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10:18-10:36

Multi-temporal analysis of land use transition considering lifetime

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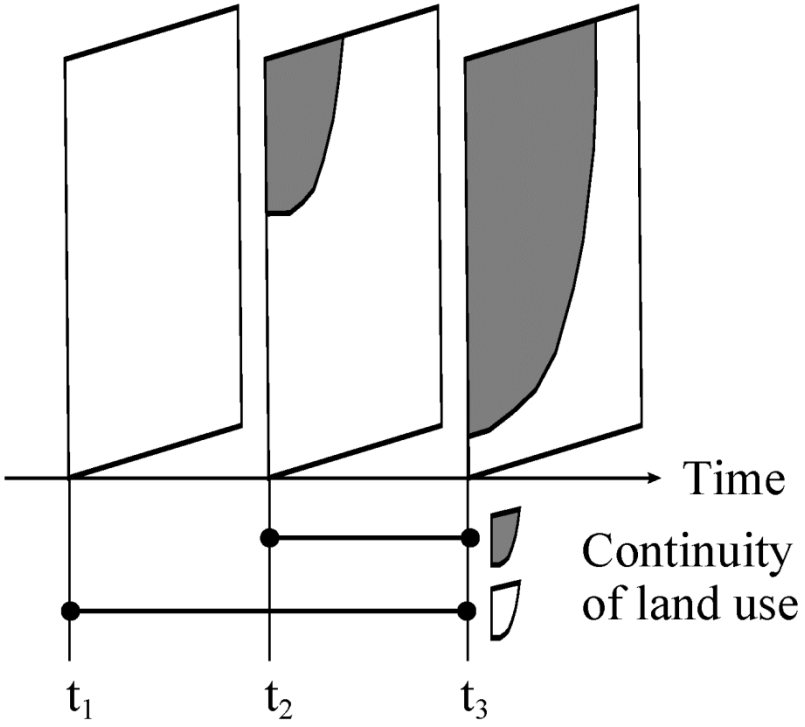
IGC IGU 2012 @Colonge

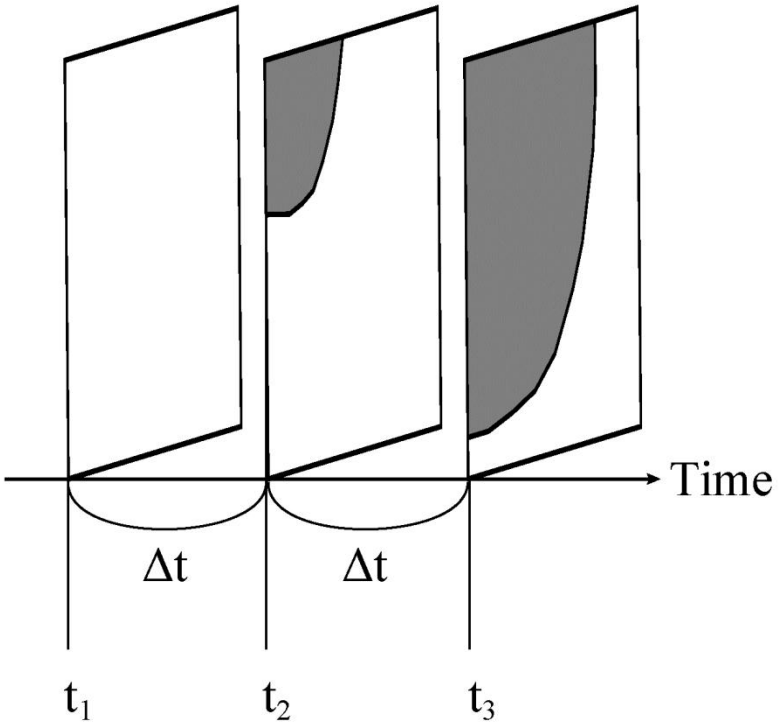
Outline

- 1. Introduction
- 2. Objective
- 3. Methodology
- 4. Results & Summary
- 5. Conclusions

1. Introduction:
Concept of multi-temporal analysis



Multi-temporal analysis



Bi-temporal analysis

>>Missing temporal continuity of land use

1. Introduction: Limited availability of LU dataset with high temporal resolution

- LU dataset are up-dated every 5 years in 5 time steps
  - Up-dating LU dataset requests large expense
  - Incorrespondence of methodology

- LU dataset with high temporal resolution is limited to analyze temporal continuity of LU

