BEACH EROSON CAUSED BY THE CHANGE OF LAND USE
- detection of the shoreline by JERS-1 satellite image -

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ABSTRACT

Applicability of satellite image to detect the location of shoreline for investigating topography change is examined using JERS-1/SAR images and Landsat/TM images in two representative beaches in Thailand and Vietnam where rapid beach erosions have been taking places. It is found that SAR images of JERS-1 provide quantitative information about the beach erosion/accretion in coastal regions when we can set more than five grand controlling points. Band-4 images of Landsat/TM also provide important information about the change in the land use from the mangrove forest to shrimp farming ponds.

KEYWORDS

Beach erosion, change in land use, shrimp farming pond, satellite image, JERS-1

INTRODUCTION

Mangrove forest in coastal zones in Southeast and South Asia have been developed rapidly to construct shrimp ponds that have higher productivity. These developments in coastal regions weaken the ability of the beach to protect coastal disasters such as beach erosion, wave overtopping and so on and increase the possibility to encounter various kinds of disaster, especially beach erosion. The relation between the development in coastal region and the beach erosion has not been investigated quantitatively.

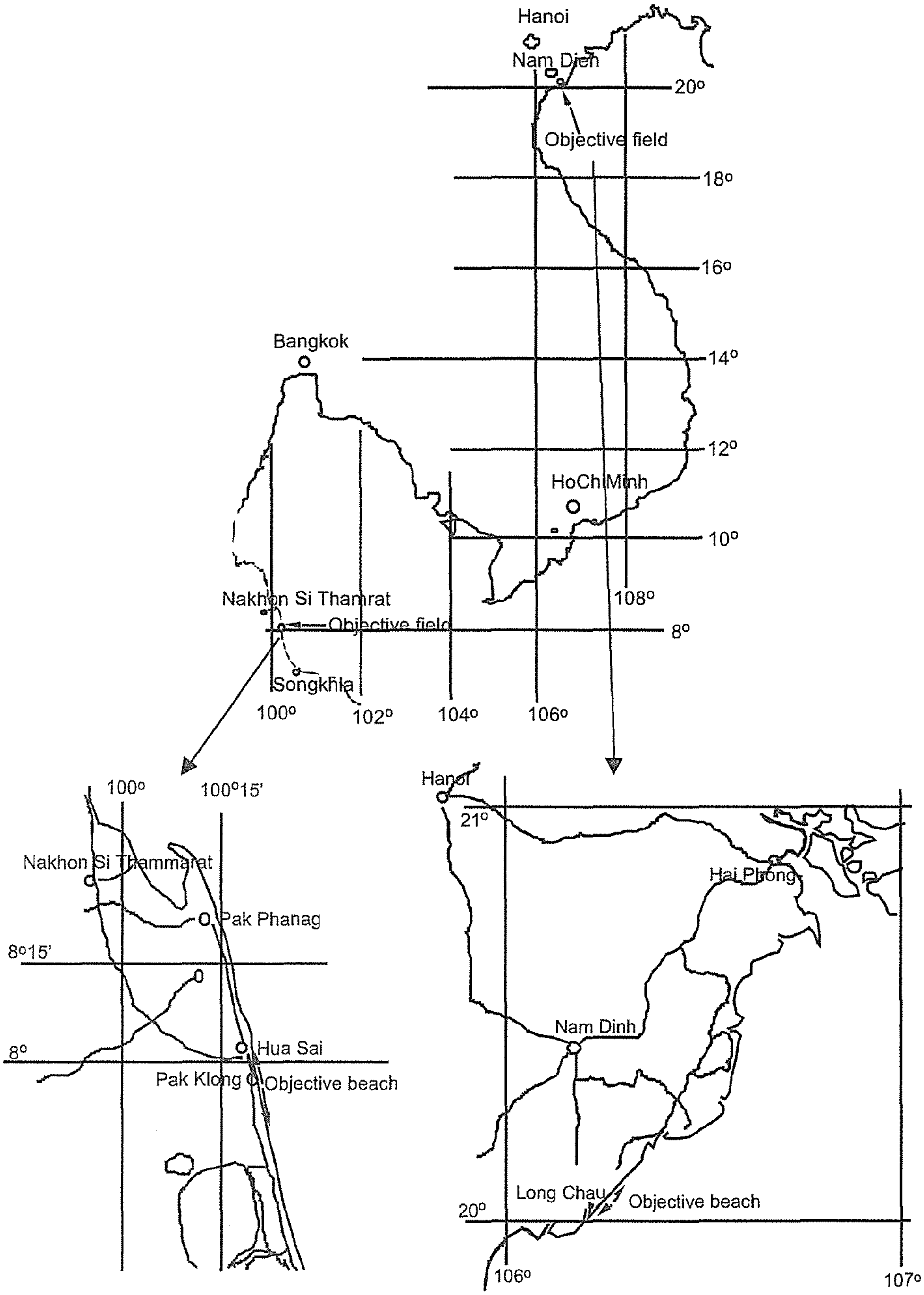
On the other hand, mangrove plantations have also been carrying out by various organizations. Mangrove plantation around river mouth may trap discharged sediment from the river that will be the source of the bed material of the sandy beach around the river mouth. This is the negative effect of mangrove plantation from the viewpoint of the shore protection. However, this effect also has not been evaluated yet.

