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"Geospatial Information for a Smarter Life and Environmental Resilience"
Positional accuracy improvement for heterogeneous geodata integration

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What I am going to say

• Role of Integration Heterogeneous Geodata in using Map Legacy in Vietnam
• PAI Workflow For Cadastral Data using Rubbersheeting Transformation
• Test Results PAI Cadastral Maps according National Geographical Database
1. Integration Heterogeneous Geodata

- Unresolved problem in all countries: Integration of multi-origin data, different in spatial reference system, established method, time and precisions
- GIS databases: built with layer-to-layer integration, overlapping thematic data layers mechanically
- Unsolved spatial conflict = Difficulty in Use map legacy for computer aided spatial analysis
- Use of map and geodata legacy requires improved positional accuracy according to high-precision reference topodata
Somewhere in the world ...

- Pioneers: Ordnance Survey, Bureau of Census, Swisstopo
- US Census Bureau: improved TIGER database from 150m error to reach RMSE 3.8m after PAI.
- UK Ordnance Survey: improved RMSE of LandLine and OSMaster Map 2.8m to 1.1m in rural areas and 0.4 m in urban areas using GPS results
Spatial integration problem in Vietnam

• National Geographical Database 2011: High accuracy (1: 2000 - 1:10 000) reference data, provided by Ministry of Natural Resources and Environment

• Heritage thematic data:
  - Geology, hydrography, soil, landcover, forest cadastral … based on old, low accuracy topographic maps 1: 5 000 -1: 100 000
  - Old, low accuracy cadastral maps 1: 200 -1: 10 000 were basis for public transport maps, underground, urban and rural planning …. 
Case of cadastral data

• Main part: between 1999 and 2009 according to different regulations (1999 and 2008)
• Basic cadastral map of 1: 10 000 for forest land. Regular maps-1: 200 to 1: 5 000
• In the past: Used as a basis for large scale thematic maps: public transport maps, underground works, urban planning, landuse and agriculture planning
Cadastral vs. Topographic

- Cadastral maps:
  RMSE 0.6mm for parcel points and 0.9mm for other objects
  Controlled by local authority
  Inconsistencies in positional accuracy
- Topographic: RMSE 0.5-0.7mm

Integration is inevitable!
2. PAI Workflow For Cadastral Map Legacy

Rubbersheeting: a set of local transformations based on the Delaunay Triangle Network. Within each triangle, the difference in coordinates $\delta X_i, \delta Y_i$ is interpolated by one of the common transformation algorithms, such as the Helmert or Affine, based on the difference in coordinates $\delta X, \delta Y$ of the linked points between the source and destination data.
Workflow

Cadastral and Land Database

Forest cadastral maps
Regular cadastral maps

National Geographic Database

1. Material and data evaluation

2. Selection of linked objects

3. Link creation

4. Improvement

5. Evaluation
3. Test

- Data: 1: 10,000 cadastral map established in 2004 and national geographic database of 1: 10 000 (2012) Thai Nguyen province
- Tool: ArcGIS 10.2 Conflation Toolkit with the Generate RubberSheet Links and Rubbersheet Features tools.
- Link features: Roads, rivers, boundaries and elevation points
- Search radius: 10m (1mm at map scale)
Results

• Maximum parcel area change : $4 \times 10^{-6} \text{ m}^2$
• Maximum length of the parcel edges change: $5 \times 10^{-9} \text{ m}$
• Maximum point shift : 15m
• Topology relation: unchanged
• Attribute data: unchanged
Before and after PAI

Overlay of land parcels at 200% magnification
CONCLUSION

• Improvement geodata accuracy based on data with higher accuracy is a key to solving the problem of integrating multi-source data and enabling the use of map legacy.

• Proposed PAI workflow of cadastral data can be applied when the it has a lower positional accuracy than national geographic data.
Thank for Your Attention