  >>The lack of understanding of temporal aspect of land use transition

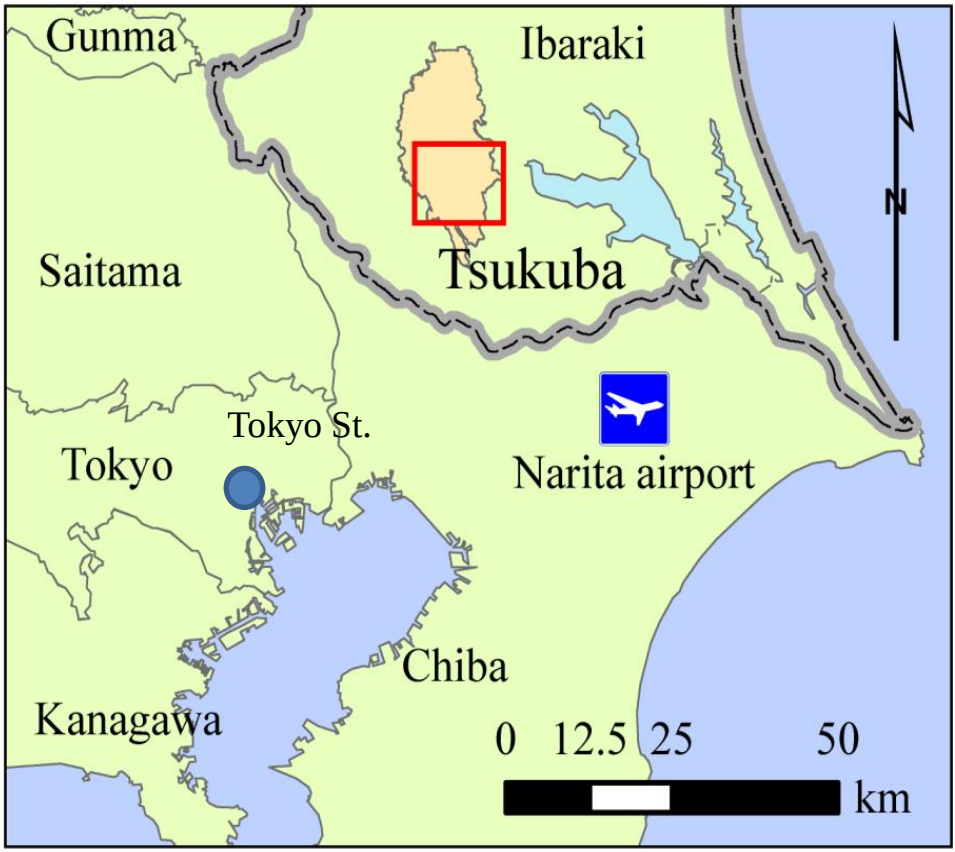
2. Objective

- This study aims **to understand temporal and spatial aspects of land use transition process** through multi-temporal analysis of land use transition

3. Methodology: Study area & Data used

- Center part of Tsukuba City, Ibaraki Prefecture which is located at the north-east of Tokyo

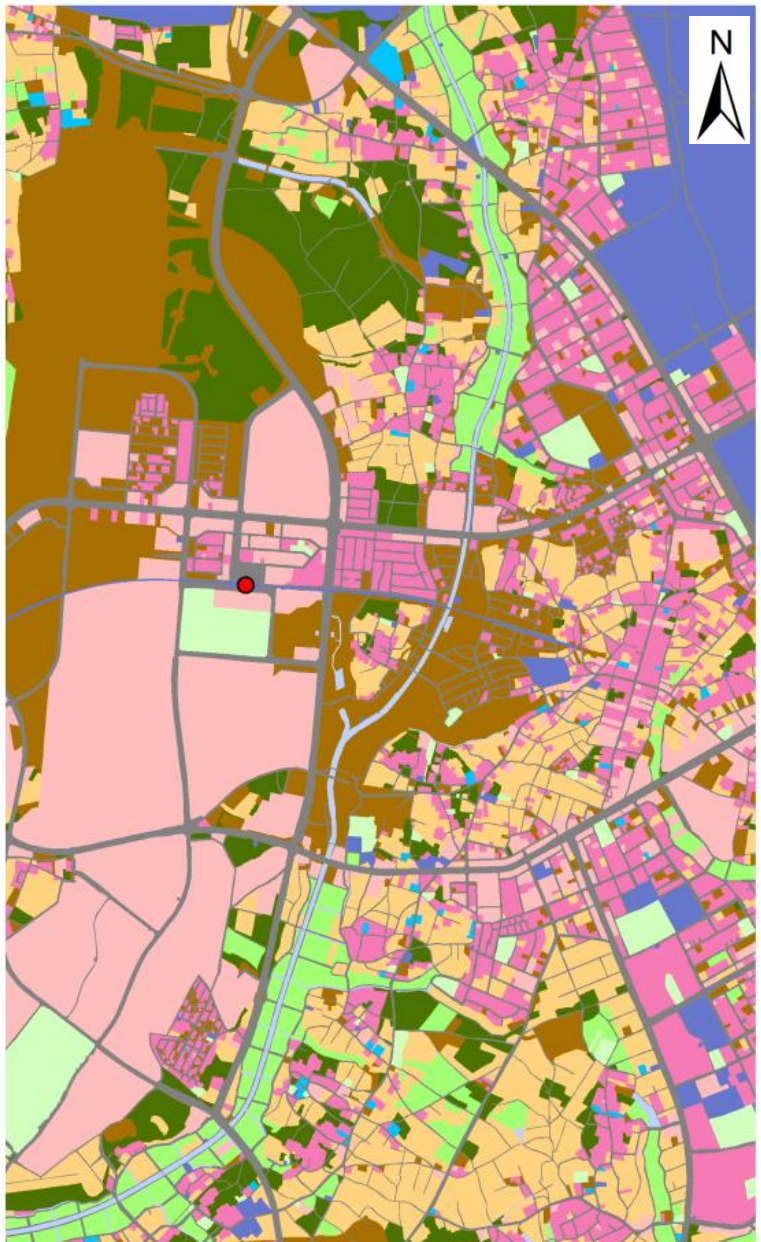
- New rail way which connects Tsukuba to Akihabara has been opened since 2005



(a) Location of Tsukuba City

3. Methodology: Study area & Data used

- Study area includes build-up area (east side) and newly developed area (north-west side).



Land use

- Forest & wasted land
- Paddy field
- Farm land
- Improving & vacant area
- Industrial area
- Residential area
- Commercial land
- Road
- Park & open space
- Public institution
- Water body
- Kenkyu-gakuse St.

