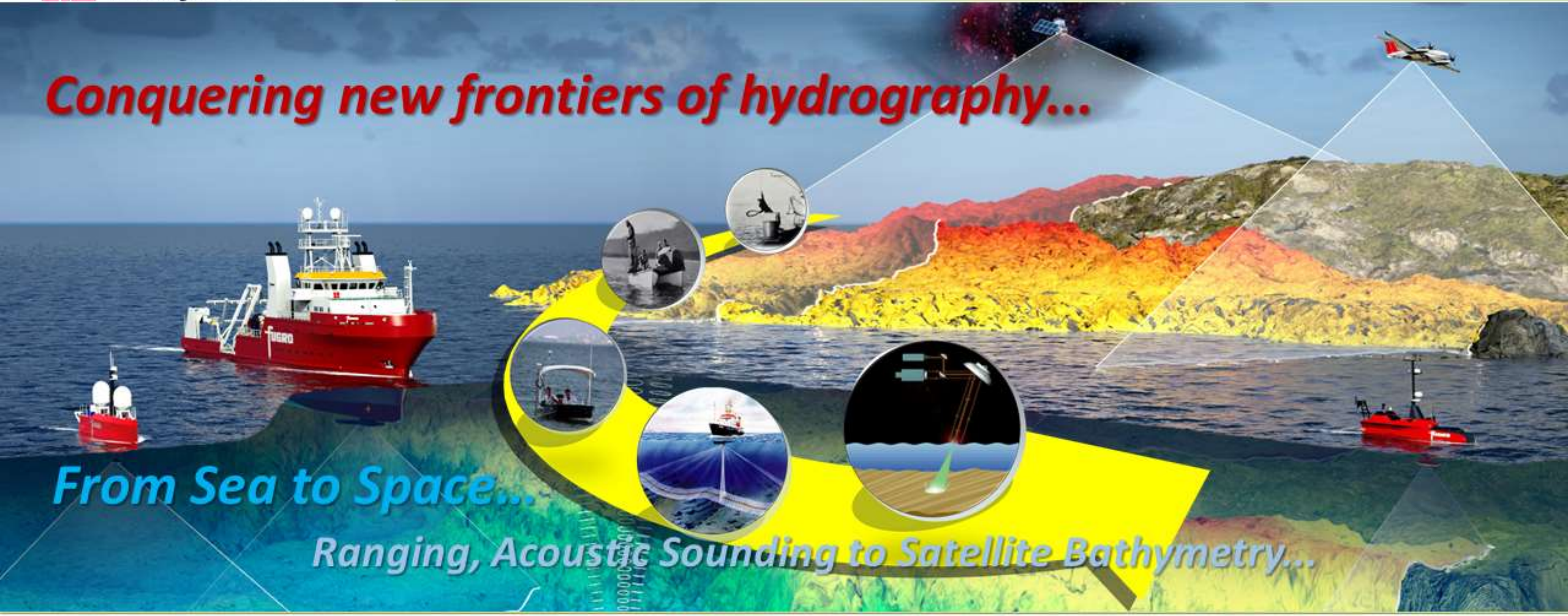
CHALLENGES OF NEARSHORE BATHYMETRIC MAPPING USING SATELLITE DERIVED BATHYMETRY IN MALAYSIA (12045)

Mohd Razali MAHMUD & Kelvin Kang Wee TANG (Malaysia)

RAPID DEVELOPMENT IN COASTAL ZONE

LAND
Total land area of Malaysia
329,758 km²
WATER
Total water area of Malaysia
569,845 km²
15.9%
Marine jurisdictions of Malaysia have been surveyed by SBES
(90,653.41 km²)
As per 2020
61.8% Marine jurisdictions of Malaysia have been surveyed. 38.2% remains uncharted.
45.9%
Marine jurisdictions of Malaysia have been surveyed by MBES
(262,035.85 km²)
COASTLINE
Total length of coastlines in Malaysia
6,036.7 km
ISLANDS
Total Islands in Malaysia
883


Conquering new frontiers of hydrography...
From Sea to Space...
Ranging, Acoustic Sounding to Satellite Bathymetry...

