

# Assessment of Classification Accuracy of Four Global Land Cover Data in Nine Urban Agglomerations

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## ABSTRACT

Land cover data is an important information in natural resource survey, land management, environmental monitoring, etc. It is worthy of meaning to estimate its accuracy and reveal its category confusion characteristics for many scientific fields. In this study, nine urban agglomerations were selected as the study area, and samples were collected by visual interpretation of Google Earth's high-resolution images. Then, the spatial distribution characteristics and classification accuracy of four land use cover data products (FROM-GLC, GLC-FCS30, GlobeLand30 and CCI-LC) were analyzed quantitatively and qualitatively. The results show that all products have achieved good results in the classification of urban agglomeration features, among which FROM-GLC has the highest overall accuracy reaching 82.34%, and CCI-LC is relatively low, with the overall accuracy of 78.09%.

**Keyword---**Land cover data, Spatial consistency, Overall accuracy, Kappa coefficient

## INTRODUCTION

Land cover data is a key source of information for understanding the complex interactions between human activities and global change. While land cover data reflects real land cover information, information loss and errors are inevitable, so evaluating the quality of land cover products is very meaningful. This paper selected nine typical mega-city agglomerations in the world as research areas, and the classification accuracy of four different land cover datasets were analyzed from both qualitative and quantitative comparisons. It provides a certain scientific reference for users to scientifically and rationally select data, and also provides a basis for research on urban land expansion, grain yield forecast, forest area survey and land use.

## OBJECTIVES

- To evaluate and compare the classification accuracy of four kinds of global land cover data.
- From the aspect of spatial distribution, qualitative analysis of the four kinds of data feature distribution trend difference.
- To evaluate and analyze the classification accuracy differences of the four datasets for various ground objects quantitatively.

