ABAE
AGENCIA BOLIVARIANA PARA ACTIVIDADES ESPACIALES

SERVICIO DE HIDROGRAFÍA OCEANOGRAFÍA METEOROLOGÍA Y CARTOGRAFIADO NÁUTICO
ARMADA

SATELLITE DERIVED BATHYMETRY (SDB) FROM IMAGES OF THE SUCRE VRSS-2 SATELLITE

CMDR. DANIEL ROJAS CONTRERAS
MSC. IN HYDROGRAPHY
CAT B IN MARINE CARTOGRAPHY AND DATA PROCESING

Promoting the overall development of nations through the use of spatial data and applications.

SCHEDULE

- ✓ Introduction
- ✓ Impact Benefit Relationships
- ✓ Sucre VRSS-2 satellite characteristics
- ✓ Procedures
- ✓ Results Case Study
- ✓ Future Projects
- ✓ Conclusions



Bathymetry project derived from satellite images
Impact / Benefit

1. Determination of depths in non-hydrographed tourist areas;

2. Marine cartography for navigation in unmapped areas

1. Information management for the establishment of possible recreational boat ports or land facilities in support of tourist boats or tourist developments.

2. Knowledge of the marine environment to support governance management decisions;

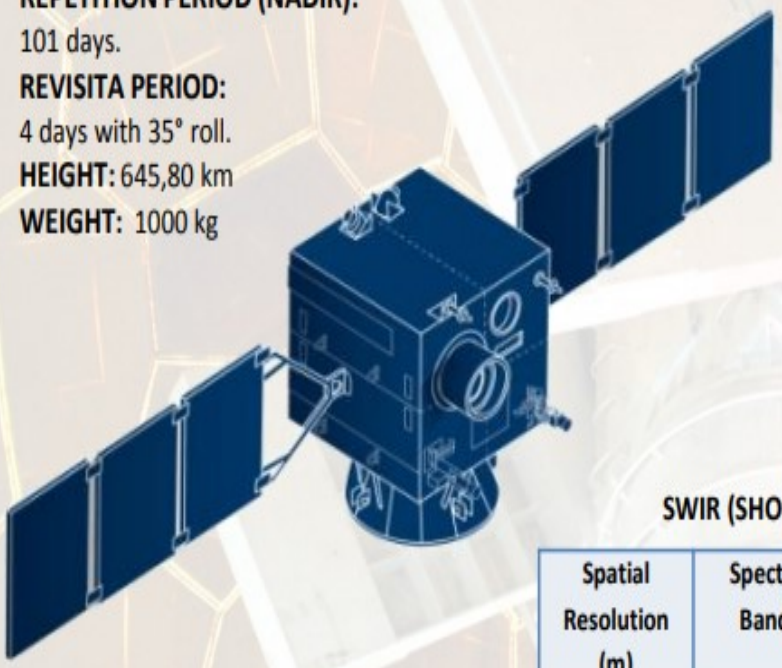
3. Greater coastal bathymetry, with complete and updated coverage;

VRSS-2

SATELLITE SUCRE

TECHNICAL ASPECTS

LOCAL TIME OF THE ASCENDING NODE:
10:30 am.
TYPE OF ORBIT:
Sun Synchronous.
REPETITION PERIOD (NADIR):
101 days.
REVISITA PERIOD:
4 days with 35° roll.
HEIGHT: 645,80 km
WEIGHT: 1000 kg



HRC SENSOR

(High Resolution Camera)
Radiometric Resolution: 10 bits
Sweeping Width: 30 km

Spatial Resolution (m)	Spectral Bands	Spectral Ranges (nm)
1	PAN	500 – 800
3	MSS 1	450 – 520
3	MSS 2	520 – 590
3	MSS 3	630 – 690
3	MSS 4	770 – 890

IRC SENSOR

(Infra Red Camera)
Radiometric Resolution: 12 bits
Sweeping Widht: 30 km

SWIR (SHORT WAVE INFRARED)

Spatial Resolution (m)	Spectral Bands	Spectral Ranges (nm)
30	1	900 – 1100
30	2	1180 – 1300
30	3	1550 – 1700

LWIR (LONG WAVE INFRARED)

Spatial Resolution (m)	Spectral Bands	Spectral Ranges (nm)
60	1	10300 – 11300
60	2	11500 – 12500

IMPORTANT STEPS IN THE SATELLITE BYPASS PROCEDURE INCLUDE:

- PRETREATMENT
- WATER SEPARATION
- SPATIAL FILTERING
- APPLICATION OF THE BATHYMETRY ALGORITHM
- IDENTIFICATION OF THE EXTINCTION DEPTH
- VERTICAL GEOREFERENCING

Optimization approach that assumes the vertically invariant water column. A subcategory of this is a relationship approach that derives bathymetry based on the log relationship (or record relationship) of two bands.

Note:

For an algorithm that can be used by the hydrographic community in GIS software, a relationship transformation algorithm based on an optimization approach provides a robust solution that does not require sampling the environment. However, this proposal allows the capture of data in the field through two methods for greater precision of the results.

