



Ministry of Infrastructure
VENICE WATER AUTHORITY

Environment Protection of Venice



Jesus Cisneros Aguirre. PhD. - Information Service



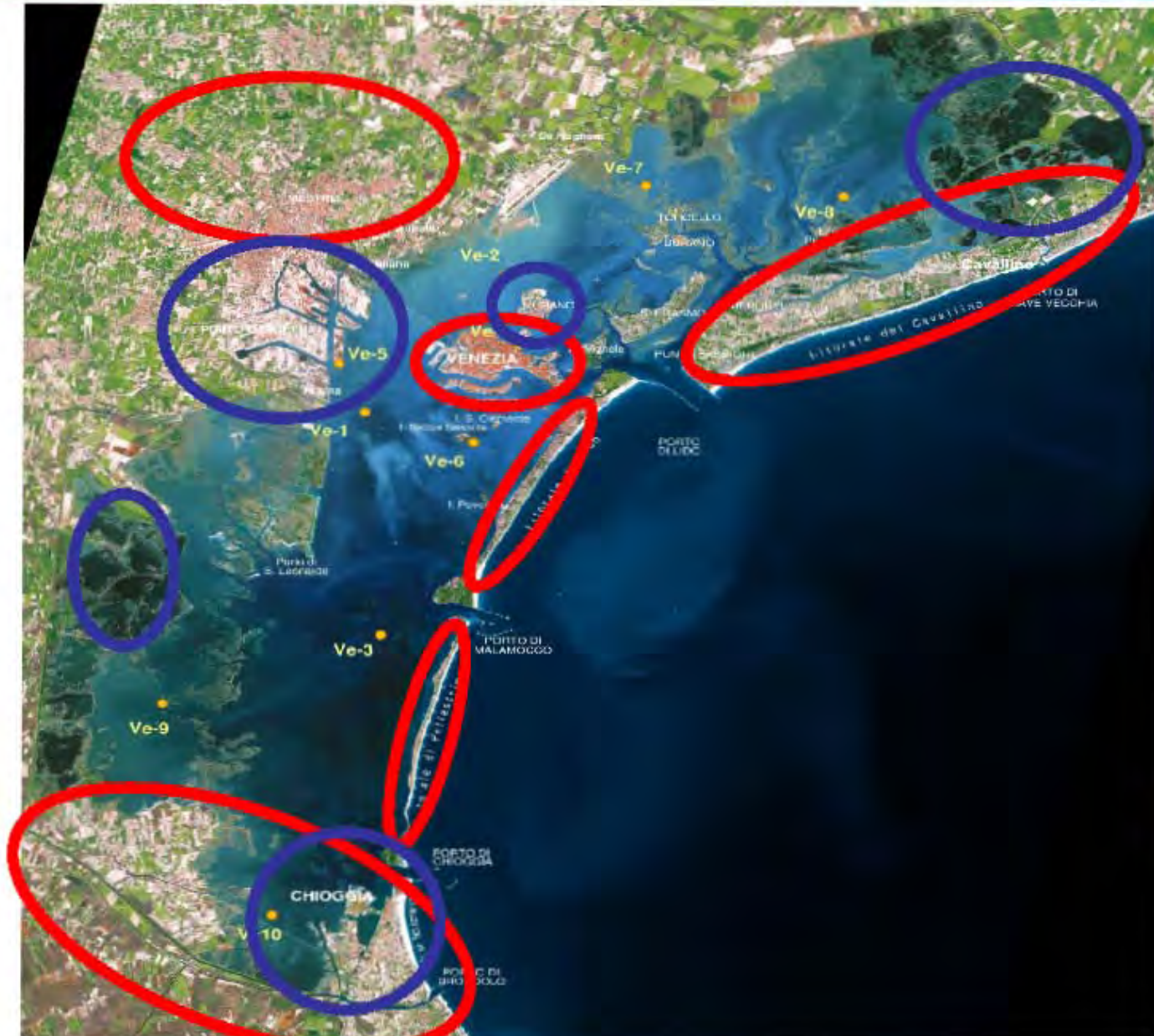
VENICE LAGOON

The lagoon, in a constant 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.

