The Detection and spatiotemporal composite of Commercial Accumulations

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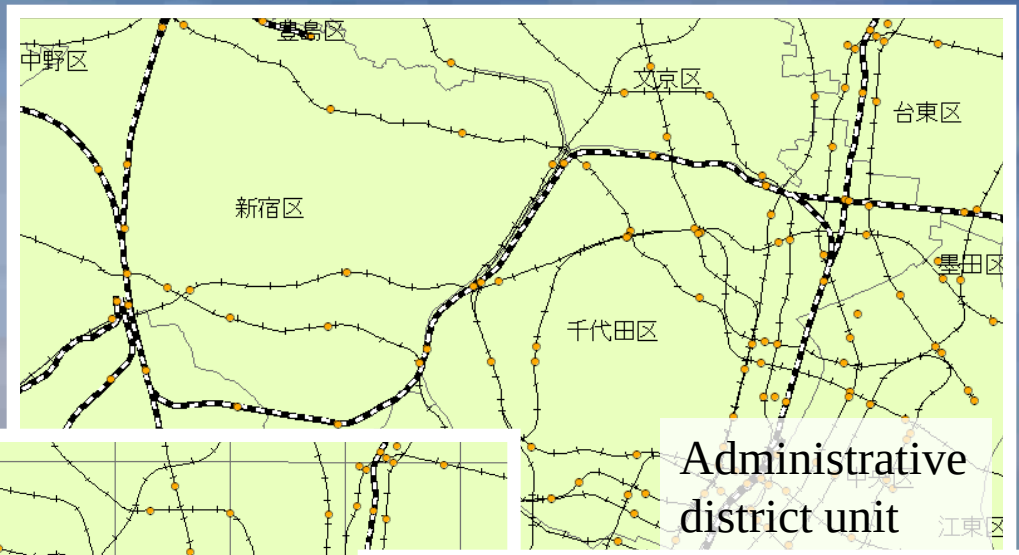
December 9, 2010

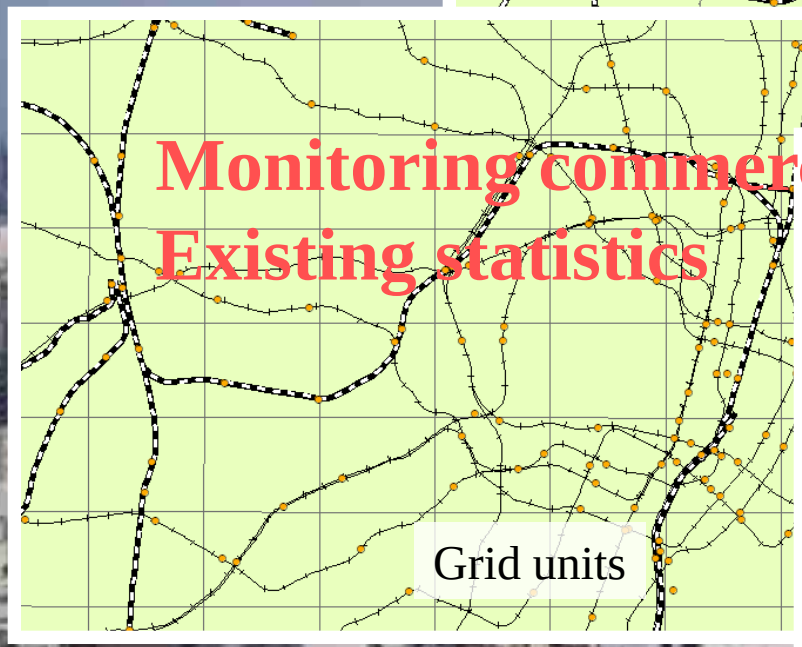
OBJECTIVE

Monitoring commercial development or decline widely, cheaply and in detail

Background

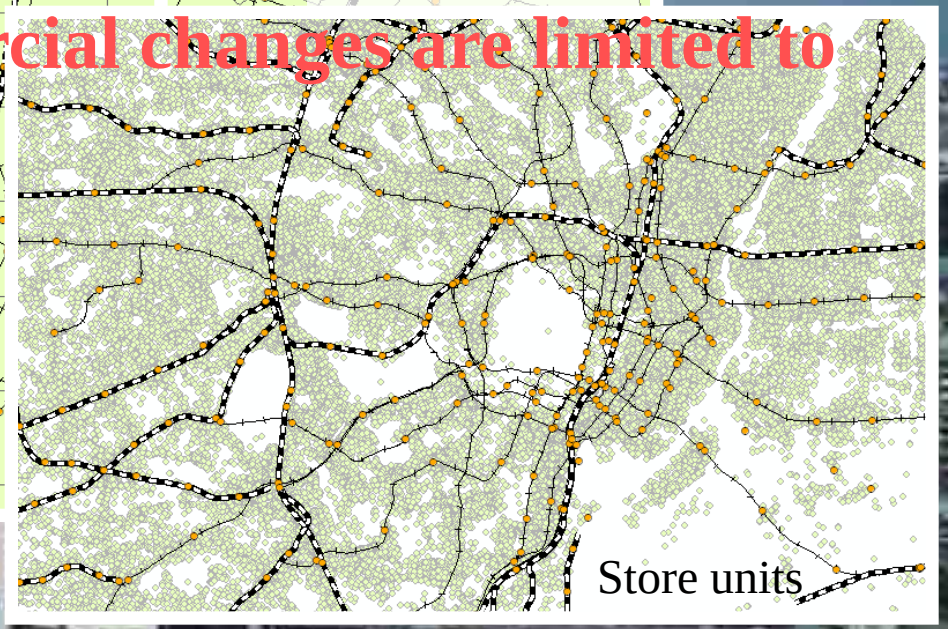


Administrative district unit



Grid units

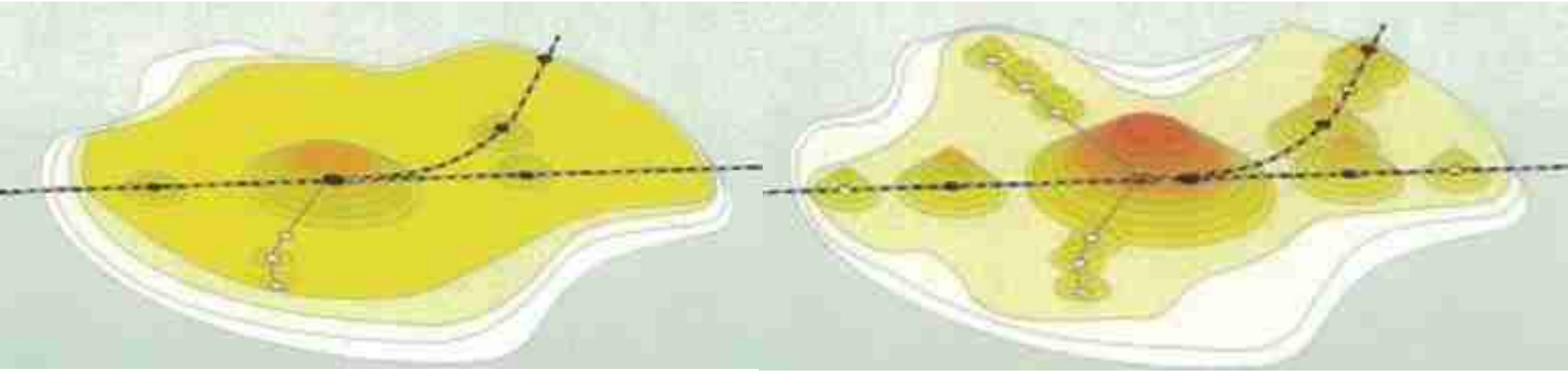
Monitoring commercial changes are limited to Existing statistics



Store units

GOAL

Develop statistics summed up on new unit “Commercial Accumulation”



polygon features

INDEX

1. Dataset: Digital Yellow Page data

電話帳

Tokyo as a study area

1990,1995,2000 and 2005

Database of telephone registration

◆**Point data (GIS data)**

Owner, Business categories, **Address**, building information, Etc

1751 kinds of business categories (2005)

