GEOMAT GUIDE: DIRECTIONS FOR BUILDING A GEOMAT WEB ARCHITECTURE FOR ANY INVESTIGATION OR CASE STUDY

Study the Past; Understand the Present; Prepare for the Future

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This guide introduces GEOMAT (Geographic Events Ordering: Maps, Archives, Timelines) an original innovative web architecture template with great internal flexibility so that it can frame the analysis and Internet presentation of many different kinds of human events and processes. It is not a software program and can use whatever commercial website programs the researcher likes. Using the unique properties of the Internet, the GEOMAT web architecture can make vast amounts of archival documents and images articulated to time and space accessible easily and quickly. Individual web architectures form case studies of particular events, including the dynamic streams of events leading up to the central event and the aftermath, the streams of consequences flowing from the event. A GEOMAT can be used for many kinds of investigations whether for political, detective, intelligence, and other investigative work or for academic research questions. A GEOMAT integrates analysis and synthesis. We can then use the Internet not just for information/data, that is facts, but for creating knowledge and understanding. A GEOMAT can aid conflict resolution by creating web architectures for all sides of a conflict, articulating large amounts of documents and other data in a single website. It is especially useful for historical geographical research.

The GEOMAT web architecture's framework: its conceptual structure

Two ruling goals for the GEOMAT web architecture are:
first, to make available as much data as possible and,
second, to do that with as much accuracy and precision as the archived data/documents allow.

Four ecological statements form the GEOMAT framework that can be used at varying scales from the global to the local.

- Every event occurs at a single time in a single place.
- Some events are landmark events that change our planet's history and geography irrevocably. The Yukon gold rush, the opening of the Suez Canal, and the eruption of Mt. St. Helens are examples.
- In each event both human actors and environmental actors are involved.
- Their actions are recorded and preserved in archives, landscapes, and settlements.

When creating a GEOMAT case study, both human data and environmental data can be integrated into an ecological whole erasing the divide between "Human" and "Nature". The GEOMAT design enables ecological thinking in webs of connections through time-space in branching patterns.

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The Core Matrix of Timeline and Location Map

The core of the GEOMAT web architecture is a matrix juxtaposing two web pages locating the central landmark event in time and space, one a vertical timeline showing the dates of the historical event being analyzed; the second, an index map of places/sites significant to the event. In these two core components are set link anchors of text or other symbols which access data and documents articulated to key times and places.

Using this core rigid matrix of timeline and map, the GEOMAT design uses the Internet's unique properties to form a new method of analysis for research incorporating seamlessly both history and geography. It creates linked webpages that articulate archived primary documents and secondary sources for an event to the core matrix of timeline and map. These Internet properties are the ability to make webpages, the instant linking of webpages, the vast storage capacity for archived data and documents, the ability to access and copy archived materials from many places globally, the capacity for color images, for graphic static and moving images such as charts, diagrams and graphs, and for moving images - video and films, as well as music and speech, and the availability of freeware for making websites. GEOMATs can be used to provide the analytical framework for GIS maps.

GEOMAT case studies are organized around landmark events, the actors involved in them and the documentary sources for knowledge of the actors and the events. A landmark event is an event that changes the course of history and geography irrevocably. The dissolutions of the Soviet Union is a recent example on a global scale. Actors are both human and environmental. Human actors are conceptualized as agents of corporate groups and institutions. Environmental actors are dynamic agents in the event. In a GEOMAT, both human and environmental actors can be identified at particular places in the core timeline as well as being mapped as to their locations at critical times. Biographies of human actors can be included in satellite core matrices. Historical documentation of environmental actors can have their own satellite core matrices, for instance, yearly series of weather data and weather maps. By electronic linking, vast amounts of primary data and documents as well as secondary sources can be included in a single GEOMAT accurately articulated to the timeline and location map.

Because of the vast storage capacity of the electronic medium, the primary data and documents testifying to an event as well as secondary sources crafted from primary documents can be displayed. Also, linked GEOMATs can show the agreed upon facts of an event as well as the various stories of that event however discrepant and contentious they may be. A contemporary example of such a situation are the differing narratives of the events of 1948 that created the state of Israel, called al Nakba - "The Catastrophe" - by the Palestinians and "The War of Independence" by the Israelis.

A GEOMAT case study articulating large amounts of data and documents necessarily reflects the web architecture builder's own interpretation as presented in the framing and arrangement of the original materials. Readers, however, can engage the original documents directly as well and through that process come to their own conclusions,

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interpretations, and readings. This is the beauty of providing original data and documents immediately available electronically.

Rules for Core Matrix construction will be illustrated below by examples taken from our students' work in a course supported by several academic units specializing in Middle Eastern subjects at the University of Michigan.

The Core Matrix Timeline webpage is formed on the principle of a calendar that is, using evenly spaced standard time periods (Figure 1). The GEOMAT timeline is vertical unlike conventional timelines for two reasons:

- first, each line of text forms a standard space signifying a standard period of time: years, months, days, minutes, even seconds. In a GEOMAT, no time period is left out for brevity or to enhance the story line; thus, periods of inaction, as well as action, become evident. GEOMATs use existential time aligned with our personal experience. Any calendar may be used in the timeline.
- second, the vertical timeline allows text descriptive of a particular event to be entered at each date or time. Words or phrases in each text can serve as anchors for links that access websites or webpages contributing pertinent data and documents to the understanding of the event.

