Area Informatics
– Concept and Status –

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Abstract. Area studies are interdisciplinary science of humanities, natural and technological researches. Area informatics is a new information paradigm in area studies to integrate and analyze data from variety disciplines quantitatively and objectively. Spatiotemporal data gives a few quantitative attributes that are relatively easy to be derived from area studies' data. The Humanities GIS research group (H-GIS) is a leading joint research group in Japan to apply spatiotemporal informatics to area studies. This paper sums up current situations on area informatics and introduces the H-GIS outcomes about applying spatiotemporal informatics to area studies.

Keywords: area informatics, area studies, spatiotemporal tools, digital gazetteers, HuMap, HuTime, H-GIS.

1 Introduction

Area studies are interdisciplinary science to investigate and understand particular areas comprehensively. Natural and technological sciences such as meteorology, biology, ecology, forestry, hydrology, pedology, medicine, and disaster prevention are the major disciplines of area studies, and furthermore, humanities such as anthropology, ethnology, folklore, history, politics, linguistics, and sociology also play essential rolls in area studies. Unfortunately, the concept of comprehensive investigation and understanding of area studies is hardly realized.

Humanities generally use qualitative data and process them interpretively and subjectively, but on the other hand, natural and technological studies commonly use quantitative data and process them numerically and objectively. However, a paucity of appropriate frameworks to use and process qualitative data together with quantitative data makes it difficult to organize a huge volume of humanities' resources into databases and to utilize them for visualizing, comparing, calculating, and analyzing objectively and logically. This is a reason of area studies failing in constructing comprehensive images of particular areas.

Informatics is science to analyze and understand everything quantitatively and objectively by introducing distinctive norms and methods, which develops many algorithms and means to quantify and classify qualitative data. Area informatics is a new information paradigm in area studies to make a breakthrough in constructing

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comprehensive images of particular areas. Area informatics rather focuses on humanities' side of area studies: by applying informatics methods, area informatics tries to build frameworks of organizing resources, quantifying qualitative data, integrating them with quantitative data from natural and technological sides of area studies, analyzing whole data sets, and finally constructing comprehensive, objective and reproducible images of particular areas.

However, qualitative data sets of area studies are too diverse to treat everything from the beginning, and this is the reason why area informatics begun focusing on time and space attributes. Spatiotemporal perspectives form a common basis for humanities: time and place are a few quantitative attributes that are familiar to humanities and relatively easy to be derived from humanities' resources, and accordingly a huge amount of knowledge about how to use spatiotemporal attributes explicitly and implicitly has been accumulated in the fields. In the past, quantitative approaches to using spatiotemporal attributes were not popular in humanities, because appropriate methods and tools to describe and process these attributes were not matured. Recently, circumstances have gradually changed due to the dissemination and development of excellent and free software such as GIS (Geographic Information Systems/Sciences) tools, digital maps, digital gazetteers, and metadata that treat spatiotemporal attributes appropriately.

The Humanities GIS Research Group (H-GIS) [1] is a leading interdisciplinary research group in Japan to develop and apply spatiotemporal informatics to humanities. The H-GIS was originally established voluntarily by researchers from a variety of fields including information, engineering, history, literature, geography, health science, and ecology. Later, the H-GIS was reestablished as a research group under the Joint Research Project organized by the Center for Integrated Area Studies (CIAS) [2] Kyoto University, and has focused its efforts on area studies. Dialoguing between humanities and information researchers to make mutual consensus, and studying information engineering technologies such as GIS, GPS (Global Positioning System), RS (Remote Sensing), database, metadata, and ontology and so on, the H-GIS has developed many databases, Resource Sharing Systems to integrate databases on the Internet, spatiotemporal tools called HuMap and HuTime, and some ontology dictionaries about places and dates.

In this paper, current situations of spatiotemporal informatics in area studies will be summed up, and then H-GIS outcomes will be introduced as an example of applying spatiotemporal informatics to area studies. Chapter 2 introduces two information models proposed by the H-GIS and explains the concept and structure of area informatics, chapter 3 explains Resource Sharing Systems, chapter 4 overviews some spatiotemporal tools, and chapter 5 briefly introduces ontology databases. Finally, status of area studies is summarized and future directions especially related to ontology are considered in chapter 6.

2 Information Models for Area Informatics

Following chapters describe some outcomes accomplished by the H-GIS. First, this chapter introduces two information models. One is the schematic model that organizes an overall image of area informatics from data, information and knowledge flows, and the second is the data model that gives the basic concepts of the H-GIS research approaches and tools.

2.1 Research Model of Area Studies

Area studies can be modeled from the viewpoint of data, information and knowledge flow as shown in Figure 1. This picture is developed to organize an overall image of the relationships between research phases of area studies, data/information/knowledge flows, and necessary information technologies and tools [3, 4].