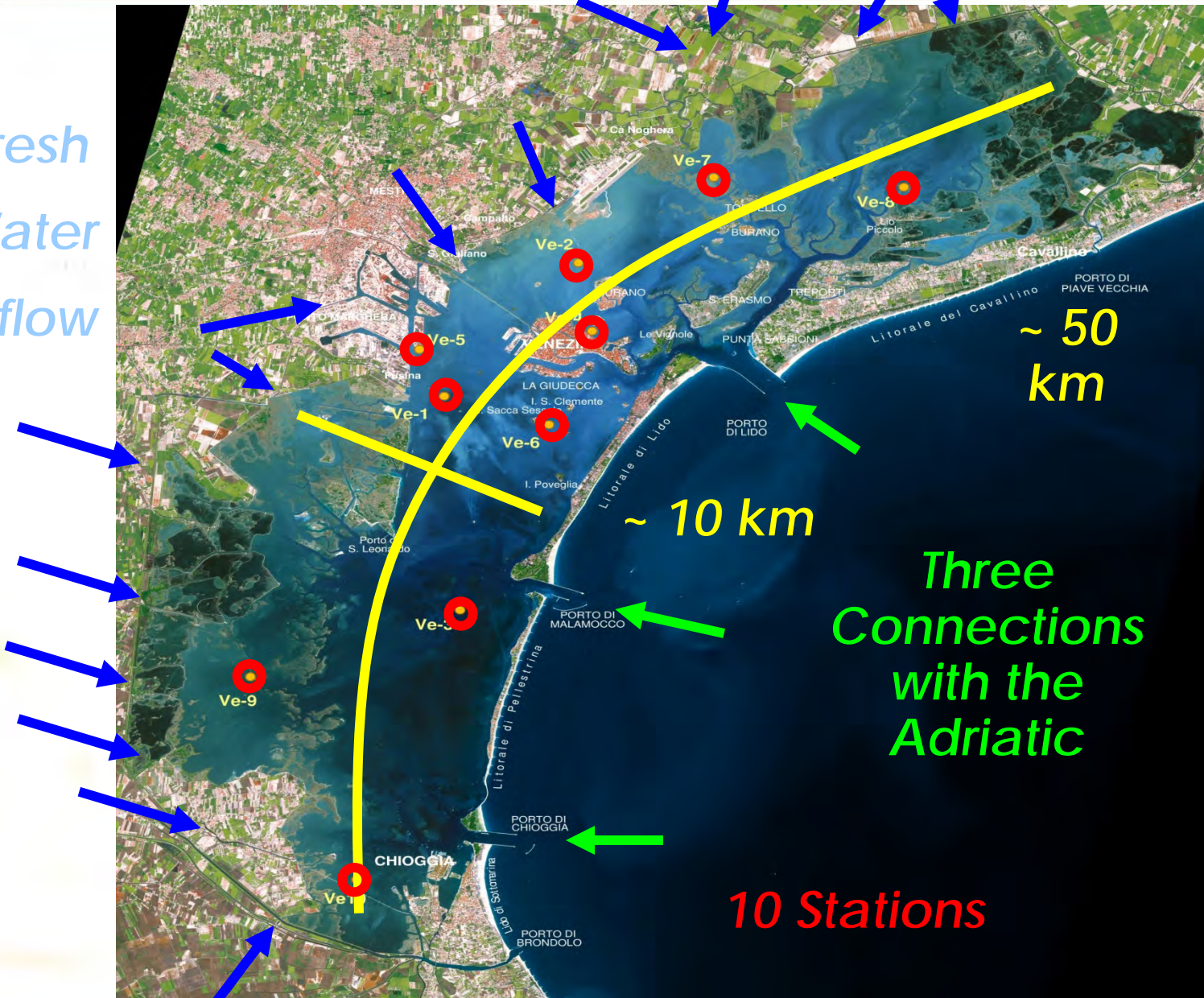


The Venice Lagoon



The Venice Lagoon

Fresh
Water
inflow



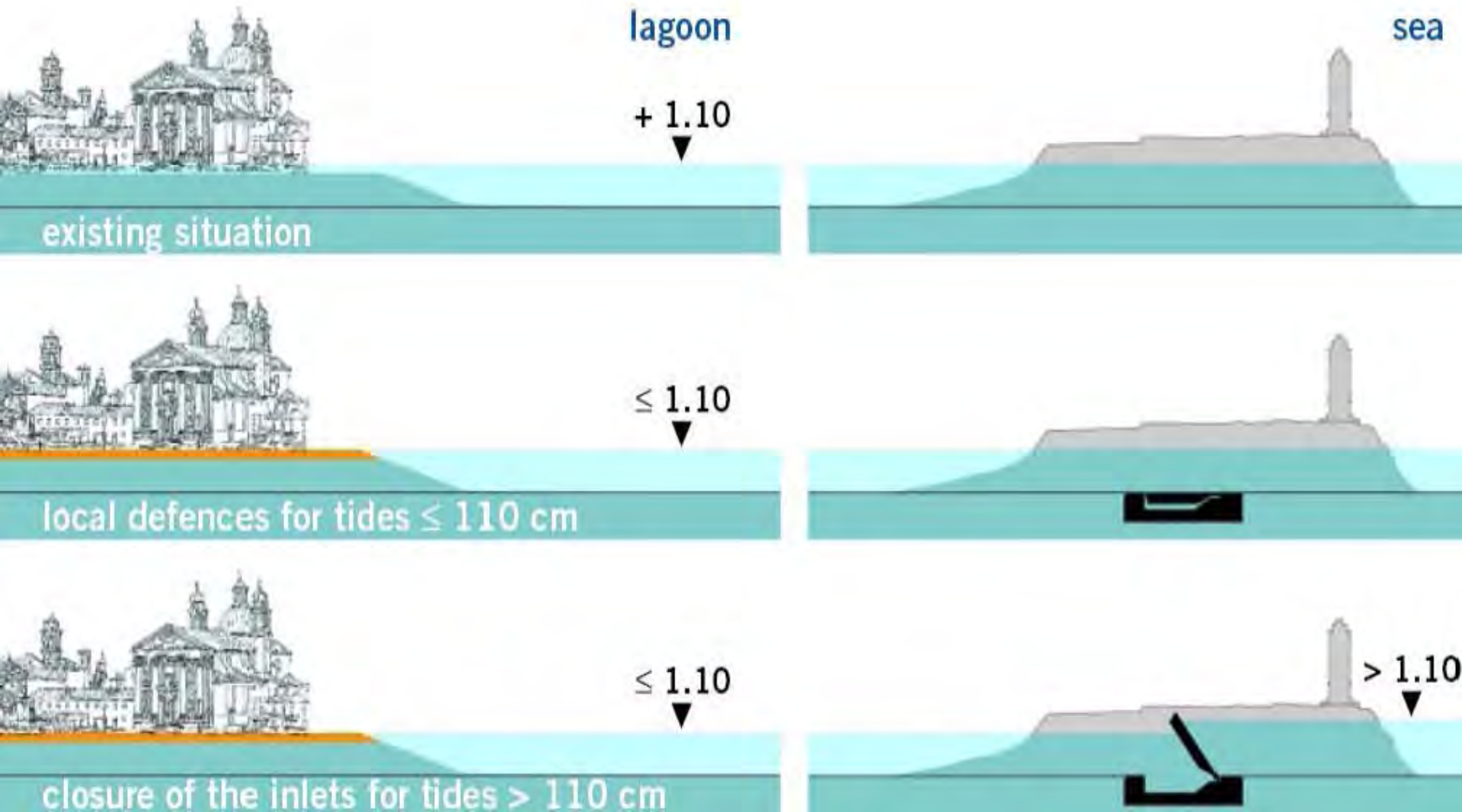


SYSTEM OF INTERVENTIONS





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



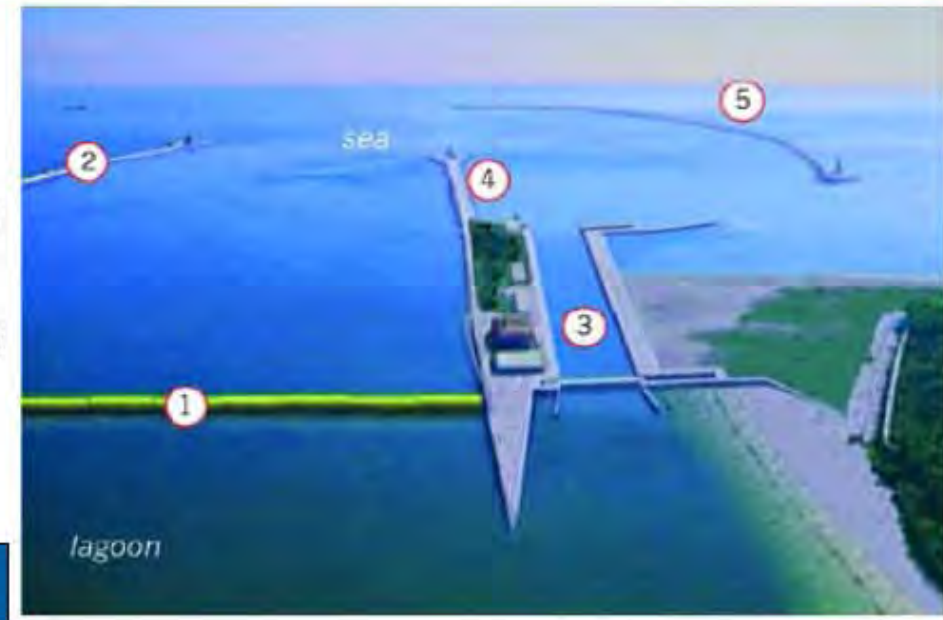
work in progress



Mobile barriers for the defense of Venice – Malamocco inlet

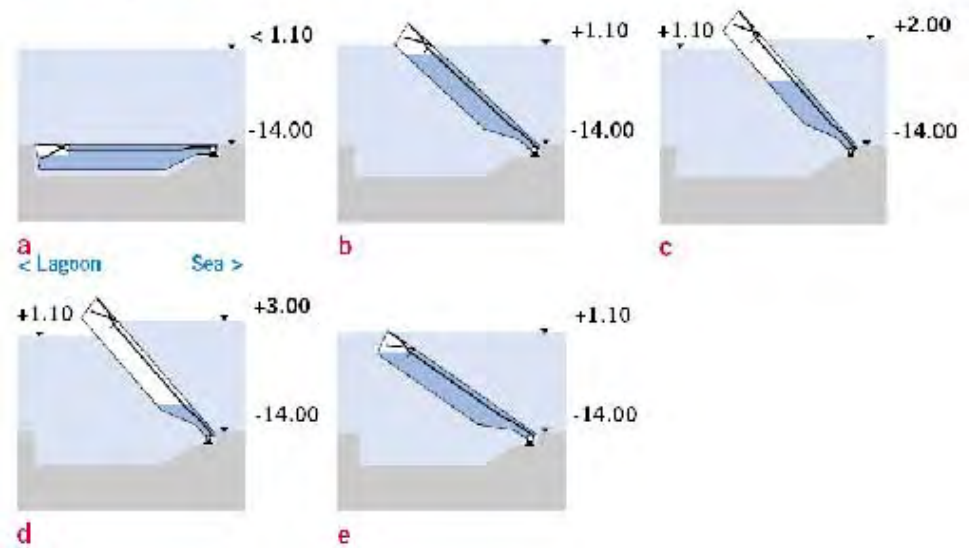
View of the inlet after the realisation of the MOSE system for the defence from high tides and with the navigation lock for the passage of ships bound for the port

- 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

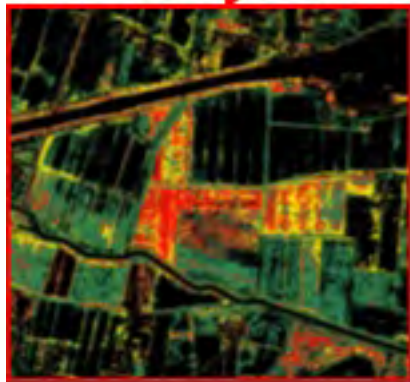
- Updating GIS and specific overviews of the individual phenomena and their correlations
- Salt marshes, mud flats and shallows monitoring
- identification and monitor sites polluted by illegal dumps
- Water monitoring
- Subsidence monitoring



Classification of the possible polluted areas



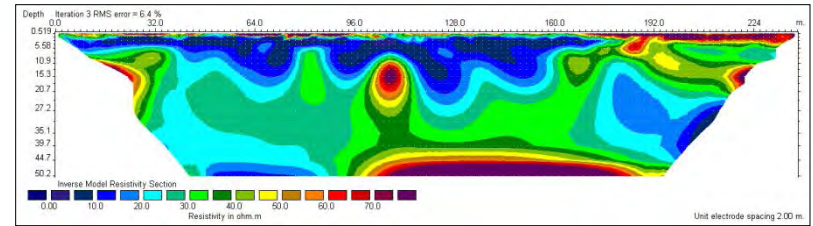
Initial recognition of possible contaminated sites using ML classification (maximum likelihood algorithm) for the identification of the stressed vegetation





Classification of the possible polluted areas

geophysical monitoring



site inspection

Two chemical laboratories for analyses





Dangerous dumps

Eutrophication
and ecological collapses



Intervention areas

- 1) Montiron
 - 2) Area Sordon
 - 3) MSW via Bottenigo
 - 4) Barene del Passo
 - 5) MSW Cavallino
 - 6) Ausimont
 - 7) Sacca S. Mattia Murano
 - 8) Pili
 - 9) Lusore Brentella channel
 - 10) Island between oil tanker channel and Tresse channel
 - 11) Moranzani
 - 12) "40 ettari"
 - 13) ex Incinerator island
 - 14) Enichem a Fusina
 - 15) Dogaletto
 - 16) Ex Rasego
 - 17) MSW Val da Rio
- works completed
● works underway
● works proposed



Island of Tresse. Pollution





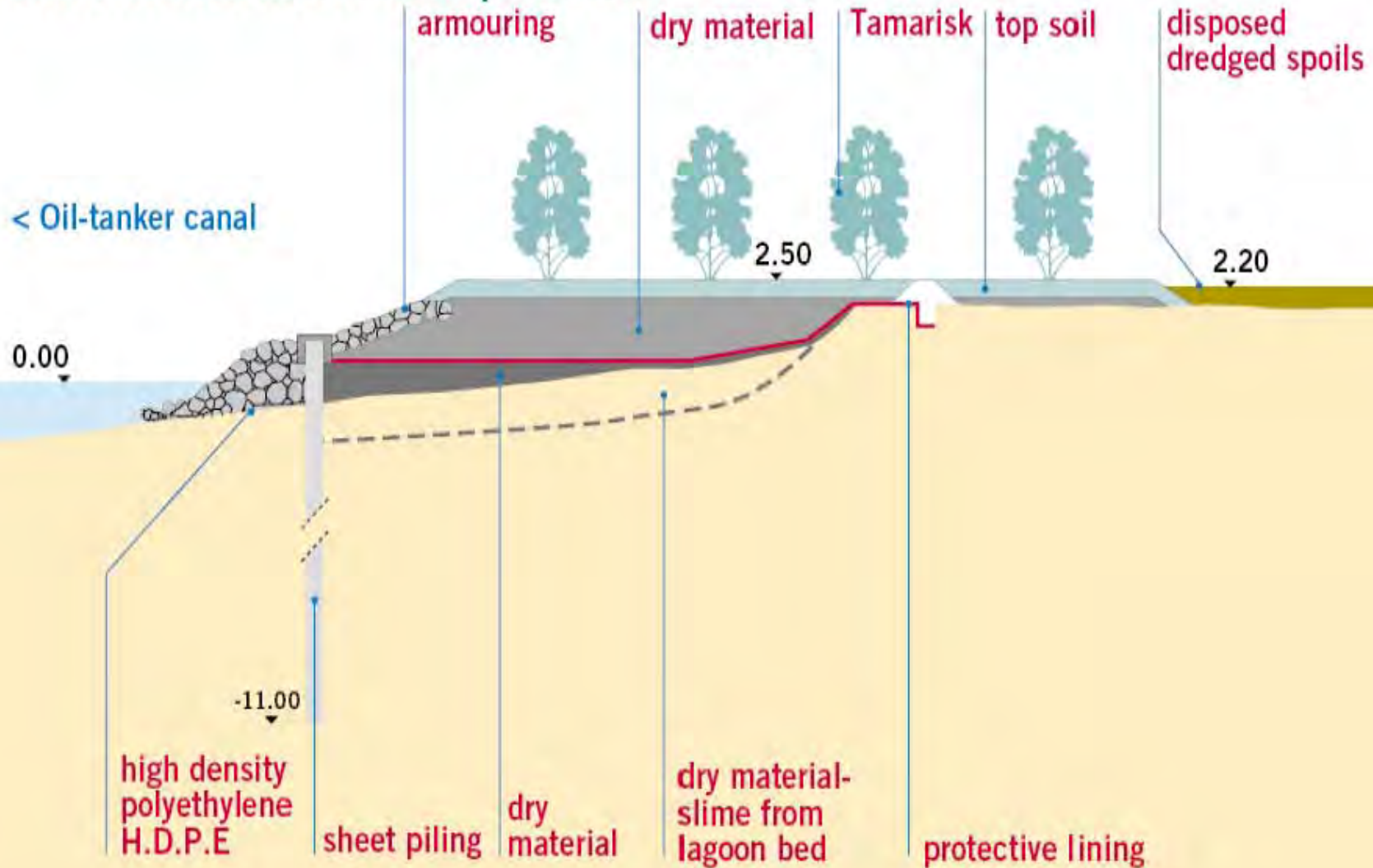
Island of Tresse before interventions





Island of Tresse. New banks

Environmental deterioration prevention





Island of Tresse after interventions

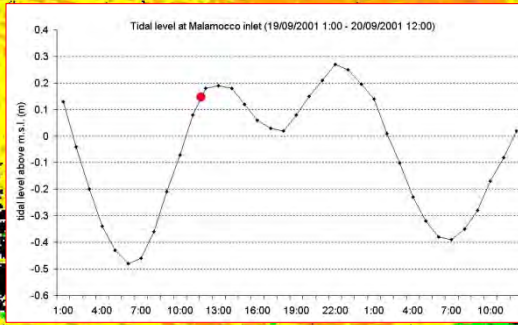
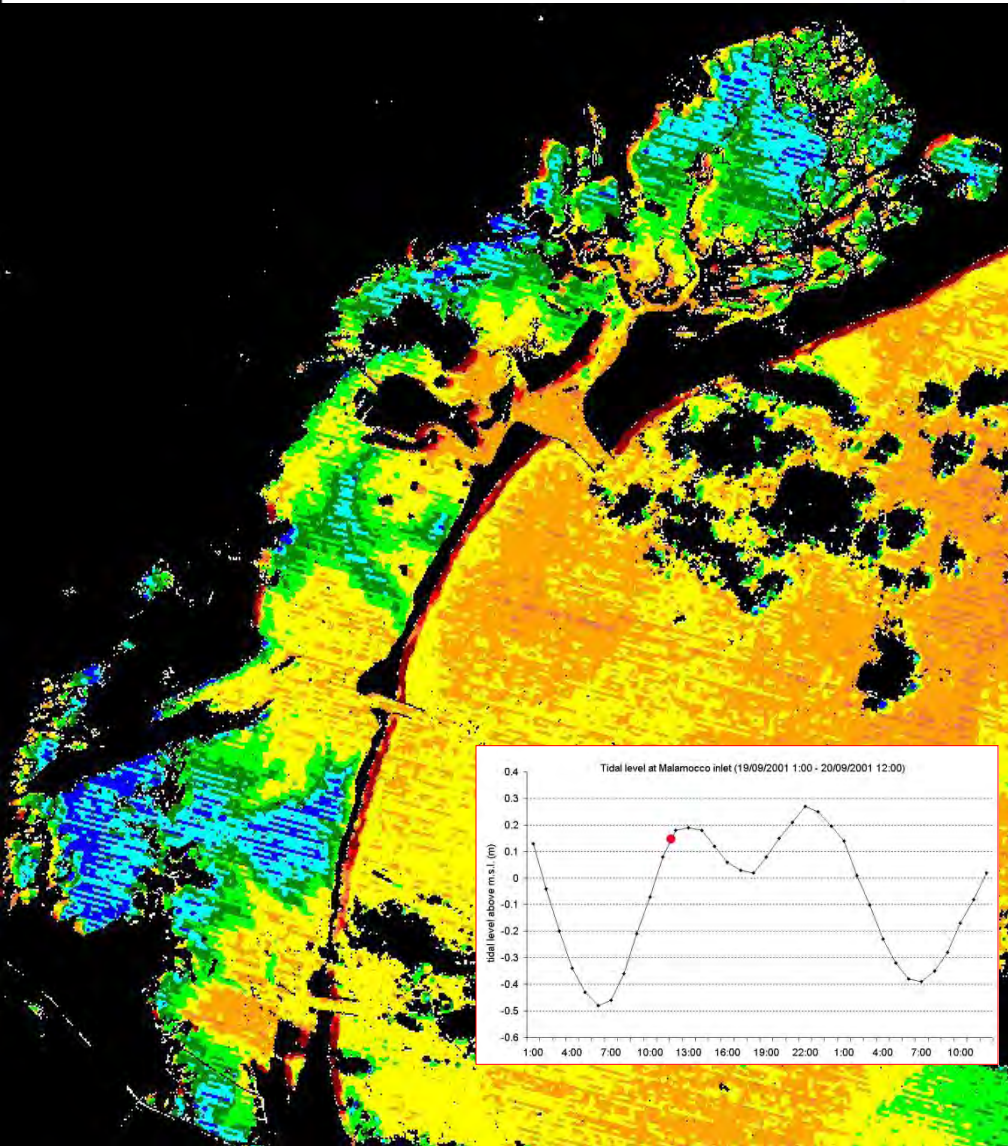




