

# Visualization, analytics and spatial decision support in the Geosciences Network (GEON)

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Department of Geography, Penn State*



# There were three academics on a train...

- A Geographer, a Geologist and a Mathematician...



# Cyberinfrastructure (CI)

*“Like the physical infrastructure of roads, bridges, power grids, telephone lines, and water systems that support modern society, **“cyberinfrastructure”** refers to the distributed computer, information and communication technologies combined with the personnel and integrating components that provide a long-term platform to empower the modern scientific research endeavor.”*

["National Science Foundation Releases New Report from Blue-Ribbon Advisory Panel on Cyberinfrastructure,"](#)

# The Geosciences Network (GEON):

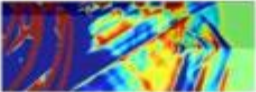
[www.geongrid.org](http://www.geongrid.org)

## GEON


### THE GEOSCIENCES NETWORK


  
  
**News**  
**GEON's Outreach Extends to Fall AGU Meeting**  
Several GEON PIs and graduate students presented their project-related work at the 2006 Fall AGU Meeting, held in San Francisco Dec 11-15th.  
**GEON Node to be Deployed by Chesapeake Bay Environmental Observatory Network (CBEO)**  
A team of environmental researchers, hydrologists and computer scientists from several universities across the country recently received a 3-year NSF award.  
**GEON Co-PI re-elected to IEEE-Computer Society Board of Governors**  
Ann Q. Gates (Co-PI, UTEP) was re-elected for a second term.


**About GEON**  
Calendar  
Newsletter  
Participants  
Annual Reports  
**Science**  
Workshops  
Publications  
**Resources**  
Data  
Tools  
**Education**  
Summer Institute  
Courses  
**Contact Us**

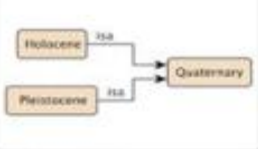
**Featured Science Activity**  
**Synthetic Seismogram Computational Tool Now Available**  
*One of GEON tools, SYNSEIS (Synthetic Seismogram Computation Tool), is now available for research and educational studies. The tool is used within the GEON network environment and enables users to simulate regional seismic records in 2D or 3D environments. SYNSEIS is built as a service oriented system and it accesses IRIS DMC to obtain observed waveforms, model builders to construct 2D/3D models, and national supercomputer centers for computations.*  


**About the GEON Portal : Resources for Geoscientists**  
*The GEON Portal is the entry point for accessing online resources such as data and tools. Different sections of the portal (a.k.a. portlets) provide different functionality such as search, myGEON, and access to tools and applications. Resources available at the Portal include:*

**Data**  
Data can be shared, published, and integrated with other data at the Portal

**Tools**  
Tools can be registered, accessed, and downloaded for use

**Web Services**  
Web services can be registered and invoked using a standard authentication system

**Knowledge Representation**  
Controlled vocabularies, hierarchies, and more complex relationships (a.k.a. ontologies) among scientific terms can be registered and accessed

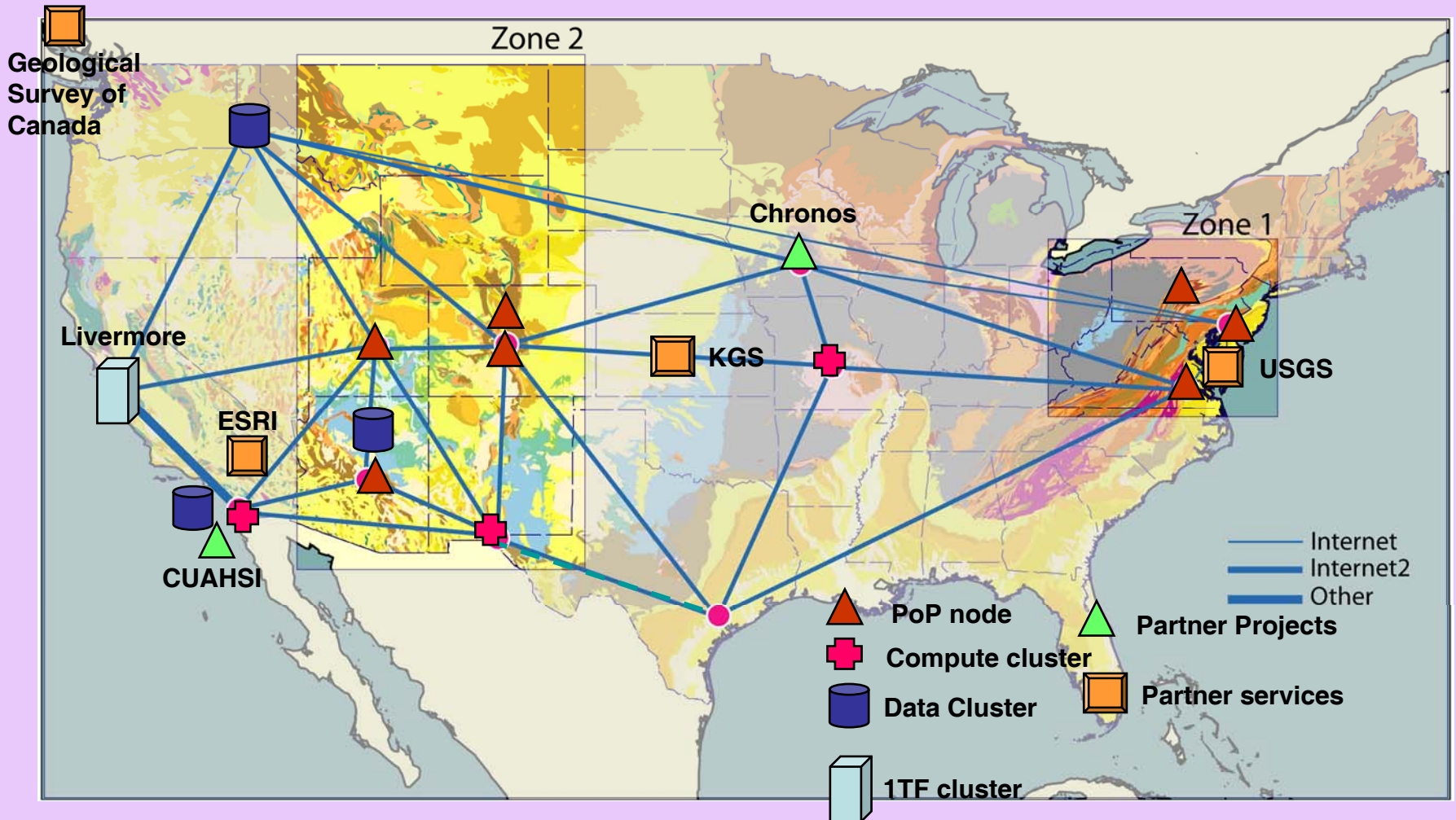
New to the GEON Portal? [click here!](#)

Recent events: CSIG 2006 Geoinformatics 2006 Beijing CI Workshop

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For further information about GEON news and updates, please e-mail [info@geongrid.org](mailto:info@geongrid.org).  
For comments/questions about the geongrid.org website, please e-mail [webmaster@geongrid.org](mailto:webmaster@geongrid.org)

Done

# Cyberinfrastructure: The GEON Network



# Higher-Order CI Services

## 1. Data Integration

- Defining “views” across multiple sources

Multiple database schemas, e.g. in GEON PAST (Paleogeography and AMOCO database), Chronos (Paleostrat, Neptune, Paleobiology), Geochemisry (Navdat, PetDB, ...)

Multiple maps and map layers

## 2. Visualization

- Simulation of earthquake dynamics
- Visualizing knowledge structures and visual search for useful resources

## 3. Analysis and Workflows

- Iconic representation of databases and tools
- Ability to link together tools and data to specify computations

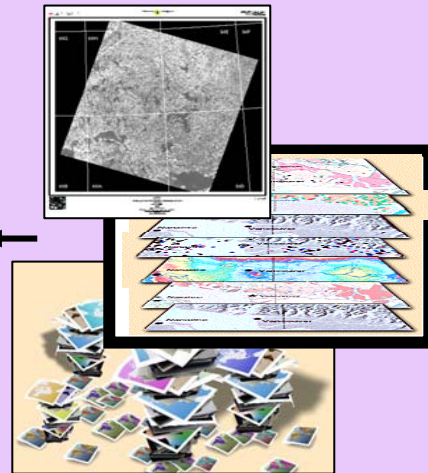
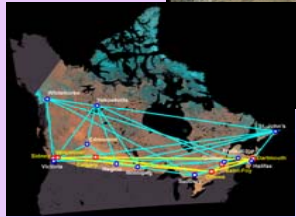
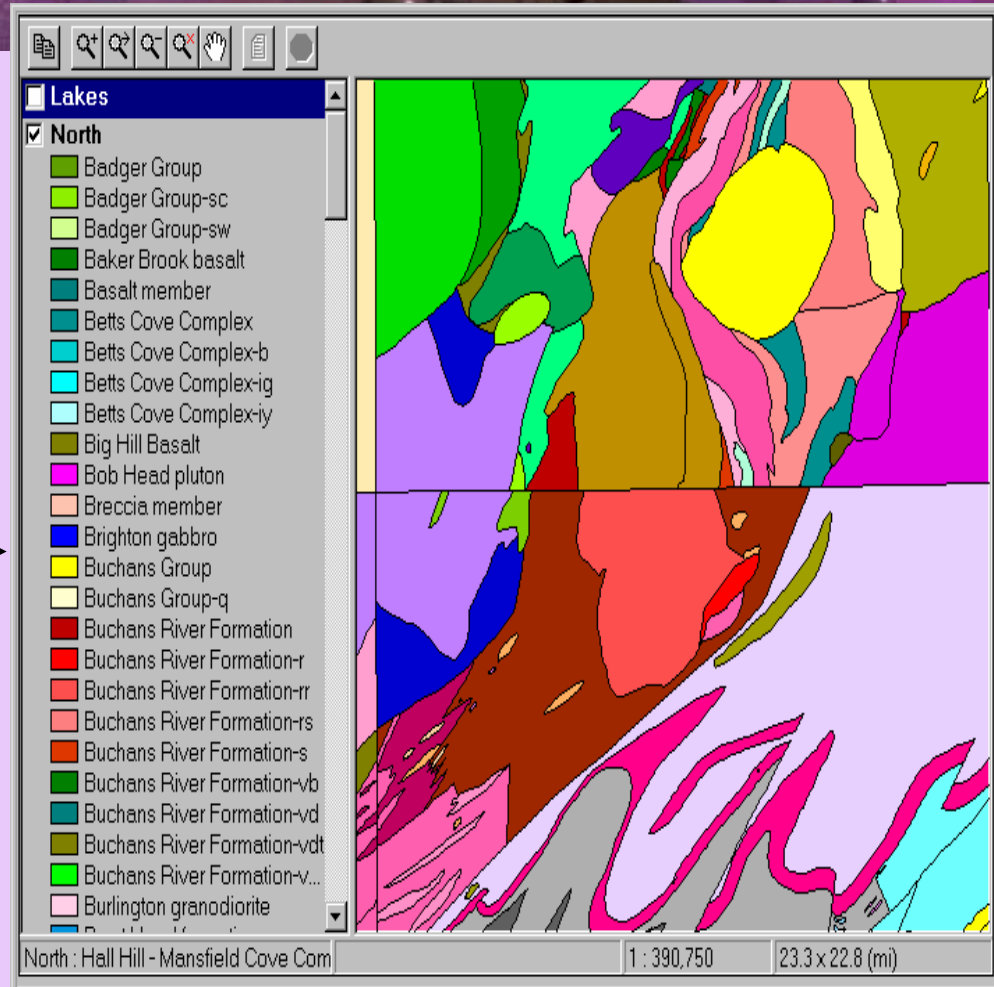


