

Spatial Synthesis

Volume II, Book 2:

Making It Clear: The Importance of Transparency

Sandra Lach Arlinghaus
 sarhaus@umich.edu
<http://www-personal.umich.edu/~sarhaus/>

Volume I of the *Spatial Synthesis** series focuses on theory;
 Volume II* of the series focuses on applications, turning theory into practice.

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- [ESCHER / BARR EARTH](#)
- [FRACTAL EARTH](#)
- [KLEIN EARTH](#)

These chapters use subtle effects and reflect the importance of transparency in making concepts become clear.

INTRODUCTION

Graphics created on the computer often employ subtle capabilities that did not really exist in a paper and pen environment. Thus, "white" becomes a color to be used in the same way as red or green. "Transparent" also becomes a color by which to uncover parts of other images. Two dimensional maps composed of layers in Geographic Information Systems software may look through one layer to see part of another. Images created in Adobe Photoshop can be assigned partially opaque colors to let still others show through. The world of three-dimensional models suggests a host of opportunity for making things "clear." The emphasis in this second book in Volume II of the *Spatial Synthesis* is on the importance of transparency.

A visual annotated bibliography of previous related applications appears below. In the figure, click on an image (including the Earth at night) to go to related links. Author names appear on linked materials. These images link to electronic materials internal to the Institute of Mathematical Geography (IMaGe). Individual articles contain links to citations to a variety of materials. A poster based on this image was presented at the first "Scientific Applications with Google Earth Conference," October 22-23, 2008, at The University of Michigan, Ann Arbor. ([Link](#) to full-sized poster presented by the author.)

POPULATION-ENVIRONMENT DYNAMICS: A GOOGLE EARTH APPROACH

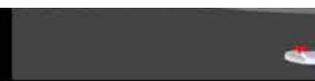
Sandra Lach Arlinghaus, Ph.D., Adjunct Professor of Mathematical Geography and Population-Environment Dynamics, School of Natural Resources and Environment, The University of Michigan; Member Executive Committee, Community Systems Foundation

BEFORE GOOGLE EARTH...

MUNICIPAL APPLICATIONS:
 PLANNING, ZONING, AND EMERGENCY MANAGEMENT

ARCHIMEDES IN ANN ARBOR:
 VISUALIZATION OF THE ALLEN CREEK FLOODPLAIN





THEN CAME GOOGLE EARTH...

A HOST OF BUILDINGS (OVER 400) WAS CREATED, TOWN AND GOWN--TEXTURED AND UNTEXTURED, AND FROM THAT WORK, 2006 FORWARD, FLOWED OTHER APPLICATIONS...

Allen Creek



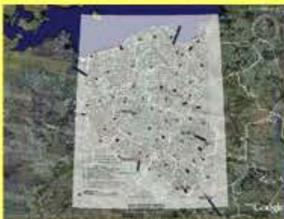
The Skyline as Barchart:
The Vertical City--Urban Change over Time.



Banda Aceh,
Piling up of Tsunami Waters



Classical Central Place Theory



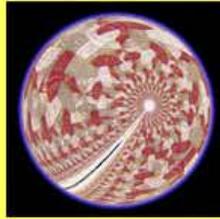
A Study in Shadows



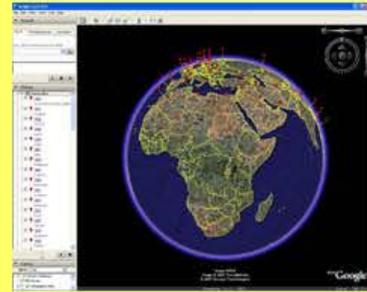
Burundi Buffers: DevInfo Data to Google Earth



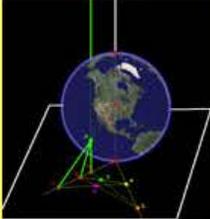
Google, Escher, and...?



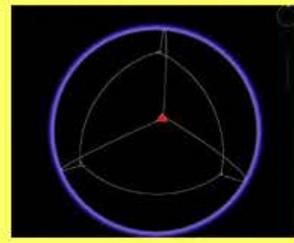
Tracking the spread of possible
honeybee extinction



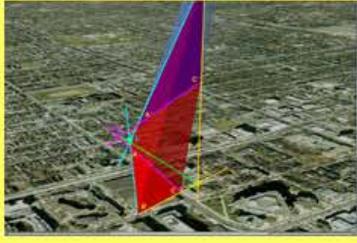
Harmonic Map Projection
Theorem



The Transparent Google Globe:
The Next Frontier?
Tetrahedron in the Google Globe



Desargues's Two Triangle Theorem



Neighborhood Watch



Selected References:



ON THE HORIZON...



Solstice: An Electronic Journal of Geography and Mathematics
<http://www.imagenet.org/>

Spatial Synthesis eBooks: <http://www.imagenet.org/>

3D Atlas of Ann Arbor series: <http://www.imagenet.org/>

Lists of various other contributors can be found in associated books and articles found at the url above. In addition, all those works are also archived in Deep Blue:
<http://deepblue.lib.umich.edu/handle/2027.42/58219>

"Archimedes" is the pseudonym of Arlinghaus in the Google 3D Warehouse; s/he is a Featured Google Earth Modeler in the 3D Warehouse
<http://sketchup.google.com/3dwarehouse/>

Models by "Archimedes" are also featured in "Help Model A City" and in "Cities in Development." <http://sketchup.google.com/3dwarehouse/>

Spatial Synthesis, a continuing collection of eBooks:
<http://www.imagenet.org/>

Population-Environment Dynamics applications.
Mathematical Geography applications.

*2005: Book. *Spatial Synthesis, Volume I: Centrality and Hierarchy, Book 1.* Arlinghaus, Sandra Lach and Arlinghaus, William Charles. June 21.

2008: Book. *Spatial Synthesis, Volume II, Book 1. Scientific, Planning, Humanitarian, and Teaching Applications, From DevInfo to Google Earth.* Arlinghaus, Sandra Lach, et al.

Software used for analysis:

- DevInfo 5.0: <http://www.devinfo.org/>
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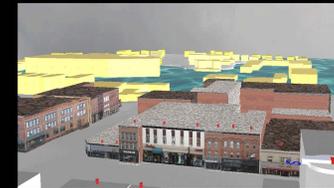
Sandra Lach Arlinghaus, Ph.D., a.k.a. "Archimedes" in the Google 3D Warehouse, Adjunct Professor of Mathematical Geography and Population-Environment Dynamics, School of Natural Resources and Environment, The University of Michigan

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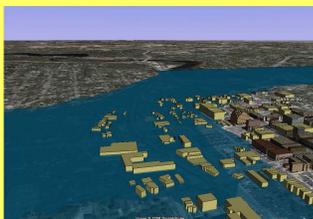
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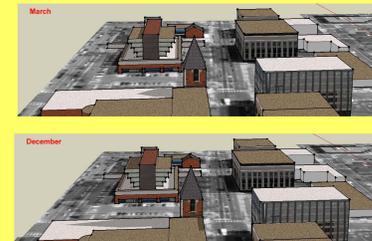
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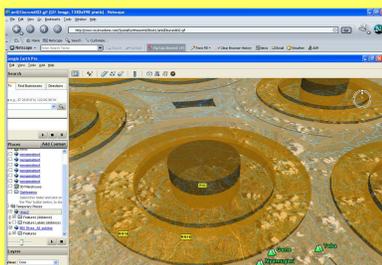
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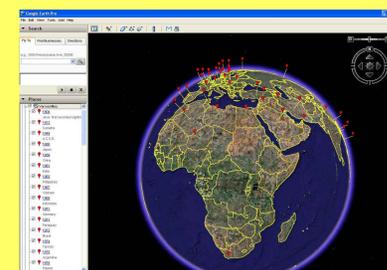


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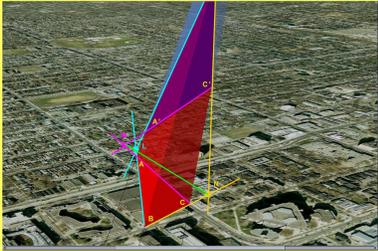
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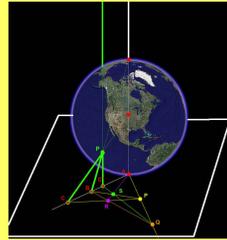




Desargues's Two Triangle Theorem



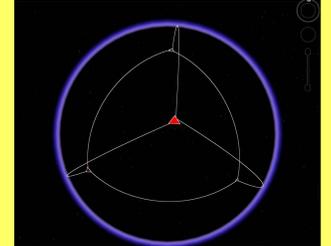
Theorem



Neighborhood Watch



The Transparent Google Globe: The Next Frontier? Tetrahedron in the Google Globe



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ON THE HORIZON...

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Making It Clear: The Importance of Transparency.
Includes a range of applications from Mathematics to Art
to Population-Environment Dynamics.
Escher/Barr Earth; Klein Earth; Fractal Earth
E-book, in press.

More Population-Environment Dynamics applications,
some with Michael Batty.

More Mathematical Geography applications.



Spatial Synthesis

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ANNOTATED RELATED LINKS

ARCHIMEDES IN ANN ARBOR: VISUALIZATION OF THE ALLEN CREEK FLOODPLAIN





Virtual reality files created in 3D Studio Max suggest local changes in flooding that might come from a downstream disruption. While these files are correctly referenced in relation to each other they are not correctly geo-referenced in relation to latitude and longitude and therefore are not compatible with the original City of Ann Arbor GIS maps that served as base maps. The red semi-opaque chimneys on the rooftops are not there in the real world. These serve as links to pages that inventory the building content for emergency management purposes.

IMaGe LINKS

The links in this section go to files presented to municipal authorities (at the 3D Laboratory of the Duderstadt Center at The University of Michigan, at City Hall, and at the Downtown Development Authority) to visualize possible outcomes from displacement of water due to the building of new structures in the Allen Creek floodplain and also to understand implications that might involve emergency management.

The red rooftop links to building content inventories were designed as a consequence of a building fire in the downtown in which a flammable substance stored in the basement caused a problem. Matthew Naud, Environmental Coordinator and Emergency Manager (at the time of file creation) worked with the author to suggest various strategies for the models. Links to the vrml files that create these images are included in the references.

The floodplain model illustrates the problems of building new structures in floodplains and suggests, based on Archimedes Principle of Displacement, the possible unintended consequences that might come about. When one drives through the vrml model, it is possible to see which basements would be flooded in addition to the more obvious problems for buildings above ground.

