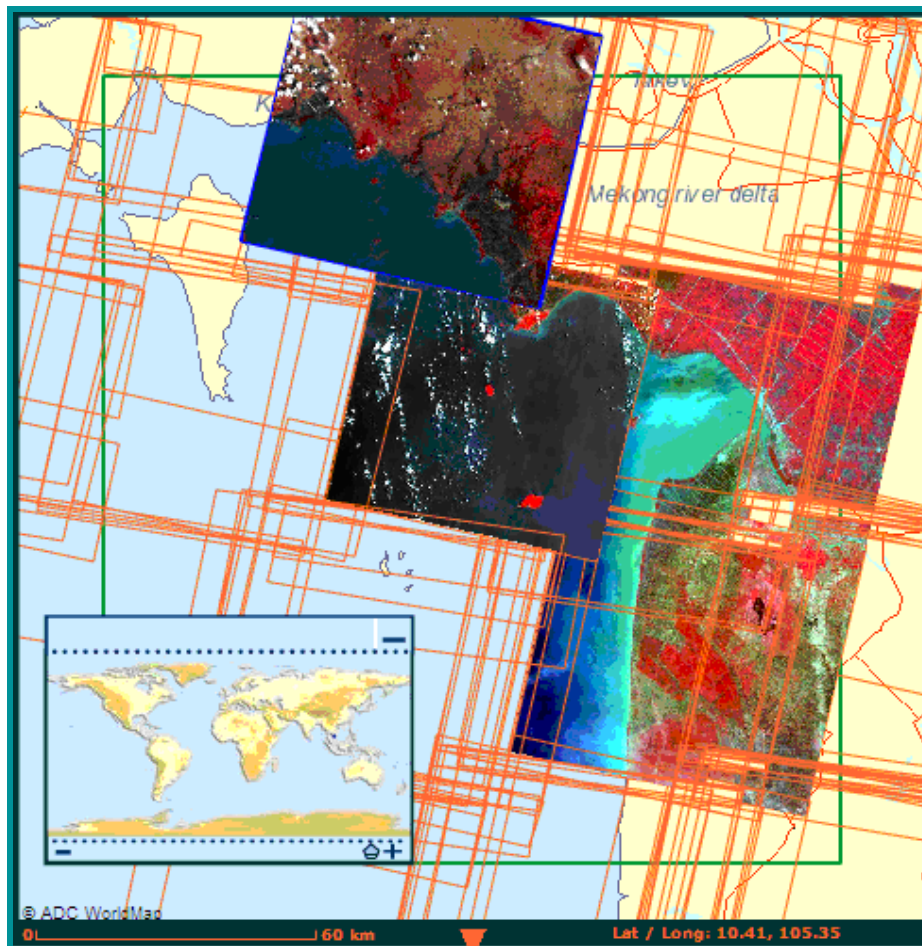


REMOTE SENSING AND MAPPING OF MANGROVES

A case study in Kien Giang Province



OVERVIEW

The overall aim of the National Action Plan is to promote the protection, rehabilitation and wise use of mangrove ecosystems towards sustainable development so that their protective functions and biodiversity values can satisfy socioeconomic development and environmental protection objectives in river estuaries and coastal areas (Government of Vietnam 2005).

In order to achieve these aims it is necessary to first establish the extent and condition of current tidal wetland habitats in Vietnam, allowing accurate mapping of future changes to these important habitats.



Conservation and Development
of the Kien Giang Biosphere
Reserve Project

To date, no official assessments of historical shoreline dynamics, potential coastal vulnerability to the effects of climate change and the function of mangroves in ameliorating these effects, have been conducted in Kien Giang province. Here we assess temporal and spatial changes in mangrove forests and shoreline erosion over time. This data will aid in the prediction of areas most at risk of extreme erosion events in the near future.

