6as Jornadas de Engenharia Hidrográfica
1as Jornadas Luso-Espanholas de Hidrografia

Salt marsh response to changing hydrodynamics: the case of Ancão Inlet migration (Ria Formosa coastal lagoon)

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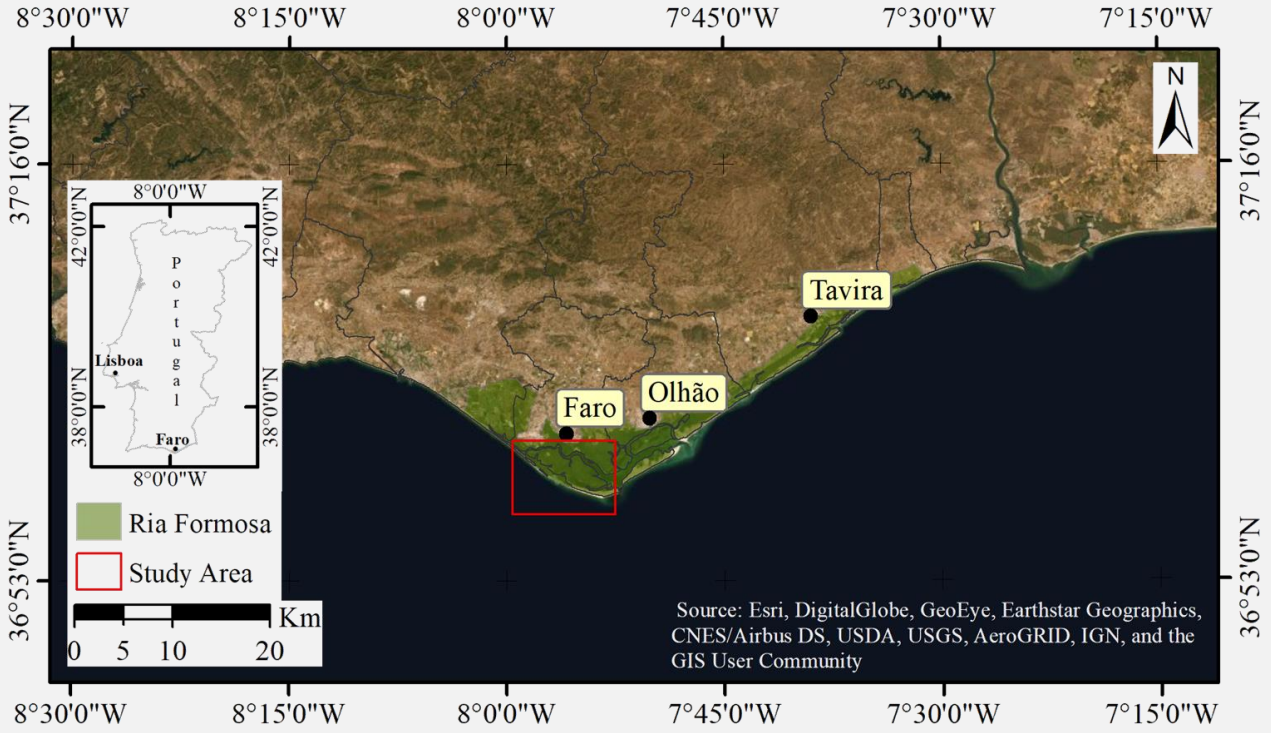
Influence of Ancão Inlet natural migrating stages and human relocation to the surrounding **salt marsh development**, over the last 67 years

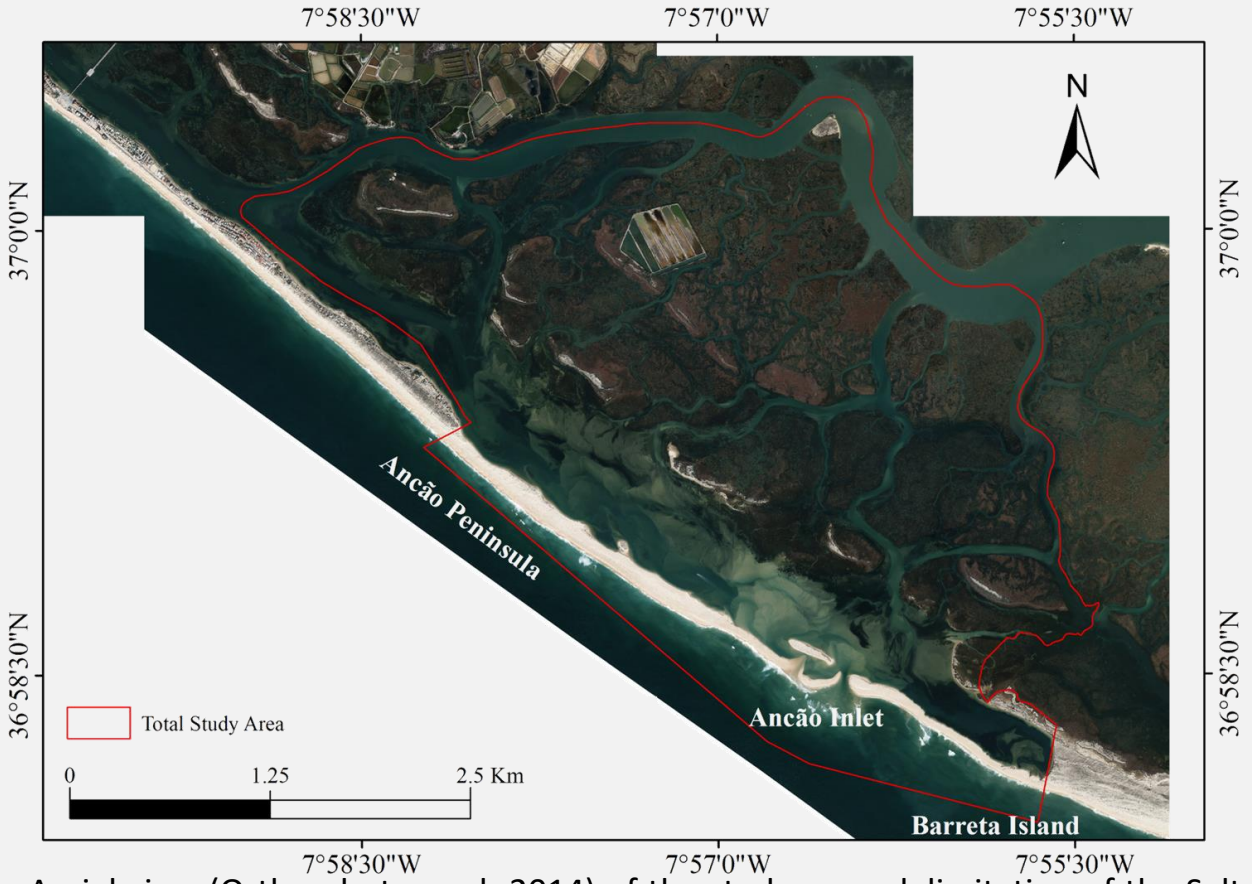
Determine how the diverse sand contributors (e.g., tidal flat and flood deltas) present in the lagoon system interact and influence the **salt marsh development**



Location of Ria Formosa lagoon, and delimitation of the study area.

