

MAEViz

Mid-America Earthquake Center Seismic Loss Assessment System

This work was supported by the Mid-America Earthquake Center through the Earthquake Engineering Research Centers Program of the National Science Foundation under NSF Award No. EEC-9701785.

University of Illinois at Urbana - Champaign (MAE Center Headquarters)

Georgia Institute of Technology
Texas A&M University
University of Memphis
University of Michigan

University of Puerto Rico, Mayaguez Campus
University of Texas, Austin
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MAEViz PI

- Bill Spencer

Co-PI

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- Terry McLaren

Software Team:

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

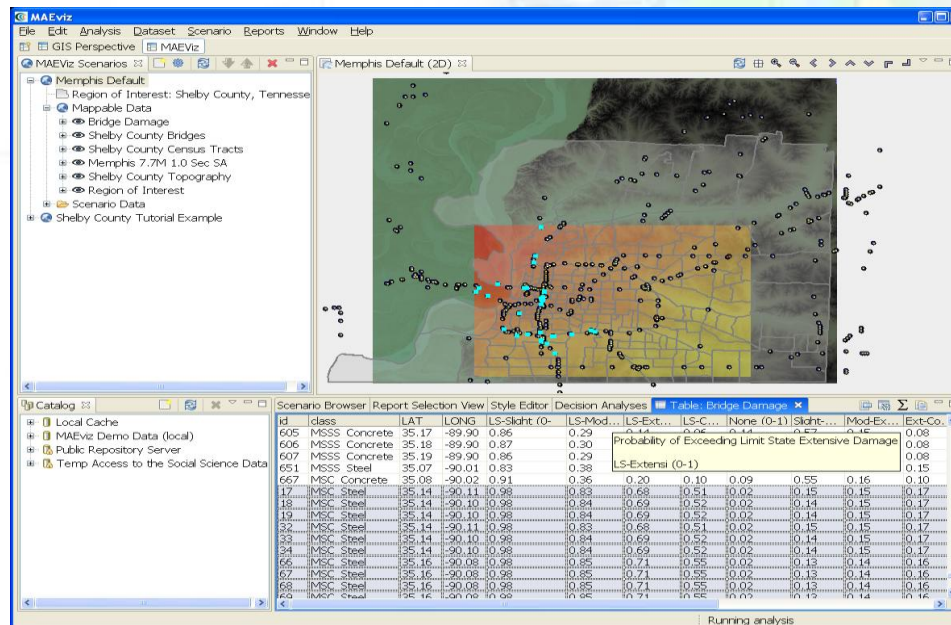


MAEviz Presentation Overview

- MAEviz Overview
- MAEviz Demonstration
- MAEviz as a MAE/NCSA Cyberenvironment Partnership

What is MAEviz?

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

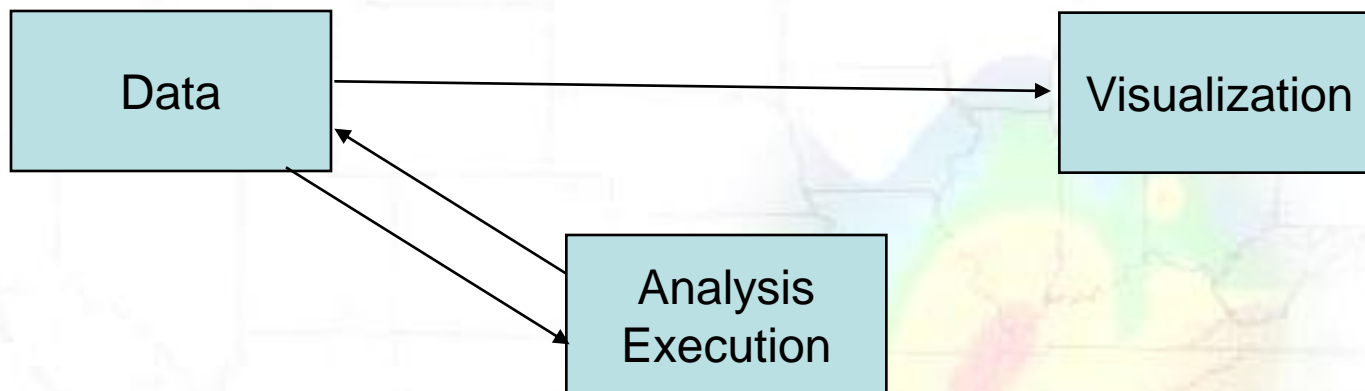


MAEviz Benefits

- MAEviz is a tool to coordinate planning and event mitigation, response, and recovery
- MAEviz provides framework to add new data and algorithms or update existing data and algorithms
- MAEviz connects the latest research and engineering practices to practitioners and decision makers
- MAEviz provides a mechanism to analyze “What if” scenarios
- MAEviz is Open Source

MAEviz Basic Design

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



- MAEviz leverages other Open Source Projects



eclipse.org/rcp



geotools.org/



vtk.org/



jasperreports.sourceforge.net/

JFreeChart

sourceforge.net/projects/jfreechart

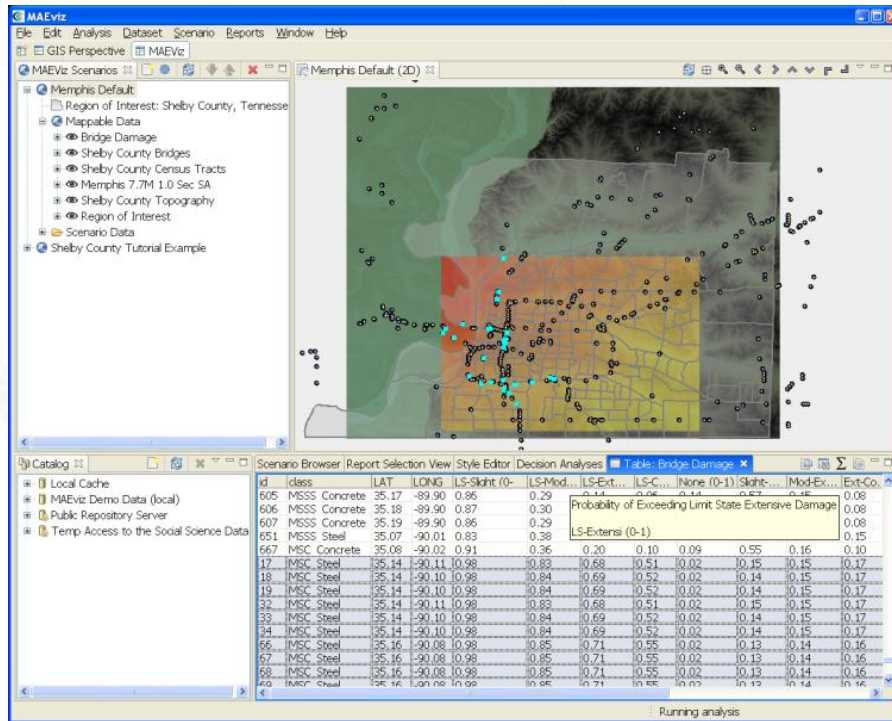
Ktable

sourceforge.net/projects/ktable/



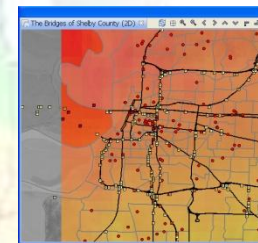
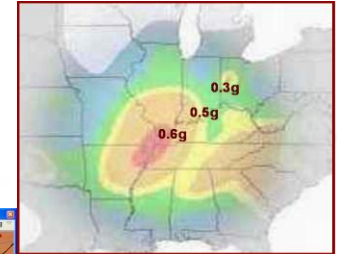
The MAEviz Model

