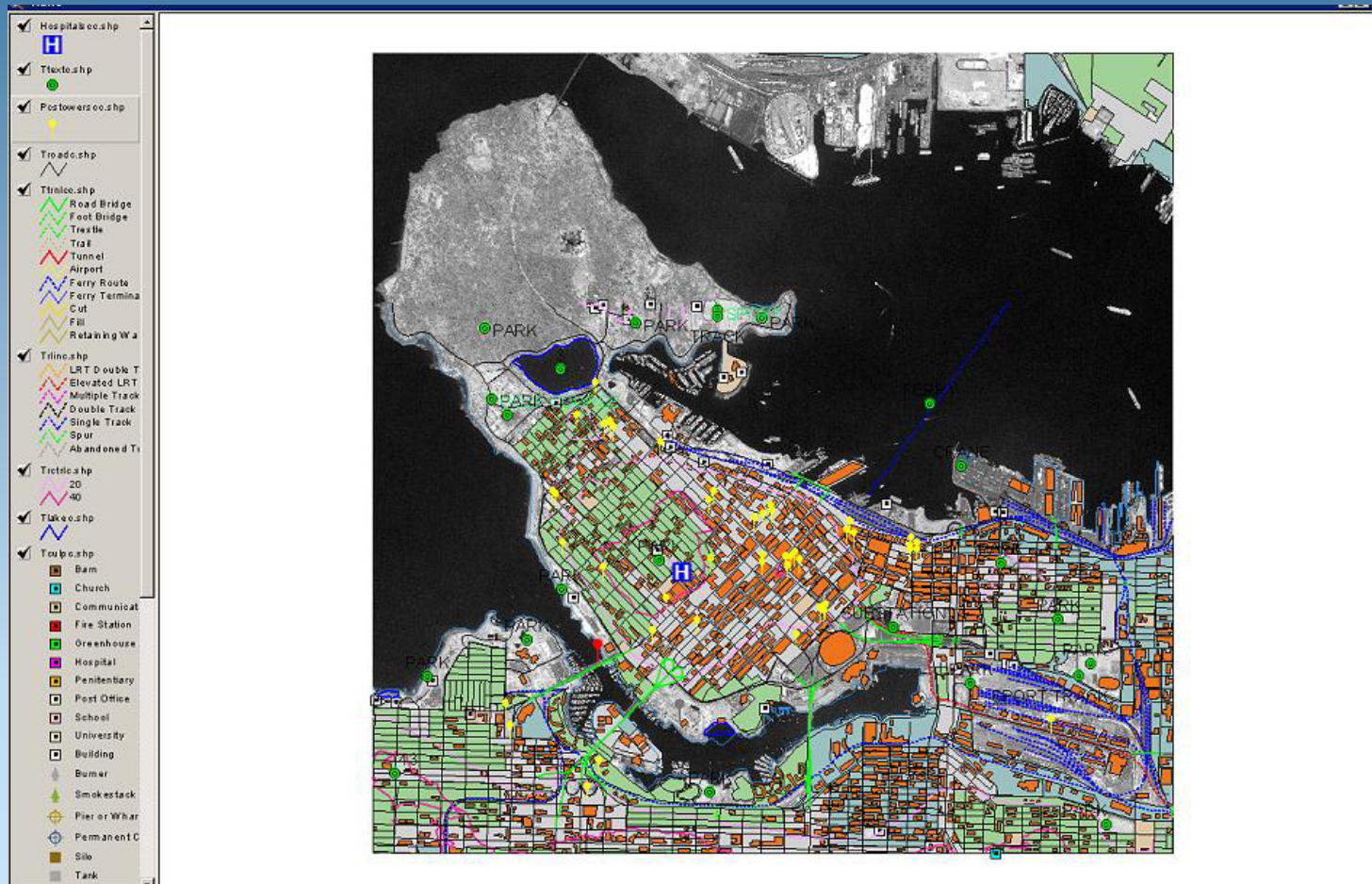
Bathymetry and census information were used as background information for modeling flood inundation and for calculating population at risk



