LONG-TERM SHORELINE CHANGES ON THE BAEKSAJANG BEACH, WEST COAST OF KOREA

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ABSTRACT: Long-term shoreline changes on the Baeksajang beach, west coast of Korea were investigated using seven sets of aerial photographs taken from the year 1985 to 2012. Both ground control points and check points which were surveyed by VRS-GPS techniques were used to orient photographs absolutely. Shoreline of the study area was defined as the Approximately Highest High Water Level (3.6 m above datum). Such 3-D shoreline as well as 1 m and 2 m contours were mapped and compiled into time-series data sets. GIS techniques associated with Digital Shoreline Analysis System were employed to estimate rate of shoreline changes.

1. INTRODUCTION

Shoreline change data play an important role for investigating trend of coastal erosion and deposition, establishing setback regulation, estimating insurance rate of coastal land (Leatherman, 2003), conducting measure of restoring submerged land (Kim and Lee, 2009), and so on. They are highly required by coastal engineers and managers, but found to be rare in most coastal areas. Only U. S. and Netherlands show a good example of constructing shoreline change data sets on a national scale (US Army, 1971; Horn, 2002).

Archive historical aerial photographs have been the most valuable data sets providing long-term shoreline changes. In Korea, National Geographic Information Institute has taken aerial photographs over the Korean territory every 5 years since the 1960s. However, a standard method for producing shoreline change data using aerial photographs has not been established yet (Moore, 2000). Also, definition of shoreline is various so that it is difficult to compile different data sources (Boak and Turner, 2005). In this study, we deal with 3-D shorelines, elevation of which is determined by tide observations.

We present a case study for long-term shoreline changes on the Baeksajang beach, west coast of Korea (Figure 1). Objectives are to analyze tendency of temporal and spatial change of shorelines and to estimate rate of shoreline changes using long-term shoreline change data obtained from archive historical aerial photographs. The Baeksajang beach is located at the northwestern side of Anmyondo, which has a unique history that it became island due to several canal construction activities since the year 1134.

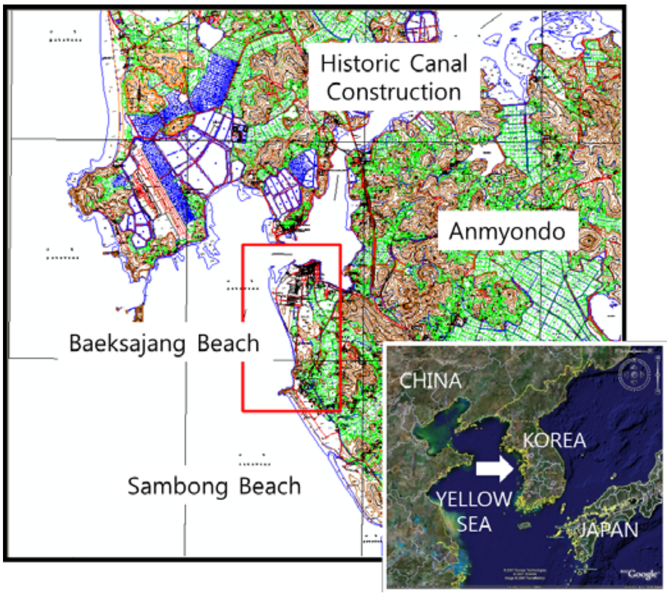

Figure 1. Map showing study area (Image source: earth.google.com)

2. CURRENT BEACH STATE

Figure 2 shows the current condition of Baeksajang beach. Photographs were taken in February, 2014. Artificial structure was constructed to prevent beach erosion, but it did not work well.

Figure 2. Panoramic photograph showing failure of artificial structure

3. METHODS

Figure 3 shows overall procedure of obtaining rate of shoreline changes, which is separated into two parts. The first part is presented by Yun and Kim (2014), where inventory of historical aerial photographs, measurement and distribution of ground control points, and aerial triangulation are described. The second part, shoreline mapping and estimation of shoreline changes, is described briefly here.

