

Mapping: Methods & Tips

Historical Mapping Using Google Earth

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Introduction

Maps capture information about land, culture, politics, and people that often cannot be found in other sources. Once printed, the information gains a historical significance, as it records geographical information of a specific place at a specific time. Historical maps provide essential information for scholars studying political, physical, and land use changes over time. Much of the information learned about the past will also influence studies, findings, and changes for the future. Analyzing change requires accurate comparisons of maps, a challenge when working with the static confines of print. More and more researchers are turning to geographical information system (GIS) technology to digitize maps for computational analysis, georeferencing tools, 3-D modeling, and to combine the maps with other spatial data sources.

Historical mapping within a GIS has been used to explain past and present phenomena, to predict changes as well as to make changes to our landscape. Scholars have studied historical maps and documents with the aid of GIS technology, gaining information on tree invasion (Mast, Veblen, and Hodgson 1997), property identification (Leppin et al. 2000), agricultural land use (Domaas 2007), railroad networks (Siebert 2004), accuracy of historical maps (Pearson 2005), and much more. Using historical maps within a GIS to trace land use practices can be an effective and efficient method of analyzing and visualizing historical land use patterns.

Historical GIS, although not a new field, is certainly becoming very popular and attracting individuals who are not geography, history, or GIS professionals. With access to historical maps and GIS software on the Internet, historical mapping is intriguing both the young and old and, with such ease of access, is interesting them in their local and world history. Whether their interest is in military mapping, historical demograph-

ics, distribution of diseases, or genealogy, the tools are available for them to access.

Historical GIS Online

There are many historical databases and interactive mapping sites available on the Internet. The National Historical Geographic Information System (NHGIS) is an example of a data provider as well as an online map viewer that provides aggregate census data and boundary files for the U.S. between 1790 and 2000. Users may download the data to use with their own GIS software programs, or they may use the Social Explorer, an interactive mapping program that allows users to visualize demographic data in map form. Another popular example is Great Britain Historical Geographical Information System, a GIS collection of information about Britain's localities as they have changed over time. The source of information is from census reports, historical gazetteers, travellers' tales, and historical maps (GBHGIS 2008). Users can map population, mortality rate, housing, industry, and more for the period 1801-2001.

There are many more examples of historical GIS projects on the Internet. Lancaster University hosts an excellent collection of historical GIS project links collected by Ian Gregory and Paul Ell. See the Historical GIS Research Network at <http://www.hgis.org.uk/resources.htm>.

In the last few years, there has been a tremendous increase of map services and free geographic viewers. These developments have increased usability and accessibility, especially because most Internet users do not have the GIS expertise required to work with historical datasets off-line. Mapping historical data has become a less technologically imposing process thanks, in part, to Google Earth. For instance, Google Earth has included David Rumsey's collection of over 120 historical maps in its program (Rumsey 2008). Many organizations, in lieu of creating their own viewers, are offering Google-Earth-supported Keyhole Markup Language (KML) files for download. Users download the KML files from the Internet and view them in Google Earth, using it as their own customizable interactive mapping program. Examples of some of the KML files available for download will be discussed in the next sections.

Historical Mapping in Google Earth

David Rumsey Historical Map Collection

One of the more recent additions to Google Earth 4.3 is David Rumsey's Historical Map Collection. David Rumsey has a personal collection of over 150,000 historical maps, many available from his Web site, <http://www.davidrumsey.com/>. Google Earth has incorporated a sampling of over 120 of his maps, representing time periods between 1680 and 1930 and covering geographical locations across the world. All the map images available from Google Earth have been georeferenced to align them correctly to the earth's surface. Google Earth users can, therefore, view a modern image of an area on the globe and superimpose the historical map to go back in time for that exact geographical location. Users can trace differences in the landscape and see for themselves whether much change has occurred in the last 80 or 300 years.

To view David Rumsey's Collection, the user must have version 4.3 of Google Earth installed.