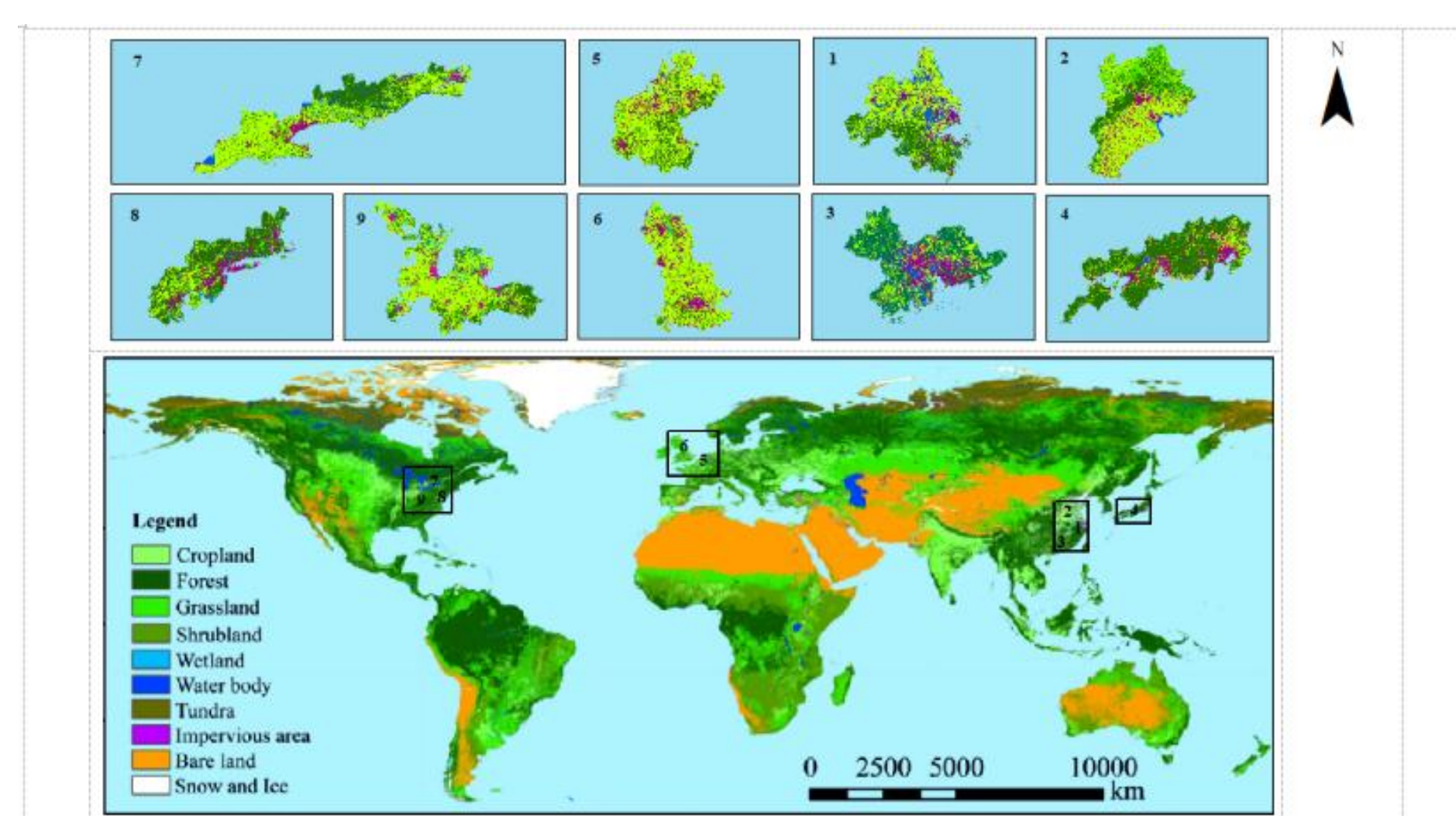


Fig. 1. STUDY AREA  
Note: 1, the Yangtze River Delta Urban Agglomeration; 2, the Beijing-Tianjin-Hebei Urban Agglomeration; 3, the Guangdong-Hong Kong-Macao Greater Bay Area; 4, the Japan Pacific Coastal Urban Agglomeration; 5, the Northwest Urban Agglomeration; 6, the Greater London Urban Agglomeration; 7, the West Coast Urban Agglomeration; 8, the Atlantic Coast Urban Agglomeration; 9, the Great Lakes City Urban Agglomeration.

## METHODS

- Data Reprocessing
- Samples Collection
- Confusion matrix

Confusion matrix is the most commonly used way for assessing assortment precision and an essential measure when comparing the accuracy of multiple data products. The method utilizes cross-tabulation of image classification data and ground validation data and can provide multiple accuracy metrics, including overall accuracy, producer accuracy, user accuracy and Kappa coefficient. The overall accuracy is a macro description of the data accuracy, which can represent the area ratio of the correct type in all land cover types. The user accuracy and mapping accuracy represent the data accuracy from the perspective of different land types.

From a macro point of view, the four land cover classification products of the same urban agglomeration have similar classification patterns, and the spatial distribution trends of similar ground objects are roughly the same. But from a micro point of view, the four data products are different in terms of cropland, forest, water body, etc. The classification details of the objects have different performances, and the consistency is not very high.

