The Dynamic Remote Sensing Monitoring of Eight Outlets in Pearl River Estuary

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ABSTRACT: Pearl river, the largest river in the south of China, is composed of West river, North river and East river, and flows into South sea through eight big outlets. Due to sand siltation and humen being's inning, the coastline of eight outlets changed very much during last twenty years. Compared with conventional method, remote sensing technology is macroscopical, speedy and economical. Furthermore, remote sensing can be used to record historical scene. So it has many advantages in monitoring change of riverway and outlet. In the paper, Landsat TM images of pearl river in 1977, 1988 and 1999 are chosen to dynamically monitor the change of its eight outlets. The change rule of eight outlets from the 1970's to 1990's are analyzed. The research result is useful to the decision-making of synthetical programming, sea-route fathering, ecological-environmental fathering and so on.

KEYWORDS: Pearl river Coastline change Remote sensing Monitoring

1. Introduction

Pearl river, the largest river in the south of China, is composed of West river, North river and East river, and flows into South sea through eight big outlets. The eight big outlets include Humen outlet, Jiaomen outlet, Hongqimen outlet, Hengmen outlet, Modaomen outlet, Jitimen outlet, Hutiaomen outlet and Yamen outlet. Due to sand siltation and humen being's inning, the coastline of eight outlets changed very much during last twenty years. It's very urgent to investigate the outlet change of Pearl river.

The conventional investigation consumes not only many resources(including labor and money), but also time. Compared with conventional method, remote sensing technology is macroscopical, speedy and economical. Furthermore, remote sensing can be used to record historical scene. So it has many advantages in monitoring change of riverway and outlet.

In the paper, Landsat TM images of pearl river in 1977, 1988 and 1999 are selected to dynamically monitor the change of its eight outlets. The change rule of eight outlets from the 1970's to 1990's are analyzed and main factors that lead to change are discussed.

2. Research region and data collection

In the paper, the research region mainly include eight big outlets of Pearl river that has been listed in last paragraph. Because of higher resolution and lower cost, Landsat image was chosen as main data source. In order to dynamically monitoring the change of coastline of each outlet during the last twenty years, Landsat TM images of Pearl river in 1977, 1988 and 1999 are collected. The season time of these images are mainly in winter, that means in low water. The detail information of all the images collected is listed in table.1.

Tab.1 Image list

Time	Path	type	resolution
1977.2.10	122-44	MSS	80m
1977.2.10	122-45	MSS	80m
1988.12.10	122-44	TM	30m
1988.11.24	122-45	TM	30m
1999.12.9	122-44	TM	30m
1999.12.9	122-45	TM	30m

3. Extraction of coastline from Landsat image

3.1 Pre-processing of remote sensing image

Image pre-processing is the process of making an image more interpretable for a particular application. Pre-processing makes important features of raw, remotely sensed data more interpretable to the human eye. Pre-processing techniques are often used for feature extraction—studying and locating areas and objects on the ground and deriving useful information from images. Image pre-processing mainly include data correction(radiometric and

geometric correction), radiometric enhancement, Spatial enhancement, spectral enhancement, image mosaic and so on.

In the paper, all raw landsat image are georeferenced, in addition, different time image of the same place are registrated. After image pre-processing, we get three large geocoded and registrated image.

3.2 Thematic information extraction of river bank and coastline

It's clear that river bank and coastline are boundary of water, so we can get bank and coastline through extraction ofwater body form image. In Landsat image, the fifth channel (TM5) contains most water information then other several channels, the second is TM4. Generally, in the fifth channel image, the lighteness of water is rather low, but the lighteness of land is widely high. Based on this rule, two-value method can be taken. In this method, a correct threshold must be chosen, the pixels which lighteness is higher than the threshold will be looked as wa ter body., then the boundary of water and land can be got. Howerer, not all the extraction results are ideal, it's necessary to correct the extraction results by man-computer alternated interpretation. In addition, before extraction of thematic information, enhancement processing to image is very necessaryfor getting more ideal result.

Figure 1 to 6 are monitoring result of eight outlet of Pearal river during 1977 to 1999. In those figures, the author extracted the coastline of eight big outlets in 1977,1988 and 1999 respectively.

