FIG WORKING WEEK 2019

22–26 April, Hanoi, Vietnam

"Geospatial Information for a Smarter Life and Environmental Resilience"

ORGANISED BY FIG

PLATINUM SPONSORS esri THE SCIENCE OF WHERE Trimble

Evaluates the possibility of shallow water bathymetry mapping using optical satellite imagery

Present contents

1. Introduction
2. Research methods
3. Data and test areas
4. Research results
5. Conclusion

1. Introduction

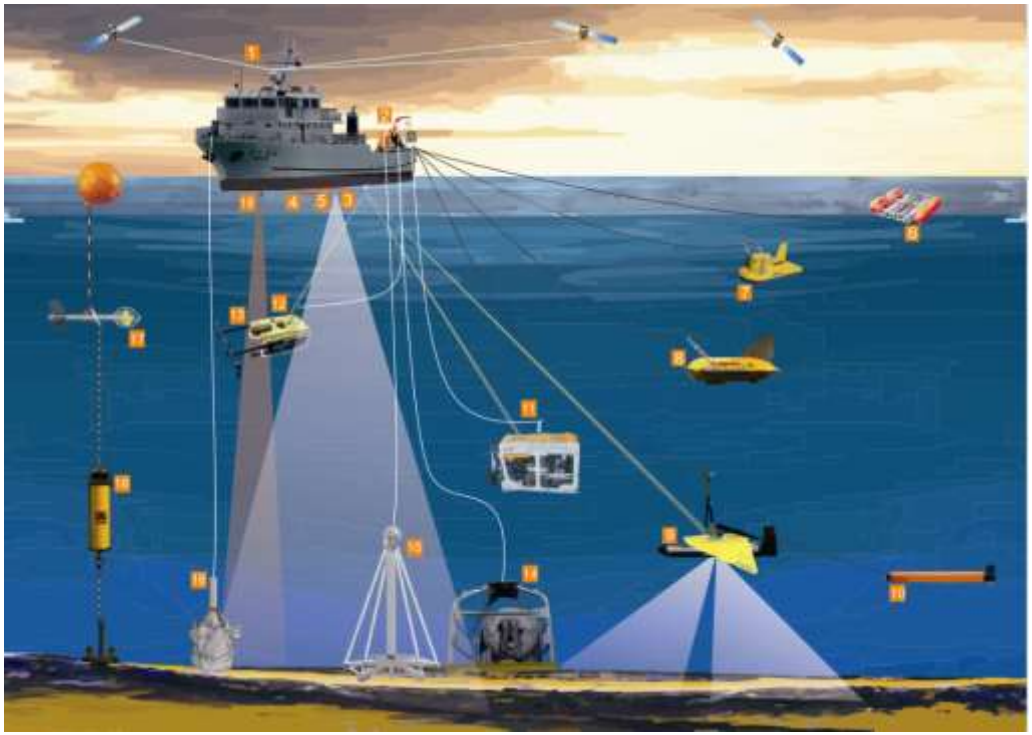
- Vietnam has an internal marine area of 4,200 km²
- Coastline length 3.444 km
- There are 3,000 large and small islands and two archipelagos of Hoang Sa and Truong Sa

1. Introduction

1. Updating information chart, serving maritime navigation, ensuring people's activities.
2. Ensuring topography for national defense and security activities: Operation of military protection on island, serving rescue and rescue at sea.
3. Serving the construction of island projects: creek, jetty, island protection embankment, military works ...
4. Ensuring information to study other factors along the island: Sea environment, hydrology …

1. Introduction

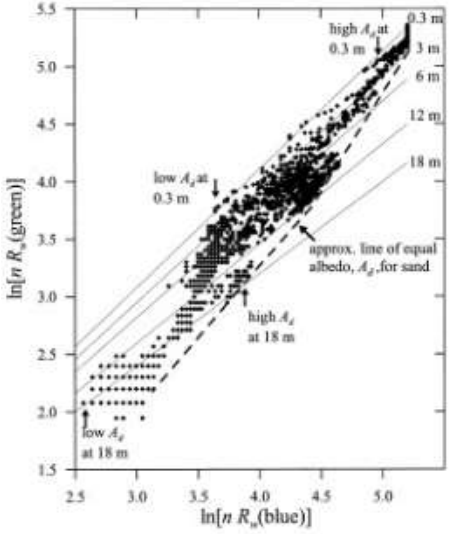
- Manual depths survey by plumb line and rod
- RS methods:
  + Acoustic RS
  + Side Scan Sonar
  + Bathymetry Lidar
  + Satellite Altimetry
  + Hyper spectral image
  + Multi spectral image



