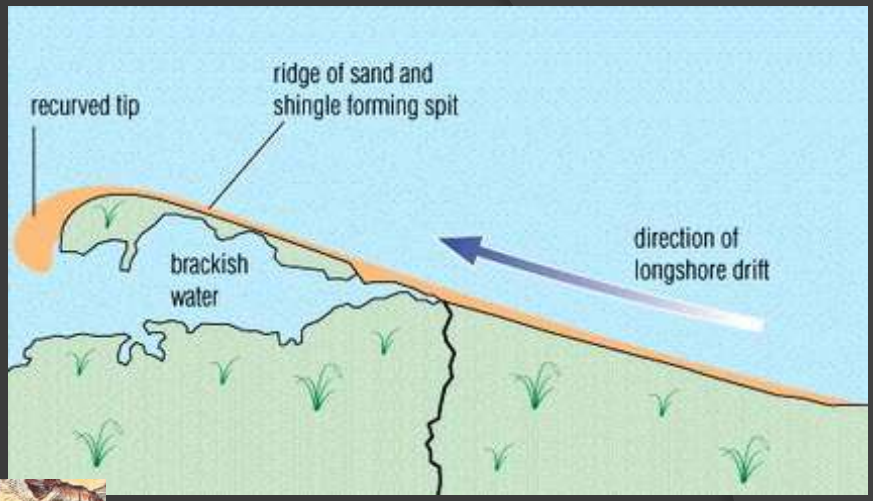
Lagune e ambienti umidi

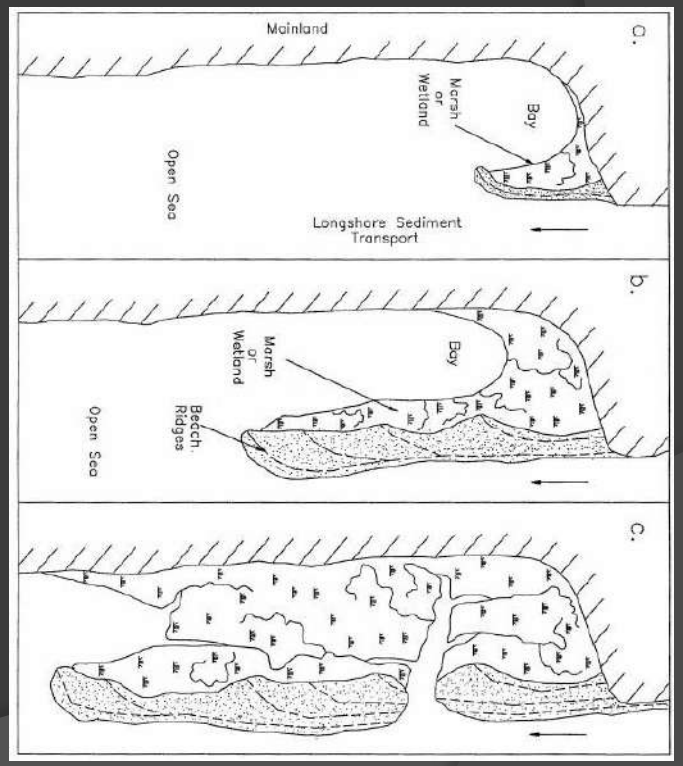
Origine delle lagune

Fattori determinanti: (entroterra a bassissimo gradiente, trasgressione, apporti fluviali, marea)

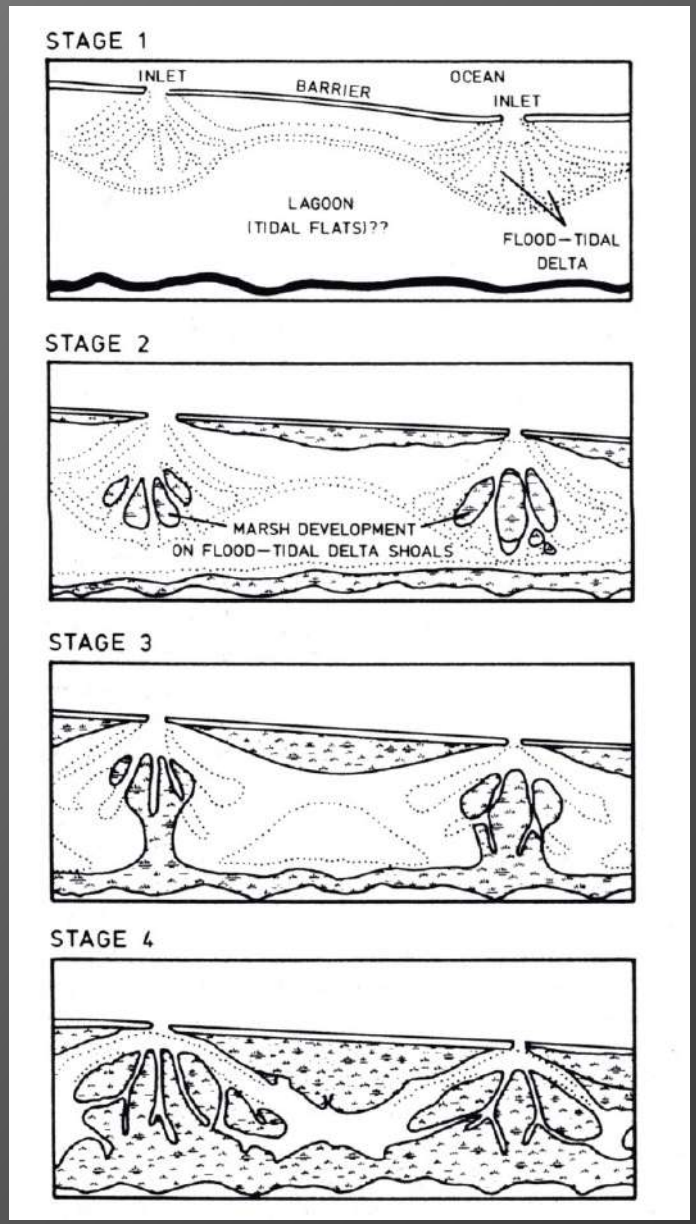
Origine

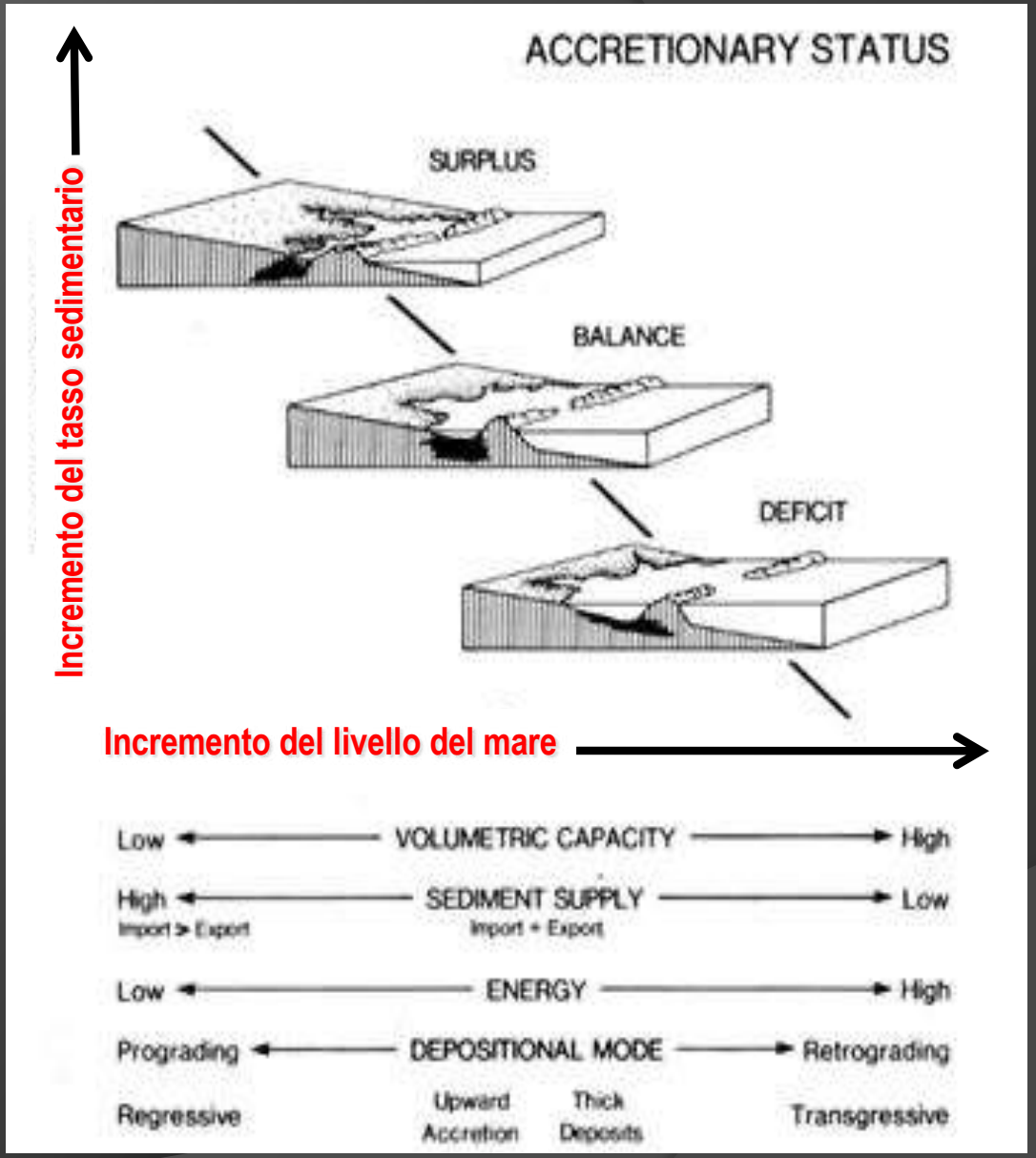
La progradazione di uno spit
e le isole barriera

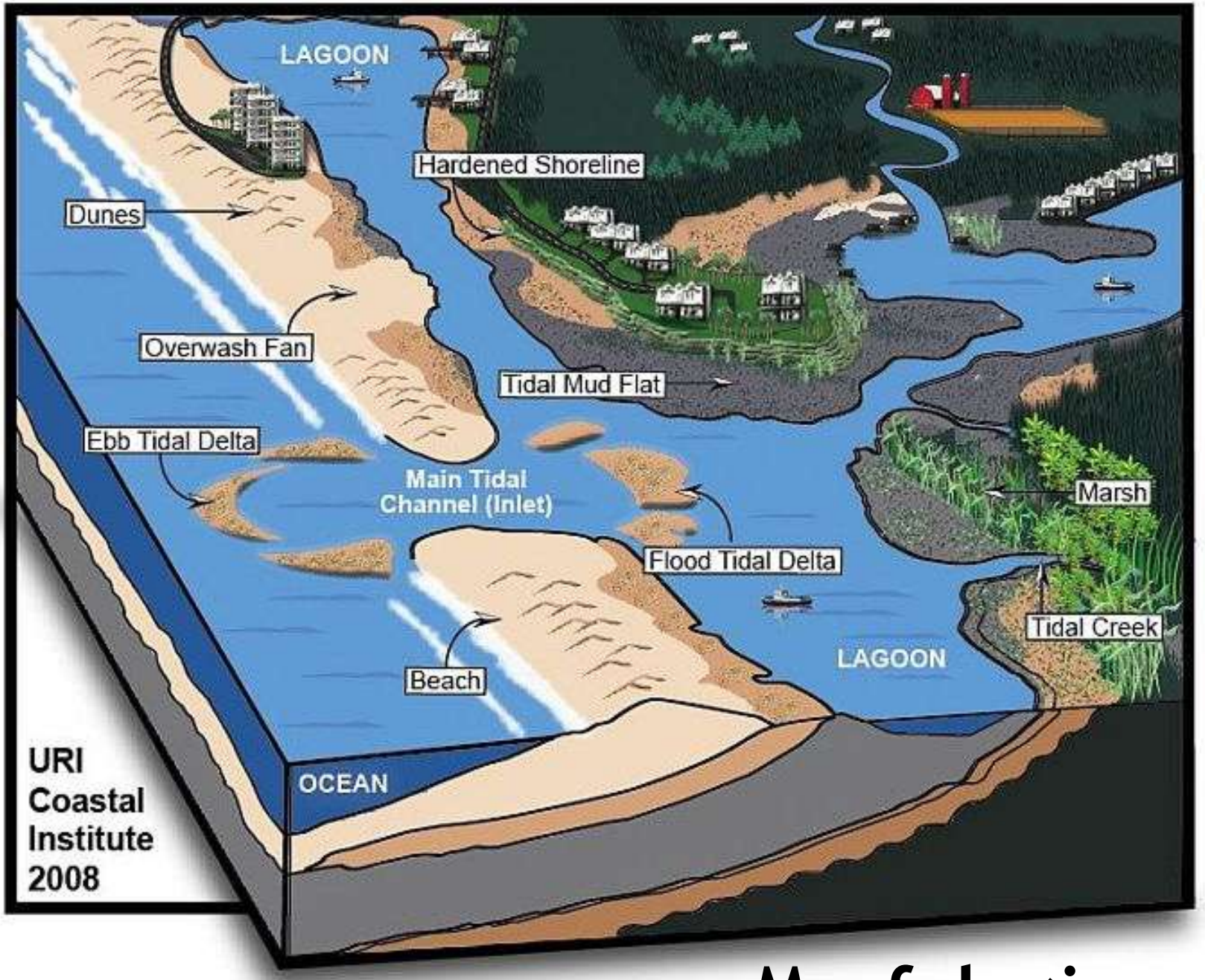




Il bilancio tra le forzanti

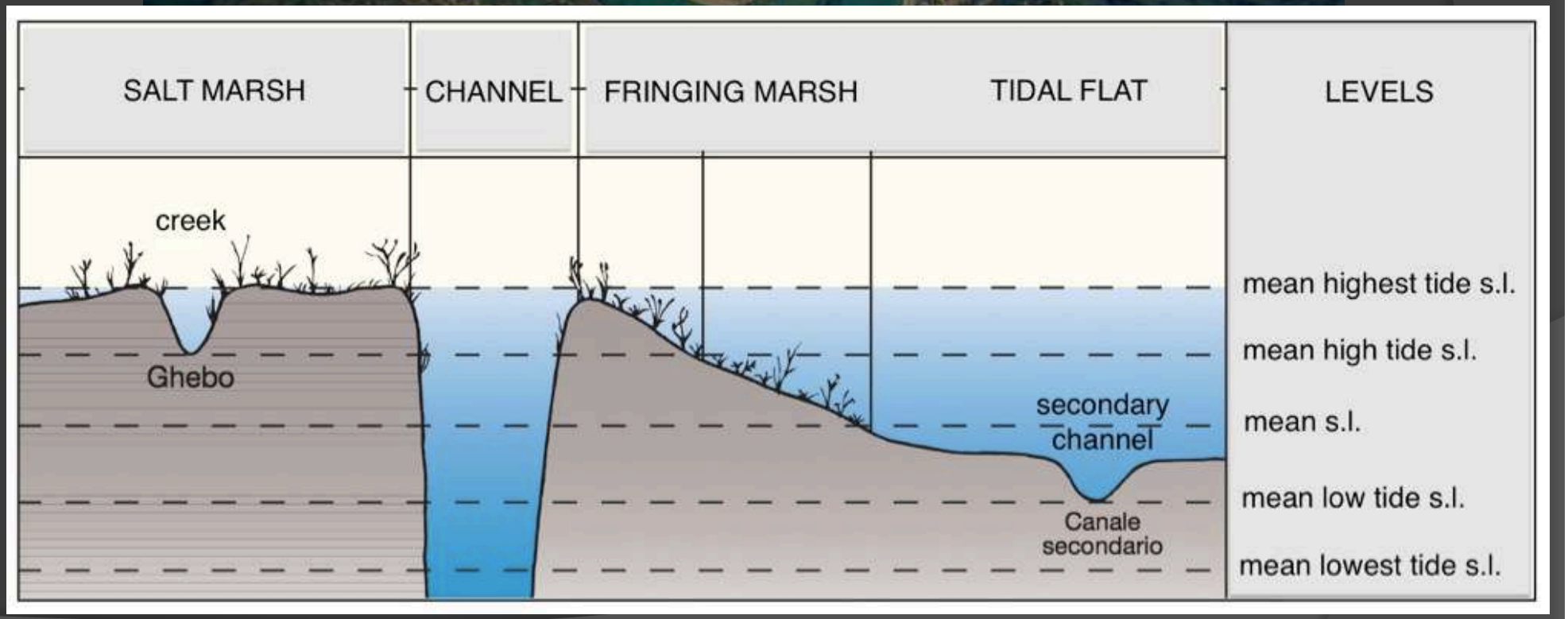





LAGOON
Hardened Shoreline
Dunes
Overwash Fan
Tidal Mud Flat
Ebb Tidal Delta
Main Tidal
Channel (Inlet)
Marsh
Flood Tidal Delta
Tidal Creek
LAGOON
Beach
OCEAN
URI
Coastal
Institute
2008

