The Need and Development for Dynamic Integrated GIS Enhancement and Support Tools (DIGEST) – The Geospatial Project Management Tool (GeoProMT)

Chris S. Renschler and Laercio M. Namikawa

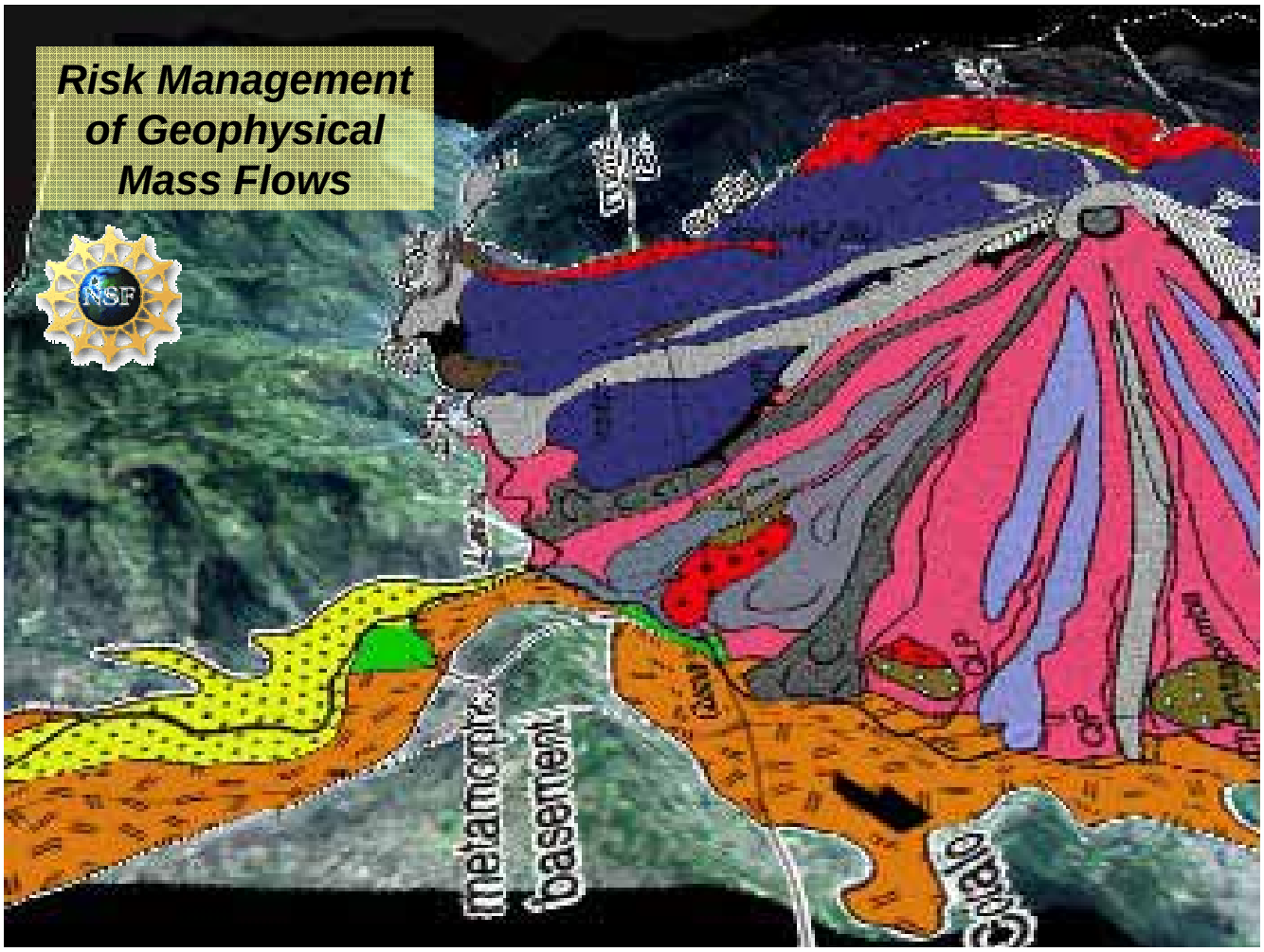
National Center for Geographic Information and Analysis (NCGIA), University at Buffalo (SUNY)

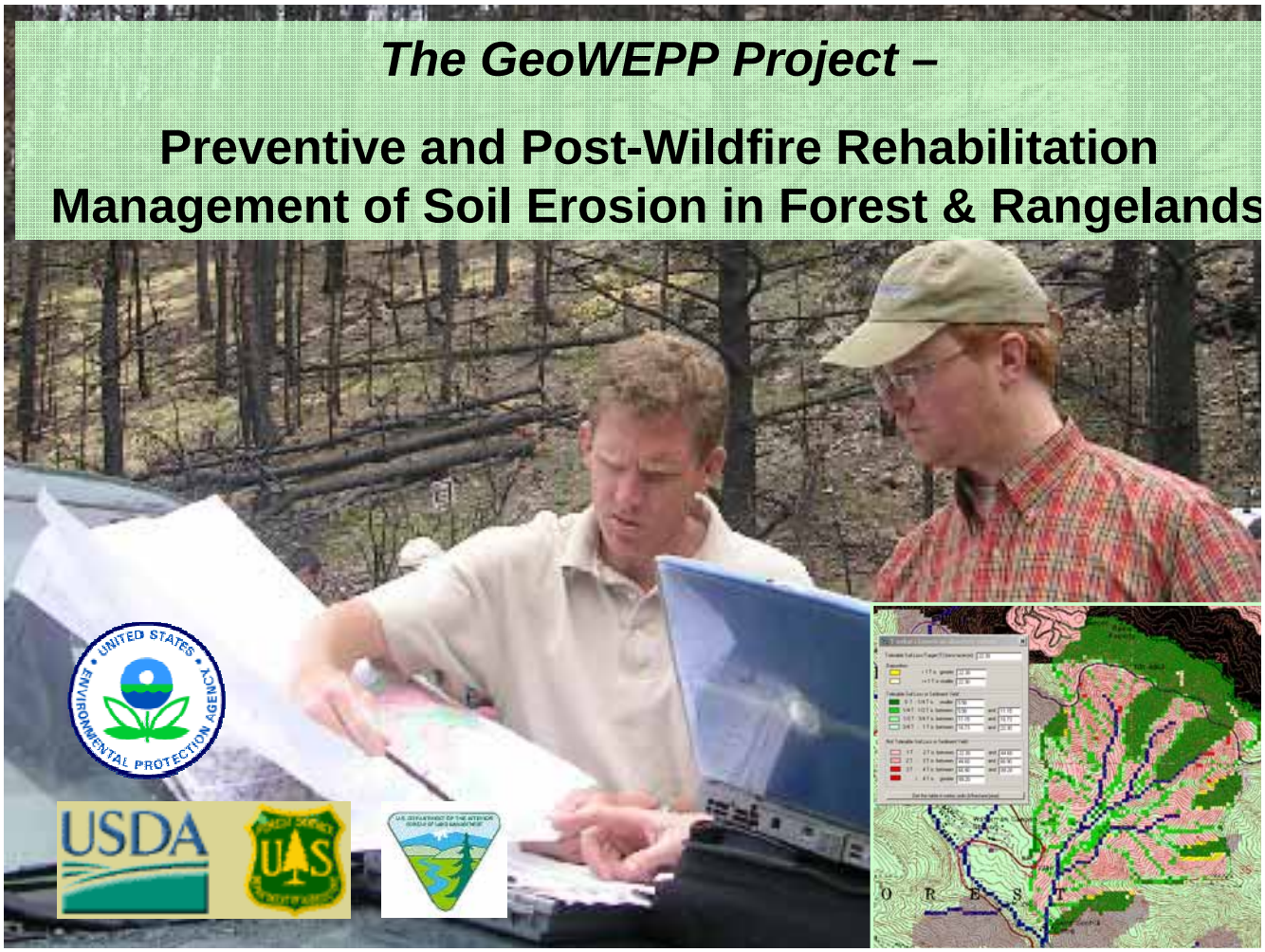
Buffalo, New York, USA

Landscape-based Environmental System Analysis & Modeling (LESAM) Laboratory

Research Leader: Chris S. Renschler

The LESAM Mission:
The development and integration of appropriate and user-friendly analysis and modeling techniques in
GIScience and Environmental Modeling Tools
with readily available data sets
to support a rapid, practical and effective decision-making in natural resources and natural hazard management.

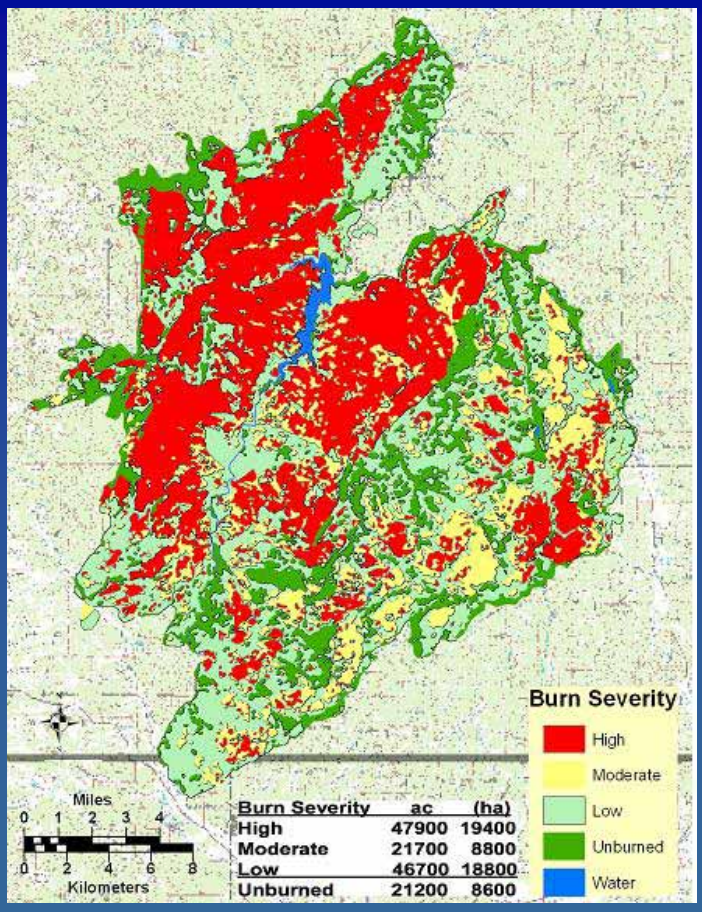

Risk Management
of Geophysical
Mass Flows
NSF
metamorphic basement


The GeoWEPP Project –
Preventive and Post-Wildfire Rehabilitation
Management of Soil Erosion in Forest & Rangelands
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
USDA
FOREST SERVICE
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Hayman Fire, Colorado

August 2002

~470 km^2



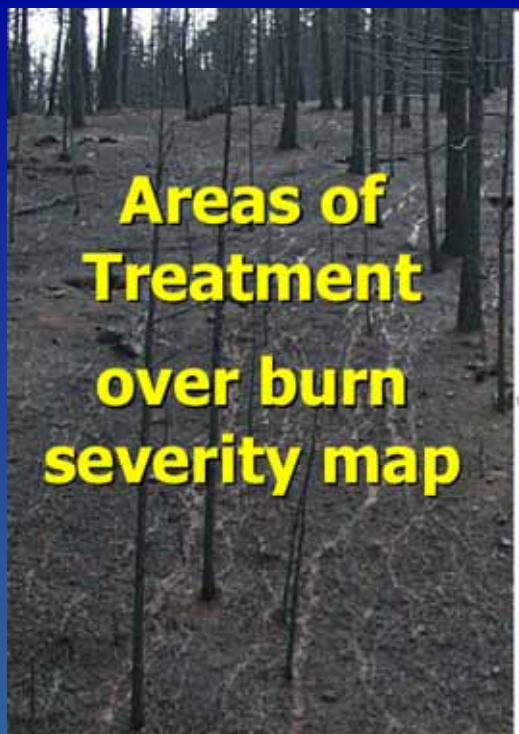
View of Spring Creek downstream after the fire but BEFORE the 12 July 1996 rainstorm

Same view of Spring Creek downstream after the fire but AFTER the 12 July 1996 rainstorm

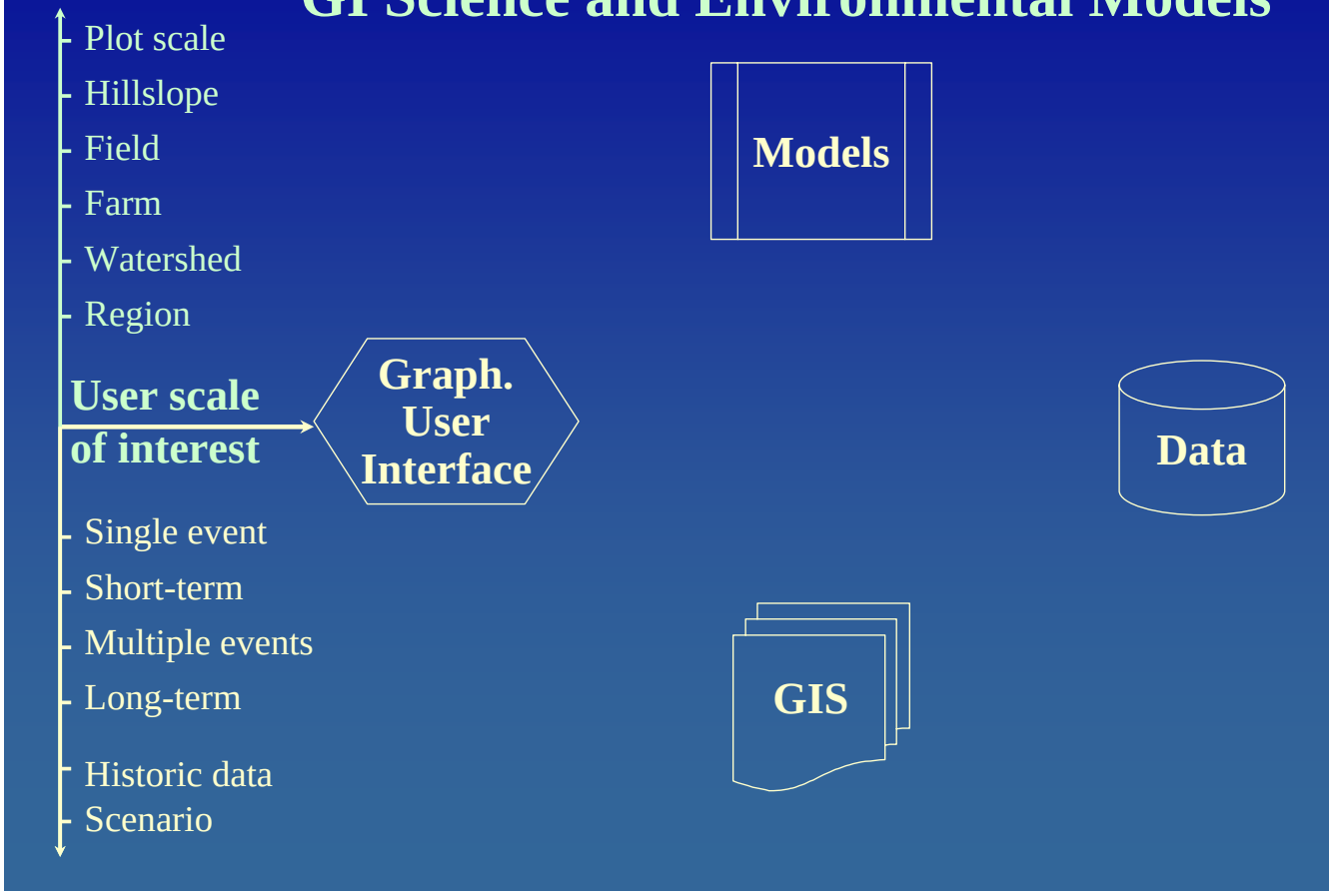
United States Department of Agriculture
Forest Service
Rocky Mountain Research Station
General Technical Report RMRS-GTR-63
September 2000