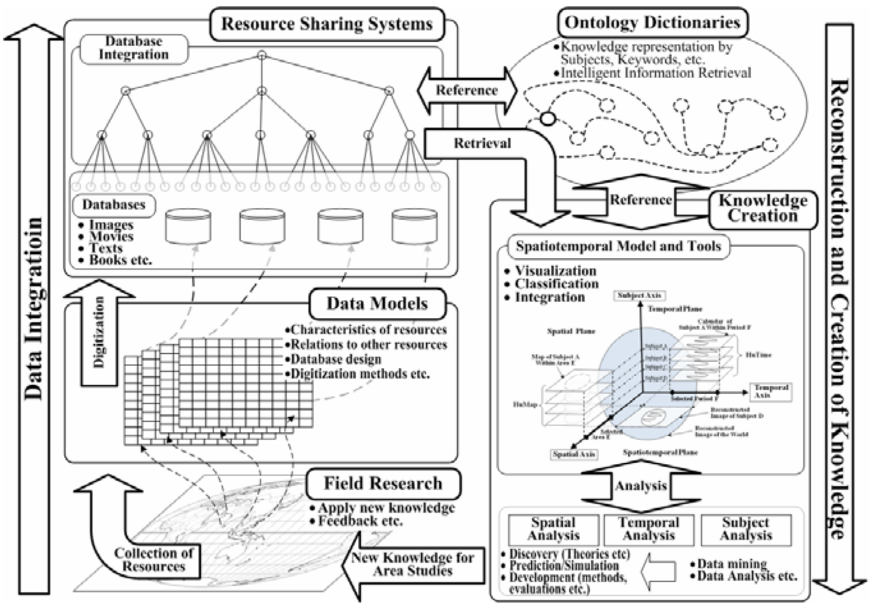


Fig. 1. Schematic Structure Model of Area Studies

Area studies are carried out in "research places" such as research fields, libraries, archives, laboratories and so on. Research resources are collected by observing, measuring, interviewing, reading, searching, and discovering activities. Authoring tools, on-site data entry tools, wireless data terminals are the typical necessary information tools in this phase [5, 6].

Collected resources are organized according to appropriate "data models". That is, resources are digitized and encoded depending on their disciplines (e.g., history, economy, agriculture, ecology, anthropology, and medicine), media (e.g., texts, images, movies, and sounds), data types (e.g., numbers, strings, and symbols), storage media, and collection types (relations with other resources). Digitizing techniques, media technologies, data models, metadata, and encoding methods are the main information topics in this phase. The H-GIS is preparing for several guidelines to digitize and organize resources.

Organized resources are compiled into "databases". Database management systems, information retrieval methods, and user interfaces are the main information technologies in this phase. Databases are the basis of information processing, but in Japan, numbers and sizes of databases especially for humanities are smaller than other countries. The H-GIS has supported database creation to enrich humanities' databases.

Most of the digital resources are distributed over databases. Researchers must know locations of databases for a start, then access databases one by one, and retrieve them by different methods. This is time consuming and tedious jobs. A "Resource Sharing System (RSS)" is a new information system to integrate databases on the Internet and to provide users with a uniform interface to retrieve databases seamlessly in one operation [7, 8]. RSSs are the key technology to integrate digital resources. Structures of RSSs will be explained in Chapter 3.

Each database encodes data by specific language, vocabularies, and terminologies according to the discipline that the database depends on. Since a given word does not always have the same meaning in different disciplines, RSSs alone are not enough to retrieve data across disciplines. Dictionaries that organize words and their meanings in a formalized structure are necessary to solve this problem. Using these dictionaries, computers can automatically relate words according to their meanings (synonym, antonym), hierarchical conceptions (taxonomy) and so on. Ontology is thought to be the key technology in this phase, and RSSs together with "ontology dictionaries" are expected to provide advanced data accessing methods. Some ontology tools developed by the H-GIS will be mentioned in Chapter 5.

"Knowledge Creation" is the final phase of the model. All data are visualized, integrated, classified, compared, and analyzed to discover and/or create new knowledge about particular areas. Spatiotemporal attributes are crucial in this phase, and spatiotemporal information tools, geo-statistics, and data mining techniques are key technologies to process these attributes. New knowledge created in this phase is fed back to the fields, and a new research process will begin. Spatiotemporal tools developed by the H-GIS will be explained in Chapter 4.

All information concepts and technologies indicated here are necessary for area studies, but the following chapters will focus on RSSs, spatiotemporal informatics, and ontology.