- Ria Formosa coastal lagoon
- Located on southern coast of Portugal (Algarve)
- Protected by multi-inlet barrier island system
- Characteristics (Costa et al. 2001):
  - Wave direction **W-SW** (71% of incidence)
  - **Semi-diurnal** Tides
    - **Mesotidal**
  - Wave energy is **Moderate to High**
  - Mean annual **Hs** offshore waves **0.92m**

- The salt marsh study area is located in the west part of Ria Formosa, near the Ancão Inlet
- Ancão Inlet presents a progressive easterly migration
- Migration cycle (Dias et al., 2009; Pilkey et al., 1989):
  - Opening in a western position
  - Eastward migration (mean rate of ~67 m/yr)
  - Ends with the inlet reaching its most eastern position and finally closing
  - Starting of a new cycle, with the opening of a new inlet in a former western position
- Inlet relocation in 97 to improve hydrodynamic efficiency (Vila-Concejo et al., 2004)



Aerial view (Ortho-photograph 2014) of the study area, delimitation of the Salt Marsh patches relevant to the study.

Vertical photograph analysis

Ortho-photographs (OP)

- Georeferenced
- Orthorectified
  - ✓Camera tilt
  - ✓Relief
  - ✓Lens distortions

Aerial photographs (AP)

- Simple raster image

Years	Type	Scale/Resolution	Bands
1947	AP	Unknown	1
1952	AP	1:20000	1
1958	AP	1:26000	1
1972	AP	1:6000	1
1976	AP	1:30000	1
1989	AP	1:10000	1
1996	AP	1:8000	3
1999	AP	1:8001	3
2001	AP	1:8002	3
2002	OP	70 cm	3
2008	OP	15 cm	4
2014	OP	15 cm	4

Raster data used and respective information: year of the flight, data type (aerial photo AP or ortho-photo OP), resolution and number of bands available.

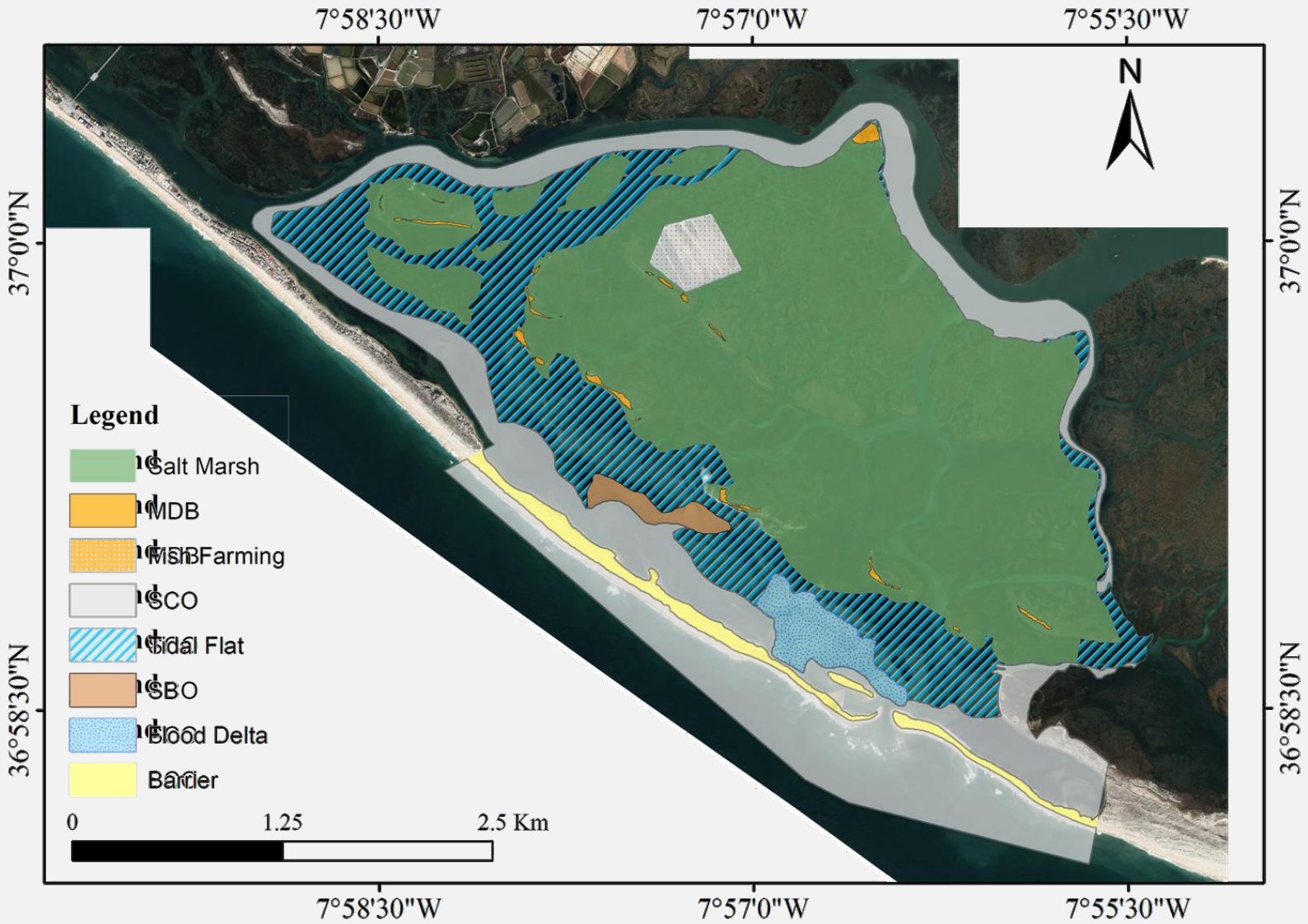
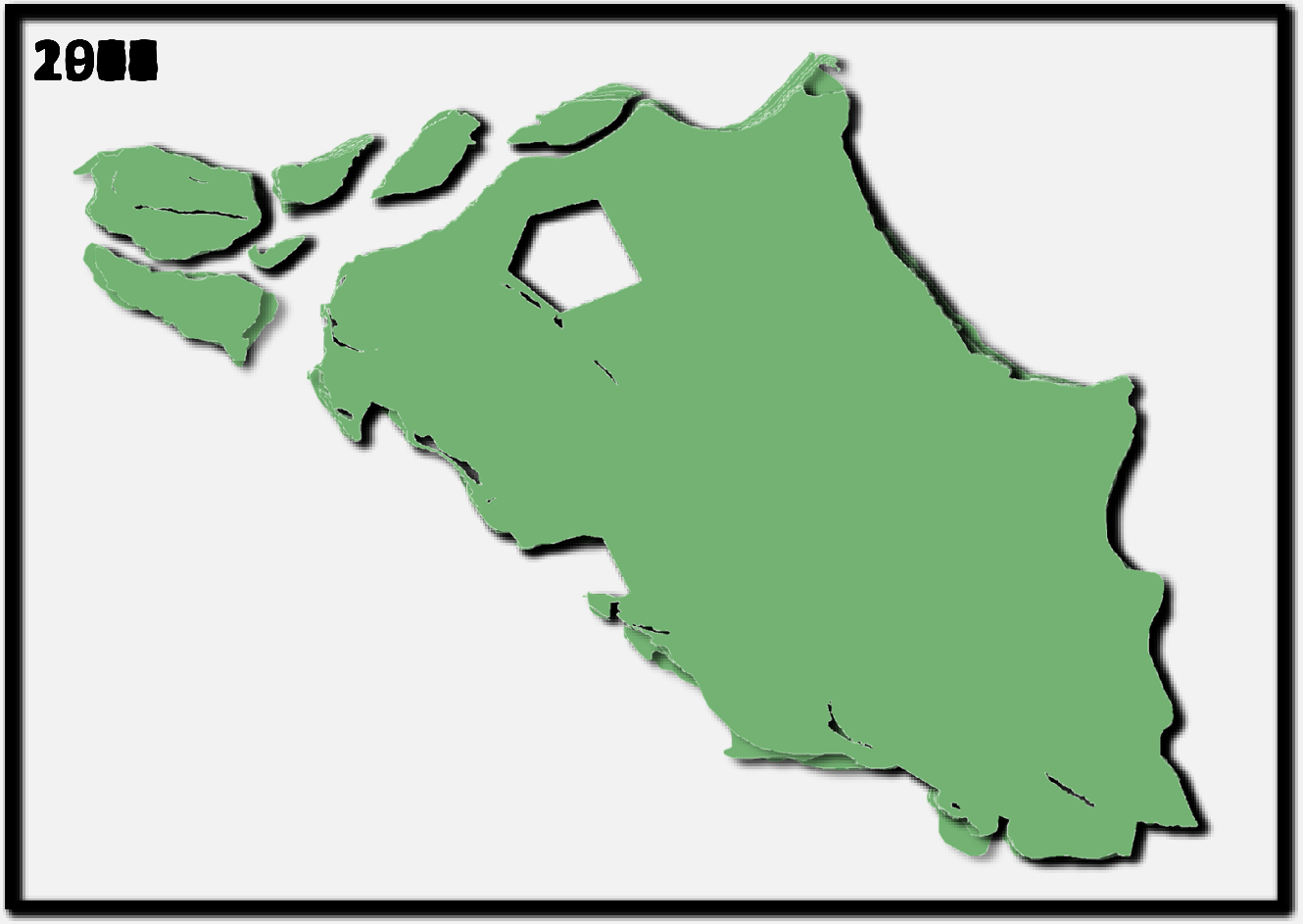


