

THE FUTURE OF GIS

2013 AND 2025

- What is the state of geospatial computing today?
- What are the issues today?
- Unresolved problems
- What will geospatial computing be like in 2025?
- What issues will be of concern then?

COMPUTING ISSUES IN 2013

- Building the cyberinfrastructure
- The digital divide
- The “where” of computing
- User interfaces and Web 2.0/3.0
- Who owns software?
- Too much data

GEOGRAPHIC INFORMATION TECHNOLOGY IN 2013

- Countering industry trends, LBS
- Positioning systems commonplace
- Geobrowser era, and VGI
- Mobile GIS
- New generation of earth imaging (e.g. webcams)
- Interoperability and standards

WHAT WILL THE ISSUES BE IN 2025?



CYBERINFRASTRUCTURE

aka Grid computing

NSF Vision for next era of computing

“integrated suite of computational engines, mass storage, networks, digital libraries and databases, sensors, software and services” (NSF, 2003).

Can include human users and the user interface

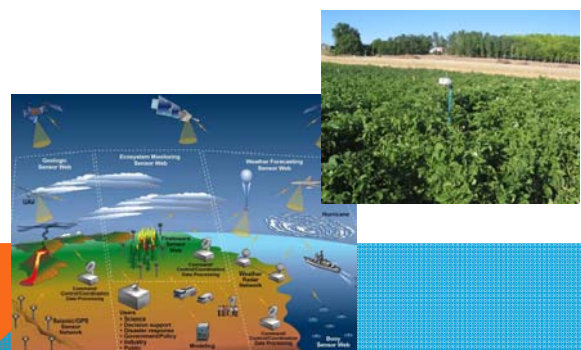
NSF (2003) *Revolutionizing Science and Engineering Through Cyberinfrastructure: Report of the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure*: Atkins report.

COMPUTING ON THE GRID



- Services available on demand
- Independence of source
- “The computer is the network”
- Cloud computing
- Virtual organizations

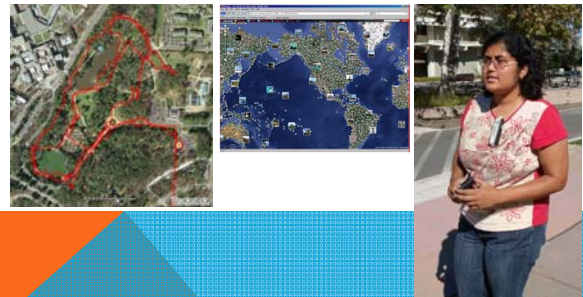
GEOSPATIAL ELEMENTS OF THE GRID: SENSOR WEBS



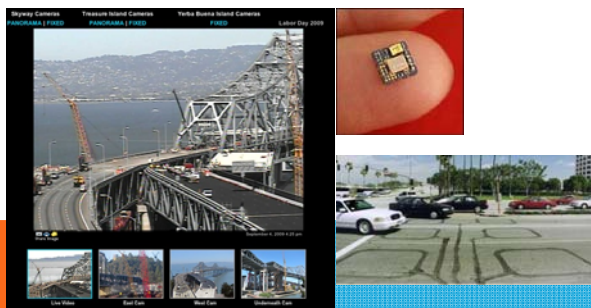
LOCATION-BASED SYSTEMS



CITIZENS AS SENSORS



MORE SENSORS



FOR EXAMPLE:

Bookstore entrance:

<http://www.tps.ucsb.edu/Webcams/webcamBookstore.aspx>

East Gate:

<http://eastentrance.tps.ucsb.edu/view/index.shtml>

THE GEOSPATIAL WEB

- Content on server side
- What content? (Map, image, video, text)
- Who supplies and moderates the content?
- How can the geospatial web build a market?



Dick Cheney's House

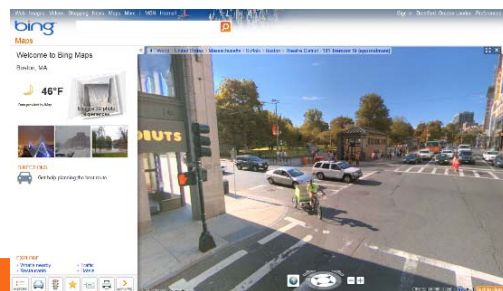
GOOGLE STREETVIEW



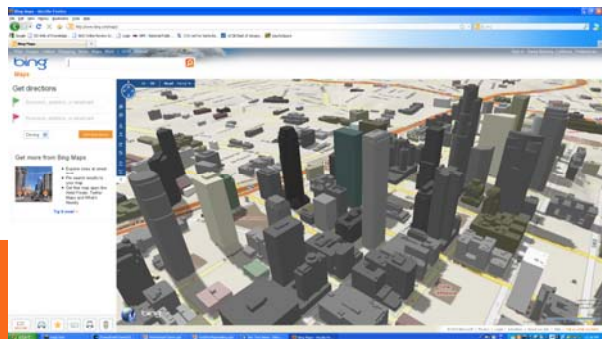
STREETVIEW NAVIGATION



BING MAPS



BINGMAPS 3D SELECTED CITIES (LA)



EVERYSCAPE



WHAT IF?

