



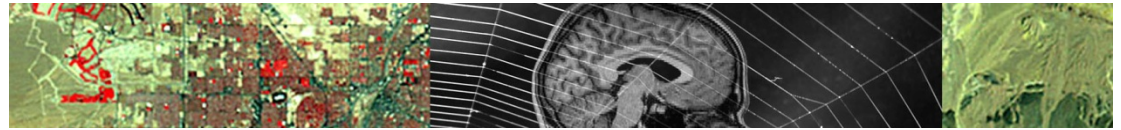
Citizens as Sensors: Web 2.0 and the World of Volunteered Geography

Michael F. Goodchild
University of California
Santa Barbara



How is geographic information created?

- By authorities
 - USGS
 - NGA
 - Ordnance Survey
 - military in many countries
 - state and local governments
- Disseminated to users
 - with restrictions
 - at cost of production or reproduction?
 - restrictions since 9/11



Defining geographic information

- every item is georeferenced
- atomic form
<location, time, property>
- alias geospatial



The formal naming process

- U.S. Board on Geographic Names
 - 1890
- A hierarchy of boards from local to national
 - no role for amateurs, the general public
- Need to standardize
 - to avoid confusion
 - postal delivery



National Spatial Data Infrastructure

- Breakdown of the authoritative system
 - government reluctance to fund
 - increasing demand
 - empowerment of smaller agencies and individuals
 - collapse of initial costs
 - abundance of data sources
- 1992 National Academy report
 - a patchwork approach
 - Executive Order 12906 in 1994
 - facilitated by standards
 - Federal Geographic Data Committee
 - Open Geospatial Consortium, ISO



The Waldseemüller map

- St Dié-des-Vosges, 1507
- A name that stuck



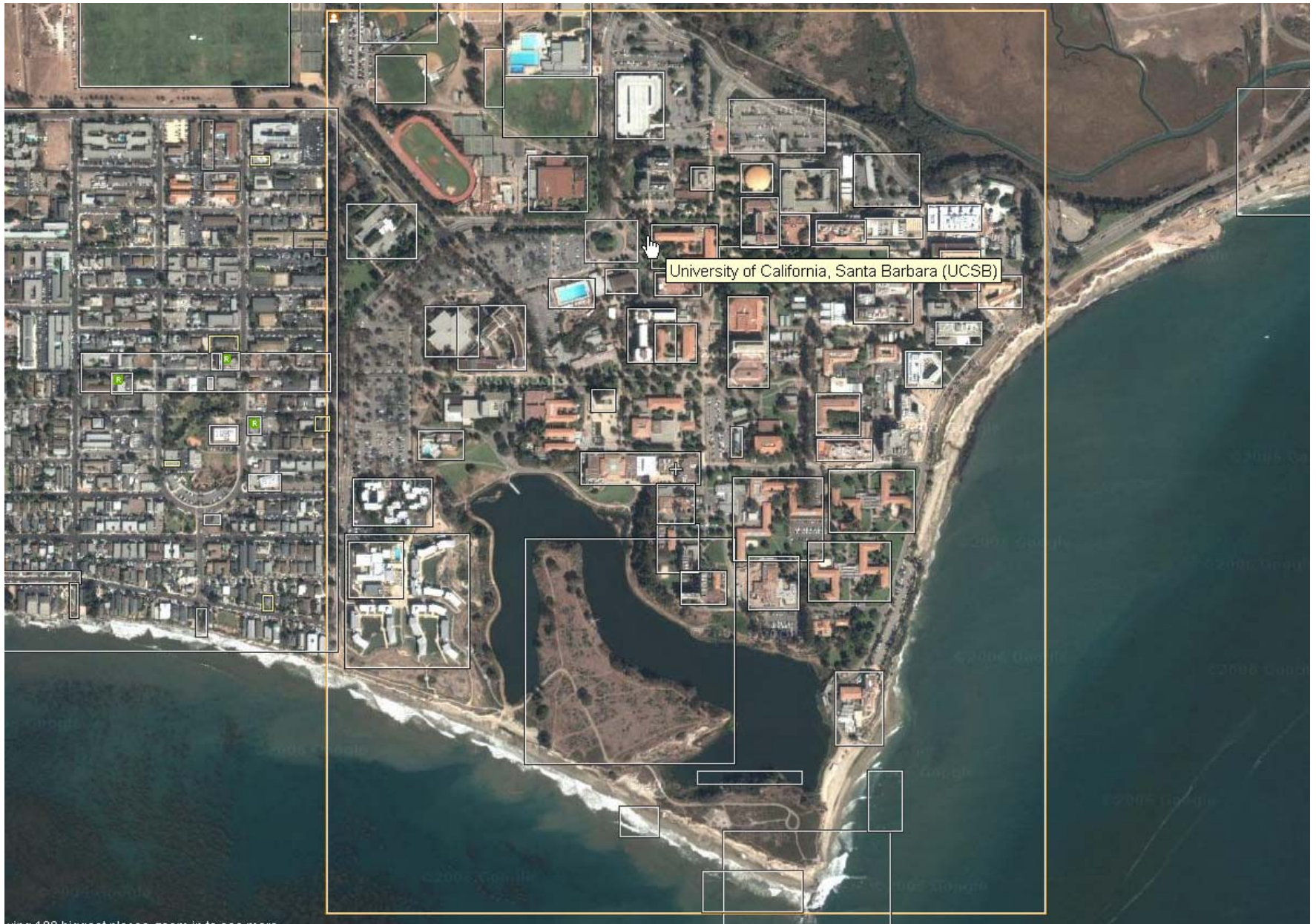




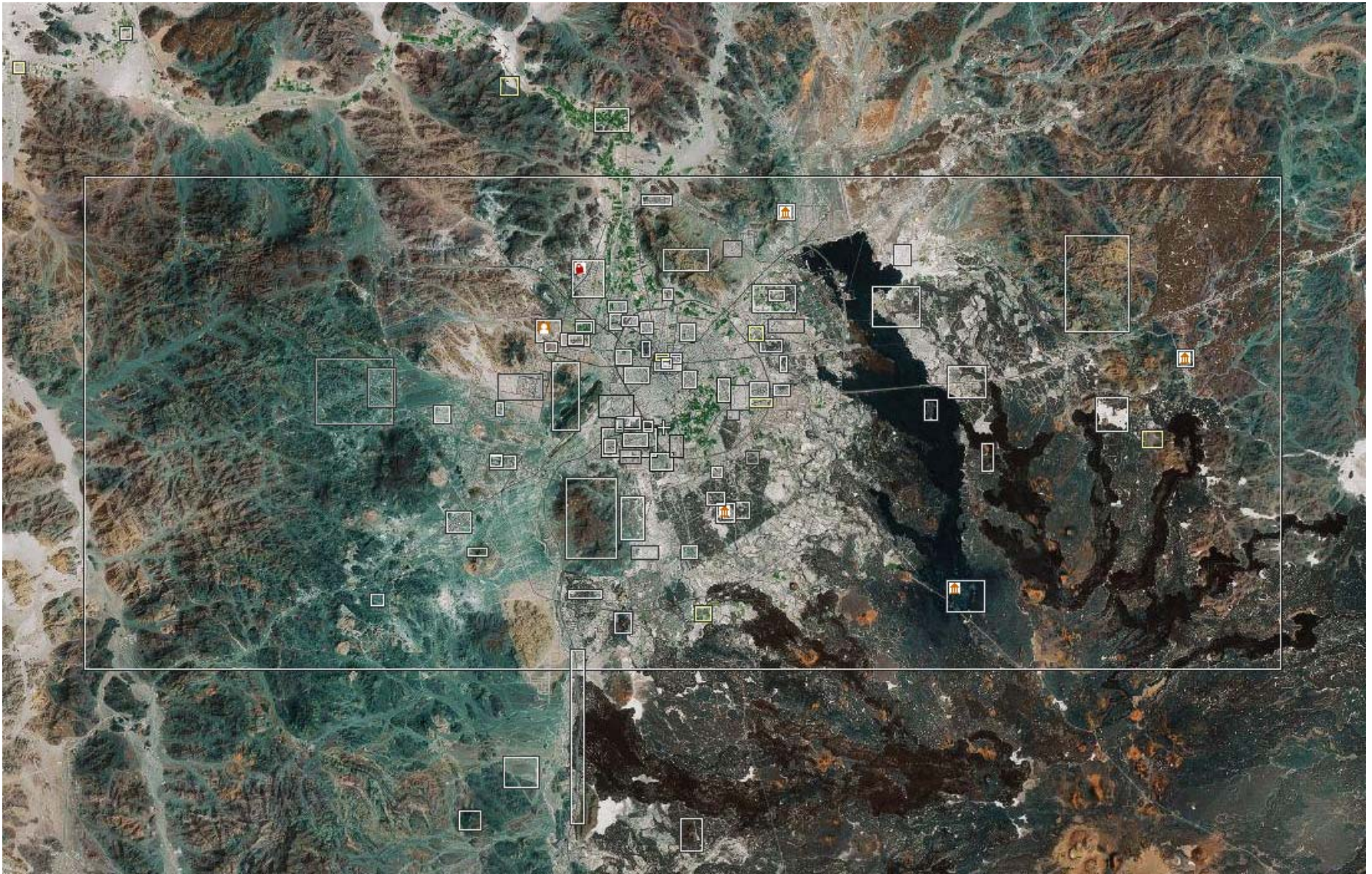


Volunteered geographic information (VGI)

- A phenomenon of the 21st Century
 - recent months
- *User-generated content*
- *Collective intelligence*
- *Crowdsourcing*
- *Asserted information*
- *Neogeography*
- The empowerment of millions of private citizens
 - largely untrained
 - no obvious reward
 - no guarantee of truth
 - no authority



www.wikimapia.org



www.wikimapia.org



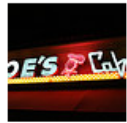
www.flickr.com

You're on page **1 of 1**
1 photo taken here

Map
[Hybrid](#)
[Satellite](#)

