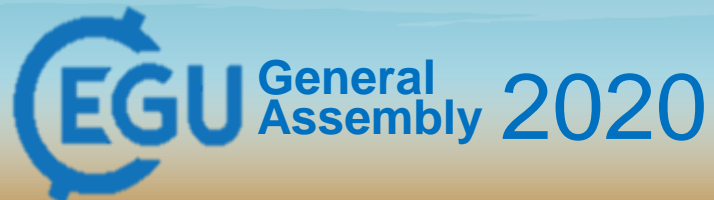


# SEABED MAPPING OF TROPICAL TIDAL CHANNELS, NE BRAZIL

FERREIRA, A.L.<sup>1</sup>; VITAL, H.<sup>1,2</sup>; GOMES, M.P.<sup>1,2</sup>; SILVA, A.G.A.<sup>1</sup>, PEREZ, Y.A.R. <sup>1</sup>

*<sup>1</sup>Federal University of Rio Grande do Norte-UFRN, Laboratory of Marine Geology and Geophysics and Environmental Monitoring - GGEMMA, Postgraduate Program in Geodynamics and Geophysics-PPGG; <sup>2</sup>CNPq Researcher.*



# SUMMARY

- Introduction
- Methods
- Results



# Importance of the study area

Source: Jornal O Globo



The villages of Galinhos and Guamaré established their importance in the economy of the state of Rio Grande do Norte since 1600, with the implementation of the salt industry.

1970s, establishment of the oil industry. 80's and 90's, shrimp farming in captivity (shrimp farming) .

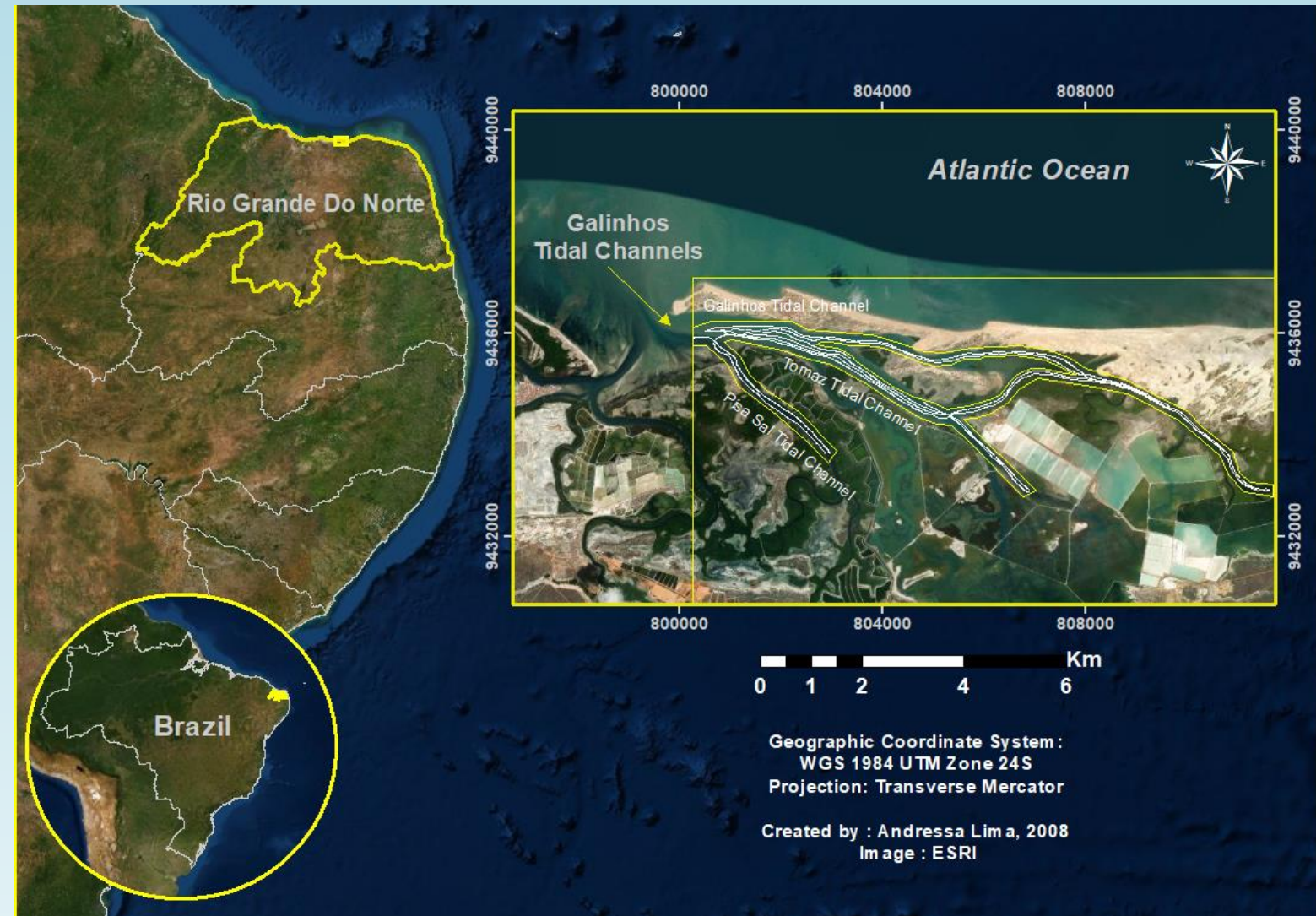
Source:Revista PEGN



Source: VNTonline



# Location

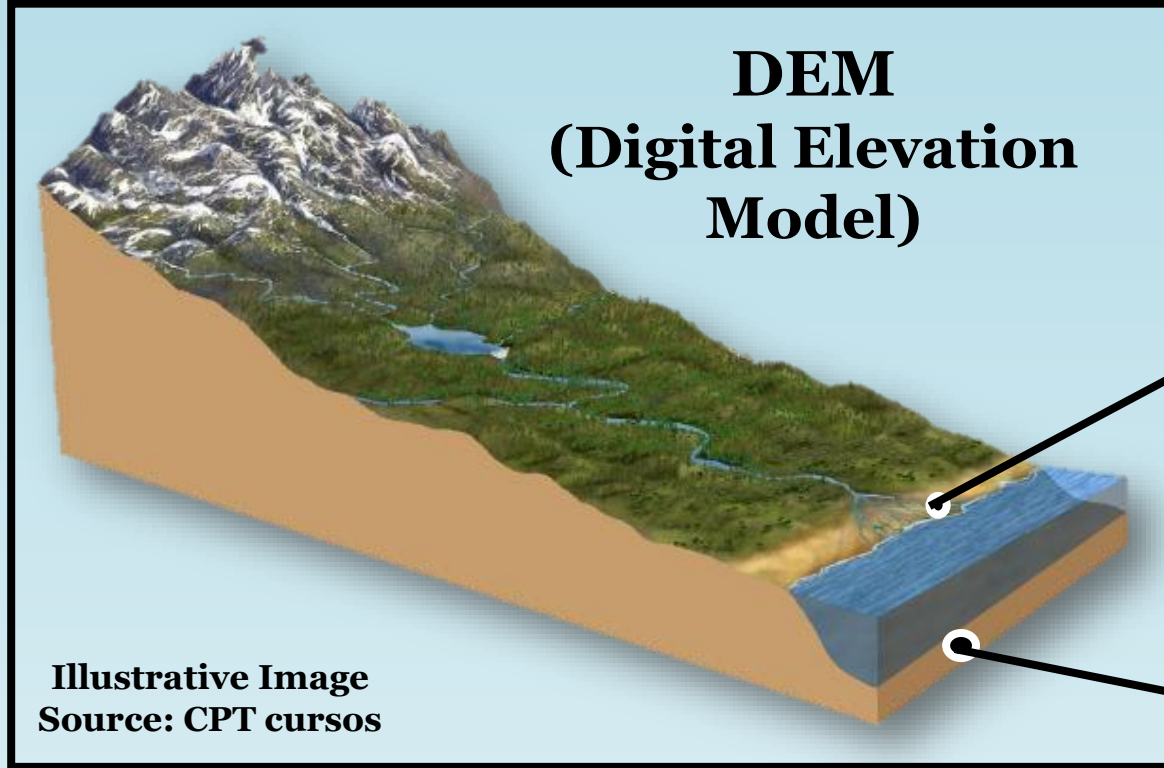


## CHARACTERISTICS OF THE REGION

Warm and semi-arid climate  
Emerged region + submerged region  
= 111km<sup>2</sup>

174km from the capital of Rio Grande do Norte (Natal)

# Objective



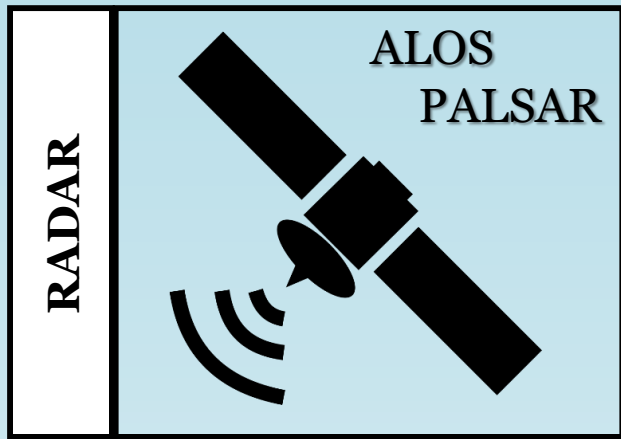
## EMERGED REGION

The altitude data came from the  
ALOS PALSAR Satellite

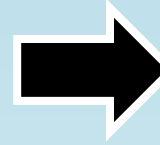
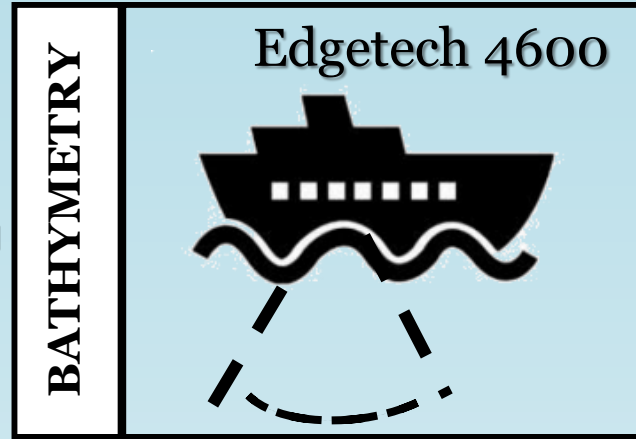
## SUBMERGED REGION

Depth and sonographic data  
came from a swap bathymetry  
and Side Scan Sonar

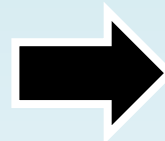
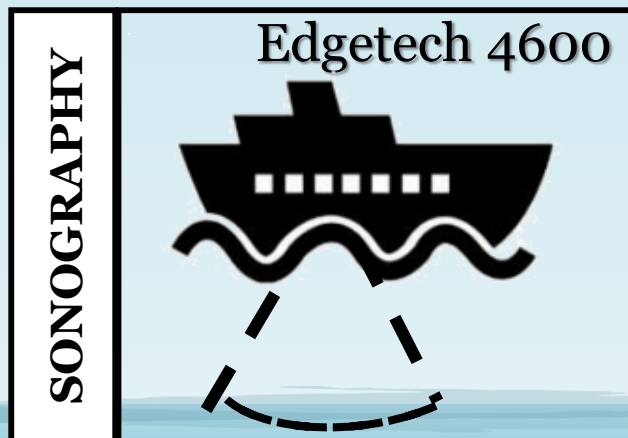
Create a 3D model with depth and  
altitude data as well as recognize  
the region's background shapes



