



Analytical and Computer Cartography Winter Quarter 2017

Lecture 16: The NSDI and a Digital Earth

What is the NSDI?



National Spatial Data Infrastructure

“...the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve the utilization of geospatial data.”

What is the NSDI?

- Organizations and individuals cooperating
- Using electronic technology to help find and share geographic information
- Following mutually accepted standards
- Developing common base themes of data

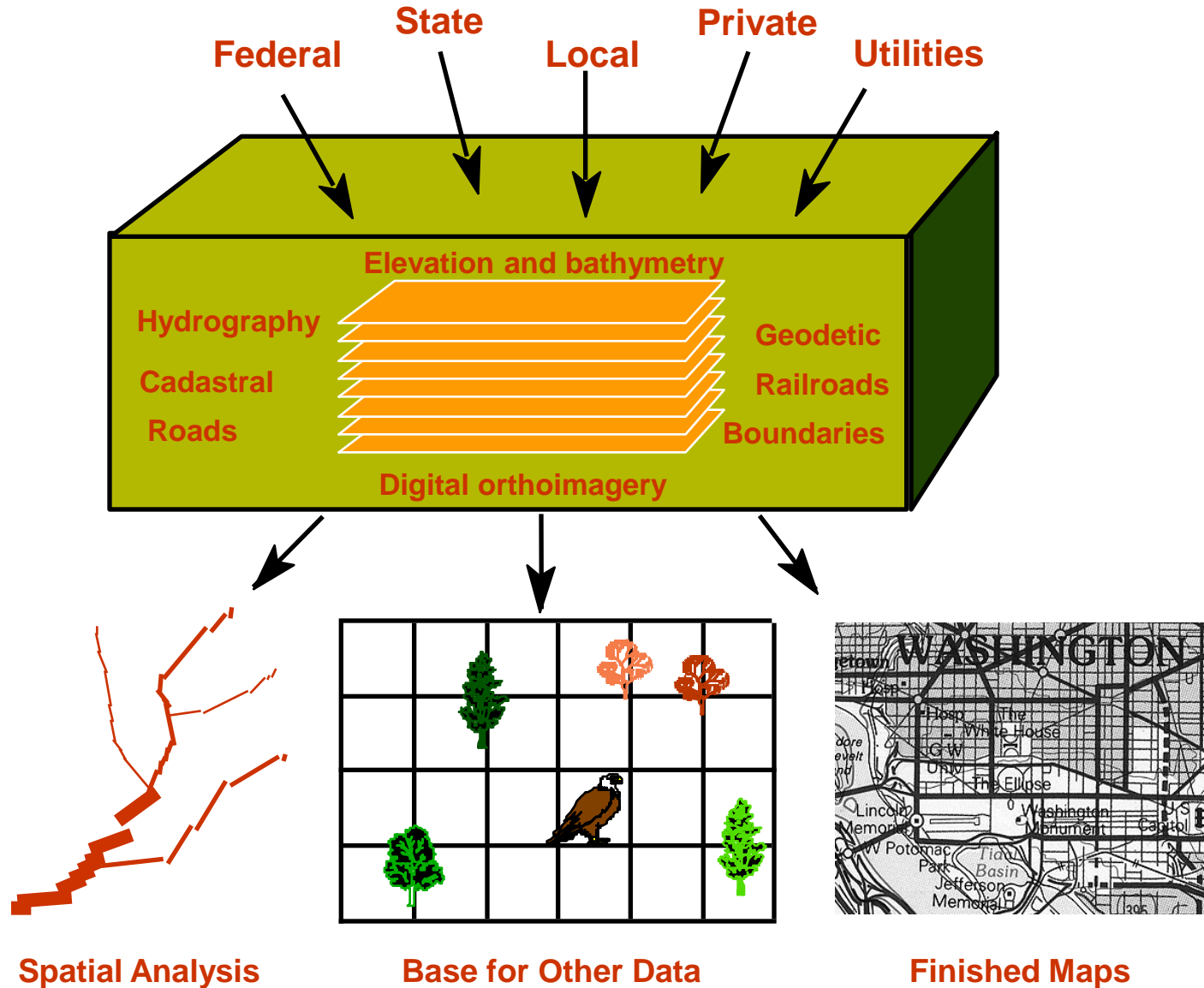
In reality....

- Data are hard to find
- Data are difficult to access
- Data are hard to integrate
- Data are not current
- Data are undocumented
- Data are incomplete

Two types of data

- Community-developed data sets usually derived for a single purpose but made available for potential re-use
- Data sets developed to a common content specification for high re-use potential. These are known as “Framework” data.

Framework Data



Metadata: Data about data

- Provides documentation of existing internal geospatial data resources within an organization (*inventory*)
- Permits structured search and comparison of held spatial data by others (*advertising, discovery*)
- Provides end-users with adequate information to take the data and use it in an appropriate context (*liability*)

Clearinghouses provide...

- Discovery of spatial data
- Distributed search worldwide
- Uniform interface for spatial data searches
- Advertising for your data holdings
- Means to clip, restructure and download

e.g. the National Map Viewer

The image shows a screenshot of the USGS National Map Viewer web application. The browser is Firefox, and the address bar shows the URL `viewer.nationalmap.gov/viewer/`. The page title is "USGS TNM 2.0 Viewer". The application interface includes a search bar, a layer selection panel on the left, and a map of the United States. The map shows state boundaries, major cities, and topographic features. The bottom of the screen displays the cursor position and scale.

Browser Information:
Firefox | USGS TNM 2.0 Viewer | `viewer.nationalmap.gov/viewer/`

Page Title: USGS TNM 2.0 Viewer

Search Bar: Search

Layer Selection Panel (Left):
Overlays | Selection | Cart
Content | Reorder Layers
Base Data Layers:
+ US Topo
+ Geographic Names (GNIS)
+ Structures
+ Transportation
+ Governmental Unit Boundaries
+ Map Indices
+ Hydrography (NHD)
+ Land Cover
+ Elevation Availability
+ Elevation Contours - Small Scale
+ Imagery
+ Scanned Topo Maps
+ Reference Polygons

Map Interface:
Standard | Advanced | Annotation | Active Tool: None (Map Navigation)
Topo | Imagery | Hydro-NHD | Hill Shade | Blank
 Show

Map Content: A map of the United States showing state boundaries, major cities, and topographic features. The map is centered on the central United States, showing states like Wyoming, Colorado, Nebraska, Kansas, Oklahoma, Texas, and others. Major cities like Denver, Chicago, and New York are visible.

Map Controls:
Scale: 1:18,489,298
Cursor Position: 40° 00' 57.496" N 87° 13' 24.144" W

Footer:
FAQ | Accessibility | FOIA | Privacy | Policies and Notices
8:57 AM 3/12/2013

e.g. Geoplatform.gov

The screenshot shows a web browser window displaying the GeoPlatform homepage. The browser's address bar shows the URL <https://www.geoplatform.gov>. The page features a large satellite map background. The main heading reads "Welcome to the Geospatial Platform". Below this, a sub-heading states: "The GeoPlatform provides shared and trusted geospatial data, services, and applications for use by the public and by government agencies and partners to meet their mission needs." A list of benefits for users is provided, including a one-stop shop for data, authoritative data for decision-making, reusable applications, shared infrastructure, and a focal point for data visualization. A "Learn More" button is positioned below the list. The "Featured" section contains three cards: 1) "Geospatial Platform Workshop Event Summary" with logos for the U.S. Department of the Interior, National Geospatial-Intelligence Agency, and WWHGD, and a link to FGDC.GOV. 2) "Geospatial Interoperability Reference Architecture (GIRA)" which includes a grid of nine reference models: Governance, Standards-Based Interoperability, Examples, Templates And Artifacts, Business Reference Model, Data Reference Model, Application Reference Model, Infrastructure Reference Model, Security Reference Model, and Performance Reference Model. 3) "Cloud Hosting Services" with a diagram of servers and clouds. The Windows taskbar at the bottom shows the time as 10:52 AM on 3/1/2017.

Fractal Topography by K... x GeoPlatform x

Secure | <https://www.geoplatform.gov>

Apps Google Google Calendar Breaking News, U.S., V Breaking News and O Web of Science [v.5.1] The New GauchoSpace Course Login | Online eGrades ScholarOne Manuscript

GeoPlatform Menu Sign In

Welcome to the Geospatial Platform

The GeoPlatform provides shared and trusted geospatial data, services, and applications for use by the public and by government agencies and partners to meet their mission needs.

GeoPlatform users have access to

- A one-stop shop that delivers trusted, consistent data and services
- Authoritative data to support informed decision making
- Reusable applications and services for governmental and nongovernmental use
- A shared infrastructure that can host your data and applications
- A focal point where governmental, academic, private, and public data can be visualized together to inform national and regional issues

[Learn More](#)

Featured

Geospatial Platform Workshop Event Summary

Download presentation slides and audio from the workshop on Dec 7-8, which presented the capabilities of the GeoPlatform to the community of data stewards.

[Learn More](#)

Geospatial Interoperability Reference Architecture (GIRA)

A governance and oversight framework to guide the acquisition, management and development decisions for geospatial technical architectures across government.

[Launch](#)

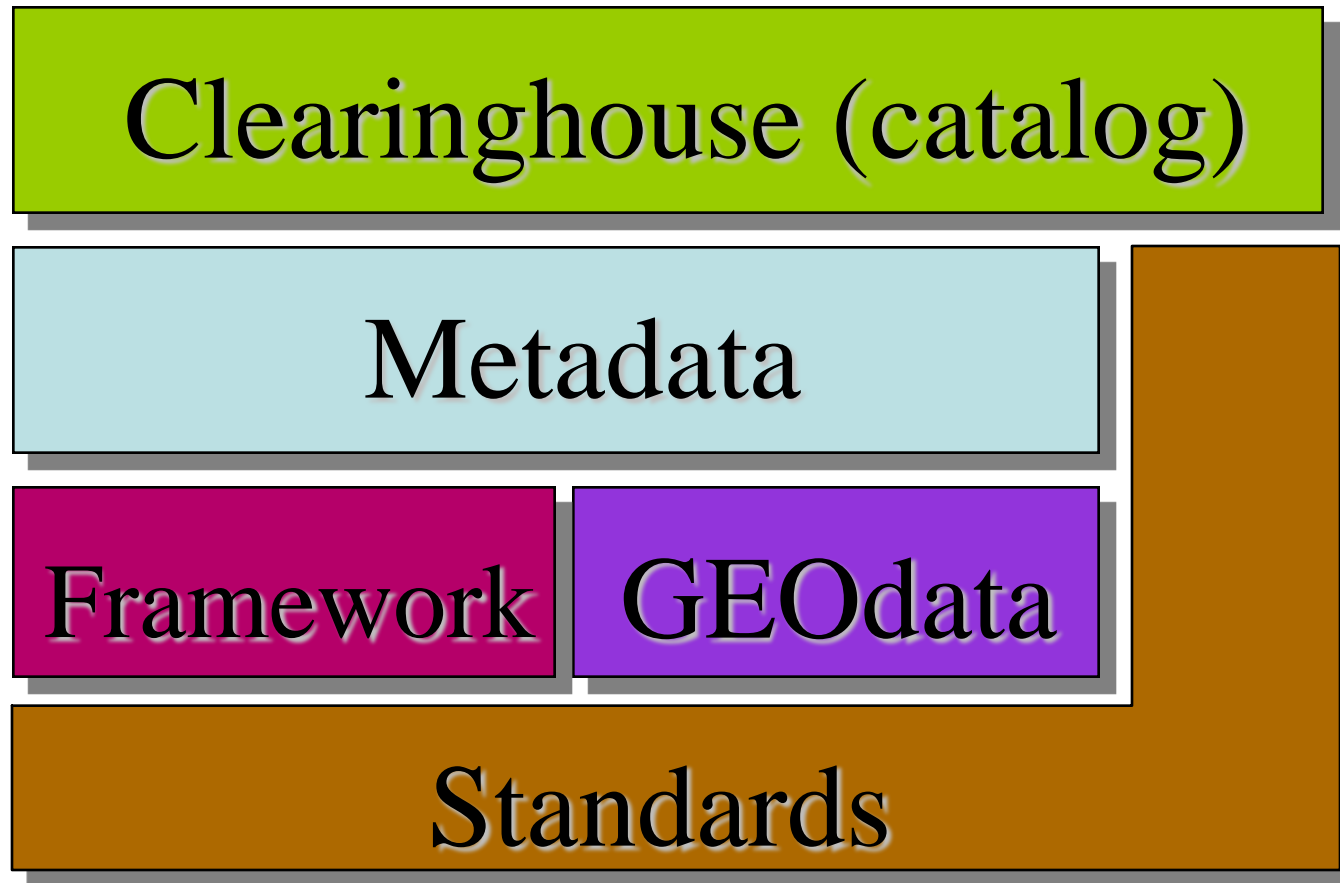
Cloud Hosting Services

Learn more about the managed hosting services offered by GeoPlatform and FGDC for geospatial assets!