◆**Cover all over Japan**

◆**Updated every year**

1. Dataset: Digital Yellow Page data

includes

Yellow page data / 電話帳

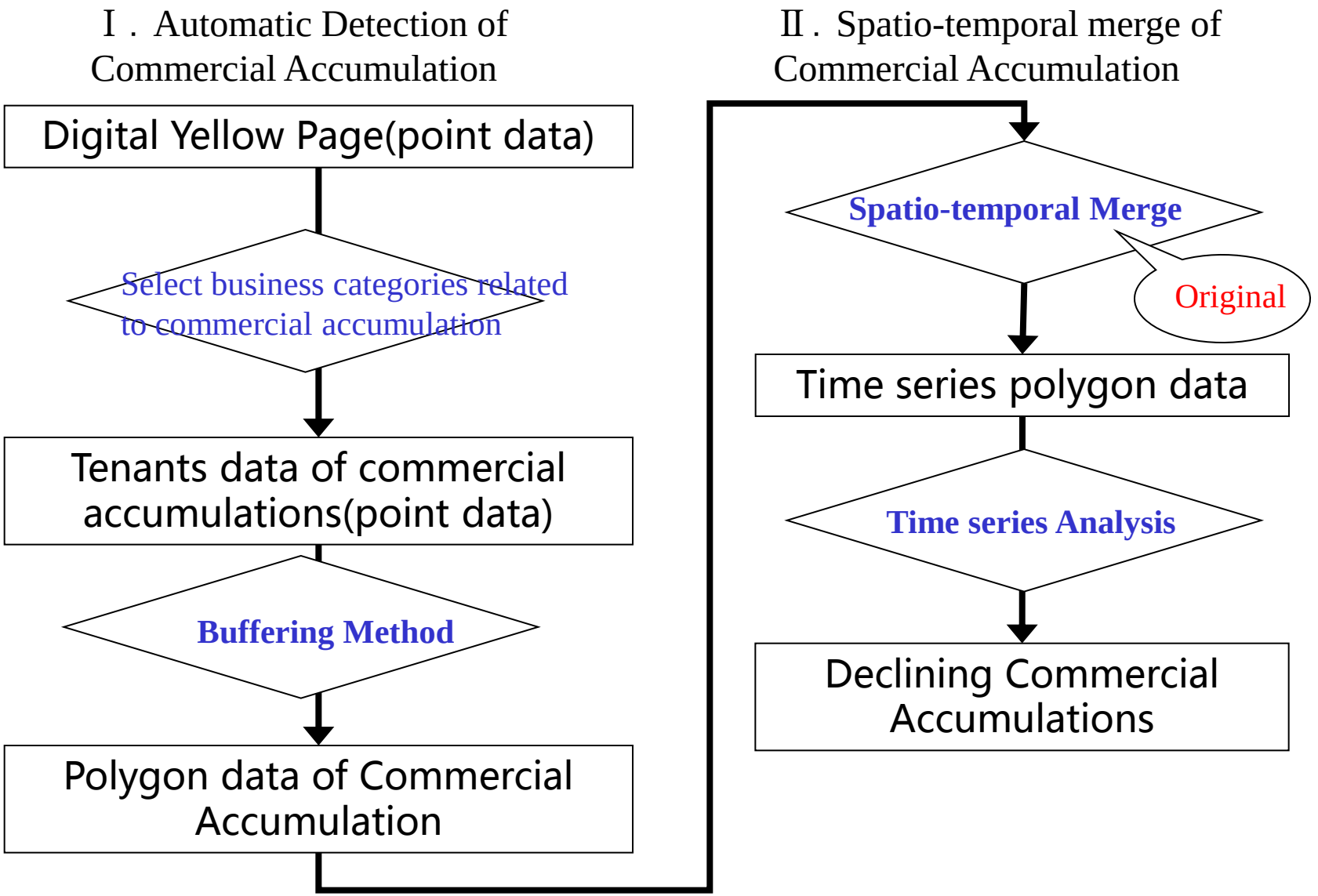
Personal Residences

Tenants

Commercial Areas

Office / Enterprise

2. Work Flow


Ⅰ. Automatic Detection of Commercial Accumulation
Digital Yellow Page(point data)
Select business categories related to commercial accumulation
Tenants data of commercial accumulations(point data)
Buffering Method
Polygon data of Commercial Accumulation
Ⅱ. Spatio-temporal merge of Commercial Accumulation
Spatio-temporal Merge
Original
Time series polygon data
Time series Analysis
Declining Commercial Accumulations

3. Automatic Detection of Commercial Accumulation

①Select business categories of commercial accumulation

Digital Yellow Page

Tenants information derived from web page

Matching based on location information

Tenants data of commercial accumulations

Characteristic business categories of commercial accumulations

（tenant name, business categories, address）

Elect merged data

Name of shopping area	Total	Merged	Rate(%)
Kami-Shakujii(上石神井)	169	144	85.21
Ebaramachi(えばらまち)	112	110	98.21
Ohanajaya(お花茶屋)	84	84	100.00
Mita(三田)	80	67	83.75
South Shimo-Kitazawa(下北沢南口)	185	183	98.92
Kudan(九段)	100	94	94.00

3. Automatic Detection of Commercial Accumulation

②Make Polygon data by Buffering Method

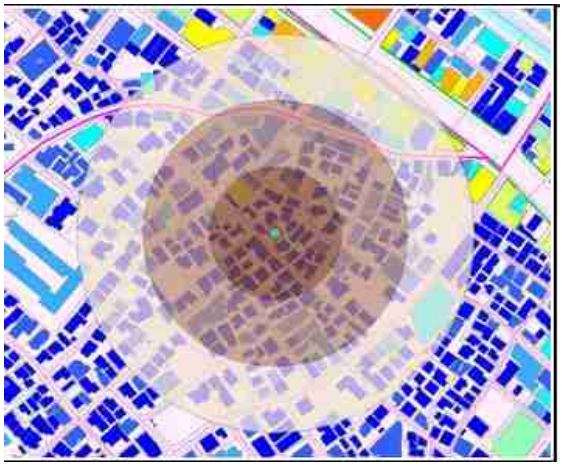
The extent of accumulation based on Connectivity of tenants

Adjust buffering size corresponding to average distances between tenants in study area.

How to decide Buffering distance

$$B_0 = \frac{\sum_{k=1}^{n} dE_k + d_0}{n+1}$$

B0: Buffering distance
n: Number of point data in study area.
d0: Distance from central point to Nearest neighbor point
dEn: Distance from other points near from central points to Nearest neighbor point



Buffering Methods:

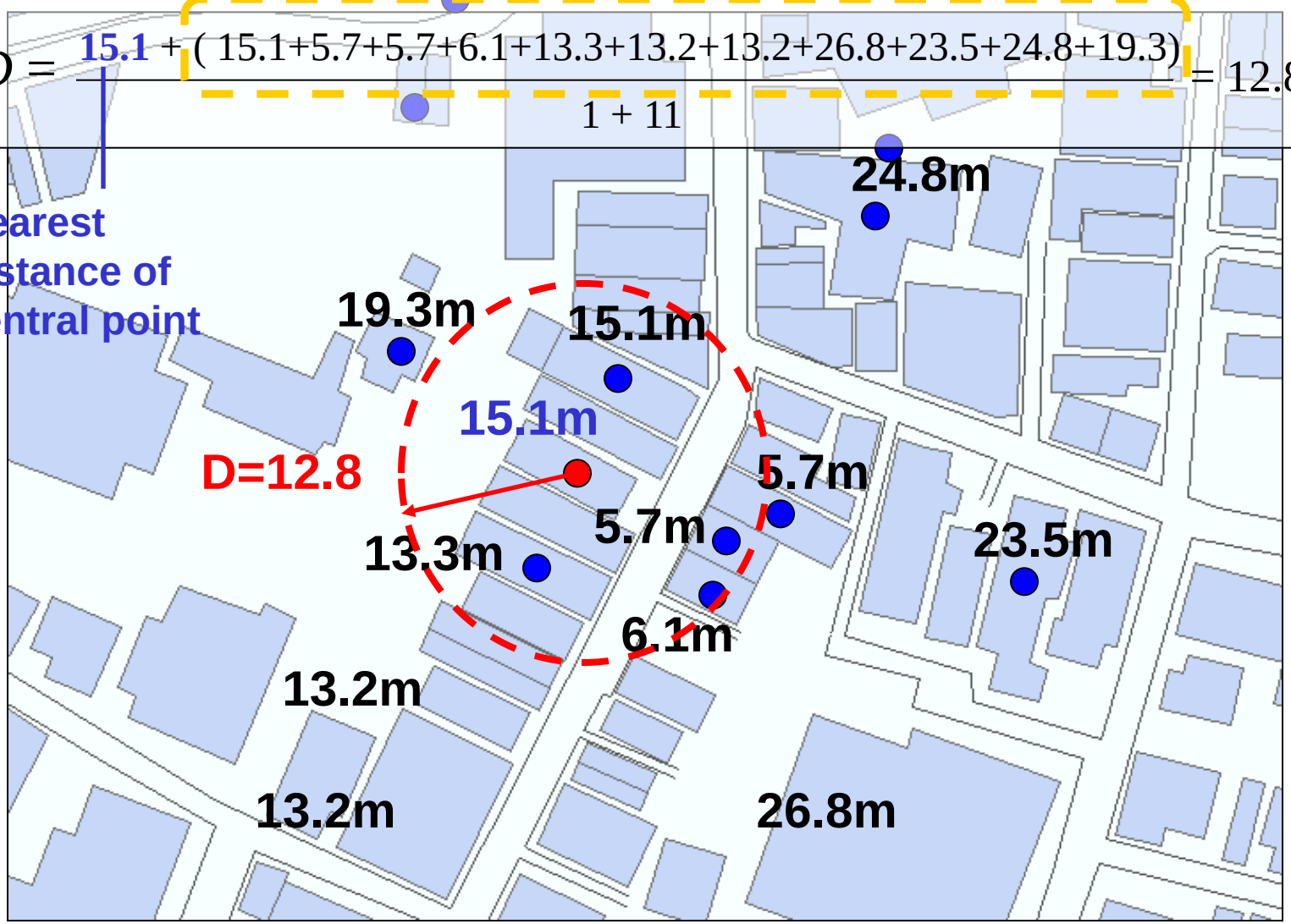
Make a circle polygon data from point data based on distance