# 1. Data Integration

*Automated schema integration  
using ontologies...*

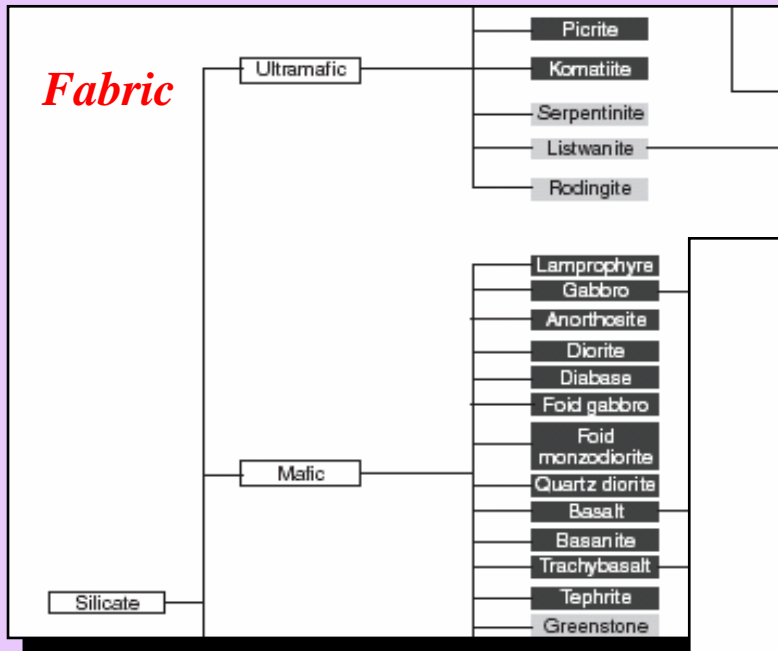


# ONE MOTIVATING EXAMPLE: Map construction and semantic conflict

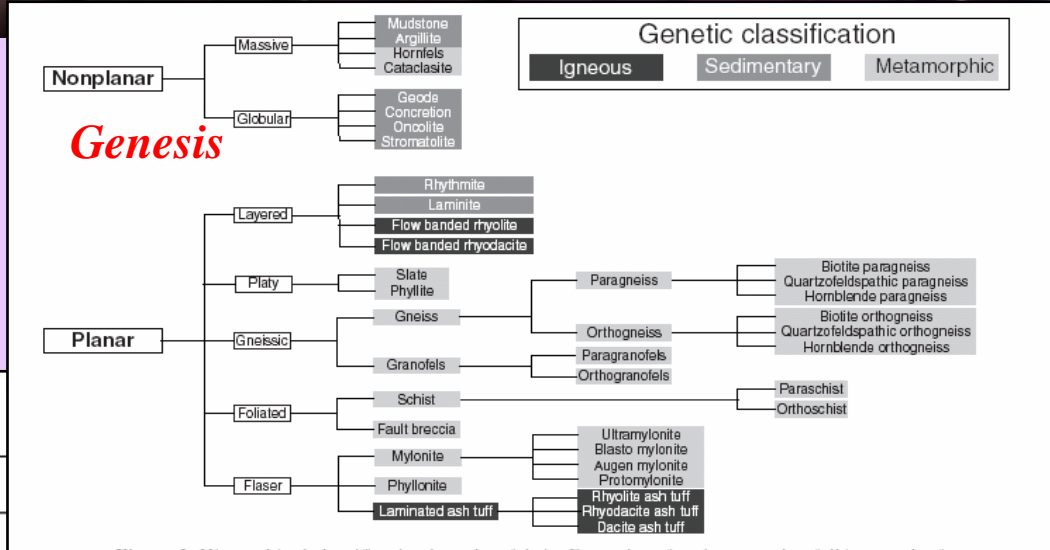


# GEON: Multiple, different geological ontologies

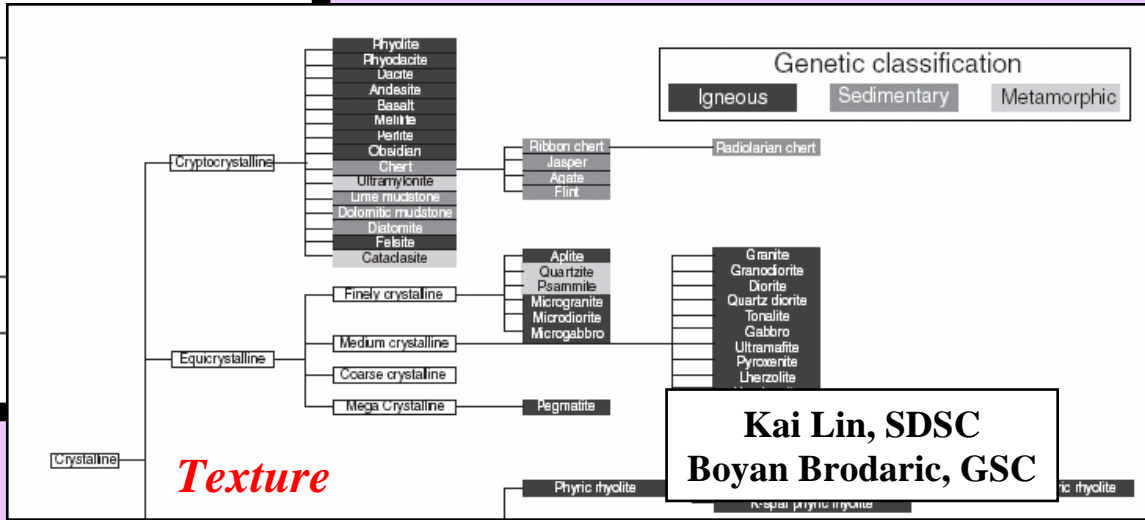
## *Fabric*



## *Genesis*



## *Texture*

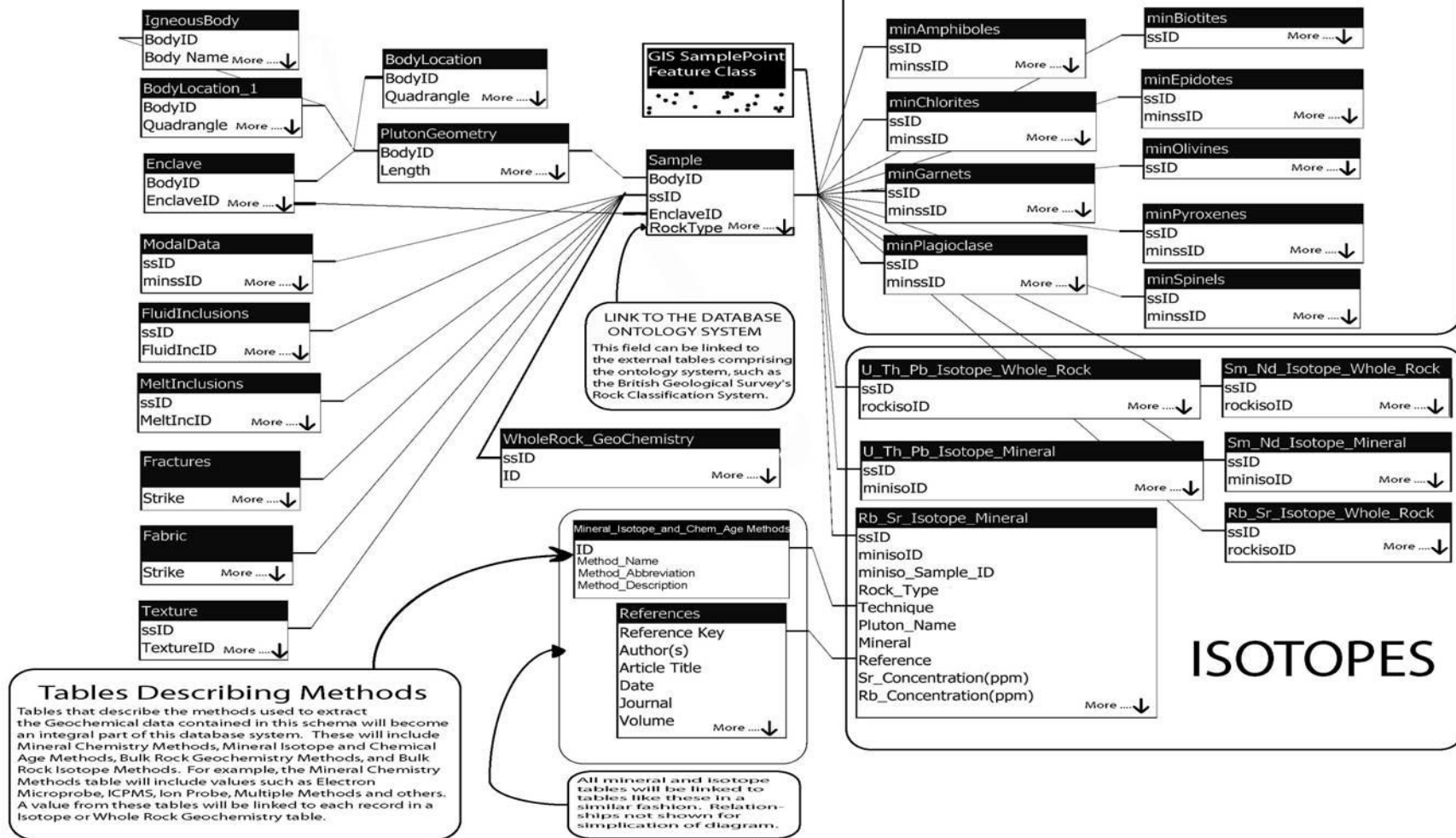


Kai Lin, SDSC  
Boyan Brodaric, GSC

# Integration via shared schema

## IGNEOUS ROCK DATABASE SCHEMA - Simplified

## MINERALS



**AKS1** We have constructed a pluton schema that is strongly field based. Many of the databases within this schema are searchable . It is important to emphasize that multiple schemas ( as long as attributes are clearly organized) can be integrated through GEON.  
A. K. Sinha, 10/24/2003

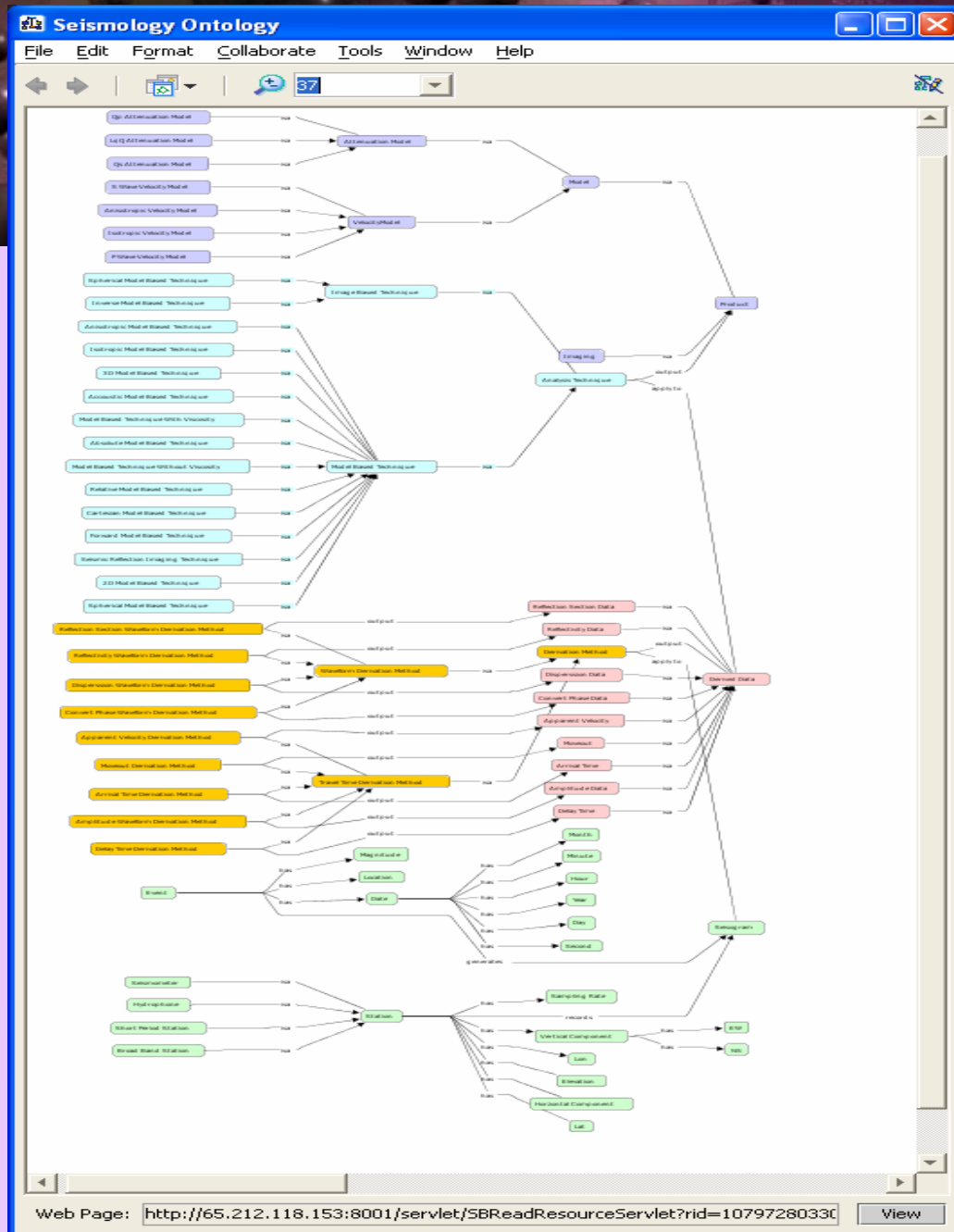
# Rock Taxonomy

Geological taxonomy converted to an ontology

Gathered from experts during a specially convened workshop

Formalizes relationships between concepts

**Randy Keller (UTEP),  
Bertram Ludaescher, Kai Lin,  
Dogan Seber (SDSC), et al**



# Geologic Map Integration in the Portal

The image shows two overlapping browser windows. The left window is the GEONgrid Portal, displaying a navigation menu with 'GeologyMapIntegration' selected. The right window is the Interactive Geologic Map, showing a map of the United States with a legend on the right. The legend includes dropdown menus for GeologicAge, Genesis, Composition, Texture, and Fabric, all of which are circled in red. A red arrow points from the 'Geology mapping integration' section of the portal to the map interface.

**GEONgrid Portal - Microsoft Internet Explorer**  
Address: http://geon01.sdsc.edu:8282/gridsphere/gridsphere?action=applist&cid=oadreg&JavaScript=enabled

**Interactive Geologic Map - Microsoft Internet Explorer**  
Address: http://geon01.sdsc.edu:8888/cgi-bin/mapserv?map\_web\_imagepath=/home/kin/programs/apache/htdocs/

**Geology mapping integration**

**Ontology-enabled Data Registration and Integration**

Applications: [Ontologies](#) | [Datasets](#)

Home | Application List

Name	<a href="#">Ontology-enabled Map Integrator</a>
Classes	<a href="#">GeologicAge</a> , <a href="#">Genesis</a> , <a href="#">Composition</a> , <a href="#">Texture</a> , <a href="#">Fabric</a>
Datasets	<a href="#">Arizona Geology Map</a> , <a href="#">Colorado Geology Map</a> , <a href="#">Montana East Geology Map</a> , <a href="#">New Mexico Geology Map</a> , <a href="#">Nevada Geology Map</a> , <a href="#">Utah Geology Map</a> , <a href="#">Wyoming Geology Map</a> , <a href="#">Montana West Geology Map</a> , <a href="#">Idaho Geology Map</a> , <a href="#">Mid-Atlantic Geology Map</a> , <a href="#">Washington Geology Map</a>

**Interactive Geologic Map**

GeologicAge: -Cenozoic  
Genesis: -Igneous  
Composition: -Mafic  
Texture: -Cryptocranular  
Fabric: -Gneissic  
Query

Zoom In | Zoom Out | Pan | Browse | Info | Reset

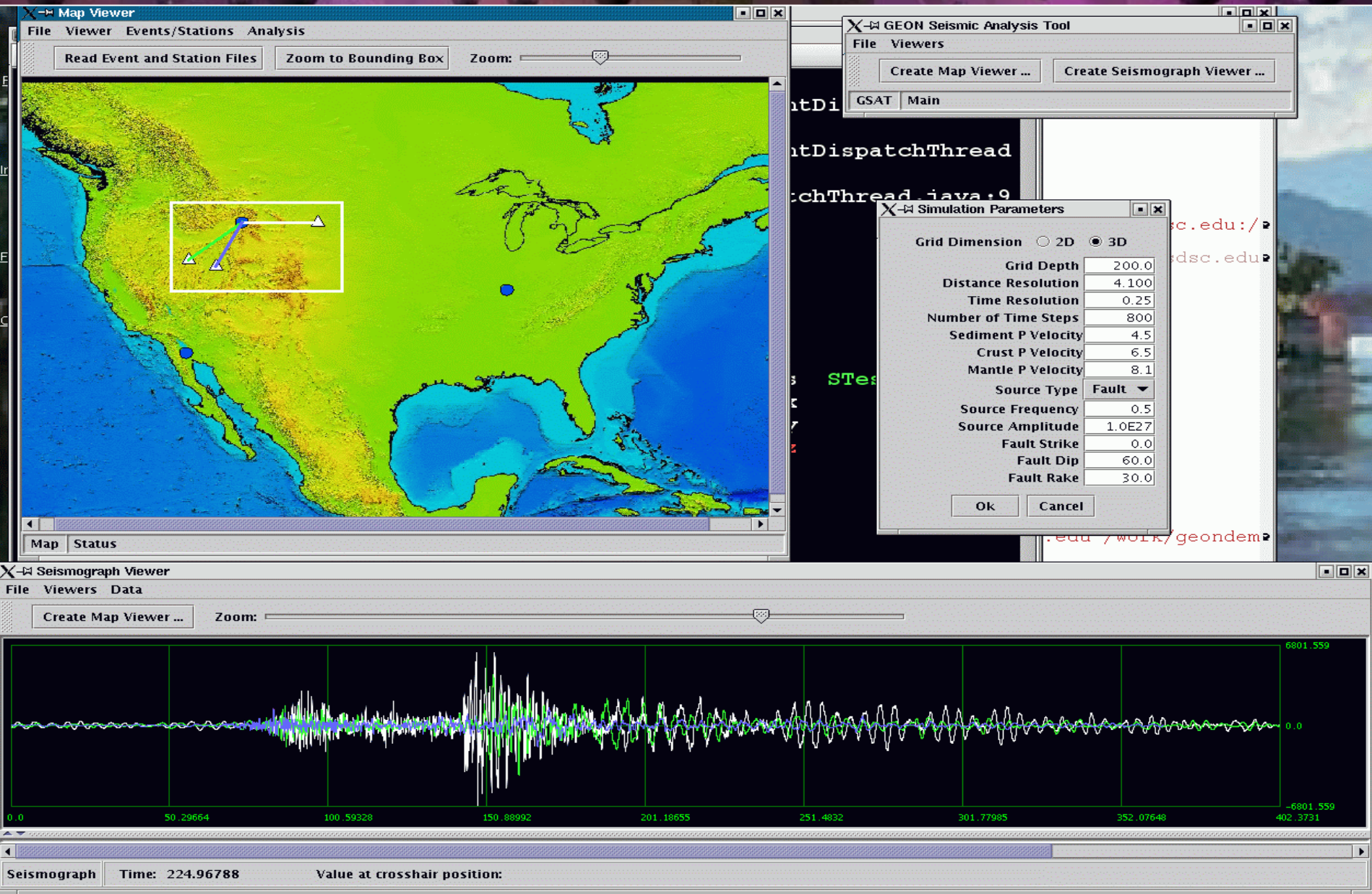
- ***After registering datasets, and their ontologies, mappings can be constructed between the datasets via the ontologies—semantic mediation***