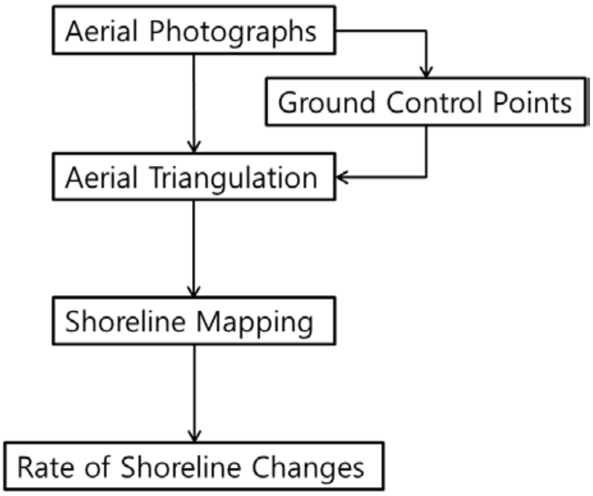

Figure 3. Diagram of data analysis

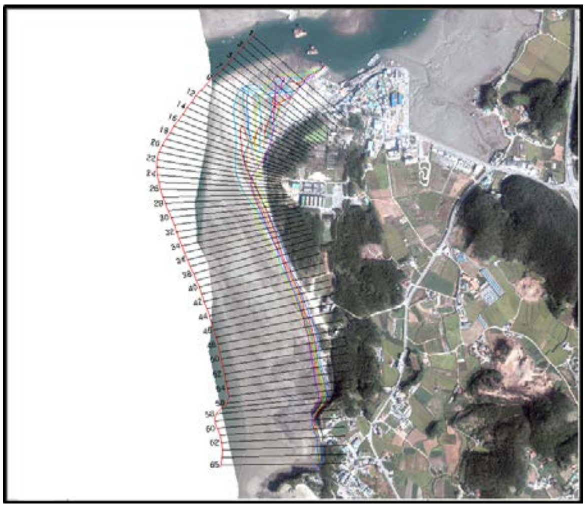

Figure 4. Distribution of shorelines and transect lines

After aerial triangulation, stereo-models of photographs are realized by LPS stereo analyst software (Leica Geosystems, 2003). This software is able to conduct 3-D point measurements, so that shorelines with elevation 3.5 m as well as contours can be manually identified. In fact, this manual process is sometimes so subjective for gently-sloped coastal morphology such as beach and tidal flat. To complement this process, contours generated by DEM are imported into the stereo-models and used as a reference to map 3-D points more objectively.

Time-series data sets of shorelines and contours are analyzed by using DSAS as shown in Figure 4 (Thieler et al., 2005). Transect lines are set in an interval of 30 m over the beach, resulting in a total of 65 lines. Although DSAS gives several parameters of shoreline change rate, we focus on only EPR (end point rate) in this study.

4. RESULTS

A time-series of shorelines and contour lines of 1 m and 2 m was constructed using 7 years aerial photographs. Since shorelines are composed of both natural and artificial shoreline attributes, it would be reasonable to use only natural shorelines when we calculate shoreline change rate. Instead of artificial shoreline, we use 1 m and 2 m contours as a proxy of shoreline changes.

In 2012, shoreline lengths of Baeksajang beach were 1.8 km. Composition of natural and artificial shoreline was about 45% and 55%, respectively.

Deposition dominated in the northern part of Baeksajang beach due to development of natural sand spits. Most of the southern part was composed of artificial shorelines and influenced by severe erosion. At the southern part, average retreat rates of 1 m and 2 m contours for the period from the year 1985 to 2012 were 3 m/yr and 1 m/yr, respectively (Figures 5 and 6).

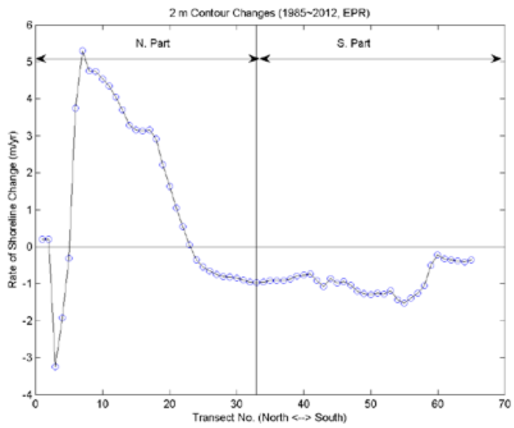

Figure 5. Rate of 2 m contour changes

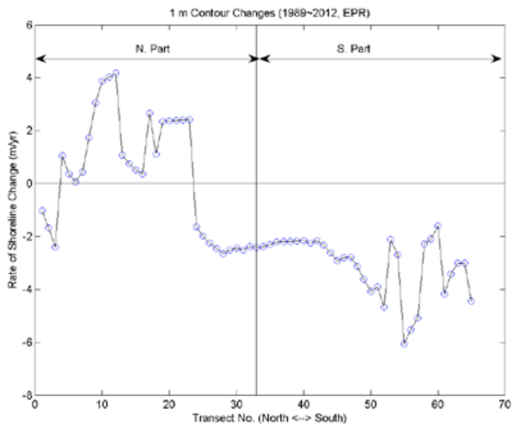

Figure 6. Rate of 1 m contour changes

5. CONCLUSIONS

Scientific data of shoreline changes will play an important role for helping related parties such as local people, local government, and academic organization understand coastal erosion problems objectively. Also, they will provide basic data for coastal management activities for erosion prevention countermeasure as well as environmental restoration measure.

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