Water quality evaluation

calibration of a finite elements hydrodynamic model using remote sensing images

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



HYDRODYNAMIC MODEL OF THE VENICE LAGOON



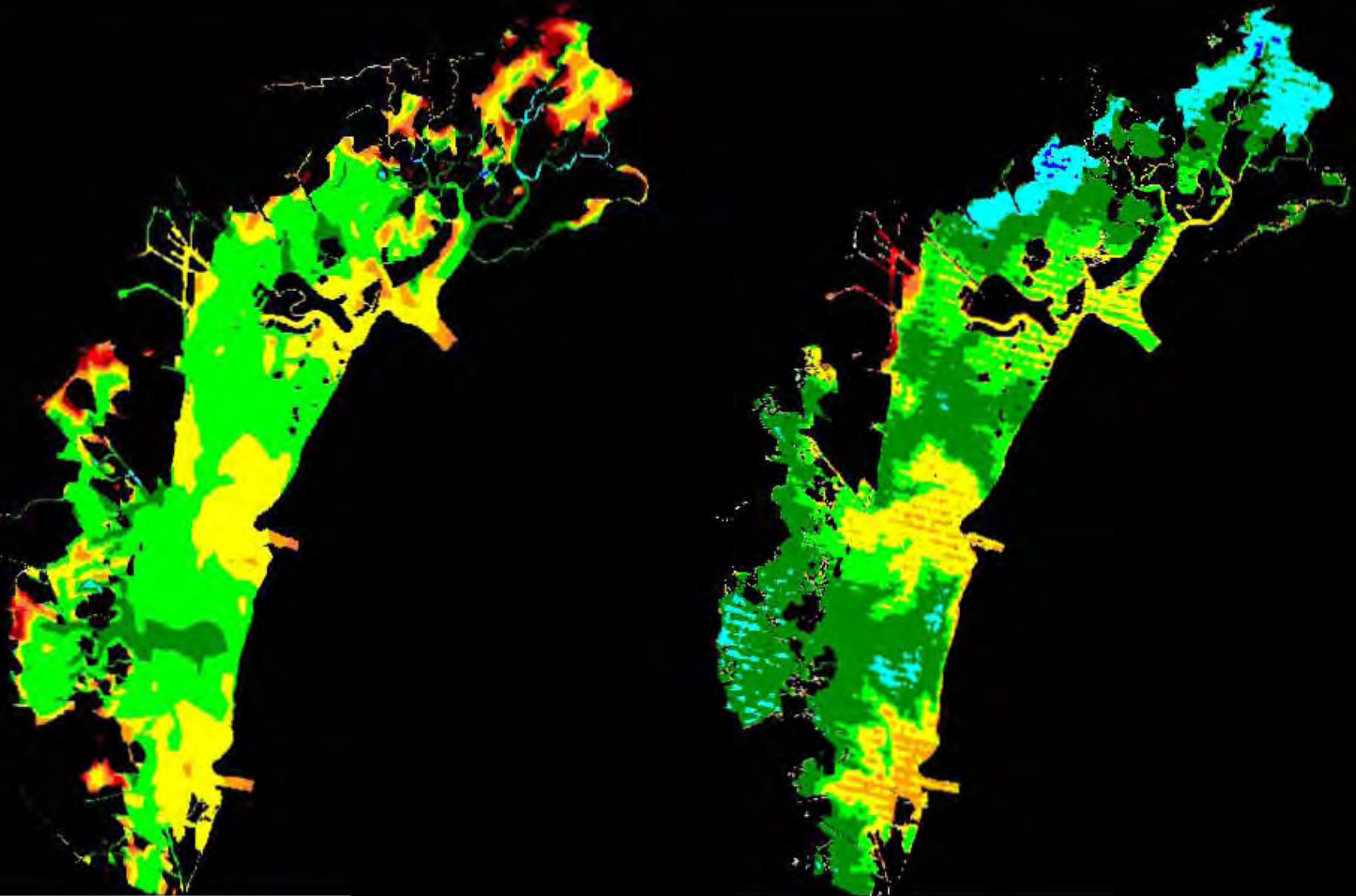


Water quality evaluation

calibration of a finite elements hydrodynamic model using remote sensing images

Hydrodynamic model output after 24 hours

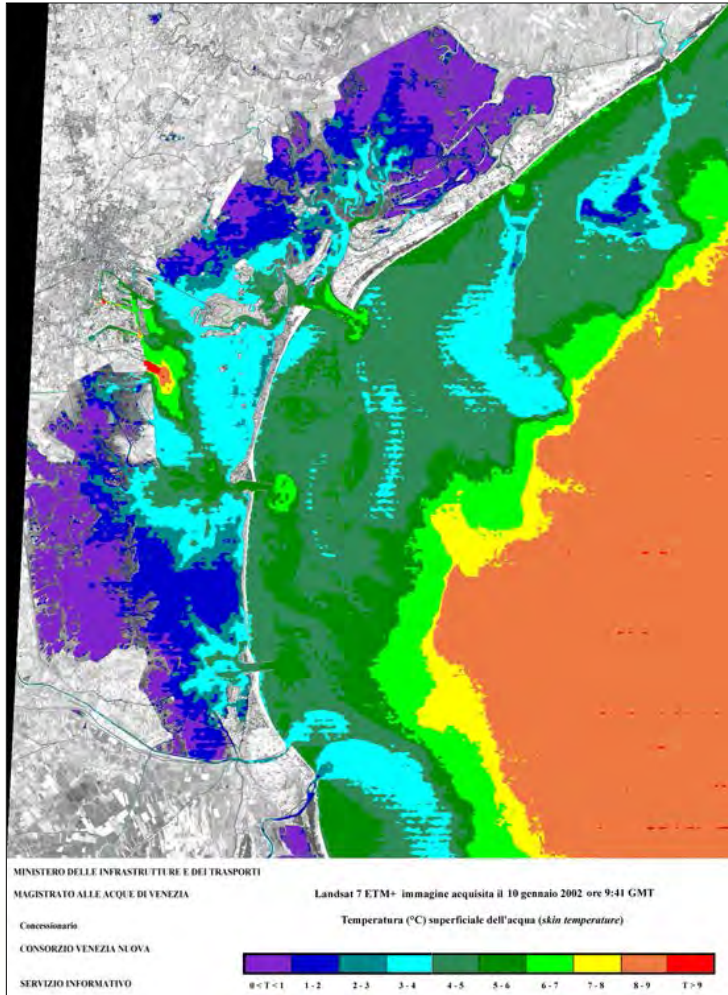
Landsat 7 ETM+ 20/09/2001 - 9:41 GMT



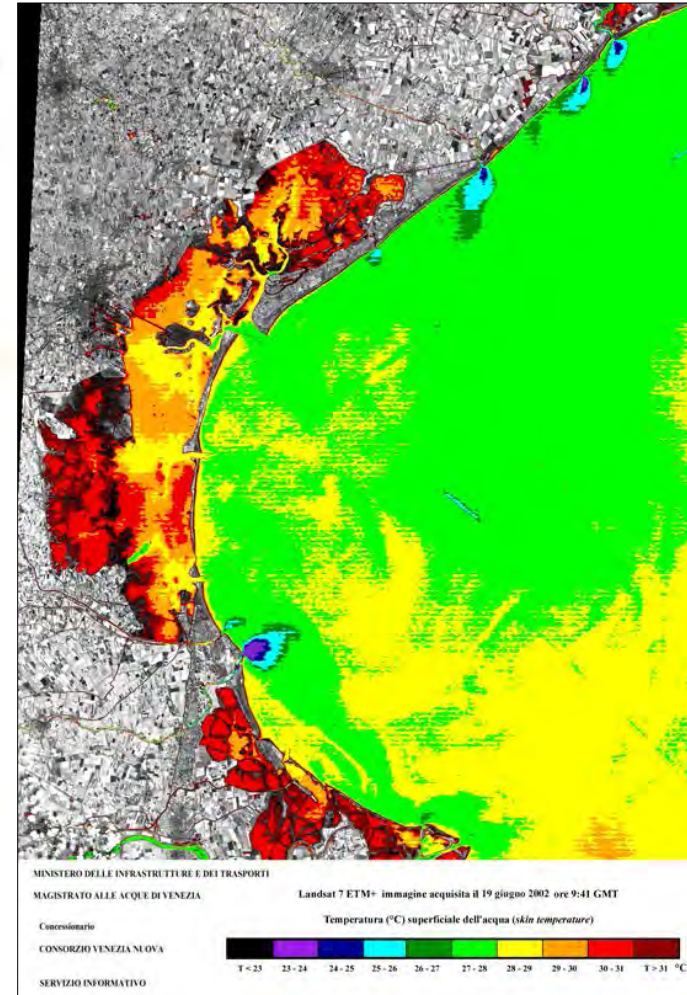


Temperature monitoring

winter



summer





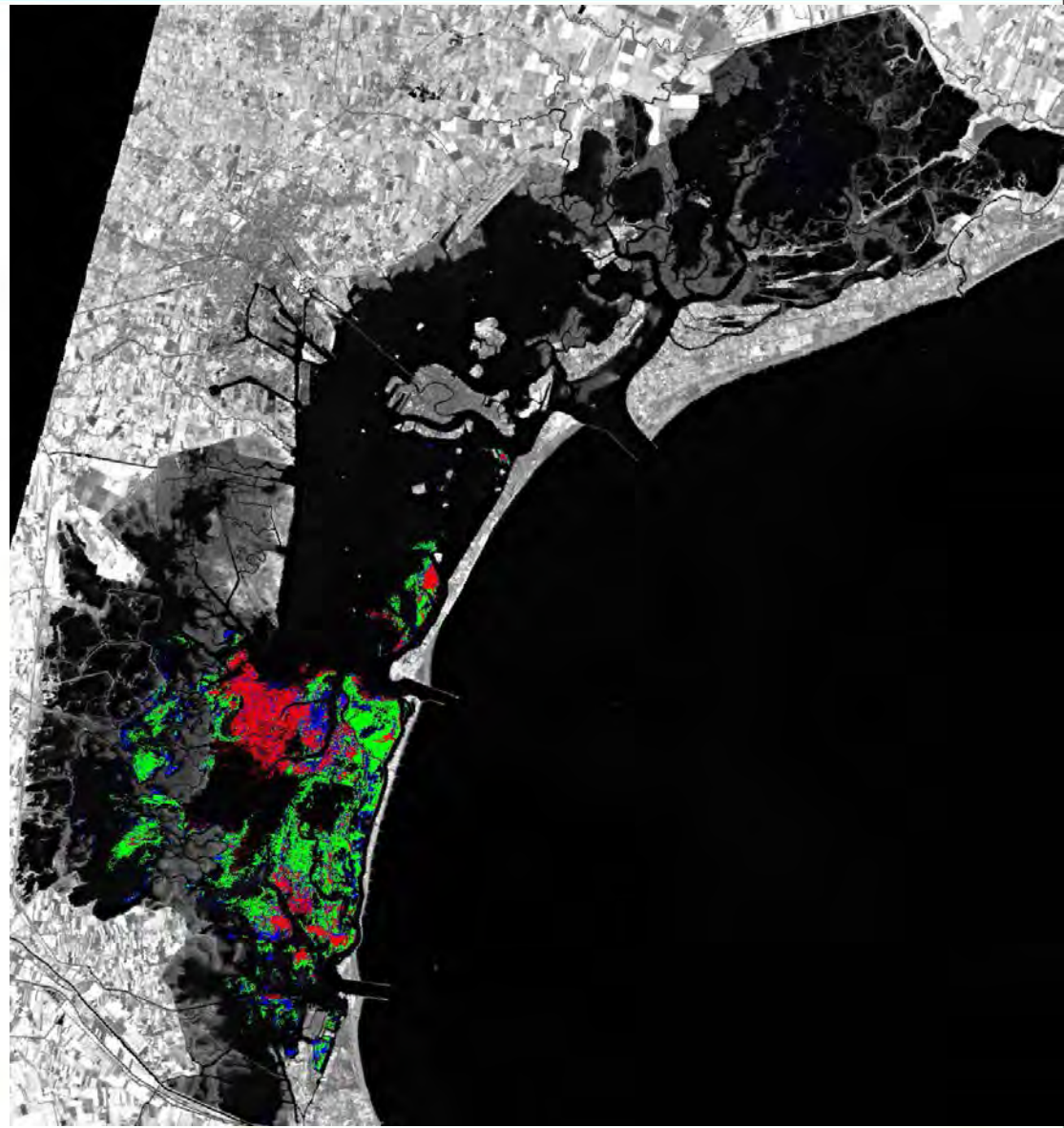
Evaluation of the lagoon environment quality

