Ministry of Infrastructure

VENICE WATER AUTHORITY

Environment Protection of Venice

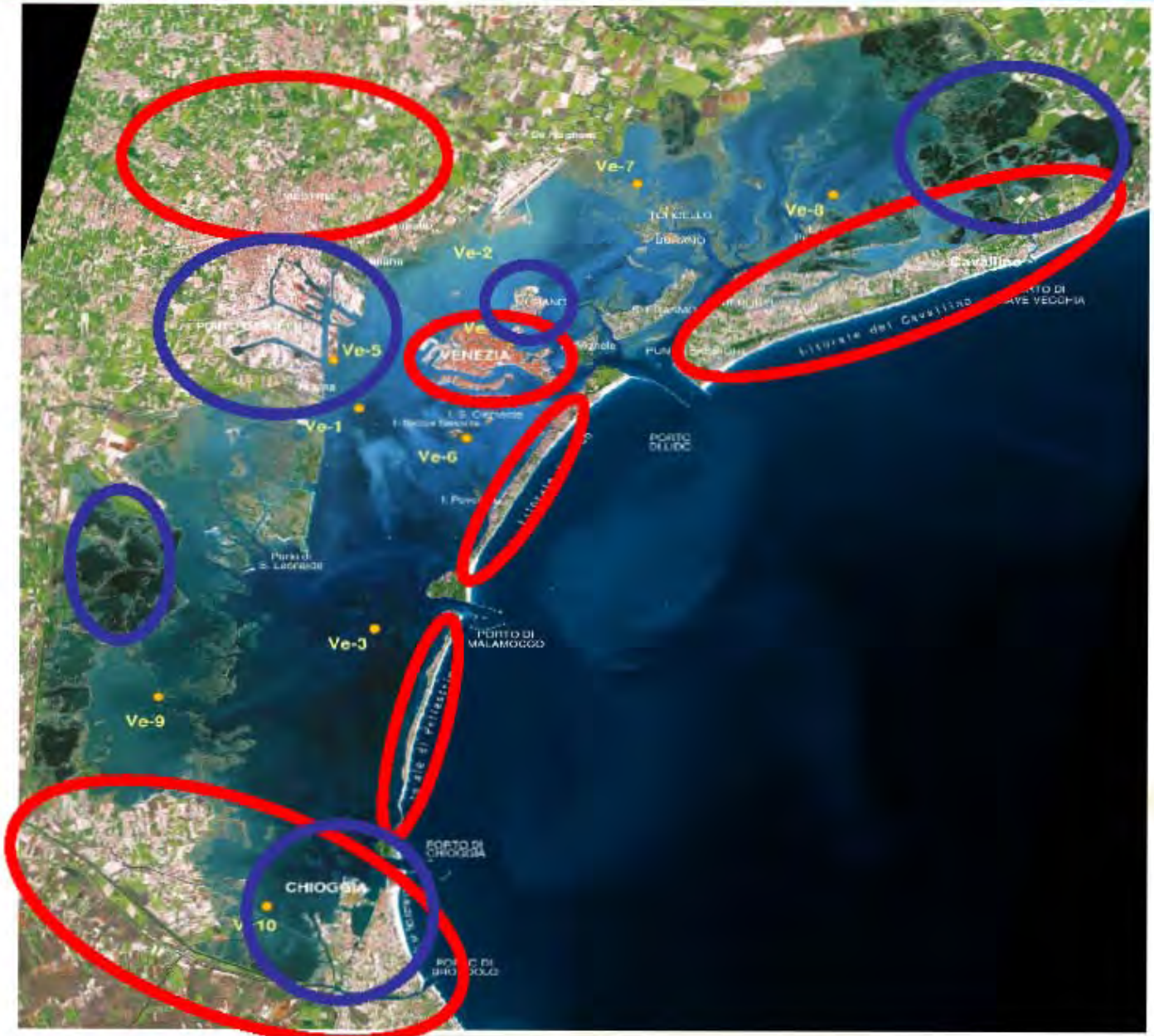
Jesus Cisneros Aguirre. PhD. - Information Service

VENICE LAGOON

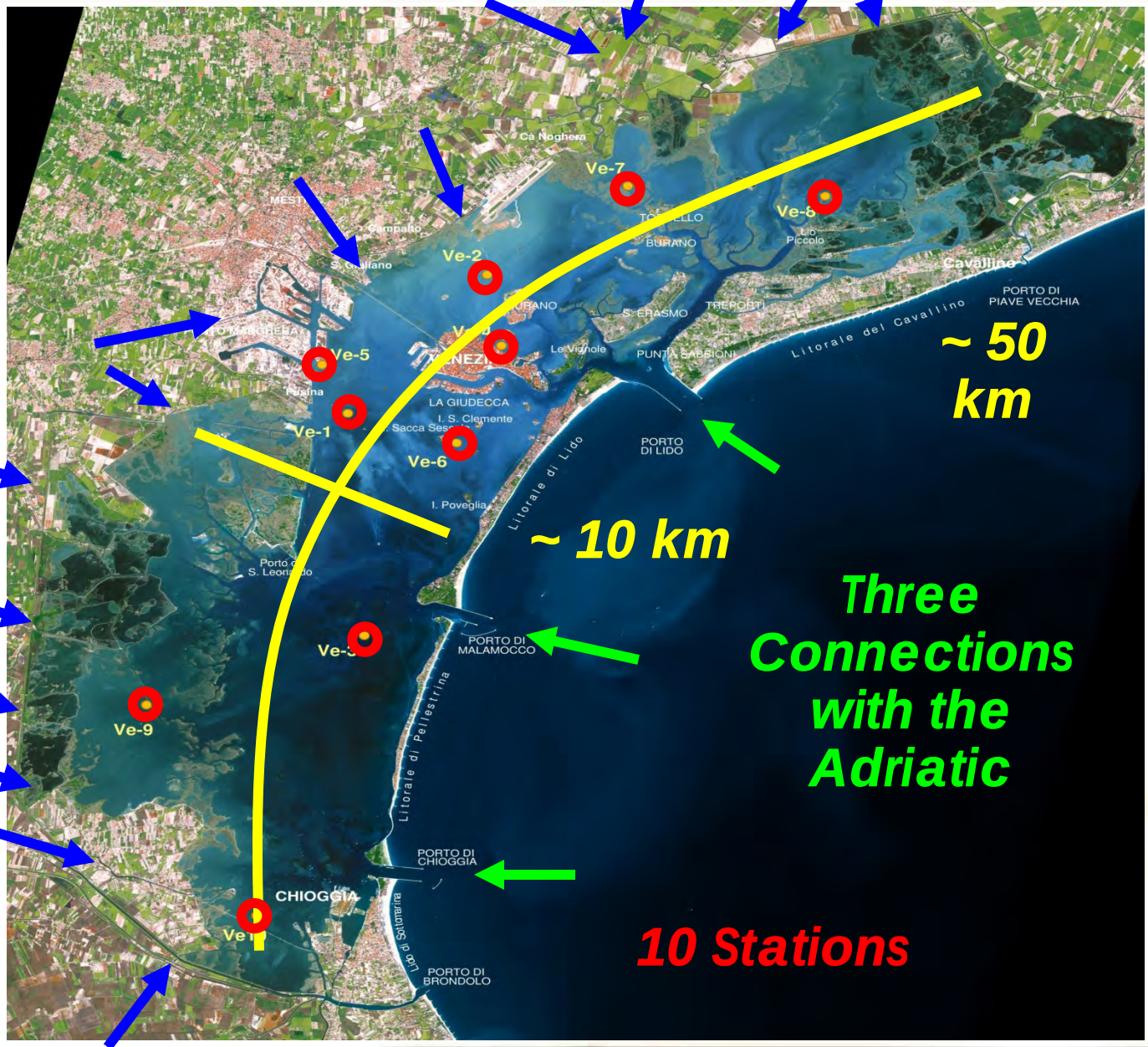
The lagoon, in a costant state of limbo between land and water, is an ecosystem where continually changing environments coexist in the space between the mainland and the sea.

The lagoon of Venice, with a surface area of about 550 square km, of which 418 square km are open to the tides of the Upper Adriatic (the highest tides in the Mediterranean), is the largest Italian lagoon. The sea and the lagoon are connected through the three inlets of Lido, Malamocco and Chioggia.

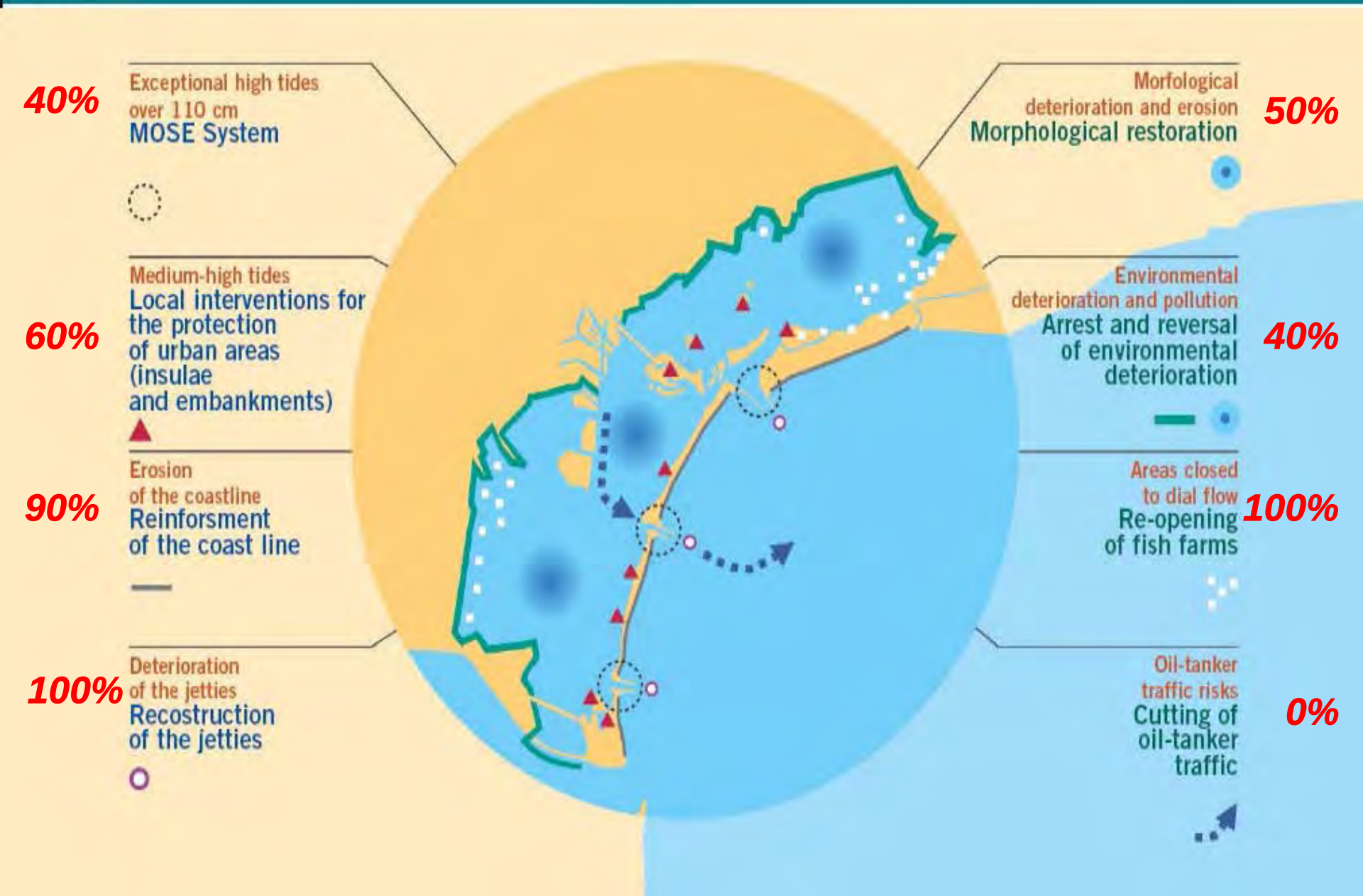
The Venice Lagoon



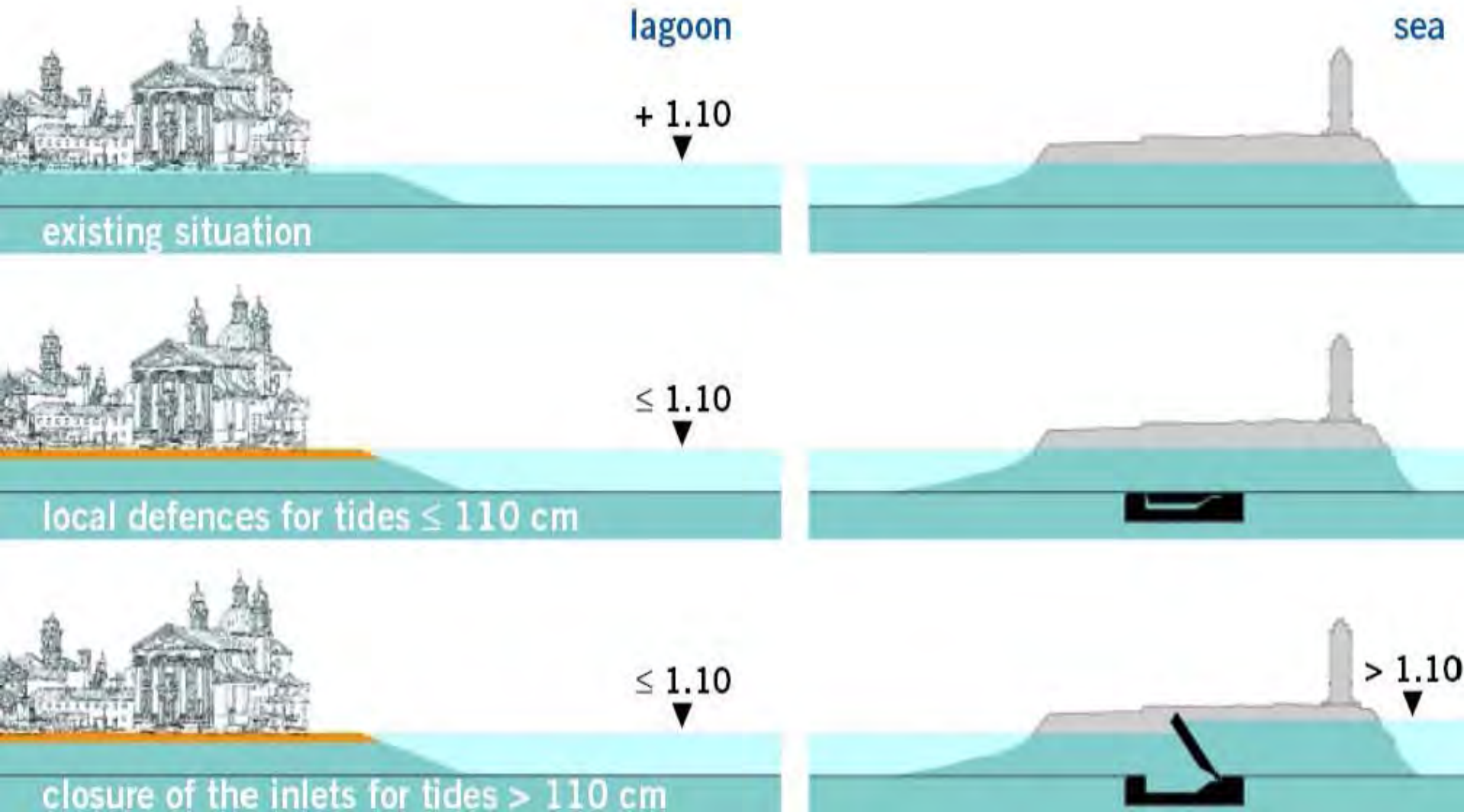
The Venice Lagoon



SYSTEM OF INTERVENTIONS



High tide protection system



Mobile barriers for the defense of Venice – Malamocco inlet

the final layout

The new lay-out of the inlet after the realization of the MOSE System for the defence from high tides