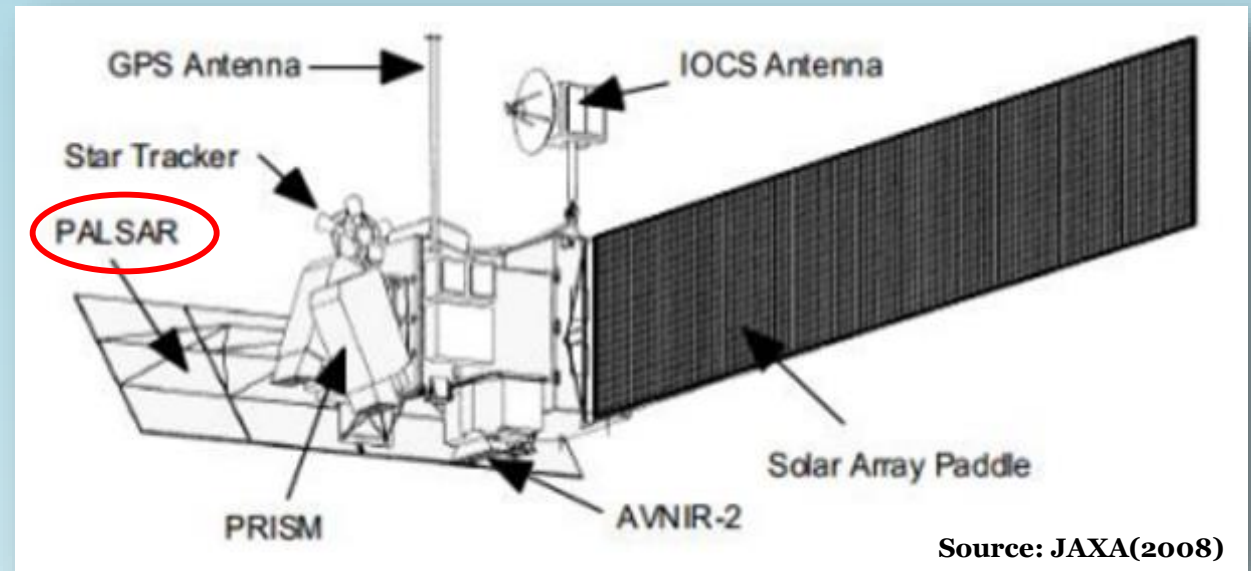
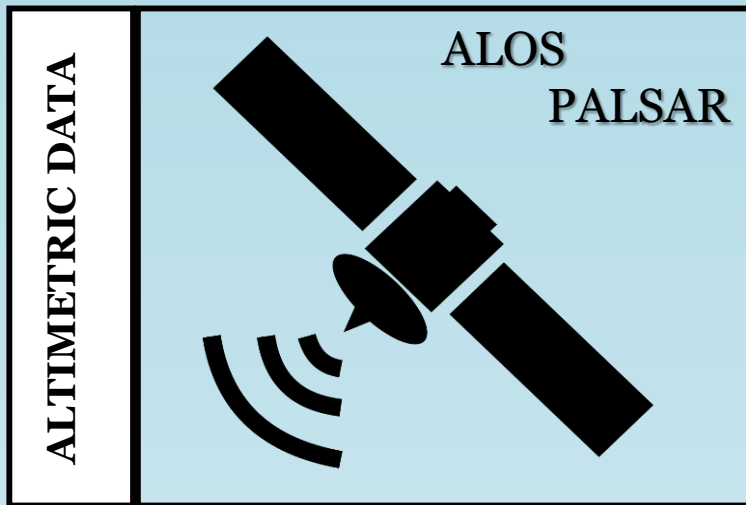
+



Obtaining  
geomorphological  
information  
the region, from the  
analysis of the **DEM**



Obtain information about  
seabed morphology



■ 54 km<sup>2</sup> of data

■ *Server Hi-Res Terrain  
Correct (12,5m)*

■ 2 images DEM

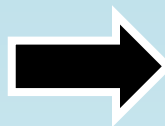
*ASF - Alaska Satellite Facility  
Collection*

### **Main applications:**

Topography and Geology  
Oceanography and Coastal Zone  
Land Use and Land Cover  
Water Pollution Analysis

**BATHYMETRY and  
SONOGRAPHY**

Edgetech 4600

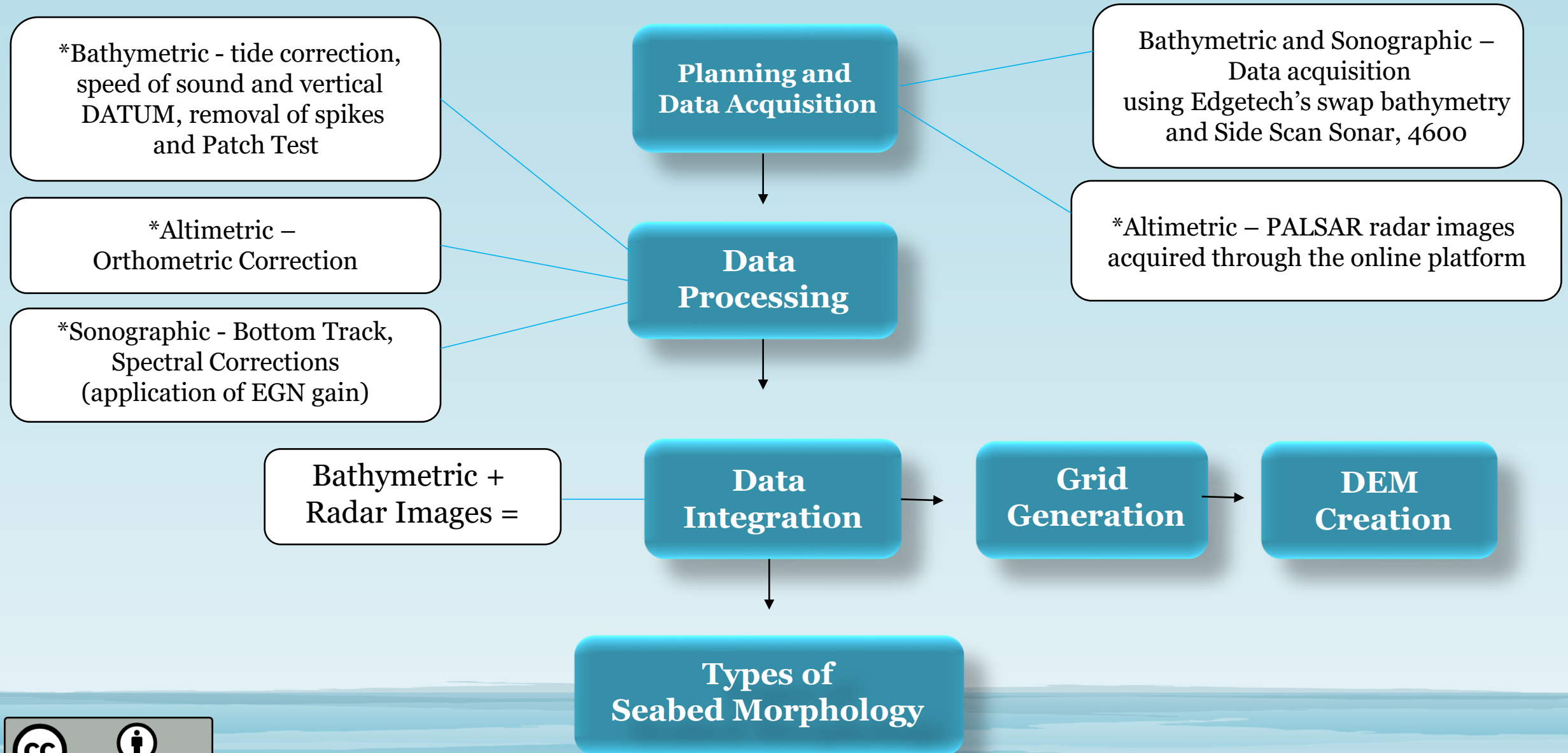


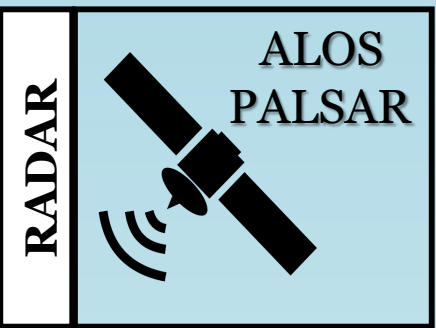
Source:  
Database GGEMMA (2016)

- 7.4km<sup>2</sup> total insonified area



# PRODUCTION FLOWCHART

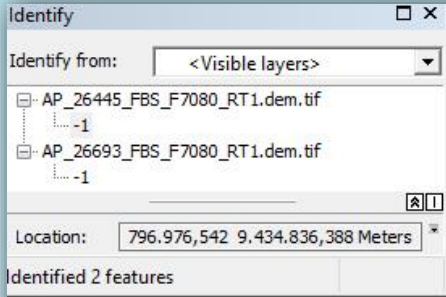




# Orthometric correction

**What should I evaluate?**

- Previous information about the area
- Previous knowledge of elevation values for the area



**Before Correction**



**It was necessary to correct both images.  
The value used for pixel correction was the elevation value of the RN2412B station.**

# Station Report

**Estação :** 2412B      **Nome da Estação :** 2412B      **Tipo :** Referência de Nivel - RN  
**Município :** GUAMARÉ      **UF :** RN

**Última Visita:** 04/04/2002      **Situação Marco Principal :** Destruido

### DADOS PLANIMÉTRICOS

Latitude 05° 06' 26" S  
 Longitude 36° 19' 15" W  
 Fonte Carta 1:100000  
 Origem Transformada  
 Datum SIRGAS2000  
 Data Medição 13/10/1983  
 Data Cálculo 15/06/2011  
 Sigma Latitude(m)  
 Sigma Longitude(m)  
 UTM(N) 9.434.865  
 UTM(E) 797.056  
 MC -39