Lagoon vegetation

Eelgrass and macroalgae

Landsat 7 ETM+ image
19 June 2002

	<i>Zostera marina</i>
	<i>Cymodocea nodosa</i>
	<i>Ulva rigida</i>





Elgrass





Elgrass transplantation

Morphological restoration



Intervention areas

- Harvesting
- Transplantation
- Intervention completed



Macroalgae harvesting





Macroalgae utilized in agriculture and paper production



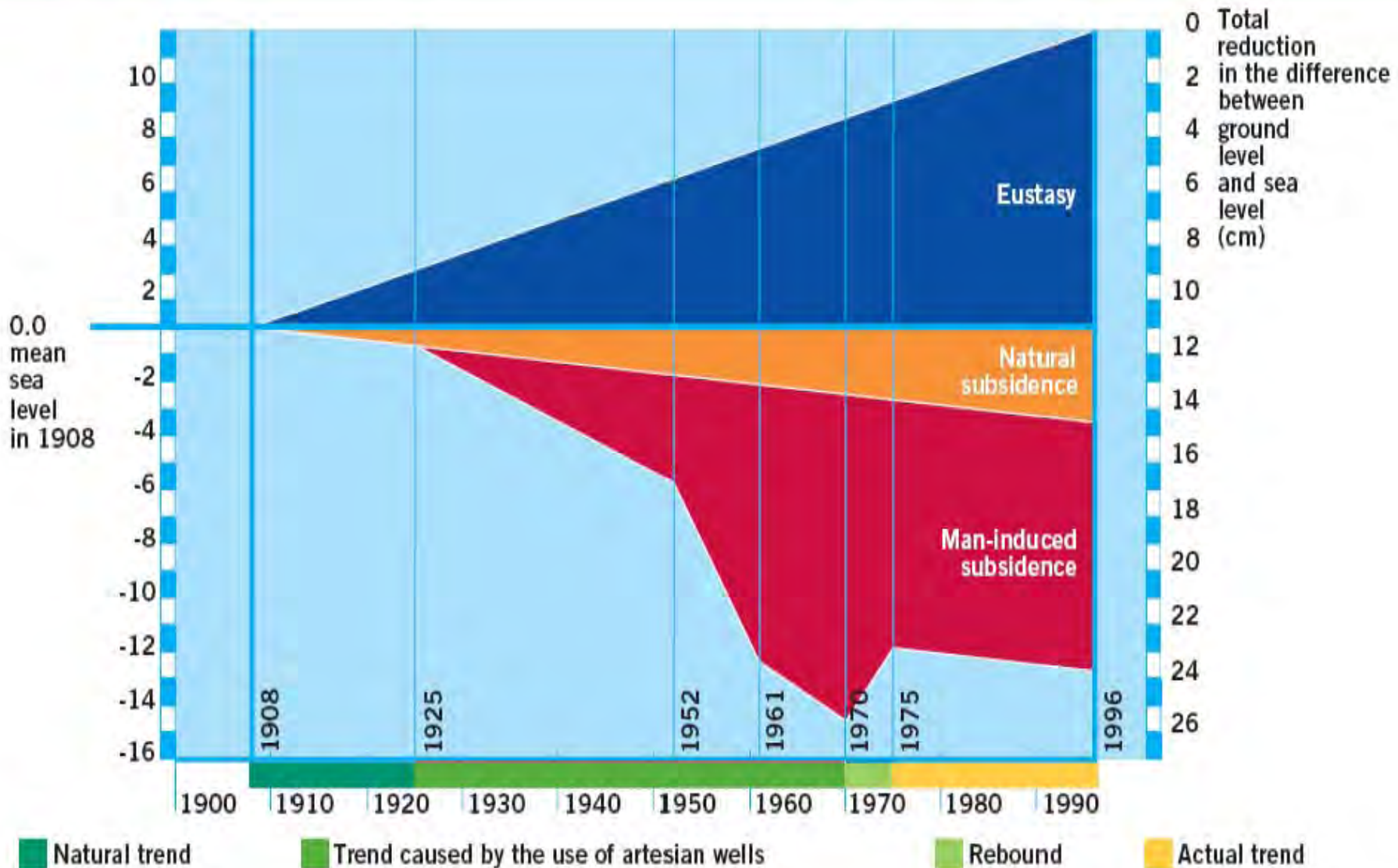
fertiliser



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

- 100 cm
no area
is flooded
- 120 cm
- 140 cm





Flooding in Venice today

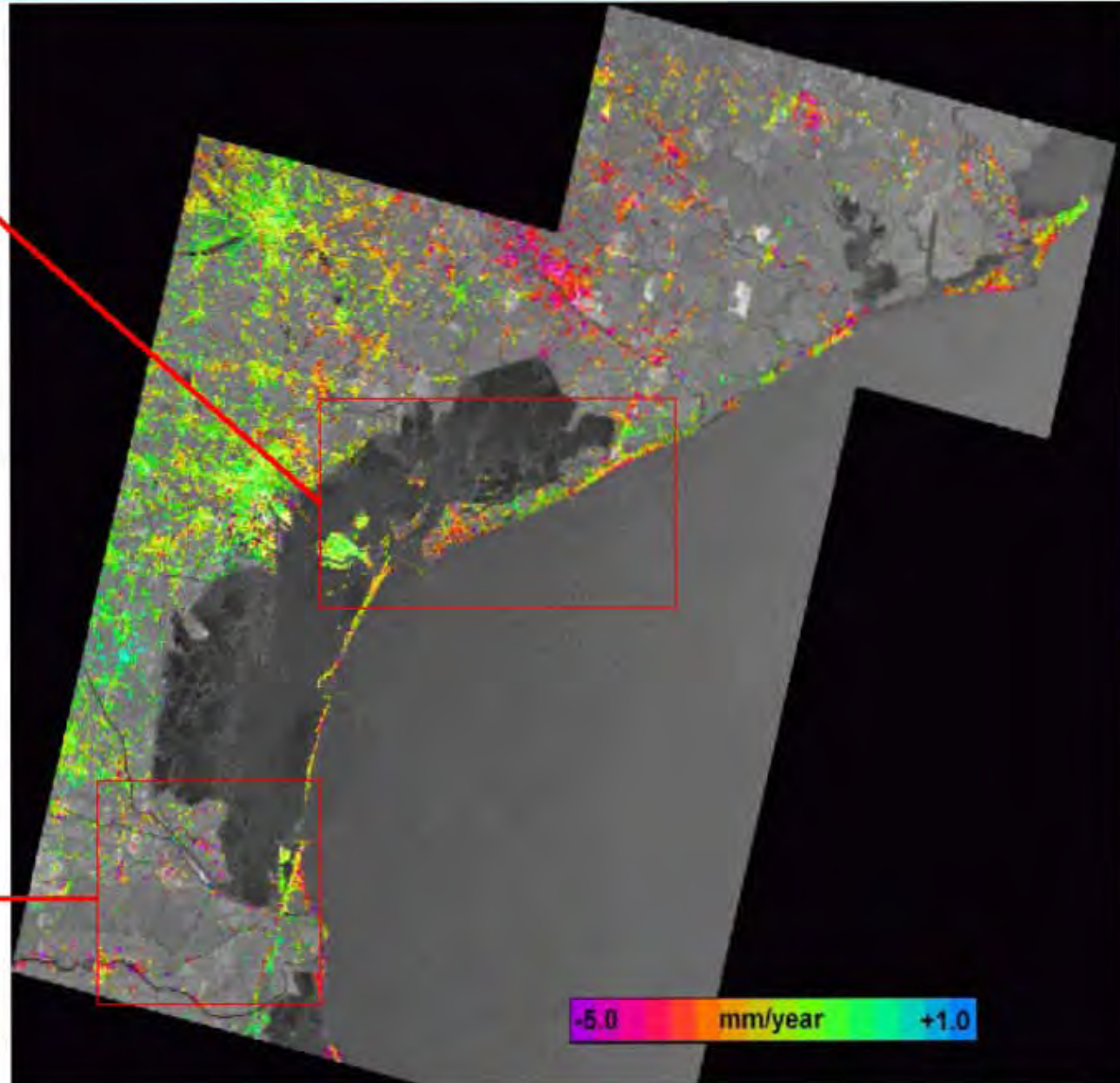
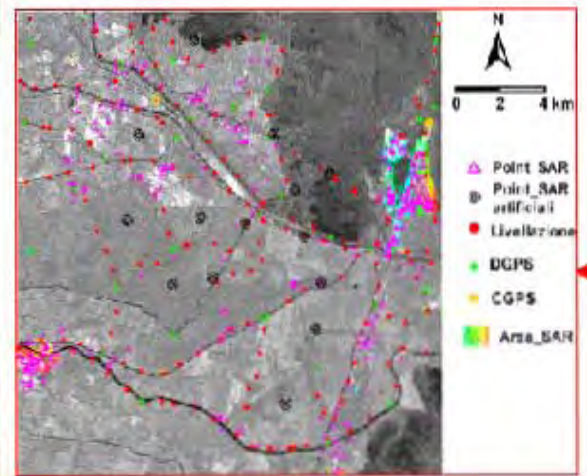
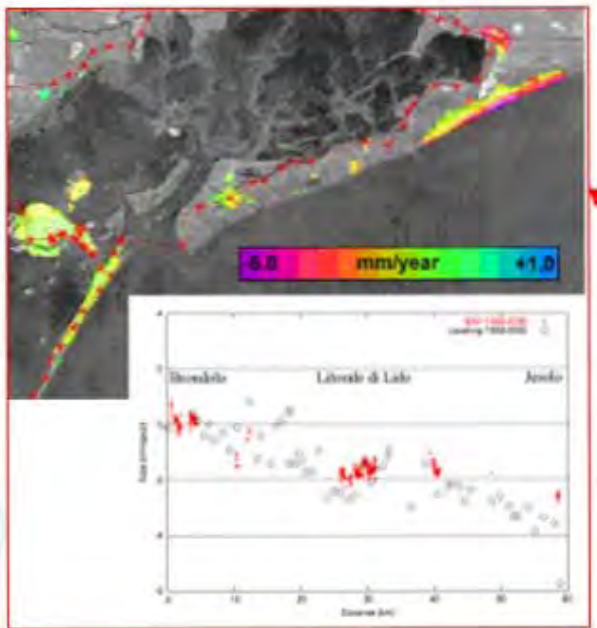
- 100 cm
- 120 cm
- 140 cm