David Rumsey's Historical Maps can be viewed in Google Earth by turning on the "Rumsey Historical Maps" button under the Gallery layer. Zooming into the virtual globe will display several historical map symbols (see Figure 1), indicating map availability. Clicking on the symbol will display a thumbnail of the map, as well as a link to David Rumsey's Web page for a very detailed description and catalog record of the map. Clicking on the thumbnail image will overlay the image in Google Earth. The image layer becomes visible in the Temporary Places area. Any layer under this area can be saved as a KML file, enabling users to export the image and either view in Google Earth again at another time, or share with others. KML files are extremely convenient to pass on to others as they are relatively small in file size and consist of just one file. Sending a historical map as a KML file to another Google Earth user doesn't require the other user to turn on all of Rumsey's historical maps. Once the KML file is saved, it becomes like an external file and is not dependent on the custom features the user selects in Google Earth. The KML file can be opened in other software programs that support this file.

Adding Historical Images into Google Earth

Google Earth enables users to add external images into the mapping program. Supported image file formats include BMP, DDS, GIF, JPG, PGM, PNG, PPM, TGA, and TIFF. Users can add their own personal maps or air photos, or those downloaded from a Web site. Many Web sites offer images of scanned historical maps and atlases. David Rumsey's collection is available from <http://www.davidrumsey.com/>. His

collection offers thousands more than what Google Earth has included as part of their collection. Another source is a large compilation of links provided by the University of Texas Perry-Castañeda Map Collection, available from http://www.lib.utexas.edu/maps/map_sites/hist_sites.html. Both sources provide world coverage of historical maps. The U.S. Government's National Oceanic and Atmospheric Administration (NOAA) is yet another site that offers thousands of downloadable maps. The maps date from 1655 to 2001, and include a large number of Civil War battlefield maps. An online catalog is available, searchable by keyword, geography, type of map, or year of map. This site is available at http://historicalcharts.noaa.gov/historicals/historical_zoom.asp.

The benefit of using Google Earth to view imagery is that it provides tools to georeference the image. Without tagging the image with geographical coordinates, users may not know what part of the world is shown on the map. The combination of historical maps and georeferencing technology brings traditional map interpretation to a higher level. With the tools available, a user can compare the past and the present with very close precision. When the image is georeferenced, the user can overlay the historical image neatly over a modern air photo or satellite image and use modern streets, also provided in Google Earth, to help navigate around the historical image.

Adding an Image with Known Coordinates

Before adding an image into the program, the user should be zoomed into the approximate location of the geographical extent of the image. The image is added as an Image Overlay (from the drop down menu along the top - *Add -Image Overlay*). The user is given the option to type in the name of the image, and then the user must browse to the location of the image on the desktop. See Figure 2.

If the coordinates of the four corners of the image are known, perhaps taken from a topographic map, the coordinates need to be manually added in the *Image Overlay's* Location properties. The *Image Overlay* window is always accessible by right-clicking on the image layer from the "My Places" area on the left side of the program and selecting "properties."

If the coordinates have been assigned correctly, the historical map image will be properly georeferenced and will relatively accurately drape over Google Earth's satellite image. See Figures 3 and 4.

Adding an Image Without Known Coordinates

Geographical coordinates are not easily accessible for many images downloaded from the Internet. For users who do not need precise ground location mapped into



Figure 1. The "Rumsey Historical Maps" button appearing in Google Earth.

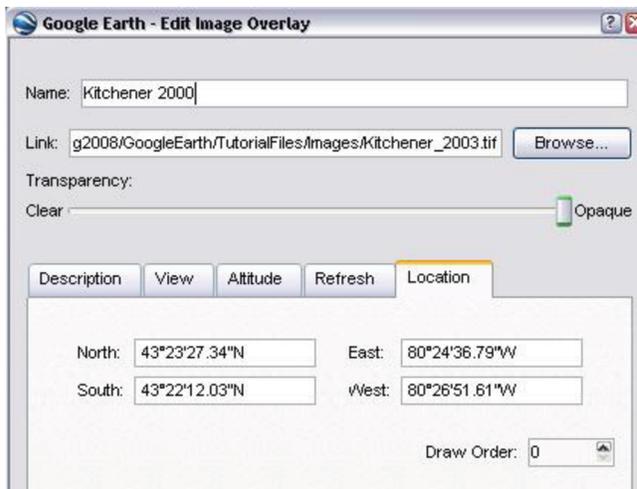


Figure 2. Google Earth's Image Overlay Interface.