The main reason for the difficulty of such kinds of investigation is the lack of information about the topography in the coastal zones. In such cases, a so-called satellite image may provide useful information.

The aim of this study is to examine the applicability of the satellite image to detect the location of shoreline to provide useful information about the topography change in two objective fields, i.e. Southeastern coast of Thailand and southern part of Red river in Vietnam.

OUTLINES OF TWO OBJECTIVE FIELDS

We chose two objective fields (Site-A and Site-B) where severe beach erosions were reported to take place since 1990's. Site-A is the southeastern coast of Thailand between Nakhon Si Thamarat and Songkhla and Site-B is the southern part of Red River river-mouth, about 100km south from Hanoi in Vietnam. The locations of these areas are shown in Fig.1.



(a) Site-A(Southeast coast of Thailand) (b) Site-B (Southern part of Red River, Vietnam)
Fig.1 Location map of objective fields

Site-A is the long straight sandy beach with many small river mouths bordering the thick mangrove forest. Beach configuration is mainly controlled by waves. The typical beach transformation observed in Site-A is shown schematically in Fig.2. Phase-1 is the original beach profile. Phase-2 illustrates the cross-section just after the construction of shrimp pond near shoreline. The seaward bank of the pond is usually not strong enough to protect land from severe waves. Once the seaward bank is destroyed, the location of the shoreline retreat by the width of the pond.

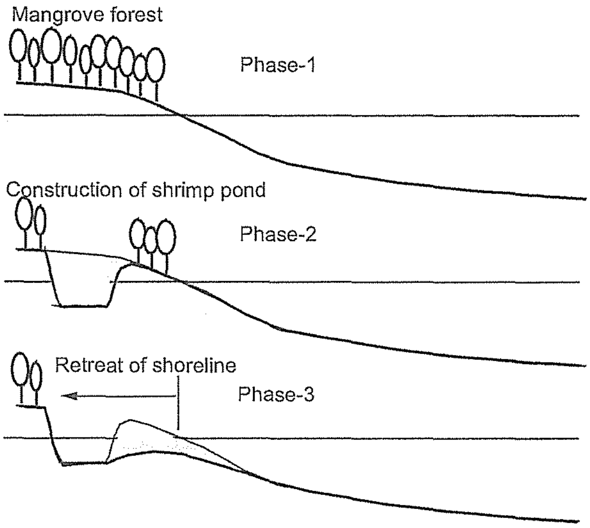


Fig. 2 Expected topography change around the shrimp pond

Figures 3 nd 4 show an example of beach erosion caused by the above mentioned mechanism. The seaward bank of the pond in Fig.3 is nearly destroyed. Figure 4 shows the retreated shoreline reached the route by the destruction of the pond.