0 0.25 0.5 1 km

3. Methodology: Study area & Data used

- 11 time steps
- Total: 3565 days

Time-step	date	[days]
t01	25 Feb 2000	
t02	26 Dec 2000	305
t03	16 Nov 2001	325
t04	26 May 2002	191
t05	20 Sep 2002	117
t06	10 Dec 2003	446
t07	4 Nov 2004	330
t08	8 Nov 2005	369
t09	11 Jan 2008	794
t10	7 Apr 2009	452
t11	29 Nov 2009	236

I would like to thank Dr. Mamoru KOARAI (the **G**eo**S**patial **I**nformation Authority of Japan) for providing the opportunity to analyze the LU dataset with high temporal resolution.

3. Methodology

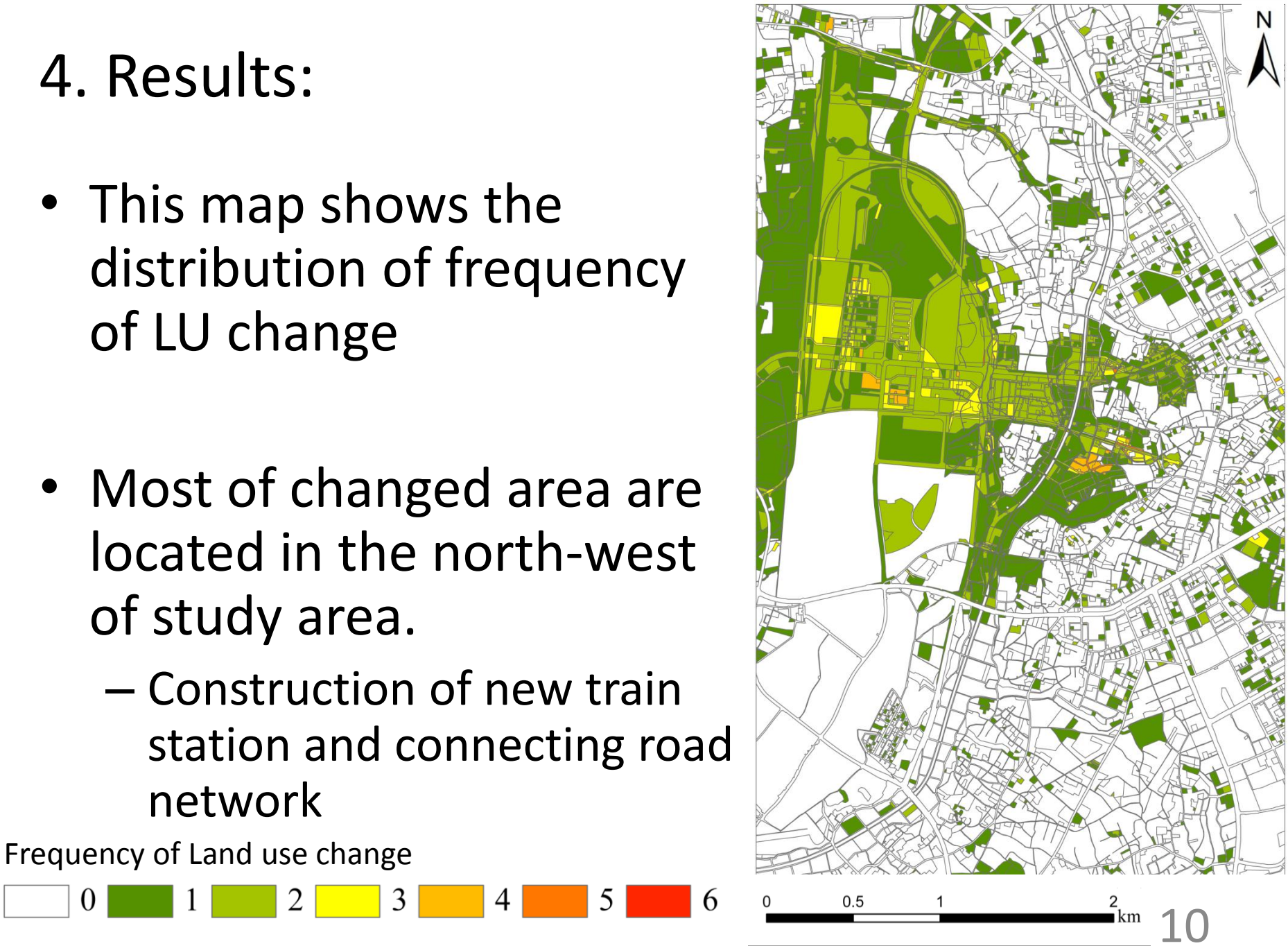
- 1. Analyze adjacency of land use changed area
- 2. Execute survival analysis for lifetime of LU

  - Survival analysis is often used in the field of “medical science” and “reliability engineering” to estimate lifetime of patient and product
  - def. Lifetime: period with arbitrary state (e.g. land use type)

