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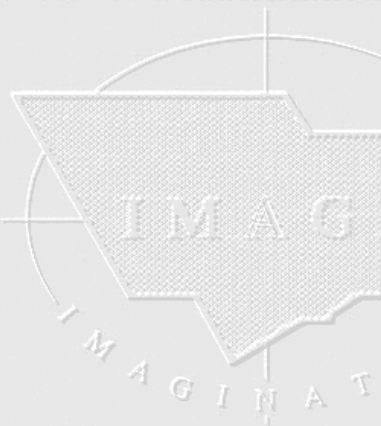
SOLSTICE,
VOLUME XX, NUMBER 2;
DECEMBER, 2009.

Front matter: December, 2009.
Editorial Board, Advice to Authors, Mission Statement

Awards

ARTICLES
(reviewed)

The Perimeter Project, Part 2:
Fragile Lands Protection Using Cemetery Zoning

Associated .kmz file
Associated video file (with thanks to Roger Rayle)
Sandra L. Arlinghaus and William E. Arlinghaus

Southeast Asia: Historical Place Names Visualized in Google Earth
Sandra Lach Arlinghaus and Robert F. Austin
See Revised Monograph #4, below.

Essays on Mathematical Geography: Contemporary Visualizations
Sandra L. Arlinghaus
See Revised Monograph #3, below

NOTES

Emergency Phones: A Google Earth Approach
Sandra L. Arlinghaus

3D Annotated Archive
Sandra L. Arlinghaus

Revised eBooks and eBook Supplements,
Reflecting the power of current technology

IMaGe Monograph #3:
Sandra L. Arlinghaus, 1986.
Essays on Mathematical Geography.
Link to original
Link to supplementary material--see notation above

IMaGe Monograph #4:
Robert F. Austin, 1986.
A Historical Gazetteer of Southeast Asia.
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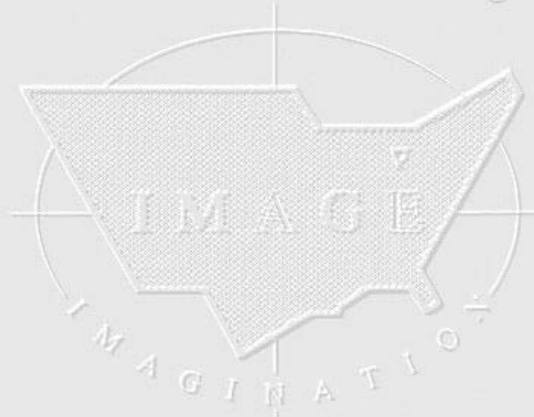
Solstice Archive

Institute of Mathematical Geography

IMaGe

IMAGINATION

Solstice: An Electronic Journal of Geography and Mathematics,
Volume XX, Number 2
Institute of Mathematical Geography (IMaGe).
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MISSION STATEMENT

The purpose of Solstice is to promote interaction between geography and mathematics. Articles in which elements of one discipline are used to shed light on the other are particularly sought. Also welcome are original contributions that are purely geographical or purely mathematical. These may be prefaced (by editor or author) with commentary suggesting directions that might lead toward the desired interactions. Individuals wishing to submit articles or other material should contact an editor, or send e-mail directly to sarhaus@umich.edu.

SOLSTICE ARCHIVES

Back issues of Solstice are available on the WebSite of the Institute of Mathematical Geography, http://www.imagenet.org and at various sites that can be found by searching under "Solstice" on the World Wide Web. Thanks to Bruce Long (Arizona State University, Department of Mathematics) for taking an early initiative in archiving Solstice using GOPHER.

PUBLICATION INFORMATION

To cite the electronic copy, note the exact time of transmission from Ann Arbor, and cite all the transmission matter as facts of publication. Any copy that does not superimpose precisely upon the original as transmitted from Ann Arbor should be presumed to be an altered, bogus copy of *Solstice*. The oriental rug, with errors, serves as the model for creating this weaving of words and graphics.

The Perimeter Project:
Cemetery Zoning Used in Fragile Lands Protection

Sandra L. Arlinghaus and William E. Arlinghaus

Updated material presented at the

Seventh Annual Conference of

Community Systems Foundation

Held in 2024 Dana Building

School of Natural Resources and Environment

The University of Michigan

October 17, 2009

Part I:
Conceptual Overview and Implementation Strategy, Memorialization, Pilot Project, and Virtual Cemetery Visualized Using Google Earth and SketchUp

Sandra Lach Arlinghaus, Ph.D.

- CSF Board of Trustees, Executive Committee (Secretary)
- Adjunct Professor of Mathematical Geography and Population-Environment Dynamics, School of Natural Resources and Environment, The University of Michigan
- President, Arlinghaus Enterprises
- sarhaus@umich.edu

Conceptual Overview: Burial Practice

- Conventional US burial practice involving chemical embalming and cement vaults damages the environment.

- Scattering of ashes following cremation removes this difficulty but offers little constructive to the environment

- Green or natural burial also removes this difficulty and may offer even more to the environment when done with care.

Conceptual Overview:
Memorialization, Conventional and Creative

- Scattering and Green burial approaches offer no means for memorialization. The Internet does so, when website memorials are trust-funded in the same manner as conventional cemeteries. Such memorialization has the added advantage of integrating far-flung family members in virtual space.

- Archived Memorials Online offers such capability (AMO = "I love" in Latin). Sample Basic AMO Memorial on the next slide.

AMO

In memory of

Marian H. Schinske

1921-2008

SCHINSKE - Marian H. Schinske, aged 87, was called to God on Friday, December 26, 2008, in Denton, TX. Marian was employed by General Motors Diesel Division in Wyoming, MI, for many years and is a graduate of Union High School. She was preceded in death by her parents, Clarence and Anna Young; her siblings, Virginia Zanella, Percy, Bud, Gerald and Bob Young. She is survived by her children, Richard VanDyke, Patricia Miller, Linda Rutty, Terry VanDyke, and John Schinske, 14 grandchildren; 16 great grandchildren; three great-great grandchildren; and sister, Betty DeBoer. The Bible says that a day with God is like a thousand years on earth, so though it seems sometimes like an eternity of loss, our time apart is but a brief moment. The Funeral Service will be held 1:00 p.m. Friday, January 2, at Stroo Funeral Home, with Rev. Tom Meyer officiating. Interment in Chapel Hill Memorial Gardens.

Lot Location: Masonic 155 B 4

Memorialization: Zoning Implications

- Thus, one might employ online memorials as a means to encourage more environmentally-sensitive burial practice.

- Furthermore, with such encouragement in place, one might turn the idea around and attempt to protect fragile lands by acquiring cemetery zoning for them (which is the most difficult to change--zoning can be a moving target that responds to the political whim of varying administrations).

Perimeter Project: Mission

- It is the mission of the Perimeter Project to implement the idea of using cemetery zoning to protect environmentally sensitive lands
- Many of these lands/waters represent a "perimeter" between land and water, competing landuse types, and so forth. Thus, a "Perimeter" might be
  - Physical—coastal, for example.
  - Perceptual or cultural
  - Related to Environmental Justice—adjacent to a "lulu"
  - Use imagination…

Pilot Project: Chapel Hill Memorial Gardens Grand Rapids, Michigan

- A sample of the more than 300 online memorials, "AMOs", appears in the movie on the next slide. A small set of AMOs has been online since 2003.
  - The Pilot Project at Chapel Hill began January 1, 2009 as the first time integration of AMOs with an actual cemetery occurred
  - That project has generated hundreds of new Basic AMOs as part of the standard burial package (more in Part II of this talk).
- The AMOs appear at various sizes to fit into a standard movie frame (next slide) http://www.ArchivedMemorialsOnline.com

"*Not marble nor the gilded monuments of princes*
Shall outlive this powerful rime" **William Shakespeare, Sonnet LV**
…Nor perpetual Internet memorialization!

If the movie below does not launch automatically, open this link (in a new window, if you wish):

Chapel Hill Memorial Gardens

Music: Wolfgang Amadeus Mozart, Requiem (Lacrimosa).

Virtual Cemetery
Visualized Using Google Earth and Google SketchUp

- Associated cemetery maps are embedded on the Google globe

- Balloons mark burial location

- AMOs popup when clicked on within the Google Earth browser interface

- Associated features add extra reality
  - Mausoleum buildings created in SketchUp
  - 3D trees found online
  - Street views interior to the cemetery from field photographs
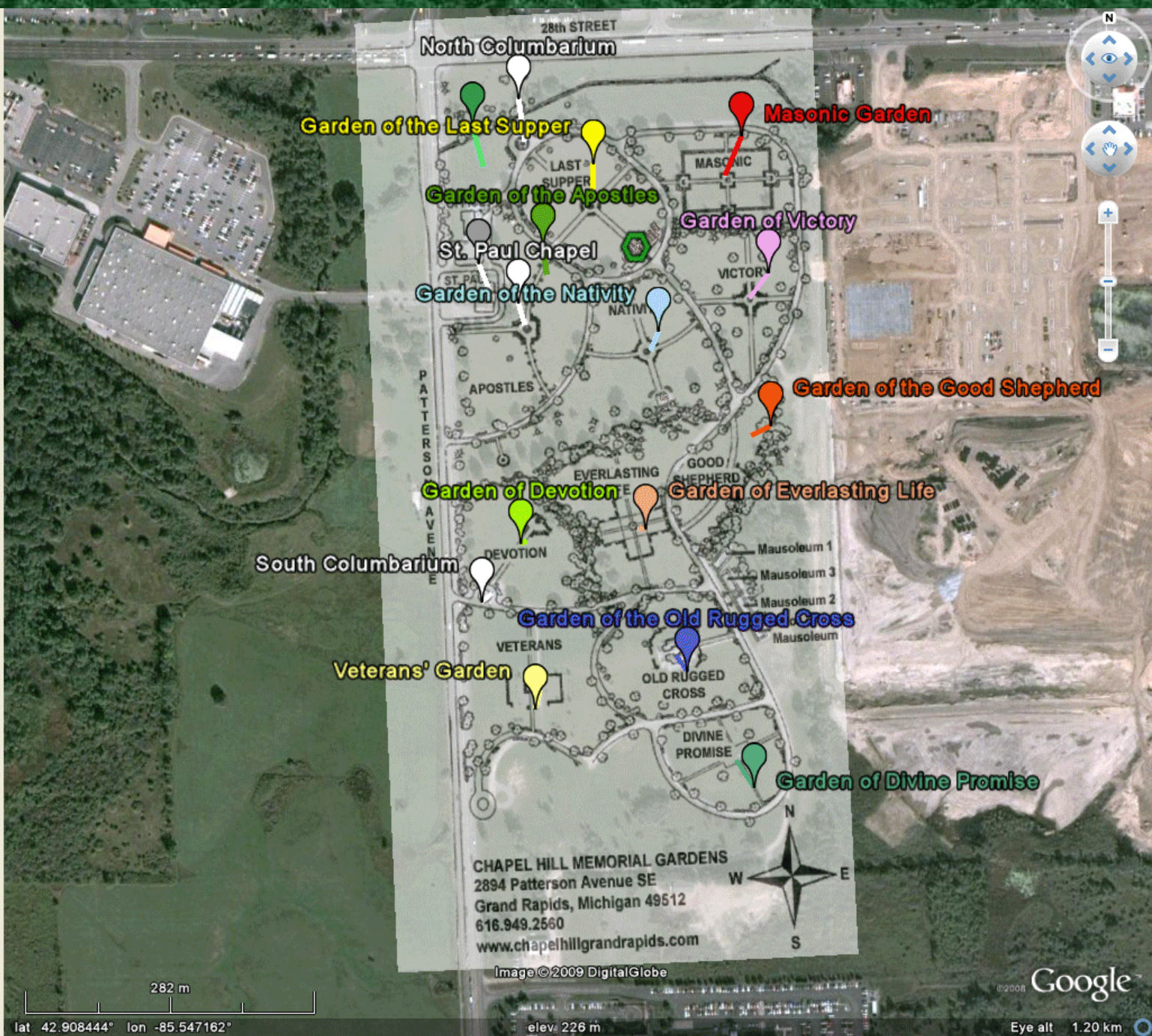 - Special events visuals of various kinds

Directions…Memorialization

- Beyond the Basic AMO
  - Custom AMOs with added visuals or videos—possible associated contacts: PWilliams productions
  - GEOMAT personal biographies: Ann Larimore, Ph.D. and Robert Haug Ph.D. Candidate—developed in a conflict resolution context over three years of classroom experience.
- Facebook—Personal Memorialization Wall,
  in association with Jen Osburn, CHMG
- Teaching of new staff
  - Handbook in progress
  - Online materials in progress

Directions…Related Pilot Projects

- Extensions to other existing cemeteries might offer opportunities to learn more about database management and related issues

- Municipal extension might involve
  - Matt Naud, City of Ann Arbor Environmental Coordinator
  - Roger Rayle, CSF Research Associate and Chair of Scio Residents for Safe Water
  - Allen Creek Greenway or other citizen groups

- Regional extension might involve various groups as spin-offs from Pilot Projects, especially in association with land acquisition issues.

- International extension to developing nations and database management issues will involve DevInfo and Kris Oswalt (CSF).

- In cremation it is necessary (lest the crematorium explode), and in green burial it is desirable, to remove pacemakers and other metal from the body. We have necessary contacts, from funeral homes, to handle such removals.

- Kim Eagle, M.D. and Timir Baman M.D. (Cardiovascular Center, University of Michigan) have a pacemaker recycling project in progress in which pacemakers will be recycled in hospitals in developing nations.

  - When hospitals and online legal forms are ready from UM, we are prepared to supply pacemakers.
  - As both projects evolve, there may be further opportunity for synergistic effort in the international arena.

Part II:
Pilot Project, Marketing, Extension Strategy to Other Cemeteries

William Edward Arlinghaus, B.A.

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- B.A. Theoretical Linguistics, The University of Michigan
- William.Arlinghaus@gmail.com

Pilot Project

- Chapel Hill Memorial Gardens
- Memorialization
  - Evolution of "Basic AMO" project
  - Extension to "Custom AMOs"
- Green burial
  - Perception by clients
  - Legal issues
  - Environmental issues

Marketing

- The importance of bundling the AMO with other items
- Interdisciplinary issues: perception problems with funeral director industry
- Legal issues: consent forms and more.
- Perception issues associated with cremation
- Attitudes toward "green" burial

Extension Strategy

- Other existing cemeteries—the easiest extension
- Land acquisition issues—zoning is often for a parcel larger than immediately foreseen (as in cluster housing, for example). Mixed use is critical with cemetery zoning for the entire parcel. Orchards, tree farms, and various other uses mix well with cemetery use.
- Leveraging funds: water towers and other locally undesirable uses might help
- Support from the political and environmental communities sought:
  - Crematoria are incinerators and use fossil fuels and may produce pollution and similar problems.
  - Green burial integrates the remains throughout a site—into the grass, trees, and elsewhere: zoning is most permanent (in conventional burial, the remains are together and conceivably could be moved).

Extension Strategy, continued

- Investigation of alternative methods of disposal of human remains continues—both from the scholarly and real-world vantage points:
  - Resomation: conversion of the remains to a liquid that might be used in garden or forested areas. http://en.wikipedia.org/wiki/Resomation
  - Natural burial: use of support for a vertically-buried body to prevent an accordion effect. Ann Larimore notes a need to use a disposable casket or to accommodate, in a sensitive manner, a variety of preference.
  - Cryogenics: Fred Goodman notes a personal communication involving routine applications of this freezing process in Western Europe. http://en.wikipedia.org/wiki/Cryopreservation
- Spatial planning: use small hexagonal plots and arrange them in a hierarchy to take advantage of fractal central place analysis for close-packing and associated benefits in movement and administration.

http://www-personal.umich.edu/~copyrght/image/books/Spatial%20Synthesis2/

THE END

Many thanks to Kris Oswalt for his support of this project.

CSF archive
http://www.csfnet.org

Information related to this topic
http://www.MyLovedOne.com
http://www.ArchivedMemorialsOnline.com
http://www.ChapelHillGrandRapids.com

Southeast Asia: Historical Place Names Visualized in Google Earth

Sandra Lach Arlinghaus and Robert F. Austin

Download Google Earth

Download kmz file to open in Google Earth

File created October 26, 2009.

Dedicated to the memory and achievements of Donald F. Lach, 09/24/1917 - 10/26/2000.

To place the visual files supplied in this update into context for the reader, we quote the original introduction by Austin to his Gazetteer of historical Southeast Asian place names.

INTRODUCTION

There are a number of approaches that one may take in compiling a gazetteer. The most logical approach from the perspective of contemporary geographers might be to compile an exhaustive list of toponyms currently in use. The Official Standard Names Gazetteer series prepared by the United States Board on Geographic Names constitute such a compendium, and no attempt has been made to duplicate these documents (although they have been used as the source of latitude and longitude coordinates). Rather historical place-names have been emphasized.

Having made a commitment to historical place-names (although the reader will note some contemporary citations for cases of recent official changes), a decision remains with regard to the type of historical entries that would be most useful. In this gazetteer, no attempt has been made to provide spellings or usages that are "correct" in the sense of currently preferable in the academies and institutes of language of the several nations involved. Instead, this is a collection of place-names <u>as they appeared in print</u>. I have not attempted to correct obvious misprints in the original sources, nor have spelling errors been corrected. The entries are recorded here as they were published. Cross-references have been provided to allow the reader to determine the place of reference. There is little value, in an exercise such as this, in telling the reader what Pigafetta, Crawfurd, or other early chroniclers <u>should</u> have written; that is generally obvious. Rather, the real value of this gazetteer lies in its record of the given usage.

Although sufficient examples have been included to introduce the subject, no thorough attempt has been made to portray place-name variations arising from the use of different European orthographies (specifically Dutch versus English). As these variations are of a fairly regular nature, users are referred to the dictionaries cited in the bibliography.

Throughout at least the historical period in Southeast Asia, the concept of territoriality has differed from that observed in Europe and North America. One of the most striking pieces of evidence for this assertion is related to national boundaries. In general, the kingdoms and states of the region existed as extensions of a central, frequently sacred, capital city. Although at any given time possessing quite well-defined boundaries, the extent and location of those boundaries (and the fortunes of the states) fluctuated, often dramatically. Hence, it is often more appropriate to speak of the center <u>as</u> the state (for example, Ayuthia or Brunei). This issue has generally been resolved, for the purposes of this gazetteer, by citing the geographically smallest entity. Thus Chiengmai is listed as a town, despite the fact that this same name is also applied to a larger political unit.

The entries generally take one of two forms. Primary entries include: 1) the current name of a geographical entity; 2) a generic description, unless that is obvious from the name; 3) the nation(s) in which the entity is located (although this gazetteer should <u>not</u> be considered an official authority in this respect); 4) latitude and longitude coordinates; 5) other names which have been applied to each entity in the literature or in common English usage; and 6) occasional supplementary notes. As noted above, latitude and longitude coordinates are taken from the gazetteers of the U.S. Board on Geographic Names for the majority of entries. However, coordinates for certain ancient towns are approximations, and the coordinates supplied for physically large entities are for a central location. Names about which there is some question as to reference are noted with a question mark (?). Such citations are included for the sake of completeness, and should not necessarily be interpreted as an endorsement. Entries of the second type include: 1) a geographical name; 2) a reference (of the form "see _____") to the geographical name currently used to designate that entity; and 3) occasionally, a short bibliographic citation or explanatory note.

This is a gazetteer of given use, not prescribed or correct use. As such, this historical place-name cross-reference could be of potential interest to geographers, historians, and other social scientists studying the area. In the present case, a number of other purposes could also be served. Studies of Chinese trade and political relations with Southeast Asia could be facilitated by the material presented here. The same comment may be made with regard to contacts with India and the Arab World. Other uses might include the better comprehension of archaeological sites, research on floral and faunal assemblages based on historical references, and the linguistic and cultural analysis of place-name derivations. It is my belief that this gazetteer could be useful in a variety of other contexts, and it is my hope that the flaws that undoubtedly remain will not detract excessively from that usefulness.

Robert F. Austin, 1986.
A Historical Gazetteer of Southeast Asia
Institute of Mathematical Geography, Monograph Series.
Monograph #4
Ann Arbor, Michigan.

What is missing, however, in the earlier (text only) work is visualization of these placenames. That lack is not a weakness of the work; it is rather a sign of the

times. Maps were static; production costs of maps prohibited the use of large numbers of maps. Color production was costly. Portrayal of materials on a globe, in a dynamic fashion, was unheard of. Today, all of those lacks are easily addressed. It is important to address them and bring fine scholarly documents, such as Austin's, into the contemporary realm where they might continue to stimulate others for years to come.   The spatial component, and its visualization, is critical to persistence of geographical information.

The visual material below suggests one way to update Austin's contribution by the easy introduction of a substantial spatial component.   Only entries from the Gazetteer with coordinates noted there are included in these files (other than in those dealing with benchmarking of files).

