Dynamic Maps and Cultural Atlases
From the Silk Road to the North American Missions
Jeanette Zerneke
September 5, 2005

Introduction

The Electronic Cultural Atlas Initiative (ECAI) is a global consortium working to develop the genre of cultural atlases. Many scholars affiliated with ECAI are working on digital atlases, including development of local, regional, and global atlases. These in turn are linked in a growing web of interactive dynamic atlases. In addition to actively collaborating in the development of atlases, ECAI has been hosting international conferences since 1997, developing technical tools, working on research projects, developing a framework for ePublications and developing a central Clearinghouse of spatial data.

In this paper I will focus on development of atlases, specifically the projects of the ECAI participants who are working with the core staff at University of California, Berkeley.

Cultural Atlases

First off, what do we mean by a cultural atlas? An Atlas is an authored collection of maps. It includes data and cartography chosen by the author(s). A cultural atlas focuses on a specific time period, spatial coverage, and cultural community. Typically it includes maps that focus on cultural attributes, with examples of associated culture--either descriptions or images. A typical electronic cultural atlas is multi-media, having text and images as well as maps, and is an interactive, taking advantage of new technologies. The foci of electronic cultural atlases ranges from small sites / communities to global information projects.

Individuals or collaborative groups develop projects covering single sites or small areas. One such project, Begram Ivory and Bone Carvings, focuses on an archaeological site of Begram in Afghanistan. See Figure 1. The project integrates site maps, a catalog of artifacts, and commentary. One of ECAI's initial visions was to be able to zoom from a global menu to a specific location and see multiple individual projects in context. This ability is demonstrated in the ECAI Silk Road Atlas developed with sponsorship of University of California, Berkeley's Cal Performances and the Yo-Yo Ma's Silk Road Project. Regional atlases focus on time periods, empires or cultures. One example shows the spread of the North American colonial missions. The French and Spanish Missions in North America atlas shows the differing histories of the Spanish and French missions in North America over time. It includes a video display of the founding and closing of the missions. See Figure 2.

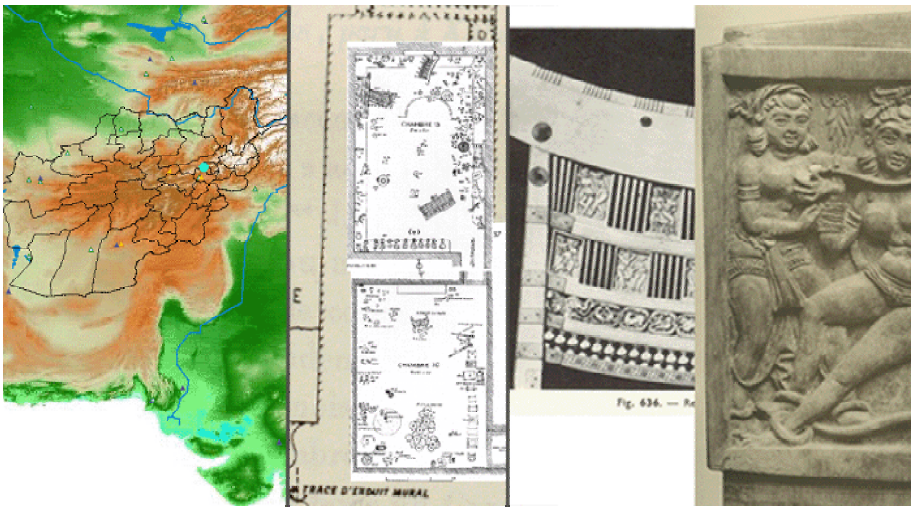

Figure 1: Begram in Afghanistan – Site plan – Detail of site artifact

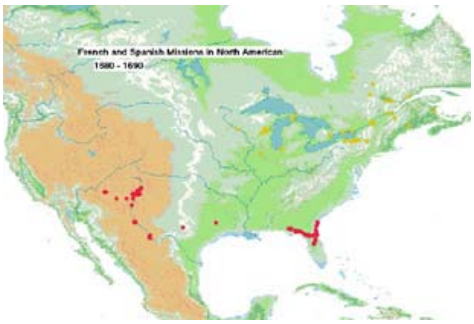

Figure 2: Video of Mission history from 1550 to 1850 (3.5MB AVI)

Many of the ECAI projects focus on specific genres of information such as historical, cultural gazetteers, historic maps, or language atlases. These can be valuable resources on their own but can also provide contextual material for additional cultural resources and research. Examples of these works include the Religious Atlas of China and the Himalayas, funded by the Luce Foundation, currently under development; the Historical map collection of David Rumsey; and the Language Atlas of the Pacific, partially funded by the Shung Ye Foundation.