MAPPING OF MANGROVE AREAS IN KIEN GIANG – CENTRAL AND SOUTHERN DISTRICTS

2009 SPOT 5 (10 m x 10 m) satellite imagery covering the districts of Hon Dat, Rach Gia, An Bien, An Minh and Chau Thanh, encompassing around 70% of the entire Kien Giang Province, was provided by the Remote Sensing Station Tu Liem in Hanoi. The imagery was georeferenced to UTM WGS-1984 Zone 48N projection and coordinate system and further analysis was carried out using the ArcGIS 9.3 Spatial Analyst Toolbox.

The Maximum Likelihood Classification was used to divide the image into spectrally similar classes. Using a combination of Aerial photography and ground truthing the classes were assigned to one of four land use categories; mangrove type 1, mangrove type 2, bare wet ground and other. Table 1 lists the extent and condition of mangrove forested areas in the five mapped districts of Kien Giang province. The two spectral clusters identified as mangrove classes, mangrove type 1 and mangrove type 2, are yet to be linked to distinctive vegetation characteristics. Future mapping (where satellite and photographic imagery become available), will better allow such links to be made.

Table 1: Area of mangroves in central and southern coastal districts of Kien Giang for 2009.

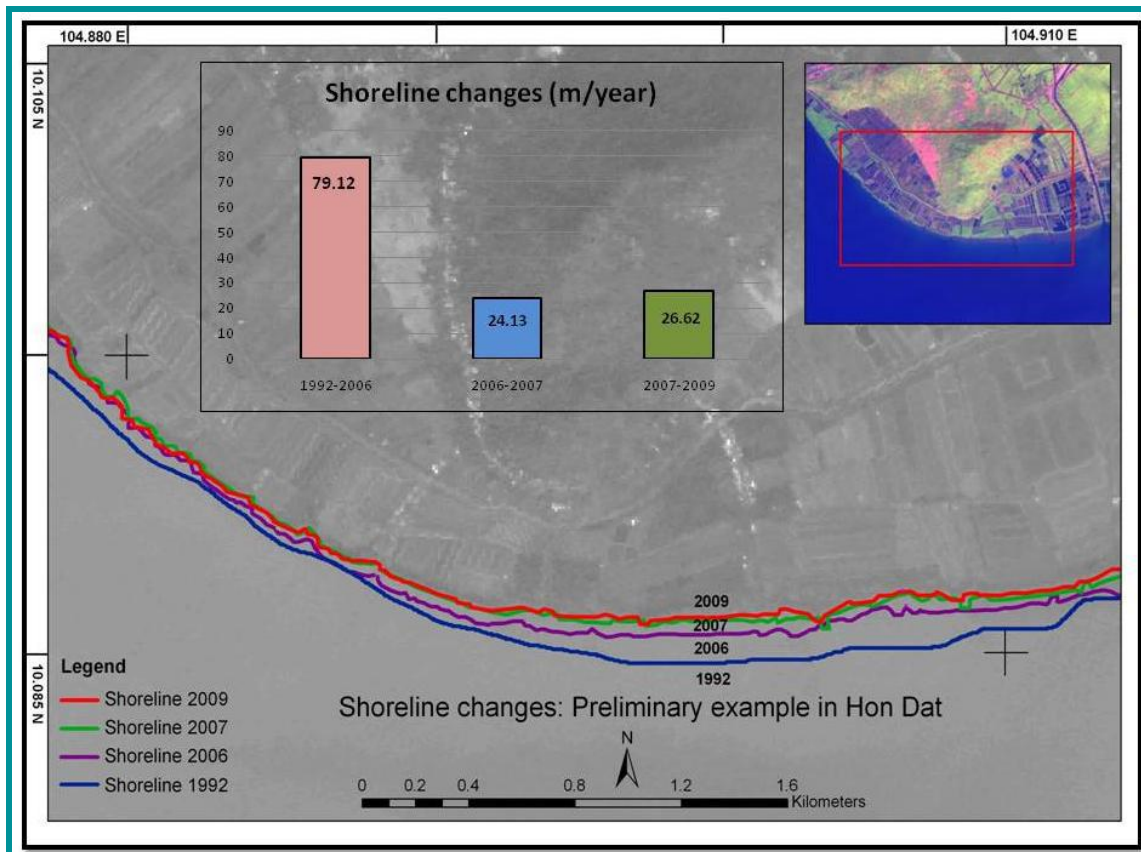
Region	Mangrove Type 1		Mangrove Type 2		Total mangrove (ha)
	ha%		ha%		
Hon Dat	406	51	387	49	793
Rach Gia	89	46	104	54	194
Chau Thanh	27	48	32	52	60
An Bien	263	51	255	49	518
An Minh	424	44	549	56	973
Totals for mapped districts	1210	48	1328	52	2537