Evaluating the Effectiveness of Postfire Rehabilitation Treatments

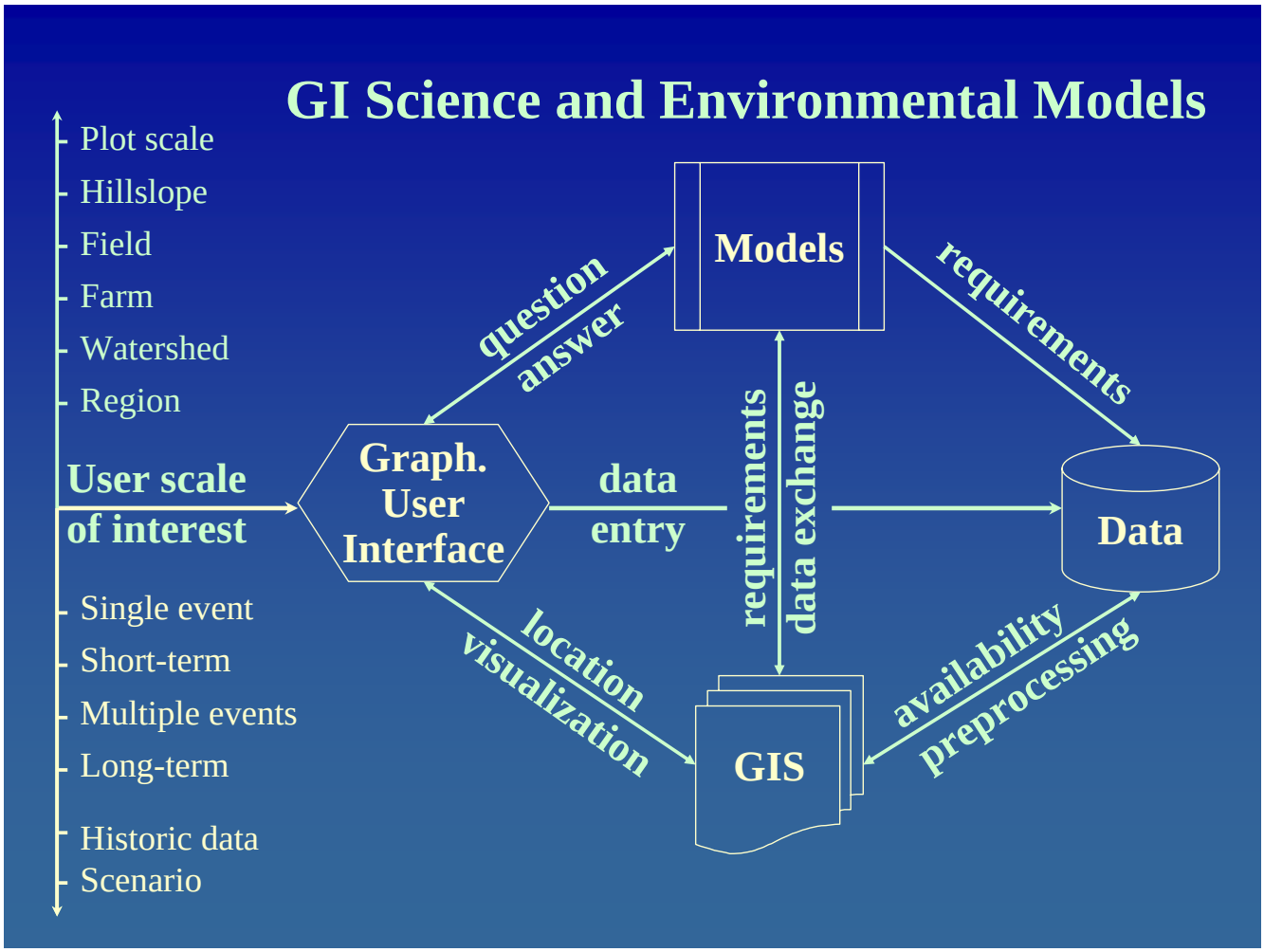
Peter R. Robichaud
Jan L. Beyers
Daniel G. Neary

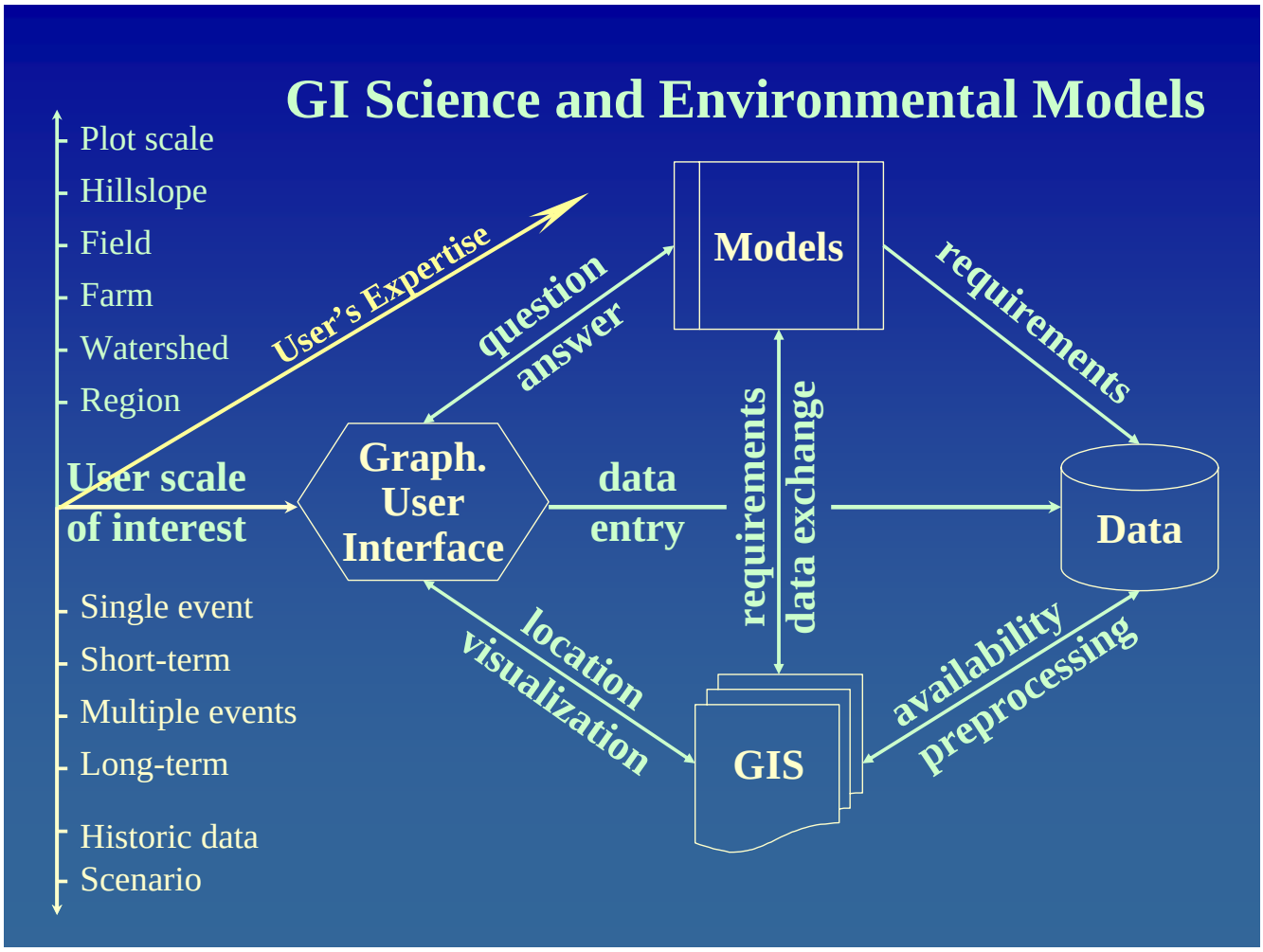


GI Science and Environmental Models

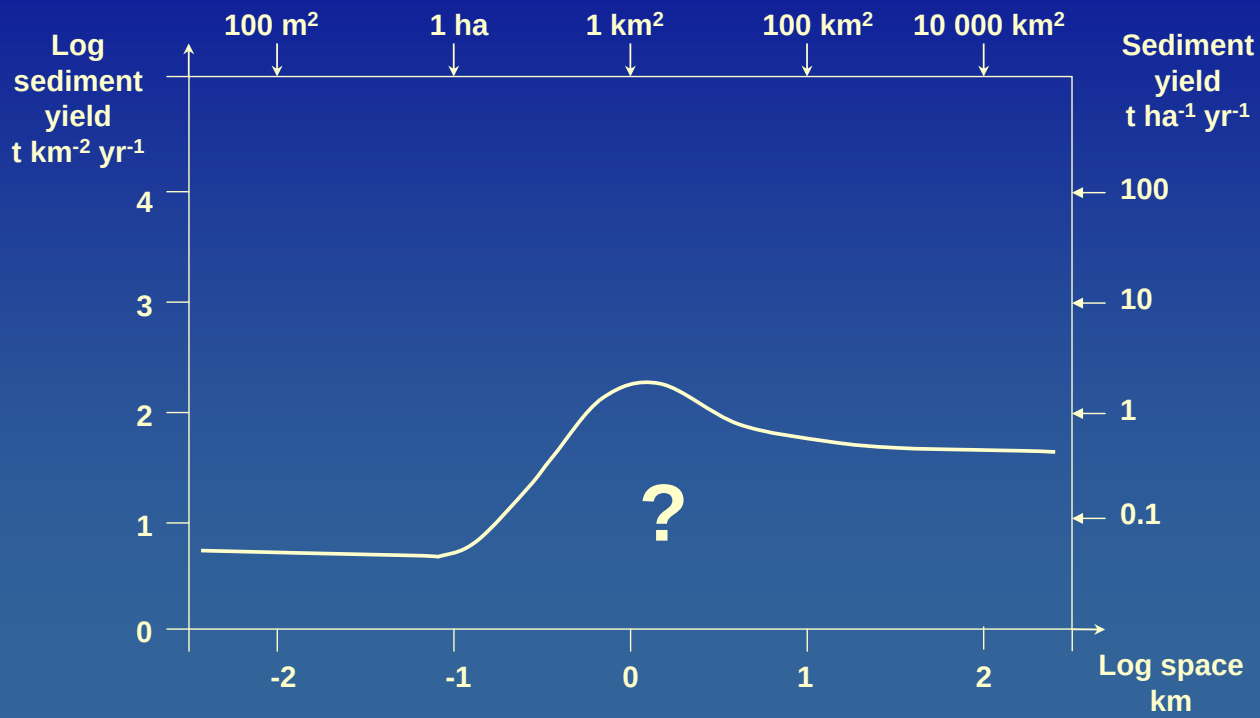


GI Science and Environmental Models



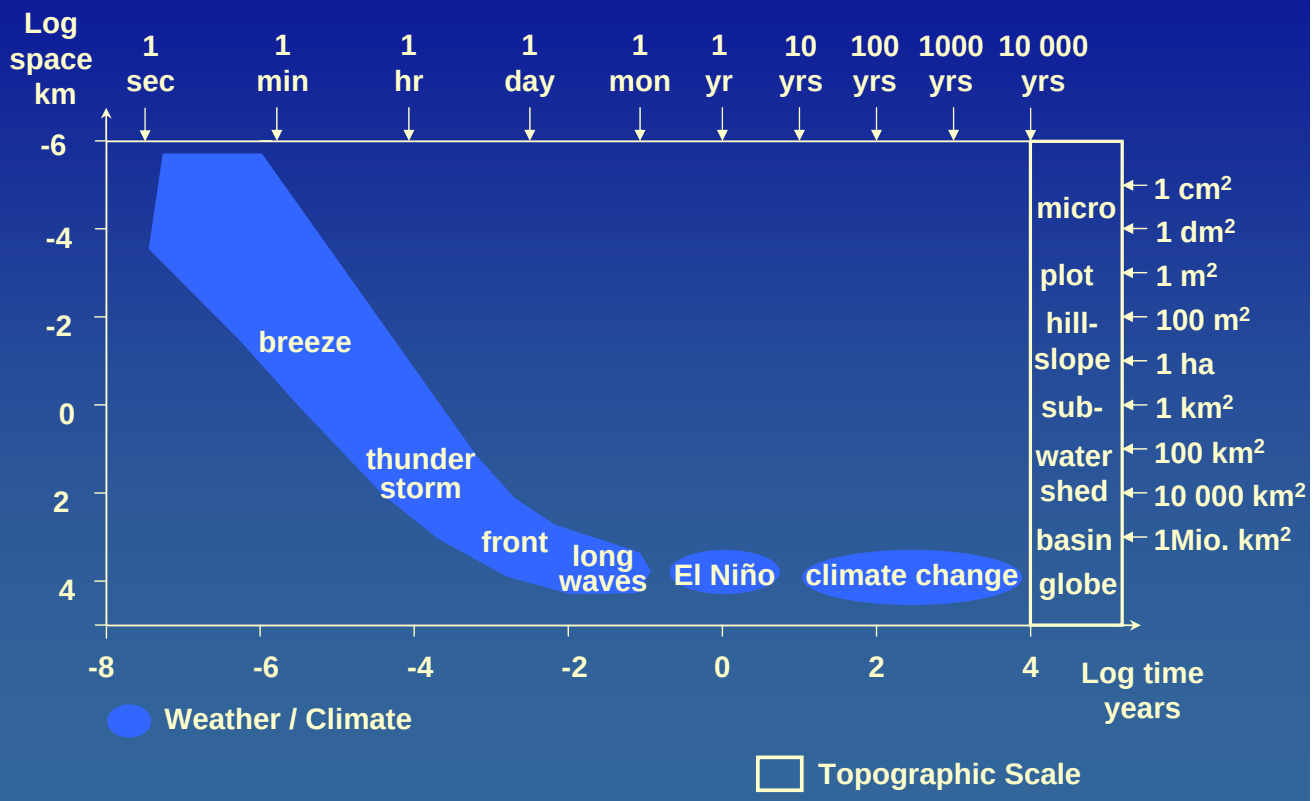

GI Science and Environmental Models
Plot scale
Hillslope
Field
Farm
Watershed
Region
Single event
Short-term
Multiple events
Long-term
Historic data
Scenario
User's Expertise
User scale of interest
Graph. User Interface
question
answer
Models
requirements
data entry
requirements
data exchange
Data
location
visualization
GIS
availability
preprocessing

Scale of erosion processes and sediment yields

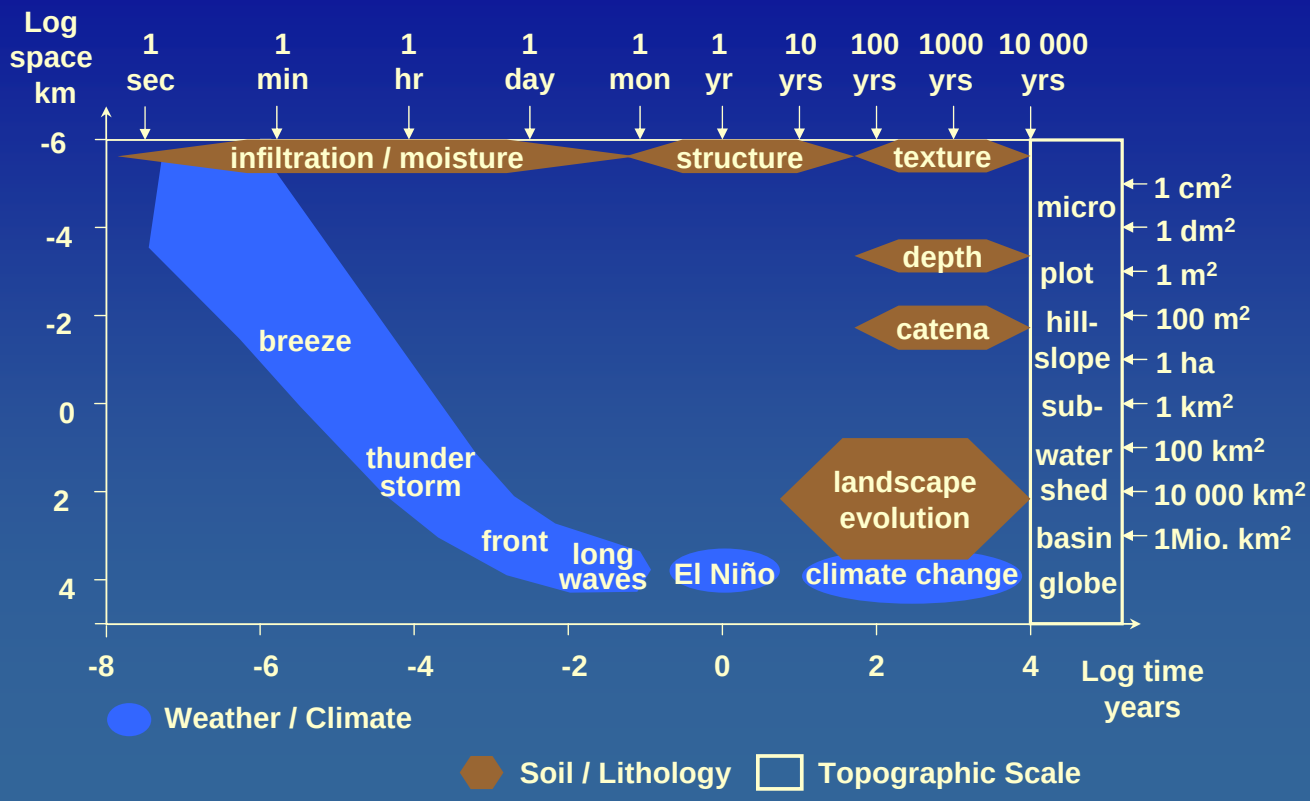


Susquehanna River Basin, PA (modified from Osterkamp & Toy, 1997)

