Case Studies

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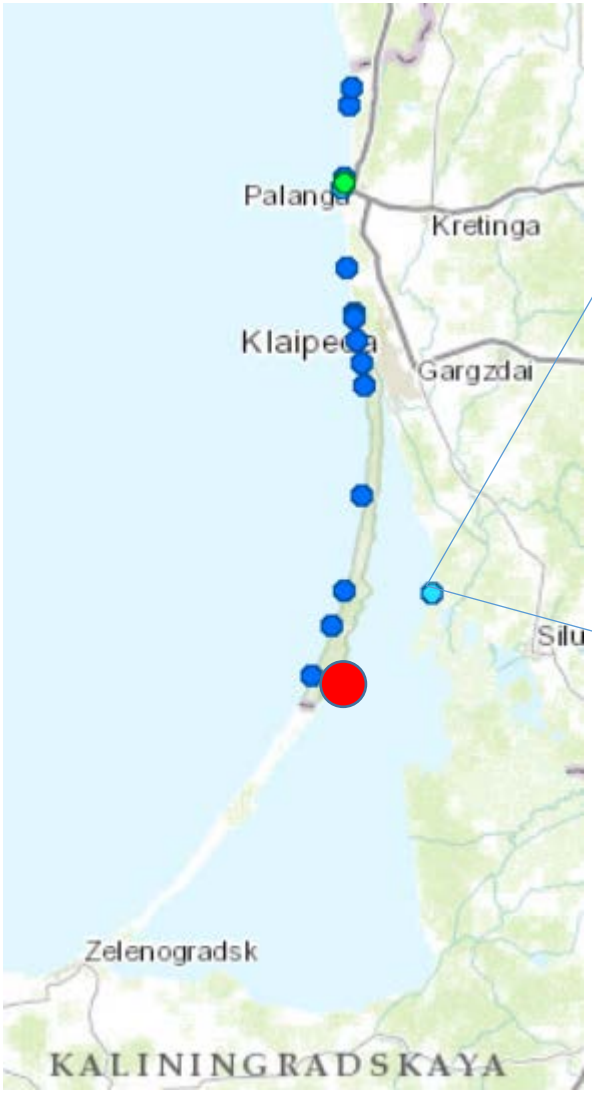
Case 1: A beach in the Curonian Lagoon

Current situation in Curonian lagoon

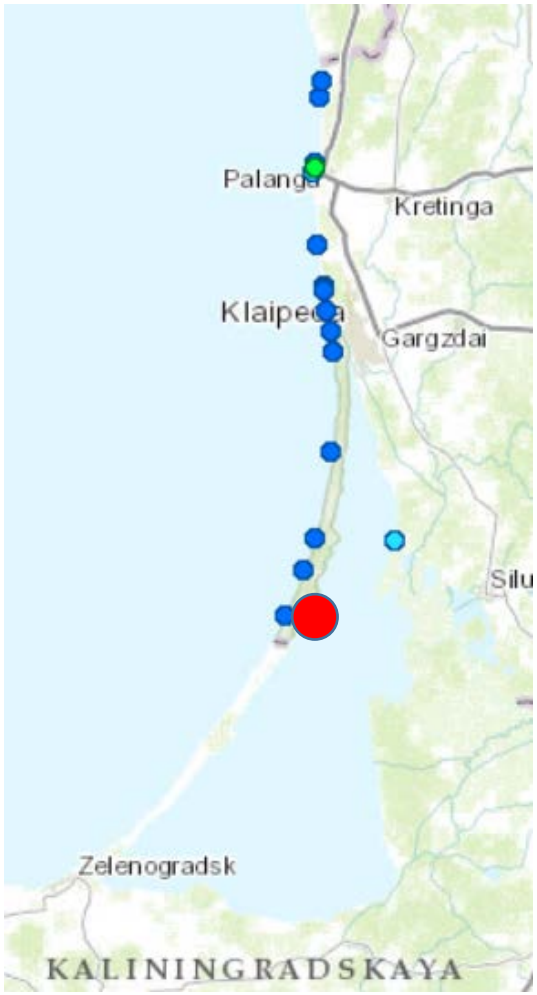


Beach in Kintai

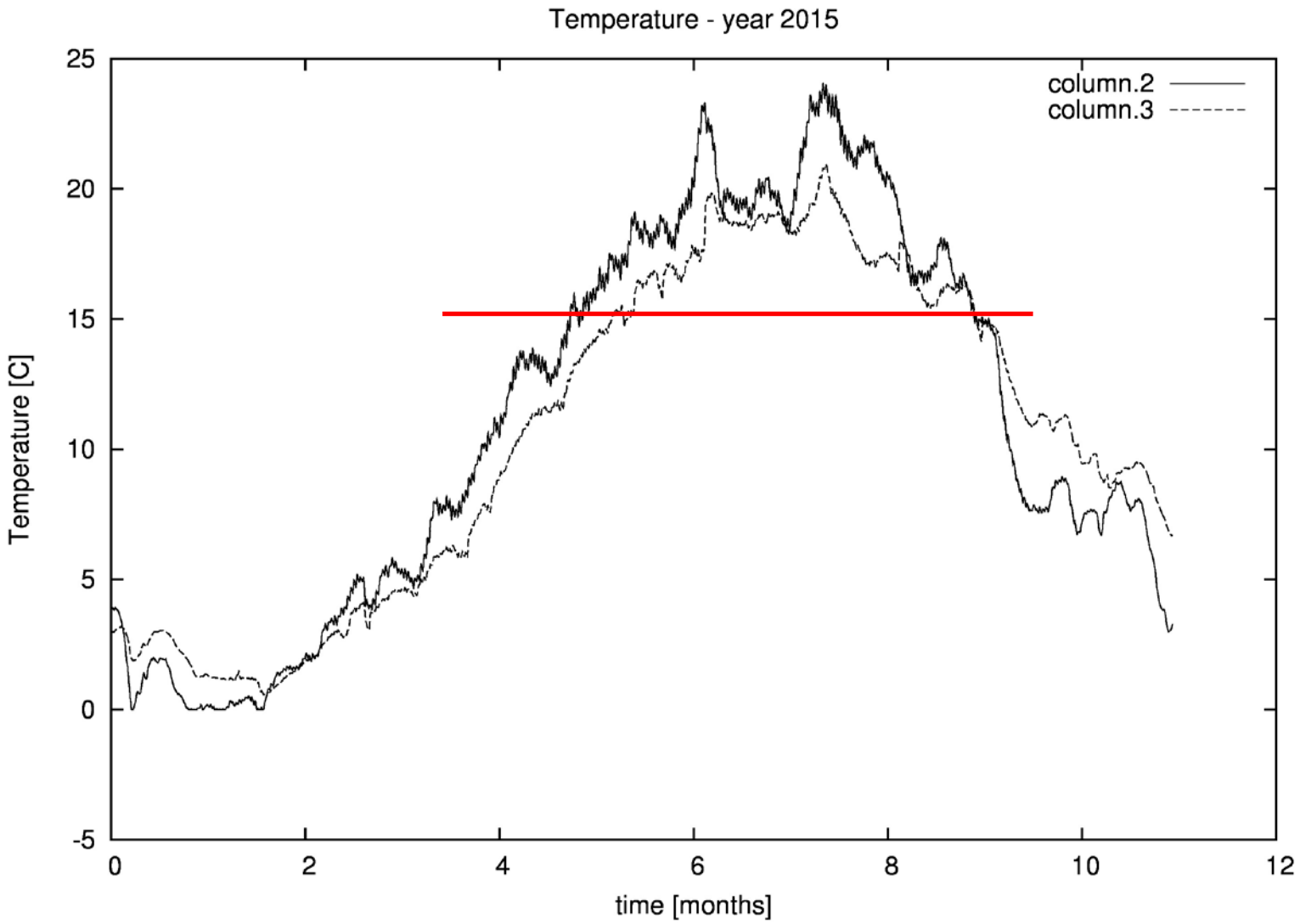
In the past, especially in Baltic inner coastal waters, several beaches had to be closed because of insufficient bathing water quality. Today, increasing tourism causes a strong demand to reopen these beaches again and to establish additional beaches, especially in large lagoons, like the Curonian lagoon and on the Lithuanian coast.

The proposed beach

Neringa municipality wants to establish the beach on lagoon side



Nida beach and lagoon temperature



State of bathing waters

Bathing water quality by location

Bathing water quality

- Excellent water quality or Compliant with the guide values (CG)
- Good water quality
- Sufficient water quality or Compliant with the mandatory values but not guide values (CI)
- Poor water quality or Not compliant with the mandatory values (NC)
- Closed or Banned (B)
- Quality classification not possible: new bathing waters/ bathing waters with changes/ not enough samples

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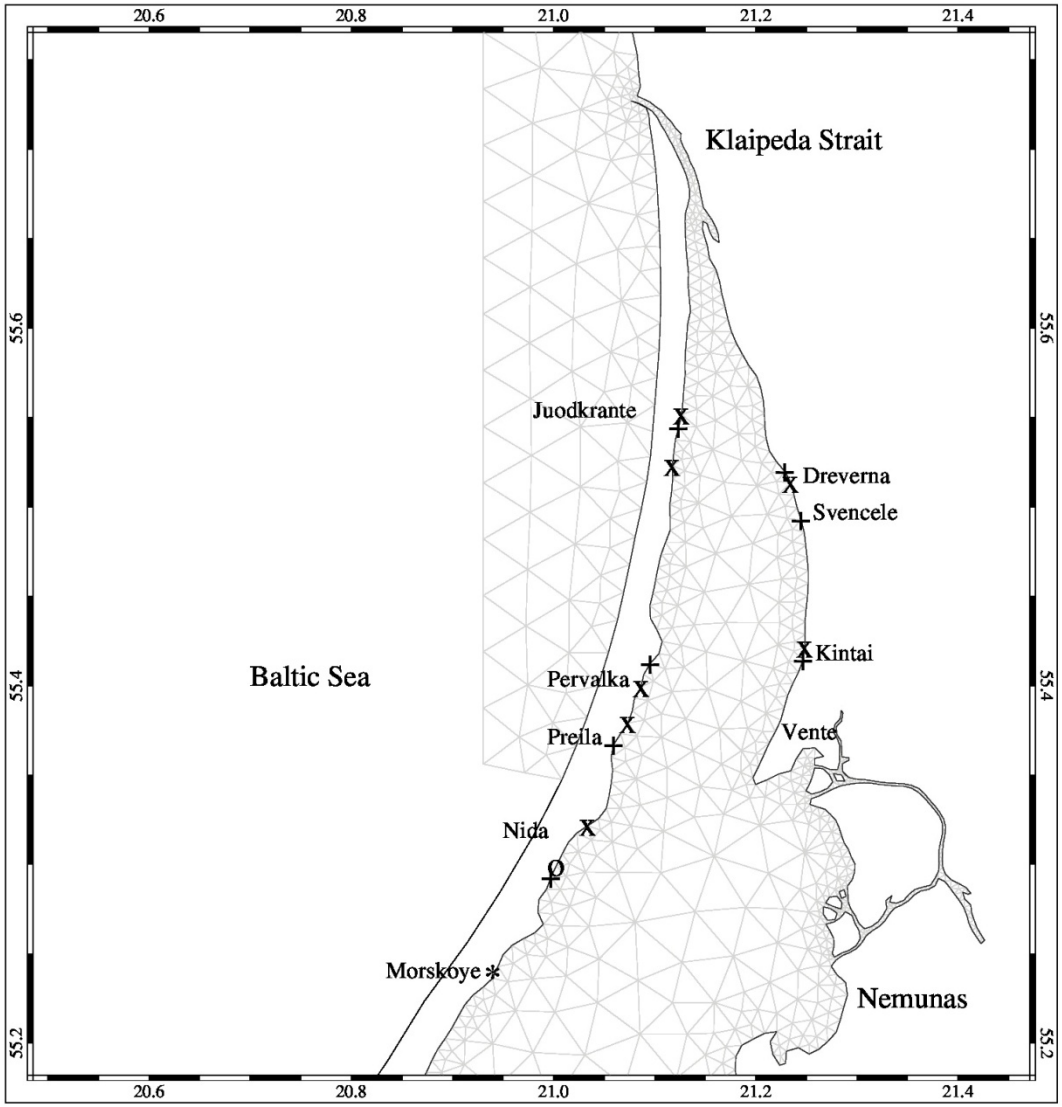
15min.lt

Kuršių marių ties Kintais maudyklos vanduo neatitiko higienos normų

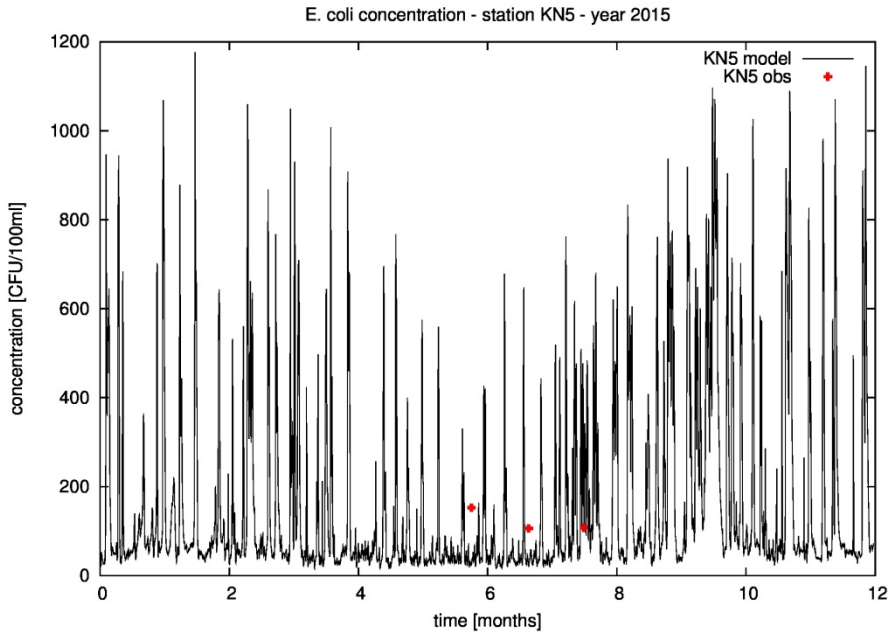
Sveikatos mokymo ir ligų prevencijos centras, įvertinęs gautus rugpjūčio mėnesio antros pusės maudyklų vandens kokybės tyrimų rezultatus, informuoja, kad Kuršių marių ties Kintais maudykloje vandens kokybė neatitiko Lietuvos higienos normos reikalavimų, todėl maudytis joje nėra saugu.