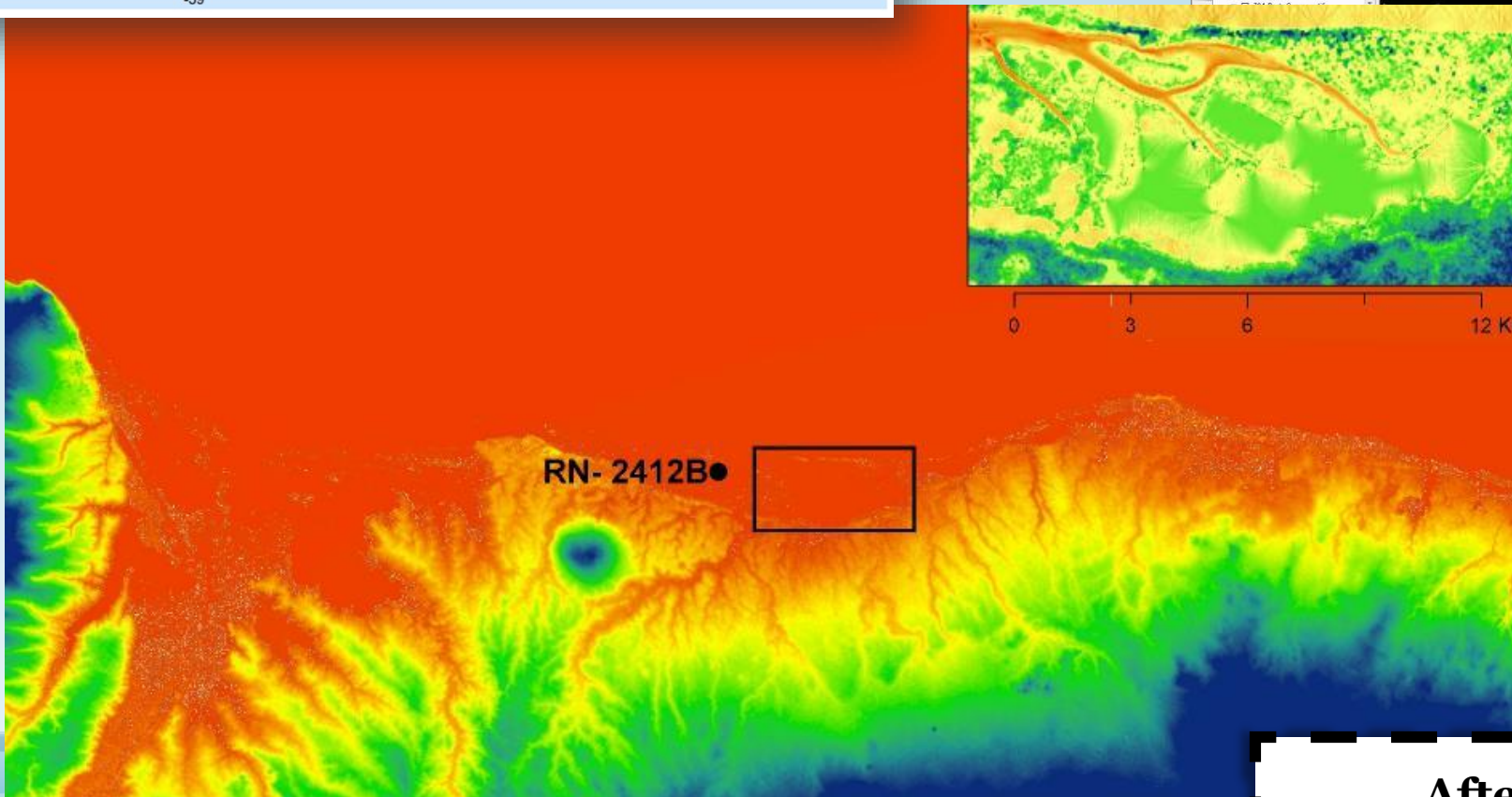
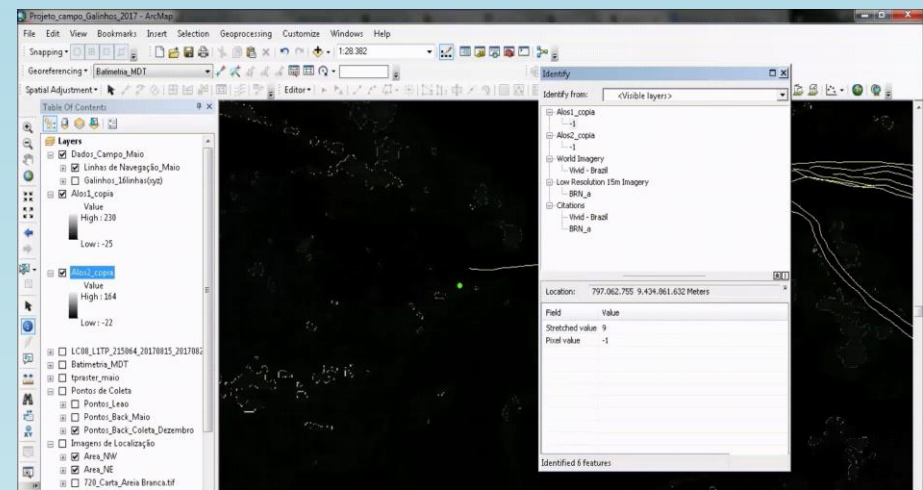
### DADOS ALTIMÉTRICOS

**Altitude Ortométrica(m)** 3.5142  
 Fonte Niveiamento Geométrico  
 Sigma Altitude(m) (#)  
 Data Medição  
 Data Cálculo

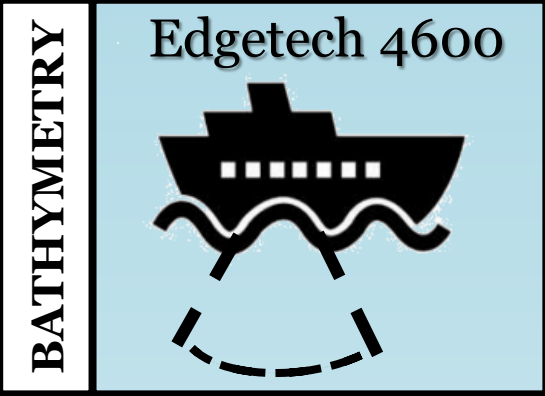
### DADOS GRAVIMÉTRICOS

Gravidade(mGal)  
 Datum  
 Data Medição  
 Data Cálculo

Elevation value for the geodetic station



**After Correction**

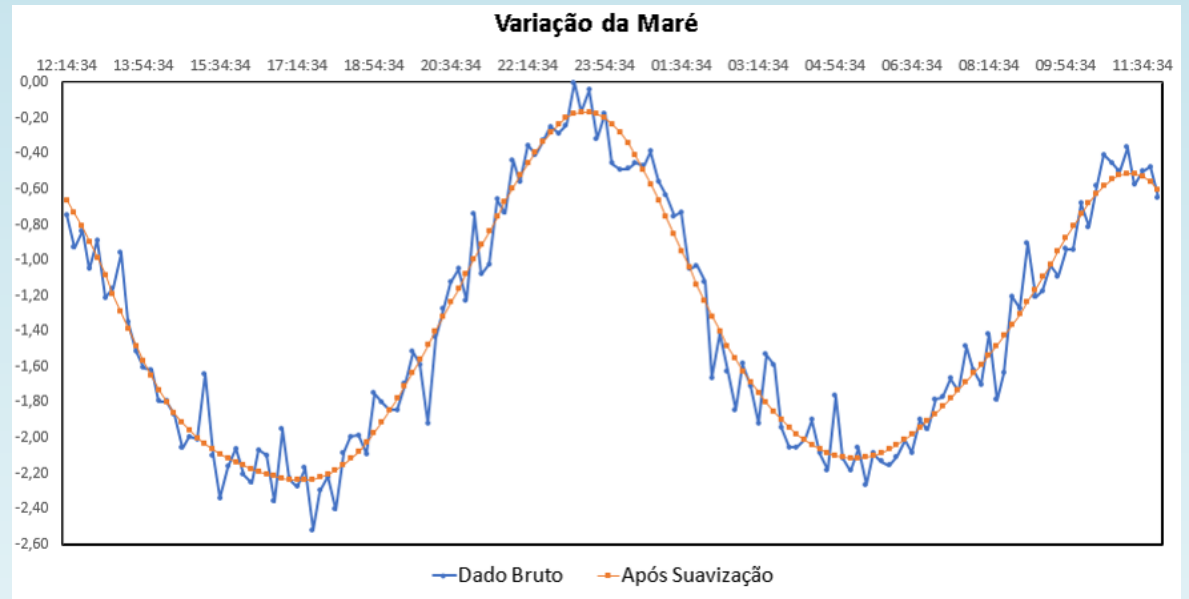
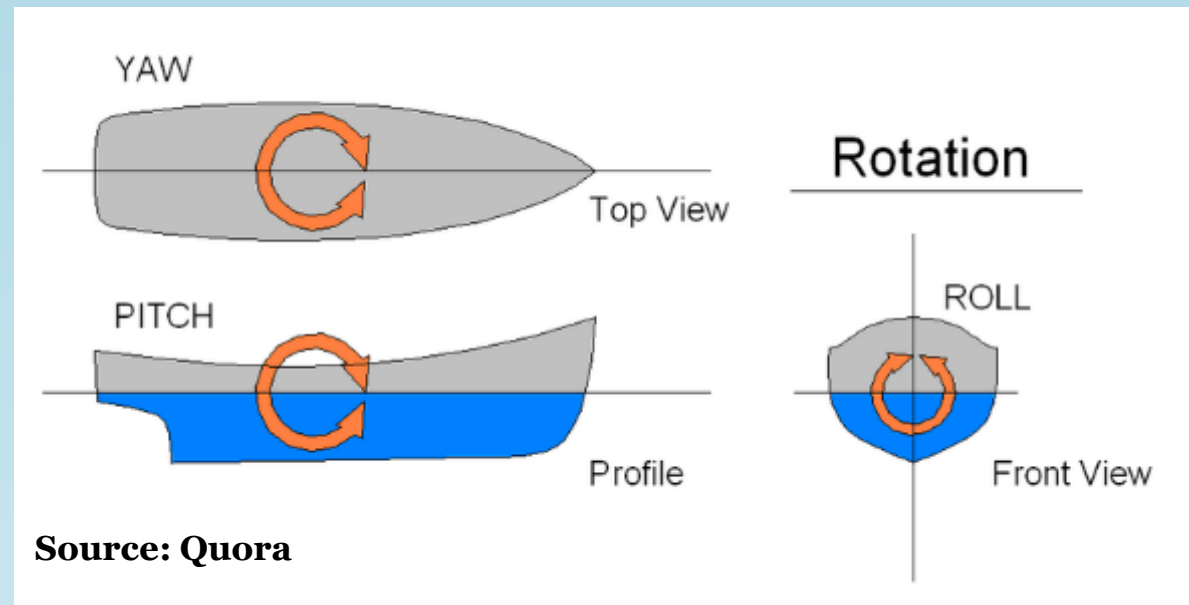
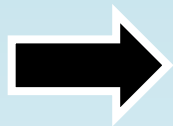
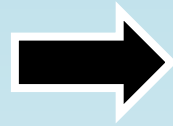


Offsets and *Patch Test* Correction

Tidal and Sound Velocity Correction

Removal of *Spykes*

Correction of the Reduction level



Edgetech 4600

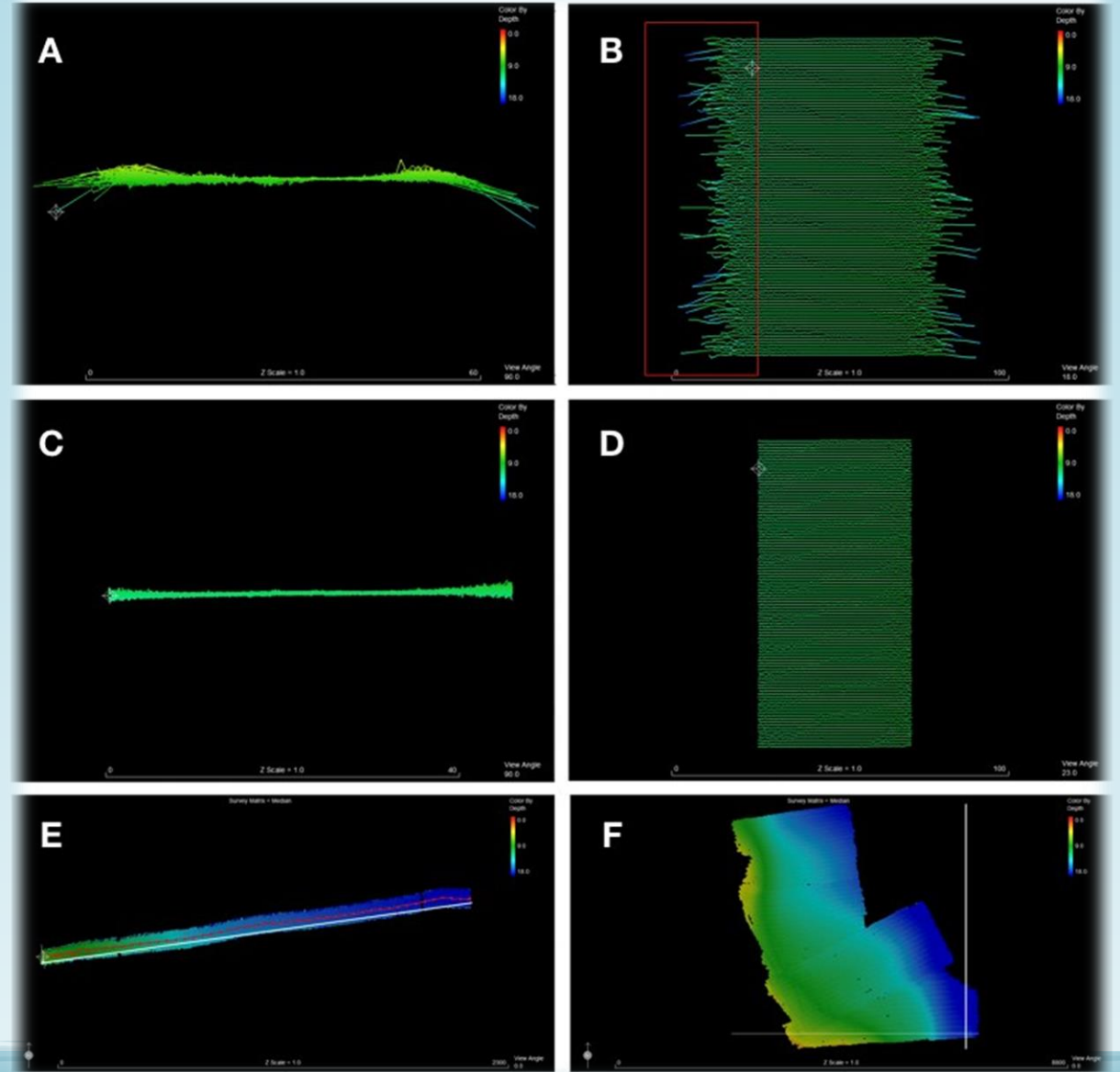
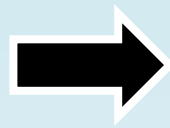


Offsets and *Patch Test* Correction

Tidal and Sound Velocity Correction

Removal of *Spykes*

Correction of the Reduction level



Why is it necessary to correct the Reduction Level?

