Small Area Statistics on Population: Japan's Experience and Challenge

Regional Training Workshop
on Use of Population and Housing Census Data
for Local Development Planning

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Chiba, Japan

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National
Statistics Center
Incorporated Administrative Agency

NTT docomo

Contents

1. Introduction

- Population Census of Japan
  - conducted every five years by Statistics Bureau (SBJ)
  - Produces
    - Tabulation at national, prefecture and municipal level
    - Small area statistics
      - Tabulation for small area
      - Grid Square Statistics
- Mobile Spatial Statistics
  - developed by NTT DOCOMO
  - derived from mobile network operational data
  - demonstrate small area population changes on a hourly base.

2. Population Census of Japan

- Legal Basis of the Census
  - The Population Census is conducted in conformity with provisions of ***Article 5*** of ***the Statistics Act***.

” With regard to persons specified by a Cabinet Order as those residing in Japan, ***the Minister*** *of Internal Affairs and Communications* ***shall conduct a complete census*** *concerning individuals and households and produce statistics based on such a census.*

The Minister *of Internal Affairs and Communications* ***shall conduct a complete census every ten years*** *and produce population census statistics.* ***In the fifth year from the preceding population census,*** *the population census shall be* ***conducted in a simplified manner*** *to produce population census statistics. “*

2. Population Census of Japan

- The first Census: 1st October 1920
- The latest Census: 1st October 2010

Organization of Data Collection

Statistics Bureau, Min. of Internal Affairs and Com.

- 47 Prefectures
  - 1728 Municipalities (Cities, towns and villages)
    - apprx. 90,000 Supervisors
      - apprx. 700,000 Enumerators
        - apprx. 52mil. Households (128mil. People)

NB: SBJ doesn't have local office.

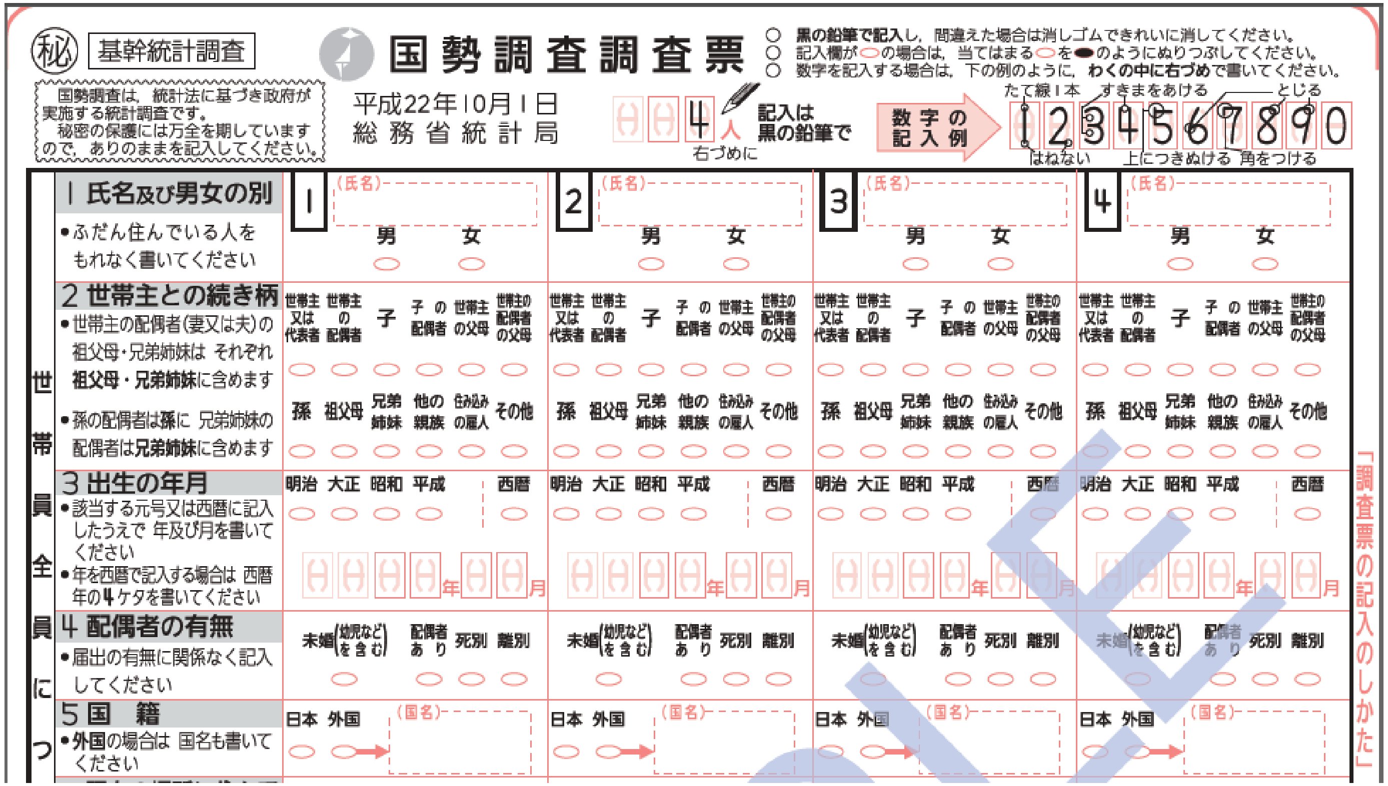
2. Population Census of Japan

- Enumeration Districts (EDs)
  - One year before the census-taking, *Enumeration Districts* (EDs) for the Census are demarcated all over the Japan (378,000 km^2) by all the municipalities:

    General ED, Special ED, Waterfront ED
  - EDs are demarcated so as to comprise roughly 50 households per General ED.
  - The number of EDs for 2010 Census is apprx. 1,010,000.

2. Population Census of Japan

- Self-administered Questionnaire
  - Enumerators deliver questionnaires to each household and request to fill out them.


㊙ 基幹統計調査

国勢調査調査票

○ 黒の鉛筆で記入し、間違えた場合は消しゴムできれいに消してください。
○ 記入欄が⬭の場合は、当てはまる⬭を⬬のようにぬりつぶしてください。
○ 数字を記入する場合は、下の例のように、わくの中に右づめで書いてください。

国勢調査は、統計法に基づき政府が実施する統計調査です。秘密の保護には万全を期していますので、ありのままを記入してください。

平成22年10月1日
総務省統計局

4 人 右づめに 記入は黒の鉛筆で

数字の記入例 1 2 3 4 5 6 7 8 9 0
たて線1本 すきまをあける とじる はねない 上につきぬける 角をつける

世帯員全員につ

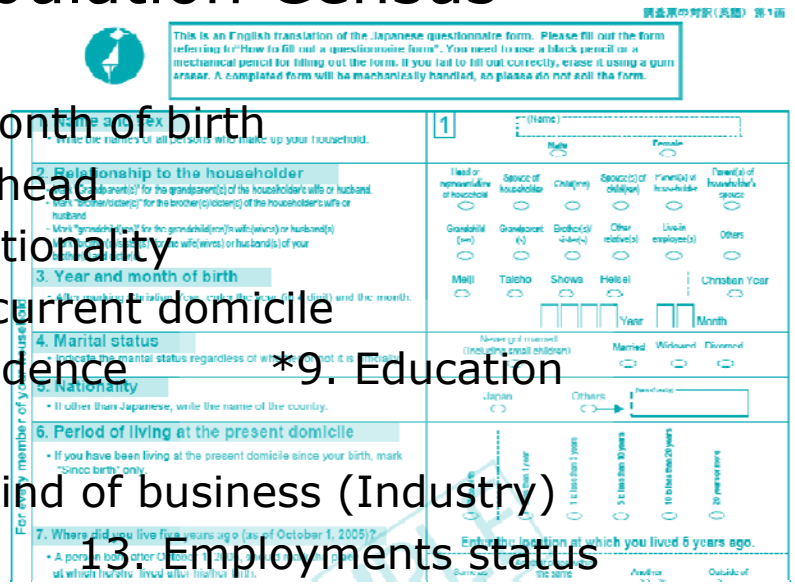
	1	2	3	4
1 氏名及び男女の別 ●ふだん住んでいる人をもれなく書いてください	(氏名) 男 女	(氏名) 男 女	(氏名) 男 女	(氏名) 男 女
2 世帯主との続き柄 ●世帯主の配偶者(妻又は夫)の祖父母・兄弟姉妹は それぞれ 祖父母・兄弟姉妹に含めます ●孫の配偶者は孫に 兄弟姉妹の配偶者は兄弟姉妹に含めます	世帯主又は代表者 世帯主の配偶者 子 子の配偶者 世帯主の父母 世帯主の配偶者の父母 孫 祖父母 兄弟姉妹 他の親族 住み込みの雇人 その他	世帯主又は代表者 世帯主の配偶者 子 子の配偶者 世帯主の父母 世帯主の配偶者の父母 孫 祖父母 兄弟姉妹 他の親族 住み込みの雇人 その他	世帯主又は代表者 世帯主の配偶者 子 子の配偶者 世帯主の父母 世帯主の配偶者の父母 孫 祖父母 兄弟姉妹 他の親族 住み込みの雇人 その他	世帯主又は代表者 世帯主の配偶者 子 子の配偶者 世帯主の父母 世帯主の配偶者の父母 孫 祖父母 兄弟姉妹 他の親族 住み込みの雇人 その他
3 出生の年月 ●該当する元号又は西暦に記入したうえで 年及び月を書いてください ●年を西暦で記入する場合は 西暦年の4ケタを書いてください	明治 大正 昭和 平成 西暦 年 月	明治 大正 昭和 平成 西暦 年 月	明治 大正 昭和 平成 西暦 年 月	明治 大正 昭和 平成 西暦 年 月
4 配偶者の有無 ●届出の有無に関係なく記入してください	未婚(幼児などを含む) 配偶者あり 死別 離別	未婚(幼児などを含む) 配偶者あり 死別 離別	未婚(幼児などを含む) 配偶者あり 死別 離別	未婚(幼児などを含む) 配偶者あり 死別 離別
5 国籍 ●外国の場合は 国名も書いてください	日本 外国 (国名)	日本 外国 (国名)	日本 外国 (国名)	日本 外国 (国名)

「調査票の記入のしかた」

2. Population Census of Japan

Items surveyed in 2010 Population Census

- For household members:



1. Name 2. Sex 3. Year and month of birth
4. Relationship to the household head
5. Marital status 6. Nationality
*7. Duration of residency at the current domicile
*8. Place of 5 years previous residence *9. Education
10. Type of activity
11. Name of establishment and kind of business (Industry)
12. Kind of work (Occupation) 13. Employments status
14. Place (Municipality) of work or location of school
*15. Transportation to the place of work or the location of school

NB: Item 7,8,9, 15 are added compared to the 2005 Population Census.