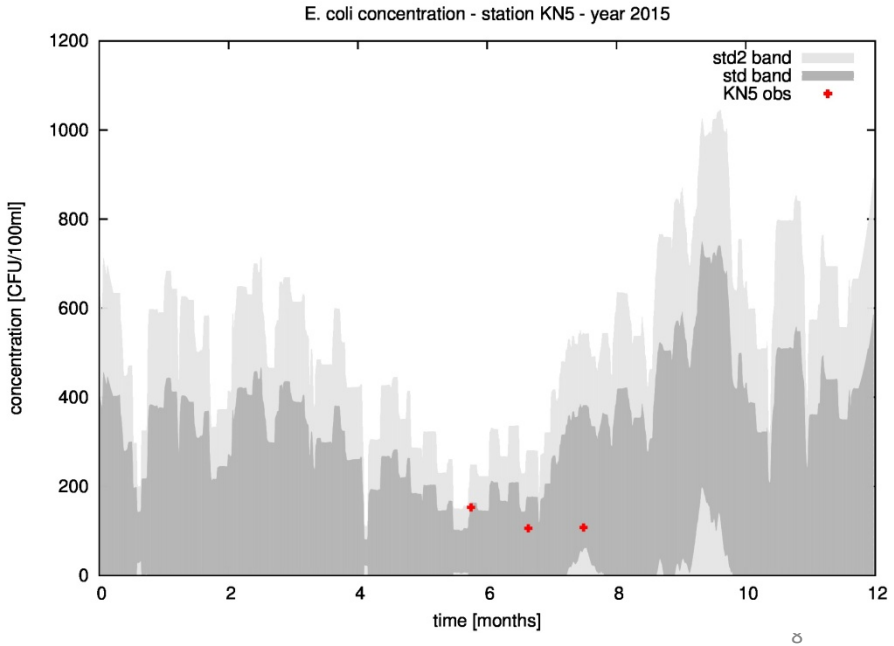
In august 2013 the amount of fecal coliform (*E. coli*) exceed 1.9 times the allowed threshold

Modeling: sewage input

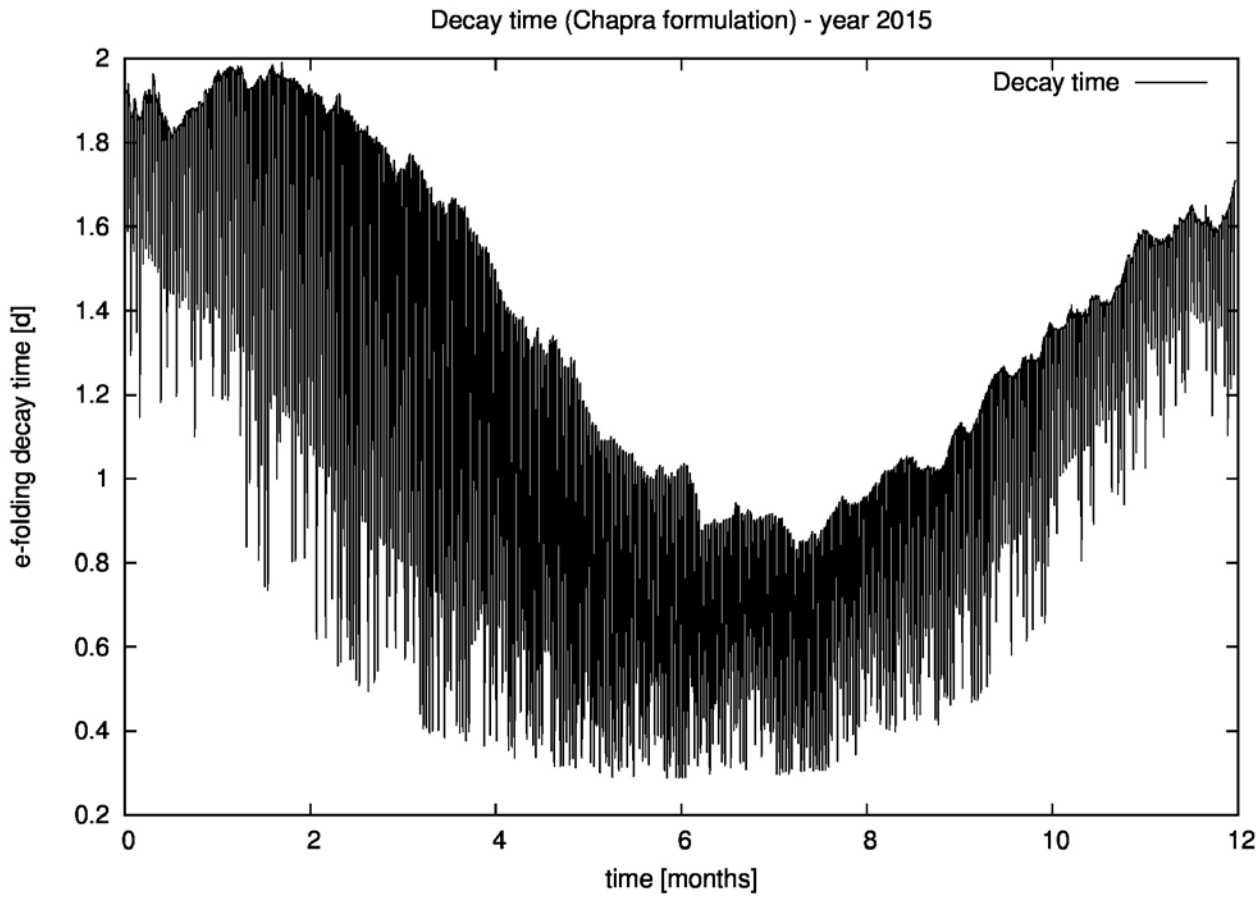


Calibration and validation





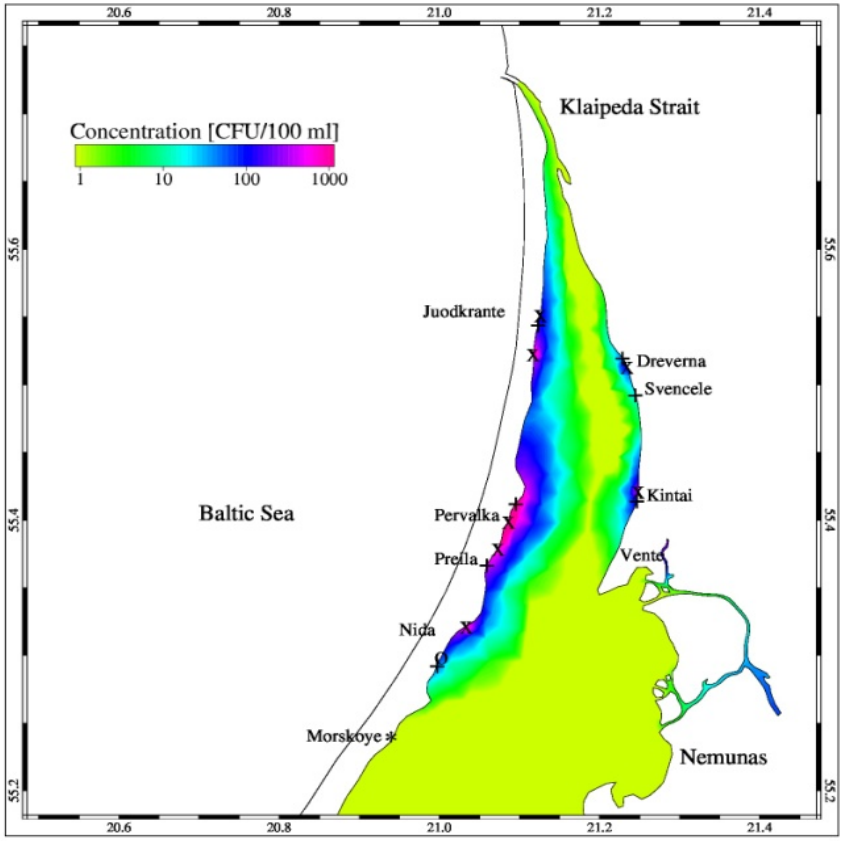
Decay time sensitivity

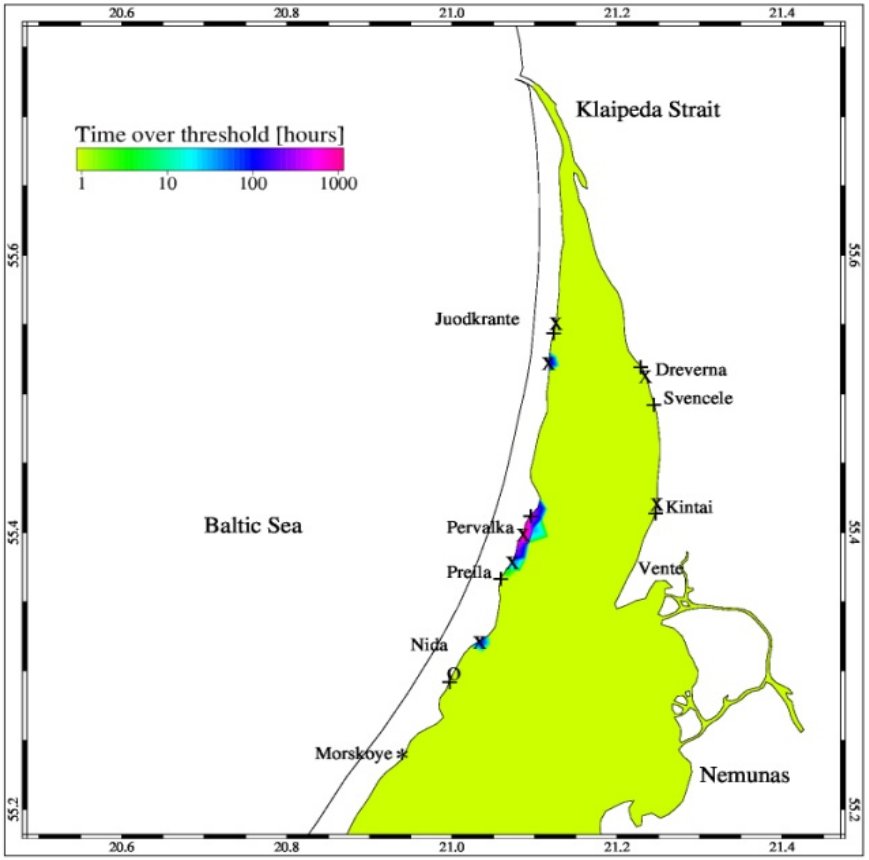


Scenario description

Name	Period	Description
Reference (R)	2015	Reference simulation, calibrated inputs
Scenario 1 (S1)	2015	Tourism on Spit (input*5)
Scenario 2 (S2)	2015	Extreme wind conditions (wind*2)
Scenario 3 (S3)	2015	Breakdown of sewage system (input*10)
Scenario 4 (S4)	2015	High loading from rivers (input*10)
Scenario 5 (S5)	2015	Input from Russian side
Reference long (RL)	2004-2015	Reference simulation for 12 years
Scenario 3 long (S3L)	2004-2015	No sewage system for 12 years (input*10)