4. Results:

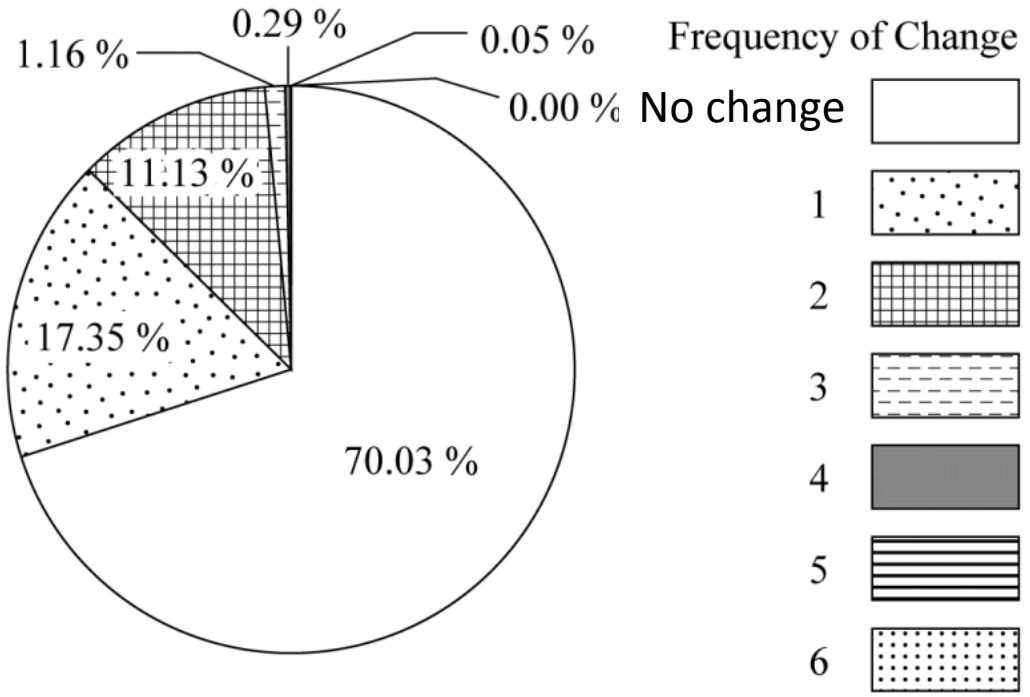
- This map shows the distribution of frequency of LU change

- Most of changed area are located in the north-west of study area.
  - Construction of new train station and connecting road network

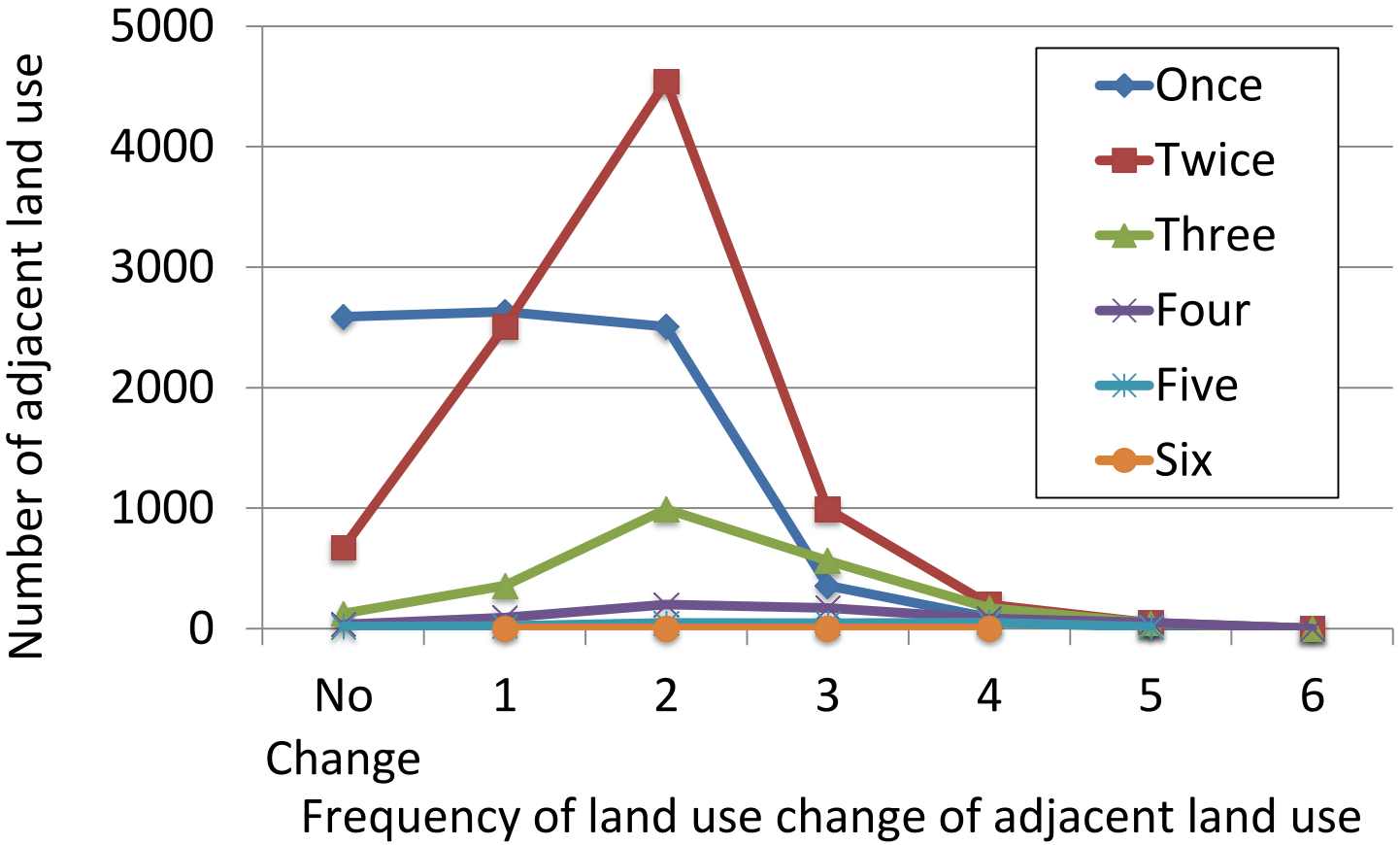


4. Results:
Areal ratio by frequency of land use change

- LU changed area is appr. 30 % of whole area
- Almost all the land use changed area have experienced once or twice of land use change



4. Results: Number of adjacent land use in frequency of land use change



If the frequency of land use changed is once, the adjacent land use shows no change or Once to Twice changes of land use. While, if the frequency of changes are more than twice, the adjacent land use has experienced land use change at least once.