- For households:

1. Type of household 2. Number of household members
3. Type and tenure of dwelling 4. Area of floor space of dwelling
5. Type of building and number of stories

2. Population Census of Japan

- Options for submitting filled-out the 2010 Census questionnaires:
  - enumerators' pickup
  - mail-back to municipalities
  - (For households in Tokyo Metropolitan only) Internet response (online-questionnaire)

2. Population Census of Japan

- The Questionnaires
  are processed and tabulated
  by National Statistics Center (NSTAC),
  an incorporated administrative agency
  attached to SBJ.

  NB: NSTAC had been a part of SBJ until 1984 (as Tabulation Department).
- The Questionnaires are captured
  by optical mark/character reader
  and image scanner.
- Data editing and imputation
  are processed on the computer screen
  (paperless operation).

2. Population Census of Japan

- The Tabulation Plan

1. Preliminary Counts of the Population and Households: February 2011

2. Preliminary Sample Tabulation: June 2011

- Tabulation with one percent sample of households to offer preliminary results on the basic characteristics of population and households
  including sex, age, labour force status, industrial and occupational structure, place of work or schooling, and Migrant.

2. Population Census of Japan

- The Tabulation Plan (cont.)

3. Basic Complete Tabulation on Population and Households : October 2011
4. Basic Complete Tabulation on Industries: April 2012
5. Basic Complete Tabulation on Occupations: November 2012
6. Detailed Sample Tabulation: October 2013

- Tabulation with apprx. one tenth sample of household to provide more detailed tables with finer classifications of industry and occupation of employed persons.

2. Population Census of Japan

- The Tabulation Plan (cont.)

7. Tabulations on Place of Work or Schooling: June 2012 and after

- to provide statistics on the daily movement of workers and students commuting between their homes and places of work or schooling and economic characteristics of commuters.
- The results of this tabulation are also used to calculate the daytime population in each municipality to be compared with each nighttime population i.e. the de jure population.

2. Population Census of Japan

- The Tabulation Plan (cont.)

8. Tabulation on Internal Migration
   - to provide statistics concerning the number, direction and characteristics of those who changed usual place of residence.

1-8 are Tabulation at national, prefecture and municipal level.

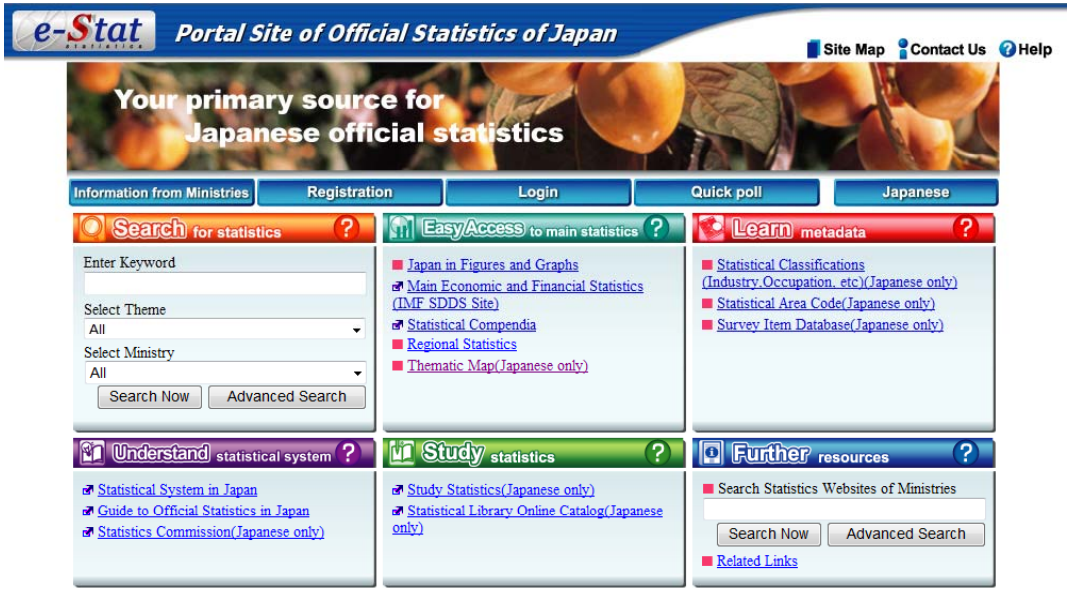
… and 9. Tabulation for Small Area

3. Tabulations for small area

- Small area for statistical presentation
  - **Enumeration Districts** (EDs) are demarcated for census taking purpose. Therefore it is NOT always convenient for statistics users to refer to Statistics by ED
  - For ease of statistical use, ***Cho's and Aza's*** (kinds of city blocks and town blocks) are formulated by combining EDs.
  - **Tabulations for small area** are released in December 2011 and after. (Tables of EDs and *Cho's and Aza's*)

3. Tabulations for small area

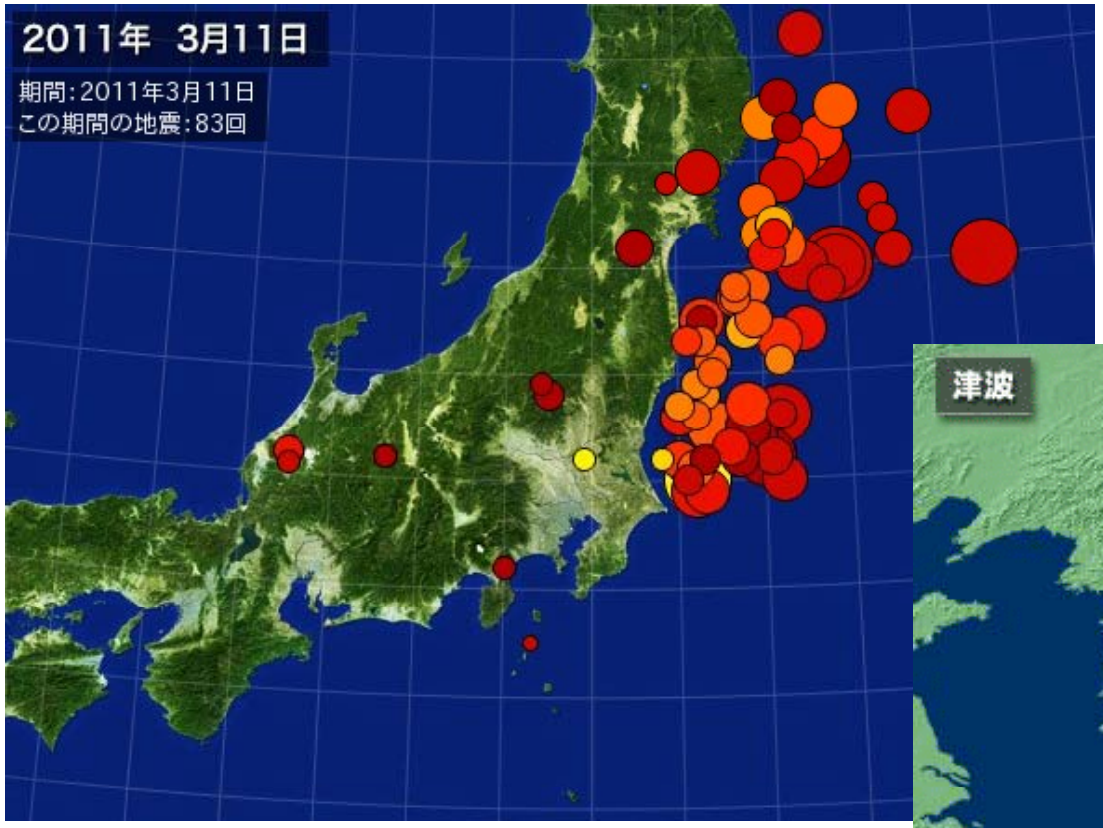
DEMO

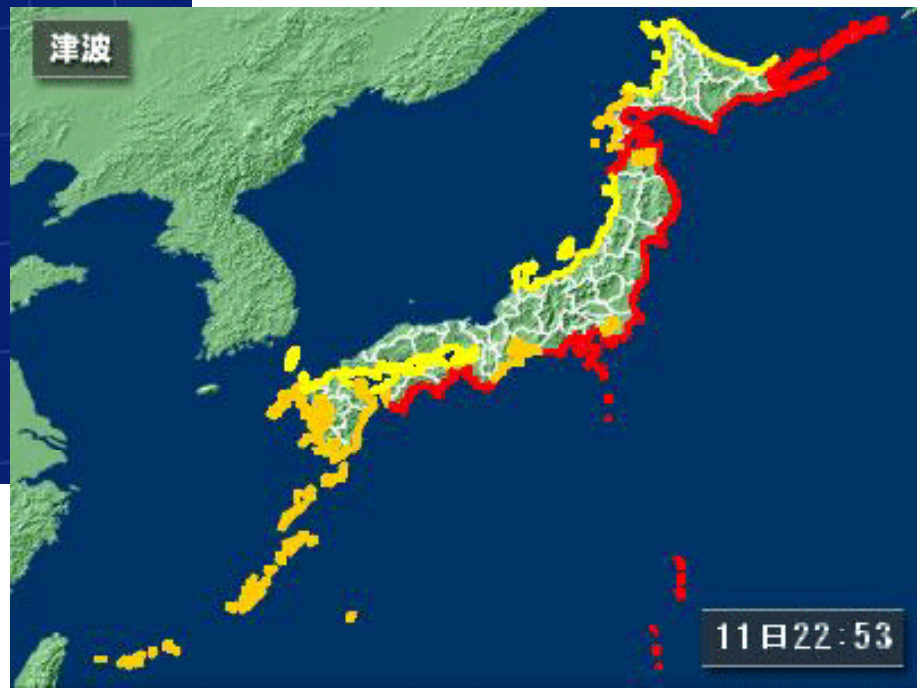


www.e-stat.go.jp

e-Stat GIS is in Japanese language only.