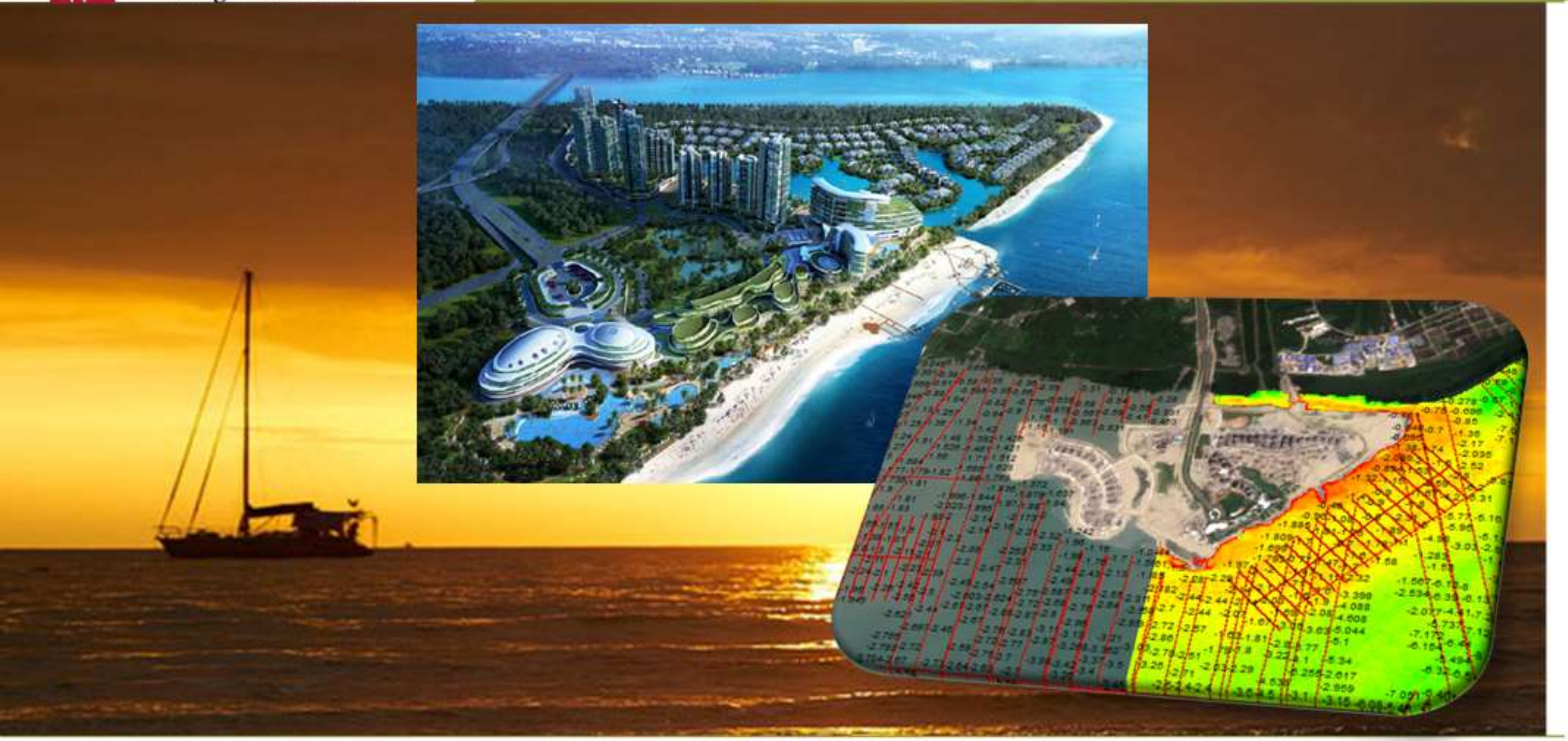
Coastal Reclamation Projects in Malaysia