2.2 Data Model of Area Studies

When resources are applied to computer processing, their data must be comparable, that is, they must be quantitative values, ordered values or at least symbols clearly distinguishable from others. Typical resources related to area studies are books, magazines, papers, documents, maps etc. These resources have bibliographic attributes such as subjects, creators, titles, contributors that can be used to identify and find resources. Unfortunately, most of the bibliographic attributes are ambiguous and difficult to quantify, but time and place are a few quantitative attributes that are relatively easy to be identified from bibliographic attributes. Moreover, there are also many other resources whose bibliographic attributes are difficult to identify. Nontext materials such as archaeological remains, excavations, and natural phenomena are typical examples. For these resources, times and places (when and where a resource

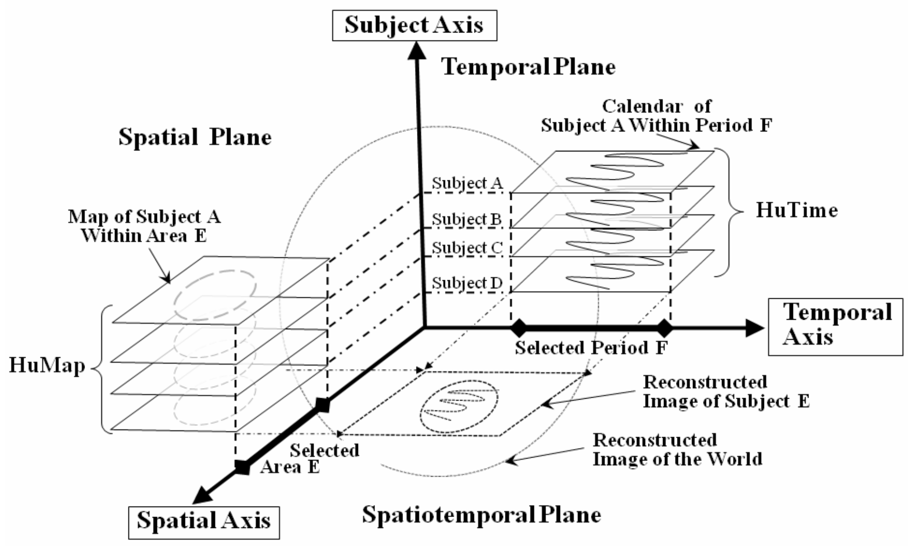


Fig. 2. Data Model of Area Studies

created, used, discovered etc.) might be the only quantitative attributes which can be used to identify and retrieve resources. These are backgrounds why spatiotemporal attributes together with traditional bibliographic attributes are essential in area informatics especially in "Knowledge Creation" phase in the Figure 1.

Figure 2 shows the data model proposed by the H-GIS [9], which is developed to give an overall view of relationships between data types and tools necessary for area studies. In this model, all objects (materials, events, phenomena etc.) are expressed as dots distributed in a 3D space spanned by three axes.

The subject axis groups objects by subjects (i.e., vocabularies/meanings), which corresponds to bibliographic databases. An RSS is the typical database system developed by the H-GIS, which will be explained in Chapter 3. A retrieval operation extracts objects that are distributed within a particular section on the axis (i.e., a particular subject). Zoom-in operation narrows down subjects using narrower vocabularies listed in thesauruses. Zoom-out is the opposite operation. Data mining is to discover some relationships among objects by vocabularies.

The spatial axis arranges objects by place, which corresponds to maps. A mapping operation extracts objects that are distributed within a particular section on the axis (i.e., a particular area). A 2D plane spanned by the subject axis and the spatial axis includes maps about particular subjects and areas (subject maps). These maps correspond to "layers" of GIS tools. HuMap is a GIS tool developed by the H-GIS, which will be explained in Chapter 4. Zoom-in operation enlarges a particular area of a map in great detail. Zoom-out is the opposite operation. Data mining is to find patterns from distributions of objects on a map such as randomness, coherency, periodicity and decrement from the center to periphery, and to find patterns between maps such as coexistence and transition.

The temporal axis arranges objects by time, which corresponds to calendars. A calendaring operation extracts objects that are distributed within a particular section on the axis (i.e., a particular period). A 2D plane spanned by the subject axis and the temporal axis includes calendars about particular subjects and periods (subject calendars). These calendars correspond to "layers" of temporal information tools. HuTime is a temporal information tool developed by the H-GIS, which will be explained in Chapter 4. Zoom-in operation enlarges a particular period of a calendar in great detail. Zoom-out is the opposite operation, showing a broad sweep of history. Data mining is to find patterns from distribution of objects on a calendar such as randomness, coherency, periodicity and decrement from one time point, and to find patterns between calendars such as coexistence and transition.

A 2D plane spanned by the spatial axis and the temporal axis includes spatiotemporal layers; there are no traditional tools (e.g., maps, calendars, GIS tools) corresponding to this plane. Tools that can treat these layers are innovative, which will be discussed in Chapter 6.