Morfologie

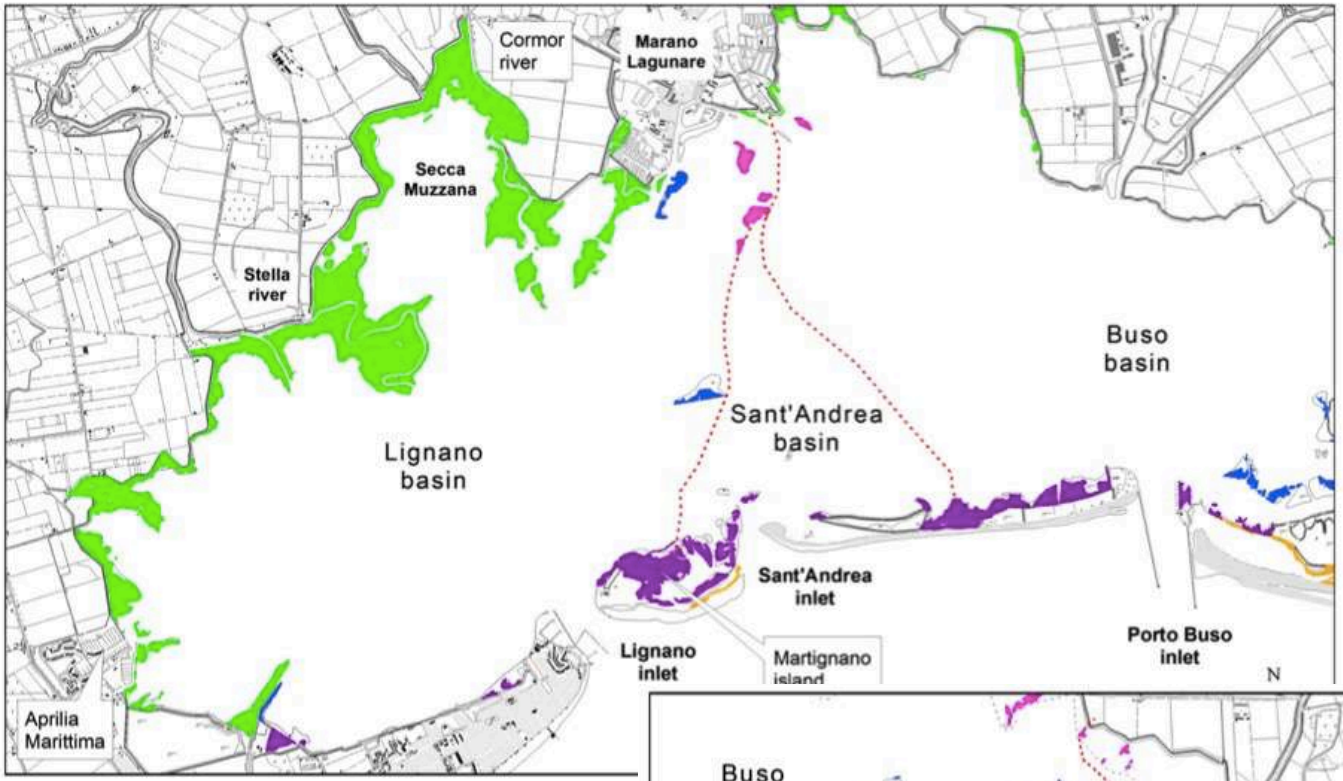
Morfologie

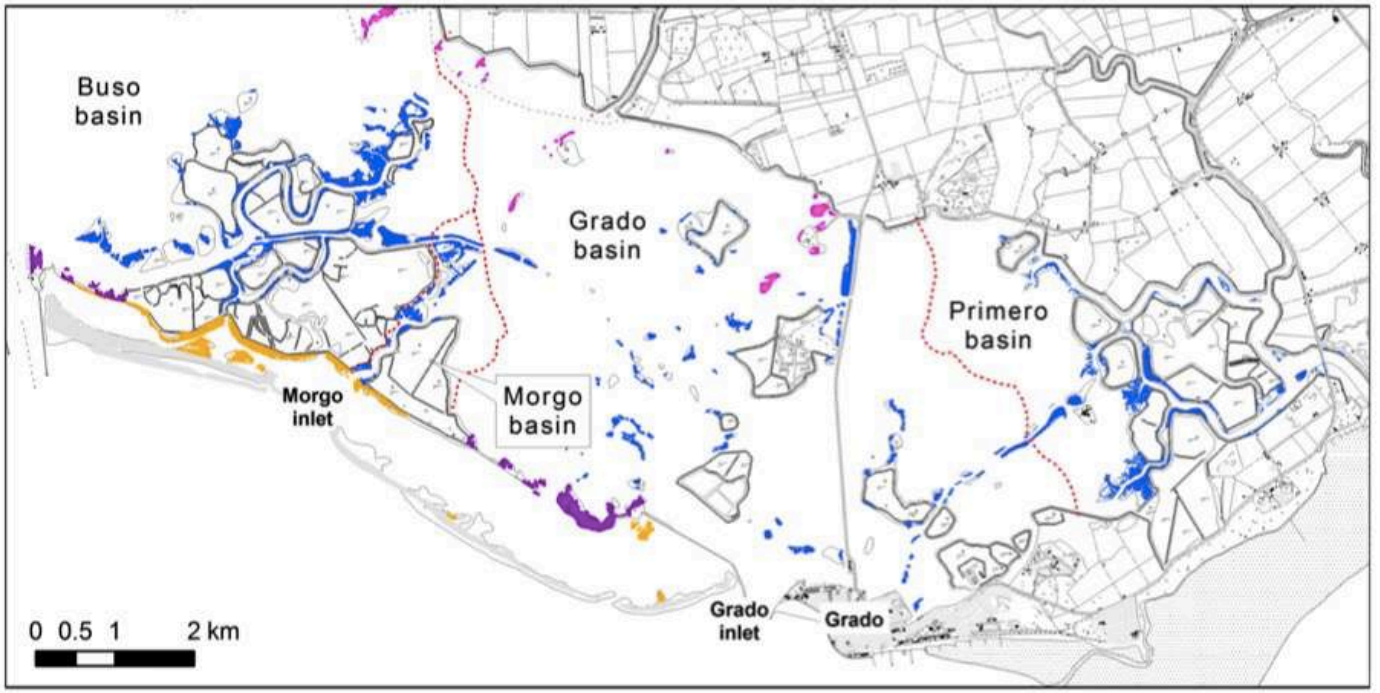

SALT MARSH
CHANNEL
FRINGING MARSH
TIDAL FLAT
LEVELS
creek
Ghebo
secondary channel
Canale secondario
mean highest tide s.l.
mean high tide s.l.
mean s.l.
mean low tide s.l.
mean lowest tide s.l.

Morfologie lagunari

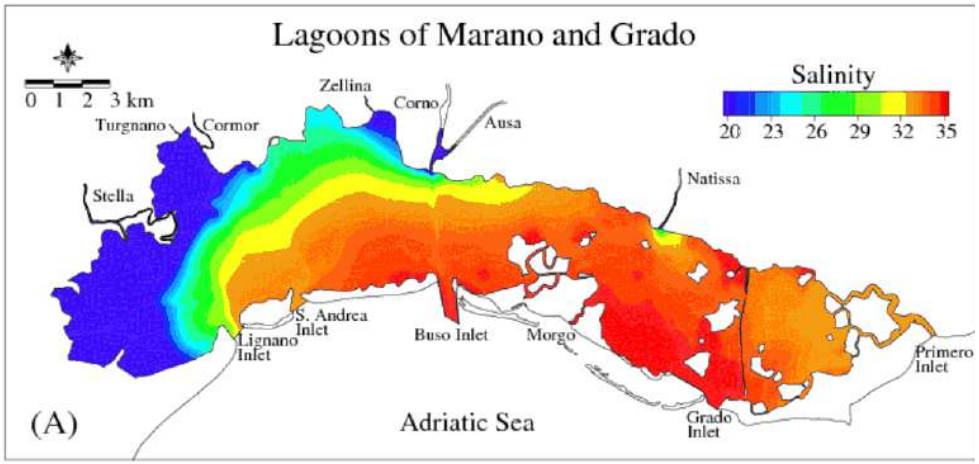
Barene e ghebi *(Saltmarsh and creeks)*

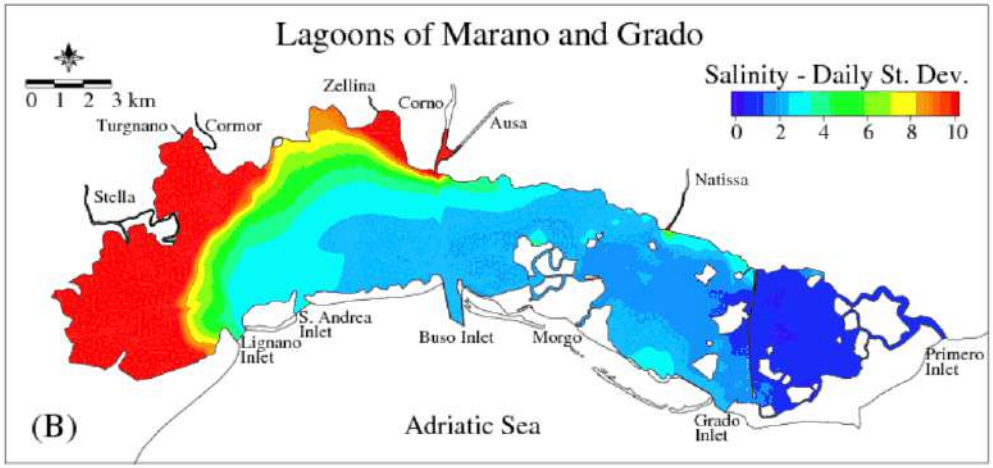
Tipi di barene



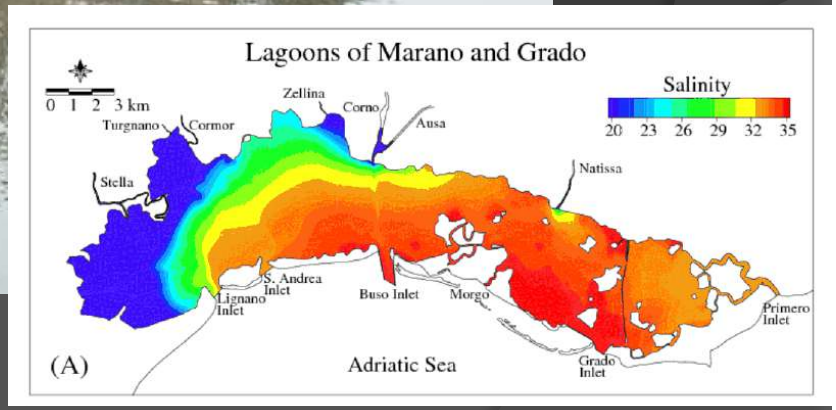


L’ambito estuarino: il gradiente di salinità





Barene di margine lagunare



Barene di margine di canale

LE TRASFORMAZIONI AMBIENTALI

Adattamento alle forzanti trasgressive (innalzamento relativo del livello del mare)

a) Traslazione dei banchi (ROLLOVER)

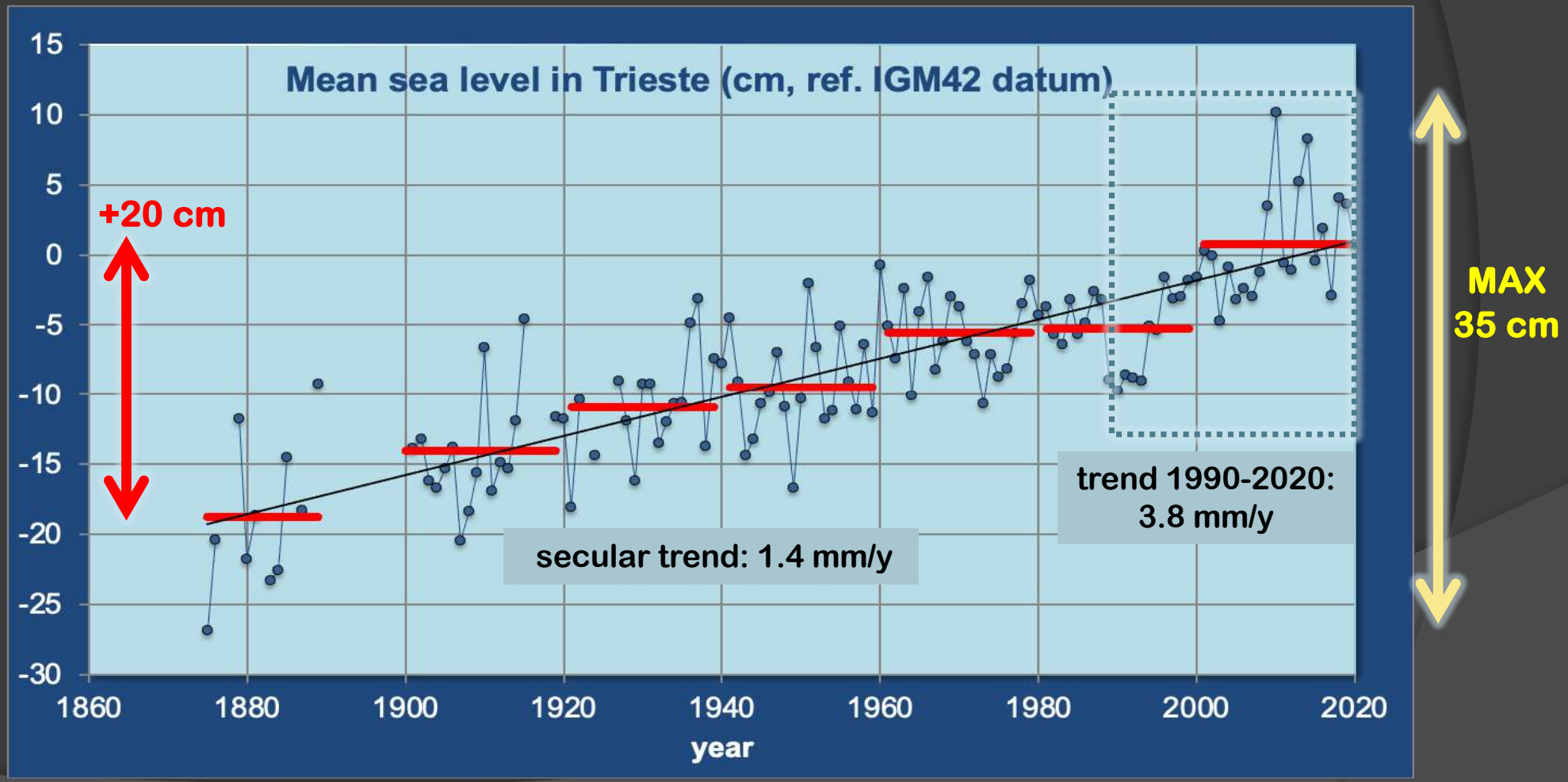
b) Perdita di ambienti intertidali (barene e velme)

FORZANTI INTERNE AL SISTEMA

- Subsidenza regionale: valore medio 0.5-0.6 mm/anno (Antonioli et al., 2009)
- Subsidenza locale: variabile, pochi dati disponibili (tra 0-4 mm/anno)

FORZANTI ESTERNE AL SISTEMA

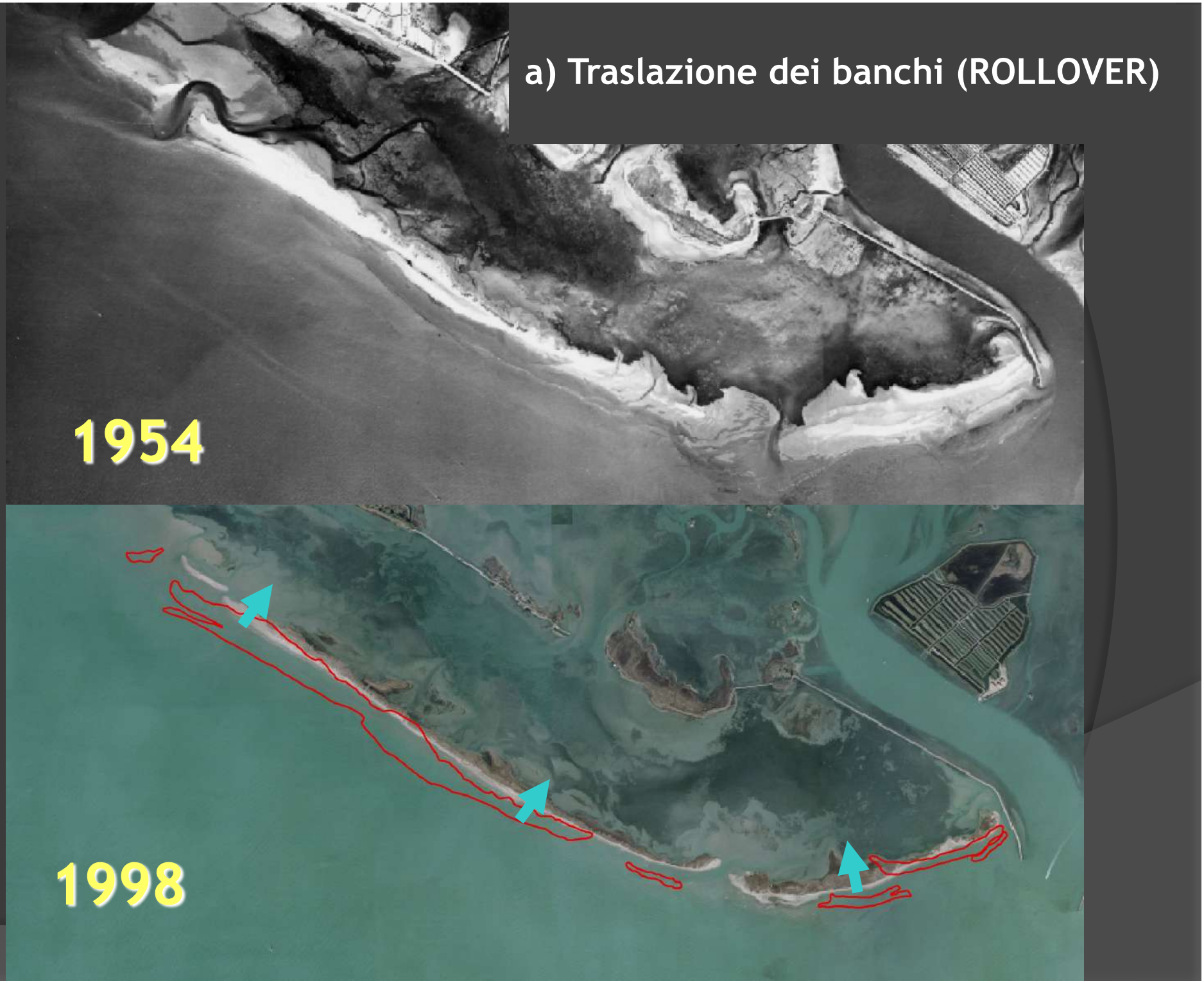
- Innalzamento del livello del mare: media +5 cm (1954-2007) a Trieste



