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MAEviz

Terry McLaren

Project Manager,
Cyberenvironment Technologies (CET),
National Center for Supercomputing Applications (NCSA),
University of Illinois at Urbana-Champaign

Presentation Overview

- Who is the MAE Center?
- What is MAEviz?
- MAEviz Overview
- Architecture Overview
- Extending MAEviz
- Conclusions

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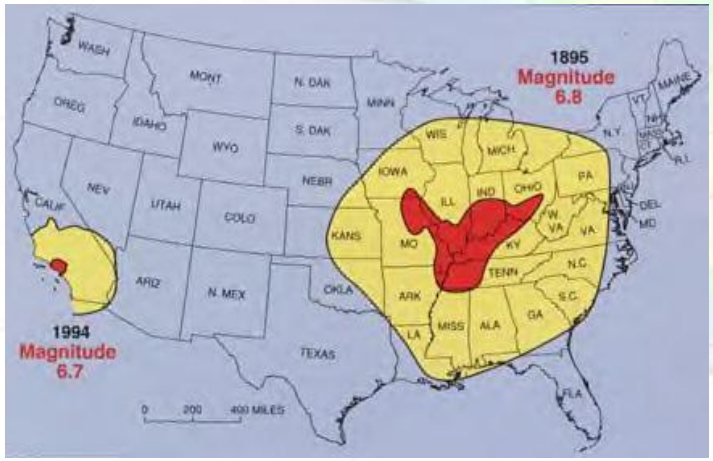
Who is the MAE Center?

- Mid-America Earthquake Center is an NSF Sponsored Center to research new engineering approaches to minimize consequences of future earthquakes
- Primary science focus includes but not limited to Eastern and Central US



- MAE Center Developed the Consequence-based Risk Management Model

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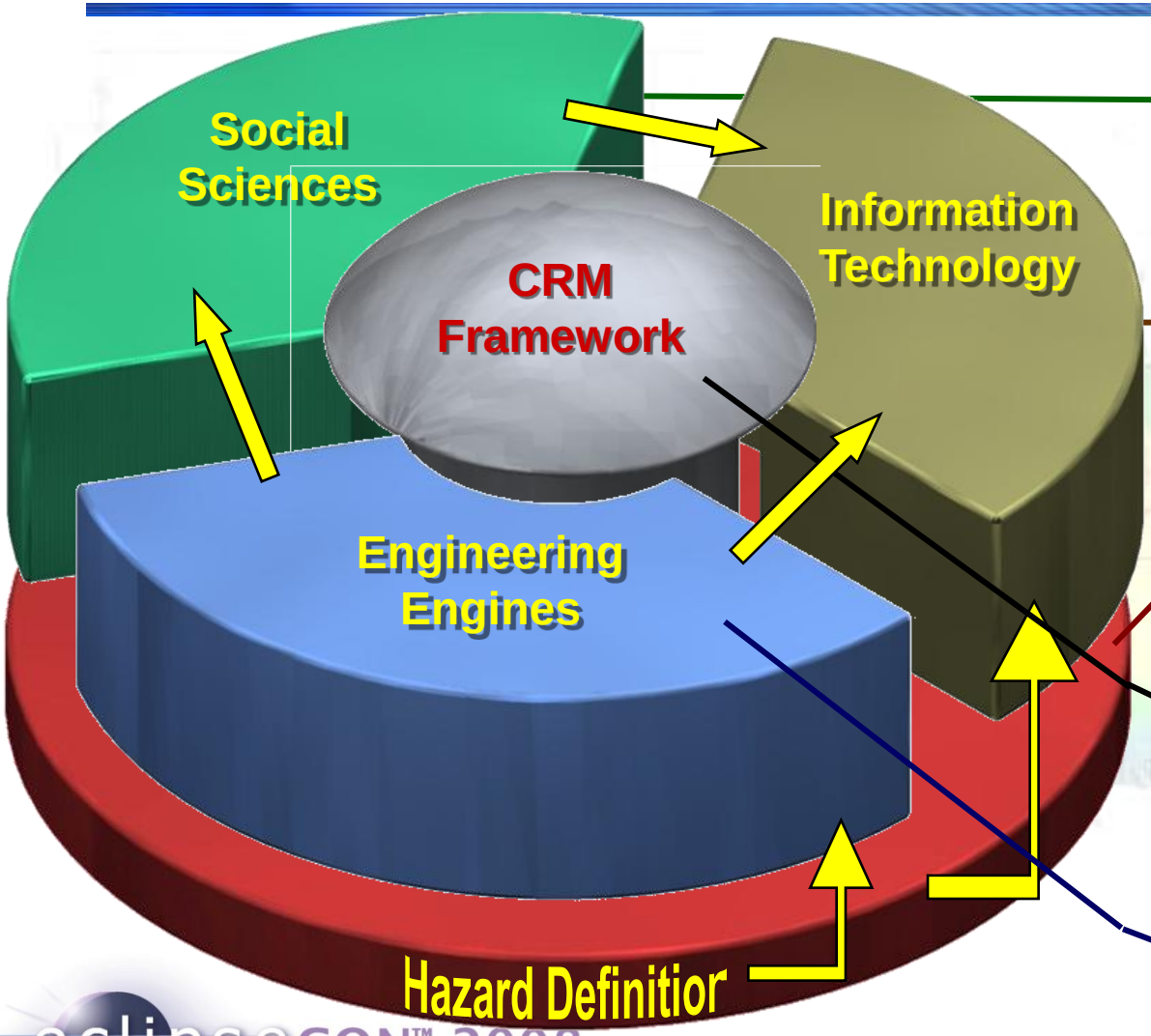
Integrated Loss Assessment and Reduction