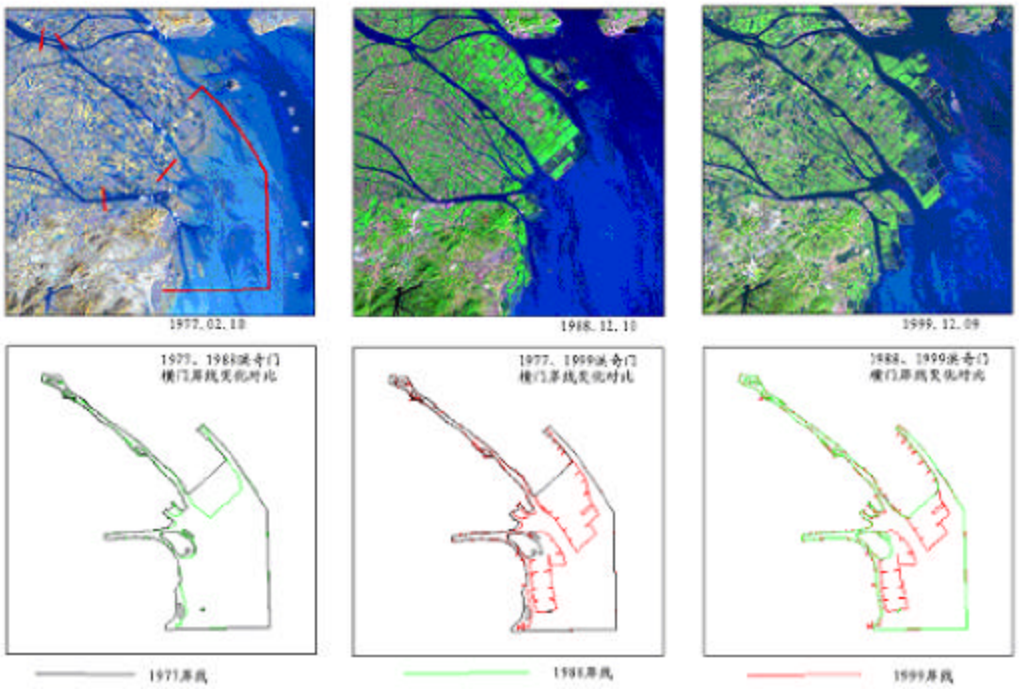

Fig.1 Coastline change of Hongqimen outlet and Hengmen outlet during 1977-1999

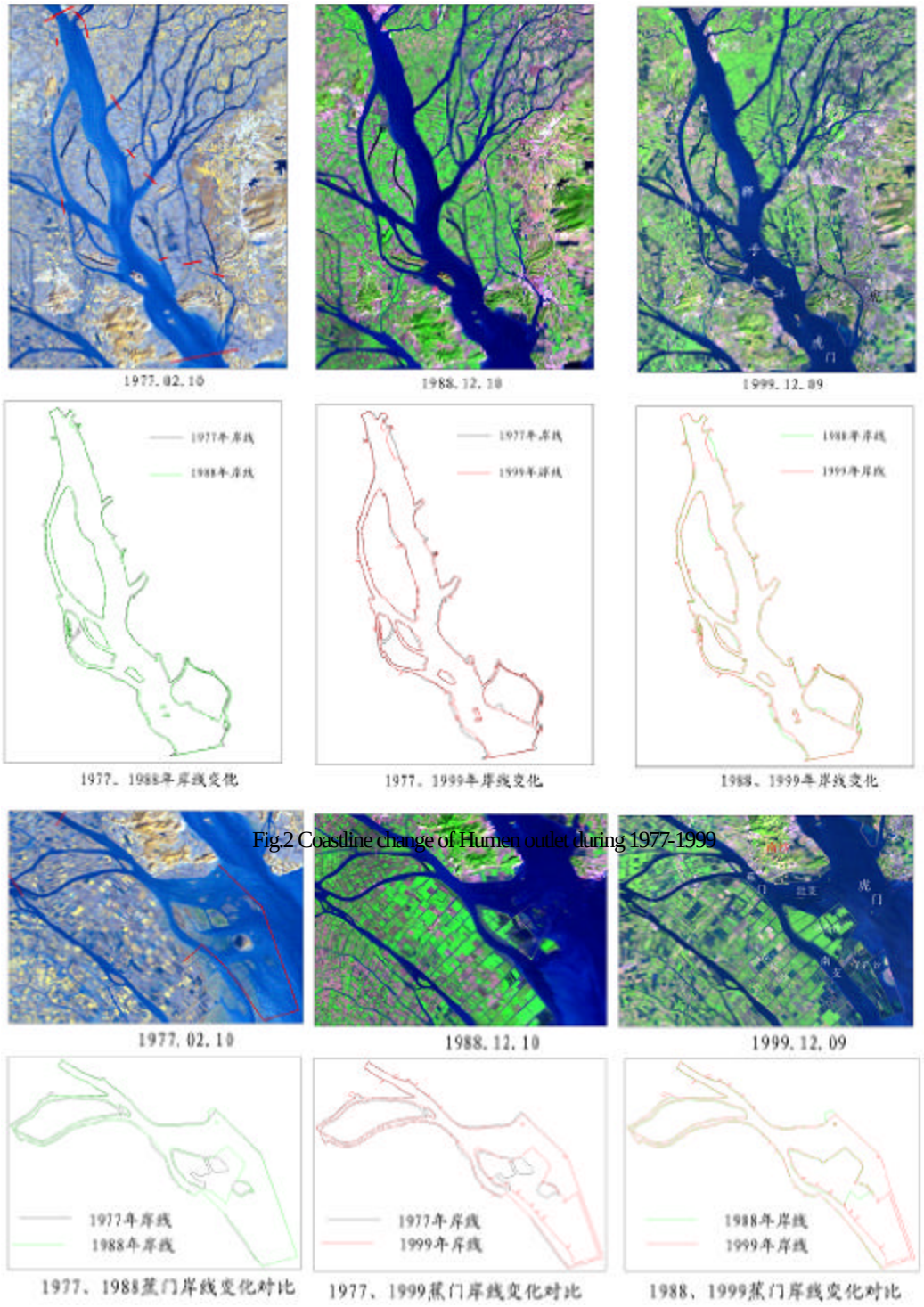

Fig.2 Coastline change of Humen outlet during 1977-1999

Fig.3 Coastline change of Jiaomen outlet during 1977-1999

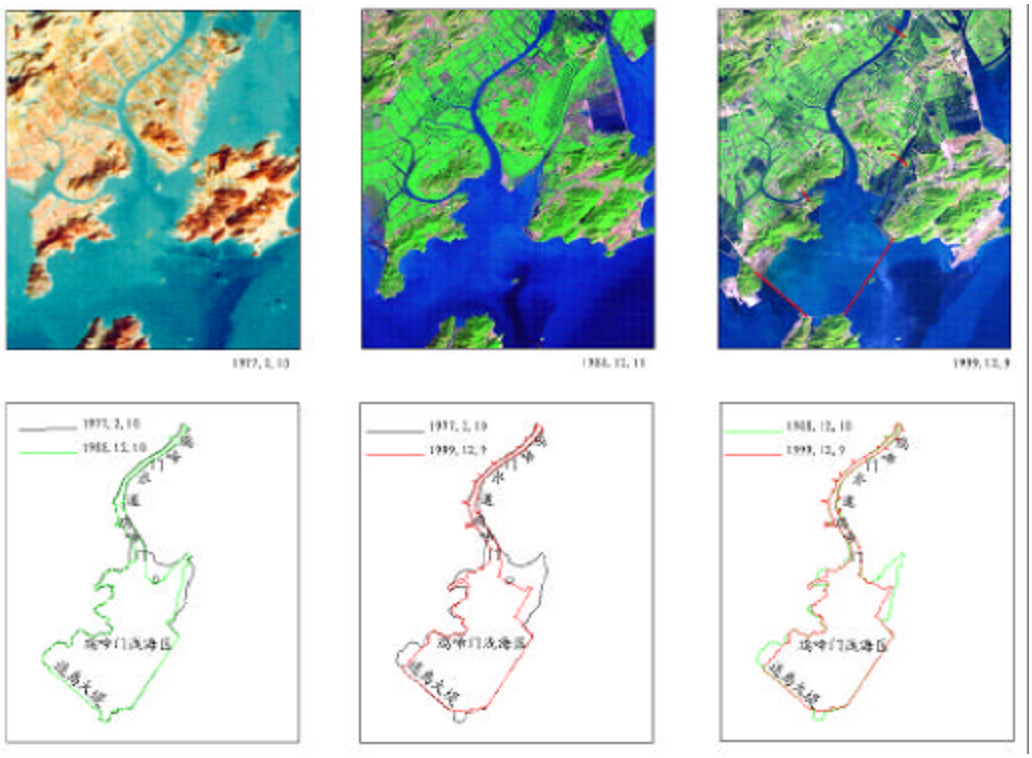

Fig.4 Coastline change of Jitimen outlet during 1977-1999

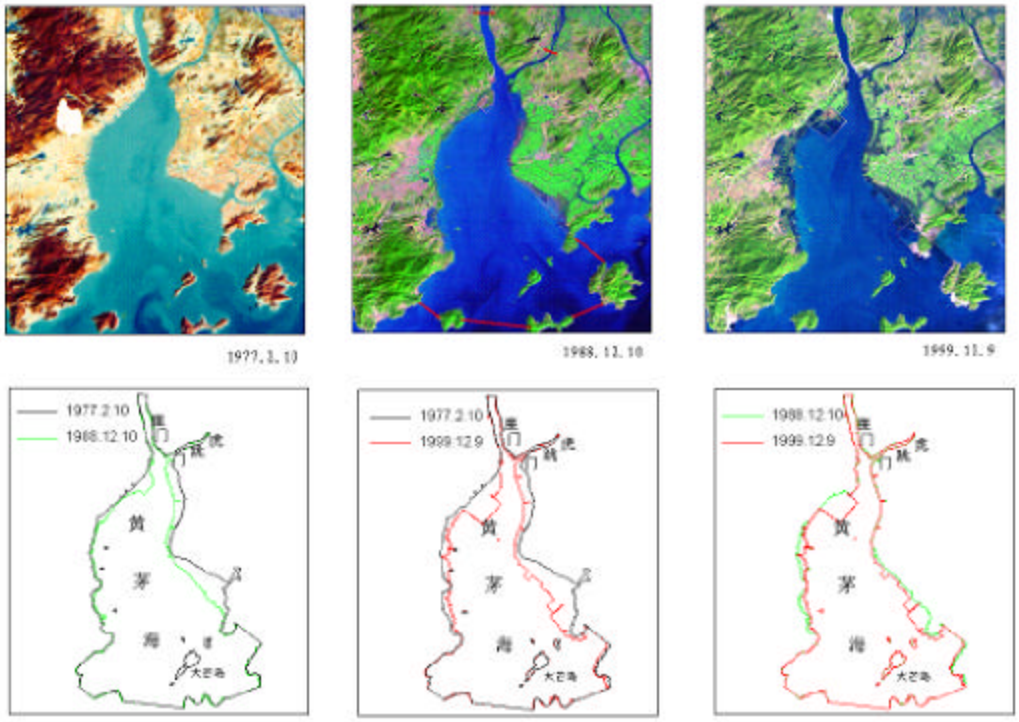

Fig.5 Coastline change of Yamen and Hutiaomen outlet during 1977-1999

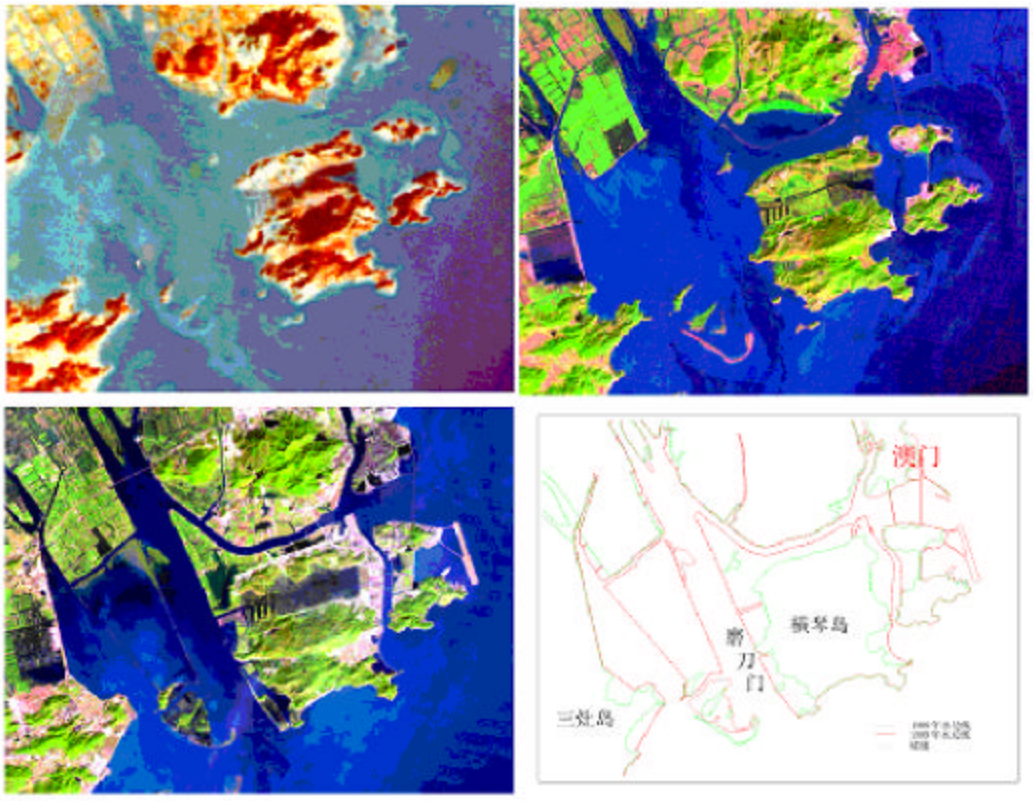

Fig.6 Coastline change of Modaomen outlet during 1977-1999

4. Results analysis