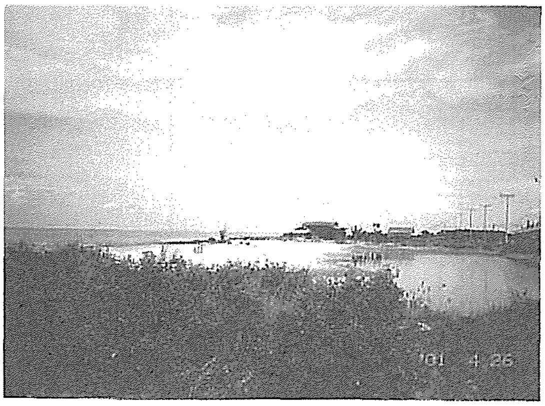


Fig. 3 Almost abandoned shrimp pond near Hua Sai

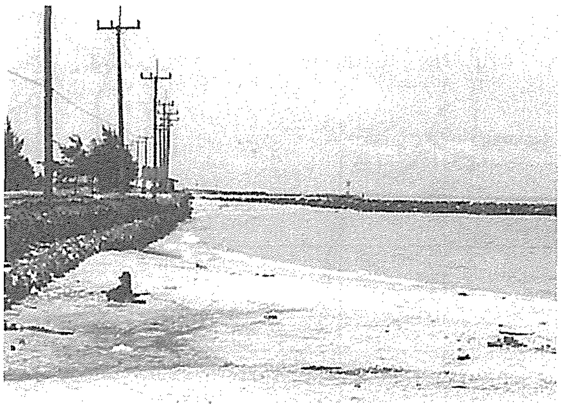


Fig. 4 Beach erosion reached to the Route No. 4013 Near Hua Sai

Site-B is near the southern end of huge delta area of Red River. Bottom topography is controlled by waves and river discharge.

SATTELITE DATA USED IN THE ANALYS

Satellite images used in this study are listed in Table-1. SAR Images of JERS-1 are used to detect the change in the location of shorelines in both sites. Although the SAR image is monochrome, it has high spatial resolution (15m/pixel) while the spatial resolution of Landsat/TM image is about 30m/pixel. In Site-A, Landsat/TM data are also used to investigate the change in the land-use by analyzing NDVI (Normarized difference vegetation index).

Table-1 Satellite images used in the analysis

	1989, May, 29	1992, Nov. 2	1994, Feb. 20	1996, Dec. 7	1998, April, 5
Site-A	Landsat/TM	JERS-1/SAR	Landsat/TM	JERS-1/SAR	JERS-1/SAR
Tidal level		7.5cm		5.2cm	4.0cm

	1993, Aug. 3	1995, Feb. 9	1998, May, 12
Site-B	JERS-1/SAR	JERS-1/SAR	JERS-1/SAR

Figure 5 shows the true color image of Landsat-Tm (1989/05/29) in Site-A and Fig.6 shows the SAR image (1993/08/03) of JERS-1 in Site-B.

Fig. 5 True color image of Landsat-TM in Site-A (1989/05/29)

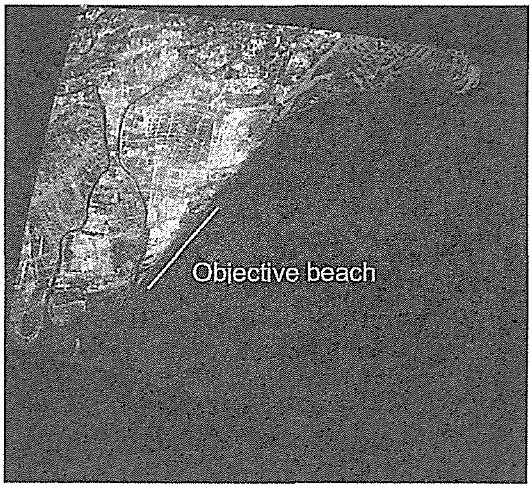


Fig. 6 SAR image of JERS-1 in Site-B (1993/08/03)

DETECTION OF THE SHORELINE

After carrying out geometrical correction of each SAR image, the intensity of brightness of each pixel in each SAR image was filtered and the location of the shoreline are determined by the following two methods:

- determine the pixel in the land where the intensity is larger then a certain value.
- determine the location og the shoreline at the pixel where the gradient of the intensity is the maximum.