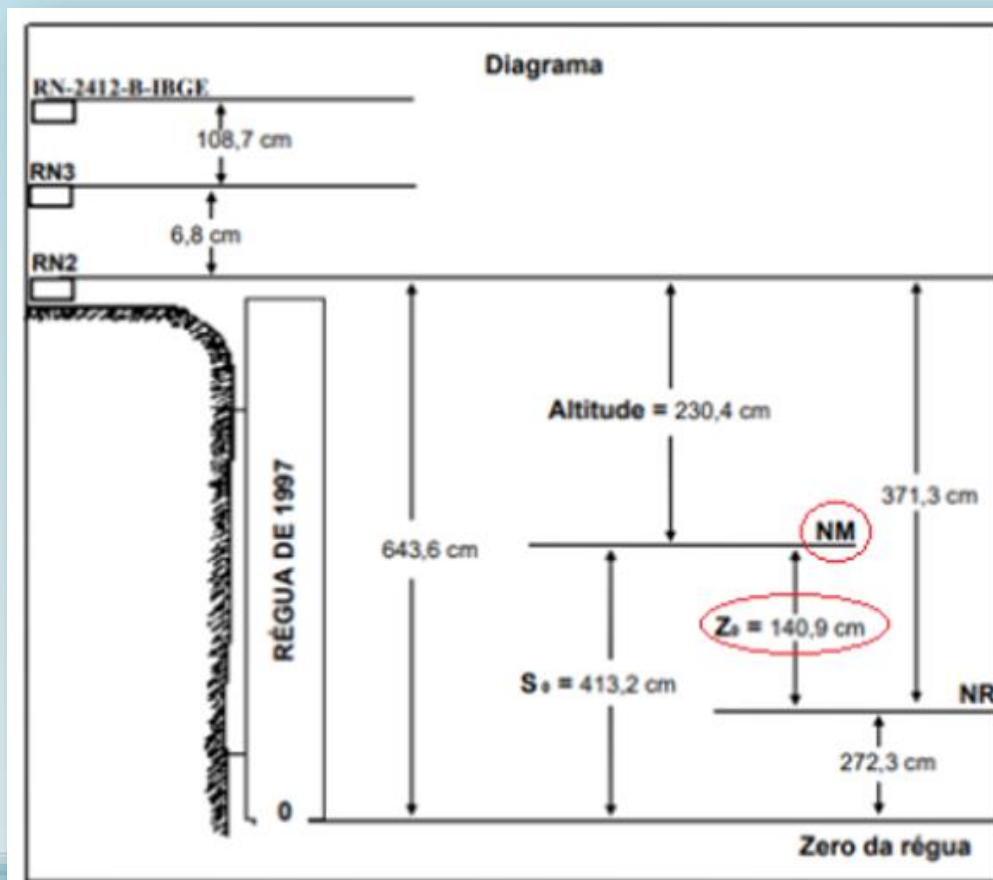
Offsets and *Patch Test* Correction

Tidal and Sound Velocity Correction

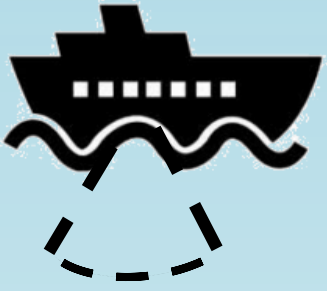
Removal of *Spykes*

Correction of the Reduction level

For the purposes of creating the ALT-BAT model, all data must share the same reference (NMM).



Fonte: Banco de Dados da Marinha do Brasil.



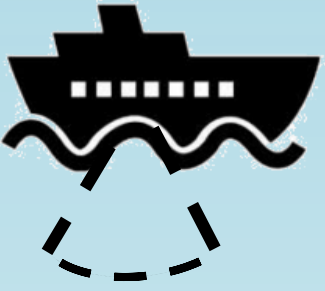
# Botton Track Removal



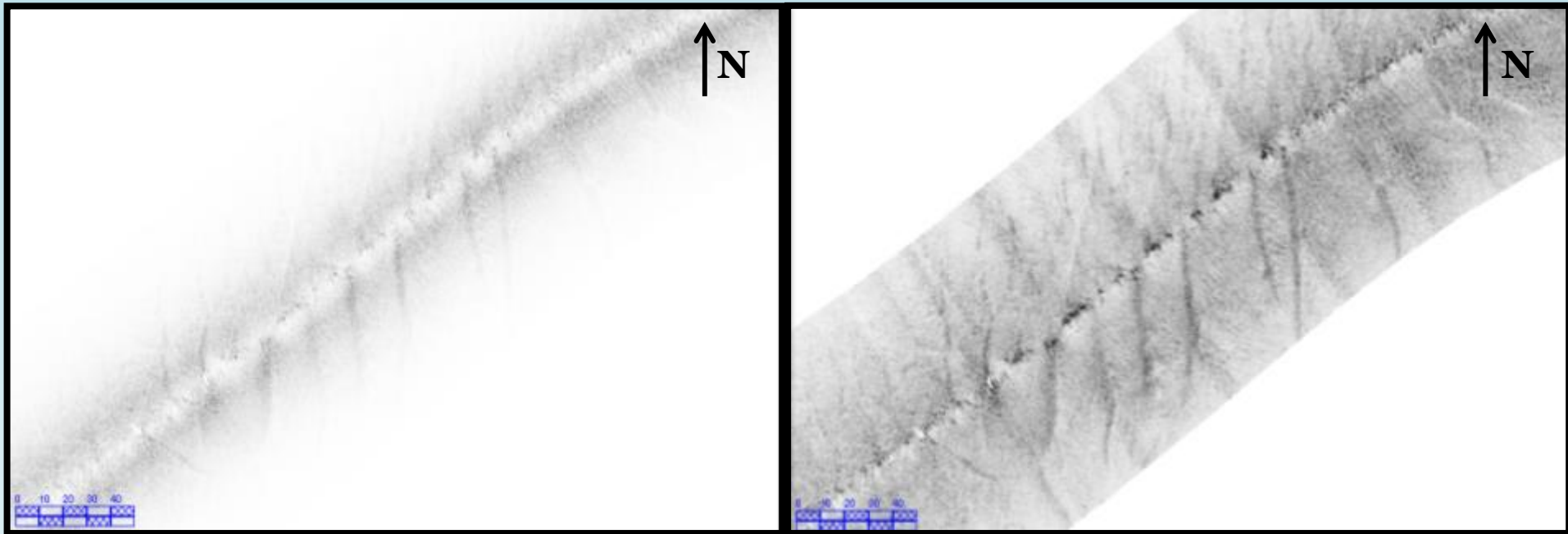
Sonograms without *Botton Track*



Sonograms after *Botton Track*



## Gain Application



Data without EGN

Data after EGN application

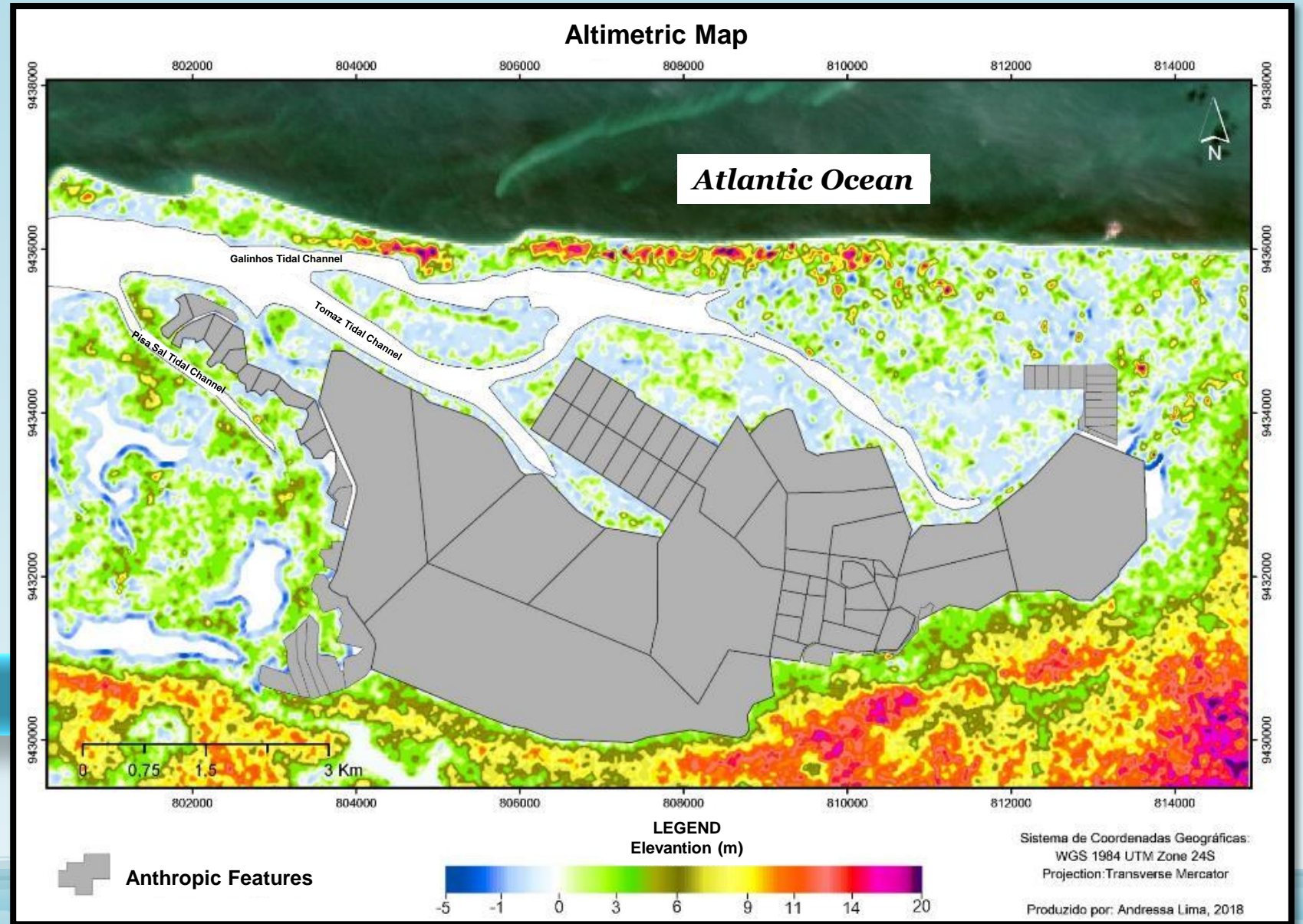
**Empirical Gain Normalization (EGN)** : EGN is a function that sums and averages up all of the sonar amplitudes in all pings in a set of sonar files by altitude and range.



