

Temporally Dynamic Maps

The Electronic Cultural Atlas Initiative Experience

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Understanding context is important in the humanities and social sciences. Temporally dynamic maps provide a framework for showing and analyzing context in terms of what was happening around a particular time and place. Such maps are investigated in the Electronic Cultural Atlas Initiative (ECAI), an informal international collaboration of educators, researchers, librarians, and information technology specialists, based at the University of California, Berkeley. In addition to organizing conferences and advocating the development of standards and best practices, ECAI has participated in the creation of several multimedia publications that include temporally dynamic maps. This article describes the experiences that have been gained in the work with dynamic maps to enhance the display of catalog search results and to express geographical aspects of search queries, as well as with gazetteers that are used for linking between text and maps. The ECAI experiences have also resulted in the identification of numerous problems concerning the completeness, documentation, authenticity, and preservation of geo-temporal data, problems that are discussed in the article.

Keywords: time, cultural maps, temporally dynamic maps, Electronic Cultural Atlas Initiative, ECAI, library catalogs, gazetteers

In the humanities and social sciences there is a strong need to understand context. What else was happening in or near a particular time and place? Paper maps are static. The use of arrows and a sequence of printed maps

can give an impression of change. Digital maps, on the other hand, can be dynamic with respect to data sets (allowing layers to be added, removed, and combined), spatially (panning and zooming), temporally (showing change over time), and by supporting links to and from other resources. In this paper, we summarize the experience that the Electronic Cultural Atlas Initiative has had with digital publications, including temporally dynamic maps and how these maps can be used as interfaces for bibliographic searching.

The Electronic Cultural Atlas Initiative

The Electronic Cultural Atlas Initiative (ECAI) originated in 1997 when a group of scholars met in Berkeley to discuss how better maps could be developed to support their research and teaching. One example of a problem was the high cost and limited effectiveness of using printed maps to illustrate how Buddhism had changed as it spread north out of India and east across Asia. ECAI is administratively a small center under the Dean of International and Area Studies at the University of California, Berkeley, but it operates as an informal collaboration between scholars, librarians, educators, and information technology specialists worldwide.

ECAI's programs include two international conferences a year, the development of standards and best practices, and the creation of digital publications that incorporate dynamic cultural maps, mainly using the TimeMap software.

TimeMap

TimeMap™ was developed at the University of Sydney, Australia, under the leadership of Ian Johnson, an archaeologist. TimeMap includes the usual functions of a GIS-based map visualizer but also has some important additional amenities. In particular, it handles temporal data. A time bar can be set dynamically to any desired span of time and only data relating to that period is visible in the display. When the time bar slider is moved, the map shows the changes through time dynamically, with an intuitively attractive video-like effect. In addition, TimeMap includes software to compile a catalog ("clearinghouse") of Internet accessible geotemporal data sets and the tools to search for, select, download, and edit these resources to compile a complex resource for visualization. An

implementation in Java is in progress. TimeMap is freely available for research and educational purposes and is being moved to open source. For fuller details, see the TimeMap web site at <<http://www.timemap.net/>>

Cultural Atlases

ECAI is, by its mission, concerned with cultural maps for education and research. "Cultural atlas" is a convenient term for two or more cultural maps that form a coherent, thematic whole. In practice, when the necessary explanation and documentation has been added, atlases become digital publications that include one or more cultural maps. New cultural atlases are created when scholars are willing to invest the effort to publish their work in this way and/or sponsors are willing to subsidize the effort. ECAI cultural atlases include "Sasanian Seals in Context," "Mapping the Mainline: Using Historical GIS to Study American Religion," the "ECAI Silk Road Atlas," Austronesian language studies, and "ECAI Iraq." ECAI Iraq is a temporal-spatial portal into existing digital resources about history, cultural sites, archaeological excavations and heritage preservation initiatives.