- MAEviz Implements Consequence-Based Risk Management (CRM)



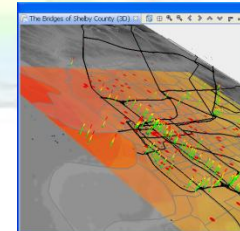
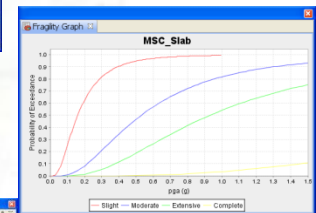
- Inputs - Hazards, Inventory, Fragility Models
- Output - Damage Prediction, Reporting, Decision Support

Hazard Definition



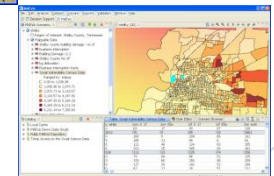
Inventory Selection

Fragility Models

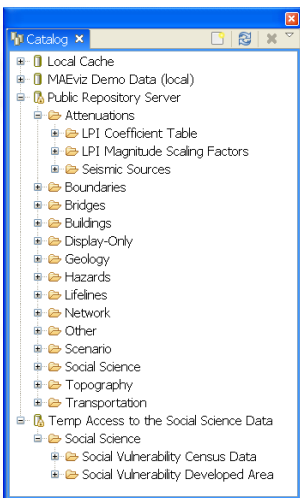


Damage Prediction

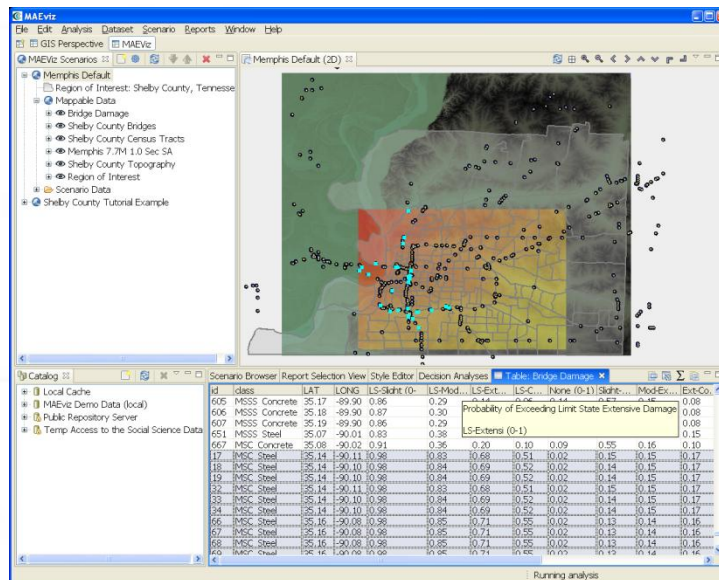
Decision Support



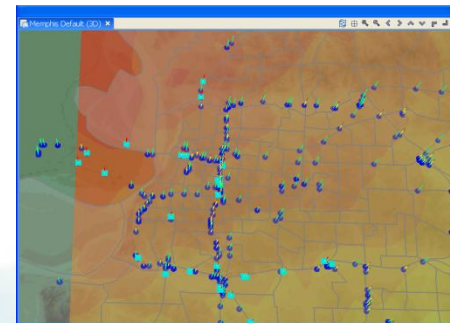
MAEviz – Quick View



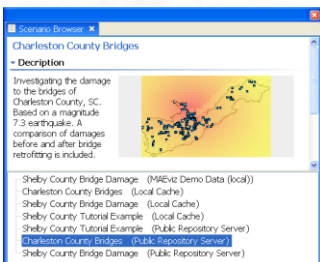
Data Catalog



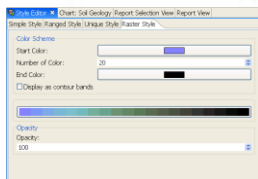
Main Window



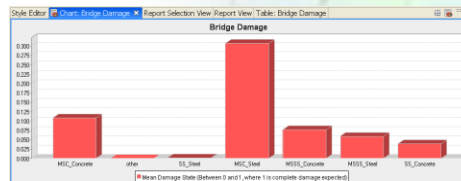
2D & 3D Views



Scenario Browser



Style Editor

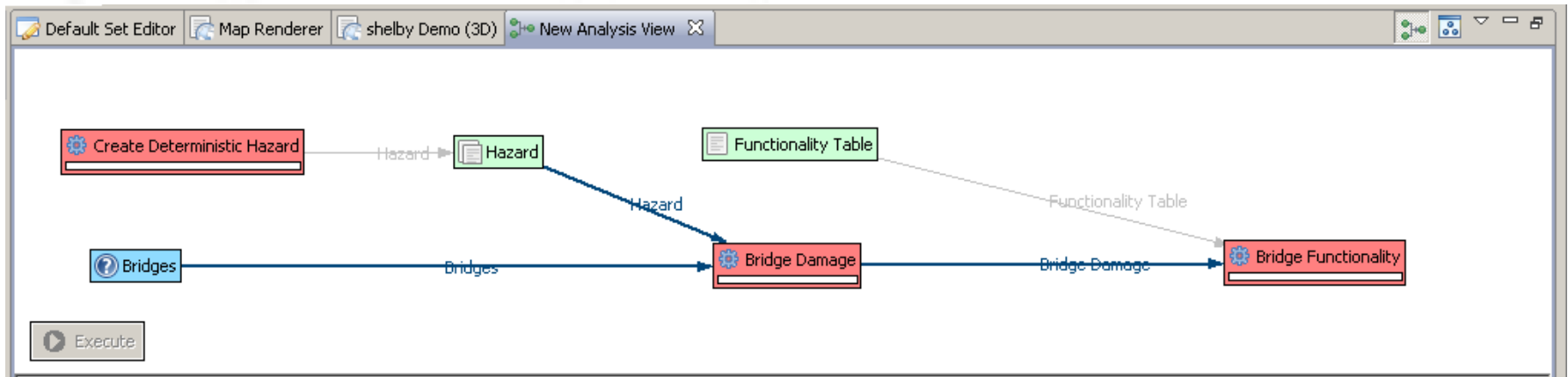


Result Charting

ID	Name	LAT	LONG	LS-Shmt (0-1)	LS-Mod	LS-Ext	LS-C	None (0-1)	Shkt	Mod Ext	Ext Co	Damage	Notes
41	MSSC Concrete	35.17	-89.90	0.86	0.29							0.08	0.08
42	MSSC Concrete	35.18	-89.90	0.87	0.30							0.08	0.08
43	MSSC Concrete	35.19	-89.90	0.86	0.29							0.08	0.08
44	MSSC Steel	35.07	-90.01	0.83	0.38							0.15	0.15
45	MSSC Concrete	35.08	-90.02	0.91	0.36	0.20	0.10	0.09	0.55	0.16	0.10	0.10	0.10
46	MSSC Steel	35.14	-90.11	0.98	0.83	0.68	0.51	0.02	0.15	0.45	0.17	0.17	0.17
47	MSSC Steel	35.14	-90.10	0.98	0.84	0.69	0.52	0.02	0.14	0.45	0.17	0.17	0.17
48	MSSC Steel	35.14	-90.10	0.98	0.84	0.69	0.52	0.02	0.14	0.45	0.17	0.17	0.17
49	MSSC Steel	35.14	-90.11	0.98	0.83	0.68	0.51	0.02	0.15	0.45	0.17	0.17	0.17
50	MSSC Steel	35.14	-90.10	0.98	0.84	0.69	0.52	0.02	0.14	0.45	0.17	0.17	0.17
51	MSSC Steel	35.14	-90.10	0.98	0.84	0.69	0.52	0.02	0.14	0.45	0.17	0.17	0.17
52	MSSC Steel	35.16	-90.08	0.98	0.85	0.71	0.55	0.02	0.13	0.44	0.16	0.16	0.16
53	MSSC Steel	35.16	-90.08	0.98	0.85	0.71	0.55	0.02	0.13	0.44	0.16	0.16	0.16
54	MSSC Steel	35.16	-90.08	0.98	0.85	0.71	0.55	0.02	0.13	0.44	0.16	0.16	0.16
55	MSP Chwall	134.42	1.00	101.60	01.02	101.94	101.02	101.93	101.42	101.42	101.42	101.42	101.42