- The animations are made from screen captures of material in Google Earth.
- Links to individual frames, and to movies, are provided for readers wishing a closer view and control over individual animation frames.
- The reader who is truly serious, however, about augmenting the text with optimal visualization capability should download associated .kmz files (from the link at the top) and view them in Google Earth.
    - Figure 1, the most important visualization. See Austin's work on the surface of the globe in association with the text, all within a single window. View more; use the .kmz file in Google Earth. Scroll down in the text section to view the entire chapter in association with appropriate images.
    - Figure 2. Or, look for patterns in linguistic variation by first letter of place name. Why are the names beginning with C so clustered while those beginning with other letters are not? Do observations such as these offer guidance for research paths not only in history and geography but also in far-flung fields such as linguistics?
    - Figure 3. Test the geographic coordinates given in the Gazetteer against place names already present in Google Earth.
    - Figure 4. Zoom in, take a look around and think about how what you are seeing associates with what you already know about the location and also think about how it might offer guidance for related research paths!
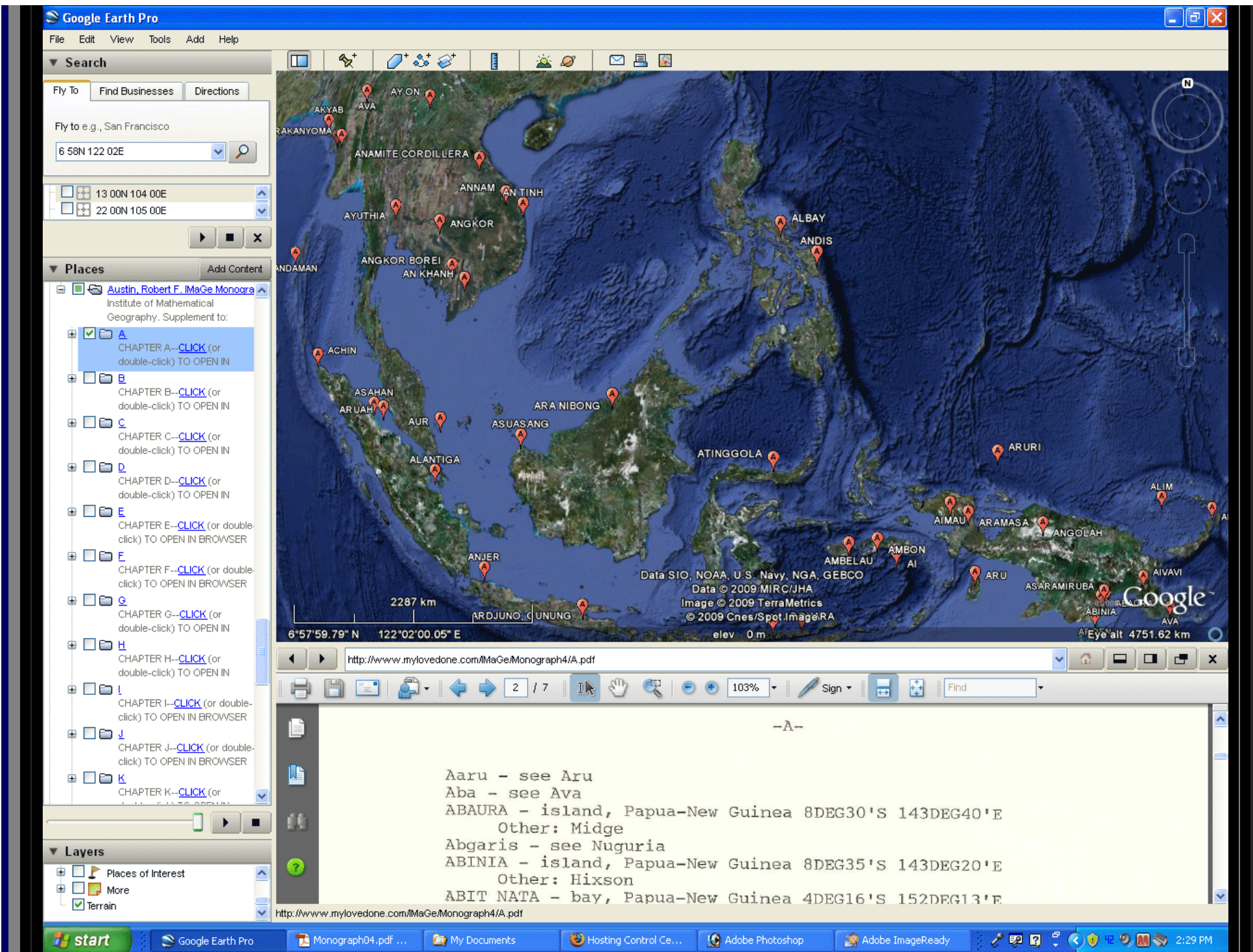
Figure 1. See Austin's work on the surface of the globe in association with the text, all within a single window.
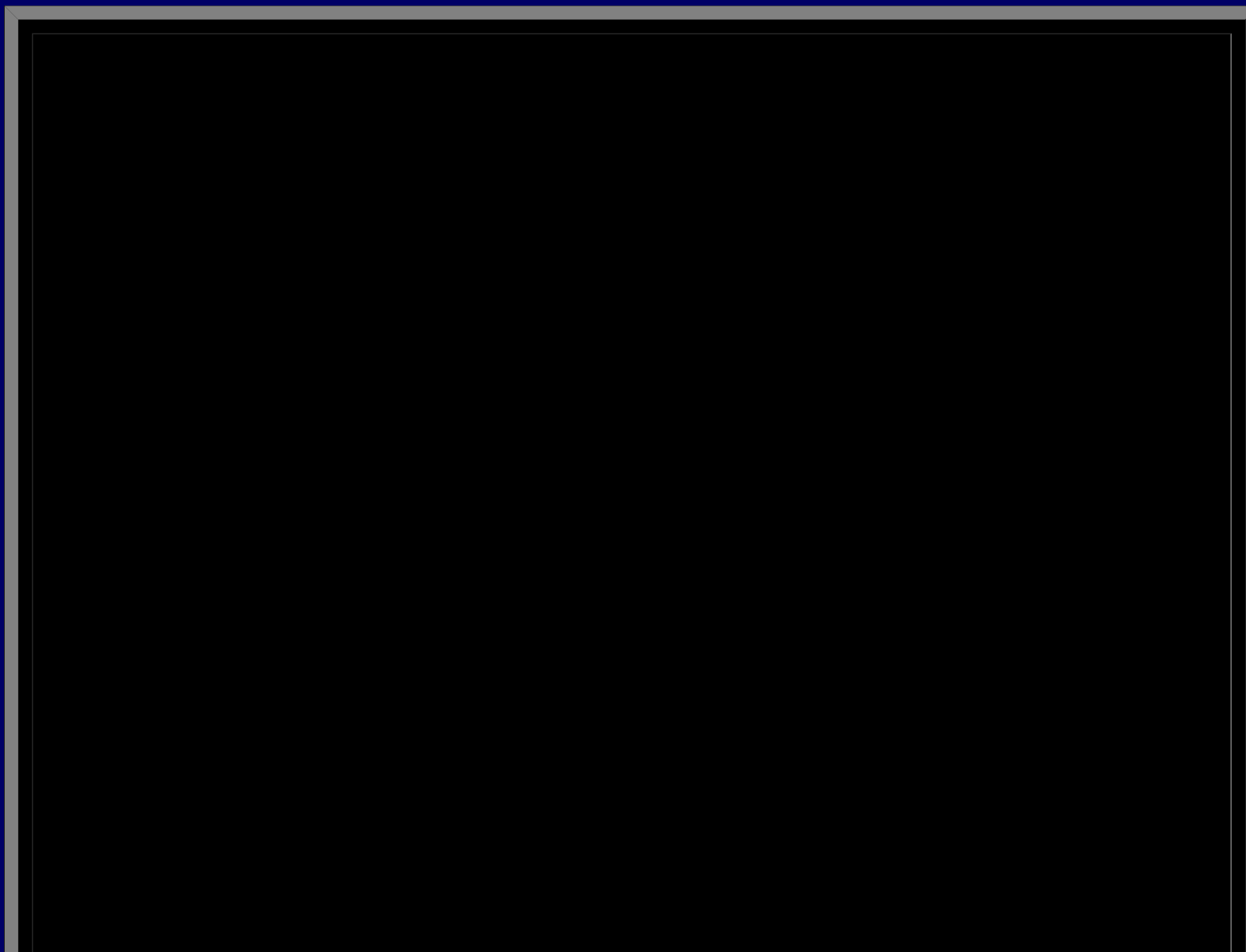
Best view: download the Google Earth .kmz file, open Google Earth, pull down file, and choose "open". Then navigate to where you chose to store the .kmz file and open it. Otherwise:
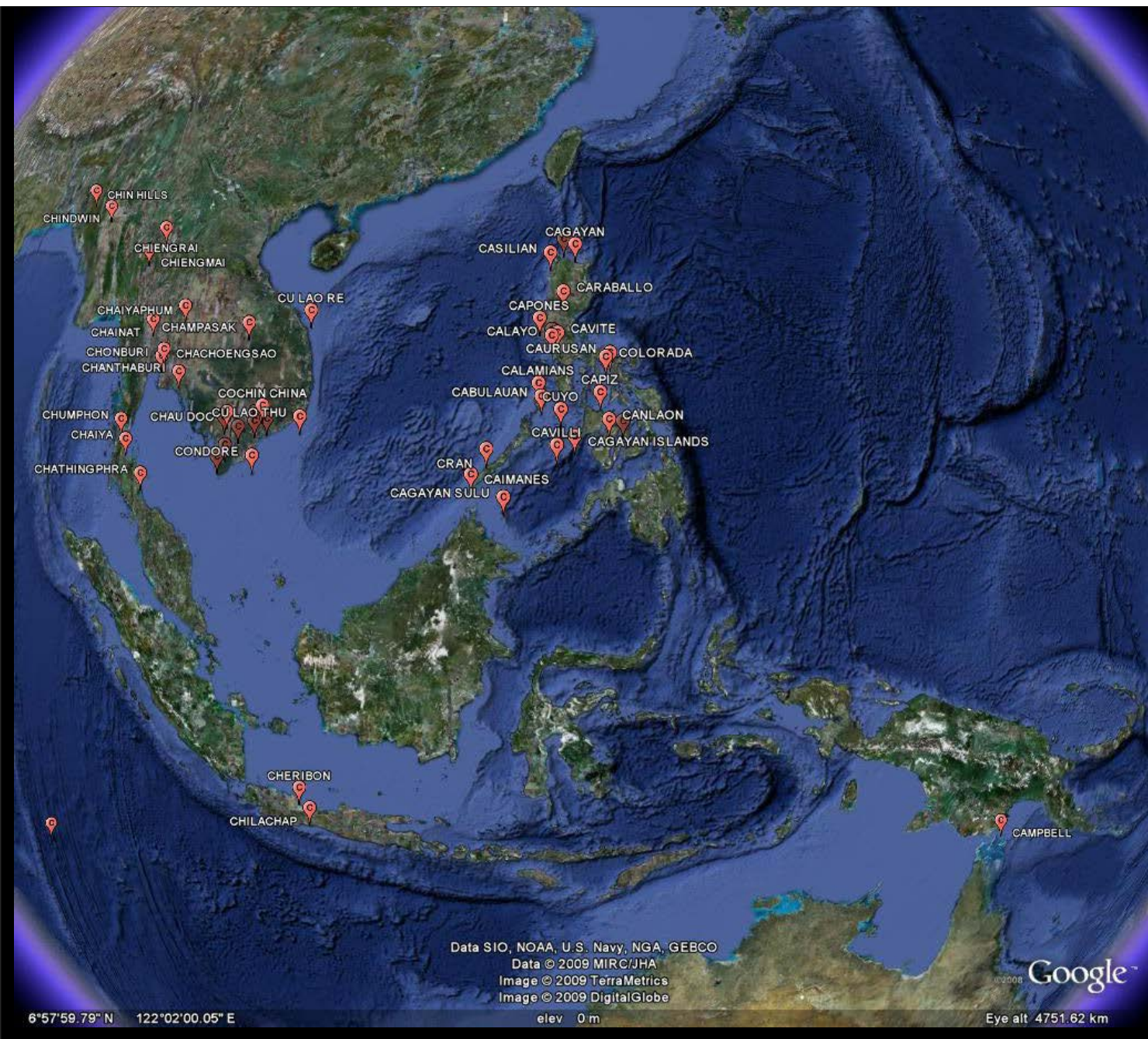
Links to individual images: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z. All layers, together.

Links to individual chapters: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

Link to movie.

Visualization offers far more than mere displays to brighten up text. When used creatively, it may support existing knowledge in a positive manner, suggest related channels for research that were previously hidden, or even suggest directions for entirely new research projects (see Figure 2).

Figure 2.   Why are the names beginning with C so clustered while those beginning with S are not? Is that observation of significance or is it simply a consequence of the selection of the subset of names from all names (or both)?
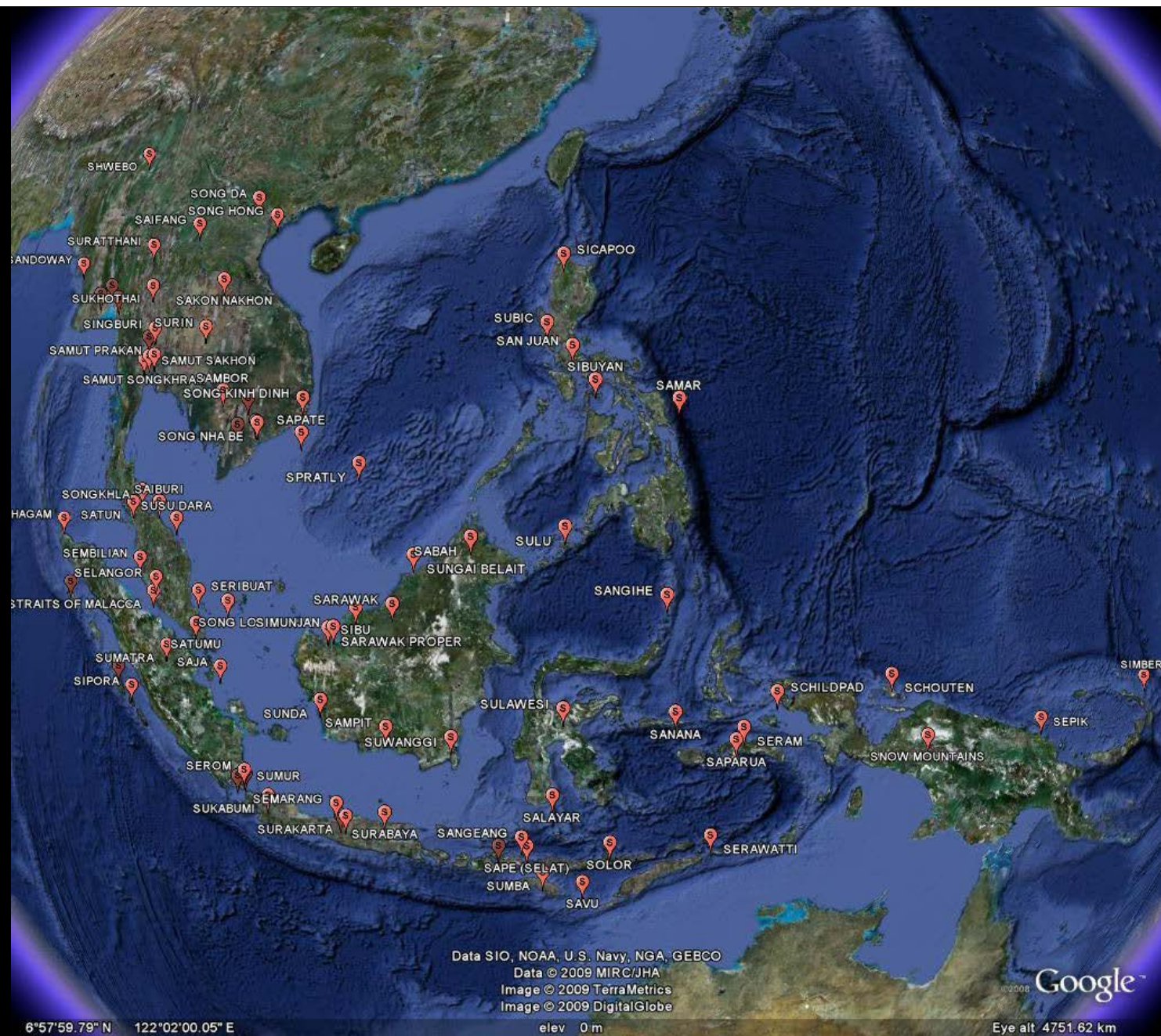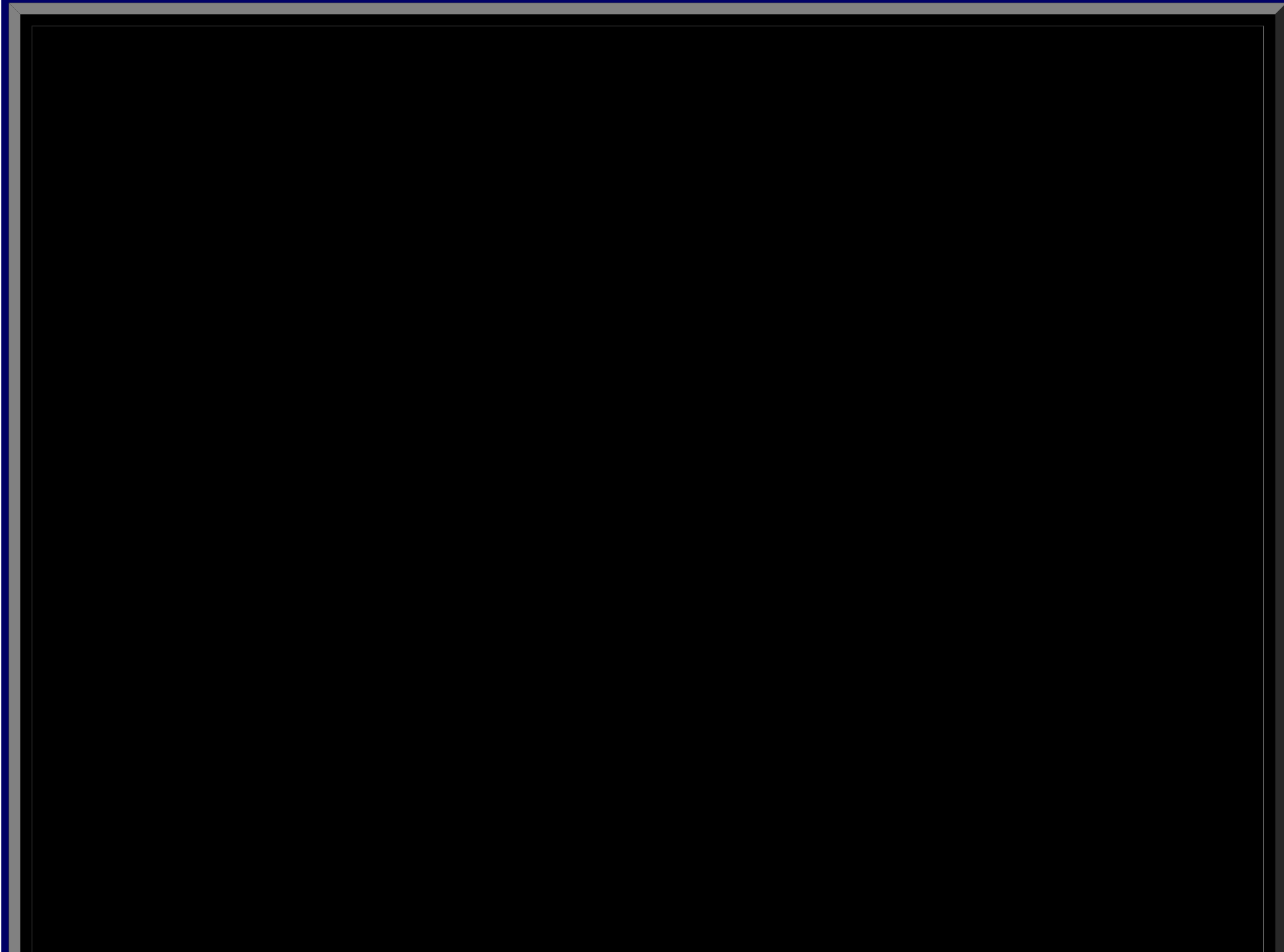
Benchmark the locations in the monograph against locations in the Google Earth default database. Good alignment offers some degree confidence in both. Gaps in alignment offer opportunities for closer looks (see Figure 3).

Figure 3. Test the geographic coordinates given in the Gazetteer against place names already present in Google Earth. Here, place names beginning with the letter "H" are used. The green hexagons show Gazetteer place names that also appear in Google Earth together with the yellow markers for the Google Earth locations. In most cases, but not all, the fit is good but not perfect. The case of Hermana Menor and Major cannot be separated at the broader scale and so a closer look is taken. The need to do so gives the reader a clear idea of the coarseness of the scale in terms of separation, or lack thereof, of icons. The set of all Gazetteer place names beginning with H is shown along with the hexagons to suggest the level of coverage between Gazetteer and Google Earth. In the case of this letter, the coverage is about half. Pink triangular icons mark locations in the Gazetteer but not in the Google Earth database.

View recent Tsunami, or other environmental, damage in relation to historical place names. Think about the traditions and cultural contexts that might have been substantially altered in a brief amount of time. Consider studying the rebuilding process as the phoenix rises around the world.
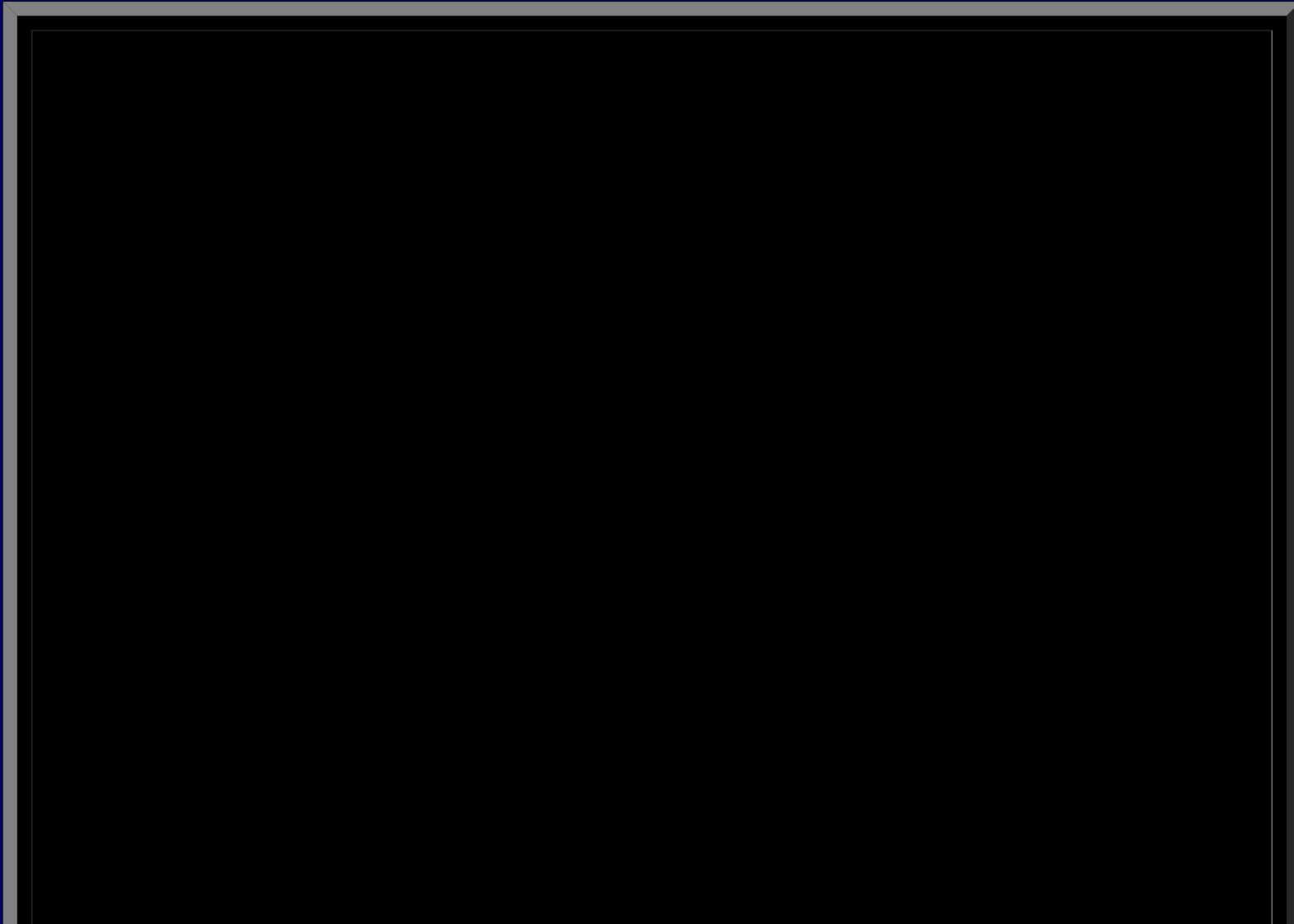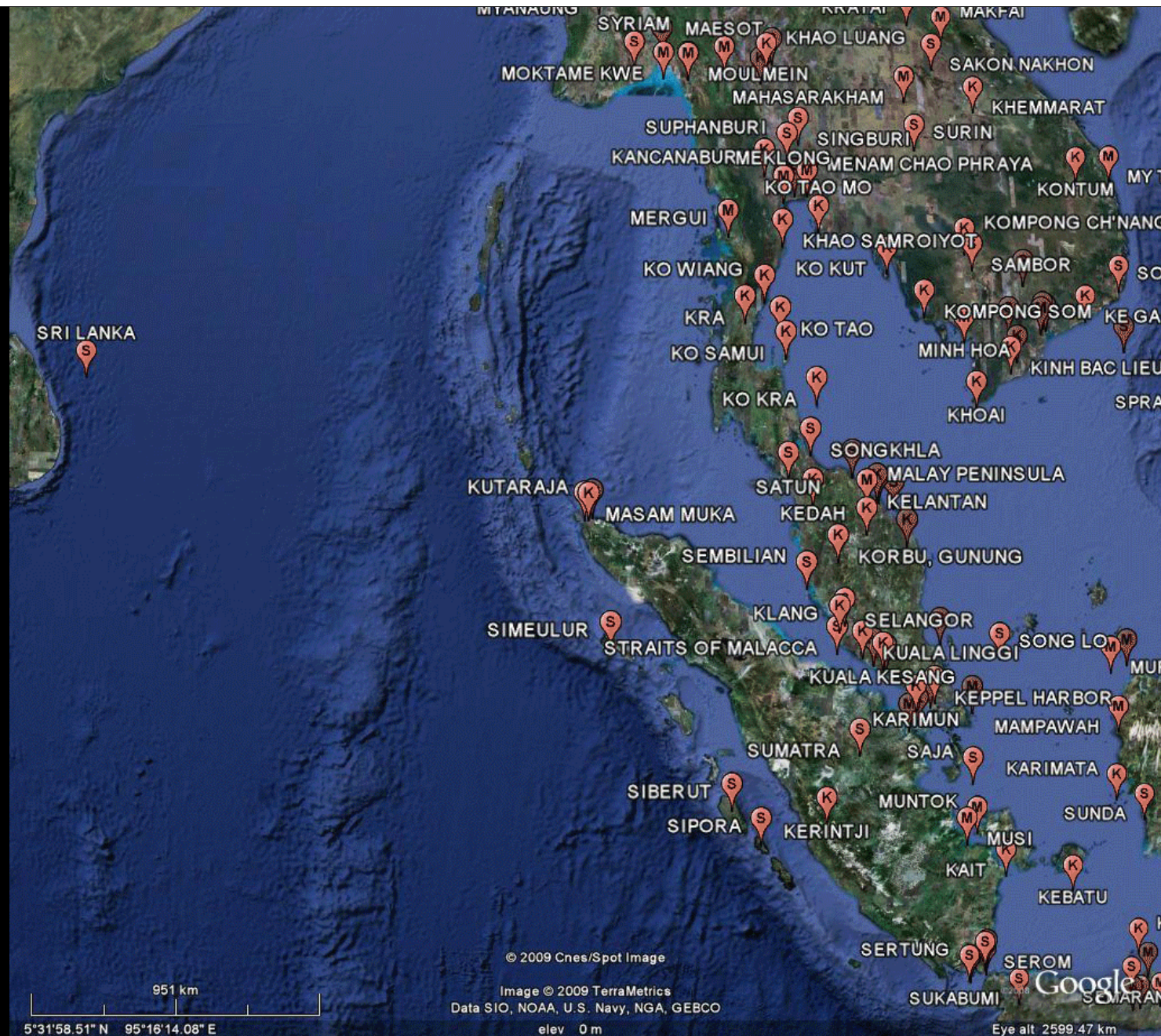
Figure 4. Zoom in, take a look around and think about how what you are seeing associates with what you already know about the location and also think about how it might offer guidance for related research paths!

Once you are comfortable using Austin's Gazetteer in the Google Earth context, consider bringing in some of the historical maps already present in Google Earth, or add your own as overlays. Integrate GIS maps with a variety of kml/kmz files. Use Google SketchUp to create 3D buildings of your own. The

possibilities are endless!

REFERENCES

- Arlinghaus, Sandra Lach. 2006. <u>Banda Aceh: A View on the Globe</u> . Solstice: An Electronic Journal of Geography and Mathematics. Ann Arbor: <u>Institute of Mathematical Geography</u>.
- Austin, Robert F. 1986. *<u>A Historical Gazetteer of Southeast Asia</u>*. Ann Arbor: <u>Institute of Mathematical Geography</u>.
- <u>Lach, Donald F.</u> Asia in the Making of Europe. Volumes I and II; with E. VanKley, Volume III. University of Chicago Press.