Cultural Atlases as Search Interfaces

Two studies have explored the use of cultural atlases as interfaces to library catalogs. The "Cebuano Language Atlas" was a technical feasibility exercise in the use of language area maps and bibliographical access. A set of library catalog records for resources in the Cebuano language and/or concerning the Cebu region in the Philippines was harvested internationally using the Cheshire information retrieval system (<<http://cheshire.lib.berkeley.edu/>>) and the Z39.50 search and retrieve protocol. A script derived latitude and longitude for places of publication and for places named in subject headings from a large gazetteer to create two layers of dots on a map-visualization that included several map layers, including two language area maps. Using TimeMap, one can zoom to any area of interest, set the time bar to the period of interest, and two differently colored sets of icons appear: one set links to a list of books *published in* that place during the selected time period; the other set of icons leads to books *about* that place that have been published during

that time period. The catalog records include the source library and sometimes the call number. (See Figure 1.)

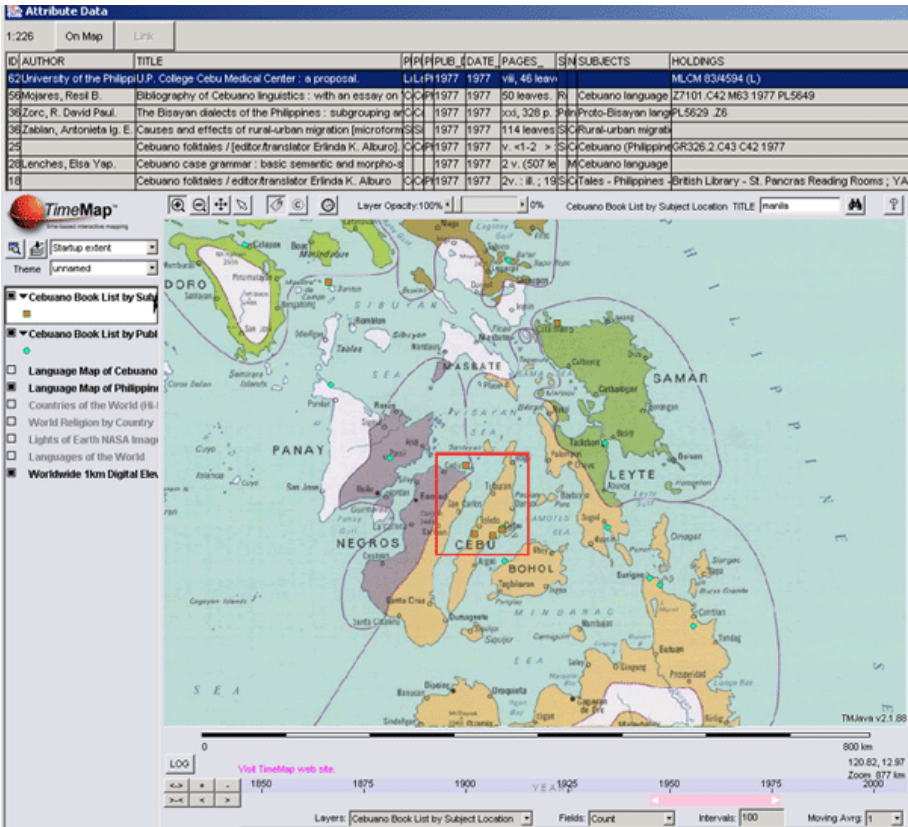


Figure 1. Cebuano Language Atlas screenshots.

ECAI Iraq is a much more elaborate publication created in response to international concerns following the invasion of Iraq in 2003. It provides a rich set of images and links to web sites relating to sites of antiquity in the Iraq area. The basic structure is a large suite of portal pages linking to a wide range of web-accessible resources. A temporally dynamic map visualization using TimeMap allows one to locate historic sites within any user-defined area and time. Each icon on the map leads

to a portal to resources for the site located. In another approach, time bars are used to aid searching. Rolling the cursor over sections of a time line generates additional time lines for dynasties and other conventionally defined cultural periods within or overlapping that time interval. Links lead to a portal for each dynasty or cultural period. The individual portals for each site or era contain numerous links to web-accessible resources grouped into categories, typically images, library books, collections of artifacts, historic site data, historical accounts, and preservation issues. An innovation is that the category “library books” does not link to a fixed bibliography, as in the Cebuano atlas. Instead, three different links are provided: to the University of California’s MELVYL online union catalog, to the Library of Congress online catalog, and to COPAC, a union catalog of the leading research libraries of the United Kingdom. Clicking on any one of these links generates a live search of the catalog for material on the topic of that page, e.g. Abbasid Caliphate, or Ctesiphon. A live search not only avoids the need for duplicative storage, but, more importantly, means that the search result is as up-to-date as the libraries’ cataloging and, sometimes, provides a direct link to a digital version of the item cataloged. In the case of Iraqi antiquities, very rich documentary resources can be found in these libraries. (See Figure 2.)