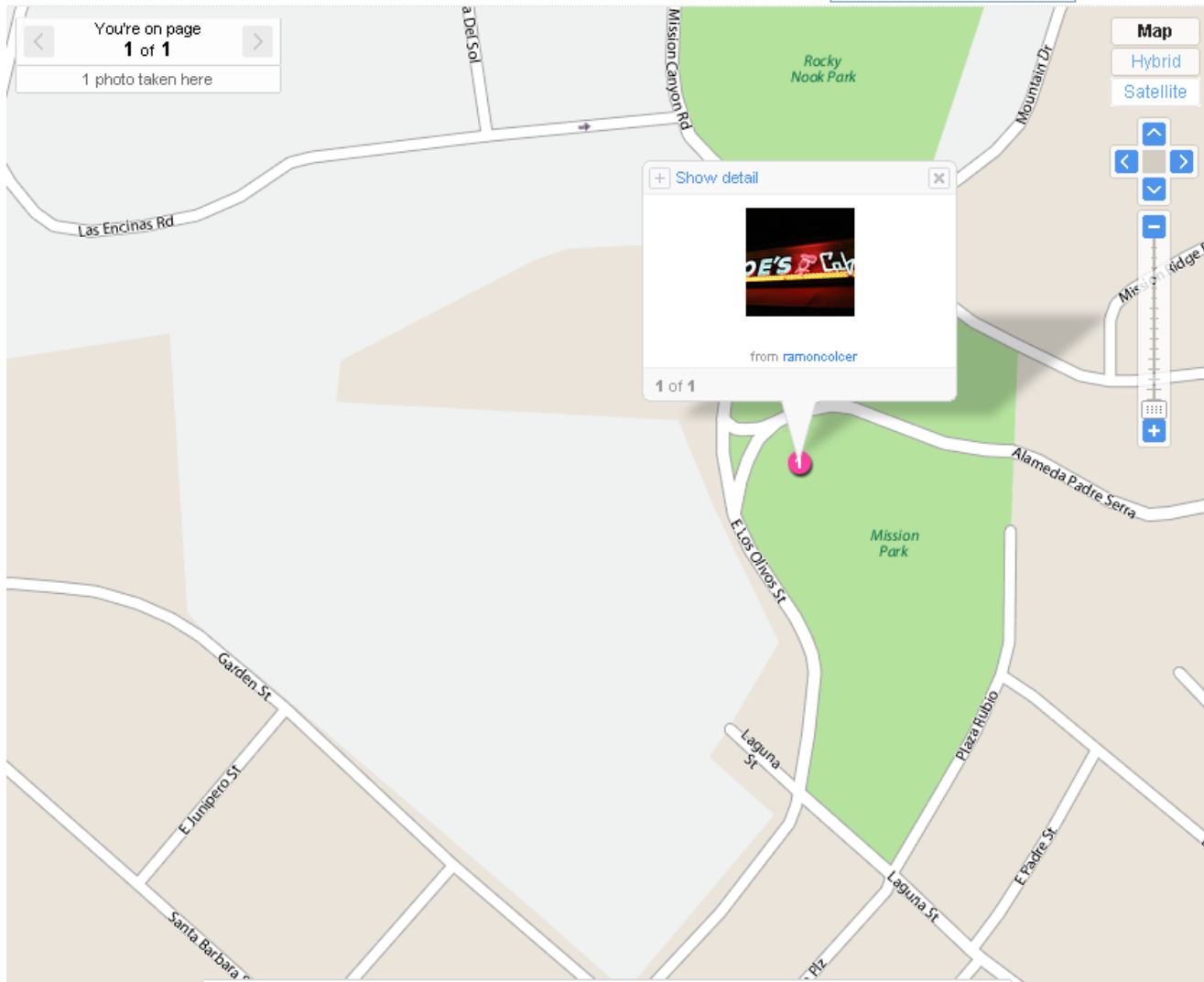


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from [ramoncoler](#)

1 of 1

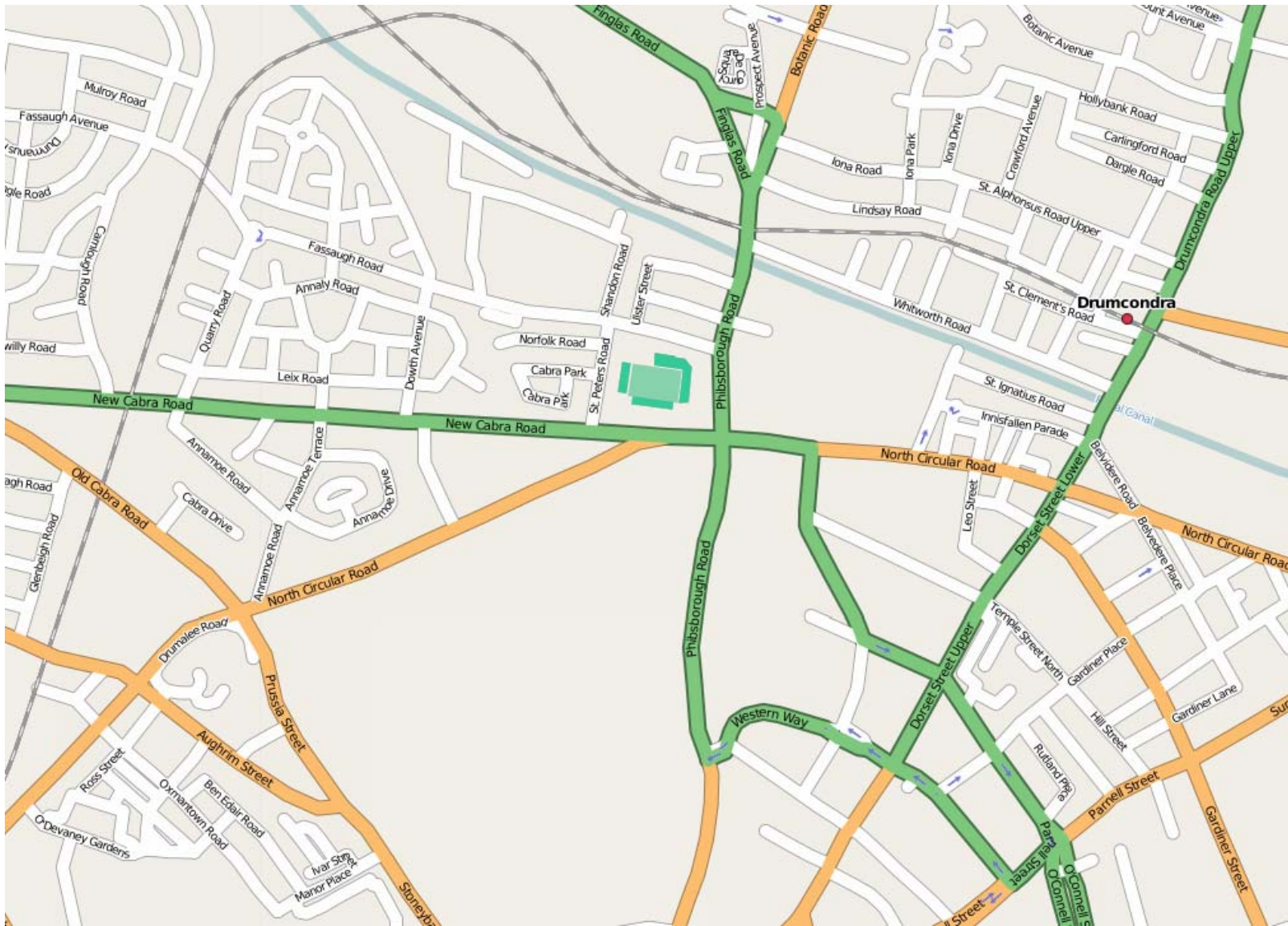


Search [GO](#) [Clear](#)

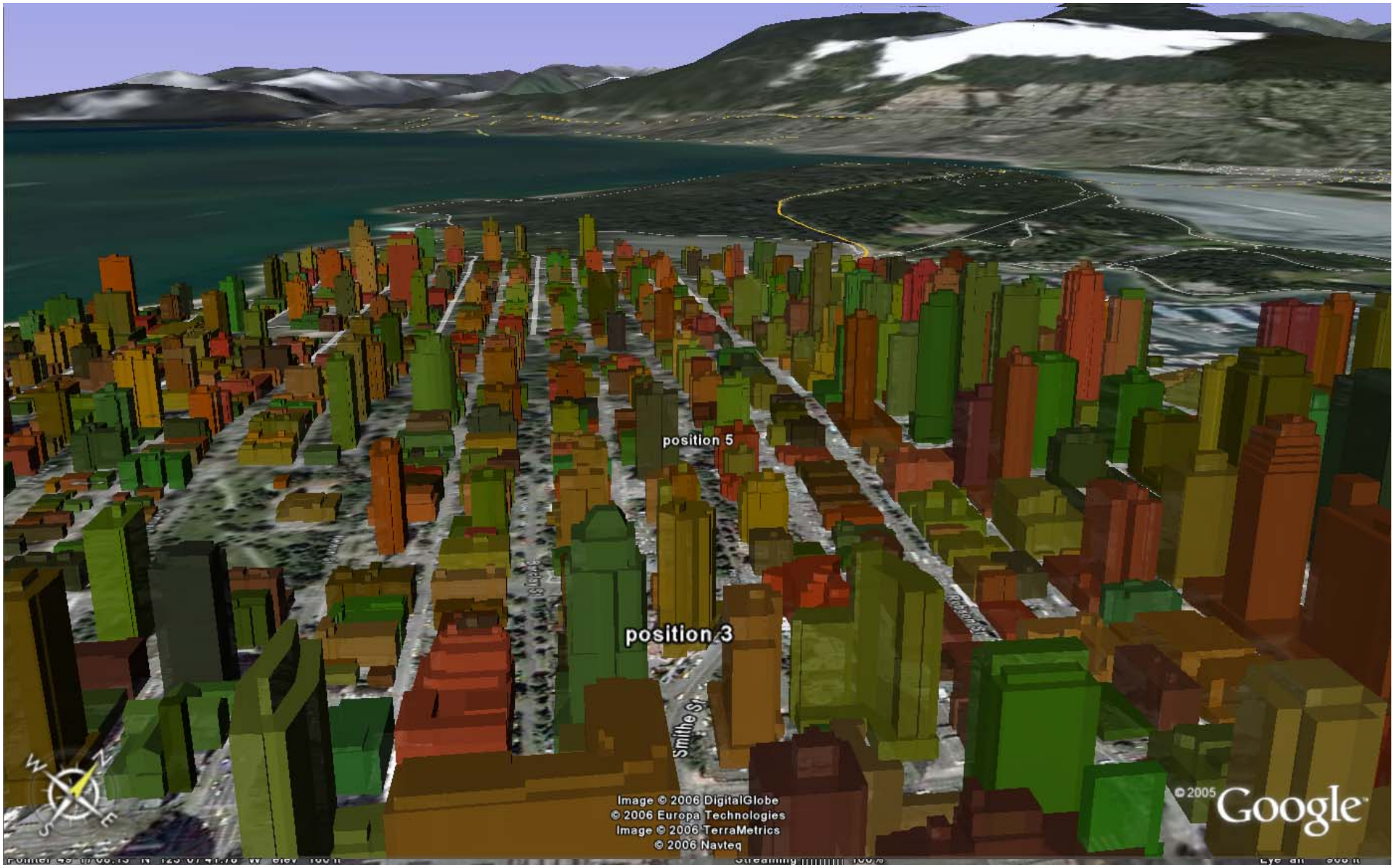
You're looking at **All geotagged photos matching "restaurants".** [Clear all](#)