## 2. Visualization

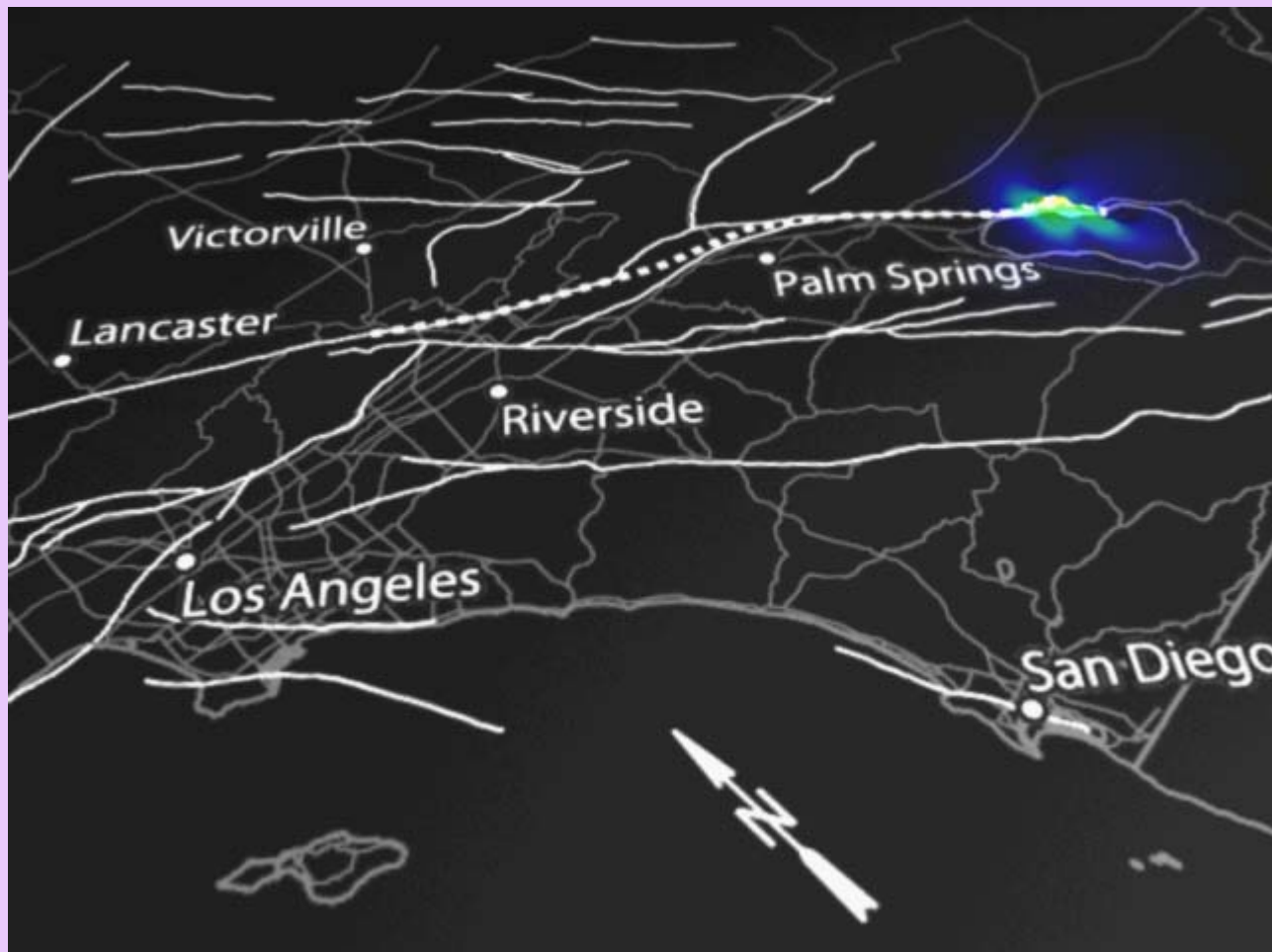
*Visualizing simulations, data,  
knowledge...*

# 3D Earthquake Modeling using HPC

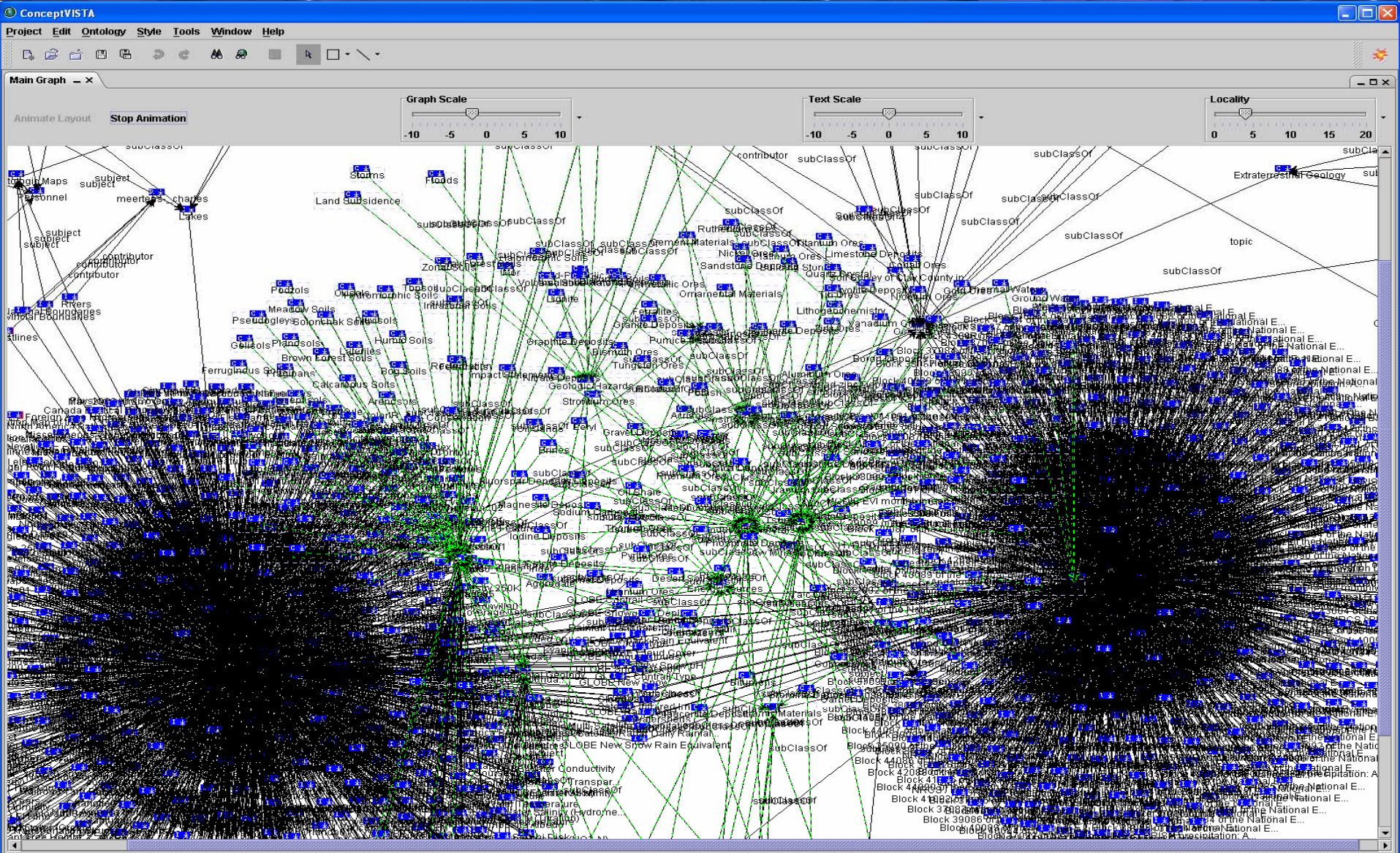




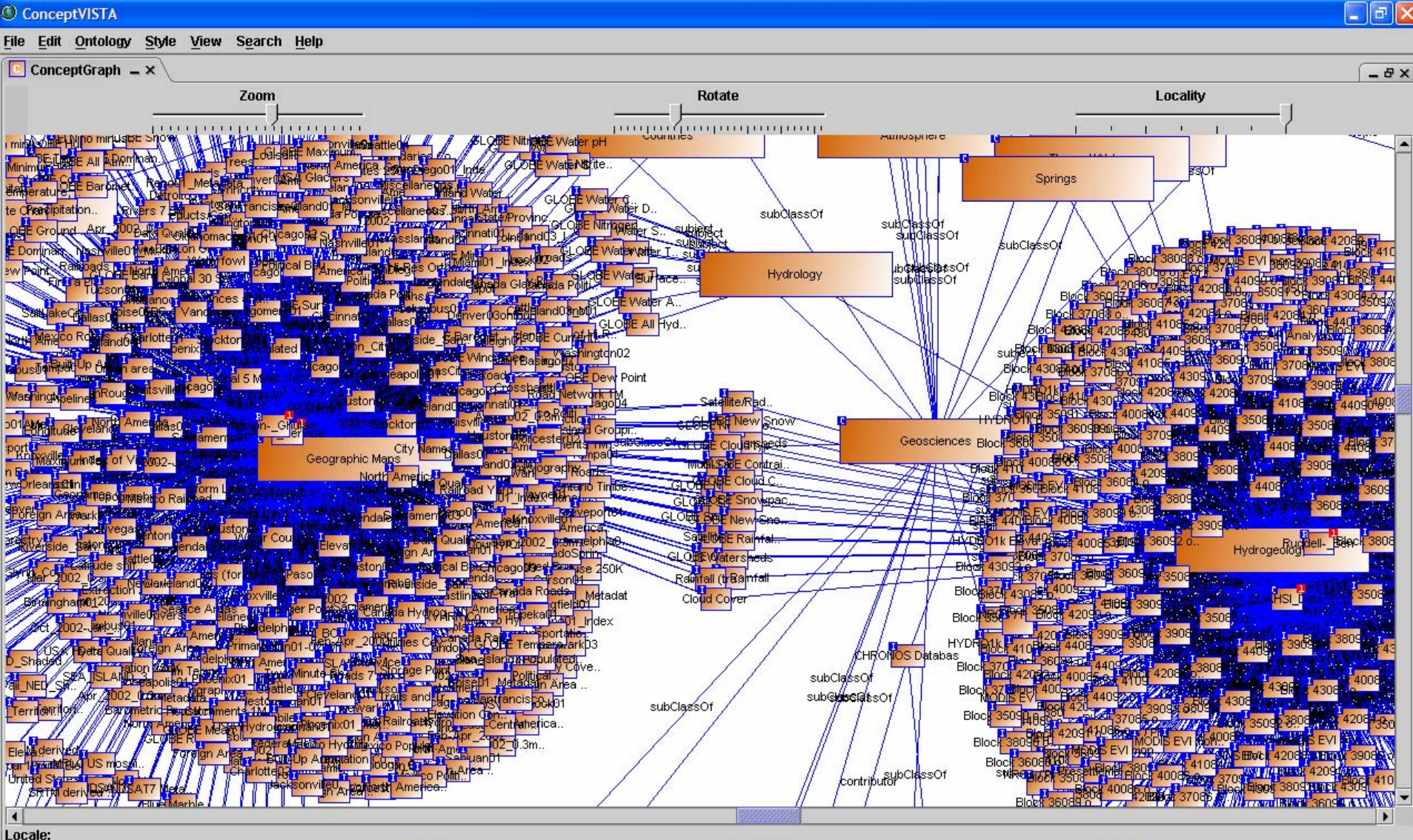
# Earthquake scenarios



# Finding what you need: Searching the GEON Resource Catalog



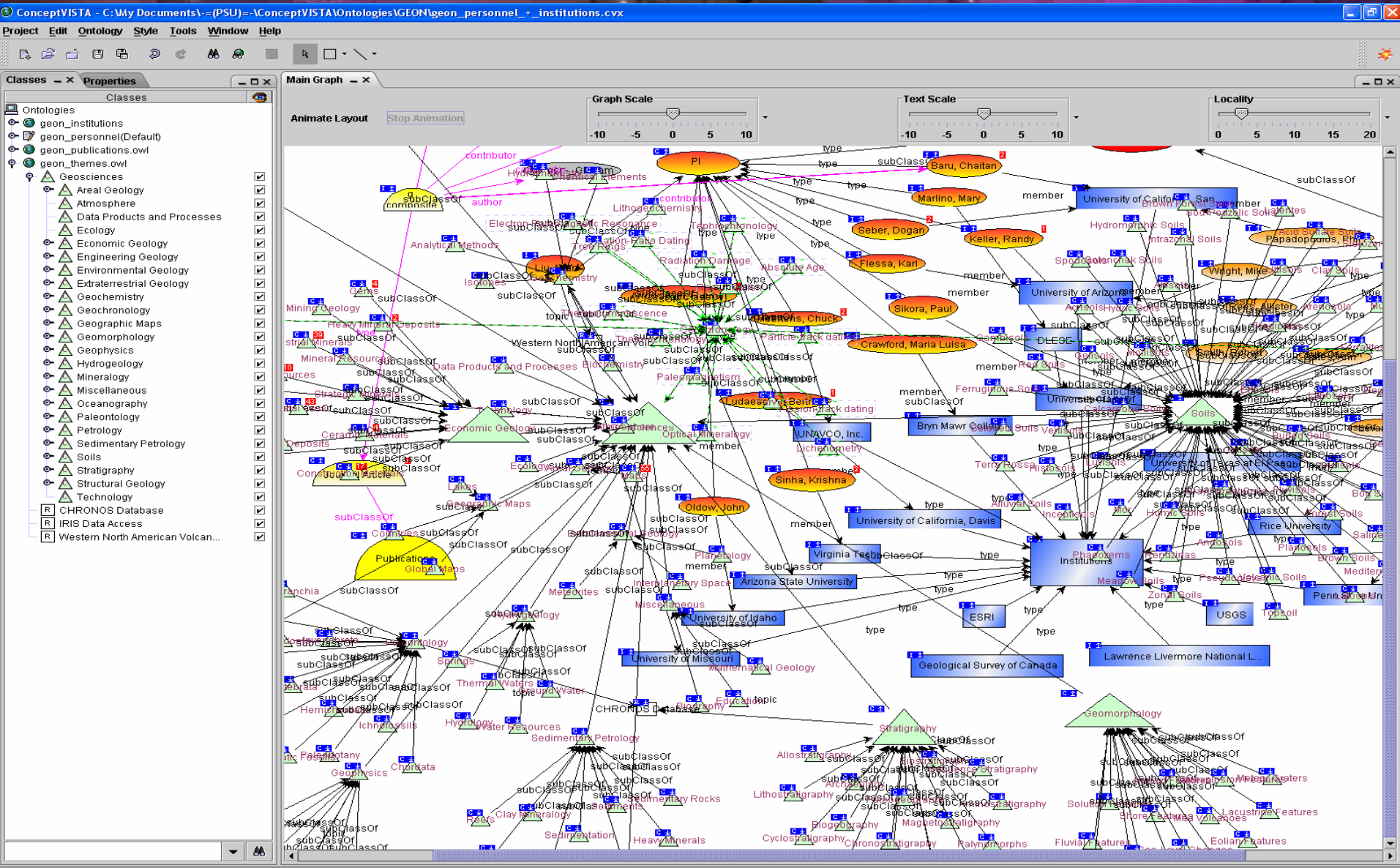
# GEON: Thematic Areas (AGI topic map)