PRELIMINARY REVIEW OF A HISTORICAL MAPPING STRATEGY

A preliminary assessment has been conducted to review an assessment strategy proposed for the entire Kien Gien Coastline. Aerial photographs and SPOT 5 Imagery covering 1992, 2006, and 2007 were co-registered to the georeferenced 2009 SPOT 5 image using ER-DAS Imagen 9.3. A Vegetation Line Indicator (VL) was extracted from each image to derive historical rates of shoreline change for the coastal study area. The VL was identified as the mangrove-seaward margin. This seaward margin was defined as unbroken canopy edge, thus excluding opportunistic and pioneer mangrove vegetation (Gilman et al. 2007). In places where there was no vegetation and artificial structures evident at the seaward edge of a backshore, the seaward limit of artificial structures were taken as VL. ArcGIS was used to digitise and create a single shoreline position in the specific year and baseline at a scale of 1/10,000.

The results of the preliminary study (Figure 1) show evidence of significant coastal erosion in key sections of the coastal margin of Kien Giang province. The progression of extrapolated coastlines for 1992, 2006, 2007 and 2009 show a steady retreat landward in Hon Dat district. The rate of coastline retreat is estimated at up to 24 m per year.

Figure 1: Shoreline changes in Hon Dat region, Kien Giang province



DISCUSSION

Based on the data to date giving mangrove area of ~70% of the Kien Giang coastline, we estimate total mangrove area within Kien Giang province to be ~3500 ha. This figure is somewhat lower than the 2006 estimate of Cuc et al. (2008), however based on landuse mapping so far we believe it is unlikely that the remaining 30% of unmapped coastline could host another >2500 ha of mangrove area at present.

Mangrove vegetation is being threatened in two distinct ways: one, by coastal retreat and erosion; and two, by severe pressure from fragmentation, conversion to other landuse types, and high levels of disturbance. The spatial image maps show a very thin line of fringing mangrove vegetation with notable fragmentation. The gaps and spaces amongst the coastal mangrove zone are also recognizably geometric – a certain indicator of the disturbances being made by people.

A dramatic feature of the sea-edge mangrove vegetation in Kien Giang is the degree of erosion that is occurring, both in terms of depth of mangrove being lost and the length of coast affected. The rate can be very rapid (Figure 2).

Hon Dat region was found to have the lowest mangrove biodiversity (16 species) of the five regions sampled. Hon Dat is also subject to high levels of erosion, with 24 m per year of active erosion. The shoreline vegetative buffer of Hon Dat is severely degrading through erosion of the foreshore in several areas and the fringing mangrove forest is clearly very narrow in many areas. Dykes in Hon Dat are heavily eroded and will likely be further damaged in coming years. It is likely that the ability of mangroves to ameliorate the effects of climate change will be significantly reduced unless appropriate mitigation actions are undertaken soon.

Figure 2: Mangrove retraction between 2003 and 2007 at Hon Queo. Yellow line represents 2003 mangrove front. Note canals cut through forest between dates, plus further loss since 2007 (not shown) (Image: Google Earth).