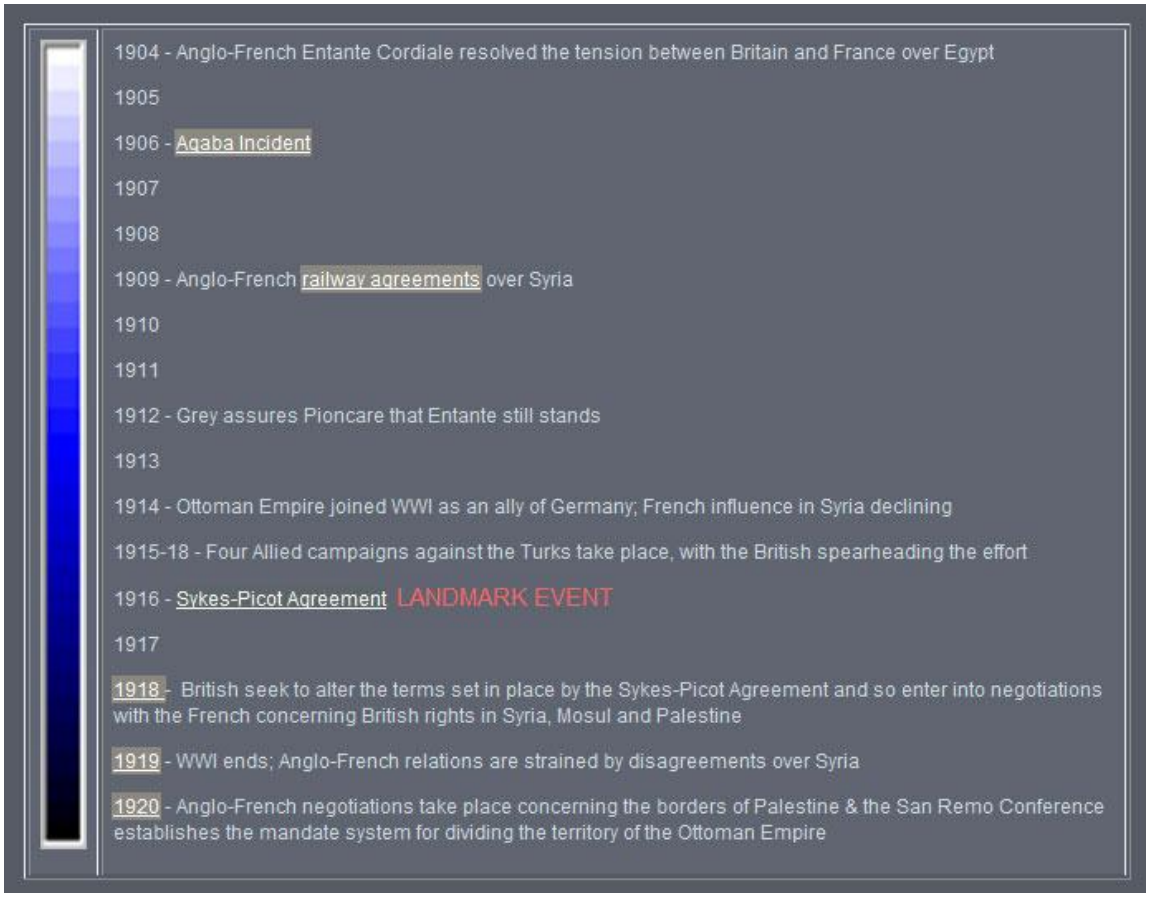

Figure 1. Core Matrix Timeline: From work of Ruth Gryniewicz, Fall 2007.

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All Core Matrix Timelines used standard time intervals such as years and days, but may use different calendar systems. Any calendar system may be used and differing ones may be juxtaposed such as, for instance, the Islamic moon -based calendar with the European sun-based calendar.

Figure 1 shows a Core Matrix Timeline from a study of the Sykes-Picot secret agreement in World War 1 between the British and the French governments using a year interval. By a link inserted at a particular year with much activity, a secondary timeline using months can pop out where more precise facts can be entered. If a rapid exchange of messages or a rapid flow of events is to be entered, a timeline or days, or hours, or even minutes or seconds can be added by linking.

The text in particular time intervals can indicate the Landmark Event as well as link anchor descriptors. Here the Landmark Event is identified in red. Link anchor descriptors are identified by underlines. Vacant intervals identify gaps in historical data and raise the question: what was happening under the surface of documented events?

The Core Matrix Map webpage locates the event on the Earth's globe, showing the location of the event site or sites embedded within the surrounding human/physical geography of cities, towns, farms, and natural terrain features like rivers, hills, plains, and mountains. Buttons/hotspots can be placed at significant points to link to documents including other maps (Figure 2). This map shows the migration routes of Palestinians during al Nakba/The War of Independence. It is superimposed on a Google Earth view of the eastern Mediterranean. Buttons and hotspots can be embedded in the map to articulate particular data and documents. In these balloons, link anchors can be inserted as well.