The vrml files have sounds linked to them to accentuate the effect. A bounding box for various types of sounds, from Beethoven's Sixth associated with the top image, to emergency sirens and rescue helicopters associated with the bottom image, circumscribe sound to make it drop off with distance. Considerable effort was taken to make the scenes realistic. They were shown to members of City Council, Planning Commission, University Administrators, and Downtown Development Authority staff.

In eBooks:

- [3D Atlas of Ann Arbor, 3rd Edition](#), Sandra Lach Arlinghaus with input from others noted throughout. June 2007.
- [3D Atlas of Ann Arbor, 2nd Edition](#). Sandra Lach Arlinghaus, November, 2006.
- [3D Atlas of Ann Arbor, 1st Edition](#). Editor and principal author: Sandra Lach Arlinghaus with co-authors noted throughout the files. June, 2006.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XV, Number 1, 2004](#)
 - [The View from the Top: Visualizing Downtown Ann Arbor in Three Dimensions](#) Sandra L. Arlinghaus, Fred J. Beal, and Douglas S. Kelbaugh
 - [One Optimization of an Earlier Model of Virtual Downtown Ann Arbor](#) Klaus-Peter Beier
- [Volume XII, Number 1 Maps and Decisions: Allen's Creek Floodplain, Opportunity or Disaster?](#) Sandra Lach Arlinghaus

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- [FRACTAL EARTH](#)
- [KLEIN EARTH](#)

Software used in analysis:

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- Adobe® PhotoShop and ImageReady
- Adobe® DreamWeaver
- ESRI:
 - ArcView® 3.2
 - ArcGIS® 9.2
 - ArcCatalog®
 - ArcMap®
- Google Earth®

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heights of buildings in the downtown and in understanding how changes in zoning might alter the vertical city.

The author introduced 3D models to her colleagues on the City of Ann Arbor Planning Commission during her years of service to that group (1995-2003). Initially, in the late 1990s, there were 3D models with no textures made in ArcView 3.2 with Spatial Analyst and 3D Analyst extensions. The Ordinance Revisions Committee of Planning Commission was able to use these in selected applications.

The image at the top of the page shows a report on a public hearing in Council Chambers in Ann Arbor City Hall. That hearing was the outcome of months of work using the urban planning models described above in association with the Downtown Residential Task Force of the Downtown Development Authority (DDA). The models were handed over to the DDA and ultimately to Calthorpe Associates who subsequently used them in making a variety of recommendations to City Council.

In 2003, after leaving City Planning Commission, she was able to learn (when serving as a Faculty Advisor) to make more realistic looking models in 3D Studio Max. In continuing work with Matthew Naud, Environmental Coordinator for the City of Ann Arbor (and then Emergency Manager, as well) a variety of other 3D models were developed with textures on the buildings so that they appeared to be more realistic.

The second image on this page shows a screen capture of a virtual reality file made using 3D Studio Max. The files were large in size and were not georeferenced. Thus, their use was not backward compatible with the city GIS files from which the building footprints were originally derived. Also, they were not aligned with the City aerials and contours. Nonetheless, their realism was attractive. Naud saw them as a possible way for firefighters, in their downtime, to have fun with them on laptops with the intended consequence of having them learn more about the road network and street names of the city they were serving.

Because, the file size is large, separate files with building textures were built a block at a time. In all, 12 blocks of the downtown were done. Photographic assistance came from students in Prof. Klaus-Peter Beier's Virtual Reality course in the College of Engineering of The University of Michigan. Being able to link between files was of course critical if one were to drive around town and learn about it. The semi-transparent red "kiosk" in the street intersection in the bottom figure is not really there; it was introduced as a place to click to go to the next file. Because it is somewhat transparent, building façades are not obscured.

The list of references below is selected from a much larger set. Additional citations may be found in the linked article co-authored by Arlinghaus, Beal, and Kelbaugh.

In eBooks:

- *3D Atlas of Ann Arbor, 3rd Edition*. Sandra Lach Arlinghaus with input from others noted throughout. June 2007.
- *3D Atlas of Ann Arbor, 2nd Edition*. Sandra Lach Arlinghaus, November, 2006.
- *3D Atlas of Ann Arbor, 1st Edition*. Editor and principal author: Sandra Lach Arlinghaus with co-authors noted throughout the files. June, 2006.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- Volume XVI, Number 1, 2005 *Kioskland: A Strategy for Linking Hierarchical Levels of Virtual Reality Maps* Sandra Lach Arlinghaus et al.
- Volume XV, Number 1, 2004
 - *The View from the Top: Visualizing Downtown Ann Arbor in Three Dimensions* Sandra L. Arlinghaus, Fred J. Beal, and Douglas S. Kelbaugh--contains many references to related work.
 - *One Optimization of an Earlier Model of Virtual Downtown Ann Arbor* Klaus-Peter Beier
- Volume XIV, Number 2, 2003
 - *Ann Arbor, Michigan: Virtual Downtown Experiments, Part II* Sandra Lach Arlinghaus
 - *Ann Arbor, Michigan: Virtual Downtown Experiments, Part III* Taejung Kwon, Adrien A. Lazzaro, Paul J. Oppenheim, Aaron Rosenblum
- Volume XIV, Number 1, 2003 *Ann Arbor, Michigan: Virtual Downtown Experiments* Sandra Lach Arlinghaus

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ANNOTATED RELATED LINKS ANN ARBOR, 3D ATLASES AND RELATED MATERIALS



IMaGe LINKS

The links in this section reflect the direct evolution of the *3D Atlas of Ann Arbor* series.

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- [3D Atlas of Ann Arbor, 3rd Edition](#), Sandra Lach Arlinghaus with input from others noted throughout. June 2007.
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- [3D Atlas of Ann Arbor, 1st Edition](#). Editor and principal author: Sandra Lach Arlinghaus with co-authors noted throughout the files. June, 2006.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XVII, Number 1, 2006](#) *3D Atlas of Ann Arbor: The Google Earth® Approach Part I; Part II* Sandra Lach Arlinghaus
- [Volume XVI, Number 2, 2005](#) *NEWS: UPDATE ON THE 3D ATLAS OF ANN ARBOR*
 - [Archimedes in Ann Arbor?](#) Sandra Lach Arlinghaus

- **Virtual Flood in the Allen Creek Floodplain and Floodway.** Alyssa J. Domzal, Ui Sang Hwang, and Kris J. Walters, Jr.
- **Volume XVI, Number 1, 2005** **Kioskland: A Strategy for Linking Hierarchical Levels of Virtual Reality Maps** Sandra Lach Arlinghaus et al.
- **Volume XV, Number 1, 2004**
 - **The View from the Top: Visualizing Downtown Ann Arbor in Three Dimensions** Sandra L. Arlinghaus, Fred J. Beal, and Douglas S. Kelbaugh
 - **One Optimization of an Earlier Model of Virtual Downtown Ann Arbor** Klaus-Peter Beier
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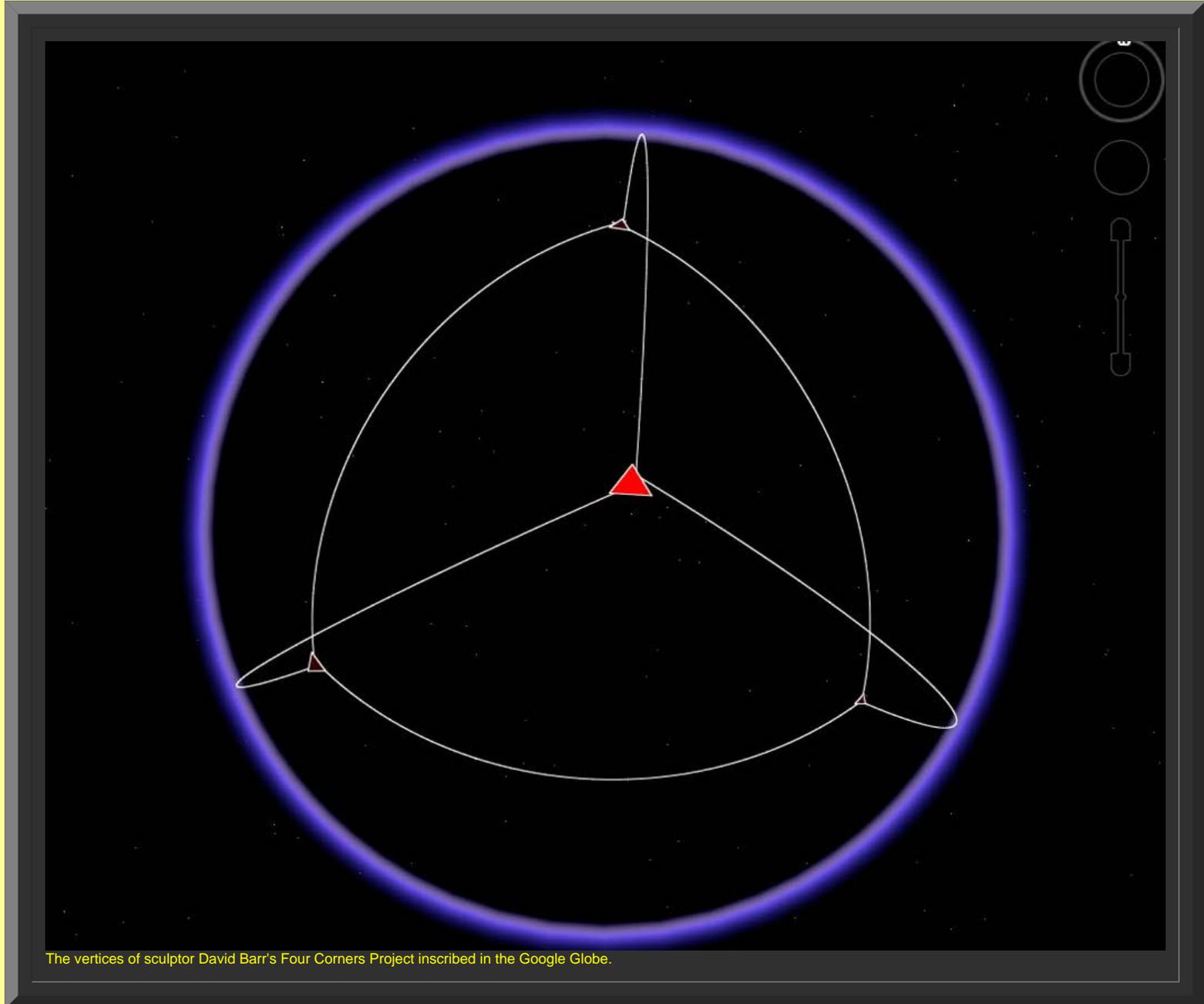
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ANNOTATED RELATED LINKS

THE TRANSPARENT GOOGLE GLOBE: THE NEXT FRONTIER? TETRAHEDRON IN THE GOOGLE GLOBE



The vertices of sculptor David Barr's Four Corners Project inscribed in the Google Globe.

