The study of land use/land cover in coastal area of Chanthaburi province,Thailand, Using Cosmo-SkyMed : X band and Radarsat-2 :C-band

Wimon Pathtong, Amornchai Prakobya, Suramongkon Siripon and Nuttorn Kaewpoo
Geo-Informatics and Space Technology Development Agency
120 The Government Complex Commemorating
His Majesty The King's 80th Birthday Anniversary, 5th December, B.E. 2007
Ratthaprasasanabhakti Building 6th and 7th Floor, ChaengWatthana,
LakSi, Bangkok 10210, Thailand.
Wimon@gistda.or.th[1]
amornprk@gistda.or.th[2], srmk64@hotmail.com[3],nuttorn@gistda.or.th[4]

KEYWORDS: Cosmo-SkyMed :X band,Radarsat-2 :C band ,Polarization, Synthetic Aperture Radar, Back Scattering

ABSTRACT: This paper presents the application of Synthetic Aperture Radar (SAR) for land use and land cover in coastal area.The objective is to study satellite data COSMO - SkyMed: X band and Radarsat-2: C band land use / land cover in coastal areas of Chanthaburi province.The important advantage of SAR imagery is that it is independent of the impact of climate factors, e.g., rain, haze, and cloud. As a result, the SAR imagery can be acquired from all seasons; therefore, it is suitable for tracking land use and land cover changes. Additionally, the potential capability of SAR sensor is to provide the backscattering data and these data can be performed to classify land use/land cover. However, the backscattering characteristics depend on the wavelength, direction of the radiated electromagnetic field, surface roughness, and moisture content.

Cosmo-SkyMed (X-band, HH polarization) and Radarsat-2 (C band, HH,HV polarization) were used in this study. Those multi-temporal satellite images were acquired in May, August, and November 2013. The study area is in Chanthaburi province, Thailand. Land use in this area are paddy fields, cassava, rubber Trees, shrimp farms, mangrove, forest, orchard, buildings, forest, and water.

The result of this study exhibited that the backscattering from buildings showed very high values in all wavelength and direction, where as the back scattering of water and shrimp farms were very low, which appears black on images because such surfaces are smooth forest, orchard and rubber Trees represented similar backscattering levels due to the characteristics of sparse vegetation canopy and paddy fields are medium roughness.

The backscattering gray scale in this study area demonstrated different values from different materials according to the wavelength and direction of the radiated electromagnetic. This study found that surface roughness and moisture content are also the major factors of different backscattering values. If surfaces are rough, the brightness value will be white, such as roof and concrete road. Other important factors are moisture, wind, and incident angle.

In addition, the result indicated that the major land use/land cover of this area, included paddy fields, shrimp farms, orchard, rubber trees,and cassava,respectively. Land uses/land cover within 15 km. of coastline in Chanthaburi province were also illustrated in this study. The accuracy of classification using the Radarsat-2 satellite data are 80% and using the Cosmo-SkyMedsatellite data is 75%.

1. INTRODUCTION

Geo-Informatics technology can provide data in a short time with accurate location and direction. In addition, satellites with SAR system have a potential in recording data without the problem of cloud, fox, and rain. Sensors of SAR Satellites, for example COSMO-SkyMed and Radarsat-2 were developed to capture data with the long range of microwave wavelengths. Capturing both images at night time and day time can provide data that meet the need of users and it can provide multi-temporal data for all seasons.

According to these benefits of SAR system, this study applies multi-temporal COSMO - SkyMed and Radarsat-2 to increase its efficiency in studying land use/ land cover in coastal area of Chanthaburi in Khlung, Laem Sing, Chanthaburi Mueang ,and Na Yai Am. This study uses multi-temporal data of Cosmo-Sky-Med (X-band, HH polarization, 30 m resolution) and Radarsat-2 (C band, HH, HV polarization, 25 m resolution) taken in

May, August, and November 2013. Land uses in this area are paddy fields, cassava, rubber plantation, shrimp farms, mangrove forest, orchard, buildings, forest, and water.

2. OBJECTIVES

1) To classify 9 land uses/land covers in coastal area of Chanthaburi;
2) To create maps of land uses/land covers in coastal area of Chanthaburi

3. STUDY AREA

The study area is in coastal area of Chanthaburi province in the east part on the shore of the Gulf of Thailand.