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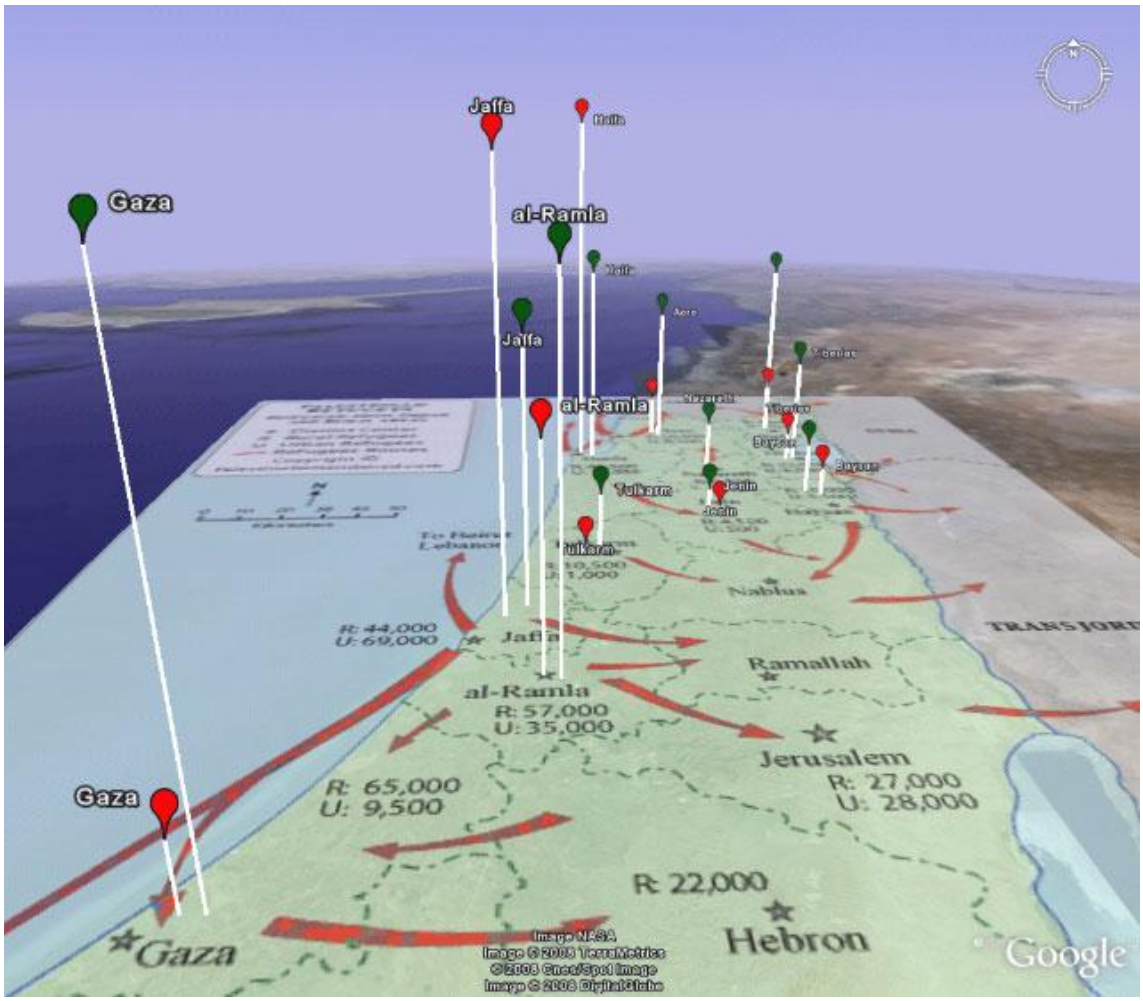

Figure 2. Core Matrix Map: From work of Ali Thabet, Fall 2008. The use of Google Earth permits balloons to highlight significant places. Further, one can embed links in the balloons to attach significant documents to the mapped locations.

Figure 3. Core Matrix Map: From work of Sandra Arlinghaus, 2005. Animation superimposed on GIS base map shows the paths of naval and terrestrial forces leading to the fall of Rhodes.

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GIS/Geographic Information Systems and animated maps can show the dynamic process of historical change in accurate time and space simultaneously (Figure 3). Here a screen from an animated map of the Ottoman Sultan Suleyman's deployment of military naval and land forces in the conquest of Rhodes uses a GIS base map.

Figure 4 below shows the integration of a Core Matrix Timeline with a Core Matrix Map in an analysis of water resources exploited in Israel and the Sinai. On it, the reader may scroll down the timeline and see associated change on the adjacent map.

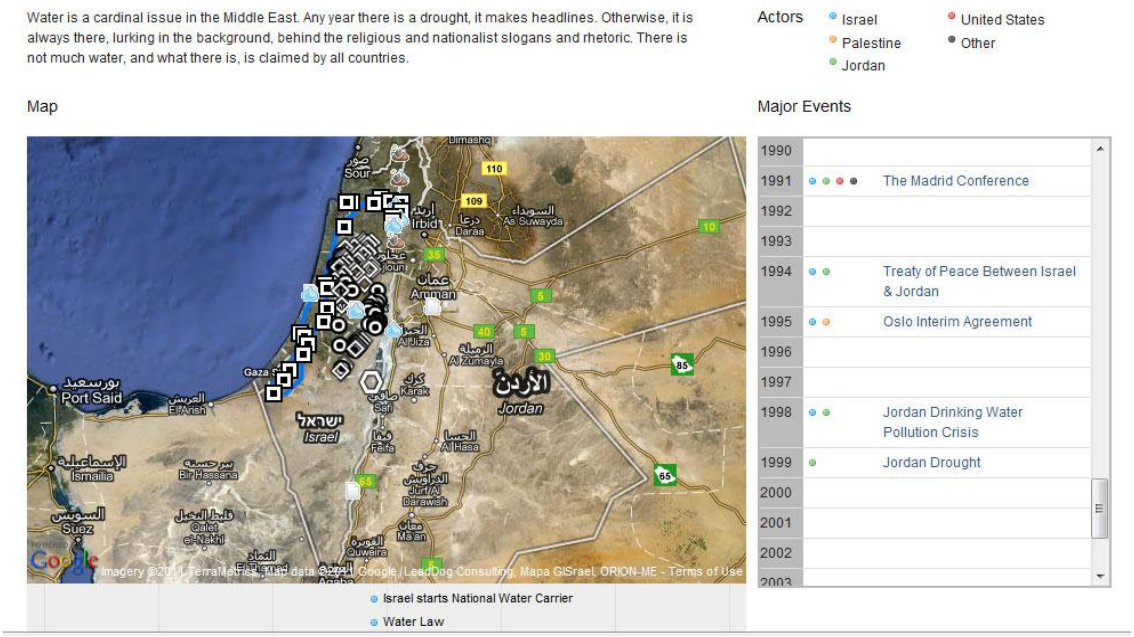

Figure 4. Core Matrix Map and Timeline: From work of Andrew Turner, Fall 2007.

