Corona declassified imagery for land use mapping: Application to Koh Chang, Thailand.

Michiro Kusanagi, Jun Nogami, Yann Chemin, Thinley Jyamtsho Wandgi, Kyaw Sann Oo, Prasad Bauchkar Rudrappa, Duong Van Hieu.
STAR PROGRAM: Co-ordinator, Assistant, Doctorate Student, Associated Scholars.
Asian Institute of Technology, 58 Moo 9, Km. 42, Paholyothin Highway
Klong Luang, Pathumthani 12120,Thailand.
E-mail: kusanagi@ait.ac.th

ABSTRACT : This study uses the images from the Corona "spy" satellite, which have been declassified in November 2002 and available on Internet order for a very low cost. The image used dates from 1973 and has about 6m panchromatic characteristics. Along with a Landsat5TM of 1990 and Aster of 2001, a temporal range of about 30 years is achieved. A simple classification of the area was processed and crosschecked manually from the available recent toposheets of Thailand.
Results show the development of human infrastructure in the Protected Island of Koh Chang in Thailand, from 1973 to date. Specific human locations are identified linked either to tourism development, or to villages of fishermen.
Scope for using Corona in land cover changes on a longer time period than usual satellite images is possible. Some classification issues coming from the sensor have to be taken into account. Accuracy assessment is also an issue because of the age of the sensor.
KEY WORDS: land cover, mapping, monitoring, remote sensing, Corona, Koh Chang, Thailand

1. Introduction

Koh Chang Island, as the name says is the " land of elephants'. The second biggest island in Thailand after Phuket is virtually virgin and hardly touched by the hands of modern era. Because of it's pristine environment and beautiful landscape, sometimes it is called the secret of wonders and some even call Kohchang island as "the land of Paradise Islands in south-east Asia". It is infact the place where one can find peace, harmony, and tranquility and see the real beauty of nature and be part of it. The island really boasts of spectacular waterfall, deep gorges, fine sand beaches, rich and diverse distribution of flora and fauna species and the aquatic species in abundance in and around the island.

Koh Chang is the largest of the 52-island Marine National Park where the environmental conditions and nature reserves are intact as it was. The local inhabitants and the visitors are very much very happy with the way the Koh Chang island has shaped up so far making heavenly places for people coming from far and near. It did remain devoid of luxury and the modernization till today. The pureness and the sanctity of KohChang Island had always exhibited the high spirits and emotional satisfaction to all the visitors.

Geographically, Koh Chong Island is located about 330 kilometers east of Bangkok or approximately 4 hours by road and another 30 to 45 minutes by boat or ferry. It is located within the latitude range from 11deg 32 min 28 sec (lat) to 12 deg 10 min 20 sec (lat) and longitude from 102 deg 12 min 38 sec (long) to 102 deg 37 min 51 sec (long). The island is about 30 km in length and about 8 km in its widest points. The elevation in Kohchang ranges from the mean sea level to the highest points of 800 meters. About 70% of the total area of Kohchang Island is covered with Rain forest.

Kohchang Island cannot afford to remain isolated with the advent of modernization. It has to cope with the advancing world in terms of developments and other service facilities like tourism, which could be the main source of revenue for the island. Further to boost the economy, it has to adapt to the modern method so as to avail the best livelihood within the minimum resources available. At the same time, the environmental problems, which could arise as result of modernization, should be carefully foreseen. In this eventuality, the probability of the ecosystem changing effected by the anthropogenic factors should be clearly understood [1].

The main objectives of this Kohchang Project (KC2003) are as follows.
1. Plan, coordinate, design, budget and execute a Balloon remote sensing survey.
2. Mapping the Kohchang Island using methods like GPS and photographing.
3. Developments of information system for the tourism for Kohchang Island.
4. Building a database in general for the Kohchang Island.
5. The impact of tourism industry on environment.
6. Creation of Web GIS for Kohchang Island.
7. Generation of soft copy (CD) of the database created.

The land use of Koh Chang is changing, a series of satellite images, coming down from the 1970s up to the recent years have collected from various websites over the Internet. Three major images where obtained, a Corona image from 1973, a Landsat 5 TM of 1990 and an Aster image of 2001. Images needed preprocessing and analysis of Land use before being used in any future work. The following describes the detailed work done on the data.