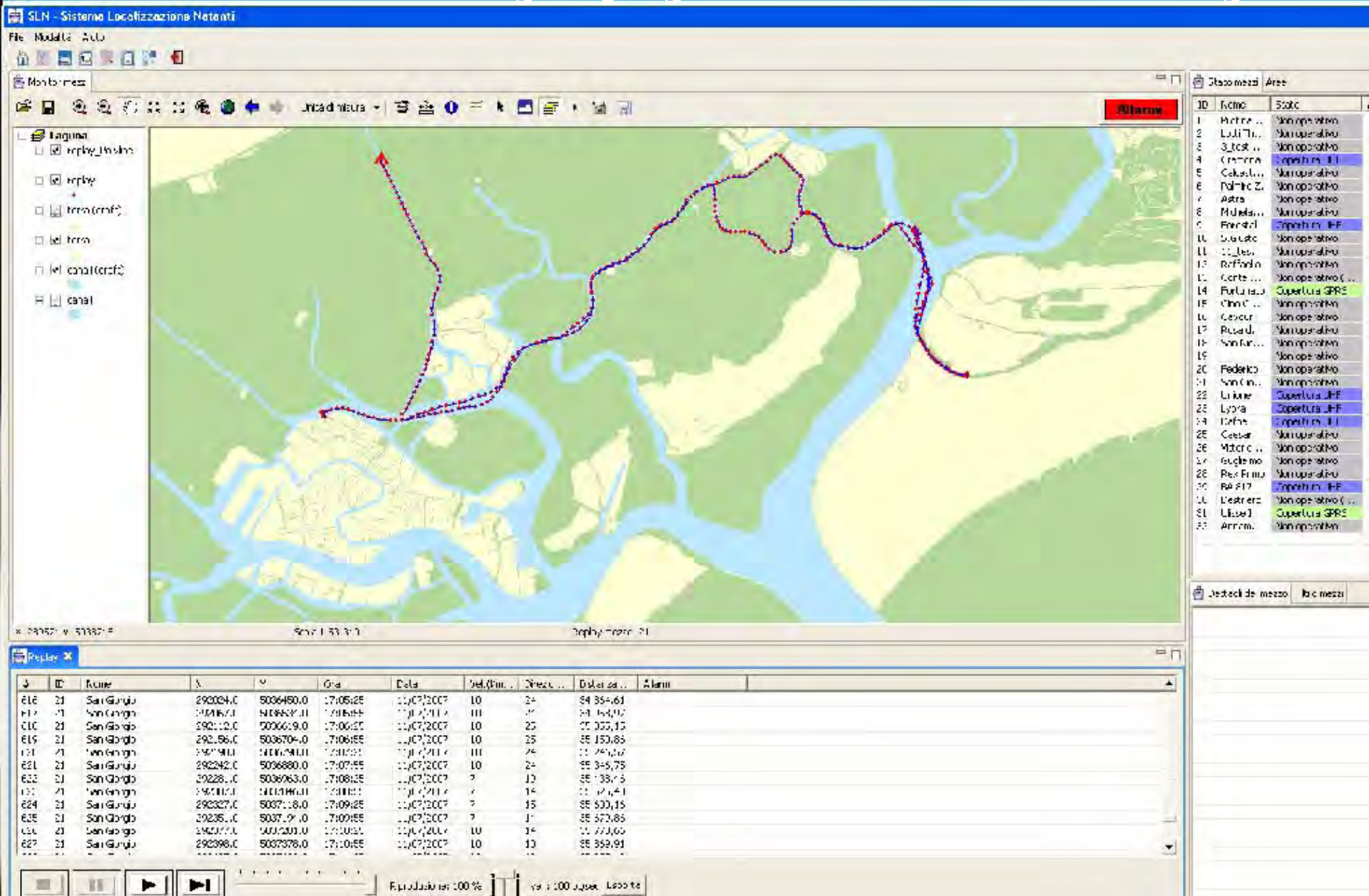
Evaluation of the land subsidence

Envisat ASAR images elaboration and correlation



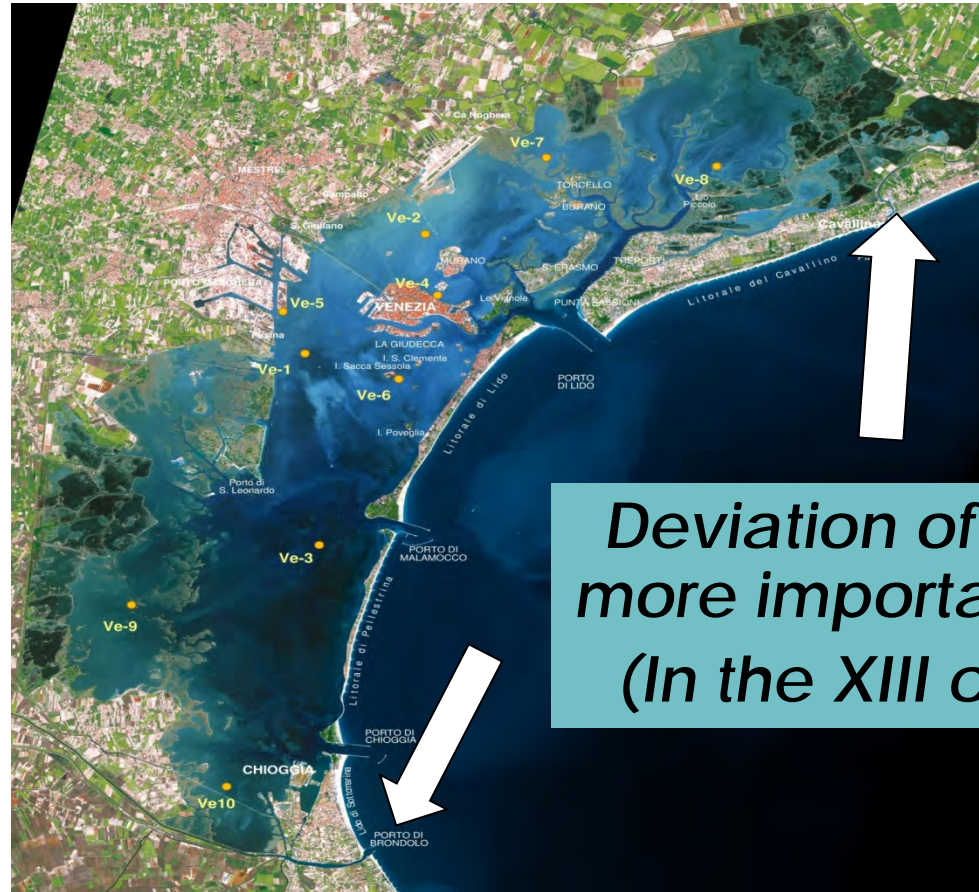


A replay of San Giorgio boat's movements: wednesday 7 july 2007 – the whole day

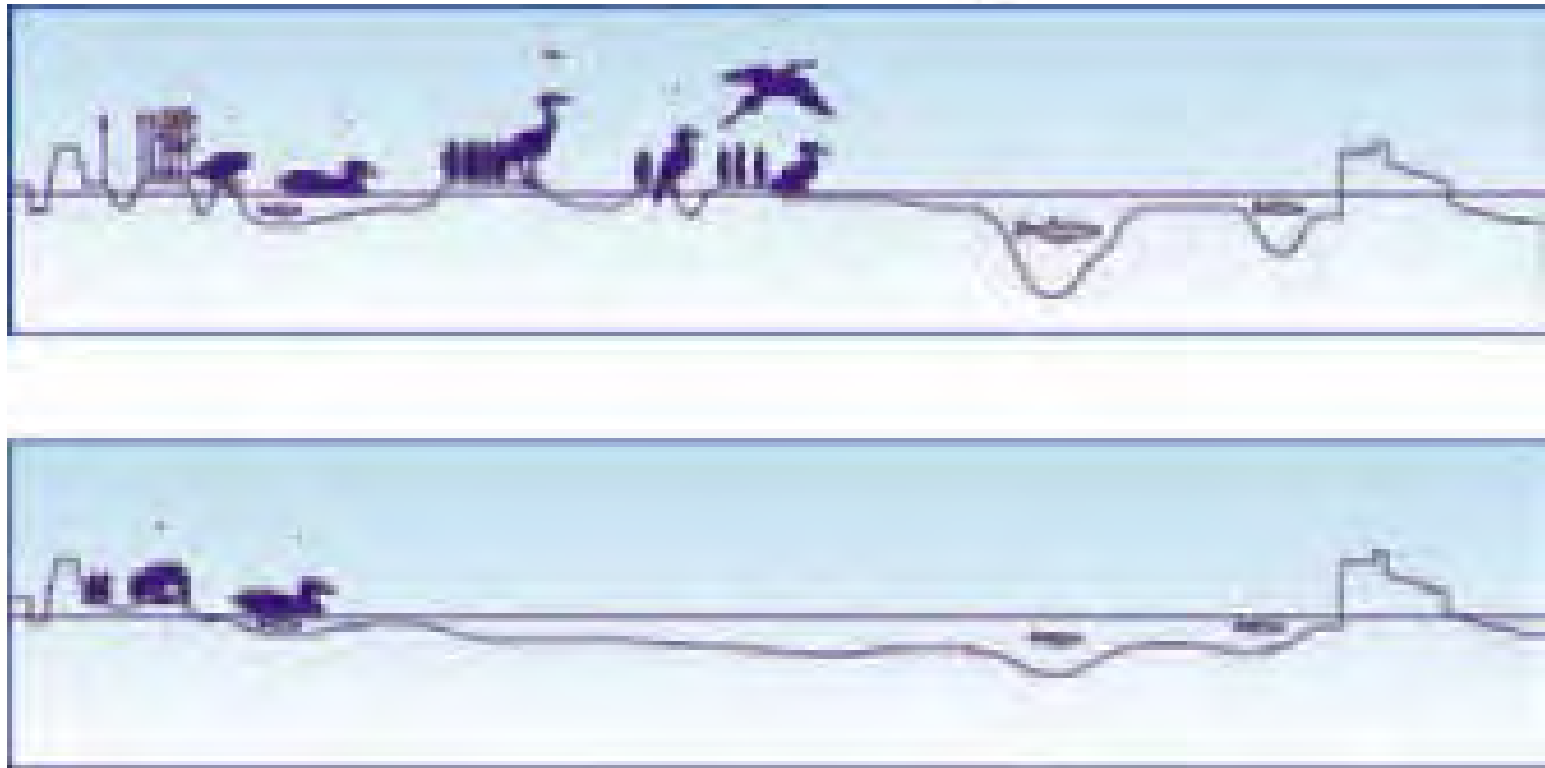


Sediments Management

The sediment balance in the lagoon is negative



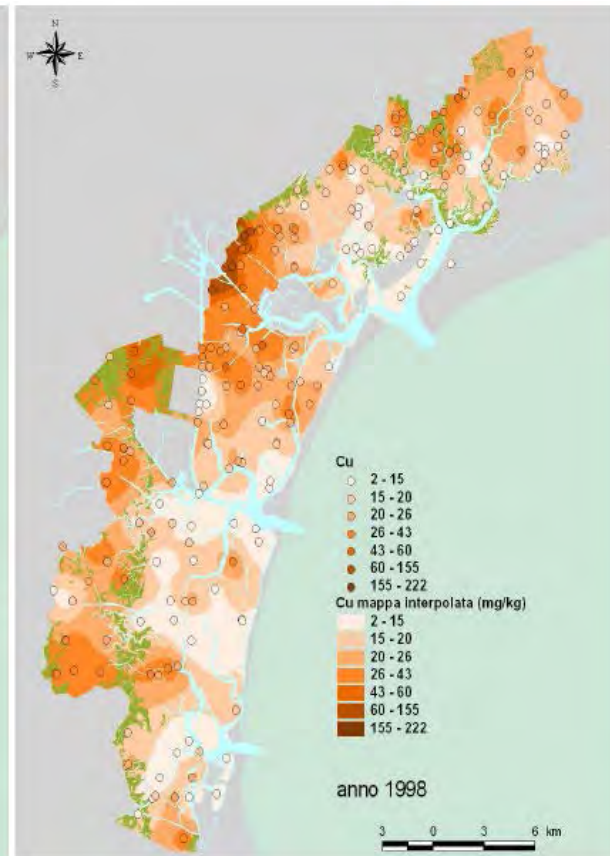