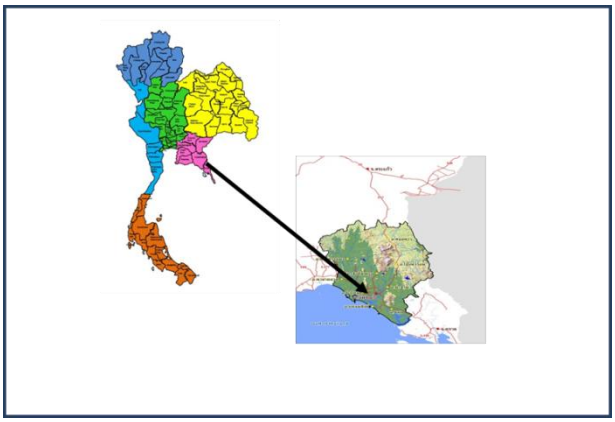


Figure 1 The location of study coastal area of Chanthaburi. Province (Source : http: //th.wikipedia.org).

4. METHODOLOGY

1) Using of satellite images Landsat-5, HH polarization of COSMO Sky-Med: X band and HH & HV polarization of Radarsat-2: C band acquired on May, August and November 2013

2) Geometric correction, Radiometric correction and image filtering using a 3x3 window in NEST software and ENVI for celebration

3) Multi-temporal satellite images acquired on May, August, and November 2013 were initially geometrically corrected and co-registered and the coefficient, σ^o of HH polarized of Cosmo-SkyMed and HH & HV polarized of Radarsat-2 complex images were evaluated using a 3x3 window with NEST software and get back scattering coefficient, σ^o in dB

σ^o (r,c) $10*\log_{10}(\sigma^o(i,j)$

4) Classification info Land use / Land cover the landscape classifies employment model .
Maximum Likelihood classification Supervise classification to classify 9 land uses/land covers such as paddy rice, shrimp farm, building, orchard, forest, mangrove, cassava and rubber trees in ERDAS software

5) Checking of accuracy with field survey

6) Mapping of land use/land cover of multi-temporal of cosmo-SkyMed and Radarsat-2 in ARC GIS

.

7) Summary and Reports

Cosmo-SkyMed and Radarsat-2 satellite images in gray scale and multi-temporal data

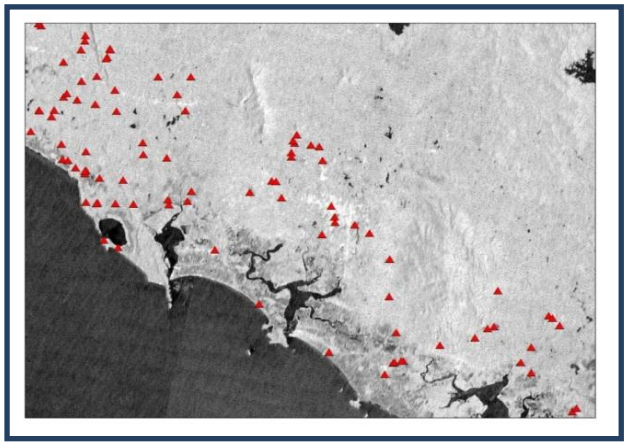


Figure.2 Satellite images of Cosmo-SkyMed : X band HH Polarization acquire on 19 August 2013

.

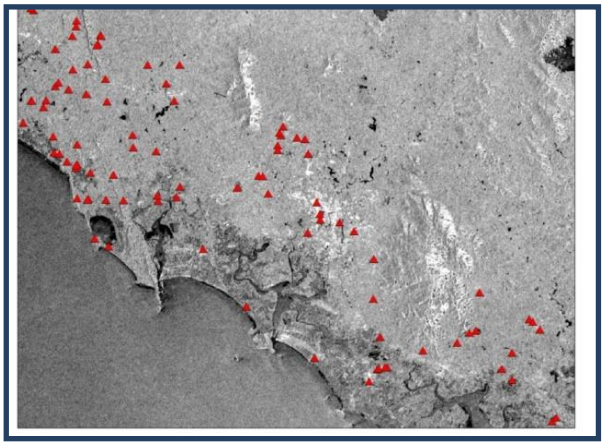


Figure.3 Satellite images of Radarsat- 2:C band HH Polarization acquire on 19 August 2013

