Asia-Pacific
Economic Cooperation

Proceedings of SAKE-3 Workshop

The Third APEC SAKE Workshop on Satellite Data Processing and Applications for Marine Resources Inventory

Jakarta, October 14~16, 2008

APEC Marine Resources Conservation Working Group

October 2009

Proceedings of SAKE-3 Workshop
Satellite Data Processing and Applications for Marine Resources Inventory
SAKE is APEC-sponsored project "Satellite Applications on Knowledge-based Economy"

APEC Project #MRC04/2008

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Sponsors
Asia-Pacific Economic Cooperation, Marine Resource Conservation Working Group
Agency for the Assessment and Application of Technology (BPPT), Indonesia
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Agency for Marine and Fisheries Research (BRKP), Indonesia
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APEC Marine Resource Conservation Working Group Project:
Satellite Applications on Knowledge-based Economy

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Cho-Teng Liu and Chung-Chen Liu
National Taiwan University

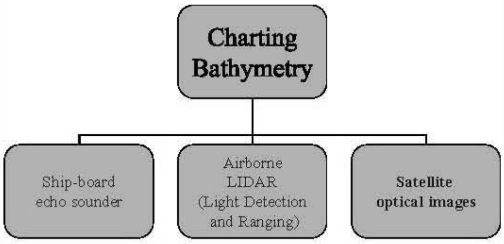
Remote Sensing Bathymetry of Corals with Formosat-2 image

Third SAKE Workshop of APEC
Jakarta, October 15-16, 2008

Cho-Teng Liu and Chung-Chen Liu
National Taiwan University

1

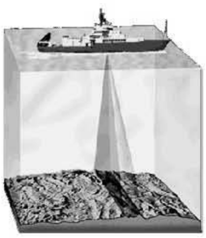
Introduction



2

Ship-board Echo Sounders

- Advantage:
  High accuracy, cheap and generally available
- Disadvantage:
  single data for single point, expensive for charting remote region, especially over regions far away from survey teams
- Multi-beam Echo Sounder:
  swath is limited by water depth, i.e. low efficiency over shallow regions, like corals

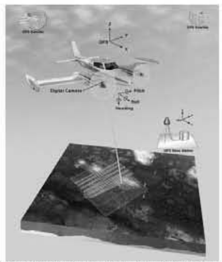


http://www.dorits.org/gallery/tech/orfesml-c.htm

3

LIDAR

- Advantage:
  good accuracy on depth data, fast coverage over large region;
- Disadvantage:
  weather and airport limited,
  high initial costs for setting up the system, or a survey



gulfsci.usgs.gov/tampabay/data/1mapping/lidar/

4

Satellite Images

- Advantage:
  large coverage,
  lower cost per area
- Disadvantage:
  no cloud,
  over clear water;
  detection range is 20 m for 2-band ratio

Formosat-2, multi-spectral, 2007/7/20, South Bay

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Former studies

- Beer's Law on electromagnetic wave in water

  $L(z) = L(0) \exp(-Kz)$

  $L(z)$: spectral radiance (W/m/m/sr/nm) at depth z
  K: attenuation coefficient
  z: estimated water depth

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- Lyzenga(1978), derived the relation between depth and surface reflectance R_w

  $R_w = (A_d - R_\infty) \exp(-gz) + R_\infty$

  R_w: observed surface reflectance
  A_d: sea bottom albedo
  R_∞: optical reflectance at deep water
  g: attenuation function

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Depth from Single Band

- linear transform is sensitive to the type and material of sea bottom
- 15m seems to be the limitation in estimating depth
- Lots of real measurement is necessary for regression analysis and for empirical parameters

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Introduction of Formosat-2 Satellite

- Formosat-2 (F-2) belongs to NSPO (National Space Organization) launched on 2004/5/21
- It has altitude 891 km, seeing Jakarta twice per day
- Side looking angle is up to ±45˚
- F-2 may monitor global land and ocean in near real time
- It's payload includes a camera of Panchromatic (PAN) and Multispectral (MSS) bands.
- At nadir Swath of F-2 is 24 km, the ground resolution is 2 m for PAN, and 8 m for MSS

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- **MSS has 3 visible bands (blue, green, red), and a near-infrared band**

RS Camera	Bands (nm)
Panchromatic	450~900
Multi-spectral	450~520 (blue)
	520~600 (green)
	630~690 (red)
	760~900 (near-infrared)

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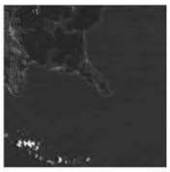
Region of Study

South of Taiwan Island:
Nanwan (southern bay): 21.9N~22.0N, 120.73E~120.80E



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- Nanwan is filled with super clean water from Taiwan Current (upstream of Kuroshio)
- Coral is abundant in Nanwan; It is famous for bio-diversity and sight seeing like corals laying eggs

Kenting National Park Service
http://www.ktnp.gov.tw/...

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Basics for Deriving Depth from Satellite images

- **Assuming homogenous atmosphere over a clean water that is free of sediments and pollutants**
- **The absorption of light by sea water is about 4 times higher on green light, and 100 times higher for near IR, than blue light.**
- **Land-ocean separation is determined with near-infrared image**
- **The ratio of blue to green light reflected to satellite increases with depth, i.e. more bluish;**
- **Water depth may be derived from the ratio of blue to green band, then correct it with tidal**

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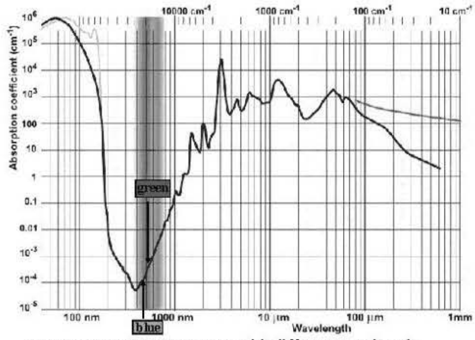

Water **absorption coefficient** with different wavelength

http://www.lsbu.ac.uk/water/vibrat.html

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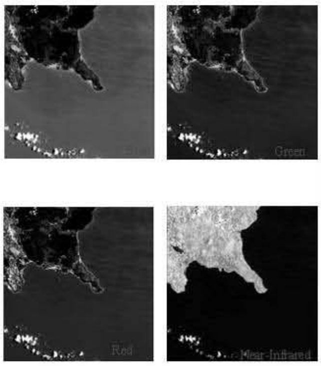
- R/G/B/IR bands of Formosat-2 satellite images of Nanwan



3-band ratio for water depth

- Reflectance from shallow water as seen at sea surface:

$$R_w = \frac{\pi Lw\ (\lambda)}{Ed\ (\lambda)}$$

Lw : water leaving radiance (W/m/m/sr/nm)
Ed : incident irradiance entering water
λ : bands, R/G/B/IR

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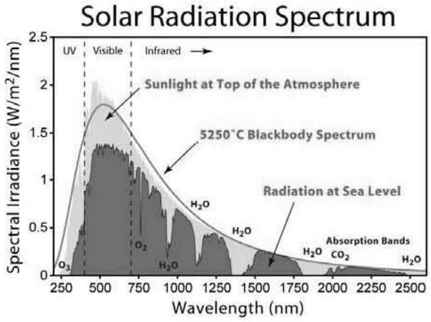

http://www.globalwarmingart.com/wiki/Image:Solar_Spectrum.png

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$$R_w = R_T(\lambda_i) - Y(\lambda_i)R_T(\lambda_{IR}) - R_r(\lambda_i)$$

R_T: total reflectance as seen at the satellite

Y: a transfer coefficient from IR band reflectance to B/G reflectance due to aerosol and Fresnel reflectance at sea surface

R_r: Rayleigh reflectance of atmospheric molecules

i : Visible bands, R/G/B

IR: near infrared

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$$R_T(\lambda_i) = \frac{\pi L_T(\lambda_i)/E_0(\lambda_i)}{(1/r^2)T_0(\lambda_i)T_1(\lambda_i)\cos\theta_0}$$

L_T: total spectral radiance that is received by the satellite

E_0: spectral irradiance

r: distance between the Sun and the Earth (in astronomic unit)

T_0: downward transmissivity of sunlight to Earth surface

T_1: upward transmissivity of reflected light to the satellite

θ_0: solar zenith angle

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Stumpf et al. (2003)

$$Z = m_1\frac{\ln(nR_w(\lambda_i))}{\ln(nR_w(\lambda_j))} - m_0$$

m_1:adjustable constant

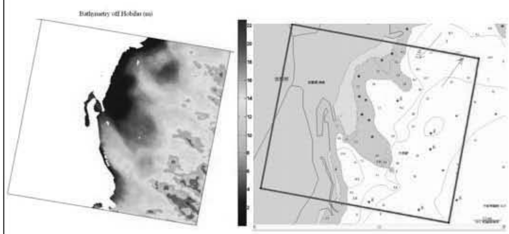
n: constant

m_0: bias for zero depth

i, j: different bands (B, G, R)

20

Result of 2-band Analysis (no IR) Western Nanwan



Left: Water depth that is estimated from B/G bands;
Right: Electronic nautical chart (depth at lower low tide)
Too shallow for deep water region

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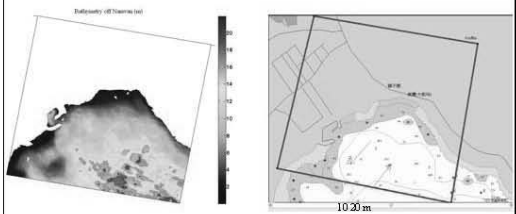
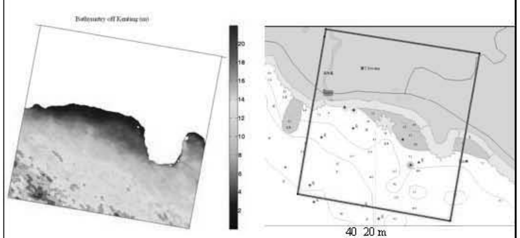
Result of 2-band Analysis (no IR) central Nanwan



Left: Water depth that is estimated from B/G bands;
Right: Electronic nautical chart (depth at lower low tide)

22

Result of 2-band Analysis (no IR) Eastern Nanwan



Left: Water depth that is estimated from B/G bands;
Right: Electronic nautical chart (depth at lower low tide)

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General comments

- 20 m depth seems to be the limit of 2-Band method, i.e. use B/G bands to derive water depth
- There are surface wave pattern in the derived bathymetry
- Surface wave interference should be removed for satellite to see deeper

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Discussion

- Remote sensing of water depth is best with clear and non-polluted water, like water over corals;
- The often used satellite channels are blue band and green band;
- 1-band analysis has the detection limit of water depth about 12 m
- 2-band analysis extends the detection limit of water depth to about 20 m, which depends on the incidence angle of solar beam on the sea surface, the clarity of water and air (least aerosol, dust, etc.), and homogeneity of bottom albedo.

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Discussion (2)

- It is important to have "ground truth" or "**sea truth**" to verify the result of remote sensing studies;
- Nautical charts, like electronic bathymetry charts are often used as the "sea truth" to check the accuracy of remote sensing analysis
- But, **nautical charts** are designed for **safe navigation**, therefore it emphasizes the shallowest part of the sea bottom, not the real distribution of water depth;
- It means that
  "sea truth" may be only a "partial truth"

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Discussion (3)

- With the correction for aerosol scattering and surface reflection in blue and green (B/G) bands, like extra reflection due to swell and surface waves, one may derive more accurate radiance in B/G bands from water body and from sea bottom, and therefore better accuracy on deriving radiance value from water body and from sea bottom
- Aerosol: scatters light with little dependence on wavelength λ (unlike Raleigh scattering varies with λ^{-4}
- Surface reflectance: Fresnel reflectance depends on index of refraction which is nearly uniform from visible bands to IR bands

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Discussion (4)

- Because water absorbs IR strongly, there is almost no IR emitted or scattered from water body, or sea bottom, and the Rayleigh scattering of IR is very small in the atmosphere
- IR signal detected by the satellite is mostly from aerosol and sea surface
- The aerosol-scattered and surface-reflected signal in B/G bands can therefore estimated from IR band in Formosat-2 data
- The ratio ***Y*** between B & IR band is near 1 for surface reflectance, but varies with type of aerosol

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Including data from IR band to estimate contribution from aerosol and surface reflectance, i.e. *Y* is larger than zero

$$R_w = R_T(\lambda_i) - Y(\lambda_i)R_T(\lambda_{IR}) - R_r(\lambda_i)$$

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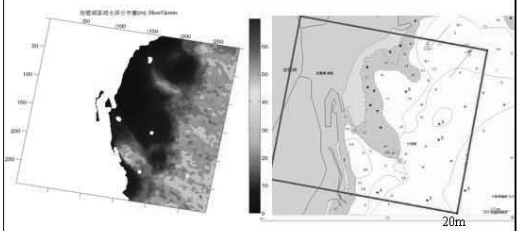
Result of 3-band Analysis Western Nanwan



Left: Water depth that is estimated from B/G bands;
Right: Electronic nautical chart (depth at lower low tide)

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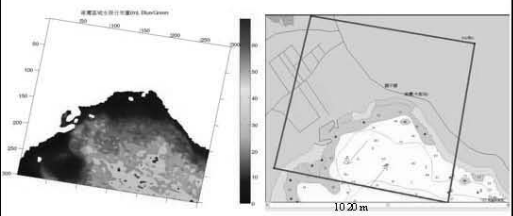
Result of 3-band Analysis central Nanwan



Left: Water depth that is estimated from B/G bands;
Right: Electronic nautical chart (depth at lower low tide)

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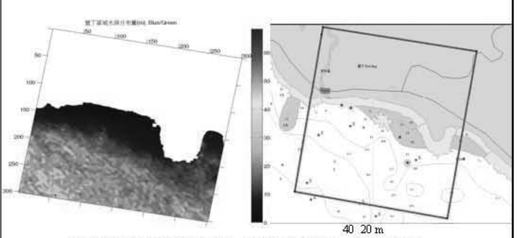
Result of 3-band Analysis Eastern Nanwan



Left: Water depth that is estimated from B/G bands;
Right: Electronic nautical chart (depth at lower low tide)

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General comments

- Wavy pattern near SW corner is nearly disappeared
- The derived water depth has extended to larger depth and seems to be in a more realistic range
- Verification is needed with continuous measurement of depth, instead of comparing nautical chart

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Summary

- **Remote sensing coral depth** can be extended from 12 m ~ 20 m range, to **30m**, if we can estimate the contribution from aerosol scattering and surface reflectance from IR band
- This method is especially useful in removing long surface **wave** pattern in the image, as demonstrated with Formosat-2 image of corals south of Taiwan Island.

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Applications of Remote Sensing and GIS in Studying Coastal Zone and Sea Water

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HCMC Institute of Resources Geography (HCMIRG), VAST

APPLICATIONS OF REMOTE SENSING AND GIS IN STUDYING COASTAL ZONE AND SEA WATER

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Introduction

- The center's functions are research, development and application of GIS and remote sensing in fields:
  - Natural resources and environmental monitoring
  - Coastal zone management
  - natural disaster monitoring, etc.

Introduction

- Some results of application satellite imageries and remote sensing in:
  - Detect coastal shoreline changes
  - Mangrove ecosystem
  - Monitor coastal bathymetry and water turbidity
  - Map sea surface temperature - SST

Results and Discussion

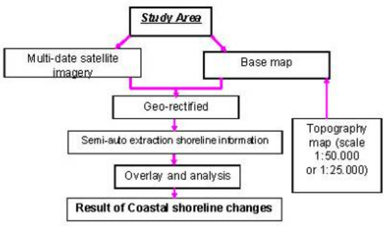
1. Coastal Zone Management

The approach of remote sensing and GIS technology has had the advantages of being quick and effective in coastal zone management

- using time series satellite imagery
- Landsat, SPOT, ASTER, and ALOS-AVNIR2 is often used

Results and Discussion

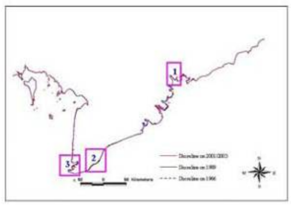
1.1 Procedure of processing for coastal shoreline change detection



Results and Discussion

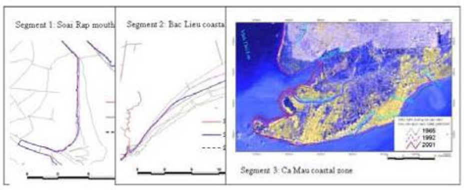
1.2 From Binh Thuan to Kien Giang province in 1966 – 2003

- The shorelines have not changed much.
- The erosion and accretion areas have usually happened step by step with small speed
- There are some places changed strongly as segment 1, segment 2, and segment 3



Results and Discussion

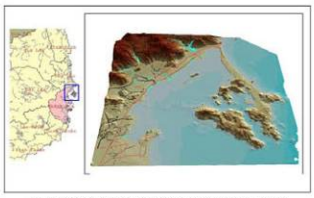
1.2 From Binh Thuan to Kien Giang province in 1966 – 2003



Results and Discussion

1.3 Van Phong bay in 1968 – 2001

- Van Phong bay belongs to Van Ninh and Ninh Hoa district, towards East – North of Khanh Hoa province
- Total water surface area of this bay is about 400km².