These projects are beginning to form a multi-dimensional web of cultural atlases that can be drawn upon for dynamic creation of new works. The ECAI Iraq project, supported by the Hewlett Packard Company, links together the ECAI Silk Road Atlas, information from the The Sasanian Seals Collection, and other resources. It is an example of linking materials from multiple institutions and scholars using a spatio-temporal framework to provide an atlas portal to major providers of multi-media digital information.

A truly global cultural atlas would include the diversity of human cultures over time. Although this would be an infinite project, ECAI has developed a Clearinghouse for spatio-temporal data to encourage sharing of information. The ECAI Clearinghouse provides a repository that allows multiple views to co-exist. As is the case with libraries, multiple views give a more accurate reflection of human cultural. It is hoped that this architecture will encourage participation of a wide variety of communities to design their own cultural atlases. The ECAI Clearinghouse currently has approximately 950 cultural datasets and over 1,500 historic maps from the David Rumsey collection. Viewing the entry screen for the ECAI Clearinghouse you can see bounding boxes of many overlapping datasets and atlases. See Figure 3. These records are datasets that can be used as data layers for dynamic maps and atlases or they are MapSpaces of multiple data layers with cartography and navigation controls.

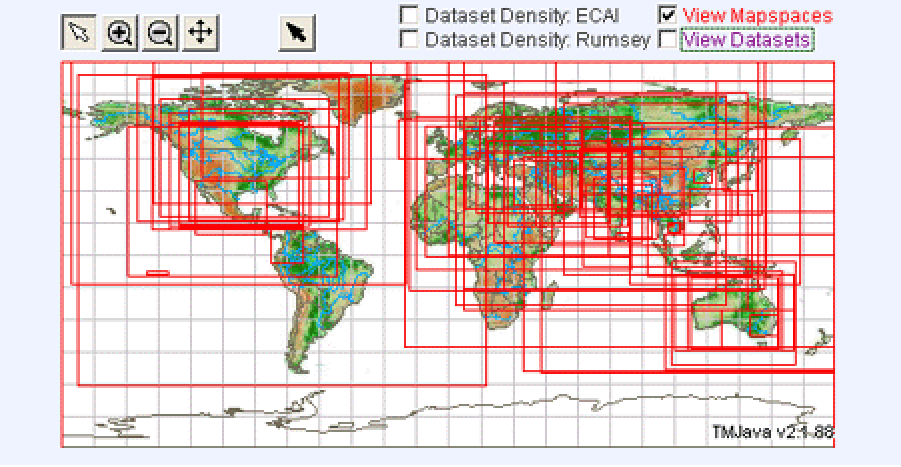

Figure 3: Bounding boxes show records in the ECAI Clearinghouse

Issues in Dynamic Map and Cultural Atlas Development

What have we learned in the process of developing this wide variety of resources? Many issues, not all technical, have been identified. They include:

- Time is as important as space in cultural atlases and many historical representations.
- In this area as in others, system designers must consider the availability of Internet access and the skill-base of their users.
- Data for creating the context for cultural presentations has been hard to find and copyright issues are unclear.
- There is a tension between developing distributed / global infrastructure and the holding of local knowledge.
- There are often difficulties of representing qualitative, incomplete or contested data in computer systems, which require quantitative data.
- We know there is a wide range of cultural paradigms relating to time and space. How can these be represented using computer tools?
- Integration of spatio-temporal displays with other media in websites is crucial and not always easy. A system with good integration can greatly enhance a users understanding of the material by blending visual and written explanations of information.

Time

Time is of equal importance to place. Documenting change over time is essential for historical processes. However, there is no tradition of using time in dynamic maps. Time is traditionally represented by using a series of discrete maps. Hopefully, each map has the same background information such as shape of landmasses, location of geographic features, and the same scale. The user can look at one map after another to construct a view of change over time. Most printed historical atlases include a collection of maps not all at the same scale or with the same information layers.