Total distance of points around central point to nearest points

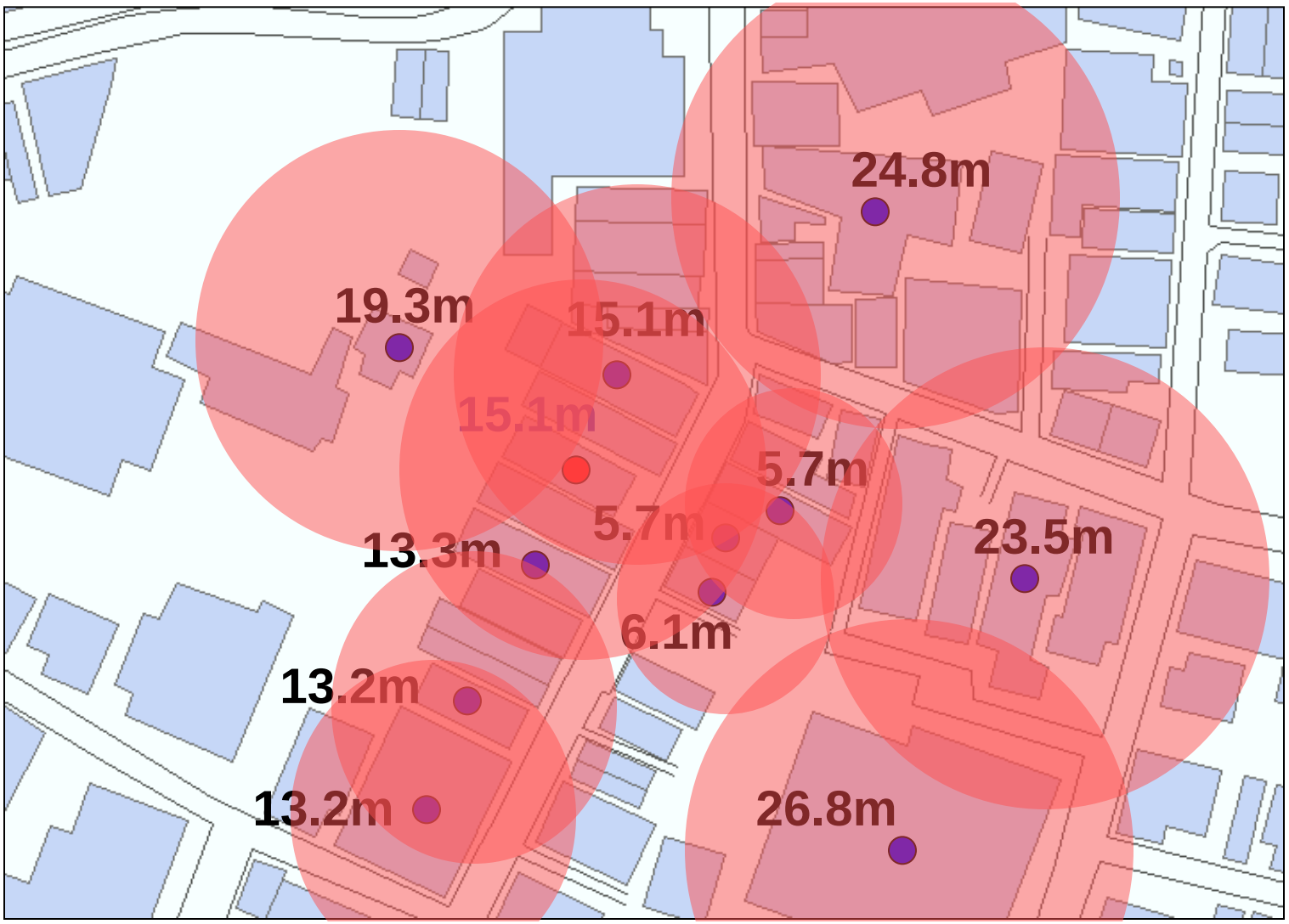
3. Automatic Detection of Commercial Accumulation : Exmaple

$$D = \frac{15.1 + (15.1+5.7+5.7+6.1+13.3+13.2+13.2+26.8+23.5+24.8+19.3)}{1+11} = 12.8$$

