B-12.1 Study on preparation and collection of basic data and classification of coastal zone (Final Report)

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Abstract Coastal zone directly receive the effect of the global scale environmental change such as sea level rise by the global warming. It is anticipated that the large-scale artificial modification by population explosion and economic development more and more also occurs. The critical situation for the global ecosystem and survival of the mankind will be faced, if such environmental variation loses original value and resources of the coastal zone. In order to be correspondent to such problem, to build prediction method coastal zone global environmental change of coastal zone, and to integrate environmental information database by Geographic Information System (GIS) and constructs the system of assessment for impacts of sea level rise.

This study carried out research on investigation of the geographic data set and its specification, when the examination on effects of acquired data of the accuracy on the assessment for impacts of sea level rise in the case study in Thailand. And LANDSAT-TM land cover classification in Thailand coast was made in this study shows effectively classify urban area, salt farm, paddy field, field, forest, sea area, coral reef, mangrove.

Key Words GIS, GPS, Classification of coastal zones, Classification of land cover

1. Introduction

According to IPCC (Inter governmental Panel on Climate Change), the sea level rise in 2100 has been predicted as about 50cm. Detailed coastal zone landform, vegetation, land use, coast facilities or topographic maps are not unimproved or closed in each country in Asia-Pacific region. For this bottle neck, to examine the method for simply making basic data in economically and without violating the sovereignty of these countries are important. In South-East Asia region where are many cases in which basic information has not been arranged on land use of coastal zone or information deviated by the rapid change. Land use is possible to classify at any accuracy by remote sensing technology. However, the ecosystem of the South-East Asia coastal zone unlike in a middle latitude areas such as mangrove and coral reef is distributed, and the utility form is also different on the paddy field, that says necessity

of the classification algorhysm.

Land cover classification map was made using remote sensing in Thailand where basic information had comparatively gathered based on such point in this study, and the evaluation was carried out in comparison with land use figure. To clarifying land cover classification algorithm by remote sensing and the accuracy can grasp actual condition of coastal zone's land use and change in South-East Asia region with small basic information.

2. Research Objective

In this study, coastal zones are categorized as one of the frames of criterion for evaluation considering local characteristics for doing assesment of sea level rise. The categorization of coastal zone is an useful method even in the case in which the modeling of response of coastal zone for the global environmental change.

Maps and image information such as topographic map, aerial photograph, satellite images are analyzed, and categorization based on landform and land use classification is mainly done.

3. Methodology

(1) Acquisition and processing of basic data

1) Investigation on data format and GIS software and data acuisition

Available GIS software for personal computer, data formats and space analysis function is investigated, and determine the specification of the GIS data for sea level rise reseach. Then, investigates location and accuracy information of geographic data in Thailand and in Japan, and collects available data.

2) Ground elevation data acquisition

Detailed ground elevation data is necessarily for assessment of sea level rise. Sub-2 carries out to build detailed ground elevation data set with GPS and leveling in sample district.

(2) Preparation of satellite land cover classification map

Remote sensing land cover classification map is effective for monitoring of ecosystem distribution and land use change of coastal zone. Especially, repetition observation of wide area where difficult to be obtained field data directly. However, land cover classification by the satellite is also frequent on the misclassification or some mutually division. We examined the most efficient classification item and algorithm in coastal zone of tropical and subtropical zone using satellite image. And the final goal of this study is applying same algorithm to ASTER (Advanced Spaceborne Thermal and Emission Radiometer).

4. Result

(1) Acquisition and processing of basic data

1) Investigation on data format and GIS software

Following nessecities are required for the data processing.

a. Data format and software is general
b. GIS software should be having customizing function
c. Initial cost is comparatively low
d. Operating should be on personal computer

i. Data format

Data format made individually by preparation organization. Input/output format of vector and raster (image) by major GIS softwares are shown in table 1.

