

Venice, 19-20 March 2012



## Climate risk management at the local level and protection of Venice's cultural heritage

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Activities in the Venice Lagoon





Location: 45°10' N 12°40' E,  
Length: ab. **51km**. Width: ab.  
**12km**. Perimeter: 157km.

Total surface: **540km<sup>2</sup>**, of which  
8% land above sea level  
(littorals, reclaimed areas,  
islands, embankments) and  
92% "water system": channels  
(11,9%), shallows, mud flats  
and salt marshes (80,1%).

**Channels and open waters**  
(depth >150cm): 66km<sup>2</sup>.

**Shallows** (depth between 150 e  
40 cm): **243km<sup>2</sup>**.

**Mud flats** (inertial areas  
between -0.40 and +0.24 on  
the m.s.l.): 98km<sup>2</sup>.

**Salt marshes** (areas higher than  
+0.24m, but flooded by high  
tide): **11km<sup>2</sup>**.

**Embanked fish farms**: 92km<sup>2</sup>.

**Islands**: 29km<sup>2</sup>.



## Position and physical pressures

Venice is placed almost at the top of the Adriatic Sea.

Position characteristics:

- High tide excursion
- Reflections of wave tides (seiches)
- Strong winds, which can “push” the seawater towards the coast line



4<sup>th</sup> Nov 1966 (192 cm)

## “Acqua Alta”

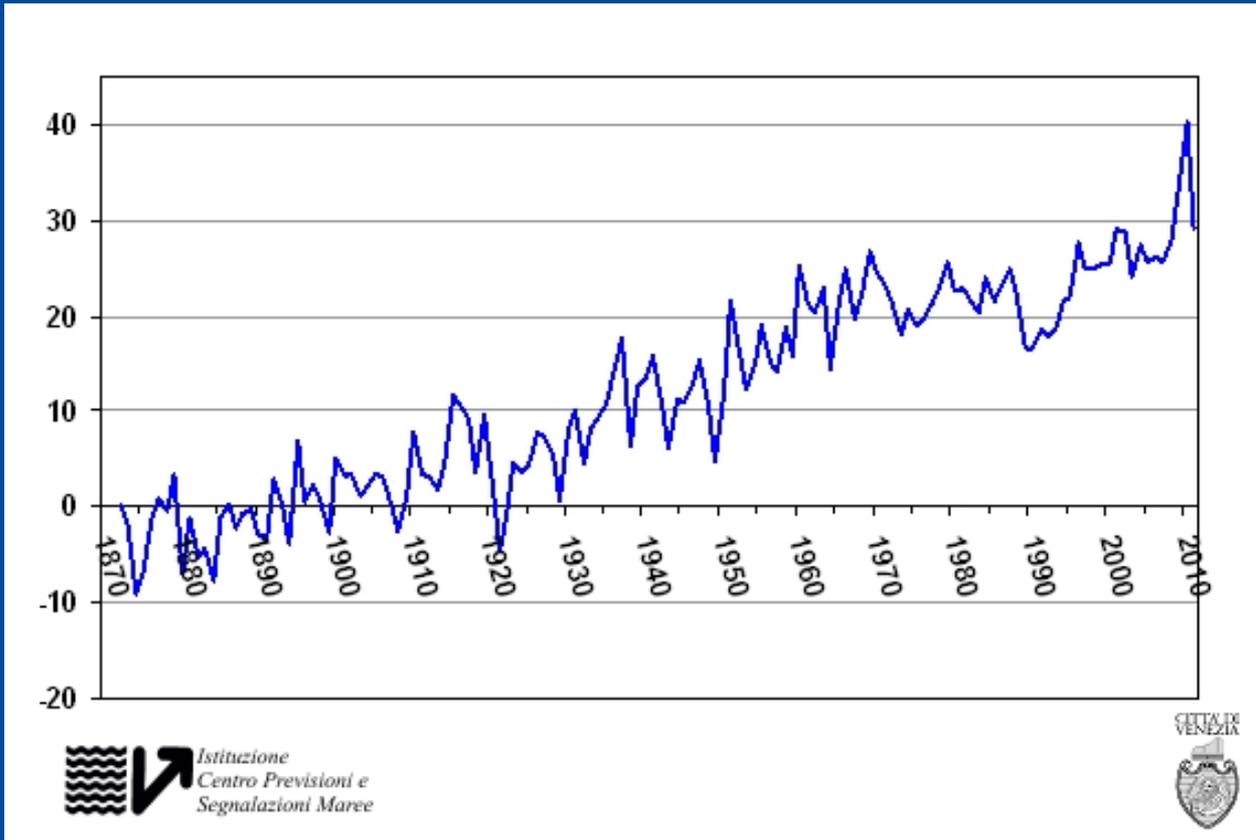
Fluctuations in Sea Level:

tides + atmospheric conditions

Relative Sea Level Rise:

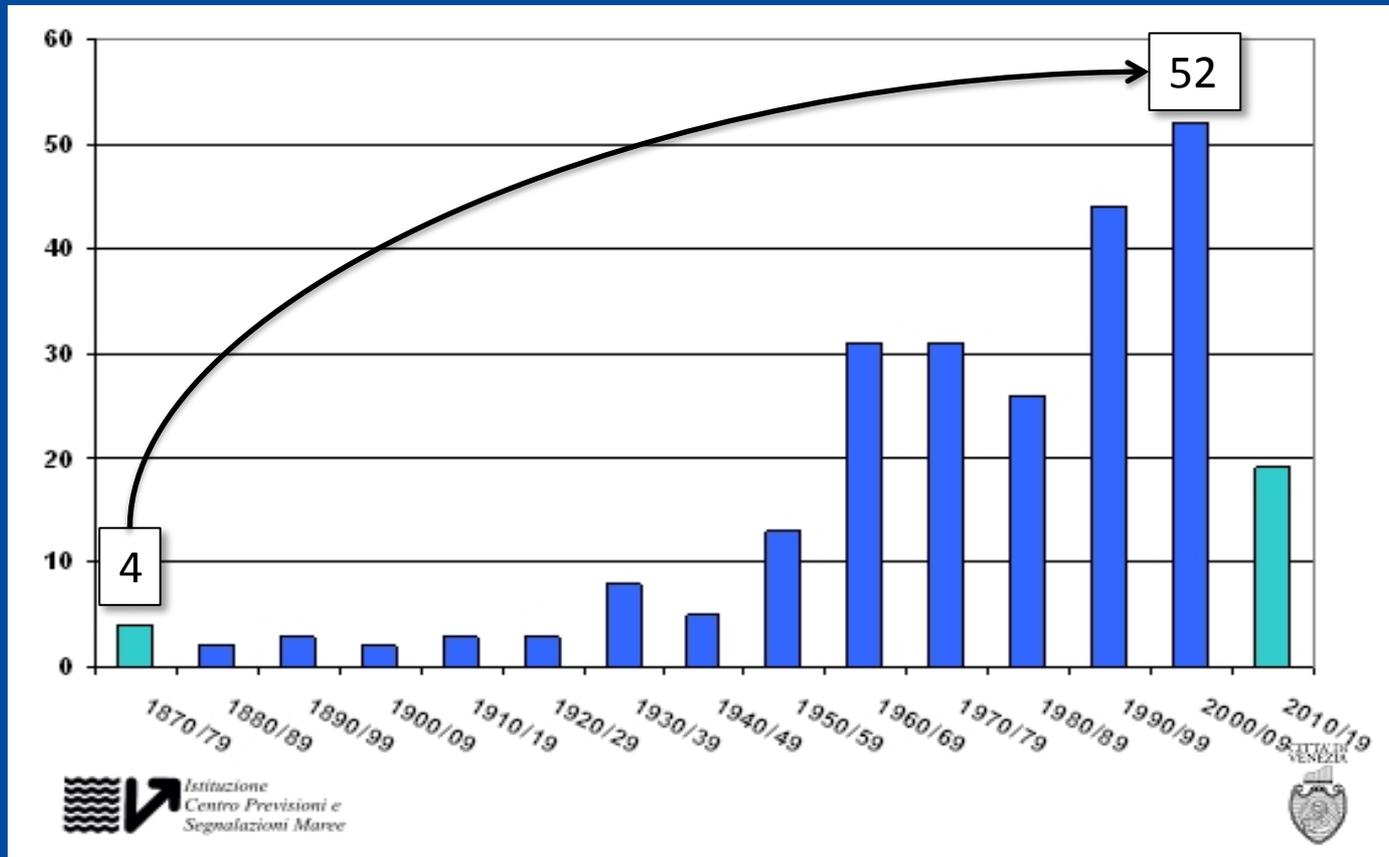
land subsidence + climate change

# The Relative Sea Level



1872 – 2011: RELATIVE SEA LEVEL ca. +30cm

# Increasing of Flooding events



Ten-year distribution of flooding events > 110cm period: 1870-2011

# The “acqua alta” phenomena in Venice

“Acqua Alta” events (flooding) have **always occurred** in the millenary history of Venice.

However, also the fortunes of Venice have always been connected with the sea.