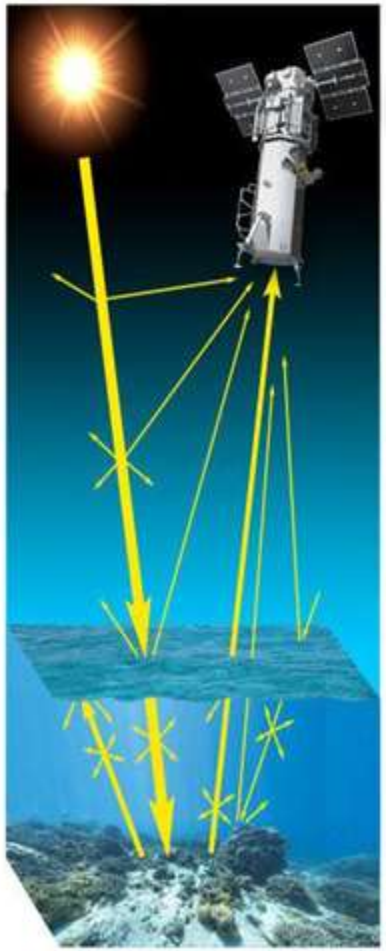
State	Completed Project Locations	Artificial islands projects (stage of project x number of islands)
Kedah	Entire coast Pulau Bunting, Daerah Yan	
Penang	Tanjung Tokong Bayan Lepas	Tanjung Tokong (underway x 2) Permatang DamarLaut (proposed x 3)
Perak	Lekir Coastal Development, Pulau Pangkor, Daerah Manjung Perak Heavy Industries Park (PHIP), Bagan Datoh Teluk Muroh Bagan Datoh	Teluk Muroh (completed x 1) Marina Island, Pangkor (completed x 1) Lukut (proposed x 1)
Selangor	Port expansion at Westport, Pulau Indah Kelang	
Negeri Sembilan	Entire coast	
Melaka	Pantai Kundur Malacca City Pulau Panjang, Daerah Melaka Tengah	Malacca City (completed x 2) Off Melaka (proposed x 3)
Johor	Southern International Gateway Project and Tanjung Puteri Lido Boulevard, Johor Bahru Independent Deepwater Petroleum Terminal, Pengerang Mersing Laguna Phase III dredging and reclamation works at Pelabuhan Tanjung Pelepas Marine and Riverine Facilities on Lot PTD 504 and Lot 1668, Sungai Batu Pahat Integrated Hub and Maritime Industrial Park, Tg Piai R&F Tanjung Puteri Lot PTD 220207 and Par of Lots PTD 194792, PTD 194794 - PTD 194797, Mukim Plentong, Johor Bahru	Forest City Island Reclamation and Mixed Development (underway x 4)
Kelantan	Jetty and industrial zone construction, Tumpat	
Sabah	Kudat	Kudat (completed x 1)
Federal Territory of Labuan	Integrated Port, Ranca-Ranca Oil and gas industrial base, Kg Ranca-Ranca	

Source: Department of Environment (DOE), Malaysia.

Seamless mapping

From Mount Kinabalu & Mount Tahan to the edge of the continental shelf.





01. SEAFLOOR MORPHOLOGY

Malaysia's nearshore areas can be quite complex, features with sandbanks, reefs, rocky headland, muddy and swampy shoreface as well as submerged vegetation. Those features can affect the accuracy of SDB due to the scatter, refraction and reflection effects, which leads to inaccurate depth measurements.

02. CLOUD COVER

Malaysia experiences a significant amount of cloud cover due to its location in the tropical region, which can hinder the collection of satellite imagery required for SDB.

03. WATER TURBIDITY

The presence of micro-organisms and suspended sediment in the water can affect the attenuation of spectral signals, leading to false depth measurements

04. GROUND TRUTH DATA

Most of the derivation models are highly dependent on the availability of precise and accurate ground truth data, which can be limited in the ultra-shallow and remote areas, making it challenging to validate the SDB outputs.

05. WATER PROPERTIES

The variability in water properties, such as salinity and temperature can affect the accuracy of SDB, and these water properties can vary across a single scene, making it difficult to obtain accurate derived depth measurements.

Geographically, Malaysia is known as a maritime country with a approximately coastline length of 4,809 kilometres. These coastal belts varies from scenic bays flanked by rocky headlands to shallow mud flats lined with mangrove forests.

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On the east coast of Peninsular Malaysia, Sabah and Sarawak, the high sediment yield from river discharges and harsher wave environment create the setting for a coastline of hook-shaped sandy bays facing the South China Sea.

Meanwhile, on the west coast, the mild wave climate of the Strait of Malacca make for wide mud shores and coastal forests rich in biodiversity. Indeed, this swampy area is vegetated by lavish mangroves and the shoreface is fronted with turbid suspended sediment.

These morphology variations can affect the accuracy of SDB due to the scatter, refraction and reflection effects, which leads to inaccurate depth measurements.

SEAFLOOR MORPHOLOGY

Malaysia is formed by Peninsular Malaysia and East Malaysia (Sabah and Sarawak). And it lies close to the equator, is situated between latitudes of 1° to 7° N and longitudes of 100° to 119° E.

Generally, the coastal and shallow water along the 4,809 kilometres coastal belts off the mainland consists mainly fronted with three types of sediment types such as mud, sand and rock.

CLOUD COVER

Cloud cover is a critical factor in remote sensing mapping, as it can significantly affect the quality of satellite images and the accuracy of the resulting maps.