LE ISOLE BARRIERA della LAGUNA DI GRADO

banchi di Anfora, Orio, Tratauri

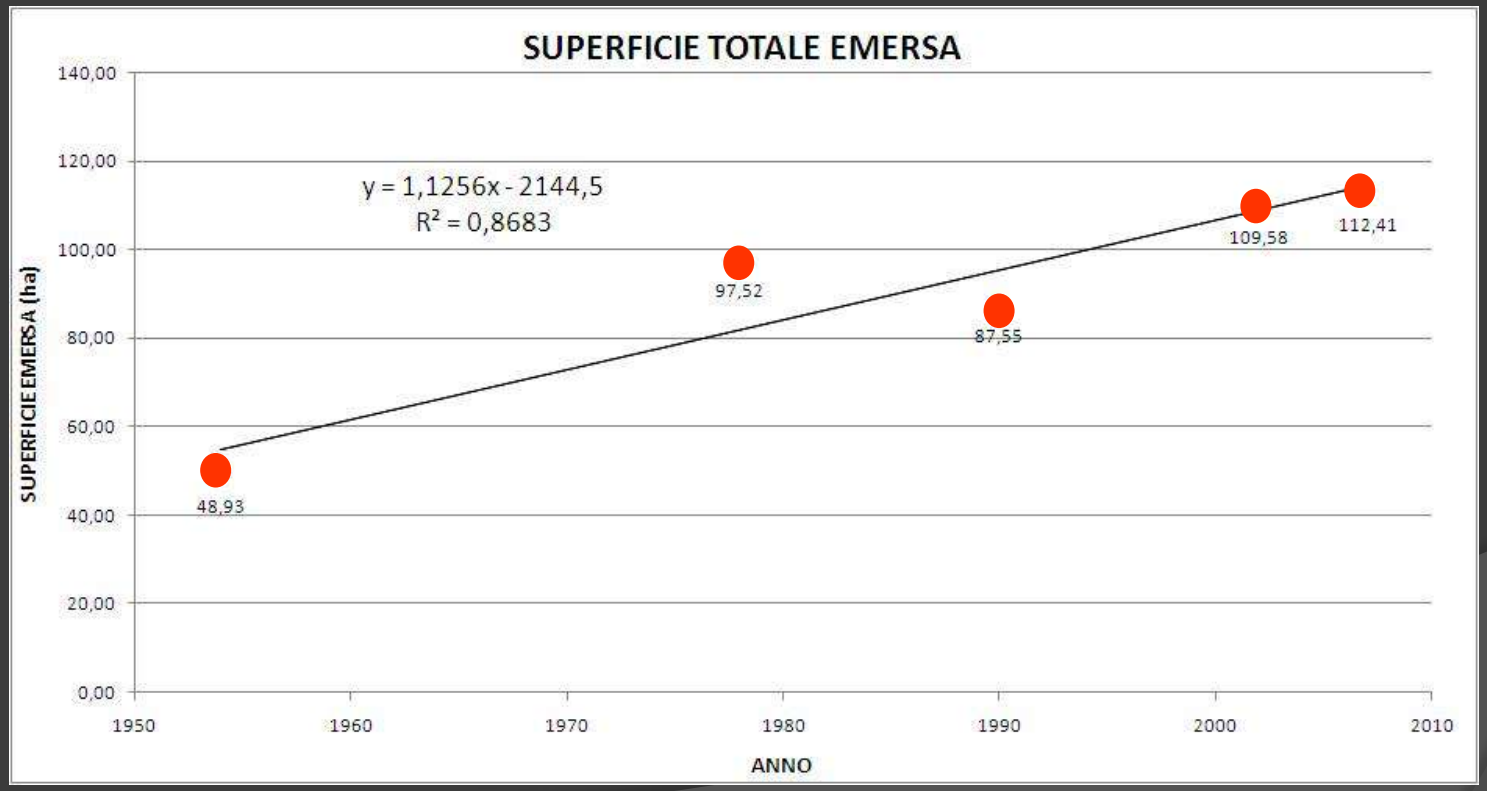
a) Traslazione dei banchi (ROLLOVER)



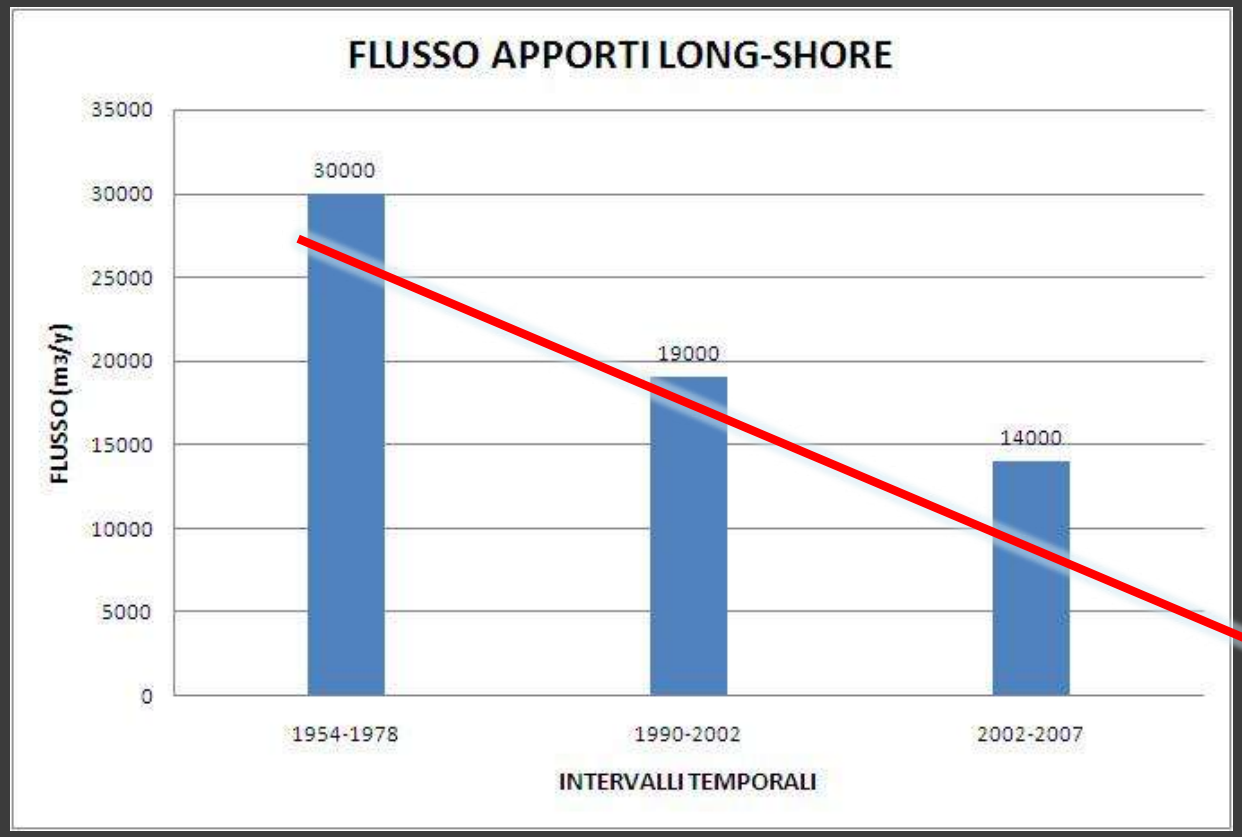
DINAMICHE PREDOMINANTI:

- ✓ CORRENTE LONGSHORE - MICROCANNIBALIZZAZIONE
- ✓ WASHOVER
- ✓ INPUT ESTERNI

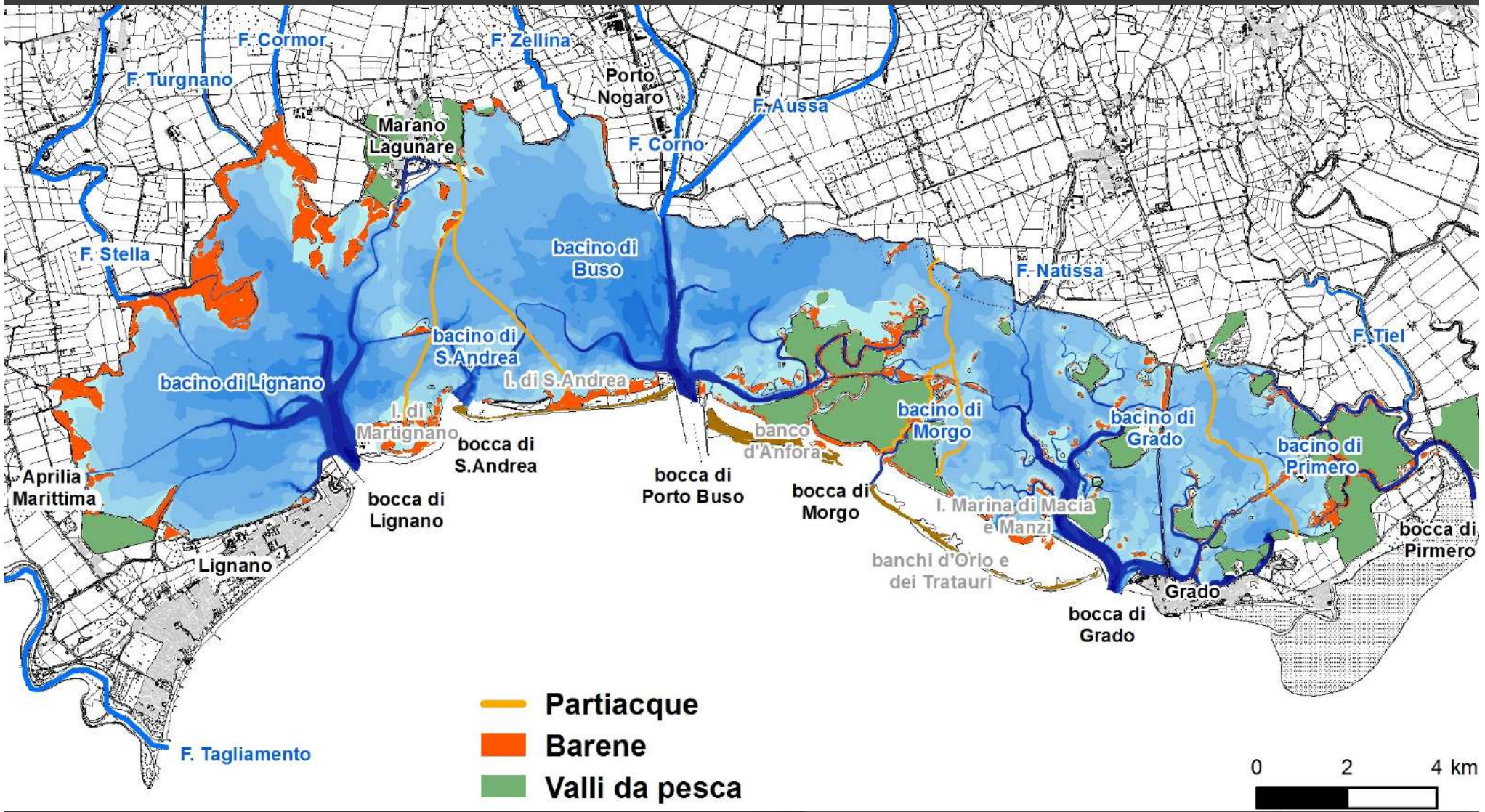
Attualmente il sistema di isole barriera della Laguna di Grado si auto-sostiene in termini di bilancio sedimentario



L’analisi ha evidenziato un decremento del flusso sedimentario nel tempo (dal 1954 al 2007), probabilmente a causa della diminuzione degli apporti per by-pass da est

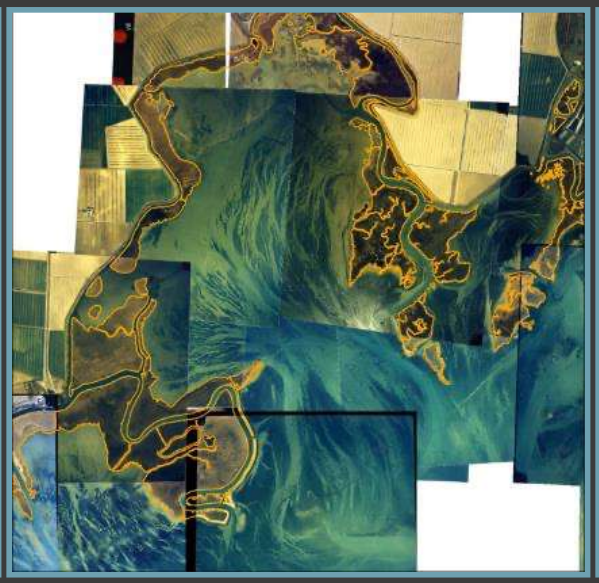


b) Trasformazioni interne (barene)