- All geospatial content becomes available over distributed systems
- Geobrowsers link content and facilitate search
- Most other web (and data) content become linked by geography?
- Vision of a "Digital Earth"

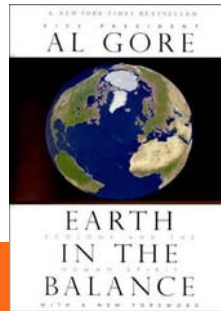
DIGITAL EARTH

- Visionary concept: Holistic perspective
- Popularized by former US VP [Al Gore](#)
- Virtual and 3-D representation of the Earth
- Spatially referenced
- Connected with digital knowledge archives
- Vast amounts of scientific, natural, and cultural information
- "to describe and understand the Earth, its systems, and human activities."

**MARY BAKER EDDY LIBRARY
FOR THE BETTERMENT OF
HUMANITY 1935**



**GORE'S EARTH IN THE BALANCE
(1992)**



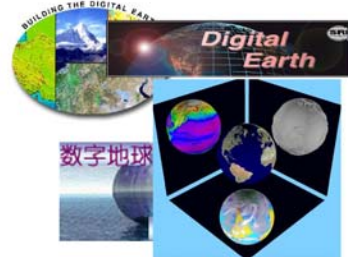
"A multi-resolution, three dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data."

CONSENSUS DEFINITION 1999

Digital Earth will be a virtual representation of our planet that enables a person to explore and interact with the vast amounts of natural and cultural information gathered about the Earth.

(Consensus definition adopted at 2nd Interagency workshop, 1999 Sept 23)

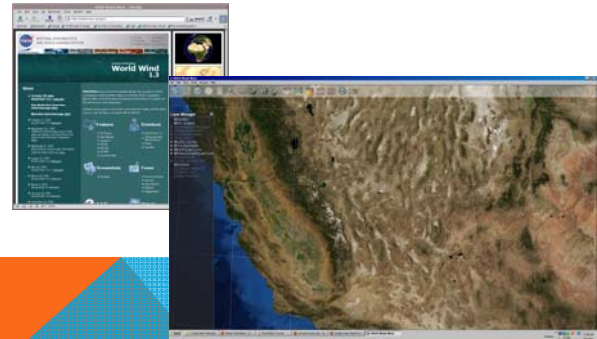
WORLD WIDE PARTICIPATION



THE NASA WEB SITE



NASA WORLDWIND



SO WHAT ABOUT CONTENT? GLOBAL MAPS

- LOD and drill-down
- Maps and imagery plus search
- Crosses boundaries between
 - MAPS
 - IMAGERY
 - TOPONYMY

GENERALIZATION IN COMPUTER GRAPHICS: LEVEL OF DETAIL

James H. Clark (1976) *Hierarchical Geometric Models for Visible Surface Algorithms*.
Communications of the ACM, October 1976, 19, 10, pp 547-554.



Polys apprx.
60.000 6.000 600 60

← DISTANCE TO CAMERA →

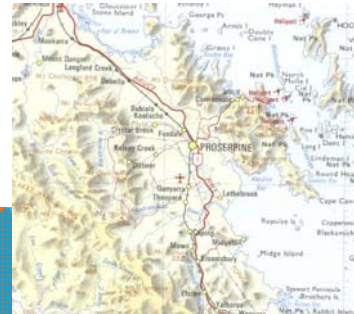
very close very far away

WE'VE BEEN THERE BEFORE:

GLOBAL MAPS

- International Millionth Map of the World
- VMAPO (DCW)
- GlobalMap

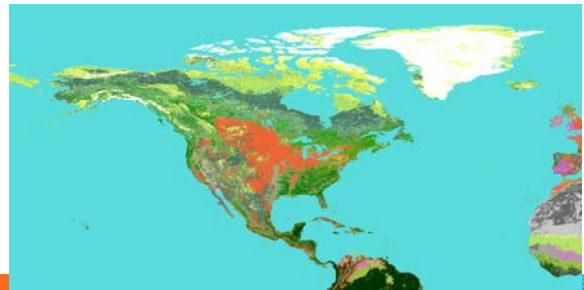
AUSTRALIA SERIES (PART)