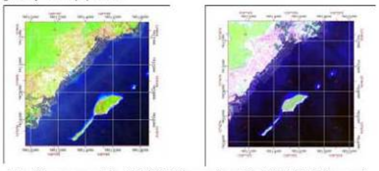


Location map of Van Phong Bay and its DEM

Results and Discussion

1.3 Van Phong bay in 1968 – 2001

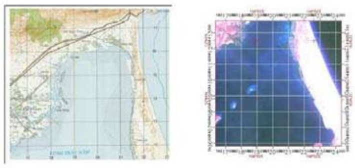
Remarkably, at Van Gia and Tuan Le segments, the coastal shoreline was changed by shrimp ponds



Van Gia segment in 1999 (left image) and in 2001 (right image)

Results and Discussion

1.3 Van Phong bay in 1968 – 2001

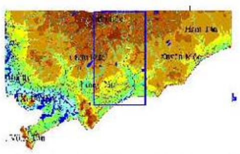


Tuan Le segment in 1991 (left) and 2001 (right)

Results and Discussion

1.4 Loc An river mouth in 1953 – 2001

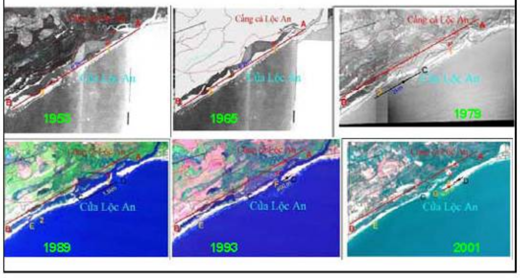
- Loc An river mouth belongs in Phuoc Thuan and Loc An commune, Ba Ria – Vung Tau province.
- Loc An area is estuary of the Ray and Ba Dap rivers.
- The morphology of estuary is sand bars, which were changed much



Location map and DEM of Loc An river mouth

Results and Discussion

1.4 Loc An river mouth in 1953 – 2001

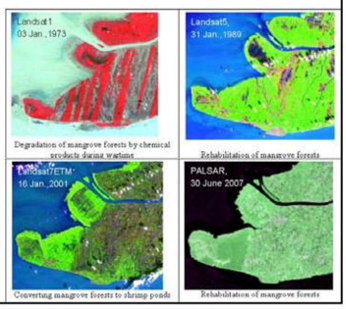


Results and Discussion

2. Mangroves – Ca Mau Peninsula

PALSAR data acquired in June 2007 and Landsat imageries were used to compare the changes of mangrove areas

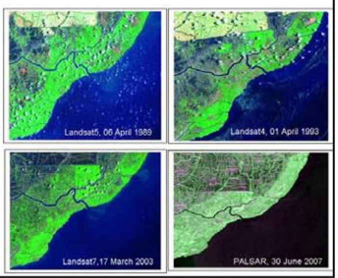
The changes of mangrove in Nam Can district, Ca Mau province from 1973 to 2007



Results and Discussion

2. Mangroves – Ca Mau Peninsula

The changes of mangrove in Ngoc Hien district, Ca Mau province from 1973 to 2007

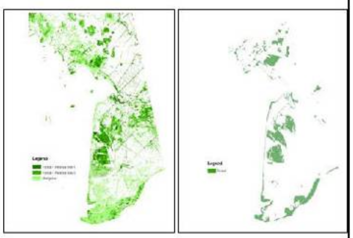


Results and Discussion

2. Mangroves – Ca Mau Peninsula

The mangrove map (left image) was created by using PALSAR data

compared with land use/ land cover in 2006 (right image)

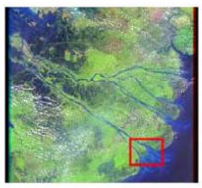


Results and Discussion

3. Bathymetry and Turbidity - Dinh An river mouth

- The study area was limited by Dinh An river mouth with the area of 40 x 40 km² (the red square)
- Data is used: MOS/MERRS 1988, 1992, 1996; Landsat7 ETM+ 2001

Sea bottom cross-section in 1989 and 1993



Study area of Dinh An

Results and Discussion

3. **Bathymetry and Turbidity - Dinh An river mouth**

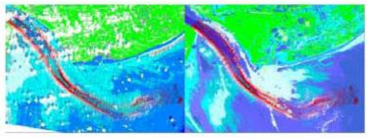
The image MOS-MESSR was acquired at the end of rainy season (December, 1988).

At that time, there are cloudy and suspended solid, so it was not used for classifying, only for referencing

Results and Discussion

3. **Bathymetry and Turbidity - Dinh An river mouth**

These images were used to classify and its classified result was suitable to depth measurements in 1993



Depth measurements on September 1993 overlaid on MOS image on January 1992 (left image) and February 1996 (right image)

Results and Discussion

3. **Bathymetry and Turbidity - Dinh An river mouth**

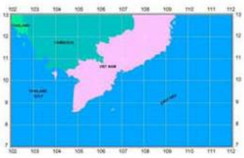
As Landsat ETM+ image acquired in rainy season (September 2001), there are cloudy.

Addition, because of the concentration of suspended solid, it is not suitable to analyze depth information on this image

Results and Discussion

4. **SST mapping - Eastern sea, Viet Nam**

Study area is the Eastern sea, Viet Nam. It covers from 7°00'N to 13°00'N and from 102°00'E to 112°00'E



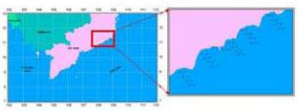
Location map of Eastern sea, Viet Nam

Results and Discussion

4. **SST mapping - Eastern sea, Viet Nam**

Data collections

- The SST measurements were collected from Institute of Oceanography, Nha Trang. They were measured from May to October 2007 and from April to June 2008 at 22 points (KC-01 to KC-20 and KC-BS1, KC-BS2) in Binh Thuan



- To estimate the accuracy of SST values extracted from satellite data, MODIS Aqua were also collected on 22 April, 24 May and 26 May 2008; 24-25 May, and 24 August 2007

Results and Discussion

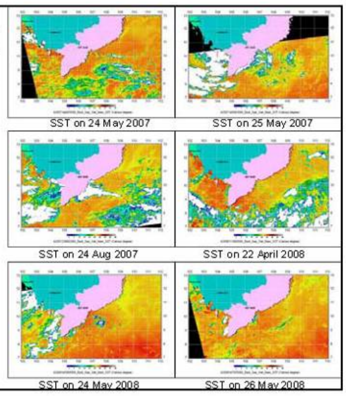
4. **SST mapping - Eastern sea, Viet Nam**

SST map

- SST in this area is about from 25°C to 31°C

No data

Cloud



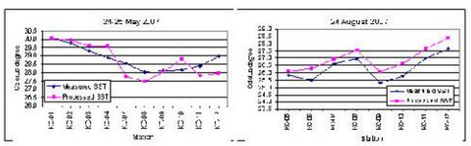
SST on 24 May 2007 | SST on 25 May 2007 | SST on 24 Aug 2007 | SST on 22 April 2008 | SST on 24 May 2008 | SST on 26 May 2008

Results and Discussion

4. **SST mapping - Eastern sea, Viet Nam**

The accuracy

In 2007, the maximum error is ± 0.98°C and the minimum error is ± 0.03°C

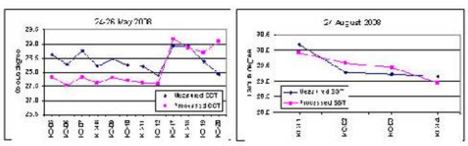


Results and Discussion

4. **SST mapping - Eastern sea, Viet Nam**

The accuracy

In 2008, the maximum error is ± 1.15°C and minimum error is ± 0.07°C



Conclusion

- The research studies achieved preliminary results, still going on. Some of them have been studied as a part of on going projects, such as Planet Action project (mangrove and shoreline change detection) and WISDOM project (LU/LC changes)
- In near future, the proposed studies on sea level rising by using satellite altimetry data (Topex/Poseidon, Jason-1, ERS-1 and ERS-2, and EnviSat) and applications of GIS and RS for supporting fishery activities (SST, chlorophyll) will be conducted by remote sensing group of our Center

THANK YOU

FOR YOUR ATTENSION

Applications of FORMOSAT-2 Multispectral Imagery for Habitat Mapping in Congkak Reefs and Lebar Reefs, Seribu Islands

Vincentius P Siregar, Syamsul B Agus, and Nani Hendiarti

APPLICATION OF FORMOSAT-2 MULTISPECTRAL IMAGERY FOR HABITAT MAPPING IN CONGKAK REEFS AND LEBAR REEFS, SERIBU ISLANDS

Vincentius P Siregar, Syamsul B. Agus, and Nani Hendiarti

The 3rd APEC SAKE Workshop Formosat Satellite Data Processing and Applications for Marine Resources Inventory

Introduction

- Tropical seascape in Indonesia is highly attributed to the presence of biogenic carbonate framework, the coral reefs. Being the country with the largest area of coral reefs (Spalding et al. 2001) there is an urge need to assess the exact area of seabed occupied by coral reef communities.
- Within various spatial scale, such information is an essential metric for understanding coral reef ecology and to designate the appropriate management for sustainable development. Accurate calculations of coral reef area require new methods to accurately cover certain spatial domains (large or small area) within short time.

Introduction

- The interpretation of remotely sensed data is the best tool currently available for this task (Green et al. 2000), even in detail features such as coral benthic communities (Hochberg and Atkinson 2000), coral cover (Isoun et al. 2003).
- Nearshore habitats, particularly coral reefs, are a challenge to study using for being heterogeneous, often at scales smaller than the highest resolution of spaceborne sensors.
- Remote sensing community attempts to assess and mapped reef habitat using satellite image data within various spatial scale. Accurate calculations of coral reef area require new satellite data enables in accurately covering certain spatial domains (large or small area) within short time.

FORMOSAT-2 Imagery

- FORMOSAT is a series of earth observation imaging satellites designed and launched by National Space Organization of Taiwan, with support from France and United States.
- This paper presents the results of multilevel spectral classification at coarse (habitat) levels using depth variant index and derivative spectra of reef bottom types from FORMOSAT-2 in Congkak and Lebar Reefs, Seribu Islands.

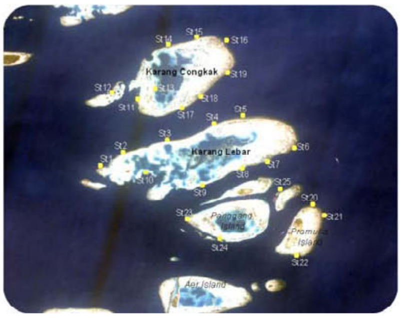
Methods

- This study focused on mapping habitat features of Congkak Reefs and Lebar Reefs (Fig. 1), in patch reef complexes of Seribu Islands.
- There were 25 sites of field check(Table 1), in which corals data were obtained using Line Intercept Transect Method (after English et al. 1997) and Rapid Reef Assessment (after LIPI 2006). Seven LIT sites of 3x10 m and 18 RRA sites were located haphazardly to assess coverage of benthic substrata surrounding Congkak Reefs and Lebar Reefs.

Methods

- Congkak Reefs and Lebar Reefs are located in one of the best-known patch reef complexes in Indonesia, the Kepulauan Seribu (Thousand Islands) island chain, which separated 45 km away from Jakarta.
- The typical submerged habitats found around the islands are seagrass beds, algal assemblages in different proportions, soft and hard coral habitats, and sandy and rocky substrates.

Location of field check



Location of Field check

Benchmark site	Metode	Longitude	Latitude	Depth(m)
St1	LIT	106.56361	-5.72856	15.2
St2	RRA1	106.56938	-5.72519	7.3
St3	RRA2	106.58072	-5.72189	8.7
St4	RRA3	106.59289	-5.71767	9.4
St5	RRA4	106.60033	-5.71564	4.3
St6	RRA5	106.61358	-5.72394	5.4
St7	LIT	106.60667	-5.72756	9.8
St8	RRA6	106.60027	-5.72925	3.8
St9	RRA7	106.589972	-5.73369	2.9
St10	RRA8	106.57522	-5.73031	2.1
St11	LIT	106.57311	-5.71141	5.6
St12	RRA9	106.56648	-5.70976	4.9
St13	RRA10	106.57766	-5.70868	2.4
St14	RRA11	106.58105	-5.69717	4
St15	LIT	106.58833	-5.69528	11.7
St16	RRA12	106.59601	-5.69612	4.4
St17	LIT	106.58455	-5.71377	6.4
St18	RRA13	106.58942	-5.71079	5.2
St19	RRA14	106.59633	-5.70443	2.7
St20	LIT	106.61839	-5.73856	2.3
St21	RRA15	106.62141	-5.74143	3.5
St22	RRA16	106.61419	-5.75177	7.1
St23	LIT	106.58599	-5.74236	9.3
St24	RRA17	106.59444	-5.74746	3.3
St25	RRA18	106.61002	-5.73463	8.9


Menara BTS di P Karya


Dermaga di P Aer

Satellite data

- Multispectral imagery was acquired using the FORMOSAT-2 satellite.
- The depth invariant index (Green, et al. 2000) was used to compensate the effect of variable depth on multispectral data in order to mapping bottom features.
- Many study had applied the algorithm for reef habitat mapping in Seribu Islands (1995) and Karimun Jawa Islands (2004) indicating its high efficiency and appropriateness in mapping process. The algorithm is written as:

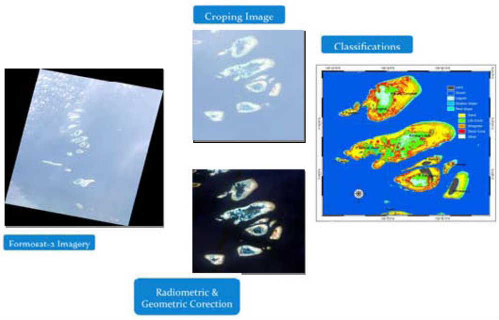
$$Y = \ln Ch1 - k_i/k_j * \ln Ch2$$

$$Y = \ln (Ch1) - 0{,}59289 * \ln (Ch2)$$

Notes: Ch1= Spectral band no.3; Ch2= Spectral band no.2; Ki/kj = attenuation coefficients for band pairs: a+ √(a^2+ 1); a= ((var Ch1 -var Ch2))/(2 * (covar Ch1Ch2))

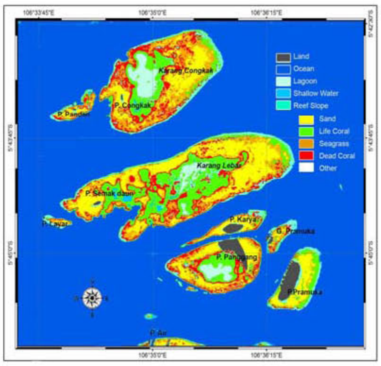
Satellite data

- Morphologies of the beaches, lagoons, seagrass beds, and several zonation of reefs were classified on the basis of the spectral signatures of their various habitats using images produced from the latest FORMOSAT-2 satellite data.
- Image of Congkak Reefs and Lebar Reefs were captured in 29 August 2007, following radiometric and geometric correction for further analyses.
- Deep water (>30 m depth) pixels were identified and masked using the upper 95% confidence limit of the mean DN for Band 1 (blue) to delineate the threshold between deep and shallow water pixels. The remaining pixels delineated polygons equivalent to the outer boundaries of coral reef areas.
- Supervised classifications trained with existing ground-truth data were performed using the maximum likelihood classifier (Green et al. 2000) in ER Mapper and Arc GIS.



Results

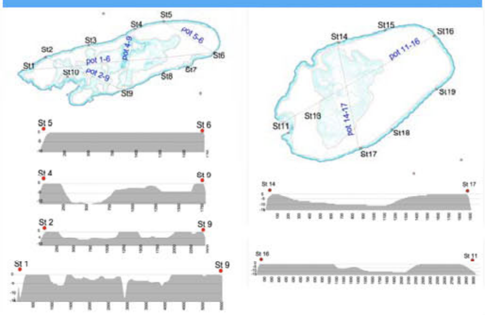
- Map of reef habitat with high resolution (8 m) were generated for Congkak and Lebar Reefs from a mosaic of FORMOSAT-2 multispectral imagery.
- Contrast-stretched, multi-spectral image maps provided a qualitative method to distinguish highly reflective sand from less reflective living corals, seagrasses, and sand habitats, and to outline nearshore habitat features and textures.
- These maps, in a geographic information system (GIS) format, can be used for fieldwork, as base maps for other scientific studies and for management of coral reef ecosystem.
- Based on the FORMOSAT-2 image, we generated ten morphological categories of reef habitat: land, ocean, lagoon, shallow water, reef slope, sand, live coral, seagrass, dead coral, and others.

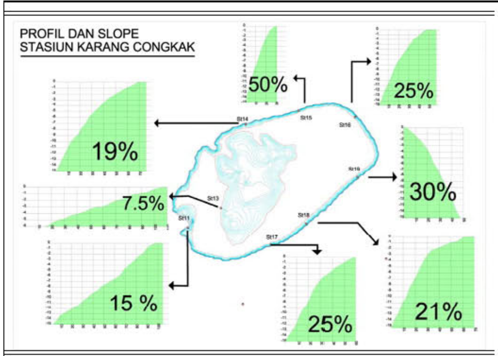


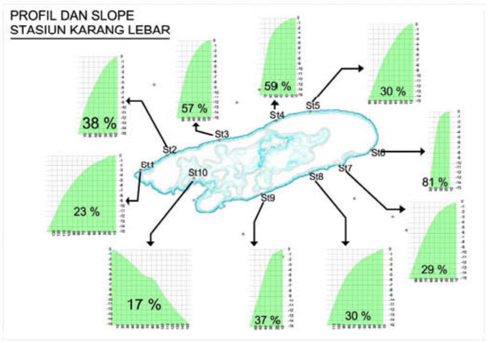
Classification

- live corals (477.376 ha),
- dead corals (297.651 ha),
- seagrass beds (374.669 ha),
- sand (543.61 ha).

Profile Of coral at different segment

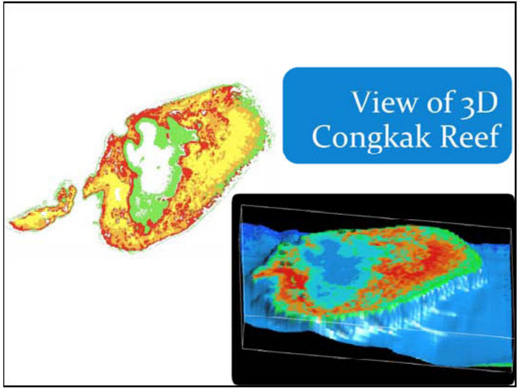


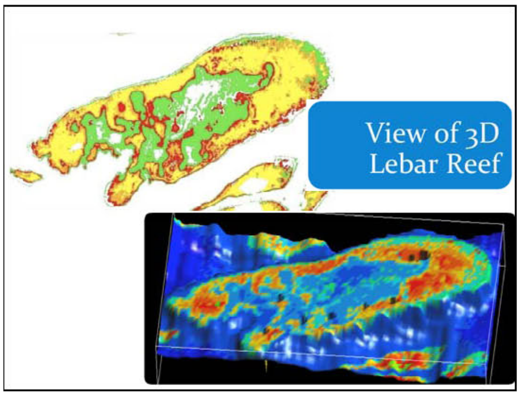




Satellite data

- Green et al. (2000) stated that habitat, in remote sensing point of view, may be limited to communities (assemblages) of plant and animal species (or higher taxonomic or functional descriptors) and the substrata which collectively comprise the upper layer of the seabed.
- Using FORMOSAT-2 imagery, we produce seven distinct reef-top islands, namely Gosong Pandan, Gosong Congkak, Semak Daun Island, Karya Island, Gosong Pramuka, Panggang Island, and Pramuka Island.
- Apart from the ocean habitat which covers extend area, we managed to differentiate four important reef substrata with detail information of cover area:
  - live corals (477.376 ha), dead corals (297.651 ha),
  - seagrass beds (374.669 ha), sand (543.61 ha).