Nearest distance of central point



3. Automatic Detection of Commercial Accumulation : Sample image



3．Automatic Detection of Commercial Accumulation

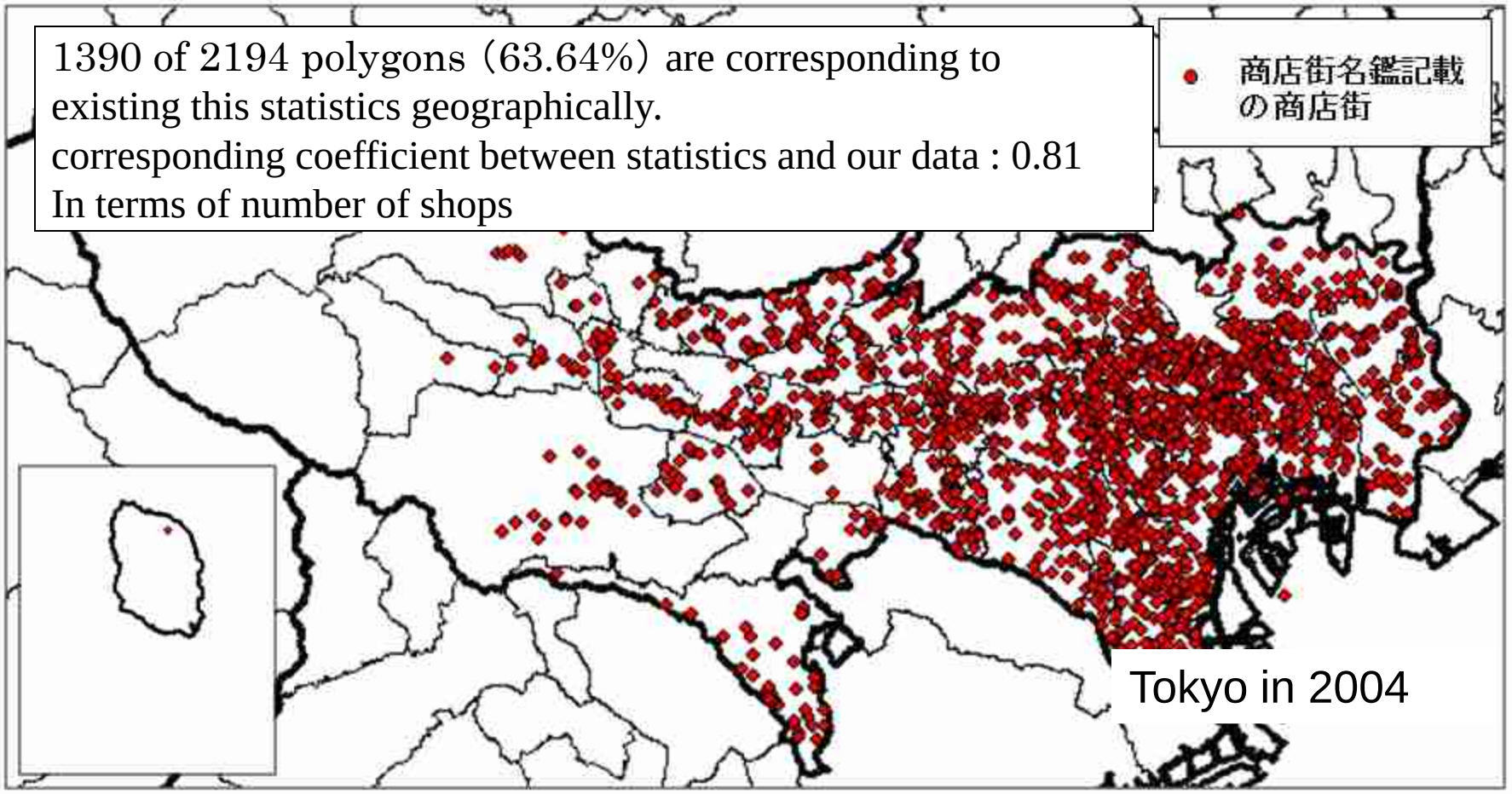
③Result of making Polygon data

2005

3. Automatic Detection of Commercial Accumulation

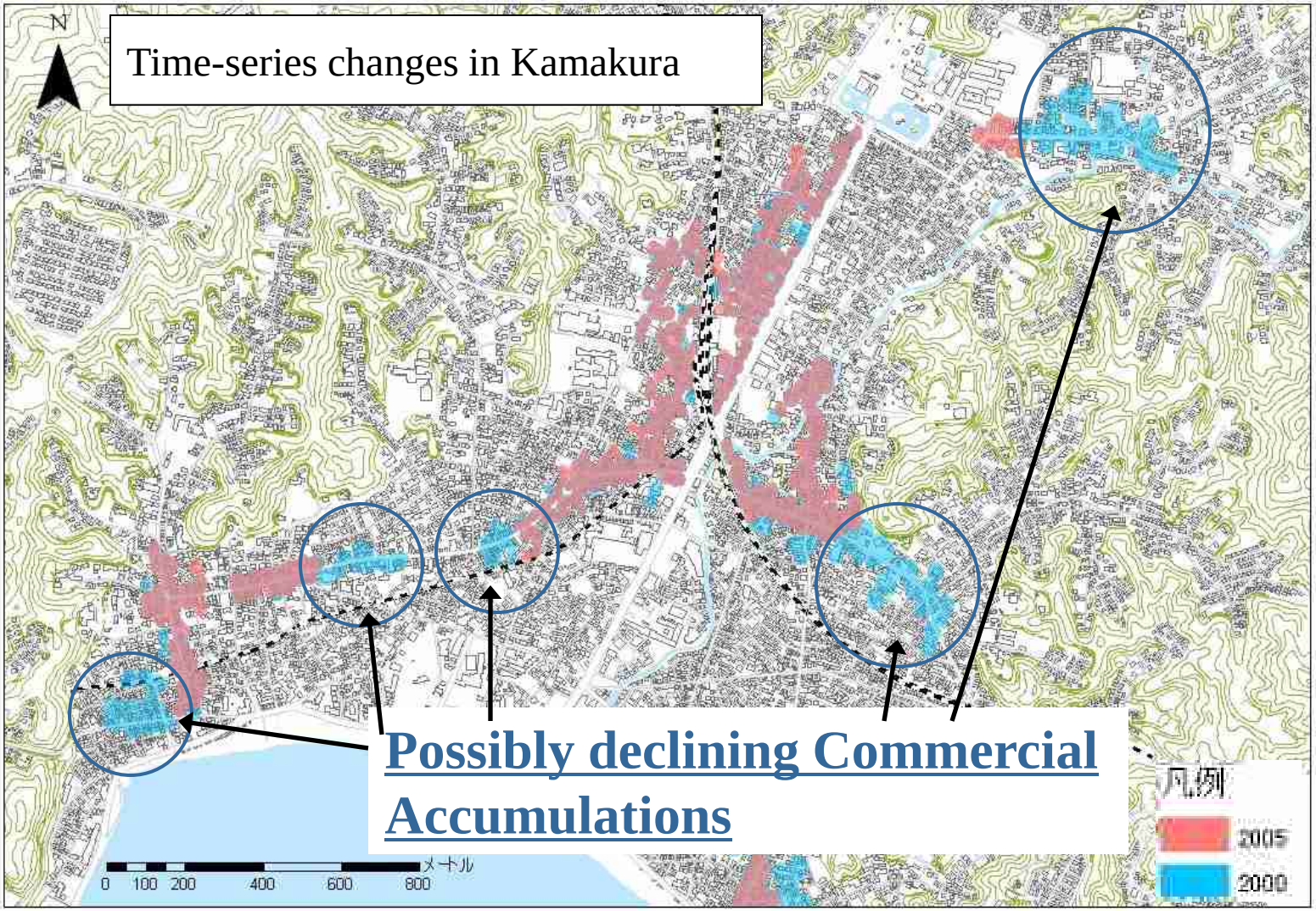
④Validation using existing statistics

1390 of 2194 polygons（63.64%）are corresponding to existing this statistics geographically.
corresponding coefficient between statistics and our data : 0.81
In terms of number of shops



4. Spatiotemporal composite of Commercial Accumulation

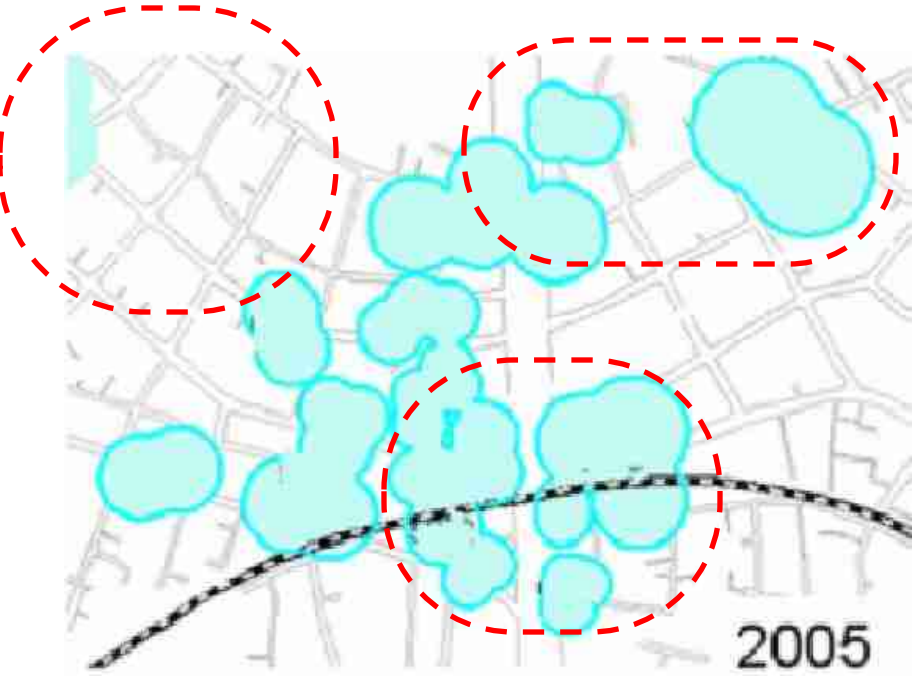
Commercial Accumulation Polygon data in time series



4. Spatiotemporal composite of Commercial Accumulation

Problem of time series comparison

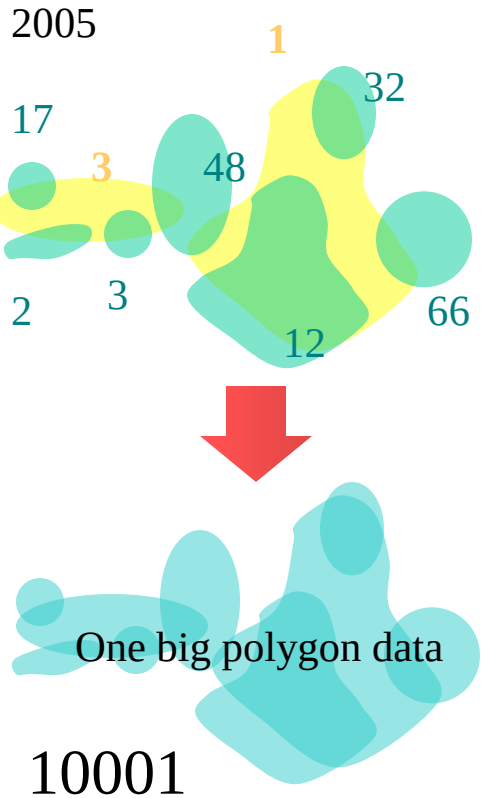
Differences of location and shape of commercial accumulation



