Coordinates

Series B, No.8

Problems That Arise When Providing Geographic Coordinate Information for Cataloged Maps

Persistent URL for citation: http://purl.oclc.org/coordinates/b8.pdf

Date of Publication: 10/16/07

Jorge A. Gonzalez

Jorge A. Gonzalez (e-mail: sgautama@ufl.edu) has worked at the George A. Smathers Libraries at the University of Florida, Gainesville for the last 23 years. He has been a map and science materials cataloger for the last 10 years. He is currently working on his Masters degree in Geography.

Abstract

Maps are not always published with coordinates. However, by following strict guidelines in the 034 and 255 MARC fields, and by using cataloging rules, one can interpolate this data in order to provide coordinates in bibliographic records. Bounding boxes and center point coordinates are key components in the catalog record, but problems arise with maps providing information outside of discussed or established standards, or maps not providing coordinates at all for different reasons.

This article explores the importance of correctly understanding, using, and interpreting map cataloging rules to provide the most accurate information possible, with the goal of making it possible to find maps quickly and accurately—whether using database retrieval or a coordinate-driven search engine. It is proposed that we can find an efficient universal method to represent locations, addresses, and areas of the world through the use of geographic coordinates for print and digital cartographic materials. Finally, the article states the strong need to standardize spatial cataloging information to improve search query responses by providing uniform information and by addressing the problems discussed in this article.

Keywords: Bounding box coordinates, center point coordinates, metadata, mathematical coordinate conversion, map cataloging, metadata quality,
cartographic coordinate data representation

While you are divided from us by geographical lines, which are imaginary, and by a language which is not the same, you have not come to an alien people or land. In the realm of the heart, in the domain of the mind, there are no geographical lines dividing the nations.

Anna Howard Shaw (1847–1919)
U.S. minister, suffragist, and speaker; born in England.

Introduction

Cataloging is the art and science of describing physical works. In the case of this article, it is the process of cataloging cartographic materials, more specifically maps. This discussion addresses the problem of providing and describing coordinates in library bibliographic records.

Traditionally, library cataloging elements have lacked certain descriptive information that meets the needs of today's users for locating spatial resources, especially with the advances in digitization and the availability of metadata. Recently, library cataloging has been struggling to adapt to the needs of locating resources within many new sources and formats of information, including: CD-ROMs, Internet/electronic sources, satellite images, cultural objects—all of which reflect georeferenced-spatial points. However, library cataloging continues to provide a high level of information resulting in a high success rate for patron retrieval of bibliographic items (Frank 1994, 10-11).

Map libraries have traditionally relied on place names for geographical searches. Geographical searches using coordinates of latitude and longitude can complement spatially related searches based on place names. The results of coordinate-based searches can, in turn, help locate information near or between the identified coordinates. Library catalog records are often indexed with coordinate data that may be useful in future software applications (Buckland 2007, 376).

New metadata schema (XML, etc.) and GIS technology provide mechanisms that perform fast searches combined with automatic retrieval in a database server environment. These tools are still in their infancy in regards to established standards for index coding, but hold promise that cooperative work or indexing standards will lead to many high level information retrieval applications. As these tools develop, they will eventually allow users more search refinement possibilities than present OPAC (online public access catalog) systems.

Workstations that include GIS programs and their datasets can be installed at local information desks or map libraries. GIS workstations may be connected to library OPACs, or to the Internet, to make it possible to download other cartographic information (Stevenson 2000). The ideal GIS application can combine data from different fields—merging spatial data into GIS attributes of point, line and polygon, while using a library database catalog system. The retrieval can take on a spatial range indexing aspect, effectively helping us retrieve queries efficiently. The key is use of the geographic coordinate system (latitude/longitude) as the basic framework.

Problem

Performing a library use survey specifically related to cartographic use, it was revealed that over 70% of geography-related researchers surveyed at the University of Florida (UF), relied more on the Internet and other sources compared to using the physical library (just under 25%) to research and retrieve cartographic materials. Independent of recent across the board trends, or what other subject or branch experiences may be, the numbers seem to reflect a higher dependence on non-physical library resources than on the actual physical buildings where professional help is readily available. After this survey, a review was made of literature that discusses and attempts to provide ideas and answers that can increase in-library use statistics.