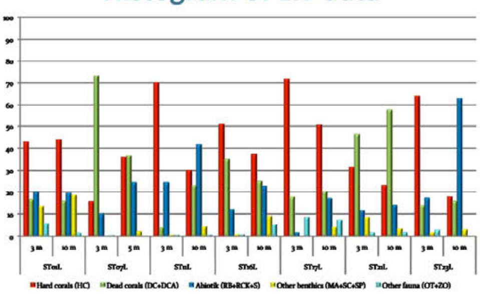


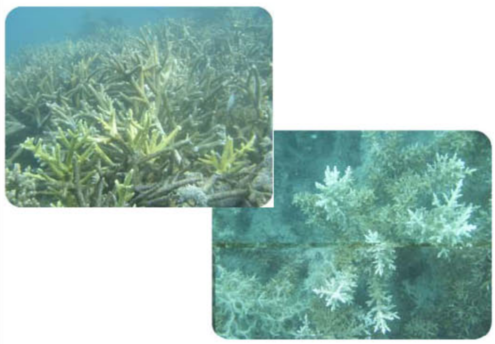
Bentic Community

Field Check data

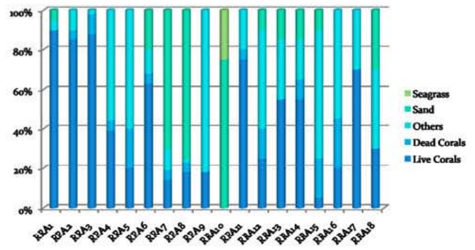
- In May 2008, we conducted rapid ecological survey for reef fish stock assessment using high resolution satellite data in Congkak Reefs and Lebar Reefs, Seribu Islands.
- Results of LIT data and RRA data are provided in separate histogram.
- Using FORMOSAT-2 imagery, we produce seven distinct reef-top islands, namely Gosong Pandan, Gosong Congkak, Semak Daun Island, Karya Island, Gosong Pramuka, Panggang Island, and Pramuka Island.
- Apart from the ocean habitat which covers extend area, we managed to differentiate four important reef substrata with detail information of cover area:
  - live corals (477.376 ha), dead corals (297.651 ha),
  - seagrass beds (374.669 ha), sand (543.61 ha).

Histogram of LIT data





Histogram of RRA data



Bentic Community

	ST01L		ST07L		ST11L		ST16L		ST17L		ST21L		ST23L	
	3m	10m	3m	5m	3m	10m	3m	10m	3m	10m	3m	10m	3m	10m
Hard corals (HC)	43.13	44.23	15.93	36.27	70.13	30.13	51.27	37.53	71.77	50.93	31.57	23.27	63.93	17.97
Acropora Branching (ACB)	5.60	0.00	1.67	12.03	34.23	1.17	6.47	2.87	16.67	3.73	6.17	0.73	38.20	2.33
Acropora Digitate (ACD)	1.70	0.00	1.37	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00
Acropora Tabulate (ACT)	2.87	0.00	1.53	0.00	0.00	0.00	7.37	1.20	15.50	3.27	0.27	0.00	1.10	0.00
Coral Branching (CB)	3.13	2.27	0.53	0.60	0.00	1.40	9.23	1.20	15.57	3.17	1.03	0.40	6.67	2.17
Coral Encrusting (CE)	0.00	0.00	0.00	0.17	0.73	1.67	0.00	1.47	1.90	2.30	0.03	2.63	0.00	0.40
Coral Foliose (CF)	4.10	4.20	7.20	14.67	0.30	6.23	23.43	15.23	7.83	14.97	12.93	8.30	7.60	8.20
Coral Heliopora (CHL)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	1.33	0.00	0.00
Coral Massive (CM)	20.20	24.77	2.17	6.63	4.17	14.70	4.70	12.07	0.67	17.63	9.37	3.07	3.03	4.73
Coral Millepora (CME)	1.57	10.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coral Mushroom (CMR)	0.00	0.00	0.57	0.00	1.37	0.00	0.07	1.63	8.27	1.53	0.00	6.33	4.63	0.00
Coral Submassive (CS)	3.97	2.40	0.30	0.00	29.33	4.57	0.00	1.27	5.37	4.33	0.87	0.47	2.10	0.13
Dead corals (DC+DCA)	16.93	16.17	73.27	36.97	3.90	23.13	34.97	25.10	17.83	20.40	46.53	57.50	14.03	16.13
Dead Corals (DC)	2.57	0.00	1.40	0.00	0.00	1.57	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.47
Dead Corals with Algae (DCA)	14.37	16.17	71.87	36.97	3.90	21.57	34.97	24.57	17.83	20.40	46.53	57.50	14.03	15.67
Abiotic (RB+RCK+S)	20.23	19.60	10.33	24.60	24.60	41.20	12.13	22.83	1.70	17.17	11.63	14.23	17.37	62.90
Rubble (RB)	9.23	17.00	7.37	19.93	15.33	0.00	8.63	12.67	0.63	4.10	7.07	11.47	11.57	4.73
Rock (RCK)	5.37	0.00	0.00	0.87	0.00	0.00	0.00	0.00	0.00	0.00	2.70	0.00	4.37	0.00
Sand (S)	5.63	2.60	2.97	3.80	9.27	41.20	3.50	10.17	1.07	13.07	1.87	2.77	1.43	58.17
Other benthic (MA+SC+SP)	13.73	18.60	0.00	2.17	0.70	4.20	0.80	9.13	0.00	4.07	8.67	3.27	1.23	3.00
Macroalgae (MA)	9.17	6.43	0.00	0.00	0.70	1.53	0.00	0.27	0.00	0.00	4.73	0.00	0.00	1.30
Soft Corals (SC)	4.13	9.63	0.00	0.47	0.00	0.00	0.00	6.83	0.00	1.87	1.00	0.40	0.00	0.00
Sponge (SP)	0.43	2.53	0.00	1.70	0.00	2.67	0.80	2.03	0.00	2.20	2.93	2.87	1.23	1.70
Other fauna (OT+ZO)	5.97	1.40	0.47	0.00	0.67	0.73	0.83	5.40	8.70	7.43	1.60	1.73	2.83	0.00
Others (OT)	0.27	1.40	0.47	0.00	0.67	0.73	0.83	3.13	8.70	7.43	1.60	1.73	2.83	0.00
Zooanthids (ZO)	5.70	0.00	0.00	0.00	0.00	0.00	0.00	2.27	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL COVERAGE	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Field Check data

- In general, the heterogenous reef substrata were classified into five groups namely hard corals, dead corals, abiotic, other fauna, and other benthic within LIT data and live corals, dead corals, others, sand, and seagrass within RRA data.
- Histogram of LIT data shows that the condition of hard coral coverage at 3 m was better compare to 10 m, particularly in Site11 and Site17.
- Histogram of RRA data informs excellent cover of live corals in Site 2, 3, and 4 (RRA 1, RRA2, and RRA3).
- Both facts reveals that condition of reef habitats in the western part of both patch reef complexes are better compare to the eastern.

Conclusion

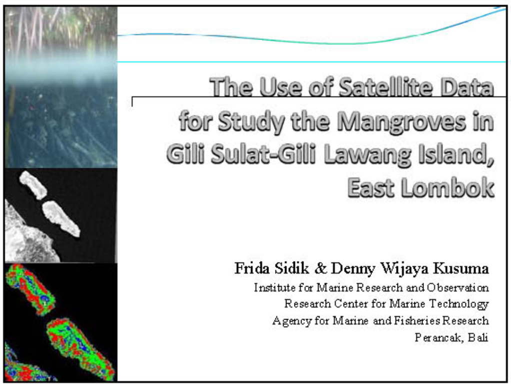
- Multispectral FORMOSAT-2 imagery have profound capability in profiling morphological features of reef habitat in Congkak Reefs and Lebar Reefs, Seribu Islands.
- Ten morphological features of reef habitat and detail coverage of four classified reef substrata were successful to be achieved using FORMOSAT-2 satellite data.

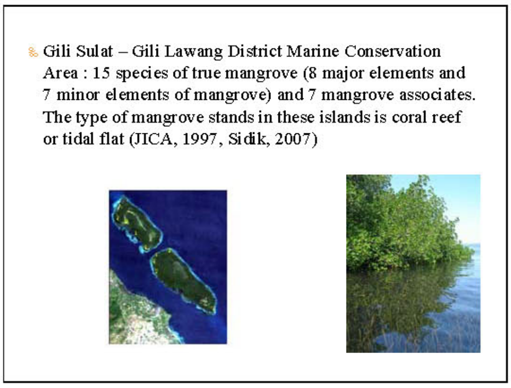
Thank You ☺

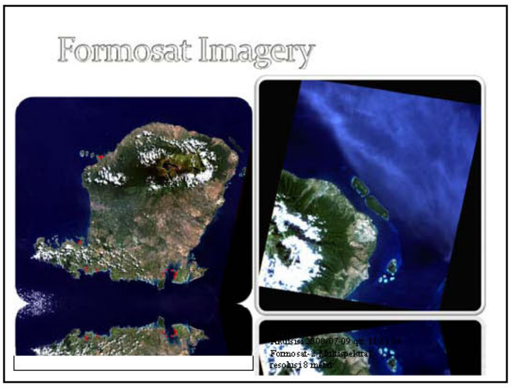
The Use of Satellite Data for Study the Mangroves in Gili Sulat – Gili Lawang Island, East Lombok

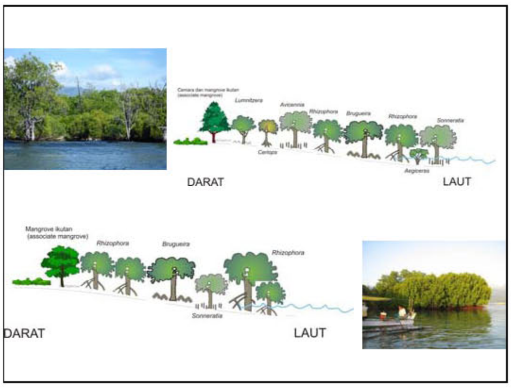
Frida Sidik & Denny Wijaya Kusuma

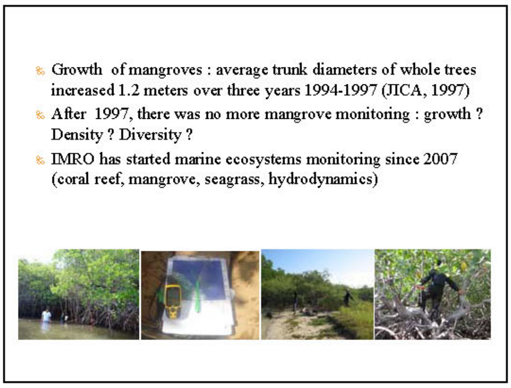
Institute for Marine Research and Observation Research Center for Marine Technology
Agency for Marine and Fisheries Research Perancak, Bali

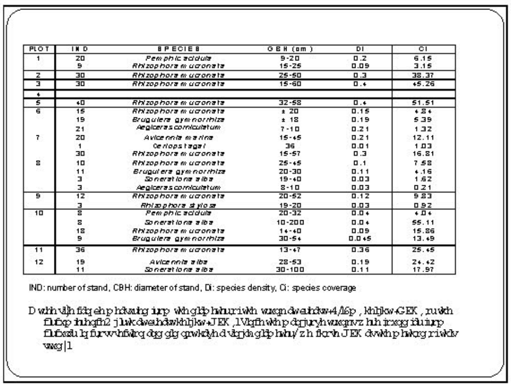




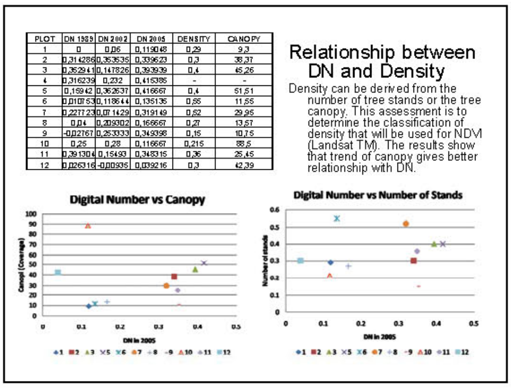




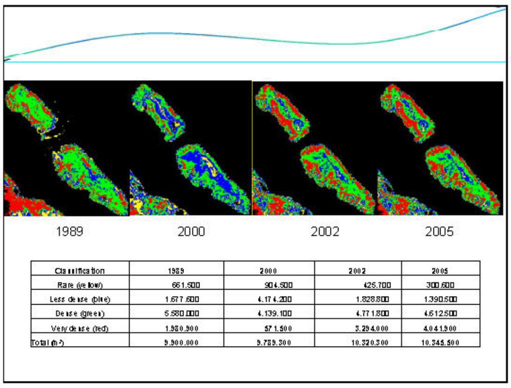




PLOT	IND	SPECIES	GBH (cm)	Di	Ci
1	20	*Pemphic acidula*	9-20	0.2	6.15
	9	*Rhizophora mucronata*	15-25	0.09	3.15
2	30	*Rhizophora mucronata*	25-50	0.3	38.37
3	30	*Rhizophora mucronata*	15-60	0.4	45.26
4					
5	40	*Rhizophora mucronata*	32-58	0.4	51.51
6	15	*Rhizophora mucronata*	± 20	0.15	4.84
	19	*Bruguiera gymnorrhiza*	± 18	0.19	5.39
	21	*Aegiceras corniculatum*	7-10	0.21	1.32
7	20	*Avicennia marina*	15-45	0.21	12.11
	1	*Ceriops tagal*	36	0.01	1.03
	30	*Rhizophora mucronata*	15-57	0.3	16.81
8	10	*Rhizophora mucronata*	25-45	0.1	7.58
	11	*Bruguiera gymnorrhiza*	20-30	0.11	4.16
	3	*Sonneratia alba*	19-40	0.03	1.62
	3	*Aegiceras corniculatum*	8-10	0.03	0.21
9	12	*Rhizophora mucronata*	20-52	0.12	9.83
	3	*Rhizophora stylosa*	19-20	0.03	0.92
10	8	*Pemphic acidula*	20-32	0.04	4.04
	8	*Sonneratia alba*	10-200	0.04	55.11
	18	*Rhizophora mucronata*	14-40	0.09	15.86
	9	*Bruguiera gymnorrhiza*	30-54	0.045	13.49
11	36	*Rhizophora mucronata*	13-47	0.36	25.45
12	19	*Avicennia alba*	28-53	0.19	24.42
	11	*Sonneratia alba*	30-100	0.11	17.97



PLOT	DN 1989	DN 2002	DN 2005	DENSITY	CANOPY
1	0	0,06	0,119048	0,29	9,3
2	0,314286	0,353535	0,339623	0,3	38,37
3	0,352941	0,147826	0,393939	0,4	45,26
4	0,316239	0,232	0,415385	-	-
5	0,15942	0,362637	0,416667	0,4	51,51
6	0,010753	0,118644	0,135135	0,55	11,55
7	0,227723	0,071429	0,319149	0,52	29,95
8	0,04	0,209302	0,166667	0,27	13,57
9	-0,02767	0,253333	0,349398	0,15	10,75
10	0,25	0,28	0,116667	0,215	88,5
11	0,391304	0,15493	0,348315	0,36	25,45
12	0,026316	-0,00935	0,039216	0,3	42,39

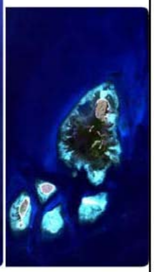


Classification	1989	2000	2002	2005
Rare (yellow)	661.500	904.500	425.700	300.600
Less dense (blue)	1.677.600	4.174.200	1.828.800	1.390.500
Dense (green)	5.580.000	4.139.100	4.771.800	4.612.500
Very dense (red)	1.980.900	571.500	3.294.000	4.041.900
Total (m²)	9.900.000	9.789.300	10.320.300	10.345.500

- Mangroves in Gili Sulat-Gili Lawang have undergone a significant growth after 2000 which was 6 years after mangrove rehabilitation program started.
- The approach is useful for mangrove monitoring especially for mangrove rehabilitation program.

Thank You ☺

Gili Sulat, Gili Lawang and Gili Petagan



Preliminary Study on Formulation of New Algorithm for Seaweed Identification in Indonesia

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Preliminary Study on Formulation of New Algorithm for Seaweed Identification in Indonesia

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PLQLVWU\#RI#PDULQH#DIIDLUV#DQG#ILVKHULHV#
UHSXEOLF#RI#LQGRQHVLD

Objectives

Year 1 Development of remote sensing methods for seaweed identification

Year 2 Development of algorithm formulations for seaweed identifications

Year 3
- Map of potential locations for seaweed culture
- Calculations of potential amount for seaweed harvest prediction

Objectives

To formulate new algorithm of FORMOSAT digital image analysis for seaweed identification in Indonesia Seas

To produce data and information about seaweed habitat spatial distribution, derived from FORMOSAT-2 satellite images, to support the aquatic resources management in coastal area

Type of Seaweed in Indonesia

CLASS	SEAWEED TYPE	CONTAIN
RHODOPHYCEAE (red algae)	1. *Eucheuma cottonii* 2. *Eucheuma spinosum* 3. *Hypnea sp.*	CARRAGEENAN
RHODOPHYCEAE (red algae)	1. *Gracilaria verrucossa* 2. *Gracilaria gigas* 3. *Gelidium sp.*	JELLY
PHAEOPHYCEAE (brown algae)	*Sargassum sp.*	ALGINATE

Survey Locations

Seagrass and Seaweed on the Survey Location

	Cape of Sireh		Selotong	Sepi Bay		Nambung	Ekas Bay			
	St1	St2		St1	St2		St1	St2	St3	St4
DATE	8 July 2008		9 July 2008				10 July 08			
LOCAL TIME	11.15	11.45	10.14	11.45	12.12	13.16	10.12	10.45	11.05	11.45
Seagrass										
Cymodocea rotundata			10%							
Enhalus accoroides	80%	40%	40%	60%	30%		60%			
Halophila ovalis			10%				30%			
Thalassia hemprichii			20%							
Seaweed										
Achantophora spicifera						*	***			
Caulerpa lentillifera						***				
Dyctiota dentata							***			
Euchema kotonii				*	**					
Gelidiopsis intricata							***			
Gelidium [illegible]							**			
Gracillaria verrucosa						***				
Halimeda conoides		**								
Halimeda simulans							***	**		
Hallymenia durvellaei							**			
Hydroclathrus clathrathus			*							
Padina pavonia			**	**	**					
Sargassum ilicifolium				**	**					
Sargassum silliquosum		*		**	**	**			****	****
Turbinaria conoides						**				
Turbinaria ornata			***					***		
Ulfa						**				

Annotation
- * Found some colony
- ** Found more than 10 colony
- *** Found in a large amount
- **** Found in a huge amount

Water Quality Measurement

Lokasi	Tanggal	Temp (celcius)	DO (mg/L)	pH	pHmV (mV)	ORP (mV)	Salinitas (ppt)	Keterangan Tambahan
Pantai Medana	08/07/2008	23,90	8,99	7,70	-59,3	284	33,19	
	08/07/2008	23,29	8,54	7,99	-71,2	249	33,15	
	08/07/2008	23,91	8,80	8,01	-79,0	244	33,17	
	08/07/2008	23,90	8,50	8,02	-79,5	233	32,78	
Pantai Medana	08/07/2008	23,09	8,93	8,00	-72,1	203	33,38	
	08/07/2008	23,33	8,98	8,02	-79,1	208	33,21	
Tanjung Sireum	08/07/2008	28,30	8,21	8,59	13,5	285	34,34	
	08/07/2008	23,13	7,95	7,51	-41,8	235	33,35	
Tanjung Sireum	08/07/2008	28,75	7,49	7,74	-58,0	199	34,33	ditemukan Sargassum
	08/07/2008	23,14	7,98	8,05	-75,0	178	33,35	sp., Kecepatan arus 1,2
	08/07/2008	23,54	7,47	8,14	-30,7	188	33,88	m/sec
	08/07/2008	23,82	7,48	8,18	-32,9	181	33,59	
Tanjung Sireum	08/07/2008	27,14	8,24	8,08	-75,4	191	34,35	ditemukan Enhalus sp.
	08/07/2008	23,41	8,19	8,17	-32,8	175	33,34	
	08/07/2008	23,77	8,27	8,20	-34,7	183	33,70	
	08/07/2008	23,91	8,94	8,21	-35,4	184	33,84	
Teluk Sepi	08/07/2008	25,77	7,98	7,03	-15,9	250	34,12	
	08/07/2008	24,85	8,90	7,78	-58,3	202	35,08	
Teluk Sepi	08/07/2008	28,05	7,92	8,09	-79,9	177	33,35	
	08/07/2008	28,12	7,78	8,08	-75,0	185	33,31	
	08/07/2008	28,02	8,92	7,94	-87,8	158	33,33	
	08/07/2008	28,11	7,48	8,05	-74,3	147	33,32	
	08/07/2008	25,90	7,95	7,92	-88,4	182	34,47	
	08/07/2008	25,33	7,19	8,09	-79,5	151	34,05	
	08/07/2008	28,05	7,18	8,08	-75,4	147	33,34	
	08/07/2008	25,82	7,22	8,02	-79,1	143	34,12	