# Altimetric Map

Altitude values : 0 (SL) - 20m

SL: Sea Level



## Central Region

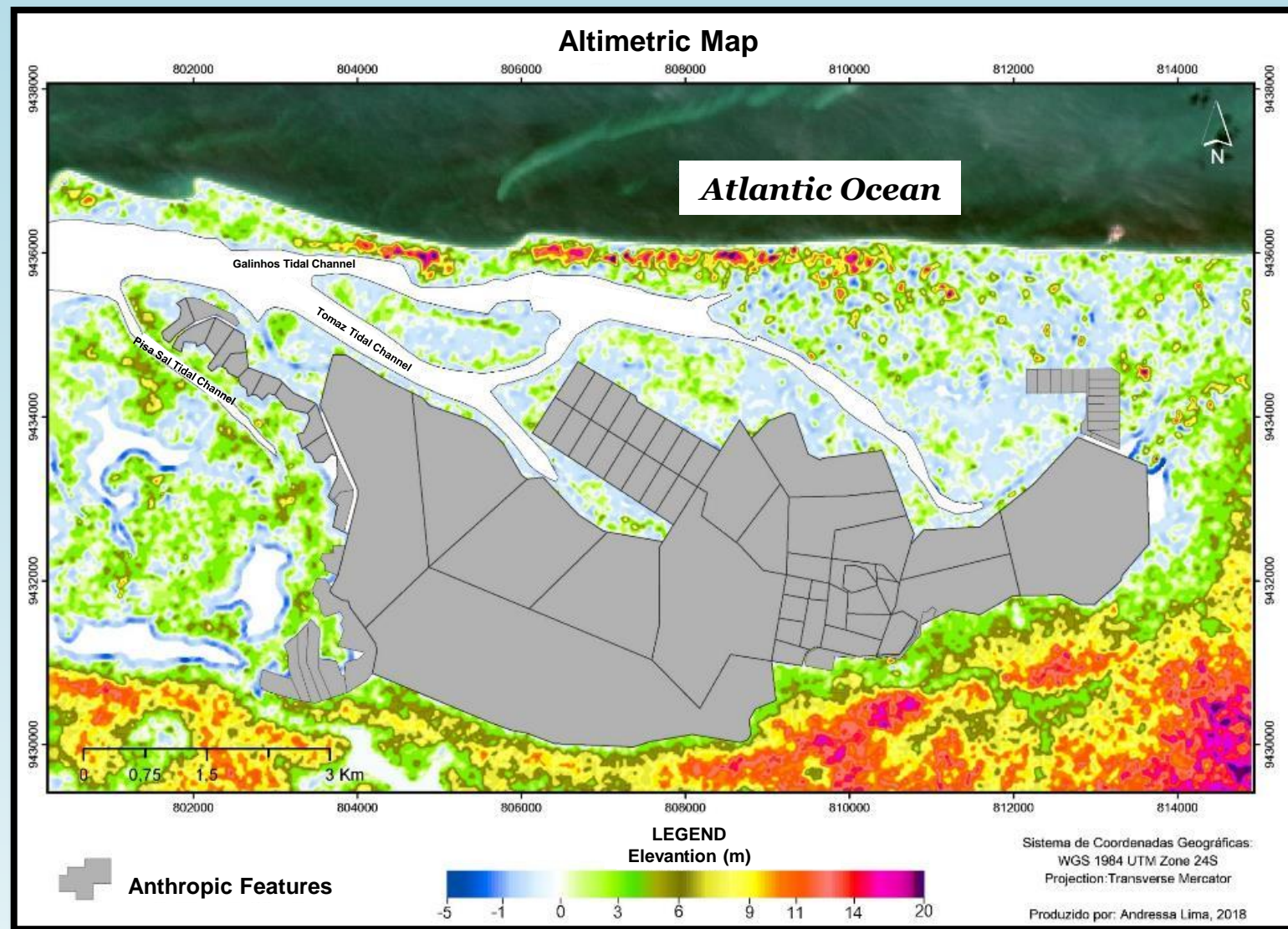
- Concentration of lower altitude regions
- Flatter region - 0 to 6m

## South Region

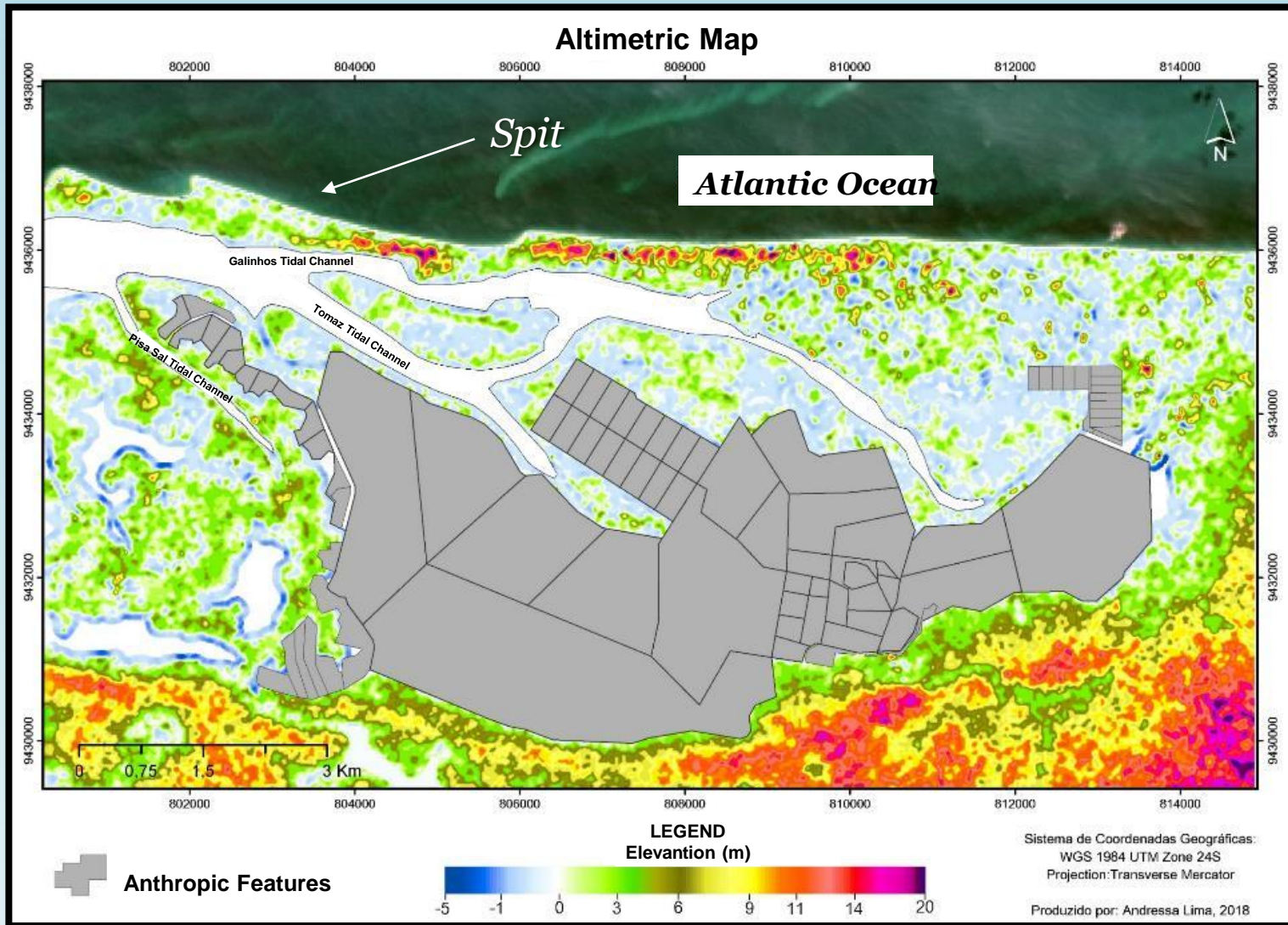
Concentration of altitudes above 10m in the southern portion

Altitude values : 0 (SL) - 20m

The flooded regions were well delimited by the method limitation. Having better results in regions with depth above 3m.



BY

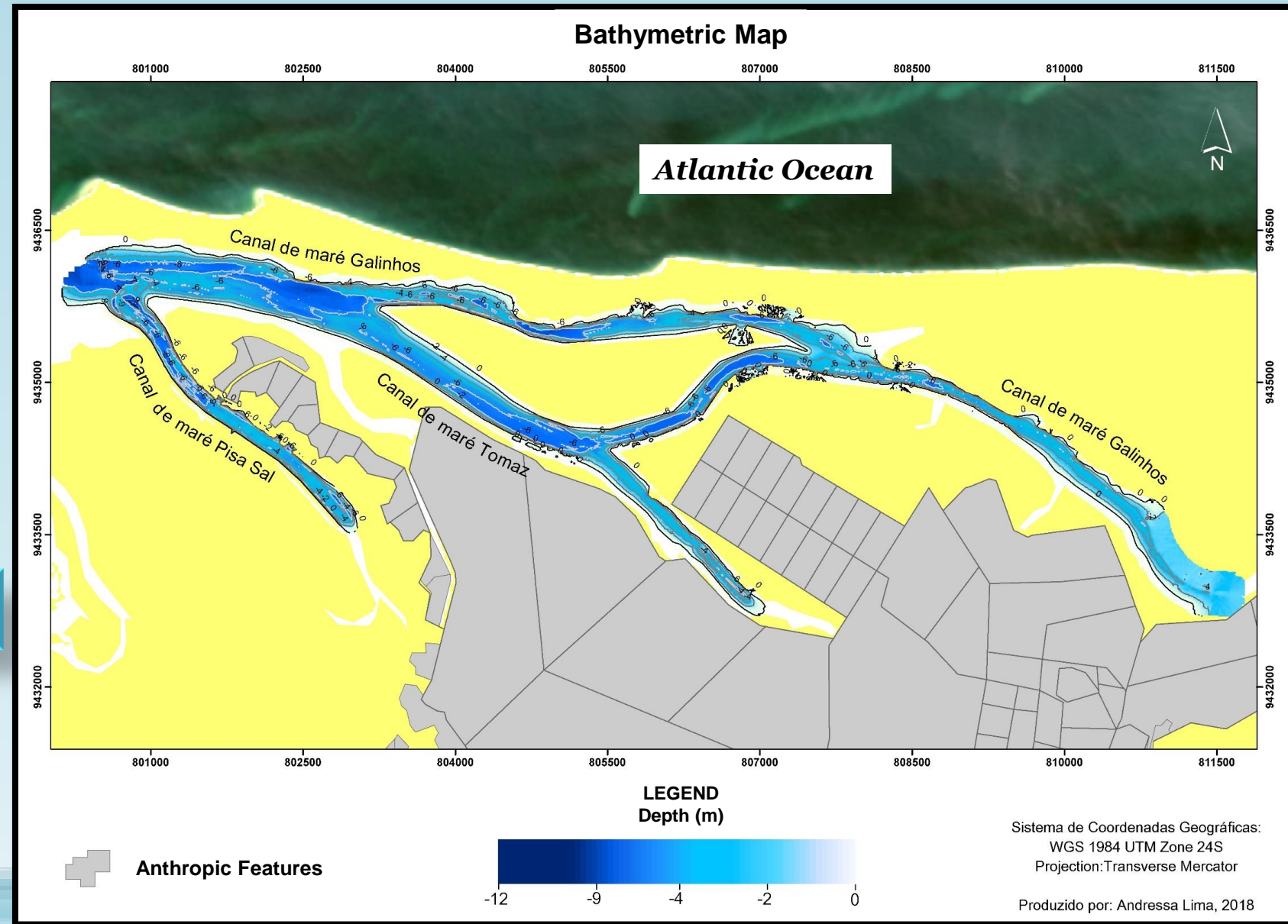


The Spit integrates a region of low average altitude - 2 to 7m

The altitude values are due to the local topographic elevation since the region does not have high vegetation or large anthropic constructions