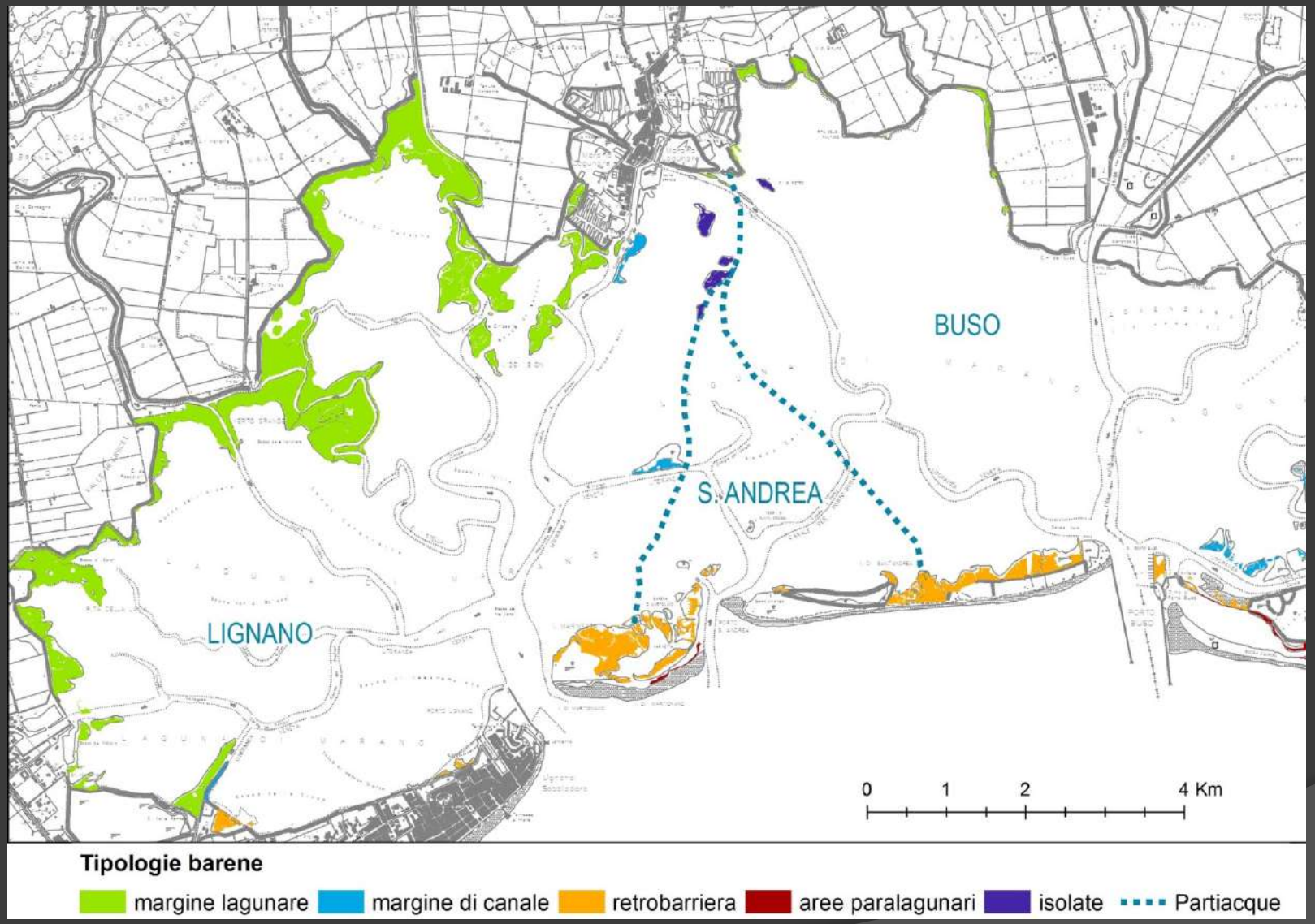
ANALISI A MACROSCALA

- Vettorializzazione dei contorni delle barene dalle foto aeree 1954, 1990, 2006



1954 **1990** **2006**

1) Classificazione delle barene in tipi morfologici



Stato di fatto:
760 ettari nel 2006

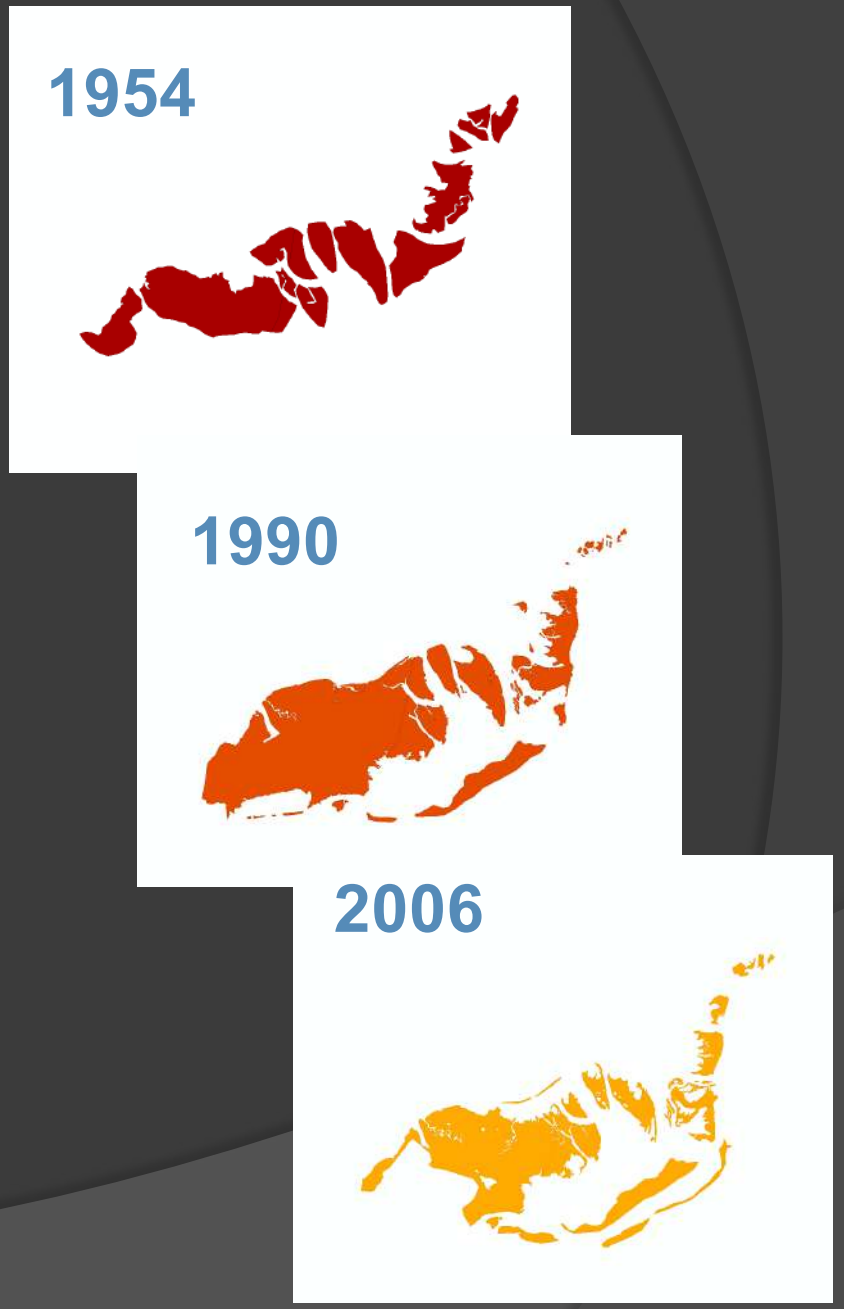
3) Analisi evolutiva a differenti scale

SINGOLA BARENA

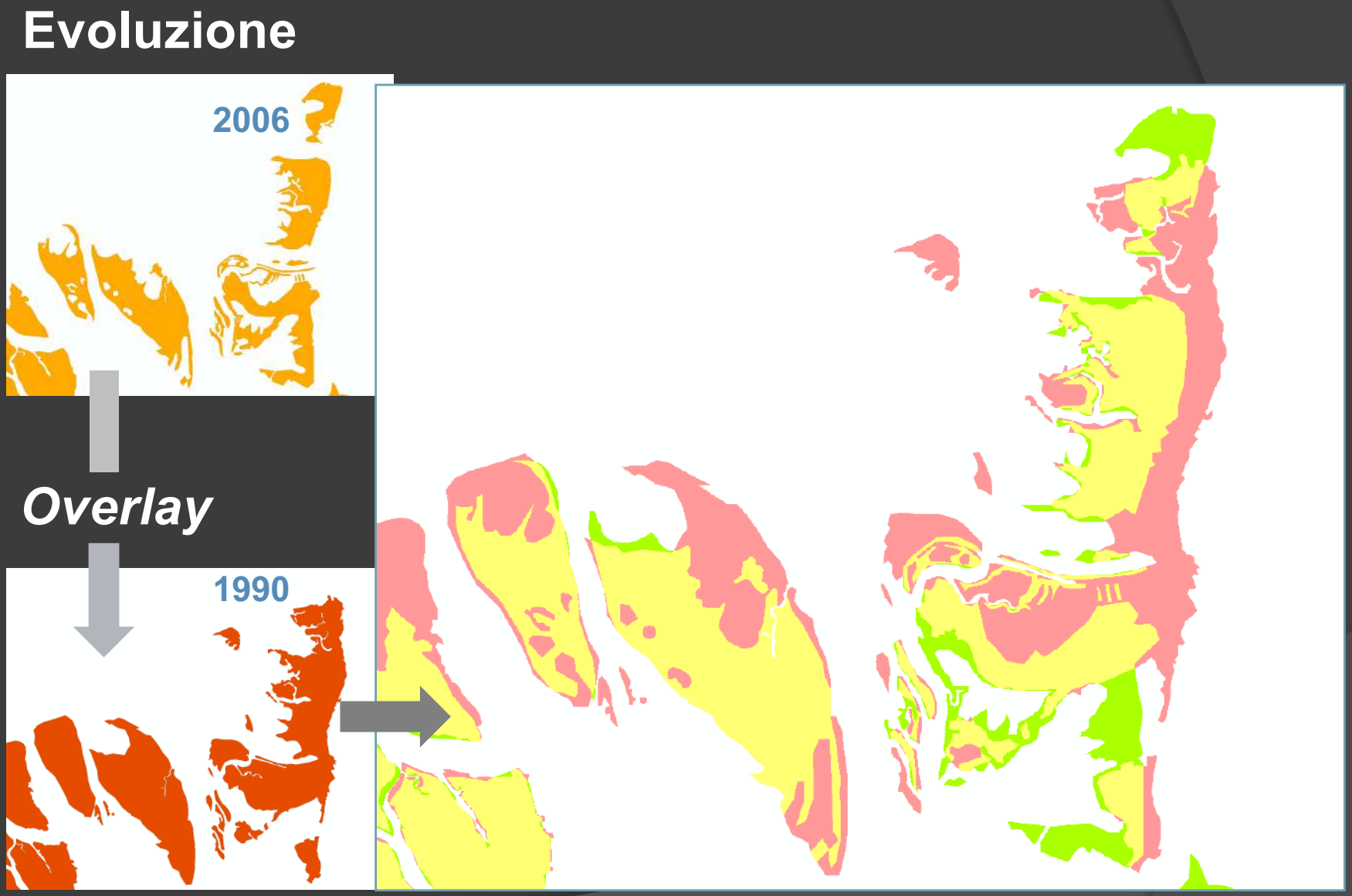
GRUPPI DI BARENE

BACINO

INTERA LAGUNA



Evoluzione: analisi topologica multitemporale

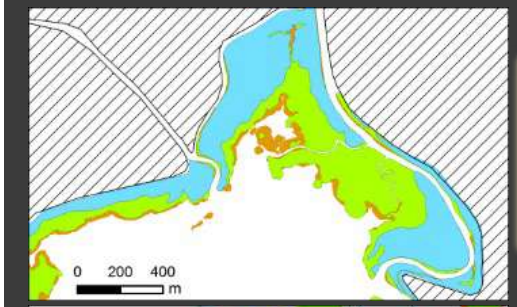


4) Individuazione di tipologie Erosive / deposizionali

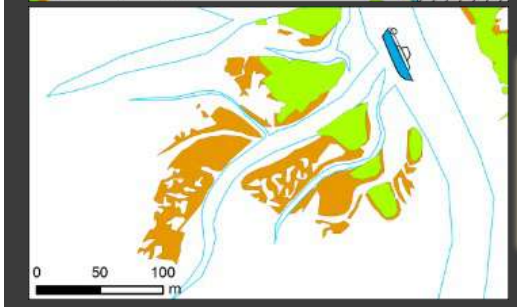
PARAMETRI MORFOLOGICI E GEOGRAFICI

- modalità evolutiva (accrescimento arretramento)
- morfologia dei margini in pianta e in sezione
- posizione rispetto a elementi morfologici significativi naturali o antropici
- tipo di vegetazione