Synchronized Data Views

MAEviz - Analysis View



- Easy to understand the analysis workflow
- User configurable analysis defaults
- Users can run multiple analyses simultaneously



MAEviz Analyses - Overview

- Approximately 40 Analyses to-date
- Analysis Types Include:
 - Building
 - Bridge
 - Hazard
 - Lifeline
 - Socioeconomic

Building and Bridge Analyses

- Building
 - Cost Benefit Analysis *
 - Direct Economic Damage
 - Liquefaction Analysis (HAZUS)
 - Liquefaction Analysis (Memphis, TN only)
 - Non-Structural and Content Damage (generalized)
 - Repair Cost *
 - Retrofit Cost Estimation
 - Structural Damage
- Bridge
 - Cost Benefit Analysis *
 - Damage
 - Functionality
 - Repair Cost *
 - Retrofit Cost Estimation *

* Unique to MAEviz

Decision Support & GIS Analyses

- Decision Support
 - Equivalent Cost *
 - Multi Attribute Utility *
 - Network Based Seismic Retrofit Analysis *
 - Utility Analysis *
- GIS
 - Aggregate features to regions
 - Digital Elevation Model Slope Map
 - Overlay: Intersection

* Unique to MAEviz

Hazard and Lifeline Analyses

- Hazard
 - Create Scenario Earthquake
 - Generate Liquefaction Potential Index (LPI) Map (Shelby, TN)
- Lifeline
 - Buried Pipeline Damage
 - Electric Power Facility Damage (HAZUS Style)
 - Electric Power Plant Loss
 - Electric Substation Damage
 - Potable Water Facility Damage (HAZUS Style)
 - Utility Network Builder *
 - Water Tank Damage

* Unique to MAEviz



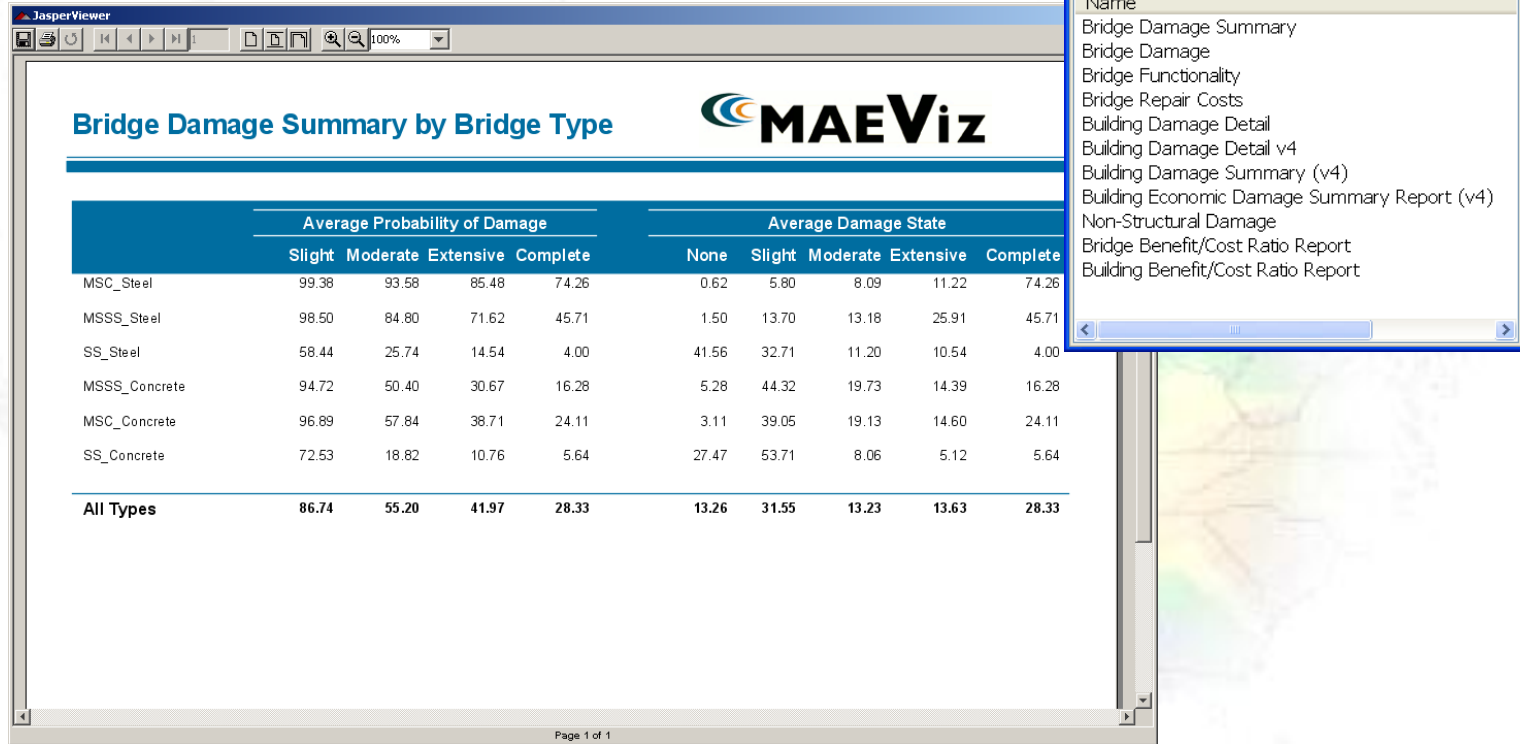
Socioeconomic Analyses

- Socioeconomic
 - Business Content Loss
 - Business Interruption Loss
 - Business Inventory Loss
 - Fiscal Impact *
 - Household and Population Dislocation
 - Shelter Requirements
 - Short Term Shelter Needs
 - Social Vulnerability *

* Unique to MAEviz

MAEviz Reporting

- Multiple Report Types



The screenshot displays the JasperViewer application window showing a report titled "Bridge Damage Summary by Bridge Type" from MAEViz. The report contains a table with the following data:

	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

Overlaid on the right side of the screenshot is a "Report Selection View" dialog box with a list of report types:

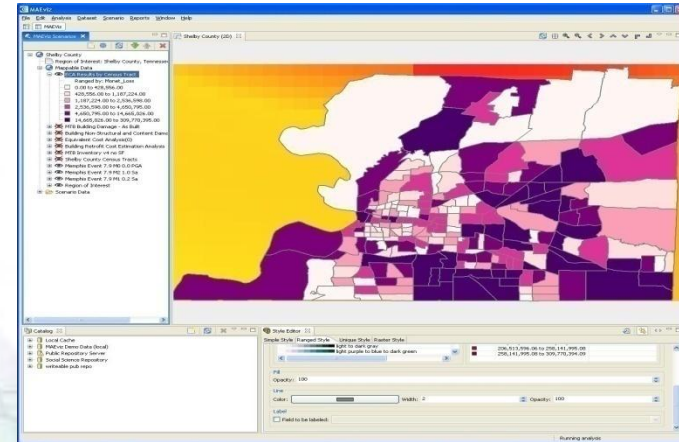
- Bridge Damage Summary
- Bridge Damage
- Bridge Functionality
- Bridge Repair Costs
- Building Damage Detail
- Building Damage Detail v4
- Building Damage Summary (v4)
- Building Economic Damage Summary Report (v4)
- Non-Structural Damage
- Bridge Benefit/Cost Ratio Report
- Building Benefit/Cost Ratio Report

- Generates PDF, HTML, Excel, ...

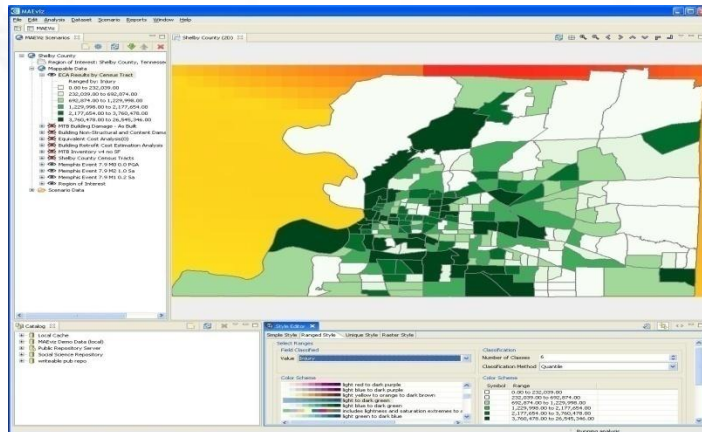


Data Aggregation

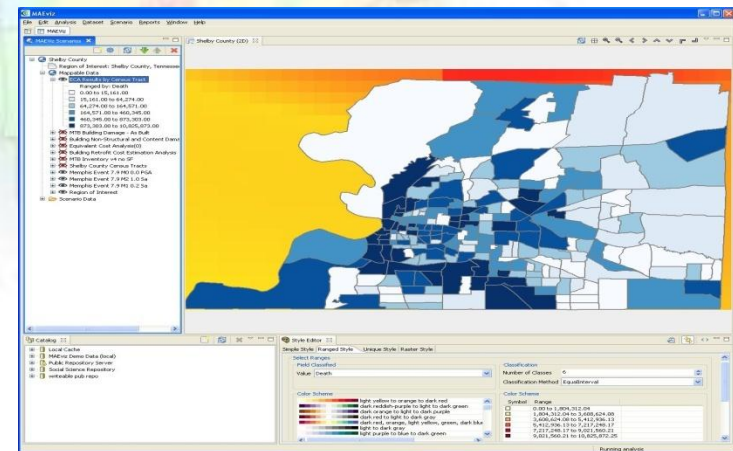
- Building Dataset
 - Memphis Building Inventory (w/out single family homes)
- Event
 - Magnitude 7.9 Earthquake at Blytheville, AR
- Analysis
 - Equivalent Cost Analysis
 - Death = \$5,000,000 per
 - Injury = \$1,500,000 per
 - Function loss = \$100,000 per sq. ft. per day



Monetary Loss by Census Tract



Deaths (\$) by Census Tract

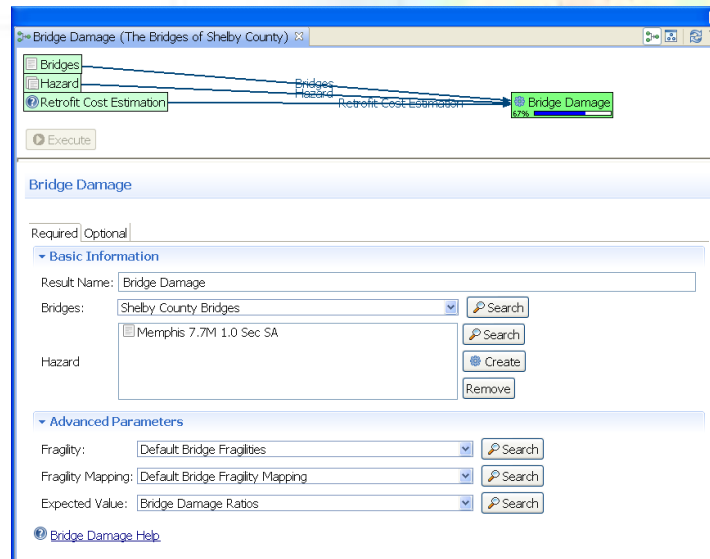


Injuries (\$) by Census Tract



Save Scenarios and Analysis Templates

- Scenarios are automatically saved with all user input and preferences
- Scenarios can be published for peer review
- Analysis templates can be saved with settings
- Users can change one parameter and compare results



Current Efforts

- Temporary Housing Algorithm
- HAZUS Data Integration
- HAZUS Lifeline Analyses
- Dynamic Traffic Modeling
- Analysis Validation Framework
- Data Provenance
- Common Visualization Layer
- Custom Report Generation

