Slide Presentations, Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Barry Wellar, Editor

Presentation Slides from the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Colloquium held at
Esri International Headquarters
Redlands, California
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wellarb@uottawa.ca

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Published by: Information Research Board Inc.
ISBN: 978-0-9921435-2-7

2015

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PREFACE

The Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets is organized around a directive question:

> **How can looking back at what has been done, or not been done in the field of geographic information systems (GIS), contribute insights into why and how the field of GIS could and should evolve in the coming years?**

With that question providing an overall sense of purpose, the 2015 colloquium is an important first step in elaborating what we can learn from the past, and how we can learn from the past, to inform the futures of:

- GIS technology research, design, development, and implementation;
- GIScience methods, techniques, and operations; and,
- The uses of GIS technology and GIScience by government, business, academe, the media, and other organizations.

This colloquium production consists of two parts: the colloquium background materials; and the thirteen individual slide decks.

The next several pages I provide background information to put the colloquium in context. It is anticipated that these materials will be instructive for those who want to relate the colloquium activity to other research activities and experiences.

And, it occurs that the background materials may be informative for future inquiries into the rationale, purpose, objectives, etc., of the colloquium initiative.

As demonstrated by numerous postings about the colloquium, (http://www.wellar.ca/wellarconsulting/home.html), and a variety of industry, academic, professional association, and other reports on the colloquium, the event took place after many months of deliberations and communications, and yielded a substantial body of documentation. It is anticipated that the body of documentation may be assembled at a future date as part of the history on the Esri retro initiative.

In the interim, the why's and how's, and key contributors behind the colloquium are outlined in the next several pages through the following background materials:

- Origins of the Research Colloquium on
  Using the Retrospective Approach to Mine for GIS Nuggets,
- Colloquium Announcement,
- Call for Presentations, and
- Acknowledgements.

ORIGINS OF THE RESEARCH COLLOQUIUM ON USING THE RETROSPECTIVE APPROACH TO MINE FOR GIS NUGGETS

The decision to organize a research colloquium on using the retrospective approach to mine the literature for GIS nuggets arose as a result of reviews of *AutoCarto Six Retrospective,* in which 37 authors re-visited papers written 30 years previously for the Sixth International Symposium on Automated Cartography in 1983. (http://wellar.ca/wellarconsulting/AutoCarto_Six_Retrospective.pdf)

Four summary points appear sufficient to establish the rationale underlying the decision to proceed from the *AutoCarto Six Retrospective* project to the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets.

First, the general sense of the reviews was that the papers in *AutoCarto Six Retrospective* made an excellent case to significantly broaden the scope and function of the retrospective approach. Using the retrospective approach to mine the literature for GIS nuggets was among the topics that came to mind when I thought of possible next steps.

Feedback on the article, Using the Retrospective Approach to Commemorate AutoCarto Six (published in *International Journal of Applied Geospatial Research (IJAGR*). 5(1), 93-99), confirmed my impression that this was an important but overlooked aspect of GIS and GIScience evolution, and that a colloquium would be an instructive way to further explore the challenges and opportunities of a GIS retrospective research agenda.

Second, contributors to *AutoCarto Six Retrospective* suggested that the retrospective research "model" initiated by the project warranted more attention and more discussion.

It was their view that with *AutoCarto Six Retrospective* providing a substantive link to many aspects of the original thinking behind GIS and GIScience, a directive body of material was in place to guide the design of a colloquium or similar gathering to explore the idea of using the retrospective approach to mine the literature (and other productions) for GIS nuggets.

Third, and continuing a pattern that began to be established *circa* a decade or more ago, the retrospective project led to another round of communications from Canada, the U.S., and abroad lamenting the lack of government support for research or science, applied or otherwise.

The general tenor of comments was that the retrospective initiative by the private sector was a needed and welcome contribution to GIS and GIScience development and expansion, and that it provided a substantive basis to elaborate and extend the ideas and expert opinions found in *AutoCarto Six Retrospective.* Further, the idea of organizing a colloquium as a follow-on project was positively received, and especially if the presented materials would be digitally accessible and freely available.

And, fourth, while there was support for organizing a conference as a major part of a GIS retrospective program, it became readily apparent after exchanges with potential contributors that a conference in the immediate future would be premature. Rather, a research colloquium emerged as a prudent, practical next step.

Specifically, in the absence of a well-developed body of published, precedent work on applying the retrospective approach to mine for GIS nuggets, the colloquium should emphasize presentations that identify likely sources of GIS nuggets, and suggest, outline, etc., how to design retrospective mining activities.

Then, depending upon the outcomes of the colloquium, an informed decision could be made about whether to take the conference route.

This is the long story short regarding the origins of the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets.

Readers seeking more details may find them in papers published in the colloquium proceedings; the colloquium slide decks; materials that can be viewed at several websites, including (http://www.wellar.ca/wellarconsulting/; and http://www.slideshare.net/wellarb/presentations); as well as in two journal articles: B. Wellar, 2014. Using the retrospective approach to commemorate AutoCarto Six. *International Journal of Applied Geospatial Research (IJAGR*). 5(1), 93-99; and B. Wellar, 2015. Review and implications of the AutoCarto Six retrospective project. *International Journal of Applied Geospatial Research (IJAGR*). 6(3), 73-90.

Barry Wellar, Organizer
Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Ottawa, ON
February 20, 2015

COLLOQUIUM ANNOUNCEMENT

(Posted July 3, 2014 at http://wellar.ca/wellarconsulting/home.html)

Esri to Support and Host GIS Retro Colloquium

Dr. Barry Wellar received a grant from Esri International to support organizing the *Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets*. The Colloquium will be held February 13-14, 2015, at the Esri campus in Redlands, California.

In 1983, Prof. Wellar was director of the technical program committee and editor of the *Proceedings, Sixth International Symposium on Automated Cartography* (http://wellar.ca/wellarconsulting/home.html), which is widely regarded as one of the most influential international contributions to the evolution of automated cartography, geographic information systems, remote sensing, surveying, and related fields.

Then in 2013, to commemorate the 1983 conference he organized and edited *AutoCarto Six Retrospective,* in which 37 authors re-visited papers written 30 years previously. (http://wellar.ca/wellarconsulting/AutoCarto_Six_Retrospective.pdf)

Topics discussed by these leading contributors to the literature include:

- Thoughts shaping the design of the 1983 papers;
- Derivative attributions;
- Original contributions to the literature;
- Impacts;
- What was new in the papers; and
- What was different in the papers.

Background documents which will be used to design the colloquium curriculum and the conference program include "Using the Retrospective Approach to Commemorate AutoCarto Six", which is published in the ***International Journal of Applied Geospatial Research*** (Volume 5, Issue 1, 93-99) and a second paper, "Review and Implications of the AutoCarto Six Retrospective Project" which also has been accepted for publication post-colloquium in the *International Journal of Applied Geospatial Research (IJAGR)*.

Don Albert, editor of *IJAGR*, has agreed that a pre-publication copy of "Review and Implications of the AutoCarto Six Retrospective Project" can be made available to colloquium participants.

CALL FOR PRESENTATIONS

(Posted August 15, 2014 at http://wellar.ca/wellarconsulting/home.html)

Esri-GIS Retro Research Colloquium: Using the Retrospective Approach to Mine for GIS Nuggets. February 13-14, 2015.

Topics

The 2015 Retrospective Research Colloquium is designed in conjunction with plans for a possible follow-on Conference in 2016. The focus of the Research Colloquium is on presentations which discuss why and how different kinds of literature and other sources could be mined for GIS nuggets serving one or more of the following missions:

- **M1.** Designing and developing geographic information systems technology;
- **M2.** Defining and elaborating geographic information science;
- **M3.** Using geographic information systems technology and/or geographic information science.

The kinds of literature to be discussed include:

- Learned Literature
- Popular (Media) Literature
- Legal Literature
- Regulatory Agency Literature
- Oversight Agency Literature
- Professional Literature
- Public Interest Literature
- Special Interest or Vested Interest Literature
- Corporate/Institutional-Public Literature
- Corporate/Institutional-Private Literature
- Other Productions

Presentation and Publication Options

Presentations can be given at the Colloquium, or remotely by means of WebEx.

Published works will be included in the Colloquium's video production, or as a paper in a digital proceedings.

Further Information

View materials at http://wellar.ca/wellarconsulting/home.html or contact Barry Wellar at: wellarb@uottawa.ca.

ACKNOWLEDGEMENTS

I am pleased to recognize the following for their insights, endorsements, financial support, technical support, and other forms of assistance and encouragement.

Contributors to *AutoCarto Six Retrospective*. Given their roles as early, influential, and longstanding forces in the evolution of GIS, GISience, and the uses of GIS and GIScience, their votes of confidence were a critical first step in the decision to consider the colloquium option.

William L. "Bill" Garrison, Professor Emeritus at California-Berkeley. The decision to proceed with the colloquium was contingent upon having an *éminence grise* available, since the kind of retrospective research agenda that I had in mind was not one with a well-trodden path of precedents.

The willingness of Prof. Garrison to assist in the colloquium design and comment on papers allowed me to draw on his data-information-knowledge transform experiences that began in the 1950s, and his involvement in academic, government, and business research provided an exceptional sounding board for "bouncing around" research design and applied research topics.

Don Albert, Editor, *International Journal on Applied Geospatial Research*, (*IJAGR*). Don is instrumental in achieving dialogue among geospatial researchers in academia, government, and business through publications in *IJAGR*. An excellent case in point is his thoughtful handling of the two *IJAGR* papers discussing the AutoCarto Six Retrospective project.

The timely publication of "Using the retrospective approach to commemorate AutoCarto Six", *International Journal of Applied Geospatial Research (IJAGR*). 5(1), 93-99, January-March, 2014 assisted in promoting the retrospective research agenda and designing the colloquium. And, by granting permission to make a pre-publication copy of "Review and implications of the AutoCarto Six retrospective project" available to colloquium participants, he assisted in providing guidance to participants about colloquium objectives and expectations.

Gordon Plunkett, Director, Spatial Data Infrastructure, Esri Canada. Taking on the colloquium project was conditional upon Gordon's availability to assist. We thank Alex Miller, president, Esri Canada, for supporting Gordon's involvement, and we are indebted to Gordon for the timely information and sound advice that he provided regarding colloquium program design, the accommodation of on-site and off-site (WebEx) presentations, and the documentation of colloquium contributions.

Sam Herold, Technical Advisor, Information Research Board. Taking on the colloquium project was conditional upon Sam being available to handle the production of materials, including papers, slides decks, and this record of the colloquium papers. We are indebted to Sam for fitting the colloquium engagement into his busy schedule.

The closing words of acknowledgment recognize the founder and president of Esri International, Jack Dangermond, an internationally known leader in the GIS industry, with a distinguished track record.

Back in the day, so to speak, Jack participated in the AutoCarto Six Symposium in 1983, for which I was program chair.

At my request Jack agreed to give a keynote address on the topic “Science and Geographic Information Technology”, which was one of the early occasions that the concepts of GIS technology and scientific methodology were combined in a high-profile international conference event.

Thirty years later in 2013, when asked to contribute to *AutoCarto Six Retrospective,* Jack responded by authoring the “Introduction”, and arranged for Esri to financially support publishing the compilation of papers.

And, when presented with the idea of a colloquium on the topic of using the retrospective approach to mine for GIS nuggets, Jack offered financial assistance to organize the colloquium, and made facilities and staff available to hold the colloquium at the Esri campus in Redlands.

We are deeply indebted to Jack for his continued, enthusiastic support of research seeking to advance GIS technology, GIScience methodology, and the uses of GIS and GIScience.

As organizer of the colloquium and editor of the proceedings and the deck of slide presentations, I wish to conclude these brief remarks by emphasizing that the lead-up to the colloquium, the colloquium event itself, and this production are the results of a team effort.

I am deeply grateful for the assistance and encouragement received during the GIS retrospective initiative.

Barry Wellar, Editor
Slide Presentations, Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Ottawa, Ontario
February 20, 2015

SUMMARIES OF SLIDE PRESENTATIONS, RESEARCH COLLOQUIUM ON USING THE RETROSPECTIVE APPROACH TO MINE FOR GIS NUGGETS

Brief summaries overview how the slide presentations represent an important first step in elaborating what we can learn from the past, and how we can learn from the past, to inform the futures of:

- GIS technology research, design, development, and implementation;
- GIScience methods, techniques, and operations; and,
- The uses of GIS technology and GIScience by government, business, academe, the media, and other organizations.

Fundamentals of Mining for GIS Nuggets: Introductory Remarks

Barry Wellar

These slides outline the three fundamentals underlying the GIS retrospective program, namely defining GIS nuggets, providing illustrative nuggets to be derived from mining "the literature", and elaborating the many of bodies of published material which collectively comprise the GIS literature.

Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Design and Module Considerations

Barry Wellar

The compendium paper presents four idea-based modules: 1. Ideas about "doing"; 2. Ideas about objects of attention; 3. Principal GIS components as ideas; and 4. Ideas as questions and questions as ideas. The slides in this presentation outline modules 1, 2, and 3, and suggest how the modules can be used as guides to mine the different literatures – corporate/institutional-private; corporate/institutional-public; learned legal; oversight agency; popular (media); professional; public interest; etc. – for nuggets such as: New or different ways to add to GIS technology: New or different reasons to add to geospatial information; and, New or different uses of GIScience research methods.

Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Populating the Questions Module

Barry Wellar

The compendium paper presents four idea-based modules: 1. Ideas about "doing"; 2. Ideas about objects of attention; 3. Principal GIS components as ideas; and 4. Ideas as questions and questions as ideas. Slides for this presentation outline key aspects of module 4 of the compendium paper which demonstrates the value of questions as guides to mining the different literatures – learned, legal, oversight, corporate/institutional-private, corporate/institutional-public, popular (media), professional, public interest, etc. – for nuggets such as: New or different ways to add to GIS technology; New or different reasons to add to geospatial information; and, New or different uses of geospatial data.

Looking Back, Looking Ahead: Industry Thoughts for the GIS Retro Colloquium
Jack Dangermond

The success of the colloquium depends upon all the key players -- industry and business, government, academia, and other institutions or organizations -- sharing their ideas about how each of them separately and all of them collectively can contribute to mining various literatures for GIS nuggets.

The slides in this presentation emphasize the value of a needs orientation for the colloquium, and provide an industry perspective on numerous ways that the retrospective approach can contribute to: advancing the design, development, and implementation of GIS technology; strengthening the body of GIScience methods, techniques, and operations; and, furthering the uses of GIS technology and GIScience by governments, business, academe, the media, and other organizations.

Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map and Stewardship Map Concepts as Compelling Arguments to Retrospectively Mine the Popular Literature for GIS Nuggets
Barry Wellar

Organized around the concepts of the Doomsday Map and the Stewardship Map, this slide presentation outlines how media articles on the abuse versus care of land, water, and air resources over the 25 years between 1990 and 2015 provide a basis for questions to guide retrospectively mining the popular literature for GIS nuggets.

Key questions include: Who caused the change from abuse to care to occur? What caused the change from abuse to care to occur? Why did the change from abuse to care occur? When did the change from abuse to care occur? Where did the change occur? How did the change occur?

And, for each of those questions, the really BIG question, Was GIS a factor? The presence of geography in all the headlines and stories demonstrates the importance of giving the popular media literature its due regard as a significant, international source to mine for GIS nuggets involving GIS technology, GIScience methods and techniques, and the uses of GIS and GIScience in government, business, and academia.

The Role of Federal Agencies in Directing the Research Agenda: Is this a Case of the Cart before the Horse? A TIGER Case Study

Tim Trainor

Agencies typically react to their needs in the geospatial arena rather than respond to provocative research topics that may help formulate a new direction. This was the case with the development of the U.S. Census Bureau's TIGER System. In the geospatial community, there is a complete void on a vision for the next 25 years. What are the Big Ideas and challenges? Environments such as institutions, policy, data, budget considerations, and to a lesser extent technology contribute to that discussion in the government arena. Thoughts on these factors are offered as part of a TIGER retrospective for further discussion.

Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development

Barry Wellar

Oversight agencies are key players in the processes of democratic governance. This presentation reveals why more attention should be given to mining publications of federal oversight agencies which examine and evaluate federal government policies and programs that are geospatial in nature, and/or that use GIS technology, GIScience methods and techniques or geospatial data in their oversight operations, and/or which recommend changes in why and how GIS technology, GIScience methodology, or geospatial data or information is used by federal line departments and agencies.

Mining Open Data in Search of GIS Nuggets

Gordon Plunket

Many governments around the world have signed and are implementing the Open Data Charter that among other things encourages government created data to be accessible and (re)useable by default. Because this is a global phenomenon which is facilitated by technology and led by governments, there is significant potential for the geospatial community to use open data for developing geographic innovations and for helping improve the flow of spatial and non-spatial data within and between communities.

While governments collect a wide range of data for their own uses, they often do not share these data sets in ways that are easily discoverable, useable, or understandable by the public or sometimes even by the experts. By examining existing policies, sources and uses of open data, this paper demonstrates the potential value of open data for GIS and GIScience practitioners.

Extracting Nuggets – Data Quality and Metadata

Nick Chrisman

The standards processes in the 1980s left some fugitive literature that bears reconsideration. Important issues on the data quality front were decided based on the technology available. Metadata content standards have become a chore for agencies, and much of the current metadata archives are full of blank cells even in required fields. Returning to the original intent of data quality reporting might provide a guide to treating data quality content as regular spatial data. The DCW/VMAP standard is one possible resource.

Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment

Barry Wellar

As the link or bridge between federal and municipal governments, provincial and state governments have mandated responsibilities affecting the commercial, cultural, economic, environmental, health, housing, industrial, legal, regional, social, transportation, urban, and other geographies of their jurisdictions. By examining productions of the Environmental Commissioner of Ontario for illustrative purposes, this presentation outlines how mining oversight agencies at the provincial and state level could yield a bounty of GIS and GIScience nuggets.

Preserving Institutional Memory: Capturing Knowledge Key to GIScience

Stephen Guptill

One of the potential roles of GIScience is to characterize and analyze the changes that have occurred to our planet over time. To do this requires the use of historical geographic data collected by institutions and individuals. Absent documentation of procedures, specifications, instructions and guidelines, an institution's collective memory is encapsulated in the data produced by the institution. The data sets persist long after they were created. Without an understanding and record of the context or process by which the data were collected, then it is impossible to determine if the data are fit for a particular use or if investigative results are scientifically valid.

Revisiting Classical Land Classification, Assessment, and Management Literature to Inform GIS Research

Michael DeMers

This slide presentation outlines the academic and professional roots of GIS, including the technical and conceptual aspects, and briefly overviews the role that historical land classification research might have had in the conceptual evolution of geography and in the development of GIS. Based on a retrospective examination of the literature, the slides suggest how land classification research adds the best of the descriptive and scientific approaches to enhance the development of GIS.

Integrated Land Evaluation – History of a Track Not taken

Nick Chrisman

Prior to the development of full GIS capabilities, there was a substantial body of practice centered on integrated land evaluation, particularly in Australia. A sign of this community's importance worldwide is that Roger Tomlinson travelled to Canberra to present his first paper on CGIS. Various forms of integrated mapping were developed, including the ITUM approach. As GIS capabilities developed, the layer-based logic became the dominant approach, for a variety of reasons. It may be useful to revisit the advantages of integrated land evaluation and not lose sight of the close attention to the interactions of environmental factors.

It is recalled in closing that the colloquium body of documentation also includes papers which are in a companion publication to be posted in March, 2015, and a recording of the closing session discussion. Information about access to the recording will posted In due course.

Barry Wellar, Editor
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Fundamentals of Mining for GIS Nuggets: Introductory Remarks

Barry Wellar

Slides for the

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Fundamentals of Mining for GIS Nuggets: Introductory Remarks

Dr. Barry Wellar
Owner and Principal, Wellar Consulting Inc.
President, Information Research Board Inc.
Professor Emeritus, University of Ottawa

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Context

The graphics used in these introductory remarks are discussed in detail in the following posted papers:

- *Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map Concept as a Compelling Argument to Retrospectively Mine the Popular Literature for GIS Nuggets*
- *Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development*
- *Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment*
- *Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Considerations*

Figure 1. GIS Nuggets Defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

Table 1. Illustrative nuggets derived from using the retrospective approach to examine “the literature”

1. New or different reasons to add to GIS technology
2. New or different ways to add to GIS technology
3. New or different reasons to add to geospatial data
4. New or different reasons to add to geospatial information
5. New or different reasons to add to geospatial knowledge
6. New or different ways to add to geospatial data
7. New or different ways to add to geospatial information
8. New or different ways to add to geospatial knowledge
9. New or different uses of GIS technology
10. New or different uses of geospatial data
11. New or different uses of geospatial information
12. New or different uses of geospatial knowledge
13. New or different uses of GIScience research methods
14. New or different uses of GIScience research techniques
15. New or different uses of GIScience research operations

Table 2. Bodies of literature and other productions to mine for GIS nuggets

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Design and Module Considerations

Barry Wellar

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Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Design and Module Considerations*

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**Paper can be viewed at http://www.wellar.ca/wellarconsulting/home.html*

Overview

The compendium paper presents four idea-based modules: 1. Ideas about “doing”; 2. Ideas about objects of attention; 3. Principal GIS components as ideas; and 4. Ideas as questions and questions as ideas. This presentation discusses modules 1, 2, and 3 as guides to mining the different literatures – corporate/institutional-private; corporate/institutional-public; learned legal; oversight agency; popular (media); professional; public interest; etc. – for nuggets such as: New or different ways to add to GIS technology: New or different reasons to add to geospatial information; and, New or different uses of GIScience research methods.

Origins of the Idea of Developing a Compendium of Ideas (1)

Prior experience, including the AutoCarto Six Retrospective project, pointed to the value of a digitally accessible compendium of ideas as a means to engage an international audience, open the door to more ideas being introduced to the discourse, and create a “host” to which more ideas can be added.

Origins of the Idea of Developing a Compendium of Ideas (2)

Stimulus for the compendium also came from members of the GIS and GIScience communities who had contributed to *AutoCarto Six Retrospective,* and/or had reviewed the two related papers prepared for the *International Journal on Applied Geospatial Research.* Specifically, there was general agreement that a compendium could contribute to the correction needed to bring better questions and more rigour into research involving GIS technology, GIScience methodology, and the uses of GIS and GIScience.

Origins of the Idea of Developing a Compendium of Ideas (3)

The idea of the compendium of ideas was greeted as an innovative and useful way to advance using the retrospective approach to mine for GIS nuggets. It was suggested that publishing the initial version would likely be a catalyst for prompting additional entries in updates, revisions, etc.

Compendium Design Principles

Four design principles (1. Focus on connecting “ideas” and “nuggets”; 2. Use a modular approach; 3. Limit the modules to those required to effectively and efficiently launch the project; and 4. Make it easy for those with different interests to modify the content of modules) provide directions for navigating the compendium-building process.

Terms of Reference for the Compendium Design

Three broad terms of reference appear sufficient to put the compendium design in context, and to provide guidelines for additions to the present compendium, or to create a variation of the present version. The terms are:

1. GIS Nuggets as Findings.
2. Bodies of Literature and Other Productions to Mine for GIS Nuggets.
3. Nuggets as Links in Chains that Tie Past, Present, and Future.

GIS Findings as Nuggets

GIS nuggets are <u>findings</u> from the literature or other sources which serve one or more of the three core missions expressed in Figure 1.

Figure 1. GIS Nuggets Defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

Illustrative Nuggets/Ideas

Table 1. Illustrative Nuggets/Ideas to be Derived from Using the Retrospective Approach to Examine “the Literature”

1. New or different reasons to add to GIS technology
2. New or different ways to add to GIS technology
3. New or different reasons to add to geospatial data
4. New or different reasons to add to geospatial information
5. New or different reasons to add to geospatial knowledge
6. New or different ways to add to geospatial data
7. New or different ways to add to geospatial information
8. New or different ways to add to geospatial knowledge
9. New or different uses of GIS technology
10. New or different uses of geospatial data
11. New or different uses of geospatial information
12. New or different uses of geospatial knowledge
13. New or different uses of GIScience research methods
14. New or different uses of GIScience research techniques
15. New or different uses of GIScience research operations

Bodies of Literature and Other Productions to Mine for GIS Nuggets

Table 2. Literature and Other Productions to Mine for GIS Nuggets/Ideas

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

Purpose of Compendium of Ideas

To provide suggestions, hypotheses, theories, impressions, pointers, clues, indications, hunches, concepts, notions, beliefs, inklings, perceptions, guesses, estimates, views etc., that support, encourage, and offer directives on mining the literature and other productions listed in Table 2 in the search for nuggets such as those listed in Table 1 which serve one or more of M1, M2 and M3 in Figure 1.

Nuggets as Links in Chains that Tie Past, Present, and Future

"You use the word nuggets in useful ways. Perhaps nuggets could be thought of as links in the chain that ties the past to the present.... and in important ways the present to the future. Is that a thought about using nuggets to achieve richer futures?" W.L. Garrison.

Macro-Temporal Aspect

Given the macro-temporal aspect (past, present, future) which applies to the evolution of GIS and GIScience, and the uses of GIS and GIScience the macro-temporal aspect applies to all the three compendium materials which follow.

Compendium Design: Initial Considerations

Four primary design considerations for the initial phase;

1. Focus on connecting “ideas” and “nuggets”;
2. Use a modular approach;
3. Limit the modules to those required to effectively and efficiently launch the project; and
4. Make it easy for those with different interests to modify the content of modules.

Ideas about “Doing” Research or GIS

The applied aspect of the GIS retrospective program involves doing research and doing GIS to derive nuggets. The **104** terms in Table 3 represent a mix of ”doing” types of activity in research in general, and in the applications, design, development, education, management, operations, research, and training aspects of GIS. The terms serve both as ideas, and sources of ideas, for designing projects to retrospectively mine the literature and other productions for GIS nuggets.

Table 3. Examples of Research and GIS Verb Forms Which are Sources of Ideas for Doing Research and/or Doing GIS

adapting	disaggregating	incorporating	rating
adopting	displaying	indexing	recording
aggregating	disseminating	indicating	representing
analyzing	distributing	informing	researching
applying	educating	interpolating	reviewing
approximating	elaborating	locating	routing
ascertaining	engaging	managing	sampling
assessing	enhancing	mapping	scoping
buffering	envisioning	measuring	searching
calculating	estimating	mining	sectioning
calibrating	evaluating	modelling	selecting
cataloguing	examining	modifying	separating
certifying	expanding	monitoring	shaping
championing	experimenting	observing	simulating
classifying	explaining	organizing	structuring
combining	exploring	parameterizing	studying
computing	extrapolating	parcelling	supporting
confirming	forecasting	plotting	synthesizing
connecting	functioning	positioning	testing
constructing	generalizing	postulating	theorizing
deconstructing	generating	predicting	tracking
depicting	hypothesizing	projecting	training
describing	identifying	promoting	validating
designing	illustrating	prototyping	viewing
detecting	implementing	quantifying	visioning
directing	improving	ranking	visualizing

Research and GIS “Doing” Verbs as Search Keywords

The verb form of every term in Table 3 can be logically preceded by modifiers or qualifiers, such as “how to”, as in how to adapt, how to adopt, how to aggregate, how to analyse, how to apply, how to approximate, how to buffer, how to calculate, how to calibrate, how to catalogue, etc.

As a result, each of the terms is a possible keyword for finding of one or more nuggets contained in previous work.

Maintaining a Dynamic “Doing” Vocabulary

Due to the dynamic nature of language where technology is involved, it is prudent idea to begin thinking now about how to maintain the compendium vocabulary so that is can effectively support retrospectively mining for GIS nuggets in the face of rapidly-changing terminology.

Adaptability of “Doing” Module

This compendium module, Ideas about “Doing” Research or GIS, can readily be expanded, extended, contracted, re-oriented, etc., to accommodate general as well as particular interests affecting decisions about doing research or doing GIS.

Ideas about Objects of Research and GIS Attention

The interests of academia, governments, business, trade associations, professional associations, etc., in research and GIS are driven by numerous objects of attention. A selection of core objects of research and GIS attention are presented in Table 4 as ideas, and sources of ideas, which could guide mining the literature and other productions for GIS nuggets.

Table 4. Core Objects of Attention for Mining Activities

algorithms	functions	orders	relationships
analyses	generalizations	organizations	reviews
applications	heuristics	overviews	routes
approaches	imagery	paths	routines
arcs	instruments	patterns	schemes
areas	links	plans	standards
attributes	maps	plots	structures
charts	means	polygons	styles
controls	methods	practices	syntheses
courses	methodologies	procedures	systems
designs	modes	processes	techniques
devices	models	programs	tools
frameworks	operations	protocols	ways

Prioritizing Core Objects

Core objects are more likely to have benefitted from above-average documentation and archiving, which points them as more promising search drivers.

“Birds of a Feather”

Core objects of attention are likely to have received consideration on multiple occasions in a variety of circumstances over an extended span of time. It is therefore probable that GIS nuggets associated with core objects of attention did not occur in isolation, and finding them in batches or clusters could be a matter of connecting the dots through doing research and/or doing GIS in the manners suggested in Table 3.

Combining Tables 3 and 4

Table 3 and Table 4 contain terms which of themselves have little or no practical beginning or end. However, in combination they provide an insightful <u>indication</u> of the variety of things and activities – in essence, ideas – which are central to elaborating how to design and use retrospective research to mine for GIS nuggets.

Adaptability of Objects of Attention Module

The compendium module, Ideas about Objects of Research and GIS Attention, can readily be expanded, extended, contracted, re-oriented, etc., to accommodate general as well as particular interests affecting decisions about selecting and prioritizing objects of attention for mining purposes.

Principal GIS Components

The term ‘principal’ refers to GIS components which are critical, vital, central, core, essential, fundamental, basic, etc., the implication being that principal components play key roles in achieving GIS research, education, training, applications, operations, and management objectives.

Principal GIS Components as the Results of and the Spawners of Ideas

Principal GIS components are the products of ideas on the one hand, and the spawners of further ideas on the other, in a complementary relationship of inputs-outputs-inputs … As a result, they are included in the compendium as starting points in thinking about why and how to mine the literature and other productions for GIS nuggets.

Criteria for Selecting Components

The GIS components in Table 5 are culled from the literature of academic, government, business, trade, and professional organizations listed in Table 2, and most of them date from the earliest days of GIS evolution. All the selected components have been “works in progress” and potential GIS nugget generators for at least 30 years, to as many as 50 years or so for some, and counting.

Table 5. Principal GIS Components as Initial Targets for Mining Activities

GIS applications	GIS operations
GIS calls for proposals	GIS opportunities
GIS capabilities	GIS performance
GIS challenges	GIS plans
GIS decision systems	GIS policies
GIS education programs	GIS programs
Enterprise GIS	GIS protocols
GIS expressions of interest	GIS replies to proposals
GIS futures	GIS research activities
GIS implementation	GIS research gaps
GIS infrastructure	GIS research needs
GIS innovations	GIS research programs
GIS management practices	GIS research trends
GIS markets	GIS standards
GIS maxims	GIS training programs
GIS needs	GIS trends

Seeking and Embracing Differences = Smart Mining

There are legislative, institutional, organizational, political, social, ideological, administrative, financial, technological, technical, financial, entrepreneurial, competency, etc., differences among entities. Consequently, there are inevitable differences in the principal GIS components that are i**dentified**, **adopted**, and **implemented** by those entities and your entity. Every entry in Table 5 is a potential mother lode of difference-based GIS mining opportunities.

Smart Mining = Taking Advantage of the Input Process of Others

Smart mining by GIS User means looking for <u>inputs</u> to principal components and, specifically, any ideas incorporated in a component that:

- ❖ Had not been identified by GIS User;
- ❖ Had been identified by GIS User but not adopted; and,
- ❖ Had been adopted but not implemented by GIS User.

To re-phrase, whatever others did that was not done by GIS User, from identify to adopt through to implementation of a principal component or parts thereof, represents nugget potential for GIS User.

Smart Mining = Taking Advantage of the Outputs Achieved by Others

Smart mining by GIS User means looking for <u>outputs</u> from principal components and, specifically ideas (questions, declarations, announcements, affirmations, rejections, doubts, etc.) spawned by a principal component that:

- ❖ Were not identified by GIS User;
- ❖ Were identified but not adopted by GIS User; and,
- ❖ Were adopted but not implemented by GIS User.

To re-phrase, whatever outputs from other governments, agencies of governments, businesses, etc., that were not shared by GIS User, from identify through to adopt and implement, represent nugget potential for GIS User.

Adaptability of Principal GIS Components Module

The compendium module, Principal GIS Components, can readily be expanded, extended, contracted, re-oriented, etc., to accommodate general as well as particular interests affecting decisions about selecting and prioritizing GIS components for mining purposes.

Nuggets as Links in Chains

For the closing slides I recall the observation by Professor Bill Garrison regarding the time factor, and its essential significance in retrospective research, and research in general.

"You use the word nuggets in useful ways. Perhaps nuggets could be thought of as links in the chain that ties the past to the present.... and in important ways the present to the future. Is that a thought about using nuggets to achieve richer futures?"

GETTING A SENSE OF "THE BIG PICTURE"

Tables 3, 4, and 5 are initial approximations of what could be in the compendium under the headings Doing Research and Doing GIS, Core Objects of Attention for Retrospective Mining Activities, and Principal GIS Components. Separately they provide insight into the potential yields from retrospective mining activities, and in combination they provide a clear indication of the potential scope and value of a compendium of ideas on using the retrospective approach to mine for GIS nuggets

Acknowledgements

Advice given by William L. Garrison, Professor Emeritus of Civil and Environmental Engineering, and Emeritus Research Engineer in the Institute of Transportation Studies, University of California, Berkeley, and by Gordon Plunkett, Director, Spatial Data Infrastructure, Esri Canada, in creating the colloquium paper from which the slides are derived is gratefully acknowledged. I also wish to acknowledge the slide preparation assistance of Sam Herold, Technical Advisor, Information Research Board Inc.

Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Populating the Questions Module

Barry Wellar

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-14, 2015

Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Populating the Questions Module*

Dr. Barry Wellar
Owner and Principal, Wellar Consulting Inc.
President, Information Research Board Inc.
Professor Emeritus, University of Ottawa

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**Paper can be viewed at http://www.wellar.ca/wellarconsulting/home.html*

Overview

The compendium paper presents four idea-based modules: 1. Ideas about "doing"; 2. Ideas about objects of attention; 3. Principal GIS components as ideas; and 4. Ideas as questions and questions as ideas. This presentation discusses module 4 of the compendium paper and the value of questions as guides to mining the different literatures – learned, legal, oversight, corporate/institutional-private, corporate/institutional-public, popular (media), professional, public interest, etc. – for nuggets such as: New or different uses of GIScience research techniques; New or different ways to add to geospatial knowledge; and, New or different reasons to add to GIS technology.

Origins of the Idea of Developing a Compendium of Ideas (1)

Prior experience, including the AutoCarto Six Retrospective project, pointed to the value of a digitally accessible compendium of ideas as a means to engage an international audience, open the door to more ideas being introduced to the discourse, and create a “host” to which more ideas can be added.

Origins of the Idea of Developing a Compendium of Ideas (2)

Stimulus for the compendium also came from members of the GIS and GIScience communities who had contributed to *AutoCarto Six Retrospective,* and/or had reviewed the two related papers prepared for the *International Journal on Applied Geospatial Research.* Specifically, there was general agreement that a compendium could contribute to the correction needed to bring better questions and more rigour into research involving GIS technology, GIScience methodology, and the uses of GIS and GIScience.

Origins of the Idea of Developing a Compendium of Ideas (3)

The idea of the compendium of ideas was greeted as an innovative and useful way to advance using the retrospective approach to mine for GIS nuggets. It was suggested that publishing the initial version would likely be a catalyst for prompting additional entries in updates, revisions, etc.

Compendium Design Principles

Four design principles (1. Focus on connecting “ideas” and “nuggets”; 2. Use a modular approach; 3. Limit the modules to those required to effectively and efficiently launch the project; and 4. Make it easy for those with different interests to modify the content of modules) provide directions for navigating the compendium-building process.

Terms of Reference for the Compendium Design

Three broad terms of reference appear sufficient to put the compendium design in context, and to provide guidelines for additions to the present compendium, or to create a variation of the present version. The terms are:

1. GIS Nuggets as Findings.
2. Bodies of Literature and Other Productions to Mine for GIS Nuggets.
3. Nuggets as Links in Chains that Tie Past, Present, and Future.

GIS Findings as Nuggets

GIS nuggets are findings from the literature or other sources which serve one or more of the three core missions expressed in Figure 1.

Figure 1. GIS Nuggets Defined

GIS nuggets are findings from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

Illustrative Nuggets/Ideas

Table 1. Illustrative Nuggets/Ideas to be Derived from Using the Retrospective Approach to Examine “the Literature”

1. New or different reasons to add to GIS technology
2. New or different ways to add to GIS technology
3. New or different reasons to add to geospatial data
4. New or different reasons to add to geospatial information
5. New or different reasons to add to geospatial knowledge
6. New or different ways to add to geospatial data
7. New or different ways to add to geospatial information
8. New or different ways to add to geospatial knowledge
9. New or different uses of GIS technology
10. New or different uses of geospatial data
11. New or different uses of geospatial information
12. New or different uses of geospatial knowledge
13. New or different uses of GIScience research methods
14. New or different uses of GIScience research techniques
15. New or different uses of GIScience research operations

Bodies of Literature and Other Productions to Mine for GIS Nuggets

Table 2. Literature and Other Productions to Mine for GIS Nuggets/Ideas

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

Purpose of Compendium of Ideas

To provide suggestions, hypotheses, theories, impressions, pointers, clues, indications, hunches, concepts, notions, beliefs, inklings, perceptions, guesses, estimates, views etc., that support, encourage, and offer directives on mining the literature and other productions listed in Table 2 in the search for nuggets such as those listed in Table 1 which serve one or more of M1, M2 and M3 in Figure 1.

Nuggets as Links in Chains that Tie Past, Present, and Future

"You use the word nuggets in useful ways. Perhaps nuggets could be thought of as links in the chain that ties the past to the present.... and in important ways the present to the future. Is that a thought about using nuggets to achieve richer futures?" W.L. Garrison.

Macro-Temporal Aspect

Given the macro-temporal aspect (past, present, future) which applies to the evolution of GIS and GIScience, and the uses of GIS and GIScience, the macro-temporal aspect applies to the design and structure of questions in module 4 of the compendium.

Compendium Design: Initial Considerations

Four primary design considerations for the initial phase;

1. Focus on connecting “ideas” and “nuggets”;
2. Use a modular approach;
3. Limit the modules to those required to effectively and efficiently launch the project; and
4. Make it easy for those with different interests to modify the content of modules.

Ideas as Questions and Questions as Ideas

Questions about situations, issues, concerns, goals, policies, programs, plans, etc., for which we want or need answers, are frequently behind decisions to engage in research activities and/or to undertake GIS projects. The questions in this module add a variety of perspectives to ideas in Tables 3, 4, and 5 in the companion compendium presentation, with the net result being the generation of even more grounds to retrospectively mine the literature and other productions for GIS nuggets.

Ideas as Questions and Questions as Ideas (2)

Providing a list of topics through questions is an instructive, efficient, and inclusive way to illustrate possibilities for future retrospective research and GIS conferences, seminars, or other projects.

Deriving of Questions

Questions in the initial version of the module are derived from multiple sources, including suggestions from members of the contact list.

Focus of Questions (1)

The majority of questions focus on the how dimension, with the intention of leading to papers and presentations which contribute to our knowledge about how to design and how to apply the retrospective approach to mine for GIS nuggets. Examination of the GIS research publication record suggests that the how aspect is under-served relative to the aspects of who, what, where, and when, so it is appropriate that the colloquium address that shortfall.

Focus of Questions (2)

The focus on how is consistent with serving the two primary goals of science, namely, to add to knowledge, and to add to ways of continuing to add to knowledge, neither of which happens at a non-trivial level without support by methodology and empirical evidence which are non-trivial.

Focus of Questions (3)

Due to the limited scope of the colloquium, it was not possible to employ a formal mail survey, focus group, Delphi, or other technique to assemble and prioritize the questions. However, positive responses by reviewers indicate that in structure and content the provided questions are appropriate for the initial version of the compendium.

Sources of Questions

Sources used to compile the list of question-based topics include journals, proceedings, newsletters, conference programs, workbooks, list serve comments, etc. of professional, trade, and academic organizations, of government agencies, of businesses, of the popular media, and of websites such as slideshare.net.

In addition, suggestions were received from participants in colloquium and conference planning activities.

Convertibility of Questions

The questions are highly convertible, and frequently two or more of GIS applications, design, education, management, operations, research, or training can be interchanged with little or no loss of generality or pertinence. As a result, the approach taken is to use one of the terms for illustrative purposes, with the expectation that readers are fully capable of interchanging terms should they wish to produce a more detailed or more explicit listing.

Questions for Presentation

There are **145** questions in Table 6 in the compendium paper, and many more are available by interchanging related terms in Table 1 and Table 2 above, and Tables 3, 4, and 5 in the companion compendium presentation. A small selection of questions are presented in Table 3 and briefly commented upon for illustrative purposes.

Table 3. An Indicative Selection of Entries Illustrating the Module of Question-based Topics (1)

1. How can the ‘retro approach’ contribute to documenting the GIS field as science?

2. How can the ‘retro approach’ contribute to more informed use of time-geospatial continuum knowledge in federal government programs?

3. How can the ‘retro approach’ contribute to more informed use of time-geospatial continuum knowledge in business?

4. How can the ‘retro approach’ promote continuity among members of the GIS community?

Table 3. An Indicative Selection of Entries Illustrating the Module of Question-based Topics (2)

5. How can the ‘retro approach’ contribute to reducing the hype in communications about “analytics”?
6. How did best practice concepts affect GIS evolution?
7. How did curiosity- and client-driven research combine to affect GIS evolution?
8. How did enterprise GIS ideas arise and evolve?

Table 3. An Indicative Selection of Entries Illustrating the Module of Question-based Topics (3)

9. How has GIS affected news media?

10. How has GIS affected quantitative synthesis?

11. How has GIS affected urban design?

12. How has GIS affected spatial cataloguing?

Table 3. An Indicative Selection of Entries Illustrating the Module of Question-based Topics (4)

13. How have GIS and geo-based data added to processes examined in the medical sciences?

14. How have GIS and geo-based data added to processes examined in the natural sciences?

15. How have GIS and geo-based data added to processes examined in the social sciences?

16. How have GIS and geo-based data affected examination of built environment processes?

Table 3. An Indicative Selection of Entries Illustrating the Module of Question-based Topics (5)

17. How have GIS and geo-based data been used to counter claims of climate change?

18. How have GIS and geo-based data been used to demonstrate the cascading process which affects interdependent spatial infrastructures?

19. How have GIS and geo-based data contributed to indexes for measuring pedestrians' safety?

20. What were the origins of incorporating GIS in standard of care practice?

Adaptability of Principal GIS Components Module

The compendium module, Ideas as Questions and Questions as Ideas, can readily be expanded, extended, contracted, re-oriented, etc., to accommodate general as well as particular interests affecting decisions about selecting and prioritizing GIS components for mining purposes.

Feedback on the Questions Module

Feedback from reviewers in academia, government, and business on the questions module finds that this module is a substantive contribution to GIS evolution, and will significantly increase in value as the GIS field matures.

Attribution: Recognizing Prior Research

Many questions or variations of questions in Table 6 in the colloquium paper may have been used in dissertations, theses, agency or installation reviews, research proposals, proceedings presentations, journal articles, etc. I would appreciate having the source information (author, publisher, date, link) brought to my attention.

Recommendation

That a second phase of refining and populating the question module of the Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets be supported by governments and business, as well as by organizations with an interest in GIS, GIScience, and the uses of GIS and GIScience. Organizations which come immediately to include AAG, AGI, ANZLIC, ASC, ASPRS, CAG, CaGIS, CIG, GISA, GITA, ICA, INFORMS, NACIS, OGC, and URISA.

Acknowledgements

Advice given by William L. Garrison, Professor Emeritus of Civil and Environmental Engineering, and Emeritus Research Engineer in the Institute of Transportation Studies, University of California, Berkeley, and by Gordon Plunkett, Director, Spatial Data Infrastructure, Esri Canada, in creating the colloquium paper from which the slides are derived is gratefully acknowledged. I also wish to acknowledge the slide preparation assistance of Sam Herold, Technical Advisor, Information Research Board Inc.

Looking Back, Looking Ahead: Industry Thoughts for the GIS Retro Colloquium

Jack Dangermond

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
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Review History

Understanding

Fun

PURPOSE

Learning

Create the Future

Re-new Relationships

Creating

Sharing

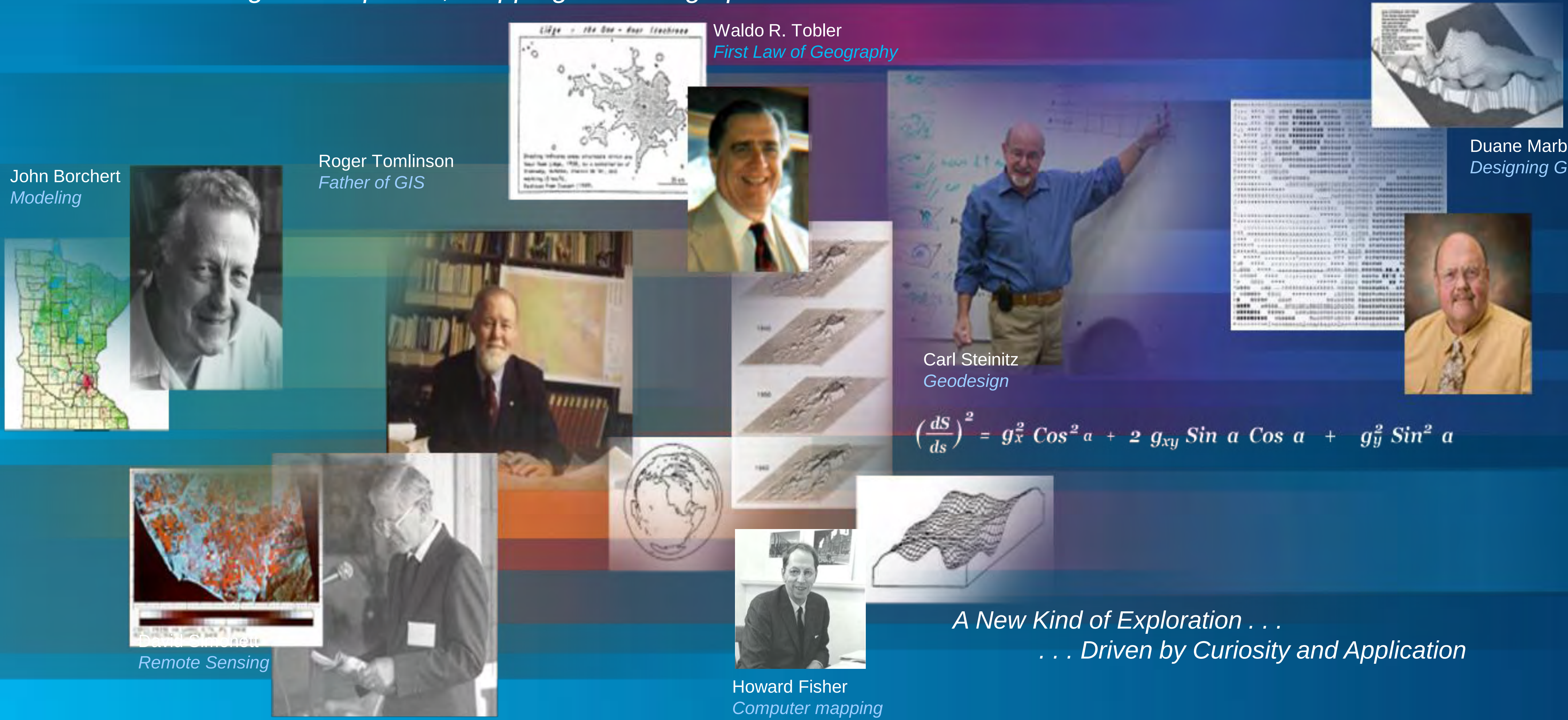
Discuss Successes and Failures

Geography — Exploring and Describing Our World

Creating Better Understanding

Computational Geography

The Blending of Computers, Mapping and Geographic Science



A New Kind of Exploration . . .
. . . Driven by Curiosity and Application

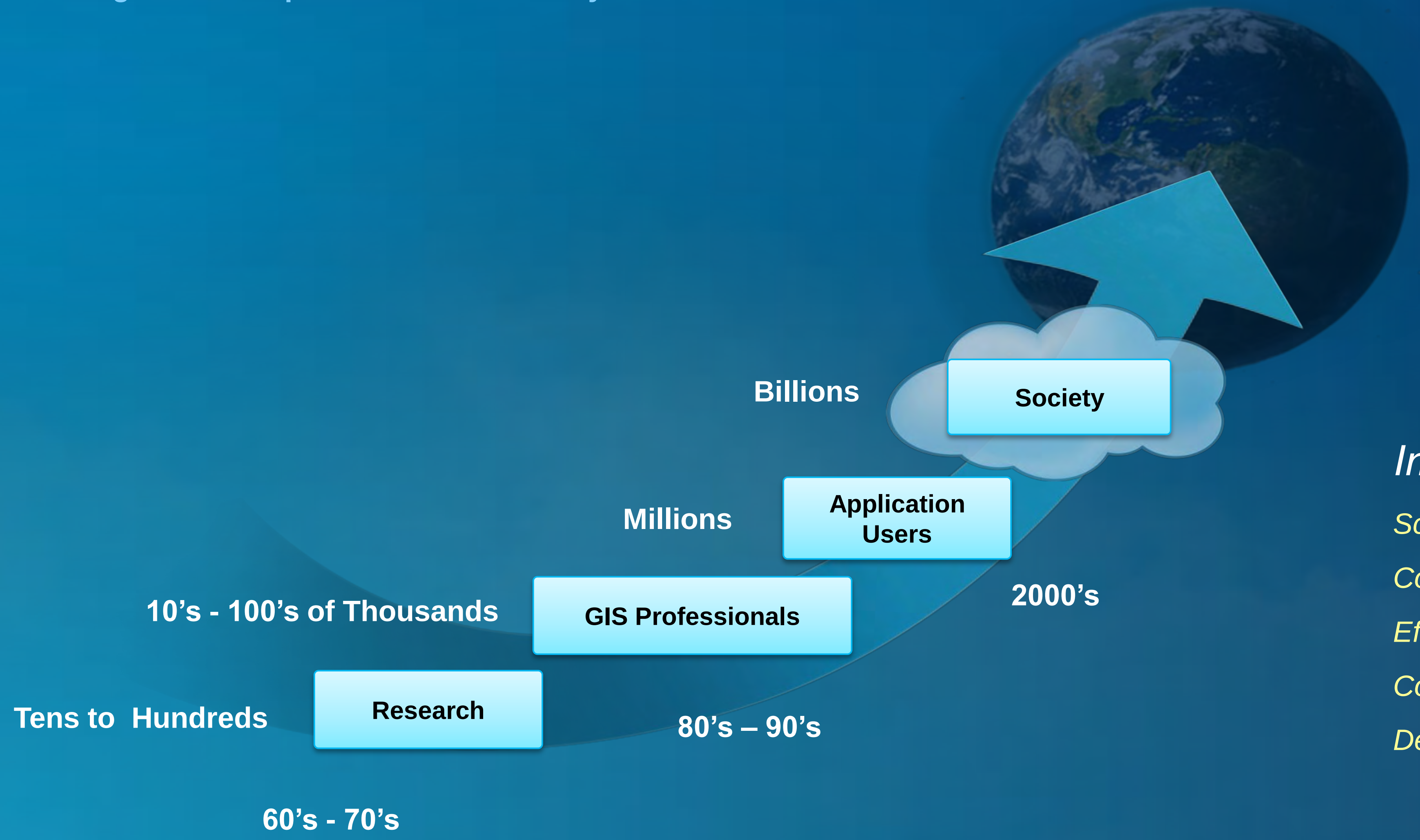
GIS Emerged – Creating a New Foundation For

Geographic Information , Management, Analysis, Modeling and Visualization. . .

Opening Our World To New Forms Of Exploration. . .
. . .and Application

GIS Continues to Evolve

Providing a Road Map for a Smarter Society



Improving….