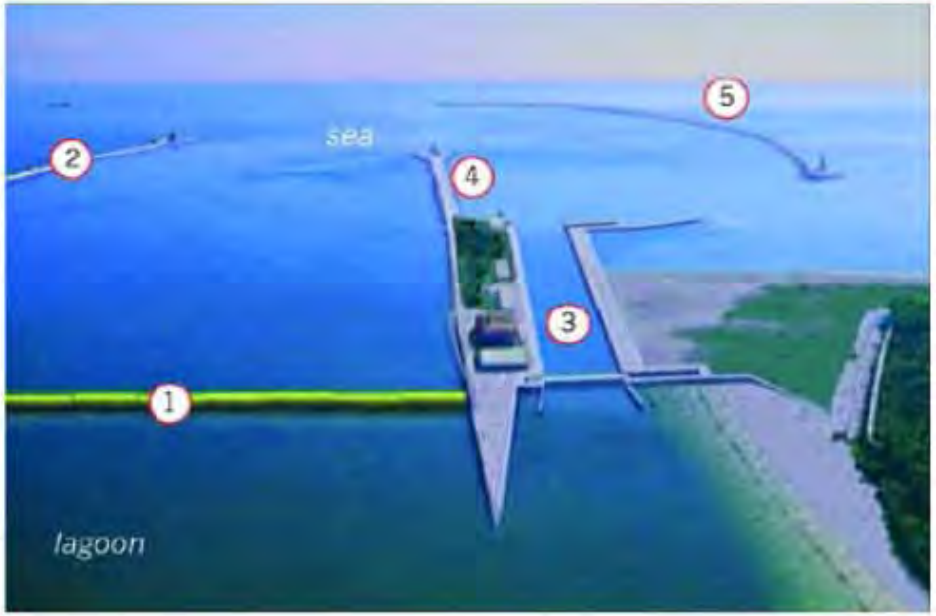
1. row of gates
2. northern jetty (existing)
3. navigation lock
4. southern jetty (existing)
5. breakwater

work in progress

Mobile barriers for the defense of Venice – Malamocco inlet

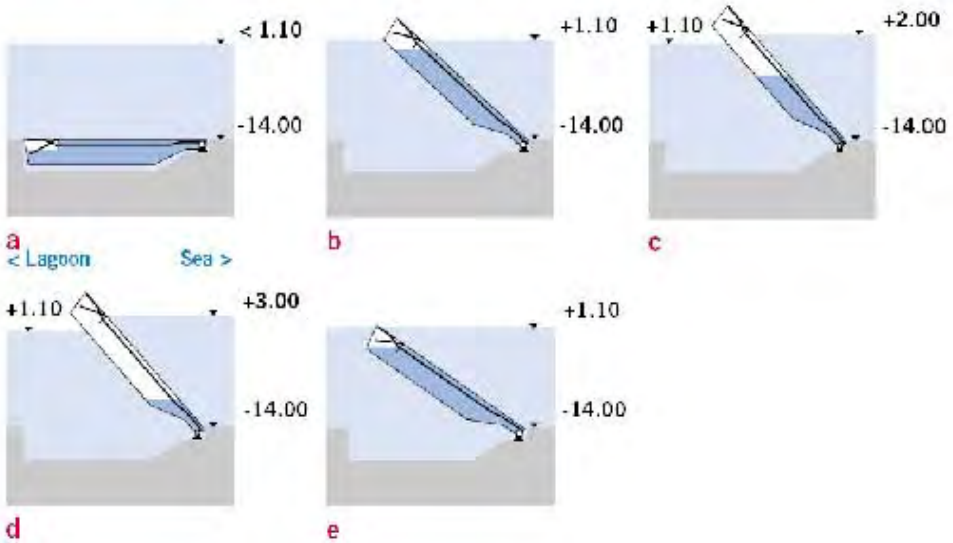
View of the inlet after the realisation of the MOSE system for the defence from high tides and with the navigation lock for the passage of ships bound for the port

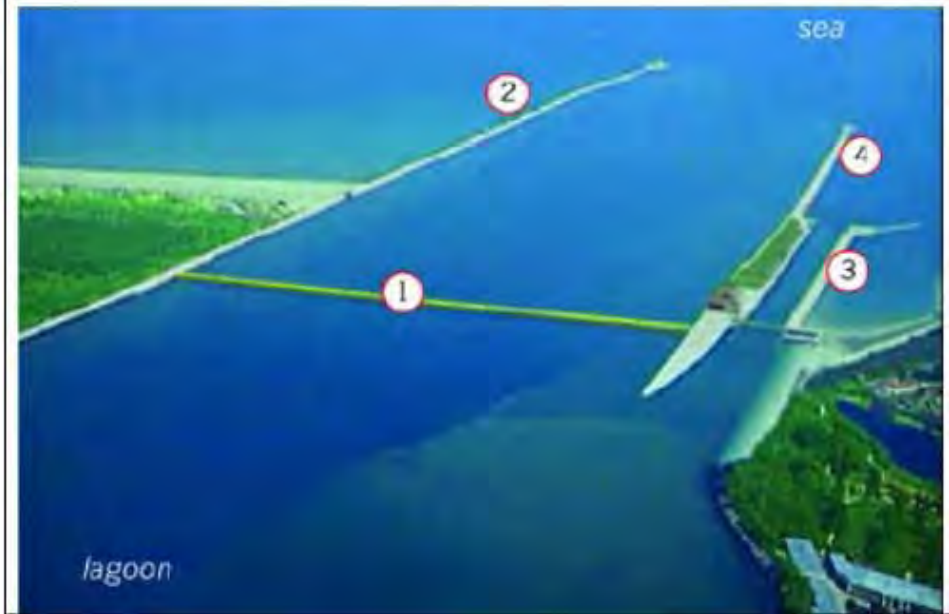
1. row of gates
2. northern jetty (existing)
3. navigation lock
4. southern jetty (existing)
5. breakwater



How the floodgates work

Defence against exceptionally high tide





Physical model of Venice Lagoon

scale 1:250 – 1:20

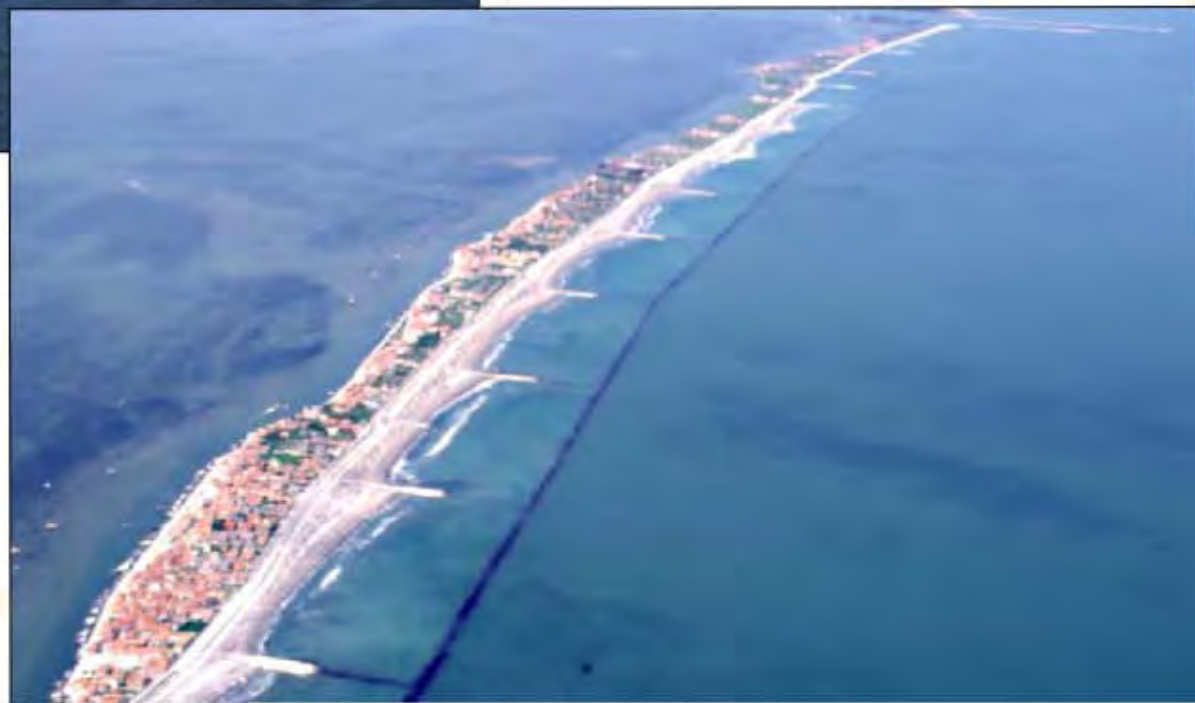
Chioggia entrance model

scale 1:60

Chioggia entrance physical model for tests of gates scale 1:30

Pellestrina. The bank after and during interventions

Pellestrina litoral before and after interventions



Satellite sensors and some applications

SATELLITE/PLANE SENSORS OR SERVICES

Medium resolution
(about 300 images)

- **Landsat TM/ETM**
- **Aster**
- **SPOT 4/5**
- **SAR on ERS1/Envisat**

High resolution
(coverage: Veneto region)

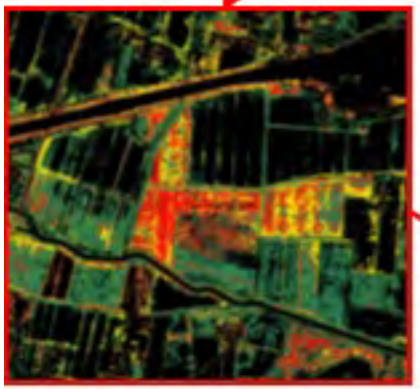
- **Ikonos**
- **Quick Bird**
- **Mivis**

SOME APPLICATIONS

- Updating GIS and specific overviews of the individual phenomena and their correlations
- Salt marshes, mud flats and shallows monitoring
- identification and monitor sites polluted by illegal dumps
- Water monitoring
- Subsidence monitoring

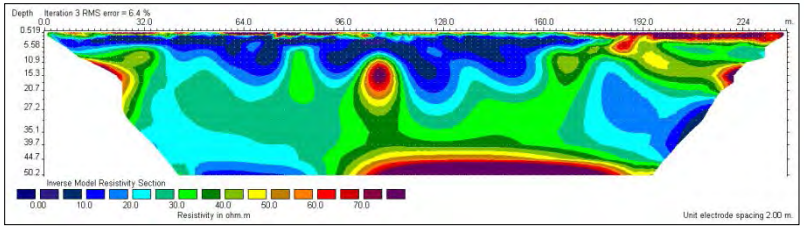
Classification of the possible polluted areas

Initial recognition of possible contaminated sites using ML classification (maximun likelihood alghoritm) for the identification of the stressed vegetation)