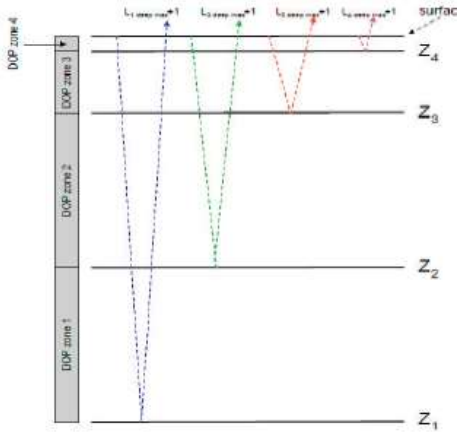
1. Introduction

Studies in the World of MS images determine depth

Liner band by David Lyzenga 1978, 1981, 1985, 2006



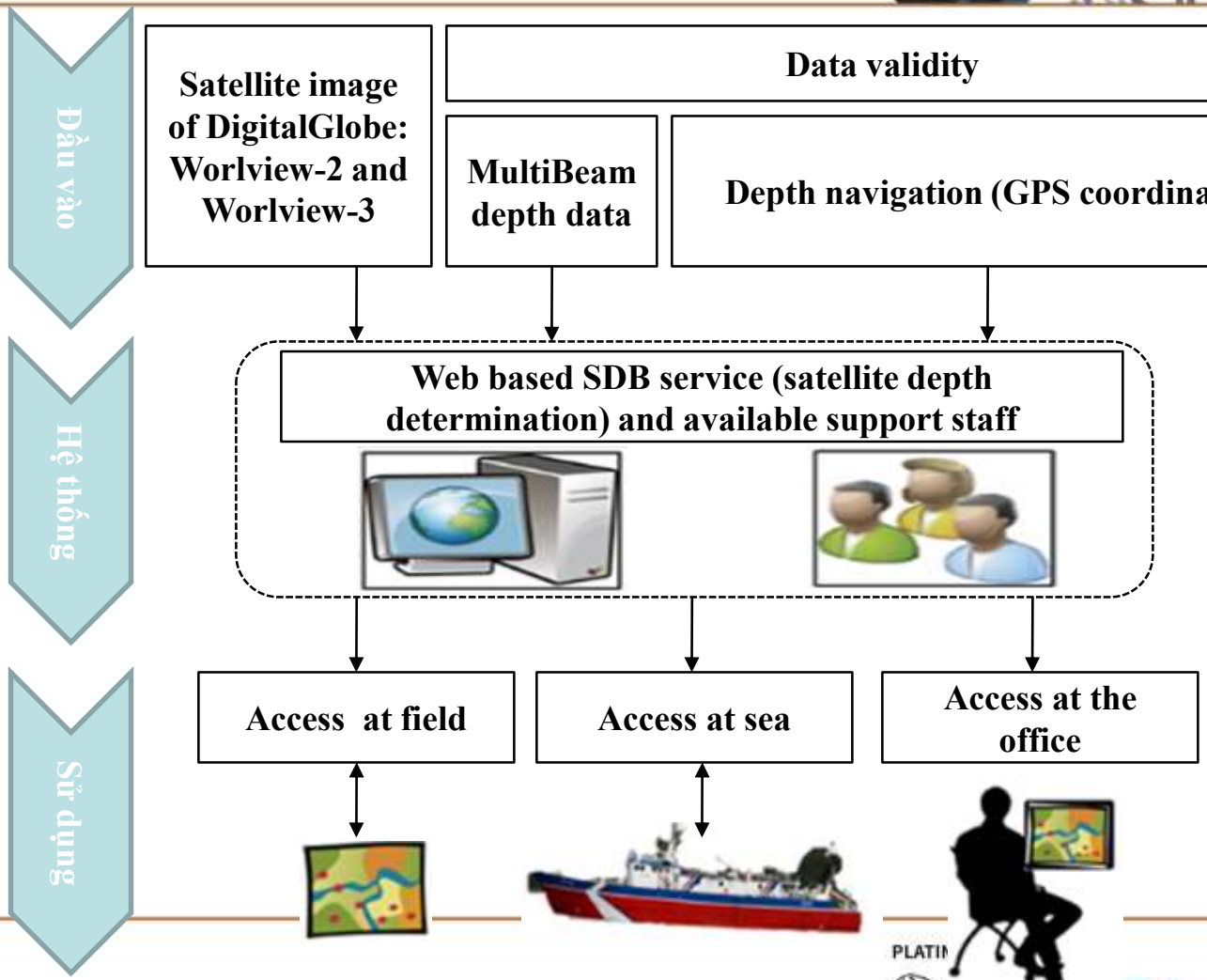