Figure 3. In the foreground is a historical air photo that is superimposed over Google Earth's modern satellite imagery.

Google Earth, the image can be placed in its approximate location and then manually adjusted to match up with modern information, if necessary.

The image is added into Google Earth in the same way as described above, taking extra caution to zoom into the approximate location of the image before doing so. Instead of adding the coordinates, however, the user will adjust the image by extending or retracting it with the mouse. Whenever the Image Overlay property box is open, the image will have green markers surrounding it. See Figures 5 and 6.

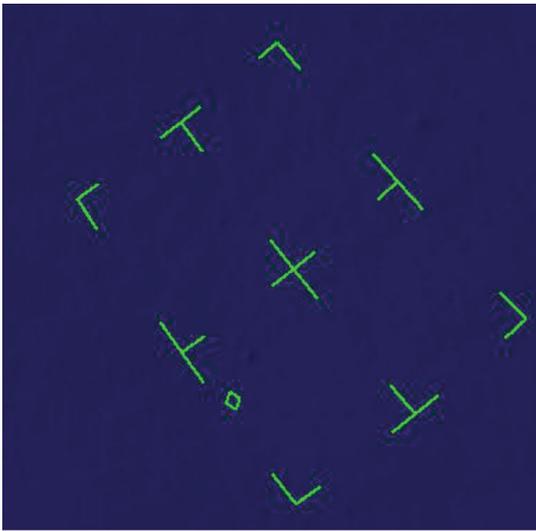


Figure 4. These are several historical images added into Google Earth. With one click, the user can remove the image, revealing landscape changes. The centre historical image had been removed.

The user may need to move the property box to the left to access the map view better. Clicking on the centre green cross will move the image entirely. Clicking on any of the edge markers will drag the image, and clicking on the diamond shape will rotate the image. The best way to georeference the historical image is to zoom into corners or road intersections and drag the corner green markers until they match up with the modern photo. The location of the image is being captured in geographical coordinates and can be saved for future use. Saving the image as a KML will prevent the user from having to adjust the image coordinates every time.

Adding Historical KML Files into Google Earth

What is easier than adding image files into Google Earth is adding images that are in KML format? KML files are already georeferenced and are extremely easy to work with. KML files are geospatial data formats, either raster or vector, that have been created or converted using a special program or tool. The David Rumsey example above described how a KML file can be created very quickly within the Temporary Places area of Google Earth. Some Desktop GIS programs will also offer conversion tools to create KML files from GIS vector files such as Shapefiles, or raster files such as TIFF or JPG. There are also conversion programs freely accessible on the Internet that will make conversions. This will be discussed in the next sections.



Figures 5 and 6. The location of the photo can easily be adjusted using the image location tool.

Accessing KML Files from the Internet

Offering the public historical images in KML format is becoming a popular trend. Libraries, personal bloggers, government sources, and institutions compile collections of historical map KML files and offer them to the public for free download. A visit to the Google Earth Library blog, for example, at (<http://www.gelib.com/>), will provide one with access to historical topographic maps and aerial photography. See Figures 7 and 8. Some of the KML files available for download include a collection of over two thousand historical USGS Topographic maps, some dating back to the late 1800s, a handful of state-specific thematic maps, as well as historical air photos including coverage for Manhattan, New York, and California. Another Web site offering historical aerial photography in KML format is the University of Waterloo Map Library's Historical Air Photos Digitization Project, available at <http://www.lib.uwaterloo.ca/locations/umhd/project/index.html>. This site offers hundreds of air photo images from the 1930s and 1940s of the Kitchener-Waterloo area in Ontario, Canada.

A Web site called Google Earth Hacks, available at <http://www.gearthhacks.com/downloads/> offers a large variety of image files including over five hundred historical war-related air photos. This site also offers non-image KML files, such as historical placemarks. With over seven hundred worldwide historically significant placemarks available, users can download individual KML files to zoom in to the site of interest in Google Earth. Examples include burial sites, plane and ship wreckages, historically significant buildings, castles, forts, and more.