GLOBAL MAP: VMAPO PLUS



MASSIVE AMOUNTS OF DATA: LU



INTERFACES

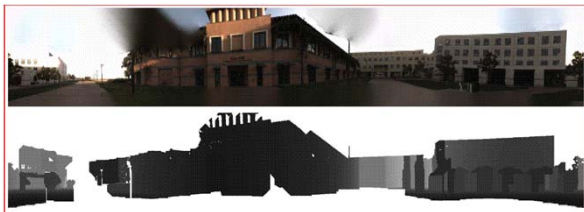
- GUI and WIMP
- Perceptual and multimodal interfaces
- User centered design, “cognitive engineering”

GESTURE RECOGNITION AND AR



Images/Movies courtesy of Mathias Kolsh, UCSB

AUGMENTED REALITY



WEARABLE GIS

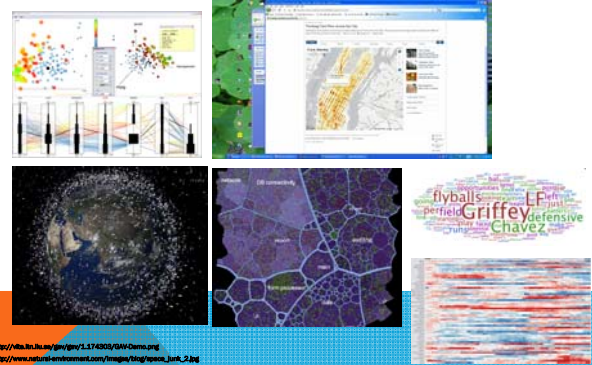


<http://www.itmedia.co.jp/broadband/030918/>

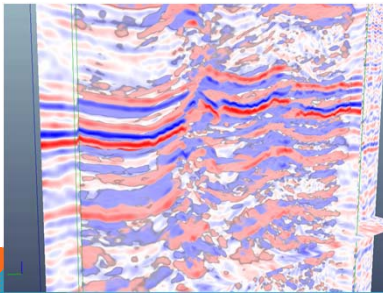
GEOVISUALIZATION

- New technologies and methods
- New hardware
- Visual analytics

Visual analytics:
the science of analytic reasoning, facilitated by interactive visual interfaces.

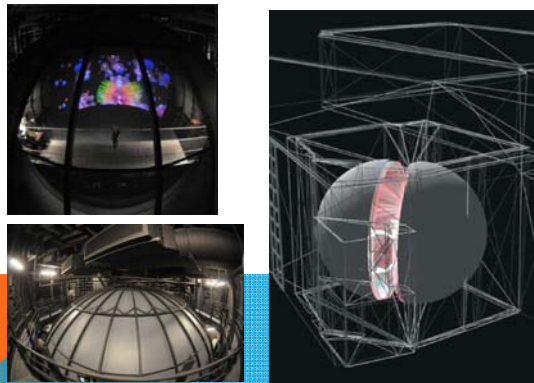


VISUALIZATION OF UNCERTAINTY

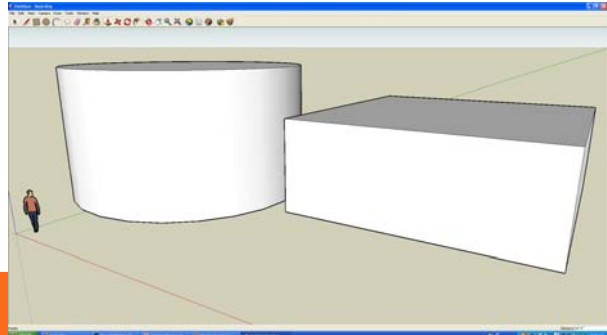


Prof. Dr. Bernd Fröhlich
Visualization of Uncertainty: Visualizing Errors and Uncertainties in Geo-Scientific Data
<http://www.uni-weimar.de/cms/medien/vr/research/visualization/scivis/uncvis.html>

VIRTUAL REALITY: THE ALLOSPHERE



SIMPLEST 3D TOOL: SKETCH-UP (KML)



3D BUILDINGS/FLAT TREES

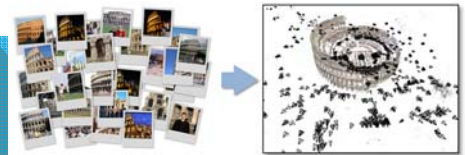


POLYGON EXTRUSION (ARCSCENE)



BUNDLER

- Structure-from-motion system for unordered image collections (for instance, images from the Internet) written in C and C++. Opensource, UWash+Cornell
- Outdoor game: <http://photocitygame.com/>
- "Our ultimate goal is to reconstruct the entire world, one photo at a time."