Classification of the possible polluted areas

geophisical monitoring



site inspection

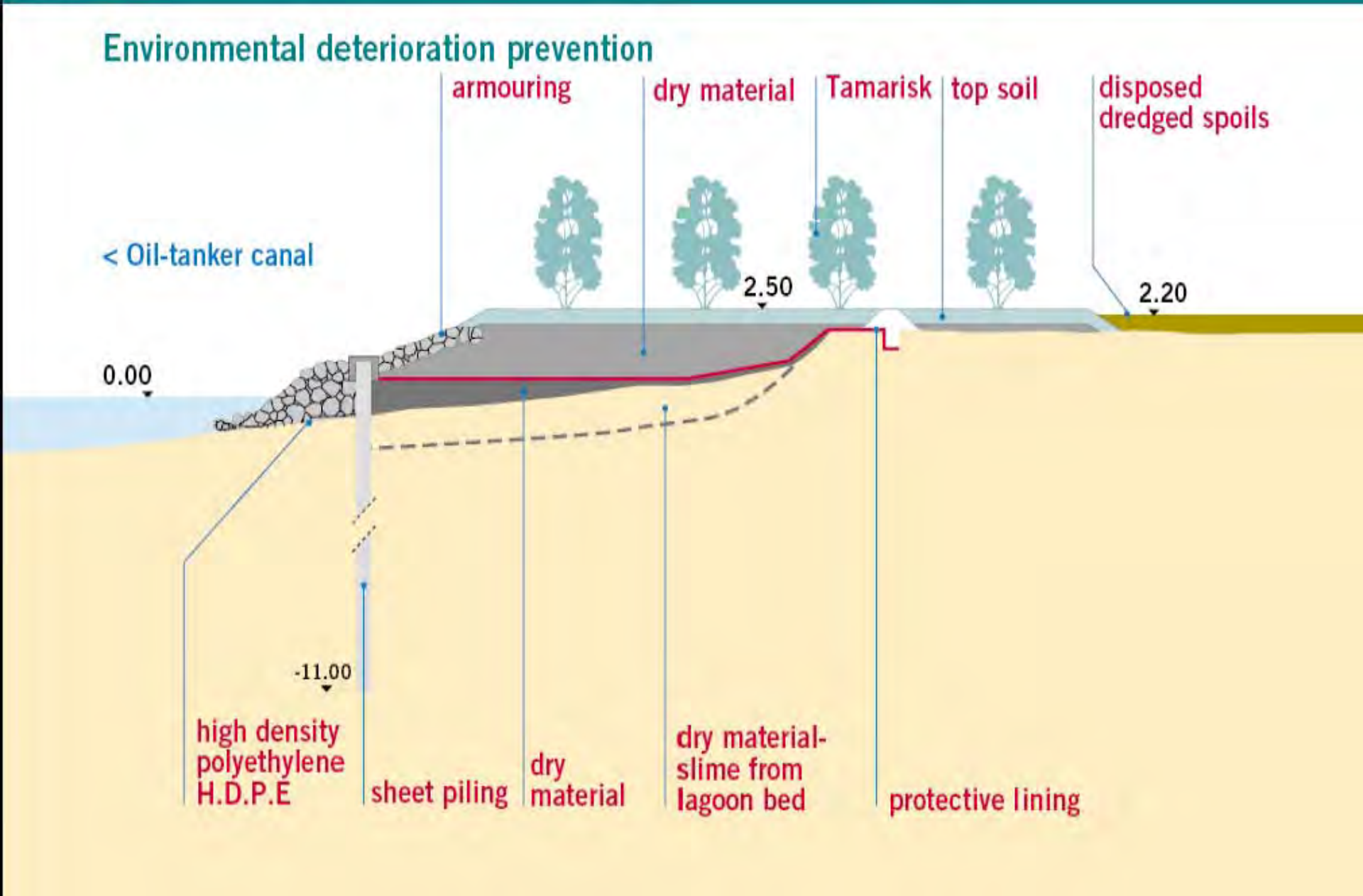
Two chemical laboratories for analisies

Dangerous dumps

Island of Tresse. Pollution

Island of Tresse before interventions

Island of Tresse. New banks

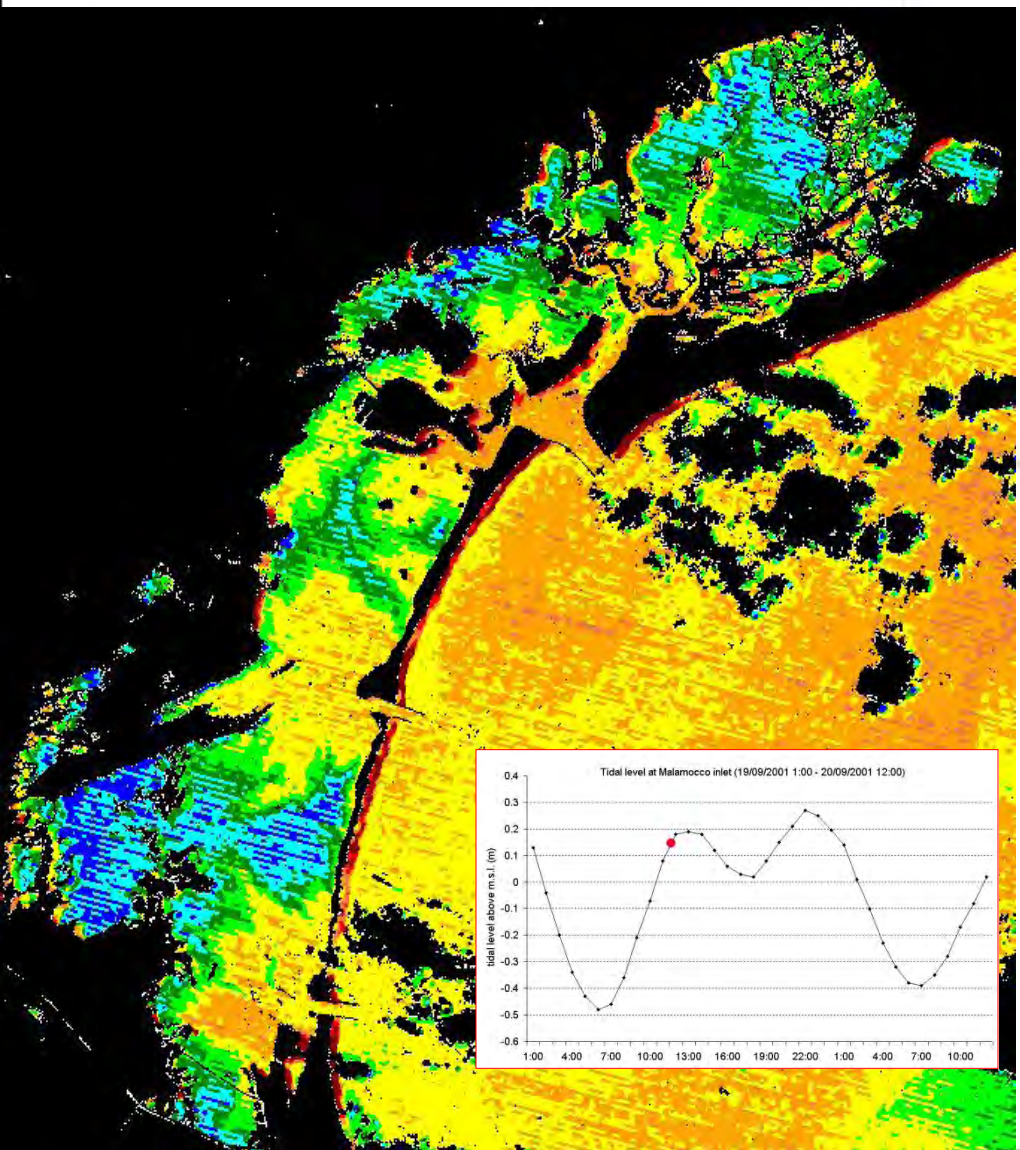


Island of Tresse after interventions

Water quality evaluation

calibration of a finite elements hydrodinamic model using remote sensing images

LANDSAT 5 TM - 19/09/2001 - 9:39 GMT



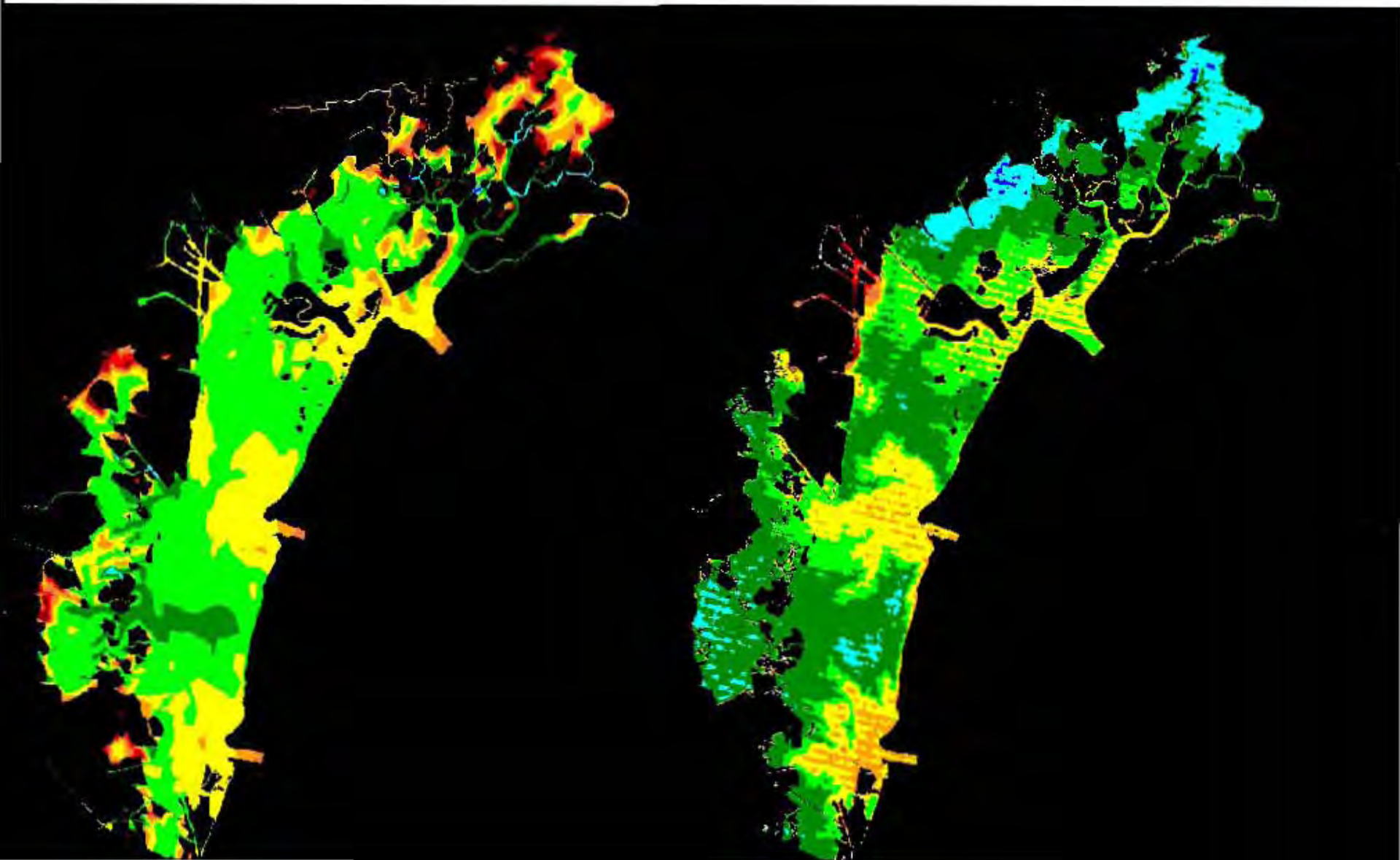
HYDRODYNAMIC MODEL OF THE VENICE LAGOON

Water quality evaluation

calibration of a finite elements hydrodinamic model using remote sensing images

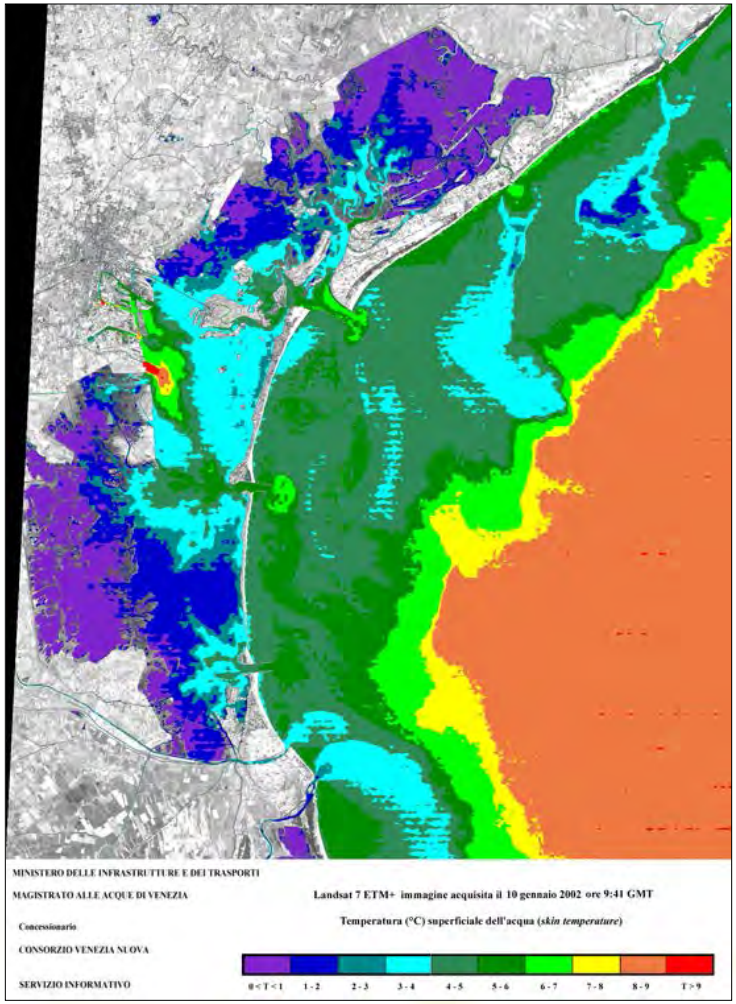
Hydrodynamic model output after 24 hours