Summer 2015: max and hours over threshold





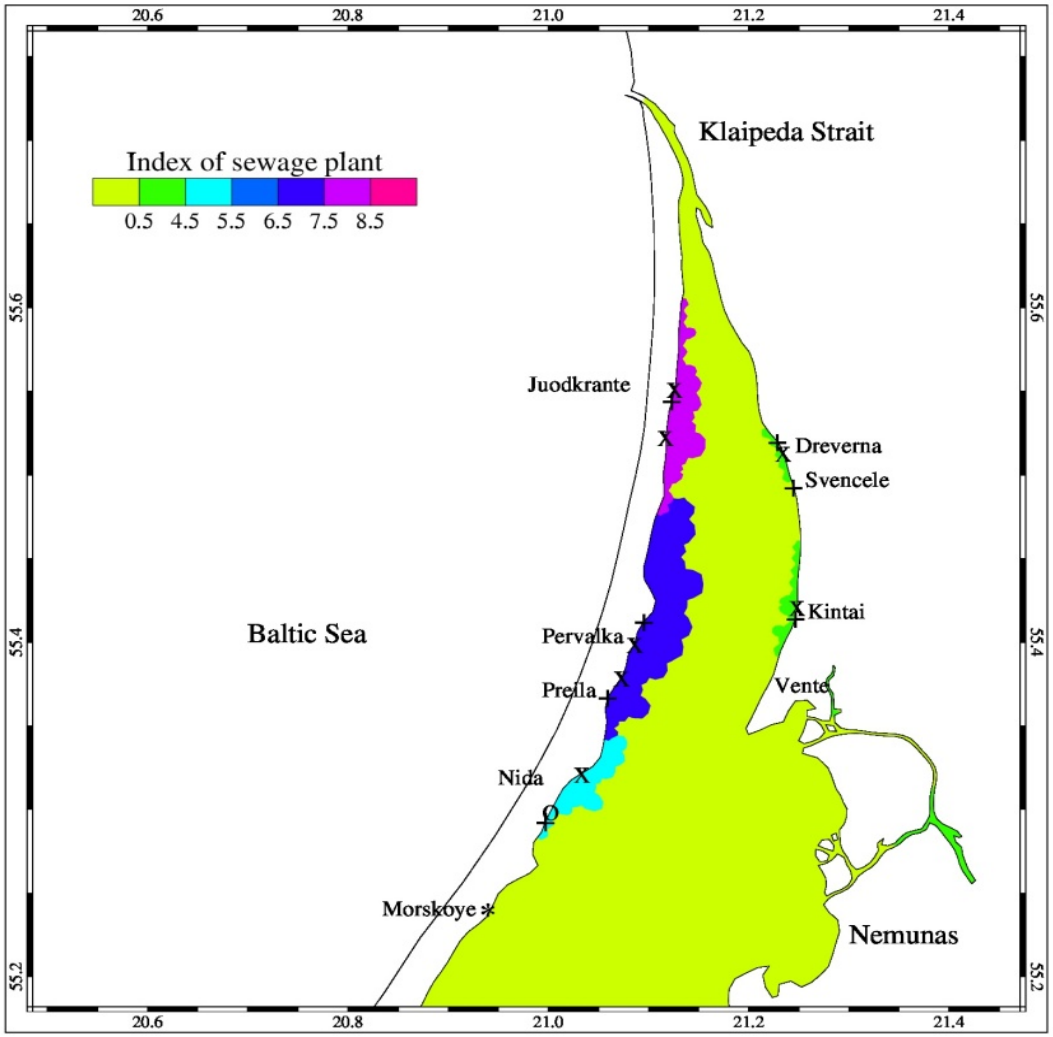
Results for 2015

name	Max concentration		Hours over theshold		Days over threshold	
	spring	summer	spring	summer	spring	summer
R	95.2	74.5	0	0	0	0
S1	475.9	372.5	0	0	0	0
S2	155.1	90.8	0	0	0	0
S3	951.9	744.9	23	81	4	13
S4	95.2	74.5	0	0	0	0
S5	95.2	74.5	0	0	0	0
S3d	951.9	744.9	23	81	4	13
S5a	95.2	74.5	0	0	0	0

Results for 2004-2015

Name and period	Maximum concentration [cfu/100 ml]	Hours over threshold	Days over threshold
RL winter	242.6	0	0
RL spring	103.8	0	0
RL summer	91.3	0	0
RL autumn	259.9	0	0
S3L winter	2183.3	8481	550
S3L spring	934.0	879	119
S3L summer	821.8	667	102
S3L autumn	2338.9	5774	388

Areas of influence



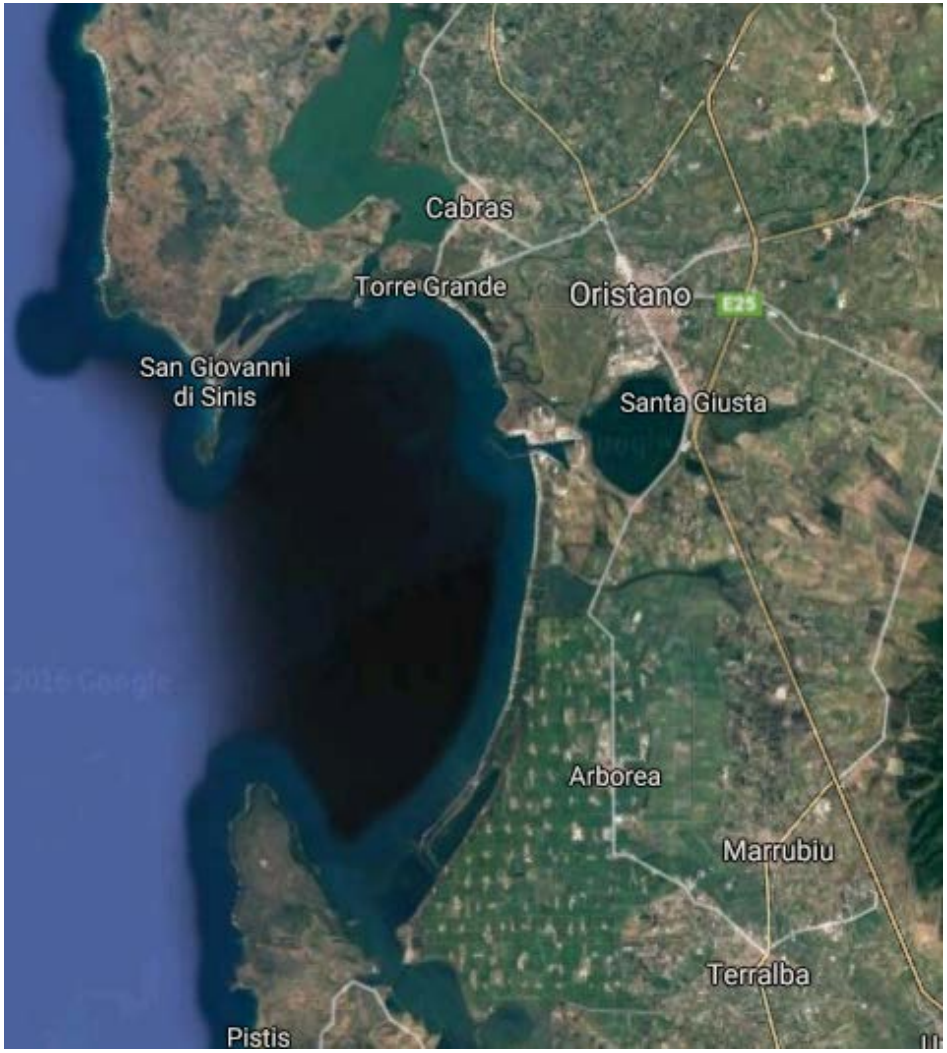
Main points to consider

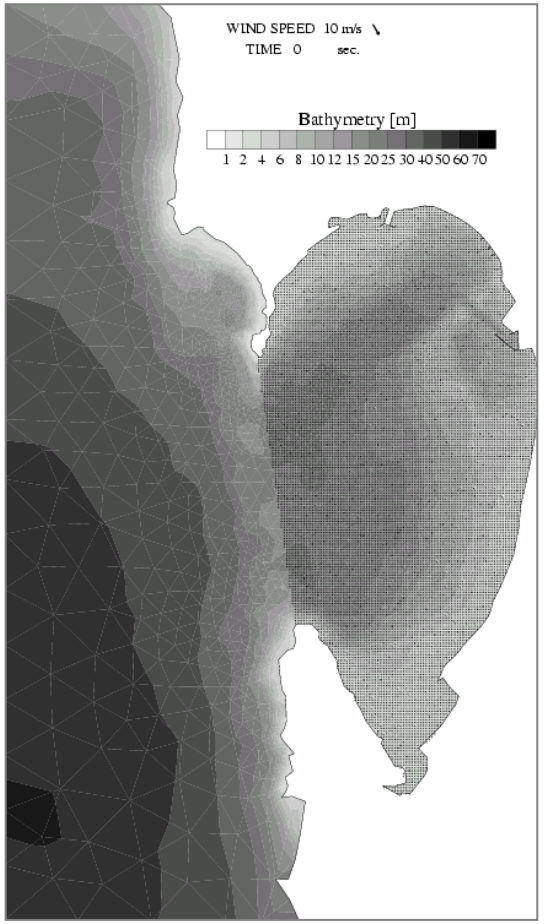
- What are the economic implications creating a beach inside the lagoon?
- Will this attract more people?
- Will sewage systems have to be upgraded?
- What will be the maintenance costs for the beach?

Case 2: A new sewage outlet

- The Gulf of Oristano is a small bay in the west of Sardinia
- The exchange with the ocean is mainly due to wind action, since there are very little tides
- Sewage outlets must be planned carefully because the exchange capabilities with the open sea are limited

The Gulf of Oristano



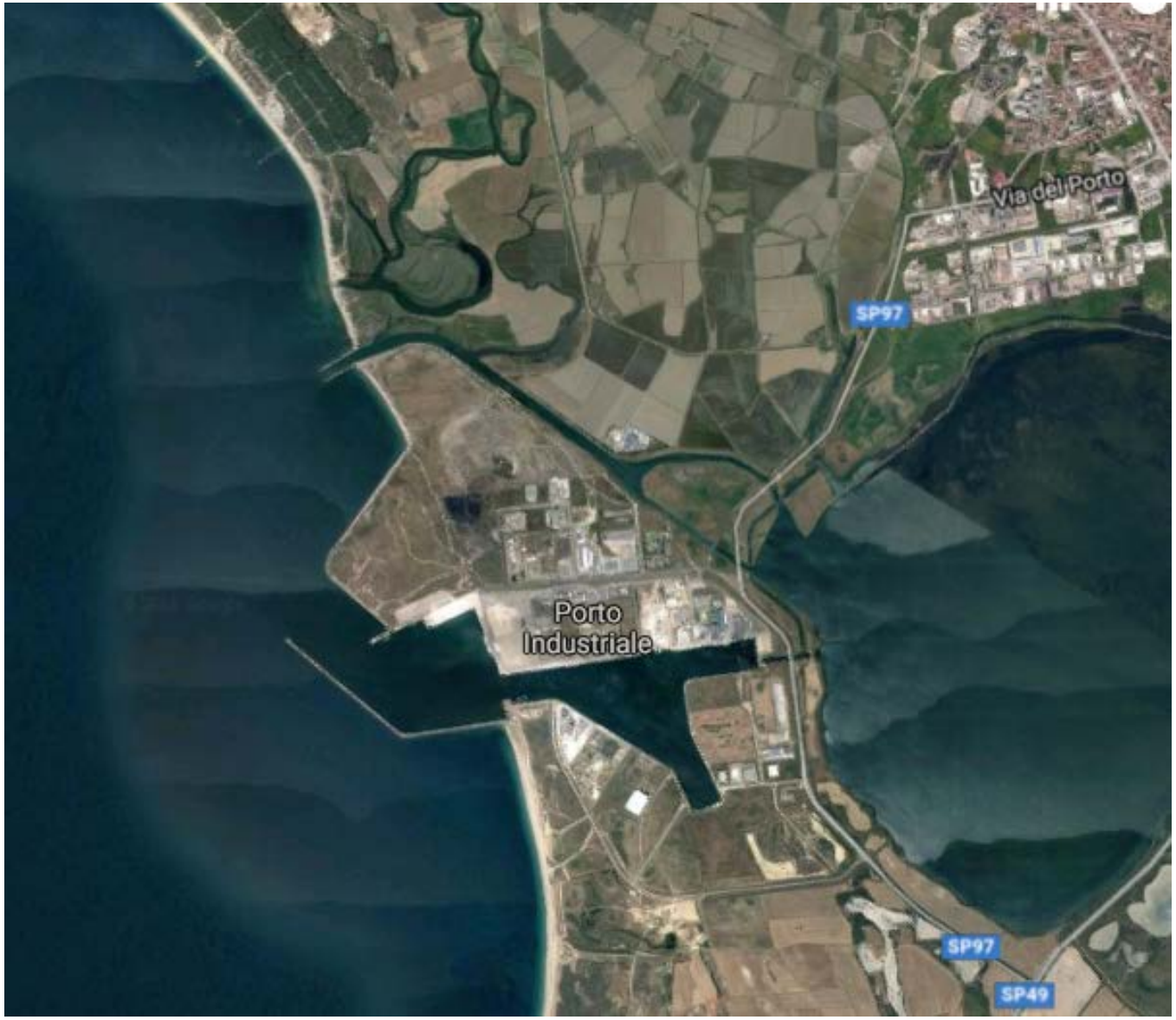


The Gulf of Oristano

Sardinia has beautiful beaches

The industrial port of Oristano

- A new sewage outfall is planned close to the industrial port.
- It is necessary to assess the impact of the sewage outfall on the surrounding areas.