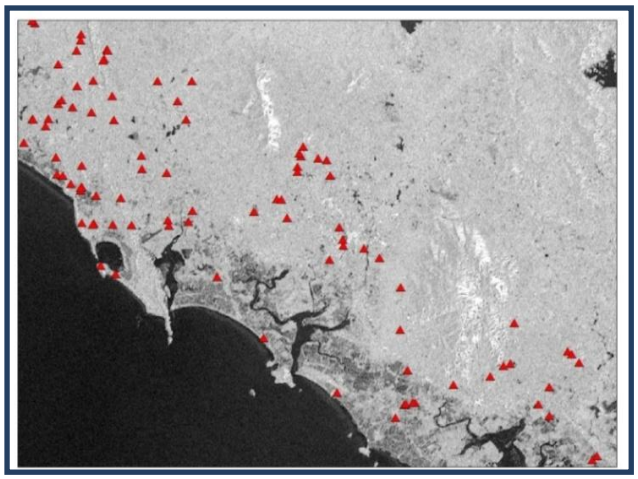


Figure.4 Satellite images of Radarsat-2 : C Band HV Polarization.data on 19 August 2013

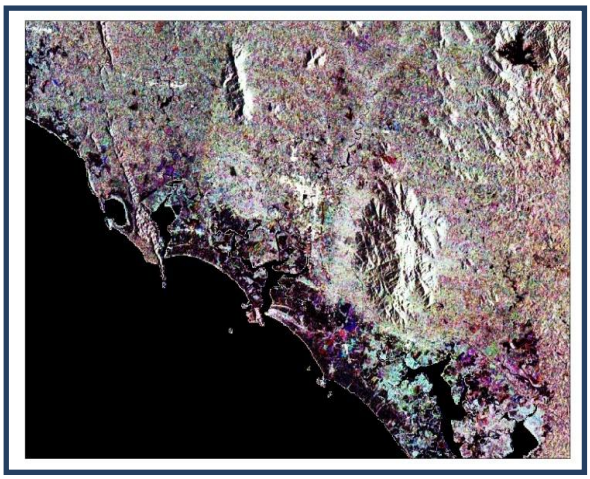


Figure.5 Satellite of Cosmo- SkyMed HH Polarization Multi-temporal data acquired on May15 , August 19 and November 23 2013

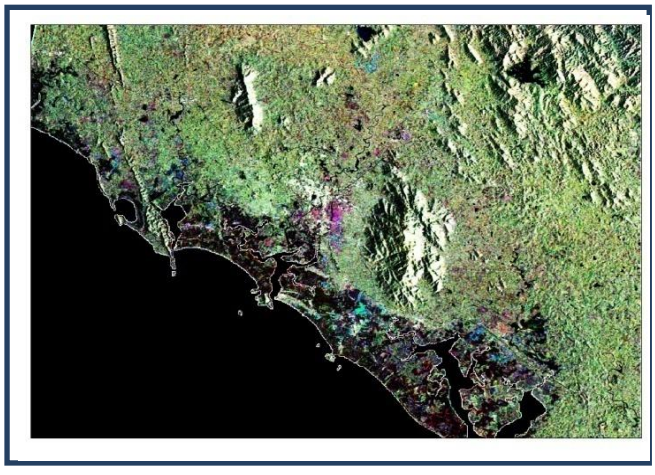


Figure. 6 Satellite of Radarsat-2 HH Polarization multi-temporal data acquired on May15, August19 and November 23 2013

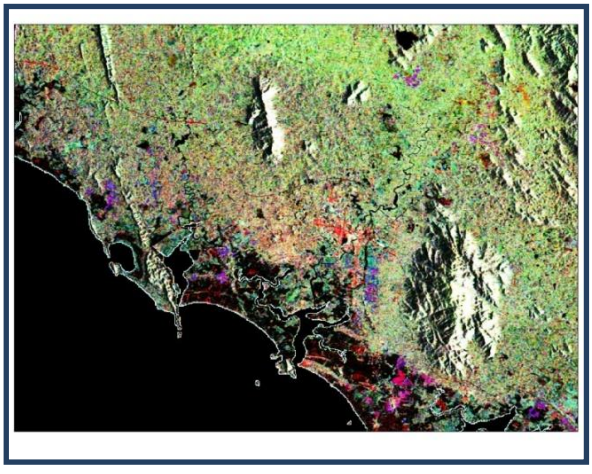


Figure.7 Satellite of Radarsat-2 HV Polarization multi - temporal data acquired May15,August19 and November 23 2013

5. RESULTS

The result of this study found different levels of gray scale from different land uses/land covers. The backscattering of 9 land uses/ land covers demonstrated different values from different materials according to the wavelength and direction of the radiated electromagnetic. The image classification of COSMO-SkyMed: X Band and Radarsat-2: C Band can identify 3 characteristics of land uses/ land covers as follows: (Table.1- 2)

(1) Smooth surface or quite smooth surface

The backscattering from smooth surface provides low values, which appears black on images such as water and shrimp farms. The grey scale of water is low and Sigma naught (σ^o) is -23.68 in X band and -16.13 in C band. Sigmanaught (σ^o) of shrimp farm is -12.38 in X band and 12.04 in the C band.