Landsat 7 ETM+ 20/09/2001 - 9:41 GMT

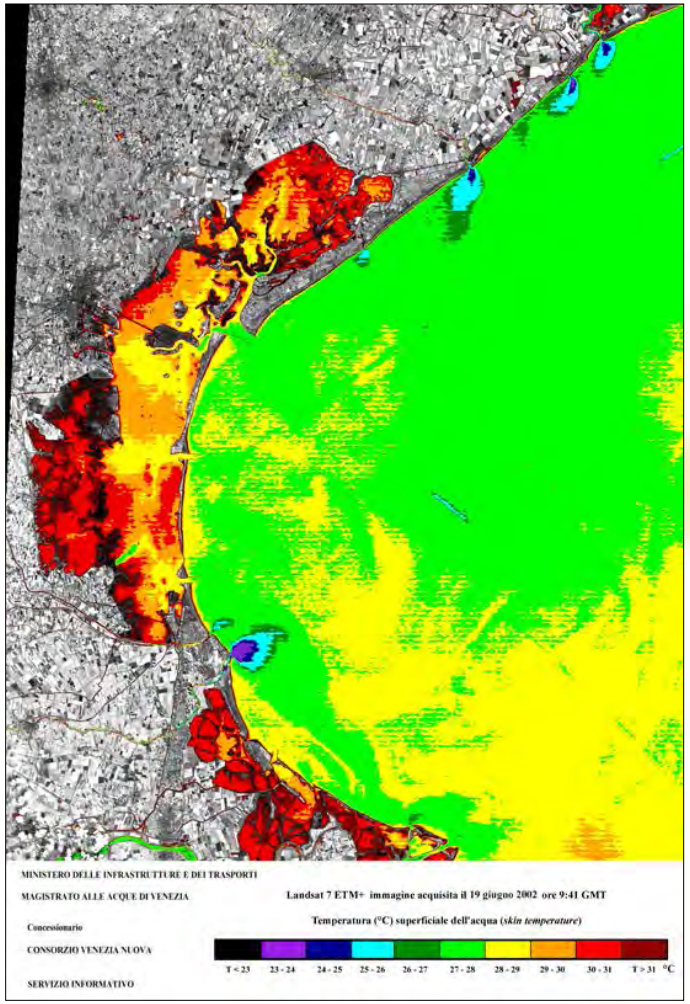


Temperature monitoring

winter



summer

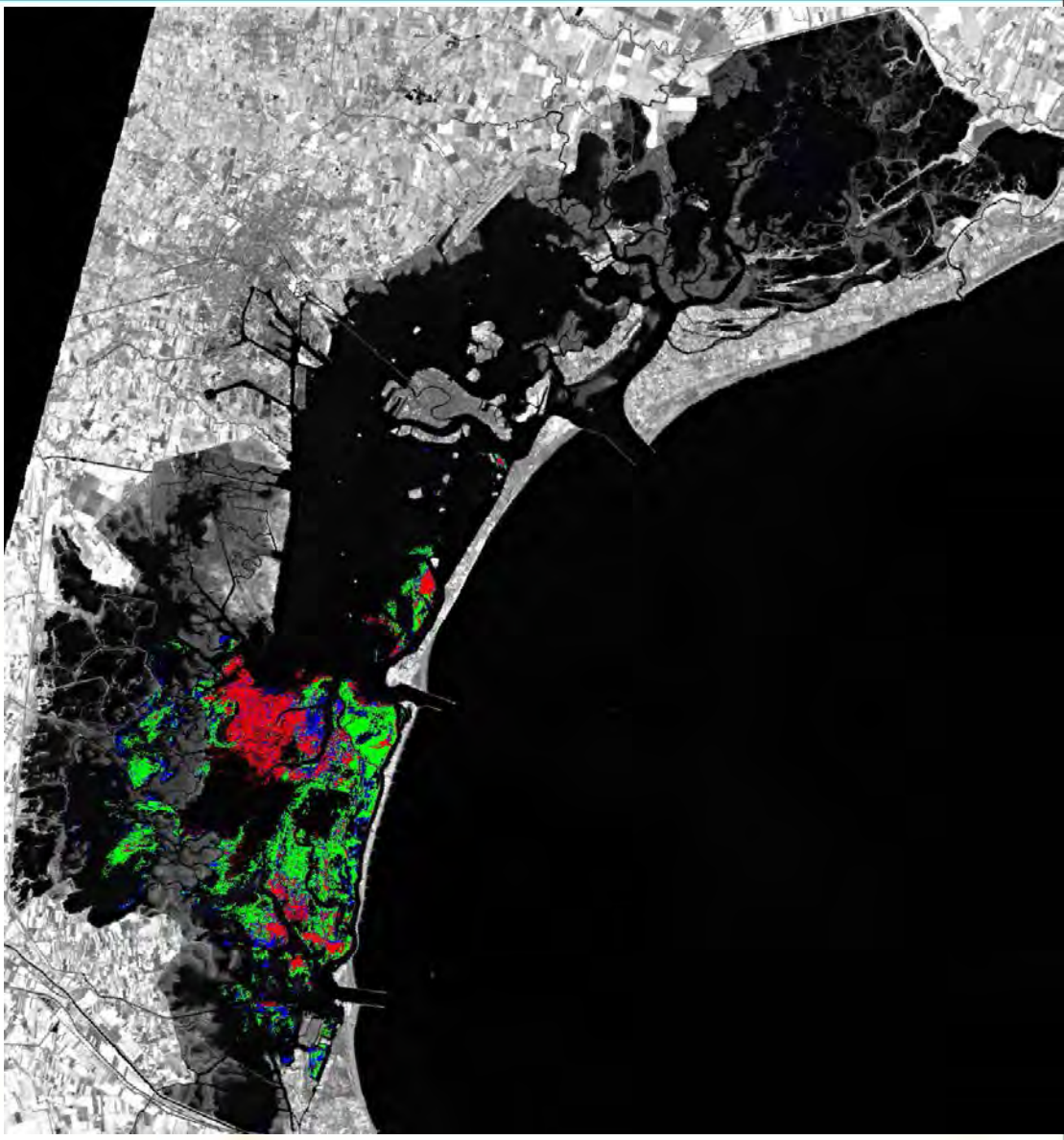


Evaluation of the lagoon environment quality

Lagoon vegetation

Eelgrass and macroalgae

Landsat 7 ETM+ image
19 june 2002



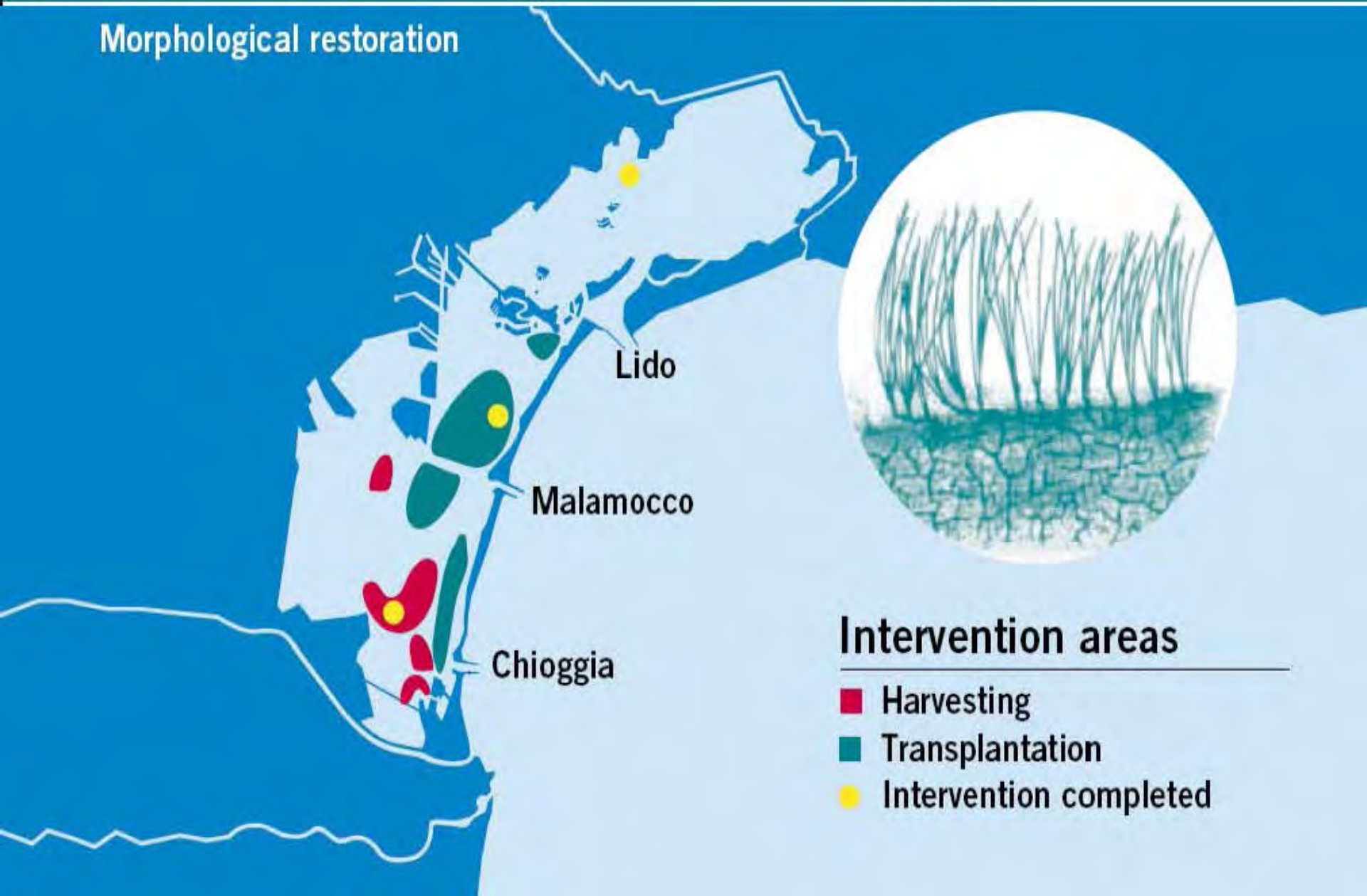
Zostera marina

Cymodocea nodosa

Ulva rigida

Elgrass

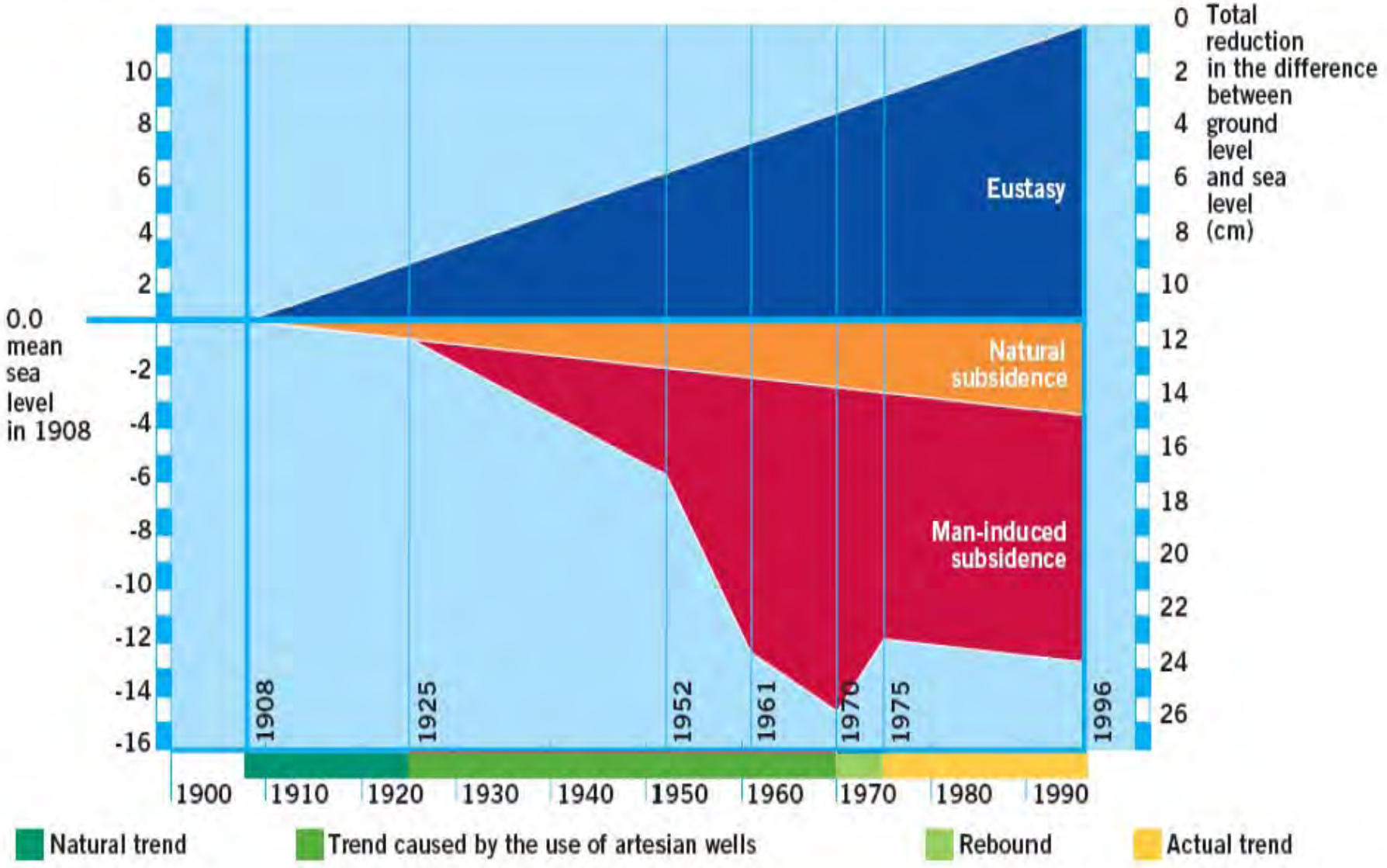
Elgrass transplantation



Macroalgae harvesting

Macroalgae utilized in agriculture and paper production

Eustasy and subsidence



Eustasy and subsidence

Subsidence, or the lowering of ground level, is the result on the surface of processes occurring underground. Subsidence can occur because of natural reasons (for the most part tectonic deformations of strata deep beneath the earth or the progressive consolidation caused by the geostatic loads of fine alluvial deposits, like silt and clay), or because of human-induced causes, the most common of which is the intense extraction of underground water supplies.

Eustasy is the variation which occurs in sea level. During the coldest periods of geological time, precipitation is held back in the form of ice and, consequently, the level of the sea lowers. The contrary happens during the hottest periods. The eustatic rise, which is a phenomena independent of subsidence, “reduces” the altimetry of ground level (in coastal areas this altimetry refers to sea level).

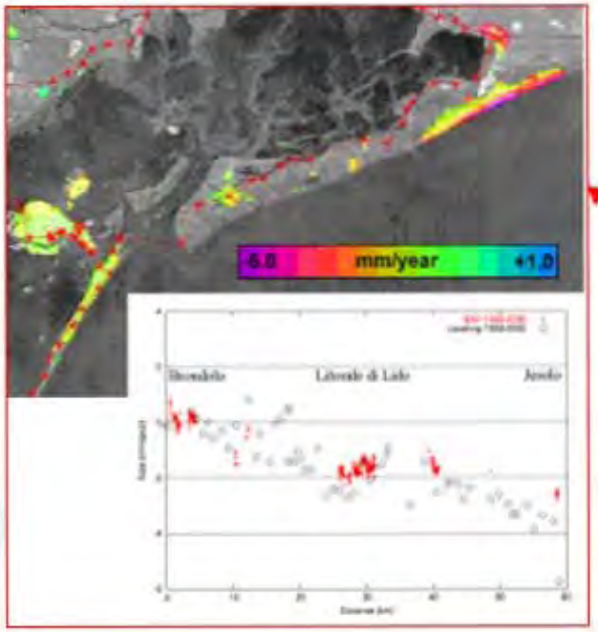
If subsidence and positive eustasy predominate over the accumulation of solid materials, a lagoon could be invaded by the sea and disappear.

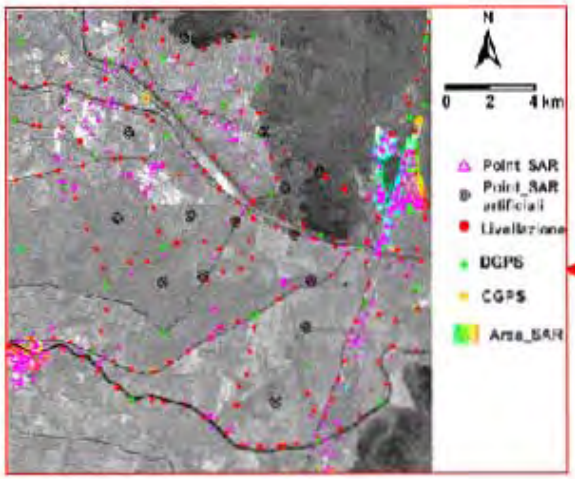
Flooding in Venice at the turn of the 20th century

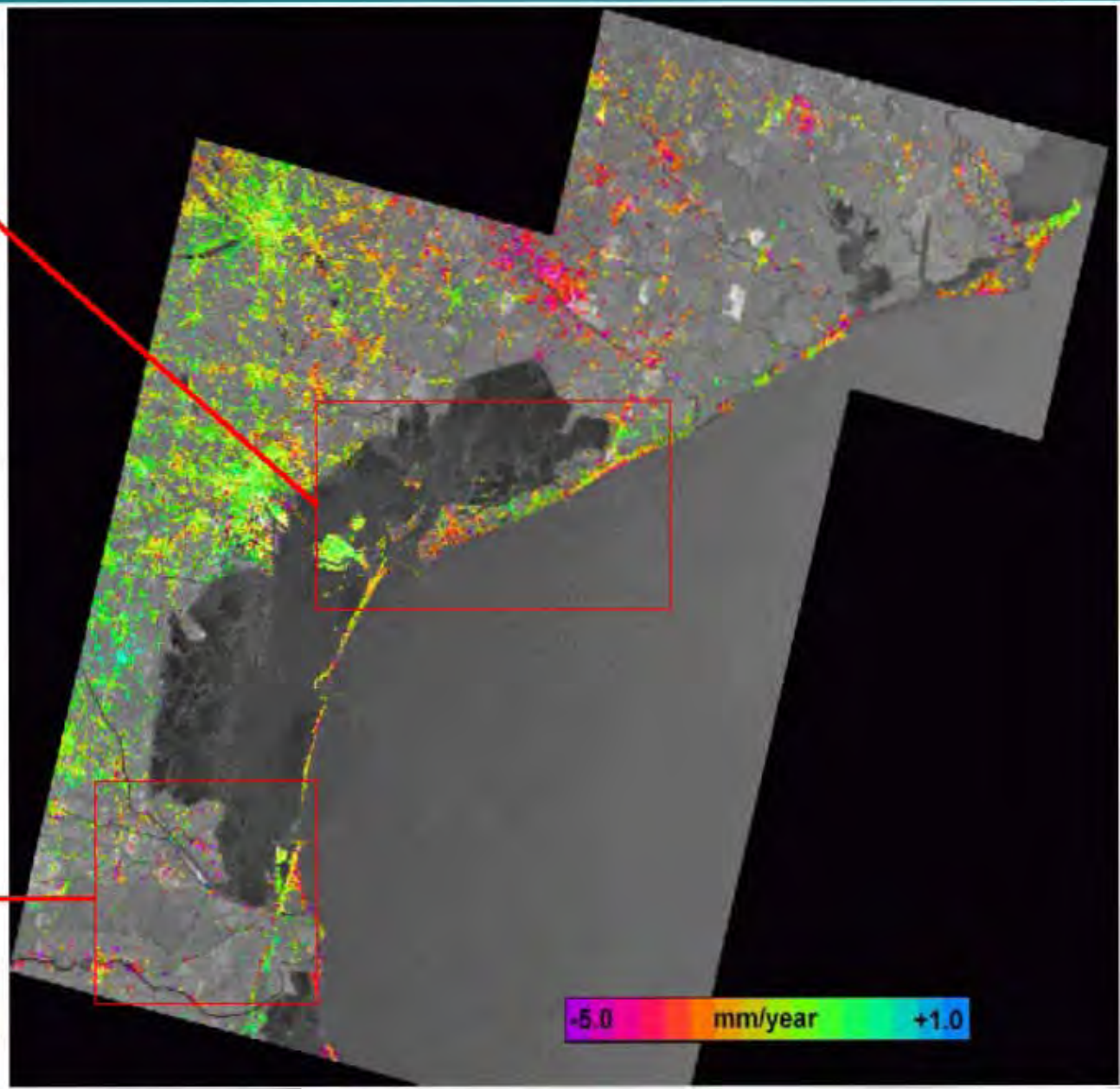
Flooding in Venice today

Evaluation of the land subsidence

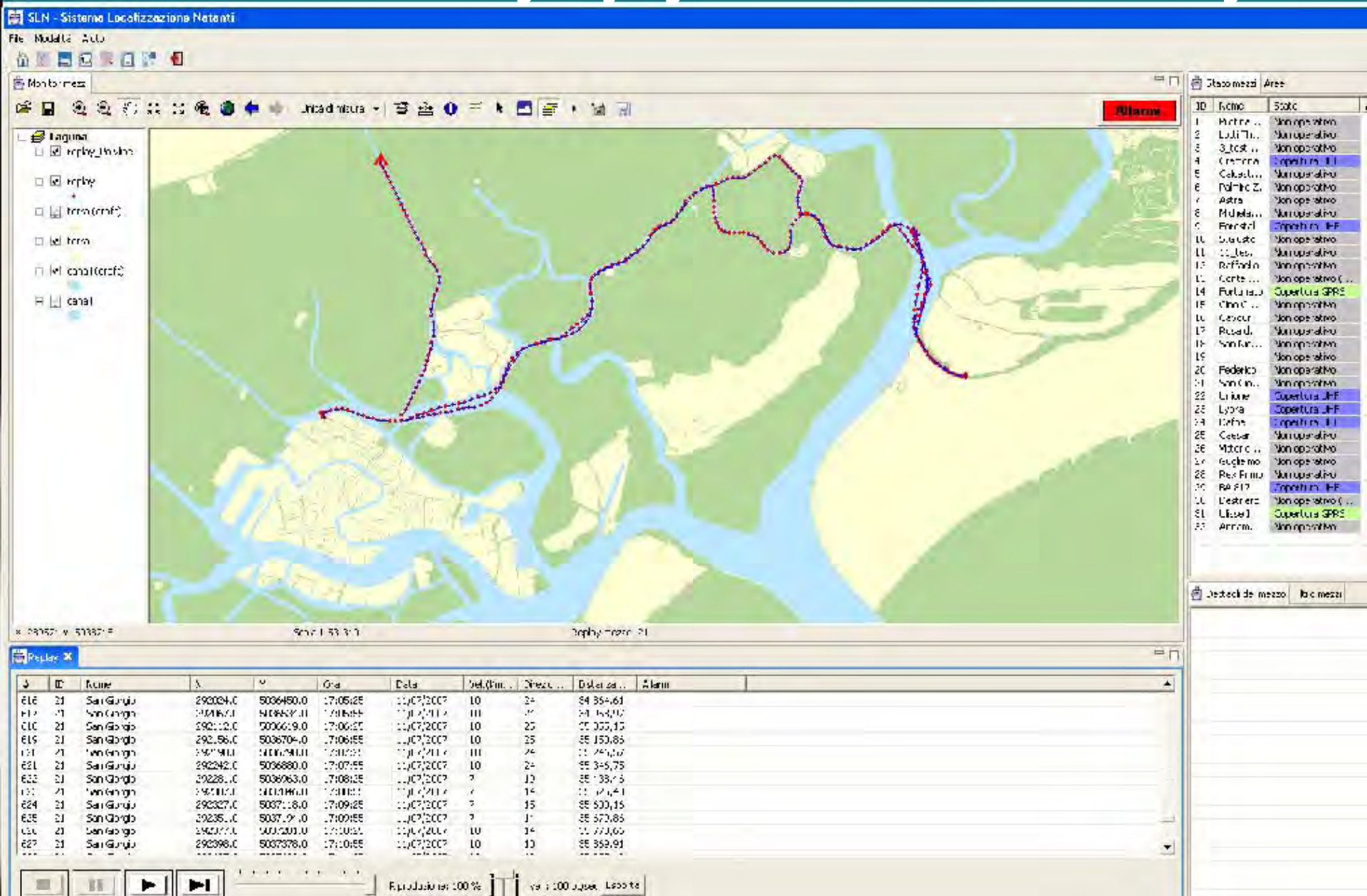
Envisat ASAR images elaboration and correlation