PENETRATION OF LIGHT.
OCEANIC WATER

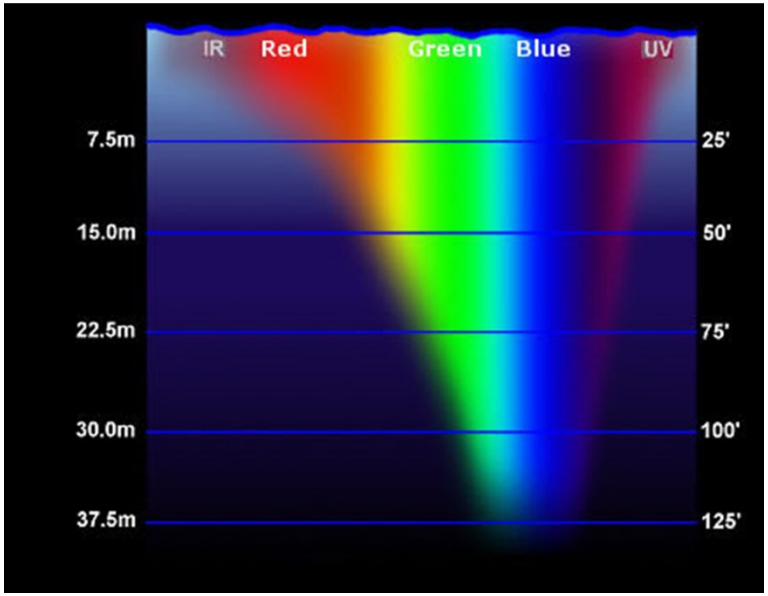
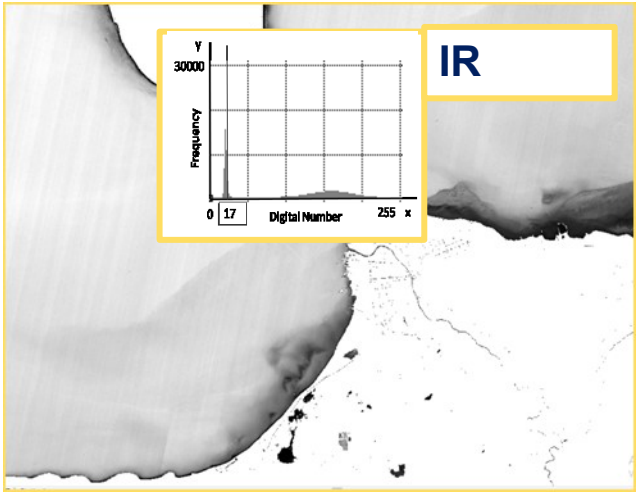
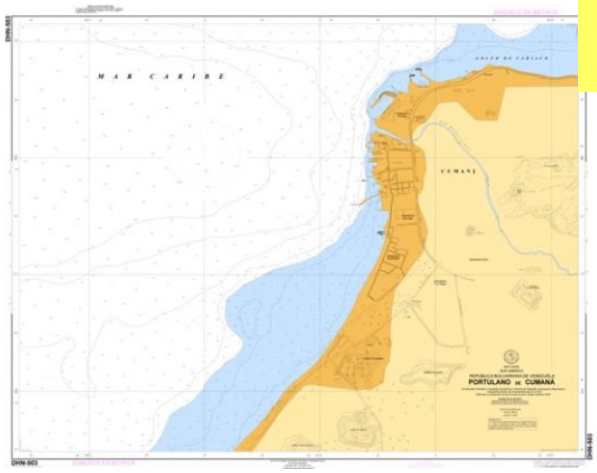