IMaGe LINKS

The link in this section is to a monograph about the work of sculptor David Barr. Imagine all the figures from this earlier book cast in the Google Globe so that one might try to understand the great difficulty in traversing the terrain difficulties Barr encountered in planting his four corners in Easter Island, the Kalahari Desert, the Greenland icecap, and Irian Jaya. Later material in this book will examine the detail of making the Google Earth ball become transparent and present other ways to use the transparent

Google Globe.

Book

Monograph One 78 pp. (master document prepared using MTS by Gwen Nystuen)

Sandra L. Arlinghaus and John D. Nystuen, 1986.

Mathematical Geography and Global Art: the Mathematics of David Barr's 'Four Corners Project'.

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ANNOTATED RELATED LINKS NEIGHBORHOOD WATCH AND COMMUNITY SITES

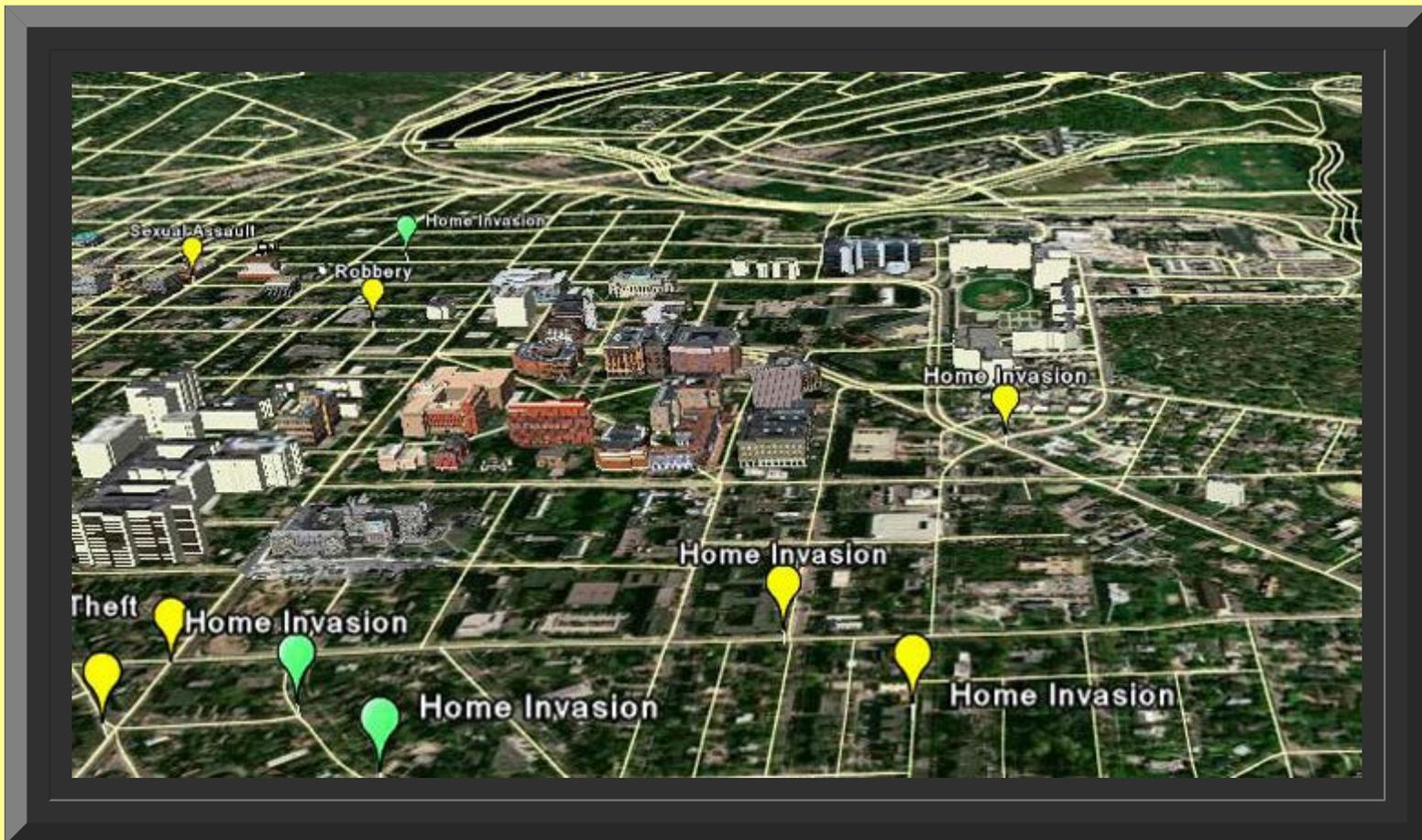


IMaGe LINKS

The links in this section include material from the City of Ann Arbor, from The University of Michigan, and from a local citizens group. The image above shows a screen capture of a Google Earth display of crime statistics from the City of Ann Arbor Police Department, Neighborhood Watch Program, gathered during the authors tenure on the city-wide Neighborhood Watch Advisory Panel (to Adele El-Ayoubi, Neighborhood Watch Coordinator, City of Ann Arbor Police Department). Because there is very little crime in Ann Arbor, it was possible to enter the data by hand to display

the power of the approach, especially when coupled with the 3D building stock (created by the author as Archimedes--over 400 buildings). Work is underway to automate the process using a live feed (see the article below by Lars Schumann).

In Solstice: An Electronic Journal of Geography and Mathematics:

- **Volume XIX, Number 1, 2008**
 - **Another Tale of Two Cities: Neighborhood Watch from Ann Arbor to Baghdad** Sandra Lach Arlinghaus
 - **Google Earth Applications in a Community Information System: Scio Residents for Safe Water** Roger Rayle
 - **Huron River Tour, Ann Arbor** Matthew Naud
 - **Real-time Animation Scripts for Google Earth** Lars Schumann
- **Volume XV, Number 1, 2004** **A Golfer's Resource: Huron Hills Golf Course, Ann Arbor, Michigan** Andrew Walton

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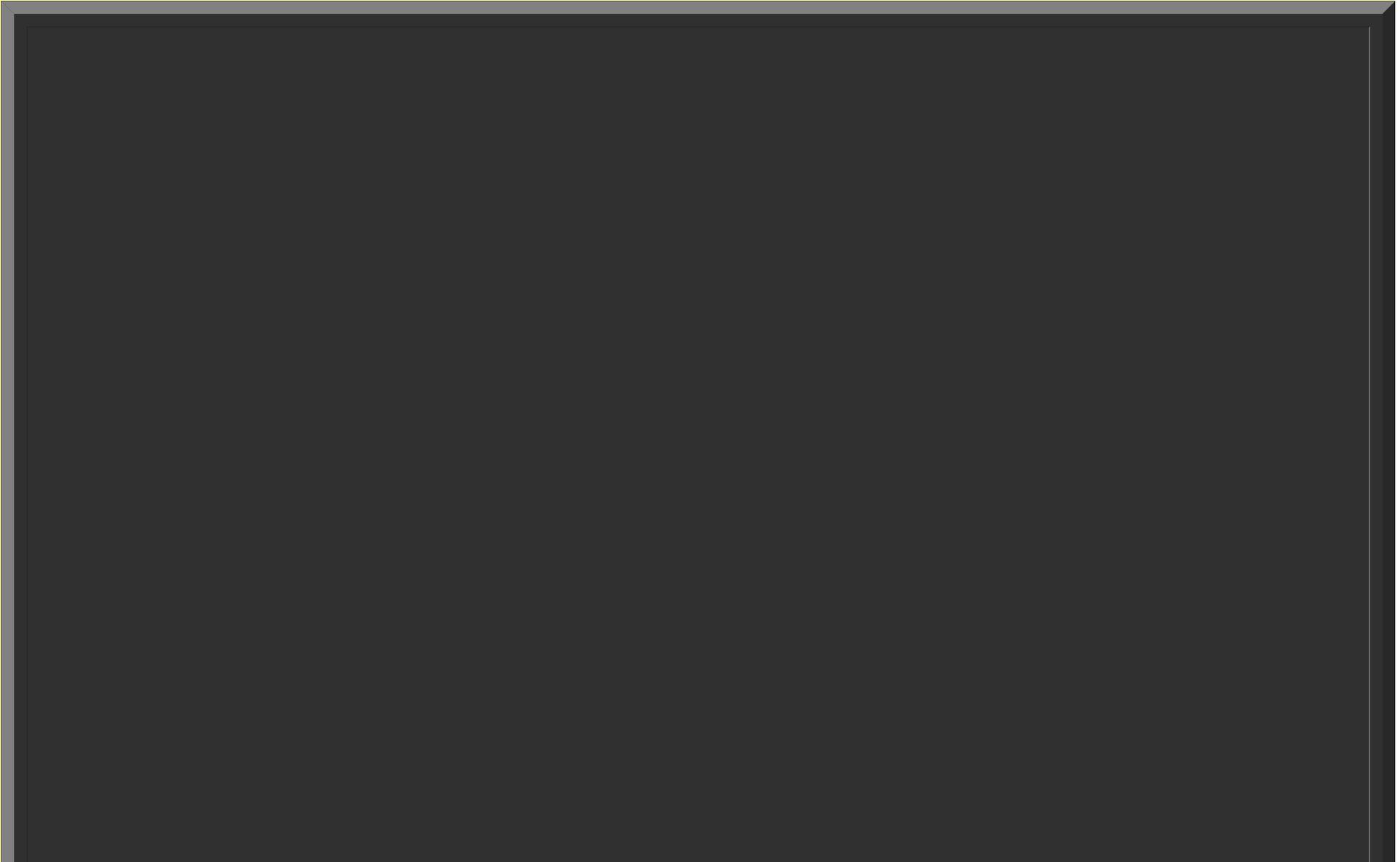
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ANNOTATED RELATED LINKS
DESARGUES'S TWO TRIANGLE THEOREM