# Bathymetric Map

Depth values : 0 - 12m

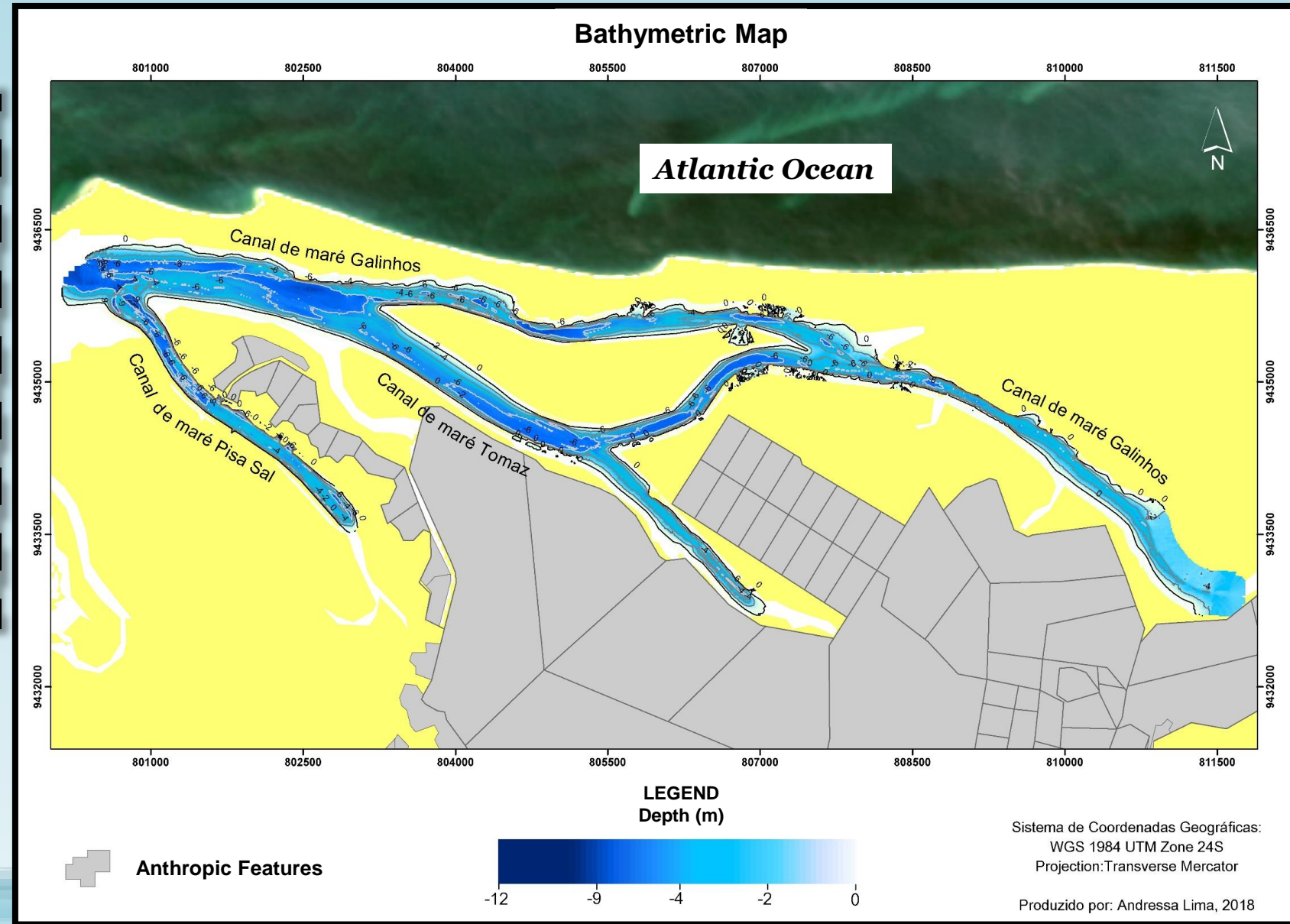


## Galinhos tidal channel

Main channel, 900 m wide and  
12 km long

Irregular bottom and  
asymmetric margins

Average depth between 4 and  
7m

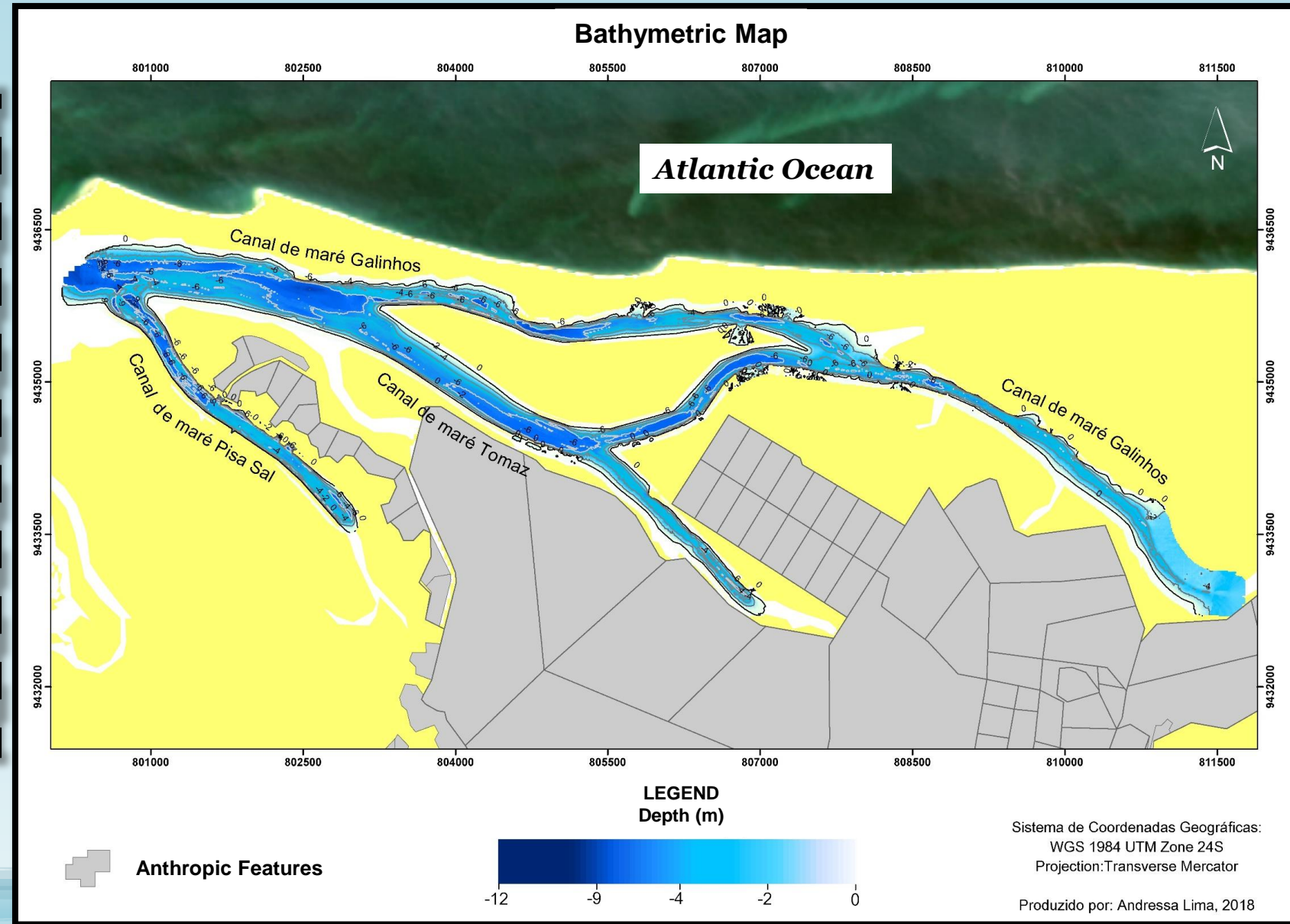


## Tomaz tidal channel

Greater depths on the right bank - 7m  
Average depth of the left margin - 5.5m to 6m