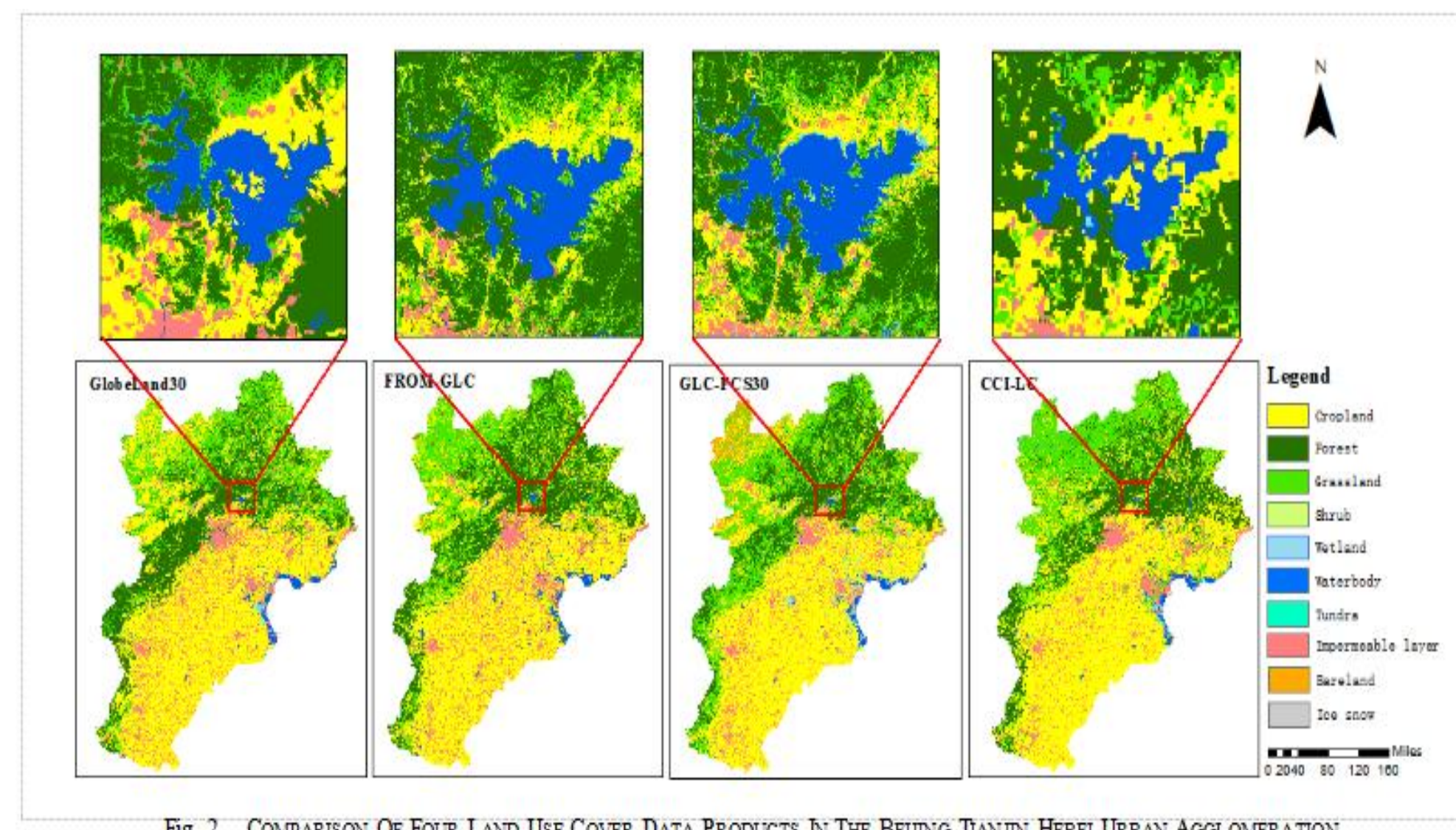


Fig. 2. COMPARISON OF FOUR LAND USE COVER DATA PRODUCTS IN THE BEIJING-TIANJIN-HEBEI URBAN AGGLOMERATION

Looking at the following picture (Fig.3), it shows that the classification accuracy of the four products for various ground objects. We can see that the accuracy of various ground objects in four data products has quite diverse performance generally. On the one hand, the four types of land features including forest, water body and impervious layer with high proportions and concentrated distribution have better precision performance in these 4 data products. Among them, the average producer accuracy of forest and impervious layer is higher than 90.00% and the water body reaches 88.99%. For the three types of shrubs, wetlands, and bare land with low proportions and scattered distribution, the assortment precision of the 4 products is relatively low, and the average producer accuracy is below 30.00%. Human activities will increase the degree of fragmentation of the surface, and there will be inevitable errors in the visual interpretation of these three types of objects, resulting in low overall accuracy in these areas. This is an area that needs to be improved in the future. On the other hand, from the perspective of single ground objects, GlobeLand30 has reached better assortment results in cropland and impervious layers, with assortment precision reaching 91.71% and 94.82% respectively. GLC-FCS30 has the best classification accuracy in water body, with an accuracy value of 95.03%. Also, FROM-GLC has better classification accuracy for forest and can be used for forest area survey, regional forest carbon storage estimation and other research.