FUTURE DIRECTIONS

Imagery acquired to date includes only the 2009 SPOT5 imagery which will be used to represent our assessment baseline from which future and past change can be measured. A range of imagery from various time periods have been identified in order to make a comprehensive assessment of historical change for the entire coastline of Kien Giang province.

Table 2: SPOT imagery and aerial photographs for historical shoreline interpretation.

Sources	Year	Resolution/scale	Supplier
Aerial photographs	1952-1954	1/44,000	COSAMD
Aerial photographs	1975-1989	1/40,000	COSAMD
Aerial photographs	1990	1/14,000	COSAMD
SPOT 3	1994-1995	20mx20m	NVRSC
SPOT 5	2003	10mx10m	NVRSC
SPOT 5	2009	10mx10m	NVRSC

Further analysis of the historical images will allow the development of models of changes in mangrove areas under different scenarios of predicted sea level rise > 17cm/100 year. The rate of change and the peat accumulation rates will have serious implications for the survival of mangrove forest. It is highly likely that extensive, uncontrolled wood harvesting and felling of shoreline mangroves is exacerbating shoreline erosion.

Figure 3: Shoreline Landuse Classification of Hon Dat.

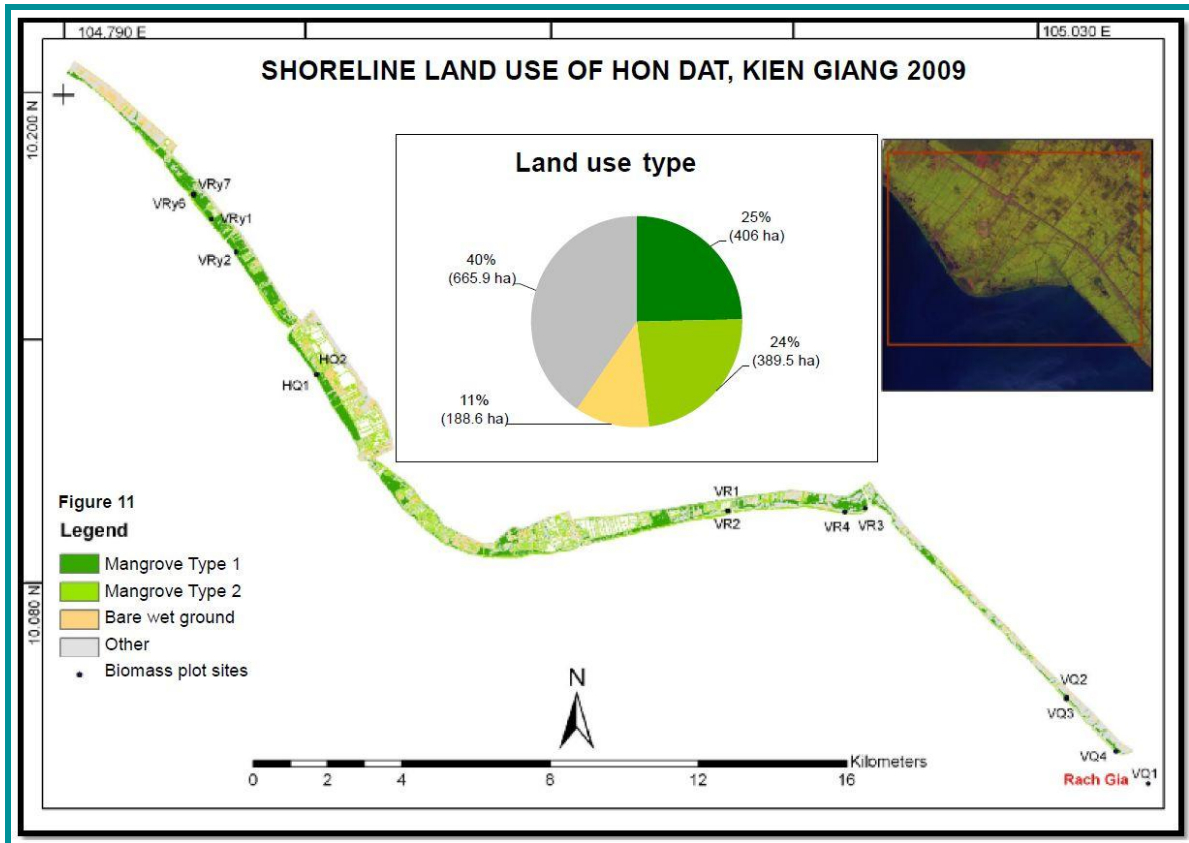


Figure 4: Shoreline Landuse Classification of Rach Gia.