3 Resource Sharing Systems and Metadata

Variety types of databases have been created as the result of research activities. These databases must be expected to be the basis of area studies. However, one database cannot always hold all related resources, for example, users must visit many databases to make up the whole map of South East Asia. These users must be disappointed. Since each database is designed and built based on conventions of each institution and/or discipline, even the same materials are organized differently by databases. That is, locations, metadata, languages, vocabularies, terminologies, and retrieval procedures (i.e., specifications) are different from databases, and users have to learn specifications of all databases they want to retrieve data. A "Resource Sharing System (RSS)" is developed to solve these problems by integrating databases on the Internet.

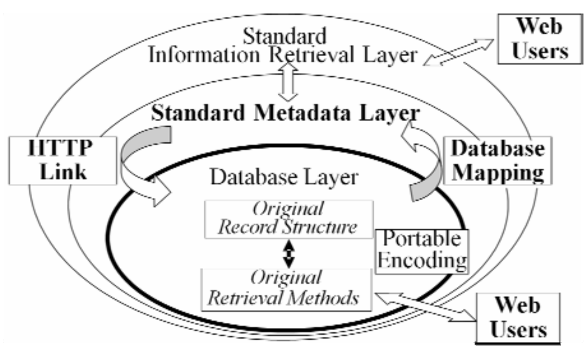


Fig. 3. Resource Sharing Data Model

By the way, a nationwide OPAC system can also integrate all library databases in a country. This integration is achieved by the technique that all databases in an OPAC system must follow the same specification, that is, an OPAC system consists of homogeneous (or same structure) databases. The remarkable innovation of an RSS, different from OPAC systems, is that an RSS can integrate heterogeneous (or different structure) databases on the Internet. This is crucial to area studies, because researchers use and need heterogeneous databases (e.g., libraries, archives, museums). For example, the NIHU RSS [10] seamlessly integrates more than 100 heterogeneous databases that five institutes hold. The CIAS also opens its RSS for area studies [11].

An RSS is modeled as 3-layered structure shown in Figure 3. The first layer is "Database Layer" where original databases are allocated. Databases in this layer are required to encode data by XML. An RRS needs frequent data conversion and exchange processes between databases. Since data structure is different from each database and data definitions are often modified, data conversion process must be easy to follow these differences and modifications uniformly and independently from databases. In addition, since binary data encoding and structures are different from database systems, "data portability" is necessary while exchanging data between database systems. XML has effective data conversion methods (XSLT) and data portability function between heterogeneous information systems.

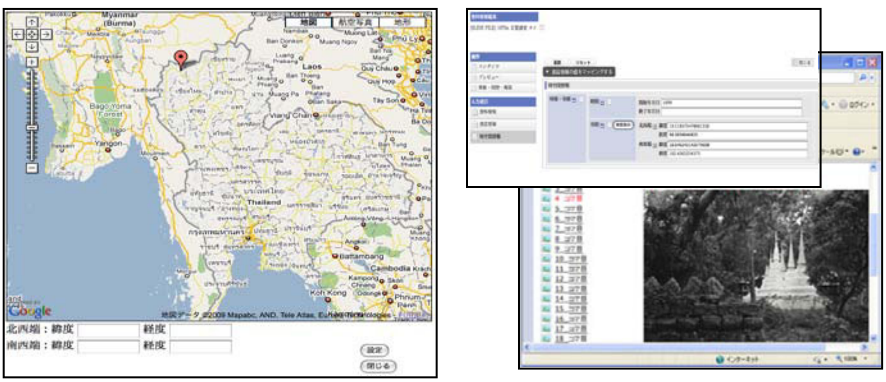
The second layer is "Metadata Layer". Standard metadata is essential to "hub-data" that gives an independent record structure from databases. In an RSS, records of each database are converted into (or mapped onto) the hub-data records, by which all records of databases integrated into an RSS have the same structure. Figuratively speaking, Metadata Layer is an envelope that wraps databases, and users can see all databases in this envelop as one database (i.e., one record structure). Selection or definition of metadata decides the performance of RSSs.

The third layer is "Information Retrieval Layer". Metadata specifications define only record structures. Even if database systems integrated into an RSS adopt the same metadata, retrieval procedures may be different from database systems. Database systems in this layer are required to cope with a standard retrieval procedure. Figuratively speaking, Information Retrieval Layer is also an envelope that wraps database systems, and users can see all database systems within this envelop as one database system (i.e., one record structure and one retrieval procedure).

Spatiotemporal attributes are often difficult to organize as metadata: there are many kinds of spatiotemporal attributes in the world, but most metadata have few elements for them. To solve this problem, some RSSs expand original metadata by adding their own elements. The NIHU RSS is an example. Since the purpose of the NIHU RSS was to integrate heterogeneous databases, a minimum element set was thought to be the best metadata, and NIHU therefore adopted the Dublin Core Metadata Element Set (DCMES) [12] as its base metadata. DCMES is simple and widely used on the Web, but it is too small to describe precise spatiotemporal attributes. To describe a variety of spatiotemporal attributes of humanities' resources, the NIHU RSS adds spatiotemporal elements to expand the original DCMES [13].