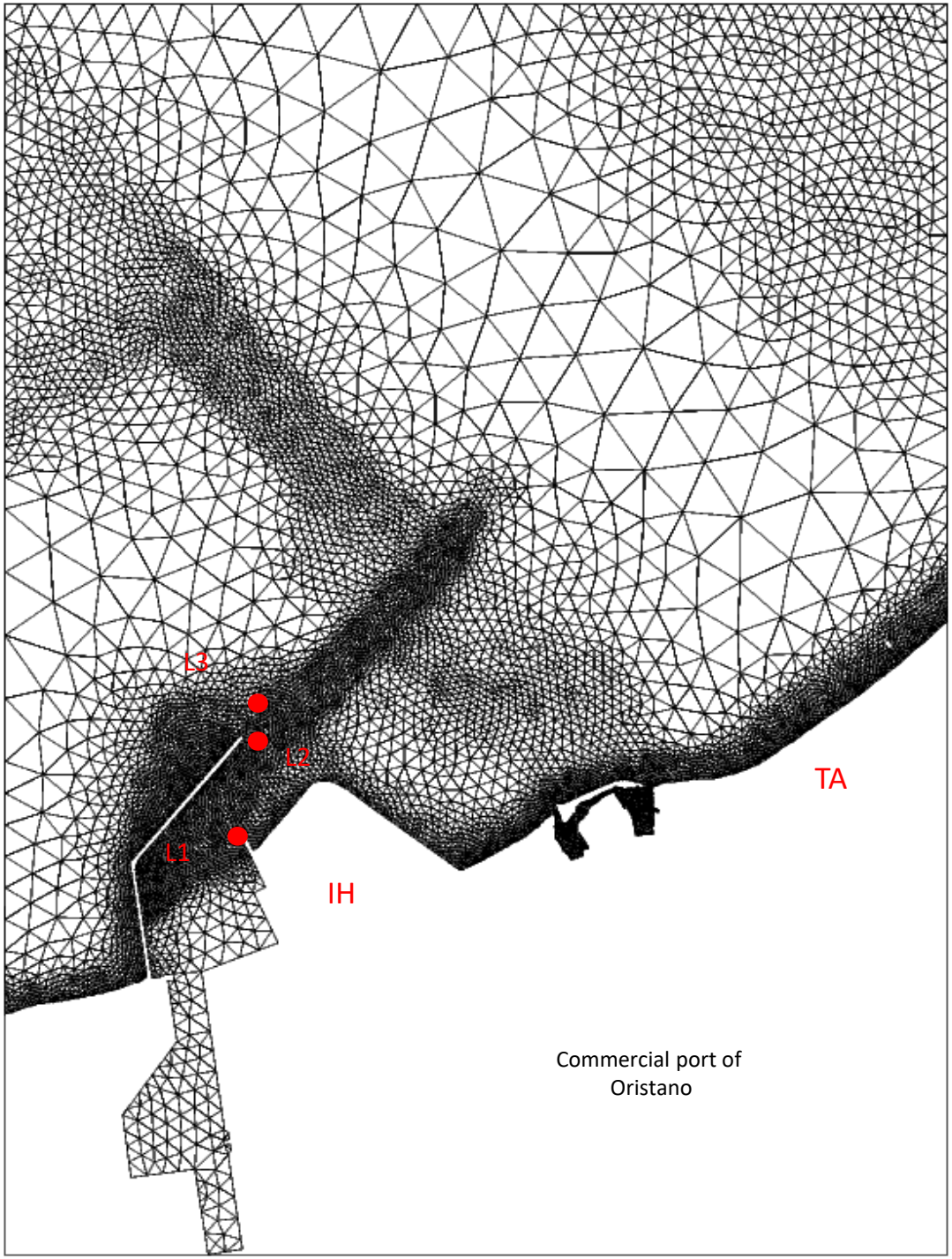


The industrial port of Oristano

Impact of waste water discharge

Test area:

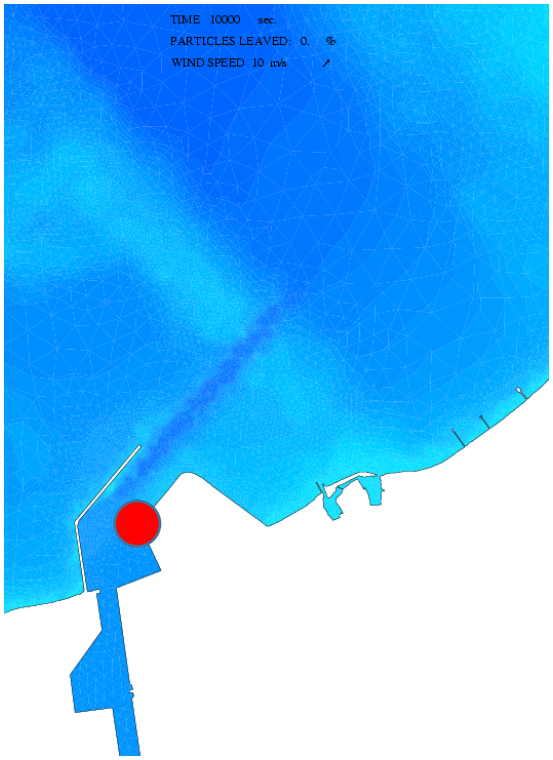
- Industrial port [IH]
- Possible sewage outlet position [L1, L2, L3]
- Touristic area [TA]



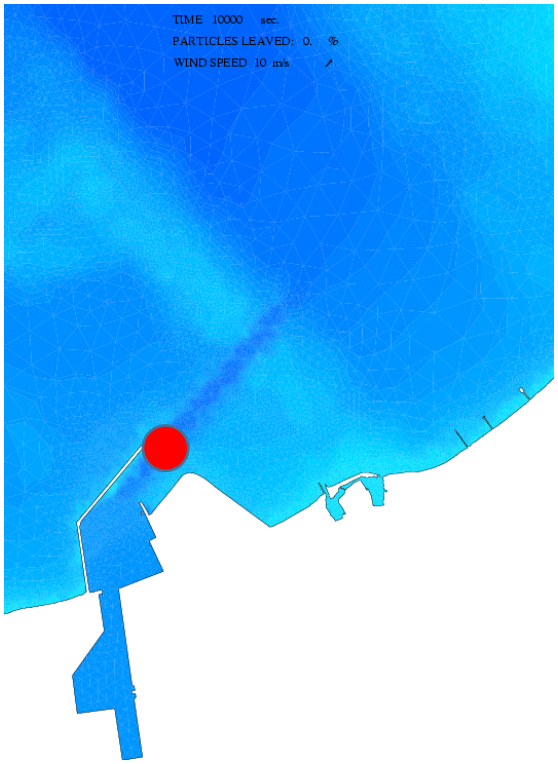
Evaluate impact of pollutants

- constant SW wind with speed of 8 m/s

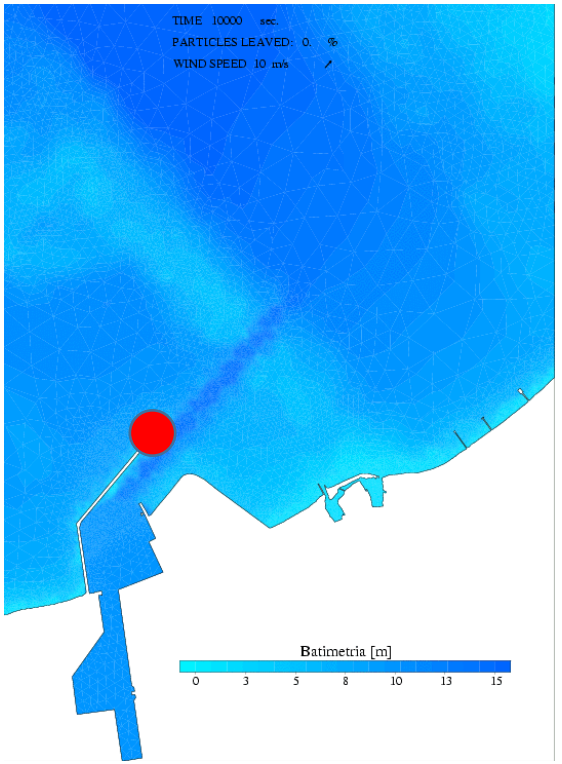
L1



L2



L3



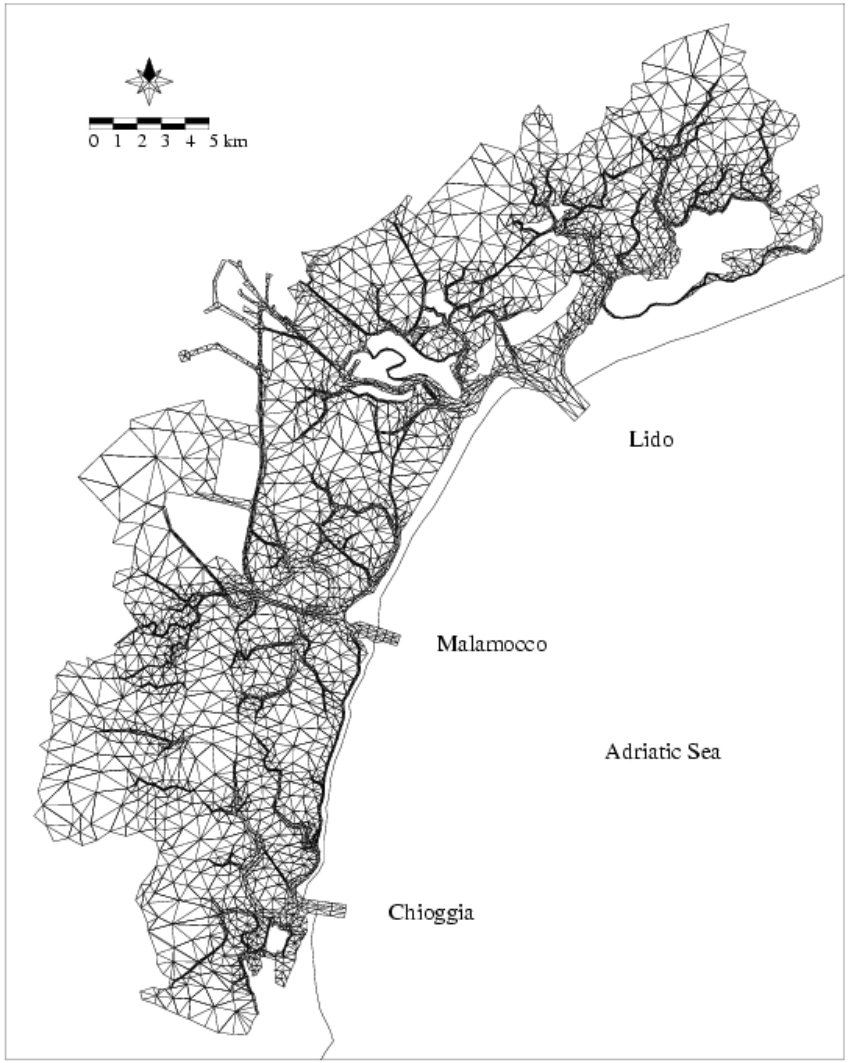
Main points to consider

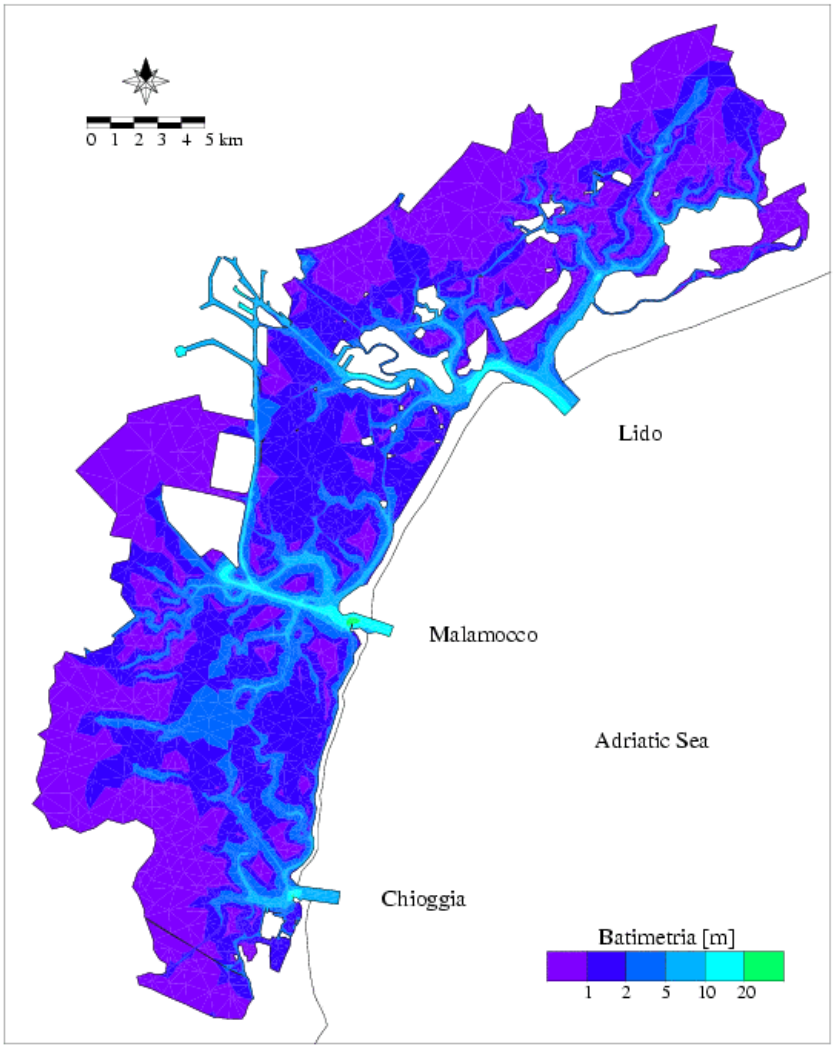
- Which solution out of the proposed ones is better and why?
- Are there other options to place the sewage outlet?
- What will be the costs for the pipeline?
- How will the touristic industry be impacted?
- What about the water quality in the harbour?