[Filters](#)

100 m
1250 ft
Data ©Navteq, TeleAtlas



www.openstreetmap.org



position 5

position 3

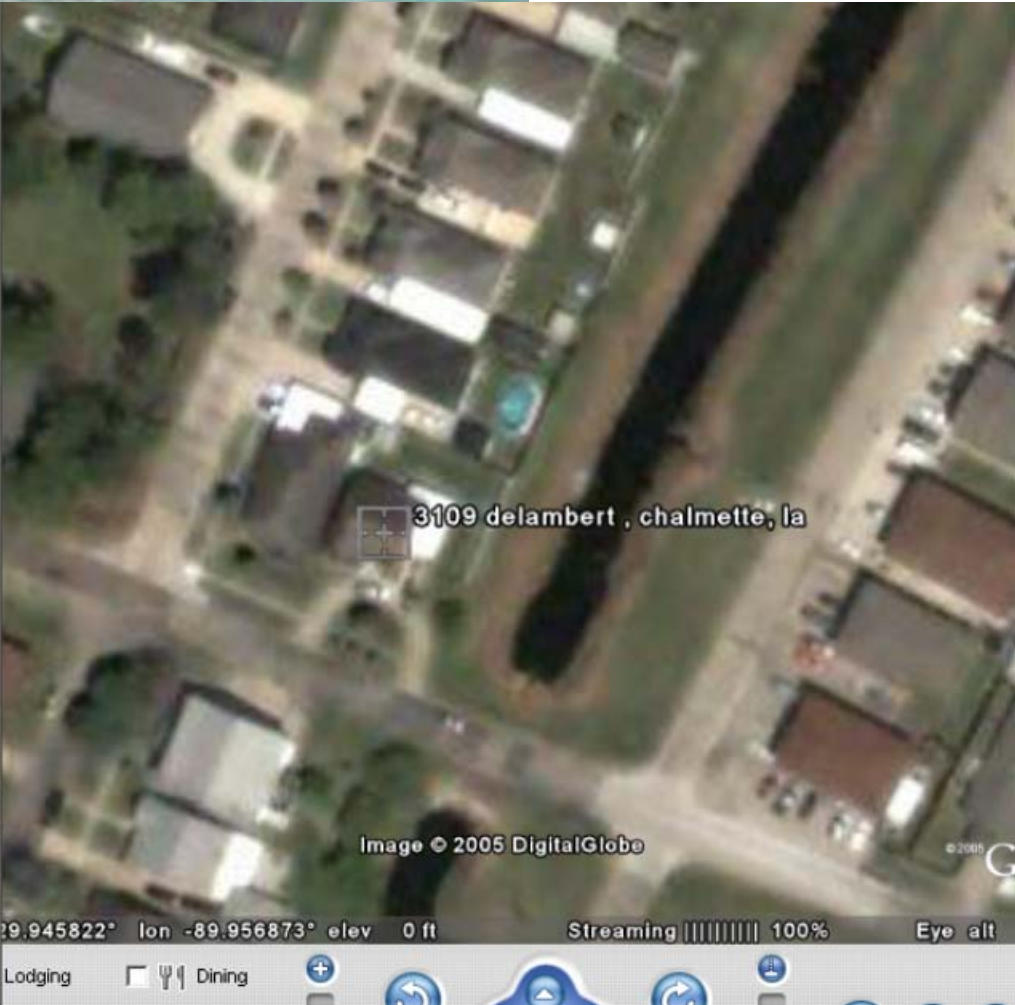
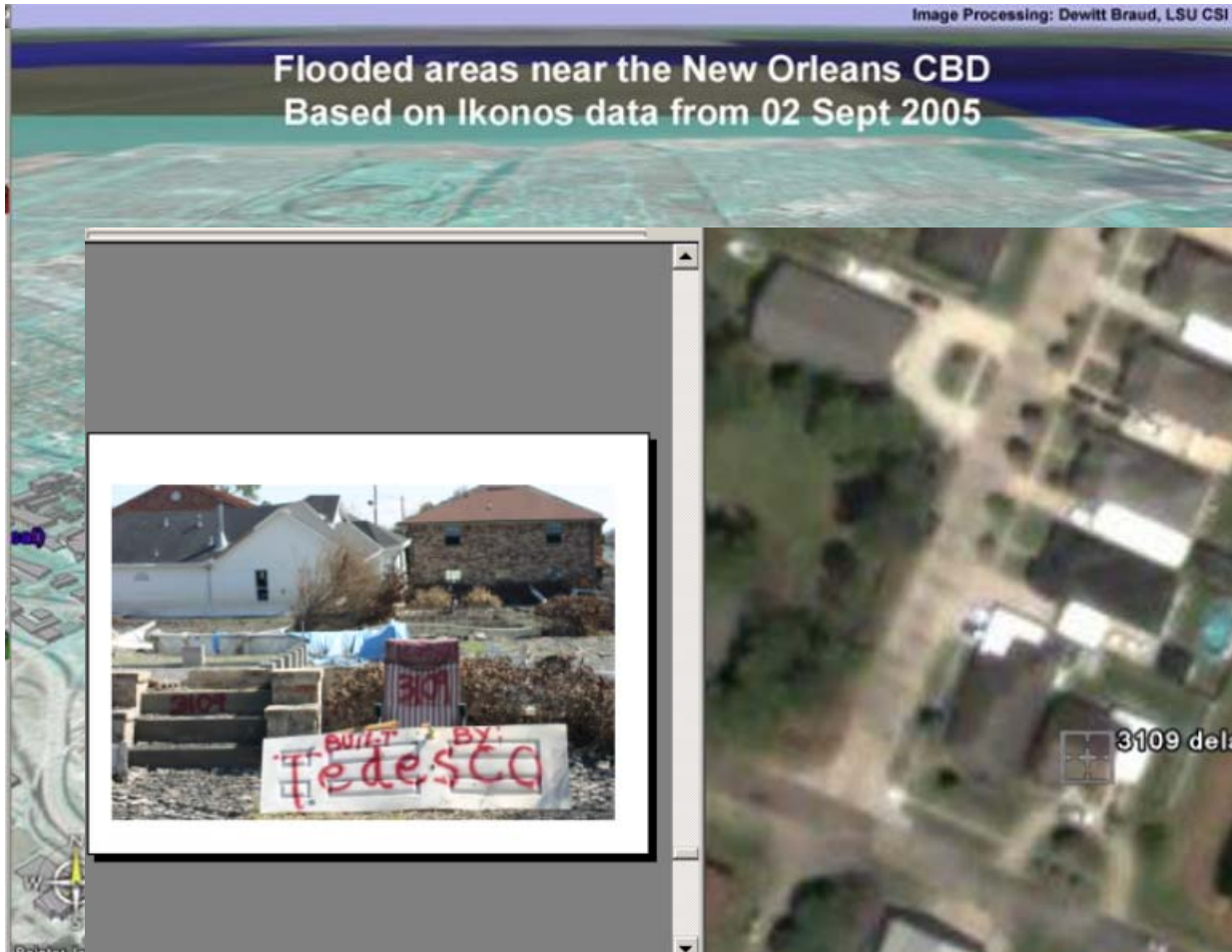
Smith St

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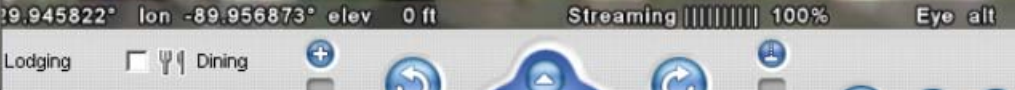


Flooded areas near the New Orleans CBD Based on Ikonos data from 02 Sept 2005



A
to add notes

h





1. Google Earth image
2. 1843 map of London from David Rumsey collection
3. Pump and death locations from my own web site



What makes this possible?

- Web 2.0
 - from downloaded content
 - to user-generated content
 - compare blogs, wikis
- Web search engines
 - making it possible to find user-generated content
 - Google Earth mash-ups
 - “Jane Austen Google Earth”
 - the power consumption problem
 - how long will Google scale?



Image NASA
 © 2007 Europa Technologies
 © 2007 Cnes/Spot Image
 © 2007 Infoterra Ltd & Bluesky



Georeferencing

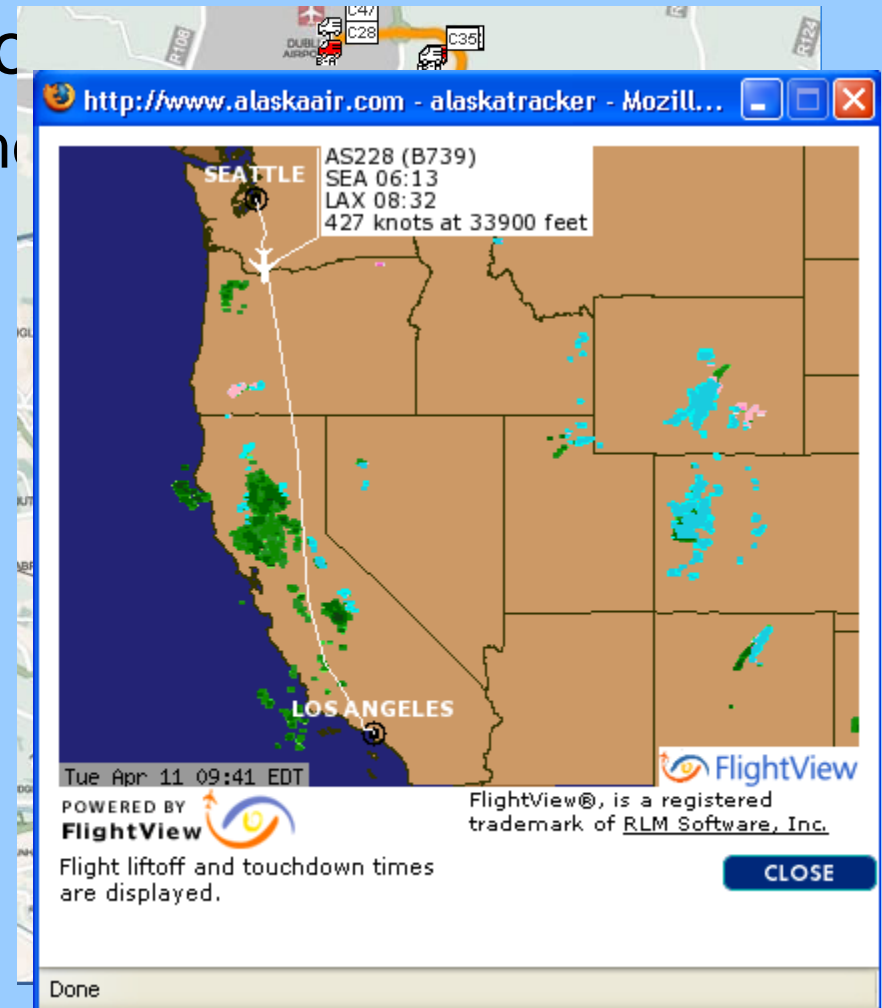
- The ability to determine location quickly and easily
 - most people do not know their latitude and longitude
 - what is at:
120.12456 W, 34.89176 N
5789654N, 314654E, Zone 11, Northern Hemisphere
NE 1/4, Section 12, Township 23 Range 5 of the Second
California Principal Meridian
909 West Campus Lane, Goleta, CA 93117, USA
- Read coordinates from Google Earth etc.
- GPS