There is a need for proposals and projects to evaluate, promote, and improve use of the library in general, to promote the benefits of using professional reference librarians, and to make users aware of the availability of research materials accessible to them. Librarians and library paraprofessionals, like teachers, must see how technology can support standards, facilitate library use, and make learning interesting for students and researchers. Technology must enhance lessons taught for the lessons to be effective.

This article is based on the principle that more access points on a bibliographic record will improve search results for the library user. The main concept discussed here is providing geographic coordinates to all map bibliographic records. This article will present the problems faced with implementing this tool to improve search queries.

The map cataloger is used to providing all kinds of spatial information to describe maps: scale, projection, source, place names, etc. Other non-spatial information is also included: title, author, subject (non-geographic) terms, type, edition, and situation date. These provide many of the elements necessary for spatial resource users, and do so in a variety of approaches and interpretations under a uniform standard. However, many of the spatial metadata elements are retrieved in manners unique to individual systems. Therefore, let us look at limitations to providing coordinate information both from within the cartographic item and via established library standards, as well as what additional limitations exist once the information is provided.

Rationale and Standards

Data accuracy is important for maintaining uniformity and easy communication, while also making it possible to transport or export information. The following factors should all be considered as means of reducing errors and increasing accuracy when creating bibliographic information:

1. Documentation of library materials by cataloging. Recording of bibliographic information of library materials helps preservation of data, its legacy, and longevity for future use.

2. Viable transfer of data and its documentation through metadata. Metadata improves document retrieval while supporting and transferring data information from one collection to another.

3. Uniform symbols and numbers for representation of data. Standardized use of symbols and punctuation improves interpretation of their meaning and eliminates duplication of symbols to mean other definitions.

4. Selection of elements of content to be presented. Use of agreed-to elements helps save time by working with established terms and helps with communicating using this terminology.

5. Distribution format(s). Library materials may include many types of materials. These items may also later be reproduced in another format, such as book, photograph, map, atlas, etc.

6. Identification of map subject/use content. Metadata reflecting concepts of the map's author to help users to identify the item's theme and intended use.

7. Consideration for international bodies and open sources. Finding a balance between material copyright or licensing issues versus equal access to all.

8. Resolution between the dominating approach behind laissez-faire industries driving the preferred or monopolized use of metadata standards. This involves legal issues tied to duplication of material or efforts to reproduce material in different formats.

Standards facilitate the development, sharing, and use of spatial data. Agencies like the United States Federal Geographic Data Committee (FGDC) develop standards for implementation, sharing and use of spatial data on a national level. This is done in consultation and cooperation with state, local, and tribal governments, along with the private sector, the academic community, and (to the extent feasible) the international community. Standards and uniformity contribute to common or "agreed-upon" ways of cataloging and supplying spatial information to bibliographic records and metadata. As such, data built to standards are more valuable since they are more easily shared, again, through the use of metadata.

Cartographic materials—including maps, atlases and satellite images—are cataloged according to the latest national standards for descriptive content and punctuation. These standards are included in the latest versions of *Anglo-American Cataloguing Rules* (Second Edition, Second Revision), and *Cartographic Materials: a Manual of Interpretation for AACR2* (2002 Revision, published in 2003). Local standards and variations to higher level rules are also taken into consideration, usually applied to special projects or formats and recorded online for the benefit of the department staff and to maintain uniformity and accuracy.

These standards call for taking the information from the map or source itself, or from the principal sheet of a set of maps. If that fails, one may use the container or other accompanying material, in that order, as the source of information. Important information that is used in the description of a map includes: title(s), author(s), geographic subject headings (place names) represented on the map, date(s), physical description, scale, projection, type of relief, and geographic coordinates.

Geographic coordinates are useful and important because of their ability to specify precisely positions on the earth's surface. Their uses include comparing positions, calculating distances, and general assistance in navigating from one point or place to another.

Precision, Resolution, and Accuracy

Cataloging and the creation of metadata are very detail-oriented, and the following factors must be taken into account to reduce the number of errors as much as possible:

1. the exactness of measurement or description of material in hand,
2. the degree of correspondence between the data and the real world,
3. the authoritative control of the input data,
4. the reliability of the sources of the data, and the processing steps it takes to carry out the work,
5. the degree to which the data represent the world at the present moment in time.

Accuracy, or completeness, can be measured by the discrepancy between the encoded and the actual value of an attribute; or by the number or lack of errors. In turn, this includes precision, which can be described as the degree of detail that can be displayed in time, space or topic as subject entries, and includes maintaining a consistency, which is the absence of contradictory information in the database.