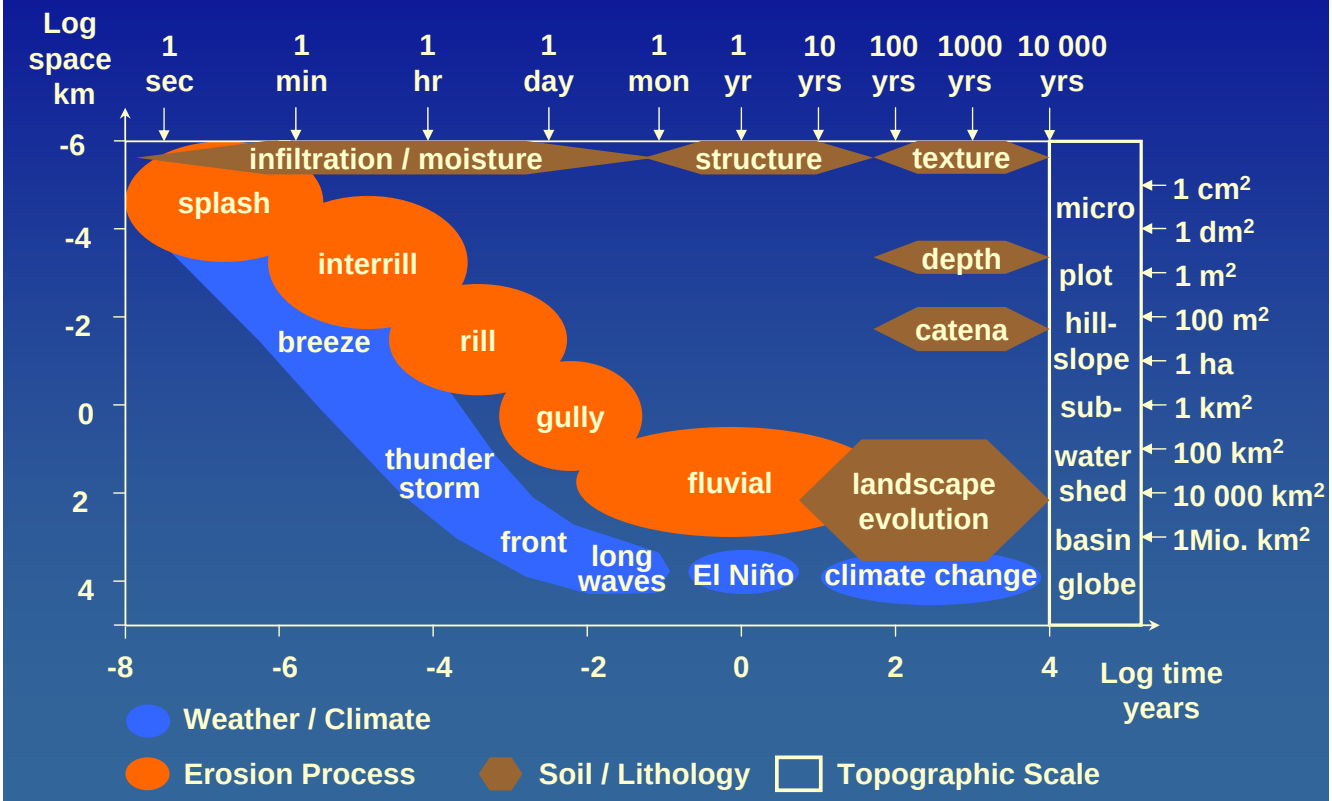
Natural variability and role of scale



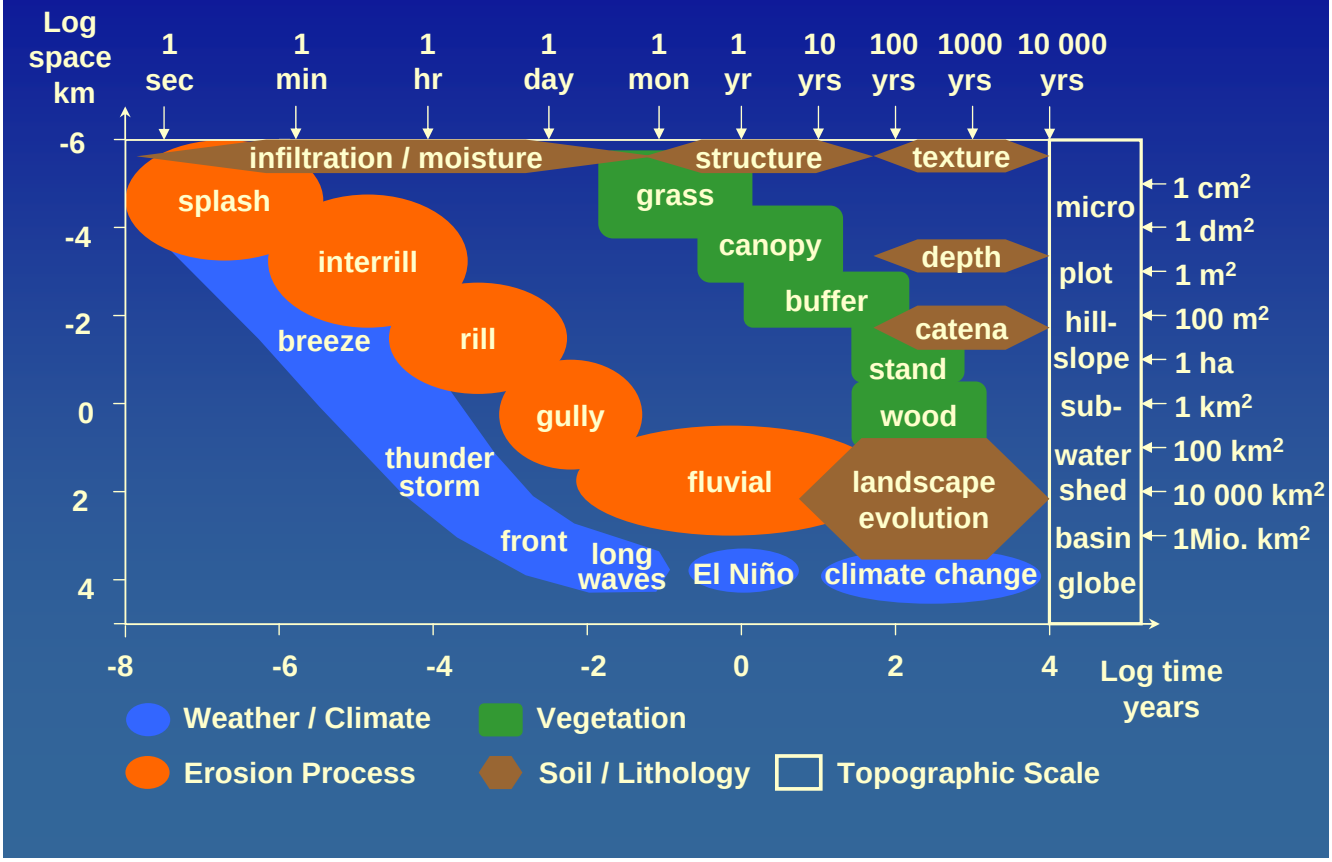
Natural variability and role of scale



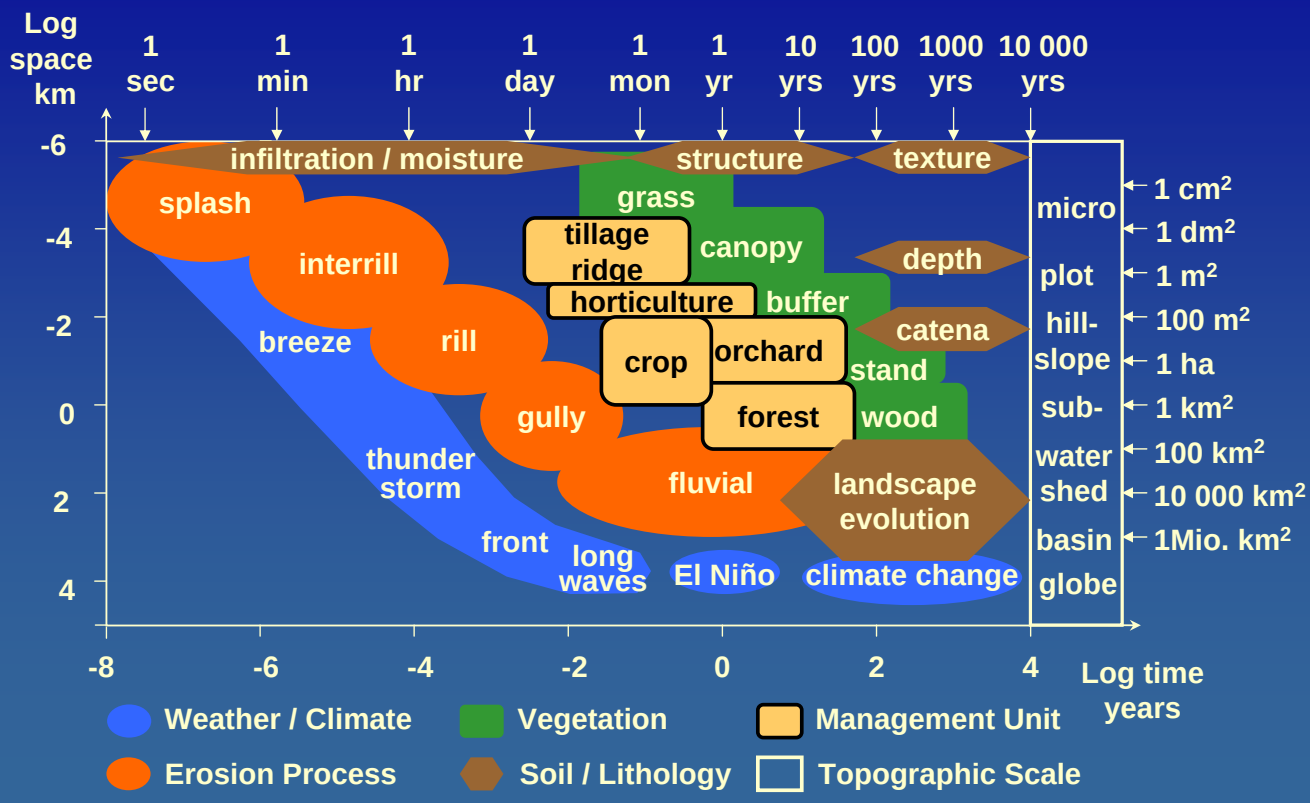
Natural variability and role of scale



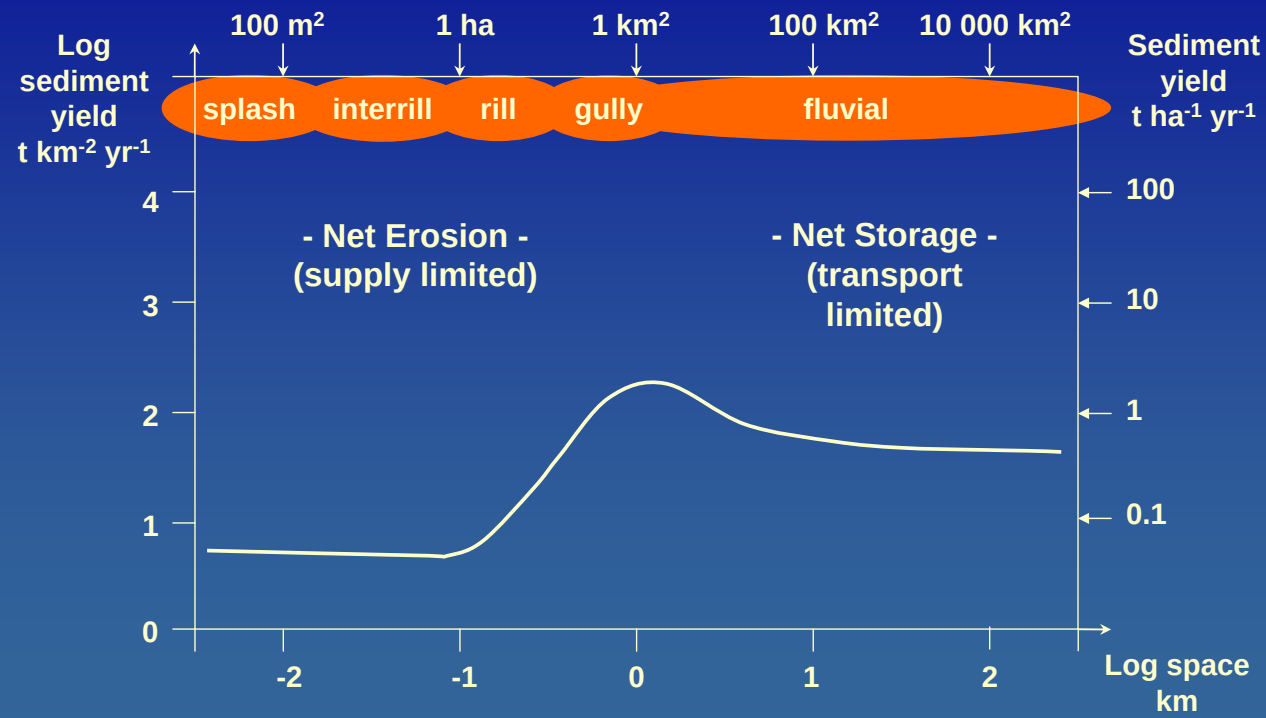
Natural variability and role of scale



Natural variability and role of scale

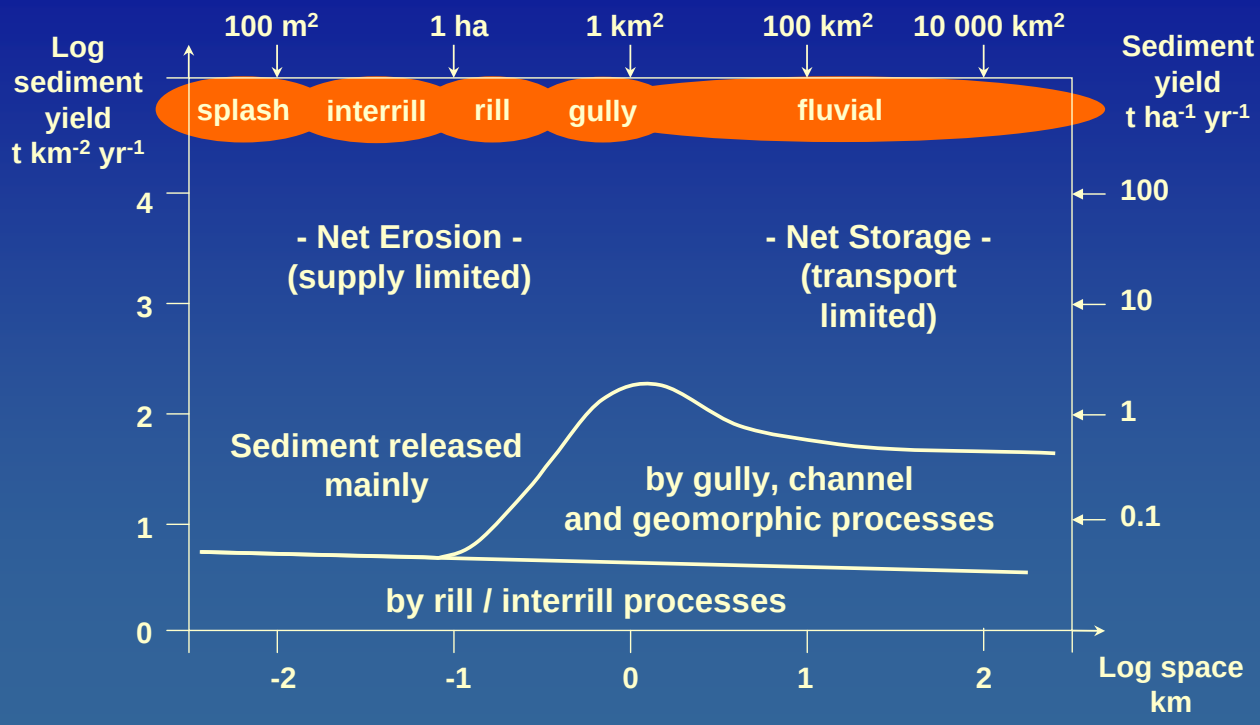


Scale of erosion processes and sediment yields



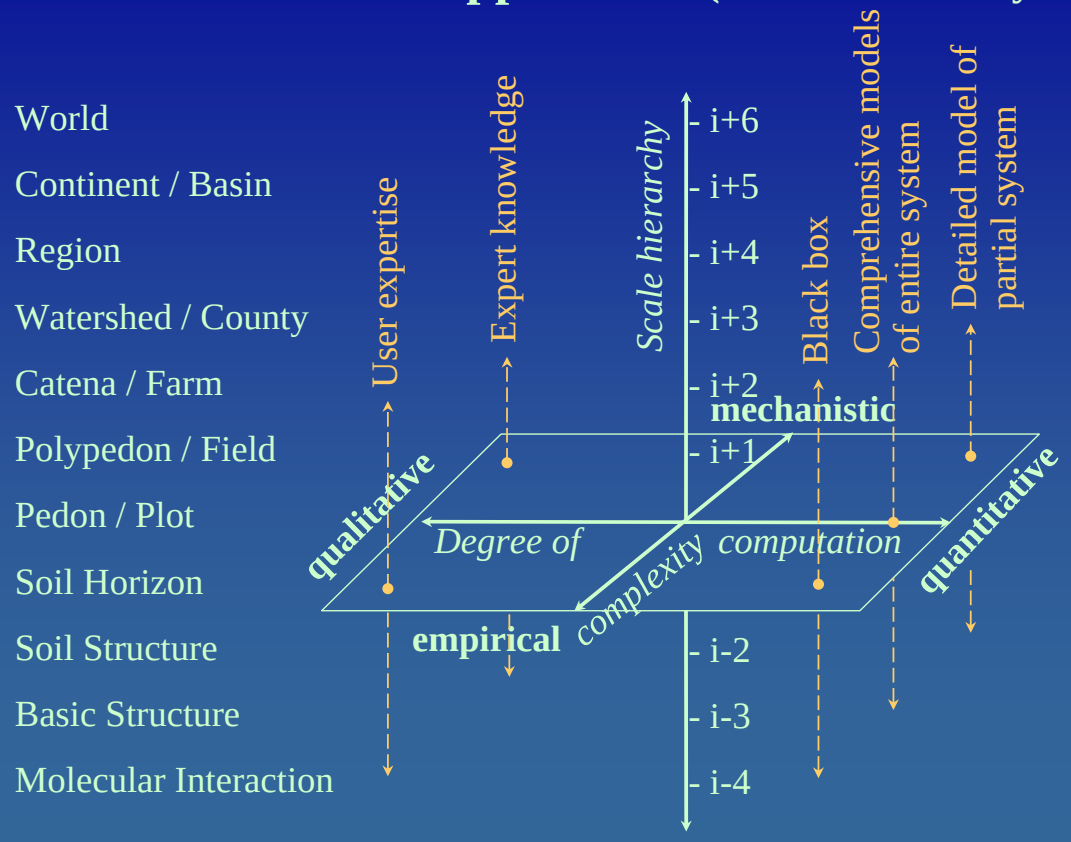
Susquehanna River Basin, PA (modified from Osterkamp & Toy, 1997)

Scale of erosion processes and sediment yields



Susquehanna River Basin, PA (modified from Osterkamp & Toy, 1997)

Classification of model approaches (Hoosbeek & Bryant)

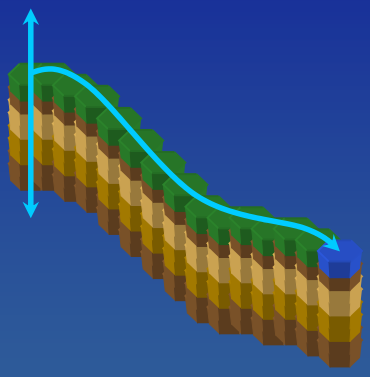


Model concepts to simulate landscape processes

Pedon
1-D vertical

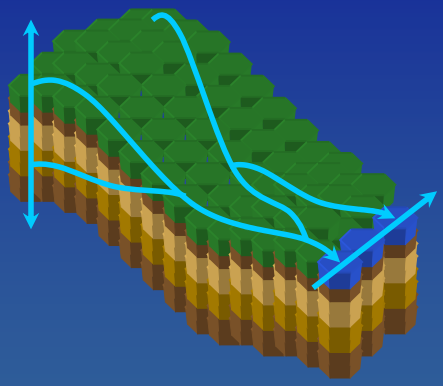
Water balance at point scale

Flowpath / Catena
1-D vert. + 1-D horiz.