Dynamic geographic information

- Live feed to desktop
 - integrated with other
 - www.aircoach.ie



Loma Linda University Medical Center DISCOVERIES AEGIS - Microsoft Internet Explorer

File Edit View Favorites Tools Help

LOMA LINDA UNIVERSITY MEDICAL CENTER • DISCOVERIES PROJECT
Advanced Emergency Geographic Information System

Help Log Out
Current Time: 10-24-07 16:29:23

Station ID: []

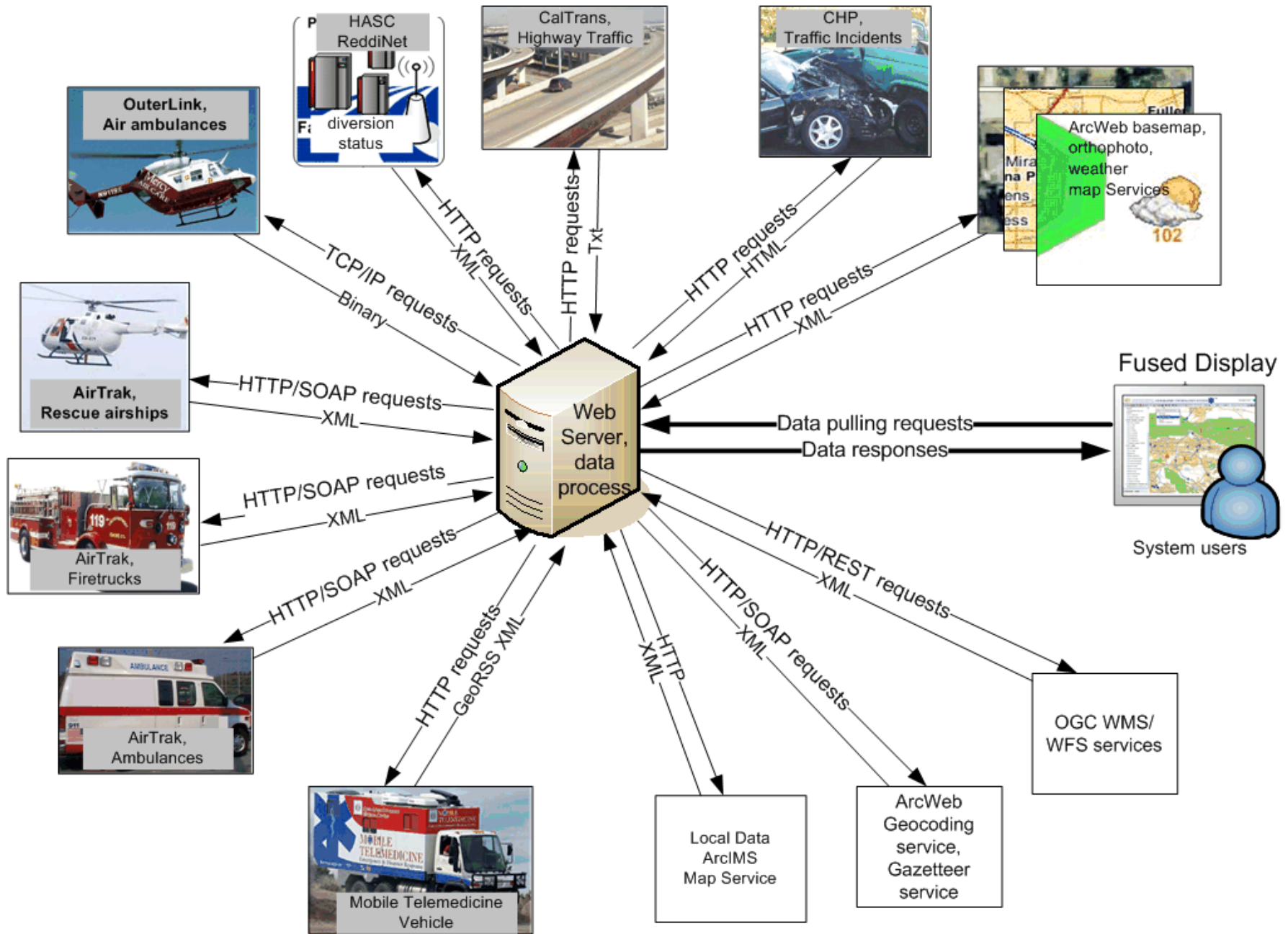
Zoom to: []
Refresh Rate: Off []
Turn Orthophoto [On] [Off]
Refresh Map

- MX_Weather_Current
- TC_Traffic
- geomac
 - Current Fires
 - Current Fire Perimeters
 - MODIS Thermal Satellite
 - HMS Thermal Satellite
 - All 2007 Fires
 - Past 2007 Perimeters
 - Past 2007 MODIS
 - 2006 Fires
 - 2005 Fires
 - 2004 Fires
 - 2003 Fires
 - 2002 Fires
 - Historic Fire Perimeters (2001-2006)
 - RAWs Weather Stations
 - Cities and Towns
 - Road Numbers
 - Roads and Interstates
 - States
 - Counties
 - Land Ownership
 - Lakes and Ponds
 - Rivers and Streams
 - Wildland-Urban Interface
 - Shaded Relief
- LLUMC_LocalData
- MX_Precipitation
- GlobeExplorer_Premium_US

Pacific Ocean

0 3 5 km

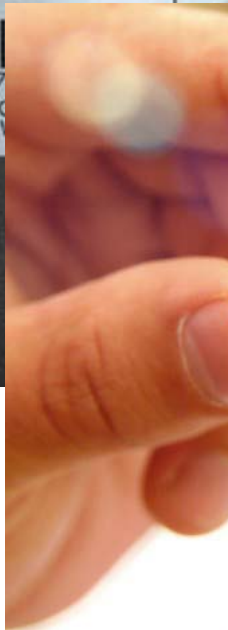
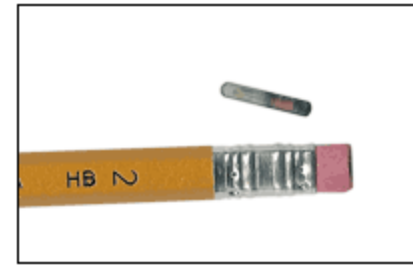
Done Internet





RFID

- Radio frequency identification
 - scanning without the laser
 - active or passive
- Tracking of objects
 - goods from production to retail display to sale
 - construction materials
 - pets, livestock, children, parolees



Mar 2007 Issue

Feature Articles



SELECT AN ISSUE

March 2007

IN THIS ISSUE:

FEATURE ARTICLES

NEWS ANALYSIS

OPINIONS

RESOURCES

INDUSTRY FOCUS

UNIVERSITY FOCUS

SPECTRUM EXTRAS

Product & Industry Search
POWERED BY THOMASNET

Winner
of two 2007
Jessie H. Neal
Awards for
editorial excellence.

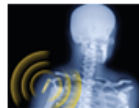
Winner of two 2007



PHOTO: AMAL GRAAFSTRA

Hands On

How radio-frequency identification and I got personal



RFID inside
The murky ethics of implanted chips



AT&T's Attic
Locked away in a suburban New Jersey warehouse, a quirky archive preserves funky but priceless relics of the electronic age



What Is It?
In our wanderings through the AT&T Archives, we came across some truly weird and mysterious artifacts. See if you can figure out what they are

[» More feature articles](#)

TOP NEWS

'Fridge Magnet Monitors Energy Use
April 26, 2007

Billionaires Join Forces to Aid Schools
April 25, 2007

U.S. High-Tech Jobs Accelerating Again
April 24, 2007

U.S. Spacecraft Give Sun a CAT Scan
April 23, 2007

YOUR OPINION

If they made your life easier, would you get RFID chips implanted in your body?