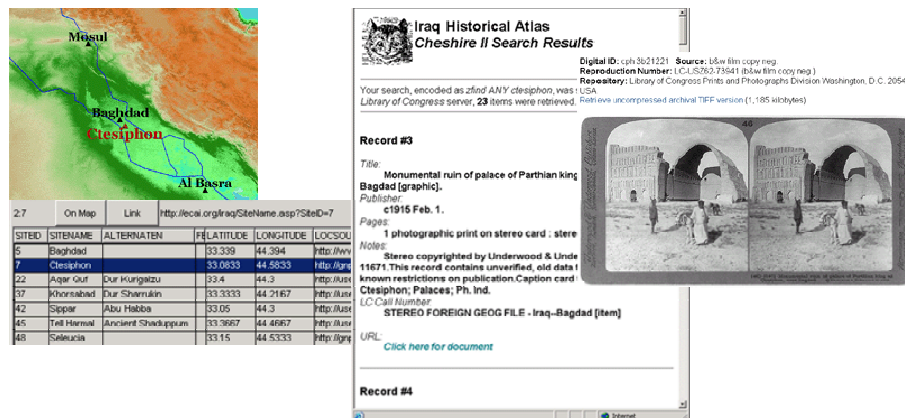


Figure 2. Screenshots from ECAI Iraq.

A New Role for Gazetteers

Working with digital maps in conjunction with digital texts provides new opportunities for old tools, in particular gazetteers, best known for their use as indexes in the back of printed atlases. Gazetteers can be viewed as a kind of bilingual dictionary relating place (a cultural concept) and space (a scientific concept). Places often have multiple, unstable, ambiguous, and/or politically sensitive names. A typical gazetteer entry includes the place name, the category of place (“feature type”), and spatial coordinates: a point or polygon defined in latitude and longitude. Gazetteers, like Geographical Information Systems generally, have been developed primarily for contemporary, practical purposes in support of government, industry and military activities. The humanities bring additional requirements that have so far been neglected: support for multiple languages and scripts, “feature types” relevant to the humanities scholar (e.g. varieties of religious monuments), and a time code for when that particular name was in use. This is especially acute in a current ECAI project, in which teams of scholars are collaborating to assemble an historical Religious Atlas of China and the Himalayas, which includes Taoists, Buddhists, Jews, Christians, Muslims, and others, as well as several different languages over five thousand years. (See <<http://ecai.org/chinareligion/>>.)

Gazetteers are of special interest for the interface of information retrieval systems. The same name applied to different places, such as the eighteen places in China named “Beijing,” can be differentiated by their differing latitude and longitude; different names for the same place can be identified by having the same latitude and longitude; and, because gazetteer entries supply latitude and longitude, named places can be located on a map display. Search results with a geographical aspect can be displayed on a map, and a point, region, or arbitrary polygon drawn on a map can be converted through a gazetteer into text form as a list of place names that can be searched in a catalog. These issues have been explored in an ECAI project entitled “Going Places in the Catalog: Improved Geographic Access.” (See <<http://ecai.org/imls2002>>.)

Time Period Directories

In speech and writing, time periods are commonly expressed by a name or phrase: “Grand Siècle,” “Napoleonic,” “during the Second World War,” and so on, rather than by calendar dates. Names for time periods resemble place names in being derivative and, sometimes, multiple, ambiguous (“Civil War”), or unstable (“The Great War” was renamed “The First World War”). So a named time directory, analogous to a gazetteer, proves useful and needed if textual resources are to be linked to temporally dynamic maps. In current work we are experimenting with a named time period constructed from chronological subdivisions used in the Library of Congress Subject Headings. (See <<http://ecai.org/imls2004>>.)

Lessons from the ECAI Experience

We have learned several lessons from working with scholars to create temporally dynamic maps:

The importance of time: Time is as important as space in cultural atlases. Documenting and displaying change over time is central in the humanities and social sciences.