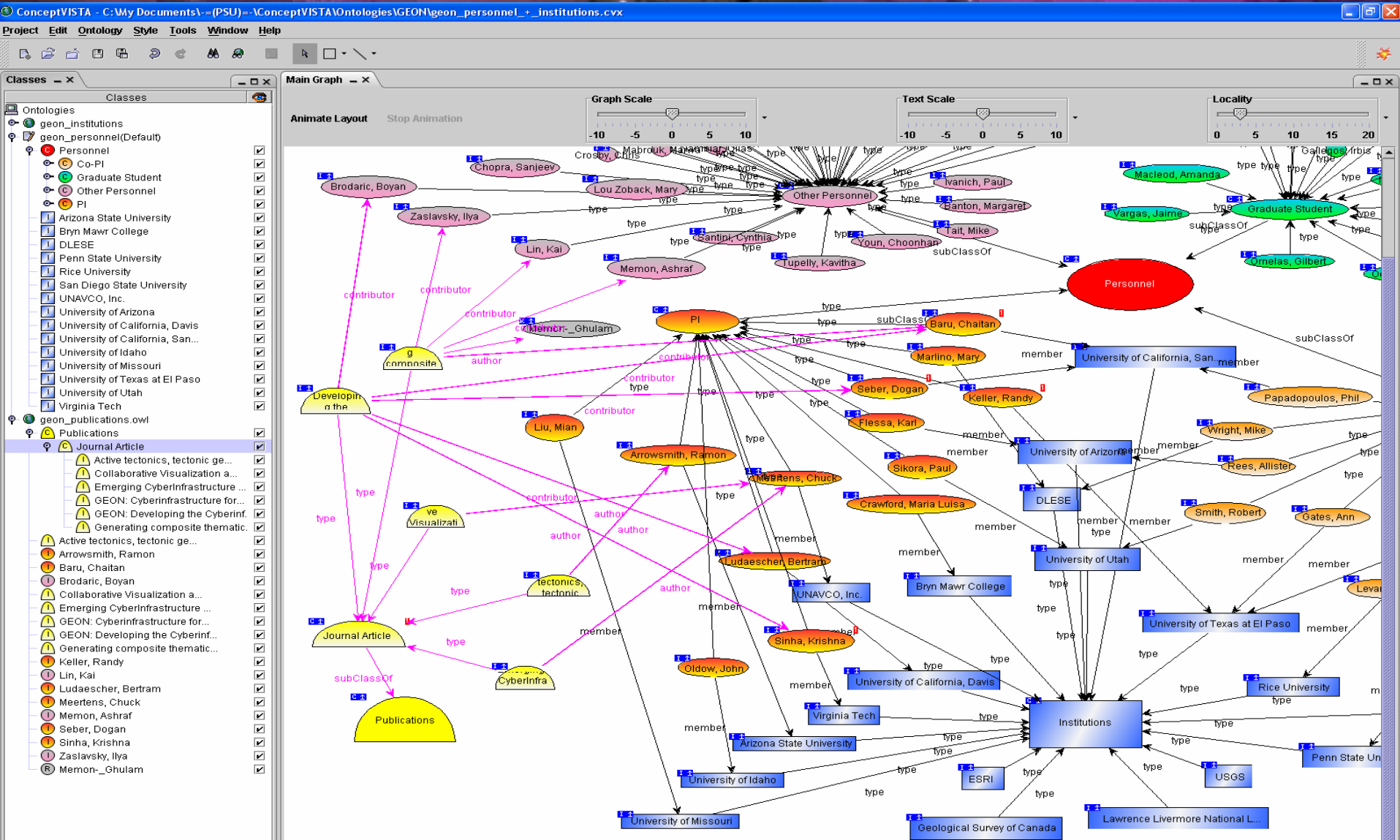
# Ontologies by themselves are not enough

- Top down knowledge (ontology) only gets you so far...
  - Experiences, use-cases (situations surrounding the use of resources), Social networks, etc. also carry meaning
- Current ontologies are static resources...
  - Our understanding is dynamic & continually evolving...
- What happens to all the millions of geographical resources that predate ontologies?
  - The cost of retro-fitting ontologies is prohibitive.
- We DO NOT all understand the world in the same way
  - We do not share the same ontologies

# Adding in people, places, publications, organizations, ...

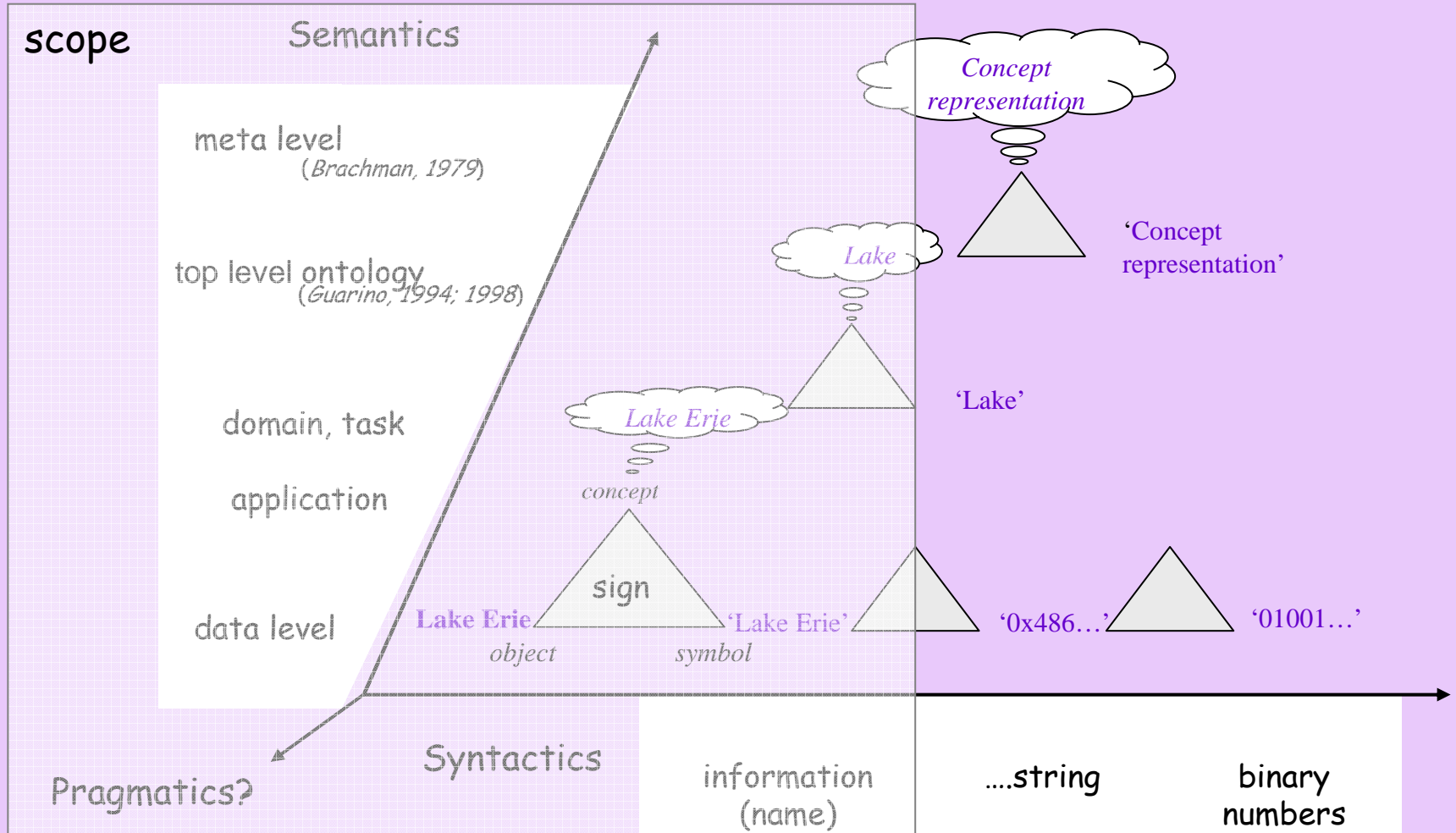


# ...and tools for navigation



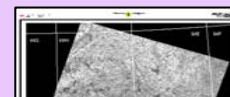
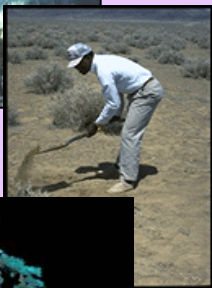
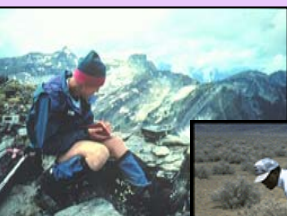
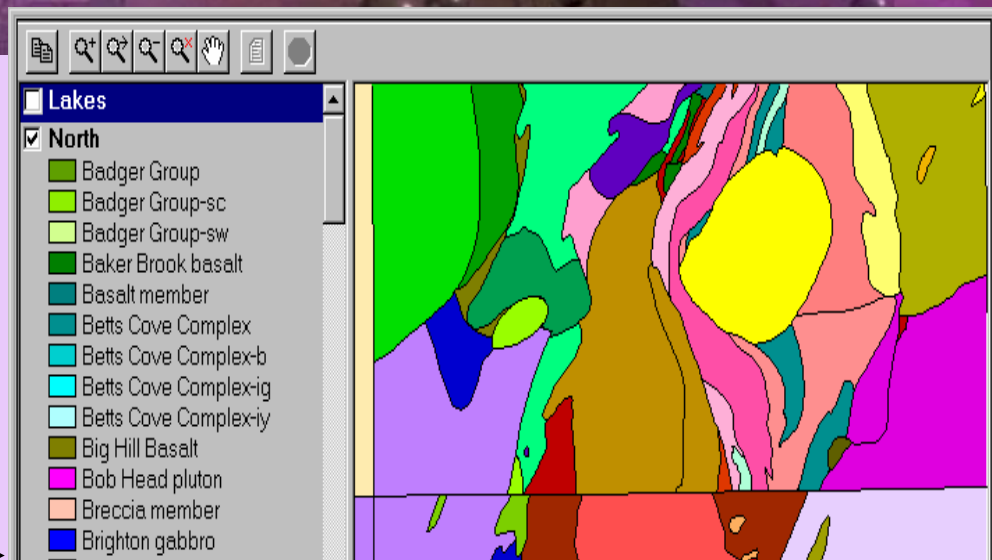
# Meaning is carried in formal descriptions (*semantics*) but also in how things are used and made (*pragmatics*)

• Information Semiotics (after Sowa, 2000)

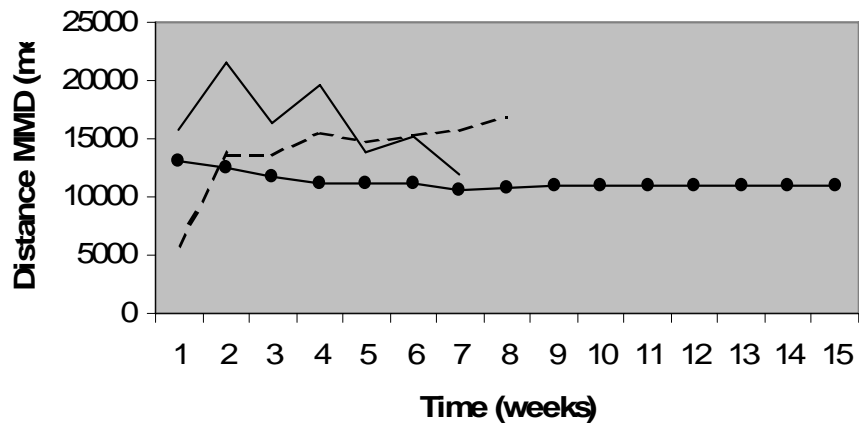


Brodaric and Gahegan. 2005

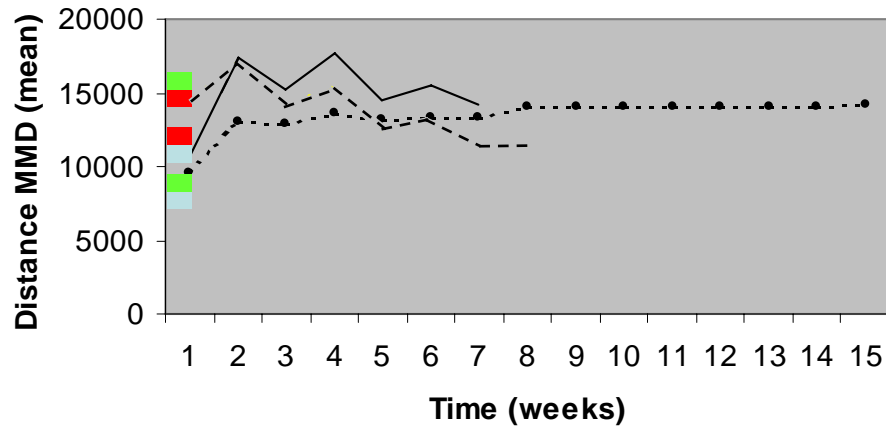
# Looking Deeper: Map construction and semantic conflict



**C: intra-geologist clustering**

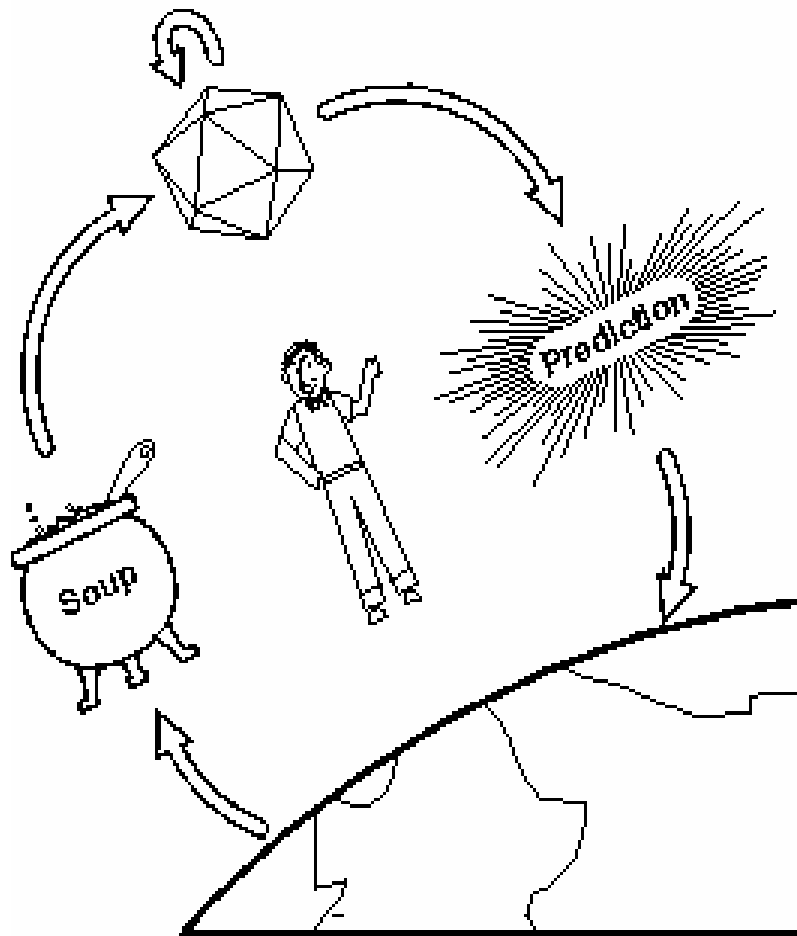


**C: inter-geologist similarity**





# “Knowledge soup” – Sowa, 2002



# A knowledge portal

(Nexus of knowledge structures: Whitehead, 1923)