In the past (since the XIV century), the Venice's strategy included two main different targets:

- **Defence of the city from flooding**
- **Grant access to the port**



Today the conservation of historical architectures is a not-negotiable constraint

# "Acqua Alta": structural measures (1)

## Raising pavements



before



after

# Sea walls and beach nourishment

before



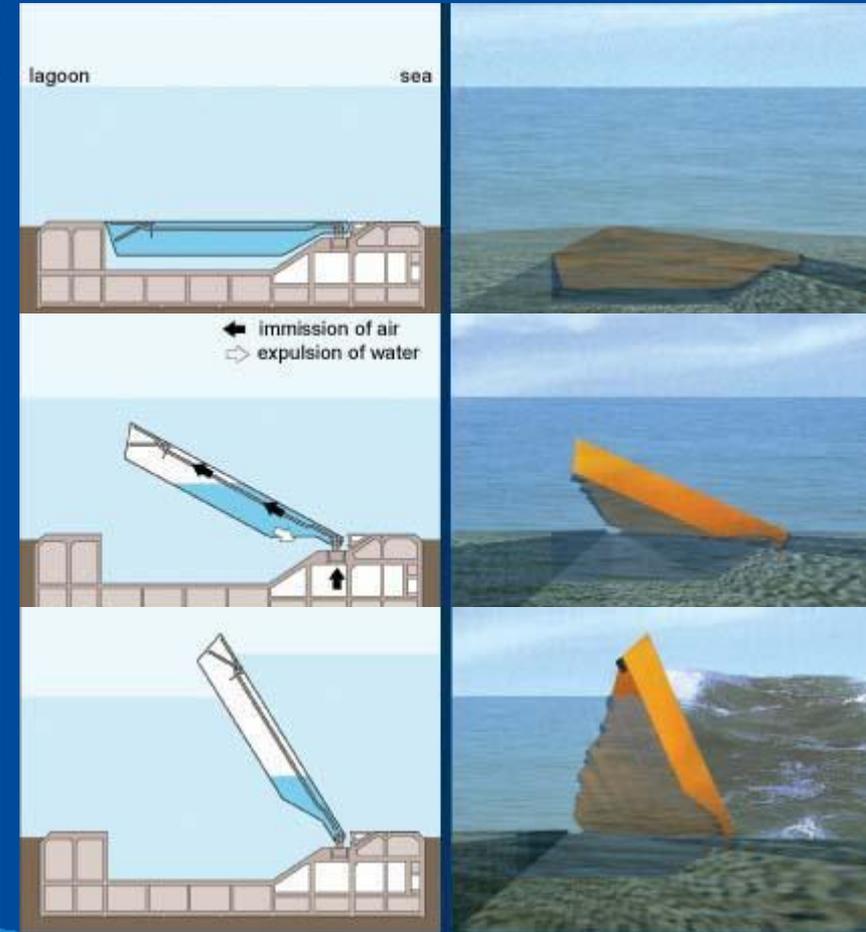
after

A new beach 9 km - 5,000,000 m<sup>3</sup> of sand.