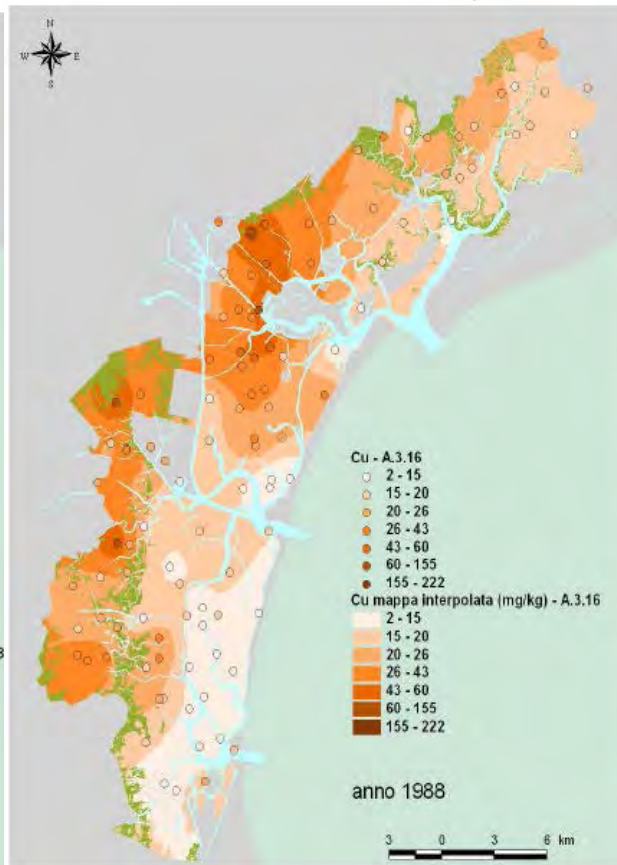
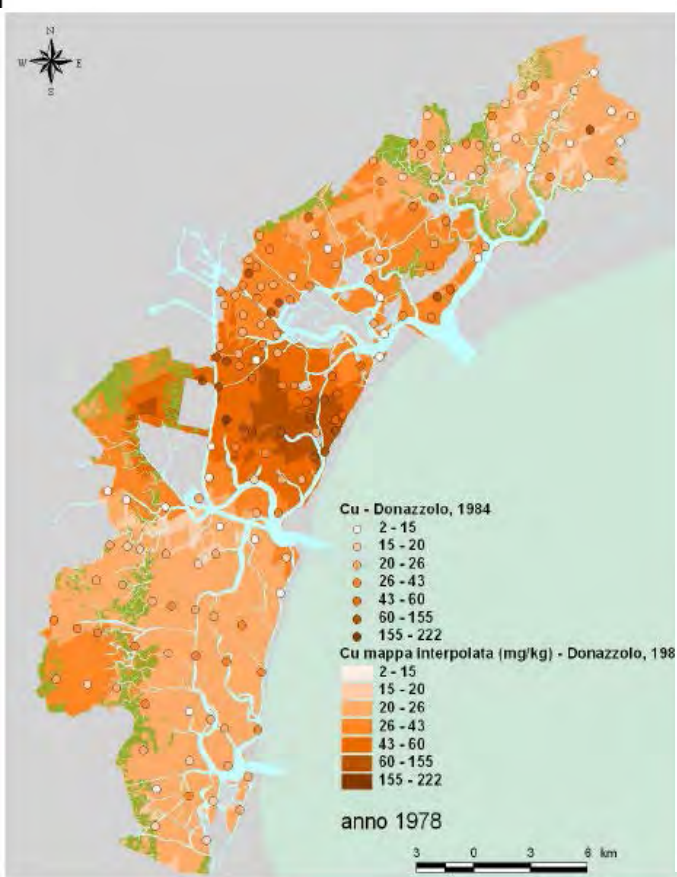
Natural Tendency to an homogeneous environment



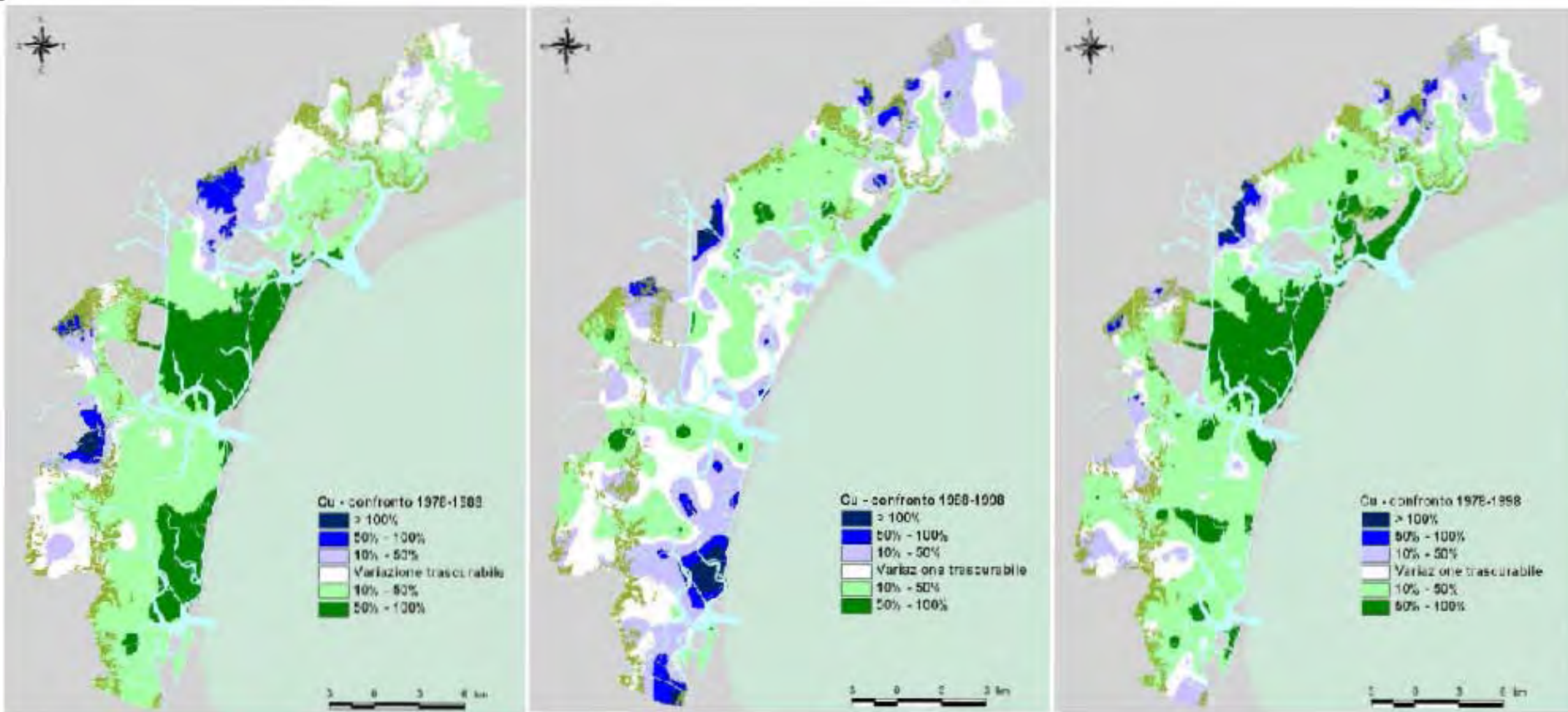
Principal objective for Sediment Management

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

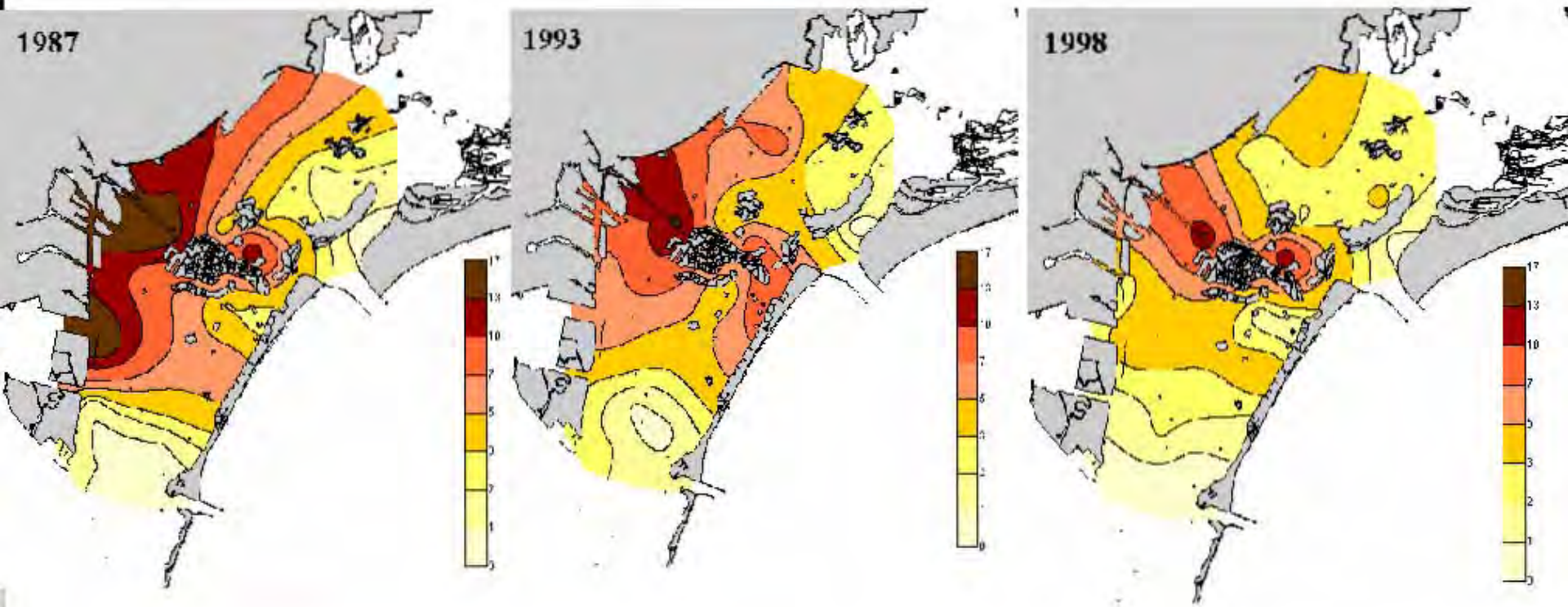
Distribution of Cu in sediments in 1978, 1988 and 1998