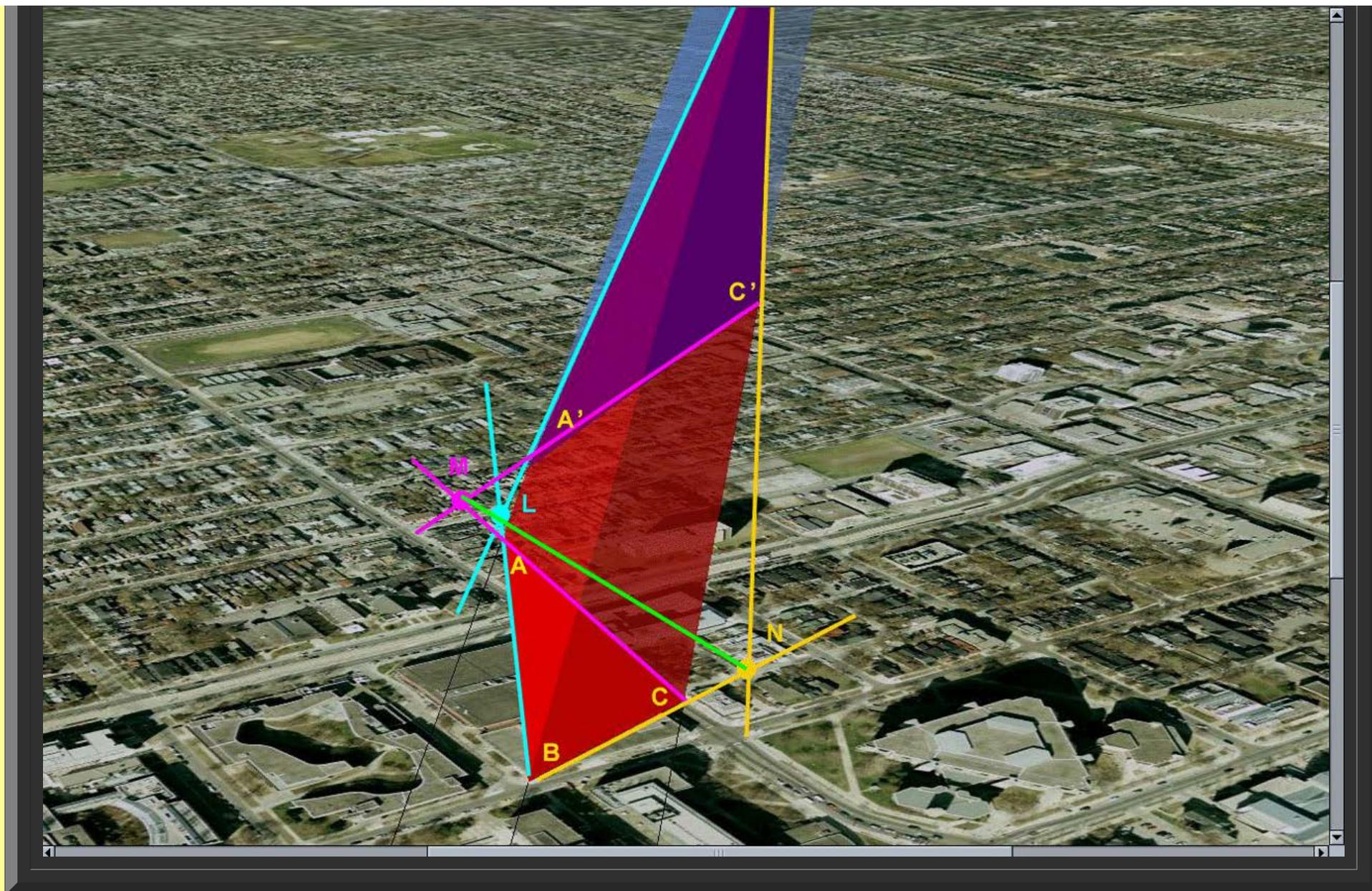


IMaGe LINKS

The links in this section suggest the power of Google Earth in visualizing non-Euclidean geometry theorems. The image above uses transparency to look through the otherwise complicated appearance of Desargues's Two Triangle theorem from Projective Geometry. The lines joining corresponding vertices of two triangles are concurrent, forming a tower with these triangles as sections. In this case, the tower is situated over the Sidney Smith Building of the University of Toronto, home to the Department of Mathematics and the late, great, geometer Professor H. S. M. Coxeter: mathematics history is linked to the mathematics itself.

Transparency makes the locations of intersection points of corresponding sides, and their associated collinearity, become clear. Visualizing a two-dimensional theorem in three dimensions, using semi-opaque colors, makes geometric relationships become clear.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XVIII, Number 2, 2007](#) (all by Sandra Lach Arlinghaus)
 - [Special Issue on Projective Geometry Constructions](#)
 - [Geometry/Geography, Visual Unity](#)
 - [The Animated Pascal](#)
 - [Desargues's Two-Triangle Theorem](#)
- [Volume XVII, Number 1, 2006](#) [Zipf's Hyperboloid?](#) Sandra L. Arlinghaus and Michael Batty

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- Adobe® DreamWeaver
- ESRI:
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 - ArcGIS® 9.2
 - ArcCatalog®
 - ArcMap®
- Google Earth®

Author affiliation:

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Spatial Synthesis

Volume II, Book 2:

Making It Clear: The Importance of Transparency

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ANNOTATED RELATED LINKS
HARMONIC MAP PROJECTION THEOREM

In Solstice: An Electronic Journal of Geography and Mathematics:

Volume XVIII, Number 2, 2007 Geometry/Geography, Visual Unity Sandra Lach Arlinghaus

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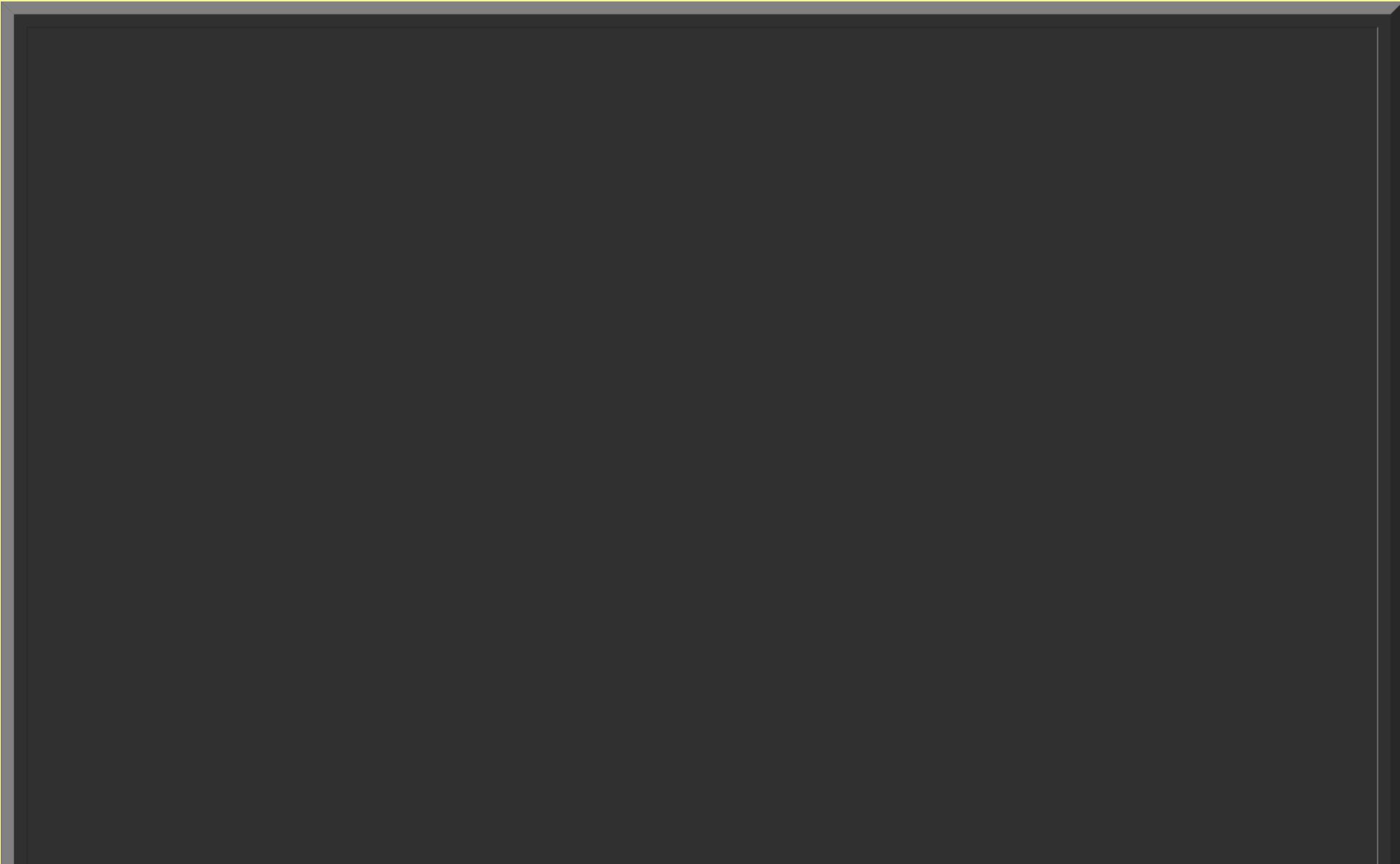
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ANNOTATED RELATED LINKS
TRACKING THE SPREAD OF POSSIBLE HONEYBEE EXTINCTION



The image is a screenshot of the Google Earth Pro application window. The main view is a 3D globe centered on Africa, with a blue glow around the horizon. Numerous red pins are placed across the globe, and yellow outlines delineate various geographical regions. On the left side, there is a search panel with a 'Fly To' section containing 'Find Businesses' and 'Directions' buttons, and a search input field with the placeholder text 'e.g., 1600 Pennsylvania Ave, 20006'. Below the search panel is a 'Places' list showing a series of red pins with corresponding years and locations, such as '1904 Java: first recorded sightin', '1912 Sumatra', '1949 U.S.S.R.', '1955 Japan', '1959 China', '1961 India', '1963 Philippines', '1967 Vietnam', '1968 Indonesia', '1971 Germany', '1971 Paraguay', '1972 Brazil', '1974 Taiwan', '1975 Argentina', and '1975 Poland'. At the bottom left, there is a 'Layers' panel with a 'View: Core' dropdown and several checked layers: 'Primary Database', 'Terrain', and 'Geographic Web'. The bottom right corner of the application window contains copyright information: 'Image NASA', 'Image © 2007 TerraMetrics', '© 2007 Europa Technologies', and the Google logo. Below this, it says 'Streaming | 100%' and 'Eye alt 7067.61 mi'. The top of the window shows the standard Windows-style title bar with 'Google Earth Pro' and window control buttons.