2. Data

Corona image of Kohchang area was taken on 27 December 1973, it was ordered from the EarthExplorer Website (http://edcsns17.cr.usgs.gov/EarthExplorer/), where it is available since its declassification from Defence Secret level on November 2002. Landsat 5TM image of 08 January 1990 (path=128; row=052) was downloaded freely from The Global Land Cover Facility (http://glcf.umiacs.umd.edu/index.shtml). Aster image of 09 December 2001 was ordered through the Eros Data Gateway for US$55/- (http://edcimswww.cr.usgs.gov/pub/imswelcome/).

Additional data provided by Royal Thai Government standard 1:50,000 toposheets are: elevation, villages, roads, cultural places, schools, districts and province.

Finally, ground truthing of tourist facilities, "backpackers" interviews and aerial photography [1] of some tourism places was arranged during a field trip.

3. Methodology

1) Preprocessing of Corona Image

Corona has a panchromatic sensor with a claim of 20-30 feet ground resolution that we found true. The data arrived in the form of a photographic high resolution product of 9"x18" for the cost of US$16. The Koh Chang island was scanned at 2400DPI (~3x3m ground resolution) in order to catch the best of the spatial resolution available. Finally, a 6x6m resolution resampling was found to be most realistic for processing while keeping all the spatial information available. Georeferencing of the image (Figure 1) was done based upon the Aster image of 09 December 2001.

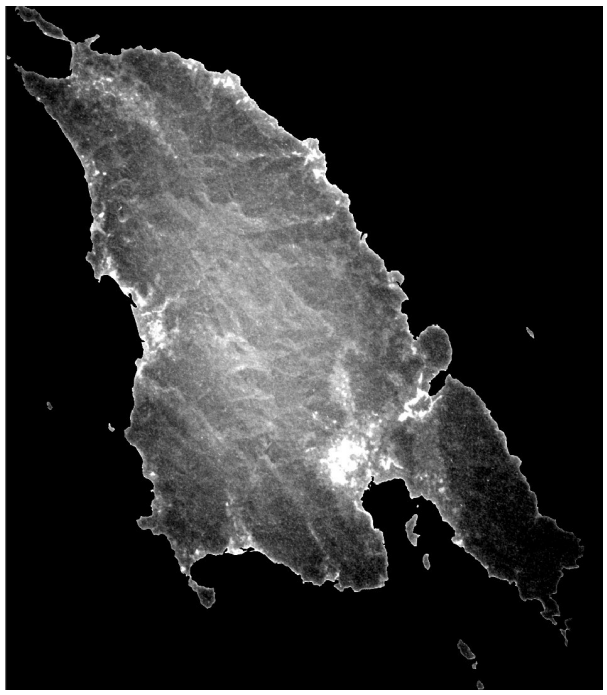

Figure 1: Corona image of Koh Chang.

2) Processing of the three images into basic land use

Unsupervised classifications were initially performed on each of the images, leading mediocre results. The patchiness and the slope/sun shadow effects are confusing simple classification methods. Similar results were found by multi-temporal merging classification, where all images are classified as one, even though it is visually attractive, spectrally it is unclear. Finally, a single date classification with additional elevation layer brought significant results in combination with unsupervised classification techniques. Indeed, the land use is very dependent on elevation in this particular island (30 km length, 15 km width and 750m highest point).

Subsequently, some thresholding were used to remove uncertainties in classification when height/slope were incompatible with a certain land use.

4. Results and conclusion

Results (Figure 2) show the development of human infrastructure in the Protected Island of Koh Chang in Thailand, from 1973 to date. Specific human locations are identified linked either to tourism development (esp. West coast), or to villages of fishermen (esp. South part). It is rather logical that the areas of slope inferior to 10% are the places where settlements and agricultural lands are located. Since most of the island is having high slope values, any potential settlement development is soon going to be constricted, facing the reduction of agricultural land to higher income land occupation such as shop, bungalow accommodation, industry or resort.

Further processing is however necessary for quantitative accuracy of the latest image processing. An additional field survey is planned by end 2003 for this purpose.

Scope for using Corona in land cover changes on a longer time period than usual satellite images is possible. Some classification issues coming from the sensor have to be taken into account. Accuracy assessment is also an issue because of the age of the sensor.

References

[1] Guan, Y., de Jong, S.M., de Meijere, J., 2000. Integration of RS and GIS to Assess Human Impact on Ecosystem Change in Llanos Area (Venezuela). *Proc. ACRS'2000*, Taipei, Taiwan.