18 containment groynes, connected by a submerged breakwater parallel to the coast, 300 m from the shore along the full length of coastline.

# "Acqua Alta": structural measures (2)

## MOSE - Mobile flood barriers

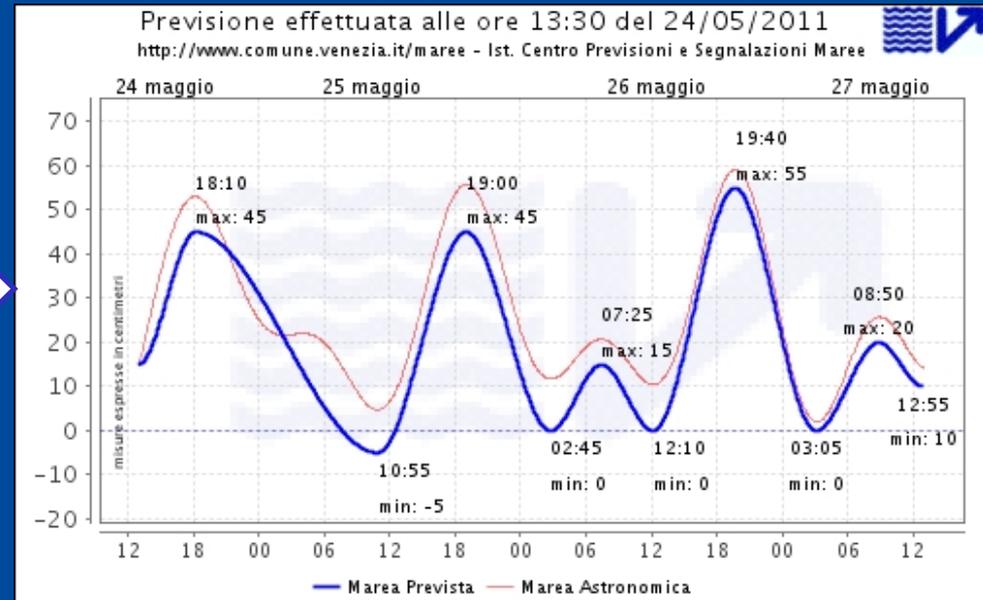


# "Acqua Alta": non structural measures (1)

## Monitoring and Forecast



The ICPSM (Tidal Forecasting and Early Warning Centre) is an office of the Municipality of Venice, founded in 1980 to inform and alert the citizens in case of flooding tides