Table 1 Input/Output format

System	SIS	SPANS	AutoCAD Map	MapInfo	ARC/INFO	ArcView3
Vector input	MapInfo, IGES, DXF, ARC/INFO, SHP	ARC/INFO, DXF, IFF, MapInfo, TIGER,SIF, DLG30	ARC/INFO, SHP, MapInfo MIF/MID, DGN, DXF, SDF	MIF, DXF, ARC/INFO	DXF, DLF, TIGER IGES, DIME, SHP	ARC/INFO, MicroStation, SDE, MapInfo, DXF
Vector output	DXF, RDB, SHP	DLG30, DXF, GINA, SIF	ARC/INFO, SHP, MapInfo MIF/MID,DGN, DXF, SDF	MIF, DXF	DXF, DLF, TIGER, IGES, DIME, SHP	SHP
Raster data (Image)	TIFF, BMP, RLE, RLC, JPEG	TIFF, ERDAS, MPC, PCI	BMP, DIB, GIF, JPG, PCT, PCX, RLE, TIFF	SPOT, GIF, TIFF, PCX, BMP, JPEG	TIFF, ERDAS, SunRaster, GRASS	ERDAS, TIFF, JPEG, BMP, BIL, SPOT, SunRaster, CGM, PICT

SHAPE FILE format for vector format is a one of popular format, because format itself has been opened to public(http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf).

JPEG or TIFF are high generality in raster (image) data. JPEG is possible to reduce disk space by image compression, although it can not be reproduced original data. Shape File format for vector data and TIFF format for raster (image) data were adopted in this study.

ii. Geodetic datum and Projection

All countries of world defines and uses geodetic coordinate systems and a reference ellipsoid which originally suit each region. When neccesary to refer rationally or wide region, common datum to all earth is required. WGS84 is used for this study. Because, WGS84 is able to reffer all earth.

Any projection is required for position coordinate of the earth are expressed on the plane. Geographic (longitude and latitude) coordinate was adopted for this study because it is easy to transform to other projection.

2) Geographic data acquisition

Major available geographic data which covers wide area or earth whole area shown

in table 2.

Table 2 Geographic information which covers the wide area

	Title	Area	Year	Resolution
Geographic Information	World boundary data bank	Whole area	1990	1/10 degree
	World boundary data bank II	Whole area	1972	1/10 degree
	Digital Chart of the World	Whole area		1:1,000,000
	Arc World	Whole area		1:3,000,000 1:25,000,000
	Arc World Supplement	Whole area		1:3,000,000
	Arc Atlas	Whole area		1:25,000,000
Elevation	GTOPO30	Whole area		1/120degree
	DTED Level 0	Whole area		1/120degree
	ETOPO5	Whole area		1/12degree
Vegetation	Holdridge Life Zones (Ecological Zones)	Whole area	1990	1/2degree
	Major Ecosystem Complexes (Olson Vegetation)	Whole area	1983	1/2degree
	Matthews Vegetation	Whole area	1953-1979	1/1degree
	OAA Global Vegetation Index (GVI)	75N-55S, 180W-180E	1982-1990	16km
	World Vegetation Map (Murai & Honda; University of Tokyo)	Whole area	1985-1987	16km
Meteolological data	Cyclone	Whole area	1996	

"Thailand on a Disc" of which produced by Thailand Environmental Insititute as a geographic data which covers whole. This data set has been contracted in 1:250,000, and it contains several map data and statistical information.

3) Ground elevation data acquisition

GTOPO30 as 30 second arc (approximately 1km) grid cell and 1m interval elevation data set which covered all earth is available. However, high-precise and high-density altitude data is not available in this area, therefore this study carried out DEM generation method.

There are some methods in way of generating of the DEM as follows.

a. Generate from contour line data of existing maps
b. Using remote sensing technology such Synthetic Apature Rader

The region about 300km^2 in Bangkok south-eastern area as a sample district to build 50cm interval DEM with GPS and leveling with Triangular Illegular Network function on GIS software.

(2)Coastal zone satellite land cover map

1)Land cover classification in tropical zone and subtropical.

i. Classification categoies

The algorithms which can classify coral reef and mangroves are necessary in the coast of tropical and subtropical zone. It is desirable that farmland such as paddy field, sugarcane field and forest can be divided in the land. From them, following things are examined as a classification categories.

a. Land : Forest, farmland, paddy field, grassland, urban district, bare field
b. Coast : Mangrove, coral reef, sandy beach
c. Waters : River, lagoon lake, sea area

ii. Classification of land use

Land use can be classfied in temperate zone by comparison of moisture status and change of vegetation rate of satellite images in 2 seasons. First, in comparison with the change of surface water minute condition in early spring (before rice transplanting) and middle spring. In this comarizon, paddy field, waters and other land are divided. Next, it is possible to divide bare field and urban district, farmland and dry grassland, grassland and forest by comparing change of vegetation rate between early spring and early summer. Though forest and urban district and bare field were clearly extracted, it is difficult to divide bare field, grassland and farmland. Because there is often no clear seasonality in planting or harvesting of paddy field and farmland, further examination will be necessary in the future.

iii. Extraction of the mangrove

Water, vegetation and soil can separate effectively by plotting the value of reflection luminance of two bands in visible range and near infrared. In addition, accuracy will be raised by using DEM data.

iv. Extraction and classification of coral reef

First, waters and land were divided using surface reflection luminance in thermal infrared area. Next, coral reef area and oceanic region were divided using visible bands. In addition, coral reef community and sand bottom can be divided by comparing with field data. By using bottom index in the shallow sea which removed effect of water depth, coral reef community and bottom material were divided.