Science and Understanding

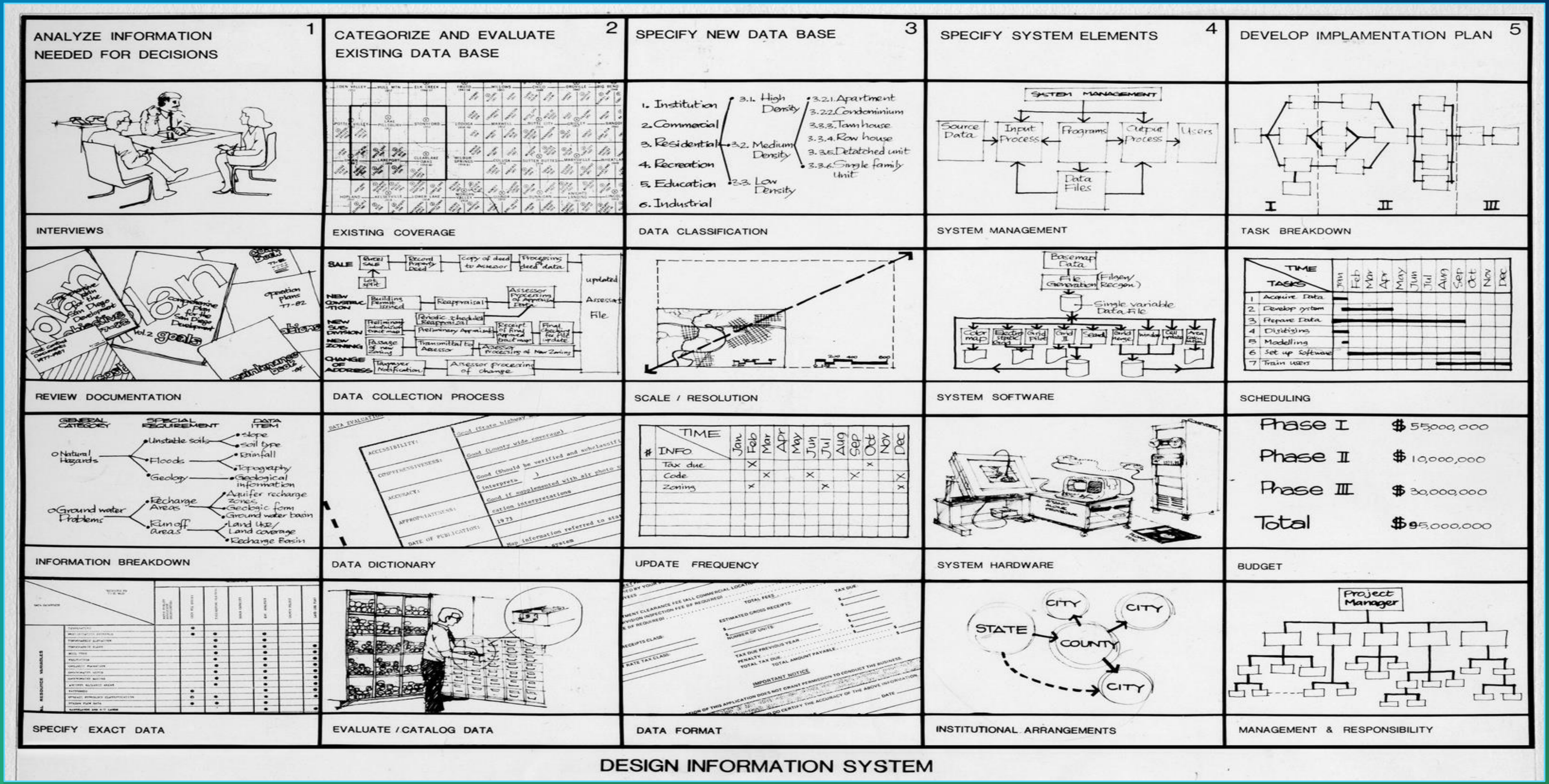
Collaboration

Efficiency

Communication

Decision Making

Early GIS Design Work
User Needs and System Design

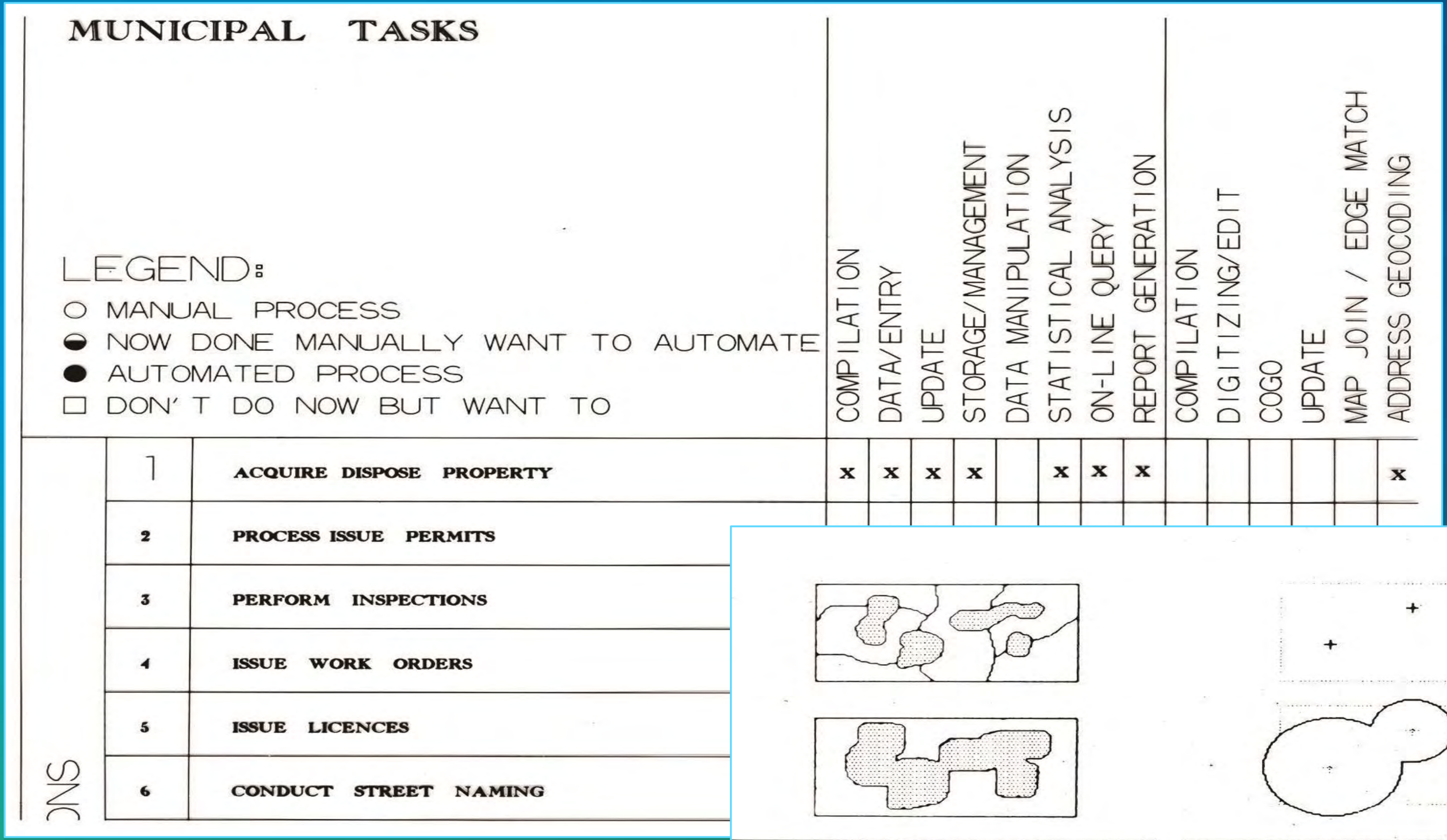


All Cities Do Routine Geospatial Workflows

OBSERVED GENERIC MUNICIPAL TASKS

1. AQUIRE/DISPOSE PROPERTY
2. PROCESS/ ISSUE PERMITS
3. PERFORM INSPECTIONS
4. ISSUE WORK ORDERS
5. ISSUE LICENCES
6. CONDUCT STREET NAMING
7. MANAGE MAILING LISTS
8. REVIEW/APPROVE SITE PLANS
9. REVIEW/APPROVE SUBDIVISIONS
10. PERFORM STREET ADDRESSING
11. PERFORM EVENT RECORDING
12. DISPATCH VEHICLES
13. PERFORM VEHICLE ROUTING
14. CONDUCT TRAFFIC ANALYSIS
15. ALLOCATE HUMAN RESOURCES
16. SITE FACILITIES
17. CONDUCT AREA DISTRICTING
18. MANAGE/SURVEY FACILITIES
19. MANAGE INVENTORIES
20. MANAGE RESOURCES
21. ADMINISTER ZONING BYLAWS
22. PREPARE OFFICIAL/SECONDARY PLANS
23. CONDUCT ENGINEERING DESIGN
24. CONDUCT DRAFTING
25. MAINTAIN TOPOGRAPHIC DATA BASE
26. MANAGE DRAWINGS
27. DISSEMINATE PUBLIC INFORMATION
28. CONDUCT DEVELOPMENT TRACKING
29. RESPOND TO PUBLIC ENQUIRIES
30. CONDUCT TITLE SEARCHES
31. BILL/COLLECT TAXES AND FEES
32. MANAGE DATA BASES/SYSTEMS

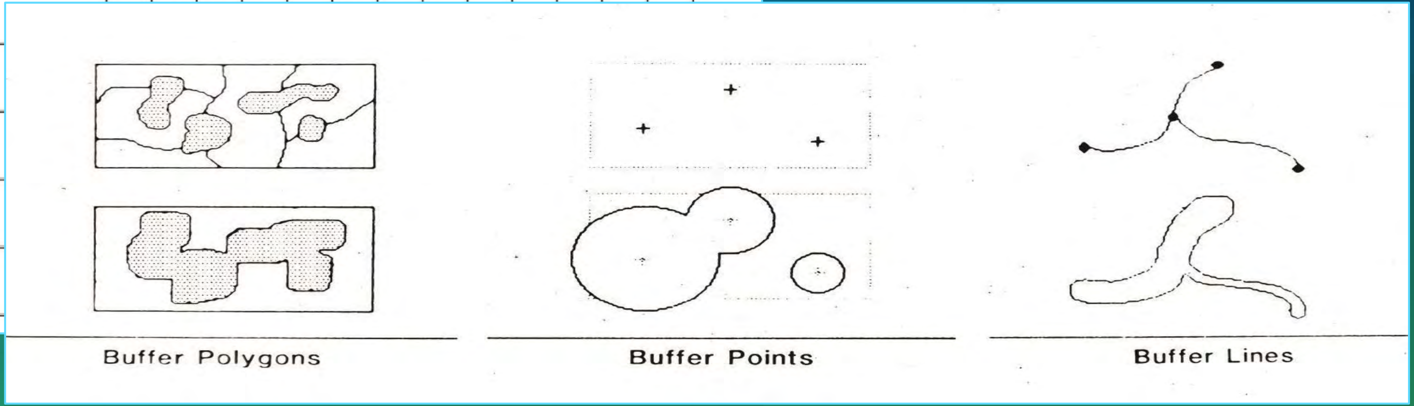
These Generic Workflows Need Common GIS Functions



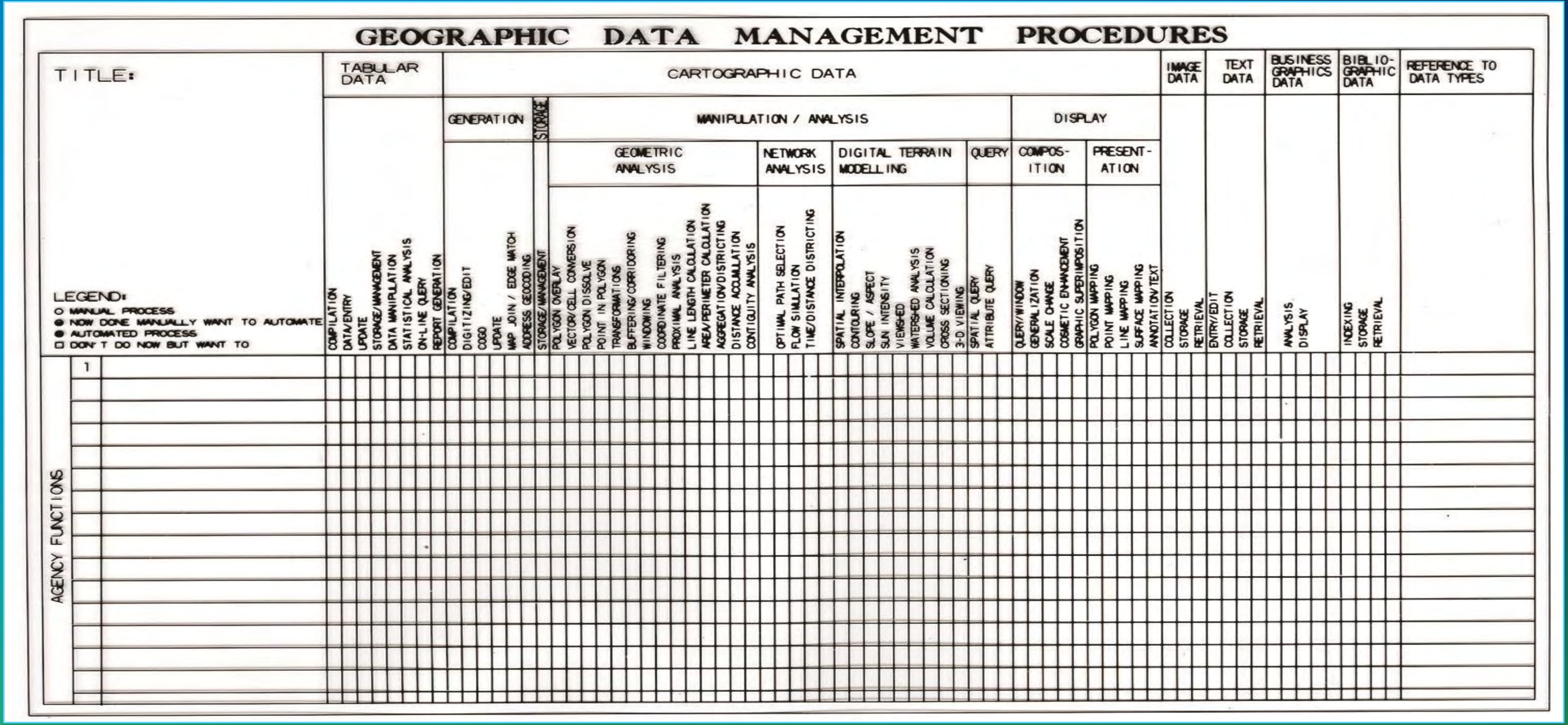
MUNICIPAL TASKS

LEGEND:
- ○ MANUAL PROCESS
- ◒ NOW DONE MANUALLY WANT TO AUTOMATE
- ● AUTOMATED PROCESS
- □ DON'T DO NOW BUT WANT TO

		COMPILATION	DATA/ENTRY	UPDATE	STORAGE/MANAGEMENT	DATA MANIPULATION	STATISTICAL ANALYSIS	ON-LINE QUERY	REPORT GENERATION	COMPILATION	DIGITIZING/EDIT	COGO	UPDATE	MAP JOIN / EDGE MATCH	ADDRESS GEOCODING
1	ACQUIRE DISPOSE PROPERTY	X	X	X	X		X	X	X						X
2	PROCESS ISSUE PERMITS														
3	PERFORM INSPECTIONS														
4	ISSUE WORK ORDERS														
5	ISSUE LICENCES														
6	CONDUCT STREET NAMING														



These Generic Workflows Need Common GIS Functions



These Workflows Create and Use Common Geospatial Data

TABLE 2
Page 3 of 3

DATA REQUIREMENTS

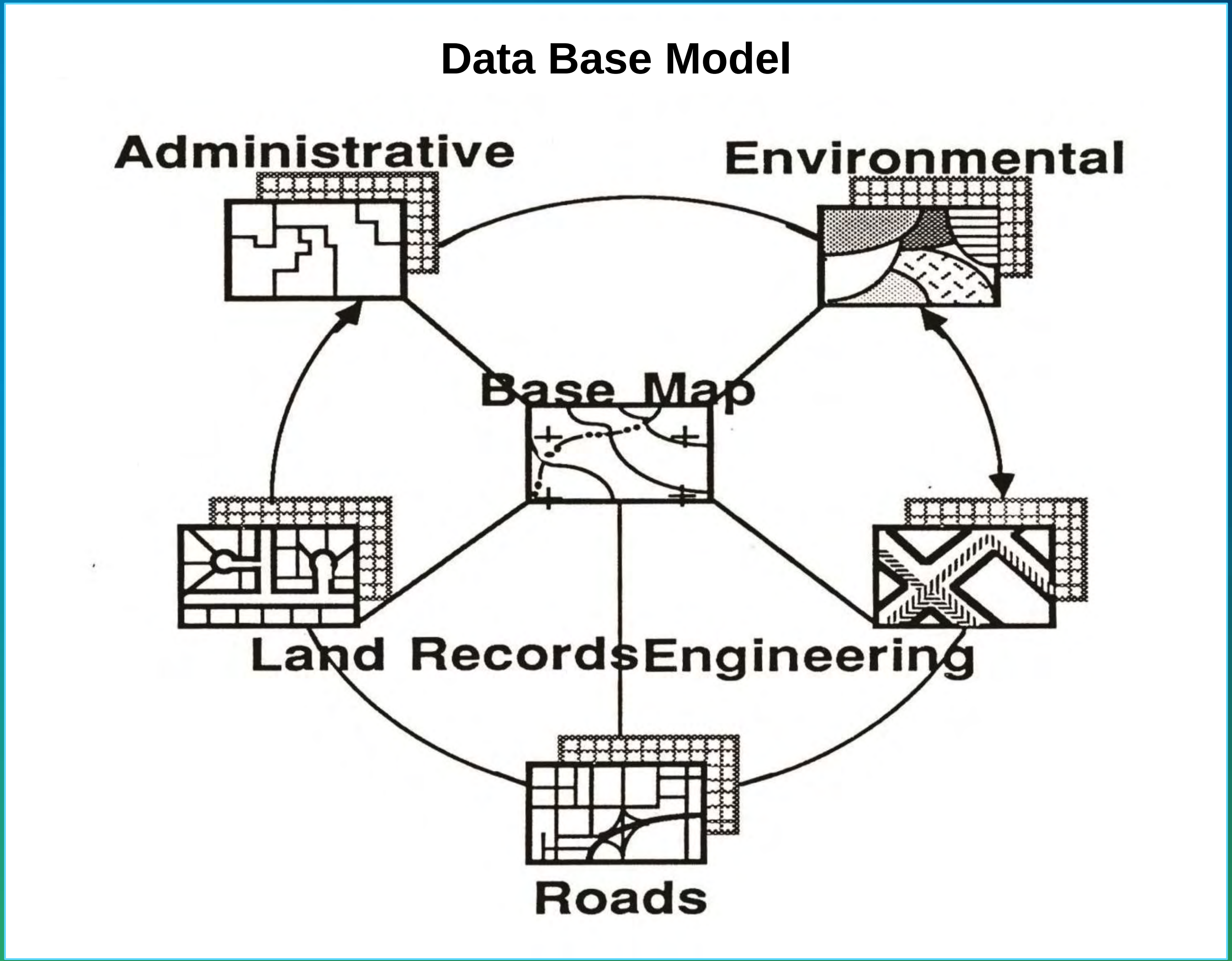
POTENTIAL USES	BASEMAP	ENVIRONMENTAL OVERLAYS	ENGINEERING OVERLAYS	PLAN/PROFILE DRAWINGS
27 Conduct Weed Control				
28 Perform Map Management	X	X	X	
29 Conduct Drawing Management			X	X
30 Perform Data Base Management	X	X		
31 Conduct Development Tracking				
32 Disseminate Public Information				
33 Respond to Public Inquiries		X		

TABLE 2
Page 1 of 3

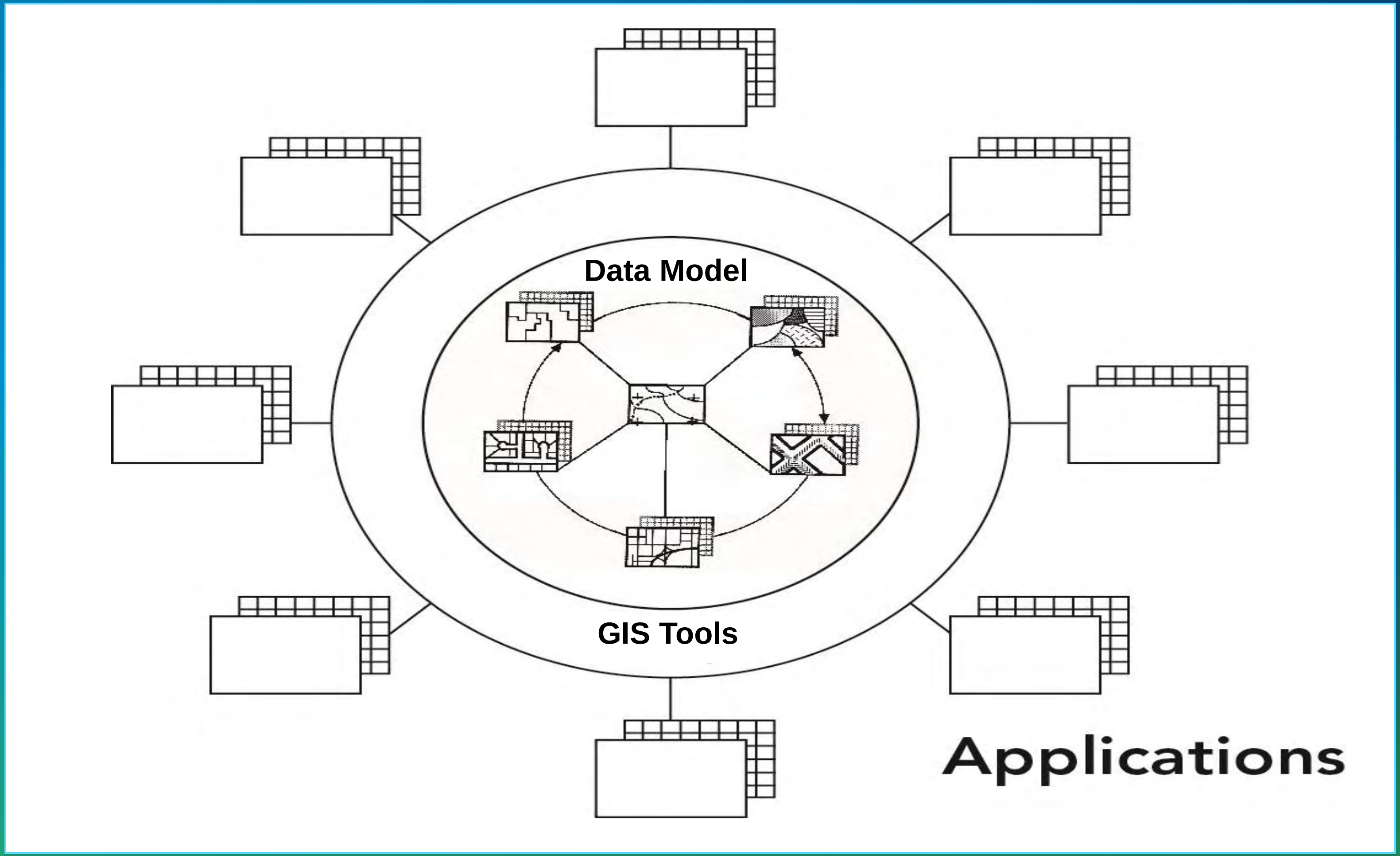
DATA REQUIREMENTS

POTENTIAL USES	BASEMAP	ENVIRONMENTAL OVERLAYS	ENGINEERING OVERLAYS	PLAN/PROFILE DRAWINGS	PARCEL MAPS	PARCEL/ADDRESS TABULAR DATA	AREA TABULAR DATA	STREET NETWORK FILE (GBF)	STREET TABULAR DATA	AREA BOUNDARY MAPS
1 Acquire and Dispose of Property		X			X	X	X			X
2 Process and Issue Parcel-Related Permits		X			X	X				X
3 Perform Inspections	X	X		X	X	X		X		
4 Provide Legal Notification	X				X	X		X		
5 Issue Licenses	X									
6 Conduct Streetnaming										
7 Review Site Plans										
8 Review Subdivisions	X	X	X	X	X	X		X		
9 Create Street Addresses					X			X		
10 Perform Event Reporting		X			X		X			X
11 Conduct Dispatching					X	X				
12 Perform Vehicle Routing		X			X		X	X	X	X
13 Conduct Traffic Analysis		X	X					X	X	

A Generic Geospatial Urban Data Model



Urban Data Model & GIS Tools Provided a Platform For Applications



ArcGIS

Provides a
Common Platform

Supporting and Connecting Multiple Communities

GIS – Creating Our Future

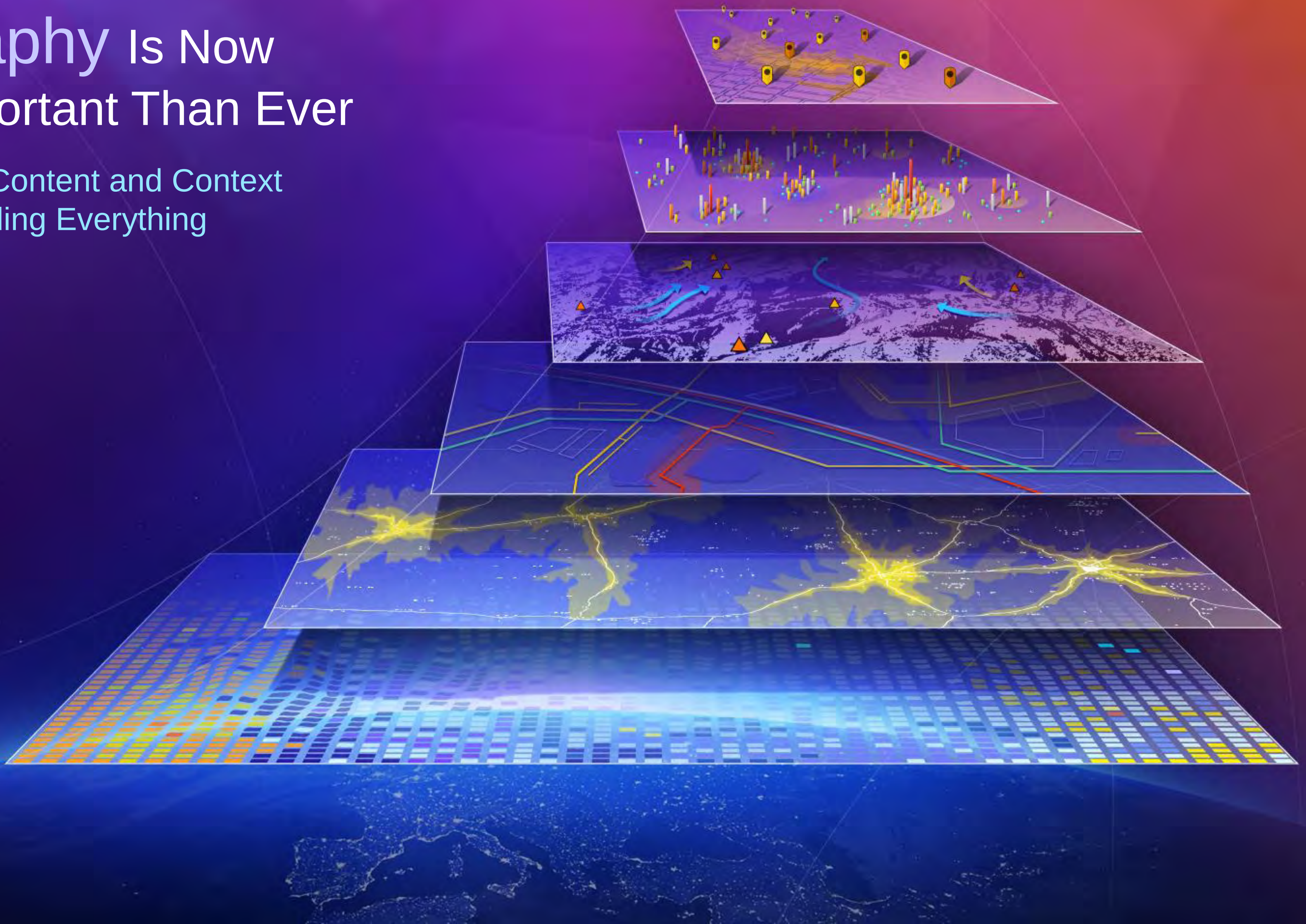
Our World Is Facing Serious Challenges

Our World Is Facing Serious Challenges

Our World Is Facing Serious Challenges

Geography Is Now More Important Than Ever

Providing the Content and Context
for Understanding Everything

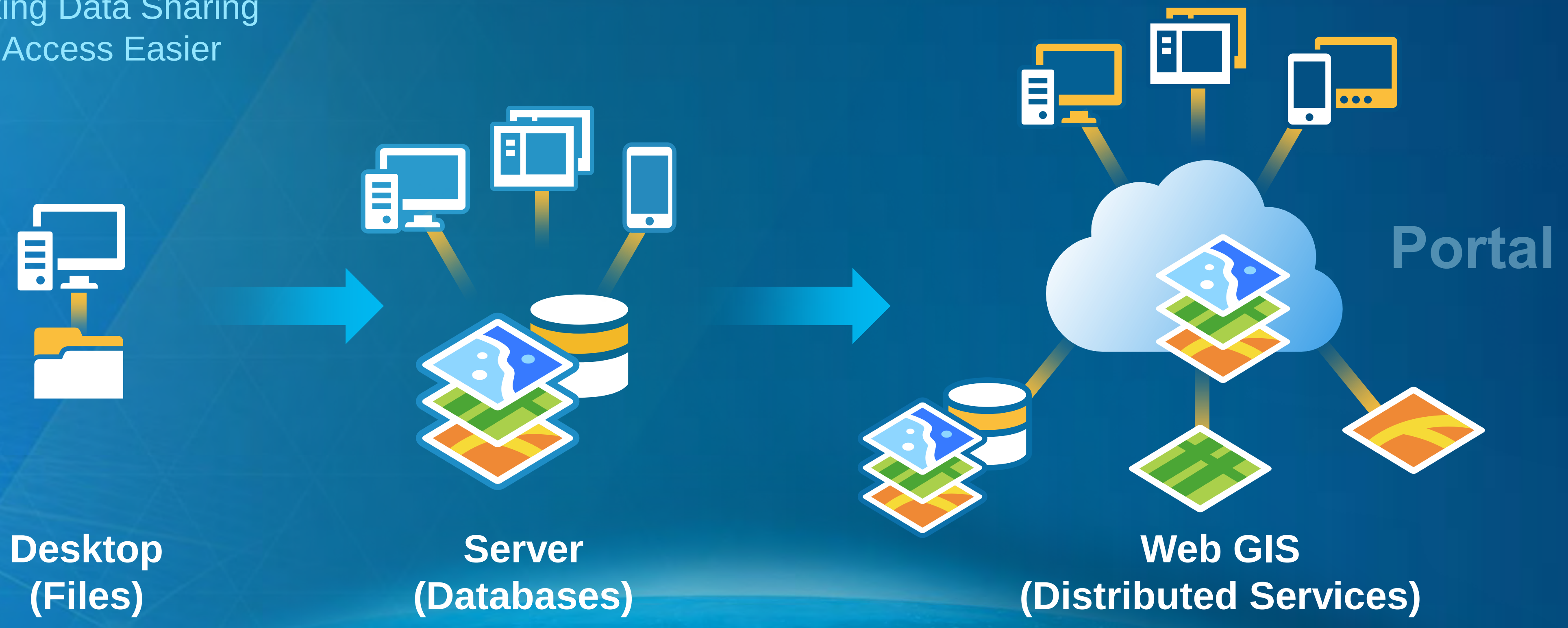


GIS Is Integrating Geography into Everything We Do

Changing the Way We Think and Act

GIS Is Evolving
Web GIS Is a New Architecture

Making Data Sharing
and Access Easier



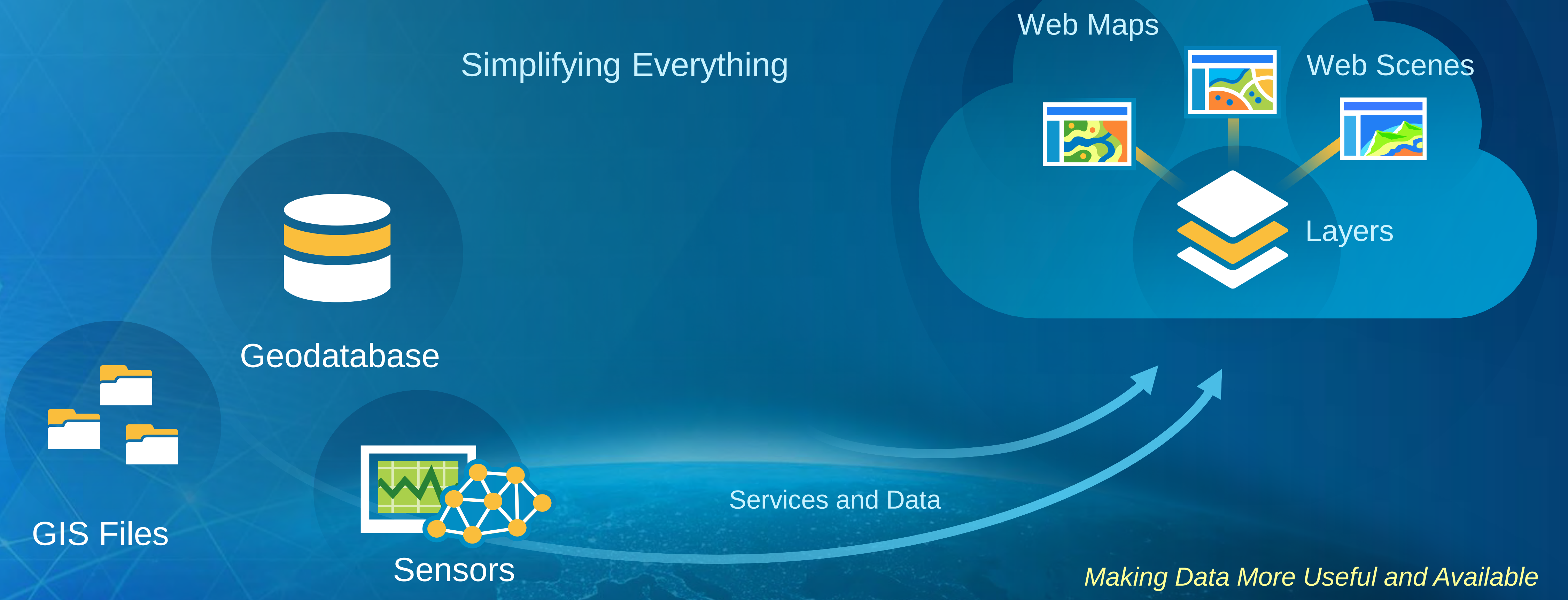
Your GIS Is Becoming Part of an Interconnected Platform

Web GIS Abstracts Data

Into Web Maps, Web Scenes and Layers

Leveraging Existing Data Models

Geo Information Model

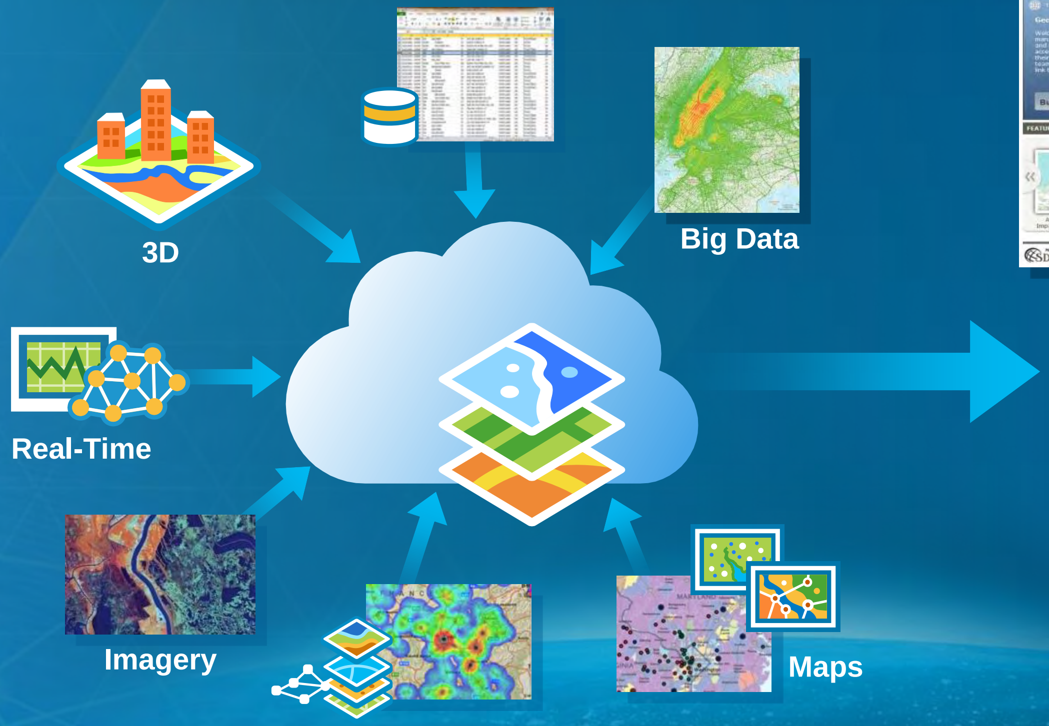


Web GIS Leverages Advancing Technology

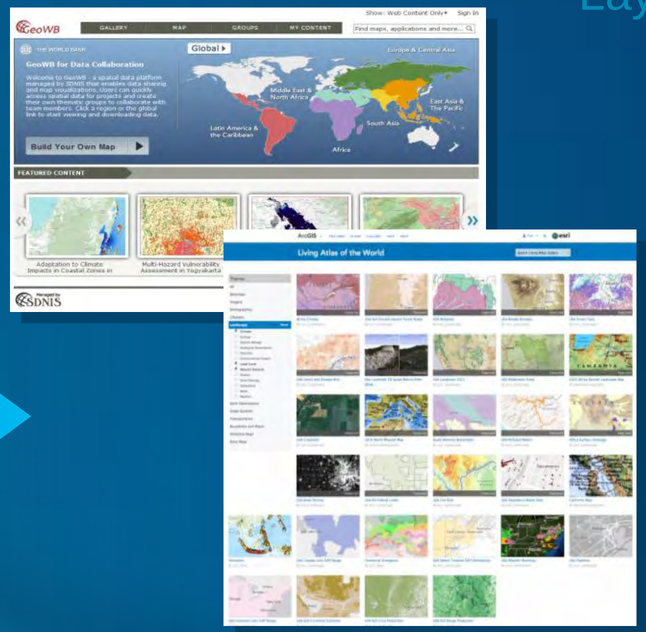
In Measurement, Computing, and Networks

Web GIS Abstracts
All Types of Information

Organizing and Sharing Your Work



Portal



Geo Information

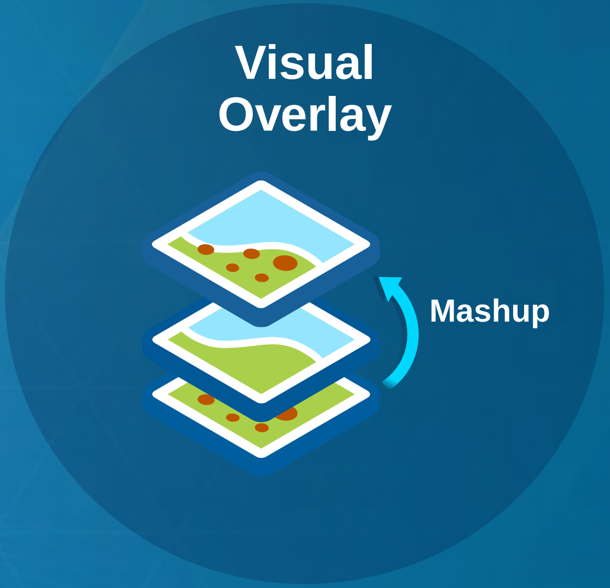
- Web Maps
- Web Scenes
- Layers

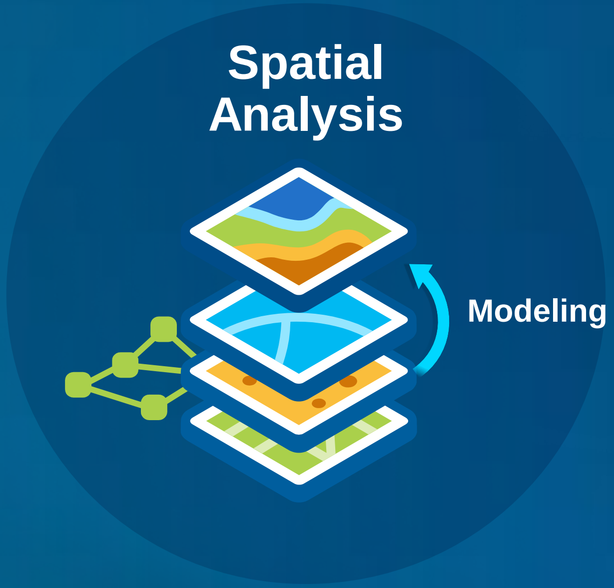
Web Maps and Web Scenes

Both Internally and on the Open Web

Web GIS Dynamically Integrates Information

Combining and Analyzing Information





Helping to Discover and Understand Relationships . . .

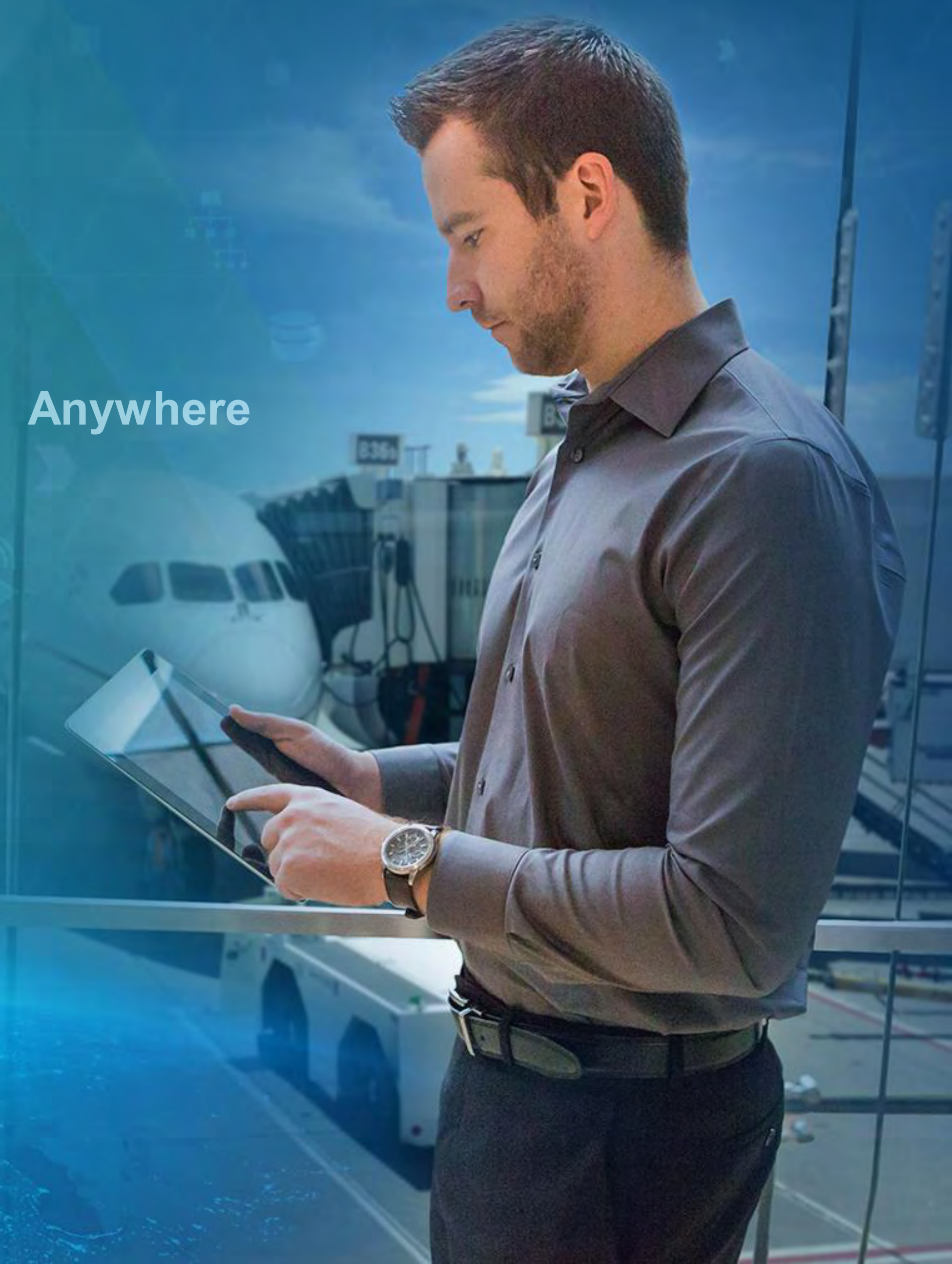
The App Revolution

Is Making Web GIS Available Everywhere

Anytime

Anywhere

Any Device



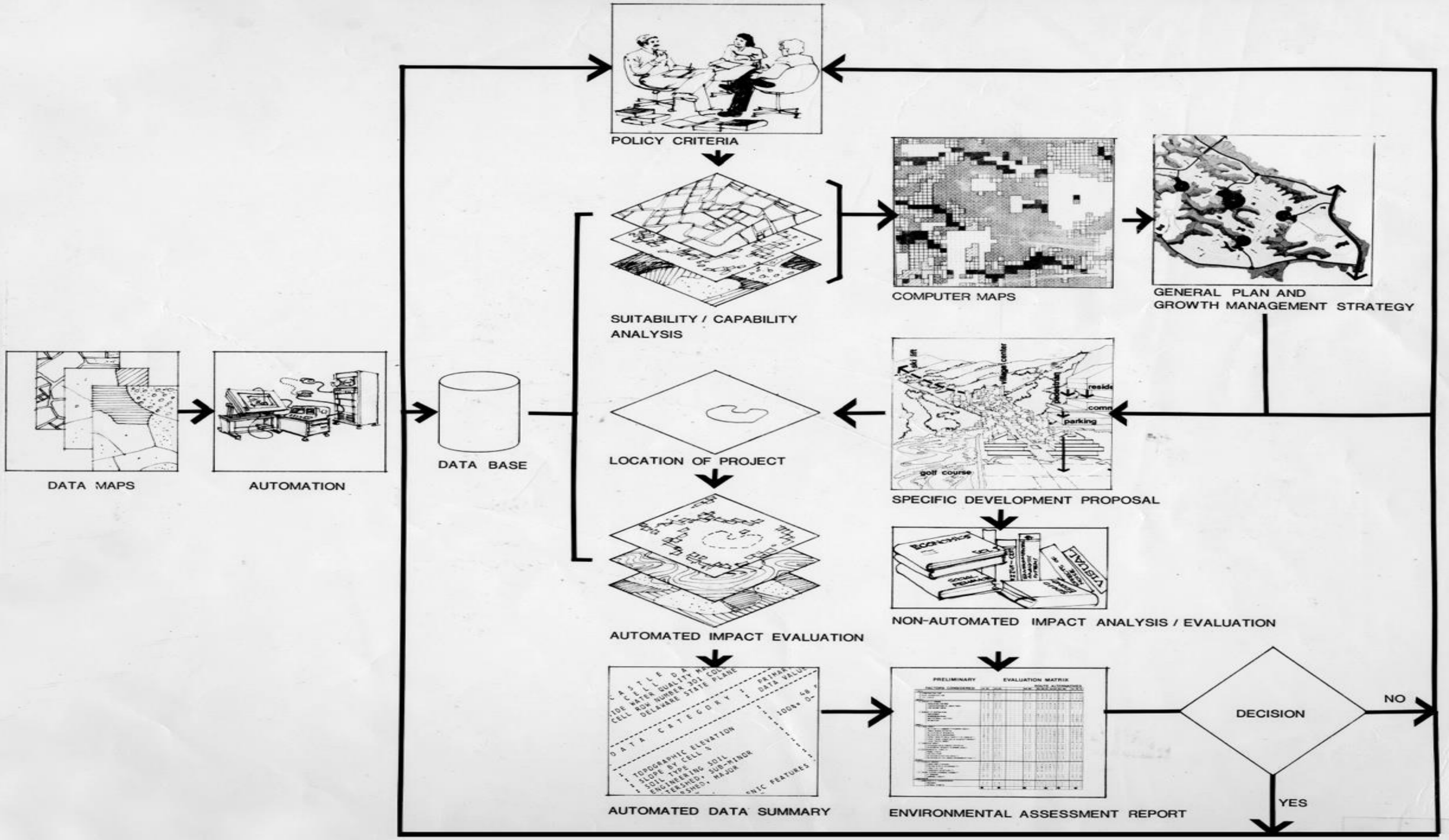
Web GIS is and Enterprise Platform

Extending GIS Across Organizations

Throughout Communities

Geodesign

Early Geodesign Work



Planning Information System

Planning Information System

While GIS Technology Is Evolving and Improving

It Is Not Enough . . .

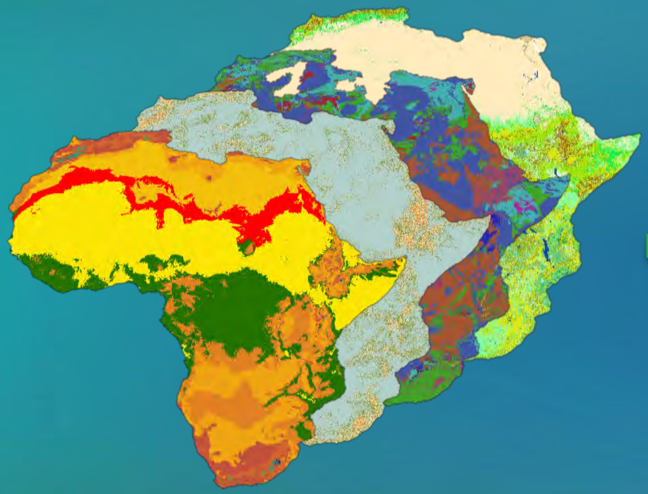
- Vision and Leadership
- Management and Organization
- Data Policies
- Planning
  - Technical Architecture
  - Standards
  - Data Models
  - Governance and Finance
  - Policies
- Implementation Work
- Good People

. . . And a Spirit of Collaboration . . .

Collective
Geographic
Understanding
Computing & Networks
Mainframes
Mini's
Workstations
PC's
Internet
Mobile
Measurement
Remote Sensing
Scanning
Digitizing
GPS
Geocoding
Real Time
Sensor Networks
Crowd Sourcing
GIS Software
Data Models
Data Management
Mapping
Spatial Analysis
Modeling
3D
Usability
Geographic Science
Relationships
Patterns
Models
Visualization
Temporal
Processes
Networks
Open Data Policies
Standards
Data
Collaboration
Services
Portals
Visualization

Big Data Computation

Is Making Analysis of Very Large Spatial Data Bases Practical



Results
-588,191,976 Units -Classified into Several thousand unique Ecological Units

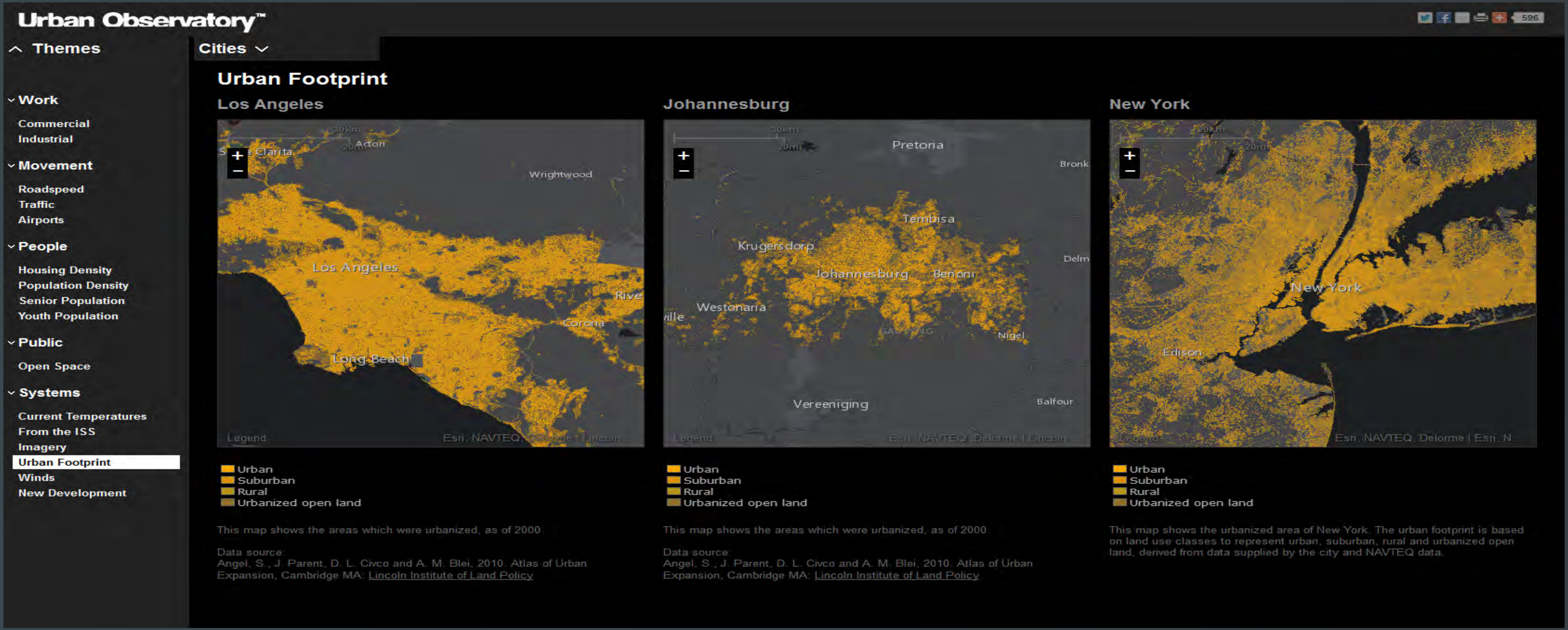
Urban Observatory

Themes

- **Work**
  - Commercial
  - Industrial
- **Movement**
  - Roadspeed
  - Traffic
  - Airports
- **People**
  - Housing Density
  - Population Density
  - Senior Population
  - Youth Population
- **Public**
  - Open Space
- **Systems**
  - Current Temperatures
  - From the ISS
  - Imagery
  - Urban Footprint
  - Winds
  - New Development

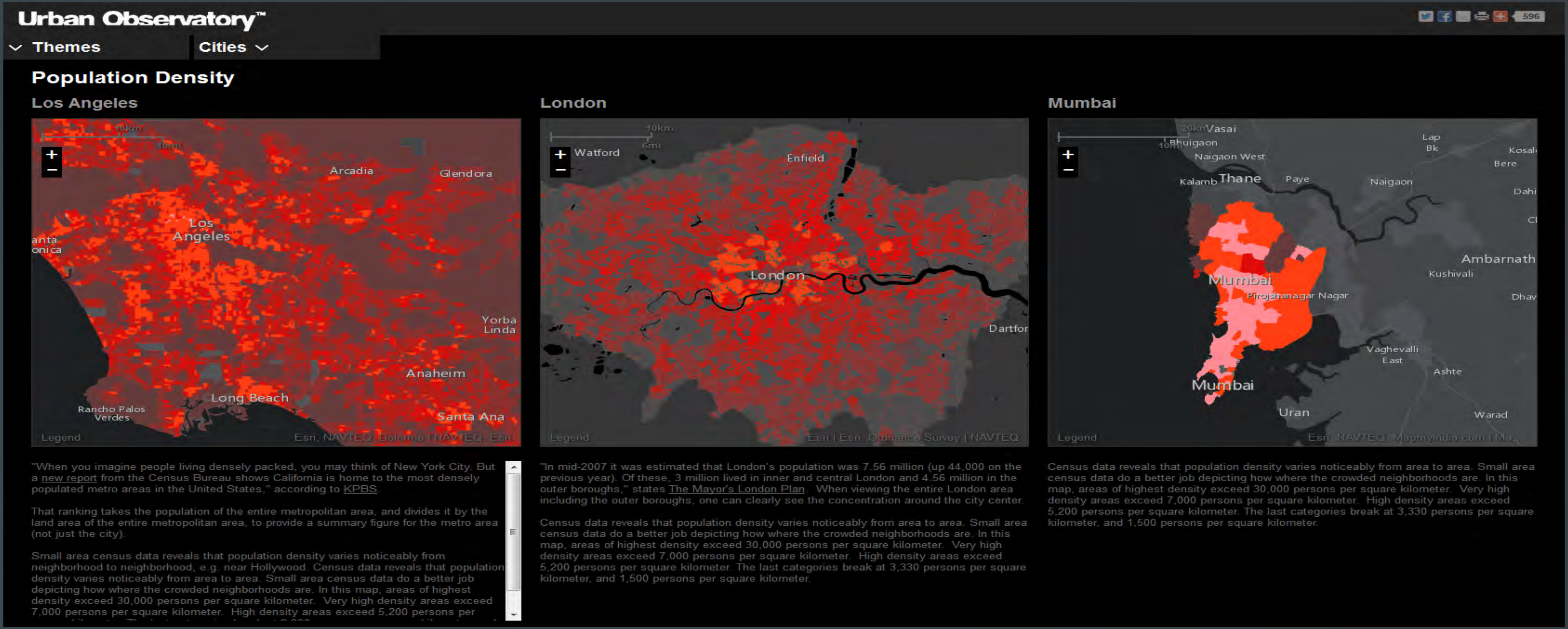
Urban Observatory

Urban Footprint



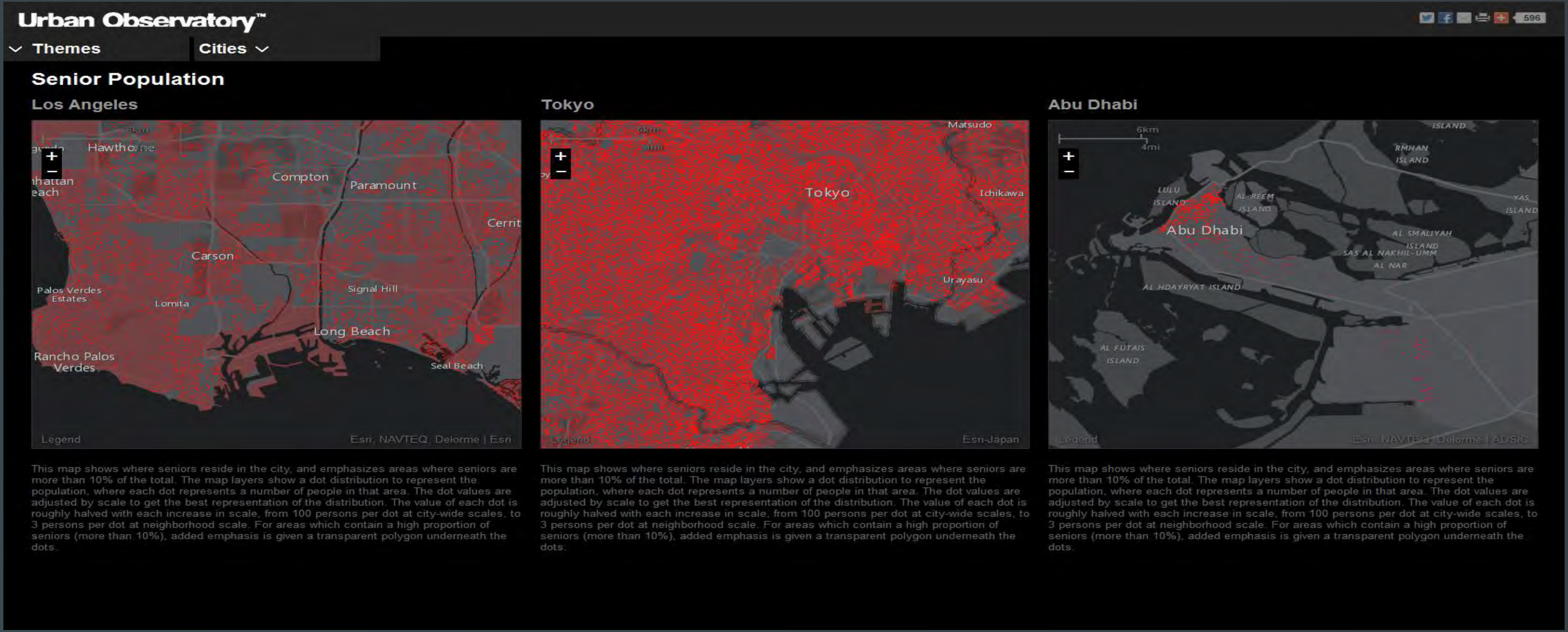
Urban Observatory

Population Density



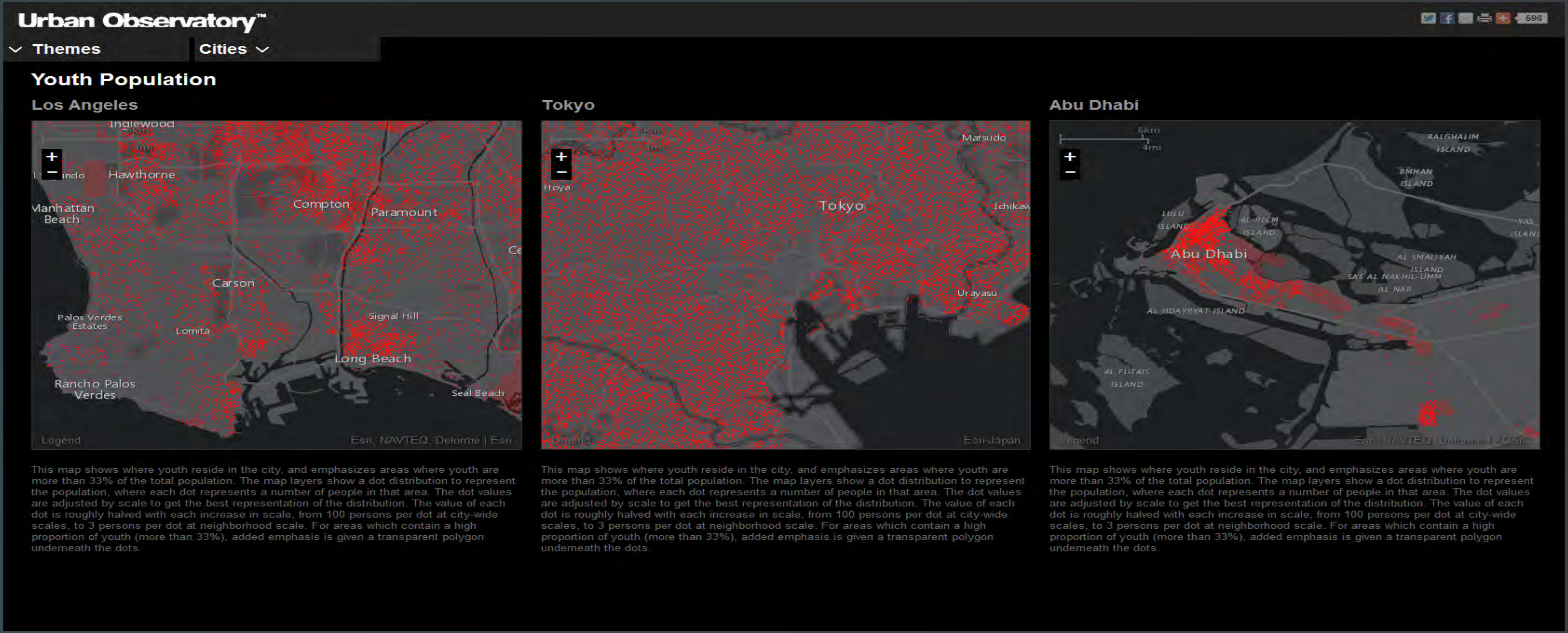
Urban Observatory

Senior Population



Urban Observatory

Youth Population



Urban Observatory

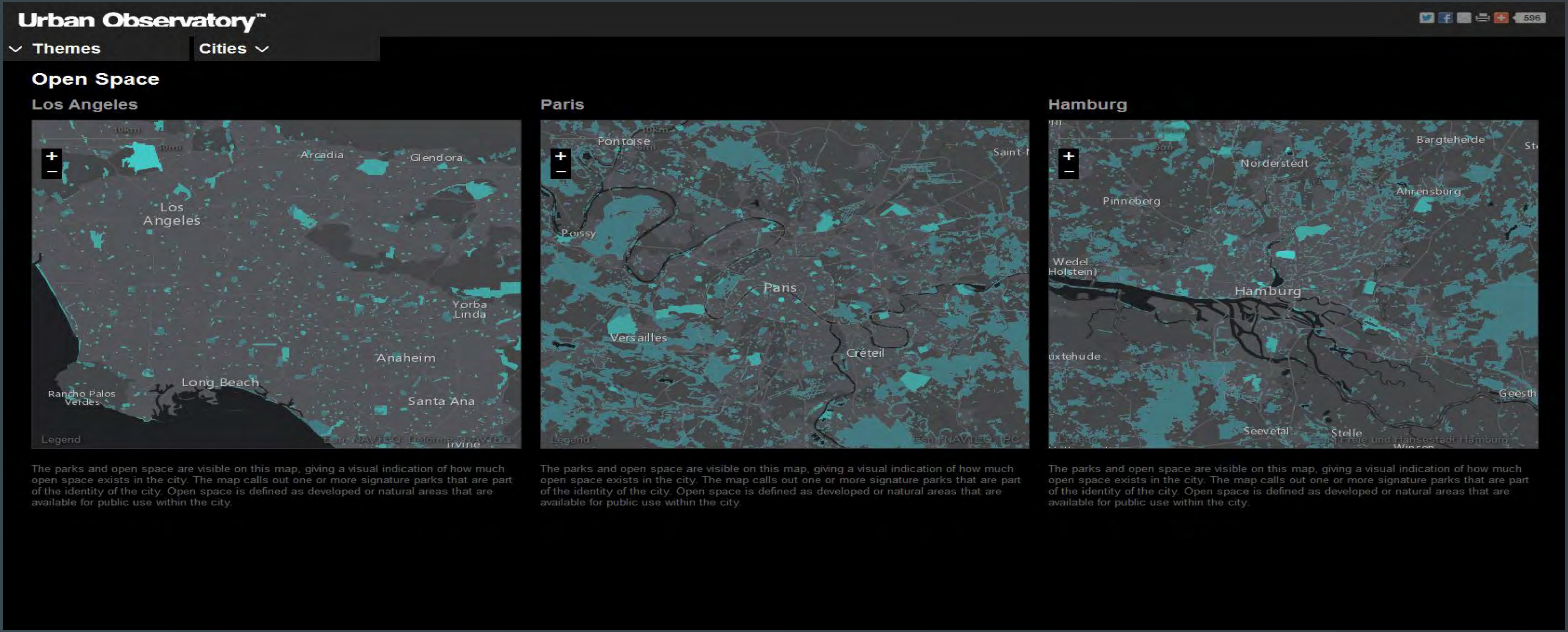
Roadspeed

Urban Observatory

Real Time Traffic

Urban Observatory

Open Space



Mining Open Data in Search of GIS Nuggets

Gordon Plunket

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-14, 2015

Mining Open Data in Search of GIS Nuggets

Presented by:

Gordon Plunkett, Director, Spatial Data Infrastructure
gplunkett@esri.ca

February 13-14, 2015

Topics

1. **Introduction and History**
2. **Background and Context**
3. Open Data Initiatives
4. Impact of Open Data on GIS Communities
5. Implementation
6. Conclusions

Please feel free to ask questions at any time

Introduction

- The 1983 AutoCarto Conference paper:

  "*On the Transfer of Remote Sensing Classifications into Polygon Geocoded Data Bases in Canada*".