[Learn More](#)

Windows taskbar: 10:52 AM 3/1/2017

NSDI Components



Partners in FGDC

- 15 Federal Agencies within the U.S. Government
- 18 State or regional affiliated agencies
- FGDC is Principal Member of the OpenGIS Consortium
- Coordinates with the National Association of Counties (NACO) and National States Geographic Information Council (NSGIC)

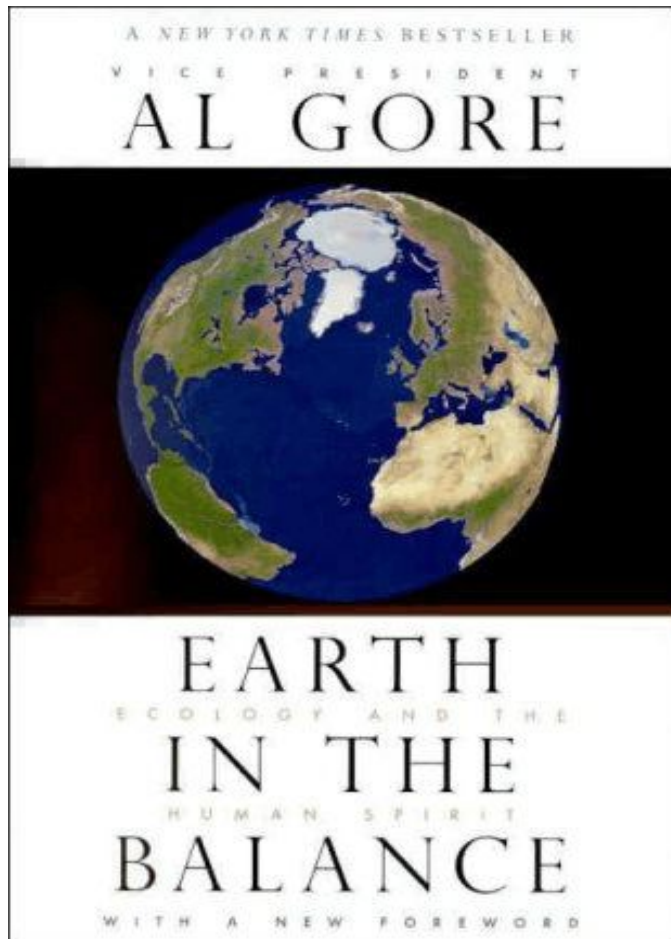
NSDI today

- FGDC working on next generation of vision
- Open Geospatial Consortium has lead on standards
- Host of Federal initiatives, GeoSpatial One Stop, eGovernment, Imagery for the Nation, National GIS
- Emerging GSDI

NSDI and Digital Earth

- Beyond portals and data supply
- Framework concept has led to much embellishment, e.g. TIGER
- GeoBrowsers now commonplace, BingMaps, GoogleEarth, etc.
- Could the current situation, both bottom-up and top-down, lead to a DE?

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.”



Source: <http://www.filmweb.no>

Gore's DE Vision

- What is digital earth?
- Do we have it today?
- If not, what more do we need?
- What advantages does a DE offer?

Gore's Digital Earth: 1998

“Imagine, for example, a young child going to a Digital Earth exhibit at a local museum. After donning a **head-mounted display**, she sees Earth as it appears from space. Using a **data glove**, she **zooms** in, using higher and higher levels of resolution, to see continents, then regions, countries, cities, and finally individual houses, trees, and other natural and man-made objects. Having **found** an area of the planet she is interested in exploring, she takes the equivalent of a ‘magic carpet ride’ through a **3-D visualization** of the terrain. Of course, terrain is only one of the **numerous kinds of data** with which she can interact. Using the system’s **voice recognition** capabilities, she is able to request information on land cover, distribution of plant and animal species, real-time weather, roads, political boundaries, and population. She can also visualize the environmental information that she and other students all over the world have collected as part of the **GLOBE** project. This information can be **seamlessly fused** with the digital map or terrain data. She can get more information on many of the objects she sees by using her data glove to click on a **hyperlink**. To prepare for her family’s vacation to Yellowstone National Park, for example, she plans the perfect hike to the geysers, bison, and bighorn sheep that she has just read about. In fact, she can follow the trail visually from start to finish before she ever leaves the museum in her hometown.

She is not limited to moving through space, but can also travel through **time**. After taking a virtual field-trip to Paris to visit the Louvre, she moves backward in time to learn about French history, perusing **digitized maps** overlaid on the surface of the Digital Earth, **newsreel footage, oral history, newspapers and other primary sources**. She sends some of this information to her personal e-mail address to study later. The **time-line**, which stretches off in the distance, can be set for days, years, centuries, or even geological epochs, for those occasions when she wants to learn more about dinosaurs.” (U.S. Vice President Al Gore, in a speech written for presentation at the California Science Museum, Los Angeles, January 1998)

Gore's Digital Earth

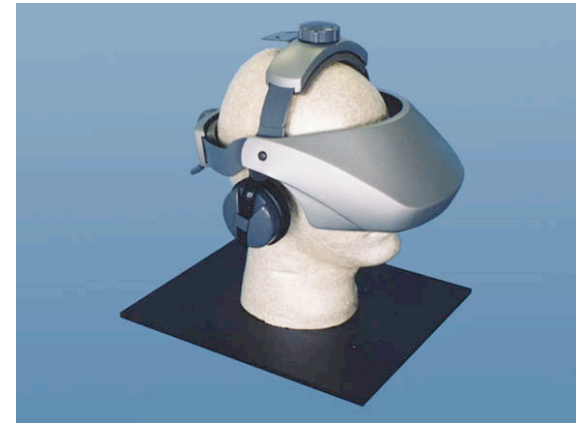
Hardware

- virtual digital globe display
- head-mounted display (immersive VR)
- data glove



Interactive Capabilities

- voice recognition
- zoom
- search
- 3-D visualization and movement
- time-lines



Interactive capability

- Voice recognition
- Navigation
- Zoom: “Drill down”: Progression
- Search
- 3-D visualization and movement
- Time-line
- Multimedia : web portals



Gerhard Mercator: Terrestrial globe, 1541
© Österreichische Nationalbibliothek

“This giant, 200-foot diameter sphere will be a miniature earth -- the most accurate global representation of our planet ever to be realized.”
"This... *Geoscope* would make it possible for humans to identify the true scale of themselves and their activities on this planet. Humans could thus comprehend much more readily that their personal survival problems related intimately to all humanity's survival." — R. Buckminster Fuller, 1962



The Geoscope, as drawn by Tom Shannon, for the Buckminster Fuller Institute

Mary Baker Eddy Library for the Betterment of Humanity 1935



Coordinates and Interaction

Text-based search: Toponymy

The screenshot shows a Mozilla Firefox browser window with the address bar containing `http://maps.google.co.uk/maps?hl=en`. The search bar contains the text "coffee islington". Below the search bar are buttons for "Search the map", "Find businesses", and "Get directions".

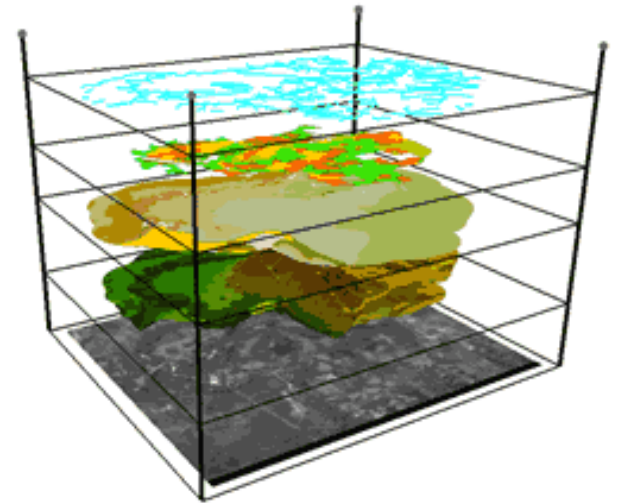
The main content area displays a map of London with several red location pins in the Islington area. To the left of the map is a sidebar with the following content:

- Sponsored Links**
 - Coffee big brands Coffee**
Top brand coffees at great prices
next day delivery to your office
www.zepbrook.co.uk
England
- Results 1-10 of about 7,959 for coffee near Islington - [Modify search](#)**
- Categories: [Coffee Shops](#), [Cafes](#)**
- A Don Matteos - [more info](#)**
74d Upper St, London, N1 0NY
020 7354 5135
- B Tiffany's**
18a Chapel Market, London, N1 9EZ
020 7837 2225
- C Cafe Latte - [more info](#)**
42a Penton St, London, N1 9QA
020 7689 0021
- D Starbucks Coffee Co (UK) Ltd - [more info](#)**
62 Exmouth Market, London, EC1R 4QE
020 7278 0551
- E Euro Cafe - [more info](#)**
4 King's Cross Rd, London, WC1X 9QA
020 7837 4811

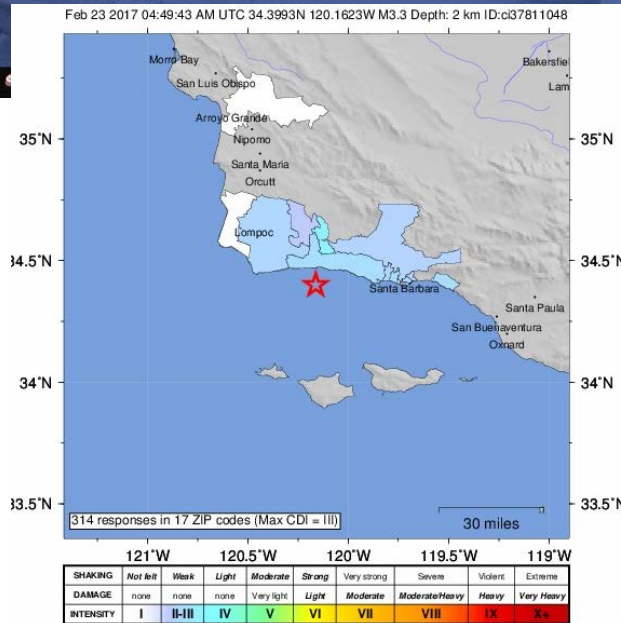
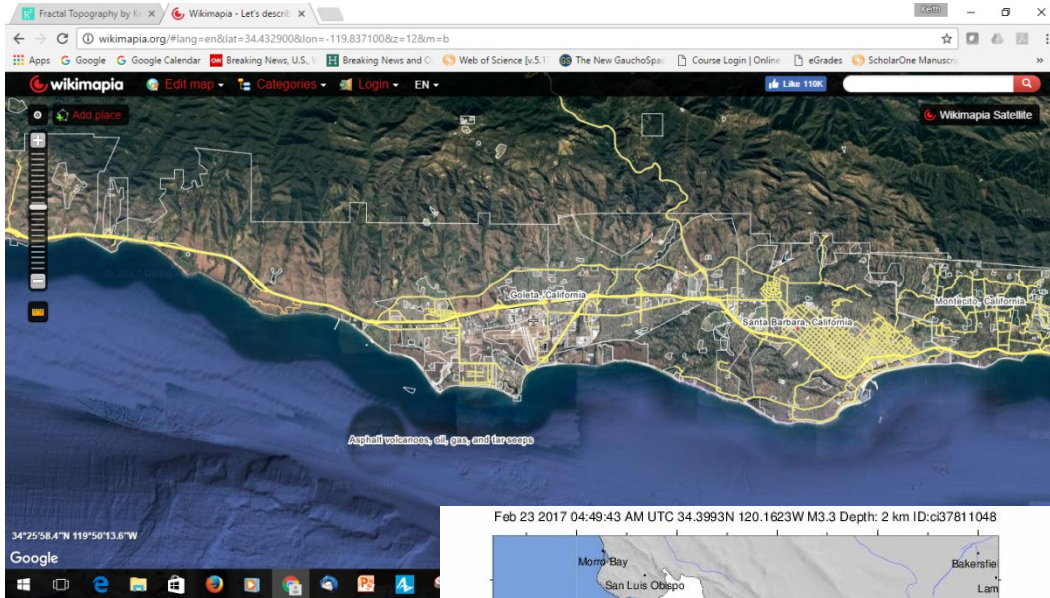
The map shows the Islington area in London, with various streets and landmarks labeled. A scale bar at the bottom left indicates 2000 feet and 1 km. The bottom of the browser window shows the Windows taskbar with the Start button, several open applications (Microsoft PowerPoint, Google Earth), and the system tray showing the time as 12:37 PM.