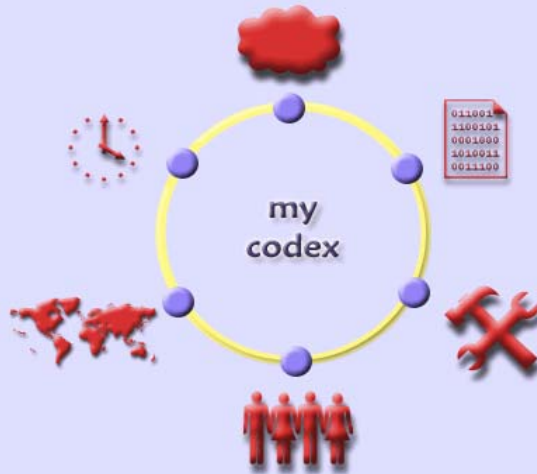
HERO Project

Bill's workspace

- [Population density](#)
- [Anderson Level I land cover categories](#)
  - [Water system sensitivity](#)

[Create a new concept...](#)

Concepts



Tasks

- [Vulnerability assessment](#)

[Start a new task...](#)

Places

- [State College, PA](#)
- [Spring Creek watershed](#)

[Record a new place...](#)

Files

- [Spring Creek Watershed boundary](#)
- [Centre County Census 2000 SF3](#)
- [HERO meeting minutes 2002-12-09](#)

[Add a new file...](#)

Tools

- [Scatterplot matrix](#)
- [Parallel coordinate plot](#)
- [2D Map](#)



[Add a new tool...](#)

Groups

- [HEROINE](#)
- [Vulnerability working group](#)

[Create a new group...](#)

© 2003 HERO and The Pennsylvania State University

RDF Powered  Dublin Core Used Here 

Codex: Bill Pike (PSU, PNNL): GEON researcher

Local intranet

# Gravitational anomaly concept map (GEON: Randy Keller)

HERO | codex - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address <http://hero.geog.psu.edu/codex/jsp/linkbrowser/CodexGraph.jsp?graphid=15122> Go

codex

Bill Pike [link.txt] HERO Project

James  
Experimental Petrology team  
Junyan  
Rookies group  
Gravity model  
Jamison  
Alistair  
Isaac

**Graph Info**  
Viewing usage info for concept **Gravity Model**

**Description:** Basic framework for gravity modeling, including data sources and analysis steps. Contains pointers to external data repositories.

**Created by:** Bill Pike ([wpike@psu.edu](mailto:wpike@psu.edu))  
**Created on:** Tue, 30 September 2003 at 11:07  
**Built from:** [Geological features](#) | [Basin](#) | [Fault](#) | [Uplift](#) | [\[more...\]](#)  
[\[more...\]](#)

**# of concepts:** 21  
**Resource ID:** 15121  
**Used by:** [\[list\]](#) [\[graph\]](#)  
**Used in:** none

Find node:  Find... Zoom: -30 3 19 Locality: 0 2 6

Applet com.touchgraph.linkbrowser.LinkBrowserApplet started

Internet

# Knowledge does not exist in isolation: Connecting Concepts to Data

**Data Distribution**

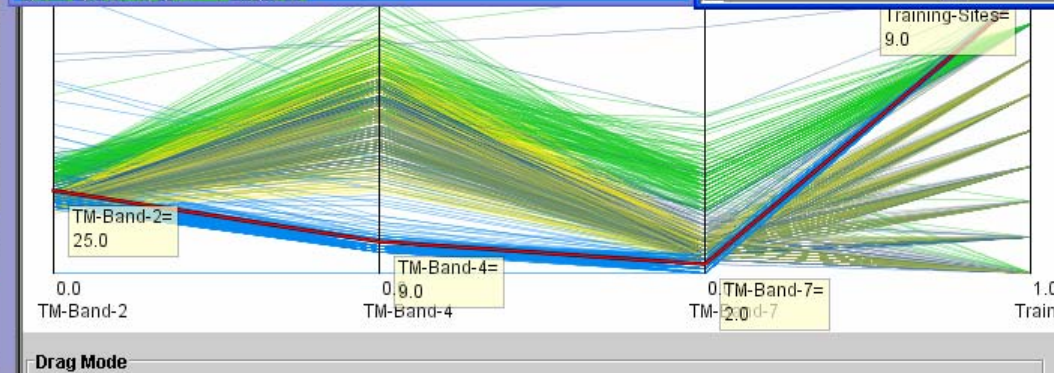
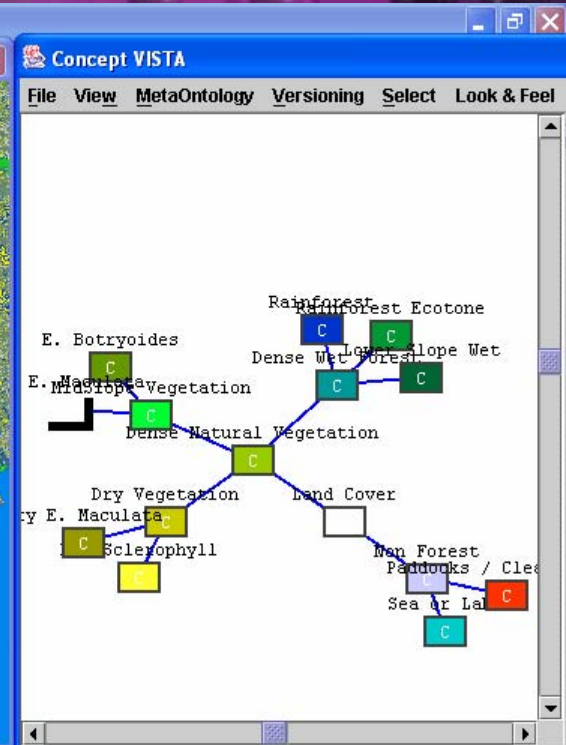
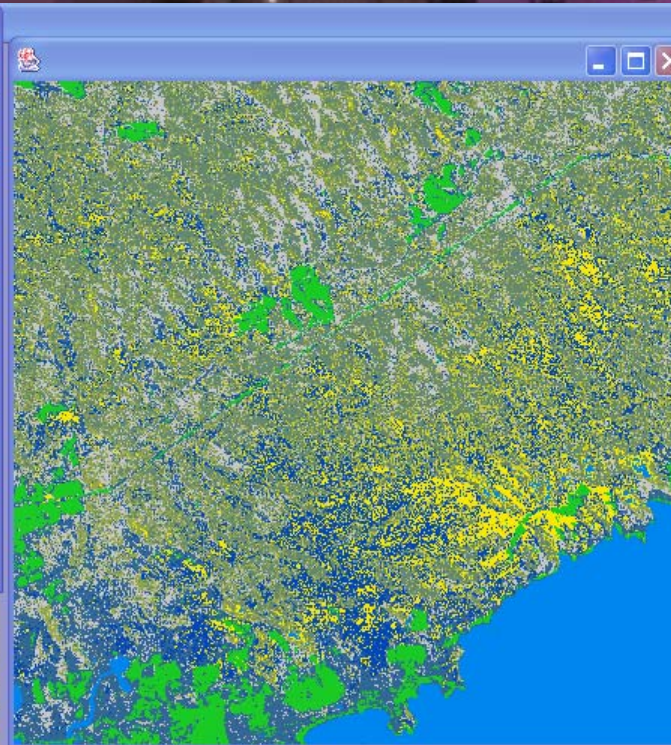
M			
	TM-Band-2		
		TM-Band-4	
			TM-Band-7

**Sea or Lake**  
 Lower Slope Wet  
 Rainforest Ecotone  
 Rainforest  
 Dry E. Maculata  
 Dry Sclerophyll  
 E. Botryoides  
 Wet E. Maculata

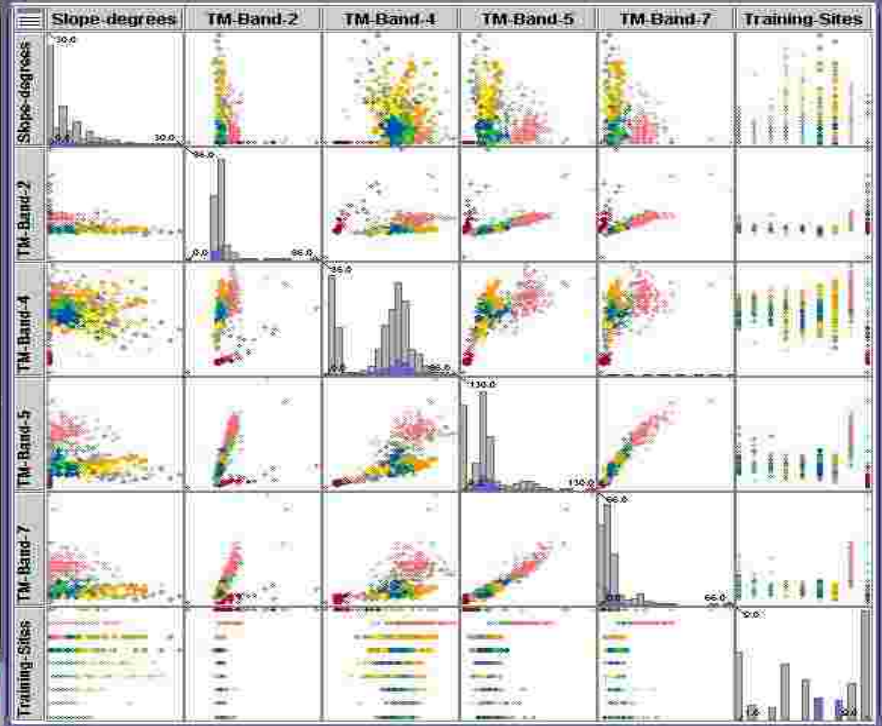
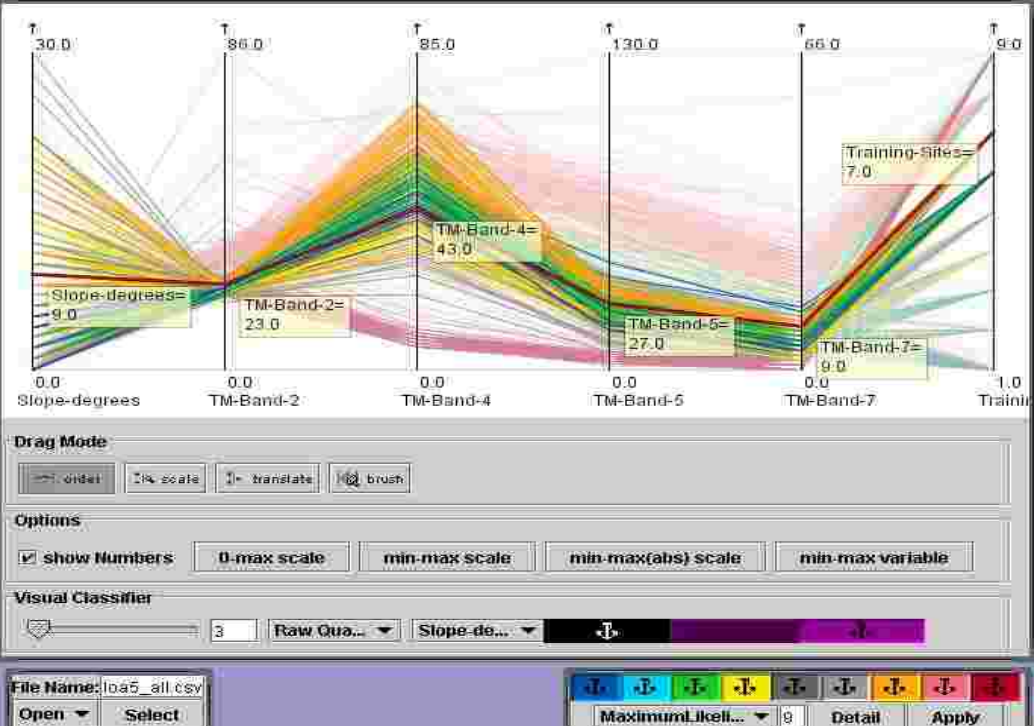
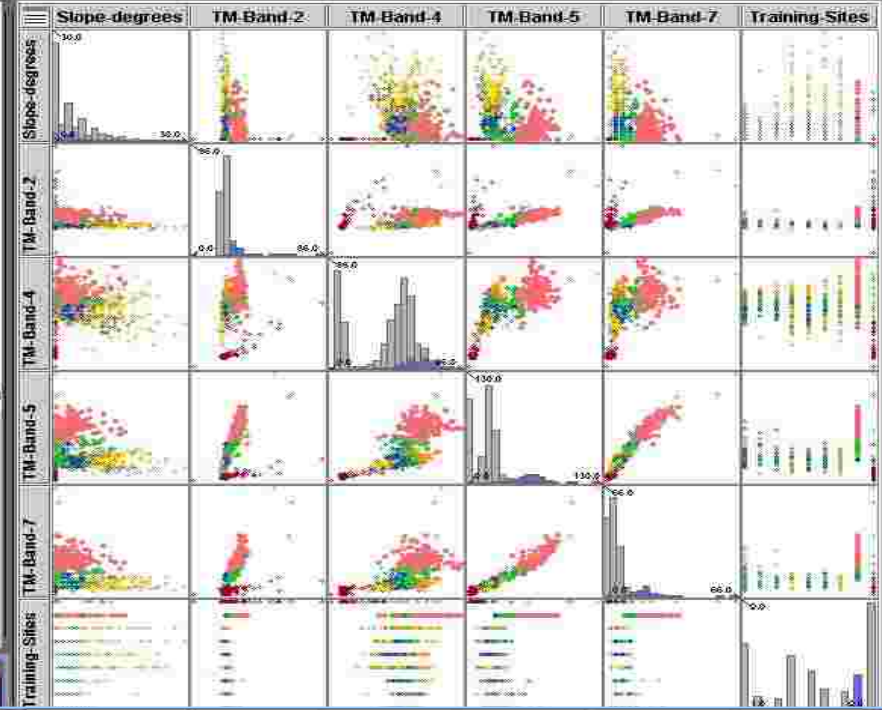
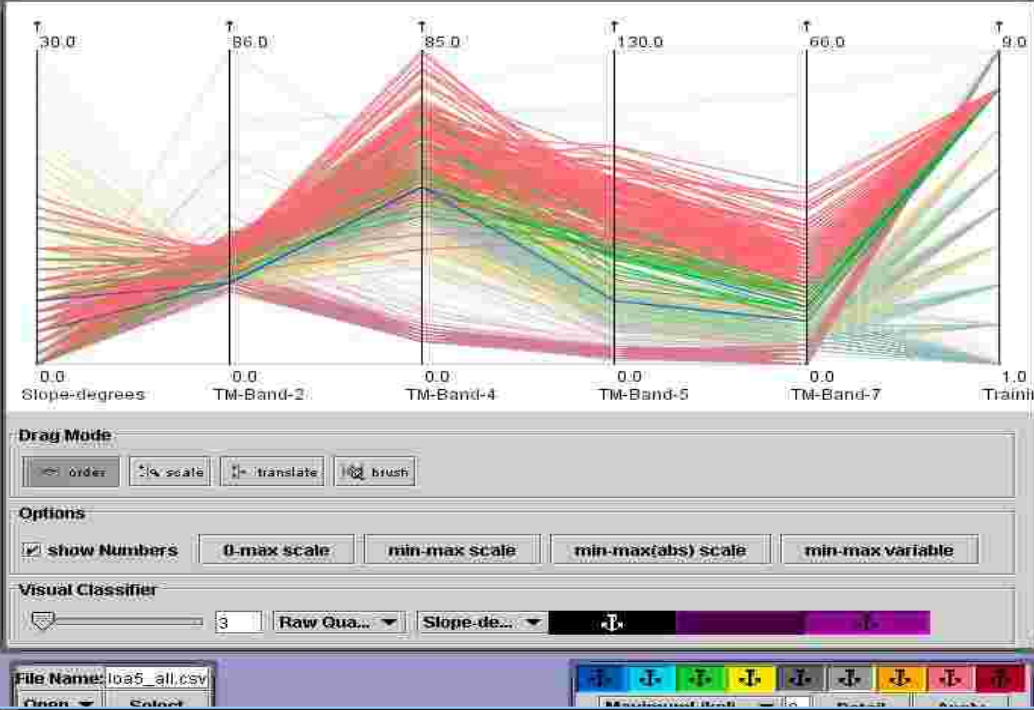
**Name:** Paddocks / Cleared Land  
**Category Label:**  
**Description:** Paddocks or cleared land  
**Preferred Color:** █  
**Application Context:**  
**Preferred Classification method:**  
**Examples for This Category:**