On the other hand, the CIAS RSS is designed to organize wide range of resources collected by researchers of area studies. Since these resources are collections of field notes, photographs, maps, and so on, minimum elements' sets are not enough for the purpose. The CIAS RSS needs larger metadata sets [13], and introduces combinations of EAD (Encoded Archival Description) [14], METS (Metadata Encoding & Transmission Standard) [15] and MODS (Metadata Object Description Schema) [16]. MODS is bibliographic metadata to describe information about each material. However, bibliographic attributes are not enough for collections: descriptions about the origins of resources, histories of ownership and the relationships between other resources are important information for collections. EAD is appropriate archival metadata to describe such information. Materials themselves, their bibliographic data, and their collection data must be linked together. METS is introduced to package these metadata, functioning as an envelope to organize related metadata.

A retrieval example of the CIAS RSS is shown in Figure 4. In this example, locations of the contents are indicated by marks on the map. If a mark is selected, its information will be displayed.



(a) (b)

Fig. 4. Retrieval Example of the CIAS Resource Sharing System. (a) is a map view to retrieve records by locations, and (b) is an example of the retrieved record.

4 Spatial and Temporal Tools

Spatial tools and temporal tools are essential to area informatics to integrate, visualize, and analyze data quantitatively and objectively. This chapter explains a HuMap (a spatial tool) and HuTime (a temporal tool) that the H-GIS has developed.

4.1 A Spatial Information Tool (HuMap: Humanities Map)

HuMap is a newly developed free GIS tool that can handle objects on layers spanned by the subject axis and the spatial axis (i.e., subject maps) in Figure 2. HuMap is derived from TimeMap [17]. The innovation of TimeMap is that it can carry out temporal operations, but weakness is that it is rather a viewer than an analysis tool. The latest HuMap is completely different software from TimeMap: it can carry out visualization operation, spatial operations and temporal operations. Functions of HuMap are summarized as follows.

Basic Viewer Functions

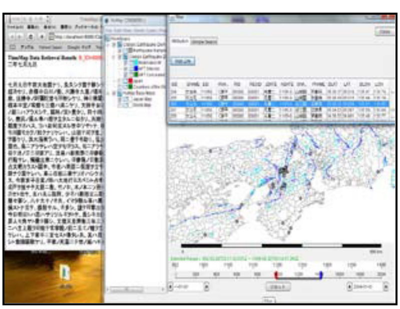
- Arrange/display various data by place and time
- Use maps whose coordinate systems are different simultaneously
- Multi-format: ESRI shape file, CSV, XML metadata, JPEG, JPEG2000 etc.
- Layer selection, change layer order, create new layers, delete layers etc.
- Change symbol/color/size/α-value of an object (feature)
- Zoom-in/out by place and time
- Import/export layer data
- Web-link
- Put and retrieve annotations on layers

Functions as a Spatial Tool

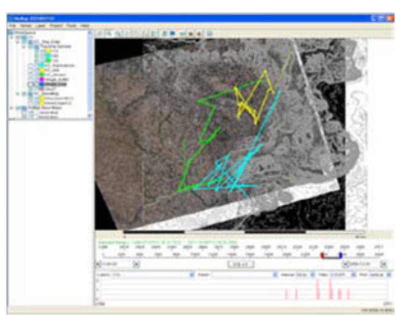
- Link with the data clearing house
- Retrieve objects (features) by place, time, and subject
- Choropleth Map
- Animations/tracking
- Logical operations between layers (Intersection, Union, Merge etc.)
- GIS functions (Dissolve, Buffering, Clipping, Tracking etc.)
- JAVA and R plug-ins for advanced analysis (under construction)

Data visualization is the basic use of HuMap. A typical view of HuMap is shown in Figure 5 (a). Main layers of the view are political-boundaries (polygon features), seismic active-faults (line features), and earthquake-events (point features) that are reconstructed from historical resources about earthquakes. We can see the spatial relationships between active faults and earthquake-events. Spatiotemporal queries are important function of HuMap that is used to select objects within the particular area and period. The upper-right table in the figure shows the result of the query to choose earthquake-events during 1000 AD to 1500 AD in Kyoto area. HuMap also has a Web-link function to link an object and its related information on the Web using URLs. The left side text box in the figure shows the linked document of an earthquake-event in the full-text database.

HuMap can carry out basic logical operations between layers and some spatial operations such as dissolve, buffering, clipping, tracking, etc. Figure 5 (b) is the example of tracking to analyze the movement of objects according to time.