- Business purpose: Landsat data analysis to GIS for decision making.
  - Data models
  - Data formats
  - Image classification

Introduction

Landsat Satellite

Ground Station

LGSOWG

GE Image-100

SDTC/SDTF

ArcInfo GIS

Introduction

Landsat Satellite

Ground Station

LGSOWG

GE Image-100

SDTC/SDTF

ArcInfo GIS

Introduction

Landsat Satellite

Ground Station

LGSOWG

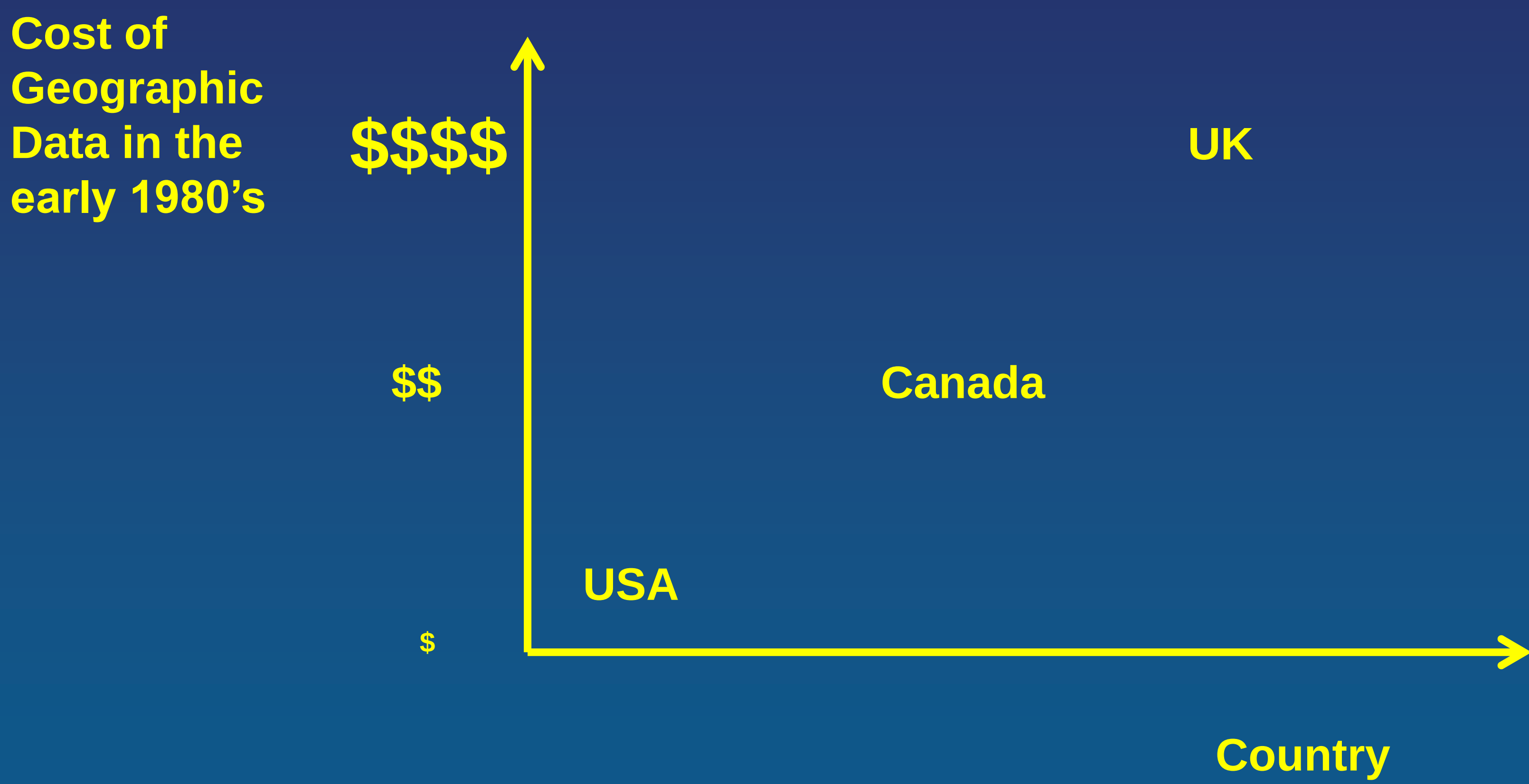
$$$$

GE Image-100

SDTC/SDTF

ArcInfo GIS

History of Open Data



History of Open Data (Canada)

- In the 1990's
  - Statistics Canada - Data Liberation Initiative
  - Natural Resources Canada – GeoGratis
  - Canadian Committee on Geomatics - GeoBase
- In 2010
  - Federal Government Digital Economy Strategy
- In 2011 & rebranded in 2014
  - Federal Government Open Government of Canada Portal

History of Open Data (Globe)

- In 2013, the Group of Eight (G8) signed
  - Open Data Charter
  - Set of principles:
    - > Open Data by Default
    - > Quality and Quantity
    - > Useable by All
    - > Releasing Data for Improved Governance
    - > Releasing Data for Innovation

Open Data Canada

- Open data is defined as structured data that is machine-readable, freely shared, and can be used and built on without restrictions.
  - Availability and Access
  - Re-use and Redistribution
  - Universal Participation
- Open Data 101

Open Data Policy (Canada)

- Canada's Open Data Principles
  1. Completeness
  2. Primacy (authoritative source)
  3. Timeliness
  4. Ease of Physical and Electronic Access
  5. Machine readability
  6. Non-discriminatory access
  7. Use of Commonly Owned Standards
  8. Licensing
  9. Permanence
  10. Usage Costs

Open Data Policy (Canada)

- Benefits of Open Data
  1. Support for innovation
  2. Advance government accountability
  3. Leverage OD for consumer or commercial products
  4. Increased use of existing investment in broadband and community information infrastructure
  5. Support for research
  6. Support informed decisions for consumers
  7. Proactive disclosure

Open Data US

- Manage information as an asset
- Promote openness and interoperability
- Properly safeguard systems and information.
- Increase operational efficiencies, reduce costs, improve services, support mission needs, and increase public access to valuable government information.
- US Open Data Policy

Open Data Policy (US)

- US Open Data Principles:
  1. Public
  2. Accessible
  3. Described
  4. Reusable
  5. Complete
  6. Timely
  7. Managed Post-Release

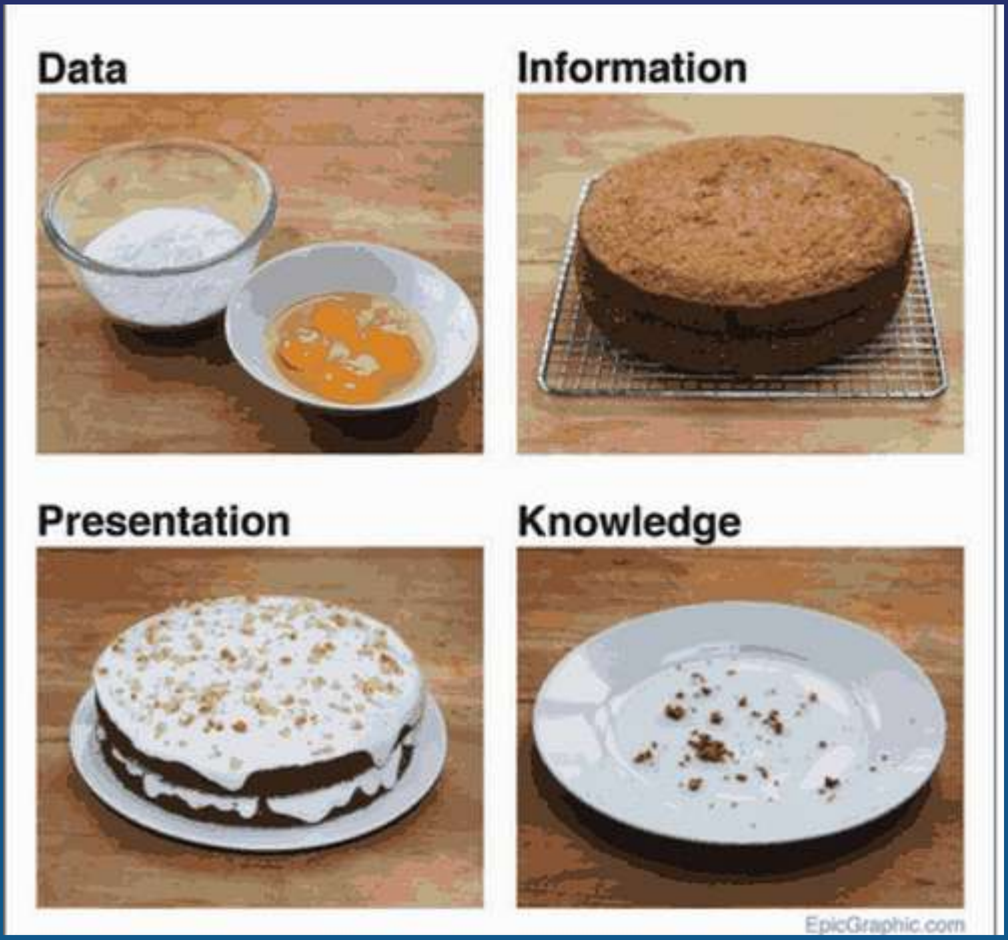
Open Data Policy (US)

- US Open Data Benefits:
  1. Fuel entrepreneurship
  2. Stimulate innovation
  3. Advance scientific discovery
  4. Improve Americans' lives
  5. Contribute significantly to job creation.

Open Data Handbook

- There are benefits and advantages to open data.
- The Open Data Handbook has examples where open data and especially open government data is creating value.
  - Transparency and democratic control
  - Government participation and self-empowerment
  - Innovation and new private products and services
  - Improved efficiency and effectiveness of government services
  - New knowledge from combined data sources and patterns in large data volumes

Open Data Concerns



Ref: The revolution will NOT be in Open Data, October 21, 2013, Open Development, WG Development Blog by Duncan Edwards from the Institute of Development Studies.

Open Data Concerns

- Duncan Edwards in his blog post related to international development assistance entitled "The revolution will NOT be in Open Data" states
- He feels uncomfortable with the framing of many open development projects with the assumption "openness + ICTs = development outcomes".
- Just providing open data is not sufficient for uptake and use.
- Further work is required and in developing countries, this often does not occur without (often financial) assistance.
- Also concerned that risks and privacy were not being adequately considered.

Open Data Initiatives

- Sir Tim Berners-Lee who first invented the World Wide Web started the Open Data Institute (ODI) in 2013.
- Open data would not be possible without the invention of the Internet.
- The ODI provides:
  - > information about open data
  - > training on open data
  - > open data certification program
  - > held its first annual summit meeting in November 2014.
  - > May 2015 - International open data conference Ottawa http://opendatacon.org/

Government Open Data

- Canada - http://open.canada.ca/en
- US - http://www.data.gov/
- UK - http://data.gov.uk/
- New Zealand - https://data.govt.nz/
- Australia - http://data.gov.au/
- Europe - http://publicdata.eu/
- Brazil - http://translate.google.ca/translate?hl=en&sl=pt&u=http://dados.gov.br/&prev=search

Government Open Data

- British Columbia - http://www.data.gov.bc.ca/
- Alberta - http://data.alberta.ca/
- Saskatchewan - http://opendatask.ca/
- Ontario - http://www.ontario.ca/government/government-ontario-open-data
- Quebec - http://www.donnees.gouv.qc.ca/?node=/accueil
- New Brunswick - http://www.snb.ca/gdam-igec/e/2900e.asp
- Nova Scotia - http://www.novascotia.ca/geonova/home/

Government Open Data

- California - http://data.ca.gov/about/
- Kentucky - http://opendoor.ky.gov/search/Pages/maps_data.aspx
- Washington DC - http://opendata.dc.gov/
- Washington - https://data.wa.gov/
- Missouri - https://data.mo.gov/

Government Open Data

- Toronto, ON - http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=9e56e03bb8d1e310VgnVCM10000071d60f89RCRD
- Vancouver, BC - http://vancouver.ca/your-government/open-data-catalogue.aspx
- Hartford, CT – https://data.hartford.gov/
- Charlotte, NC - http://clt.charlotte.opendata.arcgis.com/

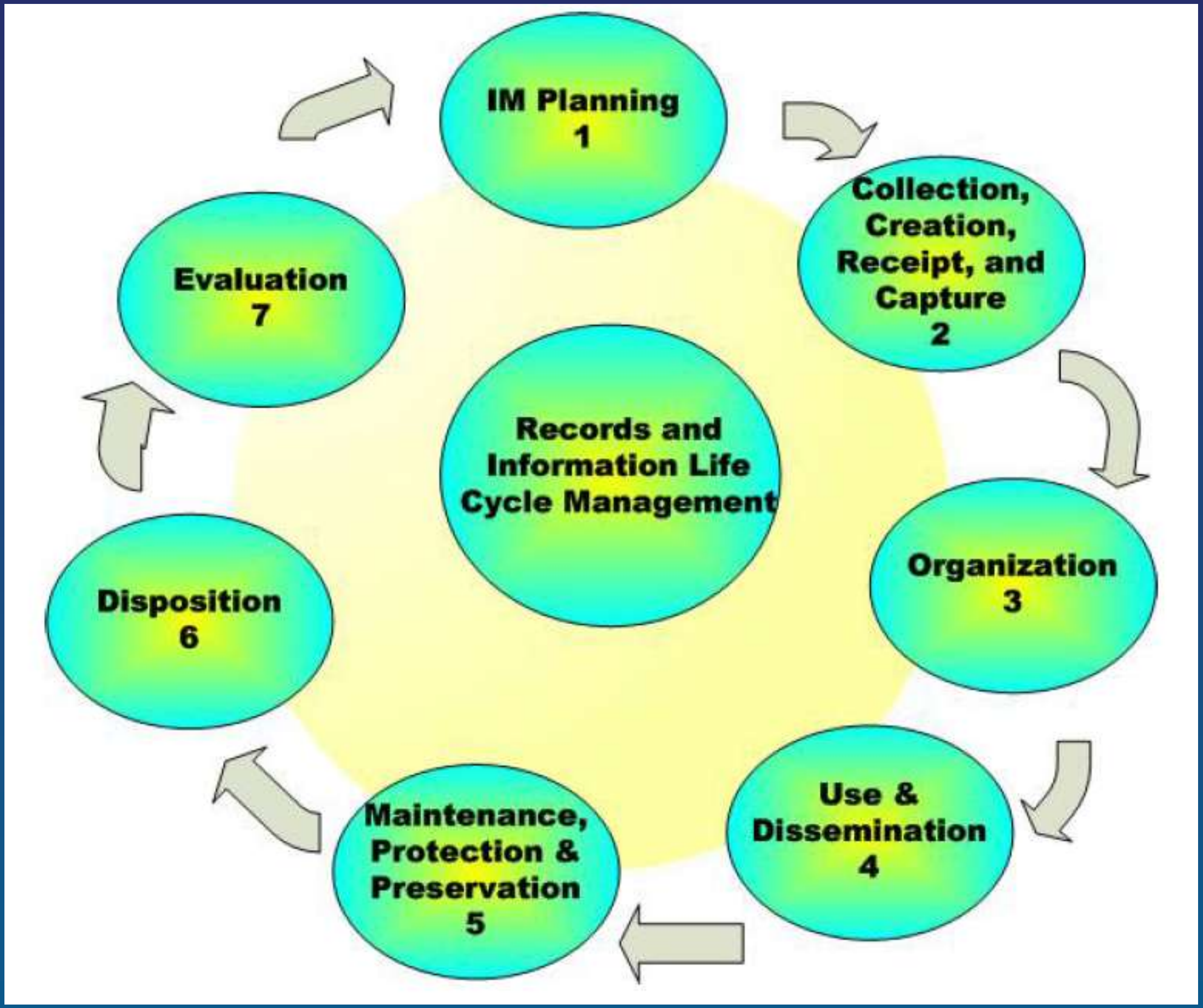
Government Open Data

- United Nations - http://data.un.org/
- World Bank - http://data.worldbank.org/
- FAO - http://data.fao.org/
- CIDA - http://www.acdi-cida.gc.ca/data
- USAID - http://www.usaid.gov/data

Government Open Data

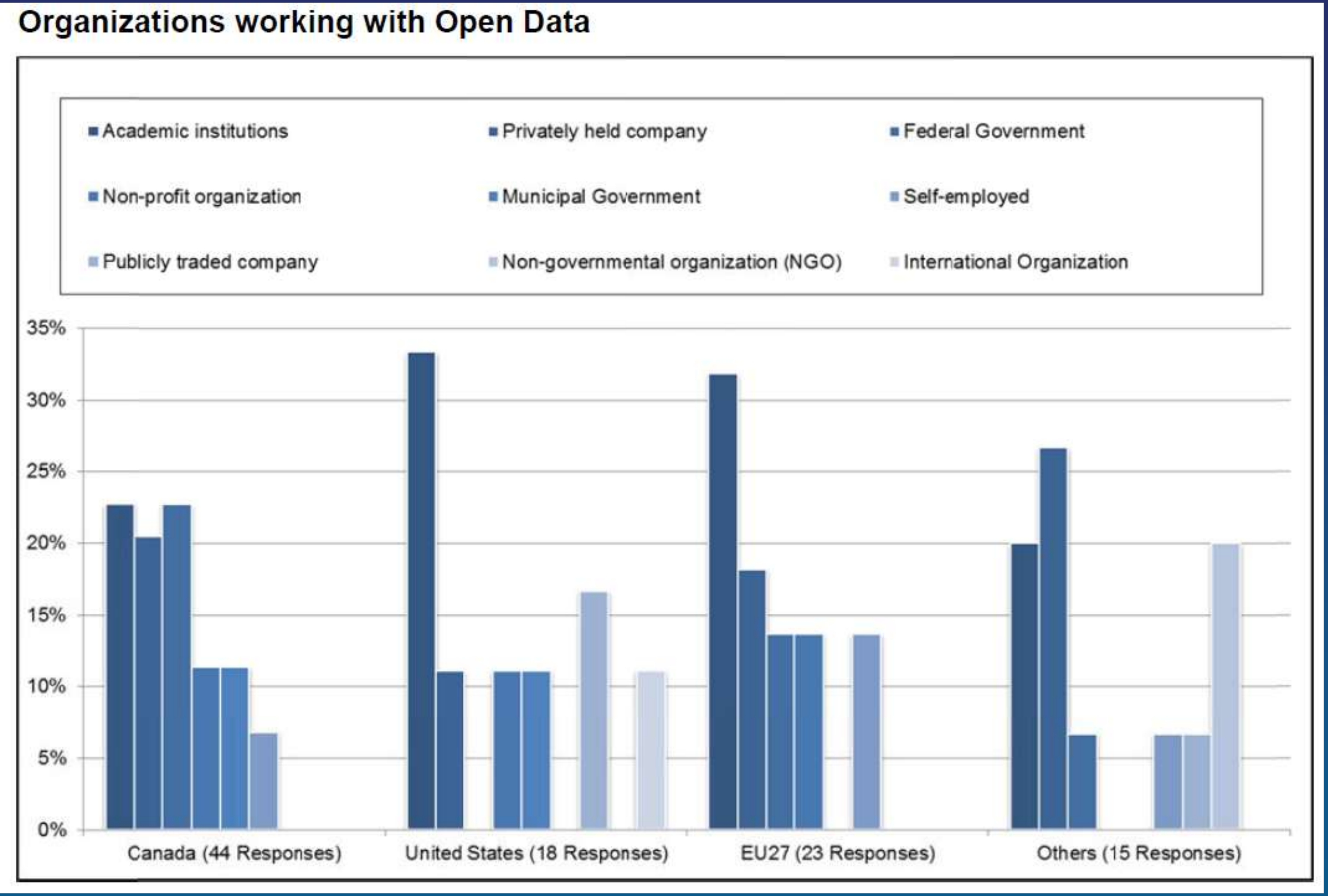
- Esri Canada - Community Map of Canada
- Esri – World Topographic Map

Benefits of Open Data



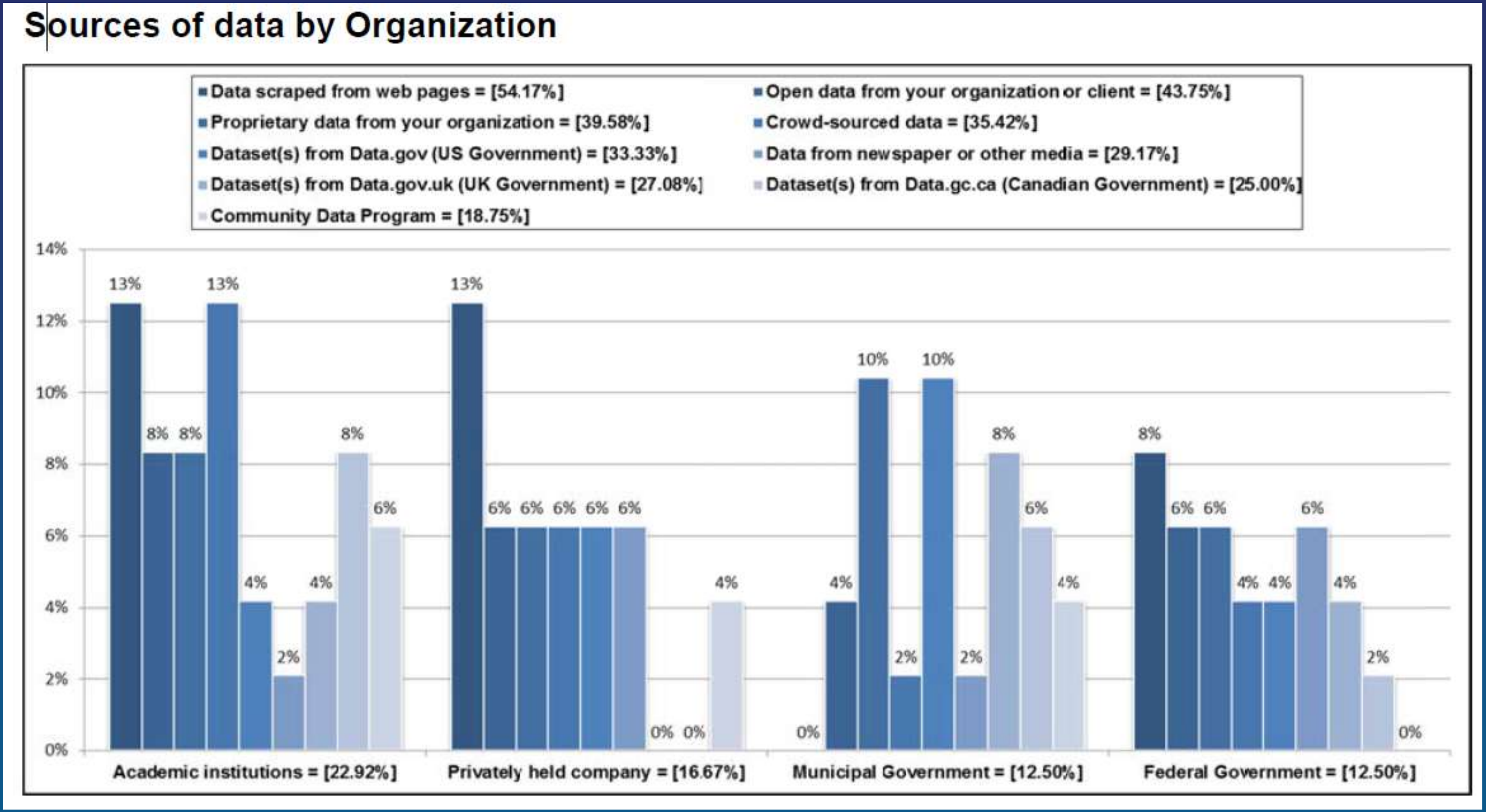
Benefits of Open Data (Steve Reitano, 2013)

Benefits of Open Data



[Benefits of Open Data](Steve Reitano, 2013)

Benefits of Open Data



Benefits of Open Data (Steve Reitano, 2013)

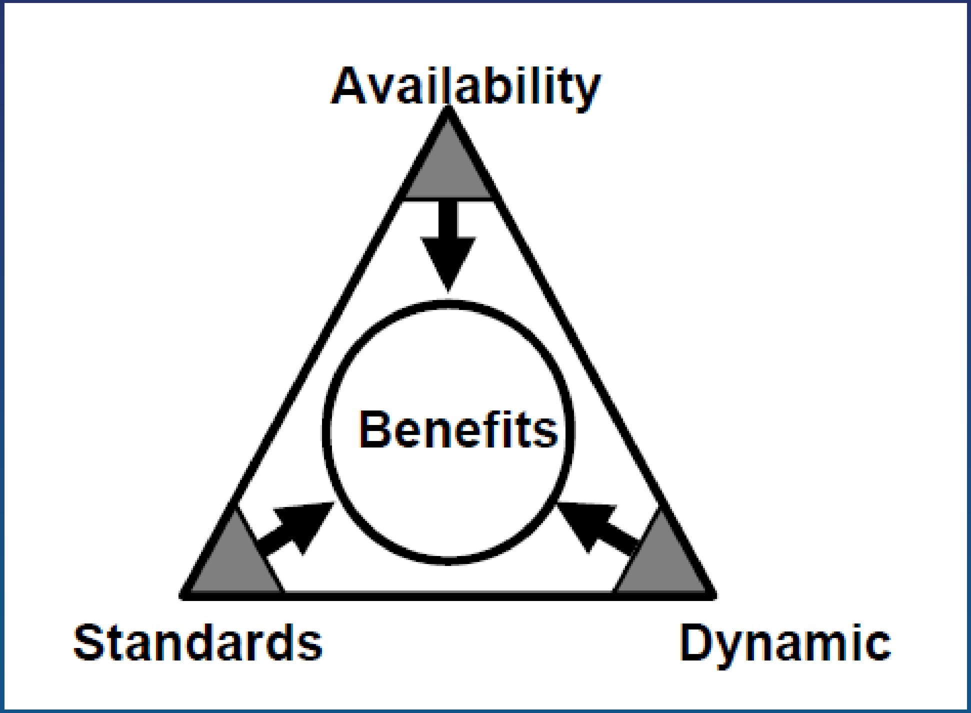
Benefits of Open Data

Comments related to Open Data Projects

Thinking about your project(s), do you agree or disagree	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
I am more likely to use open data	2%	0%	14%	48%	36%
They could be repeated in another country/area if the data was available	7%	0%	18%	39%	36%
They will provide social benefits	5%	0%	14%	52%	30%
They will have an impact on people's lives	5%	0%	27%	36%	30%
They were shaped by the data that was available	7%	11%	2%	55%	25%
They would have been different if additional datasets were available	7%	9%	14%	45%	25%
They were experiments which I will continue to develop	5%	16%	14%	43%	23%
I have been waiting for open data	5%	9%	30%	36%	18%
I will need to update my project(s) when datasets get updated	7%	7%	25%	41%	18%
They will provide economic benefits	11%	7%	30%	36%	14%
I would have started them anyway without open data	18%	23%	14%	34%	11%
They will generate an anticipated profit for me or my organization	20%	34%	27%	9%	7%
They will generate a need for additional staff	14%	16%	43%	18%	7%

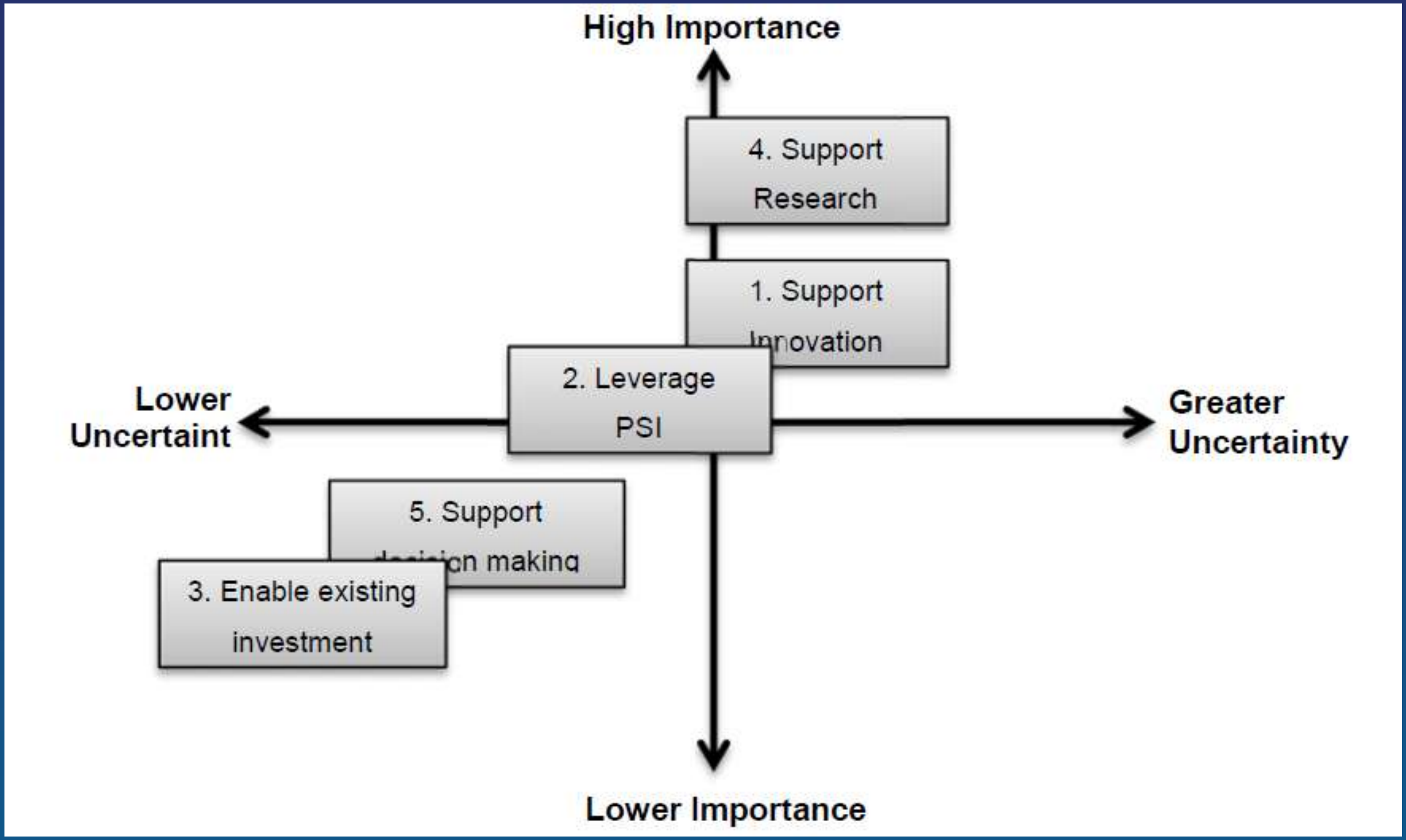
Benefits of Open Data (Steve Reitano, 2013)

Benefits of Open Data



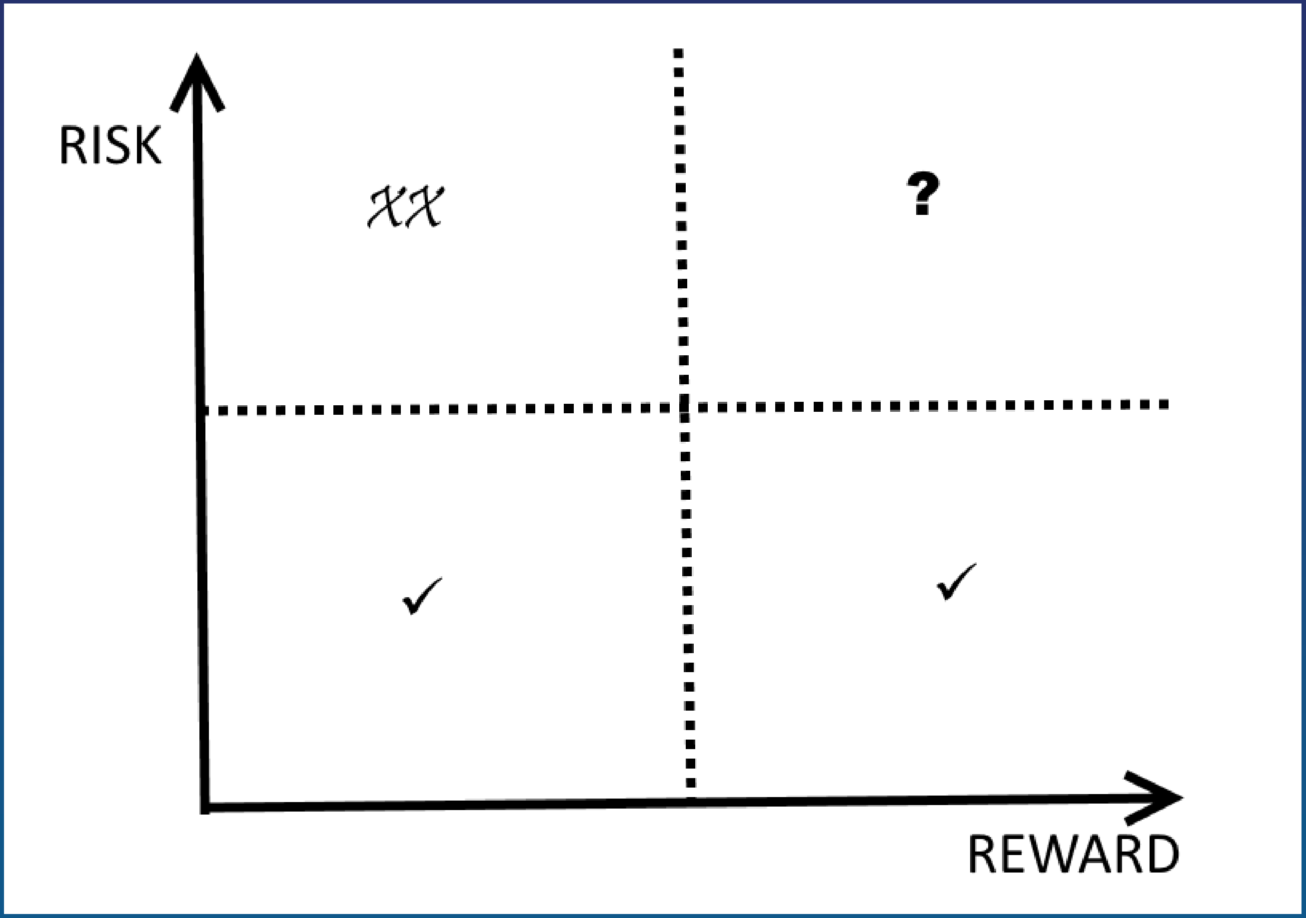
Benefits of Open Data (Steve Reitano, 2013)

Benefits of Open Data



Benefits of Open Data (Steve Reitano, 2013)

Benefits of Open Data



esri Canada

Investigating Open Data

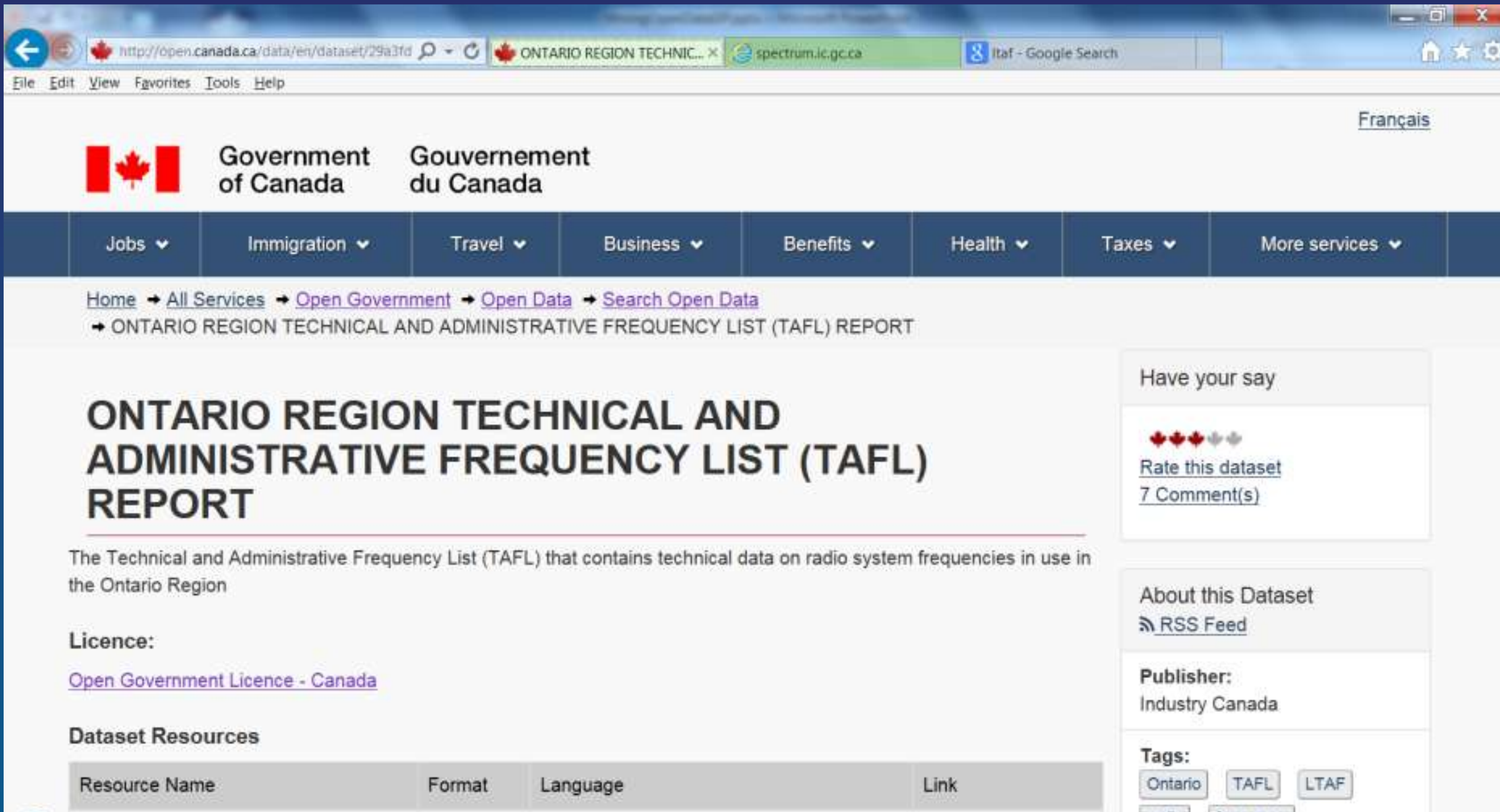
- A three step process is suggested to help users decide if open data is right for their application.

1. Review the background, context and synopsis of open data, and review the kind of open data that would be suitable for the proposed application.
2. Locate the specific open data that may be suitable for the user's application.
3. Examine and test the open data under controlled conditions to determine if that specific data set is right for them.

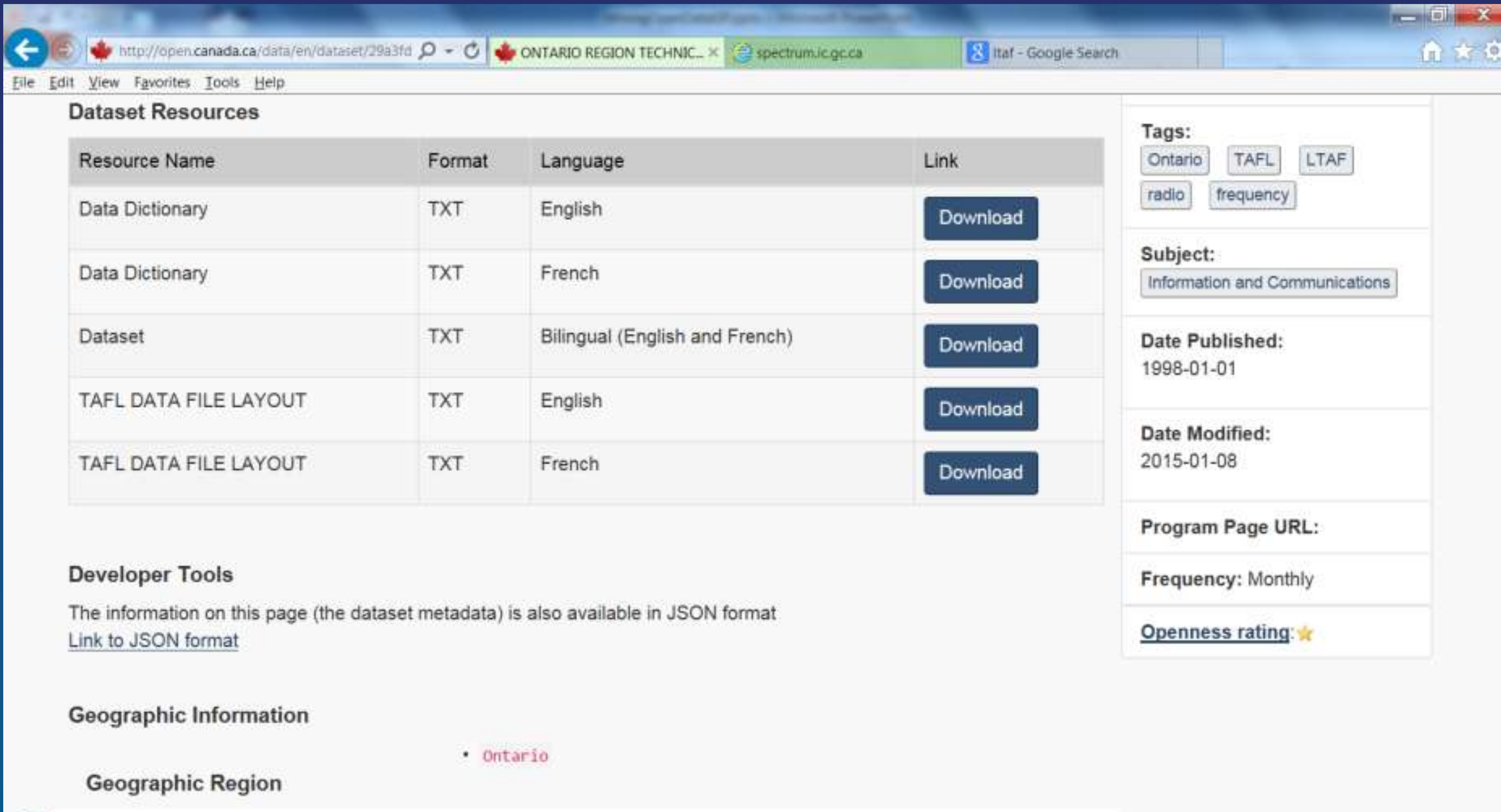
Example Open Data

- Mobile Phone antenna locations.