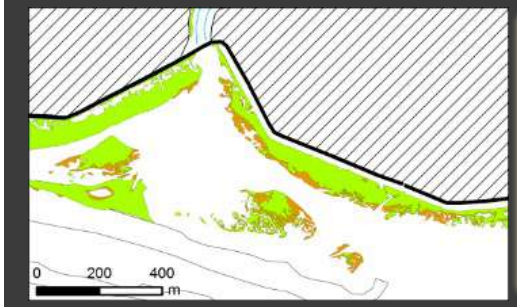
ACCRESCIMENTO



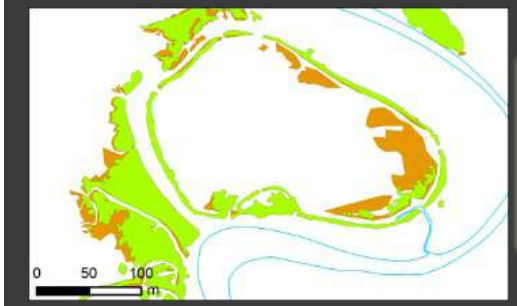
A1 input fluviale



A2 input lagunare



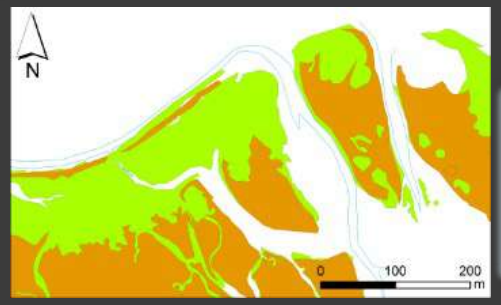
A3 aree paralagunari recenti



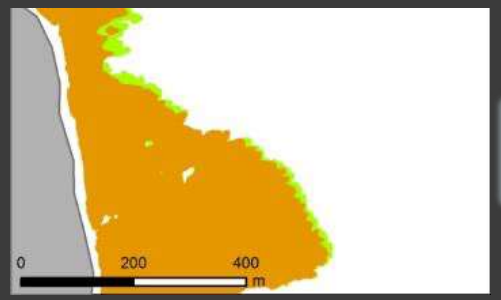
A4 ex valli da pesca

A5 riporto di sedimenti dragati

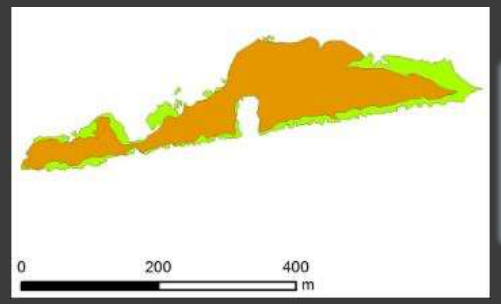
EROSIONE



E1 annegamento



E2 moto ondoso

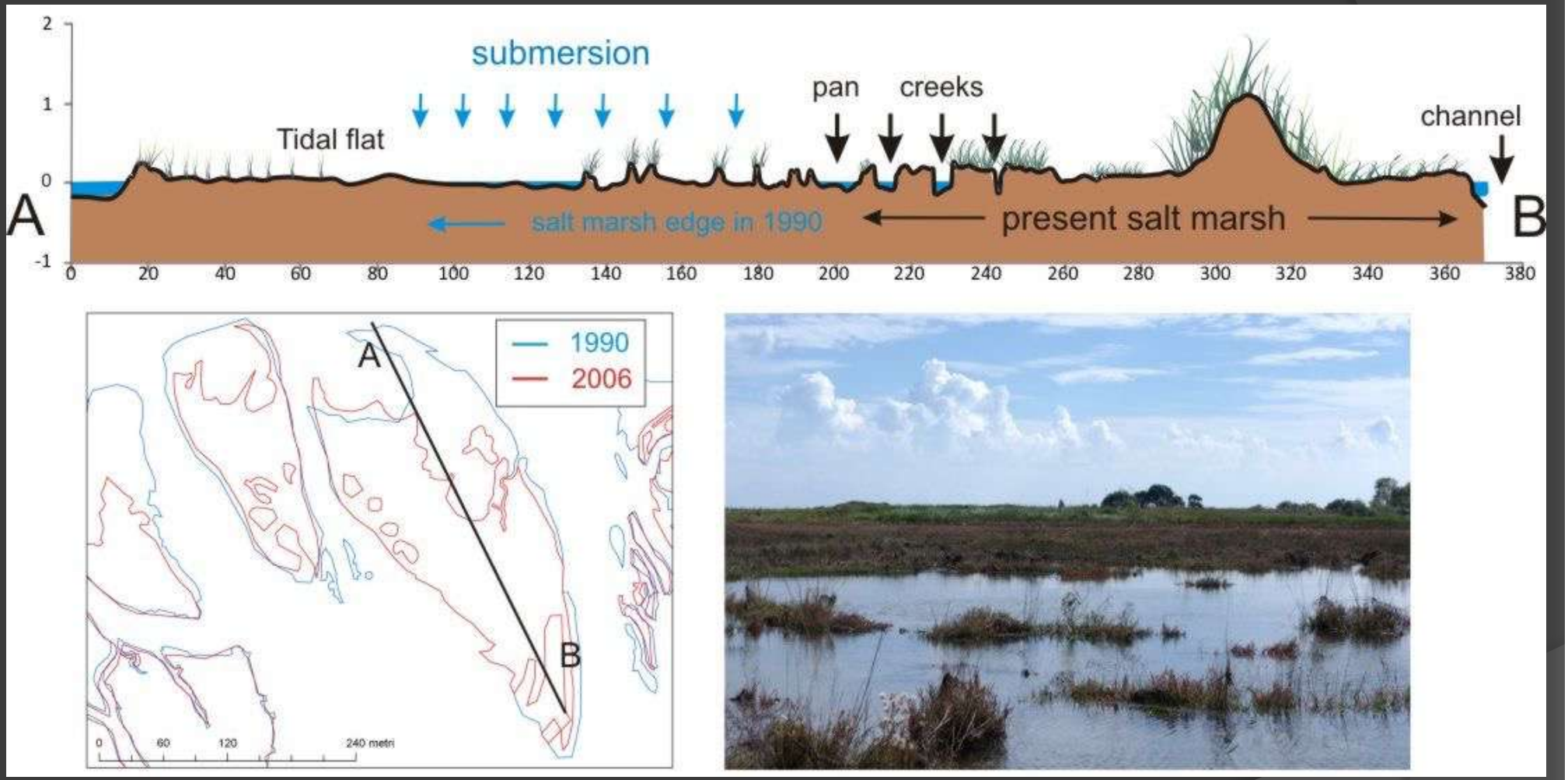


E3 moto ondoso da natanti

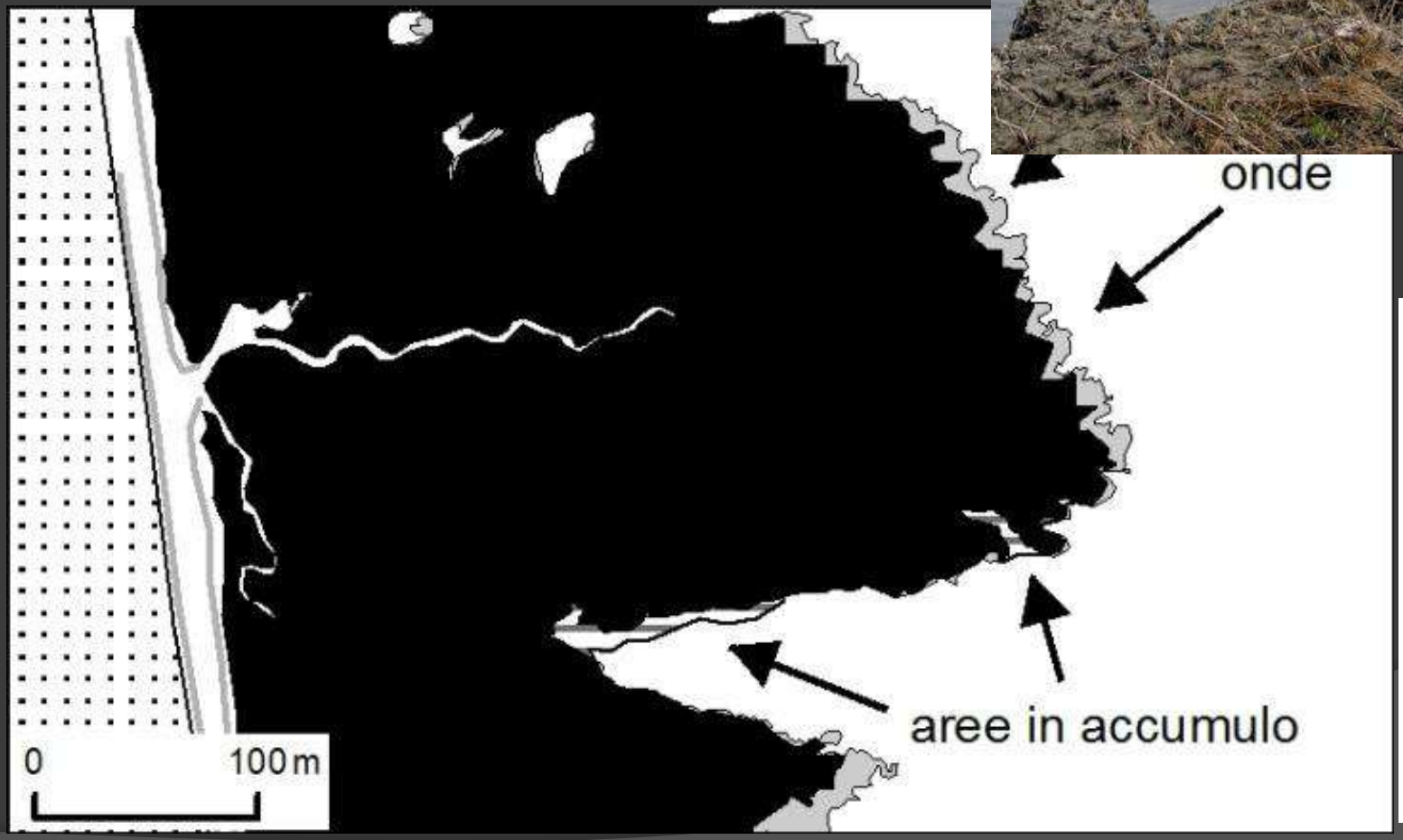
E4 dinamica costiera

E5 interventi antropici diretti

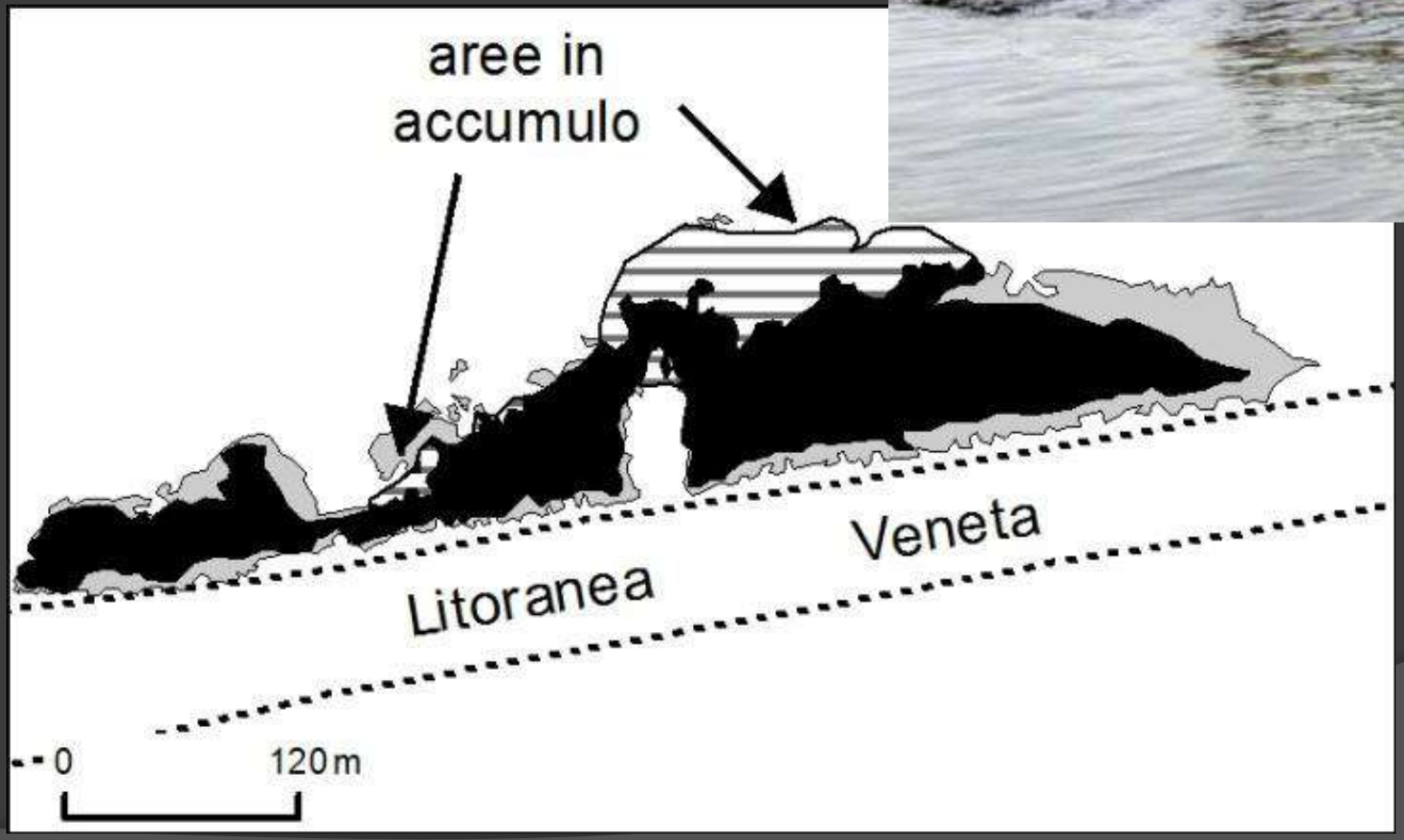
E1 ANNEGAMENTO



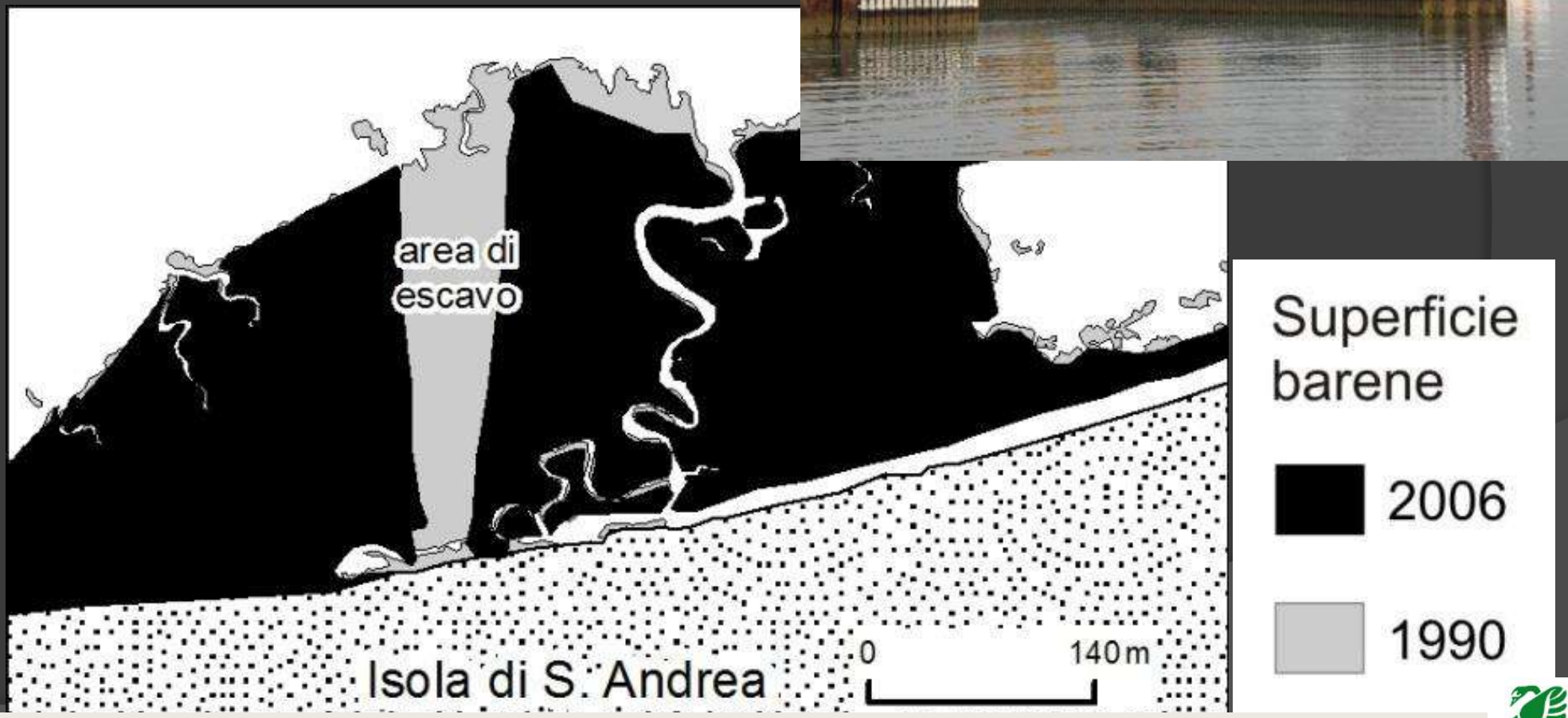
E2 MOTO ONDOSO



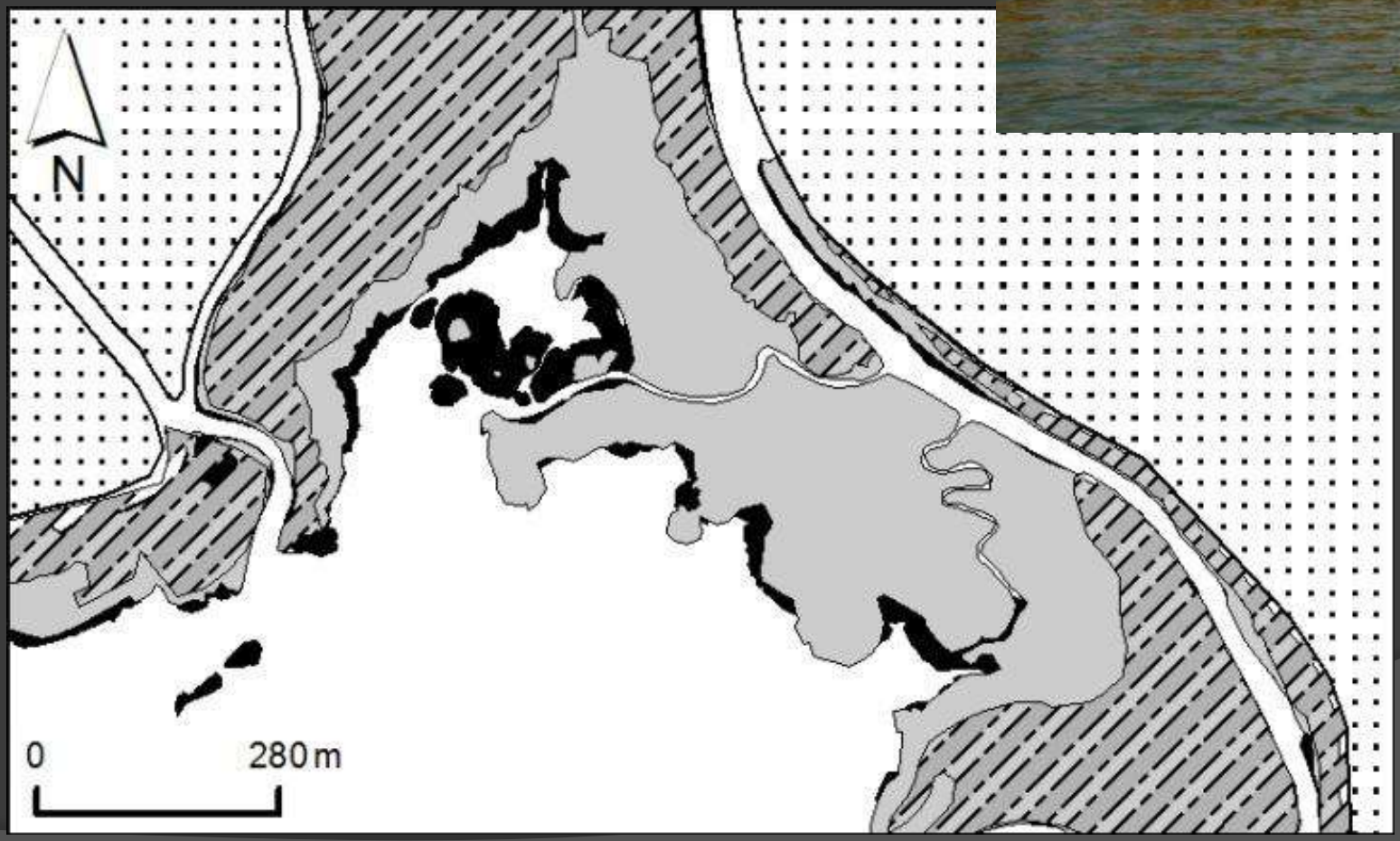
E3 MOTO ONDOSO DA NATANTI



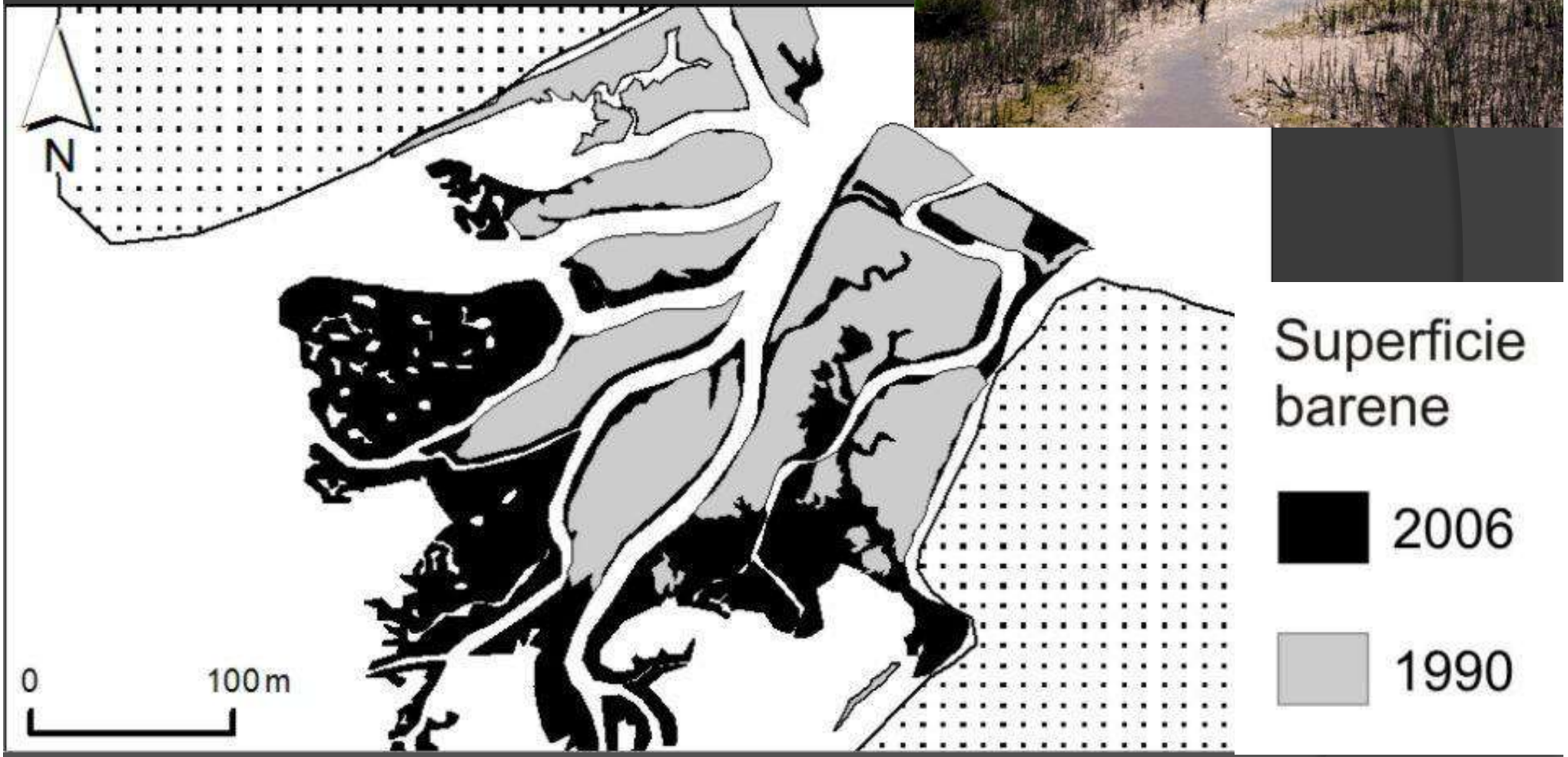