Institute of Mathematical Geography

IMAGE

IMAGINATION

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Congratulations to all *Solstice* contributors.

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Essays on Mathematical Geography: Contemporary Visualizations

Sandra Lach Arlinghaus

Download Google Earth

Download kmz files to open in Google Earth:
Chapter 1, **Chapter 2**, **Chapter 3**, **Chapter 6**, **Chapter 8**.

This set of essays was originally published in 1986. There are 10 essays, each with text, images, and some with maps. Many of the essays involve mathematical notation and may appear complex. Visualization of these materials is limited. What is missing is visualization that displays color, 3D, and interactive imagery. That lack is not a weakness of the work; it is rather a sign of the times. Maps were static; production costs of maps prohibited the use of large numbers of maps. Color production was costly. Portrayal of materials on a globe, in a dynamic fashion, was unheard of. Today, all of those lacks are easily addressed. It is important to address them and bring fine scholarly documents into the contemporary realm where they might continue to stimulate others for years to come. The spatial component, and its visualization, is critical to persistence of geographical information.

The visual material below suggests one way to update these Essays by the easy introduction of a substantial spatial component. Each Essay, considered as a Chapter in the book, is treated separately. In some cases, many of the original visual materials are recast in current technology. In others, where simple line drawings suffice, fewer are done. In three cases, simple line figures seemed sufficient, alone. Generally speaking,

- The animations are made from screen captures of material.
- Links to individual frames, and to movies, are provided for readers wishing a closer view and control over individual animation frames.
- The reader who is truly serious about augmenting the text with optimal visualization capability should download associated files and view them in Google Earth.

CHAPTER 1: THE WELL-TEMPERED MAP PROJECTION

In this Essay, a theorem is proved (using concepts from projective geometry) linking harmonic conjugacy to perspective map projection. It is called the Harmonic Map Projection Theorem, and what it draws up and shows is that

- centers of projection that are inverses in relation to the poles of a sphere are harmonic conjugates in the projection plane in relation to the projected images of the poles of the sphere.
- as a special case of the observation above, it follows that gnomonic and orthographic projections, with inverse centers of projection in the sphere, are composed of points that are harmonic conjugates of each other in the plane [Arlinghaus, 1986].

Thus, the material below shows images from the original document in parallel with newer, livlier variations (some of the materials appeared in Arlinghaus, 2007):

- on harmonic conjugacy construction, Figure 1.1a, 1.1b, 1.1c.
- on perspective map projection construction, Figure 1.2a, 1.2b.
- on merging harmonic conjugacy and perspective map projection (Harmonic Map Projection Theorem), Figure 1.3a, 1.3b.
- on a wish for future development, Figure 1.4.
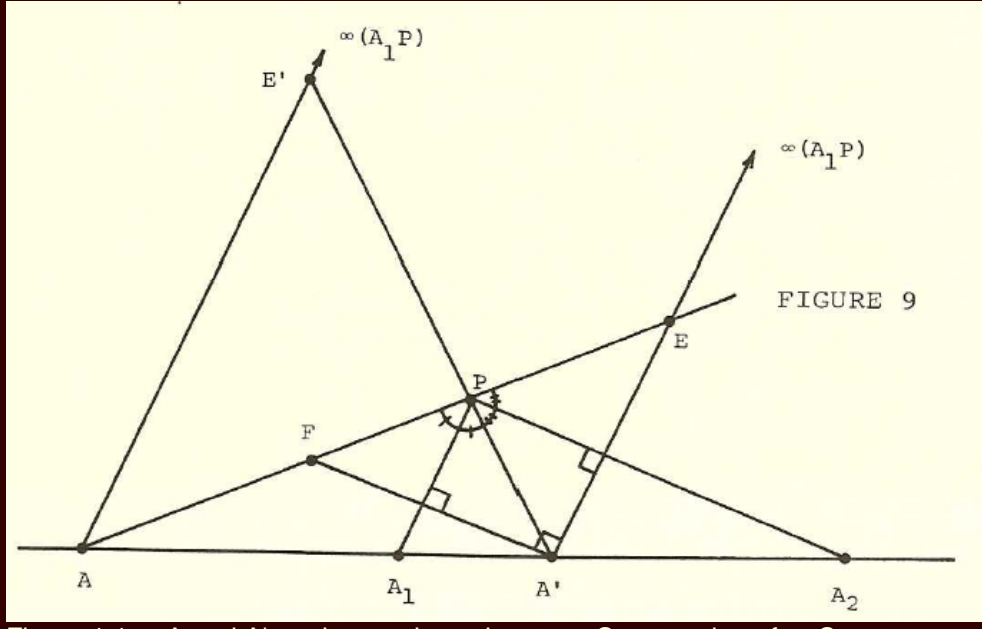
Harmonic Conjugacy Construction

Figure 1.1a. A and A' are harmonic conjugates. Construction after Coxeter.

Construction of harmonic conjugates.

Sandra Lach Arlinghaus, Ph.D.
Director, Institute of Mathematical Geography
http://www.imagenet.org/
sarhaus@umich.edu

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Figure 1.1b. *C* and *C*' are harmonic conjugates.

Construction of harmonic conjugates.

Sandra Lach Arlinghaus, Ph.D.
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http://www.imagenet.org/
sarhaus@umich.edu

All rights reserved, November, 2007.

Figure 1.1c. *C* and *C*' are harmonic conjugates.

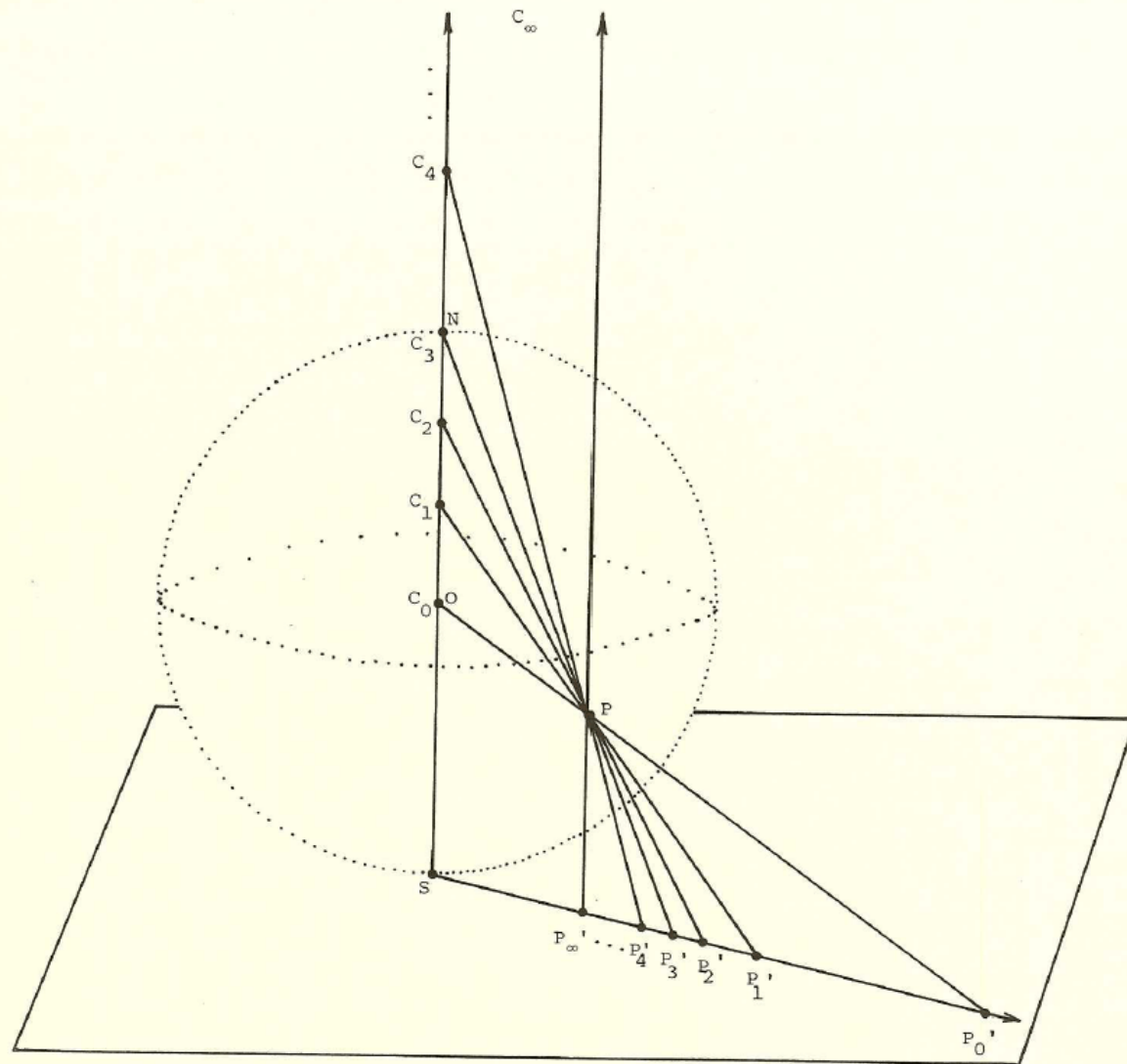**Perspective Map Projection Construction**

Figure 1.2a. Illustration showing method of projecting sphere to tangent plane using a variety of projection centers.
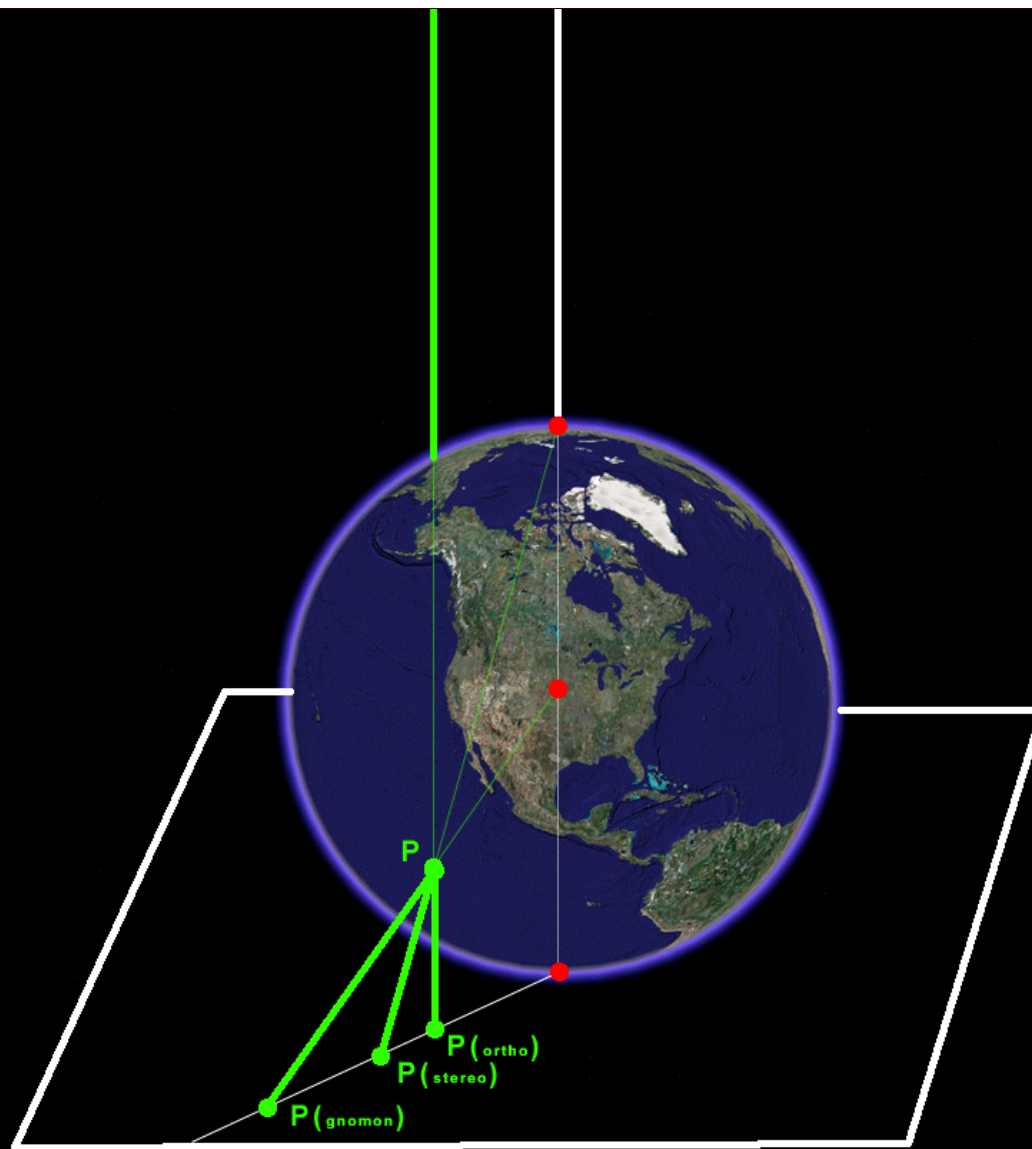
Figure 1.2b. Relationship among different perspective projection types.

Merging Harmonic Conjugacy and Perspective Map Projection Constructions: Harmonic Map Projection Theorem

Figure 1.3a. Harmonic Map Projection Theorem. Gnomonic and orthographic projections of a point *P* on the sphere, into a tangent plane, are harmonic conjugates with respect to the point of tangency of sphere and plane, *S*, and the corresponding stereographic projection of *P* into the same tangent plane.

Perspective Map Projection Construction
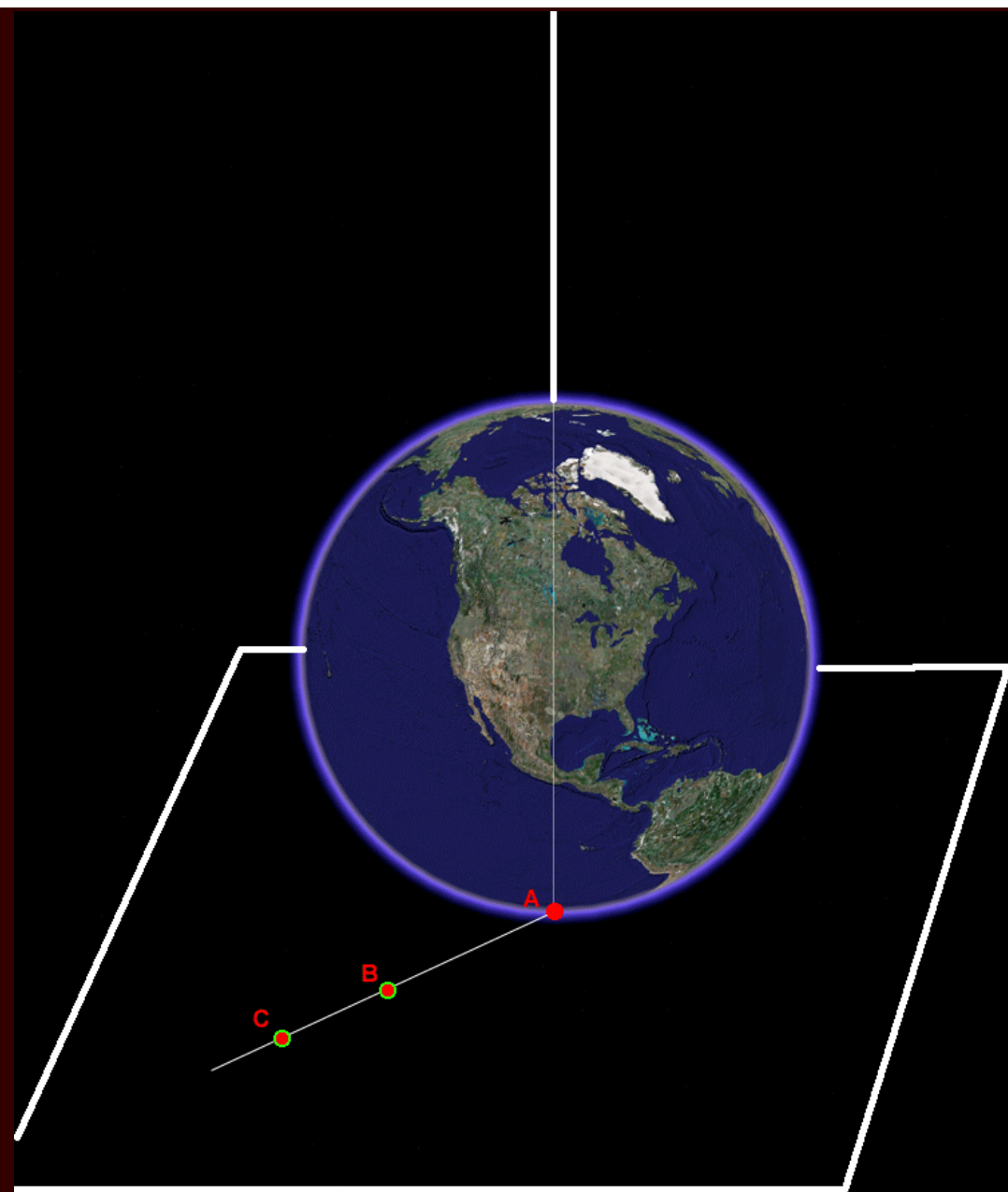
Figure 1.3b. Animation displaying content of Harmonic Map Projection Theorem. Some of the animation sequencing needs improvement for clarity of exposition of Theorem content: Join *B* to the north pole (reverse Stereo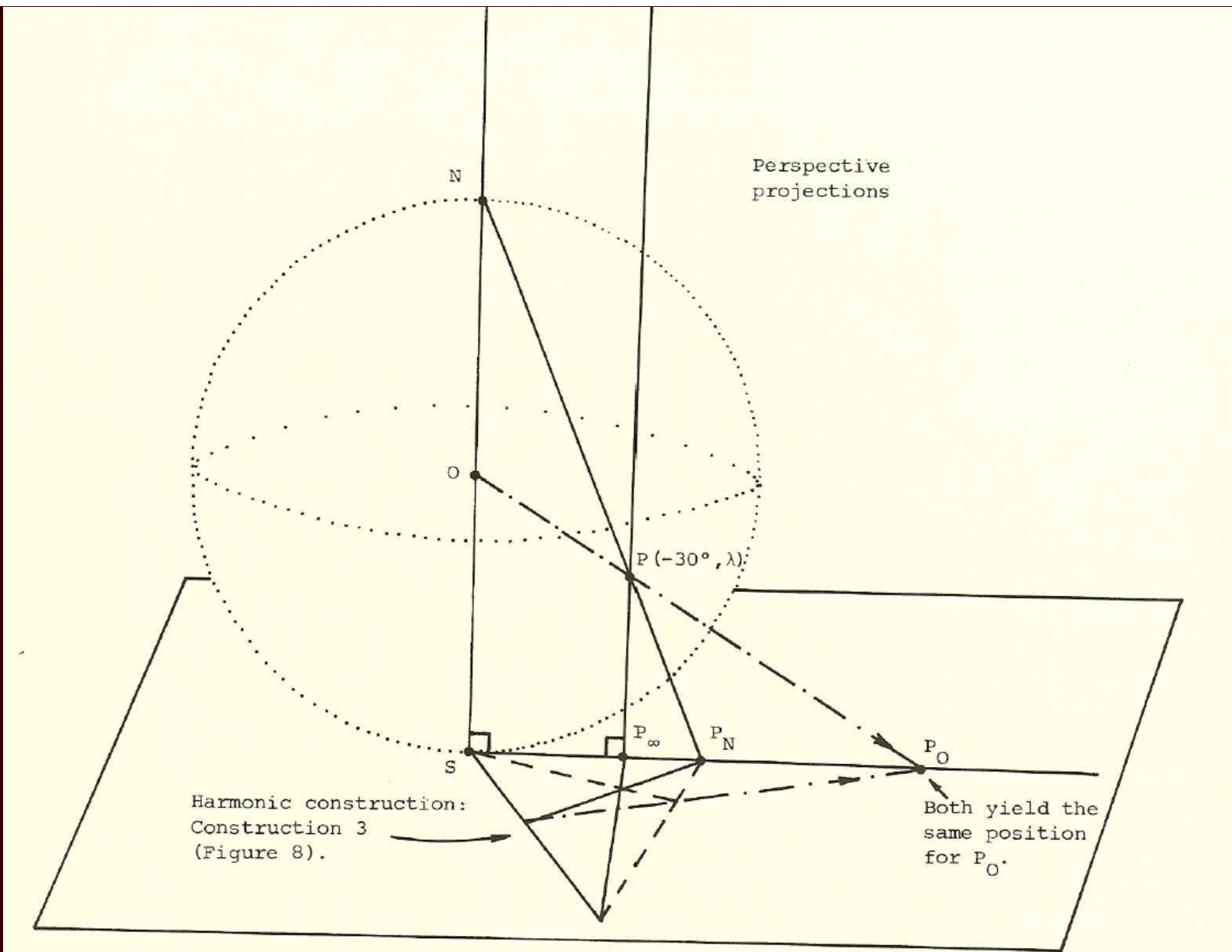graphic projection) to locate *P* on the sphere--then *C* and *C'* emerge (respectively) as harmonic conjugates of gnomonic and orthographic projection. Animation change is made in Figure 4, below. First, the harmonic construction is shown in the plane of tangency; then perspective projection, involving *P*, is merged with it.

A Wish for Future Development

Figure 1.4. The animation on the right shows the animation from Figure 1.3b with improved animation sequencing. It is an easy matter to display the animated .gif side by side with the interactive Google Earth globe. The "wish," however, is to be able to execute animated .gif style of construction

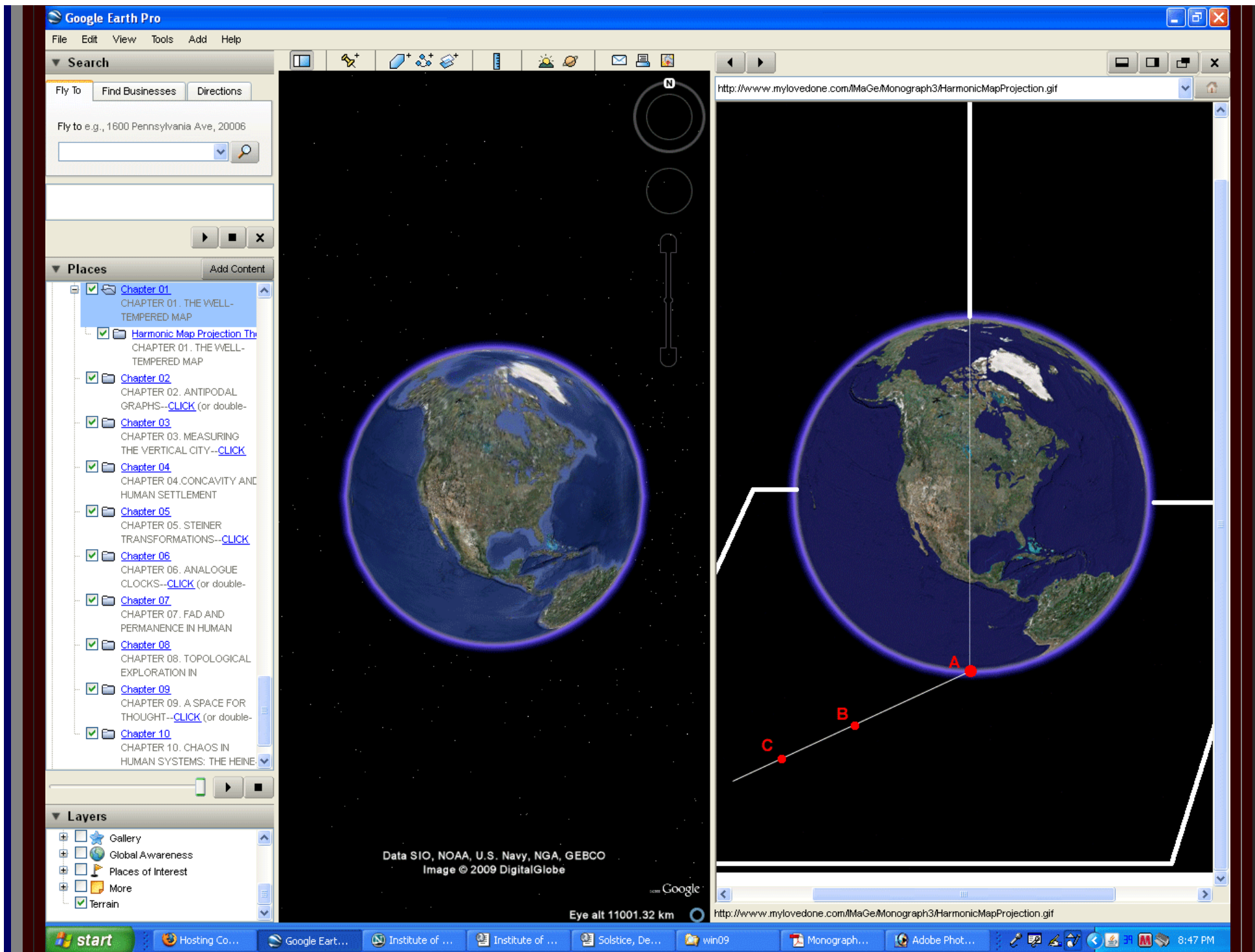directly in Google Earth (not currently possible). Were the "wish" to come true, then one might imagine that maps could be drawn in the tangent plane, showing directly how Mexico, for example, appears under orthographic projection and as the harmonic conjugate of a gnomonic projection of Mexico. The reality of maps and images could once again bring the mathematics to life! Link to movie

CHAPTER 2: ANTIPODAL GRAPHS

Satellite navigation systems often employ satellite locations that provide highly symmetric tesselations of their orbital spheres [Laurila, 1976, 1983; Wenninger, 1979]. Evenness in satellite spacing, suggested by engineering demands, may produce as an upper bound for the number of satellites visible to an earth-based observer, half the number of the total in the entire configuration. Thus, when the satellites appear in antipodal pairs, so that as one satellite descends beyond the horizon another ascends, a flat geographical map that conforms to the earth-based observer's view of the satellite sphere, and that represents simultaneously the entire satellite configuration, would appear with antipodal points identified (abstractly glued together), as an "antipodal graph" of the satellite system.