4. Results: Summary

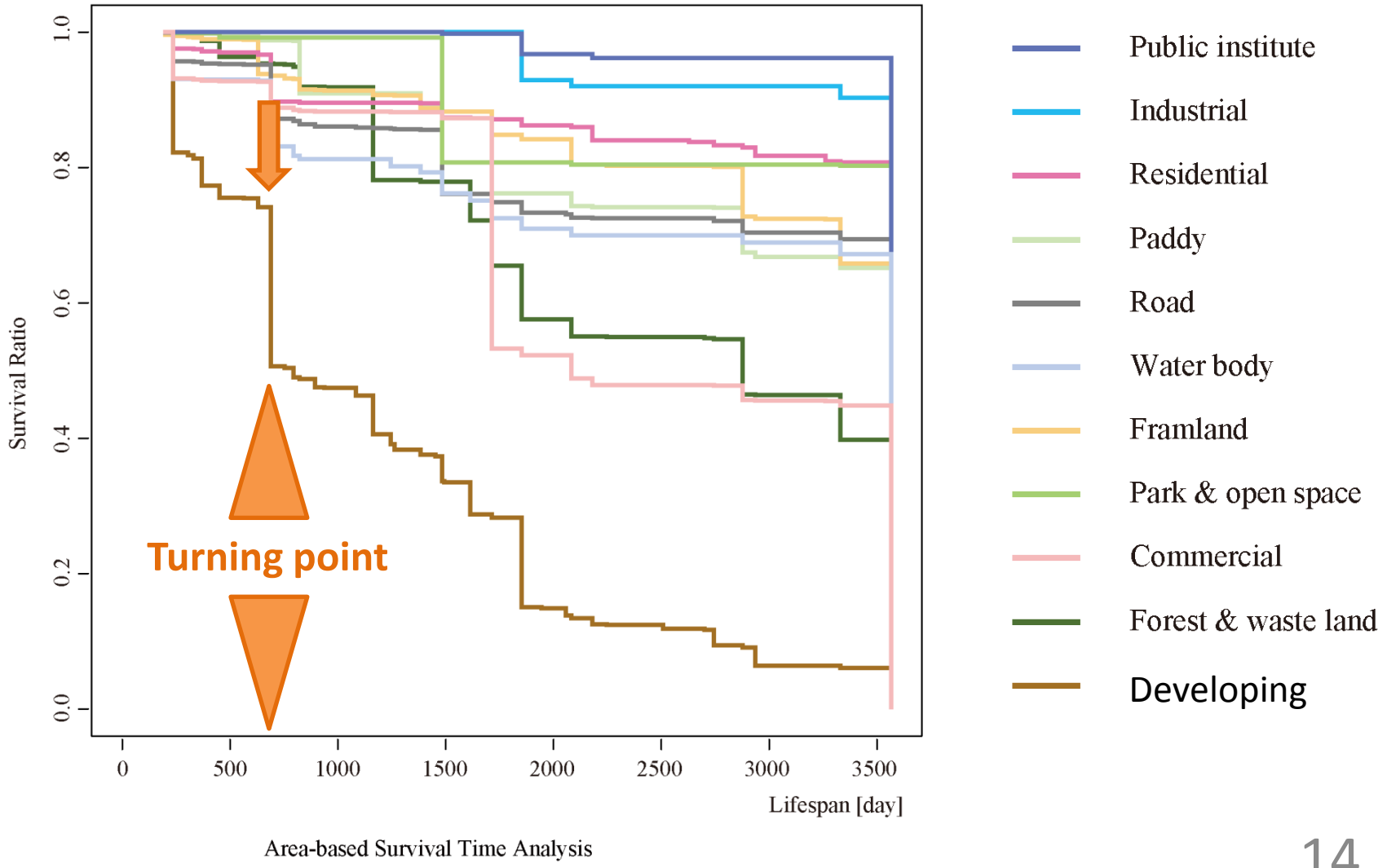
- Large land use changed area are located in the North-east of study area

- The adjacent land use has experienced land use change at least once, if the frequency of changes are more than twice.