Analysis and Processing – Flood Inundation

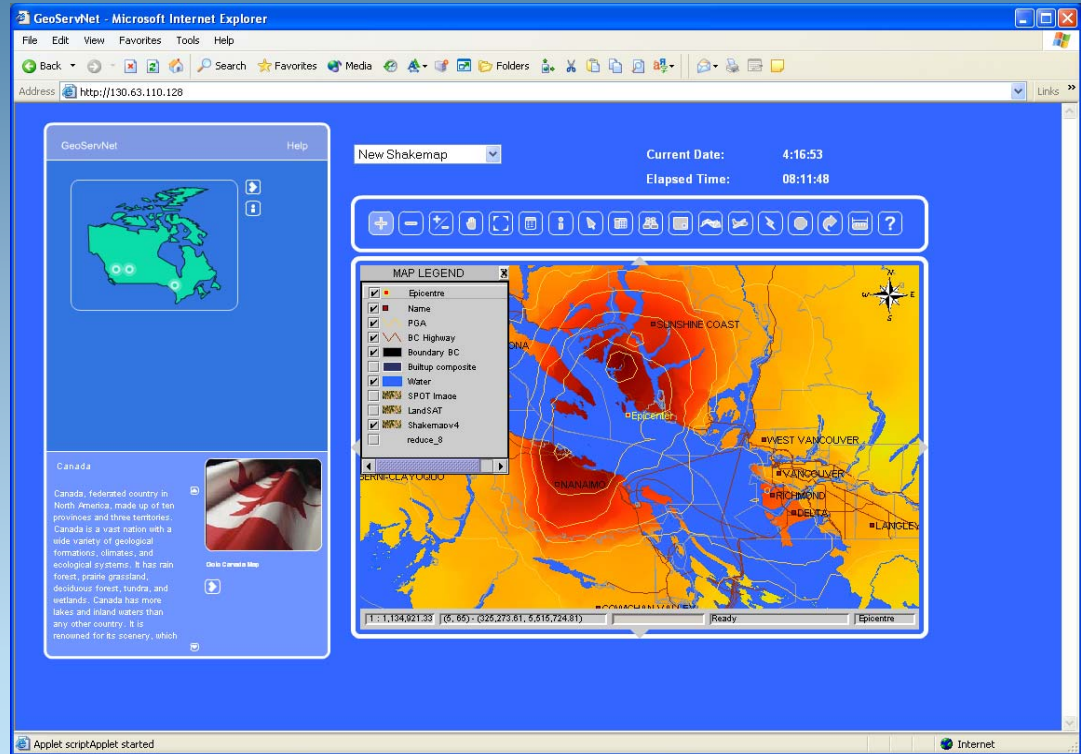


Analysis and Processing – Damage Assessment

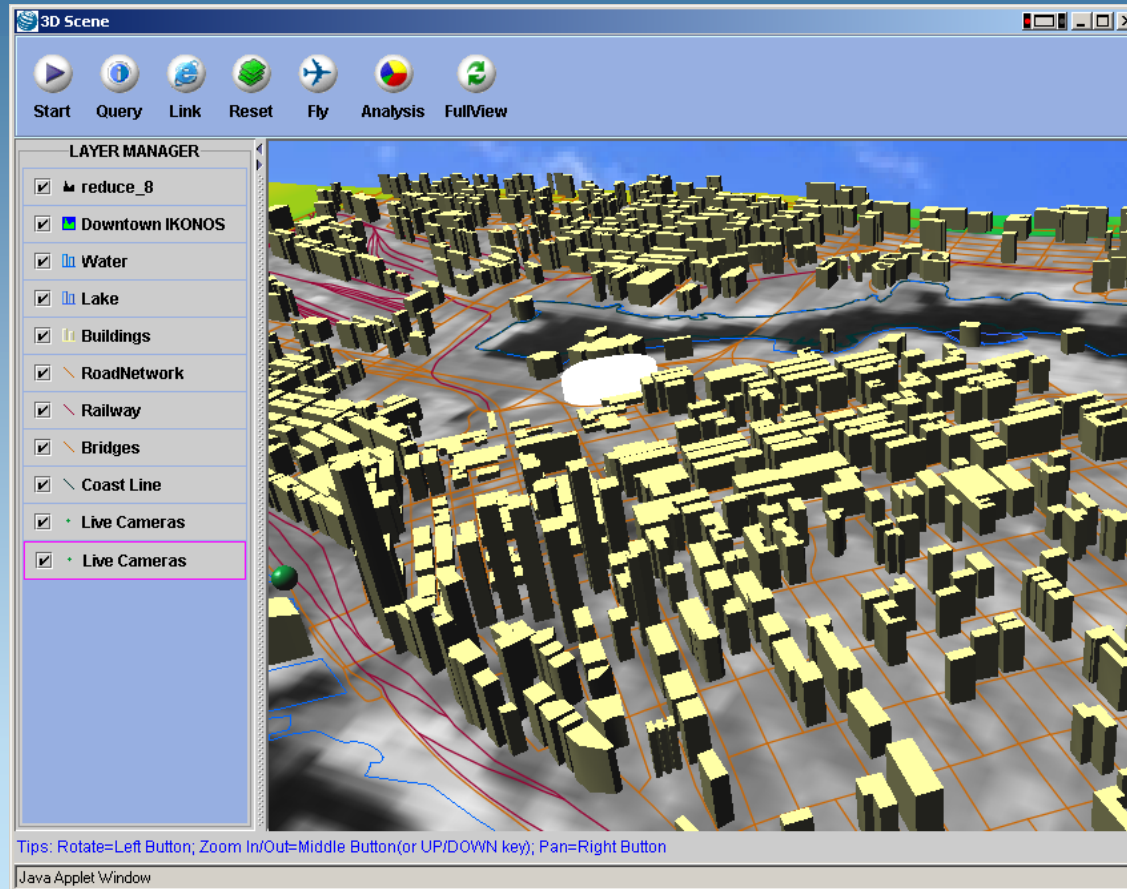


Modeling Results

GeoServNet Client Interface showing Vancouver Shakemap



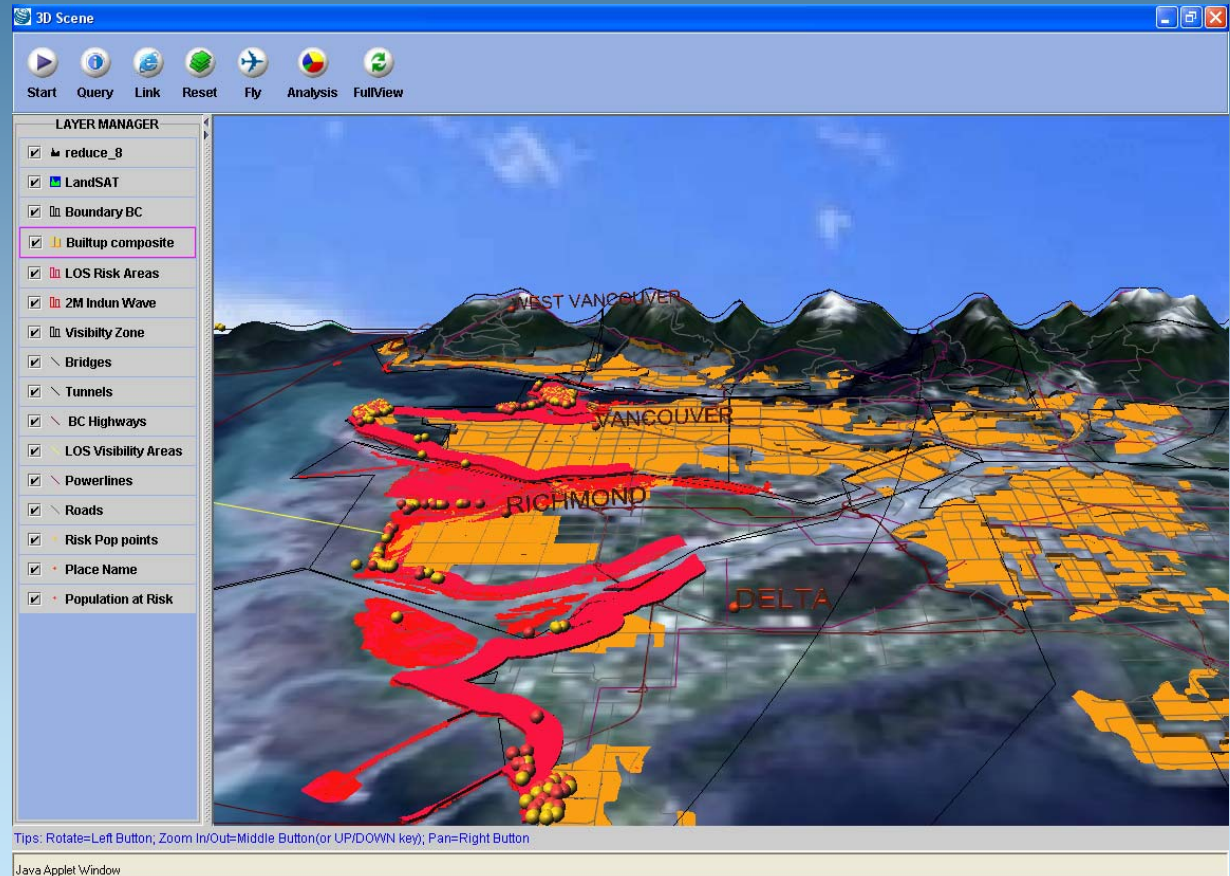
Modeling Results



GeoServNet 3D Vancouver Downtown Model

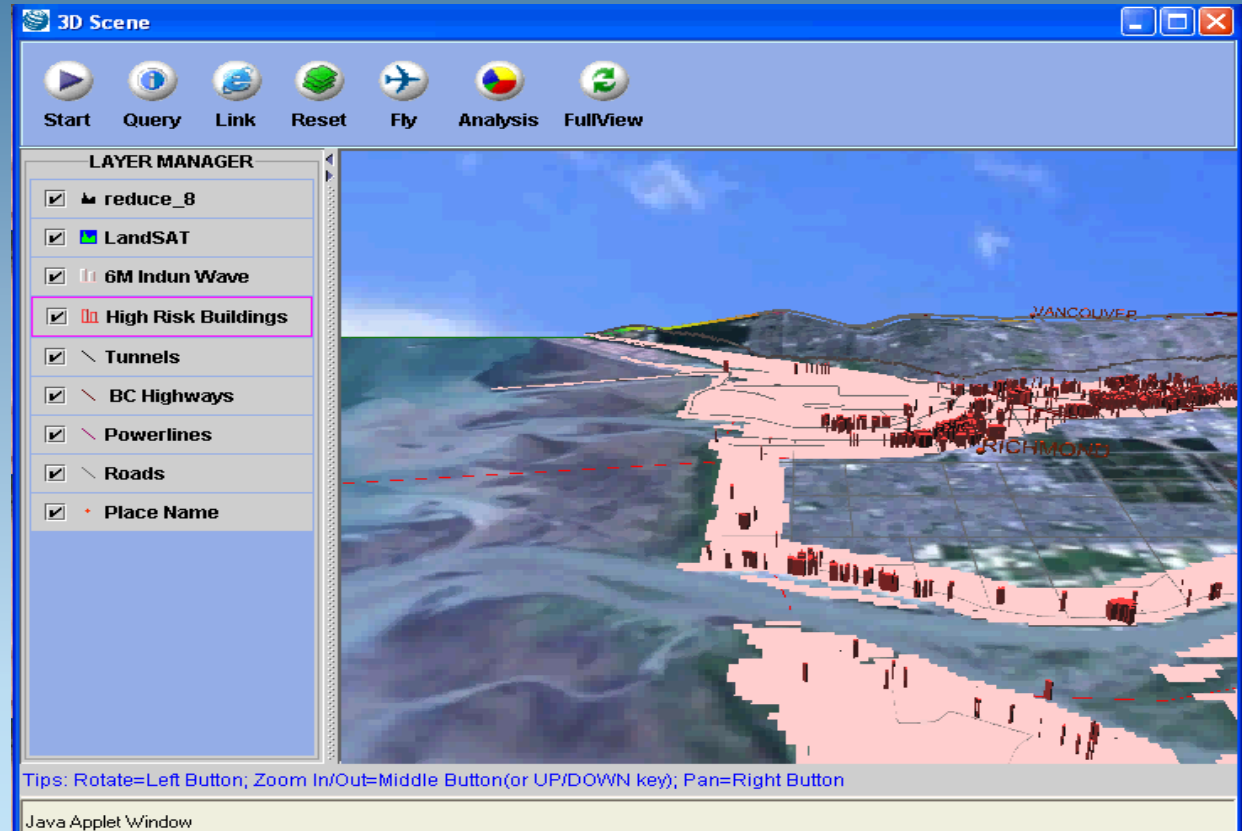
Modeling Results

- GeoServNet 3D Client Interface showing Vancouver Flood Inundation 3D Model with population



Modeling Results

GeoServNet 3D Client Interface showing Vancouver Flood inundation 3D model with Buildings and infrastructure at Risk



Challenges Encountered

■ Data

- One of the key challenges was to combine Federal, Provincial and Local datasets together. Each use different characteristics that define their requirements and needs.
- It was difficult to identify the suitable level of detail for the three levels of decision-making involved. Each look at the same location from own perspective.