Case 3: The Venice lagoon mobile barriers (MOSE)

- 50 km long
- 10 km wide
- 300,000 inhabitants
- 30,000,000 tourists annually
- 1.5 m average depth
- tidal range 1.0 m
- 50 km^2 salt marshes

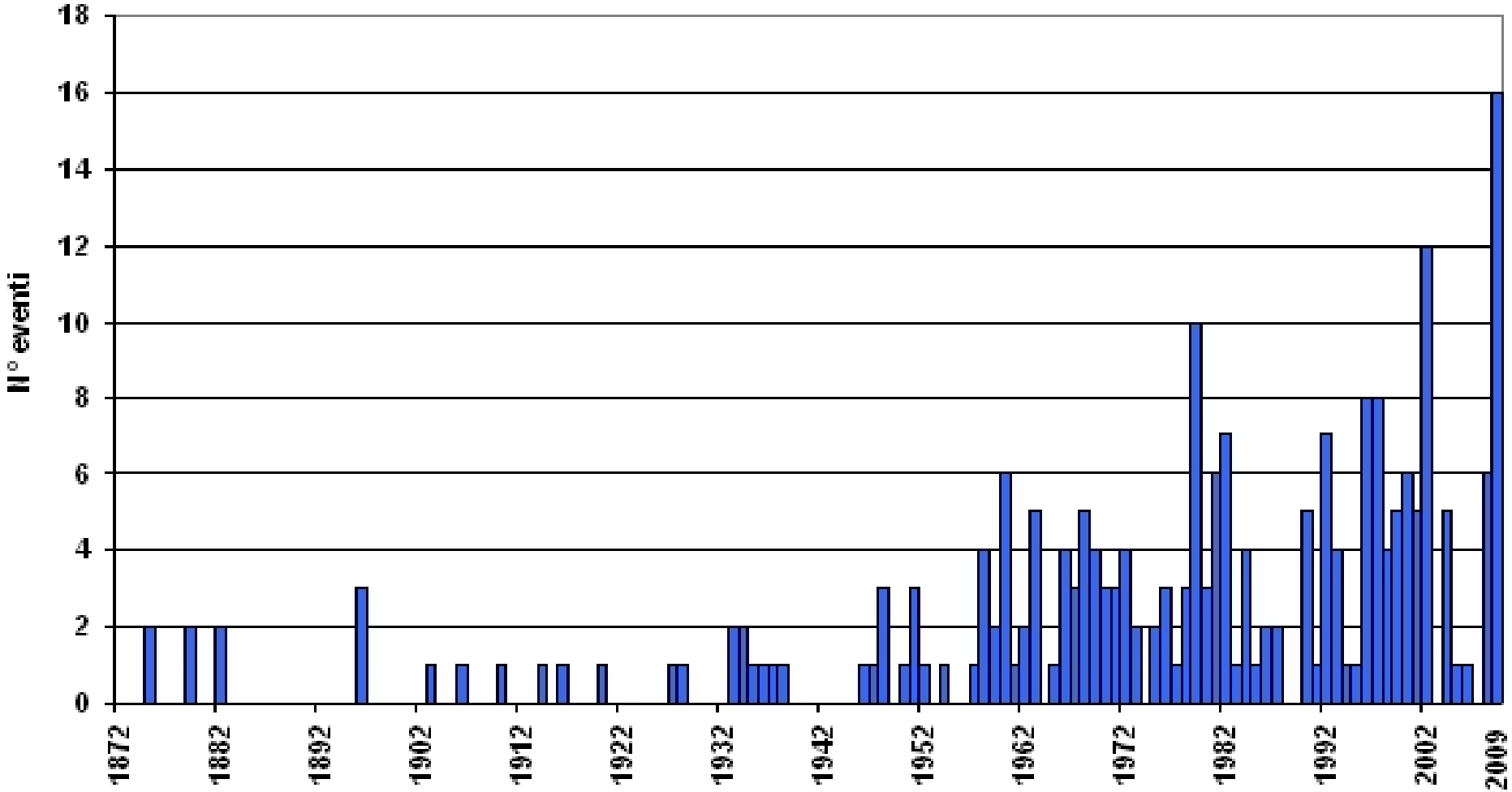
Hydrodynamic model: grid and bathymetry





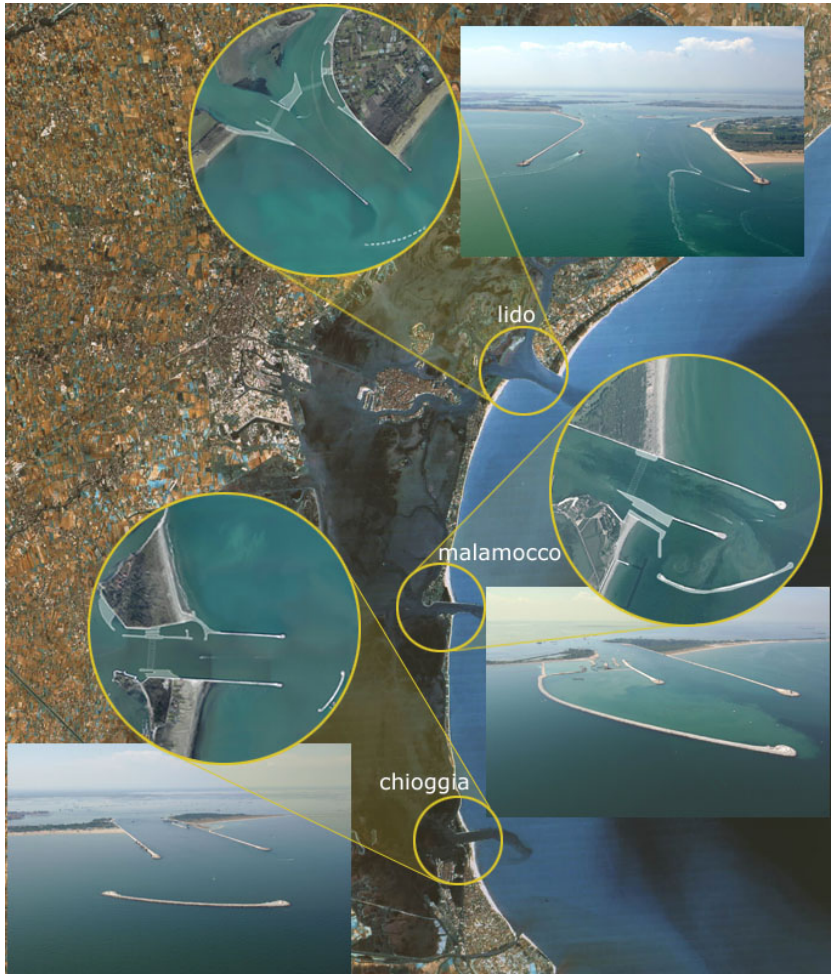
Venice is flooded 20 times a year

Annual frequency of flooding events (= tides >1.10 m above local datum) in Venice (from1872 to 2009)

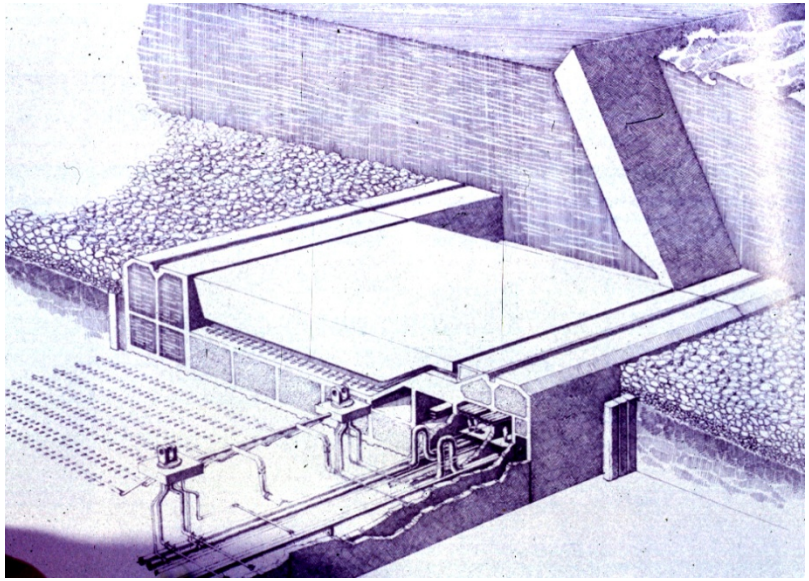


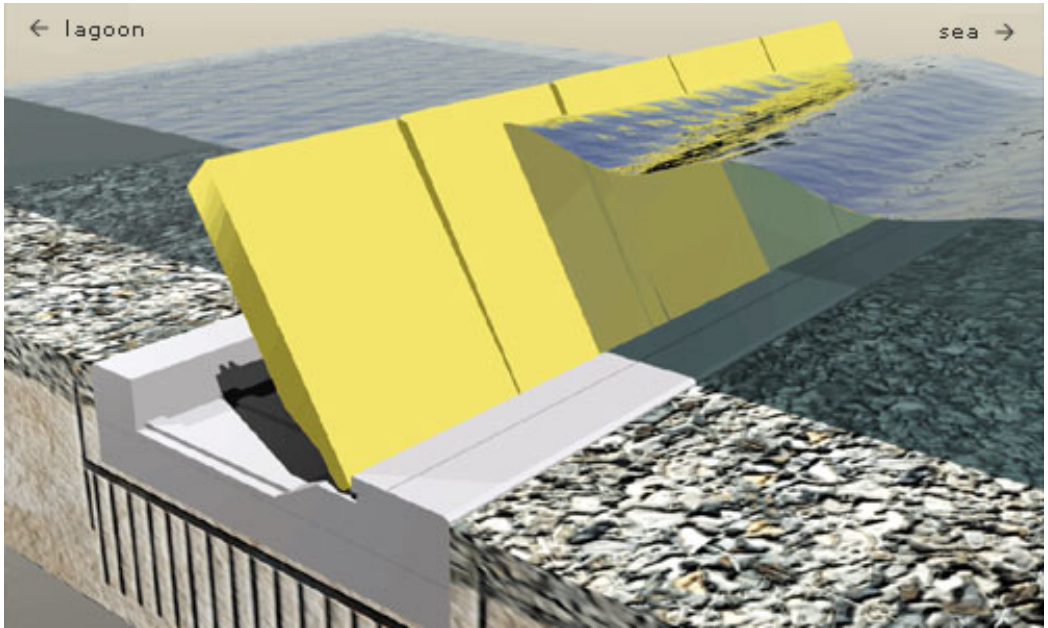
Istituzione
Centro Previsioni e
Segnalazioni Maree

Interventions at the inlets: The Mose project



Mose: how it works





Pros & Cons

- Very efficient for protection
- Work only if needed
- Do not change the water budget of the lagoon
- Can be used to artificially enhance circulation in the lagoon
- Localized interventions