4. Spatiotemporal composite of Commercial Accumulation

Spatio-temporal composite method

Integrate overlapped polygon spatially and temporally

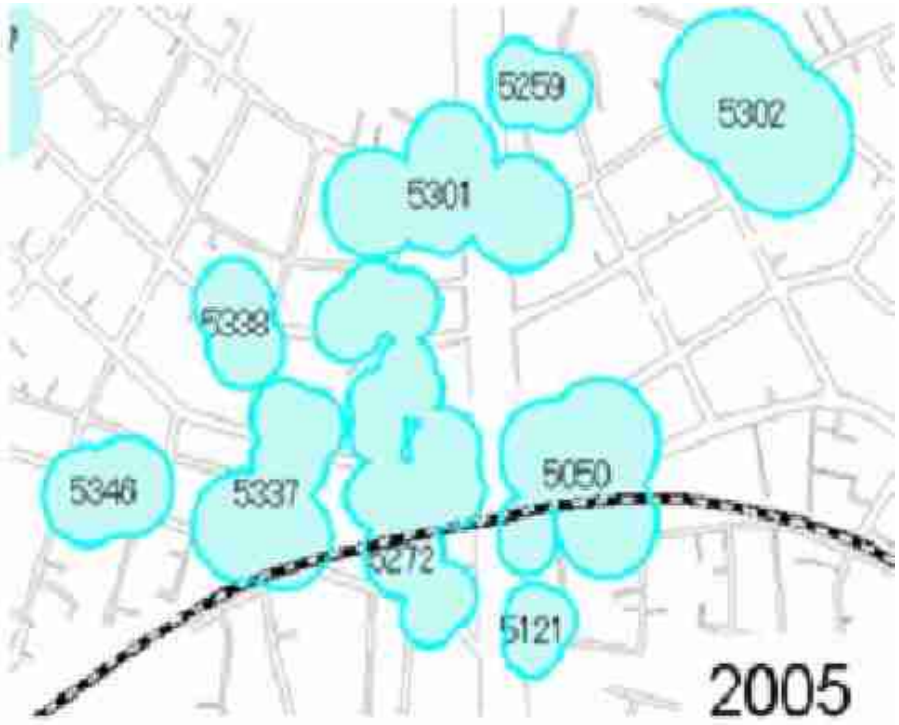


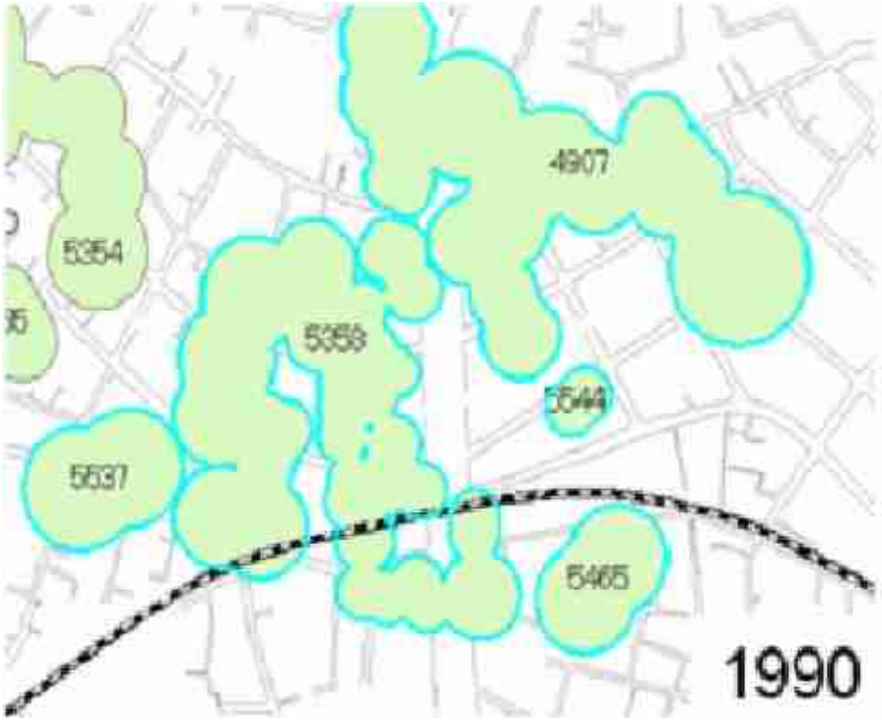
2005	2000	1995	1990
{ 1 }	{ 9 , 144, 178 }	{ 12, 32, 48, 66}	{ 8, 74, 302 }
{ 2 }	{ 159 }	{ 281 }	{ 379 }
{ 3 }	{ 1, 12, 54, 138}	{ 2, 3, 17, 48}	{ 7, 14, 73}
{ 4 }	{ 132, 155 }	{ 224 }	{ 10, 323 }

2005	2000	1995	1990	Cluster ID
{ 1, 3 }	{ 1, 9 , 12, 54, 138, 144, 178 }	{ 2, 3, 12, 17, 32, 48, 66}	{ 7, 8, 14, 73, 74, 302 }	-> 10001
{ 2 }	{ 159 }	{ 281 }	{ 379 }	-> 10002
~~{ 3 }~~	~~{ 1, 12, 54, 138}~~	~~{ 2, 3, 17, 48}~~	~~{ 7, 14, 73}~~	
{ 4 }	{ 132, 155 }	{ 224 }	{ 10, 323 }	-> 10003

4. Spatiotemporal composite of Commercial Accumulation

①Assign each polygon data ID





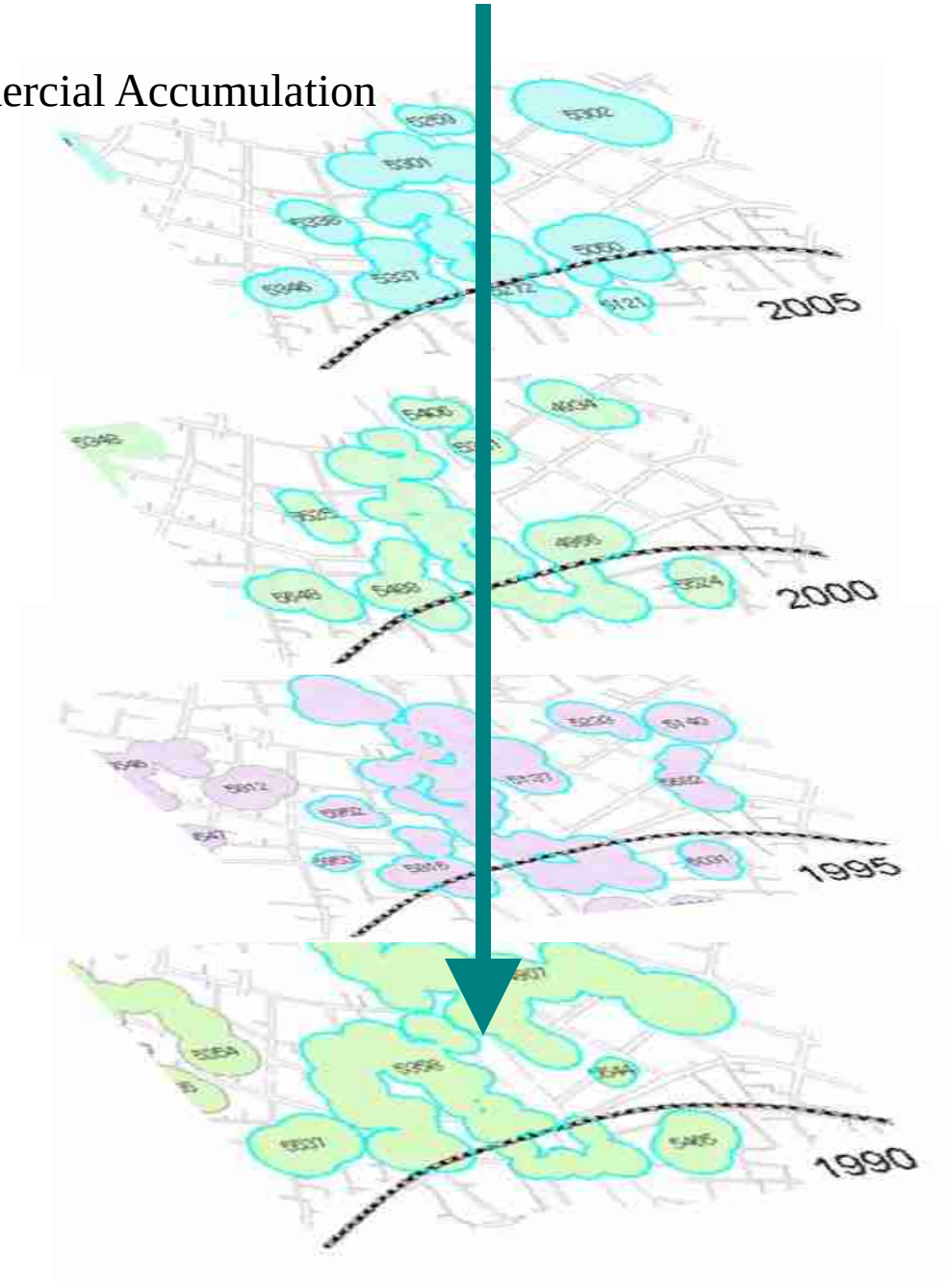
4. Spatiotemporal composite of Commercial Accumulation