(a)



(b)

Fig. 5. Example Displays of HuMap: (a) is a typical view of HuMap and example of spatiotemporal query, and (b) is an example of tracking analysis

4.2 A Temporal Information Tool (HuTime: Humanities Time)

HuTime is an innovative temporal information tool that can handle events on layers spanned by the subject axis and the temporal axis (i.e., subject calendars) in Figure 2. In the same way as HuMap overlays and visualizes maps and images by referencing positions, HuTime arranges calendars, documents, graphs, and images by referencing time lines. Users can easily grasp temporal relations and/or patterns of events from different calendars by time. Although there are some temporal tools such as SIMILE Timeline [18], these tools primarily focus on data visualization. The strength of HuTime is that it can carry out basic temporal operations. Functions of HuTime are summarized as follows.

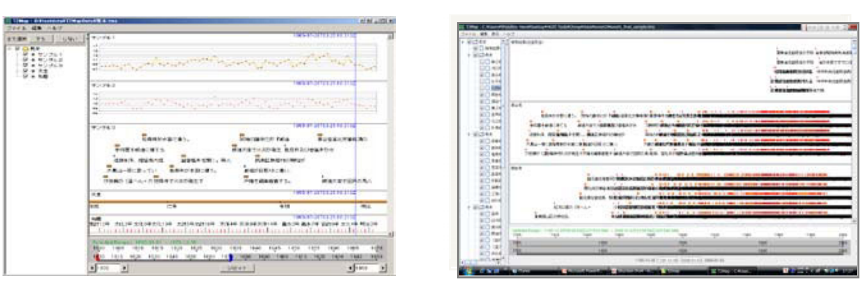
Basic Viewer Functions

- Arrange/display various data by time
- Use calendars whose calendar systems are different simultaneously
- Multi-format: CSV, XML metadata, JPEG, GIF etc.
- Layer selection, change layer order, create new layers, delete layers etc.
- Change symbol/color/size/α-value of an event
- Zoom-in/out by time
- Import/export layer data
- Web-link

Functions as a Temporal Tool

- Link with data clearing house (under construction)
- Retrieve data by time and subjects
- Search/filter functions to select specific events on a layer
- Logical operations between layers
- Analyze periodicity, causal relation etc (under consideration)

Figure 6 shows example displays of HuTime. A typical view of HuTime is shown in (a). This view consists of a wind velocities layer (dots graph), a precipitation layer (dots graph), articles about natural disasters layer (document) and a Japanese calendar layer. We can see the relationships between winds, rainfalls and disasters. Temporal queries are the basic function of HuTime to extract objects occurred within a designated period and/or matched with specific conditions (b).



(a) (b)

Fig. 6. Example Displays of HuTime: (a) is a typical view of HuTime, (b) is an example view of a temporal query

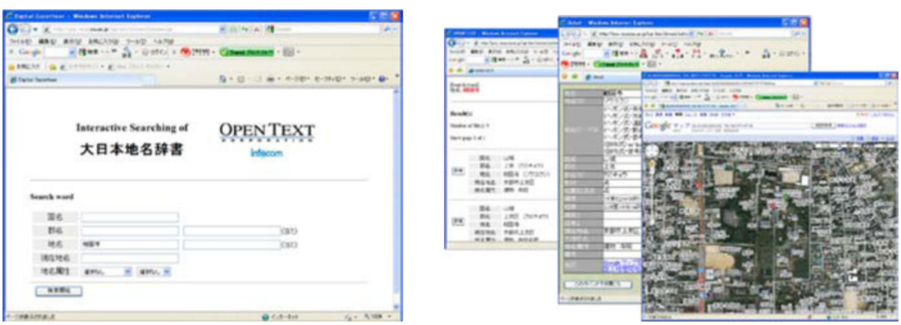
5 Ontology Databases

Two databases, the "Japanese Historical Gazetteer" and the "Calendar Database", have been developed by the H-GIS to support spatiotemporal data organization for databases and to add advanced data retrieval functions to RSSs. Strictly speaking, they are, at present, "thesauri" rather than ontology dictionaries.

5.1 Japanese Historical Gazetteer

The "Japanese Historical Gazetteer" [19] is a simple thesaurus. Entry words of the thesaurus are historical place names in Japan collected from "Dainihon Chimei Jisho (Dictionary of Place Names in Greater Japan compiled by Togo Yoshida)", "Engishi Jinmyocho (Procedures of the Engi Era)", "Nihon Jiin Sokan (Directory of Japanese Temples)", "Jinsoku-zu (Quick Mastery Maps: Kanto Region)", and "Kasei-zu (Temporary Maps: Kinki Region)". At present, about 150,000 place names are registered in the Gazetteer. This is the largest free academic gazetteer database in Japan. Each entry word includes its present place name, attributes (pronunciation of the place name, types of the place, broader and narrower place names and so on), and geographic coordinates (longitude and latitude).

This gazetteer will be used to identify correct place names, to convert a place name into a pair of coordinates, to visualize spatial relationships between places, to analyze spatial patterns of particular place names and so on. Figure 7 shows example displays of the Gazetteer (searching for the Shokoku-ji Temple).



