Current Status of Building a Spatial & Temporal Infrastructure for Interdisciplinary Studies at Academia Sinica, Taiwan

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Introduction

• Personal Experiences
• Why Mapping the History, and How?
• The Last Buyer of GIS: Literature Critic?
• Evolution of (Geospatial) Information Technology
• AS GIS Roadmap for Chinese Study in Space and Time
Personal Experiences

- From Hand-Drawing Maps to Virtual Worlds
- CITAS Project in '90s
Why Mapping the History, and How?

Space, Time and Events are essentials of Human Recognition

- Collecting any information about the past, and reflecting status of topography, administrative division, social-economic status, demography, and climate etc. at old time.
- Understanding and Simulating the change through time: "Read Time in Space", "Historical Space & Fictional Space“
- Global Change: Why is that today?
- Serving as an infrastructure to integrate contents and computing systems
- Analyzing large volume of variant data thematically or correlatively, spatially and temporally
- Visualizing information in temporal maps to convey complex information intuitively
- Toward a Knowledge Base of China
The Last Buyer of GIS: Literature Critic?
Evolution of (Geospatial) Information Technology

- IT Changes all the time, e.g., Mac in 10 years ago
- New Device and Technology
- Utilization of Geospatial Information Technology
- Integration of GIS, GPS, and Remote Sensing
AS GIS Roadmap for Chinese Studies in Time and Space (CSITS)

- Digitize Historical Atlas of China (HAC, turned into eHAC) and extend to be the basis of Chinese Studies in Time and Space (CSITS).
- Incorporate and collect more other geospatial materials, including contemporary and historical, to enrich both spatial and temporal base of CSITS.
- Enhance the fully spatial coverage contents by compilation more variant thematic information.
- Deploying more efficient and scalable system architecture and information management and retrieval mechanism.
- Devise a thin, friendly, but powerful client environment - Web GIS
From HAC to eHAC to CSITS

- The Historical Atlas of China (HAC)
- Contemporary Map of China
- Digital Mapping of HAC
- Data Capture and Cleaning
- Data Modelling
- Issues
The Historical Atlas of China (HAC)

- The Atlas is composed of 8 volumes with 21 map groups that hold 307 maps, and covers more than 2,000 years of Chinese history temporally.
- **Summary of the Atlas in Time**
Contemporary Map of China

1. The Shan Pao Map (1930s)

2. The Digital Map Database of China (1:1,000,000) consists of an overview and a map library containing the 1:1,000,000-scale data. The overview provides general aspects of the entire country, including Chinese provinces and major points of interest, and an index of the map library. The map library covers administrative boundaries down to the county level, populated places such as cities and towns, hydrography, hypsography, transportation, land cover, culture, and other natural features. (excerpted from ESRI Website)

The ArcChina
Digital Mapping of HAC

• **The Process and work flow**
  – Clean and Digitization
  – Rectification
  – Vectorization
  – Overlay Analysis
  – Verification
  – Digital Mapping Proofing

*The Lab has spent more than 8 man-years for the above workflows till now.*

• Data Capture and Cleaning
• Data Modelling
• Issues
## Data Capture and Cleaning

![Image of a table with data](image_url)

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### Data Capture and Cleaning

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Data Modelling

- Content Analysis
- Information Categorization
- Information Coding
- Data Schema Design (ref. Adm. Hierarchy)
Issues

• Evolution of Administrative Hierarchies in Chinese History
  ✓ Administrative Levels in HAC and also the full set of historical administrative hierarchies of China have been analyzed.
  ✓ Concluded with 10 basic classes of change modes, and 38 types of instances: Examples.
  ✓ As the basic criteria for modeling the changes over time.

• Quality Control
  ✓ Workflow for Information Lifecycle
  ✓ Accuracy, Completeness, Consistency, and Uncertainty
  ✓ Measurement and Metrics
  ✓ Verification and Proof

• Management of Geospatial Contents

• Inconsistency Check and Solution
  ✓ Inconsistency of Place Locations between maps of the same/different time
  ✓ Inconsistency of Boundaries between maps of the same time
  ✓ Inconsistency of administrative level for points
  ✓ Inconsistency between simplified and traditional Chinese for labels and names: Table1, Table2
The Spatial and Temporal Infrastructure of CSITS

• Content Space
• The Spatial and Temporal Base
• Building a working platform for researchers from various fields
• System Integrations
Content Space

Events

Temporal

Spatial

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The Spatial and Temporal Base

- Weaved by Historical and Contemporary Atlas and Images
- HAC acts as the major historical base maps
- ArcChina acts as the contemporary base map
- More than 100,000 maps in various time to fill the gaps, including the Shen Bao Map
- More than 2,000,000 remotely sensed images for enhancing factual proofs
Building a Working Platform for Researchers of various fields

- Integrating the Computer Servers, Software Tools, and Metadata-based Geospatial Data
- Management Systems as the Infrastructure.
- Enrich and Collect more Geospatial Materials (paper maps, aerial photos, and satellite images, etc.) continuously
- Developing Core Technologies
### Infrastructure in terms of Contents

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注1:年代資料參照“中國歷代行政區域圖”書中各朝代年代
注2:為估算數，平均每個朝代有707可對照地名數，由秦至清有16個朝代
707 * 16 = 11,312
注3:參照“中國歷代人名大辭典”資料中有生年或沒年不可考，無法確定該庫頑活分布年代
System Integration

- **Scripta Sinica**
- **Union Catalog of Local Gazetteers**
- **Gazetteer of Taiwan**: Fig1, Fig2, Fig3
- **Grain Price & Population Database in Qing Dynasty**
- **Archaeological Records in Shinjiang** (from Pre-history to Qing Dynasty) and Taiwan
- **Database of Tombs** in Han Dynasty
- **Changes of Riverway**: The Yellow River(1), (2)
- **Historical GIS of Taiwan**: Fig
- **Legacy Aerial Photos of Taiwan**
- **Other basic spatial material**: hydrographic data, satellite images, etc.

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Applications

- Trade Routes of Ming and Qing Dynasties
- Urbanization of Kiangnan in Ming and Qing
- Correlated Analysis of Grain Price & Population in Qing Dynasty
- The Dispersal of Formosan Aborigines in Taiwan
- Database of Archaeological Site Investigation in Taiwan (Fig)
- Beacon Towers in Han Dynasty
- Gazetteer of Taiwan (Fig)
- Taiwan Earthquake Information Network (Intro)
- Integration with Union Catalogs of Local Gazetteer/History
Applications

Case 1: Trade Routes of Ming and Qing Dynasties
Applications

Case 2: Urbanization of Kiangnan in Ming and Qing
Applications

Case 3: Correlated Analysis of Grain Price & Population in Qing Dynasty
Service Models

- WebGIS-based tools and application systems
- Collaboration: Collaboration in Project, thru Web or anyway
- Consulting: Consulting and Value-added by Geospatial Information Processing
- Application Services:
  - Application of Geospatial Information Technologies
  - Packaged System Services: Digital Maps, Location-based services, GPS data rectification
  - Geospatial Visualization Support
- Training
WebGIS in Usage Model

1. Navigation (Browse and Query)
WebGIS in Usage Model

2. Web Mapping
The Vision

• An *Open Lab* for studying Chinese Civilization (and nature)
• Distributed Geolibrary
• Cross Cultural, lingual, and format Information System integration (loosely/tightly)
• Clearinghouse/Portal for Contents of Chinese Civilization
• Digital Earth
• *Virtual Center of Sinological Studies* (Knowledge Base of China Studies, Geolibrary implementation)