Yes: 44%

No: 56%

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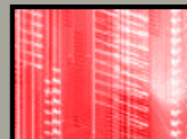
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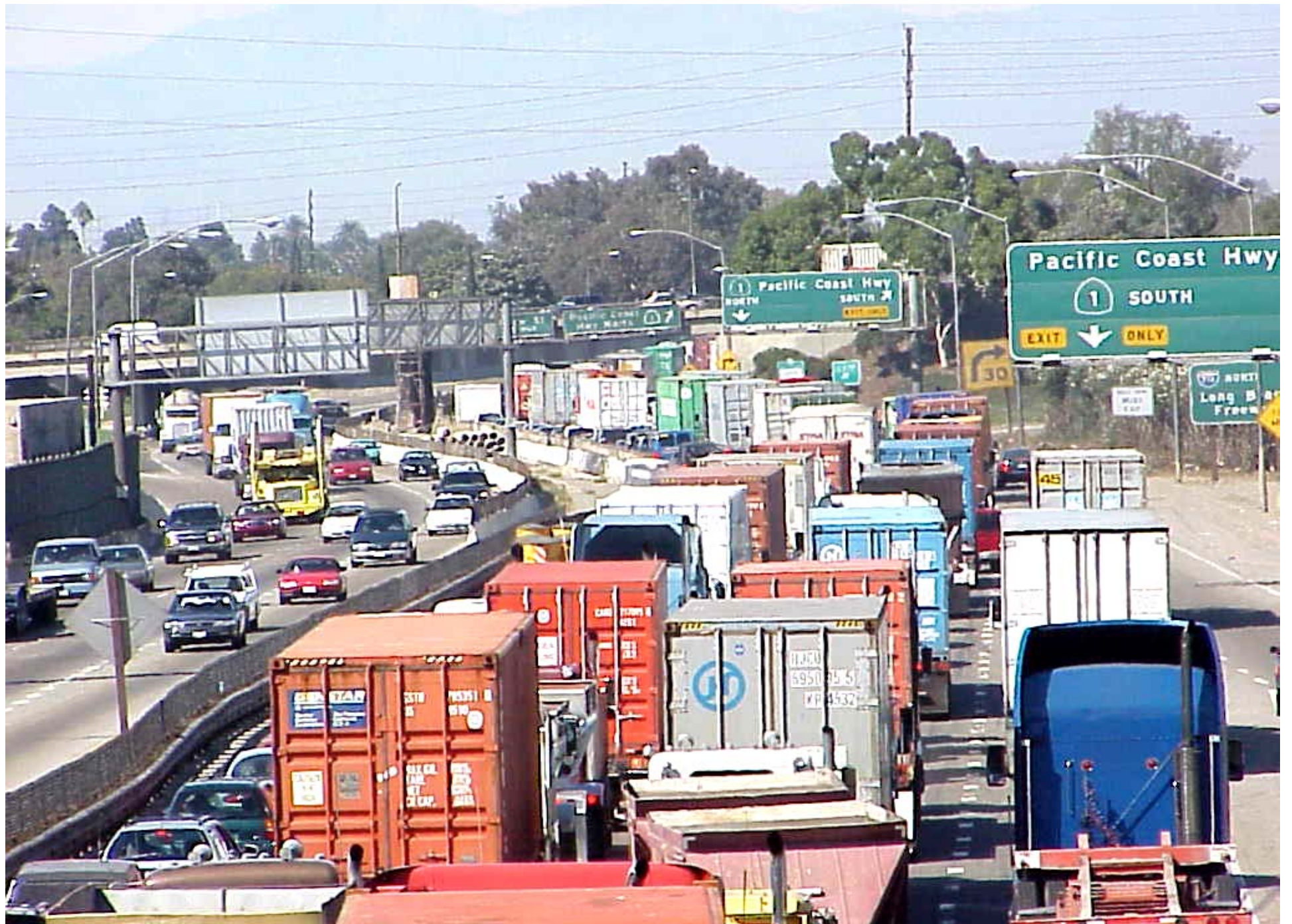


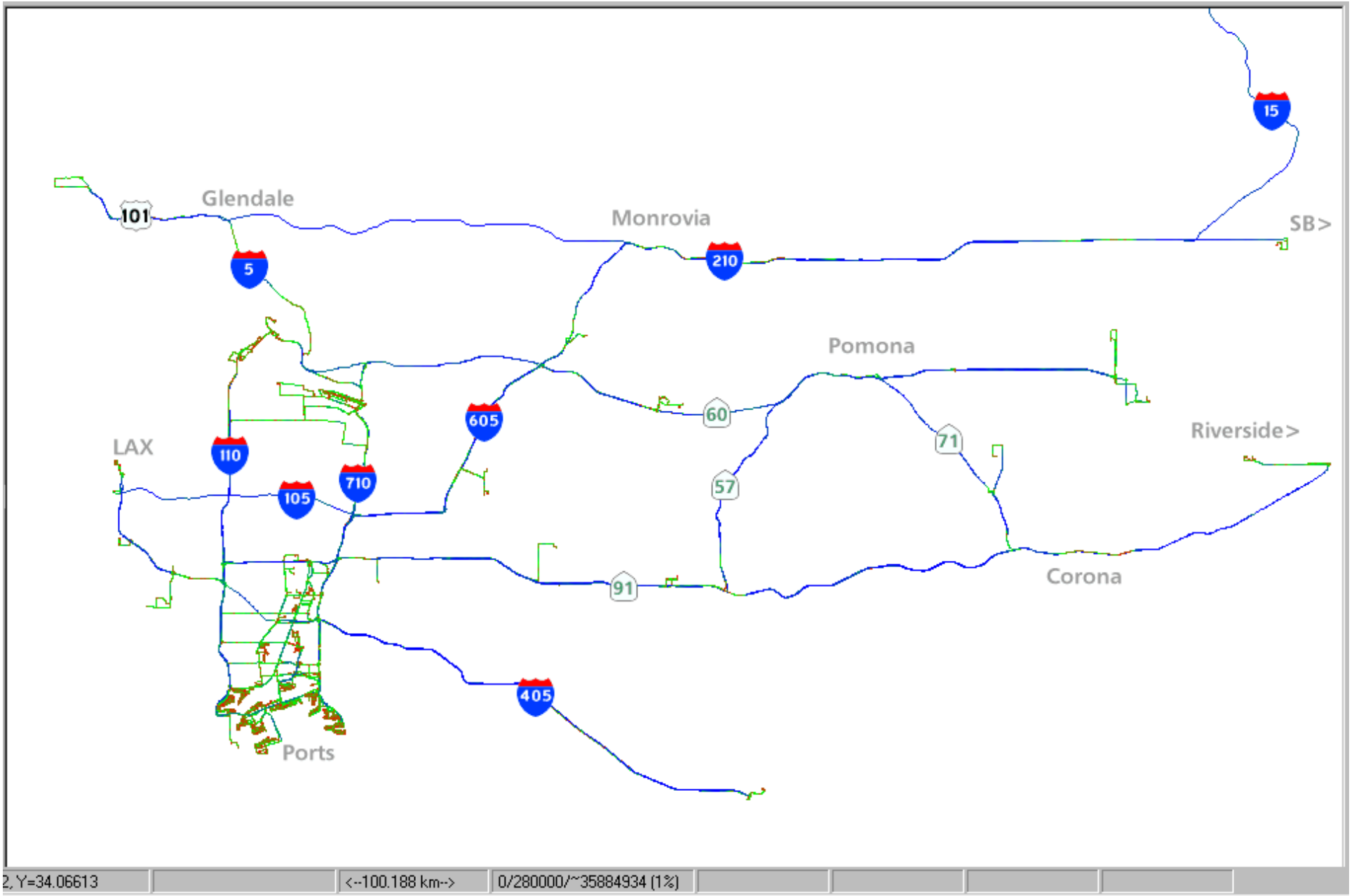


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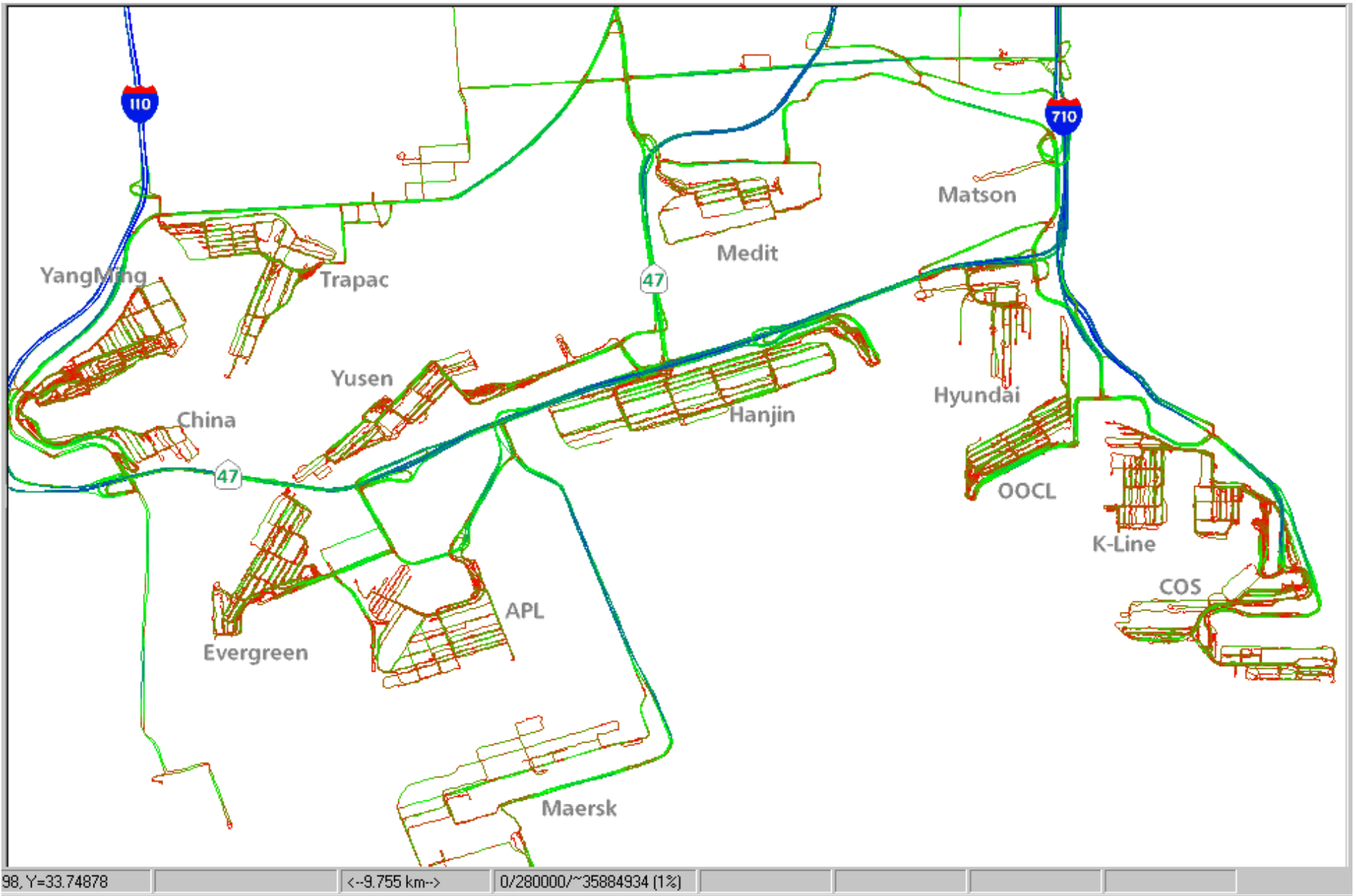
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L002: LA Basin, 4 months