E5 INTERVENTI ANTROPICI



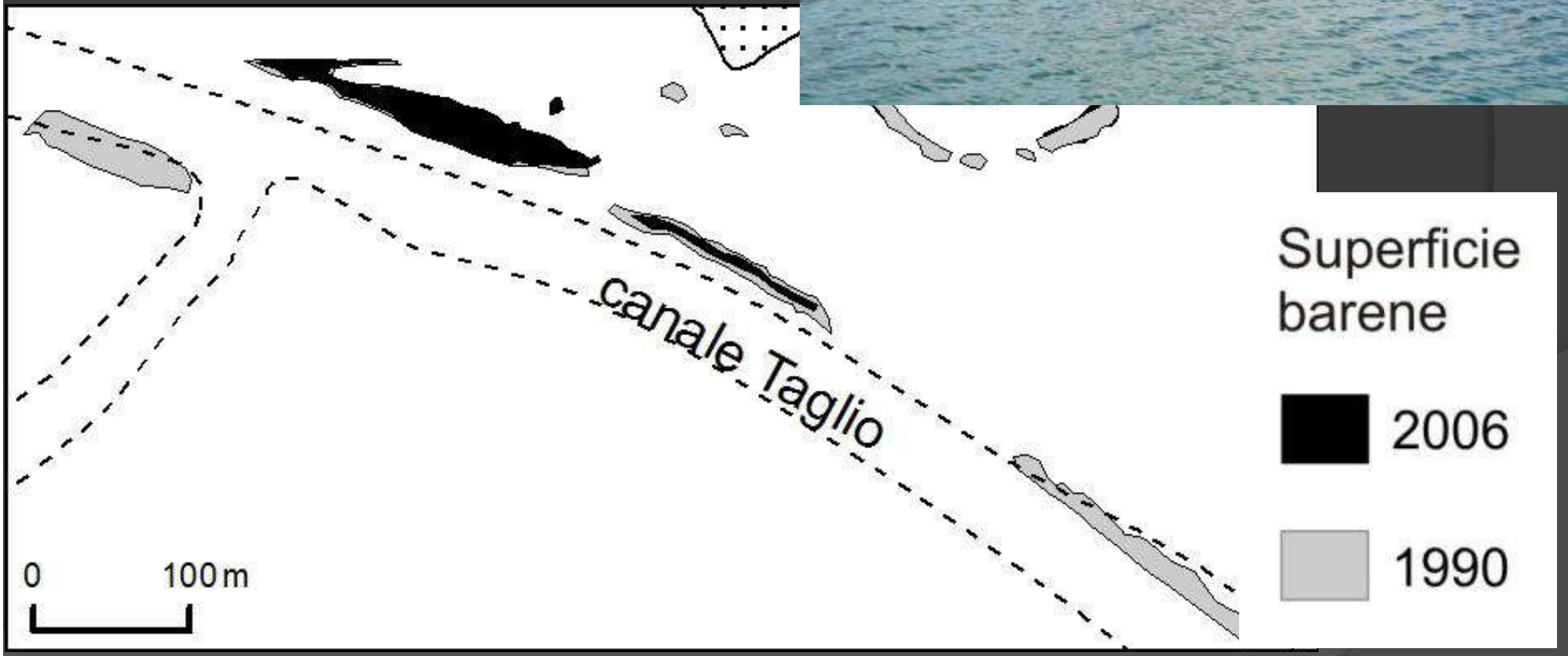
A1 APPORTO FLUVIALE



A2 APPORTO TIDALE

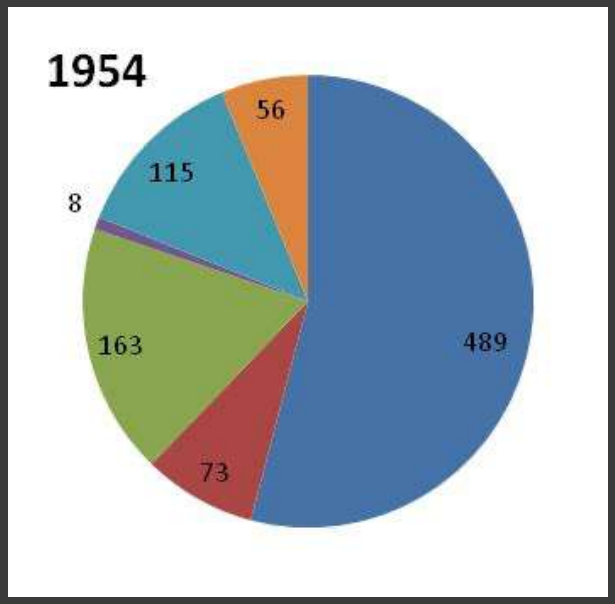


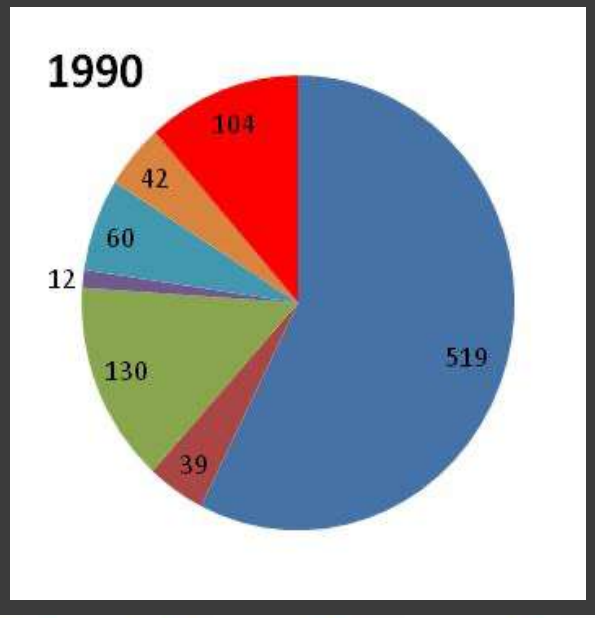
A5 RIPORTO DI SEDIMENTI

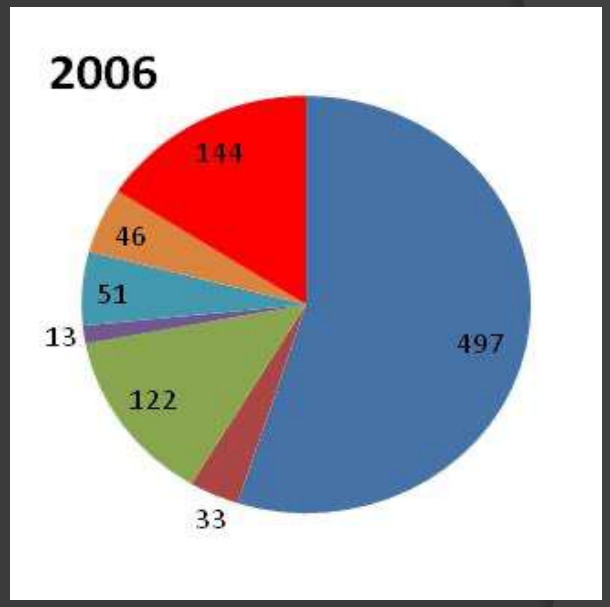


Analisi a macroscala: risultati

Evoluzione delle barene



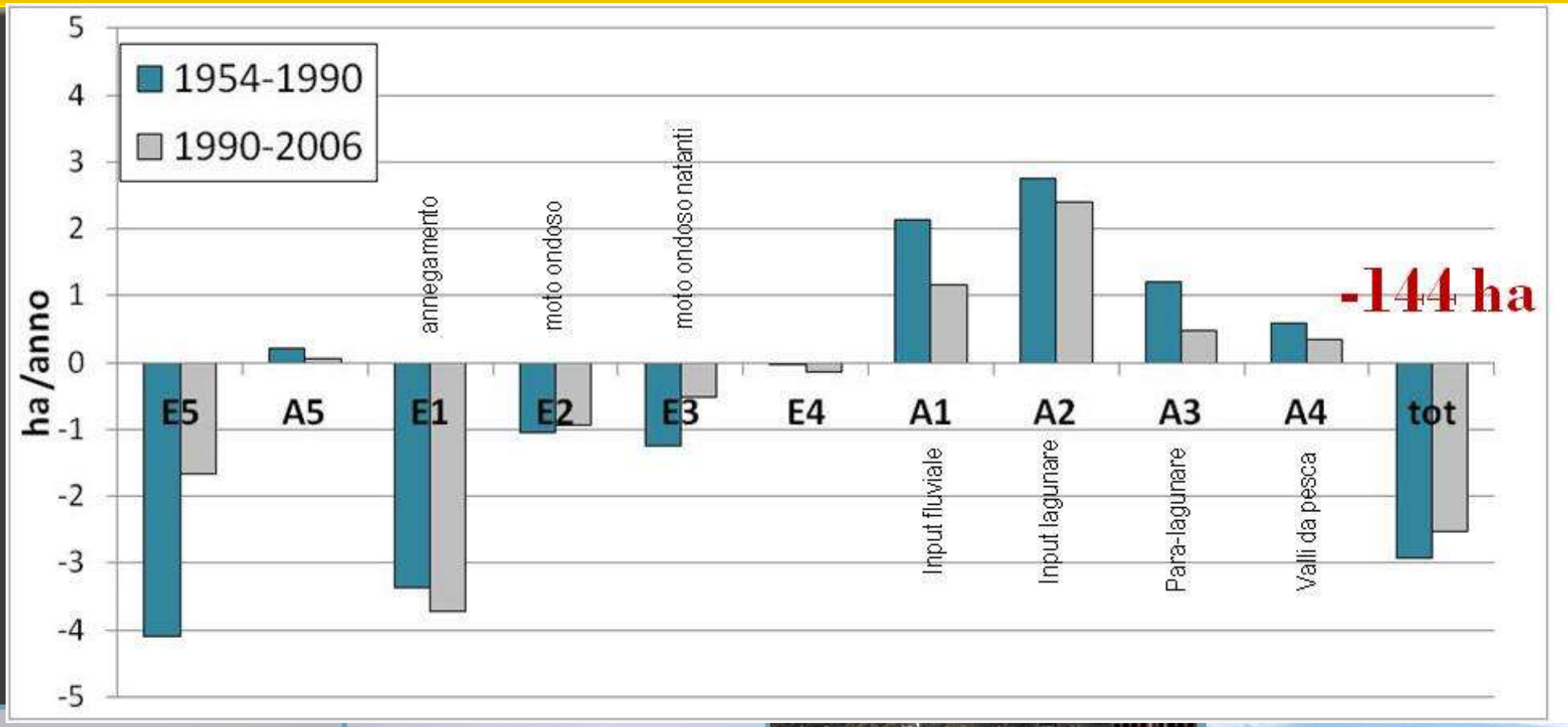




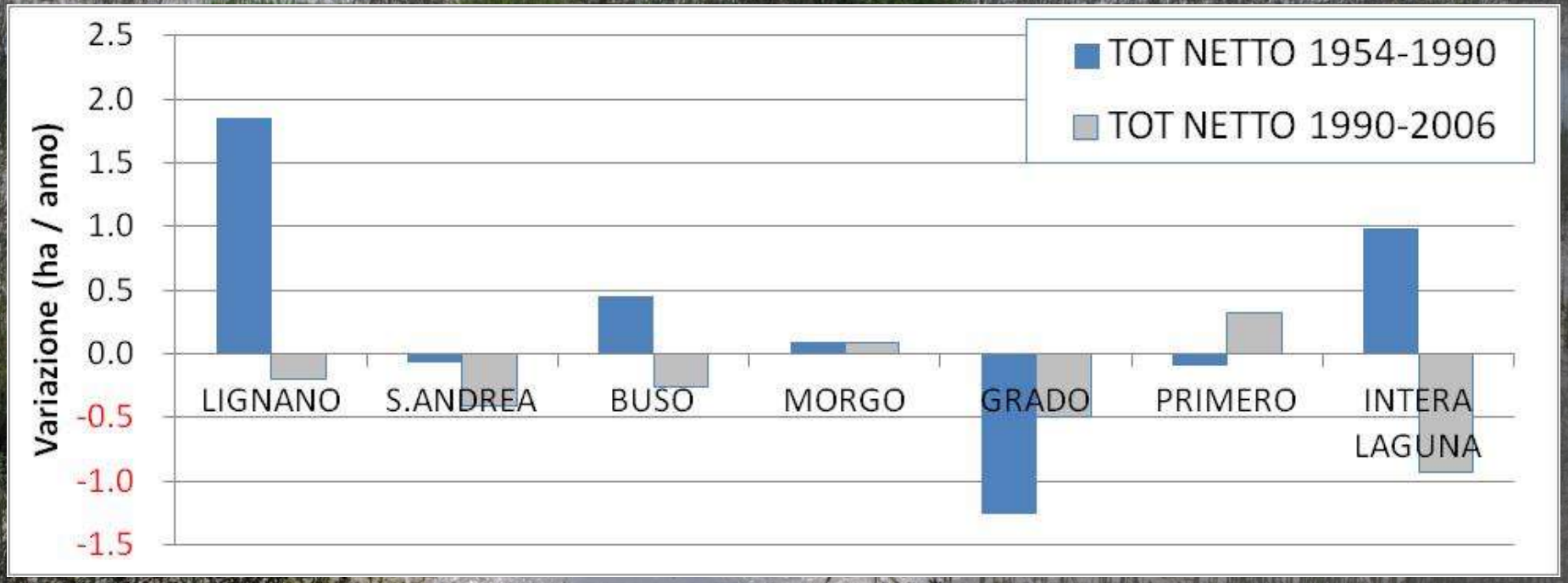
Lignano | S. Andrea | Buso | Morgo | Grado | Primero | aree scomparse

904 ha → **-16%** → **761 ha**

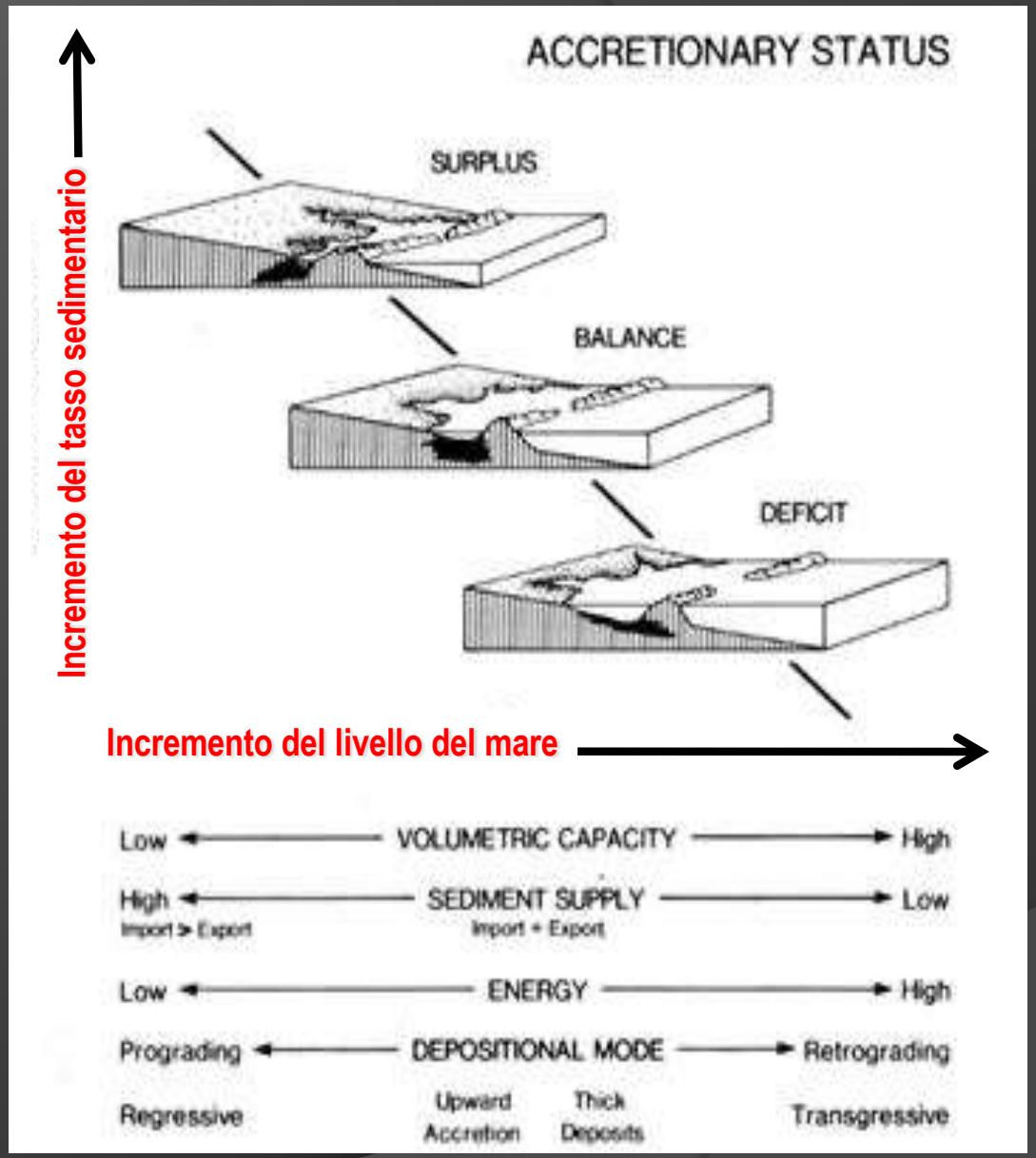
Bilancio delle forzanti intera laguna



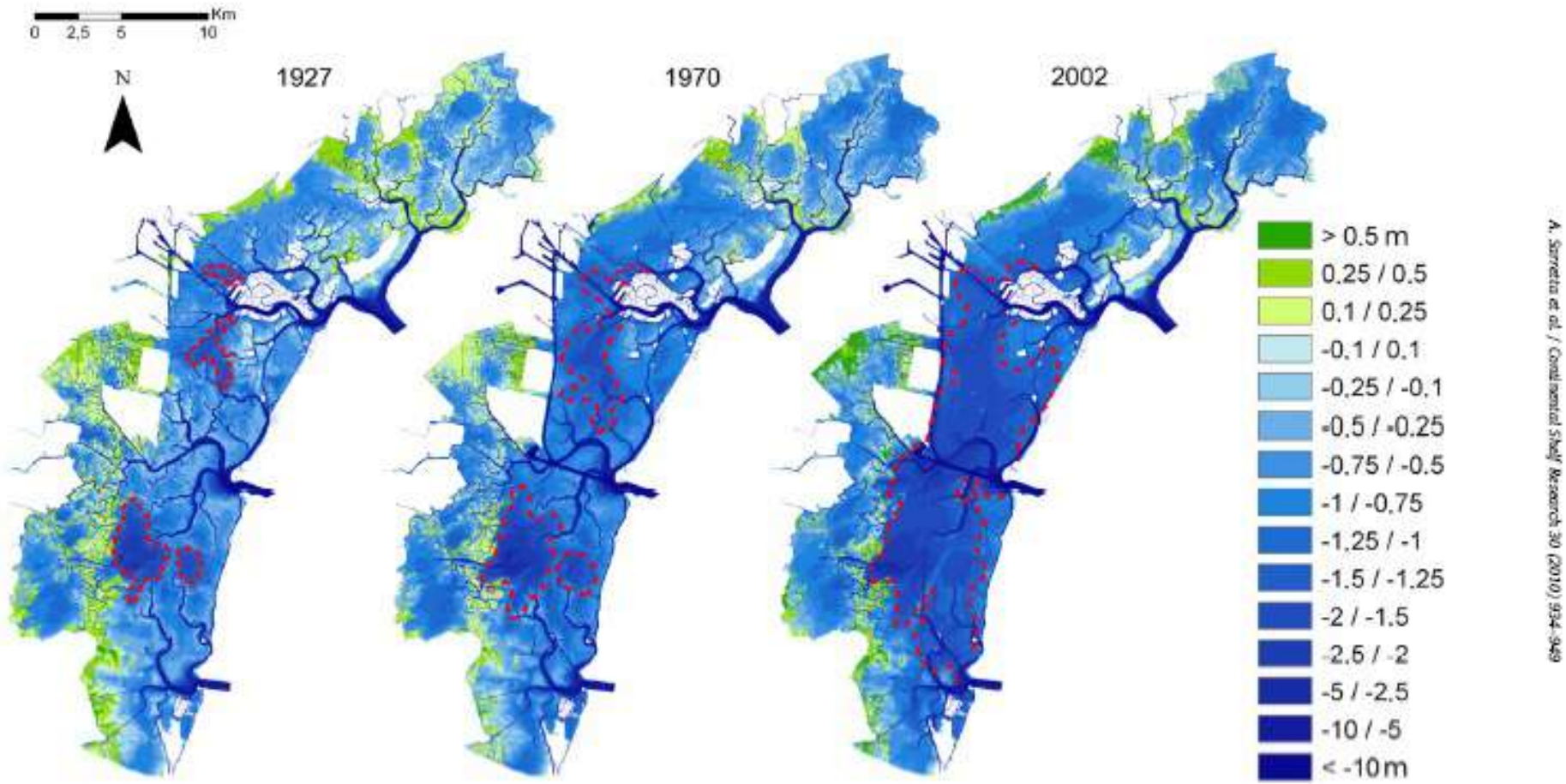
Evoluzione “naturale”



Il bilancio sedimentario

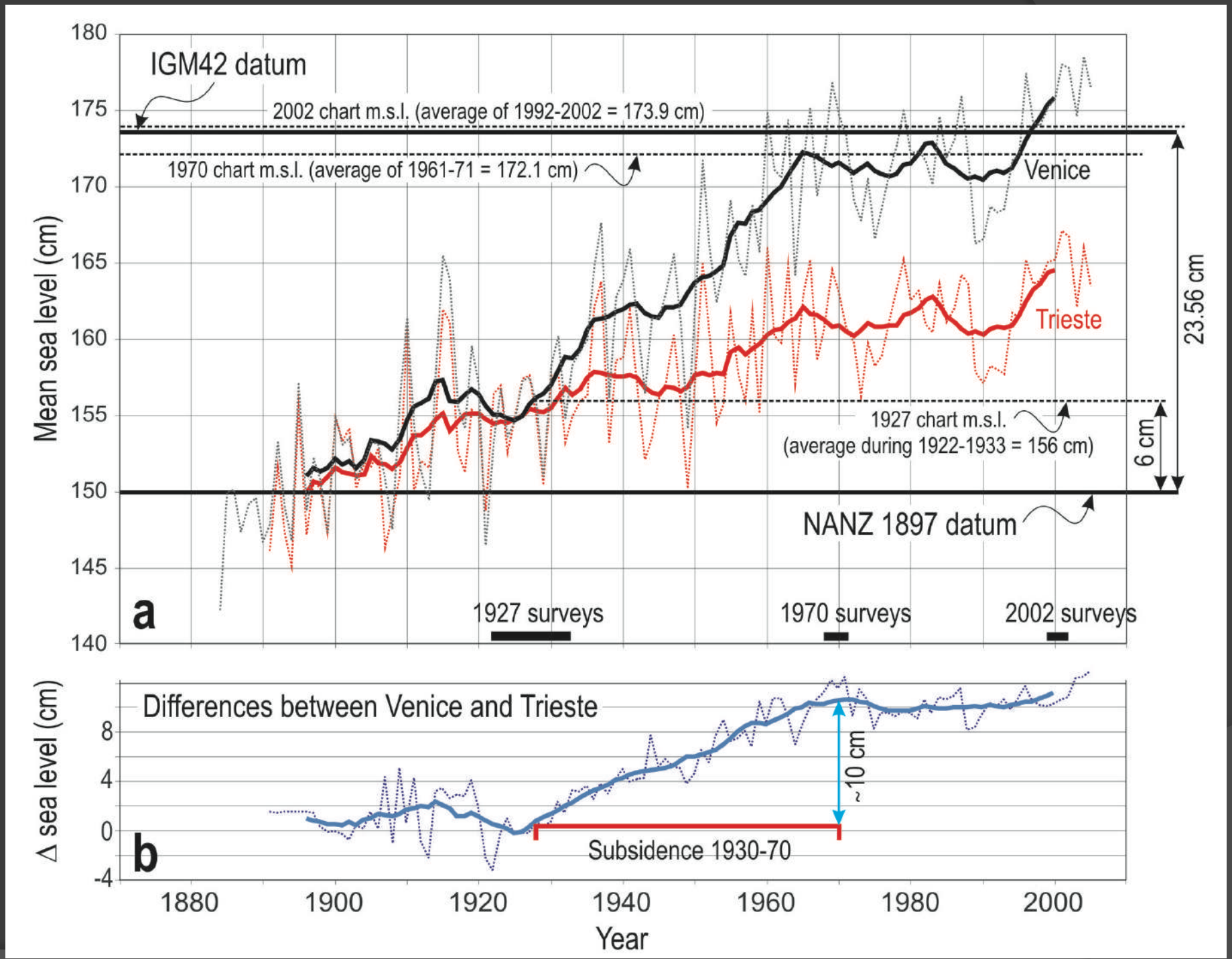


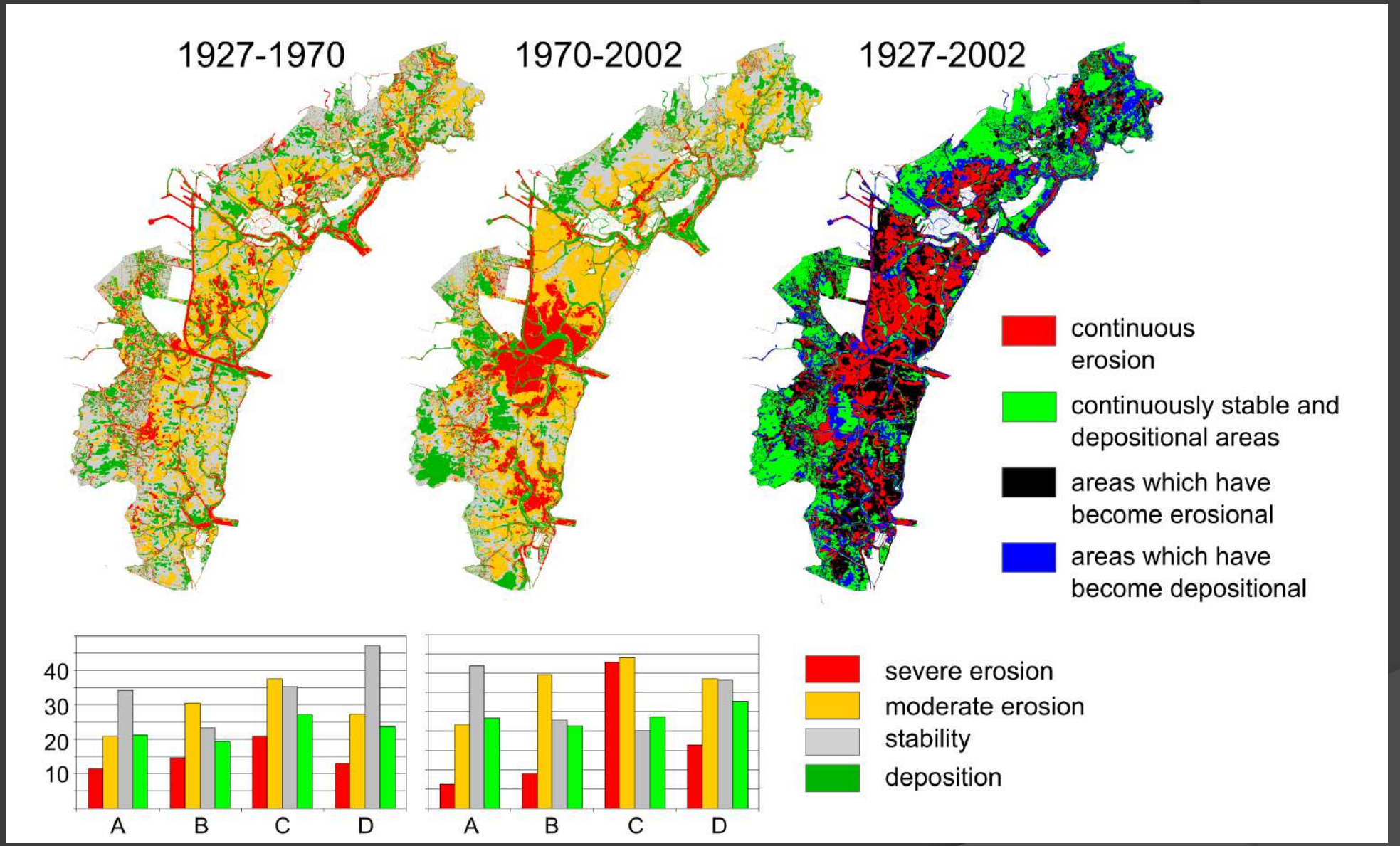
Sommersione nella Laguna di Venezia (1927-2002)