3. Tabulations for small area

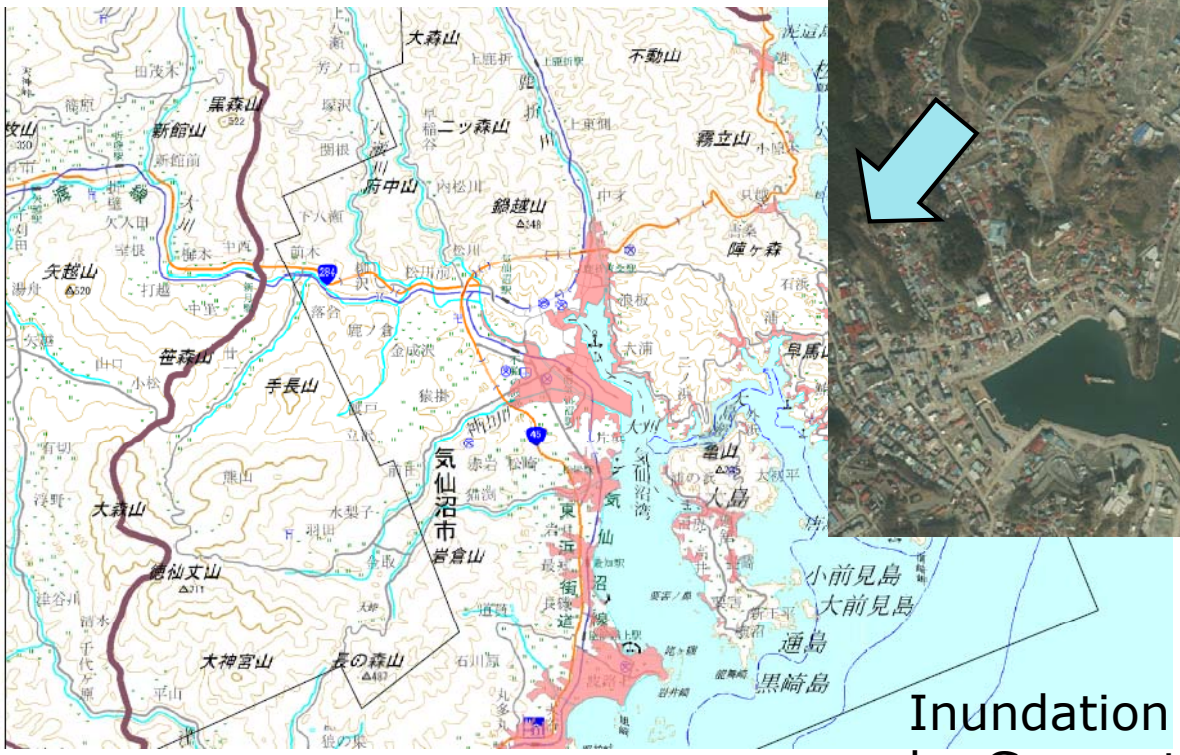




3. Tabulations for small area

- Aggregation of population in the Tsunami inundation area of Great East Japan Earthquake, 2011

Kesennuma City, Miyagi Pref.



Aerial photo after Tsunami

Inundation Area mapped by Geospatial Information Authority

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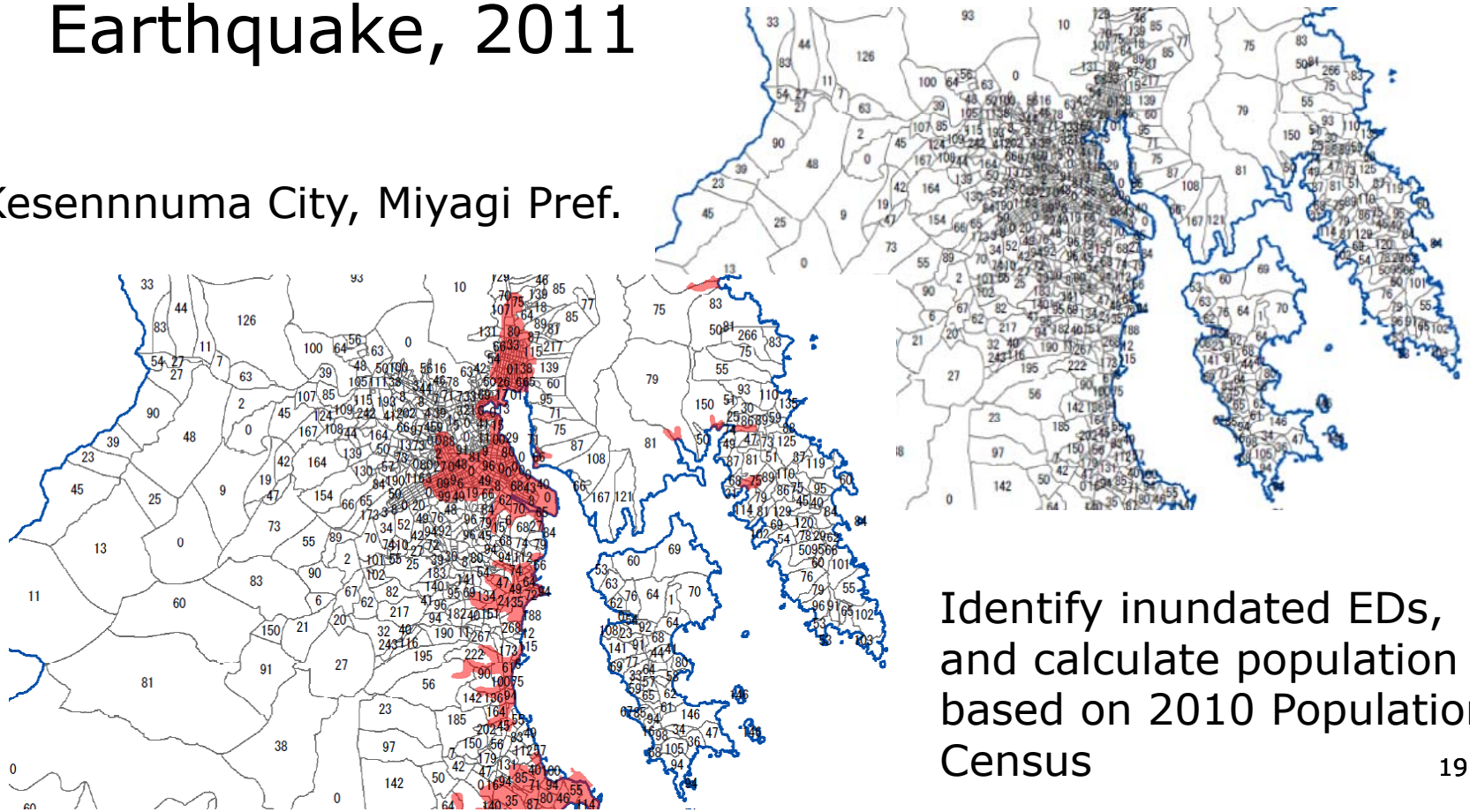


Identify inundated EDs, and calculate population based on 2010 Population Census

3. Tabulations for small area

- Aggregation of population in the Tsunami inundation area of Great East Japan Earthquake, 2011

Fukushima Pref. City/Town #Popul. #Households

県		市区町村		人口	世帯数
07	福島県	204	いわき市	32,520	11,345
		209	相馬市	10,436	3,076
		212	南相馬市	13,377	3,720
		541	広野町	1,385	444
		542	楢葉町	1,746	543
		543	富岡町	1,401	552
		545	大熊町	1,127	359
		546	双葉町	1,278	402
		547	浪江町	3,356	1,006
		561	新地町	4,666	1,400
			合　計	71,292	22,847

※人口・世帯数は、整備中の基本単位区（調査区）境界を基に作成

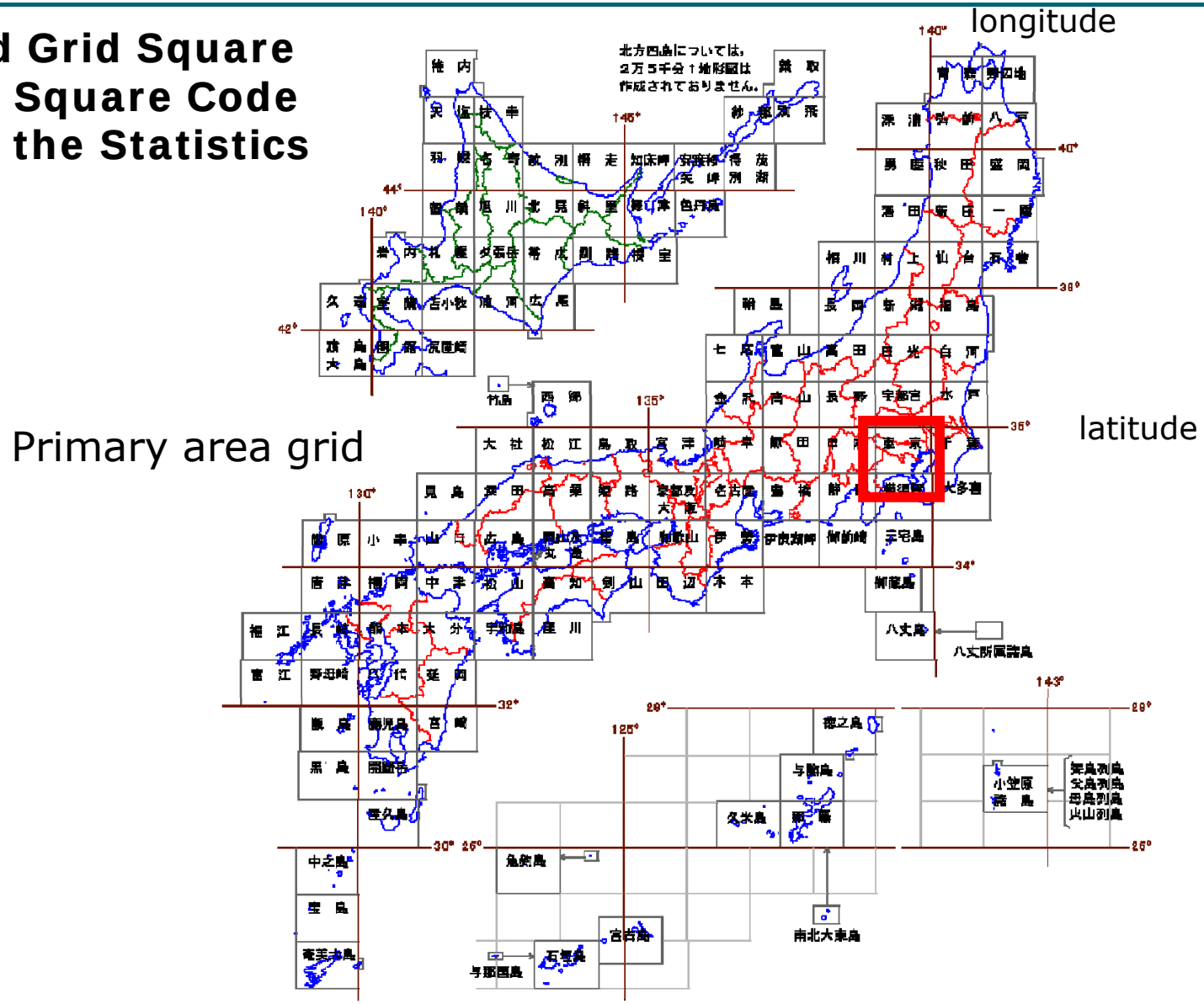
http://www.stat.go.jp/info/shinsai/pdf/sinsui07.pdf
(Japanese language)