Among the quality issues affecting the cataloging of cartographic materials, the following should be considered:

1. spatial precision when providing the actual coordinates,
2. accurate measurement of materials,
3. not providing coordinates (or working with missing data),
4. consulting current source data for carrying out updated revisions, while simultaneously providing local interpretations to procedural rules.

These are susceptible to errors in human definitions:

1. uncertainty of measurements,
2. no follow-up on discrepancies,
3. prioritizing or deciding what information to leave in or out,
4. converting data to internationally accepted or other local standards.

Accurate cataloging is vital for effective results in the information-providing world. Cataloging information will be relied on by individuals, researchers, and even government agencies. Bad cataloging decisions contribute to the absence of reliable, accurate information, and increase the chances of producing a product that will impair or flaw the scientific process. It is important to have standards free from government influencing or controlling the diffusion of information. Data is susceptible to human inaccuracy and conditional to what gets measured and what gets ignored.

Advances in technology, such as in the digitization of materials, are increasing the range of what can be measured. Since library science involves providing information, librarians, specifically catalogers, find themselves increasingly involved in providing more information. The human factor in the increase of providing information makes us susceptible to more inaccurate information. Standards must be constantly reviewed to decrease or at least keep to a minimum the number of errors.

Metadata Language Use

Libraries rely on the MARC (Machine Readable Cataloging) format, which has been criticized for shortcomings relevant to digital spatial data. In reality no other metadata scheme is so carefully reviewed, revised, amended, and so universally in place as is the MARC format for library materials. Ercegovac and Borko argue (in Frank 1994) that use of the MARC format "requires cataloger's memorization of a large number of rules, which change frequently." Additionally, MARC contains a lot of variants and interpretations among different interest groups and committees that have led to a few problems in exchanging bibliographic data (Frank 1994, 23). And while the MARC record format does contain fields that identify spatial data—including map scale, projection, map bounding coordinates—the use of such fields is inconsistent and some of the information is optional for the cataloger to provide.

There is a continual cooperative effort among the national, state and local library communities and organizations to attempt to identify and solve these problems. However, currently many bibliographic databases using MARC formatted data limit the ability of users to search for information based on the spatial metadata supplied. Despite some apparent shortcomings, MARC continues to be the primary choice for integrating bibliographic data in the library community because of its versatility and well established nature —i.e., it is true and tested (Frank 1994, 90). Comparatively, a simpler form of gathering this type of data, a descriptive standard called Dublin Core, has a very limited set of fields and few or no uniform rules for application.

MARC's geographical searching limitations include restricting the search parameters to a particular location in space. This is done by specifying a place name or by applying geographic coordinates, if supplied by the cataloger or already available on the record. Place names can be ambiguous, having different meanings for different users (Las Malvinas vs. Falkland Islands), and can suffer from variations in spelling (Colombia v. Columbia). Place names are commonly used as a retrieval key in most bibliographic systems (Hill and Zheng 1999). However, this article is about providing and establishing uniformity in coordinate systems.

For a map, one of the most common methods of describing spatial constraints is to specify a center point location and a search radius, or, preferably, to specify diagonal corner locations of a minimum bounding rectangle or "box," or to specify the locations of vertices of a polygon within which the searcher would expect the data to exist. Authoritative database systems such as the Alexandria Digital Library, the United States Geological Survey's Geographic Names Information System (GNIS), the United States Board on Geographic Names, etc., offer one or more of these geometric constraint methods to users. Other spatial constraint methods currently used are to specify a satellite path and frame number for remotely sensed imagery, or to specify a "tile" of a hierarchical order (Frank 1994, 90).

The thematic data issues for using and providing metadata include a constant awareness and knowledge of current data, and of data needing revisions and updating, plus challenges with missing data in regard to compensating for it and/or noting the absence of it.

Cataloging Procedures

Coordinates that are provided in library bibliographic records allow users to find specific points or areas on the earth's surface as represented on the map. A 2-point set (center point) system of coordinate values identifies a specific point on the earth's surface, often to show a point of elevation or the location of a city on a map. Map catalogers historically have been providing "bounding (box) coordinates," or a set of four points that surround some geographic region as shown on a map (Andrew 2003, 94-95). Quite a number of sheet maps identify the four coordinate points representing the interior area that has been mapped. The variety of interpretations of map cataloging rules leads to catalogers providing coordinates whether they appear on a map or not, which is further complicated by asking for interpolation, or rather the estimation of a coordinate value from other known information on the map, which may lead to faulty measurements and human error.