Quantitative Social Impact
Decision Dynamics
Organizational Structure
Economic Impact Models

Loss Models Implementation
HCI Applications for MAEviz
Deployment on the Grid

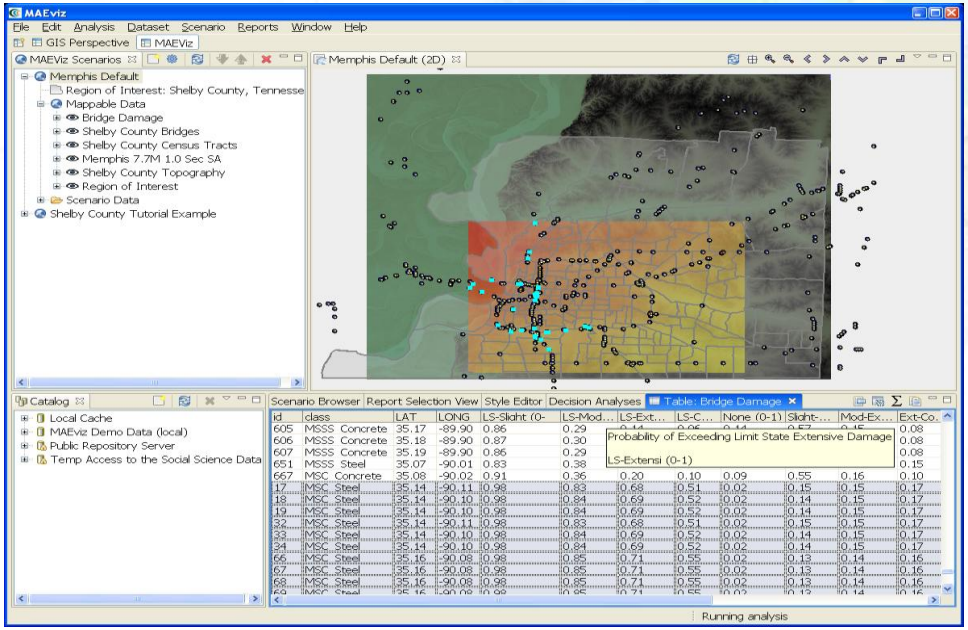
Ground Motion Maps
Strong-motion Records

Framework Development
The Three Test Beds
Uncertainty Management

Uniform Fragilities
Dynamic Transportation
Networks & Interaction
Inventory Technologies
Multi-hazards Interaction

What is MAEviz?

- MAEviz is an extensible network aware application and environment
- MAEviz **integrates** spatial information, data, and visual information to perform **seismic risk assessment and analysis**.

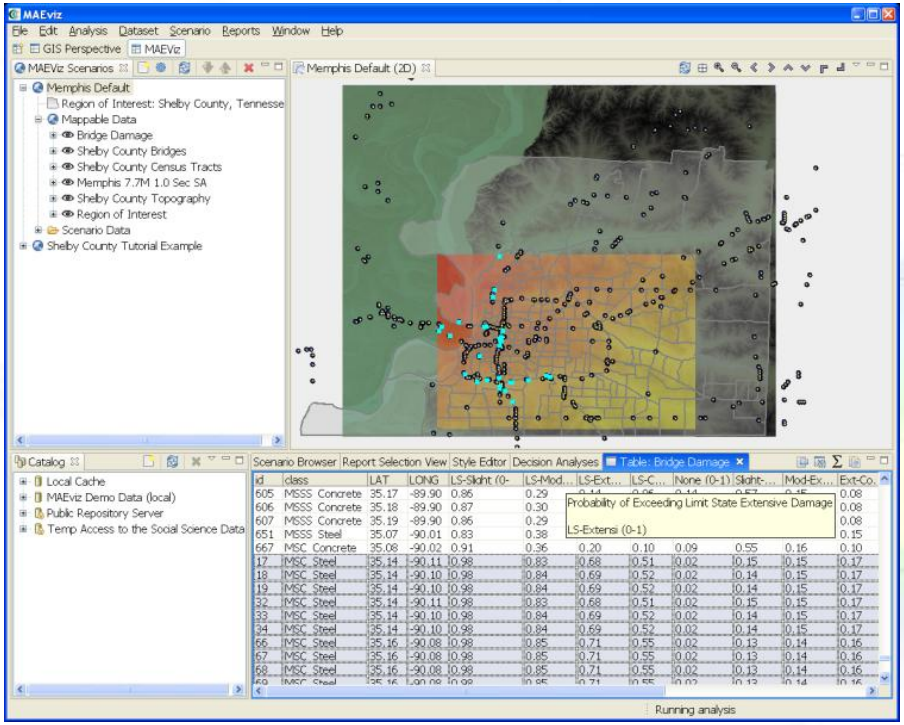


MAEviz Benefits

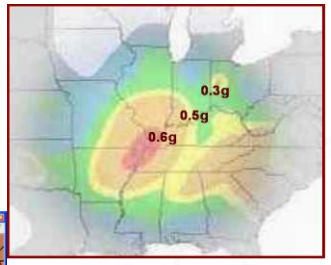
- Revolutionizes the practice of earthquake research and catastrophe event management
  - Connects researchers, scientists, engineers to practitioners and decision makers
  - Can be used to coordinate critical infrastructure planning and mitigation, response, and recovery
- Provides a mechanism to analyze “What if” scenarios
- Provides framework to add new data and algorithms or update existing data and algorithms
- MAEviz is Open Source