4. Grid Square Statistics

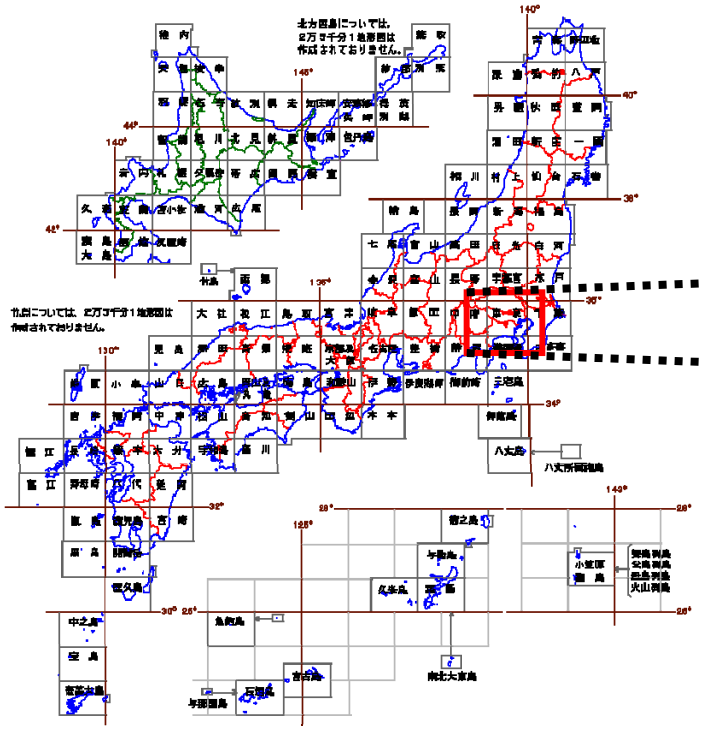
- *Another* small area statistics
- The whole area of Japan is divided into grid squares based on latitudinal and longitudinal lines.
  - approximately 1 km^2, 500 m^2 or 250 m^2
- Advantage of GSS
  - Easy to compare and analyze statistics thanks to **uniform shape across region and over time.**
  - Useful to overlay layers of other statistics or natural and social features.
- GSS based on 2012 Population Census to be released by the end of 2012

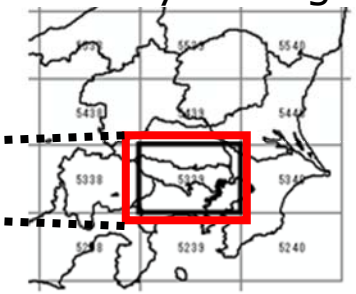
4. Grid Square Statistics

Standard Grid Square and Grid Square Code Used for the Statistics (1973)



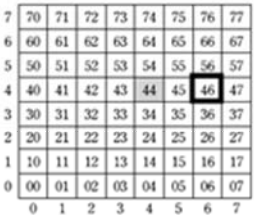
4. Grid Square Statistics





Primary area grid

⇨ 5339



Secondary area grid

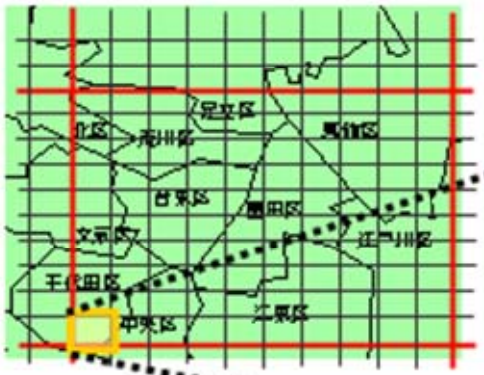
⇨ 5339-46

A **primary regional grid** is some 80 km long in each side.

A **secondary regional grid** is around 10 km long in each side.

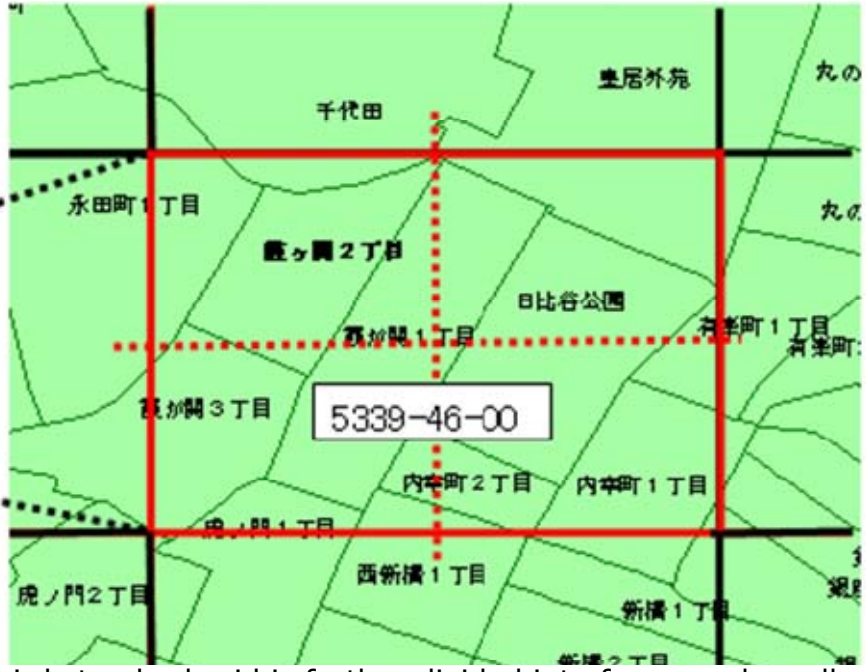
4. Grid Square Statistics

A secondary regional grid divided into 100 smaller blocks, with 10 smaller ones on each side of the secondary block



Third Area grid
(Basic grid square)

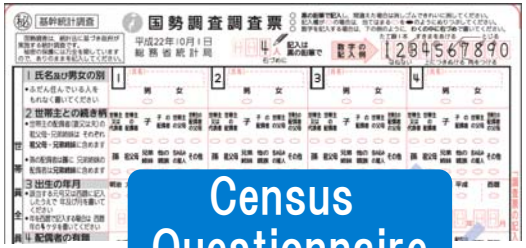
Around 1 km in each side (0.925 km north-south and 1.132 km east-west in Tokyo)



A third standard grid is further divided into four equal smaller blocks, which form the **Half grid square**.

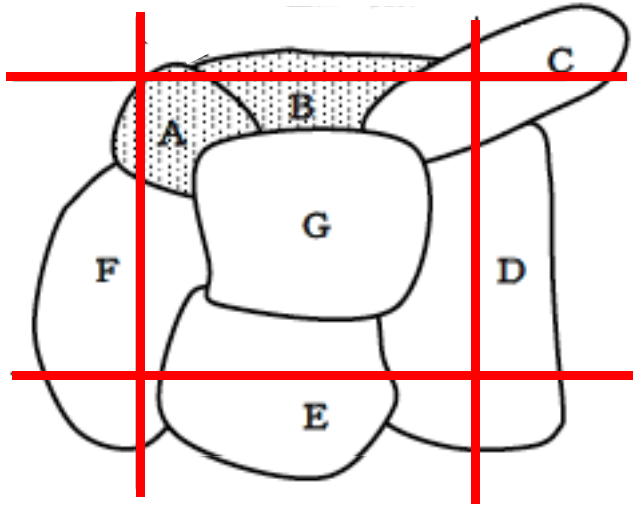
(Each smaller block is some 500 m long in each side.)

4. Grid Square Statistics

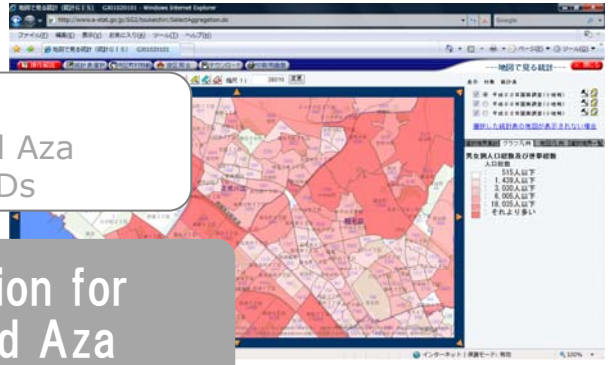


Census Questionnaire

Boundary of Census EDs

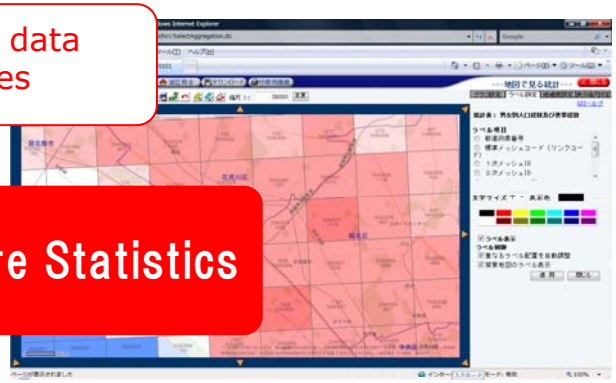


Compiling
data of Cho and Aza
by combining EDs



Tabulation for
Cho and Aza

Assigning ED data
to grid squares



Grid Square Statistics

4. Grid Square Statistics

- Methods of assigning ED-data to Grid

If an ED is completely included in a single grid

-> The whole data are attributed to the grid

If an ED is divided into parts by multiple grids

-> The ED data are distributed to grids in certain ways:

distributed by area ratio;