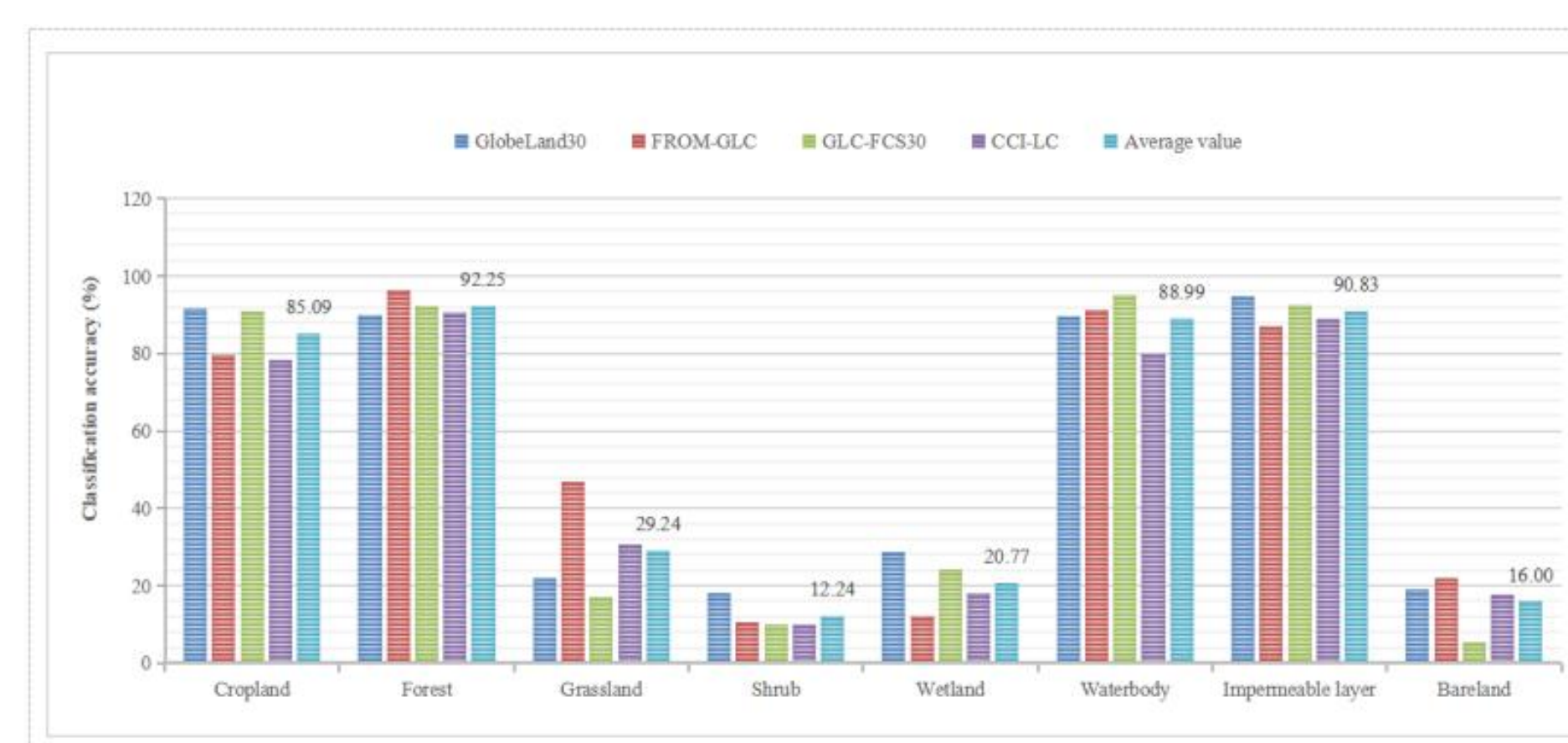


Fig. 3. CLASSIFICATION ACCURACY OF FOUR LAND USE COVER DATA PRODUCTS FOR VARIOUS LAND OBJECTS

## RESULTS

The evaluation results show that there are certain differences in precision of the four data products (Table III). In general, FROM-GLC data product has the best categorical performance, its overall average assortment precision for the 9 city clusters is 82.34% and the Kappa coefficient is 0.75. The precision of GLC-FCS30 data products is second only to FROM-GLC, with the overall average assortment precision is 82.31% and Kappa coefficient is 0.75. The precision performance of GlobeLand30 data product is the third among the four, with an overall average classification precision of 81.79% and Kappa coefficient of 0.75. Due to the resolution of CCI-LC data product is lower, it has the worst accuracy performance. Its overall average assortment precision is 78.09% and the Kappa coefficient is 0.69.

TABLE III. THE ACCURACY OF FOUR CLASSIFICATION DATA PRODUCTS FOR NINE URBAN AGGLOMERATIONS

Urban Agglomeration	FROM-GLC		GLC-FCS30		GlobeLand30		CCI-LC	
	Total accuracy	Kappa coefficient	Total accuracy	Kappa coefficient	Total accuracy	Kappa coefficient	Total accuracy	Kappa coefficient
Beijing-Tianjin-Hebei Urban Agglomeration	88.74%	0.86	87.33%	0.84	87.41%	0.84	77.31%	0.71
Yangtze River Delta Urban Agglomeration	82.77%	0.78	83.93%	0.79	80.36%	0.75	72.05%	0.64
Guangdong-Hong Kong-Macao Greater Bay Area	88.70%	0.85	83.70%	0.79	86.27%	0.82	81.07%	0.75
Northwest Urban Agglomeration	89.96%	0.86	61.00%	0.51	59.21%	0.5	74.34%	0.66
Japan Pacific Coastal Urban Agglomeration	87.14%	0.8	91.13%	0.86	87.59%	0.81	81.92%	0.72
Greater London Urban Agglomeration	69.46%	0.56	82.08%	0.7	82.77%	0.71	69.15%	0.53
Atlantic Coast Urban Agglomeration	80.01%	0.66	86.24%	0.77	89.91%	0.83	86.37%	0.77
Great Lakes City Urban Agglomeration	72.18%	0.62	77.57%	0.69	70.61%	0.59	73.09%	0.63