[2] Kusanagi, M., Nogami, J., Choomnoommanee, T., Laosuwan, T., Peñaflor, E., Shulian, Niu, Zuyan, Y., 2003. Koh Chang Island Eco-Tourism Mapping. Balloon remote sensing imagery with directional control. *Proc. ACRS'2003*, Busan, Korea.

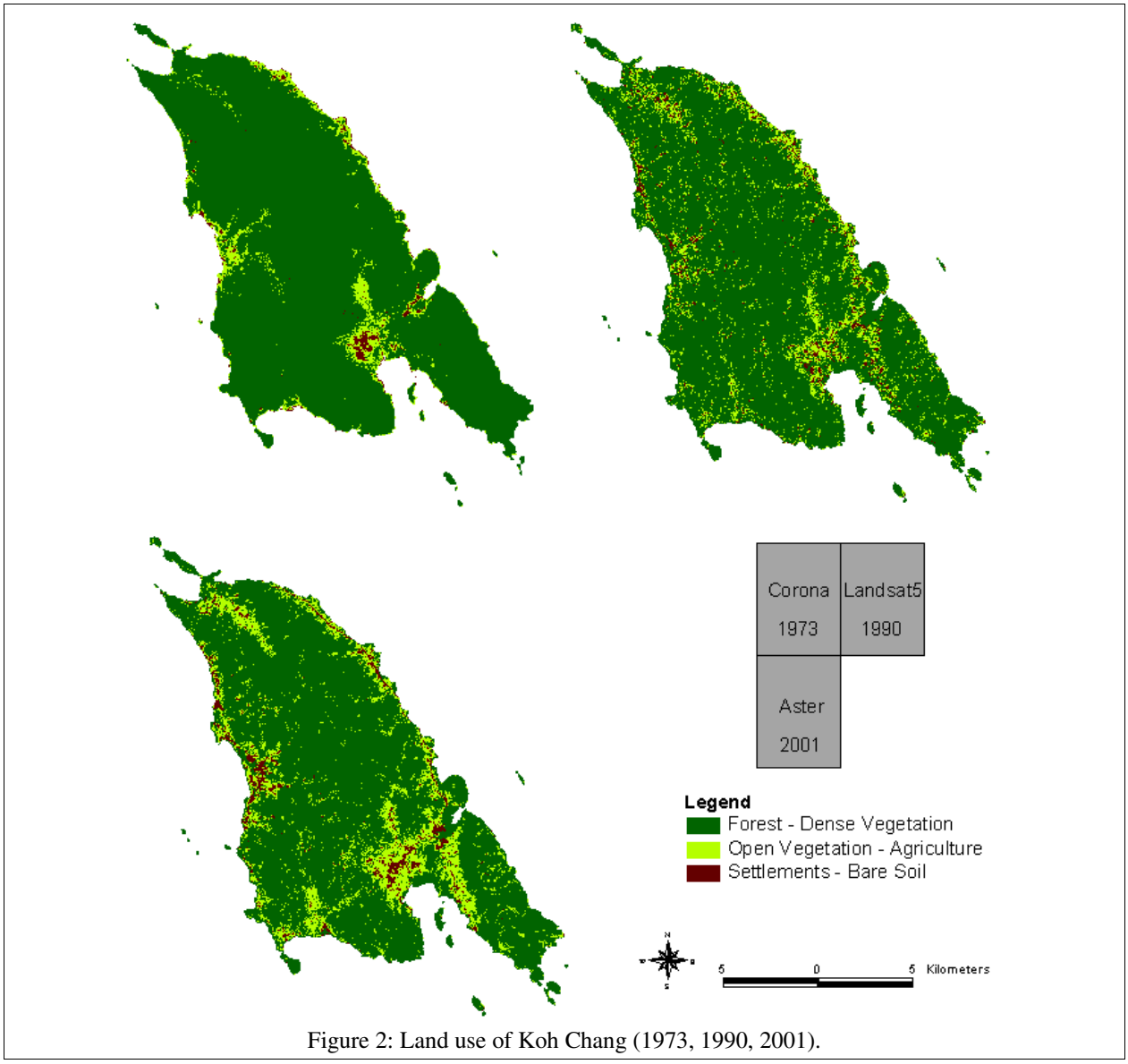

Figure 2: Land use of Koh Chang (1973, 1990, 2001).