Visualizing the antipodal graph is straightforward in the plane. Figure 2.1 shows such images in the right-hand column. What is more difficult to visualize, however, is the solid embedded in a sphere and the projection of that solid to the plane, as a Schlegel diagram (which ultimately is what makes it easy to visualize the antipodal graph in the plane). The left-hand column in Figure 2.1 offers very approximate line drawings of solids while the central column portrays the Schlegel diagram of each.
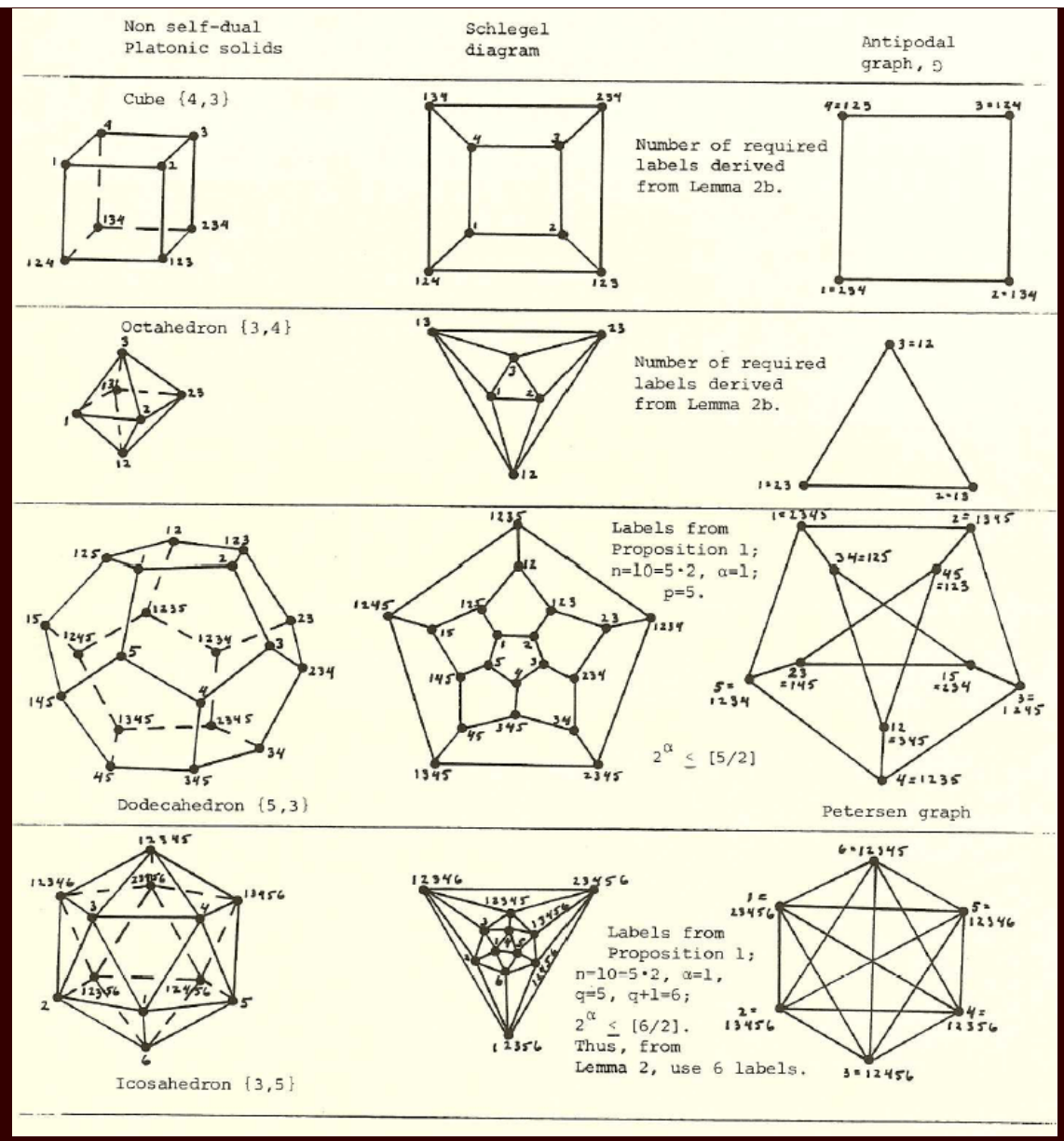
Figure 2.1. Line drawings from the original Monograph.

It is not too difficult, using Google Earth, to visualize the four polyhedra as embedded in a sphere with polyhedral edges as arcs on the sphere. When transparency is inserted in place of the Earth skin, then the corresponding Schlegel diagram emerges easily. Thus,

- Figure 2.1 shows how to make the Google Globe transparent.
- Figure 2.2 shows the cube in the transparent globe and illustrates derivation of the corresponding Schlegel diagram.
- Figure 2.3 shows the octahedron in the transparent globe and illustrates derivation of the corresponding Schlegel diagram.
- Figure 2.4 shows the dodecahedron in the transparent globe and illustrates derivation of the corresponding Schlegel diagram.

- Figure 2.5 shows the icosahedron in the transparent globe and illustrates derivation of the corresponding Schlegel diagram.

The Transparent Globe

In this essay, as in the supplement to Monograph #1, the skin is removed from Google Earth so that the globe becomes fully or partially transparent, depending on its orientation. Here, it will be used only as a fully transparent globe; in the Monograph #1 supplement, the eclipse-effect that hides lines that are sometimes apparent was studied. In the figures below, the polyhedra are oriented so as to avoid that effect although the reader who manipulates the .kmz files, from which these images were derived, will discover that eclipse effect.
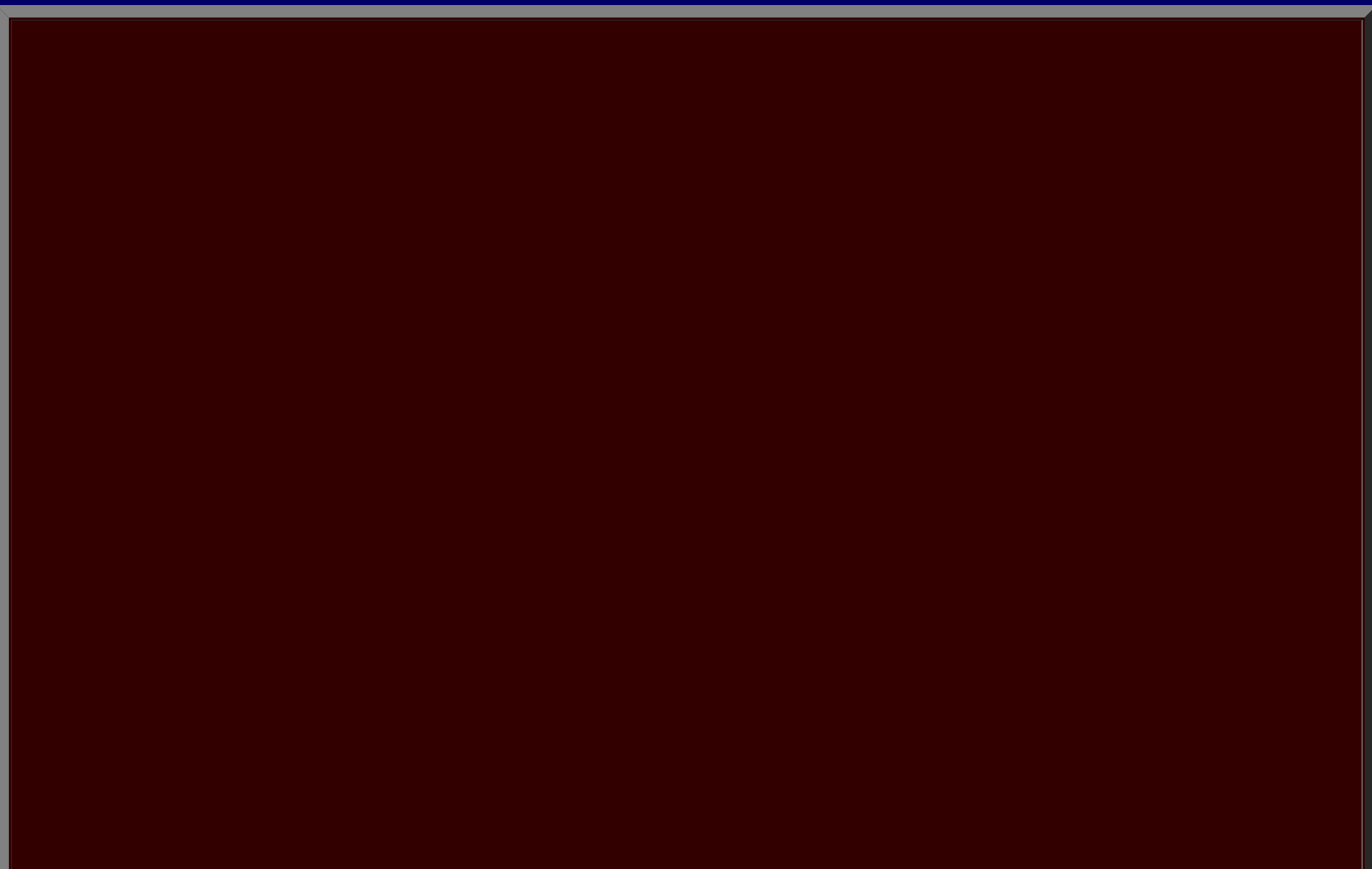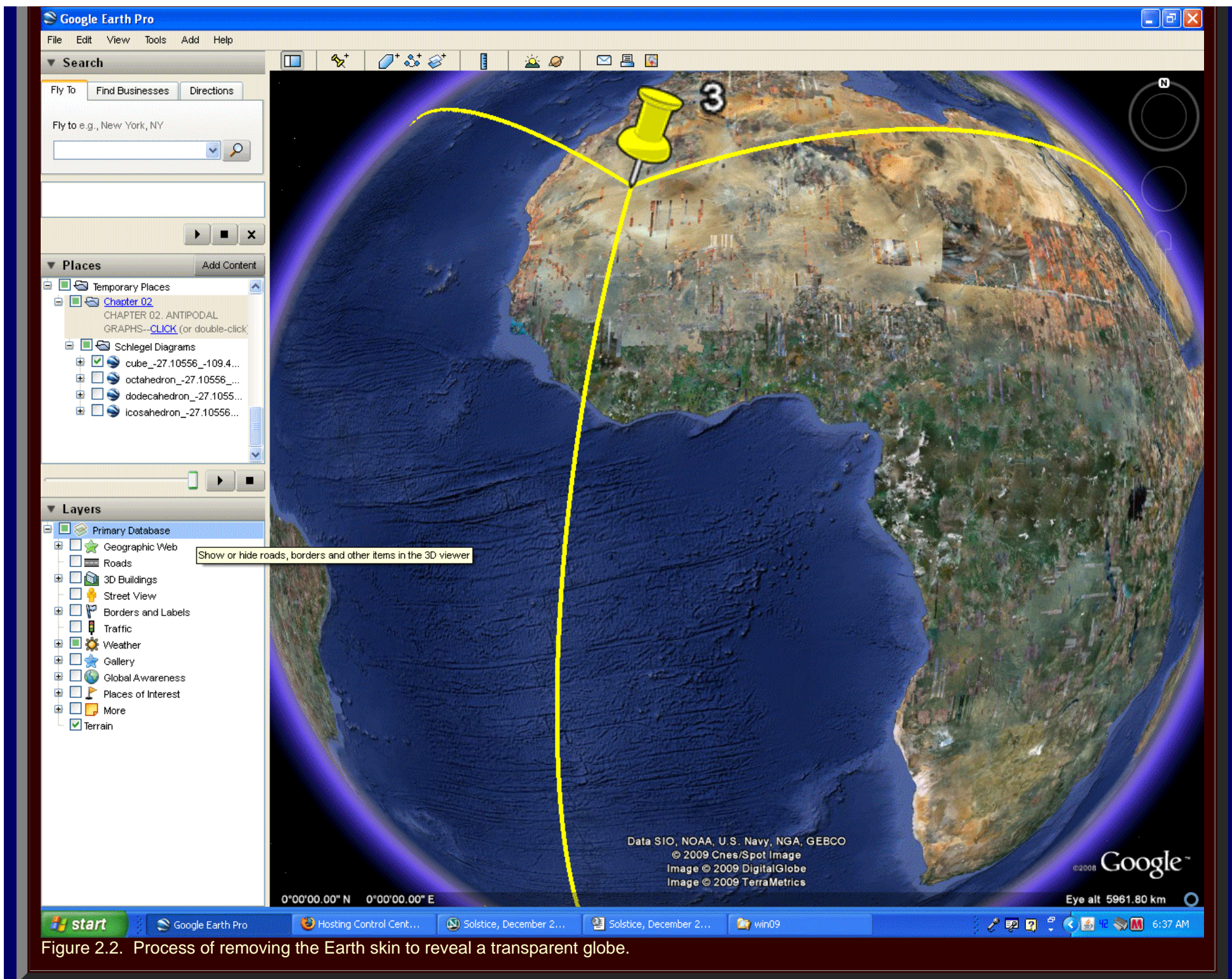
Figure 2.2. Process of removing the Earth skin to reveal a transparent globe.

The Cube Embedded in a Sphere and its Associated Schlegel Diagram

14°18'09.04" N   143°56'43.91" W   elev 0 m   Eye alt 9733.37 km

Figure 2.3a. Different views of a cube embedded in a sphere.
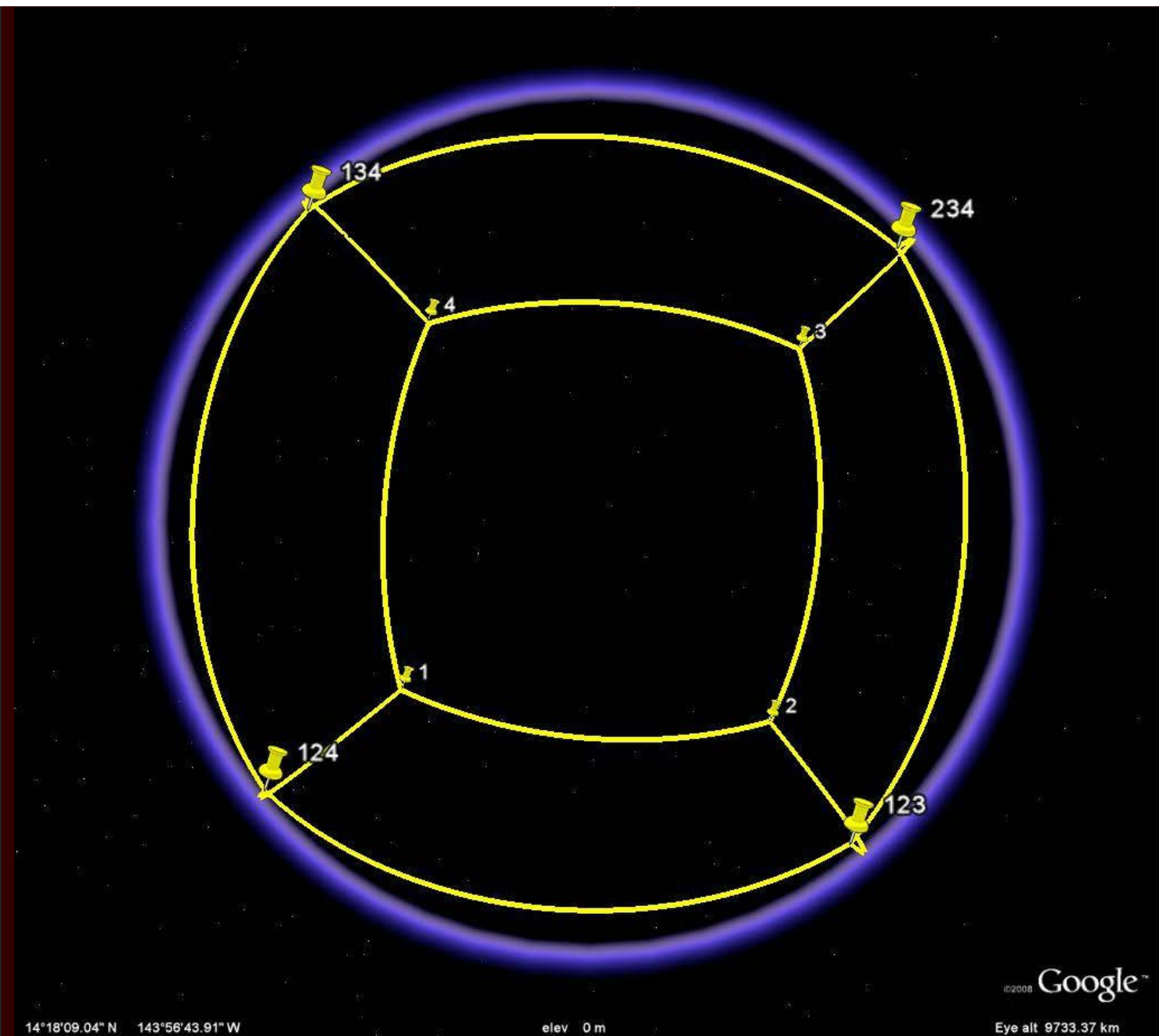
Figure 2.3b. Schlegel diagram of the cube.

Figure 2.3c. All vertices are labelled with large marker pins; however, the large ones for 1, 2, 3, and 4 are not visible through the globe, even though the edges of the cube are visible. Thus, to get a screen capture of a Schlegel diagram associated with the cube, insert an extra four pins (smaller) visible from the "front" view. In this animation, note that as the globe moves, the large marker pins come into view. Those added simply to create the Schlegel diagram from one perspective do not stay attached as the cube moves on the sphere. This sort of "flattening" effect of the notation is what brings the Schlegel diagram to life.

The Octahedron Embedded in a Sphere and its Associated Schlegel Diagram

Figure 2.4a. Different views of an octahedron embedded in a sphere.
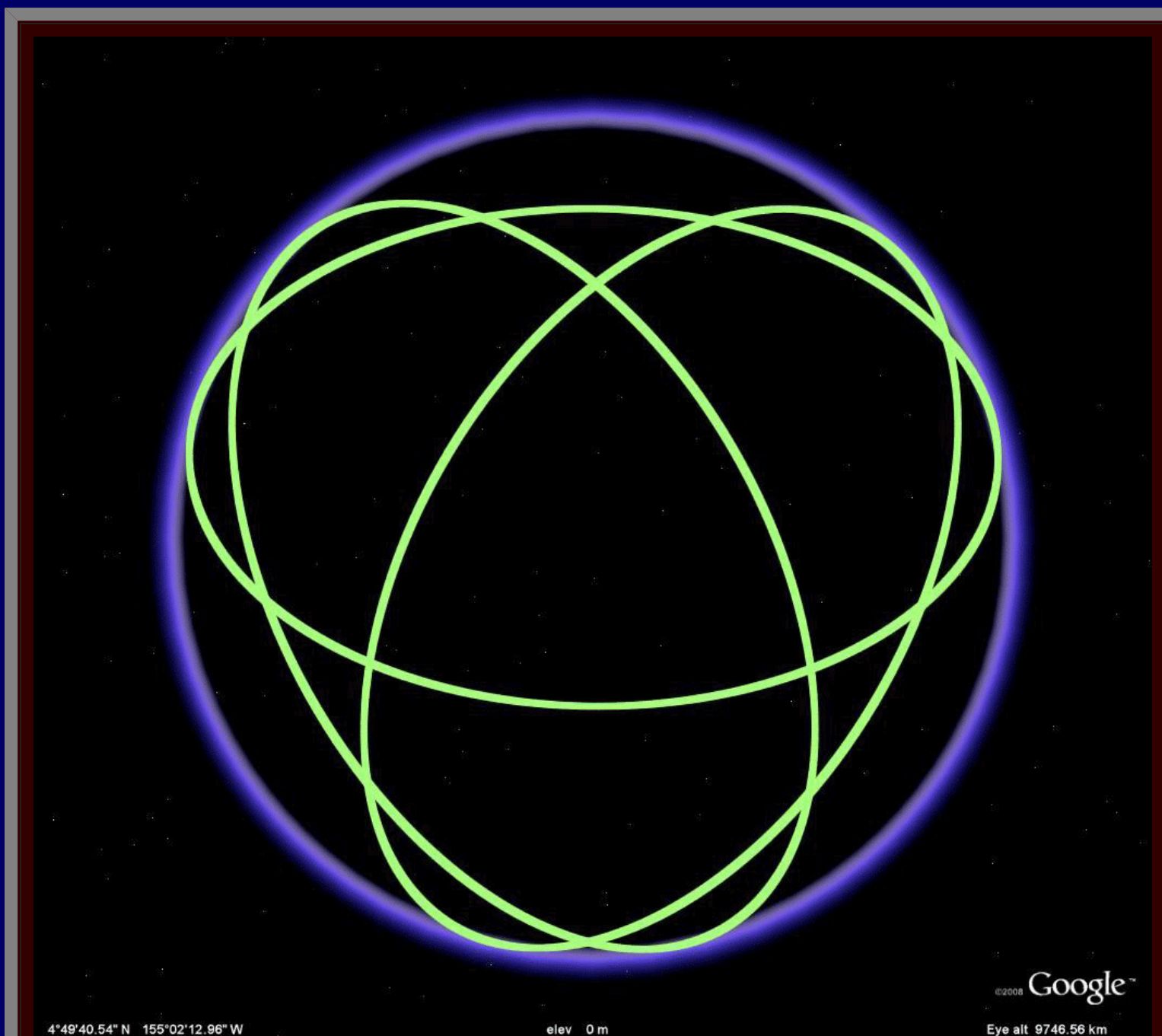
4°49'40.54" N   155°02'12.96" W   elev 0 m   Eye alt 9746.56 km
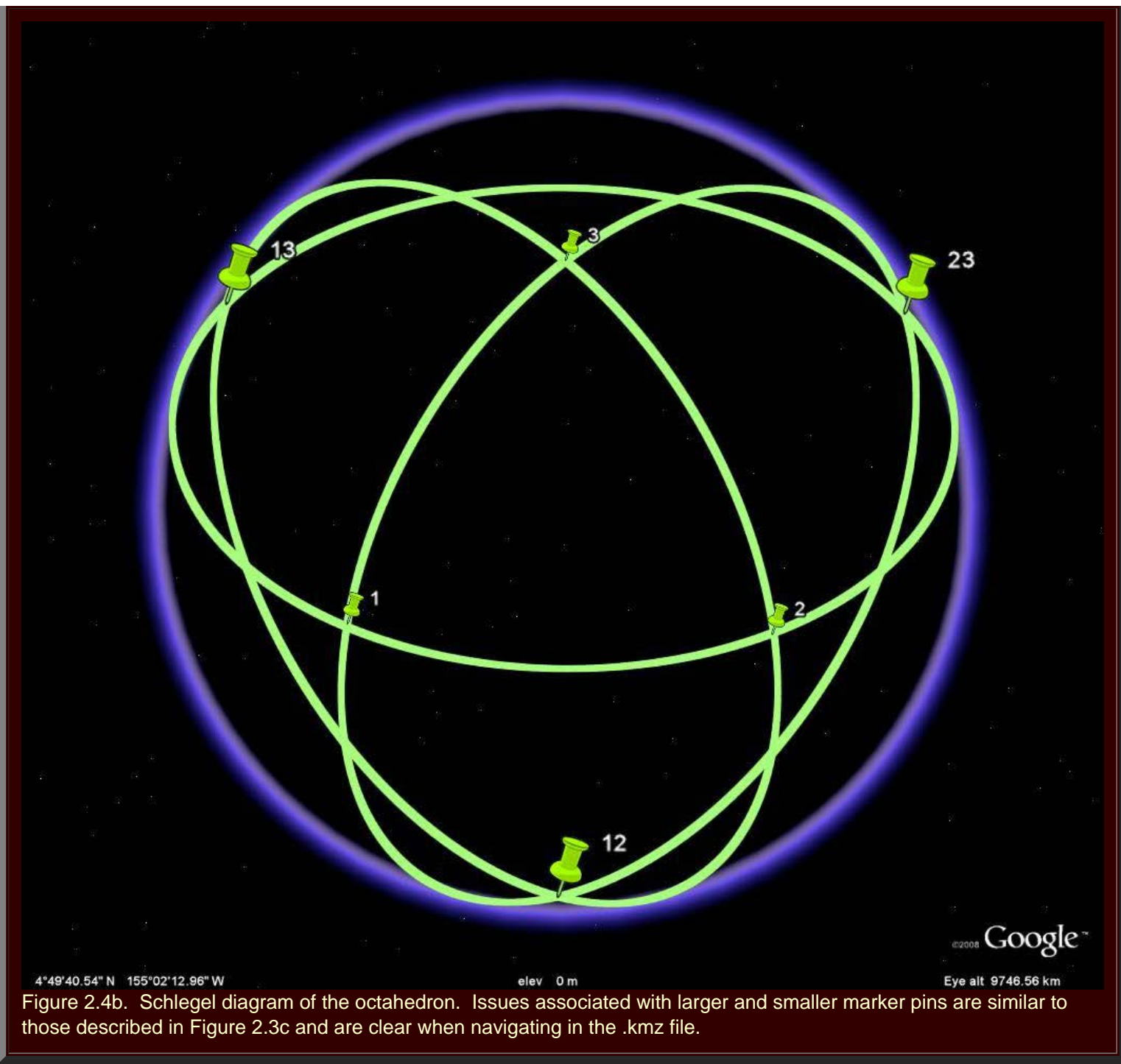
Figure 2.4b. Schlegel diagram of the octahedron. Issues associated with larger and smaller marker pins are similar to those described in Figure 2.3c and are clear when navigating in the .kmz file.