Fig. 8 - Representation of the different morphologies present in the study area.

- **Mapped Morphologies**
  - ✓ Sea, Channels and Others (SCO)
  - ✓ Barrier
  - ✓ Flood Delta
  - ✓ Sand Banks (SB)
  - ✓ Tidal Flat (TF)
  - ✓ Marsh Detached Beaches (MDB)
  - ✓ Fish Farming (FF)
  - ✓ Salt Marsh

The mapped morphologies are the base of the study. Giving information about the area and limit of the morphologies in each available year.

Animation of Salt Marsh spatial Variation



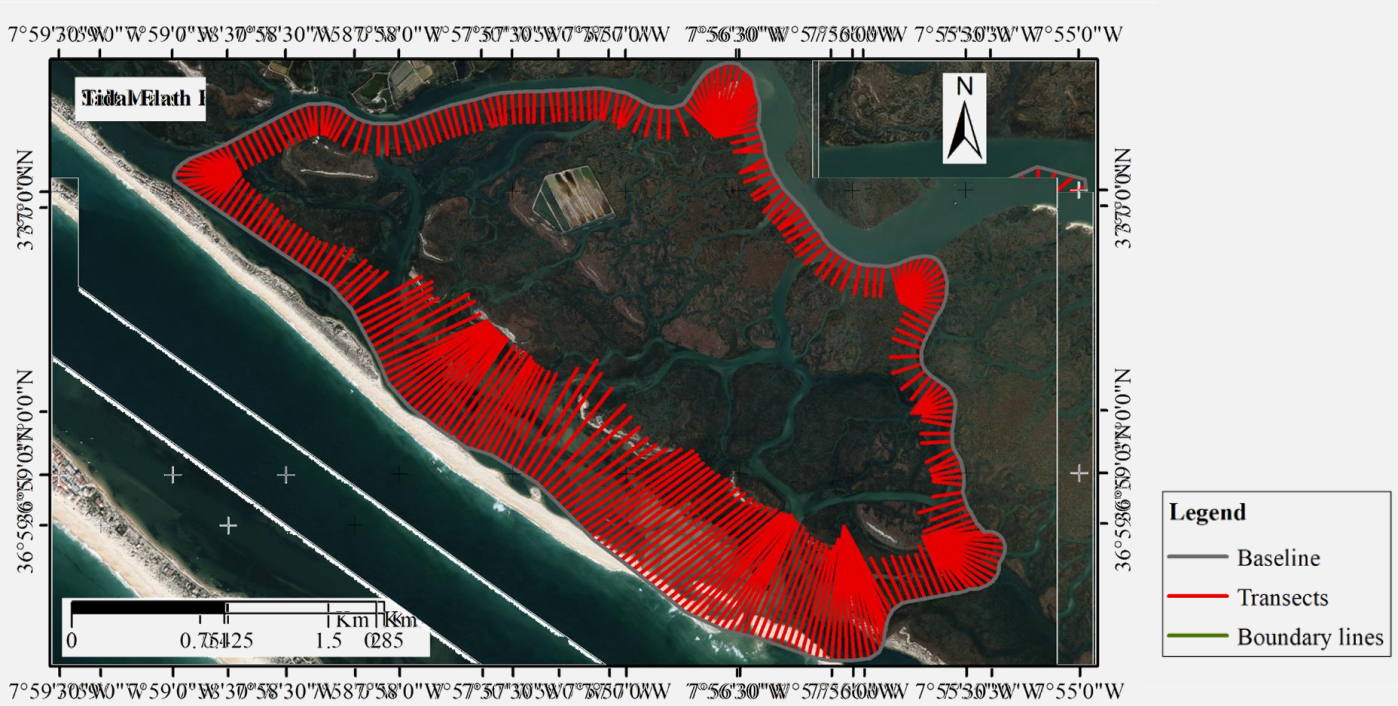
Salt Marsh horizontal variation over time.