### Final Part (After the division)

Width reduction from 260m to 140m  
Flat bottom  
Greater depth - 7m



## Pisa Sal tidal channel

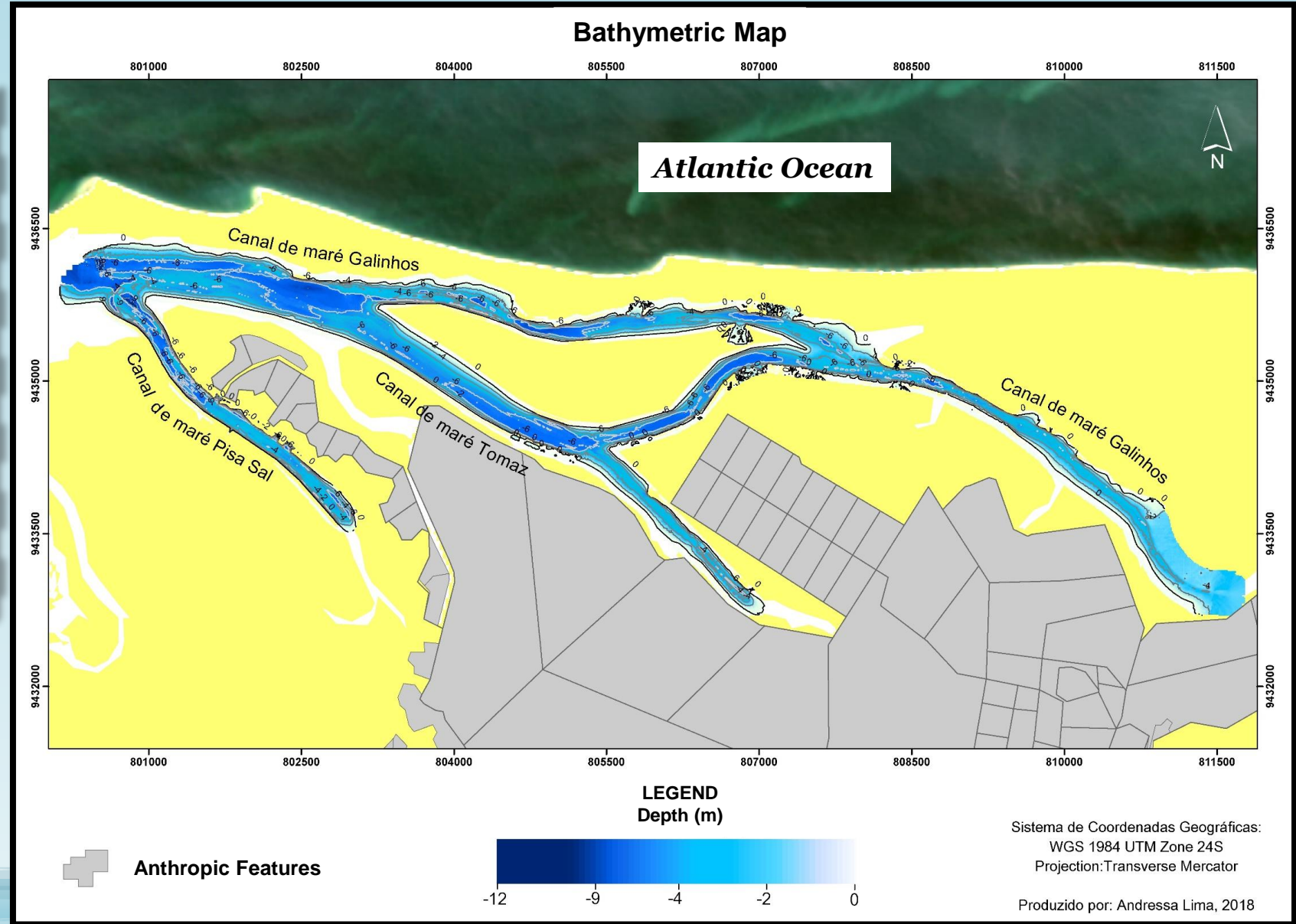
"U" shaped cross section

### Initial Part

Average depth between 6.5 and 8m

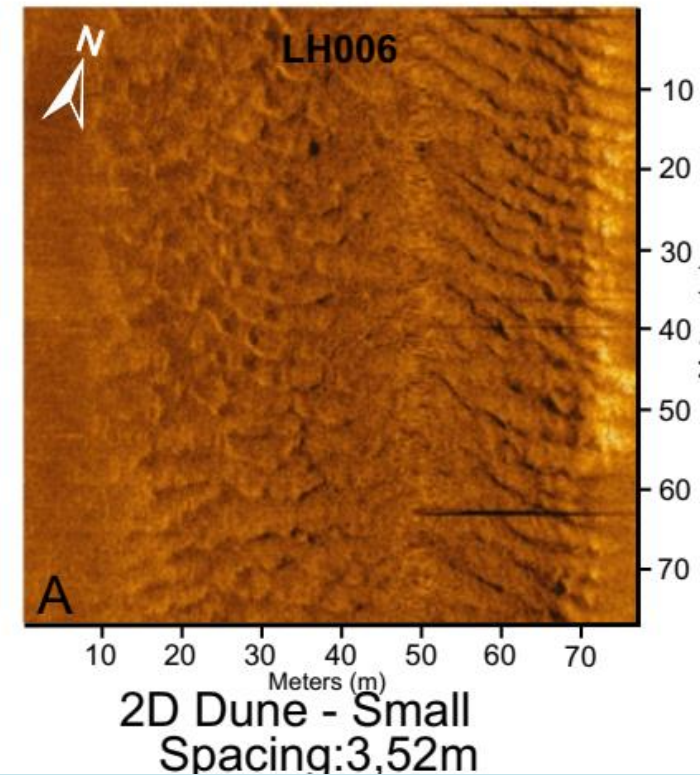
### Final part

Depth decreasing until 5m

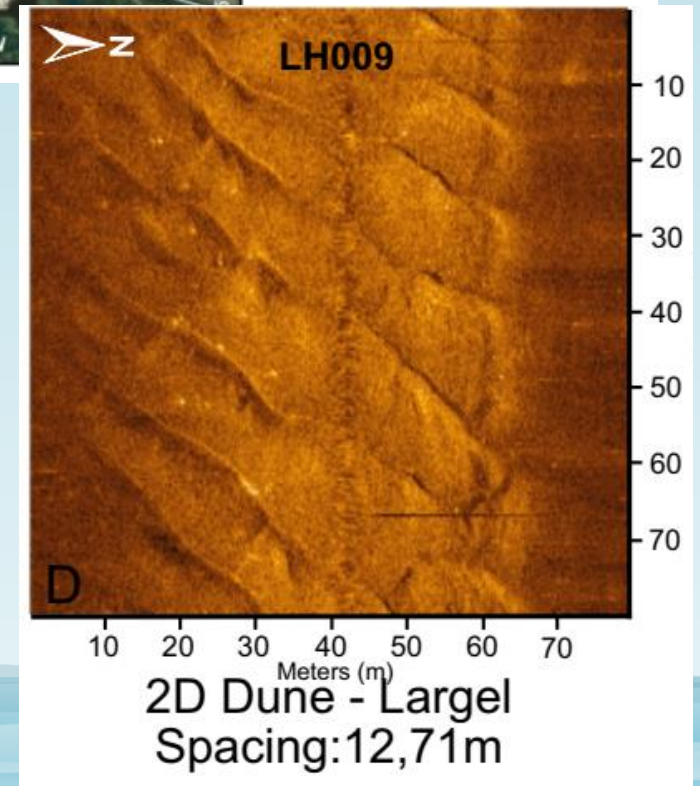




Small Dunes  
 Locations: A,B,C  
 With spacing varying between from 1,93m to 3,52m





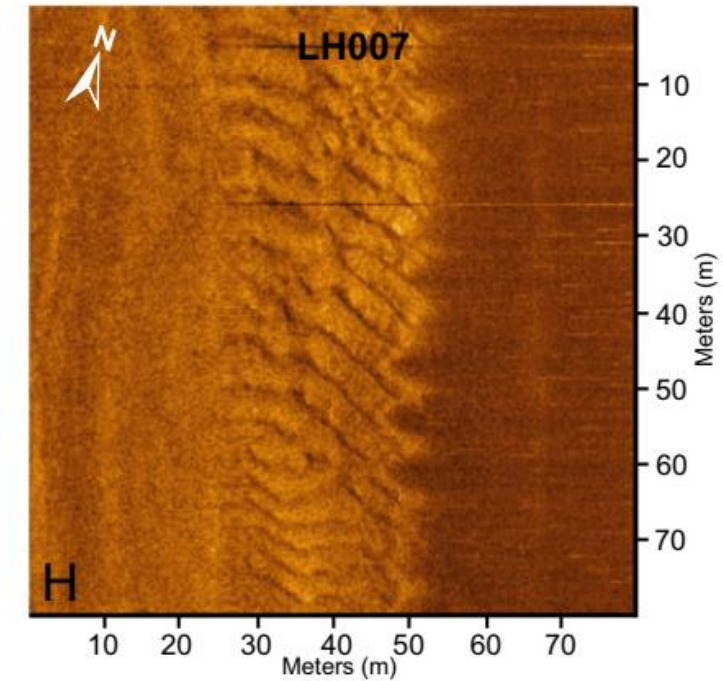
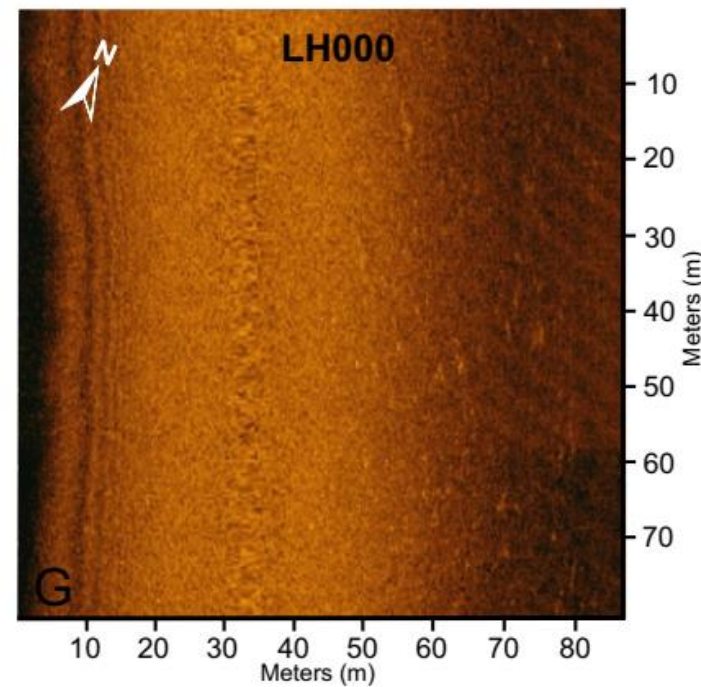


Large Dunes  
 Locations: D,E,F  
 With spacing varying between from 12,71m to 13,63m