Content

- “numerous kinds of data” = Themes
- Participant content
- Seamlessly fused
- Hyperlinks
- Multi-temporal



Participant Content



USGS Geography: The National Map Corps - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://nationalmap.gov/TheNabio

USGS science for a changing world

The National Map

USGS Home Biology Geography Geology Water Contact Us Ask USGS Search USGS

The National Map Corps
Volunteer for a Changing World

Join The National Map Corps

The National Map Corps consists of private citizens who devote some of their time to provide mapping information to the U.S. Geological Survey's *The National Map*. Members may be invited to participate in projects within mutually determined work areas. The only requirements needed to contribute to this effort include owning a GPS receiver and having Internet access.

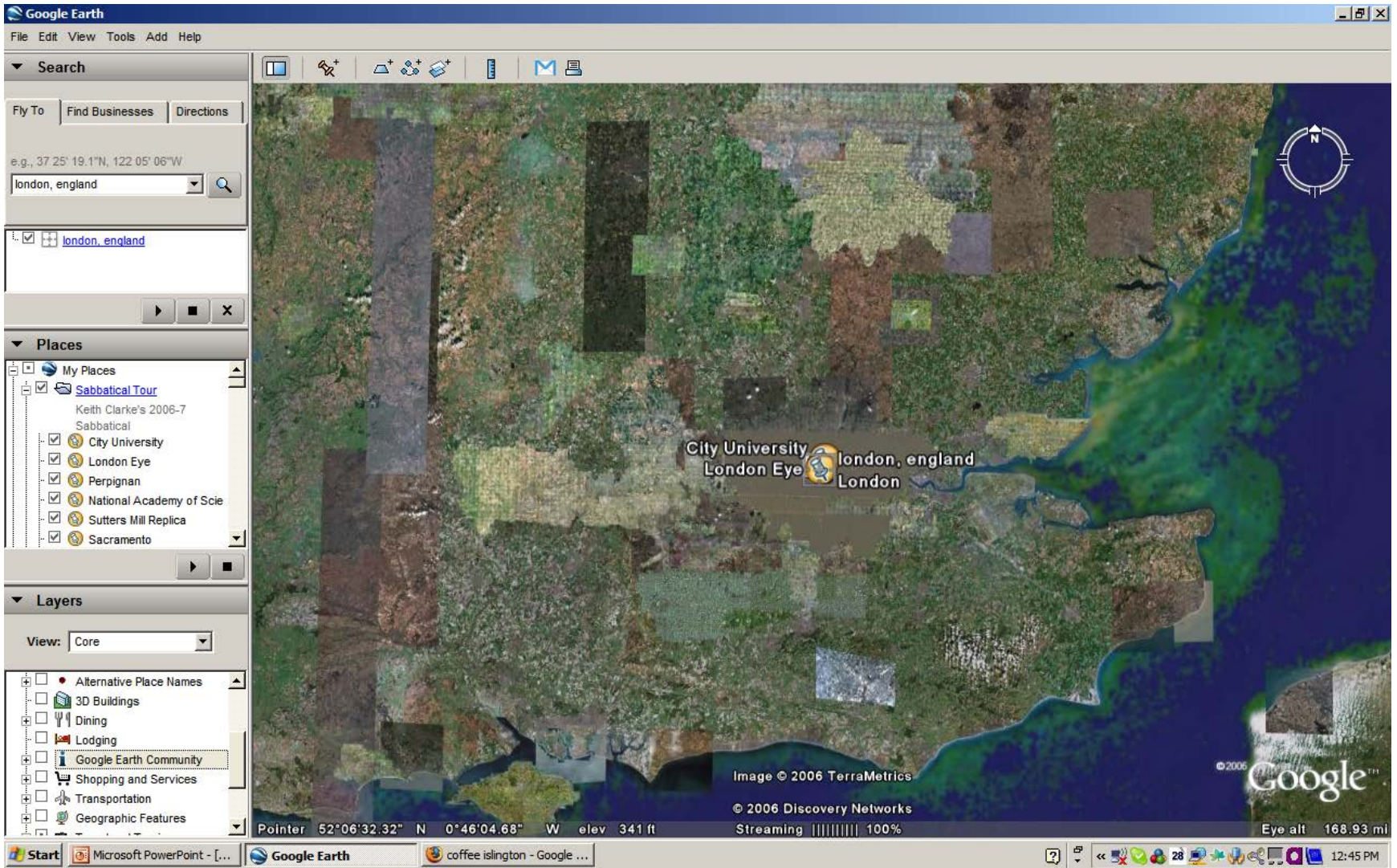
The National Map is a consistent framework for geographic knowledge needed by the Nation. It provides public access to high-quality, geospatial data and information from multiple partners to help support decisionmaking by resource managers and the public.

Ready to get started?

- U.S. Geological Survey [Topographic Maps](#) has a wealth of information on topographic mapping, including what it is, how maps are made, and how to read them.
- [The National Map Corps GPS Volunteer Guide](#) provides GPS data collection instructions in PDF format. NOTE: Viewing and printing PDF files requires [Adobe Acrobat Reader](#).
- Want to volunteer? Please read our list of [Frequently Asked Questions](#).
- [Instructions for determining a quadrangle name](#).

Apply to join *The National Map Corps*

“Seamlessly fused” Time and space



Seamless Manhattan?

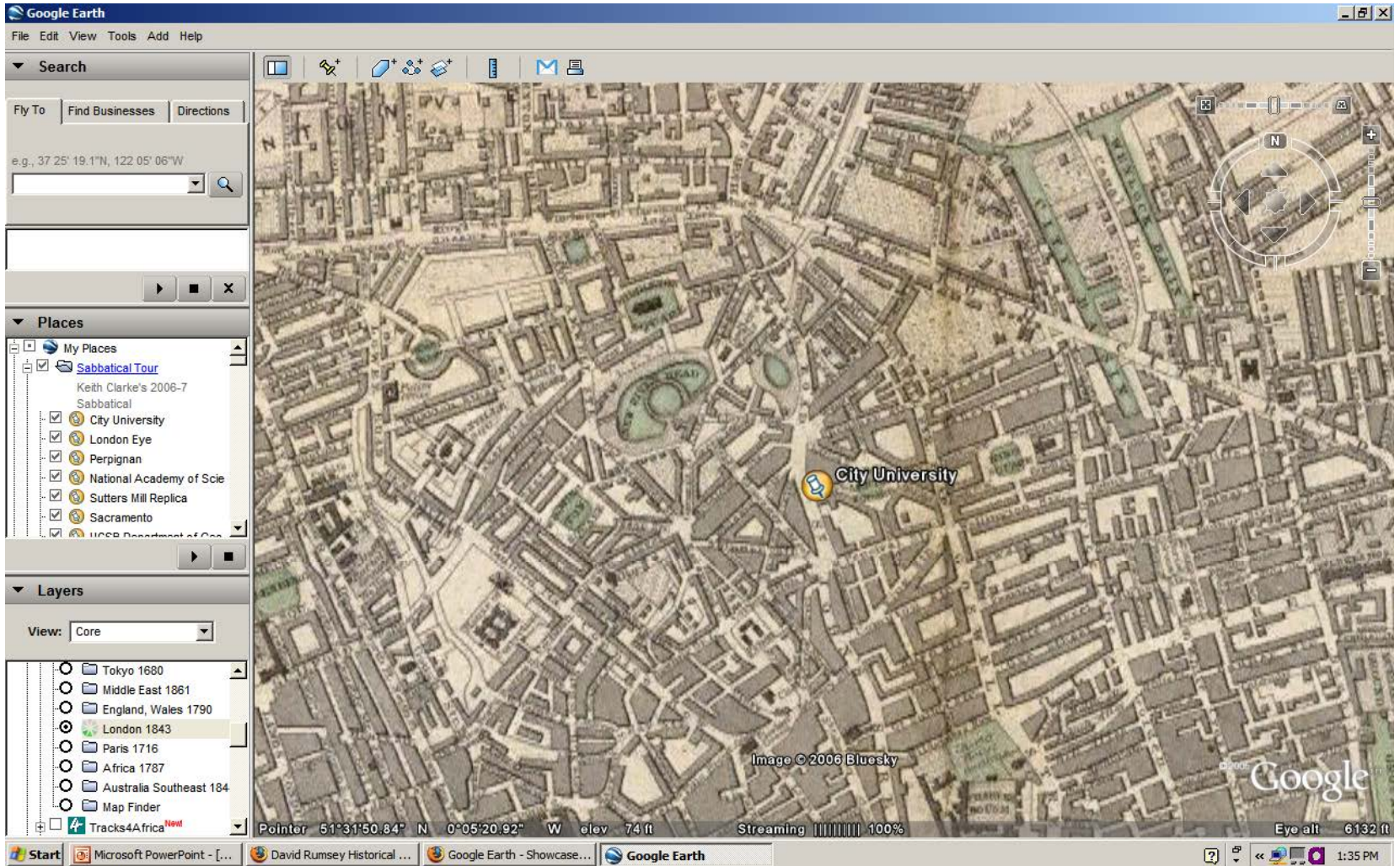


© 2008 Europa Technologies

Image © 2008 Sanborn

Google

Multi-temporal: Rumsey Map Collection



Timeline

The screenshot displays the Google Earth interface with a satellite view of a coastal region. A red line traces a path across the landscape, representing a fire's progression. A timeline window is open at the top center, showing a date of 3/14/2008 and a time range from 8:49 am to 8:50 am. The left sidebar contains several panels: 'Search' with a search bar, 'Places' with a list of saved locations including 'Untitled Image Overlay', 'MGRS GridLines by Nearby.org.uk', and 'UTM GridLines by Nearby.org.uk', and 'Layers' with a list of map features like 'Primary Database', 'Borders and Labels', and '3D Buildings'. The bottom status bar shows the 'Imagery Date: 8/31/2007', coordinates '34°27'06.23" N 119°50'14.96" W elev 78 ft', and the 'Eye alt 37635 ft'. The Windows taskbar at the bottom includes the Start button and several open applications: iTunes, magicJack, C:\Documents and Se..., Lecture15.ppt, newsdi.ppt, and Google Earth.