Image Analysis Process

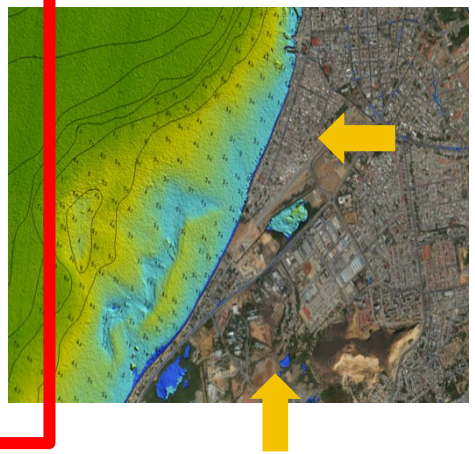
Identify land / water

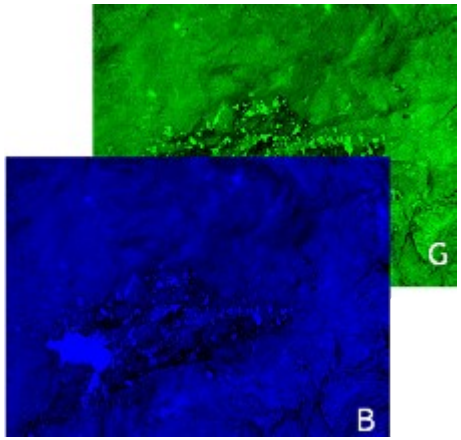




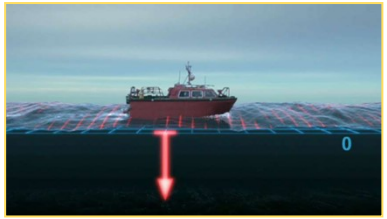
SATELLITE DERIVED BATHYMETRY

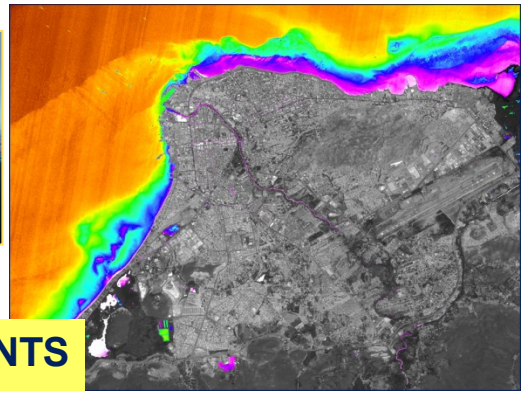
Georeferencing to hydrographic zero





GREEN



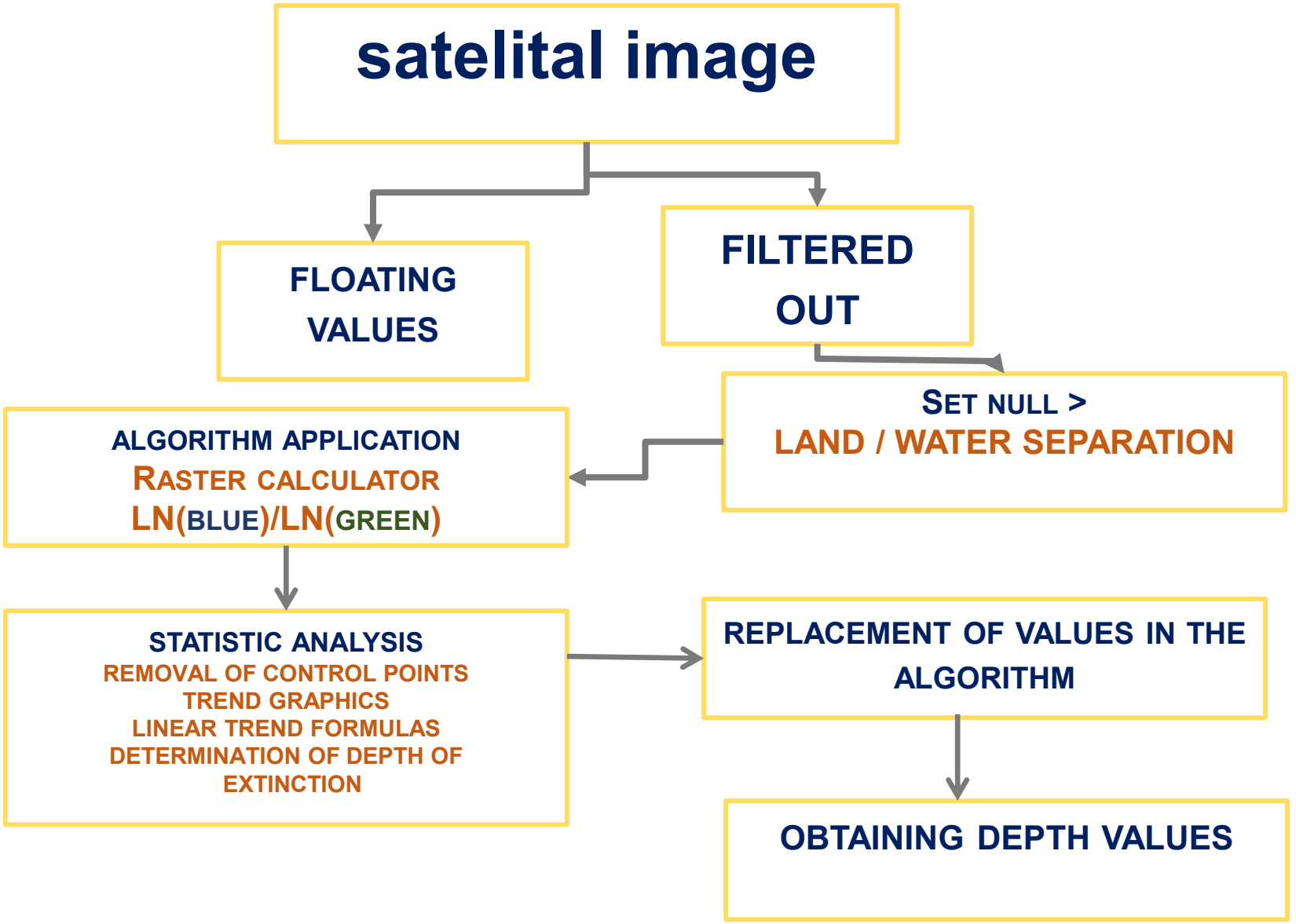


SURVEY CONTROL POINTS

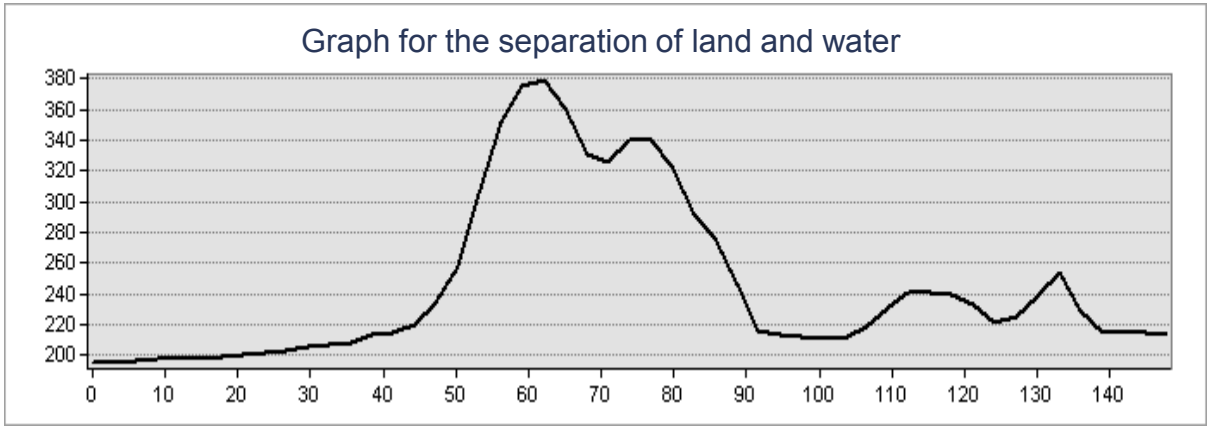
Blue and green band analysis