IMaGe LINKS

The links in this section track the progress of Diana Sammartaro's research on the Varroa mite that threatens the world's honeybee population.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XVIII, Number 1, 2007 Update on the Varroa Mite Map](#) Diana Sammartaro [with Editorial Commentary]
- [Volume XVII, Number 2, 2006 Update on the Varroa Mite Map](#) Diana Sammartaro
- Volume XII, Number 1, 2001 [Update on the Varroa Mite Map](#) Diana Sammartaro
- Volume IX, Number 1, 1998 [Animaps](#) Sandra L. Arlinghaus, William D. Drake, and John D. Nystuen with data and other input from: Audra Laug, Kris S. Oswald, and Diana Sammartaro

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ANNOTATED RELATED LINKS
GOOGLE, ESCHER, AND ?

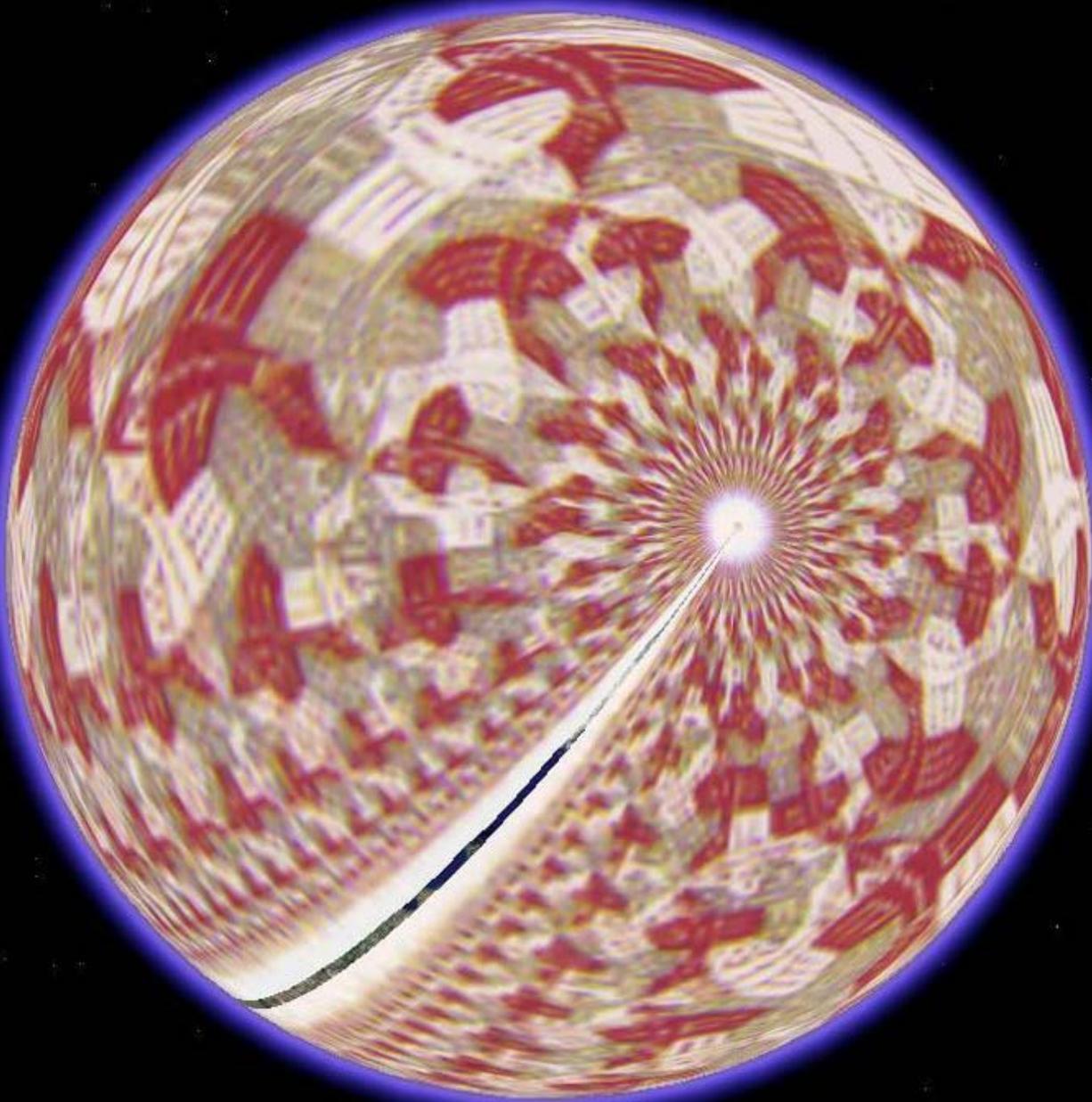


IMaGe LINKS

The links in this section reflect a variety of uses of transparency, blank space, alternative viewpoints, and imaginative input. The paraphrase in the title is a reference to Douglas Hofstadter's Pulitzer Prize winning book, *Gödel, Escher, Bach*. One "natural" way to fill in the "?" in the page title of "Google, Escher, ?" is with the rhyming maiden last name of the author, thus making the title, "Google, Escher, *Lach*"...however, there may well be better ways and that remains a challenge to readers!

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XIX, Number 1, 2008 Mouth Geography...Or, Sleep Apnea and Linguistics?](#) William E. Arlinghaus
- [Volume XVIII, Number 2, 2007 The Animated Pascal](#) Sandra L. Arlinghaus
- ◊
- [Volume XVII, Number 1, 2006 PseudoCoup: A Psubtle Puzzle Link to Solution](#) William C. Arlinghaus
- [Volume XVI, Number 1, 2005 A Methodology for Historical Geography: Internet Implementation](#) Ann Evans Larimore with Sandra Lach Arlinghaus and Robert Haug
- [Volume XV, Number 2, 2004](#)
 - [Two Rivers Ridge: Capturing Art](#) Sandra Arlinghaus and Braxton Blake
 - [Goode's 80th!](#) Sandra Lach Arlinghaus
- [Volume XIV, Number 2, 2003 Lewis and Clark, 200 Years: A Visual Tribut to an Exploration. The Gates of the Rocky Mountains.](#) Sandra Arlinghaus, Robert Haug, Ann Larimore
- [Volume XIV, Number 1, 2003 Animated Time Lines: Coordination of Spatial and Temporal Information](#) Sandra Arlinghaus, Michael Batty, and John Nystuen
- [Volume IX, Number 1, 1998 Revitalizing Maps or Images?](#) Sandra L. Arlinghaus, Ruben De la Sierra

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 - ArcCatalog®
 - ArcMap®

- Google Earth[®]

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ANNOTATED RELATED LINKS
BURUNDI BUFFERS: DEVINFO TO GOOGLE EARTH

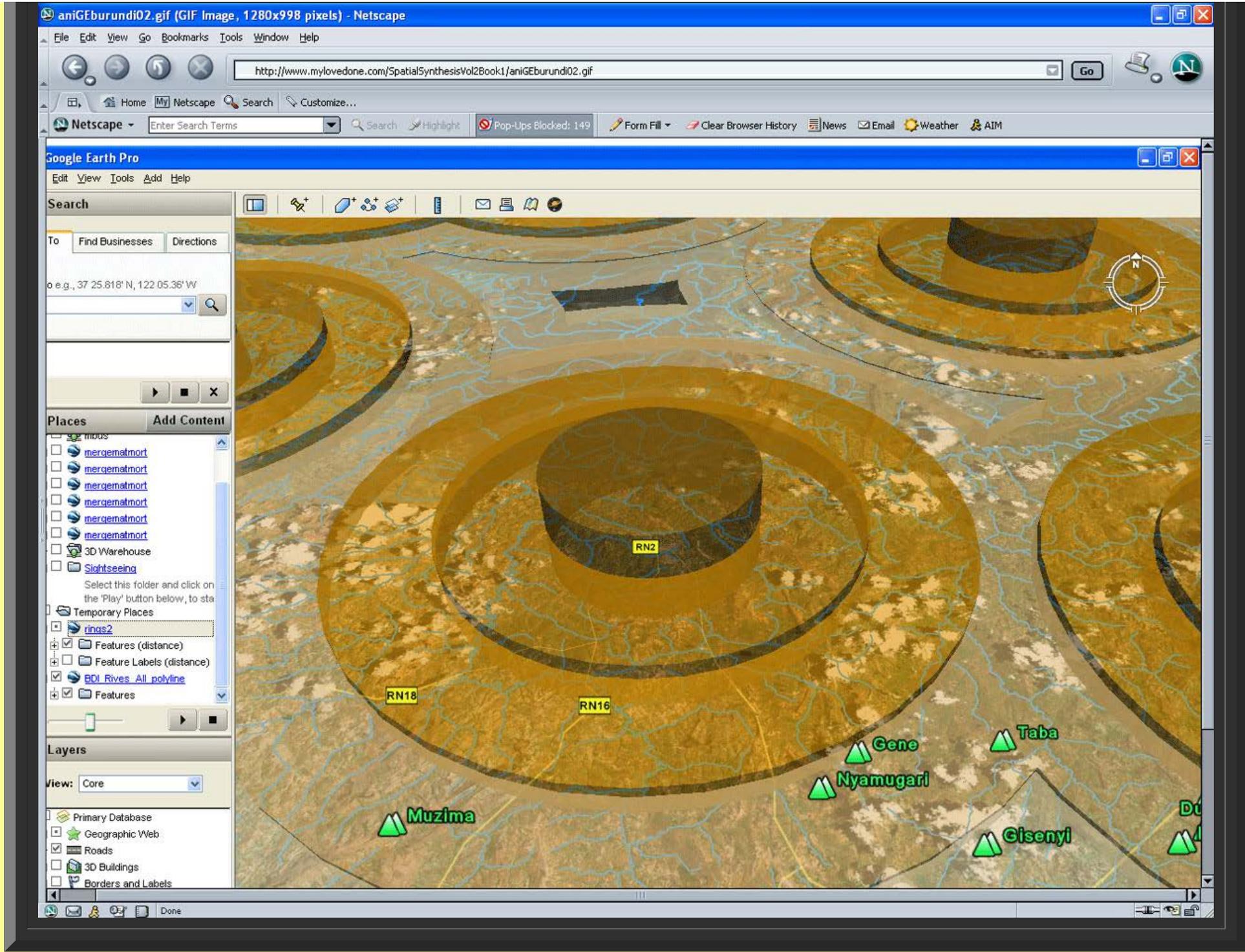


IMaGe LINKS

The links in this section suggest a variety of uses, most involving transparency and others involving related ideas, for spatial buffers. Buffers are often used to represent tributary errors to point locations--the city and its hinterland, and so forth. Partially transparent buffers permit us to look through to other maps, as Schlossberg suggests. Later work lets partially transparent reveal terrain and all that Google Earth has to offer.