Numerous Internet sites offer placemarks or point files for historical places. The U.S. Holocaust Memor-

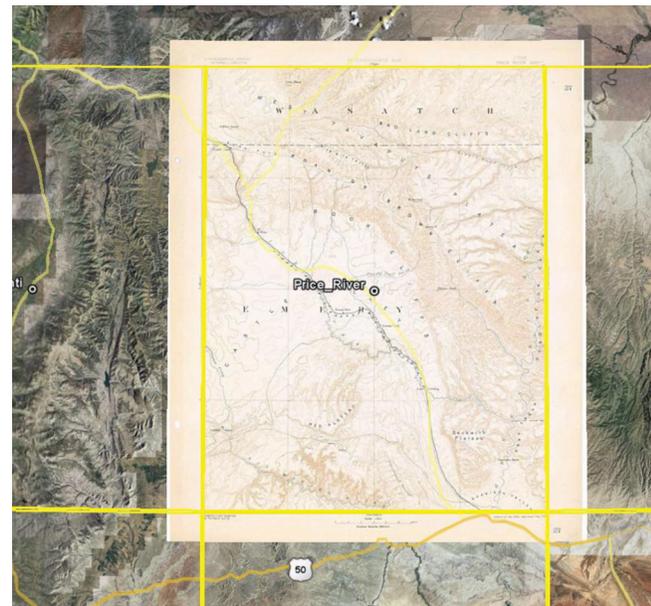


Figure 7. Peace River, Utah. Historical topographic map retrieved in KML format from Google Earth Library.

ial Museum, at <http://www.ushmm.org/maps/>, for example, offers KML files for locations of concentration camps, camp files, and links to more information. Their files also include an animated camp timeline that displays in Google Earth, showing camps throughout their years of operation. ArchaeoBlog, by James Q. Jacobs, at <http://www.jqjacobs.net/blog/index.html> offers a large number of KML files related to archaeological sites in the world. The user can choose a site of interest, download the file, and view it in Google Earth. The KML file also includes information about the archaeological site. Figure 9 shows Pueblo Bonito and placemarks of four wall corners and the center points of two great kivas.

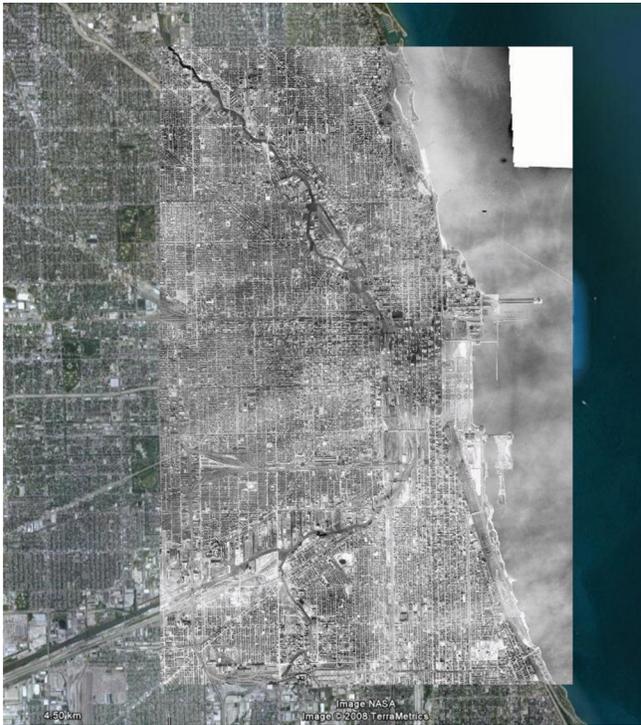


Figure 8. 1938 air photo of Chicago. Air photo retrieved in KML format from Google Earth Library.



Figure 9. Pueblo Bonito archaeological site. Labeled points are KML file overlays.

Adding KML files into Google Earth

KML files that are accessible from the Internet can be added into Google Earth by simply clicking on the KML file and selecting the option to open in Google Earth. This will not only add the file to the Temporary Places area of the program, but it will also zoom into

the geographical extent of the file. If the KML file is downloaded to the user's local drive, it may be opened in Google Earth from the File menu (File – Open). All KML files that have been collected under Temporary Places may be saved as one KML file by right clicking on Temporary Places – Save Place As. This way, the user has only one file to work with in the future.