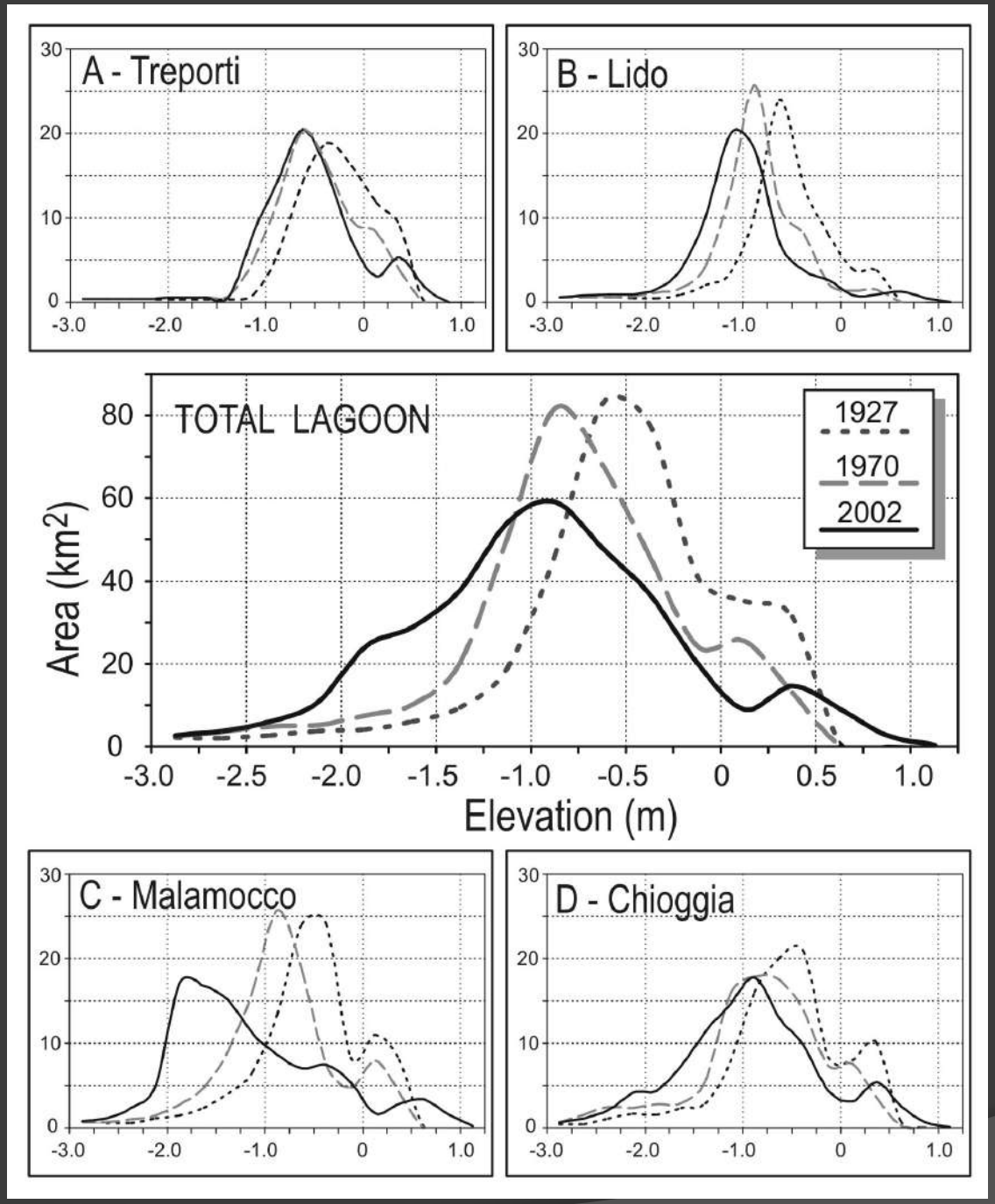


A. Sarretta et al. / Continental Shelf Research 30 (2010) 934–949

Fig. 3. Colour-shaded bathymetric maps of Lagoon of Venice (from left to right: 1927, 1970; 2002). Dotted red line indicates migration of −1.2 m contour line, showing an overall increase in depth (progressively darker blue colour). Emergent areas are indicated in green. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

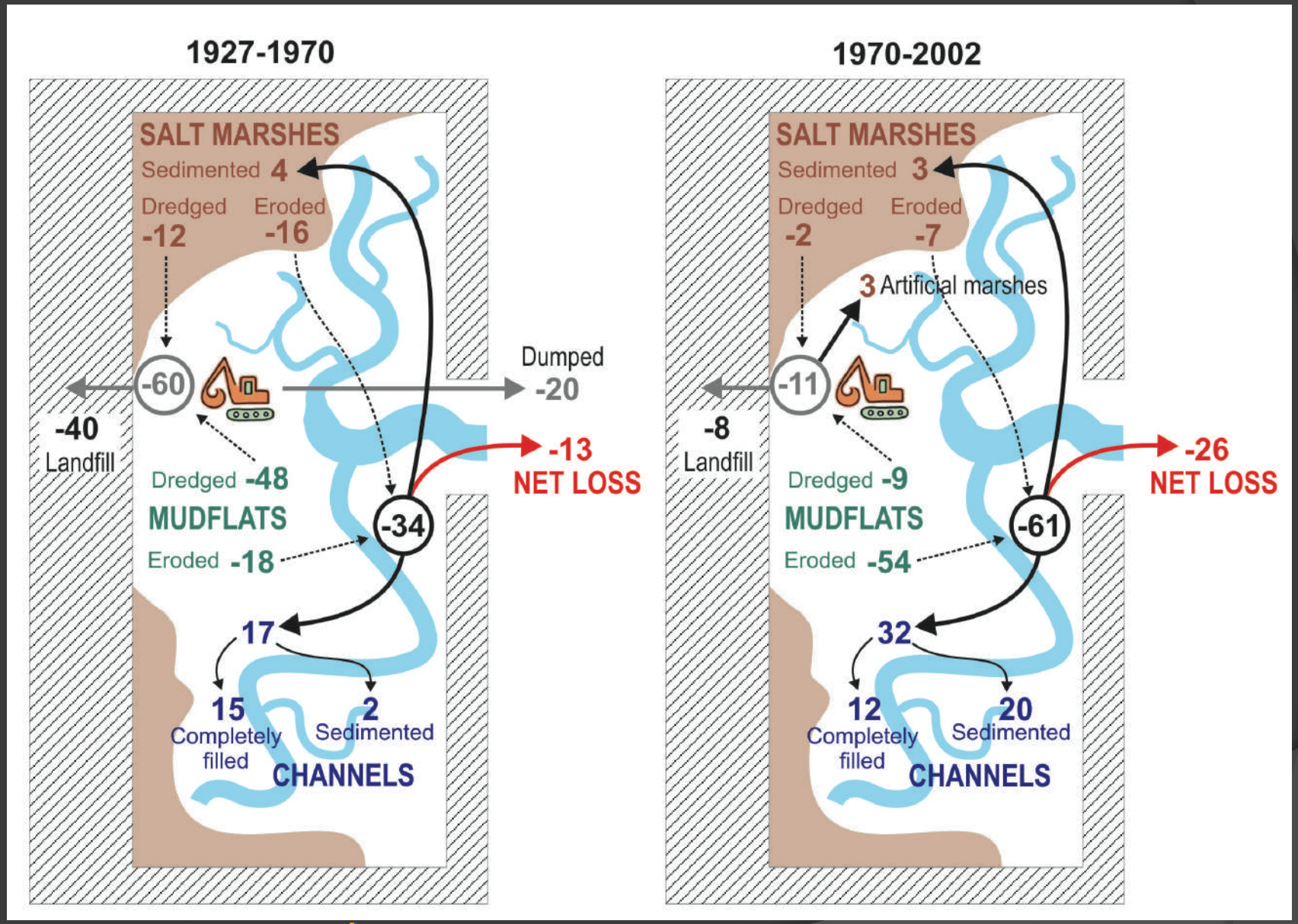

IGM42 datum
2002 chart m.s.l. (average of 1992-2002 = 173.9 cm)
1970 chart m.s.l. (average of 1961-71 = 172.1 cm)
Venice
Trieste
1927 chart m.s.l.
(average during 1922-1933 = 156 cm)
23.56 cm
6 cm
NANZ 1897 datum
Mean sea level (cm)
180
175
170
165
160
155
150
145
140
a
1927 surveys
1970 surveys
2002 surveys
Differences between Venice and Trieste
Δ sea level (cm)
8
4
0
-4
10 cm
Subsidence 1930-70
b
1880
1900
1920
1940
1960
1980
2000
Year


1927-1970
1970-2002
1927-2002
continuous erosion
continuously stable and depositional areas
areas which have become erosional
areas which have become depositional
40
30
20
10
A
B
C
D
A
B
C
D
severe erosion
moderate erosion
stability
deposition



Laguna di Venezia

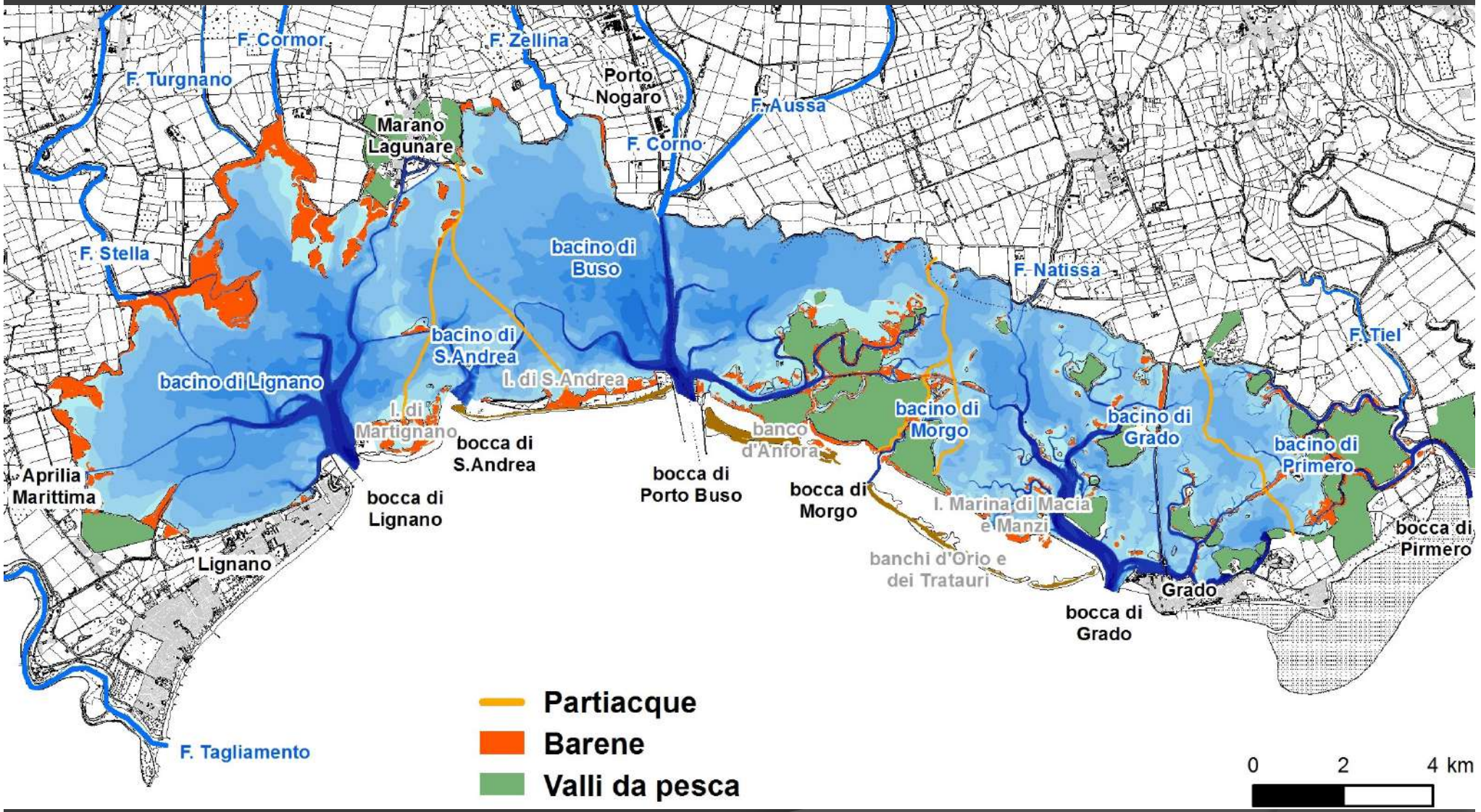
Laguna di Venezia



-300.000 mc/anno

-800.000 mc/anno

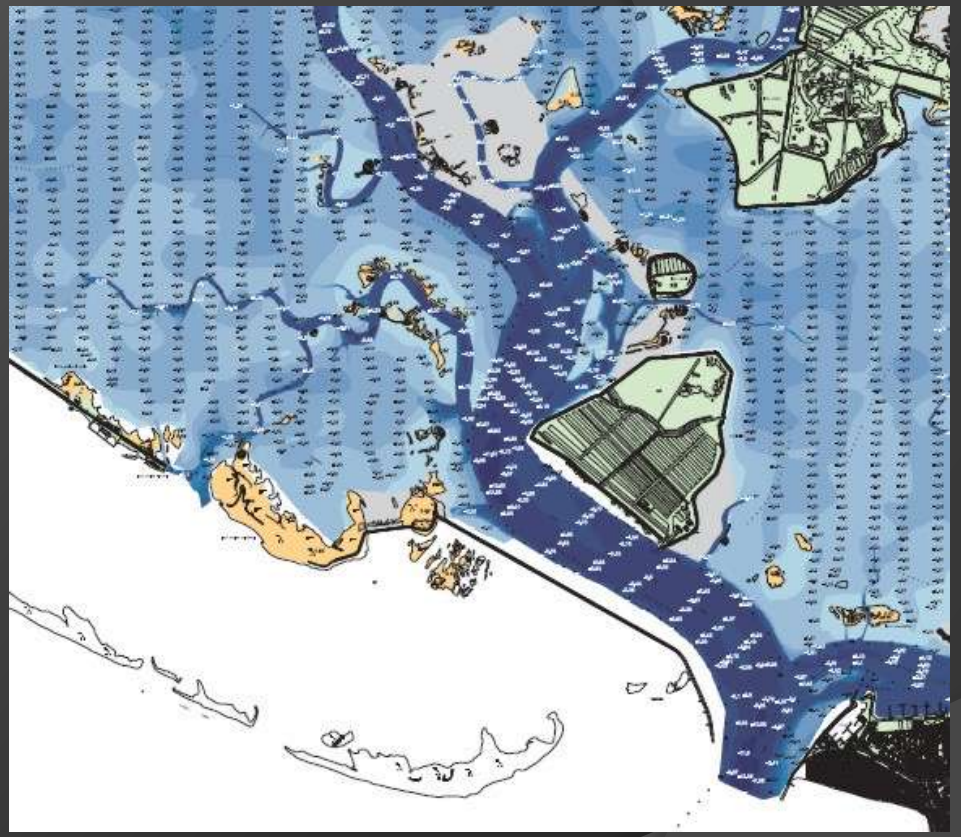
Laguna di Marano e Grado



Dinamiche di bacino e bilanci di massa

Carta Idrografica del Magistrato alle Acque di Venezia (1966)

Carta batimetrica della Laguna di Marano e Grado (2011)