Google Earth

File Edit View Tools Add Help

Search

Fly To Find Businesses Directions

Fly to e.g., Reservoir Rd, Clayville, NY

Places

- My Places
- Untitled Image Overlay
- GAP Fire as of 7/6/2008
- MGRS GridLines by Nearby.org.uk
- Notes on these features
- UTM GridLines by Nearby.org.uk
- Notes on these features
- 120-degrees-west_near_EI-Ca...
- 120 degrees west
- Commute031408.kmz
- Soviet Map
- Urban Growth Simulation
- 7m.kmz
- Hwy217:24K
- Goleta DRG
- LightBlueLine (7m): Santa Barb
- Marks the new waterfront due to a 7-meter sea-level rise if
- Sightseeing
- Select this folder and click on the

Layers Earth Gallery

- Primary Database
- Borders and Labels
- Places
- Photos
- Roads
- 3D Buildings
- Ocean
- Weather
- Gallery
- Global Awareness
- More

Timeline: 3/14/2008 8:49:19 am

8:49 am 8:50 am

Imagery Date: 8/31/2007 1994

34°27'06.23" N 119°50'14.96" W elev 78 ft

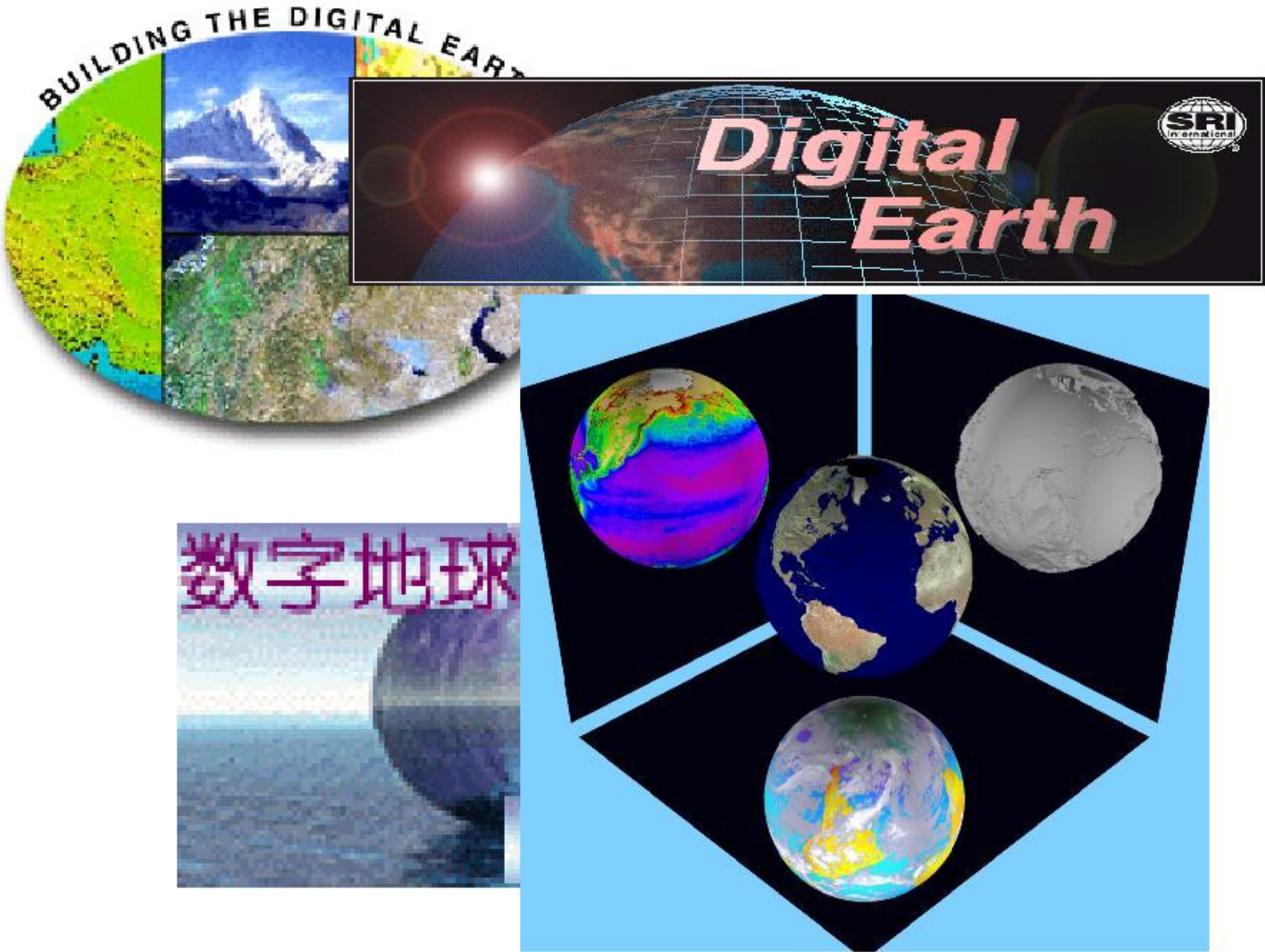
Eye alt 37635 ft

start iTunes magicJack C:\Documents and Se... Lecture15.ppt newsdi.ppt Google Earth 3:14 PM

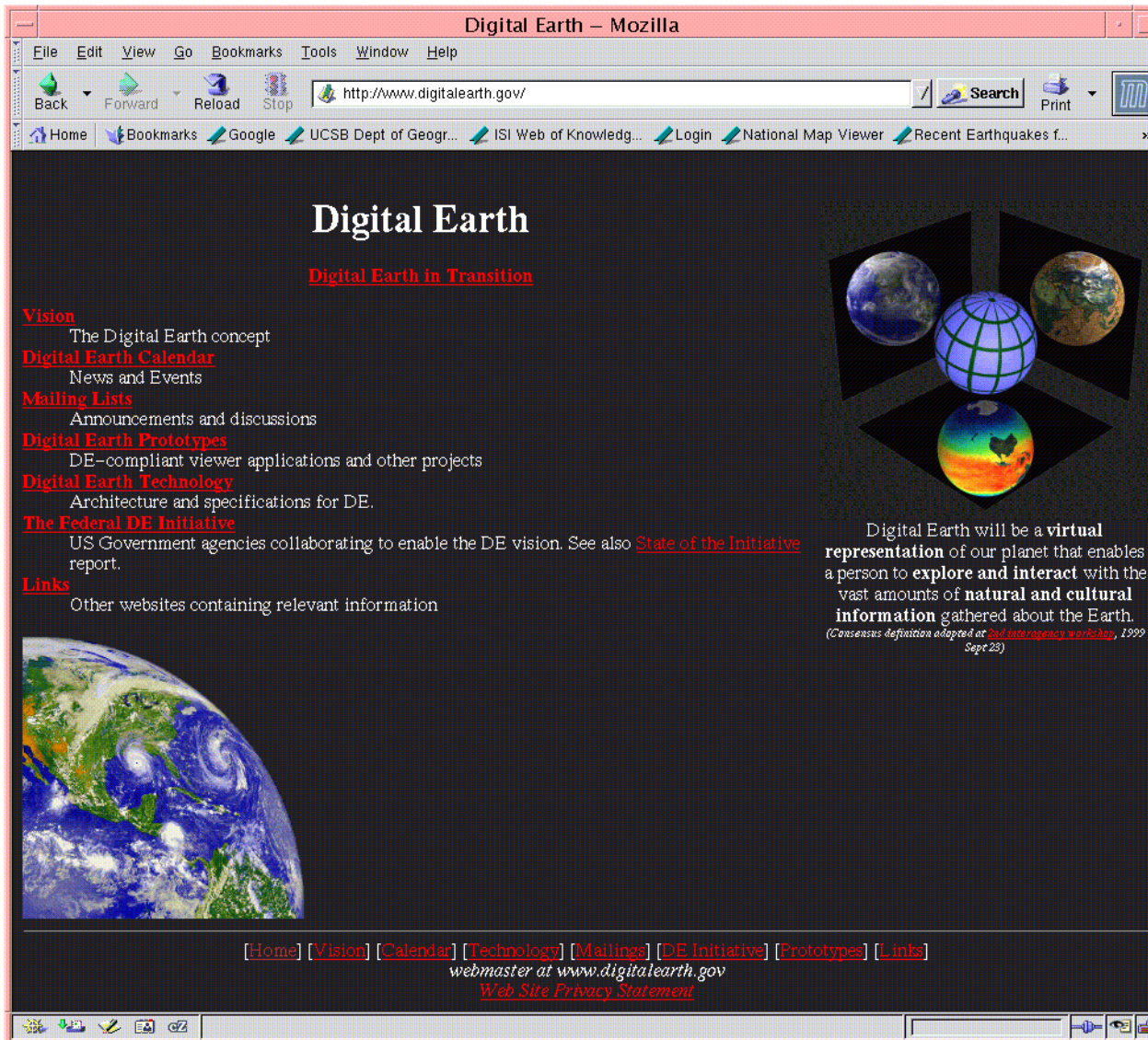
Data MBARI
Image © 2011 DigitalGlobe
Image U.S. Geological Survey
Data CSUMB SFML, CA OPC

Trackstick © 2010 Google

What became of Digital Earth?



NASA leadership to January 2001



The image shows a screenshot of a Mozilla browser window displaying the Digital Earth website. The browser's address bar shows the URL <http://www.digitalearth.gov/>. The website content includes a navigation menu on the left with links for [Vision](#), [Digital Earth Calendar](#), [Mailing Lists](#), [Digital Earth Prototypes](#), [Digital Earth Technology](#), [The Federal DE Initiative](#), and [Links](#). The main content area features the heading "Digital Earth" and a sub-heading "Digital Earth in Transition". A central graphic displays four globes: a blue and white globe, a blue and green globe, a brown and green globe, and a colorful globe with a map of the United States. To the right of this graphic is a definition of Digital Earth: "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." Below this definition is a note: "(Consensus definition adopted at [2nd interagency workshop](#), 1999 Sept 28)". At the bottom of the page, there is a footer with navigation links: [\[Home\]](#) [\[Vision\]](#) [\[Calendar\]](#) [\[Technology\]](#) [\[Mailings\]](#) [\[DE Initiative\]](#) [\[Prototypes\]](#) [\[Links\]](#), contact information: "webmaster at www.digitalearth.gov", and a link to the "Web Site Privacy Statement".

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)

DE Leadership since 2000

- IDEW (Interagency Digital Earth Working Group)
- ISDE (International Society for Digital Earth)
- 11 other companies, agencies, universities
- UCSB's Alexandria Digital Earth Prototype (ADEPT)

But no central government leadership or funding, other than in China

Digital Earth Symposia

- Beijing (1999)
- New Brunswick, Canada (2001)
- Brno, Czech Republic (2003)
- Tokyo (2005)
- Auckland (2006)
- San Francisco (2007)
- Beijing (2009)
- Perth (2011)
- Digital Earth Summit (2012) Wellington, New Zealand
- Halifax, Nova Scotia (2015)
- Sydney (2017)

So what is Google Earth?

“We are like an iPod for Earth images.”