Liner ratio of Stumpf 2003



DOP of Jupp1989

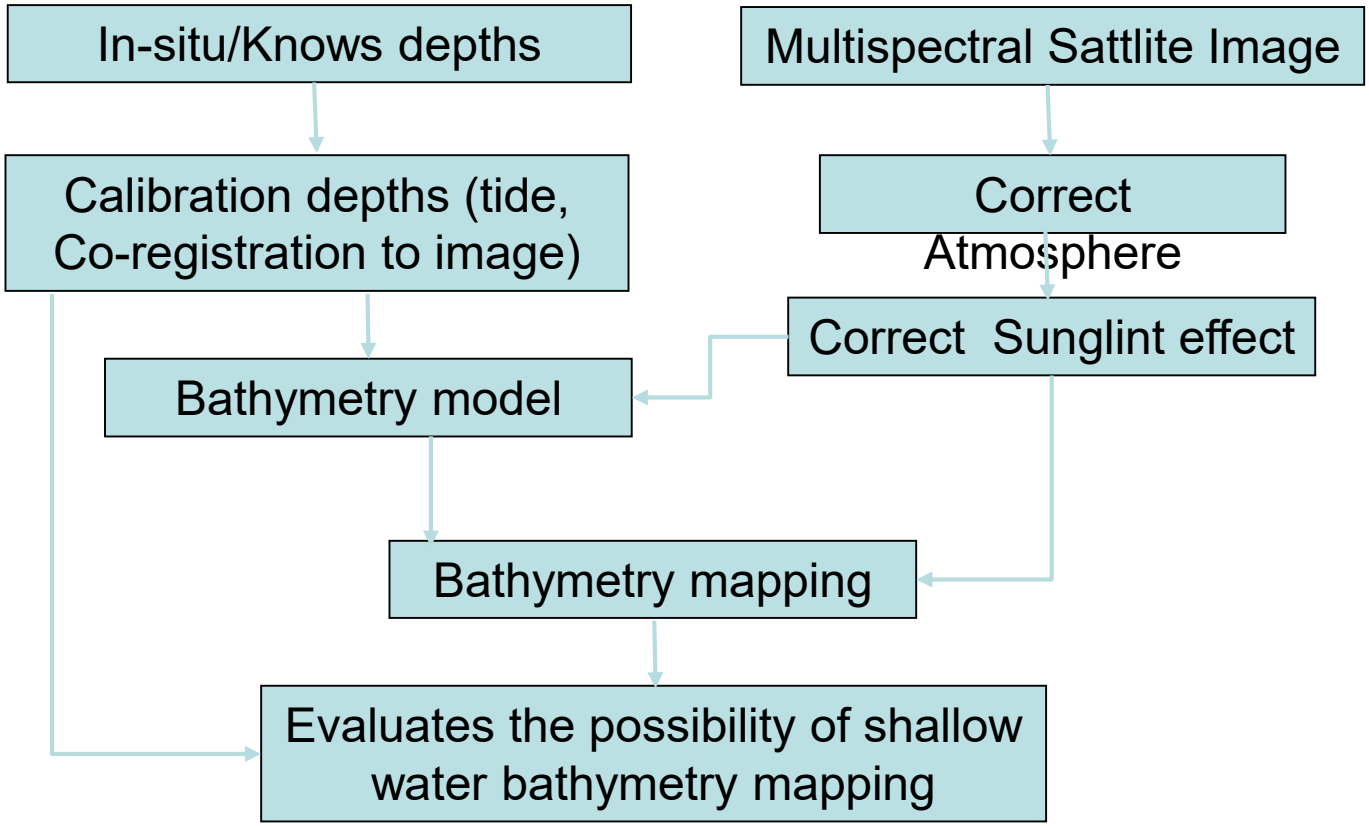
1. Introduction

Service of determining the depth of sea water from the international satellite system of the European space agency



