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Physical metrics for recreation related ecosystem services and the use of mobile big data for valuation of the services from free-access open spaces

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Today's topic

1. Backgrounds
2. Data sources of mobile location big data (MLBD)
3. An application of MLBD for the valuation
4. SEEA-EA for RES in Kyushu
5. Considerations
6. Conclusions

1. Backgrounds

- Recreational related ecosystem services (RES) are unique in terms of the valuation
  - It is defined only from a user perspective (SEEA-EA, para 6.117)
  - It encompasses experimental and non-material connection between people and ecosystems (SEEA-EA, para 6.116)
  - Their value is recognized only when they are directly used or consumed by people
- Physical metrics of RES
  - The number of visits to a specific natural location is regarded as a suitable proxy (SEEA-EA, para7.49)
- Monetary valuation of RES
  - Travel cost method (TCM) is often used
  - In the method, the number of visits is also crucial

The number of visits is crucial data for RES

1. Backgrounds

- How to obtain the data on N. of visits
  - Onsite social surveys in most cases
  - However, for free access open spaces which have no identified entrances and exits, such kind of survey is not applicable
- One of the solutions
  - To utilize big data, specifically mobile location big data (MLBD)
  - MLBD have already utilized in various research fields
- Purposes of this study
  - To introduce how to utilize big data for the valuation of ecosystem services focusing on MLBD and to examine pros and cons of the data
  - To apply MLBD to the valuation of RES using cases in Japan

2. Data sources of MLBD

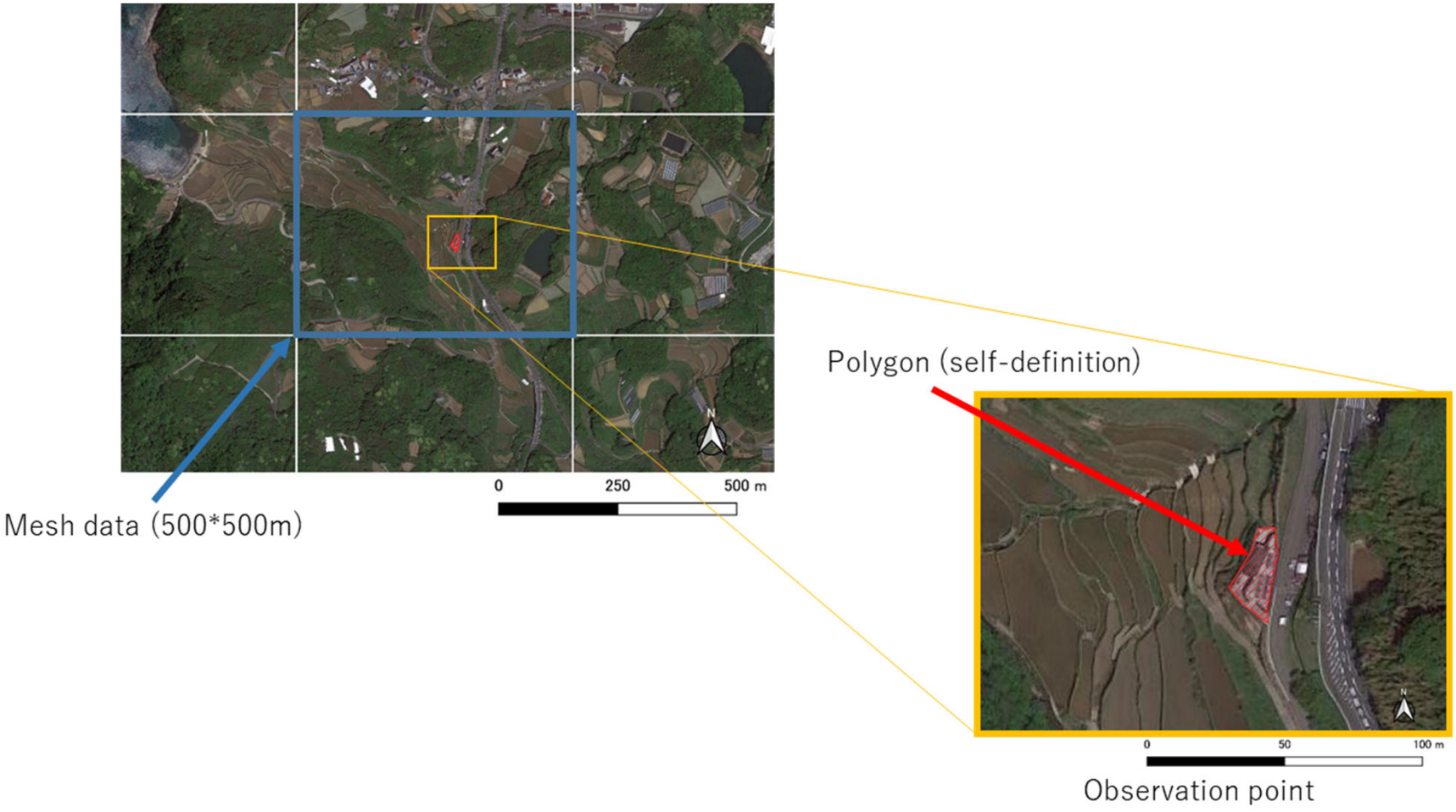
- Three different types of MLBD
  - Mesh
    - Appropriate for relatively large areas
    - Easy to connect with other mesh-formed statistical data
    - May include not only target area but also other non-target areas
  - Polygon
    - Possible to identify a small target area: urban green space, one plot of land etc.
    - A polygon can be defined freely by users and easy to analyze the data
    - Users have to define a polygon by oneself, and it may in turn be a time-consuming and requires much works especially when target areas are large
  - Point
    - Easy to understand the movement of a person at a street level
    - Not also suitable for a larger area
- Data selection
  - Depends on in which area one should value ecosystem services