Michael T. Jones, Chief Technologist, Google Earth (Nov 2006)

Google Earth: A history

- Gore represented Tennessee in the US Senate, 1985-1992. VP 1993-2001. Served on Senate Select Committee on Intelligence
- Dayton Peace Agreement /Wright-Patterson Air Force Base, Ohio Dec 1995, ends war in Bosnia
- Google founded 1998
- Keyhole Earthviewer (2002) In-Q-tel funding, Dual use
- Google buys Keyhole (Oct. 2004)
- Google Maps/Local Feb. 8th 2005
- Google Earth (June 2005)
- Google Earth Community added (2005)
- Partnership with National Geographic (2006)
- 100 million downloads: Version 4 (Nov. 2006)
- 1 billion (2011)
- Development ended 2015



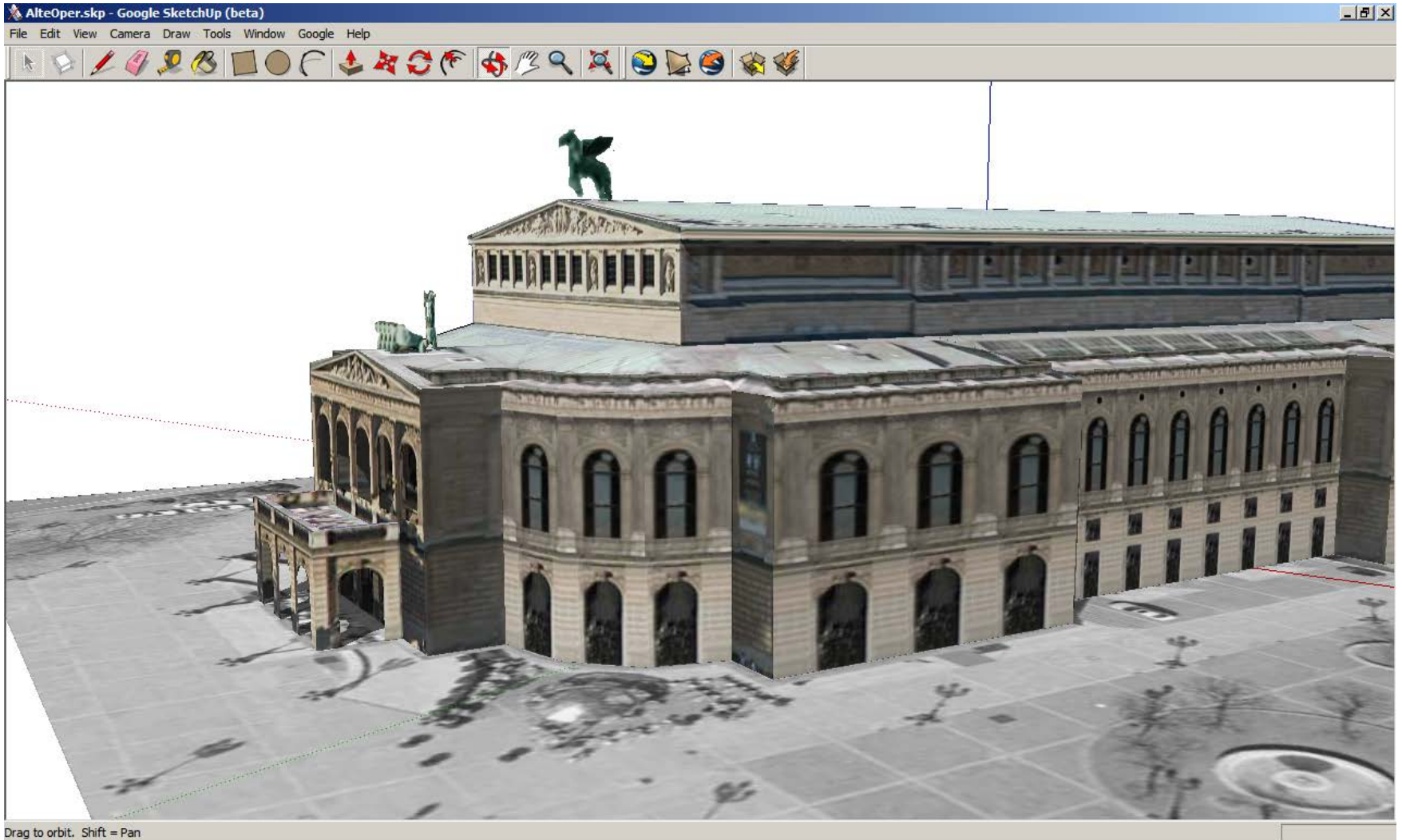
In-Q-Tel (Created 1999)

"The (Senate Select Committee on Intelligence) encourages a symbiotic relationship between the Intelligence Community and the private sector using innovative approaches, such as the CIA's In-Q-Tel. In-Q-Tel is a venture capital fund, largely funded by the US Intelligence Community, to stimulate new technologies through private sector entrepreneurs. It shows great promise." Comments by Senator Graham, Chairman of the Senate Select Committee on Intelligence, introducing the Intelligence Authorization Act for Fiscal Year 2002

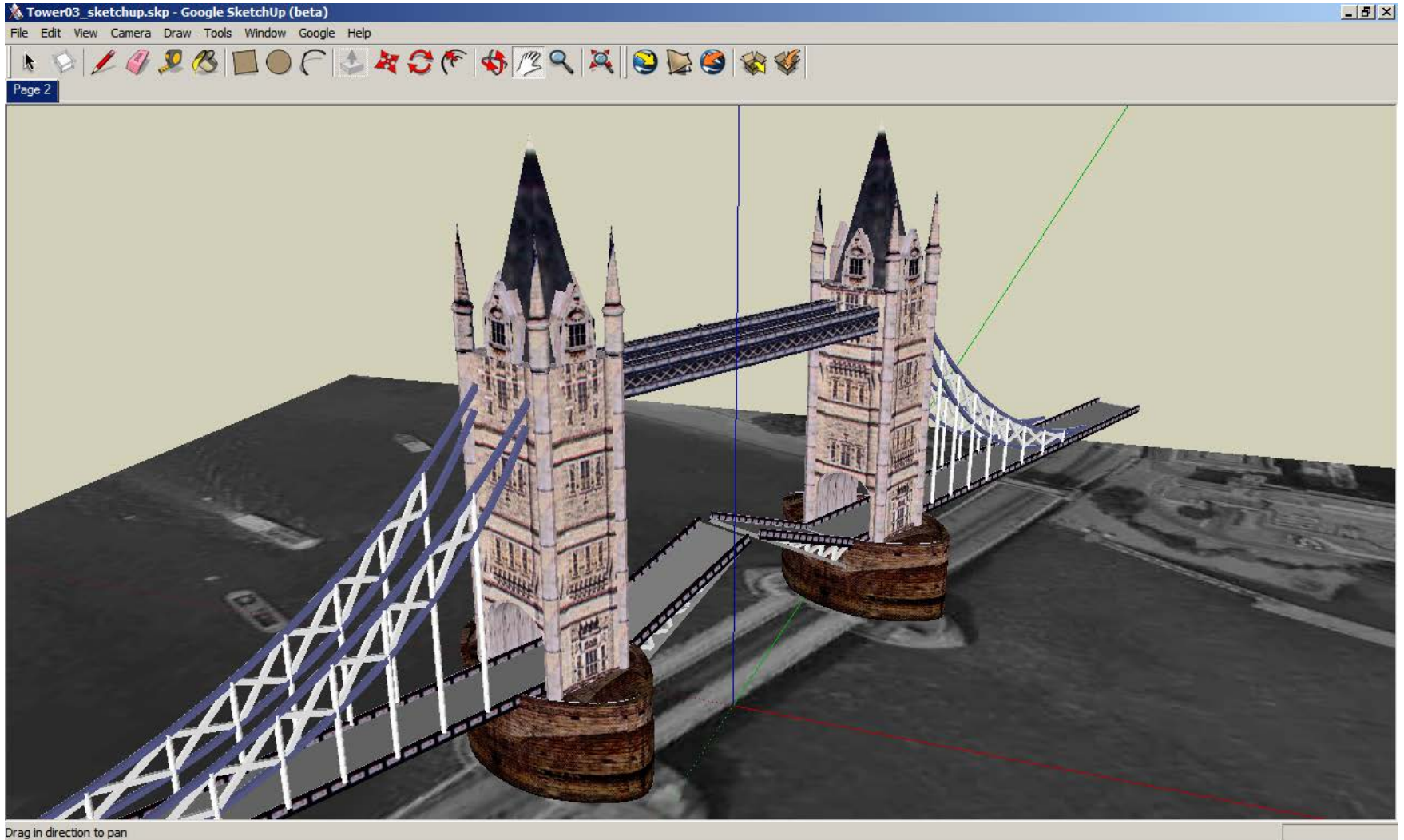
Google Earth Today

- Google Earth viewer downloadable free
- Google Earth Plus GPS device support, import spreadsheets, drawing tools and better printing
- Google Earth Pro “the ultimate research, presentation and collaboration tool for location information.”
- Various additional tools e.g. Streetview, GoogleMaps, API, etc.

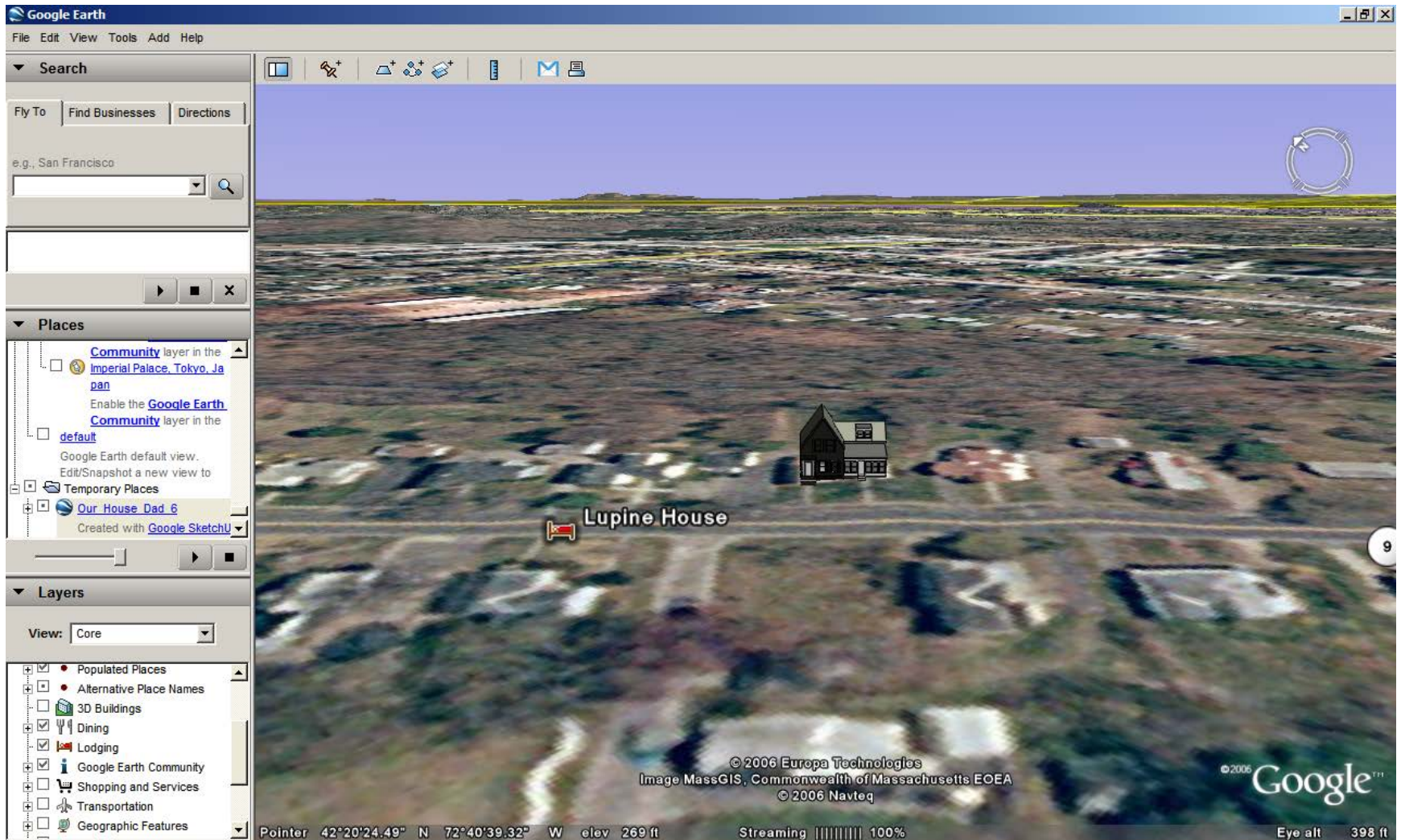
Google SketchUp Model of the Alte Oper, Frankfurt



