Developing Historical Geographic Information Systems for Japan

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Abstract:

With the development of Geographic Information Systems (GIS) for researching the history of particular localities in Japan, there is increasing awareness and interest in the idea of creating a broader GIS resource for all of Japan. In order to demonstrate the potential for a Japan Historical GIS, the China Historical GIS project, with support from the Reischauer Institute of Japanese Studies, has completed a basic geodatabase for contemporary Japanese placenames (circa 1995) and several historical GIS layers for the Tokugawa Period (circa 1664 and 1820). The resulting database is available for browsing online, using a search engine adapted from the CHGIS data model, and the historical GIS layers are available for free download to academic researchers. This paper will briefly outline existing examples of Japan Historical GIS, the methodology used to develop our demonstration GIS, and the means of searching the data online.

1.1 Existing Japan Historical GIS

In the United States, one of the first major GIS datasets compiled from historical sources in Japan was undertaken by G. W. Skinner in the mid 1990's. These included *gun* and *mura* boundaries for the Nobi Region and Owari District, based on 1890 map sources. [1] Another major GIS project that tracks the spatial history of towns and railways in the Tokyo region was compiled by Loren Siebert. [2] Siebert has gone on to map earlier sources for the same region using Edo gazetteers. [3] Corporate land tenure regimes in Japan are being explored with GIS by Philip Brown. [4] An extensive collection of historical maps of Japan has been digitized and made available online by David Rumsey. [5]

In Japan, numerous local GIS projects are beginning to appear, such as the Edo Period Nagoya Atlas. [6] The cities of Nara and Kyoto are in the planning stages of creating a GIS to record all their major historical sites, which is no small task. Several museums, have announced similar plans to study the original spatial distribution of the objects in their collections, such as the 3-D GIS project of Doshisha University. [7] In addition, several research institutes are developing their own GIS to study various aspects of Japanese history. An example of this work is a project directed by Yuji Murayama (Tsukuba University), where they have developed a GIS model to combine historical demographic data from the Meiji, Taisho, and Showa periods with points in GIS layers. [8]

The trend toward utilizing GIS technology for the representation of historical places and spatial analysis of historical statistical data is clearly accelerating. To encourage more work in this area, and to provide an example of how historical data has been captured for the China Historical GIS project, we have made use of our existing data model to implement a simple GIS dataset for Japan. The sources, methodology, and results of the Japan Historical GIS demo are described in the following sections.

2.1 Sources for the Japan Historical GIS Demonstration

The basic GIS database for Japan was designed to contain information about both contemporary and historical places.

2.2 Sources for Contemporary Japan

For contemporary places, the municipal areas listed in the 1995 census were used, and for each of the areas approximate points, roughly located at the center of each administrative unit were defined in a GIS layer. This was done as an expedient, since we did not have time or funding to digitize the boundaries of these municipal areas. Our primary concern was to input the correct placename in *kanji* characters (using Unicode UTF-8 character set), and to input the correct *hiragana* and *romaji* readings for each of these placenames.

It is worth pointing out that the "municipal" districts listed in the 1995 Census include various types of administrative units, including urban districts, entire cities, towns, and villages, depending on how the Census figures are tabulated for different places. Once the list of these districts was complete, an administrative hierarchy was established, using a "part of" or containership table, as developed for the CHGIS data model. For example, a particular *mura* [village] would be listed as "part of" a particular *gun* [county]. This is done quite simply using two tables in the relational database. The first table, or main table, contains all the unique municipal districts and is augmented by each superior unit as needed. Each of these records is given a unique ID number.

To illustrate, imagine the case of Takagimura:

Main Table
Takagimura ID#1

The 1995 Census is arranged geographically by administrative districts, so we know that Takagimura is part of the county: Shimoinagun. Therefore we must add Shimoingun to the main table and assign it a unique ID # as in:

Main Table
Takagimura ID#1
Shimoinagun ID#2

Now we can create the containership relationship in the "part of" table.

PartOf Table
Takagimura ID#1 >is part of> Shimoinagun ID#2

The same process is repeated for Shimoinagun, which is in the jurisdiction of Naganoken, and so on until we reach the top of the administrative hierarchy, which in this case is Nihon. This allows us to run a loop query on the PartOf Table, which can provide us with the administrative hierarchy for Takagimura, or:

Takagimura
Shimoinagun
Naganoken
Nihon

Using this method a complete administrative hierarchy was developed for Japan, as reflected in the 1995 Census. The *ken* [prefecture] and the basic regions of Japan (such as Kinki, Kanto, etc) were then linked to the UNEP/GRID [9] dataset, which is publicly available for scholarly use, and is available for download from the International Potato Center. [10]

Once the data for 1995 Census was completed, we added another dataset of some 35,000 named places in Japan, which is made freely available by the National Imagery and Mapping Agency. [11] The NIMA dataset contains no *kanji* or *hiragana* whatsoever, and has a high percentage of dubious *romaji*. Nonetheless, the addition of the NIMA dataset adds a fairly dense coverage of placenames for Japan and leverages the 1995 administrative hierarchy as contextual information in a way that is not available elsewhere.