There is not any significant difference between the locations of shoreline determined by these two methods.

Figure 7 shows examples of the shoreline configurations of 1992 and 1998 in Site-A. The vertical and horizontal axes are the north latitude and east longitude, respectively. We neglected the effect of tidal level because the there was little tidal difference as shown in Table-1. From Fig.7(a), it is found that the shoreline between 8.0406° north and 8.0418° north retreated about 100m during six years. This position just coincides the area shown in Fig.4. Such kind od shoreline retreat can be seen at many places in Site-A.

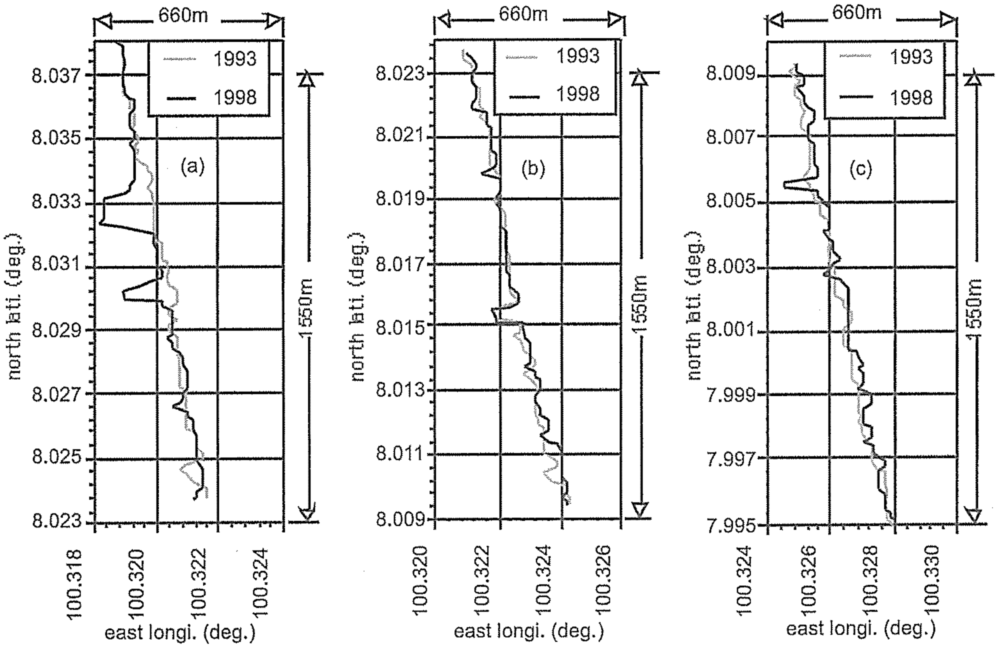
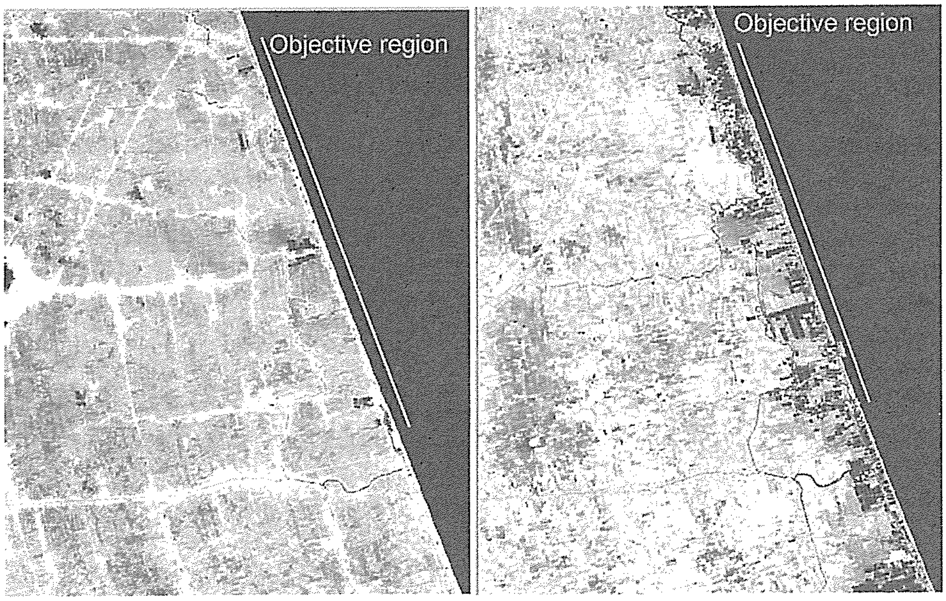