Although the rule for providing coordinates is considered optional to apply, when a cataloger does so practice dictates that they are provided as a set forming a bounding box or rectangle. This information enables new search engines to retrieve records using coordinates, while currently old systems are being adapted so more library software allows such searches.

Scale information shown on maps is provided by the cataloger in two locations and in different formats. One of the MARC fields used to display this information is the 034 (Coded Cartographic Mathematical Data) field, containing data for scale and coordinates. Scale information and coordinates, when provided, are presented in numerical form, though coordinate values also include the abbreviation in textual form of the hemispheres being covered. (Andrew 2003, 42). Also, coordinate data values may be given either in the form of hdddmmss (hemisphere-degrees-minutes-seconds), or as decimal degrees. The degree, minute, and second sub-elements are each right justified and unused positions contain zeros (Library of Congress 2006).

Example in (hemisphere) degrees/minutes/seconds:

hdddmmss
034 1_ a ||b 22000000 ||d W1800000 ||e E1800000 ||f N0840000 ||g S0700000

Example in decimal degrees:

hddd.dddddd
034 1_ a ||d E079.533265 ||e E086.216635 ||f S012.583377 ||g S020.419532

The 034 MARC field is directly based on parts of information from MARC field 255 (Cartographic Mathematical Data). Although present cataloging practice makes it optional to include bounding coordinates appearing on a map, when they are included in the bibliographic record they must be included in both the 255 and 034 fields. The 255 field contains the coordinates in degree, minute and second (dms) symbols, with appropriate hemisphere denoted, and must contain a scale statement as either a representative fraction when known, or through the means of a standard phrase such as "scale not given."

Examples of coordinates in 255 field:

d m s
255 _ _ ||a Scale 1:250,000 ||c (E 32°30'07"--E 34°30'12"/N 35°30'11"--N 35°00'00").
255 _ _ ||a Scale not given ||c (W 125°--W 65°/N 49°--N 25°).

Both fields are repeatable, meaning they can provide coordinate information for multiple maps appearing or on the same sheet or additional sheets that make up the whole region. The coordinate information should be provided as long as the information is present or can be estimated. Greenwich is assumed when no prime meridian is identified on the map. If a different meridian is specified on an old map, the cataloger records the coordinates in Greenwich, but may choose to give other meridians provided in the notes area of a record (Mangan 2005).

The coordinate grid information is also provided in a uniform way, since providing the coordinates randomly would defeat the purpose of identification, and this again helps to reduce the number of errors while allowing people to read and understand the information in a standard way. The following lists the order in which coordinates on a map are given in the record:

1. westernmost ("leftmost") longitude of the map,
2. easternmost ("rightmost") longitude of the map,
3. northernmost ("topmost") latitude of the map; and,
4. southernmost (bottommost") latitude of the map.

This order is followed no matter what region is being described anywhere on the planet. As important as the order is, the mathematical expression of the coordinates is important also, since this will come closer to precision than if expressed linguistically. When bounding box coordinates are not available or difficult to determine, or center point coordinates have been provided or found in an authoritative source, then the center point coordinates can be provided by repeating the latitude and longitude numbers in the above order.

In regard to thematic data issues in cataloging, the textual format is critical in both providing what is displayed by completely transcribing what is on the material and coming as close as possible to correcting mistakes by providing accurate information. One must also provide a sense of completeness with the information provided from the material in hand, knowing there is other information missing. When choosing which enumeration standard to provide or convert, one will sometimes need to round off numbers. These issues include to what degree of the propagation of errors from an original source can be minimized, and making a decision of what enumeration and manipulation of data to keep.

Comparing Methods of Representing Coordinates

The bounding box representation works well for providing information on library records, and it is easy to understand despite the need to follow a uniform order. But optionally, since maps do not always fit a rectangular bounding box shape and can be any sort of polygon, they may be identified with a center point coordinate. The centroid, or the point at the geometric center of the polygon, can be used to represent the area.

Center point representation contains one latitude line and one longitude line that intersect at a single point. It is the standard used within the Geographic Names Information System (GNIS), developed by the U. S. Geological Survey in cooperation with the U.S. Board on Geographic Names (BGN). The database holds federally recognized names of features and defines the location of each feature, including its geographic coordinates. It is easy to work with the GNIS to find features on maps, but it is not so useful for figuring out the size or shape of a geographic feature, or for analytical work that involves describing parts of a larger item, collected works, or sophisticated data.