When Google Earth is linked to DevInfo, particularly strong possibilities for 3D modeling in developing nations become apparent (see the first book below). DevInfo is software in place, through the United Nations, in over 80 developing nations of the world. It was developed by Community Systems Foundation (Ann Arbor), an international NGO in partnership with the United Nations. The backbone of the software is GIS. It is a stand alone package that is given to client nations along with training so that they become self-sufficient in monitoring and evaluating a host of humanitarian issues. It has seen use in a variety of humanitarian applications, from maternal and child health care to rescue efforts following earthquakes. Related links: <http://www.CommunitySystemsFoundation.org/> ; <http://www.csfnet.org/>

In eBooks:

- [*Spatial Synthesis: Scientific, Planning, Humanitarian, and Teaching Applications, From DevInfo to Google Earth*](#). Volume II, Book 1. September 2008. Sandra L. Arlinghaus, et al.
- [*Spatial Synthesis: Centrality and Hierarchy. Volume I, Book 1*](#). Sandra Lach Arlinghaus and William Charles Arlinghaus. June 21, 2005.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XV, Number 1, 2004 *Visualizing Accessibility II: Access to Food*](#) Marc Schlossberg
- [Volume XIV, Number 2, 2003 *Tornado Siren Location, Response to Previous Article*](#)
 - [Letter from United States Member of Congress, John Dingell](#)
 - [Quotations from articles in The Ann Arbor News](#)
- [Volume XIV, Number 1, 2003 *Tornado Siren Location: Ann Arbor, Michigan*](#) Sandra Lach Arlinghaus
- [Volume XIII, Number 2, 2002 *Visual Accessibility with GIS*](#) Marc Schlossberg
- [Volume XII, Number 2, 2001 *Base Maps, Buffers, and Bisectors*](#) Sandra Lach Arlinghaus
- [Volume X, Number 2 *A Map of Jackson, Mississippi*](#) Sandra L. Arlinghaus

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ANNOTATED RELATED LINKS

A STUDY IN SHADOWS



IMaGe LINKS

The links in this section are related to shadows. The image above shows shadow change, modeled in Google SketchUp for a segment of downtown Ann Arbor. The shadows that grow over time are more transparent than are the fixed ones that came in with the aerial baseplate from Google Earth.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XVII, Number 1, 2006](#) 3D Atlas of Ann Arbor: The Google Earth® Approach [Part I](#) Sandra Lach Arlinghaus
- [Volume XVI, Number 2, 2005](#) [Beyond the Shadow](#) Sandra L. Arlinghaus and William C. Arlinghaus (Variation on a submission for the Pirelli Challenge of 2005).

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ANNOTATED RELATED LINKS

CLASSICAL CENTRAL THEORY

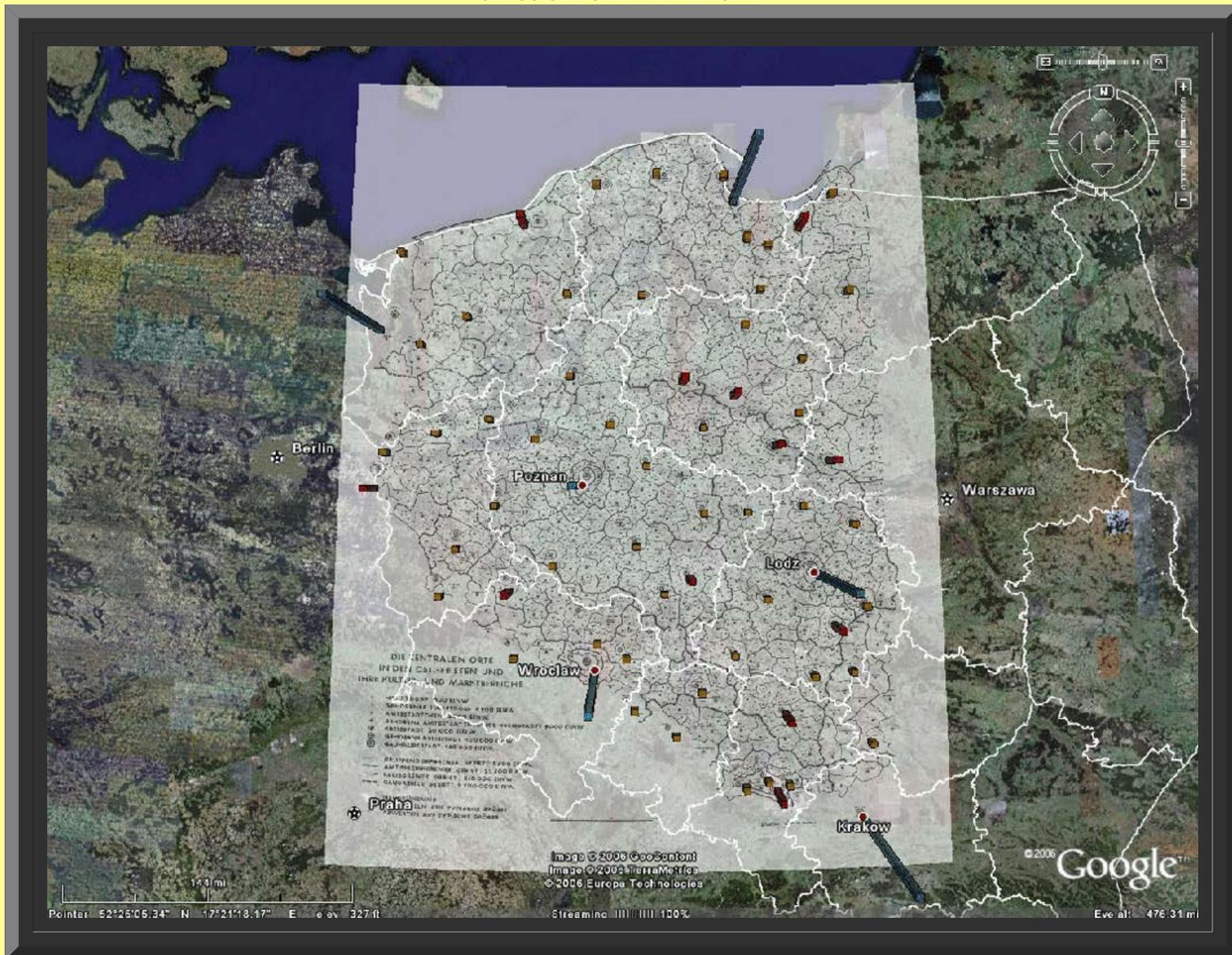


IMaGe LINKS

The links in this section reflect the evolution of an approach to classical central place theory created by S. Arlinghaus in 1985 (Arlinghaus, S. "Fractals Take A Central Place" *Geografiska Annaler*, 67B, 1985, pp. 83-88, Journal of the Stockholm School of Economics; Arlinghaus S. and Arlinghaus, W. "The Fractal Theory of Central Place Hierarchies: A Diophantine Analysis of Fractal Generators for Arbitrary Loschian Numbers" *Geographical Analysis: An International Journal of Theoretical Geography*, Ohio State University Press, Vol. 21, No. 2, April, 1989, pp. 103-121) written about in these references and [elsewhere](#).

The image above illustrates a strategy for aligning an historical map with the actual landscape. It also inserts bars as part of a hierarchy of the spatial distribution of cities and tributary areas in World War II Poland.

In eBooks: [Spatial Synthesis: Centrality and Hierarchy, Volume I, Book 1](#). Sandra Lach Arlinghaus and William Charles Arlinghaus. June 21, 2005.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XVII, Number 2, 2006](#) (all by Sandra Lach Arlinghaus)
 - [Special Issue on Internet Geometry and Geography: Introduction to the Special Issue](#)
 - [Visualizing a Map of Walter Christaller, Poland 1941](#)
 - [Part I: Benchmarking the Map](#)
 - [Part II: Interpolation of the Benchmarked Map](#)
- [Volume XV, Number 1, 2004 Spatial Synthesis Sampler. Geometric Visualization of Hexagonal Hierarchies: Animation and Virtual Reality](#). Sandra Lach Arlinghaus and William Charles Arlinghaus. Semi-Finalist, Pirelli INTERNETional Award.

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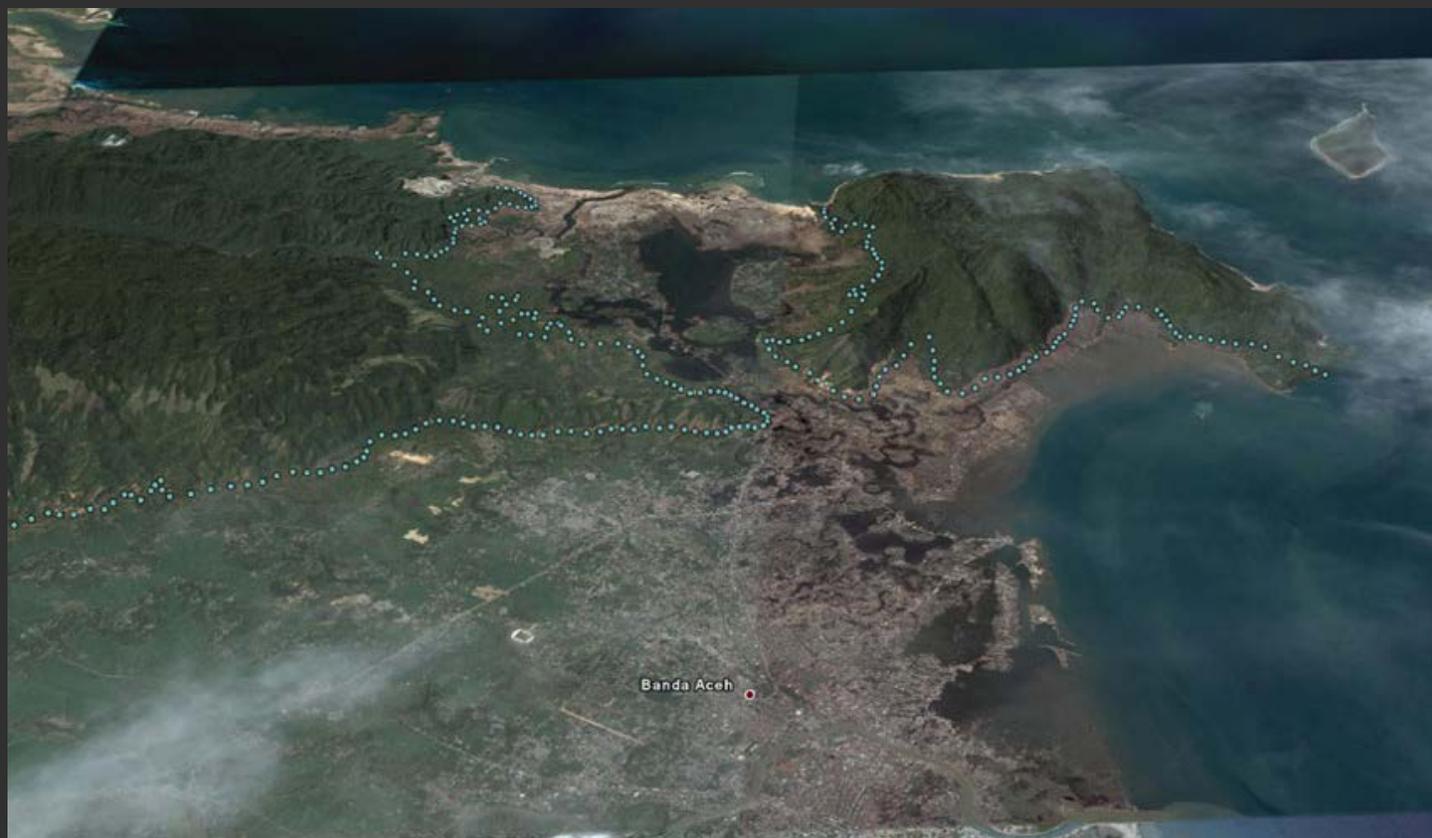
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ANNOTATED RELATED LINKS BANDA ACEH, PILING UP OF TSUNAMI WATERS