Area X → Time → Area X’

- Variation of area over time, from the initial year X to the final year X'

The evolution of total area with time provides a first estimation of the overall behavior over time.

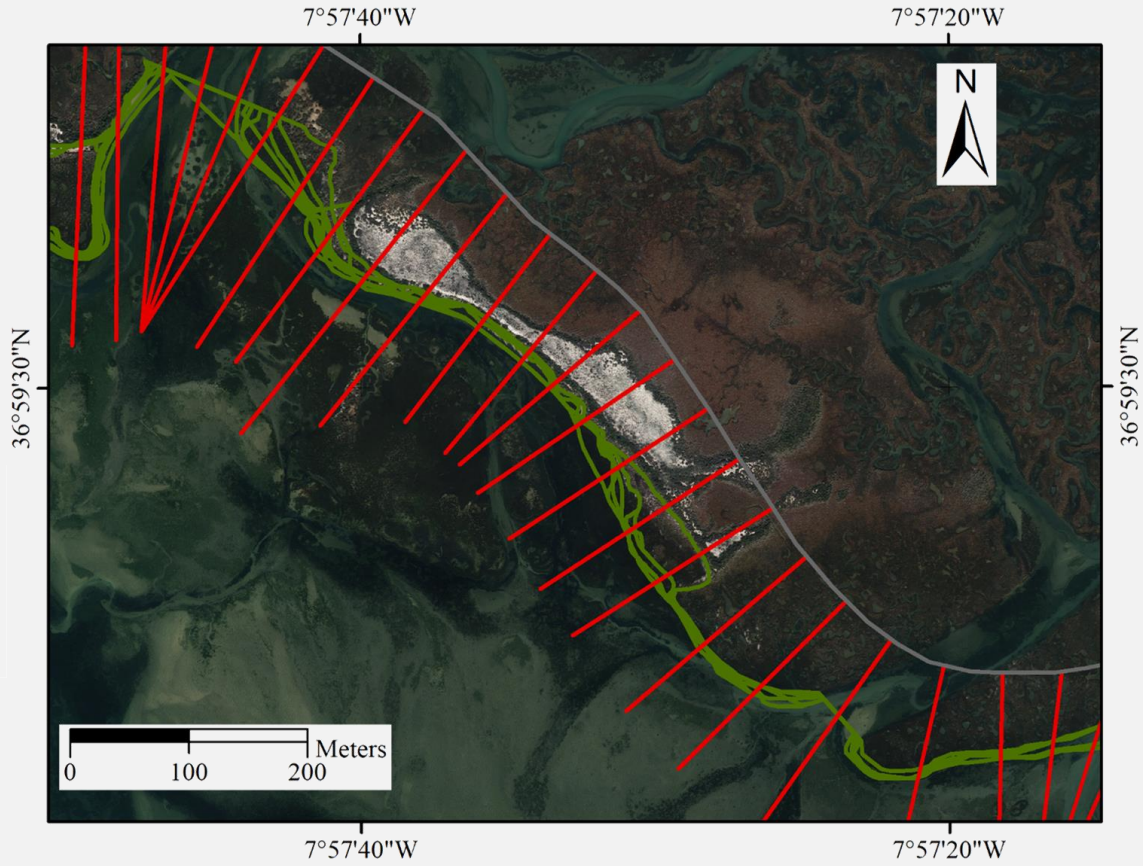
2.7. Salt marsh and Tidal Flat boundaries change



Representation of baselines and transects corresponding to the following morphologies: Salt Marsh West section, Salt Marsh East section and Tidal Flat.