Creating KML Files

The KML examples that have been shown so far have been created by individuals in several different ways. The previous sections have already illustrated how one can georeference an image in Google Earth and save the file as a KML. GIS programs such as ArcGIS will also georeference images and convert them to KML format. Other files, such as a series of placemarks, can be created in Google Earth by using the "placemark" feature. See Figure 10. When the placemark feature is selected, the user can click on a location on the globe and mark it with the placemark icon. The placemarks are added into the Temporary Places areas. The series of placemarks created can be saved as one KML file. If a user comes across an interesting site in Google Earth, he or she can add a placemark and upload the KML to a Web site to share with others.

Placemarks can also be created in Excel. This is a more efficient approach if working with a large num-



Figure 10. Google Earth's "placemark" feature.

ber of files. The Excel file must include the latitude and longitude of the places of interest. Without the geographic coordinates, the file is not spatial in any way and will not display in the correct location in Google Earth. To convert an Excel file to KML, one can use a KML generator program called Earth Point, found at <http://www.earthpoint.us/ExcelToKml.aspx>.

Earth Point is a real estate site from Idaho. The Excel-to-KML converter tool available from this site was created so that users could view real estate listings on Google Earth. It's a simple converter, supporting xls, xlsx, xlsm, xlsb (Excel), csv (comma separated values), or txt (tab delimited) files.

For users who don't have geographic coordinates for their points but do have address information, such as street name and number, a free online tool is available that allows users to input their points of interest into the database and will output a KML file of them. This tool is Batchgeocode and is available at <http://www.batchgeocode.com/>. Batchgeocode is a free online product that locates addresses and geocodes spreadsheets. Based on Yahoo! Geocoding API, it will accept any North American and European address

with a street name and number and will geocode the addresses to provide the user with its latitude and longitude in the WGS84 coordinate system. The updated spreadsheet can then be mapped using either desktop GIS software or Google Earth.

KML files can also be created from geospatial files such as Shapefiles. Any Shapefile (streets, river, buildings, vegetations, etc.) can be converted into a KML. ArcGIS 9.2 will convert one or more files into KML format. Another option is the free Shapefile-to-KML converter, Shp2kml, <http://www.zonums.com/shp2-kml.html>, which is a stand-alone product that allows for the customization of the layer—the user can specify symbols (colors, width), classification field, and labeling preferences. The Shapefile attributes are retained in the KML file as well. See figures 11 and 12. Shp2kml supports Shapefiles in Lat/Long or UTM, in points, lines, and polygons.

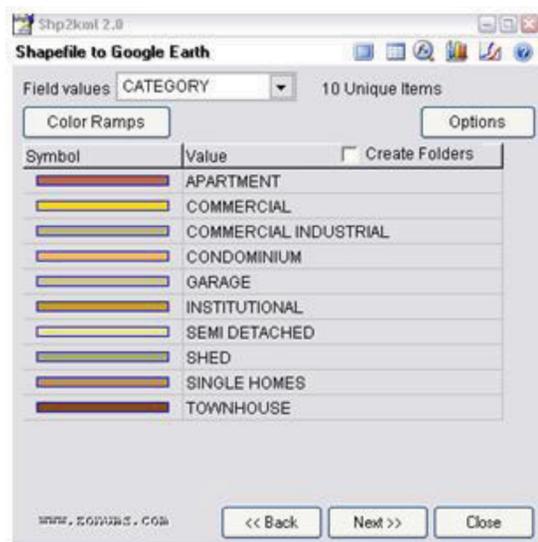


Figure 11. Shp2kml supports custom symbolization of attribute information.

Conclusion

With the increase of popular online GIS tools, GIS and non-GIS users are largely utilizing the technology for research, interest, and entertainment purposes. Without easy access to or even interest in desktop GIS software, many are finding interesting and exciting GIS-related activities to do on the Web. Google Earth is one of the leaders of online mapping that enables users to view, create, publish, and share map-related information. With tens of millions of KML files available online and hosted on more than 100,000 unique domain sites, Google Earth users can virtually study and map anything on the Earth's surface. Originally interested in modern imagery, Google Earth attracted millions of Internet users to trek around the world.



Figure 12. Once converted, the KML file can be opened in Google Earth. The attribute information is retained as well.

Now supporting users' interest in historical imagery and data, Google Earth is becoming a representation of not only the earth, but of humanity.

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