2. PHƯƠNG PHÁP NGHIÊN CỨU

2. Research methods



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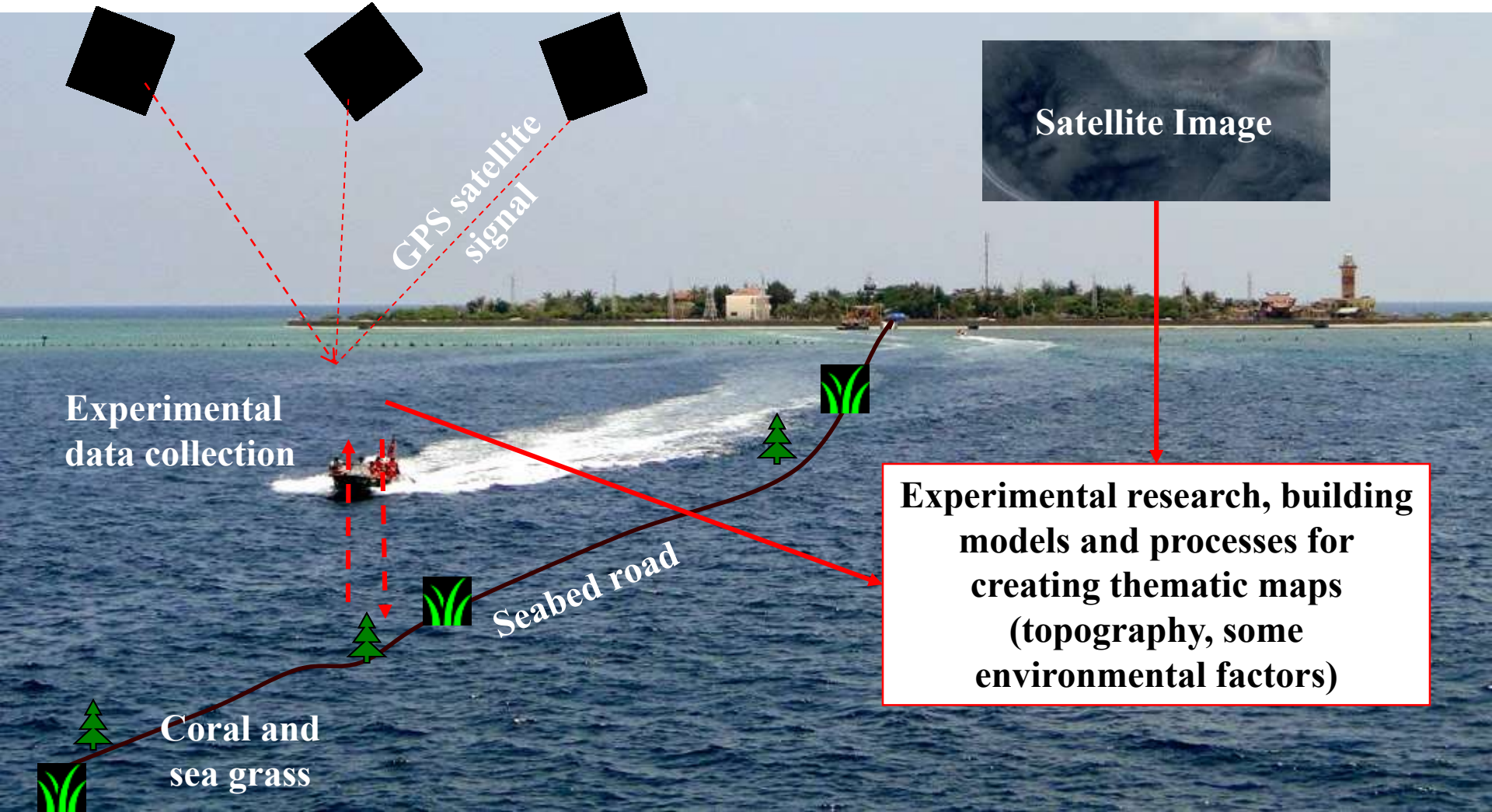
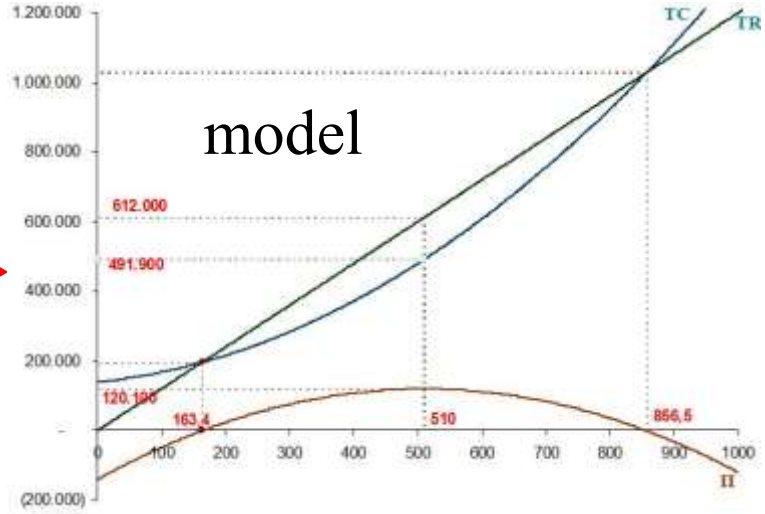
2. Research methods