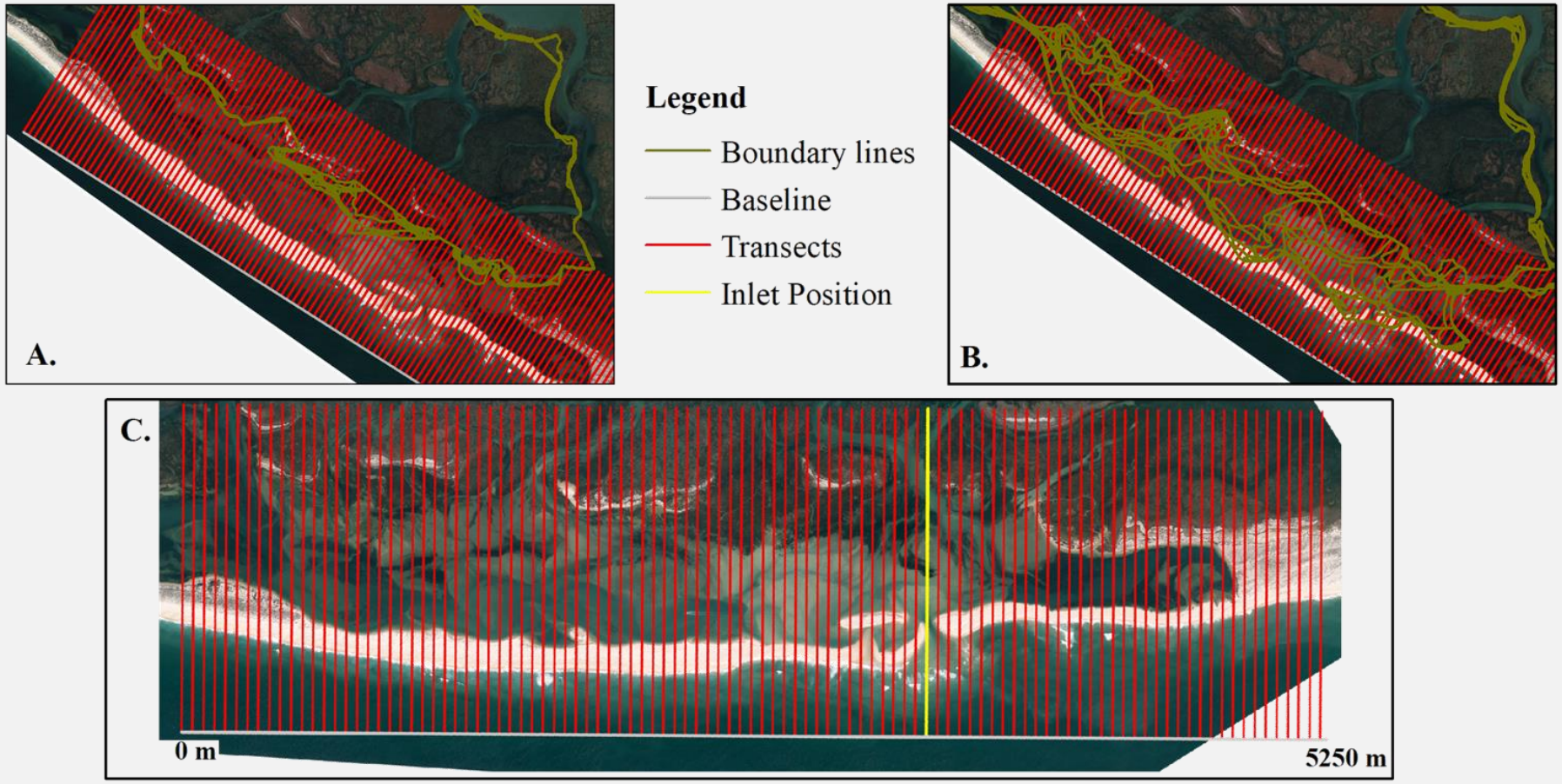
Inherent errors related to mapping (below MSL) morphologies on raster images:

- Morphologies can be buried below suspended sediment, thus leading to incorrect, local erosion-accretion rates



Zoomed area showing the Salt Marsh boundary lines the baseline and the transects (green, grey and red lines, respectively)

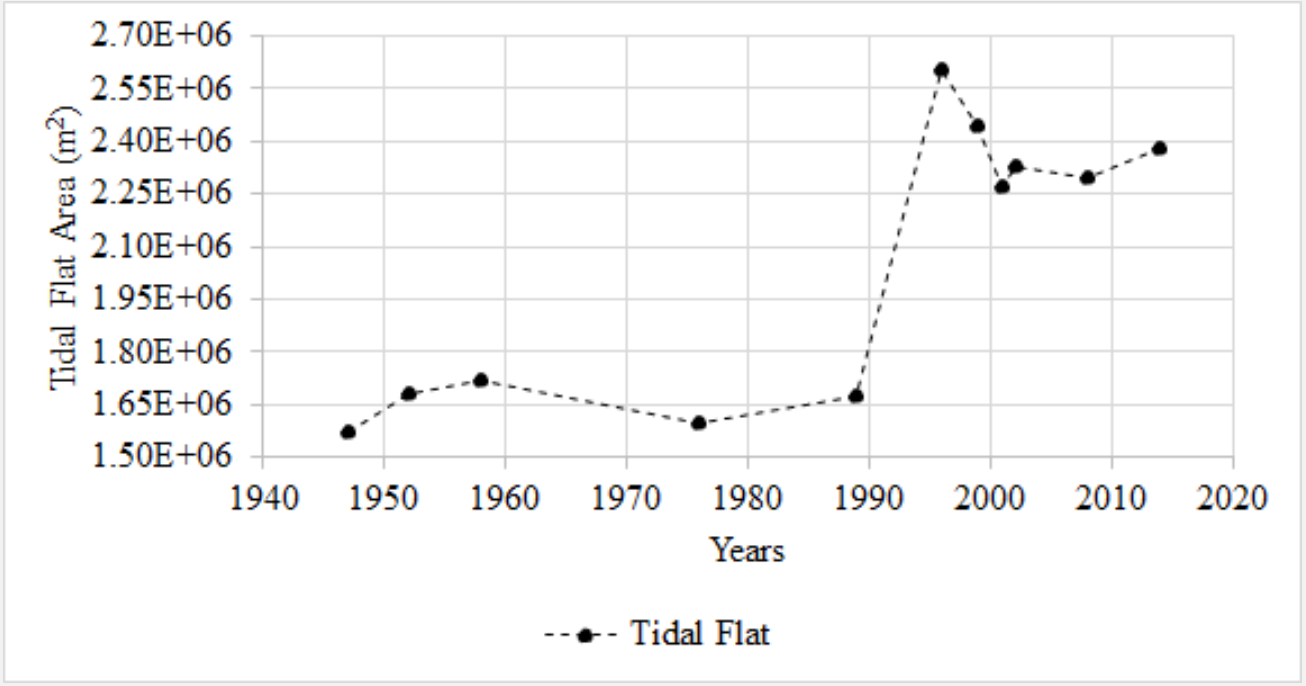
2.8. Salt March and Tidal Flat boundaries change, fronting the Ancão Inlet



Representation of the baseline and transects used to calculate the changes of the Salt Marsh (A.) and Tidal Flat (B.) boundaries fronting the Ancão Inlet; Position of the transects and representation of the Ancão inlet position in yellow (C.).