2) Land cover classification of Thailand coastal zone

Land-cover classification and comparison with field data were carried out in Bangkok coast, Phuket and Songkhlar lake. LANDSAT-TM data taken on April 24th, 1997 were used. Land cover classification image was made from the bands 2, 4 and 7 with supervised classification method. Referring to existing topographical map (scale 1:50000) and literature, the classification category was set from features of image by visual observation interpretation. Based on this category, pixels as a training data were chosen. LANDSAT-TM bands 1, 5, and 7 were used for land cover classification. Sea area was removed from the image by decision tree method using band 7, and the pixels in land were chosen.

TM false color image and TM land cover classification image of Bangkok region are shown in figures 1 and 2.

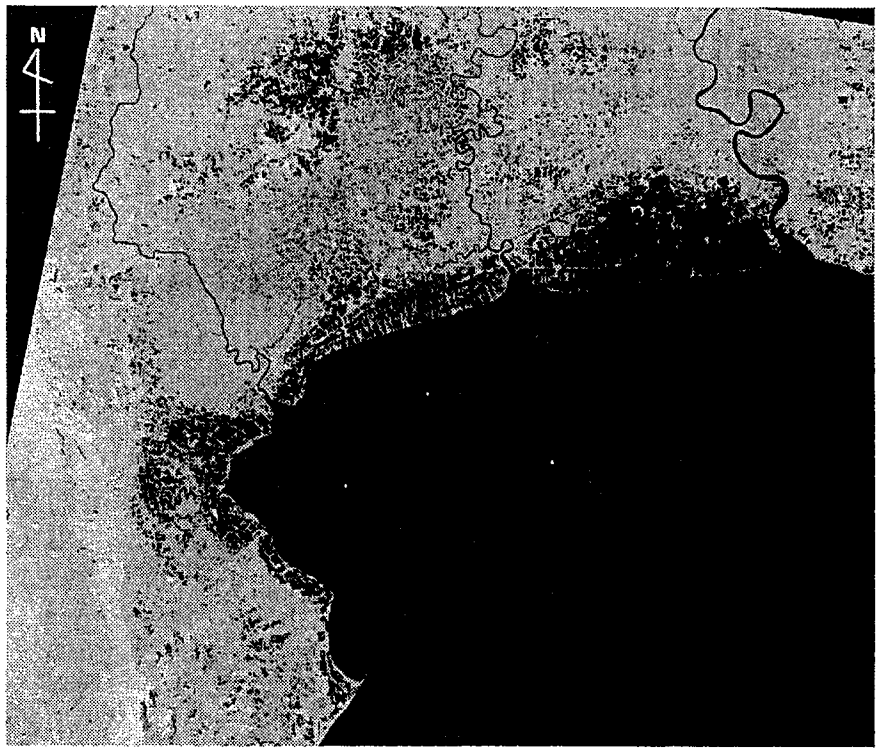

Figure 1 TM false color image

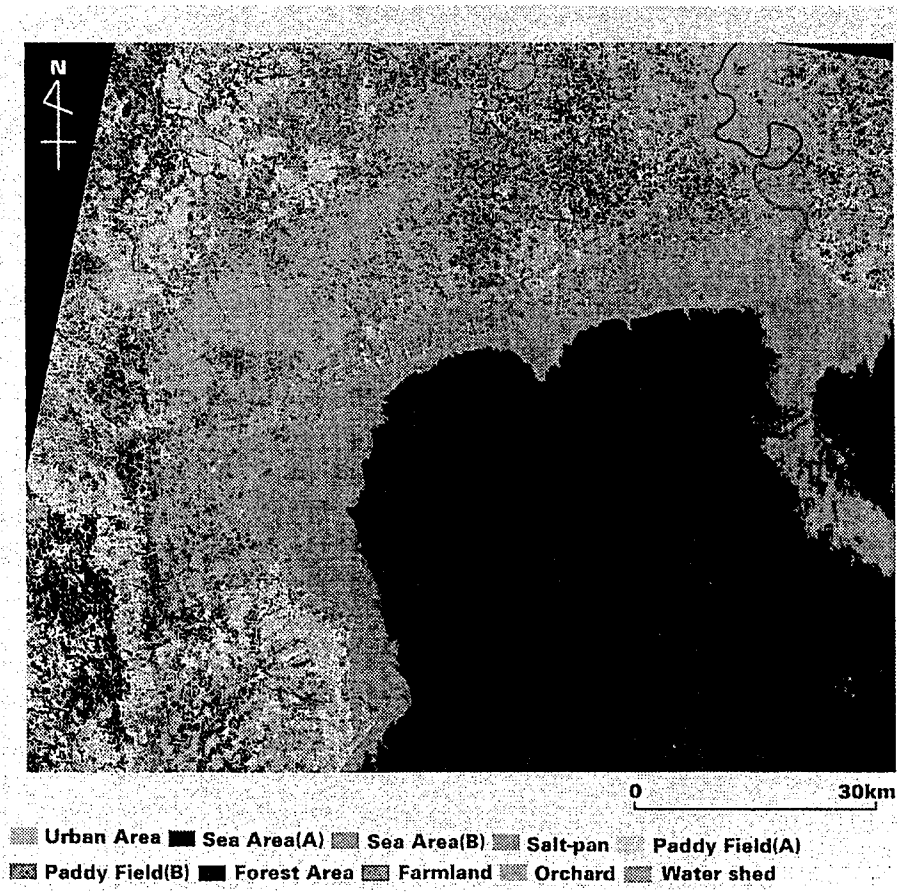

Figure 2 TM land cover classification image

3) Evaluation of land cover distribution map

The satellite land cover map were verified by "Thailand on a Disc", other GIS data, existing topographical maps and references.

(2) Coastal zone data

i. Result of comparison

The comparison between TM land cover map and GIS land use category is shown in table 3.

Table 3

TM land cover classification	GIS land use map
Urban Area	U0101:City town and commercial land
Salt-pan	A0902:Fish
Paddy Field(A)	A0101:Transplanted paddy field >> F0100:Evergreen forest > A0401:Mixed orchard
Paddy Field(B)	A0101:Transplanted paddy field
Forest Area	F0000:Forest land
Farmland	A0401:Mixed orchard / F0000:Forest land
Orchard	A0400:Orchard >> A0405:Coconut > A0101:Transplanted paddy field
Sea Area(A)	unclassified
Sea Area(B)	unclassified
Water Shed	unclassified