Clouds can obscure the Earth's surface, making it difficult to obtain clear images and identify land features, such as vegetation, water bodies, and urban areas.

Tropical regions are characterized by high levels of atmospheric moisture, which can lead to the formation of clouds and fog. This can result in persistent cloud cover, making it difficult to obtain cloud-free satellite imagery.

High revisit sensors and cloud-free satellite imagery are two important aspects of remote sensing that can help overcome the challenges posed by cloud cover.

For example, the Sentinel-2 & Landsat-8 satellites have a high revisit time of 5-16 days, which means multiple images of the same area can be captured every two weeks.

One approach to obtaining cloud-free satellite imagery is to use data from multiple sensors or platforms. Data fusion involves combining data from different sensors or modalities to create a more comprehensive picture of the Earth's surface.

Another approach is to use advanced cloud masking algorithms that are able to identify clouds and remove them from satellite images.

The presence of micro-organisms and suspended sediment in the water can affect the attenuation of spectral signals, leading to false depth measurements.

Water turbidity refers to the amount of suspended particles and organic matter in water that can cause the water to appear cloudy or opaque. These suspended particles can include sediment, algae, and other organic materials.

In particular, they can affect the amount of solar irradiance that penetrates the water column, causing scattering and absorption of solar irradiance that penetrates throughout the water column.

Hence, it also reduces the amount of light that reaches the bottom of the water column, resulting in donating false depth measurements in SDB Mapping.

The impacts of water turbidity on solar irradiance can be particularly pronounced in coastal regions and estuaries. In these regions, changes in land use or increased erosion can lead to increased levels of turbidity in the water

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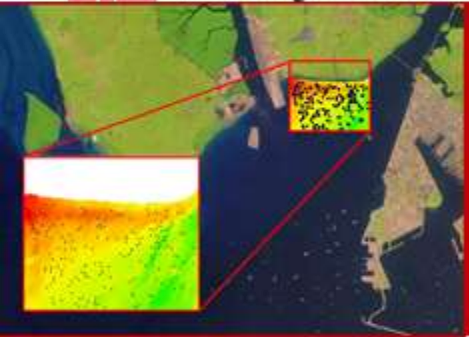
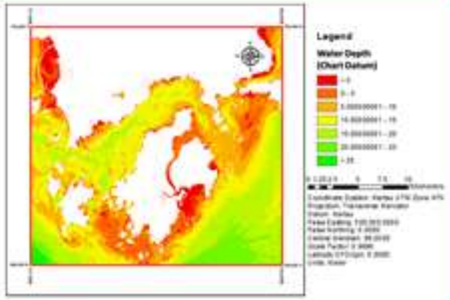


GROUND TRUTH DATA

Ground truthing is the process of collecting data on the ground to validate or supplement data obtained from remote sensing technologies such as satellite images.



In the context of SDB mapping, ground truthing data can help to improve the accuracy and reliability of the data by verifying or correcting the information obtained from remote sensing.

Most of the derivation models are highly dependent on the availability of precise and accurate ground truth data, which can be limited in the ultra-shallow and remote areas, making it challenging to validate the SDB outputs.

Ground truthing data can be collected using a variety of techniques, such as field surveys (e.g. GNSS, SBES, MBES, etc.). These data can then be compared to the derived depths obtained from satellite imagery to verify the accuracy of the bathymetric modelling. In the context of SDB, ground truthing data can help to improve the accuracy and reliability of the data by verifying or correcting the information obtained from multispectral imagery.

Overall, ground truthing data is an important component of SDB, as it helps to ensure the accuracy and reliability of the data obtained from remote sensing technologies. By combining remote sensing data with ground truthing data, SDB can provide a more complete and accurate picture of the Earth's surface and the resources it contains..

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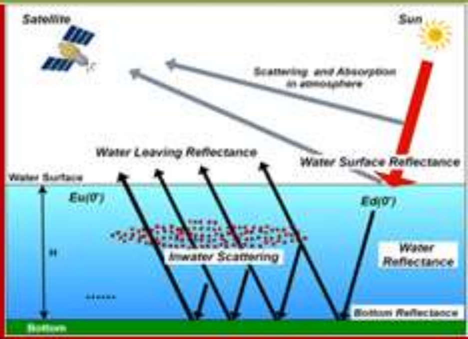
Variability in water properties, such as salinity and temperature, can affect the accuracy of SDB, especially in regards to derived depth measurements.