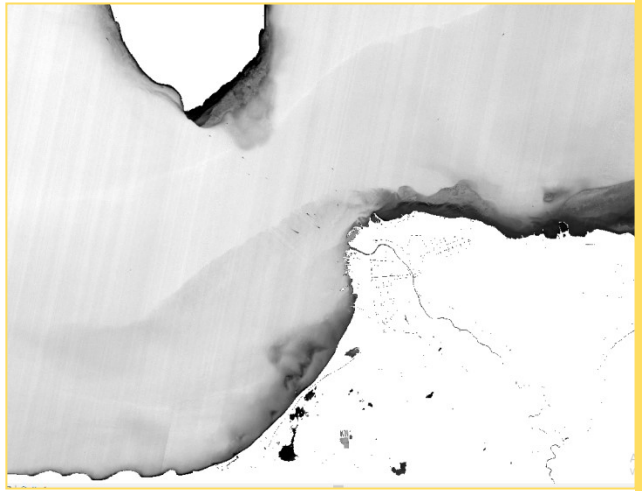
Apply the algorithm

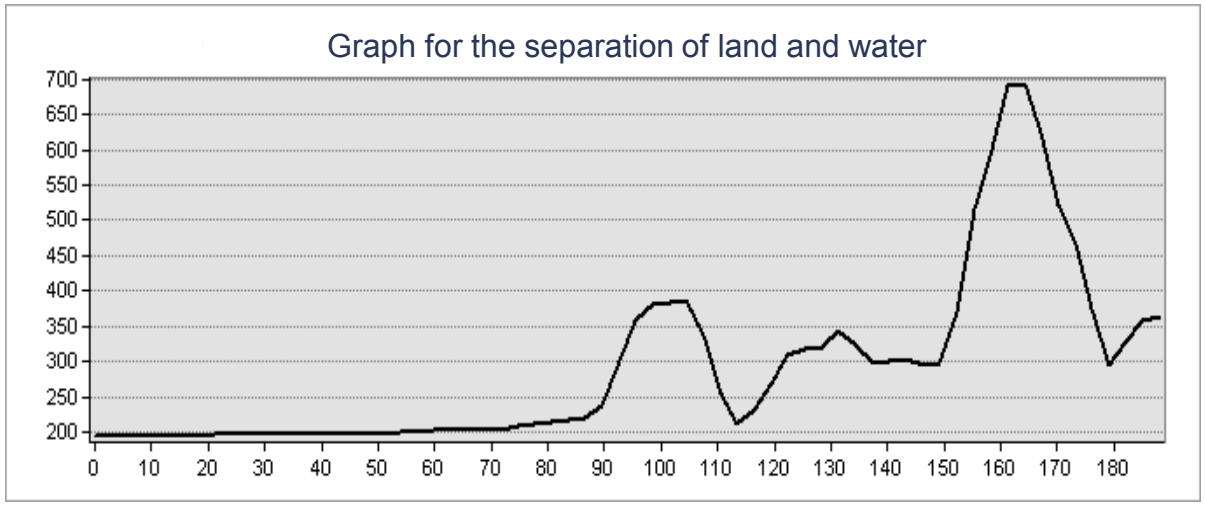
SDB PROCESS


satelital image
FLOATING VALUES
FILTERED OUT
SET NULL > LAND / WATER SEPARATION
ALGORITHM APPLICATION
RASTER CALCULATOR
LN(BLUE)/LN(GREEN)
STATISTIC ANALYSIS
REMOVAL OF CONTROL POINTS
TREND GRAPHICS
LINEAR TREND FORMULAS
DETERMINATION OF DEPTH OF EXTINCTION
REPLACEMENT OF VALUES IN THE ALGORITHM
OBTAINING DEPTH VALUES