MAEviz Demonstration

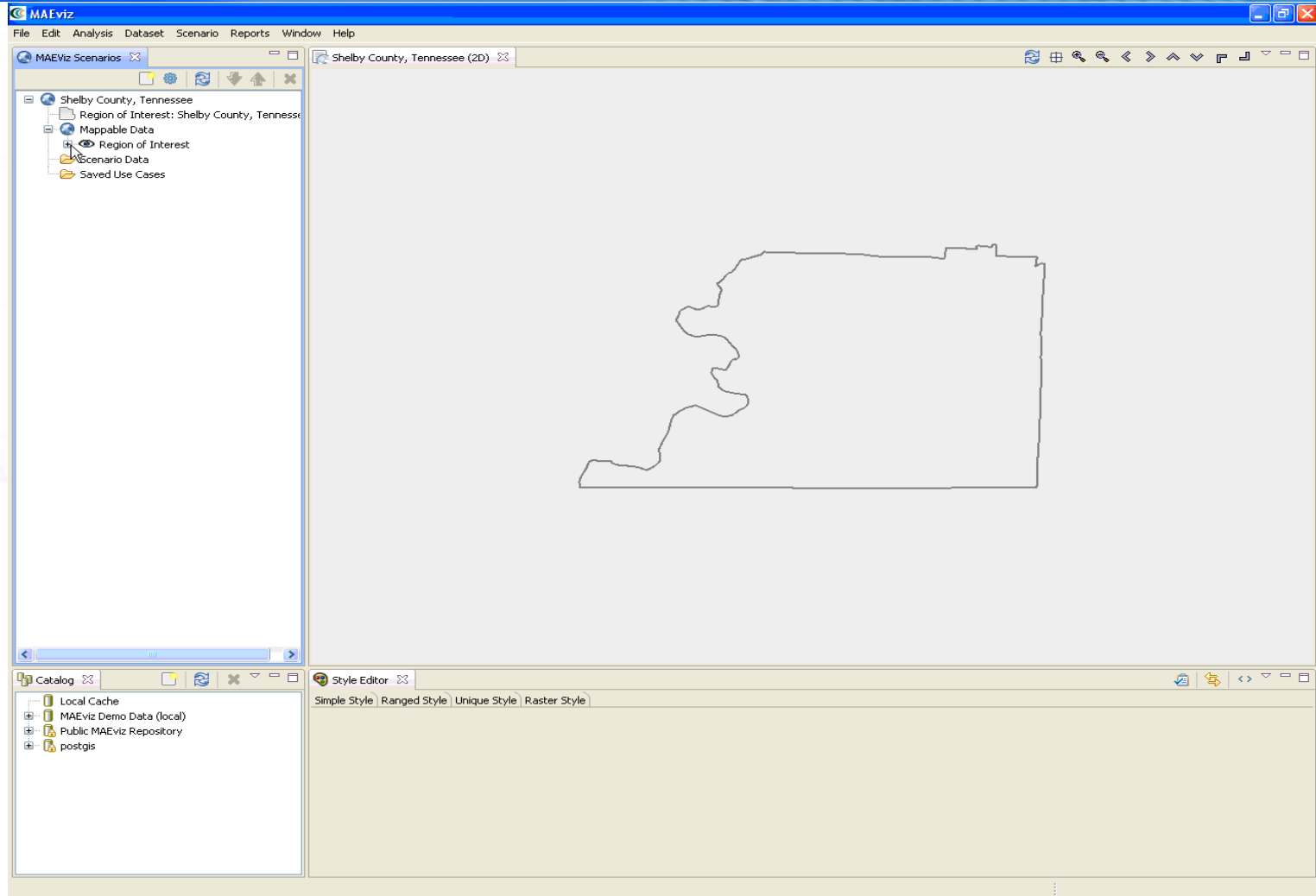
Chris Navarro



Outline

- Social Vulnerability Analysis (planning)
 - Determine highly vulnerable areas based on demographic information
- Building Damage Analysis
 - Compute physical damage to determine economic loss
- Economic Loss & Population Dislocation
 - Compute economic loss to determine population dislocation

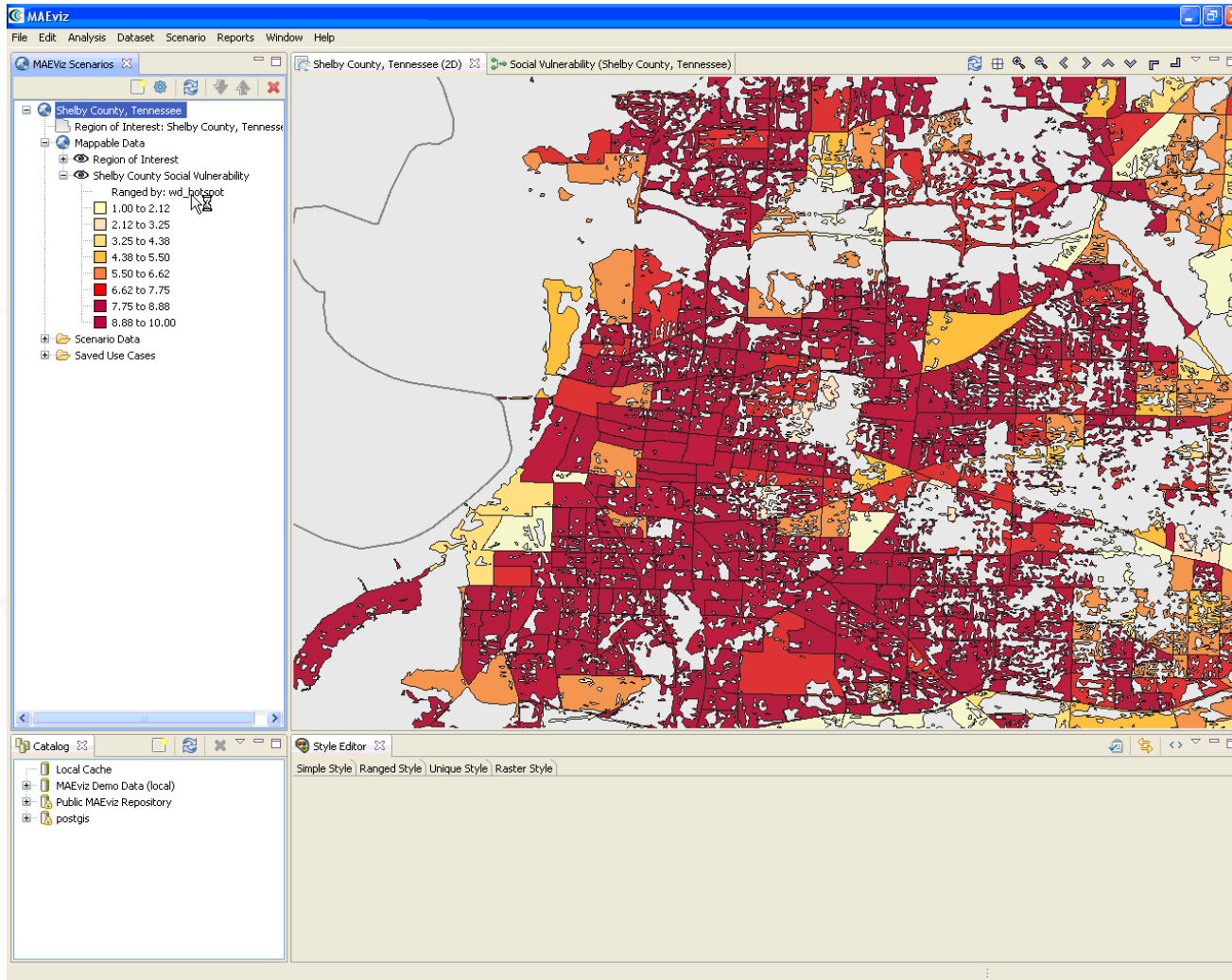
Social Vulnerability Demo



Structural Damage Key Points

- Structural Damage Analysis
 - Inventory
 - RES3 structures
 - Hazard
 - 7.9 Blytheville event
 - Demonstrating inverse analysis development
 - Starting from damage (the result), we need a hazard input
- Result Comparison
 - Damage with and without hazard uncertainty
 - Select fields to compare