Add Combine Divide Save

MaximumLikel... 9 Detail Apply  
 ClassifyTrain ClassifyLoad Display Save





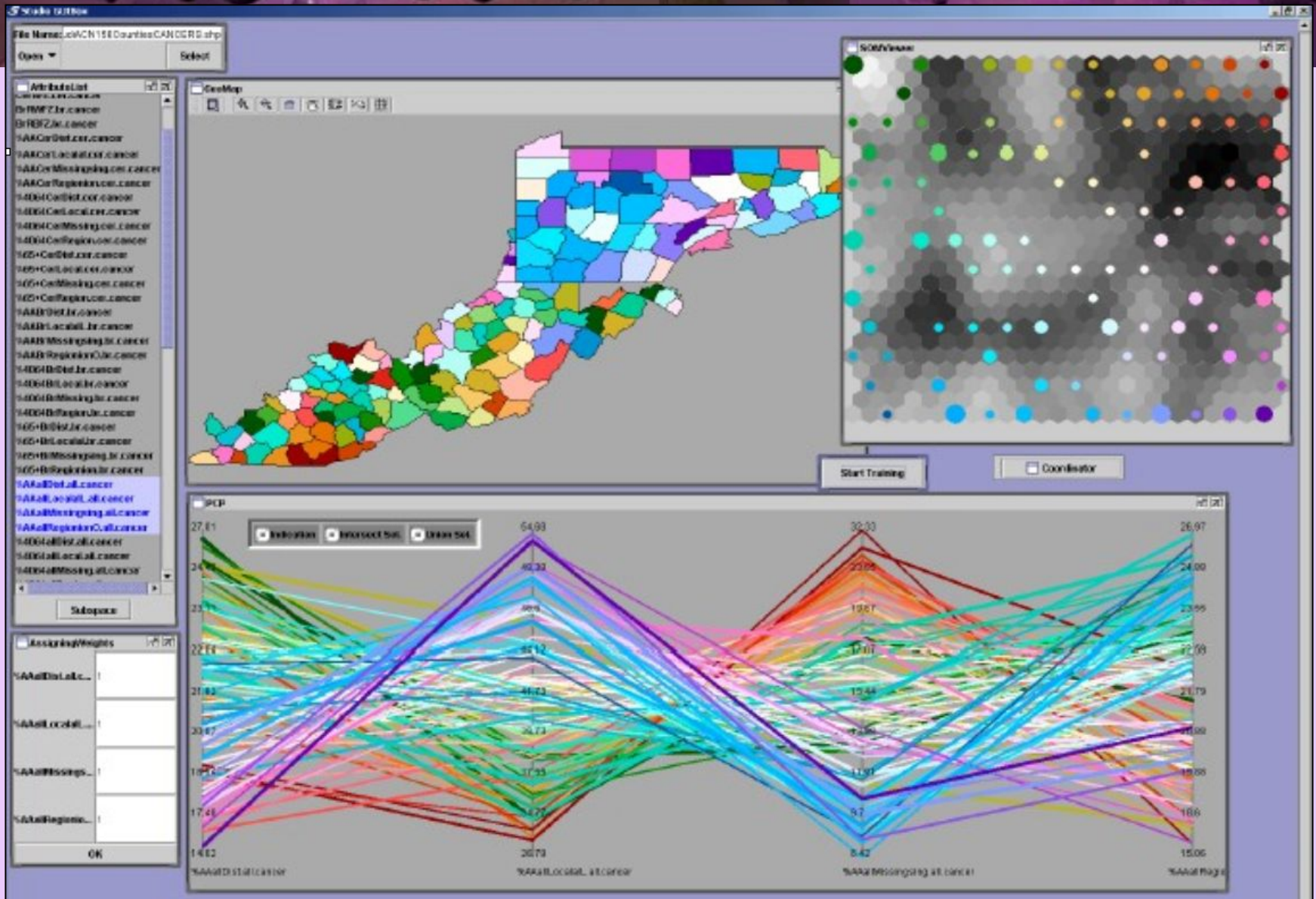




# 3. Analysis and Workflows

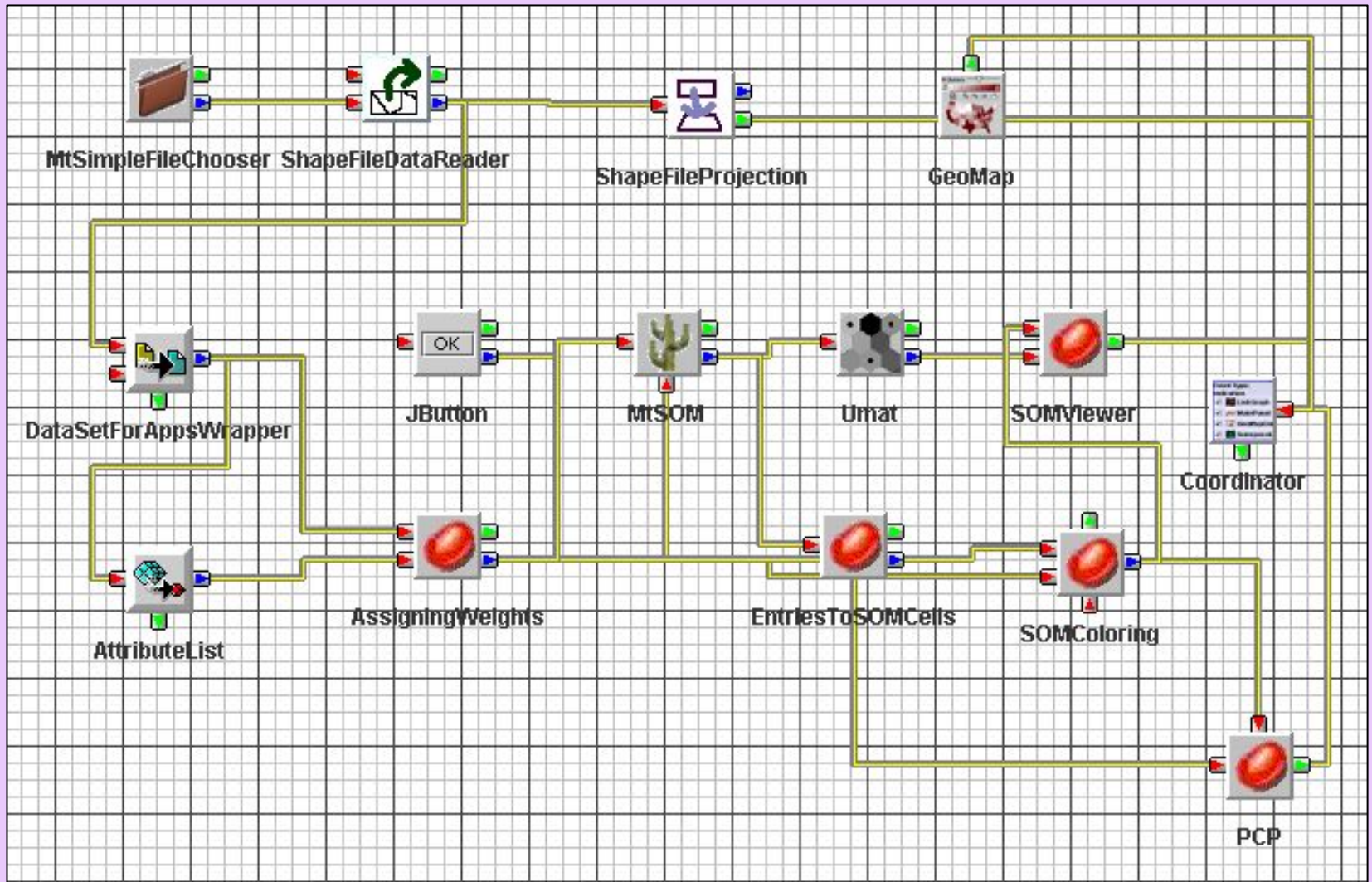
*Creating, sharing and preserving  
experiments in GeoVISTA Studio...*

# Example: GeoVISTA Studio





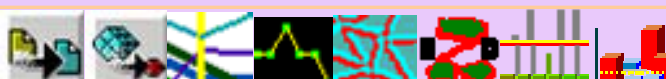





# Heterogeneous components wired together in the *Studio* Design Box

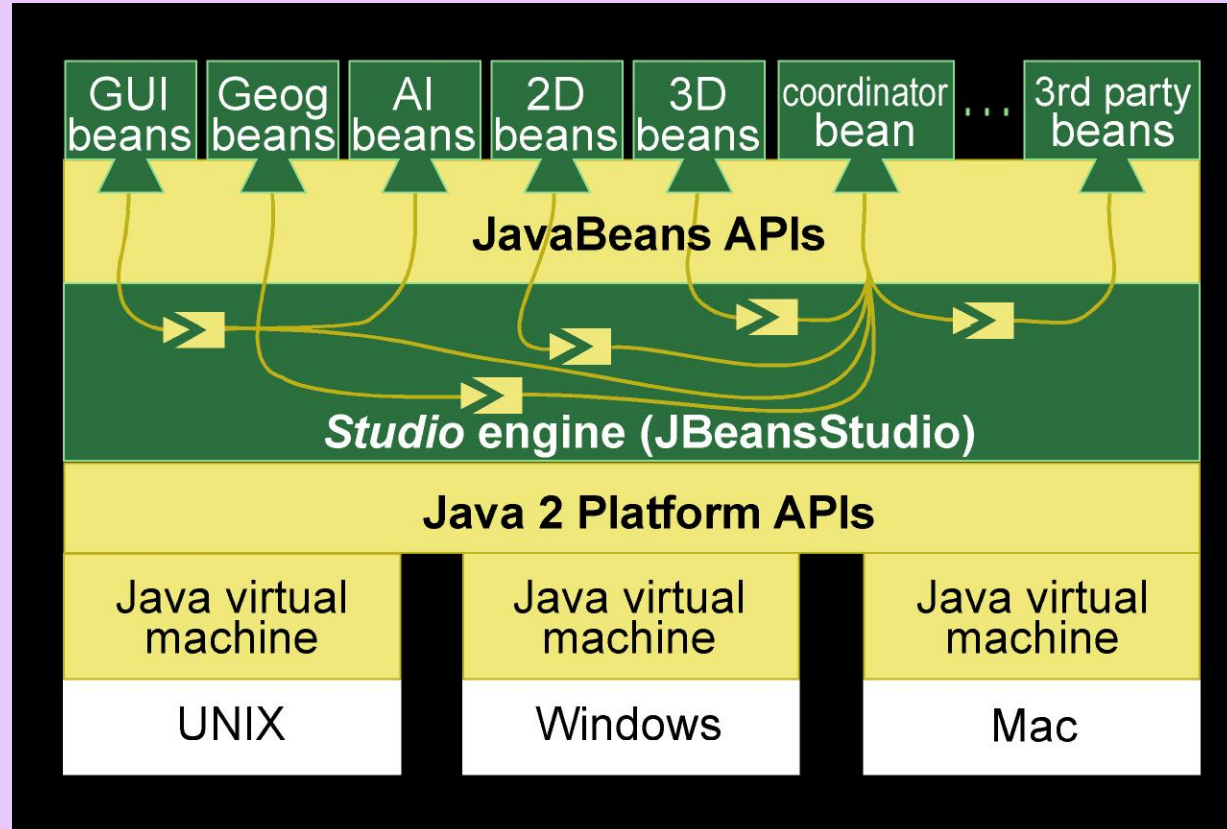


# Identify Relevant Resources

Categories	Domains of Origin	Sample JavaBeans Components
Swing	Basic GUI components from the javax.swing package.	
GeoViz	General components for geographical visualization.	
Java3D	3D visualization components based on Java3D technology.	
SOM	Pattern clustering and classification tools based on self-organization map.	
SpatialDM	Specialized data analysis and information visualization tools tailored for spatial data mining.	
GeoTools	Geospatial data handling tools based on OpenGIS standards and the GeoTools API.	

# How does *Studio* work?

- *Studio* employs JavaBean technology to construct tools. The JavaBean specification defines a set of standardized Application Programming Interfaces (APIs) for the Java platform.
- From this, the builder automatically constructs a syntactic description of the functionalities and i/o methods of any bean.
- Will run on any platform with JVM / JBean API