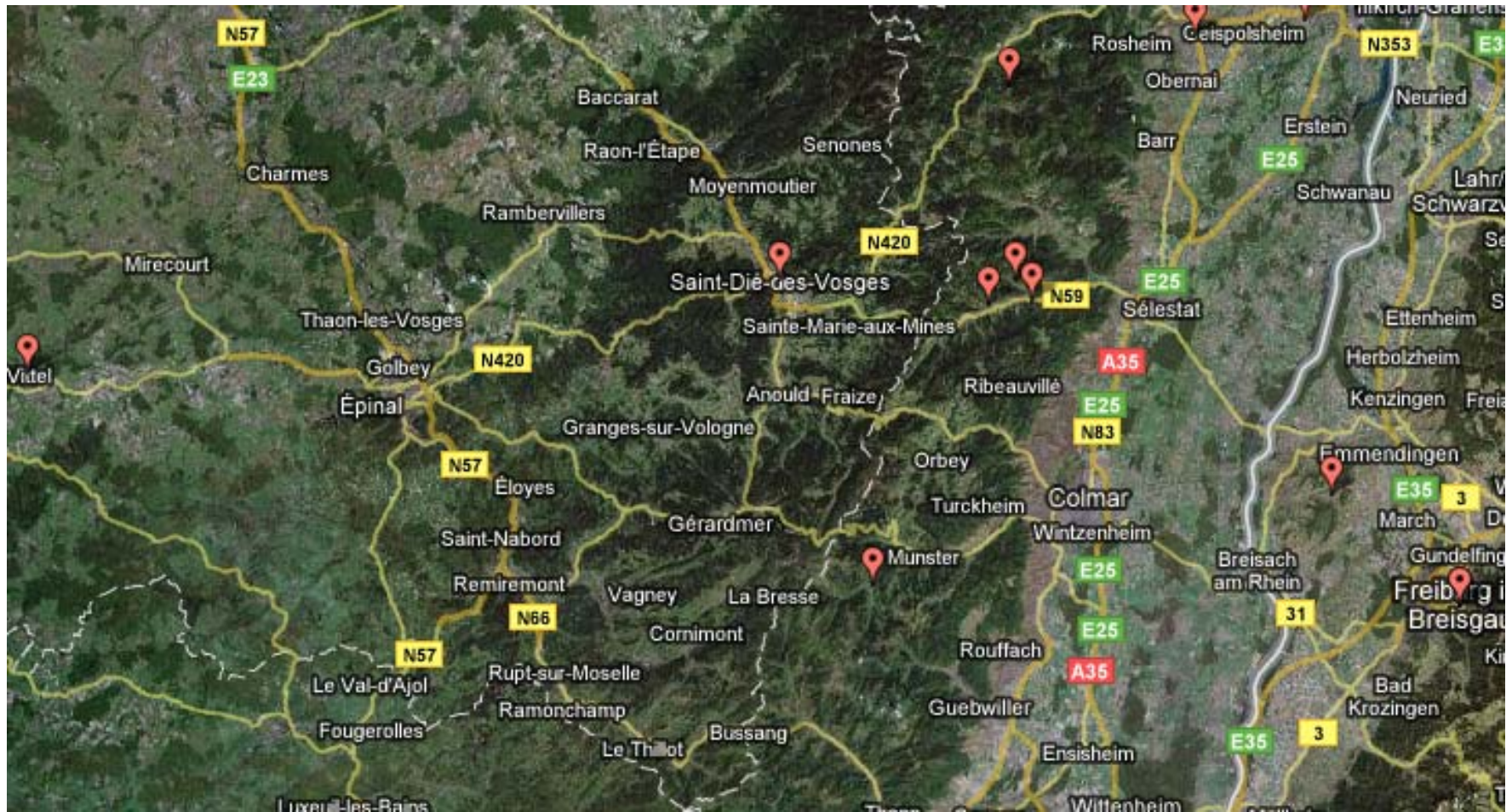


L002: Port terminals



Geotags

- Invisible codes inserted into Web text
 - Wikipedia entries



www.geonames.org



Concepts

- Spatial data infrastructure
 - 1993 in U.S.
 - response to declining role of national mapping agency
 - increasing role of local agencies, private sector, individuals
- A patchwork
 - variable spatial detail
 - determined by local demand, local supply
 - independent contributions
 - integrated with software
 - edge-matched
 - using IT to overcome differences and ambiguities
 - rather than authority to remove them



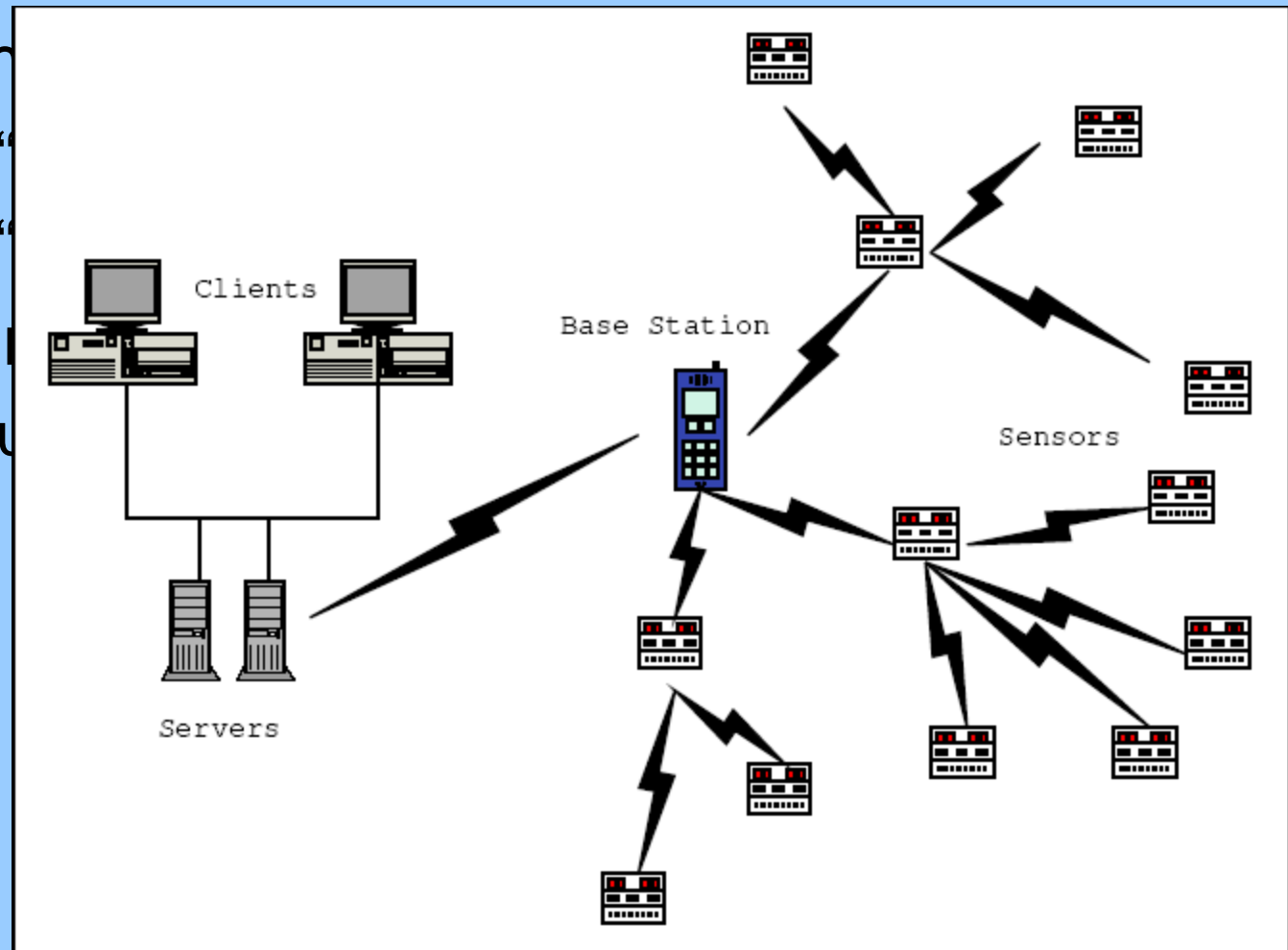
Humans as sensors

- Sensor networks
 - sensors that know where they are
 - report appropriate features of environment
 - networks of video monitors
 - atmospheric sensors



Sensor networks

- Sm
- “
- “
- Se
- U





The spatial web

- Objects that know and report where they are
 - together with other information
- Servers that compile and distribute information
- Users who can combine data from various sources
- [NPR audio clip](#)



Three types of sensor networks

- Inert, fixed
- Carried on moving objects
 - vehicles
 - pedestrians
 - asthma research
- Human beings
 - 6 billion intelligent sensors
 - informed observers
 - rich local knowledge
 - uplink technology
 - broadband Internet
 - mobile phone



Citizen science

- Networks of amateur observers
 - possibly trained, skilled
- Christmas Bird Count
 - thousands of volunteer participants
 - protocols
- Project GLOBE
 - an international network of school children
 - reporting environmental conditions
 - central integration and redistribution



Participant populations

- Open to all
 - Wikimapia, Flickr
- Trained or skilled volunteers
 - Christmas Bird Count
- School children
 - GLOBE
- Vehicle fleets
 - Inrix
- Farmers
 - precision agriculture
- Reversing the traditional top-down flow