2. PHƯƠNG PHÁP NGHIÊN CỨU

2. Research methods

RS methods



Model method

2. PHƯƠNG PHÁP NGHIÊN CỨU

2. Research methods

The relationship between radiation and water depth according to Austin (1974):

$$L(z) = L(0)\, e^{-2kz} = L_s + L_b e^{-\alpha z}$$

Where L_s is deep water radiance with deep-> ∞

L_b is the bottom reflector

α is light attenuation coefficient in water

2. PHƯƠNG PHÁP NGHIÊN CỨU

2. Research methods

$$\Rightarrow Z = \frac{1}{\alpha}\ln(L_b) - \frac{1}{\alpha}\ln(L_z - L_s) \quad \text{Where } L_z - L_\infty \geq 0$$

Lyzenga

$$Y_i = \sum_{j=1}^{N} A_{ij} X_j \quad \text{Where } X_j = \ln(L_{hj} - L_{\min sj})$$

$$\hat{h} = h_o - \sum_{j=1}^{N} h_j X_j$$

2. PHƯƠNG PHÁP NGHIÊN CỨU

2. Research methods

Evaluates the possibility of bathymetry mapping

Error of point position

$$\Delta_{position} = \sqrt{\Delta^2_{origin} + \Delta^2_s}$$

Where:

$$\Delta_s = \Delta X^2 + \Delta Y^2$$

$$\Delta_{origin} = 0{,}5 \text{ (mm)} * M$$

Error of depth

$$\Delta_Z = \sqrt{\Delta^2_{Z\_origin} + \Delta^2_z}$$

Where:

$$\Delta_z = Z(m) - z(m)$$

Δ_{Z_origin} = Contour Intervals/3

3. DỮ LIỆU & KHU VỰC NGHIÊN CỨU

3. Data and test areas

- Sentinel-2A satellite image 16/6/2016

- Control points data
+ Control points for Co-registration: 4
+ Position test points: 4
+ Depth control points build model: 25
+ Depth test points : 12