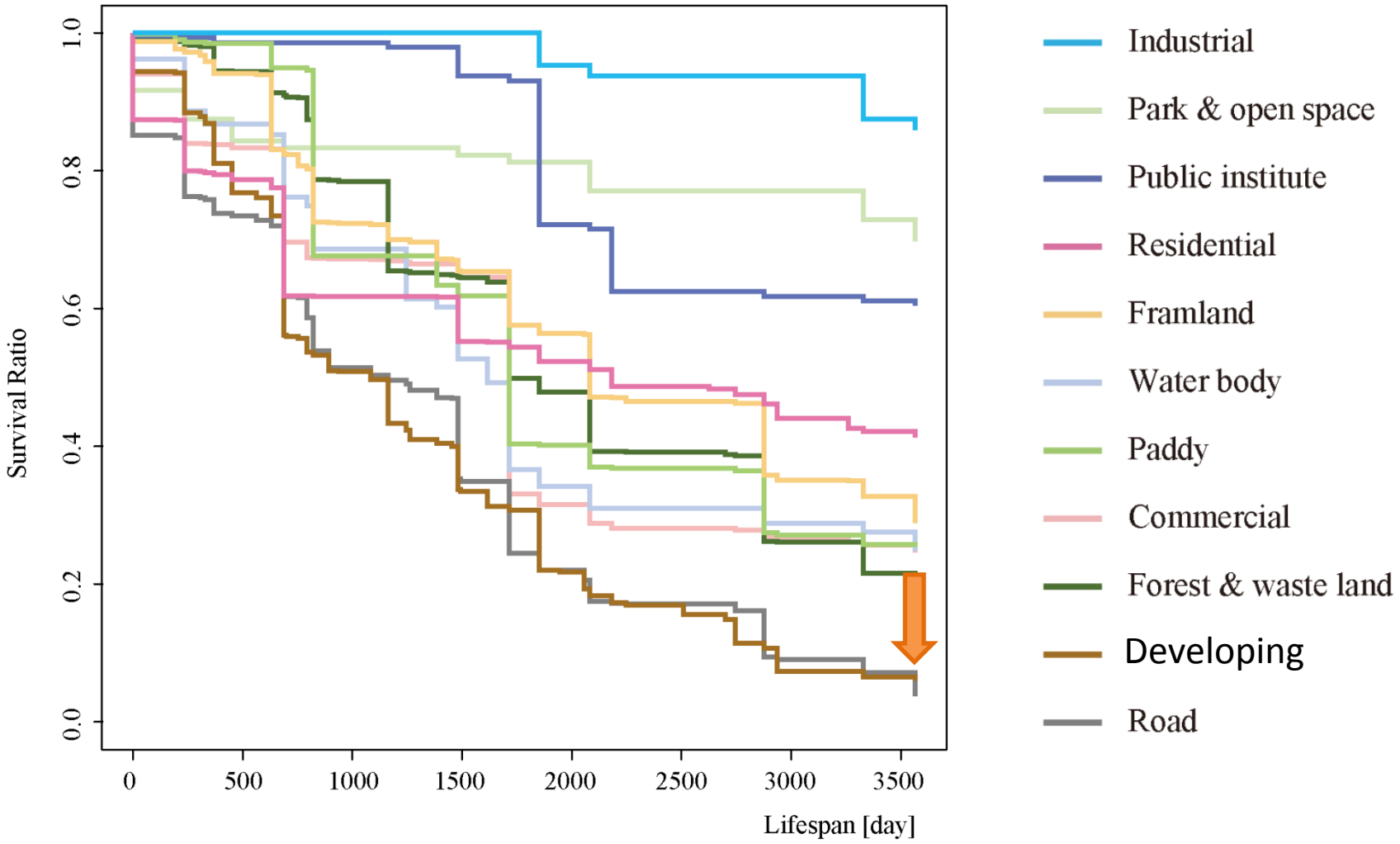
- This indicates the existence of local variability of land use change

4. Results:

Area-based survival time analysis of land use



4. Results: Number of polygon-based survival time analysis of land use



Number of Polygon-based Survival Time Analysis

4. Results: Summary

- Focusing on lifetime, survival time analysis highlighted the turning point of the transition

- Survival time analysis executed in both the number of land use and the area to clarify the variability for each land-use type.

5. Conclusions

- Multi-temporal analysis of land use transition indicated the existence of local potential of land use change.

- Because of the spatial interactive relationships between land uses (e.g., neighborhood effect), survival analysis for land use is required to analyze in both the number of land use and the area.

5. Conclusions

- It is a step forward to deepen spatiotemporal analysis with representation of the continuity of land use by multi-temporal land use analysis.

THANK YOU FOR YOUR ATTENTION!

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Survival Probability

- $S(t) = \left(1 - {}^{d_1}/_{n_1}\right) \times \left(1 - {}^{d_2}/_{n_2}\right) \times \cdots$