Human experience is with four dimensions - three of space and one of time. In modern culture we are familiar with representing three dimensions on a two dimensional surface and using time to represent change over time as in videos. ECAI has been working with the TimeMap project for the past seven years. The TimeMap methodology of using a time bar in addition to the standard GIS spatial representation has the advantage of maintaining the relationship between spatial layers and allowing users to dynamically control change over time. It produces a very intuitive video like visual representation. See Figure 4.

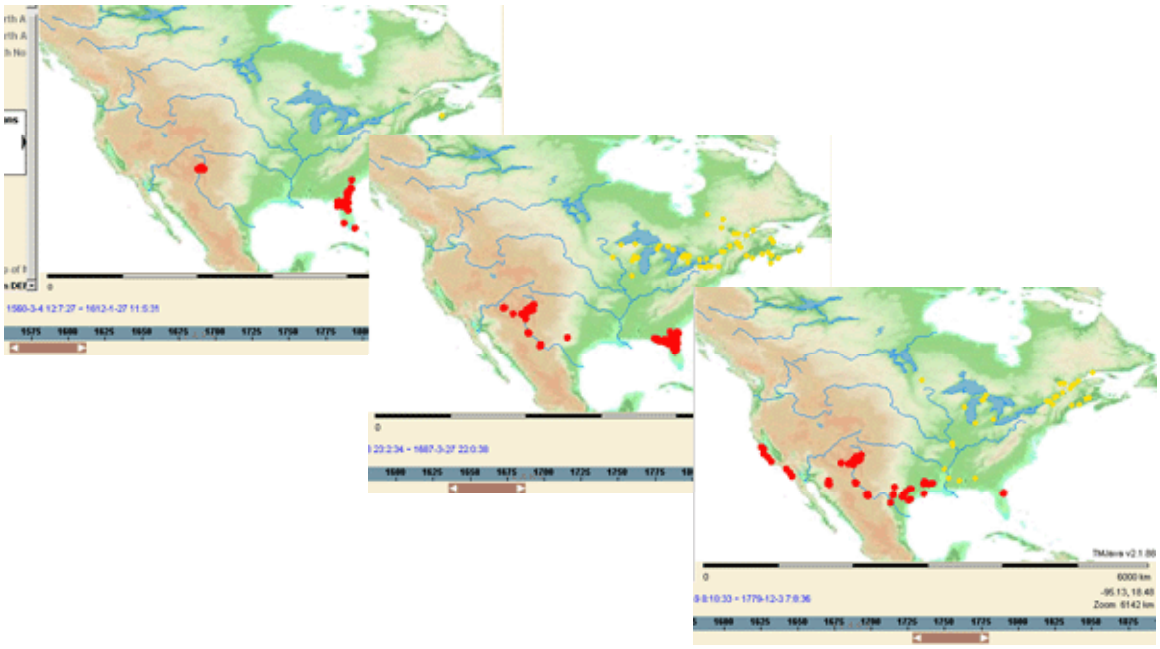

Figure 4: Three views of spatial information controlled by moving the time bar.

User Access and Skill-base
ECAI has often tried to address problems head on such as the representation of time or how to create dynamic publications and then found that they are ahead of their user base.

Widespread access to high bandwidth computers necessary for many of the techniques involved in dynamic mapping is necessary. The situation is gradually improving. However, many users are still not capable of viewing and manipulating java based web map browsers with their current computer infrastructure. These days we even find that users have turned off Java fearing that it may be a security risk.

Up until now there has been very little development of a common vocabulary for dynamic maps that web map designers can assume their users will be familiar with. There is no common tool set for dynamic interactive control of time maps as there is for web browsing and video games. MapQuest, Google maps, and others are now making some basic elements of dynamic mapping more familiar to a wider audience on the Internet. These dynamic maps are, however, still limited to simple things like zoom, pan and click on icons. The full cartographic vocabulary including map layers, data attribute information, and GIS analysis has seen a lot of development in professional use of GIS tools, but not in common web use. While visual analysis is quite intuitive, it can be quite inaccurate if the user is not aware of complexities arising from map projection, cartographic representation, and limitations in the representation of qualitative data.