Water-land separation process

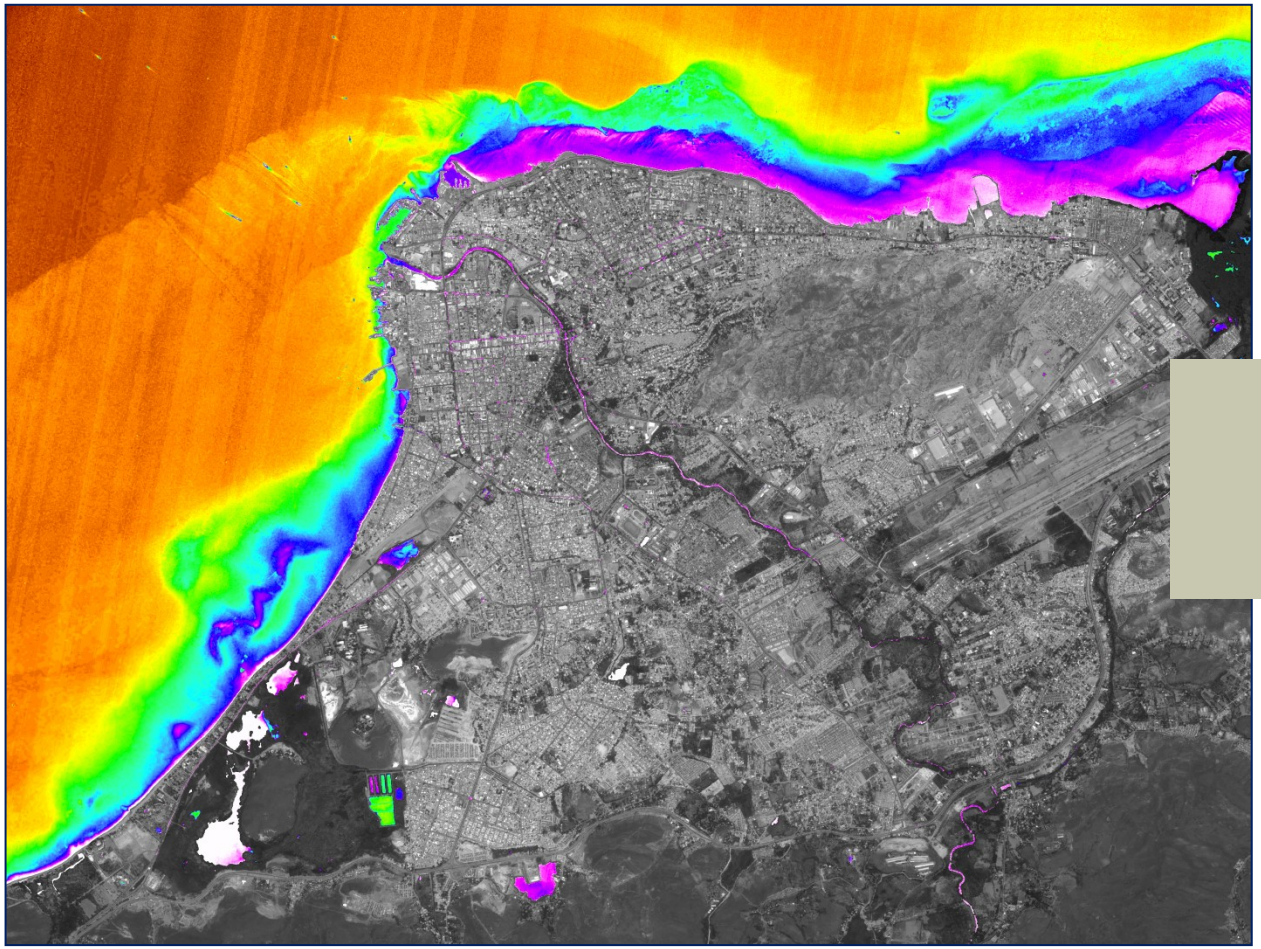


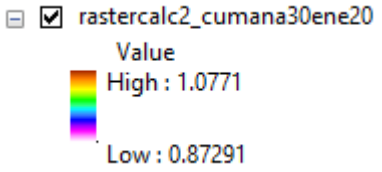




SEPARATION THRESHOLD
WATER - LAND
+/- 220

BATHYMETRIC ALGORITHM

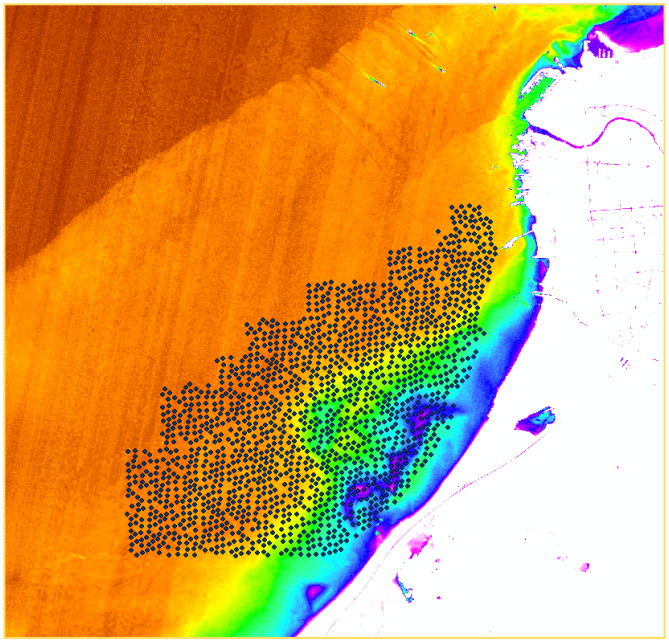




RASTER CALCULATOR
LN(AZUL)/LN(VERDE)

$$z = m_1 \left(\frac{\ln(L_{obs}(Banda_{azul}))}{\ln(L_{obs}(Banda_{verde}))} \right) - m_0$$

