Visualizing Geographic Processes and the role of Visualization in Scientific Research
Overview

What is Geovisualization?

Why is the work needed?

What are its applications and uses?
What is Geovisualization?

Leveraging the pattern-recognition and information-extracting abilities of the eye-brain system.

"Visual Thinking" - tools to 'see' and explore complex geospatial data sets in the hopes of discovering new insights.

Vision is a high bandwidth sensory channel….we’re "hardwired" for visual information (perceptual) and good at abstract visual thinking (cognitive).
Research Frontiers...

Map Animation

NSIDC 20-year Average Sea Ice Concentration

October
Fall
Research Frontiers...

Collaborative Visualization and Immersive Technology
Research Frontiers...

Geocomputation and Database Semantics

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        <p align="left">Cutting Edge Research and Applications</p>
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        <p><font face="Arial, Helvetica, sans-serif" size="5" color="#33CCFF">Collaborative Visualization</font></p>
        <p><font face="Arial, Helvetica, sans-serif" size="5" color="#33CCFF">Database Semantics</font></p>
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        <p><font face="Arial, Helvetica, sans-serif" size="5" color="#33CCFF">Immersive Technology</font></p>
        <p><font face="Arial, Helvetica, sans-serif" size="5" color="#33CCFF">Uncertainty and Data</font></p>
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<p><a href="GEOVISTA_graphics/Apsatemporalquery.jpg" target="_blank">Example 1</a></p>
<p><a href="GEOVISTA_graphics/StudioMultivariateAnalysis.jpg" target="_blank">Example 2</a></p>
<p><a href="GEOVISTA_graphics/Studios00Mleftview.jpg" target="_blank">Example 3</a></p>
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Research Frontiers...

Uncertainty and Data Quality
Why does this matter?

just techie stuff, right?

an example
Issue #1

How we think about the world influences how we make maps. In turn, how we make maps influences how we think about the world.
Issue #2

Turning data into information (and ultimately knowledge)

Massive amount of digital space-time data: How do we make use of it?
Issue #3

Time and Process - Hard to Represent

A shift from PATTERNS to PROCESSES
Knowledge Construction

Early in the research process: Help to form hypotheses about geographic systems when formal hypotheses may be lacking.

Later in the research process: May be used to confirm, synthesize, and ultimately present ideas and information.
Cartography$^3$

presenting knowns  

revealng unknowns  

human-map interaction  

visualization  

communication  

public  

private  

low  

high  

after MacEachren (1994)
Demos
3D Animation and Fly-Over Maps

Mostly Hype or Useful Tools?

Billions of pixels

$200 software
We all-too-often assume 3-d is better than 2-d, that animation is superior to static graphics, and that realism is more powerful than abstraction.

Ben Shneiderman

aim to be clear, not cool.
The trouble with 3D Fly-overs

(1) Scale is not constant \((x, y, \text{ or } z)\)

(2) Information Overload

(3) Visual occlusion

(4) People Love Them \((\text{and then promptly forget them})\)

(5) Folks Get Lost!
Oh really?

Pen and paper at the ready...
Q1: Trace your path!

Q2: How far have you travelled?

Q3: How high is the final climb?

Q4: How many villages did we fly over?

...all answerable with a 2D topo!!
HOWEVER!...

(1) *Not* anti-flyover (they’re too cool, and they’re here to stay)

(2) So... *How* and *When* to best use them!

(3) And what can we do *improve* them?
HOWEVER!...

(1) **Not anti-flyover** *(they’re too cool, and they’re here to stay)*

(2) **So...How and When to best use them!**

(3) **And what can we do improve them?**

This is one of my research foci
It’s not the technology, it’s how you use it.

Mike Gleischer

choropleth not so good for elevation
What Problems?!

(1) **Non-constant scale?** = Info filtering + mix 2d and 3d + how reality works

(2) **Visual occlusion?** Just fly around + transparency + roll-up earths

(3) **Judging distance?** Grids + new measuring tools + 2d inset
BUT... Most of these are INTERACTIVE SOLUTIONS

Fly-overs (low interactivity)

VS.

VEs (high interactivity)

Used often as overview/reference map to create “survey knowledge”
Most research has focused on VEs, not fly-overs.
So how did we get here?
A Brief History
A Brief History

TerraVision 1994
25 years on...

...better software BUT still many unknown questions in fly-over cartography:

- path complexity
- flight speed / height
- look-ahead / angle / fixed?
- fixed vs. variable fly height
- animation length
- banking
- scene complexity
- orientation cues, etc.
To date...

Some research in GISci, mostly in HCI / VE communities ...

*Is our technology ahead of our theory?*
Problem #1
Disorientation

People get lost / disorientated / overwhelmed!

Again, and again this is shown in research


Why?
Problem #1
Disorientation

Why?

People don’t know where they are
People don’t know where they’ve been
And they don’t what they’re looking at
Core Problem

Fly-overs need to better foster development of the basic components of a mental map

#1 Survey/Configural Knowledge: Legible environment is one whose parts can be recognized and organized into coherent patterns (Lynch 1960, Thorndyke 1983, Elvins 1997)

#2 Procedural Knowledge: e.g., driving directions

#3 Landmark Knowledge: e.g., relational
Enhancing Fly-over Maps

- Starts with a labeled overview map (map mixes ego- and exo-centric views)
- Previews flight path
- Soundscape creates increased sense of immersion
PRO: It really helps

CON: Split attention Screen space
Inspiration:
Heads-Up Display / Augmented Realty
Sky Compass Ticks

Provides external frame of reference
Orientation aid works only if horizon is visible
Landscape Grid

Helps with distance and angular relationships
Landscape Grid

Should decrease split attention
Z scale needed with vertical exaggeration
Labels / Landmarks

Value-added cartography play an important role in mental map development.
Monorail

Previews motion ahead
Answers “have I been here before?”
Experimental Findings: Directional Errors

Avg Directional Error = 45°
Monorail and Grid halved that
Compass eliminated it
Labels made it worse
Experimental Findings: **Survey Knowledge**

**Path Drawing**
Monorail most successful, followed by Grid
Compass no help
Labels made it worse


Important Distinction: Analytical vs. Subjective Map Reading Tasks

1: Engendering a sense of place
   “Experiential Cartography”

2: Grabs our attention

3: Bridges our lived experience and map data

...all good things
The Grand Canyon
The Grand Canyon
The Grand Canyon - Google Earth Demo
Thank you!

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