②Spatial Join

Integrate overlapped commercial accumulation spatially

same aggregate of polygon

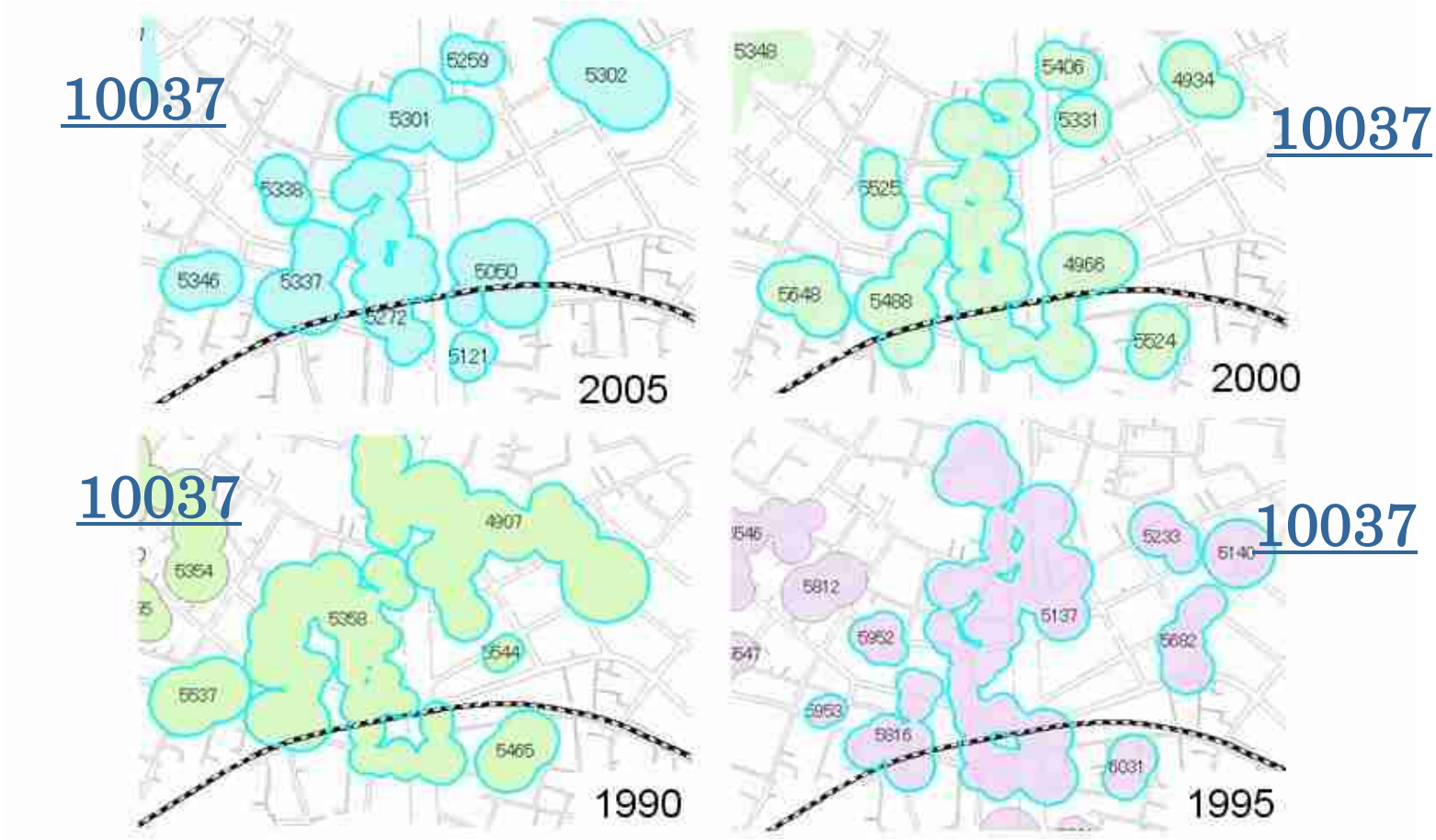
One Group



4. Spatiotemporal composite of Commercial Accumulation

③Assign “Cluster ID “

Assign ID corresponding to each merged commercial Accumulations



4. Spatiotemporal composite of Commercial Accumulation

④Result of Integration

Integrate total number of commercial accumulation polygons into about 60 or 70% of them.

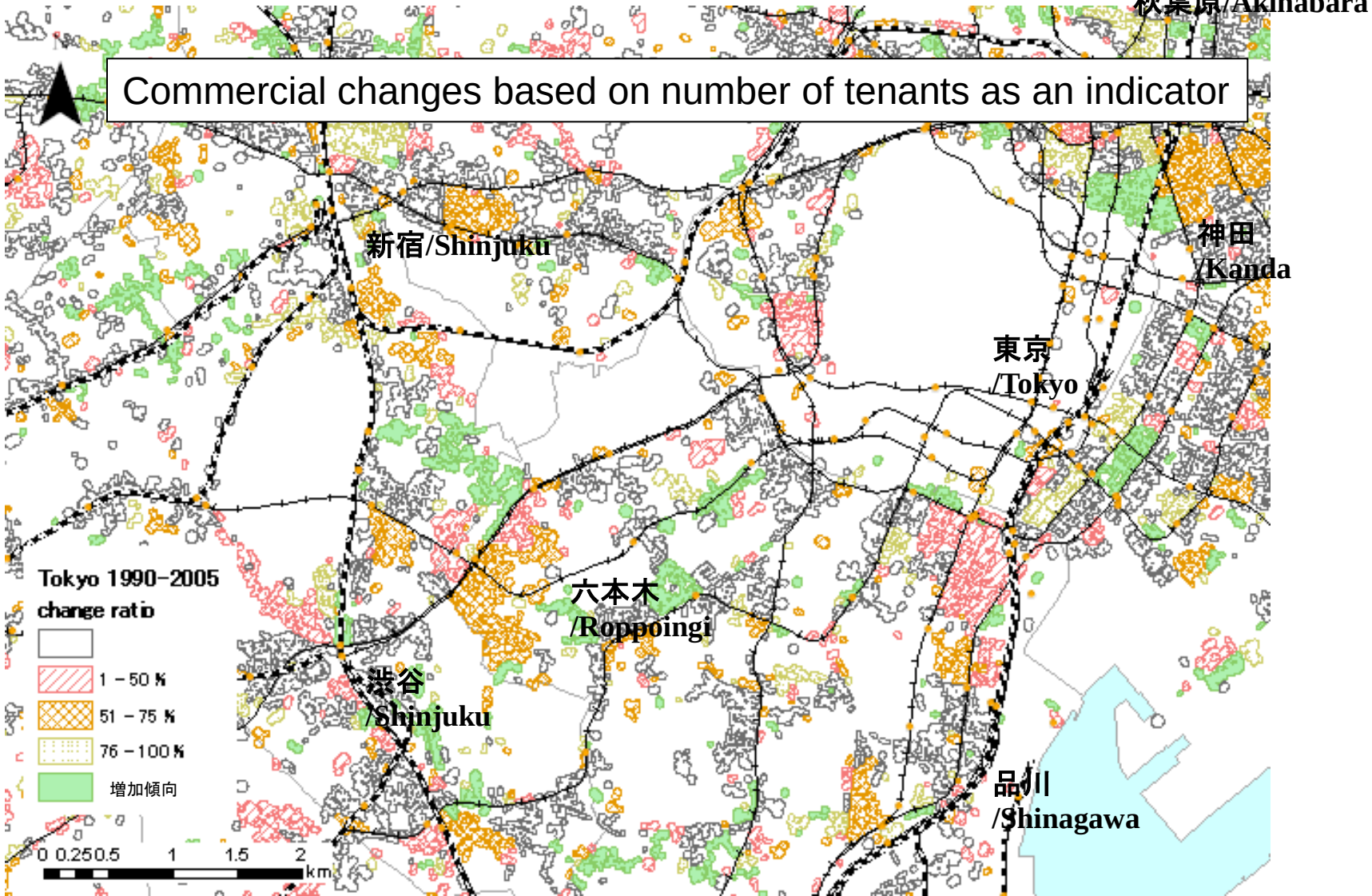
The transition of commercial accumulations from 1999 to 2005

	1990	1995	2000	2005
Number of Commercial Accumulation	17954	16895	16366	15602
Number of Commercial Accumulation cluster	12789	12693	11995	9976
Ratio	71%	75%	73%	64%