Damage Analysis Demo

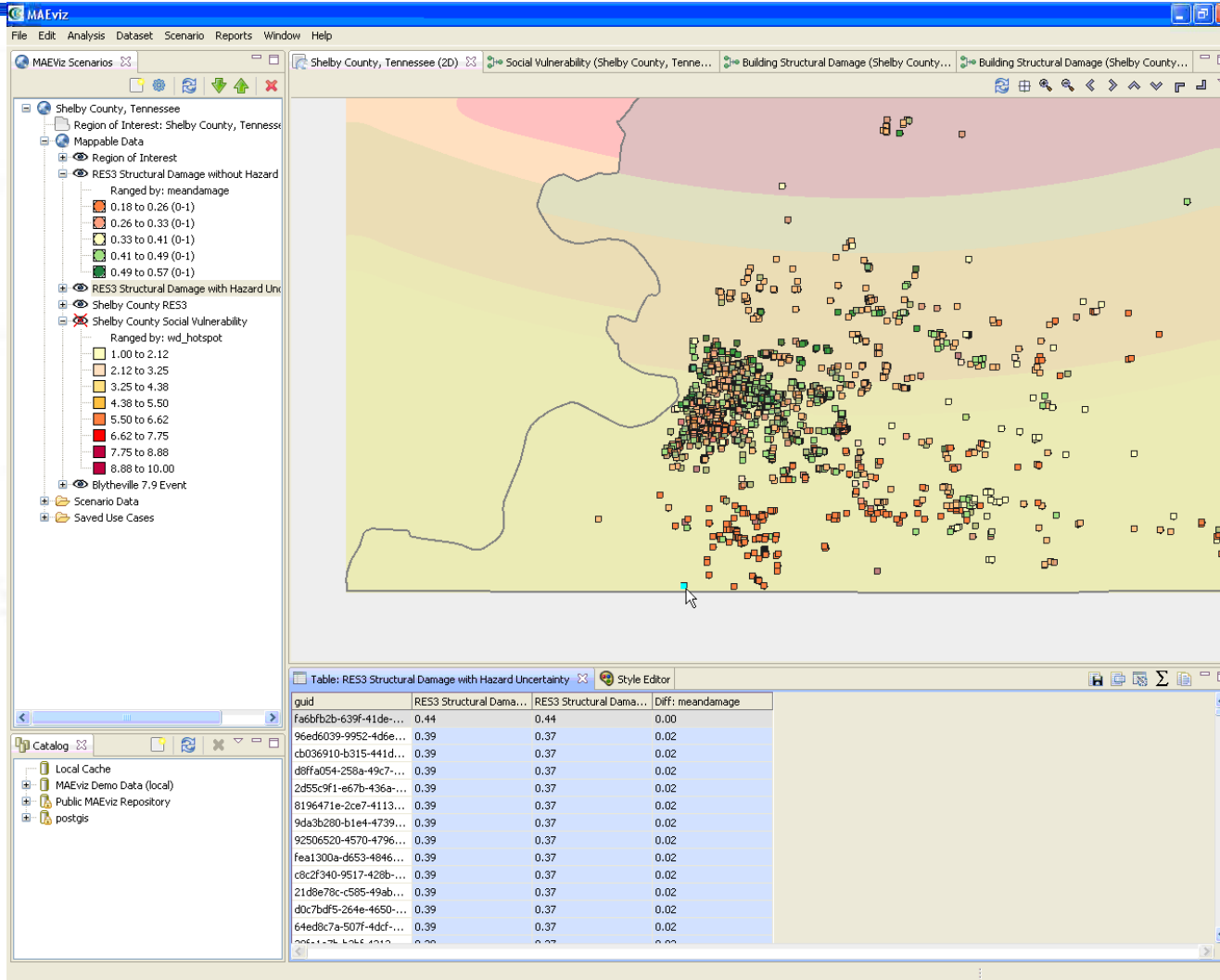


Economic Loss & Dislocation Key Points

- Economic Loss
 - Demonstrating forward analysis development
 - Start at building damage with uncertainty and work forward to Economic loss
 - Adjust loss for inflation
- Population Dislocation
 - Economic loss with hazard uncertainty
 - Demographic information
- Explore distribution of attributes
 - Mean, Sum, etc of attribute fields
 - Display histogram



Economic Loss & Dislocation Demo



Questions?

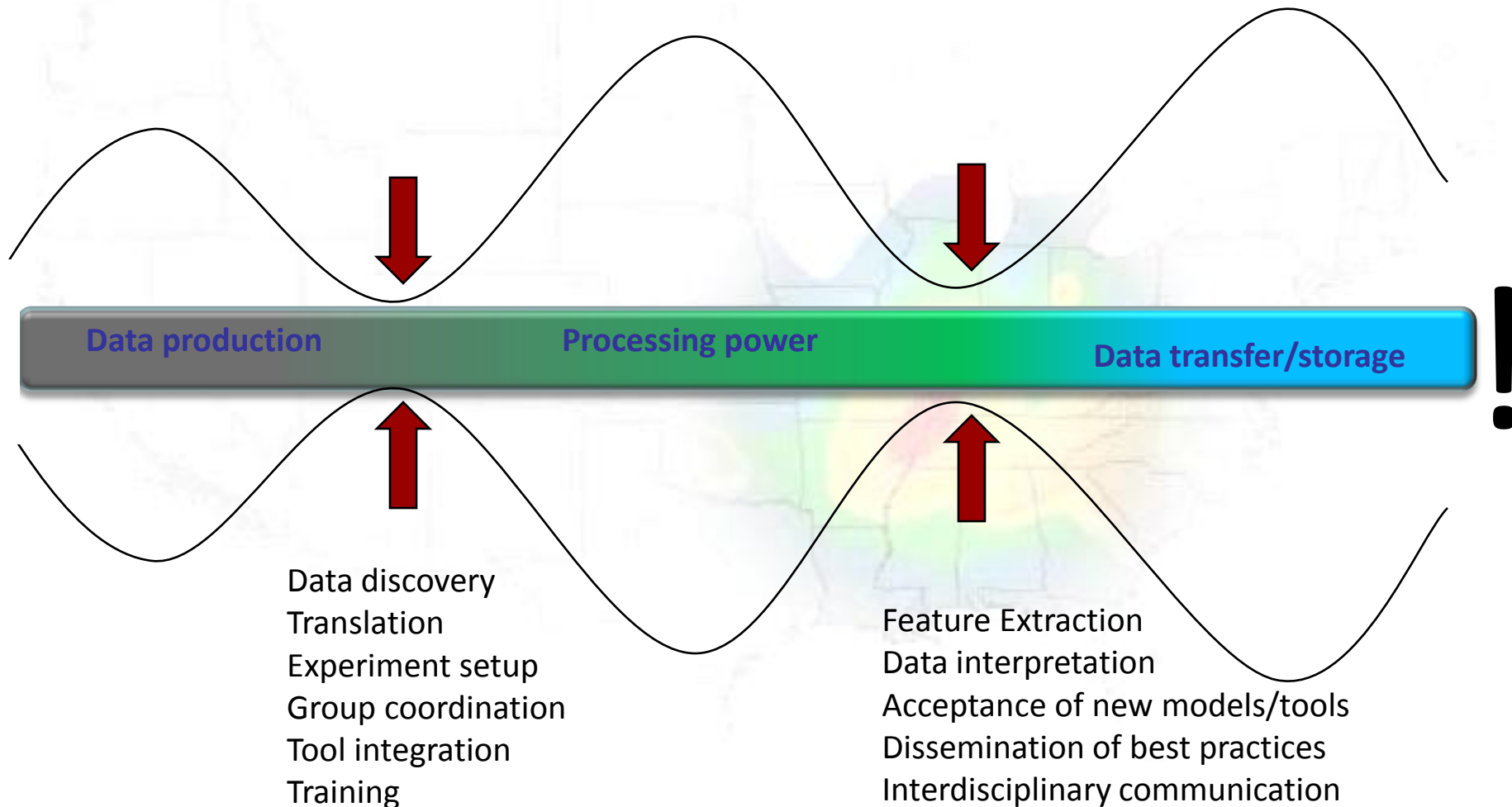
- We are available afterwards for live demonstrations or other questions.