(2) Medium roughness surface

The backscattering from medium roughness surface provides medium value range of the grey scale. The example of land use/land cover in this type is vegetation. Forest, orchard, and rubber trees represent similar backscattering in medium levels due to the characteristics of sparse vegetation canopy and moisture. Rice paddies has Sigma naught (σ^o) of -9.85 in the C band and Sigma naught (σ^o) of -10.31 in X-band. X-band has longer wavelength than C-band; therefore, the radar signal of this wavelength can penetrate much more deeply into the surface beneath the vegetationand provide lower values than C- band. Vegetation, which has less complex structure and long leaf, also has higher backscattering in C band than X band due to the shorter wavelength of C band than X band.

(3) High roughness surface

The backscattering from high roughness surface provides very high values of gray scale, which appears white on images such as building, roof, and concrete road. In addition, the gray level of bush/canopy vegetation, such as forest, mangrove forest, perennial, shrub, and woodland, is very high in all wavelengths and directions. The gray level of building has Sigma (σ^o)of -3.38, and -6.75 in the X band and Sigma (σ^o) of -3.38 and -8.94 in C band.

(4) Figure10-11.Shows mapping of land use/land cover of Landsat-5 and the resulting image of Maximum Likelihood classification, which further Classifies in coastal area of Chantaburi province comparison of Land use/Land cover of Radatsat-2 and Cosmo-SkyMed on the probability of occurrence of these values for each pixels.On applying morphological operation to the classified image the Cosmo-SkyMed : X band data gives a good classification in the water body and shrimp farm and Radarsat-2:C Band data gives a good classification cassava,mangrove,,forest,Orchard, paddy field and rubber trees.The accuracy of Radarsat-2 closely Landsat-5 but Cosmo-SkyMed less than

The False Color Composite image of back scattering coefficient and backscattering difference images. Because of the coherence and the backscattering coefficient values, as combination of both satellites the values has best efficiency to classify the pixel.Low coherence and low backscattering coefficient separates the water from forest, mangrove, rubber trees and building area which has a high values of these parameter. Therefore the water appears black due to low coherence value and forest, mangrove, rubber trees, cassava and building region in red and green due to the moderate and highest coherence values respectively.

Table.1 compare Radar backscatters/Image of Land/use Land cover

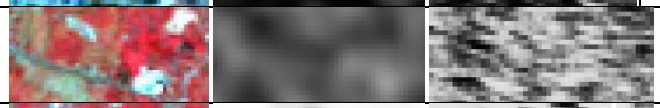
Number	The kind of Material	Optical	The kind of SAR		Sigma σ^o X band	Sigma σ^o C band	Images characteristics X band	Images characteristics C band	Detail
		Landsat-5	X band	C band					
1.	Paddy field				-10.31	-9.85	surface modern roughness	surface modern roughness	Grayscale color
2.	Cassava				-7.48	-8.60	surface modern roughness	surface modern roughness	medium Backscattering
3.	Shrimp farm				-12.38	-12.04	Surface smooth and low gray value images are	To the gray middle ground is quite flat	C Band backscattering over X band
4.	Para rubber				-6.75	-8.94	Surface high roughness	Surface high roughness	Bush canopy and high backscattering
5.	buildings				-3.38	-3.38	High grayscal value	High grayscale value	Images white color
6.	Mangrove				-5.87	-10.02	Surface high roughness	Surface high roughness	Bush canopy and high backscattering
7.	Forest				-6.68	-8.63	Surface high roughness	Surface high roughness	Bush canopy and high backscattering
8.	*Orchard*				-6.51	-8.64	Surface high roughness	Surface high roughness	Bush canopy and high backscattering
9.	*water*				-23.68	-16.13	Surface smooth and low gray value images are	To the gray middle ground is quite flat .	C Band backscattering over X band

Figure.8 Comparison of back scattering of 9 of kind material and False color composite