The Dodecahedron Embedded in a Sphere and its Associated Schlegel Diagram

1°00'53.36" N   134°18'23.94" W   elev 0 m   Eye alt 9754.97 km
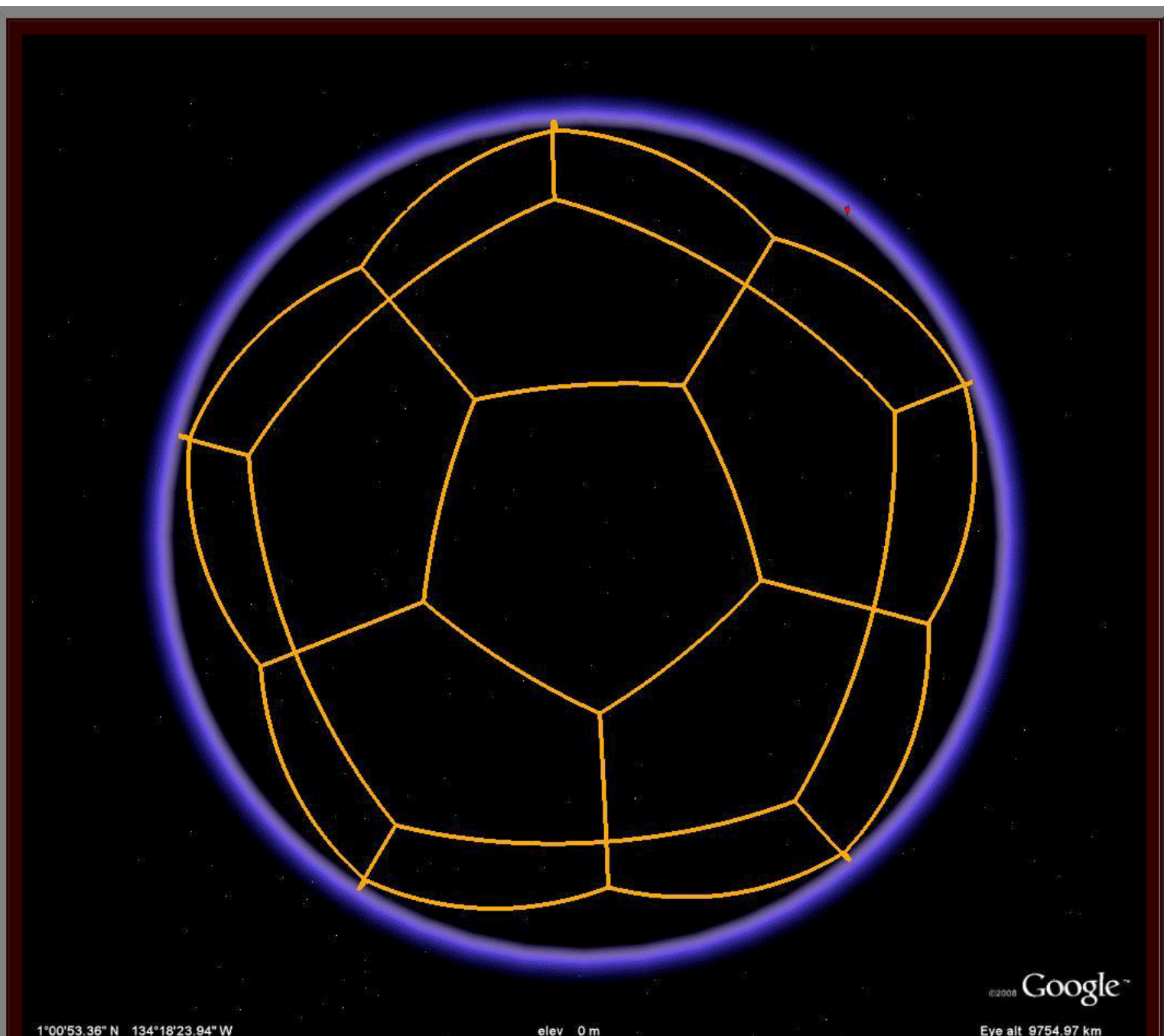
Figure 2.5a. Different views of a dodecahedron embedded in a sphere.
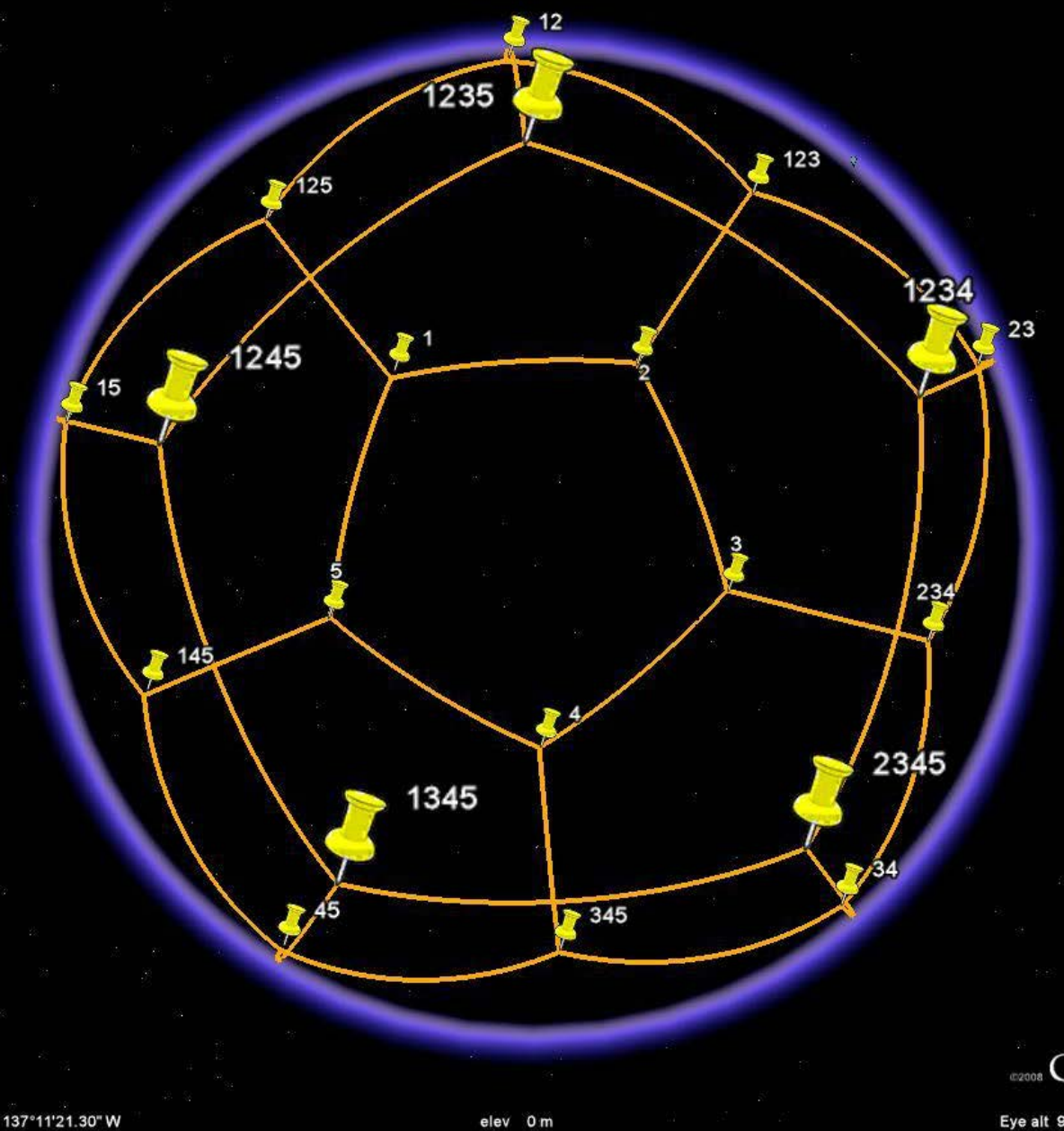
Figure 2.5b. Schlegel diagram of the dodecahedron. Issues associated with larger and smaller marker pins are similar to those described in Figure 2.3c and are clear when navigating in the .kmz file.

The Icosahedron Embedded in a Sphere and its Associated Schlegel Diagram

9°58'14.15" N   35°07'35.48" E   elev 931 m   Eye alt 9731.71 km
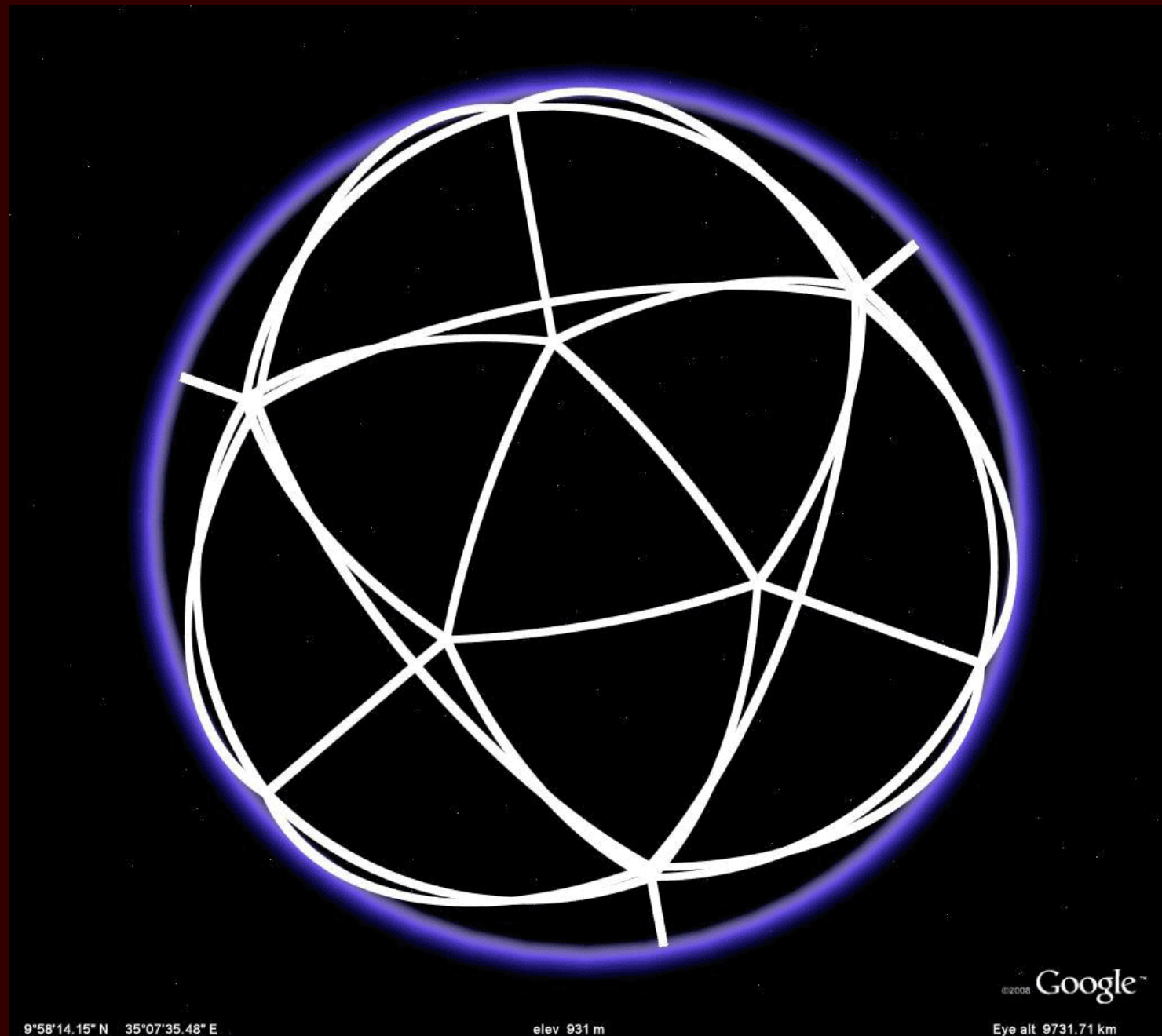
Figure 2.6a. Different views of an icosahedron embedded in a sphere.
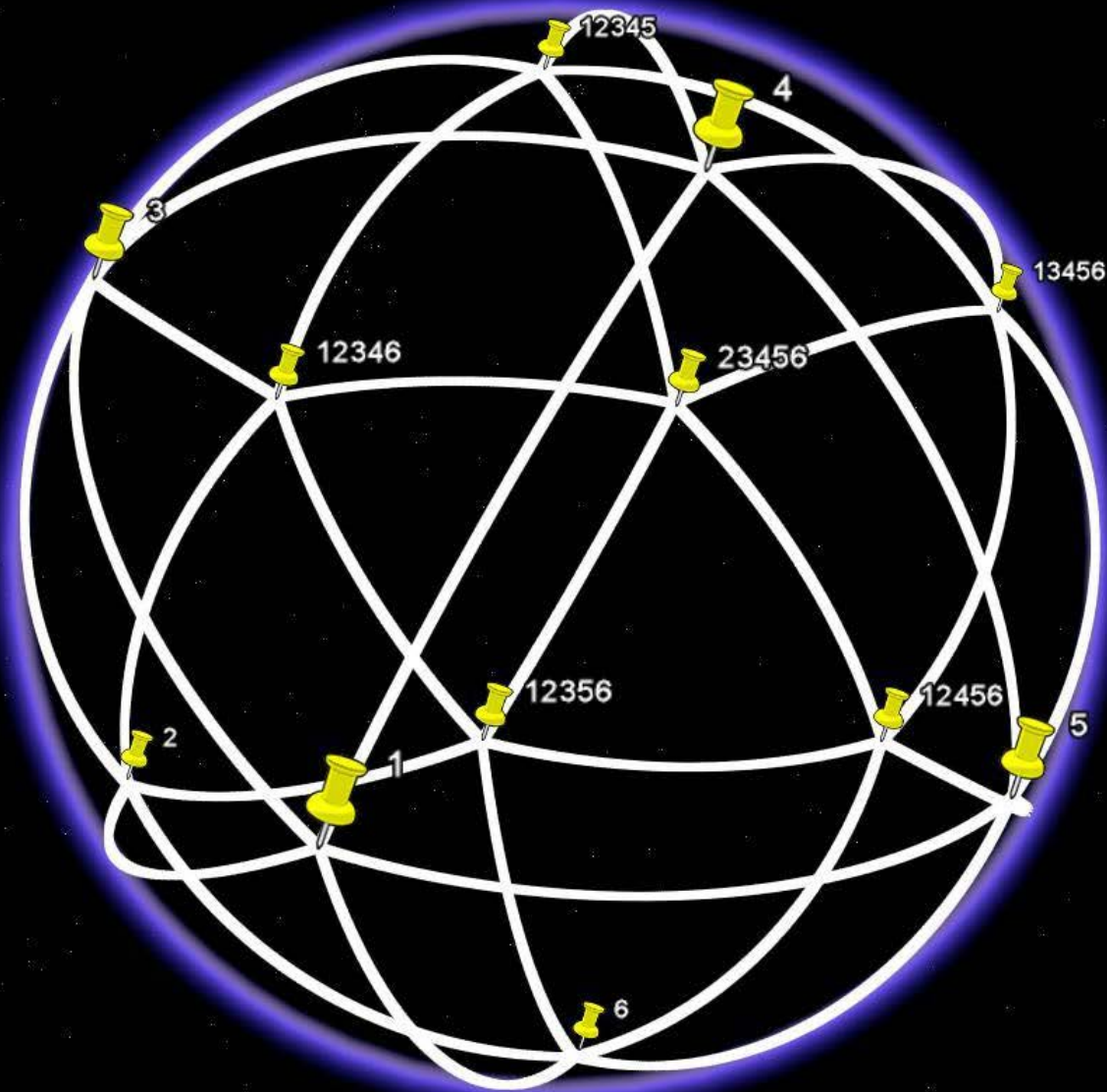
Figure 2.6b. Schlegel diagram of the icosahedron. A vantage point for viewing this configuration was chosen so that all vertices would show. Issues associated with larger and smaller marker pins are similar to those described in Figure 2.3c and are clear when navigating in the .kmz file.

The reader wishing to see other interactive views of graph theory and geography might look elsewhere in *Solstice* or might read the work of Arlinghaus,

Arlinghaus, and Harary (2002).

CHAPTER 3: MEASURING THE VERTICAL CITY

   In this essay, the idea of planning using "volume" in addition to parcels, is explored. Analysis of hypothetical parcel maps, and their extrusions, is executed using matrix algebra in order to quantify a 3D "view" of the city. Google SketchUp and other 3D modeling software offers contemporary ways to capture a volumetric approach to planning in relation to possible volume standards and elements of code. Here, the concept is to have a terraced approach so that tall buildings are set back and do not loom large over streets and pedestrian corridors. Other planning approaches of course might be adopted but those do not alter the conceptual approaches advanced here nor do they alter the appropriateness of using 3D models to capture spatial elements of urban planning.

FIGURE 1

center
of
block

street

street

street

street

o	o	o	o	o	o	o	o	o	o	o	o
o	1	1	1	1	1	1	1	1	1	1	o
o	1	2	2	2	2	2	2	2	2	1	o
o	1	2	3	3	3	3	3	3	2	1	o
o	1	2	3	4	4	4	4	3	2	1	o
o	1	2	3	4	5	5	4	3	2	1	o
o	1	2	3	4	5	5	4	3	2	1	o
o	1	2	3	4	4	4	4	3	2	1	o
o	1	2	3	3	3	3	3	3	2	1	o
o	1	2	2	2	2	2	2	2	2	1	o
o	1	1	1	1	1	1	1	1	1	1	o
o	o	o	o	o	o	o	o	o	o	o	o

street

FIGURE 2

Figure 3.1. Hypothetical parcel map, below, and suggestion of how to visualize it in 3D, above.
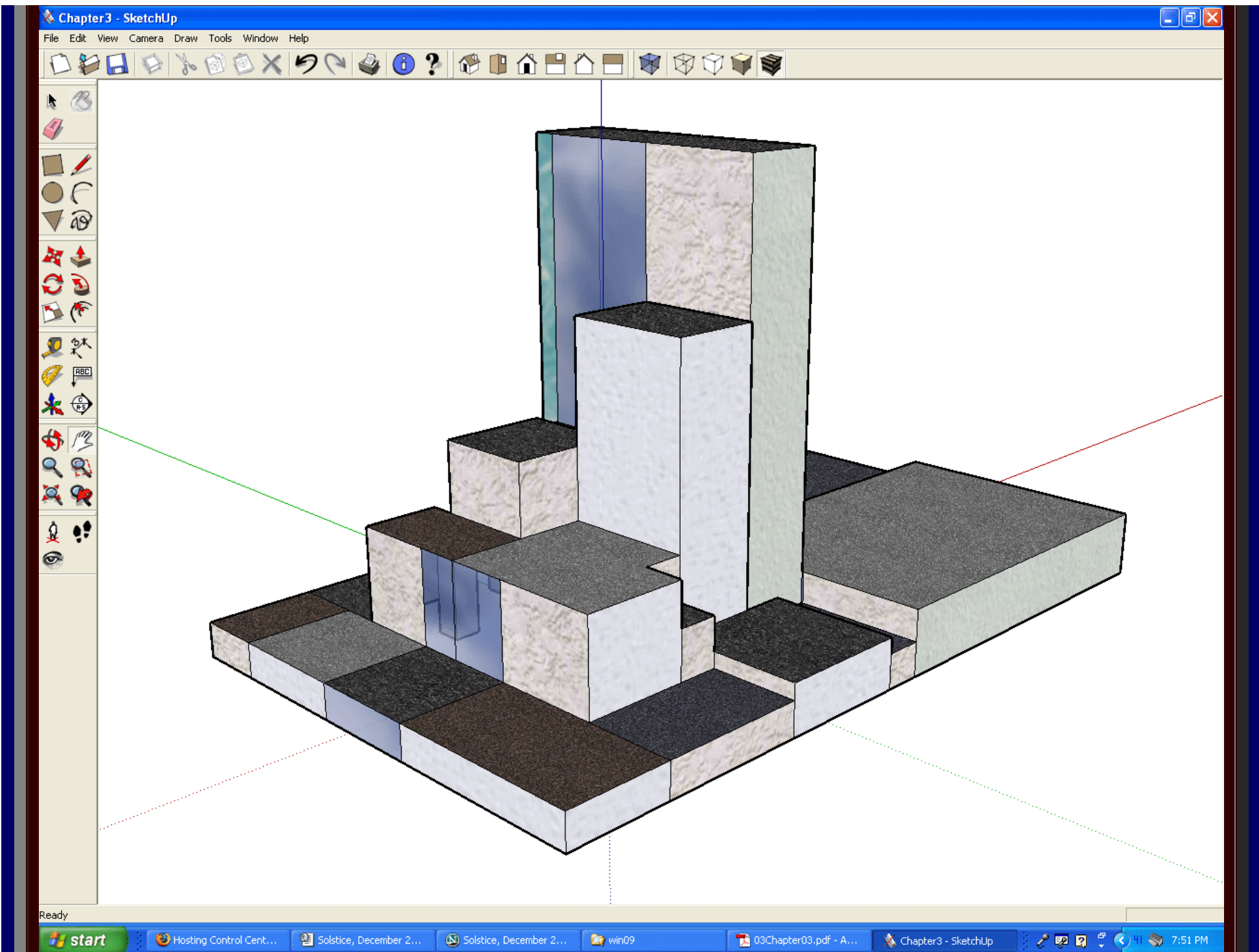
Figure 3.2. A more contemporary approach to visualizing a hypothetical parcel map (more complex than the one in Figure 3.1) together with associated terraced volumes of possible building masses offers added analysis opportunity, particularly when coupled with other conceptual material, such as the

matrix algebra characterizations of vertical parcel occupation by buildings. Viewshed calculations and related concepts come about from such considerations.

January
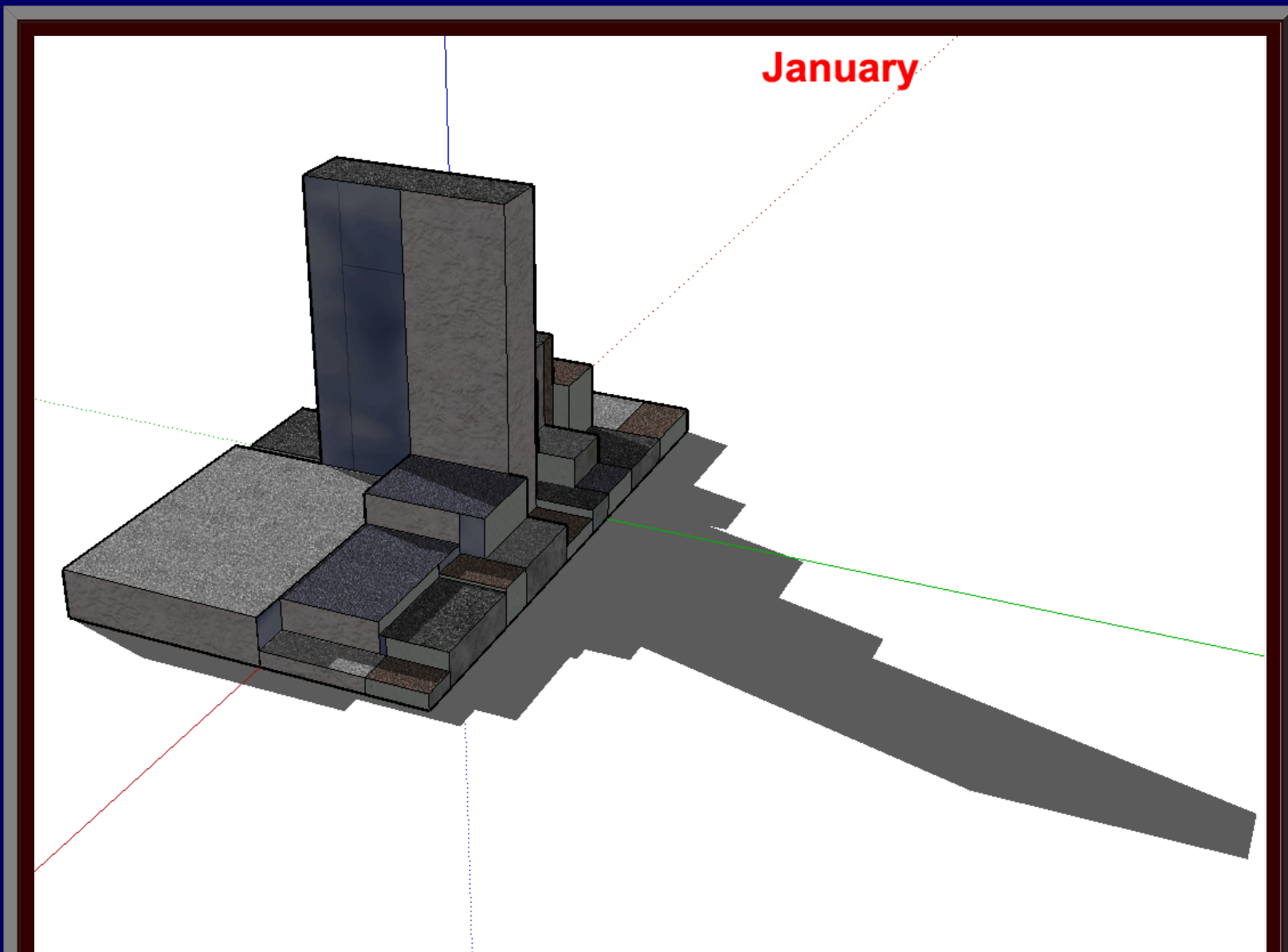
Figure 3.3. Google SketchUp offers the opportunity to study shadow patterns, as well. Here, screen captures of shadows from the hypothetical block dance across the screen, in a labelled animation, in each of the 12 months of the year. Watch the shadows on the ground and also on the other buildings. The time of day is about 1:00p.m. Latitude is not given.