Data Validity
Development of GIS tools has not fully addressed the problems encountered in representing the 'fuzzy' and incomplete data usually available for cultural atlases. GIS tools were initially developed for land use and other fairly precise mapping needs. The adaptation of these tools to humanities and social science presents significant problems. In printed works where the maps are collections of unique objects, it can be clear to the user that only some information is available. What is not mapped may not be known. However, with online maps it may be hard to show incomplete data. For instance, you may know that coins were minted in various places in specific years. So you can plot those points. Then, when the users view these dynamically over time, it appears to the user that there is a pattern that may not exist. For another example a data source may say that something is a one-day walk from a certain location. There may be multiple interpretations of this distance, but with a quantitative tool you must represent it as a single numeric value.

GIS limitation to three types data (points, lines, and polygons) is a basic problem. Limitation of each dataset to only one of these data types is an additional problem. For instance we may have a collection of events, some of which occurred in cities with a known location that can be represented by points. Other items in the collection may have occurred in locations described geographically as "by the lake" or "near a tree." These should be represented by a polygon with an imprecise boundary. However, from the historical point of view they are members of the same dataset.

It is difficult to represent cartographically the level of accuracy and precision of a map layer. With Web use, people do not expect to have to read explanatory text or legends to understand the data they are being presented. This leads to a risk of misrepresentation and incorrect assumptions. In addition, there is not a very strong tradition of documenting the source of information for map layers. The tradition of using bibliographic information to identify the source of facts and opinions in text works was much stronger than for printed maps. This situation has become even worse in website presentations. The pedigree of each layer of information should be easily accessible to the online user. Dynamic maps do, however, allow for the presentation of multiple views of the same information. If there are multiple versions of history or information available they can both be presented and then compared in a dynamic map.

Data Availability
There has recently been an increase in the availability basic physical data. Data such as satellite imagery can be used to create realistic background information for cultural data. However, good digital reference works such as timelines, historical gazetteers, biographical dictionaries, and high quality DEMs are not available online in ways that they can easily be used by dynamic map designers. Some work is being done such as the Alexandria Digital Library Gazetteer with its online protocol. But that project is not well enough funded and has no real guarantee of long-term persistence. National projects to develop historical gazetteers are beginning to make progress, but are very complicated to use. This information is the

equivalent of the reference works, catalogs and metadata of the previous generation of libraries international – not just national – infrastructure for digital resources needs to be developed.

One additional complication is that the copyright situation for map data is completely unclear. Does a publisher own the data behind a map or just the finished cartographic representation? Can someone own information on the location of historical events?

Integration

As discussed above, experimentation with development of cultural atlases is growing. Atlases covering a wide range of locations, time periods and scales are being developed. From small-scale atlases covering perhaps the historical development of a city to regional atlases of large scale such as the ECAI Silk Road Atlas. See Figure 5. There are as yet no agreed upon 'best practices' for these products.

Figure 5: ECAI Silk Road Atlas

Integrating dynamic maps with other forms of data (other media) in online systems needs to be designed to take advantage of the unique characteristics of the data and still be intuitively navigated by users. However, data should also be made available in ways that users and other scholars can integrate it into systems for their unique needs. These two requirements mean that data should be delivered in multiple and flexible formats. One example is the ePublication of the North American Missions project. A complex dynamic map of the Mission location and attributes, videos of the founding and closing of Missions, and screen shots of the dynamic map and source files of the spatio-temporal data are all available within the publication.

How can the dynamic maps add to the value of textual data? How can they be 'read' within dynamic digital publications? Can they also be used in situations that encourage more linear 'viewing' of the data for specific pedagogical uses in teaching? These are very challenging questions. The ECAI Iraq atlas encourages navigation between the dynamic map content and the dynamically displayed cultural resources. It also allows a more textual browsing of the information. For teaching purposes probably a collection of simpler maps presented in a more linear textual environment may be required. This however means more work for the instructor to construct the specific maps for each lesson.