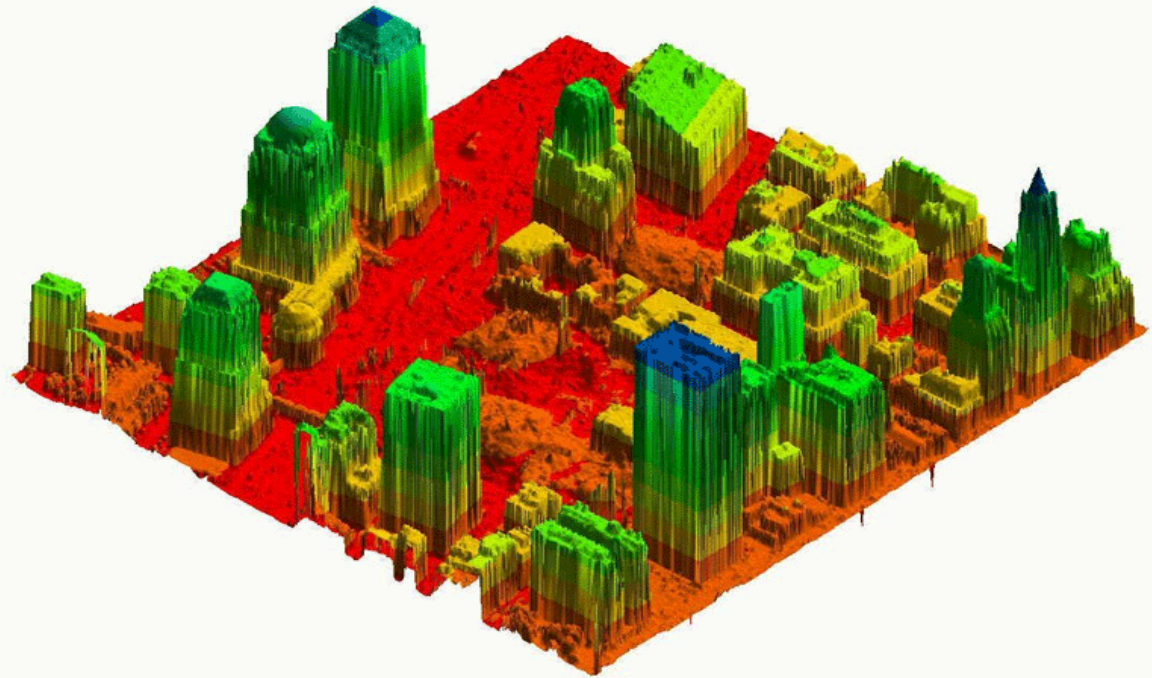
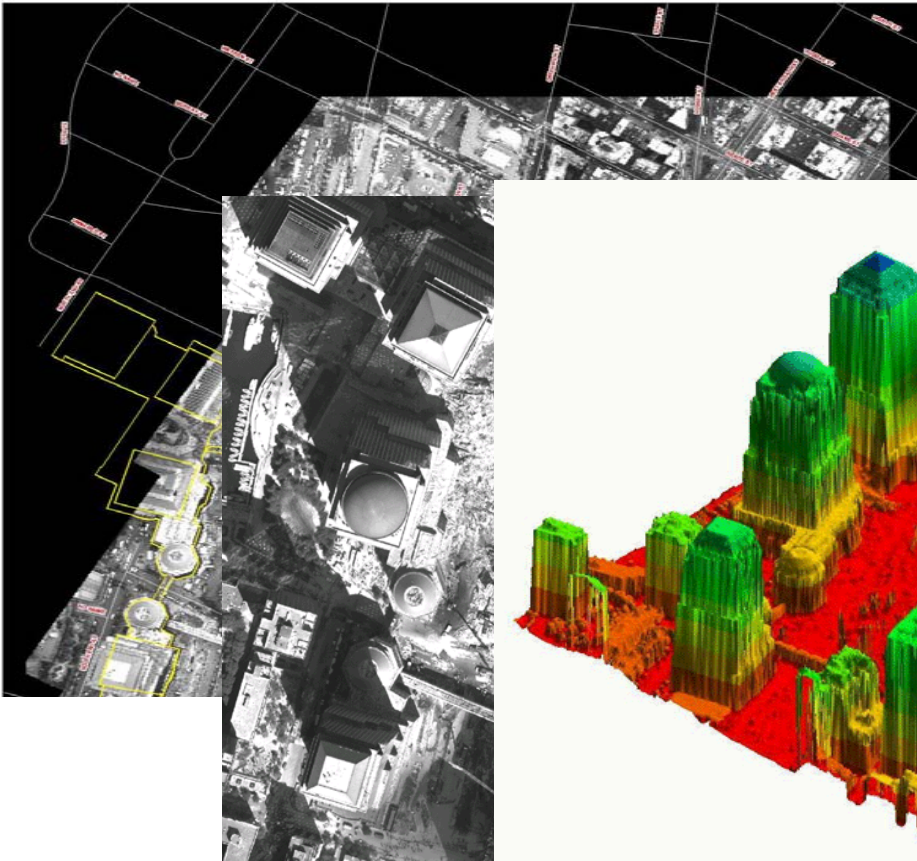


Early warning

- Recent disasters
 - Indian Ocean tsunami
 - Hurricane Katrina
- Breakdown of technology
 - no power
 - no computers
 - no Internet connections
- Delays in acquiring imagery from satellites
- Human observers in the impacted area



City of New York
Emergency Mapping Center
Rudolph W. Giuliani, Mayor



NYC Office of Emergency Management and NY Office of Cyber Security and Critical Infrastructure Coordination



New Orleans, January 2006



Andrew Smith, MapAction, www.mapaction.org

<http://www.irlogi.ie/>



Why do people do this?

- Self-promotion
 - exhibitionism
 - information remains identified with source
 - compare Census
- Altruism
 - a belief that everything on the Web can be found
 - and will be used to good effect
- A desire to fill gaps in available data
 - especially in areas where data are not available
 - or where access is denied for security
- Sharing with friends, relatives
 - but accessible by all



Authority and assertion

- Traditional mapping to high quality
 - authoritative
- Potential for subversion
 - Soviet mapping
 - compare spam, viruses, attacks
- The Wikipedia process
 - anyone can edit
 - reviewed by volunteers



Google Earth coverage of Santa Barbara



Channel Island Rd

Lagoon Rd

© 2007 Google™

Pointer lat 34.407924° lon -119.842092° elev 0 m

Image © 2007 DigitalGlobe
© 2007 Europa Technologies

© 2007 Navteq

Streaming ||||| 100%

Eye alt 491 m



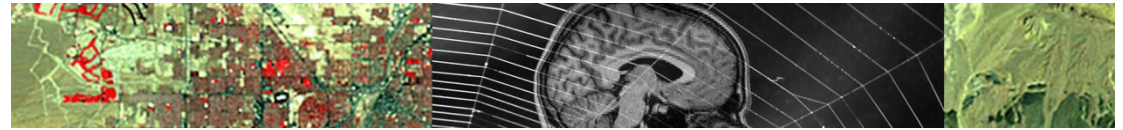
The digital divide

- VGI implies connectivity
 - preferably broadband
 - for both uplink and downlink
 - what can be achieved with a cellphone and text?
- Roman alphabet dominant
 - problems with diacriticals

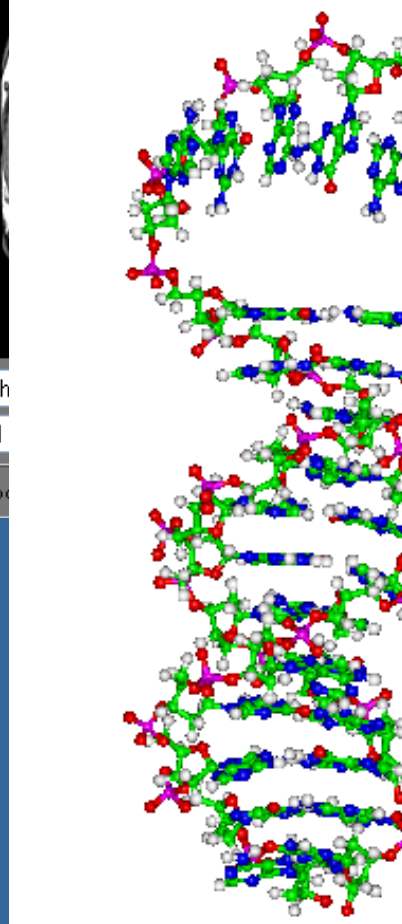
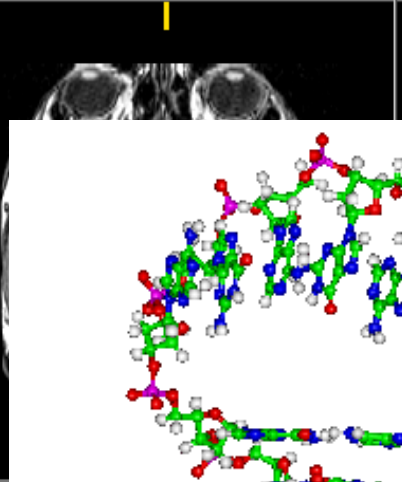


The value of VGI

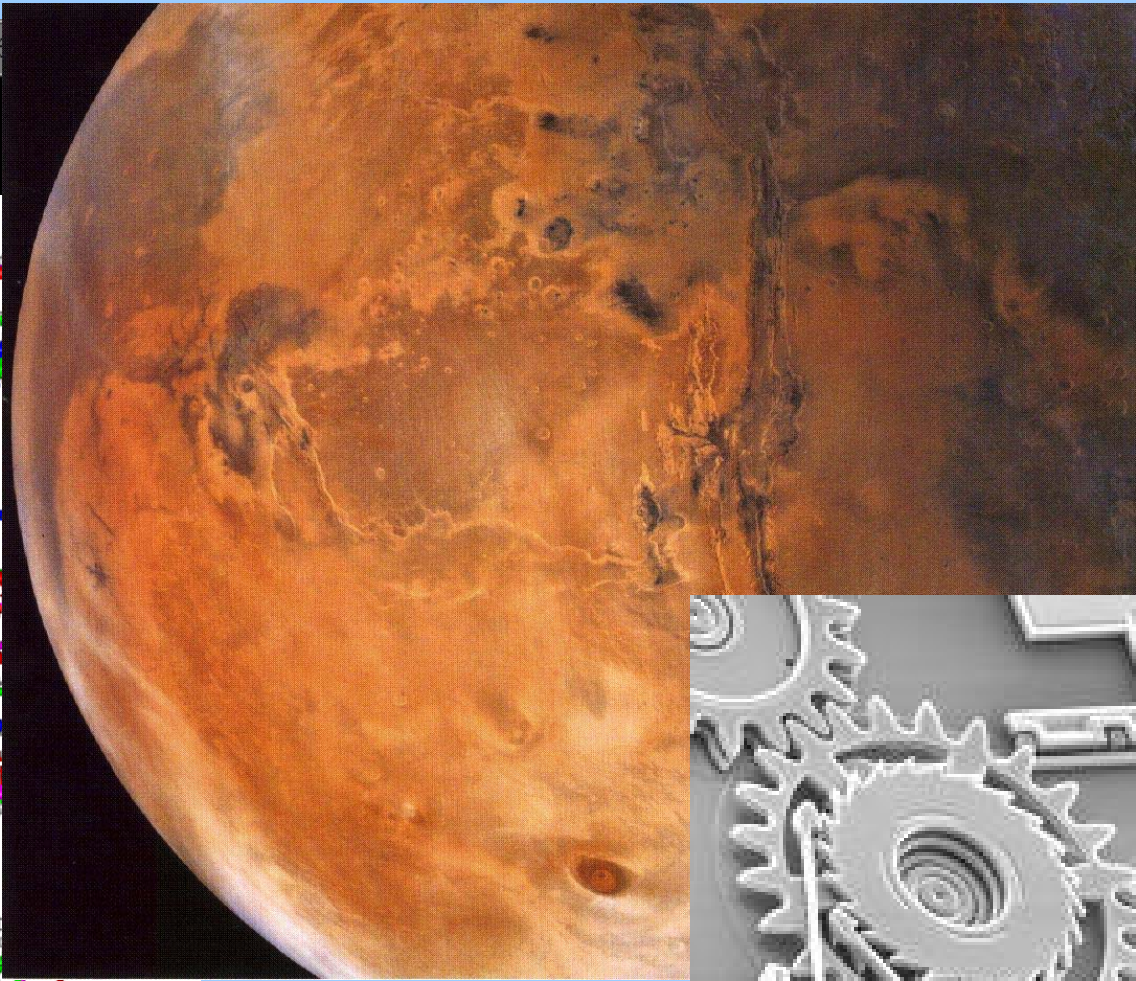
- A significant contribution to geography
 - enhancing our knowledge of the Earth
 - local focus
 - engaging citizens
- Many unresolved questions
 - trust
 - preservation
 - social psychology

