Methods for Space-Time Analysis:
Examples From the China Historical GIS

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Harvard Yenching Institute

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Data Models for History in GIS

__ History for historians or data managers?
__ Arc/INFO Coverage model or Geodatabase?
__ Transactional model or Versioning?
__ ESRI White Paper: “Modeling and Using History”
Chinese History: Why GIS?

- Historical continuity of records and county seats
- County gazeteers and memorials as data sources
- Position of counties in administrative hierarchy
The Chinese Historical GIS Project

Main project goals
- Create a database of historical administrative geography
- Provide a common framework for georeferencing historical materials
- Offer a GIS platform for spatio-temporal analysis

Other historical GIS projects:
- Great Britain Historical GIS
- US National Historical GIS
- TimeMap (University of Sydney)
- Electronic Cultural Atlas Initiative
Today's Topic: Data Models

Three components
- Textual notes
- Digital map
- Data Tables
  - Historical Instance Table

One “Historical Instance” has
- One place name
- One administrative status
- One spatial object
Name Change Makes Two Historical Instances

Time = 1

Spatial Object = Poly 524

Name = Pingding

Time of Name Change

Name = Luqiao

Time = 2
More Changes Make More Instances

- Spatial Data = Polygon 524

- Name = Pingding
- Name = Luqiao
- Name = Pingding
- Name = Baoding

- Unit = Fu
- Unit = Xian

Spatial data changes
Name changes
Administrative status change
Attributes Unchanged Through Each Instance

<table>
<thead>
<tr>
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<th>Polygon</th>
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Administrative Hierarchy

province

prefectures

counties

towns

begin year - 1200
### Historical Instances Table

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Suzhou from 1367 to 1990

### Historical Source Notes

Source Note: Suzhou Fu (1375-1723)原筑
明洪武十八年（1385年），扬州府常熟县来属，府境扩大。清顺治二年（1645年）入清，属江南省。康熙六十年（1671年）为江苏省会。清康熙二年（1724年），太仓州升为直隶州，府域缩小。

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### Spatial Objects (Regions)

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Source Note: 苏州府（1375-1723年）界线
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</table>
Suzhou from 1367 to 1990

Spatial Objects (Regions)

1367

1375

1724

1990
Generating Slices in Time

_ “Atomic Polygons” with Regions for each historical instance

_ Select Instances for a specific date
  Resel HistInst.dat start <= 1644 and ~
  end >= 1644
  Resel cov region.fu keyfile HistInst.dat ~
  info fu# keyitem sys-id

_ Select Arcs associated with Regions
  Resel cov.PALfu info keyfile cov region.fu ~
  unit keyitem fu#
  Resel cov arc keyfile cov.PALfu info fu# ~
  keyitem arc

_ Assign boundary symbols by comparing neighbors' parents
  Resel cov arc PALright//PartOfTable//part-of ~
  <> PALleft//PartOfTable//part-of
  Calc cov arc slice1644//btype = ~
  slice1644//btype + 1
  Arclines cov slice1644//btype ~
  boundarysymbols.alut
The Modifiable Areal Unit Problem (MAUP)

- Comparing areal units of different sizes in space
  - Aggregation effects
  - Scale effects
- MAUP compounded as units change through time
- Smallest Common Unit approach

Chongming not in Suzhou

Chongming in Suzhou Fu
REGIONXAREA to Identify Smallest Common Units

- XAREA table gives area and percentage of overlap between pairs of regions
- If overlap is not 100%, iteratively merge other regions that overlap
- Calculate statistics for Smallest Common Unit
The MAUP and Analytical Mergers

Cities merged with surrounding counties

Smallest common units across time
Analytical Mergers: Shanghai
The Spatial Approach to Chinese History
Space-time analysis of junior middle schooling, FEMALES only:
data by year of birth, 1922-1975
(and reference year, 15 years later, 1937-1990)
and by HRS zone, Lower Yangzi macroregion
Methods for Space-Time Analysis: Examples From the China Historical GIS

www.fas.harvard.edu/~chgis

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