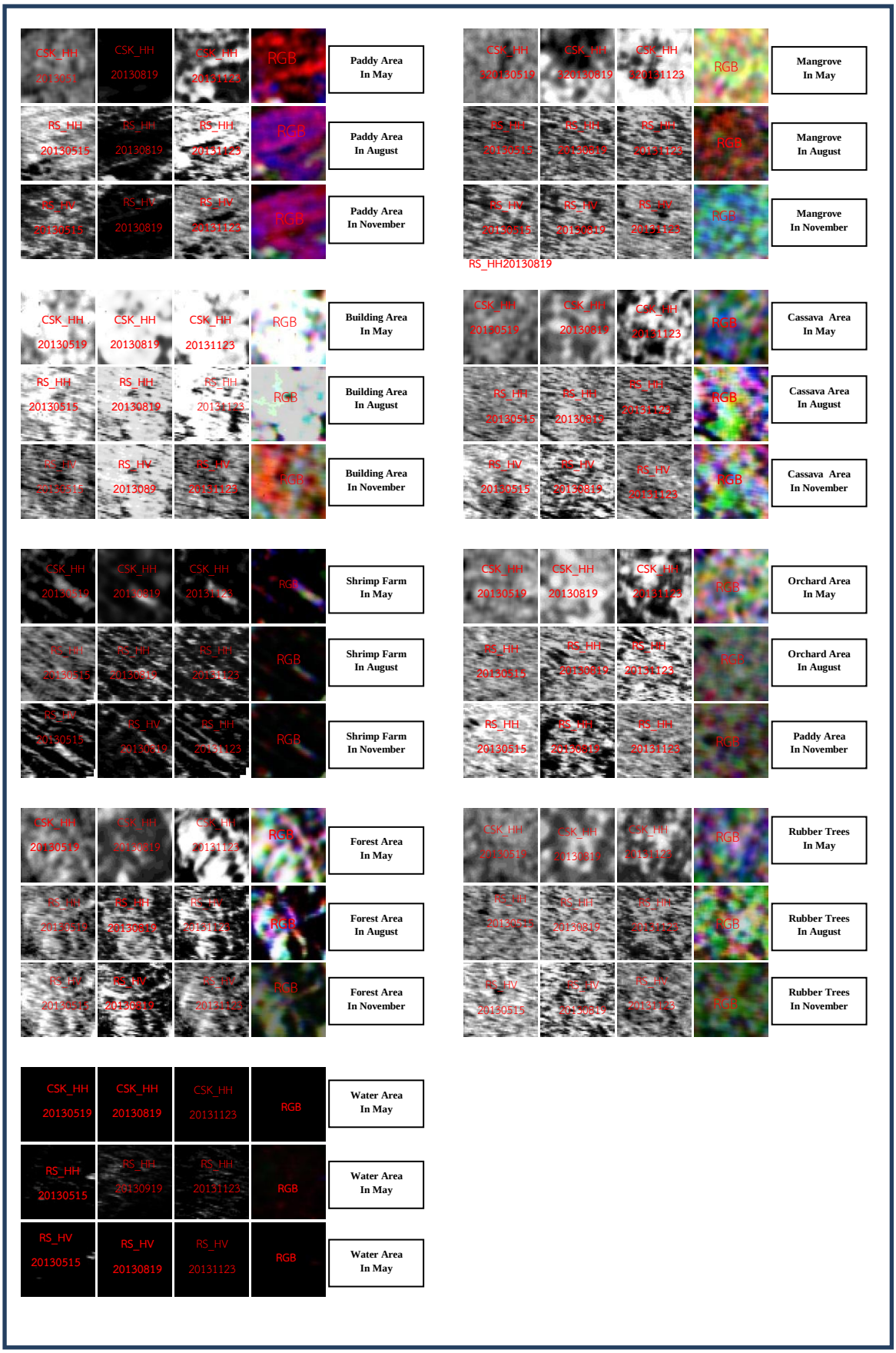
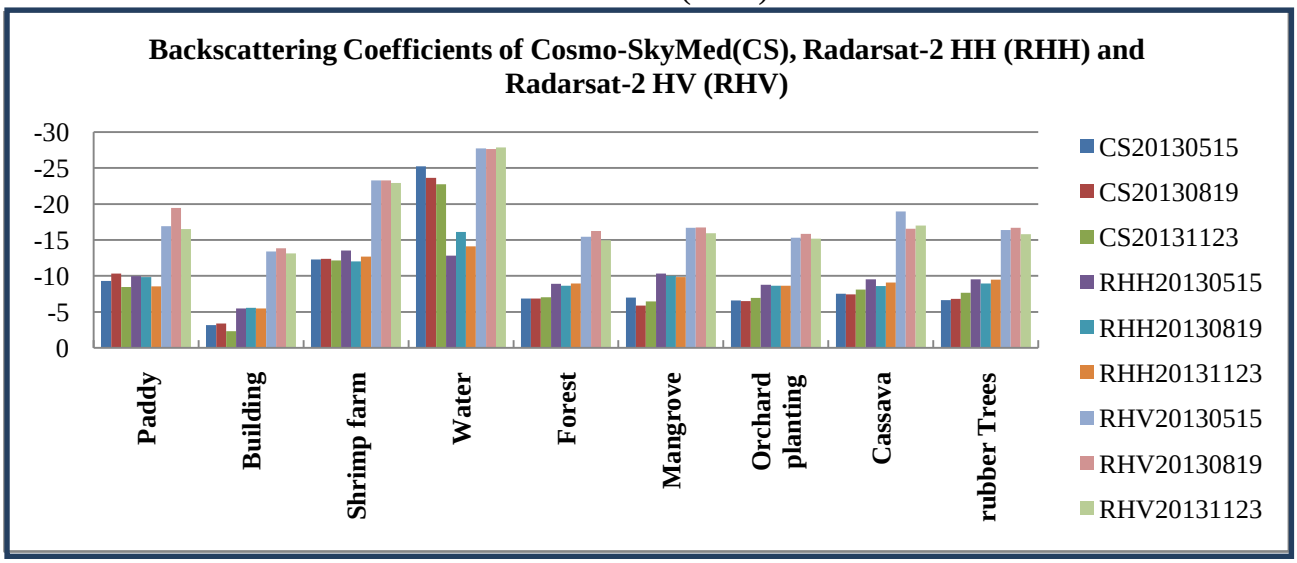