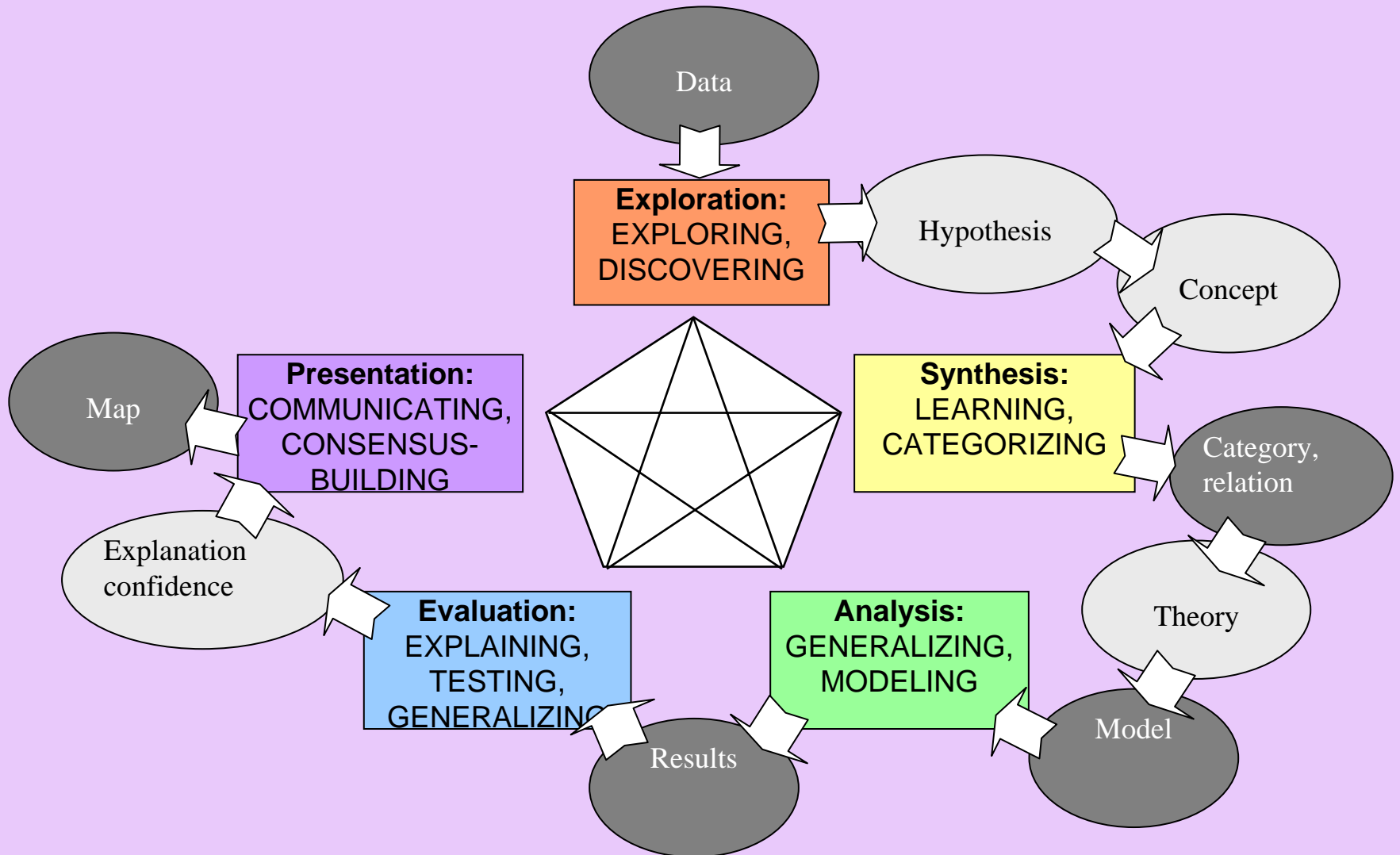


Architecture: application builder

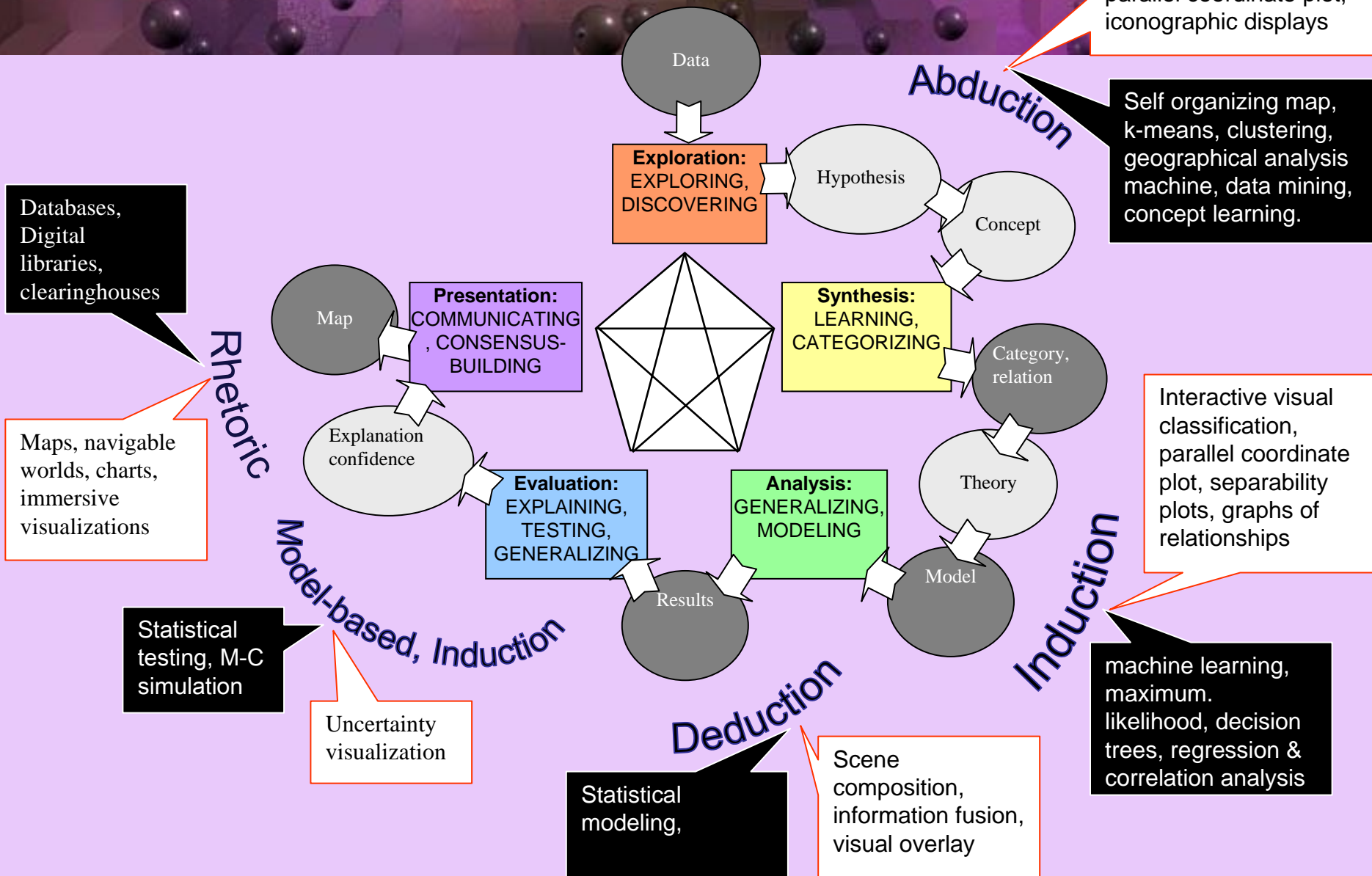
# WHICH TOOLS GO WHERE? Methods according to the roles they play

	<i>Databases</i>	<i>Statistics</i>	<i>A. I.</i>	<i>Visualization</i>
<b>Finding</b>	Association rules	Local pattern analysis and global inferential tests	Neural networks, decision trees	Exploratory visualization Visual data mining
<b>Reporting</b>	Rule lists	Significance and power	Likelihood estimation, information gain	A stimulus within the visual domain
<b>Representing</b>	Schema update, metadata	Fitted statistical models, local or global	Conceptual graphs, meta models	Shared between the scene and the observer
<b>Validating</b>	Weak significance testing	Significance tests	Learning followed by verification	Human subjects testing.
<b>Optimizing</b>	Reducing computational complexity	Data reduction and stratified sampling strategies	Stochastic search, gradient ascent methods	Hierarchical and adaptive methods, grand tours

# Moving between activities: a 'discovery' path



# Activities, tools and inferences



# Discovery: Activities, Tools, Representation forms and Reasoning

Activity	Visualization	Computation	Representation		Reasoning
			Object	Collection	
Exploration	PCP, Scatterplot, iconographic displays	SOM, k-means, clustering methods, GAM	Attribute	Description	<i>Abductive</i>
			Description	Dataset	
Synthesis	Interactive visual classification, PCP	machine learning, max. likelihood, decision tree	Concept	Taxonomy	<i>Inductive</i>
Analysis	Scene composition, visual overlay	Statistical analysis	Rule	Theory	<i>Deductive</i>
			Occurrence	Model	
Explanation	Uncertainty visualization	Statistical testing, M-C simulation	Inference	Explanation	<i>Model-based</i>
Presentation	Maps, charts, reports, etc.	Web mapping, digital libraries, collaboratories	Narrative	Story	<i>Rhetorical</i>
			Symbol	Map	

(Gahegan & Brodaric, 2002)



Classes - x Properties

Ontology

http://cv.geovista.psu.edu/ontology19707269.xml#

- imports
- Assessment
- Control Points
- Coordinate Transformation
- Geoid
- Geospatial Measurement Scale
- Horizontal\_Datum
- Interaction
- Learning\_Approach
- Outcome
- Projection Classes
- Projection Properties
- Task
- Technique

Georegistration Map Projections - x

Annotation Properties Web Page

# Map Projections

webpage maintained by the John A. Dutton e-Education Institute, PennState

Latitude and longitude coordinates specify point locations within a coordinate shape and size. To display extensive geographic areas on a page or computer screen efficiently, it is necessary to flatten the Earth.

mapprojections

ConceptGraph - x

Zoom Rotate Locality

Locale: Coordinate Transformation



# Example: An emergent disease, possibly vector-borne

penn51.viz

File Edit Misc Base Meta Help

Co... Pennsylvania

- Northampton
- Northumberland
- Montour
- Union
- Clarion
- Jefferson
- Mercer
- Centre
- Schuylkill
- Clearfield
- Lehigh
- Snyder
- Berks
- Butler
- Armstrong
- Mifflin
- Dauphin
- Lawrence
- Juniata
- Indiana
- Perry
- Huntingdon
- Lebanon
- Blair
- Cambria
- Lancaster
- Beaver
- Cumberland
- Allegheny
- Westmoreland**
- York
- Franklin
- Bedford
- Adams
- Washington

County Demographics

Population Density (2000)

Disease cases

Age

Days Passed August 22

Concept Map

Graph Scale: -10 -5 0 5 10

Text Scale: -10 -5 0 5 10

Variables

- Percentage Poor 99
- Crowded 2000
- MD ration 95
- Hospital 95
- Population Density 2000
- Pctlang 2k

Demographic Variables

Counties	FIPS	County	pctpoor99
49	42007	Beaver	9.17
50	42041	Cumberland	6.132
51	42003	Allegheny	10.885
<b>52</b>	<b>42129</b>	<b>Westmo...</b>	<b>8.455</b>
53	42133	York	6.619
54	42055	Franklin	7.404

Concept Hierarchy

Classes

- Ontologies
  - OWL(System)
  - RDF(System)
  - RDFS(System)
  - RossRiverScenario10(Default)

Human Cases

County	Age	Gender	Date
Philadel...	46	Male	14
Philadel...	60	Female	17
Philadel...	58	Female	19
Westmo...	81	Female	19
Philadel...	69	Male	25
York	28	Male	25
York	50	Female	25
York	48	Male	27

Resources

Property	Value	Annotation	Visible
date	Sep 02, 2007		<input checked="" type="checkbox"/>
week	1.0		<input checked="" type="checkbox"/>
type	Cases		<input checked="" type="checkbox"/>
county	Westmoreland		<input checked="" type="checkbox"/>
sex	Male		<input checked="" type="checkbox"/>
age	69.0		<input checked="" type="checkbox"/>
member	Viral_pneumonia		<input checked="" type="checkbox"/>
symptoms	Chills		<input checked="" type="checkbox"/>
numDays	4.0		<input checked="" type="checkbox"/>
label	Case 009		<input checked="" type="checkbox"/>

Untitled

start

C:\Documents and Se... C:\Documents and Se... C:\WINDOWS\systeme... penn51.viz

8:23 AM

# Is it West Nile Virus?

penn51.viz

File Edit Misc Base Meta Help

Co... Pennsylvania

Wayne  
Susquehanna  
Bradford  
Tioga  
Pike  
Potter  
Erie  
Lackawanna  
Wyoming  
Mc Kean  
Warren  
Sullivan  
Lycoming  
Luzerne  
Monroe  
Crawford  
Cameron  
Elk  
Columbia  
Clinton  
Forest  
Carbon  
Venango  
Northampton  
Northumberland  
Montour  
Union  
Clarion  
Jefferson  
Mercer  
Centre  
Schuylkill  
Clearfield  
Lehigh  
Snyder  
Berks

County Demographics

20.00  
10.00  
0.00 5000.00  
Population Density (2000)

Disease cases

Age  
50.00  
0.00 25.00  
Days Passed August 2

Concept Map

Graph Scale -10 -5 0 5 10  
Text Scale -10 -5 0 5 10  
Locality 0

Concept Hierarchy

Classes


- West Nile Virus
  - Geographic Spread
    - Cases (2002)
    - Cases (2003)
  - Institution
    - Acambis
    - CDC
    - FDA
    - NASA

Resources

Web Content Properties Annotation

Address: ntology/Stephen\_Guptill/West\_Nile\_Virus.htm

West Nile virus was first isolated from a febrile adult woman in the West Nile District of Uganda in 1937.



The ecology was characterized in Egypt in the 1950s.

The virus became recognized as a cause of severe human meningoencephalitis (inflammation of the spinal cord and brain) in elderly patients during an outbreak in Israel in 1957.

Concept Map details: A central node 'Cases' is connected to numerous nodes labeled 'Case 001' through 'Case 036'. A node 'West Nile Virus' is connected to 'Cases' via a 'member' relationship. Other nodes include 'Influenza (Flu)', 'Viral Pneumonia', and 'Dr. Stephen Guptill'. Relationships like 'subClassOf' and 'member' are indicated.

Concept Hierarchy details: A tree structure showing 'West Nile Virus' as the root, with sub-classes for 'Geographic Spread' and 'Institution'. Under 'Geographic Spread' are 'Cases (2002)' and 'Cases (2003)'. Under 'Institution' are 'Acambis', 'CDC', 'FDA', and 'NASA'.

Resources details: A window displaying web content with a URL, a text description of the virus's discovery, a photograph of a mosquito, and historical context regarding its ecology and recognition as a cause of severe disease.

Start

C:\Documents an... C:\Documents an... cases observed... C:\WINDOWS\sy... penn51.viz

8:36 AM

# Exploring anticipated infection patterns

penn51.viz

File Edit Misc Base Meta Help

Concept Map

Graph Scale: -10 -5 0 5 10 | Text Scale: -10 -5 0 5 10 | Locality: 0 5 10 15 20

Concept Hierarchy

- Classes
  - West Nile Virus
    - Geographic Spread
    - Institution
    - Investigator
    - Research
    - Surveillance
      - Migratory Birds
        - Captured Birds
        - Culex Infection
        - Transient Birds
        - Viremic Birds
      - Prevalence
      - St. Tammany Parish

Resources

Web Content Properties Annotation

Address: 20Documents\MyDemos\CV\data\ontology\Stephen\_Guptill\Birds\_Viremic.htm

UNKOWN 38  
Cases

West Nile Virus 26  
subClassOf: Stephen Gupitill

Populations (hw. are) 4

St. Tammany Parish 2  
subClassOf: Vector Borne Infectious Disease 1

Surveillance 1  
subClassOf: Prevalence 3

Captured Birds 4  
subClassOf: Laboratory Birds 3  
subClassOf: Viremic Birds 1

Transient Birds 3  
subClassOf: Viremic Birds 1

Viremic Birds 1

Symptoms 1

Map: Epidemic Focus, No local establishment, 2000, 2001, 2002

# Matching symptoms against CDC documents

Concept Map

Graph Scale: -10 to 10 (0 at 0)

Text Scale: -10 to 10 (0 at 0)

Locality: 0 to 1 (0 at 0)

Wayne  
Susquehanna  
Bradford  
Tioga  
Pike  
Potter  
Erie  
Lackawanna  
Wyoming  
Mc Kean  
Warren  
Sullivan  
Lycoming  
Luzerne  
Monroe  
Crawford  
Cameron  
Elk  
Columbia  
Clinton  
Forest  
Carbon  
Venango  
Northampton  
Northumberland  
Montour  
Union  
Clarion  
Jefferson  
Mercer  
Centre  
Schuylkill  
Clearfield  
Lehigh  
Snyder  
Berks

Influenza (Flu)  
Hepatitis  
Mumps  
Lassa fever  
Chills  
Lyme Disease  
Severe Headache  
Backache  
Joint Pains  
Rash  
Vomiting

Case 003  
Case 014  
Case 009  
Case 018  
Case 005  
Case 004  
Case 010  
Case 007  
Case 015  
Case 017  
Case 001  
Case 006  
Case 013  
Case 020  
West Nile Virus

member  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf  
member  
subClassOf

Disease cases

Age

Days Passed August 22

Human Cases

County	Age	Gender	Date
Philadel...	46	Male	14
Philadel...	60	Female	17
Philadel...	58	Female	19
Westmore...	81	Female	19
Philadel...	69	Male	25
York	28	Male	25
York	50	Female	25
York	48	Male	27
York	71	Female	27
Philadel...	76	Female	28

Resources

Web Content Properties Annotation

Address: [tp://www.cdc.gov/ncidod/dvbid/index.htm](http://www.cdc.gov/ncidod/dvbid/index.htm)

National Center for Infectious Disease  
Division of Vector-Borne Diseases

start  
3 Windows Expl...  
Looking for alter...  
Health Report - 1...  
C:\WINDOWS\sy...  
penn51.viz  
9:37 AM

# Searching for alternative explanations

The screenshot displays a desktop environment with several windows open. The primary window is a concept map application titled "penn51.viz".

