ANALYSIS OF SHORELINE VARIABILITY VIA EVEN AND ODD METHOD AT DARANG RIVER MOUTH, VIETNAM

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1. INTRODUCTION

Darang is an important river mouth in Phuyen province. In recent years, the phenomenon of accretion and erosion in this area has been considered to be severe for a long period. There were many researchers analyzing this area before; for instance, Cong et al. (2005), Huong et al. (2009) discussed about the mechanism of seasonally and annually topography and Hoang et al. (2015) analyzed morphological change from 2009 to 2015 by using Google images. To investigate long-term shoreline variation at Darang River mouth, this study employs the satellite images - Landsat images from 1988 to 2015 and analyzes the acquired data by using the even and odd method. At Darang River mouth, according to the definition, the onshore/offshore retreat and advance of both sides performs the even portion while the odd portion is represented by asymmetric shoreline change.

2. STUDY AREA AND DATA COLLECTION

As shown in Figure 1, Darang is the river mouth of the Ba River located in Tuyhoa City, Phuyen province, south central Vietnam, roughly 400km northeast of Hochiminh City.

This research utilized Landsat images obtained from U.S Geological Survey database in the period from 1988 to 2015 and rectified to the WGS-84 (World Geodetic System–84). The shoreline is detected from the rectified images by means of depending on the peak of the gradient density which characterizes the color contribution difference in pixels. Because the resolution of Landsat images is relatively low about 15-30m per pixel; as a consequence, the utilization of Landsat images must be considered strictly. In this research, areas in which striking change of magnitude occurs can be acknowledged rather than those where the changes are smaller than image resolution.

3. RESULT AND DISCUSSIONS

3.1 River mouth shifting

To apply the even and odd method, the river mouth location plays a influential role in analysing the shoreline variation of the river mouth. The position of the river mouth in each time can be measured by defining the center point, (x_C, y_C), as known as the narrowest point of river mouth. As indicated in Figure 2, based on the acquired shoreline data, the center point is able to be specified by taking the middle point between two points which are closest to each other from two sandspits respectively.

The movement of the river mouth is shown clearly in Figure 2. From this, it emphasizes that the position of river mouth moved to right direction in the period of about 3 years from 1988 to 1991. Afterwards, in 1993 the river mouth has started moving to the left side of the river mouth. It is noticed that from 1995 until now, the location of the river mouth has not come back to the position in the period from 1988 to 1991.

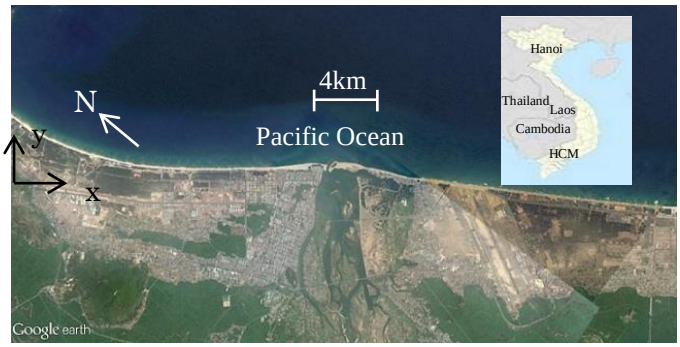


Figure 1. Study area

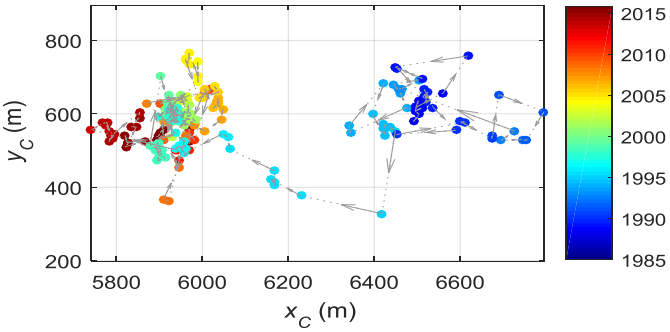


Figure 2. Temporal variation of center point (x_C, y_C)

3.2 Even and odd analysis

In order to apply the even and odd method, an independent time interval of shoreline variation is required with a separate assumption that the wave and wind climatology causing onshore/offshore and longshore transport is stationary in time (Walton, 2002). By Rosati and Kraus (1997), the total shoreline change $f(x') = y(x', t_n) - y(x', t_m)$ (t_n, t_m are the last and first shoreline data in the independent time interval) at an alongshore distance $x' = x - \bar{x}_C$ ($\bar{x}_C$ is the average center point in the analysed interval) from the inlet is composed of an even (symmetric) component, $f_E(x')$ and an odd (asymmetric) component, $f_O(x')$:

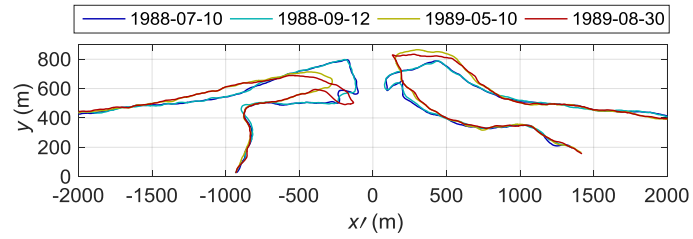
$$f(x') = f_E(x') + f_O(x') \quad (1)$$

where $f_E(-x') = f_E(x')$ and $f_O(-x') = -f_O(x')$. The even and odd components are extracted from the total (measured) shoreline change expressed by:

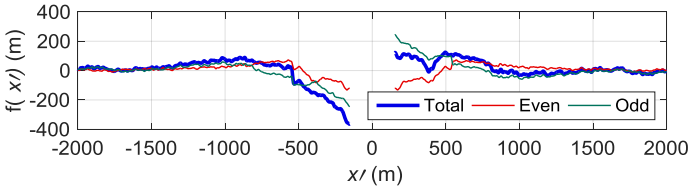
$$f_E(x') = \frac{f(x') + f(-x')}{2} \quad (2)$$

$$f_O(x') = \frac{f(x') - f(-x')}{2} \quad (3)$$

By the definition above and based on achieved shoreline data, from 1988 to 2015 several periods are chosen to apply the even-odd method in order to express the change of shoreline and also the predominance process in those studied time.

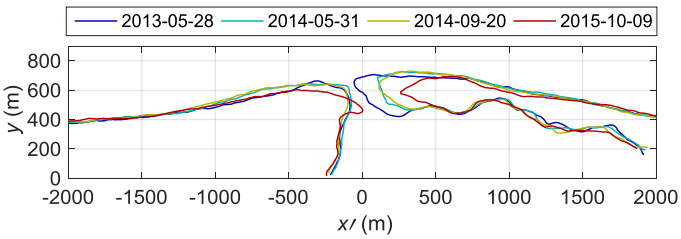


(a) Shoreline position

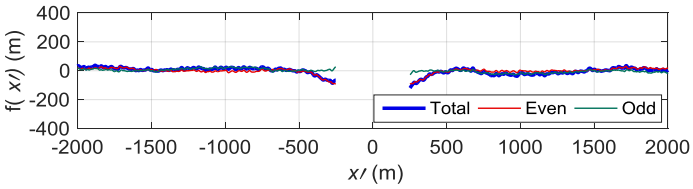


(b) Even-odd function

Figure 3. Shoreline position and even-odd functions during Period 1 (3/1988-10/1989)



(a) Shoreline position



(b) Even-odd function

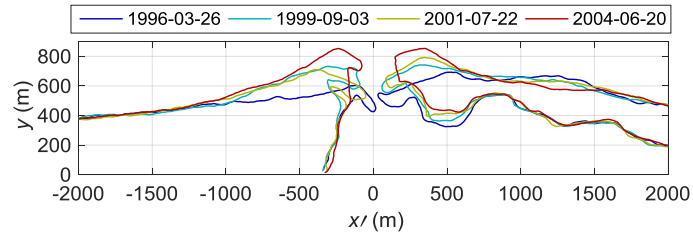
Figure 5. Shoreline position and even-odd functions during Period 3 (04/2013-09/2015)

Period 1: 1988-1991

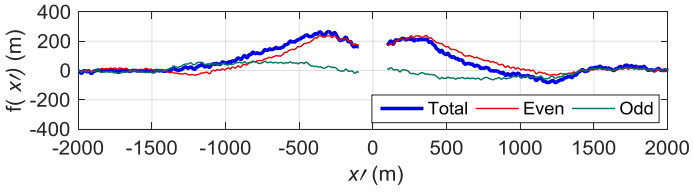
The shoreline behavior in this period is described by asymmetric shoreline position as seen in Figure 3(a). From that, it is notable that the area surrounding the river mouth is the most fluctuating area. About 800m from the right of the river mouth was advanced whereas from the left side, a large amount of shoreline was retreated in the area of nearly 800 m. Eventhough, there was some deposited areas from both sides of the river mouth, but the asymmetric change between two sandpits is more prevalent. Subsequently, the predominant process captured in this period is even portion as displayed in Figure 3(b).

Period 2: 1996-2004

Period 2 shows the offshore sediment advance in both sides after river mouth has been moved. From Figure 4(a), the sandspits from two sides of the river mouth was seen to behave a considerable shoreline increase from 1996 to 2004. And after the movement of the river mouth centralized to the left sandspit, it could be witnessed the shoreline retreat in few areas from the right sandspit. But the increase in shoreline in either left or right side of the river mouth can be noted to be the trend of this period. This leads to the predominance of even portion as shown in Figure 4(b).



(a) Shoreline position



(b) Even-odd function

Figure 4. Shoreline position and even-odd functions during Period 2 (03/1996-06/2004)

Period 3: 2013-2015

Different from two previous periods, period 3 presents the onshore retreat in two sides of the river mouth. Figure 5(a) performs that either left or right sandspit was eroded, especially the right side in which a great of sediment amount was dissapeared. Otherwise, there is not much distinct variation which can be observed precisely in this period. Accordingly, the even process can be obviously obtained to be the predominant process in this interval time by Figure 5(b).

4. CONCLUSIONS

The erosion at the Darang River mouth has focused on the tip area of two sides of the river mouth. The shoreline in both sides has been unstable and changed consecutively in couple years. The change of shoreline is principally affected by natural events such wave, wind, sediment supply from river mouth. On the other hand, there is an observation that the location of the river mouth has been centralizing to be near the left sand spit in a long term causing the substantial deposition to both sides and the threat of closing the river mouth.

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