2. Data sources of MLBD

Table 1 Characteristics of different types of mobile location big data

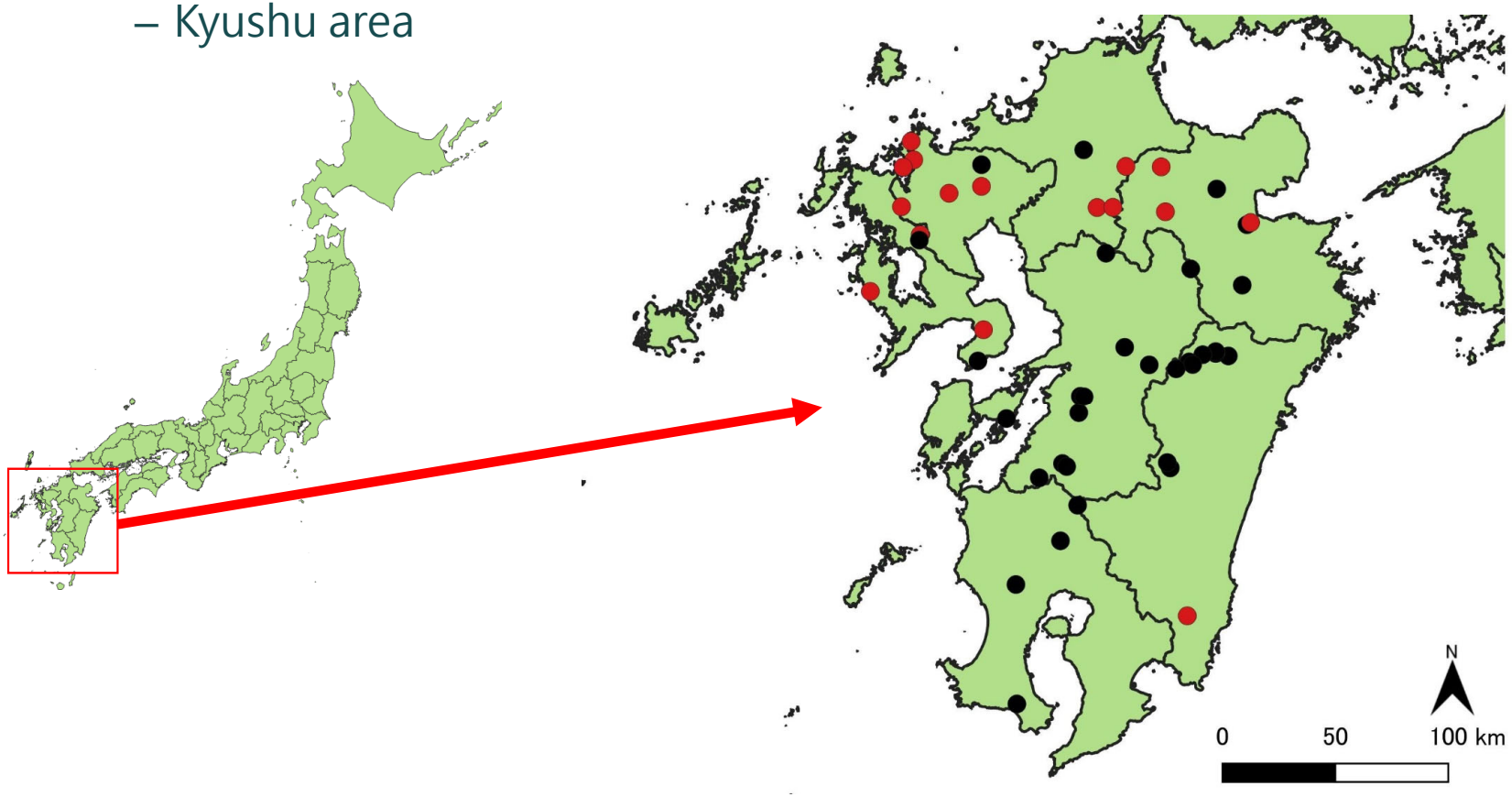
	NTT docomo Softbank	KDDI	Softbank
Data type	・Meshes	・Self-defined polygons	・Self-defined points
Acquisition of data	・By GPS via communication base station	・By GPS function in a gadget	・By a specific application
Attribution of visitors	・Connected with officially certificated data used for mobile phone contracts Age, gender, etc.	・Connected with officially certificated data used for mobile phone contracts Age, gender, etc.	・Data voluntarily registered by users Presumption from registered data
Advantages	・Large number of samples ・Able to combine with other mesh-formed statistical data	・Able to define any areas and to obtain data in the areas ・Able to analyze a specific facility or area	・Able to analyze at street level ・Able to analyze with detailed location data ・Able to analyze on the movement within a small area
Disadvantages	・Data availability depends on the location of communication dase stations, causing low data availability for small population areas	・Data available only for those who accept to the data provision ・Not suitable for analysis of large area	・Data available only for those who use the application AND accept to the data provision ・Possibility for biased data ・Low data availability for small population areas
Sample size	・Huge (Tens of millions)	・Big (Millions)	・Small (Hundreds of thousands)
Suitable to	Larger area ⟷ Smaller area		