It is important to point out that the example of integrating the 1995 Census data and the NIMA data was done based on the assumption that all the records were valid for the year 1995. The data model being used is also capable of tracking changes over time by allowing each record to have a valid span of time by entering different begin and end dates. However, this adds a great deal of complexity when recording the hierarchical relationships in the PartOf Table, and requires accurate documentation explaining each instance of change over time. Though the Chinese Time Series data requires this level of detail, for the purposes of the Japan demonstration, the contemporary records were treated as a single time slice (for the year 1995), and the tokugawa records were treated in the same way (ignoring the fact that the *daimyo data* was dated 1664, and the parent records for *kuni* and *doo* were dated 1828). The following section provides further details about how the historical data was compiled.

2.3 Sources for Tokugawa Japan

Owing to the time constraint of developing the Japan GIS demo (six weeks from start to finish), it was not feasible to attempt to extend the work done previously by Skinner on the Nobi Region to all of Japan. That would have required extensive research into historical maps for the late Meiji period, together with time and funding far beyond the scope of a simple demonstration. Therefore, we looked for a basic map showing the *daimyo* [feudal lordships] of Japan after they had stabilized in the decades following the start of the Tokugawa period. The map chosen, from the student reference book *Nihonshi nempyo chizu*, [12] provided the *daimyo* name, the capital seat name, and a color-code indicating whether the *daimyo* was directly or indirectly affiliated with the Tokugawa Bakfufu. In addition, the *kokudaka* [taxable capacity of rice revenue] figures were listed. This 1664 CE map, though lacking in any source documentation, provided us with rough boundaries and *kanji* names for more than 200 *daimyo*. The *hiragana* and *romaji* readings were entered into the database, and the locations of each capital seat and *daimyo* shape were carefully plotted on a reference map before being joined to the correct boundaries in the GIS layer.

For the *kuni* [province] and *doo* [circuit] boundaries, a basic map (dated to the late 18th century) was found on the Japan Ministry of Land Infrastructure and Transport website. [13] The map image of the "Five Capital Districts and Seven Circuits" was georectified in GIS and boundaries digitized, from which a simple administrative hierarchy was derived. All the historical names were entered into the main table and assigned ID numbers (as explained above), and the administrative hierarchy was constructed in the PartOf Table. This allows us to look up the superior units for our historical divisions in the same way as we did the 1995 districts. For example:

Hyuga no kuni
Saikaidoo
Tokugawa Bakufu

Finally, the *kuni* boundary layer was spatially joined in GIS with the *daimyo* capital points layer. This results in each capital seat record in the *daimyo* layer being stamped with the ID number of the *kuni* jurisdiction where it is located, providing an approximate administrative hierarchy for each of the 200 *daimyo*, as in:

Soumatadatane
Mutsu no kuni
Toosandoo
Tokugawa Bakufu

The resulting hierarchy, however, is problematic for both temporal and spatial reasons. First, as explained above, the *daimyo* are valid for the year 1664, while the superior jursidictions are valid for the year 1828. The Chinese Historical GIS search engine would not allow the disjoint dates between subordinate unit and superior jurisdiction, but for demonstration purposes this constraint has been circumvented in the Japan GIS search engine. Another problem is in spatial overlap. There are numerous cases of the area representing a particular *daimyo* overlapping the jurisdictional boundaries of several *kuni*. Therefore the administrative hierarchy shown for the *daimyo* should be understood as illustrative of the location of the *daimyo*, and not indicative of being spatially contained within the immediately superior jurisdiction.

3.1 Using the Search Engine

In total, the named features in both the contemporary (circa 1995) and the historical (circa 1664 and 1800) datasets numbers about 40,000 records. These records in the Main Table, and their relationships to superior units listed in the PartOf Table have been loaded into a MySQL database on the CHGIS server. By re-using the same search scripts and interface already developed for the CHGIS project, the entire web search engine was available online the very same day that the tables were completed.

The URL for the Japan materials page is: **www.fas.harvard.edu/~chgis/japan**. Using the search engine is quite simple. A placename can be entered in one of three ways: in *romaji* script, in *kanji* characters, or in *hiragana* script. For *kanji* or *hiragana* Unicode UTF-8 is used as the character set encoding, which is compatible with the Global Input Method Editor (built into Microsoft Windows), or the Japanese Language Kit (available for Macintosh).

The query may also include filtering by feature type, year, or dataset. For example, it is possible to search for all feature types = *daimyo*, or all items in the 1995 Census dataset.

The initial search will produce a list of matches, from which the user can proceed to details with one additional click. On the details page the full database attributes, administrative hierarchy, and a simple guide map are provided.

3.2 Downloading the GIS Data

For anyone wishing to obtain the original GIS datasets for the Tokugawa Period that were developed for this demonstration, they are available free for academic use from the website. The name, organization, and email address of those wishing to download is requested in order to obtain the login and password to the downloads area of the website.

With the Japan Historical GIS demonstration, the CHGIS project has attempted to demonstrate the flexibility and reliability of the underlying data model for recording historical instances of geographic features. We hope, in the short term, that the online search engine with be helpful for students, teachers, researchers, catalogers, and the general public. We also hope, in the long run, that a larger project to accurately document the historical geography using GIS will be pursued, and we look forward to assisting that effort in any way we can.

Notes:

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URL: http://grid2.cr.usgs.gov/datasets/datalist.php3

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11. National Imagery and Mapping Agency [NIMA]. GEOnet Names Server.
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