Example Open Data



Example Open Data



http://open.canada.ca/data/en/dataset/29a3fd | ONTARIO REGION TECHNIC... | spectrum.ic.gc.ca | ltaf - Google Search

File Edit View Favorites Tools Help

Dataset Resources

Resource Name	Format	Language	Link
Data Dictionary	TXT	English	Download
Data Dictionary	TXT	French	Download
Dataset	TXT	Bilingual (English and French)	Download
TAFL DATA FILE LAYOUT	TXT	English	Download
TAFL DATA FILE LAYOUT	TXT	French	Download

Developer Tools

The information on this page (the dataset metadata) is also available in JSON format
Link to JSON format

Geographic Information

- Ontario

Geographic Region

Tags: Ontario TAFL LTAF radio frequency

Subject: Information and Communications

Date Published: 1998-01-01

Date Modified: 2015-01-08

Program Page URL:

Frequency: Monthly

Openness rating:

Example Open Data

```
==========================================================================
FIELD DESCRIPTION           DEFINITION/VALUES
==========================================================================

TX                          Transmitting frequency. Assigned or proposed in
                                MHz or lower frequency of the assigned or
                                proposed frequency band in MHz.
                                0.01 to 999999.999999


RX ONLY FLAG                1 - Receive only frequency assignment, or
                            Blank - Others

RX                          Receiving frequency.  Assigned or proposed in
                                MHz or lower frequency of the assigned or
                                proposed frequency band in MHz.
                                0.01 to 999999.999999

F                           Frequency status code.  Processing status of the
                                frequency.
                                6 = Frequency Licensed
                                7 = Under Reconsideration

RECID/ENREG                 Record identifier number. An eleven (11) digit
                                number assigned by the program to each
                                individual record at the time of the
                                original data entry.

LOCATION                    Station location name.  Geographical name or
                                town and province of the station's location.

IC                          US/Canada/IFRB arrangement code.   Letter code
                                indicating under which arrangement the
                                coordination was requested.
                                A = Coordination with the FCC
                                B = Coordination with the FAA
                                C = Coordination with the JCS
                                D = Coordination with the NTIA
                                Z = IFRB has been notified

LAT                         North latitude of the station's antenna or, for
                                a transportable station, north latitude of
                                the center of area of operation. All latitudes
                                are in the NAD83 standard.

LONG                        West longitude of the station's antenna or, for
                                a transportable station, west longitude of
                                the centre of area of operation. All
                                longitudes are in the NAD83 standard.
```

Example Open Data

TAFL DATA FILE LAYOUT

FIELD NAME	INITIAL LOCATION	FINAL LOCATION	FIELD LENGTH	CHARACTER TYPE
TX Frequency	1	12	12	9
RX only Flag	13	13	1	X
RX frequency	15	26	12	9
Frequency Status	29	29	1	9
Record Identifier	31	41	11	9
Station Location	43	77	35	X
Co-ordination Code	79	80	2	X
Latitude TX Frequency	82	87	6	9
Longitude TX Frequency	89	95	7	9
Effective Radiated Power	97	101	5	9
Antenna Gain	103	107	5	9
Antenna Azimuth	109	114	6	9
Antenna Site Elevation	116	120	5	9
Antenna Height	122	125	4	9
Antenna Farm	127	130	4	9
International Coord.	132	132	1	9
International Zone Flag	134	134	1	9

Example Open Data

039150000000	039850000000	6	41070178001	GUELPH, ON							
039850000000	039150000000	6	41070178001	GUELPH, ON							
000000066000	000000066000	6	42046828002	MARKHAM ONT. 245 RIVIERA DR.		435010	0791959	-23.0	0.0	360.0	182
000000132000		6	42046828001	MARKHAM ONT. 245 RIVIERA DR.		435010	0791959	-18.2	0.0	360.0	182
000000248204		6	45011818001	BUTTONVILLE, ONT. NDB		435601	0791945	16.9	0.0	0.0	198
000000257204		6	45011919001	TORONTO CITY CENTER ON NDB/RX		433645	0792308	13.9	0.0	0.0	76
000000341204		6	45011925001	TORONTO		433740	0794352	15.9	0.0	0.0	169
000000368204		6	45011907001	TORONTO		433710	0793252	14.0	0.0	0.0	108
000000385204		6	45011852001	TORONTO		434416	0793415	16.9	0.0	0.0	137
000000391204		6	45011853001	OSHAWA	X	435515	0785400	16.9	0.0	0.0	138
000000403204		0	45010930001	TORONTO, PIA15-OM/NDB		434420	0794208	16.0	0.0	0.0	201
000000403204		7	45010930001	TORONTO, PIA15-OM/NDB		434420	0794208	16.0	0.0	0.0	201
000001590000		6	42023606001	BOWMANVILLE, ONT. MOSPORT RACE PARK		440314	0784032	10.0	0.0	0.0	332
000002894400	000002894400	6	42033435001	MISSISSAUGA, ONT. 3111 CONVAIR DR		434017	0793554	18.0	0.0		164
000003395500	000003395500	6	42073664003	DOWNSVIEW, ONT.		434445	0792722	25.9	0.1	0.0	192
000004726000	000004726000	6	42073664004	DOWNSVIEW, ONT.		434445	0792722	25.9	0.1	0.0	192
000005332000	000005332000	6	42094711001	CALEDON, ON 12435 HERITAGE RD		434123	0795350	18.5	0.0	0.0	260
000005332000	000005332000	6	42094636001	BRAMPTON, ON 25 RIVERVIEW DR		434016	0794407	20.0	0.0	0.0	197
000005332000	000005332000	6	42094710001	MAPLE, ON 82 GARDNER PLACE		435111	0793134	18.5	0.0	0.0	228
000005332000	000005332000	6	42094816001	TORONTO,ON,230 STIBBARD AVENUE		434303	0792328	18.5	0.0	0.0	166
000005332000	000005332000	6	42094426001	MARKHAM, ON 59 PORT RUSH TRAIL		435356	0791943	18.5	0.0	0.0	191
000005348000	000005348000	6	42094711002	CALEDON, ON 12435 HERITAGE RD		434123	0795350	18.5	0.0	0.0	260
000005348000	000005348000	6	42094636002	BRAMPTON, ON 25 RIVERVIEW DR		434016	0794407	20.0	0.0	0.0	197
000005348000	000005348000	6	42094710002	MAPLE, ON 82 GARDNER PLACE		435111	0793134	18.5	0.0	0.0	228
000005348000	000005348000	6	42094816002	TORONTO,ON,230 STIBBARD AVENUE		434303	0792328	18.5	0.0	0.0	166
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000005358500	000005358500	6	42094816003	TORONTO,ON,230 STIBBARD AVENUE		434303	0792328	18.5	0.0	0.0	166
000005358500	000005358500	6	42094426003	MARKHAM, ON 59 PORT RUSH TRAIL		435356	0791943	18.5	0.0	0.0	191
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000005373000	000005373000	6	42094636004	BRAMPTON, ON 25 RIVERVIEW DR		434016	0794407	20.0	0.0	0.0	197
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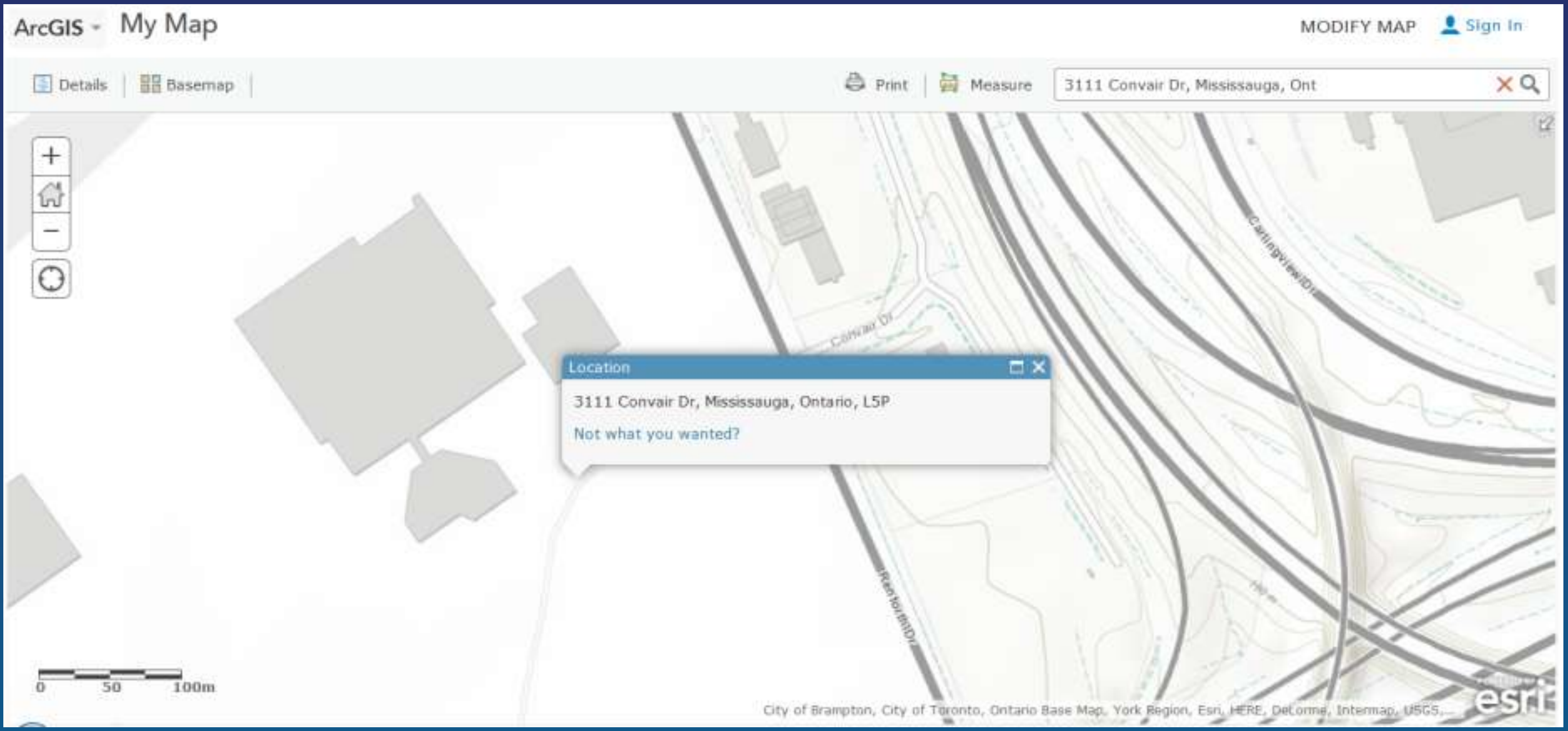
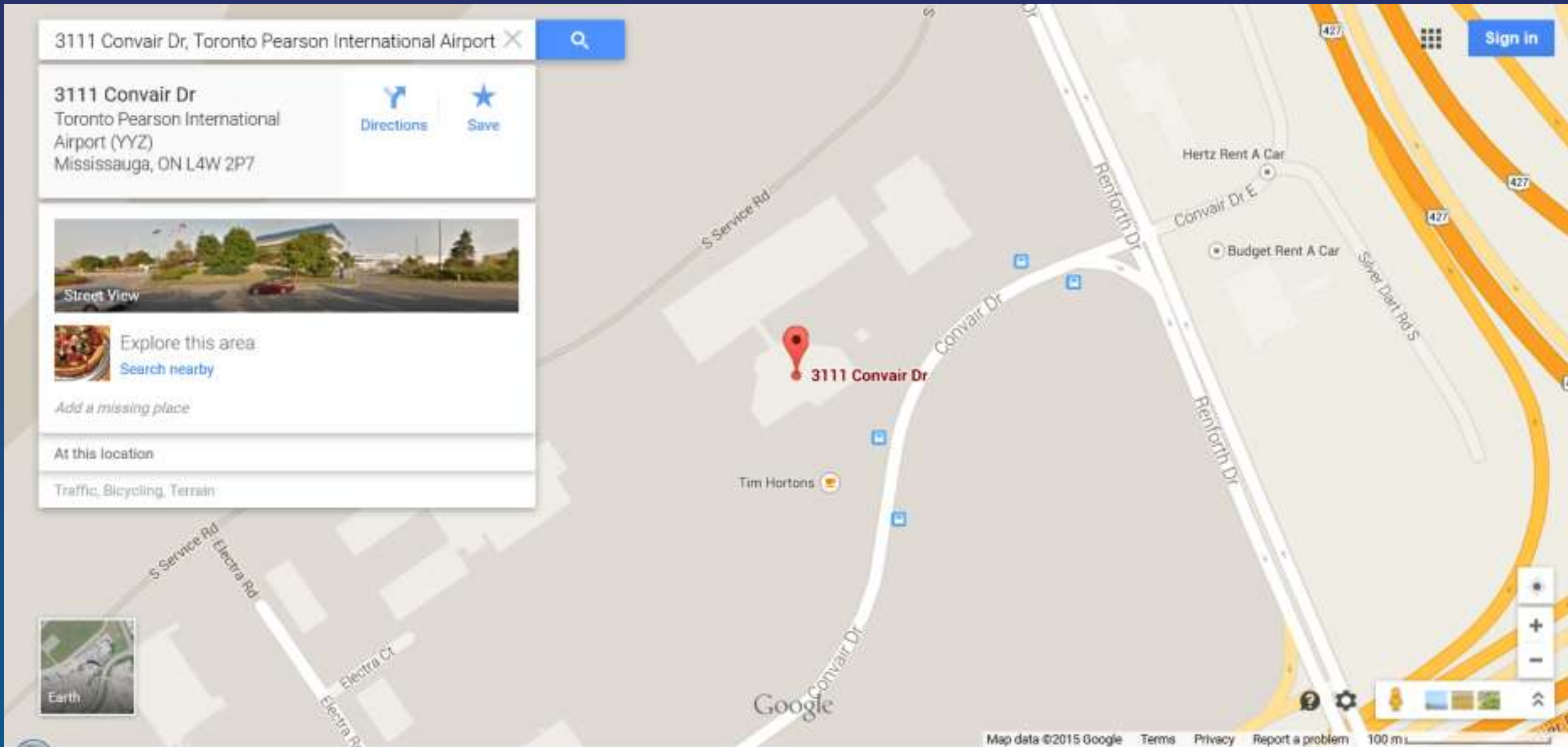
000005405000	000005405000	6	42094636005	BRAMPTON, ON 25 RIVERVIEW DR		434016	0794407	20.0	0.0	0.0	197
000005405000	000005405000	6	42094710005	MAPLE, ON 82 GARDNER PLACE		435111	0793134	18.5	0.0	0.0	228
000005405000	000005405000	6	42094816005	TORONTO,ON,230 STIBBARD AVENUE		434303	0792328	18.5	0.0	0.0	166

Example Open Data



esri Canada

Example Open Data



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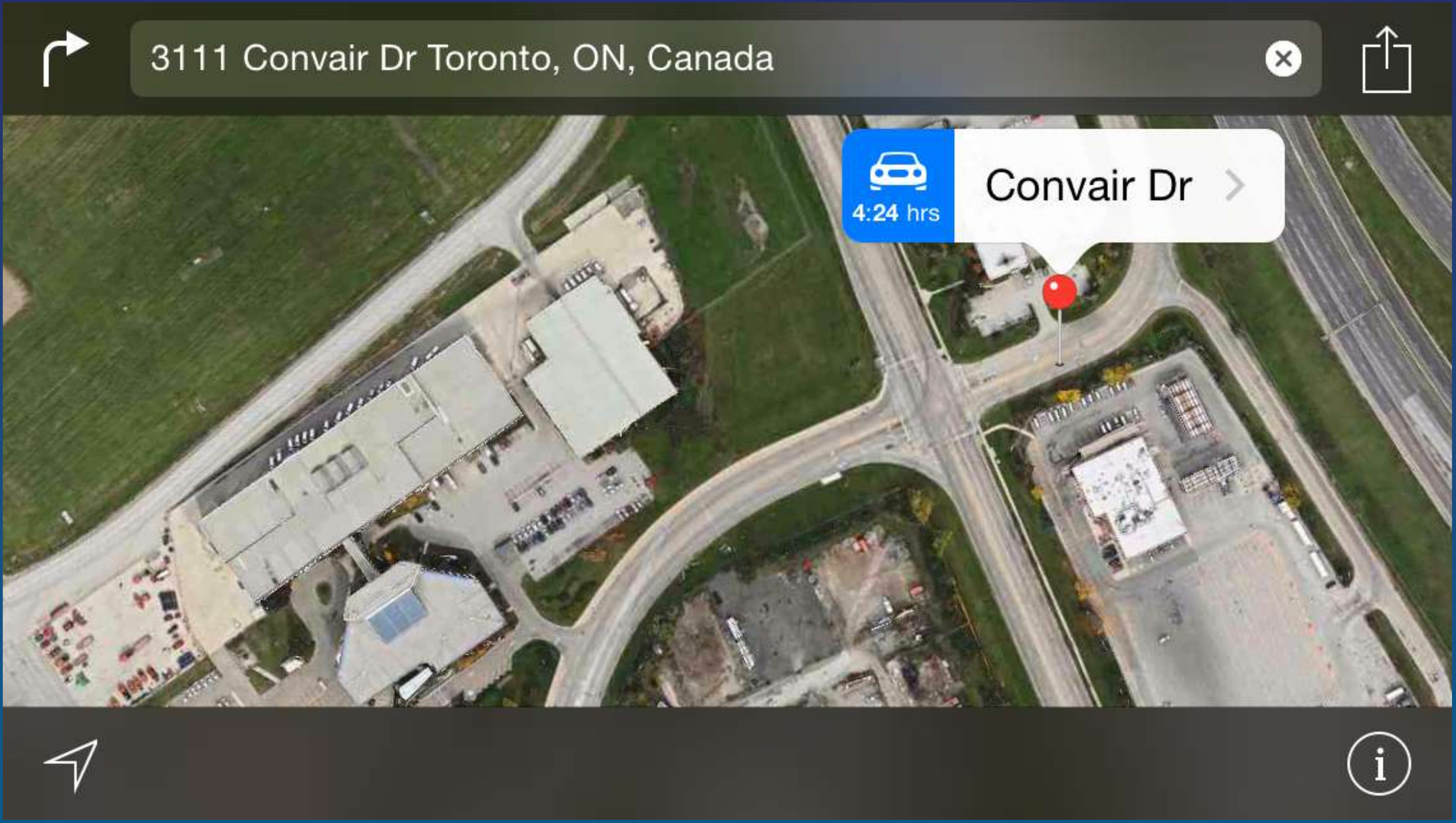
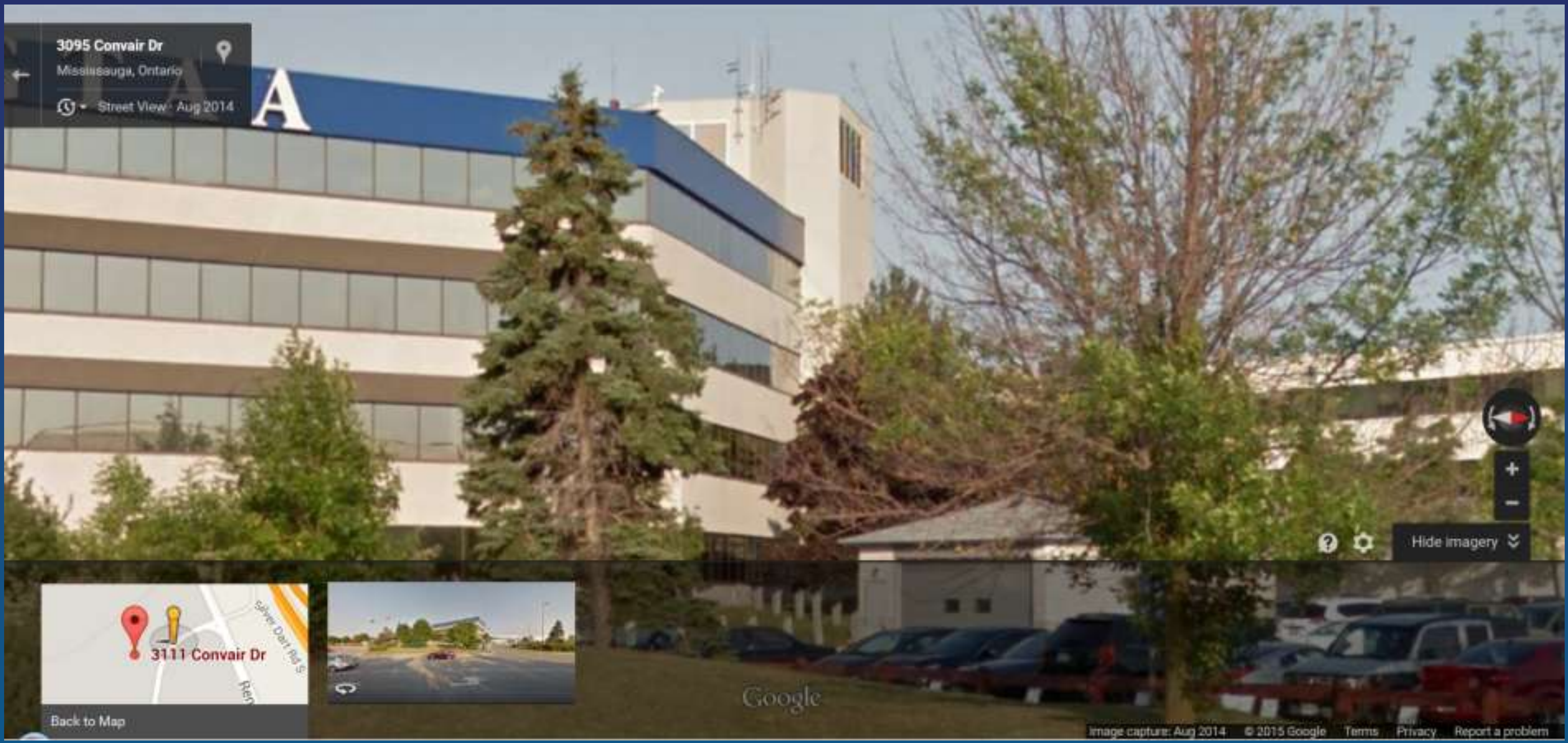


Example Open Data



esri Canada

Example Open Data

Convair Drive	
street address:	Convair Drive
ZIP/postal code:	M9C
city:	Toronto
state/province:	ON
country:	CA
latitude, longitude:	43.672657, -79.592189 N43° 40.3594', W079° 35.5313' *(precision: STREET)*

Degrees Minutes Seconds to Decimal Degrees

Enter Degrees Minutes Seconds latitude: 43 40 17

Enter Degrees Minutes Seconds longitude: 79 35 54

Convert to Decimal | Clear Values

Results: Latitude: 43.671389 Longitude: 79.598333

000000391204		6	45011853001	OSHAWA	X	435515	0785400	16.9	0.0	0.0
000000403204		0	45010930001	TORONTO, PIA15-OM/NDB		434420	0794208	16.0	0.0	0.0
000000403204		7	45010930001	TORONTO, PIA15-OM/NDB		434420	0794208	16.0	0.0	0.0
000001590000		6	42023606001	BOWMANVILLE, ONT. MOSPORT RACE PARK		440314	0784032	10.0	0.0	0.0
000002894400	000002894400	6	42033435001	MISSISSAUGA, ONT. 3111 CONVAIR DR		434017	0793554	18.0	0.0	
000003395500	000003395500	6	42073664003	DOWNSVIEW, ONT.		434445	0792722	25.9	0.1	0.0
000004726000	000004726000	6	42073664004	DOWNSVIEW, ONT.		434445	0792722	25.9	0.1	0.0
000005332000	000005332000	6	42094711001	CALEDON, ON 12435 HERITAGE RD		434123	0795350	18.5	0.0	0.0
000005332000	000005332000	6	42094636001	BRAMPTON, ON 25 RIVERVIEW DR		434016	0794407	20.0	0.0	0.0
000005332000	000005332000	6	42094710001	MAPLE, ON 82 GARDNER PLACE		435111	0793134	18.5	0.0	0.0

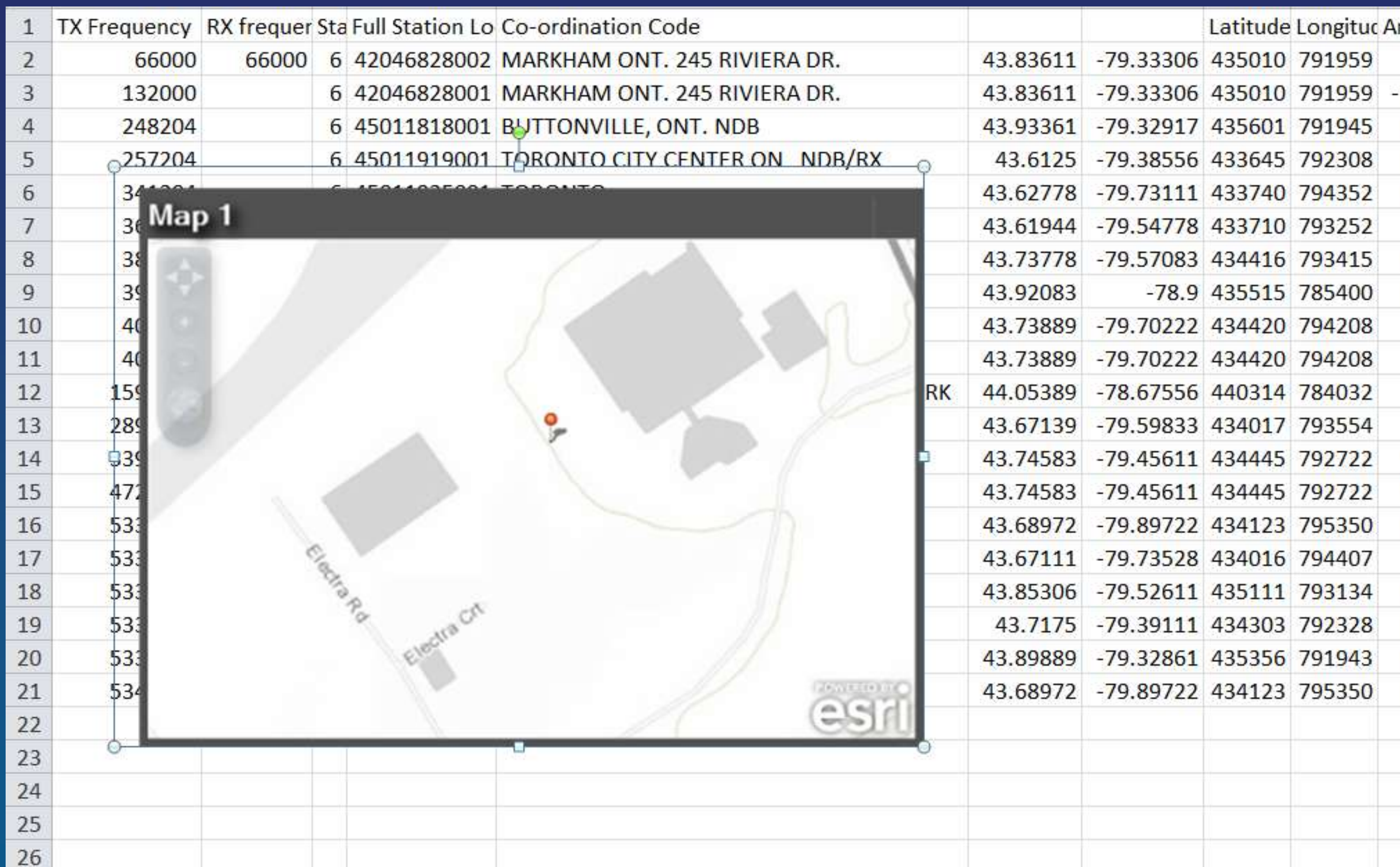
Example Open Data

	A	B	C	D	E	F	G	H	I	J	K
1	TX Frequency	RX frequer	Sta	Full Station Lo	Co-ordination Code			Latitude	Longituc	Antenr	Ante
2	66000	66000	6	42046828002	MARKHAM ONT. 245 RIVIERA DR.	43.83611	-79.33306	435010	791959	-23	0
3	132000		6	42046828001	MARKHAM ONT. 245 RIVIERA DR.	43.83611	-79.33306	435010	791959	-18.2	0
4	248204		6	45011818001	BUTTONVILLE, ONT. NDB	43.93361	-79.32917	435601	791945	16.9	0
5	257204		6	45011919001	TORONTO CITY CENTER ON NDB/RX	43.6125	-79.38556	433645	792308	13.9	0
6	341204		6	45011925001	TORONTO	43.62778	-79.73111	433740	794352	15.9	0
7	368204		6	45011907001	TORONTO	43.61944	-79.54778	433710	793252	14	0
8	385204		6	45011852001	TORONTO	43.73778	-79.57083	434416	793415	16.9	0
9	391204		6	45011853001	OSHAWA X	43.92083	-78.9	435515	785400	16.9	0
10	403204		0	45010930001	TORONTO, PIA15-OM/NDB	43.73889	-79.70222	434420	794208	16	0
11	403204		7	45010930001	TORONTO, PIA15-OM/NDB	43.73889	-79.70222	434420	794208	16	0
12	1590000		6	42023606001	BOWMANVILLE, ONT. MOSPORT RACE PARK	44.05389	-78.67556	440314	784032	10	0
13	2894400	2894400	6	42033435001	MISSISSAUGA, ONT. 3111 CONVAIR DR	43.67139	-79.59833	434017	793554	18	0
14	3395500	3395500	6	42073664003	DOWNSVIEW, ONT.	43.74583	-79.45611	434445	792722	25.9	0.1
15	4726000	4726000	6	42073664004	DOWNSVIEW, ONT.	43.74583	-79.45611	434445	792722	25.9	0.1
16	5332000	5332000	6	42094711001	CALEDON, ON 12435 HERITAGE RD	43.68972	-79.89722	434123	795350	18.5	0
17	5332000	5332000	6	42094636001	BRAMPTON, ON 25 RIVERVIEW DR	43.67111	-79.73528	434016	794407	20	0
18	5332000	5332000	6	42094710001	MAPLE, ON 82 GARDNER PLACE	43.85306	-79.52611	435111	793134	18.5	0
19	5332000	5332000	6	42094816001	TORONTO,ON,230 STIBBARD AVENUE	43.7175	-79.39111	434303	792328	18.5	0
20	5332000	5332000	6	42094426001	MARKHAM, ON 59 PORT RUSH TRAIL	43.89889	-79.32861	435356	791943	18.5	0
21	5348000	5348000	6	42094711002	CALEDON, ON 12435 HERITAGE RD	43.68972	-79.89722	434123	795350	18.5	0
22											
23											
24											

Example Open Data

	A	B	C	D	E	F	G	H	I	
1	TX Frequency	RX frequer	Sta	Full Station Lo	Co-ordination Code			Latitude	Longituc	Ar
2	66000	66000	6	42046828002	MARKHAM ONT. 245 RIVIERA DR.	43.83611	-79.33306	435010	791959	
3	132000		6	42046828001	MARKHAM ONT. 245 RIVIERA DR.	43.83611	-79.33306	435010	791959	-
4	248					43.93361	-79.32917	435601	791945	
5	257					43.6125	-79.38556	433645	792308	
6	341					43.62778	-79.73111	433740	794352	
7	368					43.61944	-79.54778	433710	793252	
8	385					43.73778	-79.57083	434416	793415	
9	391					43.92083	-78.9	435515	785400	
10	403					43.73889	-79.70222	434420	794208	
11	403					43.73889	-79.70222	434420	794208	
12	1590					44.05389	-78.67556	440314	784032	
13	2894					43.67139	-79.59833	434017	793554	
14	3395					43.74583	-79.45611	434445	792722	
15	4726					43.74583	-79.45611	434445	792722	
16	5332					43.68972	-79.89722	434123	795350	
17	5332					43.67111	-79.73528	434016	794407	
18	5332					43.85306	-79.52611	435111	793134	
19	5332					43.7175	-79.39111	434303	792328	
20	5332					43.89889	-79.32861	435356	791943	
21	5348					43.68972	-79.89722	434123	795350	
22										
23										
24										

Example Open Data



1	TX Frequency	RX frequer	Sta	Full Station Lo	Co-ordination Code			Latitude	Longituc	An
2	66000	66000	6	42046828002	MARKHAM ONT. 245 RIVIERA DR.	43.83611	-79.33306	435010	791959	
3	132000		6	42046828001	MARKHAM ONT. 245 RIVIERA DR.	43.83611	-79.33306	435010	791959	-1
4	248204		6	45011818001	BUTTONVILLE, ONT. NDB	43.93361	-79.32917	435601	791945	1
5	257204		6	45011919001	TORONTO CITY CENTER ON NDB/RX	43.6125	-79.38556	433645	792308	1
6	34					43.62778	-79.73111	433740	794352	1
7	36					43.61944	-79.54778	433710	793252	
8	38					43.73778	-79.57083	434416	793415	1
9	39					43.92083	-78.9	435515	785400	1
10	40					43.73889	-79.70222	434420	794208	
11	40					43.73889	-79.70222	434420	794208	
12	159				RK	44.05389	-78.67556	440314	784032	
13	289					43.67139	-79.59833	434017	793554	
14	339					43.74583	-79.45611	434445	792722	2
15	472					43.74583	-79.45611	434445	792722	2
16	533					43.68972	-79.89722	434123	795350	1
17	533					43.67111	-79.73528	434016	794407	
18	533					43.85306	-79.52611	435111	793134	1
19	533					43.7175	-79.39111	434303	792328	1
20	533					43.89889	-79.32861	435356	791943	1
21	534					43.68972	-79.89722	434123	795350	1
22										
23										
24										
25										
26										

Conclusions

- There is value in open data and there are nuggets of open GIS data that are worth obtaining and using in your GIS.
- Issues or barriers have been or are in the process of being broken down.
- Government policy is improving access by making open data accessible by default.
- Technical issues are being reduced through the use of commonly accepted industry standards.
- Legal and liability issues are no longer an impediment due to common open data licenses.

Conclusions

- Perfect data syndrome
- Data quality
- Data currency
- Data completeness
- Data accuracy and precision
- Users need to be vigilant
- Currently in infancy with lots of room to run.

Questions

Thank you

- Gordon - gplunkett@esri.ca

Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map and Stewardship Map Concepts as Compelling Arguments to Retrospectively Mine the Popular Literature for GIS Nuggets

Barry Wellar

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-14, 2015

Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map Concept as a Compelling Argument to Retrospectively Mine the Popular Literature for GIS Nuggets*

Dr. Barry Wellar
Owner and Principal, Wellar Consulting Inc.
President, Information Research Board Inc.
Professor Emeritus, University of Ottawa

Slides for the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-15, 2015

**Paper can be viewed at http://www.wellar.ca/wellarconsulting/home.html*

Overview

This paper encourages and supports mining the popular literature – newspapers, magazines, television, radio, and all other forms of media – for GIS nuggets, that is, GIS findings which serve three related functions: designing and developing geographic information systems technology; defining and elaborating geographic information science; and, using geographic information systems technology and geographic information science.

Questions, Questions, Questions

Organized around the concepts of the Doomsday Map and the Stewardship Map, media articles on the abuse versus care of land, water, and air resources over the 25 years between 1990 and 2015 provide the basis for questions to guide retrospectively mining the popular literature for GIS nuggets: Who caused the change from abuse to care to occur? What caused the change from abuse to care to occur? Why did the change from abuse to care occur? When did the change from abuse to care occur? Where did the change occur? How did the change occur? And, for each of those questions, the really BIG question, Was GIS a factor? If so, or if not, details please.

General Finding from Popular Literature Research

The popular literature is a vital source to retrospectively mine for GIS nuggets, and is a critical link in the process of understanding the evolution of GIS technology, GIScience, methodology, and the uses of GIS and GIScience.

Presentation Structure

The three pillars of the retrospective research design are outlined, and then discussion of concepts behind the Doomsday Map and the Stewardship Map illustrates why and how media headlines and stories can be mined for nuggets which are key to advancing GIS technology, GIScience methodology, and their uses by government, business, academia, and the general public.

Figure 1. GIS Nuggets Defined

GIS nuggets are <u>findings</u> from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

Table 1. Illustrative nuggets derived from using the retrospective approach to examine “the literature”

1. New or different reasons to add to GIS technology
2. New or different ways to add to GIS technology
3. New or different reasons to add to geospatial data
4. New or different reasons to add to geospatial information
5. New or different reasons to add to geospatial knowledge
6. New or different ways to add to geospatial data
7. New or different ways to add to geospatial information
8. New or different ways to add to geospatial knowledge
9. New or different uses of GIS technology
10. New or different uses of geospatial data
11. New or different uses of geospatial information
12. New or different uses of geospatial knowledge
13. New or different uses of GIScience research methods
14. New or different uses of GIScience research techniques
15. New or different uses of GIScience research operations

Table 2. Bodies of literature and other productions to mine for GIS nuggets

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

Background of the Doomsday Map Project

The Doomsday Map Project was developed in the mid-1980s as an element in urban geography, urban and regional planning, GIS, and research methods courses at the University of Ottawa. It was introduced into the broader public domain about 25 years ago in conference presentations, proceedings papers, and media stories.

Now, 25 years later and with a great deal of hindsight from which to benefit, I am discussing why and how the Doomsday Map Project and, by extension, similar projects of years past for any body of literature, warrant retrospective examination as potential sources of the kinds of GIS nuggets identified in Table 1.

Origins of the Doomsday Map Concept (1)

Government experience, 1972-1979. Overall, decisions taken, and actions not taken, in regard to land, water, and air abuses were vigorously driven by political, economic, and financial ideologies, abetted by large dollops of self-interest and convenience.

Conversely, minimal consideration was given to long-term implications, with the only exception of note that I recall being to assure the availability of sufficient quantities of zoned land for future residential and commercial development purposes.

Origins of the Doomsday Map Concept (2)

Academic experience, post-1979. Newspaper-based assignments in my undergraduate and graduate courses yielded an unending supply of articles from across Canada (as well as from the U.S. and abroad) about the chronic, widespread, and seemingly wholesale abuse of land, water, and air resources, thereby perpetuating and reinforcing the record of resource abuse observed during my government appointment.

Origins of the Doomsday Map Concept (3)

Community experience, post-1972 and counting. The triangulation of evidence was completed by participation in community-based transportation, planning, and development matters throughout the National Capital Region, and in other areas of Canada. That experience provided ground-level confirmation of the lack of due regard for land, water, and air resources.

Geography? What Geography?

Throughout the 1970s and 1980s the term “geography” (or any for synonym for geography) received little to no substantive consideration by governments, businesses, and seemingly a large portion of the Canadian public. In the face of such abject disregard for things geographic, the notion of the “Doomsday Map“ was born, with emphasis on the inclusion of geographic factors as decision variables,

Working Hypothesis

If the argument was persuasively made that continued abuse of our land, water, and air resources would result in dire consequences in the near future, then responsible individuals and businesses, and eventually governments, would cease their resource-abusive ways.

Why Doomsday?

I believed that on its face the notion of *doomsday* was sufficiently clear in its connotation to give reasonable individuals, business owners, executives, and shareholders, as well as government officials, cause to pause.

Why Map?

Land, water, and air resources readily lend themselves to being described in geographic terms and, hence, being mapped in various ways, many of which are readily understood by children, teens, and adults. To recall a phrase that no doubt has been stated many times, “There can be something for everybody in a map”.

Maps do not need to involve large quantities of numbers, which are anathema to many Canadians, including civil servants and, in my experience, an overwhelming majority of politicians at all levels.

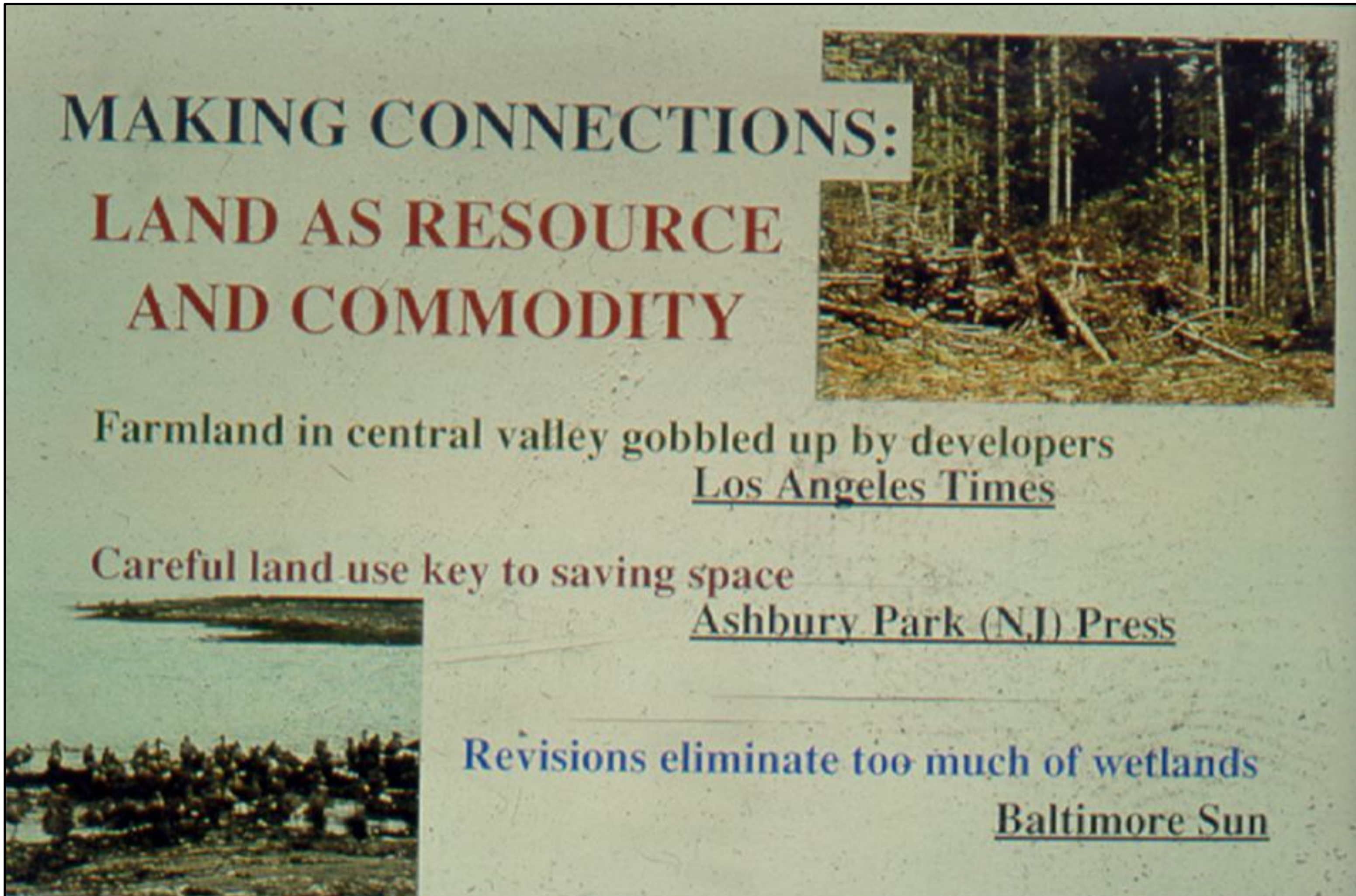
Maps can be made relatively self-explanatory, which minimizes the amount of text required to describe or explain the entities, relationships, themes, etc., represented on a map.

GIS Technology Enters the Picture

Informal testing over several years suggested by the late 1980s that there was both need and merit in putting the concept of the ***Doomsday Map*** into the broader public domain. Further, significant advances in GIS technology and its increased usage in academia, government, and business supported such an initiative.

25 Years Ago, Waste Disposal Headlines

25 Years Ago, Land Conflict Headlines



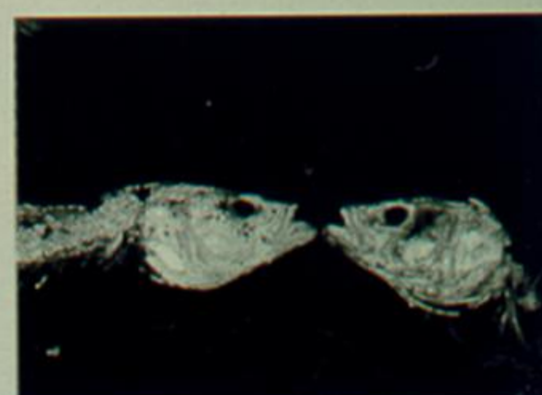
25 Years Ago, Water Problem Headlines

MAKING CONNECTIONS:

WATER, WATER EVERYWHERE?

Water quality managment urged as part of land use planning
<u>Newark Star Ledger</u>

Tax bills aim to conserve water supply
<u>Miami Herald</u>



The Great Lakes: World's largest body of "fresh" water is filthy, probably dangerous and not likely to be cleaned up soon
<u>Toronto Star</u>

25 Years Ago, Climate Change Headlines

25 Years Ago, Nasty Toxic Waste Headlines

MAKING CONNECTIONS:

TOXIC WASTES:
WHAT TO DO?
WHERE TO DO IT?

Site decisions on hazardous waste on hold
Atlanta Constitution

Toxic ghosts still lurk along banks of the Bow
Calgary Herald

Illinois N-waste plan sparks fear and anger
USA Today

25 Years Ago, More Nasty Toxic Waste Headlines

All the headlines dealt with concepts, things, decisions, actions, etc., which can be described or explained in geographic terms:

- ❖ As geographic entities or attributes
- ❖ As occupants of geographic spaces
- ❖ As occupants of geographic locations
- ❖ As occurrences at geographic places
- ❖ As manifestations of geographic relationships
- ❖ As inputs to spatial decision support systems
- ❖ As outcomes of spatial decision support systems

Reading between the Lines: Geography, Geography, and more Geography

All the headlines dealt with concepts, things, decisions, actions, etc., which can be described or explained in <u>geographic</u> terms:

- As representations of geographic processes
- As representations of spatial patterns
- As representations of spatial interactions
- As representations of spatial diffusion
- As representations of spatial flows
- As representations of clustered spatial distributions
- As representations of ordered, regular, or uniform spatial distributions
- As representations of random spatial distributions
- As representations of source-sink spatial networks
- As representations of space-time confluence

Conditions for Building Files from News Reports about Land, Water, and Air Abuse or Care Practices as Potential Resources to Mine for GIS Nuggets

If the stories about land, water, and air abuse or care practices can be

- ❖ Represented by geospatial data,
- ❖ Incorporated in a geographic information system (GIS), and
- ❖ Displayed in map form or other graphic representations,

Then they could be

- ❖ Mined for possible pointers, hints, indicators, suggestions, clues, etc., about where and how to discover, recover, or uncover GIS nuggets.

Connecting the Doomsday Scenario and the Geographer's Lament

Although the abuses of land, water, and air resources were of a seemingly obvious geographic nature, the geographic aspect of the abuses received little or no short-term much less long-term consideration by the perpetrators, or by many of the journalists writing the stories. Seemingly, it was as though geographic considerations *per se* simply did not matter to governments, to businesses, or to many individuals. Hence, the Lament.

The Geographer's Lament

With so many wrong things
In so many wrong places,
We have just about -----------
All our life-support spaces

Doomsday Map and GIS Day 2009

For GIS Day 2009 at the University of Ottawa, presentations to elementary and secondary school students included slides about the Doomsday Map and the Lament (http://www.geomatics.uottawa.ca/gaw09/index.html). Questions to illustrate the importance of knowing about and having respect for geography:

- ❖ Where are we to put our garbage?
- ❖ Where do we grow food?
- ❖ Where do we obtain clean water?
- ❖ Where do immigrants locate in Canada?
- ❖ Where do we intensify in order not to sprawl?
- ❖ Where do we locate the mass transit lines?

More questions to illustrate the importance of knowing about and having respect for geography:

- Where are the most dangerous intersections?
- Where have the glaciers gone?
- Where are the sources of airborne pollutants?
- Where are residents to shop if the area loses its food store?
- Where should the new bridge be located?
- Where does the wildlife go if the wetland is drained?

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Sentinel satellite spies ice cap speed-up. Melting at one of the largest ice caps on Earth has produced a big jump in its flow speed, satellite imagery suggests. *BBC News.* May 8, 2014. http://www.bbc.com/news/science-environment-27330321.

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Questions Investigating the Role of GIS in Decisions Affecting the State of Land, Water, and Air Resources

QA. Was GIS a factor in lessening, mitigating, terminating etc., previous abuses of land, water, or air resources?

QB. Did GIS support or promote continuation of previous abuses of land, water, or air resources?

QC. Did GIS support or promote abuses of land, water, or air resources in ways that did not exist 25 to 30 years ago?

QD. For abuses of land, water, or air resources that might have occurred post-1990, but were prevented or avoided due to interventions by governments, businesses, or individuals, did GIS contribute to the interventions?

Comments on Popular Literature Materials Regarding Oversight Agency Productions

1. Private sector corporations and government line departments rarely rush to publicly admit to committing or aiding and abetting abuses of land, water, and air resources.

2. When it comes to abuses of land, water, and air resources arising since 1990, we tend to learn about them from <u>oversight agencies</u> which are (purportedly) independent of "political strings", and whose mandate is to inform about matters of public interest.

A Short, Short List of Oversight Agencies with Responsibilities for Informing about the State of Land, Water, and Air Resources (1)

1. Alberta Environmental Monitoring, Evaluation and Reporting Agency (Canada)
2. Bureau of Land Management (USA)
3. California Office of Spill Prevention and Response (USA)
4. Climate and Pollution Agency (Norway)
5. Commissioner of the Environment and Sustainable Development (Canada)
6. *Environmental* Protection *Agency (USA)*
7. European Environment Agency (EU)

A Short, Short List of Oversight Agencies with Responsibilities for Informing about the State of Land, Water, and Air Resources (2)

8. Federal Environment Agency Soil Protection Commission (Germany)
9. International Joint Commission (water) (Canada, USA)
10. Intergovernmental Panel on Climate Change (UN)
11. Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (Québec, Canada)
12. Ministry of Infrastructure and the Environment (Netherlands)
13. National Commission of the Environment (Chile)
14. National Institute of Health Sciences (Japan)

A Short, Short List of Oversight Agencies with Responsibilities for Informing about the State of Land, Water, and Air Resources (3)

15. National Water Commission (Australia)
16. Northern Pipeline Agency (Canada)
17. Office of Management and Budget (USA)
18. Public Ministry (Brazil)
19. Soil Conservation Service (Iceland)
20. Virginia Department of Environmental Quality (USA)

Significance of Oversight Agencies

The requirement to inform on many aspects of abuse or stewardship of land, water, and air resources falls within the purview of oversight agencies.

It is most likely that reports of these agencies contain a great deal of geographic data, geographic information, and/or geographic knowledge about the state of land, water, and air resources in their respective jurisdictions.

Oversight Agencies and Popular Literature Reports

The qualifying question is whether the agencies were the sources for popular literature productions since 1990. The more specific questions for which we seek answers from oversight agencies are:

> Did GIS support or promote abuses of land, water, or air resources in ways that did not exist 25 to 30 years ago?

And,

> For abuses of land, water, or air resources that might have occurred post-1990, but were prevented or avoided due to interventions by governments, businesses, or individuals, did GIS contribute to the interventions?

Oversight Agencies and Popular Literature Reports: Lessons from the United Nations

The United Nations has huge oversight responsibilities, including those involving land, water, and air resources. Review of numerous publications, including “United Nations: Poor data, weak agencies hamstring environmental oversight” suggests that oversight agencies and the GIS community could mutually benefit from collaborating on how to use the retrospective approach to mine for both GIS nuggets and action-oriented environmental enlightenment.

Retrospective Mining for GIS Nuggets Includes Seeking "Good News and Bright Futures" Stories as Contributions to the Stewardship Map

Headlines and stories of particular interest are:

- ❖ Geography-based;
- ❖ Deal with a significant matter of public interest;
- ❖ Involve the care or stewardship of land, water, or air resources;
- ❖ Represent a general thought, hoped-for-future wish, election promise, letter-to-editor comment, etc., with a brighter future orientation;
- ❖ Represent a significant departure from past practices, which prompts questions about why and how the shift occurred,

And, most importantly for this project,

- ❖ Represent a potential source to be mined for GIS nuggets.

A Short List of Imagined Good News Headlines about the Care (Stewardship) of Land, Water, and Air Resources

Midwest aquifer recharging rate best in a decade

Algae blooms decrease across Mexico

Tailings dams in Australia checked, no leaks

Ottawa beaches now open after decades of run-off pollution

Another great salmon run for Washington's Pristine River

Strategic greening reduces urban flash flood impacts in India

Zoning now precludes building in Mississippi River flood plain

ATV group promotes saving Vermont's environmentally sensitive lands

World Bank allocates $50 billion in 3-year plan for rainforest preservation

Convictions on clear-cutting mean jail time for executives in Malaysia

More Imagined Stewardship Map Stories

U.N. congratulates Equatorial Africa for national forest reserve program

Soil erosion remedies working in Illinois and Wisconsin

Prime farmland designated sole highest and best land use in Finland

Japan's prime agricultural land reserves expanded

Natural habitat loss in Germany cut for third straight year

Loons returning to Minnesota

Critters now "roaming old stomping grounds" in the Maritimes

Urban sprawl thing of the past in more of China's metro regions

Smart intensification key to Nashville's sprawl turnaround

Agency uses geographic index to direct urban development in Brazil

Integrated land use and transit planning cuts demand for roads in B.C.

More Imagined Stewardship Map Stories

Worldwide, commuter vehicle use declines, air pollution levels drop

Paris leader in sustainable transport: Wins Challenge Cup

In landmark decision, New Mexico court accepts GIS standard of care evidence

Clear skies in Ontario signal drop in pollution from coal-burning plants

Vigorous enforcement of 3R policy extends NYC landfill life by 35 years

Glaciers and ice caps expanding, ocean levels lowering

Insurance companies impose new limits on building in harm's way

Republicans enthusiastically endorse Obama's *Green Initiative*

Renewable energy supply growing rapidly across Europe

Switzerland enshrines stewardship principle in law

Google hosts worldwide *Stewardship Map* program

Questions for Ascertaining the Reasons behind the Change from Abuse to Care of Land, Water, and Air Resources, and the Role of GIS

1. Who caused the change from abuse to care to occur?
   Was GIS a factor?
2. What caused the change from abuse to care to occur?
   Was GIS a factor?
3. Why did the change from abuse to care occur?
   Was GIS a factor?
4. When did the change from abuse to care occur?
   Was GIS a factor?
5. Where did the change occur?
   Was GIS a factor?
6. How did the change occur?
   Was GIS a factor?

Four basic relationship statements (R1, R2, R3, and R4) about situations and patterns are derived from the doomsday and stewardship headlines. Each relationship statement is accompanied by several questions to guide retrospectively searching the popular literature for GIS nuggets.

R1. There was apparent land, water, or air abuse in 1990, and there is apparent land, water, or air abuse now. Over the years,

Was GIS used?

If yes, did GIS fail?

Why did GIS fail?

If GIS was not used, why not?

R2. There was apparent land, water, or air abuse in 1990, and there is apparent land, water, or air care now. Over the years,

Was GIS used?

Did it support the abuse-to-care change?

If yes, how?

R3. There was apparent land, water, or air care in 1990, and there is apparent land, water, or air abuse now. Over the years,

Was GIS used?

Did it fail?

Why did GIS fail?

R4. There was apparent land, water, or air care in 1990, and there is apparent land, water, or air care now. Over the years,

Was GIS used?

If yes, how was it used?

The Power of R1, R2, R3, and R4: General Aspect

Because of their general nature, relationships R1, R2, R3, and R4 and the questions can apply to single jurisdictions or to multiple jurisdictions.

The Power of R1, R2, R3, and R4: Timeframe Aspect

R1, R2, R3, and R4 can be used without loss of generality in whatever timeframe is supported by the popular literature, that is, from days, weeks, months, and years, to decades.

Because of the general design of the relationships connecting 1990 and 2015, in principle they can be used to examine connections between headlines and stories in 2015 and those published in years subsequent to 2015.

KEEPS THE BIG PICTURE IN FOCUS OVER TIME AND SPACE

The popular literature is a report card on how well we are caring for our land, water, and air resources, and recalling the Doomsday Map project of 25 years ago prompts important questions about whether GIS had anything to do with the situations described in R1, R2, R3, or R4, and, ultimately, the resultant effects on GIS technology, GIScience methods, techniques, or operations, and the uses of GIS and GIScience.

Acknowledgements

Advice given by William L. Garrison, Professor Emeritus of Civil and Environmental Engineering, and Emeritus Research Engineer in the Institute of Transportation Studies, University of California, Berkeley, and by Gordon Plunkett, Director, Spatial Data Infrastructure, Esri Canada, in creating the colloquium paper from which the slides are derived is gratefully acknowledged. I also wish to acknowledge the slide preparation assistance of Sam Herold, Technical Advisor, Information Research Board Inc.