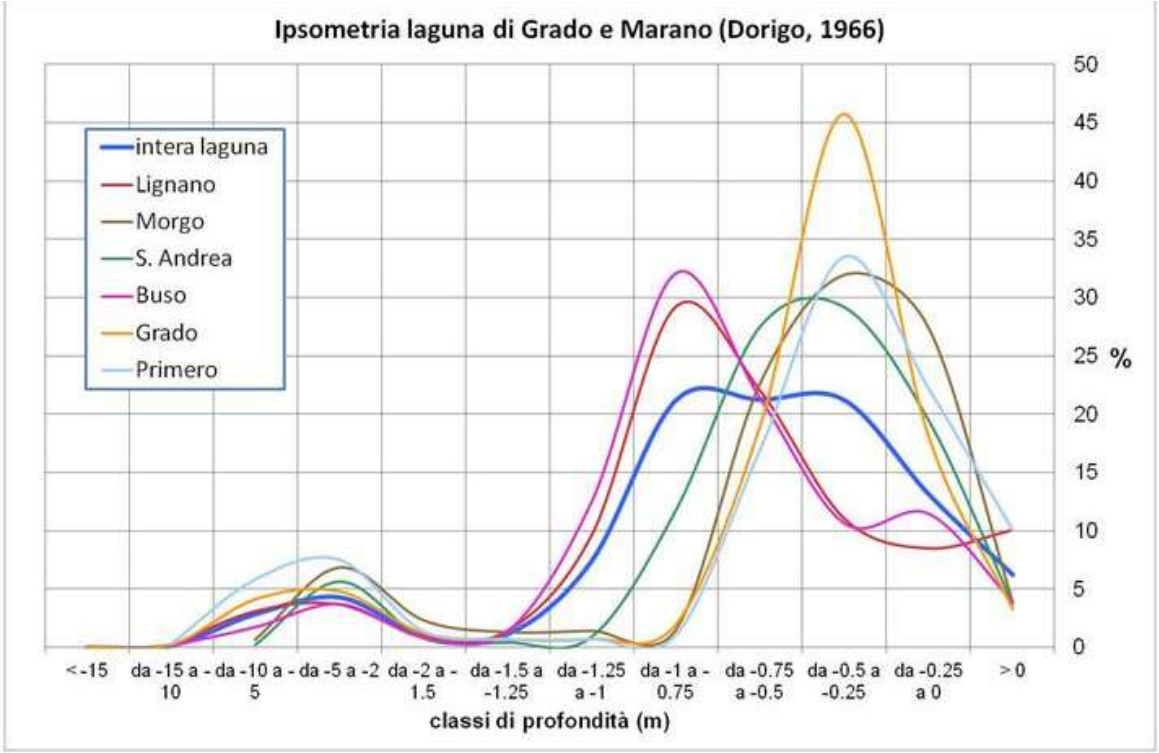


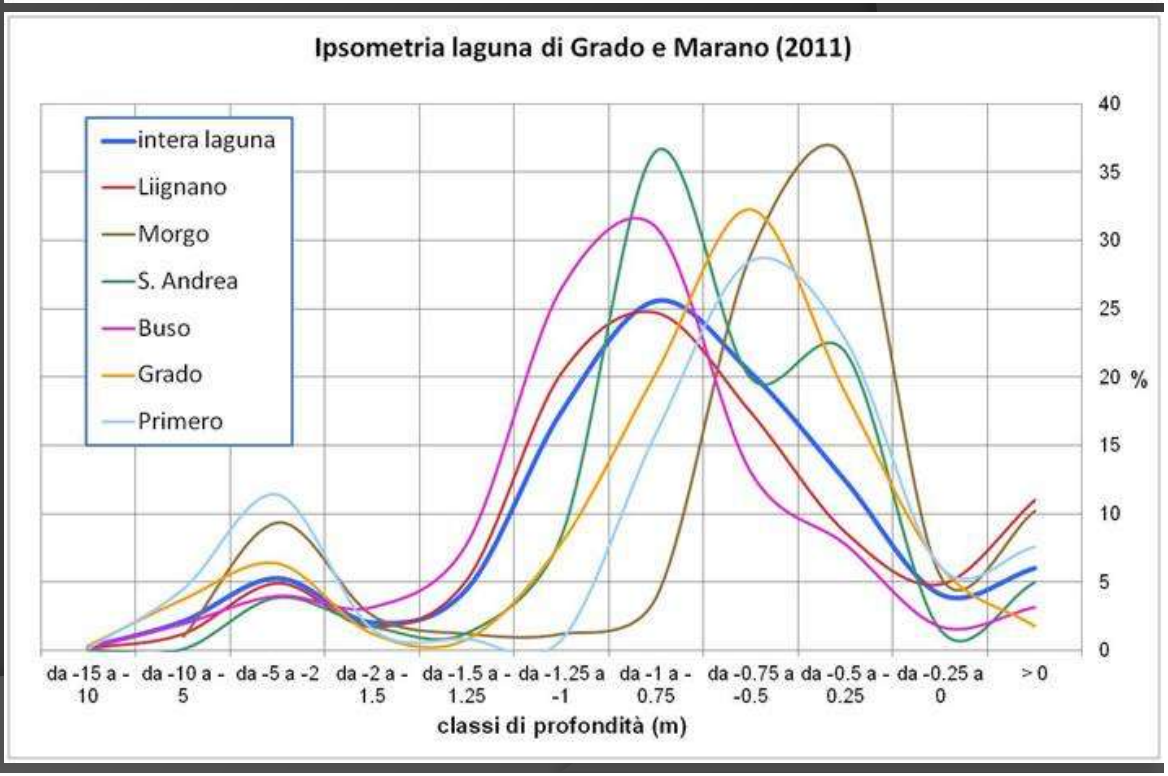
Metodologia (Sarretta et al., 2010)

Creazione dei due modelli tridimensionali (TIN) → Trasformazione in raster a maglia 10m (grid) → Confronto su intervalli di profondità

Evoluzione ipsometrica

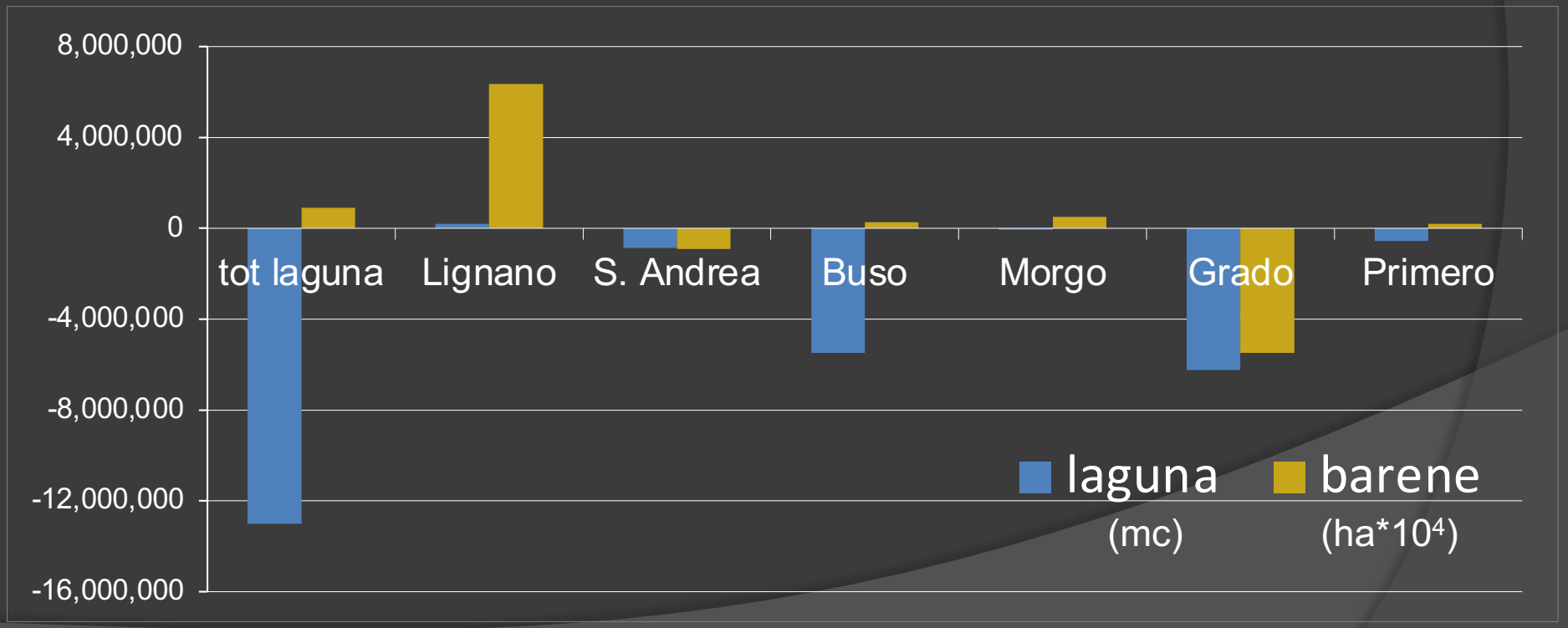
- Iniziale forte peculiarità morfologica dei bacini
- Aumento della profondità media, perdita di aree intertidali (velme), deficit sedimentario
- Perdita di caratterizzazione e peculiarità morfologica
- Interrimento dei canali, espansione delle aree subtidali (comprese tra -0,75 e -2,00 m)





Dinamiche di bacino e bilanci di massa

	Tot laguna	Lignano	S. Andrea	Buso	Morgo	Grado	Primero
Variazione barene 1954-2006 (ha)	9.1	63.4	-9	2.6	5.0	-54.9	2.1
Bilancio totale 1966- 2011 (m^3/anno)	-325 000	-5 000	-17 000	-140 000	-1 700	-152 000	-10 000



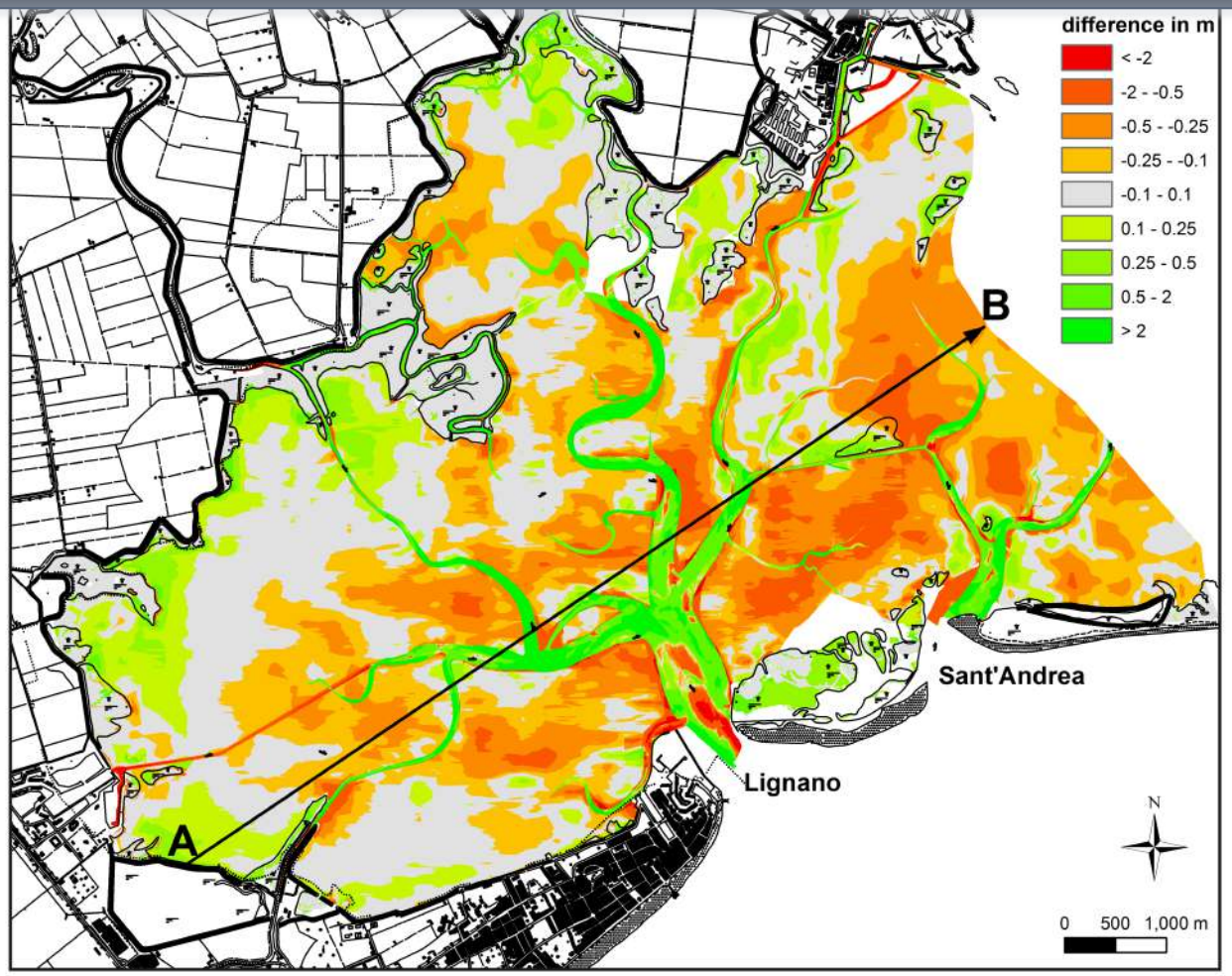
L’asimmetria evolutiva

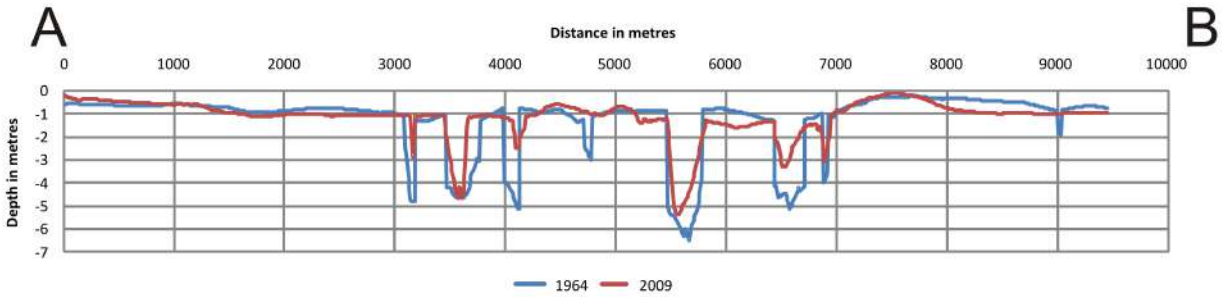
A parità di bilancio sedimentario, i processi di erosione delle piane e di accumulo nei canali, rendono la laguna asimmetrica, cioè sempre più sfasata tra i bordi interni e quelli esterni.

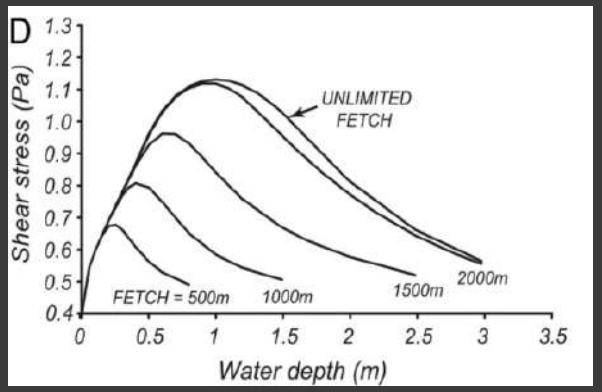
Al tempo stesso i canali perdono funzionalità e tendono a riempirsi, per raccordarsi alle piane, sempre più profonde.

DESTINO GEOLOGICO:

trasformazione in una baia (marinizzazione)



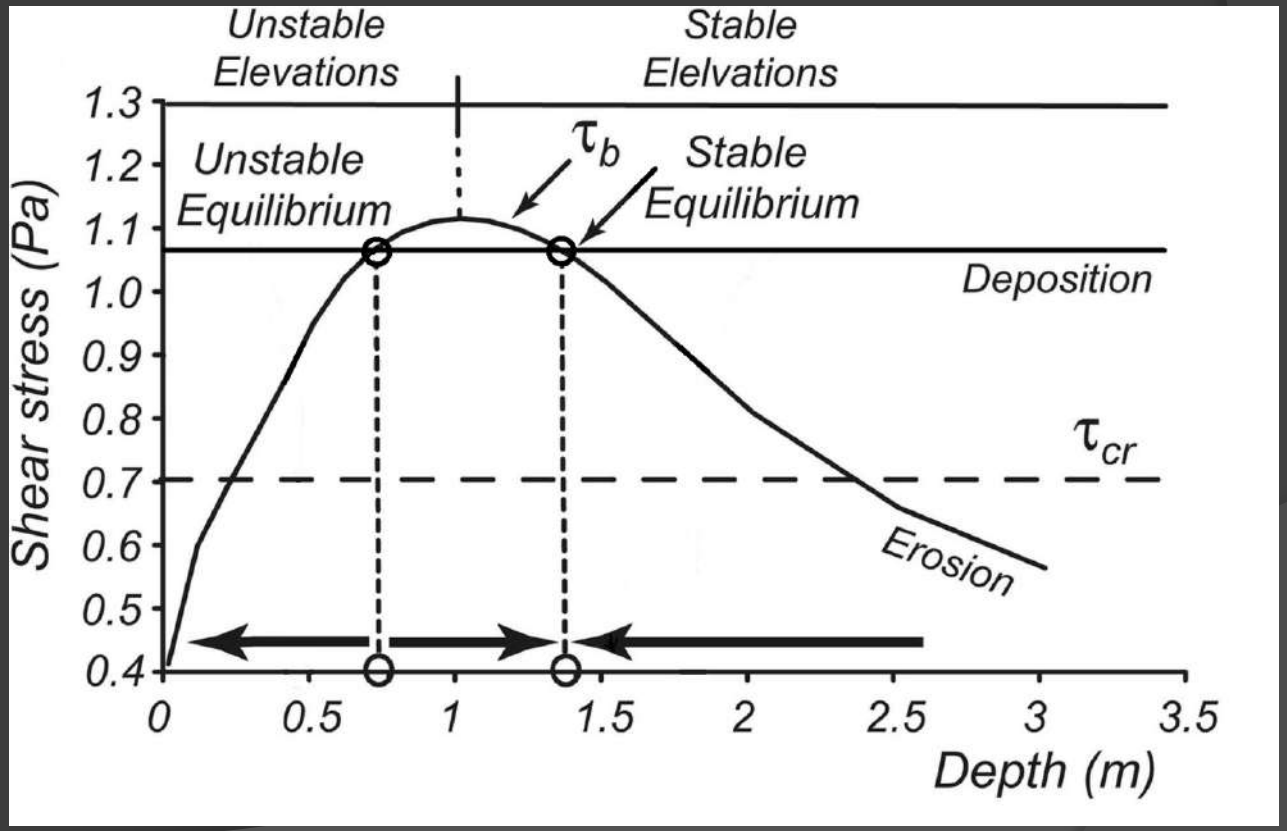




- Per Lignano il range si restringe alle profondità corrispondenti alle aree intertidali e subtidali comprese tra -0.7 e -1.3 m

❖ Modello di Fagherazzi et al. (2006): sforzo di taglio delle onde da vento in funzione della profondità:

- Stabilità al di sotto della linea dello sforzo di taglio critico
- Per Venezia equilibrio instabile e stabile si hanno rispettivamente alle profondità di 0,5 e 1,7 m



Il controllo mareale