It is clear that there are advantages to adding geographic coordinates to a specific data field for geographic places, but problems that still need addressing include uniformity, and a universal protocol that includes deciding on one system to use—that of decimal degrees instead of degrees, minutes, and seconds of data for sufficient advantages of retrieval and interoperability, or converting the coded form of degrees, minutes and seconds to decimal form and including both. It may also be noted that the Board on Geographic Names, a likely and optimal authoritative source for this data, provides center point coordinates as contrasted with bounding box coordinates typically found in sheet maps, again contributing to the debate of "best fit" numbers in the information allowed by the cataloging rules. It is also important to bring up a temporal problem regarding coordinates. Should date information be provided because of the likelihood of changes occurring to boundaries because of political or natural events? Also, as with most researched work, should the sources of information for these dates be provided with links to trace the origin of the information?

While these issues may eventually be resolved by the bodies that govern the choices of content of library bibliographic and authority records, some of them need to be determined sooner rather than later to keep up with users' needs and their ever-expanding access to information and technology.

According to the 1994 report *Promoting the National Spatial Data Infrastructure through Partnerships* from the Mapping Science Committee of the National Research Council, "The twenty-first century will see geographic information transported from remote nodes using computer networks to support decision making throughout the nation.... Timely use of these data would be difficult due to ill-defined format, quality, and accuracy. National or regional decision making would be severely impaired because most data sets are not adequately characterized" (National Research Council 1994). Enhancing the power of authority records, those separate records maintained and linked to various kinds of descriptive records to better partner with the problem-solvers who use GIS to address our problems, is a worthwhile endeavor (Lundgren 2005).

Retrieval of Materials

The idea behind providing coordinates is to develop a user-friendly way of retrieving maps from a digital database. Additionally, some systems will allow users to specify as spatial constraints such things as census tracts, cities, counties, state regions, area codes, or zip codes—all ways of describing something spatially. This may be done by specifying a geographic name or by selecting a graphic map representation. Furthermore, areas defined by geographic coordinates may be specified or coupled with a geographic name, usually borrowed from an important adjacent area along with geographic type to serve as a substitute for regions without established, known or authoritative place names.

Regardless of what form of spatial query the database uses, geographic name or coordinates, or both, common representations of spatial data can be utilized by developing a well defined uniformity in the description of the material. This will allow appropriate and consistent treatment of the material to help in development of descriptive information for researchers and other information seekers while serving as a method to reduce errors in information.

Providing the latitude and longitude with complete degree, minute and second information reduces the margin of error and provides for the closest approximation to the true measurement of the area on a map being represented. Maps will sometimes either leave out coordinates, or if they do include them, they may provide them using different systems than ones commonly used. The cataloger will have to rely on providing approximations for maps with no coordinate information, and will have to decide whether a conversion is needed to provide an agreed-upon measurement. The cataloger will also have to consider whether to include information as it appears on the material, in addition to converted data. The cataloger will also have to account for providing both corrected data and the original data on the map (Larson 1996).

The availability of spatial searching capabilities allows for interoperable services. Larsgaard (1978) identifies several methods of providing geographic coding, or “geocoding” for spatial representation:

1. using explicit boundary delineations in mathematical form (stating plane coordinates or latitude and longitude values),
2. using nominal values that do not indicate spatial relationships among entities (place names),
3. using ordinal values to indicate relative positions of spatial units within some defined system, such as census tracts,
4. using unique designations for undefined or implicitly defined locations, such as zip codes.

One of the most important contributions of geocoding is its benefit to multiple applications. All coordinate based implementations can be translated to other coordinate based implementations, albeit with the risk of losing positional accuracy. And, although coordinate values can also be translated to place names by arbitrarily or authoritatively assigning names to sets of coordinates, many, if not most, cartographic materials do not have such assigned names.

Whether the transportability of the information is from or to different sources, the information needs to be consolidated to the same location, although it may be identified differently by different sources (e.g., USPS, Sanborn, US Census). On the other hand, it is a daunting task to identify, digitize and code all areas identified on a map. So there is a trade-off affecting the level of accuracy your information can have (Sears 2004).