Integration of dynamic maps in digital library systems allows the development of new search and discovery tools. For instance, navigating from a query based on place to a library search for books related to the

location adds a visual spatio-temporal capability to traditional word based searches. An example of this is used in the ECAI Iraq project where users can navigate from a specific location to queries in online library catalogs for books relating to that location. See Figure 6.

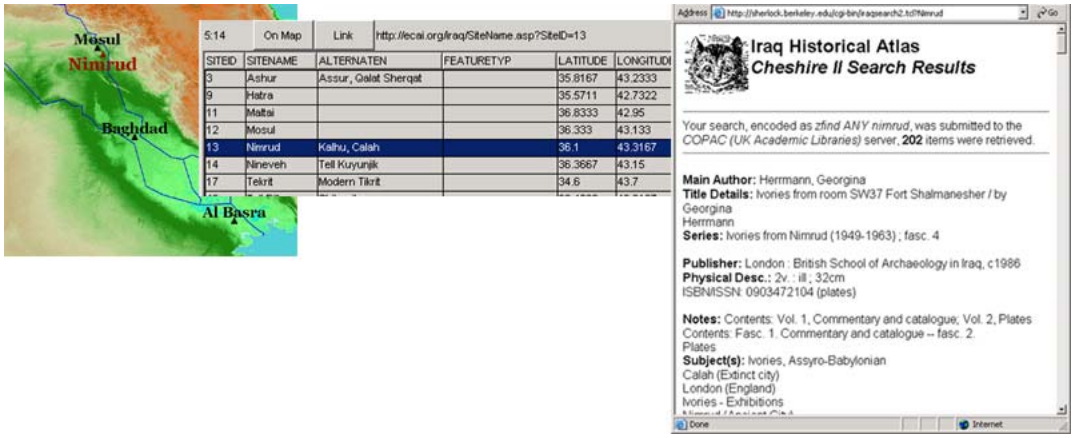

Figure 6: Place-based query of library catalog

Using Cultural Atlases – What we've learned

The projects have helped to improve our understanding of history by linking related data, text, and image recourses from multiple sources, enabling visual comparisons, interactive navigation, and analysis.

Mapping Original Data Sources

In constructing the ECAI Iraq Atlas we've learned much about collecting disparate information into an integrated environment. However, we also found that it was very difficult to determine the original source of the information that was mapped. Even the best printed atlases do not attribute each boundary in a map to its original source. So, what is the source of our commonly used maps for development of empire in Mesopotamia? Perhaps what is needed now that we have the capability is to go back to original source materials such as distribution of cultural artifacts and manuscripts describing cultural interchanges or documenting claims of control and map them directly. Then we could begin to address questions such as: what are the cultural correlates of empire, how and why did empires arise in human culture.

Integration of dispersed collections

The use of dynamic mapping to integrate dispersed collection is very valuable. Using a digital mapping system we can collect the images of the Begram Ivories from museums and collections all over the world and begin to reconstruct the archaeological site.

Can we show a linkage between Sasanian Seals and their location of use or creation? Not yet. Multiple theories on their use have been presented, but in order to test them a larger pool of data showing location of finds would be required. With continued digitization and cataloging of archaeological records and museum collections perhaps we will be able to.

We can visually see a correlation between the Buddhist iconography in various sites along the Silk Road – but again, we need much more data.

The massive destruction cultural sites in Iraq and the general disappearance of cultural information in our contemporary world makes it more crucial that these tools be used to re-integrate what is left of our cultural heritage. These representations will be the essential material for all our future research.

Use of images from Space

Use of satellite and aerial imagery is very useful in locating and providing a context for cultural sites. It is also useful in reconstructing historic land use patterns and their relationship to religious or political structures. For example, work on mapping land use and water management in Angkor, Cambodia is helping to understand the pattern of cultural sites, provide clues about general life patterns of its inhabitants, and help to analyze the rise and eventual decline of the empire. See Figure 7.