**Concept Map Application (penn51.viz):**

- Menu:** File, Edit, Misc, Base, Meta, Help
- Left Panel:** A list of Pennsylvania counties: Wayne, Susquehanna, Bradford, Tioga, Pike, Potter, Erie, Lackawanna, Wyoming, Mc Kean, Warren, Sullivan, Lycoming, Luzerne, Monroe, Crawford, Cameron, Elk, Columbia, Clinton, Forest, Carbon, Venango, Northampton, Northumberland, Montour, Union, Clarion, Jefferson, Mercer, Centre, Schuylkill, Clearfield, Lehigh, Snyder, Berks.
- Top Panel:** "Concept Map" tab with "Graph Scale", "Text Scale", and "Locality" sliders. "Animate Layout" and "Stop Animation" buttons are present.
- Main Area:** A complex concept map with nodes and relationships. Nodes include "Human Sentinels (2002)", "Avian Human (2002)", "Neurological function", "Measure", "Newspaper", "Cases", "Case 034", "Case 035", "Influenza (Flu)", "Rash", "USGS OWE", "Migratory Birds", "Captured Birds", "USGS", "Clinical Trial", "IgM", "Test", "Chimeric", "Cocktail", "Treatments", "DNA", "Epidemiology", "Geography", "PA Human (2003)", "PA Avian Hu...", "Mosquito Ecology", "Prevalence Sampling", "Aerial View", "Prevalence", "USGS", "NIAID", "USGS", "Migratory Birds", "Avian Bird", "Captured Birds", "USGS", "Clinical Trial", "IgM", "Test", "Chimeric", "Cocktail", "Treatments", "DNA", "Epidemiology", "Geography", "PA Human (2003)", "PA Avian Hu...", "Mosquito Ecology", "Prevalence Sampling", "Aerial View", "Prevalence", "USGS", "NIAID", "USGS", "Migratory Birds", "Avian Bird", "Captured Birds", "USGS".
- Right Panel:** "Concept Hierarchy" showing a tree structure of classes: RossRiverScenario10(Default), Cases, Dr. Stephen Guptill, Populations (by age), Symptoms, Vector Borne Infectious Disease. Below it is a "Human Cases" table.

**Human Cases Table:**

County	Age	Gender	Date
Philadel...	46	Male	14
Philadel...	60	Female	17
Philadel...	58	Female	19
Westmo...	81	Female	19
Philadel...	69	Male	25
York	28	Male	25
York	50	Female	25
York	48	Male	27

**Web Browser (Mozilla Firefox):**

- Title:** rossriver.pdf (application/pdf Object) - Mozilla Firefox
- Address Bar:** <http://www.health.nsw.gov.au/public-health/cdscu/facts/pdf/rossriver.p>
- Page Content:** "Ross River Fever" title, followed by "WHAT IS ROSS RIVER VIRUS?" and "WHAT IS THE TREATMENT FOR ROSS RIVER VIRUS INFECTION?".

**Taskbar:**

- Windows Explorer (checking cases ti...)
- rossriver.pdf (ap...)
- start button
- System tray: 9:48 AM

# Analyzing likely impacts

**penn51.viz** File Edit Misc Base Meta Help

**Co...**

- Wayne
- Susquehanna
- Bradford
- Tioga
- Pike
- Potter
- Erie
- Lackawanna
- Wyoming
- Mc Kean
- Warren
- Sullivan
- Lycoming
- Luzerne
- Monroe
- Crawford
- Cameron
- Elk
- Columbia
- Clinton
- Forest
- Carbon
- Venango
- Northampton
- Northumberland
- Montour
- Union
- Clarion
- Jefferson
- Mercer
- Centre
- Schuylkill
- Clearfield
- Lehigh
- Snyder
- Berks

**Pennsylvania**

**Concept Map**

Graph Scale: -10 to 10

**Human Cases**

County	Age	Gender	Date
Philadel...	46	Male	14
Philadel...	60	Female	17
Philadel...	58	Female	19
Westmore...	81	Female	19
Philadel...	69	Male	25
York	28	Male	25
York	50	Female	25
York	48	Male	27
York	71	Female	27
Philadel...	76	Female	28
Philadel...	74	Male	28
Philadel...	68	Female	38
Philadel...	79	Female	38
Westmore...	64	Male	39
Philadel...	63	Male	40
Philadel...	71	Female	40
Philadel...	62	Male	52
Westmore...	32	Female	52
Philadel...	70	Female	55
Westmore...	40	Female	55

**County Demographics**

**Disease cases**

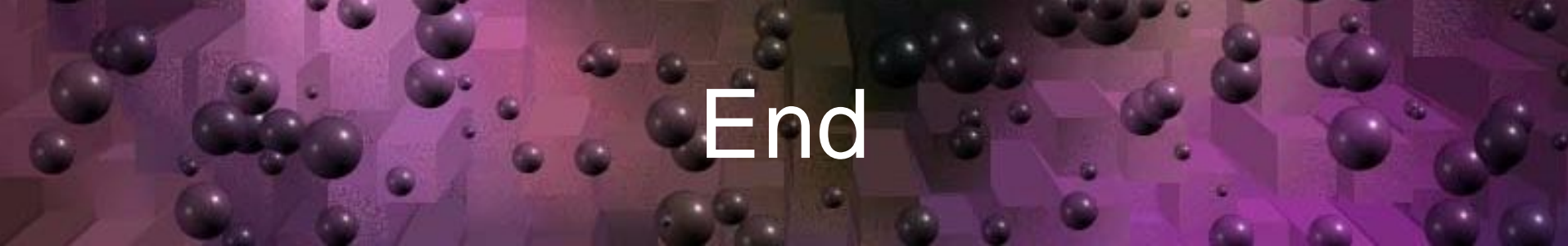
**Demographic Variables**

	pctlang2k	pop95	pop2k	Week1
	1.16	187979.0	181412.0	0.0
	0.66	205959.0	213674.0	0.0
	1.27	1309821.0	1281666.0	0.0
	0.82	376501.0	369993.0	1.0
	0.62	362793.0	381751.0	6.0
	0.49	126444.0	129313.0	0.0
	0.26	49192.0	49984.0	0.0
	0.73	83998.0	91292.0	0.0
	0.78	208017.0	202897.0	0.0
	0.8	80113.0	80023.0	0.0
	0.12	14362.0	14261.0	0.0
	0.61	146827.0	148644.0	0.0
	0.52	41114.0	40672.0	0.0
	1.08	573901.0	597635.0	0.0

start | 3 Windows... | Infection to ... | rossriver.pd... | C:\WINDO... | penn51.viz | status: Disc... | 1:45 PM

# Summary: Many CI challenges

- Technical...
- Conceptual...
- Sociological... **What needs to change?**
  - Self-sustaining cyberinfrastructure?
  - Participation and adoption by science communities (opportunities, risk, resistance)?
  - Recognition of different forms of science contribution...

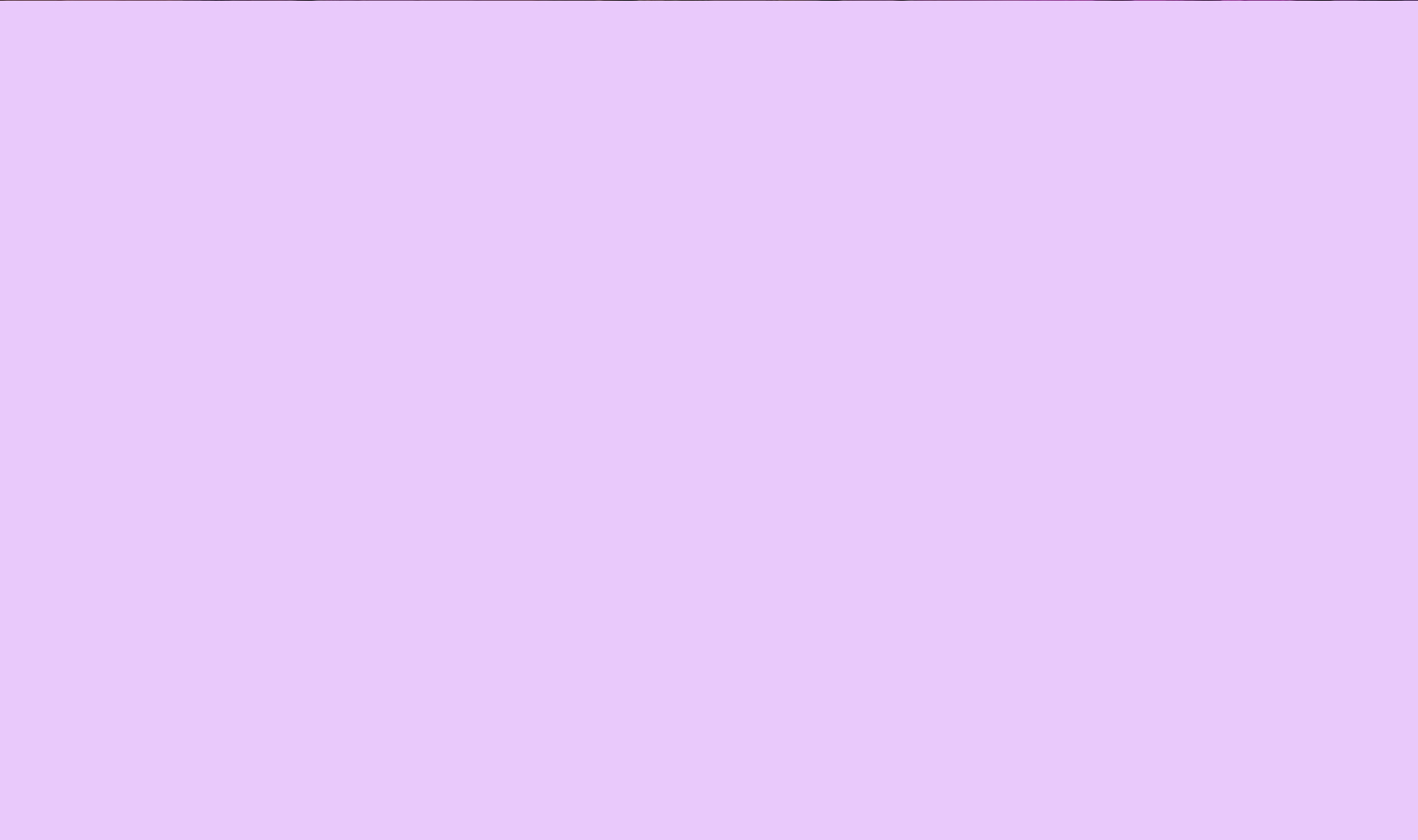


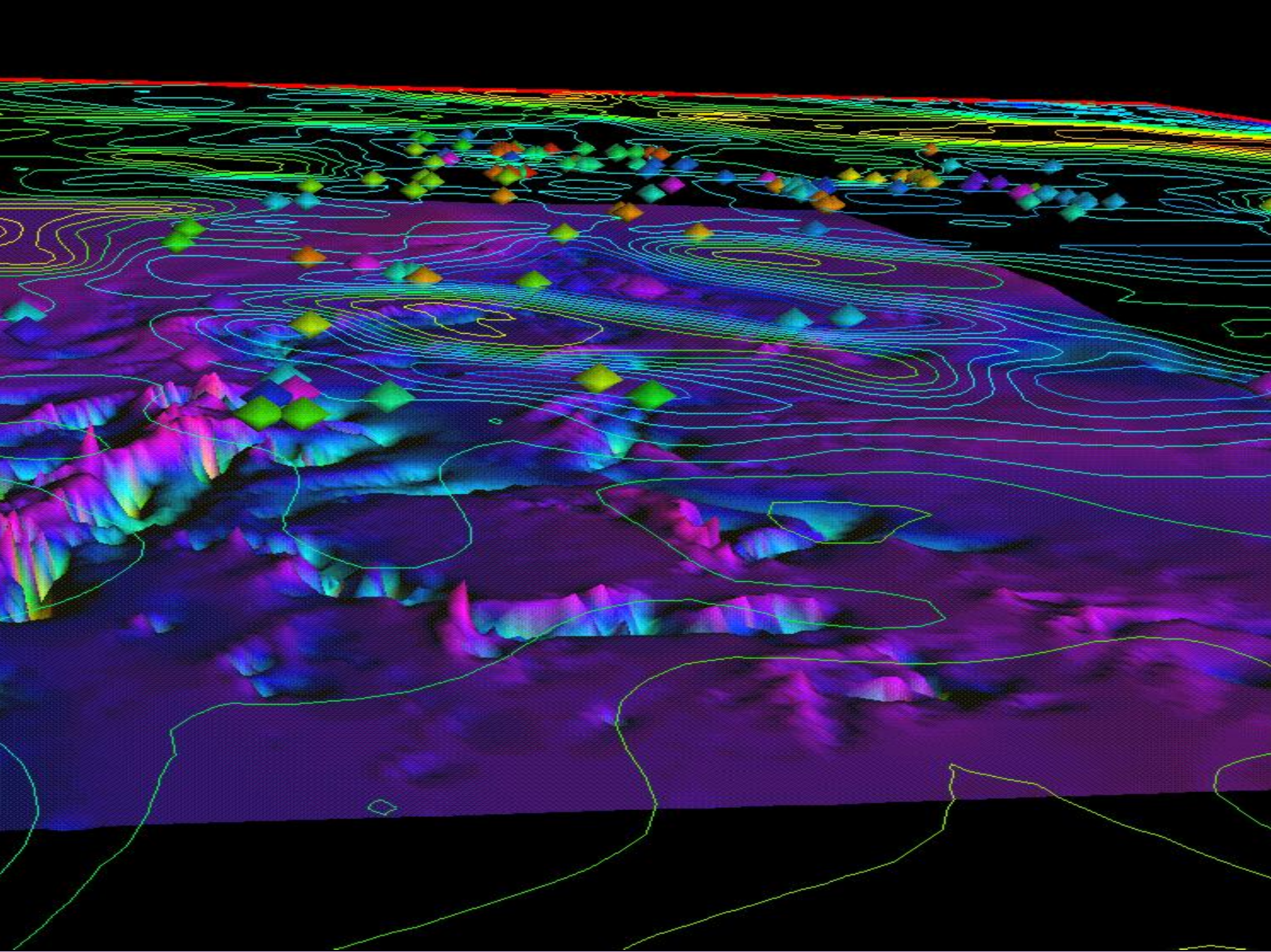
End

Questions?

Suggestions?







# Inspiration

- “Knowledge keeps no better than fish”  
-- Alfred North Whitehead
- “You cannot put your foot in the same stream twice”  
-- Heraclitus
- “You can know the name of a bird in all the languages of the world, but when you're finished, you'll know absolutely nothing whatever about the bird... So let's look at the bird and see what it's doing -- that's what counts.”  
-- Richard Feynman