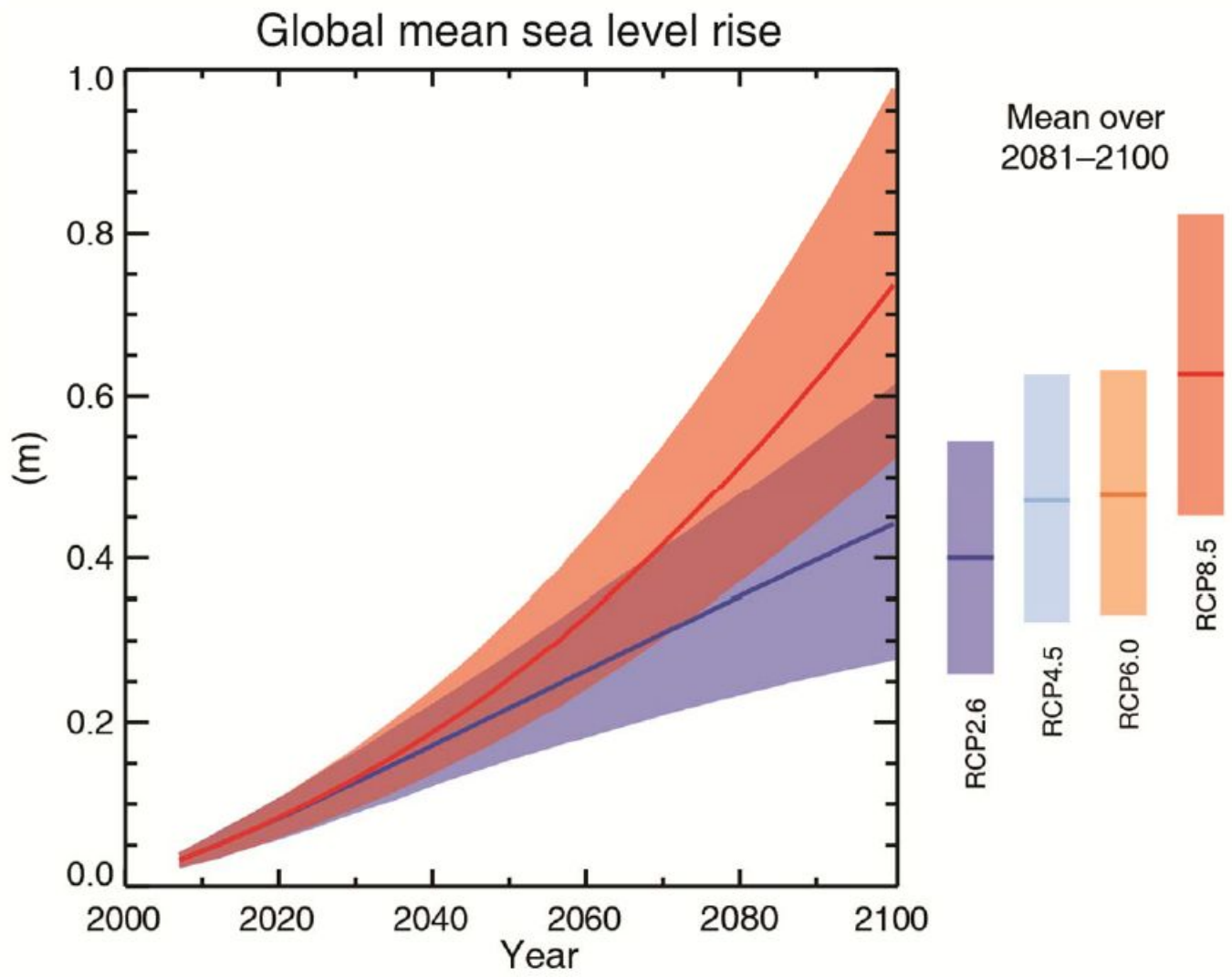
- Very expensive
- Maintenance and management will be difficult
- Sea level rise will question the utility of the barriers
- Strong intervention in the natural equilibrium of the lagoon

The lagoon with tidal marshes

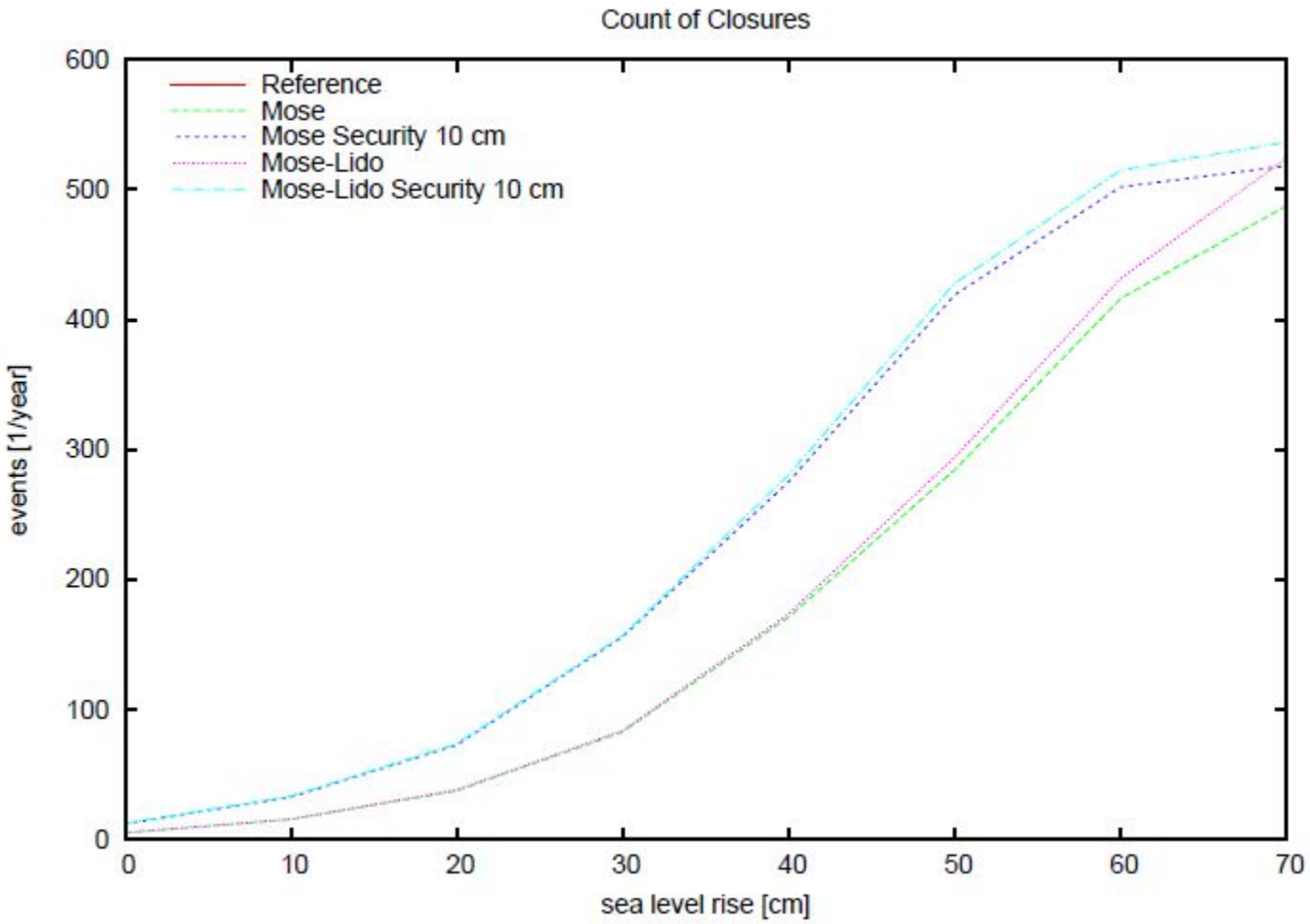
Ship traffic and the MOSE

- The planned mobile barriers will not only change the water exchange with the open sea but they will also interfere with the ship traffic

IPCC report 2013 (AR5)



Closures of Mose (projection)



approx. 1 closure per day for 50 cm SLR

If or when?

- The question will not be **if** it happens but **when** it happens
- In this case the only possibility will be to cut off the lagoon from the Adriatic Sea, transforming it into a fresh water lake
- In order to close the lagoon some conditions must be fulfilled:
  - no pollution
  - a sewage system for the city of Venice
  - the industrial and touristic port should be transferred out of the lagoon
- The Danube Delta or the Baltic lagoons show us nice examples of fresh water lagoons

Main points to consider

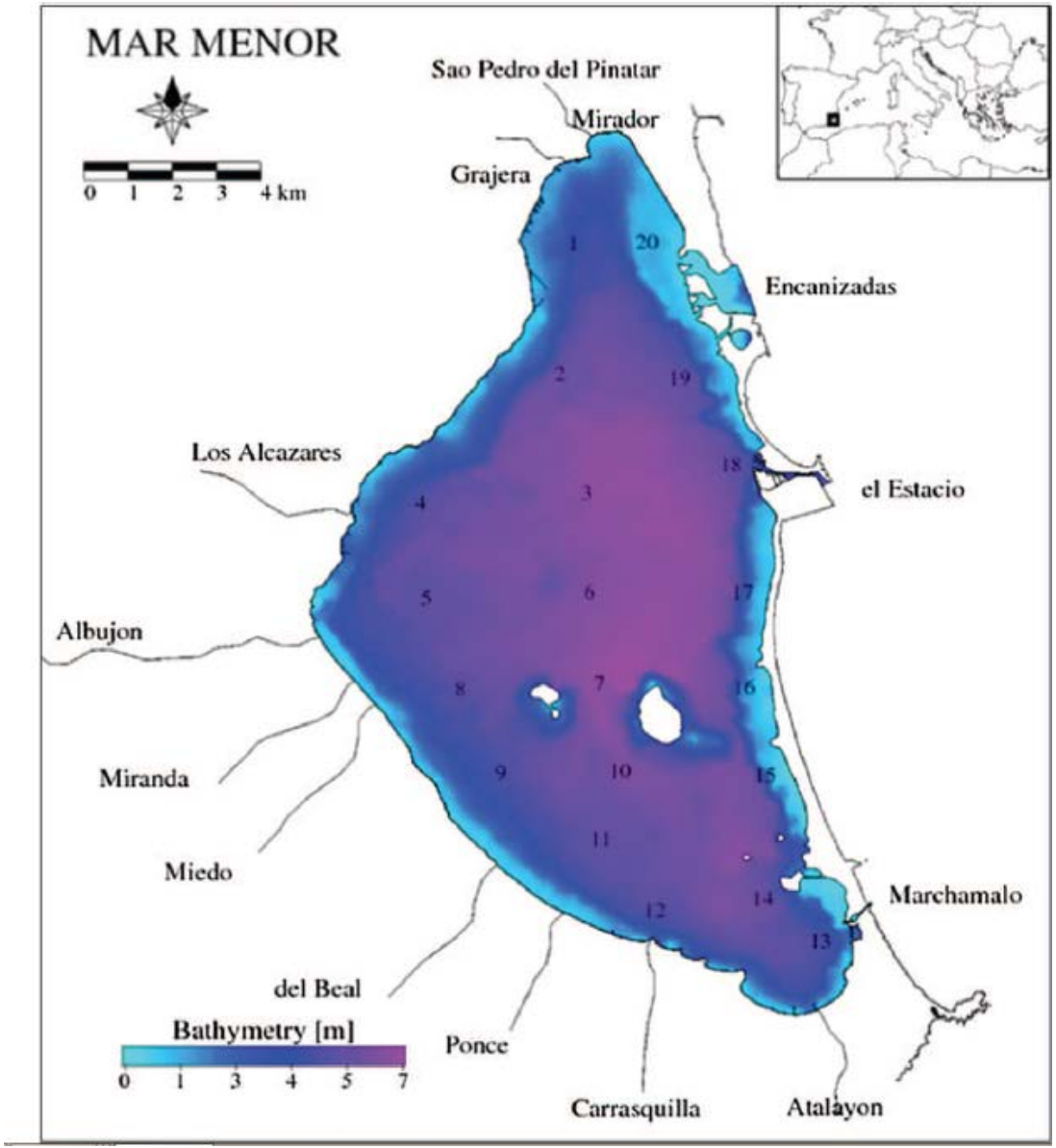
- Can we estimate the benefits of limiting the water level to 110 cm?
- What is the implication to ship traffic?
- How many closures a year are affordable for the ship traffic and the water exchange?
- How will tourism be impacted by the MOSE?
- How can we deal with a regime shift in the ecological system? Do we maybe need an ecological model to deal with this?