MAEviz as a MAE/NCSA Cyberenvironment Partnership

Jim Myers

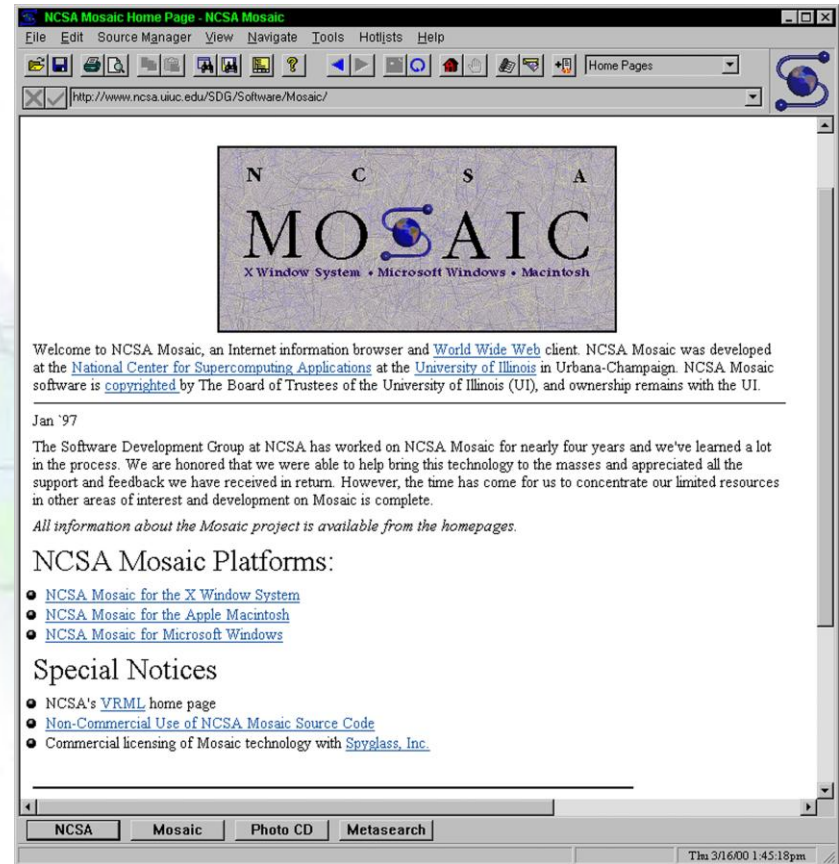


Cyberenvironments Recognize 'Amdahl's Law' for Scientific Progress



Mosaic and Cyberenvironments

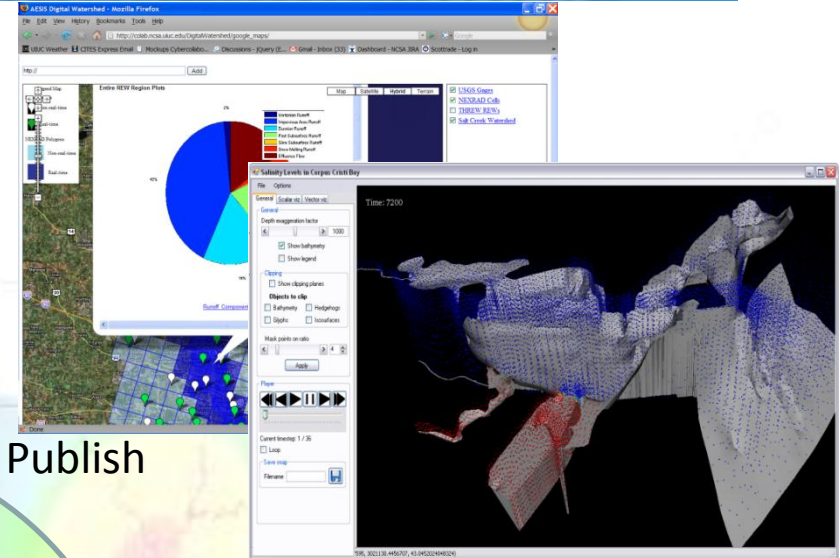
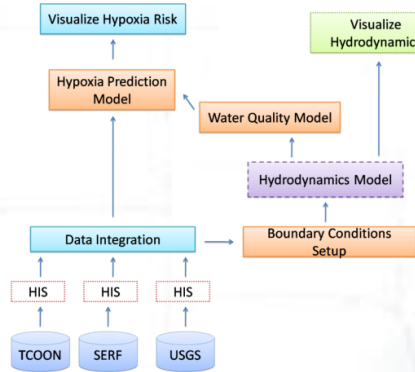
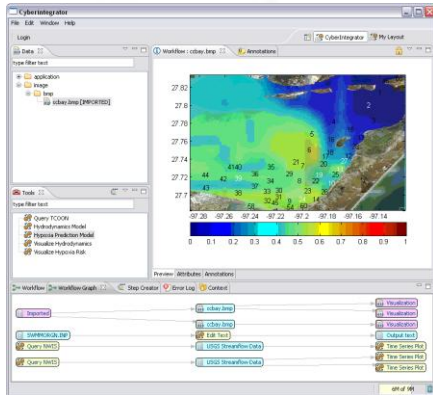
- Mosaic
 - By early 1990s, the internet had a wealth of resources, but they were inaccessible to most scientists
 - *Individual publishing*
 - *Browsing versus retrieving*
 - See “Web 2.0 ... The Machine is Us/ing Us”
- Cyberenvironments
 - By the early 2000’s, the internet and grid had a wealth of interactive resources, but they were inaccessible to most scientists
 - *Individual information models*
 - *Fusion versus gathering*