The land channel linking two coasts created greater piling up of Tsunami waters inland than along either coast. A similar, but not identical, effect occurs with tides in the Bay of Fundy. Policy makers of all sorts might be well-advised not to create channels with man-made structures that could cause unintended consequences from the piling up of water, air, or other naturally flowing substances.

IMaGe LINKS

The links in this section reflect a growing association in using Google Earth in projects and interests of Community Systems Foundation, an international NGO in Ann Arbor partnered with the United Nations.

In eBooks: [*Spatial Synthesis: Scientific, Planning, Humanitarian, and Teaching Applications, From DevInfo to Google Earth*](#). Volume II, Book 1. September 2008. Sandra L. Arlinghaus, et al.

In Solstice: An Electronic Journal of Geography and Mathematics:

[Volume XVII, Number 2, 2006 Banda Aceh: A View on the Globe](#) Sandra Lach Arlinghaus

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Spatial Synthesis

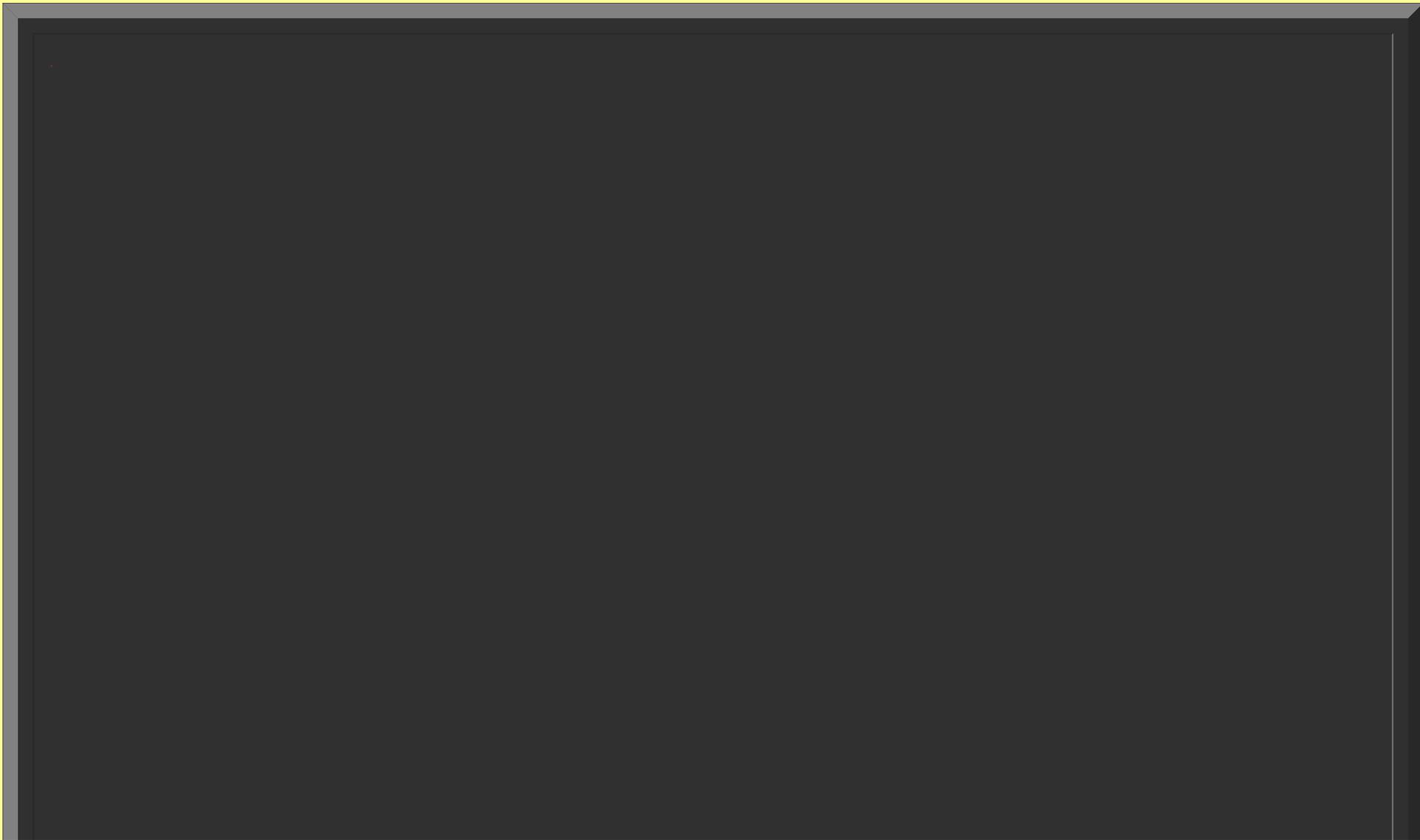
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ANNOTATED RELATED LINKS

THE SKYLINE AS BARCHART: THE VERTICAL CITY--URBAN CHANGE OVER TIME





United Kingdom 1901 urban population data of Michael Batty, visualized in Google Earth.

IMaGe LINKS

The links in this section reflect collaboration between S. Arlinghaus and M. Batty in the use of geometry in geography. An added link to a Tobler paper reflects his long-standing and continuing interest in that same interaction. A wide variety of linked articles reflecting relations between geometry and geography is available in the Solstice archive and in the online eBooks archive, <http://www.imagenet.org/>

In Solstice: An Electronic Journal of Geography and Mathematics:

- [Volume XVII, Number 2, 2006 Visualizing Rank and Size of Cities and Towns](#) Sandra Arlinghaus and Michael Batty
 - [Part I: England, Scotland, and Wales, 1901-2001](#)
 - [Part II: Greater London, 1901-2001](#)
- [Volume XVII, Number 1, 2006 Zipf's Hyperboloid?](#) Sandra L. Arlinghaus and Michael Batty
- Volume XII, Number 2 [Spherical Measures without Spherical Trigonometry](#) Waldo Tobler

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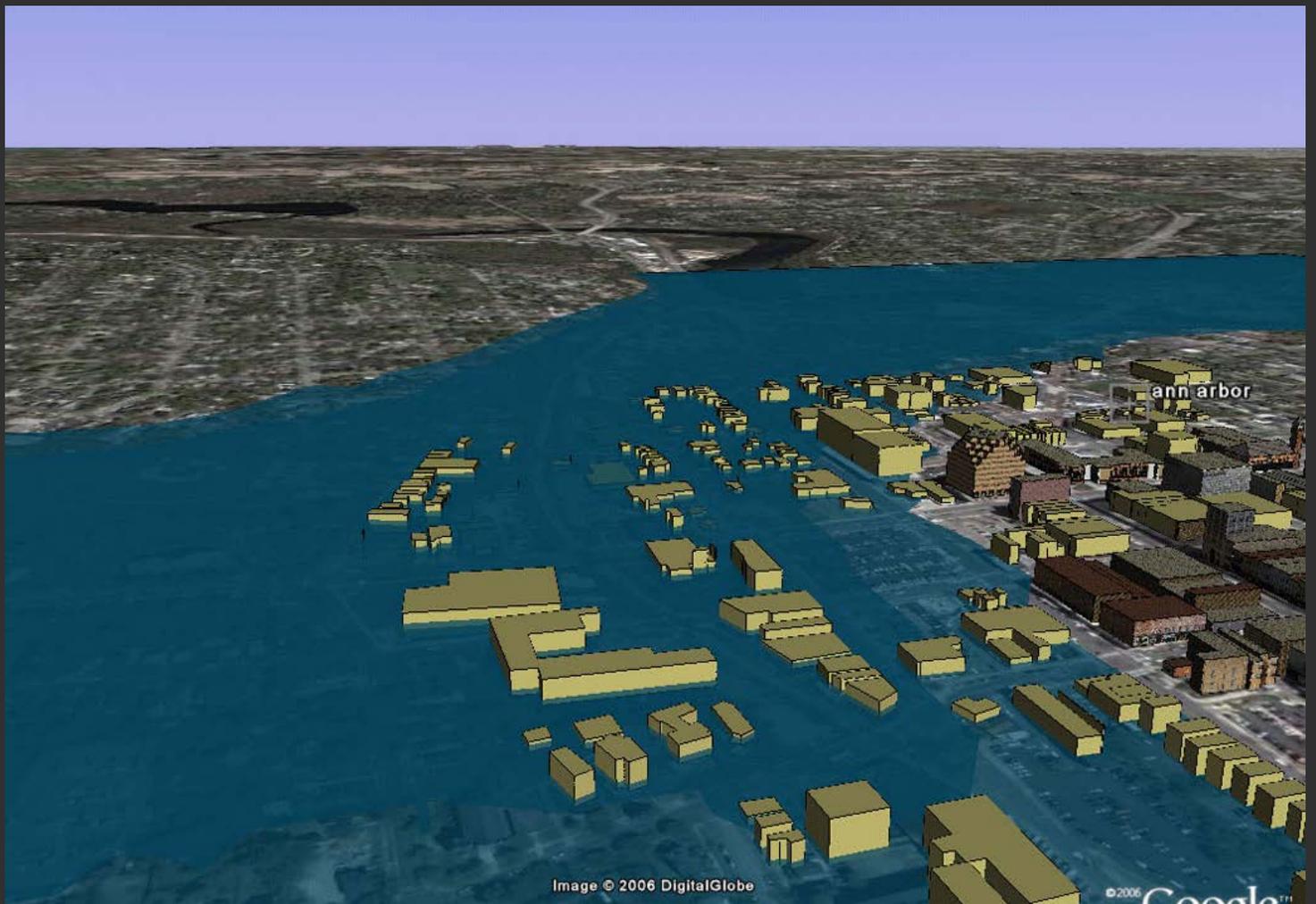
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ANNOTATED RELATED LINKS ALLEN CREEK



Semi-opaque layers of flood waters at different contours allow the reader to look through and see previous flood stages as well as what is already present in Google Earth and in the stock of 3D buildings. Diving through the layers permits one to see which basements lie below the flood waters at various levels.