Case 4: Connectivity in the Mar Menor

- The Mar Menor is a lagoon on the Mediterranean coast of Spain
- Touristic industry is very important
- The exchange with the Mediterranean is extremely limited

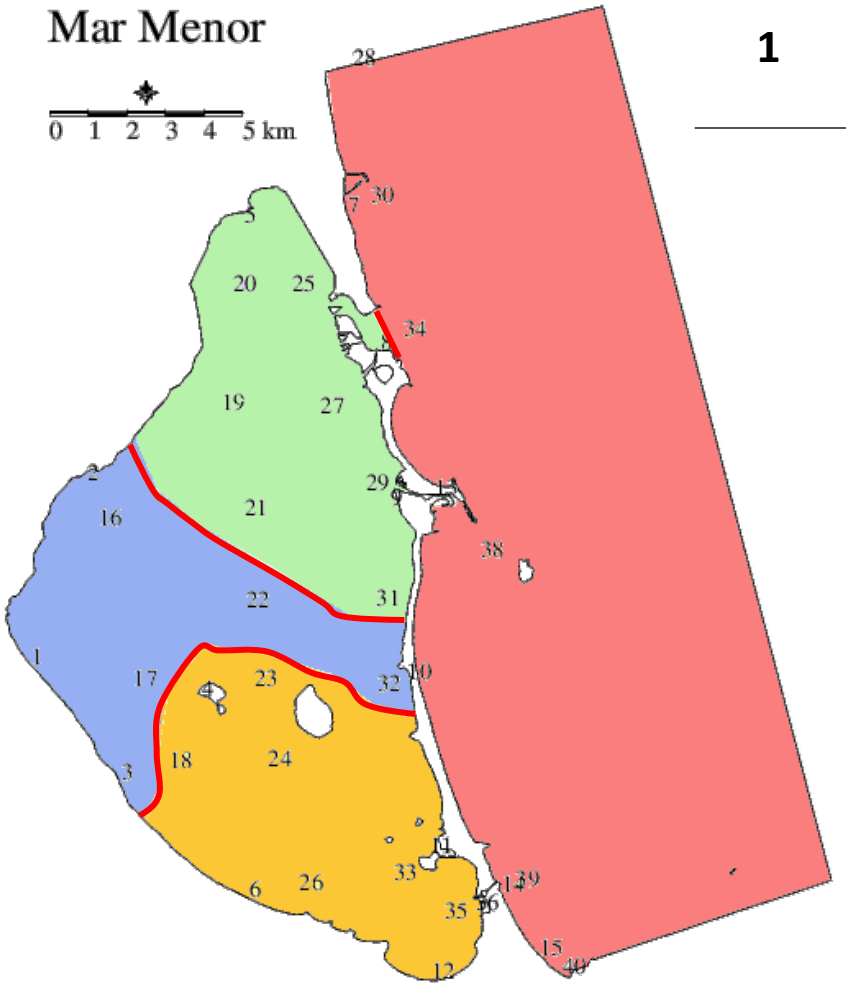
The Mar Menor is heavily populated

Modeling connectivity in the Mar Menor



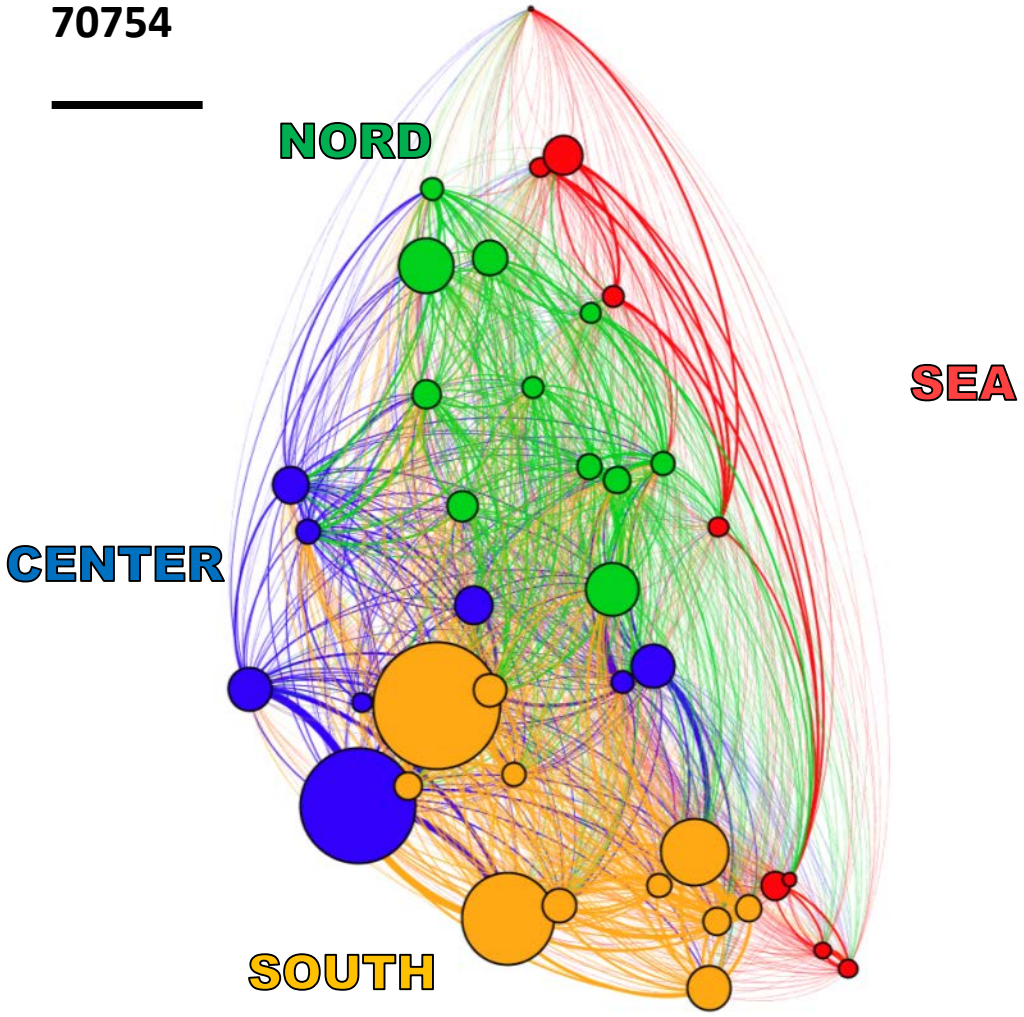
Connectivity results

PARTICLES EXCHANGED



Range thickness

1 **70754**



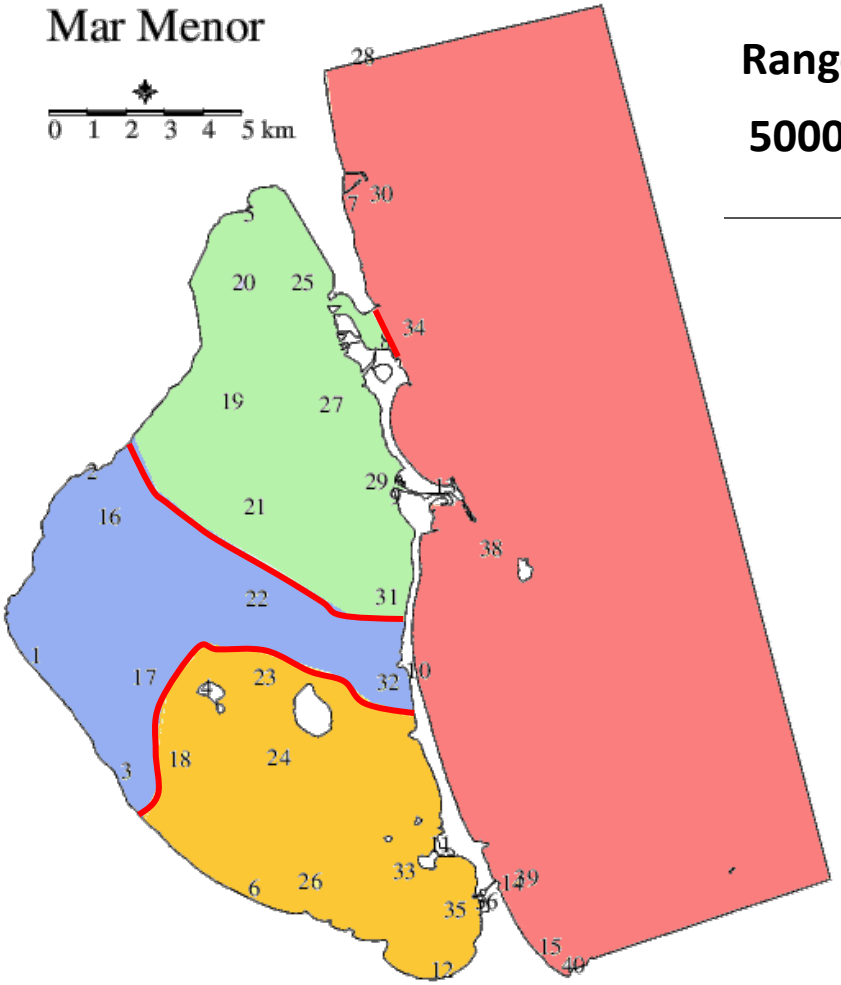
Connectivity results

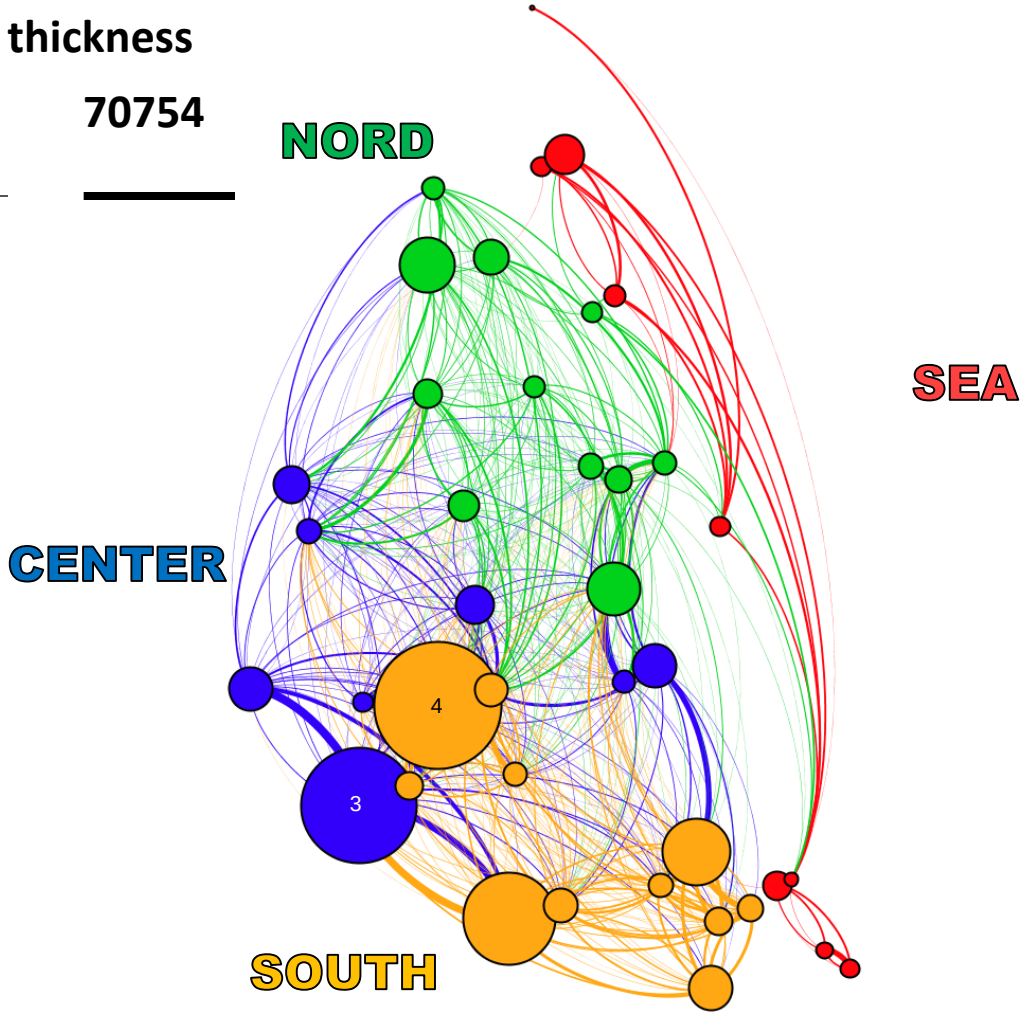
PARTICLES EXCHANGED

Edges filtered

Range thickness

5000 **70754**

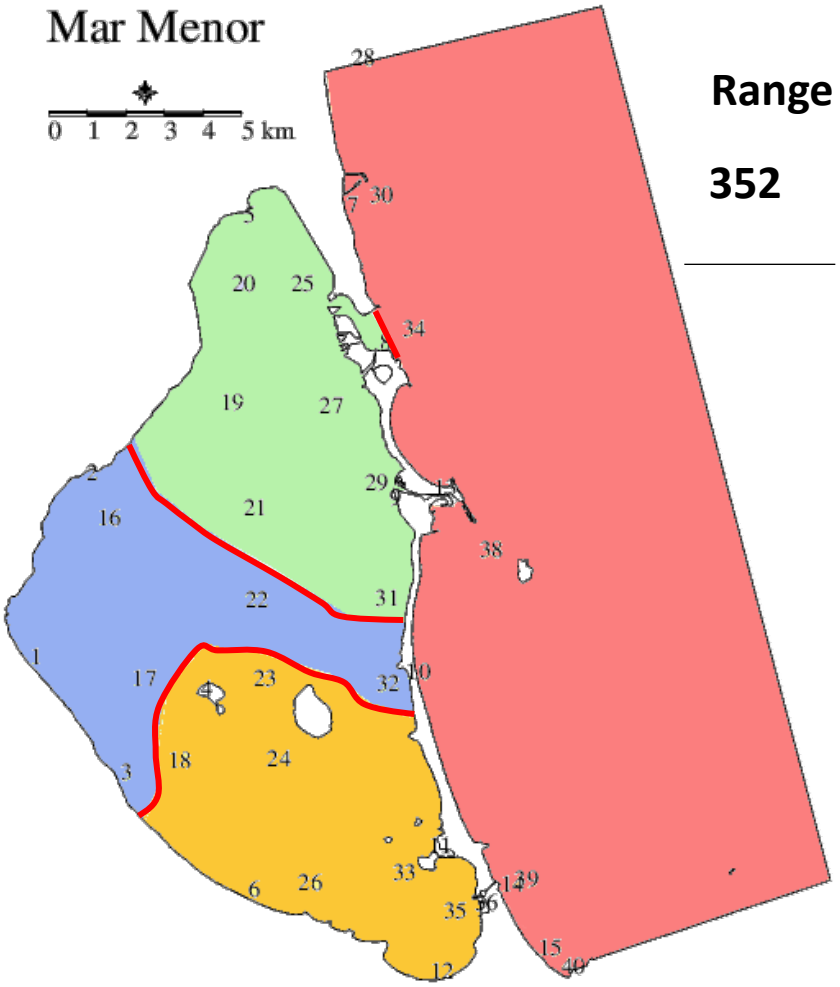




Connectivity results

PARTICLES EXCHANGED

Range of particles exchanged averaged on groups edges



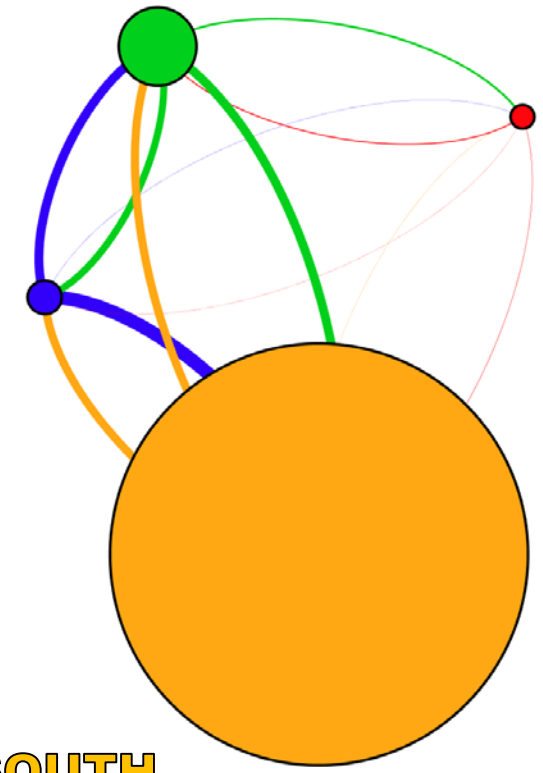
Range thickness

352 **11056**

NORD

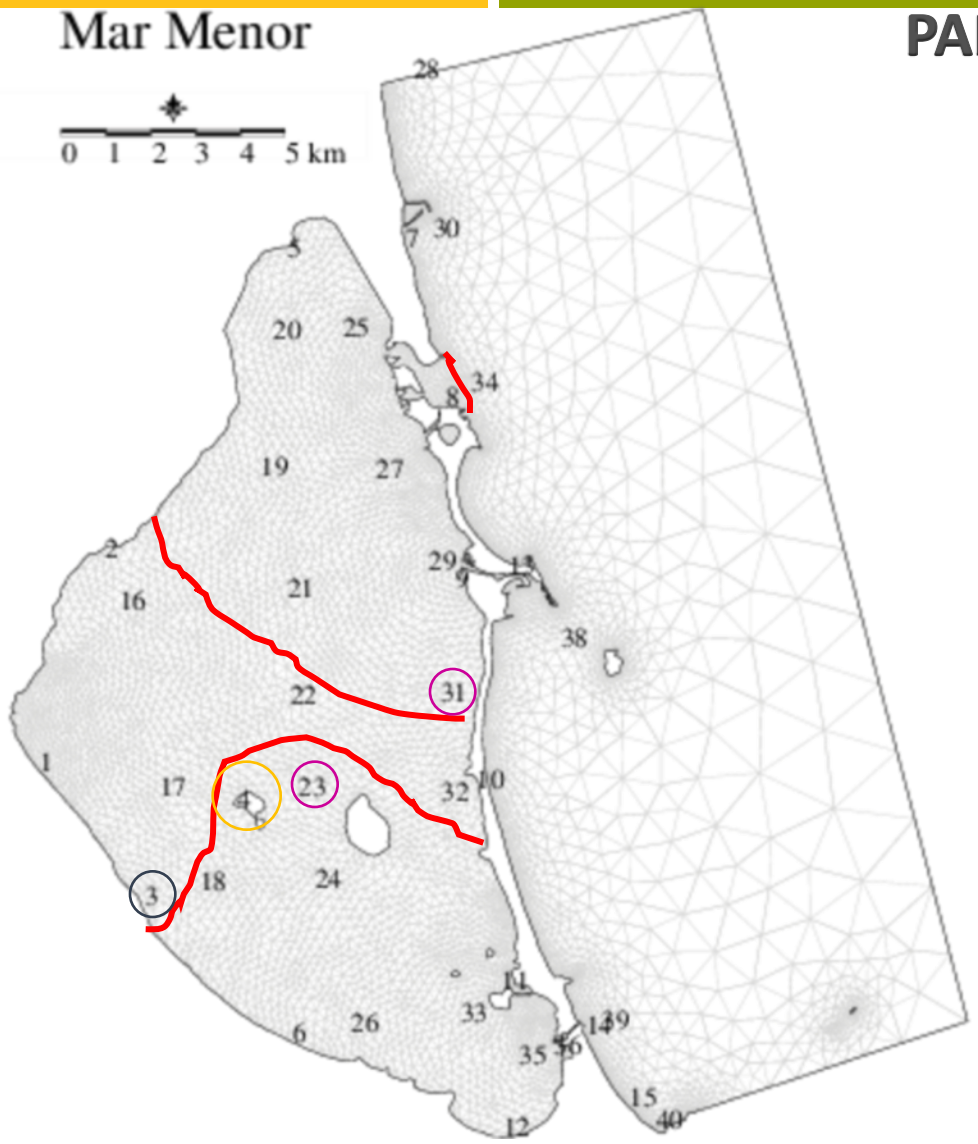
SEA

CENTER



SOUTH

Connectivity results: conclusions



PARTIAL CONCLUSIONS:

Particles generated in the northern sub-basin are the most scattered in the lagoon; particles generated in the southern sub-basin are more confined.