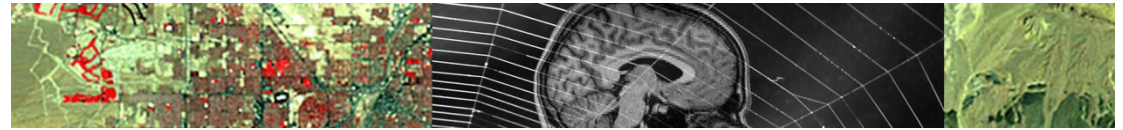


Transaxial# 72



Brain-h
orbital
Show p





Natio

Buffalo

AI

National Center for Ecological
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University of California Santa Barbara

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Cognitive Science Program UCSB

Welcome

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 - Courses
 - Join the Program
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 - Departments & Programs
 - Faculty
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The SAGE Center
For the Study of the Mind

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Introduction

visiting distinguished fellows

lecture series

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SAGE Publications gives generous \$3.5 million gift for creation of innovative new center at UCSB.

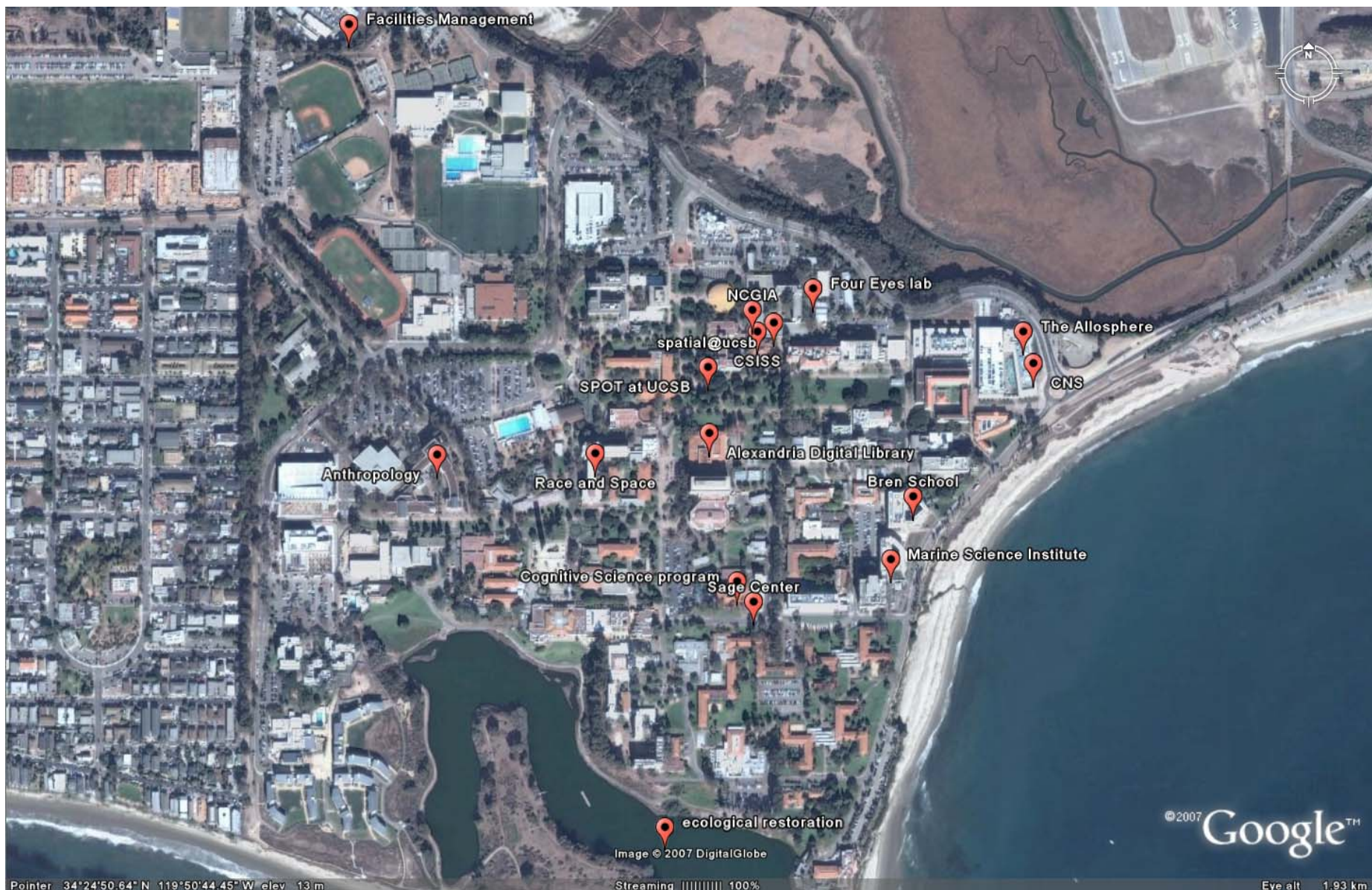
Michael Gazzaniga to serve as Center Director.

Shanto Ivengar will serve as a Visiting Distinguished Fellow starting October 2007.

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

CNS-UCSB
Center for Nanotechnology in Society

UCSB is spatial



Facilities Management

NCGIA

Four Eyes lab

The Allosphere

spatial@ucsb

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Bren School

Cognitive Science program

Sage Center

Marine Science Institute

ecological restoration

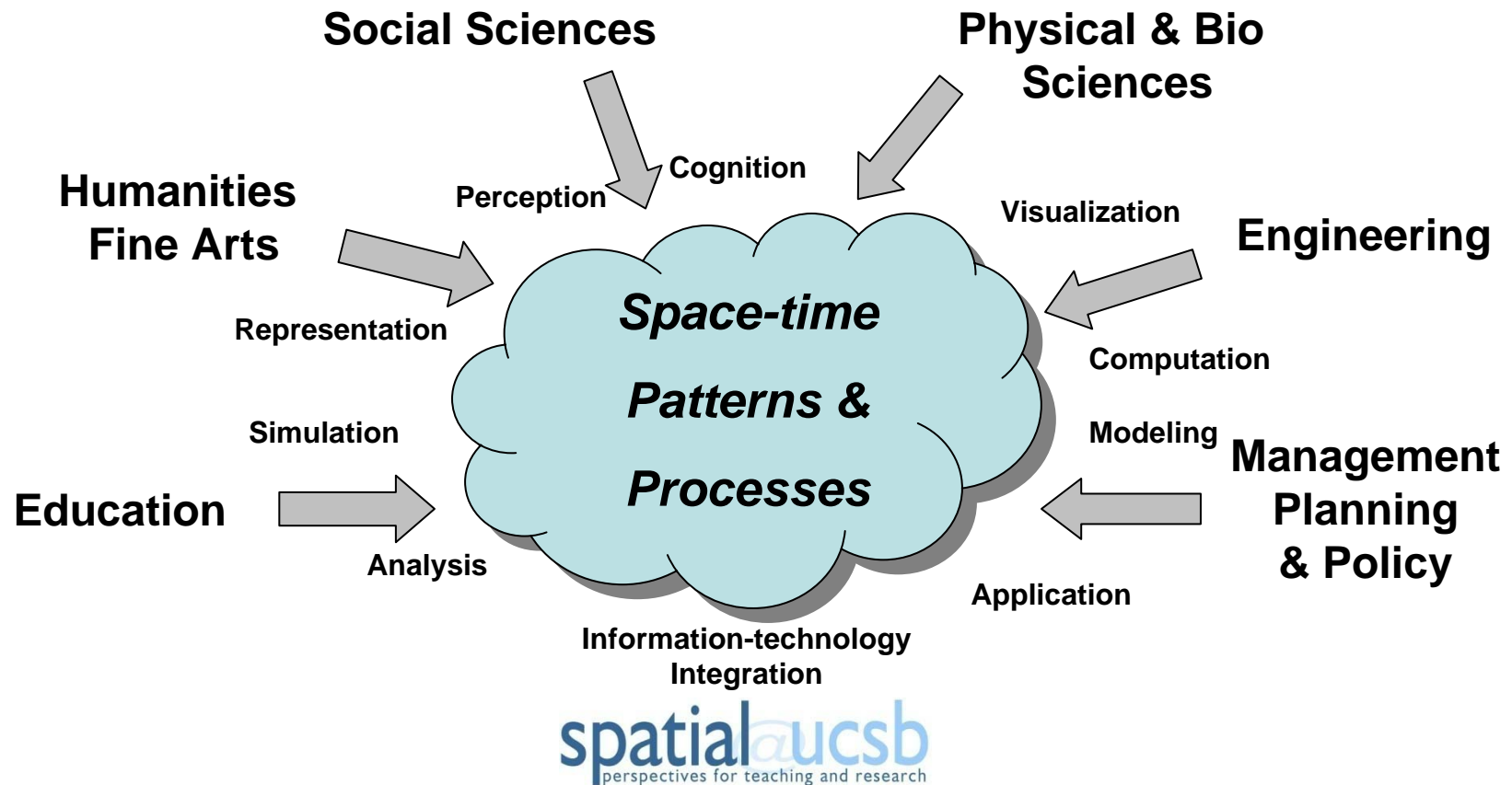
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Pointer 34°24'50.64" N 119°50'44.45" W elev 13 m

Image © 2007 DigitalGlobe

Streaming ||||| 100%

Eye alt 1.93 km



- Exchange ideas and resources
- Promote new tools, research, and applications
- Enhance spatial literacy
- Community of spatial thinkers
- Web portal on spatial UCSB
- Seminars and workshops
- Spatial help desk
- General course(s) on spatial thinking