$$= \prod_{t_i<t} \left(1 - {}^{d_i}/_{n_i}\right)$$

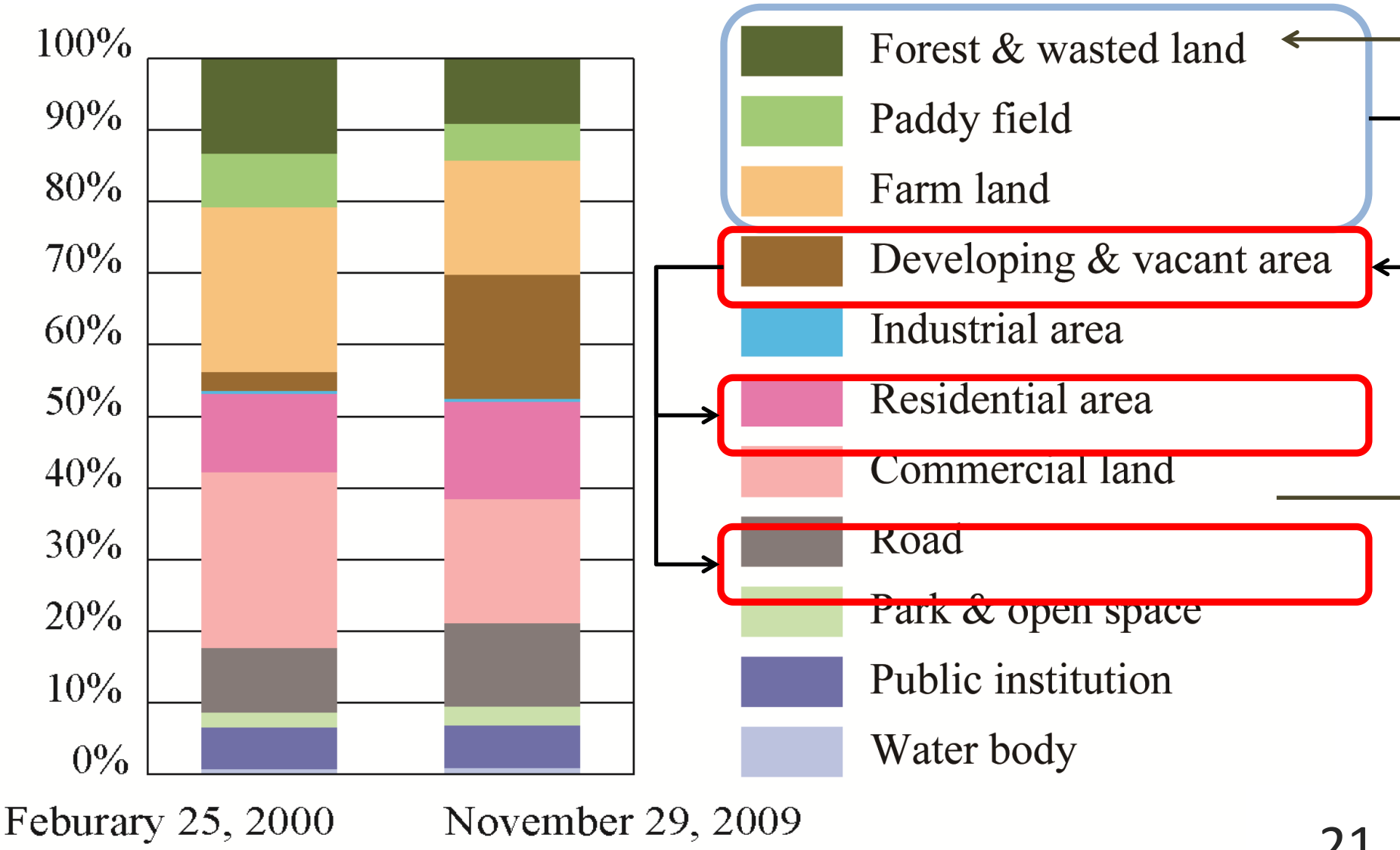
where:

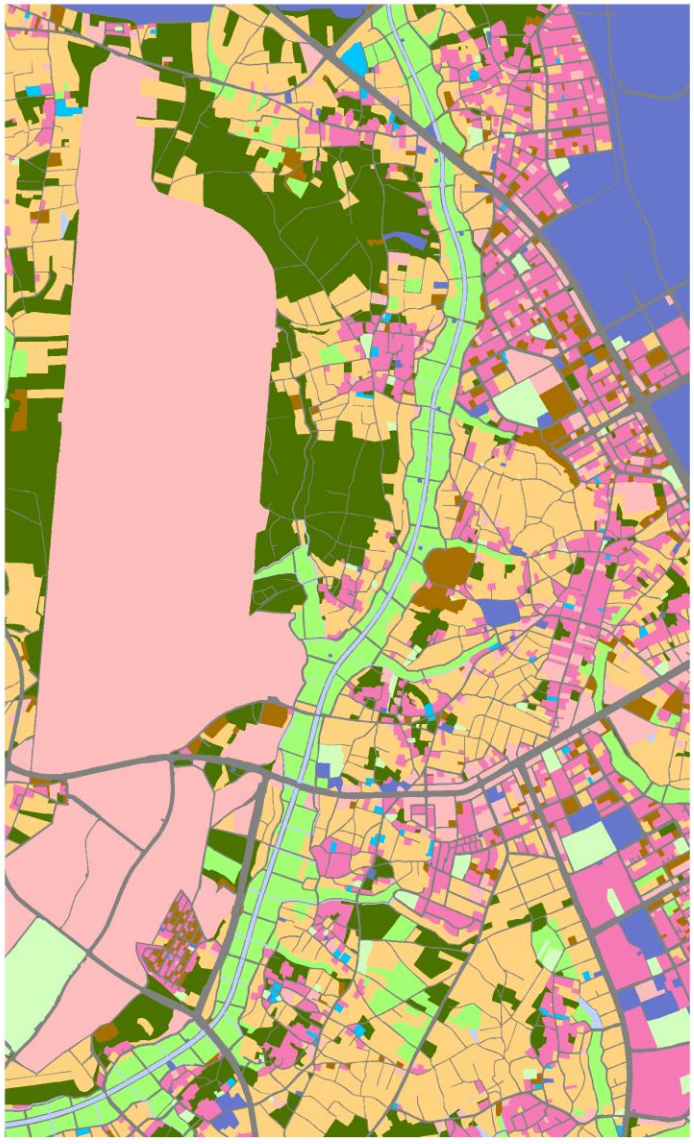
d_i: Land use change at t_i

n_i: Existed land use at $t_{(i-1)}$

$\left(1 - {}^{d_i}/_{n_i}\right)$: Survival probability of t_i

Overview: Land use structure





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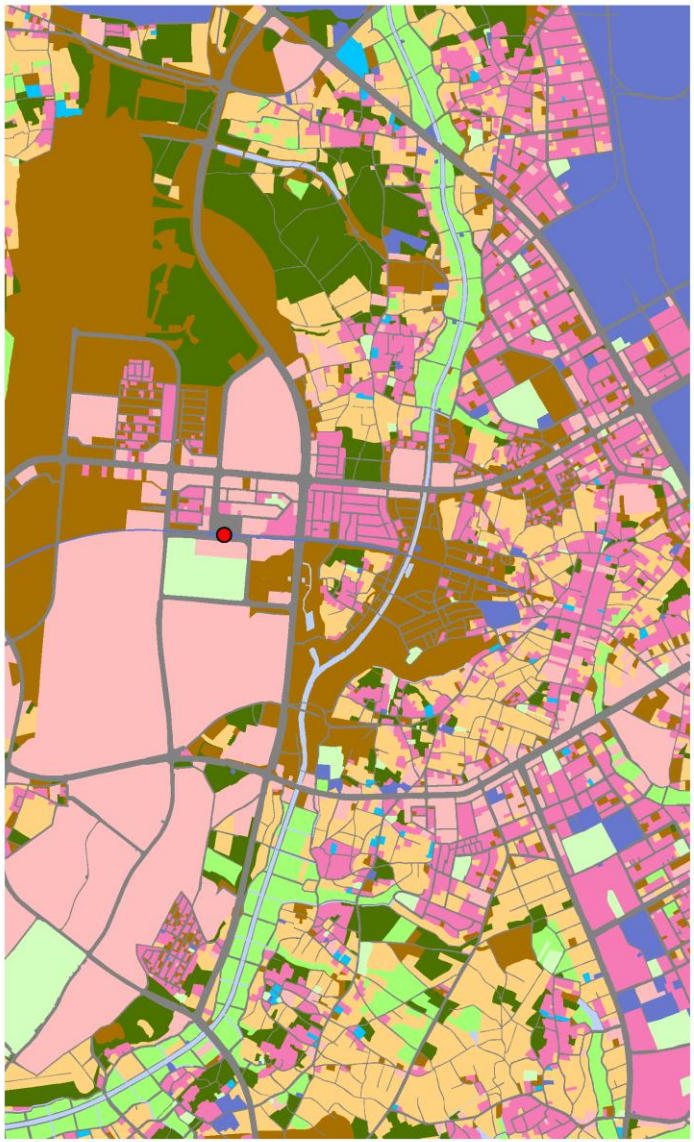

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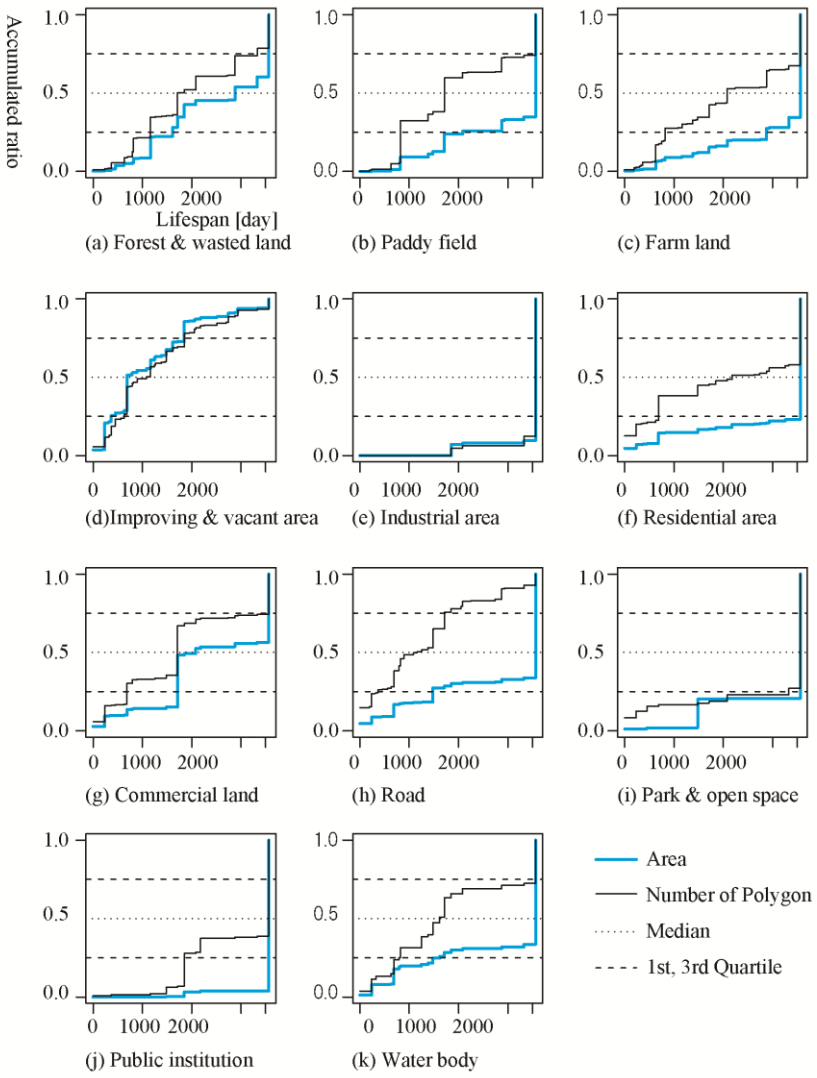

Figure Comparison between Areal-based Accumulated Ratio and Number of Polygon-based one