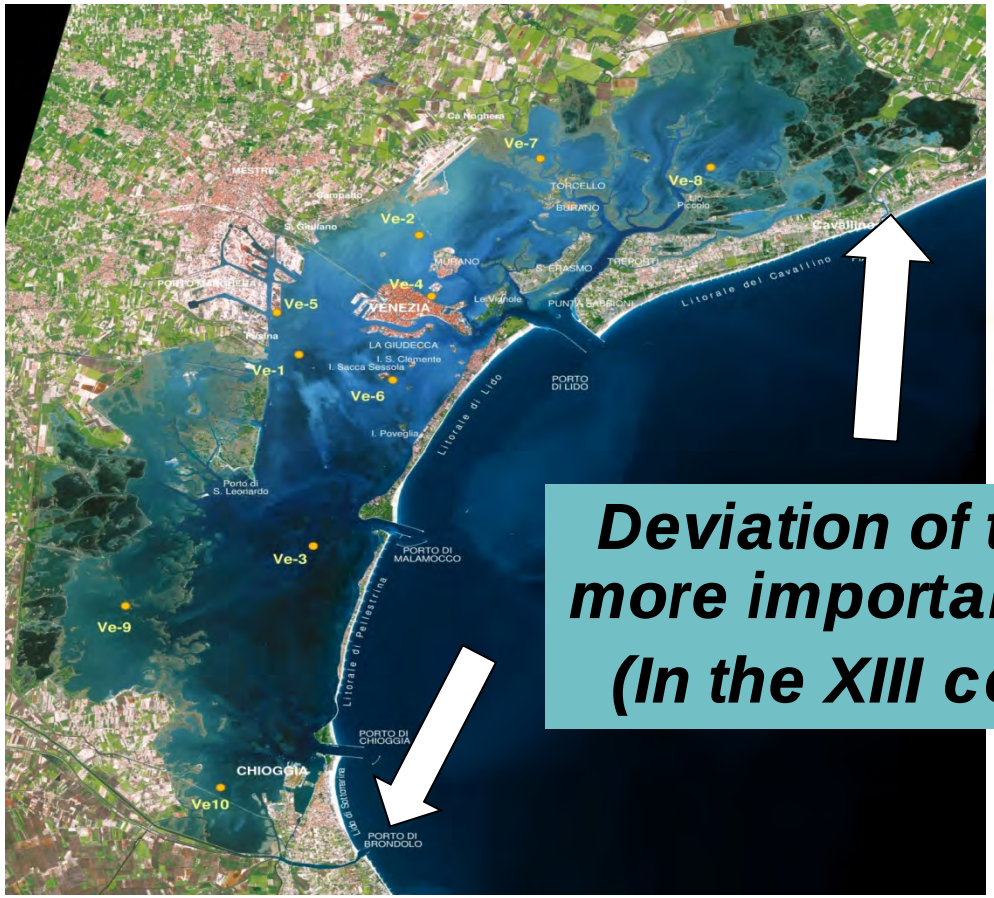


A replay of San Giorgio boat's movements: wednesday 7 july 2007 – the whole day



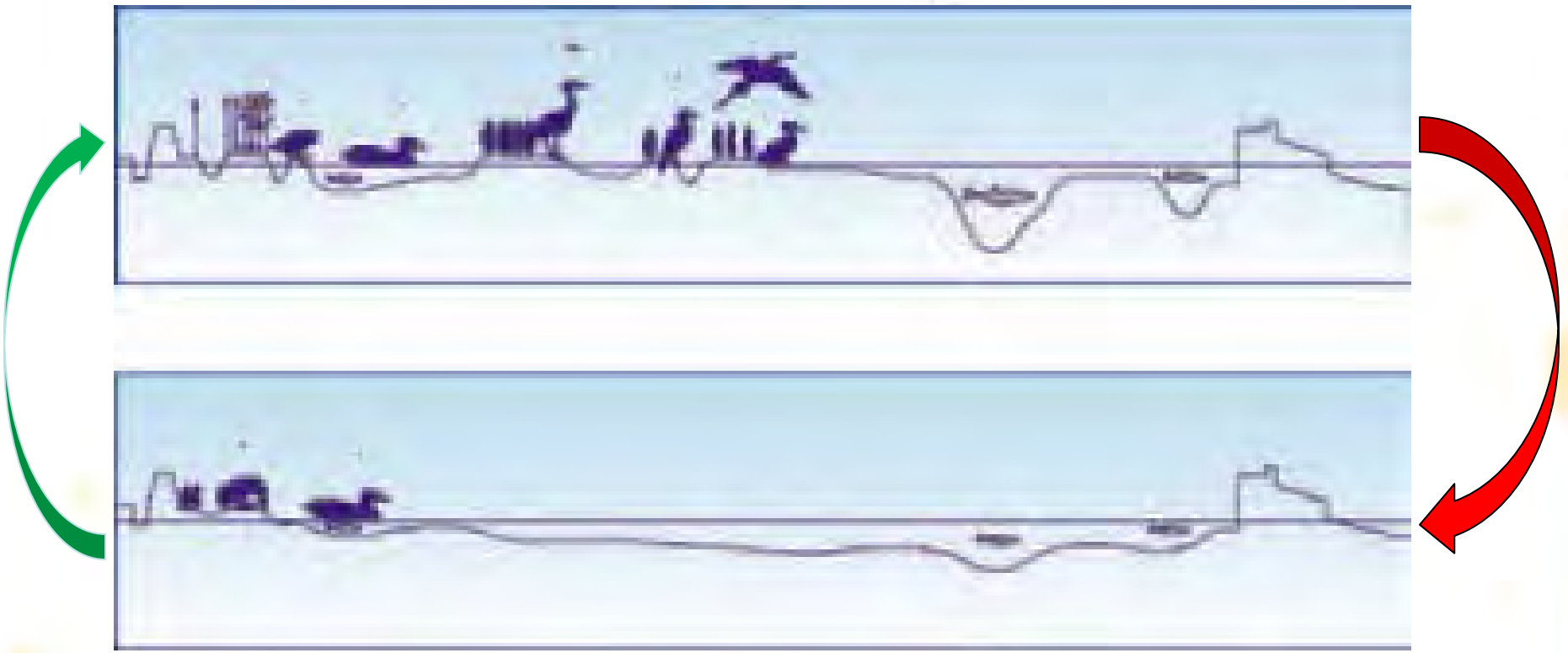
Sediments Management

The sediment balance in the lagoon is negative



Deviation of the two more important rivers. (In the XIII century)

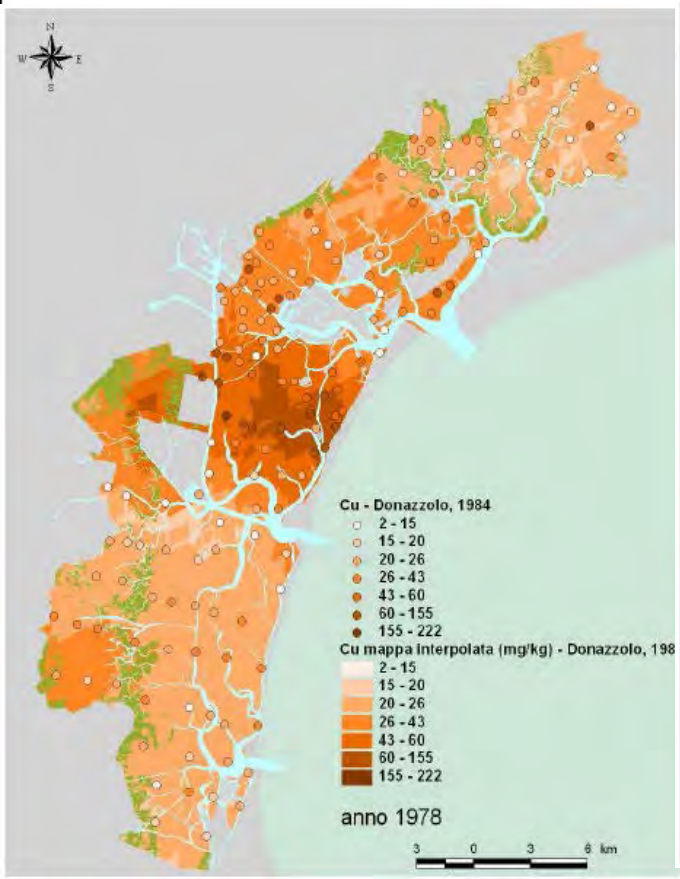
Natural Tendency to an homogeneous environment

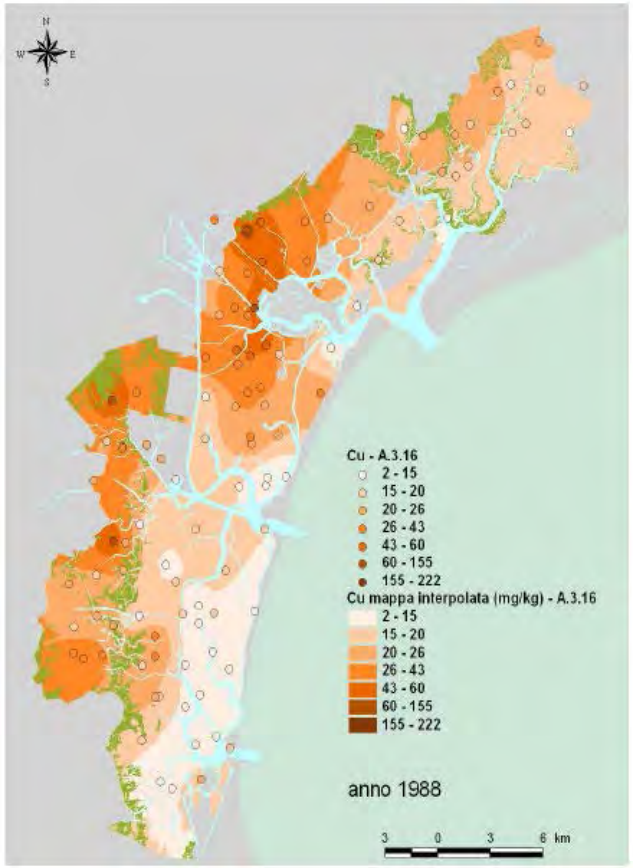


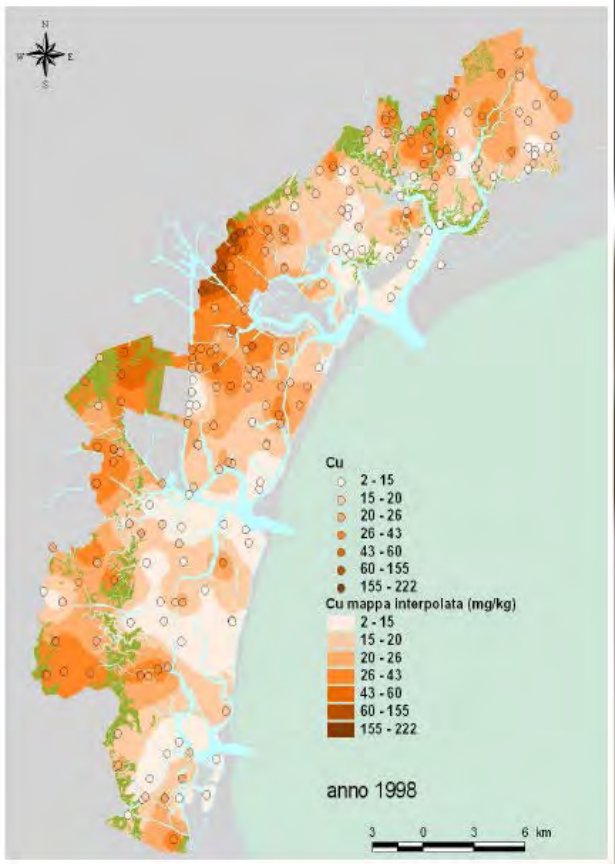
Principal objective for Sediment Management

- Promote the use within the lagoon, to morphological restore.
- Avoid as possible, export outside the site the sediments.

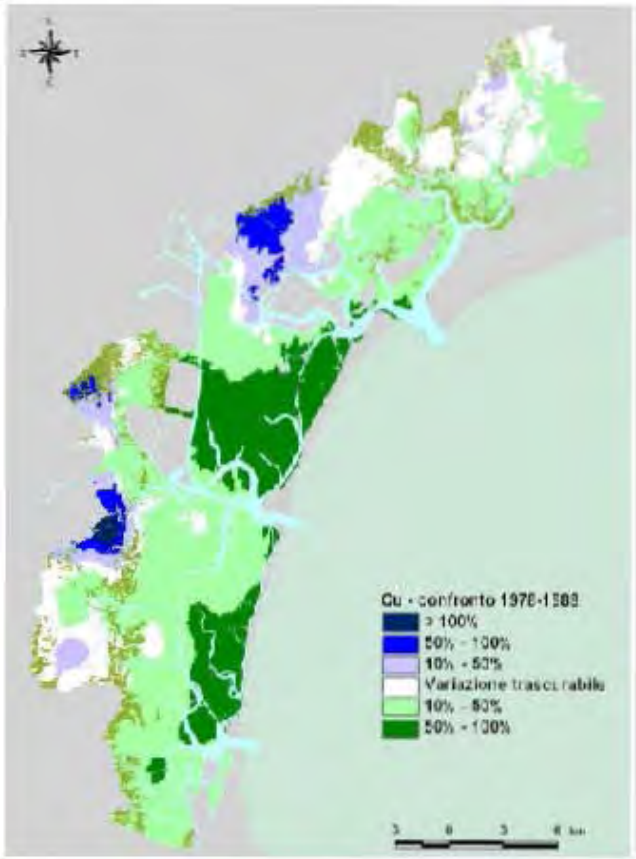
Distribution of Cu in sediments in 1978, 1988 and 1998