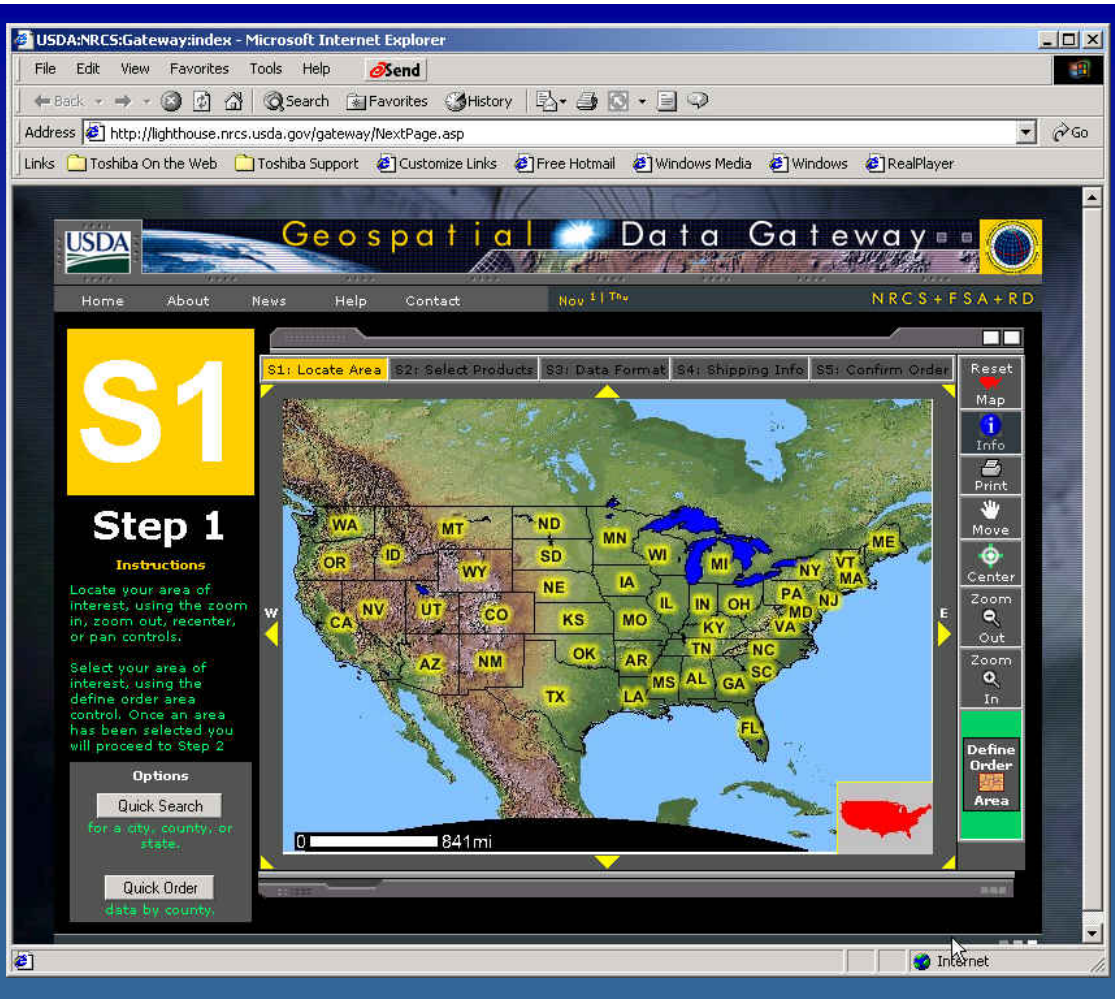


Surface runoff & soil erosion at flowpath scale

Hillslope / sub-catchment
1-D vert. + 2-D horiz.



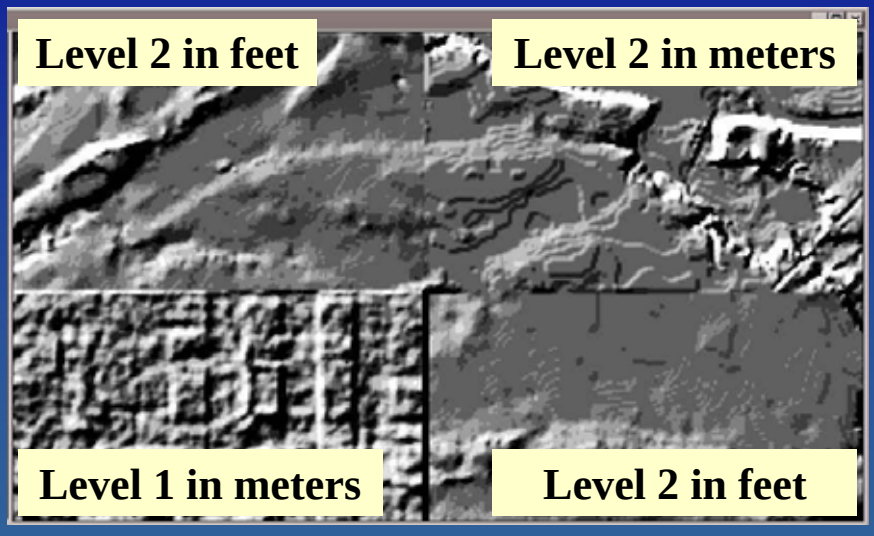
Water balance & geomorphology at hillslope scale



Commonly Available U.S. Data Sources

Information	DEM/Topography	Land Use/Cover	Hydrography	RS Imagery
Source Data	•Field survey •Photogrammetry •Interferometry •LIDAR •Topographic Maps	•Classification of Landsat images	•TIGER database •FEMA Flood Data •Water Bodies •Hydrologic Units	•Landsat TM •Landsat ETM •National Aerial Photography Program (NAPP)
Collection Date	•2000 (SRTM)	•1990, 2000/02	*various*	*Historic/Actual Images*
Scale/ Resolution	•3-arc-sec •1 arc-sec •1/3 arc-sec •1/9 arc-sec	•30 m	•1:24,000 •1:100,000 •1:250,000	•30 m •15 m •1 m
Format	•Binary •ARCgrid	•GeoTIFF	•Shapefile	•GeoTIFF
Available from	•USGS	•USDA-NRCS	•NOAA	*Variuos platforms*

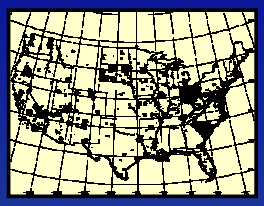
USGS DEM Vertical Resolution



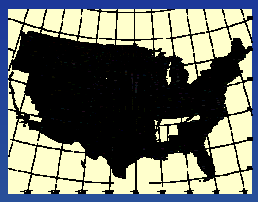
- The hill shade view of several DEM quads allows you to quickly evaluate their accuracy

USGS Digital Elevation Data (1:24,000)

DLG - Digital Line Graph

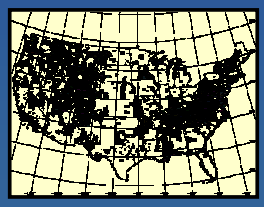


Topographical maps (DRG)

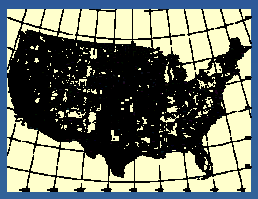


DEM - Digital Elevation Models:

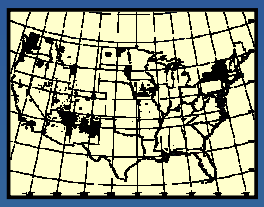
Level 1 / 30m*



Level 2 / 30m



Level 2 / 10m



***High altitude Photogrammetry**

U.S. Geological Survey, 1999

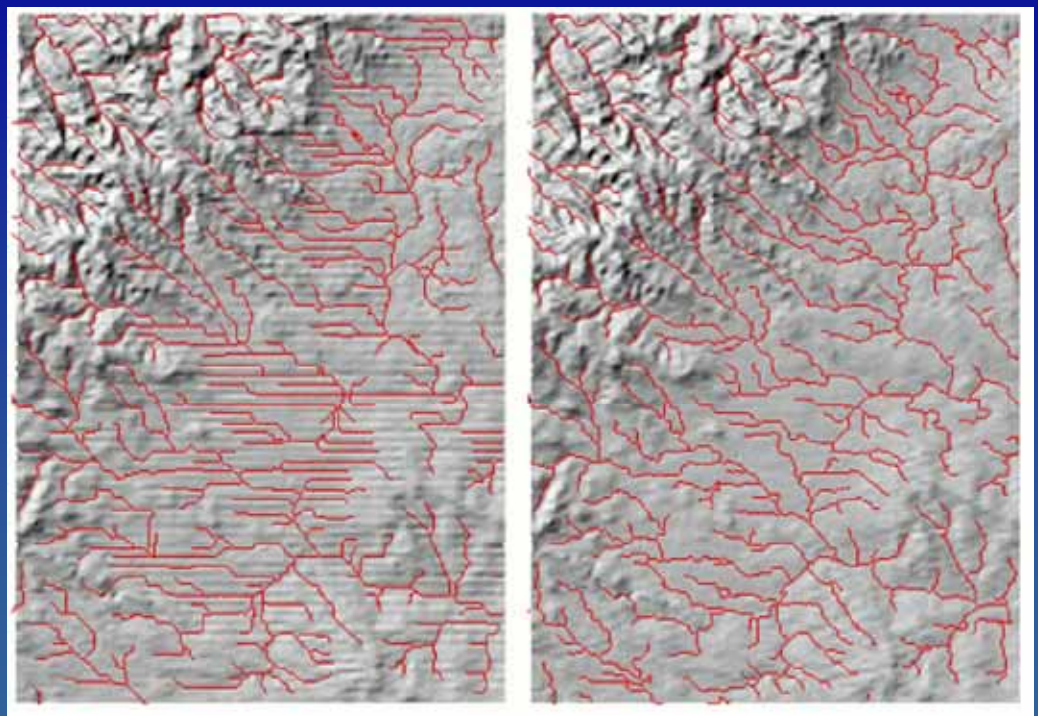


Figure 2: A shaded-relief representation of the Rockypoint, Wyoming, 7.5-minute digital elevation model is shown above on the left. The same area is shown on the right after NED artifact filtering has been performed. The superimposed red lines are synthetic drainage networks derived from each elevation dataset.

Natural pattern	Process Scale	True Process Scale and Variance
⇓	**Measuring**	⇓ **BASIC SCALING** ⇓
Representation	Measurement Scale	Observation Unit (measurement device)

Natural pattern	Process Scale	True Process Scale and Variance
⇓	**Measuring**	⇓ **BASIC SCALING** ⇓
Representation	Measurement Scale	Observation Unit (measurement device)
⇓	**Pre-processing**	⇓ **1st SCALING** ⇓
Representation	Database Scale	Common Database Unit (data availability)

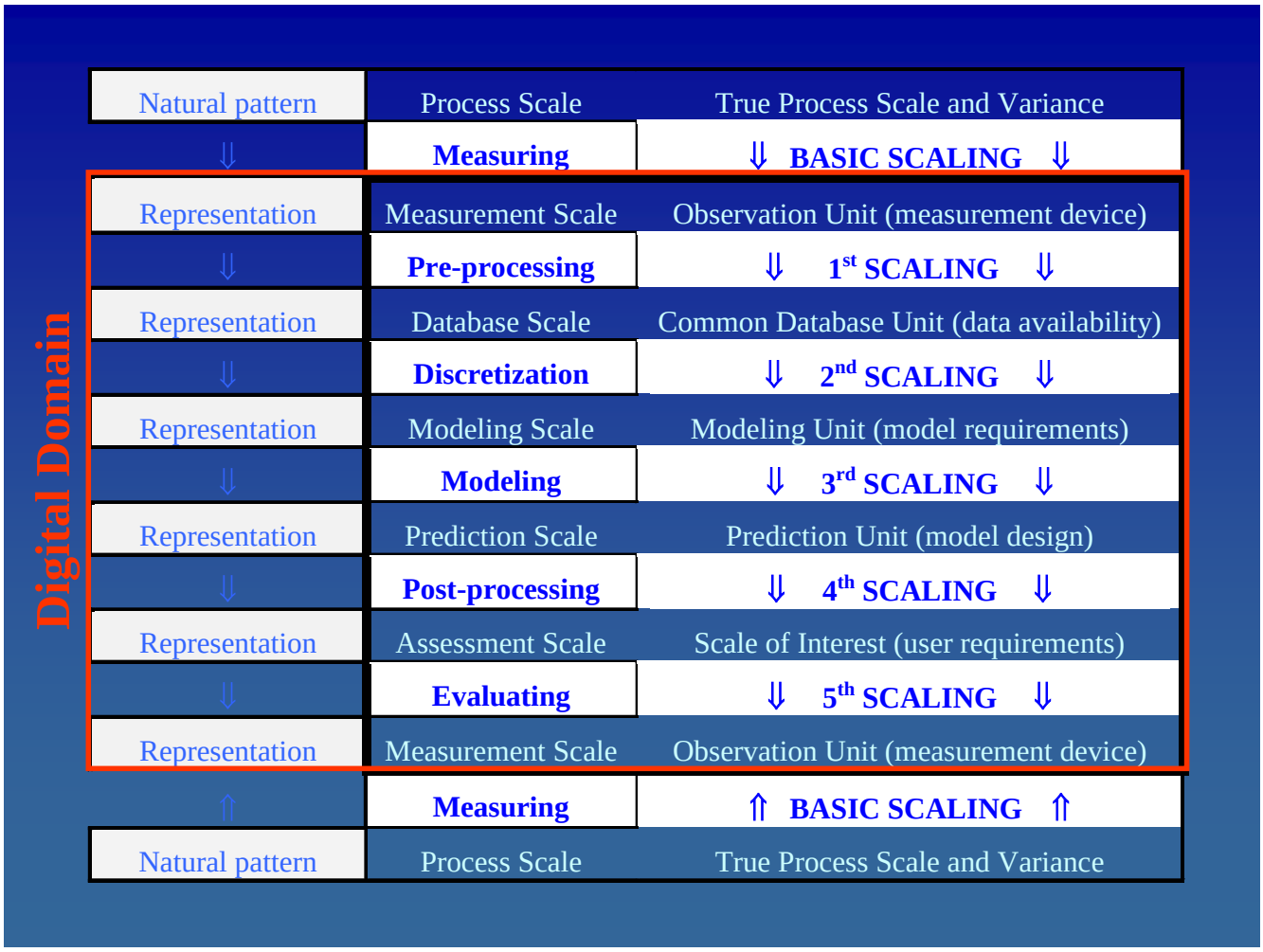
Natural pattern	Process Scale	True Process Scale and Variance
⇓	**Measuring**	⇓ **BASIC SCALING** ⇓
Representation	Measurement Scale	Observation Unit (measurement device)
⇓	**Pre-processing**	⇓ **1st SCALING** ⇓
Representation	Database Scale	Common Database Unit (data availability)
⇓	**Discretization**	⇓ **2nd SCALING** ⇓
Representation	Modeling Scale	Modeling Unit (model requirements)

Natural pattern	Process Scale	True Process Scale and Variance
⇓	**Measuring**	⇓ **BASIC SCALING** ⇓
Representation	Measurement Scale	Observation Unit (measurement device)
⇓	**Pre-processing**	⇓ **1st SCALING** ⇓
Representation	Database Scale	Common Database Unit (data availability)
⇓	**Discretization**	⇓ **2nd SCALING** ⇓
Representation	Modeling Scale	Modeling Unit (model requirements)

⇓	**Modeling**	⇓ **3rd SCALING** ⇓
Representation	Prediction Scale	Prediction Unit (model design)

Natural pattern	Process Scale	True Process Scale and Variance
⇓	**Measuring**	⇓ **BASIC SCALING** ⇓
Representation	Measurement Scale	Observation Unit (measurement device)
⇓	**Pre-processing**	⇓ **1st SCALING** ⇓
Representation	Database Scale	Common Database Unit (data availability)
⇓	**Discretization**	⇓ **2nd SCALING** ⇓
Representation	Modeling Scale	Modeling Unit (model requirements)
⇓	**Modeling**	⇓ **3rd SCALING** ⇓
Representation	Prediction Scale	Prediction Unit (model design)
⇓	**Post-processing**	⇓ **4th SCALING** ⇓
Representation	Assessment Scale	Scale of Interest (user requirements)