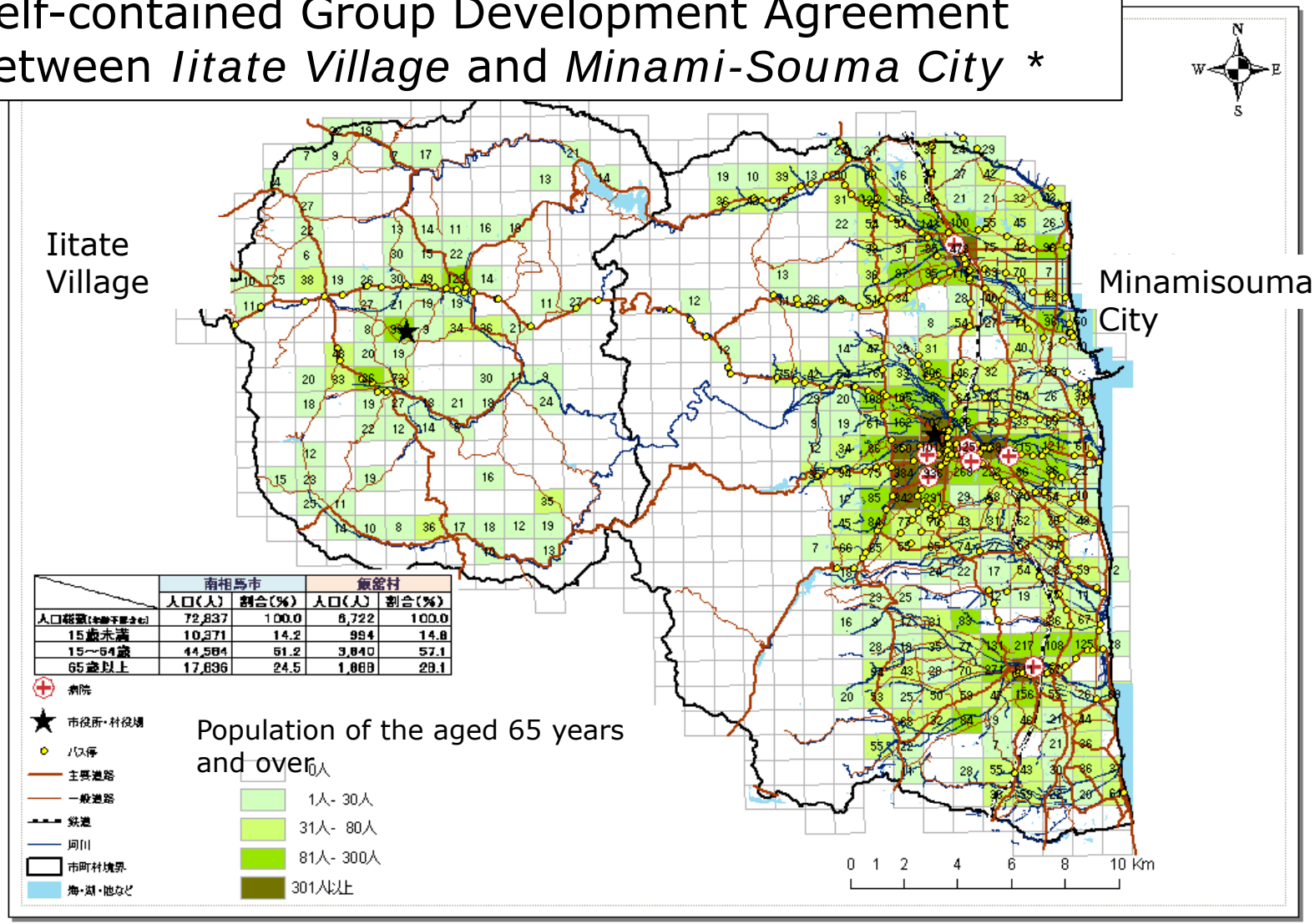
attributed to some inhabited areas; etc.

4. Grid Square Statistics

- Enumeration District Map (EDM)
  - Paper Age: -1990
    - Municipalities demarcated EDs on paper maps (City Planning Maps, Topographic Maps, etc.) and submit paper EDMs to SBJ via prefectures.
  - Transitional Age: 1995-2005
    - SBJ introduced computers for Geographic Information System (GIS), and developed digital ED data by digitizing boundary lines drawn on paper EDM.
  - Digital Map Age: 2010
    - All prefectures borrow data (digital ED data and background map) and GIS software from SBJ and edit EDM on the digital map.

4. Grid Square Statistics

Self-contained Group Development Agreement between *Iitate Village* and *Minami-Souma City* *



* http://www.teijyu-jiritsu.jp/city/detail.php?ccid=11 (Japanese language)

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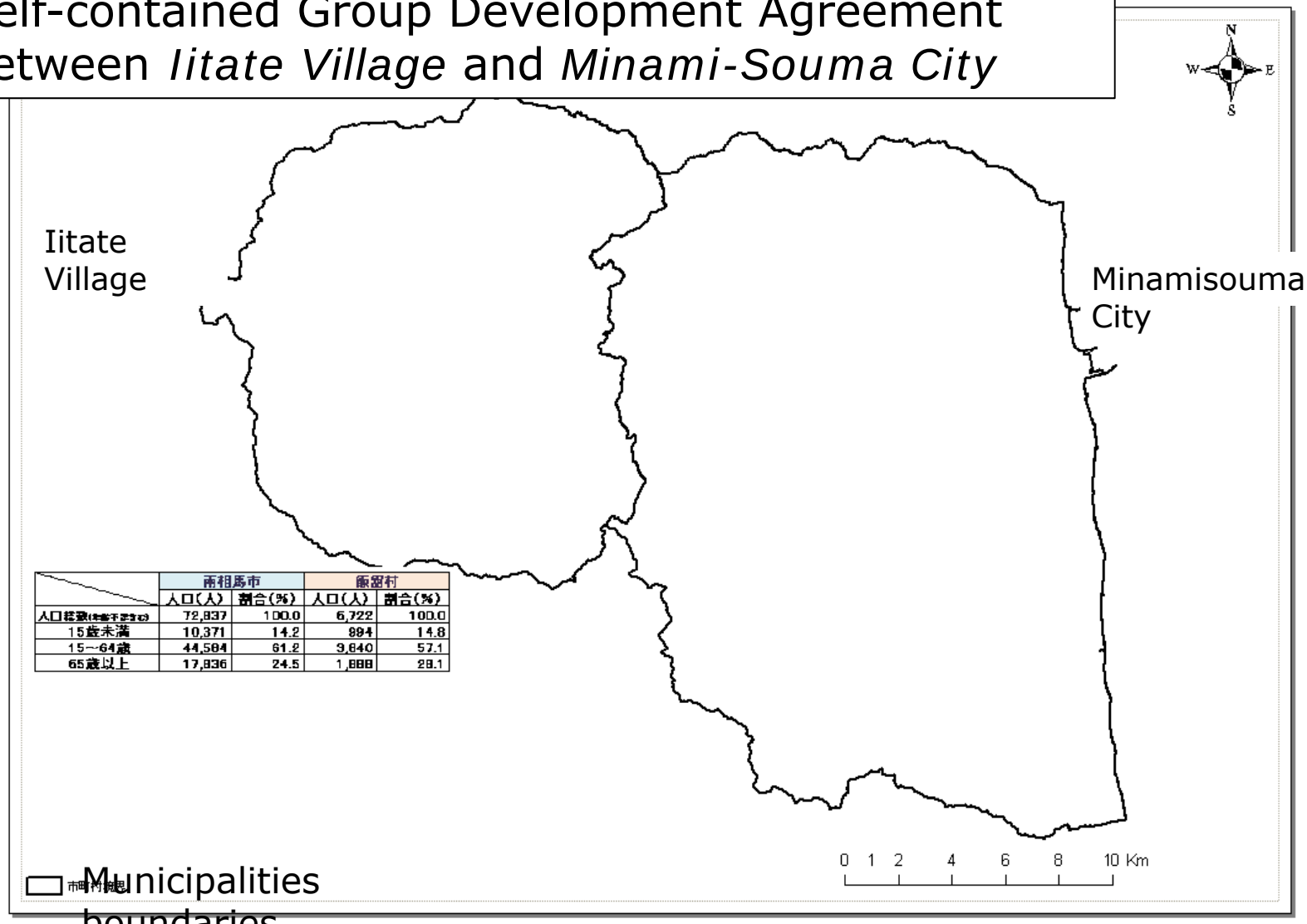

	南相馬市		飯舘村	
	人口(人)	割合(%)	人口(人)	割合(%)
人口総数	72,837	100.0	6,722	100.0
15歳未満	10,371	14.2	894	14.8
15～64歳	44,584	61.2	3,840	57.1
65歳以上	17,836	24.5	1,888	28.1

4. Grid Square Statistics

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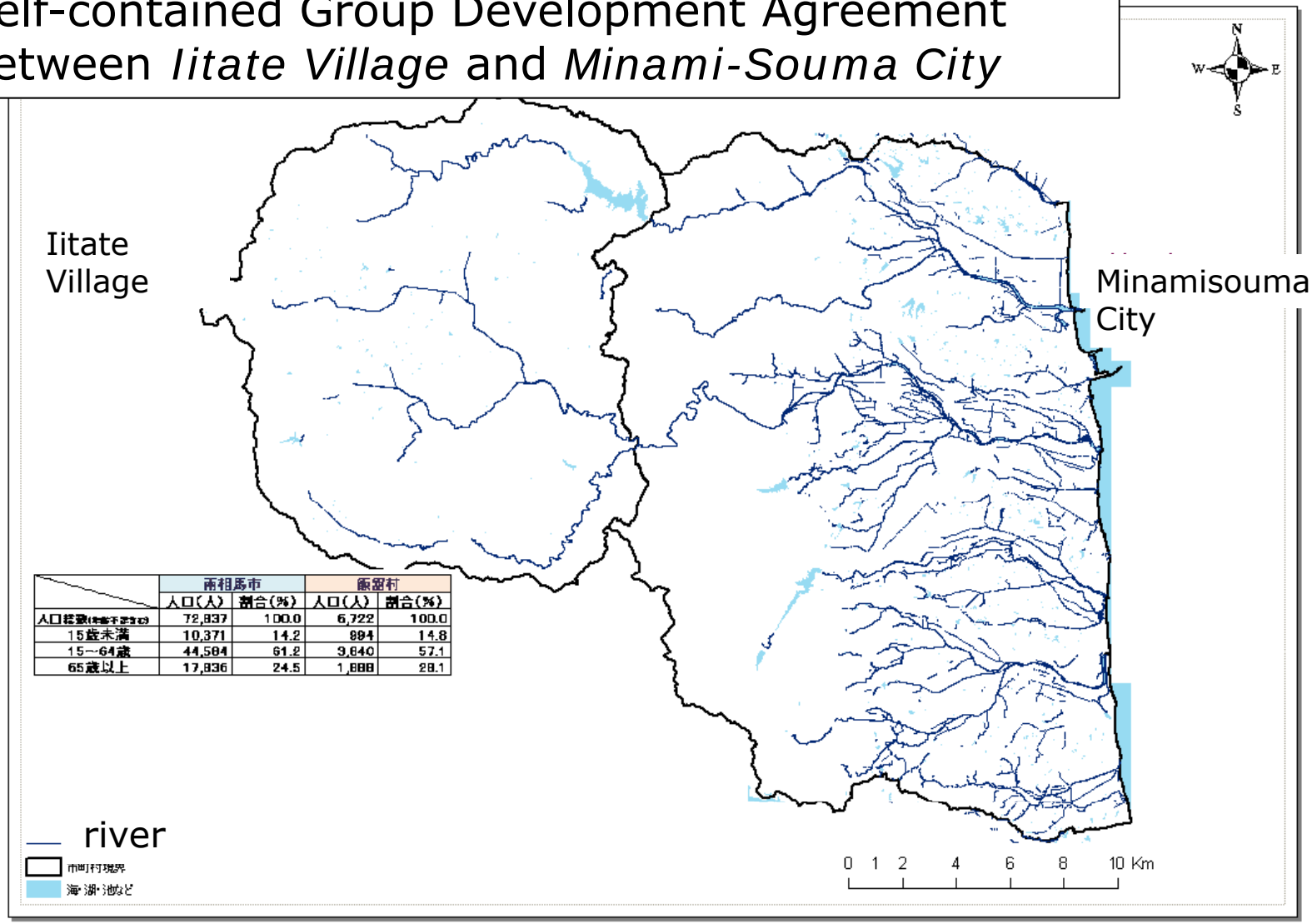