Monitoring Networks

Sea Level Forecast



## “Acqua Alta”: non structural measures (2)



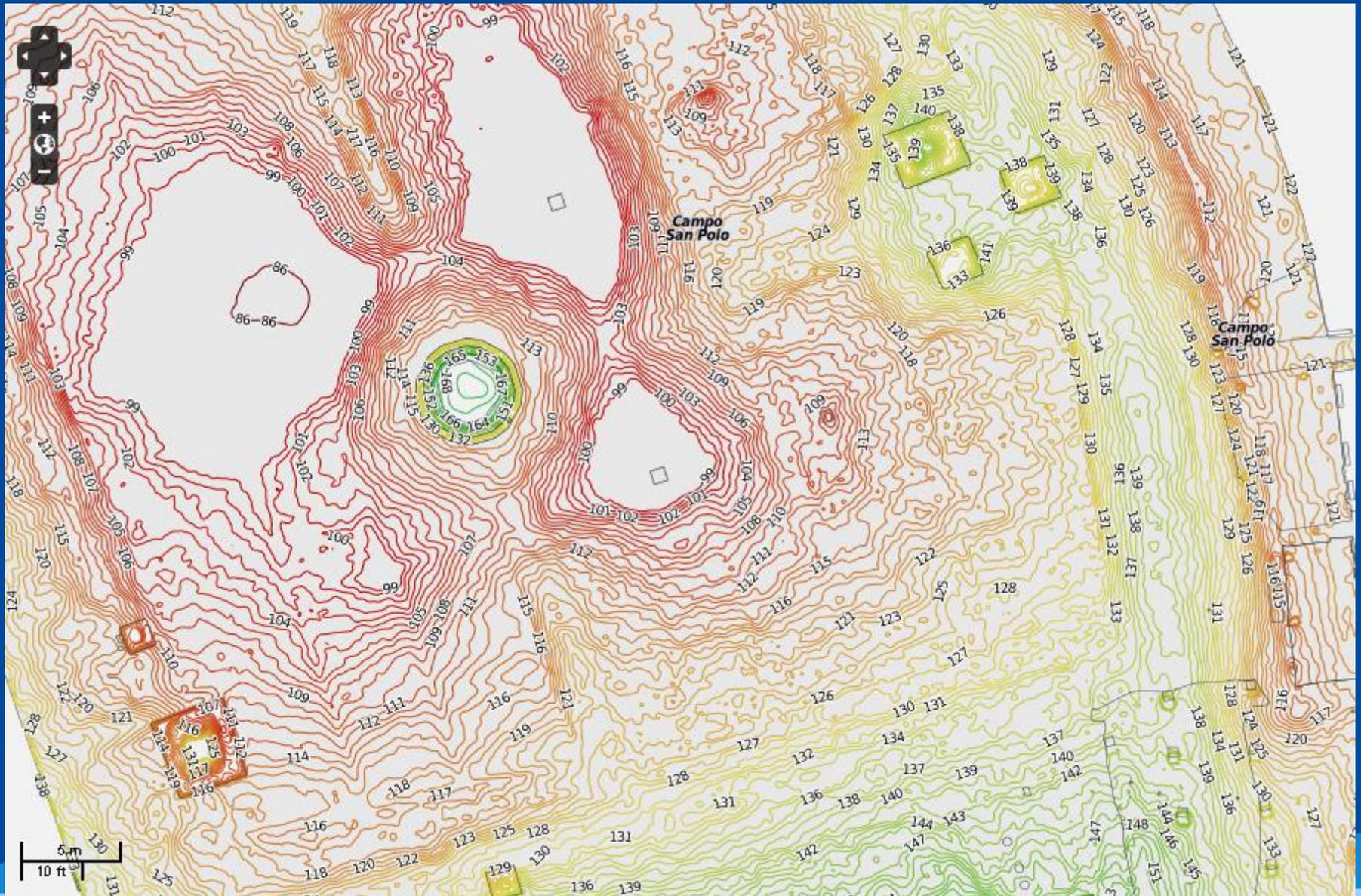
## “Adaptation”

During “acqua alta” events, Venice can rely on the strong awareness of its citizens and their capacity to adopt adaptation measures in order to protect their assets.

# Cleaning channels, restoring buildings and sewage system



# Flooding maps. Precision 1 cm



# Towards a CLIMATE PLAN for Venice

The next step is to systematise the adaptation and mitigation actions, thus optimizing the efforts and filling in the gaps.

If planning so far has been based on historical data, it is now necessary to take on, in terms of programming, the acceleration of the changes under way: preparing based on current experience means being already late in the next decade.

By going more in depth into the climate change forecasts, through data that the scientific community makes available at the local level, the City is getting ready to outline a Climate Plan projected over forthcoming decades.