Humanities genres need updating: Gazetteers exemplify the exciting potential of traditional humanities genres when deployed in a digital environment. Gazetteers are centrally important for the link between place and space and between text and map. We need more and better gazetteers and the adoption of standards for content and format suited to the humanities. Chronologies and language maps are other examples for which moving to digital technologies can and should have a transformative effect.

Infrastructure and IT skills: System designers need to take into account the very uneven distribution of Internet access and IT skills in the humanities. Many scholars are not able to view and manipulate Java-based map browsers with their current computing infrastructure and telecommunications bandwidth. Simple maps supporting zoom, pan, and clicking on icons constitute a very limited subset of the full repertoire of dynamic maps. The full cartographic vocabulary, including map

layers, data attribute information, and GIS analysis, has seen a lot of development in the professional use of GIS tools, but not in common web use.

Data validity: GIS tools were initially developed for land use and other fairly precise mapping needs. Better methods are needed for representing the vague, imprecise, and incomplete data often encountered in the humanities. How far, for example, is one day's travel time? With printed maps, what is known is depicted; with digital visualizations, data is often displayed selectively and so it is much less clear when the underlying data are incomplete. It is difficult to represent the level of accuracy and precision of a map layer cartographically. With Web use, people do not expect to have to read explanatory text and legends to understand what they see displayed. Nor is there a strong tradition of documenting the source of information for map layers.

GIS limitations: GIS limitations to three types of data (points, lines, and polygons) is a basic problem. Limitation of each dataset to only one of these data types is an additional problem. Historical data may be a mixture of all three and, in addition, be imprecise.

Integration: A wide range of cultural atlases are being developed, on very different scales ranging from a single city to a region to a large extent, such as the Silk Road. There are, as yet, no agreed "best practices" for these products. The integration of dynamic maps with other forms of data (other media forms) in online systems needs to take advantage of the unique characteristics of the data and still be intuitively navigated by users. But the data should also be made available in ways that users and other scholars can integrate into their own systems for their own needs. These two requirements may mean that data should be delivered in multiple and flexible formats. One example is the current development of a digital publication on the history of North American religious Missions. A complex dynamic map of the missions' locations and attributes, a video of the founding and closing of missions, screenshots of dynamic maps, and source files of spatio-temporal data are all made available within the publication.

Dynamic maps and text are different media forms and it is not clear how they are best related for different purposes. The ECAI Iraq atlas encourages navigation between dynamic map content and dynamically displayed cultural resources. It also allows textual browsing. For teaching purposes, a collection of simpler maps in a more linear textual environment might be more effective.

Integrating dynamic maps with digital library search systems opens up rich possibilities as the traditional isolation of the library catalog continues to be diminished. As noted above, with a gazetteer one can do more than with a traditional place name authority file. The latter should be linked to, or itself become, a gazetteer.

Mapping original data sources: In constructing the ECAI Iraq atlas, much was learned about collecting disparate information into an integrated environment. We also found that it was often very difficult to determine the original source of the information that was mapped. Copyright status is often unclear. What is the source of commonly used maps of historic Mesopotamia? At the same time, the ability to create temporally dynamic maps from distributed data provides a new tool for analyzing historic data on the distribution of cultural artifacts and manuscripts describing cultural interchanges, in order to research the probable course of historic boundaries.

Infrastructure, preservation, and institutions: There is a continual tension between individual data holders and institutional providers. There is a cultural dimension in that different communities treat knowledge holding differently and knowledge is usually community based. It is often difficult to represent specialized knowledge within a larger system. The sharing of data between different communities with different objectives may be resisted and the validity of data from unfamiliar sources is liable to be questioned. In addition, collected data may be, or may be considered to be, a source of potential income or competitive advantage. Finally, huge questions remain unsolved for the long term preservation of digital resources, and the more complex the software, the more difficult preservation is likely to be.

Conclusion

Digital maps have several advantages over paper-based maps. One special advantage is the ability to create temporally dynamic maps. The Electronic Cultural Atlas Initiative endeavors to build a community of interest across disciplines internationally, to promote better standards and practices and, especially, to learn through practical experience. Lessons learned include the importance of gazetteers, and the rich possibilities of combining media genres, notably maps, texts, images, and catalogs. Understanding and documenting the source, ownership, and validity of data remains major challenges.

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Further reading

The projects and studies mentioned can be found at or through the ECAI web site, <<http://ecai.org>>.

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