Water Quality Measurement

Lokasi	Tanggal	Temp (celcius)	DO (mg/L)	pH	pHmV (mV)	ORP (mV)	Salinitas (ppt)	Keterangan Tambahan
Nambung	09/07/2008	24,42	8,08	7,12	-17,5	195	33,70	
	09/07/2008	25,99	8,58	7,85	-62,8	169	24,32	
	09/07/2008	25,63	8,00	8,07	-78,1	153	33,98	
	09/07/2008	25,78	7,92	8,14	-30,4	152	33,48	
	09/07/2008	25,73	7,78	8,17	-31,7	149	33,59	
Teluk Ekas (Dermaga)	10/07/2008	24,13	9,35	8,51	19,8	211	34,30	Air berwarna hijau
	10/07/2008	25,18	8,79	7,54	-49,5	177	34,18	
	10/07/2008	25,45	7,35	7,87	-89,5	184	33,98	
Teluk Ekas (Planet Laut Suga 1)	10/07/2008	24,84	8,80	7,91	-29,4	179	34,23	Dilakukan pengambilan
	10/07/2008	24,99	7,39	7,31	-59,9	185	34,05	
	10/07/2008	24,24	7,49	7,39	-84,3	183	34,69	
	10/07/2008	24,33	7,09	8,02	-72,7	159	34,18	
	10/07/2008	24,50	7,29	7,99	-70,5	169	34,42	
	10/07/2008	24,92	7,19	8,05	-74,4	180	34,12	
Teluk Ekas (Planet Laut Suga 2)	10/07/2008	25,50	10,12	7,25	-25,3	174	33,37	Warna air laut hijau
	10/07/2008	25,99	8,89	7,31	-59,7	184	33,98	kebiruan, banyak
	10/07/2008	25,94	7,79	7,93	-70,0	153	33,37	partikel tersuspensi
	10/07/2008	24,44	7,75	7,92	-88,9	157	34,53	
	10/07/2008	25,20	7,03	8,04	-74,2	149	34,04	
	10/07/2008	25,35	9,84	7,53	-48,1	232	33,71	
	10/07/2008	25,42	7,19	8,09	-79,4	215	34,08	
	10/07/2008	25,41	7,19	8,04	-79,9	211	34,08	
Teluk Ekas	10/07/2008	25,40	7,19	8,04	-74,1	210	34,08	Lokasi budidaya rumput
	10/07/2008	25,42	7,10	8,05	-74,5	205	34,08	laut dengan karamba
Teluk Ekas	10/07/2008	25,49	9,39	7,97	-89,5	142	34,04	Substrat berpasir, warna
	10/07/2008	25,47	7,87	8,09	-79,2	193	34,09	air laut hijau terang
	10/07/2008	25,47	7,10	8,05	-74,9	195	34,04	
Teluk Ekas	10/07/2008	28,20	33,30	8,03	-78,9	174	34,19	Warna air laut hijau tua
	10/07/2008	28,28	9,58	8,14	-30,0	169	34,17	
	10/07/2008	28,28	9,03	8,14	-30,1	162	34,17	
	10/07/2008	25,28	8,51	8,15	-30,5	158	35,31	
Teluk Ekas	10/07/2008	28,62	33,11	8,17	-31,9	162	34,01	Sampling Sargassum sp., substrat berpasir,

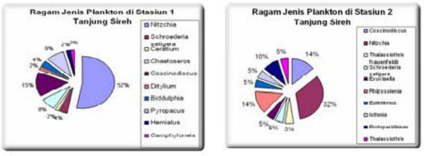
Cape of Sireh

- Data sampling in 2 different location.
- In location 1, seagrass average covering for *Enhalus accoroides* are 80% and the range is 50m from the beach line. The seagrass in this location are associated with algae (seaweed) *Padina pavonia*, and *Euchema cottonii*.
- In location 2, seagrass average covering for *Enhalus accoroides* are 40% and the range is 150m from the beach line. The seagrass in this location are associated with algae (seaweed) *Sargasum siliquosum* and *Halimeda conoides*

Marine Productivity in Cape of Sireh

No	Stasiun	Nitrate	Silicate	orthophosphat	Total Suspended Solid	Plankton
	LIMIT	0.005	0.1	0.001	1	-
1	St1	0.58 ppm	<0.1 ppm	0.051 ppm	3 ppm	477.273 Ind/L
2	St2	0.0172 ppm	< 0.1 ppm	0.0036 ppm	7 ppm	187.500 Ind/L

Variety of Plankton in Cape of Sireh



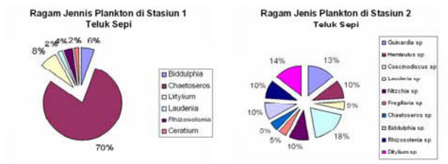
Sekotong Bay

Sepi Bay

Marine Productivity in Sepi Bay

No	Stasiun	Nitrat	Silikat	o-Fosfat	Total Suspended Solid	Kelimpahan Plankton
	LIMIT	0.005	0.1	0.001	1	-
1	St1	0.0064 ppm	<0.1 ppm	0.0053 ppm	5 ppm	460.227 Ind/L
2	St2	0.0111 ppm	< 0.1 ppm	0.0063 ppm	7 ppm	204.545 Ind/L

Variety of Plankton in Sepi Bay



Sepi Bay

Nambung Bay

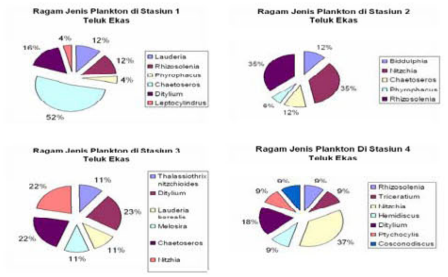
In this location the species of algae (*seaweed*) are *Acanthophora spicifera, Ulva, Gracilaria verrucosa, Caulerpa lentillifera, Sargassum siliquosum,* dan *Turbinaria conoides.*

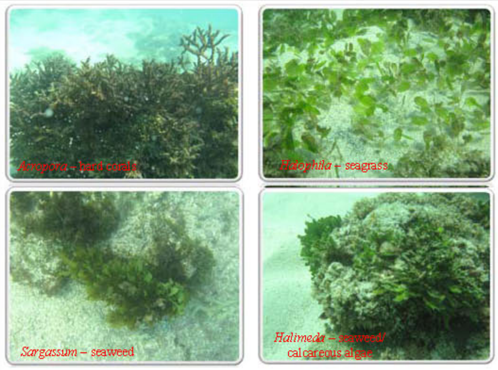
Awang Beach and Ekas Bay

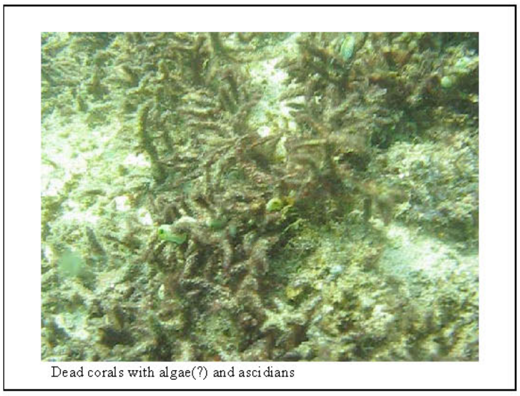
Marine Productivity in Ekas Bay

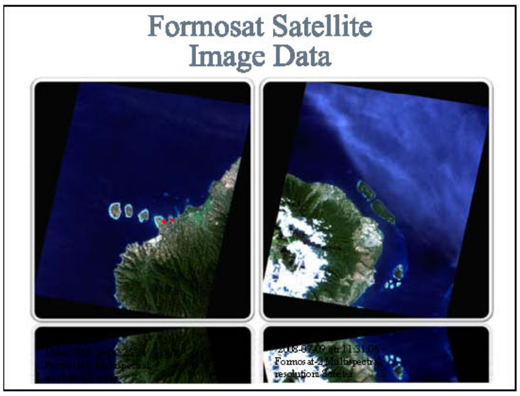
No	Stasiun	Nitrat	Silikat	o-Fosfat	Total Suspended Solid	Kelimpahan Plankton
	LIMIT	0.005	0.1	0.001	1	-
1	St1	0.0153 ppm	<0.1 ppm	0.182 ppm	3 ppm	221.591 Ind/L
2	St2	0.0175 ppm	<0.1 ppm	0.0045 ppm	6 ppm	187.500 Ind/L
3	St3	0.0039 ppm	<0.1 ppm	0.0028 ppm	9 ppm	93.750 Ind/L
4	St4	0.167 ppm	<0.1 ppm	0.0036 ppm	11 ppm	102.273 Ind/L

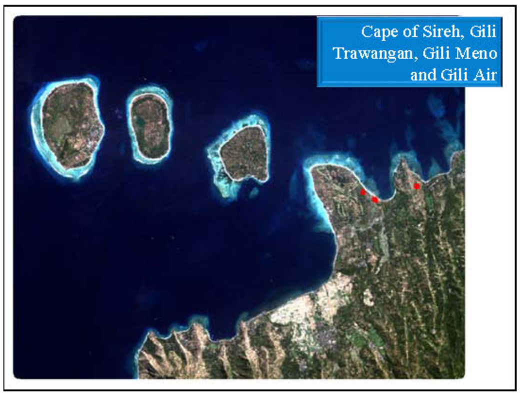
Variety of Plankton in Ekas Bay

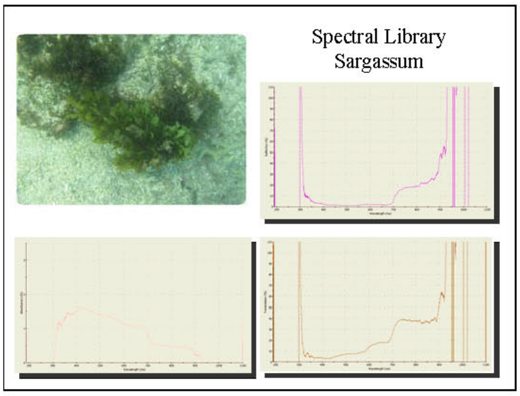


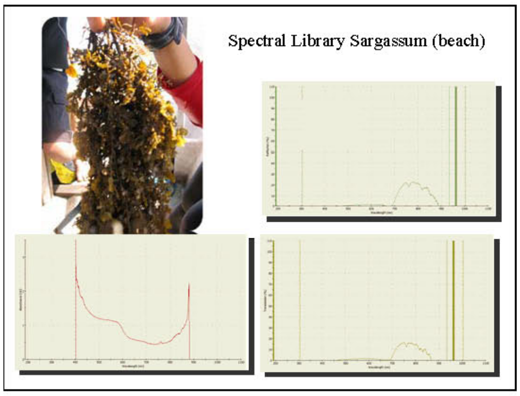


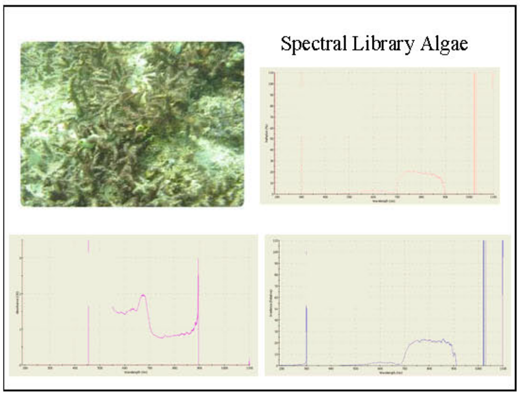

Dead corals with algae(?) and ascidians

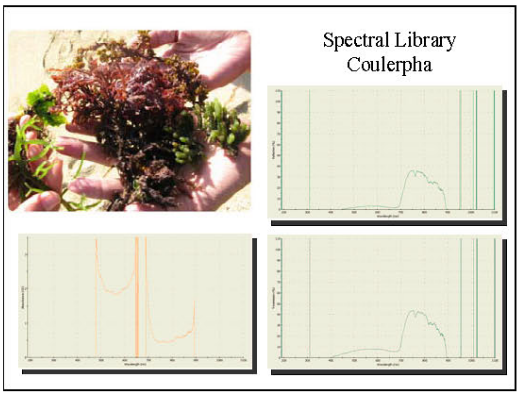

Formosat Satellite
Image Data


Cape of Sireh, Gili Trawangan, Gili Meno and Gili Air


Spectral Library
Sargassum


Spectral Library Sargassum (beach)


Spectral Library Algae


Spectral Library
Coulerpha

Application of Remote sensing Techniques in Marine Sciences - Potential realistic utilities in Vietnam

Tong Phuoc Hoang Son

Department Head of GIS and Remote Sensing. Institute of Oceanography,
Vietnamese Academy of Science and Technology

With the dramatical development of information technology, GIS and remote sensing technology (using satellite images) are widely applied in different research fields such as: Geodesy, Earth Science, planning for land use, studies of resources and environment, etc,…

In marine science, remote sensing techniques has been being applied gradually in some different studied fields.

This paper introduces some results of the remote sensing technology application on marine science in Vietnam which has been carried out by Institute of Oceanography for 10 years, such as:

- Detection on the distribution of mangrove forest, coral reefs, seagrass beds, seaweed meadows, etc…
- Assessment on the natural disasters and environmental risks in coastal waters of Vietnam seas

The capacity of remote sensing techniques on the forecast of fishery domains and environmental monitoring is also presented.

Through this paper, the author hope that: the application of remote sensing techniques in marine studies will become more popular and get more pratical results for reasonable utility of marine resources and also sustainable environmental protection in coastal waters of Vietnam Sea.

Study on Coastline Change Using Landsat and Formosat Image: Case Study in Pandeglang District, Banten Province

Afiat Anugrahadi[1)&2)] and Vivien Anjarsari[1)]

1) Geological Engineering Department FTKE USAKTI

2) Center for Mineral Resources and Marine Coastal Management Studies FTKE USAKTI

Study on Coastline change using Landsat and Formosat image. Case study in Pandeglang District, Banten Province [3)]

By

Afiat Anugrahadi[1)&2)] and Vivien Anjarsari [1)]

1) Geological Engineering Department FTKE USAKTI

2) Center for Mineral Resources and Marine Coastal Management Studies FTKE USAKTI

3) Presented on APEC SAKE 3rd Workshop 2008 in BPPT Jakarta.

INTRODUCTION

- Indonesia has 81.000 kilometres of the coastline, however the coast presents have problems on erosion, accretion, flooding, pollution, and the continued threats posed by rising sea levels.
- The aim of the study is to know about the coastline change impact for physical environment.

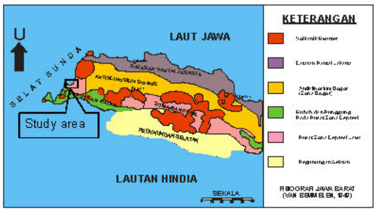
STUDY AREA

- Study area are located at the Tanjung Lampe, Teluk Lada, Tanjung Dadap and Tanjung Lesung beach in Pandeglang District of Banten Province.

06°23'00" LS – 06°32'30" LS

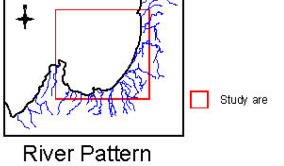
105°39'40" BT – 105°50'00" BT

WEST JAVA FISIOGRAPHIC MAP (van Bemmelen,1949)



GEOMORFOLOGY

This area has 2 geomorfologic units that occured from volcanics products. The height at the flat of coast area 1 – 3 meters above sea level and hilly area.



River Pattern

GEOMORFOLOGIC UNIT MAP

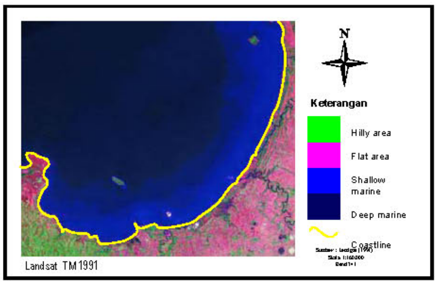
A : Flat area

B : Hilly area

Band 542 (Landsat ETM+, 2002)

METHODOLOGY

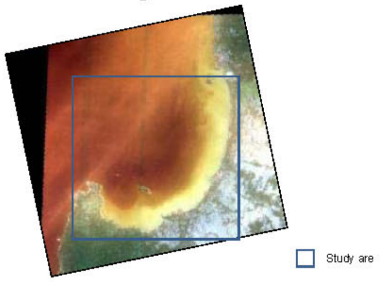
- The combination of remote sensing data and insitu data were used to improved understanding of the erosion and accretion off west coastline Banten Province.
- Using time series data Landsat image period of acquisition 1991, 2002, 2008 and Formosat-2 image of acquisition 2007.



