

# GIS APPLICATION IN COASTAL ENVIRONMENT EVALUATION

Le Trung Tuan\*  
Tomoya Shibayama\*

Member JSCE  
Fellow JSCE

Graduate Student  
Professor

Yokohama National University  
Yokohama National University

## 1. Introduction

Coastal area is one of the most sensitive areas, subjected to strong impacts of human activities and natural processes. Evaluation of coastal environment is considered important for the development and management of this area. Recently, the development of GIS and remote sensing technology and the availability of GIS data have provided a new tool for this task. This paper discusses the possibility of GIS application and presents some preliminary applications in the analysis of coastal characteristics in Tokyo bay and Sagami bay.

## 2. Coastal environment problems and framework of GIS application

Figure 1 shows a working hypothesis to analyze the major coastal problems, which are related to industrialization process of the economy.

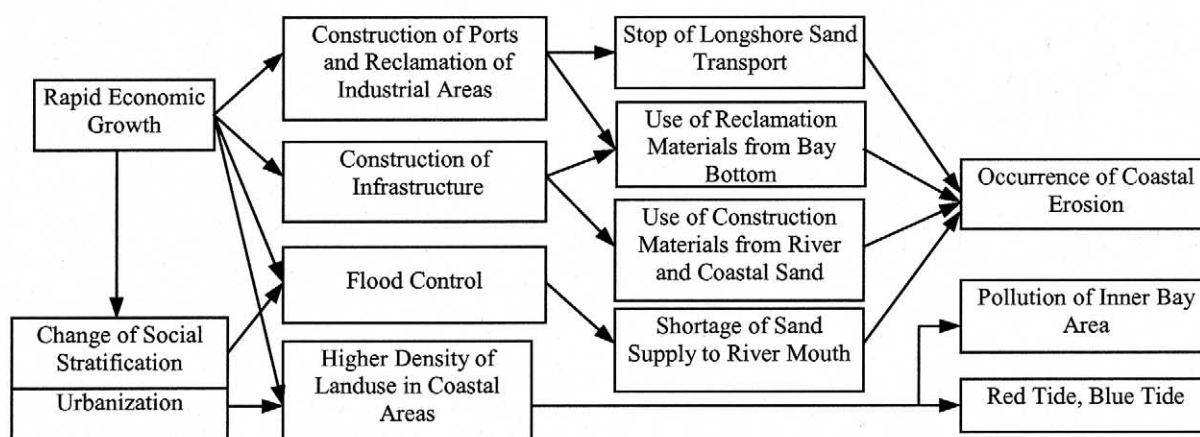


Figure 1. Industrialization process and coastal problems (Shibayama, 1997)

GIS is useful for coastal environment evaluation because of its ability to integrate a diverse range of datasets, easily access and update information, easily produce maps and reports and carry out spatial analysis. Figure 2 shows the functioning framework of a GIS.

## 3. GIS data sets

The following data sets are typically used for coastal area applications:

*Digital elevation models (DEM):* including 50-meter grid elevation maps produced by the Geographical Survey Institute. Cell values represent elevations at cell center and elevations are quoted to 0.1 meter.

*Landuse maps:* including 10-meter grid digital maps. Different land uses are classified into 15 categories and represented in the maps by unique colors.

*Satellite images:* Landsat MSS and TM images with seven bands derived at different times are used. The typical image's spatial resolution is 30 meters.

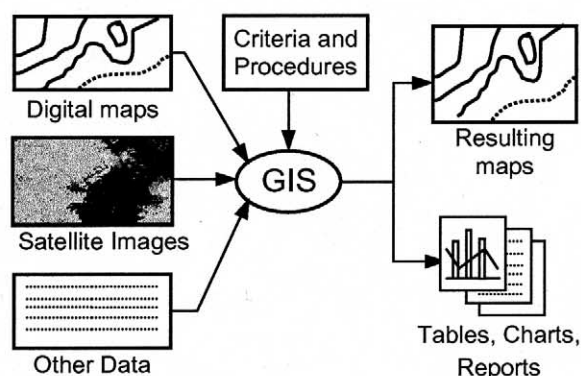


Figure 2. GIS integrates spatial data with other data to perform environmental analysis

Key words: coastal environment evaluation, GIS application, digital map, satellite image

\* Department of Civil Engineering, 79-5 Tokiwadai, Hodogaya-ku, Yokohama, Japan 240-8501 Tel: 045-339-4036  
Fax: 045-331-1707

*Coastal feature maps:* These are digital maps showing the number of storm surges and tsunamis since 1907, the classification of coast, the location of breakwaters, and the characteristics of river basins (area, river discharge).