For example, the speed of sound in water, which is used to estimate water depth using acoustic sensors, is affected by changes in water temperature and salinity. As a result, variations in these properties can introduce errors into depth estimates obtained from acoustic sensors.

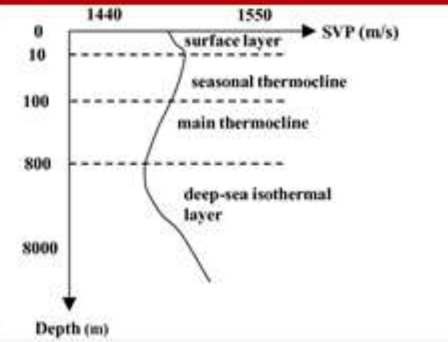
To address these challenges, it is important to take into account the variability in water properties when interpreting remote sensing data and developing SDB. This can involve using models that incorporate information on water temperature and salinity to correct for errors in depth measurements or to improve the accuracy of water quality parameter estimates.

WATER PROPERTIES



Variability in water properties, such as salinity and temperature, can affect the accuracy of SDB, especially in regards to derived depth measurements.

Understanding the variability in water properties and its impact on satellite remote sensing measurements is important for developing accurate and reliable SDB.



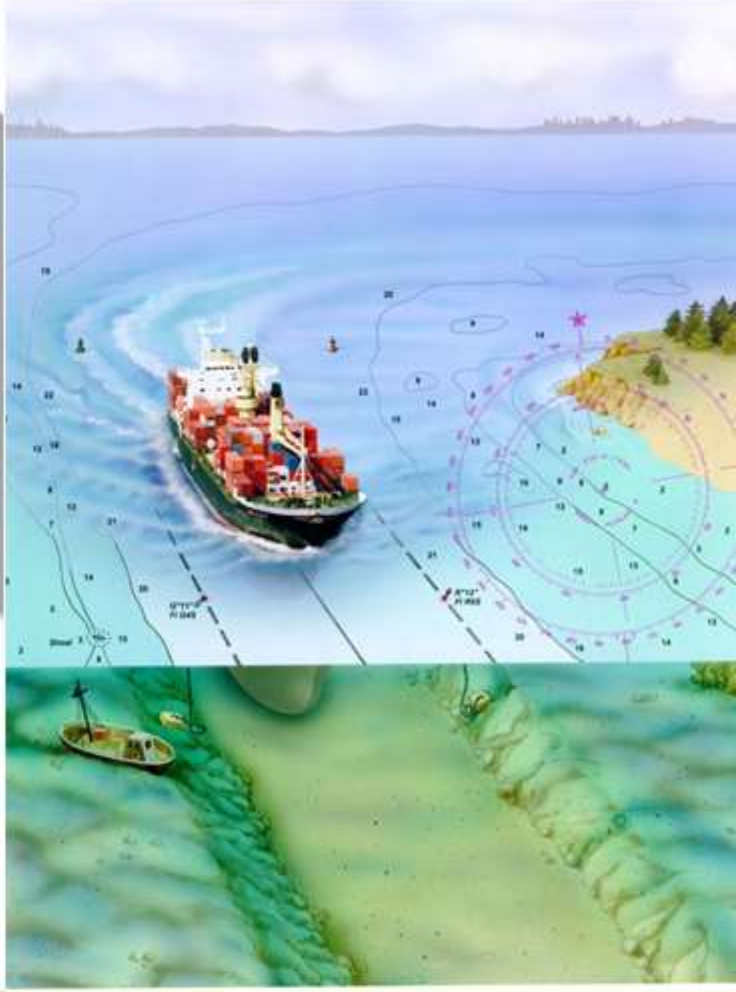
Concluding Remarks

Uncontrolled variation is the enemy of quality;

Understanding variation is the key to success in quality and business.

THANK YOU!

Q&A



THANK YOU

PROF. Sr DR. MOHD RAZALI MAHMUD
Ts. Sr DR. KELVIN TANG KANG WEE
GeoCoastal Research Unit (Gi2RG)
Faculty of Built Environment & Surveying
Universiti Teknologi Malaysia

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

In the Name of God for Mankind

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Mohd Razali Mahmud and **Kelvin Kang Wee Tang** (Malaysia)

razalimahmud@utm.my / tkkelvin@utm.my

GEOCOASTAL RESEARCH UNIT (GI2RG)

FACULTY OF BUILT ENVIRONMENT AND SURVEYING

UNIVERSITI TEKNOLOGI MALAYSIA