According to the table 3, Urban Area, Salt-pan and Forest area are matched with each other, however Paddy field (A) and Orchard contain several categories. It is necessary to examine whether Orchard and Coconut can be classified by their spectrum characteristics.

Salt-pan, based on the legend on 1:50000 topographical map, is utilized as Fish Pond at present. Some of the salt-pan area should be categorized as Mud-area.

ii. Comparison between TM land cover classification result and GIS coastal zone classification map

Table 4 Comparison between land cover classification result and coastal zone classification map

Result of TM land cover classification	Coastal zone classification map using GIS
Urban Area	U0101:City town and commercial land
Salt-pan	unclassified(BLANK)
Paddy Field(A)	M0102:Bush and shrub?
Paddy Field(B)	unclassified(BLANK)
Forest Area	outside
Farmland	outside
Orchard	A0405:Coconut
Sea Area(A)	unclassified
Sea Area(B)	unclassified
Water Shed	unclassified

The Urban area agreed with the GIS maps, however most of the other categories are not classified in GIS maps.

4) ASTER utilization

Land cover information will be obtained by using satellite remote sensing. Objectives of ASTER are to monitor and to map resources, and global scale fluctuation of land-use. ASTER is opened for monitoring South-East Asia coast, because satellite land cover mapping algorithm has been evaluated to this study. Researchers are also possible to request data of ASTER via Earth Remote Sensing Data Analysis Center[1].

5. Result of this study.

(1) The geographic data formats and geodetic datum was investicated.

(2) Developed DEM generation technique using GPS and leveling.

(3) The classification was verified on the interpretation of land cover using satellite image.

Reference

1) GSI(1993～1995) : Report on the assessment for impacts of sea level rise by Global Warming

2) MURAKAMI Masaki(1999) : Geodetic Coordinates 2000 -Present Status and Problems of Tokyo Datum-, Journal of the Geographical Survey Insitute No91, pp16-23.

[1] http://www.ersdac.or.jp