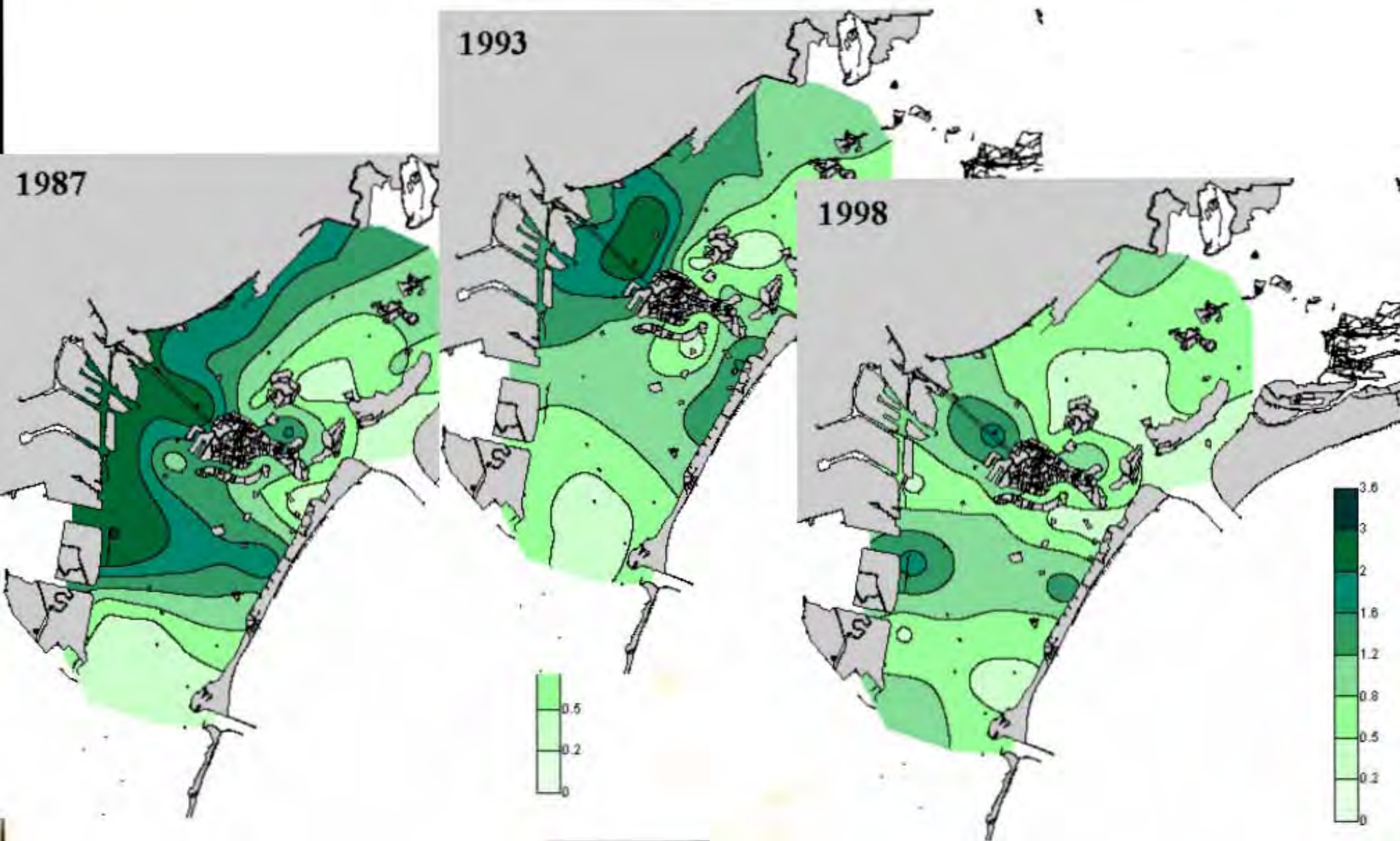
Difference (%) of Cu between the years 1978-1988, 1988-1998,



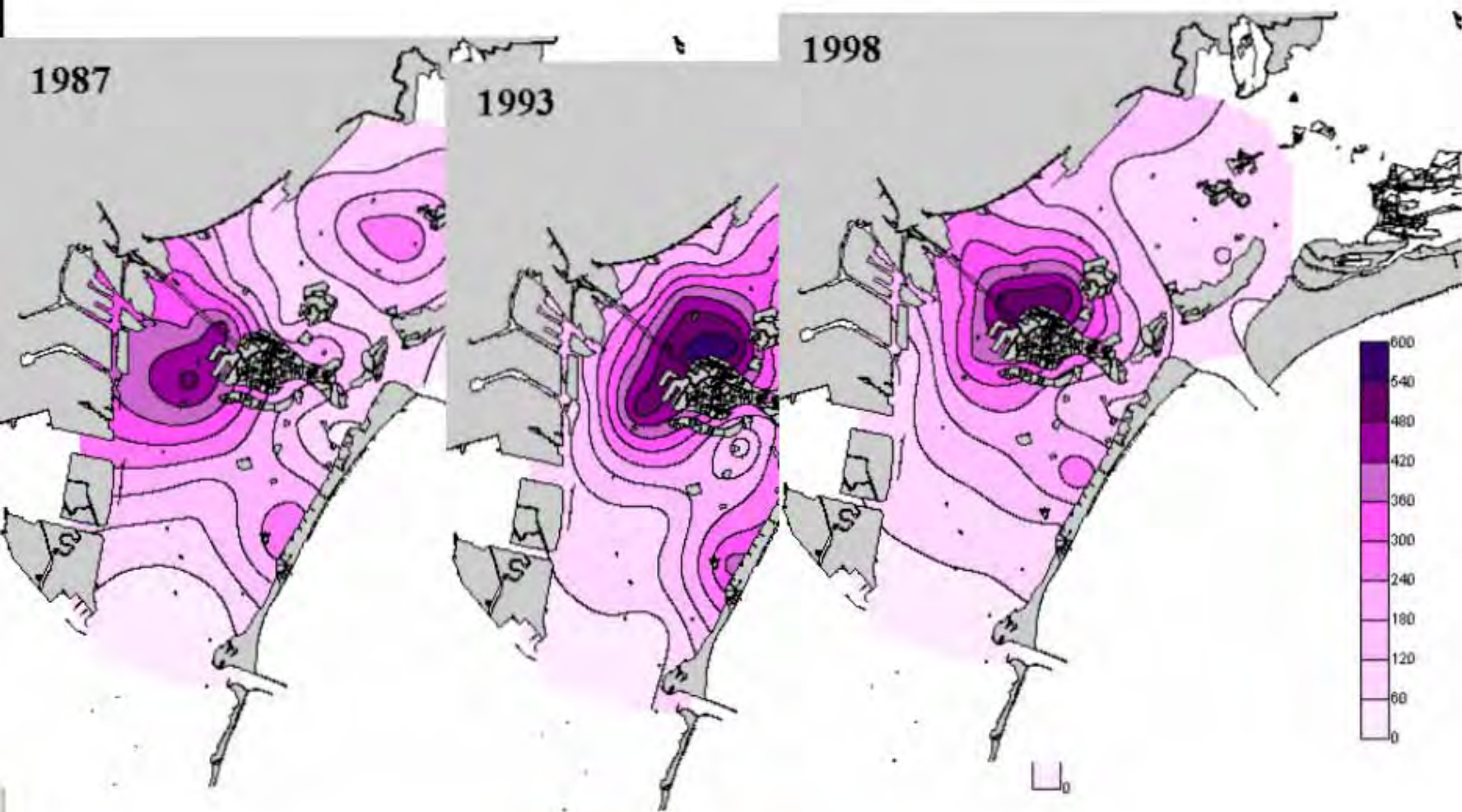
PCB (ng g⁻¹ d.w.)

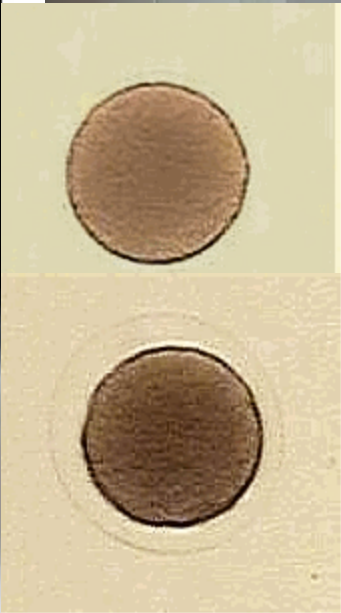
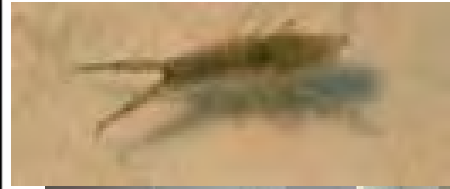


PESTICIDI (ng g⁻¹ d.w.)



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

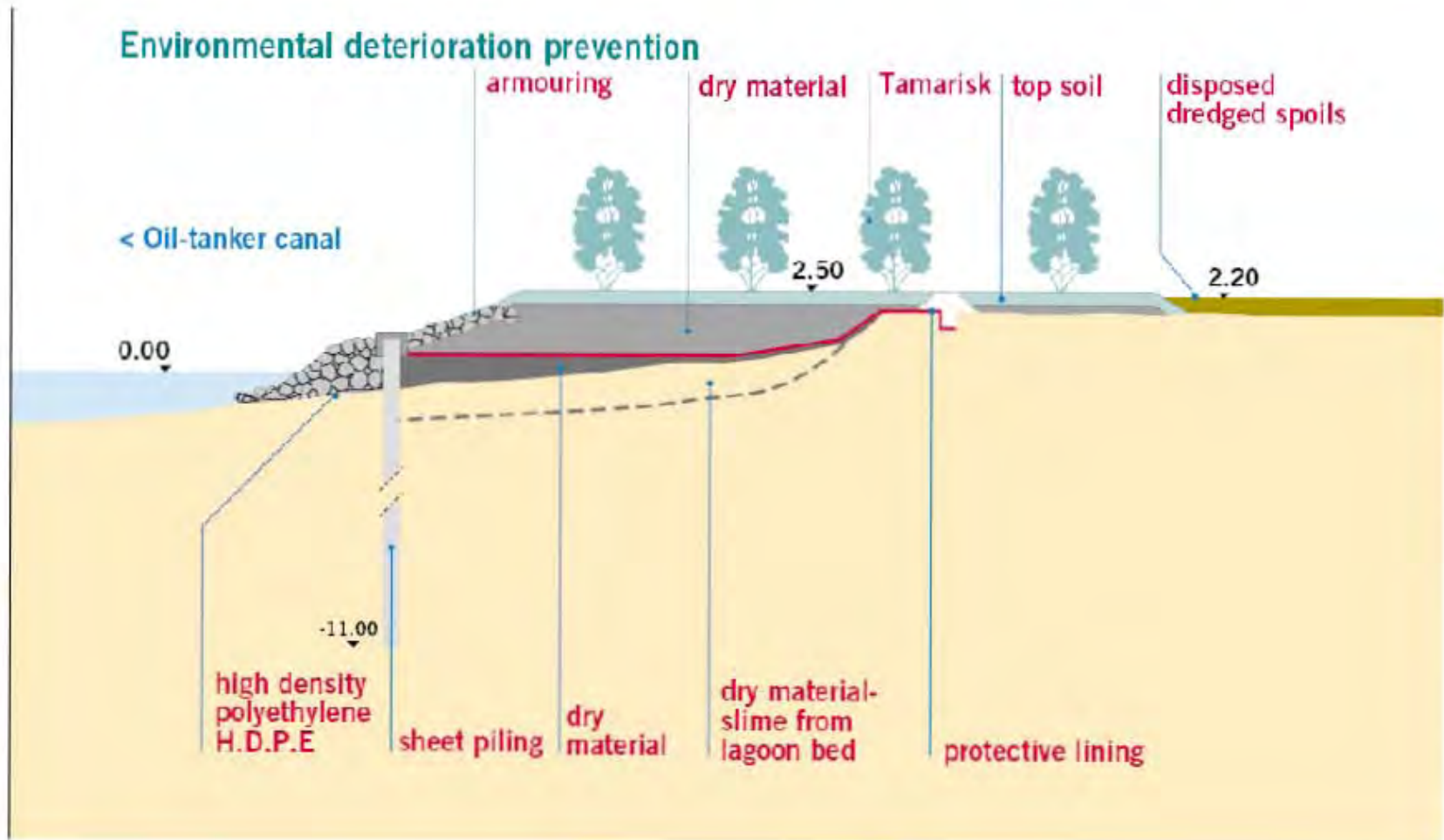
Protocols

- **A** Morphological restoration, in open contact with water (1998 – 2008; 8.000.000 m³)
- **B** Morphological restoration with total isolation from water. Avoiding erosion and submersion. (1998 – 2008; 2.500.000 m³).
- **C** Isolation in specific places prepared for that purpose. (Isola delle Tresse) (1998 – 2008; 3.400.000 m³).
- **>C**: Treated in specific plants. (1998 – 2008; 320.000 m³). (Impianto Alles).