The Role of Federal Agencies in Directing the Research Agenda: Is this a Case of the Cart Before the Horse? A TIGER Case Study

Tim Trainor

Slides for the

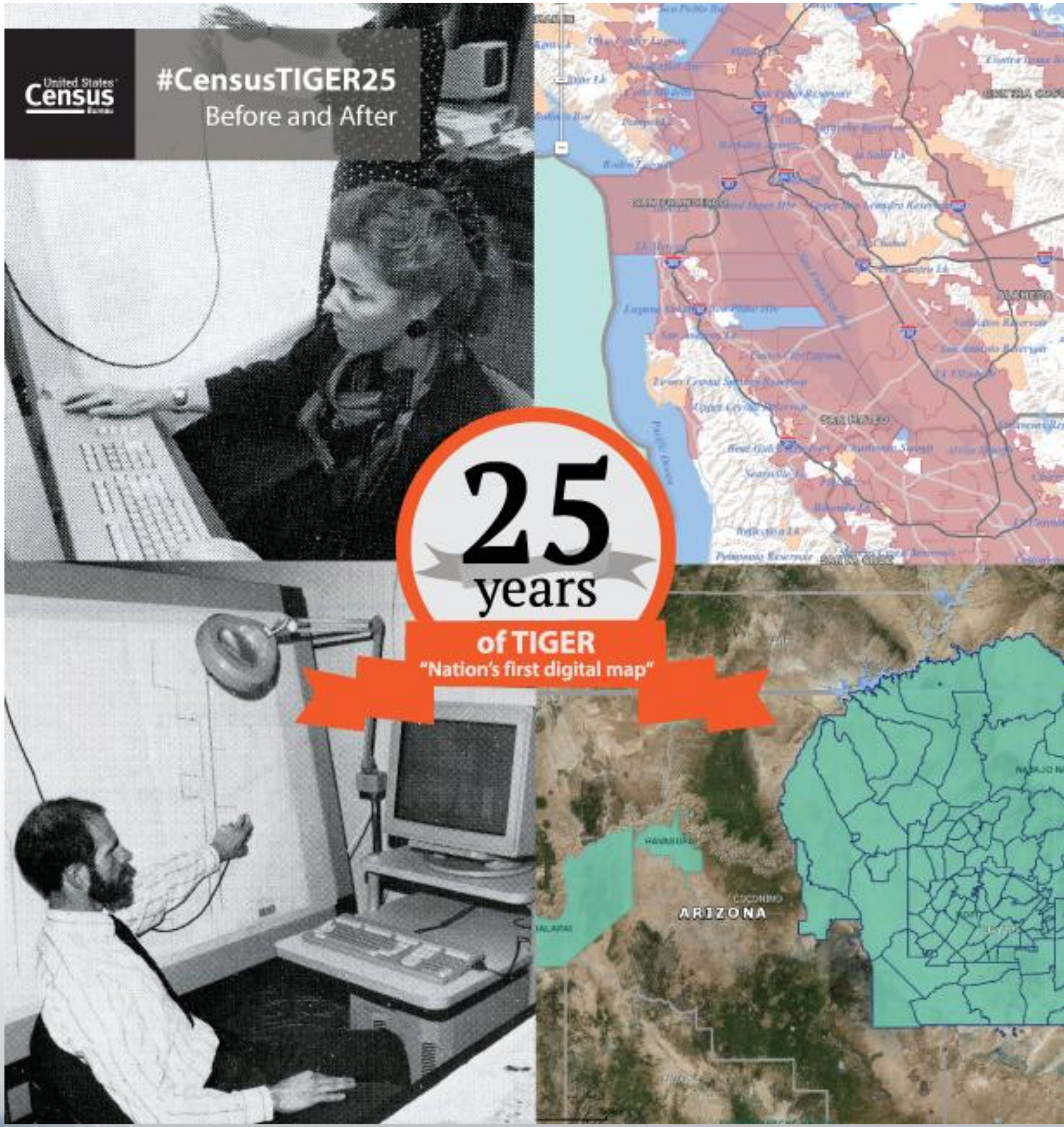
Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-14, 2015

The Role of Federal Agencies in Directing the Research Agenda: A TIGER Case Study

Tim Trainor

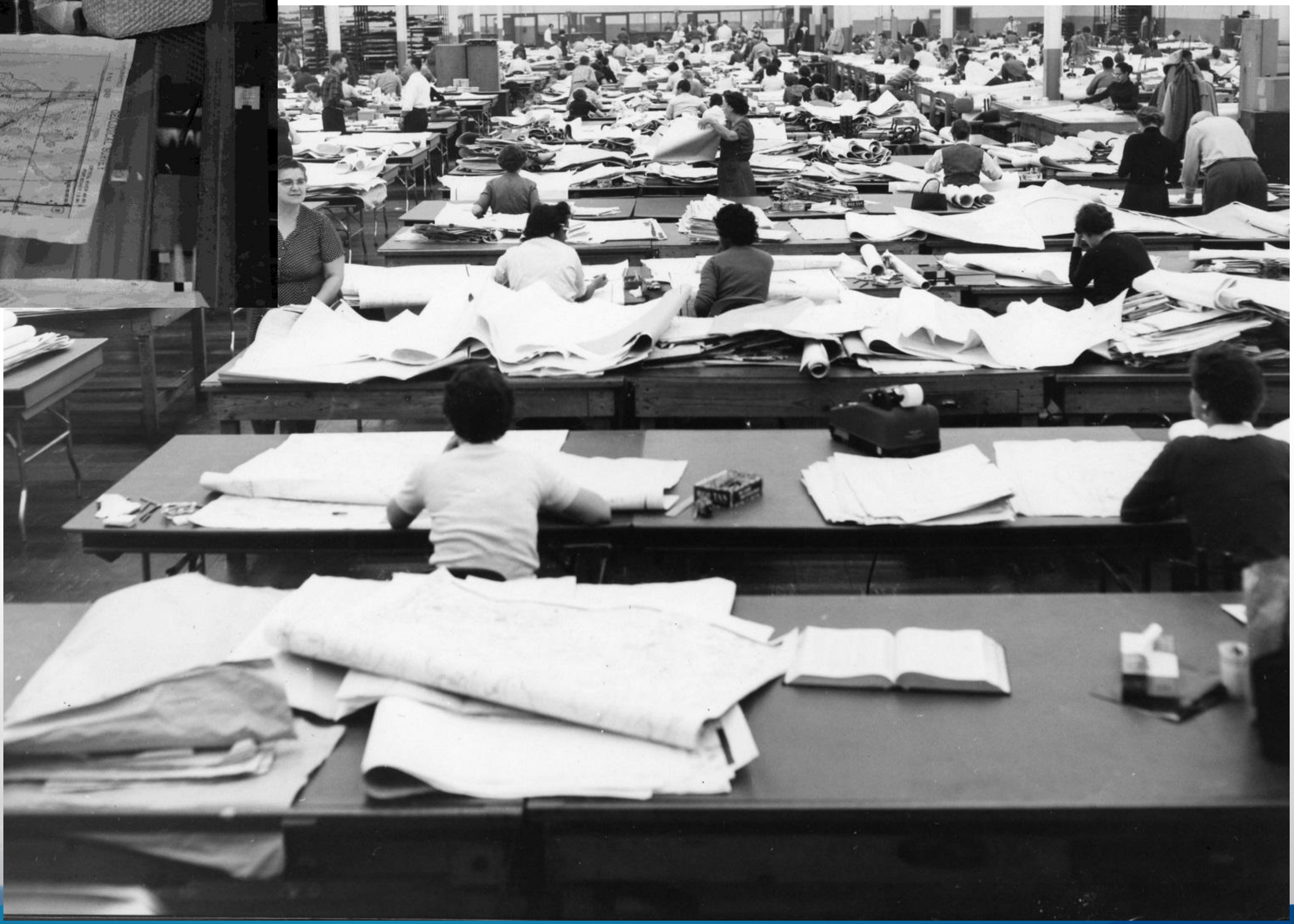
U.S. Census Bureau



The Need for TIGER

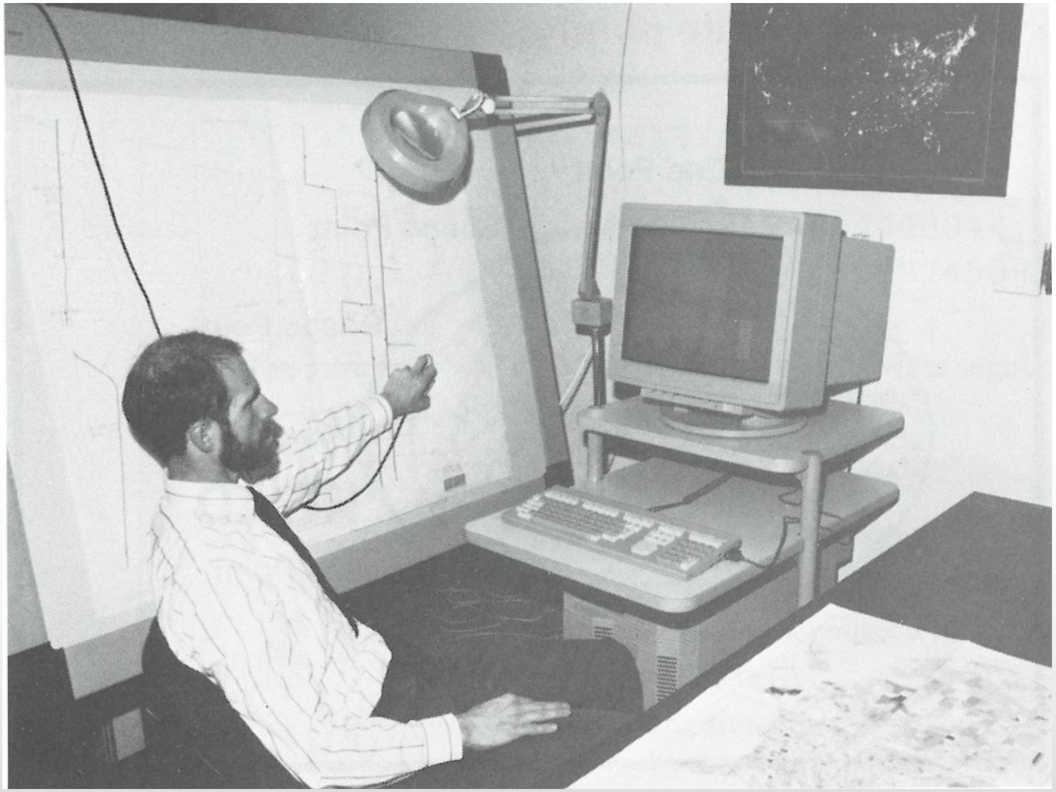
- Problem: Inconsistent maps, address lists, and geographic areas
- Solution: A single source from which all products would emanate

National Processing Center Preparing for the Census



The Path Forward

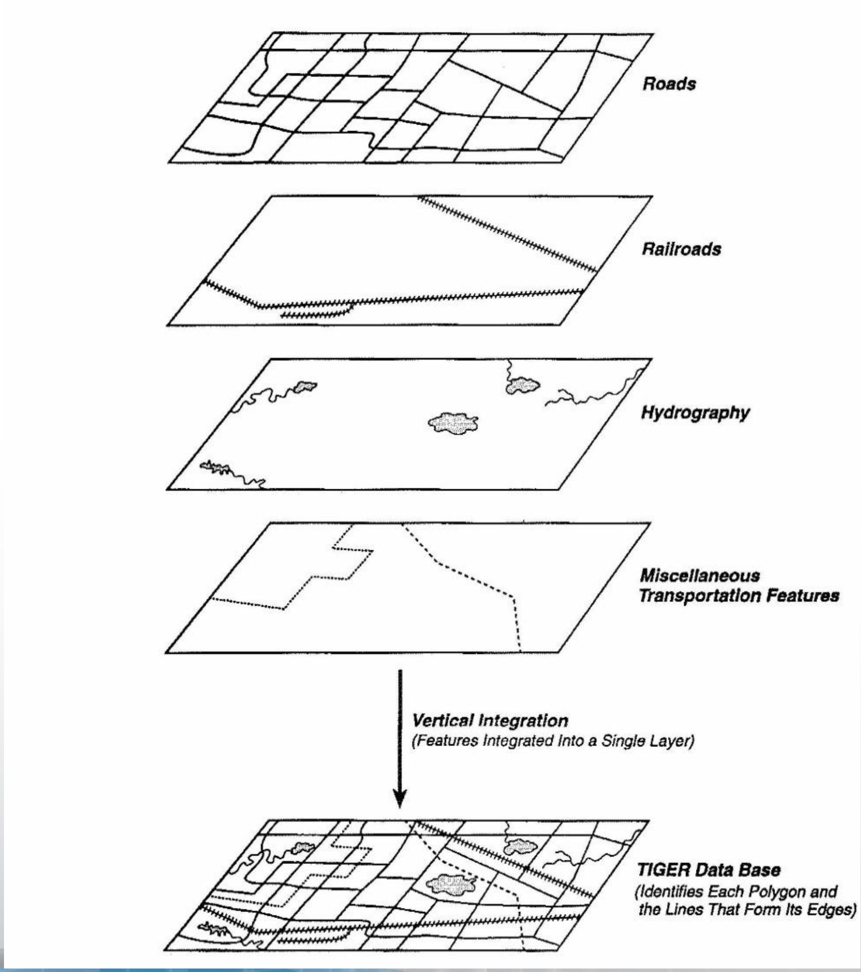
- Contracted with SPAD to determine the feasibility of scanning existing cartographic products
- Census prepared manual digitizing specifications to digitize the 56,000 1:24,000-scale topographic quadrangles for the lower 48 states.



Working with USGS

- Process:
  - USGS started collection of 1:100,000 DLGs
  - Tested feasibility of using 1: 100,000-scale to make larger scale maps for Census needs
  - Census committed to use DLG for base of TIGER
  - USGS changed production procedures to align with Census needs
- The focus for Census was on relative accuracy rather than positional accuracy, but the data capture process did adhere to National Map Accuracy standards.

Research and Planning



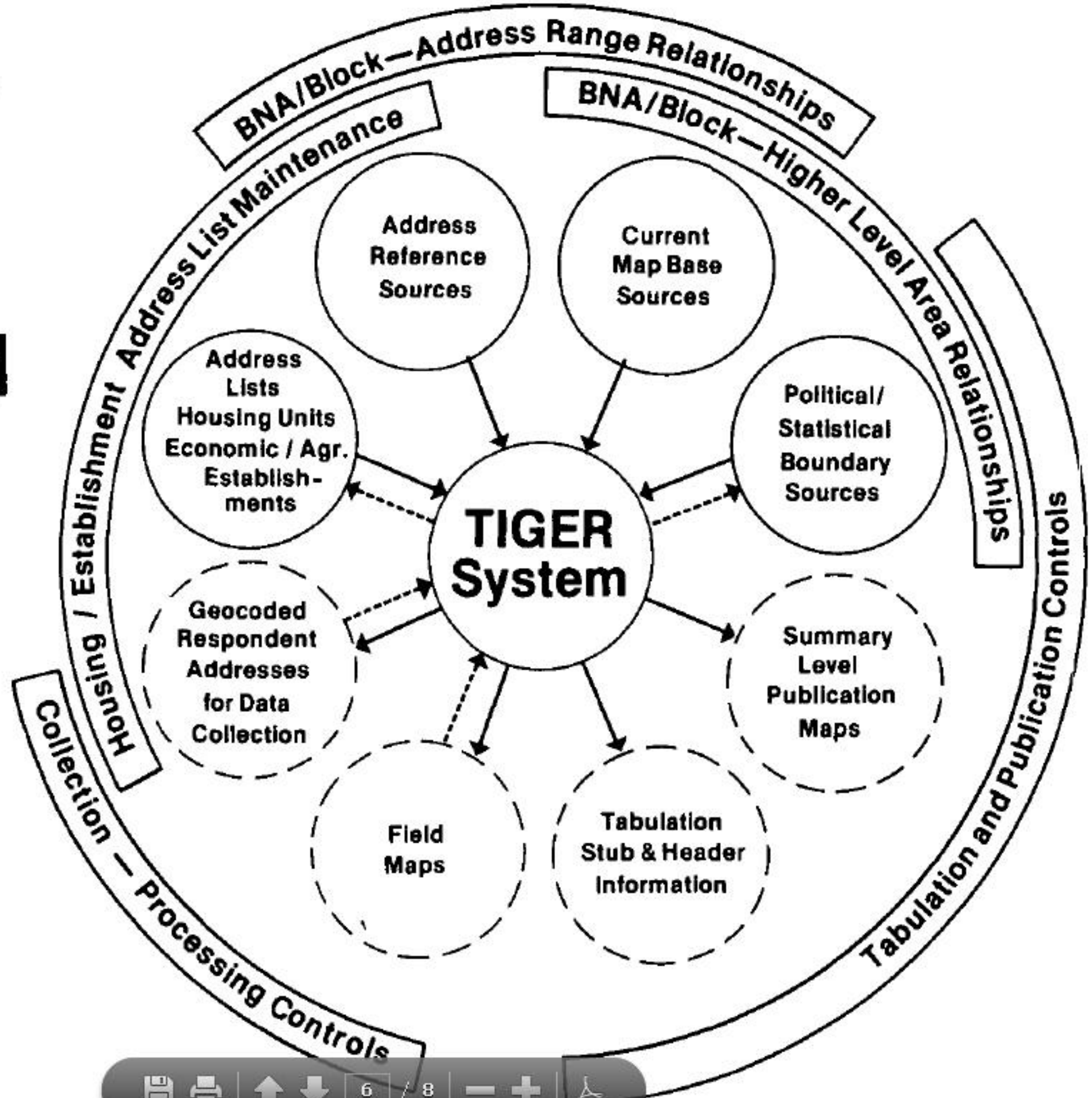
- Database content
- Database Structure
  - Topology
- Quadtrees
  - UMd – Samet

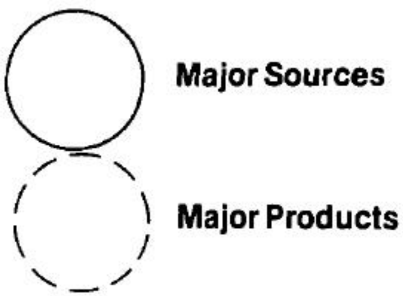
Census Geographic Areas

Plans for TIGER

- 20 year resource to initially support the 1990 Census
- No plan for a public product
- First public product produced for Columbia, Missouri
  - Positive response led to the development of TIGER/Line

Topologically Integrated Geographic Encoding and Referencing System





Creating the Master Address File

- 1970 – First mail-out/mail-back census
  - Purchased residential address lists from commercial vendors
  - Prelisting
  - Help from the USPS
- 1990 - Address Control File used as the starting point
  - The Census Address List Improvement Act of 1994
    - USPS updates from the Delivery Sequence File (DSF) beginning in 1995
    - Geographic partnership programs for tribal and local governments
  - Address Listing and Block Canvassing

Text Placement: A Retrospective

A Program for Automated Name Placement

by

John Ahn and Herb Freeman

United States™ Census Bureau
U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU
census.gov

Collaborative Review and Validation of the Proposed DLG and TIGER Conceptual Models

Airlie House

A Change in Methodology

Prior to 1960
- Door to door enumeration

1960
- First mail-out census
- USPS delivered a questionnaire to every household on their routes
- Enumerators collected the completed forms

1970
- Census created an address register for densely populated USPS routes
- First mail-out/mail-back census
- Urban areas mailed back their forms; rural area forms were collected by enumerators

1980
- ~95% of the U.S. population is now included in the mail-out/mail-back census
- Address list created from the ground-up

1990
- First use of TIGER
- Address list created from the ground-up

2000
- Birth of the MAF
- MAF/TIGER Enhancement Project
- 1990 Address list was used as a starting point
- Began receiving the DSF from the USPS

2010
- Continuous update of the MAF to support the ACS
- Address canvassing covered the entirety of the U.S. prior to Census day

2020
- Introduction of Targeted Address Canvassing and the Geographic Support System Initiative (GSS-I)

Big Ideas and Challenges: Institutional Arrangements

- United Nations Global Geospatial Information Management
  - How geospatial information can be used to help respond to global issues
    - Decision Making
    - Peacekeeping
    - Climate Change
- Working across agencies and departments
  - Voluntary vs. legislated

Big Ideas and Challenges: Policy Implications

- Privacy
- Confidentiality
- Coordination
- Partnerships

Big Ideas and Challenges: Budget Considerations

- Should government fund national initiatives?
- Good idea vs required cost savings
- The process…

Big Ideas and Challenges: Data

- Sustainability Indicators and Metric Ad-hoc Interagency Group
  - UN Statistical Commission Process & Meeting;
  - UN General Assembly post 2015 development agenda process and Statistical Commission FOC Group;
  - “Data Revolution” Expert Panel and US Working Group process;
  - System of Environmental and Economic Accounts process;
  - UN Global Geospatial Information Management Initiative (GGIM) process;
  - GEO/GEOSS engagement

Big Ideas and Challenges: Technology

- Perception vs reality
- Needs to be reactive

Thank you

Tim Trainor

US Census Bureau

Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development

Barry Wellar

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

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Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development*

Dr. Barry Wellar
Owner and Principal, Wellar Consulting Inc.
President, Information Research Board Inc.
Professor Emeritus, University of Ottawa

Slides for the Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

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February 13-15, 2015

**Paper can be viewed at http://www.wellar.ca/wellarconsulting/home.html*

Overview of Overview Agency Mandate

The Commissioner of Environment and Sustainable Development (CESD) is a Government of Canada oversight agency. CESD reviews and evaluates federal department and agency progress in developing and implementing strategies to serve and promote sustainable development (which applies to both the built and the natural environments); and, CESD also oversees the environmental petitions process involving citizens.

This paper discusses CESD’s mandate, its annual Reports to Parliament, and the focus of the Reports on the importance of <u>information</u> which is to be collected and processed by federal departments and agencies, and then used to monitor and analyze environmental and sustainable situations and processes, as well as to direct and support policy, program, and strategy decisions, and to communicate with citizens on environmental and sustainable development challenges, opportunities, issues, options, and initiatives.

General Finding from Popular Literature Research

The paper concludes that CESD Reports to Parliament are an important body of literature to be mined for GIS nuggets.

Presentation Structure

The three pillars of the retrospective research design are outlined, and then the presentation demonstrates that oversight agencies are potential sources of GIS nuggets themselves, and are also likely to be sources of intelligence about real and potential GIS nuggets resident in the policies, plans, programs, and operations of federal agencies subject to oversight.

Figure 1. GIS Nuggets Defined

GIS nuggets are findings from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

Table 1. Illustrative nuggets derived from using the retrospective approach to examine "the Literature"

1. New or different reasons to add to GIS technology
2. New or different ways to add to GIS technology
3. New or different reasons to add to geospatial data
4. New or different reasons to add to geospatial information
5. New or different reasons to add to geospatial knowledge
6. New or different ways to add to geospatial data
7. New or different ways to add to geospatial information
8. New or different ways to add to geospatial knowledge
9. New or different uses of GIS technology
10. New or different uses of geospatial data
11. New or different uses of geospatial information
12. New or different uses of geospatial knowledge
13. New or different uses of GIScience research methods
14. New or different uses of GIScience research techniques
15. New or different uses of GIScience research operations

Table 2. Bodies of literature and other productions to mine for GIS nuggets

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

(After: Wellar, B. 2005. *Geography and the Media: Strengthening the Relationship*. Ottawa: Canadian Association of Geographers, Canadian Royal Geographical Society and the Canadian Council on Geographic Education. http://www.ccge.ca)

Why Oversight Agency Literature?

The reasons for selecting oversight agency literature for a colloquium topic arose while writing the paper, Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map Concept as a Compelling Argument to Retrospectively Mine the Popular Literature for GIS Nuggets. As stated,

> "… in the case of case of abuses of land, water, and air resources arising since 1990, we tend to learn about them from <u>oversight agencies</u> which are (purportedly) independent of "political strings", and whose mandate is to inform about matters of public interest."

Exhibit 1. Statement Describing the Commissioner of the Environment and Sustainable Development

The Commissioner of the Environment and Sustainable Development provides parliamentarians with objective, independent analysis and recommendations on the federal government's efforts to protect the environment and foster sustainable development.

The Commissioner conducts performance audits, and is responsible for assessing whether federal government departments are meeting their sustainable development objectives, and overseeing the environmental petitions process.

Exhibit 2. Sustainable Development Strategies

At the 1992 Earth Summit in Rio de Janeiro, Canada committed to developing national strategies for sustainable development by making selected federal departments and agencies responsible for sustainable development. The aim was to ensure that environmental, economic, and social considerations would be systematically taken into account in their decision making, and lead to changes in policies, programs and operations that would further sustainable development.

Exhibit 3. Departmental Sustainable Development Strategies

The Commissioner of the Environment and Sustainable Development assesses the quality of departmental sustainable development strategies and whether the plans set out in the strategies have been implemented. The results are presented in various reports of the Office of the Auditor General of Canada, including the Commissioner's reports to the House of Commons.

Table 3. Canada's Federal Departments and Agencies Required to Prepare a Sustainable Development Strategy and Respond to Environmental Petitions (1)

1. Agriculture and Agri-Food Canada
2. Atlantic Canada Opportunities Agency
3. Canada Border Services Agency
4. Canada Economic Development for Quebec Regions
5. Canada Revenue Agency
6. Canadian Heritage
7. Canadian International Development Agency
8. Citizenship and Immigration Canada
9. Environment Canada
10. Finance Canada, Department of
11. Fisheries and Oceans Canada
12. Foreign Affairs and International Trade Canada
13. Health Canada

Table 3. Canada's Federal Departments and Agencies Required to Prepare a Sustainable Development Strategy and Respond to Environmental Petitions (2)

14. Human Resources and Skills Development Canada
15. Indian and Northern Affairs Canada
16. Industry Canada
17. Justice Canada, Department of
18. National Defence
19. Natural Resources Canada
20. Parks Canada
21. Public Health Agency of Canada
22. Public Safety Canada
23. Public Works and Government Services Canada
24. Transport Canada
25. Treasury Board of Canada Secretariat
26. Veterans Affairs Canada
27. Western Economic Diversification Canada

De Facto Geography at the Federal Level

In view of the fact that each of the 27 departments or agencies has direct or indirect responsibility for some geographically distributed element of the natural or built environment, each of them is a potential source of GIS nuggets which serve one or more of the M1, M2, or M3 missions in Figure 1.

Exhibit 4: Reports to Parliament by the Commissioner of the Environment and Sustainable Development

2014 Fall Report of the Commissioner of the Environment and Sustainable Development

2013 Fall Report of the Commissioner of the Environment and Sustainable Development

2012 Fall Report of the Commissioner of the Environment and Sustainable Development

1999 May Report of the Commissioner of the Environment and Sustainable Development

Technical Expertise Factor

Reports from oversight agencies are frequently the most technically sophisticated of all documents published for public consumption by government agencies.

Skills Required to Mine Oversight Agency and CESD Reports for GIS Nuggets

Expertise in GIS and GIScience, and a combination of: graduate-level courses in research methodology; experience in both client-driven and curiosity-driven research; a stint in a federal or provincial agency that involved participation in program or policy activities; experience in evaluating research proposals; and an education and training background in the subject matter domain of the CESD production being mined for GIS nuggets.

Ideas for Mining CESD Reports in Search of GIS Nuggets

Excerpts from the 1999 CESD Report to Parliament are accompanied by comments on how to mine that document (and subsequent CESD reports to Parliament) for GIS nuggets. To assist in tracking who wrote what, materials from the 1999 Report to Parliament are black and italicized, and my comments are red and plain text.

Excerpt A. *Federal-provincial agreements to protect the environment*

The federal government has entered into environmental partnership agreements with the provinces to reduce overlap and duplication. The seven agreements we audited cover activities such as inspection, enforcement, monitoring and reporting …

Comment A1

Spatial data files, maps, or other spatial records were possibly part-and-parcel of every federal-provincial agreement. If so, they are a pertinent basis for measuring progress in subsequent years, and could be models for other countries considering such agreements. If not, what was the thinking about how impact assessments would be done without a spatial data base to record spatial phenomena, and to monitor and analyze changes to spatial distributions over time?

Comment A2

The literature on impact assessment began more than 30 years prior to 1999, so this Report raises important questions about the state of GIS technology and GIScience, and their uses, across all federal agencies considered in the 1999 Report.

Excerpt B. *A work in progress*

Departments are now in the early stages of turning their strategies into action. They are making progress in delivering on their commitments. However, the quality of the information they have provided varies widely among departments….

Comment B1

How long does it take? Canada began down the environmental assessment and sustainable development paths more than 20 years prior to the 1999 Report. Further, Canada was an international leader in the design, development, and use of geographic information systems technology and GIScience methods, techniques and operations well before 1999.

Comment B2

GIS nuggets could reside in hard questions put directly to CESD as well as to federal departments and agencies about the kinds of spatial data files, maps, and other spatial records, as well as GIS technologies and GIScience capabilities that the departments put in place in 1999.

Excerpt C. *Sustainable development challenges*

At the 1*997 special session of the United Nations General Assembly… the international community expressed deep concern that overall global trends had worsened in the five years since the Rio Earth Summit. Greenhouse gas emissions, toxic pollution and solid waste were increasing; renewable resources like fresh water, forests, topsoil and fisheries were being overused; and the gap between the rich and the poor was growing.*

Comment C1

There is a high degree of correspondence between the messages presented in the 1989-1990 Doomsday Map headlines of land, water, and air abuses, the unsustainability themes of the Earth Summit in 1992, the concerns about global trends expressed at the special session of the UN General Assembly 1997, and the gaps between abusing and caring for land, water, and air resources in 2015.

Comment C2

Most significant with regard to mining for GIS nuggets is the high degree of correspondence in the variables used to define and measure sustainability, as well as in the awareness that <u>geography</u> is a central part of defining, measuring, and representing sustainability situations and processes, including the shifts from abusing to caring for land, water, and air resources.

Comment C3

In order to “demonstrate measurable progress toward sustainable development”, federal departments and agencies would have incorporated GIS technology and GIScience methodology in their data, information, and knowledge development and reporting procedures. If so, then the 1999 Report to Parliament points to federal departments and agencies as highly likely rather than just potential sources of GIS nuggets. And, CESD could also be a continuing source of GIS nuggets if it pursues this theme in future reports.

Excerpt D. *This year's Report*

This Report maintains our focus on the challenges the federal government faces in dealing with environmental and sustainable development issues. It illustrates that unsustainable development is not simply a distant global problem: it affects us where we live and where we work. How we manage sustainable development issues has important economic, social and environmental consequences.

Comment D1

The key word in Excerpt D is “where”, as in the statement “…*unsustainable development is not simply a distant global problem: it … affects us where we live and where we work*”.

Comment D2

Recalling Comment C2, the concepts of sustainable development or unsustainable development are expressed by variables, and those of a geographic nature can be dependent or independent variables, depending upon the research design, reporting design, etc. This statement in the 1999 Report could be a catalyst for federal initiatives that produced nuggets pertinent to missions M1, M2, and/or M3 in Figure 1. And, CESD could also be a continuing source of GIS nuggets if it pursues this theme in future reports.

Excerpt E. *The Arctic - A Barometer of Global Environmental Change*

To meet Canada's environmental commitments in the Arctic, scientists and program managers have been struggling with many of the same challenges discussed elsewhere in this report: building a solid information base through scientific research and monitoring…

Comment E1

Given that the Arctic accounts for 40 per cent of Canada's land mass and 2/3 of the country's coastline, departmental efforts to build and maintain geospatial data bases and undertake scientific research, policy research, geopolitical research, etc., would necessarily tie in with missions M1, M2, and M3 in Figure 1. It therefore follows that departments would be highly likely sources of GIS nuggets, and CESD would also be a highly likely and continuing source of GIS nuggets if it pursues this theme in future reports.

Excerpt F. *Implementing sustainable development strategies*

Monitoring and reporting on federal progress toward sustainable development is a key part of my mandate… Through those strategies, departments are being challenged to take environmental, economic and social considerations into account more systematically across the board - in their policies, their programs and their day-to-day operations.

Comment F1

The word “geography” is notable by its absence from Exhibit 11, and especially because in the real world “*environmental, economic, and social considerations*” do not exist in a vacuum. Rather, they are a function of real-world situations and circumstances which are often affected directly or indirectly by such geographic factors, functions, and structures as: accessibility, adjacency, barriers, boundaries, buffers, closeness, clusters, compactness, concentration, congestion, connectivity, contiguity, density, diffusion, dispersion, distance, elevation, encroachment, intensification, interaction, isolation, location, migration, mobility, morphology, movement, nearness, networks, patterns, proximity, scale, segregation, separation, shape, sprawl, spread, territory, and topography.

Comment F2

Following from Comment F1, the CESD challenge, *Through those strategies, departments are being challenged to take environmental, economic and social considerations into account more systematically across the board - in their policies, their programs and their day-to-day operations,* the implementation challenge can only be fully met by intense, sustained recourse to GIS technology and GIScience methods, techniques, and operations.

Comment F3

The content of Excerpt F could be the catalyst for a number of GIS nuggets being included in productions by MPs (including cabinet ministers) from across Canada, as well as in productions of federal departments, and CESD itself <u>in 1999 and in subsequent years</u>.

Summary Comment on CESD 1999

The 1999 Report to Parliament by CESD is a potentially rich source of GIS nuggets, and it also points to other sources of GIS nuggets, including federal departments as well as Members of Parliament who receive the CESD Reports.

Excerpts from the 2014 CESD Report to Parliament

The next slides examine remarks from the section, *The Commissioner's Perspective*. To assist in tracking who wrote what, materials from the 2014 Report to Parliament are black and italicized, and my comments are red and plain text.

Excerpt G. *Some progress has been made*

… the federal government is working with the province of Alberta to lay the groundwork for more comprehensive monitoring of the environmental effects of oil sands development. If this program, which is industry-funded, is fully implemented as planned, it will result in more frequent monitoring of more environmental parameters over a greater <u>geographic [</u>underline added] area.

Comment G1

The oil sands development situation in Alberta is only one of many federal actions across Canada with a geographic dimension. Questions arise about the methodology employed by CESD to monitor and evaluate progress by the federal government.

Comment G2

Does CESD maintain a geographic database or require that the federal government maintain such a database informing staff, MPs, and the Canadian public, including the media, about the extent of federal interest in matters geographic?

Comment G3

Do CESD Reports and/or communications to departments and agencies include references to GIS technology and GIScience use by CESD and/or federal agencies in order to meet their respective information and informing requirements?

Excerpt H. *Information for decision making*

We need sound information to ensure that the resources developed today yield lasting social and economic benefits without imposing unacceptable environmental costs in the future….. I am concerned that, as a consequence, some significant projects will not be adequately assessed and that decision makers will therefore lack the information they require to mitigate environmental impacts.

Comment H1

The situation described by the Commissioner may well be regarded as appalling by those experienced in the matter of achieving better decisions through better information.

Comment H2

The Commissioner is making an excellent case for specifying and implementing highest order, all-that-is-needed GIS technology and GIScience across all federal departments and agencies having any association with CESD terms of reference.

Comment H3

It is now more than 15 years since the CESD operation began, and after all those years, not months but years, some federal departments or agencies still need to be pushed and prodded by CESD to get up to speed on the matter of information for decision making.

Comment H4

Something is seriously wrong when one of the world's leading countries in information technology and geographic information systems is having such apparent difficulty implementing the results of its own federal R&D programs, <u>some of which were launched more than 35 years ago.</u>

Excerpt I1. *Engaging Canadians*

The best decisions are made when people with various perspectives sit at the same table, listening to each other, learning, and coming to consensus where possible.

Comment I1

The absence of any mention of GIS and GIScience in this section is puzzling to say the least. However, it is anticipated that at least a dozen of the 27 federal departments and agencies reporting to CESD will have looked into this matter, and their files are likely sources of a number of GIS nuggets applicable to M1, M2, and especially M3 in Figure 1.

Excerpt I2. *Engaging Canadians*

Many stakeholders have noted that they can no longer participate meaningfully in federal environmental assessments because they lack the capacity to respond.

Comment I2

GIS technology in combination with the Internet brings the Government of Canada virtually close to every Canadian with access to a computer or other electronic communication device, which means that there is no technological or technical reason for most Canadians in much of the country to be precluded from participating in environmental assessments.

Excerpt I3. *Engaging Canadians*

To make the best decisions, the government needs to engage citizens and share information.

Comment I3

Over the years there has been steady progress in advancing GIS technology and GIScience, leading to major strides in accelerating the data->information->knowledge transform process. As a result, there are no technical or technological reasons for federal departments or agencies with a spatial aspect in their mandates to reject using GIS technology and GIScience methods, techniques, and operations to provide timely, comprehensive CESD-related analog and digital data and information to Canadians from coast-to-coast-to-coast.

Excerpt I4. *Engaging Canadians*

Without sufficient information and engagement, Canadians have fewer opportunities to communicate their concerns to decision makers and fewer opportunities to legitimize future resource development decisions.

Comment I4

The theme, “lack of sufficient information and engagement” is a common denominator among CESD Reports to Parliament, beginning in 1999 and appearing again in 2014. Question: If there are no technical or technological constraints to meeting a mandated obligation, why is the information and engagement obligation not being fully met?

General Finding about CESD Reports to Parliament

The comments on excerpts from the 1999 and 2014 CESD Reports to Parliament are more than sufficient to establish the value of mining them and other CESD Reports, for GIS nuggets. Further, all the Reports to Parliament include links to additional, relevant materials, which substantially increases and enriches the CESD body of literature as a source of GIS nuggets.

Recommendations

The oversight agency (CESD) reports emphasize a core theme about the importance of <u>information</u> that is to be collected and processed by federal departments and agencies, which leads to the recommendation that each Report to Parliament by the Commissioner of Environment and Sustainable Development, from 1999 to 2014 (and in future years) be mined for GIS nuggets.

Acknowledgements

Advice given by William L. Garrison, Professor Emeritus of Civil and Environmental Engineering, and Emeritus Research Engineer in the Institute of Transportation Studies, University of California, Berkeley, and by Gordon Plunkett, Director, Spatial Data Infrastructure, Esri Canada, in creating the colloquium paper from which the slides are derived is gratefully acknowledged. I also wish to acknowledge the slide preparation assistance of Sam Herold, Technical Advisor, Information Research Board Inc.

Preserving Institutional Memory: Capturing Knowledge Key to GIScience

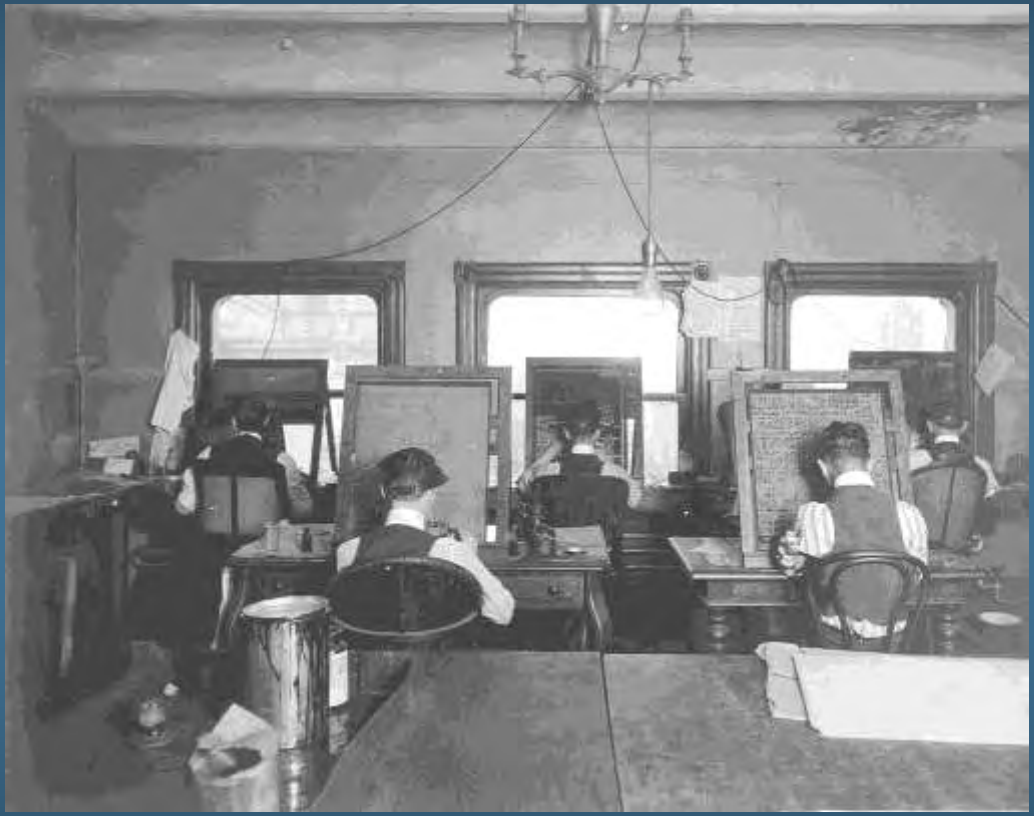
Stephen Guptill

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

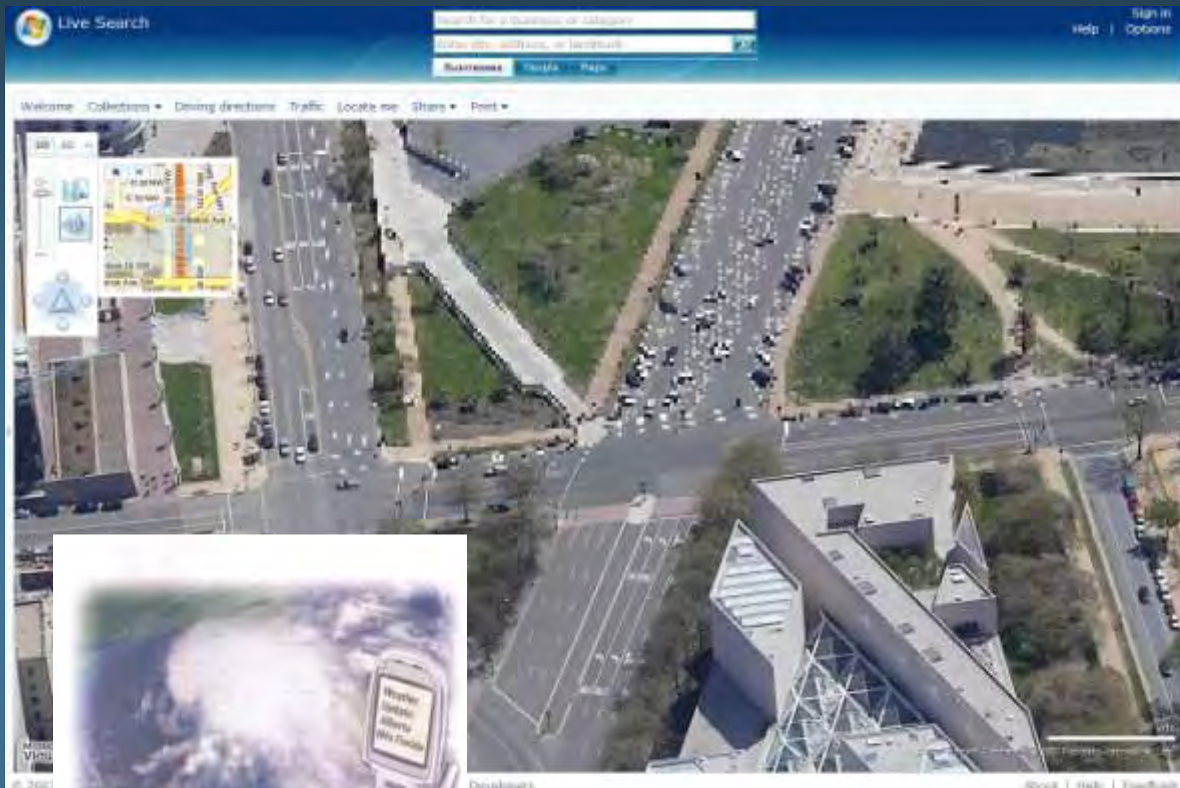
Esri International Headquarters
Redlands, California
February 13-14, 2015

Preserving Institutional Memory: Capturing Knowledge Key to GIScience



Stephen C. Guptill

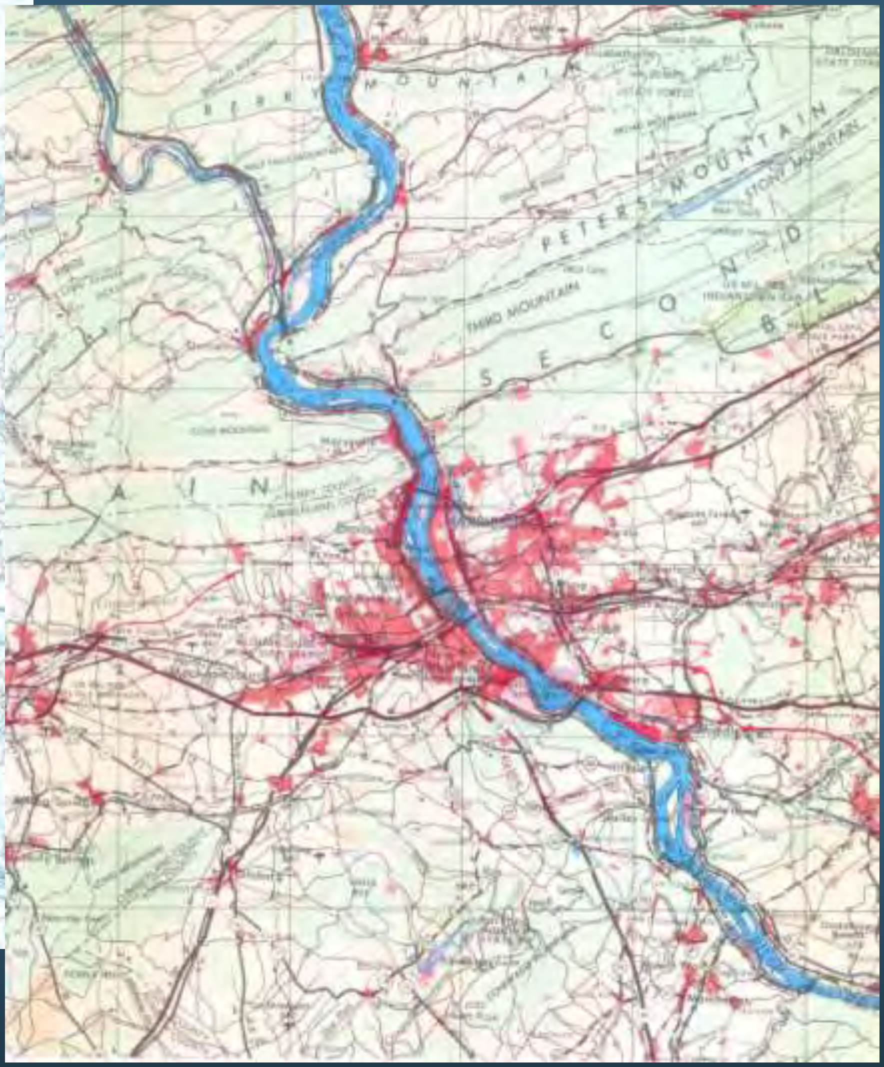
The Power of Maps (circa 2007)



How did we get here?

Automating Cartography

Mapping + Basic GIS



Or basic GIS with very basic maps

Domestic Information Display System (DIDS).

The system is being developed by more than 15 Federal agencies. It is a prototype of operational systems which will use public data and commercial hardware.

The system is questioned using a simple keyboard with a visual display. On the display, the system presents options of data based on the line of questioning of the decision-maker.

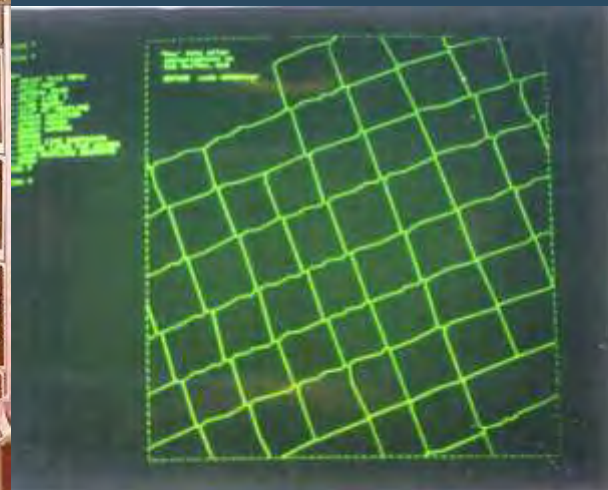
The system displays the data requested in color on simple geographic format for direct understanding.

For instance, green would indicate the highest income, while orange indicates the lowest income.

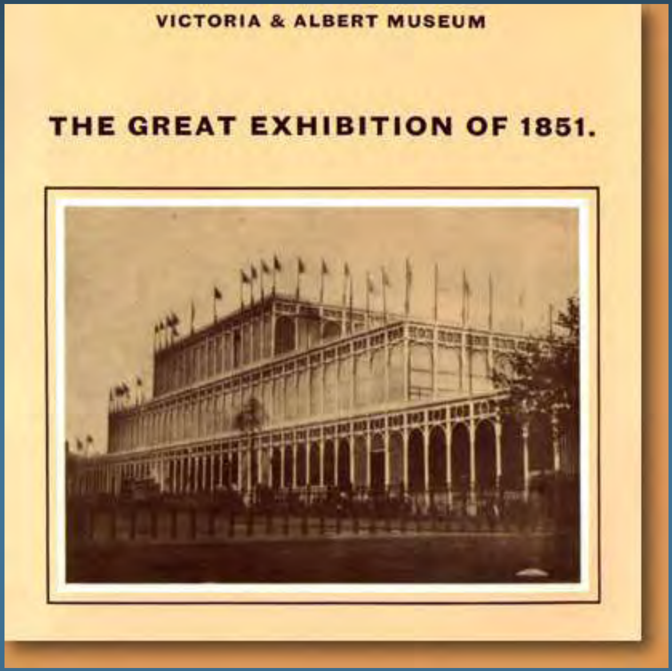
Operator Selects Display Options Through Keyboard.

Resulting Graphic Display.

Garage Shops



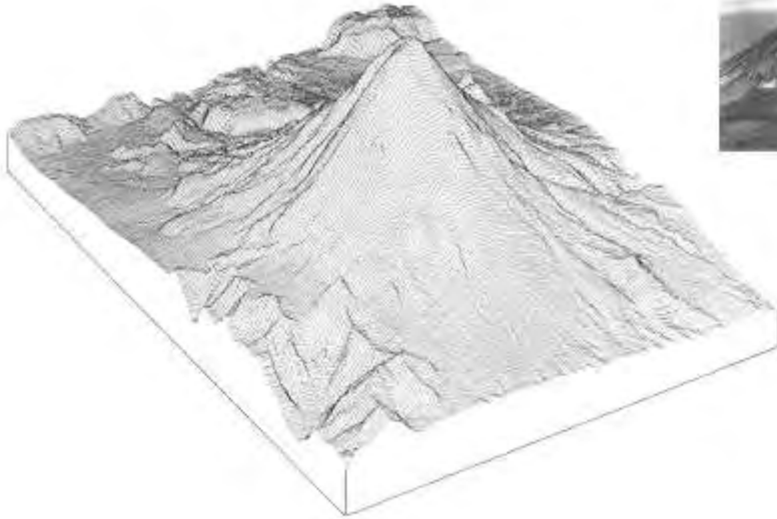
Crystal Palaces

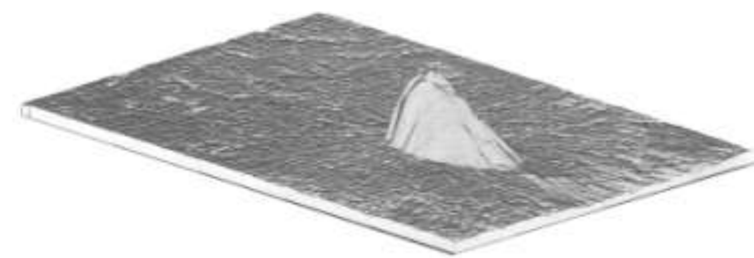


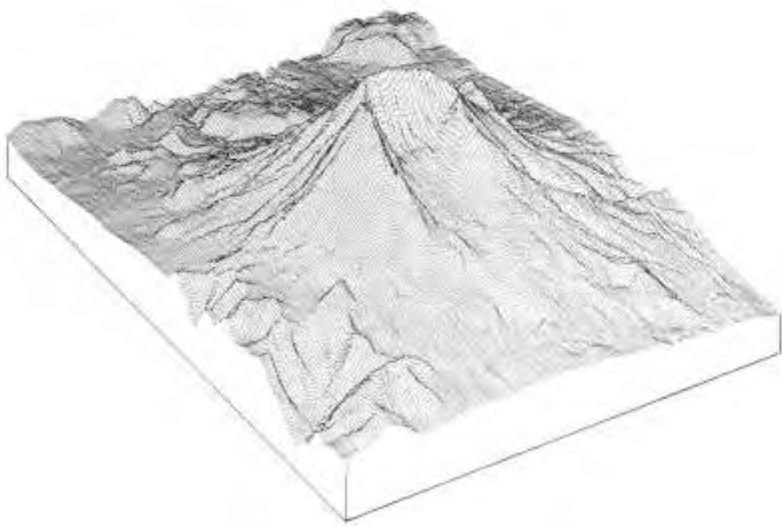
Crystal Palaces

Crystal Palaces

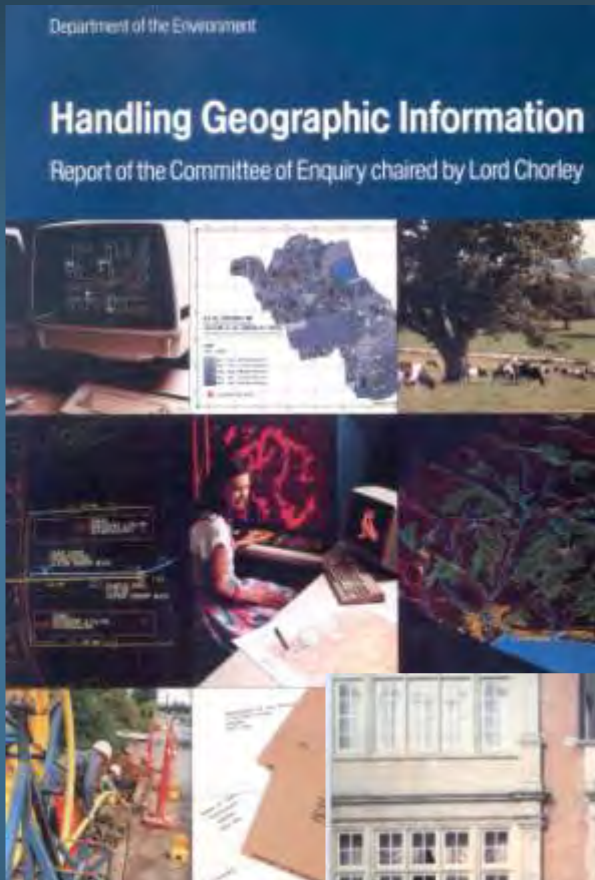
Creating new products…

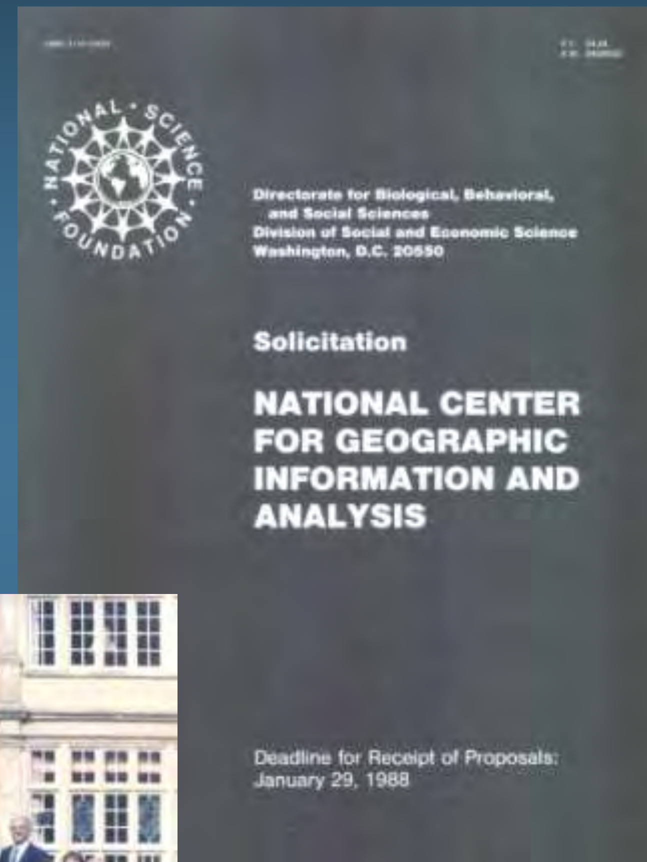




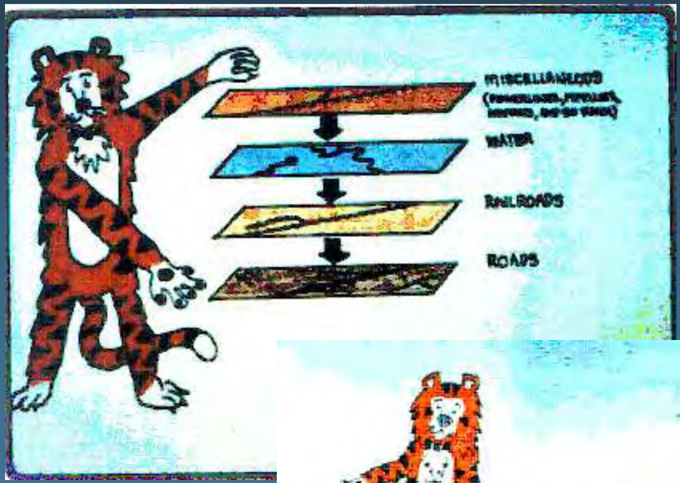


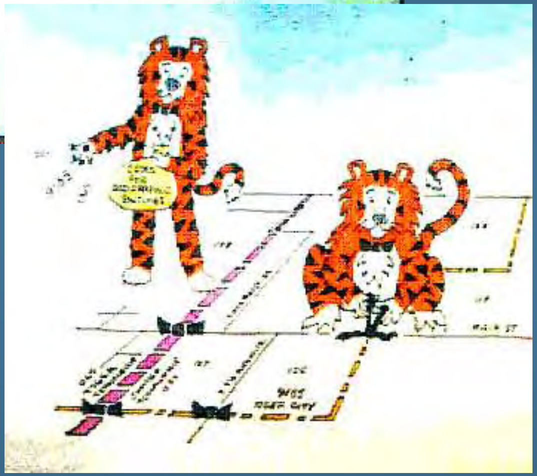
The Rise of GIS and Geospatial Data





Triumphs



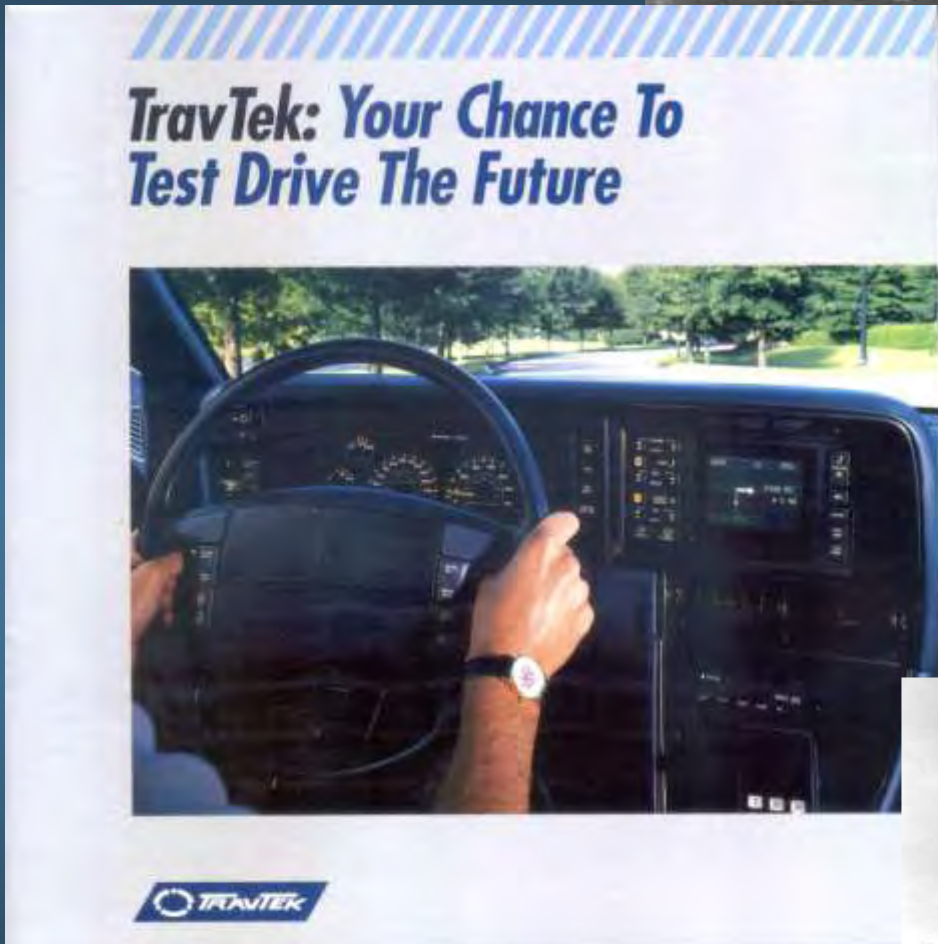


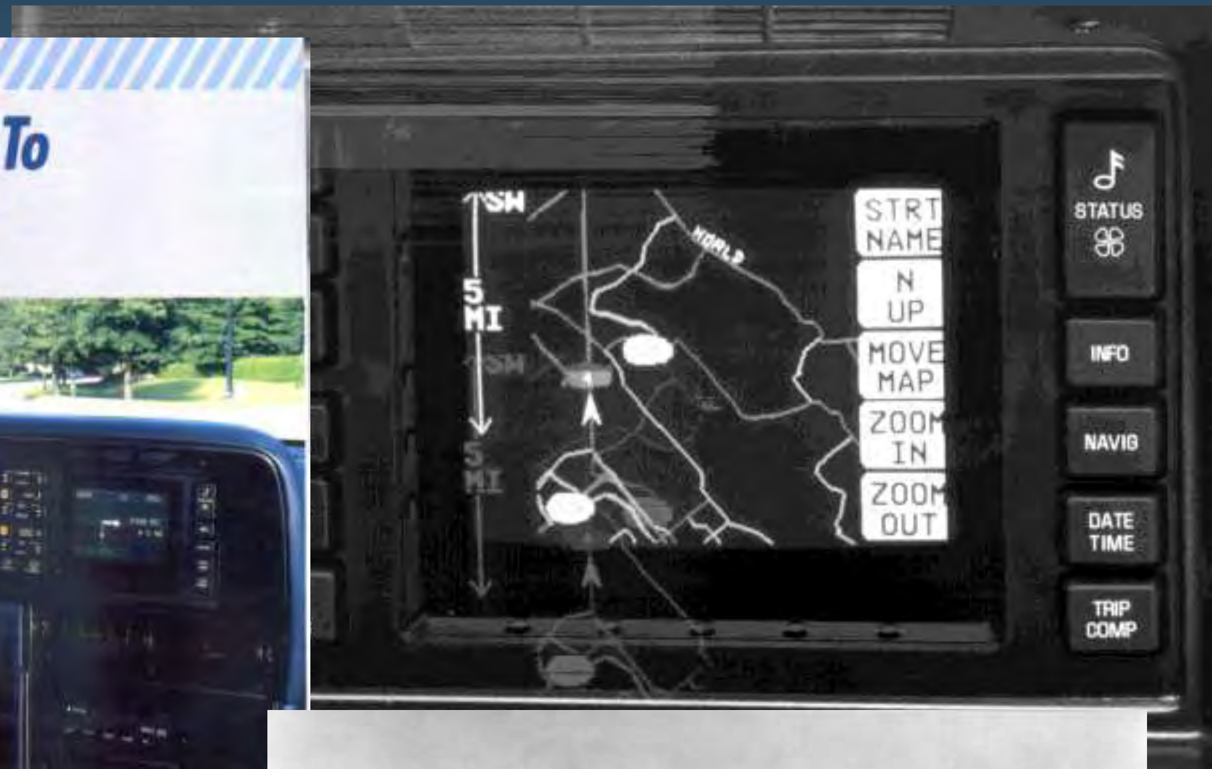
USGS/Census Effort – 100K coverage of conterminous US