The great value of the GEOMAT web architecture for research lies in its capacity to include vast numbers of archival materials. This is a technical advantage over print media that quickly become too cumbersome for a researcher to interact with. Because of the electronic features of linking and scanning, truly vast amounts of archival materials can be articulated in time and place to the GEOMAT core timeline and map matrix. Furthermore, subsidiary timeline and map matrices with their articulated archival materials can be linked to the core matrix. One example (Figure 5) is the linking of major players' biographical timeline and map matrix to the times and places that player was active in the core matrix of a particular event or series of events.

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Figure 5. Biographical matrix. From work of Angelina Sulaka, Fall 2007.

Actors interacting with each other make events. Here is the webpage listing the human actors in the 1991 Madrid Middle East Peace Conference together with their photograph (Figure 5). This webpage is linked to the core matrix. Each name is a link to a biographical timeline-map matrix that can provide rich information about how the person's past life has led up to their presence here. Figure 6 shows another way to link actors into the matrix.

Archival materials come in many forms now increasingly digitized or available on the Internet. And many materials in print archives can be scanned and uploaded to a website. It is worth noting that archival materials include many types of data and documents, not necessarily just those in the formal archives of governmental and private institutions. Weather statistics, troves of letters and other ephemera, collections of photographs, original maps in books, original passages in books, leaflets, newspaper articles, assessor's documents, governmental statistics for current operations, advertisements, television news clips, commercials, and Internet websites are all archival materials. The great flexibility of the GEOMAT web architecture permits incorporating many forms of visual media: text, graphic images, animated images, cinema clips even entire documentary and other types of films, email messages and other working documents. The documents in all kinds of media generated by yesterday's events are already archival material. The ultimate form of a GEOMAT case study comes from the judicious arrangement of the core matrix and its linked archival material.

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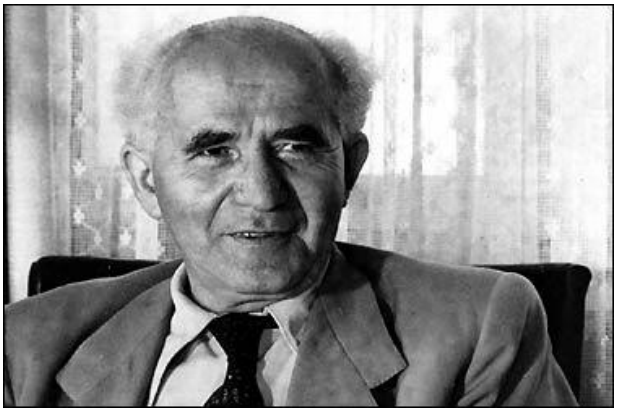
(New York Times) 1930s- Palestinians' failed attempt of rebelling against Britain
http://www.nytimes.com/2007/07/08/weekinreview/08erlanger-ART.html?n=Top/Reference/Times%20Topics/People/A/Arafat,%20Yasir&_r=1&adxnnl=1&oref=slogin&adxnnlx=1196875782-4/ci+tWzD+zXVI4PvMCZeg



Camp David Accords, September 17, 1978
http://concise.britannica.com/ebc/art-74951/Egyptian-President-Anwar-el-Sadat-US-President-Jimmy-Carter-and

Figure 6. Photographs of actors linked to a webpage. From work of Justin Adams, Fall 2007.

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Because of the articulation of particular archival documents in electronic proximity, an investigator may be able to discern relationships between facts and patterns produced by arrangements of facts much more easily than with print. The use of GIS in historical geography has already explored this. The conversion of crime statistics, for example, from lists arranged by time of reporting to animated maps will show spatial patterns not otherwise evident. Health statistics arranged alphabetically by place when mapped may reveal patterns of occurrence and transmission otherwise invisible.

The GEOMAT content's structure

For the full power of a GEOMAT case study to be realized, two sets of intersecting components need to be included. First is a set of broad categories of substantive data that form an ecological whole: these eight systems interact simultaneously at any place on the earth's surface. Human individuals in groups are embedded in these systems and act through them. Identifying the essential actors, human or environmental, which have produced a particular event, enables us to analyze how these systems interact in time and space.

The set of broad CATEGORIES OF SUBSTANTIVE DATA that form an ecological whole is:

1. Climatic and weather systems including the water cycle, regional climatic seasons, and extreme weather conditions
2. Terrain and topographic formations, including mountain chains and plateaus, their geomorphology, watersheds of rivers and streams
3. Distribution of flora and fauna and other natural resources such as mineral deposits including changes like the movements of plants and animals both domesticated and wild
4. Population settlements, villages, towns, and cities, and movements such as urbanization and migration including their routes of transportation and communication
5. Family formation, operation, and reproduction through generations
6. Political institutions' formation, operation, reproduction, spread and decline
7. Social institutions' formation, operation, reproduction, spread and decline
8. Economic institutions formation, operation, reproduction, spread and decline including those of land use systems.