A Morphological restoration



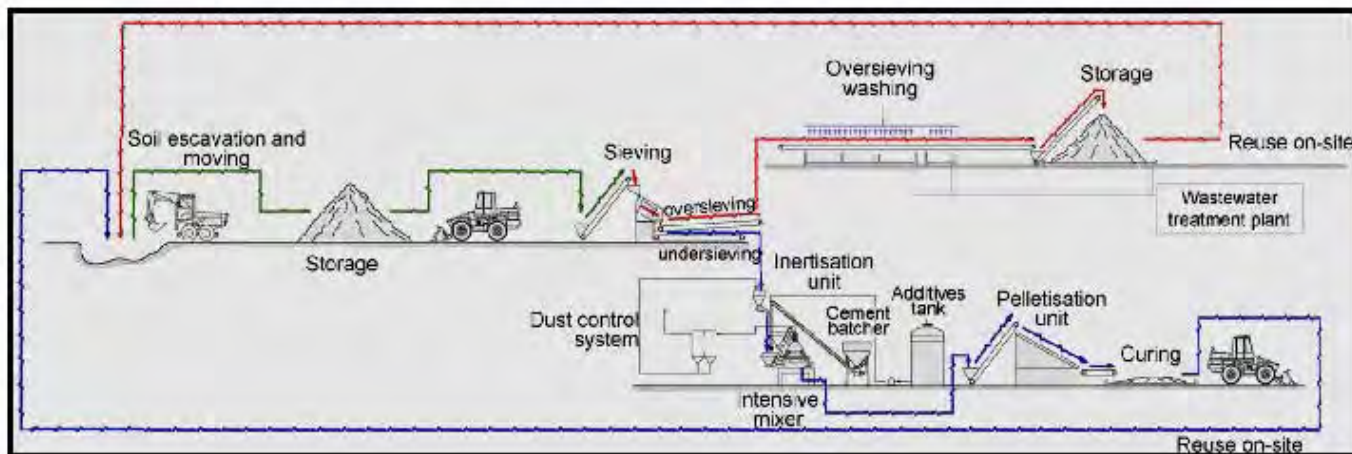
B Morphological restoration



C Isolation in specific places



>C Treatment



Sediment Dredging in Porto Marghera



Sediment classification



Class A 7%



Class B 26%



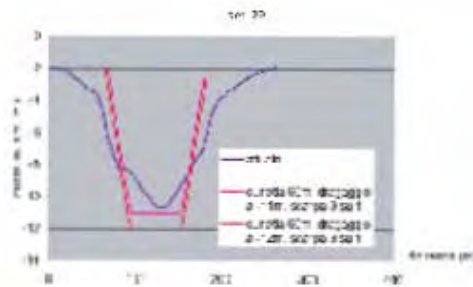
Class C 45%



> C 22%



Channel restoration



ANALISI	PROTOCOLLO DI VENEZIA			
	NO. T. COL. A	Mb. V. COL. B	ES. ° COL. C	GRUPPI C
Assento	15	26	50	162
Cuneiti	1	5	20	120
Ciclonoidi	20	10	200	1000
Misure	0,5	2	10	110
Vole	45	50	150	1150
Rivete	40	10	100	1100
Rinvi	40	50	100	1100
Alco	100	400	800	11000
Sonmetria osidolo armonici	1	10	20	120
Relati in carico in m. l. col.	0,051	0,02	0,3	10,5
13F	0,61	0,5	2	1,7
droca o. l. totali	35	500	1000	11000



**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

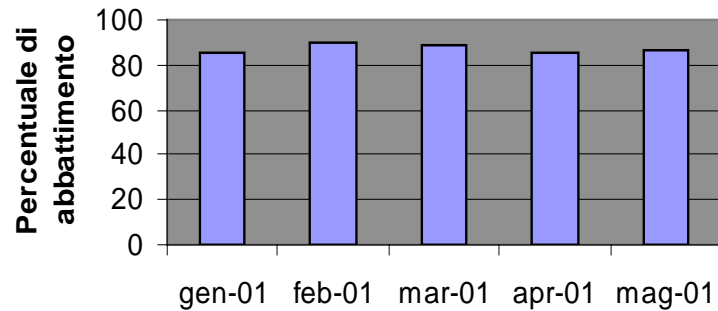


Submarine Depuration System

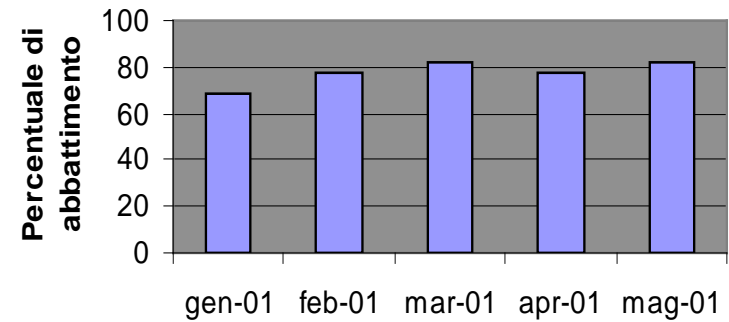


Microbiological and chemical analysis

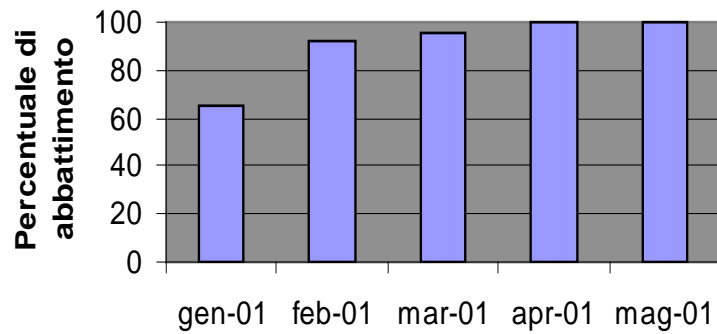
COD



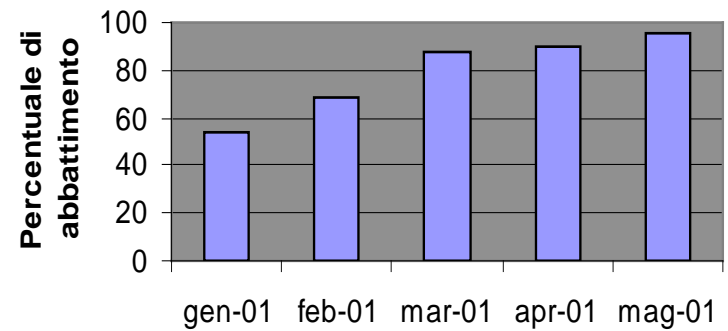
Solidi sospesi



Coli fecali



Coli totali





SAMANET

Net of Stations
Water Continuous Monitoring

Magistrato alle Acque

SAMANET



10 STATIONS OF CONTINUOUS MONITORING

USERS

- ***CVN***
- ***CNR***
- ***UNIVE***
- ***CORILA***
- ***THETIS***
- ***PUBLIC***



SAMA



SIN

***CSMO
LAB***

LAB-VE

10 ATMOSPHERIC DEPOSIMETERS





Decision support system

SLN - Sistema Localizzazione Natanti

File Modalità Aiuto

Filtro mezzi

Stato dei mezzi

ID	Nome	Stato	Ip (GPRS)	Ultimo messaggio	Ultimo scarico service file	Giorni
1	Pilotina CVN	Non operativo	217.201.77.142	01/01/2000 01:02:32	01/06/2007 09:11:07	108
2	Lotti Thetis II	Non operativo	217.201.134.30	11/01/2007 16:57:20	12/01/2007 16:01:06	247
3	3_test_thetis_interno	Non operativo	217.201.5.105	14/09/2007 16:10:01	14/09/2007 15:31:06	2
4	Cremona	Copertura UHF	217.201.198.74	17/09/2007 09:32:30	17/09/2007 09:02:06	0
5	Calcestruzzi Po	Non operativo	217.201.18.202	12/07/2007 14:50:15	12/07/2007 02:56:09	67
6	Palmiro Z.	Non operativo	217.201.148.239	17/09/2007 08:49:40	16/09/2007 03:01:12	1
7	Astra	Non operativo	217.201.135.105	09/02/2007 14:36:28	21/02/2007 15:31:25	207
8	Michelangelo	Non operativo	217.201.75.221	19/07/2007 14:18:09	31/07/2007 18:53:15	47
9	Forestal	Copertura UHF	217.201.14.116	17/09/2007 09:32:47	17/09/2007 09:01:17	0
10	S. Giusto	Non operativo	217.202.106.182	17/09/2007 09:04:41	17/09/2007 02:41:07	0
11	11_test_Nicola Z.	Non operativo	217.201.162.88	16/02/2007 15:03:08	12/03/2007 14:03:15	188
12	Raffaello	Non operativo	217.201.202.65	12/09/2007 11:16:06	12/09/2007 10:43:07	4
13	Conte Savoia	Non operativo (...)	217.202.200.145	12/09/2007 14:44:27	12/09/2007 02:51:17	5
14	Fortunato	Non operativo	217.201.65.90	17/09/2007 09:32:21	17/09/2007 02:42:07	0
15	Gino Cucco	Non operativo	217.201.136.202	16/04/2007 15:54:49	16/04/2007 02:51:06	154
16	Cavour	Non operativo	217.202.3.214	01/01/2000 01:07:35	14/09/2007 02:52:07	3
17	Rosa dei Venti	Non operativo	217.201.11.91	14/09/2007 14:07:55	14/09/2007 09:01:12	3
18	San Nicola	Non operativo	217.202.146.87	14/09/2007 14:47:01	14/09/2007 10:51:16	2
19	Cavaliere Sergio	Non operativo	217.201.151.95	17/09/2007 09:05:45	17/09/2007 09:11:11	0
20	Federico	Non operativo	217.202.146.210	07/09/2007 15:06:56	07/09/2007 14:56:07	5
21	San Giorgio	Non operativo	217.201.14.99	01/01/2000 01:01:07	01/08/2007 02:53:17	47
22	Unione	Copertura UHF	217.202.192.252	17/09/2007 09:31:20	17/09/2007 02:52:07	0
23	Lybra	Copertura UHF	217.202.154.140	17/09/2007 09:26:36	16/09/2007 14:51:41	0
24	Dafne	Copertura UHF	217.202.2.66	17/09/2007 09:31:36	17/09/2007 02:51:07	0
25	Caesar	Non operativo	217.202.53.167	15/09/2007 07:42:49	15/09/2007 02:54:07	2
26	Vittorio Veneto	Non operativo	0.0.0.0	17/09/2007 08:55:07	13/09/2007 08:51:20	4
27	Guglielmo	Non operativo	217.202.15.41	16/09/2007 23:03:37	16/09/2007 02:54:06	1
28	Rex Primo	Non operativo	217.202.153.14	17/09/2007 08:03:19	17/09/2007 02:53:07	0
29	BA 817	Copertura UHF	217.201.71.156	17/09/2007 09:32:03	15/09/2007 02:55:24	2
30	Destriero	Non operativo (...)	217.201.20.49	15/09/2007 18:57:08	15/09/2007 03:02:30	2
31	Ulisse I	Copertura GPRS	217.202.58.24	17/09/2007 09:32:38	17/09/2007 09:03:05	0
32	Annamaria Z.	Non operativo	217.201.197.27	13/09/2007 15:22:01		

GIS overview map showing coastal areas and infrastructure. Legend includes: LINEA CONFERMAZIONE 1990 (150), pascesteri_inrete (102), accessi (197), diga_sottiflotta (1), Progetto Mose (in corso di realizzazione) (11), Riempronte_Terr_Agg (6), linea_permanente (1346), paratoie (78), Lunette (2), Mare Adriatico (40 (3), 30 (5), 25 (7), 20 (8), 15 (2), 10 (4), 5 (6), 2 (4)), Bricole (7968), Contorni amministrativi (2), Insi_com_mod (969), Beni naturali (acqua aperta) (9697), Beni naturali (viti da pesca) (14377), Beni difese e ricostituite (in corso di realizzazione) (13), ultima (58), Sovmazzi atesi e ricostituiti (in corso di realizzazione) (3), ultima (8).

Boat's control console

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

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



(Centro Sperimentale Microinquinanti Organici)

- **PCB (Policloro biphenyl)**
 - **IPA**
(Hydrocarbons Policiclid Aromatic)
- **HCB (Hexaclorobenzene)**
 - **PCDD**
(Policlorodibenzodioxins)
 - **PCDF**
(Policlorodibenzofurans)



Continuous Updating/Upgrading of Laws

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

Indirizzo <http://www.salve.it/uk/default.htm>

SALVE activities for the safeguarding of Venice and its lagoon

italian DEFENCE from high waters see the information



news

- map of the site
- frequently asked questions
- lagoon glossary
- information centre of **punta laguna**
- link
- search the site

introduction lagoon ecosystem safeguarding activities on line archives themed sections

- Information Service
- Voltabarozzo Hydraulic Models Experimental Centre
- safeguarding and archaeology: S. Marco in Boccalama
- navigation simulator

infonews@salve.it | Ministry for Infrastructure - Venice Water Authority - concessionary Consorzio Venezia Nuova

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.**