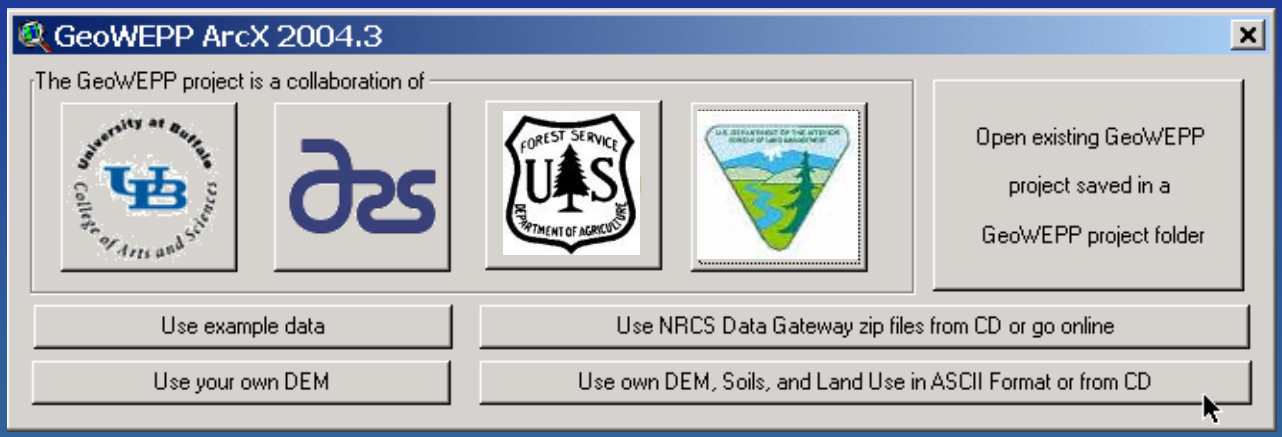
Natural pattern	Process Scale	True Process Scale and Variance
⇓	**Measuring**	⇓ **BASIC SCALING** ⇓
Representation	Measurement Scale	Observation Unit (measurement device)
⇓	**Pre-processing**	⇓ **1st SCALING** ⇓
Representation	Database Scale	Common Database Unit (data availability)
⇓	**Discretization**	⇓ **2nd SCALING** ⇓
Representation	Modeling Scale	Modeling Unit (model requirements)
⇓	**Modeling**	⇓ **3rd SCALING** ⇓
Representation	Prediction Scale	Prediction Unit (model design)
⇓	**Post-processing**	⇓ **4th SCALING** ⇓
Representation	Assessment Scale	Scale of Interest (user requirements)
⇓	**Evaluating**	⇓ **5th SCALING** ⇓
Representation	Measurement Scale	Observation Unit (measurement device)



Integrated Modeling System 1

Soil Erosion Assessment with the Geospatial Interface to the Water Erosion Prediction Project (GeoWEPP)

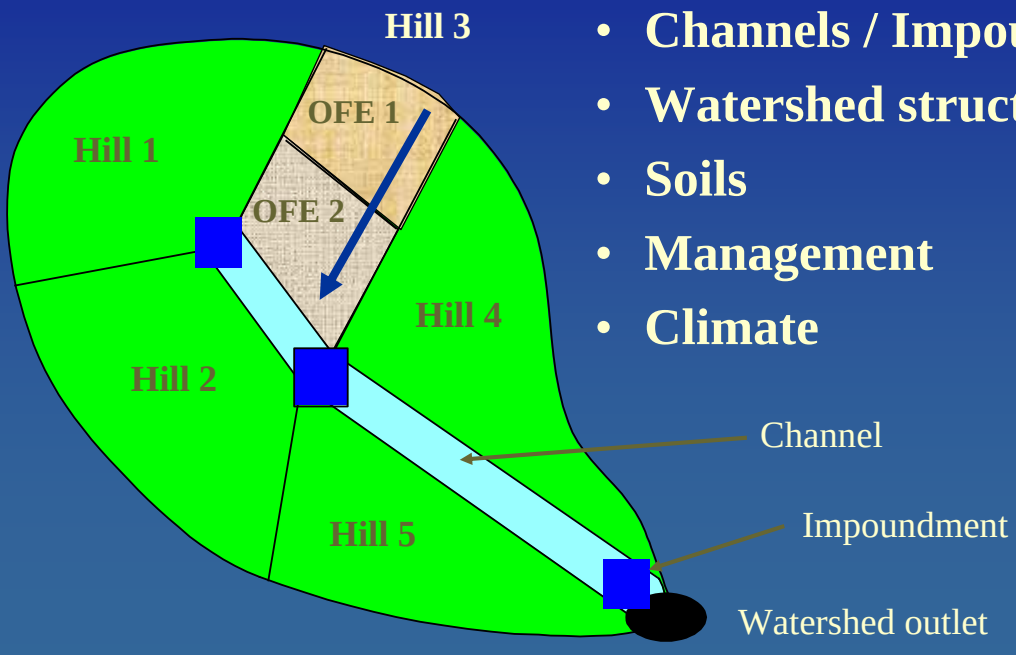
Geo-spatial interface for the Water Erosion Prediction Project – GeoWEPP

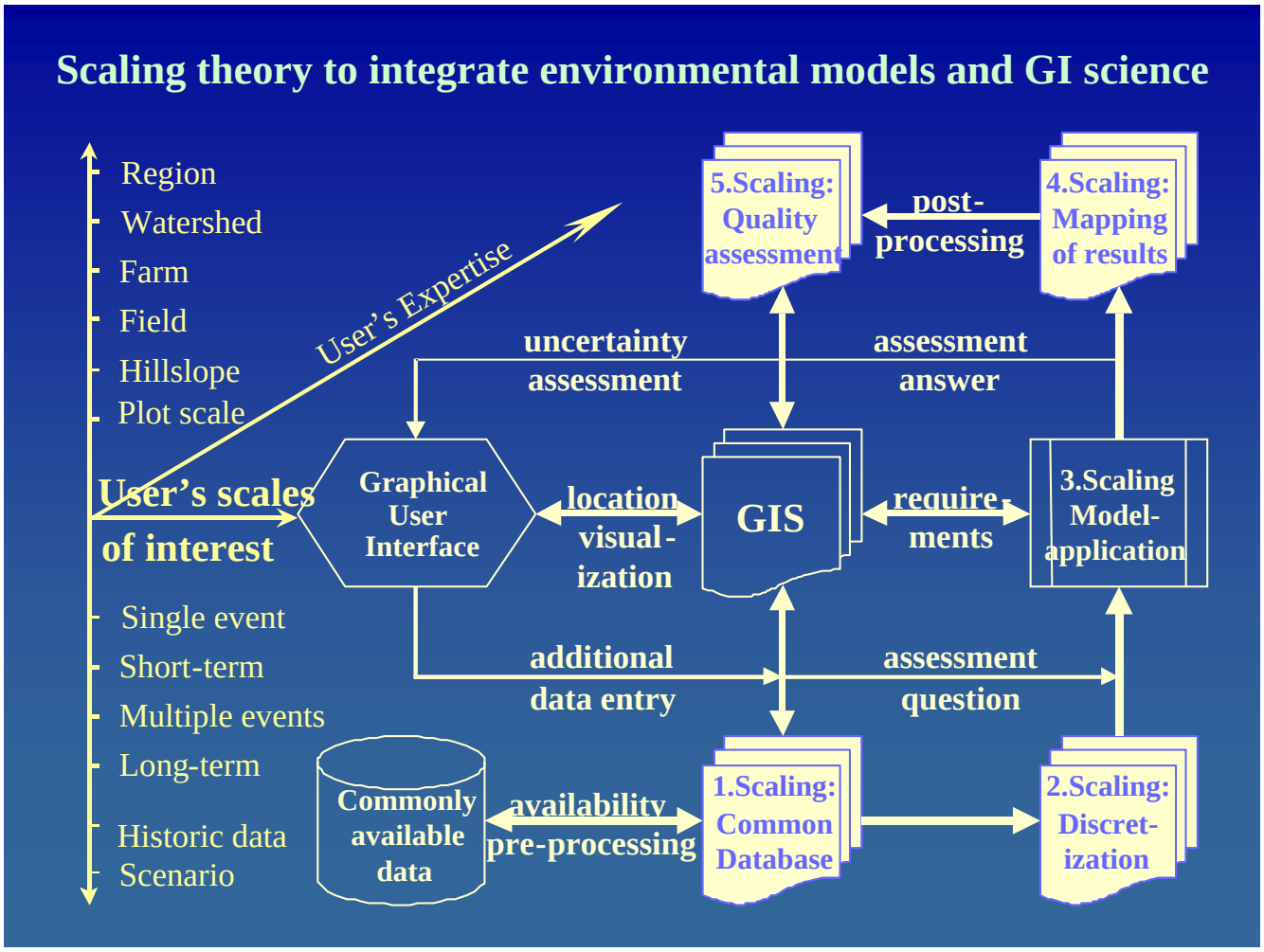


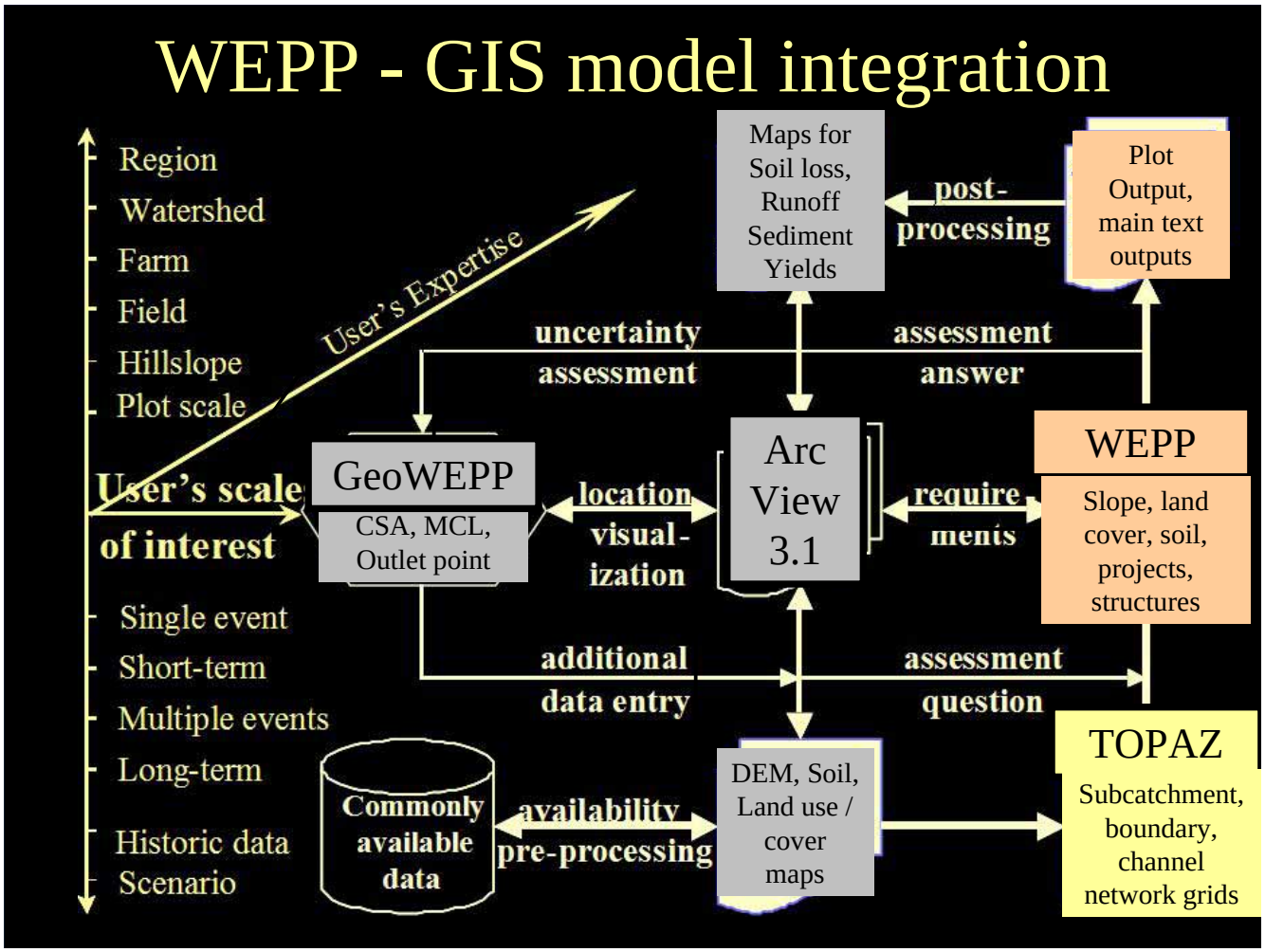
USDA UNITED STATES DEPARTMENT OF AGRICULTURE

WEPP Watershed

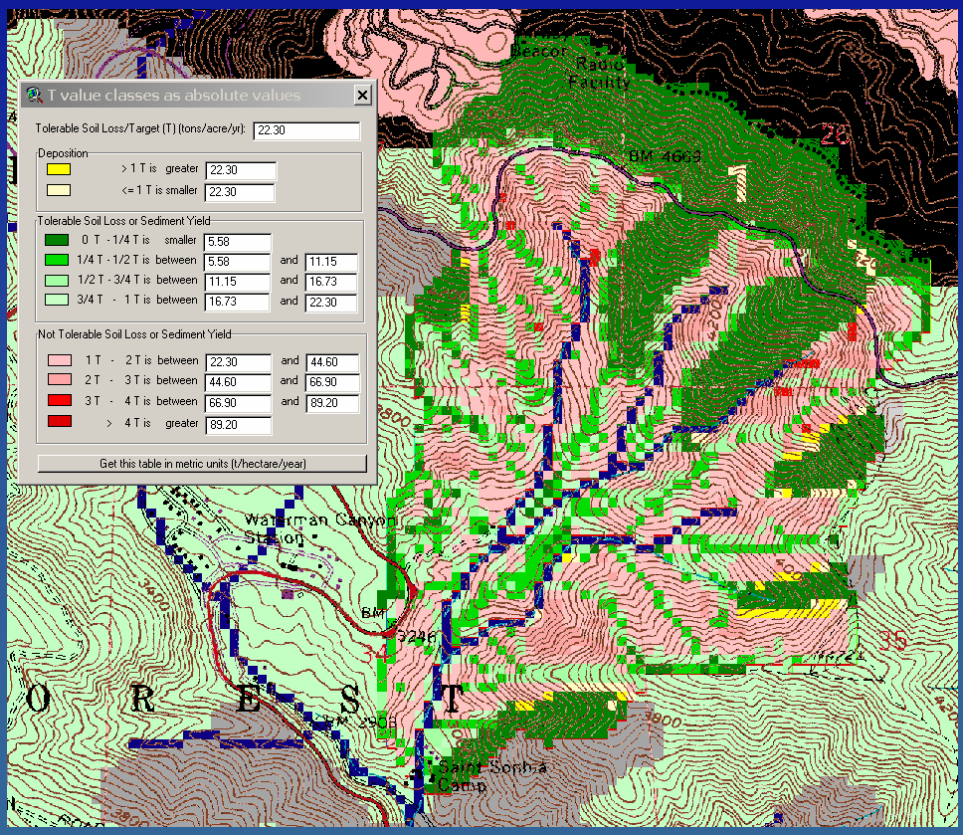
- **Hillslopes**
  - **Overland flow elements OFE's**
- **Channels / Impoundments**
- **Watershed structure**
- **Soils**
- **Management**
- **Climate**




Scaling theory to integrate environmental models and GI science
Region
Watershed
Farm
Field
Hillslope
Plot scale
User's Expertise
User's scales of interest
Single event
Short-term
Multiple events
Long-term
Historic data
Scenario
5.Scaling: Quality assessment
post-processing
4.Scaling: Mapping of results
uncertainty assessment
assessment answer
Graphical User Interface
location visual-ization
GIS
require-ments
3.Scaling Model-application
additional data entry
assessment question
Commonly available data
availability pre-processing
1.Scaling: Common Database
2.Scaling: Discret-ization


WEPP - GIS model integration
Region
Watershed
Farm
Field
Hillslope
Plot scale
User's Expertise
User's scale of interest
Single event
Short-term
Multiple events
Long-term
Historic data
Scenario
Maps for Soil loss, Runoff Sediment Yields
post-processing
Plot Output, main text outputs
uncertainty assessment
assessment answer
GeoWEPP
CSA, MCL, Outlet point
location visual-ization
Arc View 3.1
require-ments
WEPP
Slope, land cover, soil, projects, structures
additional data entry
assessment question
TOPAZ
Subcatchment, boundary, channel network grids
Commonly available data
availability pre-processing
DEM, Soil, Land use / cover maps

Old Fire (Waterman Canyon, Dec '03)