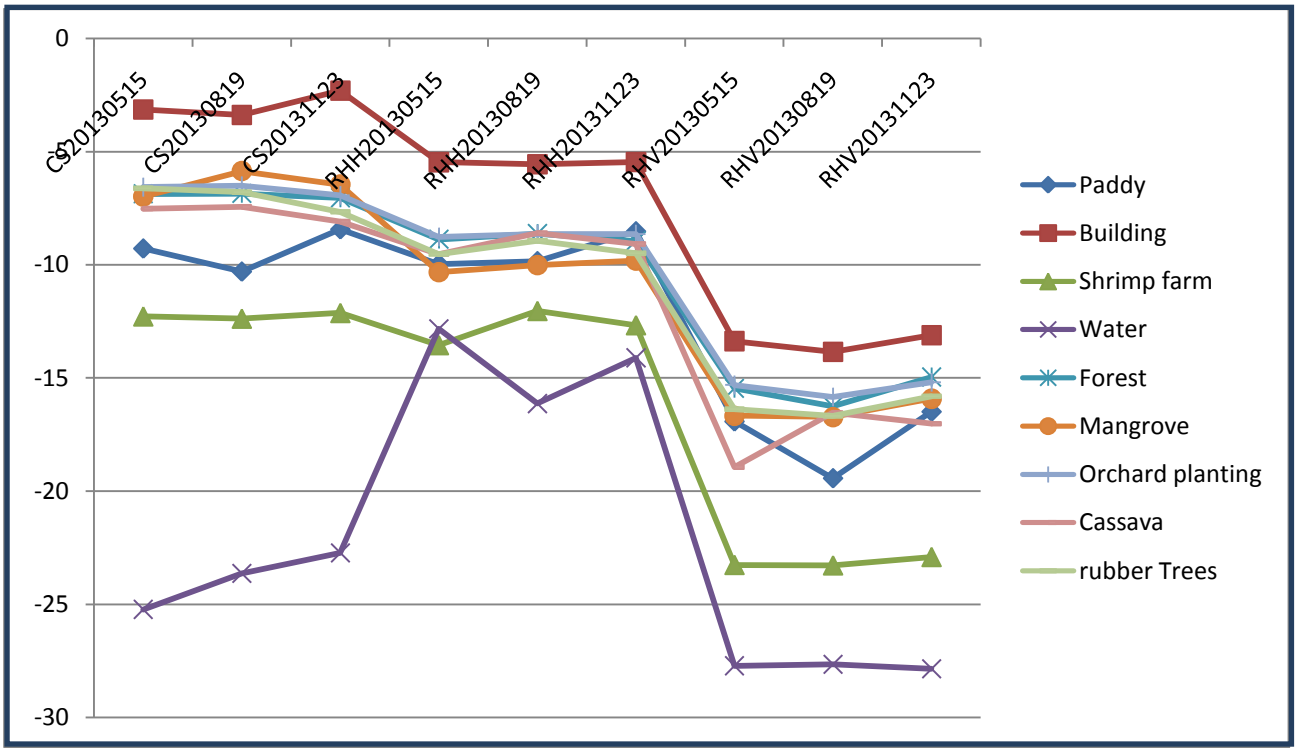