(a) (b)

Fig. 7. Example Displays of Japanese Historical Gazetteer: (a) is a search window, and (b) shows its retrieval displays

5.2 Calendar Database

The "Calendar Database" is a simple table to organize all dates (Japanese dates, Chinese dates, Gregorian dates and so on) according to Julian dates. It is used to convert a date from one calendar to another.

6 Discussions and Considerations

The motivation of the H-GIS was to apply spatiotemporal informatics to humanities (especially of area studies) for facilitation of data usage and data integration with natural and technological studies. The H-GIS has made progresses in collaboration with some international projects such as ECAI (The Electronic Cultural Atlas Initiative) and PNC (The Pacific Neighborhood Consortium). ECAI, based at University of California, is a global consortium of people who share the vision of creating a distributed virtual library of cultural information with a time and place interface [20]. The H-GIS and ECAI keep in exchanging technologies and knowledge about spatiotemporal informatics. PNC, mainly supported by Academia Sinica, explores issues of interdisciplinary collaboration, and the development of the cultural knowledge contents [21]. The focus of PNC is not exactly on spatiotemporal informatics, but many members engage in digitization of materials, programming spatiotemporal tools and so on for humanities' contents. The H-GIS also keeps in communicating with PNC about spatiotemporal issues. Spatiotemporal informatics in the humanities is gradually becoming recognized as an important paradigm in Japan. Some academic societies such as "IPSJ SIG Computers and the Humanities" and "Branch of Historical Geography, The Human Geographical Society of Japan", for example, are interested in spatiotemporal informatics. The H-GIS keeps relationships with these societies.

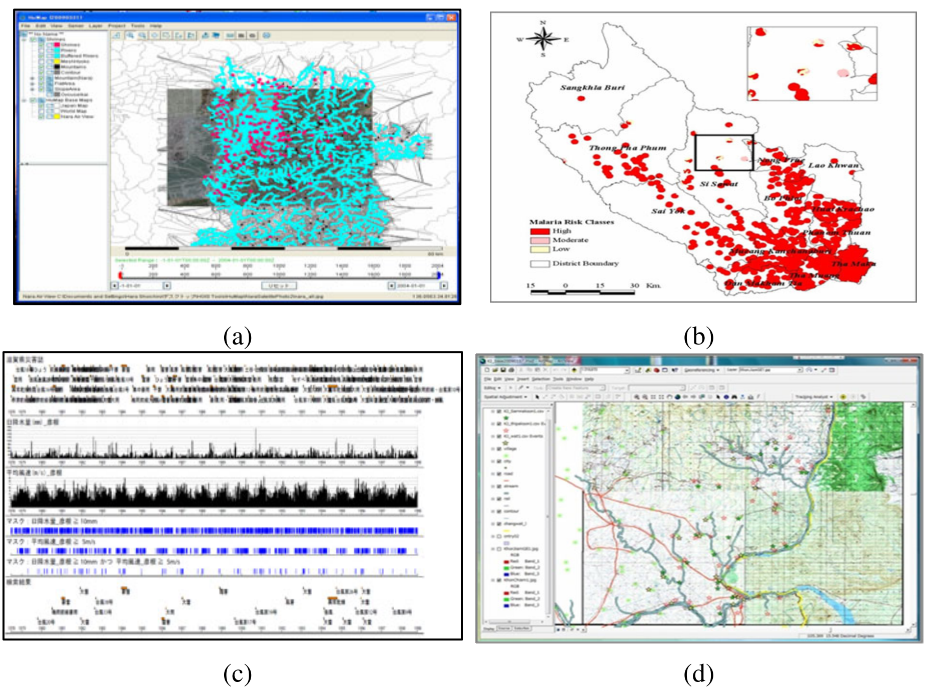


Fig. 8. Research Examples using HuMap and HuTime: (a) is a landscape analysis, (b) is a Malaria risk analysis, (c) is a temporal analysis about weather and disasters, (d) is a spatiotemporal analysis about Thai monks' movement

The H-GIS has at last developed HuMap, HuTime, the Japanese Historical Gazetteer Database and the Calendar Database. These tools are in a trial phase, and they are used by researches. Figure 8 shows some research examples using HuMap and HuTime. The example (a) is a landscape analysis of sacred places around ancient Shinto-shrines. The example (b) is a Malaria risk analysis in Thailand, which is a typical GIS application to health and medical care. The example (c) is a temporal analysis using weather data (Figure 6 (a)) to find relationship between heavy rainfall, strong wind, and disastrous events. The example (d) is a spatiotemporal analysis to find backgrounds that explain pilgrimages of monks in Thailand. These research trials gradually attract interesting of area studies' researchers. On the other hand, the H-GIS gets feedbacks from researchers to modify and expand functions of the tools.