West Coast Urban Agglomeration	82.11%	0.74	87.84%	0.82	91.98%	0.88	87.52%	0.81
Average Value	82.34%	0.75	82.31%	0.75	81.79%	0.75	78.09%	0.69

## DISCUSSION

Land cover data is an important information in natural resource survey, land management, environmental monitoring, etc. It is worthy of meaning to estimate its accuracy and reveal its category confusion characteristics for many scientific fields. In this study, nine urban agglomerations were selected as the study area to assess classification accuracy of four global land cover data.

## CONCLUSIONS

- The main conclusions of this paper are as follows:
- FROM-GLC, GLC-FCS30, GlobeLand30 and CCI-LC all have a good classification of urban agglomeration features, of which the overall classification accuracy of FROM-GLC is the highest, reaching 82.34%, and CCI-LC is relatively low, with an overall accuracy of 78.09%.
  - The analysis of nine urban agglomerations shows that the regional adaptability of different classified data products is different, so in the specific application process, it is necessary to select appropriate data products according to the actual needs.
  - The classification accuracy of the four data for different land types is different. Among them, farmland, forest, water body and impervious layer, which cover a large area and are concentrated in distribution, the four products have achieved good classification results. However, for small and scattered types, such as shrubs, wetlands and bare land, the classification accuracy is relatively low.

The research results of this paper can help users better understand the advantages and disadvantages of data, and help users choose the appropriate land cover data set according to the research purpose and region. In addition, data producers can receive feedback information to promote the improvement of data processing algorithm and classification technology.

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