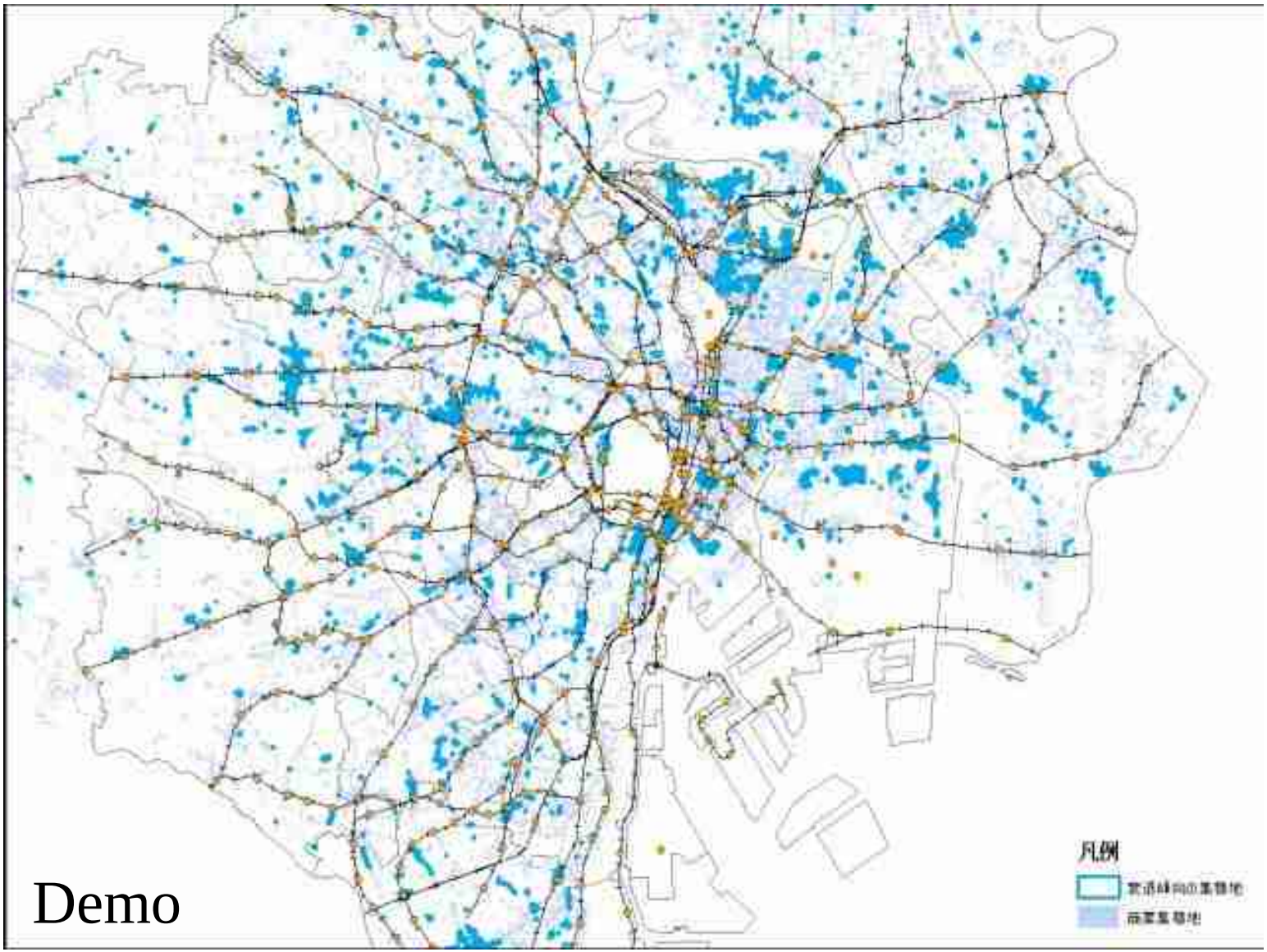
※These are number of tenants summed up in same places, and don't indicate existing same tenants.

4. Spatiotemporal composite of Commercial Accumulation

⑤Time-series analysis



5. Result of the composite: Declining areas in Tokyo



Demo

6.Conclusion

This study has developed new data unit, “ Commercial Accumulation area” and detected commercial changes.

Ⅰ. Automatic detection of commercial accumulations

Ⅱ. Spatiotemporal composite of commercial accumulation data

6.Further Studies

Improve model accuracy and background of theory validating results.

◆Validation of results of detecting decline areas

◆Comparing other existing methods on the same basis

Ex. Develop Polygon data based on Kernel Density

◆Increase case study of URBAN ANALYSIS using Commercial Accumulation data

Thank you for your attendance !!

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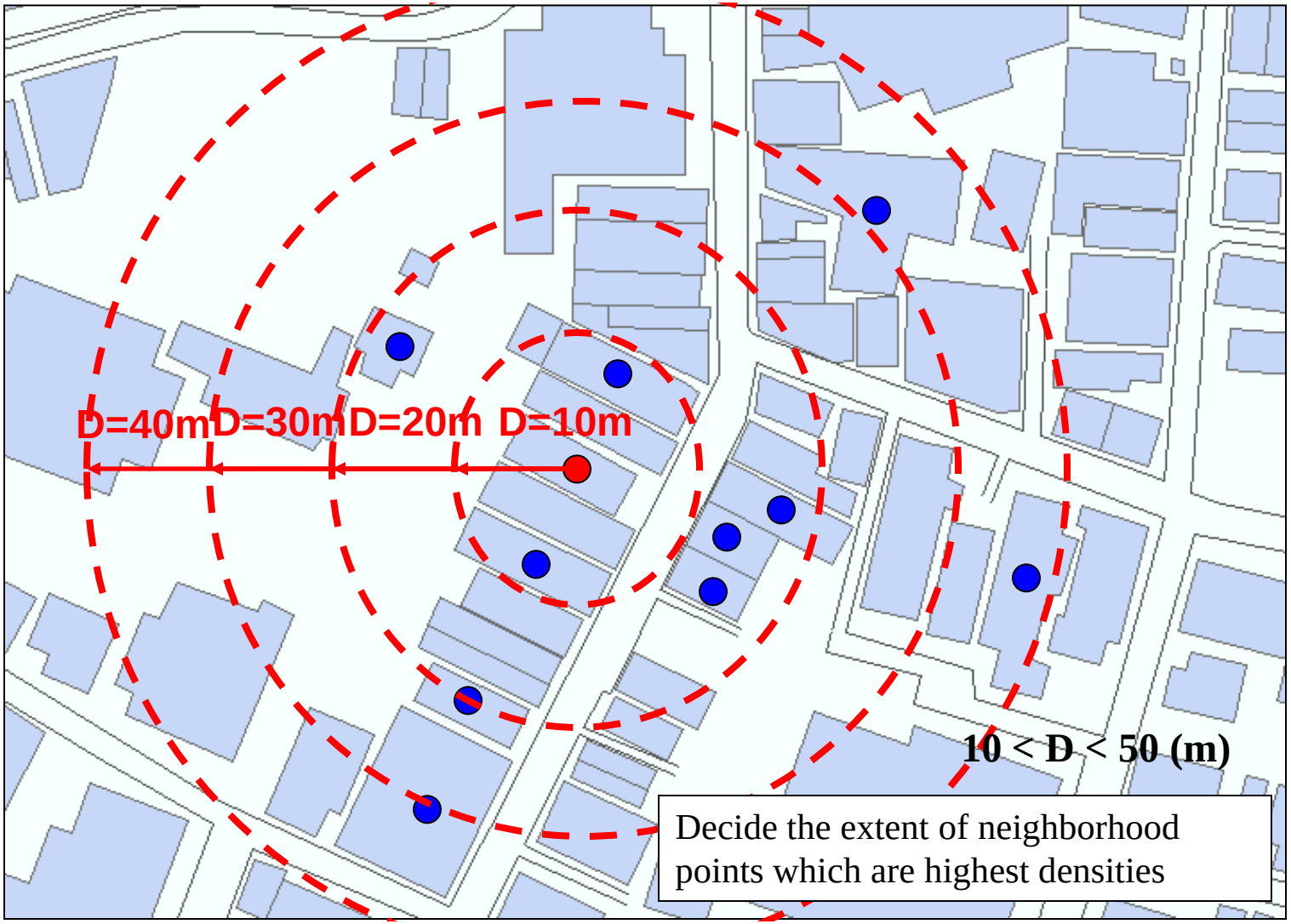
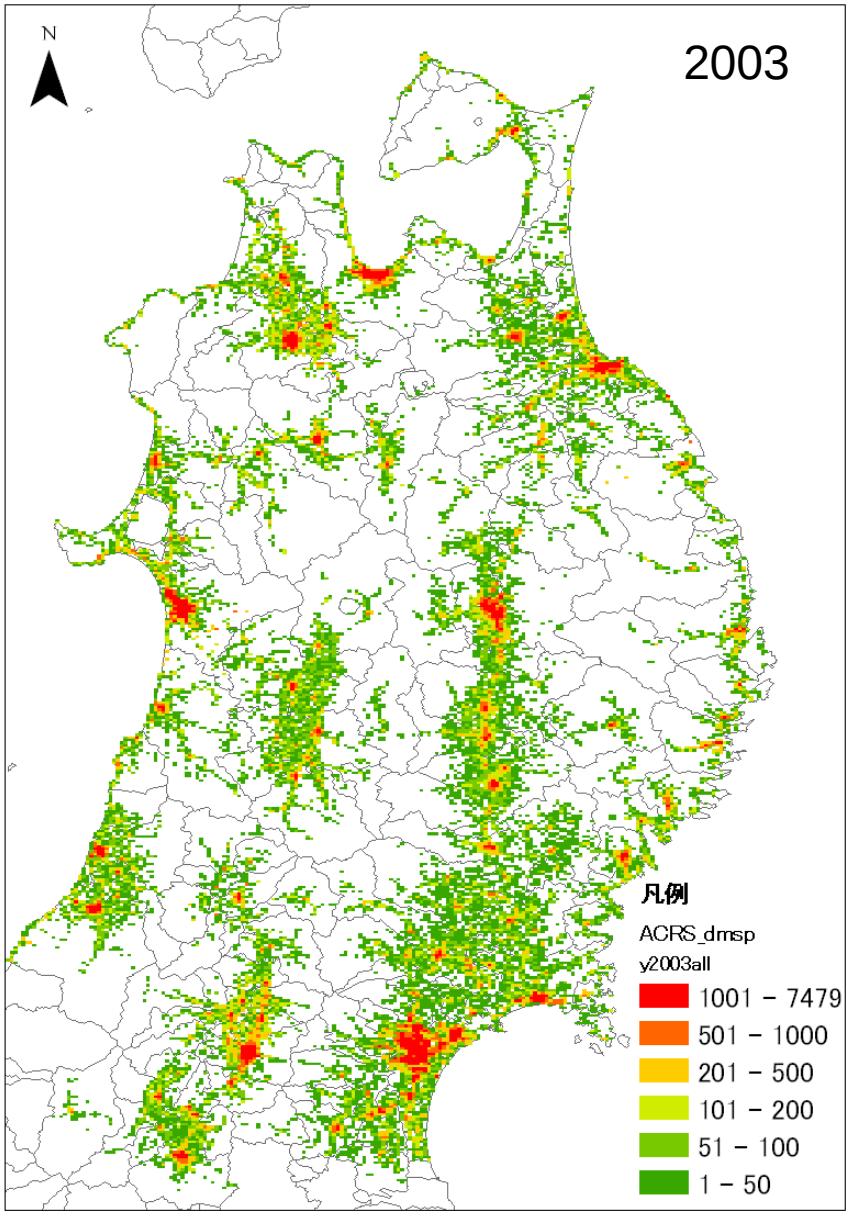
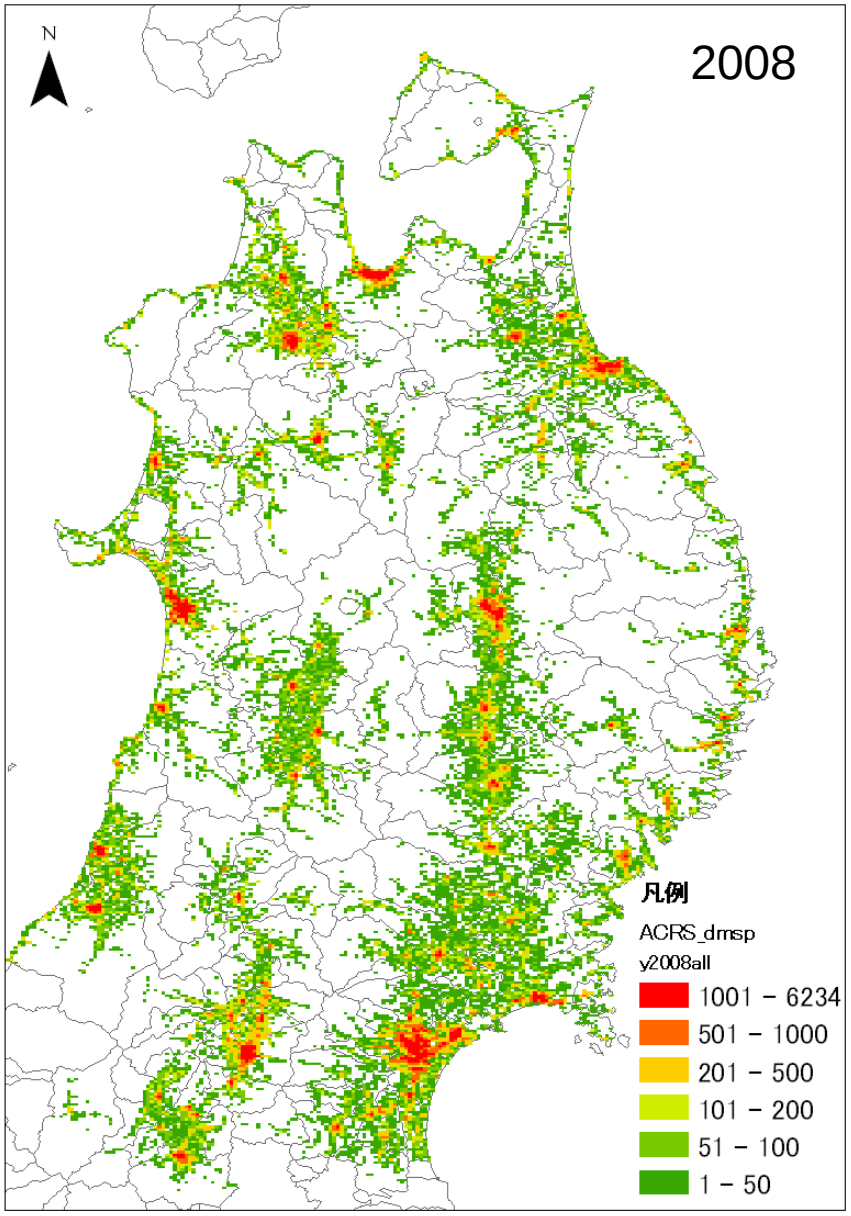
補足資料: 商店会と商業集積地の定義