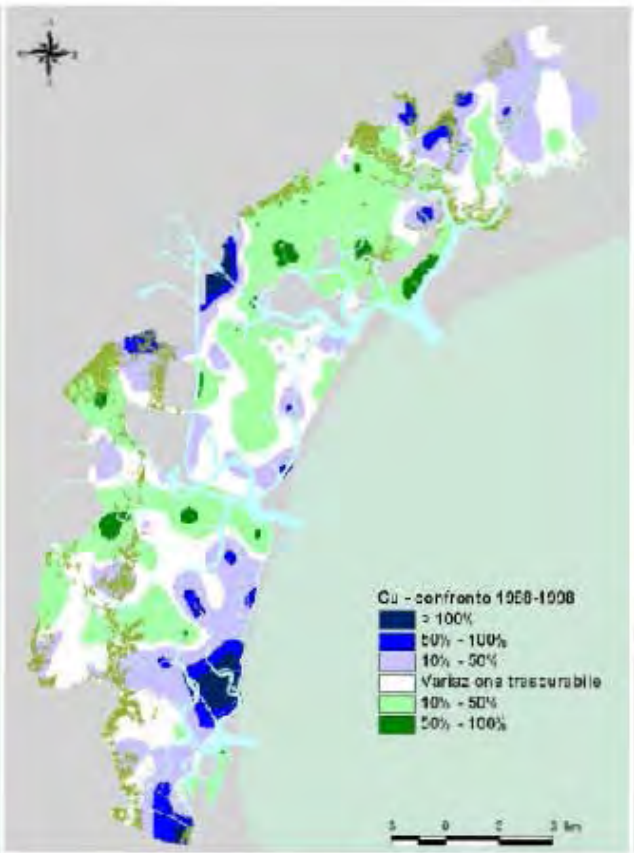


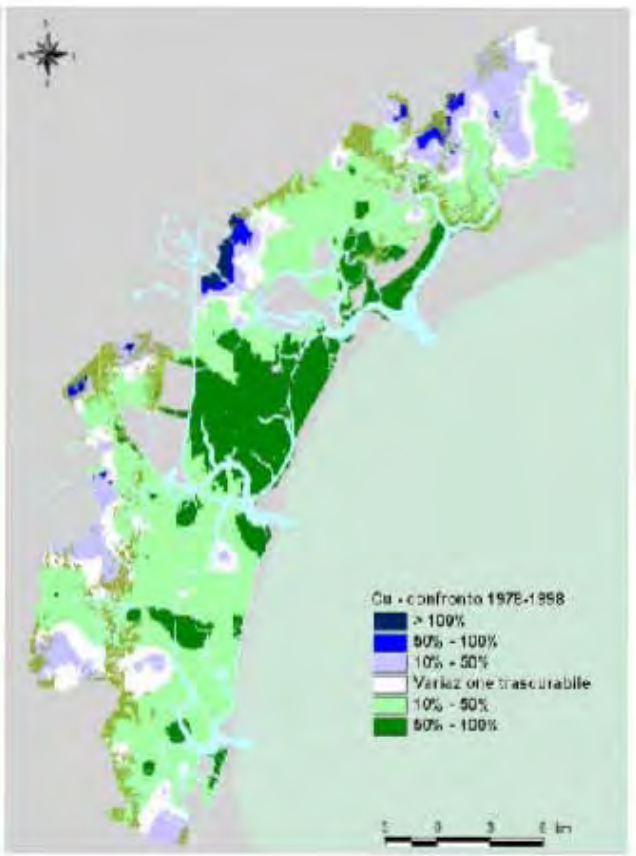




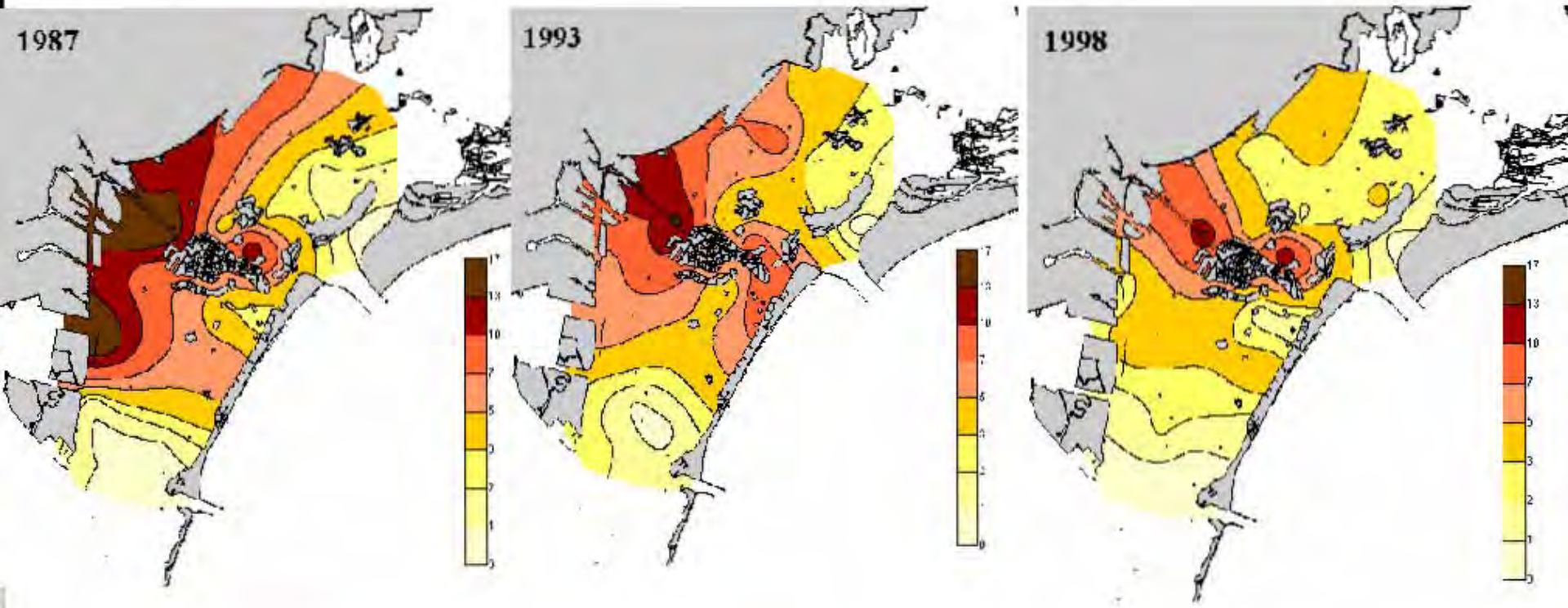
Difference (%) of Cu between the years 1978-1988, 1988-1998,



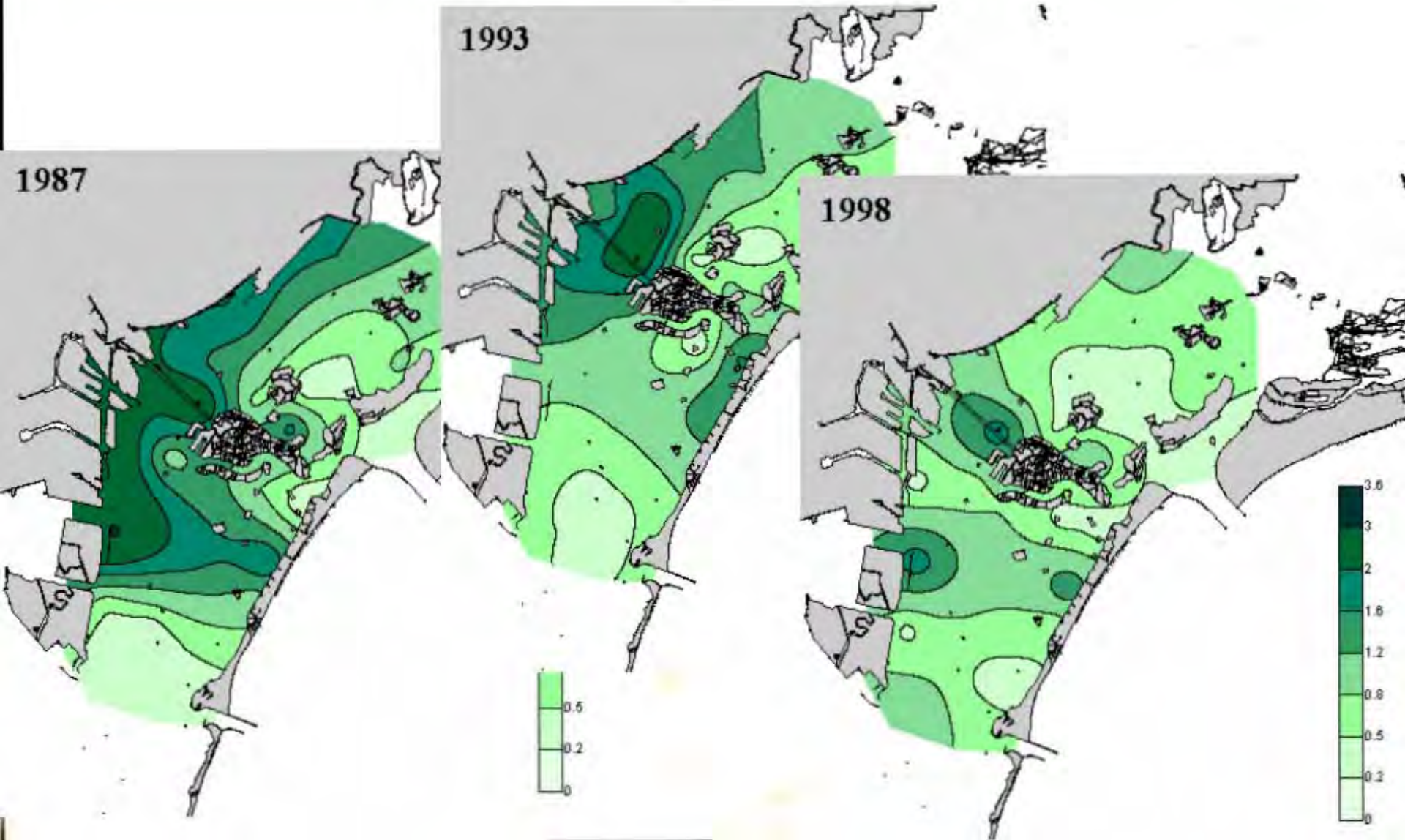




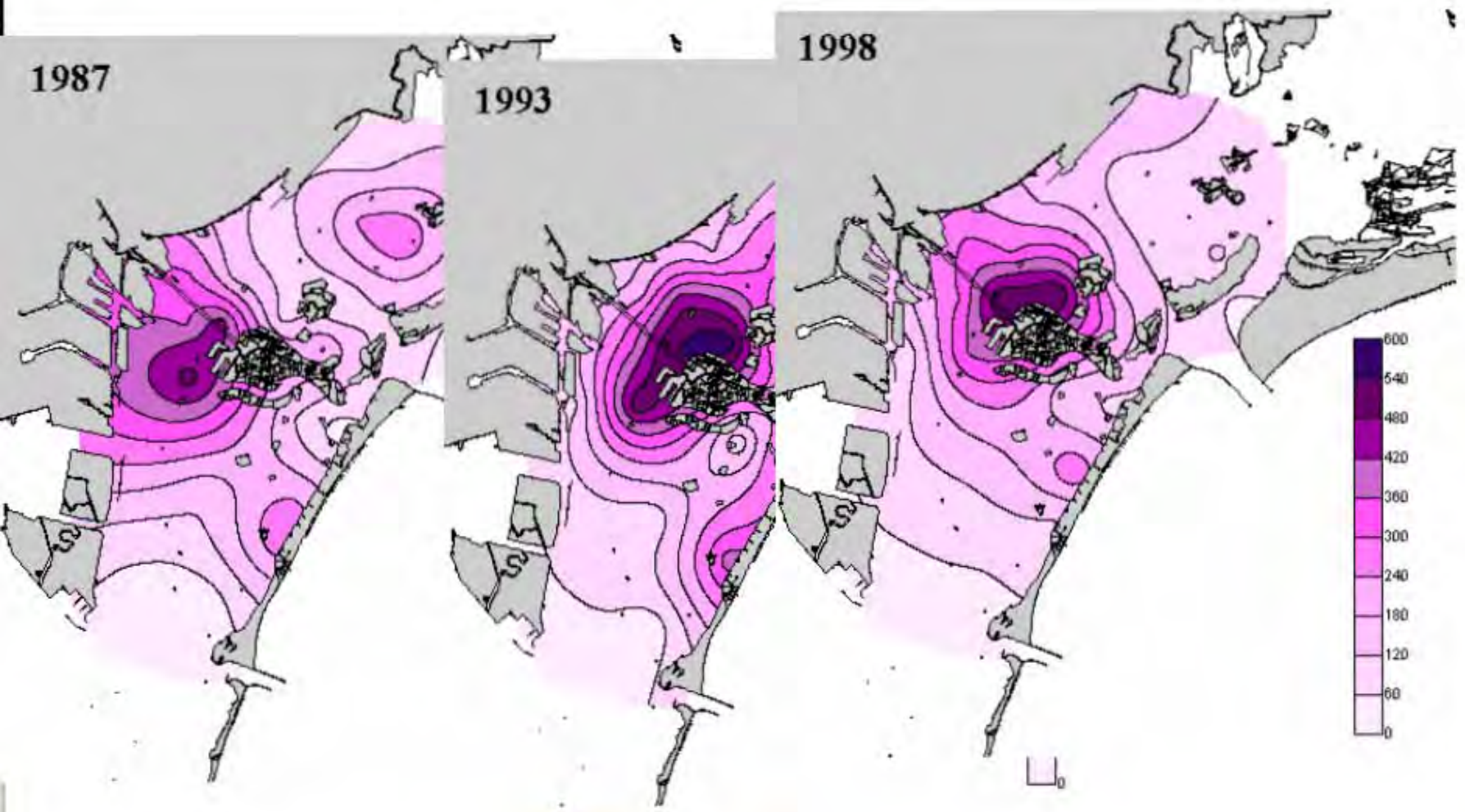
PCB (ng g-1 d.w.)

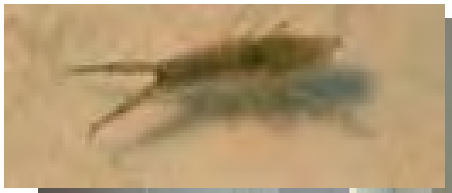


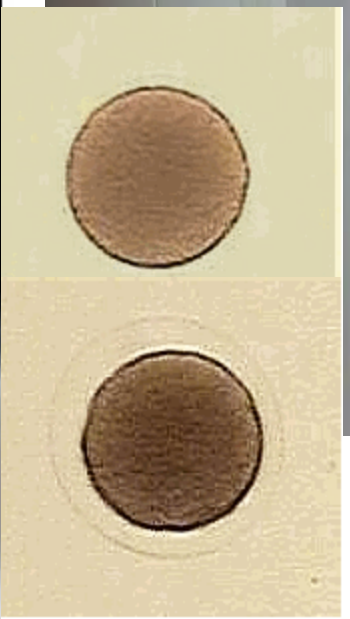
PESTICIDI (ng g-1 d.w.)



IPA (ng g-1 d.w.)







Eco toxicology

Ecological Risk

Continuous Validation World Wide Experiences

Sampling Organism

Bioaccumulation

Genetic Disturbances

Sediment Clasification

Protocollo d'Intesa del ' 93 mg/Kg SS				
Metallo	**Classe**			
	A	**B**	**C**	**oltre C**
Hg	0,5	2	10	>10
Pb	45	100	500	>500
Cd	1	5	20	>20
Ni	45	50	150	>150
Zn	200	400	3000	>3000
Cr	20	100	500	>500
Cu	40	50	400	>400
Idrocarburi totali	30	500	4000	>4000
IPA	1	10	20	>20
PCB	0,01	0,2	2	>2
POC	0,001	0,02	0,5	>0,5

Protocols

- **A** Morphological restoration, in open contact with water (1998 – 2008; 8.000.000 m^3)
- **B** Morphological restoration with total isolation from water. Avoiding erosion and submersion.

(1998 – 2008; 2.500.000 m^3).