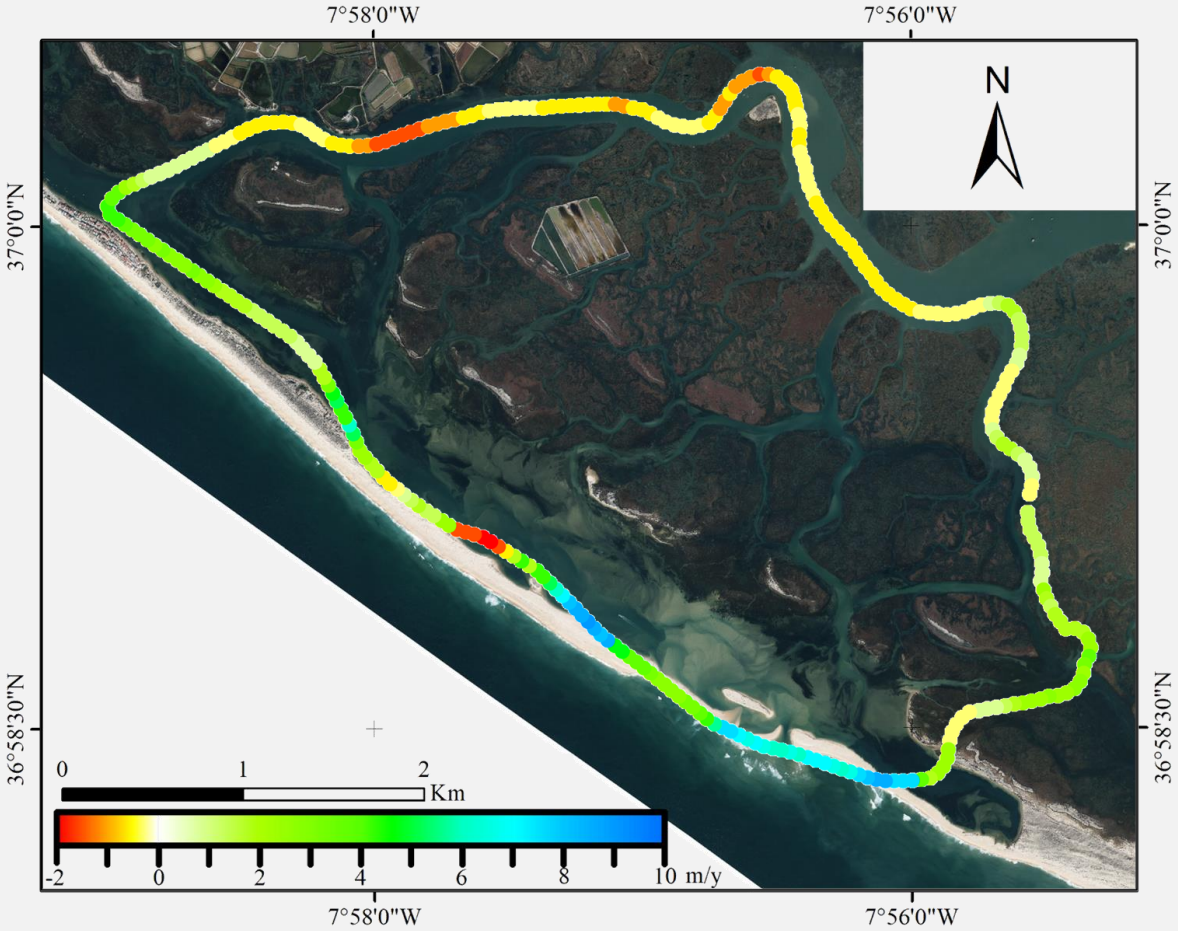
3.1. Salt marsh and Tidal Flat boundaries change

Evolution of the Tidal Flat area (1947-2014)



Evolution of the Tidal Flat areas between 1947 and 2014.

Evolution of the Tidal Flat boundary (1947-2014)



Weighted Linear Regression rates (m/y) between 1947 and 2014 for the Tidal Flat morphology.

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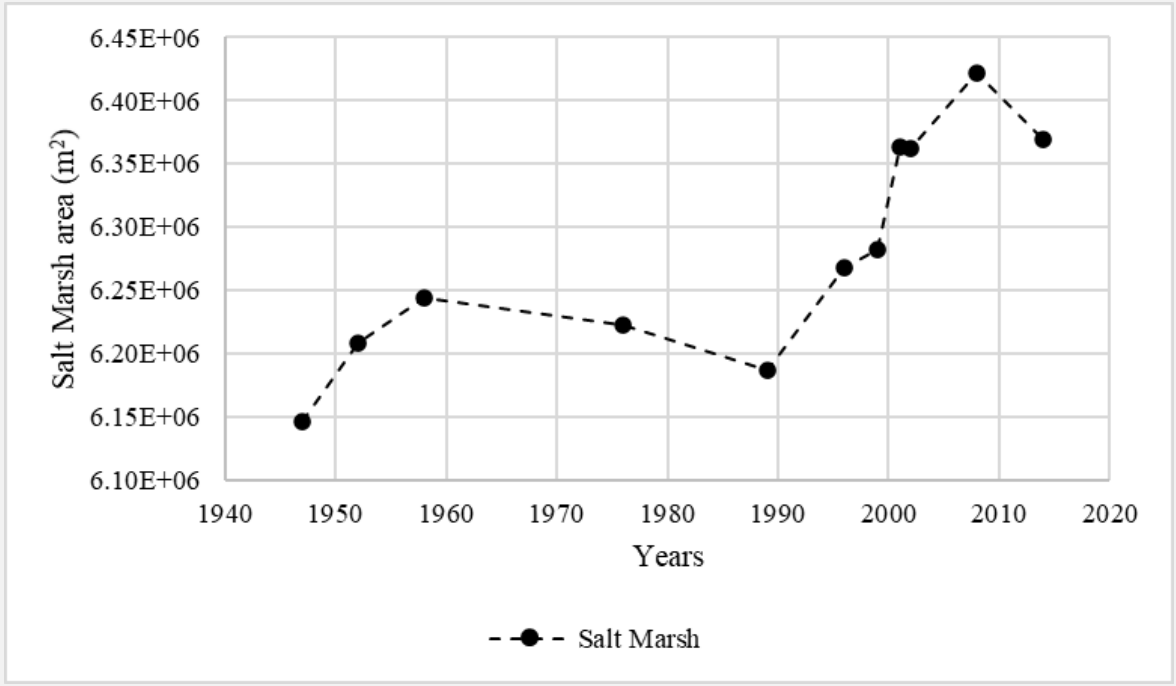
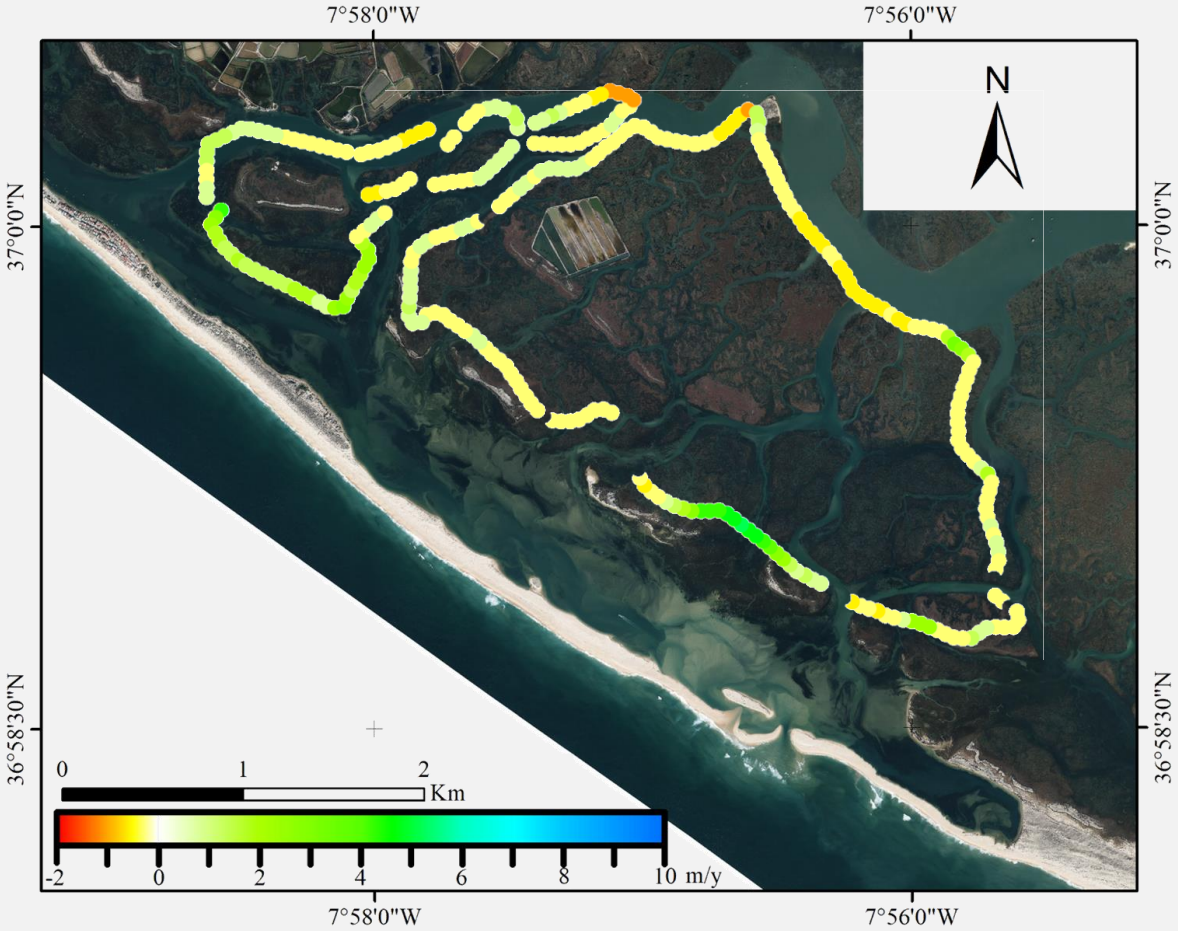