Began 1983 – only 960/1823 quads available for digitizing

Completed 1987 – basis of TIGER and NHD

Lead to New Applications





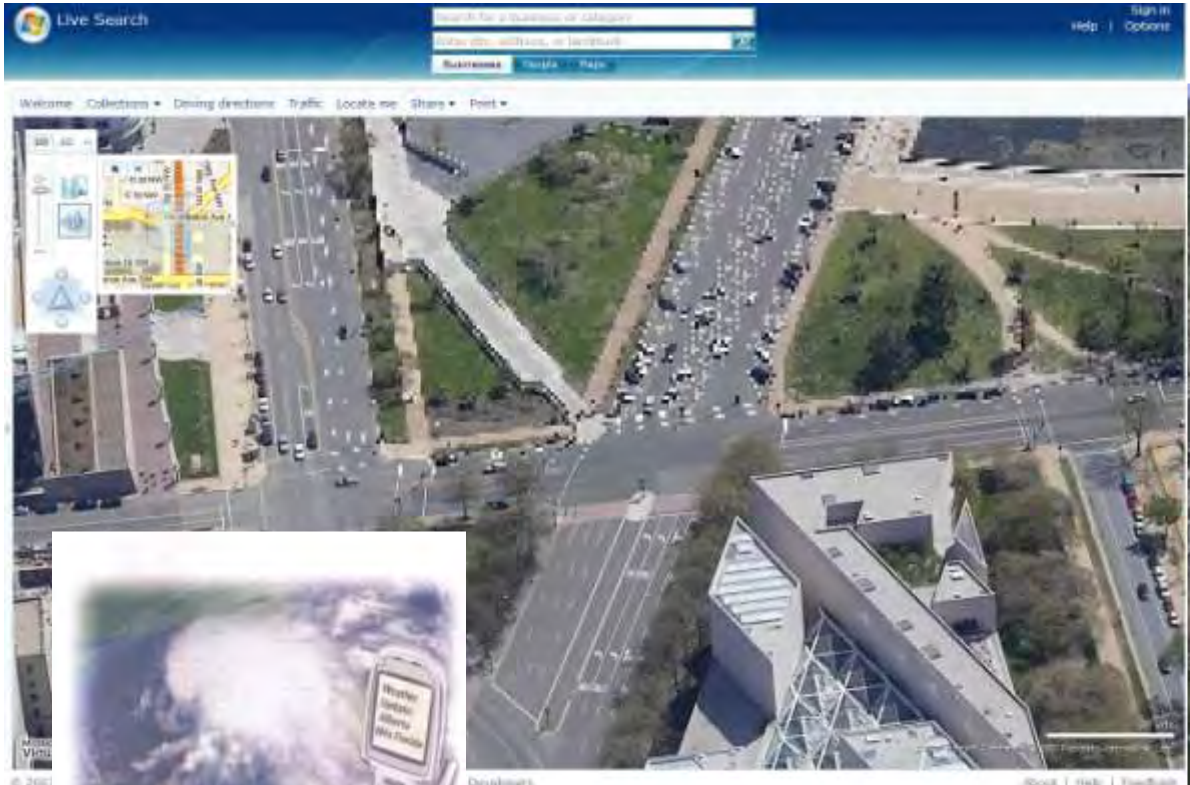
Geospatial Technology Moves From Palaces to Desktops and Beyond

Sun SPARCstation 1 – 1989 (Unix)

Motorola Cell Phone – 2007

Dell Workstation – 2005 (XP)

The Power of Maps (circa 2007)



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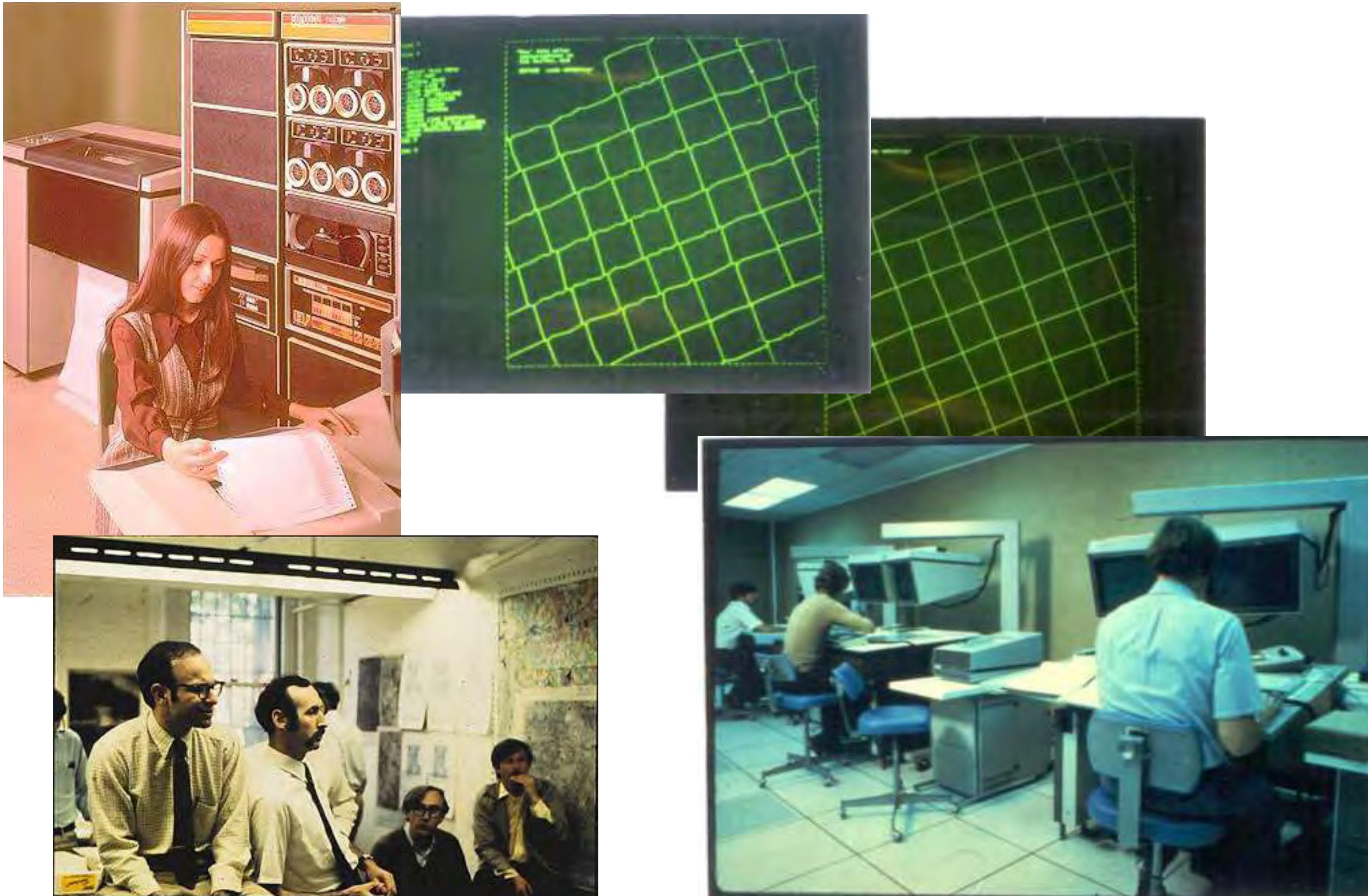
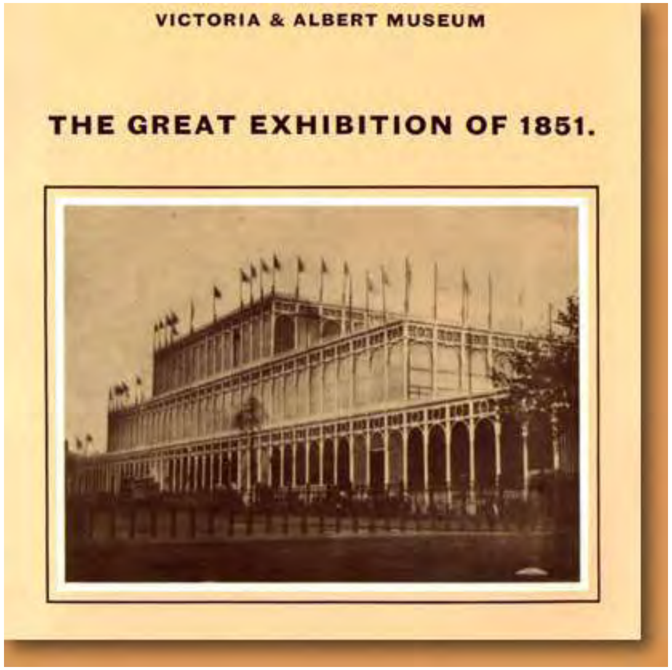


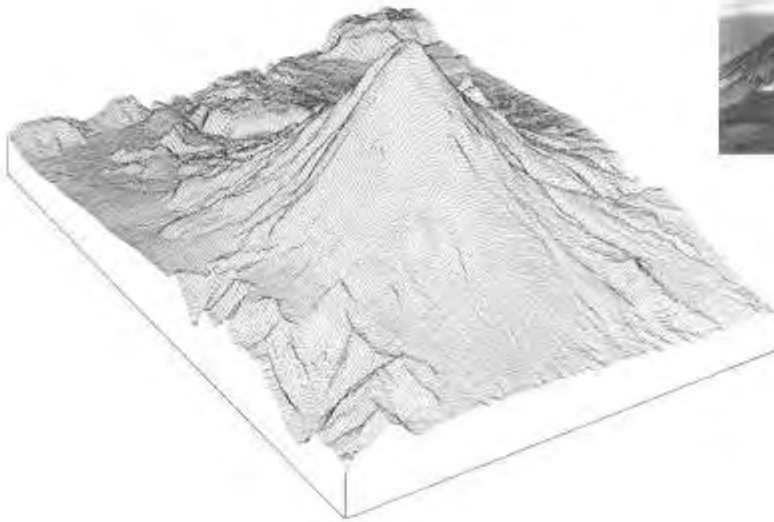
Crystal Palaces

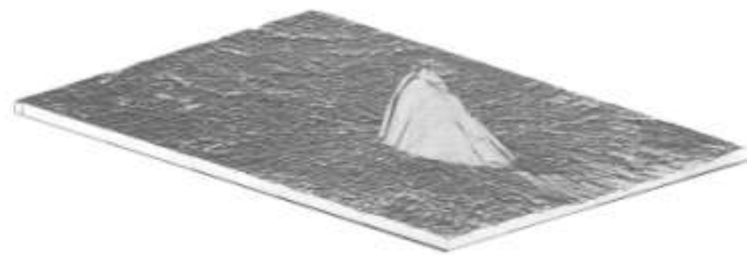


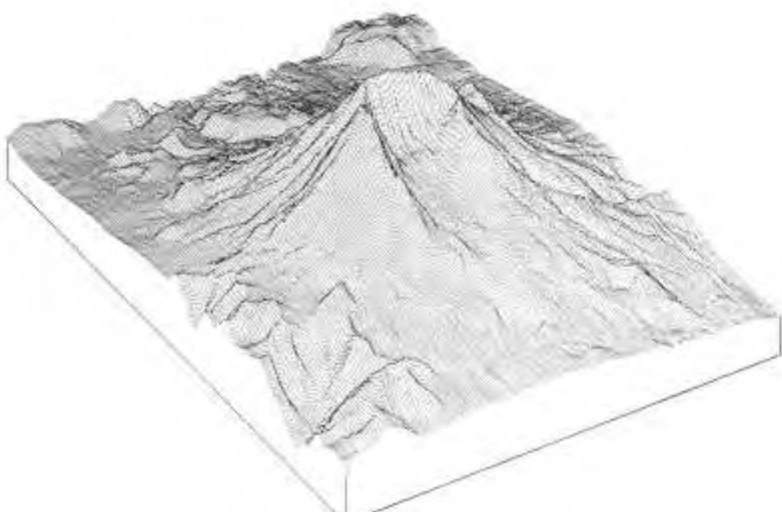
Crystal Palaces

Crystal Palaces

Creating new products…







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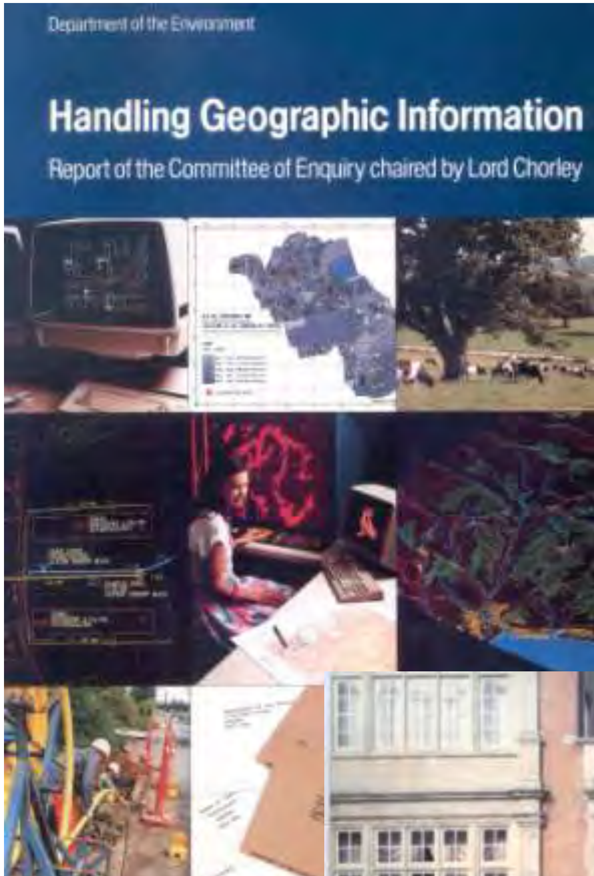
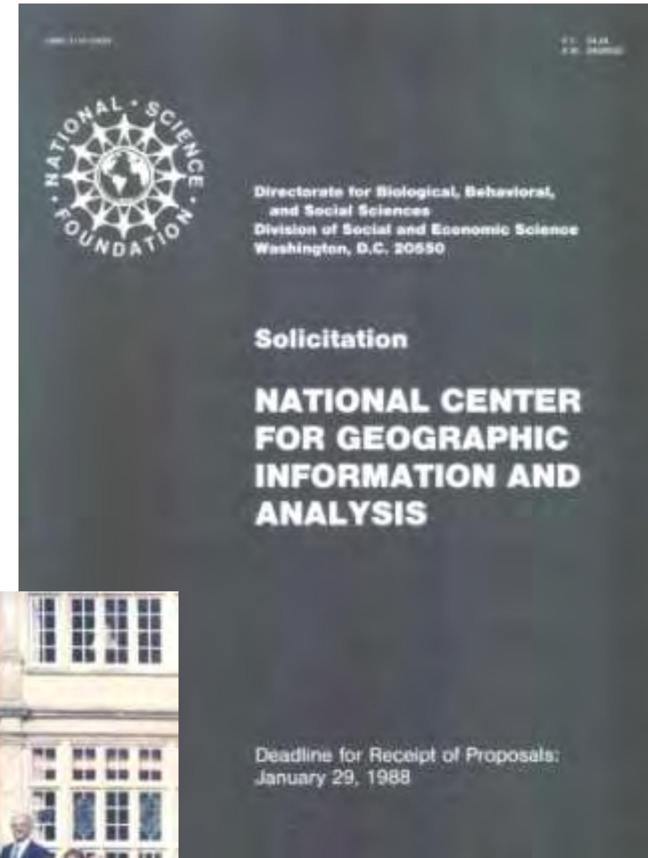
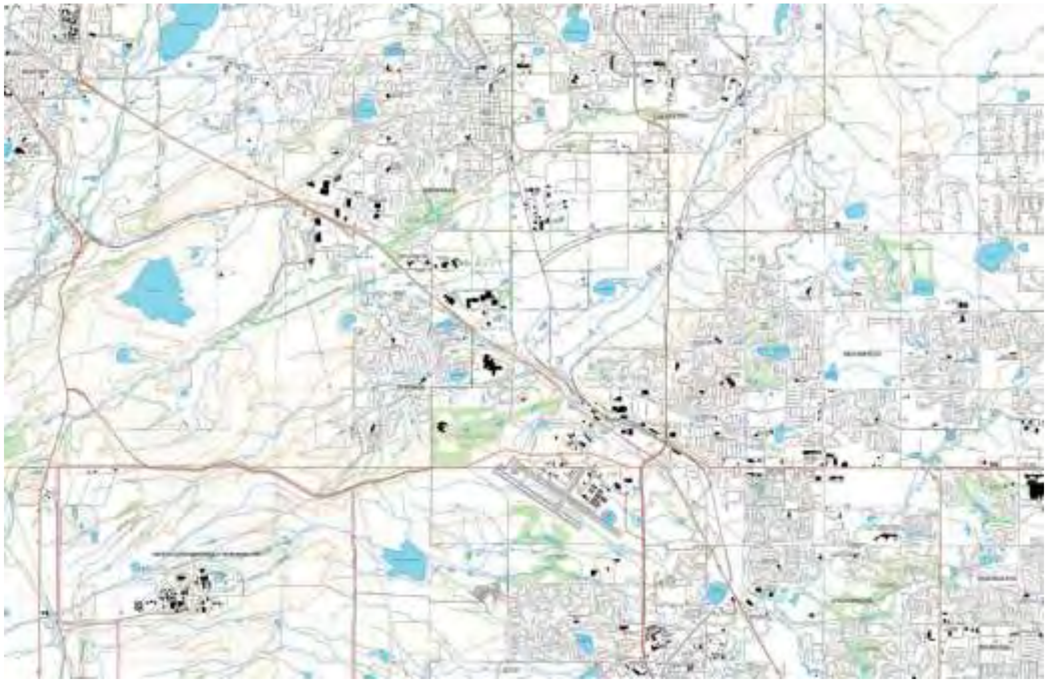
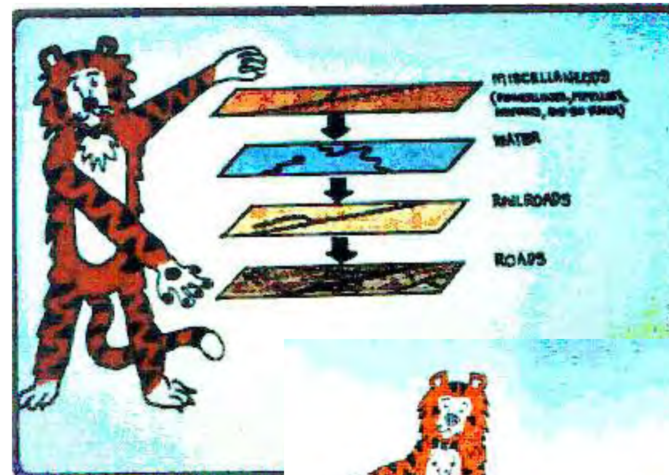
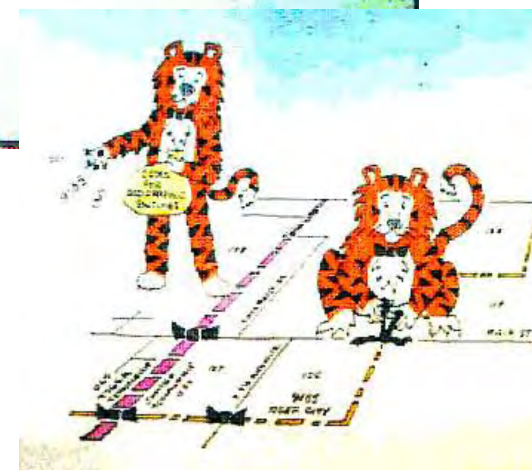




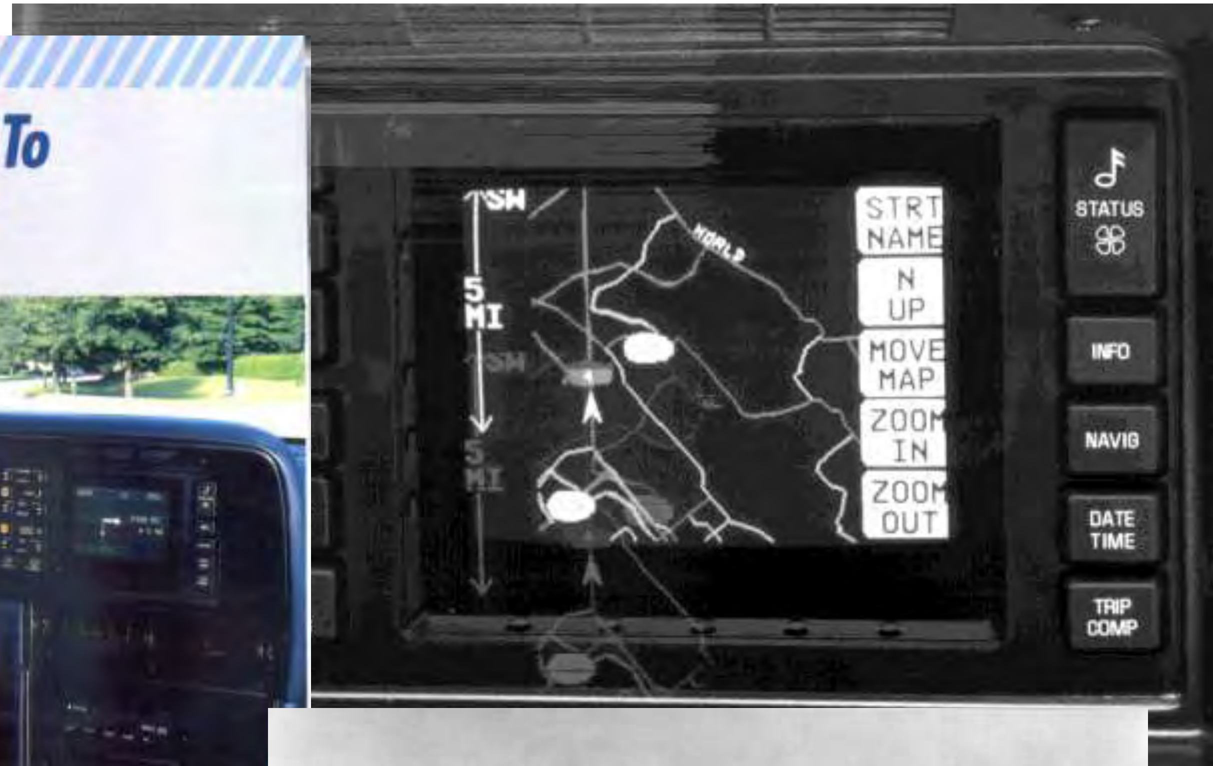
Triumphs





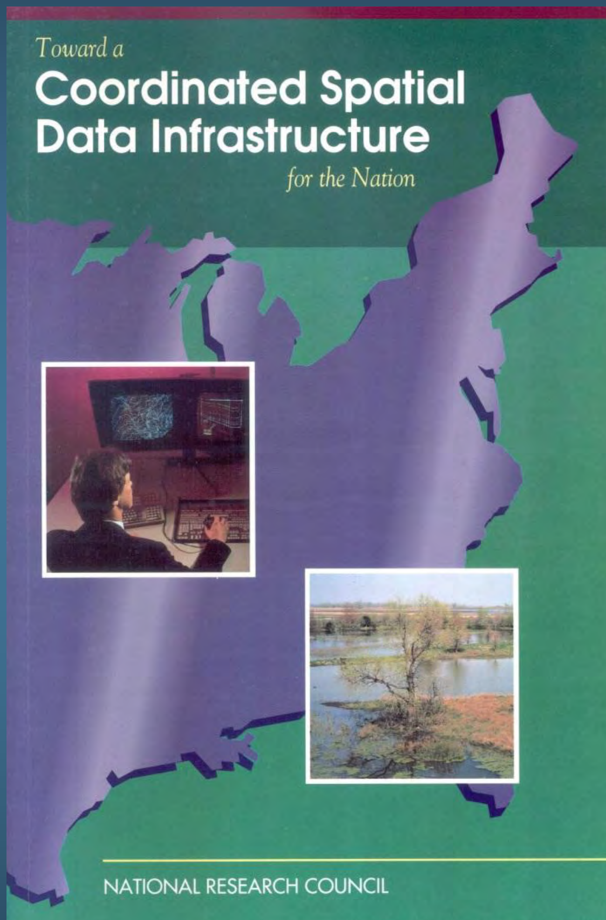


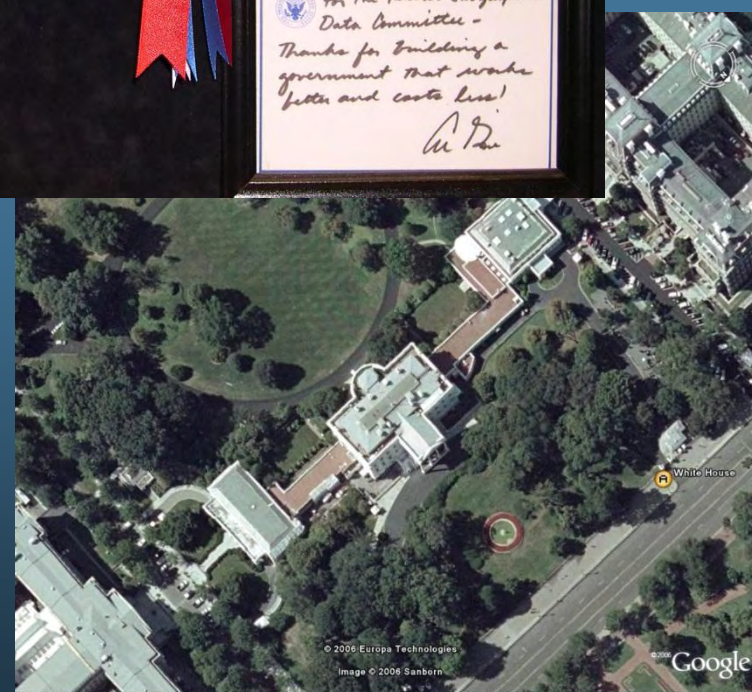
Lead to New Applications



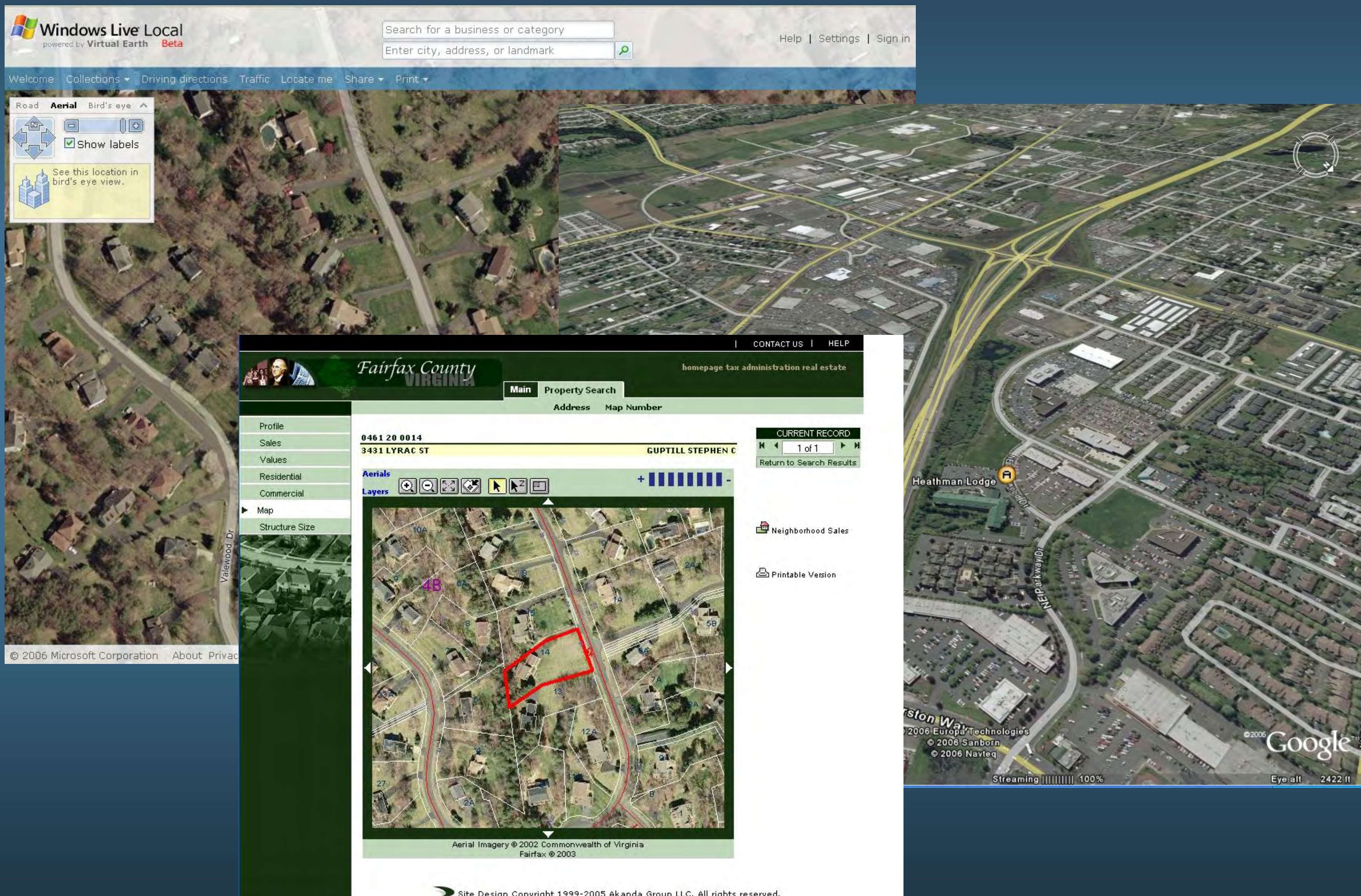
Geospatial Technology Moves From Palaces to Desktops and Beyond

As Technology Costs Decrease, New Paradigms for Data Production Emerge

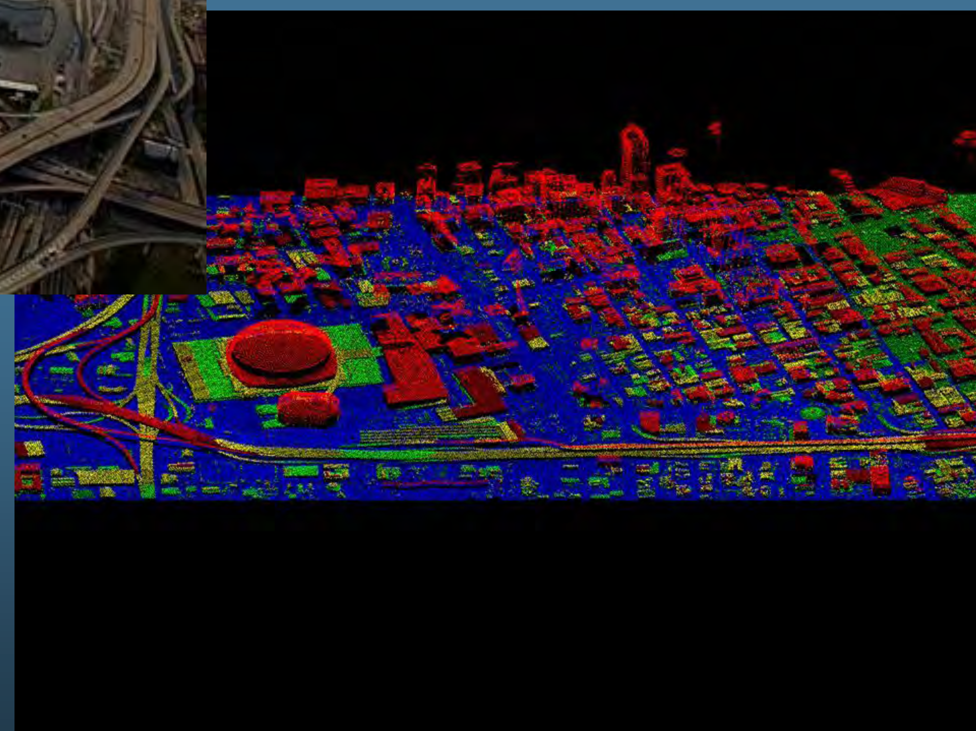




New Producers – New Applications

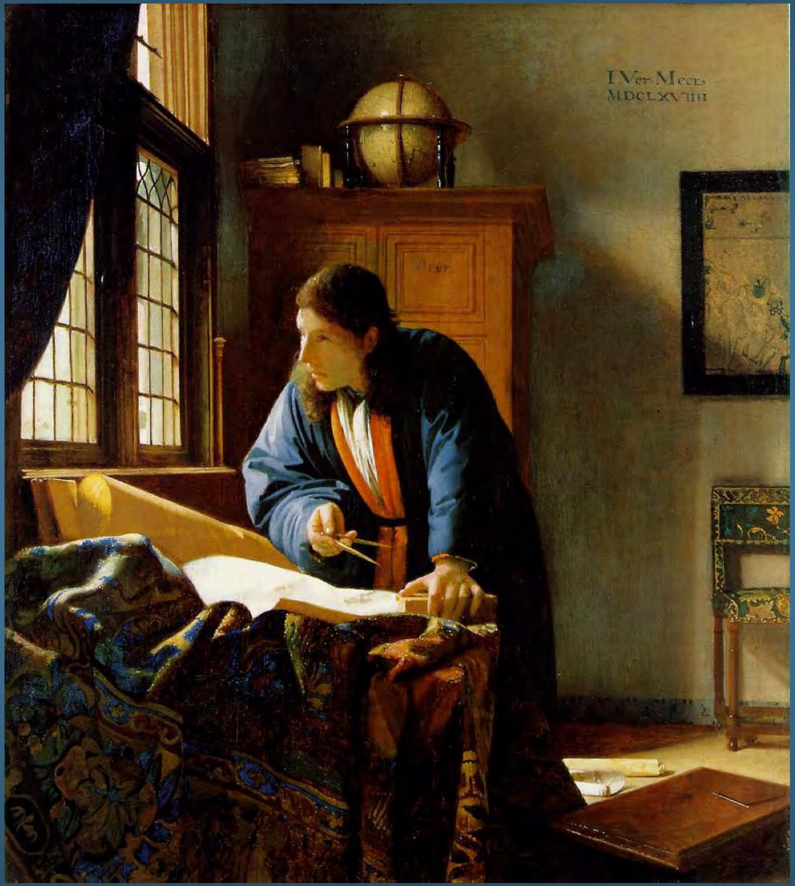


Abundant Geospatial Data – Progress or Chaos?



Conducting GIScience Investigations

- Define the Question
- Gather Information
- Form a Hypothesis
- Plan the Research
- Collect the Data
- Organize and Analyze the Data
- Draw Conclusions
- Communicate the Results



The Geographer – Johannes Vermeer, 1668

Institutional Memory is Encapsulated in the Characteristics of its Data

- In order to properly utilize data, details about its provenance must be well understood.
- This is true not only of current data sources but especially of archival data sets and longitudinal studies.
- Many factors go into determining the “fitness for use” of a dataset.

Land Use/Land Cover example

USGS
science for a changing world

USGS Home
Contact USGS
Search USGS

Long Term Archive

HOME | ABOUT | PRODUCTS | GET DATA | USER SERVICES

- Home
- About
- Products
- Get Data
- User Services

Home

Land Use and Land Cover (LULC)

Land Use and Land Cover (LULC) data consists of historical land use and land cover classification data that was based primarily on the manual interpretation of 1970's and 1980's aerial photography. Secondary sources included land use maps and surveys. There are 21 possible categories of cover type. Along with the LULC files, associated maps are included which provide additional information on political units, hydrologic units, census county subdivisions, and Federal and State land ownership.

LULC classification including political and census boundaries *(Spokane, WA)*

LULC data is available for the conterminous U.S. and Hawaii, but coverage is not complete for all areas. The data is based on 1:100,000- and 1:250,000-scale USGS topographic quadrangles.

All LULC files are cast to the Universal Transverse Mercator (UTM) projection, and referenced to the North American Datum of 1983 (NAD83). The files are available in GIRAS (Geographic Information Retrieval and Analysis System) or CTG (Composite Theme Grid) format.

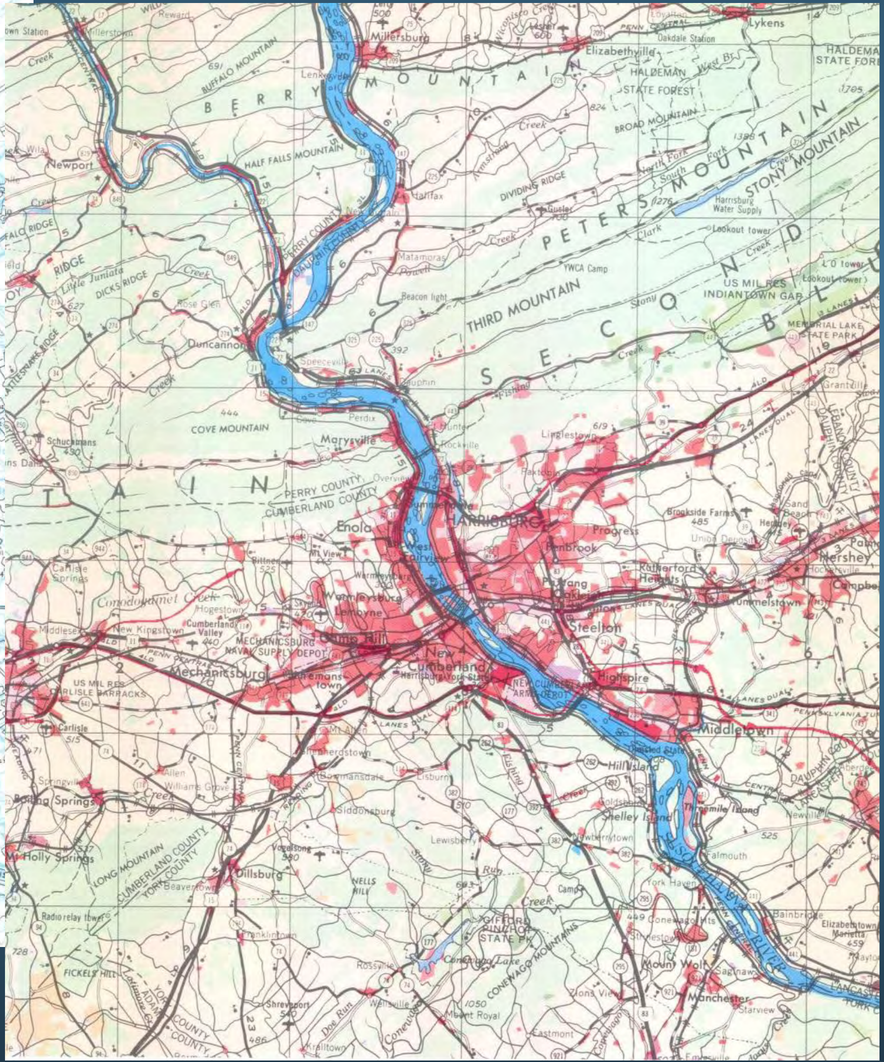
The spatial resolution for all LULC files will depend on the format and feature type. Files in GIRAS format will have a minimum polygon area of 10 acres (4 hectares) with a minimum width of 660 feet (200 meters) for manmade features. Non-urban or natural features have a minimum polygon area of 40 acres (16 hectares) with a minimum width of 1320 feet (400 meters). Files in CTG format will have a resolution of 30 meters.

All LULC data is available via FTP download only. LULC data in ArcInfo export format is also available from the EPA (1:250,000 scale only).

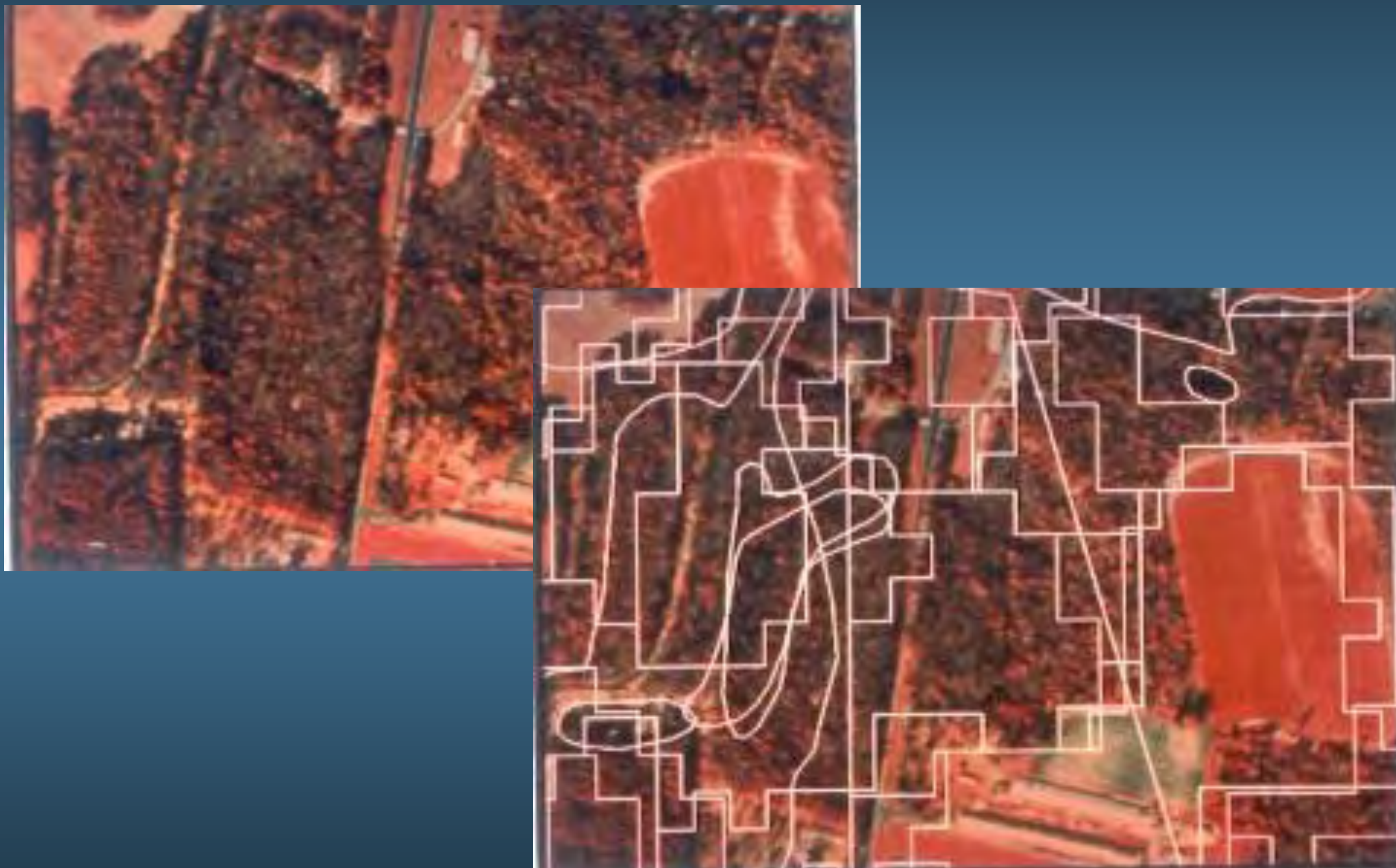
Product Info | Get Data | Policies | Help

All LULC data is available at no charge.

Anderson Level II LU/LC



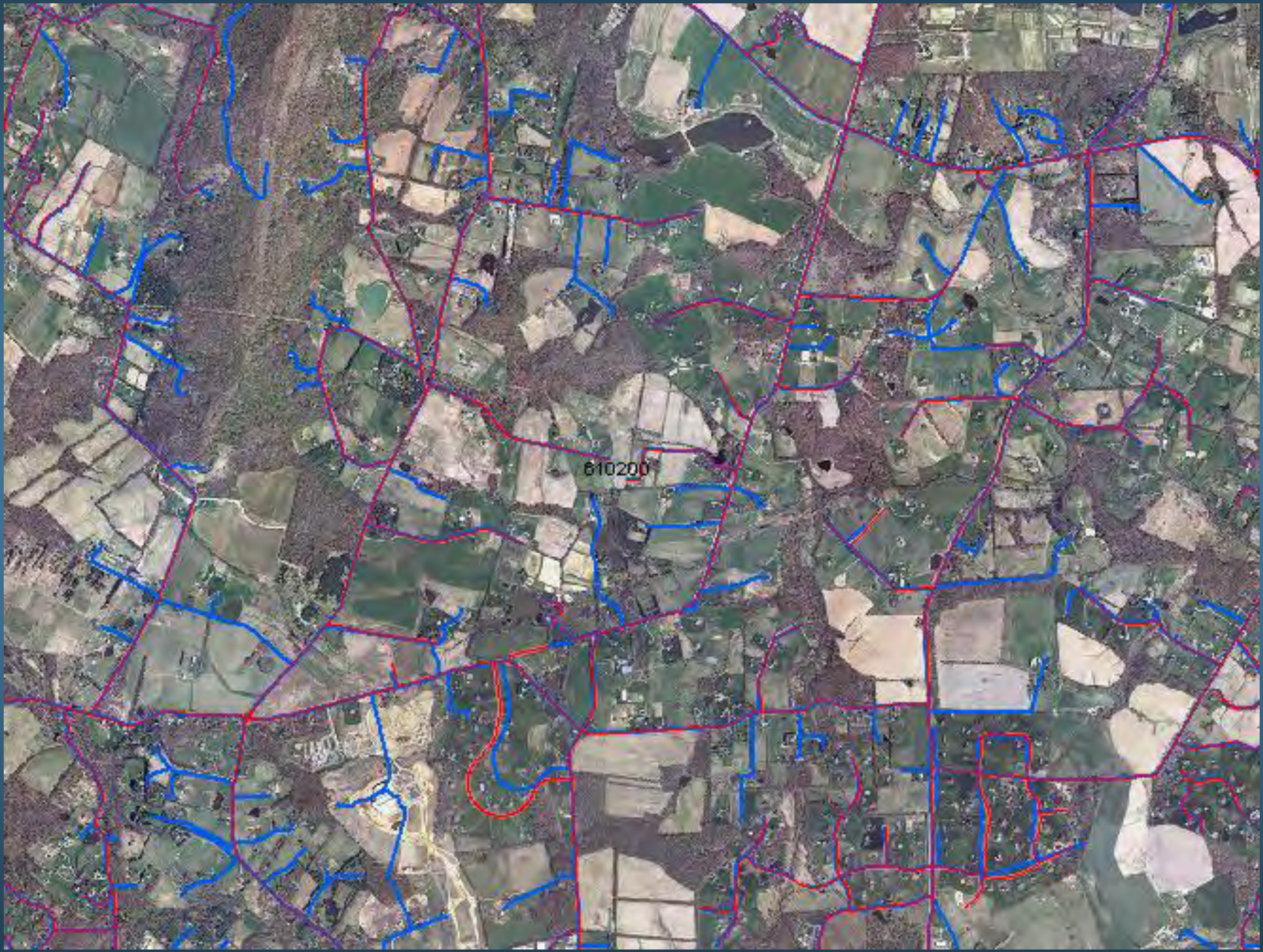
Wetlands Example



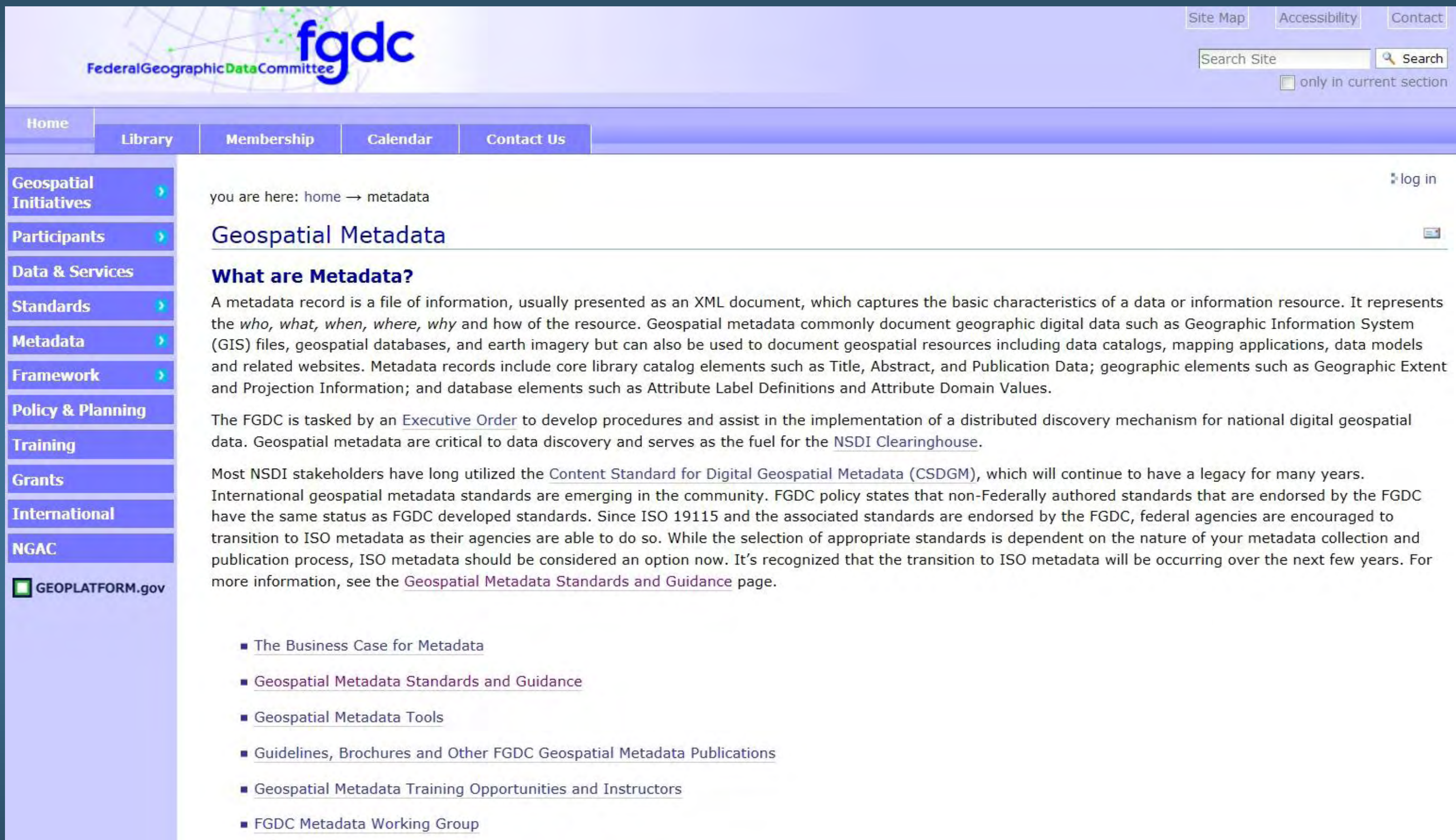
Wetlands Example

TIGER Roads and Loudoun Co. Roads

Roads missing in the local roads file (shown in red) which are present in TIGER (shown in blue). These roads appear to be mostly private driveways.



Metadata has the info – right?



FederalGeographicDataCommittee fgdc

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Geospatial Metadata

What are Metadata?

A metadata record is a file of information, usually presented as an XML document, which captures the basic characteristics of a data or information resource. It represents the *who, what, when, where, why* and how of the resource. Geospatial metadata commonly document geographic digital data such as Geographic Information System (GIS) files, geospatial databases, and earth imagery but can also be used to document geospatial resources including data catalogs, mapping applications, data models and related websites. Metadata records include core library catalog elements such as Title, Abstract, and Publication Data; geographic elements such as Geographic Extent and Projection Information; and database elements such as Attribute Label Definitions and Attribute Domain Values.

The FGDC is tasked by an Executive Order to develop procedures and assist in the implementation of a distributed discovery mechanism for national digital geospatial data. Geospatial metadata are critical to data discovery and serves as the fuel for the NSDI Clearinghouse.

Most NSDI stakeholders have long utilized the Content Standard for Digital Geospatial Metadata (CSDGM), which will continue to have a legacy for many years. International geospatial metadata standards are emerging in the community. FGDC policy states that non-Federally authored standards that are endorsed by the FGDC have the same status as FGDC developed standards. Since ISO 19115 and the associated standards are endorsed by the FGDC, federal agencies are encouraged to transition to ISO metadata as their agencies are able to do so. While the selection of appropriate standards is dependent on the nature of your metadata collection and publication process, ISO metadata should be considered an option now. It's recognized that the transition to ISO metadata will be occurring over the next few years. For more information, see the Geospatial Metadata Standards and Guidance page.

- The Business Case for Metadata
- Geospatial Metadata Standards and Guidance
- Geospatial Metadata Tools
- Guidelines, Brochures and Other FGDC Geospatial Metadata Publications
- Geospatial Metadata Training Opportunities and Instructors
- FGDC Metadata Working Group

A Futile Quest?

Full histories of data collection and processing methods need to be documented and associated with the datasets.

Without such information, any conclusions drawn from utilizing that data may not be scientifically sound.

However, all this takes time, costs money, and requires a long term commitment to the effort.

In today's society, these are all in short supply.

Sisyphus – Titian, 1549

Déjà Vu

Portolan Chart: Mateus Prunes, 1559


Questions, Comments?
sguptill@guptillgeoscience.com

Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment

Barry Wellar

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-14, 2015

Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment*

Dr. Barry Wellar
Owner and Principal, Wellar Consulting Inc.
President, Information Research Board Inc.
Professor Emeritus, University of Ottawa

***Slides for the
Research Colloquium on Using the Retrospective
Approach to Mine for GIS Nuggets***

Esri International Headquarters
Redlands, California
February 13-15, 2015

**Paper can be viewed at http://www.wellar.ca/wellarconsulting/home.html*

Summary of Mandate, Province of Ontario Oversight Agency: Environmental Commissioner of Ontario (ECO)

The Environmental Commissioner of Ontario (ECO) is tasked with monitoring and reporting on compliance with Ontario's *Environmental Bill of Rights,* and the government's success in reducing greenhouse gas emissions and achieving greater energy conservation. In addition, citizens can submit complaints to the ECO concerning environmental degradation and pollution.