# Fire Risk

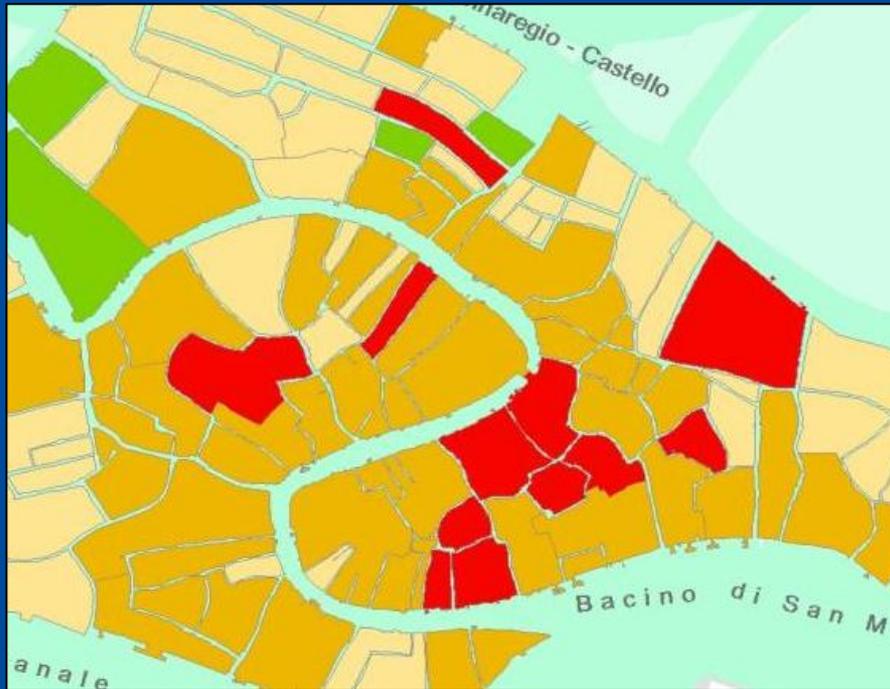
Its specific urban conformation (old buildings, large use of wood, high density) makes Venice exposed to serious fire risk.

With the addition of the difficulty of reaching the fire zone (shallow and/or narrow canals, distance between the boat berth place and the fire zone), and the quick spreading of the fire.



# New fire hydrant network (1)

## Fire Risk Map 1998



## Fire Risk Map 2006



- RISK**
- high
  - medium-high
  - medium-low
  - low
  - hydrant

→ autonomous from the aqueduct  
→ connection allowed also for private buildings

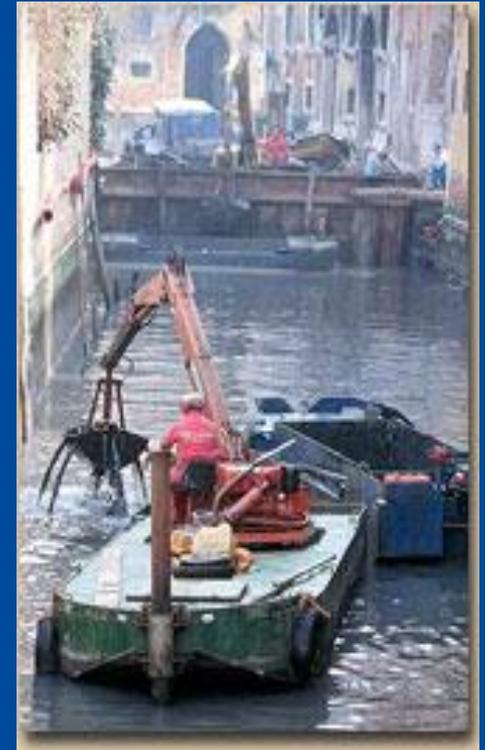


# New fire hydrant network (2)



Updated Sep 2011

# Cultural and art heritage at risk



# Citizens' participation



Since 1995 in Venice is active a group of volunteers dedicated to the protection of cultural assets in case of emergency