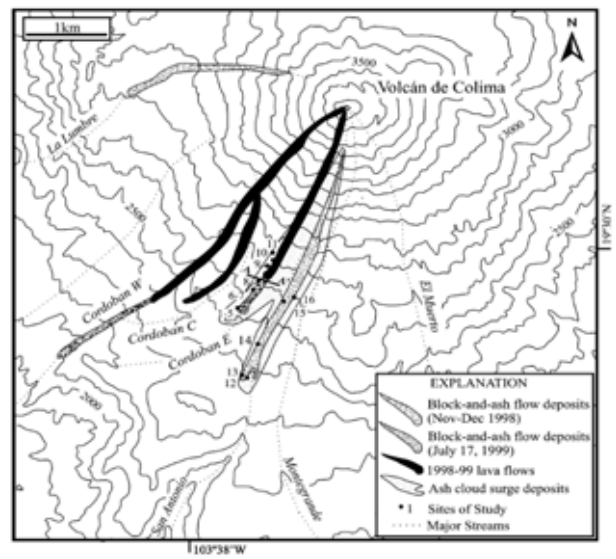


Integrated Modeling System 2

Volcanic Debris Flow Assessment with TITAN2D

Flow Extents

- Colima, Mexico

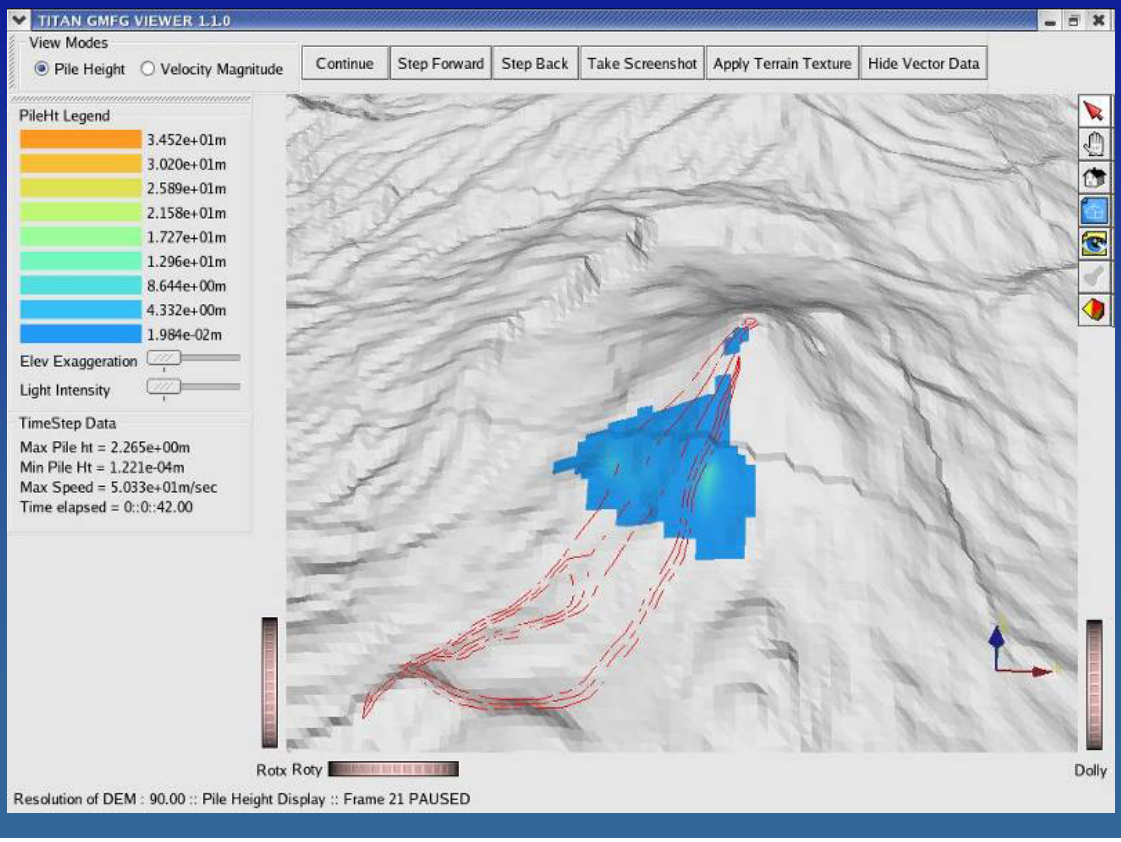


Saucedo, R., J. L. Macias and M. Bursik (2004). "Pyroclastic flow deposits of the 1991 eruption of Volcan de Colima, Mexico." Bulletin of Volcanology **66**(4): 291-306.

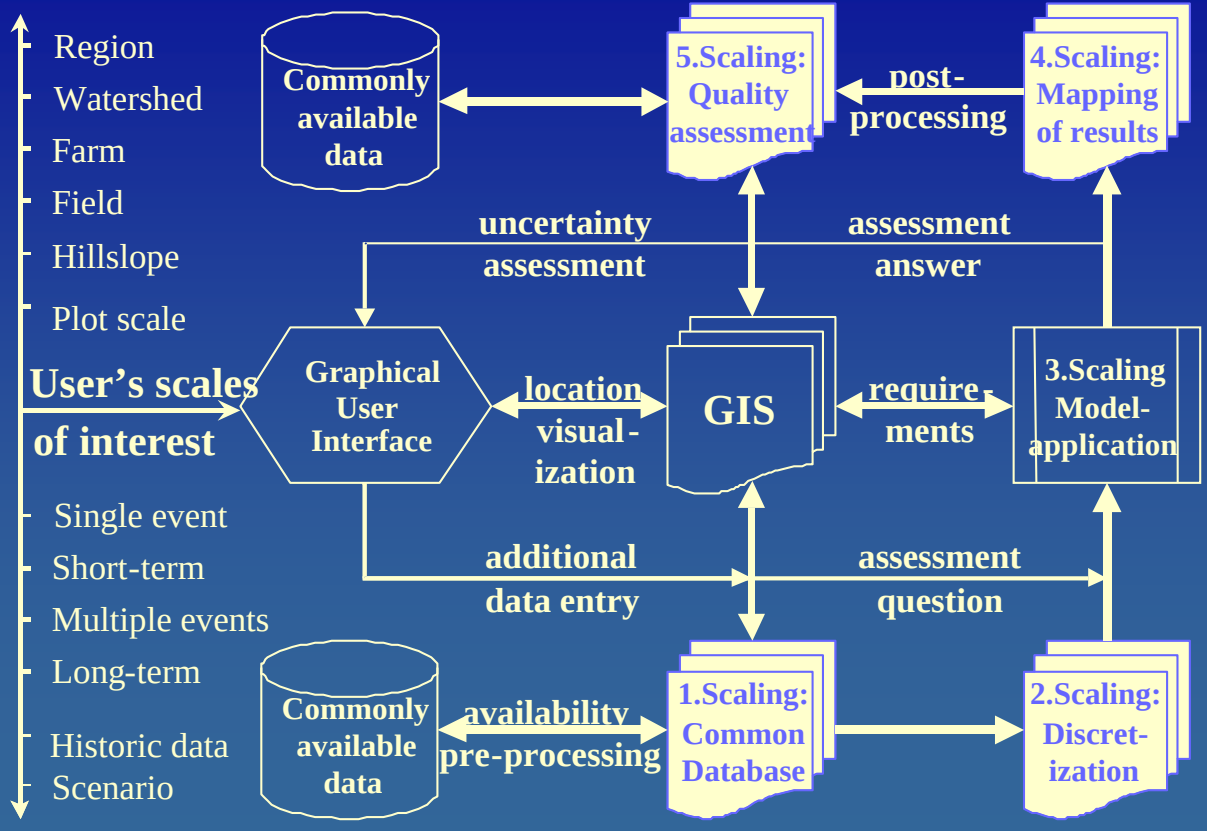
TITAN2D

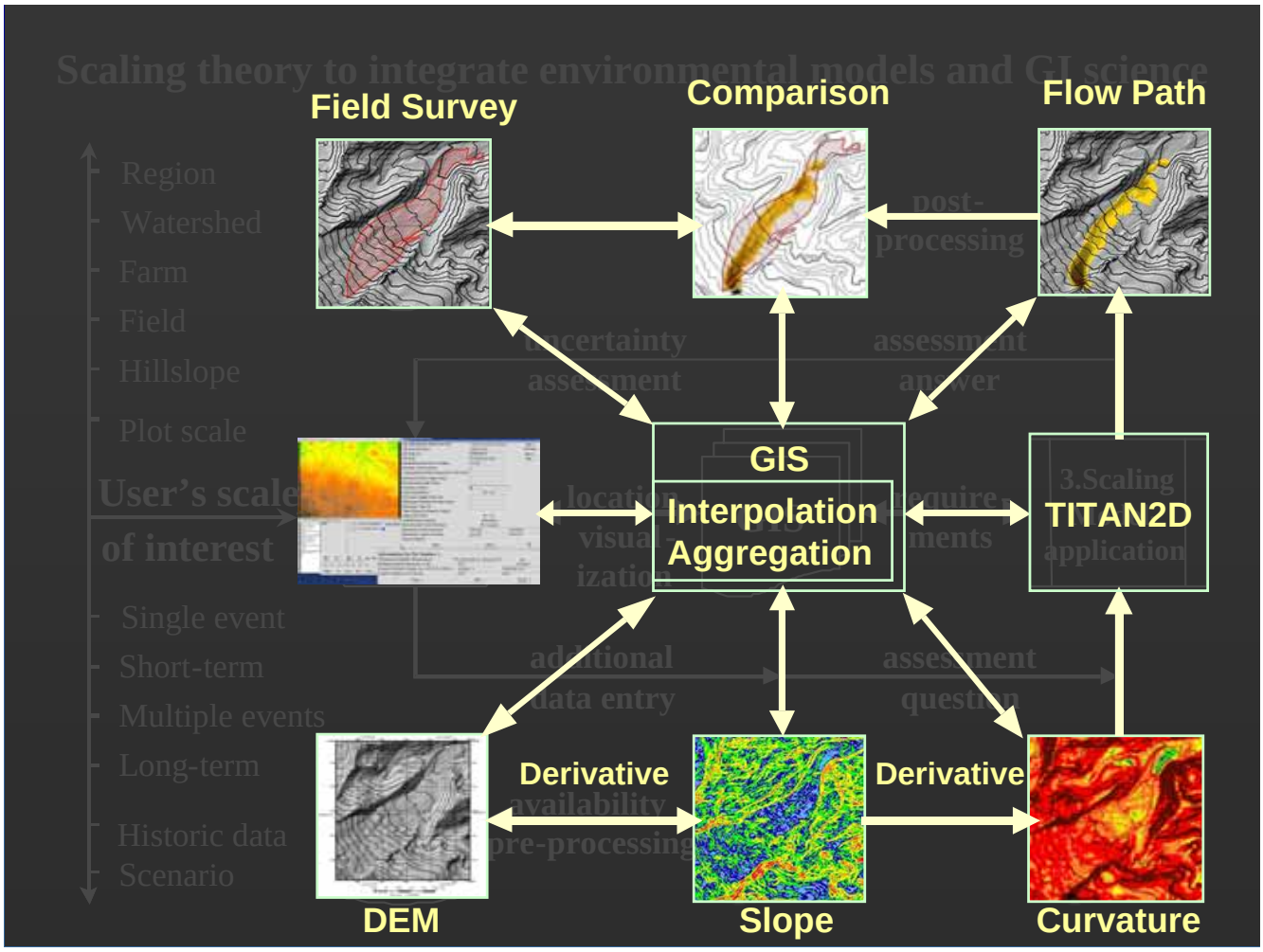
- Mathematical, deterministic, and dynamic model of avalanches and debris flows.
  - Flows triggered by volcanic and seismic activities, and extreme precipitation events.
  - Particles - centimeter to meter-sized.
  - Flow travels at up to hundreds of meters per second, over tens of kilometers.

Visualization of Flow and GIS Data



Scaling theory to integrate environmental models and GI science




Scaling theory to integrate environmental models and GI science
Field Survey
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Plot scale
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Single event
Short-term
Multiple events
Long-term
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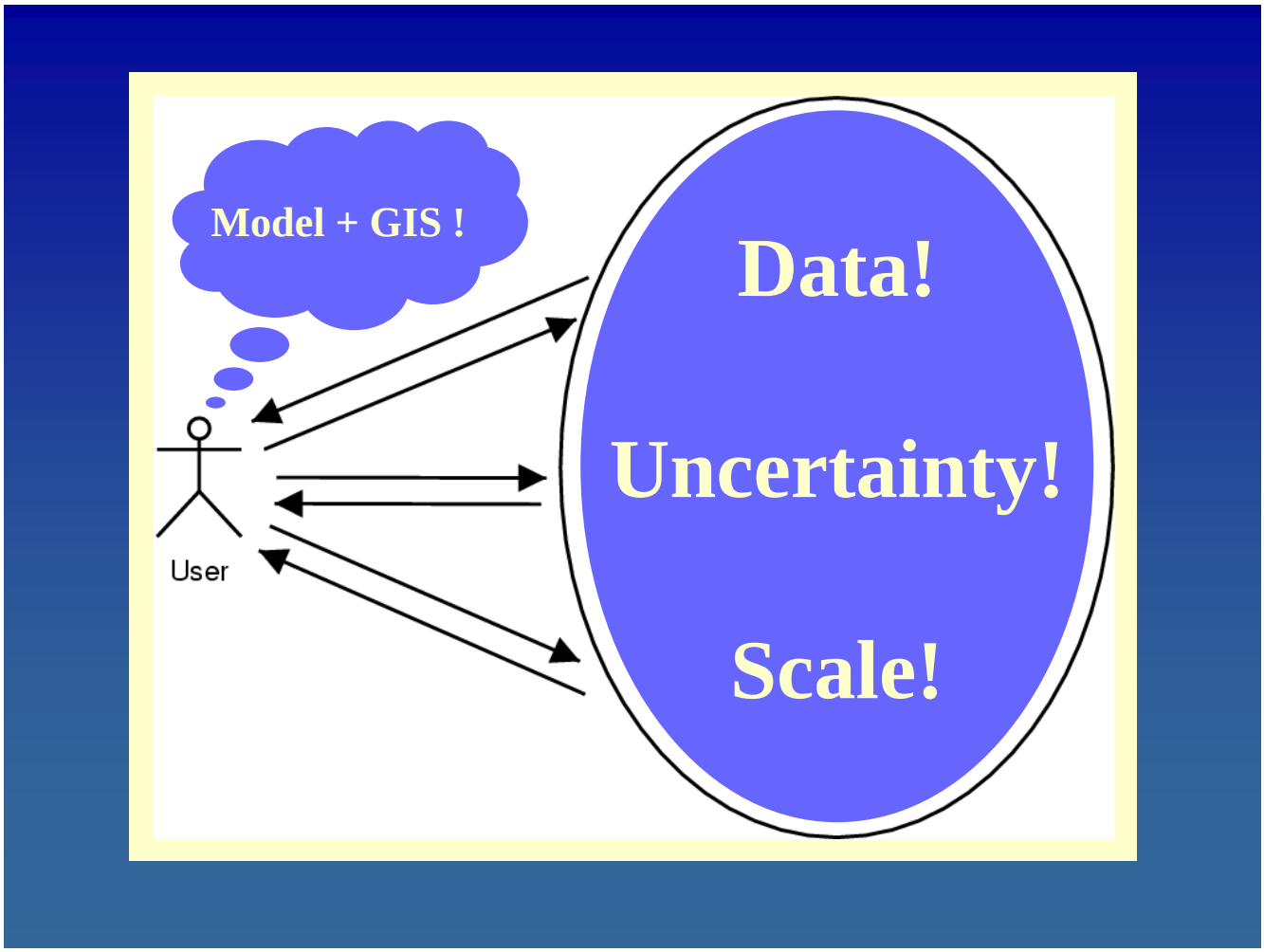
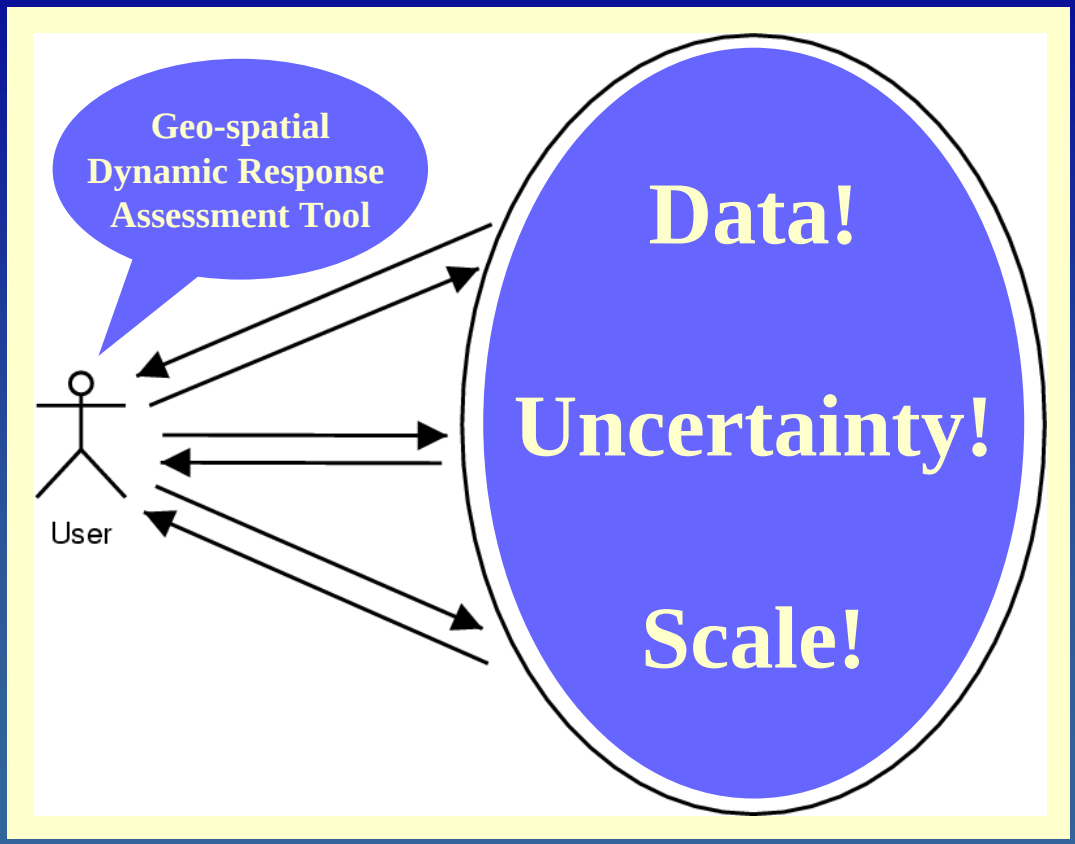
Scenario
post-processing
uncertainty assessment
assessment answer
GIS
Interpolation
Aggregation
3.Scaling
TITAN2D
application
location
visualization
acquire
ments
additional data entry
assessment
Derivative
availability
pre-processing
Derivative
DEM
Slope
Curvature


Model + GIS !
User
Data!
Uncertainty!
Scale!



