Study on the Spatial Dynamic Change of Tidal Flat in the Pearl River Estuary from 1990 to 2020

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Abstract: This paper Based on GIS and remote sensing analysis methods, it uses multi-source remote sensing data to obtain the coastal mudflat change and land cover/land use change data of the the Pearl River Estuary Bay Area in 1990, 2005 and 2020. This paper studies the temporal and spatial change characteristics of the coastline in the the Pearl River Estuary Bay Area in three periods, the temporal and spatial pattern change of land use, and the relationship between the two, and summarizes their change rule and causes.

Keywords: The Pearl River Estuary; Tidal Changes; Temporal and Spatial Changes

1. Overview of the study area and data sources

1.1 Overview of the Pearl River Estuary

Located in the south-central part of Guangdong Province, the Pearl River Delta is a delta where river networks and remnant estuaries coexist. The watershed is characterized by large runoff, low sand content, etc. The tributaries in the delta area are divided into a dense water network. At present, there are seven channels in the Pearl River Estuary, which open to the east and west[1]. The tidal wetlands of the delta contain rich biological species and large functional ecosystems that play an important role in the regional ecosystem[2].

1.2 Data overview

The data for the study in this paper were obtained from the geospatial data cloud (www.gscloud.cn) with the row and column number 117031, and the data for 1990 were obtained from Landsat4-5TM satellite digital products, and the data for 2000-2020 were obtained from Landsat8 OLI_TIRS satellite digital products.

2. Pearl River Estuary Shoreline Extraction

2.1 Characterization method of spatio-temporal change of coastline

2.1.1 Shoreline structure ratio

In this paper, the coastline structure of the Pearl River Estuary Bay Area is divided into natural and artificial coastlines, and in order to analyze the change process of natural and artificial coastlines in the process of coastline change, the concept of coastline structure ratio is introduced, which is used to describe the trend of the change of natural and artificial coastlines.

$$LSV = \frac{L_1}{L_2} \qquad (1)$$

Where LSV is the ratio of shoreline structure, L1 is the length of natural shoreline and L2 is the length of artificial shoreline.

2.1.2 Intensity of shoreline change

In order to respond more objectively to the situation of shoreline length in the comparison monitoring period, the annual average percentage change of shoreline length in a certain period of time is utilized to explain the shoreline intensity[3].

$$LCI_{ij} = \frac{L_j - L_i}{L_i(j-i)} \times 100 \qquad (2)$$

Where: LCIij is the Length Change Intensity from year i to year j, Li is the specific length of the coastline in year i, Lj is the specific length of the coastline in year j.

2.2 Results of shoreline extraction and analysis of results

2.2.1 Extraction results of the coastline of the Pearl River Estuary

In the process of extracting the coastline of the Pearl River Estuary, this paper establishes the corresponding rules, and refines the acquisition of the waters part in the Landsat remote sensing images in 1991, 1995, 2001, 2005, 2009, 2015, and 2020. Through the human-computer interactive method to test and modify the misjudgment information , we obtain the accurate and complete interpretation results close to the actual feature information, and overlay the extracted results for mapping, and finally integrate and compare to study the general process of its change. As shown in Figure 1 is the histogram of the coastline change in the Pearl River Estuary.

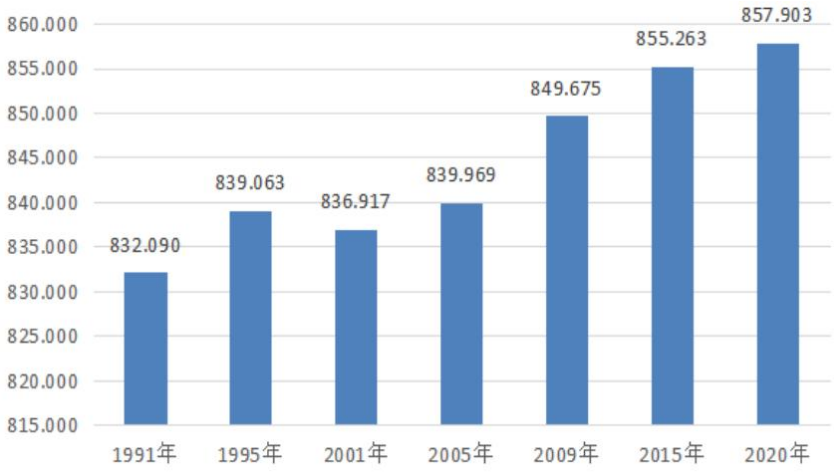

Figure 1 Histogram of coastline length change

2.2.2 Analysis of the results of coastline extraction in the Pearl River Estuary

Through the above experimental analysis, it find that the coastline structure ratio is significantly negatively correlated with the index of the degree of land use change, the process of gradual increase of the coastline structure ratio, is mainly affected by the reclamation of land, coastal road construction, airport construction, expansion of aquaculture land, and other human activity factors. In the area where the natural shoreline decreases, the land use type is mainly transformed from other land use types to artificial surface land and breeding land, and the land use proceeds in the direction of deviating from the ecological environment.