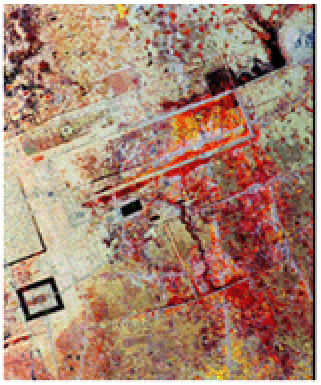

Figure 7: Satellite of Angkor

Infrastructure, preservation, and institutions

There is a continual tension between individual knowledge/data holders and institutional infrastructure providers. This tension has multiple dimensions. There is a cultural dimension in that different communities treat knowledge holding differently and knowledge is usually community or place based. It is often difficult to represent the knowledge of local communities in a larger system. There are significant differences in the understanding of place and time between different cultures. An example of representing a historical view of time and space can be seen in the project on Taoist cosmology currently under development. See Figure 8. Accurately representing these differences in a digital system is a challenge. Linking them into an integrated system is an even larger challenge.

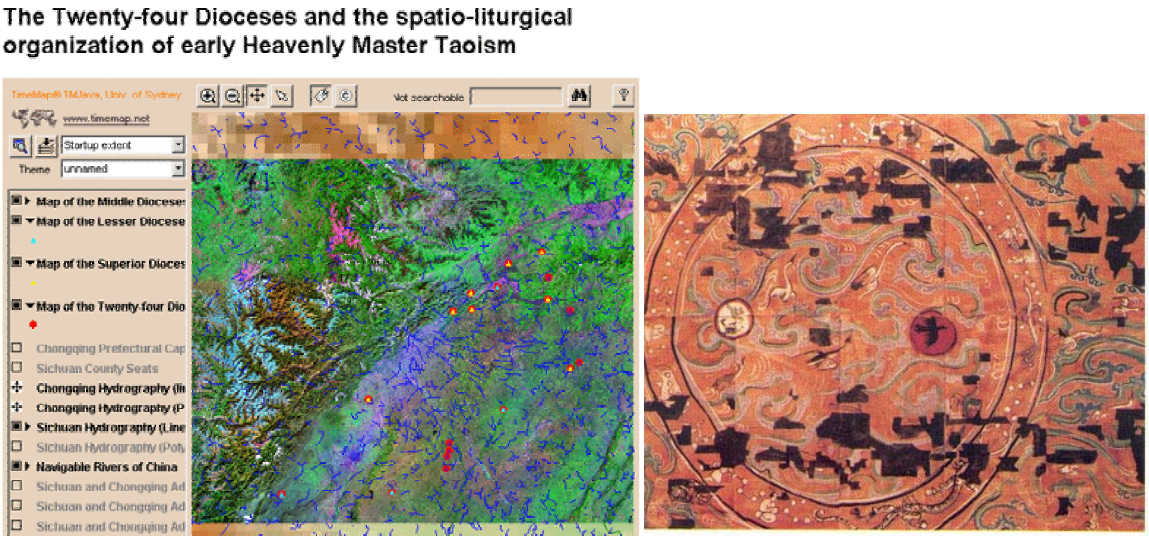

Figure 8: Two representations of Taoist Dioceses

In addition, data collections are often considered a resource that an individual researcher can use to leverage monetary support for their research or a personal commodity needed for their academic credentials. In all these cases the creation of a global resource of human culture are limited.

There is however, more likely to be stability of resources and infrastructure in larger institutional systems. ECAI developed its Clearinghouse as a method of providing a community solution. A place where ECAI affiliates can collect and share data from multiple sources. Hopefully, developing long-term institutional support for the future. This is still a challenge. There is still no clear way to fund long-term infrastructure for this type of community project. ECAI has also developed a program to collaborate with the University of California's California Digital Library to host Cultural Atlas ePublications. This project is attempting to provide preservation of digital materials, and longevity for dynamic systems.

Conclusion

Much has been accomplished as can be seen in the projects demonstrated here. However, as we can see from the list of issues still to address and the types of lessons we still expect to learn, we are still at the beginning of this frontier.

Bibliography of websites

Alexandria Digital Library Gazetteer
Begram Ivory and Bone Carvings
Cal Performances, University of California, Berkeley
California Digital Library, University of California
David Rumsey Map Collection
ECAI Clearinghouse
ECAI ePublications Series
ECAI Iraq
ECAI Silk Road Atlas
French and Spanish Missions in North America
The Henry Luce Foundation
Hewlett Packard Company
Language Atlas of the Pacific
Religious Atlas of China and the Himalayas
The Sasanian Seals Collection
TimeMap
Yo-Yo Ma's Silk Road Project