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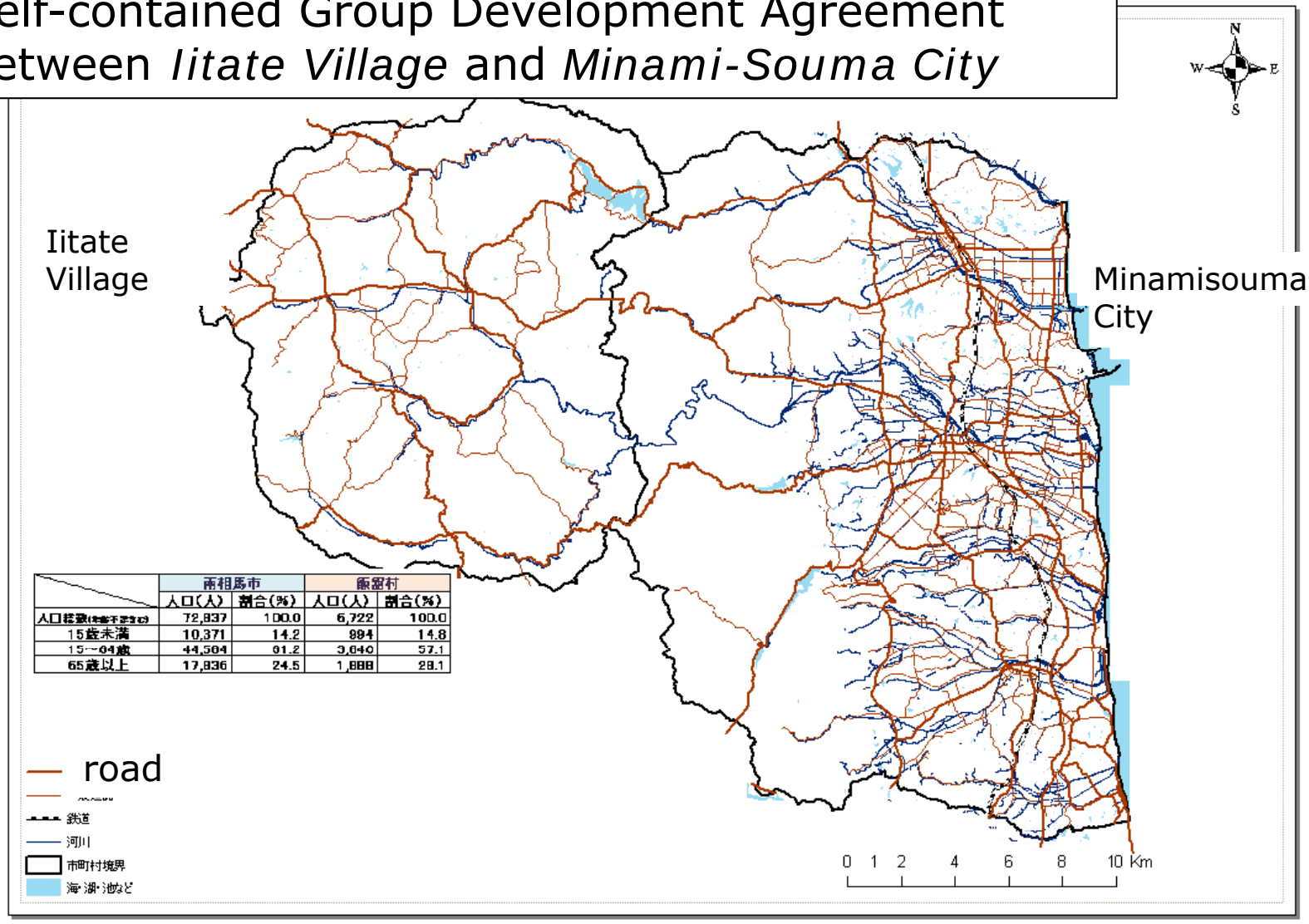

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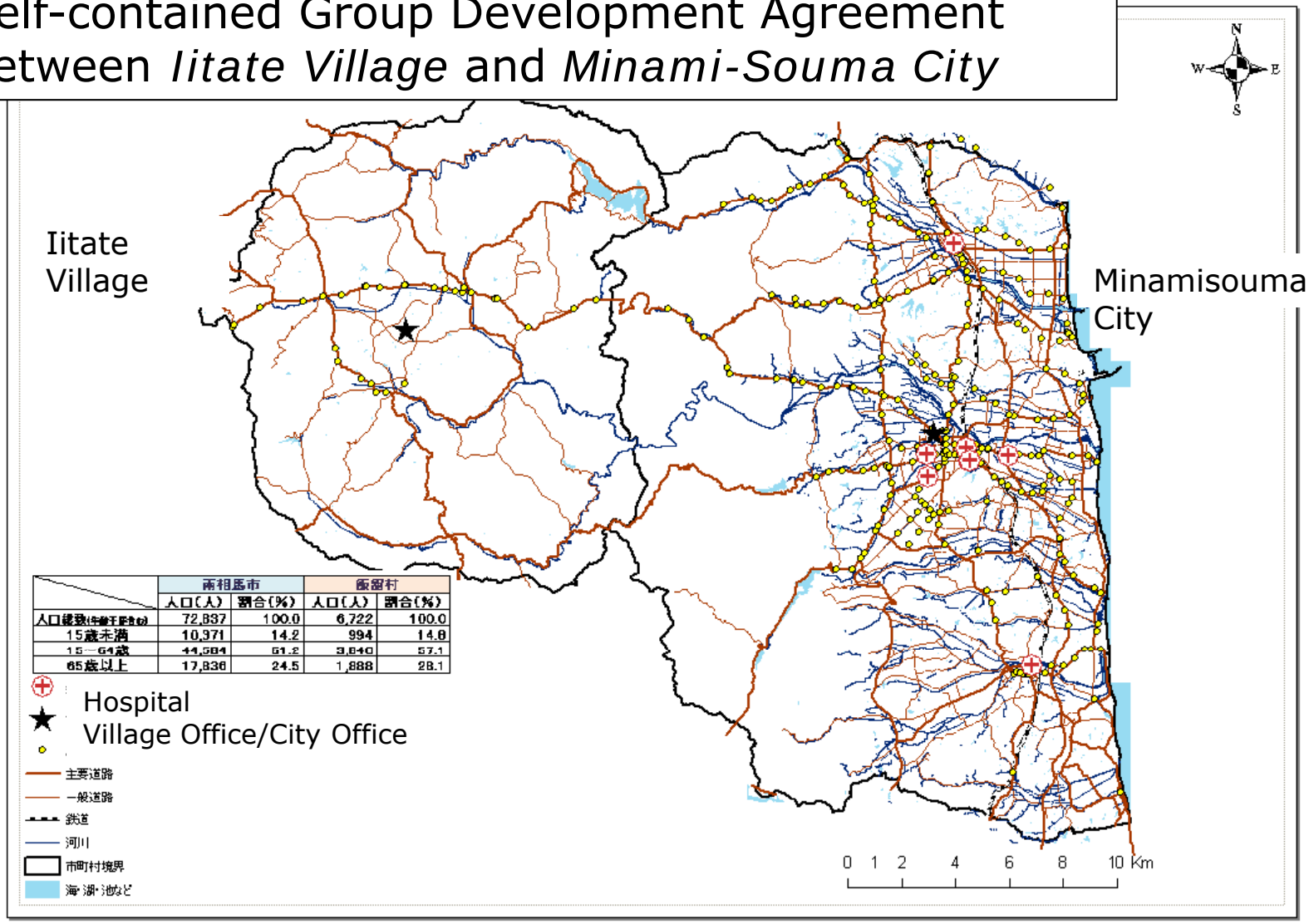