Rule of selecting point



Number of whole telephone registration

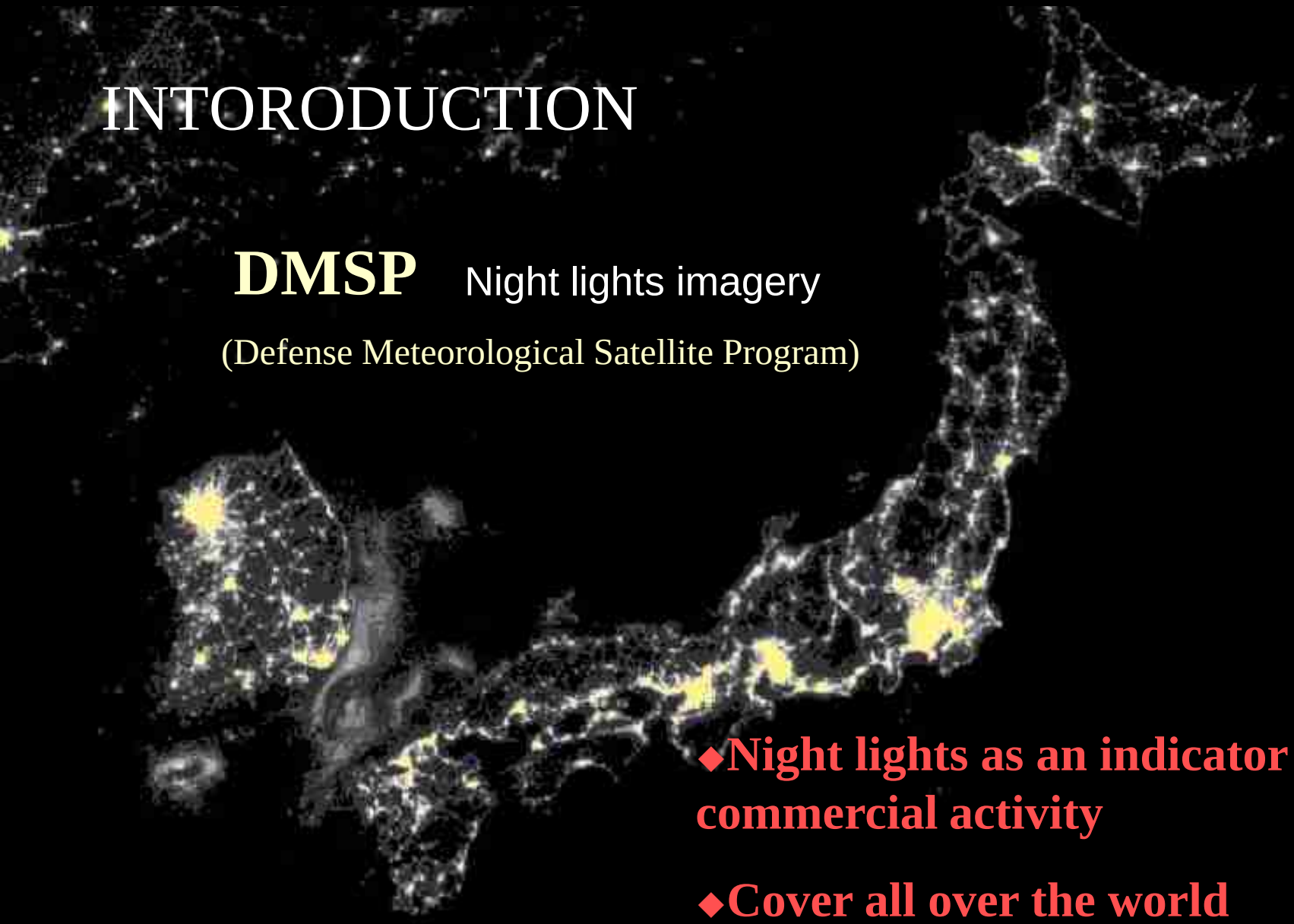




INTORODUCTION

DMSP Night lights imagery

(Defense Meteorological Satellite Program)



- **Night lights as an indicator of commercial activity**
- **Cover all over the world**
- **Having archived since 1992**

If used in time series, commercial changes can be revealed all over the world.