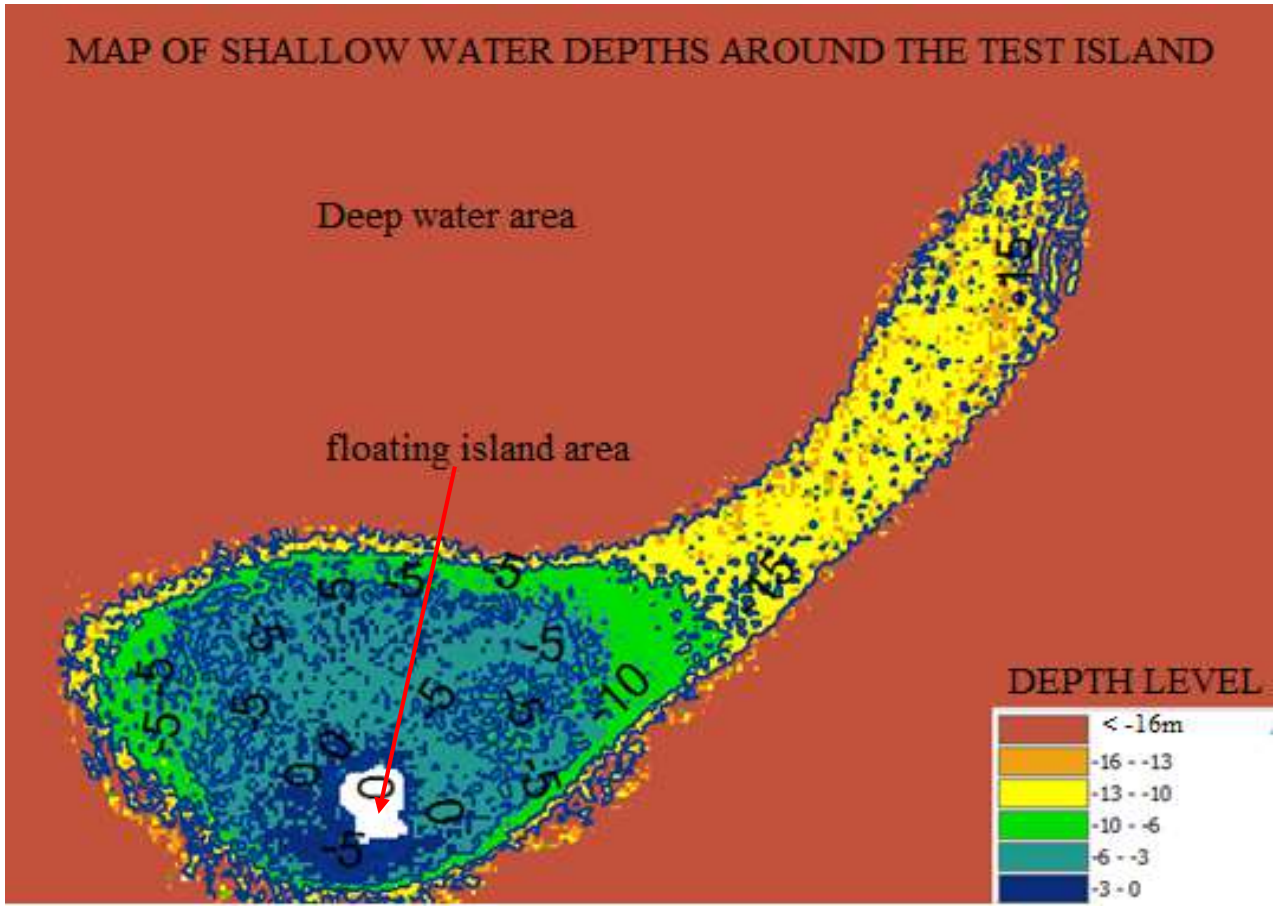
4. KẾT QUẢ NGHIÊN CỨU

4. Research results

$$\hat{h} = -16.39 * \ln(B2) + 17.26 * \ln(B3) - 0.13 * \ln(B4) - 9.47$$

Parameters	Multiple R	R Square	Adjusted R Square	RMSE
Value	0.94	0.89	0.88	0.99

4. Research results



4. Research results

TT	ΔX	ΔY	Δs	Δ_{origin}	$\Delta_{position}$	Noted
1	8.32	9.13	12.3523	1	12.392	Gain scale 1:25.000
2	8.19	10.24	13.1123	1	13.150	Gain scale 1:25.000
3	8.77	6.25	10.7691	1	10.815	Gain scale 1:25.000
4	14.1	13.6	19.5900	1	19.615	Gain scale 1:50.000

4. Research results

TT	Z	z	Δ_z	Δ_{z_origin}	Δ_Z	Noted
1	-0.5	-0.1	-0.4	0.33	0.518556	height between contours 5 m
2	-0.3	0.8	-1.1	0.33	1.148434	height between contours 5 m
3	-0.9	-1.6	0.7	0.33	0.773886	height between contours 5 m
4	-1.5	-0.9	-0.6	0.33	0.684763	height between contours 5 m
5	-3.2	-4.7	1.5	0.33	1.535871	height between contours 5 m
6	-4.7	-5.9	1.2	0.33	1.244548	height between contours 5 m
7	-5.5	-7.1	1.6	0.33	1.633677	height between contours 5 m
8	-6.9	-8.2	1.3	0.33	1.341231	height between contours 5 m
9	-9.6	-7.9	-1.7	0.33	1.731733	height between contours 10 m
10	-11.4	-9.1	-2.3	0.33	2.323553	height between contours 10 m
11	-13.6	-13.2	-0.4	0.33	0.518556	height between contours 5 m
12	-15.2	-14.6	-0.6	0.33	0.684763	height between contours 5 m

5. Conclusion

- Using Sentinel 2 images can establish a depth map with an average scale of 1: 25,000 -1: 50,000, 5m contour

- Accuracy of the map depends on many factors such as the input satellite image resolution, the interference effect in the image acquisition process, the control point precision and the calculation model...

-The research results have solved the set objectives, as a basis for step by step research into the shallow seabed topography mapping from satellite imagery.