These eight systems interact simultaneously at any place on the earth's surface. Human individuals and groups are embedded in these systems and act through them. Analyzing how these systems interact to produce a particular event enables us to identify the essential actors, human or environmental, which have produced the event.

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Second is a set of FORMAT CATEGORIES:

1. Maps showing various features of areas where landmark events took place.
2. Calendrical timelines showing the sequence of different kinds of events at appropriate time scales, pop-out timelines, and zoom-in timelines.
3. Identification of specific events, especially landmark events which irrevocably changed the situation being chronicled in a case study.
4. Biographies, accounts, and images of human actors - corporate group agents contributing to the sequence of events and their institutions and organizations.
5. Reports about and images of other actors such as plants, animals, landscape features, terrain, mineral deposits, productive land use, weather and climate.
6. Arrays of archived primary documents – governmental and private, records of messages exchanged, oral history accounts, historical and contemporary images.
7. Accounts of, documents, and images from, contemporary settlements such as cities, towns, villages, resorts, and rural areas, farmed and wild.
8. Documents and images from archeological sites and records of past settlements.

These eight kinds of information categories serve to alert the investigator to the need to search out information in different conceptual frameworks and formats.

To conclude, the GEOMAT template with its core matrix timeline-map makes possible accuracy, accurate degrees of precision, comprehensive documentation, ecological reasoning tracing out web connections, and presentation of conflicting stories of events positioned in relation to the agreed-upon facts. The GEOMAT is a new analytical, synthesizing, and presentation methodology that innovates by utilizing the unique properties of the Internet - its global reach, its website construction architecture, its storage capacity, and its instantaneous linking capability to create knowledge and understanding of geographical change.

Figure 7a-7e illustrates examples of various kinds of linked archival materials drawn from student work.

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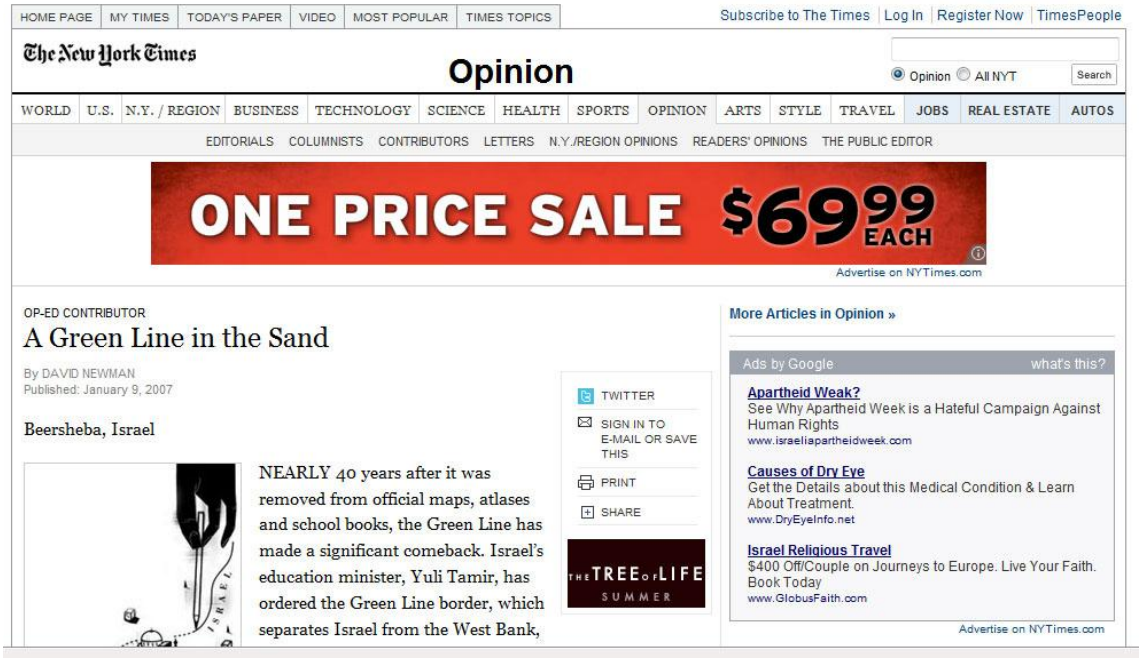

Figure 7a. From work of Jennifer Trigger, Fall 2007. Linked contemporary press clipping.