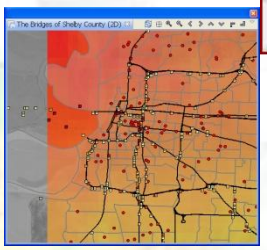
The MAEviz Model

- MAEviz Implements Consequence-Based Risk Management (CRM)



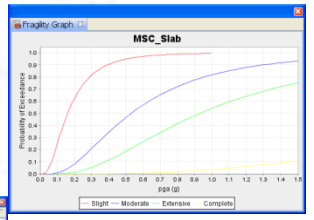
Hazard Definition

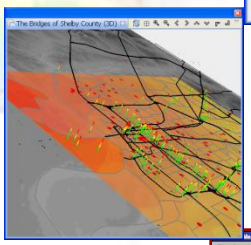




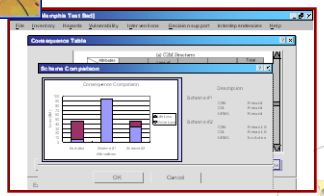
Inventory Selection

Fragility Models





Damage Prediction



Decision Support

- Inputs - Hazards, Inventory, Fragility Models
- Output - Damage Prediction, Reporting, Decision Support

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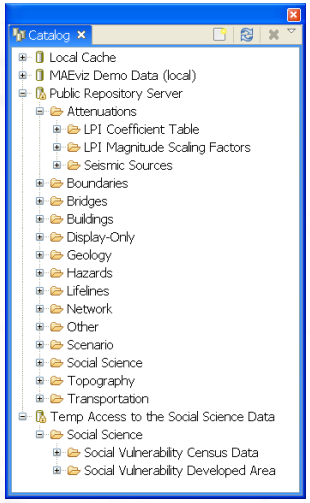
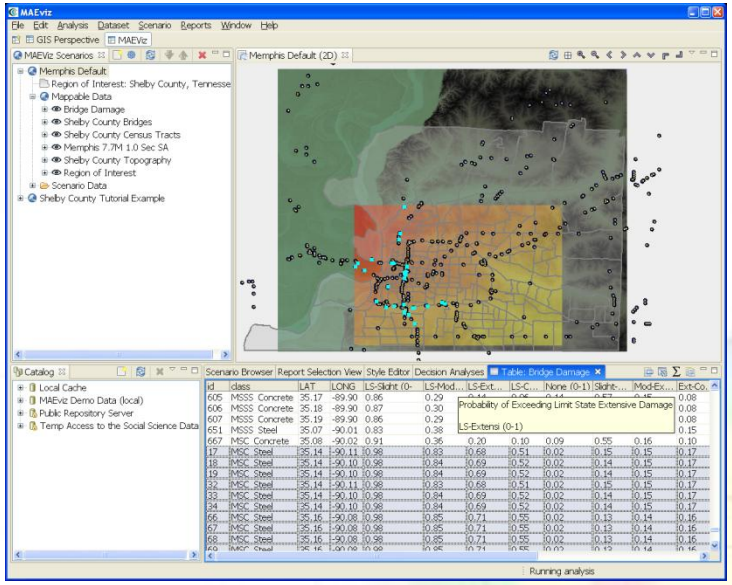
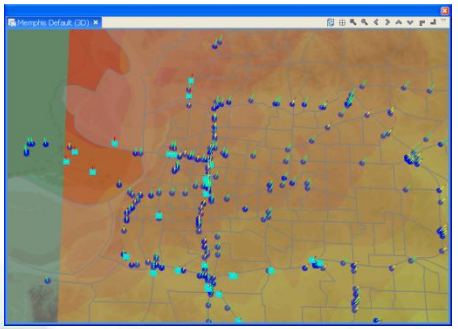
MAEviz – Quick View