Tower Bridge by Rene Almere



177 N Main St- Model of house in Florence, MA

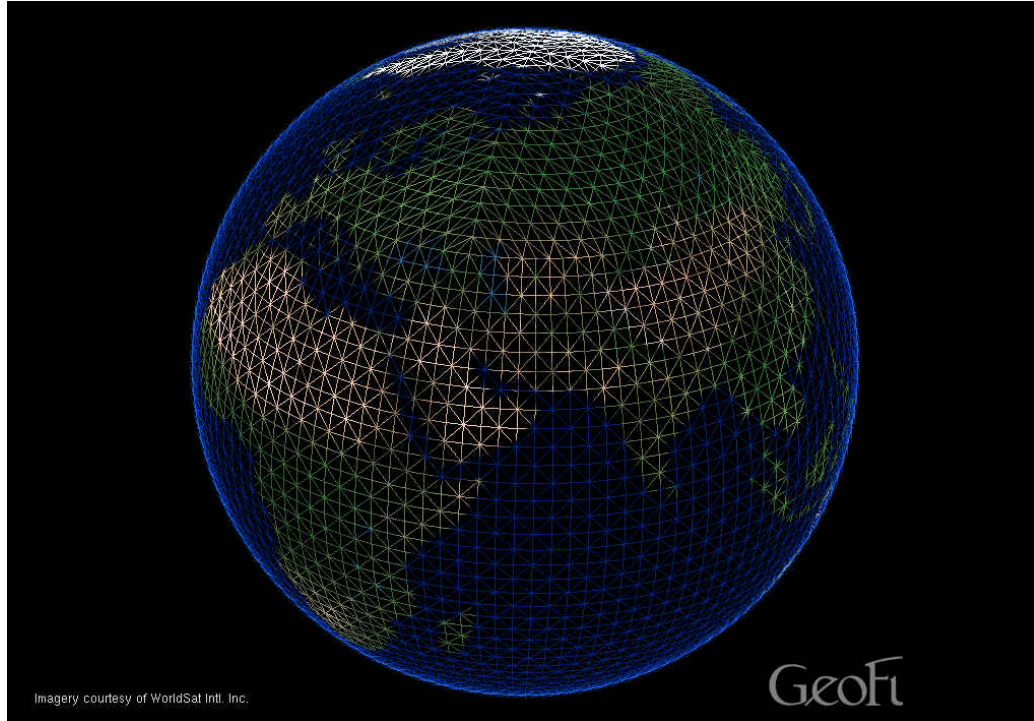


So is Google Earth Digital Earth?

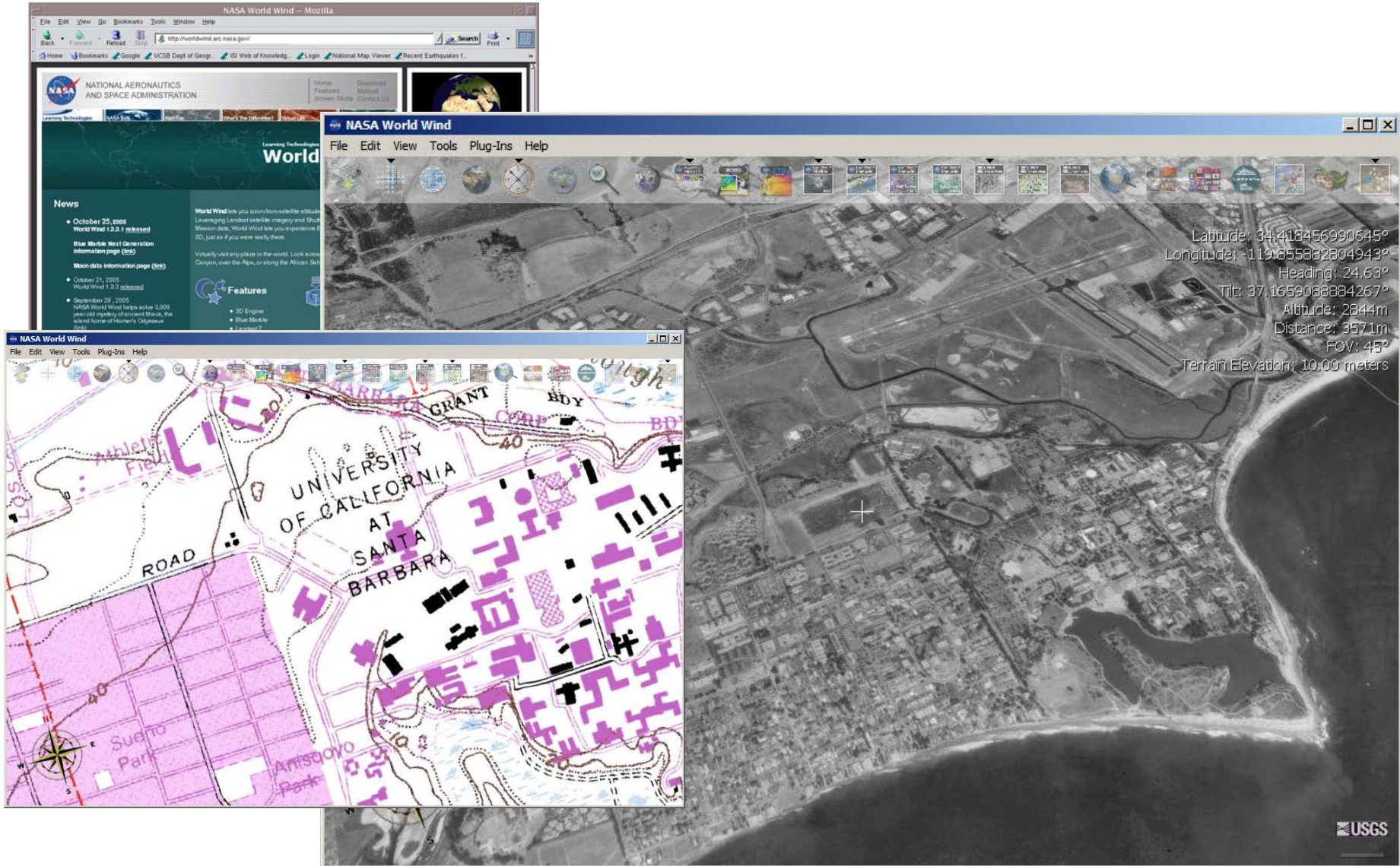
NO: because

- Not all components of the vision are in place
- Google is a media company, not an information broker
- Not yet in a position to do exploratory visualization in depth
- DE = Geobrowser + Global data
- Many browsers (30 on web)
 - NASA Worldwind (2003)
 - GeoFusion GeoPlayer (2001)
 - ESRI ArcExplorer
 - Microsoft Virtual Earth

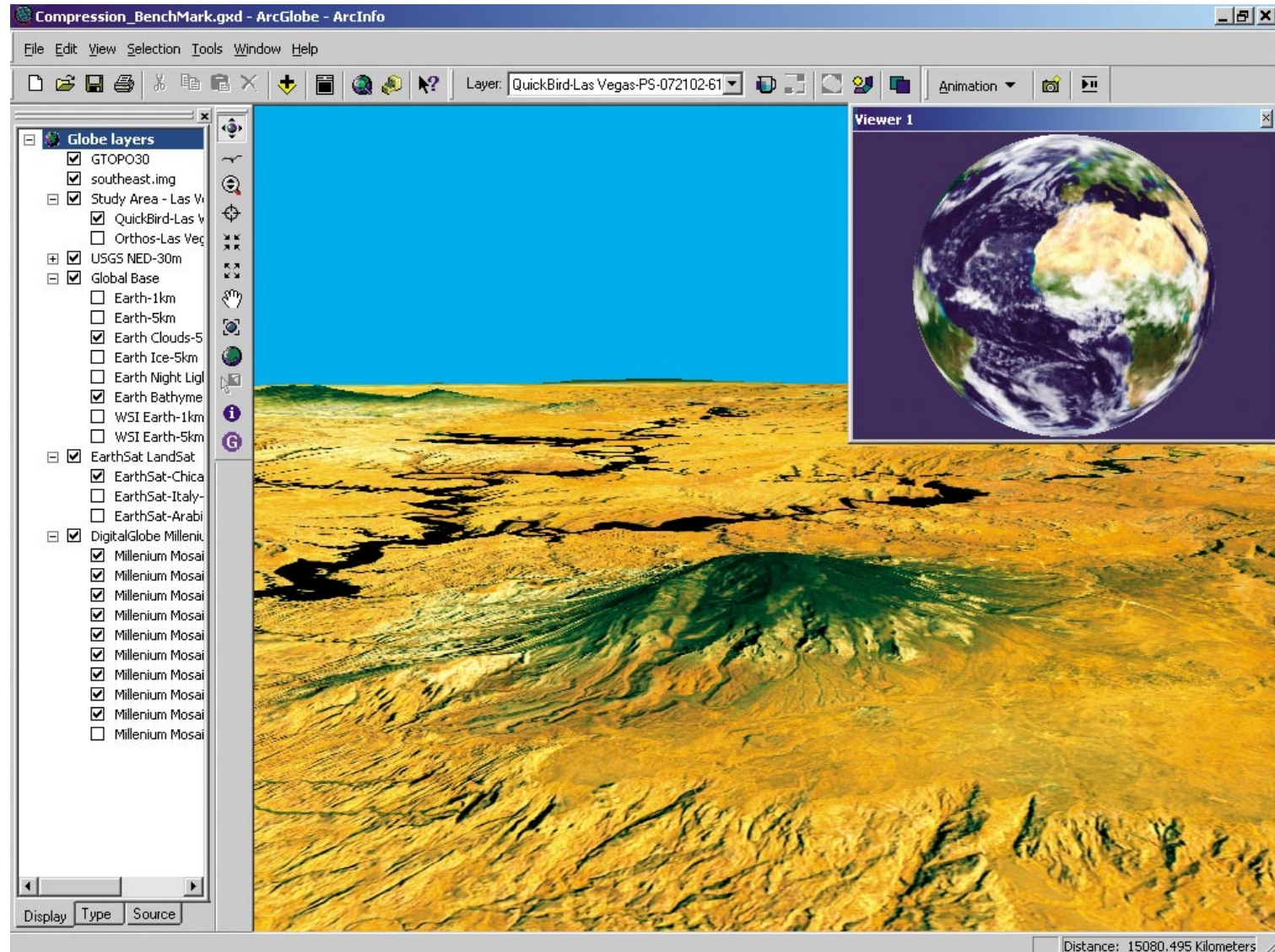
Geofusion (Aligned with ESRI)