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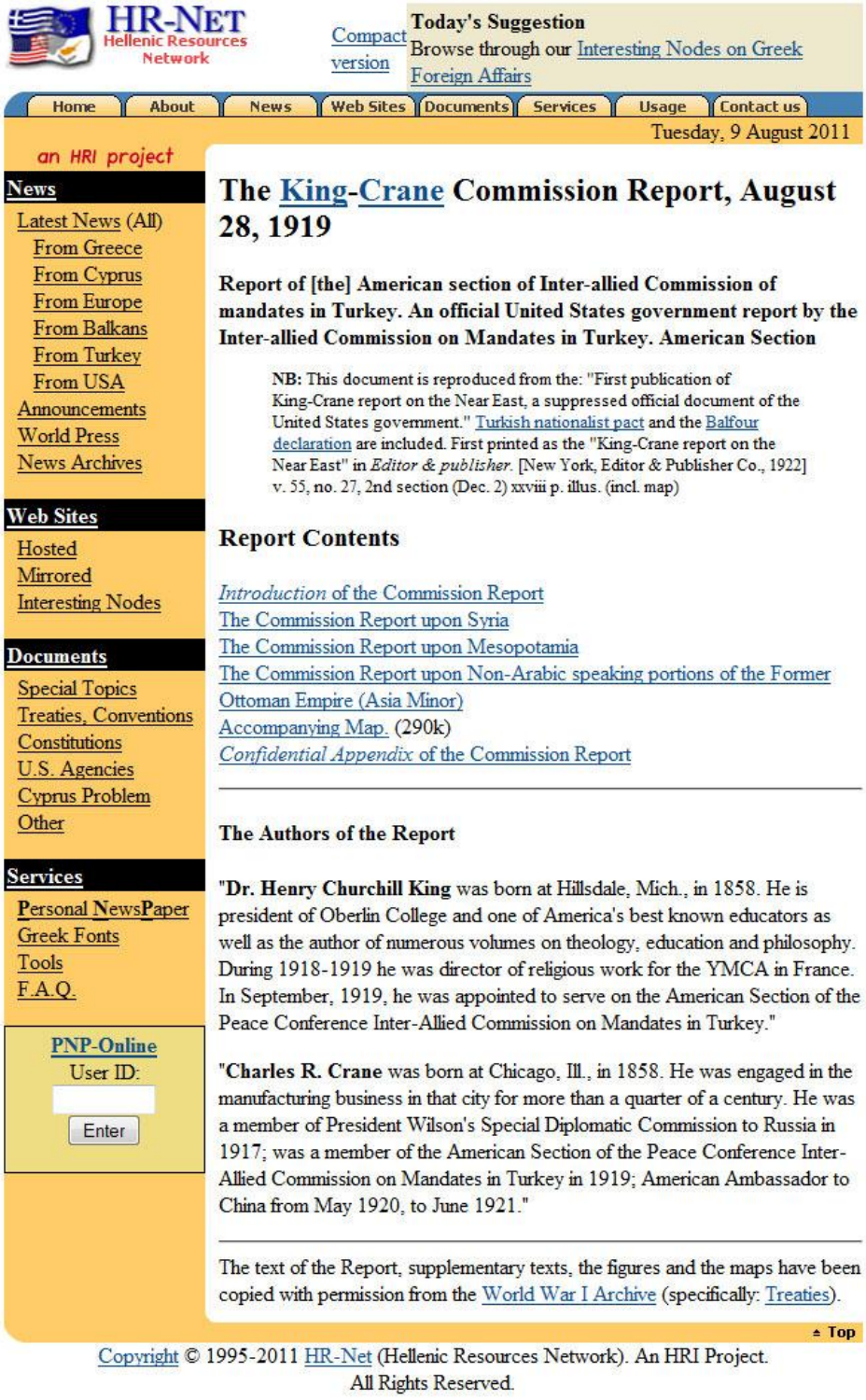

Figure 7b. From work of Ruth Gryniewicz, Fall 2007. Linked official report contemporary to events.

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Israel-Palestine Water Issues

Timeline | Actors | Hydrology | Climate | Demographics | Usage | Resources

Mountain and Coastal Aquifers

Aquifers of the Region

Israel, the West Bank, and Gaza are part of the Jordan River Watershed and utilize three primary aquifers: Coastal, Mountain, and Northern.

The Cenomanian-Turonian Mountain Aquifer system underlying and largely recharged from the West Bank is by far the most important source of water in this area. The aquifer system is highly permeable due to its geological nature. The Coastal Aquifer extends from Gaza in the south to Mount Carmel in the north along some 120 km of Mediterranean coastline. The width of the aquifer varies from 3-10 km in the north to about 20 km in the south, where it constitutes the chief resource of water for Gaza. The depth to groundwater in Gaza ranges from 60 m in the east to 8 m or less near the shore.

The mountain aquifers supply:

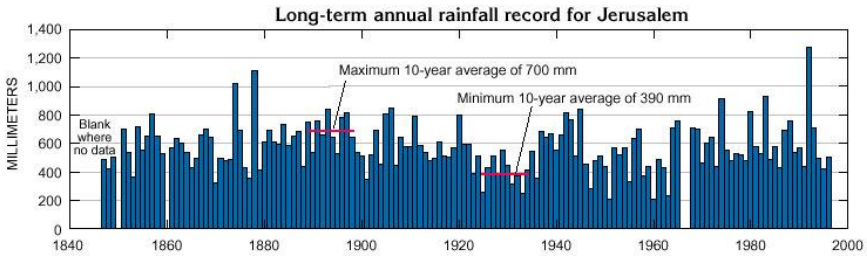
- **Yarkon-Tanninim Aquifer** This supplies Israel with about 340 million cubic meters of water annually, which are used by the Jerusalem-Tel-Aviv area. Palestinians use about 20 million cubic meters a year.
- **Nablus-Gilboa Aquifer** This supplies Israel with about 115 million cubic meters a year, largely for agricultural irrigation in the kibbutzim (communes) and moshavim (cooperative settlements) in Galilee.
- **The Eastern Aquifer** This supplies about 40 million cubic meters annually to the Israeli settlements in the Jordan Valley, and about 60 million cubic meters to the Palestinians.

source: MidEast Web: West Bank Water Resources For more information, see the EXACT-ME Overview of Middle East Water Resources.

Israel-Palestine Water Issues

Timeline | Actors | Hydrology | Climate | Demographics | Usage | Resources

Annual Precipitation



graph source: EXACT-ME

Figure 7c. From work of Andrew Turner, Fall 2007.