CHAPTER 4: CONCAVITY AND HUMAN SETTLEMENT PATTERNS

The shape of the northern coastline of Australia has been generalized, by biologist Joseph Birdsell, as two concave-down lobes of land separated by a concave-up lobe of water (Gulf of Carpentaria) [Birdsell, 1950]. Through this geometric observation, and through a study of the hunting and gathering practices of early migrants, he argued that a strong sense of territoriality would force migrants toward the interior, away from points of entry on the coast, and that coastline shape would force concentration of migrant settlement under concave-down northern coastline segments and dispersal of migrant settlement under concave-up northern coastline segments (Figure 4.1). One speculation derived from these geometric observations is that greater genetic diversity would occur in settlements located under concave-down northern coastline segments than would occur in settlements located under concave-up northern coastline segments.
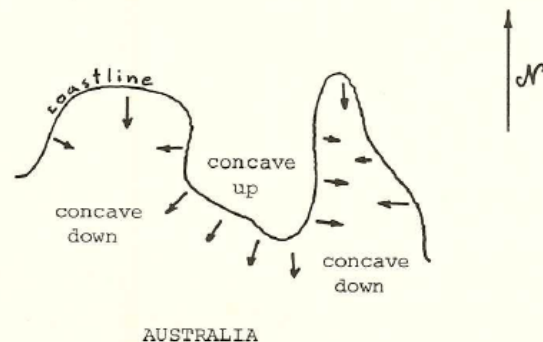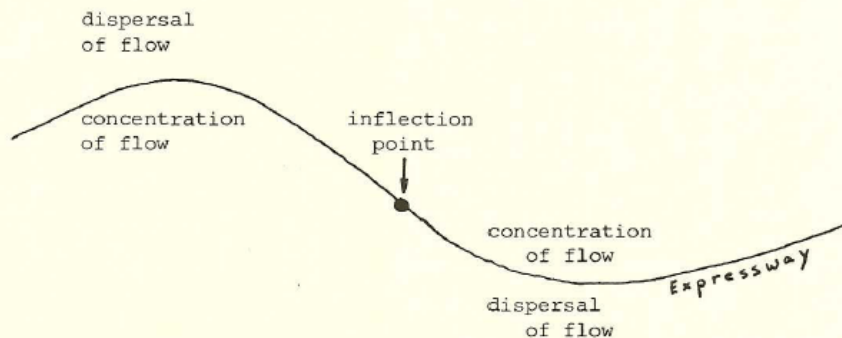
FIGURE 1

FIGURE 2

Figure 4.1. The concave down region concentrates flows; the concave up portion disperses flows.

   While the geometry of this idea is clear from simple line drawings such as those in Figure 4.1, it is not at all clear what the physical context of the region is like or was like. Aerial images of terrain are useful for that purpose; until recently, however, it was difficult to have ready access to aerials of remote regions of the world. A screen shot from Google Earth quickly fills that gap (Figure 4.2a). Often, roads are an indicator of population concentrations; in this case, however, the data are sparse and the pattern in Figure 4.2b suggests little except to illustrate a road leading to Darwin with a few offshoots and a road leading east to Queensland coastal cities (perhaps as Great Barrier Reef tourism access).

Figure 4.2. Aerials of the region at the top of Figure 4.1.
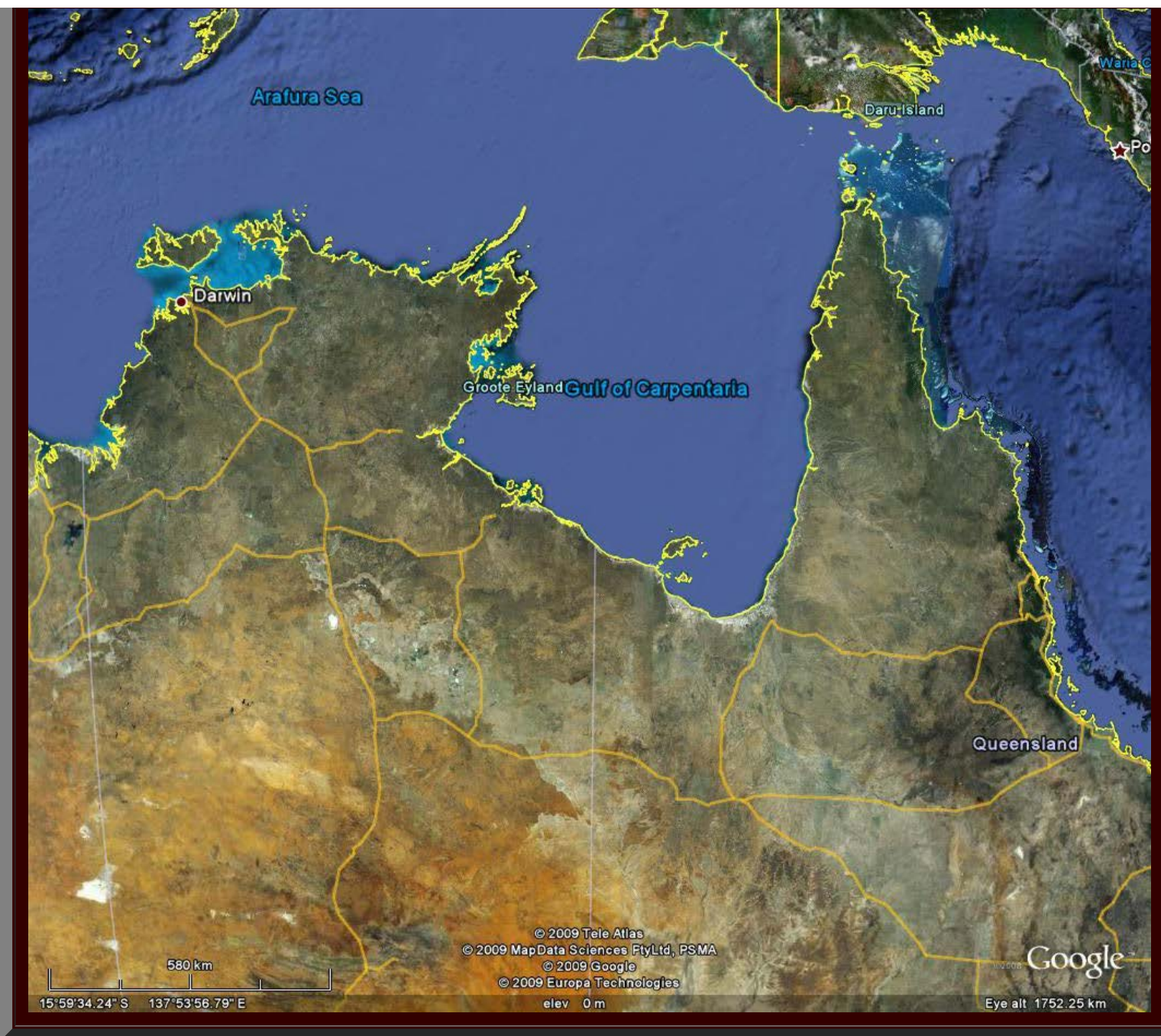
One might hope that the data set that comes on board Google Earth would permit the use of some surrogate variable to test the genetics speculation noted above. However, the on board data set consists typically of relatively recent information along with historical information of long-settled parts of the world. Neither of these sets is useful in this case. A critical issue is that the speculation is based on the assumption that arriving migrants are practicing hunting and gathering; the maps in Figure 4.1a and 4.1b show mainly coastal concentration of population. These populations are not the hunters and gatherers; they are,

instead, no doubt derivative of a British colonial period superimposed on earlier native populations. Disaggregation of these data sets would be required in order to test the speculation involving genetic diversity.

CHAPTER 5: STEINER TRANSFORMATIONS

Steiner trees are graph-theoretic structures which provide a shortest distance network of edges joining a finite set of points. The tree links all points and does so as a "tree" with no redundant linkage forming circuits. Previous work, and work to follow, has emphasized the fundamental importance of transformations. This essay looks at using the process of Steiner tree formation as an iterative construction to reduce non-tree graphical structure to full or partial tree-like structure. This iterative construction, parallel in idea to "self-similarity," is called a "Steiner Transformation."

In the original essay, simple line drawings sufficed for much of the discussion. To illustrate the process of Steiner transformation, however, the introduction of both color and animation make the transformation clearer and bring it to life. Figure 5.1 shows the original sequence from Monograph 3; Figure 5.2 shows the animated color version of that figure.
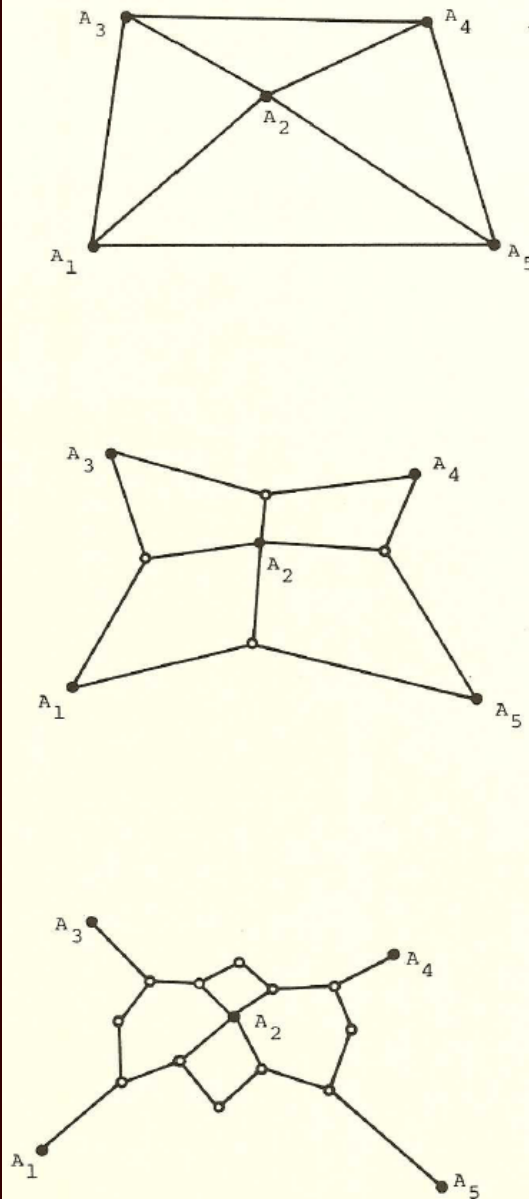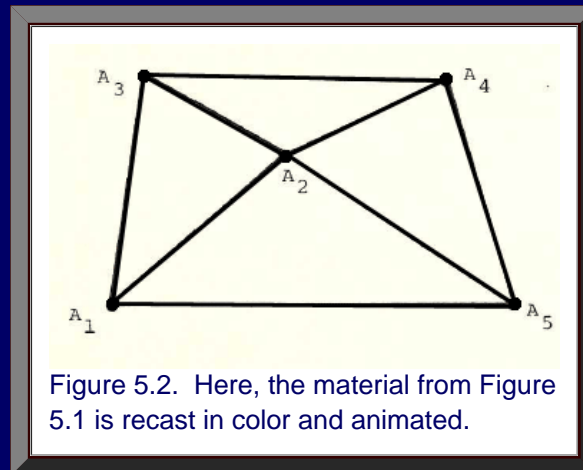
Figure 5.1. Steiner Transformation viewed as successive replacement of network structure within a "wheel" centered on a hub at A_2. As replacement of circuits, by trees, takes place, tree-like structure emerges as the circuit structure tightens around the hub of the wheel.

Figure 5.2. Here, the material from Figure 5.1 is recast in color and animated.

In Figure 5.2, the first level of the animation shows a wheel composed of four triangles centered on a hub. Then, Steiner points, blue, are determined within each black triangle. The Steiner network on these points is drawn and the black network lines are discarded: Steiner lines replace initial lines--a "Steiner Transformation." Iterating the process: red Steiner points are located within each remaining blue polygon as are associated red Steiner networks (visual suggestions of them rather than precisely plotted ones). When the blue network of the previous transformation is discarded, the red network represents the second iteration of the Steiner Transformation. Continuing the process will force the polygonal/cellular structure to tighten around the hub and convert the initial global polygonal structure to a more tree-like form. This essay applies the concept to park planning; one might easy imagine any number of applications that center on reducing cellular mass and introducing efficient, but minimal, connectivity among far-flung points.

CHAPTER 6: ANALOGUE CLOCKS

The theorems in this chapter center on the relationship of longitude to time. As in the previous chapter, many of the line drawings directly support the notation. Thus, one sees application of Euclidean geometry to issues associated with time and longitude, including proof of a "fundamental" theorem that it is only from the center of the Earth-sphere that the familiar association of time and longitude is correct.

Figures 6.1a and b illustrate the "obvious" connection between time and longitude: there are 360 degrees in the rotation of the earth on its north-south polar axis and 24 hours in a day, so there are 360/24 = 15 degrees of longitude covered in one hour. Thus, in theory, time zones should run along meridians, every 15 degrees. While this notion is the general idea, there are many deviations from "correct" longitude, generally on land. The animation in Figure 6.1a runs through a sequence of frames in order to arrive at a final frame showing clearly where longitude and time zones overlap. Figure 6.1b shows the pattern of globe movement in relation to meridians and time. The reader wishing to study this notion in the globe more carefully is referred to the associated .kmz file for Google Earth.
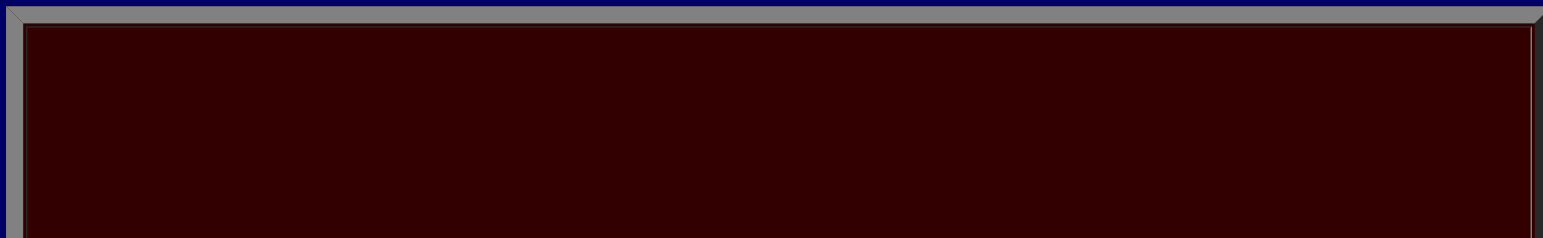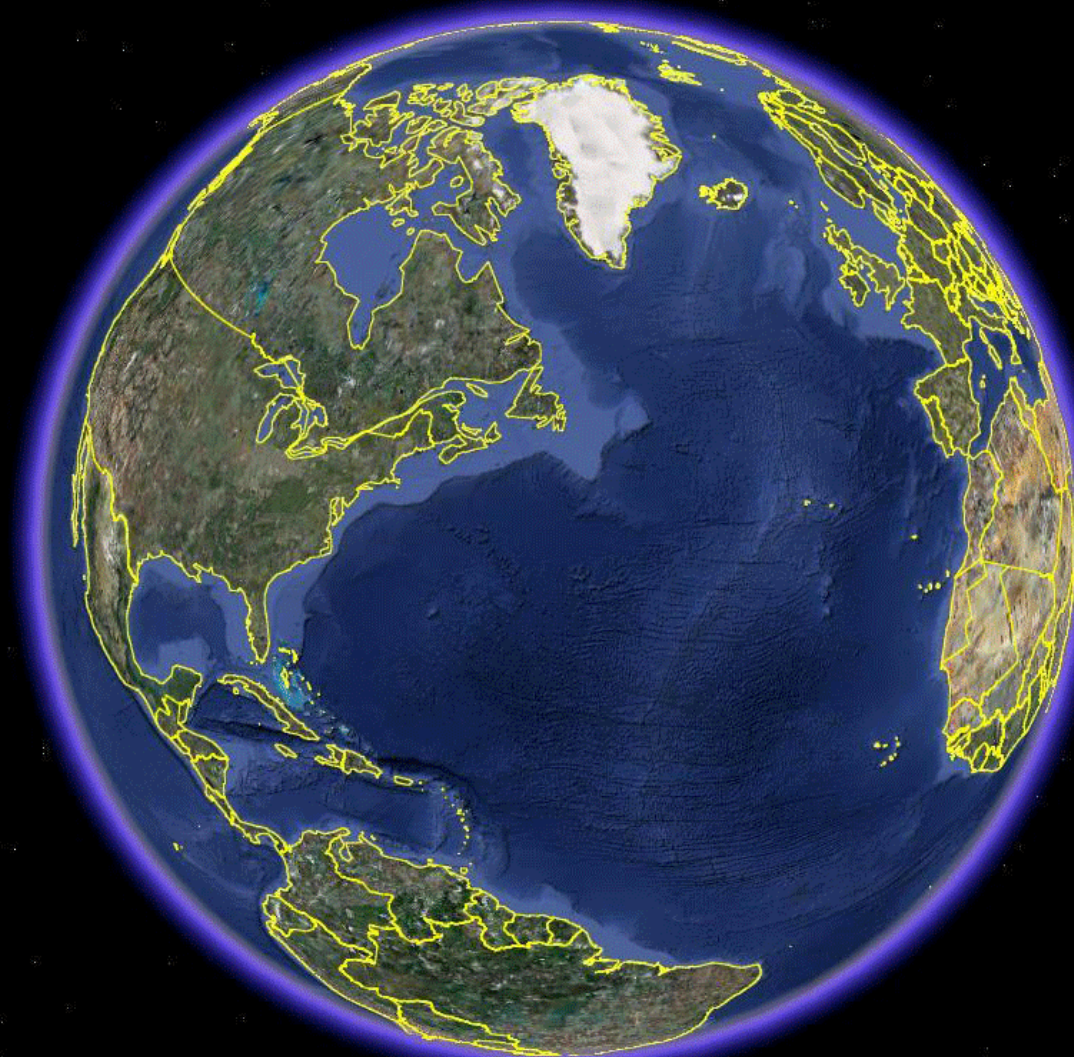
38°31'02.61" N   53°29'03.94" W   elev   0 m   Eye alt 10568.15 km

Figure 6.1a Association between time zones (red) and longitude (meridians in yellow), every 15 degrees.
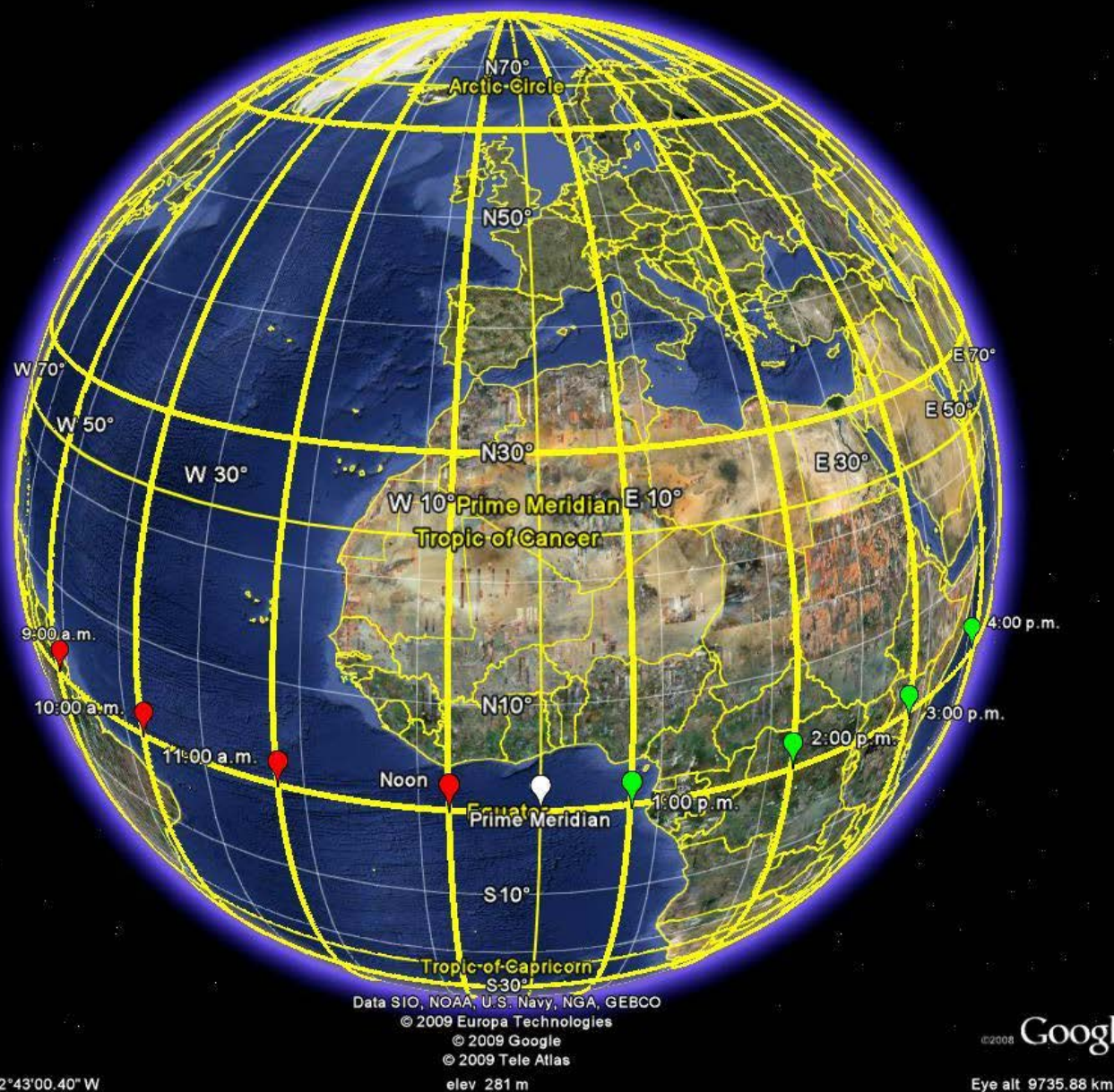
Figure 6.1b. Longitude and time.

Creation of the material in the animation of Figures 6.1a required the use of a variety of software. The grid in Google Earth is spaced every 10 degrees. While that is nice for many purposes, it is not well-suited to displaying the connection between time zones and meridians. Thus, GIS software (ArcMAP 9.2 from ESRI) was used to map the geographic grid at 30 degree intervals. This grid was then exported from ArcMAP to Google Earth, using "Export to kml" plug-in to

ArcMAP. The grid was exported first by shifting it 7.5 degrees to the east and then 7.5 degrees to the west, centering the Prime Meridian as a central meridian in a time zone. Then, with the 10 degree grid removed, the alignment between time zones and meridians drawn at 15 degree intervals became clear. Because the alignment is displayed on a globe with landmasses, one can take a closer look in the .kmz file to study more closely deviations of time zone from meridian in any part of the world.

   Communication of this association, however, varies from culture to culture. Two common ways (there are others) of measuring time involve analogue clock faces. If one considers that there are 24 hours in a day, the time taken for the Earth to make a complete rotation on its north/south polar axis, then it is natural to split a circular clock face into 24 hours, mimicking the partition of the Earth's diametral plane into 24 wedges of 15 degrees of longitude. Under this system, 1 o'clock is uniquely determined as meaning one hour after midnight. If, however, a pie with 24 pieces seems to be too many, then it might make sense to have a clock face with 12 numerals and have 1 o'clock mean either one hour after midnight or one hour after midday ("meridian"--"meridies"). We append a.m. (ante (before) meridian) and p.m. (post (after) meridian) to indicate which is which and restore uniqueness to the communication.