NEW IMAGERY SOURCES

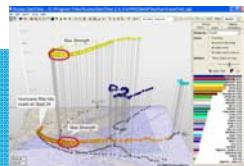
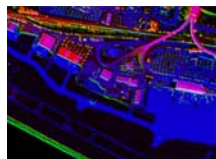
- VGI: GeoTagged photographs
- Kite photography
- Microsoft Kinect
- Quadcopters
- UAVs
- Webcams
- Virtual geography



SOME UNSOLVED PROBLEMS

- Fusion
- Conflation
- Spatio-Temporal GIS (4D GIS)
- Change detection
- Multiple moving objects
- Forecasting, modeling and simulation

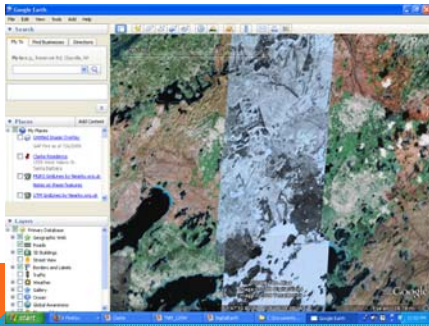
Fusion: aggregation, integration and conflation of geospatial data across time and space with the goal of removing the effects of data measurement systems and facilitating spatial analysis and synthesis across information sources



CONFLATION



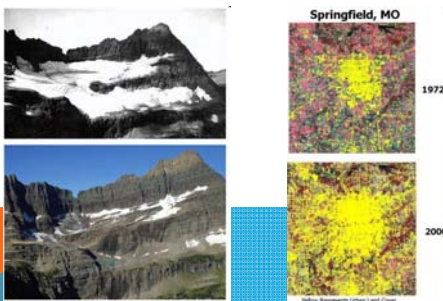
TEMPORAL CONFLATION



SOURCE/SCALE CONFLATION



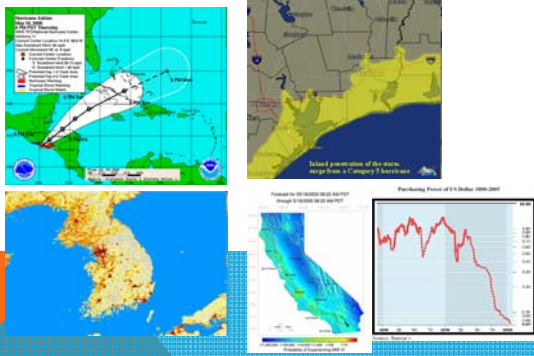
AUTOMATED CHANGE DETECTION



MULTIPLE MOVING OBJECTS

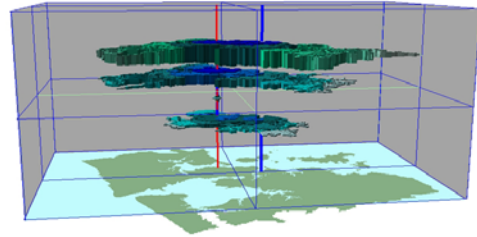


Forecasting: an operational research technique used to anticipate outcomes, trends, or expected future behavior of a system using statistics and modeling.

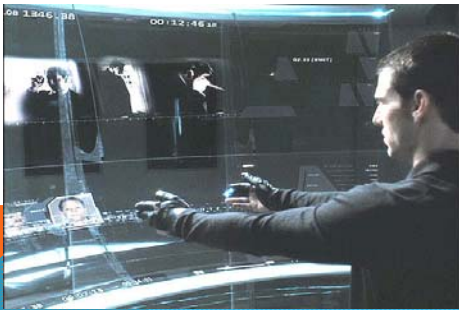


GEOSPATIAL ISSUES IN 2025 GEOPRIVACY

Who owns your lifeline?

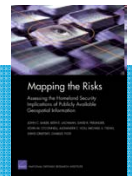


LOSS OF ANONYMITY (MINORITY REPORT 2002)



THE THREATS

- FOIA vs. "Mapping the Risks"
- Geoslavery
- "You have no privacy - get over it." (Scott McNealy, Sun Microsystems)



COMING NEXT

The Final Exam!