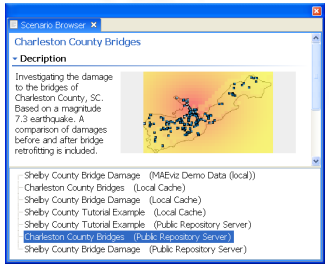
Data Catalog



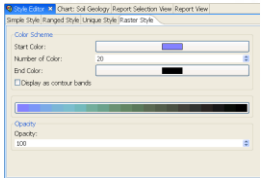
Main Window



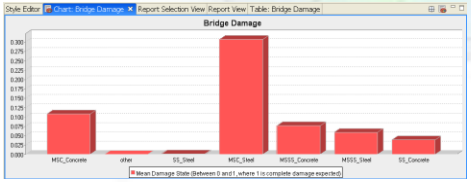
2D & 3D Views



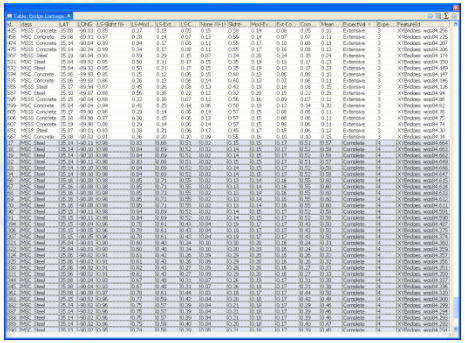
Scenario Browser



Style Editor



Damage Summary



Synchronized Data Views

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MAEviz Analyses

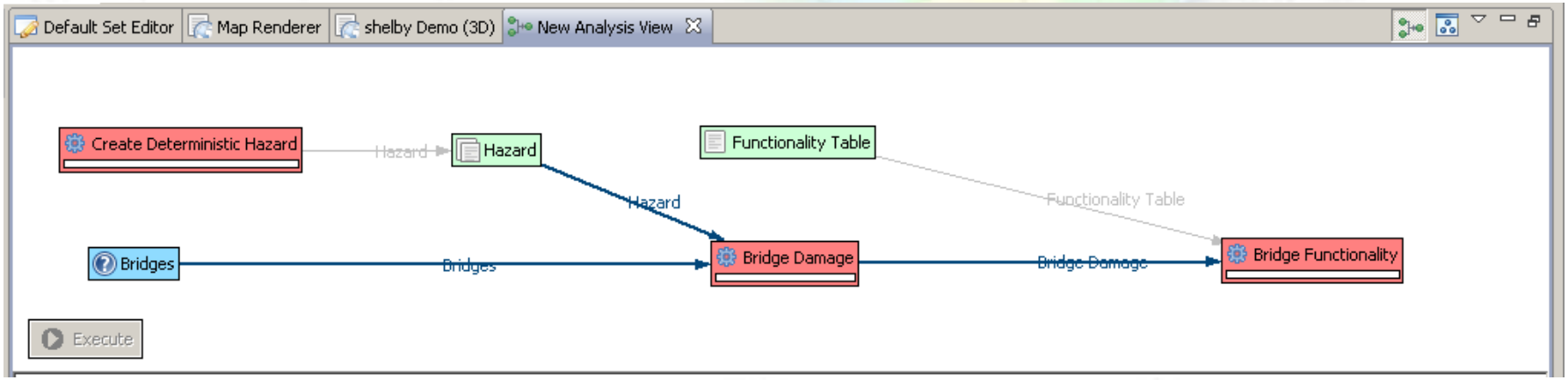
- +40 Analyses to-date

- Building:
  - Damage, Non-Structural Damage, Economic Loss, Liquefaction Damage
- Bridge:
  - Damage, Functionality, Repair Cost Analysis
- Gas:
  - Network Damage
  - Repair Rate Analysis

- Hazard
  - Deterministic Earthquake
  - Probabilistic Earthquakes (USGS Maps)
- Network loss by using traffic modeling
- Decision support
- GIS
  - Overlay (i.e. intersect)
  - Aggregate by regions
- Social Impact Analysis

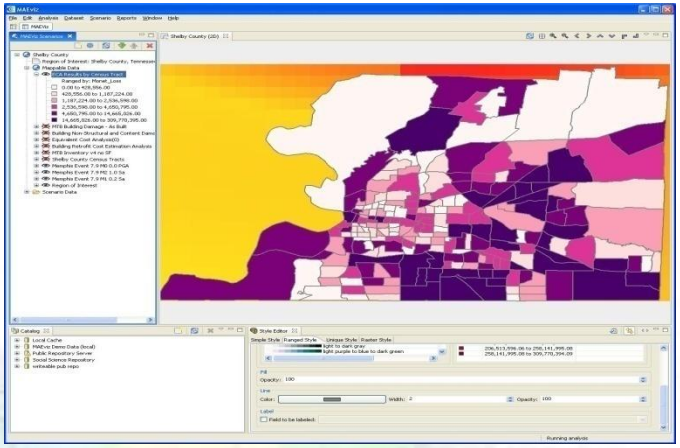
MAEviz - Analysis View

- Easier to understand the data flow and analysis dependency
- User-configurable analysis defaults
- Multiple analyses can run simultaneously
- Utilizes the Graphical Editor Framework (GEF)