3. Analysis of land use change in the Pearl River Delta

3.1 Study on the dynamics of land remote sensing data in the Pearl River Estuary

Referring to the Classification of Land Use Status Quo and combining the current land use situation in the Pearl River Estuary, a two-level classification system was selected to classify land use in the study area , and at the same time, based on the principles of remote sensing image interpretation, considering the image interpretability as well as the spatial resolution, the Pearl River Estuary Land Use Classification System was established to merge the secondary classifications of the land use types, and it was decided that the The structural distribution in the study area is divided into six categories: farmland, grassland, forest land, artificial surface land, water and other land.

3.2 Analysis of data dynamic changes

3.2.1 Analysis of the current status of land type area

Open the attribute table of the data after eliminating the completion of each year respectively, choose the export path and change the file name to export. The data will be organized and summarized, the results of the status quo analysis are shown in Table 1.

Table1 Summary of data for 1990, 2005, 2020

In 1990,	code	Area / km2	In 2005,	code	Area / km2	In 2020,	code	Area / km2
forest	1	6642.686	forest	1	1286.275	forest	1	5108.739
meadow	2	4441.848	meadow	2	3639.716	meadow	2	1910.785
farmland	3	2922.984	farmland	3	4326.658	farmland	3	2495.61
waters	4	894.658	waters	4	813.04	waters	4	999.224
Artificial surface	5	3202.514	Artificial surface	5	8154.873	Artificial surface	5	7730.627
else	6	687.86	else	6	571.988	else	6	547.566
total area	18792.55		total area	18792.55		total area	18792.55	

3.2.2 Dynamic change analysis

The transfer matrix area statistics of the Pearl River Estuary for 1990-2005 and 2005-2020 were derived from the transfer matrix model. The main land use types in the Bay Area of the Pearl River Estuary are forest land, cropland, grassland, watershed, construction land, unutilized land, and bare soil. The area levels of construction land, cropland and forest land remain above 9.60%, 17.32% and 16.85%, respectively.

3.2 Accuracy Verification

Accuracy assessment requires the following steps: selecting validation points, extracting classification attributes to the validation points, making pivot tables, calculating confusion matrix accuracy assessment parameters, and using MAPGIS as the software platform for this accuracy validation, and adopting the "human-computer interaction interpretation method" based on the remote sensing images of the three phases of 1990, 2005, and 2020. The remote sensing interpretation of land use types in the Pearl River Estuary is based on visual interpretation, and the second-level classification is directly interpreted during the interpretation process. After the interpretation is completed, the results need to be verified for accuracy, and this study mainly assesses the accuracy of the interpretation through the quality check of the image interpretation, which is conducted in accordance with the ratio of 100% of the first-level inspection and 5% of the second-level sampling, and the quality check of image interpretation mainly includes the type of map spot and the type of land use. The quality check mainly includes checking the type of map, checking the missing map, checking the accuracy of map outlining, checking the reasonableness of map boundary, checking the attribute table and checking the topology of map. In this paper, a total of 2,496 plots were sampled for checking, and 96.5% of the second level of sampling were qualified, and the interpretation results basically meet the requirements of this study.

3.3 Analysis of the coupling relationship between coastline and land use change

Through the above analysis of the spatio-temporal change characteristics of coastline and the change of spatio-temporal pattern of land use in the Bay Area of Pearl River Estuary in 1990, 2005 and 2020, it is found that in the process of change of the coastal zone, the change of the coastline and its coastal land use influences each other, the bivariate correlation analysis method of SPSS software is used to combine the spatio-temporal change characteristics of the coastline The characteristic parameters of the spatio-temporal changes of the coastline, such as the length of the coastline, the coastline structure ratio and the intensity of the coastline changes, and the model indices of the spatio-temporal changes of the land use, such as the information entropy of the land use, the urbanization rate and the index of the degree of change of the land use are correlated

two by two to explore the correlation between each parameter of the coastline, mainly from the time scale. The specific changes are as follows: in 1990, there was a strong negative correlation between the coastline structure ratio and the degree of change index, with a significance of 0.054; in 2000, there was a significant negative correlation between the coastline structure ratio and the degree of change index, with a significance of 0.041; in 2012, the coastline structure ratio and the degree of change index continued to be significantly negatively correlated, with a significance of 0.041, which is basically at the same level as that of 2005; and in 2010, the coastline structure ratio and the degree of change index were significantly negatively correlated. In 2012, the coastline structure ratio and the degree of change index continued to be significantly negatively correlated, with a significance of 0.041, basically at the same level as in 2005. It can be seen that in the evolution of the time series, there is a strong correlation between the shoreline structure ratio and the index of the degree of change in the process of land use change, which can be explored in depth.

4. Conclusion

By analyzing the coupling relationship after land use classification to draw corresponding relationship conclusions, it provides favorable data support for subsequent land management and facilitates the formulation of land management policies. Strengthen the supervision of the environment around the protected area to stop the transformation of grassland and wetland to agricultural land, construction land and bare land, and the restoration of wetland within the Pearl River Estuary has begun to bear fruit. Moderately develop the ecological economy and promote the development of local tourism economy.

References

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