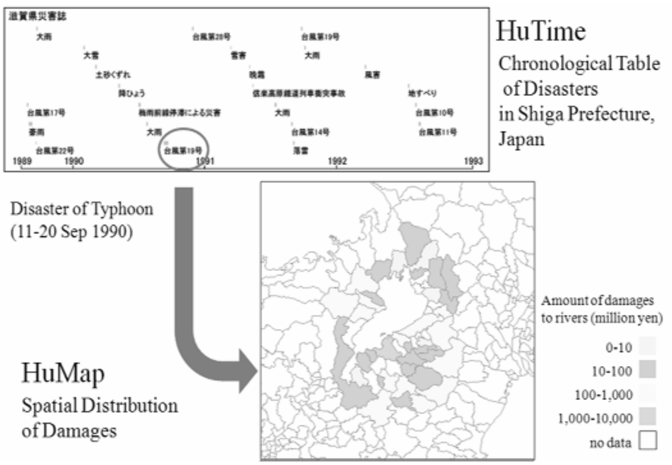


Fig. 9. A Simulation of Spatiotemporal Analysis by Switching HuMap and HuTime

HuMap has rich spatial functions but limited temporal functions, while HuTime has no spatial functions but rich temporal functions. The H-GIS is trying to combine these two tools to create a revolutionary tool that can handle objects on the planes spanned by the spatial axis and the temporal axis in Figure 2. A map is a "piece" of the world we see from a narrow window of particular subject and area, and a calendar is also a "piece" of the world viewed from a narrow window of particular subject and period. Area studies (and sciences) can be said the processes of reconstructing the world image from these pieces. A layer in spatiotemporal plane is an image reconstructed from a pair of map and calendar. Analogically speaking, just as a 3D human body image can be reconstructed from many pieces of CT images, the world image can be reconstructed from variety pieces of maps and calendars.

If such a tool is realized, users will be able to analyze objects from spatial and temporal perspectives simultaneously. However, since maps and calendars have different layout structures and four dimensions are at least necessary to display them simultaneously, it is difficult to design such viewers. One solution may be to switch HuMap and HuTime properly according to users' perspectives. Figure 9 shows a simulation that visualizes relationships between temporal climates patters and spatial disasters patterns by switching HuMap and HuTime. Figure 10 shows the schematic specification of a spatiotemporal tool. Internal data structures of HuMap and HuTime are not identical due to different development backgrounds, which make data exchange between two tools difficult. To solve this problem, a mutual metadata is defined. Just like a pipeline, data are exchanged via this metadata. This switching function will be realized within this year. These flexible developments are possible because all tools are programmed and owned by the H-GIS. This is the reason why the H-GIS has developed all systems and tool by itself.

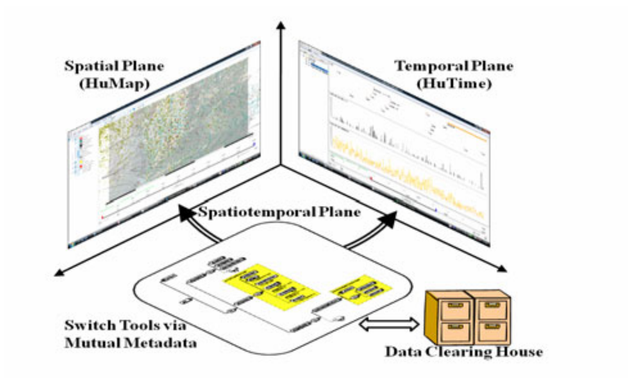


Fig. 10. Schematic Specification of a Spatiotemporal Tool

Accumulations of data whose semantics and spatiotemporal attributes are well organized are essential in order to fully use spatiotemporal tools. An RSS is a solution to this problem, and several systems are in operation. Two challenges now remain to be faced. One is to introduce ontology technology. Since area studies are collection of many disciplines, a given word in a discipline not always has the same meaning in the other discipline. Vocabularies should be organized by meaning so that computers can process them, allowing information retrieval from a wide range of databases.

The second challenge is to expand and refine the spatiotemporal attributes of metadata. The NIHU RSS uses DCMES. DCMES is simple but does not allow precise description of spatiotemporal information. The NIHU RSS expands DCMES to describe spatiotemporal information precisely. However, this makes the metadata different from that of standard DCMES and difficult to link with other RSSs. The CIAS RSS uses a combination of MODS, EAD and METS. These metadata are good enough to describe precise information. However, there are several ways to describe the same piece of information, which decreases retrieve abilities between other RSSs.

Spatiotemporal informatics in area studies has almost accomplished its initial step. To make next progresses, the H-GIS is trying to set up interdisciplinary research projects to collect, organize, analyze and integrate a variety of data sets using RSSs and spatiotemporal tools. Evaluations, requests and opinions are being fed back from researchers, which will be the hints for further developments. Concurrently, the H-GIS is preparing for compiling thesauri of several disciplines related to area studies, which will be used for intelligent data processing.

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