General Finding from Examination of ECO Literature

Examination of annual reports and other productions reveal that ECO is a major source of information and suggestions about mining provincial government agencies for potential GIS nuggets involving GIS technology, GIScience methods, techniques and operations, and the uses of GIS technology and GIScience.

Presentation Structure

The three pillars of GIS retrospective research design are outlined, the role of ECO is summarized, and then ECO is discussed as a source of GIS nuggets, and as a source of intelligence about GIS nuggets resident in the policies, plans, programs, and operations of provincial agencies subject to oversight.

Figure 1. GIS Nuggets Defined

GIS nuggets are findings from the literature or other sources which serve three core, related missions:

M1. Designing and developing geographic information systems technology;

M2. Defining and elaborating geographic information science;

M3. Using geographic information systems technology and/or geographic information science.

Table 1. Illustrative nuggets derived from using the retrospective approach to examine “the Literature”

1. New or different reasons to add to GIS technology
2. New or different ways to add to GIS technology
3. New or different reasons to add to geospatial data
4. New or different reasons to add to geospatial information
5. New or different reasons to add to geospatial knowledge
6. New or different ways to add to geospatial data
7. New or different ways to add to geospatial information
8. New or different ways to add to geospatial knowledge
9. New or different uses of GIS technology
10. New or different uses of geospatial data
11. New or different uses of geospatial information
12. New or different uses of geospatial knowledge
13. New or different uses of GIScience research methods
14. New or different uses of GIScience research techniques
15. New or different uses of GIScience research operations

Table 2. Bodies of literature and other productions to mine for GIS nuggets

1. Corporate/Institutional-Private Literature
2. Corporate/Institutional-Public Literature
3. Learned Literature
4. Legal Literature
5. Oversight Agency Literature
6. Popular (Media) Literature
7. Professional Literature
8. Public Interest Literature
9. Regulatory Agency Literature
10. Special Interest Literature
11. Vested Interest Literature
12. Other Productions

Why Oversight Agency Literature?

Research into oversight agencies in Canada and other countries reveals that the mandates of a number of them extend over many aspects of the natural and built environments. The reports of these agencies contain abundant geographic data, geographic information, and/or geographic knowledge about their respective jurisdictions, and the literature of oversight agencies is therefore a prime body of material to mine for GIS nuggets.

Provincial-Municipal Government Relations

Local governments are creatures of the provinces in Canada. As a result, provincial governments directly affect local government functions such as: land use planning and development; environmental protection; water and wastewater treatment; infrastructure maintenance and expansion; quarrying; preservation of open space; transportation networks involving major roads; transit; freight rail and passenger service; subdivision planning approvals; waste disposal; intensification; densification; sprawl; land zoning and/or rezoning; and energy sources and distribution systems..

Scope of Provincial Oversight Agencies

First and foremost, their monitoring, reporting, and other tasks apply directly to provincial agencies.

However, because provincial policies, plans, programs, and "political decisions" impact on local governments, oversight agencies similar to ECO by definition are obliged to broaden or extend their scope to include what is happening or not happening within the geographical boundaries of local governments across the respective provinces.

Provincial Oversight Agencies and Vertical and Horizontal Information Flow Issues

How provincial governments deal with achieving horizontal information flows within agencies, and vertical information flows involving local governments, is a computer-based information systems issue with a history that began more than 50 years ago.

The addition of oversight agencies to the body of provincial agencies creates issues and questions about how geographic data, GIS technology, and GIScience methods, techniques, and operations are used by provincial oversight bodies to examine what provincial agencies are doing in regard to environmental matters.

Issues and questions also arise about how geographic data, GIS technology, and GIScience methods, techniques, and operations are used to carry out the mandates, duties, obligations, etc., of any provincial agency that involve local governments in the task of implementing, delivering, enforcing, etc., provincial legislation, policies, programs, plans, or other instruments of provincial governance.

Comments on ECO Materials

Exhibit 1 provides the basic terms of reference for ECO activities. Italics are used in the remainder of the paper to identify materials produced by ECO.

Exhibit 1. Statement Describing the Environment Commissioner of Ontario (ECO)

The ECO [often referred to as Ontario's "environmental watchdog," reports to the Legislative Assembly – not to a political party or to a ministry]:

- *Monitors and reports annually on Ontario environmental issues and government compliance with the Environmental Bill of Rights (EBR).*
- *Monitors and reports annually on the government's success in reducing greenhouse gas emissions and in achieving greater energy conservation in Ontario.*
- *Periodically produces Special Reports.*
- *Helps you use and understand your rights under the EBR.*
- *Serves as a clearinghouse for Applications for Review and Applications for Investigation made under the EBR.*
- *Helps you access the Environmental Registry, which gives you information about the environmentally significant proposals and decisions made by Ontario ministries.*
- *Supports a resource centre reference library, which features a large and growing collection of environmental resource materials.*

Comment on Exhibit 1

The ’“watchdog” role of the ECO is illustrated by the functions in Exhibit 1, and the pertinence of ECO to the task of mining for GIS nuggets is demonstrated by the scope of ECO Reports revealed in Exhibit 2.

Exhibit 2. ECO Issues: A Searchable Database for Reports of the Environmental Commissioner of Ontario (ECO)

Aggregate Resources Act	Planning Act
Climate Change Policies in Ontario	Protected Areas
Energy	Provincial Policy Statement
Environmental Assessment Act	Species At Risk
Biodiversity in Ontario	Transportation
Green Energy Act	Water Quality
Land Use Planning	Wetlands
Northern Ontario	Great Lakes
Waste Management	Forestry
Oak Ridges Moraine Conservation Act	Air Quality
Ontario Municipal Board	

Comment on Exhibit 2

As revealed by even a cursory examination of materials, there is a geographical aspect to all the database categories. Therefore, each category is a candidate to be mined for GIS nuggets which serve one or more of the core missions identified in Figure 1.

Methodology for Mining ECO Reports in Search of GIS Nuggets: A *Caveat*

Oversight agencies are technically sophisticated operations, and readers are referred to the paper for detailed suggestions on how to mine ECO materials. One important design feature which warrants mentioning here for mindset purposes is to start with the latest ECO finding, warning, etc., of interest, and track the item of interest back from present or recent reports to prior reports.

Comments on Exhibits from Environmental Commissioner of Ontario Reports

The following slides are intended for colloquium discussion purposes. Readers are referred to the paper for details. For the convenience of the reader, materials from the ECO are in italics.

Exhibit 3. Aggregate Resources Act

Background

The Ministry of Natural Resources (MNR) has overall responsibility for managing aggregates under the Aggregate Resources Act (ARA). Despite an array of laws, regulations, policies and approvals that outline requirements for planning, permitting and managing aggregate operations, the ECO and others have raised a number of concerns including ….:

Source:
http://www.ecoissues.ca/index.php?title=Category:Aggregate_Resources_Act

Comment 1 on Exhibit 3

Four of the six concerns identified by the ECO –

- ❖ siting of aggregate operations near urbanized areas and sensitive natural areas;
- ❖ a low rate of rehabilitation of pits and quarries;
- ❖ inadequate long-term planning; and
- ❖ the geographic scope of the *ARA* –

have <u>explicit</u> geographic implications, and the two other concerns –

- ❖ a lack of capacity at MNR to fulfil its obligations; and
- ❖ a lack of compliance with approvals by aggregate producers and enforcement of approvals by the province –

could be directly related to limitations/failures by MNR in the use made of GIS technology and GIScience.

Comment 2 on Exhibit 3

These concerns were previously identified in the mid-1990s by the ECO, and again in the 2002/2003 Annual Report, so about 20 years have gone by without corrective action being taken. Among the questions that arise as a result of failed corrective action are those regarding the role that geo-based decision support systems played, could have played, or should have played in this matter.

Exhibit 4. Geographic Scope of the ARA

Although aggregate operations throughout southern Ontario are subject to the ARA, aggregate operations in only very limited areas of northern Ontario are subject to the ARA MNR's handling of these concerns was described in our 2004/2005 Annual Report, Planning our Landscape.

Comment on Exhibit 4

The logic behind different regimes being employed by MNR in applying the Aggregate Resources Act in southern Ontario versus northern Ontario is problematic, and is cause for questioning why this is the case. When it comes to mining for GIS nuggets, questions arise as to why advances in the availability of spatial data, the capabilities of GIS technology, and the robustness of GIScience were not sufficient to bring about equitable regulation of aggregate extraction throughout the province.

Exhibit 5A. Land Use Planning in Ontario, Primer and Recommendations of the Environmental Commissioner of Ontario

The existing "development-first, environment-second" approach to planning has spawned a confusing mix of legislation and provincial plans. Rather than viewing an ecological feature, such as a provincially significant wetland, as being important enough to protect no matter where it is situated in the province, the PPS requires that separate rules be applied depending on its location. The result is that the same type of natural area will receive different treatment depending on whether it lies on specific parts of the Niagara Escarpment, in the Greenbelt, on the Oak Ridges Moraine, in the Lake Simcoe watershed, in southern Ontario or in northern Ontario.

Comment on Exhibit 5A

Exhibit 5 refers to selective, spatial bias on the part of all the agencies, Government of Ontario, that have engaged in arbitrary and discriminatory decision-making based on location. A standard principle of good planning is to avoid discrimination when supporting or opposing planning or zoning amendment applications, and the principle is violated by the Government of Ontario if it arbitrarily uses location as a driving policy or program variable. Mining this vein has the potential to yield very, very significant GIS nuggets which inform about political interests dictating public policy.

Exhibit 5B. Land Use Planning in Ontario, Primer and Recommendations of the Environmental Commissioner of Ontario

Working with MNR and MOE, MMAH has prepared a series of 17 technical papers that represent the Ontario government's approach to implementation of plan policies

Comment on Exhibit 5B

The 17 reports would have been prepared by and/or supervised by professionals, including professional planners and engineers, and, possibly, GIS professionals. Given, therefore, that there is a spatial aspect to each and every one of the report topics, and that the technical reports are classifiable as professional productions, it follows that GIScience supported by GIS technology would have been integral to the preparation of all the reports.

Mining the current reports will no doubt yield an abundance of GIS nuggets, with many more to be found when the spatial contents of these reports are updated (using GIScience and GIS technology) as baselines, and as points of reference for future analysis, synthesis, and subsequent reports.

Exhibit 6A. ECO Recommendations on Land Use Planning

The ECO recommends that the Ministries of Municipal Affairs and Housing and Natural Resources develop performance indicators for natural heritage protection under the Provincial Policy Statement and provide their findings to the public.

Comment on Exhibit 6A

Designing and developing performance indicators with a spatial basis is of critical importance to the advancement of GIScience methodology, and to the use of GIScience and GIS technology. Mining materials associated with this ECO recommendation could yield a number of M2 and M3 GIS nuggets for organizations and individuals with an interest in performance indicators, as well as in success indicators, disruptive indicators, and distribution indicators used in policy formation and evaluation.

Exhibit 6B. ECO Recommendations on Land Use Planning

The ECO recommends that the Ministries of Municipal Affairs and Housing, Natural Resources, and Environment and Energy begin planning and implementing the promised systems for monitoring and evaluating the Oak Ridges Moraine Conservation Plan. (p. 47)

Comment on Exhibit 6B

Materials from most if not all of the 17 technical reports are likely incorporated in the *“promised systems for monitoring and evaluating”*, which points to an excellent source to mine for M1, M2, and M3 GIS nuggets.

Exhibit 6C. ECO Recommendations on Land Use Planning

The ECO recommends that MMAH undertake public consultation on the government’s population growth modeling and projections in order to provide a transparent context for land use planning decisions. (p. 47)

Comment on Exhibit 6C

The spatial aspect of the Oak Ridges Moraine Conservation Plan means, by definition, that spatial data, GIScience, and GIS technology are part of the *“population growth modeling and projections”* design activity, which points to a high potential for GIS nuggets when the recommendation is acted upon.

Exhibit 6D. ECO Recommendations on Land Use Planning

The ECO recommends that MMAH work with the Ministry of Public Infrastructure Renewal (now the Ministry of Infrastructure) to increase the GGH Plan's intensification and density targets above existing business-as-usual development targets. (p. 48)

Comment on Exhibit 6D

Both density and intensification concepts are based on spatial considerations, so any action on this recommendation points to GIS nuggets.

Exhibit 6E. ECO Recommendations on Land Use Planning

The ECO recommends that MNR significantly speed up the process of wetland identification and evaluation and ensure that Provincially Significant Wetlands are incorporated into municipal official plans. (p. 48)

Comment on Exhibit 6E

Methodologically-based action on this recommendation would involve retrospectively tracking research that goes back 30 or 40 or more years, as illustrated in the Doomsday Map publications. The response to the recommendation would of necessity be GIS-based and GIScience-driven. Again, we appear to be in mother lode territory with regard to mining for GIS nuggets.

Exhibit 6F. ECO Recommendations on Land Use Planning

The ECO recommends that MMAH amend the Provincial Policy Statement to prohibit new infrastructure such as highways in Provincially Significant Wetlands unless there are no reasonable alternatives and it has been demonstrated that there will be no negative impacts on their ecological functions. (p. 48)

Comment on Exhibit 6F

The stipulation, *"it has been demonstrated that there will be no negative impacts on their ecological functions"* is preceded by a body of impact assessment literature with a history of more than 40 years. How MMAH (Ministry of Municipal Affairs and Housing) incorporates GIScience and GIS technology in demonstrating impacts would undoubtedly be a body of demonstration material worth deep, intensive mining for M1, M2, and M3 types of GIS nuggets.

Exhibit 6G. ECO Recommendations on Land Use Planning

The ECO recommends that MNR, in association with Conservation Ontario, review and update floodplain maps in Ontario in order to adapt them to impacts from climate change. (p. 49)

Comment on Exhibit 6G

Issues involving geospatial data, GIS technology, and GIScience methods, techniques, and operations are central to the review and update of floodplain maps, the design and implementation of the situation review and map update processes, as well as the field work aspect. This recommendation by the ECO has the potential to become a mother lode of M1, M2, and M3 GIS nuggets for years to come.

General Findings about ECO Reports

Reports by the Environmental Commissioner of Ontario (ECO) are prime oversight agency productions to mine for GIS nuggets, and are significant sources of intelligence about reports of other Government of Ontario agencies which are likely sources of GIS nuggets serving GIS technology, GIScience, and the uses of GIS and GIScience.

Recommendations

All productions of the Environment commissioner of Ontario warrant being mined for GIS nuggets serving GIS technology, GIScience, and the uses of GIS and GIScience.

Acknowledgements

Advice given by William L. Garrison, Professor Emeritus of Civil and Environmental Engineering, and Emeritus Research Engineer in the Institute of Transportation Studies, University of California, Berkeley, and by Gordon Plunkett, Director, Spatial Data Infrastructure, Esri Canada, in creating the colloquium paper from which the slides are derived is gratefully acknowledged. I also wish to acknowledge the slide preparation assistance of Sam Herold, Technical Advisor, Information Research Board Inc.

Extracting Nuggets – Data Quality and Metadata

Nick Chrisman

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-14, 2015

Extracting Nuggets

Data Quality and Metadata

Nicholas Chrisman

Independent Scholar

Bellingham WA

Motivation

- AUTO-CARTO 6: Chrisman talks about *“The role of Data Quality in the long-term functioning of GIS”*
  - **After 40 years, it may be getting long-term sometime soon…**

Something failed

- Plans for data discovery
  - Data quality reports
  - Metadata on sources
- Current realities

Sad truth

- Clearinghouses abound
  - Filled with
    - empty fields *(even for required elements)*
    - incomplete metadata
    - miserable data quality reporting

Was it just a dream?

- 1980s, long exhausting road to standards
  - NCDCDS => SDTS
  - Metadata Content Standard
- led to OGC, TC211, ISO

Some (modest) accomplishment

- National Mapping agencies in the era used fixed thresholds
  - certain were on their way to fix those thresholds in digital form (somehow)
- 1980s process adopted principles of fitness for use

Where is metadata best adopted?

- In the crowdsource sector (OSM)
  - metadata taken seriously, part of the job
  - photos in the field to validate

Nugget? Lessons?

- Implementation matters.
- You can lead a horse to water, but you can't make it drink…
  - Lacking an incentive for adoption

Conclusion

- History is written by the winners
- Good ideas do not always prevail
- Can’t remain stuck on one implementation, remain flexible...

It's a long process

Toward Los Angeles; Dorothea Lange, 1937

Revisiting Classical Land Classification, Assessment, and Management Literature to Inform GIS Research

Michael DeMers

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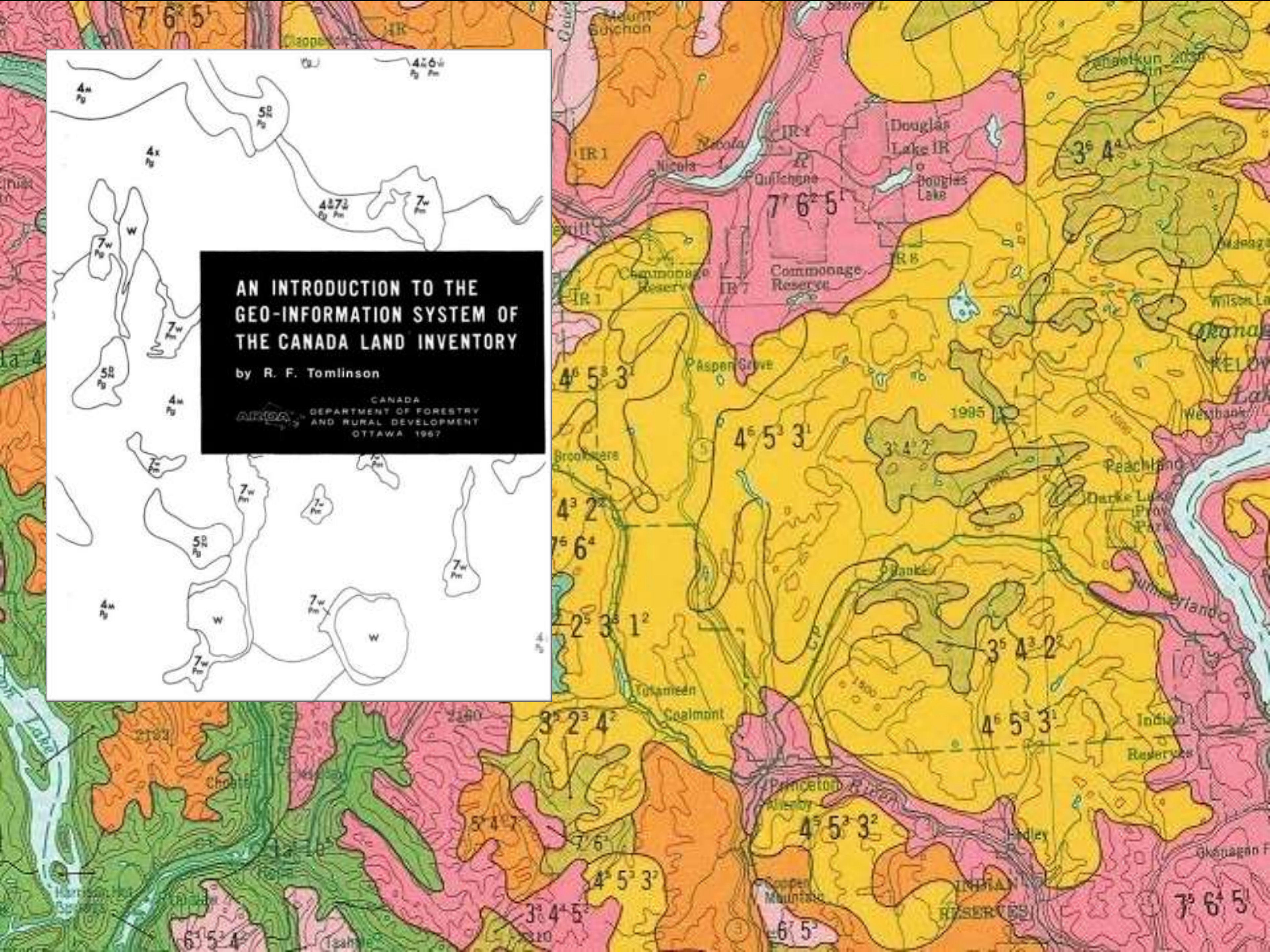
Revisiting Classical Land Classification, Assessment, and Management Literature to Inform GIS Research

Michael N. DeMers

Introduction


geographic
base file system--
uses, maintenance,
problem solving
conference proceedings
U.S. DEPARTMENT OF COMMERCE
Spatial data
in relational tables
Attributes in
relational tables
Polygon Attribute Table
Arc Attribute Table
Point Attribute Table
Arc
Label
point
OutPutMap
InputMap
OutPutMap
InputMaps
Arc Topology
Arc | Start Node | End Node | Left Polygon | Right Polygon
a1 | N1 | N2 | D | A
a2 | N2 | N3 | D | B
a3 | N3 | N1 | D | C
a4 | N1 | N4 | A | C
a5 | N4 | N2 | A | B
a6 | N3 | N4 | C | B
Polygon Topology
Polygon | Arcs
A | a1, a4, a5
B | a2, a5, a6
C | a3, a4, a6
D | outside study area
Node Topology
Node | Arcs
N1 | a1, a3, a4
N2 | a1, a2, a5
N3 | a2, a3, a6



AN INTRODUCTION TO THE GEO-INFORMATION SYSTEM OF THE CANADA LAND INVENTORY

by R. F. Tomlinson

ARDA

CANADA
DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT
OTTAWA 1967

Morton Matrix

	85	87	93	95	117	119	125	127	213	215	221	223	245	247	253	255
	84	86	92	94	116	118	124	126	212	214	220	222	244	246	252	254
	81	83	89	91	113	115	121	123	209	211	217	219	241	243	249	251
	80	82	88	90	112	114	120	122	208	210	216	218	240	242	248	250
	69	71	77	79	101	103	109	111	197	199	205	207	229	231	237	239
	68	70	76	78	100	102	108	110	196	198	204	206	228	230	236	238
	65	67	73	75	97	99	105	107	193	195	201	203	225	227	233	235
	64	66	72	74	96	98	104	106	192	194	200	202	224	226	232	234
111	21	23	29	31	53	55	61	63	149	151	157	159	181	183	189	191
↑ 110	20	22	28	30	52	54	60	62	148	150	156	158	180	182	188	190
101	17	19	25	27	49	51	57	59	145	147	153	155	177	179	185	187
Y 100	16	18	24	26	48	50	56	58	144	146	152	154	176	178	184	186
3 011	5 0101	7 0111	13 1101	15 1111	37	39	45	47	122	135	141	143	165	167	173	175
2 010	4 0100	6 0110	12 1100	14 1110	36	38	44	46	132	134	140	142	164	166	172	174
1 001	1 0001	3 0011	9 1001	11 1011	33	35	41	43	129	131	137	139	161	163	169	171
0 000	0 0000	2 0010	8 1000	10 1010	32	34	40	42	128	130	136	138	160	162	168	170
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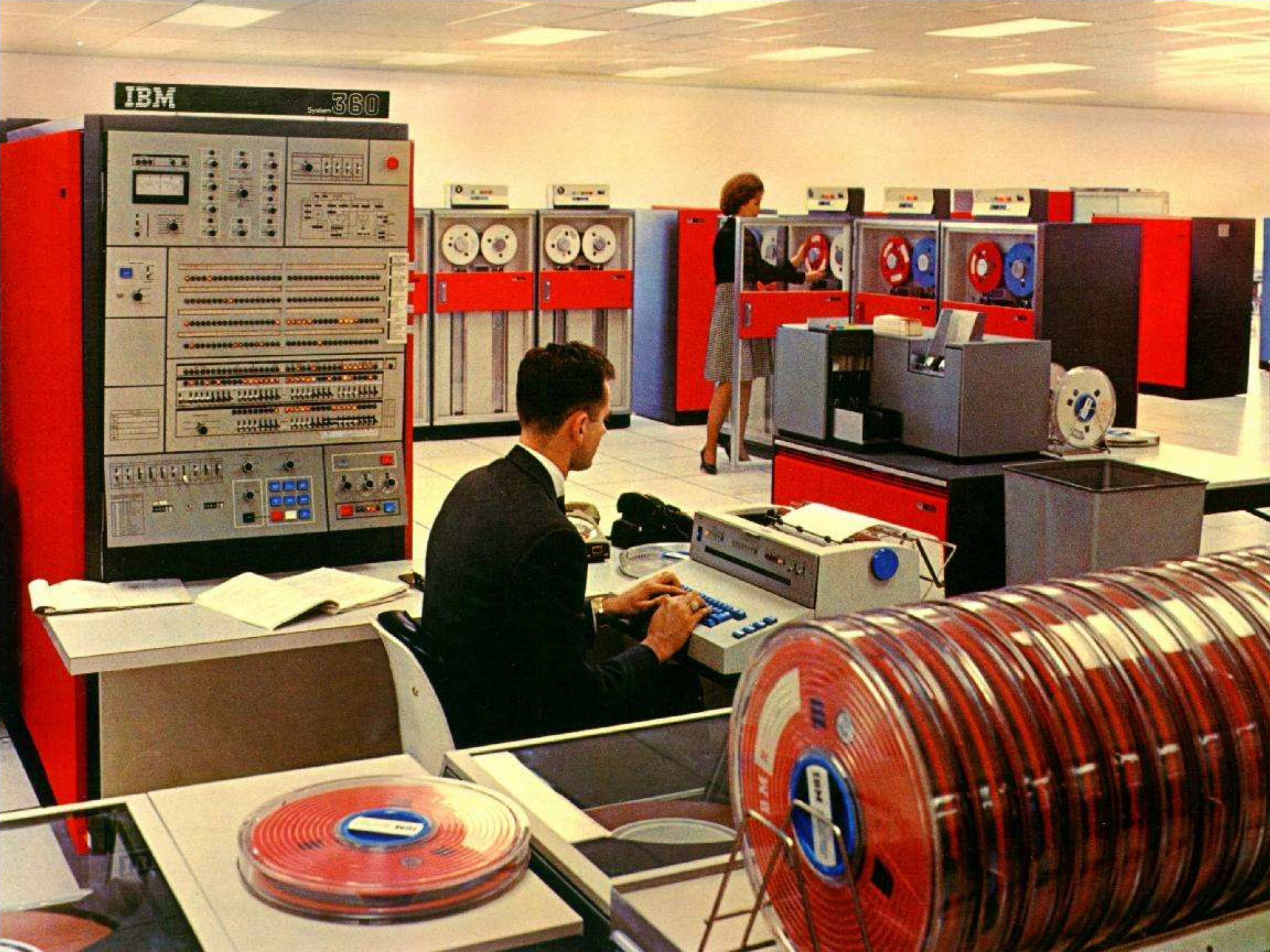
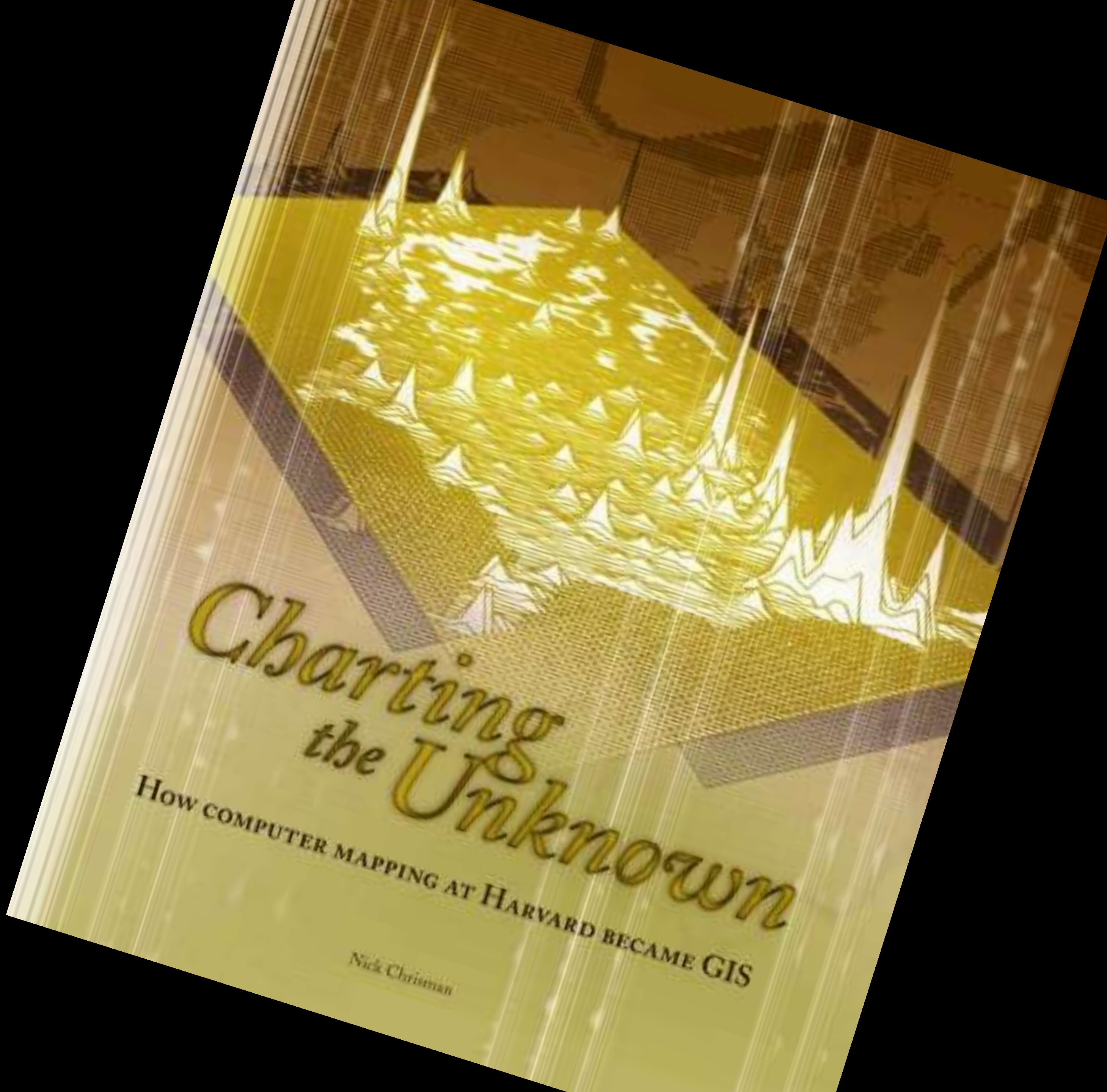
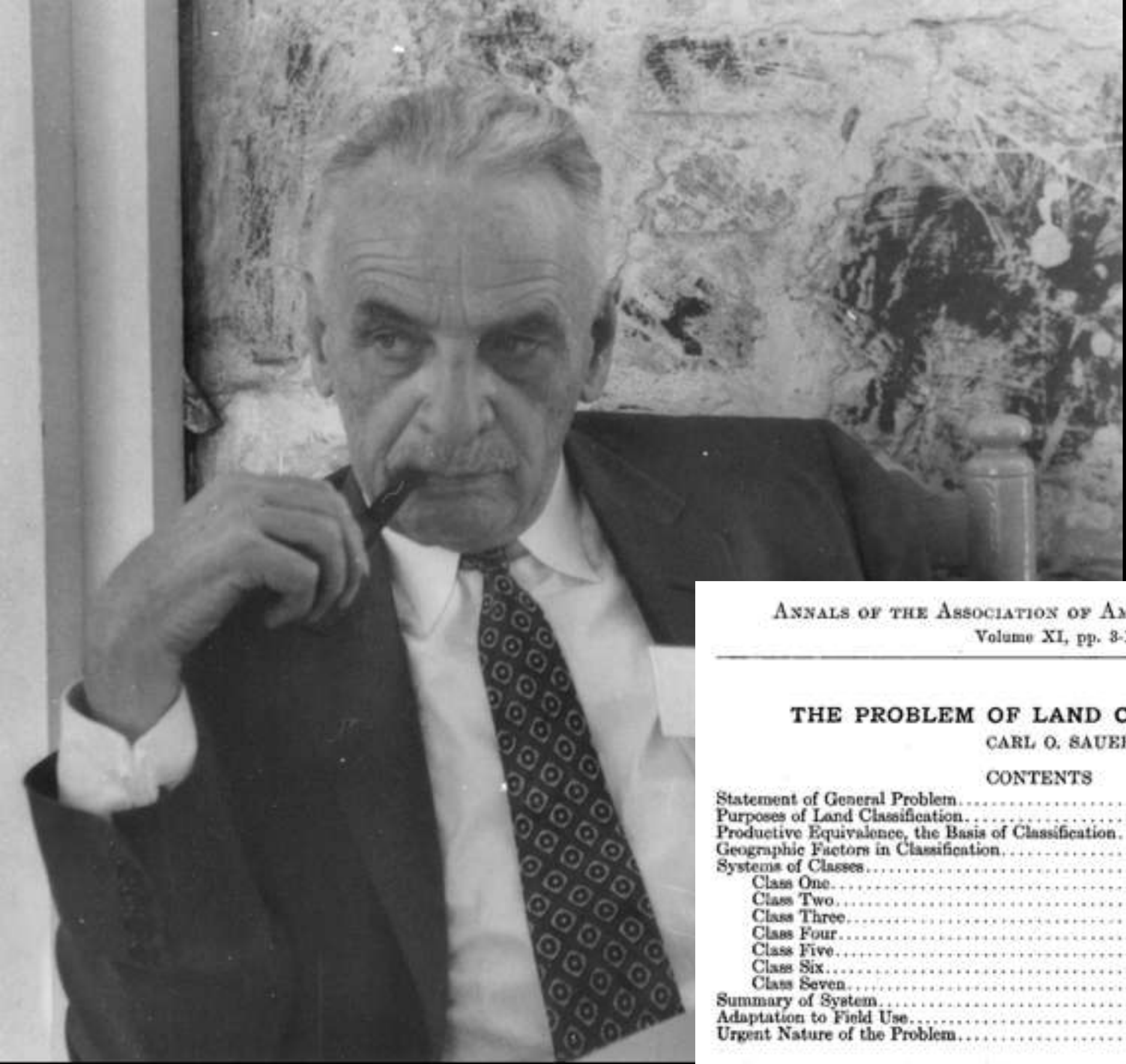

IBM
System 360


Rand Tablet


Charting the Unknown
How computer mapping at Harvard became GIS
Nick Chrisman

ODYSSEY
PIOS
ARITHMICON
MAP
TIGER
GRID
MAP/MODEL
SYMAP
MAPII
IMGRID
SYMVU
ARC/GRID
LUDA/GIRAS
EPPL
DLG

The Problem of Land Classification



Annals of the Association of American Geographers
Volume XI, pp. 3-16

THE PROBLEM OF LAND CLASSIFICATION

CARL O. SAUER

CONTENTS

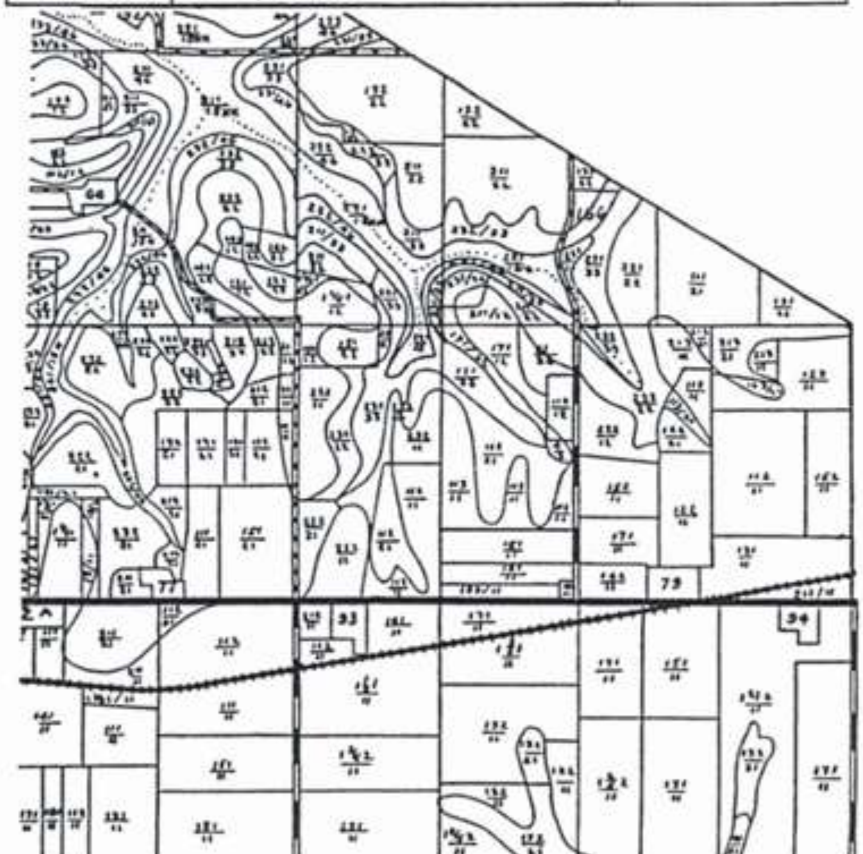
EXPLANATION OF FRACTIONAL SYMBOLS

NUMERATOR

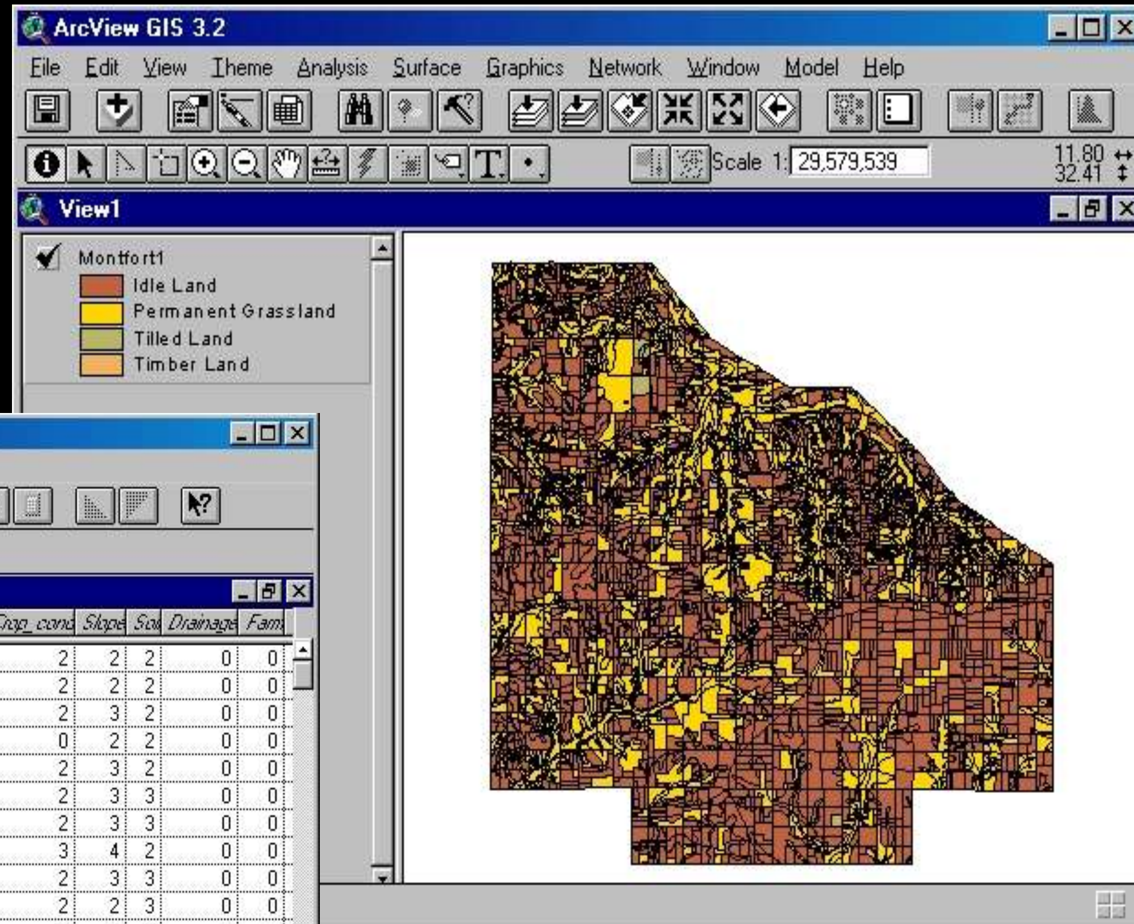
Left-hand Digit MAJOR USE TYPE	Second Digit SPECIFIC CROP OR USE TYPE		Third Digit CONDITION OF CROP
1. TILLED LAND	1. CORN (MAIZE) 2. OATS 3. HAY, (IN ROTATION) 4. PASTURE (" ") 5. BARLEY 6. WHEAT	7. PEAS (Mainly for canning) 8. SOY BEANS 9. POTATOES T. TOBACCO X. SUDAN GRASS ½ OATS AND BARLEY MIXED	1. GOOD 2. MEDIUM 3. POOR
2. PERMANENT GRASS LAND	1. OPEN GRASS PASTURE 2. PASTURE WITH SCATTERED TREES OR BRUSH 3. WOODED PASTURE 4. PERMANENT GRASS CUT FOR HAY		1. GOOD 2. MEDIUM 3. POOR
3. TIMBER LAND	1. PASTURED 2. NOT PASTURED		1. GOOD 2. MEDIUM 3. POOR
4. IDLE LAND	1. IS CAPABLE OF USE		

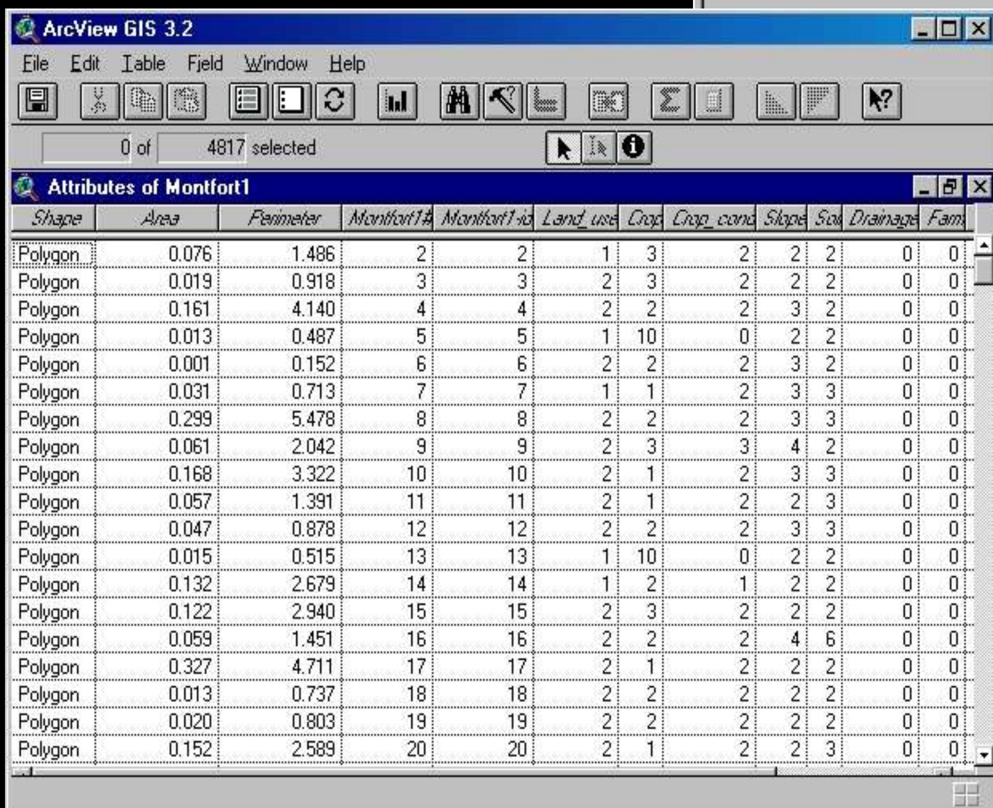
DENOMINATOR

Left-hand Digit SLOPE OF LAND	Second Digit SOIL TYPE (With Soil Survey terminology).	Letter X (if indicated) CONDITION OF DRAINAGE
1. LEVEL, 0° TO 3° 2. ROLLING, 3° - 8° 3. ROUGH, 8° - 15° 4. STEEP, Over 15°	1. MARSHALL SILT LOAM 2. KNOX " " 3. " " " (STEEP PHASE). 4. LINTONIA " " 5. WABASH " " 6. ROUGH, STONY LAND	X POOR XX VERY POOR



Montfort, Wisconsin
1933 Land Use

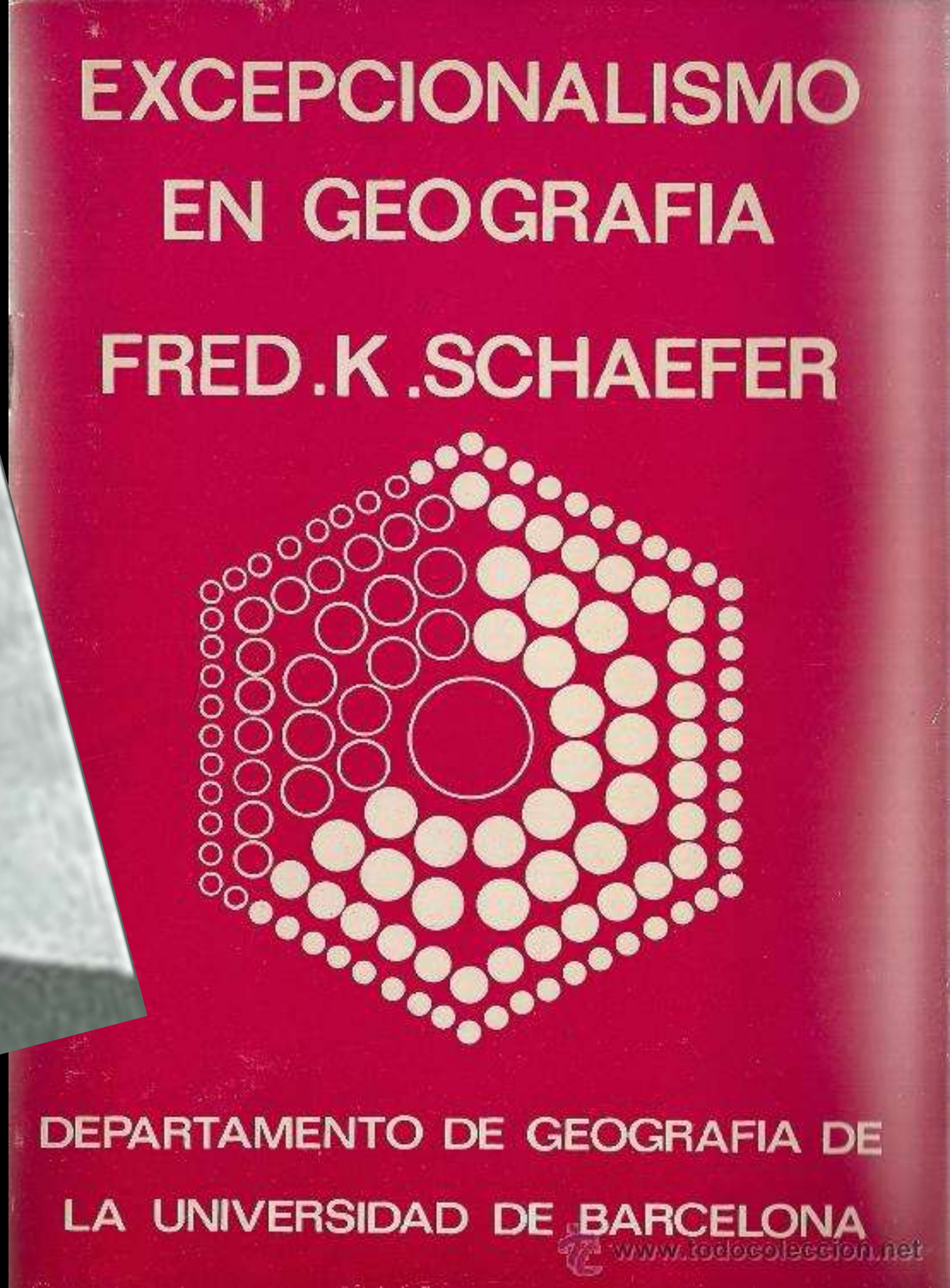




Shape	Area	Perimeter	Montfort1#	Montfort1-id	Land_use	Crop	Crop_cond	Slope	Soi	Drainage	Fam
Polygon	0.076	1.486	2	2	1	3	2	2	2	0	0
Polygon	0.019	0.918	3	3	2	3	2	2	2	0	0
Polygon	0.161	4.140	4	4	2	2	2	3	2	0	0
Polygon	0.013	0.487	5	5	1	10	0	2	2	0	0
Polygon	0.001	0.152	6	6	2	2	2	3	2	0	0
Polygon	0.031	0.713	7	7	1	1	2	3	3	0	0
Polygon	0.299	5.478	8	8	2	2	2	3	3	0	0
Polygon	0.061	2.042	9	9	2	3	3	4	2	0	0
Polygon	0.168	3.322	10	10	2	1	2	3	3	0	0
Polygon	0.057	1.391	11	11	2	1	2	2	3	0	0
Polygon	0.047	0.878	12	12	2	2	2	3	3	0	0
Polygon	0.015	0.515	13	13	1	10	0	2	2	0	0
Polygon	0.132	2.679	14	14	1	2	1	2	2	0	0
Polygon	0.122	2.940	15	15	2	3	2	2	2	0	0
Polygon	0.059	1.451	16	16	2	2	2	4	6	0	0
Polygon	0.327	4.711	17	17	2	1	2	2	2	0	0
Polygon	0.013	0.737	18	18	2	2	2	2	2	0	0
Polygon	0.020	0.803	19	19	2	2	2	2	2	0	0
Polygon	0.152	2.589	20	20	2	1	2	2	3	0	0

ArcView Database
Note Tabular Data

Classification VS Quantitative Geography

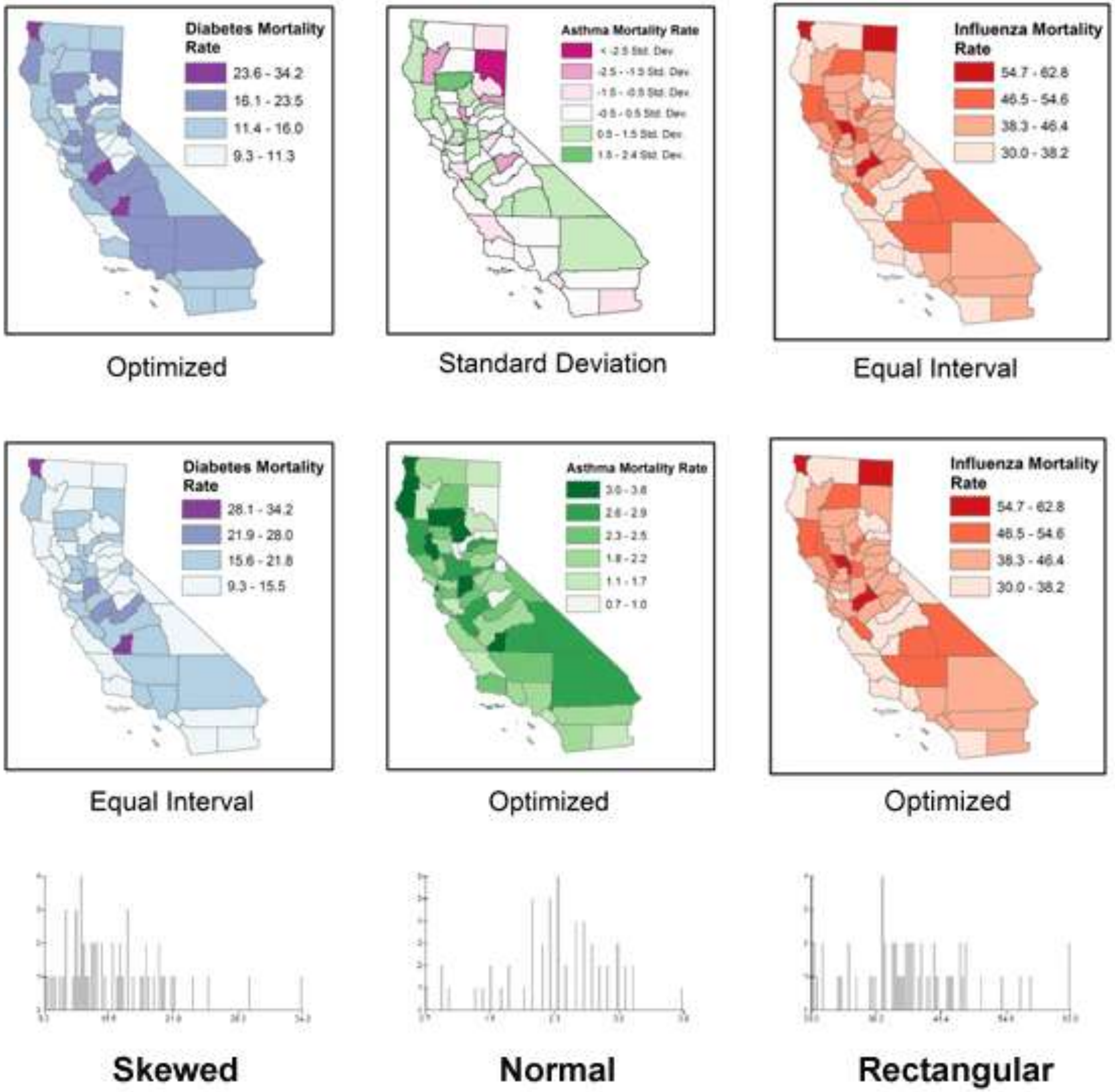

EXCEPCIONALISMO
EN GEOGRAFIA
FRED.K.SCHAEFER
DEPARTAMENTO DE GEOGRAFIA DE
LA UNIVERSIDAD DE BARCELONA
www.todocoleccion.net

Reflections on Richard Hartshorne's

The Nature of Geography

Occasional Publications of the Association of American Geographers

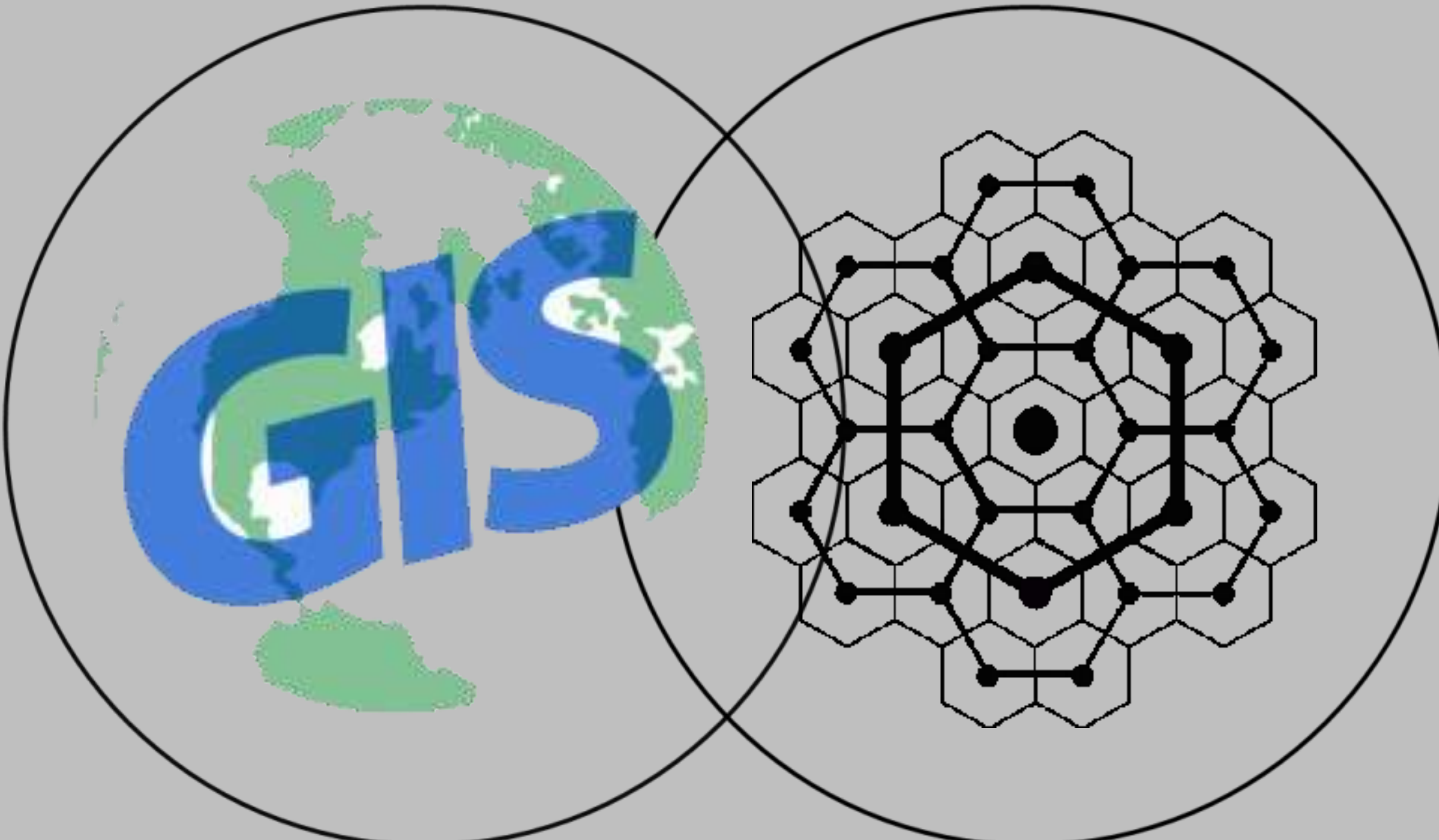
Editors: J. Nicholas Entrikin and Stanley D. Brunn