Table.2 Graph of Backscattering Coefficients of Cosmo-SkyMed(CS), Radarsat-2 (RHH) Radarsat-2 HV (RHV)





Backscattering Coefficients	Paddy	-9.29	-10.31	-8.44	-9.98	-9.85	-8.53	-16.93	-19.44	-16.50
	Building	-3.14	-3.38	-2.31	-5.47	-5.56	-5.46	-13.38	-13.85	-13.12
	Shrimp	-12.28	-12.38	-12.13	-13.55	-12.04	-12.67	-23.26	-23.28	-22.91
	Water	-25.23	-23.64	-22.73	-12.83	-16.13	-14.11	-27.72	-27.65	-27.85
	Forest	-6.87	-6.86	-7.05	-8.88	-8.63	-8.95	-15.46	-16.25	-14.96
	Mangrove	-6.99	-5.87	-6.46	-10.33	-10.02	-9.82	-16.68	-16.73	-15.92
	Orchard	-6.57	-6.51	-6.93	-8.77	-8.64	-8.65	-15.31	-15.84	-15.19
	Cassava	-7.52	-7.44	-8.09	-9.53	-8.60	-9.08	-18.94	-16.54	-17.02
	Rubber	-6.62	-6.79	-7.66	-9.53	-8.94	-9.49	-16.38	-16.68	-15.81