Map Services and Mapping Tools

Google Maps offers powerful, user-friendly mapping technology. It includes integrated business search results to help find business locations and contact information.   The maps can be clicked and dragged, which allows viewing of adjacent sections. Iit also provides a layer of satellite images to view desired locations in that format. As with other address-oriented online maps, it provides detailed driving directions, along with the standard shortcuts, and arrow key use for panning maps in different directions, and also zooming and scroll abilities. Another Google service, Google Earth, displays 3-D images and supplies coordinates, but has not made the coordinates a searchable indexed element to date (Gurnitsky 2006).

The Alexandria Digital Library (ADL) includes datasets of U.S. topographic map quadrangles, as well as parts of the GNIS data from the U.S. Geological Survey. The database allows you to search for place names, including both primary and variant names for a geographic location. To help with the establishment of one standard place name from many alternative spellings, the ADL provides a general way to specify the type of feature in the query. Narrower terms of a selected feature type are included to allow browsing for related words: e.g., to look for farms in an area, you can find out that they are given the general type of “agricultural features”.

An ideal search query should be able to integrate a feature type thesaurus into the search interface for the gazetteer. For querying cartographic materials these definitely need to be digitized and geocoded. This involves taking a street address, in the form of a point on a map identified by geographic coordinates, and converting it into decimal latitude and longitude coordinates so that it can be displayed in a map database. When trying to locate the segment, the following may all be used: street number, street name, street direction, street type, and the city, state and zip code. This is what makes locating addresses and viewing multiple locations on a map instantly possible.

The benefits of a gazetteer include the provision of geographic coordinates, which can supply the basic structure for named places using map visualization software. Georeferencing now usually involves the intersection of one line of latitude and one line of longitude, but as the use of map interfaces increases, more complex georeferencing schemes may appear—such as the use of two lines of latitude and of longitude to form a bounding box or a polygon approximating actual boundaries (Buckland 2007, 381). A georeferencing calculator is a tool to aid in the referencing of localities of digitized items, such as maps that are found in library, museum, or similar collections. Displaying the position of a site geographically can help detect errors and increase data quality. GIS tools contain analytical functions which make possible the prediction of spatial distributions (Wieczorek 2004, 764).

ArcGIS contains a tool that allows geographic interfaces to bibliographic citations and library records offering graphic alternatives to searching text strings of place names. ArcView’s “hotlink” tool permits linking to external data utilizing a point for each of the place names created from the associated latitude and longitude fields. Using this functionality, you can look at a map, click on a point in an area and retrieve relevant bibliographic records in a new window. The same type of URL search can be created for any library catalog or database that is capable of linking to remotely generated URLs.

Database Discussion

Maps are an integral part of data researchers’ need for emphasizing the relationships between place, time, and subject in the study of culture, environment, architecture, engineering, history, etc. To enhance map retrieval with better tools and standard practices by way of digitization, there is a need to develop software that will allow downloading and editing geo-temporal data to dynamic maps, which will also allow manipulation of representation and editing of the data. Availability of shared data accessible through map-based interfaces, standards for gazetteers and time period databases, continuous research, studies to develop and improve geographic aspects in online catalogs, and good practice guidelines for preparing paper and electronic publications will improve this interface (Buckland 2004).

In order to display information in geographic-tool software, map data must be georeferenced. To create base maps and contribute additional map layers, the map data must routinely include data with latitude and longitude attributes, along with the use of place names that were collected in the course of research on historical texts or actual material in hand. The Alexandria Digital Library is a powerful player on the authoritative level of selecting place names for this kind of work (Hill 2000).

Eventually databases may come with the ability to convert diverse coordinate information to a single standard, and with uniform data. Even then, successful information retrieval will depend on the ability of the researcher to carry out queries based on an adequate understanding of the database that provides the information.

Geographical Searching in Library Catalogs

Library catalogs are designed primarily for searching by author, title, or subject. But they are in the process of developing their spatial searching capabilities through the implementation of GIS capabilities, and by providing additional numerical data. One can search for place names in titles, keywords or in subject headings, but geographical headings tend to be of political or administrative jurisdictions, which depend on current use, and can be useless for historical or political changes.

Geographic coordinates, however, along with the place name feature type, are effective in selecting different places with the same name and associating different names for the same place. The idea is that geographic information systems will allow data with geographic coordinates to be visualized as map layers in a common coordinate system after conversion from other standards. Multiple map layers, showing other divisions by topic, history, topography, etc., for example, will be superimposed in a single viewing environment. Coordinates for place names in subject headings will allow for retrieving maps by clicking on a georeferenced dot.