   In this discussion, the 12 hour clock face is viewed as derivative of the 24 hour clock face. Is there, however, a direct geometric construction from the Earth that shows the two together, transforming one into the other? The answer is "yes" and it is shown in the static diagram in Figure 6.2a. The color, animated image in Figure 6.2b brings this transformation of time and space to life in a different way as the direct transformation enters in successive frames of the animation.
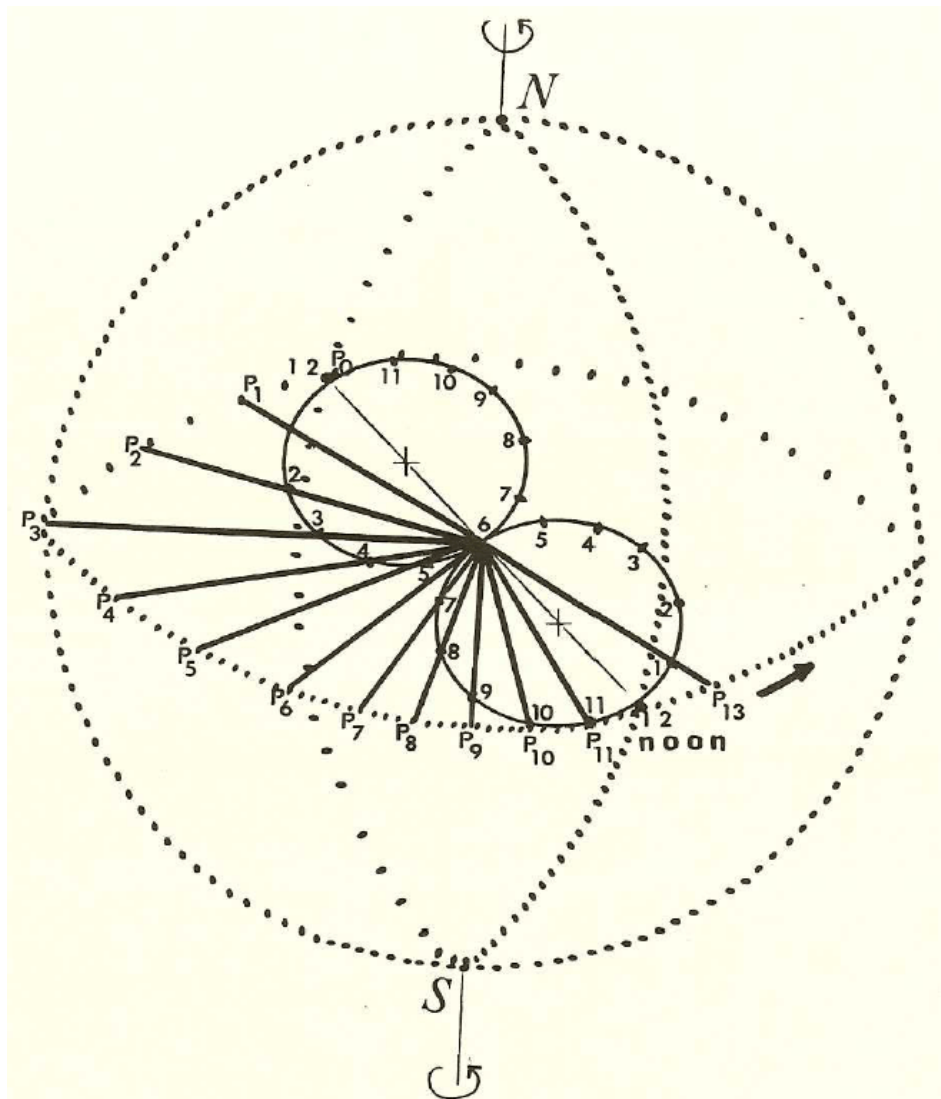
Figure 6.2a. Two twelve-hour clock faces, embedded in the equatorial diametral plane of the globe, show a direct association between the 24 hour clock and the 12 hour clock (without deriving the 12 hour face from the 24 hour clock).
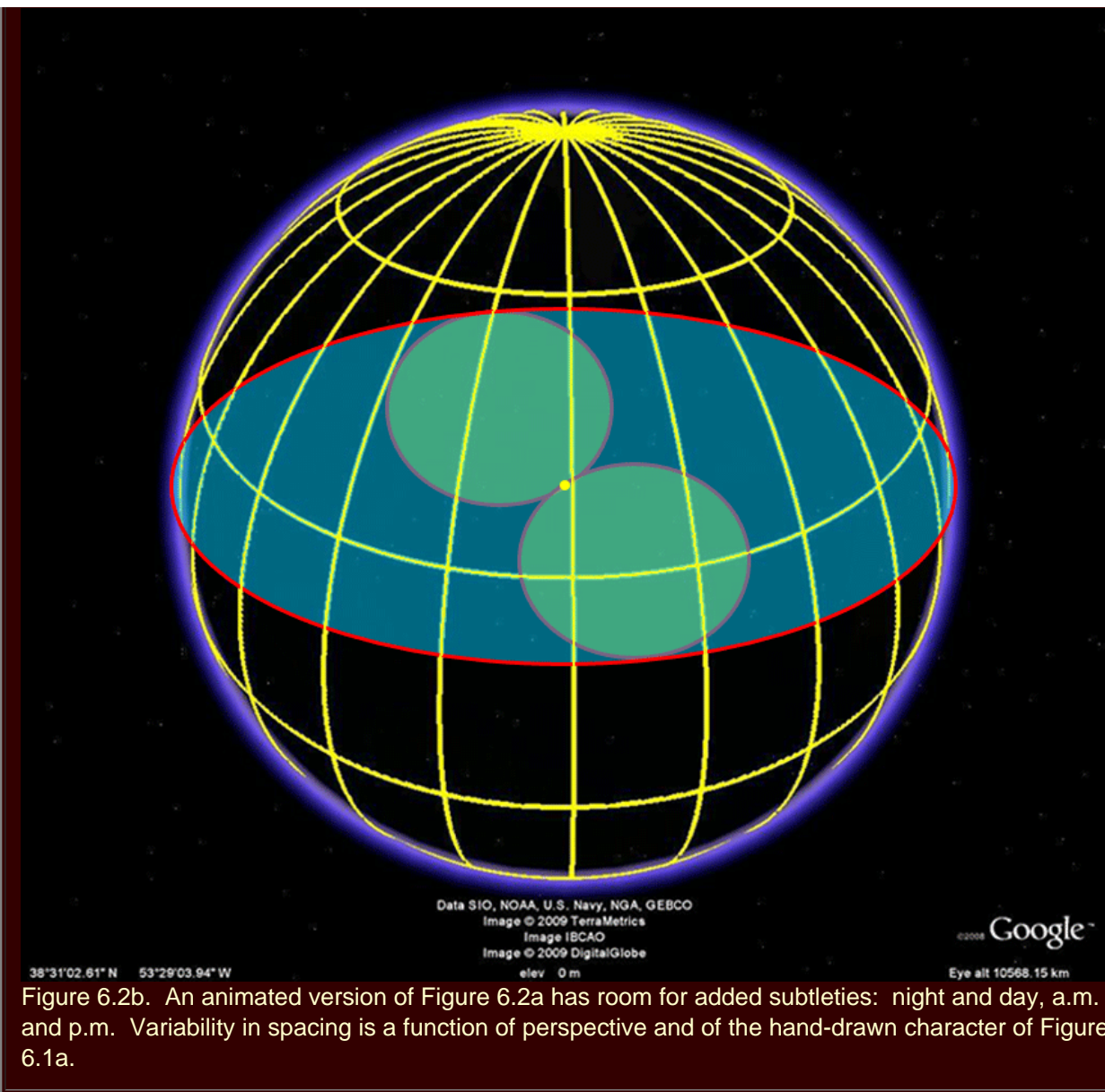
Figure 6.2b. An animated version of Figure 6.2a has room for added subtleties: night and day, a.m. and p.m. Variability in spacing is a function of perspective and of the hand-drawn character of Figure 6.1a.

   While digital clocks may be "accurate" and interesting timepieces, they function as mere trackers of time. The analogue clock face not only tracks time but also ties time to space through Euclidean geometry!

CHAPTER 7: FAD AND PERMANENCE IN HUMAN SYSTEMS

The material in this chapter has visual support that appears to be sufficient.

CHAPTER 8: TOPOLOGICAL EXPLORATION IN GEOGRAPHY

In this essay, concepts from point set topology are aligned with geographic examples of various sorts. One study involves looking at intersections of open sets surrounding Kiosks on the campus of The University of Michigan. The Kiosk location data is from field mapping done in 1976. The maps in the Monograph are also from that period. Viewsheds are calculated for each Kiosk and mapped in simple line-of-sight maps (Figure 8.1). How much more exciting, and revealing, it is to use Google Earth and actually navigate around the 3D buildings to see when one of the orange Kiosk placemarks might come up. Download the kmz file and try it for yourself in Google Earth. Screen shots of a few views are shown below (Figure 8.2).

Figure 8.1. Kioskland maps.

Figure 8.2. Views of Kioskland in Google Earth; 3D buildings are placed on the base map, as a map overlay, from Figure 8.1.

Visit Kioskland on your next trip to Ann Arbor!

CHAPTER 9: A SPACE FOR THOUGHT

The material in this chapter has visual support that appears to be sufficient.

CHAPTER 10: CHAOS IN HUMAN SYSTEMS--THE HEINE-BOREL THEOREM

The material in this chapter has visual support that appears to be sufficient.

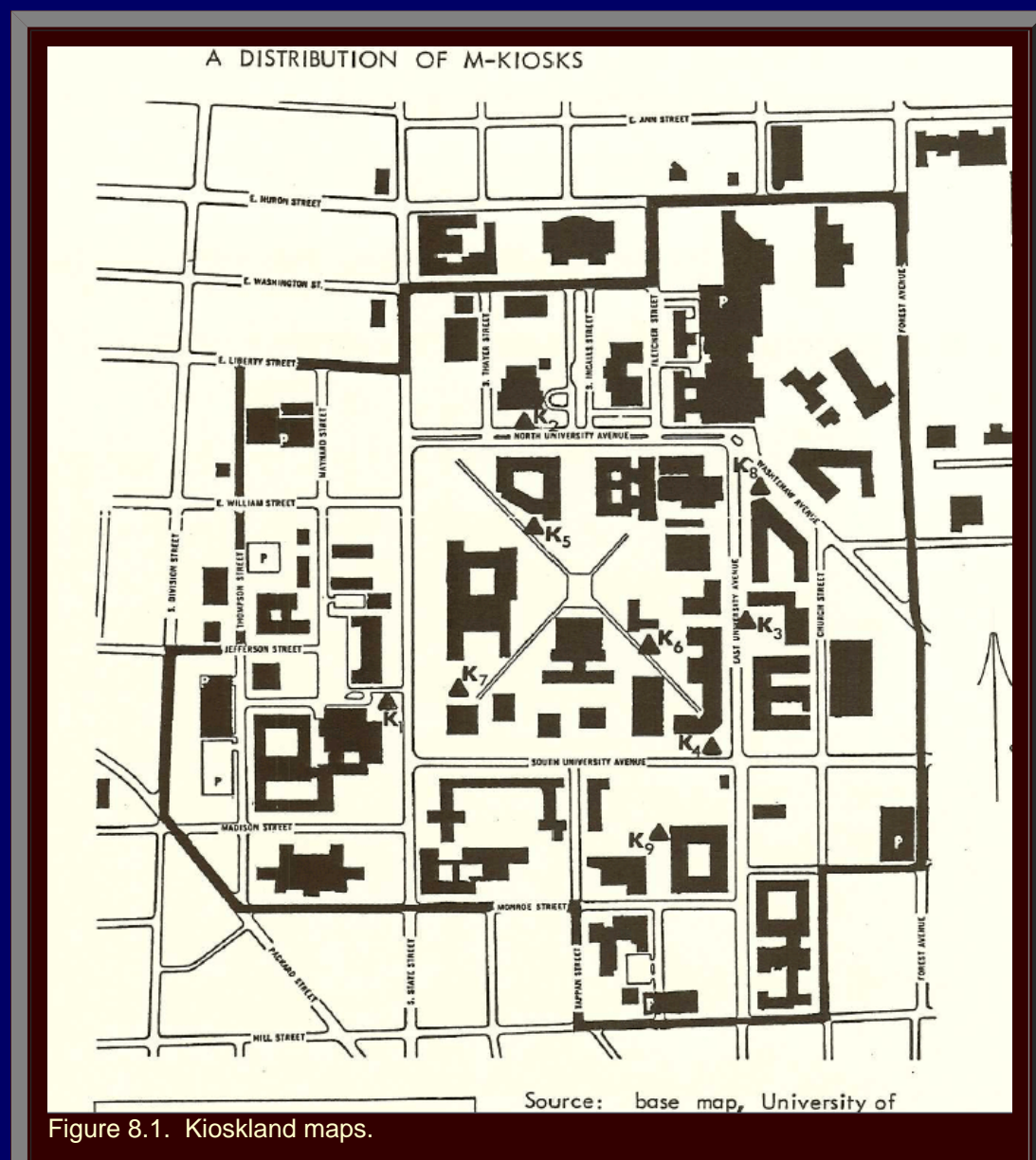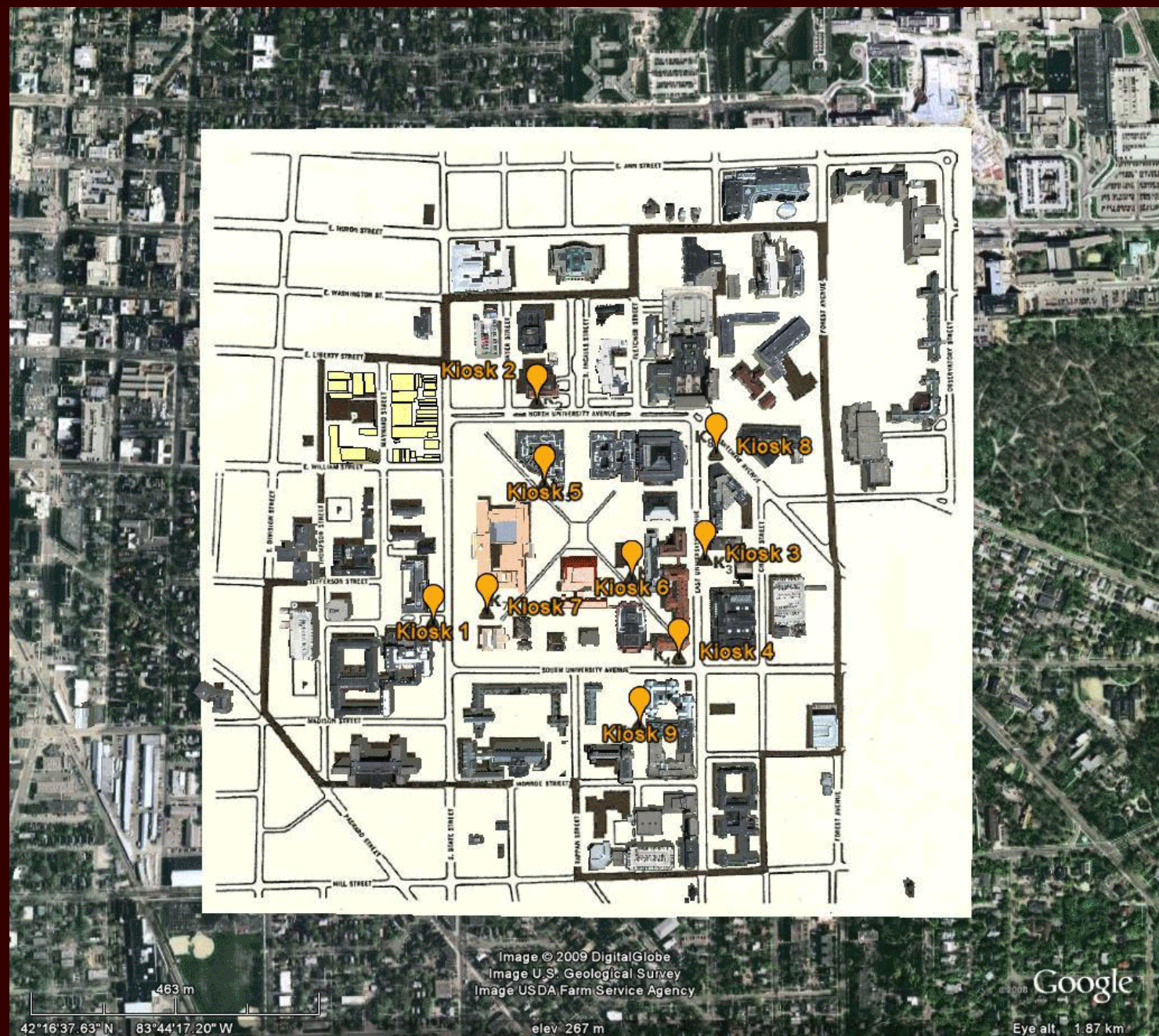Visualization offers far more than mere displays to brighten text. When used creatively, it may support existing knowledge in a positive manner, suggest related channels for research that were previously hidden, or even suggest directions for entirely new research projects. Consider bringing in some of the historical maps already present in Google Earth, or add your own as overlays. Integrate GIS maps with a variety of kml/kmz files. Use Google SketchUp to create 3D buildings of your own. The possibilities appear endless!

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IMaGe

IMAGINATION

Solstice was a Pirelli INTERNETional Award Semi-Finalist, 2001 (top 80 out of over 1000 entries worldwide)

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Solstice is listed in Geoscience e-Journals

IMaGe is listed on the website of the Numerical Cartography Lab of The Ohio State University: http://ncl.sbs.ohio-state.edu/4_homes.html

Congratulations to all *Solstice* contributors.

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Emergency Phones: A Google Earth Approach

Sandra L. Arlinghaus

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Download kmz files to open in Google Earth:
phones.kmz.

Maps of emergency telephone networks are naturally important: public safety is enhanced when the local population knows where to look for a systematically distributed network of phones. Recent 3D software offers one way to enhance transmission of information. Thus, in this note, locations for campus emergency phones at The University of Michigan, Ann Arbor, are cast in Google Earth. Indeed, given Ann Arbor's recent ranking as the most "pedestrian friendly" city in Michigan [Ann Arbor.com], such networks become all the more important in ensuring that "friendliness"!

Take a look at the screen captures below. Figure 1 shows the distribution of emergency phones across the entire campus; each phone is positioned, approximately, using the map that appeared in the recent campus safety handbook. Individual phones are represented by light cyan balloon placemarks that will shrink in size as one zooms in within the .kmz file. Load in buildings from Archimedes in the Google Earth 3D Warehouse and take a look at phone location in relations to buildings (Figure 2). Navigate the 3D scene in Google Earth by loading the .kmz file above and create your own scenes as you familiarize yourself with phone locations.
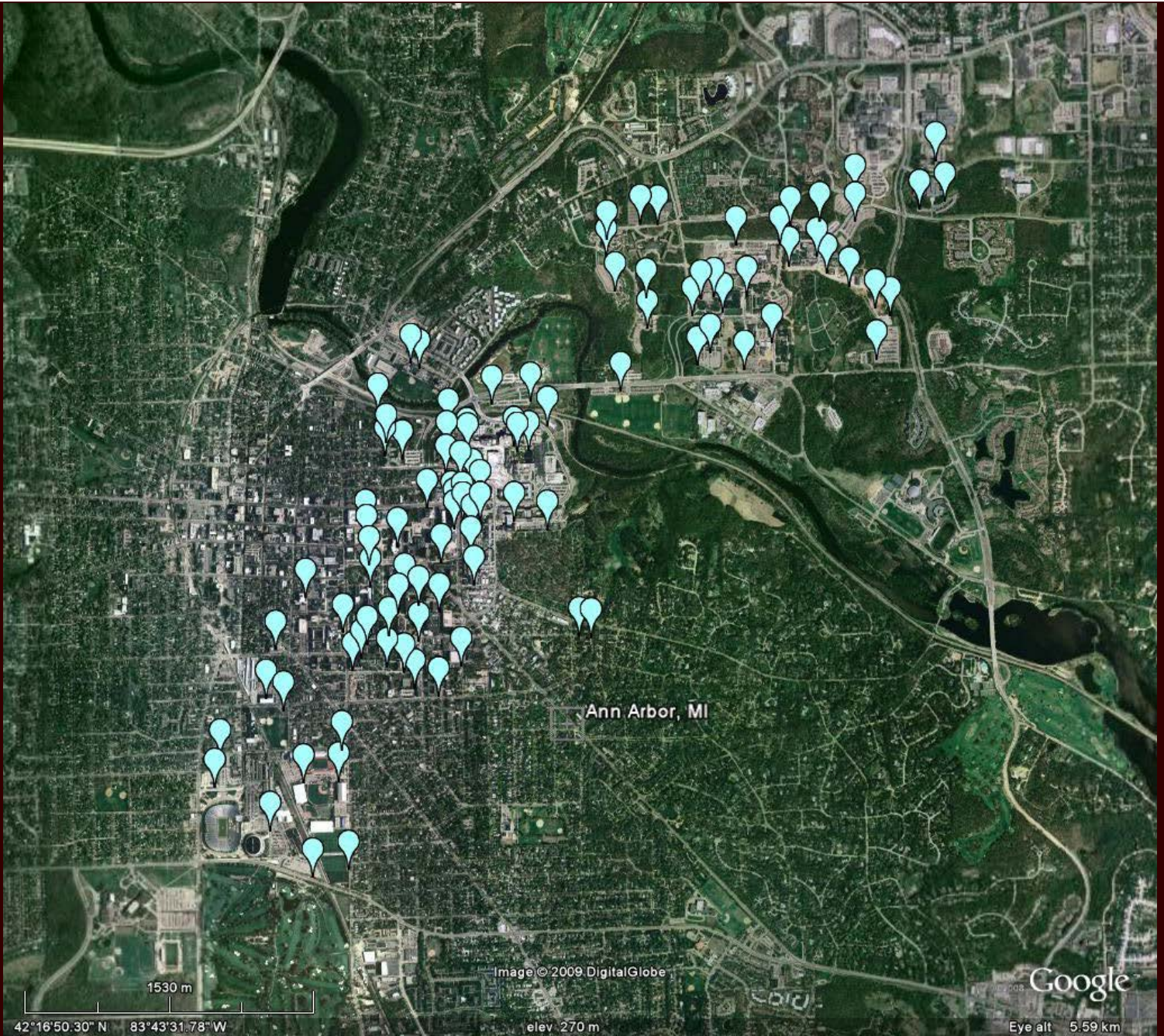
Figure 1. Distribution of emergency phones on the Ann Arbor campus of The University of Michigan.
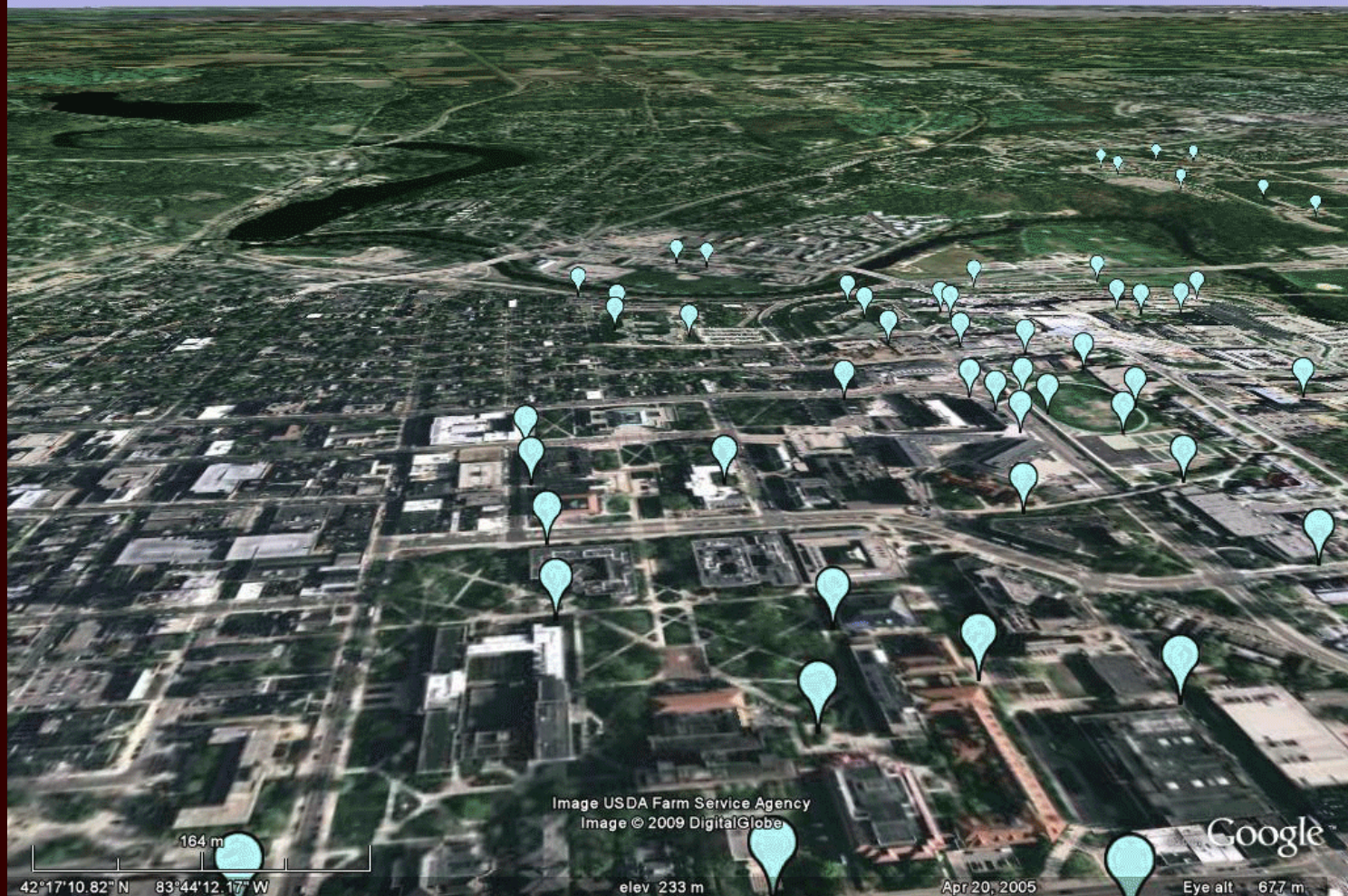
Figure 2. Emergency phones and 3D buildings.