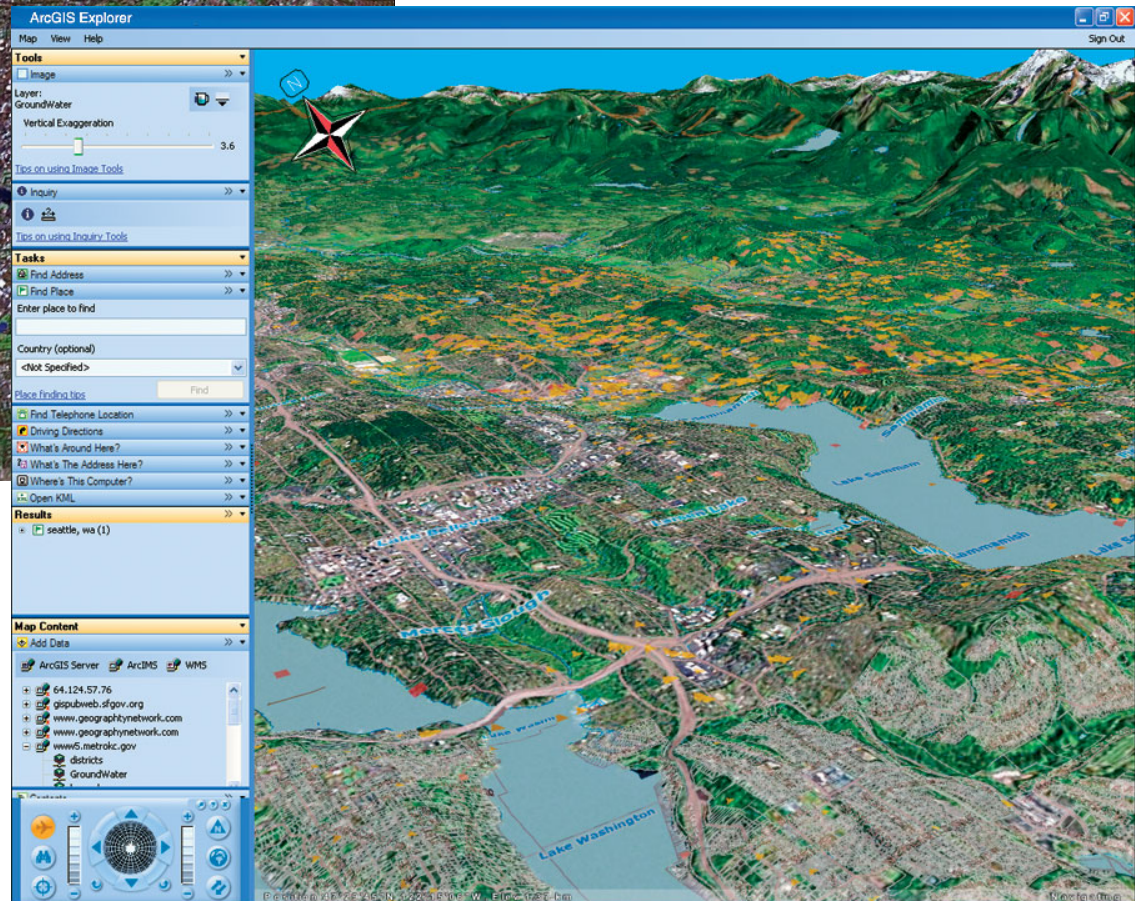
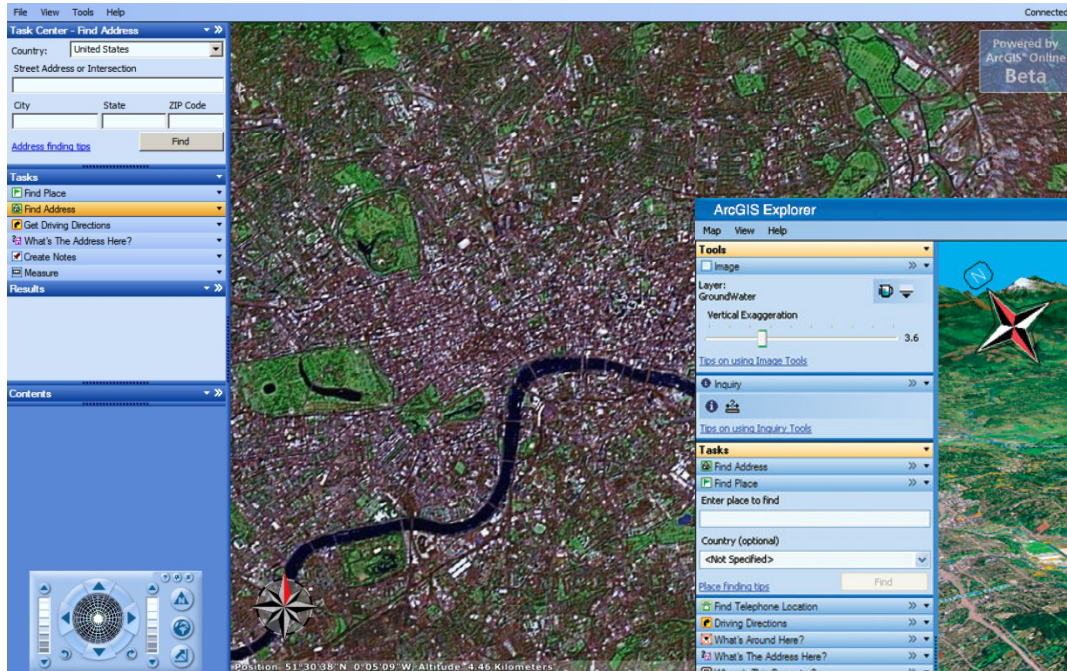
NASA World Wind



ArcGlobe: 3D Analyst Extension



ArcExplorer



Microsoft: Virtual Earth -> Bing Maps

The screenshot shows a Microsoft Internet Explorer browser window displaying the Live Search website. The address bar shows a URL for a map: `http://maps.live.com/default.aspx?v=2&cp=44.023938~-99.71&style=h&vl=4&tilt=-89.875918865193&dir=0&alt=7689462.6842358`. The page features a search bar with the text "Search for a business or category" and "Enter city, address, or landmark". Below the search bar are tabs for "Businesses", "People", and "Maps". The "Maps" tab is selected, and the main content area displays a 3D map of North America. The map is titled "Microsoft Virtual Earth" and includes a navigation interface with "2D" and "3D" buttons, a zoom slider, and a compass. A sidebar on the left contains a "Welcome" message and an advertisement for "Introducing 3D maps!" with a "Free! Download now!" button. The footer of the page includes copyright information: "© 2006 Microsoft Corporation" and "© 2006 NAVTEQ", along with links for "About", "Help", and "Feedback". The Windows taskbar at the bottom shows the Start button and several open applications, including Microsoft PowerPoint, David Rumsey Historical..., GeoFusion, Inc. Homepa..., and Live Search - Micro...

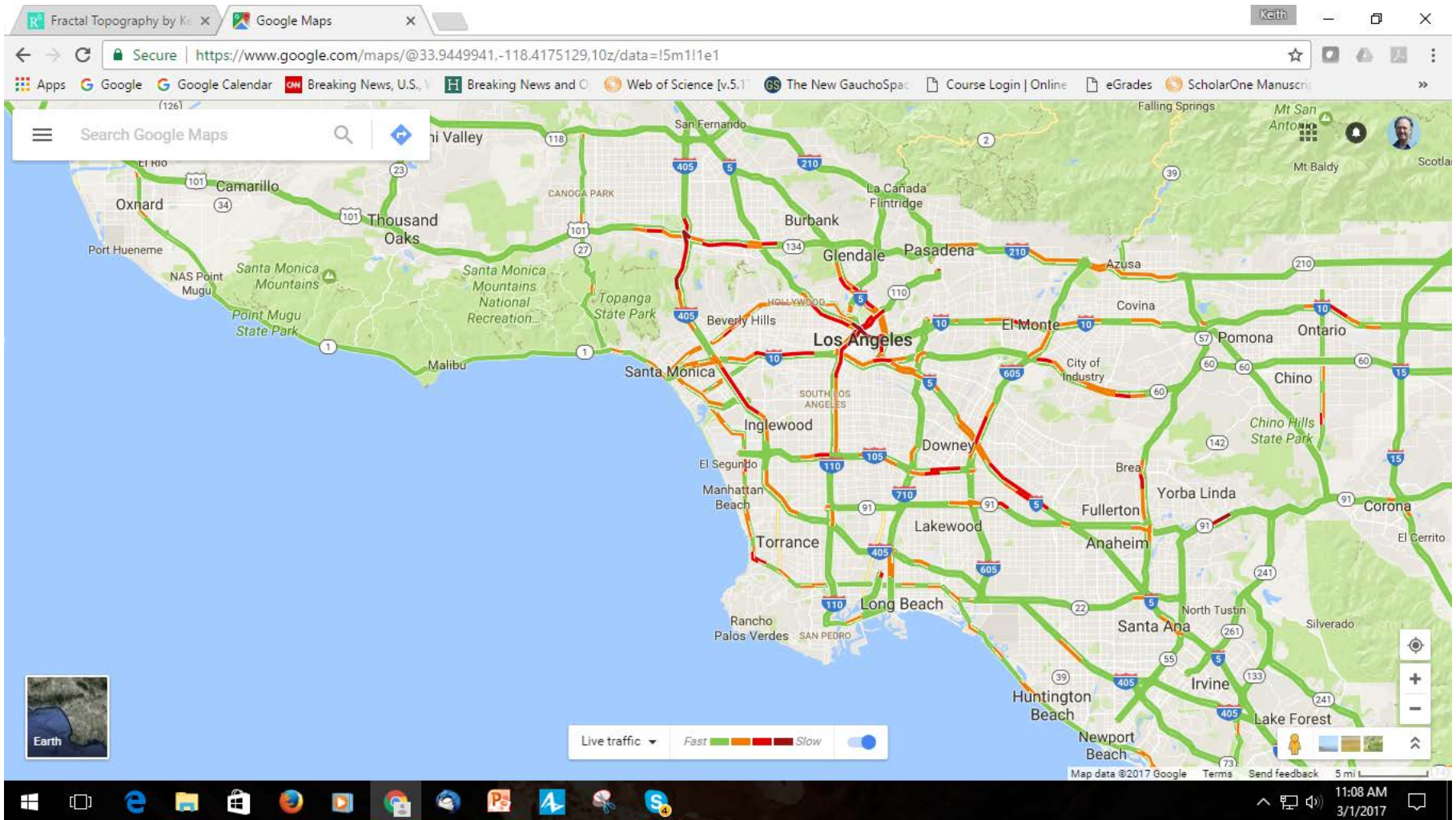
Bing Maps 3D



Here (Navtec, Nokia)

The screenshot displays the HERE WeGo web application. The browser's address bar shows the URL <https://wego.here.com/?map=34.43398,-119.75101,12,normal>. The search bar contains the text "Where to?". Below the search bar, a dark grey button displays "Near Santa Barbara, California". A blue notification box in the upper left of the map area reads "Getting around town just got a lot easier" and lists icons for walking, driving, carpooling, and cycling. The map itself shows a pink route starting from the coast near Santa Barbara and heading inland. The bottom of the page features a dark grey cookie consent banner with the text: "WE USE COOKIES | HERE uses cookies from our websites to bring you services and info that matter more to you, including advertising from our partners. By using this website, you consent to the use of cookies. [Find out more](#)". The Windows taskbar is visible at the very bottom of the image.

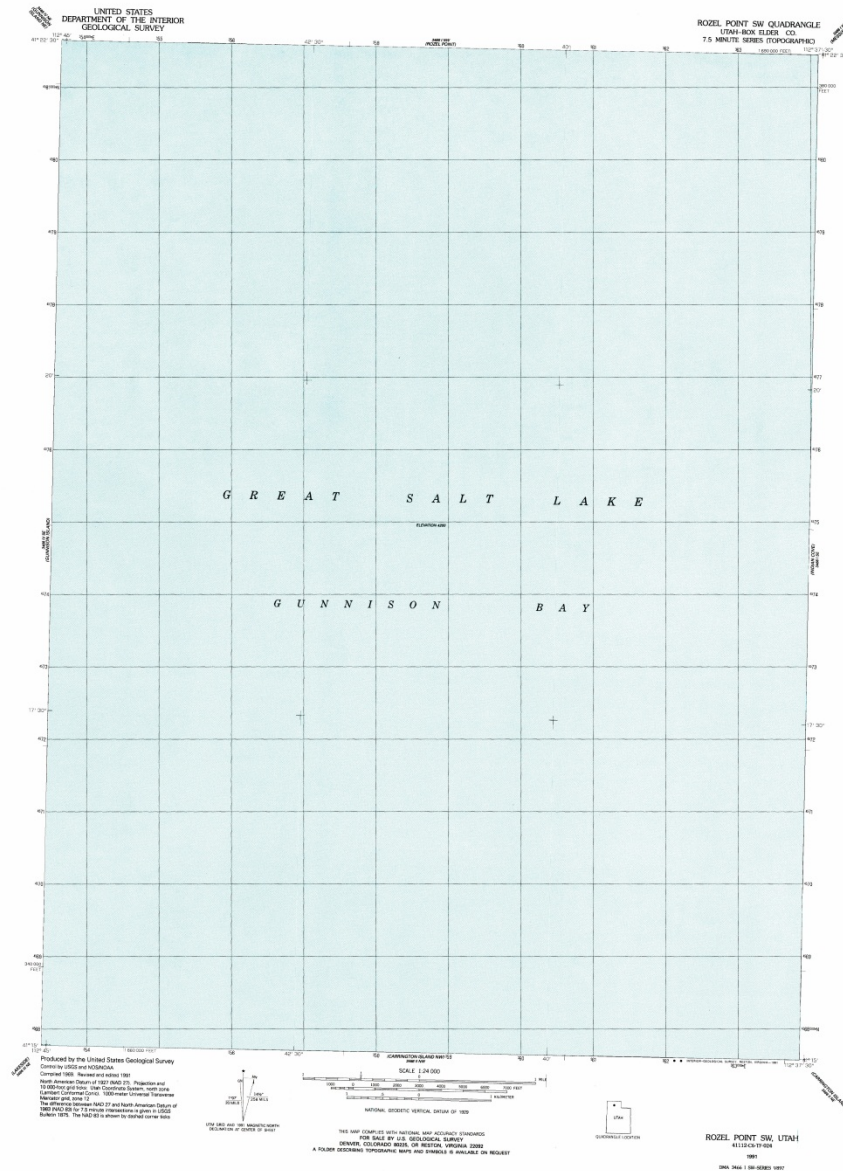
LA Traffic: 11:08am 3-1-2017



What about Content?

