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Nobusuke Iwasaki

National Agriculture and Food Research Institute, Institute

David Spraguea

National Agriculture and Food Research Institute, Japan

Ayaka Onohara

Japan Society for the Promotion of Science

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Classification of land use/cover change in the Kanto region, Japan using FOSS4G and Open Data

Nobusuke Iwasaki^a, David Sprague^a, Ayaka Onohara^b

^a National Agriculture and Food Research Institute, ^b Japan Society for the Promotion of Science –
niwasaki@affrc.go.jp, sprague@affrc.go.jp, aonoa68@gmail.com

ABSTRACT:

In this study, we classified land use/cover change from the 1880's to 2010's in the Kanto Region, Japan. First, we developed a 100m grid land use/cover database of the 1880's with QGIS application and PostGIS database. The data were published through the GitHub Site as an Open Data (CC BY 4.0).

We imported Japanese national Open Data about land use (1970's and 2010's) to the PostGIS database, and carried out a spatial join with land use/cover data of the 1880's. A model-based clustering method was applied to the land use/cover change data that were summarized based on a 1 km by 1 km grid.

The land use/cover change was classified into 29 categories, and we applied multi-dimensional scaling (MDS) analysis to categorize data. Based on MDS analysis, the categories were divided into 7 groups, and each land use/cover change category had a strong relation with distance and direction from central Tokyo and topographical features.

KEYWORDS: Historical map; land use change; Open Data

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Nobusuke IWASAKI (NIAES, niwasaki@affrc.go.jp), David S. SPRAGUE (NIAES) and Ayaka ONOHARA (JSPS Research Fellow, aonoa68@gmail.com)



Abstract

In this study, we classified land use/cover change from the 1880's to 2010's in the Kanto Region, Japan. First, we developed a 100m grid land use/cover database of the 1880's with QGIS application and PostGIS database. The data were published through the GitHub Site as an Open Data (CC BY 4.0). We imported Japanese national Open Data about land use (1970's and 2010's) to the PostGIS database, and carried out a spatial join with land use/cover data of the 1880's. A model-based clustering method was applied to the land use/cover change data that were summarized based on a 1 km by 1 km grid. The land use/cover change was classified into 29 categories, and we applied multi-dimensional scaling (MDS) analysis to categorize data. Based on MDS analysis, the categories were divided into 6 groups, and each land use/cover change category had a strong relation with distance and direction from central Tokyo and topographical features.

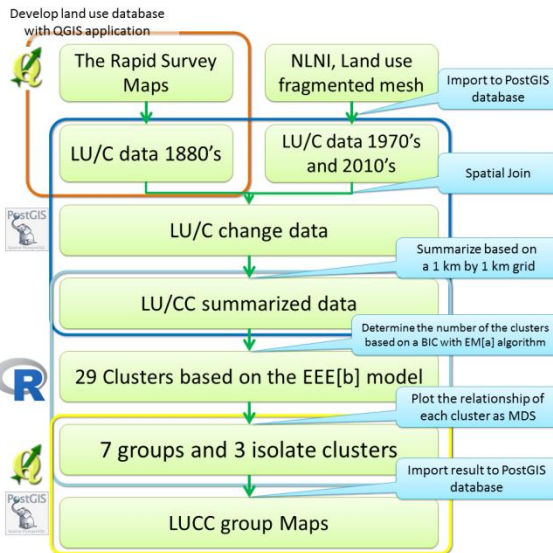
Introduction

- Historical land use/cover change are valuable information for biodiversity evaluation, disaster management and many other uses. The Rapid Survey Maps (RSM) that were surveyed in the 1880's (early Meiji Era), are the first modern cartographical map series of Japan and important sources of information on traditional land use in early modern Japan.
- We developed a grid based land use database using QGIS and PostGIS, and published the database using GitHub and carried out a model-based clustering method to land use/cover change data derived from Open Data.

Material & Methods

- Material**
 - Land use data
 - 1880: The Rapid Survey Maps
 - 1970's and 2010's : National Land Numerical Information (NLNI) Land use fragmented mesh

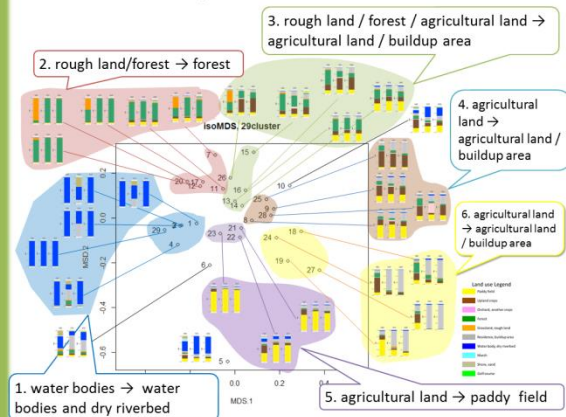
Methods



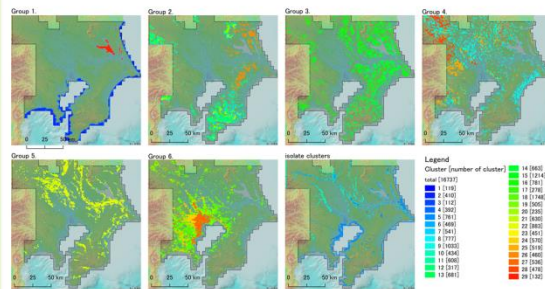
- [a] EM algorithm for maximum likelihood estimation of multivariate mixture models[1].
- [b] EEE models , covariance structure has the following features → distribution: ellipsoidal, volume: equal, shape: equal, orientation: equal

Result

- The relationship between each cluster based on MDS



Spatial distribution of clusters



Discussion and Conclusion

- Based on MDS analysis, the categories were divided into 6 groups, and each land use/cover change category had a strong relation to distance from central Tokyo and topographical features.
 - Group 6, i.e. urbanization, occupied any topographical condition nearby Tokyo. On the other hand, Group 5 occupied Alluvial plain far from Tokyo.
 - Land use/cover change to the forest and agricultural land occurred far from Tokyo.
- FOSS4G has a good capability to develop and analysis this kind of a large data set.
 - Total numbers of land use/cover change records are about 170 million and land use/cover summarized records are 1.7 thousands.

Reference
 [1] Fraley C, Raftery AE. Model-Based Clustering, Discriminant Analysis, and Density Estimation. Journal of the American Statistical Association. 2002 Jun;97(459):611-631

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