Emergency phone networks and various locational strategies for determining where to put them have been an object of research interest for many years [Arlinghaus; O'Kelley] and of general interest by scholars [Moellering]. What is exciting here is to consider the role that enhanced visualization might offer to such projects as well as to note its natural public benefit.

REFERENCES AND SOFTWARE

- Adobe, PhotoShop and ImageReady
- Ann Arbor.com, November 10, 2009.
- Arlinghaus, Sandra L., 1986. *Essays on Mathematical Geography*. "Topological Exploration in Geography," "Kioskland" example; Monograph Series, Monograph #3. Ann Arbor: Institute of Mathematical Geography.
- Google Earth
- Google SketchUp 3D Warehouse.
- Moellering, Harold. Personal communication.
- O'Kelley, Morton, Citation List, Ohio State University.
- University of Michigan Campus Safety 2009-2010 Handbook

Solstice: An Electronic Journal of Geography and Mathematics,
Volume XX, Number 2
Institute of Mathematical Geography (IMaGe).

Solstice was a Pirelli INTERNETional Award Semi-Finalist, 2001 (top 80 out of over 1000 entries worldwide)

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3D Annotated Archive
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The catalogue below serves as an archive of 3D materials created by the author, and colleagues as noted in linked files, over the past seven years. In it, links are provided to servers that maintain persistent storage (in so far as possible). Brief descriptions accompany many of the links, making the archive and annotated one. Collections of links are grouped primarily according to style of software used to create the file and secondarily by topic. Recently, Google presented software to aid in the making of models of buildings; the addition is a welcome one and reduces the need for independent modelers to spend hours in tedious, but interesting, virtual construction. Models awarded "Blue Ribbon" status by Google appear in the default onboard layer of Google Earth called "3D Buildings."

Books:

- 3D Atlas of Ann Arbor:
  - 2006: 1st Edition   Link in Deep Blue.
  - 2006: 2nd Edition   Link in Deep Blue.
  - 2007: 3rd Edition   Link in Deep Blue.
- Spatial Synthesis.
  - Volume I
    - 2005: Book 1   Link in Deep Blue.
  - Volume II
    - 2008: Book 1   Link in Deep Blue.
    - 2008: Book 2   Link in Deep Blue.
    - 2008: Book 2a   Link in Deep Blue.
    - 2008: Book 3   Link in Deep Blue.
    - 2009: Book 4   Link in Deep Blue.

In the Google 3D Warehouse:

- Featured Google Earth modeler, Arlinghaus, known as "Archimedes" 2007-present.   Link
- Archimedes's models (created by the author; the Collection in the Warehouse contains a few extras submitted by others)
  - Adjusted Collections:
    - University of Michigan, Adjusted. Contains 41 models. In June of 2007, higher resolution aerials were introduced. In these, there appeared to be a datum shift from the previous lower resolution images. Thus, models built on building footprints for the lower resolution files need to be realigned to fit with the building footprints for the higher resolution images. This collection represents such a set for the campus of The University of Michigan. It also includes a few older

models that would not respond appropriately to re-alignment and subsequent upload to the server (work continues on those). Download this entire set of models to have "best possible" coverage of the entire campus.

- **Ann Arbor, Adjusted**. **Contains 3 models.** In June of 2007, higher resolution aerials were introduced. In these, there appeared to be a datum shift from the previous lower resolution images. Thus, models built on building footprints for the lower resolution files need to be realigned to fit with the building footprints for the higher resolution images. This collection represents such a set for the city of Ann Arbor beyond The University of Michigan campus.
- **Adjusted Models, Ann Arbor**. **Contains 2 collections of models from above.** In June of 2007, higher resolution aerials were introduced. In these, there appeared to be a datum shift from the previous lower resolution images. Thus, models built on building footprints for the lower resolution files need to be realigned to fit with the building footprints for the higher resolution images. This collection represents a set of adjusted collections.

○ Original Collections, made prior to June 2007, using earlier aerials.

- **University of Michigan: Textured and Partially Textured Building Groups**. **Contains 14 models.** Sets of buildings: all have textured rooftops and at least one building in each group is fully textured (as a naming anchor for the set).
- **University of MIchigan: Textured**. **Contains 34 models.** Contains buildings of The University of MIchigan, Ann Arbor, that are fully textured.
- **University of MIchigan**. **Contains 41 models.** All buildings of the University of Michigan on campus maps appear here (about 300 buildings). Unless otherwise noted, all models were created by Sandra Lach Arlinghaus. Special thanks (full citations appears in 3D Atlas of Ann Arbor, http://www.imagenet.org/): 3D Laboratory in the Duderstadt Center of The University of Michigan for their advice. Dr. Klaus-Peter Beier, Director; Lars Schumann, Manager; Steffen Heise, 3D Lab. Thanks for base GIS files: Donald T. Uchman, Drafting Intermediate Supervisor, Space Information, The University of Michigan; Matthew Naud, Environmental Coordinator, City of Ann Arbor; Wendy Rampson, City of Ann Arbor; and Karen Hart. Citations for materials obtained from public sites that were incorporated into files in this collection--as one might include pertinent quotations (and cite sources) in a conventional document, so too, pertinent model bits and sources are cited here: 1. http://sketchup.google.com/3dwarehouse/details?mid=d9df666120fee38c7fb60589c24fde63&prevstart=12 2. http://sketchup.google.com/3dwarehouse/cldetails?mid=a7b9f69d31356fbef96dfde99ac0e896 , primarily by "Surreal 3D" and "Google Guy." 3. http://sketchup.google.com/3dwarehouse/details?mid=c29682940165845a7c81e315a70337ac&prevstart=0 4. http://www-vrl.umich.edu/VRML/Field2.JPG and http://www-vrl.umich.edu/VRML/crowd.JPG 5. http://bentley.umich.edu/bhl/exhibits/umosu/umsongs.htm
- **Ann Arbor**. **Contains 403 models.** 3D models of buildings in Ann Arbor. This collection includes textured buildings for 24 blocks of the DDA, textured buildings for 27 single University of Michigan buildings, textured buildings in partially textured groups for another 11 partially textured groups of the University of Michigan, files for the remaining buildings of the DDA and the rest of Ann Arbor (not textured but set against the terrain), and environmental files involving the Allen Creek. Thus, the reader may use the collection as a source of completed models and also as a source of models to complete. To complete University of Michigan models, try obtaining photos for individual buildings from: http://uuis.umich.edu/cic/buildingproject/ . To complete others, try the Assessor's website on the City of Ann Arbor site, http://www.a2gov.org/ . BE A VOLUNTEER PHOTOGRAPHER AND SEND IN YOUR PHOTOS OF ANN ARBOR! For a more carefully partitioned file, see "Ann Arbor, MI: Collections" There, textured files are separated from non-textured ones. The models marked as "nonmapped" are untextured buildings extruded from footprints contained in The University of Michigan GIS database but not contained on the map on the university's website, http://www.umich.edu/ Unless otherwise noted, models were created by Sandra Lach Arlinghaus (http://www-personal.umich.edu/~sarhaus/). For complete references, see the 3D Atlas of Ann Arbor, first edition, second edition, and third edition, at
http://www.imagenet.org/
- **Ann Arbor, MI. Untextured Buildings Outside the DDA and UM**. **Contains 2 models.** A single .kmz file set correctly against the terrain. Building height arbitrarily set at 2 stories. The buildings in this basic file are useful only as very general backdrop when looking at the massing of buildings throughout the urban area--especially in relation to terrain.
- **Ann Arbor, MI. DDA, Textured**. **Contains 13 models.** Textured blocks of the Downtown Development Authority, Ann Arbor, Michigan.
- **Ann Arbor, MI: DDA**. **Contains 52 models.** Extruded building footprints are set to the correct height. These simple structures create a backdrop for viewing skylines and general urban form. They offer a challenge to others to acquire photographic textures and make the buildings more recognizable. They are a beginning. The single model containing all buildings is to be used in Google Earth; it is correctly set against the terrain. Smaller groupings of buildings are for use in SketchUp and will need to be adjusted against terrain. The files contain a reference to a coordinate system in their name. A file with 2N3E is a block of the DDA two blocks north of the intersection centroid of Main and Huron Streets and 3 blocks to the east of the location.
- **Allen Creek Floodplain**. **Contains 17 models.** Blue region depicts flooding of the Allen Creek floodplain to different topographic elevations. The region lies on the west side of downtown Ann Arbor, running from the Huron River, south to the University of Michigan golf course and west to the edge of town. These models make sense only when viewed in Google Earth with the terrain switch "on". They look best when also loaded in Google Earth with buildings from the Ann Arbor collection; two general files are enclosed here; there are others, with textured buildings to fill in the gaps in the DDA and The University of Michigan, in the "Ann Arbor, MI: Collections" file.
- **Help Model Ann Arbor, MI**. **Contains 2 collections of models from various locations above.** Help finish building the 3D Ann Arbor. Take a look in the "untextured" collection: the basic geometry is supplied there. Then, apply textures, submit your model to sarhaus@umich.edu, and once complete, then it will be moved to the "textured" collection! Watch Ann Arbor grow through YOUR efforts! There are already many completed buildings...add to this collection which already has served local municipal authorities in Planning, Emergency Management, Environmental Applications, and Citizens Groups. The modeling of the city is merely the

beginning...applications of the model are important!

- **Archive Archimedes: Blue Ribbons**. Contains 45 models. Newer versions of these models are present in other collections; these persist only here and are therefore archived. The icon for this particular collection is the Clements Library of the University of Michigan which archives prized books and artifacts.
- **Untextured Models or Partially Textured Models, Ann Arbor, MI**. Contains 3 collections of selected models. Use the geometry of these models as a base for applying photographic textures (to come in Picasa, or find your own on the web). Complete a partially completed block or building! Then, submit the completed models and watch as this collection shrinks in size and the virtual, 3D city of Ann Arbor grows...all thanks to YOUR efforts!
- **Textured Models, Ann Arbor, MI**. Contains 2 collections of selected models. Models of Ann Arbor that are "complete." No model, though, is really "complete." Land uses change; buildings are torn down or rebuilt; businesses change hands--consider updating an existing complete model and submit it. Or, think you can make a better model? Go for it! The completed models are partitioned into various child collections for convenience: the partition is based on University of Michigan buildings, Downtown Development Authority (DDA) buildings, and other buildings. http://www.imagenet.org/
- **Google Earth: Benchmarking a Map of Walter Christaller**. Contains 18 models. Vertical benchmarks, with height in proportion to rank of city in a hierarchy created by Christaller, are used to align a map from 1941 (of unknown projection) with the Google Earth sphere. Thus, environmental texture is introduced into the original map. Based on an original article by Arlinghaus that appeared in Solstice: An Electronic Journal of Geography and Mathematics, Vol. XVII, No. 2, December, 2006, http://www.imagenet.org/. A direct link to that article is provided here: http://www-personal.umich.edu/%7Ecopyrght/image/solstice/win06/Germany/index.html Download the full .kmz of all benchmarks from the following link Link: http://www-personal.umich.edu/%7Ecopyrght/image/solstice/win06/Germany/Benchmarks.kmz or upload those associated with blue (highest) and red (secondary) levels of the hierarchy from the .skp files below. In addition, you will need also to have a copy of the map that is being benchmarked: Link: http://www-personal.umich.edu/%7Ecopyrght/image/solstice/win06/Germany/Poland,%201941%20Base%20Maps.kmz Also, consider the second article in this set which uses the benchmarked map in Google Earth only, to examine the problems associated with interpolating lower level (smaller) central places on the Google earth.
- **1901 United Kingdom**. Contains 47 models. This historical study offers visualization of the total population distribution of England, Scotland, and Wales in 1901. In it, bar charts are situated on the Google Earth sphere in locations corresponding to urban areas and towns. Thus, one gets a picture of size in relation to location and the opportunity to consider distance and environmental effects in population growth. Visualization of this sort brings history to life in an environmental, whole-earth, context. There are 199 .skp files created individually, each representing a single bar perpendicular to the earth. Each was uploaded to Google Earth where they were merged to form a more convenient single .kmz containing all the information. To see that .kmz that portrays the distribution across the entire island, one must download the .kmz from the link below (rather than merely uploading from the .skp file offered here as a sample of the entire package). Link: http://www-personal.umich.edu/%7Ecopyrght/image/solstice/win06/arlbat2/1901UnitedKingdom.kmz Or, upload each of the sample files (below) directly to GE from the .skp files in this collection. The text in the Alnwick file serves for all (rather than repeating it). This work appeared originally in Arlinghaus and Batty, Solstice: An Electronic Journal of Geography and Mathematics, Vol. XVII, No. 2, December 21 2006. It is archived in the Directory of Open Access Journals of the University of Lund, among other places.
- **Population-Environment Dynamics**. Contains 4 collections of selected models. Collections in this set go beyond building creation and attempt to make imaginative use of both Google SketchUp and Google Earth.
- **1901-2001 Greater London**. Contains 11 models. Visualize changing population patterns in relation both to the earth's surface and time: the process can add substantially to traditionally graphed information. The materials in this collection appeared originally in an article by Arlinghaus and Batty, published in Solstice: An Electronic Journal of Geography and Mathematics, Vol. XVII, No. 2, December 2006, http://www.imagenet.org/. This article and a related one draw on simply viewing clusters of bar charts as being similar to clusters of buildings: vertical pattern offers insight of various sorts. Direct link to that article: http://www-personal.umich.edu/%7Ecopyrght/image/solstice/win06/arlbat2/indexPartII.html The .kmz files associated with the many .skp files have been accumulated into one .kmz. Download that .kmz from the link below or use the sample .skp files below to create individual .kmz files for Bromley. Switch successive decades off and on in GE to animate the pattern. The .kmz file below contains data for Bromley and for 31 other London boroughs and for London, from 1901 to 2001. Link: http://www-personal.umich.edu/%7Ecopyrght/image/solstice/win06/arlbat2/GreaterLondon.kmz
- **Ann Arbor, MI: Collections**. Contains 10 collections of selected models. Set of collections of geo-referenced models of Ann Arbor, both urban and environmental: 1. Textured buildings of the Downtown Development Authority (DDA) 2. Untextured buildings of the DDA extruded to correct height. 3. Textured buildings of The University of MIchigan 4. Sets of partially textured buildings of The University of MIchigan 5. kmz file of all buildings outside the DDA and outside The University of MIchigan, untextured and extruded to an arbitrary height of 2 stories. 6. Allen Creek Floodplain.
- **Archimedes' Selected Collection**. Contains 52 models. This collection includes a selection of models by Archimedes of buildings and scenes in Ann Arbor, Michigan. For a full set, see "Cities in Development." Also, for numerous other 3D models of Ann Arbor, see http://www.imagenet.org/ and navigate to various versions of the "3D Atlas of Ann Arbor."

Google Earth models appearing in *Solstice: An Electronic Journal of Geography and Mathematics* that do not appear above. A link is given to the live article and also to the zipped (or other format) file in **Deep Blue**.

- 2009. Volume XX, Number 1. With William E. Arlinghaus. The Perimeter Project: Fragile Lands Protection Using Cemetery Zoning. Link to Deep Blue file.
- 2009. Volume XX, Number 1. With Diana Sammataro. Bee Ranges and Almond Orchard Locations: Contemporary Visualization. Link to Deep Blue file.
- 2009. Volume XX, Number 1. Kerry Ard. Air Pollution Changes in the Detroit Metro Area from 1988 - 2004. Link to Deep Blue file.
- 2009. Volume XX, Number 1. The Platonic Solids: Earth-sculpture Anchored at Easter Island (Barr's Condition). Link to Deep Blue file.
- 2009. Volume XX, Number 1. Down the Mail Tubes: Yesterday, Today, and...Tomorrow? Link to Deep Blue file.
- 2008. Volume XIX, Number 2. With Michael Batty. Charting the Past: Population-Environment Dynamics. Link to Deep Blue file.
- 2008. Volume XIX, Number 2. Project Archimedes: Google Earth Experiments in Innovative Scientific Communication. Link to Deep Blue file.
- 2008. Volume XIX, Number 1. Roger Rayle. Google Earth Applications in a Community Information System: Scio Residents for Safe Water. Link to Deep Blue file.
- 2008. Volume XIX, Number 1. Matthew Naud. Huron River Tour, Ann Arbor. Link to Deep Blue file.
- 2008. Volume XIX, Number 1. Detroit North American Bridge Championship: the Google Earth Display. Link to Deep Blue file.
- 2008. Volume XIX, Number 1. Bert Onstott. Unit 174. American Contract Bridge League Bridge Clubs: Greater Houston. Link to Deep Blue file.
- 2008. Volume XIX, Number 1. Another Tale of Two Cities. Neighborhood Watch from Ann Arbor to Baghdad. Link to Deep Blue file.
- 2008. Volume XIX, Number 1. Lars Schumann. Real-time Animation Scripts for Google Earth. Link to Deep Blue file.
- 2007. Volume XVIII, Number 2. Geography/Geometry -- Visual Unity. Link to Deep Blue file.
- 2007. Volume XVIII, Number 2. The Animated Pascal. Link to Deep Blue file.
- 2007. Volume XVIII, Number 2. Desargues's Two-Triangle Theorem. Link to Deep Blue file.
- 2007. Volume XVIII, Number 1. 3D Atlas of Ann Arbor, 3rd Edition.
- 2007. Volume XVIII, Number 1. Diana Sammataro Update on the Varroa Mite Map, [with Editorial Commentary].
- 2006. Volume XVII, Number 2. With Michael Batty. Visualizing Rank and Size of Cities and Towns: Part I: England, Scotland, and Wales, 1901 - 2001. Link to Deep Blue file.
- 2006. Volume XVII, Number 2. With Michael Batty. Visualizing Rank and Size of Cities and Towns: Part II: Greater London, 1901 - 2001. Link to Deep Blue file.
- 2006. Volume XVII, Number 2. Visualizing a Map of Walter Christaller, Poland 1941. Part I: Benchmarking the Map. Link to Deep Blue file.
- 2006. Volume XVII, Number 2. Visualizing a Map of Walter Christaller, Poland 1941. Part II: Interpolation of the Benchmarked Map. Link to Deep Blue file.
- 2006. Volume XVII, Number 2. *Announcement: 3D Atlas of Ann Arbor, 2nd Edition*;
- **2006.   Volume XVII, Number 2.   Banda Aceh: A View on the Globe . Link to Deep Blue file.**
- 2006. Volume XVII, Number 1. 3D Atlas of Ann Arbor: The Google Earth® Approach. Part I. Link to Deep Blue file.
- 2006. Volume XVII, Number 1. 3D Atlas of Ann Arbor: The Google Earth® Approach. Part II. Link to Deep Blue file.
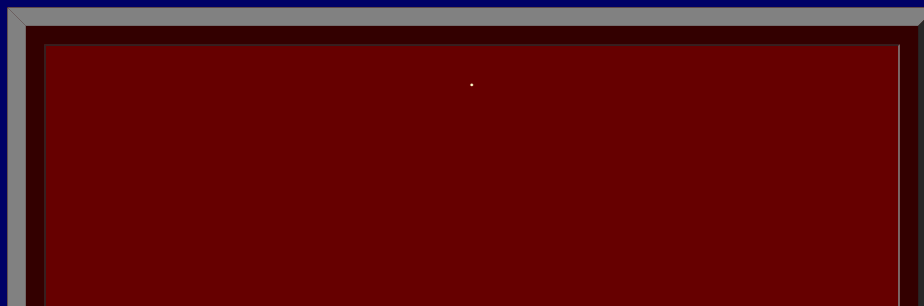
Solstice articles. Virtual Reality Modeling Language (VRML) models made using direct vrml code or 3D Studio Max software. Early ones use GIS software from ESRI (ArcView with Spatial Analyst and 3D Analyst extensions).

- 2005. Volume XVI, Number 2.   News: Update on the 3D Atlas of Ann Arbor. -- Archimedes in Ann Arbor? and, with Alyssa J. Domzal,
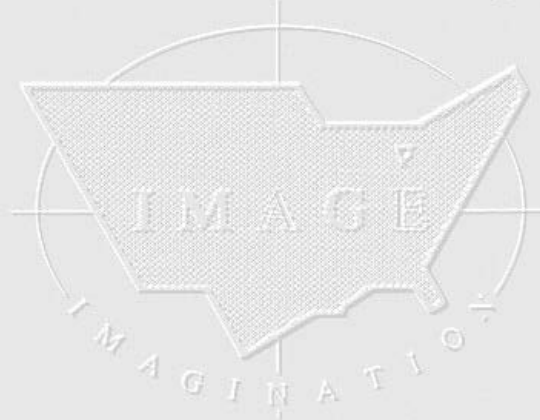
Ui Sang Hwang, and Kris J. Walters, Jr. Virtual Flood in the Allen Creek Floodplain and Floodway. Link to Deep Blue file. (Related partially to a student project in K.-P. Beier's Virtual Reality course.) <>

- 2005. Volume XVI, Number 1. **Spatial Synthesis: The Evidence of Cartographic Example: Hierarchy and Centrality** . Link to Deep Blue file.
- 2005. Volume XVI, Number 1. Kioskland: A Strategy for Linking Hierarchical Levels of Virtual Reality Maps . Link to Deep Blue file.
- 2005. Volume XVI, Number 1. With Ann Evans Larimore and Robert Haug. A Methodology for Historical Geography: Internet Implementation . Link to Deep Blue file.
- 2004. Volume XV, Number 2. Spatial Synthesis: 3D Atlas of Ann Arbor. Link to Deep Blue file.
- 2004. Volume XV, Number 2. With Braxton Blake. Two Rivers Ridge: Capturing Art. Link to Deep Blue file.
- 2004. Volume XV, Number 1. With William Charles Arlinghaus. Spatial Synthesis Sampler. Geometric Visualization of Hexagonal Hierarchies: Animation and Virtual Reality . Link to Deep Blue file. Pirelli INTERNETional Award, Semi-Finalist.
- 2004. Volume XV, Number 1. Klaus-Peter Beier. One Optimization of an Earlier Model of Virtual Downtown Ann Arbor. Link to Deep Blue file.
- 2004. Volume XV, Number 1. With Fred J. Beal and Douglas S. Kelbaugh. The View from the Top: Visualizing Downtown Ann Arbor in Three Dimensions. Link to Deep Blue file.
- 2004. Volume XIV, Number 1. Andrew Walton. A Golfer's Resource: Huron Hills Golf Course, Ann Arbor, Michigan. Link to Deep Blue file.
- 2004. Volume XIV, Number 1. Thana Chirapiwat. Visualization of Geographic Information with VRML. Link to Deep Blue file.
- 2003. Volume XIV, Number 2. With Ann Evans Larimore and Robert Haug. **Lewis and Clark, 200 Years: A Visual Tribute to an Exploration. The Gates of the Rocky Mountains**. Link to Deep Blue file.
- 2003. Volume XIV, Number 2. Ann Arbor, Michigan: Virtual Downtown Experiments, Part II. Link to Deep Blue file.
- 2003. Volume XIV, Number 2. Taejung Kwon, Adrien A. Lazzaro, Paul J. Oppenheim, Aaron Rosenblum. Ann Arbor, Michigan: Virtual Downtown Experiments, Part III. Link to Deep Blue file. (Related partially to a student project in K.-P. Beier's Virtual Reality course.)
- 2003. Volume XIV, Number 1. Ann Arbor, Michigan: Virtual Downtown Experiments. Link to Deep Blue file.
- 2002. Volume XIII, Number 2. Marc Schlossberg. Visual Accessibility with GIS. Link to Deep Blue file.
- 2001. Volume XII, Number 1. Maps and Decisions: Allen's Creek Floodplain, Opportunity or Disaster? Link to Deep Blue file.
- 2000. Volume XI, Number 2. Nakia D. Baird. Animap Sequences . Link to Deep Blue file.
- 2000. Volume XI, Number 1. Animaps, IV: Of Time and Place. Link to Deep Blue file.
- 1998. Volume IX, Number 1. With Ruben de la Sierra. Revitalizing Maps or Images?. Link to Deep Blue file.

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