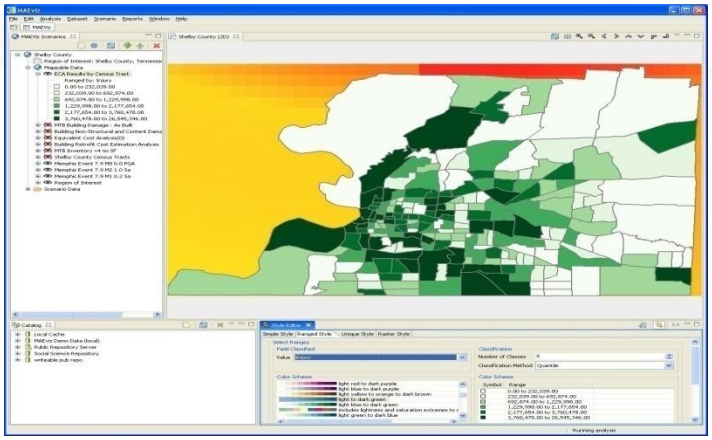


Decision Support - Data Aggregation

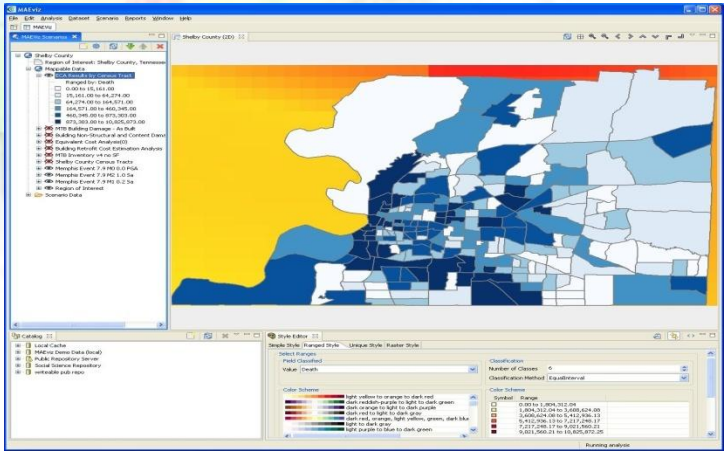
- Building Dataset
  - Memphis Building Inventory (w/out single family homes)
- Event
  - Magnitude 7.9 Earthquake at Blytheville, AR
- Analysis
  - Equivalent Cost Analysis
    - Death = $5,000,000 per
    - Injury = $1,500,000 per
    - Function loss = $100,000 per sq. ft. per day



Monetary Loss by Census Tract



Deaths ($) by Census Tract



Injuries ($) by Census Tract

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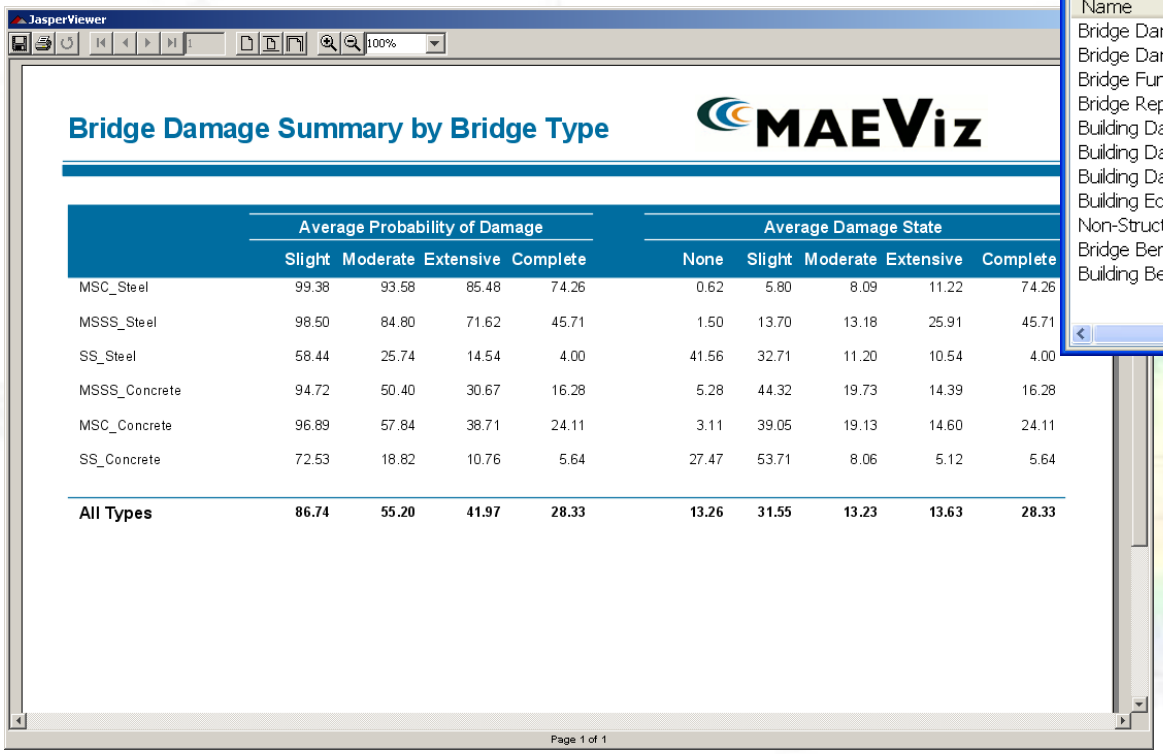
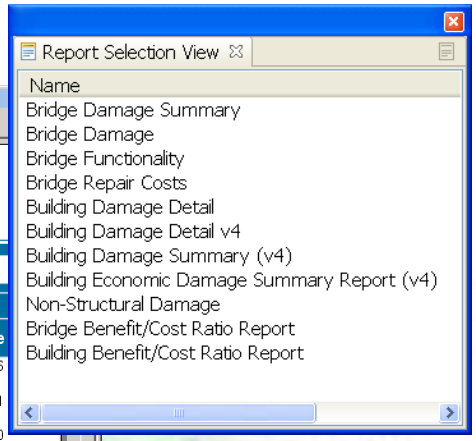
MAEviz Reporting