- Maps
 - International Millionth Map of the World
 - VMAP0 (Digital Chart of the World)
 - GlobalMap
- Imagery
 - US 133 Cities images
 - USGS digital orthophoto quadrangles 1m
- Toponymy (NGA web service)
- BUT: Proprietary vs. Public domain

The empty quad problem



Where next for Digital Earth?

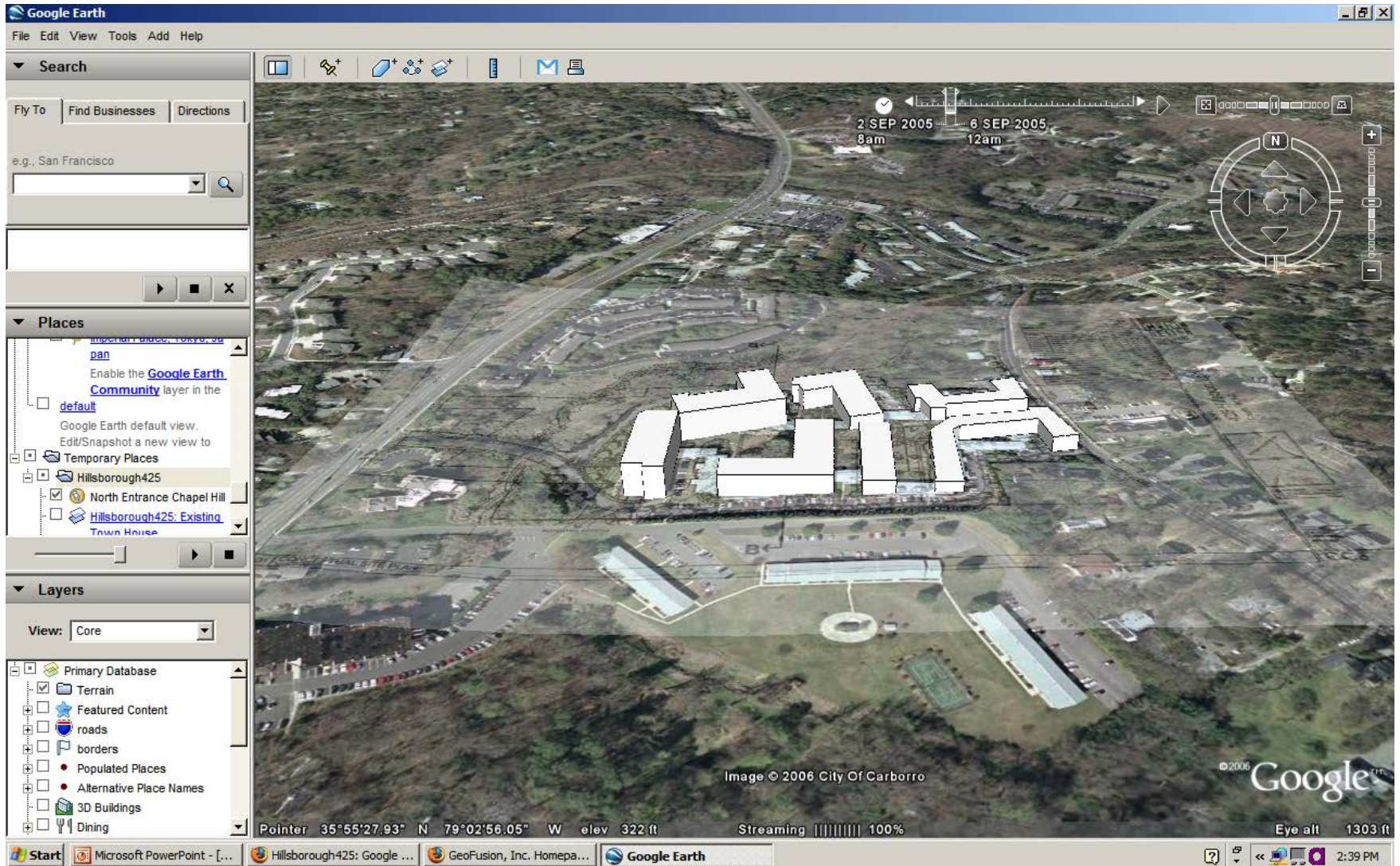
Negative

- Linking text, maps and imagery: Fusion
- Making maps and images text searchable
- Data structures, content and resolution
- Timeliness and accuracy
- High license cost: but Google pays (\$500M/year)
- Privacy

Positive

- Standards in place
- Supports proprietary and open data by encryption
- Can add content easily, if contributed by users
- Strong link to www
- Excellent source of public information

Hillsborough 425, Chapel Hill NC



Nanaimo, Canada

<http://earth.nanaimo.ca/data.html>

Google Earth
File Edit View Tools Add Help

Search
Fly To Find Businesses Directions
e.g., San Francisco

Places
Assessment Parcels
 169 COMOX ROAD
 10 TERMINAL AVENUE
 91 COMOX ROAD
 41 CHAPEL STREET
 510 COMOX ROAD
 54 PRIDEAUX STREET
 77 SKINNER STREET
 11 CLIFF STREET
 45 CHAPEL STREET

Layers
View: Core
Primary Database
 Terrain
 Featured Content
 roads
 borders
 Populated Places
 Alternative Place Names
 3D Buildings
 Dining

11 CLIFF STREET
Folio: 81255.000
Size: 0.63 ACRES
PID: 008-813-078
Legal Description: LOT 4, EXC PART IN VIP53951, LOT 5, EXCEPT THE EASTERLY 40 FEET AND PLNVIP53951, AND LOT 10, ALL OF BLOCK 42, SECTION 1, AND THE EASTERLY 40 FEET OF LOT 5, BLOCK 42, SECTION 1, PLAN 584, LOT A, SECTION 1, PLAN 51267, NANAIMO DISTRICT
Zone: C-27
Zone Description: TERMINAL AVENUE ZONE

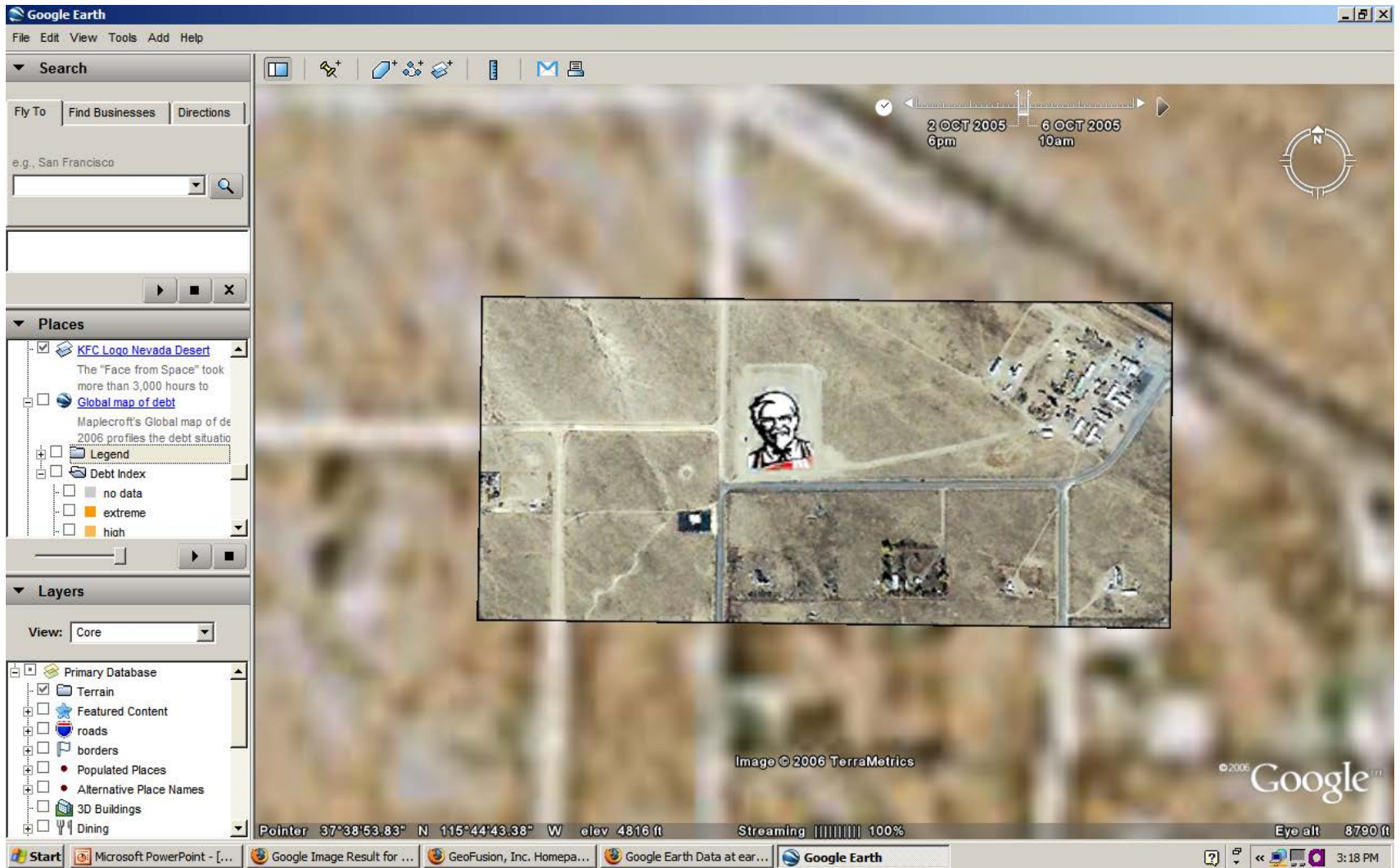
11 CLIFF STREET - Property Report - earth.nanaimo.ca

URL: <http://earth.nanaimo.ca/reports/property.php?gislink=106103>

2 SEP 2005 8am 6 SEP 2005 12am
Image © 2006 Nanaimo
Pointer 49°10'11.72" N 123°56'24.35" W elev 31 ft Streaming 100% Eyo alt 2113 ft

Start Microsoft PowerPoint - [...] Google Earth (My Passio... GeoFusion, Inc. Homepa... Google Earth Data at ear... Google Earth 2:50 PM

Nevada KFC Logo



Summary

- US Federal Vision of a National Spatial Data Infrastructure
- Based on metadata, standards, framework layers, clearinghouses
- Led to vision of a Digital Earth
- Changing vision, but much now available
- Examined development of Google Earth
- Examined some issues for open data today