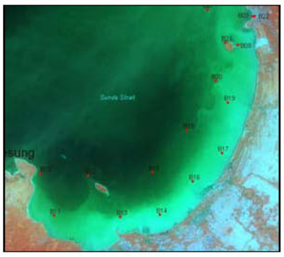
Landsat ETM+, 2008

Formosat-2 image

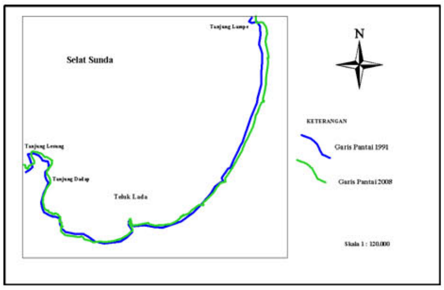
Geometric correction



Formosat-2 image (2007)



COASTLINE CHANGE MAP



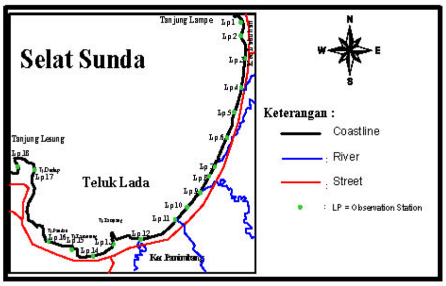
Calculation

Duration : 1991 to 2008 = 17 years Scale : 1:120.000

Coastal Change = Distance x Scale Velocity = Distance/Duration

Location	Sta	Distance (mm)		Coastal Change (m)		Velocity (m/year)		Process	
		Short	Long	Short	Long	Short	Long		
Tj. Lempe	1-5	2	4	240	480	14.11	28.4	Erosion	
Teluk Lada	6-12	2	4	240	480	14.11	28.4	Accretion	
	13-16	1	2	120	240	7.06	14.11	Erosion	
Tj. Dadap-Lesung	17-18	3	4	360	480	21.17	28.23	Accretion	

Observation Station Map



METHODOLOGY (Continue)

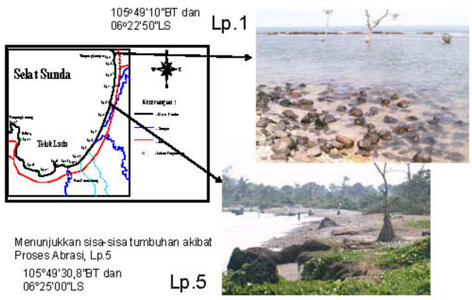
- Field check data with GPS to observe the coastline changes in 2006 and 2008.
- Analyses of sediments provided an information on the sedimentary processes in the coast.

Tanjung Lampe

Tumbuhan dan pemecah ombak yang terendam akibat proses abrasi Lp.1

105°49'10"BT dan 06°22'50"LS

Lp.1



Menunjukkan sisa-sisa tumbuhan akibat Proses Abrasi, Lp.5

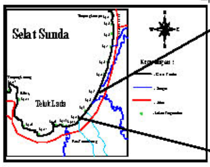
105°49'30,8"BT dan 06°25'00"LS

Lp.5

Teluk Lada

Kondisi Pantai Teluk Lada yang mengalami proses akresi dengan paras pantai yang cenderung melebar, Lp.7

Lp.7



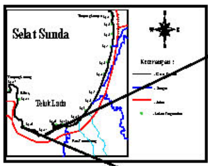
105°48'10"BT dan 06°28'50"LS

Pantai Yang Cenderung Melebar, sebagai Proses Akresi, Lp.11

105°45'08"BT dan 06°31'18"LS

Teluk Lada

Kondisi Pantai Teluk Lada Yang Mengalami Proses Abrasi, Lp.14

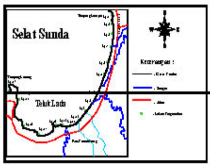


Lp.14 105°42'24"BT dan 06°31'40"LS

Proses Abrasi, Lp 15

105°41'15"BT dan 06°31'20"LS

Tanjung Lesung



Pertambahan Daratan Akibat Proses Akresi Lp.17

Lp.17 105°40'05"BT dan 06°28'38"LS

Wind Direction per month 1991 - 2006 (BMG, 2007)

Bulan	Musim Barat	Musim Timur	Arah
Januari	BL		BL
Febuari	BL		BL
Maret		TL	TL
April		TL	TL
Mei		TL	TL
Juni		TL	TL
Juli		TL	TL
Agustus		TL	TL
September		TL	TL
Oktober		TL	TL
November	BD		BD
Desember	B		B

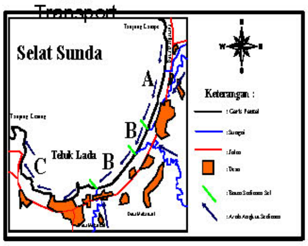
Curah Hujan (mm) daerah Banten dan sekitarnya tahun 1991 – 2006 (BMG 2007)

Bulan	1	2	3	4	5	6	7	8	9	10	11	12
Jumlah	311	311	181	237	50	13	0.1	0	0	78	133	141
Jumlah	347	344	187	168	35	86	31	88	159	148	261	184
Jumlah	354	231	52	246	173	103	33	150	71	44	224	87
Jumlah	215	315.8	269.4	125	32.2	36.3	0	0	11.2	39	126	85
Jumlah	393	266	264	221	102	92	166	22	59	90	248	205
Jumlah	296	375	197	261	212	82	9	133	78	233	230	285
Jumlah	295	171	147	199	143	33	2	0	0	0	39	89
Jumlah	170	209	243	114	222.2	113.6	59	94.3	42.7	231.3	122.6	165.5
Jumlah	318	238.2	96.7	100	39.8	53.4	54.5	14.6	20.2	151	75.7	248.2
Jumlah	383	300.4	95	127	132	29	101	22	24	117	134	72
Jumlah	222	330	143	85	62	164	85	49	96	136	190	64
Jumlah	292	348	118	280	88	86	95	33	5	8	97	135

Grain size Analysis

Besar Butir	Lokasi Pengambilan Contoh Pasir							
	Lp.1	Lp.2	Lp.4	Lp.8	Lp.10	Lp.12	Lp.15	Lp.18
1 mm	35,9	45,8	25,4	12,6	10	15	25,7	10
0,7 mm	53,6	55,3	34,8	36,8	38,9	28,9	38,9	15,8
0,5 mm	67,8	77,3	56,7	46,8	56,9	46,8	53,6	31,6
0,35 mm	88,4	83,7	75,7	68,4	76,3	67,9	75,9	55,9
0,18 mm	93,5	89,3	89,9	89,3	88,2	88,4	91,7	74,9
<0,18 mm	99,7	99,5	99,7	99,9	99,2	99,9	99,6	99,8

Supply Sediment Transport



Sub-cell A coarse to gravel and reef.
Sub-cell B fine - coarse grain size
Sub-cell C fine – medium grain size.

CONCLUSION

- The result showed the coastline change by erosion that occurs for 17 years period (1991-2008) approximately about 120– 480 meters and accretion that occurs is about 240 – 480 meters.
- The erosion cause that occurs at the study area is dominated by the high wind activity and the sea waves at coast and high human activities.
- The Accretion that occurs is caused by the high rain and also by the increase of surface water that contains suspended sediment that accumulated on the coast, and human activities for land use.

Sea Surface Anomaly Detection Using Optical Satellite Images

Chi-Farn Chen and Li-Yu Chang

Center for Space and Remote Sensing Research, National Central University

Sea Surface Anomaly Detection Using Optical Satellite Images

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Introduction

- Sources of Anomalies on sea surface
  - Human actives
    - Pollution of oil spill
    - Discharge of waste water
  - Natural actives
    - Red tide algae
- Anomalies and Remotely Sensed Images
  - The reflectance of such anomaly changed abruptly
  - It imply that this phenomenon can cause great differences in normal background

Difficulties in detection anomalies on sea surface

- Not only anomaly can cause the reflectance change
  - Waves and current
  - Bathymetry
    - Coastal zone
  - Noise
    - Distribution of radiance

The proposed scheme

- Automatically retrieve anomaly on ocean surface
  - Preprocessing of input multispectral image
  - Automatic threshold selection
  - Spatial filtering

Preprocessing of input multispectral image

- Multispectral image contains more abundant spectral information than single band image
- However, the variation and characteristic are quite different for each bands of multispectral image
- Normalization and transformation are needed preprocessing

Preprocessing of input multispectral image

- Assuming that the dominate target of input image is normal sea surface
  - The background can be modeled by global mean
- Measure the degree of anomaly by the difference from mean
  - Remove mean for all bands to get a vector to measure the degree of abnormal
- Normalization
  - Normalization according to the covariance matrix

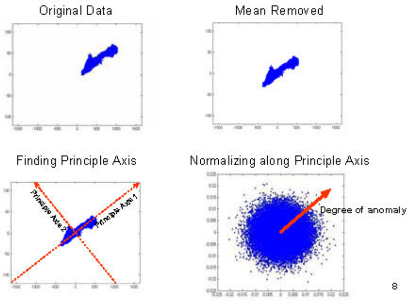
RXD

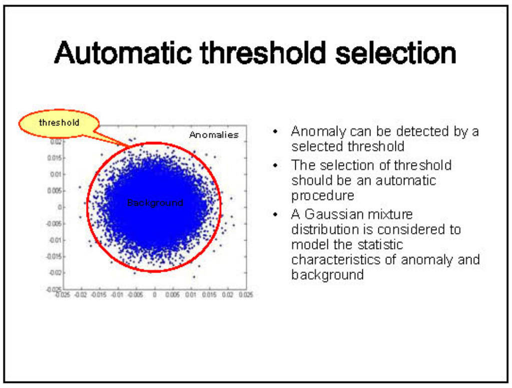
$$\delta_{RXD}(r) = (r-\mu)^T K_{L*L}^{-1}(r-\mu)$$
$$= (r-\mu)^T A\,\Lambda^{-1} A^T (r-\mu)$$
$$= (r-\mu)^T A\,\Lambda^{-1/2}\Lambda^{-1/2} A^T (r-\mu)$$
$$= [s*(r-\mu)]^T [(s*(r-\mu)] \qquad (s = \Lambda^{-1/2} A^T)$$

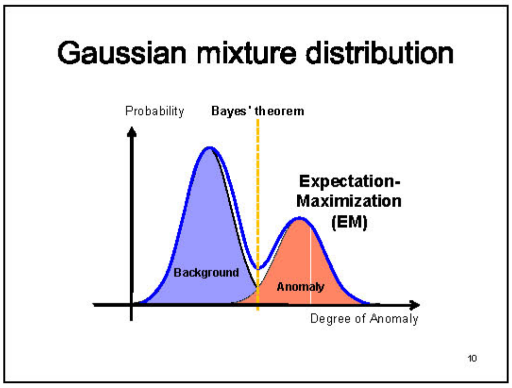
K : Covariance matrix
s : whitening matrix
A : eigenvector matrix
Λ : eigenvalue matrix

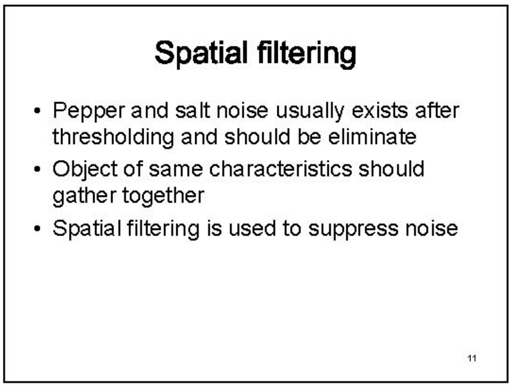
1. Normalizations are performed along each eigenvector (principle axis) with standard deviation of data on it.
2. Take Square sum of normalized distance to measure the degree of anomaly.

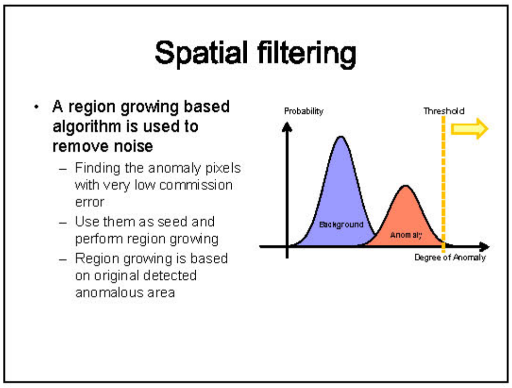
RXD

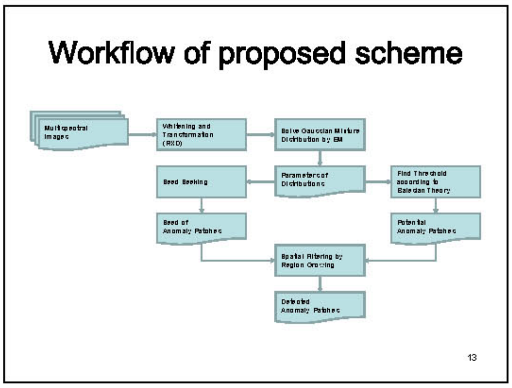


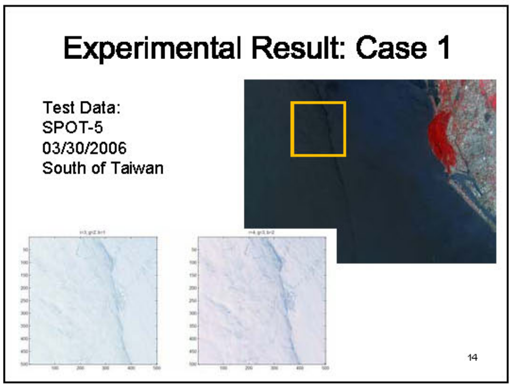

Automatic threshold selection
threshold
Anomalies
Background
• Anomaly can be detected by a selected threshold
• The selection of threshold should be an automatic procedure
• A Gaussian mixture distribution is considered to model the statistic characteristics of anomaly and background

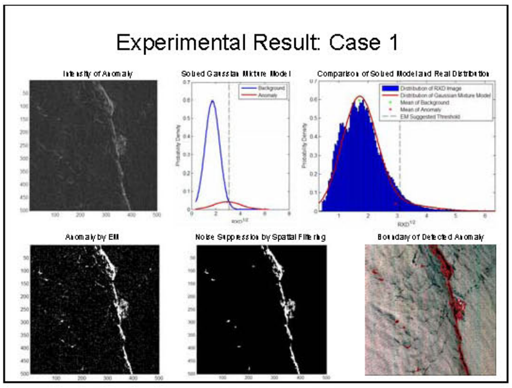

Gaussian mixture distribution
Probability
Bayes' theorem
Expectation-Maximization (EM)
Background
Anomaly
Degree of Anomaly
10

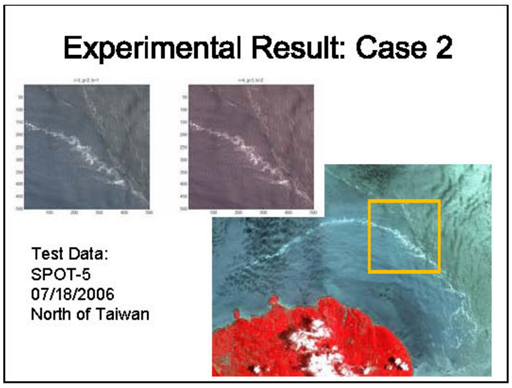

Spatial filtering
• Pepper and salt noise usually exists after thresholding and should be eliminate
• Object of same characteristics should gather together
• Spatial filtering is used to suppress noise
11


Spatial filtering
• A region growing based algorithm is used to remove noise
– Finding the anomaly pixels with very low commission error
– Use them as seed and perform region growing
– Region growing is based on original detected anomalous area
Probability
Threshold
Background
Anomaly
Degree of Anomaly

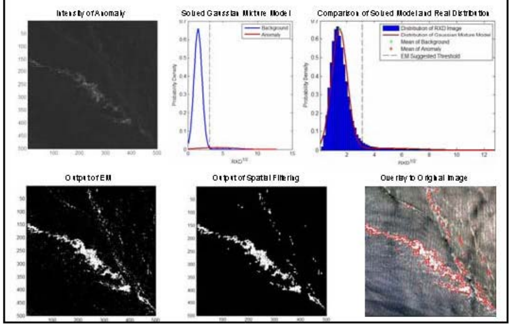

Workflow of proposed scheme
Multispectral Images
Whitening and Transformation (RXD)
Solve Gaussian Mixture Distribution by EM
Seed Seeking
Parameters of Distributions
Find Threshold according to Bayesian Theory
Seed of Anomaly Patches
Potential Anomaly Patches
Spatial Filtering by Region Growing
Detected Anomaly Patches
13


Experimental Result: Case 1
Test Data:
SPOT-5
03/30/2006
South of Taiwan
14


Experimental Result: Case 1
Intensity of Anomaly
Solved Gaussian Mixture Model
Comparison of Solved Model and Real Distribution
Anomaly by EM
Noise Suppression by Spatial Filtering
Boundary of Detected Anomaly


Experimental Result: Case 2
Test Data:
SPOT-5
07/18/2006
North of Taiwan

Experimental Result: Case 2



Conclusion

- RXD can be used to normalize each band of multispectral image and extract the degree of sea surface anomaly.
- EM is able to provides an opportunity to get a threshold with minimum error by Bayes' theorem.
- According to the generated distributions of EM, it is possible to evaluate the potential accuracy of result.
- Spatial filtering can effectively reduce pepper and salt noise. Therefore, a higher user's accuracy can be achieved.
- Presently, the threshold form proposed method will be affected by the ratio between background and anomaly. In future, a better algorithm should be considered to eliminate such problem.

18

Oil Spill Response in Indonesian Marine and Coastal Environment

Beny Bastiawan

Assistant Deputy Ministry for Marine and Coastal Degradation Control

Oil Spill Response in Indonesian Marine and Coastal Environment

Assistant Deputy Ministry for Marine and Coastal Degradation Control

Out Line

- Legal Aspect
- Existing conditions
- Oil Spills case

International Convention

Indonesia has ratified and implemented the international Convention regarding Marine Pollution:

- The International Convention on Marine Pollution Prevention from Ship 1973 and its protocol of 1978 (MARPOL 73/78),
- Civil Liability Convention 1969 and its protocol of 1992 (CLC 69/92); For executing and enforcing that convention SEACOM as the Lead Agency.
- Basel Convention 1989.

National Legislation

Indonesia also has adopted international convention into the national Legislation regarding Marine Pollution such as:

1. The Exclusive Economic Zone Act No. 5/1983.
2. The Continental Shelf Act No.1/1973
3. The Merchant Shipping Act No.21/1992.
4. The Indonesian Water Territorial Act No.6/1996.
5. The Environmental Quality Act No.23/1997.
6. The Petroleum Mining Act No.22/2001.
7. Fisheries Act No.31/2004
8. Local Government Act No.32/2004

Presidential Decree no. 109 of 2006 regarding National Contingency Plan of oil spill response in Indonesian waters has the following objective:

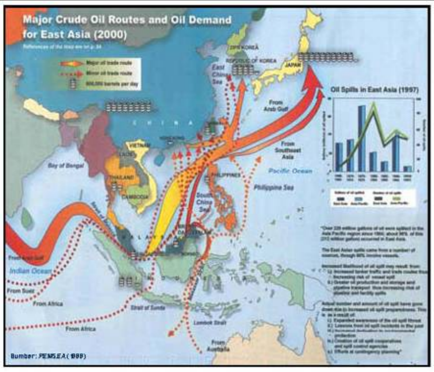
1. To provide a mechanism for coordinating response systems for effective containment and recovery of oil;
2. To enhance capability with the 'existing resources' with respect to equipment and manpower as well as training in combating oil spill.
3. To minimize potential adverse impact to the environment arising from the spill.