# Turning problems into opportunities

## PROTECTING CULTURAL ASSETS...

**HIGH SKILLED  
PROFESSIONALS**



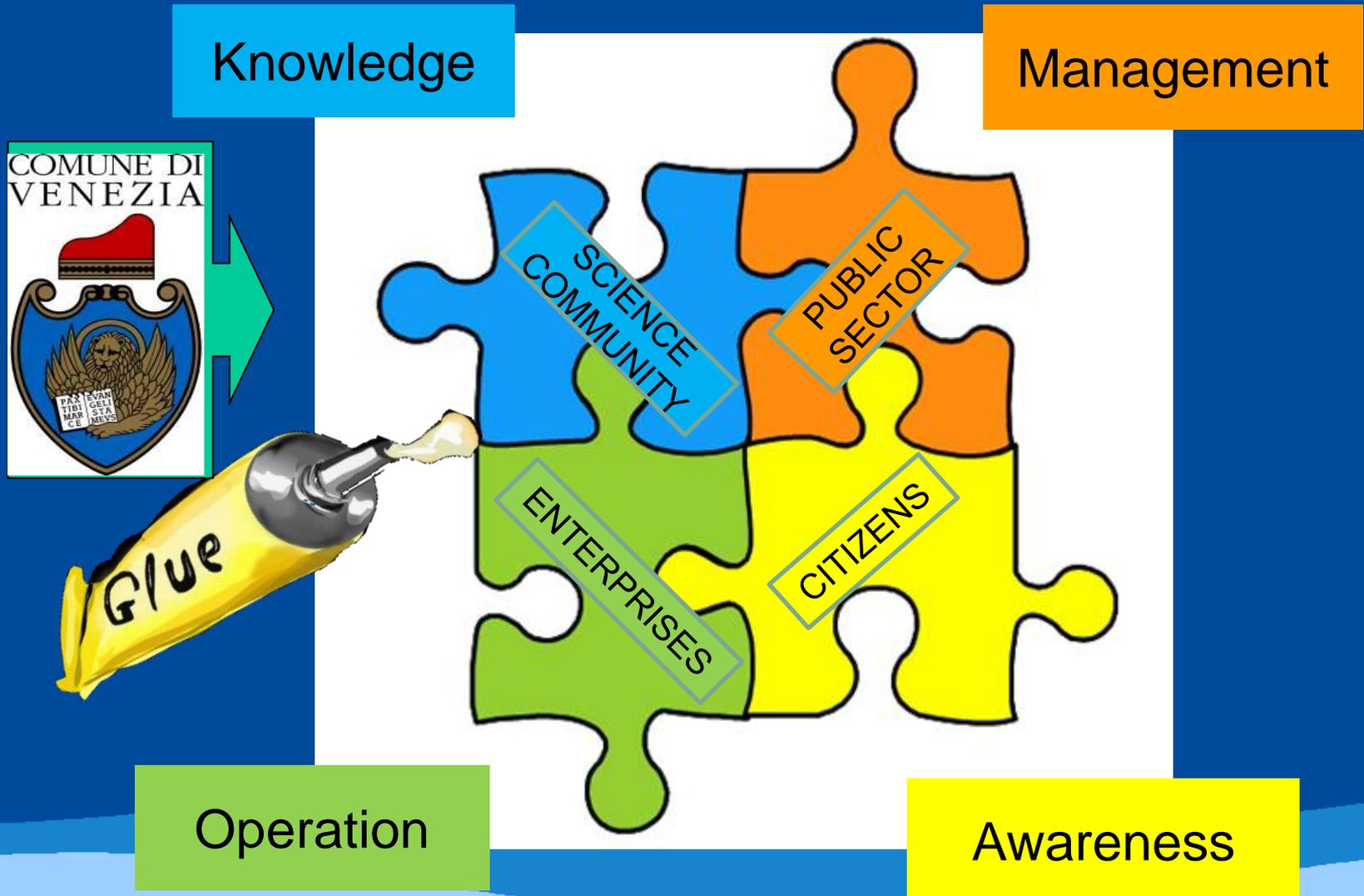
**SOCIAL MEANING  
for people**

**ECONOMIC  
VALUE**



**... it is not just  
sentimentalism!!**

# The risk reduction strategy components



# Concluding remarks

- The Venice lagoon is a **paradigmatic** case, in which research and management, natural and social sciences, technology and arts are tightly interrelated.
- Systems such as Venice can be viewed as a sort of **sentinel** for monitoring and forecasting global changes, their consequences and possible remedial
- Today the main hydrogeological problems come from “behind”, i.e. the **mainland**, which is of extreme importance for Venice given its productive and residential role.
- Cultural heritage protection is not more viewed only as a constraint, but as an opportunity.

# Acknowledgments

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*Thank you for your attention*