- Multiple Report Types



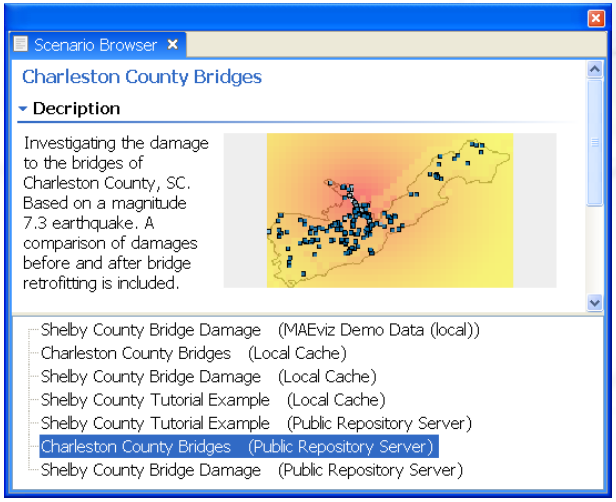
	Average Probability of Damage				Average Damage State				
	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
MSC_Steel	99.38	93.58	85.48	74.26	0.62	5.80	8.09	11.22	74.26
MSSS_Steel	98.50	84.80	71.62	45.71	1.50	13.70	13.18	25.91	45.71
SS_Steel	58.44	25.74	14.54	4.00	41.56	32.71	11.20	10.54	4.00
MSSS_Concrete	94.72	50.40	30.67	16.28	5.28	44.32	19.73	14.39	16.28
MSC_Concrete	96.89	57.84	38.71	24.11	3.11	39.05	19.13	14.60	24.11
SS_Concrete	72.53	18.82	10.76	5.64	27.47	53.71	8.06	5.12	5.64
All Types	**86.74**	**55.20**	**41.97**	**28.33**	**13.26**	**31.55**	**13.23**	**13.63**	**28.33**

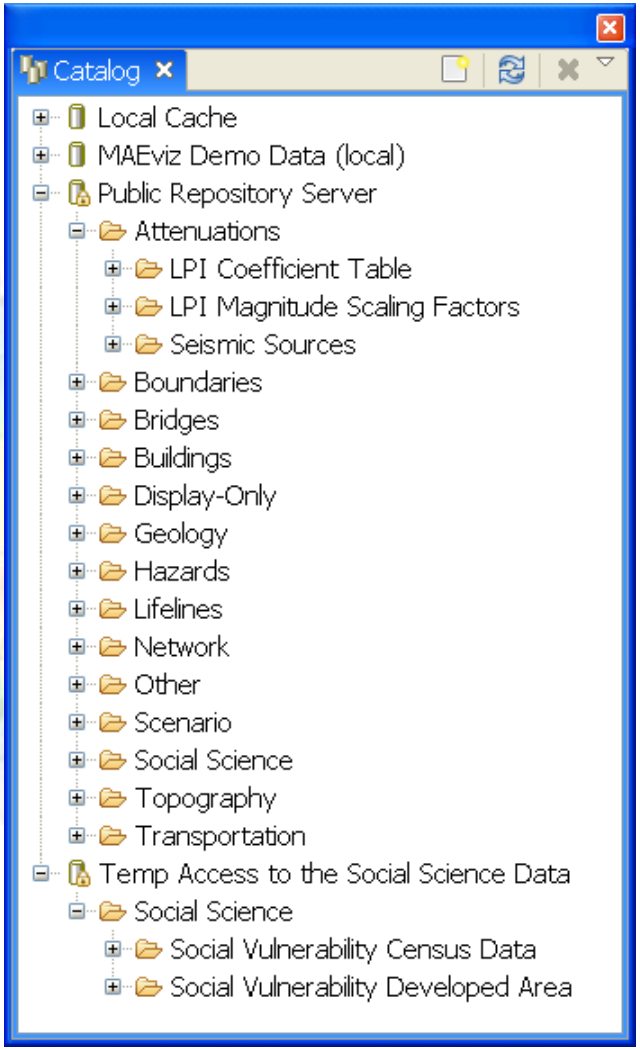


- Currently using Jasper Reports
- Plan to move to BIRT

MAEviz – Extension & Plug-in Example

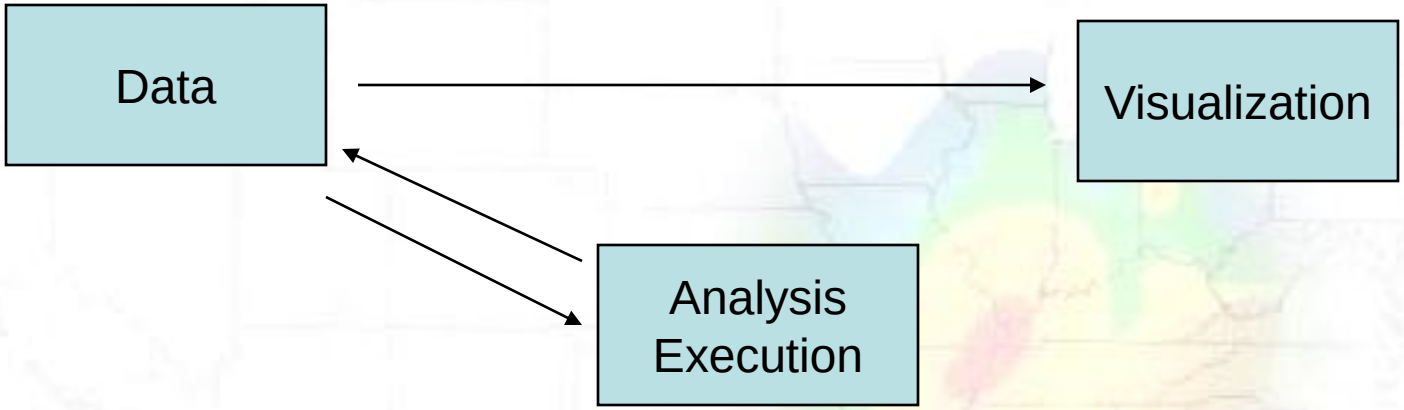
- Repository types are extensible
  - Supports local files systems and WAN
  - SAM WebDAV
  - PostGIS dB (v2.4)
  - Supports Quick Access to Saved Scenarios
- Extensible data types
  - Bridges, buildings, pipelines, etc.