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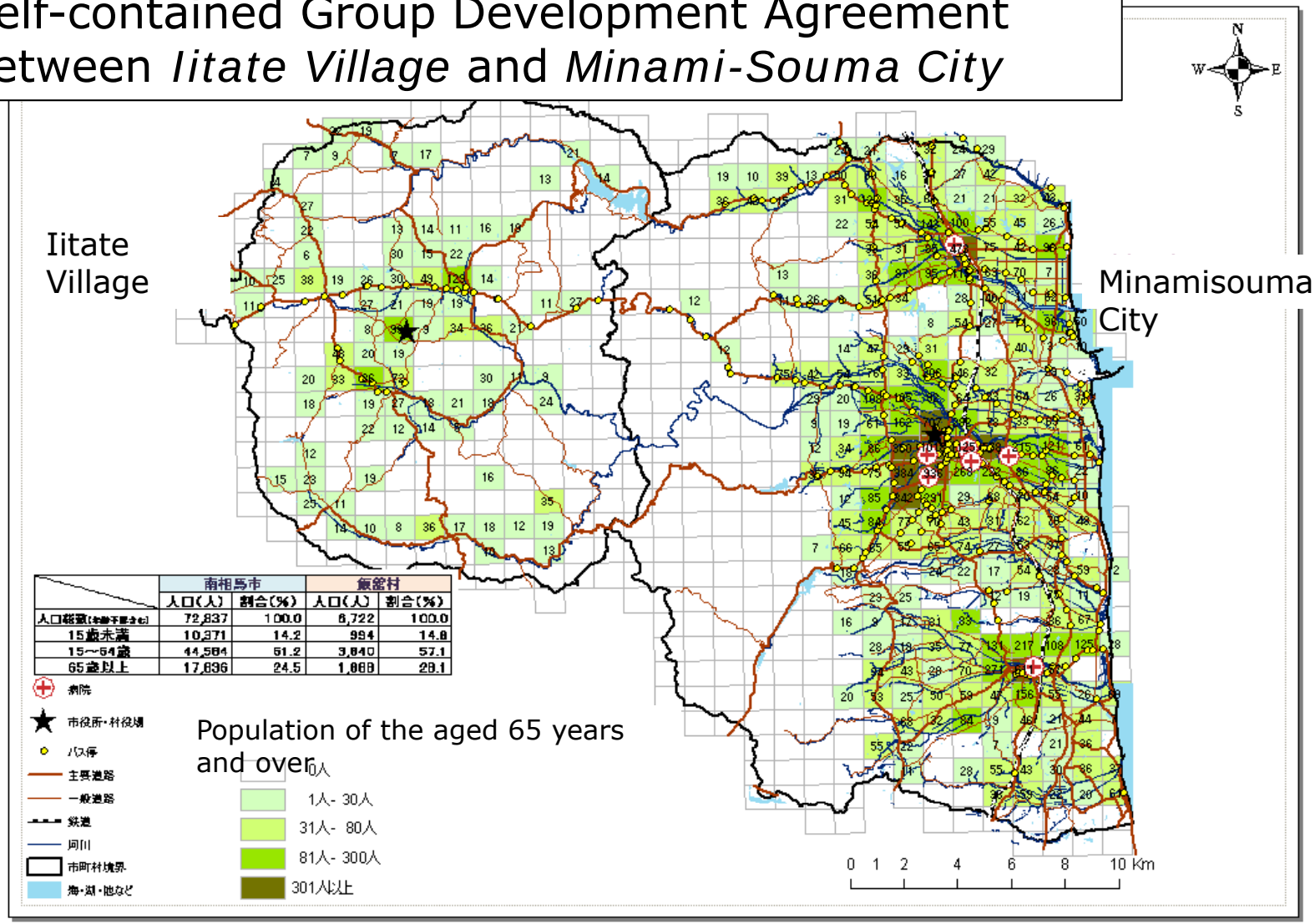
人口総数(年齢不詳を除く)	72,837	100.0	6,722	100.0
15歳未満	10,371	14.2	994	14.8
15—64歳	41,584	51.2	3,840	57.1
65歳以上	17,836	24.5	1,888	28.1

4. Grid Square Statistics

Self-contained Group Development Agreement between *Iitate Village* and *Minami-Souma City*



5. Mobile Spatial Statistics

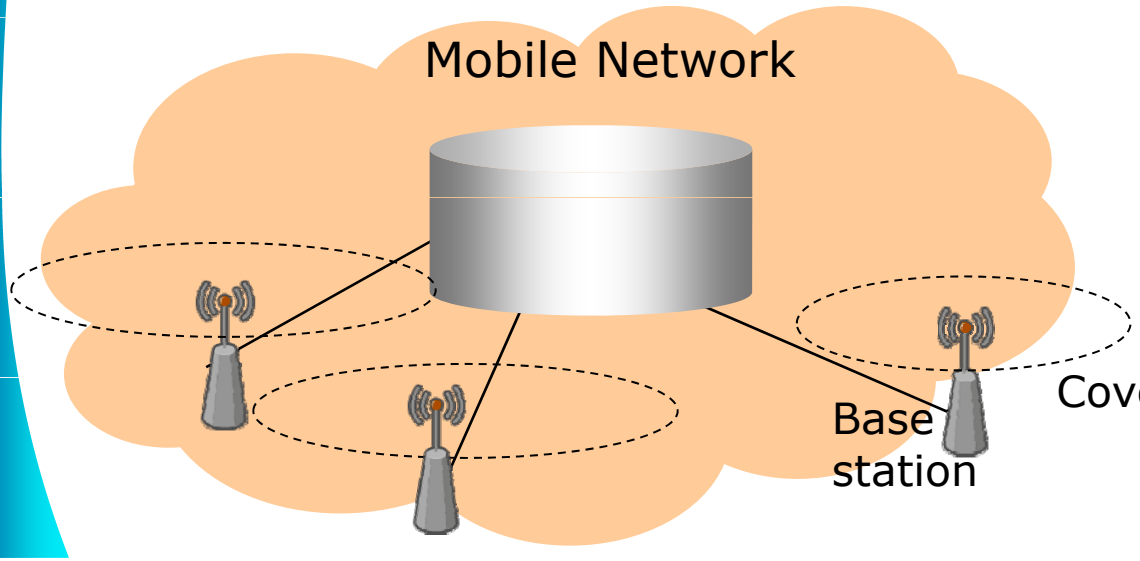
- Japan:
  - Population of 128 million
  - Mobile-phone penetration rate ≈ 100%
- NTT DOCOMO
  - The largest service provider of mobile phones in Japan
  - More than 60 million subscribers.
- Approximately, one out of two Japanese people uses DOCOMO's.

5. Mobile Spatial Statistics

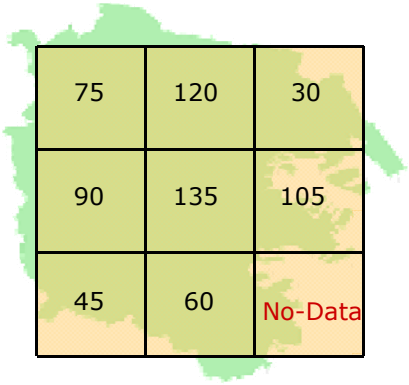
DOCOMO has been developing
small area population estimates on an hourly basis
derived from the operational data of their mobile network

Operational Data

Mobile Spatial Statistics



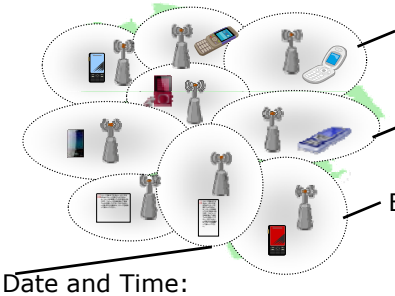
Population Estimation



By age group and sex

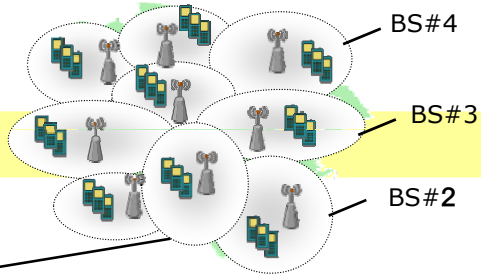
5. Mobile Spatial Statistics

Operational Data



Base station#1, Date and Time:
090-XXXX-, ..., Male, Birthday:10/11/1968, 1-2 B Str. A-city Tokyo
090-YYYY-, ..., Female, Birthday: 10/11/1955, 3-4 D Ave. C-city Chiba
...

1. De-identification process

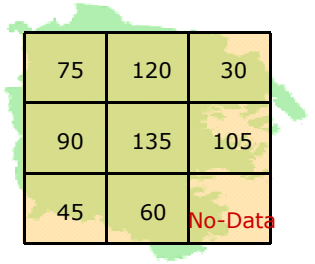


Base station#1, Date and Time:
Male, 40's, A-city Tokyo
Female, 50's, C-city Chiba
…