#### 4. Proposed applications

The following areas are proposed for possible application of GIS in coastal area:

*Evaluation of influence of sea level rise:* GIS is used to integrate the spatial data (elevation, topographic features, and landuse) with the forecasted sea level change and wave data to evaluate the influence of this phenomenon on the coastal area.

*Producing erosion potential map and coastal disaster potential map:* The multi-temporal nature of remotely sensed data provides sufficient data on changes in the coastal zone, including erosion. GIS combines this data with topographical map, landuse map, soil property map and data on wave climate to produce the erosion potential as well as other disaster potentials in the coastal area.

*River-Coast integrated management system:* Rivers and coastal environment have a close relationship. River sediment discharge is the major factor affecting the sedimentation as well as the erosion processes in coastal areas, especially in those close to the river mouth. A river-coast integrated management system based on GIS is developed to integrate the river sediment data with the spatial data of coastal zone to analyze this relationship. The system is useful for the assessment of influence of structures in upstream such as reservoirs and flood control structures to coastal areas.

#### 5. Preliminary results and discussion

*Definition of coastal area:* There is no official definition of coastal area. However, studies on coastal area often need information about the extension of coastal area from the shoreline. Using ArcView, we define the coastal area by using two criteria: (1) the distance from shoreline; and (2) the elevation of the location. This method is applied to the coastal area of Tokyo bay and Sagami bay, the resulting map is shown in figure 3.

*Derivation of average slope:* The average slope is calculated from the elevation values of a cell and its surrounding cells. The resulting average slope map is shown in figure 4.

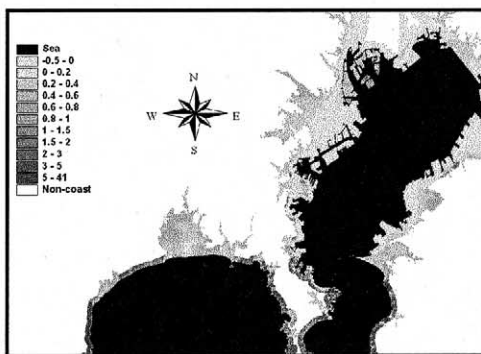


Figure 3. The extension of coastal area from shoreline and its elevation

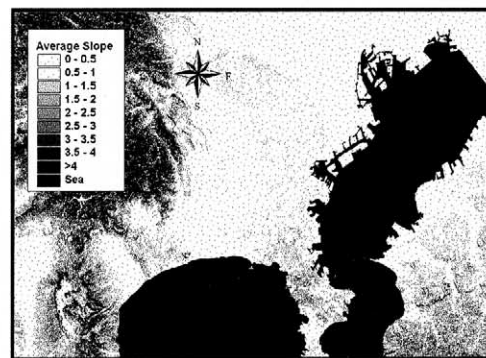


Figure 4. Average slope map, slopes are showed in percent

From these maps, the coastal area can be classified into three categories: (1) the inner-bay area characterized by low elevation and mild slope with greater coastal extension and muddy coast; (2) the Miura peninsula characterized by high slope rocky coast and limited coastal extension; and (3) Kanagawa coast characterized by low elevation, low slope sandy coast.

#### 6. References

- Graves, M.R. 1994. Remotely Sensed Data: Information for Monitoring Dynamic Wetland Systems. *Technical report WG-SW-2.1*. US Army Engineers Waterways Experiment Station, pp. 113.
- Sato, A and Mimura, N. 1997. Environmental Problems and Current Management Issues in the Coastal zones of South and Southeast Asian Developing Countries. *Journal of Global Environment Engineering*, JSCE, Vol. 3, pp. 163-181.
- Shafer, D.J. et al. 1998. National Guidebook for application of Hydrogeomorphic Assessment to Tidal Fringe Wetlands. *Technical report WRP-DE-16*. US Army Engineers Waterways Experiment Station, pp. 59.