The Inner Workings

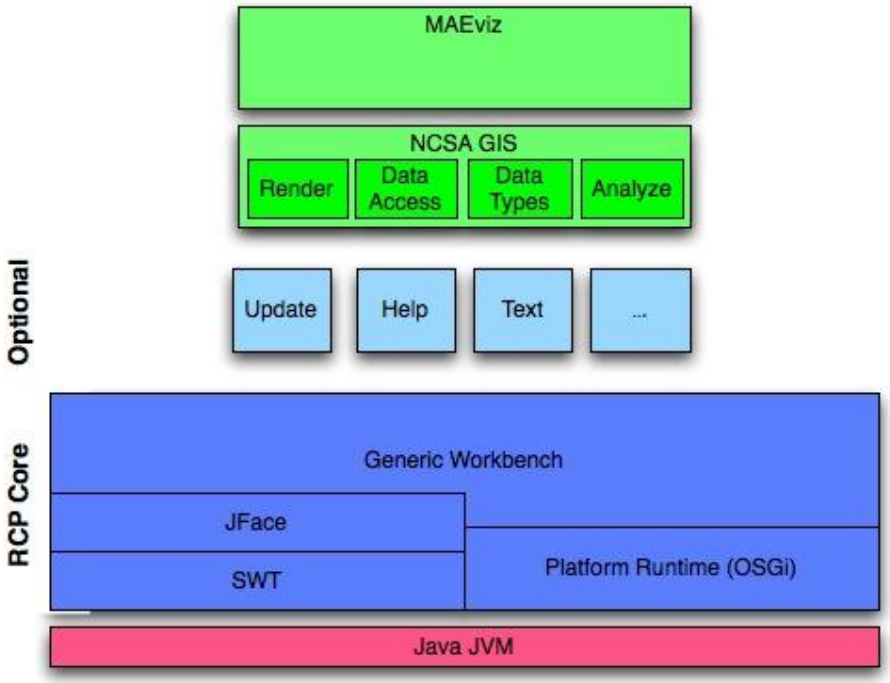
- MAEviz primary goal is to analyze and visualize independent data sources



- MAEviz Application is made from Eclipse RCP, NCSA GIS Baseline, MAEviz plug-ins

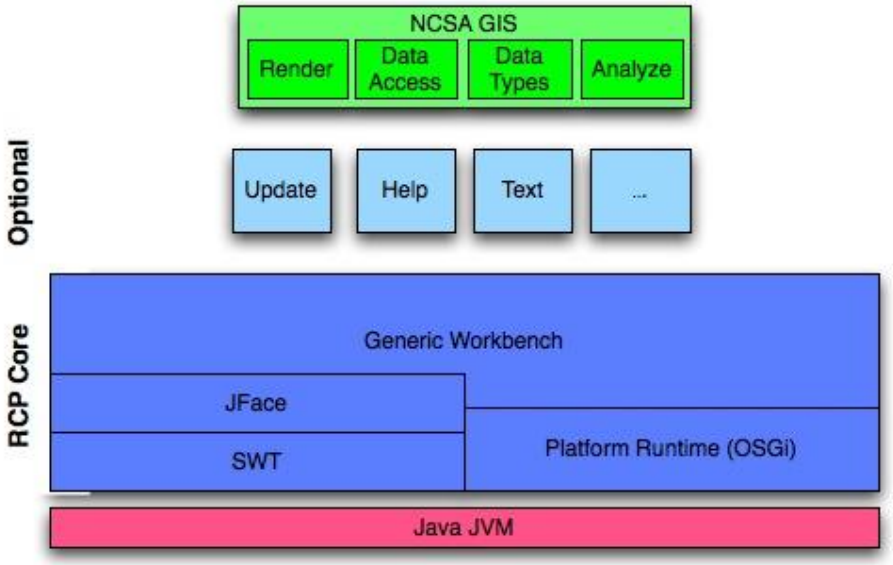
MAEviz - An NCSA GIS Application

- Features and capabilities driven by the MAE Center to support earthquake engineering
- Extensions to NCSA GIS and RCP all provided by plug-ins.
- Common extensions include:
  - Data Types
    - Hazards
    - Buildings
    - Bridges
    - Pipelines
  - Analyses
    - Bridge Damage
    - Displacement
    - Traffic Modeling
- MAE Center branding



NCSA GIS - A Rich Client Application

- Base Application with Three Main Functions
  - Data Management
    - Typing
    - Ingestion
    - Access
    - Provenance Tracking
  - Visualization
    - Support for 2D and 3D views
    - Zoom
    - Selection
    - Highlighting
  - Analysis Execution
    - Support for local multithreaded execution
    - (Support for remote execution forthcoming)
    - Visual dataflow system in development