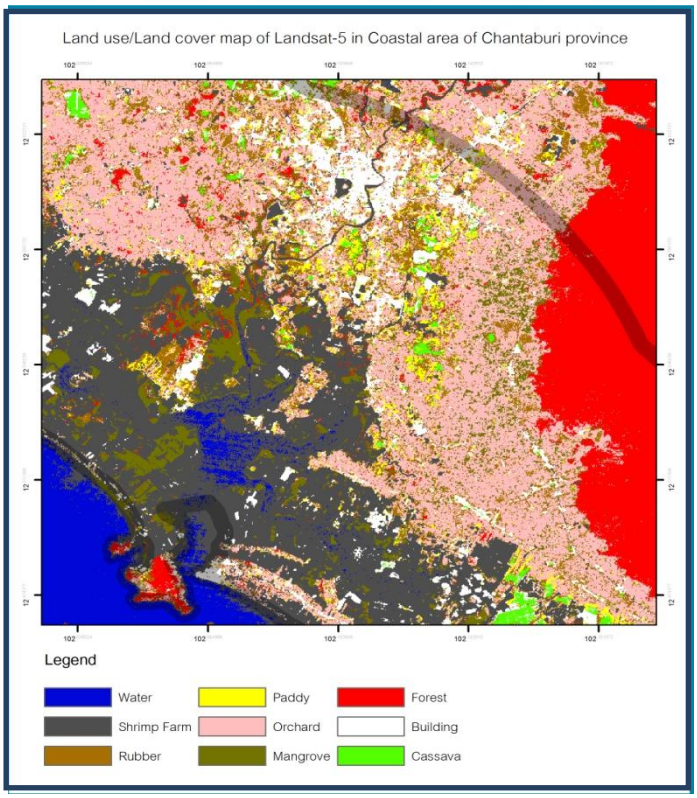


Figure. 9 Show of Land use/Land cover of Landsat-5

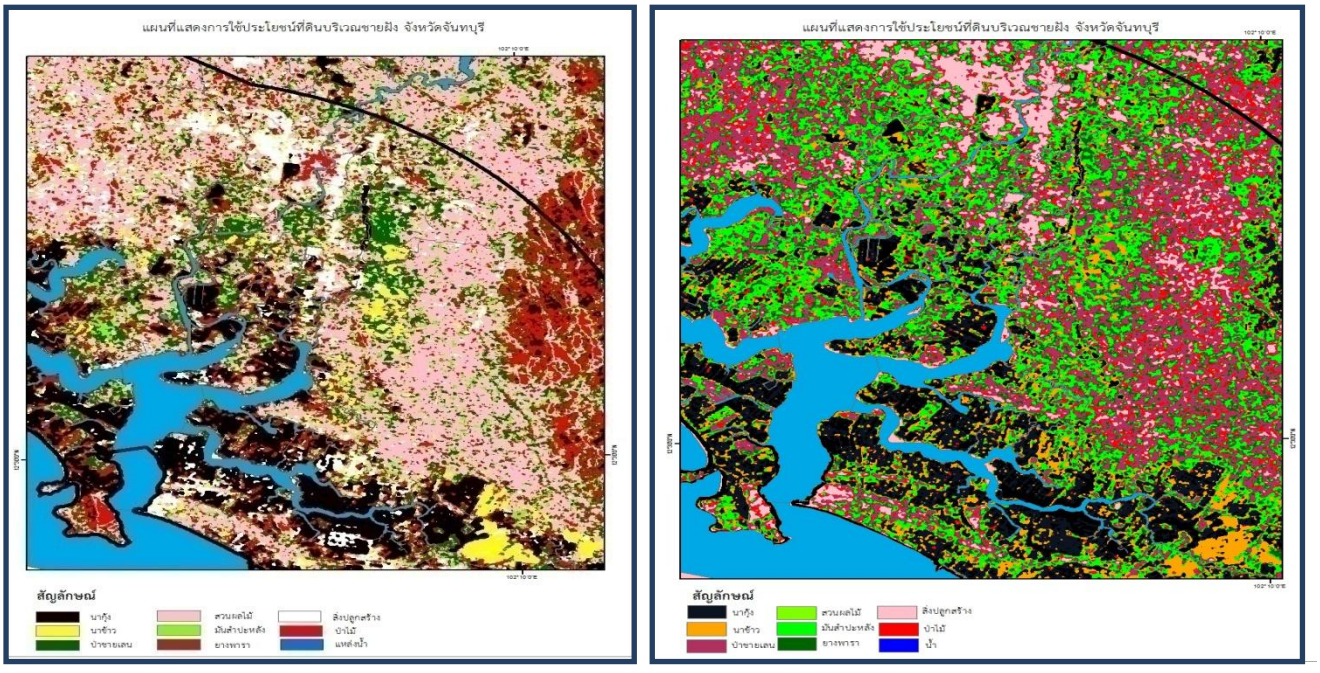


Figure 10. Result of Land use/Land cover of Radatsat-2 and Cosmo-SkyMed

6. CONCLUSION

The classification algorithm implemented in this paper, results in delineating the land use/land cover classes such as water ,shimp farm, orchard, mangrove, forest cassava, paddy rice,building and rubber trees in the better way. But the Radarsat-2 :C band gives a good classification for orchard, mangrove, forest cassava, paddy rice, and rubber trees and Cosmo-SkyMed data gives a good classification for water ,shimp farm and building. Finally the resulting image has been mapped accurately with field survey verification.

7. REFERENCE

- Brisco and Protz, (1978) Application of Radar in Agriculture.p 109-116
- Chantothai e al, 1995 Yusoff and Yasin.,Radarsat Applications Review of GlobeSAR Program p.51- 64
- FrancescoPalazzo*,Daniele Latint2,Valerio Baiocchi3,Fabio Det Frate1,Franccesca Giannone3,Donatella Dominici4 and SylvleRemondiere 2009 An application of COSMO-SkyMed to coastal erosion studies.pp 361-370.
- Giuseppe Satalino1, Donato Impedovo1,2, Anna Balerzano1,Francesco Mattia1,2011 Land cover classification by using MultiTemporal COSMO-SKYMED Data
- Hoogeboom P. Classification of Agriculture Crops in Radar Images .IEEE Transacyion on Geoscience and Remot Sensing 1983;GE-21:p.329-336
- Le Toan T. Laur H. MouginE.Lopes A. 1989, Multi-Temporal and dual Polarization Observations of Agriculture Vegetation covers by X –band SAR .IEEE Transacation on Geosciencs and Remote Sensing .pp709-718
- kwounandZhonglu 2009, Multi-temporal RADARSAT -1 and ER and Coastal Wetlands in Southeastern Louisiana,pp607-617.
- Simone Pettinate *,EmanucleSanti,Simonetta Paolo Pampaloni and Giacomo Fonfanelli 2013 The Intercomparison of SAR Imags from COSMO-SKYMed and TerraSAR-X Satellites:CaseStudies,pp 2928-2942.
- Takeuchi (1993) Rice Paddy monitoring using Radarsat-1 data.Asian Association on Remote Sensing AARS - Processding
- V, Vijaya&G.JennyNivditha 2012 Classfication of COSMO SkyMed SAR Data Base on Coherence and Backscattering Coefficient.Pp 60-63