Goals for GeoDRAT Platform with Role-Based Access Control (RBAC)

Integration of tools in interdisciplinary projects involving

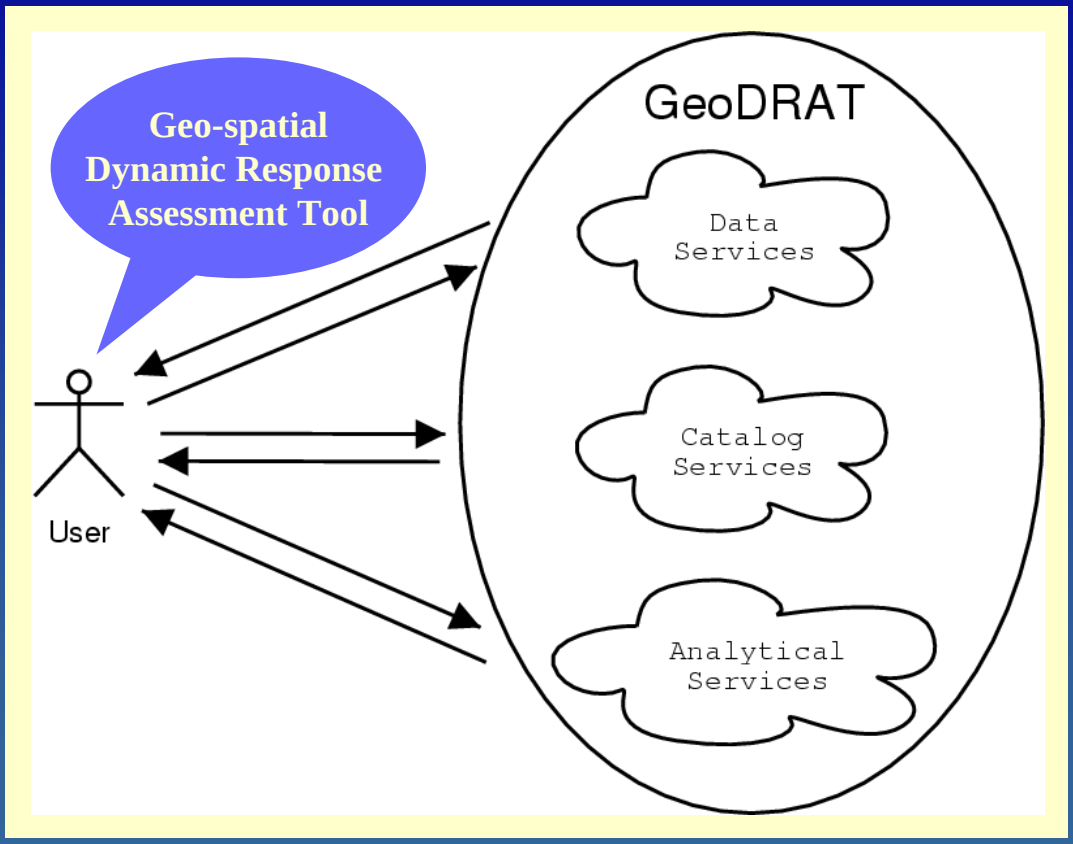
- spatial data processing,
- environmental process modeling,
- geo-visualization, and
- decision-making components.

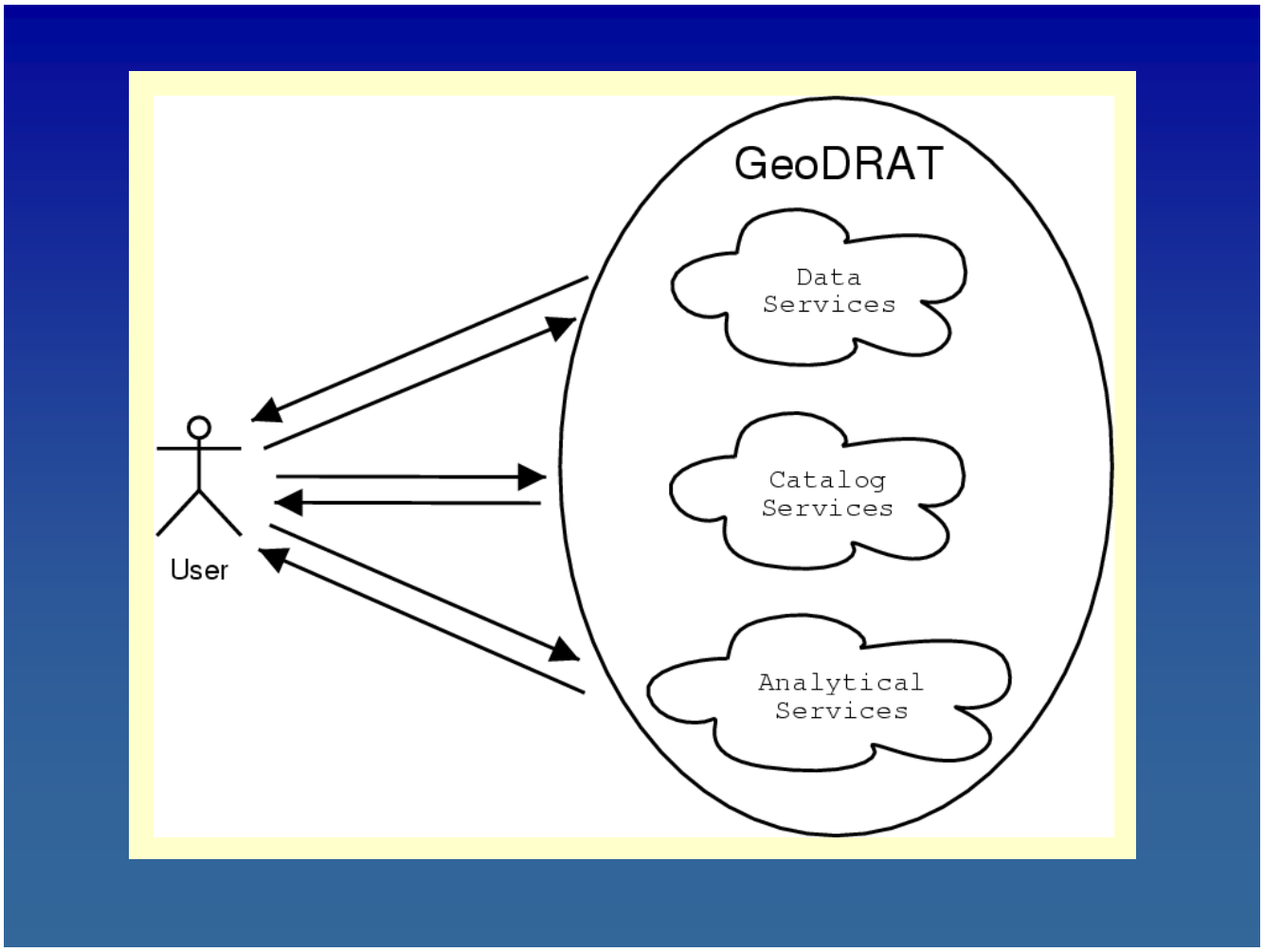
Consideration of Data, Scales and Uncertainties through:

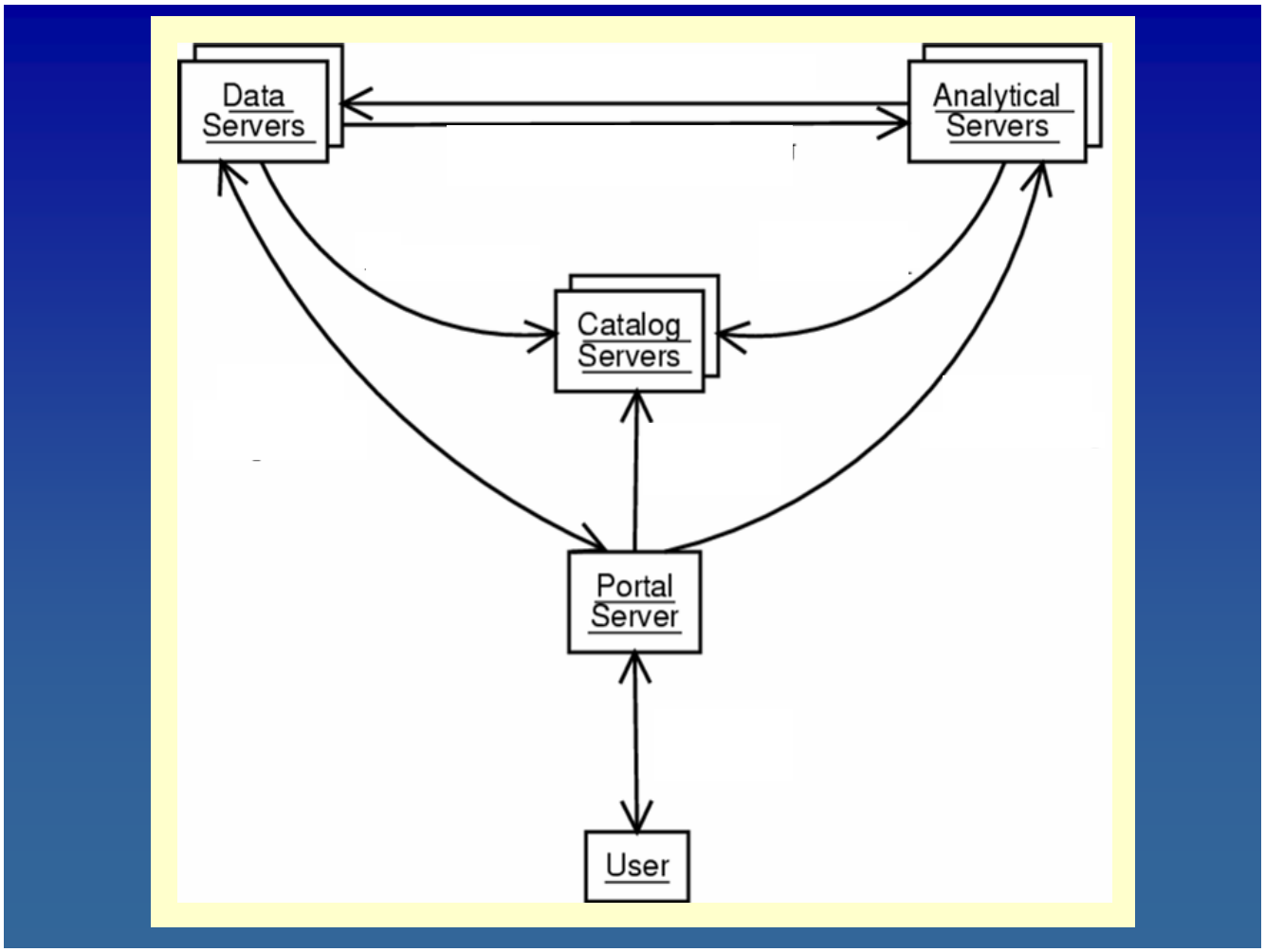
- effective and seamless spatial data processing/sharing, and
- minimizing the impact of data processing algorithms on results.

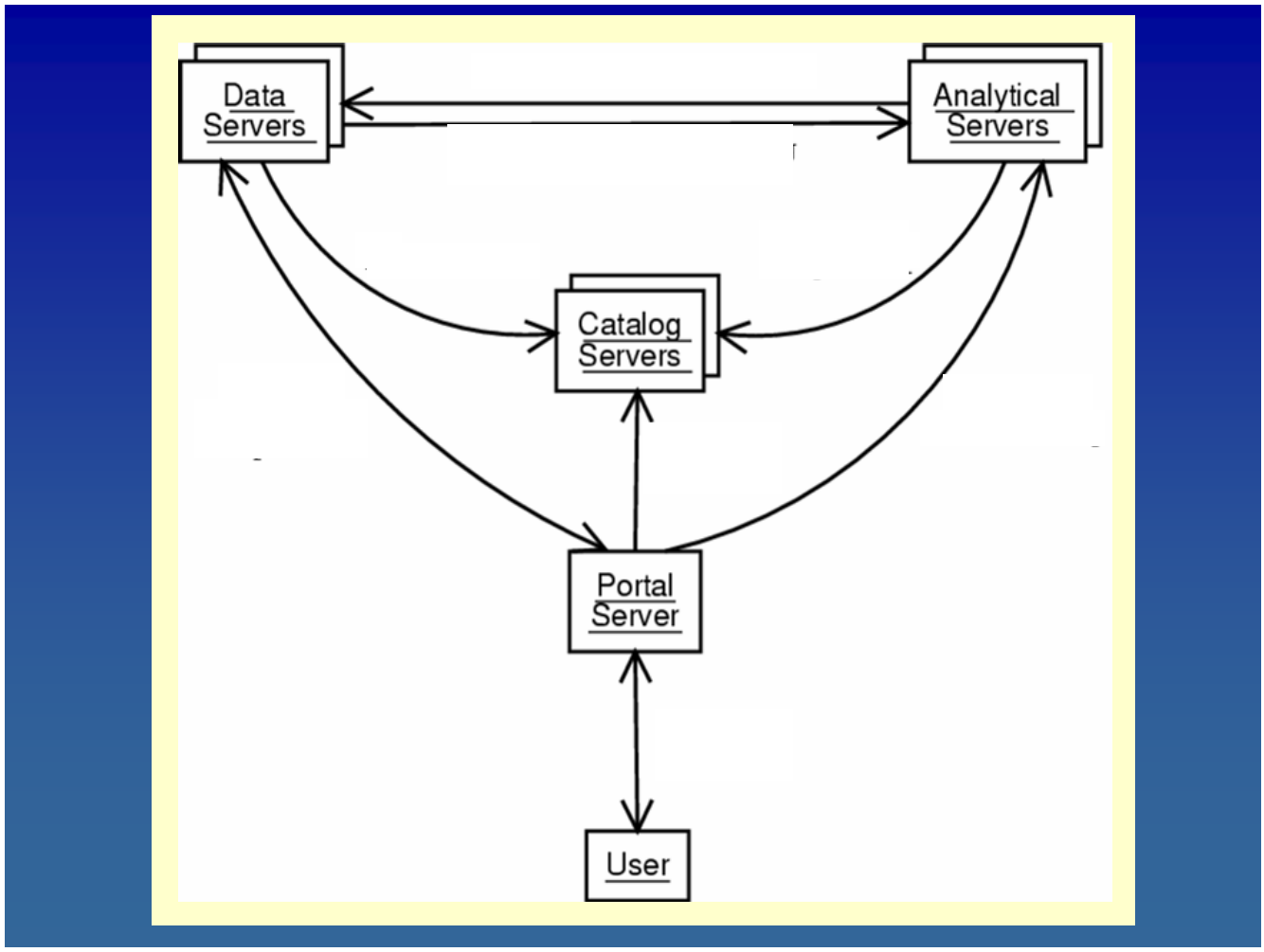
GeoDRAT Services

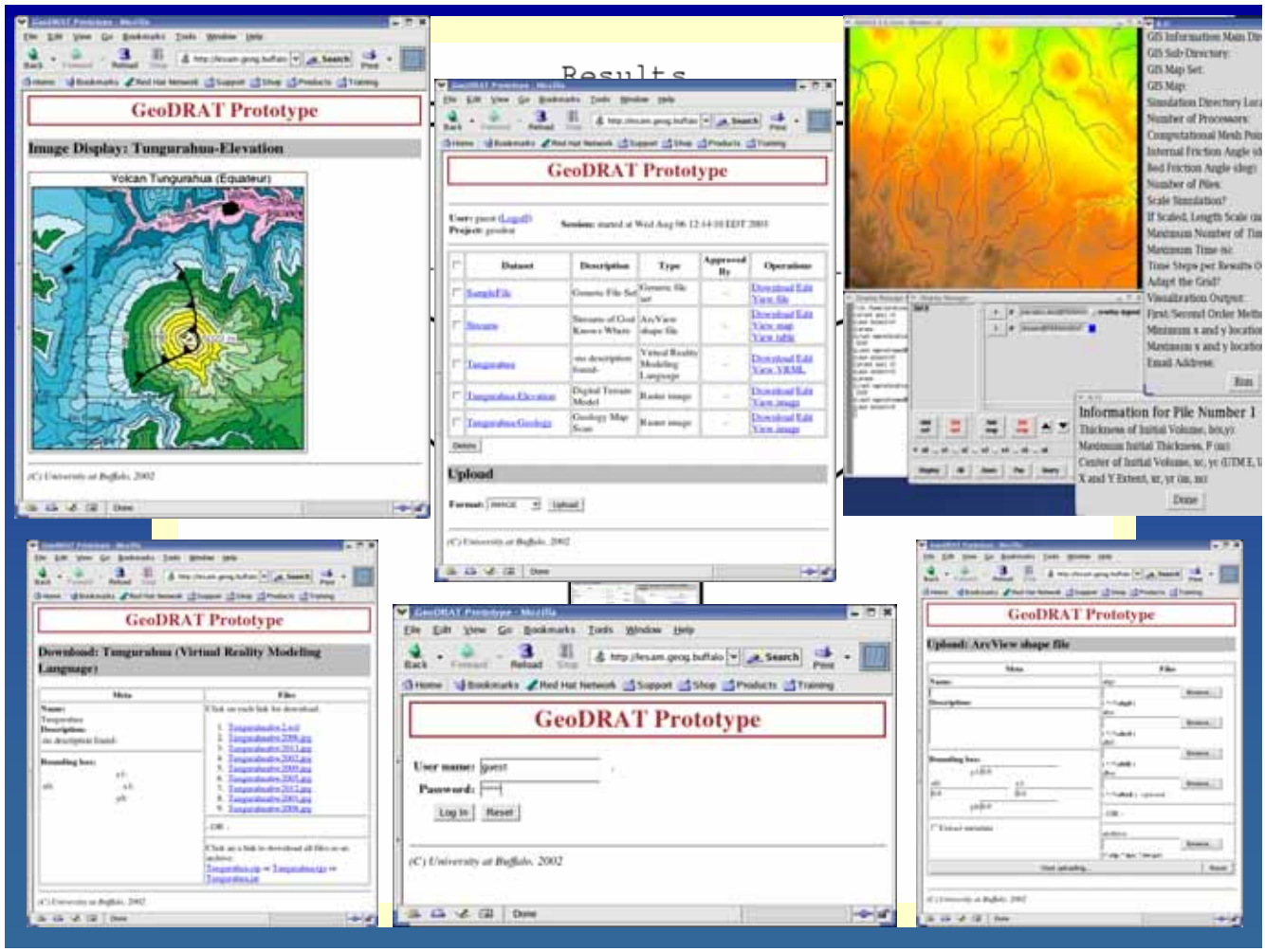
- utilize network data processing capabilities
- access shared data sources
- share own data and processing capabilities
- streamline interaction among interdisciplinary research groups.