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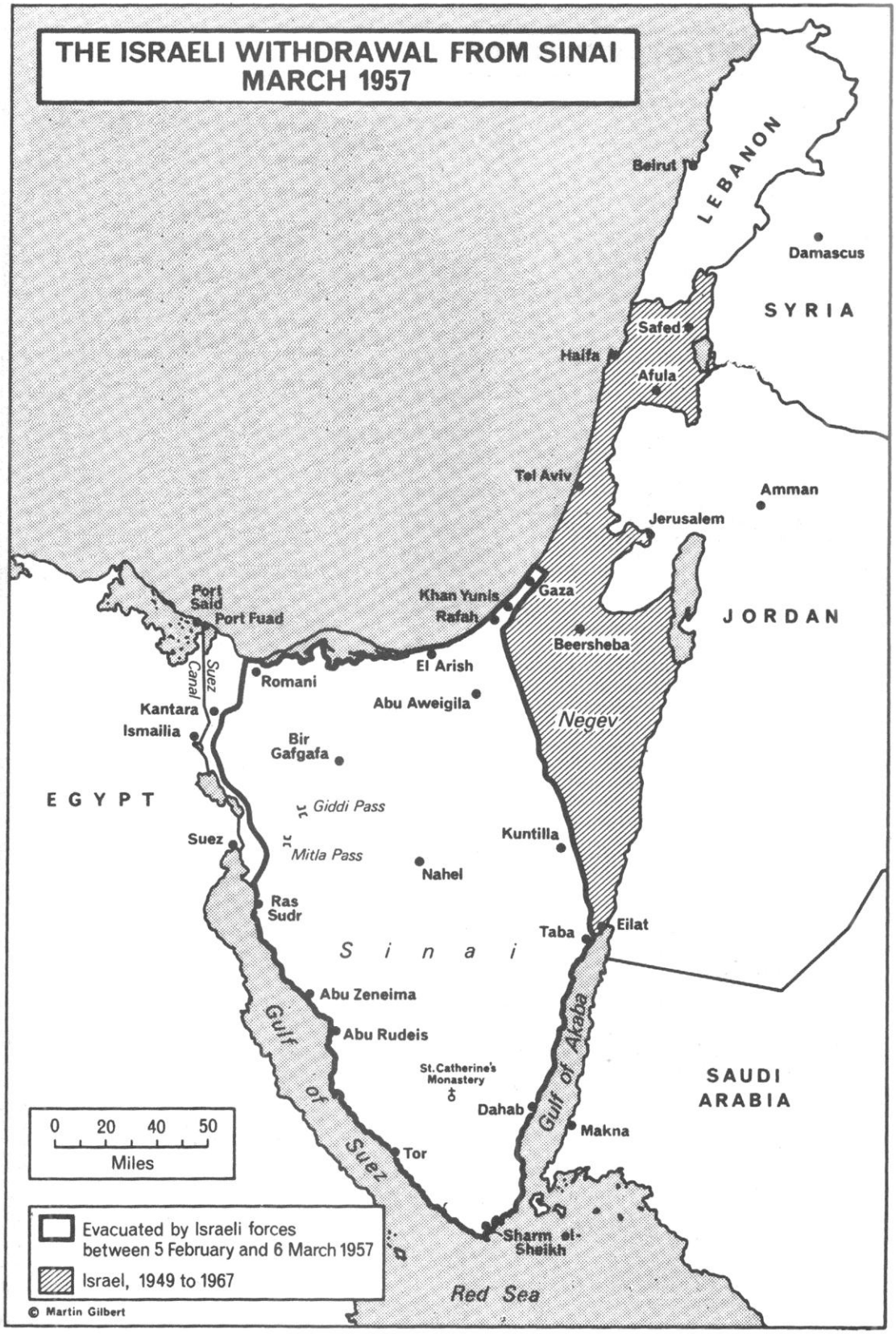

Figure 7d. From work of Justin Adams, Fall 2007. Link to an existing map.