See “The Machine is Us/ing Us”! Michael Wesch



Digital Observatories

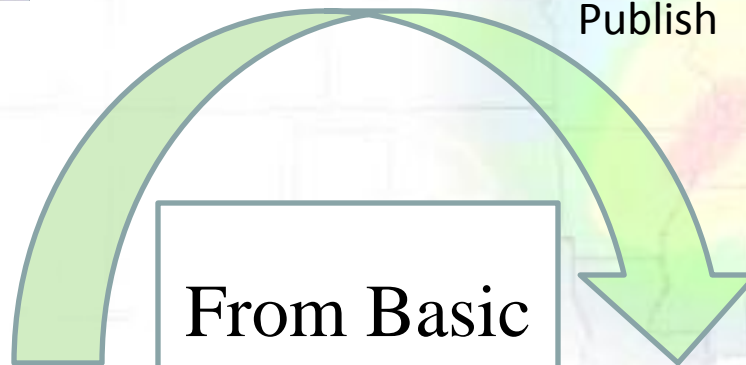


Model

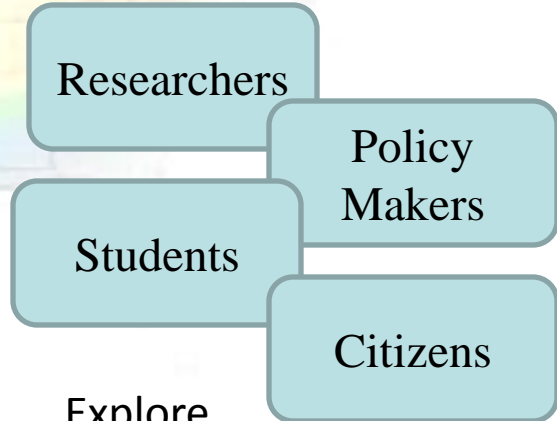
Publish



Observe



From Basic Research to Societal Impact



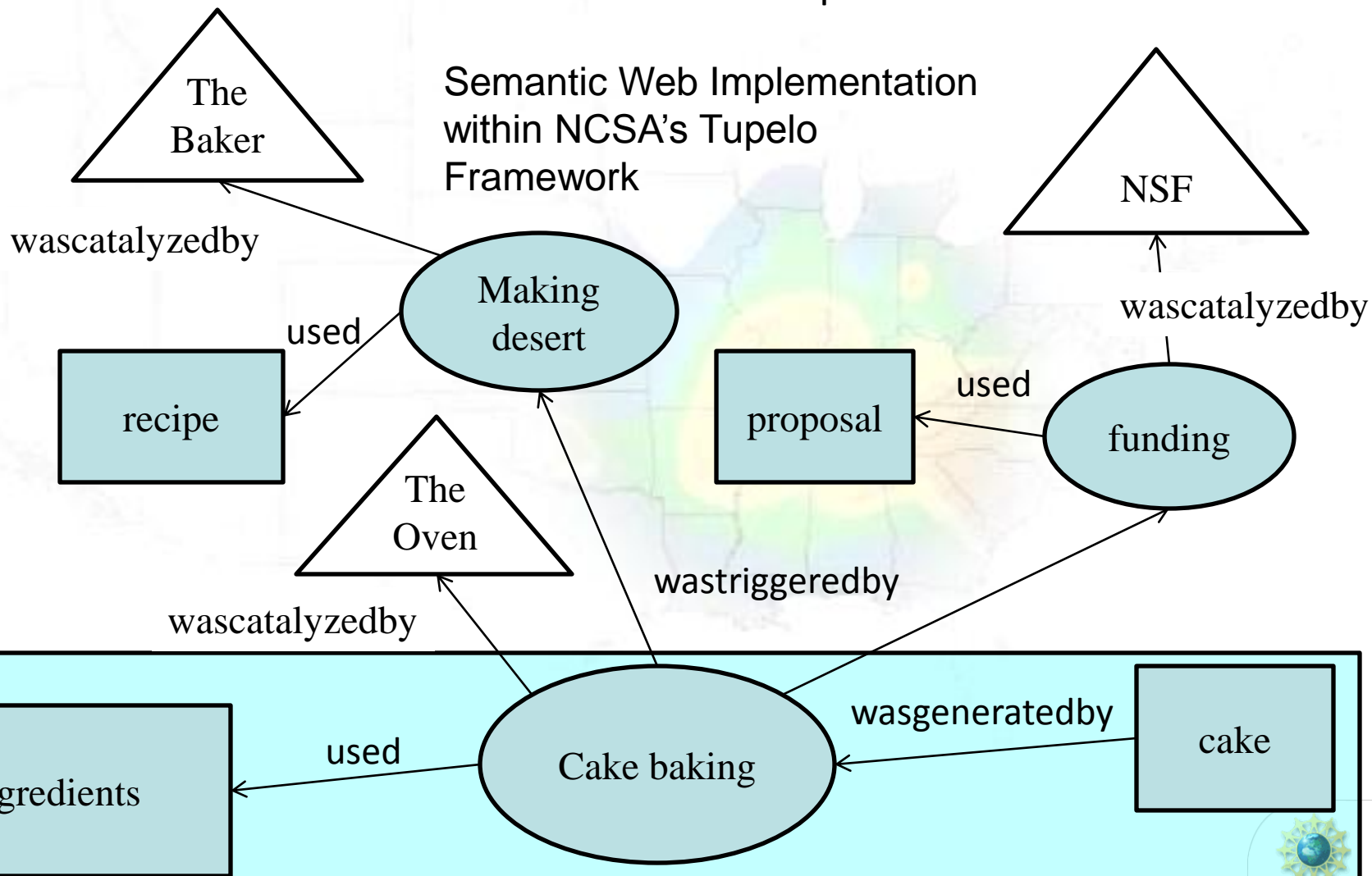
Explore

Understand



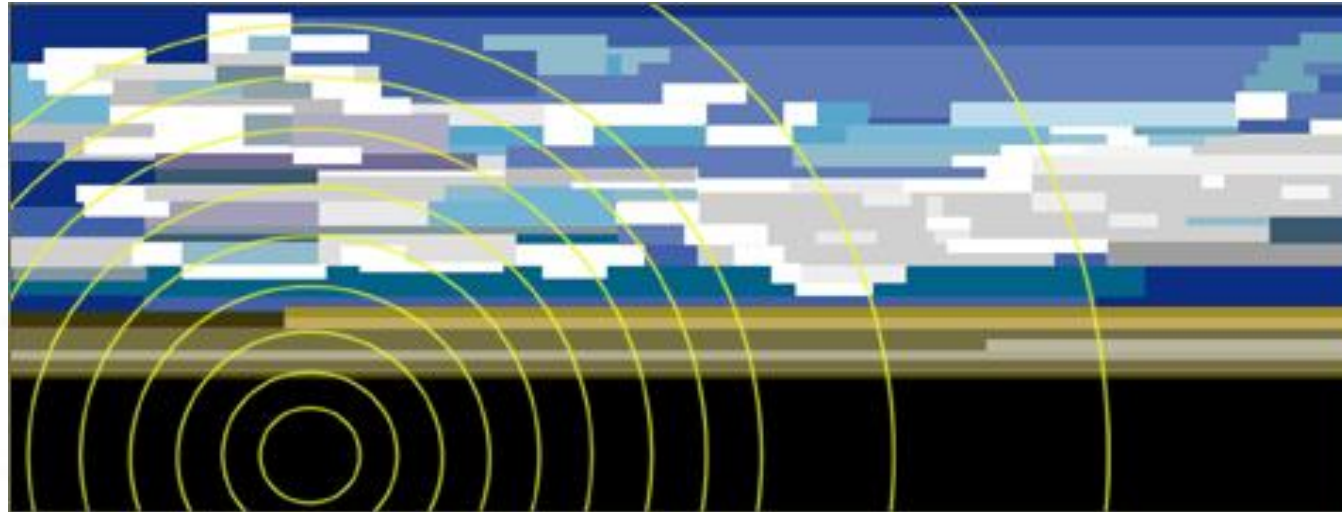
The Open Provenance Model:

NCSA, Pacific Northwest National Laboratory, U. Utah, U. Southampton, the International Provenance and Annotation Workshop series



Conclusion

- 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 tools
- Continued open source development will only improve the capabilities available to the community
- MAEviz is a platform for continuing community development in risk mitigation analysis
- We are available afterwards for live demonstrations or other questions.



MAE Viz

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This work was supported by the Mid-America Earthquake Center through the Earthquake Engineering Research Centers Program of the National Science Foundation under NSF Award No. EEC-9701785.

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