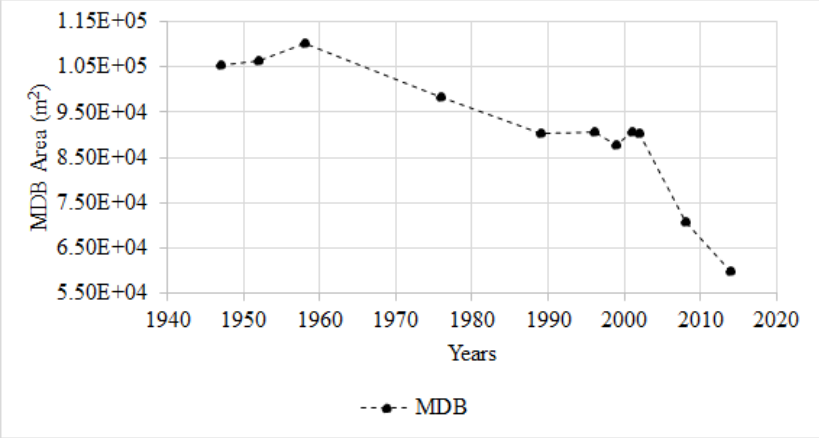
Evolution of the East and West Sat Marsh sections areas between 1947 and 2014.

Evolution of the Salt Marsh boundary (1947-2014)



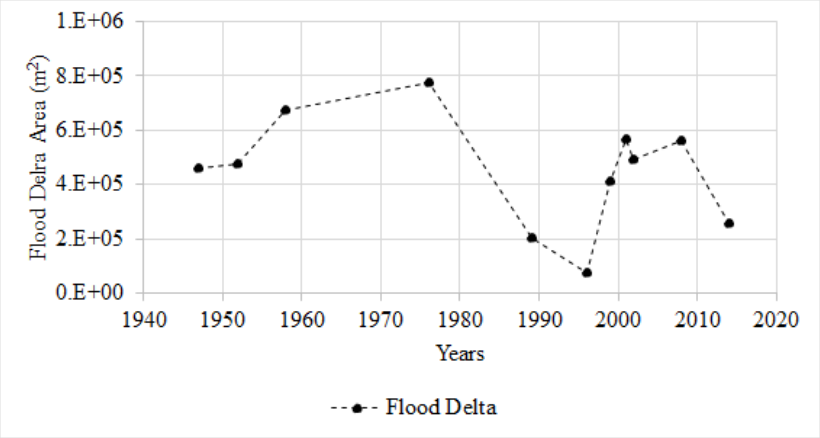
Weighted Linear Regression rates (m/y) between 1947 and 2014 for the Salt Marsh morphology.

Marsh Detached Beaches



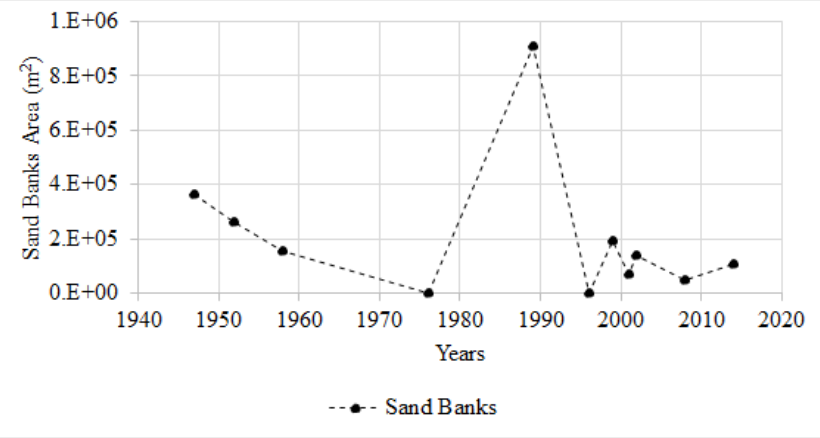
Evolution of the Marsh Detached Beaches areas between 1947 and 2014.