IMaGe LINKS

The link in this section goes to files presented to municipal authorities (at the 3D Laboratory of the Duderstadt Center at The University of Michigan) to visualize, in Google Earth, possible outcomes from displacement of water due to the building of new structures in the Allen Creek floodplain. The image above shows an overlay in which different levels of water are visible. The image below shows an animation of successive fillings of the floodplain to different contour levels, from 770 to 900 feet. Both were used in conjunction with a discussion of Archimedes Principle of Displacement ("bathtub principle") to illustrate the difficulty of building new structures in an existing floodplain. New structures will cause unintended consequences when the "bathtub" is filled; the filling water that has been displaced will overflow the "tub" perimeter.



In Solstice: An Electronic Journal of Geography and Mathematics:

- [Volume XVI, Number 2, 2005 NEWS: UPDATE ON THE 3D ATLAS OF ANN ARBOR](#)
 - [Archimedes in Ann Arbor?](#) Sandra Lach Arlinghaus
 - [Virtual Flood in the Allen Creek Floodplain and Floodway.](#) Alyssa J. Domzal, Ui Sang Hwang, and Kris J. Walters, Jr.

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ANNOTATED RELATED LINKS SPATIAL SYNTHESIS



Great Lakes Basin: City Lights in Google Earth. Link to an earlier related article in *Solstice*: [Volume XIII, Number 1, 2002](#) [The Lights Are On, All Over the World](#) Sandra Lach Arlinghaus.

IMaGe LINKS

The links in this section reflect the direct evolution of the *Spatial Synthesis* series.

In eBooks:

- [Spatial Synthesis: Scientific, Planning, Humanitarian, and Teaching Applications, From DevInfo to Google Earth](#). Volume II, Book 1. September 2008. Sandra L. Arlinghaus, et al.
- [Spatial Synthesis: Centrality and Hierarchy, Volume I, Book 1](#). Sandra Lach Arlinghaus and William Charles Arlinghaus. June 21, 2005.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

- [Volume XVI, Number 1, 2005](#)
 - [Spatial Synthesis: The Evidence of Cartographic Example: Hierarchy and Centrality](#) Sandra Lach Arlinghaus
 - [Spatial Synthesis: Investigations in Progress](#) Sandra Lach Arlinghaus

- [Volume XV, Number 2, 2004 Spatial Synthesis: 3D Atlas of Ann Arbor](#) Sandra Lach Arlinghaus
- [Volume XV, Number 1, 2004 Spatial Synthesis Sampler. Geometric Visualization of Hexagonal Hierarchies: Animation and Virtual Reality](#) Sandra Lach Arlinghaus and William Charles Arlinghaus. Semi-Finalist, Pirelli INTERNETional Award.
- [Volume XIII, Number 2, 2002 Spatial Synthesis: A Research Program](#) Sandra L. Arlinghaus and William C. Arlinghaus

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- DevInfo 5.0: <http://www.devinfo.org/>
 - Adobe® PhotoShop and ImageReady
 - Adobe® DreamWeaver
 - ESRI:
 - ArcView® 3.2
 - ArcGIS® 9.2
 - ArcCatalog®
 - ArcMap®
 - Google Earth®
-

Author affiliation:

Arlinghaus, Sandra Lach. Adjunct Professor of Mathematical Geography and Population-Environment Dynamics, School of Natural Resources and Environment, The University of Michigan. Executive Committee Member (Secretary) Community Systems Foundation, sarhaus@umich.edu, <http://www-personal.umich.edu/~sarhaus/>

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Spatial Synthesis

Volume II, Book 2: Making It Clear: The Importance of Transparency

Sandra Lach Arlinghaus
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ANNOTATED RELATED LINKS AWARDS



View of The University of Michigan, Ann Arbor. Central quadrangle, "The Diag."

IMaGe LINKS

The link in this section shows selected "Blue Ribbon" models, of Archimedes, in the Google 3D Warehouse. Models receiving a Blue Ribbon appear in the default loadset of Google Earth when the 3D Buildings switch is clicked on. The scene above is aligned correctly with the underlying aerials. As aerials have changed in Google Earth over time, the alignment has become distorted.

In *Solstice: An Electronic Journal of Geography and Mathematics*:

Volume XVIII, Number 2, 2007

- [Awards \(contains recent listing of "blue ribbons" from the "Best of the Google 3D Warehouse"\)](#)

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- **ESCHER / BARR EARTH**
 - **FRACTAL EARTH**
 - **KLEIN EARTH**
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Volume I of the *Spatial Synthesis** series focuses on theory;
 Volume II* of the series focuses on applications, turning theory into practice.

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These chapters use subtle effects and reflect the importance of transparency in making concepts become clear.

INTRODUCTION

Graphics created on the computer often employ subtle capabilities that did not really exist in a paper and pen environment. Thus, "white" becomes a color to be used in the same way as red or green. "Transparent" also becomes a color by which to uncover parts of other images. Two dimensional maps composed of layers in Geographic Information Systems software may look through one layer to see part of another. Images created in Adobe Photoshop can be assigned partially opaque colors to let still others show through. The world of three-dimensional models suggests a host of opportunity for making things "clear." The emphasis in this second book in Volume II of the *Spatial Synthesis* is on the importance of transparency.

A visual annotated bibliography of previous related applications appears below. In the figure, click on an image (including the Earth at night) to go to related links. Author names appear on linked materials. These images link to electronic materials internal to the Institute of Mathematical Geography (IMaGe). Individual articles contain links to citations to a variety of materials. A poster based on this image was presented at the first "Scientific Applications with Google Earth Conference," October 22-23, 2008, at The University of Michigan, Ann Arbor. ([Link](#) to full-sized poster presented by the author.)

POPULATION-ENVIRONMENT DYNAMICS: A GOOGLE EARTH APPROACH

Sandra Lach Arlinghaus, Ph.D., Adjunct Professor of Mathematical Geography and Population-Environment Dynamics, School of Natural Resources and Environment, The University of Michigan; Member Executive Committee, Community Systems Foundation

BEFORE GOOGLE EARTH...

MUNICIPAL APPLICATIONS:
 PLANNING, ZONING, AND EMERGENCY MANAGEMENT

ARCHIMEDES IN ANN ARBOR:
 VISUALIZATION OF THE ALLEN CREEK FLOODPLAIN





THEN CAME GOOGLE EARTH...

A HOST OF BUILDINGS (OVER 400) WAS CREATED, TOWN AND GOWN--TEXTURED AND UNTEXTURED, AND FROM THAT WORK, 2006 FORWARD, FLOWED OTHER APPLICATIONS...

Allen Creek



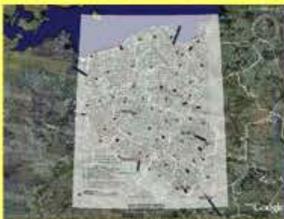
The Skyline as Barchart:
The Vertical City--Urban Change over Time.



Banda Aceh,
Piling up of Tsunami Waters



Classical Central Place Theory



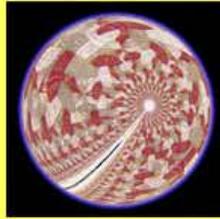
A Study in Shadows



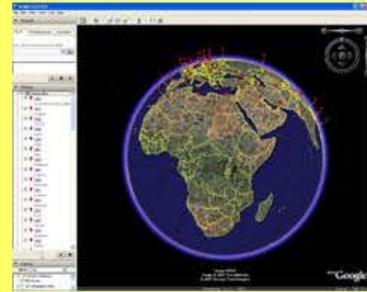
Burundi Buffers: DevInfo Data to Google Earth



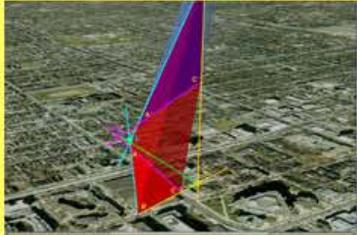
Google, Escher, and...?



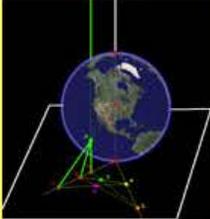
Tracking the spread of possible
honeybee extinction



Desargues's Two Triangle Theorem



Harmonic Map Projection
Theorem



Neighborhood Watch



The Transparent Google Globe:
The Next Frontier?
Tetrahedron in the Google Globe



Selected References:



ON THE HORIZON...

Solstice: An Electronic Journal of Geography and Mathematics
<http://www.imagenet.org/>

Spatial Synthesis eBooks: <http://www.imagenet.org/>

3D Atlas of Ann Arbor series: <http://www.imagenet.org/>

Lists of various other contributors can be found in associated books and articles found at the url above. In addition, all those works are also archived in Deep Blue:
<http://deepblue.lib.umich.edu/handle/2027.42/58219>

"Archimedes" is the pseudonym of Arlinghaus in the Google 3D Warehouse; s/he is a Featured Google Earth Modeler in the 3D Warehouse
<http://sketchup.google.com/3dwarehouse/>

Models by "Archimedes" are also featured in "Help Model A City" and in "Cities in Development." <http://sketchup.google.com/3dwarehouse/>

Spatial Synthesis, a continuing collection of eBooks:
<http://www.imagenet.org/>

Population-Environment Dynamics applications.
Mathematical Geography applications.

*2005: Book. *Spatial Synthesis, Volume I: Centrality and Hierarchy, Book 1.* Arlinghaus, Sandra Lach and Arlinghaus, William Charles. June 21.

2008: Book. *Spatial Synthesis, Volume II, Book 1. Scientific, Planning, Humanitarian, and Teaching Applications, From DevInfo to Google Earth.* Arlinghaus, Sandra Lach, et al.

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