Additionally, geographical coordinates will be able to be calculated in the form of “nearby” searches by perhaps defining a radius around a center point, making this useful for border and frontier studies along with studies of near neighbor effects. With today’s technology, the linking of online library catalogs with online gazetteers, along with linking to cooperative authority work, could transform geographical information searching throughout libraries and the Internet (Buckland 2004).

Conclusion

This article is written to provide an understanding of the work that is involved in cataloging and providing metadata for cartographic materials, and to show the factors that may contribute to thematic errors. To demonstrate what is involved in cataloging maps, one must understand the need for providing spatial data as the basis for geographic information retrieval. The discussion concentrated on one aspect of spatial data: that of geographic coordinates. The ideal is to provide coordinate information for the purpose of facilitating document retrieval, while concurrently resolving problems relating to accuracy, consistency, conversion, and unavailable data.

The development and use of spatial information and metadata cataloging paradigms has depended on, and grown along with, the advances in information technology, and with what computer memory has allowed. The recent library information shift has created a crisis in the establishment of standards to keep up with the changes. AACR has given way to a much delayed introduction to new standards, RDA (Resource Description and Access) to tackle the new challenges in describing digital resources in the new Information

Age (Joint Steering Committee 2005).

However, it may be a long time before the number of solutions can be reduced, or before a single solution can be found or agreed upon, for providing spatial information for library records. Despite these difficulties, library science will continue to improve its already workable information infrastructure using the latest methods and sources for providing and locating spatial resources.

Despite the aforementioned unresolved issues, including competing gazetteers and lack of standards to keep up with technology, we can forge ahead knowing that applying the practices discussed in this article will help to confront the problems and reduce errors. The ideal includes being able to search most, if not all, maps in a library collection by using geographic coordinates, and thus find every map that included within a coordinate range.

Map collection databases must be able to go beyond the service of gazetteers, and provide many layers of maps in an instant. We must understand that providing coordinates is not a panacea, but must work in conjunction with place names and feature topic names and probably further beyond to a subject/topic thesaurus and hierarchical relational data— i.e., planet, hemisphere, continent, country, primary level administration, secondary level administration, city, neighborhood, etc., among other geographic regions.

The hope is that identifying the hurdles here will make it easier to keep up with changes in information technology. We must not be defeated by the number of problems to be overcome, but rather be resilient and progressive in our thinking. Through cooperative efforts at every level, it is important to make the necessary, and in some cases overdue, adjustments in standards, procedures, cataloging rules, and information retrieval services among the contributing and authoritative parties for the benefit of those needing access to this information.

Bibliography

Adkins, Sally. 2000? Geographic and projected coordinate systems – keys to creating and understanding maps (Geographic Coordinate Systems). http://www.geoplan.ufl.edu/giseducation/coordinates.html.

Alexandria Digital Library Project. *Guide to the ADL Gazetteer Content Standard, version 3.2 (2. Overview).* February 26, 2004. http://www.alexandria.ucsb.edu/gazetteer/ContentStandard/version3.2/GCS3.2-guide.htm (modified date: Feb. 26, 2004).

Andrew, Paige. 2003. *Cataloging Sheet Maps, the Basics.* New York: Haworth Information Press.

Buckland, Michael et. al. 2007. "Geographic search: catalogs, gazetteers, and maps." *College and Research Libraries* 68, no. 5:376-387.

Buckland, Michael and L. Lancaster. 2004. “Combining place, time, and topic: the electronic cultural atlas initiative." *D-Lib Magazine*10 no. 5. http://www.dlib.org/dlib/may04/buckland/05buckland.html.

Caldwell, Douglas R. 8/29/05. "Unlocking the mysteries of the bounding box." *Coordinates: Online Journal of the Map and Geography Round Table, American Library Association*, Series A. no. 2. http://www.sunysb.edu/libmap/coordinates/seriesa/no2/a2.htm.

Frank, Steven M. 1994. *Cataloging Paradigms for Spatial Metadata.* (Ph.D. Thesis: University of Maine).

Goodchild, Michael F. 2004. "The Alexandria Digital Library Project: review, assessment, and prospects." *D-Lib Magazine*10, no. 5 http://www.dlib.org/dlib/may04/goodchild/05goodchild.html.

Graf, William L. 2004. "In the critical zone: geography at the U.S. Geological Survey." *The Professional Geographer* 56, no. 1:100-108.