Fig.1 to fig.6 show that the change of eight outlets in Pearl river is very large. In order to quantitatively analyse those change, the author drew a boundary for each outlet. With the help of Geographical Information System(GIS), the water body area of each outlet in 1977,1988 and 1999 are calculated(see Tab. 2).

Tab.2 Water body area change of the eight outlet in Pearl river

year / region	1977	1988	1999	reduced area from 1977 to 1988	reduced area from 1988 to 1999	reduced area from 1977 to 1999	reduced area percent from 1977 to 1988
Lingding Sea	1091	1001	891.9	90	109.1	199.1	18.25%
Humen outlet	120.93	120.3	116.3	0.63	4	4.63	3.83%
Qiaomen outlet	83.56	72.19	53.17	11.37	19.02	30.39	36.37%
Hongqimen outlet, Hengmen outlet,	197.54	166.5	128.9	31.04	37.6	68.64	34.75%
Modaomen outlet	263.82	198.00	139.1	65.82	58.9	124.72	47.27%
Jitimen outlet	92.651	84.26	74.79	8.391	9.47	17.861	19.28%
Hutiaomen outlet , Yamen outlet and Huangmao Sea	605.21	549.1	501.4	56.11	47.7	103.81	17.15%

In tab.2, its clear that the change of water body area in Jiaomen outlet, Hongqimen outlet , Hengmen outlet and Modaomen outlet is large, and Humen outletis little. Compared with 1977, the water body area of Modaomen outlet in 1999 reduced 42.27%, the water body area of Qiaomen outlet in 1999 reduced 36.37%. The reduction in Humen outlet is smaller, about 3.83%.

5. Discussion

Remote sensing technology has been applied in flood monitoring and soil erosion monitoring very often. In the paper, remote sensing technology is applied todynamically monitor the change of bank and coastline. The research result show its feasible. Due to lack of ground data, the analysis of monitoring result is preliminary. In addition, the type of data source also limit the result precision, if IKONOS image with high resolution and Radarsat image with ability of

penetration are used in this research, then the result precision may be higher.