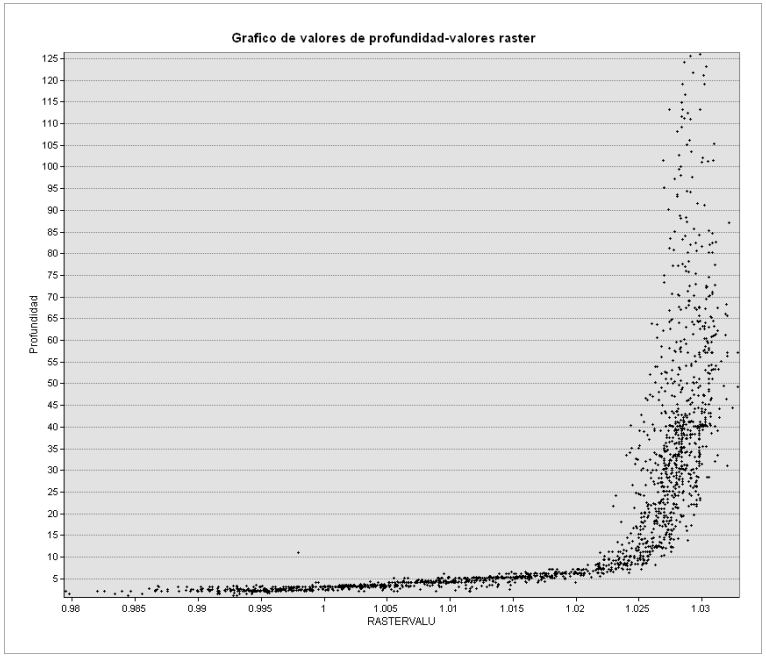
RASTER VALUE EXTRACTION



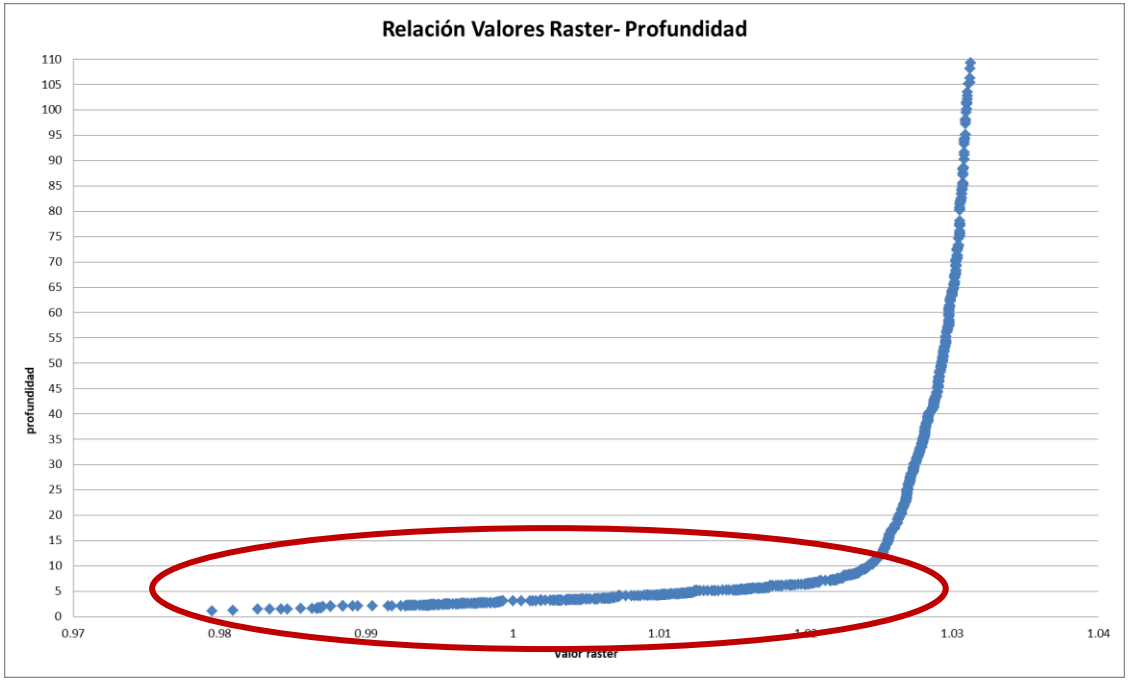
CONTROL POINTS

STATISTIC ANALYSIS

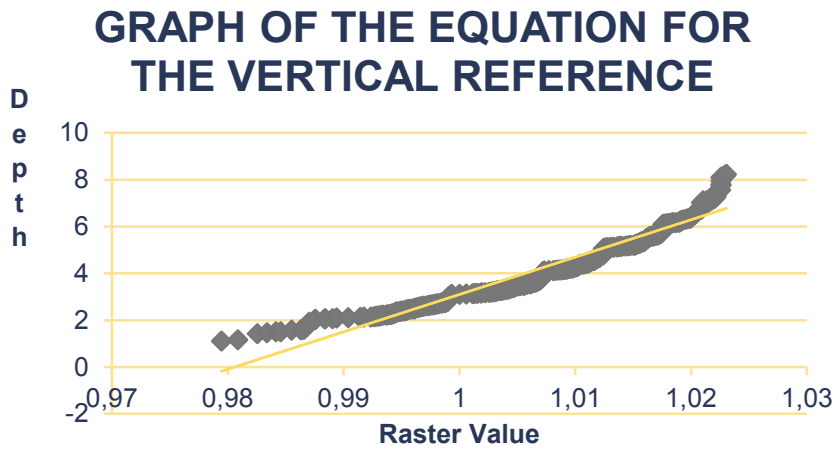
SURVEY AREA
10,5KM^2



CALCULATION OF RELATION R^2



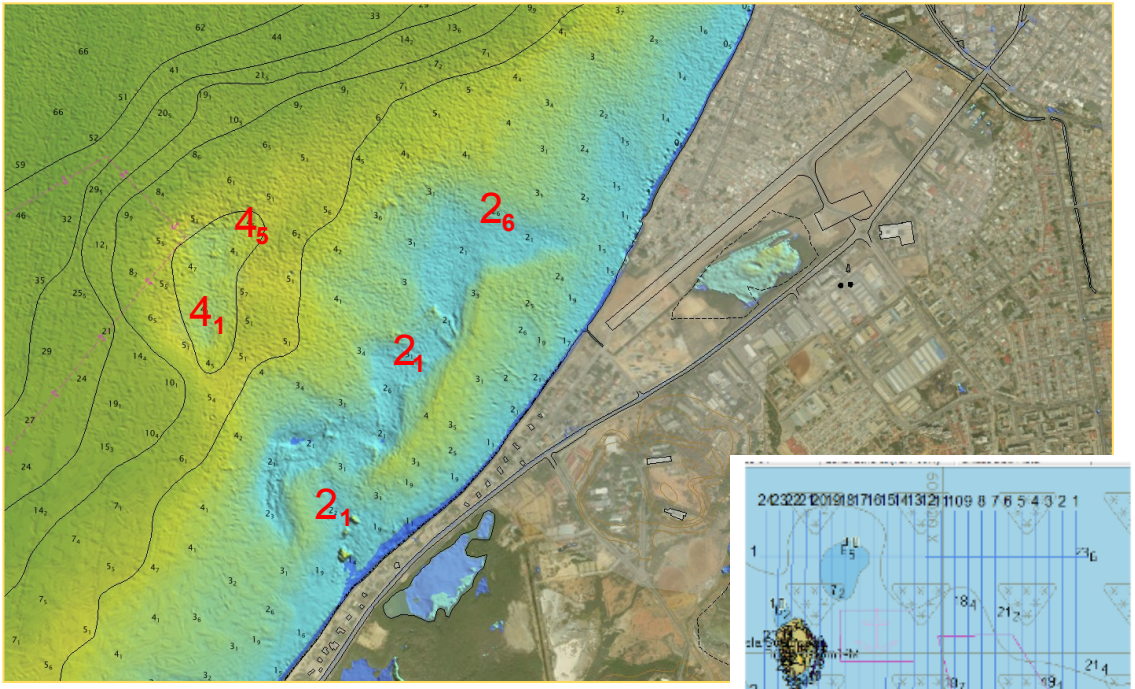
The SDB estimates of the VRSS2 Sucre images, derived from the blue / green band relationship, exhibited a water attenuation extinction depth of 8.8 meters with a coefficient of determination **$R^2 = 0.9298$.** When carrying out the respective modeling it was possible to show that the waters located north of Cumaná are highly dynamic affected mainly by the currents generated in the Gulf of Cariaco and by the action of the wind.