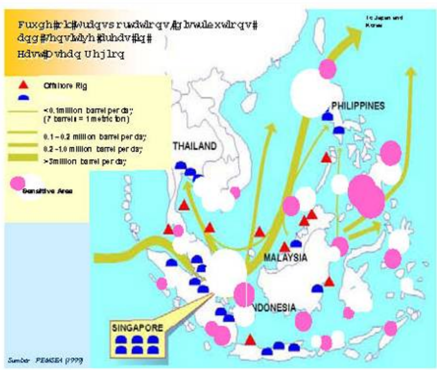
The Response Oil Spill Organization

1. Directorate General of SeaTansportation (DGST) is responsible as the Lead agency for the national and regional plans is in charge of operational command and control of oil spill response in Indonesia.
2. Ministry of Environment act as the focal point which analyzed the assessment of natural damages and socio-economic losses and rehabilitation
3. Oil Company act, as the supporting agency in oil spill response operation, which have the equipment and human resources in oil spill handling.
4. Other agencies participate in addressing marine pollution, among them are: The Local Government, Department of Energy and Mineral Resources, Department of Fisheries, Department of Forestry, Department of Foreign Affair, Health have support roles in operation and advisory.

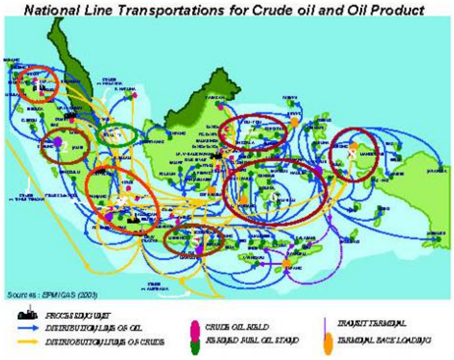
Tiered Response Concept implemented in Indonesia based on the 'Area Responsibility and Capability', divided into 3 tiers:

- Tier 1 : Independent Combating, carried out by Oil Company with respective Oil Spill Contingency Plan (OSCP)
- Tier 2 : Local Combating, in case independent unit cannot handle the oil spill, joint combating operation between Oil Company and relevant agencies carried out by coordination and command of Port Authority.
- Tier 3 : National Combating, in case the Port Authority don't have capability to handled the incident, then DGST HQ will be take-over responsible for coordinating and commanding the response operation.

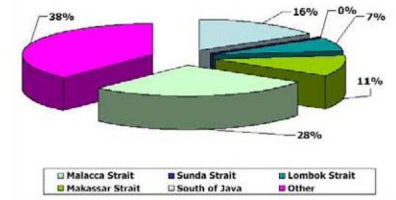




National Line Transportations for Crude oil and Oil Product



OIL SPILL RISK AREA IN INDONESIAN WATERS



MAJOR OIL SPILL INCIDENT IN INDONESIA (from 2000 to 2006)

Incident		Location	Quantity of Spill
Date	Name of Vessel		
01 Apr 2000	MT. King Fisher	Cilacap – Central Java	750 Ton
03 Oct 2000	MT. Natuna Sea	Karang Batu Berhanti-P.Sambu	7000 Ton
11 Dec 2001	MT. Steadfast vs MV. Viking	Tegal – Central Java	1200 Ton
24 Des 2002	Tkg. Bumindo	Tg Sekodi – Bengkalis	400 Ton
07 July 2003	MV. An Giang vs TB. PLTU I	Gerong river Plaju Palembang	Collision
14 Feb 2004	Tkg. OSCO 10 / TB. Range 001	Wiriagar waterSorong	Capsize

Source : DGSC-MOT 2007

No	Years	Location	Incident & Quantity
1.	1975	Selat Malaka	Showa Maru kandas (1 juta barel solar)
2.	1975	Selat Malaka	Tabrakan Isugawa Maru dan Silver Palace
3.	1979	Buleleng, Bali	Choya Maru pecah (300 ton bensin)
4.	1979	Lhokseumawe	Golden Win bocor (1500 KL minyak tanah)
5.	1984	Delta Mahakam	Pemboran minyak milik Total indonesia
6.	1992	Selat Malaka	Tabrakan MT Ocean Blessing dan MT Nagasaki Spirit (5000 barel minyak)
7.	1993	Selat Malaka	Tanker Moersk tertabrak
8.	1994	Cilacap	Tabrakan MV Bandar Ayu dan kapal ikan
9.	1996	Natuna	KM Batamas Sentosa II tenggelam (MFO)
10.	1996	Kepulauan Riau	Tanker MT. Kuala Berkah Tenggelam, Jenis minyak LSWR
11.	1996	Belawan	MT. Pan Oil , Tenggelam, Minyak CPO
12.	1997	Banten	TKG. Regent III, Tenggelam , Minyak MFO
13.	1997	Kepulauan Riau	Orapin Global dan Evoikos tabrakan
14.	1997	Kepulauan Riau	Pipa Transfer minyak Caltex, bocor , minyak mentah
15.	1997	Selat Makasar	Mission Vikin tenggelam, minyak
16.	1997	Selat Makasar	Platform E-20 UNOCAL tenggelam
17.	1997	Selat Madura	SETDCO tenggelam
18.	1998	Tanjung Priok	Kapal Pertamina suplai no 27 kandas
19.	1998	Amamapare,Papua	MV. Lonian Express, Tabrakan, Minyak Mentah

No	Years	Location	Incident and Quantity
20.	1999	Batam	Mighty Serent II, Tenggelam, Minyak Sisa
21.	1999	Tanjung Priok	Pertamina Supply OS. 27, Tumpah, Minyak Sisa
22.	1999	Sungai Siak Riau	MT. Stephanie XVII, Tubrukan, Premium
23.	1999	Cilacap	MT King Fisher robek (640 ribu lt tumpah)
24.	2000	Cilacap	KM HHC tenggelam (9000 ton aspal)
25.	2000	Batam	MT Natuna Sea kandas (4000 ton minyak)
26.	2001	Tegal-Cirebon	Stedfast tenggelam (1200 ton limbah minyak)
27.	2002	Bengkalis Riau	TKG. Bumindo, Kandas, MFO
28.	2004	Wiriagar	TK-OSC 10, Tenggelam, Crude Oil
29.	2004	Wilayah TSS	MV. Kamimasen Hyundai, Tongkang Cargo, Tubrukan, Minyak
30.	2004	Santuriang	Tanker MT Pan Sejati, Tenggelam, Minyak
31.	2004	Teluk Tomini	Tanker MT Istana VII, Tenggelam, Minyak
32.	2004	Balikpapan	Tanker MT Panos 6, Bocor, Minyak
33.	2004	Teluk Tomini	Tanker MT North Star, Tenggelam, Minyak
34.	2004	Tanjung Balai Karimun	Tanker, MT. Vista Mariner, Kandas, Minyak
35.	2004	Pekanbaru	Tanker MT. Maulana, Terbakar, Minyak
36.	2004	Cilacap	Tanker MT. Lucky Lady, Bocor, Minyak
37.	2004	Batu Ampar Batam	Kapal Motor, KM. Swadaya Lestari, Minyak Kotor
38.	2004	Ambon	Tanker MT, PSJT 03 /YB 9043, terbakar, solar

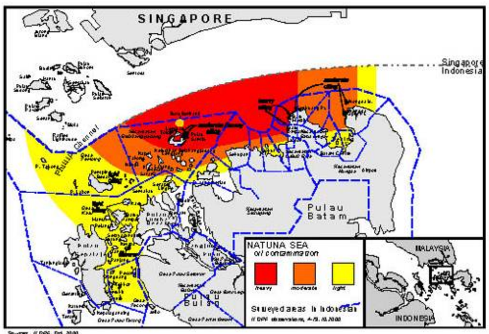
The NATUNA SEA Incident

At 0620 hours on 3 October 2000, the 51,095GT/82,169DWT 1980 built tanker NATUNA SEA loaded with 70,190MT Nile Blend Crude out of Marsa Bashayer, North Sudan, and bound for Jinzhou, Republic of China, grounded on the Indonesian rocky outcrop of Batu Berhanti, approximately 320 meters to the south of the southern extremity of the eastbound traffic separation scheme between Singapore and Indonesia.

What was particularly interesting about this grounding is the fact that the location is also about 6NM from the NATUNA SEA's Managers' office! The immediate consequence of the grounding was that cargo tanks 1C, 2C, 3C, 1S and 3S were ruptured and an estimated 7,000mt of cargo escaped into the sea *(Ferguson / The London P&I Club).*

International Convention on Civil Liability for Oil Pollution Damage (*CLC 1969*) defines 'pollution damage' as follows:

"(a) Loss or damage caused outside the ship by contamination resulting from the escape or discharge of oil from the ship, wherever such escape or discharge may occur, provided that compensation for impairment of the environment other than loss of profit from such impairment shall be limited to costs of reasonable measures of reinstatement actually undertaken or to be undertaken;
(b) the costs of preventive measures and further loss or damage caused by preventive measures"

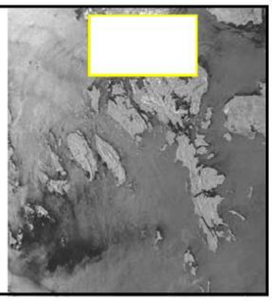


Remote Sensing for Detection of Oil Spill on The Natuna Cases, Oct. 2000)

Natuna Sea

- 3 Oct 2000
- Grounded In Singapore Strait
- Est. 7000 t of cargo spilt

ERS 2
11 October 2000



Oil Spill in Indonesian waters

Qdwxqd Vhd#Fdvh#+R fwrehu#5333,

Hyrlfrv Fdvh#+R fwrehu#4<<:,

Total compensation claims

Several vessel groundings and collisions occured in the past two years, some resulting in spillage of oil, such as the 'Natuna Sea' (October 2000) and 'Singapora Timur' (May 2001).
Total compensation claims for the 'Natuna Sea' from the 3 littoral States were US$127,003,226, but only 8.48% *(US$10,769,873.5648)* was paid due to unsubstantiated and disallowed claims, especially on environmental and fishery-related damages (Annex 2). (*word Bank-2004*)

Reliable information on the Strait's natural resources, particularly its economic value, is certainly important and urgently needed in order to better quantify the economic losses incurred in the event of a chemical or oil spill in the Straits.

Thank you for Your Attention

Joint Research on Application of Remote Sensing Technology for Oil Spill Monitoring, Case Study: Kepulauan Seribu, Indonesia

Marina CG Frederik, Nani Hendiarti, Beny Bastiawan

The 3rd APEC SAKE Workshop on Satellite Data Processing and Applications for Marine Resources Inventory

Joint Research on

Application of Remote Sensing Technology for Oil Spill Monitoring.

Case Study: Kepulauan Seribu, Indonesia

Marina CG Frederik, Nani Hendiarti, Beny Bastiawan

Since 1975, there has been more than 20 cases of oil spill in Indonesian waters, which for most of these occurrences only official reports were produced without proper mitigation actions.

In the Thousand Island area, north of Jakarta, there were 6 cases of marine pollution caused by oil spill within the period of 2003-2004 (A. Sudrajat, 2007)

Remote sensing technology offers a significant advantage in monitoring of marine pollution, where the image covers a large area acquired in a short period of time after the spill

In this joint research, the image of Formosat-2 satellite will be used. It is an optic satellite with high spatial resolutions and daily revisit, launched by NSPO,Taiwan in 2004

Institutions Involved:

BPPT: Agency for Assessment and Application of Technology, Indonesia

KLH: The State Ministry of Environment, Indonesia

CSRSR - NCU: Center for Space and Remote Sensing Research, National Central University – Taiwan

IO - NTU: Institute Oceanography – National Taiwan University

NSPO: National Space Organization of Chinese Taipei

EPA: Environmental Protection Agency of Chinese Taipei

COMC - NCKU: Coastal Ocean Monitoring Center, National Cheng-Khung University – Taiwan



The 3rd APEC SAKE Workshop on Satellite Data Processing and Applications for Marine Resources Inventory, 15-16 October 2008, Jakarta-Indonesia

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Goal

To increase awareness of the advantages of new technologies such as high resolution remote sensing data.

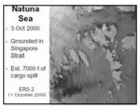
To promote methodology development based on satellite observation during an emergency situation of oil spill.

To promote technology and knowledge transfer in processing and interpretation of high resolution image.

To optimize the results of APEC SAKE (*Satellite Application in Knowledge-based Economies*) project in Indonesia.

To promote the dissemination on use of remote sensing data for oil spill monitoring to the decision makers and stakeholders.

Remote Sensing for Detection for Oil Spill on The Natuna Cases, Oct 2000



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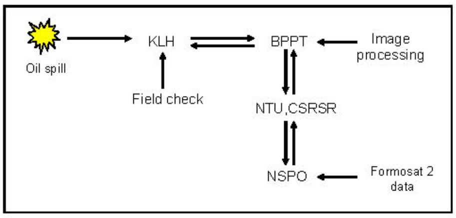
Methodology

1. Identification of oil spill by anomaly detection algorithm
2. Map of spread of spill and affected area estimation
3. Field verification



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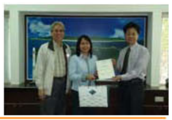
Project's duration: 8 months (April - November 2008)

Activities:

Oil Spill training in NCU, Taiwan 21-27 April 2008

Focus on image processing and anomaly detection





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Activities:

Visit ground receiving station in NCU

Visit National Space Organization and National Science and Technology Center for Disaster Reduction


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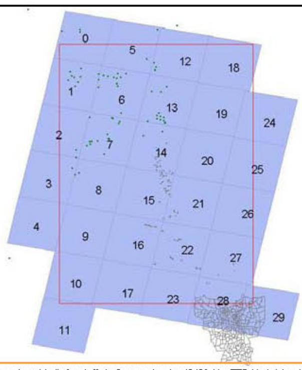
With NSPO and CSRSR decide the Area of Interest and grid numbers for oil spill monitoring.

Focusing on the Thousand Island and oil platforms located North of Jakarta (green dots)



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Projected Results

- Image map on location of oil spill with high accuracy using Formosat-2 data and validated by field survey
- Map of area estimation of ecosystem affected

- In the case there is no oil spill occur until end of project, produce a map of oil platform location, updated, using the Formosat-2 images

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Location of oil platforms in North of Jakarta (yellow color)

Background:
images of Landsat ETM+, 2000 and 2001

The 3r... Inventory, 15-16 October 2008, Jakarta-Indonesia

Thank You !

Seasonal Variability of Sea Surface Chlorophyll-a and Their Impact on the Marine Productivity in the Coastal Area of South Kalimantan

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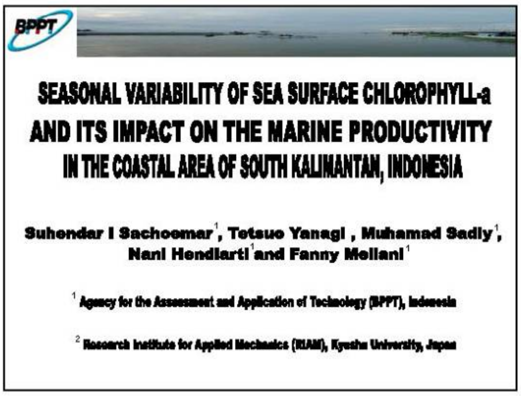
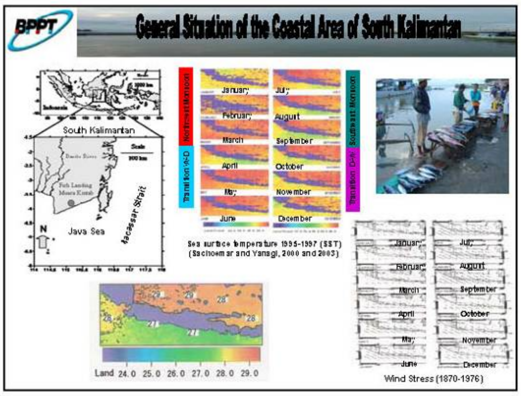
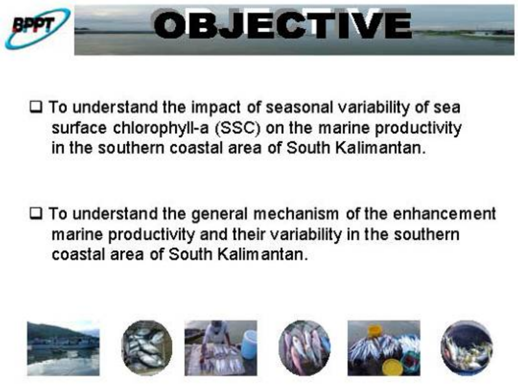
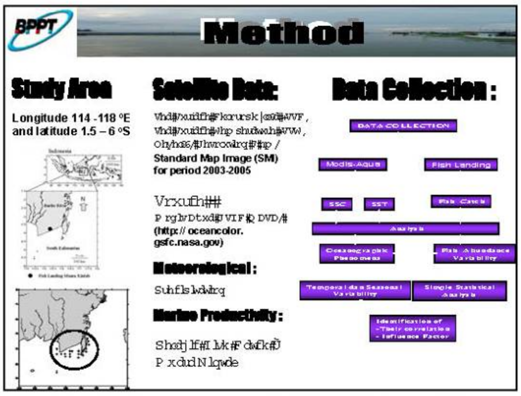
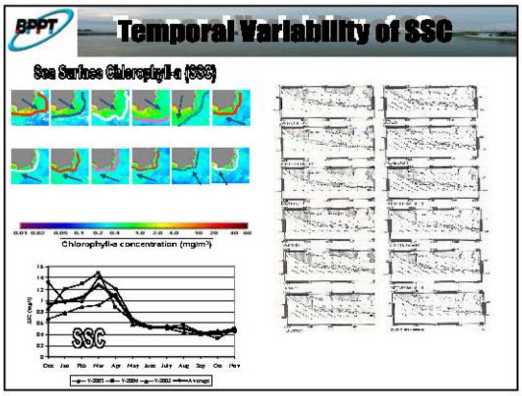
1. Agency for the Assessment and Application of Technology (BPPT), Indonesia
2. Research Institute for Applied Mechanics (RIAM), Kyushu University, Japan