2. Data sources of MLBD



3. An Application of MLBD for the valuation

- Study site
  - Kyushu area



3. An Application of MLBD for the valuation

- Valuation target: terraced rice paddies (TRPs)
  - There are 48 TRPs in Kyushu which are registered to “The Best 100 TRPs in Japan”
  - Among which 16 have visitor accommodation facilities (observation points, parking spaces, rest spaces, etc.)
  - We chose these 16 TRPs for valuation target
- Data collection
  - Apply polygon type MLBD provided by KDDI
  - Data is collected for all 16 TRPs in each month from 2018 to 2022
  - But at moment, we conducted trial data collection and only data in May and in September. from 2018 to 2021 is collected

3. An Application of MLBD for the valuation

- Valuation with travel cost method (TCM)
  - $TC_{ij} = C_{Tij} * 2 + C_{Oij}$
  - $TC = \sum_j (\sum_i (TC_{ij}) * V_j)$
    - C_{Tij}: one-way transportation cost for visitor i from city j
    - C_{Oij}: opportunity cost
    - V_j: N. of visits from city j
- Data collection
  - Apply polygon type MLBD provided by KDDI
  - Data is collected for all 16 TRPs in each month from 2018 to 2022
  - But at moment, only data in May and in September from 2018 to 2021 is collected

Photo: K. Yoshida

4. SEEA-EA for RES in Kyushu

2018 Ecosystem accounting for recreational service of rice paddy terrace in Kyushu
2019 Ecosystem accounting for recreational service of rice paddy terrace in Kyushu
2020 Ecosystem accounting for recreational service of rice paddy terrace in Kyushu
2021 Ecosystem accounting for recreational service of rice paddy terrace in Kyushu

	Physical accounting			Monetary accounting		
	Number of visitors (presons)			Monetary value (JPY)		
	From Kyushu inside	From out of Kyushu	Total	Domestic consum.	Export	Total
2021/1						
2021/2						
2021/3						
2021/4						
2021/5	5444	206	5650	16,167,483	6,663,398	22,830,882
2021/6						
2021/7						
2021/8						
2021/9	6294	74	6368	13,537,286	3,830,779	17,368,065
2021/10						
2021/11						
2021/12						
1st Qt	0	0	0	0	0	0
2ns Qt	5,444	206	5,650	16,167,483	6,663,398	22,830,882
3rd Qt	6,294	74	6,368	13,537,286	3,830,779	17,368,065
4th Qt	0	0	0	0	0	0
2021 total	11,738	280	12,018	29,704,770	10,494,177	40,198,947