- **C** Isolation in specific places prepared for that purpose. (Isola delle Tresse)

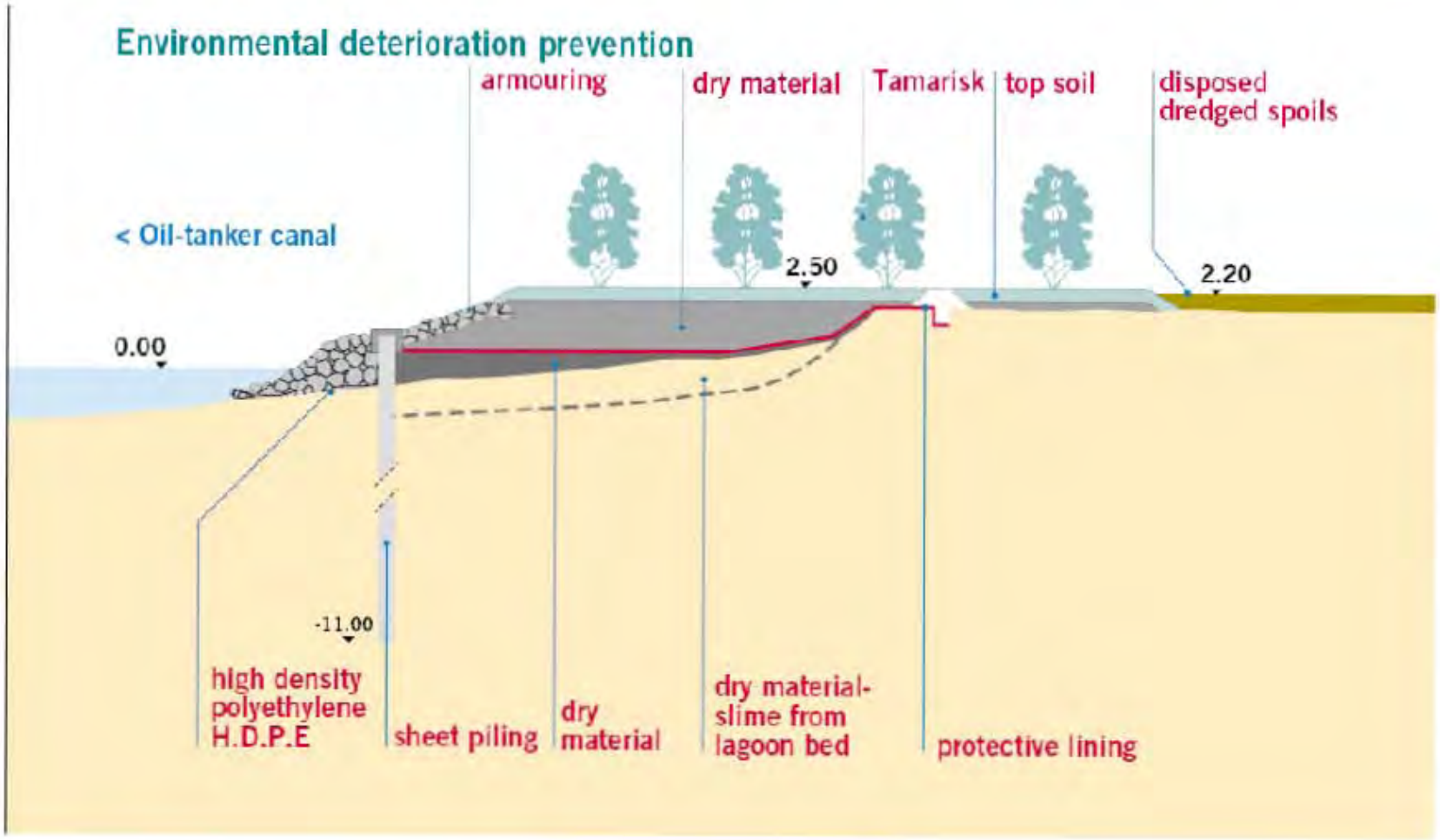
(1998 – 2008; 3.400.000 m^3).

- **>C**:Treated in specific plants.

(1998 – 2008; 320.000 m^3). (Impianto Alles).

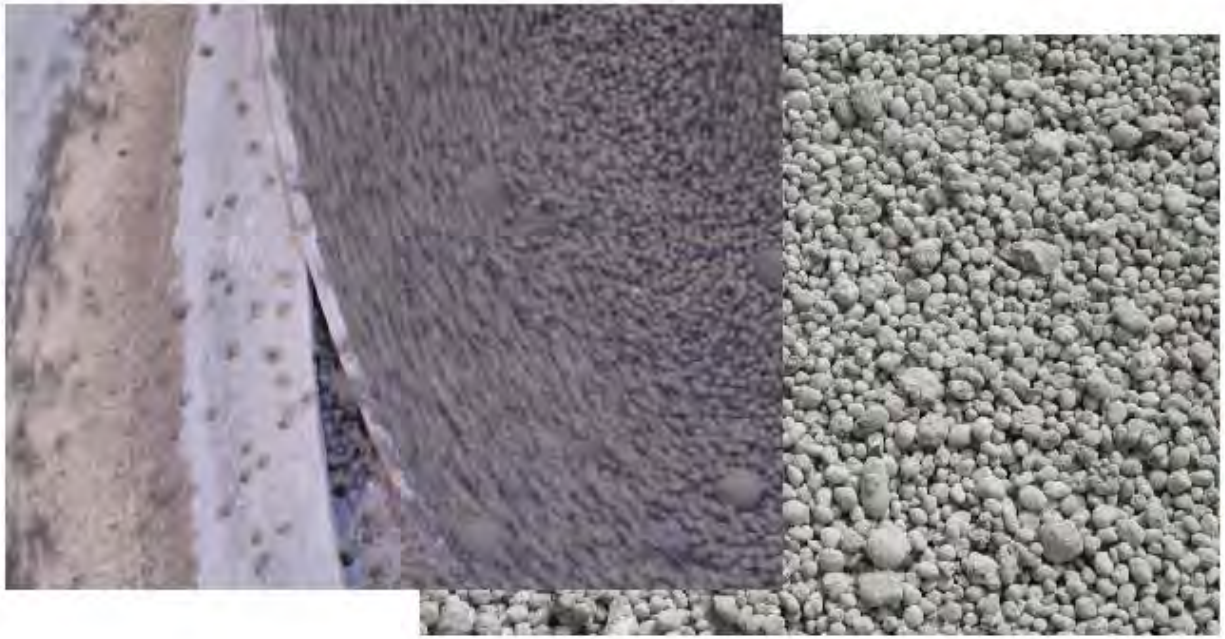
A Morphological restoration

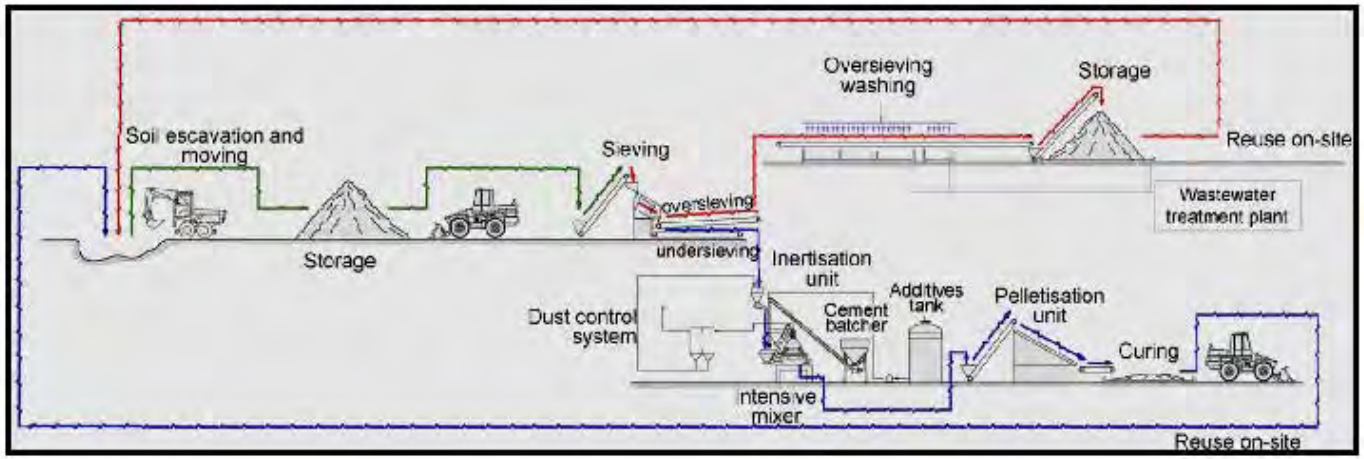
B Morphological restoration



C Isolation in specific places

>C Treatement





Sediment Dredging in Porto Marghera

Sediment clasification

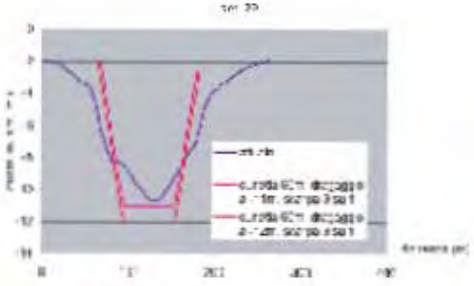
Class A 7%

Class B 26%

Class C 45%

> C 22%

Channel restoration



ANALITI	PROTOCOLLO DI VENEZIA			
	[illegible]	[illegible]	[illegible]	[illegible]
Arsenico	15	25	50	>50
Cromo	1	5	50	>50
Cromo totale	50	90	250	>250
Mercurio	0,5	2	10	>10
Nichel	45	90	250	>250
Piombo	90	150	500	>500
Rame	90	150	400	>400
Zinco	500	800	3000	>3000
Sommatoria policlorobifenili	1	10	40	>40
Residui organoclorurati totali	0,01	0,02	0,3	>0,3
TBT	0,01	0,1	2	>2
Idrocarburi totali	30	500	1000	>1000