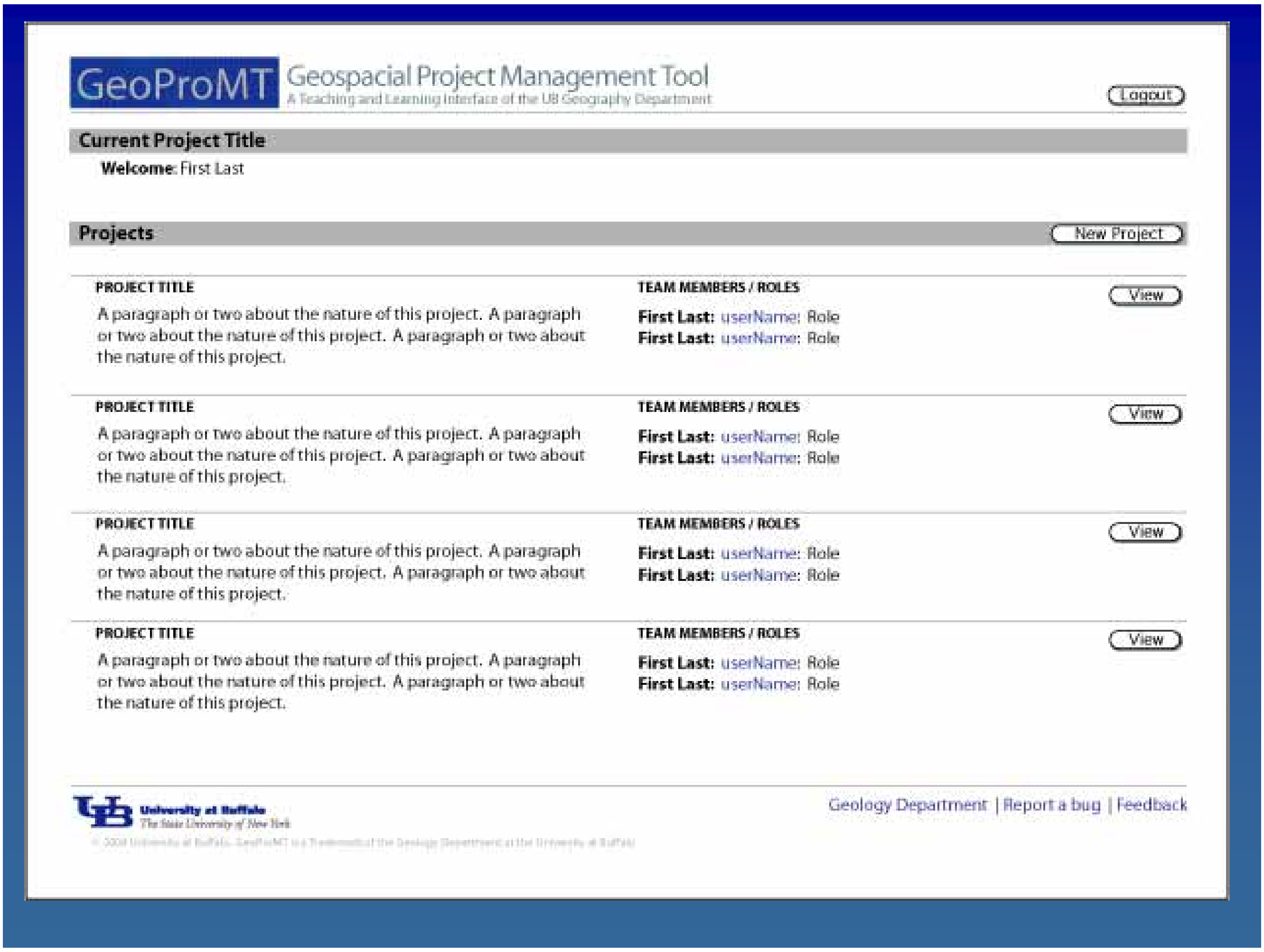



GeoDRAT
Data Services
Catalog Services
Analytical Services
User


Data Servers
Analytical Servers
Catalog Servers
Portal Server
User


Data Servers
Analytical Servers
Catalog Servers
Portal Server
User


GeoDRAT Prototype
Image Display: Tungurahua-Elevation
Volcan Tungurahua (Equateur)
Results
GeoDRAT Prototype
Upload
GeoDRAT Prototype
Download: Tungurahua (Virtual Reality Modeling Language)
GeoDRAT Prototype
User name: guest
Password:
Log In
Reset
(C) University at Buffalo, 2002
GeoDRAT Prototype
Upload: ArcView shape file
Information for File Number 1


GeoProMT Geospacial Project Management Tool
A Teaching and Learning Interface of the UB Geography Department
Logout
Current Project Title
Welcome: First Last
Projects
New Project
PROJECT TITLE
A paragraph or two about the nature of this project. A paragraph or two about the nature of this project. A paragraph or two about the nature of this project.
TEAM MEMBERS / ROLES
First Last: userName: Role
First Last: userName: Role
View
PROJECT TITLE
A paragraph or two about the nature of this project. A paragraph or two about the nature of this project. A paragraph or two about the nature of this project.
TEAM MEMBERS / ROLES
First Last: userName: Role
First Last: userName: Role
View
PROJECT TITLE
A paragraph or two about the nature of this project. A paragraph or two about the nature of this project. A paragraph or two about the nature of this project.
TEAM MEMBERS / ROLES
First Last: userName: Role
First Last: userName: Role
View
PROJECT TITLE
A paragraph or two about the nature of this project. A paragraph or two about the nature of this project. A paragraph or two about the nature of this project.
TEAM MEMBERS / ROLES
First Last: userName: Role
First Last: userName: Role
View
University at Buffalo
The State University of New York
Geology Department | Report a bug | Feedback


GeoProMT Geospacial Project Management Tool
A Teaching and Learning Interface of the UB Geography Department
Logout
Current Project Title
Change Project
Welcome: First Last
Project Role: Role
Project Description
Last Edited: MM/DD/YYYY
By: User Name: userName
Modify
PROJECT GOAL
A paragraph or two about the nature of this project. A paragraph or two about the nature of this project. A paragraph or two about the nature of this project.
TEAM MEMBERS / ROLES
First Last: userName: Role
First Last: userName: Role
Project Overview
Project Workflow
NAME
University at Buffalo
The State University of New York
Geology Department | Report a bug | Feedback

GeoProMT Geospacial Project Management Tool
A Teaching and Learning Interface of the UB Geography Department

Logout

Current Project Title

Welcome: First Last **Project Role:** Role

Model Output Detail Add Item

TASK	TITLE / PURPOSE	DOCUMENT	CERTIFICATION	ASSIGNS	COMMENTS	TOOLS
1	**Title of work flow item** Purpose of work flow item	**Name** Type	Certified	userName userName	**Manager:** 00 **Assigns:** 00	Delete Modify **Last Edited:** MM/DD/YYYY **By:** userName
2	**Title of work flow item** Purpose of work flow item	**Name** Type	Pending	userName userName	**Manager:** 00 **Assigns:** 00	Delete Modify **Last Edited:** MM/DD/YYYY **By:** userName
3	**Title of work flow item** Purpose of work flow item	**Name** Type	Begun	userName userName	**Manager:** 00 **Assigns:** 00	Delete Modify **Last Edited:** MM/DD/YYYY **By:** userName
4	**Title of work flow item** Purpose of work flow item	**Name** Type	Halted	userName userName	**Manager:** 00 **Assigns:** 00	Delete Modify **Last Edited:** MM/DD/YYYY **By:** userName
5	**Title of work flow item** Purpose of work flow item	**Name** Type	Pending	userName userName	**Manager:** 00 **Assigns:** 00	Delete Modify **Last Edited:** MM/DD/YYYY **By:** userName
6	**Title of work flow item** Purpose of work flow item	**Name** Type	Begun	userName userName	**Manager:** 00 **Assigns:** 00	Delete Modify **Last Edited:** MM/DD/YYYY **By:** userName

Cancel Submit

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Geology Department | Report a bug | Feedback

1 After logging into GeoProMT the user is presented with a listing of the projects that he has a role in. He is also presented with the option to create a new project or view an existing project.

2 When viewing a project the user is presented with an overview of the project stages and workflows. This view gives the view a quick look at the progress of the project and allows the user to view details of a whole project stage (item 3) or to look at a specific document within a workflow (item 4).

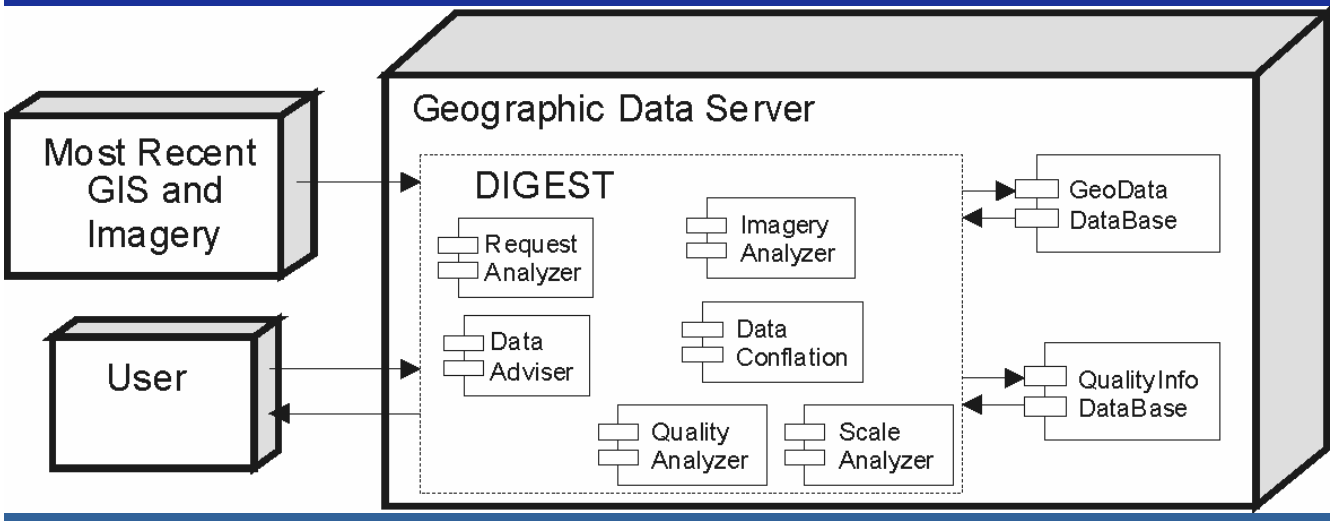
3 The detail view allows a user to see an overview of all the documents for a given stage of the project. They are also presented with tools to create a new document, and edit or delete and existing document.

4 Wether adding a new document, viewing or editing an existing document the user is presented with the document view. In this view the user is presented with all the tools to describe and manage a document that is a part of the projects workflow.

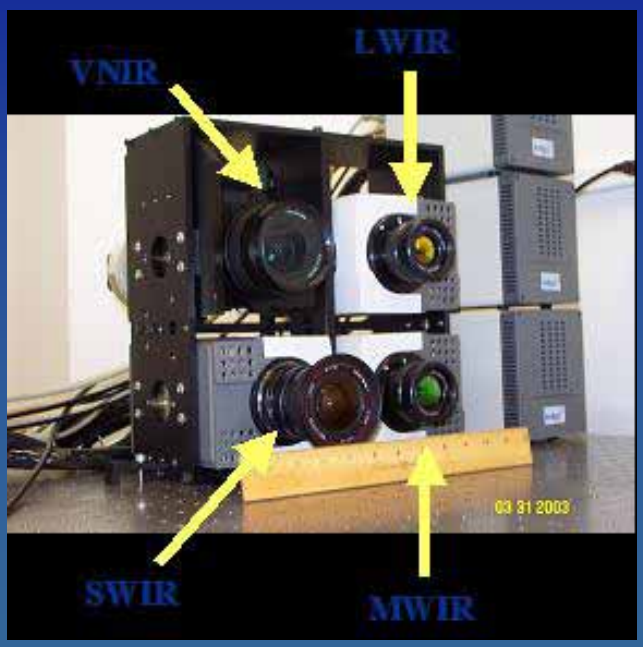
GeoProMT Geospacial Project Management Tool
A Teaching and Learning Interface of the UB Geography Department

Integrated Geospatial Data Modeling System
+
Geospatial Project Management Tool (GeoProMT/GeoDRAT)
=
Dynamic Integrated GIS Enhancement and Support Tools (DIGEST)

DIGEST system integrated in a Geographic Data Server



Mapping Camera System for Real- time Images and Algorithm Validation



Visible-Near (VN), Short (SW), Medium (MW), and Long Wave (LW) Infrared (IR)

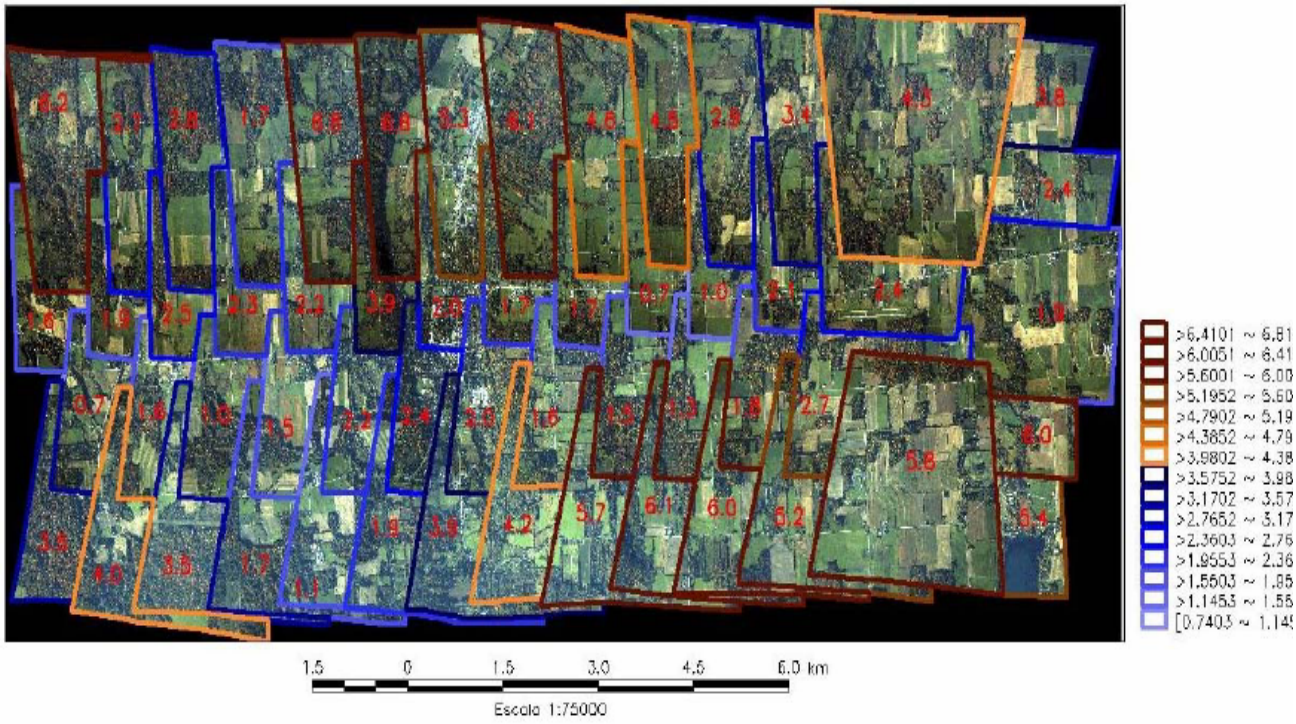
Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology (RIT)

WASP

Warsaw Image

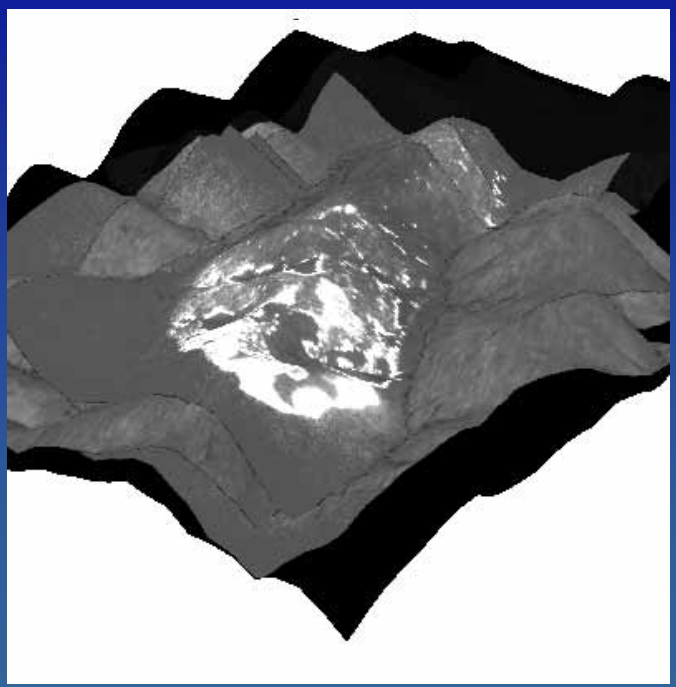
Error Analysis

Comparison between WASP image and Orthophoto



Escala 1:75000

Time Sequence of Fire Propagation in LWIR



Conclusions:
Integrating GI Science & Environmental Models

- Interdisciplinary development / implementation
- Process-based approaches for wide application
- Evaluation of data scaling effects are essential
- Utilizing commonly available data sources
- Include educational tools to understand processes pattern, basic problems and practical solutions