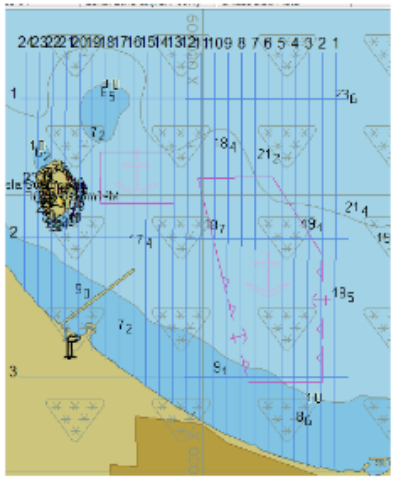


$y = 159.64x - 156.54$
$R^2 = 0.9298$

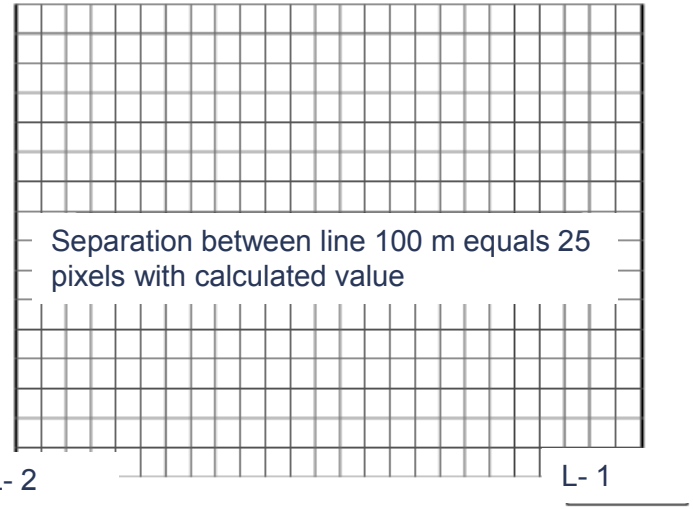
(159.64x{ln(azul)/ln(verde)}-156.54

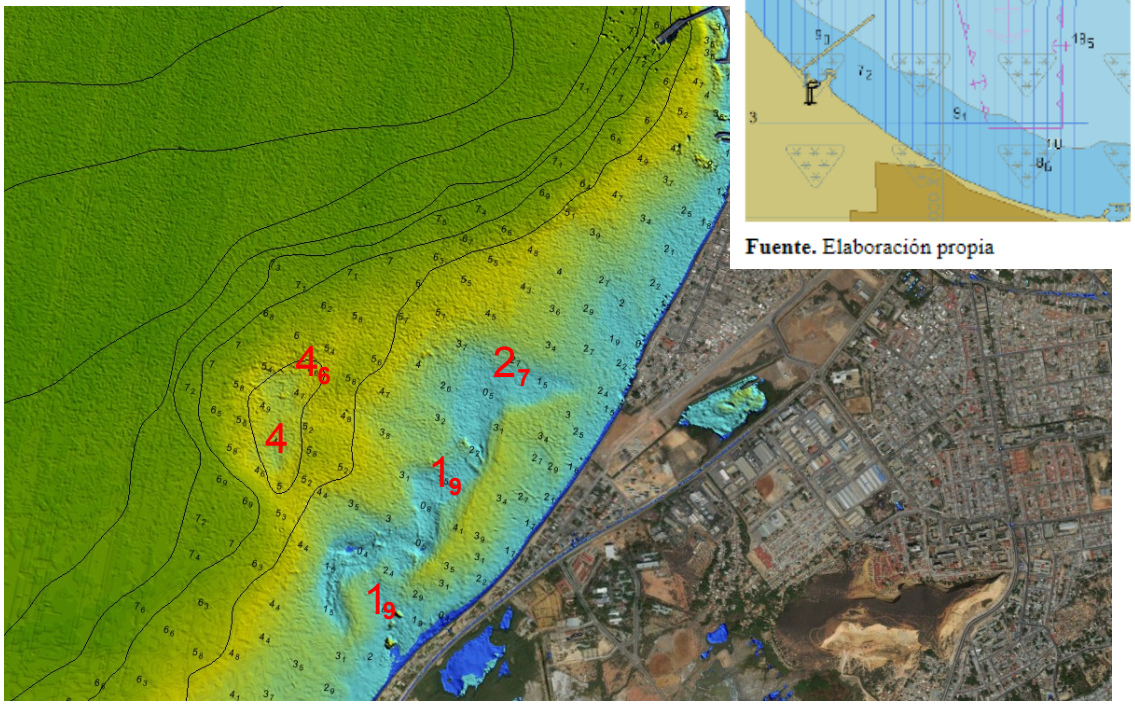
SURVEY DATA 2011





Fuente. Elaboración propia



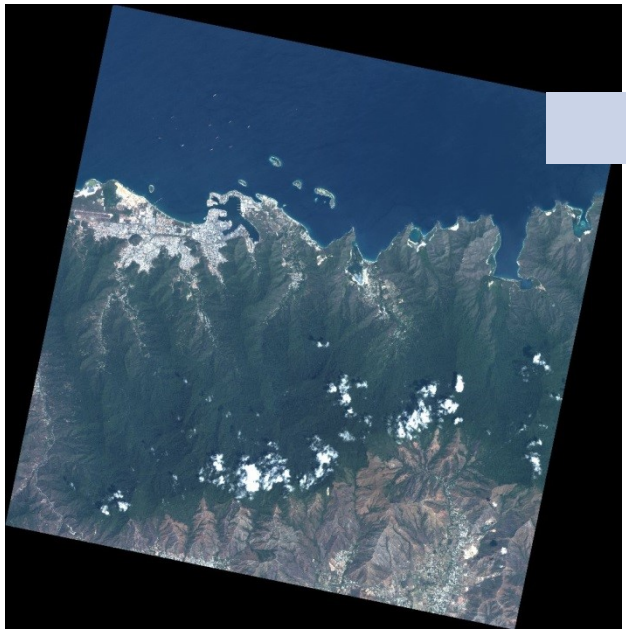


DEPTHS OBTAINED FROM SATELLITE IMAGES

Survey Cost

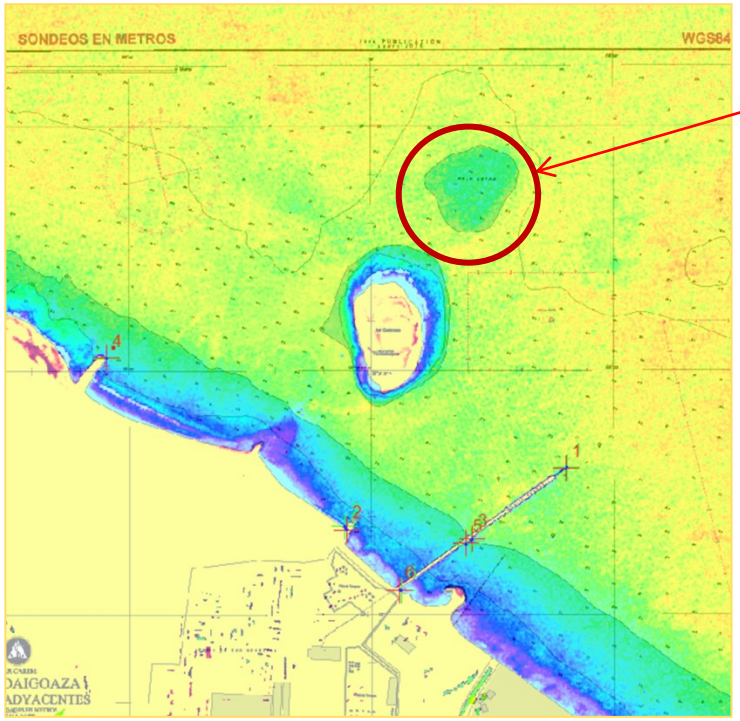
	Acustic	Lidar (CZMIL)	Satellite Sucre vrss2
Survey (20 km^2)	50.000	30.000	200
Duration (hours per Km^2)	140	1,6	0
Processing (hours per km^2)	420	80	60
Total cost(per km^{2-}) EUR	**66.000**	**34.000**	**2000**
Total Duration total(hours per km^2)	560	80	60