Ministero delle Infrastrutture

Magistrato alle Acque

Sezione Antinquinamento – Servizio Informativo

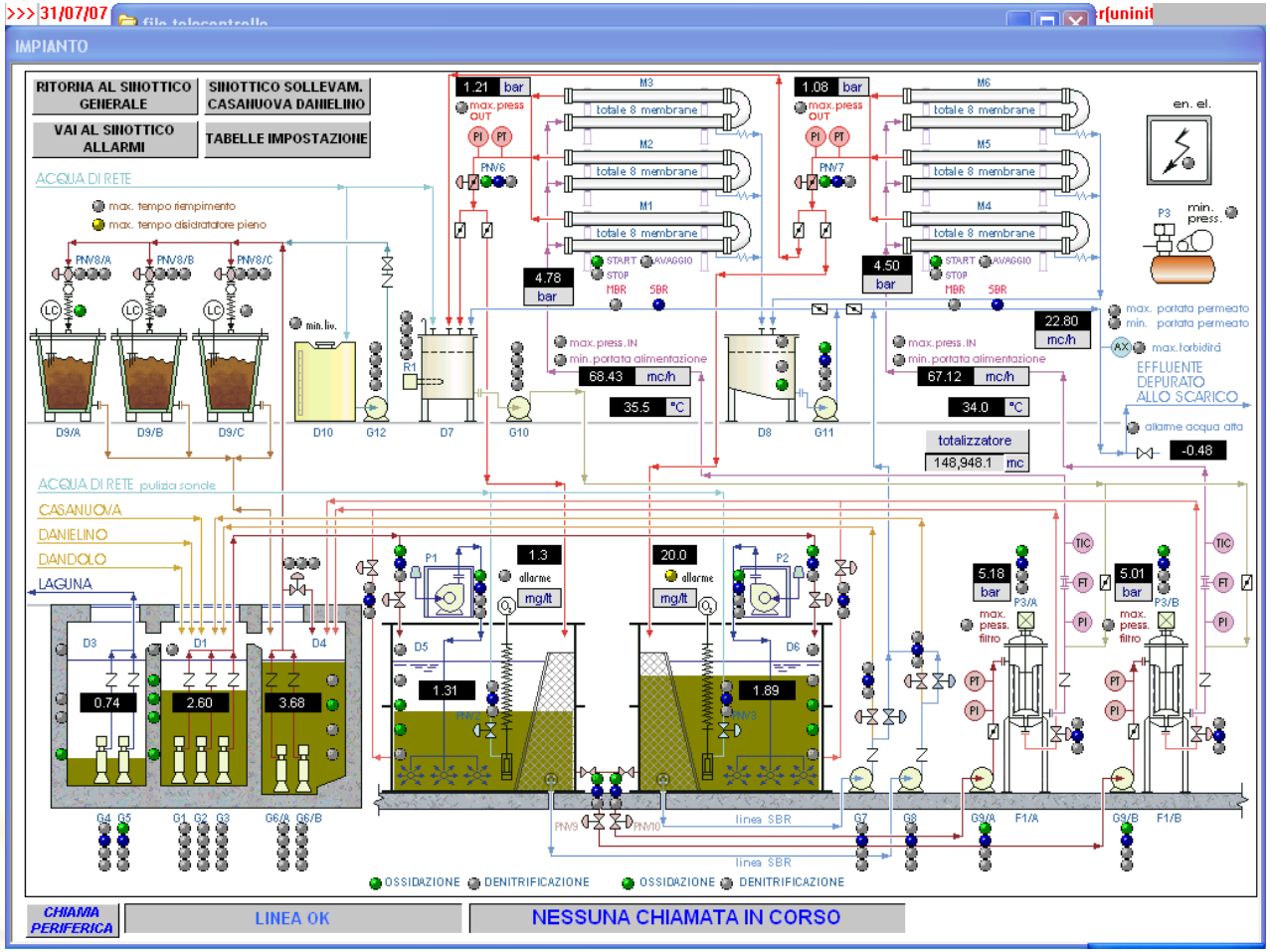
New philosophy for water depuration

VENICE DEPURATION SYSTEM

Ubicazione degli impianti di depurazione

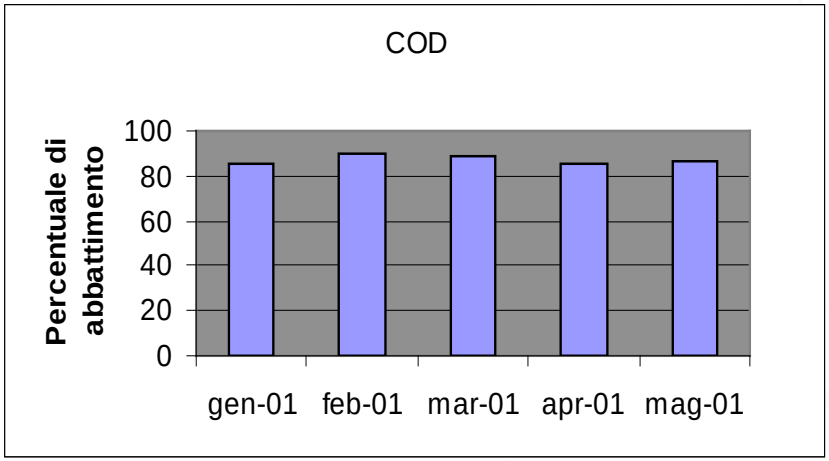
High level hotel with depuration system

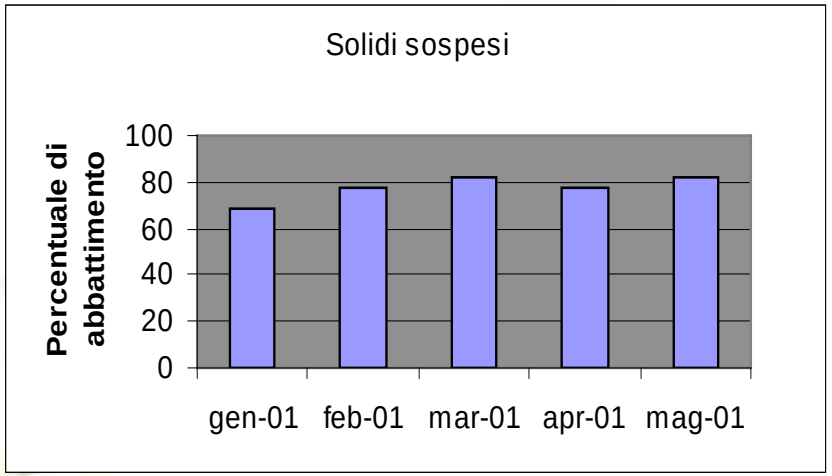
Sinoptic system of: Hotel Danieli

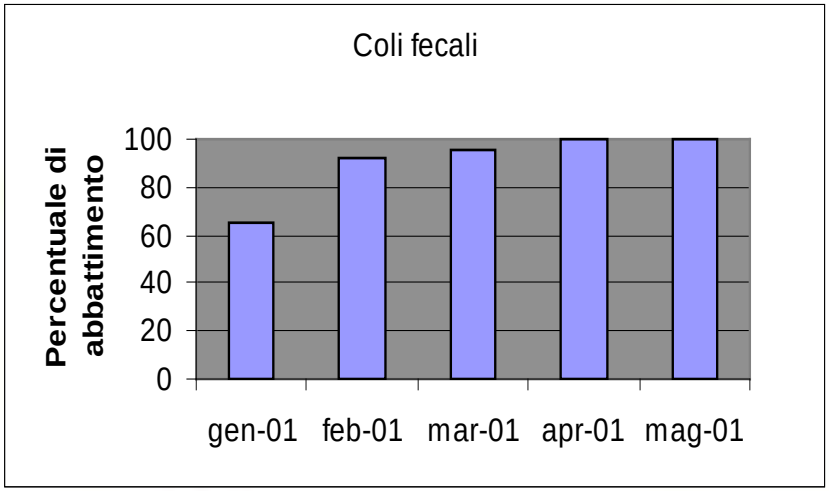


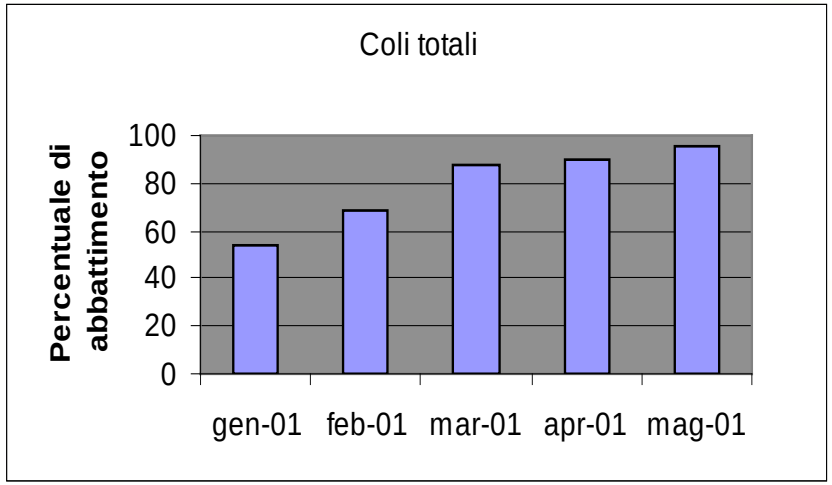
Submarine Depuration System

Microbiological and chemical analysis









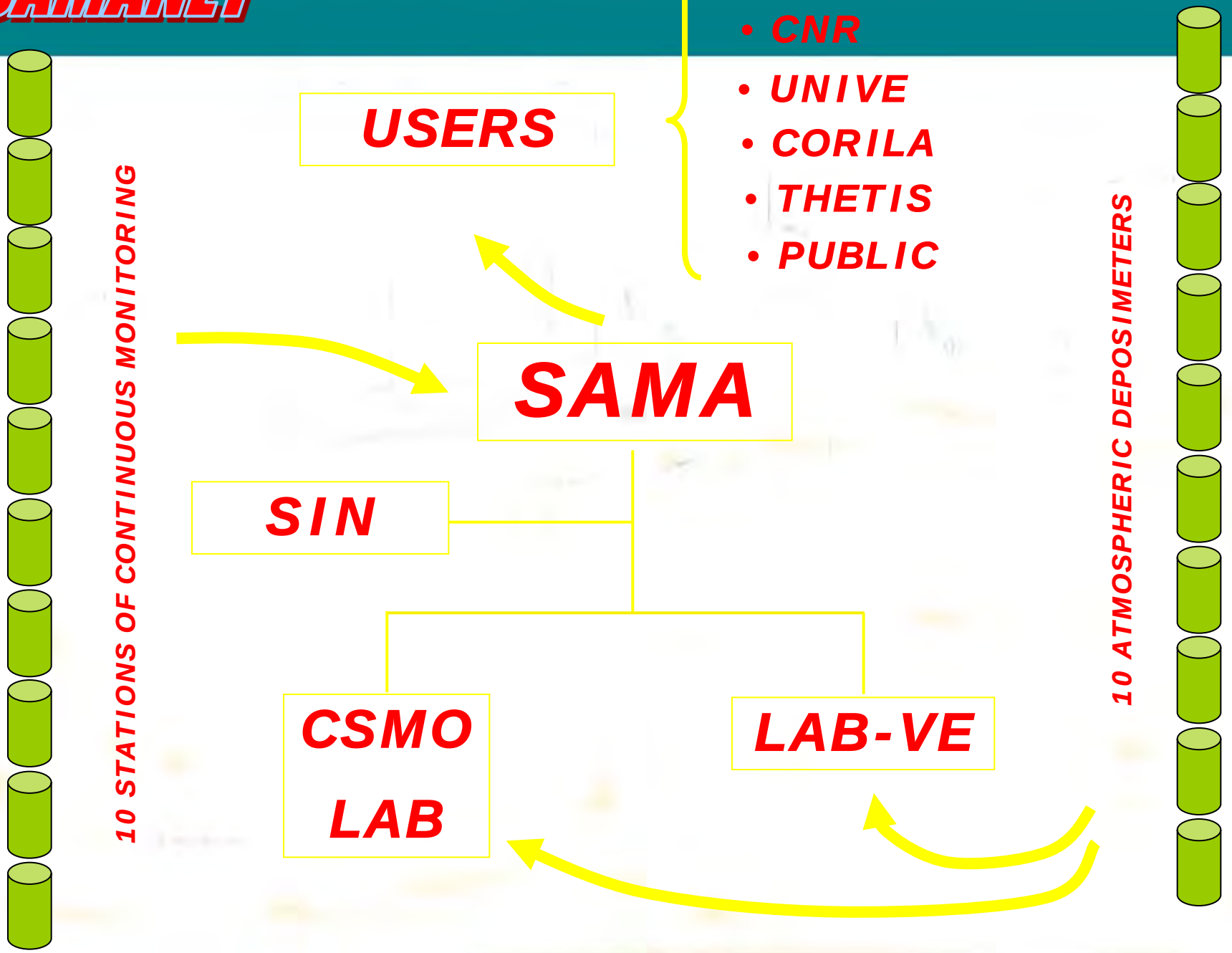
SAMANET

Net of Stations

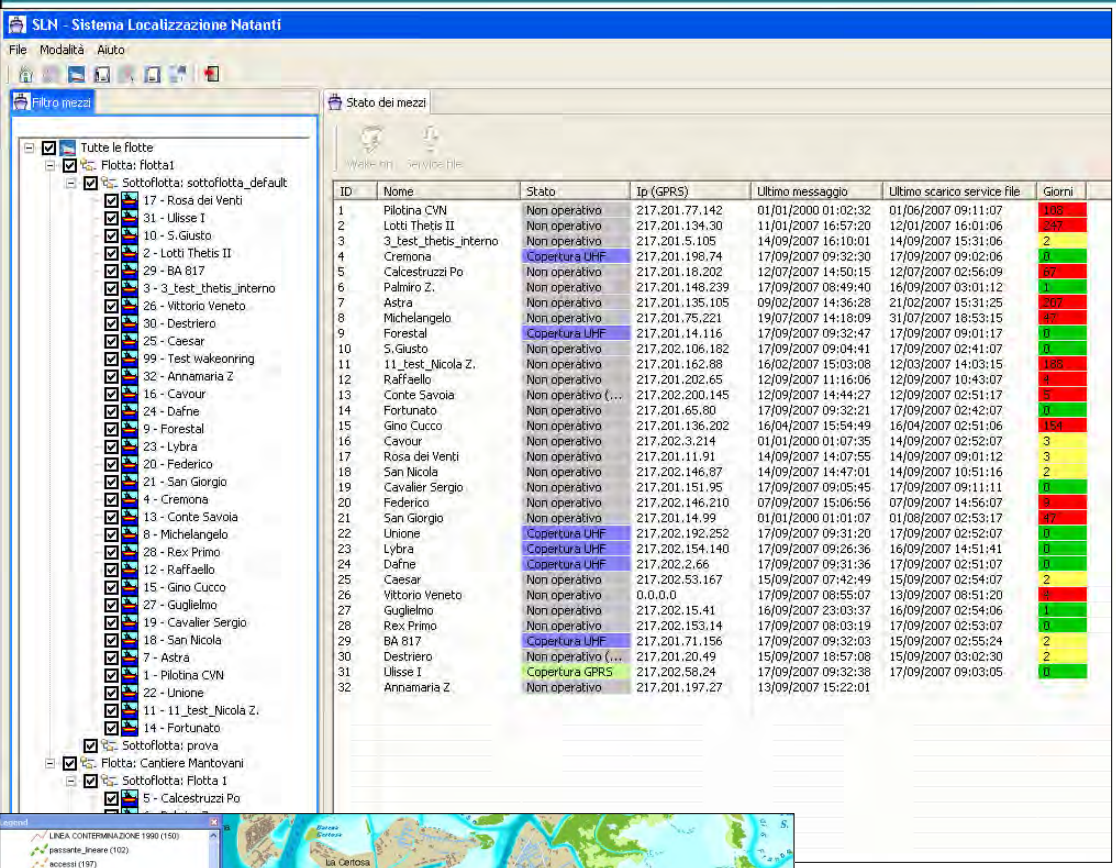
Water Continuous Monitoring

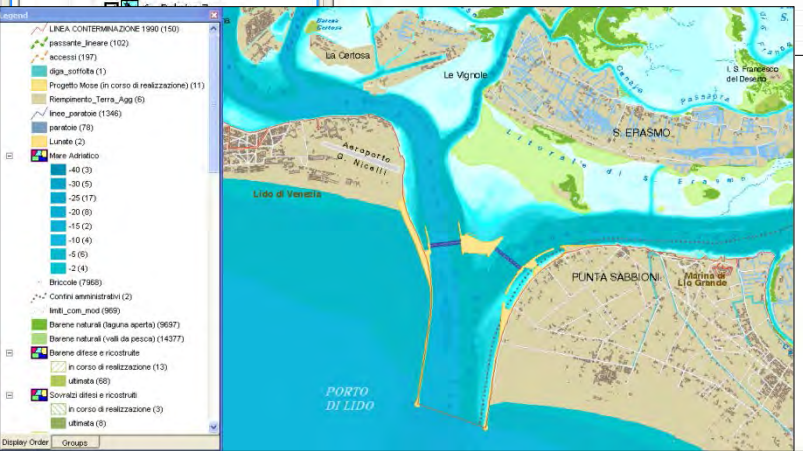
Magistrato alle Acque

SAMANET


USERS
• CVN
• CNR
• UNIVE
• CORILA
• THETIS
• PUBLIC
SAMA
SIN
CSMO LAB
LAB-VE
10 STATIONS OF CONTINUOUS MONITORING
10 ATMOSPHERIC DEPOSIMETERS

Decision support system





Boat's control consolle

Water quality – *monitoring systems*

GIS overview – *the two types of data (water quality and boat's traffic) are inside the GIS environment*

Oceanographic Probes Idronaut

Parameter	Range		Accuracy		Resolution	
Pressure	0.. 1000	dbar	0.1	% full scale	0.03	%
Temperature	-3.. +50	°C	0.003	°C	0.0005	°C
Conductivity	0.. 64	mS/cm	0.003	mS/cm	0.001	mS/cm
Dissolved Oxygen	0.. 500	% sat	1	% sat.	0.1	% sat.
Dissolved Oxygen	0.. 50	ppm	0.1	ppm	0.01	ppm
pH	0.. 14	pH	0.01	pH	0.001	pH
Oxidation-reduction	- 1000..a + 1000	mV	1	mV	0.1	mV

Ocean Seven 316

SAMANET

VENICE LABORATORY

- *Nutrients*
- *Heavy metals*
- *Bacteriological Analysis*
- *Total Hydrocarbons*
- *Turbidity*

SAMANET

VOLTABAROZZO LABORATORY (CSMO)

(Centro Sperimentale Microinquinanti Organici)

- PCB (Policloro biphenyl)
- IPA (HydrocarbonsPolicyclidAromatic)
- HCB (Hexaclorobenzene)
- PCDD (Policlorodibenzodioxins)
- PCDF (Policlorodibenzofurans)

Continuous Updating/Upgrading of Laws

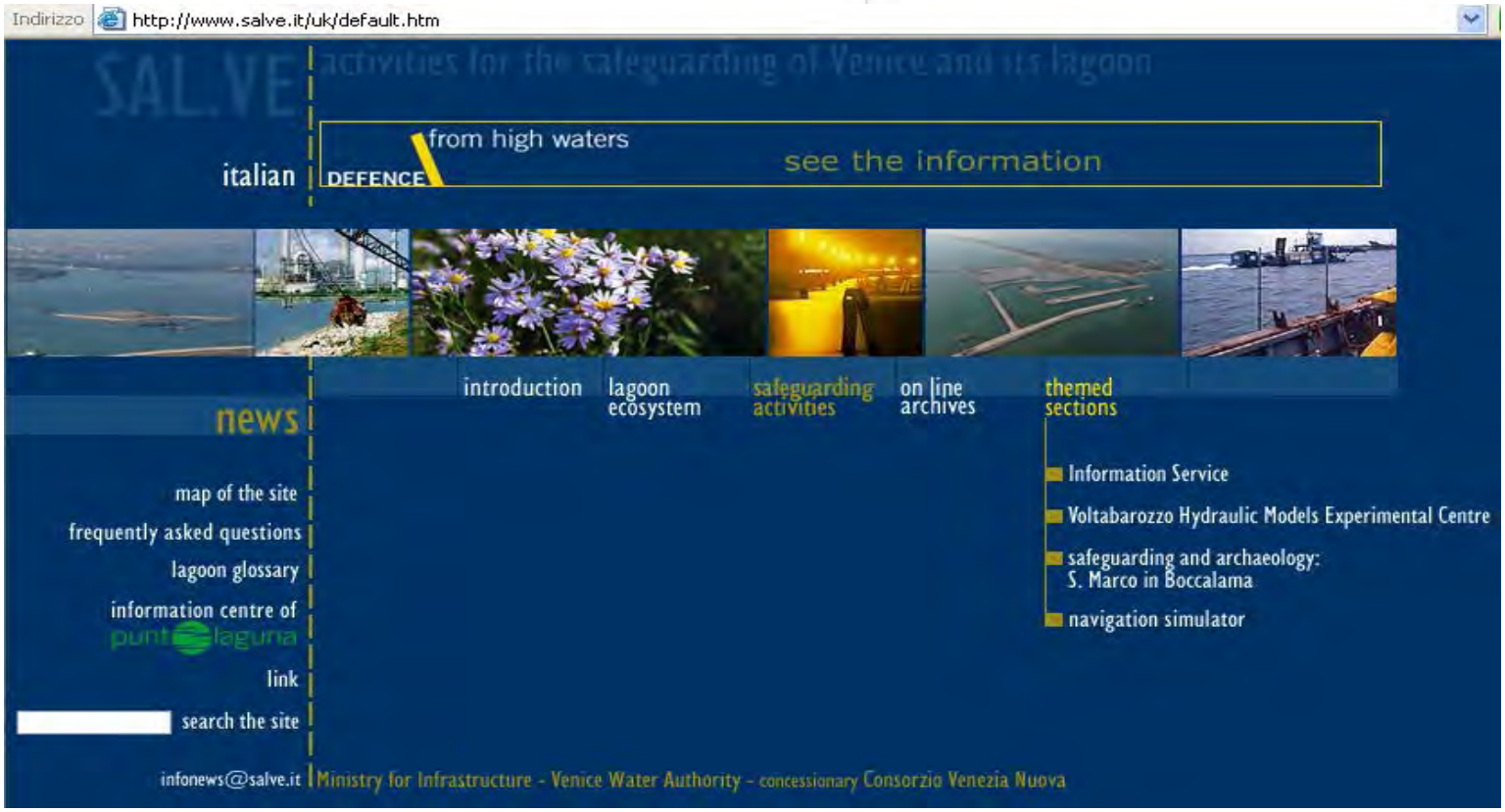
- There is a specific Packet of Laws for Venice and the Lagoon

- The is a parallel evolution of the Venice Laws and the technical and Scientific progress, with direct and continuous Technical-Scientific assistance

Ministry of Infrastructure

VENICE WATER AUTHORITY

Jesus Cisneros Aguirre – Information Service



WEB site: www.salve.it

Most relevant of the project

As initial goal:

Try to found a global solution for water/sediments management.

We are trying to export this point of view.