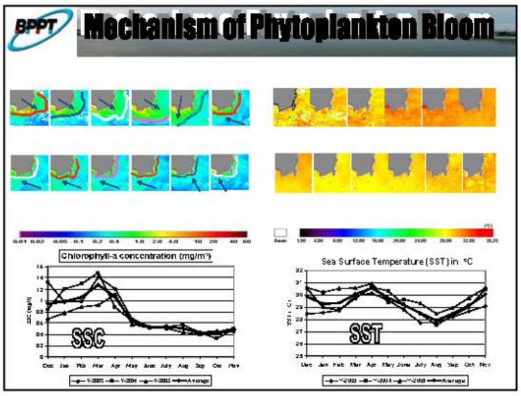


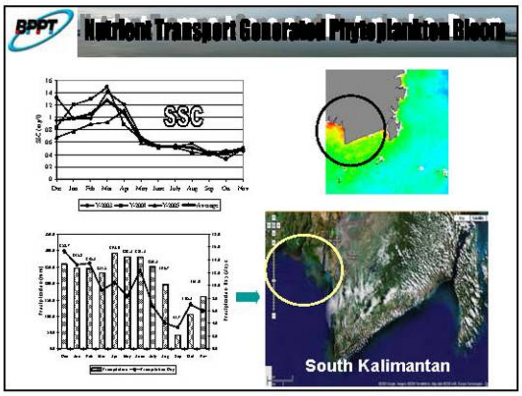


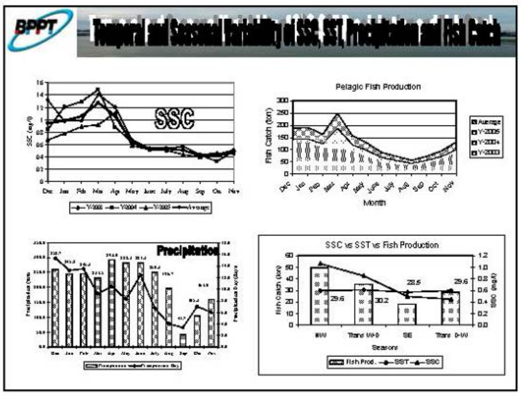


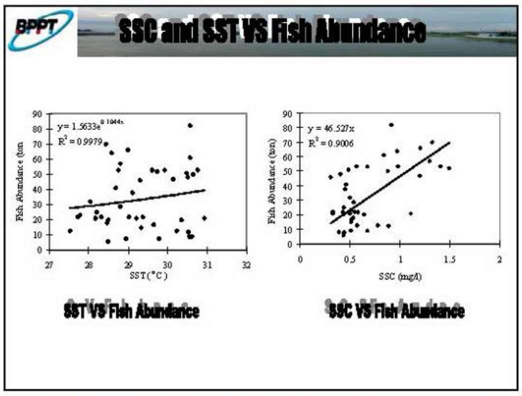


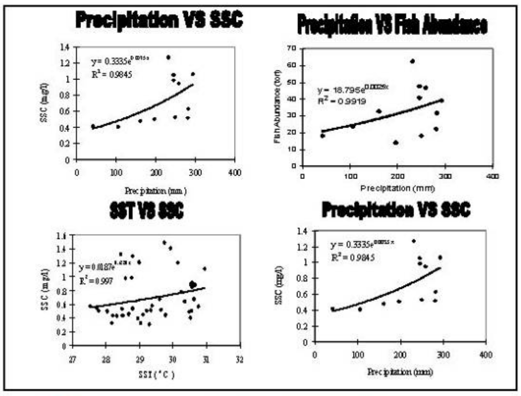


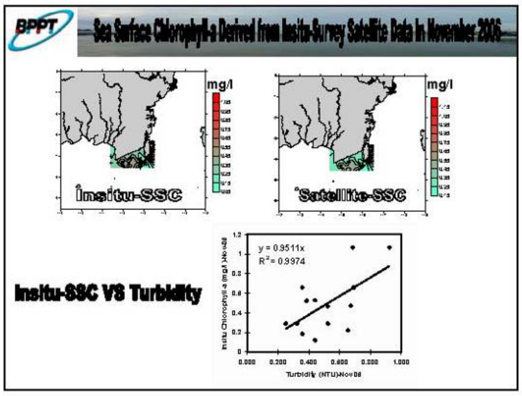












Summary

- Modis satellite data was well applied for marine productivity study in tropical area
- Temporal and seasonal variability of SSC was well corresponded with marine productivity (pelagic fish abundance) in the coastal area of South Kalimantan and governed by the enhancement of the nutrient generated by precipitation and transported through the rivers in the western part of South Kalimantan.
- Temporal and seasonal variability of marine productivity in the Coastal Area of South Kalimantan has controlled by monsoonal system

Thank You

Historical Data Satellite Source for Marine Observations

In 1978, the NIMBUS 7 satellite with Coastal Zone Color Scanner (CZCS) was launched for phytoplankton identification within the surface water up to 1987.

Since 1980's NOAA/AVHRR data have been widely used for monitoring of earth environment in global scale. For regional scale, AVHRR sensor still has been only one practical data source to be used to monitor land and sea environment, such as the distributions/conditions of vegetation, sea surface temperature (SST) and to monitor disaster phenomena such as forest fire or volcano eruption.

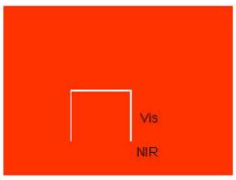
In 1994, Orbital Science Corporation was launched Sea Star satellite with SeaWiFs (Sea Viewing Field Sensor).

In 1996. The ADEOS with MIDORI sensor was launched to contribute to elucidation of phenomena of the earth system through integrated observation of geophysical parameters using a number of sensors. The main parameters observed by MIDORI are 1) energy flux between atmosphere and ocean, 2) three-dimensional distribution of atmospheric temperature and water vapor, 3) aerosol distribution over ocean, 4) three-dimensional distribution of atmospheric ozone, 5) chlorophyll distribution in ocean, 6) sea surface temperature, 7) ocean wind vector and 8) vegetation distribution.

In 1997. Ocean Color and Temperature Scanner (OCTS) is an optical radiometer to achieve highly sensitive spectral measurement with 12 bands covering visible and thermal infrared region. In the visible and near-infrared bands, the ocean conditions are observed by taking advantage of spectral reflectance of the dissolved substances in the water and phytoplankton. On the other hand, the sea surface temperature is accurately measured in 4 thermal infrared bands. As the swath width of OCTS is about 1,400km with scanning mirror (west-east) and OCTS also scans south and north, it can observe the entire earth surface for 3 days. The spatial resolution is about 700m.

Nowadays, some new sensors are going to be available in global and regional scale,i.e. SEASTAR/SeaWiFS and TERRA/MODIS. The spatial resolution of these sensors are moderate and compatible to that of AVHRR, however, the number of spectral band is significantly increased, especially for MODIS sensor.

By these new sensors, the spectral information is significantly enhanced compared with that by conventional AVHRR sensor and therefore, they are highly expected to extract more plentiful and accurate environmental information in global or regional scale.

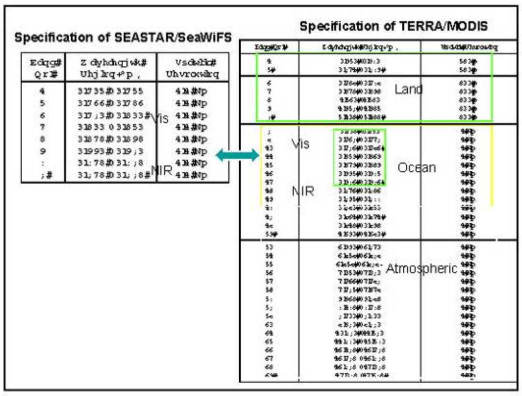


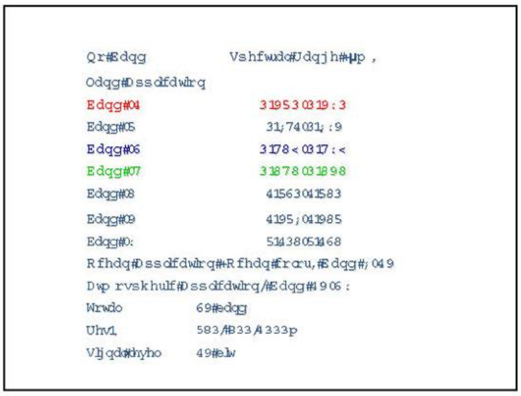
Specification of NOAA-14,15/AVHRR.

Edqg# Qr1	Z dyhdhqjwk# Uhjlrq+p ,#	Vsdwldo# Uhvroxwlrq
4 5 6 7 8#	318;#319; 31:58#414 TIR 6188#61k6 ru#18;#4197# +Q 048#kqo, 4316#4416 4418#4518#	41#Np 41#Np 41#Np 41#Np 41#Np

Specificationof Sensor OCTS-ADEOS

Band	Panjang Gelombang (µm)		Radiance (Wm2sr-1µm-1)	S/N
1	0,402-0,422	Vis	145	450
2	0,433-0,453	Vis	150	500
3	0,480-0,500	Vis	130	500
4	0,510-0,530	Vis	120	500
5	0,555-0,575	Vis	90	500
6	0,660-0,680	Vis	60	500
7	0,745-0,785	NIR	40	500
8	0,845-0,885	NIR	20	400
			Target Temp (K)	NEDT (K)
9	3,55-3,88	TIR	300	0,15
10	8,25-8,20	TIR	300	0,15
11	10,3-11,4	TIR	300	0,15
12	11,4-12,5	TIR	300	0,20


Specification of SEASTAR/SeaWiFS
Specification of TERRA/MODIS
Vis
NIR
Land
Ocean
Atmospheric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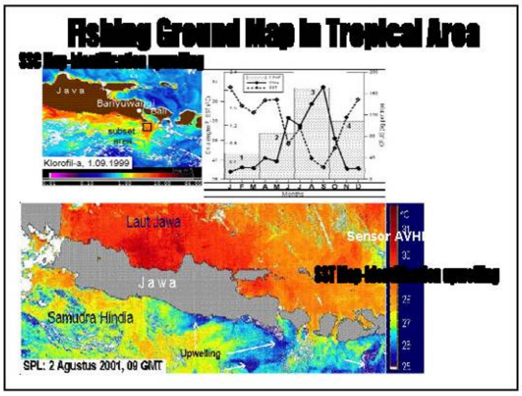
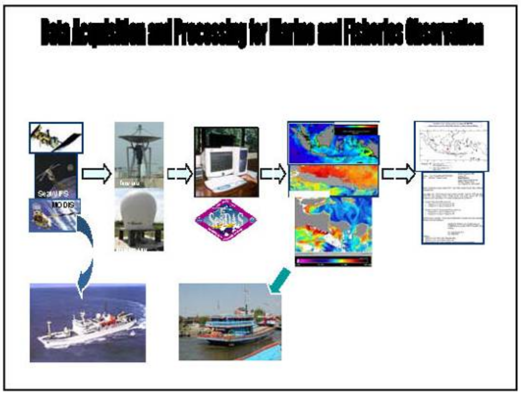

Fishing Ground Map in Tropical Area
SSC Map-Identification upwelling
Java
Banyuwangi
Bali
subset area
Klorofil-a, 1.09.1999
Laut Jawa
Sensor AVHRR
Jawa
SST Map-Identification upwelling
Samudra Hindia
Upwelling
SPL: 2 Agustus 2001, 09 GMT


Data Acquisition and Processing for Marine and Fisheries Observation
SeaWiFS
MODIS

Local Comparison of Sea Level Observation from Altimetry and Tide Gauges at Coastal Areas in Indonesia Seas

Asmi Marintan Napitu

Institute for Marine Research and Observation, Ministry of Marine Research and Fisheries

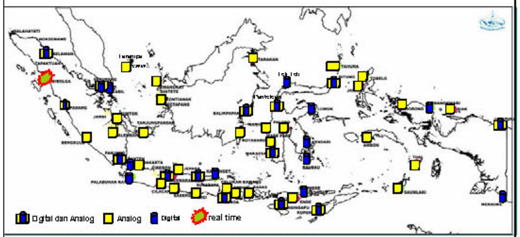
LOCAL COMPARISON OF SEA LEVEL OBSERVATION FROM ALTIMETRY AND TIDE GAUGES AT COASTAL AREAS IN INDONESIA SEAS

ASMI MARINTAN NAPITU
INSTITUT FOR MARINE RESEARCH AND OBSERVATION
MINISTRY OF MARINE RESEARCH AND FISHERIES

BACKGROUND

- Sea level study is important with understanding that sea level measurements can be used as indicators of the ocean processes
- we have about 60 tide gauges spreading in Indonesia waters to measure sea level heights ➔Indonesia coast line length > 81,000 km with complex tophography and unique coastal morphology ➔number of 60 tide gauges is very little number ➔ lack of comprehensive information occurred and not being able monitor sea level for the whole area
- Altimetry Technology helps us to provide sea level data

BACKGROUND



now 60 stations, 50% of the stations have been recording over ten years,
NATIONAL COODINATING AGENCY FOR SURVEYS AND MAPPING (BAKOSURTANAL)

BACKGROUND

ALTIMETRIC DATA	TIDE GAUGE DATA
•Synoptic observation every 10 days •Lack of data in the coastal areas (decreased accuracy of the corrective terms + technical problems) • altimetry provides information in the open sea.	•Local observation (measures coastal sea level) •High temporal resolution (more adapted to the study of coastal dynamics)

SCIENTIFIC ISSUES

- Nevertheless, the application of altimetry data for sea level monitoring in Indonesia is not easy since Indonesia is an archipelago country, having complex topography and unique coastal morphology leading to many noises to the sea level signals recorded by altimeter radar, Indeed, the use of altimetric data near the coasts is challenging, due to technical problems and uncertainties in the corrective terms

OBJECTIVES

- Comparing tide gauge data and altimetry data in order to measure accuracy degree of altimetry data and also to know the level of correlation between tide gauge data and altimetry in Indonesian area
- The main objective of this study is to analyze, at different regional and temporal scales, the degree of coherence between tide gauge and altimetry observations in Indonesia seas

DATA

- Wlgh Jdxjh Gdwd
- Dowlp hwu| gdwd +Mdvrq 4 / JIR / Hqylvdw,

DATA

- Wlgh Jdxjh Gdwd +JORW QHWZ RUN,

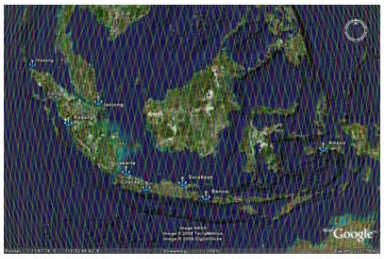
Name	Latitude	Longitude	Time period of comparison
Sabang	05.50 N	095.20 E	1/1/2007 – 31/1/2007
Sibolga	01.45 N	098.46 E	1/1/2007 – 31/1/2007
Padang	00.57 S	100.22 E	1/1/2007 – 31/1/2007
Jakarta	06.07 S	106.51 E	1/1/2003 – 31/1/2003
Surabaya	07.13 S	112.44 E	1/1/2003 – 31/1/2003
Benoa	08.45 S	115.13 E	1/1/2007 – 31/1/2007
Ambon	03.41 S	128.11 E	1/1/2003 – 31/1/2003
Cilacap	07.45 S	109.01 E	1/1/2007 – 31/1/2007
Tanjung Pagar	01.16 N	103.51 E	1/1/2007 – 31/1/2007
Cocos	12.07 S	096.54 E	1/1/2007 – 31/1/2007

DATA

Altimetry data, Due to various data of altimetry, we use two type data of altimetry, there are

- Grided data, produced by CLS. This data is produced by combining three altimetry satellites, there are Jason-1, Geosat Follow On (GFO) and Envisat. Time interval for grided data is every day.
- Along track Jason data. A standard correction has been applied to this data with time interval is every ~10 days (9.9156 days exactly).

DATA

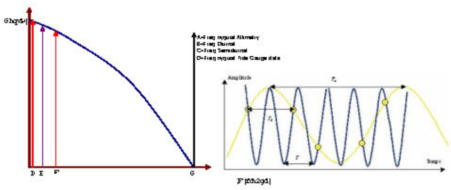


Indonesia seas overlay with Jason,GFO,Envisat theoretical track (Red=Jason 1, Green= Envisat, Yellow=GFO)

METHODS

- **Filtering/Detidal**

Due to aliasing problem



METHODS

•Filtering/Detidal

In this study we use The Demerliac filter [Bessero, 1985] to remove the tidal energy at diurnal and higher frequencies (semi-diurnal, quarter-diurnal) from sea level elevations filter prevents the user from using the Fourier transform of the time series in the frequency domain to retrieve non desired frequencies and to compute the new inverse Fourier transform.

Fourier transform can select the tide components to be remove but in practical cases it is to complex to set (because of holes in the tie signal, random values, high peaks in data...). The whole computations are made in the time domain which is faster and better to handle gap in time series data. The Demerliac requires 72 data (generally hours but not essential).

METHODS

•Filtering/Detidal

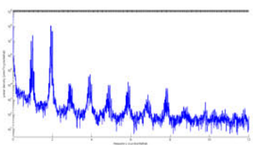
The formula of the Demerliac method is:

$$a(-k) = a(k)$$

Where k is

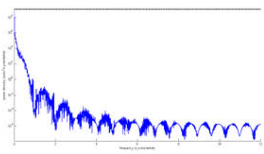
768	766	762	752	738	726	704	678	658	624	586	558	512	465	435	392	351	325
288	253	231	200	171	153	128	106	91	72	55	45	32	21	15	8	3	1

METHODS



← Tide gauge data

Tide gauge data after demerliac filter was applied →



METHODS

Grided Data From 3 satellites, GFO, JASON and ENVISAT.

The main characteristics of the processing combining different satellite measurements are divided in two main steps:

- The orbit error correction scheme is based on a global minimization of the crossover differences between TOPEX and ERS-2 (Le Traon, Gaspar et al. 1995)
- The mapping technique has been specifically devised to take into account the unusual structure of the altimetric measurement errors, and in particular of the residual orbit error (Le Traon and Ogor 1998).