Fig.7 Detected shoreline around Hua Sai, Site-A (1992 and 1998)

Figure 8 shows the Band-4 images of Landsat/Tm (1989 and 1994). The dark part of the image is the water surface. Just landward of the shoreline, a lot of dark part spreads like patchwork. This means that a large part of the mangrove forest along the shoreline has been developed to construct shrimp farming ponds.



(a) 1989, May 29 (b) 1994, Feb. 20

Fig. 8 Band-4 images of Landsat/Tm in Site-A

Figure 9 illustrates examples of detected shorelines in 1993 and 1998 in Site-B. As can be seen from Fig.9(b), a large scale beach erosion of about 50-80m took place around 19.998° north and 20.010° north. However, the pattern of beach erosion is different from that detected in Site-A. The unbalance of longshore sediment transport plays important roll in Site-B

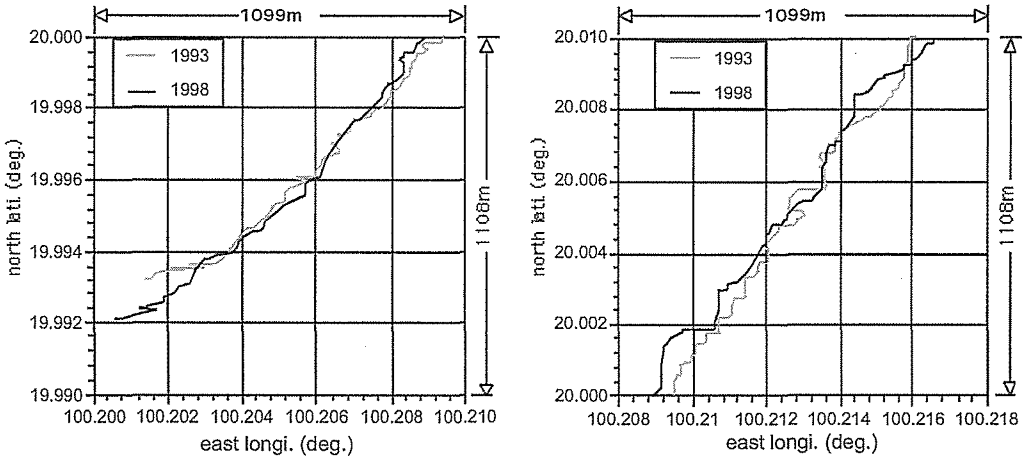


Fig. 7 Shoreline change detected around Long Chau, Site-B (1992, 1998)

To investigate such kind of beach deformation in river delta, we have to analyze wave fields together with river discharge. The authors already reported one possible procedure for analyzing topography change around the river mouth in the last seminar.

CONCLUSIONS

We examined the applicability of satellite image to investigating beach process in a relatively wide area. It is found that SAR image of JERS-1 provide us an important information about the quantity of the shoreline deformation and characteristics of beach deformation. Although the activity of JERS-1 stopped, ASTER started its activity. We hope that ASTER sensor provide more clear and accurate images for various use.