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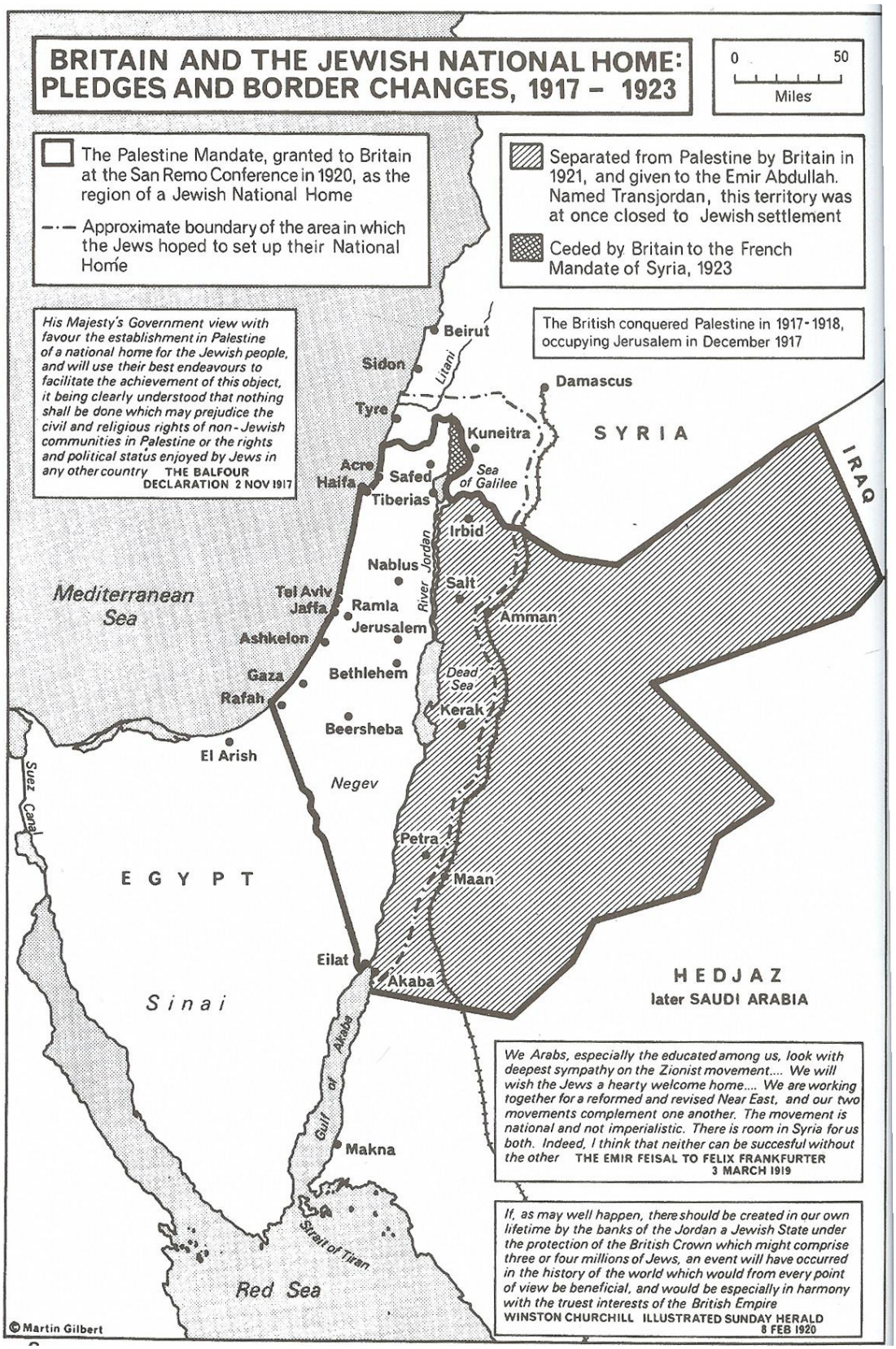

Figure 7e. From work of Esmaeel Reza Dadashzadeh, Fall 2007. Combinations of archival materials associated with a particular Declaration.

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Community and Academic GEOMAT Study Group Operational Procedures

GEOMATs may be used by individual researchers for analysis, synthesis, and presentation. They may also be used by teams working on the solutions to conflict situations, on the revealing of the facts about a puzzling or little-known set of events, or on the organization of fragmentary materials in complex situations.

To utilize the GEOMAT web architecture method to contribute to conflict-solving and other types of team work, the following work structure may be useful:

- Form a collaborative study group of no more than 5-7 people, scholars and stakeholders with differing perspectives on the conflict to be studied. The chair should be outside the issue at hand but knowledgeable about collaborative procedures and process.
- The study group's procedures and process need to be designed to be fair, equitable, consensual, and open to scrutiny.
- The study group would establish a charge/mission statement and a calendar of operations.
- The study group would seek funding for specialist personnel to develop the GEOMAT /complex of GEOMATs under study group supervision.
- Study group calendar: the work would be organized in trimesters corresponding to school and higher education institutions' calendars. A standardized work calendar would be established: data and document collection, webpage design decisions, text and image composition for individual webpages. An electronic library of data and documents outside the GEOMAT itself would be developed.
- Public participation once each trimester: the developing GEOMAT would be put on the Internet in a Read Only format once a trimester for a few weeks. There would be bulletin boards for public comment.
- A contact address would be provided for submission of data and documents to the study group for the study group's decision to accept or reject. To be accepted, all data would need time and location of data, public name and address of contributor verified and confirmed. Metadata (authorship, date, purpose, agents and conditions of creation) would be required for any documents or data submitted.
- For permanency of the GEOMAT development as it moves along, there would be a trimester burn to CD/DVD that would be put in a cold storage vault. Also, if available, persistent online storage might be useful. Copyright and similar items would of course be honored.

Once these operational procedures are coupled with the scholarly concerns involving mapping, timelines, text, and a variety of historical and geographical matters, the GEOMAT evolves into its full and useful form!

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For more information about GEOMAT in research and teaching:

The GEOMAT Project: Geographic Events Ordering: Maps, Archives, Timelines
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Arlinghaus: sarhaus@umich.edu
Haug: haugrt@ucmail.uc.edu
Larimore: annevans@umich.edu

Student Case Studies 2007:
http://www-personal.umich.edu/~sarhaus/MapsAndTimelines/Fall2007/index.htm

Overview of Technical Material

GEOMATS were composed in Windows. Website software is increasingly easy to use. For simple, hard-coded, website creation we are currently using SEAMONKEY, a free Mozilla product. For those beyond beginner level, any number of options become available, from specialized software to server-side include files to create dynamic webpages. To manipulate images and to create animated maps we used Adobe Photoshop. To work with maps, we used products from Google and from ESRI. Any number of other software programs might be effective.

Bibliography

Anne Kelly Knowles' two books on GIS for history and historical geography are very valuable.

Anne Kelly Knowles and Amy Hiller, Placing History: How Maps, Spatial Data, and GIS are Changing Historical Scholarship (2008)

Ann Kelly Knowles, ed., Past Time, Past Place – GIS for History (2002)

Ian N. Gregory has been a pioneer in historical GIS.

Ian N. Gregory, Paul Ell, Historical GIS: Technologies, Methodologies, and Scholarship (Cambridge Studies in Historical Geography) 2008

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