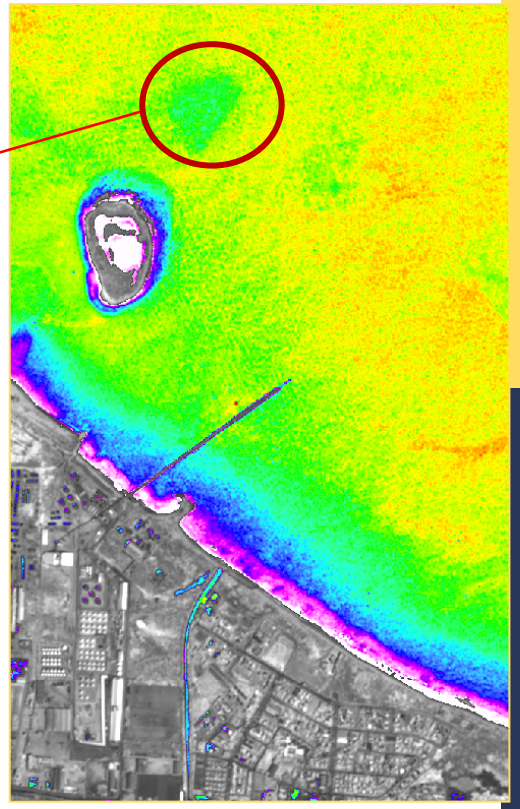
OTHER EXERCISES



VRSS2_MSS_0291_0327_20180301_L2B_1129181858944

PUERTO CABELLO

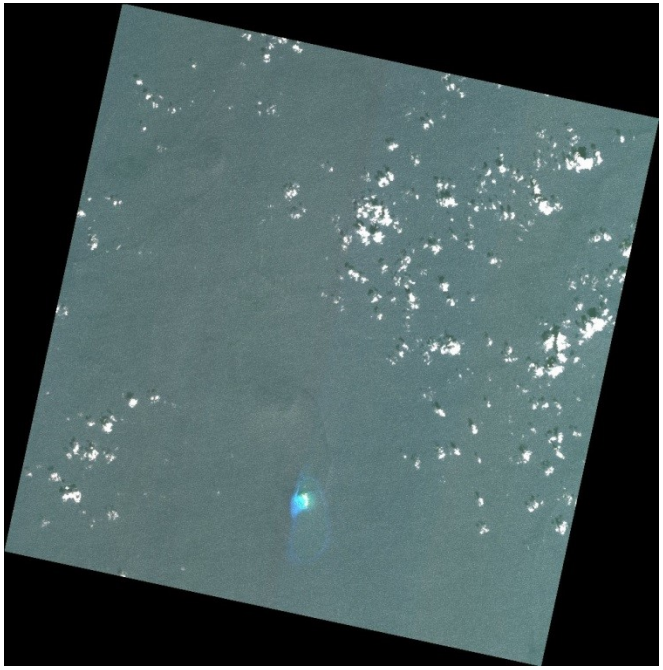


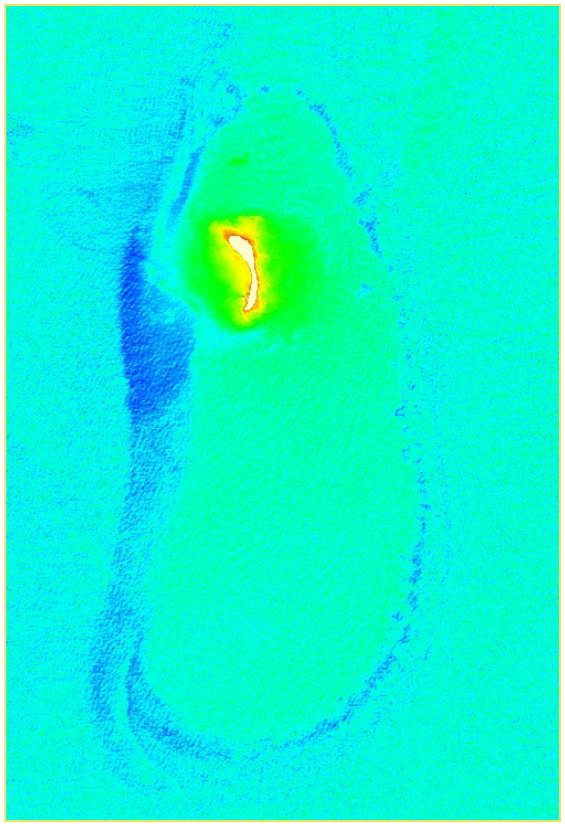


OTHER EXERCISES

VRSS-2_MSS_0278_0305_20181024_L2B_1129182911229

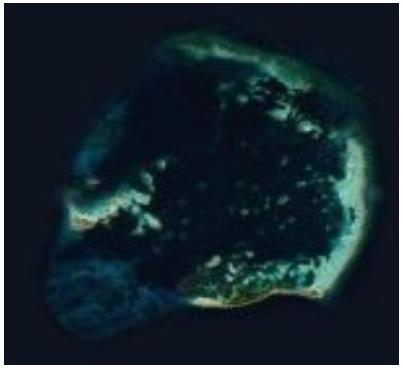
VISUALIZATION ISLA DE AVES





NEXT STEPS

Archipelago Aves (Aves de Sotavento)
Total area approx. 72 Km^2



Archipelago Aves (Aves de Barlovento)
Total area approx. 67 Km^2

Archipelago Los Roques
Total area approx. 650 Km^2

Conclusions

- BDS can be of great help in filling information gaps in mapping at a reasonable cost.
- BDS has great potential for employment in our country with the use of VRSS-2 Satellite images, Gran Mariscal Antonio José de Sucre.
- BDS is not the ideal technique but it is something, in places where there is no bathymetric information it is of great benefit.
- The places where greater precision is required should be surveyed with MBES or LIDAR.
- The BDS provides a great advance among the countries of Latin America and the Caribbean in the use of this tool.

CIENCIA Y PATRIA

THANKS FOR YOUR ATTENTION