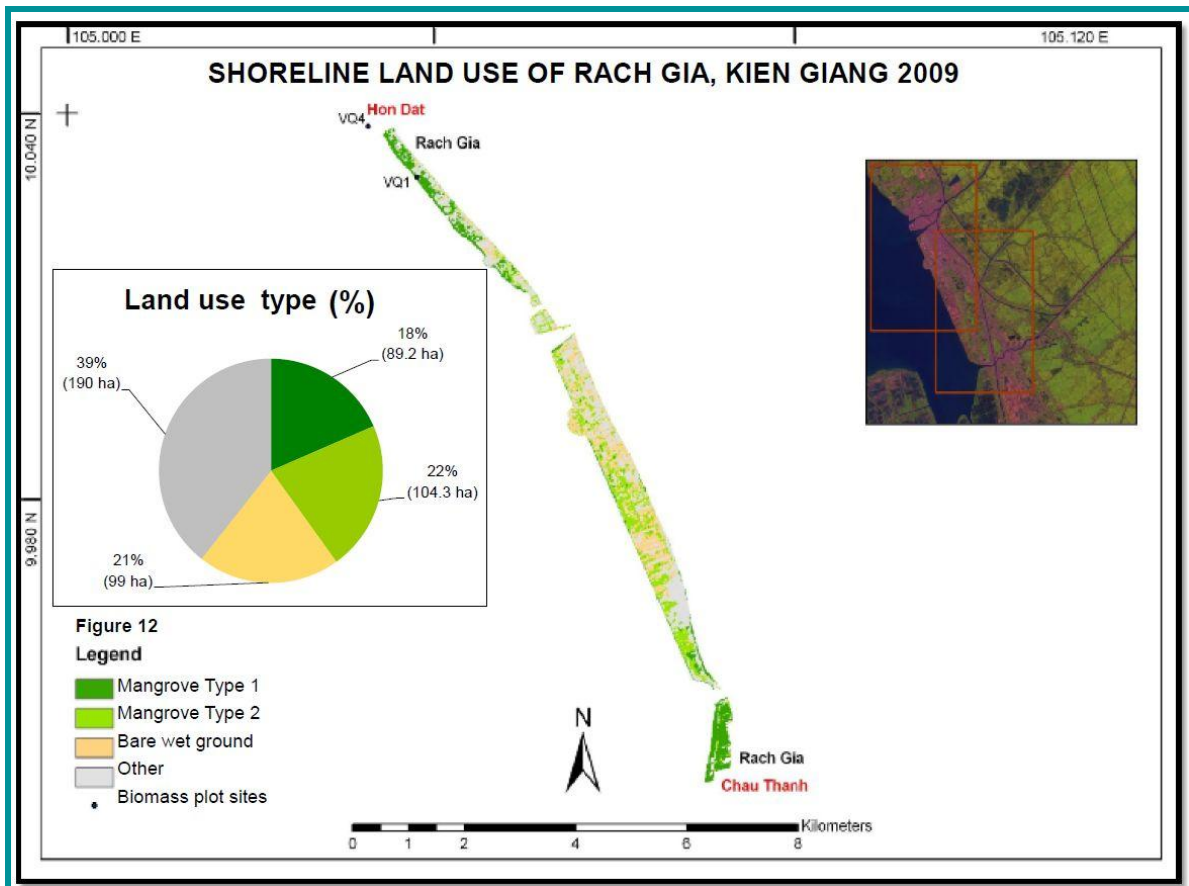
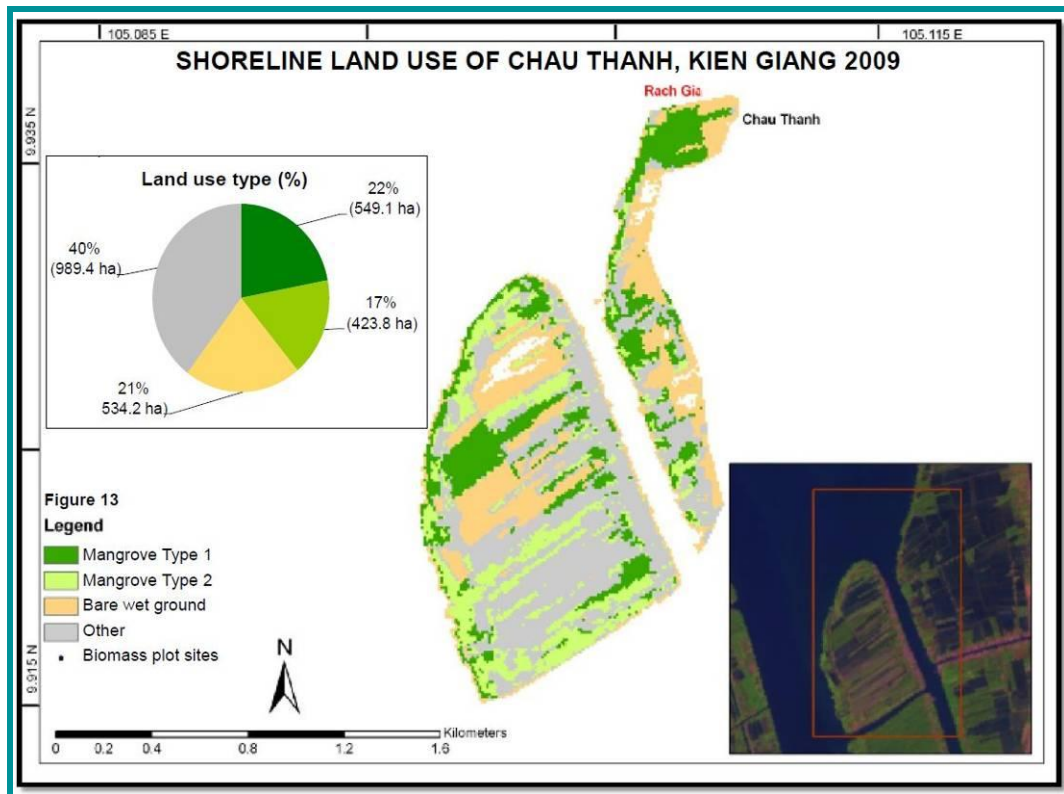


Figure 4: Shoreline Landuse Classification of Chau Thanh.



1. Observations of retreat, damage and loss correspond with ongoing conversion of mangrove areas to aquaculture, coupled with wide-scale erosion along the coast edge, and with the pervasive damage of unregulated cutting for timber products.
2. It is likely that the ability of mangroves to ameliorate the effects of climate change will be significantly reduced unless appropriate mitigation actions are undertaken soon.

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Government of Vietnam (2005).), National Action Plan for the protection and development of Vietnam's mangrove forest until 2015, Agriculture Publishing House, Hanoi.

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Internationale Zusammenarbeit (GIZ) GmbH

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Conservation and Development of the Biosphere Reserve
of Kien Giang Province Project,
Department of Science and Technology,
320 Ngo Quyen Street, Rach Gia City,
Kien Giang Province, Vietnam.
T +84 77 3942 937
F +84 77 3942 938
E office.kgpb@giz.de
I www.kiengiangbiospherereserve.com.vn
www.giz.de/vietnam