The central stations 31 and 23 act as transit areas.

These patterns are consistent with the circulation of the main current at the Estacio inlet, which crosses the basin transversally.

Enlarging the main entrance

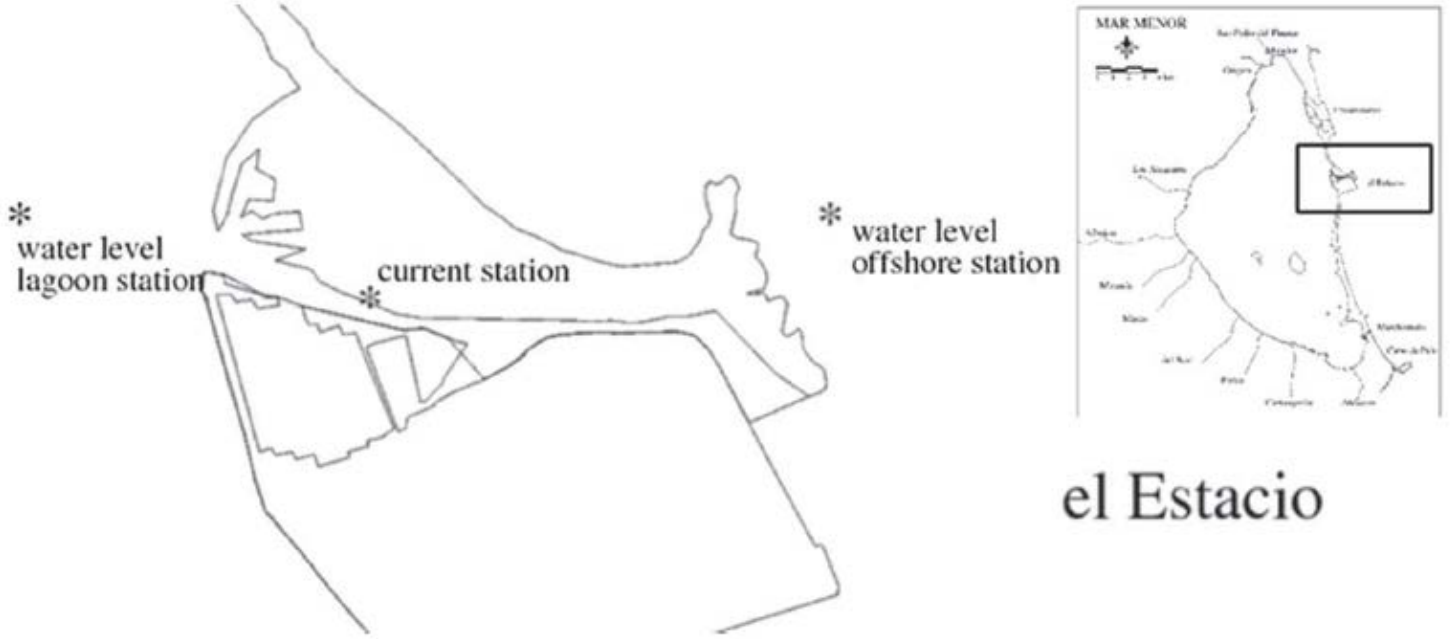


Fig. 2. Location of stations for water level and current measurements for the period 25/12/85–25/04/86.

- There is intention to enlarge the main entrance to the Mar Menor

The main entrance to the lagoon

The Mar Menor during Climate Change

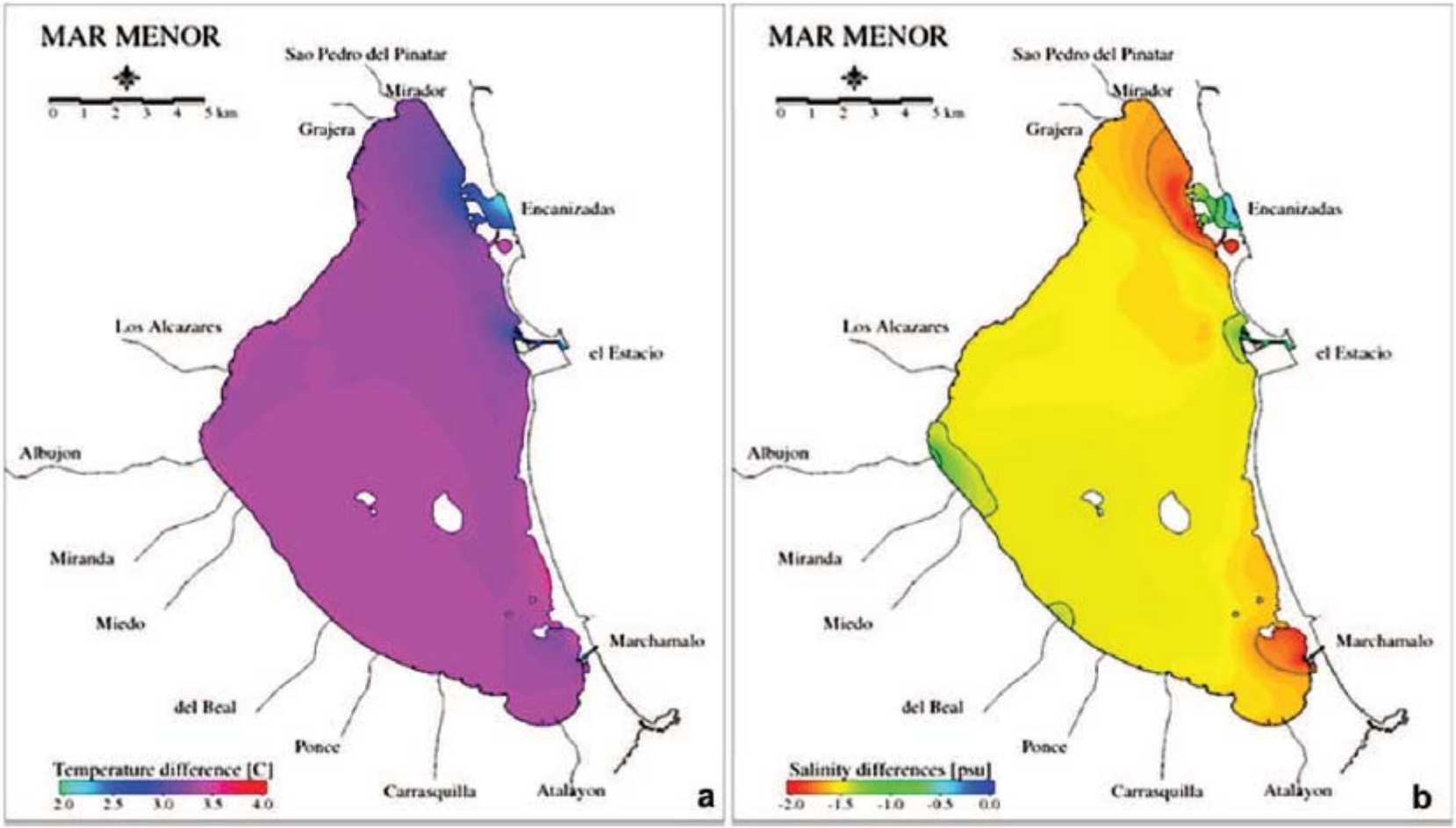


Fig. 7. Spatial differences between 2100 and 1997 values of the annual average for temperature (a) and salinity (b).

Main points to consider

- What are the economic implications enlarging the inlet?
- How does the circulation change?
- Is it always beneficial having more exchange with the sea?
- What happens to salinity in the Mar Menor?
- Will the fish population change in the lagoon?
- How might tourism be affected by the opening?