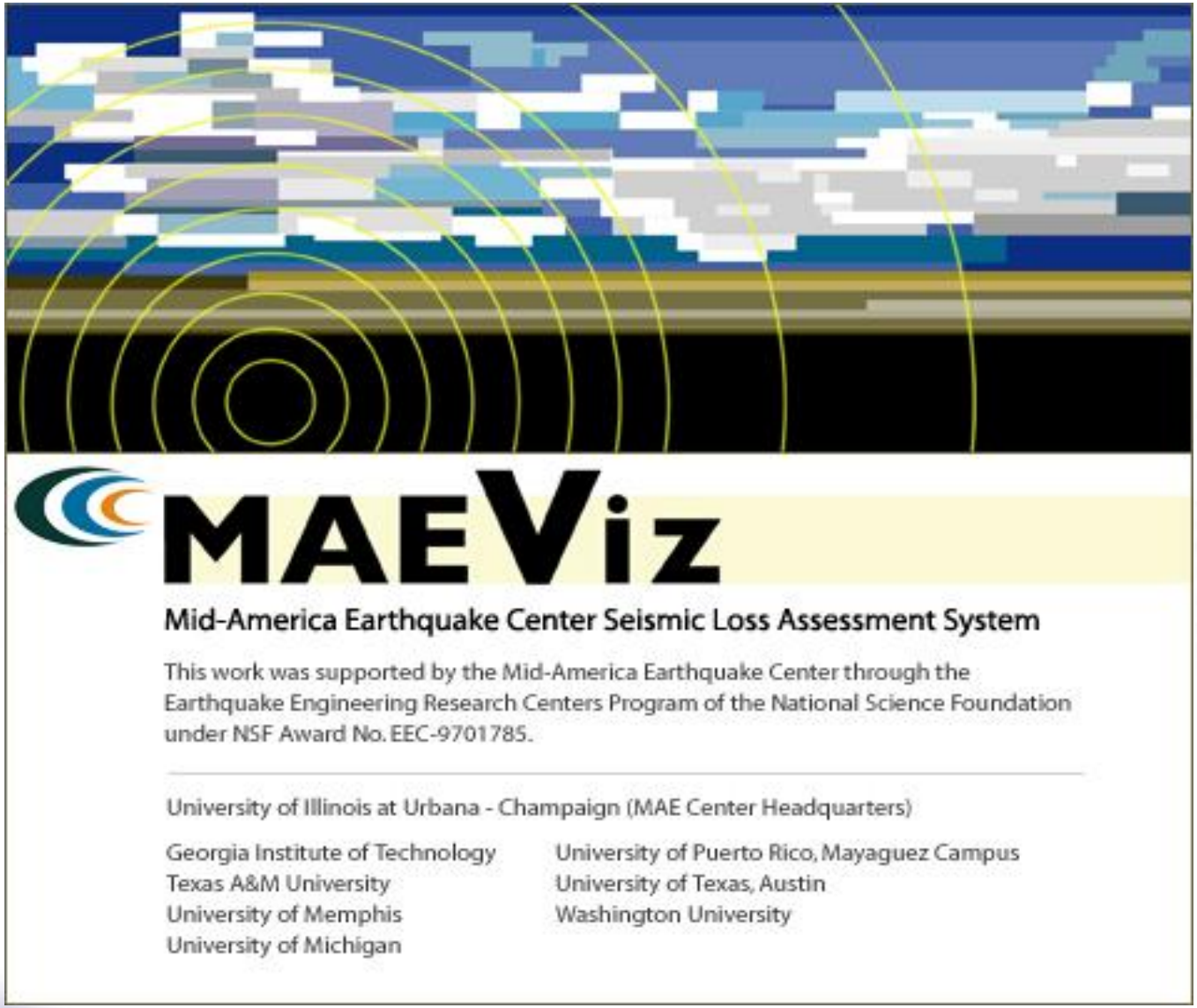


Extending MAEviz - Other Options

- MAEviz currently supports around 20 extension points
- Common Extension Points:
  - Countries
  - Units
  - Unit conversions
  - Dataset factories
  - Metadata types
  - Visualization renderers
  - Repository Types
  - Base geometries
  - Analysis parameter types
  - Data store mappings
  - GIS Schemas
  - Location factories
  - Metadata location
  - Etc.

Conclusion

- RCP made it possible to make MAEviz modular and extensible and can support other analyses and hazard types (water, wind, etc.)
- MAEviz is a next-generation collaborative environment to link research and engineering to decision makers
- MAEviz represents new era of analysis and risk assessment
- Continued open source development will only improve the capabilities available to the community
- Contributing scientists and developers are welcome to join the effort



Software Team:

- Chris Navarro
- Shawn Hampton
- Jong Sung Lee
- Nathan Tolbert

MAE Center PI

- Amr Elnashai

MAEviz PI

- Bill Spencer

Co-PI

- Jim Myers

PM

- Terry McLaren

http://maeviz.ncsa.uiuc.edu

Poster & GIS Application BOF

- Poster
  - MAEviz: An Earthquake Loss Assessment RCP Tool
  - Wednesday, 5:30-7:30PM
  - Great America Ballroom JK
- BOF
  - Developing Geographic Information Systems (GIS) on Eclipse RCP
  - Wednesday, 7:30PM
  - Room 203/204