Flood Delta



Evolution of the Flood Delta areas between 1947 and 2014.

Sand Banks



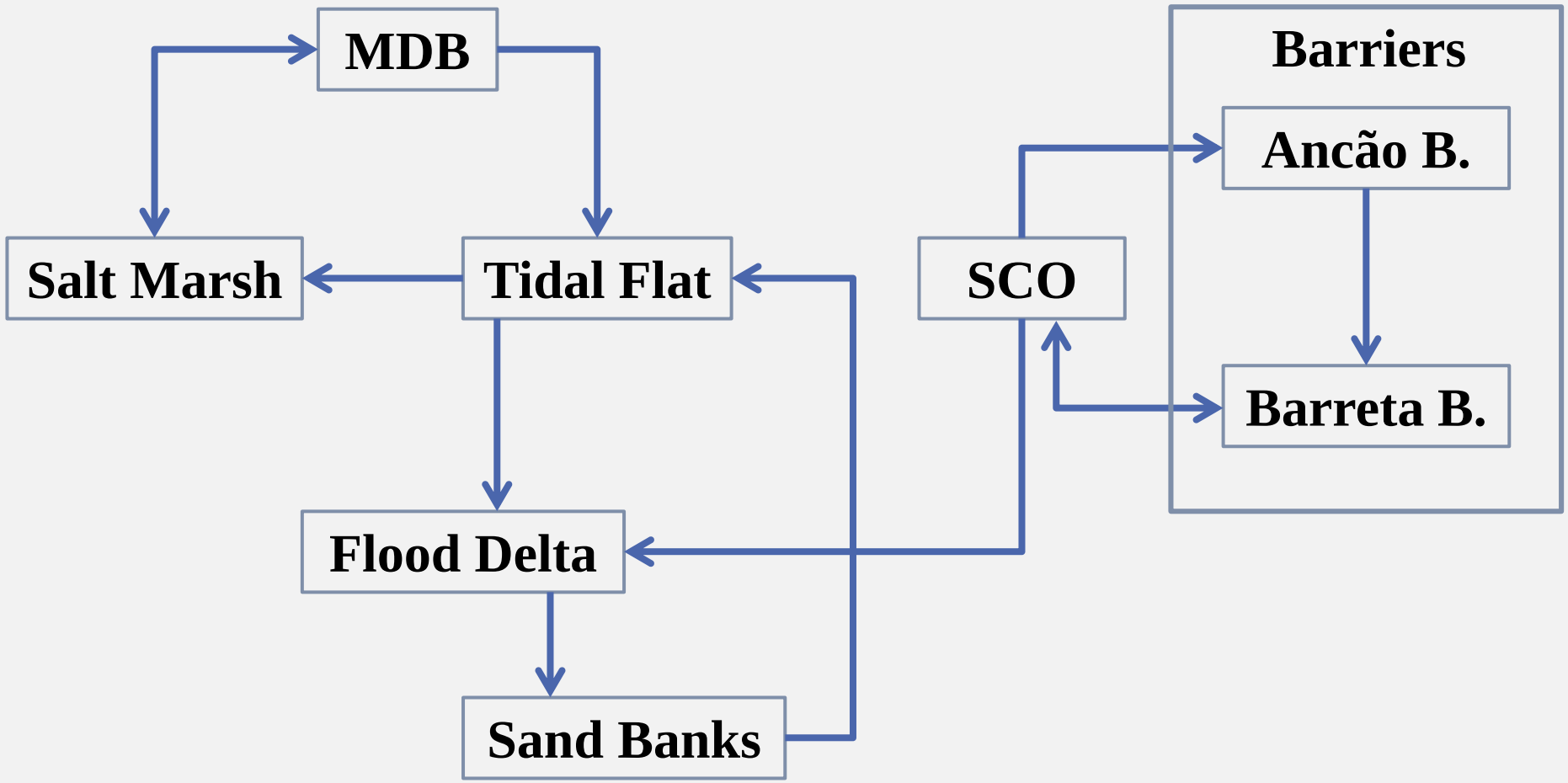
Evolution of the Sand Banks areas between 1947 and 2014.

1947 \ 2014	FD	SM	Barrier	SB	MDB	TF	SCO
FD	0%	1%	0%	62%	0%	14%	1%
SM	0%	94%	0%	0%	0%	3%	3%
Barrier	29%	0%	33%	0%	24%	1%	15%
SB	0%	0%	0%	0%	0%	13%	1%
MDB	0%	1%	0%	0%	58%	0%	0%
TF	8%	4%	0%	0%	18%	46%	5%
SCO	63%	0%	68%	38%	0%	23%	75%
	100%	100%	100%	100%	100%	100%	100%

FD - Flood Delta
FF - Fishing Farm
SM - Salt Marsh
Ancão Barrier
Barreta Barrier
SB - Sand Banks (SB),
MDB - Marsh Detached Beaches
TF - Tidal Flat
SCO - Sea, Channels and Others

Percentages of morphology shifts between 1947 and 2014 (e.g. 63 % of SCO in 1947 transformed to FD in 2014). Values filled in grey represent the preserved area of each morphology, and dark green the transitions above 50 %.

1947-2014



FD - Flood Delta
FF - Fishing Farm
SM - Salt Marsh
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SB - Sand Banks (SB),
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Conceptual scheme representing significant morphology land-cover changes, along all the study period (1947-2014).

4. Conclusion

Evolution of salt marsh areas neighbouring a tidal inlet

Salt Marsh studied shows a over all growth. However the north limit shows signs of erosion that are compensated by the higher accretion values found on the south limit Salt Marsh.

Influence of Ancão Inlet natural migrating stages and human relocation to the surrounding salt marsh development, over the last 60 years

Salt Marsh presents signals of growth on the initial face of the inlet cycle and decrease on the mid and closer migration phase.

Its growth is mainly dependent on the Tidal Flat.

In a long term the Ancão Inlet natural migration seems to have a positive impact on the Salt Marsh development.

The human relocation seems to have no impact big impact on the Salt Marsh however the realization of a relocation too soon can preclude the Salt Marsh development.

Determine how the diverse sand contributors (e.g., tidal flat and flood deltas) present in the lagoon system interact and influence the salt marsh development

The direct driver for the Salt Marsh development is the Tidal Flat. Therefore is indirectly influenced by the same factors that lead to the Tidal Flat development (sand contributors). Consequently making the Ancão Inlet the initial trigger for the Salt Marsh development.

Thank you for your attention.