[Gurnitsky, Joanna]. (June 2006). Try Google Earth: a Magnificent Satellite View of the World. http://netforbeginners.about.com/od/readerpicks/a/google_earth.htm.

Hill, Linda L., et al. 2000. "Alexandria Digital Library: user evaluation studies and system design". *Journal of the American Society for Information Science*, 51, no.3:246-259.

Hill, Linda L. and Zheng, Ki. 1999. *Indirect Geospatial Referencing through Place Names in the Digital Library: Alexandria Digital Library Experience with Developing and Implementing Gazetteers*. http://www.alexandria.ucsb.edu/~zheng/papers/asis99.pdf.

[J. Paul Getty Trust]. 28 March 2006. Coordinates. *Getty Thesaurus of Geographic Names Editorial Guidelines.* http://www.getty.edu/research/conducting_research/vocabularies/guidelines/tgn_3_7_coordinates.html.

Joint Steering Committee (JSC) for Revision of AACR. April 24-28, 2005. *Outcomes of the Meeting of the Joint Steering Committee Held in Chicago, U.S.A.* http://www.collectionscanada.ca/jsc/0504out.html.

Larson, Ray R. 1996. "Geographic information retrieval and spatial browsing," in *Geographic Information Systems and Libraries: Patrons, Maps, and Spatial Information* [Papers presented at the 1995 Clinic on Library Applications of Data Processing, April 10-12, 1995]: 81-124. Retrieved Fall 2005 from http://www.ideals.uiuc.edu/bitstream/2142/416/2/Larson.pdf.

Larsgaard, Mary Lynette. 1978. *Map Librarianship: An Introduction*. Littleton, CO: Libraries Unlimited.

Library of Congress. Network Development and MARC Standards Office. 2006. *MARC 21 Concise Format for Bibliographic Data, Number and Code Fields (01X-04X), 034-Coded Cartographic Mathematical Data*. http://www.loc.gov/marc/bibliographic/ecbdnumb.html#mrcb034.

Lundgren, Jimmie and Jorge A. Gonzalez. *Recording Geographic Coordinates*. February 26, 2004. *MARC Discussion Paper no. 2006-DP01*. http://www.loc.gov/marc/marbi/2006/2006-dp01.html.

McEachren, Alan M. 1998. "Cartography, GIS and the World Wide Web." *Progress in Human Geography*. 22, no. 4:575-585.

Mangan, Elizabeth Unger; Anglo-American Cataloguing Committee for Cartographic Materials. 2005. *Cartographic Materials: a Manual of Interpretation for AACR2, 2002 Revision (2004 Update)*. Chicago: American Library Association.

National Research Council. 1994. *Promoting the National Spatial Data Infrastructure through Partnerships.* http://www.nap.edu/catalog/4895.html.

OCLC Bibliographic Formats and Standards. November 2003. [*034 versus 255 MARC Fields*]. http://www.oclc.org/bibformats/en/ (viewed: Aug. 10, 2007).

Oracle Technology Network. 2005. *Oracle® Spatial User's Guide and Reference 10g Release 2 (10.2)*. http://download.oracle.com/docs/html/B14255_01/toc.htm.

Rumsey, David. June 2, 2005. *Historical Maps Online*. http://www.oreillynet.com/pub/a/network/2005/06/02/davidrumsey.html.

Sears, Brian. April 20, 2004. "Geocoding challenges: why accuracy matters." *Directions Magazine*. http://www.directionsmag.com/article.php?article_id=558&trv=1.

[Steele, Randy.] 2000. *Getting Map Coordinates from a Historical Topo Map for Use with GPS, or How to Determine the Latitude and Longitude on a USGS Topo Map*. http://www.nb.net/~resteele/newsites/find_log_lat.htm.

Stevenson, Bill. 2000. "Servicing map users at Aalborg University Library." *Liber Quarterly*. 10:454-464.

USGS Geographic Names Information System – GNIS.15-Jun-2005. http://nhd.usgs.gov/gnis.html.

Vestavik, Oyvind. 2003? *Geographic Information Retrieval: an Overview*. http://www.idi.ntnu.no/~oyvindve/article.pdf.

Wieczorek, John., et al. 2004. "The point-radius method for georeferencing locality descriptions and calculating associated uncertainty." *International Journal of Geographical Information Science*. 18, no.8:745-767.

Top | MAGERT Home | Coordinates Home