No-identifiable data

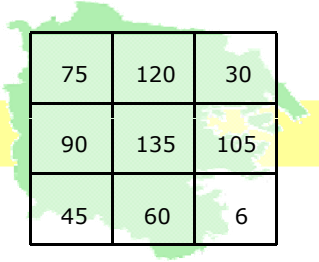
2. Estimation process

Mobile Spatial Statistics



By age group and sex

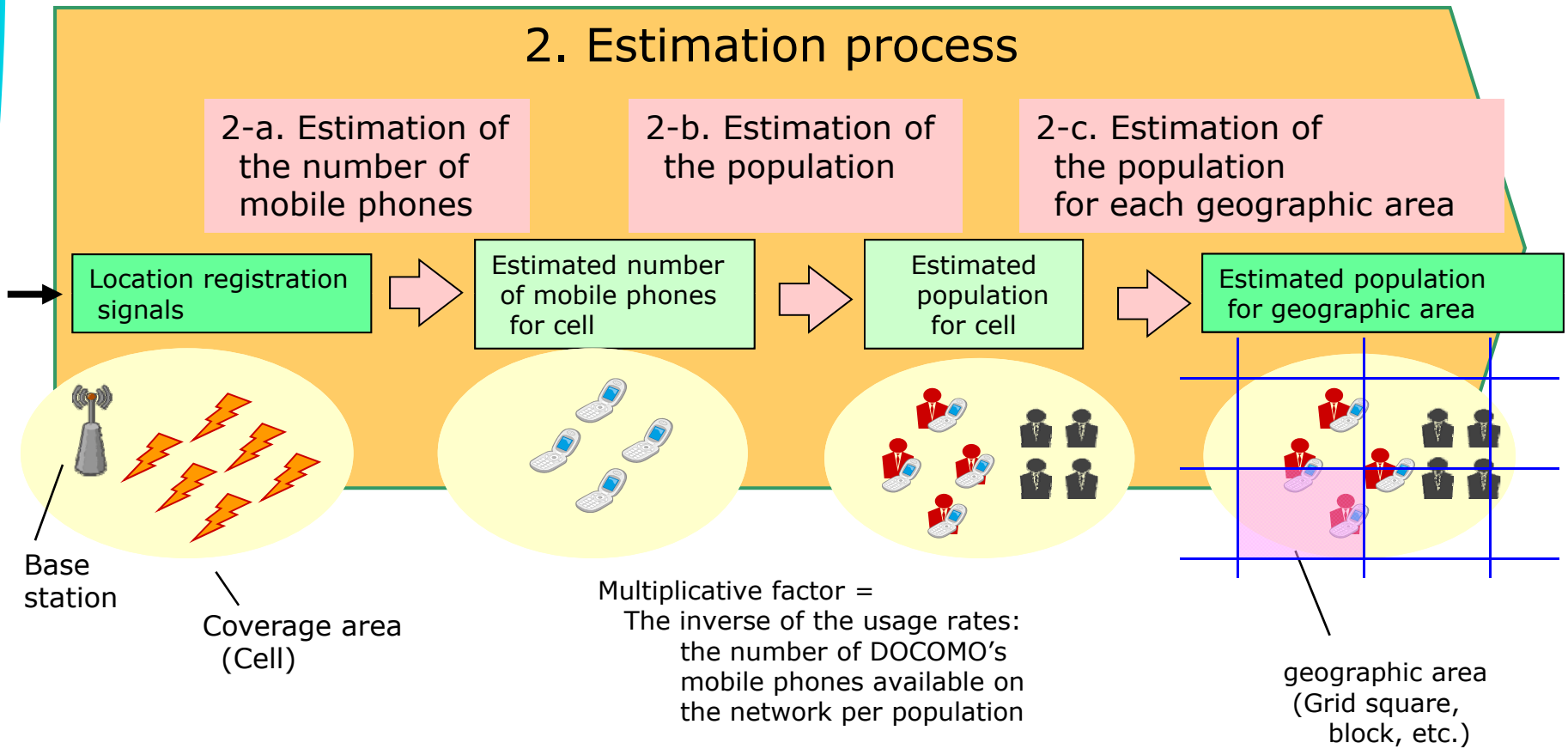
3. Disclosure limitation process



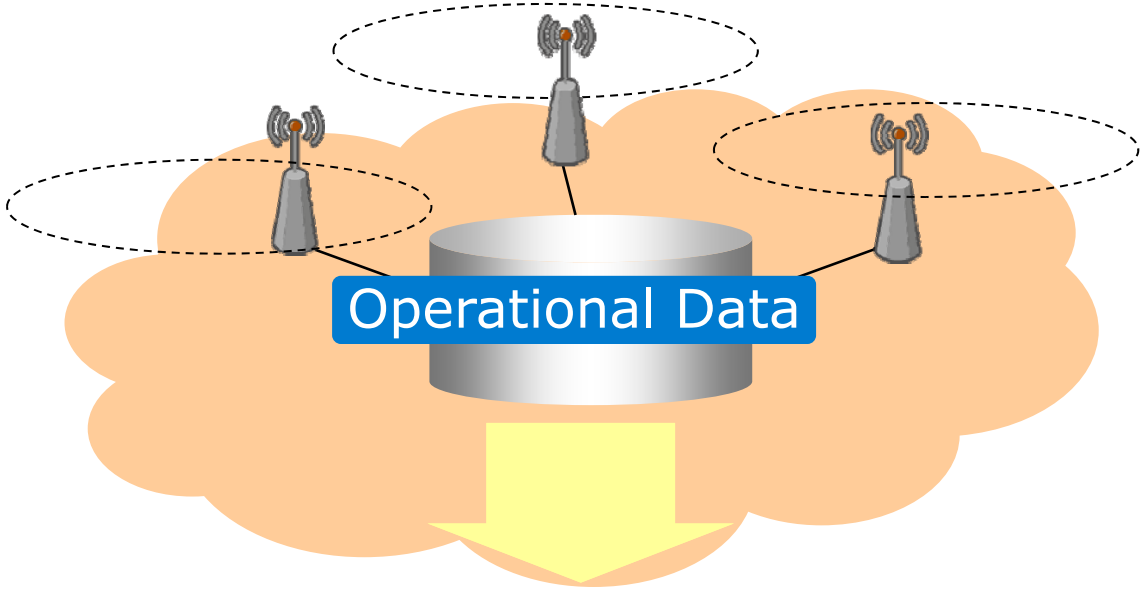
By age group and sex

Estimated population

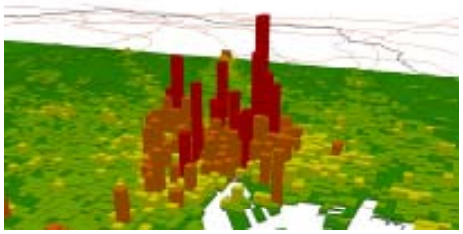
5. Mobile Spatial Statistics



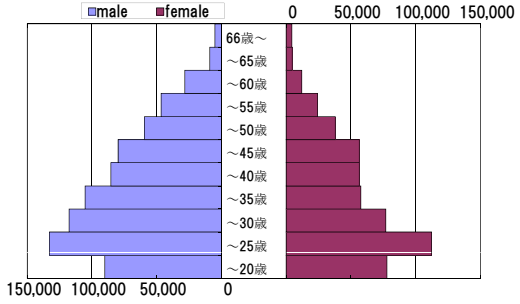
5. Mobile Spatial Statistics



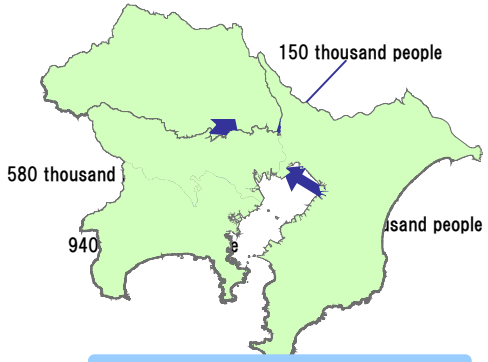
Mobile Spatial Statistics



Population Distributions



Population Demographics



Commuting Population

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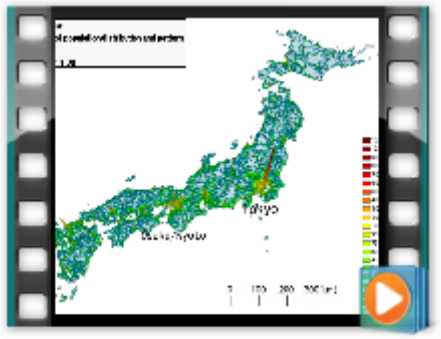
5. Mobile Spatial Statistics

DEMO



5. Mobile Spatial Statistics

- Mobile Spatial Statistics
  - Less accurate than Census's GSS
    - Its method is not a kind of probability sampling.
  - Nevertheless, valuable
    - might grasp the trend of population change on an hourly basis for certain areas
    - can be produced frequently on a timely basis
  - An important difference in the definition
    - GSS: the location of a person is the place where the person usually lives
    - MSS: the location of a person is the place where the person actually exists.

5. Mobile Spatial Statistics

- MSS have many potential statistics users in the field of disaster prevention, local area marketing, etc.
- But they are not convinced of the relevance to make use of MSS.
- There are needs to assess the quality of MSS.

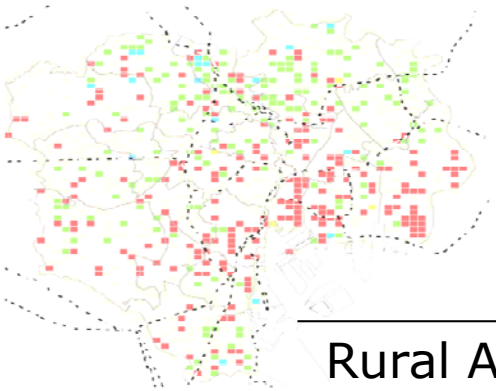
5. Mobile Spatial Statistics

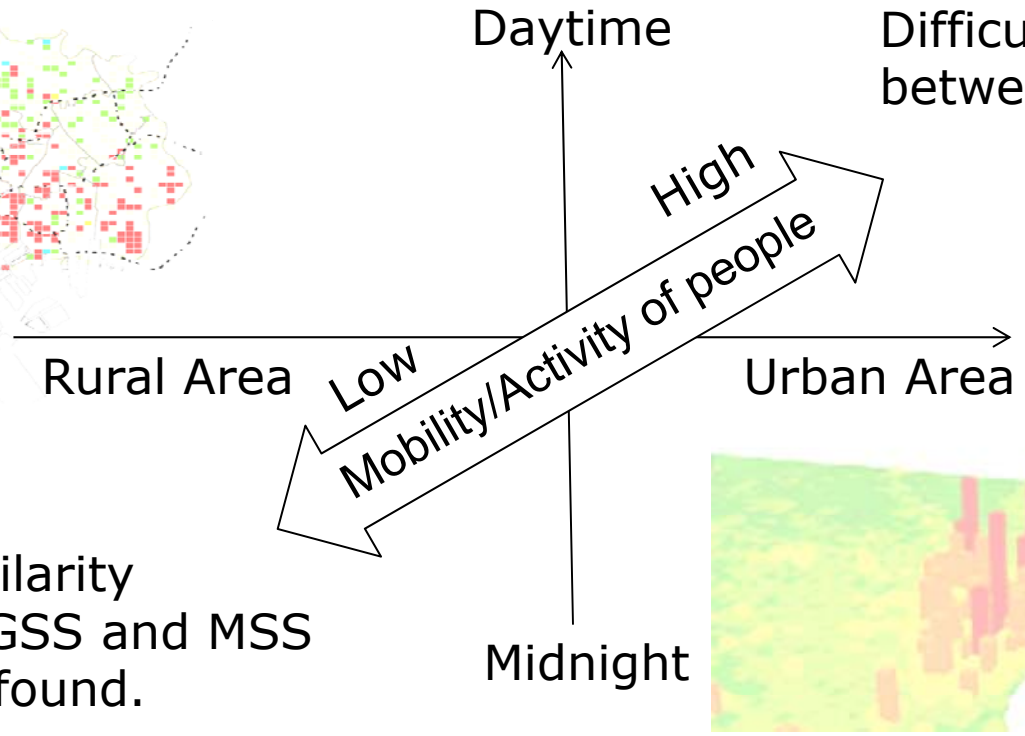
- NSTAC and DOCOMO agreed
  to launch a joint research
  to assess the quality of MSS
  and explore the usability and limitation.

- Research Plan
  - Compare and analyze the data of GSS and those of MSS for the Census day of 2010, when GSS become available by the end of 2012

5. Mobile Spatial Statistics

- Compare and analyze
  the data of GSS and those of MSS





Difficult to find similarity between GSS and MSS.

How to treat people flow into urban areas ? (workers, students, shoppers, etc.)

Some similarity between GSS and MSS might be found.

6. Concluding Remarks

- Small area statistics on population is informative for local development planning
  - Disaster countermeasure
  - Social welfare

- New kind of statistics are emerging.
  - Mobile Spatial Statistics may be, in a sense, useful to serve the needs of statistics users.
  - The quality shall be assessed.

Thank you for your attention!
Any questions?

Views and opinions expressed in this document are those of the authors, and not necessarily those of the organizations which the authors belong to.