Diabetes Mortality Rate
23.6 - 34.2
16.1 - 23.5
11.4 - 16.0
9.3 - 11.3
Optimized
Asthma Mortality Rate
< -2.5 Std. Dev.
-2.5 - -1.5 Std. Dev.
-1.5 - -0.5 Std. Dev.
-0.5 - 0.5 Std. Dev.
0.5 - 1.5 Std. Dev.
1.5 - 2.4 Std. Dev.
Standard Deviation
Influenza Mortality Rate
54.7 - 62.8
46.5 - 54.6
38.3 - 46.4
30.0 - 38.2
Equal Interval
Diabetes Mortality Rate
28.1 - 34.2
21.9 - 28.0
15.6 - 21.8
9.3 - 15.5
Equal Interval
Asthma Mortality Rate
3.0 - 3.6
2.6 - 2.9
2.3 - 2.5
1.8 - 2.2
1.1 - 1.7
0.7 - 1.0
Optimized
Influenza Mortality Rate
54.7 - 62.8
46.5 - 54.6
38.3 - 46.4
30.0 - 38.2
Optimized
Skewed
Normal
Rectangular

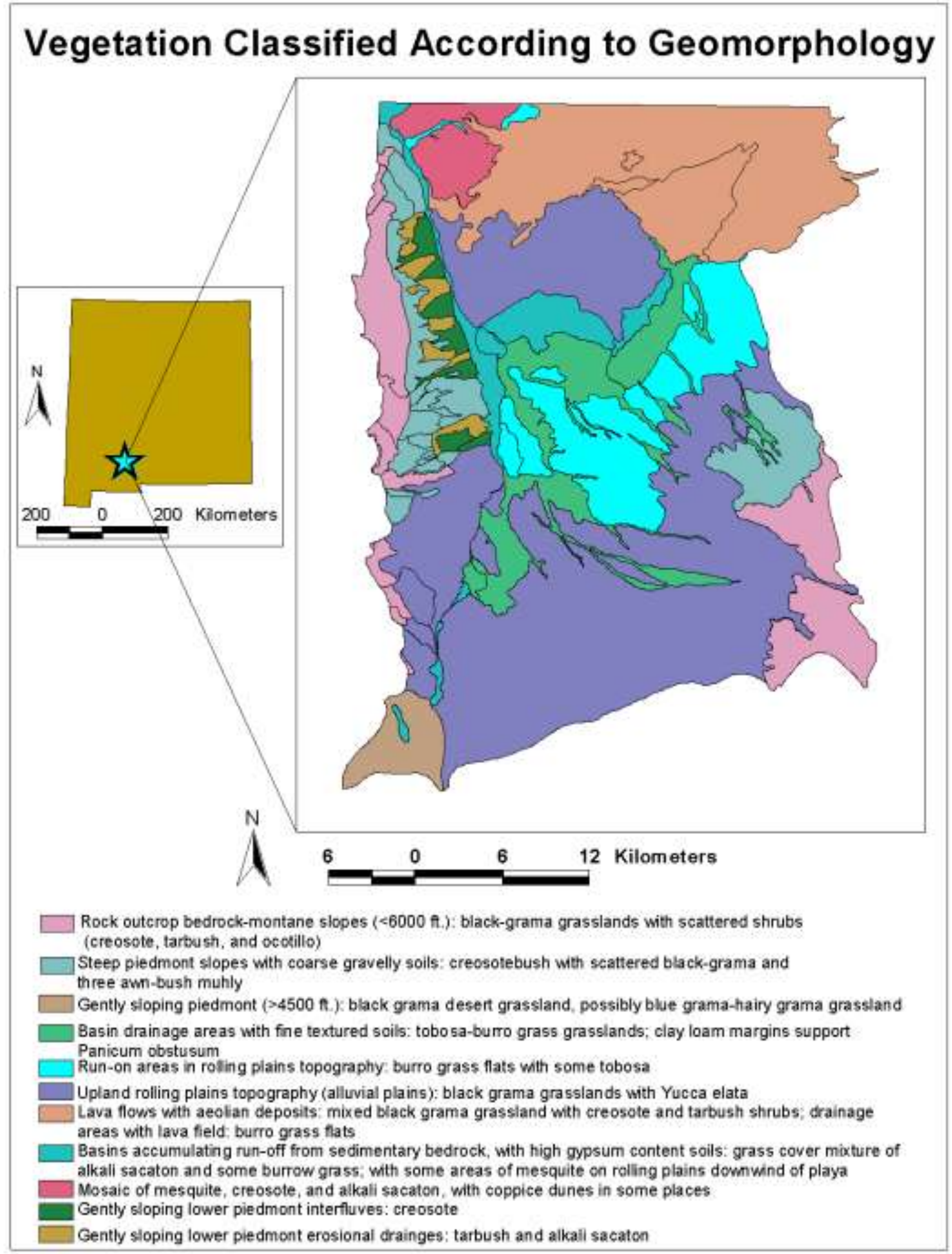
Retrospective View

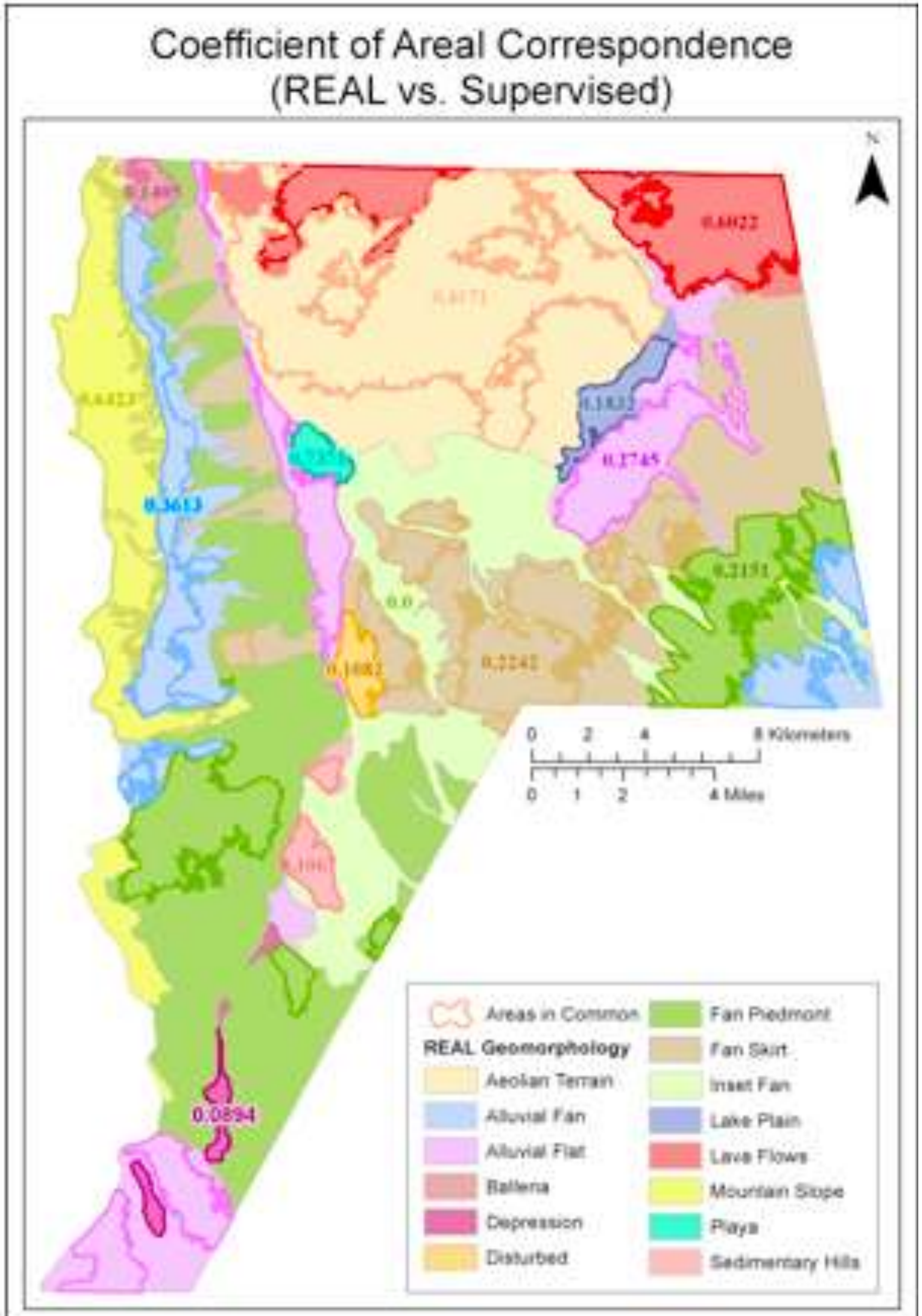
1990’s



Land Classification Informing GIS Development

Geomorphology-Based Vegetation Classes





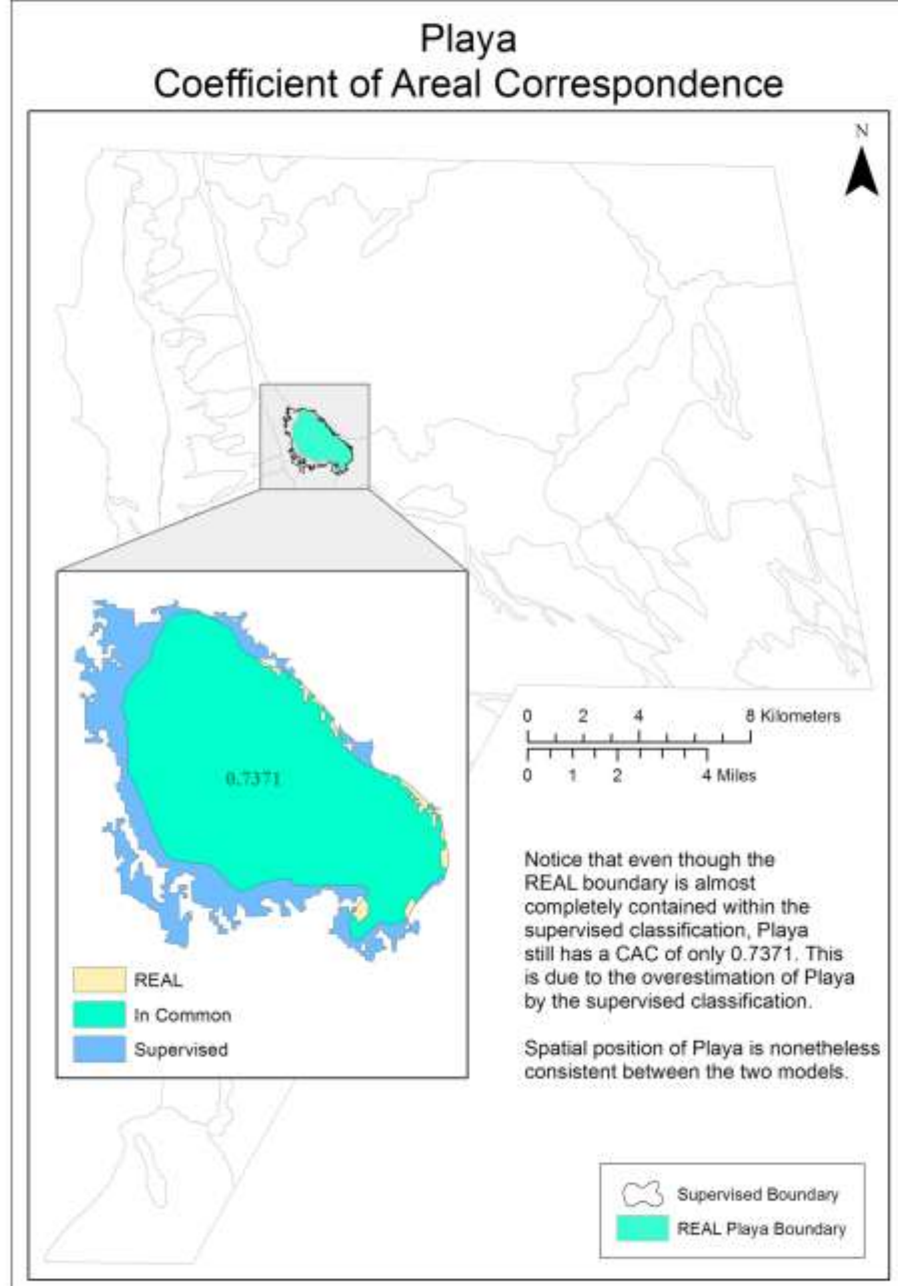


FIGURE 23

PLAYA EXAMPLE OF COEFFICIENT OF AREAL CORRESPONDENCE (CAC) LIMITATION

ELSEVIER

Landscape and Urban Planning

Volume 77, Issue 3, 30 August 2006, Pages 227–239

Spatial adjacencies and interactions: Neighborhood mosaics for landscape ecological planning

Anna M. Hersperger · [Author Vitae]

Abstract

Ecological planning routinely falls short in considering the spatial configuration of land-use types and intensities even though it is well known that unfavorable configurations can lead to undesirable effects on humans and nature. The neighborhood mosaic is proposed as a promising unit for studying, planning, and managing spatial configurations. The neighborhood mosaic is a local assemblage of landscape elements linked together by strong interaction. Three aspects of the neighborhood mosaic concept are crucial: patch adjacency, patch-and-matrix pattern, and patch neighborhood. Examples from landscape ecology and planning are used to describe each aspect. A list of questions is provided to help planners to determine the appropriate facet for a given planning situation and to define the neighborhood mosaic. Based on that, a list of strategies is provided to improve the planner's ability to create spatial configurations that take into account the effects land uses exert onto each other. The spatial concept of the neighborhood mosaic is a tool for analysis as well as a design concept with the potential to foster the integration of landscape ecological knowledge into planning. There is much potential for developing the presented qualitative approach into a quantitative one.

Analysis of Classified Land (landscape metrics)

STATISTICAL TESTING OF REGIONAL BOUNDARIES

LEONARD ZOBLER

Barnard College, Columbia University

REGIONAL METHODOLOGY

THE organization of the surface of the earth into spatial units having stated levels of difference in specific characteristics is the aim of regional geography. From a methodological viewpoint the procedures employed in regionalization by geographers and sociologists fall into two categories:

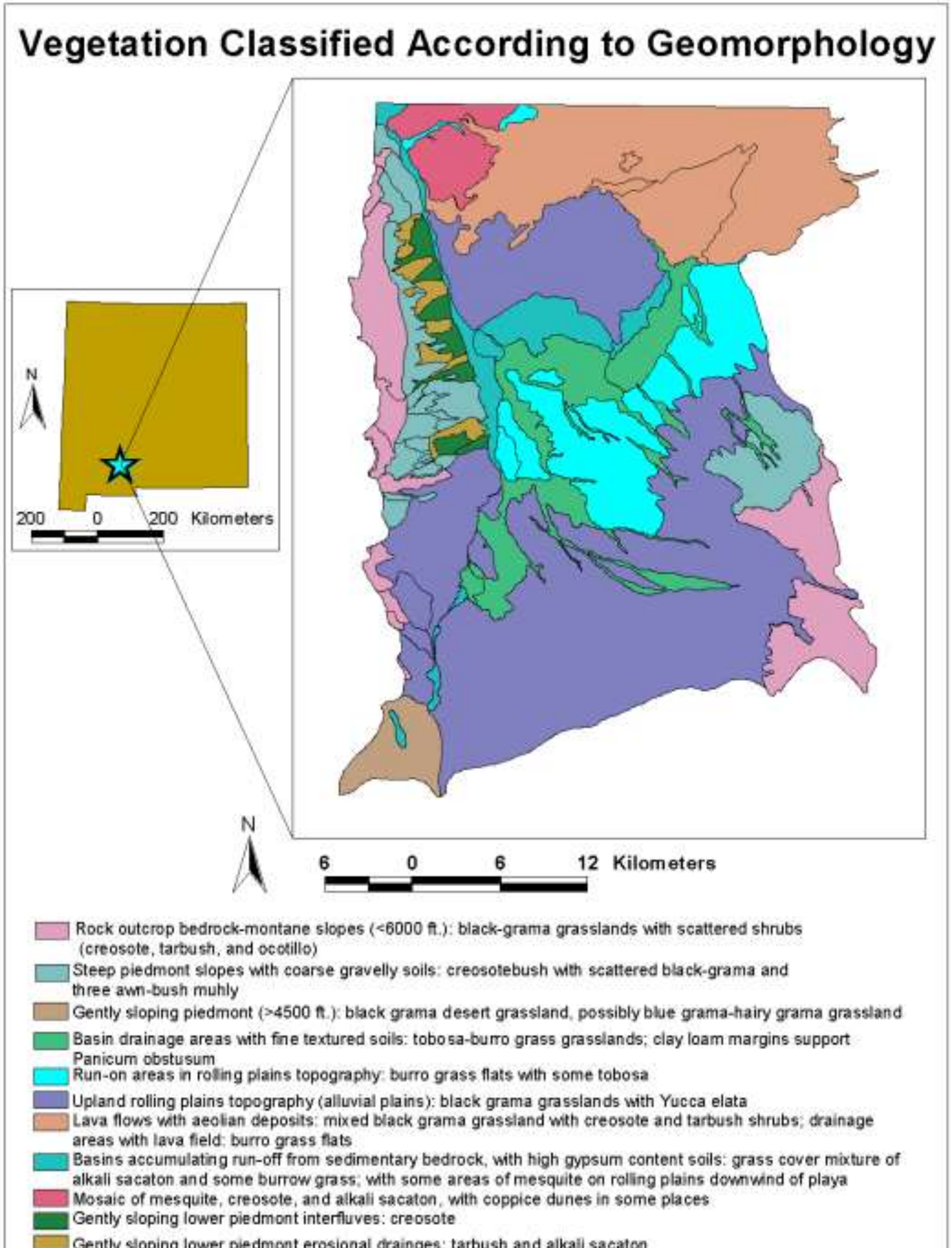
1. Observational-descriptive
2. Observational-relational

According to the first approach, which is purely empirical, physical or socioeconomic data are collected by means of field traverses or assembled from [illegible] units. Boundaries are established to separate regions where noticeable changes occur. The raw data may be [illegible]

pirical and hypothetical studies, regional boundaries are based on earth features, especially physiography and climate, and other data are assembled according to the resultant areal patterns. This approach rests upon the hypothesis of a relationship between the features of the natural environment used to delimit the area and the physical and socioeconomic properties of the regions. This is the method which is widely used in regional geography textbooks.

An important methodological distinction between the two procedures derives from the difference in the information used to draw the boundary lines and the information used to describe the regions. Simple observational-descriptive procedures employ the same data

Analysis of Classified Land (boundary verification)



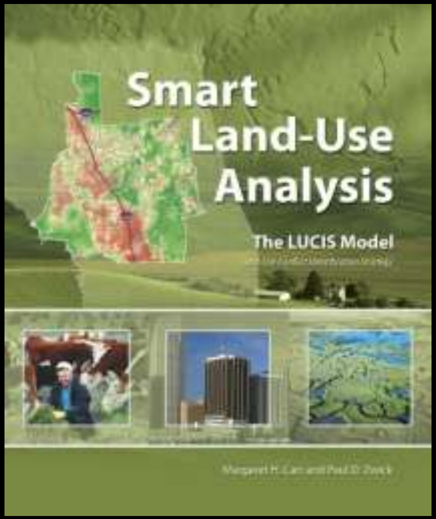
H_0

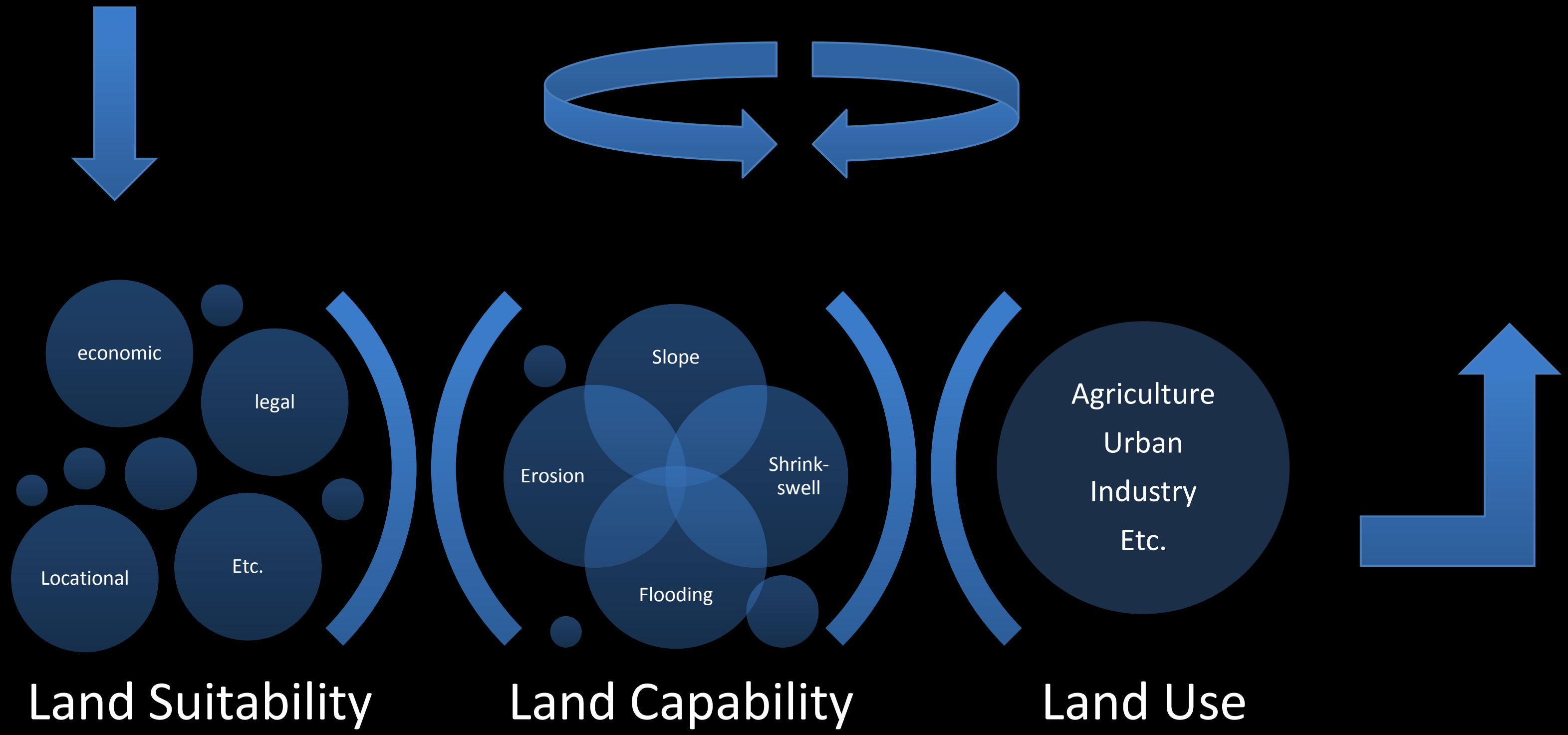
vs

H_A

map categories as hypotheses

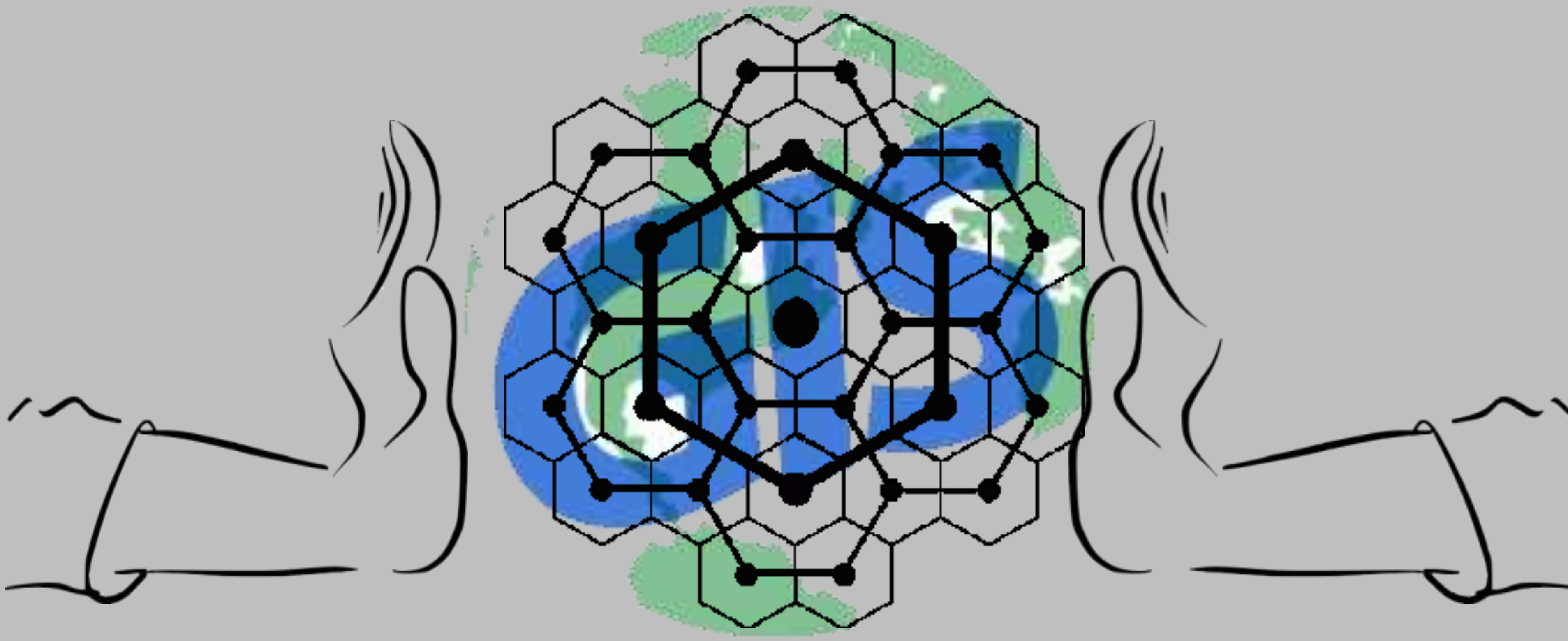
Geodesign & What If Analysis





Conclusion

The Future



Integrated Land Evaluation – Story of a Track Not taken

Nick Chrisman

Slides for the

Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

Esri International Headquarters
Redlands, California
February 13-14, 2015

Integrated Land Evaluation

Story of a track not taken

Nicholas Chrisman

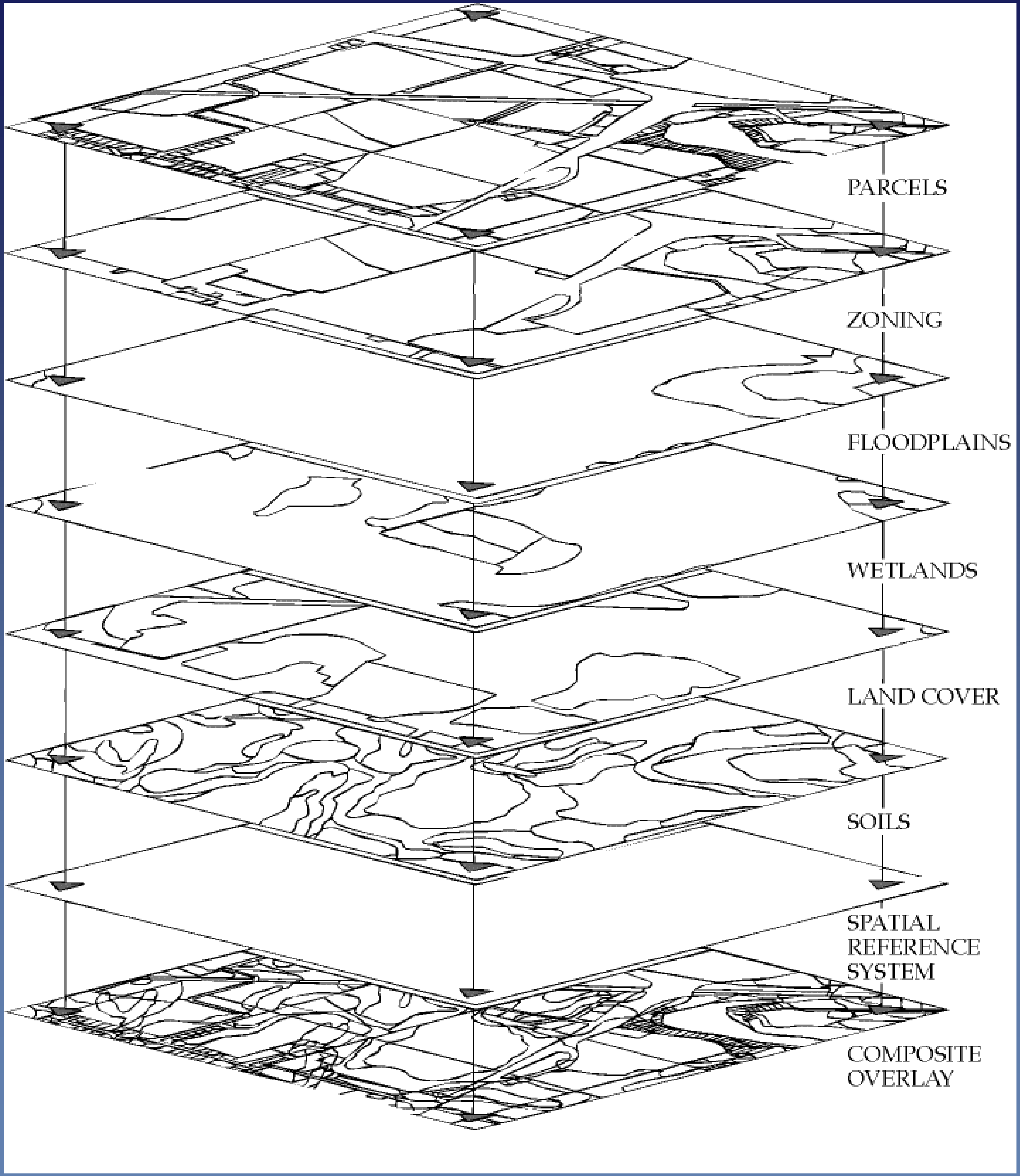
Honorary Professor

Geospatial Sciences, School of Mathematical and Geospatial Sciences

RMIT University, Melbourne, AUSTRALIA

A moment to reflect

- Pathways of science and technology
  - Historical situatedness
  - Missed opportunities
  - New openings



Layer Diagram

- Omnipresent model
- Custodians integrated by geodesy
- Dates from 1985

Today: 3 threads

- Now: Big data?
- Then: Integration
  - (lessons of an Australian past)
- Always: Information

Big Data?

- AGILE-2012 conference: Jean-Philippe LAGRANGE (then at IGN France) set out the dilemma of an organization flooded with data.
- Years prior to 2007: 50 Tb total
- Now 100 Tb / year and increasing…

I am suspicious; demand out of balance.

Economic bubbles

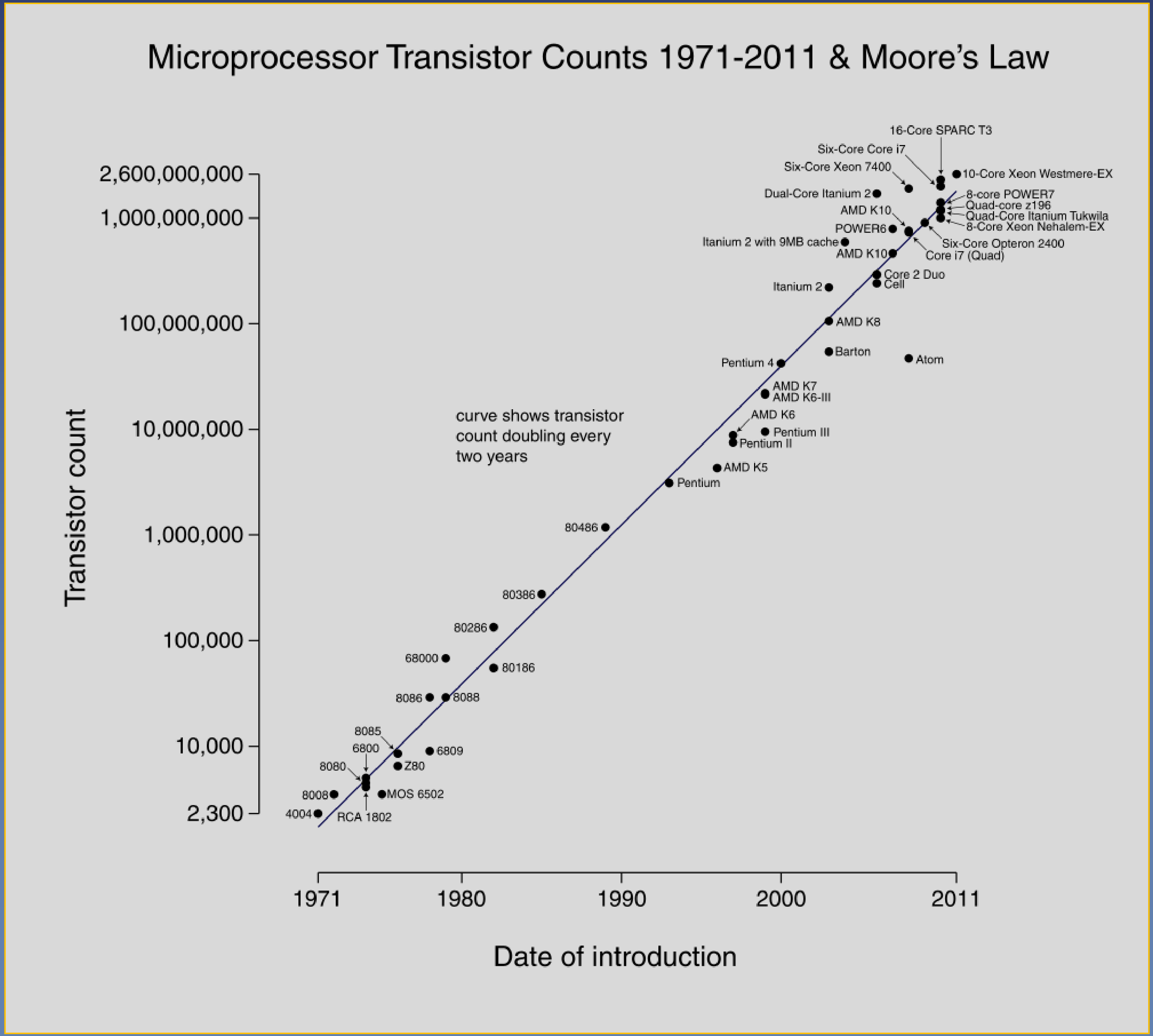
- Public enthusiasm (and greed) take charge
  - 1637: Tulipomania (Netherlands)
  - 1720: Compagnie perpetuelle des Indes (France)
  - 1720: South Seas Bubble (England)
  - And more recently…

Has Moore's Law been protecting us from our lack of innovation?

Paper presentated at AGILE 2012

Moore's Law

- Gordon Moore (Fairchild Semiconductors)
- *1965: density of transitors doubles in 2 years*
- *Converted to chip power doubles in 18 months*
- *Or something like that…*



The Great Moore's Law Compensator (TGMLC)

- "Software is getting slower more rapidly than hardware becomes faster" (Wirth 1995)
- Other versions attributed with ironic reference to various devils (Bill Gates, etc.)

Consequences for Geographic Information Science

- Databases expand to fill the available space
- Operating systems and user interfaces consume more and more cycles
- Overall laziness propped up by expanding power and capacities

Inability to choose

- For now, we are storing everything.
- Delaying the moment when we will have to return to the old rules of selection, compilation;
- Hard truth that information has to be extracted, reducing the data

Nugget? Lessons?

- Is the technology really the issue?
- Is it important to use resources sparingly (intelligently)?
- Is calculation essentially ‘free’?

Integration: return to roots

- When Roger Tomlinson presented his work on the “first GIS”, where did he give the presentation?

… Canberra

- 26-31 August 1968
- Conference on Terrain Evaluation
- Hosted by CSIRO

Vibrant research community

- Terrain evaluation had an established group of practitioners
- 1950s 60s, CSIRO
- 1960s ITC
- International focus, development

Mabutt's taxomony

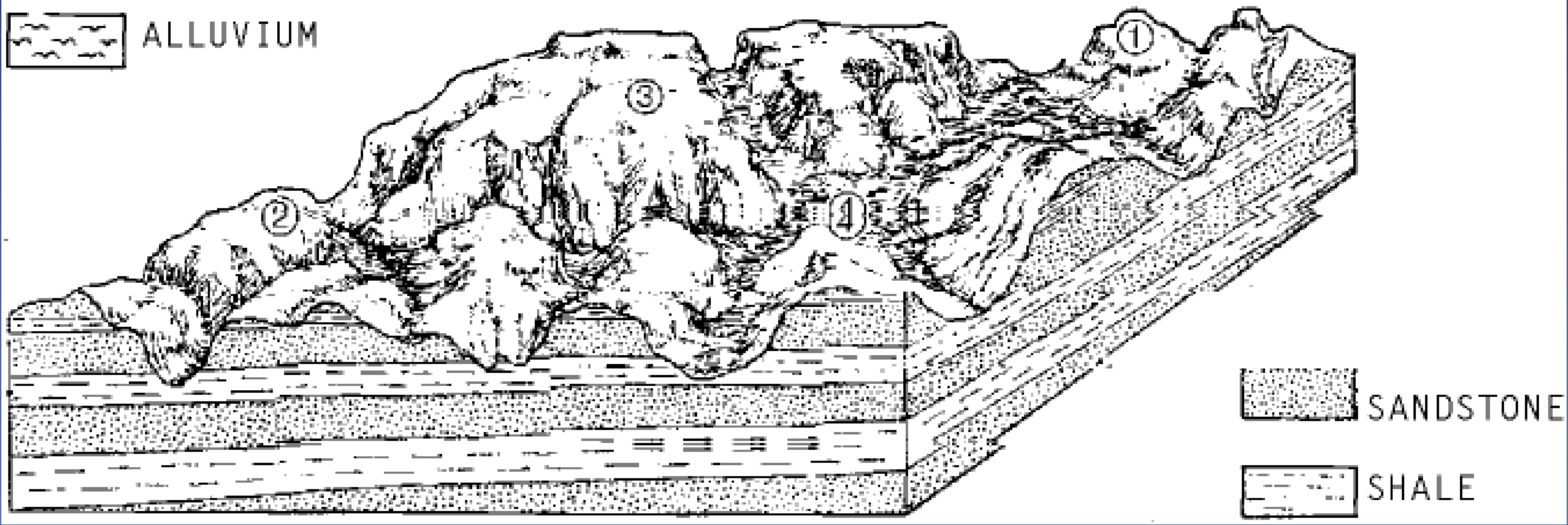
- Genetic mapping (processes that produced the result)
- Parametric mapping (map one variable)
- Landscape assessment (produce a consistent integration of disciplines; *seeing the environment as a whole*)

Central principle: integration

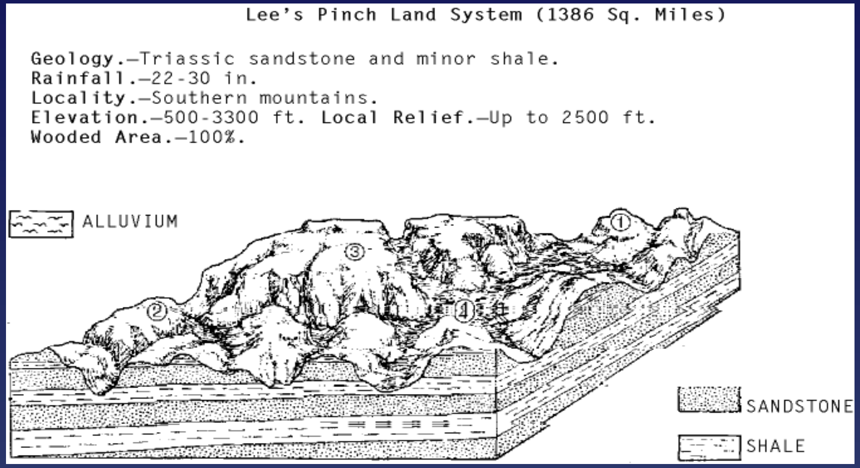
- Multidisciplinary collaborations
- "The land complex as a whole is the object of study, even where a particular attribute may be of prime interest to a land classifier." (Mabutt, 1968, p. 16)

Lee's Pinch Land System (1386 Sq. Miles)

Geology.—Triassic sandstone and minor shale.
Rainfall.—22-30 in.
Locality.—Southern mountains.
Elevation.—500-3300 ft. Local Relief.—Up to 2500 ft.
Wooded Area.—100%.



An example: Hunter Valley, 1963



Legend: General Report on Hunter Valley, Story and others 1963

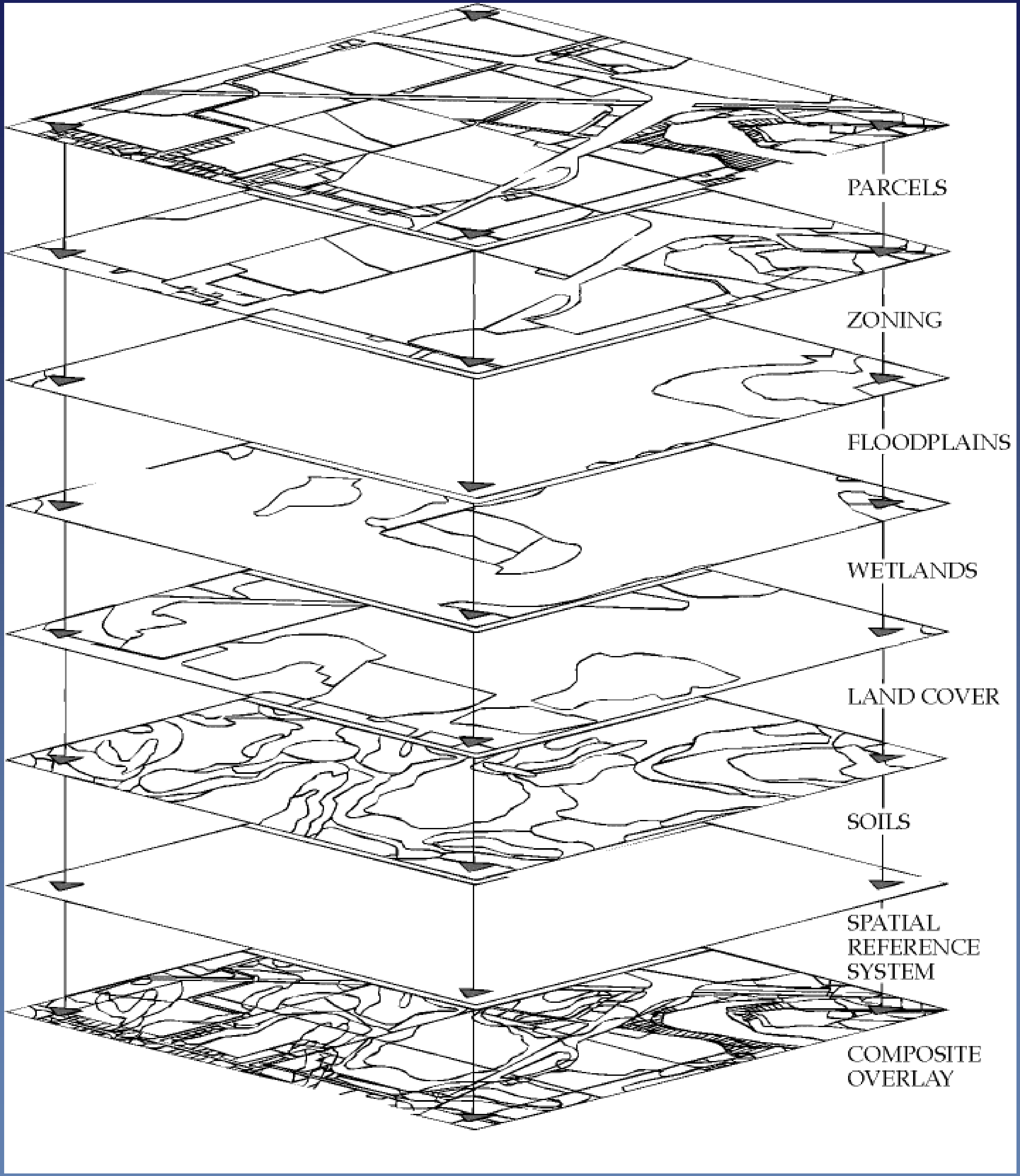
Unit	Area	Land Forms	Soils	Vegetation
1	30%	Rugged hills with rounded summits; irregularly benched slopes often littered with boulders and with very frequent sandstone outcrops including low cliffs up to 30 ft. high; fairly narrow flat-floored valleys 400 - -1000 ft deep	Mainly shallow coarse-textured skeletal soils and bare rock; in moist cool sites humic surface-soils; infrequently on interbedded shales or arkosic sandstones shallow podzolic soils (Binnie, Pokolbin); in stable sites coarse-textured earths	Shrub woodland of ironbark and gum 40-80 ft high, iron-barks common, with E. punctata, E aggiomerata,and E. oblonga, and with scattered or dense Callitris endlicheri, Casuarina torulosa, and Persoonia spp. below; shrubs usually abundant and mixed,Leguminosae common; ground cover poor, of grasses and herbs
2	30%	Rugged hills margined by sandstone cliffs 50 - -500 ft high usually overlooking steep shaly slopes littered with boulders; cavernous weathering of the cliffs; narrow inaccessible valleys 500 - -2500 ft deep	Similar to unit 1; predominantly coarse-textured non-humic skeletal soils; probably more bare rock	As for unit 1, but with more herbs, shrubs, and non-eucalypt trees in ravines and at bases of cliffs
3	35%	Stony, hilly plateaux with ridges and escarpments up to 200 ft high; very steep margins including cliffs up to 100 ft high; narrow gorges along the major rivers	Restricted observations; similar to units 1 and 2; deep yellow earth (Mulbring) in level, stable site on plateau	Shrub woodland of ironbark and gum 30 ft high, includingE. punctata, E. trachyphola,and stringybarks; ground cover poor; many non-eucalypts in ravines and at bases of cliffs
4	<5%	Sandy alluvium occupying valley floors in unit 1; liable to frequent flooding and deposition of sand in middle and upper reaches	Restricted observations; deep sandy stratified alluvial regosols (Rouchel); sedimentation in valley bottoms frequent and calamitous owing to low soil stability on sandstone hills	Shrub woodland or ironbark and gum with an admixture of non-eucalypt trees, sometimes cleared and under pioneer grasses

CSIRO Lands Directorate

- Went on to build one of the first topologically oriented GIS software systems
  - *Bruce Cook, 1967*

Integrated Terrain Unit Mapping

- Also espoused by one Jack Dangermond (1980)
- One map, many interpretations.
- Inconsistencies reduced through compliation, expert judgement, not raw geometry…



Parametric mapping: the winner

- Presented by Ministers yesterday
- Custodians integrated by geodesy
- Dates from 1985

Why?

- A better fit to institutional circumstances
- Modular
- Executed piecemeal

- ***Better? Remains to be proven…***

Nugget?

- Remember that parametric maps (and thus the layer model) are just one way of seeing the world.

comes down to information

Extract from a paper:

Order from Noise:

Towards a social theory of information

Barbara Poore, US Geological Survey

Nick Chrisman, GEOIDE, Canada

Two conflicting models of information

- *Both arise from Cybernetics movement in late 1940s*
- Shannon [Bell Labs] (publicized by Weaver)
  - Transmission model: encoding as bits
- Norbert Weiner [MIT, Lincoln Labs]
  - Control of aircraft gunnery, cybernetics
  - Feedback as main issue

Shannon’s boxes and arrows

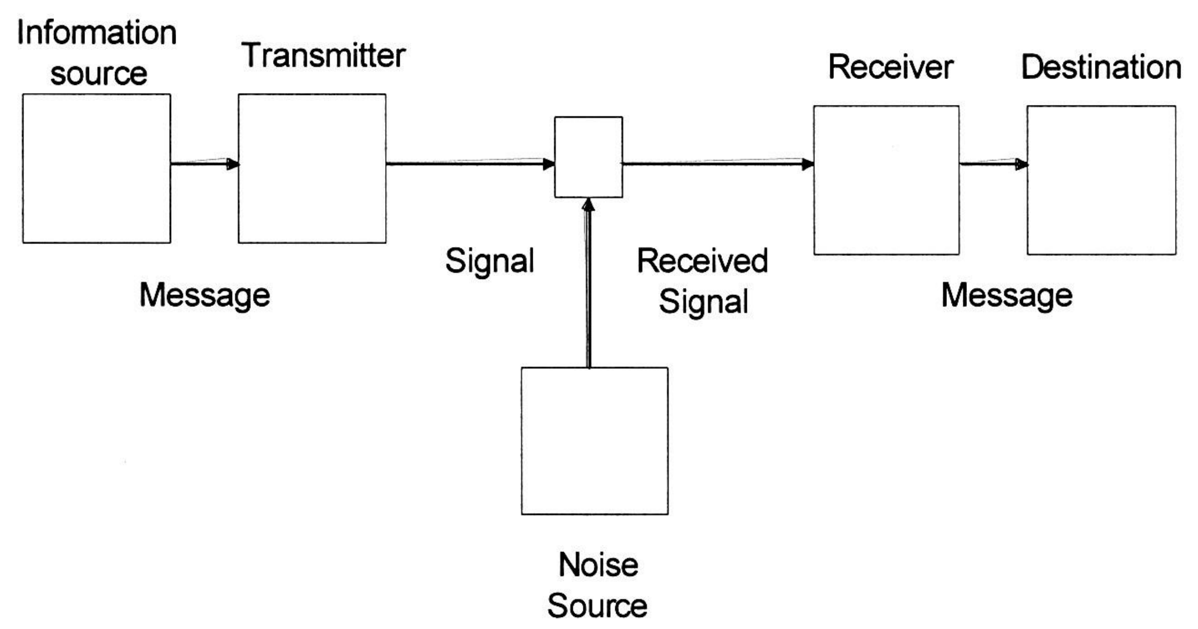
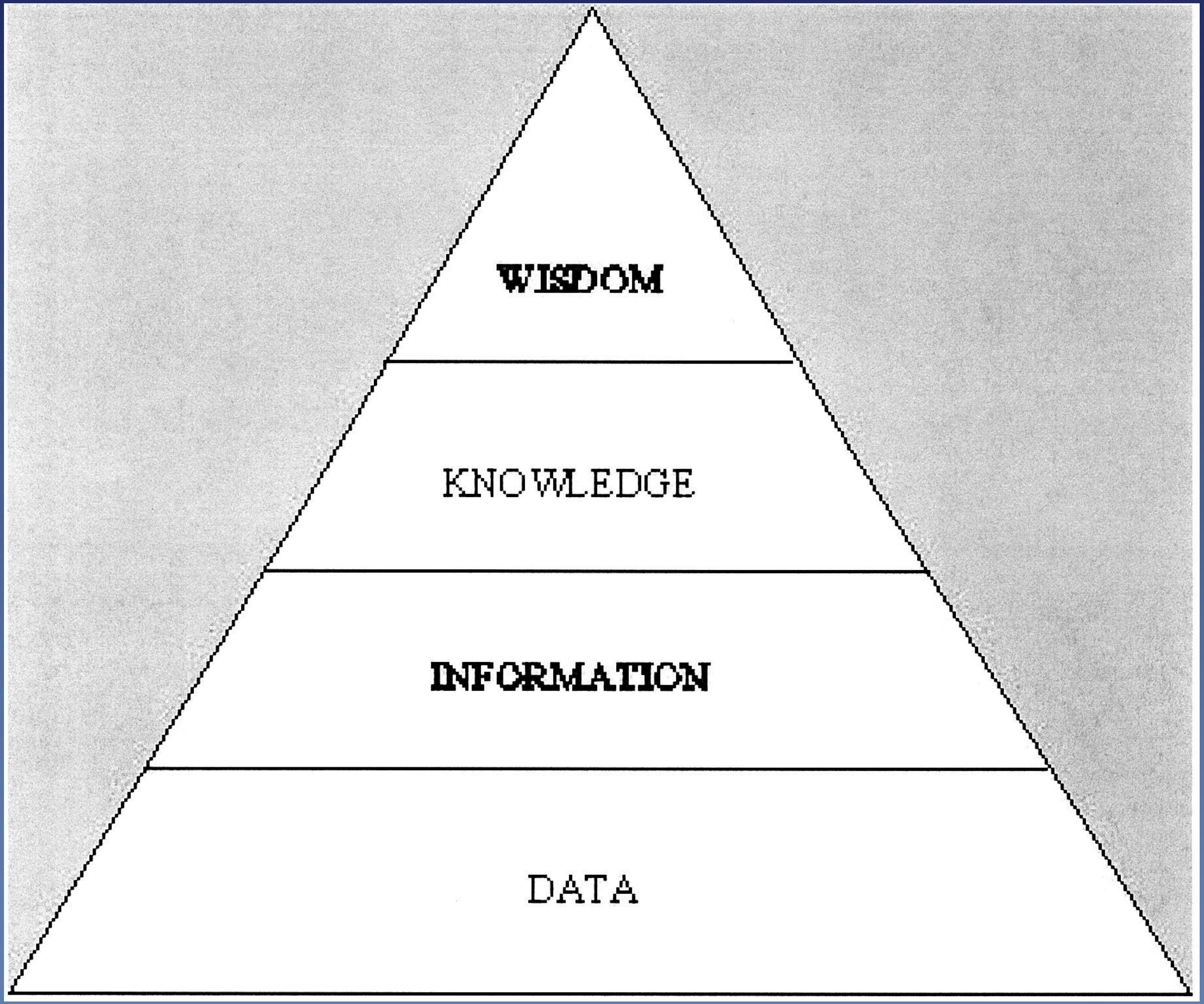


Figure 1. After Shannon and Weaver. 1949. The Mathematical Theor y of Communication. Chicago , University of Illinois Press p. 34

Invariance through transmission;

Meaning not a part of model

Model of refinement



Weiner promotes the mythology

How the information model matters:

Treated as a “thing”, information is capital, a precious resource

BUT, information is the result of work, interactions of sensors and humans

- Sensor webs depend on a more social view of information…

A social model of information

Goguen: *an interpretation of a configuration of signs for which some social group is accountable.*

Bateson: *"a difference that makes a difference"*

And a consequence (or two)

- van Foerster: *« you can turn a library upside down, but not a drop of information will flow out »*
- All writing requires an audience; meaning is interpreted by the reader

Nugget?
Defining Value

- Comes from use
- NOT inherent in the data

Conclusion

- History is written by the winners
- Good ideas do not always prevail
- Lessons to learn in what appear to be dead-ends, and tracks not taken.
- Pay attention to the real source of value

It’s a long process

Toward Los Angeles; Dorothea Lange, 1937

Acknowledgements

- Research support
  - Recent: RMIT
  - Past: NSF, USA; GEOIDE, Canada
- *Assistance: many students*
- *Photo: Dorothea Lange (FSA, 1937…)*