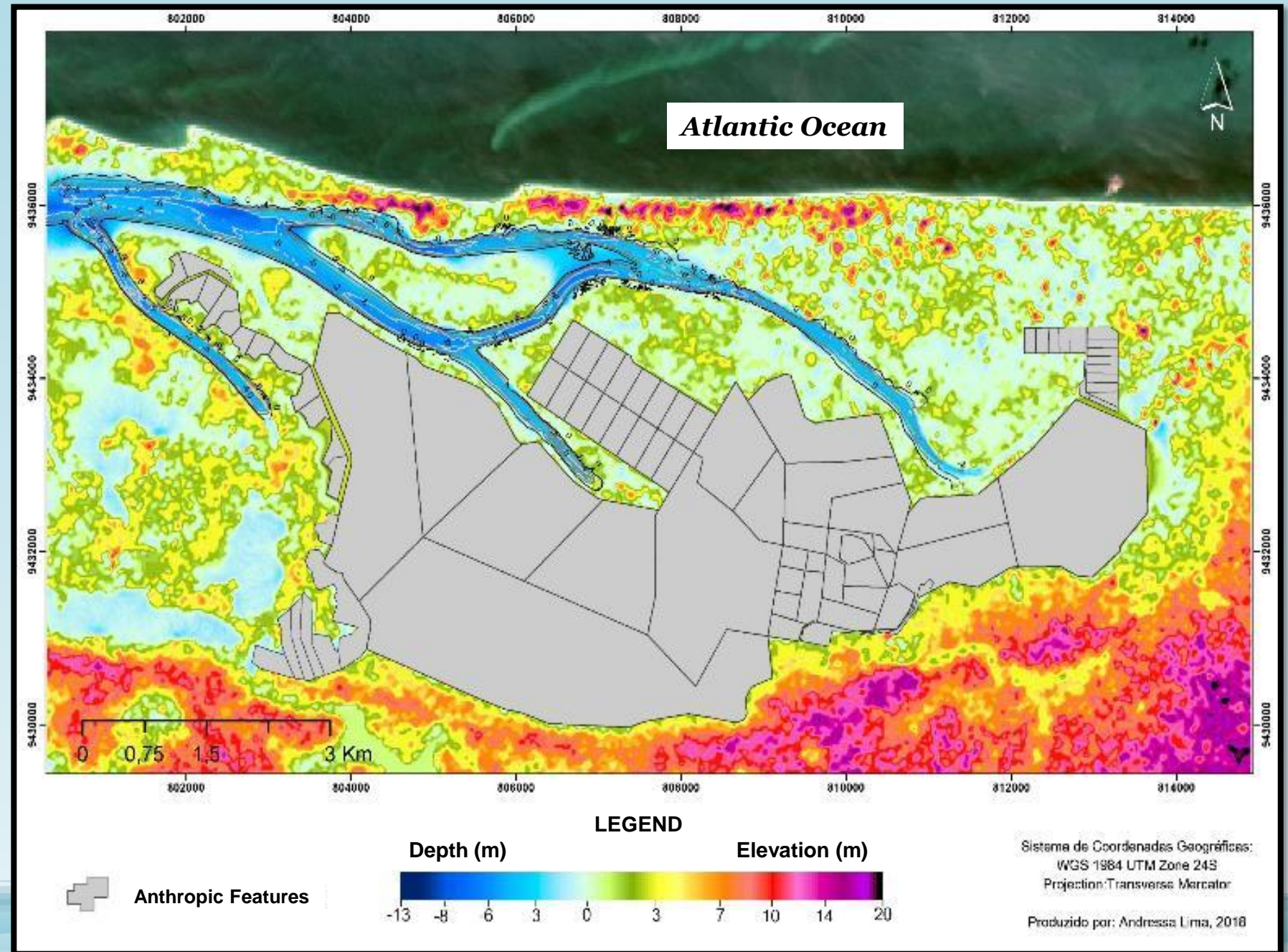


Plane Bed  
Locations: G

Medium Dunes  
Locations: H  
With spacing of 4,48m



# ALT-BAT Model



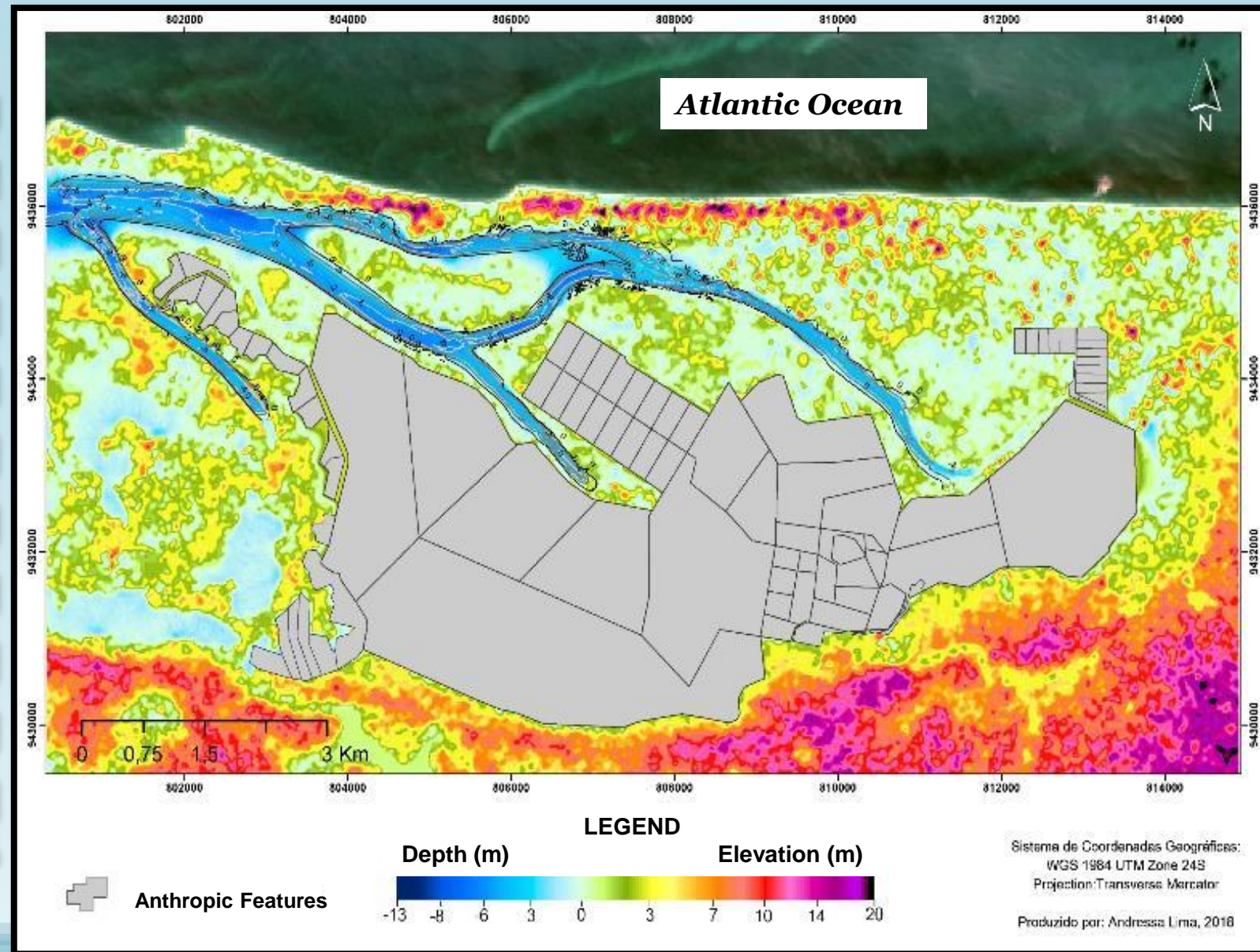
# ALT-BAT Model

## How can it be used?

It can be used as a tool for coastal management in planning projects in two ways:

**For the recognition of possible danger areas**

**Study, modeling and creation of possible danger scenery**



# Advantages and Disadvantages of the ALT-BAT Model



## Main advantages

Spatial Coverage of Extensive Areas

Speed in Obtaining Results

Operational Simplicity

Low cost

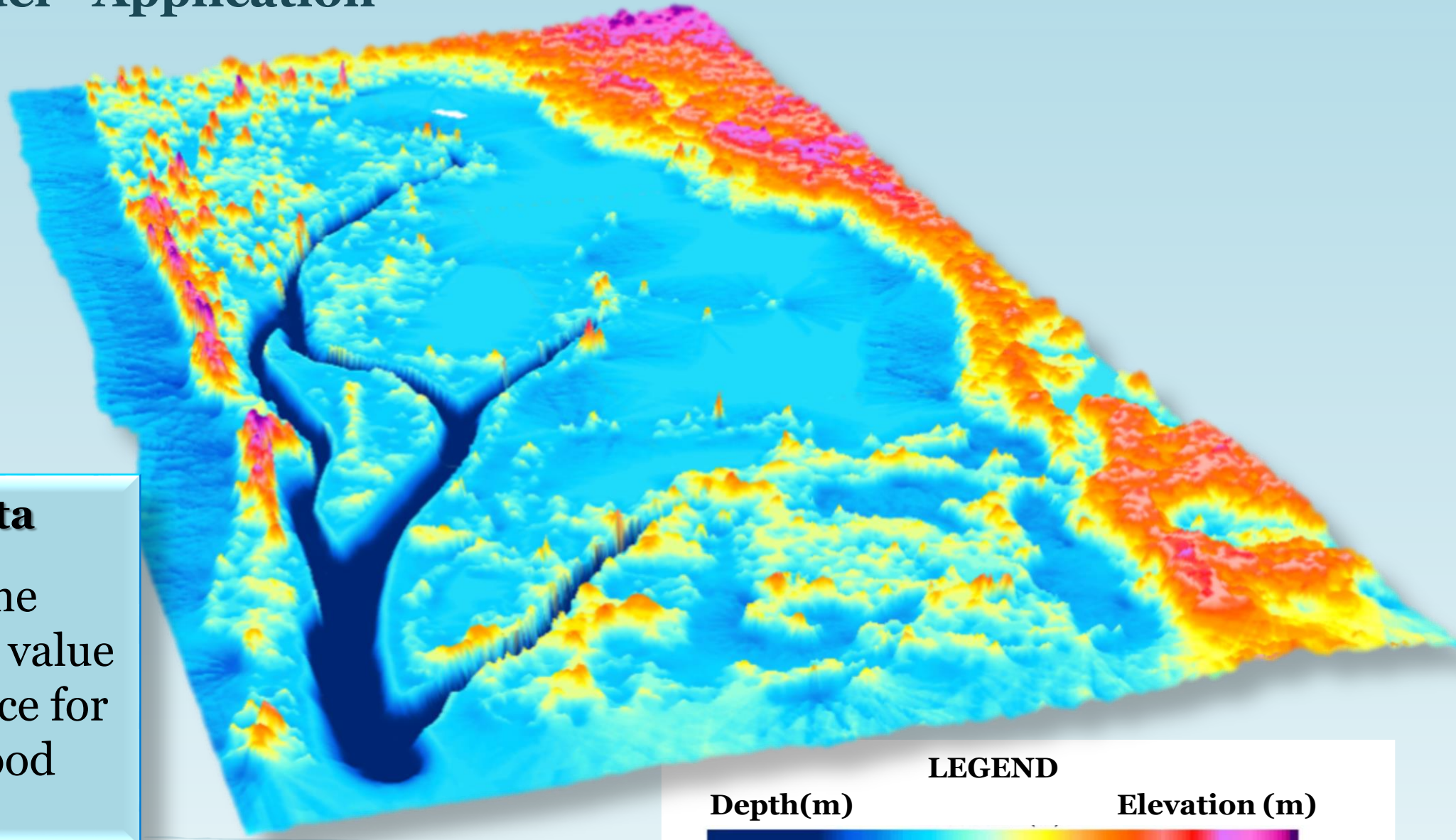


## Main Disadvantages

Limitation of Use of Radar Image for Study of Detail

Artifacts from the Interpolation Process

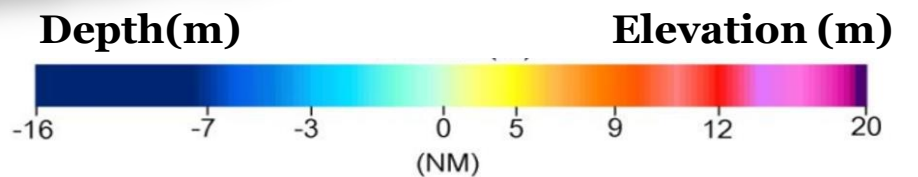
# ALT-BAT Model - Application



## Flood Quota

Expresses the maximum limit value above the surface for a possible flood

### LEGEND

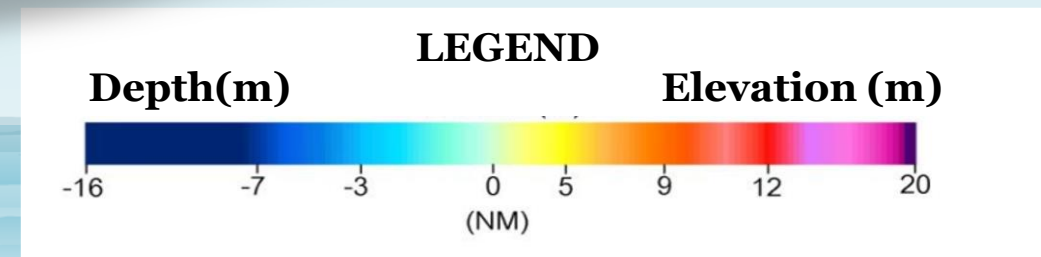
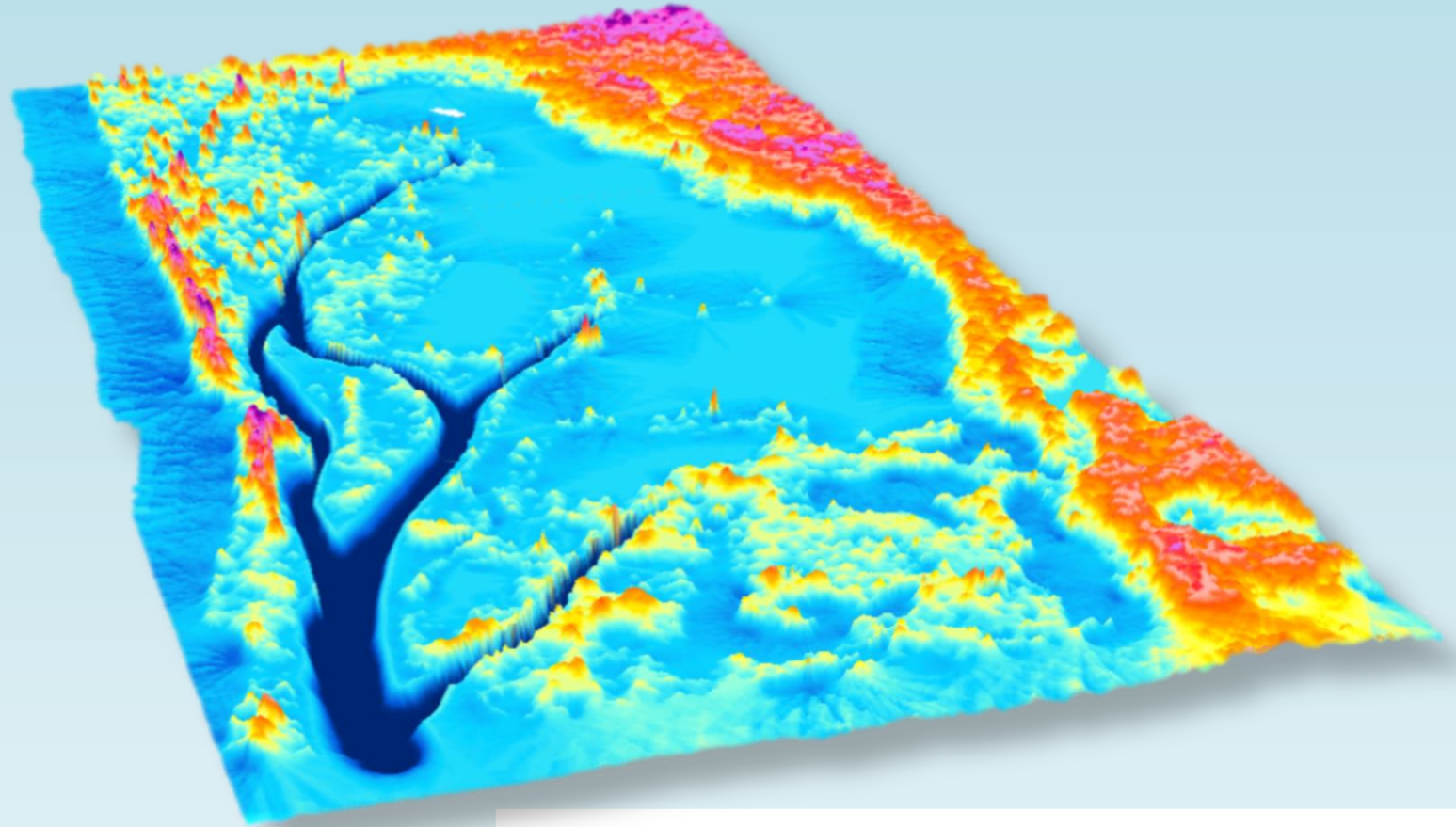


# ALT-BAT Model – Application (+3m)

For a hypothetical scenario, an increase in the average sea level of 3m was considered.

The low altitudes of this scenario revealed the total submersion of the city of Galinhos and as the safest areas the southern portion, where the high altitudes preserved the region.

It was observed that the low altitudes between the dunes present in the Galinhos spit favor the entry of sea water towards the innermost portion of the area, contributing to the complete flooding of the lower portion.



# Acknowledgement



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MINISTÉRIO DA CIÊNCIA E TECNOLOGIA



CENTRO DE CIÊNCIAS EXATAS E DA TERRA