- It was difficult to convince different departments that the data will be used from outside is an add up not replacement to their current data.

Challenges Encountered

- **Functionality Development**
 - 3D GIS was not well perceived from some of GIS professionals.
 - Web GIS with scalable structure was of interest to all three levels involved with this project.
 - Shakemap visualization was very welcomed as a new risk assessment tool.
 - Internet GIS has added additional dimension to modeling damage assessment; however, there was an argument about other factors to be incorporated in the model. i.e. Civil Engineering and Construction factors for accurate damage assessment.
 - The major intent was to demonstrate deployable and scalable proof of concept rather than providing optimal solution.

Challenges Encountered

■ Interoperability

- Creating system nodes and data servers was constrained by Information access privileges.
- Clear policy issues needed to be addressed when accessing information databases for disaster management.
- The readiness of local level authorities to share their system resources and data was in question.

Concluding Remarks

- GeoServNet was efficient in integrating, processing and visualizing heterogeneous datasets in different formats from different sources.
- Web GIS has provided the ease for real-time access and simultaneous informed decision-making process for all the three government levels involved with Emergency Management Scenario simulated.
- More collective efforts are needed for the implementation of effective interoperable GIS.
- Policy issues related to information access during emergencies requires revision.

A Web-based 2D/3D interactive visualization technology for National Defense



GSN 3D Fly and 3D Analysis Technology

GSN Image Streaming Technology

GSN Vector Streaming Technology

GSN V1.8

[GSN V1.8 from Java Web Start](#)



Acknowledgement

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Thank You