METHODS

Along Track Data from Jason

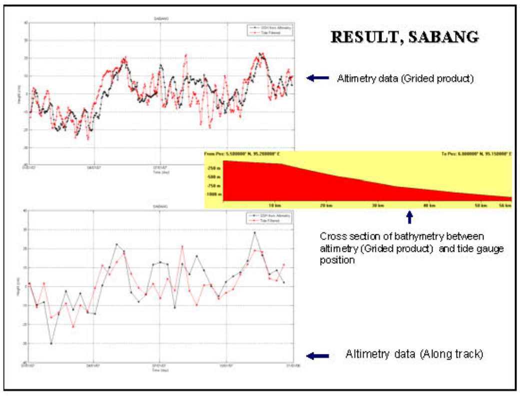
- All along track data product has been corrected by standard corrections by AVISO project. Otherwise the data still have track inconsistency. We have to make a further process to put the entire track on the same track (nominal track) . Cubic spline method has been applied in order to reposition all tracks to the same position and geophysical correction was applied (cross track gradient were corrected by the means of the geoid).
- The problem is to compare Jason data with in situ tide gauges which are not under Jason tracks. This is the reason why a specific model approach was performed. The solution was to propagate in-situ measurements toward the satellite tracks by the use of specific algorithms
- The data was taken from cycle 183 until cycle 220 (period 2007) and cycle 36 to cycle 73 (period 2003)

RESULTS

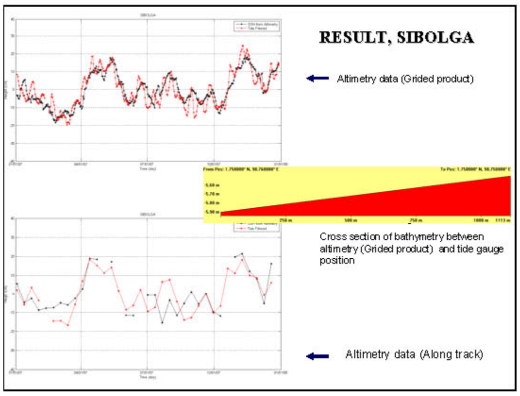
Product		Sabang	Sibolga	Padang	Cilacap	Benoa	Cocos
Grided Product (CLS)	Correlation	72%	84%	63%	93%	87%	97%
Along Track	Correlation	71%	76%	64%	93%	54%	96%

Product		Surabaya	Jakarta	T.Pagar	Ambon
Grided Product (CLS)	Correlation	31%	32%	81%	41%
Along Track	Correlation	Too many gap	39% Too many gap	75%	26 Too many gap

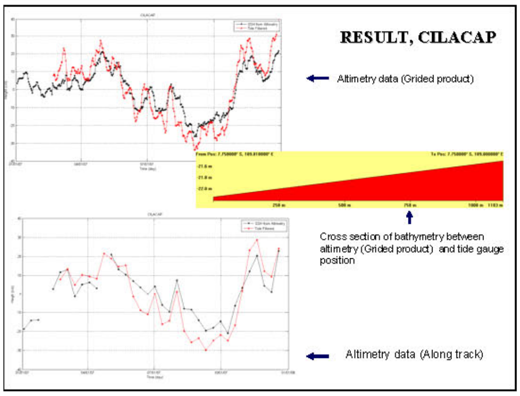
RESULT, SABANG



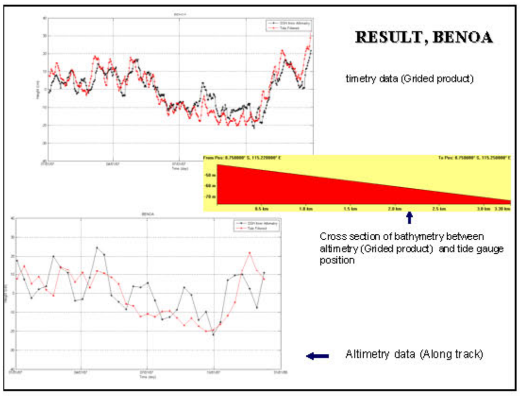
RESULT, SIBOLGA



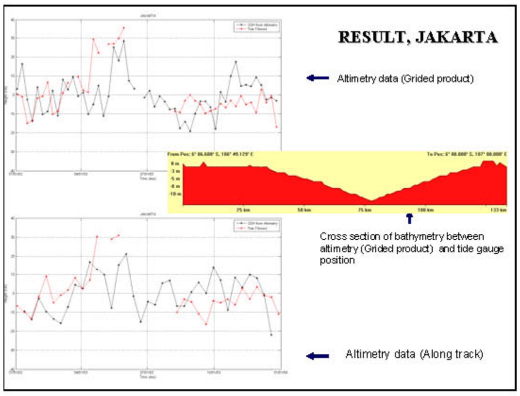
RESULT, CILACAP



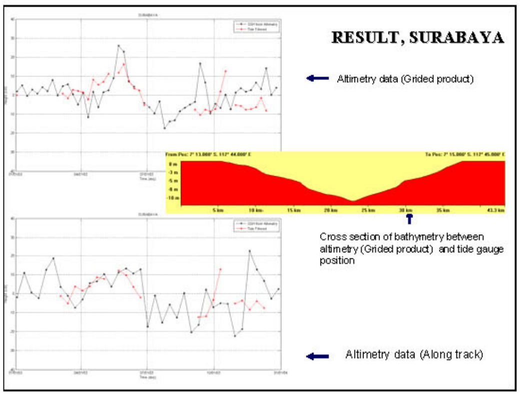
RESULT, BENOA



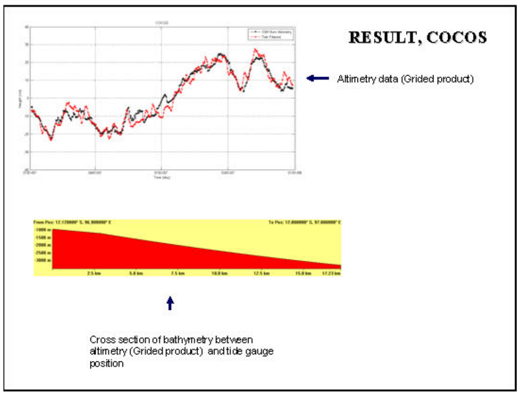
RESULT, JAKARTA



RESULT, SURABAYA



RESULT, COCOS



DISCUSSION

Indian Ocean

- There are 5 tide gauge stations located in the Indian Ocean. Almost all locations gave a good agreement between tide gauges and altimetric sea level anomalies data, mostly they gave correlation value > 70%. If we see from cross section condition the location of those data at open ocean and although they at coastal area they have deep bathymetry.

DISCUSSION

Java Sea

- The characteristics of Java Sea are closed sea, shallow depth and narrow area. Unfortunately because of access data problem, we only have 3 stations in this section. As mention before, all the data in this section have many gaps, it makes analysis difficult to do. Nevertheless by using existing data, we found bad agreement between tide gauges and altimetric sea level anomalies data, it is shown by correlation value (<50%). Although we have to remind again, we can not just rely to this result because of the data and stations availability is limited. Further analysis can be done if we have more data and stations..

DISCUSSION

- A problem with coastal tide gauge is about the computation of the Mean Sea Surface in shallow waters and especially in coastal areas. The MSS is computed with gravitational and altimetry remote sensing measurements which are not accurate at the interface between the oceanic floor and the continental earth. This is the reason why we can not present rms differentiation because we are not computed specific coastal MSS for each coastal tide gauge which are involved in the study.

CONCLUSION

- Altimetry against tide gauge data give a good correlation (>75%) for several positions, mostly at Indian Ocean (open seas). It shows that we can use altimetry data for the study of sea level in blank areas (no tide gauges are available) Otherwise, weak agreement between two data is shown with low correlation value, mostly at closed and shallow seas.
- Comprehensive analysis can not be done for whole Indonesian seas because of insufficiently tide gauge data. Complete data is needed for this study to give better analysis
- The operational geophysical models used to correct the effects of tide and atmospheric high frequency forcing are not adapted to the coastal physics and introduce important errors
- The altimetric data processing used in this study improves the accuracy of altimetric data near the coasts.
- Developing and maintaining ea tide gauge network within the Indonesian waters is of crucial importance to monitor the sea level in real time but also to develop and enhance tide numerical model in such waters.

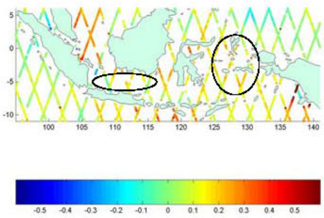
Z KDW Z H KDYH WR GR QH[W

- SLV= $H - \rho - \varepsilon$

$$\varepsilon = \varepsilon^{io} + \varepsilon^{tro(wet)} + \varepsilon^{tro(dry)} + \varepsilon_{SSB} + \varepsilon^{ot} + \varepsilon^{et} + \varepsilon^{pt} + \varepsilon^{iB} + \varepsilon^{L} + \ldots$$

  We need further enhancement in order to use altimetry data coastal area. Since the factor that we take it into account for this study is tidal, so we can assume one of the problem for the difference between them is because of tidal correction for altimetry data. As we said before, removing tidal signal from altimetry data is by using tidal model then among other geophysical correction in altimetry data, Improving tidal model is a best way to obtain good altimetry data at Indonesian seas → large variations of tidal regime and strong tides in some parts
- Further analysis will be carried out to assess the relationship between the sea level observations and climate variables due to atmospheric correction.

VHD OHYHO DQRPDO\ /WUDFN 4<<:



ACKNOWLEDGMENT

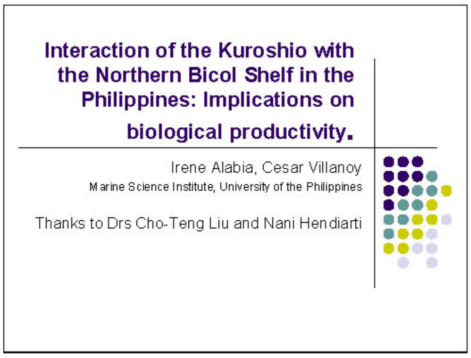
˘ XQHVFR / VHD OHYHO IHOORZ VKLS SURJUDPH
˘ FOV/DYIVR / IUDQFH

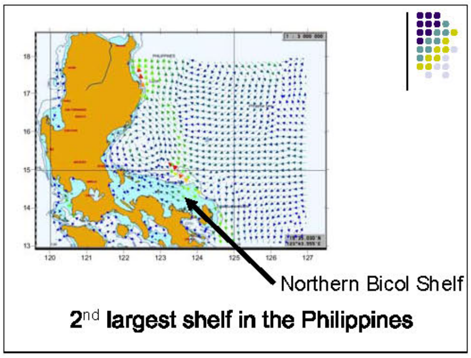
THANK \RX

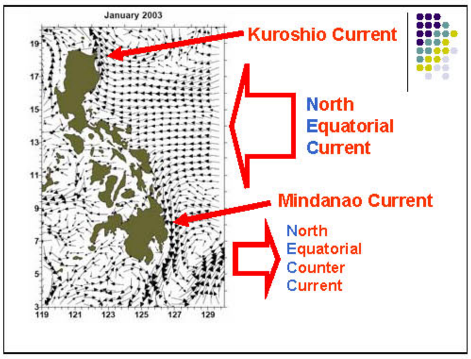
Interaction of the Kuroshio with the Northern Bicol Shelf in the Philippines: Implications on Iiological Productivity

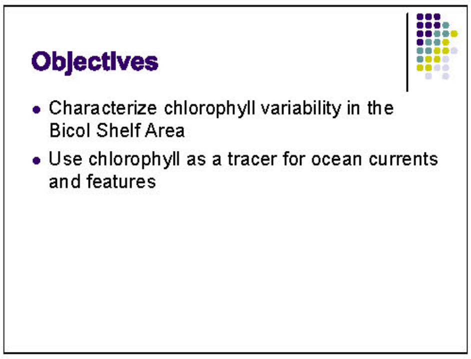
Irene Alabia, Cesar Villanoy

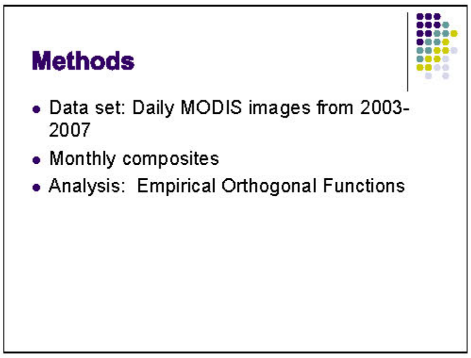
Marine Science Institute, University of the Philippines

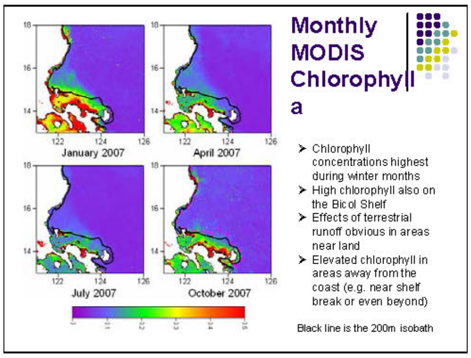


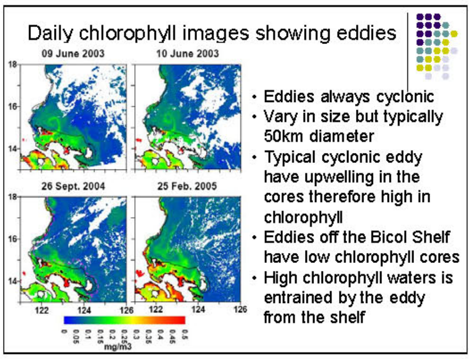


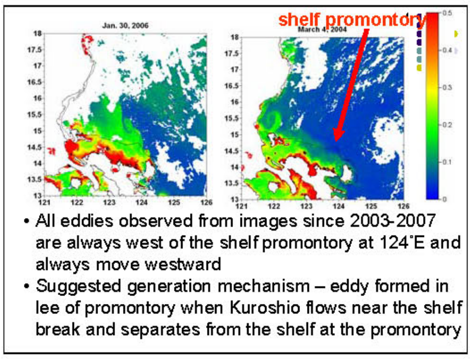




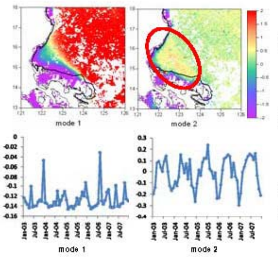








Empirical Orthogonal Function Analysis of Chlorophyll-a



Mode 1 (74% of variance)
- Accounts for the large chlorophyll difference between shelf and oligotrophic waters off the shelf

Mode 2 (5% of variance)
- Highlights high chlorophyll area northwest of the shelf (marked by red ellipse) west of promontory, particularly during summer
- This area represents area where all of eddies are found
- Does this also suggest that eddy activity is higher during summer? (difficult to say because of cloud cover poblems with images)
- Eddies is one mechanism of bringing highly productive shelf waters onto deep waters

Summary and Conclusions

- Chlorophyll distributions in the Northern Bicol Shelf show interesting mechanism interaction of Kuroshio with shelf.
- Promontory on shelf margin steers Kuroshio away from shelf, creating lee eddies which travel westward.
- Eddies are always cyclonic and have low chlorophyll cores.
- Chlorophyll margins of eddies probably entrained watter from the shelf – May be important mechanism for increasing productivity of waters northwest of shelf.

Acknowledgements

- Our deepest appreciation to Cho-Teng Liu and Nani Hendiarti for giving this presentation on our behalf
- Philippine Department of Science and Technology for funding support
- SAKE Project for scientific cooperation

Appendix I: Announcement of the 3rd APEC SAKE Workshop

Announcement

The 3rd APEC SAKE Workshop 2008

Satellite Data Processing and Applications for Marine Resources Inventory

Dates / Venue	:	**October 15-18, 2008, in Jakarta and Lombok, Indonesia.**
Workshop Goals	:	The 3rd APEC SAKE (Satellite Applications on Knowledge-based Economy) Workshop will be held in Jakarta, Indonesia. This scientific gathering will disseminate high resolution satellite data e.g. Formosat-2 application on marine resources, inventory and water pollution.
Agenda		
October 15-16	:	Workshop on capability and main applications of high resolution satellite data in the field of marine resources inventory, coastal management, coastal and marine pollution, and on marine oil spill investigation.
October 17-18	:	Field demonstration of SAKE training program using FORMOSAT-2 satellite data around Lombok coasts.
Important Dates		
October 5	:	Submission of Abstract (maximum 300 words) to contact persons.
October 10	:	Announcement of Workshop Program.
October 31	:	Submission of Extended Abstract. (Format of Extended Abstract will be e-mailed to participants)
Location	:	This workshop will be hosted in Jakarta. Following this workshop, there will be a field demonstration to Lombok as a unique place and study area for algorithm development using FORMOSAT for seaweed identification in Indonesia.
Participants	:	About 50 scientists are expected to attend this workshop from various Institutions and Universities, from Indonesia, Chinese Taipei, Philippines, Vietnam, Japan, France, Germany, and Australia.

Supported by :

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Appendix II: Agenda of the 3rd APEC SAKE Workshop

SAKE-3 Workshop and Field Demonstration

Tentative Agenda

I. The 3rd APEC SAKE Workshop on Satellite Data Processing and Applications for Marine Resources Inventory

Venue: Jakarta, Indonesia

Tuesday, 14 October 2008
Arrival of the Speakers **Welcome Dinner** hosted by BPPT **(18.30 – 20.30)**

Wednesday, 15 October 2008		
Opening Ceremony and Keynote Speech **(09.00 – 10.15)**		
1.	Report by Chairman of The 3rd APEC SAKE Workshop	Dr. Aryo Hanggono
2.	Remarks by Project Overseer	Dr. Y.F. Liang
3.	Introductory Remarks	Ir. Wahyu Indraningsih, MSc.
4.	Keynote Speech and Opening Ceremony	Dr. Jana T. Anggadiredja
Group Photo and Coffee Break		
Session 1 **(11.00 – 12.00)** **FORMOSAT Capability and Satellite Data Processing** **Chairman: Mr. Taufik Dwi Ferindra** ▪ Remote Sensing of Coral Depth, Cho-Teng Liu and Chung-Chen Liu ▪ Applications of Remote Sensing and GIS in Studying Coastal Zone and Sea Water in the Sout h of Vietnam, Nguyen Thanh Minh, Lam Dao Nguyen		
Lunch **(12.00 – 13.30)**		

Session 2
(13.30 – 14.50)

Application of High Resolution Satellite Data for Marine Resources Inventory

Chairman: Dr. M. Sadly

- Application of FORMOSAT-2 Multispectral Imagery for Habitat Mapping in Congkak and Lebar Reefs, Seribu Islands (Vincentius P Siregar, Syamsul B Agus, and Nani Hendiarti)
- Use of satellite data for mangrove study in Gili Sulat-Gili Lawang, East Lombok (Frida Sidik)
- Preliminary Study on Formulation of New Algorithm for Seaweed Identification in Indonesia (Indra Pratama)

Coffee Break
(14.50 – 15.15)

Session 3
(15.15 – 16.15)

Application for Coastal Management

Chairman: Mr. Berny A. Subki

- Application of Remote sensing Techniques in Marine Sciences - Potential realistic utilities in Vietnam (Tong Phuoc Hoang Son)
- Analysis on coastline change using Landsat and Formosat images. Case study in Kabupaten Pandegelang, Banten Province (Afiat Anugrahadi & Vivien Anjarsari)
- Paper reserved by Dr. Indra Jaya

Dinner for the speakers hosted by KLH
(18.30 – 20.30)

Thursday, 16 October 2008

Session 4
(09.00 – 10.15)

Applications for Monitoring of Water Pollution

Chairman: Prof. Chi-Farn Chen

- Sea Surface Anomaly Detection Using Optical Satellite Images (Chi-Farn Chen and Li-Yu Chang)
- Water Pollution from Oil Spill on Marine and Coastal Environment in Indonesia (Beny Bastiawan)
- Joint Research on Application of Remote Sensing Technology for Oil Spill Monitoring. Case Study: Kepulauan Seribu, Indonesia (Marina CG Frederik, et al)

Coffee Break
(10.15 – 10.50)

Session 5
(10.50 – 12.00)

Applications for Observing Coastal and Ocean Phenomena **Chairman: Dr. Nani Hendiarti** ▪ Seasonal Variability of Sea Surface Chlorophyll-a and Their Impact on the Marine Productivity in the Coastal Area of South Kalimantan (Suhendar I Sachoemar, et al) ▪ Local Comparison of sea level observation by using Altimetry and Tide Gauges In Indonesia Seas (Asmi Napitu) ▪ Interaction of the Kuroshio with the northern Bicol Shelf in the Philippines: Implications on biological productivity (Irene Alabia and Cesar Villanoy)
Panel Discussion **Chairman: Dr. Yusuf Surachman**
Lunch **(12.00 – 13.15)**

II. Training Workshop on satellite application validation

Venue: Jakarta, Indonesia

Thursday, 16 October 2008
Lecture and Discussion **(13.30 – 15.15)** **Chairman: Prof. Cho-Teng Liu** ▪ Discussion on future collaboration on seaweed and oil spill applications and other possibility studies ▪ Briefings by experts from Taiwan and Indonesia on Goal/method/schedule of Field Demonstration ✓ V-fin for Under Water Photograph Illustration for Assembling (Cho-Teng Liu) ▪ Discussion and Update the Plan of Field Demonstration
Coffee Break **(15.15 – 15.30)**