Physical and monetary accounts for RES

- Characteristics
  - Accounting period
    - Yearly, quarterly and monthly
  - Local consumption and export
    - Consumption of RES by outsiders can be recorded

2021	Units of measure	Economic units				Ecosystem assets				
		Recreation services	Households		Total	Forest	Clopland			Grasslands
			Inside Kyushu	Out of Kyushu			Paddies		Arable land	
							TRPs	Others		
Supply RES	1000JPY						40,199			
Use RES	1000JPY		29,705	10,494	40,199					

2021	Units of measure	Economic units				Ecosystem assets				
		Recreation services	Households		Total	Forest	Clopland			Grasslands
			Inside Kyushu	Out of Kyushu			Paddies		Arable land	
							TRPs	Others		
Supply RES	# Visits						12,018			
Use RES	# Visits		11,738	280	12018					

Supply and use tables (monetary and physical)

Note: Figures are tentative

5. Considerations

- Advantages of MLBD utilization
  - Visitation data can be obtained from free-access open spaces
  - A couple of data sources are available depending on valuation targets from local to national scales
  - Past data is available

5. Considerations

- Limitations
  - In all types of MLBD, the data provided to public is anonymized, and are not actual visitation figures and manipulated by data supplier due to constraint on the provision of private information
  - The data is updated at any time
    - Results vary depending on the date we conduct the valuation
  - Missing link with visitors' information

These challenges may lead to inaccurate valuation and upgrade of the databases are strongly required

Difference in figures between data obtained January 2023 (1st) and that obtained in June 2023 (2nd)

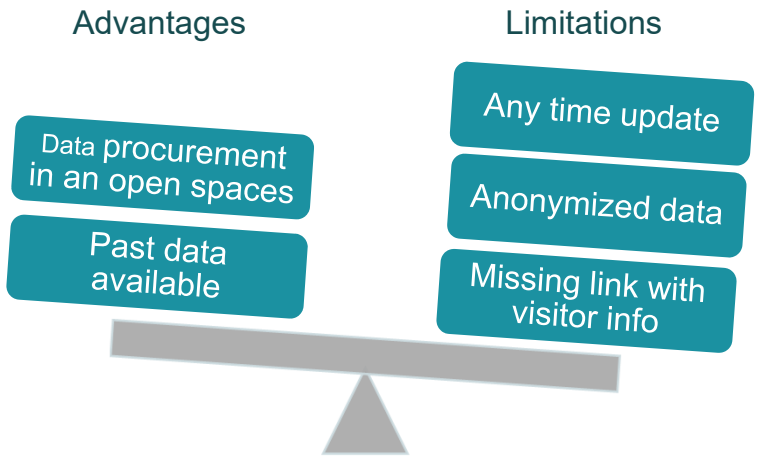
Origin	Visitation in May 2018			Visitation in Sept. 2018		
	1st analysis	2nd analysis	Ratio	1st analysis	2nd analysis	Ratio
Chiba	46	62	1.35	NA	NA	
Tokyo	NA	NA		NA	NA	
Ishikawa	NA	NA		NA	NA	
Shizuoka	NA	NA		30	NA	
Mie	103	NA		NA	NA	
Osaka	NA	NA		26	34	1.31
Nara	NA	NA		NA	NA	
Wakayama	67	82	1.22	NA	NA	
Okayama	NA	NA		NA	NA	
Hiroshima	NA	NA		NA	NA	
Yamaguch	NA	NA		NA	NA	
Fukuoka	231	346	1.50	147	194	1.32
Saga	145	189	1.30	34	46	1.35
Nagasaki	NA	NA		NA	NA	
Kumamot	NA	NA		NA	NA	
Oita	NA	NA		NA	NA	
Total	592	679	1.15	237	274	1.16

6. Conclusions

- Recently, the development of big data is accelerating worldwide
- We investigated the possibility to utilize the data for valuations of ecosystems and their service particularly for RES
- Although MLBD hold a possibility to improve the valuation of ecosystems and their services, there also are some (big) challenges which have to be tackled
- So at moment, the contribution of MLBD to precise estimation of visitors is limited in the case of this study, which is very small area like TRPs
- We hope that the databases will be upgraded so that it can be utilized for SEEA accounts

6. Conclusions

- Big data including MLBD is still in the stage of development and will be improved and updated in the near future
- We, authors will continue to keep eye on the development and improvement of big data.
- We believe that it is important to utilize these new data sources in the context of SEEA framework and concepts and to discuss how we, can utilize it for SEEA completion



Thank you very much!

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